# REPORT ON <br> TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS <br> FOR <br> POTOMAC RIVER BRIDGES AND INNER TRAFFIC LOOP 

Prepared for
National Capital Planning Commission
by

Wilbur Smith and Associates
265 Church Street

FILE NO: 35.3

## Wilbur Smith and Associates

| TRAFFIC P PARKING - TRANSIT - HIGHWAYS |  |
| ---: | :--- |
|  | 265 CHURCH STREET |
| New Haven, Conn. |  |

June 14, 1955

Mr. Harland Bartholomew, Chairman National Capital Planning Commission Washington 25, D. C.

Dear Mr. Bartholomew:
We are pleased to transmit to you our report on traffic volumes and capacity requirements for Potomac River bridges and the proposed Inner Traffic Loop. This study was authorized by the National Capital Planning Commission in an agreement dated June 26, 1954.

It is evident from the analyses and investigations that additional Potomac River crossings will be required to adequately accommodate future traffic. The recommended system of crossings includes both new central and peripheral bridges, as well as improved existing bridges. Approach and connector roads must be carefully integrated with bridge plans to provide efficient distributor facilities.

The Inner Loop should be developed as a high capacity multi-lane expressway. A substantial portion of this route is needed to accommodate traffic which would desire to use new bridges. Improvements to north-south roadways serving southwest Washington must provide capacity increases between the expressway and Constitution Avenue.

In deriving traffic requirements, we made exhaustive studies of all factors affecting traffic growths and desires. Consideration was given to population and vehicle ownership trends in the District of Columbia and its metropolitan area in Virginia and Maryland; proposals for redevelopment plans, for dispersal of governmental activities, and for the removal of temporary buildings; and finally, the need for stabilizing and directing the growth of the central business district as recommended in the Comprehensive Plan. The scope of the study was such that we were able to use previously collected data, principally that developed from the 1948 origin-destination study in our report on Highway Transportation for the Metropolitan Area of Virginia.

In reviewing the report, you will note that we have attempted to evaluate the roadway needs in terms of peak-hour traffic requirements. This is a sound highway planning approach; however, we realize that such close evaluation of needs must be reconciled or adapted to budgettry and timing factors. A completely desirable solution is unlikely. Also, management controls cannot be overlooked as a potential means of modifying peak-hour needs.

## 2.

We have assumed that the automobile will not be drastically changed in functional design and relative cost before 1970. Here, again, we realize that a basically different vehicle might alter the estimates of traffic needs on which our recommendations are based.

Trends in present modes of travel have been assumed to continue until 1970. New and competing forms of transportation, and marked changes in preferences for particular modes of transportation would alter results we have anticipated. While these factors are recognized as very important, we do not believe that changes in them can be accurately enough forecast to permit their use in the calculation of future traffic patterns for the Washington Metropolitan Area.

Throughout the course of our studies we have been in close contact with the Department of Highways of the District of Columbia as well as the staff of the National Capital Planning Commission. We are grateful for all of the valuable help furnished during the conduct of the work. In addition, we appreciate the splendid assistance and cooperation of the many other governmental agencies within Virginia, the District of Columbia, and Maryland.

We hope that our work will point the way toward an early solution of a most important problem.


WSS:nkm

# REPORT ON <br> TRAFFIC VOLUMES AND CAPACITY REQUIREMENTS FOR 

POTOMAC RIVER BRIDGES AND INNER TRAFFIC LOOP

Prepared for National Capital Planning Commission
by

Wilbur Smith and Associates
265 Church Street New Haven, Connecticut

1955

## PART I - TRAFFIC AND CAPACITY NEEDS FOR POTOMAC RIVER CROSSINGS

INTRODUCTION ..... 1
Population Factors ..... 2
Land Use Trends ..... 5
Traffic Considerations ..... 7
Previous Studies ..... 9
Purpose and Scope ..... 12
BASIC DATA ..... 14
Origin-Destination Studies ..... 14
Special Studies ..... 15
Development of Present and Future Travel Desires ..... 16
COMPREHENSIVE PLANNING PROPOSALS ..... 19
General Considerations ..... 19
Land Use and Generators in the Central City ..... 20
Location of Central Business District ..... 22
Circulation System - Thoroughfare Plans ..... 24
Possible Effects of Proposed Federal Highway Legislation on Route Planning ..... 27
POTOMAC RIVER BRIDGES ..... 29
Existing Bridges ..... 29
Future Bridge Needs ..... 40
Accepted Proposed Bridges on Outer Circumferential ..... 41
New Proposed River Crossings Considered ..... 42
Traffic Potentials of Potomac River Crossings ..... 47
RECOMMENDATIONS ..... 53
Inner Loop Expressway ..... 53
Improvements to Existing River Crossings and Approaches ..... 53
New Potomac River Crossings ..... 56
Schedule ..... 59
PART II - INNER TRAFFIC LOOP
INTRODUCTION ..... 62
General Planning Considerations ..... 63
Traffic Considerations ..... 64

## TABLE OF CONTENTS

PAGE
THE INNER LOOP ..... 67
Traffic Usage ..... 67
Land Requirements ..... 69
Priority of Development ..... 72
DISTRIBUTION PROBLEMS from SOUTH and WEST ..... 73
Present Traffic Flows Across Mall ..... 73
Southwest Redevelopment ..... 75
Southwest Expressway ..... 76
Street Capacity and Volumes ..... 77
North-South Connectors ..... 78
PART III - SUMMARY AND CONCLUSIONS
SUMMARY AND CONCLUSIONS ..... 82
River Crossings ..... 82
The Inner Loop Expressway ..... 84
PART I - TRAFFIC AND CAPACITY NEEDS FOR POTOMAC RIVER CROSSINGS
FIGURE Follows

1. Potomac River Crossings - Washington and Vicinity ..... 1
2. Population Trends ..... 3
3. Distribution of Population - 1953 and 1970 ..... 4
4. Traffic Volumes - Downtown Washington ..... 7
5. Passenger Car Registration 1920-1970 ..... 7
6. Origin-Destinations Zones and Stations ..... 14
7. Major Trip Desires - Typical 1953 Day ..... 16
8. Trend of Total Daily Traffic Crossing the Potomac River ..... 17
9. Total Potomac River Crossings Generator by Zones ..... 17
10. Major Trip Desires - Typical 1970 Day ..... 17
11. Distribution of Government Employment - 1954 ..... 21
12. Distribution of Virginia Trips in Zero Sector of Central Washington ..... 22
13. Proposed Regional Thoroughfare Plan ..... 25
14. Existing Elements - Metropolitan Expressway System ..... 27
15. Assumed Status - 1970 - Metropolitan Expressway System ..... 27
16. Hourly Traffic Variations - Highway Bridge ..... 30
17. Present Traffic Volumes - Highway Bridge and Approaches ..... 30
18. Hourly Traffic Variations - Memorial Bridge ..... 31
19. Present Traffic Volumes - Memorial Bridge and Approaches ..... 31
20. Hourly Traffic Variations - Key Bridge ..... 32
21. Present Traffic Volumes - Key Bridge ..... 32
22. Hourly Traffic Variations - Chain Bridge ..... 33
23. Trends in In-bound Peak Hour Potomac River Bridge Traffic ..... 37
24. Trends in Outbound Potomac River Bridge Traffic ..... 38
25. Trends in Daily Potomac River Bridge Traffic ..... 38
26. Inner Loop Expressway and Potomac River Bridges ..... 43
27. Present Traffic Distribution Based on Transriver Trip Desires. ..... 48
28. Anticipated 1970 Traffic Distribution - Potomac River Crossings ..... 52
PART II - INNER TRAFFIC LOOP
29. Inner Loop Expressway as Related to Redevelopment Areas ..... 64
30. Present Traffic Volumes - Independence Avenue Sector - Typical 1954 Day ..... 67
31. Anticipated Traffic Volumes - Typical 1970 Day ..... 68
32. Present Traffic Operations, North-South Street at Constitution Avenue, Typical 1954 Day ..... 73
33. Anticipated Traffic Volumes, North-South Streets at Constitution Avenue, Typical 1970 Day ..... 77
34. Possible Future Traffic Operations, North-South Streets at Constitution Avenue ..... 79

PART I
TRAFFIC AND CAPACITY NEEDS FOR POTOMAC RIVER CROSSINGS

## INTRODUCTION

The Potomac River traverses the Washington Metropolitan Area in a meandering course. Below Little Falls it becomes a broad waterway affected by tidal waters. Washington is located at the head of tidewater navigation; above the city the Potomac is a mere stream, below it rapidly transforms into an arm of Chesapeake Bay. Crossings are affected by the change in river width and navigation.

While not dominant economic assets in the city's development, the Potomac and Anacostia Rivers have greatly influenced the patterns of development and planning of the metropolitan area. Because of Washington's role as a "capital city", the banks of the Potomac have been devoted principally to park and recreational rather than to commercial purposes.

The river has never been a formidable barrier to the development of Greater Washington. Bridges have spanned the Potomac since the earlier periods of development and have diminished the barrier effects of the river. Figure 1 shows how the present and proposed Potomac River crossings relate to the land development and highway patterns in the Washington Metropolitan Area.

Increased Federal employment and extended use of the automobile have been instrumental in the expansion and dispersal of Washington in the last quarter century. Strong interplay has occurred between the population and settlement changes in the metropolitan area, the available Potomac River crossings, and trans-river trips. The development of the suburban areas in the Washington Metropolitan Area has accentuated the need for effective interchange of movements across the Potomac. This is particularly true since the principal employment centers are located in the central area.


## Population Factors

The Washington Metropolitan Area as defined by the census encompasses the District of Columbia, Prince Georges and Montgomery Counties in Maryland, Arlington and Fairfax Counties in Virginia and the separate cities of Alexandria and Falls Church.

Metropolitan Washington is growing--in the decade between 1940 and 1950 its population increased over 50 percent, to $1,464,292$ persons. Since 1940, a significant portion of the land in the metropolitan area has been urbanized. Population trends are apparent from the data shown in Table I.

The expansion of the city of Washington into adjoining areas has diminished the dominance of the central city. This is quite evident from Figure 2 which graphically portrays the relative growths of the various districts. In 1940 the central city contained 69 percent of the total population; by 1950 this value was reduced to 55 percent. Between 1940 and 1950 populations increased over 200 percent in Fairfax and Arlington Counties, Virginia, and in Prince Georges County, Maryland. Population in Montgomery County increased 96 percent; in Alexandria, the oldest community in Virginia, population grew 84 percent.

The automobile has developed Arlington into a dormitory community of Washington. It has doubled its population more than four times since 1900. Its 1953 population is estimated at 155,500, giving it a population density exceeding 7,000 persons per square mile.

Over half of the population increase in the Virginia area from 1950 to 1953 took place in Fairfax County. Growth can be expected

TABLE I

## POPULATION TRENDS IN WASHINGTON METROPOLITAN AREA

Years

| Census Area | 1900 | 1910 | 1920 | 1930 | 1940 | 1950 | 1953 | 1970 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

## Virginia

| Alexandria | 14,528 | 15,329 | 18,060 | 24,150 | 33,520 | 61,790 | 75,000 | 103,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Arlington County | 6,430 | 10,321 | 16,040 | 26,615 | 57,040 | 135,450 | 156,000 | 165,000 |
| Fairfax County | 18,580 | 20,536 | 21,943 | 25,264 | 40,929 | 98,557 | 128,000 | 293,000 |
| Falls Church | (Included in Fairfax County until 1948) |  |  |  |  | 7,535 | 8,200 | 9,000 |
| TOTAL | 39,538 | 46,186 | 56,043 | 76,029 | 131,489 | 303,332 | 367,200 | 570,000 |
| District of Columbia | 278,720 | 331,070 | 437,570 | 486,870 | 663,090 | 802,180 | 819,500 | 910,000 |
| Maryland |  |  |  |  |  |  |  |  |
| Montgomery County | 30,451 | 32,089 | 34,921 | 49,200 | 83,910 | 164,400 | 212,600 | 304,000 |
| Prince Georges County | 29,898 | 36,147 | 43,347 | 60,100 | 84,490 | 194,180 | 278,700 | 416,000 |
| TOTAL | 60,349 | 68,236 | 78,268 | 109,300 | 168,400 | 358,580 | 491,300 | 720,000 |
| TOTAL Washington Metropolitan Area | 378,607 | 445,492 | 571,881 | 672,199 | 962,979 | 1,464,092 | 1,678,000 | 2,200,000 |
| Central City as Percent of |  |  |  |  |  |  |  |  |
| Metropolitan Area | 73.5 | 74.4 | 76.5 | 72.5 | 68.8 | 54.7 | 48.8 | 41.3 |

Note--1953 and 1970 population estimates include only urbanized portions of the Fairfax, Montgomery and Prince Georges Counties as indicated in Figure 3.

to continue in this area because of the availability of attractive vacant lands to absorb the centrifugal growth of the metropolitan area.

Future Trends--Based on available population information there were l,678,000 persons living in the urbanized portions of the Washington Metropolitan Area in 1953. This represents an increase of about 15 percent over the 1950 population for the entire census area. Preliminary estimates for 1954 reveal that approximately one and three-quarter million persons reside in metropolitan Washington. It is anticipated that by 1970 there will be over 2,000,000 persons living in the urbanized metropolitan area, delimited in Figure 3.

The number of persons residing within the District of Columbia should become stabilized at about 900,000 persons by this year. (It should be noted that in the earlier draft of this report, an approximate value of 700,000 was indicated. This population estimate was derived after considerable research undertaken for the report on Highway Transportation in the metropolitan area of Virginia. It has been increased as a result of subsequent conferences with Highway and Planning officials.) This stabilization can be attributed to the earlier maturity of the District, and the greater attraction of the suburbs. It should be noted that there is only a very limited amount of land vacant within the District. The likely development of additional school and playground sites, the dispersal of Federal employment centers, urban redevelopment with controlled population densities, and the construction of a major highway net which will require much land for rights-of-way all will limit the increases in population.


Present and anticipated future population distributions within the various origin-destination zones in the metropolitan area are shown in Figure 3. The large population increases in peripheral suburban areas are readily apparent.

## Land Use Trends

Washington is the seat of the Federal Government. The governmental character of the National Capital Region 1 / is reflected in the relatively large amount of land in public use, the major portion of which is federally owned. Other occupied land is largely devoted to residential use. There is only a scattering of heavy industrial development, found principally along the waterfront and along railroad lines.

Areas of most intense development within the metropolitan region include the District of Columbia (only about 5 percent is vacant); older parts of Alexandria, most of Arlington County, Falls Church, and Vienna, in Virginia; a small sector of Prince Georges County along Baltimore Boulevard (U. S. Route 1), and the southernmost extremity of Montgomery County, Maryland. Accordingly, future residential expansion must mainly occur in the three larger counties--Fairfax, Prince Georges, and Montgomery--beyond present urban limits.

The central business district of Washington is centrally positioned within the National Capital Region. Including most governmental and private offices and the principal retail shopping areas, it is the major attractor of persons from throughout the metropolitan area. Residential

[^0]development in the District is relatively dense, particularly in the old city. A sizable amount of the high density residential districts are within walking distance of employment centers. Low density residential areas are found in the outskirts of the city.

Zoning for traffic and parking is becoming an important step in the planned development of Washington. Giving full cognizance to the effect of traffic generators on roadway and parking conditions, zoning permits off-street parking and access facilities to become an integral part of land development.

Dispersal of population has been accompanied by a corresponding expansion of retail shopping and service facilities; this appears to be the most evident change in the existing regional land use pattern. Encouraged by the freedom and flexibility of the automobile, such changes can be expected to continue.

Within the District of Columbia, much attention is being given to the elimination of blighted areas, and nonconforming land uses. The Southwest Redevelopment Area and similar projects may be effected in future years. These, and other new developments, will provide positive population control.

In Virginia, future increase in residential use is expected to take place in the Bailey's Crossroad district, at Annandale, and in the vicinity of Falls Church. In Alexandria, recent annexations have greatly increased the amount of land available for new development. Present trends indicate that most of the vacant property will be used for housing--both the single and multifamily types.

## Traffic Considerations

Key trafficways converge on Washington. The concentration of traffic volumes in the central business district is graphically depicted in Figure 4. The Potomac River Crossings constitute the main corridors for travel between the District and southern and western destinations, as well as for commuters between the central city and the metropolitan area in Virginia.

Transportation in the metropolitan area is oriented strongly towards the use of private passenger vehicles; virtually all the recent suburban growth has been predicated on the automobile. Under present conditions, it is not likely that mass transportation will increase its importance as a means of suburban travel. Automobile registrations have increased rapidly in the region as shown in Figure 5. They will continue to increase, because of the prevailing trend toward higher vehicle ownership and the expanding population of the National Capital Region.

Growths in trans-river crossings have far outpaced the increases in population and vehicle registration. Since 1940 the total river crossings have more than doubled. This is readily evident from Table II which summarizes bridge crossings in recent years. In 1924, approximately 12,000 vehicles per day crossed the Potomac River on the Highway Bridge; today over 100,000 vehicles utilize the bridge daily. This corresponds to an increase of over 700 percent.




NATIONAL CAPITAL PLANNING COMMISSION
YEAR
Wilbur Smith $\mathfrak{F}$ Associates
FIGURE 5

Table II

## TRAFFIC GROWTHS

## POTOMAC RIVER BRIDGES

| Year | Chain <br> Bridge | $\begin{gathered} \text { Key } \\ \text { Bridge } \end{gathered}$ | $\begin{gathered} \text { Memorial } \\ \text { Bridge } \\ \hline \end{gathered}$ | Highway <br> Bridge | Total <br> Crossings | Annual <br> Percent <br> Increase |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1940 | 4,638 | 30,189 | 32,288 | 38,512 | 105,627 |  |
| 1941 | 4,819 | 32,639 | 39,885 | 43,989 | 121,332 | 15 |
| 1942 | 4,447 | 29,062 | 37,673 | 38,024 | 109,206 | -10 |
| 1943 | 3,251 | 21,241 | 27,348 | 36,028 | 87,868 | -20 |
| 1944 | 3,356 | 21,928 | 28,166 | 36,889 | 90,339 | 3 |
| 1945 | 3,653 | 23,871 | 33,091 | 42,535 | 103,150 | 14 |
| 1946 | 5,534 | 30,603 | 40,288 | 52,806 | 129,231 | 25 |
| 1947 | 5,670 | 31,356 | 42,760 | 55,054 | 134,840 | 4 |
| 1948 | 6,996 | 32,930 | 46,723 | 60,000 | 146,649 | 9 |
| 1949 | 8,164 | 35,971 | 51,437 | 66,051 | 161,623 | 10 |
| 1950 | 8,939 | 43,946 | 52,211 | 77,094 | 182,190 | 13 |
| 1951 | 10,757 | 45,537 | 51,278 | 92,087 | 199,659 | 10 |
| 1952 | 11,641 | 46,122 | 52,854 | 97,664 | 208,281 | 4 |
| 1953 | 13,111 | 46,052 | 53,295 | 100,428 | 212,886 |  |
| 1954* | 14,000 | 47,000 | 54,000 | 102,000 | 217,000 | 2 |
| 196 | 18900 | 60.15 6 | 688,590 | 117214 | 264,864 |  |

*Typical days based on first eleven months - 1954.

It is interesting to note, too, that traffic crossing the Potomac River has been increasing twice as rapidly as movements across the central business district cordon. Typical comparative growths are shown in Table III.

|  | Central Business District Cordon |  | Potomac River |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Vehicles | $\begin{aligned} & \text { Index } \\ & 1953=1.00 \end{aligned}$ | Vehicles | $\begin{aligned} & \text { Index } \\ & 1953=1.00 \end{aligned}$ |
| 1947 | 635,195 | 0.84 | 135,000 | 0.63 |
| 1953 | 752,141 | 1.00 | 213,000 | 1.00 |
| $\begin{aligned} & 1970 \\ & \text { (Ant. Normal } \\ & \text { Growth) } \end{aligned}$ | 940,000 | 1.25 | 328,000* | 1.54 |

> *Based on data contained in Highway Transportation in the Washington Metropolitan Area of Virginia, Wilbur Smith and Associates, 1953.

## Previous Studies

The need for additional traffic capacity across the Potomac River has been recognized for some time. Earlier studies, such as the OriginDestination Survey of Central Crossings, August 1944, developed by the District Department of Highways in cooperation with the Public Roads Administration, gave primary consideration to improving the old Highway (14th Street) Bridge. These studies became crystallized in the 1945 Congressional Hearings, $2 /$ and resulted in the construction of an additional structure at this location.

The Metropolitan Area Origin-Destination Survey of 1948 has provided a factual basis for analyzing and evaluating the highway needs

[^1]of the Metropolitan Area.3/ The survey was undertaken as a cooperative project of the Board of Commissioners for the District of Columbia, the State of Maryland and the Commonwealth of Virginia acting through the Advisory Committee of the Washington Metropolitan Area. It developed basic information about the magnitude and distribution of travel desires.

In 1952, the Advisory Committee of the Washington Metropolitan Area Transportation Study submitted a detailed program of Highway improvements for the area. $4 /$ Recommendations were based on the detailed traffic studies, and on cost estimates.

The 1948 origin-destination data have been utilized in recent analyses of Potomac River Crossings. In June 1952, A Report on Future Bridge Crossings of the Potomac River, Washington, D. C. by Harland Bartholomew and Associates was prepared for the National Capital Park and Planning Commission, emphasizing planning aspects relevant to new river crossings. The report recommended the construction of an Inner Ring Route, and further study of Intermediate and Outer Ring Routes, including the Alexandria and Nebraska Avenue Bridges and the Southwest Expressway. The report further recommended against construction of an "E" Street Bridge because of terminal difficulties on the District side of the river.

A Report on Potomac River Bridges, Washington, D. C., submitted to the Board of Commissioners, District of Columbia by Modjeski and Masters with Lloyd B. Reid, Traffic Consultant, July 1952, recommended the
3. See Washington Metropolitan Area Transportation Study, Volumes 1-4, Regional Highway Planning Committee, 1952.

4/ A Recommended Highway Improvement Program for the Washington Metropolitan Area, Regional Highway Planning Committee, 1952.
construction of a central river crossing at "E" Street followed promptly with the construction of an Alexandria crossing and later with the Nebraska Avenue Bridge or "such other crossings as may be required further upstream".

Both the National Capital Planning Commission and the District of Columbia Highway Department have conducted further studies of river crossing needs.

In August 1954, the President of the United States signed H.R. 1980, a bill authorizing the construction of two bridges over the Potomac River, one from a point at or near Jones Point, Virginia, and the other from the vicinity of Constitution Avenue in the District of Columbia to the Virginia side. The President recommended that legislation be amended to preserve the setting of the Lincoln Memorial and the Arlington Memorial Bridge.5/ It is the desire of the President that the Secretary of the Interior "keep control and jurisdiction over all park lands in the vicinity of the bridge except the actual bridge structure and the road and street surface between curbs necessary for maintenance by the District of Columbia. The Secretary of the Interior also should be authorized to approve all plans for the bridge and approach roads at both ends of the bridge since park structures and land are involved".

5/ "The bill, however contains serious defects which should be corrected as soon as possible. Certain of the defects can be corrected by executive action in the forms of instruction, whereas others will require amendment of the legislation." ----- "Title I of the enrolled bill ----- fails to provide statutory recognition and adjustment of the relationship of the bridge, together with its approaches and connecting roads to existing and potential improvements on park lands." ---------Statement by the President, August 30, 1954.

In this regard, the Fine Arts Commission opposed construction of the bridge in November 1954 on the basis that it would detract from the beautiful setting of the Lincoln Memorial. A tunnel was recommended by that body. Studies have been subsequently initiated to determine the feasibility of a tunnel to meet the concern of the President and the Fine Arts Commission.

The President also recommends that the responsibility for the construction, maintenance and operation of the Jones Point Bridge be transferred from the Secretary of the Interior to other agencies.6/ Purpose and Scope

This report on Traffic Volumes and Capacity Requirements for Potomac River Bridges and the Inner Traffic Loop was authorized by the National Capital Planning Commission in an agreement dated June 26, 1954. Part I of the report reviews factors affecting traffic operations on the existing Potomac River Crossings, and determines future bridge requirements based on anticipated traffic and land use patterns. Part II determines traffic needs of the Inner Loop Expressway, with especial emphasis on the Southwest Expressway loop and north-south connector streets across the Mall.

The report makes certain traffic analyses, findings, conclusions and recommendations with respect to the Commission's plan for a Potomac River bridge in the vicinity of Roaches Run and an upper central area crossing of the Potomac River.

6/ "There is in my opinion, no logical basis for the performance of these functions by that department since it is not a construction agency and the bridge will not primarily concern or serve areas administered by that department." Statement by the President, August 30, 1954.

The report determines the following:

1. Volume characteristics of 24 -hour and peak hour traffic crossing the Potomac River relative to the location of existing and proposed free bridges.
2. The required traffic capacity and design standards for the Inner Loop Expressway, and the traffic capacity of surface streets within the Inner Loop commensurate with the existing and proposed Potomac River bridge traffic volumes. 3. The adequacy of the Southwest Expressway as proposed and the north-south surface streets as distributors of Roaches Run and Highway Bridge traffic to the central area, and the adequacy as evaluated in the light of anticipated southwest redevelopment.
3. The recommended useful and economic traffic capacity which would be desirable to develop over the Roaches Run and Highway Bridges, and over the upper central area Potomac River Bridges. Capacity needs of integrated highway approach systems serving these bridges.

## Chapter II

## BASIC DATA

A thorough knowledge of existing traffic conditions and characteristics is a prerequisite to the solution of specific problems. When present traffic is related to the land and population patterns and trends, it is possible to derive anticipated traffic values. For this report, comprehensive field studies were undertaken to augment and update the available traffic volume and origin - destination date. Origin - Destination Studies

A principal source of information used in all studies made in the Washington area since 1950 is the comprehensive 1948 home-interview origin-destination survey. During the 5-year period immediately following the survey, population in the metropolitan area increased by more than 50\%. Accordingly, a careful zone by zone review of population changes and automobile ownership increases was made to derive the patterns of internal travel for 1953. Factors which entered into up-dating the 1948 survey included trip frequencies, travel distances, and intensities of transit use. Special adjustments were applied to key traffic generators such as business areas and governmental centers. Zones of origin and destination used in this study are indicated in Figure 6; it should be noted that they include a series of zones beyond the original limits of the 1948 survey area. 7/

7/ The 1948 origin-destination study established an arbitrary cordon which delimited the urbanized Washington metropolitan area. The area within the cordon was divided into "sectors", the central business districtsbeing designated as sector "O". The sectors were sub-divided into 62 "districts", each being relatively homogeneous.


To anticipate 1970 river crossings, the 1953 origin-destination volumes have been projected to 1970 values. This has been accomplished on the basis of detailed estimates of population distribution and vehicle ownership, as affected by travel times, trip frequencies, and competing modes of travel.

## Special Studies

Current traffic volume statistics for bridges and arterial highways within the studied area were obtained from the various governmental agencies responsible for traffic control, regulation and planning. These were supplemented by special vehicular volume counts taken at key locations.

The quality of traffic operations on each of the bridges and their approach road systems was determined, with emphasis being given to the morning and evening rush periods when the greatest traffic demands develop. From these studies it has been possible to identify and evaluate the restrictive features which curtail operational efficiency. Capacities on bridges and approaches were thus established for use in appraising each of the Potomac River crossings.

Speed and delay runs were conducted during both peak and off-peak traffic conditions, so that the efficiency and fluidity of the principal streets and highways which serve bridge traffic could be determined. These studies serve the dual purpose of identifying those conditions which impede traffic flow, and of establishing the relative ease of access to each bridge from all places within the metropolitan area.

Preliminary reconnaissance surveys were made to inspect possible bridge sites along the Potomac River and to determine the feasibility
of construction at each. Reconnaissance studies included consideration of existing land uses which would be affected by new bridge locations, plus evaluation of terminal street and highway connections at both ends of each structure.

Development of Present and Future Travel Desires
Major trans-river trip desires for 1953 are graphically depicted in Figure 7. In 1953 approximately 213,000 vehicles crossed the Potomac River daily. The Washington central business district was found to attract about 30 percent of the total crossing movement. The heavily populated district to the north of downtown Washington generates another 14 percent of the total trans-river trips. About three-fourths of all 1953 crossings had origins or destinations within the District of Columbia.

The centroid of all trans-river trip desires, based on the origindestination study was found to be about an eighth of a mile to the south of the Memorial Bridge, about a fifth of the way between the Memorial and Highway Bridges. It is evident that the greatest pull is to the north of the Mall on the Washington side; hence, it follows that the centroidal trip desire line has a northeast to southwest orientation. Increases in the settlement and trip generating potentials of Fairfax County would likely shift the centroid to the north of its present location.

The principal through trip movements in the Washington Metropolitan Area are between U. S. Route 1 in Maryland and the Shirley Highway, U. S. Routes 29-211, and U. S. Route 50. U. S. Route 240 in Maryland is a secondary generator of through trips. The recent completion of


# MAJOR TRIP DESIRES ACROSS POTOMAC RIVER 

TYPICAL 1953 DAY
the Balitmore-Washington Parkway will likely modify the through trip distributions.

The trends in total Potomac River crossings are shown in Figure 8. It is expected that by 1970 there will be approximately 328,000 vehicles crossing the Potomac River daily. This value represents a 50 percent increase over the 1953 movement of 213,000 trips.

The types of trips crossing the river in 1970, and 1953 are given in Table IV. It is anticipated that the through and external trips will be a slightly more important part of the over-all traffic pattern in 1970 than they are in 1953.

Table IV
SOURCE OF
PASSENGER CAR AND TRUCK TRIPS CROSSING THE POTOMAC RIVER*

|  | 1953 |  | 1970 |  |
| :--- | ---: | :--- | ---: | :--- | ---: |
| Type Trip | Number | Percent | Number | Percent |
| Virginia Districts of <br> Metropolitan Area |  |  |  |  |
| (to Metropolitan Washington <br> and external Maryland Points) | 195,700 | 91.9 | 299,000 | 91.1 |
| External Virginia Trips <br> to Metropolitan Washington | 9,200 | 4.3 | 16,000 | 4.9 |
| Through Trips | 8,100 | 3.8 | 13,000 | 4.0 |
|  | 213,000 | 100.0 | 328,000 | 100.0 |

INCREASE 1970:1953 = 50 percent
*Taken from data contained in Highway Transportation in the Washington Metropolitan Area of Virginia.




# MAJOR TRIP DESIRES ACROSS POTOMAC RIVER 

TYPICAL 1970 DAY

Total Potomac River crossings generated by zones of origin or destination in 1970 and in 1953 are compared in Figure 9. The greatest growths in trans-river crossings will be generated in Fairfax County. This county is expected to develop the greatest population increases in the metropolitan area. The principal trans-river trip desires for 1970 are depicted in Figure 10.

## COMPREHENSIVE PLANNING PROPOSALS

The planning of traffic and transportation facilities must be related to the general planning of land use and occupancy. Accordingly, it is essential that origin-destination data and other information which form the basis for most traffic studies be integrated with many other planning considerations in devising a sound and workable traffic plan for the Washington Metropolitan Area. Studies for the location and design of new bridges and highways must anticipate the future distribution of populations and their sources of employment. Plans for the regulation of future land use and land occupancy should evolve in conjunction with the realistic extension of transportation facilities to integrate travel and movement of goods in the entire area.

Past developments of comprehensive plans have found certain principles and concepts of transportation planning especially useful and effective. Such concepts are not static. In the field of urban traffic they are presently in a state of change. It is important, therefore, to consider the possible changes in basic concepts which might gain wide-spread acceptance in future years. Hence, conventional traffic analyses and traffic planning concepts have been augmented with considerations of land use and occupancy which affect recommendations on bridge locations and construction priorities.

## General Considerations

General aims of the National Capital Planning Commission's Comprehensive Plan include the creation of satisfying healthful living
conditions through the best possible arrangement of uses of land; the encouragement of a stable attractive central business area; the restoration of livability to conservation and blighted residential areas; the achievement of orderly development on urban fringe and outlying sections where the land is still vacant; and the efficient movement of persons and goods within the metropolitan area.

It is evident that the National Capital city must represent a symbol of the aspirations and accomplishments of the nation. The overall plans have been based on factual information and are constantly reviewed in light of objective values which are subject to change.

## Land Uses and Generators in the Central City

Much attention in recent years has been given to the correct future development of metropolitan Washington, with especial emphasis being placed on the central city area. In its planning, full cognizance should be given to future traffic requirements.

The governmental center itself is due for a re-appraisal. The removal from the governmental area of temporary office buildings erected during the war is a primary planning objective. At present more than 40,000 government workers are housed in these buildings. These workers generate high peak hour traffic movements which frequently tax available street capacities. The re-housing of these workers must be made an important consideration in planning and should be integrated with plans for the dispersion of governmental functions. Removal of the temporary government buildings along the northwestern section of the

Mall will somewhat reduce street capacity and access requirements in the western downtown area.

Dispersed development of governmental employment centers is desirable not only from a security or military standpoint, but also as a means of reducing excessive concentration, and hence congestion in the central area. Such plans impose a practical ceiling on the amount of federal employment in the central area and thus tend to stabilize it, even though there might be some new construction of federal buildings in the area. A primary objective of the National Capital Plan is a ceiling of 140,000 federal employees west of the capitol. Figure 11 shows the present distribution of federal employment in central Washington; it should be noted that approximately one-third of all federal employees are currently housed in temporary buildings.

The need for reducing urban vulnerability is becoming apparent in both private and official quarters. At present the Atomic Energy Commission recommends a 30 mile radius dispersal distance as the daily minimum dispersal for all federal Executive Branch agencies.

Trends in nongovernmental developments which are taking place at the present time are also of import. Washington is becoming the headquarters for an ever-increasing number of business and professional associations. Private construction of office facilities has provided a great deal of new office space within the past ten years, much of it within and near the central business district in blocks located between the business center and the more exclusive residential areas to the northwest. The demands for new office space by business and professional

organizations is focused on the downtown area. These facilities will generate new demands for the movement and storage of automobiles.

Within the past few years, regional type shopping centers, specifically oriented to the mobile auto-borne patron, have accelerated the decentralization of retail shopping. A considerable volume of retail sales is now transacted in outlying shopping centers in the Washington metropolitan area. Some of these centers offer a wide variety of goods and a range of prices comparable to those in the downtown area. Trade is attracted to outlying centers by their proximity to potential customers and the availability of parking space.

A basic support for the future of the central area, however, is the fact that it is, and will remain, central. It is almost inconceivable that any suburb will ever be as readily accessible as the central business district from the entire metropolitan area. It will continue to be a focal point of traffic and parking demands.

## Location of Central Business District

The focus of the central business district in downtown Washington lies between the White House and the Union Station. The main shopping district with its department stores and specialty shops extends from 7 th to 15 th Streets northwest and from Pennsylvania Avenue to "H" Street. As previously indicated, office buildings and a "quality" retail development are spreading to the northwest; these growths have been stimulated by their proximity to high income residential areas. Some similar new development is also taking place at the eastern perimeter of the area.


The central business district is located in the approximate center of the Washington metropolitan area. The governmental buildings adjacent to it are the largest centers of employment in the city, thus the downtown shopping district is well situated to serve a high proportion of the areas' wage earners. The governmental buildings and the White House also attract large numbers of tourists and other visitors, many of whom are drawn to the shopping center. There is every reason to believe that the central business district will continue to increase in importance as the metropolitan area grows. The increase in importance of the area will come primarily from increases in activities other than retail trade. Changes in the utilization of land will influence traffic and parking demands accordingly.

The distribution of Virginia trips in the "Zero Sector" of Washington, which encompasses the central business district are shown graphically in Figure 12 for both 1953 and 1970. District 05 in which the downtown sector is located is the primary attractor; it generates a third of all trips between Virginia commuters and the center of the city. Table $V$ shows the present and anticipated distribution of transriver trips in downtown Washington. The 1970 values assume some redevelopment in the southwest areas of the city (including district 03) and the elimination of temporary governmental buildings (district 08). By 1970, it is estimated that district 05 will generate an even higher proportion of all downtown travel than at present.

## Table V <br> DISBTIBUTION OF VIRGINIA TRIPS TO ZERO SECTOR OF

 CENTRAL BUSINESS DISTRICT| District ${ }^{1 /}$ | Percent of Total Trips |  |
| :---: | :---: | :---: |
|  | 1953 2/ | 1970 3/ |
| 01 | 5.4 | 5.9 |
| 02 | 2.7 | 2.2 |
| 03 | 7.7 | 10.8 |
| 04 | 2.8 | 3.1 |
| 05 | 33.0 | 37.1 |
| 06 | 9.1 | 10.2 |
| 071-075 | 16.8 | 18.8 |
| 076-079 | 7.0 | 7.4 |
| 08 | 10.6 | 0.2 |
| 09 | 4.9 | 4.3 |
|  | 100.0 | 100.0 |
| Notes <br> lDistricts are shown in Figure 12. 2Based on 1948 O-D Survey. |  |  |
| 3 Assumes elimination of temporary government buildings and effectuation of Southwest Redevelopment Project. |  |  |

## Circulation System--Thoroughfare Plans

The primary thoroughfare systems of major metropolitan areas have traditionally developed in a random piecemeal manner as the communities grew in size. When the communities were small the primary systems consisted simply of the major streets. As the urban areas expanded
the relative importance of specialized major and minor streets became evident and a larger variety of thoroughfares were developed. Primary thoroughfares in the modern metropolis should consist of a system of express highways designed to limited access standards with separation of intersections and crossings and with control of abutting access. They may include parkway features to enhance their attractiveness to the road user. These freeway type facilities should be supplemented with adequate secondary roads, together forming a comprehensive continuous road net.

A number of plans and programs have been set forth for the development of a major thoroughfare system for metropolitan Washington. Some studies have been quite comprehensive and have attempted to establish an integrated network of roads and bridges which would serve the entire area. The most comprehensive of these studies are those of the National Capital Planning Commission, first published in 1950, and the "Recommended Highway Improvement Program" prepared by the Regional Highway Planning Committee in 1952 as an outgrowth of the 1948 origin-destination study. Both have been supplemented in part by studies of highway needs at specific locations.

Proposed Regional Thoroughfare Plan of the National Capital Planning Commission is shown in Figure 13. Utilizing the existing elements of a comprehensive system, the plan develops an extensive system of radial and circumferential thoroughfares, of which express highways and parkways are the key elements. Three "ring roads" serve to intercept radial traffic--an inner loop around the central business district of Washington, an intermediate loop, and an outer ring road in Maryland and Virginia. The plan calls for four new bridges across the Potomac River to provide the trans-river links in the pattern.


The construction of a Constitution Avenue Bridge, approved in a recent resolution by the National Capital Planning Commission, has now been authorized by Congress. Other principal features of the thoroughfare plan also approved by the Commission include the widening of Key Bridge, the development of the Inner Loop Expressway and the construction of a Roaches Run Bridge.

Improvements indicated in the program of the Regional Highway Committee of Washington have been designed to increase the capacities of the street systems in downtown Washington and in congested suburban centers, of important radials, and of crosstown and cross-county routes. It also recommends the eventual construction of an outer-circumferential highway about the Washington area and corrective treatments for principal trafficways in the metropolitan area. Relevant to Potomac River Crossings, and the Inner Loop Expressway, the Committee's program is in substantial accord with, and designed to carry out, the objectives of the Comprehensive Plan.

It is evident that integration of the various proposals, programs, and plans is necessary in order to complete a well-rounded highway and street system. Continuity of capacity and fluidity are requisite.

The specific needs of this study required that an estimate be made of 1970 traffic demands in the Washington Metropolitan Area. The time required to travel between origin and destination--from home to work, from work to shopping, etc.--is a basic element in the generation of travel by either automobile or bus. It has been necessary, therefore, to anticipate the degree to which an express highway network will have been completed to serve the metropolitan area by 1970, and to estimate the time required to travel on it from one zone to another.

Existing elements of a comprehensive highway plan are shown in Figure 14. Typical of the expressways are the Baltimore-Washington Parkway, Suitland Parkway, Shirley Highway and the Pentagon network. The Rock Creek and Potomac Parkway, the Mount Vernon Memorial Boulevard and the George Washington Memorial Parkway have partial expressway characteristics. The Kenilworth Avenue improvement and the East Capitol Street Bridge are now under contract. Further sections of the WashingtonAnnapolis Expressway and the Washington National Pike are now scheduled for early construction.

The Commission's proposed thoroughfare plan published in 1950 is now being studied by concerned highway and planning agencies in light of more recent studies and new information. The portions of the plan which appear to be most likely of acceptance and realization by 1970 are shown in Figure 15. It is this system of expressways which forms the basis for the 1970 estimates of traffic interchange in the Washington area. This system includes the extension of the George Washington Memorial Parkway both in the Maryland and Virginia sides to Cabin John, the Inner and Outer Circumferentials and the Fort Drive Link in the Intermediate Circumferential between Sargent Road and just south of Kenilworth expressway.

Possible Effects of Proposed Federal Highway Legislation on Route Planning
The possibilities of legislative action in the immediate future which might modify the scope of anticipated construction programs cannot be overlooked. There are strong indications that Congress is preparing to enact highway legislation which will greatly increase the tempo of highway construction in and around large metropolitan areas, particularly those routes designated as part of the National Inter-regional Highway


EXISTING ELEMENTS
METROPOLITAN EXPRESSWAY SYSTEM


[^2]System. If the tentative proposals thus far announced were to be enacted, even in part, it is clear that funds for new highway construction would be available in much larger amounts than those on which the present plans are based.

If an accelerated program of highway construction takes place in the Washington Metropolitan area and the highways anticipated for 1970 are built before that date, traffic volumes will undoubtedly increase more rapidly than the forecasts indicate.

## POTOMAC RIVER BRIDGES

Increased river crossing demands are a reflection of the suburbanization of Virginia, and of the development of traffic generators, such as the Pentagon, on the Virginia side. River crossings have more than doubled in the last 15 years; at present (1954) there are 217,000 transriver trips. By 1970, based on normal growths, it has been shown that the total crossings will be about 328,000 daily.

## Existing Bridges

Analysis of traffic characteristics and operations of existing bridges is a prerequisite to the determination of future bridge needs. Accordingly, performance of the four vehicular bridges currently spanning the Potomac River--Highway Bridge, Memorial Bridge, Key Bridge, and Chain Bridge--have been studied. General characteristics of these bridges are summarized in Table VI.

Table VI
PHYSICAL CHARACTERISTICS: POTOMAC RIVER BRIDGES

| Bridge | Year Open to Traffic | Pavement Width | Lanes | Type Span |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { Highway - Old } \\ \text { (14th Street) } \\ \text { New } \end{gathered}$ | 1903 | 40 | 3 | Movable |
|  | 1950 | 50 | 4 | Movable |
| Memorial | 1932 | 60 | 6 | Movable |
| Key | 1924 | 50 | 4 | Fixed |
| Chain | 1938 | 30 | 2 | Fixed |

Highway Bridge - The Highway Bridge is the principal and most direct connector between central Washington and Alexandria. The original bridge, with its 40 foot roadway was erected in 1903. In 1927, when crossings
totaled 12,000 daily, the street railway tracks were removed and the bridge resurfaced. The bridge roadway carried two lanes of traffic in each direction prior to 1950 when a companion Highway Bridge with a fifty foot roadway was placed in operation to the south of the original structure. The new bridge provides four lanes of traffic inbound, while the old bridge carries three outbound lanes.

On a typical 1954 weekday, the Highway Bridge carried between 100,000 and 107,000 vehicles. Hourly traffic variations on the bridge are indicated in Figure 16 for typical 1953 and 1954 days. Peak directional volumes were found to approximate 5,400 vehicles per hour--inbound during the morning rush period and outbound during the evening rush. Effects of Virginia employment centers (viz the Pentagon) are evident from the pronounced secondary "counter rush" peak values.

A detailed traffic flow diagram for the Highway Bridge, and its Washington approaches (14th Street and connectors) is presented in Figure 17 for a typical morning rush hour. The dispersion of bridge traffic to Maine Avenue, D Street, Independence Avenue and 15 th Street is readily apparent. Only about 15 percent of the total inbound bridge traffic crosses Constitution Avenue northbound on 14 th Street.

Maximum lane capacity of the Highway Bridge was determined to be about 1,800 vehicles per hour. The practical lane capacity for the bridge was found to be l,500 vehicles per hour. In Virginia, the Highway Bridge has limited Anecess connections with the Mount Vernon and Shirley Memorial Highways, U. S. Route 1 and the Pentagon Road net. The capacity of these roads is sufficient to accommodate all Virginia-bound bridge traffic.



In Washington, except for a devious turnoff to 15 th Street, the four inbound lanes must converge to three before reaching the off ramp at Maine Avenue. This restrictive cross section prevents full utilization of the inbound roadway. The effective inbound bridge capacity is reduced to three lanes, and backups of traffic into Virginia frequently result. It should also be noted that 14 th Street (three lanes each way) is saturated during periods of maximum bridge traffic. Traffic signals at "C" Street and Independence Avenue impede the steady flow inbound. Insufficient bridge capacity during peak evening hours often develops traffic backups of southbound traffic across the Mall on 14 th Street.

Memorial Bridge - The Arlington Memorial Bridge was opened to traffic in 1932. It is centered upon an axis connecting the Lincoln Memorial in Washington with the Memorial entrance to Arlington National Cemetery. The bridge connects major parkways and roadways on the Virginia side with Constitution Avenue, Independence Avenue, 23rd Street, and the extension of Rock Creek and Potomac Parkway on the Washington side of the river.

Fifty-four thousand vehicles use the Memorial Bridge on a typical weekday. Peak directional volumes amount to about 4,400 vehicles per hour, inbound towards Washington in the morning and outbound to Virginia in the evening. Typical hourly traffic variations are shown in Figure 18 and pinpoint the preponderance of peak hour flows. Bridge capacity values are also indicated.

The traffic flow patterns on Memorial Bridge and its environs are depicted in Figure 19 for a typical peak morning rush hour. The intermingling of bridge and other movements is readily apparent. Over 30 percent of all inbound bridge traffic travels north on 23rd Street.



Bridge traffic on Constitution Avenue at 14 th Street is only about 15 percent of the total inbound crossings.

The Memorial Bridge, in terms of lane densities, is the lightest travelled bridge even though its maximum per lane flows of 1,500 vehicles per hour exceed optimum capacity value. Short turning radii on the traffic circles at both ends of the Memorial Bridge, particularly at the Lincoln Memorial, restrict speed and develop critical weaving conflicts.

Key Bridge - The Francis Scott Key Bridge, Georgetown, was completed in 1924 replacing an old iron bridge constructed in 1888. The bridge has a 50 foot roadway, with a double streetcar track in the center. There are two moving lanes of traffic in each direction of travel. The bridge connects with the Whitehurst Freeway and "M" Street on the District side of the Potomac River. In Virginia a traffic circle connects Lee Highway (U.S. 29-211) and local streets to the bridge. The local streets serve as connectors to Wilson Boulevard.

The Key Bridge currently carries 47,000 vehicles daily. Hourly traffic variations as related to bridge capacities are indicated in Figure 20. Peak directional flows approach 2,700 vehicles per hour.

The traffic flow patterns on the Washington approach of the bridge are graphically depicted in Figure 21 for a typical 1954 morning peak hour. Approximately 80 percent of all inbound movements are destined to the east. The greater number of these vehicles utilize the Whitehurst Freeway.

Capacity restrictions on both the Washington and Virginia approaches prevent the Key Bridge from developing a possible lane capacity in excess of about l, 400 vehicles per lane. As shown in Figure 20 this saturation


## hOURLY TRAFFIC VARIATIONS

 KEY BRIDGE

## PKESENT TRAFFIC VOLUMES

## KEY BRIDGE

capacity is frequently equalled. Traffic backups onto the bridge in the morning hour from the eastern terminus of the Whitehurst Freeway often impede bridge traffic flows. Similarly the signalized operations at "M" Street cannot efficiently accommodate the approaching steady flows. In the evening rush period westbound freeway traffic backs up across the outbound ramp from the signalized intersection at Canal Road. Similarly, the traffic circle at Virginia and nearby traffic signal operations decrease possible bridge capacities. Some capacity restrictions result from street railway operation on the bridge roadway. They appear to be relatively minor when compared to the restrictive conditions on the bridge approaches.

Chain Bridge - The Chain Bridge, located upstream and farthest removed from central Washington, was first built in 1797. The present bridge has been in operation since 1938 and superseded five earlier structures.

The Chain Bridge has a thirty foot wide roadway; one lane of traffic moves in each direction. In Virginia the bridge connects with Glebe Road, Military Road, and Route 123. It connects with Canal Road in the District south of the river. There are 14,000 Potomac River crossings over the bridge on a typical 1954 day.

Hourly traffic variations for the Chain Bridge, and bridge capacities are shown in Figure 22. Flows are relatively minor when compared to the loadings on the other river crossings. Movements during the peak hour exhibit pronounced directional tendencies. Peak hour directional volumes approximate 1,500 vehicles.

The sharp curvature on the Washington side of the bridge, and the intersection of Route 123 and Glebe Road on the Virginia side of the


HOURLY TRAFFIC VARIATIONS CHAIN BRIDGE

Potomac River with its restricted sight distance reduce the possible bridge capacity to about 1,500 vehicles per lane per hour. This value is reached during peak hours.

General Traffic Characteristics of Existing Bridges. The existing Potomac River Bridges must also be analyzed as a system of river crossings. The location and general accessibility of each bridge as related to desire lines of travel and the traffic attractiveness or capacity of the bridge will determine the proportion of trans-river trips that will use any given facility.

The distribution of the present trans-river crossings are summarized in Table VII. Almost half of the 217,000 daily crossings, and about 40 percent of the total peak hour directional movement of 14,000 vehicles use the Highway Bridge. There is relatively equal usage throughout the day of the Memorial and Chain Bridges, with a somewhat heavier share of the total peak hour crossings on the Memorial Bridge.

TABLE VII
RELATIVE UTILIZATION POTOMAC RIVER BRIDGES

1954

| Bridge | Daily Traffic Vehicles | \% of Total Crossings | Peak Hour Inbound |  | Peak Hour Outbound |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Vehicles | \% of Total | Vehicles | \% of Total |
| Highway | 102,000 | 47.0 | 5,400 | 38.8 | 5,350 | 38.4 |
| Memorial | 54,000 | 24.9 | 4,230 | 30.4 | 4,420 | 31.7 |
| Key | 47,000 | 21.7 | 2,660 | 19.3 | 2,670 | 19.2 |
| Chain | 14,000 | 6.4 | 1,600 | 11.5 | 1,490 | 10.7 |
| TOTAL | 217,000 | 100.0 | 13,890 | 100.0 | 13,930 | 100.0 |

The traffic composition of vehicles crossing the Potomac River is summarized in Table VIII. Passenger cars comprise over 85 percent of the total movement across all bridges.

Peak hour directional movements are compared with the total daily river crossings for each of the existing bridges in Table IX. Inbound trips in the morning peak hour and outbound trips in the evening peak hour each constitute over 6 percent of the total daily crossings. Peak hour traffic ranges from 5 percent of the total daily movements across the Highway Bridge to 11 percent of the total daily Chain Bridge traffic.

TABLE VIII
TRAFFIC COMPOSITION
POTOMAC RIVER BRIDGES

| Type Vehicle | $\begin{array}{r} \text { Hig } \\ \mathrm{Bri} \\ 1948 \\ \hline \end{array}$ | hway dge 1953 <br> \% | Percent of Total Traffic  <br> Memorial Key <br> Bridge Bridge |  |  |  | Chain <br> Bridge |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Passenger Vehicles | 84.6 | 87.8 | 97.2 | 97.4 | 83.7 | 87.0 | 90.8 | 93.2 |
| Single Unit Trucks | 9.4 | 7.8 | 0.4 | 0.5 | 12.1 | 10.6 | 8.7 | 6.3 |
| Combination Trucks | 3.2 | 2.9 | 0.0 | 0.0 | 1.8 | 0.8 | 0.3 | 0.3 |
| Buses | 2.8 | 1.5 | 2.4 | 2.1 | 2.4 | 1.6 | 0.2 | 0.2 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Equivalent |  |  |  |  |  |  |  |  |
| Passenger Vehicles | 106 | 105 | 100 | 101 | 106 | 104 | 103 | 102 |

## PEAK HOUR TRAFFIC CHARACTERISTICS POTOMAC RIVER BRIDGES 1954

| Bridge | Daily Traffic | Peak Hour Inbound |  | Peak Hour <br> Outbound |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Highway | 102,000 | 5,400 | 5.3 | 5,350 | 5.2 |
| Memorial | 54,000 | 4,230 | 7.8 | 4,420 | 8.2 |
| Key | 47,000 | 2,660 | 5.6 | 2,670 | 5.6 |
| Chain | 14,000 | 1,600 | 11.5 | 1,490 | 10.6 |
| TOTAL | 217,000 | 13,890 | 6.4 | 13,930 | 6.4 |

Peak hour traffic is slightly more concentrated on the bridges than on the adjacent street net in the District. As shown in Table $X$ evening peak hour traffic leaving the inner cordon area of central Washington represents about 5 percent of the total daily movements. In evaluating all peak hour traffic flows it must be remembered that 15 and 30 minute peaks within the hour often have greater intensities than the indicated hourly values.

By relating the traffic demands placed on a facility to the available capacity, its adequacy can be determined. Accordingly, capacity values for the existing bridges and their approaches were calculated. 8 / Consideration was given to the number and efficiency of moving lanes, nature and extent of interferences, vehicular headways, and related operational factors which influence capacities.

Present bridge and approach capacities are summarized in Table XI. The minor variances between inbound and outbound capacities result

[^3]from the critical approach conditions. The combined present possible directional capacity of the four bridges and their approaches approximates 14,500 vehicles per hour. The maximum optimum directional loading is about 12,000 vehicles per hour for the bridges and approaches. Present total peak hour directional loadings approximate 14,000 vehicles.

The potential capacities of the bridges, if restrictive approach conditions were eliminated, are also indicated. The most marked capacity increase is that of the inbound span of the Highway Bridge. Full utilization of all four lanes would increase present capacities about a third.

Trends in inbound peak hour Potomac River Bridge traffic are compared with available capacities in Figure 23. It is significant to note that the practical capacities of all bridge systems have been exceeded in recent years.

Table X
PEAK HOUR TRAFFIC IN CENTRAL WASHINGTON
AS PERCENT OF TOTAL ADT-1953

|  | A.M. Rush Hour |  |  | P.M. Rush Hour <br>  <br>  <br> Inbound <br>  <br> South Side Inner Cordon |  | $4.5 \%$ | $4.8 \%$ | $4.1 \%$ | $4.7 \%$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| West Side Inner Cordon | 5.6 | 4.3 | 3.2 | 6.7 |  |  |  |  |  |
| North Side Inner Cordon | 4.9 | 3.4 | 2.9 | 5.0 |  |  |  |  |  |
| East Side Inner Cordon | 4.7 | 3.7 | 2.9 | 5.0 |  |  |  |  |  |
| Entire Cordon Area* | $5.0 \%$ | $3.8 \%$ | $3.2 \%$ | $5.2 \%$ |  |  |  |  |  |

*Cordon extends south of Constitution, West of 21st, North of L Street, East of Third Street.


MEMORIAL


KEY


TRENDS IN INBOUND PEAK HOUR POTOMAC RIVER BRIDGE TRAFFIC

Table XI

## PRESENT BRIDGE CAPACITIES

BRIDGE: $\quad \frac{\text { HIGHWAY* }}{\text { IN }} \quad \frac{\text { MEMORIAL }}{\text { IN OUT }} \quad \frac{\text { CHAIN* }}{\text { IN }} \frac{\text { KEY* }}{\text { OUT }} \quad \frac{\text { TOTAL* }}{\text { IN }}$

Possible Capacity Bridge \& Approaches

$$
5,400 \quad 5,400 \quad 4,800 \quad 4,800 \quad 1,600 \quad 1,500 \quad 2,900 \quad 2,700 \quad 14,700 \quad 14,400
$$

Possible Capacity Bridge Only

$$
7,200 \quad 5,400 \quad 4,800 \quad 4,800 \quad 1,800 \quad 1,800 \quad 3,400 \quad 3,400 \quad 17,200 \quad 15,400
$$

Practical Capacity
Bridge and
Approaches

$$
4,500 \quad 4,500 \quad 3,900 \quad 3,900 \quad 1,300 \quad 1,300 \quad 2,400 \quad 2,400 \quad 12,100 \quad 12,100
$$

Peak Hour Loading $1954 \begin{array}{lllllllllll} & 5,400 & 5,350 & 4,230 & 4,420 & 1,600 & 1,490 & 2,660 & 2,670 & 13,890 & 13,930\end{array}$

## *Commercial vehicles would reduce these capacities slightly.

Trends in outbound peak hour Potomac River Bridge traffic as related to capacities are shown in Figure 24. The patterns of growth are similar to those for inbound traffic.

Approximate daily capacities have also been determined from the present (1954) relationships between peak hour directional loadings and average daily flows. These capacity values have been superimposed over the trends of average daily traffic crossing the Potomac River on existing bridges and are graphically summarized in Figure 25. The need for additional bridge capacity is evident!

The traffic sufficiencies for the existing Potomac River bridges and their approaches are indicated in Table XII. Peak hour volumes are expressed as a percent of available capacities. It is readily apparent


TRENDS IN OUTBOUND PEAK HOUR POTOMAC RIVER BRIDGE TRAFFIC

that the practical capacities of all four bridges are exceeded during peak traffic hours. Possible or saturation capacity values are reached during both peaks on the Highway Bridge, and are approached on all the other structures. The Memorial Bridge appears to be the least overloaded.

The sufficiency of the Potomac River Crossings is summarized in Table XIII. The seriousness of the bridge problem, and the need for additional river crossings, is evident. At the present time the directional peak hour traffic exceeds the combined "practical capacity" of all bridges. The peak hour loads are within 95 percent of the possible capacity of the combined bridges. Peak hour congestion involving river crossings can be expected to reach the "breaking point" - complete saturation - in approximately one year.

TABLE XII
TRAFFIC SUFFICIENCIES
POTOMAC RIVER BRIDGES*
PEAK HOUR VOLUNE AS PERCENT OF AVAILABLE CAPACITY

INBOUND
A B 120

108
111
122
100

OUTBOUND
A B
119
100
11493
11299
11499

A - Practical Capacity B - Possible Capacity *As affected by restrictive approach conditions.

TABLE XIII
PRESENT TRAFFIC SUFFICIENCY*
POTOMAC RIVER BRIDGES

|  | Inbound | Outbound <br> Total Volume-Typical 1954 Day <br> Peak Hourly Flow | 13,890 |
| :--- | ---: | ---: | ---: |
| Practical Capacity | 13,930 |  |  |
| Sufficiency | 114 | 12,100 |  |
| Possible Capacity | 14,700 | 14,400 |  |
| Sufficiency | 94 | 96 |  |

*Volume as percent of capacity.

## Future Bridge Needs

It has been previously indicated that, based on normal growth trends, there will be about 328,000 vehicles crossing the Potomac River daily by 1970. This value represents an increase of approximately 50 percent over present crossings. If attractive and fully adequate systems of approach roads can be provided, the desired crossings can be expected to approach 393,000 daily.

To effectively meet peak hour demands and to accommodate reasonable trip requirements, the minimum lane requirements will be fourteen additional lanes within the next 16 years. This assumes that the new bridges will be located so as to permit direct and effective travel between motorists' principal points of origins and destinations and that all lanes will be utilized. It is evident that their locations will have to conform with natural travel patterns. The new bridges will have to be located so that their capacity can be served by approach roads on each side of the river. Approach road nets must be carefully integrated with bridge plans. Inadequate approach highways, or required circuitous travel will greatly reduce
the practical effectiveness of a bridge. Improper locations can mean, therefore, that more lane capacities will be required.

## Accepted Proposed Bridges on Outer Circumferential

Comprehensive plans for new Potomac River Bridge crossings should give cognizance to both capacity and access needs. Bridges should be constructed not only to eliminate capacity deficiencies, but also at those locations where they will become integral links of primary regional trafficways. A balanced system of Potomac River crossings should contain both central and peripheral bridges.

Highway as well as planning officials have already agreed on the construction of the Jones Point and Cabin John Bridges as part of the Greater Washington outer circumferential route. This is an accepted condition in the report.

Jones Point Bridge - The location for a river crossing at Alexandria has been one of the Regional proposals of the Comprehensive Plan. Bill H.R. 1980, signed by the President, authorized the Jones Point Bridge. The Jones Point crossing site is located south of the central district of Alexandria. Traffic analyses reveal that a four-lane bridge would meet traffic demands although it is understood a 6-lane structure has been contemplated. In Virginia the bridge would have interchange with the Mount Vernon Memorial Highway, Jefferson Davis Highway and Telegraph Road, and, via an extension, with the Shirley Highway. If the proposed Potomac River expressway is developed it would likely provide access to the bridge. In Maryland the bridge would have interchange with the proposed George Washington Memorial Parkway, Indian Head Road, and eventually be extended eastward as part of the Outer Circumferential.

The bridge would provide a valuable traffic service by affording a much needed by-pass of central Washington. It would permit direct routing between southwestern portions of the Metropolitan area and southeastern Washington, and eliminate virtually all the reverse movements currently negotiated over the Highway and south Capitol Street Bridges. Similarly, the connection to the Shirley Highway would attract traffic which would otherwise be required to traverse the Pentagon Road net. It would encourage suburbanization and would provide a "dispersed development" erossing of the Potomac River.

Cabin John Bridge - The Cabin John Bridge would span the Potomac in the vicinity of Cabin John Park about 8 miles northwest of central Washington. It would have contact with Route 193 in Virginia and MacArthur Boulevard in Maryland. It would also connect the George Washington Memorial Parkway on both sides of the Potomac River. The bridge would be an integral link in the Outer Circumferential. It would tap new areas and stimulate their development.

Preliminary traffic studies indicated that there are insufficient traffic potentials to justify its construction at present. In light of the recent plans by Maryland to expedite the construction of the Outer Circumferential, it is reasonable to expect substantial increases in the bridge's future traffic potentials. Accordingly, it is desirable that rights-of-way be reserved at the present time for the bridge approaches in both Virginia and Maryland.

New Proposed River Crossings Considered
Highway and planning agencies recognize the need for the construction of new intermediate and central Potomac River Crossings. Three general locations have been considered:
(1) a downstream central location in the vicinity of Roaches Run or Hains Point;
(2) a midstream central location in the vicinity of Constitution Avenue; and
(3) an upstream intermediate crossing between the Key and Chain Bridges.

Tentative locations and alinements of the Roaches Run and Constitution Avenue River Crossings are shown in Figure 26.

Roaches Run - The planned Roaches Run Crossing would be located in the vicinity of Roaches Run approximately 800 feet down stream of the railroad bridge; and would be a six-lane facility. The bridge would connect directly with the Southwest Expressway leg of the Inner Loop, and 12th Street in Washington and have interchange with Mount Vernon Memorial Highway and the Pentagon road network on the Virginia side via high type connectors.

By development of the Four Mile Run Expressway between the bridge and the Shirley Highway much trans-river traffic could be intercepted before reaching the Pentagon road net and conveyed directly to the bridge. The Four Mile Run Expressway integrates well into the planned Intermediate Circumferential in the Virginia metropolitan area. The contemplated Potomac River Expressway to Alexandria can be readily tied into the bridge.

Advantages -- Attractive interchanges can readily be provided on both approaches to the bridge. The facility can be expected to provide substantial relief to the heavy traveled Highway Bridge. It can advantageously serve densely populated sectors of the metropolitan area;

|  |
| :---: |

about two-thirds of the people in the Virginia metropolitan area currently live south of Arlington Boulevard. It is readily possible to integrate the bridge approach roads with the Southwest Expressway, and Southwest Redevelopment Plans. Opportunities exist for providing off-street parking areas in proximity of bridge approaches. It should be noted that these plans would increase the traffic attractibility of the southwest portions of central Washington. Via the Southwest Expressway Bridge traffic would have free flowing access to the South Capitol Street as well as to the Third Street leg of the Inner Loop Expressway. The bridge would provide all-weather express access to the National Airport. It provides direct access to the central shopping district and areas to the east. Much of the land required for the bridge approaches is under Federal ownership and can be readily committed to a bridge location at any time.

Disadvantages -- Increased north-south traffic flows on surface streets tributary to the bridge can be expected to develop needs for additional capacity at intersections along Constitution Avenue. The anticipated north-south flows and required capacities are developed fully in Part II of this report.

Constitution Avenue Bridge - The proposed Constitution Avenue Bridge is located about 1200 feet north of the Arlington Memorial Bridge. It connects with George Washington Parkway, Arlington Boulevard and the Jefferson Davis Highway on the Virginia side in a series of high capacity type interchanges. On the Washington side the bridge would have complete interchange with the west leg of the Inner Belt Expressway and would have a direct connection to Constitution Avenue. Twenty-third Street would be carried over Constitution Avenue thereby increasing the capacity of
both roadways. Integrated with the new bridge are new Mall roads which would serve the Memorial Bridge traffic, and reduce existing weaving maneuvers. An attractive contact between the Belt Expressway and a widened "E" Street Mall roadway would be provided.

Advantages -- The bridge provides a direct central crossing for Arlington Boulevard, Washington Memorial Parkway, and Lee Highway traffic approaching from the west and north. The bridge would attract vehicles currently using Memorial and Key Bridges relieving capacity problems on these facilities. It provides attractive access to the west central area. Virtually all of the land required for bridge approaches is under Federal ownership.

Disadvantages -- Converging traffic from Virginia Avenue onto Constitution east of the bridge is likely to develop capacity problems on the street, even with widening.

To separate Memorial and Constitution Avenue Bridge traffic, the Mall has been converted into a through trafficway to Ninth Street, thereby increasing traffic movements on the Mall roadway. The Constitution Avenue Bridge serves areas presently occupied by temporary buildings whose future access needs are likely to decrease. The bridge will not substantially relieve the traffic loadings on the Highway Bridge. The attractive interchange provided with Arlington Boulevard will likely develop increased traffic loads on the Virginia thoroughfare which is currently saturated during peak traffic hours. It should be noted that between 1948 and 1952 traffic volumes in Arlington Boulevard increased about 140 percent. Normal increases in local Virginia traffic alone will tax the capacities to be provided by the planned widening.

The additive bridge traffic would aggravate this condition and restrict operations on the roadway. To repeat, present trans-river traffic combined with the rapidly growing intra-Virginia traffic would absorb the capacity of this important expressway as rapidly as it is provided.

The Commission of Fine Arts has clearly set forth the impact of the structure on central area aesthetics. The Commission states that if a crossing must be provided at this location that it should be a tunnel. This type facility would be very costly although it would connect with the same road network as a bridge.

E Street Bridge - Early plans for a central crossing also considered a bridge connecting Arlington Boulevard with E Street in the vicinity of the E Street Inner Loop interchange. This bridge was superceded by the Constitution Avenue Bridge.

Three Sisters Bridge - The proposed Three Sisters Bridge would span the Potomac River over the Three Sisters Island. It would connect with Canal Road, MacArthur Boulevard, Foxhall Road and the planned Glover Archbold Parkway on the Washington side. On the Virginia side it would connect with the existing Washington Memorial Parkway, and its planned extension in a "bulb" type interchange. The proposed eastwest expressway serving the Falls Church area would be linked with the existing spur of the Washington Parkway to Lee Highway. The proposed Whitehaven Parkway in Washington about a mile to the north of the bridge would serve as a major east-west distributor.

Advantages -- The Three Sisters Bridge would strategically "intercept" Washington bound traffic from northwestern Virginia areas which would otherwise use Key, Central, or Memorial Bridges. That is, the "traffic shed" of the Three Sisters Bridge includes many of the
fastest growing areas in the Metropolitan region. This will occur to an even greater extent when the east-west expressway becomes completed. The bridge would permit direct and efficient trans-river movements to northwest Washington from all of metropolitan Virginia. This is a function which none of the existing bridges provides. The planned Intermediate Circumferential could easily utilize the bridge. Possibilities exist for connecting the bridge with the Inner Loop.

Disadvantages -- For the Three Sisters Bridge to offer maximum traffic service to trans-river crossings it should have a limited access connection via the Whitehaven Parkway to the Inner Loop. This necessitates an extension of the Whitehaven Parkway most likely through several blocks of relatively expensive residences and buildings, to connect with the Inner Loop at about Florida and Connecticut Avenues. The bridge will not serve traffic traveling to and from central Washington as efficiently as a more central crossing. Unless Canal Road is developed to expressway $\backslash$ standards and the present bottlenecks of the Whitehurst Freeway at its eastern 1 terminus are removed, Three Sisters Bridge traffic will tend to overload these roadways during peak inbound periods.

Nebraska Avenue - The Nebraska Avenue crossing of the Potomac River is located about midway between the Three Sisters and the Chain Bridges. The facility would be almost entirely an intermediate crossing and would not develop the traffic potentials of the Three Sisters. Field studies indicate that it would be difficult to provide attractive and economical connections on the Virginia side.

Traffic Potentials of Potomac River Crossings
The present trans-river crossing desires were related to the transportation services afforded by the available road net of metropolitan

Washington. The amount of traffic potential to any bridge depends on the relative time and distance savings, and the quality of flow over the given facility as compared with competing routes, and its relation to vehicle origins and destinations. Motorists can be expected to seek out the easiest route from their origins to their destinations. The diversion factors that have been employed give due cognizance to that component of traffic which is potential to several alternate facilities. Origin-destination characteristics of central Washington were analyzed in detail.

Assignments of 1954 average daily traffic volume to the existing bridges are summarized in Table XIV. The actual traffic flows on the existing bridges are also indicated. In general, there is a reasonable correspondence between the actual and assigned crossings. It should be noted that the traffic assigned to the Key Bridge is considerably lighter than the volumes recorded on the facility. This crossing appears unattractive when trip desires are considered, chiefly because of its indirect approach connections and its poor orientation. The present loadings are to a considerable extent resultant from the extreme traffic pressures on more direct crossings and their approaches. In this regard the Key Bridge is used as an alternate route for the Memorial Bridge.

The desire traffic loadings on each bridge are shown graphically in Figure 27. Trip desires to the zero sector are also indicated. It is interesting to note that over 35 percent of all trips assigned to the Memorial and Highway Bridges are between Virginia and downtown Washington.


## PRESENT TRAFFIC DISTRIBUTION

TYPICAL 1954 DAY

| Bridge | Effec- <br> tive <br> Lane | Approx. <br> Daily <br> Practical <br> Capacity* | $\frac{\text { Actual Count }}{\text { Daily }} \begin{gathered} \text { Traffic } \end{gathered}$ | Percent of Total Crossings | $\begin{aligned} & \text { Assigned } \\ & \hline \text { Daily } \\ & \text { Traffic } \end{aligned}$ | Percent of Total Crossings |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Highway | 6 | 85,000 | 102,000 | 47.0\% | 106,000 | 48.7\% |
| Memorial | 6 | 50,000 | 54,000 | 24.9 | 67,000 | 30.8 |
| Key | 4 | 43,000 | 47,000 | 21.7 | 31,000 | 14.3 |
| Chain | 2 | 12,000 | 14,000 | 6.4 | 13,000 | 6.2 |
| TOTAL |  |  | 217,000 | 100.0 | 217,000 | 100.0 |

*Capacities are based on the relation of existing peak hour directional volumes to total daily traffic.

Present trans-river crossings projected to 1970 approximate 328,000 vehicles daily. As new bridges and approach road systems are placed into operation they will generate new traffic trips. This generated traffic is additive to normal projected volumes. Accordingly, the total anticipated 1970 trans-river crossings, assuming the development of new Potomac River bridges has been estimated at 393,000 trips daily. This value is used in subsequent traffic assignments.

Anticipated 1970 traffic volumes have been assigned to existing and proposed bridges. Assignments were predicated on the completion of certain highway improvements, delineated in Figure 15. They have assumed the planned Outer Potomac Crossings at Cabin John and Jones Point, and an intermediate new crossing at Roaches Run. With these bridges in place, anticipated loadings were determined for the entire system of Potomac River crossings assuming (1) a central Constitution Avenue

Bridge and (2) a Three Sisters Bridge. Traffic values are indicated in Table XV. These distributions by desire would remain essentially the same if a lesser total of trips is considered. The Three Sisters location was considered preferential to the Nebraska Avenue site because it can be more readily integrated into overall highway plans.

A study of this table shows that the maximum percentage of traffic on any one bridge is about half the present percentage. A more equitable overall distribution of traffic is attained. Over 85 percent of all transriver crossings would use central or intermediate bridges; only 15 percent of the total traffic is potential to Jones Point, Chain and Cabin John Bridges.

Traffic demands would be served best by either the Constitution Avenue or Three Sisters Bridge. Either crossing would attract about one-quarter of the total transriver trip demands. Either facility would divert appreciable volumes from existing adjacent bridges. The Roaches Run Bridge would substantially reduce overall loadings on the Highway Bridge.

The Constitution Avenue crossing attracts considerably more traffic than the Memorial Bridge because of its ability to "intercept" trans-river trips approaching from western and northern Virginia areas. It affords relief to Memorial and Key Bridges. Similarly the Three Sisters crossing attracts significantly greater volumes than Key Bridge because of more direct roadway connection. It provides greatest relief to Key and Chain Bridges, although it diverts traffic from Memorial Bridge as well.

Table XV
ANTICIPATED 1970 TRAFFIC DISTRIBUTION
OF
POTOMAC RIVER CROSSINGS

## Based on Trip Desires

| BRIDGE | CENTRAL CROSSING <br> AND <br> OUTER CROSSINGS |  | THREE SISTERS CROSSING <br> AND <br> OUTER CROSSINGS |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Daily } \\ \text { Traffic } \end{gathered}$ | Percent of Total Crossings | $\begin{gathered} \text { Daily } \\ \text { Traffic } \end{gathered}$ | Percent of Total Crossings |
| Jones Bridge | 29,000 | 7.4 | 29,000 | 7.4 |
| Roaches Run | 51,500 | 13.1 | 52,500 | 13.3 |
| Highway | 93,500 | 23.8 | 96,500 | 24.6 |
| Memorial | 53,200 | 13.5 | 76,200* | 19.4 |
| Constitution | 95,000 | 24.1 | - | - |
| Key | 44,000 | 11.2 | 18,000 | 4.6 |
| Three Sisters | - | - | 101,000 | 25.7 |
| Chain | 17,500 | 4.5 | 12,000 | 3.0 |
| Cabin John | 9,300 | 2.4 | 7,800 | 2.0 |
| TOTAL | 393,000 | 100.0 | 393,000 | 100.0 |

*Exceeds the practical capacity of bridge. Traffic would distribute to Key and other bridges where excess capacity is available.

In assigning traffic it has been assumed that the Roaches Run and Constitution Avenue or Three Sisters Bridges would provide three moving lanes in each direction, while the outer bridges would be four lane facilities. Assigned loadings to the Three Sisters or Constitution Avenue Bridges appear to exceed optimum capacity values. There is a tendency for traffic to distribute itself in accord with available capacities. Hence the traffic excess or overload has been re-allocated
in order to determine the actual traffic volumes on each of the Potomac River crossings. Anticipated 1970 volumes based on trip desires and capacities are summarized in Table XVI. Highway and the Constitution Avenue or Three Sisters Bridges will carry the heaviest flows: Figure 28 graphically summarizes and compares the anticipated 1970 traffic loadings on the Potomac River Bridges.

Table XVI
ANTICIPATED 1970 TRAFFIC DISTRIBUTION
OF
POTOMAC RIVER BRIDGE CROSSINGS
Based on Trip Desires as Related to Bridge Capacities

Central
Crossings and
Approx. Outer Daily Crossings Practical Daily
Lanes Capacity*

Three Sisters Crossings and Outer Crossings \% Daily of Total Traffic Crossings

| Bridge | Lanes | Capacity* | Traffic | Crossings | Traffic | Crossings |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Jones Point | 4 | 50,000 | 29,000 | 7.4 | 29,000 | 7.4 |
| Roaches Run | 6 | 75,000 | 54,000 | 13.7 | 55,000 | 14.0 |
| Highway | 8 | 100,000 | 94,000 | 23.9 | 98,000 | 24.9 |
| Memorial | 6 | 60,000 | 58,200 | 14.8 | 60,000 | 15.3 |
| Constitution | 6 | 75,000 | 75,000 | 19.1 | - | - |
| Key | 6 | 75,000 | 56,000 | 14.2 | 53,700 | 13.6 |
| Three Sisters | 6 | 75,000 | - | - | 75,000 | 19.1 |
| Chain | 2 | 20,000 | 17,500 | 4.5 | 14,500 | 3.7 |
| Cabin John | 4 | 50,000 | 9,300 | 2.4 | 7,800 | 2.4 |
| TOTAL |  |  | 393,000 | 100.0 | 393,000 | 100.0 |

[^4]

## Chapter V

## RECOMMENDATIONS

Long-range plans for Potomac River Crossings can be made from the data and analyses presented. Also, other improvements essential to efficient use of the bridges are apparent. In evaluating bridge requirements, consideration has been given to a system of river crossings. When existing bridges are modernized, care should be taken to insure no reductions in crossing capacities during construction periods.

Coincident with the improvement of existing bridges, and their approaches, and taking precedence over the construction of new central crossings, it is essential that additional street capacity be provided on the Washington side of the river. Roadways are currently taxed during peak hours and cannot accommodate the additional loadings which would result from increased bridge capacity.

## 1. Inner Loop Expressway

The Inner Loop Expressway distributor should be developed before any new central bridge is built. Trafficwise, this is a most desired objective. It is realized, however, that the magnitude of this undertaking limits its early achievement. It is recommended, therefore, that the key sections of the Expressway--the Southwest Expressway, the western leg, and the 3rd Street leg between the Southwest Expressway and a point to the immediate north of Constitution Avenue--be developed prior to or, at the latest, in conjunction with the new central bridges. 2. Improvements to Existing River Crossings and Approaches

Capacities of existing bridges and their approaches can be readily increased. Existing bridges should be improved as follows:

Highway Bridge - A new four-lane span should be constructed to replace the original Highway Bridge which has outlived its structural utility. This new span would be located in about the same alinement as the structure it will replace. This improvement is being considered by the District of Columbia Department of Highways. The inbound bridge should be connected to the Inner Loop via Main ${ }^{\text {Avenue }}$ or by other means which permits full utilization of the four inbound lanes. These improvements will increase the bridge capacity about 25 percent. The plans to depress 14 th Street under Independence Avenue and the Mall are good, and will increase both north-south and east-west capacities. Long-range plans should develop north-south one-way operations through the Central area. Pairing of 14 th and 15 th Streets as a one-way system between Massachusetts Avenue and 14 th and Madison Drive would substantially improve operations through the downtown area and should be considered.

Memorial Bridge - By modification of the ramp connections on the Virginia side of the river, the capacity of several weaving sections can be improved. Improvements on the Washington side are in part contingent on the development of a Constitution Avenue crossing. The present weaving maneuvers at the Lincoln Memorial should be reduced by making Bacon Drive a one-way eastbound roadway and by increasing its radius at Constitution Avenue, or by a similar functional treatment. Pending the grade separation of 23rd Street at Constitution Avenue, westbound bridge traffic should turn left at 24 th Street extended and merge with bridge-bound traffic on the

Loop from Ohio Drive. These improvements should increase optimum Memorial Bridge capacities about 10 percent.

Key Bridge - Street railway operation on this bridge should be replaced with buses and the existing streetcar tracks removed as planned. The bridge should be widened to provide three moving lanes in each direction by including the cantilevering of the south walk. Efficient interchanges accommodating all important movements should be provided between Key Bridge and George Washington Memorial Parkway a.t Rosslyn. Initially a one-way street system over existing right-of-way should connect Arlington Boulevard to Key Bridge with grade separations developed at Arlington and Wilson Boulevards. Long range plans should provide for a limited access north-south connector to Arlington Boulevard. On the Washington side a grade separated interchange at " $\mathrm{M}^{\prime \prime}$ Street should be constructed. 35 th and 34 th Streets should be developed as one-way connectors through the western fringe of Georgetown to Wisconsin Avenue and the planned Whitehaven Parkway.

Plans to develop Canal Road as an expressway extension of the Whitehurst Freeway will eliminate the present congested operations at their intersection. The improvement of " K " Street as an eastern extension of the Whitehurst Freeway will eliminate the present bottleneck at the eastern terminus and permit over a 30 percent increase of inbound freeway capacity. For maximum stability and flexibility of operations attractive connectors should be developed between the Whitehurst Freeway and the Inner Loop. The widening of Key Bridge and the improvement of its approaches should increase the
crossing capacity over 15 percent. Both the widening of the Key Bridge and the improvement of Canal Road are included in the Highway Department's program.

Chain Bridge - The planned improvement of Canal Road will improve the bridge approach on the Washington side. In Virginia, widening of the nearby intersection, including the provision of increased sight distance,is desirable. About a 10 percent increase in bridge capacity would be realized after these improvements are effected.

## 3. New Potomac River Crossings

The analyses of traffic growth and origin-destination data reveal that by 1970 a minimum of 14 additional bridge lanes will be required, assuming that the lanes are all positioned in accord with drivers' desire lines of travel. Recommended improvements to the Highway and Key Bridge will provide four new lanes. New river crossings are required to provide the ten other lanes. Inasmuch as full capacity usage cannot be achieved on all bridges, additional lanes will be required to provide capacities commensurate with principal travel patterns.

1. New bridges must have adequate approach and distributor connections on both sides of the river. At present a relatively flexible road net exists on the Virginia side.
2. While the acceptance of the outer loop bridges at Jones Point and Cabin John is desirable from the standpoint of regional development and accessibility, the bridges would divert relatively small proportions of traffic and thereby would not provide substantial relief for the more centrally located crossings. Four lane roadways would adequately accommodate
traffic demands at each crossing beyond 1970 but additional lanes might be justified as part of long range plans. These bridges will become increasingly important in the future access pattern for the metropolitan area. It is essential, therefore, that their rights-of-way be now procured.
3. Roaches Run must be developed as a separate new facility and not merely as another bridge to replace the old Highway Bridge. It should provide six lanes.
4. A new upstream six lane crossing should be provided. The development of either the Constitution Avenue or Three Sisters Bridge or a bridge somewhere between these two locations with adequate approaches and connectors would afford maximum traffic service.
(a) Both bridges would have about the same overall traffic effects on the system of Potomac River crossings and would relieve existing crossings.
(b) The Constitution Avenue Bridge would be better adapted for trips to or from the central area of Washington. The Three Sisters Bridge would receive its greatest usage by other than downtown oriented trips, and would relieve other central bridges from this type of travel.
(c) The Three Sisters Bridge appears to have better long range planning possibilities. It permits a north to south transriver movement removed from the central area. Its Virginia approaches are removed from the heavy peak hour loadings in the Pentagon Road net.

It is better suited to new highway development: the planned expressway serving the Falls Church area in Virginia which will tap some of the fastest growing sections of the metropolitan region would link directly into the bridge. Similarly, the bridge would attract traffic from areas served by the George Washington Memorial Parkway extension. The bridge can and should be integrated with the intermediate circumferential route. To effect this in Washington the Glover Archbald Parkway should be extended northward to Nebraska and Wisconsin Avenues.
(d) For either the Constitution Avenue or Three Sisters Bridge, direct limited access connections to the Inner Loop Expressway should be provided. To achieve this for the Three Sisters Bridge the planned Whitehaven Parkway would have to be developed between the Inner Loop and the Glover Archbald Parkway.
5. Even with the proposed system of bridges, by 1970 all motorists would not be able to cross where they prefer during peak hours, although there would be sufficient total reserve capacity. In any large metropolitan area it is never possible to accommodate all trip desires, and some redistribution of traffic is necessary.
6. Anticipated traffic requirements and assignments have been predicated on optimum capacities.9/ Higher capacity values are

2/ Practical lane capacity values approximating 1,500 vehicles per steady flow lane per hour were assumed.
currently attained on existing bridges and can be expected to develop on new facilities as pressures mount. Thus, the use of conservative capacity criteria represents a reserve insofar as future bridge requirements are concerned.

## Schedule

In programming proposed Potomac River Bridge improvements, it is evident that primary attention should be turned to central crossings. Outer bridges should be built subsequently as funds become available, although their rights-of-way should be reserved at the present time.

The authorization by Congress for the Jones Point Bridge would give the bridge a high priority in the overall program of river crossings.

In scheduling improvements, new lanes have been added in accord with drivers' desires, and to achieve an equitable distribution of the total crossing capacity. While surplus lanes would be provided at some locations, particularly at the outer bridges, there would be little excess capacity on the central bridges. It must be remembered that bridges should, in accord with Bureau of Public Roads' policies, provide sufficient capacities for a thirty-year period.

The recommended scheduling of improvements follow. Priorities have given cognizance to the traffic needs; however the ease of effectuation of the various bridge projects has also been considered.

## IMMEDIATE PROGRAM

A. Improvement and Replacement of Existing Bridges

1. Replace the Old Highway Bridge Span and improve the Washington approaches so as to develop four effective lanes in each direction. It has been indicated that the old iron trestle will need replacement, structurally, in the very near future. The new structure would be developed on approximately the same alinement.
2. Widen the Key Bridge and improve its approach interchanges on both sides of the Potomac River.
3. Improve the approaches to the Memorial Bridge.
B. New Construction
4. Reserve the rights-of-way for the Jones Point and Cabin John bridges.
5. Build the Inner Loop Expressway, giving priority to the Southwest Expressway, to a Third Street Expressway connector to a point to the north of Constitution Avenue and to the west leg.
6. Construct a new upper central Potomac River crossing at the Three Sisters or Constitution Avenue locations or somewhere between these two locations.
7. Initiate by 1957, coordinate with the Southwest Expressway, the construction of the Roaches Run Bridge. The two should be placed in operation at the same time. If adequate approach road connectors could be developed on the Virginia side, the Roaches Run Bridge could be constructed earlier.

## FUTURE PROGRAM

1. Improve the approaches to the Chain Bridge.
2. Initiate by 1960 the construction of the Jones Point Bridge.
3. Initiate by 1968 the construction of the Cabin John Bridge.

Bridge improvement scheduling must, of course, be integrated into the overall highway plans for the metropolitan area. In light of this, some modifications in the recommended construction sequence may be necessary.

## INTRODUCTION

Part II of the authorized study involves the development of volume and capacity data for the Inner Loop Expressway and north-south connector roads. This aspect of the work required the use of the traffic volume and origin-destination data developed in the Bridge and Metropolitan Area studies. Comprehensive new travel data were not available.

The Inner Loop Expressway as conceived by the National Capital Planning Commission will encompass central Washington and serve as a controlled access circumferential. Through planned connections with existing streets and other major highway facilities, the roadway will serve to distribute traffic around and into the central area of the city from all approaches. It is comparable to inner expressway facilities currently planned in many large cities.

The concept of such a distributional roadway circumscribed around the central area of a city is not new. It was a primary street planning objective even before the automotive era, as is typified in the "Inner Quadrangle" of the Burnham Plan for Chicago. Boston, New York, Cleveland, London, and Kansas City are among the metropolitan areas that embody new circumferential roadways in their street plans and systems.

In Washington, the need for the Inner Loop Expressway has been apparent. "The lack of wide continuous crosstown streets in the 1898 highway plan, and the finger-like pattern of the park, public and semipublic land use areas has encouraged development of radial routes and retarded the development of crosstown routes."10/ In common with other

10/ Moving People and Goods - A Portion of the Comprehensive Plan for the National Capital and its Environs - National Capital Park and Planning Commission - Washington, D. C. Monograph No. 5 June 1950.
cities, Washington's system of radial highways has received the greatest amount of improvement. It is evident that an efficient internal circulation system must provide ring or circumferential routes that augment the radial ways. Studies by the National Capital Planning Commission reveal that about 25 percent of the persons entering the downtown area in rush periods are passing through; this statistic clearly pinpoints the need for an attractive circumferential bypass facility.

## General Planning Considerations

The Inner Loop will encompass the central business district of Washington as the innermost of three complete circumferential routes planned for the metropolitan area by the National Capital Planning Commission. It will be circumscribed around the existing gridiron street net in the central area, and will intercept the key radials that converge on downtown Washington. It will be a dominant thoroughfare in both of these street patterns.

A comprehensive study has been recently authorized by the District of Columbia Highway Department to determine the detailed location, alinement, and design of the route. Many policy decisions remain to be made concerning interchanges and connectors. It is understood that the route would form an approximate circle with a radius of slightly over one mile from the White House, as shown in Figure 26 . On the west the route would follow Twenty-Fifth Street N.W. and Riverside Drive, on the north "S" or "T" Streets, on the east Third Street and New Jersey Avenue, and on the south Independence Avenue and "F" Street southwest. The Southwest Expressway forms part of the southern leg of the Inner Loop and will traverse "F" Street in general alinement.

The development of the Inner Loop Expressway affords excellent opportunities to combine traffic, transportation and parking with land use planning.

The Inner Loop traverses many of the existing areas in Washington which are blighted or near blighted in character; see Figure 29. It straddles many of the 11 areas which have been recently recommended to the District Commissioners as targets for a 10-year program of redevelopment and renovation. These areas contain some 65,000 dwelling units, a fourth of the city's total; some 20,000 are substandard or dilapidated. They include southwest Washington where urban redevelopment is already underway.

## Traffic Considerations

Present roadways in central Washington are currently taxed during peak hours. To provide progressive traffic movements on key arteries such as Constitution and Pennsylvania Avenues, it is necessary to restrict cross-street capacities. The capacities of major routes are, in turn, limited by their intersections with each other. Heavily traveled diagonals, such as Maryland, Massachusetts and Pennsylvania Avenues, create many complex, plaza-type intersections with severe capacity restrictions.

In deriving traffic needs it is essential that traffic conditions during peak morning and evening rush periods be given careful consideration. Inadequate traffic capacities during these peak travel hours develop congested operations which often have impeditive effects on "near-peak" hours. Accordingly, it is essential that new and improved roadway facilities provide relief for rush hour traffic flows if they are to be

of lasting value. Traffic requirements based on lesser volumes would fall short of providing the necessary relief. 11/

It is evident that all sections of the Inner Loop must provide sufficient capacities to meet anticipated peak hour loadings, and also provide a "reservoir of capacity" for adjacent surface streets. The expressway should become the foundation of the master highway plan. Accordingly, it follows that the Inner Loop Expressway should be a multilane limited access facility and that it be continuous in character, design and capacity. It must be remembered that an Inner Loop facility at grade, when superimposed on the street pattern of downtown Washington, could not develop sufficient capacities nor permit attractive and fluent movements.

Functional Ob,jectives - The traffic services and values of the Inner Loop Expressway have been long recognized by the National Capital Planning Commission. Most of the following functional objectives have been set forth in their Comprehensive Plan. The Inner Loop Expressway should:

1. serve to carry traffic around central Washington;
2. facilitate the distribution of traffic within the central area;
3. equalize accessibility to all sides of the central business district;
4. serve as a connector and distributor between key radials, presentfuture;

[^5]5. afford attractive ingress and egress into strategically located peripheral parking areas;
6. relieve all-purpose business streets as the primary trafficways in the central business district; and
7. serve traffic origins and destinations in areas adjacent to central Washington.

Scope - The study endeavors to relate the proposed Expressway to new bridge crossings and to other important developments which will have a direct bearing upon the traffic generating characteristics of the Washington Metropolitan Area - particularly the central area of the city. Needs of the Southwest Expressway and connectors have been given special consideration. Further information on inner loop capacities and capacity recommendations for intersecting streets will be forthcoming from the Highway Department's study currently underway.

## THE INNER TRAFFIC LOOP

Many of the streets that the Inner Loop would follow, or parallel, are essentially local in character. Third Street, the approximate location of the east leg, is currently heavily traveled and serves as an easterly bypass of central Washington. However, its capacity and attractiveness as a trafficway are limited by the numerous signalized intersections along its extent.

Only one segment of the existing roadways that the Inner Loop would follow has partial expressway characteristics. Such partial expressways would include Ohio Drive, Independence Avenue, and Maine west of 14 th Street. This connector, traversing Federal park land, affords some control of access and permits relatively fluent movements in both directions of travel. The present traffic volumes along the route at the elliptical rotary junction with l7th Street are depicted in Figure 30. Maximum directional flows exceed 3,000 vehicles during peak hours. Heavy weaving movements during rush periods limit capacities and saturate the intersection. It is evident that this seotor cannot absorb additional traffic unless improved.

## Traffic Usage

Anticipated 1970 traffic loadings on the Inner Loop Expressway have been determined. In developing these values, consideration has been given normal population and traffic growths, probable changes in land use and travel patterns, and new bridge crossings. These factors and how they affect present trip desires and flow patterns have been discussed in detail in Part I.


Present traffic volumes potential to the Southwest Expressway have been derived. If the Expressway were in operation today, it could be expected to carry about 75,000 vehicles daily and its peak hour directional volume would approximate 3,700 vehicles. Based on a maximum desired lane capacity of 1,500 vehicles per hour, six limited access lanes (three in each direction) would be required to accommodate indicated traffic volumes. This would allow some excess capacity.

Anticipated 1970 daily traffic volumes on the Inner Loop Expressway are shown in Figure 31. It is reasonable to assume that the entire Loop would be in operation by that year and that flows on it would have become stabilized. It must be remembered that these values would likely be modified to conform with the final expressway design.

In determining anticipated traffic volumes for 1970 it has been assumed that:

1. the Highway Bridge would be improved to provide four effective moving lanes in each direction;
2. the Roaches Run Bridge would be developed as a new six lane facility;
3. the Jones Point Bridge would be built;
4. urban redevelopment would occur in Southwest Washington; and,
5. a new upper central Potomac River crossing would be developed, probably at Constitution Avenue.

It has also been assumed that during peak hours the Highway Bridge, the Roaches Run Bridge, and the other central river crossings would be loaded to their practical capacity.

The average anticipated 1970 traffic volumes for the Southwest Expressway would exceed 100,000 vehicles per day. With the construction of a


INNER LOOP EXPRESSWAY
TYPICAL 1970 DAY

Constitution Avenue River crossing, the volumes might be as great as 120,000 vehicles per day. Peak directional volumes in 1970 for this section of the Expressway would range from 5,300 to 5,900 vehicles, depending on the construction of a Constitution Avenue crossing.

The daily 1970 traffic volumes on the west leg of the Inner Loop Expressway would range from 70,000 to 100,000 vehicles, assuming the development of a Constitution Avenue crossing. The heaviest movements can be expected to occur between Constitution Avenue and "E" Street and would approximate 96,000 vehicles daily. Peak directional volumes would be about 5,700 vehicles per hour.

It is anticipated that the north leg of the Inner Loop would serve about 85,000 vehicles per day, with peak hour directional volumes of about 4,300 cars. These vehicles can be expected to use both express and service roads. Volumes on this section of the expressway would be substantially the same if a Three Sisters Bridge, rather than a Constitution Avenue facility were constructed.

The anticipated traffic volumes for the east (Third Street) leg of the Inner Traffic Loop would average about 75,000 vehicles a day, with peak directional loadings approaching 4,000 vehicles.

## Lane Requirements

Traffic volumes take on added significance when related to capacity values. A maximum possible lane capacity approximating 1,700 vehicles per lane per hour should be attained on the Inner Loop Expressway. Frequent merging, diverging and weaving areas will likely prevent achievement of higher values. Lane requirements for the expressway should be based on a practical capacity of 1,500 vehicles per lane per hour. This is an
accepted capacity standard for continuous flow in urban areas and has been widely used in the Washington Metropolitan Area.

The 1970 lane requirements, as related to anticipated traffic volumes on the Inner Loop Expressway, are summarized in Table XVII. A six lane expressway should accommodate anticipated traffic demands, except for sections of expressway adjacent to the Constitution Avenue and Roaches Run River crossings where 8 steady flow lanes will be required. A multilane expressway providing these lane requirements will efficiently accommodate 1970 peak hour loadings, and provide some excess capacity for future growths. Parallel service roads will likely carry sizable flows on many sections of the Inner Loop, thereby representing a factor of capacity reserve.

The Southwest Expressway between Twelfth and Third Streets would provide some surplus in "possible capacity" even at the anticipated peak hour volumes in 1970. However, the provision of a lesser lane capacity would obviously be inadequate for sound highway planning and design. Initial construction of a 6 lane limited access roadway with expansion to 8 lanes prior to 1970 will provide the necessary capacities.

LANE REQUIREMENTS
INNER LOOP EXPRESSWAY

Section of Route
Anticipated
1970 Volumes Express Approx. Peak Lanes Daily Hour Required

Sufficiency* Sufficiency* Dir. In Each Practical Possible
Flow Flow Direction Capacity Capacity

## West Leg

| Constitution Ave. to | 96,000 | 5,700 | 4 | 6,000 | 95 | 6,800 | 84 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| "E"St. |  |  |  |  |  |  |  |
| "E"St. to Mass. Ave. | 74,000 | 4,300 | 3 | 4,500 | 96 | 5,100 | 85 |

## North Leg

"T" St. - Rhode Island Ave. $86,000 \quad 4,300 \quad 4,500 \quad 96 \quad 5,100$85

## East Leg

Rhode Island Avenue -
Mass. Ave. .
Mass. Ave. to "F" St. 70,000 3,500** $3 * *$ 4,500 78** 5,100 69**
South Leg
Constitution Ave. -
Roaches Run Bridge

| $* * *$ |  |  |  |  |  |  |
| ---: | ---: | :--- | :--- | :--- | :--- | :--- |
| 72,000 | 3,600 | 3 | 4,500 | 80 | 5,100 | 71 |
| 115,000 | 5,900 | 4 | 6,000 | 99 | 6,800 | 87 |

*Volumes as percent of capacity.
**Values across the Mall, based on desires, would approximate 3,000. However, limitations in capacity on north-south streets should increase peak loads to about 4,000 vehicles.
***Volumes and lane requirements at 17 th Street are contingent on interchange design. An elliptical type treatment would require additional lane capacity.

## Priority of Development

The desirability of early traffic operations on the Inner Loop Expressway has been indicated emphatically in Part I. Immediate attention should be furnished those key sections of Expressway which will be principal avenues of approach or connectors to new Potomac River Crossings. Accordingly, it is recommended that the Southwest Expressway, the West (25th St.) Leg, and the 3rd Street Leg between the Southwest Expressway and a point north of Constitution Avenue be developed prior to, or at the latest in concurrence with, new central river crossings. Remaining sections of the Inner Loop should be completed prior to 1965. A tentative priority follows:

## Immediate Construction

1. Southwest Expressway (Highway Bridge to S. Capitol St.)
2. West (25th St.) Leg - (Memorial Bridge to "M" Street)
3. East (Third St.) Leg - (Southwest Expressway to "E" Street)

Subsequent Construction

1. South Leg (Memorial Bridge to Highway Bridge)
2. Third Street Leg ("E" Street to Rhode Island Ave.)
3. West Leg. ("M" Street to Massachusetts Ave.)
4. North Leg (Massachusetts Ave. to Rhode Island Ave.)

The distribution of vehicles entering the central area from the south and west have been given special consideration. Future traffic needs of north-south roadways entering the central business district from the south have been ascertained.

## Present Traffic Flows Across Mall

A review of the existing patterns of traffic movement across the Mall reveals that over 150,000 vehicles crossed the Mall on a typical 1953 day; see Table XVIII. The greatest traffic magnitudes were found on Third and 14 th Streets, each carrying about 20 percent of the total daily volume. During the peak rush hours, about 7,000 vehicles cross the Mall in each direction of travel. While total movements in the evening rush period are slightly greater than morning rush hour loadings, it is believed that the impact of Highway Bridge traffic is greatest inbound during the morning hour. (See the hourly traffic variations set forth in Figure 16.) In the evenings, traffic generators in Washington represent the largest source of traffic origins.

Present traffic flows at Constitution Avenue, by corridors of travel, are summarized in Table XIX. It is apparent that the greatest concentrations of traffic occur on 14 th, 15 th and 17 th Streets, inbound during the morning rush and outbound during the evening rush period. At these times, almost half of all trans-Mall traffic travels in this westerly corridor.

The impact of Highway Bridge traffic on total north-south flows is evident from Figure 32 which shows present traffic operations across the Mall during a typical 1954 rush hour. Bridge traffic comprises about
-

| $\dot{\omega}$ | ¢ | ぁ |
| :---: | :---: | :---: |
| $\stackrel{\text { 덷 }}{ }$ | $\begin{aligned} & \text { 되 } \\ & \end{aligned}$ | ¢ |



$$
\begin{array}{ccc}
\dot{\omega} & \dot{\infty} & \dot{\omega} \\
\stackrel{5}{\omega} & 51 & \text { 잉 }
\end{array}
$$



## PRESENT TRAFFIC OPERATIONS

NORTH-SOUTH STREETS AT CONSTITUTION AVE.
TYPICAL 1954 DAY
PEAK MORNING RUSH HOUR
INBOUND

Table XVIII

## NORTH-SOUTH TRAFFIC VOLUMES

 AT CONSTITUTION AVENUE*Average 1953 Weekday

|  | Northbound AM Hour Vehicles | \% of Total | Northbound PM Hour Vehicles | \% of Total | Southbound AM Hour Vehicles | \% of Total | Southbound PM Hour Vehieles | \% of Total | Total Daily Movement Vehicles | \% of Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3rd St. | 1,130 | 16.6 | 1,328 | 18.0 | 1,223 | 19.8 | 1,511 | 21.0 | 31,208 | 20.6 |
| 4 th St. | 505 | 7.4 | 732 | 9.9 | 510 | 8.3 | 500 | 6.9 | 11,411 | 7.5 |
| 7th St. | 540 | 7.9 | 636 | 8.7 | 633 | 10.3 | 615 | 8.5 | 13,151 | 8.6 |
| $\underset{\sim}{\sim} \quad 9$ th St. | 278 | 4.1 | 371 | 5.1 | 423 | 6.8 | 391 | 5.5 | 7,290 | 4.8 |
| 12th St. | 1,157 | 17.0 | 1,293 | 17.5 | 681 | 11.1 | 751 | 10.5 | 20,375 | 13.5 |
| 14th St. | 1,208 | 17.9 | 924 | 12.6 | 929 | 15.0 | 1,164 | 16.2 | 29,404 | 19.4 |
| 15th St. | 801 | 11.8 | 778 | 10.5 | 833 | 13.5 | 1,116 | 15.4 | 17,102 | 11.3 |
| 17th St. | 1,046 | 15.4 | 801 | 10.9 | 831 | 13.4 | 1,146 | 16.0 | 19,697 | 13.0 |
| 21st St. | 127 | 1.9 | $\underline{498}$ | 6.8 | 109 | 1.8 | - | - | 1,893 | $\underline{1.3}$ |
| Total | 6,792 | 100.0 | 7,361 | 100.0 | 6,172 | - 100.0 | 7,194 | 100.0 | 151,531. | 100.0 |

*Inner Cordon - Annual Weekday Averages 1953.

## NORTH-SOUTH TRAFFIC DISTRIBUTION AT

CONSTITUTION AVE.
Average 1953 Weekday

| Northbound - AM Peak Hour |  | Corridors of Travel |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Vehicles | $\frac{3 \mathrm{rd}-4 \mathrm{th}}{1,635}$ | $\begin{aligned} & 7 \text { th } 9 \text { th } \\ & \frac{-12 \text { th }}{1,975} \end{aligned}$ | $\begin{aligned} & 14 \text { th- } 15 \mathrm{th} \\ & \frac{-17 \mathrm{th}-21 \mathrm{st}}{3,182} \end{aligned}$ | $\frac{\text { Total }}{6,792}$ |
|  | \% | 29.0 | 29.0 | 47.0 | 100.0 |
| Northbound - PM Peak Hour | Vehicles | 2,060 | 2,300 | 3,001 | 7,361 |
|  | \% | 27.9 | 31.3 | 40.8 | 100.0 |
| Southbound - AM Peak Hour | Vehicles | 1,733 | 1,737 | 2,702 | 7,172 |
|  | \% | 28.1 | 28.2 | 43.7 | 100.0 |
| Southbound - PM Peak Hour | Vehicles | 2,011 | 1,757 | 3,426 | 7,194 |
|  | \% | 27.9 | 24.5 | 47.6 | 100.0 |
| 24 Hours | Vehicles | 42,619 | 40,816 | 68,096 | 151;531 |
| Both Directions | \% | 28.1 | 26.9 | 45.0 | 100.0 |

40 percent of total flows. A comparison of traffic volumes and capacities indicates an overall traffic sufficiency. Inbound north-south traffic was found to use 75 percent of the available possible capacity during the morning rush hour. It should be noted that congestion is apparent along 17 th, 15 th, and 14 th Streets which are currently operating at or near their possible capacities.

## Southwest Redevelopment

It is essential that adequate road, parking, and mass transit facilities be provided in conjunction with the Southwest Redevelopment. It is understood that the southwest area as envisioned by Webb and Knapp would contain about the same residential population that it has at present. About 15,000
additional persons would be attracted into the area daily, mostly to the new office buildings that are proposed. About 40 percent can be expected to come by transit, and the remainder by car. The development would generate about 9,000 vehicle trips daily of which approximately a third would be transriver in character. Translated into peak hour movements, between 2,000 and 2,500 trips would be made into the area during the morning rush period. Motorists would come from all points of the compass and would be dispersed on all approach streets. Most of these vehicles would travel a direction counter to prevailing bridge flows.

The plans call for $1,500,000$ square feet of office buildings. At least 3,000 parking spaces should be provided to meet this need. Additional parking should be provided in accord with the attractiveness of other key generators.

## Southwest Expressway

The Southwest Expressway will serve as a distributor for Roaches Run and Highway Bridges, and also serve as a principal approach roadway to the Southwest Redevelopment Area. It is this expressway that makes the provision of additional bridge capacity feasible.

It is essential that attractive ramps be provided between the Expressway and north-south streets, so that full usage can be made of the connector streets. Ramps should be amply designed for weaving, merging, and storage of traffic. Assignment of traffic to surface streets will, of course, depend on the detailed traffic designs. These plans at present are fluid.

Anticipated inbound traffic volumes on north-south roadways across the Mall are shown in Figure 33 for a typical 1970 morning rush hour. $12 /$ Indicated values can be considered as somewhat liberal. The total northbound movement approximates 12,000 vehicles. The impact of Highway and Roaches Run Bridge traffic on total flows is readily apparent: 4,200 vehicles ( $34 \%$ ) come from the Highway Bridge and 3,000 vehicles ( $24 \%$ ) come from the Roaches Run Bridge, respectively.

In deriving lane requirements it must be realized that lane capacity is a variable concept. It is affected by such determinants as the operational efficiencies (present and potential) of the streets involved, the spatial and traffic patterns of intersecting streets, and the quality of operations desired.

It is estimated that by 1970 about 8 steady flow lanes would be required across the Mall to accommodate the peak inbound (A.M.) hour traffic between 17 th and 3rd Streets, based on maximum optimum lane loadings. A similar number of lanes would likely be required to accommodate the peak "outbound" movement during the evening rush period. These directional lane requirements are roughly the equivalent of about 25 surface lanes.

It appears that about 42 percent of the inbound lane demand would be required west of 13 th Street ( 14 th, 15 th and 17 th Streets). While desired 1970 traffic volumes in this sector might exceed optimum lane

12/ (1) Non-Highway Bridge traffic has been increased in accord with normal growths in downtown Washington. (2) Highway and Roaches Run Bridges were loaded to their practical capacities. (3) Bridge traffic was added to determine composite volumes.


NOTE:
THESE VOLUMES SHOW DESIRED PATHS OF TRAVEL, AND WOULD BE MODIFIED BY AVAILABLE CAPACITIES.

ANTICIPATED TRAFFIC VOLUMES<br>NORTH - SOUTH STREETS AT CONSTITUTION AVENUE<br>TYPICAL 1970 DAY<br>PEAK MORNING RUSH HOUR<br>INBOUND

loadings, even with indicated improvements, some excess capacity will exist to the east of 13 th Street (12th to 3rd Streets) and would be able to accommodate the "overflow" loadings. About 30 percent of the lane capacity is required between 13 th and 6 th Streets and appears attainable. The balance of capacity would be required between 6 th and 2nd Streets. This capacity would be provided by development of the 3rd Street leg of the Inner Loop Expressway; a minimum of three limited access lanes in each direction should be provided.

## North-South Connectors

It has been indicated that improved access from Virginia on the Highway Bridge, and the planned Roaches Run Bridge, related to traffic increases resulting from normal growths and urban redevelopment, will require increases in north-south capacities across Independence Avenue, the Mall and Constitution Avenue. Coincident with the development of the Southwest Expressway, and by completion of the Roaches Run Bridge, it is essential that the Third Street Leg of the Inner Loop Expressway be completed across Constitution and Pennsylvania Avenues. Six limited access lanes should be provided with possible future expansion to eight. The roadway would provide an increase of 25 percent over the present lane capacities across the Mall between the Washington Monument and the Capitol. The continuation of the Southwest Expressway along Third Street would afford an attractive and time saving route into the central business district. This east leg of the Inner Loop would encourage a redistribution of north-south traffic volumes principally in accord with capacities available.

## Plans have been set forth by the National Capital Planning

Commission for the underpassing of north-south streets under Independence Avenue and the Mall. These plans provide attractive traffic services south of the Mall and encourage continuous movements to and from the Highway and Roaches Run Bridges. It is essential that these plans be integrated with traffic treatments along Constitution Avenue so as to assure sufficiency and continuity of capacity. Improved north-south traffic treatments must be effected at Constitution Avenue. Civic and governmental land use make difficult the development of grade separated interchanges. Accordingly, traffic regulatory techniques must be employed to achieve the needed capacity increases. Sufficient rights-of-way, however, are available for the flaring of intersection approaches to achieve capacity increases. A comprehensive north-south one-way system should be considered as a long range traffic objective. Suggested traffic operations are shown in Figure 34; both two-way and one-way plans are indicated:

1. Additional approach lanes should be provided on Fourteenth, Fifteenth, and Seventeenth Streets at their intersections with Constitution Avenue. Some widening will likely be required. Fourteenth and Fifteenth Streets could be developed as a oneway system between Thomas Circle and Fourteenth Street south of Constitution Avenue. Five (or possibly six) lanes in each direction could be provided with total capacities commensurate with the six lane limited access system to the south. 13/ The

[^6] tion Avenue, on 110 foot rights-of-way.


* NOTE:

IF I2-TH STREET CAN BE TIED INTO II-TH VIA
A DIRECT CONNECTOR IT COULD BE ONE WAY
SOUTHBOUND AND $10-T H$ ONE WAY NORTHBOUND. NEW LANES

## TWO WAY OPERATIONS

 NOTE:

DIRECTIONS SHOWN FOR $7-T H, 9-T H, 10-T H$ AND $12-T H$
STREETS ARE TENTATIVE AND COULD BE REVERSED
SUBJECT TO FINAL DETAILED PLANS.

ONE WAY OPERATIONS

## POSSIBLE FUTURE TRAFFIC OPERATIONS NORTH - SOUTH STREETS AT CONSTITUTION AVE.

INBOUND

NATIONAL CAPITAL PLANNING COMMISSION
system would (1) increase existing north-south capacities on these streets by more than 20 percent, (2) permit easier signal timing, (3) facilitate left turns, and (4) simplify transition movements in the environs of the White House. If street railway operation is retained on Fourteenth Street, some additional trackage will be required along Fifteenth Street.
2. Twelfth - Tenth One-Way System - Twelfth Street will receive increased usage, because of its direct connection to the Roaches Run Bridge. Some flaring of its southern approach to Constitution Avenue is desirable. The directions of the present Twelfth Tenth one-way system could be reversed, particularly if a direct connector to Eleventh Street can be provided. The reversal would reduce left turns off of Constitution Avenue at Twelfth Street, and simplify the restrictive signal phasing.
3. Ninth Street Extension - Integrated with the relocation of the Smithsonian Buildings, Ninth Street should be extended from Independence Avenue across the Mall to connect the Southwest Expressway with the central business district.
4. Ninth - Seventh One-Way System - Long range plans should consider the removal of street car tracks on these streets and the conversion of them to one-way operations north of Constitution Avenue. When instituted, this system will provide substantial capacity gains.

With the construction of the Southwest Expressway and the Southwest Redevelopment Project, consideration should be given to the restriction of certain traffic movements on Maryland and Virginia Avenues. These can be achieved through conventional traffic engineering techniques.

In retrospect, proper traffic treatments at Constitution Avenue and the development of the Third Street leg of Inner Loop Expressway will probably provide the required 1970 north-south lane capacity. The operational treatments can be effected with relative ease and will provide the much needed continuity and consistency in capacity on northsouth streets.

PART III

SUMMARY AND CONCLUSIONS

This comprehensive report on the Potomac River Crossings and the Inner Traffic Loop has been based on an evaluation and appraisal of all factors affecting traffic growths and desires. It has considered population shifts in the District of Columbia and its metropolitan area, vehicle ownership trends, redevelopment plans, dispersal of government activities, removal of temporary buildings, and changes in the land use patterns in the area.

## River Crossings

At present there are about 217,000 trans-river crossings daily. By 1970, it is anticipated that there will be about 328,000 crossings daily. If an attractive and extensive system of approach roads can be provided, the desired crossings would approach 393,000 .

The seriousness of the bridge problem is evident. At the present time, the directional peak hour traffic exceeds the combined "practical capacity" of all the bridges, and approaches the possible capacity of the combined bridges and their approach road systems.

To effectively meet peak hour demands and to accommodate reasonable trip requirements, a minimum of fourteen additional lanes will be needed by 1970. This value assumes that new bridges will be located so as to permit direct and effective travel between motorists' principal points of origins and destinations. New bridges will have to be located so that they conform with natural travel patterns. Improper locations would mean, therefore, that more lane capacity will be required.

The recommended system of Potomac River Crossings includes both new central and peripheral bridges, as well as improved existing bridges. Most transriver trip demands are and will be essentially central in nature; only 15 percent of the total (1970) crossings would desire to use Jones Point, Cabin John, or Chain Bridges. The new central bridges will afford capacity relief; other bridges will provide new access and encourage development of new areas. Approach and connector roads must be integrated with river crossings. It has been recommended that:
(1) key sections of the Inner Loop Expressway be built prior to, or concurrently with, new central crossings;
(2) existing bridges and their approach roads be improved-including the widening of the Key Bridge, and the replacement of the iron trestle Highway Bridge;
(3) a new upstream six-lane crossing be constructed at the Constitution Avenue or Three Sisters location or somewhere between these two sites;
(4) Roaches Run Bridge be developed as a separate new facility, and not as a replacement for the iron trestle Highway Bridge;
(5) Jones Point and Cabin John Bridges be constructed as part of long range crossing plans, and that their rights-of-way be procured now; and
(6) primary attention be given to central crossings in scheduling bridge improvements.

## The Inner Loop Expressway

The Inner Loop Expressway will encompass central Washington and should become an integral part of area highway plans. It should be a limited access facility, continuous in character, design and capacity.

It is anticipated that by 1970, traffic volumes on the various sections of the Expressway will range from 70,000 to 120,000 vehicles daily. Provision of six steady flow lanes, with several eight lane sections in proximity of Constitution Avenue and the Roaches Run Bridge, will provide sufficient capacities to meet peak demands.

By 1970, about eight steady flow lanes, or their equivalent, will be required across the Mall to accommodate peak inbound A.M. hour traffic between Seventh and Third Streets, based on maximum optimum lane loadings. A similar number of lanes would likely be required to accommodate the peak "outbound" movement during the evening rush periods. Indicated traffic treatments on north-south streets at Constitution Avenue, and the development of the Third Street leg of the Inner Loop Expressway should provide this needed lane capacity.


[^0]:    1/ Regional Aspects of the Comprehensive Plan. A portion of the Comprehensive Plan for the National Capital and Its Environs. National Capital Park and Planning Commission. Monograph No. 6, June 1950.

[^1]:    2/ Hearings before the Bridge Subcommittee of the Committee on Interstate and Foreign Commerce, House of Representatives, Seventy-Ninth Congress, First Session in H.R. 541, 1945.

[^2]:    NATIONAL CAPITAL PLANNING COMMISSION

[^3]:    8/ The following capacity criteria in accord with the Highway Capacity Manual were employed: maximum, possible, or saturation capacity represents the greatest sustained hourly loading that a facility can accommodate under prevalent conditions of operations. Optimum or practical capacity represents the maximum desired loading.

[^4]:    *Assumes that peak hourly directional movements will be 6 percent of total daily crossings.
    For Memorial and Chain Bridges, a 7 percent value has been used.

[^5]:    11/ Roadway facilities designed to accommodate lesser traffic loadings would become unduly congested at least four hours daily. This is readily apparent from the analysis of present volume characteristics and traffic operations over existing Potomac River Bridges. set forth in Part I.

[^6]:    13/ The roadways are 65 and 70 feet wide respectively north of Constitu-

