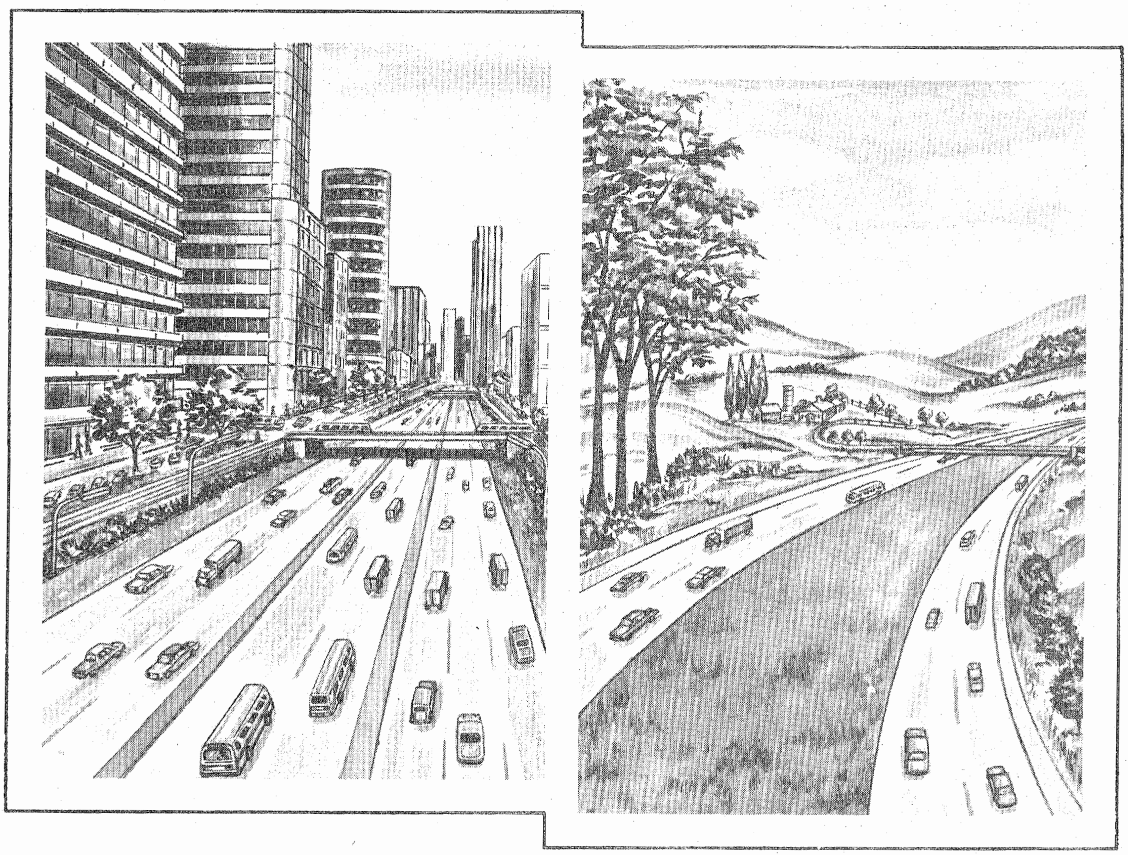
BOB NO. 04-S69053

National Highway Functional Classification and Needs Study Manual

(1970 to 1990)



MANUAL B OF NATIONAL TRANSPORTATION PLANNING STUDY

U.S. DEPARTMENT OF TRANSPORTATION/Federal Highway Administration/Bureau of Public Roads
FEBRUARY 1970

NATIONAL HIGHWAY FUNCTIONAL CLASSIFICATION AND NEEDS STUDY MANUAL (1970 to 1990)

- Approved under Budget Bureau No. 04-S69053 -
- Approval expires January 31, 1972 -
The reporting and/or recordkeeping requirements contained herein have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS
FEBRUARY 1970

PREFACE

Senate Joint Resolution 81 approved in August 1965, calls for a continuing series of biennial reports on the future highway needs of the Nation, to be prepared by the Secretary of Transportation through the Bureau of Public Roads. The first of these reports was submitted to the Congress in January 1968. The second report, due in January 1970, is required specifically to include a study of the functional classification of highways, as directed by Section 17, of the 1968 Federal-Aid Highway Act. A third report will be due in January 1972, and presumably others will be required at two-year intervals thereafter.

The General Focus

SJR 81, which provides the mandate for the National Highway Needs Reports, is quite broad in its requirement, simply calling for reports on "estimates of the future highway needs of the Nation." As stated in the Committee Report 1/, the ". . .legislation is drafted broadly, so as to vest in the Secretary of Commerce (now the Secretary of Transportation), the maximum possible discretion in selecting necessary elements of study." The Committee Report, however, does contain the following statement regarding the general purpose of the needs reports:

> "In the Federal-Aid Highway Act of 1956, the Congress declared it to be in the national interest to accelerate the construction of the Federal-aid highway system, including the Interstate System. Subsequent law authorized funds to complete the 41,000-mile Interstate System in the year 1972. The construction of the Federal-aid highway systems involves a major Federal-State road-building capability, which would be costly and difficult to reestablish if it were to be dissipated after the 1972 completion date. For this reason, it is necessary to determine now what highway needs these considerable energies can be used to fill most advantageously in the following years.
>
> "The growth of population and its urban concentration accentuate the need for a thorough review of the Nation's highway program in the light of overall transportation problems and various possible solutions. An early beginning will be necessary to permit intelligent decisions on long-range plans for the Federal-aid program after 1972."

1/ House Report No. 681, July 26, 1965, page 7.

Becoming more specific the Committee Report also records the views of the then Federal Highway Administrator (Mr. Whitton) that areas of inquiry should include among other subjects:

--The extension or improvement of the present Interstate System.
--The possible development of freeways or express routes on a different basis than the Interstate System.
--Special urban highway problems.
--Classification revision of Federal-aid Primary and Secondary systems and their urban extensions.
--The relation between highway planning and technological developments.
--Problems in financing such highway programs as are found to be desirable for the years after 1972.

The Committee then added its own recommendation that reimbursement for toll and free roads, and the question of toll facilities on the Federal-aid systems, should also be included.

Relation to Goals and Objectives

The Department of Transportation has established the following major transportation goals:

a. Economic efficiency in transportation.
b. Optimal use of environmental resources.
c. Safety.
d. Support of other national interests.

To attain these goals, certain specific highway objectives may be postulated:

a. To realign Federal-aid systems on the basis of function.
b. To establish the Federal highway investment level or levels, on the basis of effectiveness in meeting national transportation goals.
c. To establish the mixture of investments by system, by program element, and between rural and urban areas.
d. To establish equitable sources of Federal highway revenues.
e. To establish equitable Federal-aid apportionment formulas and matching ratios for the various systems.

The plans for each of the biennial reports have been drawn with these goals and objectives in mind. The first of these reports, the "1968 National Highway Needs Report," did not, however, contain specific program or financing recommendations.

The 1968 National Highway Needs Report

The 1968 Report took the position that specific program recommendations would be submitted in future reports based on more extensive studies, as follows:

> "More detailed studies of the characteristics of all segments of the highway network, to be reported on in the 1970 report, plus more analytical estimates of improvement needs and costs and concomitant benefits to be presented in the 1972 report, will then provide the additional information needed for the design of specific components of future Federal-aid highway programs."

However, the 1968 Report did suggest that the general direction of desirable Federal highway policy for the future seemed to be as follows:

> "1. Continuing assistance to the States for improving the efficiency and safety of the highway system in both rural and urban areas, particularly where traffic growth is expected. Studies will be necessary to redefine the Federal-aid systems and enable sound economic analyses to reveal how and where the investment of Federal funds would be more beneficial in terms of national objectives, general economic and social benefits, and transportation service to people and commerce.
>
> 2. Greater stress than in the past to the improvement of urban transportation and the development of transportation plans calculated to raise the quality and satisfactions of urban life.
>
> 3. Additional emphasis on the coordination of highways with other modes of transport, both intra- and interurban, to insure the optimum provision of the best features of all modes.
>
> 4. Continuing emphasis on making the highway a salutary influence on the environment both in rural and urban areas."

In July 1968 a supplement to the 1968 Needs Report was sent to the Congress. It contained six specific recommendations as steps toward a future Federal-aid highway program:

1. A nationwide functional highway classification study should be undertaken in cooperation with the State highway departments and local governments to examine the future transportation role of all highway routes and their suitability for inclusion in the Federal-aid systems.

2. The Interstate System should be restricted to its then legally established limit of 41,000 miles and the Interstate program terminated upon completion of the authorized system. Alternatives to expansion and to financing ratios would be developed from the results of the classification study.

3. A greater share of Federal-aid highway funds should be made available to metropolitan areas; the Federal-aid urban system should be expanded to include all arterial routes; areawide agencies should assume responsibilities for developing programs based on the continuing urban transportation planning process established under Section 134, Title 23, U.S.C.; and integrated with programs for urban mass transportation.

4. Federal-aid funds should be authorized to finance parking research and demonstration projects and construction of fringe parking facilities.

5. A Federal revolving fund should be established for use by the States for long-range advance acquisition of highway right-of-way.

6. DOT and HUD should coordinate programs to support joint development of highway corridors in urban areas.

Some of these recommendations became incorporated in the 1968 Federal-Aid Highway Act. However, Congress did add 1,500 miles to the Interstate System; and while a functional classification study was authorized, its ultimate format became restricted to an identification of the most logical usage of existing facilities to serve present travel and land use.

The 1970 National Highway Needs Report

The 1970 Report contains the findings of the functional classification study, and also gives attention to other possible short-run program changes.

The "Supplement to the 1968 National Highway Needs Report" outlined some ten possible study areas for inclusion in the 1970 Report. These are summarized as follows:

1. Future Federal role in highway transportation, particularly in cities.
2. Functional highway classification study.
3. Federal aid for maintenance.
4. Effects of changes in Federal-aid apportionment formulas and matching ratios.
5. Exploration of new highway revenue sources.

6. Progress report on joint development.
7. Progress report on TOPICS.
8. Effects of safety programs upon highway construction.
9. Correlating Federal-aid highway program with UMTA grant program and other DOT programs.
10. Coordinate Federal-aid highway assistance with other Federal assistance programs for metropolitan development, and facilitate comprehensive local planning for such development.

Many of these areas are covered in the 1970 Report.

The 1972 National Highway Needs Report

A proper analysis of pertinent issues proposed for the 1972 Highway Needs Report will require a great deal of information to be obtained from field studies made by the State highway departments in conjunction with local governments. This manual of instruction is designed to produce these inputs:

--It will provide a description of the existing road network and the traffic using it.

--It will provide a description of both existing and future deficiencies on our highway systems.

--It will provide an estimate of cost to provide highway service adequate for estimated future highway travel demands, giving full and explicit weight to forecasted modal splits in urbanized areas and statewide and interstate estimates of interarea travel by the various modes.

--It will provide all of these data by functional systems.

--It will provide the primary basis for measuring user benefits that would accrue if such investments were made.

To meet our goals and objectives, however, certain steps must be taken after completion of the field work to determine, by means of economic analysis, the highway benefits resulting from alternative investment levels and resulting performance levels. The goals of the Department of Transportation are to provide efficient, economical transportation systems that promote optimal use of environmental resources, safety, and support other national interests. Federal Highway Administration goals, coincident with those of the Department, are directed to the highway transport systems.

Through the years, State highway departments and urban transportation planning organizations have evaluated alternative transportation systems for the rewards that can be achieved from alternative levels of funding for highways based upon locally established goals, objectives and values. Such "local" input is highly desirable because it introduces the wishes of the people into the transportation planning process.

Benefits obtained from highway improvements on a nationwide basis must be measured in a consistent manner. Therefore, nationally consistent input must be developed to determine the benefits that alternative levels of highway service can provide. The elements necessary for creating such an evaluation procedure, to be applied on a nationwide basis, are presently being developed by the Bureau of Public Roads.

A series of analyses utilizing the data developed for the "1968 National Highway Functional Classification Study" and the "National Highway Functional Classification and Needs Study (1970 to 1990)" as input will be developed by the Bureau of Public Roads to permit systematic exploration of transportation service alternatives that can be expected from various levels of investment. An analysis will also include the development of a value matrix to assess the consequences of alternative highway programs on externalities, such as effects on recreational and cultural opportunities, on neighborhoods, on land use development, on noise and air pollution, and on environmental enhancement. The correlation of these analyses with those described above will permit selection of program and investment alternatives designed to maximize returns consonant with the objectives sought.

Other special studies will be made of the consequences of an extensive TOPICS program as an adjunct to new construction or reconstruction programs.

Lastly, financial programs will be developed to fund desired investment options, with in-depth evaluation of apportionment formulas, matching ratios, and program emphasis.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

APPENDICES

A - POPULATION ESTIMATES AND URBANIZED AREA CODES

B - STATE CODES

C - STATE-DESIGNATED AGENCIES AGREEING TO WORK TOWARD FEDERAL-STATE COOPERATIVE PROGRAM FOR LOCAL POPULATION ESTIMATES

D - TRAVEL ESTIMATING PROCEDURES

E - 1990 FUNCTIONAL SYSTEMS CHARACTERISTICS

F - STATE LIAISON OFFICERS TO BUREAU OF OUTDOOR RECREATION

G - PROCEDURES FOR DETERMINING AVERAGE HIGHWAY SPEED, AVAILABLE SIGHT DISTANCE, AND PRESENT OPERATING SPEED

H - ESTIMATING REMAINING SERVICE LIFE FOR PAVEMENTS

I - SAMPLE SETUP FOR CREATING DATA SUBMITTAL TAPE

SECTION I

PURPOSE, SCOPE, AND ORGANIZATION

PURPOSE

The overall scope and context of the series of national highway needs reports required by Senate Joint Resolution 81 has been discussed in the preface to this manual. The third in this series of reports, to be presented to Congress in 1972, will require reporting of a nationwide estimate of highway needs, by functional system, to serve travel to 1990.

This manual has been prepared to guide Bureau of Public Roads field offices, the States, and local governments in preparing estimates of needs on consistently defined functional systems using uniform procedures. It is the intent of these instructions to achieve consistency in estimates between States and regions so that comparison of needs as they might affect fiscal considerations may be made. The objective of the study is to provide reliable data upon which consideration of future highway financing and responsibility can be based. It is <u>not</u> the intent--indeed it would be impossible--to draft detailed instructions so that each State could follow them verbatim. However, to be acceptable, major deviations from the instructions contained in this manual must be satisfactorily explained to the division offices and approval documented in the files. All States are expected to adhere to the basic criteria and definitions included in the manual and all data must be reported in the formats specified.

SCOPE

This manual provides background data, definitions, criteria, procedures, and data submittal instructions for the conduct of the study by all States, the District of Columbia, and Puerto Rico, with the cooperation of their local units of government.

The classification phase of the study will encompass all existing mileage plus that needed to satisfy 1990 demands. Classification data to be submitted are similar to those reported for the 1968 functional classification. Needs evaluation will involve use of sampling, and the functionally classified system mileages will be the universes for the expansion of the sampled data. Sampling rates and procedures are described in section III of this manual.

It is planned to include estimates of the benefits resulting from fulfilling highway needs in the 1972 report. Both highway user and non-user benefits will be considered. The preparation of these estimates will be done on a national basis by the Washington Office of the Bureau of Public Roads (see the preface for additional details). User benefits will be calculated using the sampled section-by-section needs data; however, benefits vs. costs will be compared on a systemwide basis and not by individual study sections.

Data will be reported for the same types of functional systems as were identified in the 1968 functional classification study. The actual systems, however, will reflect anticipated population growth and changes in distribution, changes in land use, and the resulting changes in travel patterns and volumes. Similarly, data will again be reported for five types of areas: (1) Urbanized areas (50,000 and over population); (2) small urban areas (5,000-9,999 population); (3) small urban areas (10,000-24,999 population); (4) small urban areas (25,000-49,999 population); and (5) rural areas (the remaining area of the State). Boundaries and definitions will relate to estimated 1990 conditions rather than to 1968 conditions.

The functionally classified systems developed during this study, the minimum tolerable conditions and design standards used, and the costs estimated are for study purposes only and in no way represent a commitment or policy change by the Department of Transportation, the States, or the local participating units of government.

ORGANIZATION FOR THE STUDY

The 1990 highway functional classification and needs study is appropriately a joint enterprise of the Federal, State and local governments. While organization, guidance, and final synthesis, analysis and recommendations are the responsibility of the Department of Transportation, the actual preparation of the 1990 functional plans and needs estimates will be accomplished by the State highway departments, together with the assistance and cooperation of local governmental units.

Federal Highway Administration Functions

The Bureau of Public Roads, Office of Planning, is responsible for overall coordination of the field study as well as for data synthesis and analysis and report preparation. In addition, Washington office personnel will, to the extent possible, provide technical and field review assistance throughout the field study.

The major responsibility for guiding the States in the use and interpretation of this manual is assigned to the Federal Highway Administration's regional and division offices.

Regional office responsibilities shall include:

1. Interpretation of the guidelines to insure maximum degree of consistency, coordination, and agreement among the States.

2. Periodic review of the entire study.

3. Coordination and/or resolution of rural and urban arterial classifications at State boundaries.

4. Early review and approval of the study methodologies and projections, (e.g. need's sampling, population estimates, applicability of previous studies, etc.).

5. Supplying technical guidance when necessary.

Bureau of Public Roads division office responsibilities shall include:

1. Assisting in developing the study design and schedule.

2. Continual review of the study activities of the State and local governments to insure conformity with the manual.

377-268 O - 70 - 2

3. Supplying assistance by appropriate division office personnel when necessary.

4. Assuring that the schedule developed is maintained.

5. Review of the cost tables to be used in the needs estimate by appropriate right-of-way, bridge, district, and area engineering personnel.

The active participation of appropriate regional and division office personnel cannot be overly encouraged. It is suggested that Federal Highway Administration personnel be utilized to the maximum extent feasible, as determined by the Regional Administrator and Division Engineer, to assure realistic and effective results. The success of the study will largely depend upon the utmost use of local field knowledge and information, as supplied by State, local and the above mentioned personnel.

State Highway Department Functions

The State highway departments are responsible for the development of an adequate and consistent 1990 highway functional plan and needs estimate under the guidelines of this manual, and for the timely submittal of the study results in the prescribed form. They are also responsible for obtaining the maximum practicable participation in the study by city, county, and other local governments and by the urban transportation planning study organizations. The general approach to the study and the procedures for developing efficient, effective intergovernmental participation must necessarily be worked out within each State. As stated previously, conduct of the 1990 functional classification requires coordination with, and advice from all city, county, and Federal agencies responsible for and involved in planning land use and transportation facilities for their respective jurisdictions. During the course of the study there will inevitably be differences of opinion in developing future plans. The final resolution of these differences will be the responsibility of the FHWA region and division offices and the State highway departments, which will assure both statewide and regionwide consistency in the reported functional classification and needs.

Participation of Local Governments

It is recognized that the existence and availability of technical staffs at the county and small city level varies from State to State and that such variations exist within a given State. Therefore, a uniform level of nationwide local government participation in this study is not expected. Maximum possible utilization of local government resources and personnel is our goal.

Counties and small urban areas sampled for the needs estimate

Active participation by the counties and small urban areas sampled for the needs estimate could include assistance in the performance of the field inventories, preparation of the countywide or citywide 1990 functional plan, and the performance of the needs appraisal itself. The countywide or citywide functional plan must be coordinated with the Statewide arterial plan prepared by the State highway department as well as with the functional plans prepared by neighboring local governments. The extent of actual involvement by the counties or cities is, of course, dependent upon the availability of personnel. In those instances where only a few county or city personnal are available to assist in this study, it would be highly desirable to have them participate in the field inventories and review the 1990 functional plan, as a minimum level of involvement.

Cooperation and coordination by and with all counties and small urban areas sampled for the needs estimate are necessary to permit the State highway department to fulfill its role in this study. All local governments should provide the State with copies of available land use and transportation plans, cost data, and other available input needed to complete this study.

Counties and small urban areas not sampled for the needs estimate

Active participation by the counties and small urban areas not sampled for the needs estimate is also dependent upon the availability of personnel and could include the preparation of the 1990 countywide or citywide functional plan. The countywide or citywide functional plan must be coordinated with the Statewide arterial plan prepared by the State highway department as well as with the functional plans prepared by neighboring local governments.

Each local government in this category is expected to furnish the State highway department with available land use data and transportation plans. Local government cooperation is expected in the review of the functional plans prepared by the State.

Participation of Urban Transportation Planning Study Organizations

Direct participation by the urban transportation planning study organizations, regional planning commissions, or Councils of Governments where applicable is to be obtained by the State highway departments to the maximum extent feasible. This includes utilizing both technical staffs, to assist in accomplishing the 1990 functional plan and needs estimate, and existing committees, to provide overall guidance to the classification process for their particular urban area. All work performed by such organizations shall conform with the guidelines provided in this manual.

It is recognized, however, that the present status of the transportation planning process differs among urbanized areas in terms of active staff and accomplishments. It is assumed that participation by these organizations will be consistent with these factors. Where full scale involvement is not possible, it would be highly desirable to have transportation study personnel at least assist in the field inventory and in preparing the 1990 functional plan.

All work performed by such organizations shall be coordinated with the efforts of the State highway department and neighboring local governments actively engaged in this study. The transportation study groups are expected to furnish the States copies of available land use and transportation plans, cost data, and other available data needed to complete this study.

While formal policy approval is not required, there should be a final review (of the 1990 functional systems) by the technical and policy committees of such groups. Any comments from these entities (regarding cooperation, unresolved differences, etc.) should be forwarded by the States to the Bureau of Public Roads.

Statewide Advisory Committee

The States are encouraged to establish, or continue to utilize, a Statewide advisory committee of official county and city representatives having an interest in transportation planning. Committees established for the 1968 National Highway Functional Classification Study or other existing committees or organizations of city and county officials, such as local chapters of the National Association of Counties, the National League of Cities, and the National Association of County Engineers can serve in this capacity.

The primary purpose of the advisory committee is to provide counsel on the various factors that will affect local governments. In addition, the committee can serve as an extremely effective means for obtaining an efficient, practical solution to local governmental participation. The committee should have the opportunity to become well informed of the study in the early planning stages and to follow the course of the study through its completion.

Coordination with Other Agencies

The State highway departments are required to coordinate the classification of all arterials at the State line with neighboring highway departments to insure interstate continuity. Where State planning, development, toll authority, and other similar agencies exist they should be consulted and called upon to contribute to the study.

If future plans exist for State recreational site development, State health or higher education facilities, etc., these plans should be considered in developing the 1990 functionally classified systems. In addition, the systems developed for this study should be coordinated with non-highway transportation modes particularly at terminal facilities. Examples of this coordination include access roads with airport systems and street systems with rail lines.

Classification of facilities under the control of other Federal and State agencies should be coordinated with the agency involved. The Washington headquarters of these Federal agencies have been contacted in regard to this study and will be informed of the type of coordination that is desired at the field level. Agencies having responsibility for roads include the Bureau of Indian Affairs, Bureau of Land Management, and National Park Service, all under the Department of Interior; the Forest Service, under the Department of Agriculture; the Appalachian Regional Commission; or any other Regional Commission that may be in existence at the time of the study, i.e., Ozark Regional Commission, Upper Great Lakes Regional Commission, New England Regional Commission, Costal Plains Regional Commission, and the Four Corners Regional Commission.

In addition, if Economic Development Districts are currently staffed and actively developing transportation plans, then they should also be contacted.

The Relationship of the Highway Classification and Needs Process to Multimodal Transportation Planning

The Department of Transportation is also requesting, by separate manuals, that 1990 needs estimates be developed concurrently within the States for non-highway transportation modes. Coordination and correlation between the highway and non-highway needs estimates is a necessary ingredient to this study.

The classification and needs process includes the forecasting of 1990 street and highway traffic volumes. The urban travel forecasting process itself is concerned with the movement of all persons and goods by all modes whether intraurban, through or externally oriented. The plan development phase of the transportation planning process consists of the development and testing of alternative transportation solutions which include various levels of service that could be provided by each travel mode. The plan selected for implementation contains the most efficient, economical modal transportation systems commensurate with established local goals and objectives.

Each unimodal system that is developed by the transportation planning process is therefore an integral part of a multimodal plan, and inherently reflects planning for each modal system and subsequent system useage forecasts. Therefore, forecasts for a given mode of travel by a process of this type are truly multimodal in nature, accounting not only for alternative modal forecasts, but also to the service necessary for such modes to function efficiently. To be specific, highways perform this function by providing efficient service to all modal interfaces and serve bus transit <u>at least</u> at an equal level to trucks and automobiles.

The classification of statewide rural highway systems must also reflect multimodal forecasts and plans as described above. This may have been accomplished in those States that have conducted statewide transportation planning studies. In any event, 1990 highway travel forecasts are to be developed in accordance with statewide forecasts made for all transportation modes. To accomplish this objective, the State highway departments should consult with other agencies concerned with the development of transportation plans so that the most recent forecasts of non-highway modes can be reflected in the 1990 highway travel forecasts.

Use of Previous Classification and Needs Study Data

In a number of States future highway functional classification and needs studies have been conducted within the past few years. The results of these studies may be applicable, or at least adaptable, to this study. It is inevitable however, that certain of the criteria used in defining tolerable conditions or establishing design standards for the national study will vary from the criteria used in establishing similar guides for the individual State studies. In addition, cost data used in the individual State studies will not be consistent with the cost data (1969 bid prices or estimates) to be used in this study.

It is recognized that all truly functional system studies are made without regard to existing administrative systems. However, the individual State studies have been prepared for internal use only and the number of functional systems and/or their definitions may not coincide with those established for the national study described in this manual.

In light of the above considerations, the applicability of any portion of an individual State study to this nationwide study cannot be presumed and the extent of their relationship can be determined only after a careful comparison of the criteria and standards established for this study with those used in the State study. Final determination of such applicability rests with the Federal Highway Administration's regional office.

SECTION II

DEVELOPING A CLASSIFICATION PLAN FOR NEEDS EVALUATION

INTRODUCTION

The functional classification process, the process by which streets and highways are grouped into classes or systems according to the character of service they are intended to provide, has been widely used in conjunction with needs estimates to outline long range highway plans. In this study focus is being aimed at the development of nationwide 1990 functional plans in concert with a 1990 nationwide needs evaluation.

The logical first step in the development of the 1990 functional plan, namely, a base year functional classification of existing facilities, has been completed by the 50 States, the District of Columbia, and Puerto Rico as required by the 1968 National Highway Functional Classification Study. Functional systems developed during the 1968 study should serve as a base for this study. Functional system maps as well as mileage, travel, population and land area statistics developed during the 1968 study are a logical starting point for the development of the 1990 functional plan and related statistics.

The hierarchy of functional systems, functional system characteristics, as well as classification procedures for both rural and urban areas, as described in the "1968 National Highway Functional Classification Study Manual," 1/ are to be used for this study, unless otherwise noted in this section. It is therefore necessary to continually refer to appropriate sections of the 1968 study manual during this study.

1/ Additional copies of the manual are available upon request.

INTERRELATIONSHIP OF THE 1990 FUNCTIONAL CLASSIFICATION PROCESS TO THE NEEDS EVALUATION PROCESS

In this study the development of the 1990 functional classification plan is considered as an integral part of the needs evaluation process. Although the development of a preliminary 1990 classification plan is the forerunner to the needs estimating phase, the classification itself is hardly complete at this point. Feed-back from the needs estimating analysis is certain to result in modifications to specific route classifications. In addition, various situations encountered during the needs estimating analysis may warrant trade-offs as far as 1990 functional classification alternatives are concerned thereby requiring modification to the 1990 functional plan.

Development of the 1990 functional plan is also inseparable from the needs analysis from travel service viewpoints. By upgrading a particular route or by adding a new route in a particular area during the needs evaluation, a chain-like reaction may take place affecting the future travel usage characteristics on a number of other facilities within the area of influence. As a result of satisfying a given need, or correcting a deficiency, overall travel patterns within the area may change to the extent that certain existing facilities may be serving an entirely different type of travel in 1990, thereby changing its functional classification. Projected vehicle-miles of travel served by such facilities may also be changed by satisfying a need in the area, thereby altering the travel reporting requirements of the classification phase.

STATISTICAL AREA DEFINITIONS

Statistical area definitions for this study are similar to those used in the 1968 study. Corporate or other jurisdictional boundaries should not influence the placement of urban-in-fact boundaries. It should be noted, however, that continual urbanization (growth), will affect the reporting status of urban areas.

Some small urban areas that grow between now and 1990 may become urbanized areas by the definitions used in this study--others may become reportable from data submittal viewpoints in a higher small urban area group. On the other hand, some small urban areas may decrease in population by 1990. In this case it may be possible that such an area will become rural by definition--others may become reportable from data submittal viewpoints in a lower small urban area population group.

Small Urban Areas

Small urban areas for this study will consist of those places which meet the following qualifications: (1) Will have in 1990 a population of 5,000 or more, and (2) do not meet the criteria for urbanized areas as defined below. Hence, small urban areas will have a 1990 population in the range of 5,000 to 49,999. Classification statistics for these areas are reportable in the following three 1990 population subgroups: (1) 5,000 to 9,999; (2) 10,000 to 24,999; and (3) 25,000 to 49,999.

Urbanized Areas

Urbanized areas for the purpose of this study consist of those urban places forecasted to have a population of 50,000 or more within the 1990 contiguous urban-in-fact boundary.

Bureau of Public Roads 1990 urbanized area forecasts and corresponding population estimates are contained in table A-1, appendix A. Urbanized area codes corresponding to Public Roads forecasted urbanized areas are also contained in table A-1, appendix A.

This list may not be all inclusive. In the event additional 1990 urbanized areas are identified during the study, the Washington office should be contacted and an urbanized area code will be assigned. (See the narrative in appendix A for additional discussion.)

Rural Areas

Rural, for this study, comprises the area outside the boundaries of the small urban and urbanized areas defined above. Public Roads estimates of 1990 statewide rural populations are contained in table A-2, appendix A. Note that rural, as defined in table A-2, is below 2,500 in population. For this study rural is defined as below 5,000.

Rural subareas

As will be noted on the Rural Supplemental Data Summary Form, on page II-36, a limited amount of rural data are to be reported by county, that is, the rural portions of the county. Data submittals for counties are to be identified by appropriate county codes in the IBM coding manual.

1990 Urban Boundaries

The 1990 urban boundaries are to be established for all small urban areas and urbanized areas as defined above. Since such boundaries are to be determined for conditions expected to exist in 1990, maximum use should be made of available land use forecasts and plans. In those urbanized areas that have an urban transportation planning process underway (per Section 134 of Title 23, U.S.C.) the future land use plan developed for the study should be used. In other areas, any available future land use plan should be reviewed and used to the extent possible.

Although land use forecasts and plans may be available for many of the urban areas, few will have been developed for the target year 1990. It is therefore required that a "best estimate" be made of 1990 urban land use, using available forecasts and plans, and the assistance of knowledgeable local technicians to project the so-called urban-in-fact boundaries.

The 1990 urban boundaries are to include only that area which will have definite urban characteristics. Fringe areas with anticipated gross population densities of 1,000 or more inhabitants per square mile should be considered urban. Planned fringe areas of large nonresidential tracts devoted to urban uses, such as airports, railroad yards, factories, parks, stadiums, schools, and cemeteries, should be included in the urban area but are to be excluded when computing fringe area densities.

PROJECTIONS

Population

As was the case with the 1968 Functional Classification Study it will be necessary to identify and rank population centers as they are expected to exist in 1990. Forecasts of 1990 population are to be prepared for all areas that are expected to be urban in 1990 as well as for the remaining rural subareas. These forecasts will be prepared according to the urban and rural area statistical definitions given in this manual.

Each populated place presently containing less than 5,000 persons and not included within the delimited boundary of a 1990 urbanized area, should be examined to determine whether its anticipated population growth to 1990 will result in its classification as a small urban area as defined for this study. In addition, certain presently rural areas (i.e., suburban development, new towns, etc.) should be examined to determine those which will qualify as small urban areas due to expected population increases by 1990.

The base for forecasting the 1990 population will be the 1960 Census of Population unless data from a more recent Federal census are available. The total State, regional and national populations must be given full consideration when estimating populations of the individual urbanized and small urban areas in order that the estimates will be reasonable and consistent. Consequently, in making these 1990 urban estimates it will be necessary to develop them coincidently with and in relation to the total 1990 State population projections and the projections for the remaining rural population (including those places from 2,500 to 4,999 population).

A considerable amount of population data is available in the States through the urban transportation studies, from the work done for the 1968 National Highway Functional Classification Study, the 1970 Interstate Cost Estimate, and from agencies preparing current population estimates for the various States. A list of these latter agencies is given in appendix C, table C-1. For those presently certified urbanized areas in which either the study target year is not 1990, or the urbanized area boundary is different from that required for this study, both the population forecasts and the area boundary will have to be revised in accordance with the criteria established for this study.

Because of the variety of kinds of population forecasts and sources of forecasting advice and assistance that are available to the States, no single forecasting procedure is being specified in this manual. Of foremost importance in any procedure is the maintenance of a sound overall perspective. Specifically, the aggregate of individual place projections must stand the test of reasonableness in terms of implied overall trends for urbanized areas, for small urban areas by size group, and for rural area density.

To assure reasonable distribution of total projected population by the above categories an iterative approach with feedback tests is necessary, particularly, in some States, when a very large proportion of the total population growth will occur in urbanized areas. Proportionally small variances in forecasts for these places can have a disproportionate effect on residual values applicable to small urban places and rural areas. Hence a step-down residual forecasting procedure without feedback is to be avoided.

A more detailed description of population projection techniques is contained in the publication entitled "Population Forecasting Methods", included in the Highway Planning Program Manual as Transmittal 45, Volume 20, Appendix 36.

Washington Office population projections

A reasonable degree of consistency must be maintained in projecting population growth and classifying it in a manner in which it may be distributed regionally, by States, and in rural and urban areas. For use toward that objective, the 1969 Bureau of the Census population estimates, by States, and a set of 1990 population projections prepared in the Bureau of Public Roads' Washington office, are included in appendix A, tables A-1 through A-3 of this manual.

In preparing the 1990 projections, the historical growth of the large urban places (including those likely to reach urbanized area status by 1990) and the trends of the rural-urban division of the population were prime considerations. 1/ It is believed that these projections are consistent with predicted national trends, according to certain accepted assumptions for State, regional, and national growth.

The State population totals are those prepared for the 1970 Interstate System cost estimate. 2/ They reflect a regional and national consistency that takes into account reasonable assumptions concerning birth rates and migration within a national total. Substantial departures from these State totals would imply changes in other States and regions which may be difficult to reconcile. The national total is approximately the same as the "B" (middle estimate) series of projections of the Bureau of Census. These forecasts were reviewed by other Federal agencies for their reasonableness.

These projections are included for guidance of the States in the conduct of this classification study. Because this is a national study, the projections by any individual State must be reasonably consistent with those of other States and with regional and national totals. Since such consistency is essential, departures from the State total population projections in appendix A, table A-2, should be fully explained. Any such departures and their explanation should be submitted to the Office of Planning, as early as possible in the study, so that the merit of their use in the study can be weighed.

1/ It should be noted that the population classified as urban in table A-2 includes that of places of 2,500 population or more, although for this study only places expected to reach 5,000 population in 1990 are considered urban.

2/ Certain 1990 State estimates contained in table 1 of appendix A of the 1970 Interstate Cost Estimate manual will not agree with corresponding State totals contained in appendix A, table A-2 of this manual. These variances have previously been discussed and agreement reached between the Bureau of Public Roads and the affected States.

Travel Estimates

As part of this study, travel forecasts are to be developed. The procedures suggested for use are similar to those used in preparation of vehicle-mile estimates of travel for Bureau of Public Roads table TF-1. The 1990 daily vehicle-miles of travel must be forecast for each subarea of the State so as to provide data for each urbanized area, three strata of small urban areas, and the remaining rural area, reported by functional system, substratified by Federal-aid and administrative systems. Section-by-section estimates of present ADT and forecasts of 1990 ADT are required for all arterials and collectors included in the needs sample.

Regardless of the method used, initial estimates for individual urbanized and other areas within the State will have to be adjusted, in cooperation with the local planning groups, to provide agreement in total with the independently derived State base and forecast year totals; and the statewide total, in turn, must be consistent with national values. Estimates and forecasts are much more reliable for large areas or broad categories, of course, than for small areas or road sections.

For this study it is expected that satisfactory base year data can be obtained by using the recently completed functional classification study; and forecast year totals can be obtained from table TF-1. These data will be reviewed, adjusted as necessary and further disaggregated for this study.

The travel forecasts for the functional systems of the classification study should tie in with the administrative system forecast previously prepared and reported in table TF-1 for the 1970 Interstate Cost Estimate. The table TF-1 State total data entries forecast for 1990 as submitted for the 1970 Interstate Cost Estimate may be used to the extent applicable, after a review by the State highway department and the Bureau of Public Roads Division or Regional staff confirms that subsequent trends, changes, the availability of additional data, or other developments indicate satisfactory consistency and no changes are necessary. Any revisions of State totals approaching 5 percent of the State total or 1 percent of the national total should be brought to the attention of the Washington office, so that the effect on national consistency can be determined. The 1990 total values for mileage, vehicle-miles,

377-268 O - 70 - 3

and the related data items are of principal concern. To avoid possible subjective judgments in classifying, previous table TF-1 forecasts of mileage and travel by administrative systems, including the Interstate System, should be disregarded to the maximum extent feasible until after the initial section by section forecast work for this functional classification study is completed. Only State totals should be of principal concern initially.

Present travel

The statewide route log and urban and rural worksheets require the coding of present ADT. For purposes of this study, 1969 ADT figures should be entered, which will be assumed to be valid to December 31, 1969. The 20-year needs study period will then be assumed to cover the period January 1, 1970 to January 1, 1990. It is recognized that 1968 ADT figures produced in conjunction with the 1968 functional classification study will have to be factored up to 1969 on the basis of the TA-1 data for that year.

Appendix D outlines a detailed procedure, "The Travel Disaggregation - Adjustment Procedure", for obtaining subarea 1990 DVM's by system for use in arriving at needs section ADT for this study. The procedure is similar to the one presented in section III of the "1968 National Highway Functional Classification Study Manual."

CLASSIFICATION PROCEDURES

General

The basic concepts and functional criteria for the development of the 1990 functional classification plan are the same as those expressed in the 1968 National Highway Functional Classification Manual. The 1990 functional classification will differ from the 1968 classification in two basic respects: (1) It will be based on projected 1990 population, land use and travel; and (2) it will include, in addition to existing facilities, such projected totally new facilities as will be needed to serve 1990 land use and travel. Much of this new mileage will consist of new streets in expanding urban areas. The unbuilt Interstate mileage, not included in the 1968 classification, additional freeways developed through the transportation planning process, belts and bypasses in smaller cities, will constitute as a group, the other major category of new mileage. Some new routes may be needed to serve planned and committed new recreation areas or new towns. A final category of additional, though in one sense not "new", facilities will be those representing relocation of existing facilities, in cases where adequate standards cannot be provided on the original location, or where an existing routing is excessively circuitous. For convenience, the functional classification characteristics which define the several systems, are reprinted from the 1968 manual in appendix E. The classification procedures from the earlier manual are not repeated herein, although their review would be advisable, particularly for any study personnel who were not involved in the 1968 classification study.

Separate procedures are presented below for rural, urbanized area and small urban area classifications. In most cases, the basic approach is to use the 1968 functional classification as a base, modifying and updating it to provide a classification plan adequate for projected 1990 land use and travel. Where transportation plans exist for the year 1990 (or which can be updated to 1990) they should be considered in the classification process. Within these plans however, the functional relationships outlined in this manual shall be observed and functional systems so identified.

In developing the 1990 classification and in estimating needs in both urban and rural areas consideration must be given to the impact of forseeable developments in other modes of transportation. This consideration will be brought into the study through the urban transportation planning process. On statewide systems, especially in heavily traveled intercity corridors, the influence of high speed rail service and improved air service should be reflected in the study through the travel forecasts to the extent that they are quantifiable. Such influences will probably have more impact on the needed capacity of highway facilities than on the actual system configuration.

Rural Systems

Rural systems classification, as in the 1968 manual, should start at the top of the hierarchy and work down, developing first principal and minor arterial systems on a statewide basis, and then proceeding to collector classification on a more localized (probably county) basis.

Rural arterials

For rural arterial systems, the following steps are proposed:

1. Set-up State base map (maps) showing 1968 functional (arterial) systems.

2. Plot on map 1990 urban limits to degree of accuracy feasible at that scale.

3. Add to map all of designated Interstate system.

4. Add to map all rural routes of potential arterial character built or under construction since cut-off date (December 31,1968) of 1968 study.

5. Update ranking of traffic generators to 1990.

6. Update classification to 1990, to reflect consideration of:
   (a) Updated ranking of generators, (e.g., major shifts in ranking or new generators).

   (b) Changes in functional relationships created by adding facilities identified in (3) and (4) above.

(c) Changes in functional relationships which may be anticipated in regard to implementation of a functional plan, wherein, for example, traffic from two or more existing facilities may become concentrated on a single improved facility.

7. Update classification to include relocations required by:

   (a) Routes where needs study improvement criteria cannot be met by improvements on present location. There should be continuity in the type of service provided along a route between major control points.

   (b) Connections to new urban facilities developed in urbanized and small urban area classification plans.

Items 1-4 above need little discussion. (The actual development of 1990 urban-in-fact boundaries is discussed on page II-4.) The ranking of generators, however, does warrant some discussion.

First in such a discussion is consideration of the use of the updated ranking, and its probable effects in updating the 1968 classification.

Studies conducted over the years have indicated a large degree of stability in the routes and corridor locations of arterial systems. To a considerable extent, centers of the lower size range of places served by these systems (especially minor arterial) are not undergoing great or rapid change. Furthermore, considering mere growth, per se; if all centers were growing in proportion, without causing significant shifts in travel linkages, such growth would not affect the functional relationships in the road network. There will, however, be instances where smaller cities and towns, due to unique circumstances of location or activity, will be anticipated to undergo substantial growth. The same will apply, probably in greater degree, to other travel generators, especially recreation centers. These rapidly expanding generators will be of principal interest in reviewing the updated ranking of generators.

A discussion concerning 1990 population estimates for urban places was presented on page II-6 . Such projected 1990 estimates of population will not be required for individual places whose 1990 population is anticipated to be less than 5000. As mentioned above, large or rapid population changes are not characteristic of this level of population centers. In developing a place ranking profile, or plot, for this study, it will suffice, for these smaller places, to indicate population growth only for those in which significant change of a nature that would affect the classification plan is anticipated.

Generators other than population centers will be involved in the up-dating of the 1968 ranking of generators. Both in regard to population projections and in projecting these other generators, statewide and regional development agencies should be contacted to obtain information on development trends, available socio-economic forecasts, and statewide and regional development plans.

Visitation forecasts for important recreation centers should be obtained, or made if not available. Projections of visits should be reviewed to assure that individual forecasts are realistic in terms of use potential and that projected statewide totals reflect a growth rate consistent with overall travel growth. Figure III-1 in the 1968 manual may be used to obtain equivalent population to use in the ranking process. With the 1990 updated ranking of generators completed, the actual updating of the rural arterial classification can proceed, as outlined in step 6, page II-12 .

Note that, in addition to analysis of the effect of the new rankings, consideration is also given to the changed function of existing facilities brought about by the delineation of the total Interstate System plus other facilities placed under construction since the cut-off-date (December 31, 1968) of the 1968 study.

A few States have developed a statewide traffic model and have made traffic assignments for 1990. These States are encouraged to use the results of such efforts in this study to assist in classifying the rural highway systems.

The final step in the rural arterial classification (step 7, page II-13) is to incorporate the effect of route relocations where needs study criteria cannot be met by improvements on present locations or where needed for integration with new urban facilities. Where statewide plans exist they may be helpful in identifying such facilities. Continuity of systems and continuity of type of service that will be provided between major control points along a route are to be considered at this point.

This particular feedback linkage between needs appraisal and classification creates a problem in that arterial needs are to be sampled. The completed 1990 classification plan will provide the mileage universe into which the sampled needs mileage is to be expanded. Hence, it will be necessary to develop a reasonably accurate estimation of the mileage of arterial relocation even for portions of the network on which needs are not sampled. While this will not require the actual documentation to be carried out for the fully appraised mileage, it should be done with conscientious reference to the needs study tolerable criteria (page III-24) in conjunction with inventory data, reasonable traffic projections and knowledge of field conditions. 1/

Rural collectors

In most counties there should be a substantial degree of stability over time in the extent and location of rural collector routes. There will of course, be changes brought about by (a) changed urban-in-fact boundaries, (b) reclassification of arterials superseded by relocations; even in counties where the rural environment remains little changed, and, (c) reclassification of roads presently functioning as collectors to local classification due to the normal diversion and increased channelization of traffic on to one facility following a highway improvement.

1/ Arterial relocations, in the majority of cases, will result in reversion of the original location to collector status (less often to local).

Probable changes in land use which would significantly affect the classification plan should be forecast wherever possible. Such changes are most predictable where substantial recreation developments are being planned or where other changes in basic economic activity can be firmly projected, including some assurance as to probable activity sites. Plans and forecasts of State and local agencies should be sought out where available. It is not proposed here however, that all local plans be uncritically accepted. They should be compared with overall State forecasts for reasonableness.

As with arterials, collector needs are to be sampled. The collector mileage in counties or areas where needs are not appraised will be a portion of the mileage universe into which collector needs costs are expanded. Again, as with arterials (see discussion on page II-15), this raises the question of handling route relocations in areas where needs are not sampled. In such areas where there is obvious need for relocations because of gaps, excessive circuity, or bad terrain for instance, these relocations should be mapped. Any realignments which are not expected to cause a significant change in the total collector mileage base may be ignored.

Rural local

Rural local road mileage is to be statistically projected to 1990. The 1990 mileage will differ from the mileage reported in the 1968 study, mainly in the reduction of rural mileage brought about by changed urban boundaries. 1/ There may be some growth of rural local mileage, particularly for projected recreation, industrial, and rural residential developments. Such growth may be projected if analysis indicates that it will be extensive enough to have a significant effect on total local road needs.

1/ As in the 1968 study, the mileage of primitive roads and trails, as defined in Public Roads' instructions for reporting highway mileage statistics, is not to be included.

Urbanized Area Systems

In addition to the functional systems developed during the 1968 functional classification study, the resources and outputs of the urban transportation planning process, as required by the 1962 Federal-Aid Highway Act, are expected to be utilized to the fullest practicable extent in this study. Such utilization should not be limited to the policy and technical organizational structure but should include use of projections, analyses and the plan outputs themselves.

The 1990 functional plan in urbanized areas should evolve from the existing base classification as modified by proposed facilities contained in the transportation study target year plan. This represents merely the first step in the functional plan development process since several other factors must be taken into consideration. Of primary importance is the target year of the various forecasts and plans developed by the transportation planning process. In many instances, transportation and land use plans have not been prepared for 1990, thereby requiring additional projections to meet the requirements of this study. It is expected that all data described in the "1968 National Highway Functional Classification Study Manual" will be forecasted to 1990 and applied in the 1990 classification process in the proper manner. The 1990 functional classification plan is intended to provide an adequate and practicable traffic circulation system for 1990 travel.

One of the major elements of the ongoing urban transportation planning process is the development of an areawide highway transportation plan in coordination with land use plans and plans for other modes of transportation, all in accordance with locally derived goals and objectives for the area. The concepts, policies and procedures regularly applied to these elements of the urban studies apply also, of course, to this study and need not be reiterated here. In regard to the development of the 1990 surface street portion of the functional plan, alternative routings and alternative solutions to capacity problems will create inevitable linkages between the classification process itself and the appraisal of capacity needs.

There are three major considerations which must be simultaneously weighed and balanced in developing and appraising the arterial street portion of the functional plan. First, the plan should meet the basic functional criteria for service to generators, spacing and continuity; that is, it should be a logical circulation plan. Second, it should, at the more localized level, provide the most logical choices of individual streets to meet capacity requirements. Provision of adequate capacity may involve taking of additional rights-of-way for widening, or the selection of additional or different streets to serve as arterials through modification of the classification plan. The proposal to widen or reclassify streets brings into play the third major consideration, that of the impact of such proposals on their immediate environment.

A thorough analysis of capacity deficiencies should be made in defined travel corridors. Capacity appraisal should incorporate the presumption of peak-hour parking restrictions as a preferred alternative to widening of arterial streets. The development of a classification plan that lends itself to the most logical solution of capacity needs, while also giving adequate consideration to possible adverse effects of widenings and reclassification on the immediate environment, obviously requires both technical and policy appraisal.

The basic purpose of the functional plan is to provide a framework for a long-range nationwide estimate of highway needs, and it does not constitute a commitment to any specific project. Consequently, as pointed out in section I, formal policy approval is not anticipated. However, in developing the study through the classification and capacity appraisal stages, the policy mechanism of the urban studies should be utilized to insure that the proposal is actually representative of the kind and scope of highway improvements that might be implemented to satisfy local demand.

Small Urban Area Systems

The functional classification for the 1990 system plan in small urban areas should be developed as outlined in the numbered sequence of steps that follow:

1. Develop, in general concept, the pattern of future land uses in presently undeveloped areas within and around the city. Assumptions must be made (realistically) regarding major new commercial, industrial, institutional, and recreational developments

as well as residential development. 1/ In the absence of a 1990 land use plan, guidance must come from the pattern of land use in the present urban area (particularly from recent growth, if any), from local knowledge of any development proposals, from the pattern of existing road network, from the effect of other transportation facilities, and from an examination of the terrain conditions in the area.

2. Considering the above and the urban boundary criteria discussed on page II- 4, delimit the 1990 urban area boundary.

3. Using the classifications developed during the 1968 functional classification study as a base, delineate the principal arterial and minor arterial street networks within the 1990 urban area boundary. Included in these networks will be projected new facilities based on the land use plan or the assumption developed in (1) above. Revisions should be made to the 1968 base networks to reflect new classification (either higher or lower functional class) resulting from the inclusion of facilities projected, constructed, or reconstructed subsequent to December 31, 1968. As is the case in urbanized areas, the feedback in small urban areas between needs and functional classification is necessary. Because the needs appraisal will be accomplished for only a sample of small urban areas, there will be no factual feedback to the classification process in the nonsampled areas. Accordingly, during the classification process in the nonsampled small urban areas, a subjective analysis of the available features (pavement width, right-of-way, etc.) should be made to aid in determining whether a higher or lower functional classification of the facility in question might be appropriate and whether new facilities are warranted.

4. Evaluate (for reasonableness) the extent of the projected mileage of new facilities developed in (3). Miles of arterials per square mile of area should be comparable to the rate in areas presently developed to a similar land use intensity. This miles-per-square-mile rate for facilities in the area of future urbanization should logically not be higher than the corresponding rate for the present urban area, since the latter includes the densely developed areas of the city.

1/ Local land use planning maps, zoning maps, Department of Housing and Urban Development section 701 study maps or any other readily available information should be used.

5. Again using the 1968 functional classification study as a base, develop, (1) statistically, (2) by visual inspection and delineation on maps, or, (3) by a combination of both, the collector and local street mileages within the area projected to become urban by 1990. Where the area of projected urban growth is small, actual delineation by expanding the character of the existing network should be the simplest procedure. Where a statistical procedure is used, statistical indices, such as a street-miles-per square-mile rate, based on substantial areas of existing development, are recommended. Such areas and the resultant statistics may be taken from data in other cities provided the character of development is similar to that anticipated for the urban area under study.

6. Evaluate the adequacy of the overall classification plan to serve anticipated 1990 travel. The following questions, among others, should be considered: Does the pattern of principal arterials (if any) plus minor arterial streets provide adequate continuity for citywide movement? Can anticipated 1990 capacity requirements be met within developable rights-of-way of the designated network or should additional arterials (one-way couplets, for example) be designated? Would such added arterials, in regard to their impact on the immediate environment, be representative of realistic proposals that might be implemented to satisfy local demand? Has the distinction between arterial and collector streets been properly and consistently defined?

7. Develop the further subclassifications within the principal arterial street classes required to provide connecting links for the rural principal arterial and minor arterial systems as described on page E-10, appendix E.

SUBMITTAL OF CLASSIFICATION DATA

This section of the manual outlines the requirements for submitting information concerning the development of a 1990 functional classification plan for needs evaluation. The necessary information includes the statewide graphic ranking of travel generators, systems maps, and data summary forms. Table II-1 summarizes the submittal requirements for the classification phase of the study.

Preliminary as well as the final submissions of the classification data are requested. The submission of preliminary data will enable various interested parties to check results for reasonableness and consistency. In addition it will be used to finalize analysis techniques to be used on the final data and to aid in the development of mathematical models that will be used to simulate alternative Federal investment levels and associated benefits.

As shown in table II-1, the following forms, to be labeled as preliminary, (except as noted below) should be submitted through the Bureau of Public Roads Division office as early as possible but at least by July 1, 1970.

1. Statewide area, population, mileage and travel summary.
2. Rural data summary.
3. Three small urban area summaries (5,000 to 9,999, 10,000 to 24,999 and 25,000 to 49,999 population).
4. Individual urbanized area data summaries.
5. Urban connecting link data summary.
6. Statewide graphic ranking of travel generators (final values are to be represented in the preliminary submission; therefore no further submission is required).
7. Rural supplemental data summary (final values are to be represented in the preliminary submission; therefore no further submission is required).

The final classification data are to be forwarded upon completion of the needs analysis. The required data summaries, systems maps, and the study report are also to be included in final submission.

Table II-1--Classification data submittal requirements 1/

Item	Coverage	Preliminary submission	Final submission
Graphic ranking of travel generators	Statewide	X 3/	
Statewide systems map	Statewide		X
Countywide systems map	Each county (submit 4)		X
Urbanized area systems map	Each area (submit 1)		X
Small urban area systems map	Each area (submit 1 for each pop. group)		X
Statewide area, population, mileage and travel summary	Statewide	X	X
Rural data summary	Statewide	X	X
Rural supplemental data summary	One line entry for each county containing rural land 2/	X 3/	
Small urban area data summary, 5,000 to 9,999 population	Statewide	X	X
Small urban area data summary, 10,000 to 24,999 population	Statewide	X	X
Small urban area data summary, 25,000 to 49,999 population	Statewide	X	X
Individual urbanized area data summary	Each area	X	X
Urban connecting link data summary	Statewide (includes data of small urban areas and urbanized areas)	X	X
Statewide route log for rural principal arterials	One line entry for each route segment 2/		X

1/ Submit 3 copies of every item, one each for the Division, Region, and Washington offices of FHWA.

2/ Several copies of this form will be necessary in order to report all rural data for the typical State.

3/ This submission represents final values; if any changes should be necessary submit revised forms with final submission.

All submittals are to be made via the State highway departments to the Bureau of Public Roads Division offices. The Regional offices should not forward the data to the Washington office until their review of the data has been completed and necessary corrections made with State concurrence. All final data should be received in the Washington office no later than April 1, 1971.

All submittals to the Washington office should be addressed to:

Functional Classification and Needs Study
Office of Planning
Bureau of Public Roads
Federal Highway Administration
Washington, D. C. 20591

Systems Maps

Upon completion of all necessary adjustments to the 1990 functional plan developed for needs evaluation, certain maps are to be prepared for submittal. The requirements for these maps are outlined in the following subsections.

Statewide systems maps

The 1990 statewide systems map (functional plan) must be submitted, delineating the rural principal arterial system, subclassified as Interstate and other, and the rural minor arterial system. This map should include the following information:

1. Delineation of 1990 forecasted urban-in-fact boundaries of all urban areas with anticipated population in excess of 49,999 to the extent feasible on a statewide map.

2. Indication by map symbols of small urban areas in the following size groupings: 5,000 to 9,999, 10,000 to 24,999, and 25,000 to 49,999. In addition, place groupings below 5,000 population should be shown if pertinent to the rural minor arterial system within the State. Other important traffic generators such as large National or State parks should be shown. Standard symbols to be used on all statewide maps to provide national uniformity are shown in figure IV-1, page IV-6, of the "1968 National Highway Functional Classification Study Manual." The population symbols are to apply to the 1990 forecasted population.

3. Place name of all centers identified above.

4. Delineation of geographic barriers, such as major rivers or lakes, if their inclusion enhances the clarity of the systems map.

5. Delineation of routes of the rural portion of the 42,500 mile Interstate system, other rural principal arterials, and rural minor arterials, using the symbols shown in the above reference. In some States, 1990 forecasted urbanization will encompass a considerable portion of the geographical area of the State. In such instances connecting links of the rural principal arterial system should be shown through the area so that statewide continuity is illustrated.

6. Identification of principal arterial routes by study route numbers, in accordance with the route numbering procedures described in the needs evaluation instructions in section IV.

7. Identification of new routes on new locations as "new."

8. A mileage scale.

9. A legend identifying the State, year of the plan, and the symbols used.

In addition to the above items some States may wish to include county lines on their maps.

Countywide systems maps

Development of the rural collector classification is to be documented on individual county maps, preferably those of the county highway planning series. The complete file will be retained at the State level and only a sample of four counties is to be submitted to the Bureau of Public Roads. These sample counties should be selected so that two have approximately the same rural population density as the statewide average; a third, above average density; and a fourth, rural population density below the statewide average.

The county maps should show the following information:

1. The anticipated 1990 urban boundaries for all small urban and urbanized areas should be shown to the extent practical on maps of this scale.

2. Rural functional systems, identified as rural Interstate, other rural principal arterial, rural minor arterial, rural major and minor collectors, and rural local roads.

3. The location and names of population centers and other traffic generators selected for service by major collector routes and higher level systems.

4. New routes on new locations shall be identified as "new."

5. A legend identifying the county, the county code number, the map scale and symbols used.

Since these are essentially work maps for use within the States, colors may be used and uniform symbols are not specified. It is suggested, however, that since county line and State line coordination is required that the following color scheme be used to show systems:

Interstate ------------------------	Black
Other rural principal arterials ---	Red
Rural minor arterials -------------	Blue
Rural major collectors ------------	Green
Rural minor collectors ------------	Brown

Urban systems maps

Development of the 1990 classification plans for needs estimates for each small urban and urbanized area is to be documented on a map or maps of suitable scale. A complete file will be retained at the State level. In addition, the following maps are to be submitted to the Bureau of Public Roads:

Urbanized areas - A sample of one from each State.

Small urban areas - A sample of one from each of the population groups of 5,000 to 9,999, 10,000 to 24,999 and 25,000 to 49,999.

These maps should contain the following information:

1. Place name identification of the urban area (include urbanized area code from appendix A for urbanized areas).

2. Delineation of the 1990 urban boundary.

3. Delineation of 1990 arterial systems within the urban boundary, with appropriate map symbols for each including some means for separately symbolizing the connecting links of rural principal and minor arterials.

4. Principal arterial routes shall be identified by study route numbers, in accordance with the numbering procedures described in the needs evaluation instructions in section V.

5. New routes on new locations shall be identified as "new."

6. A mileage scale and map legend explaining the map symbols used.

As with county maps, colors may be used and uniform symbols are not specified. The following colors are suggested, however, for indicating systems:

Interstate	Black
Other freeways and expressways:	
Connecting links of rural principal arterials	Red-solid
Connecting links of rural minor arterials	Red-dashed
Other	Red-dotted
Other urban principal arterials:	
Connecting links of rural principal arterials	Blue-solid
Connecting links of rural minor arterials	Blue-dashed
Other	Blue-dotted
Minor arterial streets	Green
Collector streets (if shown)	Brown

Graphic Ranking of Travel Generators

Each State should furnish copies of the graphic ranking and grouping of travel generators developed for the rural classification. Figure III-2, page III-6, "1968 National Highway Functional Classification Study Manual," shows a typical plot of this type. The scale and format of this plot are left to each State's option. Copies of working plots are satisfactory, the only requirements being that the State name, groups, and scale be identified. In addition place names should be given for all places or recreational areas with a 1990 population (or equivalent population) of 5000 and over.

Data Summary Forms

A series of nine data summary forms provides the means of reporting the statistical data concerning the development of a classification plan for needs evaluation. These forms, shown on pages II-34 through II-42, are as follows:

1. 1990 Statewide area, population, mileage, and travel summary
2. 1990 Rural data summary
3. 1990 Rural supplemental data summary
4. 1990 Small urban area data summary--5,000 to 9,999 population
5. 1990 Small urban area data summary--10,000 to 24,999 population
6. 1990 Small urban area data summary -- 25,000 to 49,999 population
7. 1990 Individual urbanized area data summary
8. 1990 Urban connecting link summary
9. 1990 Statewide route log

Only one each of items 1 through 6 need be prepared by each State. Item 7 is to be prepared for each urbanized area (a portion therein) within the State, and as many copies of items 8 and 9 as are necessary should also be prepared. As noted in table II-1 each form is to be submitted to the Bureau of Public Roads in triplicate. All of the above with the exception of item number 9, should be submitted to the Bureau of Public Roads both as "preliminary" by July 1, 1970 and in final form by April 1, 1971. Item number 3, the 1990 rural supplemental data summary, should only be furnished during the initial submittal.

It will be noted that the forms have been designed for keypunching. However, the States are not requested to furnish any punched cards as part of the functional classification phase of this study. A supply of blank forms will be furnished to each State in the near future.

While the forms are generally self-explanatory the following instructions are furnished:

1. 1990 urbanized area codes are furnished in appendix A. State codes are furnished in appendix B.

2. All data should be entered right justified, and a zero should be entered in the right column of any field where the value is zero. Leading zeros need not be entered.

3. The following units are applicable to all entries on all forms with the exception of the statewide route log:

Land area ----------------	square miles
Population ---------------	thousands
Mileage -----------------	miles
Travel ------------------	daily vehicle miles in thousands
Registered vehicles------	in hundreds
Percent of population ---	in tenths

With the exception of certain labeled data required by the "Rural Supplemental Data Summary," all data pertain to 1990 as noted elsewhere in this manual.

4. The sum of the mileage and travel entries reported by 1990 functional system should equal the respective values entered in the "1990 Statewide Area, Population, Mileage and Travel Summary." It should be noted that subtotals from all appropriate urban forms must be added together in order to check the urban total contained in the "1990 Statewide Area, Population, Mileage and Travel Summary."

5. The sum of the mileage and travel reported on each line of all forms (except the "Rural Supplemental Data Summary," the "1990 Urban Connecting Link Summary" and the "Statewide Route Log") should equal the total mileage and travel entries contained in the first two fields at the left side of that line.

6. The Federal-aid mileage and travel entries required by certain data submittal forms for the Federal-aid Primary and Federal-aid Secondary systems should conform to present, December 31, 1969 approved Federal-aid routes. No attempt should be made to project future Federal-aid systems even though they are cross classified with 1990 functional systems. Therefore, all new mileage and corresponding 1990 travel estimates not presently designated as Federal-aid routes should be reported as non-Federal-aid.

7. Data labeled as 1968 on the "Rural Supplemental Data Summary," shall be the products of the "1968 National Highway Functional Classification Study." The following should be noted regarding the requirements of this form;

(A) The functional mileage required to complete this form is for rural portions of the counties only.

(B) 1968 mileage by 1968 functional classification is to be reported for 1968 rural portions of counties.

(C) Rural functional mileage is to be reported for all those counties sampled in the needs estimating phase of study. If available it may be reported for all counties.

(D) Both 1968 and 1990 rural population and land area are to be reported for all counties.

(E) 1968 registered vehicles are to be reported for every county if available.

Statewide Route Log

A statewide route log is required for the 1990 rural principal arterial system and all of its connecting links through small urban and urbanized areas, but excluding Interstate mileage. This information is required to assure that certain studies to be performed by the Bureau of Public Roads will have the benefit of complete knowledge of this system.

General instructions

Shown on page II-42 is the format for the above described route log. While the format has been designed for possible future data processing procedures, punched cards or listings of such cards are not required. Neat and legible hand coded forms are the only requirement for this study.

Three types of entries are included on the forms. There should be one line for each route segment, one line for each route total, and one line showing the State total of all routes.

All forms should be numbered in the upper right hand corners as shown in the example. Entries on the forms should be right justified with the exception of the description field (cols. 17-50) which should be left justified.

Coding instructions for statewide route log

Column

1-2 State code - Enter the State code number as listed in table B-1, appendix B.

3-6 Study route number - A four digit study route numbering system will be used which is consistent with the route numbers shown on the statewide systems map. As detailed in sections IV and V in the instructions for the worksheets the route numbers assigned to rural principal arterials and connecting links thereof should be between 2000 and 2999.

Column

7-9 Route segment - (Not applicable to lines reporting route or State totals)

To insure optimum utility of the route log, routes shall be segmented and data reported by segment. Route segment numbers must start with 001 for each route. Breakpoints should be established at the following locations:

1. At all 1990 small urban and urbanized area boundaries.
2. At all junctions with other rural principal arterials and connecting links thereof (including Interstate routes).
3. At such other points as may be found convenient or necessary in the interest of clarity; for example, at interchanges where major changes in traffic volume occur.

It is generally intended that route segments be as long as possible within the above framework. It is expected that route segments will generally be longer than the route sections as described in sections IV and V.

10 Type area - (Route segments only) - For each line entry code as follows (1990 conditions).

1. - Rural
2. - Small urban area, 5,000 - 9,999
3. - Small urban area, 10,000 - 24,999
4. - Small urban area, 25,000 - 49,999
5. - Urbanized area

11-16 Signed route number - (Applicable to lines reporting segment data only) - Enter the existing signed travel route number which will assist in locating the section on a map; for example US322, S 1006, C 1030 (S for State, C for county).

Column

17-50 Route or route segment description - Briefly but clearly define termini: for example:

EUL (for East urban limit) Wayville to I84
PA SL (for State line) to US1
RS (for route segment) 002 to SRN (for study route number) 2419

If extensive codes or abbreviations are used, other than those similar to the ones used in the above examples, a key should be provided at the end of the route log listing.

51-57 Rural mileage - Enter the rural mileage to the nearest tenth of a mile for the route segment, route, or State total. (Leave blank for urban route segments.)

58-63 Urban mileage - Enter the urban mileage to the nearest tenth of a mile for the route segment, route, or State total. (Leave blank for rural route segments.)

64-69 Present average daily traffic volume - Enter the present ADT for each route segment. Leave blank for route totals and State total.

If a "new" facility can be said to replace an existing one, enter the ADT for the existing facility. If the "new" facility cannot be associated with an individual existing one, leave these columns blank.

70-75 1990 average daily traffic volume - Enter the 1990 ADT for each route segment. Leave blank for route totals and State total.

Column

76 Road type - (route segments only) - Code as follows:

D = Divided - For the purposes of this study a highway is considered to be divided when two or more lanes are provided in each direction of travel and the median is four feet or more wide and constructed in a manner to preclude its use by moving vehicles except in emergencies. Where a median is less than four feet wide, the roadway should be classified as divided if the divider consists of fencing, a retaining wall, or other physical barrier.

U = Undivided - All highways not meeting the above criteria.

N = For "new" facilities

77 Access control - (Route segments only) - Code present access control as follows:

1. Full access control - Preference has been given to through traffic movement by providing interchanges with selected public roads and by prohibiting crossings at grade or direct private driveway connections.
2. Partial access control - Preference has been given to through traffic movement to a degree that, in addition to interchanges, there may be some crossings at grade with public roads. Direct private driveway connections have been minimized.
3. No access control.

78-79 Number of lanes - (Route segments only) - Enter the number of through roadway lanes. Do not include paved shoulders, channelized facilities for turning at intersections, speed change lanes, climbing lanes, and service or parking lanes which cannot be used for the movement of through traffic.

80 Card number - Code as follows:

1. Lines reporting route segment data
2. Lines reporting route totals
3. Lines reporting State totals

NOTE: For new facilities leave columns 11-16 and 77-79 blank.

BOB No. 04-S69053

1990
STATEWIDE AREA, POPULATION, MILEAGE, AND TRAVEL SUMMARY

I. State name ______________________

State code: ___ / ___ /
1 2

9 /
3

II. 1990 Land area (square miles)

State total: ___/___/___/___/___/___/
4 9

Rural: ___/___/___/___/___/___/
11 16

Urban: ___/___/___/___/___/
18 22

III. 1990 population (thousands)

State total: ___/___/___/___/___/___/
23 28

Rural: ___/___/___/___/___/
30 34

Urban: ___/___/___/___/___/___/
36 41

IV. 1990 street and highway mileage

State total: ___/___/___/___/___/___/
43 48

V. 1990 daily vehicle miles of travel (thousands)

State total: ___/___/___/___/___/___/___/___/
50 57

VI. Card identification code

9 / 9 /
79 80

1990
RURAL DATA SUMMARY

BOB No. 04-S69053

Card Number	Functional Classification	Total – Mileage – Miles	Total – Mileage – % of rural total	Total – Mileage – Cumulative % of rural total	Total – Travel – Daily vehicle miles of travel (thousands)	Total – Travel – % of rural total	Total – Travel – Cumulative % of rural total	Federal-aid primary – Miles	Federal-aid primary – Daily vehicle miles of travel (thousands)	Federal-aid secondary – Miles	Federal-aid secondary – Daily vehicle miles of travel (thousands)	Non-federal-aid – Miles	Non-federal-aid – Daily vehicle miles of travel (thousands)		State Code
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71		79 80
	Principal arterial system														
0 1	Interstate	9								0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0		
0 2	Other principal arterials	9													
0 3	Minor arterial road system	9													
	Collector road system														
0 4	Major collectors	9													
0 5	Minor collectors	9													
0 6	Local road system	9		100.0			100.0								
0 7	Total	9	100.0	–		100.0	–								

1990
RURAL SUPPLEMENTAL DATA SUMMARY

BOB No. 04-S69053

Card Number		Rural Land Area (Square Miles) 1968	Rural Land Area (Square Miles) 1990	Total 1968 Vehicle Registrations	Population 1968 Total	Population 1968 % Rural x x.x	Population 1990 Total	Population 1990 % Rural x x.x	1968 Rural Functional Mileage (1968 Functional Classification)1/ Principal Arterial System Interstate	Principal Arterial System Other Principal Arterials	Minor Arterial Road System	Collector Road System	Local Road System		Cost Area Code		County Code2/	State Code
1 2	3	4 5 6 7 8 9	10 11 12 13 14 15	16 17 18 19 20	21 22 23 24 25 26	27 28 29	30 31 32 33 34 35	36 37 38	39 40 41 42 43 44	45 46 47 48 49 50	51 52 53 54 55 56	57 58 59 60 61 62	63 64 65 66 67 68	69 70 71	72 73	74 75	76 77 78	79 80
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
0 9	9																	
1 2	3	4 5 6 7 8 9	10 11 12 13 14 15	16 17 18 19 20	21 22 23 24 25 26	27 28 29	30 31 32 33 34 35	36 37 38	39 40 41 42 43 44	45 46 47 48 49 50	51 52 53 54 55 56	57 58 59 60 61 62	63 64 65 66 67 68	69 70 71	72 73	74 75	76 77 78	79 80

1/ This portion of this form is to be completed only for the rural portions of the counties sampled in the needs estimating phase of the study.
2/ It is recognized that not all states are subdivided into counties. In some States the subdivisions are parishes and election districts. The geographical areas (and codes) referred to as counties in the IBM coding manual are those intended for use in this study.

BOB No. 04-S69053

1990
SMALL URBAN AREA DATA SUMMARY – 5,000 TO 9,999 POPULATION

Card Number	Urban Functional Classification		Total: Mileage: Miles	Total: Mileage: % of Total	Total: Mileage: Cumulative % of Total	Total: Travel: Daily vehicle miles of travel (thousands)	Total: Travel: % of Total	Total: Travel: Cumulative % of Total	Federal-aid primary: Miles	Federal-aid primary: Daily vehicle miles of travel (thousands)	Federal-aid secondary: Miles	Federal-aid secondary: Daily vehicle miles of travel (thousands)	Non-federal-aid: Miles	Non-federal-aid: Daily vehicle miles of travel (thousands)		State Code
1 2		3	4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71		79 80
	Principal arterial system															
1 1	Interstate	9									0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0		
1 2	Other freeways and expressways	9														
1 3	Other prinicpal arterials	9														
1 4	Minor arterial street system	9														
1 5	Collector street system	9														
1 6	Local street system	9			100.0			100.0								
1 7	Total	9		100.0	–		100.0	–								

State Name: ______________________

BOB No. 04-S69053

1990
SMALL URBAN AREA DATA SUMMARY — 10,000 TO 24,999 POPULATION

Card Number	Urban Functional Classification	Total: Mileage: Miles	Total: Mileage: % of Total	Total: Mileage: Cumulative % of Total	Total: Travel: Daily vehicle miles of travel (thousands)	Total: Travel: % of Total	Total: Travel: Cumulative % of Total	Federal-aid primary: Miles	Federal-aid primary: Daily vehicle miles of travel (thousands)	Federal-aid secondary: Miles	Federal-aid secondary: Daily vehicle miles of travel (thousands)	Non-federal-aid: Miles	Non-federal-aid: Daily vehicle miles of travel (thousands)		State Code
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71		79 80
	Principal arterial system														
2 1	Interstate	9								0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0		
2 2	Other freeways and expressways	9													
2 3	Other prinicpal arterials	9													
2 4	Minor arterial street system	9													
2 5	Collector street system	9													
2 6	Local street system	9		100.0			100.0								
2 7	Total	9	100.0	—		100.0	—								

State Name: ____________________

BOB No. 04-S69053

1990
SMALL URBAN AREA DATA SUMMARY – 25,000 TO 49,999 POPULATION

Card Number	Urban Functional Classification	Total: Mileage: Miles	Total: Mileage: % of Total	Total: Mileage: Cumulative % of Total	Total: Travel: Daily vehicle miles of travel (thousands)	Total: Travel: % of Total	Total: Travel: Cumulative % of Total	Federal-aid primary: Miles	Federal-aid primary: Daily vehicle miles of travel (thousands)	Federal-aid secondary: Miles	Federal-aid secondary: Daily vehicle miles of travel (thousands)	Non-federal-aid: Miles	Non-federal-aid: Daily vehicle miles of travel (thousands)		State Code
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71		79 80
	Principal arterial system														
3 1	Interstate	9								0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0		
3 2	Other freeways and expressways	9													
3 3	Other prinicpal arterials	9													
3 4	Minor arterial street system	9													
3 5	Collector street system	9													
3 6	Local street system	9		100.0			100.0								
3 7	Total	9	100.0	–		100.0	–								

State Name: ______________________

BOB No. 04-S69053

1990
INDIVIDUAL URBANIZED AREA DATA SUMMARY

Card Number	Urban Functional Classification	Total: Mileage: Miles	Total: Mileage: % of Total	Total: Mileage: Cumulative % of Total	Total: Travel: Daily vehicle miles of travel (thousands)	Total: Travel: % of Total	Total: Travel: Cumulative % of Total	Federal-aid primary: Miles	Federal-aid primary: Daily vehicle miles of travel (thousands)	Federal-aid secondary: Miles	Federal-aid secondary: Daily vehicle miles of travel (thousands)	Non-federal-aid: Miles	Non-federal-aid: Daily vehicle miles of travel (thousands)	Urbanized Area Code	State Code
1 2		3 4 5 6 7 8 9			12 13 14 15 16 17 18 19			22 23 24 25 26	29 30 31 32 33 34 35 36	39 40 41 42 43	46 47 48 49 50 51 52 53	56 57 58 59 60 61	64 65 66 67 68 69 70 71	76 77 78	79 80
	Principal arterial system														
4 1	Interstate	9								0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0		
4 2	Other freeways and expressways	9													
4 3	Other prinicpal arterials	9													
4 4	Minor arterial street system	9													
4 5	Collector street system	9													
4 6	Local street system	9		100.0			100.0								
4 7	Total	9	100.0	–		100.0	–								

State Name: ____________________

Urbanized Area Name: ____________________

1990
URBAN CONNECTING LINK SUMMARY 1/

BOB No. 04-S69053

Card Number (1–2)	Connecting Link Mileage Summary – Other Freeways and Expressways – Connectg. Lnks. of Rural Prin. Arterial Sys. (3–8)	Connecting Link Mileage Summary – Other Freeways and Expressways – Connectg. Lnks. of Rural Min. Arterial Sys. (9–14)	Connecting Link Mileage Summary – Other Urban Principal Arterials – Connectg. Lnks. of Rural Prin. Arterial Sys. (15–21)	Connecting Link Mileage Summary – Other Urban Principal Arterials – Connectg. Lnks. of Rural Min. Arterial Sys. (22–26)	Connecting Link Travel Summary (Daily VMT in Thousands) – Other Freeways and Expressways – Connectg. Lnks. of Rural Princ. Arterial Sys. (27–34)	Connecting Link Travel Summary (Daily VMT in Thousands) – Other Freeways and Expressways – Connectg. Lnks. of Rural Minor Arterial Sys. (35–42)	Connecting Link Travel Summary (Daily VMT in Thousands) – Other Urban Principal Arterials – Connectg. Lnks. of Rural Princ. Arterial Sys. (43–50)	Connecting Link Travel Summary (Daily VMT in Thousands) – Other Urban Principal Arterials – Connectg. Lnks. of Rural Minor Arterial Sys. (51–58)	1990 Land Area in Square Miles (59–64)	1990 Population (thousands) (65–69)	No. of Small Urban Areas in This Strata (70–72)	(73–75)	Urbanized Area Code (76–78)	State Code (79–80)
08	000000	000000	0000000	00000	00000000	00000000	00000000	00000000			000	090	000	
18												090	000	
28												090	000	
38												090	000	
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		
48											000	090		

1/ This form, containing 1990 data, shall be completed as follows:

A) Card number 08 shall be completed for the entire rural portion of the State – land area and population only.
B) Card number 18 shall be completed for small urban areas of 5,000 to 9,999 population – one card shall be completed per State.
C) Card number 28 shall be completed for small urban areas of 10,000 to 24,999 population – one card shall be completed per State.
D) Card number 38 shall be completed for small urban areas of 25,000 to 49,999 population – one card shall be completed per State.
E) Card number 48 shall be completed for each urbanized area (or portion thereof) within the State.

1990 STATEWIDE ROUTE LOG

BOB No. 04-S69053

Page ____ of ____

State Code	Study Route Number	Route Segment	Type Area	Signed Route Number	Description From ____ To ____	Rural Mileage (xxxxxx.x)	Urban Mileage (xxxxx.x)	Present ADT	1990 ADT	Road Type	Acc. Cont.	No. of Lanes	Card No.
1 2	3 4 5 6	7 8 9	10	11 12 13 14 15 16	17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50	51 52 53 54 55 56 57	58 59 60 61 62 63	64 65 66 67 68 69	70 71 72 73 74 75	76	77	78 79	80

SECTION III

GENERAL INSTRUCTIONS FOR HIGHWAY NEEDS EVALUATION

NEEDS EVALUATION CONCEPTS

The three major elements of a highway needs study are as follows:

1. Delineation of a functional system plan. This has been described in section II of the manual.

2. Identification of type and cost of capital improvements, both for existing and new facilities, based on their presumed (for study cost estimating purposes only) location on the ground. Both the cost of overcoming existing deficiencies (backlog needs) and correcting deficiencies occurring during the 20 year study period (accruing needs) will be estimated. While deficiencies are determined based on minimum tolerable conditions (conditions considerably below design standards), once a deficiency is noted, the improvement is based on appropriate design standards to serve forecasted travel 20 years from the deficiency alleviation. The result is that by 1990 the entire system should at least meet minimum tolerable conditions. It follows, however, that not all links in the system will be operating at the same level of service nor is attainment of a uniform level of service an objective of the study.

3. Systemwide cost estimates (by functional system) for maintenance, prorated administration, stopgaps, and second generation replacements. Maintenance, administration, stopgaps and replacements are needed to round out the total cost picture, especially as to Federal-aid matching capability, or other fiscal analyses. Instructions for estimating maintenance and administration are included in section VII of this manual. Stopgaps and replacements will be statistically estimated in the Washington office. Stopgap

costs are those costs, over and above normal maintenance, necessary to keep presently intolerable facilities useable until the necessary eventual improvement can be scheduled. Second generation replacement costs recognize that only the costs of the initial improvement on each section are identified in this study and that some facilities will become deficient again during the study period. These costs will be developed using data from nationwide road life analyses. As noted later in this section certain traffic engineering type improvements will also be estimated in the Washington office.

Construction needs can be broken down into the two broad categories of (1) new facilities (i.e., on new rights-of-way) and (2) improvements to existing facilities. These two categories have some different elements in their respective appraisal techniques.

In many States a substantial proportion of new facilities (as distinguished from improvements that utilize the present ROW) on other than the local and collector systems will be freeways or expressways. Hence while the percent of mileage of new facilities will be relatively modest, the costs are quite significant. The freeway - expressway needs will be principally (1) urban networks, developed in the urban transportation planning process, and (2) elements of statewide arterial systems based on systemwide criteria interrelating function with traffic volume and land development.

A standardized step-by-step appraisal process is more readily applicable to the improvements needed on presently existing facilities than to new facilities. For existing facilities the ingredients available are (1) a geometric and physical condition inventory and (2) a comparison, element-by-element, between what exists and yardsticks of tolerability.

The broad categories of deficiency considered are traffic capacity, alignment, width, and structural (pavement) and drainage condition. The first three of these categories, broadly labeled "geometric," can be developed quite objectively and consistently, in the sense of being readily subject to numerically quantifiable values.

Structural and drainage adequacy require judgmental evaluation. Drainage adequacy is evaluated in terms of the character of cross-section (ditches, slopes, curbs, etc.) and height of grade line. These elements provide guidance, where there is an indicated need for resurfacing or widening, as to whether such an improvement is feasible or whether reconstruction is a more practical alternative.

The basic approach to highway needs evaluation to be used in this study is the minimum tolerable condition approach. Minimum tolerable conditions, the yardsticks to which existing facilities are compared, define adequate levels for capacity, alignment, width and structural condition somewhat below the standards that would prevail for new construction. The tolerability concept recognizes that it is not realistic to propose an improvement to a facility that is providing reasonably good service, even if it is not up to the standard of a new road. The minimum tolerable conditions established for this study reflect a measure of level of service as outlined in the 1965 Highway Capacity Manual by examining operating speed and/or volume/capacity ratios (v/c). In addition, specific geometrics of the needs sections are evaluated in terms of their influence on safety. Minimum tolerable conditions and design standards for new construction are developed by functional class of highway and by traffic volume group within each class.

Appraisal of the adequacy of existing facilities involves two major steps, performed in sequence. First, the facility is appraised as to whether it meets criteria of tolerability for present traffic. If it does not, it constitutes an existing or "backlog" deficiency. If it is now tolerable, it is then appraised as to whether it meets the same tolerable criteria based on projected future traffic. If it does not meet such criteria it becomes a future deficiency. In determining future deficiencies structural deterioration of the pavement must also be considered.

The type of deficiency is a key to the type of needed improvement, e.g., resurface, widen or reconstruct. Costing will generally be done on a per mile basis. Major cost categories are ROW, grading and drainage, surface and base, structures, and other. Costs are based on the standard required to meet forecast year (not present) traffic.

The procedure outlined above pertains primarily to arterial and collector highway systems which are studied on a section-by-section basis. (As subsequently described, sampling will be used even on these systems for this study.) On local roads and streets, a mass analysis procedure will be used for estimating needs. A description of this procedure is included in section VI of the manual.

SAMPLING RATES AND PROCEDURES

The determination of needs will be made on the functional systems developed for 1990 (as discussed in section II). Since it will not be feasible to obtain physical data and make adequacy appraisals on every mile of road and street in the nation, the needs analysis for this study shall be made on a sample of the facilities on each functional system, in rural, small urban, and urbanized areas. The minimum required sampling rates and the guidelines for sample selection described in this section were developed (1) to insure a reasonable reliability in the costs developed for the various functional systems in each State, and (2) to minimize the data collection and analysis required for the study. If desired, a State may increase the sample size (even to 100%) so that the results will be of maximum utility for their own internal purposes.

The specific sampling technique and rates to be employed shall be submitted to the Bureau of Public Roads regional office for approval prior to start of work on the needs analysis.

The specific sampling procedures and rates described below require some introductory explanation. These procedures recognize that the lower a functional system is in the hierarchy, the larger and more homogeneous is its universe. Hence different sampling rates are set up, by functional system, with lesser rates for lower systems. Furthermore, the procedures recognize that there are economies inherent in the use of cluster sampling, wherever this is practicable. Cluster sampling involves appraising needs on all routes of a particular functional system in sample areas of the State, such as counties, townships, precincts, etc., for the rural analysis, and individual small urban areas for the urban analysis.

Cluster sampling will not be used for Interstate or other principal arterials, because of the relatively limited mileage of these systems. Because needs are to be reported for individual urbanized areas, and because it would be difficult to define subareas within an urbanized area with similar characteristics from which a sample could be drawn, cluster sampling is not considered practical for urbanized areas.

In rural portions of the State, the selection of subareas for cluster sampling will be done within cost areas, (to be defined directly below), rather than on a statewide basis. Within a State, rural construction costs for a particular design will usually vary with terrain, soil type, climate and other pertinent variables. In this study, the rural portion of the State is to be divided into cost areas, which will serve two related purposes. First, each cost area, having consistent costs for any particular system and design type, will provide a logical sampling universe within which it will be justifiable to use cluster sampling. Second, within each cost area it will be practicable to develop typical per mile costs which will simplify the cost estimating portion of the needs analysis. Because the delineation of cost areas is so closely involved in the subject of costing of improvements, a more complete discussion of cost areas is included in that section of the manual, on page III-18.

Where cluster sampling is used, the largest sample of areas required should first be selected from all the areas in the State or cost area. (This will normally be for minor arterials.) Next, the areas within which the collector system appraisal will be made should be selected from those areas in which the minor arterial appraisal was made. Finally, the areas in which the local system appraisal will be made should be selected from those areas in which the collector analysis was made. In this manner, the number of areas in which field inventory and detailed traffic forecasts are necessary will be minimized.

In some States the field appraisal and analysis of local and collector systems may be done by county and city personnel. In these cases, selection of sample appraisal sections randomly (within each system) in each county or small urban area, at the specified sampling rate, will be a logical alternative to cluster sampling.

For the Interstate system, as discussed on page III-22, the needs to be reported herein are those needs to 1990 which have not been reported in the 1970 Interstate Cost Estimate. Sampling will not be used in determining these needs.

Rural Systems

Table III-1 shows the minimum sampling rate for the needs analysis of 1990 rural functional systems in each cost area. The needs appraisal should be made on a representative sample of each rural principal arterial route (except for Interstate) while the appraisal for the other rural systems will be made on a sample representing the entire system.

Where cluster sampling is used for analysis of the minor arterial, collector, and local systems, the recommended sampling unit is the rural (in 1990) portion of a county. However, if the cost area includes a relatively small number of counties, smaller sample units, e.g., townships, may be a more logical choice, especially for the systems sampled at the lower rates. The sample areas should be selected on a random basis as previously discussed.

Table III-1--Minimum sampling rates for systems in rural areas

System	Percent of 1990 system miles (In each cost area)
Completed Interstate	100%
Other principal arterial	50%
Minor arterial	25%
Collector	10%
Local	5%

Systems in Small Urban Areas

Table III-2 shows the minimum sampling rate for needs analysis in each 1990 small urban area population stratum (5,000-9,999, 10,000-24,999, and 25,000-49,999 population). The 50 percent sample of other principal arterial mileage should be selected from each route in each urban area.

If cluster sampling is used for the other systems, the recommended sampling unit is the individual small urban area. The universe from which it is drawn is all urban areas in its population stratum. As with rural systems, the procedure is then to appraise all of the study system in each of the small urban areas in the sample.

In the event a State desires to estimate needs on a portion of each functional system in all small urban areas, caution should be exercised to insure that the sample is representative of all areas of the city.

Table III-2--Minimum sampling rates for systems in small urban areas

System	Percent of 1990 system miles (In each population stratum)
Completed Interstate	100%
Other freeway/expressway and other principal arterials	50%
Minor arterial street	25%
Collector street	10%
Local street	5%

Systems in Urbanized Areas

A procedure for sampling the functional systems in urbanized areas is more difficult to define since there may be no readily identifiable smaller unit of area that can be used as the sampling unit. Additionally, there can be many problems involved in selecting the appropriate segments to sample. To overcome some of these problems and to assure nationwide consistency it is recommended that the sample segments of minor arterial streets, collector streets, and local streets be selected randomly for each urbanized area. The sample segments of principal arterials should be selected from each route in the urbanized area.

In those cases where the urbanized area transportation study has prepared traffic zone maps sufficient to include the 1990 urban-in-fact area, these zones may be used for random sample selection. However, for those urbanized areas not zoned to this detail, or for areas expected to become urbanized in 1990, other procedures must be employed.

One possible procedure is to prepare a numbered grid of suitable scale as an overlay for the mapped 1990 urban-in-fact area. Randomly selected grid squares (to be applied in lieu of traffic zones) would be aggregated until the approximate percentage of mileage is obtained for the functional system in question. Table III-3 contains the percentage of 1990 system mileage required for each functional type. Whether traffic zones or grids are used it will be necessary to assure that the scale used is such as to eliminate the possibility that a very few randomly selected zones or grids would contribute the entire percentage of mileage for the functional system being examined. The mileage included in the sample should proportionally represent the mileage in each of the costing areas identified for the urbanized area.

Additional discussion concerning sampling for local streets is included in section VI.

Table III-3--Minimum sampling rates for systems in urbanized areas

System	Percent of 1990 system mileage
Completed Interstate	100%
Other freeway/expressway and other principal arterial	50%
Minor arterial street	25%
Collector street	10%
Local street	5%

Example of Sampling Techniques

Needs are to be estimated for a rural cost area containing 20 counties. All sections of completed Interstate (as discussed on page III-22) will be analyzed and one-half of the mileage on each other principal arterial route will be analyzed.

If the State desires to use cluster sampling for the remaining systems, approximately 5 counties (containing at least 25% of the total minor arterial mileage in the cost area) will be selected at random and the minor arterial needs estimated on the mileages in these counties. Next, two (considering the minimum requirements of table III-1) of these five counties will be selected and needs estimated for the collector mileage in these counties. Finally, the estimate of needs on the local system will be made on the mileage in one of these two counties.

Should the State desire to analyze needs on a portion of the mileage in each county, the sample mileage for minor arterial, collector, and local systems will be randomly selected (at the rates specified in table III-1) from the total system mileage in the county.

Expansion of Construction Needs

The required output of this study consists of the needs on each rural system, each system in each small urban area population stratum, and each system in each individual urbanized area. As shown in the following example, to arrive at these needs, an expansion factor (column 3) must be computed for each system in each rural cost area, small urban area population stratum, and urbanized area by dividing the total system miles (column 1) in the cost area, population stratum, or urbanized area by the system miles included in the sample (column 2). The construction needs (column 4) determined for the sample miles will then be multiplied by this expansion factor to arrive at the total needs (column 5) on this system (for the cost area, population stratum, or urbanized area). The total statewide needs on any particular rural system will be the summation of the system needs computed for each cost area. The total statewide needs on an urban system will be the summation of the system needs computed for each small urban area population stratum and each urbanized area.

Example - Rural minor arterial system

Cost Area	(1) Total 1990 System Miles 1/	(2) Sample Miles	(3) Expansion Factor (1)÷(2)	(4) Sample Needs	(5) Total Needs (4) x (3)
1	2,000	550	3.64	$27,500,000	$100,000,000
2	1,000	240	4.17	16,800,000	70,000,000

Total construction needs on rural minor arterial system = $170,000,000

The appropriate expansion factor is to be recorded on each needs analysis worksheet. It will not be necessary to report total system needs. However, a State can determine its total needs by system as described above.

THE NEEDS APPRAISAL PROCESS

The appraisal of arterial and collector roads and streets consists of the following steps:

1. Identifying study sections and subsections.
2. Describing existing conditions.
3. Determining the character and degree of deficiencies.
4. Estimating improvements needed to overcome deficiencies.
5. Estimating costs of needed improvements.

Each of the above steps is outlined in more detail on the following pages.

Step 1 - Identification of Study Sections

For the purpose of analyzing needs, the first step is to divide the routes included in the sample into logical study sections. Basically a study section is a length of a road or street that is

1/ This should be the final 1990 system miles, including any reclassification found necessary during the needs analysis.

relatively homogeneous as to geometrics, traffic volume and cross section, and long enough to constitute a logical section for needs appraisal. The instructions for the worksheets included in sections IV and V give further details for assigning route numbers and selecting and numbering route sections and subsections. Concurrently with this process worksheets should be initiated for each section. During this process all identification data on the worksheets should be entered. Worksheets should be initiated for both existing facilities and for new facilities identified during the classification phase of the study.

Step 2 - Describing Existing Conditions

The second step in the appraisal process is to determine the existing conditions on each study section. To the extent possible it is intended that this be performed as an office operation making use of inventory and condition data which are already available. Where such data are not available or must be supplemented, field inspections will be necessary.

During the process of describing existing conditions it may be found that additional breaks in the routes will be needed. The subsection numbering scheme should be used for this purpose.

Step 3 - Determining Deficiencies

As was outlined earlier, after present conditions on each section have been determined they must be compared with minimum tolerable conditions to judge present and future adequacy of the section. In order to obtain consistency in this nationwide needs estimate specific minimum tolerable conditions to be used in the evaluation are specified in this manual. 1/ Minimum tolerable

---

1/ It is recognized that these criteria will differ from some of those that have been used in individual State studies. However, the requirement for consistent and equitable treatment of all States cannot be met through the assembly of estimates based on varying criteria. It is again emphasized that these minimum tolerable conditions do not represent any new policy of the Department of Transportation and that they are included only for study purposes.

conditions for rural arterials and collectors are given in table III-4, page III-24. Minimum tolerable conditions for urban arterials are given in table III-5, and those for urban collector streets are in table III-6.

Each study section should initially be compared to the minimum tolerable condition using present traffic volumes and conditions. Those sections not essentially meeting these conditions will be identified as backlog needs. The deficient sections should be determined on the basis of both structural adequacy and geometric or operational elements or combinations of elements which do not meet these minimum tolerable conditions. The following are examples of conditions which place a highway in the critically deficient class:

1. Peak hour traffic volumes resulting in operating speeds lower or volume/capacity ratios higher than the minimum tolerable conditions.

2. Lane widths narrower than the minimum tolerable width specified will of itself make the section critically deficient.

3. Curves, grades, and stopping sight distance restrictions not meeting the minimum tolerable conditions resulting in unsafe conditions.

4. Structural conditions of pavements below the minimum tolerable specified.

5. Pavement type below the minimum tolerable specified.

Sections which presently are tolerable should be examined as to their future adequacy by expanding traffic by five year increments to 1990. The detailed instructions in sections IV and V furnish a procedure for estimating an annual traffic growth factor in order to determine intermediate year values when present and 20 year values are known. This factor assumes that growth compounds. Table III-16 at the end of this section provides factors for estimating traffic by five year increments using the annual traffic growth factor. Appendix H provides the procedure to be used to estimate when presently adequate pavements will become intolerable.

As outlined in section V under the instructions for calculating present capacity on urban streets, certain assumptions are made as to the extent of traffic engineering type improvements which have been made, namely the elimination of parking and the optimization of signal systems. It is realized that certain costs are associated with these presumed improvements. These costs will be similar to certain costs included in the TOPICS program. Costs for these type improvements <u>are</u> <u>not</u> to be included in the estimates prepared by the States. These costs will be estimated by the Washington office.

Table III-15 is to be used to determine the adequacy of protective devices at existing railroad crossings and the type of protection to be included in the cost estimate for those crossings anticipated in 1990. Since it will not be necessary to indicate the year of deficiency for crossing protection, 1990 traffic should be used in computing the exposure factor (ADT x number of trains).

Step 4 - Estimating Needed Improvements

Completion of step 3 above will provide information as to the type of deficiency which presently exists or will exist to the year 1990. This information is the key to the type of improvement necessary for the study sections. To assist the States in the orderly and consistent evaluation of improvements needed, figures III-1 through III-5, pages III-41 through 45 , are provided. These five flow charts indicate, by functional classification, the type of improvement appropriate to a certain set of deficiency conditions. While the charts may appear complex, they are merely a graphic portrayal of the normal analytic logic used in developing a consistent appraisal of needs.

The use of these flowcharts is dependent upon the existence of certain inventory and traffic information, which is obtained from existing inventory data and/or additional field work. This information is to be recorded on the evaluation worksheets. Detailed instructions for completion of these worksheets are included in sections IV and V of this manual. The worksheets and flow charts can then be used together to determine the type of improvement required.

These flow charts were developed as basic analytic guides, and not as the kind of comprehensive logic charts that would be applicable to machine programing. Charts for the latter purpose, in order to cover all possible considerations, would have to be much more complex than those shown here. Thus the results obtained from using these charts should be reviewed for reasonableness.

For example, if all items on a section were presently tolerable except for pavement condition the flow charts suggest resurfacing. Before resurfacing is established as the need to be reported, the analyst should assure that the section will not have a capacity deficiency within a few years. If so, widening or reconstruction might be more appropriate.

An another example, it will be noted that some decisions required to follow through the flow charts, such as "Is reconstruction feasible on existing location?" and "Is new location warranted and practical?", require consideration by the analyst beyond just comparing inventory data with minimum tolerable conditions. Concurrent consideration must be given to matters such as available ROW width, the ROW width necessary to provide the design standard cross section, the influence of a new facility on the functional relationships of adjacent highways, and the social and environmental desirability of adding a facility on new location.

Finally, in using the flow charts the concept of providing a similar type of service between major control points along a route must be considered in selecting the type of improvement.

The types of roadway improvements to be used in this study, together with their definitions, are as follows:

1. New location - Complete construction on a new alignment.

2. Reconstruction - Complete reconstruction on substantially the present alignment.

3. Isolated reconstruction - Reconstruction of some portion of an analysis section to correct a specific deficiency such as a stretch with bad curves or excessive grades.

4. Major widening - The addition of lanes to an existing facility. While the existing pavement will at least to a large degree be salvaged, costs should include resurfacing the existing pavement and other incidental minor improvements such as shoulder and drainage improvements.

5. Minor widening - Same as major widening except that the additional width does not provide any additional number of lanes.

6. Widening - (Applicable only to urban arterials other than freeways or expressways and to urban collectors.) All widening projects regardless of the width added. As with major widening the existing pavement is salvaged; however, the cost of resurfacing the existing pavement, drainage improvements, curbs, etc., should be included.

7. Resurfacing - Overlaying existing pavement plus adding material to bring shoulders up to grade. Also includes other minor associated improvements.

8. Resurfacing and shoulder improvements - Same as resurfacing except that the project includes grading to widen shoulders to design standards or complete reconstruction of shoulders to give additional strength.

Two general categories of improvements will result from the needs analysis; (1) those necessary to overcome present deficiencies or "backlog needs", and (2) those necessary to correct future deficiencies on presently adequate facilities between now and 1990. Previous statewide needs studies have shown that a substantial portion of total needs, approximately 30%, fall in the "backlog" category. Due to restraints in the availability of resources it is impractical to assume the "backlog needs" will be immediately overcome. Since some of the correction of backlog needs will be deferred, and consequently the correction of some accruing deficiencies, the design year for many improvements will be more than 20 years from the date of the deficiency. This fact must be considered in this nationwide study since it will have some influence on long-range needs and resultant user benefits. Therefore, for the purposes of this study, the year of improvement should be selected within the framework that all backlog deficiencies (present deficiencies) will

377-268 O - 70 - 6

be corrected between now and 1976; accruing deficiencies for the first five year period will be corrected before 1980; those of the 6-10 year period, before 1983; those of the 11-15 year period, before 1987; and those of the 16-20 year period, before 1990.

New facilities

The above analyses, using the evaluation worksheets and flow charts, will provide the basis for determining needs on existing facilities. However, most facilities on new location identified during the functional classification process are not susceptible to similar analysis. Needs for these facilities will be based on functional classification, future traffic volumes, and the design standards set forth in this manual. An evaluation worksheet should be prepared for each needs section representing a new facility, filling in the applicable data. In certain instances, the need for a facility on new location can be associated with deficiencies on one existing facility. In these situations the indicated year of deficiency may be helpful in determining the year of construction for the new facility. However, in many cases need for a facility on new location cannot be associated with an individual existing facility. Examples are new facilities outside of the present urban boundary but within the future urban limits, new freeways and expressways proposed to relieve areawide or corridor wide congestion, and facilities proposed to serve newly developed recreation areas or the like. On these facilities the subsequently described design standards will be applicable but the "year of need" and the "year of improvement" are less definitive. These dates should be selected after consideration of the following:

1. Degree of areawide or corridor-wide congestion the new facility is to relieve.

2. For projected facilities serving new areas such as expanding urban limits, the time such development is expected to occur.

3. Providing continuity of service over a route.

4. Reasonable allocation of funds considering time and geographical distribution.

5. Availability of engineering manpower and contracting capability.

Design standards

While completing the worksheet for a given sampled needs section, reference to the proper flow chart guide will indicate whether or not an improvement is needed. When deficiencies are encountered (either present or future), the flow charts will indicate the type of improvement that is necessary. Cost of the needed improvement will be based on the type of improvement and design standard associated with the functional class and traffic volume of the study section.

To provide for nationwide consistency, design standards have been developed for needs study cost estimating purposes only, and are shown as tables III-7 through III-9, pages III-27 through 29. They were developed after a thorough review of the design standards used by the States for previous needs studies and with reference to present AASHO standards.

These design standards are to be used in conjunction with access control criteria on pages III-30 through III-33, design capacity tables III-10 through III-13 on pages III-34 through III-37 and table III-15 - Railroad Crossing Protection Criteria on pages III-39, to arrive at an initial design for estimating pruposes.

It is recognized that in some cases, particularly in urban areas, a purely mechanical application of these design standards could result in including costs in the estimate for improvements which are completely impractical to construct. This could be due to right-of-way restrictions, adverse environmental impacts, etc. It is also recognized that explicit provision has not been made for special situations such as the construction of exclusive bus lanes and roadways, joint development of corridors, etc. To the extent that such situations can be identified, these considerations should be reflected in the needs estimates prepared by the States. Such costs should be included, however, only in those specific situations where at least preliminary studies have indicated their feasibility and desirability.

Step 5 - Estimating Costs of Needed Improvements

The costs will be estimated primarily on a per mile basis for the various roadway items and on a per square foot basis for structures. For each construction category, an average cost per mile is determined as a function of:

1. Functional class of road to be improved--rural principal arterial, urban collector, etc.

2. Type of improvement--new location, reconstruction, major widening, minor widening, resurfacing with shoulder improvements, or resurfacing only.

3. Design Standard--for each terrain type and traffic volume group.

4. Location of project by cost area.

Cost areas

The subject of cost areas has already been introduced in conjunction with the discussion of sampling procedures. Both for sampling and for costing procedures it is anticipated that it will be necessary to divide most States into cost areas, since construction costs vary by terrain, soil type, climate, density of development, labor costs, etc. Within a cost area, uniform costs per mile for the various types of work can then be developed and applied to all segments requiring improvement. In connection with sampling, the discussion of cost areas was limited to rural appraisal. But in the development of unit costs, the cost area concept is applicable in both rural and urban areas.

A rural cost area should normally consist of the rural portion (in 1990, by the criteria used in this study) of an entire county, (parish, township, etc.) or a group of adjoining counties having similar terrain, climate, soil conditions and any other feature that would indicate uniformity in construction costs. In the larger States, four or five rural cost areas may be necessary. One or two areas may suffice in some of the smaller States, although variety of terrain has as important an effect as does size.

In urban areas, costs can generally be related to the density of development of the area in which an improvement is proposed. Therefore, for this study, unit costs should be developed, for each urbanized area and for each population group of small urban areas, forthose improvements that are (1) within the built-up area (C.B.D. and fringe) and (2) within the outlying area (outlying business and residential). In some of the larger urbanized areas, where there are wide ranges of development density and resultant unit costs, additional cost areas may be desirable.

Development of average costs per mile

In developing costs per mile, consideration should be given, to the extent practical, to the recommendations in the AASHO Highway Design and Operational Practices Related to Highway Safety (AASHO "yellow book"). These have already been reflected to some extent in the design standards; however, further consideration may be necessary with regard to roadside design.

Average costsper mile are to be developed for the following categories which are to include a prorated allowance for preliminary and construction engineering:

1. Right-of-way and utility adjustments--Estimate all costs for acquisition of necessary rights-of-way and, where applicable, those for access control. Include costs for all lands required, including any developments thereon, easements including scenic, access rights and consequential damages, appraisals, legal fees, special engineering surveys, preparation of right-of-way plats, relocation payments, etc. Also include all costs which would normally be paid for all types of utility adjustments, private and public, within or to clear the right-of-way. (Betterments are not included.)

2. Grade and drain--Include costs for all items commonly covered in grade and drain construction contracts. Include all earthwork preparatory to roadside improvement such as channel changes, inlets, surface channels, flumes, dikes, underdrains, outfalls, and minor drainage structures, culverts (as usually defined) and special fill treatment. Also include the same items for interchange and frontage roads. Include costs of storm sewer adjustment and all new major storm sewer lines and appurtenances such as pumping stations and equipment. Include all costs for demolishing buildings, moving fences, clearing and grubbing, etc.

3. Base and surface--Include costs of all base courses and surfacing, including shoulders, for the through roadway, interchanges, and frontage roads. Include all curbs and sidewalks. Current practice regarding roadway structural design concerning depth and type of surfacing and shoulder treatment should be utilized. Estimates should observe the design standards specified for this study and include consideration of local soil conditions, traffic concentrations, and past experience within the State.

4. Other--Include all roadway items not included in 1, 2, and 3 above. Include traffic control devices 1/, roadside improvements (such as sodding, planting, roadside rests, etc.), lighting, guardfence, median barriers, railroad crossing protection (excluding separations). While railroad crossing protection costs are included in the category they should not be estimated on a per mile basis. Costs for this item will be estimated on a per crossing basis for various types of protection.

5. Structure costs--Include the costs for all new structures and all structure improvements. These costs will generally be estimated on a per square foot basis.

Costs per mile are to be prepared from the best available sources of information. Representative unit prices for the various construction items may be multiplied by estimated per mile quantities for a typical mile, based on study design standards and type of work. Some such quantities (e.g., base and surface) may be developable directly from study standards. On others, cost elements may require comparison of study standards with existing design practice, as a basis for factoring up or down historical quantities per mile, either to develop or confirm the quantities per mile used for the typical mile.

Wherever typical costs per mile are used directly, in lieu of the creation of a typical mile built up from unit costs, the same comparison of present design practice with study standards is to be made, to form a basis for appropriate factoring up or down

1/ See the first paragraph on page III-13 concerning costs of certain traffic engineering type improvements. While the cost of TOPICS-type improvements are not to be included, the cost of traffic control devices, signing, etc., which are part of a larger widening or reconstruction project, for example, should be included.

of historical costs. In no case should raw historical per mile costs be used without reference to study standards and adjustment if necessary. Roundhouse estimates based on undocumented judgment are also to be avoided.

In all cases estimated costs are to be based on 1969 prices. Where such data are unavailable, earlier prices, factored to 1969 prices by use of appropriate cost indices, should be used. The data being developed for the 1970 Interstate Cost Estimate should be of value in this regard.

The techniques discussed above for developing costs per mile will need to be tailored to handle special stiuations, particularly on urban principal arterials. Right-of-way costs vary by land use (business, industrial, residential), density of development, location (CBD, outlying business district, urban residential, outlying residential), quality of development in the area, and roadway design (depressed, elevated, viaduct). The right-of-way costs for the urban principal arterial should reflect these factors to the extent which they are known. Construction costs should also be adjusted, to the extent possible, to reflect the type of construction and type of area in which the study section lies. For widening projects costs per mile per foot of widening may be more applicable than costs per mile.

Sample formats for per-mile cost data are shown as figure III-6 and figure III-7, pages III-46 and 47.

Generally speaking, the estimated costs are intended to be accurate for the urban and rural costing areas or groups, and, in aggregate, the estimates should be realistic for each functional system.

In order to assure consistency of estimates, the methods and results of developing unit costs are to be reviewed and approved by the Bureau of Public Roads Division Office prior to their use.

ESTIMATING STRUCTURE IMPROVEMENTS

For the needs study, it will be necessary to note present and future structure deficiencies, new structures needed, and also to estimate a cost for necessary structure improvements. This information is to be entered on the roadway evaluation worksheets in accordance with the detailed instructions contained in later sections of this manual.

The following discussion outlines a procedure for obtaining the structure information needed. The "Structure Inventory and Appraisal Sheet" distributed with IM 50-4-69, dated June 10, 1969, and shown as figure III-8, page III-48, will provide all necessary input for existing structures for the needs study if the State has already adopted and completed these sheets. Figure III-9, page III-49, gives the instructions for this sheet. Even if they have not been completed, the sheets will still be useful as supplemental worksheets to record information from road inventory and other sources in order to complete the evaluation worksheets. This needs study provides an opportunity for each State to begin adaptation of the inventory and appraisal sheet. It is recognized that for the purposes of this study that it will not be necessary to use all items on the worksheet.

The deficiencies to be noted depend, of course, upon functional classification, bridge condition, and traffic volume. The appraisal sheet should be used in conjunction with the flow charts, evaluation worksheets for the corresponding roadway needs section, and minimum tolerable condition tables to define type of deficiency and proposed year of improvement.

The proposed improvements depend upon functional classification, design standards, and the nature of the deficiencies. The development of costs of improvements on structures should be in general accordance with instructions presented in this section on page III-18 through III-21.

The information required on condition, live load capacity, and also deficiencies to a certain extent, has already been obtained by many States as part of their bridge safety inspection required under IM 40-1-68, and should be available for inclusion in the structure inventory and appraisal sheet. This Instructional Memorandum includes as an attachment, the AASHO "Informational Guide for the Inspection of Highway Bridges".

NEEDS EVALUATION ON THE INTERSTATE SYSTEM

The 1970 Interstate Cost Estimates being prepared by the States will report needs to complete the Interstate System, including cost estimates for presently uncompleted sections and certain safety betterment and pavement overlay work. It will not be necessary to reestimate or report those costs in this study. It is recognized, however, that additional needs not reported in the above mentioned estimate will accrue on the already completed portions of the Interstate system between 1970 and 1990. These needs should be determined and reported on the evaluation work sheets in the same manner as contemplated for other principal arterials. Section breaks should be located as described for principal arterials rather than at Interstate cost estimate section breaks. The States that have performed the Interstate traveled way study and Interstate traffic flow data submittals will have a good basis for completion of inventory information required on the evaluation worksheets.

Worksheets, as further described in sections IV and V, should be prepared and submitted on only those facilities which will need improvements above or beyond the needs included in the 1970 Interstate Cost Estimate. On many uncompleted sections it should be evident that the costs included in the 1970 estimate will provide adequate service for the complete study period, 1970 to 1990. Conversely, it should be evident that on many completed sections of Interstate additional work, not included in the 1970 Interstate Cost Estimate, will be necessary during the 1970-1990 period. On the latter, worksheets will be necessary. It is recognized that, between these extremes, some sections will be in the "gray area." On these sections an evaluation will be necessary to determine into which category they fall. If an evaluation shows that in 1990 they will meet the minimum tolerable conditions prescribed in this manual, no worksheet should be submitted.

Table III-4--Minimum tolerable conditions for rural arterials and collectors

Functional systems	Rural principal arterials			Rural minor arterials									Rural collectors											
ADT for analysis year	All			Over 6,000			2,000-6,000			Under 2,000			1,000-6,000 1/			400-1,000			100-400			Below 100		
Terrain	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
Operating speed (peak hour)	55	50	45	50	45	40	50	45	40	40	40	35	-	-	-	-	-	-	-	-	-	-	-	-
Surface type		High			High			Inter.			Inter.			Inter.			Low			Low			Gravel	
Lane width		11			11			11			11			11			10			9			22' roadway	
Shoulder type		Stab.			Stab.			Stab.			Earth			Earth			Earth			Earth			-	
Graded right shoulder width (ft.)	8	8	6	8	8	6	6	6	4	6	6	4	4	4	4	4	4	4	2	2	2		-	
Safe speed 2/	65	55	45	60	50	40	60	50	40	60	50	40	50	45	35	50	40	30	50	40	30	40	35	25
Stopping sight distance	550	415	315	475	350	275	475	350	275	475	350	275	350	315	250	350	275	200	350	275	200		-	
Maximum curvature	5	6	10	5	8	13	5	8	13	5	8	13	8	10	18	8	13	23	8	13	23		-	
Maximum gradient 3/	3	4	8	3	5	9	3	5	9	3	5	9	4	5.5	10	4	6	11	4	6	11		-	
Number of lanes		4/			4/			2			2			2(1/)			2			2			-	
Pavt. cond. rating (PSR or equivalent)		2.6			2.6			2.1			2.1			2.1			2.1			2.1			-	
Railroad crossing protection	See Table III-15																							
Structures:																								
Width (ft.) 5/	Traveled way width + 6 ft			Traveled way width + 4 ft.									Traveled way width + 2 ft.									18	18	18
Vertical clearance (ft.)		14			14			14			14			14			14			14			14	
Loading		H-20			H-20			H-15			H-15			H-15			H-15			H-15			H-15	

1/ Rural collectors with present ADT above 6,000 should be multilane where necessary to maintain peak hour operating speeds of 40, 35, and 30 in flat, rolling, and mountainous terrain respectively.
2/ Approximate speed on which minimum tolerable stopping sight distance, curvature, and gradients are based.
3/ Steeper grades may be considered tolerable if lengths are relatively short or climbing lanes are provided.
4/ As necessary to maintain the operating speed specified.
5/ For bridges over 250 ft. in length, widths 4 ft. less than shown, but in no case less than the width of the approach traveled way, will be considered tolerable.

Table III-5--Minimum tolerable conditions for urban arterials

Functional system	Freeway/expressway (Uninterrupted flow)		Other urban principal arterial	Urban minor arterial
Type of area	Built up area	Outlying area		
Operating speed (peak hr.)	35	40	-	-
V/C ratio (peak hr.)	-	-	0.85	0.90
Lane width (ft.)	11	11	10	10
No. of lanes	1/		2/	2/
Surface type	High		High	Intermediate
Graded right shldr. width (ft.)	8	8	6' on uncurbed sections	
Shoulder type	Surfaced		Stabilized	
Median protection	3/		-	-
Cross section 4/	-	-	Curbs, gutters, & enclosed drainage	
Safe speed 5/	-	-	35	30
Pavement condition rating	2.6	2.6	2.6	2.1
Railroad crossing protection	See Table III-15			
Structures:				
Width (ft.)	Traveled-way width + 6 ft		Curb-curb width of approach roadway 6/	
Vertical clearance (ft.)	14	14	14	14
Loading	H-20	H-20	H-15	H-15

1/ As necessary to maintain minimum operating speed specified.
2/ Overall street width as required to maintain maximum v/c ratio.
3/ Positive type median protection unless width is at least 30 ft.
4/ An open ditch section on arterial streets in outlying areas with less than 50% development is tolerable.
5/ This item is applicable to at grade streets in outlying sections of urban areas where travel speeds are such that alignment becomes an important consideration. The lengths of critical curves and/or sight distance situations will be evaluated in determining needs.
6/ Where a shoulder rather than curbed section is tolerable, the structure width should be at least the traveled way width plus four ft.

Table III-6--Minimum tolerable conditions for urban collector streets

Surface width	Sufficient traffic lanes to restrict congestion ($v/c > 0.9$) to a relatively short daily period. A capacity analysis is not warranted unless ADT exceeds 7,000.
Lane width (ft.)	10
Cross section	On uncurbed sections at least a 5 ft. shoulder should exist with a ditch adequate to carry all but extremely heavy rainfall. Where adjacent area is more than 50% developed, a curbed section should exist.
Safe speed (mph) 1/	25
Surface type	Low
Pavement condition (PSR or equivalent)	2.1
Railroad crossing protection	See Table III-15
Structures:	
Width (ft.)	Prevailing width of travel way
Vertical clearance (ft.)	14
Loading	H-15

1/ This item is applicable to collector streets in outlying sections of urban areas where travel speeds are such that alignment becomes an important consideration. The number of critical curves or sight distance situations will be evaluated in determining needs.

Table III-7--Design standards for rural arterials and collectors

Functional systems	Principal arterials			Minor arterials						Collectors											
ADT	All			Design year above 2,000			Design year under 2,000			Design year above 2,000			Design year 800-2000 Cur. above 400			Current 250 - 400			Current below 250		
Design standard number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Terrain	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
Minimum design speed (mph)	70	70	50	70	60	50	70	60	50	60	60	40	60	50	40	60	40	30	50	40	30
Access control	See page III-30						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Median width (ft.) 1/	64	64	16	40	40	16	-	-	-	40	40	16	-	-	-	-	-	-	-	-	-
Lane width (ft.)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11	11	11	10	10	10
No. of lanes	Table III-10			Table III-11			2	2	2	Table III-11			2	2	2	2	2	2	2	2	2
Graded shoulder width (ft.) 2/	12	10	8	10	10	8	8	8	2	8	8	6	6	6	6	4	4	4	4	4	4
Surface type 3/	High			High			Intermediate			High			Intermediate			Low			Low		
Shoulder type 3/	Surfaced			Stabilized			Stabilized			Stabilized			---			---			---		
Right of way width (ft.)	4/			4/			4/			4/			4/			4/			4/		
Railroad crossing protection	See Table III-15																				
Structures;																					
Width (ft.)	Full width (surface and shoulders). Exceptions in accordance with AASHO standards.																				
Vertical clearance (ft.) 5/	16			16			16			16			16			16			16		
Loading	HS20-44			HS20-44			HS20-44			HS20-44			HS20-44			HS15-44			HS15-44		

1/ Applicable to multilane facilities only.
2/ Provide four foot left shoulder on divided facilities.
3/ See Table III-14 for surface and shoulder type definitions.
4/ As necessary for the type of construction proposed, giving due consideration to the recommendations pertaining to slopes and recovery areas in the 1967 AASHO "Yellow Book" (Highway Design and Operational Practices Related to Highway Safety).
5/ Plus allowance for resurfacing.

Table III-8--Design standards for urban arterials

Functional systems	Freeways and expressways		Other principal arterials		Minor arterial streets	
Type of area	Built up area	Outlying area	Built up area	Outlying area	Built up area	Outlying area
Design standard number	22	23	24	25	26	27
Design speed (mph)	60	70	40	50	30	40
Access control	See page III- 32		See page III- 32		—	—
Median width (ft.)	24 1/	64 1/	2/	2/	2/	2/
Lane width	12	12	12	12	12	12
No. of travel lanes	See Table III-12		See Table III-13		See Table III-13	
Graded rt. shldr. width (ft.)	12	12	—	—	—	—
Graded lt. shldr. width (ft.)	6 3/	6 3/	—	—	—	—
Curb parking lane	—	—	4/	4/	4/	4/
Surface type (incl. parking lanes) 5/	High		High		High	
Shoulder type 5/	Surfaced		—	—	—	—
Cross section	—	—	Curbs, gutters, sidewalks and enclosed drainage.			
Right of way width	6/	6/	6/	6/	6/	6/
Railroad crossing protection	See Table III-15					
Structures: Width	Full width (surface & shoulders) 7/		Curb to curb width of approach plus sidewalks where necessary			
	Exceptions in accordance with AASHO Standards					
Vertical clearance (ft.)	16		16		16	
Loading	HS 20-44		HS 20-44		HS 20-44	

1/ Lesser widths with suitable median barrier acceptable where economy dictates.
2/ Minimum of 6 ft. on principal arterials. At least 16 ft. where ROW is available and left turn lanes are to be provided.
3/ Left shoulder should be 10 ft. where 3 or more through lanes are required in each direction.
4/ Parking lanes 10 ft. wide should be provided on both sides of 2 and 4 lane facilities. On 6 lane sections, the curbs should be offset 2 feet from the travel lane.
5/ See Table III-14 for surface and shoulder type definitions.
6/ As necessary for the type of construction proposed, giving due consideration to the recommendations pertaining to slopes and recovery areas in the 1967 AASHO "Yellow Book" (Highway Design and Operational Practices Related to Highway Safety).
7/ Where the median width is 30 ft. or less, the estimate should include the cost of a single structure rather than parallel structures.
8/ Plus allowance for resurfacing.

Table III-9--Design standards for urban collector streets

Design Year ADT	12000 and above	6000 - 12000	Under 6000
Design standard number	28	29	30
Design speed (mph)	30	30	30
Number of travel lanes	4	4 or 2 1/	2
Lane width (ft.)	12		
Median width (ft.)	16 if left turns lanes provided		
Curb parking lane	2/		
Surface type including parking lanes 3/	Intermediate or high		
Cross section	Curb, gutters, sidewalks and enclosed drainage		
Stopping sight distance (ft.)	200		
Maximum gradient	5% in flat terrain, 7% in rolling terrain		
Right of way width (ft.)	4/		
Railroad crossing protection	See Table III-15		
Structures:			
Width	Approach travel way plus 6 ft. and sidewalks		
Vertical clearance (ft.) 5/	14		
Loading	HS20-44		

1/ Determine number of lanes based on a capacity analysis.
2/ In residential areas 8 ft. parking lanes should usually be provided on one or both sides. In commercial and industrial areas 10 ft. parking lanes should be provided on both sides.
3/ See Table III-14 for surface type definitions.
4/ As necessary for the type of construction proposed.
5/ Plus allowance for resurfacing.

RURAL ACCESS CONTROL CRITERIA

Basic access control criteria for rural arterial systems for this study are aimed at the dual objective of: (1) Making maximum utilization of existing investment in highways which have relatively good geometrics and adequate capacity, and (2) obtaining access control where system function and traffic volume will justify it and where present or projected deficiencies warrant major reconstruction. It is expected that approximate costs of alternative access control policies, both more liberal and more conservative, will be analyzed in Washington, based on representative per-mile costs to be developed by the States. All of the alternatives are for study purposes only and imply no commitment of the Department of Transportation or the States to any particular policy. Specific criteria for principal and minor arterials are given below. As with other design standards, it is fully intended that these criteria be applied with good judgement.

It will be noted below that the applicable access control criteria are related to the type of proposed improvement (e.g., major widening, reconstruction or new location). Procedures for identifying improvement type are indicated in the "improvement analysis guide" flow charts, figures III-1, III-2 and III-3 on pages III-41 through III-43.

The indicated access control criteria should be applied consistently over a reasonable length of highway, such as an entire urban bypass, or a length of rural highway extending between major controls, such as urban centers or arterial route junctions. In other words, short route sections with frequent changes in type of service should be avoided.

Rural Principal Arterials

New Location

For new facilities, or for instances where existing facilities are to be replaced on new location, ROW cost shall be estimated for acquisition of full access control including adequate ROW for interchanges. Where forecasted combined through and crossroad volumes permit, however, construction costs (as distinguished from right-of-way costs) may be estimated to allow for intersections at grade through 1990. All private access, however, should be presumed to be eliminated.

Reconstruction

Apply the same access control criteria as for new location. If full access control cannot be obtained on existing location, new location rather than reconstruction is to be estimated.

Major widening (added lanes)

Intersections at grade will be permitted with low volume arterials and with collector and local roads. Private driveway connections are to be minimized. In some locations where private entrances are frequent, frontage roads should be provided. If acquisition of such access control is not feasible or if the cost thereof equals that of full access control or new location, the latter type improvement is to be proposed.

Rural Minor Arterials

New location

On multilane facilities of substantial length, extending between major controls such as urban centers or arterial route junctions, and on all urban bypass routes, private driveway connections should be minimized. Public road intersections at grade will be permitted. On extremely high volume multilane facilities with frequent intersections, full control of access may be warranted.

Reconstruction

Use same criteria as for new location.

Minor widening (added lanes)

Use same criteria as for new location except that full access control will not be applicable. Where limitation of private driveways is impracticable or cost of limitation is prohibitive, this criterion should be relaxed.

377-268 O - 70 - 7

ACCESS CONTROL CRITERIA FOR SMALL URBAN AREAS

It is generally recognized that urban areas of the size included in this group do not warrant freeway systems for the movement of strictly internal traffic. Freeways are, however, often warranted to serve a combination of through traffic and local traffic movements. The criteria for access control in small urban areas is therefore dependent on the nature of through traffic patterns.

For routes which are connecting links of existing or proposed rural freeways, a freeway type design should be provided through or around the urban area usually at such time as the existing facility becomes intolerable.

For routes which are connecting links of existing or proposed rural expressways, at least an expressway type design should be provided through or around the urban area at such time as the existing facility becomes intolerable. In many such situations the through traffic combined with internal traffic movements will be sufficient to warrant a freeway type design. This is particularly applicable where there would be frequent signalized intersections with important cross streets if a full freeway were not provided.

For routes which are connecting links of rural non-access controlled facilities, the criterion is less clear cut. Freeway type design will generally not be warranted. The combination of through and internal traffic will however, often warrant an expressway type design to alleviate traffic congestion. The desirability and practicality of such a design should be analyzed on an individual route basis.

In applying all of the above criteria two important considerations should be kept in mind. First, there should not be frequent changes in the type of facility provided. Access control criteria should be applied along a route rather than to individual study sections. Secondly, and probably just as important, is the interrelationship between the type and timing of the improvement. For example, if an existing urban non-freeway facility which is a connecting link of a rural principal arterial can adequately accommodate traffic from the capacity point of view for several years, a minor improvement such as resurfacing might be appropriate where the only deficiency is the pavement condition. Conversely; an urban freeway or bypass freeway might be the first fully access controlled facility to be built along an intercity principal arterial corridor where a serious capacity deficiency exists within the urban area. Minor capacity deficiencies might however, be alleviated for several years by the addition of a lane. In summary, in addition to the consideration of continuity of design, economic consideration must also be applied in decisions concerning the type and timing of access controls which are justified.

ACCESS CONTROL CRITERIA FOR URBANIZED AREAS

The estimate of needs for access controlled facilities in an urbanized area should be based on the future year plan (adjusted to 1990) developed through the comprehensive urban transportation planning process.

An urban planning study may not currently be underway in some of the cities expected to have a population of over 49,999 in 1990; in other cities, the study may not have progressed to the plan development phase. In these areas, the 1990 functional systems are to be developed using the classification criteria in this manual. The feasibility and timing for obtaining control of access on the urban principal arterial system should be based on a section-by-section analysis of the adequacy of the existing facilities (such as that described on page III-32 for small urban areas) giving due consideration to community goals and the impact of proposed improvements upon the environment.

However, as the size of the city increases, the need for controlled access facilities to serve predominantly internal travel will also increase. The degree of access control proposed should not fluctuate along a route but remain as constant as possible even though the analysis will be on a section basis.

Table III-10--Design capacities for rural principal arterials

A. 2-lane facilities				
Terrain	Percent restricted sight distance (<1500 ft.)	Design capacity, VPH (Total in both directions)		
		Percent trucks		
		0	10	20
Flat	0	900	780	690
	20	860	750	660
	40	800	700	620
Rolling	20	860	615	485
	40	800	570	450
	60	720	510	400
Mountainous	40	770	410	280
	60	620	330	220
	80	440	230	160

B. Multilane facilities			
Terrain	Design capacity, VPH per lane		
	Percent trucks		
	0	10	20
Flat	1000	910	830
Rolling	1000	770	630
Mountainous	1200	710	500

Source - A Policy on Geometric Design of Rural Highways, 1965, AASHO.

Table III-11--Design capacities for rural minor arterials

A. 2-lane facilities				
Terrain	Percent restricted sight distance (< 1500 ft.)	Design capacity, VPH (Total in both directions)		
		Percent trucks		
		0	10	20
Flat	0	1150	1000	880
	20	1120	970	860
	40	1070	930	820
Rolling	20	1050	800	630
	40	930	660	520
	60	810	580	450
	80	680	480	380
Mountainous	40	1200	640	430
	60	1050	560	380
	80	900	480	320

B. Multilane facilities			
Terrain	Design capacity, VPH per lane		
	Percent trucks		
	0	10	20
Flat	1000	910	830
Rolling	1000	770	630
Mountainous	1200	710	500

Source - A Policy on Geometric Design of Rural Highways, 1965, AASHO.

Table III-12--Lane design capacities for urban freeways and expressways

Percent of dual tire trucks during peak hour	Design capacity 1/, average per 12-foot lane, in VPH for:			
	Built-up area (Running speed 35 to 40 mph)		Suburban or outlying areas (Running speed 40 to 45 mph)	
	Level terrain	Rolling terrain	Level terrain	Rolling terrain
0	1500	1500	1200	1200
5	1430	1300	1140	1040
10	1360	1160	1090	920
15	1300	1030	1040	830
20	1250	940	1000	750

1/ Values are based on passenger car equivalents of 2 and 4, respectively, for level and rolling terrain.

Source - A Policy on Geometric Design of Rural Highways, 1965, AASHO

Table III-13--Number of lanes needed for various design volume ranges (total in both directions) on urban arterials other than freeways and expressways

Type of area	Built-up area						Suburban or outlying area		
	Central business district			Fringe area and outlying business district			Residential areas		
Number of travel lanes	6*	4	2	6*	4	2	6*	4	2
Without separate left turn lanes									
DHV	Over 1250	800-1250	0-800	Over 1600	1050-1600	0-1050	Over 1500	1000-1500	0-1000
ADT	Over 16,000	10,000 to 16,000	Under 10,000	Over 17,900	11,600 to 17,900	Under 11,600	Over 13,800	8900 to 13,800	Under 8900
With separate left turn lanes									
DHV	Over 1550	800-1550	-	Over 1950	1050-1950	-	Over 1850	1000-1850	-
ADT	Over 19,500	10,000 to 19,500	-	Over 21,700	11,600 to 21,700	-	Over 16,700	8,900 to 16,700	-

Values based on the following assumptions using the 1965 Highway Capacity Manual:

1. City size - 75,000; PHF 0.85
2. Two-way streets with 10 percent right turns, 10 percent left turns, 5 percent trucks and through buses.
3. Parking on both sides on 2 and 4-lane facilities. No parking on 6-lane facilities. Widths as shown in standards.
4.

	Percent green time, excluding amber	Directional distribution	K factor (DHV/ADT)
CBD	45	55-45	8
Fringe and OBD	50	60-40	9
Residential	55	70-30	11

5. No local buses
6. Load factor 0.3

*Facilities needing more than six lanes should be analyzed individually.

Table III-14 --Surface and shoulder type definitions

SURFACE TYPE

Paved

High - Mixed bituminous or bituminous penetration road on a rigid base or on a flexible base with a combined (surface and base) thickness of 7 inches or more. Also, any bituminous concrete, sheet asphalt, rock asphalt, portland cement concrete, brick, block, or combination type road. (Road Type 1/ G-2, H-2, I, J, K, L, M).

Intermediate - Mixed bituminous or bituminous penetration road on a flexible base with a combined (surface and base) thickness of less than 7 inches (Road Type 1/ G-1, H-1).

Low - Bituminous surface course (less than 1 inch thick) on a base suitable to carry occasional heavy axle loads. (Road Type 1/ F).

Gravel - A graded and drained road with a surface of gravel, crushed stone, slag, shell. Surface may be stabilized. (Road Type 1/ E-2, E-3).

Graded and Drained - An earth road which has been graded into a defined roadway and having adequate drainage to prevent serious damage by normal surface water. Surface may be stabilized. (Road Type 1/ C, D-2).

SHOULDER TYPE

Surfaced - A bituminous surface course on a granular or stabilized base.

Stabilized - Gravel or other granular material with or without admixture, capable of supporting most loads even in wet weather.

Earth - Natural earth, with or without turf.

1/ As defined in the Guide for a Road Inventory Manual of Instructions, Bureau of Public Roads, April 1967.

Table III-15--Railroad crossing protection criteria

Functional system	Grade separation	Flashing lights with gates	Flashing lights	Reflectorized signs and crossbucks
Rural				
Principal arterial	Exposure factors 1/ above 35,000 and on all fully controlled access routes	Exposure factors above 10,000 2/	Exposure factors above 1,500 and all mainline tracks	All other crossings
Minor arterial	Exposure factors above 35,000	Exposure factors above 10,000 2/	Exposure factors above 1,500 for single mainline tracks	All other crossings
Collector		Exposure factors above 15,000 2/	Exposure factors above 3,000 for single mainline tracks	All other crossings
Local		2/	Exposure factors above 3,000 for single mainline tracks	All other crossings
Urban				
Principal arterial	Exposure factors above 75,000 and on all fully controlled access routes	Exposure factors above 20,000 2/	Exposure factors above 3,000 and all mainline tracks	All other crossings
Minor arterial street	Exposure factors above 75,000	Exposure factors above 20,000 2/	Exposure factors above 3,000 for single mainline tracks	All other crossings
Collector street		Exposure factors above 30,000 2/	Exposure factors above 5,000 for single mainline tracks	All other crossings
Local street		2/	Exposure factors above 5,000 for single mainline tracks	All other crossings

1/ Exposure factor is the product of the 1990 ADT times the number of trains.

2/ Flashing lights and gates should also be installed on multiple mainline tracks or where more than one train may occupy the crossing at the same time and on single tracks where train operating speeds are 70 mph or greater and sight distance is restricted.

Table III-16 -- Traffic expansion factors

Annual Traffic Growth Factor	Expansion factors for determining analysis year traffic			
(%)	5 Year	10 Year	15 Year	20 Year
0.5	1.025	1.051	1.078	1.105
1.0	1.051	1.105	1.161	1.220
1.5	1.077	1.161	1.250	1.347
2.0	1.104	1.219	1.346	1.486
2.5	1.131	1.280	1.448	1.639
3.0	1.159	1.344	1.558	1.806
3.5	1.188	1.411	1.675	1.990
4.0	1.217	1.480	1.801	2.191
4.5	1.246	1.553	1.935	2.412
5.0	1.276	1.629	2.079	2.653
5.5	1.307	1.708	2.232	2.918
6.0	1.338	1.791	2.397	3.207

FIGURE III - 1
IMPROVEMENT ANALYSIS GUIDE FOR RURAL PRINCIPAL ARTERIALS

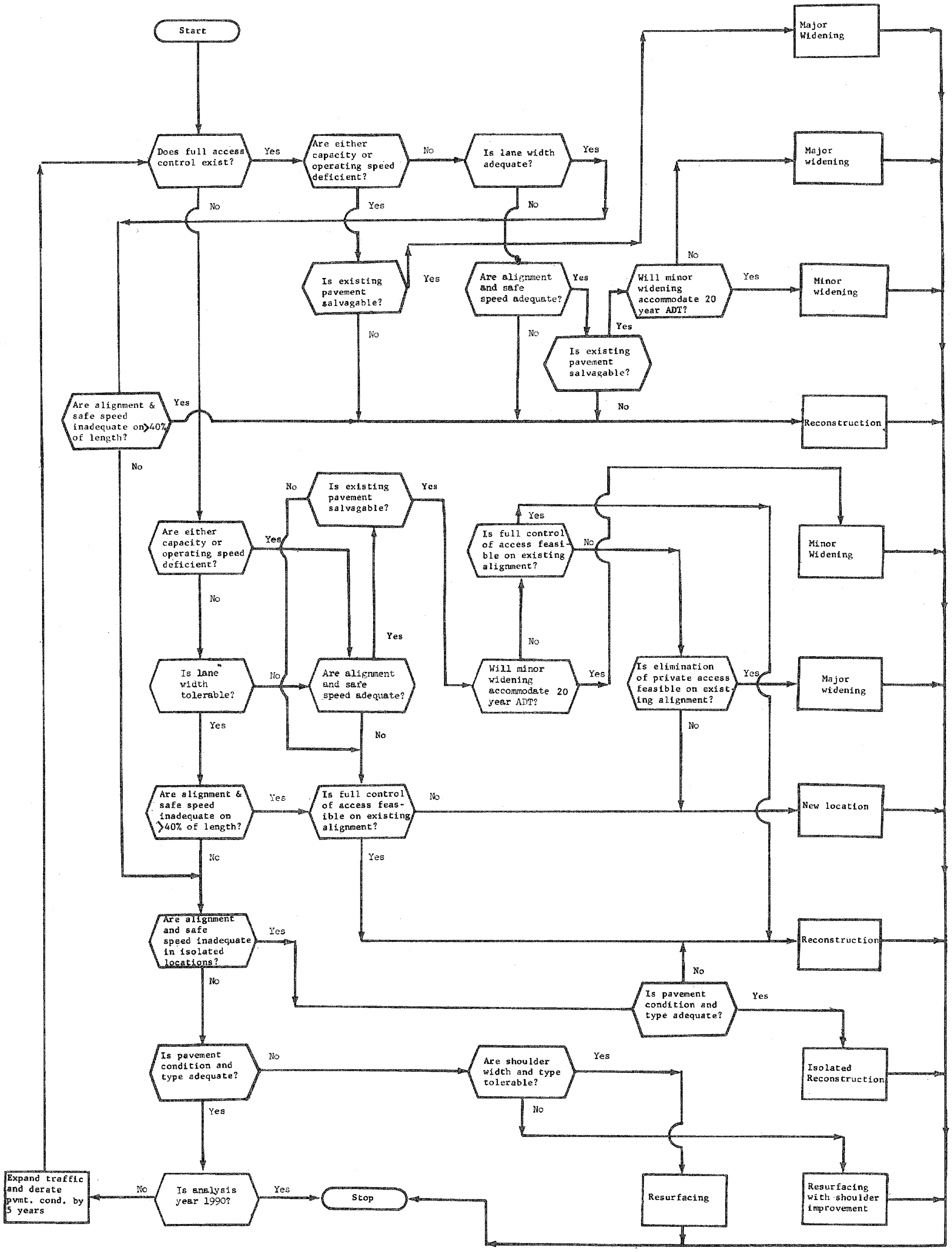


FIGURE III - 2
IMPROVEMENT ANALYSIS GUIDE FOR RURAL MINOR ARTERIALS AND COLLECTORS

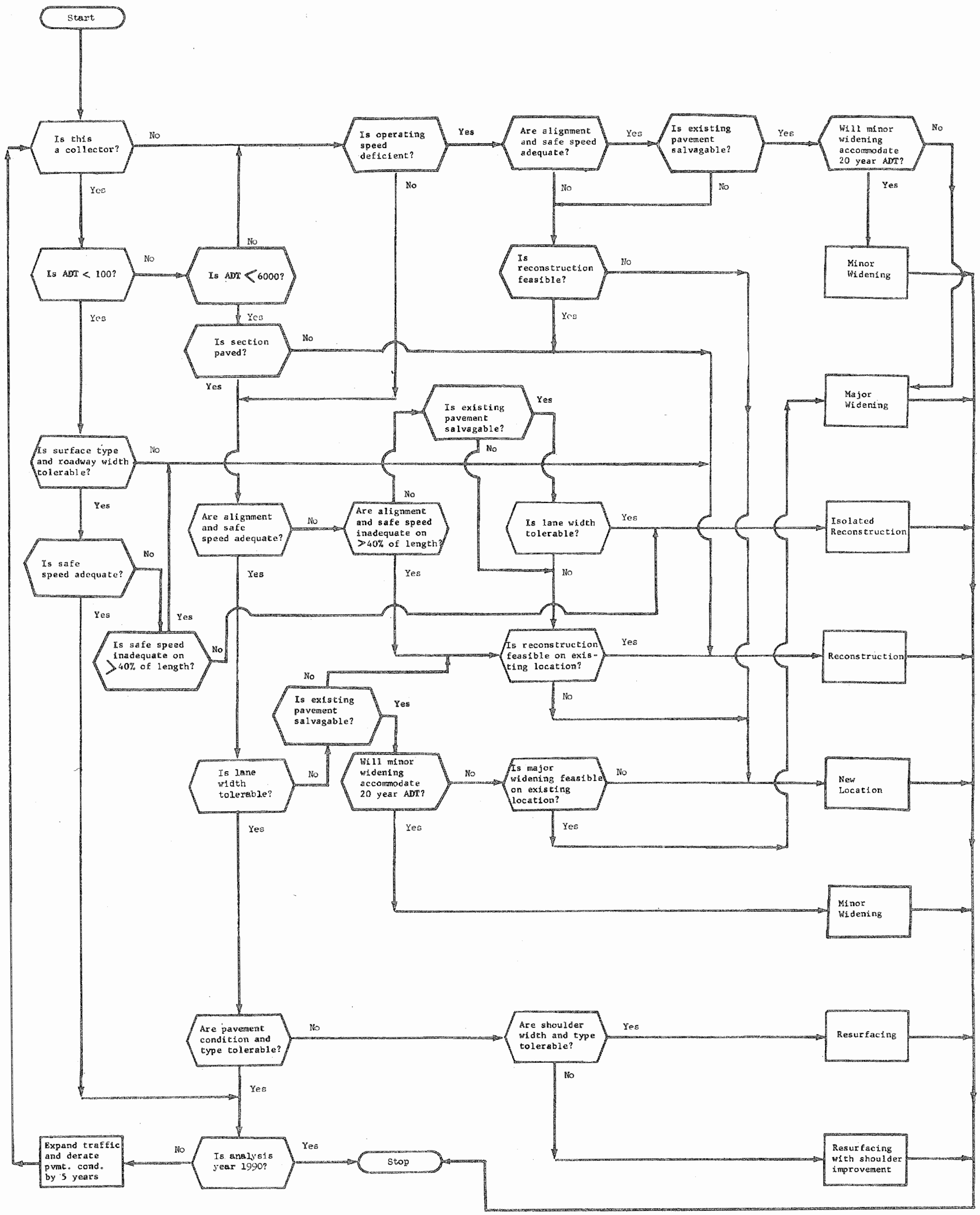


FIGURE III - 3
IMPROVEMENT ANALYSIS GUIDE FOR URBAN PRINCIPAL ARTERIALS

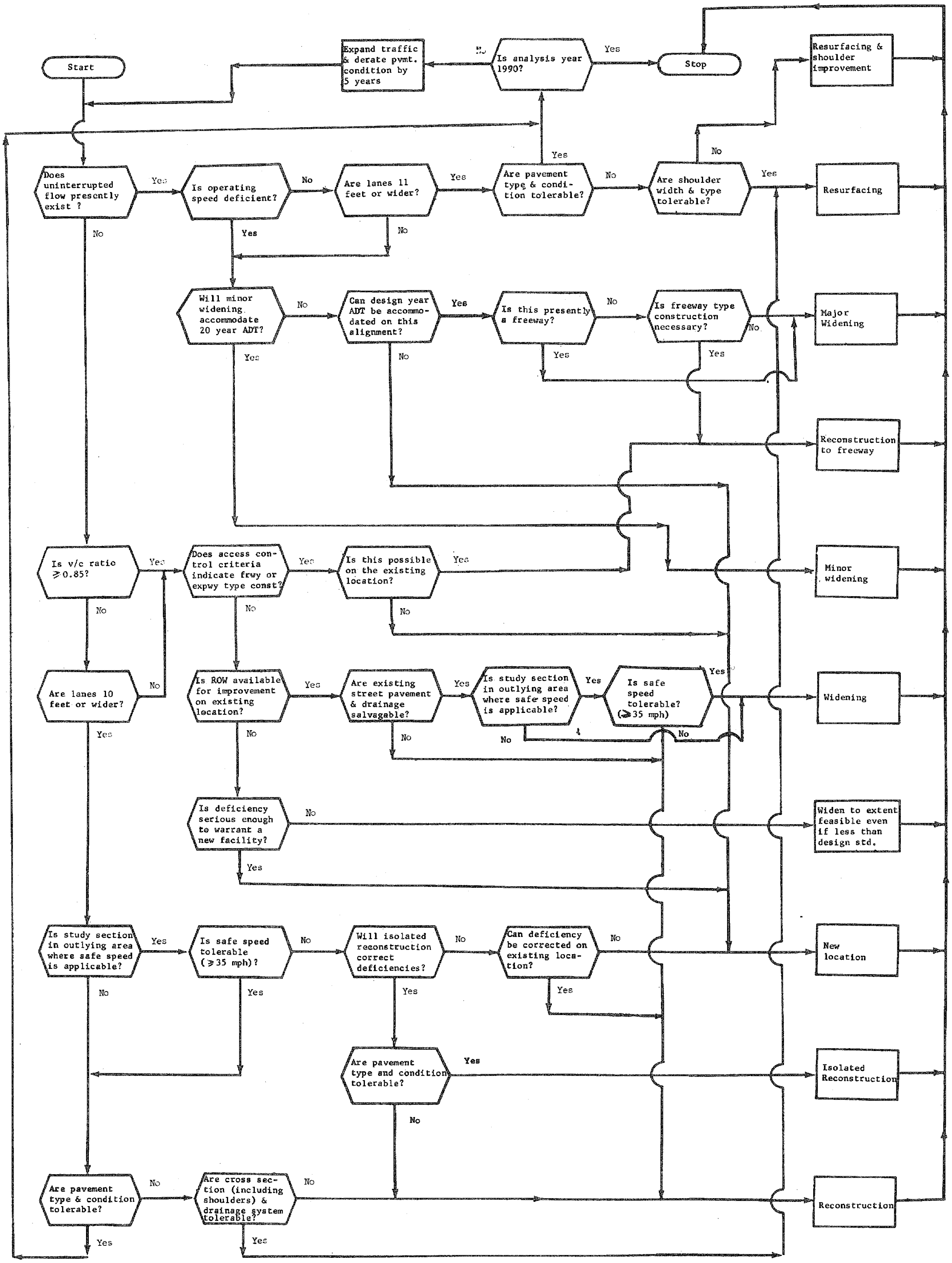


FIGURE III - 4
IMPROVEMENT ANALYSIS GUIDE FOR URBAN MINOR ARTERIALS

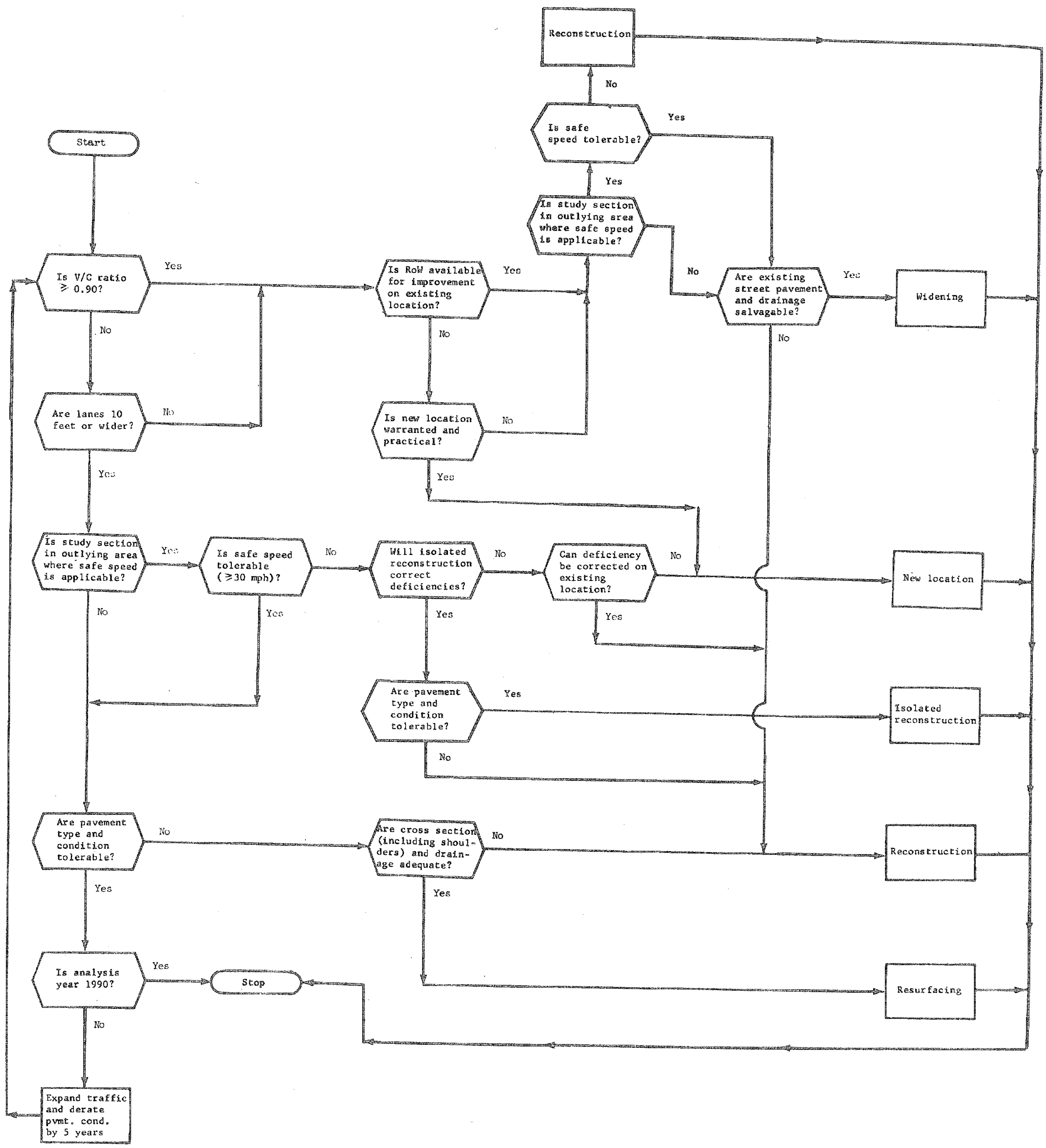


FIGURE III - 5
IMPROVEMENT ANALYSIS GUIDE FOR URBAN COLLECTORS

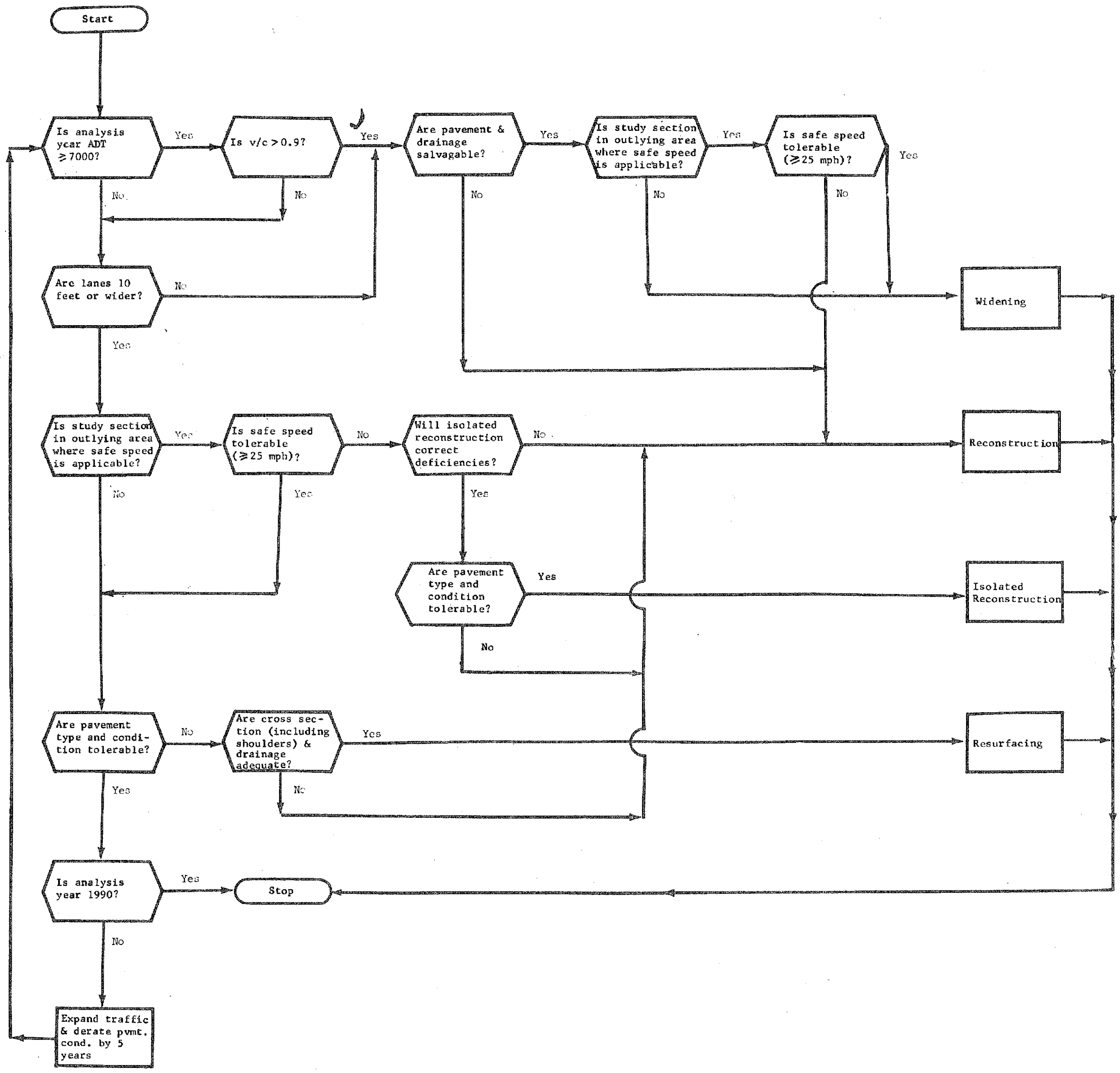


Figure III-6--Example of rural cost data format

RURAL MINOR ARTERIAL

(2 lane facility)

	Roadway Costs Per Mile				
Type Improvement	ROW & Util. adj.	Grade & Drain	Base & Surface	Other	Total
Cost Area 1					
1. New location					
2. Reconstruction					
3. Major widening					
4. Minor widening (including resurfacing)					
5. Resurfacing including shoulder improvement					
6. Resurfacing					
Cost Area 2					
1. New location					
2. Reconstruction					
3. Major widening					
4. Minor widening (including resurfacing)					
5. Resurfacing including shoulder improvement					
6. Resurfacing					
Cost Area 3					
1. New location					
2. Reconstruction					
3. Major widening					
4. Minor widening (including resurfacing)					
5. Resurfacing including shoulder improvement					
6. Resurfacing					

Figure III-7--Example of urban cost data format

OTHER PRINCIPAL ARTERIALS

(4-lane facility)

	Street Costs Per Mile				
Type improvement	ROW & Util. adj.	Grade & Drain	Base & Surface	Other	Total
Built-up Area					
1. New location					
2. Reconstruction					
3. Widening 1/					
4. Resurfacing					
Suburban or outlying area					
1. New location					
2. Reconstruction					
3. Widening 1/					
4. Resurfacing					

1/ Costs per mile of widening should be based upon the cost per mile, per foot of additional width.

377-268 O - 70 - 8

Figure III-8--Structure worksheet

(As distributed with IM 50-4-69)

STRUCTURE INVENTORY & APPRAISAL SHEET

IDENTIFICATION

Code

1 State

2 Hwy District

3 County

4 City/Town

5 Principal Route

6 Feature Crossed

7 Principal Rte ☐ Over ☐ Under

8 Structure No. ____ 1 of ____

9 Location

10

11 Route — Principal Route — Other

12 Milepost

13 Road Section No.

14 Sub-Section No.

15 Latitude ° '

16 Longitude ° '

17 DOD Rd Section

18 DOD Bridge Letter

19

20 Toll ☐ Yes ☐ No

21 Custodian

22 Owner

23 F.A.P. No.

CLASSIFICATION

24 Fed. Aid System

25 Administrative

26 Functional

	By	Date
Transfer of Data		
Condition Analysis		
Appraisal		
Cost		
General Review		
Maintenance Inspection		

STRUCTURE DATA

27 Year Built

28 Lanes on Str. ____ under ____

29 ADT on Str. ____ 30 Year ____

31 Design Load ____ Code

32 Appr. Rdwy Width W/Sh'ld

33 Median ____ ft ☐ Open ☐ Closed

34 Skew ____ °

35 Ground Level By-Pass ☐ Yes ☐ No

36 Hydraulic Structure ☐ Yes ☐ No

37 Report Available ☐ Yes ☐ No

38 Navigation Control ☐ Yes ☐ No

39 - Vertical ____ ft

40 - Horizontal ____ ft

41 Relief Structures

42 Type Service ____ Code

43 Structure Type - Main

44 - Approach

45 No. of Spans - Main

46 - Approach

47 - Total

48 Max. Span Length ____ ft

49 Structure Length ____ ft

50 Sidewalk Rt ____ ft Lt ____ ft

51 Roadway (curb-curb) ____ ft

52 Deck Width (out-out) ____ ft

53 Vert. Clearance over Deck ____ ft

54 Underclearance - Vertical ____ ft

55 - Lateral - Right ____ ft

56 - Left ____ ft

57 Utilities

CONDITION

Material — Condition Analysis — Rating (9-0)

58 Deck

59 Superstructure

60 Substructure

61 Channel & Channel Protection

62 Culvert & Retaining Walls

63 Estimated Remaining Life ____ 65 Approach Alignment

64 Permit Capacity ____ 66 Rated Loading

APPRAISAL

Deficiencies — Rating (9-0)

67 Structural Condition

68 Deck Geometry

69 Underclearances - Vert. & Lateral

70 Safe Load Capacity

71 Waterway Adequacy

72 Approach Alignment

PROPOSED IMPROVEMENTS

73 Year Needed ____ Completed ____ Describe

74 Type of Service

75 Type of Work

76 Improvement Length ____ ft

77 Design Loading ____ Code

78 Roadway Width ____ ft

79 Number of Lanes ____ 82 Prop. Rdwy Improvement - Year

80 ADT ____ 81 Year ____ 83 - Type

COST OF IMPROVEMENTS

84 $ ____, ____, 000.

Remarks

Item No.	Card Control Number	Card Col.

Figure III-9--Instructions for structure worksheet

ITEM DESCRIPTIONS

(For Structure Inventory and Appraisal Sheet)

IDENTIFICATION

1. State
2. State Highway Department District
3. County (Parish)
4. City, town or other jurisdiction
5. Principal (or major) route
6. Feature crossed by name
7. Indicate whether principal route is over or under
8. Structure or bridge number and indicate if one of twin or tandem, for twin or parallel bridges use separate inventory sheets
9. Location of structure by distance and direction from map landmark
10. Blank - for future use or extension of 9 if needed
11. Identify "Principal Route" - balance of sheet will pertain to this route. When the highway system crossed is studied, under column marked "other" enter data for items 11, 12, 13, 14, 17 and 18.
12. Milepost on route as per State's reference
13. "Needs Study" Road Section Number
14. "Needs Study" Road Subsection Number
15. Latitude in degrees, minutes and tenths of minutes
16. Longitude in degrees, minutes and tenths of minutes
17. Department of Defense, road section number
18. Department of Defense, bridge letter or number
19. Blank - for future use
20. Indicate if bridge is toll or on toll facility - Yes or No
21. Custodian - indicate responsibility for maintenance of structure
22. Owner of structure
23. If Federal aid has been used on structure indicate project number

CLASSIFICATION

24. Federal-Aid System
25. Administrative jurisdiction - County, Toll, State, Federal, etc.
26. Functional classification in accordance with classification manual

STRUCTURE DATA

27. Year construction completed and years of major reconstruction
28. Number of thru and ramp lanes on structure and thru lanes under
29. Most recent ADT for road on structure
30. Year of ADT above
31. Live load for which structure was designed. 1. H 10, 2. H 15, 3. HS 15, 4. H 20, 5. HS 20, 6. HS 20+Mod., 7. Pedestrian, 8. Railroad, 9. Other (Describe)
32. Approach roadway including shoulders, for road crossing structure (feet)
33. Median width (feet). Indicate whether structure median is open or closed.
34. Skew in degrees measured from zero, when the substructure units are normal to the superstructure. If variable, indicate approximate average.
35. Indicate if a ground level by-pass is possible in immediate vicinity of structure. Possibilities would be grade crossings of highways or RR, fording of shallow streams, etc.
36. Indicate if this structure crosses or is in the flood plain of a river or stream or otherwise involves any hydraulic considerations. If not, items 37 to 41 will be left blank.
37. For hydraulic structure indicate if hydraulic report is on file and available.
38. For hydraulic structure indicate if navigation control exists.
39. If navigation control exists, indicate minimum vertical clearance.
40. If navigation control exists, indicate minimum horizontal clearance.
41. For hydraulic structure indicate number of required structures in flood plain for flood relief and identify by structure numbers.
42. Identify type of service and code. Use a 2-digit code.

Code No.	Service on Structure	Service Under
	First Digit	Second Digit
1	Highway	Highway
2	Railroad	Railroad
3	Pedestrian	Pedestrian
4	Hwy-RR	Hwy-RR
5	2nd level (Interchange)	Waterway
6	3rd level (Interchange)	Hwy-Waterway
7	4th level (Interchange)	RR-Waterway
8	Building or Plaza	Hwy-RR-Waterway
9	Other (Describe)	Other (Describe

43. Identify type of structure and code. Use a 2-digit code.

Code No.	Minor Structure		Major Structure	
	1st Digit	2nd Digit	1st Digit	2nd Digit
1		I-Beam	Simple	Truss - Deck
2		Gdr & Floorbeam	Continuous	- Thru
3	SS Conc.	Slab		Arch - Spandrel
4	SS Steel	Box		- Thru
5	Con't. Conc.	Tee		Suspension
6	Con't. Steel	Frame		Movable
7	Timber	Orthotropic (300')		Orthotropic (300')
8	Masonry			Tunnel
9	Other	Other		Other

List any structure not described by listings above, under code 9 "Other" and describe in remarks.

44. Same as above for approach spans (use only on major bridges or with material change)
45. Indicate number of spans in main or major unit.
46. Indicate number of spans in approach spans of major bridge or of different material.
47. Total number of spans
48. Length of maximum span (feet)
49. Total length of structure (feet) out-to-out of backwalls
50. Width of sidewalks on right and left (feet and tenths of feet)
51. Roadway width between curbs (feet and tenths of feet)
52. Deck width out-to-out or if through structure, lateral clearance between superstructure members (feet and tenths of feet)
53. Minimum vertical clearance over roadway for through structure or tunnel (feet and tenths of feet). "99.9" if unlimited.
54. Underclearance - minimum vertical clearance from roadway or track to underside of superstructure (feet and tenths of feet).
55. Underclearance - minimum lateral clearance on right from edge of roadway or centerline of track to substructure unit or toe of slope. (feet and tenths of feet)
56. Underclearance - minimum lateral clearance on left (for divided highways) from edge of roadway to substructure unit or toe of slope. (feet and tenths of feet)
57. Identify type and size of any utility existing on structure.

CONDITION

Describe construction material
Briefly analyze condition of item
Condition rating from 9 (very good) to 0 (very poor) for conditions noted
- Rating of 9 --- new condition
- Rating of 8 --- good condition - no repair necessary
- Rating of 7 --- minor items in need of repair by maintenance forces
- Rating of 6 --- major items in need of repair by maintenance forces
- Rating of 5 --- major repair contract needs to be let
- Rating of 4 --- minimum adequacy to tolerate present traffic - immediate rehabilitation necessary to keep open
- Rating of 3 --- inadequacy to tolerate present heavy load - warrants closing bridge to trucks
- Rating of 2 --- inadequacy to tolerate any live live load - warrants closing bridge to all traffic
- Rating of 1 --- bridge repairable, if desirable to reopen to traffic
- Rating of 0 --- bridge conditions beyond repair - danger of immediate collapse

58. Deck - condition of slab, expansion device and wearing surface
59. Superstructure - main supporting members, bearing devices and drainage system
60. Substructure - check footing scour and navigation fender conditions
61. Channel and channel protection - stream stability and protection condition
62. Culvert and retaining walls - check culvert settlement and wall stability
63. Estimate remaining life of structure (Years)
64. Permit capacity - permitted by State for special permit loads
65. Approach alignment - describe condition and give rating in relationship to current good design
66. Rated load capacity as posted or permitted under normal use

APPRAISAL

Describe major deficiencies
Adequacy rating from 9 (adequate) to 0 (deficient) for deficiency noted
- Rating of 9 --- conditions superior to present desirable criteria
- Rating of 8 --- condition equal to present desirable criteria
- Rating of 7 --- condition better than present minimum criteria
- Rating of 6 --- condition equal to present minimum criteria
- Rating of 5 --- condition somewhat better than minimum adequacy to tolerate being left in place as is
- Rating of 4 --- condition meeting minimum tolerable limits to be left in place as is
- Rating of 3 --- basically intolerable condition requiring high priority of repair
- Rating of 2 --- basically intolerable condition requiring high priority in replacement
- Rating of 1 --- immediate repair necessary to put back in service
- Rating of 0 --- immediate replacement necessary to put back in service

Adequacy rating is related to functional classification of pertinent highway

67. Describe major structural deficiencies, give rating of critical item.
68. Deck geometry - adequacy of roadway width, clearances above deck, etc.
69. Vertical and horizontal under clearances from thru roadway to superstructure and substructure units, respectively
70. Describe deficiencies, determine safe load capacity and adequacy
71. Describe waterway inadequacies, i.e., scour, erosion, slope protection, capacity, etc.
72. Identify inadequate approach alignment conditions

PROPOSED IMPROVEMENTS

73. State year needed and when completed, indicate year
74. Type of service (see item 42)
75. Type of work - repair, replace, etc., give complete description also whether proposed to be done by State forces or contract.
76. Length of improvement, not necessarily full length of structure (feet)
77. Proposed design loading of improvement (See item 31)
78. Proposed reconstructed roadway width, curb-to-curb or face-to-face of rails if curbs less than 9" (feet)
79. Proposed number of lanes
80. ADT which controls new design
81. Year of estimated ADT
82. Year of proposed adjacent roadway improvements
83. Type of proposed adjacent roadway improvements

COST OF IMPROVEMENTS

84. Enter cost in thousands of dollars

REMARKS

In remarks include an explanation of any special environmental condition such as atmosphere, or community that could be responsible for deterioration of structure or reason for need of reapir. Comment on any special traffic pattern that would be unusual in nature. Any explanation of numbered item entries on inventory sheet should be included and referenced with proper item number.

SECTION IV

INSTRUCTIONS FOR COMPLETING THE RURAL ARTERIAL AND COLLECTOR WORKSHEET

GENERAL INSTRUCTIONS

This section contains detailed instructions for completing and coding the rural worksheet (figure IV-1). The information contained on the worksheet is to be used, together with the improvement analysis guides in section III, to determine, for each needs section, the type of deficiency, the time period in which the deficiency is expected to occur, and the type of improvement needed.

In order to facilitate compilation of the total nationwide needs and benefits for the 1972 Report to Congress by the Washington office of the Bureau of Public Roads, <u>much of the information recorded on the worksheets must be coded and placed on data cards in a consistent format</u>. The three data cards described below must be completed for each needs section or subsection included in the sample to accomplish this objective.

1. Card No. 1 - Existing conditions (1970)
2. Card No. 2 - Analysis of deficiencies
3. Card No. 3 - Costs of improvements

Section VIII of the manual includes instructions for converting the card images to a uniform tape format for submittal.

Items 1-5 on the worksheet must be recorded in columns 1-14 of all three cards. All entries should be right justified and leading zeroes coded where necessary. Items 22, 35, and 38, are not needed for the benefits analysis and should not be coded. Space has been provided at the bottom of the form for recording any remarks by the inventory crew that might assist in analysis of deficiencies, selection of improvement type, and in determining costs of improvement.

New Sections

For new sections identified in the 1990 functional classification phase of the study (as opposed to new sections identified during needs evaluation), many of the entries for existing conditions will not be applicable. However, a worksheet should be initiated for all of these new sections included in the sample for needs evaluation. The following items need not be completed for these new sections: 11-14, 16-20, 22, 23, 26-33, 35-41, and 54-58.

Where the analysis of deficiencies on an existing section indicates that an improvement should be made on new location, the worksheet containing the existing condition data should also include the information on the proposed new location. Thus, only one worksheet (per section) is required where relocations are necessary.

Sections Through Small Towns

It is recognized that certain sections on rural functional systems are in small towns (with populations of less than 5000), and have the characteristics of urban sections rather than typically rural sections. The evaluation of the tolerability of these sections should be based on their urban characteristics. On many of these sections, the proposed improvement should be to urban, rather than rural, design standards with costs based on the urban cost tables. These sections are to be identified as being in areas of dense development in Item 21 of the worksheet.

FIGURE IV-1

RURAL ARTERIAL AND COLLECTOR WORKSHEET

BOB No. 04 S69053

CARD 1

IDENTIFICATION

Item	Columns
1. State	1-2
2. County ________	3-5
3. Route Number	6-9
4. Route Section	10-12
5. Subsection Number	13-14
6. Length (0.1 mile)	15-17
7. 1968 Functional Classification	18
8. 1990 Functional Classification	19

Code ('68 and '90)	Functional System
1	Interstate
2	Other Principal Arterial
3	Minor Arterial
4	Major Collector
5	Minor Collector
6	Local ('68 Only)
7	Did Not Exist ('68 Only)

Item	Columns
9. Federal-aid System 1 FAP, Including Interstate, 2 FAS, 3 Non FA, 4 New	20
10. Jurisdictional Responsibility 1 State, 2 Federal Domain, 3 Toll, 4 Other Existing, 5 New	21

EXISTING CONDITIONS (1970)

Geometrics

Item	Columns
11. Access Control — Full 1, Partial 2, None 3	22
12. Lane Width (feet) ______	23-24
13. Number of Lanes	25-26
14. Shoulder Width (feet) _____ Right	27-28
_____ Left	29-30
15. Terrain — Flat 1, Rolling 2, Mountainous 3	31
16. Percent of Length with Intolerable Safe Speed	32-33
17. Percent of Length with Sight Distance ≥ 1500 feet	34-36
18. Median Width (feet)	37-38
19. Average Highway Speed (mph)	39-40
20. Number of Signals and/or Stop Signs	41-42
21. Type of Development — Rural 1, Dense 2	43
22. Available Right-of-Way _____ feet	

Traffic

Item	Columns
23. ADT	44-49
24. Percent Trucks	50-51
25. K Factor (DHV/ADT)	52-53
26. Directional Factor	54-55
27. Capacity (hourly)	56-60
28. Operating Speed (mph)	61-62

Structural

Item	Columns
29. Surface Type	63

1	High-Flexible
2	High-Rigid
3	Intermediate
4	Low
5	Gravel
6	Graded & Drained

Item	Columns
30. Pavement Section — 'SN' Known 1, 'D' Known 2, Heavy 3, Medium 4, Light 5	64
Structural Number (SN) or Slab Thickness (D)	65-66
31. Pavement Condition (PSR or equivalent - 0.0)	67-68
32. Shoulder Type — Surfaced 1, Stabilized 2, Earth 3	69
33. Drainage Adequacy — Good 1, Fair 2, Poor 3	70
CARD NUMBER [1]	80

REMARKS: ____________________

CARD 2

ANALYSIS OF DEFICIENCIES

Item	Columns
1-5 Identification (Repeat card 1)	1-14
34. 1990 ADT	15-20
35. Average Annual Traffic Growth ____ %	
36. Percent of Length with Intolerable Safe Speed (1990)	21-22
37. Time of Pavement Condition Deficiency — Now 1, 1-5 2, 6-10 3, 11-15 4, 16-20 5, 20+ 6	24
38. Deficiencies:	

	Code	Now	1-5	6-10	11-15	16-20	20+
Operating Speed	1						
Lane or Roadway Width	2						
Safe Speed	3						
Pavement Type and/or Condition	4						
Shoulders	5						
None	6						

Item	Columns
39. Initial Deficiency Code	25
40. Secondary Deficiency Code	26
41. Period Section Becomes Deficient — Now 1, 1-5 2, 6-10 3, 11-15 4, 16-20 5, 20+ 6	27

DESCRIPTION OF IMPROVEMENT

Item	Columns
42. Year of Improvement	28-29
43. ADT First Year After Improvement	30-35
44. Type of Improvement	36

0	No Improvement
1	New Location
2	Reconstruction
3	Isolated Reconstruction
4	Major Widening
5	Minor Widening
6	Resurfacing and Shoulder Improvement
7	Resurfacing

Item	Columns
45. Design Year ADT	37-42
46. Design Standard Number	43-44
47. Access Control — Full 1, Partial 2, None 3	45
48. Number of Lanes	46-47

RAILROAD CROSSINGS

Number of RR Crossing With: (Present 1990)

Item	Columns
49. No Protective Devices	48
50. Cross Bucks	49-50
51. Flashing Lights	51-52
52. Flashing Lights and Gates	53-54
53. Grade Separations	55-56

STRUCTURES

Item	Columns
54. Number of Structures (Present)	57-58
Number of Deficiencies (Existing Structures):	
55. Width	59-60
56. Vertical Clearance	61-62
57. Loading	63-64
58. Other	65-66
59. Number of New Structures Needed	67-68
60. Time of Structure Needs — Now 1, 1-5 2, 6-10 3, 11-15 4, 16-20 5, 20+ 6	69
CARD NUMBER [2]	80

CARD 3

COSTS, Thousands

Item	Columns
1-5 Identification (Repeat card 1)	1-14
61. Right-of-Way	15-20
62. Grading & Drainage	21-26
63. Surface & Base	27-30
64. Other	31-34
65. Structures (incl. RR Grade Sep.)	35-40
66. Maintenance	41-44
67. Administration	45-48
68. Total	49-54
69. Cost Area	55-56
70. Expansion Factor (00.00)	57-60
CARD NUMBER [3]	80

REMARKS: ____________________

Figure IV-1--(Continued)

WORKSHEET FOR CALCULATING AVERAGE HIGHWAY SPEED (AHS)

Route ______________ Section ___________ Length _______ mi.

Degree of curvature 1/	Design speed (mph)	Number of curves	Total travel time (min.) (from Table G-1)
28.0 - 43.0	25		
19.5 - 28.0	30		
14.0 - 19.5	35		
11.0 - 14.0	40		
8.5 - 11.0	45		
7.0 - 8.5	50		
5.5 - 7.0	55		
4.75 - 5.5	60		
4.0 - 4.75	65		
	Totals =		
	Tangent travel time =		
	Total travel time =		

Section length __________ mi.

-Total curve length __________ mi. (from Table G-2)

Tangent length __________ mi.

x 0.86 min./mi.

Tangent travel time __________ min.

$$\text{Average Highway Speed} = \frac{\text{Total travel time \_\_\_\_\_\_ min.}}{\text{Section length \_\_\_\_\_\_ mi.}} \times 60 = \text{\_\_\_\_\_\_ mph}$$

Rounded AHS = __________ mph

1/ For maximum superelevation rate of 0.08 ft./ft.

WORKSHEET FOR CALCULATING RURAL HIGHWAY CAPACITY

Capacity of 2-lane highways

$C = 2000\ W_c\ T_c$

C = Capacity, vph (total in both directions)

W_c = _______ (adjustment for lane width and lateral clearance, from Table 10.8 in the 1965 Highway Capacity Manual)

T_c = _______ (truck factor for overall highway sections, from Table 10.9b in the 1965 Highway Capacity Manual)

C = 2000 x _______ x _______ = __________

Capacity of multilane highways

$C = 2000\ N\ W\ T_c$

C = Capacity, vph (total for one direction)

N = _______ (number of lanes in one direction)

W = _______ (adjustment for lane width and lateral clearance, from Tables 9.2 or 10.2 in the 1965 Highway Capacity Manual)

T_c = _______ (truck factor for overall highway section, from Tables 9.3b or 10.3b in the 1965 Highway Capacity Manual)

C = 2000 x _______ x _______ x _______ = __________

WORKSHEET FOR CALCULATING REMAINING PAVEMENT LIFE

18-kip single axle equivalent constant = __________ (from W-4 table of truck weight study)

Critical lane factor = __________% (from appendix H)

Soil support = __________ (flexible pavement only - 1.5 or less, 1.6-5.9, 6.0 or more)

EALA = _______ x _______ x _______ x _______ x 365 = _______
(Present ADT) (% Trucks) (Critical lane factor) (18-kip single-axle equiv. constant)

Remaining life = __________ years (from tables H-1,2,3 or 4 in appendix H)

DETAILED INSTRUCTIONS

Card Number 1

IDENTIFICATION		Columns
Item 1 -	State. Enter the State code number as listed in table B-1, appendix B.	1-2
Item 2 -	County. Enter the county code number as shown in the IBM Reference Manual, Numerical Codes for States, Counties, and Cities. It is recognized that not all States are subdivided into counties. The codes for the geographical areas referred to as counties in the IBM coding manual are to be used for this study.	3-5
Item 3 -	Route number. For Interstate System routes, enter the designated Interstate route number. A route number between 2000 and 2999 should be assigned to each of the other rural principal arterial routes, a number between 3000 and 4999 assigned to each of the rural minor arterials included in the sample, and the number entered in these columns. The route number should be assigned on a statewide basis with no overlaps or duplications. An appropriate route identification number (perhaps the signed or traffic route number) should be assigned to collector routes included in the sample for needs analysis.	6-9

Examples:	Interstate route no.	Code
	I-5	I005
	I-81	I081
	I-35W	I35W
	I-185	I185

Columns

Item 4 - <u>Route section</u>. As part of the initial office appraisal, all routes shall be divided into sections, and section numbers, beginning with 001, assigned on each route. To the extent information is available in the office, section breaks should be established as indicated below: 10-12

1. All 1990 urban-in-fact boundaries.
2. All junctions with principal or minor arterial routes.
3. County lines.
4. Interchanges or intersections where major changes in traffic volumes occur.
5. Changes in Federal-aid system.
6. Changes in jurisdictional responsibility only where such changes result in going from one to another of the categories shown in Item 10. (That is, a section break need not occur where jurisdiction passes from county to municipality, etc. However, a break should occur where responsibility goes from county to State, State to Federal domain, etc.)
7. Locations where there are changes in the physical characteristics of the roadway. It is not the intent of this requirement that many short sections should be established. On the contrary, such sections should be avoided wherever possible. Minor changes in any of the physical characteristics, especially if they will have little or no effect on the needs analysis, should be ignored when establishing section breaks. Physical characteristics include:

    a. Pavement width
    b. Number of lanes
    c. Pavement type
    d. Shoulder width and/or type
    e. Terrain
    f. Access control

	Columns
Item 5 - <u>Subsection number</u>. This item is included to allow breaks in a section where the field appraisal party finds additional changes in the physical characteristics of the roadway. Where subsection breaks are necessary, a separate worksheet should be used for each subsection. Subsections should be numbered consecutively beginning with '01'. Where no subsection breaks are required, enter '00' in these columns.	13-14
Item 6 - <u>Length</u>. Enter the section 1/ length, to the nearest 0.1 mile. Where the improvement required is new location and the new length is appreciably different from the existing length, record the new section length.	15-17
Item 7 - <u>1968 Functional classification</u>. Enter the code shown on the worksheet which represents the 1968 functional classification of the study section or that indicates that the section did not exist in 1968.	18
Item 8 - <u>1990 Functional classification</u>. Enter the code shown on the worksheet for the 1990 functional classification of the study section.	19
Item 9 - <u>Federal-aid system</u>. Enter the code shown on the worksheet for the existing Federal-aid classification of the study section or that indicates the section does not presently exist.	20
Item 10- <u>Jurisdictional responsibility</u>. Enter the code shown on the worksheet which represents the jurisdiction having present responsibility for the existing section or indicates that the section does not presently exist.	21

1/ All future references to "section" mean section or subsection.

EXISTING CONDITIONS (1970) Columns

Geometrics

Item 11- Access control. Enter the code for the type of access control, as defined below, existing on the study section. 22

Code	Type of access control
1	Full access control - Preference has been given to through traffic movement by providing interchanges with selected public roads and by prohibiting crossings at grade or direct private driveway connections.
2	Partial access control - Preference has been given to through traffic movement to a degree that, in addition to interchanges, there may be some crossings at grade with public roads, and direct private driveway connections have been minimized.
3	No access control.

Item 12- Lane width. 1/ Enter the traffic lane width, to the nearest foot. 23-24

Item 13- Number of lanes. 1/ Enter the number of lanes carrying through traffic. Exclude short sections of truck climbing lanes. 25-26

1/ Where these features are not the same on both roadways of a divided highway, enter the more critical values in the coding blocks and record the values for the other roadway on the line provided. This information will be helpful in determining the type and cost of improvement necessary.

Columns

Item 14-	<u>Right shoulder width</u>. 1/ Enter the width of the right shoulder, to the nearest foot. Enter '0' where no right shoulder exists	27-28
	<u>Left shoulder width</u>. 1/ On divided highways, enter the width on the left (median) shoulder, to the nearest foot. Enter '0' where no left shoulder exists and for undivided or 2-lane facilities.	29-30
Item 15-	<u>Terrain</u>. Enter the code for the predominant terrain type through which the section passes.	31

Code	Terrain type
1	<u>Flat</u> terrain is that condition where highway sight distances, as governed by both horizontal and vertical restrictions, are generally long or could be made to be so without construction difficulty or major expense.
2	<u>Rolling</u> terrain is that condition where the natural slopes consistently rise above and fall below the highway grade line and where occassional steep slopes offer some restriction to normal highway horizontal and vertical alignment.
3	<u>Mountainous</u> terrain is that condition where the longitudinal and transverse changes in the elevation of the ground with respect to the highway are abrupt and where the roadbed requires frequent benching or side hill excavation.

1/ Where these features are not the same on both roadways of a divided highway, enter the more critical values in the coding blocks and record the values for the other roadway on the line provided. This information will be helpful in determining the type and cost of improvement necessary.

Columns

Item 16-	Percent of length with intolerable safe speed. Enter that percent of the section length which has a safe speed below that specified in the minimum tolerable conditions. To determine whether a safe speed deficiency exists, consideration should be given to the horizontal curvature, grades, and length of stopping sight distance available. Advisory speed signs, the design speeds used in computing average highway speed, etc., will be helpful in determining this length.	32-33
Item 17-	Percent of length with sight distance ≥1500 ft. Enter the percent of the section length (estimated to the nearest 10%) which has available passing sight distance (as measured from the driver's eye to the road surface) of at least 1500 ft. This item is applicable for all 2-lane arterials and for 2-lane collectors with 1990 ADT of 6000 or more. Enter 'XX' for all other sections. (See discussion in appendix G.)	34-36
Item 18-	Median width. Enter the predominant median width (including shoulders, if any), measured between the inside edge of the through roadways, to the nearest foot. Enter '00' for undivided or 2-lane roadways. Enter '99' where the median width is 100 feet or greater.	37-38
Item 19-	Average highway speed. Enter the average highway speed (rounded to the nearest of the following values: 70, 60, 50, 45, 40, 35) for those sections of principal arterials, minor arterials, and collectors (with 1990 ADT of 6000 or greater) that, for the most part, lie outside of small towns (1990 population less than 5,000). The average highway speed is determined by weighting the design speeds of the individual horizontal curves in the section by the length of each curve. A recommended procedure for calculating average highway speed in included in appendix G. Enter the speed limit for those	39-40

Columns

sections lying within the built-up area of these small towns. The speed limit posted on the greater part of the section should be used. Enter 'XX' for all collectors with less than 6000 ADT in 1990.

Item 20- Number of signals and/or stop signs. Enter the number of traffic signals and/or stop signs (controlling through traffic) included in the section length. 41-42

Item 21- Type of development - Enter the code shown below for the predominant type of development. 43

Code	Type of Development
1	Rural - All areas outside of urban boundaries (cities of 5,000 or more population) excluding those described as "dense."
2	Dense - Those areas outside of urban boundaries (as defined for this study) which have an urban type development (i.e., small towns).

Item 22- Available right-of-way. Record on the worksheet the right-of-way that might feasibly be used to widen or reconstruct this study section. Include existing ROW and any border area that could be acquired, considering the land costs and type of land use adjacent to the roadway. This information will assist in determining the type of improvement to be proposed and is not to be coded.

Traffic

Item 23- Present ADT. Enter the estimated present average daily traffic (total both directions). 44-49

Columns

Item 24 - Percent trucks. Enter the percentage of commercial vehicles, to the nearest percent. Exclude pickups, panels, and light (2-axle, single tired) trucks. 50-51

Item 25 - "K" factor. Enter the "K" factor (design hour volume (30th highest hour) as a percentage of the average daily traffic), to the nearest percent, for all arterials and those collectors with 1990 ADT of 6,000 or greater. Enter 'XX' for collectors with less than 6,000 ADT in 1990. 52-53

Item 26 - Directional distribution factor. Enter the percentage of the design hour traffic flowing in the peak direction, to the nearest 5 percent, for all arterials and those collectors with 1990 ADT of 6,000 or greater. Enter, 'XX' for collectors with less than 6,000, ADT in 1990. 54-55

Item 27 - Capacity. Enter the present hourly capacity (total both directions for two-lane facilities and for one direction on multi-lane facilities) of all arterials and those collectors with a 1990 ADT of 6,000 or greater. Capacity is the maximum service volume at Level of Service E, as described in the 1965 Highway Capacity Manual. (This corresponds to possible capacity as used in the 1965 AASHO "Blue Book".) The procedures described in the Highway Capacity Manual should be used for this calculation. Space for recording the calculation of capacity is provided on the back of the worksheet. 56-60

Example: The study section is a rural, 2-lane highway in rolling terrain with 11-foot unpaved shoulders, lateral obstructions outside the shoulders, and carrying 10 percent trucks. From the Highway Capacity Manual, we get a W_c of 0.83 (for 11-ft. lanes with 4-ft. lateral clearence) and a T_c of 0.71 (for 10 percent trucks in rolling terrain). Capacity is therefore 2,000 x 0.83 x 0.71 or 1,180 vph. Enter 'XXXXX' for collectors with less than 6,000 ADT in 1990.

Columns

Item 28- Present operating speed. Enter the present operating speed, to the nearest mph., for all arterials and those collectors with a 1990 ADT of 6,000 or greater. Instructions for determining present operating speed are included in appendix G. 61-62

Structural

Item 29- Surface type. Enter the code for the type of surfacing existing on the section according to the definitions given below. 63

Code	Type of Surface
1	High (Flexible) - Mixed bituminous or bituminous penetration road on a rigid base or on a flexible base with a combined (surface and base) thickness of 7" or more. Also, any bituminous concrete, sheet asphalt, rock asphalt, brick, block, or combination type road. (Road Type 1/ G-2, H-2, I, K, L, M).
2	High (Rigid) - Portland cement concrete pavements. (Road Type 1/ J).
3	Intermediate - Mixed bituminous or bituminous penetration road on a flexible base with a combined (surface and base) thickness of less than 7". (Road Type 1/ G-1, H-1).
4	Low - Bituminous surface course (less than 1" thick) on a base suitable to carry occasional heavy axle loads. (Road Type 1/ F).

1/ As defined in the Guide for a Road Inventory Manual of Instructions, Bureau of Public Roads, April 1967 (volume 20, appendix 18, of the Highway Planning and Program Manual).

377-268 O - 70 - 9

Columns

Code	Type of Surface	
5	Gravel - A graded and drained road with a surface of gravel, crushed stone, slag, shell, etc. Surface may be stabilized. (Road Type 1/ E-2, E-3).	
6	Graded and Drained - An earth road which has been graded into a defined roadway and having adequate drainage to prevent serious damage by normal surface water. Surface may be stabilized. (Road Type 1/ C, D-2).	

Item 30- Pavement section. Enter the code shown on the worksheet to indicate that the structural number ('SN' - for flexible pavements) or the slab thickness ('D' - for rigid pavements) is known or the code for the type of pavement section (heavy, medium, light) where detailed data is not known. To assist in determining the type of pavement section, table IV-1 has been prepared, showing three typical pavement sections on which the estimate of remaining pavement life (Item 37) may be based. This guide includes typical thicknesses of surface, base and subbase and the minimum combined dept of pavement structure. 64

Structural number (SN) or slab thickness. Enter the structural number (to the nearest 0.1) for those sections coded '1' above. Enter the slab thickness (in inches) for those sections coded '2' above. 65-66

1/ As defined in the Guide for a Road Inventory Manual of Instructions, Bureau of Public Roads, April 1967 (volume 20, appendix 18, of the Highway Planning and Program Manual).

Table IV-1 -Pavement section guides for estimating remaining life

Code	Type of section	Flexible pavement					Rigid pavement
		"SN" range	Surface type & thickness	Base type & thickness	Subbase type & thickness	Combined depth 1/	Range in pavement thickness "D"
3	Heavy	4.6 - 6.0	4" asphaltic concrete	9" crushed stone to PC concrete	4" gravel 2/	> 12"	9.1 - 11.0" (8" if continuously reinforced)
4	Medium	3.1 - 4.5	3" asphaltic concrete	8" gravel to penetration macadam	4" gravel	11-12"	7.1 - 9.0" (6" if continuously reinforced)
5	Light	1.0 - 3.0	Surface treatment to 2" asphaltic concrete	6" gravel or crushed stone	2" gravel or sand	10"	6.0 - 7.0"

1/ To be used as a guide where only the total depth is known or estimated.

2/ Subbase course not necessary under portland cement concrete base.

Columns

Item 31- Pavement condition. Enter the pavement condition (actual PSR or equivalent) to the nearest tenth, for all arterials and collectors having a high, intermediate, or low type surface. 67-68

The ratings for this study are equivalent to those used in making a Present Serviceability Rating (PSR), so recent PSR and Present Serviceability Index (PSI) ratings may be used where available. Also, if current sufficiency ratings of pavement condition (but excluding geometrics) are available, a correlation between the sufficiency rating scale and the PSR scale or rating factors for this study may be developed so that such existing ratings may be utilized. If there are no recent PSR, PSI, or sufficiency ratings that can be adopted for this study, the section should be rated as follows:

PSR Range	Verbal Rating	Description
5 – 4	Very good	Only new (or nearly new) pavements are likely to be smooth enough and sufficiently free of cracks and patches to qualify for this category. All pavements constructed or resurfaced during 1969 should be rated very good.
4 – 3	Good	Pavements in this category, although not quite as smooth as those described above, give a first-class ride and exhibit few, if any visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracks and spalling.
3 – 2	Fair	The riding qualities of pavements in this category are noticably inferior to those of new pavements, and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and more or less extensive patching. Rigid pavements in this group may have a few joint failures, faulting and cracking, and some pumping.
2 – 0	Intolerable	These pavements, corresponding to the PSR poor and very poor categories, have deteriorated to such an extent that they are in need of resurfacing.

Columns

Item 32- Shoulder type. Enter the code as shown below, for the predominant type of shoulder on the section. 69

Code	Shoulder type
1	Surfaced - A bituminous surface course on a granular or stabilized base.
2	Stabilized - Gravel or other granular material, with or without admixture, capable of supporting most loads even in wet weather.
3	Earth - Natural earth, with or without turf.

Item 33- Drainage adequacy. Enter the code, as shown below, for drainage adequacy of the section. Adequacy is based on a height of grade line, a design of cross section, and condition and capacity of cross drains sufficient to maintain a well drained surface on a stable subgrade.

Code	Rating
1	Good - Fully adequate drainage and cross section design. No evidence of flooding, erosion, ponding, or other water damage.
2	Fair - Height of grade line, cross section, or culvert capacity somewhat below the standard that would apply if rebuilt. Drainage structures are sound. Some added maintenance effort required due to drainage problems.
3	Poor - Evidence of severe flooding, ponding, erosion, or other drainage problems. Drainage structures may be in poor condition. Considerable excess maintenance effort required due to drainage problems.

CARD NUMBER - Precoded 1 80

Card Number 2

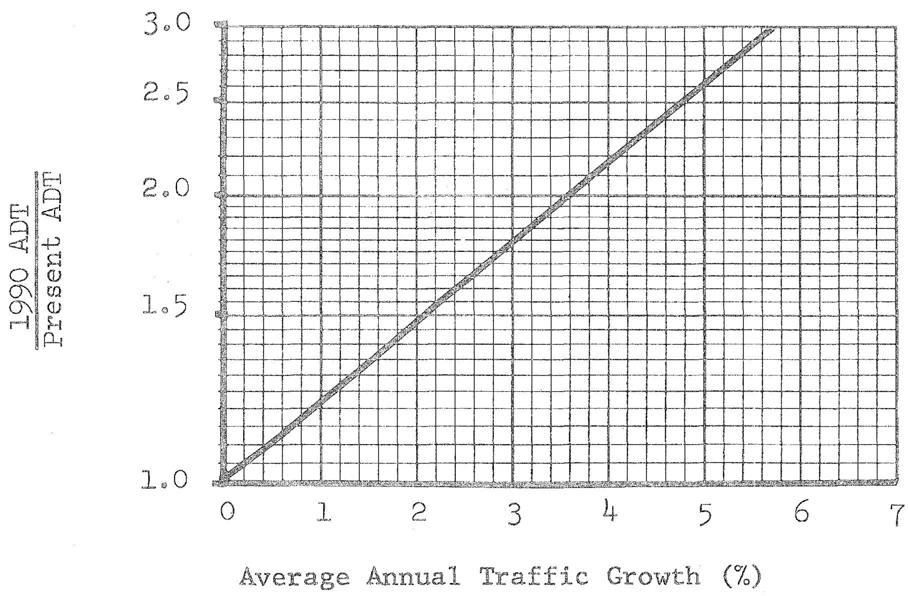
Columns

IDENTIFICATION - See Instructions for Card No. 1 — 1-14

ANALYSIS OF DEFICIENCIES

Item 34- 1990 ADT. Enter the forecast 1990 average daily traffic for the section. See appendix D for instructions for developing traffic forecasts — 15-20

Item 35- Average annual traffic growth. Record on the worksheet the average yearly traffic growth (to the nearest 0.5%) forecast for the section. If this value is not known, it can be determined using the chart below.



Columns

Item 36 - Percent of length with tolerable safe speed (1990). Enter that percent of the section length which, in 1990, without any improvements, will have a safe speed below that needed for tolerable conditions. This value should differ from that in Item 16 whenever the 1990 ADT causes a shift in ADT ranges shown in table III-4; thus, necessitating a change in minimum tolerable conditions. 21-22

Item 37 - Time of pavement condition deficiency. Enter the code (as shown on the worksheet) for the time period the pavement condition is expected to become deficient. Instructions for estimating remaining pavement life are described in appendix H. 24

Item 38 - Deficiencies. This item provides a check list of the time period when each of the elements lisited below may be expected to become deficient. While Item 38 is not coded for keypunch, the indicated codes applying to each element are used in completing Items 39-41.

Code	Deficiency type
1	Operating speed - Indicate by a check mark in the appropriate box the time period (now, 1-5 years, 6-10 years, 11-15 years, 16-20 years, or after the 20 year study period) in which the operating speed falls below the tolerable level indicated in the Minimum Tolerable Conditions. The analysis for those sections within the developed area of small towns may be based on capacity or v/c ratio as described for urban sections rather than operating speed.

Columns

Code	Deficiency type	
2	Lane or roadway width - Indicate by a check mark in the appropriate box the time period in which the lane width (or roadway width for collectors with less than 100 ADT) falls below the tolerable width specified in the Minimum Tolerable Conditions.	
3	Safe speed - Indicate by a check mark in the appropriate box the time period in which the alignment (curvature, gradient, or stopping sight distance) causes the safe speed to fall below the tolerable level indicated in the Minimum Tolerable Conditions.	
4	Pavement type and/or condition - Indicate by a check mark in the appropriate box the time period in which the pavement type and/or condition fall below the tolerable levels specified in the Minimum Tolerable Conditions. See Item 37 for the estimated remaining pavement life for paved sections.	
5	Shoulders - Indicate by a check mark in the appropriate box the time period in which the shoulders are expected to become intolerable, considering both the type of surface and the width.	
6	None - None of the above items fall below the tolerable level during the twenty-year study period.	

Item 39- Initial Deficiency Code. Using the list of codes shown for Item 38, enter the code for the first deficiency occurring (based first on the time period, and second, if more than one deficiency occurs in the first period, on the order listed in Item 38 above) Enter '6' if the section will remain tolerable during the 20-year study period. 25

Columns

Item 40- Secondary Deficiency Code. Using the list of codes shown for Item 38, enter the code for any secondary deficiency which, together with the initial deficiency, determines the type of improvement proposed on the section. (Figures III-1 thru 3 are guides for determining needed improvements based on identified deficiencies. The improvement proposed is often based on more than one identified deficiency.) Enter '6' if there is no secondary deficiency. 26

Item 41- Period section becomes deficient. Enter the code for the time period, as shown on the worksheet, in which the initial deficiency occurs. 27

DESCRIPTION OF IMPROVEMENT

Item 42- Year of improvement. Enter the year (last two digits only) in which an improvement is proposed on the section. See page III-15 for a discussion of time phasing improvements for this study. 28-29

Item 43- ADT (first year after improvement). Enter the average daily traffic forecast for the section (arterials only) during the year after completion of an improvement. See appendix D for recommended traffic forecasting procedure. Enter 'XXXXXX' for all collectors. 30-35

Item 44- Type of improvement. Enter the appropriate code (as shown on the worksheet) for the type of improvement proposed on the section. A discussion of what is included in each improvement type is on page III-14 . A procedure for determining the kind of improvement needed on a section is discussed on page III-13 . Enter '0' if no improvement is needed during the 20-year study period. 36

Columns

Item 45- Design year ADT. Enter the average daily traffic forecast for the section during the twentieth year after the year of improvement. See appendix D for a recommended traffic forecasting procedure. 37-42

Item 46- Design standard number. Enter the appropriate design standard number, as shown on the Design Standards for Rural Arterials and Collectors (table III-7) where the improvement involves new location, reconstruction, or isolated reconstruction. The design standard to be used is dependent upon the functional classification, terrain, and average daily traffic on the section. Enter '00' where other types of improvement are proposed. Enter 'XX' where no improvement is proposed during the study period. 43-44

Item 47- Access control. Enter the appropriate code for the type of access control, as defined for Item 11 of the worksheet, that is proposed on the section. See pages III- 30 for a discussion of the access control criteria to be used in this study. 45

Item 48- Number of lanes. Enter the number of lanes on the improvement proposed for this section. Tables III-10-13, containing design capacities as used in the AASHO "Blue Book", have been included for use in determining the number of lanes needed on any improvement. Corresponding values obtained through a more detailed analysis may be used where available. Enter 'XX' where no improvement is proposed. 46-47

RAILROAD CROSSINGS

Items 49-53 below are provided to record the type of crossing protection existing today and the type of protection needed in 1990, considering the criteria in table III-15 on page III-39. (The left hand series of boxes apply to the present and the right hand series of boxes apply to 1990.) For new facilities

Columns

identified in the functional classification study, enter '0' for the present. Multiple tracks should be considered as one crossing.

Item 49-	<u>No protective devices</u>. Enter the number of existing crossings with no protective devices.	48
Item 50-	<u>Cross bucks</u>.	
	a. Enter the number of crossings presently protected by reflectorized signs and cross bucks.	49
	b. Enter the number of crossings to be protected by reflectorized signs and cross bucks in 1990.	50
Item 51-	<u>Flashing lights</u>.	
	a. Enter the number of crossings presently protected by flashing lights.	51
	b. Enter the number of crossings to be protected by flashing lights in 1990.	52
Item 52-	<u>Flashing lights and gates</u>.	
	a. Enter the number of crossings presently protected by flashing lights and gates.	53
	b. Enter the number of crossings to be protected by flashing lights and gates in 1990.	54
Item 53-	<u>Grade separations</u>.	
	a. Enter the number of crossings presently protected by grade separations.	55
	b. Enter the number of crossings to be protected by grade separations in 1990.	56

STRUCTURES

Item 54-	<u>Number of structures</u> - <u>present</u>. Enter the number of existing bridges located within the section. A bridge is a structure erected over a depression or an obstruction, as water, highway, or railway, and having a passageway for carrying traffic or other moving loads and having a length measured along the center of the overcrossing of more than 20 feet. For new facilities, enter '00'.	57-58

Columns

Types of deficiencies (existing structures)

Items 55-58 are provided to report the number of structures that are deficient in width, vertical clearance, safe loading, or for other reasons. If a structure is deficient in more than one category it should only be reported once (according to the order shown). A discussion of the analysis of structure deficiencies and the minimum tolerable criteria for structures is included in section III. Enter '00' for those new roadway sections identified in the classification study.

Item 55- Width. Enter the number of existing structures on which the width is presently deficient or will become deficient by 1990. 59-60

Item 56- Vertical clearance. Enter the number of existing structures on which the vertical clearance is deficient. 61-62

Item 57- Safe loading. Enter the number of existing structures on which the safe loading is presently deficient or will become deficient by 1990. 63-64

Item 58- Other condition. Enter the number of structures on which the structural condition, navigational clearance, deck geometry, etc., are or will become such that replacement or reconstruction will be necessary. 65-66

Item 59- Number of new structures needed. Enter the number of new structures that will be needed by 1990 for reasons other than replacement of existing structures. This item will primarily be applicable for new facilities and where the proposed roadway improvement involves relocation. 67-68

Columns

Item 60- Time of structure needs. Enter the code, as shown on the worksheet, for the time period in which the structure needs occur. (It will be assumed that all structure improvements will be made during one time period.) The same basic approach used for determining the time of roadway deficiency should be used for analysis of structures (projecting traffic by 5-year periods and comparing existing conditions with minimum tolerable conditions). In addition, bridge widening or reconstruction may be required to meet design standards at the time roadway improvements are proposed. — 69

CARD NUMBER - Precoded 2 — 80

Card Number 3

IDENTIFICATION - See Instructions for Card No. 1 — 1-14

COSTS

Enter the costs, in thousands of dollars, for each of Items 61-68 listed below. Instructions for developing per mile (per square foot for structures) construction costs are discussed on pages III-18-21. The roadway costs to be entered below are the products of the per mile construction costs (from the cost table for the cost area, design standard number, and improvement type) and the section length.

Item 61- Right-of-way costs. (in thousands of dollars) — 15-20

Item 62- Grading and drainage costs. (in thousands of dollars) — 21-26

		Columns
Item 63-	Surface and base costs. (in thousands of dollars)	27-30
Item 64-	Other costs. (in thousands of dollars)	31-34
Item 65-	Structures costs. (including railroad grade separations) (in thousands of dollars)	35-40
Item 66-	Maintenance costs. Enter the total maintenance costs, in thousands of dollars, for this section during the study period. Instructions for developing per-mile maintenance costs are discussed in section VII. This total maintenance cost should include the cost of maintaining the existing section through the year of improvement and the improved section afterward (up to 1990). Leave blank for Interstate.	41-44
Item 67-	Administration costs. Enter the total administration costs, in thousands of dollars, for this section during the study period. Instructions for developing percentage factors for administration costs are discussed in section VII. Leave blank for Interstate.	45-48
Item 68-	Total costs. (Summation of items 61-67.)	49-54
Item 69-	Cost area. Enter the number of the cost area (as discussed in sections II and III) this section is in.	55-56
Item 70-	Expansion factor. Enter the expansion factor (total system miles divided by sample miles) for the functional system and the cost area in which this section lies. Total system miles refers to the final 1990 functional classification mileage. Instructions for computing the expansion factor are given on page III-9. This factor should be 01.00 for all Interstate.	57-60
CARD NUMBER - Precoded 3		80

SECTION V

INSTRUCTIONS FOR COMPLETING THE URBAN ARTERIAL AND COLLECTOR WORKSHEET

GENERAL INSTRUCTIONS

This section contains detailed instructions for completing and coding the urban worksheet (figure V-1). The information contained on the worksheet is to be used, together with the improvement analysis guides in section III, to determine, for each needs section, the type of deficiency, the time period in which the deficiency is expected to occur, and the type of improvement needed.

In order to facilitate compilation of the total nationwide needs and benefits for the 1972 Report to Congress by the Washington office of the Bureau of Public Roads, much of the information recorded on the worksheets must be coded and placed on data cards in a consistent format. The three data cards described below must be completed for each needs section or subsection included in the sample to accomplish this objective.

1. Card No. 4 - Existing conditions (1970)
2. Card No. 5 - Analysis of deficiencies
3. Card No. 6 - Costs of improvements

Instructions for converting the card images to a uniform tape format for submittal are included in section VIII.

Items 1-6 on the worksheet must be recorded in columns 1-17 of all three cards. All entries should be right justified and leading zeros coded where necessary. Items 26, 40, and 42 are not needed for the benefits analysis and should not be coded.

Space has been provided at the bottom of the form for recording any remarks by the inventory crew that might assist in analysis of deficiencies, selection of improvement type, and in determining costs of improvement.

New Sections

For new sections identified in the 1990 functional classification phase of the study (as opposed to new sections identified during needs evaluation), many of the entries for existing conditions will not be applicable. However, a worksheet should be initiated for all of these new sections included in the sample for needs evaluation. The following items need not be completed for these new sections: 13-26, 28, 32-38, 40-45, and 59-63.

Where the analysis of deficiencies on an existing section indicates that an improvement should be made on new location, the worksheet containing the existing condition data should also include the information on the proposed new location. Thus, only one worksheet (per section) will be required where relocations are necessary.

Sections in the Urban Fringe

It is recognized that certain urban sections will be in the area between the present urban boundary and the future (1990) urban boundary and that some presently have characteristics of rural roads rather than urban streets. In evaluating their present tolerability, an approximation of the time when the area will become urban-in-fact must be considered. While the urban worksheet should be used for these facilities, it may be appropriate, especially for the early years of the evaluation period, to compare existing conditions with an appropriate rural minimum tolerable condition. While some items on the urban worksheet might be inappropriate, it is believed that Item number 42, for deficiency analysis, provides for the necessary flexibility.

FIGURE V–1

URBAN ARTERIAL AND COLLECTOR WORKSHEET

BOB No. 04 S69053

CARD 4

IDENTIFICATION

	Columns
1. State	1-2
2. Urbanized or Small Urban Area ____	3-5

Code	Population	Code	Population
997	5,000- 9,999	999	25,000-49,999
998	10,000-24,999	*	50,000+

*Use Urbanized Area Code (See Appendix A)

	Columns
3. County ____	6-8
4. Route Number	9-12
5. Route Section	13-15
6. Subsection Number	16-17
7. Length (0.1 mile)	18-20
8. 1968 Functional Classification	21-22
9. 1990 Functional Classification	23-24

Pop. 5-10	10-25	25-50	50-	Functional System
11	21	31	41	Interstate
12	22	32	42	Other Freeway & Expressway
13	23	33	43	Other Principal Arterial
14	24	34	44	Minor Arterial
15	25	35	45	Collector
16	26	36	46	Local ('68 Only)
AA	BB	CC	DD	Did Not Exist ('68 Only)

(Code ('68 and '90))

	Columns
10. Federal-aid System 1 FAP, Including Interstate, 2 FAS, 3 Non-FA, 4 New	25
11. Jurisdictional Responsibility 1 State, 2 Federal Domain, 3 Toll, 4 Other Existing, 5 New	26
12. Connecting Link of: 1 Rural Principal Arterial, 2 Rural Minor Arterial, 3 Not a Connecting Link	27

EXISTING CONDITIONS (1970)

GEOMETRICS

	Columns
13. Access Control — Full 1 | Partial 2 | None 3	28
14. Approach (curb-curb) or Lane Width (feet)	29-31
15. Number of Lanes	32-33
16. Shoulder Width (where applicable; feet) Right	34-35
Left	36-37
17. Peak Hour Parking — One Side 1 | Both Sides 2 | None 3	38
18. Peak Hour Operation — 1-Way 1 | 2-Way 2 | 1-Way Rev. 3 | 2-Way Rev. 4	39
19. Percent of Length with Intolerable Safe Speed (where applicable)	40-41
20. Median Width (feet)	42-43
21. Median Type — Curbed 1 | Positive Barrier 2 | Unprotected 3	44
22. Average Highway Speed (Fwys & Expys Only)	45-46
23. Number of Signalized Intersections	47-48
24. Typical Percent Green Time	49-50
25. Type of Signalization 1 Uncoordinated Fixed Time, 2 Traffic Actuated, 3 Progressive	51
26. Estimated Total Available Row Width (feet) ____	
27. Prevailing Type of Area	52

1 CBD-3 Stories or Less
2 CBD-4 Stories or More
3 Fringe
4 Outlying Business District
5 Residential – Apartments and Row Houses
6 Residential – Single Family – 1/2 Acre or Less
7 Residential – Single Family – Over 1/2 Acre
8 Rural

TRAFFIC

	Columns
28. ADT	53-58
29. Percent Trucks	59-60
30. K Factor (DHV/ADT)	61-62
31. Directional Factor	63-64
32. Capacity (Hourly)	65-69
33. Present Operating Speed (Fwys & Expys Only)	70-71

STRUCTURAL

	Columns
34. Surface Type	72

1 High-Flexible — 4 Low
2 High-Rigid — 5 Gravel
3 Intermediate — 6 Graded & Drained

	Columns
35. Pavement Section — 'SN' Known 1 | 'D' Known 2 | Heavy 3 | Medium 4 | Light 5	73
Structural Number (SN) or Slab Thickness (D)	74-75
36. Pavement Condition (PSR or equivalent-0.0)	76-77
37. Shoulder Type — Surfaced 1 | Stabilized 2 | Earth 3	78
38. Drainage and Cross Section Adequacy — Good 1 | Fair 2 | Poor 3	79
CARD NUMBER [4]	80

CARD 5

ANALYSIS OF DEFICIENCIES

	Columns
1-6 Identification (Repeat card 4)	1-17
39. 1990 ADT	18-23
40. Average Annual Traffic Growth ___%	
41. Time of Pavement Condition Deficiency — Now 1 | 1-5 2 | 6-10 3 | 11-15 4 | 16-20 5 | 20+ 6	25
42. Deficiencies:	

	Code	Now	1-5	6-10	11-15	16-20	20+
Operating Speed or V/C Ratio	1						
Lane Width	2						
Safe Speed	3						
Pavement Type and/or Condition	4						
Cross Section & Drainage	5						
None	6						

	Columns
43. Initial Deficiency Code	26
44. Secondary Deficiency Code	27
45. Period Section Becomes Deficient — Now 1 | 1-5 2 | 6-10 3 | 11-15 4 | 16-20 5 | 20+ 6	28

DESCRIPTION OF IMPROVEMENT

	Columns
46. Year of Improvement	29-30
47. ADT First Year After Improvement	31-36
48. Type of Improvement	37

0 No Improvement
1 New Location
2 Reconstruction
3 Isolated Reconstruction
4 Major Widening } Freeways & Expressways
5 Minor Widening }
6 Widening–Other Arterials & Collectors
7 Resurfacing & Shoulder Improvements
8 Resurfacing

	Columns
49. Design Year ADT	38-43
50. Design Standard Number	44-45
51. Access Control — Full 1 | Partial 2 | None 3	46
52. Number of Lanes	47-48
53. Traveled-Way Width (feet)	49-51

RAILROAD CROSSINGS

Number of RR Crossings with: — Present 1990

	Columns
54. No Protective Devices	52
55. Cross Bucks	53-54
56. Flashing Lights	55-56
57. Flashing Lights and Gates	57-58
58. Grade Separation	59-60

STRUCTURES

	Columns
59. Number of Structures (Present)	61-62
Number of Deficiencies (Existing Structures):	
60. Width	63-64
61. Vertical Clearance	65-66
62. Loading	67-68
63. Other	69-70
64. Number of New Structures Needed	71-72
65. Time of Structure Needs — Now 1 | 1-5 2 | 6-10 3 | 11-15 4 | 16-20 5 | 20+ 6	73
CARD NUMBER [5]	80

CARD 6

COST, Thousands

	Columns
1-6 Identification (Repeat card 4)	1-17
66. Right-of-Way	18-23
67. Grading & Drainage	24-29
68. Surface & Base	30-33
69. Other	34-37
70. Structures (incl. RR Grade Sep.)	38-43
71. Maintenance	44-47
72. Administration	48-51
73. Total	52-57
74. Expansion Factor (00.00)	58-61
CARD NUMBER [6]	80

Remarks: ____

377-268 O - 70 - 10

Figure V-1--(Continued)

WORKSHEET FOR CALCULATING AVERAGE HIGHWAY SPEED (AHS)

Route ______________ Section __________ Length _______ mi.

Degree of curvature 1/	Design speed (mph)	Number of curves	Total travel time (min.) (from Table G-1)
28.0 - 43.0	25		
19.5 - 28.0	30		
14.0 - 19.5	35		
11.0 - 14.0	40		
8.5 - 11.0	45		
7.0 - 8.5	50		
5.5 - 7.0	55		
4.75 - 5.5	60		
4.0 - 4.75	65		
	Totals =		
	Tangent travel time =		
	Total travel time =		

Section length __________ mi.

-Total curve length __________ mi. (from Table G-2)

Tangent length __________ mi.

x 0.86 min./mi.

Tangent travel time __________ min.

$$\text{Average Highway Speed} = \frac{\text{Total travel time \_\_\_\_\_\_ min.}}{\text{Section length \_\_\_\_\_\_ mi.}} \times 60 = \text{\_\_\_\_\_\_ mph}$$

Rounded AHS = __________ mph

1/ For maximum superelevation rate of 0.08 ft./ft.

WORKSHEET FOR CALCULATING CAPACITY OF URBAN HIGHWAYS

Capacity of Freeway and Expressway Facilities (Uninterrupted Flow)

$C = 2000\ N\ W\ T_c$

C = Capacity (total in one direction)

N = Number of lanes (in one direction)

W = Adjustment for lane width and lateral clearance (from Table 9.2 in the 1965 *Highway Capacity Manual*)

T_c = Truck factor for overall highway section (from Table 9.3b in the 1965 *Highway Capacity Manual*)

C = 2000 x _______ x _______ x _______ = __________

Capacity of Urban Arterial Streets (Interrupted Flow)

Capacity of urban arterial streets may be determined using Figures 6.5 - 6.10 and Tables 6.4 - 6.6 in 1965 *Highway Capacity Manual* 1/.

C = ________________ x ________ x ________
(Approach vol. per hr. of green) (% green time) (Adjustment for PHF and metro. area size)

x ________________ x ________ x ________
(Approach for location within metro. area) (Adjustment for trucks and busses) (Adjustment for turns (if available))

= ______________. (total in one direction)

1/ Capacity charts developed by Jack E. Leisch may also be used.

WORKSHEET FOR CALCULATING REMAINING PAVEMENT LIFE

18-kip single axle equivalent constant = __________ (from W-4 table of truck weight study)

Critical lane factor = __________% (from appendix H)

Soil support = __________ (flexible pavement only - 1.5 or less, 1.6-5.9, 6.0 or more)

EALA = ________ x ________ x ________ x ________ x 365 = ________
(Present ADT) (% Trucks) (Critical lane factor) (18-kip single-axle equiv. constant)

Remaining life = __________ years (from tables H-1,2,3 or 4 in appendix H)

DETAILED INSTRUCTIONS

CARD NO. 4	Columns
IDENTIFICATION	
Item 1 - State. Enter the State code number as listed in table B-1, appendix B.	1-2
Item 2 - Urbanized area or small urban area code. Record on the worksheet the name of the urbanized area or small urban area in which this section lies. Enter the code number, from table A-1 in appendix A, for an urbanized area or the appropriate population strata code, as shown on the worksheet, for a small urban area.	3-5
Item 3 - County. Enter the county code number as shown in the IBM Reference Manual, Numerial Codes for States, Counties, and Cities. It is recognized that not all States are subdivided into counties. The codes for the geographical areas referred to as counties in the IBM coding manual are to be used for this study.	6-8
Item 4 - Route Number. For Interstate System routes, enter the designated Interstate route number. (See Item 3 for the rural worksheet). Connecting links to rural arterials should carry the same route number (between 2,000 and 4,999) as the rural portion of the same route. Other urban principal arterials should be assigned a route number between 5,000 and 6,999. Urban minor arterials and collector streets included in the sample for needs analysis should be assigned an appropriate route identification number, such as the signed or traffic route number.	9-12

Columns

Item 5 - Route Section. As part of the initial office appraisal, all routes shall be divided into sections, and section numbers (possibly in sequence with the rural portions of rural arterials for connecting links, or beginning with 001) assigned on each route. Using available office information, section breaks should be established as indicated below: 13-15

1. All 1990 urban-in-fact boundaries.
2. All junctions with principal or minor arterial routes.
3. Interchanges or intersections where major changes in traffic volumes occur.
4. Changes in Federal-aid system.
5. Changes in jurisdictional responsibility only where such changes result in going from one to another of the categories shown in Item 10. (That is, a section break need not occur where jurisdiction passes from county to municipality, etc. However, a break should occur where responsibility goes from county to State, State to Federal domain, etc.)
6. Locations where there are changes in the physical characteristics of the roadway. It is not the intent of this requirement that many short sections should be established. On the contrary, such sections should be avoided wherever possible. Minor changes in any of the physical characteristics, especially if they will have little or no effect on the needs analysis, should be ignored when establishing section breaks. Physical characteristics include:

    a. Pavement width
    b. Number of lanes
    c. Pavement type
    d. Shoulder width and/or type
    e. Access control

Item 6 - Subsection Number. This item is included to allow breaks in a section where the field appraisal party finds additional changes in the physical characteristics of the roadway. Where subsection breaks are necessary, a separate worksheet should be used for each section. Subsections should be numbered consecutively beginning with '01'. Where no subsection breaks are required, enter '00' in these columns. 16-17

Item 7 - Length. Enter the section 1/ length, to the nearest 0.1 mile. Where the improvement required is new location and the new length is appreciably different from the existing length, record the new section length. 18-20

Item 8 - 1968 Functional classification. Enter the appropriate code shown on the worksheet. 21-22

Item 9 - 1990 Functional classification. Enter the appropriate code shown on the worksheet for the population grouping and 1990 functional classification of the needs section 1/ being analyzed. 23-24

Item 10- Federal-aid system. Enter the code shown on the worksheet for the existing Federal-aid classification of the study section. 25

Item 11- Jurisdictional responsibility. Enter the code shown on the worksheet indicating the jurisdiction having present responsibility for the existing section or which indicates that the section does not presently exist. 26

Item 12- Connecting link identification. Enter the appropriate code number, shown on the worksheet for each needs study section. 27

1/ All future references to 'section' means section or subsection.

Columns

EXISTING CONDITIONS (1970)

Geometrics

Item 13 - Access control. Enter the code for the type of access control, as defined below, existing on the study section. 28

Code	Type of access control
1	Full access control - Preference has been given to through traffic movement by providing interchanges with selected public roads and by prohibiting crossings at grade or direct private driveway connections.
2	Partial access control - Preference has been given to through traffic movement to a degree that, in addition to interchanges, there may be some crossings at grade with public roads, and direct private driveway connections have been minimized.
3	No access control.

Item 14 - Approach or lane width. Enter the total curb-to-curb approach width (including parking lanes but excluding separate turn lanes 1/) for a typical intersection on urban arterial and collector streets. Enter the lane width for sections of freeways and expressways. All entries should be to the nearest foot. 29-31

Item 15 - Number of lanes. Enter the number of lanes carrying through traffic. 32-33

Item 16 - Shoulder width.

Right shoulder width - Enter the width of the right shoulder, to the nearest foot. Enter '00' where no right shoulder exists. 34-35

1/ If separate turn lanes exist, this should be noted in the "Remarks Section " and considered in the calculation of capacity.

Columns

Left shoulder width - On divided highways, enter the width of the left (median) shoulder, to the nearest foot. Enter '00' where no left shoulder exists and for undivided or 2-lane facilities. 36-37

Item 17 - Peak hour parking. Enter the appropriate code provided on the worksheet reflecting the type of parking, if any, that is allowed or exists on the section. 38

Item 18 - Peak hour operation - Enter the appropriate code as indicated which reflects the type of operation during the peak hour. 39

Code	Operation
1	One-way-All lanes are always in the same direction.
2	Two-way-Traffic in both directions is present at all times.
3	One-way reversible - All lanes are in one direction with the direction reversing from the a.m. to p.m. peak hours.
4	Two-way reversible - One or more, but not all, lanes are reversed from a.m. to p.m. peak hours.

Item 19 - Percent of length with intolerable safe speed. Enter that percent of the section length which has a safe speed below that specified in the minimum tolerable conditions for arterial and collector streets in outlying areas. Advisory speed signs, the design speeds used in computing average highway speed, etc., will be helpful in determining this length. Enter 'XX' for all other sections. 40-41

		Columns
Item 20 -	Median width. Enter the median width (including shoulders, if any), measured between the inside edge of the through roadways, to the nearest foot. Enter '00' for undivided or 2-lane roadways. Enter '99' where the median width is 100 feet or greater.	42-43
Item 21 -	Median type. Enter the appropriate code provided on the worksheet. Enter an 'X' if no median exists.	44
Item 22 -	Average highway speed. Enter the average highway speed, to the nearest 5 mph., for all urban freeways and expressways. The average highway speed is determined by weighting the design speeds of the individual horizontal curves and critical vertical curves in the subsection by the length of each curve. A recommended procedure for calculating average highway speed is included in appendix G. For other arterials and collector streets, enter the posted or legal speed limit.	45-46
Item 23 -	Number of signalized intersections. Enter the number of signalized intersections on the section.	47-48
Item 24 -	Typical percent green time. Enter the value of typical percent green time in effect during peak hours at the signalized intersections in this needs section. Enter 'XX' if no signalized intersections exist.	49-50
Item 25 -	Type of signalization. Enter the appropriate code number as indicated on the worksheet which best describes the signal system on the needs section being analyzed. Enter 'X' if no signalized intersections exist.	51

Columns

Item 26 - Estimated total available right of way width - Record on the worksheet the right-of-way that might feasibly be used to widen or reconstruct this needs section. This width will depend upon land costs and type of land use adjacent to the roadway. This item is needed for determining the type of improvement and is not to be coded.

Item 27 - Prevailing type of area. Enter the appropriate code shown on the worksheet which best reflects present land use in the area adjacent to this needs section. The definitions for CBD, fringe, outlying business district, and residential are discussed in the 1965 Highway Capacity Manual. If an area appears to fit in two of these categories, the code for the higher density of development should be used. 52

Traffic

Item 28 - Present ADT. Enter the estimated present average daily traffic (total both directions). 53-58

Item 29 - Percent trucks. Enter the percentage of commercial vehicles, to the nearest percent. Exclude pickups, panels, and light (2-axle-single tired) trucks. 59-60

Item 30 - "K" factor. Enter the "K" factor (design hour volume (30th highest hour) expressed as a percentage of the average daily traffic) to the nearest whole percent for arterials and those collectors with 1990 ADT of 7000 or greater. Enter 'XX' for collectors with less than 7000 ADT in 1990. 61-62

Columns

Item 31 - Directional distribution factor. Enter the percentage of the design hour traffic flowing in the peak direction, to the nearest 5 percent for all arterials and those collectors with 1990 ADT of 7000 or greater. Enter 'XX' for collectors with 1990 ADT of less than 7000 vpd — 63-64

Item 32 - Capacity. Enter the present hourly capacity (in one direction) for all arterials and those collectors with a 1990 ADT of 7000 or greater. The procedures described in the 1965 Highway Capacity Manual should be used for calculating capacity. For a recommended aid in simplifying the calculation of capacity see "Capacity Analysis Techniques for Design of Signalized Intersections" by Jack E. Leisch, printed as two separate articles in the August 1967 and October 1967 issues of Public Roads and also reprinted as a special issue. For purposes of this study a capacity consistent with Level of Service "E" as defined in the 1965 Highway Capacity Manual should be calculated and entered on the evaluation worksheets. This corresponds to "possible capacity" as used in the AASHO "Blue Book". Thus, when using the Leisch charts, the value obtained directly from the chart must be multiplied by an appropriate factor to get Level of Service E or "possible" capacity. It should be assumed that all feasible traffic engineering measures that do not involve construction have been accomplished, such as removal of parking and optimization of the g/c (green time to cycle length) ratio. Usually urban street capacity is governed by a critical intersection in the needs section under study. Where detailed information is not known, assumptions will necessarily have to be made regarding such items as percent right and left turns in order to calculate capacity by needs section. For collector streets with less than 7,000 ADT, enter 'XXX'. — 65-69

Columns

Item 33 - Present operating speed. Enter the present operating speed for all freeways and expressways to the nearest mile per hour. Instructions for determining present operating speed are included in appendix G. Enter 'XX' for all other arterials and collectors. 70-71

Structural

Item 34 - Surface type. Enter the code for the type of surfacing existing on the section according to the definitions given below. 72

Code	Type of Surface
1	High (Flexible)- Mixed bituminous or bituminous penetration road on a rigid base or on a flexible base with a combined (surface and base) thickness of 7" or more. Also, any bituminous concrete, sheet asphalt, rock asphalt, portland cement concrete, brick, block, or combination type road. (Road Type 1/ G-2, H-2, I, K, L, M).
2	High (Rigid) - Portland cement concrete pavements (Road Type 1/ J).
3	Intermediate - Mixed bituminous or bituminous penetration road on a flexible base with a combined (surface and base) thickness of less than 7". (Road Type 1/ G-1, H-1).
4	Low - Bituminous surface course (less than 1" thick) on a base suitable to carry occasional heavy axle loads. (Road Type 1/ F).
5	Gravel - A graded and drained road with a surface of gravel, crushed stone, slag, shell, etc. Surface may be stabilized. (Road Type 1/ E-2, E-3).

1/ As defined in the Guide for a Road Inventory Manual of Instructions, Bureau of Public Roads, April 1967. (volume 20, appendix 18, of the Highway Planning and Program Manual).

Item 34 (Continued) Columns

6 Graded and Drained - An earth road which has been graded into a defined roadway and having adequate drainage to prevent serious damage by normal surface water. Surface may be stabilized. (Road type 1/ C, D-2).

Item 35 - Pavement section. Enter the code shown on the worksheet to indicate that the structural number ('SN' - for flexible pavements) or the slab thickness ('D' - for rigid pavements) is known or the code for the type of pavement section (heavy, medium, light) where detailed data is not known. To assist in determining the type of pavement section, table V-1 has been prepared, showing the three typical pavement sections on which the estimate of remaining pavement life (Item 41) may be based. This guide includes typical thicknesses of surface, base, and subbase and the minimum combined depth of pavement structure. 73

Structural number (SN) or slab thickness (D). Enter the structural number (to the nearest 0.1) for those sections coded '1' above. Enter the slab thickness (in inches) for those sections coded '2' above. 74-75

Table V-1--Pavement section guides for estimating remaining life

Code	Type of section	Flexible pavement					Rigid pavement
		"SN" range	Surface type & thickness	Base type & thickness	Subbase type & thickness	Combined depth 1/	Range in pavement thickness "D"
3	Heavy	4.6 - 6.0	4" asphaltic concrete	9" crushed stone to PC concrete	4" gravel 2/	> 12"	9.1 - 11.0" (8" if continuously reinforced)
4	Medium	3.1 - 4.5	3" asphaltic concrete	8" gravel to penetration macadam	4" gravel	11-12"	7.1 - 9.0" (6" if continuously reinforced)
5	Light	1.0 - 3.0	Surface treatment to 2" asphaltic concrete	6" gravel or crushed stone	2" gravel or sand	10"	6.0 - 7.0"

1/ To be used as a guide where only the total depth is known or estimated.

2/ Subbase course not necessary under portland cement concrete base.

1/ As defined in the Guide for a Road Inventory Manual of Instructions, Bureau of Public Roads, April 1967 (volume 20, appendix 18, of the Highway Planning and Program Manual).

Columns

Item 36 - Pavement condition. Enter the pavement condition (actual PSR, or equivalent), to the nearest tenth, for all arterials and collectors having a high, intermediate, or low type surface. 76-77

The ratings for this study are equivalent to to those used in making a Present Serviceability Rating (PSR), so recent PSR and Present Serviceability Index (PSI) ratings may be used where available. Also, if current sufficiency ratings of pavement condition (but excluding geometrics) are available, a correlation between the sufficiency rating scale and the PSR scale or rating factors for this study may be developed so that existing ratings may be utilized. If there are no recent PSR, PSI, or sufficiency ratings that can be adopted for this study, the section should be rated as shown on the following page.

PSR Range	Verbal Rating	Description
5		
	Very good	Only new (or nearly new) pavements are likely to be smooth enough and sufficiently free of cracks and patches to qualify for this category. All pavements constructed or resurfaced during 1969 should be rated very good.
4		
	Good	Pavements in this category, although not quite as smooth as those described above, give a first-class ride and exhibit few, if any visible signs of surface deterioration. Flexible pavements may be beginning to show evidence of rutting and fine random cracks. Rigid pavements may be beginning to show evidence of slight surface deterioration, such as minor cracks and spalling.
3		
	Fair	The riding qualities of pavements in this category are noticably inferior to those of new pavements, and may be barely tolerable for high-speed traffic. Surface defects of flexible pavements may include rutting, map cracking, and more or less extensive patching. Rigid pavements in this group may have a few joint failures, faulting and cracking, and some pumping.
2		
1	Intolerable	These pavements, corresponding to the PSR poor and very poor categories, have deteriorated to such an extent that they are in need of resurfacing.
0		

Columns

Item 37 - Shoulder type. Enter the code as shown below, for the predominant type of shoulder on the section. Enter '0' where no shoulder exists. 78

Code	Shoulder type
1	Surfaced - A bituminous surface course on a granular or stabilized base.
2	Stabilized - Gravel or other granular material with or without admixture, capable of supporting most loads even in wet weather.
3	Earth - Natural earth, with or without turf.

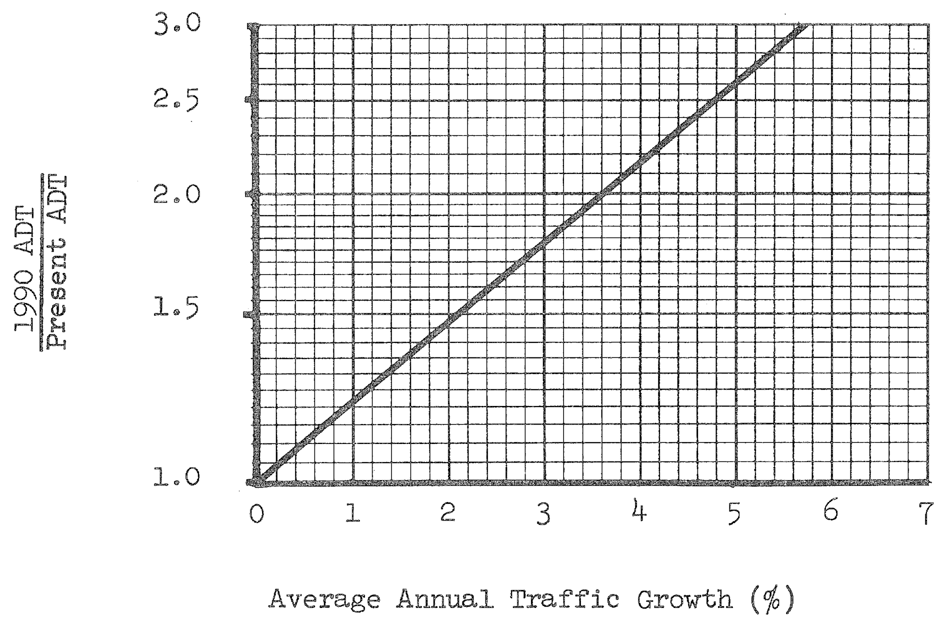
Item 38 - Drainage adequacy. Enter the code, as shown below, for drainage adequacy of the section. Adequacy is based on a height of grade line, design of cross section, and condition and capacity of the drainage system sufficient to maintain a well drained surface on a stable sub-grade. 79

Code	Rating
1	Good - Full adequate drainage and cross section design. No evidence of flooding, erosion, ponding, or other water damage.
2	Fair - Height of grade line, cross section, or drainage system capacity somewhat below the standard that would apply if rebuilt. Drainage structures are sound. Some added maintenance effort required due to drainage problems.
3	Poor - Evidence of severe flooding, ponding, erosion or other drainage problems. Drainage structures may be in poor condition. Excessive maintenance effort required due to drainage problems.

CARD NUMBER - Precoded 4 80

Card Number 5

		Columns
IDENTIFICATION - See Instructions for Card No. 4		1-17
ANALYSIS OF DEFICIENCIES		
Item 39 -	1990 ADT. Enter the forecast 1990 average daily traffic for the section. See appendix D for instructions for developing traffic forecasts.	18-23
Item 40 -	Average annual traffic growth. Record on the worksheet the average yearly traffic growth (to the nearest 0.5%) forecast for the section. If this value is not known, it can be determined using the chart below.	



Columns

Item 41 - <u>Time of pavement condition deficiency</u>. Enter the code (as shown on the worksheet) for the time period the pavement condition is expected to become deficient. Instructions for estimating remaining pavement life are discussed in appendix H. 25

Item 42 - <u>Deficiencies</u>. This item provides a check list of the time period when each of the elements listed below may be expected to become deficient. While Item 42 is not coded for keypunch, the indicated codes applying to each element are used in completing Items 43-45.

Code	Deficiency type
1	<u>Operating speed or V/C ratio</u> - Indicate by a check mark in the appropriate box the time period (now, 1-5 years, 6-10 years, 11-15 years, 16-20 years, or after the 20 year study period) in which the operating speed falls below the tolerable level or that the volume-capacity ratio exceeds the value indicated in the Minimum Tolerable Conditions.
2	<u>Lane width</u>. Indicate by a check mark in the appropriate box the time period in which the lane width falls below the tolerable width specified in the Minimum Tolerable Conditions.
3	<u>Safe speed</u> - Indicate by a check mark in the appropriate box the time period in which the alignment (curvature, gradient, or stopping sight distance) causes the safe speed to fall below the tolerable level indicated in the Minimum Tolerable Conditions.

377-268 O - 70 - 11

Columns

4 Pavement type and/or condition - Indicate by a check mark in the appropriate box the time period in which the pavement type and/or condition fall below the tolerable levels specified in the Minimum Tolerable Conditions.

See Item 41 for the estimated remaining pavement life for paved sections.

5 Cross section and drainage - Indicate by a check mark in the appropriate box the time period in which the cross section and drainage are expected to become intolerable, considering both the type of adjacent area and the functional classification of the section.

6 None - None of the above items fall below the tolerable level during the twenty-year study period.

Item 43 - Initial deficiency code. Using the list of codes shown for Item 42, enter the code for the first deficiency occurring (based first on the time period, and second, if more than one deficiency occurs in the first period, on the order listed in Item 42 above). Enter '6' if the section will remain tolerable during the 20-year study period. 26

Item 44 - Secondary deficiency code. Using the list of codes shown for Item 42, enter the code for any secondary deficiency which, together with the initial deficiency, determines the type of improvement proposed on the section. (Figures III-4-5 are guides for determining needed improvements based on identified deficiencies. The improvement proposed is often based on more than one identified deficiency.) Enter '6' if there is no secondary deficiency. 27

Item 45 - Period section becomes deficient. Enter the code for the time period, as shown on the worksheet, in which the initial deficiency occurs. 28

Columns

DESCRIPTION OF IMPROVEMENT

Item 46 - Year of improvement. Enter the year (last two digits only) in which an improvement is proposed on the section. See page III-15 for a discussion of time phasing improvements for this study. 29-30

Item 47 - ADT (first year after improvement). Enter the average daily traffic forecast for the section (arterials only) during the year after completion of an improvement. See appendix D for recommended traffic forecasting procedure. 31-36

Item 48 - Type of improvement. Enter the appropriate code (as shown on the worksheet) for the type of improvement proposed on the section. A discussion of what is included in each improvement type is on page III-14 . A procedure for determining the kind of improvement needed on a section is discussed on page III-13 . Enter '0' if no improvement is needed during the 20-year study period. 37

Item 49 - Design year ADT. Enter the average daily traffic forecast for the section during the twentieth year after the year of improvement. See appendix D for a recommended traffic forecasting procedure. 38-43

Item 50 - Design standard number. Enter the appropriate design standard number, as shown on the Design Standards for Urban Arterials and Collectors (tables III-8 and 9) where the improvement involves new location reconstruction, or isolated reconstruction. The design standard to be used is dependent upon the functional classification, type of area, and average daily traffic on the section. Enter '00' where other types of improvement are proposed. Enter 'XX' where no improvement is proposed during the study period. 44-45

		Columns
Item 51 -	Access control. Enter the appropriate code for the type of access control, as defined for Item 13 of the worksheet, that is proposed on the section. See pages III-32 and 33 for a discussion of the access control criteria to be used in this study.	46
Item 52 -	Number of lanes. Enter the number of lanes on the improvement proposed for this section. Tables III-10-13, containing design capacities as used in the AASHO "Blue Book", have been included for use in determining the number of lanes needed on any improvement. Corresponding values obtained through a more detailed analysis may be used where available. Enter 'XX' where no improvement is proposed.	47-48
Item 53 -	Traveled way width. Enter the width of roadway carrying through traffic, only if the design does not meet the applicable design standard because of restrictive local conditions. Enter 'XXX' if the traveled way width of the proposed improvement conforms to the applicable design standard.	49-51

RAILROAD CROSSINGS

Items 54-58 below are provided to record the type of crossing protection existing today and the type of protection needed in 1990, considering the criteria in table III-15 on page III- 39. (The left hand series of boxes apply to the present and the right hand series of boxes apply to 1990.) For new facilities identified in the functional classification study, enter '0' for the present. Multiple tracks should be considered as one crossing.

		Columns
Item 54 -	No protective devices. Enter the number of existing crossings with no protective devices.	52
Item 55 -	Cross bucks.	
	a. Enter the number of crossings presently protected by reflectorized signs and and cross bucks.	53
	b. Enter the number of crossings to be protected by cross bucks in 1990.	54
Item 56 -	Flashing lights.	
	a. Enter the number of crossings presently protected by flashing lights.	55
	b. Enter the number of crossings to be protected by flashing lights in 1990.	56
Item 57 -	Flashing lights and gates.	
	a. Enter the number of crossings presently protected by flashing lights and gates.	57
	b. Enter the number of crossings to be protected by flashing lights and gates in 1990.	58
Item 58 -	Grade separations.	
	a. Enter the number of crossings presently protected by grade separations.	59
	b. Enter the number of crossings to be protected by grade separations in 1990.	60

STRUCTURES

Item 59 -	Number of structures - present. Enter the number of existing bridges located within the section. A bridge is a structure erected over a depression or an obstruction, as water, highway, or railway, and having a passageway for carrying traffic or other moving loads and having a length measured along the center of the overcrossing of more than 20 feet. For new facilities, enter '00'.	61-62

Types of deficiencies (existing structures) Columns

Items 60-63 are provided to report the number of structures that are deficient in width, vertical clearance, safe loading, or for other reasons. If a structure is deficient in more than one category, it should only be reported once (according to the order shown). A discussion of the analysis of structure deficiencies and the minimum tolerable criteria for structures are included in section III. Enter '00' for those new roadway sections identified in the classification study.

Item 60 - Width. Enter the number of existing structures on which the width is presently deficient or will become deficient by 1990. 63-64

Item 61 - Vertical clearance. Enter the number of existing structures on which the vertical clearance is deficient. 65-66

Item 62 - Safe loading. Enter the number of existing structures on which the safe loading is presently deficient or will become deficient by 1990. 67-68

Item 63 - Other condition. Enter the number of structures on which the structural condition, navigational clearances, deck geometry, etc., are or will become such that replacement or reconstruction will be necessary. 69-70

Item 64 - Number of new structures needed. Enter the number of new structures that will be needed by 1990 for reasons other than replacement of existing structures. This item will primarily be applicable for new facilities and where the proposed roadway improvement involves relocation. 71-72

Columns

Item 65 - Time of structure needs. Enter the code, as shown on the worksheet, for the time period in which the structure needs occur. (It will be assumed that all structure improvements will be made during one time period.) The same basic approach used for determining the time of roadway deficiency should be used for analysis of structures (projecting traffic by 5-year periods and comparing existing conditions with minimum tolerable conditions). In addition, bridge widening or reconstruction may be required to meet design standards at the time roadway improvements are proposed. 73

CARD NUMBER - Precoded 5 80

Card Number 6

IDENTIFICATION - See Instructions for Card No. 4 1-17

COSTS

Enter the costs, in thousands of dollars, for each of items 66-73 listed below. Instructions for developing per-mile (per square foot for structures) construction cost are discussed on pages III-18-21. The roadway costs to be entered below are the products of the per-mile construction costs (from the cost table for the urban area group, design standard number, and improvement type) and the section length.

Item 66 - Right-of-way costs. (In thousands of dollars). 18-23

Item 67 - Grading and drainage costs. (In thousands of dollars) 24-29

Item 68 - Surface and base costs. (In thousands of dollars). 30-33

Item 69 - Other costs. (In thousands of dollars). 34-37

Item 70 - Structure costs. (Including railroad grade separations) (In thousands of dollars). 38-43

Item 71 - Maintenance costs. Enter the total maintenance costs, in thousands of dollars, for this section during the study period. Instructions for developing per-mile maintenance costs are discussed in section VII. This total maintenance cost should include the cost of maintaining the existing section through the year of improvement and the improved section afterward (up to 1990). Leave blank for Interstate. 44-47

Item 72 - Administration costs. Enter the total administration costs, in thousands of dollars, for this section during the study period. Instructions for developing percentage factors for administration costs are discussed in section VII. Leave blank for Interstate. 48-51

Item 73 - Total costs. (Summation of items 66-72) 52-57

Item 74 - Expansion factor. Enter the expansion factor (total system miles divided by sample miles) for the functional system and the urban area group in which this section lies. Total system miles refers to the final 1990 functional classification mileage. Instructions for computing the expansion factor are given on page III- 9 . This factor should be 01.00 for all Interstate. 58-61

CARD NUMBER - Precoded 6 80

SECTION VI

MASS ANALYSIS PROCEDURES FOR LOCAL ROADS AND STREETS

INTRODUCTION

Procedures defined in this manual for appraising needs on local roads and streets have been developed in recognition of the rather unique character of these facilities. In comparison with other functional classes of highway, local systems are characterized by a very large mileage (roughly 70 percent of all mileage) of relatively low cost facilities. They provide a relatively uniform kind of service, with travel and service demand remaining relatively stable over time. Consideration of these characteristics leads to the approach of estimating needs on local facilities by the average annual cost concept.

The average annual cost concept considers local road and street needs as a continuing replacement process. It uses statistical data developed from road life and investment studies to arrive at average service lives for major cost components, e.g., grading and drainage, surface and base, and structures. These data can be translated into average annual costs of (a) reconstructing deficient (or constructing new) facilities and retaining them in service, and (b) retaining in service facilities which are presently adequate.

Factors for determining the annual cost to reconstruct and retain deficient facilities, to retain adequate facilities, or to retain the investment in new facilities are furnished herein. They are to be applied to the initial improvement cost per mile for each design type, as estimated by the State. The other major inputs to the appraisal will include (a) the stratification of total mileage by design type, and (b) a sample field appraisal to determine the proportion of existing mileage that is now deficient. Specific details are contained in the balance of this section.

DETAILED PROCEDURE

The mass analysis procedure for local roads and streets is divided into the following five major steps:

1. Stratification of total mileage by features influencing the design.

2. Appraisal of a sample of existing mileage to determine adequacy.

3. Development of per mile costs for the various designs.

4. Determining average annual cost per mile for the various designs.

5. Determining total average annual cost.

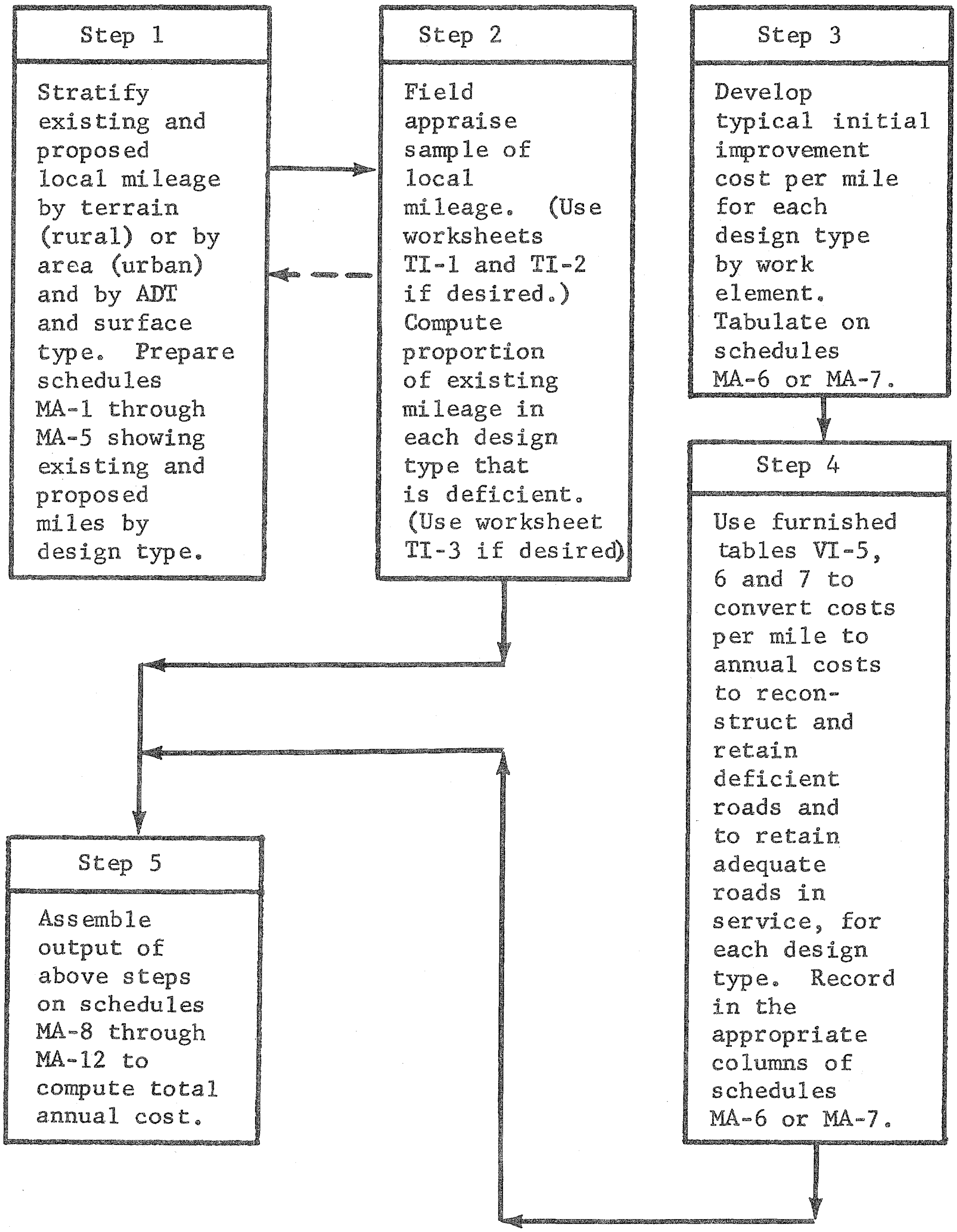
Each of these steps is outlined in detail below. Their interrelationships are shown in flow chart form in figure VI-1, page VI-3 .

Step 1: Stratifying Total Mileage

The first step in the local road and street analysis is to stratify the total existing and proposed mileage to facilitate costing by appropriate design standards. For both rural and urban facilities, stratification will be on the basis of current ADT, surface type and/or type of development. The mileage groupings so obtained should be recorded in schedules MA-1 through MA-5 shown on pages VI-4 to VI-8 . Specific descriptions of the groupings to be used for current ADT, surface type, and type of development are shown on these schedules. Space is also provided on these forms for recording the mileage of local roads and streets not now existing.

FIGURE VI-1

FLOW CHART OF MASS ANALYSIS PROCESS



SCHEDULE MA-1

Miles of Rural Local Roads

State ______________________ Cost Area ______________________

Prevailing Terrain Flat ☐ Rolling ☐ Mountainous ☐

Existing Road Mileage

BOB No. 04-S69053

Existing Surface Type 1/	Code	Type of Development: Rural by Current ADT Range, Under 50	Rural by Current ADT Range, 50-250	Rural by Current ADT Range, Over 250	Dense 2/	Total
		Dsgn.Std.	Dsgn. Std.	Dsgn. Std.	Dsgn. Std. 42	
High	1					
Inter.	2					
Low	3					
Gravel	4					
Graded and drained	5					
Total						

Proposed Road Mileage 3/

Existing and Proposed Road Mileage

Total					

1/ See table III-14 for surface type definitions.

2/ Mileage in this subcategory will include all local roads and streets through areas of urban type development which are outside of urban areas defined for this study (i.e., in areas of less than 5,000 population in 1990).

3/ Needed new local roads (included in 1990 functional classification). Mileage should be grouped by type of development and anticipated ADT, in accordance with the column headings in the upper portion of the schedule.

SCHEDULE MA-2

Miles of Urban Local Streets

Small urban areas - 5,000 to 9,999 population

State ____________________

BOB No. 04-S69053

Existing Street Mileage

Existing Surface Type 1/	Code	Industrial or commercial		Residential streets			Total
		6000 ADT or more	Under 6000 ADT	Low 2/ density	Medium 3/ density	High 4/ density	
		Dsgn. Std. 40	Dsgn. Std. 41	Dsgn. Std. 42	Dsgn. Std. 43	Dsgn. Std. 44	
High	1						
Inter.	2						
Low	3						
Gravel or lower	6						
Total							

Proposed Street Mileage 5/

Existing and Proposed Street Mileage

Total						

1/ See table III-14 for surface type definitions.
2/ Low density development - 2 or less dwelling units per acre.
3/ Medium density development - 2.1 to 6.0 dwelling units per acre.
4/ High density development - over 6 dwelling units per acre.
5/ Needed new local streets (included in 1990 functional classification). Mileage should be grouped by area served and anticipated ADT, in accordance with the column headings in the upper portion of the schedule.

SCHEDULE MA-3

Miles of Urban Local Streets

Small urban areas - 10,000 to 24,999 population

State ____________________

Existing Street Mileage

BOB No. 04-S69053

Existing Surface Type 1/	Code	Industrial or commercial		Residential streets			Total
		6000 ADT or more	Under 6000 ADT	Low 2/ density	Medium 3/ density	High 4/ density	
		Dsgn. Std.40	Dsgn. Std.41	Dsgn. Std.42	Dsgn. Std.43	Dsgn. Std.44	
High	1						
Inter.	2						
Low	3						
Gravel or lower	6						
Total							

Proposed Street Mileage 5/

Existing and Proposed Street Mileage

Total						

1/ See table III-14 for surface type definitions.
2/ Low density development - 2 or less dwelling units per acre.
3/ Medium density development - 2.1 to 6.0 dwelling units per acre.
4/ High density development - over 6 dwelling units per acre.
5/ Needed new local streets (included in 1990 functional classification). Mileage should be grouped by area served and anticipated ADT, in accordance with the column headings in the upper portion of the schedule.

SCHEDULE MA-4

Miles of Urban Local Streets

Small urban areas - 25,000 to 49,999 population

State ____________

Existing Street Mileage

BOB No. 04-S69053

Existing Surface Type 1/	Code	Industrial or commerical		Residential streets			Total
		6000 ADT or more	Under 6000 ADT	Low 2/ density	Medium 3/ density	High 4/ density	
		Dsgn. Std 40	Dsgn. Std 41	Dsgn. Std 42	Dsgn. Std 43	Dsgn. Std 44	
High	1						
Inter.	2						
Low	3						
Gravel or lower	6						
Total							

Proposed Street Mileage 5/

Existing and Proposed Street Mileage

Total						

1/ See table III-14 for surface type definitions.
2/ Low density development - 2 or less dwelling units per acre.
3/ Medium density development - 2.1 to 6.0 dwelling units per acre.
4/ High density development - over 6 dwelling units per acre.
5/ Needed new local streets (included in 1990 functional classification). Mileage should be grouped by area served and anticipated ADT, in accordance with the column headings in the upper portion of the schedule.

SCHEDULE MA-5

Miles of Urban Local Streets

Individual Urbanized Areas

State ____________ Urbanized Area ____________

Existing Street Mileage

BOB No. 04-S69053

Existing Surface Type 1/	Code	Industrial or commercial		Residential streets			Total
		6000 ADT or more	Under 6000 ADT	Low 2/ density	Medium 3/ density	High 4/ density	
		Dsgn. Std40	Dsgn. Std41	Dsgn. Std.42	Dsgn. Std.43	Dsgn. Std.44	
High	1						
Inter.	2						
Low	3						
Gravel or lower	6						
Total							

Proposed Street Mileage 5/

Existing and Proposed Street Mileage

Total						

1/ See table III-14 for surface type definitions.
2/ Low density development - 2 or less dwelling units per acre.
3/ Medium density development - 2.1 to 6.0 dwelling units per acre.
4/ High density development - over 6 dwelling units per acre.
5/ Needed new local streets (included in 1990 functional classification). Mileage should be grouped by area served and anticipated ADT, in accordance with the column headings in the upper portion of the schedule.

Subsequent use of the data recorded in schedules MA-1 through MA-5 will require line entries, in subsequent schedules, of the mileage posted in each cell of schedules MA-1 through MA-5. The coded identification of such line entries will be based on the combination of design standard code corresponding to the ADT grouping, terrain and type of development, and the code corresponding to the existing surface type. For schedules MA-1, the appropriate design standard codes from table VI-3, page VI-18, are to be entered at the head of each column, being dependent on the terrain type indicated at the top of the form. Design standard codes for the urban schedules, MA-2 through MA-5, and surface type codes for all schedules, have been indicated on the forms.

A schedule MA-1 should be prepared for each rural costing area, and a schedule MA-5 for each urbanized area. Only a single copy of each of the schedules MA-2 through MA-4, applying to all places in each size group, is necessary. The total mileage shown on these forms must equal the total local road and street mileages reported for the 1990 functional classification in accordance with instructions in section II. Procedural suggestions for stratification of rural and urban mileages are given below.

Rural local roads

Procedures for stratifying rural mileage will depend on the degree of detail available in existing maps and local road inventories. In some cases stratification by surface type may be available directly from road inventory data. County series general highway maps or USGS maps may also be examined to determine location and extent of development in an area to assist in estimating current ADT's where local roads are not included in the State or county traffic counting program. When the mileage of dense or urban type development is being determined, short isolated segments may be ignored. Only communities large enough to have a network of streets need be considered.

377-268 O - 70 - 12

Where detailed local road inventory data are not available, the sample mileage chosen for field appraisal (see section III) may also serve to identify the stratifications needed for schedule MA-1. To the degree possible however, complete inventory data are preferable for this purpose.

Small urban and urbanized areas

Categories for stratification of local street mileage are as shown on schedules MA-2, 3, 4, and 5. For small urban areas, it is recommended that the proportion of mileage in each stratification be determined from a sample of whole urban areas. An initial sample of three places, for each population group is recommended. The sample may then be enlarged if a reasonable degree of consistency is not apparent in the proportion of mileage in the various strata.

Using the 1990 map for the sampled urban area, delineate those portions of the urban area that can reasonably be expected to be industrial and commercial in 1990. 1/ Within these areas identify the mileage of local streets which would have a design ADT of 6000 or more and the mileage with a design ADT of less than 6000. There will probably be very few miles, if any, of local streets with an ADT of over 6000, especially in small urban areas.

The remainder of the urban area will be considered residential and must be substratified on the basis of density of development 1/ (low, medium, and high) as defined on schedules MA-2, 3, 4, and 5. This stratification should be for reasonably large areas rather than for developments of only one or two blocks. The local street mileage in each density group can be determined by examining one or more subareas in each group and establishing a mileage-per-square-mile rate. Applying these rates to the total of the subareas in each density group establishes total local street mileage for each of the three stratifications. Some further adjustments will naturally be necessary to assure that the total local street mileage (industrial and commericial plus residential) for the sampled urban area is equal to the total local street mileage as previously classified for that

1/ Local land use planning maps, zoning maps, DHUD 701 study maps or any other readily available information may be used in accomplishing these stratifications.

urban area. The mileage in each category in the sample small urban areas should then be expanded based on the total mileage in the population strata and entered on the appropriate schedule.

A similar procedure is recommended for urbanized areas. However, in selecting the sample of local mileage for field appraisal, (see section III) the selected sample should be checked to assure that it is adequately representative of all ADT and density substratifications.

Step 2: Appraisal of Present Adequacy

When the total local road mileage has been stratified, the next step is the determination of the percentage of mileage in each design type that is presently deficient. This is accomplished on the basis of a field inventory of local road mileage, sampled as specified in section III. Minimum tolerable conditions criteria are given in tables VI-1 (rural) and VI-2 (urban) on pages VI-12 and 13 .

In the field appraisal process, a road or street section should be rated intolerable for pavement condition only when it is considered that the condition cannot be corrected through routine maintenance.

As an aid in field appraisal of local road and street tolerability, field worksheets TI-1 and TI-2, pages VI-14 and 15, are included herein. Use of these worksheets, which require the minimum amount of evaluation data, or of similar forms is recommended. While submittal of these worksheets is not required, they should be retained in the State's files for reference purposes.

The field appraisal data from worksheets TI-1 and TI-2 are to be used to stratify the total existing mileage inventoried in step 1 into tolerable and intolerable groupings. These mileages will be used subsequently in step 5 as inputs to schedules MA-8 through MA-12. As an aid in carrying out this stratification, and in explaining what is involved, recommended worksheet TI-3, page VI-16 , is included herein.

Table VI-1 Minimum tolerable conditions for rural local roads

Element	Rural development			Dense development 1/
	Current ADT			
	Under 25	25-100	Above 100	All ADT
Surface width (ft.)	16	18	18	22 2/
Surface type 3/	Graded & drained	Gravel	Low	Paved
Shoulder width (ft.)	--	--	2	--
Safe driving speed (mph) 4/	20-25	25-30	30-35	--
Pavement condition (PSR or equivalent)	--	--	2.1	2.1
Structures:				
Width (ft.)	16	18	20	--
Loading	H-8	H-10	H-12	--

1/ Urban type development outside of urban areas as defined for this study. This set of tolerable conditions is the same as that for residential streets in Table VI-2.

2/ With curb and gutter, or 18 ft. with 2 foot stabilized shoulders.

3/ See Table III-14 for surface type definitions.

4/ Horizontal and vertical alignment must be such that the average safe driving speeds specified can be attained over the study section.

Table VI-2 -- Minimum tolerable conditions for urban local streets

Type of area	Industrial and commercial	Residential
Surface width (ft.)	28 1/	22 2/
Surface type 3/	Paved	Paved
Pavement condition (PSR or equivalent)	2.1	2.1

1/ With curb and gutter, or 20 ft. with 4 ft. stabilized shoulders where adjacent area is less than 50 percent developed.

2/ With curb and gutter, or 18 ft. with 2 ft. stabilized shoulders.

3/ See Table III-14 for surface type definitions.

BOB No. 04-S69053

WORKSHEET TI-1 RURAL LOCAL ROADS TOLERABILITY INVENTORY

COST AREA ____________ SHEET ________ OF ________

Route Number	Route Section Number or		Length (0.1 Mile)			Current ADT				Surface Width (Feet)		Existing Surf. Type	Shoulder Width (Feet)	Safe Driving Speed		Surface Adequacy	Structures (Over 20' Span)						Status**
																	Total Bridge Length* (Feet)			Bridge Width (Feet)		Loading Adequacy	
	From	To	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

*Enter total bridge length for all bridges within section.

**If bridges are intolerable but roads are tolerable within a section, separate their mileages and use a single line entry, with appropriate status code, for each.

Column 12
Existing Surface Type

High – 1
Intermediate – 2
Low – 3
Gravel – 4
Grade & Drain – 5

Column 16
Surface Adequacy

Adequate – 1
Acceptable – 2
Inadequate – 3

Column 22
Loading Adequacy*

*See Table VI-1 for minimum tolerable conditions

Adequate – 1
Inadequate – 2

Column 23
Status

Tolerable – 1
Intolerable – 2

BOB No. 04-S69053

WORKSHEET TI-2 URBAN LOCAL STREETS-TOLERABILITY INVENTORY

URBAN OR URBANIZED AREA ______________________ SHEET __________ OF __________

Street Name	From (Street)	To (Street)	Length (0.1 Mile)			Type of Area	Surface Width (Feet)		Existing Surf. Type	Surface Adequacy	Status
			4	5	6	7	8	9	10	11	12

Column 7
Type of Area

Industrial or Commercial:
- Design ADT under 6000 – 1
- Design ADT over 6000 – 2

Residential:
- Low Density – 3
- Medium Density – 4
- High Density – 5

Column 10
Existing Surface Type

- High – 1
- Intermediate – 2
- Low – 3
- Gravel or lower – 6

Column 11
Surface Adequacy

- Adequate – 1
- Acceptable – 2
- Inadequate – 3

Column 12
Status

- Tolerable – 1
- Intolerable – 2

BOB No. 04-S69053

Worksheet TI-3. Distribution of existing mileage into presently tolerable and presently intolerable groupings

Mileage group: MA-1 Rural-cost area ________ ☐
MA-2 Small urban-5,000 to 9,999 population ☐
MA-3 Small urban-10,000 to 24,999 population ☐
MA-4 Small urban-25,000 to 49,999 population ☐
MA-5 Urbanized area ____________ ☐

Design Std. No. (1)	Exist. Surf. Type (2)	Total Existing Miles 1/ (3)	Field Inventoried Miles 2/			Percent		Total Existing Miles	
			Tolerable (4)	Intolerable (5)	Total (6)	Tolerable (7)	Intolerable (8)	Tolerable (9)	Intolerable (10)

1/ From schedule MA-1, MA-2, MA-3, MA-4, or MA-5
2/ Summarized from worksheet TI-1 or TI-2

One copy of TI-3 should be made out to correspond with each of the schedules MA-1 through MA-5 that were prepared in step 1. For each cell in the existing mileage portion of the aforementioned schedule, there will be a line entry in worksheet TI-3. Each line entry is identified by a 3-digit code, the first two of which represent the design standard number and the third of which represents the existing surface type code. (This same line item identification is to be used subsequently in schedules MA-8 through MA-12.)

On worksheet TI-3 existing mileage data, from a particular MA-1 through MA-5 schedule, are entered in column 3, with appropriate design standard and surface type identification coded in columns 1 and 2. Field inventoried mileage from worksheet TI-1 or TI-2, stratified by the same design standard and surface type categories, is then entered in columns 4, 5 and 6, these columns representing tolerable, intolerable and total field inventoried mileage, respectively. The field inventoried mileage from columns 4, 5 and 6 are then converted to percent tolerable and intolerable in columns 7 and 8. These percentages are applied to total mileage from column 3 to arrive at total tolerable and intolerable mileage in columns 9 and 10. These last two columns are input to schedules MA-8 through MA-12 in step 5.

Step 3: Developing Construction Costs

The third step is the development of typical initial costs-per-mile for construction for each design standard. Standards are shown in table VI-3 (rural) and table VI-4 (urban) on pages VI-18 and 19. In general the instructions included in section III concerning the preparation of typical per mile costs also pertain to local roads and streets.

Costs are categorized by (1) grading and drainage and (2) surface and base, for both rural and urban. For local rural roads (except dense development) structures over 20 feet in length are also to be included. For urban local streets and for the similar category of rural dense development, structure costs will not be calculated since such structures are so few as to have negligible effect on total costs. Right-of-way cost is not included, since on existing facilities it has a nearly indefinite economic life, and in most cases is furnished by abutting land owners or by land developers.

Table VI-3--Design standards for rural local roads

Rural development										Dense development 1/
Element	Current ADT and terrain type									All ADT
	Under 50			50-250			Above 250			
	F	R	M	F	R	M	F	R	M	
Design standard number	31	32	33	34	35	36	37	38	39	42
Design speed (mph)	40	30	20	40	30	20	50	40	20	2/
Surface width (ft.)	20	20	20	20	20	20	20	20	20	--
Graded shoulder width (ft.)	2			4			4			--
Number of lanes	--			--			--			2
Lane width (ft.)	--			--			--			10
Curb parking lanes	--			--			--			One side-8 feet 3/
Surface type 4/	Gravel			Low			Low			Low (includes parking lane)
Cross section	--			--			--			Curb & gutter or stabilized shoulder
Structures:										
Width (ft.)	24			24	24	24	26	24	24	
Vertical clearance (ft.)	14			14			14			
Loading	H-15			H-15			HS-20			

1/ Urban type development outside of urban areas as defined for this study. This set of design standards is the same as that for low density residential streets in Table VI-4.

2/ Stopping sight distance at least 200 feet in flat terrain and 150 feet in rolling terrain.

3/ The parking area may be provided with a curb and gutter section or with flush stabilized shoulders.

4/ See Table III-14 for surface type definitions.

Table VI-4--Design standards for urban local streets

Type of area	Industrial and commercial		Residential		
Design ADT	6000 and above	Below 6000	--------		
Density of development	------	------	Low 1/	Medium 2/	High 3/
Design standard number	40	41	42	43	44
No. of lanes	4	2	2	2	2
Lane width (ft.)	12	12	10	11	11
Curb parking lanes	Both sides - 10 ft.		One side - 8 ft. 4/	One side - 8 ft.	Both sides 8 ft.
Surface type (incl. parking lanes) 5/	High		Low	Intermediate	
Cross section	Curbs, gutters, and sidewalks		Curb & gutter or stabilized shoulders	Curbs, gutters, and sidewalks	
Maximum gradient	12%		---	---	---
Stopping sight distance	200 ft.		6/		

1/ Low density development - 2 or less dwelling units per acre.
2/ Medium density development - 2.1 to 6.0 dwelling units per acre.
3/ High density development - over 6 dwelling units per acre.
4/ The parking area may be provided with a curb and gutter section or with flush stabilized shoulders.
5/ See Table III-14 for surface type definitions.
6/ Stopping sight distance in residential areas should be at least 200 ft. in flat terrain and 150 ft. in rolling terrain.

Costs are to be recorded in the second, third and fourth columns of schedule MA-6, Per Mile Costs for Rural Local Roads, on page VI-21, and schedule MA-7, Per Mile Costs for Urban Local Streets, on page VI-22. A schedule MA-6 should be prepared for each rural cost area. Costs should be entered only for the design standards applicable to that cost area. (It is assumed that each cost area will have one prevailing type of terrain.) A schedule MA-7 should be prepared for each size group of small urban areas if significant differences exist in typical costs. Similarly, a schedule MA-7 should be prepared for each urbanized area unless several urbanized areas have similar cost experience.

To determine structure costs on rural local roads, the following procedure is recommended. Several rural counties should be selected which have detailed inventories of roads and bridges. Mileage of roads and bridges should be separated and summarized by terrain, surface, and traffic volume and the average structure length per mile determined. Costs will then be determined for structures on a per-mile basis for each design standard. Where such inventories are not available, they should be obtained in conjunction with the sample inventory previously described.

Step 4: Determining Average Annual Costs Per Mile

The fourth step is determination of the average annual costs per mile for each major component for each design standard. Briefly, this involves multiplying the initial per-mile construction costs which were developed in step 3 and posted in schedules MA-6 and MA-7, by the cost factors provided in tables VI-5, VI-6 and VI-7, page VI-23, and posting these values in schedules MA-6 and MA-7.

Studies have indicated that for local roads and streets the investment in grading has an average life of 50 years; high, intermediate, and low type pavements 30, 25, and 20 years, respectively; gravel surfaces 15 years; and structures 50 years. It is emphasized that these data represent the average lives of investment in the individual component and should not be confused with the average life of the physical facilities themselves; there being salvage value in the physical facilities. Table VI-5, has been prepared taking into consideration the average lives of investment of the various components. The average annual cost factors in tables VI-5, VI-6 and

SCHEDULE MA-6

Per-Mile Costs For Rural Local Roads

State____________________ Cost area____________________

BOB No. 04-S69053

Design Standard Number (ck. rural standards applicable to cost area)	Initial Per-Mile Construction Cost			Annual per-mile cost to retain presently tolerable facilities in service			Annual per-mile cost to construct or reconstruct and retain presently deficient facilities in service		
	Grading & drainage	Base and surfacing	Structures	Grading & drainage	Base and surfacing 1/	Structures	Grading & drainage	Base and surfacing	Structures
31-F					H				
32-R					I				
33-M					L				
					G				
					G&D				
34-F					H				
35-R					I				
36-M					L				
					G				
37-F					H				
38-R					I				
39-M					L				
42					H				
					I				
					L				

1/ These letters refer to the existing type of pavement as defined in Table III-14. In determining the annual cost per mile to retain in service enter the line in Table VI-5 which describes the existing and design pavement type and apply this average annual cost per $1000 initial cost to the design standard pavement type. If the existing pavement type is higher than the design standard pavement type, enter Table VI-5 on the line corresponding with the present surface type and the same future surface type. Apply this average annual cost to the initial cost for the existing pavement type. This assumes that once a pavement type is in place the type of surface will not be downgraded.

SCHEDULE MA-7

Per-Mile Costs For Urban Local Streets

State______________ Small urban area group______________ or Urbanized area______________

BOB No. 04-S69053

Design Standard Number	Initial Per-Mile Construction Cost		Annual per-mile cost to retain presently tolerable facilities in service			Annual per-mile cost to construct or re-construct and retain presently deficient facilities in service		Annual per-mile cost to retain new urban facilities in service	
	Grading & drainage	Base & surfacing	Grading & drainage	Base & 1/surfacing		Grading & drainage	Base & surfacing	Grading & drainage	Base & surfacing
40				H					
				I					
				L					
41				H					
				I					
				L					
42				H					
				I					
				L					
43				H					
				I					
				L					
44				H					
				I					
				L					

1/ These letters refer to the existing type of pavement as defined in Table III-14. In determining the annual cost per mile to retain in service enter the line in Table VI-5 which describes the existing and design pavement type and apply this average annual cost per $1000 initial cost to the design standard pavement type. If the existing pavement type is higher than the design standard pavement type, enter Table VI-5 on the line corresponding with the present surface type and the same future surface type. Apply this average annual cost to the initial cost for the existing pavement type. This assumes that once a pavement type is in place the type of surface will not be downgraded.

Table VI-5.--Average annual cost (per $1000 initial cost) to retain presently tolerable facilities (rural or urban) in service over a 20-year period.

Surface Type 1/	Presently graded and drained to be replaced by gravel	$73.30
	Presently gravel to be replaced by gravel	63.60
	Presently gravel to be replaced by low	53.70
	Presently low to be replaced by low	47.70
	Presently low to be replaced by intermediate	45.30
	Presently intermediate to be replaced by intermediate	35.80
	Presently intermediate to be replaced by high	34.80
	Presently high to be replaced by high	29.40
	Grading and drainage	15.30
	Structures	15.30

Table VI-6.--Average annual cost (per $1000 initial cost) to reconstruct and retain presently deficient (rural or urban) facilities or construct new rural facilities, over a 20-year period.

Surface Type 1/	Gravel	$88.40
	Low	70.20
	Intermediate	63.90
	High	60.30
	Grading and drainage	54.40
	Structures	54.40

Table VI-7.--Average annual cost (per $1000 initial cost) to retain new urban facilities in service over a 20-year period.

Surface Type 1/	Low	$27.70
	Intermediate	19.20
	High	14.10
	Grading and drainage	5.70

1/ See Table III-14 for surface type definitions.

VI-7 responsive to three basic situations. Table VI-5 concerns costs to retain in service existing facilities (rural or urban) which are presently tolerable. Table VI-6 concerns costs to reconstruct and retain in service existing facilities (rural or urban) which are presently deficient, or to construct new rural facilities. Table VI-7 concerns costs to retain in service new urban facilities. (In this last category, the initial construction cost is assumed to be borne by the developer.)

These cost factors in tables VI-5, VI-6 and VI-7 are given in terms of cost per mile per $1000 of initial construction cost. The appropriate cost factors are multiplied by the initial cost per mile entries in schedules MA-6 and MA-7. The resulting average annual per mile costs are then entered in the appropriate columns in schedules MA-6 and MA-7.

Step 5: Determining Total Average Annual Costs

The fifth step in the procedure is to bring the mileage data and average annual costs per mile estimates together to develop total annual costs.

These costs are to be developed on schedules MA-8 through MA-12, pages VI-25 through 29. There will be one of schedules MA-8 through MA-12 corresponding to each of schedules MA-1 through MA-5. That is, a schedule MA-8 is to be prepared for each rural cost area, and a schedule MA-12 for each urbanized area. For schedules MA-9 through MA-11, which apply to the three size groups of small urban areas, only a single copy of each schedule, applying to all places in that size group, will be required.

Schedules MA-8 through MA-12 have been developed in data card format to facilitate subsequent data handling. However, these five schedules are the format in which local road and street needs data are to be submitted to Public Roads. Coding instructions are provided on page VI- 31.

BOB No. 04-S99053

SCHEDULE MA-8 TOTAL ANNUAL COST WORKSHEET RURAL LOCAL ROADS

State Code	Location	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A	B	C	D	E	F	G	H	J	K	L	M	N
						Miles	Annual Cost per Mile (From Schedule MA-6)			Annual Costs ($1,000)				Annual Maintenance Cost		Annual Cost of Const. and Maint. ($1,000)	Annual Cost of Admin. ($1,000)	Total Annual Cost ($1,000)
							Grade & Drain	Base & Surface		Grade & Drain	Base & Surface	Structures	Total	Per Mile	Total ($1,000)			
										A X B	A X C	A X D	E + F + G		A X J	H + K	L X __%	L + M
1 2	3	7 8	9	10 11	12	15 16 17 18 19 20				21 22 23 24 25 26 27	29 30 31 32 33 34 35	37 38 39 40 41 42 43	45 46 47 48 49 50 51 52		54 55 56 57 58 59 60 61		62 63 64 65 66 67 68 69	70 71 72 73 74 75 76 77
			Presently Tolerable															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1															
	1		1	0 0	5		Total											
			Presently Intolerable															
	1		2		0													
	1		2		0													
	1		2		0													
	1		2		0													
	1		2	0 0	7		Total											
			New															
	1		3		0													
	1		3		0													
	1		3		0													
	1		3		0													
	1		3	0 0	8		Total											
	1		0	0 0	9		All Roads											

BOB No. 04-S69053

SCHEDULE MA-9 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Small Urban Areas 5,000-9,999

							A	B	C	E	F	H	J	K	L	M	N
State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	Miles	Annual Cost per Mile (From Schedule MA-7) Grade & Drain	Base & Surface	Annual Costs ($1,000) Grade & Drain	Base & Surface	Total	Annual Maintenance Cost Per Mile	Total ($1,000)	Annual Cost of Const. and Maint. ($1,000)	Annual Cost of Admin. ($1,000)	Total Annual Cost ($1,000)
										A × B	A × C	E + F		A × J	H + K	L × __%	L + M
1 2	3	4 5 6	7 8	9	10 11	12	15 16 17 18 19 20			21 22 23 24 25 26 27	29 30 31 32 33 34 35	45 46 47 48 49 50 51 52		54 55 56 57 58 59 60 61		63 64 65 66 67 68 69	70 71 72 73 74 75 76 77
	2	997		Presently Tolerable	40	1											
	2	997		Presently Tolerable	40	2											
	2	997		Presently Tolerable	40	3											
	2	997		Presently Tolerable	41	1											
	2	997		Presently Tolerable	41	2											
	2	997		Presently Tolerable	41	3											
	2	997		Presently Tolerable	42	1											
	2	997		Presently Tolerable	42	2											
	2	997		Presently Tolerable	42	3											
	2	997		Presently Tolerable	43	1											
	2	997		Presently Tolerable	43	2											
	2	997		Presently Tolerable	43	3											
	2	997		Presently Tolerable	44	1											
	2	997		Presently Tolerable	44	2											
	2	997		Presently Tolerable	44	3											
	2	997		Presently Tolerable	00	6		Total									
	2	997		Presently Intolerable	40	0											
	2	997		Presently Intolerable	41	0											
	2	997		Presently Intolerable	42	0											
	2	997		Presently Intolerable	43	0											
	2	997		Presently Intolerable	44	0											
	2	997		Presently Intolerable	00	7		Total									
	2	997		New	40	0											
	2	997		New	41	0											
	2	997		New	42	0											
	2	997		New	43	0											
	2	997		New	44	0											
	2	997		New	00	8		Total									
	2	997			00	9		All Streets									

BOB No. 04-S69053

SCHEDULE MA-10 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Small Urban Areas 10,000-24,999

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A: Miles	B: Annual Cost per Mile (From Schedule MA-7): Grade & Drain	C: Annual Cost per Mile (From Schedule MA-7): Base & Surface	E: Annual Costs ($1,000): Grade & Drain	F: Annual Costs ($1,000): Base & Surface	H: Annual Costs ($1,000): Total	J: Annual Maintenance Cost: Per Mile	K: Annual Maintenance Cost: Total ($1,000)	L: Annual Cost of Const. and Maint. ($1,000)	M: Annual Cost of Admin. ($1,000)	N: Total Annual Cost ($1,000)
										A × B	A × C	E + F		A × J	H + K	L × ___%	L + M
1 2	3	4 5 6	7 8	9	10 11	12	15 16 17 18 19 20			21 22 23 24 25 26 2	29 30 31 32 33 34 35	45 46 47 48 49 50 51 52		54 55 56 57 58 59 60 61		63 64 65 66 67 68 69	70 71 72 73 74 75 76 77
	3	9 9 8		Presently Tolerable	4 0	1											
	3	9 9 8		Presently Tolerable	4 0	2											
	3	9 9 8		Presently Tolerable	4 0	3											
	3	9 9 8		Presently Tolerable	4 1	1											
	3	9 9 8		Presently Tolerable	4 1	2											
	3	9 9 8		Presently Tolerable	4 1	3											
	3	9 9 8		Presently Tolerable	4 2	1											
	3	9 9 8		Presently Tolerable	4 2	2											
	3	9 9 8		Presently Tolerable	4 2	3											
	3	9 9 8		Presently Tolerable	4 3	1											
	3	9 9 8		Presently Tolerable	4 3	2											
	3	9 9 8		Presently Tolerable	4 3	3											
	3	9 9 8		Presently Tolerable	4 4	1											
	3	9 9 8		Presently Tolerable	4 4	2											
	3	9 9 8		Presently Tolerable	4 4	3											
	3	9 9 8		Presently Tolerable	0 0	6		Total									
	3	9 9 8		Presently Intolerable	4 0	0											
	3	9 9 8		Presently Intolerable	4 1	0											
	3	9 9 8		Presently Intolerable	4 2	0											
	3	9 9 8		Presently Intolerable	4 3	0											
	3	9 9 8		Presently Intolerable	4 4	0											
	3	9 9 8		Presently Intolerable	0 0	7		Total									
	3	9 9 8		New	4 0	0											
	3	9 9 8		New	4 1	0											
	3	9 9 8		New	4 2	0											
	3	9 9 8		New	4 3	0											
	3	9 9 8		New	4 4	0											
	3	9 9 8		New	0 0	8		Total									
	3	9 9 8			0 0	9		All Streets									

BOS No. 04-S66053

SCHEDULE MA-11 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Small Urban Areas 25,000-49,999

State Code	Location	Urb. Area Code	Cost Area Code	Status	Design Std. Number	Exist. Surf. Type	A	B	C	E	F	H	J	K	°	M	N
							Miles	Annual Cost per Mile (From Schedule MA-7)		Annual Costs ($1,000)			Annual Maintenance Cost		Annual Cost of Const. and Maint. ($1,000)	Annual Cost of Admin. ($1,000)	Total Annual Cost ($1,000)
								Grade & Drain	Base & Surface	Grade & Drain	Base & Surface	Total	Per Mile	Total ($1,000)			
										A × B	A × C	E + F		A × J	H + K	L × __%	L + M
1 2	3	4 5 6	7 8	9	10 11	12	15 16 17 18 19 20			21 22 23 24 25 26 27	29 30 31 32 33 34 35	45 46 47 48 49 50 51 52		54 55 56 57 58 59 60 61		63 64 65 66 67 68 69	70 71 72 73 74 75 76
	4	9 9 9		Presently Tolerable	4 0	1											
	4	9 9 9			4 0	2											
	4	9 9 9			4 0	3											
	4	9 9 9			4 1	1											
	4	9 9 9			4 1	2											
	4	9 9 9			4 1	3											
	4	9 9 9			4 2	1											
	4	9 9 9			4 2	2											
	4	9 9 9			4 2	3											
	4	9 9 9			4 3	1											
	4	9 9 9			4 3	2											
	4	9 9 9			4 3	3											
	4	9 9 9			4 4	1											
	4	9 9 9			4 4	2											
	4	9 9 9			4 4	3											
	4	9 9 9			0 0	6		Total									
	4	9 9 9		Presently Intolerable	4 0	0											
	4	9 9 9			4 1	0											
	4	9 9 9			4 2	0											
	4	9 9 9			4 3	0											
	4	9 9 9			4 4	0											
	4	9 9 9			0 0	7		Total									
	4	9 9 9		New	4 0	0											
	4	9 9 9			4 1	0											
	4	9 9 9			4 2	0											
	4	9 9 9			4 3	0											
	4	9 9 9			4 4	0											
	4	9 9 9			0 0	8		Total									
	4	9 9 9			0 0	9		All Streets									

BOB No. 04-S69053

SCHEDULE MA-12 TOTAL ANNUAL COST WORKSHEET URBAN LOCAL STREETS

Urbanized Area Name ____________

State Code	Location	Urb. Area Code	Cost Area Code	Status		Design Std. Number	Exist. Surf. Type	A	B	C	E	F	H	J	K	L	M	N
								Miles	Annual Cost per Mile (From Schedule MA-7)		Annual Costs ($1,000)			Annual Maintenance Cost		Annual Cost of Const. and Maint. ($1,000)	Annual Cost of Admin. ($1,000)	Total Annual Cost ($1,000)
									Grade & Drain	Base & Surface	Grade & Drain	Base & Surface	Total	Per Mile	Total ($1,000)			
											A × B	A × C	E + F		A × J	H + K	L × __%	L + M
1 2	3	4 5 6	7 8	9		10 11	12	15 16 17 18 19 20			21 22 23 24 25 26 27	29 30 31 32 33 34 35	45 46 47 48 49 50 51 52		54 55 56 57 58 59 60 61		63 64 65 66 67 68 69	70 71 72 73 74 75 76 77
	5			1	Presently Tolerable	40	1											
	5			1		40	2											
	5			1		40	3											
	5			1		41	1											
	5			1		41	2											
	5			1		41	3											
	5			1		42	1											
	5			1		42	2											
	5			1		42	3											
	5			1		43	1											
	5			1		43	2											
	5			1		43	3											
	5			1		44	1											
	5			1		44	2											
	5			1		44	3											
	5			1		00	6		Total									
	5			2	Presently Intolerable	40	0											
	5			2		41	0											
	5			2		42	0											
	5			2		43	0											
	5			2		44	0											
	5			2		00	7		Total									
	5			3	New	40	0											
	5			3		41	0											
	5			3		42	0											
	5			3		43	0											
	5			3		44	0											
	5			3		00	8		Total									
	5			0		00	9		All Streets									

Each of schedules MA-8 through MA-12 is developed in three sections for tolerable, intolerable and new mileage respectively. Within each of these sections mileage is stratified according to each combination of design standard and surface type. These stratifications can be taken from worksheet TI-3 (see step 2) for existing mileage, both tolerable and intolerable. Data for new mileage can be taken directly from schedules MA-1 through MA-5.

In columns 10-12, enter the appropriate codes for the applicable combination of design standard number and existing surface type.

In filling in the remaining columns on these schedules, the "Annual Cost Per Mile" to be entered in sections B, C, and D is to be taken from the previously discussed schedules MA-6 and MA-7. After the annual costs per mile are entered, annual costs should be calculated by multiplying the annual costs per mile by the miles for each design standard and posting the results in section E through H.

From the maintenance schedule in section VII, obtain the per-mile maintenance costs which are to be entered in section V and then used to determine the total maintenance costs in section K.

Annual costs of construction and maintenance should then be totaled from sections H and K and shown in section L.

From the administration schedule in section VII obtain the administration cost percentage and indicate same, as well as the total administration costs, in section M.

Total annual costs should then be entered in section N which is the sum of sections L and M.

Specific coding instructions for schedules MA-8 through MA-12 follow. While these schedules are the only local roads needs data, to be submitted to the Washington office, all other information (on both worksheets and schedules) should be retained in the State files for future reference.

Coding Instructions for Worksheets MA-8 through MA-12

	Item	Column Number
1.	State Code - See appendix B, table B-1	1-2
2.	Location - Precoded	3
3.	Urbanized Area Code - Not applicable to MA-8; Code 997 on MA-9; Code 998 on MA-10, Code 999 on MA-11. See appendix A, table A-1 for codes for MA-12.	4-6
4.	Cost Area Code - On MA-8 enter an appropriate code (as discussed in section II) for the cost area being reported. Code '00' on MA-9 through MA-12.	7-8
5.	Status - Precoded	9
6.	Design Standard Number - See tables VI-3 for codes for MA-8. These columns are precoded from table VI-4 on MA-9 through MA-12	10-11
7.	Existing Surface Type - Precoded on MA-9 through MA-12. Where not precoded on MA-8, code as follows: High --------------- 1 Intermediate-------- 2 Low----------------- 3 Gravel-------------- 4 Graded and drained - 5	12
8.	Miles	15-20
9.	Annual Costs ($1,000):	
	Grade & Drain	21-27
	Base & Surface	29-35
	Structures (MA-8 only)	37-43
	Total	45-52
10.	Annual Maintenance Cost ($1,000)	54-61
11.	Annual Cost of Administration ($1,000)	62-69
12.	Total Annual Cost ($1,000)	70-77

SECTION VII

DEVELOPMENT OF MAINTENANCE AND ADMINISTRATION COSTS

In order to complete calculations leading to annual program costs for the various functional systems - rural and urban - it is necessary that States provide estimates of costs of maintenance and administration applicable to each. For systems other than the Interstate, maintenance costs on an annual per-mile basis and administrative or overhead costs as a percentage of total annual capital outlay and maintenance costs are needed. These costs provide the basis for the calculated maintenance and administration costs reported on the worksheets as described in sections IV and V. Because needs on the Interstate system are not developed on the sampling basis common to the other systems, a different reporting format, applicable only to the Interstate system, is described at the end of this section. The description of the nature of maintenance and administrative costs, as covered below, applies to all systems.

Because maintenance cost records, where available, are not kept according to functional system and because some records are ambiguous in separating construction and administration costs from actual costs of maintenance, some manipulation of known cost data will be required. Similarly with regard to administrative costs, estimates based on experience will have to be made because of the mix of jurisdictions which will be involved in some functional systems.

MAINTENANCE COSTS

In developing per-mile maintenance cost estimates, care should be taken to include only those costs which can be considered physical maintenance or traffic services as described in the AASHO Manual on Uniform Highway Accounting Procedures. These AASHO descriptions are included below. Contract maintenance costs as well as force account costs should be included. Costs of stop-gap and minor replacement construction (betterments), generally included in maintenance budgets, should be excluded from this maintenance estimate since they will be included as construction costs in compiling annual programs. Cost estimates should assume adequate levels of maintenance expenditures at 1969 prices as distinguished from actual expenditures which may reflect arbitrary budget restrictions.

Care should be taken not to duplicate equipment and material costs in arriving at maintenance cost estimates. For instance, if equipment rentals are charged against specific operations, then equipment purchases should not be considered in arriving at estimated per-mile maintenance costs. Similarly, if aggregates and other materials are charged to maintenance sections in normal cost accounting procedures, costs of stock-piled materials should not be considered as additional maintenance costs even though they might be listed as expenditures for maintenance in a particular year. Costs of operating ferries and draw-bridges and like items should be prorated to the per-mile costs of the systems to which they generally apply.

The Maintenance Schedule shown on page VII- 3 provides for reporting the average annual per-mile maintenance cost for various system categories. The pertinent information for both the rural and urban functional systems is to be presented in this schedule.

The descriptions of physical maintenance and traffic services given in the AASHO Manual of Uniform Highway Accounting Procedures are as follows:

MAINTENANCE SCHEDULE

Average annual per-mile maintenance cost estimate

State ____________

BOB No. 04-S69053

Roadway and Surface Types 1/, 2/ & 3/	Rural Study Systems			
	Principal Arterials	Minor Arterials	Collectors	Locals
6 or more lanes - fwy				
4 lanes - fwy				
Other multilane				
2 lanes 1/				
2 lanes 2/				
2 lanes 3/				
Gravel & graded & drained				

Roadway and Surface Types 1/, 2/ & 3/	Urban Study Systems				
	Freeways and Expressways	Other Principal Arterials	Minor Arterial Streets	Collector Streets	Local Streets
6 or more lanes - fwy					
4 lanes - fwy & exp					
Other multilane					
2 lanes 1/					
2 lanes 2/					
2 lanes 3/					

1/ High Type
2/ Intermediate Type
3/ Low Type. For surface type definitions see Table III-14.

Not Applicable

Physical Maintenance

The following routine maintenance operations, replacements, and minor additions, although not all-inclusive, are considered to be physical maintenance.

Roadway surfaces

Scarifying, reshaping, and restoring material losses.
Applying dust palliatives.

On bituminous or concrete surfaces, patching, repairing, surface treating, joint filling, and mudjacking.

Replacement of traveled way and shoulder in kind for less than 500 continuous feet.

Resurfacing of concrete, brick, or bituminous pavements with bituminous material of less than 3/4-inch thickness.

Replacement of unsuitable base materials in patching operations.

Shoulders and side road approaches

Scarifying, reshaping and restoring material losses.

Applying dust palliatives

Patching and repairing all bituminous types, including base.

Resealing bituminous types.

Reseeding and resodding.

Roadside and drainage

Reshaping of drainage channels and side slopes.

Restoration of erosion controls.

Cleaning and repairing culverts.

Removing slides.

Mowing and tree trimming.

Replacing topsoil, sod, shrubs, etc.

Replacement, with essentially the same design, of curb, gutter, riprap, underdrain, and culverts.

Structures

Cleaning, painting, and repairing.

Replacements, with essentially the same design, or rails, floors, stringers, and beams.

Replacement of walls in kind.

Repairs of drawbridges and ferries.

The replacements and additions of a minor nature as listed above are considered to be physical maintenance. Where they become extensive or costly, such operations should not be charged to maintenance but to construction.

Traffic Services

The following maintenance operations, although not all-inclusive, are considered to be traffic services to the public.

Snow

All operations resulting from snow, such as erection of snow fences to minimize snowdrifts and the actual removal of snow from the traveled way.

Ice

All operations to reduce hazard due to icing of the roadway surface; such as, sanding, the application of chemicals to lower melting point, opening of inlets, actual removal of ice as by scraping, and in some instances the supplying of heat.

Traffic control and service facilities

Painting of pavement stripes and markings.

Painting, repairing, and replacement in kind of signs, guardrail, traffic signals, lighting standards, etc.

Maintaining rest areas.

Replacement or roadside rest areas in kind.

Additions of small numbers of conventional traffic control devices, including signs.

Servicing highway lighting and traffic control devices.

The furnishing of power for highway lighting and traffic control devices and the regular replacement of parts such as light bulbs.

River crossings

The operation of ferries is considered to be a traffic service. The cost should include the cost of power, operators, and periodic replacements. The cost of repairing these facilities should be included as physical maintenance.

Drawbirdges serve both highway and river traffic and their cost properly should be divided between the two. As in the case of ferries, their cost of operation should include the cost of power, operators, and periodic replacements, and that part chargeable to the highway should be considered traffic services. The cost of repairing these bridges is a proper charge to maintenance, and that part chargeable to the highway is a physical maintenance charge. Because of the division of cost between highway and river traffic, the cost of maintaining and operating drawbridges should be kept in a separate account.

Road services

The cost of services performed directly for road users, among which are supervision of roadside rest areas, cleaning operations on roadsides, motor vehicle repair and towing services, and operation of information booths.

COSTS OF ADMINISTRATION

In general, administration costs described in Chapter IV of the "Manual of Uniform Highway Accounting Procedures" are items of cost that cannot be charged to identifiable capital outlay projects or specific maintenance operations. These include in part:

Salaries and expenses of commissioners.

Salaries and expenses of chief engineer and staff engineers.

Other central office salaries.

Costs of planning and research activities.

Costs of building construction and maintenance.

Employee benefits such as sick, jury and military leave, compensation insurance, pension fund costs, Federal insurance contributions and the like.

Administrative costs are related both to the level of governmental organization which administers highway affairs and to the costs of constructing and maintaining the roads themselves. The extent of planning and research activities carried out by the administering organization should have significant influence on this cost. Large city administration costs are, generally, greater than those for small cities because of the relative complexity of operations.

The Administration Schedule shown on page VII-9 should be completed to show for each system (including the Interstate, if desired), on a percentage basis, the estimated cost of administration. The figure which is entered should represent, in terms of a percentage of the total cost for the capital outlay program (construction, right-of-way, preliminary engineering, etc.,) and the maintenance program, the additional cost for administration. For example, if a governmental unit foresees an 83 million dollar capital improvement program, a 17 million dollar maintenance program, and 5.2 million

ADMINISTRATION SCHEDULE

Percentage factors for estimating costs of administration

State ______________________

BOB No. 04-S68053

Rural Systems	Percentage Factor
Principal Arterial	
Minor Arterial	
Collector	
Local	

Urban Systems	Percentage Factor			
	Urbanized	5,000-9,999	10,000-24,999	25,000-49,999
Freeways and Expressways				
Other Principal Arterials				
Minor Arterial Streets				
Collector Streets				
Local Streets				

377-268 O - 70 - 14

for administration on a particular system, 5.2% should be entered. All that is expected is a reasonably consistent array of estimated values that can be readily developed on the basis of personal knowledge, experience, and judgment. These factors, when applied to the total costs of capital outlay and maintenance should represent all highway program costs not otherwise covered. Highway patrol and other traffic police costs are to be excluded. Also, debt service (interest payments, principal retirement, or sinking fund requirements) shall not be included in the determination of administration costs.

MAINTENANCE AND ADMINISTRATION COSTS FOR THE INTERSTATE SYSTEM

Because section by section data are reported on only a portion of the Interstate system (see page III-22) and because no expansion factor for the entire system is developed for this study, it is necessary to report Interstate maintenance and administration needs on a separate schedule. This schedule is shown on page VII-12.

It should include the anticipated maintenance needs, as previously defined, for the twenty-year period, 1970 to 1990, on all Interstate regardless of its present status. The estimates should reflect however that certain as yet uncompleted sections will not have maintenance costs for the full twenty-year period.

Administration cost estimates should be developed as previously described and should reflect administration costs for completing the Interstate system. In other words, factors as described on page VII-8 should be applied to the total of the section by section needs included in this study plus additional costs included in the 1970 Interstate Cost Estimate plus maintenance needs.

As will be noted on the schedule, data are to be reported by the following categories: Rural; small urban areas substratified by the three population groups; and by individual urbanized areas. Urbanized area codes to be used are those included in appendix A, table A-1. It will be necessary for some States to use more than one sheet in order to report data for all urbanized areas.

MAINTENANCE AND ADMINISTRATION SCHEDULE FOR THE INTERSTATE SYSTEM

State ________________ Sheet _____of_____

Type of Development			Maintenance Total Cost ($1,000)	Administration Total Cost ($1,000)
Rural				
Small urban areas:				
1990 Population	5,000-9,999			
	10,000-24,999			
	25,000-49,999			
Urbanized area:				
Name	Code			

SECTION VIII

SUBMITTAL OF DATA DEVELOPED DURING THE HIGHWAY NEEDS EVALUATION PROCESS

This section of the manual summarizes the data submittal requirements of the needs evaluation portion of the study. Table VIII-1 lists those items needed to fulfill the various requirements. The total data submittal requirements of this study are listed in table II- 1 , page II-22 , and table VIII-1, page VIII-2.

All submittals are to be made via the State highway departments to the Bureau of Public Roads division office. The regional offices should not forward the data to the Washington office until their review of the data (except the urban and rural needs section/subsection data tape) has been completed and revisions, where necessary, have been made.

All submittals to the Washington office should be made by April 1, 1971, and should be addressed to:

Functional Classification and Needs Study
Office of Planning
Bureau of Public Roads
Federal Highway Administration
Washington, D. C. 20591

Table VIII-1--Summary of the data submittal requirements of the needs evaluation process

Item	Coverage	Number of Copies 1/
Rural needs section/subsection dataset on tape and urban needs section/subsection dataset on tape	One statewide	1 2/
State highway department narrative report	Statewide	3
Bureau of Public Roads division office narrative report	Statewide	2 3/
Schedule MA - 8	One per rural cost area	3
Schedule MA - 9	One statewide	3
Schedule MA - 10	One statewide	3
Schedule MA - 11	One statewide	3
Schedule MA - 12	One per urbanized area	3
Maintenance Schedule	One statewide	3
Administration Schedule	One statewide	3
Maintenance and Administration Schedule for the Interstate System	One statewide	3

1/ Wherever three copies are called for, one of each is for the Bureau of Public Roads division office, FHWA regional office, and the Washington office.
2/ The urban and rural needs section subsection datasets are to be submitted directly to the Washington office on computer tape, in the format specified in appendix I, after all errors detected during the edit and contingency checking process have been corrected. A copy of the tape need not be furnished to the division and regional offices.
3/ One is to be provided for the FHWA regional office and one for the Washington office.

URBAN AND RURAL NEEDS SECTION/SUBSECTION DATA TAPE

The data contained on the rural and urban worksheets discussed in sections IV and V shall be punched on data processing cards, sorted as card images on tape, and converted to standard tape formats as described below and shown schematically in figure VIII-1 for rural and figure VIII-2 for urban. All needs section/subsection data cards (or card images on tape) shall undergo a thorough edit and contingency checking process, with all necessary corrections made to the data files prior to the creation of the data submittal tape.

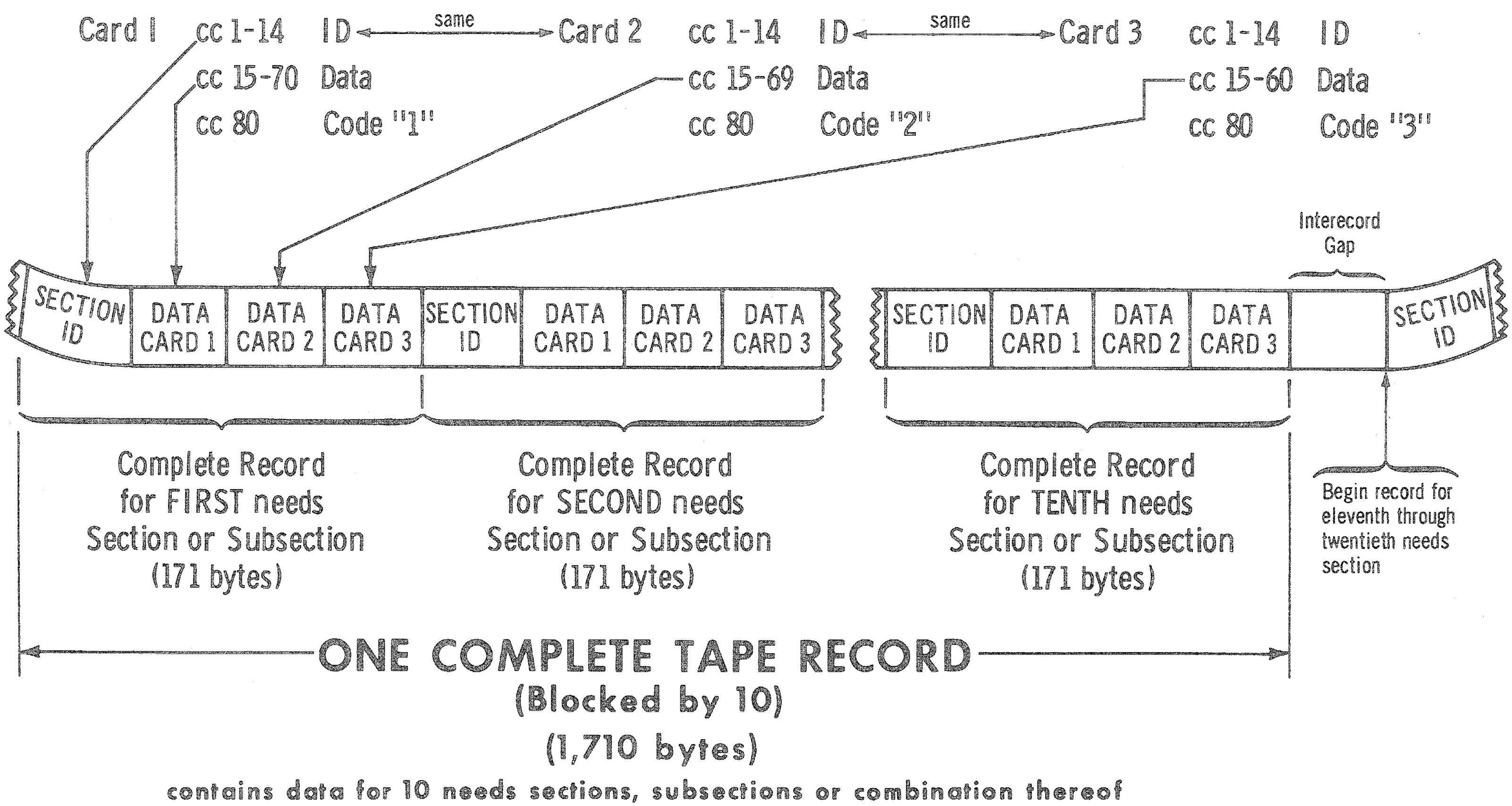
An IBM 360 (Operating System) computer program is available in the System 360 Urban Transportation Planning Package distributed by the Office of Planning, Bureau of Public Roads for converting the EBCDIC sorted card images to the standard tape formats specified. Sample setups for sorting and converting the card images using this program and the IBM supplied sort utility program are included in appendix I. Additional specifications for the data submittal tapes include the following:

1. All tapes shall be 9 track.
2. The tapes shall be in EBCDIC.
3. Standard labels shall be used.
4. Both the rural dataset and the urban dataset shall be furnished on one tape. The first dataset shall contain the rural section data and the second dataset shall contain the urban section data.
5. Submittal tapes shall be submitted with the volume serial number NHNSxx, where xx is the two digit code unique to each State furnished in appendix B. A sample setup for initializing a tape volume serial number using the IBM supplied utility program IEHINITT is included in appendix I.
6. Tape density shall be either 800 or 1600 bytes per inch.
7. Each State shall furnish the Washington office with the DSNAME's and recording density for its submittal tape.

Figure VIII-1

RURAL TAPE RECORD[1]

From Rural Worksheets (For each needs section or subsection)



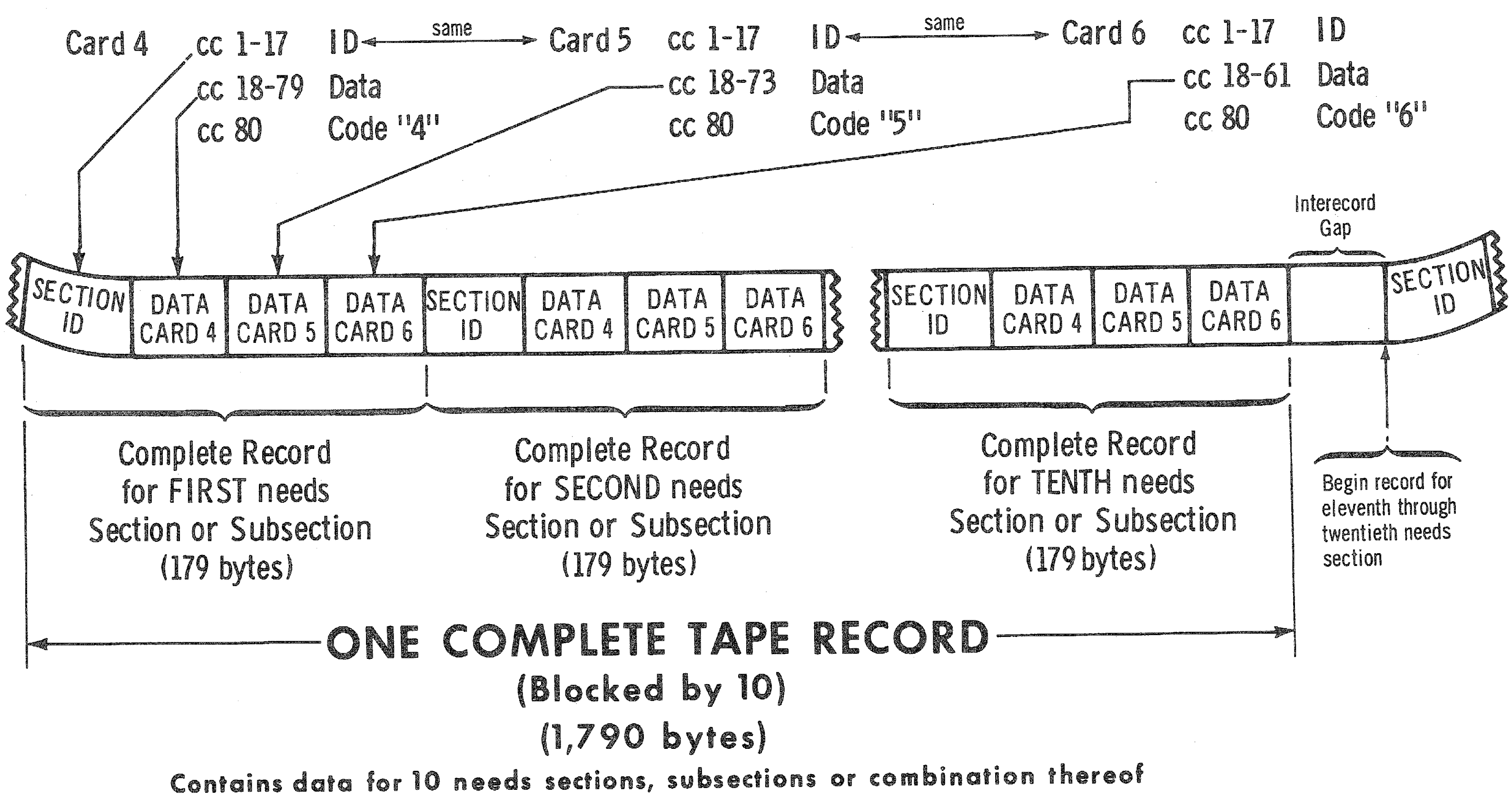
[1]Created on IBM System 360 with Operating System, 9-track EBCDIC tape, Label = (1,SL).

Record Format (RECFM = FB (fixed blocked)
Logical Record Length (LRECL) = 171 bytes
Blocksize (BLKSIZE) = 1,710 bytes

Figure VIII-2

URBAN TAPE RECORD[1]

From Urban Worksheets (For each needs section or subsection)



[1]Created on IBM System 360 with Operating System, 9-track EBCDIC tape, Label = (2,SL).

Record Format (RECFM) = FB (fixed blocked)
Logical Record Length (LRECL) = 179 bytes
Blocksize (BLKSIZE) = 1,790 bytes

8. Record Format (RECFM) = FB (Fixed Blocks)

A. Rural-Logical Record length (LRECL) = 171 bytes
block size (BLKSIZE) = 1,710 bytes

B. Urban-Logical record length (LRECL) = 179 bytes
block size (BLKSIZE) = 1,790 bytes.

9. The data must be in sort in the following order:

A. Rural Dataset
1st order sort--1990 functional subsystem
2nd order sort--Route number
3rd order sort--Section number
4th order sort--Subsection number
5th order sort--Card number

B. Urban Dataset
1st order sort--Urbanized area code (including codes 997, 998 and 999 for small urban areas).
2nd order sort--1990 functional subsystem
3rd order sort--Route number
4th order sort--Section number
5th order sort--Subsection number
6th order sort--Card number

NARRATIVE REPORTS

A narrative report concerning the classification and needs study should be prepared by each State and each Public Roads Division office.

The report prepared by the State should include, as a minimum, the following:

1. A general discussion of the 1990 functional classification, including an explanation of deviations from the guidelines, Stateline coordination difficulties (if any), and type and extent of local participation obtained.

2. A general discussion of the sampling procedure used to arrive at the sample for the needs evaluation. <u>Sampling procedures are to be approved by the Federal Highway Administration regional office prior to their use</u>.

3. A general discussion of the amount of field appraisal necessary to obtain the input data for needs analysis, by functional system.

4. A discussion of any difficulties in applying both minimum tolerable conditions and design standards to the needs sections.

5. A short discussion of the stratification procedure used for the mass analysis of local roads and streets, as included in section VI of this manual.

6. A general discussion of the derivation of unit costs used during the needs evaluation process. <u>Unit costs are to be approved by the Bureau of Public Roads division office prior to their use</u>.

The Division Office narrative report should include, as a minimum, the following:

1. A general discussion of the direct involvement by division office personnel, in the conduct and review of the classification and needs study.

2. All pertinent comments regarding application of standards and criteria during the conduct of the study in the State.

DATA SUMMARY FORMS AND SCHEDULES

Completion of several series of data summaries and schedules is necessary to perform the mass analysis of needs for local roads and streets, to derive unit costs and to estimate both maintenance and administration costs. Those which are to be submitted are indicated below. All others are to be retained in the State highway department files.

Mass Analysis Data Schedules

A series of 12 data schedules are contained in the discussion of the mass analysis procedures for local roads and streets in section VI. Schedules MA-8 through MA-12 are to be submitted to the Bureau of Public Roads in triplicate.

Maintenance and Administration Data Schedules

The completed maintenance cost schedule, page VII-3, and the completed administrative cost schedule, page VII-9, are to be submitted to the Bureau of Public Roads in triplicate. In addition, the completed maintenance and administration schedule for the Interstate System, page VII-12, is to be submitted to the Bureau of Public Roads in triplicate.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Alabama			
Anniston	260	-	62
Birmingham	006	521	907
Columbus (part)	007	28	47
Decatur	275	-	58
Dothan	276	-	60
Florence	237	-	121
Gadsden	008	69	96
Huntsville	009	75	174
Mobile	010	268	585
Montgomery	011	143	281
Tuscaloosa	012	77	169
Alaska			
Anchorage	240	-	142
Arizona			
Phoenix	013	522	1,620
Tucson	014	227	840
Yuma	277	-	60
Arkansas			
Fort Smith	015	60	110
Little Rock-North Little Rock	016	185	478
Pine Bluff	017	-	122
Texarkana (part)	018	20	39
California			
Anaheim-Santa Ana-Garden Grove	278	-	1,450
Bakersfield	019	142	300
Concord-Walnut Creek	341	-	-
Eureka	279	-	60
Fairfield-Suisun	345	-	-
Fresno	020	213	470

1/ Several States have requested the inclusion of additional urbanized areas for which area codes have been provided but population projections have not. It will be incumbent upon those States to supply the population projections. It should be noted, however, that some of these areas may be included in larger urbanized areas by 1990.

2/ Data from U.S. Census of Population 1960, Volume 1, Part A.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 2 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
California (continued)			
Los Angeles-Long Beach-Pomona-Ontario	021	6,675	12,950
Modesto	342	-	-
Monterey-Seaside	280	-	-
Oceanside-Carlsbad	344	-	-
Oxnard-Port Hueneme	346	-	166
Sacramento	024	452	1,220
Salinas	025	-	112
San Bernardino-Riverside	340	377	793
San Diego	027	836	2,800
San Francisco-Oakland-San Jose	028	3,034	6,116
Santa Barbara	030	73	228
Santa Cruz	281	-	135
Santa Rosa	282	-	122
Stockton	031	142	260
Vallejo-Napa	283	-	230
Ventura	343	-	109
Colorado			
Boulder	284	-	120
Colorado Springs	032	100	322
Denver	033	804	1,840
Fort Collins	285	-	60
Greeley	274	-	55
Pueblo	034	103	188
Connecticut			
Bridgeport-Norwalk-Stamford-New Haven-Meriden	035	947	1,613
Danbury-Bethel	262	-	3/
Hartford-New Britain	036	481	1,150
New London	263	-	90
Norwich	286	-	60
Springfield-Chicopee-Holyoke (part)	037	31	45
Waterbury	261	142	247
Delaware			
Wilmington (part)	038	266	565

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ Urban-in-fact area that contained in excess of 49,999 inhabitants in 1968.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 3 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
District of Columbia			
Washington, D.C. (part)	039	764	890
Florida			
Brevard County (Cocoa Beach)	225	-	3/ 85
Daytona	224	-	
Fort Lauderdale	040	-	1,050
Fort Meyers	255	-	56
Fort Pierce	287	-	55
Gainesville	220	-	66
Jacksonville	041	372	860
Key West	254	-	3/ 76
Lakeland	251	-	
Miami	042	853	1,930
Orlando	043	201	567
Panama City	253	-	81
Pensacola	044	128	237
St. Petersburg	045	325	867
Sarasota-Bradenton	221	-	125
Tallahassee	046	-	104
Tampa	047	302	864
Titusville	288	-	60
West Palm Beach	048	173	445
Georgia			
Albay	049	58	188
Athens	258	-	3/
Atlanta	050	768	1,920
Augusta (part)	051	111	262
Chattanooga (part)	052	20	60
Columbus (part)	007	131	346
Macon	053	114	183
Savannah	054	170	327
Valdosta	289	-	58
Hawaii			
Honolulu	055	351	794
Kailua-Laniki-Kanehoe	272	-	64

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ See footnote 3, p. A-2.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 4 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Idaho			
Boise	056	-	132
Idaho Falls	290	-	60
Pocatello	357	-	-
Illinois			
Alton	291	-	135
Aurora	057	86	3/
Bloomington-Normal	058	-	85
Champaign-Urbana	059	78	167
Chicago-Northwestern Indiana (part)	060	5,480	9,025
Danville	292	-	67
Davenport-Rock Island-Moline, Iowa (part)	061	126	186
Decatur	062	90	131
De Kalb-Sycamore	353	-	-
Dubuque, Iowa (part)	063	2	3
Elgin	347	-	-
Galesburg	293	-	60
Joliet	064	117	3/
Kanakee	354	-	-
Peoria	065	181	320
Quincy	294	-	57
Rockford	066	172	345
St. Louis (part)	067	276	483
Springfield	068	111	161
Indiana			
Anderson	069	-	95
Bloomington	295	-	55
Chicago-Northwestern Indiana (part)	060	479	1,037
Elkhart	296	-	58
Evansville	070	144	196
Fort Wayne	071	180	330
Indianapolis	072	639	1,350
Kokomo	297	-	83
Lafayette	073	-	88

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ See footnote 3, p. A-2.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 5 of 13

State and urbanized area	Urbanized area code 1/	Population 1960 2/	Population 1990
Indiana (continued)			
Louisville (part)	074	72	157
Marion	298	-	66
Michigan City	299	-	69
Muncie	075	77	122
Richmond	300	-	62
South Bend (part)	076	199	327
Terre Haute	077	81	92
Iowa			
Cedar Rapids	078	105	221
Davenport-Rock Island-Moline (part)	061	101	162
Des Moines	079	241	359
Dubuque (part)	063	-	86
Iowa City	266	-	60
Omaha (part)	080	61	114
Sioux City (part)	081	90	106
Waterloo	082	103	176
Kansas			
Hutchinson	301	-	60
Kansas City (part)	083	272	831
Lawrence	302	-	75
Salina	303	-	65
St. Joseph (part)	084	1	2
Topeka	085	120	215
Wichita	086	292	450
Kentucky			
Cincinnati (part)	087	180	300
Huntington-Ashland (part)	088	48	61
Lexington	089	112	246
Louisville (part)	074	534	1,115
Owensboro	304	-	73
Louisiana			
Alexandria	273	-	105
Baton Rouge	090	193	408

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.

377-268 O - 70 - 15

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 6 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Louisiana (continued)			
Lafayette	091	-	110
Lake Charles	092	89	232
Monroe	093	81	133
New Orleans	094	845	1,680
Shreveport	095	209	418
Maine			
Bangor-Brewer	257	-	68
Lewiston-Auburn	096	65	76
Portland	097	112	176
Maryland			
Baltimore	098	1,419	2,585
Washington, D.C. (part)	039	579	1,910
Massachusetts			
Boston-Brockton-Lowell	099	2,643	4,130
Fall River	100	118	121
Fitchburg-Leominster	101	72	97
Lawrence-Haverhill (part)	336	165	180
New Bedford	337	127	130
Pittsfield	102	62	85
Providence-Pawtucket (part)	103	44	83
Springfield-Chicopee-Holyoke (part)	037	418	680
Worcester	104	226	310
Michigan			
Ann Arbor	105	115	255
Battle Creek	246	-	106
Bay City	106	73	96
Benton Harbor-St. Joseph	247	-	3/
Detroit	107	3,538	6,050
Flint	108	278	545
Grand Rapids	109	294	500
Jackson	110	71	110
Kalamazoo	111	116	200

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ See footnote 3, p. A-2.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 7 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Michigan (continued)			
Lansing	112	169	250
Muskegon-Muskegon Heights	113	95	112
Saginaw	114	129	184
South Bend (part)	076	21	40
Minnesota			
Duluth-Superior (part)	115	111	130
Fargo-Moorhead (part)	116	25	43
Minneapolis-St. Paul	117	1,377	2,344
Rochester	271	-	78
St. Cloud	305	-	55
Grand Forks-East Grand Forks	320	-	-
Mississippi			
Biloxi	118	-	105
Columbus	306	-	55
Greenville	307	-	88
Gulfport	308	-	70
Hattiesburg	309	-	55
Jackson	119	148	390
Meridian	310	-	75
Pascagoula	256	-	85
Missouri			
Columbia	264	-	55
Jefferson City	358	-	-
Joplin	265	-	-
Kansas City (part)	083	649	1,342
St. Joseph (part)	084	80	90
St. Louis (part)	067	1,392	2,434
Springfield	120	97	148
Montana			
Billings	121	61	145
Great Falls	122	58	118

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 8 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Nebraska			
Lincoln	123	136	283
Omaha (part)	080	330	614
Sioux City (part)	081	7	15
Nevada			
Las Vegas	124	89	507
Reno	125	70	170
New Hampshire			
Lawrence-Haverhill (part)	336	1	7
Manchester	126	92	123
Nashua	311	-	65
New Jersey			
Atlantic City	127	125	166
New York-N.E. New Jersey (part)	035	3,879	7,313
Philadelphia-Trenton (part)	128	749	1,848
Vineland-Millville-Bridgeton	129	-	90
Wilmington	038	17	24
Wrightstown-New Hanover-North Hanover	338	-	-
New Mexico			
Albuquerque	130	241	730
Las Cruces	312	-	70
Roswell	313	-	64
Santa Fe	314	-	66
New York			
Albany-Schenectady-Troy	131	456	864
Binghamton	132	148	304
Buffalo-Niagra Falls	133	1,054	1,820
Elmira	315	-	105
Jamestown	005	-	3/
New York-N.E. New Jersey (part)	035	10,236	14,950
Poughkeepsie	316	-	130

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ See footnote 3, p. A-2.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands) Sheet 9 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
New York (continued)			
Rochester	134	494	930
Syracuse	135	333	866
Utica-Rome	136	188	312
North Carolina			
Asheville	137	69	113
Burlington	269	-	106
Charlotte	138	210	550
Durham	139	85	144
Fayetteville	140	-	123
Gastonia	267	-	132
Goldsboro	335	-	71
Greensboro	141	66	483
High Point	022	-	-
Kannapolis-Concord	268	-	108
Raleigh	142	94	232
Rocky Mount	317	-	55
Wilmington	143	-	81
Wilson	318	-	57
Winston-Salem	144	128	290
North Dakota			
Bismarck	319	-	64
Fargo-Moorhead (part)	116	48	89
Grand Forks-East Grand Forks (part)	320	-	59
Minot	321	-	62
Ohio			
Akron	145	458	800
Canton	146	214	347
Cincinnati-Hamilton	087	904	1,610
Cleveland-Lorain-Elyria	147	1,928	3,190
Columbus	148	617	1,210
Dayton	149	502	1,040
Huntington-Ashland (part)	088	25	40
Lima	150	63	88

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 10 of 13

State and urbanized area	Urbanized area code 1/	Population 1960 2/	Population 1990
Ohio (continued)			
Mansfield	151	-	118
Middletown	250	-	93
Newark-Heath	249	-	66
Sandusky	322	-	60
Springfield	152	90	120
Steubenville-Weirton (part)	153	47	60
Toledo	154	438	670
Wheeling (part)	155	33	50
Youngstown-Warren	156	373	570
Oklahoma			
Fort Smith (part)	015	2	3
Lawton	157	62	198
Norman	248	-	3/
Oklahoma City	158	429	910
Tulsa	159	299	435
Oregon			
Eugene	160	95	211
Portland (part)	161	605	1,178
Salem	162	-	135
Corvalis	355	-	-
Medford	356	-	-
Pennsylvania			
Allentown-Bethlehem-Gaston	163	256	444
Altoona	164	83	79
Easton	349	-	-
Erie	165	177	278
Harrisburg	166	210	373
Johnstown	167	97	106
Lancaster	168	94	157
Monessen	350	-	-
New Castle	351	-	-
Philadelphia-Trenton (part)	128	3,129	4,658
Pittsburgh	169	1,804	2,482
Reading	170	160	255

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ See footnote 3, p. A-2.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 11 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Pennsylvania (continued)			
Scranton-Wilkes-Barre	171	445	445
Sharon-Farrell	323	-	-
Williamsport	348	-	-
York	172	101	164
Puerto Rico			
Arecibo	352	-	-
Caguas	339	-	-
Mayaguez	227	59	-
Ponce	228	114	-
San Juan	226	542	-
Rhode Island			
Fall River (part)	100	6	11
Newport	229	-	80
Providence-Pawtucket (part)	103	616	881
South Carolina			
Anderson	324	-	95
Augusta (part)	051	13	31
Charleston	173	160	362
Columbia	174	163	442
Greenville	175	127	246
Spartanburg	259	-	98
South Dakota			
Rapid City	325	-	94
Sioux City (part)	081	1	2
Sioux Falls	176	66	110
Tennessee			
Chattanooga (part)	052	185	261
Kingsport	252	-	78
Knoxville	177	173	270
Memphis	178	544	1,140
Nashville	179	347	664

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands)

Sheet 12 of 13

State and urbanized area	Urbanized area code 1/	Population	
		1960 2/	1990
Texas			
Abilene	180	92	175
Amarillo	181	138	326
Austin	182	187	394
Beaumont	183	119	159
Brownsville	244	-	83
Corpus Christi	184	177	367
Dallas	185	932	1,820
El Paso	186	277	534
Fort Worth	241	503	1,215
Galveston-Texas City	187	119	204
Harlingen-San Benito	188	62	93
Houston	189	1,140	2,772
Laredo	190	61	91
Longview	245	-	58
Lubbock	191	129	342
McAllen-Pharr	192	-	83
Midland	193	63	115
Odessa	242	84	159
Port Arthur	183	116	155
San Angelo	194	59	76
San Antonio	195	642	1,322
Sherman-Denison	196	-	60
Texarkana (part)	018	33	48
Tyler	197	52	78
Victoria	326	-	60
Waco	198	116	197
Wichita Falls	199	102	195
Utah			
Ogden	200	122	250
Provo-Orem	201	61	183
Salt Lake City	202	348	765
Vermont			
Burlington	236	-	120

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.

Table A-1.--Historical and projected population in each urbanized area

(population in thousands) Sheet 13 of 13

State and urbanized area	Urbanized area code 1/	Population 1960 2/	Population 1990
Virginia			
Danville	327	-	60
Lynchburg	203	59	94
Newport News-Hampton	204	209	378
Norfolk-Portsmouth	205	508	981
Richmond	206	333	653
Roanoke	207	125	179
Washington, D.C. (part)	039	465	1,372
Washington			
Pasco-Kennewick-Richland	239	-	3/
Portland (part)	161	47	60
Seattle-Tacoma	208	1,079	2,464
Spokane	209	227	420
Yakima	238	-	58
West Virginia			
Charleston	210	170	315
Huntington-Ashland (part)	088	93	109
Parkersburg	270	-	90
Steubenville-Weirton (part)	153	34	54
Wheeling (part)	155	65	65
Wisconsin			
Appleton-Menasha-Neenah	328	-	163
Duluth-Superior	115	34	35
Green Bay	211	97	165
Janesville	329	-	74
Kenosha	212	73	205
LaCrosse	330	-	59
Madison	213	158	350
Milwaukee	222	1,150	2,093
Oshkosh	331	-	60
Racine	223	96	268
Sheboygan	332	-	63
Wyoming			
Casper	333	-	70
Cheyenne	334	-	105

1/ See footnote 1, p. A-1.
2/ See footnote 2, p. A-1.
3/ See footnote 3, p. A-2.

APPENDIX A

1990 Data Area Codes for Projected 1990 Urbanized Areas

The preceding table contains the urbanized area names and data area codes developed during the 1968 National Highway Functional Classification Study, with the addition of those areas forecasted to be urbanized by 1990. The urbanized areas contained in this list and corresponding codes shall be used in this study unless one of the following conditions are met:

1. An urban area (or rural area) with less than 50,000 population in 1968 is forecasted to have in excess of 49,999 population within the so-called urban-in-fact boundary in 1990.

Procedure--Data for this study shall be reported for these areas as urbanized. Each area meeting this condition should be reported to the Washington office staff to permit the assignment of a data area code.

2. An urbanized area that has been officially certified as such by the Bureau of the Census is forecasted to have a 1990 population of less than 50,000 within the projected urban-in-fact boundary.

Procedure--The 1990 functional classification data are to be reported in the same manner required for urbanized areas with greater than 49,999 population.

3. Two or more individual urbanized areas that have been certified by the Bureau of the Census, through continued growth, will become one large, contiguous, urban-in-fact area by 1990.

Procedure--The 1990 functional classification data shall be reported separately for each certified urbanized area unless they have been combined for the urban transportation planning process. When certified urbanized areas have been combined for the urban transportation planning process one data area code should be used. Should any code change appear necessary, please call it to the attention of the Washington office staff.

4. An urbanized area that has been certified by the Bureau of the Census as an "urbanized" area with over 50,000 population (urban-in-fact), and an area not certified, through continued growth, will become one large, contiguous urban-in-fact area by 1990.

Procedure--The 1990 functional classification study data shall be reported for the entire area as a whole, using the data area code assigned to the certified urbanized area. Changes of this nature should also be bought to the attention of the Washington office staff.

Table A-2.--Historical and projected total State, rural, and urban population, and percentage urban for selected years 1/

(population in thousands)

State	1950 2/				1960 2/				1990			
	Population			Percentage urban	Population			Percentage urban	Population			Percentage urban
	Total	Rural	Urban		Total	Rural	Urban		Total	Rural	Urban	
Alabama	3,062	1,721	1,341	43.8	3,267	1,475	1,792	54.8	4,507	1,336	3,171	70.4
Alaska	129	95	34	26.6	226	140	86	37.9	417	209	208	49.9
Arizona	750	334	416	55.5	1,302	331	971	74.5	3,145	350	2,795	88.9
Arkansas	1,909	1,278	631	33.0	1,786	1,021	765	42.8	2,672	906	1,766	66.1
California	10,586	2,047	8,539	80.7	15,717	2,144	13,573	86.4	33,302	2,805	30,479	91.6
Colorado	1,325	494	831	62.7	1,754	461	1,293	73.7	3,224	390	2,834	87.9
Connecticut	2,007	448	1,559	77.6	2,535	549	1,986	78.3	4,251	776	3,475	81.8
Delaware	318	119	199	62.6	446	153	293	65.6	816	186	630	77.2
Florida	2,771	957	1,814	65.5	4,952	1,291	3,661	73.9	12,236	2,342	9,894	80.9
Georgia	3,445	1,886	1,559	45.3	3,943	1,763	2,180	55.3	6,368	1,618	4,750	74.6
Hawaii	500	155	345	69.0	633	149	484	76.5	1,175	132	1,043	88.8
Idaho	589	336	253	42.9	667	350	317	47.5	1,024	361	663	64.8
Illinois	8,712	1,953	6,759	77.6	10,081	1,941	8,140	80.7	15,100	1,990	13,110	86.8
Indiana	3,934	1,577	2,357	59.9	4,663	1,753	2,910	62.4	6,800	1,670	5,130	72.4
Iowa	2,621	1,370	1,251	47.7	2,758	1,296	1,462	53.0	3,282	1,090	2,192	66.8
Kansas	1,905	912	993	52.1	2,179	850	1,329	61.0	3,019	576	2,443	80.9
Kentucky	2,945	1,861	1,084	36.8	3,038	1,685	1,353	44.5	3,998	1,520	2,478	62.0
Louisiana	2,684	1,212	1,472	54.8	3,257	1,196	2,061	63.3	5,315	1,175	4,140	77.9
Maine	914	442	472	51.7	969	472	497	51.3	1,207	586	621	51.4
Maryland	2,343	727	1,616	69.0	3,101	847	2,254	72.7	5,527	704	4,823	87.3
Massachusetts	4,691	732	3,959	84.4	5,149	846	4,303	83.6	7,085	927	6,158	86.9
Michigan	6,372	1,869	4,503	70.7	7,823	2,084	5,739	73.4	11,993	2,593	9,400	78.4
Minnesota	2,982	1,357	1,625	54.5	3,414	1,291	2,123	62.2	4,728	1,256	3,472	73.4
Mississippi	2,179	1,572	607	27.9	2,178	1,357	821	37.7	3,144	1,310	1,834	58.3
Missouri	3,955	1,522	2,433	61.5	4,320	1,443	2,877	66.6	5,816	1,159	4,657	80.1
Montana	591	333	258	43.7	675	337	338	50.2	944	347	597	63.2
Nebraska	1,325	703	622	46.9	1,411	645	766	54.3	1,946	587	1,359	69.8
Nevada	160	68	92	57.2	285	84	201	70.4	819	85	734	89.6
New Hampshire	533	226	307	57.5	607	253	354	58.3	895	320	575	64.2
New Jersey	4,835	649	4,186	86.6	6,067	693	5,374	88.6	10,600	572	10,028	94.6
New Mexico	681	339	342	50.2	951	325	626	65.9	1,778	268	1,510	84.9
New York	14,830	2,147	12,683	85.5	16,782	2,450	14,332	85.4	25,504	3,231	22,273	87.3
North Carolina	4,062	2,694	1,368	33.7	4,556	2,754	1,802	39.5	7,070	3,120	3,950	55.9
North Dakota	620	455	165	26.6	632	409	223	35.2	751	327	424	56.5
Ohio	7,947	2,369	5,578	70.2	9,706	2,583	7,123	73.4	15,141	3,164	11,977	79.1
Oklahoma	2,233	1,094	1,139	51.0	2,328	863	1,465	62.9	3,410	733	2,677	78.5
Oregon	1,521	702	819	53.9	1,769	669	1,100	62.2	2,949	670	2,279	77.3
Pennsylvania	10,498	3,095	7,403	70.5	11,319	3,217	8,102	71.6	15,054	3,869	11,185	74.3
Rhode Island	792	125	667	84.3	859	116	743	86.4	1,105	99	1,006	89.6
South Carolina	2,117	1,339	778	36.7	2,383	1,402	981	41.2	3,594	1,483	2,111	58.7
South Dakota	653	436	217	33.2	681	414	267	39.3	791	376	415	52.5
Tennessee	3,292	1,839	1,453	44.1	3,567	1,702	1,865	52.3	5,195	1,586	3,609	69.5
Texas	7,711	2,873	4,838	62.7	9,580	2,393	7,187	75.0	16,008	1,771	14,237	88.9
Utah	689	239	450	65.3	891	224	667	74.9	1,640	217	1,423	86.7
Vermont	378	240	138	36.4	390	240	150	38.5	550	215	335	60.1
Virginia	3,319	1,759	1,560	47.0	3,967	1,762	2,205	55.6	6,500	1,708	4,792	73.7
Washington	2,379	876	1,503	63.2	2,853	910	1,943	68.1	5,094	938	4,156	81.6
West Virginia	2,005	1,311	694	34.6	1,860	1,149	711	38.2	1,991	990	1,001	50.3
Wisconsin	3,434	1,446	1,988	57.9	3,952	1,430	2,522	63.8	5,687	1,292	4,395	77.3
Wyoming	291	146	145	49.8	330	142	188	56.8	463	130	333	71.9
District of Columbia	802	-	802	100.0	764	-	764	100.0	890	-	890	100.0
Totals	151,326	54,479	96,847	64.0	179,323	54,054	125,269	69.9	286,520	56,086	230,434	80.4

1/ The total urban population consists of (a) inhabitants of incorporated and unincorporated places of 2,500 persons or more; (b) residents of urban towns and townships; and (c) persons living in the urban-fringe of urbanized areas.

2/ Data from U.S. Census of Population, Volume 1, Part A.

Table A-3.--Estimated population 1968 and 1969 by State 1/
(Population in thousands)

State	Total resident population		State	Total resident population	
	July 1, 1968	July 1, 1969 (provisional)		July 1, 1968	July 1, 1969 (provisional)
Alabama	3,522	3,531	Montana	696	694
Alaska	276	282	Nebraska	1,453	1,449
Arizona	1,667	1,693	Nevada	449	457
Arkansas	1,983	1,995	New Hampshire	703	717
California	19,179	19,443	New Jersey	7,070	7,148
Colorado	2,067	2,100	New Mexico	994	994
Connecticut	2,961	3,000	New York	18,186	18,321
Delaware	533	540	North Carolina	5,131	5,205
Florida	6,210	6,354	North Dakota	624	615
Georgia	4,579	4,641	Ohio	10,610	10,740
Hawaii	775	794	Oklahoma	2,542	2,568
Idaho	709	718	Oregon	2,004	2,032
Illinois	10,958	11,047	Pennsylvania	11,750	11,803
Indiana	5,065	5,118	Rhode Island	908	911
Iowa	2,775	2,781	South Carolina	2,669	2,692
Kansas	2,291	2,321	South Dakota	665	659
Kentucky	3,224	3,232	Tennessee	3,952	3,985
Louisiana	3,710	3,745	Texas	11,013	11,187
Maine	978	978	Utah	1,031	1,045
Maryland	3,716	3,765	Vermont	429	439
Massachusetts	5,438	5,467	Virginia	4,604	4,669
Michigan	8,673	8,766	Washington	3,296	3,402
Minnesota	3,663	3,700	West Virginia	1,819	1,819
Mississippi	2,349	2,360	Wisconsin	4,211	4,233
Missouri	4,610	4,651	Wyoming	322	320
			Dist. of Columbia	802	798
			Total	199,846	201,921

1/ Source: United States Bureau of the Census, Series P-25, No. 436, January 7, 1970

APPENDIX B

Table B-1.--State Codes

State	Code	State	Code
Alabama	01	New Mexico	29
Arizona	02	New York	30
Arkansas	03	North Carolina	31
California	04	North Dakota	32
Colorado	05	Ohio	33
Connecticut	06	Oklahoma	34
Delaware	07	Oregon	35
Florida	08	Pennsylvania	36
Georgia	09	Rhode Island	37
Idaho	10	South Carolina	38
Illinois	11	South Dakota	39
Indiana	12	Tennessee	40
Iowa	13	Texas	41
Kansas	14	Utah	42
Kentucky	15	Vermont	43
Louisiana	16	Virginia	44
Maine	17	Washington	45
Maryland	18	West Virginia	46
Massachusetts	19	Wisconsin	47
Michigan	20	Wyoming	48
Minnesota	21	Alaska	49
Mississippi	22	Hawaii	50
Missouri	23	District of Columbia	51
Montana	24	Puerto Rico	52
Nebraska	25		
Nevada	26		
New Hampshire	27		
New Jersey	28		

APPENDIX C

Table C-1.--STATE-DESIGNATED AGENCIES AGREEING TO WORK TOWARD FEDERAL-STATE COOPERATIVE PROGRAM FOR LOCAL POPULATION ESTIMATES

(Participating States as of January 1970. Asterisk (*) represents coordinating agency as opposed to agency carrying out technical phases of program)

ALABAMA

Alabama Program Development Office*
304 Dexter Avenue
Montgomery, Alabama 36104

Center of Business and
Economic Research
Graduate School of Business
University of Alabama
Box KK
University, Alabama 35468

ARIZONA

Unemployment Compansation Division
Employment Security Commission
Post Office Box 6123
Phoenix, Arizona 85005

ARKANSAS

Industrial Research & Extension Center
University of Arkansas
Little Rock, Arkansas 72203

CALIFORNIA

Population Research Unit
State Department of Finance
1623 10th Street
Sacramento, California 95814

COLORADO

State Planning Office
State Capitol
Denver, Colorado 80203

DELAWARE

State Planning Office
Thomas Collins Building
530 South DuPont Highway
Dover, Delaware 19901

FLORIDA

Bureau of Economic & Business
Research
College of Business Administration
University of Florida
Gainesville, Florida 32601

GEORGIA

State Planning Bureau
116 Mitchell Street, S.W.
Atlanta, Georgia 30303

HAWAII

Department of Planning &
Economic Development*
State Capitol
Honolulu, Hawaii 96813

State Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

377-268 O - 70 - 16

APPENDIX C

Table C-1 (Continued)

IDAHO

State Department of Health
Statehouse
Boise, Idaho 83707

ILLINOIS

Division of Health Planning &
Resource Development
Department of Public Health
Springfield, Illinois 62706

INDIANA

State Board of Health
1330 West Michigan Street
Indianapolis, Indiana 46206

IOWA

Office of State Planning & Programming
State Capitol
Des Moines, Iowa 50319

KANSAS

Division of State Plans Coordination
State Department of Economic Development
State Office Building
Topeka, Kansas 66612

KENTUCKY

Kentucky Program Development
Office
Capitol Building
Frankfort, Kentucky 40 01

LOUISIANA

Division of Business &
Economic Research
School of Business Administration
Louisiana Polytechnic Institute
Post Office Box 5796, Tech Station
Ruston, Louisiana 71270

MAINE

State Department of Health &
Welfare
State House
Augusta, Maine 04330

MARYLAND

Division of Biostatistics
State Department of Health
& Mental Hygiene
301 West Preston Street
Baltimore, Maryland 21201

APPENDIX C

Table C-1 (Continued)

MASSACHUSETTS

Bureau of Research & Statistics
Department of Commerce & Development
State Office Building
100 Cambridge Street
Boston, Massachusetts 02202

MICHIGAN

State Bureau of the Budget
Budget Division
Lewis Cass Building
Lansing, Michigan 48913

Center for Health Statistics
Michigan Department of Public Health
3500 North Logan Street
Lansing, Michigan 48913

MINNESOTA

Vital Statistics Division
State Department of Health
Minneapolis, Minnesota 55414

MISSISSIPPI

Department of Sociology & Rural Life
Mississippi State University
Drawer C
State College, Mississippi 39762

MISSOURI

Administrative Services Section
Office of Comptroller & Budget Director
Post Office Box 809
Jefferson City, Missouri 65101

MONTANA

Bureau of Business & Economic Research
University of Montana
Missoula, Montana 59801

NEBRASKA

Nebraska Dept. of Economic Development*
Division of State & Urban Affairs
Post Office Box 94666, State Capitol
Lincoln, Nebraska 65808

Bureau of Business Research
The University of Nebraska
Lincoln, Nebraska 68508

NEVADA

Bureau of Business & Economic Research
University of Nevada
Reno, Nevada 89507

APPENDIX C

Table C-1 (Continued)

NEW HAMPSHIRE

Office of Planning & Research
Department of Resources &
Economic Development
State House Annex
Concord, New Hampshire 03301

NEW JERSEY

Department of Conservation &
Economic Development
Post Office Box 1889
Trenton, New Jersey 08625

NEW MEXICO

Bureau of Business Research
University of New Mexico
1821 Roma Street, N.E.
Albuquerque, New Mexico 87106

NEW YORK

Office of Planning Coordination*
Room 229, State Capitol
Albany, New York 12201

State Health Department
84 Holland Avenue
Albany, New York 12208

NORTH CAROLINA

State Planning Division
Department of Administration
Raleigh, North Carolina 27614

Carolina Population Center
University of North Carolina
123 West Franklin Street
Chapel Hill, North Carolina 27514

OKLAHOMA

Research & Planning Division
Oklahoma Employment Security
Commission
Will Rogers Memorial Office Building
Oklahoma City, Oklahoma 73105

OREGON

Center for Population Research &
Census
Portland State College
614 Montgomery Street (P.O. Box 751)
Portland, Oregon 97207

PENNSYLVANIA

State Planning Board
Post Office Box 191
Harrisburg, Pennsylvania 17120

APPENDIX C

Table C-1 (Continued)

RHODE ISLAND

Statewide Planning Program
Suite 300
36 Kennedy Plaza
Providence, Rhode Island 02903

SOUTH CAROLINA

Division of Research & Statistical Services
S.C. Budget and Control Board
Post Office Box 11333
Columbia, South Carolina 29211

SOUTH DAKOTA

Division of Public Health Statistics
State Department of Health
Pierre, South Dakota 57501

TENNESSEE

Tennessee State Planning Commission*
Division of State Planning
C2-208 Central Services Building
Nashville, Tennessee 37219

Center for Business & Economic Research
University of Tennessee
Knoxville, Tennessee 37916

UTAH

Utah Department of Development Services*
State Capitol
Salt Lake City, Utah 84114

Reports & Analysis Section
Utah Department of Employment Security
174 Social Hall Avenue
Salt Lake City, Utah 84111

VERMONT

Division of Public Health Statistics
State Department of Health
115 Colchester Avenue
Burlington, Vermont 05401

VIRGINIA

Bureau of Population & Economic Research
Lambeth House, University of Virginia
Charlottesville, Virginia 22903

WASHINGTON

Office of Program Planning & Fiscal Management
Population and Enrollment Section
Insurance Building
Olympia, Washington 98501

APPENDIX C

Table C-1 (Continued)

WEST VIRGINIA

State Planning Division*
Governor's Office of Federal-State
Relations
1703 Washington Street, E.
Charleston, West Virginia 25311

Office of Research & Development
Center for Appalachian Studies &
Development
West Virginia University
Morgantown, West Virginia 26505

WISCONSIN

Department of Health & Social
Services
Post Office Box 309
Madison, Wisconsin 53701

Applied Population Laboratory
University of Wisconsin
Madison, Wisconsin 53706

WYOMING

Division of Business & Economic Research
College of Commerce and Industry
University of Wyoming
Box 3925, University Station
Laramie, Wyoming 82070

APPENDIX D

TRAVEL ESTIMATING PROCEDURES

INTRODUCTION

As mentioned in section II, it will be necessary for each State to determine 1969 and 1990 ADT for each arterial and collector road or street section selected for the needs study sample. This appendix presents the "Travel Disaggregation Adjustment Procedure" for estimating the travel for the subareas of the State. These subarea forecasts provide the basis for estimating 1990 ADT for the needs sections and for obtaining 1990 forecasts by functional classification as required for the functional classification portion of the study.

The 1969 ADT's should be based on the data reported in the 1968 Functional Classification Study. The traffic data developed for that study and all available additional traffic count data should be used to obtain 1969 traffic estimates for the study sections.

Subareas for Travel Estimation Analysis

At some stage of the travel analysis it is necessary to estimate and forecast travel by subarea of the State. The logical building blocks for this purpose are the counties, since much of the data used in estimating travel, and making subsequent adjustments, are available by entire counties, usually by rural and urban population groups.

While optional for this study, consideration should be given to the comparative efficiency of treating each county as a separate subarea or grouping homogeneous counties for the purpose of estimating travel. Much Census and other data are compiled and published on a county basis, and most States have summarized traffic and other information by counties.

Sources of Data

In addition to various mileage and travel data usually available within the State highway departments, other sources of data that could be useful in estimating travel are as follows:

1. Highway Statistics, Bureau of Public Roads tables VM-1, VM-2, MV-1, DL-1, and MF-21.

2. Public Roads, Vol. 32, No. 11, December 1963--The Automobile in American Daily Life.
3. Public Roads, Vol. 31, No. 1, April 1960--Time and Fuel Consumption for Highway User Benefit Studies and Fuel and Time Consumption Rates in Freight Service.

4. Public Roads, Vol. 32, No. 5, December 1962--Passenger Car Fuel Consumption Rates.

5. Future Highways and Urban Growth, Wilbur Smith and Associates.

6. Highway Research Record 197--Relationship of Passenger Car Age and Other Factors to Miles Driven (Bostick and Greenhalgh).

7. Automobile Facts and Figures, AMA, 320 New Center Building, Detroit, Michigan, 48202.

8. Sales Management, Annual "Survey of Buying Power" (Usually published in June), 630 - 3rd Avenue, New York, New York, 10017.

9. Traffic System Analysis for Engineers and Planners, McGraw-Hill Book Company (Martin Wohl and Brian Martin).

10. Research Monograph 14, Urban Land Institute--Dimensions of Metropolitanism (John P. Pickard).

11. County and City Data Book, 1967.

12. 1963 Census of Business.

13. 1963 Census of Manufactures.

14. Current Population Reports, Population Estimates, Series P-25, Nos. 401, 404, 407, and 409 - 1966 population by county.

15. Leahy's Hotel and Motel Guide and Travel Atlas.

16. National Cooperative Highway Research Program--Report 13-Interim Running Cost of Motor Vehicles as Affected by Highway Design.

Relationships of travel within a State and especially within certain subareas of a State to such other items as available vehicles per household or registrations, fuel consumption, or population are affected in varying degree by the balance between travel within the area by out-of-area drivers and travel outside of the area by area residents. Also pertinent, of course, are the proportions of each of these in relation to total travel within the area. Typically affected are so-called "bridge" areas, which have a high proportion of trans-area traffic. Areas that are predominately residential, industrial and commercial, or recreational are also affected. Planning data available for such areas may provide a good indication of actual travel; but differential motor-fuel purchase patterns--affected by price, convenience, or tax policy--which can influence the computed miles-per-gallon rates in some areas, should be considered, even though this information is not available from the usual transportation planning study data.

THE TRAVEL DISAGGREGATION-ADJUSTMENT PROCEDURE 1/

The travel estimate disaggregation-adjustment procedure comprises estimating separately the travel for subareas of a State and road section; then making both specific adjustments for individual sections and subareas and blanket proportional adjustments so that finally the sum of their adjusted estimated travel is equal to an independently made estimate of total State travel. Adjustments for individual subareas are based on various travel and socio-economic factors, generally in the form of ratios or percentages of State totals; comparisons being made among the various factors for each individual area and between the factors for one area and those of similar areas. By this means, errors, faulty initial estimates, and discrepancies are detected and eliminated. The process is almost certain to require several repetitions, each bringing adjustments closer to the State total. The importance of such consistency for the statewide and national estimates and their use has already been noted.

Section-by-section traffic forecasts are needed for all arterials and collectors in the needs study sample. The TF-2 data should be reviewed as part of the forecast process, revised as necessary, and used for this study for the Interstate System. Also, 1990 ADT's are required for all 1990 rural principal arterials and their connecting links, on a route segment basis (see section II, Statewide Route Log).

1/ As previously noted, the use of the procedure is optional with the State. Other means of assembling the travel to be reported which provide for cooperative adjustment of study area totals to a nationally consistent State total may be used.

The suggested seven steps for preparing traffic forecasts for 1990 by the disaggregation - adjustment process, are as follows:

1a.--Inventory historical, base year, & available forecast data.

1b.--Develop guide values for base & forecast year.

2a.--Review and adjust base year (1969) mileage and travel.

2b.--Review and adjust forecast year total mileage and travel.

3a.--For each subarea, project forecast year travel using DVM per capita.

3b.--Sum subarea DVM and adjust to equal State total.

4. --Analyze each subarea for exceptional traffic growth influences.

5a.--Determine average ADT's for each functional system in forecast year for each subarea from a traffic assignment or by factoring base year.

$$F = B \times S \times D \text{ or } F = B \times S \times L_i \times C_j \times R_K$$

(See page D-36 for an explanation of this equation)

5b.--Compute DVM by functional system and subarea and compare for highs and lows.

5c.--Review and adjust as necessary. If not satisfactory, repeat 3a-5c.

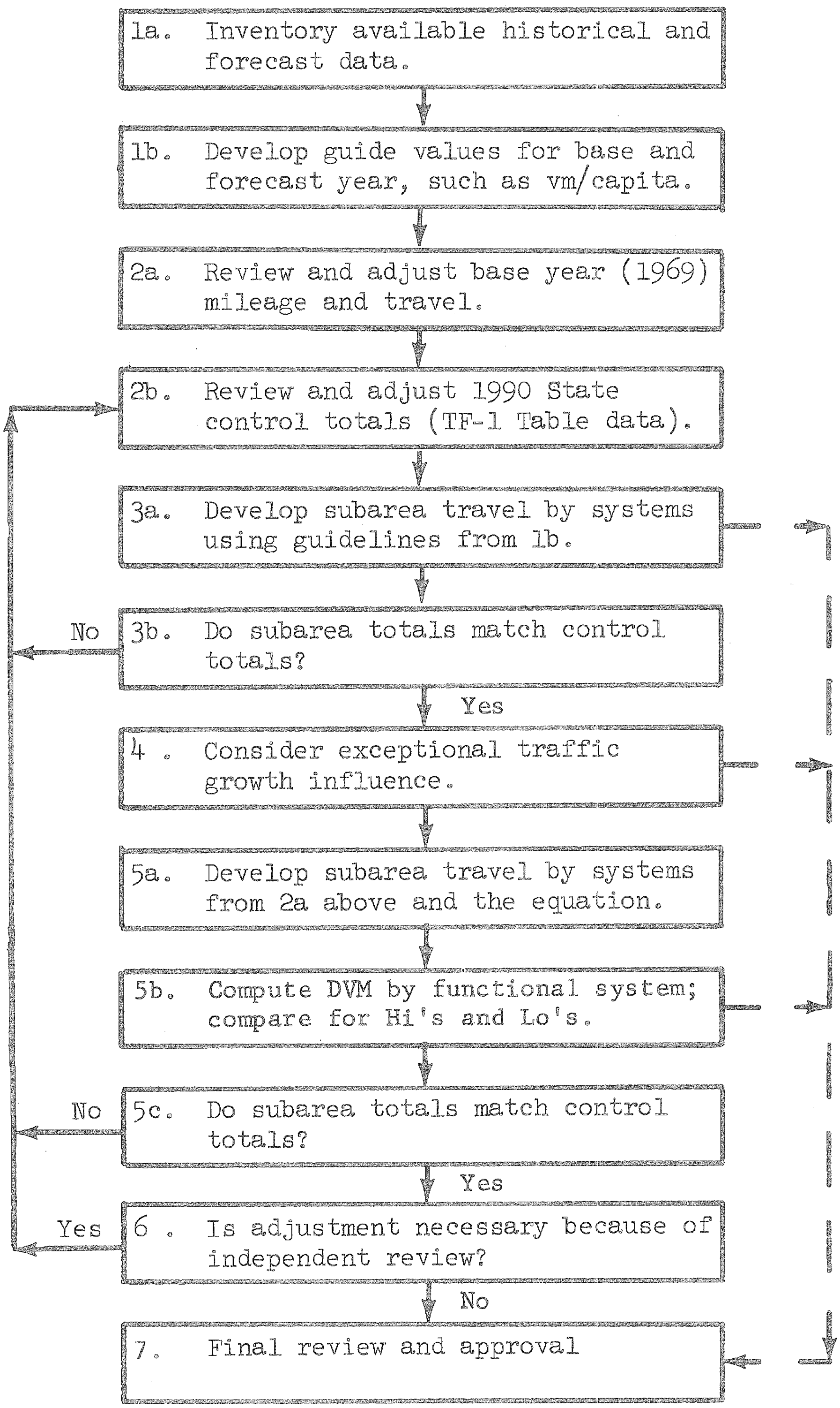
6. --Submit to independent review by other analysts.

7. --Conduct final review and adjustment.

Figure D-1 illustrates the above seven steps in flow-chart form.

FIGURE D-1

TRAVEL DISAGGREGATION ADJUSTMENT PROCEDURES



The suggested dissaggregation-adjustment procedure is presented here in a series of seven steps, four of which are divided into several substeps. Some of the principal steps will almost certainly have to be repeated two or three times to achieve reasonable and consistent results. Steps 1 and 2 should be completed first. The order of undertaking the subsequent steps, initially or in repetitions, is not critical, but all lettered substeps within a numbered principal step should be completed in sequence before proceding further.

Step 1a.--Inventory and review of available data

Historical or trend data providing information for two or more points in time over a 20-year period is particularly valuable. All available data which may be useful in forecasting travel should be sought out, assembled, screened, and reviewed. Principal sources of data have already been listed. Many data items available by county will be useful in the analyses: data on mileage, vehicle registrations, and vehicle-miles of travel will be directly applicable but current, reliable figures (especially in the latter two categories) are not likely to be available for all counties and for all cities in many States. Useful socio-economic data for small geographic areas are generally available from Census and other Federal sources, State and county agencies, and commercial directories and listings. These data include figures on population, commerce, industry, employment, income, educational level, school enrollment, type and age of dwelling units, electric power consumed, telephones in use, hotel and motel receipts or numbers of rooms, etc.

All such assembled data, including the most recent table TA-1, should be examined carefully, and adjusted or adapted as necessary.

For each of the arrays of data selected as potential indicators of travel, each subarea's percentage share of the State total should be computed.

In considering the availability of data, urban transportation study staffs should be contacted to assure that the reliability and consistency of all potentially useful data are fully appraised.

Step 1b.--Development of guideline values for travel forecasts

In most States more detailed data may be available for certain parts of the State than for others, or more extensive data may be available for earlier years.

Particularly useful are vehicle-miles per capita data for the population groups, and percentage distributions of total area mileage and vehicle miles both by road system and by rural-urban categories. If these are not directly available, they may possibly be derived from other available material for selected areas; or some other guidelines may be developed. Tables D-1 and D-2 summarize values reported by each State in tables TF-1 and TF-3 for the 1970 Interstate Cost Estimate.

The trip generation potentials for urbanized areas have been developed as part of the urban transportation planning process, and the data so developed should be used for subarea travel estimates, where applicable, to assure consistency.

Step 2a.--Computation of 1969 State mileage and travel totals

State totals of road mileage, vehicle-miles of travel, vehicle registrations, numbers of licensed drivers, motor-fuel consumption, etc., which may be used to obtain 1969 ADT should be based on table TA-1 (IM 50-1-68) and the summary forms prepared for the functional classification study.

Table D-1a.--Population, age 18-64, persons per vehicle and other data related to vehicle registrations by State as reported by the State highway departments in table TF-1 for the 1970 Interstate Cost Estimate

Division	State	Population, age 18-64, thousands			Annual miles per vehicle			Gallons per vehicle			Persons per vehicle			Licensed drivers per vehicle			Registrations per person 18-64		
		1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
New England	Connecticut	1,675	2,338	1.396	9,076	10,040	1.106	698	772	1.106	1.90	1.73	0.911	1.23	1.09	0.886	0.92	1.11	1.207
	Maine	524	657	1.254	11,583	13,773	1.189	927	1,101	1.188	2.22	1.85	0.833	1.08	1.01	0.935	0.86	0.99	1.151
	Massachusetts	2,973	3,894	1.310	9,673	10,450	1.080	776	850	1.095	2.40	2.00	0.833	1.24	1.03	0.831	0.80	0.91	1.138
	New Hampshire	370	564	1.524	10,458	10,604	1.014	791	864	1.092	1.98	1.74	0.879	1.10	1.11	1.009	0.94	1.04	1.106
	Rhode Island	501	614	1.226	9,457	10,515	1.112	693	729	1.052	2.17	1.72	0.793	1.06	0.94	0.887	0.88	1.05	1.193
	Vermont	221	306	1.385	11,902	12,617	1.060	938	982	1.047	2.16	2.05	0.949	1.11	1.20	1.081	0.88	0.91	1.034
	Total	6,264	8,373	1.337	10,358	11,333	1.094	804	883	1.098	2.14	1.85	0.864	1.14	1.06	0.930	0.88	1.00	1.136
Middle Atlantic	New Jersey	3,973	5,862	1.475	11,117	12,594	1.133	797	893	1.120	2.18	1.86	0.853	1.14	0.92	0.807	0.81	0.97	1.198
	New York	10,509	14,027	1.335	9,755	9,980	1.023	799	841	1.053	2.97	2.63	0.886	1.30	1.21	0.931	1.73	1.45	0.838
	Pennsylvania	6,469	7,102	1.098	9,501	10,536	1.109	752	834	1.109	2.19	1.99	0.909	1.11	1.11	1.000	0.82	1.07	1.305
	Total	20,951	26,991	1.288	10,124	11,037	1.090	783	856	1.093	2.45	2.16	0.882	1.18	1.08	0.915	1.12	1.16	1.036
South Atlantic (North)	Delaware	282	392	1.390	9,600	9,600	1.000	860	836	0.972	1.96	1.83	0.934	1.10	1.13	1.027	0.95	1.14	1.200
	Dist. of Col.	450	490	1.089	10,700	15,500	1.449	976	1,040	1.066	3.27	2.95	0.902	1.39	1.46	1.050	0.55	0.62	1.127
	Maryland	2,089	3,025	1.448	11,056	12,558	1.136	824	866	1.051	2.28	2.00	0.877	1.12	1.04	0.929	0.77	0.91	1.182
	Virginia	2,600	3,460	1.331	11,719	11,732	1.001	905	939	1.038	2.38	1.95	0.819	1.15	1.05	0.913	0.74	0.96	1.297
	West Virginia	978	1,049	1.073	10,163	11,133	1.095	813	891	1.096	2.37	1.91	0.806	1.12	0.90	0.804	0.78	0.99	1.269
	Total	6,399	8,416	1.315	10,648	12,105	1.137	876	914	1.043	2.45	2.13	0.869	1.18	1.12	0.949	0.76	0.92	1.211
South Atlantic (South)	Florida	3,275	6,360	1.942	9,378	10,428	1.112	755	851	1.127	1.78	1.90	1.067	1.08	1.09	1.009	1.04	1.01	0.971
	Georgia	2,466	3,369	1.366	11,221	11,300	1.007	902	930	1.031	2.08	1.63	0.784	0.99	0.93	0.939	0.88	1.16	1.318
	North Carolina	2,820	3,754	1.331	10,140	10,475	1.033	855	890	1.041	2.09	1.66	0.794	1.04	0.93	0.894	0.86	1.13	1.314
	South Carolina	1,405	1,887	1.343	11,090	11,500	1.037	869	923	1.062	2.24	1.97	0.879	1.00	0.97	0.970	0.84	0.97	1.155
	Total	9,966	15,370	1.542	10,457	10,926	1.045	845	899	1.064	2.05	1.79	0.873	1.03	0.98	0.951	0.91	1.07	1.176
East North Central	Illinois	5,928	8,115	1.369	10,333	10,761	1.041	830	875	1.054	2.26	1.79	0.792	1.20	0.99	0.825	0.81	1.04	1.284
	Indiana	2,674	3,635	1.359	10,610	11,124	1.048	849	890	1.048	1.91	1.62	0.848	1.12	1.02	0.911	0.98	1.15	1.173
	Michigan	4,626	6,500	1.405	10,901	12,241	1.123	853	964	1.130	2.08	1.73	0.832	1.18	1.00	0.847	0.89	1.07	1.202
	Ohio	5,720	8,176	1.429	9,493	9,555	1.007	764	780	1.021	1.98	1.79	0.904	1.08	1.03	0.954	0.93	1.03	1.108
	Wisconsin	2,189	3,025	1.382	11,223	11,541	1.028	817	873	1.069	2.15	1.92	0.893	1.17	1.11	0.949	0.89	0.98	1.101
	Total	21,137	29,451	1.393	10,512	11,044	1.051	823	876	1.064	2.08	1.77	0.851	1.15	1.03	0.896	0.90	1.05	1.167
West North Central	Iowa	1,425	1,717	1.205	8,155	9,187	1.127	748	765	1.023	1.67	1.46	0.874	0.96	0.91	0.948	1.16	1.30	1.121
	Kansas	1,217	1,557	1.279	8,432	8,869	1.052	722	760	1.053	1.58	1.44	0.911	0.98	0.94	0.959	1.18	1.35	1.144
	Minnesota	1,851	2,622	1.417	9,345	9,762	1.045	762	797	1.046	1.82	1.63	0.896	1.04	0.91	0.875	1.08	1.11	1.028
	Missouri	3,995	4,876	1.221	10,754	11,948	1.111	913	921	1.009	2.08	1.81	0.870	1.14	1.10	0.965	1.81	1.51	0.834
	Nebraska	750	1,029	1.372	9,805	9,803	1.000	764	771	1.009	1.62	1.45	0.895	0.99	0.89	0.899	1.18	1.30	1.102
	North Dakota	321	385	1.199	8,504	9,561	1.124	640	715	1.117	1.56	1.30	0.833	0.82	0.74	0.902	1.26	1.50	1.190
	South Dakota	335	399	1.191	10,179	10,725	1.054	749	829	1.107	1.64	1.28	0.780	0.97	0.77	0.794	1.21	1.55	1.281
	Total	9,894	12,585	1.272	9,311	9,979	1.072	757	794	1.049	1.71	1.48	0.865	0.99	0.89	0.899	1.27	1.37	1.079
East South Central	Alabama	1,913	2,425	1.268	9,193	10,700	1.164	801	835	1.042	2.04	1.74	0.853	0.92	0.92	1.000	0.91	1.07	1.176
	Kentucky	1,726	2,239	1.297	10,155	10,312	1.015	765	795	1.039	1.97	1.59	0.807	0.88	0.88	1.000	0.95	1.12	1.179
	Mississippi	1,188	1,581	1.331	9,704	10,681	1.101	908	941	1.036	2.32	2.01	0.866	0.96	0.96	1.000	0.85	0.99	1.165
	Tennessee	2,135	2,820	1.321	9,716	10,112	1.041	859	870	1.013	2.11	1.74	0.825	1.04	0.97	0.933	0.88	1.06	1.205
	Total	6,962	9,065	1.302	9,692	10,451	1.078	833	860	1.032	2.11	1.77	0.839	0.95	0.93	0.979	0.90	1.06	1.178
West South Central	Arkansas	1,035	1,336	1.291	9,787	12,841	1.312	934	932	0.998	2.00	1.60	0.800	1.00	0.80	0.800	1.00	1.20	1.200
	Louisiana	1,915	2,858	1.492	8,959	10,326	1.153	799	855	1.070	2.25	1.93	0.858	0.99	1.14	1.152	0.85	0.96	1.129
	Oklahoma	1,383	1,872	1.354	9,833	11,135	1.132	788	881	1.118	1.65	1.28	0.776	0.95	0.90	0.947	1.11	1.42	1.279
	Texas	6,095	9,823	1.612	10,011	10,443	1.043	877	949	1.082	1.92	1.78	0.927	0.95	0.94	0.989	0.97	1.03	1.062
	Total	10,428	15,889	1.524	9,648	11,186	1.159	850	904	1.064	1.96	1.65	0.842	0.97	0.95	0.979	0.98	1.15	1.173
Mountain	Arizona	908	1,642	1.808	10,038	9,775	0.974	807	831	1.030	1.85	1.73	0.935	1.09	1.01	0.927	1.01	1.11	1.099
	Colorado	1,097	1,680	1.531	8,728	8,499	0.974	706	710	1.006	1.62	1.53	0.944	1.02	0.96	0.941	1.13	1.25	1.106
	Idaho	366	540	1.475	9,090	9,538	1.049	732	770	1.052	1.55	1.33	0.858	0.94	0.92	0.979	1.24	1.43	1.153
	Montana	361	485	1.343	8,741	9,266	1.060	756	802	1.061	1.55	1.25	0.806	0.87	0.70	0.805	1.25	1.54	1.232
	Nevada	286	410	1.434	10,498	15,032	1.432	909	910	1.001	1.53	1.40	0.915	1.18	1.17	0.992	1.00	1.43	1.430
	New Mexico	506	915	1.808	10,720	12,607	1.176	921	970	1.053	1.75	1.73	0.989	0.96	1.01	1.052	1.13	1.12	0.991
	Utah	460	580	1.261	8,850	9,233	1.043	745	771	1.035	1.73	1.46	0.844	1.07	1.09	1.019	1.20	1.93	1.608
	Wyoming	177	239	1.350	11,425	11,579	1.013	965	967	1.002	1.42	1.16	0.817	0.98	0.79	0.806	-	-	-
	Total	4,161	6,491	1.560	9,761	10,691	1.095	818	841	1.028	1.63	1.45	0.890	1.01	0.96	0.950	-	-	-
Pacific	California	10,546	20,081	1.904	9,168	9,691	1.057	738	780	1.057	1.74	1.63	0.937	1.02	1.06	1.039	1.02	1.02	1.000
	Oregon	1,095	1,678	1.532	9,719	11,685	1.202	790	935	1.184	1.66	1.29	0.777	0.92	0.81	0.880	1.09	1.36	1.248
	Washington	-	-	-	9,585	9,015	0.941	724	693	0.957	1.73	1.29	0.746	1.00	0.89	0.890	-	-	-
	Total	-	-	-	9,491	10,130	1.067	751	803	1.069	1.71	1.40	0.819	0.98	0.92	0.939	-	-	-
Total - All Divisions		-	-	-	9,985	10,875	1.089	814	861	1.058	1.99	1.72	0.864	1.06	0.99	0.934	-	-	-
	Alaska 1/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hawaii	437	767	1.755	7,917	7,884	0.996	565	563	0.996	2.26	2.37	1.049	1.17	1.26	1.077	0.77	0.74	0.961
United States Total 2/		-	-	-	9,943	10,815	1.088	809	855	1.057	1.99	1.73	0.869	1.06	0.99	0.934	-	-	-

1/ Alaska has no Interstate mileage and therefore did not prepare an estimate.
2/ Where figures are not shown in this line the values were not calculated because of missing data in some States.

Table D-1b.--Miles per gallon, annual travel per capita, and other data related to travel, population, and licensed drivers by State as reported by the State highway departments in table TF-1 for the 1970 Interstate Cost Estimate

Division	State	Miles traveled per gallon of fuel consumed			Age 18-64 as percent total population			Licensed drivers as percent population			Licensed drivers as percent 18-64			Annual travel per capita, miles			Travel per licensed driver, miles			Travel per person 18-64, miles		
		1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
New England	Connecticut	13.00	13.00	1.000	57.20	55.00	0.962	64.80	63.00	0.972	113.30	114.60	1.011	4,785	5,810	1.214	7,384	9,216	1.248	8,364	10,565	1.263
	Maine	12.50	12.50	1.000	52.50	54.40	1.036	48.50	54.60	1.126	92.60	100.30	1.083	5,229	7,428	1.421	10,771	13,605	1.263	9,969	13,647	1.369
	Massachusetts	12.48	12.30	0.986	55.00	54.92	0.999	51.65	51.60	0.999	94.00	94.00	1.000	4,031	5,227	1.297	7,447	10,130	1.360	7,322	9,511	1.299
	New Hampshire	13.22	12.27	0.928	53.55	55.02	1.027	55.57	63.41	1.141	103.78	115.25	1.111	5,282	6,083	1.152	9,505	9,592	1.009	9,865	11,055	1.121
	Rhode Island	13.60	14.42	1.060	55.69	55.54	0.997	52.00	54.75	1.053	93.61	98.53	1.053	4,618	6,119	1.325	8,872	11,175	1.260	8,305	11,011	1.326
	Vermont	12.69	12.85	1.013	52.70	53.70	1.019	51.30	58.40	1.138	97.30	108.80	1.118	5,511	6,153	1.116	10,740	10,533	0.981	10,448	11,462	1.097
	Total	12.92	12.89	0.998	54.44	54.76	1.006	53.97	57.63	1.068	99.10	105.25	1.062	4,909	6,137	1.250	9,120	10,709	1.174	9,046	11,209	1.239
Middle Atlantic	New Jersey	13.95	14.10	1.011	57.00	55.30	0.970	52.30	49.80	0.952	91.70	90.00	0.981	5,103	6,785	1.330	9,765	13,635	1.396	8,954	12,270	1.370
	New York	12.21	11.87	0.972	39.50	41.39	1.048	43.89	45.98	1.048	75.20	83.61	1.112	3,283	3,792	1.155	7,480	8,247	1.103	5,625	6,895	1.226
	Pennsylvania	12.64	12.64	1.000	55.43	47.17	0.851	50.66	55.85	1.102	91.40	118.40	1.295	4,343	5,302	1.221	8,572	9,492	1.107	7,835	11,239	1.434
	Total	12.93	12.87	0.995	50.64	47.95	0.947	48.95	50.54	1.032	86.10	97.34	1.131	4,243	5,293	1.247	8,606	10,458	1.215	7,471	10,135	1.357
South Atlantic (North)	Delaware	11.17	11.48	1.028	53.82	48.04	0.893	56.40	62.20	1.103	104.61	129.34	1.236	4,915	5,257	1.070	8,714	8,460	0.971	9,116	10,942	1.200
	Dist. of Col.	10.92	14.91	1.365	55.70	55.00	0.987	42.60	49.40	1.160	76.40	89.80	1.175	3,271	5,261	1.608	7,683	10,641	1.385	5,873	9,555	1.627
	Maryland	13.42	14.50	1.080	56.70	54.70	0.965	48.90	52.20	1.067	86.20	95.40	1.107	4,842	6,278	1.297	9,901	12,027	1.215	8,532	11,470	1.344
	Virginia	12.95	12.50	0.965	56.50	53.20	0.942	48.50	53.80	1.109	85.80	101.20	1.179	4,920	6,017	1.223	10,153	11,175	1.101	8,708	11,304	1.298
	West Virginia	12.50	12.50	1.000	54.00	52.69	0.976	47.21	47.21	1.000	87.42	89.61	1.025	4,293	5,832	1.358	9,094	12,353	1.358	7,950	11,070	1.392
	Total	12.19	13.18	1.081	55.34	52.73	0.953	48.72	52.96	1.087	88.09	101.07	1.147	4,448	5,729	1.288	9,109	10,931	1.200	8,036	10,868	1.352
South Atlantic (South)	Florida	12.42	12.25	0.986	54.20	52.00	0.959	60.50	57.20	0.945	111.80	110.00	0.984	5,263	5,493	1.044	8,694	9,605	1.105	9,716	10,569	1.088
	Georgia	12.44	12.15	0.977	54.70	52.90	0.967	47.70	56.70	1.189	87.00	107.20	1.232	5,385	6,921	1.285	11,278	12,208	1.082	9,847	13,081	1.328
	North Carolina	11.86	11.77	0.992	55.60	53.10	0.955	49.50	55.90	1.129	89.10	105.20	1.181	4,844	6,297	1.300	9,781	11,268	1.152	8,713	11,859	1.361
	South Carolina	12.75	12.46	0.977	53.30	52.50	0.985	44.80	49.00	1.094	84.10	93.40	1.111	4,961	5,846	1.178	11,071	11,917	1.076	9,314	11,134	1.195
	Total	12.37	12.16	0.983	54.45	52.63	0.967	50.63	54.70	1.080	93.00	103.95	1.118	5,113	6,139	1.201	10,206	11,250	1.102	9,398	11,661	1.241
East North Central	Illinois	12.45	12.30	0.988	54.40	53.70	0.987	53.30	55.20	1.036	97.90	102.70	1.049	4,570	6,022	1.318	8,581	10,910	1.271	8,398	11,206	1.334
	Indiana	12.50	12.50	1.000	53.30	53.50	1.004	58.70	63.10	1.075	110.20	118.00	1.071	5,562	6,866	1.234	9,473	10,880	1.149	10,444	12,844	1.230
	Michigan	12.77	12.70	0.995	53.70	54.20	1.009	56.53	58.00	1.026	105.27	107.02	1.017	5,231	7,008	1.340	9,251	12,220	1.321	9,739	13,077	1.343
	Ohio	12.42	12.25	0.986	54.49	54.00	0.991	54.55	57.49	1.054	100.10	106.46	1.064	4,798	5,333	1.112	8,795	9,276	1.055	8,805	9,875	1.122
	Wisconsin	13.11	13.22	1.008	52.22	53.19	1.019	54.41	57.85	1.063	104.20	108.76	1.044	4,993	6,011	1.204	9,176	10,390	1.132	9,562	11,300	1.182
	Total	12.65	12.59	0.995	53.62	53.72	1.002	55.50	58.33	1.051	103.53	108.59	1.049	5,031	6,248	1.242	9,055	10,735	1.186	9,390	11,660	1.242
West North Central	Iowa	10.90	12.01	1.102	51.72	52.32	1.012	57.49	62.19	1.082	111.16	118.87	1.069	4,890	6,270	1.282	8,506	10,083	1.185	9,455	11,985	1.268
	Kansas	11.67	11.67	1.000	53.40	51.60	0.966	61.80	65.10	1.053	115.90	126.20	1.089	5,327	6,169	1.158	8,617	9,478	1.100	9,984	11,962	1.198
	Minnesota	12.27	12.25	0.998	51.10	55.50	1.086	57.20	56.10	0.981	112.10	101.10	0.902	5,146	5,988	1.164	8,998	10,683	1.187	10,082	10,797	1.071
	Missouri	11.78	12.97	1.101	87.06	83.85	0.963	54.78	60.96	1.113	62.93	72.72	1.156	5,181	6,615	1.277	9,458	10,850	1.147	5,952	7,890	1.326
	Nebraska	12.84	12.72	0.991	52.00	52.90	1.017	60.00	61.70	1.028	116.70	116.60	0.999	6,038	6,765	1.120	9,951	10,971	1.103	11,610	12,794	1.102
	North Dakota	13.30	13.38	1.006	50.90	51.30	1.008	52.80	56.60	1.072	103.70	110.40	1.065	5,458	7,358	1.348	10,342	13,002	1.257	10,729	14,353	1.338
	South Dakota	13.58	12.94	0.953	50.10	50.40	1.006	59.30	60.20	1.015	118.20	119.29	1.009	6,202	8,393	1.353	10,462	13,947	1.333	12,367	16,639	1.345
	Total	12.33	12.56	1.019	56.61	56.84	1.004	57.62	60.41	1.048	105.81	109.31	1.033	5,463	6,794	1.244	9,476	11,288	1.191	10,026	12,346	1.231
East South Central	Alabama	11.47	12.82	1.118	54.15	53.80	0.994	45.23	53.01	1.172	83.53	98.52	1.179	4,514	6,165	1.366	9,981	11,631	1.165	8,338	11,458	1.374
	Kentucky	13.28	12.97	0.977	53.80	56.00	1.041	45.00	55.20	1.227	83.50	98.60	1.181	5,166	6,469	1.252	11,493	11,718	1.020	9,602	11,551	1.203
	Mississippi	10.69	11.35	1.062	50.70	50.30	0.992	41.50	47.70	1.149	81.80	94.90	1.160	4,192	5,306	1.266	10,104	11,122	1.101	8,267	10,552	1.276
	Tennessee	11.31	11.62	1.027	54.20	54.28	1.001	49.43	55.91	1.131	91.19	103.01	1.130	4,612	5,800	1.258	9,331	10,373	1.112	8,510	10,685	1.256
	Total	11.69	12.19	1.043	53.21	53.60	1.007	45.29	52.96	1.169	85.01	98.76	1.162	4,621	5,935	1.284	10,227	11,211	1.096	8,679	11,062	1.275
West South Central	Arkansas	10.50	13.78	1.312	52.00	50.00	0.962	51.00	50.00	0.980	95.00	100.00	1.042	4,943	8,026	1.624	9,651	16,064	1.664	9,418	16,052	1.704
	Louisiana	11.21	12.08	1.078	52.18	53.77	1.030	44.20	58.93	1.333	84.70	109.59	1.294	3,989	5,358	1.343	9,025	9,093	1.008	7,644	9,965	1.304
	Oklahoma	12.48	12.63	1.012	54.40	54.90	1.009	57.60	70.20	1.219	105.90	127.90	1.208	5,965	8,676	1.454	10,350	12,358	1.194	10,964	15,804	1.441
	Texas	11.41	11.00	0.964	53.73	54.70	1.018	49.42	52.63	1.065	91.98	96.21	1.046	5,202	5,864	1.127	10,525	11,142	1.059	9,680	10,720	1.107
	Total	11.40	12.37	1.085	53.08	53.34	1.005	50.56	57.94	1.146	94.65	108.43	1.146	5,025	6,981	1.389	9,888	12,164	1.230	9,427	13,135	1.393
Mountain	Arizona	12.44	12.01	0.965	53.40	52.20	0.978	58.80	58.40	0.993	110.00	112.00	1.018	5,420	5,781	1.067	9,224	9,887	1.072	10,149	11,073	1.091
	Colorado	12.36	11.97	0.968	54.40	52.10	0.958	63.00	62.50	0.992	86.30	83.40	0.966	5,372	5,554	1.034	8,529	8,891	1.042	9,881	10,659	1.079
	Idaho	12.42	12.38	0.997	52.06	52.73	1.013	61.02	69.43	1.138	117.21	131.67	1.123	5,883	7,175	1.220	9,641	10,343	1.073	11,301	13,619	1.205
	Montana	11.56	11.56	1.000	51.70	51.40	0.994	56.01	55.72	0.995	92.30	92.20	0.999	5,648	7,421	1.314	10,082	13,317	1.321	10,920	14,443	1.323
	Nevada	11.54	16.52	1.432	65.00	50.10	0.771	76.80	61.10	0.796	118.20	122.00	1.032	6,848	10,774	1.573	8,914	17,648	1.980	10,535	21,522	2.043
	New Mexico	11.64	13.00	1.117	50.50	51.40	1.018	54.80	58.40	1.066	108.50	113.40	1.045	6,109	7,268	1.190	11,149	12,449	1.117	12,097	14,122	1.167
	Utah	11.88	11.98	1.008	44.30	35.40	0.799	53.70	62.70	1.168	121.80	177.40	1.456	5,120	6,305	1.231	9,533	10,050	1.054	11,543	17,829	1.545
	Wyoming	11.84	11.97	1.011	55.30	51.60	0.933	69.10	68.30	0.988	-	-	-	8,069	9,978	1.237	11,683	14,620	1.251	14,588	19,331	1.325
	Total	11.96	12.67	1.059	53.33	49.62	0.930	61.65	62.07	1.007	-	-	-	6,059	7,532	1.243	9,844	12,151	1.234	11,377	15,325	1.347
Pacific	California	12.42	12.42	1.000	55.80	60.30	1.081	56.60	57.70	1.019	101.30	95.70	0.945	5,263	5,946	1.130	9,307	10,304	1.107	9,432	9,860	1.045
	Oregon	12.30	12.50	1.016	55.30	56.90	1.029	55.60	62.80	1.129	100.40	110.40	1.100	5,844	9,043	1.547	10,514	14,400	1.370	10,492	15,899	1.515
	Washington	13.23	13.00	0.983	-	-	-	57.98	68.50	1.181	-	-	-	5,539	6,975	1.259	9,554	10,183	1.066	-	-	-
	Total	12.65	12.64	0.999	-	-	-	56.73	63.00	1.111	-	-	-	5,549	7,321	1.319	9,792	11,629	1.188	-	-	-
Total - All Divisions		12.29	12.63	1.028	-	-	-	53.97	57.65	1.068	-	-	-	5,142	6,502	1.264	9,533	11,297	1.185	-	-	-
	Alaska 1/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hawaii	14.00	14.00	1.000	57.40	56.70	0.988	51.60	53.00	1.027	91.08	93.48	1.026	3,495	3,324	0.951	6,768	6,268	0.926	6,087	5,859	0.963
United States Total 2/		12.33	12.66	1.027	-	-	-	53.92	57.55	1.067	-	-	-	5,109	6,438	1.260	9,477	11,197	1.181	-	-	-

1/ Alaska has no Interstate mileage and therefore did not prepare an estimate.
2/ Where figures are not shown in this line the values were not calculated because of missing data in some States.

Table D-2a.--Population, total travel, and daily vehicle miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Sheet 1 of 7

Division, State and urbanized or planning area within	Population 1967	Population 1990	Population Ratio 1990/1967	Population as percent of State population 1967	Population as percent of State population 1990	Population as percent of State population Ratio 1990/1967	Total travel (daily vehicle-miles) 1967	Total travel (daily vehicle-miles) 1990	Total travel (daily vehicle-miles) Ratio 1990/1967	Total travel as percent of State total 1967	Total travel as percent of State total 1990	Total travel as percent of State total Ratio 1990/1967	Vehicle miles per capita 1967	Vehicle miles per capita 1990	Vehicle miles per capita Ratio 1990/1967
NEW ENGLAND															
Connecticut:															
Capitol Region-Hartford	638,500	976,100	1.529	21.80	22.96	1.053	8,800,000	18,044,000	2.050	22.92	26.66	1.163	13.78	18.49	1.341
South Central Region-Meriden-New Haven	507,100	708,700	1.398	17.31	16.67	0.963	5,600,000	10,237,000	1.828	14.59	15.13	1.037	11.04	14.44	1.308
Central Naugatuck Valley Region-Waterbury	213,900	318,200	1.488	7.30	7.49	1.026	2,300,000	4,988,000	2.169	5.99	7.37	1.230	10.75	15.68	1.459
Southwestern Region-Stamford-Norwalk	340,200	511,200	1.503	11.62	12.03	1.035	4,000,000	6,658,000	1.665	10.42	9.84	0.944	11.76	13.02	1.107
Greater Bridgeport & Valley Regions-Bridgeport	366,600	464,000	1.266	12.52	10.91	0.871	3,700,000	5,472,000	1.479	9.64	8.09	0.839	10.09	11.79	1.168
Central Connecticut Region-New Britian	209,700	307,100	1.464	7.16	7.22	1.008	2,200,000	4,343,000	1.974	5.73	6.42	1.120	10.49	14.14	1.348
All urbanized areas 3/	2,276,000	3,285,300	1.443	77.71	77.28	0.994	26,500,000	49,742,000	1.870	69.29	73.51	1.061	11.69	15.14	1.295
Maine:															
Portland	143,000	165,000	1.154	14.31	13.67	0.955	1,342,000	1,710,000	1.274	9.38	6.96	0.742	9.38	10.36	1.104
Lewiston-Auburn	73,500	80,500	1.095	7.36	6.67	0.906	577,000	838,000	1.452	4.03	3.41	0.846	7.85	10.41	1.326
All urbanized areas 3/	216,500	245,500	1.134	21.67	20.34	0.939	1,919,000	2,548,000	1.328	13.41	10.37	0.773	8.86	10.38	1.172
Massachusetts:															
Eastern Massachusetts	3,615,390	4,733,000	1.309	66.75	66.80	1.001	35,174,356	67,806,705	1.928	58.98	66.83	1.133	9.73	14.33	1.473
Southeast Massachusetts	492,077	689,047	1.400	9.08	9.73	1.072	6,214,721	13,019,066	2.095	10.42	12.83	1.231	12.63	18.89	1.496
Worcester	288,991	355,087	1.229	5.34	5.01	0.938	2,914,888	5,646,670	1.937	4.89	5.57	1.139	10.09	15.90	1.576
Fitchburg Leominster	87,297	118,600	1.359	1.61	1.67	1.037	763,704	1,930,000	2.527	1.28	1.90	1.484	8.75	16.27	1.859
Springfield	547,900	690,000	1.259	10.12	9.74	0.962	5,024,400	9,176,000	1.826	8.42	9.04	1.074	9.17	13.30	1.450
Pittsfield	72,500	94,700	1.306	1.34	1.34	1.000	748,179	1,674,830	2.239	1.25	1.65	1.320	10.32	17.69	1.714
All urbanized areas 3/	5,104,155	6,680,434	1.309	94.24	94.29	1.001	50,840,248	99,253,271	1.952	85.24	97.82	1.148	9.96	14.86	1.492
New Hampshire:															
Manchester	117,000	151,000	1.291	16.93	14.73	0.870	1,260,000	2,230,000	1.770	12.60	13.05	1.036	10.77	14.77	1.371
All urbanized areas 3/	117,000	151,000	1.291	16.93	14.73	0.870	1,260,000	2,230,000	1.770	12.60	13.05	1.036	10.77	14.77	1.371
Rhode Island:															
Providence	662,000	792,000	1.196	73.47	71.67	0.976	6,600,000	11,900,000	1.803	57.89	64.32	1.111	9.97	15.03	1.508
All urbanized areas 3/	662,000	792,000	1.196	73.47	71.67	0.976	6,600,000	11,900,000	1.803	57.89	64.32	1.111	9.97	15.03	1.508
Division Total 3/	8,375,655	11,154,234	1.332	76.59	76.02	0.993	87,219,248	165,673,271	1.900	65.21	72.26	1.108	12.23	15.63	1.278
MIDDLE ATLANTIC															
New Jersey:															
Atlantic City	130,000	180,000	1.385	1.86	1.70	0.914	1,700,000	3,130,000	1.841	1.73	1.59	0.919	13.08	17.39	1.330
Wilmington (Salem County)	22,800	36,400	1.596	0.33	0.34	1.030	400,000	1,040,000	2.600	0.41	0.53	1.293	17.54	28.57	1.629
Tri-State (N.E. New Jersey)	5,060,000	7,045,000	1.392	72.59	66.46	0.916	52,100,000	99,200,000	1.904	53.06	50.34	0.949	10.30	14.08	1.367
Delaware Valley-Trenton	1,038,000	1,780,000	1.715	14.89	16.79	1.128	14,200,000	24,700,000	1.739	14.46	12.53	0.867	13.68	13.88	1.015
All urbanized areas 3/	6,250,800	9,041,400	1.446	89.67	85.29	0.951	68,400,000	128,070,000	1.872	69.66	64.99	0.933	10.94	14.16	1.294
New York:															
Binghamton	218,000	293,000	1.344	1.21	1.15	0.950	1,862,000	3,853,000	2.069	1.15	1.45	1.261	8.54	13.15	1.540
Albany-Schenectady-Troy	578,000	772,000	1.336	3.21	3.03	0.944	5,063,000	9,700,000	1.916	3.13	3.66	1.169	8.76	12.56	1.434
Utica-Rome	308,000	410,000	1.331	1.71	1.61	0.942	2,855,000	5,888,000	2.062	1.76	2.22	1.261	9.27	14.36	1.549
Buffalo	1,328,000	1,565,000	1.178	7.37	6.13	0.832	9,959,000	15,930,000	1.600	6.15	6.01	0.977	7.50	10.18	1.357
Rochester	663,000	1,069,000	1.612	3.68	4.19	1.139	6,156,000	12,343,000	2.005	3.80	4.66	1.226	9.29	11.55	1.243
Syracuse	412,000	572,000	1.388	2.29	2.24	0.978	3,986,000	6,938,000	1.741	2.46	2.62	1.065	9.67	12.13	1.254
New York City Metropolitan	11,335,000	15,547,000	1.372	62.95	60.96	0.968	68,600,000	97,600,000	1.423	42.36	36.83	0.869	6.05	6.28	1.038
All urbanized areas 3/	14,842,000	20,228,000	1.363	82.42	79.31	0.962	98,481,000	152,252,000	1.546	60.81	57.45	0.945	6.64	7.53	1.134
Pennsylvania:															
Allentown-Bethlehem	356,173	423,400	1.189	3.05	2.81	0.921	2,686,993	6,984,500	2.599	1.93	3.19	1.653	7.54	16.50	2.188
Altoona	105,305	125,300	1.190	0.90	0.83	0.922	952,080	1,697,000	1.782	0.69	0.78	1.130	9.04	13.54	1.498
Erie	189,880	250,000	1.317	1.63	1.66	1.018	1,175,005	2,084,000	1.774	0.85	0.95	1.118	6.19	8.34	1.347
Harrisburg	261,938	455,000	1.737	2.24	3.02	1.348	3,145,986	-	-	-	-	-	-	-	-
Johnstown	112,640	143,000	1.270	0.97	0.95	0.979	745,000	1,620,000	2.174	0.54	0.74	1.370	6.61	11.33	1.714
Lancaster	119,191	187,100	1.570	1.02	1.24	1.216	1,220,168	2,601,136	2.132	0.88	1.19	1.352	10.24	13.90	1.357
Newcastle	66,508	77,600	1.167	0.57	0.52	0.912	-	-	-	-	-	-	-	-	-
Philadelphia-Delaware Valley	3,404,235	4,217,540	1.239	29.17	28.02	0.961	20,052,644	41,749,304	2.082	14.44	19.09	1.322	5.89	9.90	1.681
Pittsburgh	1,628,738	2,148,800	1.319	13.96	14.27	1.022	11,862,000	19,180,000	1.617	8.54	8.77	1.027	7.28	8.93	1.227
Reading	181,956	206,100	1.133	1.56	1.37	0.878	1,211,406	2,140,656	1.767	0.87	0.98	1.126	6.66	10.39	1.560
Scranton-Wilkes-Barre	462,840	564,700	1.220	3.96	3.75	0.947	3,704,755	6,337,900	1.711	2.67	2.90	1.086	8.00	11.22	1.403
York	128,187	160,800	1.254	1.10	1.07	0.973	1,161,432	2,030,330	1.748	0.84	0.93	1.107	9.06	12.63	1.394
All urbanized areas 3/	7,017,591	8,959,340	1.277	60.13	59.51	0.990	47,917,469	86,424,826	1.804	34.51	39.52	1.145	6.83	9.65	1.413
Division Total 3/	28,110,391	38,228,740	1.360	76.70	74.72	0.974	214,798,469	366,746,826	1.707	53.83	53.88	1.001	7.64	9.59	1.255

Table D-2a.--Population, total travel, and daily vehicle miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Sheet 2 of 7

Division, State and urbanized or planning area within	Population			Population as percent of State population			Total travel (daily vehicle-miles)			Total travel as percent of State total			Vehicle miles per capita		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1967/1990	1967	1990	Ratio 1967/1990	1967	1990	Ratio 1967/1990
SOUTH ATLANTIC (North)															
Delaware:															
Wilmington	330,500	497,000	1.504	63.02	60.91	0.967	3,299,600	7,254,790	2.199	47.89	61.87	1.292	9.98	14.60	1.463
All urbanized areas 3/	330,500	497,000	1.504	63.02	60.91	0.967	3,299,600	7,254,790	2.199	47.89	61.87	1.292	9.98	14.60	1.463
District of Columbia:															
Washington, D. C.	808,000	890,000	1.101	100.00	100.00	1.000	7,241,000	12,827,000	1.771	100.00	100.00	1.000	8.96	14.41	1.608
All urbanized areas 3/	808,000	890,000	1.101	100.00	100.00	1.000	7,241,000	12,827,000	1.771	100.00	100.00	1.000	8.96	14.41	1.608
Maryland:															
Baltimore	1,757,000	2,472,000	1.407	47.73	44.73	0.937	15,227,086	34,137,143	2.242	31.18	35.91	1.152	8.67	13.81	1.593
Washington	999,932	1,671,835	1.672	27.16	30.24	1.113	13,655,766	30,162,143	2.209	27.97	31.73	1.134	13.66	18.04	1.321
All urbanized areas 3/	2,756,932	4,143,835	1.503	74.89	74.97	1.001	28,882,852	64,299,286	2.226	59.15	67.64	1.144	10.48	15.52	1.481
Virginia:															
Danville	61,476	111,000	1.806	1.34	1.71	1.276	441,726	1,089,104	2.466	0.71	1.02	1.437	7.19	9.81	1.364
Lynchburg	84,658	120,000	1.417	1.84	1.85	1.005	462,907	1,141,330	2.466	0.75	1.06	1.413	5.47	9.51	1.739
Northern Virginia	720,243	1,642,000	2.280	15.65	25.26	1.614	11,112,500	29,629,410	2.666	17.91	27.65	1.544	15.43	18.04	1.169
Newport News-Hampton Peninsula	307,776	518,000	1.683	6.69	7.97	1.191	3,330,056	7,099,975	2.132	5.37	6.62	1.233	10.82	13.71	1.267
Richmond	451,210	675,000	1.496	9.80	10.38	1.059	6,362,673	15,700,270	2.468	10.26	14.65	1.428	14.10	23.26	1.650
Roanoke	166,803	262,000	1.571	3.62	4.03	1.113	1,513,815	3,735,503	2.468	2.44	3.49	1.430	9.08	14.26	1.570
Southeastern Virginia-Norfolk-Portsmouth	690,743	1,211,000	1.753	15.01	18.63	1.241	6,977,900	16,660,597	2.388	11.25	15.55	1.382	10.10	13.76	1.362
All urbanized areas 3/	2,482,909	4,539,000	1.828	53.95	69.83	1.294	30,201,577	75,056,189	2.485	48.69	70.04	1.438	12.16	16.54	1.360
West Virginia:															
Charleston	245,000	317,100	1.294	13.53	15.93	1.177	2,200,000	3,400,000	1.545	10.33	10.69	1.035	8.98	10.72	1.194
Huntington	263,900	338,000	1.281	14.57	16.97	1.165	1,295,551	2,008,104	1.550	6.08	6.31	1.038	4.91	5.94	1.210
All urbanized areas 3/	508,900	655,100	1.287	28.10	32.90	1.171	3,495,551	5,408,104	1.547	16.41	17.00	1.036	6.87	8.26	1.202
Division Total 3/	6,887,241	10,724,935	1.557	60.27	68.21	1.132	73,120,580	164,845,369	2.254	49.98	63.75	1.276	10.62	15.37	1.447
SOUTH ATLANTIC (South)															
Florida:															
Ft. Lauderdale-Hollywood	550,000	1,600,000	2.909	9.10	13.08	1.437	5,500,000	26,975,000	4.905	6.31	14.65	2.322	10.00	16.86	1.686
Jacksonville	409,900	644,700	1.573	6.78	5.27	0.777	3,429,000	12,129,000	3.537	3.93	6.59	1.677	8.37	18.81	2.247
Miami	1,250,000	2,350,000	1.880	20.67	19.20	0.929	13,250,000	30,750,000	2.321	15.20	16.70	1.099	10.60	13.09	1.235
Orlando	393,000	933,500	2.375	6.50	7.63	1.174	3,652,000	15,678,000	4.293	4.19	8.51	2.031	9.29	16.79	1.807
Pensacola	160,000	342,000	2.138	2.65	2.79	1.053	1,225,000	3,250,000	2.653	1.41	1.76	1.248	7.66	9.50	1.240
St. Petersburg	450,000	1,200,000	2.667	7.44	9.81	1.319	4,433,000	9,895,000	2.232	5.08	5.37	1.057	9.85	8.25	0.838
Tallahassee	70,000	220,000	3.143	1.16	1.80	1.552	809,000	2,078,100	2.569	0.93	1.13	1.215	11.56	9.45	0.817
Tampa	410,000	784,000	1.912	6.78	6.41	0.945	6,760,000	13,953,000	2.064	7.75	7.58	0.978	16.49	17.80	1.079
West Palm Beach	375,000	875,000	2.333	6.20	7.15	1.153	5,150,000	11,450,000	2.223	5.91	6.22	1.052	13.73	13.09	0.953
All urbanized areas 3/	4,067,900	8,949,200	2.200	67.28	73.14	1.087	44,208,000	126,158,100	2.854	50.71	68.51	1.351	10.87	14.10	1.297
Georgia:															
Albany	93,400	325,000	3.480	2.07	5.10	2.464	668,000	2,400,000	3.593	1.00	1.99	1.990	7.15	7.38	1.032
Atlanta	1,242,000	2,373,900	1.911	27.54	37.28	1.354	12,049,844	40,595,182	3.369	18.12	33.63	1.856	9.70	17.10	1.763
Augusta	155,829	259,000	1.662	3.46	4.07	1.176	1,304,761	2,877,000	2.205	1.96	2.38	1.214	8.37	11.11	1.327
Chattanooga	37,100	60,192	1.622	0.82	0.94	1.146	243,438	499,980	2.054	0.37	0.41	1.108	6.56	8.31	1.267
Columbus	232,183	382,000	1.645	5.15	6.00	1.165	1,746,779	4,660,000	2.668	2.63	3.86	1.468	7.52	12.20	1.622
Macon	164,000	265,000	1.616	3.64	4.16	1.143	1,400,000	3,920,000	2.800	2.10	3.25	1.548	8.54	14.79	1.732
Savannah	186,000	247,000	1.328	4.13	3.88	0.939	1,069,351	2,570,000	2.403	1.61	2.13	1.323	5.75	10.40	1.809
All urbanized areas 3/	2,110,512	3,912,092	1.854	46.81	61.43	1.312	18,482,173	57,522,162	3.112	27.79	47.65	1.715	8.76	14.70	1.678
North Carolina:															
Asheville	68,000	115,000	1.691	1.34	1.63	1.216	870,000	1,943,000	2.233	1.29	1.59	1.233	12.79	16.90	1.321
Charlotte	260,000	675,000	2.596	5.13	9.55	1.862	2,642,000	9,585,000	3.628	3.92	7.86	2.005	10.16	14.20	1.398
Durham	103,000	170,000	1.650	2.03	2.41	1.187	957,000	2,159,000	2.256	1.42	1.77	1.246	9.29	12.70	1.367
Fayetteville	97,000	250,000	2.577	1.91	3.54	1.853	954,000	3,276,000	3.434	1.42	2.68	1.887	9.84	13.10	1.331
Greensboro	140,000	261,000	1.864	2.76	3.69	1.337	1,568,000	3,967,000	2.530	2.33	3.25	1.395	11.20	15.20	1.357
High Point	82,000	230,000	2.805	1.62	3.25	2.006	881,000	3,335,000	3.785	1.31	2.73	2.084	10.74	14.50	1.350
Raleigh	110,000	300,000	2.727	2.17	4.24	1.954	1,083,000	3,990,000	3.684	1.61	3.27	2.031	9.85	13.30	1.350
Wilmington	51,000	100,000	1.961	1.00	1.41	1.410	445,000	1,179,000	2.649	0.66	0.97	1.470	8.73	11.79	1.351
Winston-Salem	150,000	317,000	2.113	2.96	4.48	1.514	1,487,000	4,216,000	2.835	2.21	3.46	1.566	9.91	13.30	1.342
All urbanized areas 3/	1,051,000	2,418,000	2.279	20.92	34.20	1.635	10,887,000	33,650,000	3.091	16.17	27.58	1.706	10.26	13.92	1.357

Table D-2a.--Population, total travel, and daily vehicle miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Population			Population as percent of State population			Total travel (daily vehicle-miles)			Total travel as percent of State total			Vehicle miles per capita		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
SOUTH ATLANTIC (South) (Continued)															
South Carolina:															
Charleston	247,400	437,900	1.770	9.38	12.18	1.299	1,617,000	5,360,000	3.315	4.51	9.31	2.064	6.54	12.24	1.872
Columbia	209,700	423,600	2.020	7.95	11.79	1.483	1,648,000	4,360,000	2.646	4.60	7.57	1.646	7.86	10.29	1.309
Greenville	201,500	429,800	2.133	7.64	11.96	1.565	1,900,000	4,660,000	2.453	5.30	8.10	1.528	9.43	10.84	1.150
North Augusta	21,471	36,000	1.677	0.81	1.00	1.235	336,000	722,000	2.149	0.94	1.25	1.330	15.65	20.06	1.282
All urbanized areas 3/	680,071	1,327,300	1.952	25.78	36.93	1.433	5,501,000	15,102,000	2.745	15.35	26.23	1.709	8.09	11.38	1.407
Division Total 3/	7,919,483	16,606,592	2.097	43.36	56.74	1.309	79,078,173	232,432,262	2.939	30.79	47.98	1.558	9.99	14.00	1.401
EAST NORTH CENTRAL															
Illinois:															
Alton	89,000	135,000	1.517	1.00	1.00	1.000	990,000	1,770,000	1.788	0.72	0.71	0.986	11.12	13.11	1.179
Aurora	99,000	-	-	1.00	-	-	922,000	-	-	0.68	-	-	9.31	-	-
Bloomington-Normal	63,000	85,000	1.349	1.00	1.00	1.000	552,000	918,000	1.663	0.40	0.37	0.925	8.76	10.80	1.233
Champaign-Urbana	89,000	167,000	1.876	1.00	1.00	1.000	735,000	1,740,000	2.367	0.54	0.70	1.296	8.26	10.42	1.262
Chicago Illinois Part	5,924,000	9,025,000	1.523	54.00	60.00	1.111	53,900,000	98,000,000	1.818	39.52	39.34	0.995	9.10	10.86	1.193
Danville	54,000	67,000	1.241	-	1.00	-	537,000	810,000	1.508	0.39	0.32	0.821	9.94	12.09	1.216
Decatur	93,000	131,000	1.409	1.00	1.00	1.000	911,000	1,620,000	1.778	0.67	0.65	0.970	9.80	12.37	1.262
East Dubuque	2,100	3,000	1.429	-	-	-	22,000	38,000	1.727	0.02	0.01	0.500	10.48	12.67	1.209
Elgin	62,000	-	-	1.00	-	-	585,000	-	-	0.43	-	-	9.44	-	-
Joliet	125,000	-	-	1.00	-	-	1,382,000	-	-	1.01	-	-	11.06	-	-
Peoria	186,000	320,000	1.720	2.00	2.00	1.000	1,980,000	4,080,000	2.061	1.45	1.64	1.131	10.65	12.75	1.197
Rockford	183,000	345,000	1.885	2.00	2.00	1.000	1,797,000	4,110,000	2.287	1.32	1.65	1.250	9.82	11.91	1.213
Rock Island-Moline	146,000	186,000	1.274	1.00	1.00	1.000	1,460,000	2,270,000	1.555	1.07	0.91	0.850	10.00	12.20	1.220
East St. Louis	282,000	483,000	1.713	2.00	3.00	1.500	3,070,000	5,830,000	1.899	2.25	2.34	1.040	10.89	12.07	1.108
Springfield	119,000	161,000	1.353	1.00	1.00	1.000	1,244,000	2,070,000	1.664	0.91	0.83	0.912	10.45	12.86	1.231
All urbanized areas 3/	7,516,100	11,108,000	1.478	69.00	74.00	1.072	70,087,000	123,256,000	1.759	51.38	49.47	0.963	9.32	11.10	1.191
Indiana:															
Indianapolis	762,110	1,165,500	1.529	15.18	17.14	1.129	7,500,000	16,000,000	2.133	9.80	12.51	1.277	9.84	13.73	1.395
South Bend	242,140	318,766	1.316	4.82	4.69	0.973	1,460,900	1,935,000	1.325	1.91	1.51	0.791	6.03	6.07	1.007
Fort Wayne	205,788	292,162	1.420	4.10	4.30	1.049	1,375,000	1,815,000	1.320	1.80	1.42	0.789	6.68	6.21	0.930
Evansville	158,888	209,169	1.316	3.17	3.07	0.968	1,052,500	1,326,000	1.260	1.38	1.04	0.754	6.62	6.34	0.958
Terre Haute	90,045	118,540	1.316	1.79	1.74	0.972	875,000	1,104,000	1.262	1.14	0.86	0.754	9.72	9.31	0.958
Muncie	86,649	116,720	1.347	1.73	1.72	0.994	725,000	957,000	1.320	0.95	0.75	0.789	8.37	8.20	0.980
Anderson	72,620	109,300	1.505	1.45	1.61	1.110	452,000	726,000	1.606	0.59	0.57	0.966	6.22	6.64	1.068
Lafayette-West Lafayette	73,474	110,584	1.505	1.46	1.63	1.116	550,000	726,000	1.320	0.72	0.57	0.792	7.49	6.57	0.877
Northwest Area	670,000	940,000	1.403	13.34	13.82	1.036	6,190,000	12,900,000	2.084	8.09	10.08	1.246	9.24	13.72	1.485
Louisville Area	85,070	126,700	1.489	1.69	1.86	1.101	690,000	1,012,000	1.467	0.90	0.79	0.878	8.11	7.99	0.985
Cincinnati Area	12,670	16,200	1.279	0.25	0.24	0.960	122,500	174,000	1.420	0.16	0.14	0.875	9.67	10.74	1.111
All urbanized areas 3/	2,459,454	3,523,641	1.433	48.98	51.82	1.058	20,992,900	38,675,000	1.842	27.44	30.24	1.102	8.54	10.98	1.286
Michigan:															
Ann Arbor	154,000	250,800	1.629	1.79	2.09	1.168	1,849,966	4,268,167	2.307	1.50	1.83	1.220	12.01	17.02	1.417
Bay City	87,200	109,800	1.259	1.01	0.92	0.911	623,628	998,898	1.602	0.50	0.43	0.860	7.15	9.10	1.273
Detroit	4,569,000	6,649,050	1.455	53.03	55.44	1.045	45,380,034	126,199,833	2.781	36.76	54.19	1.474	9.93	18.98	1.911
Flint	445,000	720,200	1.618	5.17	6.01	1.162	4,700,000	11,700,000	2.489	3.81	5.02	1.318	10.56	16.25	1.539
Grand Rapids	402,649	629,200	1.563	4.67	5.25	1.124	3,711,420	7,396,416	1.993	3.01	3.18	1.056	9.22	11.76	1.275
Jackson	116,500	182,600	1.567	1.35	1.52	1.126	1,674,600	3,451,000	2.061	1.36	1.48	1.088	14.37	18.90	1.315
Kalamazoo	163,392	318,000	1.946	1.90	2.65	1.395	1,976,319	4,191,786	2.121	1.60	1.80	1.125	12.10	13.18	1.089
Lansing (Tri. County)	368,035	595,163	1.617	4.27	4.96	1.162	5,342,300	11,394,500	2.133	4.33	4.89	1.129	14.52	19.15	1.319
Muskegon	118,100	125,600	1.064	1.37	1.05	0.766	1,235,100	2,346,600	1.900	1.00	1.01	1.010	10.46	18.68	1.786
Niles (South Bend)	23,000	26,400	1.148	0.27	0.22	0.815	220,700	380,800	1.725	0.18	0.16	0.889	9.60	14.42	1.502
Saginaw	166,000	241,500	1.455	1.93	2.01	1.041	1,660,000	3,832,000	2.308	1.34	1.65	1.231	10.00	15.87	1.587
All urbanized areas 3/	6,612,876	9,848,313	1.489	76.76	82.12	1.070	68,374,067	176,160,000	2.576	55.39	75.64	1.366	10.34	17.89	1.730
Ohio:															
Akron	572,100	773,800	1.353	5.45	5.11	0.938	8,066,700	11,560,500	1.433	5.85	5.23	0.894	14.10	14.94	1.060
Bridgeport	43,300	51,200	1.182	0.41	0.34	0.829	548,300	827,100	1.508	0.40	0.37	0.925	12.66	16.15	1.276
Canton	352,700	532,000	1.508	3.36	3.51	1.045	4,586,400	8,005,400	1.745	3.32	3.62	1.090	13.00	15.05	1.158
Cincinnati-Hamilton	1,248,100	1,815,000	1.454	11.89	11.99	1.008	15,210,200	25,288,500	1.663	11.02	11.43	1.037	12.19	13.93	1.143
Cleveland-Loraine-Elyria	2,350,000	3,600,000	1.532	22.39	23.78	1.062	31,914,700	52,000,200	1.629	23.13	23.51	1.016	13.58	14.44	1.063
Columbus	820,000	1,310,000	1.598	7.81	8.65	1.108	10,299,700	18,211,700	1.768	7.47	8.23	1.102	12.56	13.90	1.107
Dayton	701,200	1,148,000	1.637	6.68	7.58	1.135	10,263,900	17,087,500	1.665	7.44	7.73	1.039	14.64	14.88	1.016
(continued)															

Table D-2a.--Population, total travel, and daily vehicle miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Population			Population as percent of State population			Total travel (daily vehicle-miles)			Total travel as percent of State total			Vehicle miles per capita		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
EAST NORTH CENTRAL															
Ohio: (continued)															
Ironton	45,600	55,000	1.206	0.44	0.36	0.818	599,100	876,700	1.463	0.43	0.40	0.930	13.14	15.94	1.213
Lima	88,200	126,500	1.434	0.84	0.84	1.000	1,137,200	2,131,100	1.874	0.82	0.96	1.171	12.89	16.85	1.307
Mansfield	108,500	190,000	1.751	1.03	1.25	1.214	1,592,500	3,159,500	1.984	1.15	1.43	1.243	14.68	16.63	1.133
Springfield	134,400	187,000	1.391	1.28	1.24	0.969	1,675,400	3,059,800	1.826	1.22	1.38	1.131	12.47	16.36	1.312
Steubenville	81,000	88,900	1.098	0.77	0.59	0.766	1,005,200	1,144,100	1.138	0.73	0.52	0.712	12.41	12.87	1.037
Toledo	521,700	691,000	1.325	4.97	4.56	0.918	6,924,800	10,839,000	1.565	5.02	4.90	0.976	13.27	15.69	1.182
Youngstown-Warren	527,900	742,500	1.407	5.03	4.90	0.974	7,312,900	11,491,100	1.571	5.30	5.19	0.979	13.85	15.48	1.118
All urbanized areas 3/	7,594,700	11,310,900	1.489	72.35	74.70	1.032	101,137,000	165,682,200	1.638	73.30	74.90	1.022	13.32	14.65	1.100
Wisconsin:															
Milwaukee	1,223,000	2,093,000	1.711	29.17	36.80	1.262	12,294,000	35,800,000	2.912	21.44	38.23	1.783	10.05	17.10	1.701
Madison	192,000	350,000	1.823	4.58	6.15	1.343	2,166,000	5,179,000	2.391	3.78	5.53	1.463	11.28	14.80	1.312
Green Bay	116,000	165,000	1.422	2.77	2.90	1.047	1,096,000	2,394,000	2.184	1.91	2.56	1.340	9.45	14.51	1.535
Superior	34,000	35,000	1.029	0.81	0.62	0.765	298,000	359,000	1.205	0.52	0.38	0.731	8.76	10.26	1.171
Racine	124,000	268,000	2.161	2.96	4.71	1.591	812,000	1,855,000	2.284	1.42	1.98	1.394	6.55	6.92	1.056
Kenosha	95,000	205,000	2.158	2.27	3.61	1.590	629,000	1,398,000	2.223	1.09	1.49	1.367	6.62	6.82	1.030
All urbanized areas 3/	1,784,000	3,116,000	1.747	42.56	54.79	1.287	17,295,000	46,985,000	2.717	30.16	50.17	1.663	9.69	15.08	1.556
Division Total 3/	25,967,130	38,906,854	1.498	66.21	71.10	1.074	277,885,967	550,758,200	1.982	52.27	59.56	1.139	10.70	14.16	1.323
WEST NORTH CENTRAL															
Iowa:															
Des Moines	272,200	370,000	1.359	9.88	11.27	1.141	2,246,000	4,161,000	1.853	6.08	7.38	1.214	8.25	11.25	1.364
Cedar Rapids	128,800	221,000	1.716	4.67	6.73	1.441	1,278,000	2,788,000	2.182	3.46	4.95	1.431	9.92	12.62	1.272
Davenport	116,500	159,000	1.365	4.23	4.85	1.147	963,000	2,491,000	2.587	2.61	4.42	1.693	8.27	15.67	1.895
Sioux City	93,400	136,000	1.456	3.39	4.14	1.221	919,000	1,446,000	1.573	2.49	2.56	1.028	9.84	10.63	1.080
Waterloo	115,300	171,000	1.483	4.18	5.21	1.246	1,043,000	2,546,000	2.441	2.83	4.52	1.597	9.05	14.89	1.645
Dubuque	69,600	103,000	1.480	2.53	3.14	1.241	430,000	914,000	2.126	1.17	1.62	1.385	6.18	8.87	1.435
Council Bluffs	66,600	91,000	1.366	2.42	2.77	1.145	450,000	943,000	2.096	1.22	1.67	1.369	6.76	10.36	1.533
All urbanized areas 3/	862,400	1,251,000	1.451	31.30	38.11	1.218	7,329,000	15,289,000	2.086	19.86	27.12	1.366	8.50	12.22	1.438
Kansas:															
Kansas City	348,000	805,500	2.315	15.26	26.68	1.748	3,834,640	10,097,080	2.633	11.52	19.79	1.718	11.02	12.54	1.138
Wichita	327,900	434,900	1.326	14.38	14.41	1.002	3,295,040	5,700,420	1.730	9.90	11.17	1.128	10.05	13.11	1.304
Topeka	147,400	208,000	1.411	6.46	6.89	1.067	1,269,290	2,373,570	1.870	3.81	4.65	1.220	8.61	11.41	1.325
All urbanized areas 3/	823,300	1,448,400	1.759	36.10	47.98	1.329	8,398,970	18,171,070	2.163	25.23	35.61	1.411	10.20	12.55	1.230
Minnesota:															
Minneapolis and St. Paul	1,694,000	2,994,000	1.767	46.72	63.32	1.355	18,124,000	33,364,000	1.841	35.45	43.03	1.214	10.70	11.14	1.041
Duluth	122,000	155,000	1.270	3.36	3.28	0.976	1,034,000	1,364,000	1.319	2.02	1.74	0.861	8.48	8.80	1.038
Moorhead (Fargo-Moorhead)	34,000	57,000	1.676	0.94	1.21	1.287	205,000	353,000	1.722	0.40	0.46	1.150	6.03	6.19	1.027
All urbanized areas 3/	1,850,000	3,206,000	1.733	51.02	67.81	1.329	19,363,000	35,081,000	1.812	37.87	45.23	1.194	10.47	10.94	1.045
Missouri:															
St. Louis	1,690,000	2,478,000	1.466	36.53	42.61	1.166	17,026,000	32,731,000	1.922	24.37	31.04	1.274	10.07	13.21	1.312
Kansas City	832,000	1,478,000	1.776	17.98	25.41	1.413	8,475,000	22,000,000	2.596	12.13	20.87	1.721	10.19	14.88	1.460
Springfield	119,000	202,000	1.697	2.57	3.47	1.350	1,498,000	2,550,000	1.702	2.14	2.42	1.131	12.59	12.62	1.002
St. Joseph	83,000	100,000	1.205	1.79	1.72	0.961	873,000	1,122,000	1.285	1.25	1.06	0.848	10.52	11.22	1.067
All urbanized areas 3/	2,724,000	4,258,000	1.563	58.87	73.21	1.244	27,872,000	58,403,000	2.095	39.89	55.39	1.389	10.23	13.72	1.341
Nebraska:															
Lincoln	147,729	240,000	1.625	10.24	12.33	1.204	1,126,000	2,168,000	1.925	4.72	6.01	1.273	7.62	9.03	1.185
Omaha	338,156	500,000	1.479	23.45	25.70	1.096	3,135,000	6,172,800	1.969	13.14	17.11	1.302	9.27	12.35	1.332
South Sioux City (Sioux City)	9,200	15,000	1.630	0.64	0.77	1.203	80,000	135,000	1.688	0.34	0.38	1.118	8.70	9.00	1.034
All urbanized areas 3/	495,085	755,000	1.525	34.33	38.80	1.130	4,341,000	8,475,800	1.952	18.20	23.50	1.291	8.77	11.23	1.281
North Dakota:															
Fargo (Fargo-Moorhead)	53,200	85,000	1.598	8.43	11.32	1.343	338,037	765,000	2.263	3.58	5.05	1.411	6.35	9.00	1.417
All urbanized areas 3/	53,200	85,000	1.598	8.43	11.32	1.343	338,037	765,000	2.263	3.58	5.05	1.411	6.35	9.00	1.417
South Dakota:															
Sioux Falls	77,500	129,000	1.665	11.60	16.31	1.406	691,762	1,315,972	1.902	6.09	7.23	1.187	8.93	10.20	1.142
All urbanized areas 3/	77,500	129,000	1.665	11.60	16.31	1.406	691,762	1,315,972	1.902	6.09	7.23	1.187	8.93	10.20	1.142
Division Total 3/	6,885,485	11,132,400	1.617	42.95	54.75	1.275	68,333,769	137,500,842	2.012	28.97	38.22	1.319	9.92	12.35	1.245

Table D-2a.--Population, total travel, and daily vehicle-miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Sheet 5 of 7

Division, State and urbanized or planning area within	Population 1967	Population 1990	Population Ratio 1990/1967	Population as percent of State population 1967	Population as percent of State population 1990	Population as percent of State population Ratio 1990/1967	Total travel (daily vehicle-miles) 1967	Total travel (daily vehicle-miles) 1990	Total travel Ratio 1990/1967	Total travel as percent of State total 1967	Total travel as percent of State total 1990	Total travel as percent of State total Ratio 1990/1967	Vehicle miles per capita 1967	Vehicle miles per capita 1990	Vehicle miles per capita Ratio 1990/1967
EAST SOUTH CENTRAL															
Alabama:															
Columbus-Phenix City	29,000	35,000	1.207	0.82	0.78	0.951	410,000	494,000	1.205	0.94	0.65	0.691	14.14	14.11	0.998
Birmingham	536,000	640,000	1.194	15.17	14.20	0.936	4,575,000	-	-	10.47	-	-	8.54	-	-
Gadsden	71,500	83,000	1.161	2.02	1.84	0.911	1,570,000	1,830,000	1.166	3.59	2.40	0.669	21.96	22.05	1.004
Huntsville	87,500	137,500	1.571	2.48	3.05	1.230	-	-	-	-	-	-	-	-	-
Mobile	275,000	309,000	1.124	7.78	6.86	0.882	2,180,000	-	-	4.99	-	-	7.93	-	-
Montgomery	148,000	187,000	1.264	4.19	4.15	0.990	1,250,000	2,570,000	2.056	2.86	3.38	1.182	8.45	13.74	1.626
Tuscaloosa	79,000	93,000	1.177	2.24	2.06	0.920	810,000	2,035,000	2.512	1.85	2.67	1.443	10.25	21.88	2.135
All urbanized areas 3/	1,226,000	1,484,500	1.211	34.70	32.94	0.949	10,795,000	6,929,000	0.642	24.70	9.10	0.368	8.81	4.67	0.530
Kentucky:															
Louisville	553,147	1,106,447	2.000	17.24	27.68	1.606	5,560,853	16,765,580	3.015	12.25	23.66	1.931	10.05	15.15	1.507
Covington	206,439	327,900	1.588	6.44	8.20	1.273	2,084,080	5,537,838	2.657	4.59	7.82	1.704	10.09	16.88	1.673
Ashland	58,000	85,730	1.478	1.81	2.14	1.182	640,164	1,251,741	1.955	1.41	1.77	1.255	11.04	14.60	1.322
Lexington	152,712	281,000	1.840	4.76	7.03	1.477	1,320,647	3,094,147	2.343	2.91	4.37	1.502	8.65	11.01	1.273
All urbanized areas 3/	970,298	1,801,077	1.856	30.25	45.05	1.489	9,605,744	26,649,306	2.774	21.16	37.61	1.777	9.91	14.80	1.493
Mississippi:															
Jackson	213,000	520,000	2.441	9.09	16.54	1.820	1,660,000	6,712,000	4.043	6.17	14.68	2.379	7.79	12.91	1.657
Gulf Coast	252,000	520,000	2.063	10.76	16.54	1.537	-	-	-	-	-	-	-	-	-
All urbanized areas 3/	465,000	1,040,000	2.237	19.85	33.08	1.666	1,660,000	6,712,000	4.043	6.17	14.68	2.379	3.57	6.45	1.807
Tennessee:															
Chattanooga	220,000	396,600	1.803	5.59	7.63	1.365	2,851,200	5,235,100	1.836	5.73	6.34	1.106	12.96	13.20	1.019
Kingsport	61,000	110,000	1.803	1.55	2.12	1.368	846,700	1,452,000	1.715	1.70	1.76	1.035	13.88	13.20	0.951
Knoxville	220,000	376,500	1.711	5.59	7.25	1.297	2,915,000	4,969,800	1.705	5.86	6.02	1.027	13.25	13.20	0.996
Memphis	602,200	1,194,700	1.984	15.29	23.00	1.504	6,961,400	12,544,000	1.802	13.99	15.19	1.086	11.56	10.50	0.908
Nashville	407,000	519,300	1.276	10.33	10.00	0.968	5,392,800	5,972,000	1.107	10.83	7.23	0.668	13.25	11.50	0.868
All urbanized areas 3/	1,510,200	2,597,100	1.720	38.34	49.99	1.304	18,967,100	30,172,900	1.591	38.11	36.55	0.959	12.56	11.62	0.925
Division Total 3/	4,171,498	6,922,677	1.660	32.03	41.10	1.283	41,027,844	70,463,206	1.717	24.75	25.60	1.034	9.84	10.18	1.035
WEST SOUTH CENTRAL															
Arkansas:															
Little Rock	244,487	412,103	1.686	12.40	15.42	1.244	2,391,490	6,832,000	2.857	8.99	6.18	0.687	9.78	16.58	1.695
Fort Smith	84,784	150,580	1.776	4.30	5.64	1.312	801,324	2,634,200	3.287	3.01	2.38	0.791	9.45	17.49	1.851
Pine Bluff	67,534	99,931	1.480	3.42	3.74	1.094	463,436	1,894,597	4.088	1.74	1.71	0.983	6.86	18.96	2.764
Texarkana	26,706	46,200	1.730	1.35	1.73	1.281	225,753	1,318,690	5.841	0.85	1.19	1.400	8.45	28.54	3.378
All urbanized areas 3/	423,511	708,814	1.674	21.48	26.53	1.235	3,882,003	12,679,487	3.266	14.59	11.47	0.786	9.17	17.89	1.951
Louisiana:															
Monroe	101,364	179,482	1.771	2.76	3.38	1.225	946,718	1,676,779	1.771	2.36	2.15	0.911	9.34	9.34	1.000
Lake Charles	90,038	152,422	1.693	2.45	2.87	1.171	791,608	1,484,185	1.875	1.97	1.90	0.964	8.79	9.74	1.108
LaFayette	80,615	141,674	1.757	2.20	2.67	1.214	698,158	1,226,284	1.756	1.74	1.57	0.902	8.66	8.66	1.000
Baton Rouge	275,049	489,653	1.780	7.49	9.21	1.230	3,207,249	6,062,272	1.890	8.00	7.77	0.971	11.66	12.38	1.062
Shreveport	266,769	456,082	1.710	7.27	8.58	1.180	3,668,056	6,271,521	1.710	9.15	8.04	0.879	13.75	13.75	1.000
New Orleans	1,079,229	1,556,953	1.443	29.41	29.29	0.996	7,747,635	12,632,038	1.630	19.32	16.19	0.838	7.18	8.11	1.130
All urbanized areas 3/	1,893,064	2,976,266	1.572	51.58	56.00	1.086	17,059,424	29,353,079	1.721	42.54	37.62	0.884	9.01	9.86	1.094
Oklahoma:															
Oklahoma City	606,000	1,093,000	1.804	22.84	32.05	1.344	5,576,000	20,876,000	3.744	13.42	25.76	1.920	9.20	19.10	2.076
Tulsa	395,000	633,000	1.603	15.54	18.56	1.194	3,829,000	10,259,000	2.679	9.22	12.66	1.373	9.69	16.21	1.673
Lawton	81,000	149,000	1.840	3.19	4.37	1.370	592,000	2,183,000	3.688	1.42	2.69	1.894	7.31	14.65	2.004
All urbanized areas 3/	1,082,000	1,875,000	1.733	42.56	54.99	1.292	9,997,000	33,318,000	3.333	24.06	41.11	1.709	9.24	17.77	1.923
Texas:															
Abilene	111,000	163,000	1.468	0.98	0.91	0.929	1,011,000	1,693,000	1.675	0.63	0.59	0.937	9.11	10.39	1.141
Amarillo	188,000	399,000	2.122	1.66	2.22	1.337	1,814,000	4,743,000	2.615	1.12	1.64	1.464	9.65	11.89	1.232
Austin	257,000	530,000	2.062	2.27	2.95	1.300	2,069,000	4,546,000	2.197	1.28	1.58	1.234	8.05	8.58	1.066
Corpus Christi	223,000	379,000	1.700	1.97	2.11	1.071	1,523,000	3,395,000	2.229	0.94	1.18	1.255	6.83	8.96	1.312
Dallas-Ft. Worth	2,162,000	4,472,000	2.068	19.06	24.90	1.306	24,806,000	54,890,000	2.213	15.35	19.02	1.239	11.47	12.27	1.070
El Paso	368,000	625,000	1.698	3.24	3.48	1.074	2,866,000	5,740,000	2.003	1.77	1.99	1.124	7.79	9.18	1.178
Galveston	220,000	530,000	2.409	1.94	2.95	1.521	1,823,000	5,963,000	3.271	1.13	2.07	1.832	8.29	11.25	1.357
Harlingen-San Benito	74,000	156,000	2.108	0.65	0.87	1.338	576,000	1,365,000	2.370	0.36	0.47	1.306	7.78	8.75	1.125
Houston	1,612,000	3,593,000	2.229	14.21	20.00	1.407	19,030,000	46,170,000	2.426	11.77	16.00	1.359	11.81	12.85	1.088
Jefferson-Orange Counties	362,000	633,000	1.749	3.19	3.52	1.103	2,773,000	6,204,000	2.237	1.72	2.15	1.250	7.66	9.80	1.279
(continued)															

Table D-2a.--Population, total travel, and daily vehicle-miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Population			Population as percent of State population			Total travel (daily vehicle-miles)			Total travel as percent of State total			Vehicle miles per capita		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
WEST SOUTH CENTRAL															
Texas: (continued)															
Laredo	69,000	104,000	1.507	0.61	0.58	0.951	319,000	713,000	2.235	0.20	0.25	1.250	4.62	6.86	1.485
Lubbock	185,000	394,000	2.130	1.63	2.20	1.350	1,639,000	3,939,000	2.403	1.01	1.37	1.356	8.86	10.00	1.129
McAllen-Pharr	79,000	131,000	1.658	0.70	0.73	1.043	629,000	1,143,000	1.817	0.39	0.40	1.026	7.96	8.73	1.097
Midland-Odessa	167,000	218,000	1.305	1.47	1.22	0.830	1,591,000	2,381,000	1.497	0.98	0.82	0.837	9.53	10.92	1.146
San Angelo	70,000	115,000	1.643	0.62	0.64	1.032	561,000	996,000	1.775	0.35	0.35	1.000	8.01	8.66	1.081
San Antonio	803,000	1,305,000	1.625	7.08	7.27	1.027	6,994,000	13,968,000	1.997	4.33	4.84	1.118	8.71	10.70	1.228
Sherman-Denison	60,000	112,000	1.867	0.53	0.62	1.170	518,000	1,128,000	2.178	0.32	0.39	1.219	8.63	10.07	1.167
Texarkana	40,000	64,000	1.600	0.35	0.36	1.029	361,000	653,000	1.809	0.22	0.23	1.045	9.03	10.20	1.130
Tyler	69,000	109,000	1.580	0.60	0.61	1.067	586,000	1,103,000	1.882	0.36	0.38	1.056	8.49	10.12	1.192
Waco	141,000	209,000	1.482	1.24	1.16	0.935	1,328,000	2,391,000	1.800	0.82	0.83	1.012	9.42	11.44	1.214
Wichita Falls	119,000	181,000	1.521	1.05	1.01	0.962	1,119,000	1,886,000	1.685	0.69	0.65	0.942	9.40	10.42	1.109
All urbanized areas 3/	7,379,000	14,422,000	1.954	65.05	80.31	1.235	73,936,000	165,010,000	2.232	45.74	57.20	1.251	10.02	11.44	1.142
Division Total 3/	10,777,575	19,982,080	1.854	55.19	68.07	1.233	104,874,427	240,360,566	2.292	38.86	43.07	1.108	9.73	12.03	1.236
MOUNTAIN															
Arizona:															
Phoenix	869,000	1,958,000	2.253	51.12	62.26	1.218	8,776,900	23,887,600	2.722	34.76	47.95	1.379	10.10	12.20	1.208
Tucson	319,000	591,000	1.853	18.76	18.79	1.002	3,317,600	7,387,500	2.227	13.14	14.83	1.129	10.40	12.50	1.202
All urbanized areas 3/	1,188,000	2,549,000	2.146	69.88	81.05	1.160	12,094,500	31,275,100	2.586	47.90	62.78	1.310	10.18	12.27	1.205
Colorado:															
Denver	1,012,000	1,745,000	1.724	50.14	54.12	1.079	10,163,700	17,581,200	1.730	34.22	35.84	1.047	10.04	10.08	1.004
Colorado Springs	204,670	478,814	2.339	10.14	14.85	1.464	1,666,900	3,915,000	2.349	5.61	7.98	1.422	8.14	8.18	1.005
Pueblo	114,000	168,346	1.477	5.64	5.22	0.926	882,000	1,308,600	1.484	2.97	2.67	0.899	7.74	7.77	1.004
All urbanized areas 3/	1,130,670	2,392,160	2.116	61.92	74.19	1.198	12,712,600	22,804,800	1.794	42.80	46.49	1.086	11.24	9.53	0.848
Idaho:															
Boise	102,000	166,300	1.630	14.62	16.24	1.111	955,000	1,833,000	1.919	8.43	9.10	1.079	9.29	11.02	1.186
All urbanized areas 3/	102,000	166,300	1.630	14.62	16.24	1.111	955,000	1,833,000	1.919	8.43	9.10	1.079	9.29	11.02	1.186
Montana:															
Billings	77,463	124,223	1.604	11.10	13.16	1.186	798,577	1,582,832	1.982	7.39	8.24	1.115	10.31	12.74	1.236
Great Falls	76,919	118,221	1.537	11.02	12.52	1.136	577,806	1,120,093	1.939	5.35	5.84	1.092	7.51	9.47	1.261
All urbanized areas 3/	154,382	242,444	1.570	22.12	25.68	1.161	1,376,383	2,702,925	1.964	12.74	14.08	1.105	8.92	11.15	1.250
Nevada:															
Reno	88,000	181,000	2.057	20.00	22.10	1.105	864,000	3,500,000	4.051	10.47	14.47	1.382	9.82	19.34	1.969
Las Vegas	178,000	345,000	1.938	40.45	42.12	1.041	2,161,000	6,583,000	3.046	26.18	27.23	1.040	12.14	19.08	1.572
All urbanized areas 3/	266,000	526,000	1.977	60.45	64.22	1.062	3,025,000	10,083,000	3.333	36.64	41.71	1.138	11.37	19.17	1.686
New Mexico:															
Albuquerque	262,274	564,922	2.154	26.18	31.77	1.214	2,712,000	8,760,000	3.230	16.17	24.74	1.530	10.34	15.51	1.500
Hobbs	30,114	55,023	1.827	3.01	3.09	1.027	206,000	564,000	2.738	1.23	1.59	1.293	6.84	10.25	1.499
Las Cruces	44,660	85,142	1.906	4.46	4.79	1.074	338,000	966,000	2.858	2.02	2.73	1.351	7.57	11.35	1.499
Roswell	46,139	73,516	1.593	4.60	4.13	0.898	339,000	810,000	2.389	2.02	2.29	1.134	7.35	11.02	1.499
Santa Fe	40,585	85,945	2.118	4.05	4.83	1.193	291,000	924,000	3.175	1.74	2.61	1.500	7.17	10.75	1.499
All urbanized areas 3/	423,772	864,548	2.040	42.30	48.61	1.149	3,886,000	12,024,000	3.094	23.18	33.96	1.465	39.27	58.88	1.499
Utah:															
Provo-Orem	69,000	109,000	1.580	6.65	6.65	1.000	967,000	1,884,000	1.948	6.64	6.65	1.002	14.01	17.28	1.233
Salt Lake	411,000	610,000	1.484	39.62	37.20	0.939	4,316,000	8,159,000	1.890	29.67	28.79	0.970	10.50	13.38	1.274
Ogden	136,000	215,000	1.581	13.11	13.11	1.000	1,390,000	2,685,000	1.932	9.56	9.47	0.991	10.22	12.49	1.222
All urbanized areas 3/	616,000	934,000	1.516	59.38	56.96	0.959	6,673,000	12,708,000	1.904	45.87	44.91	0.979	10.83	13.61	1.257
Division Total 3/	3,880,824	7,674,452	1.978	51.08	61.03	1.195	40,722,483	93,430,825	2.294	34.91	41.32	1.184	10.49	12.17	1.160

Table D-2a.--Population, total travel, and daily vehicle-miles per capita by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Population			Population as percent of State population			Total travel (daily vehicle-miles)			Total travel as percent of State total			Vehicle miles per capita		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
PACIFIC															
California:															
Bakersfield	172,000	375,000	2.180	0.91	1.13	1.242	1,059,500	2,266,600	2.139	0.39	0.42	1.077	6.16	6.04	0.981
Fresno	260,000	417,000	1.604	1.38	1.25	0.906	2,414,900	5,295,700	2.193	0.89	0.98	1.101	9.29	12.70	1.367
Los Angeles-Long Beach, Pomona-Ontario, San Bernardino-Riverside	8,453,000	15,135,000	1.790	44.73	45.45	1.016	96,739,900	194,392,900	2.009	35.50	35.83	1.009	11.44	12.84	1.122
Oxnard	139,000	952,000	6.849	0.74	2.86	3.865	1,001,200	12,917,500	12.902	0.37	2.38	6.432	7.20	13.57	1.885
Sacramento	552,000	1,039,000	1.882	2.92	3.12	1.068	5,593,300	18,744,000	3.351	2.05	3.46	1.688	10.13	18.04	1.781
Salinas-Monterey	55,000	128,000	2.327	0.29	0.38	1.310	486,200	946,800	1.947	0.18	0.17	0.944	8.84	7.40	0.837
San Diego	976,000	1,980,000	2.029	5.16	5.95	1.153	11,676,800	35,758,600	3.062	4.28	6.59	1.540	11.96	18.06	1.510
San Francisco-Oakland, San Jose	3,676,000	6,775,000	1.843	19.45	20.34	1.046	42,826,900	116,466,700	2.719	15.71	21.47	1.367	11.65	17.19	1.476
Santa Barbara	113,000	274,000	2.425	0.60	0.82	1.367	1,390,200	2,894,000	2.082	0.51	0.53	1.039	12.30	10.56	0.859
Stockton	156,000	233,000	1.494	0.82	0.70	0.854	1,591,300	3,298,600	2.073	0.58	0.61	1.052	10.20	14.16	1.388
All urbanized areas 3/	14,552,000	27,308,000	1.877	77.00	82.00	1.065	164,780,200	392,981,400	2.385	60.46	72.44	1.198	11.32	14.39	1.271
Oregon:															
Eugene	137,700	276,400	2.007	6.95	9.37	1.348	1,778,800	4,788,500	2.692	5.61	6.55	1.168	12.92	17.32	1.341
Salem	101,700	223,340	2.196	5.13	7.57	1.476	1,053,800	4,328,700	4.108	3.33	5.92	1.778	10.36	19.38	1.871
Portland	727,980	1,094,330	1.503	36.75	37.11	1.010	7,985,800	20,695,000	2.591	25.20	28.33	1.124	10.97	18.91	1.724
All urbanized areas 3/	967,380	1,594,070	1.648	48.83	54.05	1.107	10,818,400	29,812,200	2.756	34.14	40.80	1.195	11.18	18.70	1.673
Washington:															
Seattle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spokane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tacoma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All urbanized areas 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Division Total 3/	15,519,380	28,902,070	1.862	74.33	79.73	1.073	175,598,600	422,793,600	2.408	57.72	68.69	1.190	11.31	14.63	1.294
Total - All Divisions 3/	118,499,662	190,235,034	1.605	61.22	67.72	1.106	1,162,659,560	1,445,004,967	2.103	45.42	53.01	1.167	9.81	12.85	1.310
Hawaii:															
Island of Oahu	619,000	1,175,000	1.898	81.34	86.91	1.068	4,746,000	9,938,000	2.094	65.12	80.72	1.240	7.67	8.46	1.103
All urbanized areas 3/	619,000	1,175,000	1.898	81.34	86.91	1.068	4,746,000	9,938,000	2.094	65.12	80.72	1.240	7.67	8.46	1.103
United States Total 3/	119,113,662	191,410,034	1.607	61.29	67.82	1.107	1,167,405,560	2,454,942,967	2.103	45.47	53.08	1.167	9.80	12.83	1.309

1/ Data are from table TF-3 prepared by the State highway departments for the 1970 Interstate Cost Estimate. The data are generally for the area within the planning area cordon, but may be for area bounded by present urban limits in some cases.
2/ 1967 Interstate System mileage and travel as shown in this table are given on one of three bases: (1) completed Interstate mileage only; (2) completed mileage plus traveled-way; or (3) designated mileage for a completed system. 1990 mileage and travel are for the designated system only.
3/ United States, census division and all urbanized area totals were calculated using available data. In some cases these totals are not completely representative because of data not reported.
4/ Dashes (-) indicate either zero values or data not reported.

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
NEW ENGLAND															
Connecticut:															
Capitol Region-Hartford	2,187,755	5,205,690	2.379	24.86	28.85	1.160	3,071.00	3,367.00	1.096	52.99	77.20	1.457	25.23	22.31	0.884
South Central Region-Meriden-New Haven	1,267,770	2,048,320	1.616	22.64	20.01	0.884	2,127.00	2,418.00	1.137	31.95	31.95	1.000	15.22	9.24	0.607
Central Naugatuck Valley Region-Waterbury	349,173	1,133,140	3.245	15.18	22.72	1.497	1,288.00	1,508.00	1.171	22.03	22.70	1.030	10.49	6.56	0.625
Southwestern Region-Stamford-Norwalk	1,394,572	1,949,840	1.398	34.86	29.29	0.840	1,420.00	1,715.00	1.208	21.38	22.20	1.038	10.18	6.42	0.631
Greater Bridgeport & Valley Regions-Bridgeport	843,992	1,177,600	1.395	22.81	21.52	0.943	1,450.00	1,687.00	1.163	12.16	12.50	1.028	5.79	3.61	0.623
Central Connecticut Region-New Britian	107,912	835,080	7.739	4.91	19.23	3.916	839.00	1,001.00	1.193	7.60	11.50	1.513	3.62	3.32	0.917
All urbanized areas 3/	6,151,174	12,349,670	2.008	26.74	24.83	0.929	10,195.00	11,696.00	1.147	148.11	178.05	1.202	70.53	51.46	0.730
Maine:															
Portland	291.747	770,297	2.640	21.74	45.05	2.072	835.29	966.38	1.157	31.50	30.20	0.959	9.76	9.68	0.992
Lewiston Auburn	-	-	-	-	-	-	137.28	140.90	1.026	-	-	-	-	-	-
All urbanized areas 3/	291,747	770,297	2.640	15.20	20.23	1.989	972.57	1,107.28	1.139	31.50	30.20	0.959	9.76	9.68	0.992
Massachusetts:															
Eastern Massachusetts	5,411,364	13,517,871	2.498	15.38	19.94	1.296	13,346.81	16,327.07	1.223	155.40	222.50	1.432	44.29	47.05	1.062
Southeast Massachusetts	1,107,549	3,073,012	2.775	17.82	23.60	1.324	3,066.77	3,348.39	1.092	39.30	59.40	1.511	11.20	12.56	1.121
Worcester	480,312	1,028,715	2.142	16.48	18.22	1.106	1,221.14	1,339.36	1.097	19.20	30.20	1.573	5.47	6.38	1.166
Fitchburg Leominster	-	-	-	-	-	-	494.10	533.85	1.080	-	-	-	-	-	-
Springfield	1,186,932	3,522,996	2.968	23.62	38.39	1.625	2,834.54	3,316.93	1.170	58.00	73.90	1.274	16.53	15.63	0.946
Pittsfield	-	-	-	-	-	-	373.45	472.47	1.265	-	-	-	-	-	-
All urbanized areas 3/	8,186,157	21,142,594	2.583	16.10	21.30	1.323	21,336.81	25,338.07	1.188	271.90	386.00	1.420	77.49	81.62	1.053
New Hampshire:															
Manchester	225,000	756,000	3.360	17.86	33.90	1.898	816.50	832.70	1.020	19.90	22.10	1.111	9.54	10.28	1.078
All urbanized areas 3/	225,000	756,000	3.360	17.86	33.90	1.898	816.50	832.70	1.020	19.90	22.10	1.111	9.54	10.28	1.078
Rhode Island:															
Providence	1,800,000	4,600,000	2.556	27.27	38.66	1.418	3,059.00	3,680.00	1.203	50.10	69.80	1.393	71.67	69.66	0.972
All urbanized areas 3/	1,800,000	4,600,000	2.556	27.27	38.66	1.418	3,059.00	3,680.00	1.203	50.10	69.80	1.393	71.67	69.66	0.972
Division Total 3/	16,654,078	39,618,561	2.379	19.09	23.91	1.252	36,379.88	42,654.05	1.172	521.51	686.15	1.316	44.88	47.45	1.057
MIDDLE ATLANTIC															
New Jersey:															
Atlantic City	-	-	-	-	-	-	624.00	670.00	1.074	-	-	-	-	-	-
Wilmington (Salem County)	142,040	353,560	2.489	35.51	34.00	0.957	157.00	191.00	1.217	5.30	5.30	1.000	2.85	1.29	0.453
Tri-State (N.E. New Jersey)	8,825,986	24,609,658	2.788	16.94	24.81	1.465	16,600.00	25,687.00	1.547	107.20	213.20	1.989	57.66	51.80	0.898
Delaware Valley-Trenton	2,469,367	6,292,226	2.548	17.39	25.47	1.465	3,480.00	4,420.00	1.270	37.40	77.80	2.080	20.12	18.90	0.939
All urbanized areas 3/	11,437,393	31,255,444	2.733	16.72	24.40	1.459	20,861.00	30,968.00	1.484	149.90	296.30	1.977	80.63	71.99	0.893
New York:															
Binghamton	257,841	630,497	2.445	13.85	16.36	1.181	1,154.00	1,181.00	1.023	22.10	33.10	1.498	1.77	2.46	1.390
Albany-Schenectady-Troy	1,911,595	3,904,618	2.043	37.76	40.25	1.066	2,313.00	2,530.00	1.094	123.00	141.10	1.147	9.84	10.49	1.066
Utica-Rome	777,990	1,498,408	1.926	27.25	25.45	0.934	1,685.00	1,803.00	1.070	64.90	64.90	1.000	5.19	4.82	0.929
Buffalo	2,132,324	4,106,856	1.926	21.41	25.78	1.204	3,781.00	4,506.00	1.192	89.90	89.90	1.000	7.19	6.68	0.929
Rochester	884,587	1,703,714	1.926	14.37	13.80	0.960	2,331.00	2,663.00	1.142	58.70	58.70	1.000	4.70	4.36	0.928
Syracuse	1,332,737	2,566,851	1.926	33.44	37.00	1.106	1,602.00	1,677.00	1.047	86.20	86.20	1.000	6.90	6.41	0.929
New York City Metropolitan	10,013,556	18,037,122	1.801	14.60	18.48	1.266	14,667.00	17,453.00	1.190	176.50	172.40	0.977	14.12	12.82	0.908
All urbanized areas 3/	17,310,630	32,448,066	1.874	17.58	21.31	1.212	27,533.00	31,813.00	1.155	621.30	646.30	1.040	49.71	48.04	0.966
Pennsylvania:															
Allentown-Bethlehem	476,900	1,259,400	2.641	17.75	18.03	1.016	1,242.21	1,417.36	1.141	23.40	24.90	1.064	2.20	1.58	0.718
Altoona	-	-	-	-	-	-	421.83	454.00	1.076	-	-	-	-	-	-
Erie	29,264	56,547	1.932	2.49	2.71	1.088	511.89	543.09	1.061	6.60	6.60	1.000	0.62	0.42	0.677
Harrisburg	324,489	583,789	1.799	10.31	-	-	1,015.43	1,236.79	1.218	32.00	53.40	1.669	3.01	3.39	1.126
Johnstown	-	-	-	-	-	-	328.04	372.00	1.134	-	-	-	-	-	-
Lancaster	-	-	-	-	-	-	302.40	328.41	1.086	-	-	-	-	-	-
Newcastle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Philadelphia-Delaware Valley	2,263,758	3,543,179	1.565	11.29	8.49	0.752	5,223.53	6,200.33	1.187	80.00	137.40	1.718	7.52	8.71	1.158
Pittsburgh	2,333,435	2,738,297	1.174	19.67	14.28	0.726	2,387.12	3,248.87	1.361	55.00	55.00	1.000	5.17	3.49	0.675
Reading	6,829	13,359	1.956	0.56	0.62	1.107	542.89	585.78	1.079	4.20	4.20	1.000	0.40	0.27	0.675
Scranton-Wilkes-Barre	229,790	416,871	1.814	6.20	6.58	1.061	1,010.81	1,076.81	1.065	43.10	49.40	1.146	4.05	3.13	0.773
York	61,878	129,857	2.099	5.33	6.40	1.201	463.45	494.96	1.068	10.10	10.10	1.000	0.95	0.64	0.674
All urbanized areas 3/	5,726,343	8,741,299	1.527	11.95	10.11	0.846	13,449.60	15,958.40	1.187	254.40	341.00	1.340	23.93	21.63	0.904
Division Total 3/	34,474,366	72,444,809	2.101	16.05	19.75	1.231	67,843.60	78,739.40	1.161	1,025.60	1,283.60	1.252	41.04	38.51	0.938

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
SOUTH ATLANTIC (North)															
Delaware:															
Wilmington	684,931	2,284,931	3.336	20.76	31.50	1.517	1,138.00	2,486.00	2.185	34.70	40.60	1.170	85.47	100.00	1.170
All urbanized areas 3/	684,931	2,284,931	3.336	20.76	31.50	1.517	1,138.00	2,486.00	2.185	34.70	40.60	1.170	85.47	100.00	1.170
District of Columbia:															
Washington, D. C.	951,000	3,241,000	3.408	13.13	25.27	1.925	1,083.00	1,241.00	1.146	28.00	29.00	1.036	100.00	100.00	1.000
All urbanized areas 3/	951,000	3,241,000	3.408	13.13	25.27	1.925	1,083.00	1,241.00	1.146	28.00	29.00	1.036	100.00	100.00	1.000
Maryland:															
Baltimore	3,739,772	11,901,002	3.182	24.56	34.86	1.419	5,450.24	8,807.59	1.616	90.94	119.72	1.316	25.87	31.19	1.206
Washington	4,213,816	6,552,421	1.555	30.86	21.72	0.704	4,047.39	6,540.58	1.616	67.30	84.50	1.256	19.15	22.01	1.149
All urbanized areas 3/	7,953,588	18,453,423	2.320	27.54	28.70	1.042	9,497.63	15,348.17	1.616	158.24	204.22	1.291	45.02	53.20	1.182
Virginia:															
Danville	-	-	-	-	-	-	717.00	802.00	1.119	-	-	-	-	-	-
Lynchburg	-	-	-	-	-	-	581.00	640.00	1.102	-	-	-	-	-	-
Northern Virginia	4,591,008	9,713,941	2.116	41.31	32.78	0.794	2,308.00	2,511.00	1.088	57.50	67.60	1.176	5.45	6.32	1.160
Newport News-Hampton Peninsula	1,272,627	2,364,908	1.858	38.22	33.31	0.872	1,227.00	1,328.00	1.082	45.70	54.10	1.184	4.33	5.05	1.166
Richmond	720,276	5,349,987	7.428	11.32	34.08	3.011	2,036.00	2,255.00	1.108	55.40	92.00	1.661	5.25	8.60	1.638
Roanoke	293,917	982,140	3.342	19.42	26.29	1.354	852.00	981.00	1.151	18.50	18.50	1.000	1.75	1.73	0.989
Southeastern Virginia-Norfolk-Portsmouth	570,486	4,532,300	7.945	8.18	27.20	3.325	2,266.00	2,574.00	1.136	27.80	61.60	2.216	2.64	5.76	2.182
All urbanized areas 3/	7,448,314	22,943,276	3.080	24.66	30.57	1.240	9,987.00	11,091.00	1.111	204.90	293.80	1.434	19.42	27.46	1.414
West Virginia:															
Charleston	647,700	1,256,300	1.940	29.44	36.95	1.255	1,038.00	1,050.00	1.012	60.00	54.00	0.900	10.05	10.61	1.056
Huntington	336,522	610,380	1.814	25.98	30.40	1.170	785.00	794.00	1.011	30.00	26.00	0.867	5.03	5.11	1.016
All urbanized areas 3/	984,222	1,866,680	1.897	28.16	34.52	1.226	1,823.00	1,844.00	1.012	90.00	80.00	0.889	15.08	15.72	1.042
Division Total 3/	18,022,055	48,789,310	2.707	24.65	29.60	1.201	23,528.63	32,010.17	1.360	515.84	647.62	1.255	24.89	31.86	1.280
SOUTH ATLANTIC (South)															
Florida:															
Ft. Lauderdale-Hollywood	432,442	2,650,381	6.129	7.86	9.83	1.251	2,722.50	4,252.10	1.562	9.20	24.40	2.652	0.62	1.74	2.806
Jacksonville	812,100	2,404,800	2.961	23.68	19.83	0.837	1,291.90	1,963.90	1.520	23.10	41.90	1.814	1.55	2.99	1.929
Miami	2,311,692	3,120,650	1.350	17.45	10.15	0.582	4,435.60	6,749.10	1.522	21.90	21.90	1.000	1.47	1.57	1.068
Orlando	947,000	2,100,000	2.218	25.93	13.39	0.516	1,609.40	2,448.70	1.521	30.30	30.30	1.000	2.03	2.17	1.069
Pensacola	32,200	254,300	7.898	2.63	7.82	2.973	761.70	1,169.90	1.536	4.20	6.50	1.548	0.28	0.46	1.643
St. Petersburg	61,268	1,505,378	2.457	1.38	15.21	1.102	2,509.70	3,818.70	1.522	2.50	14.50	5.800	0.17	1.04	6.118
Tallahassee	-	245,700	-	-	11.82	-	460.00	706.00	1.535	-	7.20	-	-	0.51	-
Tampa	1,052,000	3,196,000	3.038	15.56	22.91	1.472	2,516.10	3,828.30	1.522	39.00	39.00	1.000	2.61	2.79	1.069
West Palm Beach	481,541	4,357,640	9.049	9.35	38.06	4.071	1,558.40	2,371.20	1.522	9.40	46.70	4.968	0.63	3.34	5.302
All urbanized areas 3/	6,130,243	19,834,849	3.236	13.87	15.72	1.133	17,865.30	27,307.90	1.529	139.60	232.40	1.665	9.34	16.61	1.778
Georgia:															
Albany	-	-	-	-	-	-	223.00	293.00	1.314	-	-	-	-	-	-
Atlanta	4,642,577	19,023,109	4.098	38.53	46.86	1.216	3,918.00	4,049.00	1.033	147.00	184.00	1.252	26.78	16.04	0.599
Augusta	-	471,000	-	-	16.37	-	303.00	338.00	1.116	-	35.00	-	-	3.05	-
Chattanooga	21,640	75,860	3.506	8.89	15.17	1.706	135.00	145.00	1.074	12.00	22.00	1.833	2.19	1.92	0.877
Columbus	-	280,000	-	-	6.01	-	446.00	485.00	1.087	-	7.00	-	-	0.61	-
Macon	442,000	1,220,000	2.760	31.57	31.12	0.986	474.00	517.00	1.091	35.00	43.00	1.229	6.37	3.75	0.589
Savannah	-	320,000	-	-	12.45	-	450.00	490.00	1.089	-	8.00	-	-	0.70	-
All urbanized areas 3/	5,106,217	21,389,969	4.189	27.63	37.19	1.346	5,949.00	6,317.00	1.062	194.00	299.00	1.541	35.34	26.07	0.738
North Carolina:															
Asheville	36,000	526,592	14.628	4.14	27.10	6.546	423.00	633.00	1.496	0.90	17.60	19.555	0.21	2.10	10.000
Charlotte	200,633	2,114,430	10.539	7.59	22.06	2.906	1,002.00	2,295.00	2.290	7.70	50.00	6.494	1.84	5.97	3.245
Durham	134,595	1,055,570	7.843	14.06	48.89	3.477	412.00	595.00	1.444	5.80	29.10	5.017	1.39	3.48	2.504
Fayetteville	-	313,441	-	-	9.57	-	379.00	875.00	2.309	-	12.00	-	-	1.43	-
Greensboro	108,849	1,367,592	12.564	6.94	34.47	4.967	720.00	1,175.00	1.632	5.40	29.70	5.500	1.29	3.55	2.752
High Point	-	425,989	-	-	12.77	-	452.00	1,127.00	2.493	-	14.70	-	-	1.76	-
Raleigh	-	629,030	-	-	15.77	-	442.00	1,050.00	2.376	-	21.50	-	-	2.57	-
Wilmington	-	-	-	-	-	-	215.00	370.00	1.721	-	-	-	-	-	-
Winston-Salem	264,477	924,696	3.496	17.79	21.93	1.233	656.00	1,236.00	1.884	9.70	22.20	2.289	2.32	2.65	1.142
All urbanized areas 3/	744,554	7,357,340	9.882	6.84	21.86	3.196	4,701.00	9,356.00	1.990	29.50	196.80	6.671	7.05	23.51	3.335

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
SOUTH ATLANTIC (South) (Continued)															
South Carolina:															
Charleston	140,000	910,000	6.500	8.66	16.98	1.961	327.00	396.00	1.211	13.00	17.00	1.308	3.45	2.24	0.649
Columbia	150,000	1,070,000	7.133	9.10	24.54	2.697	350.00	403.00	1.151	18.00	39.00	2.167	4.77	5.15	1.080
Greenville	340,000	780,000	2.294	17.89	16.74	0.936	500.00	595.00	1.190	27.00	27.00	1.000	7.16	3.57	0.499
North Augusta	-	71,000	-	-	9.83	-	78.00	83.00	1.064	-	5.00	-	-	0.66	-
All urbanized areas 3/	630,000	2,831,000	4.494	11.45	18.75	1.638	1,255.00	1,477.00	1.177	58.00	88.00	1.517	15.38	11.62	0.756
Division Total 3/	12,611,014	51,413,158	4.077	15.95	22.12	1.387	29,770.30	44,457.90	1.493	421.10	816.20	1.938	14.84	19.71	1.328
EAST NORTH CENTRAL															
Illinois:															
Alton	-	-	-	-	-	-	378.00	643.00	1.701	-	-	-	-	-	-
Aurora	-	-	-	-	-	-	372.00	-	-	-	-	-	-	-	-
Bloomington-Normal	36,050	380,000	10.541	6.53	41.39	6.338	248.00	417.00	1.681	5.00	18.00	3.600	0.61	1.04	1.705
Champaign-Urbana	75,800	330,000	4.354	10.31	18.97	1.840	272.00	484.00	1.779	9.00	12.00	1.333	1.10	0.70	0.636
Chicago Illinois Part	12,150,000	17,725,000	1.459	22.54	18.09	0.803	10,801.00	20,020.00	1.854	165.00	253.00	1.533	20.22	14.68	0.726
Danville	27,950	177,000	6.333	5.20	21.85	4.202	236.00	378.00	1.602	3.00	9.00	3.000	0.37	0.52	1.405
Decatur	-	354,000	-	-	21.85	-	340.00	568.00	1.671	-	21.00	-	-	1.22	-
East Dubuque	-	-	-	-	-	-	9.00	11.00	1.222	-	-	-	-	-	-
Elgin	6,480	-	-	1.11	-	-	209.00	-	-	1.00	-	-	0.12	-	-
Joliet	-	-	-	-	-	-	467.00	-	-	-	-	-	-	-	-
Peoria	115,300	759,000	6.583	5.82	18.60	3.196	665.00	1,169.00	1.758	12.00	31.00	2.583	1.47	1.80	1.224
Rockford	-	41,000	-	-	1.00	-	700.00	1,234.00	1.763	-	2.00	-	-	0.12	-
Rock Island-Moline	36,070	729,000	20.211	2.47	32.11	13.000	550.00	900.00	1.636	5.00	33.00	6.600	0.61	1.92	3.148
East St. Louis	280,600	2,862,000	10.200	9.14	49.09	5.371	1,176.00	2,000.00	1.701	14.00	78.00	5.571	1.72	4.52	2.628
Springfield	119,200	774,000	6.493	9.58	37.39	3.903	401.00	675.00	1.683	9.00	22.00	2.444	1.10	1.28	1.164
All urbanized areas 3/	12,847,450	24,131,000	1.878	18.33	19.58	1.068	16,824.00	28,499.00	1.694	213.00	479.00	2.249	27.32	27.80	1.018
Indiana:															
Indianapolis	1,050,000	8,835,955	8.415	14.00	55.22	3.944	2,500.00	4,000.00	1.600	26.20	136.10	5.195	2.41	12.00	4.979
South Bend	30,174	164,604	5.455	2.07	8.51	4.111	586.00	645.00	1.101	3.20	10.40	3.250	0.29	0.92	3.172
Fort Wayne	22,012	375,106	1.704	1.60	20.67	1.292	550.00	605.00	1.100	1.80	15.50	8.611	0.17	1.37	8.059
Evansville	-	50,500	-	-	3.81	-	421.00	442.00	1.050	-	4.10	-	-	0.36	-
Terre Haute	26,872	329,399	1.226	3.07	29.84	9.720	350.00	368.00	1.051	3.00	15.60	5.200	0.28	1.37	4.893
Muncie	-	-	-	-	-	-	290.00	319.00	1.100	-	-	-	-	-	-
Anderson	32,047	351,113	1.096	7.09	48.36	6.821	181.00	242.00	1.337	3.00	12.80	4.267	0.28	1.13	4.036
Lafayette-West Lafayette	-	-	-	-	-	-	220.00	242.00	1.100	-	-	-	-	-	-
Northwest Area	1,524,217	4,791,201	3.143	24.62	37.14	1.509	2,063.00	3,225.00	1.563	52.20	96.60	1.851	4.81	8.52	1.771
Louisville Area	170,314	591,271	3.472	24.68	58.43	2.368	230.00	253.00	1.100	6.70	18.40	2.746	0.62	1.62	2.613
Cincinnati Area	-	107,370	-	-	61.71	-	49.00	58.00	1.184	-	3.30	-	-	0.29	-
All urbanized areas 3/	2,855,636	15,596,519	5.462	13.60	40.33	2.965	7,440.00	10,399.00	1.398	96.10	312.80	3.255	8.86	27.58	3.113
Michigan:															
Ann Arbor	364,857	898,725	2.463	19.72	21.06	1.068	367.00	402.00	1.095	17.50	17.50	1.000	2.04	1.49	0.730
Bay City	113,300	254,650	2.248	18.17	25.49	1.403	159.00	161.00	1.013	7.20	7.20	1.000	0.84	0.61	0.726
Detroit	6,500,143	27,281,275	4.197	14.32	21.62	1.510	3,368.00	3,601.00	1.069	160.20	332.30	2.074	18.64	28.29	1.518
Flint	756,000	3,133,980	4.145	16.09	26.79	1.665	847.00	952.00	1.124	34.20	55.00	1.608	3.98	4.68	1.176
Grand Rapids	580,860	1,862,970	3.207	15.65	25.19	1.610	617.00	747.00	1.211	33.10	41.60	1.257	3.85	3.54	0.919
Jackson	378,700	917,300	2.422	22.61	26.58	1.176	696.00	717.00	1.030	19.80	19.80	1.000	2.30	1.69	0.735
Kalamazoo	360,000	803,380	2.232	18.22	19.17	1.052	352.00	380.00	1.080	15.80	15.80	1.000	1.84	1.35	0.734
Lansing (Tri. County)	658,850	4,073,510	6.183	12.33	35.75	2.899	1,267.00	1,317.00	1.039	47.20	104.40	2.212	5.49	8.89	1.619
Muskegon	28,720	79,520	2.769	2.33	3.39	1.455	260.00	260.00	1.000	2.80	2.80	1.000	0.33	0.24	0.727
Niles (South Bend)	-	-	-	-	-	-	47.00	65.00	1.383	-	-	-	-	-	-
Saginaw	319,470	882,290	2.762	19.25	23.02	1.196	747.00	798.00	1.068	16.80	24.20	1.440	1.95	2.06	1.056
All urbanized areas 3/	10,060,900	40,187,600	3.994	14.71	22.81	1.551	8,727.00	9,400.00	1.077	354.60	620.60	1.750	41.26	52.84	1.281
Ohio:															
Akron	1,389,000	4,468,100	3.217	17.22	38.65	2.244	2,550.61	2,850.00	1.117	53.62	60.19	1.123	4.92	3.93	0.799
Bridgeport	32,600	91,200	2.798	5.95	11.03	1.854	297.02	350.00	1.178	4.60	9.14	1.987	0.42	0.60	1.429
Canton	199,300	564,500	2.832	4.35	7.05	1.621	2,153.96	2,500.00	1.161	9.26	13.90	1.501	0.85	0.91	1.071
Cincinnati-Hamilton	2,243,000	9,026,000	4.024	14.75	35.69	2.420	4,554.96	4,960.00	1.089	86.66	157.91	1.822	7.94	10.31	1.298
Cleveland-Loraine-Elyria	4,963,000	17,976,500	3.622	15.55	34.57	2.223	6,888.45	7,570.00	1.099	110.82	283.00	2.554	10.16	18.40	1.820
Columbus	1,613,200	6,454,900	4.001	15.66	35.44	2.263	2,722.46	3,100.00	1.139	48.54	111.17	2.290	4.45	7.26	1.631
Dayton	764,800	4,278,000	5.594	7.45	25.04	3.361	3,385.65	3,770.00	1.114	45.33	76.16	1.680	4.16	4.97	1.195
(continued)															

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Sheet 4 of 7

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
EAST NORTH CENTRAL															
Ohio: (continued)															
Ironton	-	-	-	-	-	-	390.90	430.00	1.100	-	-	-	-	-	-
Lima	177,800	461,600	2.596	15.63	21.66	1.386	536.32	580.00	1.081	14.89	14.89	1.000	1.36	0.97	0.713
Mansfield	173,000	666,500	3.853	10.86	21.10	1.943	822.11	930.00	1.131	16.34	16.34	1.000	1.50	1.07	0.713
Springfield	130,000	565,000	4.346	7.76	18.47	2.380	853.11	970.00	1.137	6.69	20.89	3.123	0.61	1.36	2.230
Steubenville	-	-	-	-	-	-	547.96	560.00	1.022	-	-	-	-	-	-
Toledo	744,000	4,046,100	5.438	10.74	37.33	3.476	2,582.99	2,970.00	1.150	68.72	98.58	1.435	6.30	6.44	1.022
Youngstown-Warren	797,500	3,291,000	4.127	10.91	28.64	2.625	2,874.13	3,090.00	1.075	48.68	78.96	1.622	4.46	5.16	1.157
All urbanized areas 3/	13,227,200	51,889,400	3.923	13.08	31.32	2.394	31,160.63	34,630.00	1.111	514.15	941.13	1.830	47.13	61.47	1.304
Wisconsin:															
Milwaukee	1,603,000	5,200,000	3.244	13.04	14.53	1.114	3,384.00	6,138.00	1.814	35.00	69.00	1.971	2.53	12.28	4.854
Madison	-	-	-	-	-	-	632.00	1,043.00	1.650	-	12.00	-	-	2.13	-
Green Bay	-	225,000	-	-	9.40	-	455.00	604.00	1.327	-	5.00	-	-	0.89	-
Superior	18,000	34,000	1.889	6.04	9.47	1.568	201.00	205.00	1.020	1.00	1.00	1.000	0.07	0.18	2.571
Racine	-	-	-	-	-	-	365.00	498.00	1.364	-	-	-	-	-	-
Kenosha	-	-	-	-	-	-	298.00	355.00	1.191	-	-	-	-	-	-
All urbanized areas 3/	1,621,000	5,459,000	3.368	9.37	11.62	1.240	5,335.00	8,843.00	1.658	36.00	87.00	2.417	2.60	15.48	5.954
Division Total 3/	40,612,186	137,263,519	3.380	14.61	24.92	1.706	69,486.63	91,771.00	1.321	1,213.85	2,440.53	2.011	23.19	39.85	1.718
WEST NORTH CENTRAL															
Iowa:															
Des Moines	443,000	1,556,000	3.512	19.72	37.39	1.896	900.00	1,260.00	1.400	38.40	52.20	1.359	7.71	6.68	0.866
Cedar Rapids	-	447,000	-	-	16.03	-	590.00	770.00	1.305	-	13.40	-	-	1.71	-
Davenport	194,000	723,000	3.727	20.15	29.02	1.440	430.00	570.00	1.326	20.80	34.40	1.654	4.18	4.40	1.053
Sioux City	188,000	378,000	2.011	20.46	26.14	1.278	400.00	490.00	1.225	12.80	13.10	1.023	2.57	1.68	0.654
Waterloo	-	80,000	-	-	3.14	-	410.00	610.00	1.488	-	4.10	-	-	0.52	-
Dubuque	-	-	-	-	-	-	220.00	390.00	1.773	-	-	-	-	-	-
Council Bluffs	14,000	516,000	36.857	3.11	54.72	17.595	220.00	350.00	1.591	1.50	20.60	13.733	0.30	2.63	8.767
All urbanized areas 3/	839,000	3,710,000	4.422	11.45	24.27	2.120	3,170.00	4,440.00	1.401	73.50	137.80	1.875	14.76	17.62	1.194
Kansas:															
Kansas City	516,530	2,548,200	4.933	13.47	25.24	1.874	1,476.00	3,408.20	2.309	27.70	72.10	2.603	3.46	8.78	2.538
Wichita	183,840	1,277,100	6.947	5.58	22.40	4.014	1,305.30	1,730.90	1.326	25.90	54.30	2.097	3.23	6.61	2.046
Topeka	178,530	595,470	3.335	14.07	25.09	1.783	509.60	717.60	1.408	20.40	22.50	1.103	2.55	2.74	1.075
All urbanized areas 3/	878,900	4,420,770	5.030	10.46	24.33	2.326	3,290.90	5,856.70	1.780	74.00	148.90	2.012	9.24	18.13	1.962
Minnesota:															
Minneapolis and St. Paul	2,128,000	12,177,000	5.722	11.74	36.49	3.108	6,290.70	11,187.60	1.778	86.50	212.80	2.460	24.14	23.27	0.964
Duluth	29,000	493,000	17.000	2.80	36.14	12.907	530.10	563.60	1.063	2.60	12.00	4.615	0.73	1.31	1.795
Moorhead (Fargo-Moorhead)	14,000	53,000	3.786	6.83	15.01	2.198	109.10	140.90	1.291	2.10	2.10	1.000	0.59	0.23	0.390
All urbanized areas 3/	2,171,000	12,723,000	5.860	11.21	36.27	3.236	6,929.90	11,892.10	1.716	91.20	226.90	2.488	25.45	24.81	0.975
Missouri:															
St. Louis	3,775,000	6,915,000	1.832	22.17	21.13	0.953	4,232.00	6,450.00	1.524	87.00	121.00	1.391	12.39	10.54	0.851
Kansas City	1,364,000	2,765,000	2.027	16.09	12.57	0.781	2,745.00	4,675.00	1.703	42.00	71.00	1.690	5.98	6.19	1.035
Springfield	113,000	235,000	2.080	7.54	9.22	1.223	597.00	820.00	1.374	10.00	10.00	1.000	1.43	0.87	0.608
St. Joseph	28,000	59,000	2.107	3.21	5.26	1.639	412.00	480.00	1.165	11.00	21.00	1.909	1.57	1.83	1.166
All urbanized areas 3/	5,280,000	9,974,000	1.889	18.94	17.08	0.902	7,986.00	12,425.00	1.556	150.00	223.00	1.487	21.37	19.43	0.909
Nebraska:															
Lincoln	26,400	215,900	8.178	2.34	9.96	4.256	549.80	803.00	1.461	2.80	11.90	4.250	0.87	2.47	2.839
Omaha	135,200	1,240,800	9.178	4.31	20.10	4.664	1,062.00	1,852.00	1.744	4.00	31.40	7.850	1.24	6.53	5.266
South Sioux City (Sioux City)	-	54,147	-	-	40.11	-	61.00	89.00	1.459	-	3.10	-	-	0.64	-
All urbanized areas 3/	161,600	1,510,847	9.349	3.72	17.83	4.793	1,672.80	2,744.00	1.640	6.80	46.40	6.824	2.11	9.64	4.569
North Dakota:															
Fargo (Fargo-Moorhead)	12,110	125,870	10.394	3.58	16.45	4.595	156.00	350.00	2.244	1.40	4.50	3.214	0.25	0.79	3.160
All urbanized areas 3/	12,110	125,870	10.394	3.58	16.45	4.595	156.00	350.00	2.244	1.40	4.50	3.214	0.25	0.79	3.160
South Dakota:															
Sioux Falls	51,358	395,382	7.699	7.42	30.04	4.049	301.34	539.00	1.789	11.94	26.25	2.199	1.67	3.87	2.317
All urbanized areas 3/	51,358	395,382	7.699	7.42	30.04	4.049	301.34	539.00	1.789	11.94	26.25	2.199	1.67	3.87	2.317
Division Total 3/	9,393,968	32,859,869	3.498	13.75	23.90	1.738	23,506.94	38,246.80	1.627	408.84	813.75	1.990	10.30	15.08	1.464

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
EAST SOUTH CENTRAL															
Alabama:															
Columbus-Phenix City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Birmingham	-	-	-	-	-	-	2,825.00	-	-	-	45.70	-	-	5.06	-
Gadsden	11,000	85,000	7.727	0.70	4.64	6.629	451.50	-	-	3.70	4.70	1.270	0.82	0.52	0.634
Huntsville	-	-	-	-	-	-	-	-	-	-	3.60	-	-	0.40	-
Mobile	-	-	-	-	-	-	-	-	-	-	15.90	-	-	1.76	-
Montgomery	-	160,000	-	-	6.23	-	440.00	-	-	-	6.40	-	-	0.71	-
Tuscaloosa	-	100,000	-	-	4.91	-	302.00	320.00	1.060	-	4.20	-	-	0.46	-
All urbanized areas 3/	11,000	345,000	31.364	0.10	4.98	49.800	4,018.50	320.00	0.080	3.70	80.50	21.757	0.82	8.92	10.878
Kentucky:															
Louisville	1,169,856	4,296,345	3.673	21.03	25.63	1.219	2,108.00	3,050.00	1.447	29.80	73.20	2.456	3.98	9.92	2.492
Covington	529,300	2,964,810	5.601	25.40	53.54	2.108	560.00	965.00	1.723	15.20	57.20	3.763	2.03	7.75	3.818
Ashland	-	16,850	-	-	1.35	-	240.00	390.00	1.625	-	1.00	-	-	0.14	-
Lexington	37,350	392,850	10.518	2.83	12.70	4.488	550.00	1,025.00	1.864	3.00	13.70	4.567	0.40	1.86	4.650
All urbanized areas 3/	1,736,506	7,670,855	4.417	18.08	28.78	1.592	3,458.00	5,430.00	1.570	48.00	145.10	3.023	6.42	19.66	3.062
Mississippi:															
Jackson	652,840	2,260,640	3.463	39.33	33.68	0.856	1,052.00	1,370.00	1.302	55.70	55.70	1.000	8.21	8.21	1.000
Gulf Coast	629,910	1,777,830	2.822	-	-	-	1,962.00	2,538.00	1.294	65.50	65.50	1.000	9.66	9.66	1.000
All urbanized areas 3/	1,282,750	4,038,470	3.148	77.27	60.17	0.779	3,014.00	3,908.00	1.297	121.20	121.20	1.000	17.87	17.87	1.000
Tennessee:															
Chattanooga	692,700	1,722,600	2.487	24.30	32.90	1.354	956.00	1,960.00	2.050	22.00	34.00	1.545	3.83	7.52	1.963
Kingsport	-	-	-	-	-	-	275.00	564.00	2.051	-	-	-	-	-	-
Knoxville	587,000	1,893,200	3.225	20.14	38.09	1.891	1,030.00	2,111.00	2.050	19.00	46.00	2.421	3.31	8.27	2.498
Memphis	851,600	3,043,900	3.574	12.23	24.27	1.984	1,908.00	3,911.00	2.050	28.00	54.00	1.929	4.88	13.29	2.723
Nashville	523,700	3,030,300	5.786	9.71	50.74	5.226	1,932.00	3,961.00	2.050	27.00	94.00	3.481	4.70	13.23	2.815
All urbanized areas 3/	2,655,000	9,690,000	3.650	14.00	32.11	2.294	6,101.00	12,507.00	2.050	96.00	228.00	2.375	16.72	21.84	1.306
Division Total 3/	5,685,256	21,744,325	3.825	13.86	30.86	2.227	16,591.50	22,165.00	1.336	268.90	574.80	2.138	11.09	17.10	1.542
WEST SOUTH CENTRAL															
Arkansas:															
Little Rock	493,759	2,274,612	4.607	20.65	33.29	1.612	916.71	1,766.00	1.926	23.54	42.92	1.823	7.09	8.25	1.164
Fort Smith	29,987	350,942	11.703	3.74	13.32	3.561	478.47	1,044.00	2.182	8.03	13.73	1.710	2.42	2.64	1.091
Pine Bluff	-	-	-	-	-	-	314.61	733.00	2.330	-	-	-	-	-	-
Texarkana	9,512	64,297	6.760	4.21	4.88	1.159	152.22	355.00	2.332	1.64	2.62	1.598	0.49	0.50	1.020
All urbanized areas 3/	533,258	2,689,851	5.044	13.74	21.21	1.544	1,862.01	3,898.00	2.093	33.21	59.27	1.785	10.00	11.39	1.139
Louisiana:															
Monroe	75,930	305,620	4.025	8.02	18.23	2.223	117.00	180.40	1.542	5.09	12.00	2.358	1.82	1.66	0.912
Lake Charles	127,350	499,700	3.924	16.09	30.30	1.883	130.80	145.80	1.115	6.38	16.00	2.508	2.29	2.22	0.969
LaFayette	-	111,300	-	-	9.08	-	103.50	143.90	1.390	-	7.00	-	-	0.97	-
Baton Rouge	171,380	1,448,900	8.454	5.34	23.90	4.475	137.30	198.20	1.444	9.60	28.00	2.917	3.43	3.88	1.131
Shreveport	294,680	1,368,000	4.642	8.03	21.81	2.716	261.00	335.50	1.285	11.33	39.00	3.442	4.04	5.41	1.339
New Orleans	5,341,000	-	-	68.94	-	-	-	-	-	22.84	51.10	2.237	8.16	7.09	0.869
All urbanized areas 3/	6,010,340	3,733,520	6.212	35.23	12.72	0.361	749.60	1,003.80	1.339	55.20	153.10	2.774	19.75	21.23	1.075
Oklahoma:															
Oklahoma City	2,240,000	5,731,000	2.558	40.17	27.45	0.683	3,850.00	5,300.00	1.377	90.00	127.00	1.411	11.25	15.70	1.396
Tulsa	444,000	2,435,000	5.484	11.60	23.74	2.047	2,500.00	4,150.00	1.660	19.00	38.00	2.000	2.38	4.70	1.975
Lawton	-	-	-	-	-	-	420.00	780.00	1.857	-	-	-	-	-	-
All urbanized areas 3/	2,684,000	8,166,000	3.042	26.85	24.51	0.913	6,770.00	10,230.00	1.511	109.00	165.00	1.514	13.63	20.40	1.497
Texas:															
Abilene	106,000	487,000	4.594	10.48	28.77	2.745	662.00	922.00	1.393	16.00	16.00	1.000	0.51	0.51	1.000
Amarillo	410,000	1,534,000	3.741	22.60	32.34	1.431	1,055.00	2,126.00	2.015	27.00	27.00	1.000	0.85	0.85	1.000
Austin	508,000	1,067,000	2.100	24.55	23.47	0.956	1,212.00	2,228.00	1.838	19.00	19.00	1.000	0.60	0.60	1.000
Corpus Christi	244,000	997,000	4.086	16.02	29.37	1.833	1,206.00	1,876.00	1.556	17.00	17.00	1.000	0.54	0.54	1.000
Dallas-Ft. Worth	7,174,000	19,420,000	2.707	28.92	35.38	1.223	9,035.00	15,507.00	1.716	287.00	287.00	1.000	9.07	9.07	1.000
El Paso	667,000	2,075,000	3.111	23.27	36.15	1.554	1,835.00	2,718.00	1.481	35.00	35.00	1.000	1.11	1.11	1.000
Galveston	430,000	1,517,000	3.528	23.59	25.44	1.078	1,181.00	2,638.00	2.234	24.00	24.00	1.000	0.76	0.76	1.000
Harlingen-San Benito	-	-	-	-	-	-	510.00	908.00	1.780	-	-	-	-	-	-
Houston	6,495,000	10,769,000	1.658	34.13	23.33	0.684	6,325.00	11,947.00	1.889	112.00	112.00	1.000	3.54	3.54	1.000
Jefferson-Orange Counties	549,000	1,685,000	3.069	19.80	27.16	1.372	2,127.00	3,293.00	1.548	42.00	42.00	1.000	1.33	1.33	1.000

(continued)

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
WEST SOUTH CENTRAL															
Texas: (continued)															
Laredo	46,000	178,000	3.870	14.42	24.96	1.731	313.00	486.00	1.553	5.00	5.00	1.000	0.16	0.16	1.000
Lubbock	45,000	182,000	4.044	2.75	4.62	1.680	1,044.00	2,074.00	1.987	4.00	4.00	1.000	0.12	0.12	1.000
McAllen-Pharr	-	-	-	-	-	-	599.00	846.00	1.412	-	-	-	-	-	-
Midland-Odessa	201,000	715,000	3.557	12.63	30.03	2.378	1,036.00	1,338.00	1.292	32.00	32.00	1.000	1.01	1.01	1.000
San Angelo	-	-	-	-	-	-	409.00	639.00	1.562	-	-	-	-	-	-
San Antonio	1,918,000	4,984,000	2.599	27.42	35.68	1.301	3,771.00	5,319.00	1.411	104.00	104.00	1.000	3.29	3.29	1.000
Sherman-Denison	-	-	-	-	-	-	402.00	734.00	1.826	-	-	-	-	-	-
Texarkana	43,000	186,000	4.326	11.91	28.48	2.391	251.00	403.00	1.606	6.00	6.00	1.000	0.19	0.19	1.000
Tyler	-	-	-	-	-	-	438.00	645.00	1.473	-	-	-	-	-	-
Waco	259,000	972,000	3.753	19.50	40.65	2.085	782.00	1,112.00	1.422	17.00	17.00	1.000	0.54	0.54	1.000
Wichita Falls	-	-	-	-	-	-	673.00	980.00	1.456	-	-	-	-	-	-
All urbanized areas 3/	19,095,000	46,768,000	2.449	25.83	28.34	1.097	34,866.00	58,739.00	1.685	747.00	747.00	1.000	23.62	23.62	1.000
Division Total 3/	28,322,598	61,357,371	2.166	27.01	25.53	0.945	44,247.61	73,870.80	1.669	944.41	1,124.37	1.191	20.65	21.57	1.045
MOUNTAIN															
Arizona:															
Phoenix	752,429	3,588,033	4.769	8.57	15.02	1.753	4,593.00	6,092.00	1.326	31.10	39.80	1.280	6.70	3.39	0.506
Tucson	443,396	1,498,810	3.380	13.36	20.29	1.519	2,033.00	3,183.00	1.566	63.20	47.40	0.750	13.62	4.04	0.297
All urbanized areas 3/	1,195,825	4,086,843	3.418	9.89	13.07	1.322	6,626.00	9,275.00	1.400	94.30	87.20	0.925	20.32	7.43	0.366
Colorado:															
Denver	1,728,700	5,871,700	3.397	17.00	33.40	1.965	3,680.00	5,060.00	1.375	49.00	108.00	2.204	5.17	11.07	2.141
Colorado Springs	337,200	891,600	2.644	20.22	22.77	1.126	1,160.00	1,500.00	1.293	25.00	25.00	1.000	2.64	2.56	0.970
Pueblo	178,100	337,000	1.892	20.19	25.75	1.275	550.00	850.00	1.545	11.00	11.00	1.000	1.16	1.13	0.974
All urbanized areas 3/	2,244,000	7,100,300	3.164	17.65	31.14	1.764	5,390.00	7,410.00	1.375	85.00	144.00	1.699	8.97	14.76	1.645
Idaho:															
Boise	-	395,000	-	-	21.55	-	392.00	949.00	2.421	-	17.90	-	-	2.92	-
All urbanized areas 3/	-	395,000	-	-	21.55	-	392.00	949.00	2.421	-	17.90	-	-	2.92	-
Montana:															
Billings	48,756	316,868	6.499	6.11	6.14	1.005	421.40	502.00	1.191	16.20	16.20	1.000	1.37	1.37	1.000
Great Falls	35,501	74,575	2.101	20.02	6.66	0.333	327.20	406.00	1.241	7.00	7.00	1.000	0.59	0.59	1.000
All urbanized areas 3/	84,257	391,443	4.646	6.12	14.48	2.366	748.60	908.00	1.213	23.20	23.20	1.000	1.96	1.96	1.000
Nevada:															
Reno	133,000	437,000	3.286	15.39	12.49	0.812	348.00	720.00	2.069	5.00	6.80	1.360	0.90	1.30	1.444
Las Vegas	185,000	737,000	3.984	8.56	11.20	1.308	948.10	2,295.00	2.421	10.90	10.90	1.000	2.00	2.00	1.000
All urbanized areas 3/	318,000	1,174,000	3.692	10.51	11.64	1.108	1,296.10	3,015.00	2.326	15.90	17.70	1.113	2.90	3.30	1.138
New Mexico:															
Albuquerque	531,000	2,399,000	4.518	19.58	27.39	1.399	1,150.00	2,408.00	2.094	28.00	50.00	1.786	2.78	5.04	1.813
Hobbs	-	-	-	-	-	-	143.00	600.00	4.196	-	-	-	-	-	-
Las Cruces	98,000	260,000	2.653	28.99	26.92	0.929	195.00	665.00	3.410	13.00	21.00	1.615	1.29	2.13	1.651
Roswell	-	-	-	-	-	-	335.00	775.00	2.313	-	-	-	-	-	-
Santa Fe	50,000	91,000	1.820	17.18	9.85	0.573	190.00	655.00	3.447	5.00	10.00	2.000	0.50	0.95	1.900
All urbanized areas 3/	679,000	2,750,000	4.050	17.47	22.87	1.309	2,013.00	5,103.00	2.535	46.00	81.00	1.761	4.57	8.12	1.777
Utah:															
Provo-Orem	157,766	379,860	2.408	3.43	2.78	0.810	1,076.00	1,208.00	1.123	11.80	43.70	3.703	4.20	4.67	1.112
Salt Lake	979,242	2,320,300	2.369	21.32	16.99	0.797	1,300.00	1,368.00	1.052	32.10	101.30	3.156	11.43	10.84	0.948
Ogden	366,072	619,060	1.691	7.97	4.54	0.570	908.00	972.00	1.070	12.00	34.00	2.833	4.27	3.63	0.850
All urbanized areas 3/	1,503,080	3,329,220	2.215	22.52	26.20	1.163	3,284.00	3,548.00	1.080	55.90	179.00	3.202	19.90	19.14	0.962
Division Total 3/	6,024,162	19,226,806	3.192	14.79	20.58	1.391	19,749.70	30,208.00	1.530	320.30	550.00	1.717	12.01	10.15	0.845

Table D-2b.--Interstate mileage and travel and total road and street mileage by urbanized area, and the relationships of these items to statewide totals 1/

Division, State and urbanized or planning area within	Interstate travel 2/ (daily vehicle-miles)			Interstate travel as percent area total			Total road and street mileage			Interstate System mileage 2/			Interstate as percent State total Interstate System mileage		
	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967	1967	1990	Ratio 1990/1967
PACIFIC															
California:															
Bakersfield	-	-	-	-	-	-	652.00	1,184.00	1.816	-	-	-	-	-	-
Fresno	-	-	-	-	-	-	1,083.00	2,321.00	2.143	-	-	-	-	-	-
Los Angeles-Long Beach, Pomona-Ontario, San Bernardino-Riverside	24,186,300	48,439,100	2.003	25.00	24.92	0.997	20,517.00	32,644.00	1.591	219.00	381.00	1.740	9.94	16.65	1.675
Oxnard	-	-	-	-	-	-	383.00	3,380.00	8.825	-	-	-	-	-	-
Sacramento	1,068,200	5,210,800	4.878	19.10	27.80	1.455	2,269.00	5,354.00	2.360	26.00	65.00	2.500	1.18	2.84	2.407
Salinas-Monterey	-	-	-	-	-	-	203.00	370.00	1.823	-	-	-	-	-	-
San Diego	3,374,300	12,256,700	3.632	28.90	34.28	1.186	3,073.00	7,714.00	2.510	72.00	140.00	1.944	3.27	6.12	1.872
San Francisco-Oakland, San Jose	5,126,300	19,504,500	3.805	11.97	16.75	1.399	8,321.00	20,403.00	2.452	74.00	200.00	2.703	3.36	8.74	2.601
Santa Barbara	-	-	-	-	-	-	451.00	610.00	1.353	-	-	-	-	-	-
Stockton	-	732,000	-	-	22.19	-	552.00	739.00	1.339	-	10.00	-	-	0.44	-
All urbanized areas 3/	33,755,100	86,143,100	2.552	20.48	21.92	1.070	37,504.00	74,719.00	1.992	391.00	796.00	2.036	17.74	34.79	1.961
Oregon:															
Eugene	228,799	569,290	2.488	12.86	11.89	0.925	638.30	1,182.60	1.853	9.90	10.90	1.101	1.44	1.48	1.028
Salem	226,488	685,700	3.028	21.49	15.82	0.736	561.10	1,067.20	1.902	9.80	13.10	1.337	1.42	1.78	1.254
Portland	878,218	3,381,610	3.851	11.00	16.34	1.485	3,391.00	5,096.70	1.503	38.00	64.70	1.703	5.51	8.80	1.597
All urbanized areas 3/	1,333,505	4,635,600	3.476	12.32	15.55	1.262	4,590.40	7,346.50	1.600	57.70	88.70	1.537	8.37	12.06	1.441
Washington:															
Seattle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spokane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tacoma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All urbanized areas 3/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Division Total 3/	35,088,605	90,778,700	2.587	19.98	21.47	1.075	42,094.40	82,065.50	1.950	448.70	884.70	1.972	16.91	27.88	1.649
Total - All Divisions 3/	206,888,288	575,496,428	2.782	17.79	23.54	1.323	373,199.19	536,188.62	1.437	6,089.05	9,326.72	1.538	18.64	22.45	1.204
Hawaii:															
Island of Oahu	1,345,000	2,836,000	2.109	28.34	28.54	1.007	1,132.60	1,621.10	1.431	49.60	51.50	1.038	100.00	100.00	1.000
All urbanized areas 3/	1,345,000	2,836,000	2.109	28.34	28.54	1.007	1,132.60	1,621.10	1.431	49.60	51.50	1.038	100.00	100.00	1.000
United States Total 3/	208,233,288	578,332,428	2.777	17.84	23.56	1.321	374,331.79	537,809.72	1.437	6,138.65	9,378.22	1.528	18.77	22.55	1.201

1/ Data are from table TF-3 prepared by the State highway departments for the 1970 Interstate Cost Estimate. The data are generally for the area within the planning area cordon, but may be for area bounded by present urban limits in some cases.
2/ 1967 Interstate System mileage and travel as shown in this table are given on one of three bases: (1) completed Interstate mileage only; (2) completed mileage plus traveled-way; or (3) designated mileage for a completed system. 1990 mileage and travel are for the designated system only.
3/ United States, census division and all urbanized area totals were calculated using available data. In some cases these totals are not completely representative because of data not reported.
4/ Dashes (-) indicate either zero values or data not reported.

Step 2b.--Review and adjust forecast year total mileage and travel

The forecast 1990 totals in table TF-1 for the 1970 Interstate Cost Estimate should be reviewed and adjusted where necessary. The statewide total annual vehicle miles should be converted to daily vehicle miles (DVM). Tables D-3 and D-4, comparing the recent TF-1 forecast values with various projections of licensed drivers, vehicle registrations, fuel consumption and interrelationships, are provided to aid in this review. Table A-2 shows 1990 forecast population by State.

Step 3a.--Estimates and forecasts of subarea travel from guideline values

The guideline values from step 1b are applied to each subarea to obtain a first estimate of total and system travel for 1990. For instance, the vehicle-miles per capita guideline (for the appropriate population and density group) multiplied by the forecast subarea population produces a total travel estimate for the subarea; this total is then apportioned among the subarea's road systems and among the five rural and urban categories by use of the guideline percentage distributions. Alternatively the State total may be apportioned on a percentage basis to subareas, and to functional systems and sections.

Step 3b.--Sum and adjust to State total

The resulting travel estimates for each subarea are totaled, by system, and the totals compared with the Statewide totals obtained in step 2. Almost certainly there will be considerable differences. The initial subarea travel estimates should then be adjusted by factoring, using ratios of the subarea estimate totals to the State totals so that, as adjusted, their totals equal the State totals from step 2. The resulting values will serve as measures against the travel estimates to be developed in step 5.

Table D-3.--Miles of roads and streets in service and annual vehicle-miles of travel by State and Census division, 1967 actual and 1990 as forecasted for the 1970 Interstate Cost Estimate

Division	State	1967						1990					
		Rural		Urban		Total		Rural		Urban		Total	
		Miles	Vehicle miles (millions)	Miles	Vehicle miles (millions)	Miles	Vehicle miles (millions)	Miles	Vehicle miles (millions)	Miles	Vehicle miles (millions)	Miles	Vehicle miles (millions)
New England	Connecticut	6,039.5	3,192	11,940.7	10,822	17,980.2	14,014	5,952.0	4,977	16,248.0	19,723	22,200.0	24,700
	Maine	19,107.8	3,803	2,158.8	1,421	21,266.6	5,224	18,836.0	5,908	3,097.0	3,058	21,933.0	8,966
	Massachusetts	8,897.3	6,159	18,646.7	15,610	27,544.0	21,769	14,967.7	4,744	19,276.7	32,291	34,244.4	37,035
	New Hampshire	10,684.5	2,523	3,928.6	1,127	14,613.1	3,650	10,831.0	3,993	4,389.0	2,242	15,220.0	6,235
	Rhode Island	1,211.4	766	3,671.7	3,395	4,883.1	4,161	1,386.6	943	4,318.8	5,818	5,705.4	6,761
	Vermont	13,320.0	1,846	800.0	465	14,120.0	2,311	13,497.0	2,485	1,137.0	1,025	14,634.0	3,510
	Total	59,260.5	18,289	41,146.5	32,840	100,407.0	51,129	65,470.3	23,050	48,466.5	64,157	113,936.8	87,207
Middle Atlantic	New Jersey	14,489.6	9,953	18,694.2	25,620	33,183.8	35,573	14,310.8	18,475	30,776.8	53,449	45,087.6	71,924
	New York	82,133.7	23,523	20,158.0	35,592	102,291.7	59,115	82,897.7	27,730	33,515.5	68,986	116,413.2	96,716
	Pennsylvania	90,622.0	24,975	22,544.0	25,711	113,166.0	50,686	92,919.0	33,997	30,625.0	45,825	123,544.0	79,822
	Total	187,245.3	58,451	61,396.2	86,923	248,641.5	145,374	190,127.5	80,202	94,917.3	168,260	285,044.8	248,462
South Atlantic (North)	Delaware	3,752.2	1,313	1,137.6	1,204	4,889.8	2,517	3,235.0	1,632	2,486.0	2,648	5,721.0	4,280
	Dist. of Col.	-	-	1,083.0	2,643	1,083.0	2,643	-	-	1,241.0	4,682	1,241.0	4,682
	Maryland	20,513.1	8,824	5,071.9	8,999	25,585.0	17,823	22,397.3	10,811	8,196.3	23,887	30,593.6	34,698
	Virginia	52,887.9	14,894	6,893.4	7,747	59,781.3	22,641	56,580.0	21,904	11,420.0	17,209	68,000.0	39,113
	West Virginia	32,420.4	5,495	3,280.2	2,280	35,700.6	7,775	31,904.0	8,034	4,031.0	3,578	35,935.0	11,612
	Total	109,573.6	30,526	17,466.1	22,873	127,039.7	53,399	114,116.3	42,381	27,374.3	52,004	141,490.6	94,385
South Atlantic (South)	Florida	63,429.3	15,201	19,468.6	16,619	82,897.9	31,820	97,709.0	28,674	29,647.0	38,542	127,356.0	67,216
	Georgia	84,905.4	13,981	12,619.2	10,301	97,524.6	24,282	86,451.0	24,871	14,246.0	19,199	100,697.0	44,070
	North Carolina	72,102.1	16,846	12,117.1	7,724	84,219.2	24,570	77,866.0	25,665	18,634.0	18,855	96,500.0	44,520
	South Carolina	53,231.9	9,754	5,534.0	3,332	58,765.9	13,086	55,400.0	12,698	10,700.0	8,312	66,100.0	21,010
	Total	273,668.7	55,782	49,738.9	37,976	323,407.6	93,758	317,426.0	91,908	73,227.0	84,908	390,653.0	176,816
East North Central	Illinois	103,255.3	19,498	25,223.3	30,287	128,478.6	49,785	102,802.0	35,246	41,524.0	55,689	144,326.0	90,935
	Indiana	78,635.0	16,784	12,243.0	11,142	90,878.0	27,926	80,049.0	26,271	17,580.0	20,417	97,629.0	46,688
	Michigan	95,366.7	21,296	18,527.9	23,758	113,894.6	45,054	102,284.9	34,630	27,315.1	50,370	129,600.0	85,000
	Ohio	84,598.0	22,956	22,916.0	27,407	107,514.0	50,363	89,118.0	32,352	37,178.0	48,388	126,296.0	80,740
	Wisconsin	88,634.5	11,193	12,660.5	9,738	101,295.0	20,931	89,082.0	17,017	17,113.0	17,167	106,195.0	34,184
	Total	450,489.5	91,727	91,570.7	102,332	542,060.2	194,059	463,335.9	145,516	140,710.1	192,031	604,046.0	337,547
West North Central	Iowa	100,892.9	8,989	11,516.6	4,484	112,409.5	13,473	103,976.0	13,669	14,825.0	6,910	118,801.0	20,579
	Kansas	123,685.0	7,813	9,547.0	4,337	133,232.0	12,150	121,439.0	10,620	12,927.0	8,005	134,366.0	18,625
	Minnesota	112,761.3	10,835	14,224.1	7,826	126,985.4	18,661	114,768.2	14,178	20,331.8	14,132	135,100.0	28,310
	Missouri	100,450.7	12,542	13,834.2	11,235	114,284.9	23,777	105,573.0	17,606	14,113.0	20,867	119,686.0	38,473
	Nebraska	97,562.5	5,989	5,811.7	2,718	103,374.2	8,707	94,485.0	8,489	8,466.0	4,676	102,951.0	13,165
	North Dakota	104,525.9	2,844	2,636.7	600	107,162.6	3,444	105,869.5	4,476	3,296.3	1,050	109,165.8	5,526
	South Dakota	81,275.3	3,454	2,665.3	689	83,940.6	4,143	77,470.0	5,459	3,440.0	1,180	80,910.0	6,639
	Total	721,153.6	52,466	60,235.6	31,889	781,389.2	84,355	723,580.7	74,497	77,399.1	56,820	800,979.8	131,317
East South Central	Alabama	67,437.2	9,495	10,412.4	6,455	77,849.6	15,950	69,119.0	14,508	13,434.0	13,279	82,553.0	27,787
	Kentucky	65,349.3	11,301	4,875.9	5,272	70,225.2	16,573	65,546.0	16,863	6,252.0	8,999	71,798.0	25,862
	Mississippi	59,763.1	7,011	5,761.5	2,810	65,524.6	9,821	59,079.0	9,297	7,500.0	7,386	66,579.0	16,683
	Tennessee	68,608.1	10,338	8,574.0	7,830	77,182.1	18,168	67,152.0	15,168	17,567.0	14,965	84,719.0	30,133
	Total	261,157.7	38,145	29,623.8	22,367	290,781.5	60,512	260,896.0	55,836	44,753.0	44,629	305,649.0	100,465
West South Central	Arkansas	68,686.8	6,664	7,647.3	3,084	76,334.1	9,748	67,448.8	13,961	12,480.5	7,484	79,929.3	21,445
	Louisiana	41,960.3	9,051	9,799.5	5,588	51,759.8	14,639	46,403.0	16,641	16,169.2	11,839	62,572.2	28,480
	Oklahoma	94,508.9	8,817	12,445.9	6,346	106,954.8	15,163	94,913.0	15,335	19,790.0	14,250	114,703.0	29,585
	Texas	198,833.8	27,284	38,935.3	31,718	237,769.1	59,002	203,344.0	41,427	63,794.0	63,878	267,138.0	105,305
	Total	403,989.8	51,816	68,828.0	46,736	472,817.8	98,552	412,108.8	87,364	112,233.7	97,451	524,342.5	184,815
Mountain	Arizona	35,601.7	4,911	5,241.6	4,304	40,843.3	9,215	42,661.0	10,710	7,791.0	7,472	50,452.0	18,182
	Colorado	74,821.6	5,630	6,406.0	5,210	81,227.6	10,840	84,793.6	8,864	10,056.3	9,043	94,849.9	17,907
	Idaho	50,950.7	3,230	2,533.1	906	53,483.8	4,136	51,251.0	5,769	2,765.0	1,585	54,016.0	7,354
	Montana	73,578.1	3,198	2,169.0	744	75,747.1	3,942	71,558.0	5,598	2,385.0	1,407	73,943.0	7,005
	Nevada	45,119.3	1,831	1,678.5	1,182	46,797.8	3,013	50,092.0	5,132	3,203.0	3,692	53,295.0	8,824
	New Mexico	62,562.2	4,014	3,788.3	2,107	66,350.5	6,121	60,347.0	6,898	8,952.0	6,024	69,299.0	12,922
	Utah	34,742.8	2,906	3,940.8	2,404	38,683.6	5,310	38,233.9	5,054	5,344.7	5,287	43,578.6	10,341
	Wyoming	90,386.8	2,080	1,151.9	502	91,538.7	2,582	42,501.1	3,722	1,538.9	898	44,040.0	4,620
	Total	467,763.2	27,800	26,909.2	17,359	494,672.4	45,159	441,437.6	51,747	42,035.9	35,408	483,473.5	87,155
Pacific	California	121,574.0	32,194	41,235.0	67,278	162,809.0	99,472	128,974.0	43,222	89,857.0	154,778	218,831.0	198,000
	Oregon	82,906.7	6,904	5,422.1	4,661	88,328.8	11,565	108,097.0	13,993	9,561.0	12,675	117,658.0	26,668
	Washington	60,536.4	9,586	11,932.8	8,155	72,469.2	17,741	59,401.0	18,385	18,750.0	17,144	78,151.0	35,529
	Total	265,017.1	48,684	58,589.9	80,094	323,607.0	128,778	296,472.0	75,600	118,168.0	184,597	414,640.0	260,197
Total - All Divisions		3,199,319.0	473,686	505,504.9	481,389	3,704,823.9	955,075	3,284,971.1	728,101	779,284.9	980,265	4,064,256.0	1,708,366
	Alaska 1/	-	-	-	-	-	-	-	-	-	-	-	-
	Hawaii	2,478.3	1,235	923.2	1,425	3,401.5	2,660	2,660.0	1,836	1,432.0	2,658	4,092.0	4,494
United States Total		3,201,797.3	474,921	506,428.1	482,814	3,708,225.4	957,735	3,287,631.1	729,937	780,716.9	982,923	4,068,348.0	1,712,860

1/ Alaska has no Interstate mileage and therefore did not prepare an estimate.

Table D-4.--Vehicle registrations, fuel consumption, population, and licensed drivers by State and Census division, 1967 actual and 1990 as forecasted for the 1970 Interstate Cost Estimate

Division	State	1967				1990			
		Vehicle registrations, thousands 1/	Highway use of motor fuel, million gallons 1/	Population, thousands 1/	Licensed drivers, thousands 1/	Vehicle registrations, thousands	Highway use of motor fuel, million gallons	Population, thousands	Licensed drivers, thousands
New England	Connecticut	1,545	1,077	2,916	1,898	2,460	1,900	4,251	2,680
	Maine	452	414	986	485	651	717	1,207	659
	Massachusetts	2,223	1,844	5,416	2,791	3,544	3,012	7,085	3,656
	New Hampshire	349	276	690	371	588	508	1,025	650
	Rhode Island	434	301	899	469	643	469	1,105	605
	Vermont	194	180	417	219	278	273	570	333
	Total	5,197	4,092	11,324	6,233	8,164	6,879	15,243	8,583
Middle Atlantic	New Jersey	3,200	2,550	6,971	3,597	5,711	5,101	10,600	5,275
	New York	6,060	4,841	18,007	7,903	9,691	8,150	25,504	11,728
	Pennsylvania	5,335	4,010	11,670	5,913	7,576	6,315	15,054	8,409
	Total	14,595	11,401	36,648	17,413	22,978	19,566	51,158	25,412
South Atlantic (North)	Delaware	268	230	524	295	446	373	816	507
	Dist. of Col.	247	242	808	344	302	314	890	440
	Maryland	1,612	1,328	3,681	1,867	2,763	2,393	5,527	2,885
	Virginia	1,932	1,748	4,546	2,230	3,334	3,129	6,500	3,500
	West Virginia	765	622	1,811	855	1,043	929	1,991	940
	Total	4,824	4,170	11,370	5,591	7,888	7,138	15,724	8,272
South Atlantic (South)	Florida	3,393	2,562	6,046	3,336	6,446	5,487	12,236	6,998
	Georgia	2,164	1,953	4,509	2,153	3,900	3,627	6,368	3,610
	North Carolina	2,423	2,073	5,072	2,512	4,250	3,783	7,070	3,951
	South Carolina	1,180	1,026	2,664	1,244	1,827	1,686	3,594	1,763
	Total	9,160	7,614	18,291	9,245	16,423	14,583	29,268	16,322
East North Central	Illinois	4,818	3,999	10,874	5,801	8,450	7,393	15,100	8,335
	Indiana	2,632	2,234	5,021	2,661	4,197	3,735	6,800	4,289
	Michigan	4,133	3,527	8,615	4,514	6,944	6,693	11,993	6,956
	Ohio	5,305	4,055	10,497	5,726	8,450	6,591	15,141	8,704
	Wisconsin	1,954	1,597	4,192	2,280	2,962	2,586	5,687	3,290
	Total	18,842	15,412	39,199	20,982	31,003	26,998	54,721	31,574
West North Central	Iowa	1,652	1,236	2,751	1,584	2,240	1,714	3,282	2,041
	Kansas	1,441	1,041	2,281	1,410	2,100	1,596	3,019	1,965
	Minnesota	1,997	1,521	3,626	2,074	2,900	2,311	4,728	2,650
	Missouri	2,211	2,019	4,589	2,500	3,220	2,966	5,816	3,546
	Nebraska	888	678	1,442	918	1,343	1,035	1,946	1,200
	North Dakota	405	258	631	333	578	413	751	425
	South Dakota	407	305	668	404	619	513	791	476
	Total	9,001	7,058	15,988	9,223	13,000	10,548	20,333	12,303
East South Central	Alabama	1,735	1,390	3,541	1,598	2,597	2,168	4,507	2,389
	Kentucky	1,632	1,248	3,208	1,442	2,508	1,994	3,998	2,207
	Mississippi	1,012	919	2,343	972	1,562	1,470	3,144	1,500
	Tennessee	1,870	1,606	3,939	2,060	2,980	2,593	5,195	2,905
	Total	6,249	5,163	13,031	6,072	9,647	8,225	16,844	9,001
West South Central	Arkansas	983	844	1,995	1,013	1,670	1,556	2,672	1,335
	Louisiana	1,634	1,306	3,670	1,622	2,758	2,358	5,315	3,132
	Oklahoma	1,542	1,215	2,514	1,465	2,657	2,342	3,410	2,394
	Texas	5,894	5,169	10,847	5,601	10,084	9,571	17,957	9,451
	Total	10,053	8,534	19,026	9,701	17,169	15,827	29,354	16,312
Mountain	Arizona	890	724	1,644	964	1,821	1,514	3,145	1,839
	Colorado	1,242	877	2,018	1,261	2,107	1,496	3,224	2,014
	Idaho	455	333	703	429	771	594	1,024	711
	Montana	451	341	698	391	756	606	944	526
	Nevada	287	261	440	338	587	534	819	500
	New Mexico	571	526	1,011	549	1,025	994	1,778	1,038
	Utah	562	431	1,022	558	1,120	863	1,640	1,029
	Wyoming	226	218	320	221	399	386	463	316
	Total	4,684	3,711	7,856	4,711	8,586	6,987	13,037	7,973
Pacific	California	10,850	8,009	18,899	10,688	20,431	15,936	33,302	19,215
	Oregon	1,190	933	1,979	1,100	2,282	1,759	2,949	1,852
	Washington	1,852	1,332	3,215	1,705	3,941	2,733	5,094	3,489
	Total	13,892	10,274	24,093	13,493	26,654	20,428	41,345	24,556
Total - All Divisions		96,497	77,429	196,826	102,664	161,512	137,179	287,027	160,308
	Alaska 2/	-	-	-	-	-	-	-	-
	Hawaii	336	190	761	393	570	321	1,352	717
United States Total		96,833	77,619	197,587	103,057	162,082	137,500	288,379	161,025

1/ Data sources: Vehicle registrations, highway use of motor fuel, and licensed drivers from tables MV-1, MF-21, and DL-1, respectively, "Highway Statistics 1967;" population from "Population Estimates, Current Population Reports," Series P-25, No. 403, Bureau of the Census, September 19, 1968.
2/ Alaska has no Interstate mileage and therefore did not prepare an estimate.

Step 4.--Subarea socio-economic and exceptional characteristics analysis

This step is undertaken to assure proper consideration of special characteristics of subareas which have unusual travel patterns and growth potential in relation to the statewide framework. Each county and city has a unique combination of socio-economic, transportation, and geographic characteristics. It is important, then, to identify those characteristics likely to affect future travel demand and the relative importance of the area in relation to all others in the State. Some characteristics occasion vehicle-miles per capita values much higher or lower than State averages; others relate to unusually high or low proportions of long trips; while still others relate to extremes in growth potential. These factors in turn will affect the extent and use of functional road systems. The travel growth potentials relate primarily to economic growth potential of the area and the population characteristics of the places themselves. The two variables, population and vehicle registration, were selected for use for three reasons: (1) They have been identified as significant measures of the relative economic strength and potential of geographic areas in studies concerned with non-transportation problems such as economic analysis, plant location, and marketing; (2) they correlate closely to transportation demand; and (3) data for them are usually available for all counties, and for cities of selected population groups, on a consistent Statewide basis.

Alternate or supplemental variables, if needed, are suggested below for population and motor-vehicle registrations. Other data items which may be of value in studying special situations are also available by county, from sources indicated earlier in this section.

Whatever factors are used, the figures for each subarea are translated into percentages of the statewide total. These values will serve as measures against the travel estimates to be developed in step 5.

Population.--Travel is primarily a function of population; hence population in itself is a good relative measure against the subarea travel estimates.

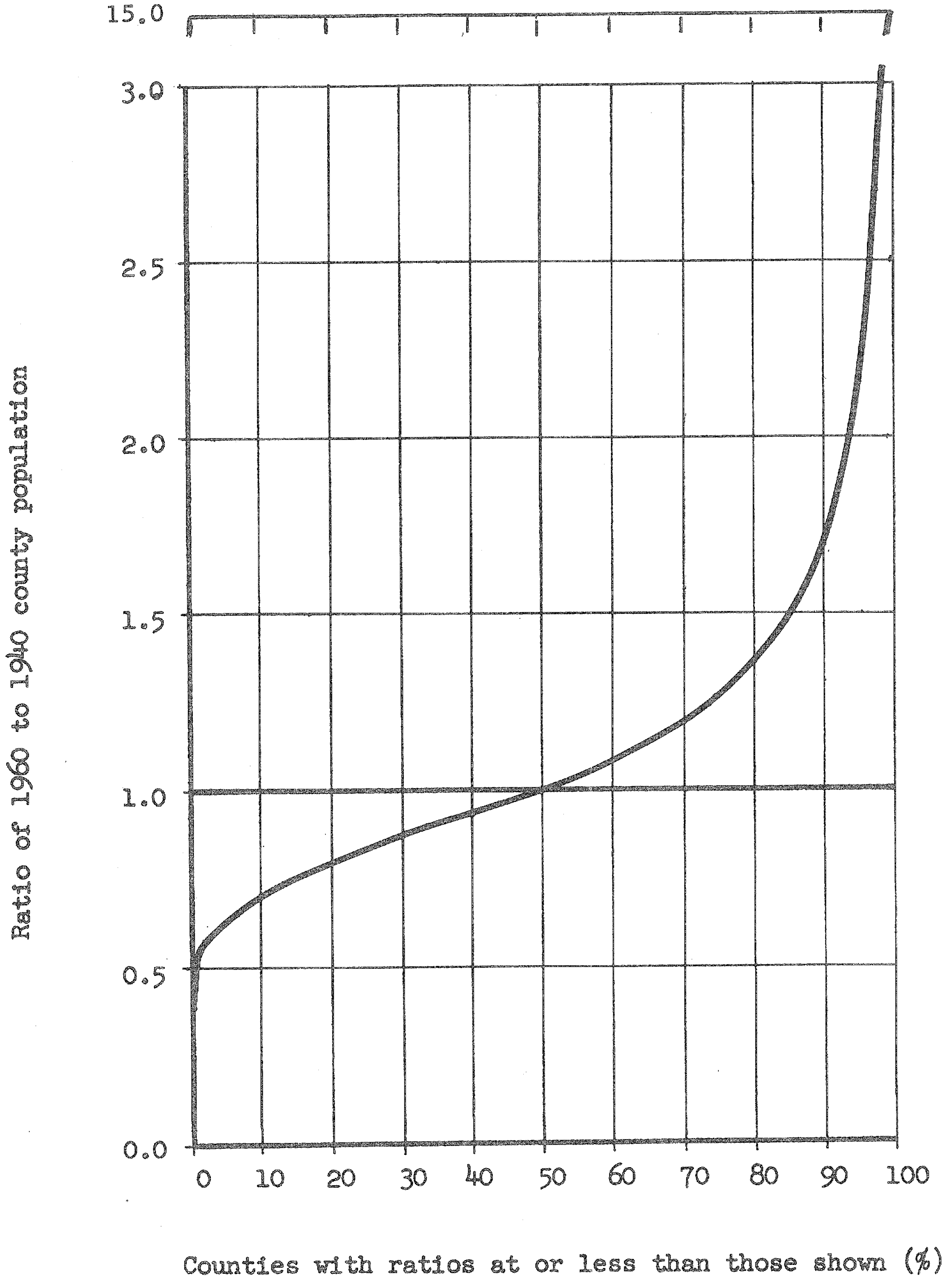
Recent data showing miles driven by driver age and licensed drivers as a percentage of their age groups indicate that a high daily vehicle-miles (DVM) per capita can be expected nationwide by 1990. This provides a fairly clear-cut indication at the national level. For a particular State or subarea the problem becomes more difficult since the location of the population can change substantially in a 20-year period. Figure D-2 shows that 15 percent of all counties experienced an increase of 50 percent or more, while 15 percent experienced a decrease of 25 percent or more. Generally the largest increases occurred in counties near large cities, while the greatest decreases were in agricultural, mining, and other areas with labor intensive economies. Thus, in forecasting future exceptional changes it is worthwhile to look for areas in the path of metropolitan expansion and those having an economy based on high labor intensive industries. From earliest recorded history, growth has been channeled along transportation corridors. While the automobile has tended to equalize accessibility over broad areas, it is evident from recent urban expansion that freeway and other transportation corridors are likely to experience more rapid growth than other areas.

Motor-vehicle registrations.--Motor-vehicle registrations per capita are usually the second most influential indicator, after population, of the travel potential of an area. Motor-vehicle registrations by county are not always available from State records, but may possibly be obtained from other sources in such cases.

Where recent motor-vehicle registration data are not available, the percentage of families with annual incomes exceeding $10,000 (or some similar range) may be available for a recent year, and this appears to be a satisfactory indicator of motor-vehicle ownership except in a few larger Eastern cities. Data for every subarea and for the entire State are required for this analysis comparison. Again, subarea values per capita should be obtained and converted to percentages of the State per-capita total.

FIGURE D-2

COUNTY POPULATION GROWTH FOR 1940 TO 1960



Historical data indicate increased per capita travel by the higher income families which own more and newer cars. Thus, while at a particular time the highest per capita travel is produced by areas having high incomes, rapid travel growth may occur where an existing high proportion of low income families, over a period of time, develop into higher income car owning families. Thus, areas with abnormally low average car ownership ratios should be reviewed closely for indications of potential increases in family income. Indicators or clues might be an increasing proportion of high school graduates going to college, decreasing proportions of unemployed, decreasing welfare cases per capita, etc.

Recreation and special locations.--Areas with a high potential for recreational development should be identified if possible. Water areas--ocean, lake, river or trout stream--attract travelers over substantial distances. Table D-5, based on the National Automobile Use Study shows the percentage of passenger car trips and travel by purpose. Table D-6 based on Motor Vehicle Use Studies in 21 States shows the distribution of travel by purpose by occupational group. The high proportion of social, recreational and vacation travel in proportion to trips indicates that long journeys are taken for these purposes.

For significant recreational areas such as national parks, where there is practically no resident population, available visitation statistics may be used as a basis for determining travel potential.

For commercial recreational activities of large scale, such as lake, beach, mountain, entertainment, and similar resorts, resident population is usually a relatively small factor in total travel, and visitation figures may not be available. Hotel and motel receipts (from sales tax or other records) are excellent indicators of travel in such areas. If data for a recent year are available for all subareas in a State which have a high number of hotel and motel units per capita, the ratio of hotel-motel receipts to population should be computed for each resort activity subarea and for the entire State. Then the per-capita receipts for each subarea are computed as a percentage of the State total per-capita receipts, and these figures will serve as relative measures of travel demand in lieu of the population values. Where hotel-motel receipts are not available in any form, the number of hotel rooms and motel units, determined from the commercial guides listed earlier or from any other comprehensive listings, may be used.

Table D-5--Distribution of passenger car trips and travel classified by trip length and by purpose of trip based on the Nationwide Automobile Use Study 1/ - all places

Trip length (one way) miles	Purpose of trip																							
	All purposes						To and from work		Related business		Medical and dental		Shopping		Other family business		Educational civic, and religious		Vacations		Pleasure rides		Other social and recreational	
	Percent		Cumulative percent																					
			Down		Up																			
	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel	Trips	Travel
	Percent distribution of trips and travel																							
0.1- 0.9	10.0	0.7	10.0	0.7	100.0	100.0	8.6	0.6	3.8	0.1	6.1	0.4	14.1	1.6	12.2	1.0	15.2	1.8	-	-	1.4	-	6.6	0.3
1.0- 1.9	16.6	2.5	26.6	3.2	90.0	99.3	14.4	2.5	9.4	0.7	13.7	2.2	22.0	5.8	18.5	3.2	25.5	6.2	-	-	3.7	0.3	11.8	1.1
2.0- 2.9	13.5	3.6	40.1	6.8	73.4	96.8	13.1	3.9	7.5	1.0	13.5	3.8	16.3	7.7	14.8	4.6	15.6	6.8	-	-	4.7	0.6	11.3	2.0
3.0- 3.9	9.3	3.7	49.4	10.5	59.9	93.2	9.5	4.2	7.1	1.4	9.9	4.1	11.1	7.7	9.0	4.1	9.3	6.1	-	-	6.8	1.2	7.8	2.0
4.0- 4.9	7.0	3.7	56.4	14.2	50.6	89.5	6.4	3.8	5.8	1.5	8.9	4.7	7.5	6.8	7.7	4.5	6.7	5.6	-	-	5.2	1.2	7.8	2.6
5.0- 5.9	6.4	4.1	62.8	18.3	43.6	85.8	6.7	4.8	6.4	2.0	5.8	3.7	5.8	6.5	6.0	4.4	4.9	5.1	-	-	10.8	3.0	7.6	3.1
6.0- 6.9	5.0	3.8	67.8	22.1	37.2	81.7	5.3	4.5	3.6	1.3	12.5	9.6	5.1	6.8	4.9	4.3	4.2	5.1	-	-	4.3	1.5	4.4	2.1
7.0- 7.9	3.8	3.4	71.6	25.5	32.2	77.9	4.8	4.7	4.1	1.8	4.0	3.7	2.4	3.8	3.5	3.6	3.0	4.4	-	-	2.4	0.9	4.1	2.3
8.0- 8.9	3.3	3.3	74.9	28.8	28.4	74.5	3.7	4.2	2.9	1.4	4.6	4.8	2.3	4.1	3.2	3.7	2.6	4.2	-	-	1.9	0.9	3.7	2.4
9.0- 9.9	1.9	2.2	76.8	31.0	25.1	71.2	2.2	2.9	1.3	0.7	2.6	3.1	1.9	3.8	1.6	2.0	1.1	2.0	-	-	1.5	0.8	2.3	1.7
5.0- 9.9 miles	20.4	16.8	-	-	-	-	22.7	21.1	18.3	7.2	29.5	24.9	17.5	24.9	19.2	18.0	15.8	20.8	-	-	20.9	7.1	22.1	11.6
10.0- 14.9	10.1	14.4	86.9	45.4	23.2	69.0	12.7	20.4	14.4	10.0	6.0	8.5	5.7	14.5	7.9	12.6	5.4	14.7	-	-	16.3	10.2	12.1	11.0
15.0- 19.9	4.4	9.1	91.3	54.5	13.1	54.6	5.3	12.1	6.3	6.2	5.3	11.3	2.7	9.8	3.8	8.9	1.8	6.0	-	-	9.6	8.9	5.5	7.1
20.0- 29.9	4.5	12.9	95.8	67.4	8.7	45.5	4.3	13.9	12.6	17.6	3.9	11.3	2.1	10.9	4.2	14.0	2.3	10.2	-	-	14.5	18.6	5.5	10.1
30.0- 39.9	1.5	6.3	97.3	73.7	4.2	32.6	1.6	7.3	4.2	8.2	1.1	4.2	0.6	4.4	0.6	2.8	0.8	5.1	-	-	5.9	11.0	2.6	6.7
40.0- 49.9	0.7	4.1	98.0	77.8	2.7	26.3	0.6	3.5	2.3	5.9	0.4	1.9	0.1	0.6	0.7	4.5	0.2	2.2	21.8	7.7	2.6	5.1	1.6	5.5
50.0- 99.9	1.5	12.1	99.5	89.9	2.0	22.2	-	5.8	5.2	23.9	0.9	7.3	0.2	3.3	1.0	8.6	0.4	6.6	30.9	17.4	7.1	24.6	3.9	20.6
100.0-249.9	0.4	7.8	99.9	97.7	0.5	10.1	0.7	0.9	2.1	16.3	0.8	15.4	0.1	2.0	0.3	7.0	0.3	7.0	31.9	38.6	1.3	10.2	1.2	14.4
250.0-499.9	0.1	2.1	100.0	99.8	0.1	2.3	-	-	-	-	-	-	-	-	0.1	4.9	-	0.9	15.4	36.3	-	-	0.2	5.0
500.0-999.9	-	0.2	100.0	100.0	0.0	0.2	-	-	-	-	-	-	-	-	-	1.3	-	-	-	-	-	-	-	-
100.0 miles and over	0.5	10.1	-	-	-	-	0.7	0.9	2.1	16.3	0.8	15.4	0.1	2.0	0.4	13.2	0.3	7.9	47.3	74.9	1.3	10.2	1.4	19.4
TOTAL	100.0	100.0	100.0	100.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Average trip length	8.3						6.4		10.3		10.7		3.9		6.8		4.5		253.6		14.9		12.7	

1/ The Nationwide Automobile Use Study was conducted for the Bureau of Public Roads by the Bureau of the Census during one week in April 1961. The sample used by Census was one CPS (Current Population Survey) Panel consisting of approximately 4,000 dwelling units.

Table D-6. Distribution of passenger-car travel classified by occupation of principal operator and major purpose of trips, 21 States 1/

Occupational group	All purposes	Earning a living: Total	Earning a living: To and from work	Earning a living: Related business	Family business: Total	Family business: Medical and Dental	Family business: Shopping	Family business: Other	Educational, civic, and religious	Social and recreational: Total	Social and recreational: Vacations	Social and recreational: Pleasure rides	Social and recreational: Other	Unknown
Percent distribution of travel by occupational group														
Professional and Semiprofessional	10.5	12.2	11.7	12.8	8.4	6.1	7.4	9.7	12.2	9.5	13.1	8.3	9.4	7.2
Proprietors, Managers, and officials														
Farmers and farm managers	8.9	7.5	2.7	14.6	14.1	20.5	18.7	9.2	18.7	7.0	5.5	9.0	6.0	5.1
Others	13.4	16.8	13.3	21.8	10.0	10.4	8.6	11.0	7.6	11.8	14.2	12.6	10.6	9.7
Total	22.3	24.3	15.0	36.4	24.1	30.9	27.3	20.2	26.3	18.8	19.7	21.6	16.6	14.8
Store and office clerks	10.6	12.2	11.7	12.9	7.2	5.4	6.3	8.3	7.2	10.5	9.1	10.3	11.1	11.8
Traveling salesmen	3.6	6.3	3.7	10.1	1.1	0.7	1.1	1.2	1.1	2.0	2.3	2.4	1.6	0.4
Craftsmen, foremen	16.9	17.9	24.1	8.8	13.9	12.6	13.2	14.7	14.0	17.6	14.4	19.0	17.5	4.6
Operatives, etc.	16.8	17.0	22.7	8.6	16.4	15.5	16.6	16.4	11.2	17.3	8.9	18.1	18.9	10.9
Protective services	3.0	2.8	3.7	1.6	2.4	2.1	2.2	2.6	1.6	3.7	3.2	2.5	4.7	1.9
Personal service workers	1.6	1.6	2.2	0.8	1.4	1.5	1.3	1.5	1.2	1.6	0.2	1.6	2.0	1.5
Housewives	8.2	3.1	2.3	4.3	15.1	15.7	17.7	12.8	11.8	10.6	20.2	7.9	10.0	11.4
Miscellaneous	6.5	2.6	1.9	3.7	10.0	9.5	6.9	12.6	13.4	8.4	8.9	8.3	8.2	35.5
All occupations	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percent distribution of travel by purpose														
Professional and Semiprofessional	100.0	49.7	28.4	21.3	14.1	1.1	4.9	8.1	4.0	31.9	5.8	9.8	16.3	0.3
Proprietors, Managers, and officials														
Farmers and farm managers	100.0	36.5	7.7	28.8	28.3	4.3	14.8	9.2	7.2	27.7	2.9	12.6	12.2	0.3
Others	100.0	53.5	25.2	28.3	13.2	1.4	4.5	7.3	2.0	30.9	4.9	11.7	14.3	0.4
Total	100.0	46.8	18.2	28.6	19.2	2.6	8.6	8.0	4.1	29.6	4.1	12.1	13.4	0.3
Store and office clerks	100.0	49.8	28.3	21.5	12.1	1.0	4.2	6.9	2.3	35.2	4.0	12.1	19.1	0.6
Traveling salesmen	100.0	74.5	25.7	48.8	5.4	0.4	2.2	2.8	1.0	19.1	2.9	8.2	8.0	-
Craftsmen, foremen	100.0	45.5	36.4	9.1	14.6	1.4	5.5	7.7	2.9	36.9	4.0	14.0	18.9	0.1
Operatives, etc.	100.0	43.5	34.5	9.0	17.4	1.7	7.0	8.7	2.3	36.5	2.5	13.5	20.5	0.3
Protective services	100.0	40.2	30.9	9.3	14.2	1.3	5.1	7.8	1.7	43.6	5.0	10.3	28.3	0.3
Personal service workers	100.0	44.0	35.5	8.5	16.2	1.8	5.7	8.7	2.7	36.6	0.7	13.0	22.9	0.5
Housewives	100.0	16.4	7.3	9.1	32.5	3.6	15.1	13.8	5.0	45.4	11.5	12.0	21.9	0.7
Miscellaneous	100.0	17.5	7.4	10.1	27.3	2.7	7.4	17.2	7.1	45.4	6.4	16.0	23.0	2.7
All occupations	100.0	43.0	25.5	17.5	17.8	1.9	7.0	8.9	3.4	35.3	4.7	12.5	18.1	0.5

1/ Summary of motor-vehicle-use study data from the following States: Arkansas, California, Colorado, Idaho, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, New Mexico, North Dakota, Oklahoma, Oregon, Pennsylvania, South Dakota, Tennessee, Washington, Wisconsin, and Wyoming.

Studies were of one-year duration and were conducted in various States in various years between 1951 and 1958.

For use in forecasting, it will be desirable to relate total recreational travel and trips to the driving age population which produces them. As shown in table D-6, more than one-third of all travel was for social and recreational purposes in the sample households. Of this the largest share--18.1 percent of all travel--is for the other recreational purposes such as weekend trips of various kinds. It is expected that increasing leisure time, higher income and higher travel speeds will result in more and longer recreational trips. Therefore, it is desirable to establish some measure of the limiting factors. As shown in table D-6, the higher income occupational groups of professionals and managers account for 22.3 percent of all travel, but only 18.8 percent of recreational travel. Increased income tends to expand the range of competing recreational activities available to a family. During the family cycle there is a period of 10 to 20 years when total available family recreational time is constrained by school attendance, related weekend activities, and often summer sports or other special recreational or training programs which limit the time available for long trips to special recreational areas. With continuing technological advancements creating emphasis on increased training and education, it is unlikely that these constaints will be substantially relaxed. In some high population regions there appear to be efforts to provide increased recreational opportunities within a 1-to 2-hour drive.

This may tend to restrain large increases in trip length. Increases in travel speeds and improved accessibility to additional areas, which favor longer recreational trips and more travel, will encourage longer trips and more travel for other purposes as well. Thus, very substantial increases in the proportion of all travel which is for recreation purposes seems doubtful. Thus it is desirable in areas with high recreational travel potential to develop a forecast of total recreational travel in several categories of recreational activity which can be related to age groups, sex, income, and other measurable attributes. Then based on average trip lengths to major population centers, estimate the total number of trips. Forecasts of usage for all individual recreational areas in a subarea or State can then be converted to travel by estimating average trip length from major population centers of users and these DVM values summed and compared to the State total travel. This will serve to identify extreme inconsistencies.

Variations in recreational travel proportions among States and subareas can be substantial. Therefore, a careful analysis should be made since proportions which may at first seem much too high or low may be reasonable.

The above discussion relates primarily to consideration of exceptional characteristics of the subareas. Following is a discussion of socio-economic considerations to be used in developing the L_i factor needed for step 5, as it relates to socio-economic growth potential.

Local subarea socio-economic factor analysis

Each county and city has unique socio-economic, transportation, and geographic characteristics. It is important to identify the characteristics likely to affect travel demand and the relative socio-economic importance of the subarea in the determination of its position in the ranking process. Some characteristics occasion traffic growth either higher or lower than State averages; others are related to high or low proportions of long trips. These in turn will affect both the growth potential of the subarea and the extent and use of functional systems. The L_i factors developed in this step are intended to be a measure of the relative travel potential of each subarea $\underline{i}$ as it relates to socio-economic indicators.

The L_i factor is simply the ratio of various socio-economic indicators by subarea to Statewide totals for these indicators, divided by the mean of the ratio for all subareas. Examples of such indicators are hotel and motel units per capita, retail sales per capita, population increase for the 10 or 20 year period, etc. The number of indicators used will depend upon the availability of data by subarea.

Step 5a.--Development of subarea travel forecasts from ADT

In this step, 1990 travel is forecast for each road system in each subarea, using ADT and any other data available and the equation previously discussed. These estimates are then adjusted as necessary to reconcile their summation with the tatewide totals from step 2. The estimates resulting from this step are independent of those obtained in step 3, and there is apt to be considerable point-by-point disagreement between them, but they should gradually converge toward consistent relationships during the repetition of the estimating and adjustment processes.

The initial operation in this step is to estimate for each subarea the 1969 vehicle-miles of travel on all mileage of each system in the subarea. The vehicle miles and ADT values from computer assignments should be used to the maximum extent feasible.

The assignment procedures should be reviewed to assure proper adjustments related to the levels of short and long trips which are included and the level of detail of the coded network.

Current travel data, recent counts (1962-67) which can be adjusted forward to 1969, and data obtained in the process of completing the 1968 Functional Classification Study, will probably be available for major roads and streets, at least in the form of ADT which can be converted readily into vehicle miles. For local roads and streets it may be necessary to make approximations or educated guesses, based on meager data and/or State ADT or DVM averages for roads and streets of the class involved. By these means trial estimates of DVM for all systems in all subareas are established which can be entered into the equation $F = B \times S \times L_i \times C_j \times R_k$, as discussed in detail below, where:

F = Forecast year traffic, ADT; (1990)

B = Base year traffic on existing facilities or base year traffic assigned to mileage to be built in the future, ADT: (1969)

S = Statewide increase ratio based on schedule TF-1 total vehicle-mile increase from 1969 to 1990 (S = 1990/1969 ratio);

D = Differential adjustment term - (L_i x C_j x R_k)

L_i = Location socio-economic function for subarea or urban place "i", relating local socio-economic growth potential to the statewide growth; (see step 4 for discussion)

C_j = A relative growth factor for traffic on each functional system "j" within the functional hierarchy.

R_k = A relative growth factor where desired to reflect forecast differences in growth rate for a particular road section or group of sections compared to others on the same functional system.

Where statewide assignment data are not available, the subarea functional systems and section-by-section forecasts "F" may be estimated by using the equation listed above. If a State has another preferred procedure for disaggregating the statewide travel estimate to subarea and functional systems, the formula need not be used.

Items "B" and "S" are entered as noted above, and item "L_i" is discussed under step 4 above.

Relative Traffic Growth Factor (C_j) By Functional System

In the absence of traffic assignment data, average $\underline{C_j}$ factors should be selected for each system, usually with a slightly greater factor for the highest order system and with decreasing values for the lower systems. For the first computation of this step, $\underline{C_j}$ values in the range 0.95-1.05 should be used except in those rings which were rural in 1969 and forecast urban in 1990. For these rings, $\underline{C_j}$ values of 2.0 to 10.0 are reasonable. For the Interstate System, current cost estimate traffic forecasts should be used unless need for change becomes evident during the adjustment process. Similarly, planning study forecasts should be used after necessary adjustments to 1990 control totals required for statewide consistency.

Present levels of service on existing arterials and the probabilities of future construction have a direct bearing on traffic growth on each functional system in and near urban areas. Where nearly all arterial mileage is operating near capacity, especially in peak hours, substantial increases in DVM require construction, a TOPICS (Traffic Operations Program to Improve Capacity and Safety) type program, or other actions to increase capacity. If adequate improvements are not provided, greater increase rates usually occur on the lower order systems as drivers necessarily seek alternative routes. Collectors and some locals may tend, in such cases, to function as minor arterials during peak hours.

Thus, for urban areas particularly, the forecaster must implicitly make an assumption concerning both the provision of needed improvements and the service levels which will be tolerated. It is often helpful to consider past accomplishments, current programs, attitudes, and priorities competing for public funds. While this is a subjective process, it is useful to weigh counteracting factors: those tending toward a high forecast and those tending toward a low forecast for each functional system.

For rural areas, with generally higher levels of service, similarly intense problems will be evident only in certain critical corridors, and usually only at limited times of the year.

Where present mileage is extremely deficient with respect to level of service provided, and considerable relative improvement can be expected, the C_j values for the various classes of arterials should be greater than 1.0 and the C_j values for collectors and locals will be less than 1.0, since the overloading of lower category systems will be relieved by the shift of traffic to the higher systems as the arterial mileage is improved. Conversely, where population growth and other developments are likely to outpace future improvements to the arterials, and the lower order systems have excess capacity (as they usually do), the local and collector C_j factors will exceed 1.0 while for arterials the $\underline{C_j}$ values will be less than 1.0.

As indicated previously, route and section forecasts are required on all rural principal arterials and on sampled other arterials and collectors. The route section forecast ratio is the term $(S \times L_i \times C_j)$ in the equation $F = B\ (S \times L_i \times C_j)$. The forecast ratio on each section will average out--when weighted by DVM--to the system ratio. Thus, for every section with an above-average increase there must usually be a section with a below-average increase. With this in mind, it is convenient to work through an entire route through all subareas involved.

The largest increases usually occur around large cities where rapid land use changes occur. This is usually reflected in urban transportation study traffic assignments, but the effect may be apparent for some distance beyond the study boundaries. On many rural sections between cities, traffic increases tend to be steady but moderate, related to population and economic growth of the cities and regions served.

When forecasts for arterials traversing several subareas have been completed, DVM should be summed and checked against subarea system totals. This cross-state procedure for forecasting arterial traffic will tend to reveal any substantial inconsistencies between subarea increase ratios. An initial check after only three or four subareas have been completed will help the forecaster to make adjustments in his procedure for balancing high and low increase ratios, thereby expediting the remainder of the work.

Relative Traffic Growth Factor R_k By Needs Sections

This factor may be used where desired to reflect forecast differences in growth rate for a particular road section or group of sections compared to others on the same functional system. Examples of sections where this factor may be applicable are those near highly developed recreation areas or industrial complexes which are relatively isolated.

The procedure should provide reasonably consistent travel estimates for all urban places and rural subareas and for each category of mileage for which travel is reported. Thus it provides means for significant comparison of traffic service and travel potential among individual cities, subareas, and functional classes of highways. However, it is not intended to and will not provide a basis for meaningful comparison among road sections or functional system increments within a subarea where adequate current road mileage and related traffic data are not available for the base year. Forecast by road section to provide this comparative data generally requires land use analysis and forecast and network trip assignment followed by careful calibration and adjustment to totals.

Step 5b.--Calculation of subarea travel distributions

Using the 1990 DVM estimates for each system in each subarea, from step 5a, road miles and vehicle-miles per capita and per square mile are computed; this should be done for each subarea as a whole and also separately for rural and urban.

Next, the vehicle-mile forecasts for all subareas are added to obtain trial State totals. Against these totals the individual subarea forecasts are factored to obtain a series of sets of percentages.

1a. Subarea rural DVM/State total rural DVM;

1b. Subarea urban DVM/State total urban DVM;

1c. Subarea total DVM/State total DVM;

2. Subarea DVM for each system/State total DVM for same system;

3. Subarea total mileage/State total mileage.

Two additional sets of percentages should be calculated, based on total DVM for the subarea (rather than the State total);

4a. Subarea rural DVM/subarea total DVM;

4b. Subarea urban DVM/subarea total DVM.

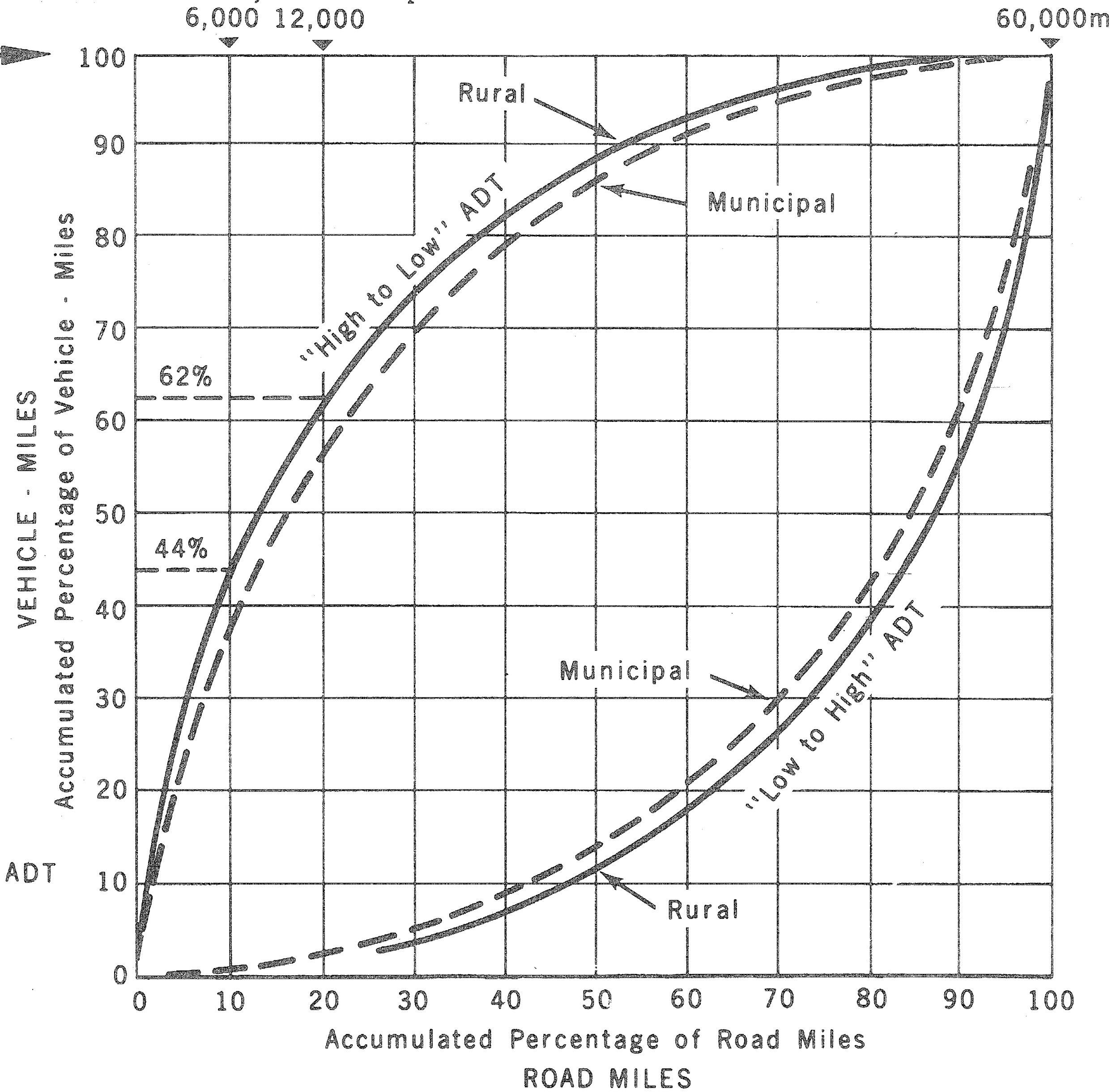
When all forecasts have thus been established, subject to the independent reviews, and the DVM figures for each arterial road section, and road system of each subarea converted to percentages of the total DVM for the subarea and the total DVM for the entire statewide system, the final forecasts should also be computed as DVM per capita and per square mile. These percentages and ratios, as well as those for all other values used in the estimating process, should be used as the basis of preparing a series of arrays of arterial road sections within subareas and subareas within State from high to low.

For example, arterial road section data may be plotted with cumulative road mileage versus cumulative vehicle mileage from the highest to the lowest volume road section. Figure D-3 is an example of such a plot on a percentage basis and illustrates its use in estimating ADT ranges. The differences in the shapes of curves plotted for the same type of data, one for base year data and one for forecast year data, should be compared. A flattening of the example curve would indicate a lesser range of differences in ADT's among road sections. Conversely, a steep climb with a sharp break would indicate a small percentage of very high-volume mileage and a high percentage of low-volume mileage. The same type of curve is often of value for other variables. For example, percent of total travel versus percent of total population will give an indication of the extent to which differences in the relationship between these two are increasing or diminishing. Accumulated percentages of vehicle-miles of travel would be plotted on the y-axis and percent of total population (ranked from left-to-right by those subareas with the highest per-capita travel to those with the lowest) on the x-axis. For comparisons, it is of course necessary that data for both years (the base year and the forecast year) be plotted on the same scale coordinates.

With these listings, a final search for inconsistencies should be made among all subareas of similar nature and between adjacent subareas. Substantial differences in percentages or ratios, particularly where no reason is evident, indicate the need for further examination and adjustment. Any individual values based on the DVM which appear to be unusually high or low, as compared with the averages for the entire State or for subareas of similar nature and size, should be questioned: "Is there valid reason for this value being higher (or lower) than the average?" Adjustments should then be made, as necessary, by repeating the essential parts of step 5.

Figure D-3--Accumulative percentage of State primary system road miles vs. vehicle miles ranked by ADT on road sections, with example calculation of ADT for one increment

28 MILLION DVM→



62-44=18%

.18 X 28 million=
5.04 million DVM

12,000
-6,000
6,000 Rd. mi.

5.04 million = 840 ADT
6,000

Step 5c.--Adjustment of subarea travel estimates

On the basis of the per-capita and per-mile DVM values and the series of percentages, computed in step 5b, comparisons are made for each subarea (and its road systems) individually and among all subareas. In addition to the values just cited, other available indicators such as land area, population, and socio-economic factors, should be used; handling of such factors was suggested in step 4. Comparisons should be made, subarea by subarea, with the guideline-value estimates made in steps 1b and 3b.

Sizeable inconsistencies will almost certainly be noted in many cases. For example, a subarea which indicators show is largely rural would not be expected to have a high proportion of its total DVM classed as urban. Similarly, a subarea with 10 percent of the State's population should ordinarily account for a larger proportion of the State's total travel than a similar subarea only half as populous.

For all subareas (and their road systems) where such inconsistencies appear, a review should be made of the base data and assumptions used and the process employed to derive the DVM estimates from them. In addition, any conditions of possible influence that might cause a seeming inconsistency should be sought and investigated: for example, a rural subarea may have a much higher proportion of total State travel than a similar subarea because the first is traversed by an Interstate System route while the second is not. Recreation and resort areas will be troublesome unless special adjustments are made for them, as described elsewhere.

The initial DVM forecasts, as a result of this review, should be appropriately adjusted to correct identifiable errors of fact or judgement and to eliminate obvious inconsistencies, so that all subarea travel estimates, as revised, are judged to be reasonable on the basis both of internal considerations and in relation to one another and to the State as a whole.

377-268 O - 70 - 19

The adjusted DVM forecasts for the subareas (and their road systems) should now be added to obtain trial State totals. These should be compared with the statewide totals developed in step 2, and if there are differences of more than 20 to 30 percent, the review and adjustment process just described should be repeated to identify and eliminate any remaining major inconsistencies that are characterized by extreme (relative) values.

Finally, a proportional across-the-board adjustment should be made to all subarea travel forecasts by factoring (using ratios of the subarea estimate totals to the statewide control totals from step 2) so that, as finally adjusted, their totals equal the statewide control totals.

This completes the initial development of travel estimates although subsequent steps may indicate the need to repeat step 5.

Step 6.--Independent review of forecasts

The statewide and subarea 1990 travel forecasts developed in steps 2, 3, and 5, and relevant data including those developed in steps 1b, and 4, should be reviewed by several staff personnel other than those who actually performed the work. The reviewers, of course, should be familiar with the State and with the various forecasting techniques that were or might have been used. Forecasts for urban study areas or special planning study areas should be reviewed by the staffs of those study areas at least twice: first, early in the process when initial forecasts for all areas have been made and adjusted, by completion of steps 2-5, and second, when steps 1-6 have been completed. In making these reviews the individual study staffs should, of course, have available the forecasts for all other study areas.

As discussed in section I, comprehensive and constructive review by officials and planning staffs of the State, counties, cities, and the Bureau of Public Roads is important. These reviews, made both independently and in collaboration with the State estimating staff, should strengthen the validity of the procedures ultimately used, and should lend confidence in and support of the reliability of the estimates.

It should be recognized that responsibility for the estimates within the State rests with the State highway department, where all conflicting opinions and judgments must be resolved.

As noted elsewhere in the manual, it is necessary to make State-line checks with adjacent State highway departments. Where significant differences in estimates occur concerning traffic volumes of major facilities, they should be resolved jointly.

Step 7.--Final reviews and adjustments

As a consequence of the independent reviews prescribed in step 6, estimates for some subarea may be adjusted; indeed, it is possible that some of the statewide forecasts in table TF-1 may be revised, which would require re-factoring all subarea estimates. Whether the adjustments are relatively few or many, it will be necessary to repeat some or all of the processes in steps 2, 3, and 5 until satisfactory estimates are obtained, considering statewide control totals, urban area forecasts, and independent reviews by other analysts.

APPENDIX E

1990 FUNCTIONAL SYSTEMS CHARACTERISTICS

Functional systems and functional systems characteristics to be applied during the development of the 1990 functional plan for needs evaluation are basically the same as those in the 1968 base study. The following pages generally duplicate the descriptions of the characteristics of the basic functional systems and their subsystems as they appear in the 1968 manual for: (1) Rural areas, (2) urbanized areas, and (3) small urban areas. The primary functional categories to be used in this study for each of the three area types are presented in table E-1.

Table E-1 -- The hierarchy of functional system

Rural areas	Urbanized areas	Small urban areas
Principal arterials	Principal arterials	Principal arterials
Minor arterial roads	Minor arterial streets	Minor arterial streets
Collector roads	Collector streets	Collector streets
Local roads	Local streets	Local streets

Since there is a wide variation in the characteristics and magnitude of service that will be provided by each of these basic functional systems, further stratification of routes in these systems is prescribed to insure greater consistency and uniformity for analysis. In rural areas, routes on the principal arterial system are to be identified as Interstate and other principal arterials; and routes on the collector road system are to be subclassified as major collector roads and minor collector roads. In urbanized and small urban areas, the routes on the principal arterial system are to be identified as Interstate, other freeways and expressways, and other principal arterials.

For internal use, States may desire to further stratify routes within the basic functional systems. For this study, data for any additional substratifications shall be aggregated and reported for the systems and stratifications discussed above.

Functional Systems for Rural Areas

Rural roads consist of those facilities that are outside of the 1990 urban boundaries projected for this study. They are to be classified into four major systems: Principal arterials, minor arterial roads, major and minor collector roads, and local roads.

Guidelines for the extent of mileage on these systems are shown in table E-2 (page E-5).

Rural principal arterial system

The rural principal arterial system for 1990 will consist of a connected rural network of continuous routes having the following characteristics:

1. Serve projected corridor movements having trip length and travel density characteristics indicative of substantial statewide or Interstate travel.

2. Serve 1/ all, or virtually all, 1990 urban areas of 50,000 and over population and a large majority of those with population of 25,000 and over.

3. Provide an integrated network without stub connections except where unusual geographic or traffic flow conditions dictate otherwise (e.g., international boundary connections and connections to coastal cities).

1/ The term "serve" is difficult to define on a national basis since it varies according to the size of the urban area, the functional system under consideration, and the effects of natural barriers where they exist. As a guide for this study, the rural principal arterial system may be considered to "serve" an urban area if the system either penetrates the urban boundary, or comes within 10 miles of the center of the place and is within 20 minutes estimated travel time (off-peak periods) of the center of the place via a minor arterial highway. The rural minor arterial road system "serves" an urban area if the system either penetrates or comes within 2 miles of the urban boundary.

In the more densely populated States, this class of highway may not include all projected heavily traveled routes warranting multilane improvements. It is likely, however, that in the majority of States the principal arterial system will include most, if not all, future rural freeways.

The principal arterial system should be stratified into the following two categories:

Interstate System--The Interstate subclassification should include the entire 42,500-mile Interstate System.

Other principal arterials--This subclassification consists of all existing and projected non-Interstate principal arterials.

Rural minor arterial road system

The rural minor arterial road system for 1990 should, in conjunction with the principal arterial system, form a rural network having the following characteristics:

1. Link cities and larger towns 1/ (and other traffic generators, such as major resort areas, that are capable of attracting travel over similarly long distances) and form an integrated network providing interstate and intercounty service.

2. Be spaced at such intervals, consistent with population density, so that all developed areas of the State are within a reasonable distance of an arterial highway.

3. Provide (because of the two characteristics defined immediately above) service to corridors with trip lengths and travel density greater than those predominantly served by rural collector or local systems. Minor arterials therefore constitute routes whose design should be expected to provide for relatively high overall travel speeds, with minimum interference to through movement.

1/ The definition of a "large" town, in terms of 1990 population, cannot be arbitrarily determined in such a way as will fit all States. It can be determined in each State during the classification process by building the system "from the top down," in terms of size of places to be served, and evaluating successive system increments on a diminishing returns basis, in terms of population service or traffic service.

Rural collector road system

The rural collector routes generally serve travel of primarily intracounty rather than Statewide importance and constitute those routes on which (regardless of traffic volume) predominant travel distances are shorter than on arterial routes. Consequently, more moderate speeds may be typical, on the average.

In order to define more clearly the characteristics of rural collectors for this study, this system should be subclassified according to the following criteria:

Major collector roads--These routes should: (1) Provide service to any county seat not on an arterial route, to the larger towns not directly served by the higher systems, and to other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, important mining and agricultural areas, etc.; (2) link these places with nearby larger towns or cities, or with routes of higher classification; and (3) serve the more important intracounty travel corridors.

Minor collector roads--These routes should: (1) Be spaced at intervals, consistent with population density, to collect traffic from local roads and bring all developed areas within a reasonable distance of a collector road; (2) provide service to the remaining smaller communities; and (3) link the locally important traffic generators with their rural hinterland.

Rural local road system

The rural local road system should have the following characteristics: (1) Serve primarily to provide access to adjacent land; and (2) provide service to travel over relatively short distances as compared to collectors or other higher systems. Local roads will, of course, constitute the rural mileage not classified as principal arterial, minor arterial road, or collector road.

Extent of rural systems

The systems criteria above have been expressed primarily in qualitative, rather than quantitative terms. Because of anticipated variations in geographic conditions (population density, spacing and size of cities, density and pattern of road network) it is not feasible to establish uniform 1990 nationwide criteria on size of population centers, on trip length and traffic volume, or on spacing of routes, that would apply to all future systems in all States. The results of studies of future classification and needs conducted in many States throughout the country do, however, show considerable consistency in the relative extent of each system, expressed as a percentage of total rural road mileage.

The 1990 systems developed for this study are generally expected, in all States except Alaska and Hawaii, to fall within the percentage ranges shown in table E-2. Any exception should be analysed and an explanation for the variation should be included in the narrative report.

The higher values in table E-2 should apply to States that will have a less extensive total road network in 1990 than is anticipated in States of similar population density. In States having a more extensive total network, the lower values would be expected to apply. The range of percentages for rural collectors is for 1990 total mileage of both major and minor collector roads, and applies to the Statewide rural mileage totals; the percentage in any particular county may vary considerably from the Statewide average. Areas having an extensive grid pattern of roads will usually have a lesser percentage of collectors than areas wherein geographic conditions impose a restricted or less regular pattern of road development.

Table E-2 Guidelines on extent of rural functional systems

Systems	Percentage of total rural miles
Principal arterial system	2-4
Principal arterial plus minor arterial road system	6-12, with most States falling in 7-10 percent range
Collector (major plus minor) road system	20-25
Local road system	65-75

Functional Systems in Urbanized Areas

The four functional systems for urbanized areas are urban principal arterials, minor arterial streets, collector streets, and local streets. The differences in the nature and intensity of development between rural and urban areas cause these systems to have characteristics that are somewhat different from the correspondingly named rural systems.

Guidelines for the extent of mileage and travel on these systems are shown in table E-3 (page E-9).

Urban principal arterial system

Every urban environment will have in 1990 a system of streets and highways which can be identified as unusually significant to the area in which it lies in terms of the nature and composition of travel it serves. In smaller urban areas (under 50,000) these facilities may be very limited in number and extent and their importance may be primarily derived from the forecasted service provided to travel passing through the area. In larger urban areas their importance also derives from service that will be provided to rural oriented traffic, but equally or even more important, from the service they provide for major movements within these urbanized areas.

This system of streets and highways, called here the urban principal arterial system, should serve the projected major centers of activity of a metropolitan area, the highest projected traffic volume corridors, and the longest projected trip interchanges; and should carry a high proportion of the total projected urban area travel on a minimum of mileage. The system should be integrated, both internally and between major rural connections.

The principal arterial system should carry the major portion of forecasted trips entering and leaving the urban area, as well as the majority of through movements desiring to bypass the central city. In addition, forecasts of significant intra-area travel, such as between major inner city communities, or between major suburban centers should be served by this class of facilities. Generally, the principal arterial system will coincide with the majority of important intraurban as well as intercity bus routes. Finally, this system in urbanized areas should provide continuity for all rural arterials which intercept the urban boundary.

Because of the nature of the travel served by the principal arterial system, almost all fully and partially controlled access facilities will be part of this functional class. However, this system is not restricted to controlled access routes. In order to preserve the identification of controlled access facilities in subsequent tabulations which will be required, the principal arterial system should be stratified as follows: (1) Interstate (consisting of the urban portion of the 42,500-mile Interstate System), (2) other freeways and expressways, and (3) other principal arterials (with no control of access).

The spacing of urban principal arterials will be closely related to forecasted trip-end density characteristics of particular portions of the urban areas. While no firm spacing rule can be established which will apply in all, or even most circumstances, the spacing of principal arterials (in larger urban areas) may vary from less than one mile in the highly developed central business areas to five miles or more in the sparsely developed urban fringes.

For principal arterials, the concept of service to abutting land should be subordinate to the provision of travel service to major traffic movements. It should be noted that only facilities within the "other principal arterial" subclass are capable of providing any direct access to land, and such service should be purely incidental to the primary functional responsibility of this class of roads.

Urban minor arterial street system

The minor arterial street system should interconnect with and augment the urban principal arterial system and provide service to forecasted trips of moderate length at a somewhat lower level of travel mobility than major arterials. This system also distributes travel to geographic areas smaller than those identified with the higher system.

The minor arterial street system includes all arterials not classified as principal and contains facilities that place more emphasis on land access than the higher system, and offer a lower level of traffic mobility. Such facilities may be expected to carry local bus routes and provide intracommunity continuity, but ideally should not penetrate identifiable neighborhoods. This system should include urban connections to rural collector roads where such connections have not been classified for internal reasons as urban principal arterials.

The spacing of minor arterial streets may vary from 1/8 - 1/2 mile in the central business district to 2-3 miles in the suburban fringes, but should normally be not more than 1 mile in fully developed areas.

Urban collector street system

The collector street system differs from the arterial systems in that facilities on the collector system may penetrate neighborhoods distributing trips from the arterials through the area to the ultimate destination, which may be on a local or collector street. Conversely, the collector street can also be expected to collect traffic from local streets in the neighborhood and channel it into the arterial systems. In the development of the 1990 functional plan, use of the collector system by through traffic should be discouraged.

The collector system should provide for both land access service and local traffic movements within residential neighborhoods, commercial areas, or industrial areas. Such facilities could contain the collector portion of some bus routes.

Urban local street system

The local street system comprises all facilities not on one of the higher systems. It serves primarily to provide direct access to abutting land and access to the higher order systems. It offers the lowest level of mobility and should not contain bus routes. Service to through traffic movement should be deliberately discouraged. It is assumed that each State will forecast 1990 urban local street mileage on a statistical basis acceptable to Public Roads.

Extent of mileage and travel on urban systems

Table E-3 contains guideline ranges of travel volume (VMT), and mileage of each of the four functional systems for urbanized areas. It is expected that the 1990 systems developed for each area will fall within the percentage ranges shown; any exceptions should be carefully analysed and explained.

Table E-3 Guidelines on extent of urban functional systems

System	Range (percent)	
	VMT	Miles
Principal arterial system	40 - 55	5 - 10
Principal arterial plus minor arterial street systems	65 - 75	15 - 25
Collector street system	5 - 10	5 - 10
Local street system	Remainder	

Functional Systems for Small Urban Areas

The systems and their characteristics listed for urbanized areas are also generally applicable to small urban areas. The basic difference is that, by nature of their size, many small urban areas will not generate internal travel warranting urban principal arterial service.

Thus the 1990 principal arterial system for small urban areas will largely consist of extensions of rural arterials into and through the areas. In many instances, these extensions will be located so as to relieve critical sections of the street system while providing efficient movement of travel around (e.g., bypasses) and through the area. The larger urban areas within this population group, particularly those above 25,000 population, may have major activity centers which warrant principal arterial service in addition to that provided by extensions of rural arterials.

The extent of the principal arterial system mileage and travel will vary significantly among the small urban areas, but will normally fall within the guidelines shown in table E-3. Some small urban areas may fall above the guidelines because of unusual geographical conditions or the fact that the city is somewhat of a focal point for statewide rural arterials.

The characteristics for the minor arterial street systems, collector street systems, and local street systems in small urban areas are similar to those for urbanized areas.

Special Urban-Rural Identification

The criteria in this section define urban and rural streets and highways according to their functional character. To assure future continuity of the rural arterial systems through 1990 urban areas, it is desirable to doubly identify (as indicated below) the urban arterials which form connecting links of the rural arterials. The term "connecting links" means those urban routings which will provide rural-to-rural continuity for the rural arterial systems. A connecting link may traverse the urban area from one boundary to another, or may simply connect to another previously delineated connecting link. (The mileage of any connecting link should not be included more than once.) The necessary continuity may be provided by loop or bypass routes. It is recommended that the identification be made after both the urban and rural functional classifications have been accomplished.

As specified in the systems characteristics in this appendix, connecting links for the rural principal and minor arterial system will be on the urban principal arterial system (continuity for the rural Interstate will, of course, be provided by urban Interstate). Connecting links for rural principal arterials should be identified prior to selecting those for minor arterials. The routing of the connecting link for a rural principal arterial should normally be fairly direct, while that for a rural minor arterial may involve some indirection of travel.

The following categories are to be used in identifying the 1990 connecting links on the urban principal arterial systems:

Other freeways and expressways:

Connecting links of non-Interstate rural principal arterials
Connecting links of rural minor arterials

Other urban principal arterials:

Connecting links of other rural principal arterials
Connecting links of rural minor arterials

Classification Criteria for Alaska, Hawaii, and Puerto Rico

The classification of rural and urban systems in Alaska, Hawaii, and Puerto Rico should generally be consistent with the functional system characteristics described in the preceding sections. However, there may be roads on small islands or in other areas that may be isolated from the remaining parts of the State or Commonwealth, and none of these roads may meet the criteria for classification as arterial because of the absence of long distance, through trips. Conversely, there may be undeveloped areas that have very few miles of collector and local roads. Thus, because of the considerably different geographic conditions existing in these areas as compared to the other 48 States, the systems extent for the rural functional classes may vary a great deal from that shown in Table E-2. The systems extent for the urban functional classes should be fairly consistent with that shown in table E-3.

APPENDIX F

Table F-1

STATE LIAISON OFFICERS TO BUREAU OF OUTDOOR RECREATION

ALABAMA

Joe W. Graham, Director
Department of Conservation
Administrative Building
Montgomery, Alabama 36104

ALASKA

F. J. Keenan, Director
Division of Lands
344 Sixth Avenue
Anchorage, Alaska 99501

ARIZONA

Roger Gruenwald
Outdoor Recreation Coordinating Commission
2211 West Greenway Road
Phoenix, Arizona 85023

ARKANSAS

Winston C. Beard (Dr.), Executive Director
Arkansas Planning Commission
Game & Fish Commission Building
Capitol Mall
Little Rock, Arkansas 72201

CALIFORNIA

William Penn Mott, Jr., Director
Department of Parks and Recreation
1416 - 9th Street, Room 1311
Sacramento, California 95814

COLORADO

Harry R. Woodward, Director
Division of Game, Fish and Parks
Department of Natural Resources
6060 Broadway
Denver, Colorado 80216

CONNECTICUT

Joseph N. Gill, Commissioner
Department of Agriculture and Natural Resources
Hartford, Connecticut 06100

DELAWARE

Rudolph Jass, Director of State Planning
State Planning Office
Thomas Collins Building
530 S. DuPont Highway
Dover, Delaware 19901

DISTRICT OF COLUMBIA

Joseph H. Cole, Superintendent
D. C. Recreation Department
3149 16th Street, N. W.
Washington, D. C. 20010

FLORIDA

Ney C. Landrum, Director
Florida Outdoor Recreational Development Council
1543 Thomasville Road
Tallahassee, Florida 32303

GEORGIA

John L. Gordon, Director
Department of State Parks
270 Washington Street, S. W.
Atlanta, Georgia 30334

HAWAII

Shelley M. Mark, Director
Department of Planning and Economic Development
426 Queen Street
Honolulu, Hawaii 96813

377-268 O - 70 - 20

IDAHO

Wilhelm M. Beckert, Director
Idaho Department of Parks
Statehouse
Boise, Idaho 83707

ILLINOIS

William L. Rutherford
Director, Department of
Conservation
400 Spring Street
Springfield, Illinois 62706

INDIANA

Perley H. Provost, Director
Department of Natural Resources
603 State Office Building
Indianapolis, Indiana 46209

IOWA

E. B. Speaker, Special Projects
Coordinator, State Conservation Comm.
State Office Building
300 Fourth Street
Des Moines, Iowa 50319

KANSAS

Lynn Burris, Jr., Director
State Park and Resources Authority
801 Harrison
Topeka, Kansas 66612

KENTUCKY

Frank J. Groschelle, Special Assistant
to the Governor
State Capitol Building, Room 157
Frankfort, Kentucky 40601

LOUISIANA

Lamar Gibson, Director
State Parks and Recreation Commission
Louisiana National Bank Building
150 N. Third Street
Baton Rouge, Louisiana 70801

MAINE

Lawrence Stuart, Director
State Parks and Recreation Comm.
Statehouse
Augusta, Maine 04301

MARYLAND

Spencer P. Ellis
Director, Department of
Forests and Parks
State Office Building
Annapolis, Maryland 21404

MASSACHUSETTS

Arthur Brownell, Commissioner
Department of Natural Resources
State Office Building, Gov't. Center
100 Cambridge Street
Boston, Massachusetts 02202

MICHIGAN

Ralph A. MacMullan, Director
Department of Natural Resources
Stevens T. Mason Building
Lansing, Michigan 48926

MINNESOTA

Jarle Leirfallom, Commissioner
Department of Conservation
301 Centennial Building
658 Cedar Street
St. Paul, Minnesota 55101

MISSISSIPPI

Spencer E. Medlin, Comptroller
Mississippi Park System
502 Milner Building
Jackson, Mississippi 39201

MISSOURI

Robert L. Dunkeson, Executive Sec.
Inter-Agency Council for Outdoor
Recreation
1203 Jefferson Building, Box 564
Jefferson City, Missouri 65101

MONTANA

Robert F. Cooney, Assistant Chief
Recreation and Parks Division
Department of Fish and Game
Mitchell Building
Helena, Montana 59601

NEBRASKA

Melvin O. Steen, Director
Game and Parks Commission
State Capitol Building
Lincoln, Nebraska 68509

NEVADA

Elmo J. De Ricco, Director
Department of Conservation and
Natural Resources
Nye Building, Room 214
Carson City, Nevada 89701

NEW HAMPSHIRE

Roger J. Crowley, Jr.
Commissioner, Department of
Resources and Economic Development
State House Annex
Concord, New Hampshire 03303

NEW JERSEY

Robert A. Roe, Commissioner
Department of Conservation and
Economic Development
Trenton, New Jersey 08625

NEW MEXICO

Arthur L. Ortiz
State Planning Officer
State Planning Office
New Capitol Building, Room 406
Santa Fe, New Mexico 87501

NEW YORK

R. Steward Kilborne, Commissioner
Department of Conservation
1220 Washington Avenue
Albany, New York 12206

NORTH CAROLINA

William L. Turner (Dr.), Director
Department of Administration
State of North Carolina
Raleigh, North Carolina 27602

NORTH DAKOTA

John Greenslit, Coordinator
State Outdoor Recreation Agency
State Office Building
900 East Boulevard
Bismarck, North Dakota 58501

OHIO

Fred E. Morr, Director
Department of Natural Resources
907 Ohio Departments Building
Columbus, Ohio 43215

OKLAHOMA

Robert H. Breeden, Director
Industrial Development and
Park Department
518 Sequoyah Memorial Building
Oklahoma City, Oakahoma 73105

OREGON

Kessler R. Cannon
Executive Secretary
Natural Resources Committee
State Capitol Building, Room 124
Salem, Oregon 97310

PENNSYLVANIA

Irving Hand, Executive Director
State Planning Board
Box 191, Finance Building
Harrisburg, Pennsylvania 17120

PUERTO RICO

Pasarell, Dora (Mrs.), Administrator
Public Parks and Recreation Administration
P. O. Box 3207
San Juan, Puerto Rico 00904

RHODE ISLAND

John L. Rego, Director
Department of Natural Resources
Veteran's Memorial Building
83 Park Street
Providence, Rhode Island 02903

SOUTH CAROLINA

John A. May (Col.)
Department of Parks, Recreation
and Tourism
P. O. Box 1358
Columbia, South Carolina 29202

SOUTH DAKOTA

Robert Hodgins, Director
Department of Game, Fish and Parks
State Office Building
Pierre, South Dakota 57501

TENNESSEE

E. Boyd Garrett, Commissioner
Department of Conservation
2611 West End Avenue
Nashville, Tennessee 37203

TEXAS

L. P. Gilvin, Chairman
Parks and Wildlife Commission
Box 9027
Amarillo, Texas 79105

UTAH

Gordon E. Harmston
Executive Director
Department of Natural Resources
319 State Capitol Building
Salt Lake City, Utah 84114

VERMONT

Forrest E. Orr, Executive Director
Interagency Committee on Natural
Resources
Statehouse
Montpelier, Vermont 05602

VIRGINIA

Elbert Cox, Director
Commission of Outdoor Recreation
Ninth Street Office Building
Ninth and Grace Streets
Richmond, Virginia 23219

WASHINGTON

Lewis A. Bell, Chairman
Interagency Committee for Outdoor
Recreation
Post Office Box 1489
Olympia, Washington 98501

WEST VIRGINIA

B. L. Coffindaffer (Dr.), Director
Federal - State Relations
State Office Building
Charleston, West Virginia 25305

WISCONSIN

John A. Beale
Deputy Secretary
Department of Natural Resources
P. O. Box 450
Madison, Wisconsin 53701

Attention: Alvin E. Nelson

WYOMING

Charles E. Rodermel, Director
Wyoming Recreation Commission
Box 309, State Office Building
Cheyenne, Wyoming 82001

APPENDIX G

PROCEDURES FOR DETERMINING AVERAGE HIGHWAY SPEED, AVAILABLE SIGHT DISTANCE, AND PRESENT OPERATING SPEED

As part of the analysis of existing urban freeways and expressways, rural principal and minor arterials, and rural collectors with 6,000 ADT or greater, it will be necessary to determine the average highway speed, available sight distance, and using these and other traffic factors, calculate the present operating speed of each highway section.

Average Highway Speed

Average highway speed, as initially introduced into highway capacity literature, was defined as "the average maximum safe speed, or the operating speed for a passenger car over a section of highway during extremely low traffic densities." 1/ It is defined in the 1965 Highway Capacity Manual as the weighted average of the design speeds within the section, when each subsection within the section is considered to have an individual design speed.

This appendix contains a recommended procedure for computing average highway speed where it is not already available. It utilizes the Highway Capacity Manual recommendation of approximately 800 feet (0.15 mile) for the effective length of each curve. Tangent sections and flat (less than 4^{o}) curves are assumed to have design speeds of 70 miles per hour. The maximum superelevation rate is assumed to be 0.08 ft./ft. (Where the superelevation rate varies appreciably from this, the curvature range shown for each design speed may be adjusted to fit the appropriate rate of superelevation.)

1/ New Methods of Capacity Determination for Rural Roads in Mountainous Terrain: Schwender, H. C., Normann, O. K., and Granum, J. O., Highway Research Board Bulletin 167 (1957).

A work sheet for average highway speed calculation is shown in figure G-1. The steps in its use are as follows:

1. For the section of highway being analysed, tally the total number of curves in each design speed grouping, in the column headed "number of curves."

2. For each design speed grouping in which curves have been tallied, select from table G-1 the travel time in minutes corresponding to that number of curves. Enter this value in the right hand column, labeled "total travel time."

3. Total the number of all curves and post this value at the foot of the "number of curves" column.

4. From the total number of curves, determine the total curve length, using table G-2. Subtract this value from the section length to determine the tangent length.

5. Compute tangent travel time by multiplying tangent length by 0.86 min./mile. Enter the resulting tangent travel time in the right hand column, headed "total travel time."

6. Sum all entries in "total travel time" column. Divide by the length of section of highway and multiply by 60 to obtain average highway speed (AHS) in miles per hour.

7. Round to the nearest of the following values: 70, 60,50,45,40,35. These are the average highway speeds for the family of operating speed curves in the Highway Capacity Manual.

A sample calculation is shown on the work sheet, figure G-1. For a rural section, three 40 mph curves have been tallied, for a travel time of 0.68 minutes, and seven 50 mph curves for a travel time of 1.26 minutes. The total of ten curves gives a total curve length of 1.50 miles (lower table). This value is subtracted from the section length of 4.20 miles, giving a tangent length of 2.70

Figure G-1--Sample average highway speed calculation

WORKSHEET FOR CALCULATING AVERAGE HIGHWAY SPEED (AHS)

Route 2339 Section 003 Length 4.20 mi.

Degree of curvature 1/	Design speed (mph)	Number of curves	Total travel time (min.) (from Table G-1)
28.0 - 43.0	25		
19.5 - 28.0	30		
14.0 - 19.5	35		
11.0 - 14.0	40	3	0.68
8.5 - 11.0	45		
7.0 - 8.5	50	7	1.26
5.5 - 7.0	55		
4.75 - 5.5	60		
4.0 - 4.75	65		
	Totals =	10	1.94
		Tangent travel time =	2.32
		Total travel time =	4.26

Section length 4.20 mi.
-Total curve length 1.50 mi. (from Table G-2)
Tangent length 2.70 mi.
x 0.86 min./mi.
Tangent travel time 2.32 min.

Average Highway Speed = $\frac{\text{Total travel time } 4.26 \text{ min.}}{\text{Section length } 4.20 \text{ mi.}} \times 60 =$ 61 mph

Rounded AHS = 60 mph

1/ For maximum superelevation rate of 0.08 ft./ft.

Table G-1--Travel times for curves of various design speeds 1/

Design speed	Travel time in minutes for number of curves indicated														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
25	0.36	0.72	1.08	1.44	1.80	2.16	2.52	2.88	3.24	3.60	3.96	4.32	4.68	5.04	5.40
30	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20	4.50
35	0.26	0.51	0.77	1.03	1.29	1.54	1.80	2.06	2.31	2.57	2.83	3.09	3.34	3.60	3.86
40	0.23	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.48	2.70	2.93	3.15	3.38
45	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00
50	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	1.98	2.16	2.34	2.52	2.70
55	0.16	0.33	0.49	0.65	0.82	0.98	1.15	1.31	1.47	1.64	1.80	1.96	2.13	2.29	2.45
60	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25
65	0.14	0.28	0.42	0.55	0.69	0.83	0.97	1.11	1.25	1.38	1.52	1.66	1.80	1.94	2.18

Table G-2--Total curve length 2/

Total curve length, in miles, for number of curves indicated																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
0.15	0.30	0.45	0.60	0.75	0.90	1.0	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
3.15	3.30	3.45	3.60	3.75	3.90	4.05	4.20	4.35	4.50	4.65	4.80	4.95	5.10	5.25	5.40	5.55	5.70	5.85	6.00
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
6.15	6.30	6.45	6.60	6.75	6.90	7.05	7.20	7.35	7.50	7.65	7.80	7.95	8.10	8.25	8.40	8.55	8.70	8.85	9.00

1/ Table G-1 was derived by multiplying the inverse of the speed (in minutes per mile) by the effective length of curve (0.15 miles).

2/ Table G-2 is the effective curve length (0.15 mi.) multiplied by the number of curves.

miles. The latter figure is multiplied by 0.86 minutes per mile (for 70 mph tangent speed), giving a tangent travel time of 2.32 minutes. This value is added to the previously posted curve travel times to obtain a total travel time of 4.26 minutes. This value, when divided by the total section length and multiplied by 60, gives an average highway speed of 61 mph. This is then rounded to 60 mph.

Available Sight Distance

In order to determine present operating speed, it will be necessary to estimate the percentage of a section length of 2-lane highways having at least 1,500 feet of sight distance (as measured from the height of the drivers eye to the road surface) available. Any available data, such as construction plans, etc., can be used in this determination.

Where other data is not available, this value can be estimated by the field inventory crew using a method similar to the following: First, the observer (sitting beside the vehicle driver) estimates ahead 1,500 feet. If the pavement surface is visible over this entire distance, he records the starting odometer reading as 'in'. If the pavement surface is not visible, he records the reading as 'out'. The crew then drives over the section and the observer records the odometer as 'out' any time the pavement surface passes from view in the 1,500 foot distance estimated ahead and as 'in' when the pavement surface 1,500 feet ahead comes back into view.

This method for identifying the 'in' and 'out' values of available sight distance applies whether restrictions are caused by vertical curvature, horizontal curvature, other facts of design within the right-of-way, or trees and permanent type billboards. Sight restrictions such as those caused by tall grass or shrubs which could be removed by routine maintenance would not be considered.

Having completed the above, the length of available sight distance is obtained by subtracting each 'in' mileage reading from the succeeding 'out' mileage reading and summing these differences. The percent of available sight distance is then calculated by dividing the total available length by the section length and multiplying by one hundred. This value should then be rounded to the nearest 10 percent and recorded on the Rural Arterial and Collector Worksheet.

Present Operating Speed

The present operating speed in this study is used as one measure of tolerability of rural highway sections. It represents the highest overall speed at which a driver can travel over the section in favorable weather and under prevailing traffic conditions without exceeding the safe speed on any part of the section.

The operating speed curves included in the 1965 Highway Capacity Manual (page 264 for freeways and expressways; page 294 for other rural multilane highways; and pages 310-312 for rural 2-lane highways) are to be used in determining the present operating speed. The proper curve for the existing highway section (freeway-expressway, other multilane, or 2-lane highways) and the average highway speed should be selected. For rural 2-lane highways, the percent with at least 1,500 feet available sight distance (Item 17 on the rural worksheet) will also be required. Enter the curve with the volume capacity ratio $\left(\frac{\text{Present ADT x "K" factor}}{\text{capacity}}\right)$, read up to the appropriate curve (average highway speed and available sight distance), and read left to the operating speed, to the nearest mph. This value should be recorded in Item 28 on the Rural Arterial and Collector Worksheet or in Item 33 of the Urban Arterial and Collector Worksheet.

Example:

Rural, 2-lane highway   ADT - 4,000 vpd   Capacity - 1,200 vph
Average highway speed - 60 mph   K-factor - 0.15
Sight distance available on 40 percent of section length

$$\frac{V}{C} \text{ ratio} = \frac{4000 \times 0.15}{1200} = 0.5$$

From Figure 10.2b in the Highway Capacity Manual, the operating speed is approximately 40 mph.

APPENDIX H

ESTIMATING REMAINING SERVICE LIFE FOR PAVEMENTS

In order to determine year of deficiency and subsequent year of improvement for the sampled roads in the needs study, it is necessary to estimate the remaining service life of the pavement. This remaining life is primarily dependent upon five items:

1. The present pavement condition (PSR, PSI, or equivalent).

2. The pavement structure or thickness, expressed as the Structural Number (SN), slab thickness (D), or correlation thereto.

3. Soil Support Value (S), or correlation thereto.

4. Number of present equivalent annual 18-kip single-axle load applications (EALA) applied to the roadway.

5. Average annual rate of traffic growth.

The first, second, and fifth items are entered on the evalaution worksheets. Detailed instructions for their determination are contained in sections IV and V of the manual. Items 3 and 4 may be derived as follows:

Soil support value (S) - The soil support value, necessary in the evaluation of flexible pavements, is expressed in an abstract scale that can be related to certain soil test procedures. Figure H-1 shows a chart, from Appendix E of the AASHO Interim Guide for the Design of Flexible Pavement Structures, which gives approximate correlations for CBR, R-Value, and Group Index. The roadbed soils at the AASHO Road Test have an S value of 3.0. When the S value for a particular state is substantially greater (S = 6 or more) or substantially less (S = 1.5 or less) than the S value at the AASHO Road Test, an adjustment must be made to the pavement structure value to account for the difference in performance ability. Figure H-2 shows the necessary adjustments.

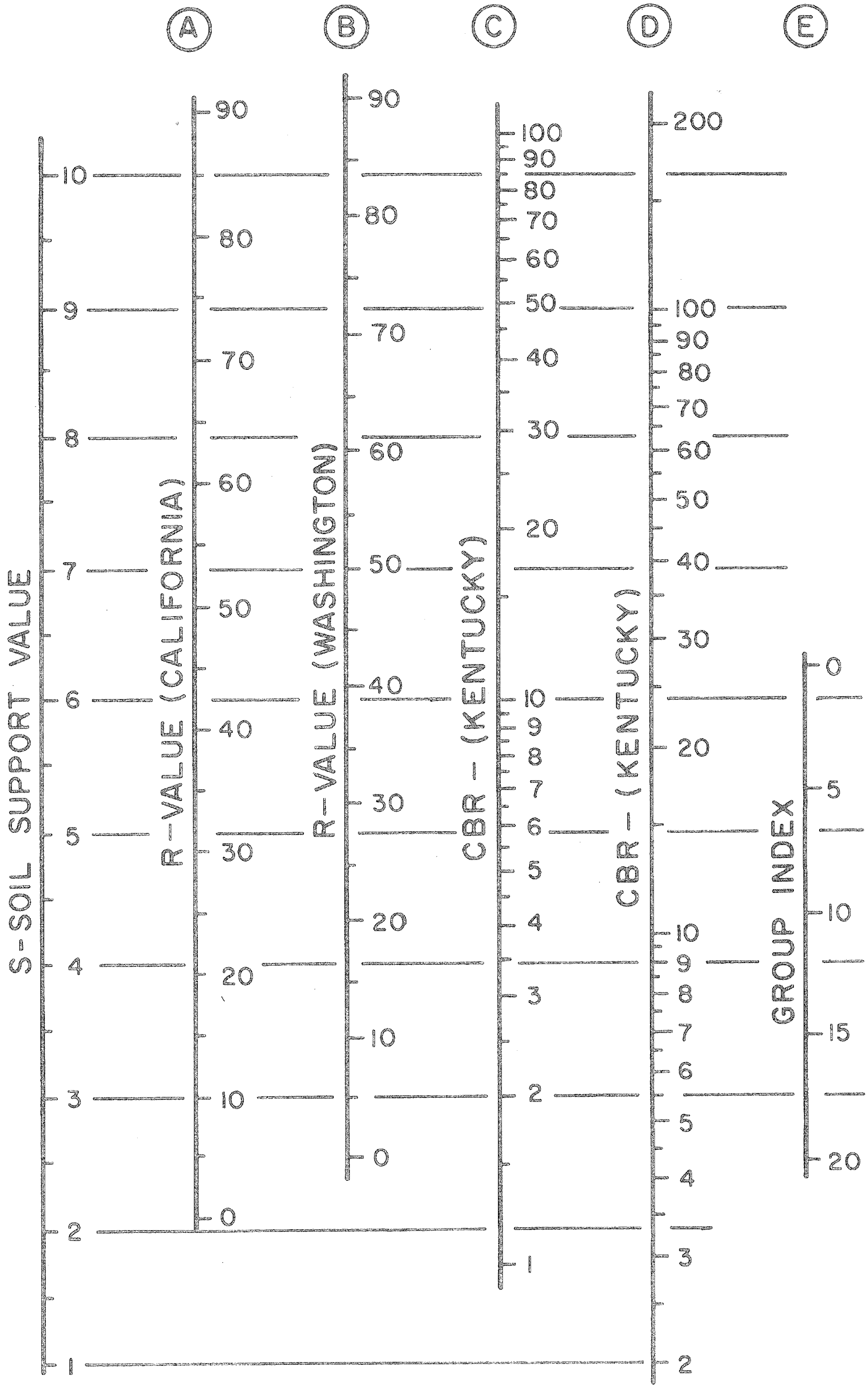


FIGURE H-I CORRELATION CHART FOR ESTIMATING SOIL SUPPORT VALUE (S)

Figure H-2: Adjustment to pavement structure value to account for difference in Soil Support Value

Soil Support Value	Pavement structure value		
	Light SN = 1.0-3.0	Medium SN = 3.1-4.5	Heavy SN = 4.6-6.0
1.5 or less	No change	Decrease to light	Decrease to medium
1.6 - 5.9	No change	No change	No change
6.0 or more	Increase to medium	Increase to heavy	No change

It is not intended that the States conduct comprehensive soil tests on each individual pavement section under consideration. Rather it is suggested, because the physical properties and supporting power of roadbed soils are related to the performance of flexible pavements, that the general soils characteristics throughout a county or cost area of a State be compared with those at the AASHO Road Test.

<u>Present equivalent annual 18-kip single-axle load applications (EALA)</u> - The following equation is used to determine the equivalent annual 18-kip single-axle load applications (EALA).

EALA = ADT x (% total trucks and combinations) x (critical lane factor) x (18-kip single-axle equivalent constant) x 365.

The present ADT and the percent total trucks and combinations are entered on the worksheets, and instructions for their determination are contained in sections IV and V of the manual. The following discussion explains the procedure for determining the 18-kip single-axle equivalent constant and the critical lane factor.

The 18-kip axle-load equivalent constant can be obtained from the W-4 tables of the State's annual truck weight study and may be applied directly to the total number of trucks and combinations in the traffic stream to arrive at the number of equivalent annual 18-kip single axle-load applications (EALA), as shown in the example included at the end of this appendix.

A detailed example explaining the use of the W-4 tables in estimating equivalent annual 18-kip single axle-load applications, or average daily load (ADL), is given on pages TCS 30 and 31 of Volume 4, Chapter III, of the Highway Planning Program Manual (HPPM). An explanation and example is also shown on pages A-62 and A-63 of the "Instruction Manual - 1970 Interstate Cost Estimate." It should be noted that the above cited examples are based upon the mean ADT for a 20-year period, rather than on current equivalent annual 18-kip single axle-load applications, as required by the procedure in this appendix for calculating remaining pavement life. Also, the examples show calculation of 18-kip single axle-load equivalents for each vehicle type, whereas this procedure uses one value for the 18-kip axle-load equivalent constant for the total truck traffic mix, which is obtained from the bottom portion of the W-4 tables.

The 18-kip axle-load equivalent constant for total trucks and combinations can be extracted directly from the section of "18-KIP AXLE EQUIVALENTS" in the W-4 table from the "Annual Truck Weight Study" for each State. This constant is located in the column for "Probable No." and on the lines for "Rate Per 1,000" for either a flexible or rigid pavement.

The critical lane factor will be obtained by applying the following percentages:

No. of Lanes	Percentage of Vehicle in Right-hand Lane
2 or 3	50
4 or more	40

If traffic in one direction is being considered, the preceding percentages must of course be doubled.

Determination of Remaining Service Life

After items 1, 2, 4, and 5 have been established for a flexible or rigid pavement section and the pavement structure value for the flexible pavement has been adjusted to account for item 3, the determination of remaining service life is a relatively simple table look-up procedure. To eliminate as much work as possible, four tables have been prepared based in part on the AASHO Road Test performance equations.

Tables H-1 and H-3 are for rigid pavements. Tables H-2 and H-4 are for flexible pavements. Tables H-1 and H-2 are to be used where the minimum tolerable pavement serviceability rating is 2.1. Tables H-3 and H-4 are to be used where the minimum tolerable pavement serviceability rating is 2.6.

The use of these tables is illustrated in the example below:

Example

Given:

1. Flexible pavement - Medium (SN = 3.1 - 4.5).
2. Soil support value - Substantially greater than AASHO (S = 6 or more).
3. Present pavement condition - Fair (PSR or PSI = 2.1 - 3.0).

Table H-1--Rigid pavement-remaining service life (minimum tolerable condition-PSR=2.1)

Pavement thickness	Years of remaining life	Annual traffic growth								
		1 to 3 percent			4 to 6 percent			7 percent and over		
		Pavement condition			Pavement condition			Pavement condition		
		Very good	Good	Fair	Very good	Good	Fair	Very good	Good	Fair
Present equivalent annual 18-kip single-axle load applications (EALA)										
Light (D=6.0-7.0)	Over 20	Less than 17,999	Less than 10,999	Less than 3,999	Less than 12,999	Less than 7,999	Less than 2,999	Less than 8,999	Less than 4,999	Less than 1,999
	16-20	18,000 to 26,999	11,000 to 14,999	4,000 to 4,999	13,000 to 20,999	8,000 to 11,999	3,000 to 3,999	9,000 to 15,999	5,000 to 8,999	2,000 to 2,999
	11-15	27,000 to 42,999	15,000 to 24,999	5,000 to 7,999	21,000 to 36,999	12,000 to 21,999	4,000 to 6,999	16,000 to 30,999	9,000 to 17,999	3,000 to 5,999
	6-10	43,000 to 92,999	25,000 to 53,999	8,000 to 17,999	37,000 to 87,999	22,000 to 50,999	7,000 to 16,999	31,000 to 80,999	18,000 to 46,999	6,000 to 14,999
	1-5	93,000 or more	54,000 or more	18,000 or more	88,000 or more	51,000 or more	17,000 or more	81,000 or more	47,000 or more	15,000 or more
Medium (D=7.1-9.0)	Over 20	Less than 103,999	Less than 70,999	Less than 21,999	Less than 75,999	Less than 51,999	Less than 15,999	Less than 48,999	Less than 32,999	Less than 9,999
	16-20	104,000 to 150,999	71,000 to 101,999	22,000 to 31,999	76,000 to 119,999	52,000 to 81,999	16,000 to 25,999	49,000 to 87,999	33,000 to 59,999	10,000 to 18,999
	11-15	151,000 to 242,999	102,000 to 164,999	32,000 to 51,999	120,000 to 211,999	82,000 to 143,999	26,000 to 44,999	88,000 to 174,999	60,000 to 118,999	19,000 to 37,999
	6-10	243,000 to 527,999	165,000 to 357,999	52,000 to 112,999	212,000 to 499,999	144,000 to 338,999	45,000 to 106,999	175,000 to 458,999	119,000 to 310,999	38,000 to 97,999
	1-5	528,000 or more	358,000 or more	113,000 or more	500,000 or more	339,000 or more	107,000 or more	459,000 or more	311,000 or more	98,000 or more
Heavy (D=9.1-11.0)	Over 20	Less than 571,999	Less than 382,999	Less than 125,999	Less than 417,999	Less than 279,999	Less than 91,999	Less than 268,999	Less than 179,999	Less than 58,999
	16-20	572,000 to 827,999	383,000 to 553,999	126,000 to 182,999	418,000 to 660,999	280,000 to 441,999	92,000 to 145,999	269,000 to 483,999	180,000 to 323,999	59,000 to 106,999
	11-15	828,000 to 1,338,999	554,000 to 895,999	183,000 to 295,999	661,000 to 1,166,999	442,000 to 779,999	146,000 to 257,999	484,000 to 961,999	324,000 to 643,999	107,000 to 212,999
	6-10	1,339,000 to 2,905,999	896,000 to 1,942,999	296,000 to 641,999	1,167,000 to 2,749,999	780,000 to 1,838,999	258,000 to 606,999	962,000 to 2,524,999	644,000 to 1,687,999	213,000 to 556,999
	1-5	2,906,000 or more	1,943,000 or more	642,000 or more	2,750,000 or more	1,839,000 or more	607,000 or more	2,525,000 or more	1,688,000 or more	557,000 or more

Table H-2--Flexible pavement-remaining service life
(minimum tolerable condition-PSR=2.1)

Pavement structure	Years of remaining life	Annual traffic growth								
		1 to 3 percent			4 to 6 percent			7 percent and over		
		Pavement condition			Pavement condition			Pavement condition		
		Very good	Good	Fair	Very good	Good	Fair	Very good	Good	Fair
		Present equivalent annual 18-kip single-axle load applications (EALA)								
Light (SN=1.0-3.0)	Over 20	Less than 699	Less than 499	Less than 99	Less than 499	Less than 299	Less than 99	Less than 299	Less than 199	Less than 59
	16-20	700 to 999	500 to 699	100 to 199	500 to 899	300 to 499	100 to 199	300 to 599	200 to 399	60 to 99
	11-15	1,000 to 1,999	700 to 999	200 to 299	900 to 1,499	500 to 999	200 to 299	600 to 999	400 to 799	100 to 199
	6-10	2,000 to 3,999	1,000 to 1,999	300 to 699	1,500 to 3,999	1,000 to 1,999	300 to 599	1,000 to 2,999	800 to 1,999	200 to 599
	1-5	4,000 or more	2,000 or more	700 or more	4,000 or more	2,000 or more	600 or more	3,000 or more	2,000 or more	600 or more
Medium (SN=3.1-4.5)	Over 20	Less than 30,999	Less than 23,999	Less than 8,999	Less than 22,999	Less than 16,999	Less than 6,999	Less than 13,999	Less than 10,999	Less than 3,999
	16-20	31,000 to 44,999	24,000 to 33,999	9,000 to 12,999	23,000 to 35,999	17,000 to 26,999	7,000 to 9,999	14,000 to 25,999	11,000 to 19,999	4,000 to 7,999
	11-15	45,000 to 71,999	34,000 to 55,999	13,000 to 20,999	36,000 to 62,999	27,000 to 47,999	10,000 to 17,999	26,000 to 51,999	20,000 to 39,999	8,000 to 14,999
	6-10	72,000 to 156,999	56,000 to 120,999	21,000 to 44,999	63,000 to 147,999	48,000 to 113,999	18,000 to 42,999	52,000 to 135,999	40,000 to 104,999	15,000 to 38,999
	1-5	157,000 or more	121,000 or more	45,000 or more	148,000 or more	114,000 or more	43,000 or more	136,000 or more	105,000 or more	39,000 or more
Heavy (SN=4.6-6.0)	Over 20	Less than 356,999	Less than 311,999	Less than 151,999	Less than 260,999	Less than 227,999	Less than 110,999	Less than 167,999	Less than 146,999	Less than 71,999
	16-20	357,000 to 515,999	312,000 to 451,999	152,000 to 219,999	261,000 to 411,999	228,000 to 360,999	111,000 to 175,999	168,000 to 301,999	147,000 to 263,999	72,000 to 128,999
	11-15	516,000 to 834,999	452,000 to 729,999	220,000 to 356,999	412,000 to 726,999	361,000 to 635,999	176,000 to 310,999	302,000 to 599,999	264,000 to 524,999	129,000 to 255,999
	6-10	835,000 to 1,810,999	730,000 to 1,584,999	357,000 to 773,999	727,000 to 1,713,999	636,000 to 1,499,999	311,000 to 731,999	600,000 to 1,573,999	525,000 to 1,376,999	256,000 to 671,999
	1-5	1,811,000 or more	1,585,000 or more	774,000 or more	1,714,000 or more	1,500,000 or more	732,000 or more	1,574,000 or more	1,377,000 or more	672,000 or more

377-268 O - 70 - 21

Table H-3--Rigid pavement-remaining service life
(minimum tolerable condition-PSR=2.6)

Pavement thickness	Years of remaining life	Annual traffic growth								
		1 to 3 percent			4 to 6 percent			7 percent and over		
		Pavement condition			Pavement condition			Pavement condition		
		Very good	Good	Fair	Very good	Good	Fair	Very good	Good	Fair
Present equivalent annual 18-kip single-axle load applications (EALA)										
	Over 20	Less than 16,999	Less than 7,999	Less than 2,999	Less than 11,999	Less than 5,999	Less than 1,999	Less than 7,999	Less than 3,999	Less than 999
	16-20	17,000 to 23,999	8,000 to 11,999	3,000 to 3,999	12,000 to 18,999	6,000 to 8,999	2,000 to 2,999	8,000 to 13,999	4,000 to 6,999	1,000 to 1,999
Light (D=6.0-7.0)	11-15	24,000 to 38,999	12,000 to 18,999	4,000 to 5,999	19,000 to 33,999	9,000 to 16,999	3,000 to 4,999	14,000 to 27,999	7,000 to 13,999	2,000 to 3,999
	6-10	39,000 to 84,999	19,000 to 40,999	6,000 to 12,999	34,000 to 79,999	17,000 to 38,999	5,000 to 11,999	28,000 to 72,999	14,000 to 35,999	4,000 to 10,999
	1-5	85,000 or more	41,000 or more	13,000 or more	80,000 or more	39,000 or more	12,000 or more	73,000 or more	36,000 or more	11,000 or more
	Over 20	Less than 81,999	Less than 44,999	Less than 12,999	Less than 59,999	Less than 32,999	Less than 9,999	Less than 37,999	Less than 20,999	Less than 5,999
	16-20	82,000 to 117,999	45,000 to 64,999	13,000 to 18,999	60,000 to 93,999	33,000 to 51,999	10,000 to 14,999	38,000 to 68,999	21,000 to 37,999	6,000 to 10,999
Medium (D=7.1-9.0)	11-15	118,000 to 190,999	65,000 to 103,999	19,000 to 30,999	94,000 to 166,999	52,000 to 90,999	15,000 to 26,999	69,000 to 137,999	38,000 to 74,999	11,000 to 22,999
	6-10	191,000 to 414,999	104,000 to 225,999	31,000 to 67,999	167,000 to 392,999	91,000 to 213,999	27,000 to 63,999	138,000 to 360,999	75,000 to 196,999	23,000 to 58,999
	1-5	415,000 or more	226,000 or more	68,000 or more	393,000 or more	214,000 or more	64,000 or more	361,000 or more	197,000 or more	59,000 or more
	Over 20	Less than 441,999	Less than 241,999	Less than 73,999	Less than 322,999	Less than 176,999	Less than 53,999	Less than 207,999	Less than 112,999	Less than 34,999
	16-20	442,000 to 639,999	242,000 to 348,999	74,000 to 107,999	323,000 to 510,999	177,000 to 278,999	54,000 to 85,999	208,000 to 373,999	113,000 to 203,999	35,000 to 62,999
Heavy (D=9.1-11.0)	11-15	640,000 to 1,034,999	349,000 to 564,999	108,000 to 173,999	511,000 to 901,999	279,000 to 491,999	86,000 to 151,999	374,000 to 743,999	204,000 to 405,999	63,000 to 124,999
	6-10	1,035,000 to 2,244,999	565,000 to 1,225,999	174,000 to 376,999	902,000 to 2,124,999	492,000 to 1,160,999	152,000 to 356,999	744,000 to 1,950,999	406,000 to 1,065,999	125,000 to 327,999
	1-5	2,245,000 or more	1,226,000 or more	377,000 or more	2,125,000 or more	1,161,000 or more	357,000 or more	1,951,000 or more	1,066,000 or more	328,000 or more

Table H-4--Flexible pavement-remaining service life (minimum tolerable condition-PSR=2.6)

Pavement structure	Years of remaining life	Annual traffic growth								
		1 to 3 percent			4 to 6 percent			7 percent and over		
		Pavement condition			Pavement condition			Pavement condition		
		Very good	Good	Fair	Very good	Good	Fair	Very good	Good	Fair
Present equivalent annual 18-kip single-axle load applications (EALA)										
	Over 20	Less than 599	Less than 299	Less than 69	Less than 499	Less than 199	Less than 49	Less than 299	Less than 199	Less than 29
	16-20	600 to 899	300 to 499	70 to 99	500 to 699	200 to 399	50 to 89	300 to 499	200 to 299	30 to 59
Light (SN=1.0-3.0)	11-15	900 to 1,499	500 to 699	100 to 199	700 to 1,299	400 to 699	90 to 199	500 to 1,099	300 to 499	60 to 99
	6-10	1,500 to 3,199	700 to 1,599	200 to 399	1,300 to 2,999	700 to 1,499	200 to 399	1,100 to 2,799	500 to 1,399	100 to 299
	1-5	3,200 or more	1,600 or more	400 or more	3,000 or more	1,500 or more	400 or more	2,800 or more	1,400 or more	300 or more
	Over 20	Less than 21,999	Less than 14,999	Less than 3,999	Less than 15,999	Less than 10,999	Less than 2,999	Less than 9,999	Less than 6,999	Less than 1,999
	16-20	22,000 to 31,999	15,000 to 21,999	4,000 to 5,999	16,000 to 25,999	11,000 to 16,999	3,000 to 4,999	10,000 to 18,999	7,000 to 12,999	2,000 to 3,999
Medium (SN=3.1-4.5)	11-15	32,000 to 51,999	22,000 to 34,999	6,000 to 9,999	26,000 to 44,999	17,000 to 29,999	5,000 to 8,999	19,000 to 37,999	13,000 to 24,999	4,000 to 7,999
	6-10	52,000 to 112,999	35,000 to 75,999	10,000 to 22,999	45,000 to 106,999	30,000 to 71,999	9,000 to 20,999	38,000 to 97,999	25,000 to 65,999	8,000 to 19,999
	1-5	113,000 or more	76,000 or more	23,000 or more	107,000 or more	72,000 or more	21,000 or more	98,000 or more	66,000 or more	20,000 or more
	Over 20	Less than 207,999	Less than 170,999	Less than 66,999	Less than 151,999	Less than 124,999	Less than 48,999	Less than 97,999	Less than 79,999	Less than 30,999
	16-20	208,000 to 300,999	171,000 to 246,999	67,000 to 96,999	152,000 to 239,999	125,000 to 196,999	49,000 to 76,999	98,000 to 175,999	80,000 to 144,999	31,000 to 56,999
Heavy (SN=4.6-6.0)	11-15	301,000 to 486,999	247,000 to 399,999	97,000 to 156,999	240,000 to 423,999	197,000 to 347,999	77,000 to 135,999	176,000 to 349,999	145,000 to 287,999	57,000 to 112,999
	6-10	487,000 to 1,056,999	400,000 to 867,999	157,000 to 339,999	424,000 to 999,999	348,000 to 820,999	136,000 to 320,999	350,000 to 917,999	288,000 to 753,999	113,000 to 294,999
	1-5	1,057,000 or more	868,000 or more	340,000 or more	1,000,000 or more	821,000 or more	321,000 or more	918,000 or more	754,000 or more	295,000 or more

4. Minimum tolerable condition - PSR = 2.1.
5. Present ADT = 15,000.
6. Percent total trucks and combinations = 12%.
7. Number of traffic lanes = 4.
8. Percent vehicles in critical lane = 40%.
9. 18-kip single axle equivalent constant = 0.720.
10. Annual traffic growth rate = 4%.

Solution:

1. From figure H-2, a medium pavement structure (SN = 3.1 - 4.5) with an S value of 6 or more must be increased to a heavy pavement structure (SN = 4.6 - 6.0).

2. EALA = 15,000 x 0.12 x 0.40 x 0.720 x 365 = 189,216.

3. Table H-2 is entered in the general section identified as "Heavy Pavement Structure" and "4-6% Traffic Growth Rate." Under the column "Pavement Condition-Fair", the ranges of EALA values are searched until the range corresponding to the EALA of 189,216 is found. The years of remaining life in five-year increments are read directly from the column "Years of Remaining Life" and the line for the EALA range. As illustrated in table H-2 for the example, the years of remaining life are 11-15 years.

If the S value in the example above had been between 1.6 and 5.9, the pavement structure value would not have required adjustment. Consequently, table H-2 would have been entered in the section identified as "Medium Pavement Structure," and the years of remaining life would have been 1-5 years.

A similar procedure is followed in determining the years of remaining life for rigid pavements. The procedure for rigid pavements, however, does not require adjustments to the slab thickness because modifications have been made to the AASHO Road Test performance equations as discussed below.

It is recognized that the AASHO Road Test performance equations pertain strictly to only those experimental conditions that prevailed at the Road Test. It is, therefore, unlikely that a strict application of the AASHO Road Test equations would yield values of remaining life entirely compatible with the experience of the individual State. With this in mind, the Road Test performance equations have been modified in this procedure to account for conditions more typical of actual experience than those at the AASHO Road Test. Also, this procedure provides for adjustments to account for subgrade support conditions different from those at the AASHO Road Test. These modifications and provisions should bring the results expressed by the Road Test performance equations into better conformity with actual pavement life experience.

These modifications do not materially affect results on a systemwide basis for this needs study, but are not sufficiently accurate for use by a State in developing such items as a pavement overlay program. Such programs require more detailed information which the State may have available from AASHO "Satellite Studies" and other similar studies.

Should a State have a procedure for determining remaining service life which they considered would be more applicable to their local conditions, then their procedure may be used in lieu of the procedures outlined above, provided documentation of the process is furnished to and approved by the Bureau's division office. It is also realized that many States have more precise methods of measuring the present serviceability index (PSI), structural number (SN), soil support value (S), etc., than has been indicated in this manual. For those States, a method of determining remaining service life based on more extensive consideration of these variables has been developed and will be made available upon request.

APPENDIX I

SAMPLE SETUP FOR CREATING DATA SUBMITTAL TAPE

THIS APPENDIX CONTAINS SAMPLE SETUPS FOR CREATING THE RURAL AND URBAN SECTION DATA SUBMITTAL TAPE FROM THE CARDS CONTAINING THE WORKSHEET INFORMATION. NO ATTEMPT IS MADE TO VERIFY THAT THE DATA IS CORRECT AND CONTAINS NO INVALID CHARACTERS. IT IS IMPERATIVE THAT EACH STATE VERIFY THAT THE CARDS PUNCHED ARE CORRECT BEFORE ATTEMPTING TO CREATE THE DATA SUBMITTAL TAPE.

A SAMPLE SETUP IS INCLUDED FOR INITIALIZING THE DATA SUBMITTAL TAPE WITH THE CORRECT VOLUME SERIAL NUMBER AS OUTLINED IN SECTION EIGHT OF THIS MANUAL. THIS INITIALIZATION MUST BE PERFORMED BEFORE ANY OF THE SUBSEQUENT JOBSTEPS ARE EXECUTED.

A FEW GENERAL COMMENTS ABOUT THE SAMPLE SETUPS FOLLOW, SO THAT EACH SUBMITTING AGENCY MAY TAILOR THE SETUP TO CONFORM TO THE REQUIREMENTS OF THE PARTICULAR INSTALLATION WHERE PROCESSING WILL TAKE PLACE.

1) PROGRAMS BPRCOPY AND REFORM, WHICH ARE CONTAINED IN THE SYSTEM 360 URBAN TRANSPORTATION PLANNING PACKAGE DISTRIBUTED SEPARATELY BY THE OFFICE OF PLANNING, BUREAU OF PUBLIC ROADS HAVE BEEN USED IN CONJUNCTION WITH THE SORT PROGRAM SUPPLIED BY IBM TO FORMAT THE DATA SUBMITTAL TAPE. THE USER IS REFERRED TO THE DOCUMENTATION MANUAL SUPPLIED WITH THE PLANNING PACKAGE FOR SPECIFIC INFORMATION ON BPRCOPY AND REFORM, AND IBM PUBLICATION FORM C28-6543-5 FOR SPECIFIC INFORMATION ON THE SORT/MERGE PROGRAM; IT IS ASSUMED THAT THE DATASET NAMED PLANPAC IS THE JOB LIBRARY FROM WHICH BPRCOPY AND REFORM WILL BE EXECUTED.
2) SPACE ALLOCATED IN THE SORTEM JOB STEP IS PREDICATED ON A SYSTEM HAVING A 2314 DIRECT ACCESS STORAGE FACILITY. THE SPACE ALLOCATED IS SUFFICIENT FOR SORTING APPROXIMATELY 53,000 CARD IMAGE RECORDS.
3) PLEASE NOTE THAT THE DCB INFORMATION FOR THE TAPEI DATASET USED BY PROGRAM REFORM HAS BEEN DEFINED SO THAT THE OPERATING SYSTEM ACCESS METHODS WILL TREAT THREE CARD IMAGES AS ONE INPUT LOGICAL RECORD. THIS REDEFINITION IS ESSENTIAL FOR THE PROPER EXECUTION OF PROGRAM REFORM.

* * * * * SAMPLE SETUP FOR INITIALIZING THE DATA SUBMITTAL TAPE * * * * *

```
//P3340001  JOB  3340,'J.B. GRANT',MSGLEVEL=1
//INIT  EXEC  PGM=IEHINITT
//SYSPRINT  DD  SYSOUT=A
//LABEL  DD  DCB=(DEN=2),UNIT=(2400,1,DEFER)
//SYSIN  DD  *
LABEL  INITT  SER=NHNS01,OWNER='STATE01'
/*
```

* * * * * SAMPLE SETUP FOR CREATING RURAL DATASET * * * * *

```
//P3340002  JOB   3340,'J.B. GRANT',MSGLEVEL=1
//JOBLIB  DD   DSNAME=PLANPAC,DISP=SHR
//COPY   EXEC   PGM=BPRCOPY
//DPNTAPE   DD   SYSOUT=A
//SYSABEND   DD   SYSOUT=A
//TAPEO   DD   DSNAME=&&RURAL,DISP=(NEW,PASS),UNIT=SYSDA,
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600),SPACE=(CYL,(3,1),RLSE,CONTIG)
//TAPEI   DD   *
*****************************************************************************
*                                                                           *
*                                                                           *
*                                DATA CARDS                                 *
*                                                                           *
*                                                                           *
*****************************************************************************
/*
//*  THE NEXT STEP SORTS THE DATA CARDS
//SORTEM   EXEC   SORTD,PARM.SORT='MSG=AP'
//SORT.SORTIN   DD   DSNAME=*.COPY.TAPEO,DISP=(OLD,DELETE),
//   DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600)
//SORT.SORTOUT   DD   DSNAME=SORTED.RURAL.DATA,DISP=(NEW,PASS),
//   VOLUME=REF=*.JOBLIB,DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600),
//   SPACE=(CYL,(3,1),RLSE,CONTIG)
//SORT.SORTWK01   DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK02   DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK03   DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK04   DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK05   DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK06   DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SYSIN   DD   *
 SORT FIELDS=(19,1,A,6,4,A,10,3,A,13,2,A,80,1,A),FORMAT=CH,SIZE=E20000
/*
//*  THE NEXT STEP REFORMATS THE CARD IMAGES TO SUBMITTAL FORMAT
//REFORM   EXEC   PGM=REFORM
//DPNTAPE   DD   SYSOUT=A
//SYSABEND   DD   SYSOUT=A
//TAPEI   DD   DSNAME=*.SORTEM.SORT.SORTOUT,
//   DISP=(OLD,DELETE),DCB=(RECFM=FB,LRECL=240,BLKSIZE=3600)
//TAPEO   DD   DSNAME=STATE01.RURAL.DATA,VOLUME=SER=NHNS01,
//   LABEL=(1,SL),DCB=(RECFM=FB,LRECL=171,BLKSIZE=1710,DEN=2),
//   UNIT=(2400-4,,DEFER),DISP=(NEW,PASS)
//SYSIN   DD   *
ID,  STATE01 1972 NATIONAL HIGHWAY NEEDS RURAL SECTION DATA
SHIFT,1,70,1
SHIFT,95,55,71
SHIFT,175,46,126
GO
/*
```

* * * * * SAMPLE SETUP FOR CREATING URBAN DATASET * * * * *

```
//P3340003  JOB  3340,'J.B. GRANT',MSGLEVEL=1
//JOBLIB  DD  DSNAME=PLANPAC,DISP=SHR
//COPY  EXEC  PGM=BPRCOPY
//DPNTAPE  DD  SYSOUT=A
//SYSABEND  DD  SYSOUT=A
//TAPEO  DD  DSNAME=&&URBAN,DISP=(NEW,PASS),UNIT=SYSDA,
//  DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600),SPACE=(CYL,(3,1),RLSE,CONTIG)
//TAPEI  DD  *
*************************************************************************
*                                                                       *
*                                                                       *
*                               DATA CARDS                              *
*                                                                       *
*                                                                       *
*************************************************************************
/*
//*  THE NEXT STEP SORTS THE DATA CARDS
//SORTEM  EXEC  SORTD,PARM.SORT='MSG=AP'
//SORT.SORTIN  DD  DSNAME=*.COPY.TAPEO,DISP=(OLD,DELETE),
//  DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600)
//SORT.SORTOUT  DD  DSNAME=SORTED.URBAN.DATA,DISP=(NEW,PASS),
//  VOLUME=REF=*.JOBLIB,DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600),
//  SPACE=(CYL,(3,1),RLSE,CONTIG)
//SORT.SORTWK01  DD  UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK02  DD  UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK03  DD  UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK04  DD  UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK05  DD  UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SORTWK06  DD  UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)
//SORT.SYSIN  DD  *
 SORT FIELDS=(3,3,A,23,2,A,9,4,A,13,3,A,16,2,A,80,1,A),FORMAT=CH,       X
               SIZE=E20000
/*
//*  THE NEXT STEP REFORMATS THE CARD IMAGES TO SUBMITTAL FORMAT
//REFORM  EXEC  PGM=REFORM
//DPNTAPE  DD  SYSOUT=A
//SYSABEND  DD  SYSOUT=A
//TAPEI  DD  DSNAME=*.SORTEM.SORT.SORTOUT,
//  DISP=(OLD,DELETE),DCB=(RECFM=FB,LRECL=240,BLKSIZE=3600)
//TAPEO  DD  DSNAME=STATE01.URBAN.DATA,UNIT=(2400-4,,DEFER),
//  LABEL=(2,SL),DISP=(NEW,PASS),VOLUME=SER=NHNS01,
//  DCB=(DEN=2,RECFM=FB,LRECL=179,BLKSIZE=1790)
//SYSIN  DD  *
ID,  STATE01 1972 NATIONAL HIGHWAY NEEDS URBAN SECTION DATA
SHIFT,1,79,1
SHIFT,98,56,80
SHIFT,178,44,136
GO
/*
```

U. S. GOVERNMENT PRINTING OFFICE : 1970 O - 377-268

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA