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The Atlantic Urban Seaboard: Development Issues and Strategies

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CONTENTS

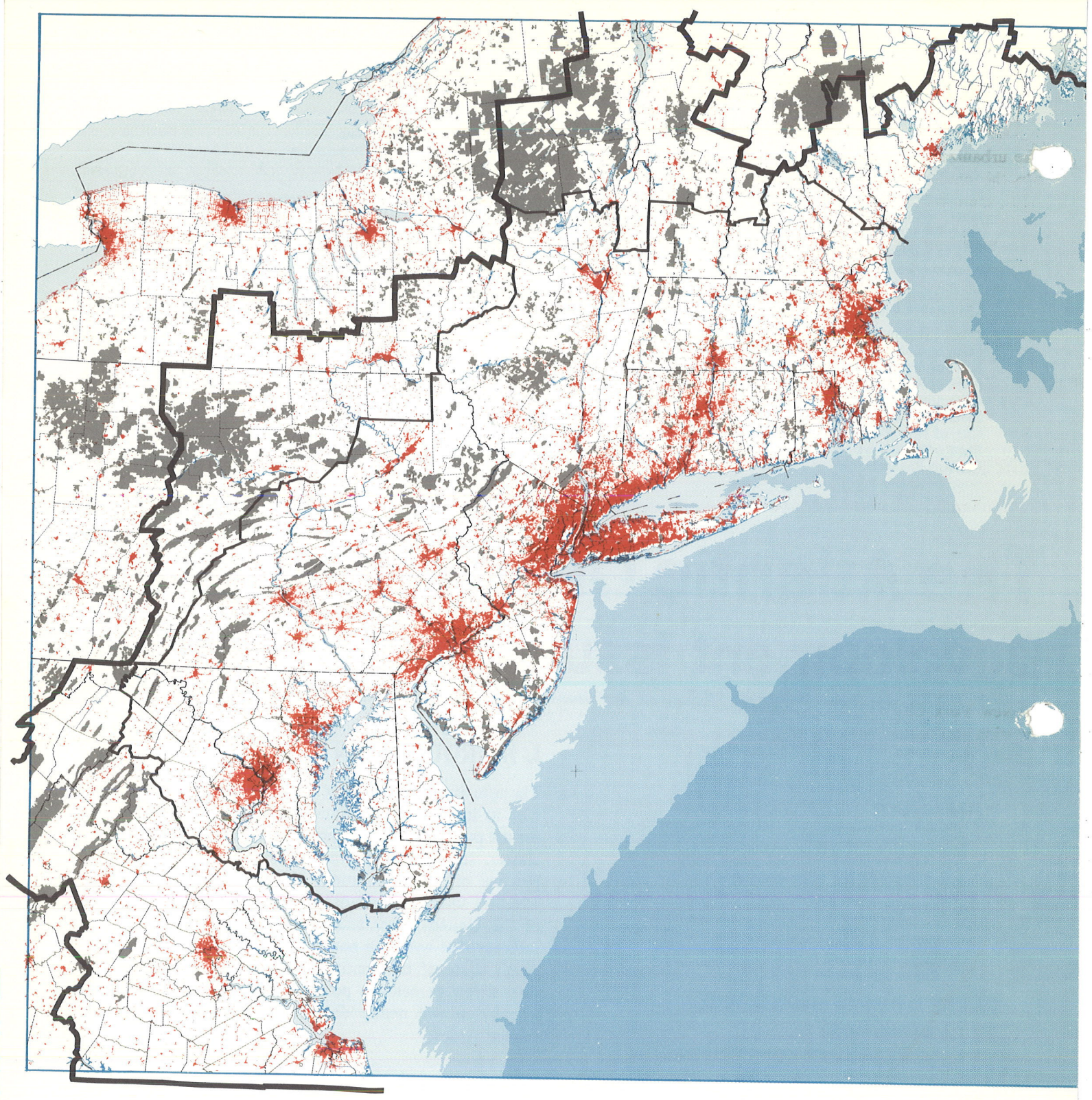
I. INTRODUCTION

The urbanized northeastern seaboard of the United States, with its immediate hinterland—called the Atlantic Region for the purposes of this paper—is the world's largest urban cluster. In 1966, it had 47.1 million people (nearly 22 percent of the population of North America) within 126,000 square miles—only 1.3 percent of the land area of the United States and Canada (Map 1). Projections indicate that over the next half-century the Atlantic Region's share of the continental population will shrink by only a few percentage points while in absolute terms its population will nearly double. This prospect raises two related issues:

1. Is it desirable to try to redistribute population more evenly across the continent in order to avoid the high concentration in the Atlantic Region?

2. What are the basic patterns of settlement open to the area (issues of over-all size and internal structure are somewhat interdependent), and how do they relate to prospective technological possibilities and social objectives?

The purpose of this paper is, then, to sketch a portrait of the Atlantic Region spotlighting these issues, and to establish a framework for subsequent discussion of impending development decisions.



1. ATLANTIC REGION

- developed land
- public open space
- 214 counties
- 150 counties
- water 0-90 feet
- 90-600 feet
- over 600 feet

II. A PORTRAIT OF THE REGION

A. Population

The urbanized Atlantic Region is both the "Main Street" and the cradle of the nation. As early—or as late—as 1700, there were only three towns with populations over 4,000 in North America (excluding Mexico)—Boston, New York and Philadelphia. By 1800, the United States had four cities with populations over 25,000—the three aforementioned plus Baltimore. The present metropolitan areas of New York, Philadelphia and Boston reached the million mark between 1850 and 1890, with the outpost of Chicago being the only million-person city away from the Eastern Seaboard.

It is quite remarkable that after the initial settlement of the West, as the tremendous expansion of the economy proceeded across the continent, the Atlantic Region maintained an almost steady share of the nation's population (Fig. 1). As westward settlement proceeded, the population of 150 counties, comprising the more heavily settled of the 214 counties of the Atlantic Region as defined for this paper,[1] declined from 25.5 percent of the nation in 1850 to 21.2 percent in 1890. With the advent of heavy industrialization, the concomitant peak of in-migration from overseas, the coming of age of the railroads and large-scale corporate management, the trend was reversed. The 150 counties' share increased from 21.2 percent of the nation in 1890 to 22.8 percent in 1930. This was also the period of New York City's most intensive growth. After the depression and particularly after World War II, as economic growth shifted toward the West and the South the 150 counties' share began to decline again, but at a moderate rate: from 22.8 percent in 1930 to 21.5 percent in 1965. In the current 1960-69 decade, as office work begins to overtake manufacturing employment, the decline appears to be much slower than in the preceding one.

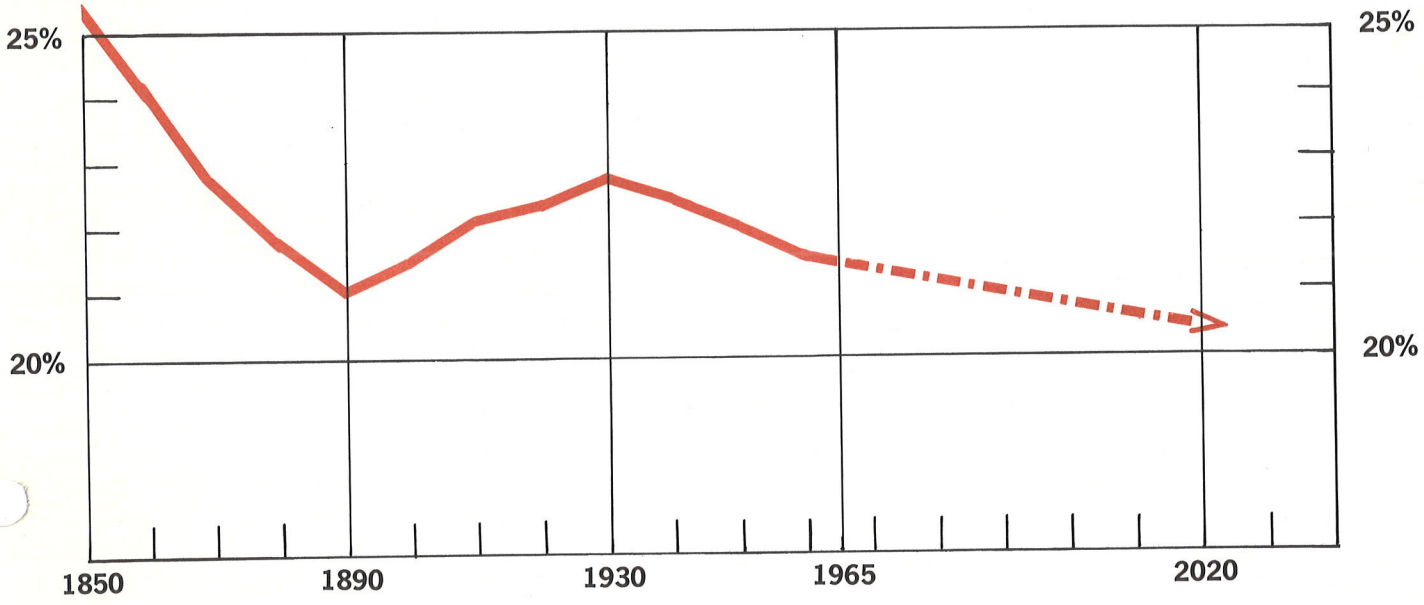
If recent trends continue, the balance between the Region and the nation that existed in 1890 will be reached again in 1980. For the longer range, Jerome Pickard's projection for the entire 214-county Atlantic Region indicates that its share of the nation's population will only decline from an estimated 24 percent in 1970 to 22.4 percent in 2020. Thus, if the truly epoch-making shifts in population and the economy that occurred over the past 120 years could not shift the balance between the Atlantic Region and the rest of the nation by more than four percentage points, it seems unlikely that the next fifty years would bring greater change.

Two conditions contribute to maintaining this relatively stable percentage of the nation's population. One is the sheer inertia of large numbers. Percentages are much more volatile when the base is small: 4 percent of the nation in 1850 meant less than 1 million; 4 percent in 2020 will mean 16 million. The other has to do with net in-migration as a source of urban growth. This source has been declining because of the dwindling reservoir of rural population, and indications are that before the end of the century the Atlantic Region's growth will be composed almost exclusively of natural increase—the excess of births over deaths.

This could be changed by a truly unexpected political occurrence, e.g., large-scale immigration from China. Or, conversely, sharply deteriorating living conditions in the

[1] For a definition of the 150-county area, see **The Region's Growth, A Report of The Second Regional Plan**, Regional Plan Association, New York, May 1967, pp. 16, 26-36.

Figure 1.
POPULATION OF THE ATLANTIC URBAN REGION (150 COUNTIES) AS PER CENT OF NATION



Atlantic Region or truly superior living and working opportunities in other parts of the nation could cut the Region's share of national population. While deterioration here is both undesirable and unlikely, improvements elsewhere have limited possibilities of diverting population. The projection of a somewhat declining share of the nation's population in the Atlantic Region reflects that condition, which will be discussed subsequently.

B. Economy

Population, as the economists' adage has it, follows economic opportunity. Since its early days as the bridgehead of Europe in North America, the Atlantic Region has had a strong and diversified economic base, heavily weighted toward **both** service industries and manufacturing, somewhat in contrast to most other cities on the continent which tend to be either predominantly service centers for the surrounding hinterland or predominantly manufacturing towns, in obvious contrast to the non-urban parts of the country, where primary industries, such as agriculture, forestry and mining, are important.[1] Since the economy is advanced, well-balanced, and specialized in top decision-making in government, service industries and manufacturing, per capita income in the Atlantic Region is 15 percent higher than the national average. Indices of education and cultural activity are similarly above the national averages.

Though the Atlantic Region occupies a preeminent position in some branches of manufacturing that are not expected to grow substantially (one-quarter of the national employment in the apparel industry is still concentrated in the New York area; one-third of the national employment in non-ferrous metals is in Connecticut), it also has a strong share of growth industries, such as electrical machinery, chemicals, instruments and printing. However, the national trend away from manufacturing, which is increasingly automating, and toward service industries is expected to have an especially pronounced effect on employment in the Atlantic Region.

For the 1960-1980 period, the following increases in employment are projected by the United States Department of Commerce, Office of Business Economics:[2]

	Atlantic Region	Nation
Manufacturing	8.1%	28.2%
Non-Manufacturing	44.5	45.6
Total	**31.1**	**40.6**

These figures do not distinguish between production workers in manufacturing ("blue-collar" jobs) and managerial and clerical types ("white-collar" jobs). The share of white-collar jobs within the manufacturing category is increasing. They are particularly concentrated in the headquarters offices of the Atlantic Region: for example, an editor in a publishing house is presently classified as a manufacturing employee, as is a clerk in a factory. If the figures were presented on an occupational, rather than industrial, basis, the specialization of the Atlantic Region in paperwork or "communications" would become even clearer. This Region can be expected to remain the white-collar capital of the nation and, to some extent, the world.

The economic impetus of the growth in white-collar jobs is reflected in the population growth rates of individual metropolitan areas within the Atlantic Region. In the 1950-1960 decade, the Washington area increased by a spectacular 37.8 percent—faster than any other within the Region. Growth of the New York area during the same decade—15.8 percent is muted by the worldwide tendency for the largest metropolitan areas to grow at a much slower rate than middle-sized metropolitan areas. But in total numbers, the New York area is still growing neck and neck with Los Angeles and is considerably ahead of all other metropolitan areas in the nation.

Over the past six years, the Atlantic Region metropolitan economies which specialize in office work have held their own in national rank. One (Hartford) has moved upward. This contrasts with the predominantly manufacturing metropolitan areas, nearly all of which have dropped in national rank (Allentown-Bethlehem-Easton; Springfield-Chicopee-Holyoke; Jersey City; Albany-Schenectady-Troy; Providence-Pawtucket-Warwick; Paterson-Clifton-Passaic). Wilmington, with its chemical industries rose one rank—an exception. In sum, the major old metropolitan areas of the East retain a strong economic attraction, despite the tendency for the newer areas farther west to grow faster. The business centers of the major old metropolitan areas remain powerful magnets for the talented and the ambitious from all over the world, and their far-flung suburban areas continue to offer attractive residential environments.

Population growth in the Atlantic Region resulting from deliberate location of jobs there and from natural increase in population creating additional jobs is supplemented by in-migration of unskilled workers without known job prospects, and their families. There is considerable evidence that this in-migration is continuing at a strong pace, at least in the New York area. This can be expected to continue as long as there is relatively cheap, obsolete housing in its central cities, and as long as substantial welfare differentials exist between the states of the Atlantic Region and the rural South and Puerto Rico. For example, the monthly average aid to dependent children in February 1968 ranged from $56.20 to $60.60 per recipient in New York, New Jersey and Connecticut, while it was $8.45 in Mississippi and $5.36 in Puerto Rico.

In view of the relative decline of job opportunities in blue-collar manufacturing jobs in the Atlantic Region as a whole and substantial absolute declines in such job opportunities in the Region's central cities, to which blacks from the rural South and Puerto Ricans are migrating, the

[1] See Gunnar Alexandersson, **The Industrial Structure of American Cities,** University of Nebraska Press, 1956.

[2] North Atlantic Regional Water Resources Study Coordinating Committee, **North Atlantic Regional Water Resources Study, Appendix B, Economic Base.** (Office of Business Economics, U.S. Department of Commerce) Table V-1A 1968.

in-migration of the unskilled is creating the most explosive social and planning problem that the Atlantic Region has to face in the decades immediately ahead. Unable to enter the white-collar labor force because of insufficient education, and frequently barred from scarce low-skill jobs by discrimination at the places of work or in housing accessible to them, the unemployed in-migrants become the charges of the local governments in the Region's central cities. In the absence of adequate compensation from higher levels of government, the increase in public service obligations for low-income persons saps the central city's ability to provide either the services needed to support its nonresidential activities (such as the office function) or those required by its remaining middle-income groups if they are to remain in the central city at all. Thus, the vicious spiral of decline and deterioration in the central cities is accelerated. These difficulties could be especially critical in the major metropolitan areas of the Atlantic Region, whose productivity as office capitals is highly dependent on the efficiency of their central business districts, where most of the important headquarters functions take place, and on their surrounding environment.

From the viewpoint of long-term social policy, however, the in-migration of the poor and underprivileged into the central cities may turn out to be a blessing. Poverty and discrimination appear politically innocuous as long as they occur in the distant mountains of Appalachia or in the rural South. But the issue is exposed and action imposed when these phenomena intrude themselves into the centers of affluence and decision-making.

C. Regional structure

The Atlantic Region represents a chain of metropolitan areas which are still economically, socially and physically heavily oriented toward the central cities from which growth of the Region began. If one defines as central cities those having a gross population density of over 10,000 residents per square mile, then into this category will fall Washington, Baltimore, Philadelphia, Newark and most of Hudson County, most of New York City (except parts of Richmond and Queens), Boston, Providence, Bridgeport, Trenton, Paterson, Yonkers, as well as a smattering of smaller cities such as Lancaster, Reading, York. On the basis of the previously mentioned 150-county definition of the Atlantic Region (which excludes Richmond, Virginia), the municipalities with densities of over 10,000 residents per square mile covered only 790 square miles (1.2 percent) of the 150 counties' land area, but housed in 1960 some 15.4 million people—40 percent of the total (Map 2).

As previously indicated, the social problems of the Atlantic Region are primarily concentrated in these older cities. Since 1950, almost all of these cities have been losing population due to the out-migration of middle-income whites to the suburbs. The loss has been partially made up by non-white in-migration, resulting in a steeply rising percentage of non-white residents in the central cities. For example, between 1960 and 1967 the non-white share of the population climbed from 15 to over 20 percent in New York City, from 15 to 24 percent in New Haven, from 34 to 52 percent in Newark. The percentage of low-income families in these cities has scarcely dropped compared to the percentage in newly-developing areas, buttressing the observation that it is the higher-income families that are moving to the newer areas.

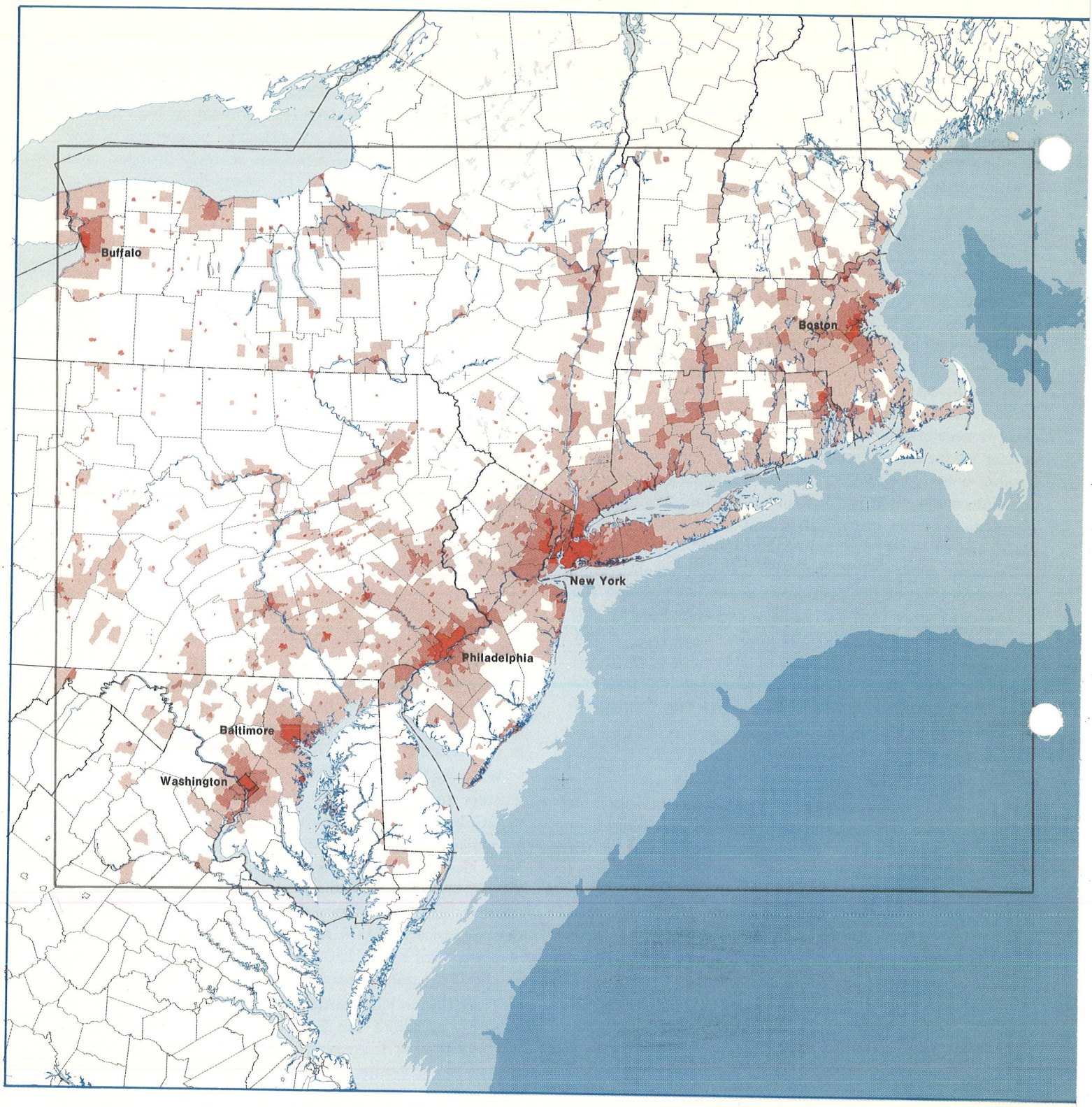
Ringing the central cities are municipalities with population densities of 1,000-10,000 per gross square mile. While mostly representing mature suburbs, these municipalities also include some cities that either have low densities of development or have substantial portions of undeveloped land in their boundaries. In 1960, the cities and suburbs in this category covered 4,700 square miles—7 percent of the land area of the 150 counties, and housed 14.6 million people (38 percent of the total), a share quite comparable to that of the high-density cities. The mature suburbs are built up predominantly with single-family houses having typical lot sizes of one-quarter to one-third of an acre per family, compared to the apartment and attached houses found predominantly in their central cities. Thus, the suburbs cover six times the land area of central cities.

The development of most of these areas began in the heyday of the railroads, between 1900 and 1930, but the bulk of the development occurred in the automobile era following World War II. The highest concentration of affluence in the nation is to be found in the mature suburbs of the Atlantic Region. But a few scattered "mini-ghettos" in old village centers are located there as well.

While compact suburban development forms discrete clusters around the major central cities, the next, or exurban, belt runs uninterrupted from near Fredericksburg, Virginia to the southern border of Maine near Portsmouth, New Hampshire, with two prongs extending out toward Harrisburg, Pennsylvania and Albany, New York. The exurban area is composed of municipalities with gross densities of 100-1,000 persons per square mile, covering nearly a third of the 150 counties' land area, and housing, in 1960, 6.7 million people, or 17 percent of the total.

The exurban belt, particularly at the edge of the built-up suburbs, is where the fastest population growth in the Atlantic Region is currently occurring. At this "frontier," the Region's future shape is being rather inadequately determined by opportunistic highway location, precipitous land speculation, lagging public services and skyrocketing costs of providing them. This, in turn, results in land-use controls designed to slow down growth (without admitting it)—especially growth of tax-consuming users such as large, low-income families—and to encourage the growth of tax-producing properties (such as clean, automated plants), irrespective of location.

Partly in response to changing tastes, but largely due to fiscal pressures, the lot sizes of single-family dwellings in the growth areas of the outer suburbs of the Atlantic Region have increased substantially in recent decades. In



2. ATLANTIC REGION

1960 POPULATION DENSITY BY MUNICIPALITY

persons per sq. mile

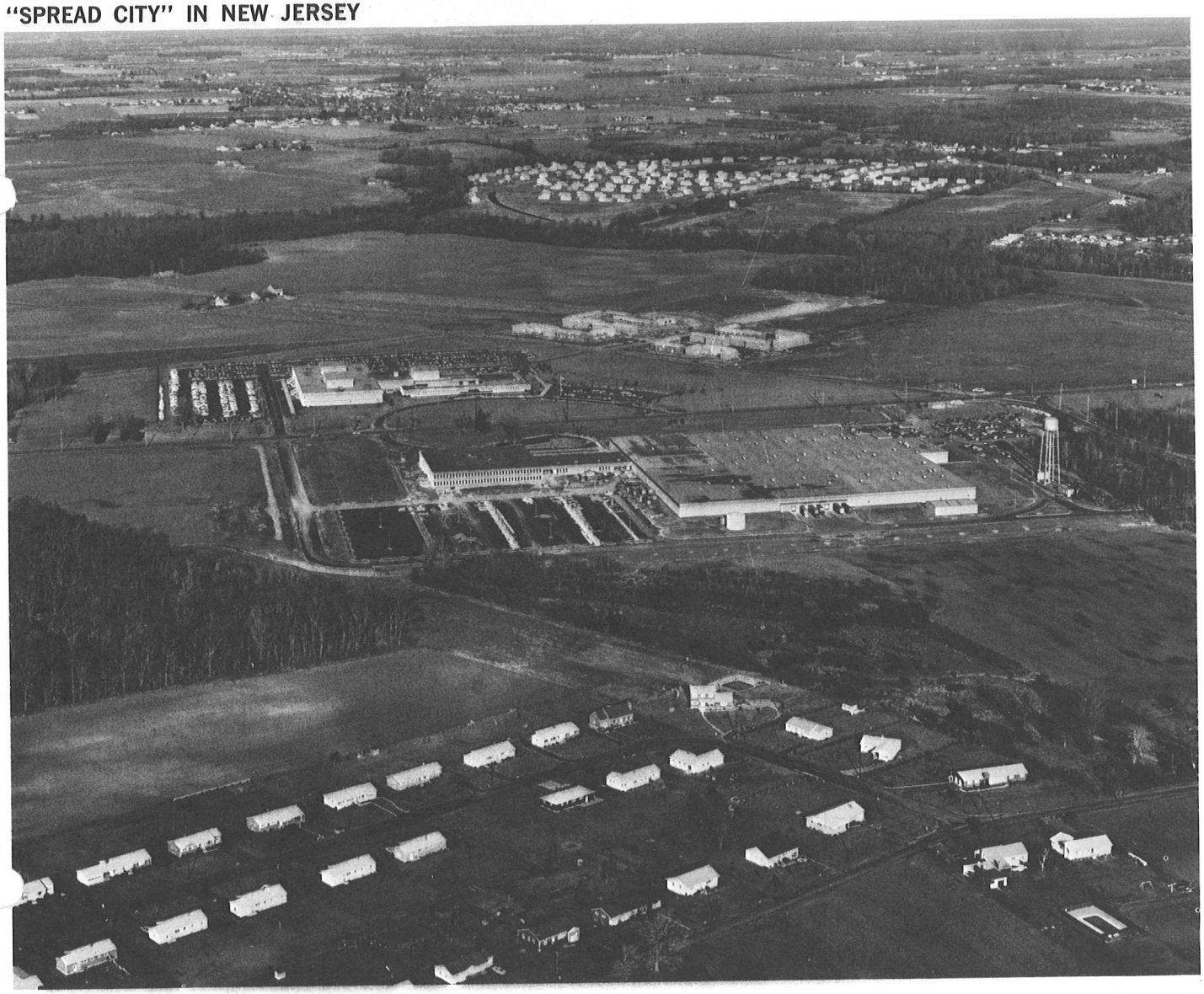
- urban 10,000-100,000
- suburban 1,000-10,000
- exurban 100-1,000
- rural 1-100

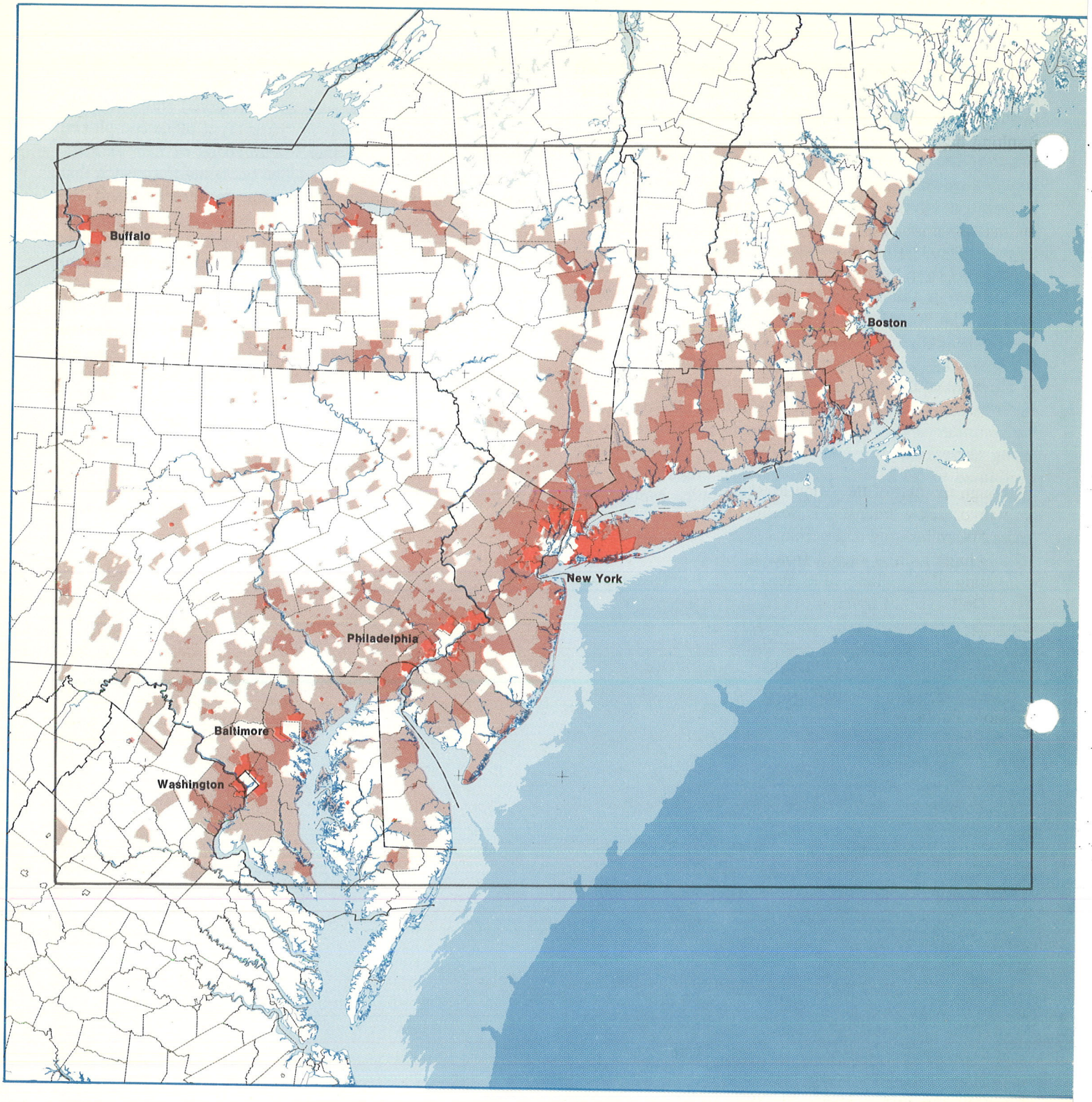
the New Jersey-New York-Connecticut urban complex, for example, average lot sizes in newly-subdivided tracts doubled between 1950 and 1960 from about a quarter-acre to about a half-acre. In 1960, zoning on vacant land surrounding the urbanized portion of the tri-state New York complex called for nearly two-thirds of the vacant land to be used for houses on half-acre lots or larger, 48 percent on acre lots or larger, 17 percent on two-acre lots or larger. Since 1960, residential land in numerous municipalities has been up-zoned to even larger lot requirements.

Not only is the density of newly developing residential areas in the Atlantic Region getting progressively lower, but the potentially compact and higher-intensity facilities are scattering in a random fashion over the landscape. First of all, most of the frontage of major non-access-controlled highways on the periphery of urbanization is "strip-zoned" for commercial use. Minor commercial establishments are lining these roads virtually continuously, impeding their usefulness to traffic and creating visual blight. Larger establishments, such as neighborhood shopping centers, discount houses or small department stores, typically spring up at intersections.

Still larger facilities, such as subregional shopping centers, manufacturing plants or "park"-type office complexes, spring up either along these same roads or near limited-access highway interchanges. The tax benefits are such that usually a municipality will rezone any tract to suit the developer, without concern for the over-all regional pattern, for future highway needs or access to labor force. Even apartment developments (with units too small for families with children) are springing up "in the middle of nowhere" on the edge of suburbia, with no chance of public transit or nearby community facilities (Fig. 2). The lure of cheap, large, undeveloped tracts, as opposed to the difficulties of land assembly and relocation in more densely built-up areas, is seducing public agencies into a similar pattern of random, scattered locations for their own facilities, such as universities and administrative buildings. When it comes to accommodating the motor vehicle traffic that such a development pattern generates, freeways have

Figure 2
"SPREAD CITY" IN NEW JERSEY





3. ATLANTIC REGION

1950-1960 POPULATION DENSITY CHANGE

persons per sq. mile

+ 10,000-1,000

+ 1,000-100

+ 100-10

< 10 or decrease

to be wiggled around and between pieces of developed land, and the opportunity to lay out and build a geometrically clear, simple and legible network is negated. The resulting highway map looks like the proverbial "spaghetti bowl."

The spreading residential lots and the scattered nonresidential facilities create a development pattern that is neither city nor suburb nor rural but rather an amorphous "Spread City." Rising land and development costs are pushing spread city farther and farther out, with isolated new houses and small subdivisions dotted along rural roads as far as 50-80 miles from the major cities. The area involved in different intensities of urban-type growth is shown on Map 3. The total shaded area indicates where more than three new households per square mile settled in 1950-1960.

D. Land requirements

Although the belt of the Atlantic Region over which urban growth of some intensity is scattered can be considered some 500 miles long and perhaps 50-100 miles wide, most of this huge area is vacant from an urban point of view, consisting of woodlands and active and abandoned farmland. Only a small fraction of the land is actually covered by urban uses, such as residential lots, the lots of commercial, industrial and institutional buildings, and the rights-of-way of streets, highways, airports, railroads and utilities. This will be called "developed land" in subsequent discussion. Public parks, forests, recreation areas and wildlife preserves will be called "open space." In Tables 1 and 2, detailed 1960-1964 land-use statistics are given for 56 counties which accounted for nearly 70 percent of the Atlantic Region's population in 1960 and 15 percent of its land area. The statistics cover all the major metropolitan areas with the exception of the Washington, D.C. metropolitan area, which lacked land-use data as of this writing.

Thus, the 30 million people in the seven major urban areas listed used about 4,000 square miles of land for strictly urban purposes, plus 1,000 square miles for outdoor recreation. The population density of developed land (as opposed to gross population density within the boundaries of a political jurisdiction) ranged from a high of 10,100 in the Penn-Jersey Philadelphia area to a low of 3,900 in eastern Connecticut. These, of course, are averages that conceal extremely high internal variations, especially in the larger areas. In New York, for example, developed land densities range from 1,000 people per developed square mile in places zoned for acre lots to 160,000 per square mile on the West Side of Manhattan; this range is concealed by an average of 8,900 for the Tri-State area as a whole. The allocation of developed land between the various uses is shown below.

It is evident that, on the average, the proportions of developed land devoted to the various uses are quite similar for the seven urban areas. Typically, one can assume slightly over half the developed land to be in residential lots; they are by far the largest consumers of land. Street and highway rights-of-way take up about one-fifth of the developed land on the average, and non-highway transportation, utilities, commerce and industry, taken together, occupy anywhere from 11 to 20 percent of the developed land. Predictably, the latter figure more closely represents industrial areas, such as Philadelphia, Baltimore or Rhode Island, whereas the former one is typical of eastern Connecticut and greater Boston. The most volatile figure is that representing institutional use. While the proportion of land devoted to such institutions as schools, colleges, general hospitals, libraries and administrative buildings of local government is rather constant and rather small, the incidence of large-scale government tracts, be they mental hospitals or military reservations, makes the "institutional" figure quite unpredictable. The presence or absence of these large-scale uses can distort the other figures substantially, as in the cases of Baltimore and Richmond.

Just as with densities, area-wide average proportions of land devoted to various uses conceal significant internal variation. The proportion of residential land typically declines as one moves from the periphery toward the center.

Table 1

LAND DEVELOPMENT IN 56 COUNTIES OF THE ATLANTIC REGION, 1960-1964

Planning area	Total land (sq. mi.)	Open space (sq. mi.)	Developed land (sq. mi.)	Percent developed	Density of developed land (persons/ sq. mi.)
1. Tri-State N.Y.*	7,297.6	357.3	2,004.4	27.5%	8,900
2. Penn-Jersey	1,175.0	46.9	455.7	38.8	10,100
3. Greater Boston	2,429.6	110.0	599.2	24.7	5,400
4. Baltimore	2,325.6	63.7	374.5	16.1	5,200
5. Eastern Conn.**	3,858.3	356.8	317.0	8.2	3,900
6. Rhode Island	1,018.1	55.6	186.5	18.3	4,600
7. Richmond, Va.	731.4	11.2	103.0	22.2	4,000
Totals	**18,835.6**	**1,001.5**	**4,040.3**	**21.4%**	**7,500**

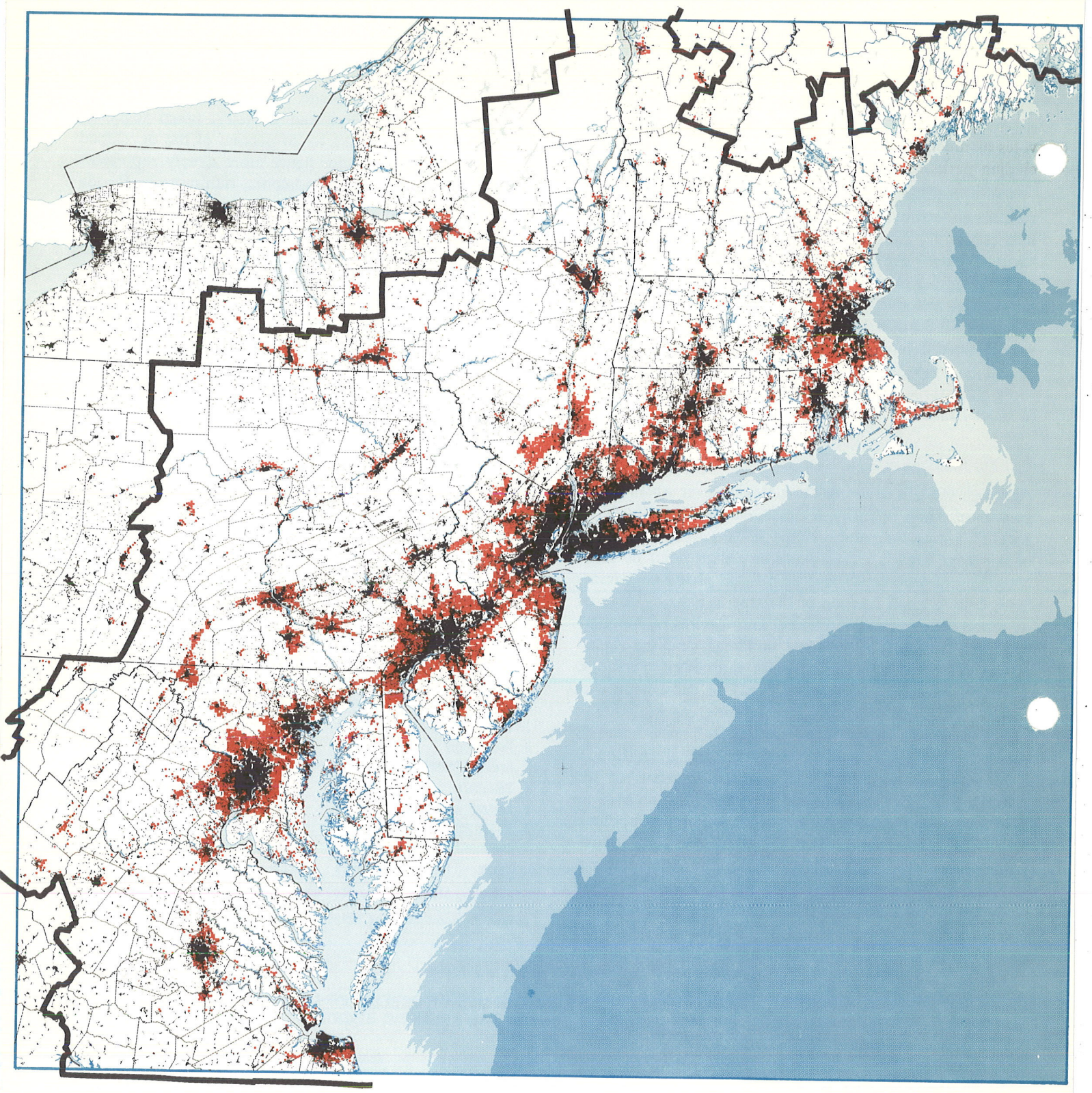
*Excluding Mercer County, N.J., included in Penn-Jersey.
**Excluding portion of Connecticut within Tri-State area.
Source: Regional planning agencies of the respective areas.

Table 2

THE USE OF DEVELOPED LAND IN 56 COUNTIES OF THE ATLANTIC REGION

Planning area	Residential	Streets, highways	Institutional	Transportation**	Commercial	Industrial
1. Tri-State, N.Y.	59.9%	22.8%	5.6%	4.5%	4.4%	2.8%
2. Penn-Jersey	57.8	18.3	6.3	4.6	4.6	8.4
3. Greater Boston	55.0	22.0*	12.3	3.8	3.1	3.8
4. Baltimore	41.3	19.5	21.8	***	3.3	14.1****
5. East. Conn.	58.3	22.0*	8.8	1.5	4.0	5.4
6. Rhode Island	45.6	19.5	14.3	11.3	4.9	4.4
7. Richmond, Va.	50.6	30.7	2.4	8.3	3.4	4.6
Averages	**56.2%**	**22.0%**	**8.7%**	**4.7%**	**4.0%**	**4.3%**

Notes:
*Estimated.
**Railroads, airports, utility rights-of-way in some cases.
***Not available, included in industrial.
****Includes transportation, as above.



4. ATLANTIC REGION
DEVELOPED LAND 1965-2020

developed land 1965

developed land 2020

The opposite is true of the proportion of land in streets. New York City, with its grid pattern of short blocks, devotes as much as 43.9 percent of its developed land (excluding parks and vacant lots) to streets (which include mapped, unpaved streets); the outlying suburbs (such as Weston, Conn.), with large lots and large, irregular blocks, have as little as 12 percent of their developed land in streets. Street width, naturally, also plays a role; the narrow streets of Philadelphia are closely reflected in the Penn-Jersey figure in Table 2.

Intensively built-up land was charted for the entire Atlantic Region by Regional Plan Association from aerial photography, as shown in Map 1. In the area for which land-use statistics are available, this intensive development accounts for 76 percent of total developed land as defined by local planning agencies and shown in Table 1. Assuming that this relationship holds true in areas for which local data were unavailable as well, total developed land in the Atlantic Region in the early 1960's can be estimated at 7,590 square miles, or only 6 percent of the land area of the 214 counties. In the 107-county Core area, defined by Jerome Pickard as the area which includes the large coastal cities, total developed land was estimated at 5,290 square miles, or 12 percent of the land area. These figures clearly explode the notion of a "solidly built-up belt" from Washington to Boston. While the diffusion of development is fairly continuous, the actual land taken up by building lots and streets is a small proportion of the total.

In fact, the area in publicly owned open space presently exceeds the developed area by far, as shown in Table 3 below.

Most of the public open space (also shown in Map 1) is in the mountain areas outside the belt of urbanization and consists of the large state forest preserves in Pennsylvania and New York and of national parks and forests, such as the Shenandoah, the Green Mountain, and White Mountain. While for the entire Atlantic Region the ratio of public open space to developed land is 1 : 0.6, for the 104 counties of the Core, the ratio is 1 : 2, and within the coastal metropolitan areas, 1 : 4. There, open space is frequently inadequate.

Land requirements for future urbanization in the Atlantic Region were projected by Shirley Sherak[1] using the assumption that current suburban development densities will prevail and that a future population such as that projected by Jerome Pickard will be attained. These are shown in Table 4 and Map 4.

Table 3

PUBLIC OPEN SPACE IN THE ATLANTIC REGION, 1965

	Atlantic Region (214 counties) (sq. mi.)	Core Area (104 counties) (sq. mi.)
County and Municipal	349	304
State	9,475	1,951
Federal	2,927	220
Total	**12,751**	**2,475**

Source: Regional Plan Association.

Table 4

DEVELOPED LAND IN THE ATLANTIC REGION, PROJECTED 1960-2020 AT CURRENT SUBURBAN DENSITIES

	Atlantic Region (214 counties)		Core area (104 counties)	
	Developed land (sq. mi.)	Percent developed	Developed land (sq. mi.)	Percent developed
1960	7,590	6.0%	5,290	12.2%
1980	10,080	8.0	7,300	16.8
2000	12,930	10.3	9,510	21.8
2020	16,120	12.8	11,980	27.5

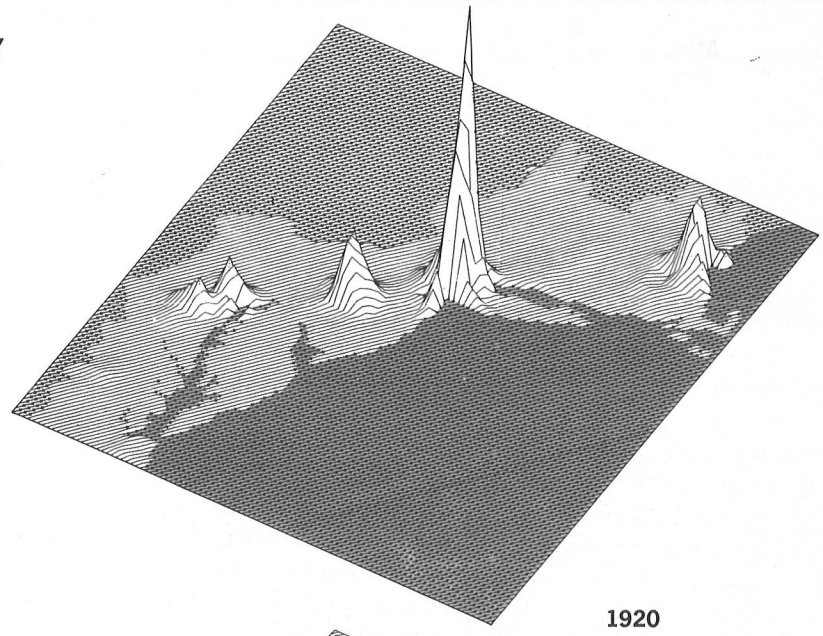
The projections indicate more than a doubling of developed land over the next half-century, or an increment of 8,530 square miles to accommodate an increment of 40 million people. This is an average density of 4,700 people per square mile of newly developed land which, if 60 percent of the developed land is in residential lots, corresponds to a net residential density of 0.27 acres per dwelling unit. One should keep in mind that if present housing preferences by age, income and household size prevail, over one-third of the future population increment will be seeking multi-family dwellings, whose land consumption, even in the garden-apartment variety, is several times smaller than that of single-family units. Thus, the average single-family lot would be in excess of one-third of an acre under this projection.

Of course, if local government policies push the average lot size to two-thirds of an acre (which is in effect what municipal zoning ordinances decree for the vacant land surrounding the New York metropolitan area),[2] projected land consumption will be accordingly higher. At 0.67, rather than 0.27, acres per dwelling unit, making no allowance for multi-family structures and assuming net residential land use still at 60 percent of all developed land (on the empirically plausible supposition that in a low-

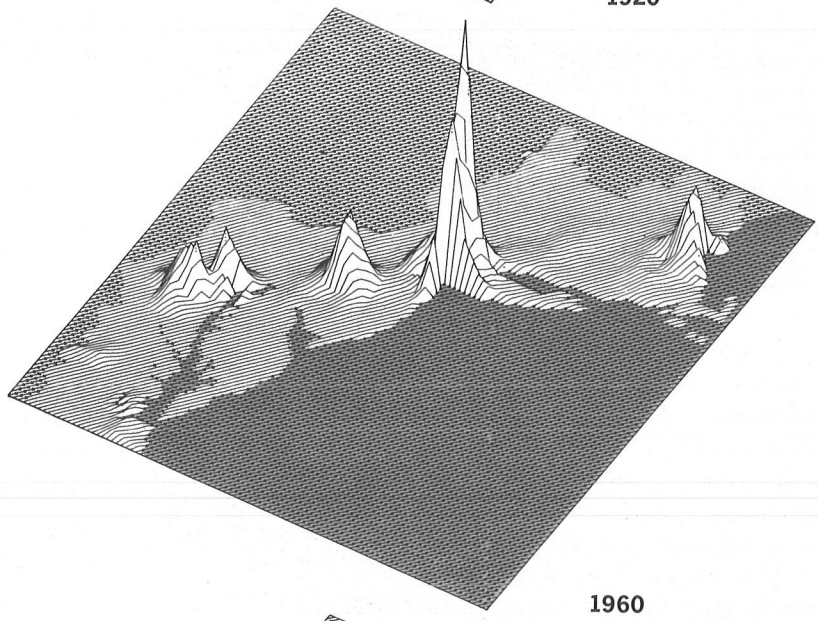
[1] These projections were developed by Regional Plan Association as a part of Contract DACW 52-68-C-0002 for the U.S. Corps of Engineers, North Atlantic Regional Water Resources study, Shirley Sherak, project manager. Both the area covered and the projected population distribution in that study vary somewhat from those accepted for this Conference. The figures were adjusted for this paper to account for the different study area definition. For original data see: **Study of Present and Projected Urban Development in the North Atlantic Region,** preliminary issue, prepared by Regional Plan Association, for the North Atlantic Water Resources Study Coordinating Committee. March, 1969. 105 + 23 pp., maps.

[2] **Spread City. Projections of Development Trends and the Issues They Pose: The Tri-State New York Metropolitan Region, 1960-1985.** Regional Plan Association Bulletin 100, September 1962, p. 11.

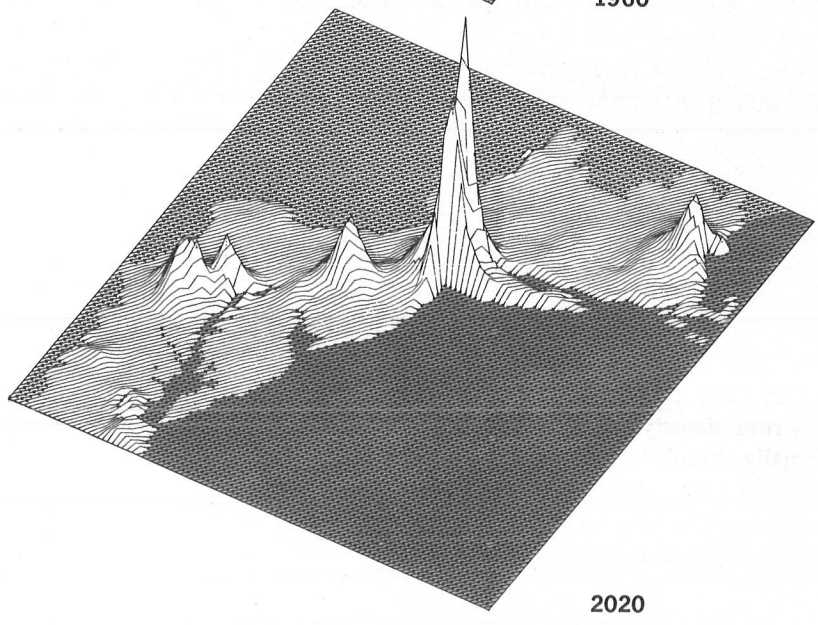
Figure 3
GROSS POPULATION DENSITY BY COUNTY



1920



1960



2020

The three isometric maps shown on this page were prepared from population density data by county, supplied by Regional Plan Association. They were drawn by computer at the Harvard Laboratory for Computer Graphics. The five most prominent peaks of population density visible in the maps are, from left to right, Washington, Baltimore, Philadelphia, New York and Boston. The gradual in-filling of population between the peaks is visible over time. The density of the highest peak, representing Manhattan, actually shrank from 103,800 persons per square mile in 1920 to 74,800 in 1960. The other four major peaks are in the 12,000 to 15,000 persons per square mile range and have remained comparatively stable over time, with the exception of Washington, which became visibly higher.

density environment nonresidential structures also acquire proportionately larger sites), the bottom line in Table 4 would look as follows:

	Atlantic Region, total		Core area	
	Developed land	Percent developed	Developed land	Percent developed
2020	28,744 sq. mi.	22.8%	21,880 sq. mi.	50.1%

No matter which of these two trends (or something in-between) prevails, availability of land does not present a constraint to urban growth in the Atlantic Region in the foreseeable future. Even under the extreme assumption of two-thirds of an acre of residential land for every new household (which really means a one-acre lot for every single-family house), the total developed area in 2020 would be comparable to the area of those municipalities which in 1960 had more than 100 residents per gross square mile—that is, had experienced some urbanization. **More than three-quarters of the land would still be vacant or in parks.** The Core area, of course, would be 50 percent developed.

The more conservative of the two land development projections—the one presented in Table 4—is shown graphically on Map 4. It shows a contiguous belt of development in 2020 from Newark, Delaware, to Northampton, Massachusetts, but the two clusters of Washington-Baltimore and Boston-Providence still appear as separate entities. A similar picture for 2020 is presented by charting gross population density by county. A contiguous string of 33 counties with population densities over 1,000 persons per gross square mile stretches from New Castle, Delaware, to Hartford, Connecticut. In the south, there is a cluster of 12 contiguous counties with such population densities—from Prince William, Virginia to Baltimore—and in the north, a cluster of 10 between Kent, Rhode Island and Essex, Massachusetts. In the west, two separate counties which reach the 1,000 persons per square mile density in 2020 are Schenectady, New York, and Dauphin, Pennsylvania.

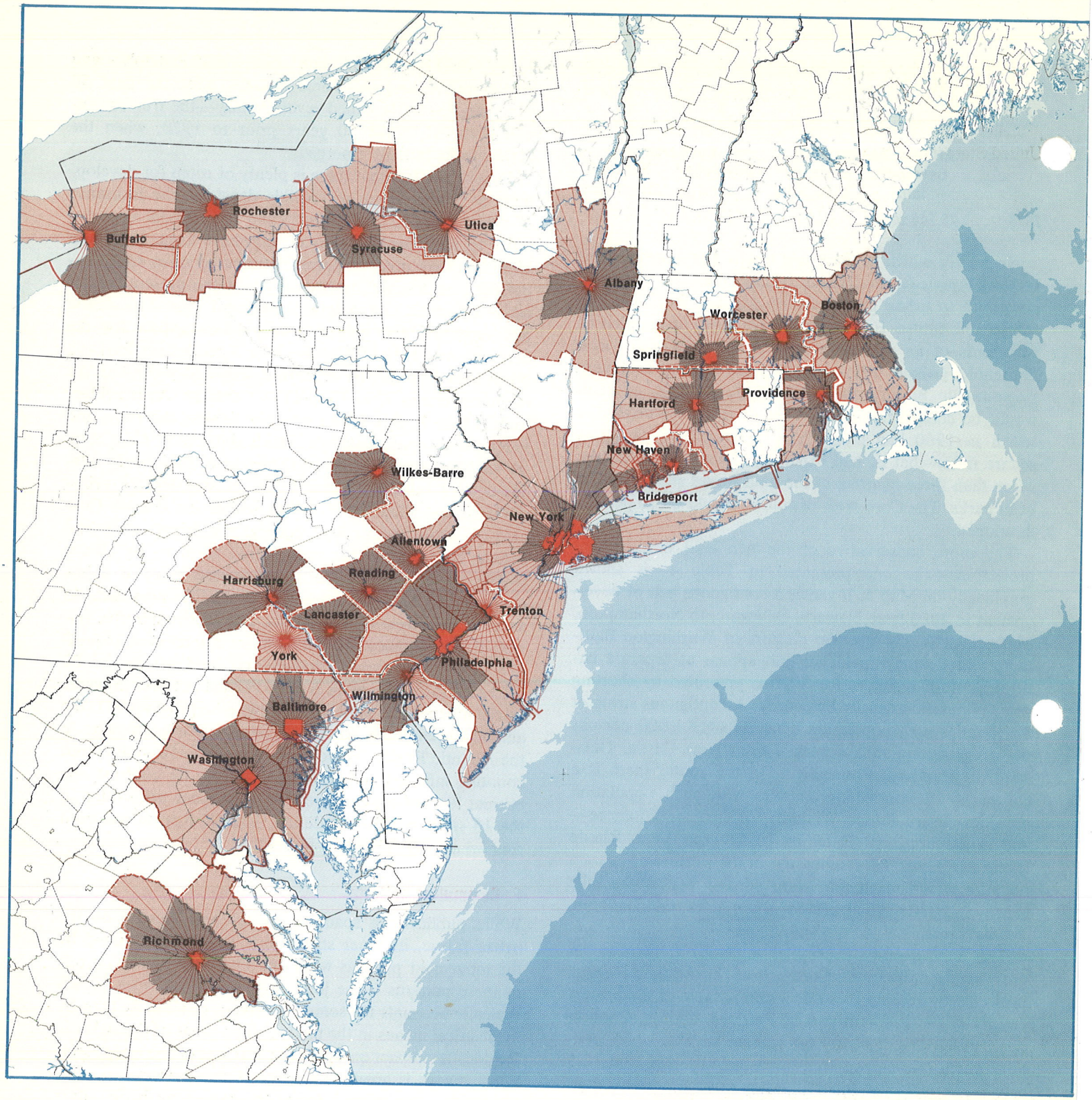
The 2020 **average** density of some 1,700 persons per gross square mile in the Core belt of the Atlantic Region, projected by Jerome Pickard, is comparable to the present density of the southern part of Fairfield County, Connecticut, which is still nearly 50 percent vacant, which contains much "developed land" that actually represents 2-5 acre residential lots, and which has some 8 percent of its land area in watershed reservations and parks.

The pattern of gross population density by county discussed above was charted in three-dimensional map form by the Harvard Laboratory for Computer Graphics. Results are shown in the three isometrics for 1920, 1960 and 2020 in Figure 3. The 1920 pattern was one of five rather sharp peaks rising abruptly from a plateau of very low rural density. By 1960 the tallest peak—Manhattan—actually shrank in height, all of the peaks became thicker, and the twin peaks of Washington and Baltimore relatively more prominent. The pattern to 2020 is one of continued suburban in-filling, especially noticeable in New Jersey, on Long Island, and south of Philadelphia and Baltimore-Washington. These changes over the next 50 years can hardly be called revolutionary—the true revolution occurred in the 50 years prior to 1920, when the major peaks initially emerged.

Despite the fact that there is plenty of room for development at a wide range of possible densities, the insurance of decent standards of amenity and recreational opportunities in an urbanized area of anywhere from 16,000 to 29,000 square miles requires attention to open space acquisition on a scale that would dwarf the present, rather active efforts in this direction. Regional Plan Association has suggested and gained considerable support for the acquisition of a 10,000 square mile Appalachian Park—a green backdrop for the urbanized seaboard protecting the mountain chains from Virginia to Vermont. As is evident from Table 3, this would roughly double the state and federal open space holdings outside the coastal Core area. At an illustrative cost of $200 per acre, this would total about $1.3 billion. To match the most extensive urban development pattern with parks within the coastal Core at 1 : 3 ratio, the present county, municipal, state and federal holdings in that area would have to be almost tripled, or an increment of 4,500 square miles of public open space **within** the area of urbanization provided. At an illustrative cost of $2,000 per acre in the suburbs, this would come to about $5.7 billion, for a total land acquisition cost—with current dollars and land prices—of $7 billion. If such a program is to be carried out over 20 years (since much of the land will otherwise be pre-empted), the annual expenditures for public open space acquisition in the Atlantic Region would have to reach $350 million, not counting inflation and rising land prices. By contrast, the current level of expenditures for open space acquisition in the 13 states which include the Atlantic Region has been somewhat over $20 million annually.

E. Commuting patterns

While public open space delineates and loosens up the urban fabric, its inner structure is largely determined by the movement patterns within it. The most important one of these patterns is the journey to and from work, which typically accounts for some 40 percent of all daily trips by mechanical means in the metropolitan areas of the Atlantic Region. Its impact on the shape and size of the transportation network is greater than that. First, journeys to work are highly concentrated during the daily peak hours (during the weekday morning and evening peaks, anywhere from 65 to 80 percent of all trips can be work trips), and it is the peak-hour trips that determine needed transportation capacities. Second, journeys to work are typically longer than the average trip; hence in person-miles of travel, they are usually over 50 percent of daily totals. Though journeys to work as a percent of all trips have a tendency to decline as increasing affluence and leisure stimulate more social and recreational trips, the region-shaping nature of the journey to work is likely to prevail over the next half-century, even if weakened.



5. ATLANTIC REGION
COMMUTERSHEDS (OVER 250,000 POPULATION)

central cities

over 20% work in central city

over 2% work in central city

Journey-to-work commuting, like trips for other purposes, are overwhelmingly confined within the individual metropolitan areas. According to the Census, some 10 percent of the journeys to work in urban areas of the United States in 1960 were on foot, and another 3 percent of the workers worked at home. These figures are representative of the Atlantic Region as well. Excluding pedestrian trips, the average trip to work in the Baltimore area, as an example, is 7.8 miles (compared to an average length of 5.8 miles for all trips); in the Philadelphia area it is 5.3 miles (compared to 4.2 miles for all trips).[1] In the Tri-State New York area, the average journey to work is about 9 miles for trips to Manhattan, and about 5.5 miles for trips to work outside Manhattan. Trips to the major central business districts of the Atlantic Region are characteristically longer than average in the Region, partly because they are made by the wealthier workers.

A convenient way of visualizing the movement structure and employment distribution of the Atlantic Region is in terms of the major commutersheds, i.e., areas from which trips are made to major work concentrations. These are shown on Map 5 and in Table 5.

Table 5

MAJOR COMMUTERSHEDS OF THE ATLANTIC REGION, 1960

Central city	Total population of commutershed	Workers working in central city	Percent of labor force working in central city	Percent of labor force working in main CBD of central city	Nonresidential floor-space in main CBD
	(thousands)				(million sq. ft.)
1. New York City-Hudson-Newark	15,816.4	4,126	64%	29%	540
2. Philadelphia-Camden	4,442.3	950	56	25	125
3. Boston-Cambridge	3,433.6	521	39	18	70
4. Washington, D.C.	2,193.8	502	55	28	75
5. Baltimore	1,775.8	396	56	16	33
6. Hartford	1,018.7	114	27	12	15
7. Providence	834.6	115	36	n.d.	n.d.
8. Albany	758.7	75	27	n.d.	n.d.
9. Worcester	576.5	88	41	n.d.	n.d.
10. Richmond	536.4	130	60	n.d.	n.d.
11. Springfield	532.5	75	37	n.d.	n.d.
12. Allentown	481.8	58	31	n.d.	n.d.
13. New Haven	439.7	85	49	23	12
14. Wilmington	414.5	60	39	n.d.	n.d.
15. Trenton	400.7	53	33	21	10
16. Harrisburg	387.5	61	34	n.d.	n.d.
17. Wilkes-Barre	346.9	37	31	n.d.	n.d.
18. York	290.2	34	29	n.d.	n.d.
19. Lancaster	278.3	40	36	n.d.	n.d.
20. Reading	275.4	52	47	n.d.	n.d.
21. Bridgeport	273.4	73	69	32	10
Total in commutersheds	**35,507.7**	**7,645**	**54**	**25 (est.)**	**n.d.**
Total outside	**7,692.3**	—	—	—	—
Total Atlantic Region	**43,200**	**7,645**	**45**	**17.5 (est.)**	—

[1] Philadelphia figures were factored by 1.2 to convert airline distance into over-the-road distance.

The commutersheds in Table 5 and Map 5 were defined on the basis of counties or Census-delineated portions of counties which send more than 2 percent of their resident labor force to work in the central city (or central cities) of a Standard Metropolitan Statistical Area or a Standard Consolidated Area of 250,000 people (or 100,000 resident workers) or more. The population figures in the first column were adjusted to account for the overlapping of some commutersheds, such as Washington and Baltimore, Philadelphia, Trenton and New York, and New York, Bridgeport and New Haven. The commutersheds of the 21 urban centers defined account for 82 percent of the population of the Atlantic Region and 84 percent of its labor force. Thus, more than four-fifths of the Region's population live within the daily influence-sphere of a middle-sized to large urban center; nearly two-thirds live within the influence-sphere of the five largest centers.

The intensity of the "influence-sphere" of a center generally falls off sharply with increasing distance. More than 70 percent of the workers residing in a central city generally work in that city, as shown in Map 5. (For the New York commutershed, New York City without Staten Island but with Hudson County and the City of Newark, New Jersey were considered "central city.") The central cities are surrounded by a ring of true "suburbs," here defined as areas that send more than 20 percent of their resident labor force to the central city. This ring generally has a radius of 10-30 miles. It shows up quite accurately on Map 5 in New England, where the units for which Census data were available are small; south and west of New York it is exaggerated by the incidence of county boundaries. Beyond the close-in suburbs lies a ring with a radius of some 30-70 miles. It is only tenuously tied to the center, sending 2 to 20 percent of its workers there.

Of those who live within the 21 commutersheds, 54 percent worked in central cities and an estimated 25 percent worked in the **main** central business district of the central cities in 1960. The percent working in the central city is generally low in those commutersheds which have multiple, separate central cities (e.g., Schenectady and Troy near Albany, New Britain near Hartford), and in those which have central cities small in geographic extent (Boston-Cambridge, York). Among the most centralized commutersheds—with over 50 percent of the resident workers working in the central city—are New York, Philadelphia, Washington, Baltimore, Richmond and Bridgeport. With the exception of Baltimore, these are also the commutersheds with the strongest central business districts—over 28 percent of the commutershed's labor force works in the main CBD.

Data on central business district employment and nonresidential floor space for a number of middle-sized central cities were not available for this paper, but generally their CBDs range from about 5 to 20 million square feet of nonresidential floor space and about 20,000 to 70,000 workers. On that basis, it is evident that the center of centers, Manhattan's CBD (the 8.6 square miles south of Central Park) with its 1,855,400 workers and 540 million square feet of

nonresidential floor space, accounts for more than half the employment and floor space of the 21 centers. It is followed by the central business districts of Philadelphia, Washington, Boston and Baltimore, in that order, but the four together have little more than half the former's employment and floor space.

Most central business districts of the cities enumerated emerged historically as retail centers of manufacturing towns, and many are up to this day little more than just that, with all the attendant difficulties of decay as the suburbanizing population and the space-consuming automobile make non-central locations more accessible than central ones. Some, however, notably New York, Philadelphia and Boston, captured the nascent "office industry" during the late nineteenth century, and around the turn of the twentieth century built rapid transit systems that immeasurably expanded the tributary area and population of their centers, enabling them to grow rapidly to their present size by about 1930. Following World War I, the "big three" were joined in office growth by Washington (60 percent of whose nonresidential floor space in the central business district is government-owned), which is, belatedly, only now embarking on the construction of a rapid transit system.

The changing character of employment in the Atlantic Region from manufacturing to office work offers many of the smaller business districts the opportunity to revitalize and expand by attracting office buildings which, in contrast to modern factories, remain a high-intensity use. So far, the tendency for new office buildings has been mostly to go to the largest business districts (in the 20 years between 1950 and 1969, 87 million square feet of rentable office space was built in Manhattan—more than the entire nonresidential floor space of the CBDs of Washington or Boston) or to locate in the suburbs. There, they frequently experience difficulties assembling their labor force and keeping it interested during non-work hours, but they have cheap land and a "nice" rural environment. Among the conditions for office growth in the smaller centers are an adequate commuter transportation network, easy linkages to other centers, and more distinguished urban design. Still, with the current upsurge in office activities and with greater public attention to the needs of older cities and more public funds devoted to urban renewal, a number of older downtowns along the Atlantic Seaboard, while losing manufacturing employment, are gaining in office employment, retail sales and related activities. There remains a residue of antipathy to the idea of "downtown" compared to the suburban shopping center and the spacious suburban office campus, but the reputation has in many cases outlived the reality. As one wag put it, "Downtowns are so crowded, no one goes there anymore."

III. THE ISSUES OF GROWTH AND STRUCTURE

With this background on the Atlantic Region's population growth, employment changes, population distribution, land requirements and employment distribution, the two questions posed in the beginning of the paper emerge more clearly. They are:

1. Should the Region grow at its projected, "most likely" rate, or should deliberate efforts be instituted to channel away some of the growth to other parts of the continent?

2. Should the Region look toward reinforcing the strongly nucleated structure inherited from the past, or should it make "spread city" work by enhancing and improving dispersed development in a continuous belt of urbanization?

A. Accommodating growth vs. population dispersal

In discussing the issue of the Atlantic Region's absolute size and its growth rate, it is useful, first, to gain some historical perspective, then to look, insofar as possible, at the costs and benefits of size and growth, and finally to consider some costs and benefits of alternative policies.

1. **Historical perspective.** Throughout history, the size of the largest contiguous human settlement has increased roughly in proportion to the total population of the world. It approached 10,000 when world population was probably 10 million over 8,000 years ago. It reached 100,000 when world population reached 100 million, before 2000 B.C., and it exceeded 1 million when world population exceeded 1 billion after 1800. Since that time, the world's largest urban area has tended to contain an increasing share of the world's population.

One can hypothesize that as the earth's physical resources are finite, the only way in which man can support his rapidly growing numbers from them is via a more complex organization of his own society. And a more complex society needs bigger "brains"—bigger cities. With the advent of industrialism, the dominant tendency in the distribution of people over space has been one of aggregation into increasingly larger entities, progressing from numerous but small and rather evenly scattered cities to a number of dominant metropolitan areas to just a few continental-scale urban belts or systems of metropolitan areas. There is no limit in sight to the size of these large-scale aggregations. A technologically advanced society finds it more efficient to group its population in a few selected areas of the continent rather than to spread it thinly all over the land, as was the case in the unspecialized hunting and gathering economy where man roamed ubiquitously in search of sustenance and was able to survive alone or in small, isolated groups.

Man is no longer able to survive in relative isolation because specialization, which makes possible the kind of effective resource use that can support the world's spectacular population growth, leads to increasing interdependence. Specialization, complexity, interdependence,

translated into physical terms, mean that people have to be in direct or indirect contact with increasing numbers of other people. Electronic communication aids notwithstanding, being in contact ultimately means being in personal contact as well as delivering goods. Both require overcoming the friction of distance, which can be alleviated by proximity. Thus specialization leads to aggregation, which enables related functions to find more opportunity to complement each other.

Our spectacular advances in saving time while overcoming the friction of distance, mostly through expanded use of energy, information and space, should not obscure the fact that transportation does have costs other than time attached to it. So, proximity will remain important for the frequent, repetitive trips, even as unique trips are going to the moon and beyond.

Meanwhile, as proximity remains important to reduce the cost of repetitive, frequent trips, concentration is also required to make the more unique ones feasible. While the relatively slow helicopter can land anywhere (within a limited range) at an exorbitant cost per seat-mile, the fast and economical long-range jet airplane can connect only a relatively limited number of points. The still faster, more specialized supersonic airplanes will be flying from still fewer, select sites. And there are probably only two spots on earth from which one can travel at the planetary escape velocity of 25,000 mph.

The need for concentration of trip termini and trip channels grows not only with increasing speed but also with increasing traffic density: channelization and control reduce the probability of conflict from random movements. The way to allow the automobile to perform with greater safety, speed and capacity was to curtail the ubiquitous character of its movement and put it onto limited access highways, where freedom is restricted in more ways than one. The capacity of an underground tube, with one degree of freedom, is always likely to remain greater than that of an airplane, with three degrees of freedom. The compensation will come from the freedom to roam about at either end of the trip as a pedestrian, unencumbered by mechanical devices.

To sum up, greater numbers of people on a continent imply greater clustering, not greater dispersal. Our emerging "megalopolitan" clusters are able to satisfy the need for greater accessibility of people to each other both with regard to the slower, more frequent and ubiquitous trips and with regard to the faster, less frequent and channelized ones. Urban growth is the result of man's own needs. It does not result from some perverse force which man must resist.

2. **Costs and benefits.** The highly skewed nature of population distributions in space resulting from all these forces is a basic fact of human ecology. Three illustrative examples:

	Percent Population	Percent Area
1. Atlantic Region (214 counties) related to North America	22%	1.3%
2. "Core" of Atlantic Region related to conterminous U.S.	19	1.4
3. Municipalities with densities over 10,000 persons per square mile within the 150-county definition of the Atlantic Region related to the Atlantic Region	40	1.2

But even if this is granted, there can be arguments over details and exact proportions. Certainly the automobile and other suburbanizing forces have caused the sagging of the highly clustered distribution of population illustrated under item 3; but, on a larger, continental scale, the curves implied under items 1 and 2 have pretty well held their own for a century, as previously described.

Relatively little research work has been done on the costs and benefits of the operation and performance of different sizes of urban clusters so that if, say, a million new people were to pay the full costs of their settlement without subsidy in New Jersey or in Arkansas, it is hard to say which location would come out ahead. Nor is it clear which parts of the country come out ahead in federal subsidies and with what effect. The issue is complicated by the fact—and this is the crux of the argument—that the benefits are not always comparable and not easily quantifiable. For example, travelling to work in Manhattan is clearly more costly and more time-consuming than working elsewhere in the New York Region—in fact almost twice so. Yet people who have higher incomes and hence more freedom of choice choose to do so in greater numbers than others. Clearly, they derive what they consider a worthwhile benefit from the trip. Locating office space in Manhattan is also more costly than locating it elsewhere in the New York Region, yet a husky share is located there, and the theoretical benefits of agglomeration are translated into very tangible profits.

A similar argument can be made for the Atlantic Region as a whole versus the rest of the continent. The purpose of cities is to bring people together for the exchange of goods, services and ideas. Within a given range of time-distance and cost, there are certainly more opportunities for interchange in this Region than in any other region in the world, and further growth will enhance these opportunities.

There are, of course, costs attached to this growth. Basically, they are the frictions of internal circulation as size and density of an urban area become very high, the costs of disposing of wastes when many people are close together, and the scarcity of unique outdoor recreation resources, such as ski slopes, ocean beaches, bays and lakes. For easy access to unpopulated open space, there can be no question that Cheyenne has advantages over New York and that increasing population in the East cannot help but make access to uncrowded natural places more difficult.

The first of these problems is soluble by technology. So far, a kind of market equilibrium has been operative in the Region. When high density of development causes speeds within an area to decline to a degree that a lower density can offer sufficiently higher speeds of circulation so that a person can reach more people (which translates into more opportunities) in the same amount of time as he can in a high-density area, development shifts to the lower densities. However, when a new generation of technology that now seems possible breaks the barrier of slow speeds in high-density areas, new benefits will be reached from concentration on a totally new scale, especially if the improvement over the auto's performance (which cannot operate efficiently in high-density areas) is of an order of magnitude of the auto's improvement over rail transit some 40 years ago, or greater.

The second problem—environmental pollution caused by wastes—is a matter of cost right now and possibly of new methods and better waste management. It is quite possible that new processes for handling wastes will make compact urban living more, rather than less, efficient in handling wastes, though right now it is clearly an extra cost of higher densities. For example, downtowns could function efficiently without large numbers of automobiles, unlike less compact job locations. But a small city in northern Canada, which can depend on the environment to dissipate its wastes, will have lower waste management costs than the Atlantic Region.

With regard to outdoor recreation, there are of course palliatives. With a looser work-week, people can plan to separate themselves from others in time, rather than in space. Some transportation innovations, such as STOL aircraft, may bring the more distant parts of Maine or Vermont within the range of a one-day trip. And in-city recreation, such as swimming pools and depolluted rivers, as well as more small parks and playgrounds near home, can keep pressures on large far-out attractions from mounting. In sum, difficult access to uncrowded open space appears to be the only unavoidable price of further population growth in the East. Those to whom this is an overriding consideration will certainly take the opportunity in an open society to migrate west.

It would appear from the preceding that growth on the scale projected for the Atlantic Region—roughly doubling in fifty years—can be hardly viewed as a disaster. After all, except for the disappearance of some rustic nostalgia and some historically distinctive buildings, few would argue that the Region today is worse off than it was around 1914, when its population was half what it is today. It can be argued that growth does provide an impetus for improvement, a "lever," as Wilbur Thompson put it, "through which desirable changes may be achieved." One can retort, of course, that given our sloppy land-use controls and fragmented or nonexistent urban development policies, the changes that growth is achieving are not very satisfactory in fact. Yet, are our political institutions in Arkansas, Wyoming or North Dakota any better equipped to accept growth than those in Maryland, New York and Massachusetts? It appears that the incredible energy necessary to induce shifts in growth to the sparsely populated parts of the nation would be much more productively spent on organizing growth in a satisfactory way right where it occurs.

Moreover, trees do not grow into the sky, as the Germans say. The overwhelming evidence, at least from the past fifty years of the Region's growth, is that population growth in a geographic area ceases as soon as it is fully "developed" or urbanized, no matter at what density. Redevelopment, whether private or public, has only rarely produced increases in population—and then rather small ones. Manhattan, despite its boom in both luxury and public housing, today has only two-thirds of its 1910 population.

In other words, within the growing Atlantic Region there will be many sections that will not grow at all. These areas will start facing problems of stability, for which we are in some ways worse equipped than for those of growth. Moreover, it is more than likely that a changing social structure and changing mores will continue the trend in declining birth rates that has been evident nationally since about 1957, so that by the middle of the next century we may be facing—nationally—the adjustment from growth to stability.

B. Regional structure: nucleated vs. spread

An urban area can be viewed—as Karl Deutsch put it—as a machine for communication, an arrangement that enlarges the scope of individual and social contacts and choices. A key measure of its efficiency, on that basis, is how many opportunities for contact it provides within some reasonable limit of time and cost. An illustration of this kind of measure of performance follows.

Manhattan in 1850 had a population density of 100,000 persons per square mile. The average speed of internal movement, which was on foot, was 3 miles per hour. In ten minutes a person could cover a half mile. Within the square of that distance, he could encounter 25,000 people. In the outer suburbs in 1960 the population density was 100 times lower, about 1,000 per square mile, but the speed by auto was 10 times higher, about 30 miles per hour. In ten minutes a person could cover five miles. Within the square of the distance covered in ten minutes, he could encounter 25,000 people. Thus, the "effective density" of opportunities within the square of a distance covered in a unit of travel time was, rather incredibly, the same in congested Manhattan 100 years ago as it is in one-acre lot suburbs today. The arithmetic of that is really quite elementary: a tenfold increase in internal circulation speed buys us a hundred-fold increase in space, if space is what we are after. Incredible or elementary, this is the basic fact underlying the phenomenon of "spread city." A price, of course, has to be paid for space, and it is paid in automobile transportation costs.

It is extremely improbable that a tenfold increase in speed will ever be achieved again for ubiquitous movement at the neighborhood scale, say within ten minutes, for reasons of both physics and physiology. The two basic neighborhood scales, the high-density pedestrian scale and the low-density automobile scale, appear to be here to stay, even if the auto evolves mechanically and perhaps takes off on a guideway after leaving the neighborhood. Clearly, much more study is needed on the detailed design and performance of these two neighborhood scales and on the tradeoffs involved. A policy emphasizing freedom of choice would probably try to perfect three types of neighborhoods: 1) low-density, exclusively dependent on the auto or its successor, where space is the main attraction, 2) high-density, exclusively pedestrian, where freedom from the automobile and the availability of public transportation may be the main attraction, and 3) mixed, combining in some proportion elements of both, as the "new towns" are trying to do.

Even though residences occupy most of the developed land and produce most of the mechanical trips, it is the nonresidential activities that are the key element of a city. A fairly large proportion of them—some 40 percent in terms of employment—are neighborhood-related and are embedded in the residential fabric, whatever its density. It is the large or unique nonresidential facilities that have an extensive market and draw trips from long distances. These make the "hearts" of a region, establish its pattern of nucleation and its major traffic flows.

The location of these large nonresidential facilities is determined by several countervailing forces. Most important among them is the tradeoff between internal scale economies and the costs of access to the market. That is to say, up to a point, a larger facility—a larger hospital, department store, library—is more efficient and can offer more services. If enough people are living within a reasonable travel time of the facility to support its size, well and good. If the surrounding population is too thinly spread or if travel is too slow, size has to be sacrificed and branches established to reduce access costs, to bring the service, even if in a diluted form, closer to the people. This balance of internal economies versus external access costs determines the spacing of facilities, which is clearly dependent on the "effective density" of an area—the people per square minute of travel time.

Once the spacing of facilities is established, there is a tendency for them to cluster either because of functional linkages (e.g., a hospital to a university), or because of joint use of other facilities (e.g., a transit station in downtown or a joint sewage plant in an industrial park), or because of catering to the same clientele (comparison shopping in a retailing district). It is these forces that produced our traditional downtowns. The downtowns, of course, had a monopolistic position with regard to access. The streetcars converged upon them, and they had a railroad station for links to the outside world. They were compact so that all internal trips could be on foot. The auto with its ubiquitous access destroyed most of these relationships. In spread city, central activities still tend to cluster, but in a very loose pattern that makes either pedestrian linkages or access by public transit virtually impossibile.

Only the largest and densest central business districts can provide within, say, a ten-minute walking distance at least as many opportunities as can be reached by car in the dispersed nonresidential clusters. Significantly, it is these large business districts that do exhibit growth and vitality, whereas the small ones have a hard time competing with spread city.

The number of nonresidential facilities needed over the next fifty years with a population increment of 40 million in the Atlantic Region is impressive indeed if one extrapolates figures calculated for the New York Region, with some adjustment.

Table 6

ILLUSTRATIVE PROJECTION OF NONRESIDENTIAL ACTIVITIES IN THE ATLANTIC REGION, 1965 TO 2020

	Increment required assuming 40 million new residents
1. Rentable office floor space	1 billion sq. ft.
2. Universities, at 45,000 students each	125 universities
3. Hospitals, at 450 beds each	400 hospitals
4. Department stores, at 250,000 sq. ft. each	400 department stores
5. Legitimate theaters	120 theaters

If one seriously faces up to the issue of locating one billion square feet of office space (five times the office space now in Manhattan), 125 universities of the largest size, 400 large hospitals and the same number of department stores, one will clearly see the potential of grouping these in large centers, not dispersing all of them through spread city in the manner of current trends continued. Among the advantages of clustering metropolitan-scale activities in large centers would be:

a) possibility of access by public transportation;

b) convenient meeting for persons involved in frequent face-to-face relations, particularly for high-level office activities, and easier links with supporting services;

c) a more compact labor market, with more choice for employer and employee;

d) wider exposure to opportunities generally, be they impulse-buying, eating in a restaurant, visiting a museum, attending a concert, or taking part in adult education—all of which can be accomplished with one multi-purpose trip to a center, whereas in spread city they require multiple, deliberately planned trips;

e) more people living close to their jobs if the apartments wanted by the people in an area surround the center.

Furthermore, if new centers are built on the bases of redeveloped and enlarged old downtowns, they will immeasurably help the social and racial problems of the old cities by infusing them with new growth and vitality. Thus, with proper organization the magnitude of growth envisaged for the Atlantic Region can become a blessing, rather than a problem.

Perhaps most important, only a center which provides most of the metropolitan activities used by residents of an area will create a genuine metropolitan community capable of organizing what does not spring up spontaneously: culture and sports, community institutions for those in need, for civic betterment and for participation in government. Spread city works against a sense of community and therefore against a sense of responsibility for more than a neighborhood or a school district. The local government—village, town, township or borough—may not even cover the same area as the school district. This lack of relationship to the place is even more true of businesses than of individuals. For example, until the United Fund recently organized county-wide in Westchester, a number of large businesses made little contribution to any local community chest. By contrast, a metropolitan community with a truly functioning "civic center" can provide a framework within which individuals and organizations can act responsibly. Eventually, even political boundaries may be aligned to correspond to the market areas of the metropolitan centers.

The realistic choice, then, is between large centers around which metropolitan communities might form, connected by high-speed ground transportation to the main regional centers (Boston, New York, Philadelphia, Baltimore and Washington), or spread city, with scattered metropolitan activities wrapped around the five regional centers, the only oases of urbanity.

There is evidence that the main regional centers alone in a sea of spread city would not adequately serve many outlying residents who could be served by a closer metropolitan center of their own. For example, a Regional Plan survey of museum attendance in Manhattan indicated that New York City residents attended in disproportionately greater numbers than suburbanites, even though the kinds of people one expects to attend museums most—upper income, highly educated—live predominantly in the suburbs. Similarly, hospitals are being built outside the regional centers as population spreads, but it is a very unusual hospital in these spread-city or suburban areas that is large enough to provide a fully adequate range of services.

A regional structure organized around large, new or revitalized metropolitan centers, with tributary populations of one-third of a million to 1 million (the minimum needed to support a full range of metropolitan services), will clearly not spring up spontaneously. It requires an overriding public commitment and combined government and business decisions. Moreover, it requires objective conditions conducive to centralization.

The dual aspect of the present-day structure of the Atlantic Region was previously described: on the one hand, it is still a chain of metropolitan areas, quite autonomous with regard to commuting patterns, growth rates, and so on. On the other hand, with regard to indices such as gross density or change in gross density in the lower ranges, it has aspects of a continuous belt.

The center structure will be reinforced by:

—the shift in employment toward white-collar jobs

—the preference of the affluent for life and leisure in high-interaction environments (e.g., East Side in Manhattan, Georgetown in Washington)

—the development of new forms of fixed-right-of-way high-speed transportation.

For example, if downtown Philadelphia is within 25 minutes of Wall Street and within 45 minutes of downtown Washington by Gravity-Vacuum Tube (GVT), and if the closest spots with a comparable access advantage are Trenton and Wilmington, clearly most people locating an office in the Philadelphia area will prefer to be within walking distance of the GVT station downtown, not in the suburbs, particularly since via GVT they can also, if need be, get to Friendship airport in 35 minutes or to Dulles in 57 minutes. Thus a high-speed underground transportation system with pedestrian access, such as GVT (Fig. 4), can return downtown or give to a new center the access advantage that downtowns enjoyed prior to the automobile era.

However, spreading tendencies will be reinforced by:

—automation in manufacturing and its continued outward movement to cheaper locations

—the preference of many affluent for life, or at least second-home leisure, in solitary environments (Vermont, Maine)

—the automobile as well as new forms of relatively ubiquitous, fast but low-capacity transportation, such as Short-Take-Off-or-Landing aircraft, whether in air-carrier scheduled service or in the form of air taxis.

For example, if southern Vermont is within an hour of Manhattan by STOL aircraft, rather than within four to five hours by car, it will not only substantially expand its ski resorts, but may also get a considerable influx of second homes, and perhaps even college parks with related research facilities. Intellectual-industrial complexes can well thrive in bucolic splendor if access to the rest of the world is convenient.

IV. DECISIONS TO BE MADE

The decisions to be made in shaping the future of the Atlantic Region will involve all levels of government as well as private business. Many of the issues are national issues, no different from those in other parts of the country. Thus, the problem of lifting the burden of poverty-related services from the budgets of central cities is clearly a national responsibility. And the decision to invest in V/STOL research and GVT also relates closely to federal policy.

The key challenge—gearing up for the building of metropolitan centers instead of for spread city—is an issue of state, local and business partnership. The states' policies on locating their own facilities, such as universities or highways, would have to change to implement a plan of centers. Local land-use controls and taxation procedures will have to change. An active public-private partnership will have to be developed to acquire land, relocate present uses and build.

This paper will focus on those decision areas that involve the Atlantic Region as a whole, those that are neither state nor metropolitan alone nor fully national in scope, but that require cooperative interregional procedures with national involvement. They fall, basically, into two areas: (1) natural resources, (2) transportation and a general notion of regional form.

A. Natural resources

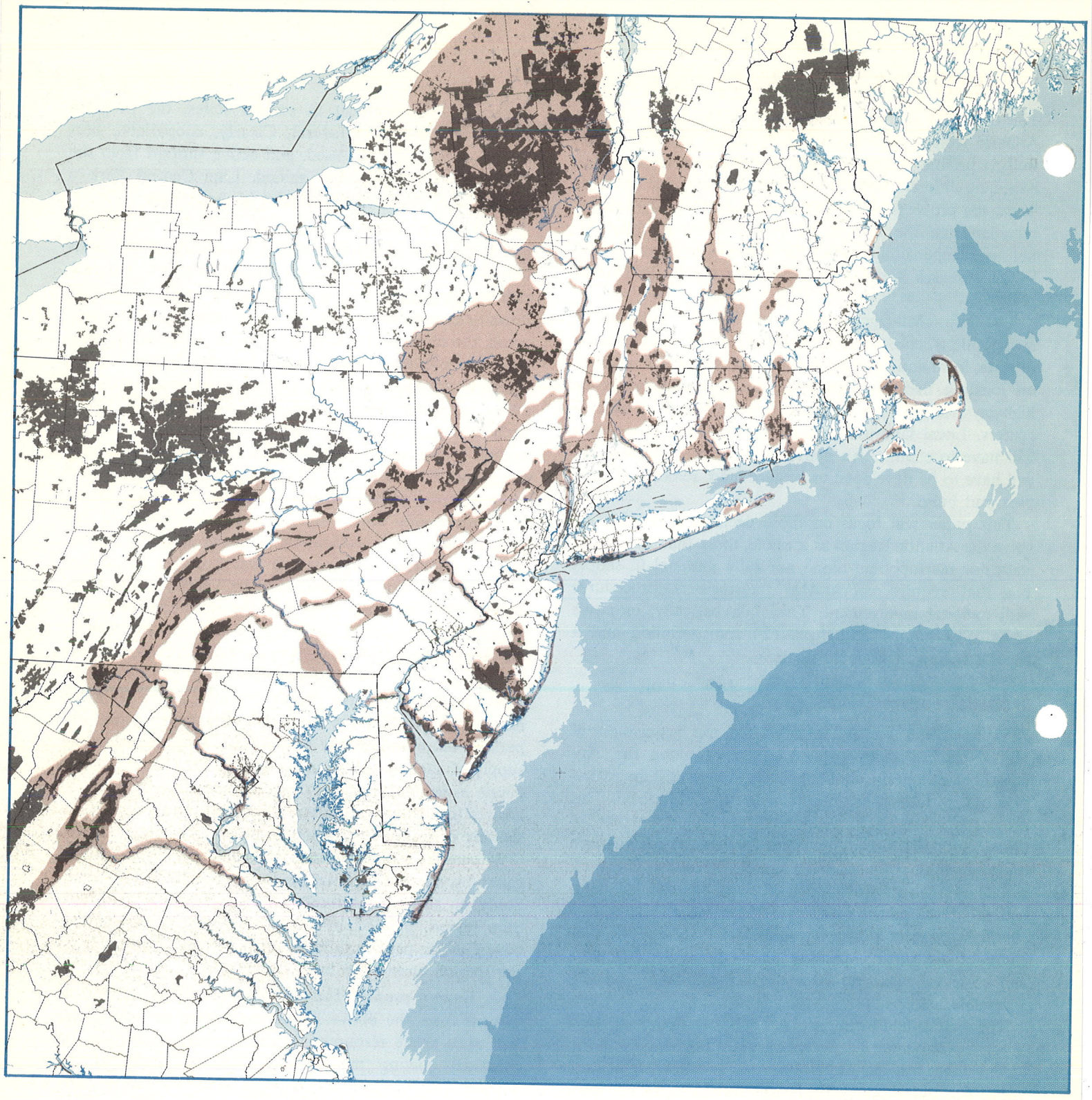
1. Appalachian Park. The need for the acquisition of 10,000 square miles of new parkland along the Appalachian mountain chain, probably at a cost in excess of a billion dollars, has been previously emphasized. This project is of utmost urgency since the outer tentacles of urbanization are already reaching the area, which was in a cycle of rural population decline for decades. The park will lose much of its value if pockets of roadside commercial development are tolerated within it. In fact, a sound investment strategy would start first with the purchase of the most expensive land—along the highways and river valleys—and later the acquisition of the less accessible hilltops.

The park would be in parts of ten States: Virginia, West Virginia, Maryland, Pennsylvania, New Jersey, New York, Connecticut, Massachusetts, Vermont and New Hampshire (Map 6). Even though the States own most of the park and forest land in the area now, as is evident from Table 3, they cannot carry out an acquisition on this scale alone: West Virginia, deep in poverty, cannot justify buying parks that will be used primarily by the residents of Washington, D.C., and Connecticut is in no rush to acquire parks for the residents of New York. Thus, the federal interest is involved. If the proposed 10,000 square mile Appalachian park were to be entirely federal, it would only put one-fifth of the national park acreage where one-fifth of the nation's population lives. On the other hand, because of the large state holdings already in place and active state involvement in several states, the program cannot be exclusively federal. Clearly, cooperative procedures will have to be used, and active support from the coastal metropolitan areas gained. Like Central Park a century ago, this is an investment in the future.

2. Water resource management. Water is an interregional problem primarily because the basins of the fourteen major rivers in the Atlantic Region in no way coincide either with state boundaries or with the economic market areas or commutersheds of the major coastal metropolitan areas, the chief water consumers. While abundant rainfall generally provides enough water for the Region for the foreseeable future, individual metropolitan areas have been importing water from neighboring watersheds for many decades, e.g., New York from the Delaware basin. As population grows, interconnections between basins will have to expand. Basic questions of investment strategy will have to be solved—whether to build expensive facilities to import high-quality water from far away, or whether to emphasize reuse and purification of closer sources. So far, many economists have charged water supply authorities with "overbuilding and underpricing." Since water management begins at the source of the watercourses in the mountains, the issue of water supply is clearly linked with the Appalachian Park development. Issues of multiple use of both the water and the surrounding land will have to be solved. Issues of energy supply are also linked to water management, not only in terms of hydro-electric power but perhaps more importantly in the future with regard to the supply of cooling water for nuclear plants. Nuclear power plants in the Atlantic Ocean have been suggested as one answer to a possible shortage of cooling water and to the scarcity of possible shoreline sites.

A number of these issues are currently being investigated by the North Atlantic Regional Water Resources Study on the federal level. The study's 167,000 square mile region, defined by the Water Resources Council, covers all or part of thirteen states. It is quite similar to the Region considered in this paper.

3. Energy supply. The question of energy supply, as evident from the above, is closely related to both water and open space resources. Water is likely to remain the principal cooling medium for thermal power plants, whether they operate on fossil fuels or nuclear reactors and pumped storage hydro-plants to handle peak-hour requirements will be increasingly needed. Open space will be intruded upon not only by the plants themselves but, more importantly, by transmission lines. The requirement for transmission lines will grow at an even faster rate than the requirement for energy, in part because of mounting pressure to keep increasingly large and increasingly nuclear plants out of major population centers, in part because the existing degree of interconnection between major power plants has proven to be inadequate, as in the Northeast "blackout" of 1965.



6. ATLANTIC REGION
APPALACHIAN PARK PROPOSALS

existing public open space

proposed public open space

A bill "to authorize the Secretary of Interior to study the feasibility . . . of establishing a park system within the Atlantic Urban Region" was introduced in Congress by Congressman William F. Ryan on July 22, 1969. (H.R. 13040) It proposes the authorization of $300,000 to develop detailed recommendations on the type of Federal program that is desirable to preserve, develop, and make accessible the scenic, scientific, historic, outdoor recreational and natural values of the area along and east of the Appalachian Mountains between Boston and Washington.

1970-1990 electric power requirements for the Northeastern United States have been projected by the Federal Power Commission's Northeast Regional Advisory Committee. Its area of jurisdiction, somewhat larger than the Atlantic Region, includes the New England Power Pool (NEPOOL), the New York Power Pool (NYPP) and the Pennsylvania-New Jersey-Maryland Interconnection (PJM). These three represent a regional combine of electric utilities that works closely with neighboring power systems in Canada and the United States.

The area's energy requirements for 1990 are estimated to be 914,700 million kilowatt hours, more than triple the 282,520 million kilowatt hours expected in 1970, and the forecast peak load will increase proportionately. To satisfy this demand, FPC Advisory Committee recommends an increase in regional generating capacity from 62,347 megawatts in 1970 to 213,420 megawatts in 1990. Thus, in 20 years the electric utilities will have to build two and one-half times as much capacity as they built in the past 80 years; the cost is estimated at $50 billion. It is expected that nuclear power will account for 58 percent of the Region's generating capacity by 1990, as against 1.1 percent in 1966, and that conventional coal and oil burning plants will decline to 24 percent from the present 89 percent.

To distribute this power, a new network of 5,400 miles of extra-high-voltage (EHV) transmission lines is envisaged, its backbone being a three-quarter-million volt line from southern Maine across New Hampshire, Vermont, and upstate New York to Lake Erie, with connections through southern New York, southwest Connecticut, Rhode Island and central Massachusetts.[1]

One should note, parenthetically, that EHV power transmission lines do not have to be aesthetically objectionable: the towers can be well-designed and the lines can be appropriately located with regard to topography and patterns of vegetation. Existing medium to high voltage transmission lines are visually objectionable either when too many lines are clustered closely together (a maze of towers and wires, as in some parts of New Jersey) or when clearings for transmission lines cut indiscriminately across forested hilltops, instead of following valleys and fields. Of course, there are areas of exceptional natural beauty where no visible man-made intrusions should be allowed; notably, in connection with the Storm King Mountain pumped storage project controversy, the proposal was eventually made to put not only the power plant completely underground, but also to put the feeder lines into an underwater cable in the Hudson River. Clearly, in order to build a network three times as powerful as the present one, a high degree of coordination with various aspects of natural resource planning and conservation will be required in locating both the new generation stations and the connecting power lines. In built-up areas, increasing emphasis will have to be placed on underground location—not only of unsightly low-voltage lines in local neighborhoods, but also of the high-voltage transmission lines.

B. Transportation

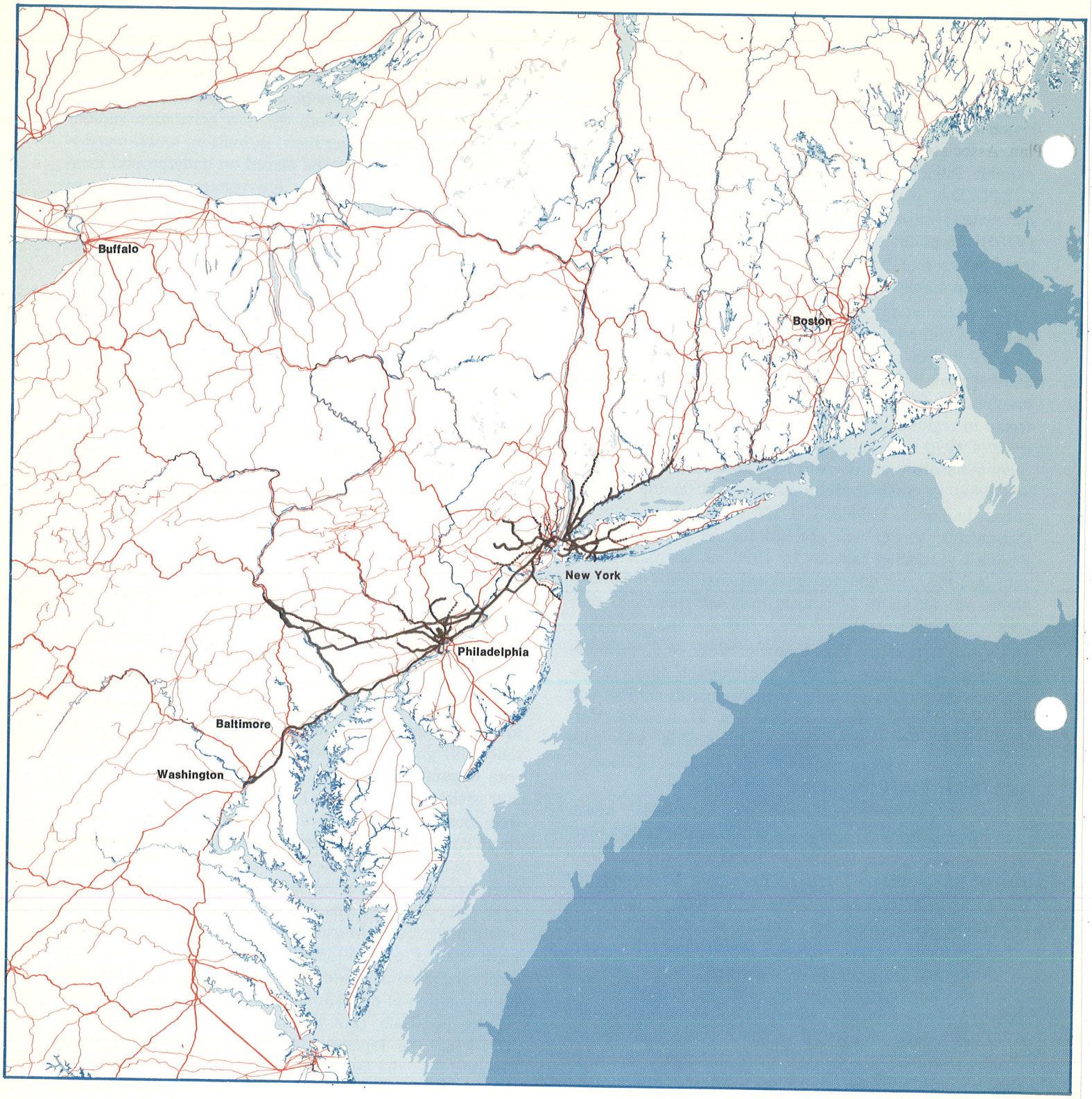
The three most important types of transportation facility which, because of their external effects, have to be considered in the context of the entire Atlantic Region, rather than by individual metropolitan areas, are the railroads and possible new forms of high-speed ground transportation, the airports and airways, and the limited access highways. Though decisions with regard to water and pipeline transport can also have inter-metropolitan implications (e.g., which port gets what share of the business), only the former three will be considered here, primarily with passenger movement in mind.

1. Rail and new forms of high-speed ground transportation. The dramatic increase in the performance of the automobile transportation system (in terms of speed, capacity, accident rates) that was occasioned by the construction of limited access highways in the 1950s; the then existing threat of traffic congestion in the air; and the concomitant drastic decline in rail passenger patronage: all focused the attention of many on the railroads as a potentially still great, but grossly underutilized, resource. For with manual operation, the freeways, with a capacity of 500 vehicles (750 persons) per lane per hour at 60 mph, were pushing the limits of the possible. A doubling of speed could not be foreseen again in the near future; what could be foreseen instead was either more and more lanes of freeway to maintain the newly gained standard of speed, or a reduction in speeds due to increasing volume on the newly built roads. Meanwhile, the French, in an experiment with a conventional electric locomotive on good tracks achieved a record speed of 205 mph in 1955, and the reputation of the railroads for carrying over 1000 passengers per train (not per hour) was well established. And while the Japanese were designing the high-speed Tokaido line, the fact that top speeds on American railroads had remained static at 60-90 mph for half a century became increasingly incongruous. It seemed clear that with investment in new plant and equipment, the railroads were capable of capturing a large share of the trips under 300 miles in length on high-density routes, and of carrying them more efficiently than autos, buses or airplanes. The extensive railroad network of the Atlantic Region (Map 7) increasingly appeared to be a valuable resource going to waste,[2] partly due to accidents of politics and economics peculiar to the United States.

Public consideration of high-speed rail transportation in the Atlantic Region dates back at least to 1962, when

[1] **Electric Power in the Northeast, 1970-1980-1990,** Federal Power Commission, Washington, D.C., February 1969.

[2] For a development of this argument, see: Dick Netzer and Boris Pushkarev, **Issues in Megalopolitan Transportation and Regional Development along the North Atlantic Seaboard** (RPA internal memorandum, October 1963, 18 p.) and **High Speed Railroads,** a Statement presented to the United States Senate Committee on Commerce, **Regional Plan News No. 79,** August 1965.



7. ATLANTIC REGION
RAILROADS

- freight
- passenger and freight
- electrified
- proposed electrification

Senator Pell of Rhode Island introduced a resolution in Congress proposing a multi-state authority to improve rail service in the Northeast Corridor (in June), and Regional Plan Association urged 200 mph rail service along the coastal mainline as a goal (July).[1] In October 1962, Senator Pell requested that the Administration provide assistance in analyzing the problem pointed to in his resolution, and an interagency task force assembled in response recommended that a ". . . comprehensive analysis of transportation problems in the Northeastern Megalopolis . . ." be carried out by the Department of Commerce. Studies began in June 1963, and in September 1964 they were given formal status as the Northeast Corridor Transportation Project. The High-Speed Ground Transportation Act of 1965, enacted by Congress in October of that year, established the Office of High-Speed Ground Transportation (OHSGT) first in the Department of Commerce, later (1967) in the new Department of Transportation. Moderate funds were provided for research and demonstration projects. Though the demonstration projects described in the legislative background were to be in the Northeast Corridor, the program was to be national in scope and was to include technologically new modes, not just railroads.

Tangible results first came in January 1969 when limited "Metroliner" service was inaugurated between New York and Washington. "Metroliner" trains consist of self-propelled high-performance electric cars capable of 160 mph top speed. They are built by the Budd Company for operation on the Penn Central railroad with OHSGT demonstration project aid. The "Metroliners" cut the New York-Washington scheduled time from 3½ or 4 hours to 3 hours with five stops and 2½ hours non-stop. This represents an average speed of 75 mph with stops and 90 mph non-stop, and the top speed generally does not exceed 120 mph. The improvement was achieved at the modest cost of about $56 million, much of it chargeable to the Penn Central's upgrading of its roadbed to maintenance standards customary on many other railroads in the United States.

Still the "Metroliner" equipment cannot achieve its full potential on the existing Penn Central tracks due to numerous speed restrictions—in the form of sharp curves, movable-span bridges, yards, several grade crossings in Maryland—and also due to the fact that the existing electrical catenary is not suitable for higher speed operation. Removal of these restrictions would involve considerable expense, as shown in Table 7.

It is evident that costs rise steeply with increasing speed. Additional reductions in travel time, beyond the values indicated above, would be purchased at rates as high as $60 million per minute saved, as indicated by the Klauder studies. Thus, while a 5½ hour schedule from Boston to Washington (as compared to an 8½ hour schedule in 1968) can be purchased for $800 million, a 4 hour schedule would be in the order of $2 billion. Moreover, there is a question whether train operation at these high speeds would be compatible with freight movement and other conventional rail operations.

Table 7

CAPITAL COST OF BOSTON-WASHINGTON RAIL IMPROVEMENTS

New York-Washington with Four Stops (in 1965 prices)			
Travel time	2½ hours	2¼ hours	2 hours
Maximum speed	125 mph	150 mph	150 mph
Estimated capital cost	**$330 million**	**$450 million**	**$765 million**
New York-Boston with Six Stops			
Travel time	3 hours	2¾ hours	2½ hours
Maximum speed	125 mph	150 mph	150 mph
Estimated capital cost	**$470 million**	**$590 million**	**$700 million**

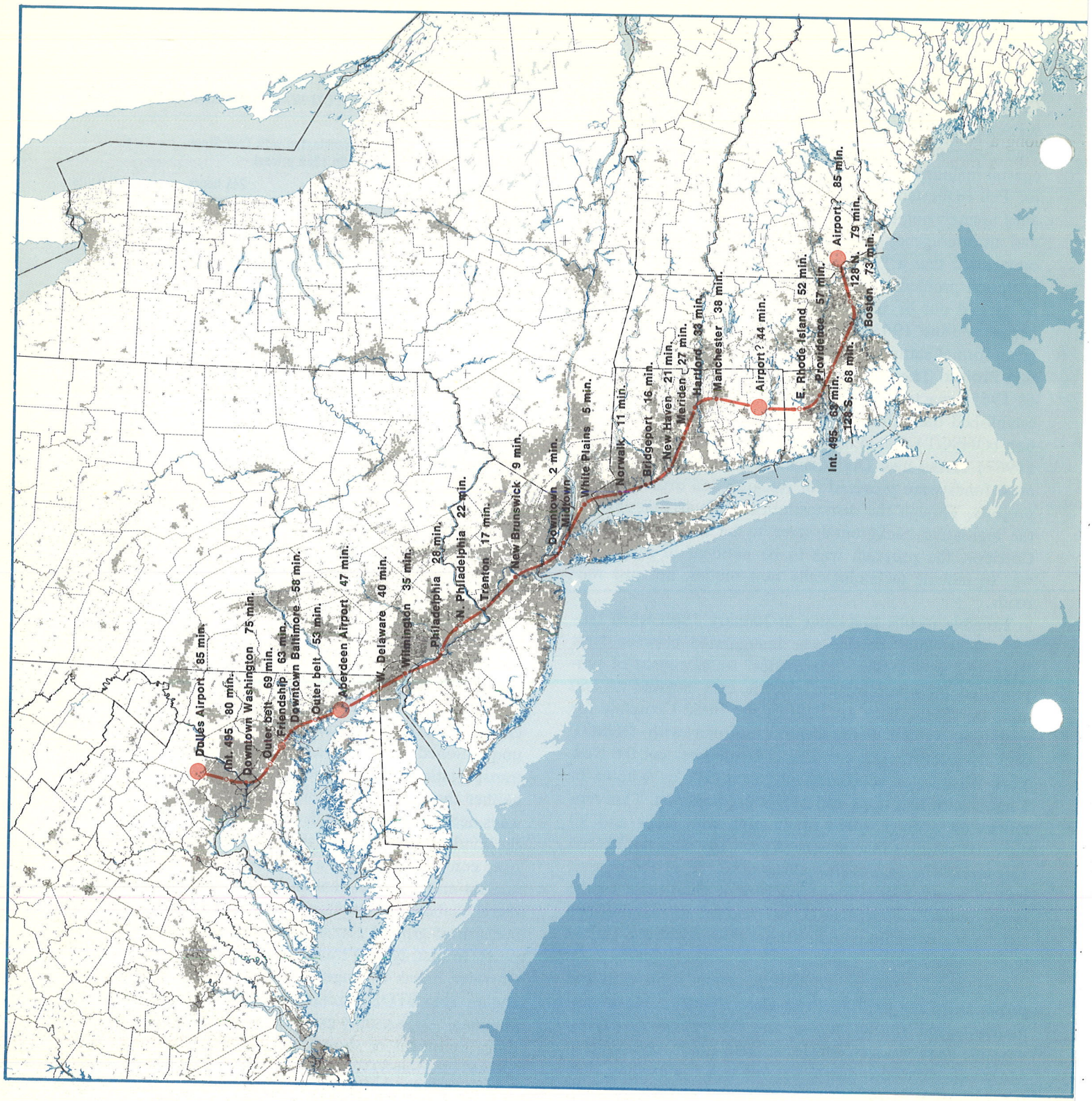
Source: Louis T. Klauder and Associates.

Nevertheless, the value of a truly high-speed ground link, competitive with air travel, is widely recognized. It can greatly facilitate the functional face-to-face linkages in the Atlantic Region—those between the government center in Washington, the business center in Manhattan, the educational, cultural, research and industrial centers along the way and even the smaller downtowns along the way, bypassed by the jet age. It can, if properly planned, give access to airports and mold the chain of cities along the seacoast genuinely into one Region.

The development of urban centers in an auto-oriented environment is an uphill fight unless they are given an unquestioned access advantage. Truly high-speed ground transportation can provide such an advantage which neither the auto nor the airplane can. New parallel freeways needed to accommodate more traffic will not produce the kind of time savings that freeways initially produced over conventional highways or over rail trips with inconvenient origins or destinations. Short-haul conventional air travel, inherently inefficient, offers no speed increases because of ground access time and congestion at the airports. In fact, typical travel time by jet on some Northeast Corridor flights is longer now than it was in the piston-engine era. STOL aircraft, inherently slower than conventional jets, are only expected to match present air travel times by means of shorter flight-paths and shorter access time to close-in STOLports.

What next in high-speed ground transportation? Three basic concepts are being advanced. One is an evolution of the automated highway whereby a dual-mode vehicle would collect passengers near their doors, plug itself onto an automatic guideway for an interurban trip at very high speed, unplug itself near a predetermined destination, and deliver its passengers to the other door with no changes in mode. Though it sounds plausible, this concept is farthest from engineering reality for top speeds in excess of 100 mph. The thorniest problem is safe hook-up and decoupling at high speed, as well as the scheduling of gaps in the traffic stream to insert vehicles entering the guide-

[1] **Report of the Meeting on Megalopolis,** Twentieth Century Fund—Regional Plan Association, July 19, 1962, 5p.; **The New York Times,** July 30, 1962.



8. ATLANTIC REGION
ILLUSTRATIVE GVT LINE

GVT

future developed land

possible airports

way. Nor is there any clear notion of how the vehicles would be propelled at high speed, or what the guideway would consist of. Carrying a multitude of small vehicles along a guideway at high speed for long distances is generally a rather inefficient proposition.

A more tangible concept for high-speed long-distance travel is the Tracked Air Cushion Vehicle (TACV). A prototype has been running in France for several years, and the U.S. Department of Transportation proposes to build a twenty-mile test track for further development work in this country. The concept is that wheels and rails on a conventional railroad become unreliable at speeds over 200 mph and should therefore be replaced by a cushion of air.

The difficulties with this type of vehicle are manifold:

a) It has high power requirements for speeds in the 200-300 mph range, on the order of 8,000 to 12,000 horsepower for a 100-passenger unit, which is comparable to about five diesel locomotives. If supplied by gas turbines, this kind of power raises very serious objections to community acceptance (noise and fumes), to operation in tunnels, and to the capability, for aerodynamic reasons, of running the vehicles in trains. Hopes are therefore pinned on the development of the linear electric motor (one without rotating parts) which would eliminate some of these objections. However, electric motors operating the air cushion compressors would still need power pickup, and that, too, remains unsolved for speeds in the 200-300 mph range.

b) The vehicle is very susceptible to a multitude of disturbances, such as high cross-winds (which may force it to be 14-20 feet wide), unavoidable roughness of the guideway, snow and ice. To stablize it with regard to both lateral loads and vertical vibrations, a highly complex "secondary suspension" system is indicated, acting in both directions. This, of course, adds to mechanical complexity, maintenance cost, and susceptibility to breakdowns.

c) If there is no capability to run the vehicles in trains, line capacity, even with highly sophisticated signalling, is probably limited to less than 5,000 per hour. This is insufficient for airport access when jumbo jets are operating.

d) Perhaps the overriding objection to Tracked Air Cushion Vehicles is the difficulty of incorporating the guideway into the urban environment: for high speeds, the alignment has to be rather straight (a 5-mile minimum radius is indicated); the width of the guideway will be considerable (35-55 feet for two tracks), making elevated structures very bulky; the cross-sectional area of tunnels (and their cost) would have to be huge if high-speed operation in them is to be considered.

e) It has problems of safety (including vandalism) and all-weather reliability, though they are shared by all surface systems.

The latter two considerations (compatibility with a built-up urban environment and safety and reliability) naturally point underground, particularly as substantial advances are made in tunneling technology. A number of proposals have been made, some involving air-breathing vehicles, but most focusing on the operation of trains through evacuated underground tubes by a combination of gravity and either linear electric or pneumatic propulsion, with the trains supported either by specialized types of wheel or magnetically under cryogenic conditions. The only one of these systems which is now under active development is Gravity-Vacuum Transit (GVT), which merits more attention. It involves the propulsion of wheel-supported trains through intermittently evacuated underground tubes of variable depth by a combination of gravity and pneumatics. As currently envisaged, the system could achieve top speeds of up to 420 mph and operate with stations spaced anywhere from one-half mile apart to 30 miles apart. This makes it suitable for urban transit purposes in the larger metropolitan areas, replacing or supplementing conventional subways, for airport access, and for interurban trips in the Boston-Washington range.

Some of the distinguishing characteristics of GVT are:

a) It accelerates on an inclined plane (or on a pendulum path) with the aid of gravity, enabling it to develop an actual horizontal acceleration roughly twice that which passengers inside the vehicle feel. Thus, within any given comfortable acceleration criterion, substantially higher actual acceleration is possible than any horizontal or surface system can possibly achieve. This is especially important for lines with frequent stops, where a major proportion of travel time is spent accelerating and decelerating.

b) It is highly efficient with regard to energy consumption. It needs about one-fifth the energy per passenger of an air cushion vehicle. Roughly 70 percent of the energy needed to propel it is borrowed from the earth's gravity as the train speeds downhill and is fully recovered (without losses in braking) as it climbs uphill. The pneumatic energy stored in the evacuated tube is produced by stationary electrical pumps working continuously, in contrast to on-board electrical motors which must operate in bursts. The need for power-pickup is avoided.

c) Being able to operate in trains, the system has high capacity (15,000-30,000 seated passengers per hour), with capacity limited primarily by train length and by the distance between stations (headway is limited to the longest running time between two stops). During seasonal peaks or on short runs of a few minutes, it is capable of handling passenger overflow by allowing a comfortable ride for standees (accelerating rates becoming slower with added passengers) and thus precludes the need for reservations. No other system has yet been devised which shows such a combination of high capacity and high speed with frequent intermittent stops.

d) By employing a very compact cross-section (less than two-thirds that of a conventional subway), it brings the expense of deep-level tunneling within reason: about $3.5 million per mile in hard rock with conventional technology, though in some urban situations the cost may climb to the neighborhood of $6 million per mile.

e) It shares with all underground systems compatibility with high density urban places—little conflict with surface development, lack of right-of-way acquisition problems, lack of environmental pollution with noise and fumes. It can enter existing or new urban centers right at the "100 percent location." It also is weatherproof.

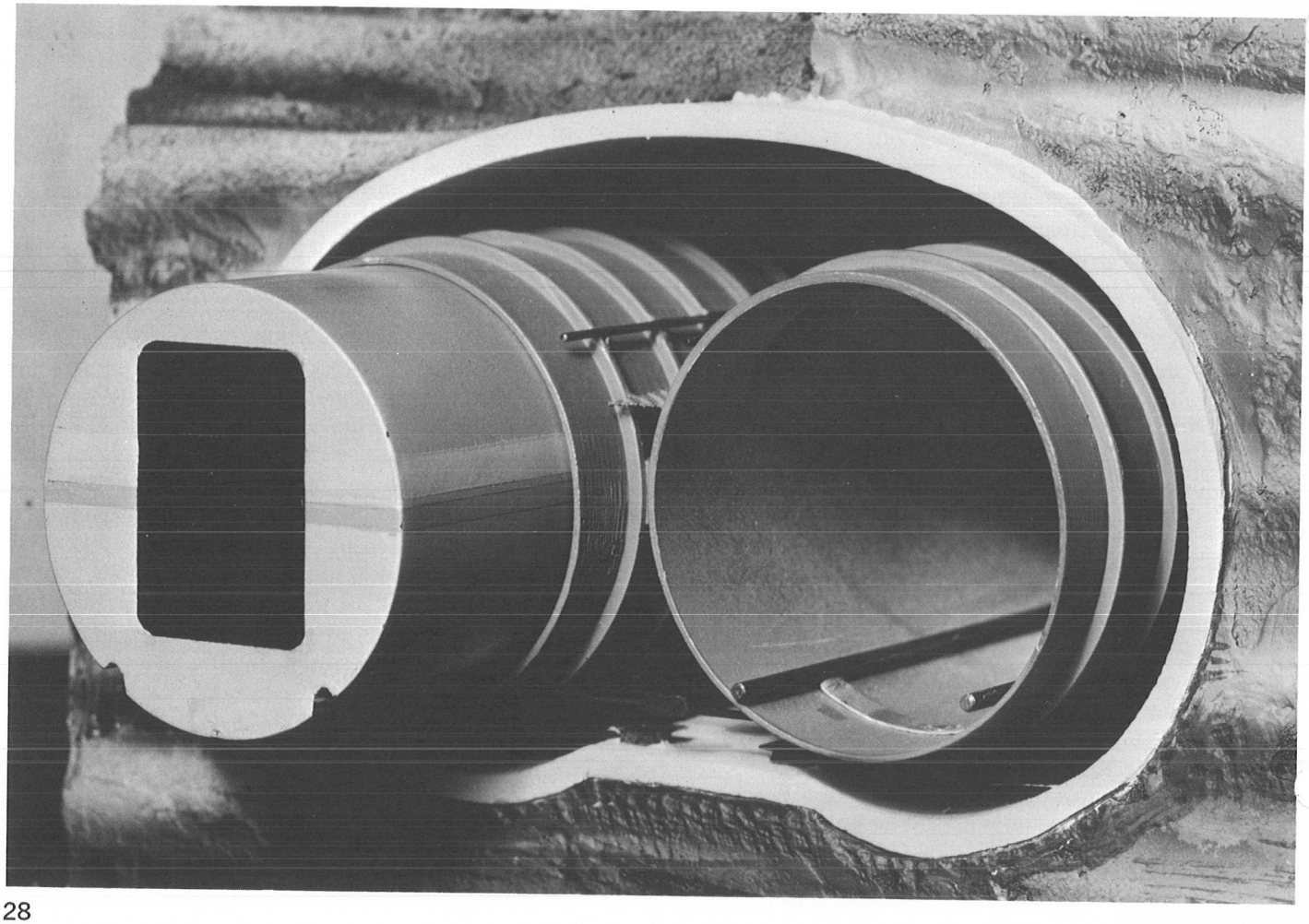
Such overwhelming advantages are not purchased free, and the system has its limitations. The location of stations is permanent and cannot be changed short of building a new tunnel: the system is incapable of branching and must operate in discrete two-way lines, with pedestrian transfers at junctions; the use of the same track for both express and local service is not possible. The system is suitable, basically, for point-to-point transportation in large or high-density urban areas and requires appropriate interchange points with the auto or other feeder systems. It is not a system to serve spread city. But it is highly appropriate for an Atlantic Region of linked metropolitan centers, which it would help to bring about as well as serving very satisfactorily.

An illustrative GVT alignment in the Boston-Washington corridor, with multiple stops to serve smaller metropolitan centers as well as existing and possible airports, is shown on Map 8. For this type of a configuration, the following performance characteristics are indicated in Table 8.

With **twelve** intermediate stops, a high-speed train on an ideal reconstructed alignment allowing top speeds of 125 mph could not achieve an average speed above about 90 mph; a Tracked Air Cushion Vehicle with a top speed of 300 mph and with twelve intermediate stops would be unlikely to exceed 120 mph on the average, compared to 175 mph for GVT.

Regional Plan Association has urged the construction of a $10 million full-scale GVT test facility to demonstrate the feasibility of the system and to solve engineering problems of accurate alignment, valve design and noise insulation. All metropolitan areas of the Atlantic Region have a high stake in such a demonstration. It appears that such a strategic investment in research and development would bring more immediate and tangible benefits than the kind of generalized and diffuse research that is being conducted in the field now. The actual development of the hardware,

Figure 4
CUT-AWAY MODEL OF GVT TUBE AND TRAIN



possible within a few years, would have to be supplemented with related studies of:

a) the impact of a high-speed point-to-point system on land values and urban form;
b) its impact on trip-generation and trip-diversion;
c) the interchange with feeder modes;
d) location to best serve the needs of the Atlantic Region;
e) multiple use of the high-speed tunnels.

With regard to the latter point, it should be stressed that with a marginally greater investment, tunnels serving high-speed passenger travel can also accommodate:

a) Circular electric waveguides, which have been advanced as the next step in the technology for transmitting telephone messages, picturephone, television and other electronic information from one city to another. Such waveguides must avoid sharp bends and be located in a protected environment. Later, laser beams may be introduced for still higher capacity.
b) Pneumatic tubes for the rapid transmission of mail, packages, newspapers, magazines and the like. In the heart of the city, these tubes may depart from the passenger line and go directly to post offices or other distribution points for convenient loading and unloading.
c) Possibly, electrical power lines. Technology has already been developed for carrying three-phase current at 345,000 volts through ten-inch diameter steel pipes laid underground. Six such pipes in a tunnel would have a combined capacity greater than the Grand Coulee Dam.

Table 8

GVT CHARACTERISTICS FOR AN ILLUSTRATIVE BOSTON-WASHINGTON ALIGNMENT

Maximum speed	420 mph
Average speed, including stops, with stations on the average 16 miles apart	175 mph
Capacity with 2,460-foot trains, 8 trains per hour: seats	18,000 passengers/hour
standees	18,000 passengers/hour
Maximum felt acceleration, seats filled	3.3 mph/s
Maximum depth of tunnel (with stations more than 15.6 miles apart)	3,500 feet
Maximum slope of tunnel	10%
Schedule time, downtown New York to downtown Washington, with 12 intermediate stops	1 hour 12 minutes

(By cutting the number of intermediate stops from 12 to 6, the New-York-Washington travel time would be reduced to just over 50 minutes.)

Source: Tube Transit, Inc.

2. Airport location. Closely related to the issue of high-speed ground transportation is the issue of airport location. Airports serve people and are thus most useful when located close to the centers of population and economic activity. On the other hand, because of the noise problem, they are most obnoxious when located close to population centers. A modern four-runway airport used by long-haul jets would, in the absence of noise abatement procedures, intermittently subject an area as large as 240 square miles to noise levels in excess of 90 perceived noise decibels. (Conversational speech takes place in the range between 58 and 84 decibels and therefore is difficult with 90 decibel noise.)

At present, the Atlantic Region is served by nine major airports, with the following annual passenger volumes (1967):

Kennedy Airport, New York	20.0 million
National Airport, Washington	8.5 million
La Guardia Airport, New York	8.1 million
Logan Airport, Boston	7.2 million
Newark Airport, New Jersey	6.1 million
Philadelphia Airport	4.6 million
Friendship Airport, Baltimore	2.0 million
Dulles Airport, Washington	1.3 million
Hartford-Springfield Airport	1.2 million

Thus, in 1967 the nine major airports had a combined annual passenger volume of 59 million—34 million, much over half, concentrated at the three Port of New York Authority airports, Kennedy, La Guardia and Newark. In the rapidly expanding air transportation field, where projections over more than five years usually have proven wrong, projections over fifty years would be extremely conjectural. Nevertheless, given present relationships between population, income and air travel, a more than tenfold increase in air passengers at the Atlantic Region airports can be foreseen by 2020. Though this would pose no special problems for Dulles, which, even with a tenfold increase in passengers, would operate far below the present level of Kennedy, the pressures on the total airport and airspace system in the Atlantic Region would be staggering, especially in the New York area.

The simplistic notion—"there will be more traffic—let's build more airports"—does not hold for more reasons than the resistance of people to widening the areas of noise. A distant new airport, poorly accessible to the market it is supposed to serve, will get little use, as Dulles has demonstrated. Consequently, it will provide little relief for the congested airports near the urban core (witness National). New York, for example, could build a new airport in Orange county, 56 miles north of Man-

hattan, or near the tip of Long Island, some 77 miles east; these would be useful to the relatively few local residents, but without compulsory diversion of trips, they would divert less than 10 percent of the passengers from existing airports.

There are other drawbacks that result from increasing the number of major airports in a relatively confined geographic area.

First, to quote a report of Airborne Instruments Laboratory, a leader in the field of air traffic control, ". . . it is an axiom of air traffic control design that existing airports should be used to their maximum before building a new airport because the complexity resulting in the airspace by the addition of another airport is great compared with the increase in capacity that results."

Second, an airport is no better than the ground access to it and the frequency of service it offers. Expanded capacity at an existing airport means either more flights to the points its serves, hence greater convenience to passengers, or, if frequency is already adequate, bigger planes on the same schedules, which means greater economy to passengers, airlines and public investment in airports and ground transportation. In order to divert passengers from existing airports, a new airport must try to match their frequency of service. In view of the smaller tributary population of new outlying airports, this means either emptier planes or smaller planes, both of which are uneconomical. Thus, a new airport increases the number of airplane movements (hence airspace congestion and airline operating cost) without improving the cost or the frequency of the air trip itself. Transfer arrangements are also made more difficult.

Of course, these costs may be balanced by the benefits of reduced ground access time for those who live or will live beyond the convenient range of existing facilities. Or costs may be substantially lower than for expansion of existing facilities. Systematic exploration of the full costs of alternative arrangements are needed, including the airline operating costs, the schedule convenience, the passenger access costs, the environmental costs and lastly the direct costs of construction, which all too often have been the only element taken into account. What is needed for the Atlantic Region is precisely such a comprehensive exploration of the future of its airport system.

Since it is impossible to acquire a 240-square mile buffer zone around airports to protect against noise in the developed part of our metropolitan areas, three solutions that minimize both access and disturbance costs are possible:

a) expansion of existing airports;

b) airports located in water (e.g., Boston Harbor, Long Island Sound, the Atlantic Ocean in shallow parts), relatively close to the shore of metropolitan areas where water is available;

c) airports located in areas likely to remain permanently rural, 50-100 miles from a city center, but linked to the city center and to suburban stations by a very high-speed underground link that could still insure access times of about half an hour (e.g., eastern Connecticut, the Delaware River, central New Jersey, Aberdeen).

Inter-metropolitan airports with interurban high-speed underground links such as GVT require inter-metropolitan cooperation in planning. The total number of airports in the Atlantic Region is at issue here as well.

With GVT even eastern Connecticut and Aberdeen would be within about 45 minutes of Manhattan. High-speed access to outlying sites offers the eventual option of phasing out close-in airports with excessive community disturbance, such as Washington National Airport.

Regardless of which of these options or which combination is eventually chosen, it is clear that all metropolitan areas of the Atlantic Region have a stake in measures that would maximize the efficiency of existing airports.[1] These include:

a) **Separation of general aviation aircraft from the major air carrier airports, especially during peak hours.** Prior to the institution of new pricing policies, general aviation at the three New York airports accounted for over 26 percent of aircraft movements but carried only 2 percent of the passengers. Thus, 2 percent of the users preempted over one-quarter of the available airport capacity, without paying a proportionate fee for its use. Sound pricing suggests that airport landing fees be scaled to the scarce resource in question—the runway occupancy time—not so much to the size of the airplane. Such measures are clearly unpopular with the owners of private aircraft but are much less costly to the public than the construction of new airports.

b) **Development of an airspace and airport system for V/STOL (Vertical- or Short-Take-Off and Landing) aircraft for air taxis and local airline flights within the Atlantic Region.** As many as 43 percent of all airline flights from New York's three airports are now to destinations less than 250 miles away. These flights account for about 23 percent of all domestic and overseas passengers. This represents another, if less dramatic, case of inefficient utilization of the big runways at major airports. STOL aircraft are expected to take off and land on runways no more than 2,000 feet long, compared to the 6,000-14,000 feet needed for large jets, and VTOL aircraft will need landing pads of only a few acres. V/STOL aircraft are expected to be economically competitive on flights some 70-300 miles long and to generate less noise. The insertion of V/STOLports into the urban fabric, though not easy, presents fewer problems than the construction of new jetports and offers very significant increases in airport capacity for those flights which have no alternative to using the major airports.

[1] **The Region's Airports;** a policy on air travel for the New York Region. **Regional Plan News No. 89,** July 1969. 39p.

c) **Development of federal policies on airline scheduling and airline mergers that would take into account their effect on airport capacity in the major metropolitan areas and encourage the use of larger aircraft.** Larger aircraft, far from being the bane that some journalists make it to be, is one of the strongest factors in reducing the need for new airports. Had aircraft size in 1969 remained the same as it was in 1949, we would now need three times the runway capacity we are presently using. Yet, in its jurisdiction over the assignment of competitive airline routes and the merger of competing airlines, the CAB is at present under no legislative mandate to consider their effect on airport capacity and the patterns of urban development. The average number of passengers per airplane is expected to roughly double between 1968 and 1980 at the New York airports, from some 52 passengers per plane today to about 100 in 1980. Under the purely hypothetical assumption that it were to triple, no added plane movements at all would be required to or from New York by 1980, even under the highest passenger projection. The key factor in the number of passengers per plane, is, of course not the ability of manufacturers to produce bigger planes, which is practically unlimited, but rather the route structure and the scheduling of the airlines, which are, or can be, matters of public policy:

—non-stop service to how many small cities?
—what frequency of service to big cities (every hour? every half-hour?)
—how many competing airlines offering service at roughly the same time to the same places?
—how many airports in one metropolitan area?

All of these issues, along with the more conventional ones of increased runway and airway capacity through improved air traffic control instruments and procedures, will have to be resolved on a national basis.

3. Limited access highways. A dominant element of regional structure and form in the lower-density parts of the Atlantic Region is the system of limited access highways, which appears on Map 9. The Atlantic Region, which in 1965 owned 18.5 million motor vehicles (20 percent of the national total), presently has about 6,200 miles of limited access highways, both Interstate and other, (roughly one-quarter of the national total). This somewhat higher proportion is not surprising historically since the construction of limited access highways on the North American continent began in the Atlantic Region some four decades ago, and as late as 1950 more than half the nation's limited access highways were concentrated in the Atlantic Region.

Location and design are basically the responsibility of the individual states, subject to the wishes of the metropolitan areas. Yet, as the system expands, its parts are becoming increasingly interrelated. The outer circumferential route around Boston doubles as a circumferential route around neighboring Worcester and Providence as well. The outer rings around Washington and Baltimore get enmeshed into a joint grid. A duplication of the New Jersey Turnpike some 15 miles to the southeast cannot become a reality without tying into long-range plans in New York, Delaware and Maryland. And the extensive systems proposed by Vermont and New Hampshire to develop their economies do not make sense unless Massachusetts provides connections.

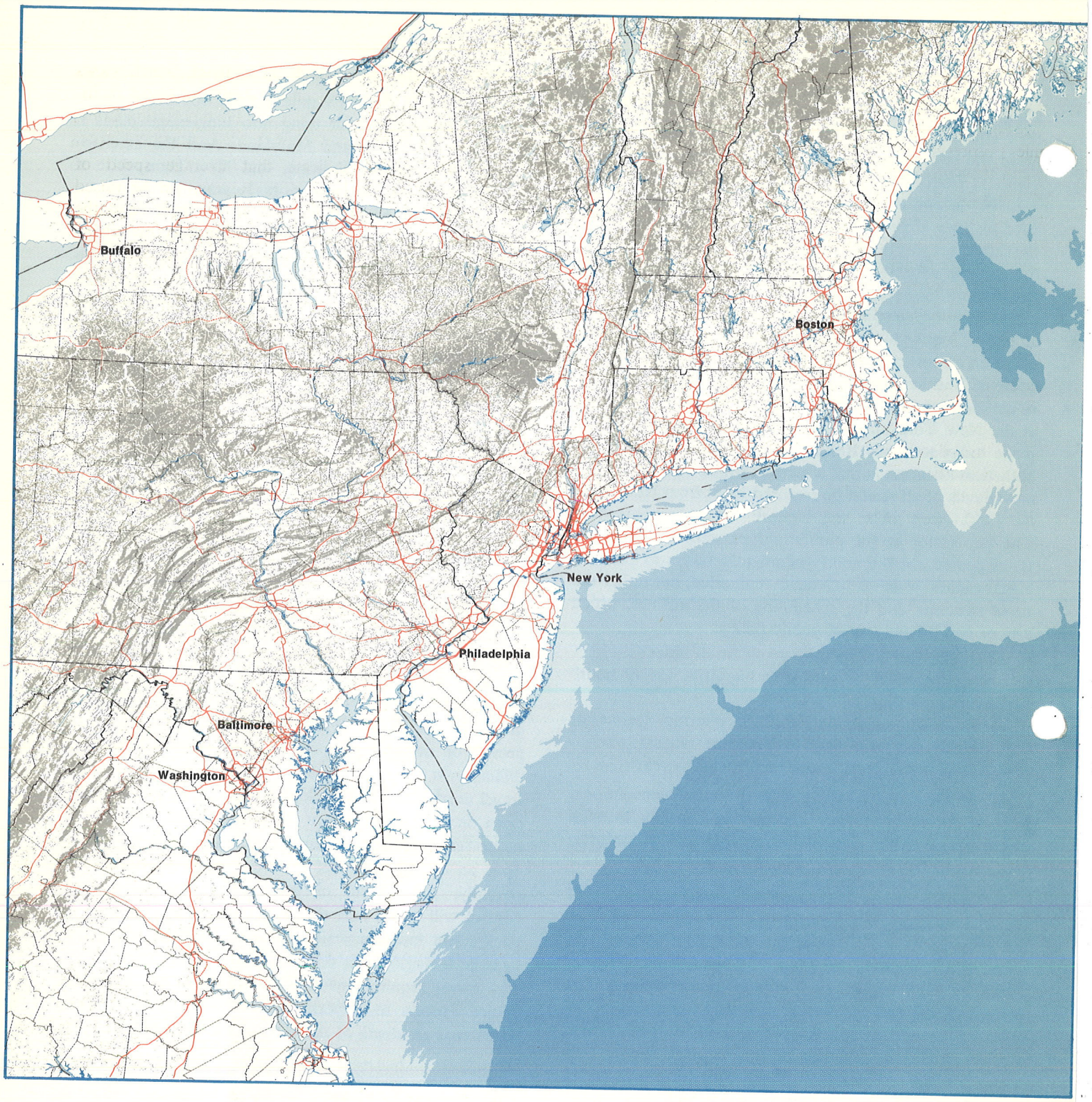
From the viewpoint of planning limited access highways, the states of the Atlantic Seaboard are increasingly becoming one Region. Yet apart from procedures that apply across the nation, there is no formal body to coordinate their plans as a whole and to design the future highway map of the Region as one entity. Federal law requires regional planning approval, but the Atlantic Region includes several of these regions. The resulting piecemeal design becomes increasingly confusing on a map, losing not only essential aesthetic urban design values, such as geometric clarity and a harmonious relationship to the natural geography, but also losing confused motorists at interchanges.

Beyond the immediate issues of clearer routing, better spacing, and a coordinated layout of the Atlantic Region freeway map as a whole, there are longer range issues of the magnitude of future freeway requirements and their relationship to the kind of Region we intend to build. With present population growth rates and vehicular traffic doubling every fifteen to twenty years, are we prepared to meet the year 2020 with a sixfold or more increase in motor vehicle traffic? It will be fairly easy to provide for growth on newly developed land, but there will be great difficulty in further expanding the capacity of the main travel corridors, be it by double-decking, as is now being done on a short section of the Long Island Expressway, or by "dual-dualization" to twelve lanes, as is now being done on a long stretch of the New Jersey Turnpike. Apparently, some form of automatic or semi-automatic control will come into the play to increase freeway capacity. But more basically, we have to think about how to build a Region that does not endlessly proliferate highway travel requirements and yet provides the degree of choice (access to opportunities within a unit of travel time) that residents of the Region are coming to expect.

Four considerations are germane to this issue:

a) **Per capita highway travel in residential areas increases as density declines.** Higher residential densities imply less vehicular travel, particularly if residences are compactly located around nonresidential centers.

b) **Travel by public transportation increases as the density and size of nonresidential centers increase.** Large centers are the only opportunity to induce substantial voluntary travel by public transportation. The perennial issue of "auto vs. public transit" is primarily an issue of land-use arrangement; it is not a private whim, as it is frequently presented in the popular press.



9. ATLANTIC REGION
LIMITED ACCESS HIGHWAYS

DIVIDED
existing or under construction, 1969

planned alignment

UNDIVIDED
existing or under construction, 1969

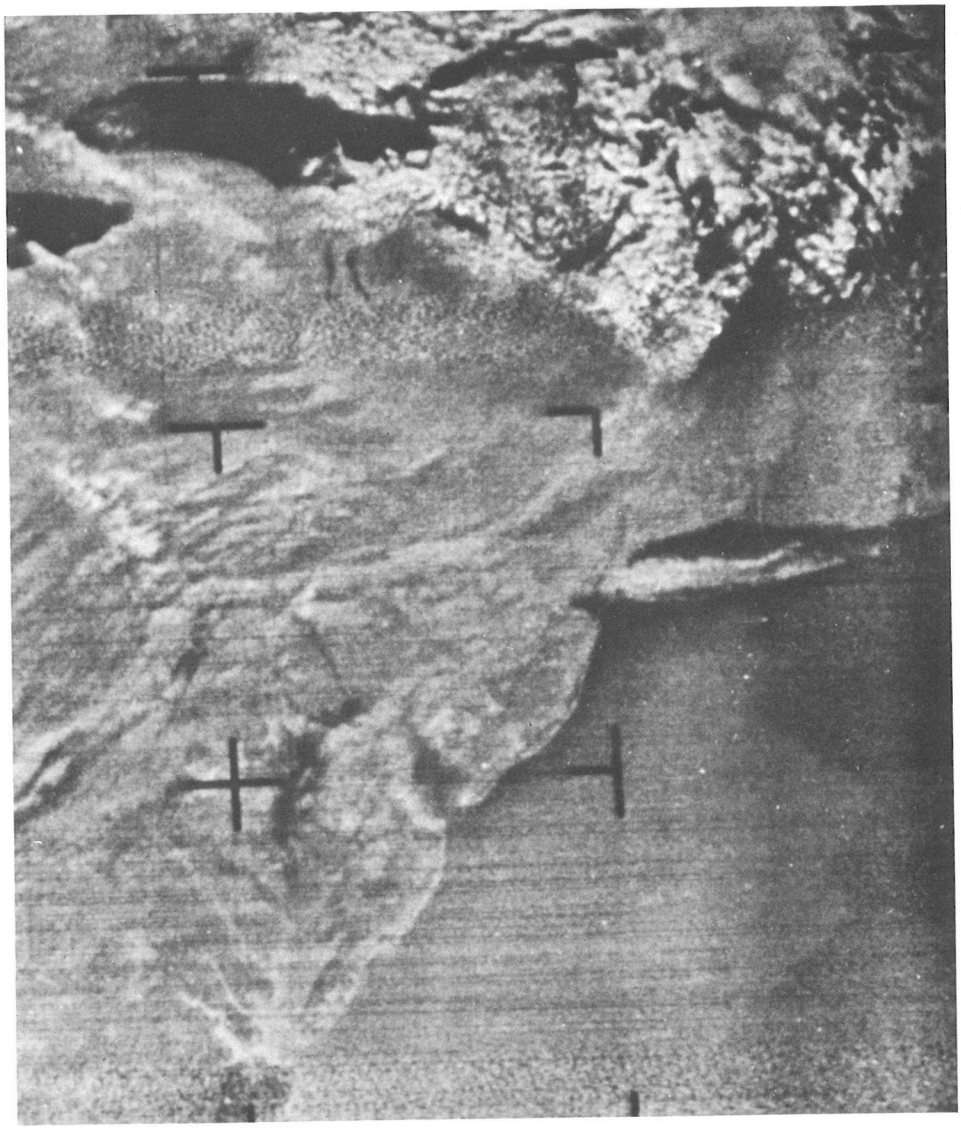
planned alignment

c) **High-speed ground transportation can significantly reduce the demand for highway travel in the main travel corridors.** Though long automobile trips (e.g., over 25 miles) represent only 5 percent of all trips, because of their length they are likely to account for 25 percent or more of the total vehicle-miles of travel, which is the basic measure of highway capacity and demand. Thus, by diverting one 25-mile trip from a highway to a high-speed mode, we are making room for five 5-mile trips, the kind for which highways are most suited.

d) **Highway travel demand is not independent of the supply of highway facilities.** In fact, the more limited access highways are built, the more new travel they induce—trips that would not have been taken in their absence. Therefore, conventional methods of projecting highway demand as if it were a deterministic magnitude are deceptive. Rather, public discussion has to focus on rather unconventional questions, such as what is the level of mobility desired for an urban area and what is the level of mobility desired worth not only in dollars but also in less tangible impacts on the environment? The beginnings of such an analysis, which views travel demand as dependent on the supply of travel facilities, have been made by the Tri-State Transportation Commission for the New Jersey-New York-Connecticut area.

Preliminary figures indicate that average speed of vehicular travel in the New York Region can be raised from a projected 29 mph in 1985 to 34 mph (and the range of opportunities accordingly expanded) by raising the percent of travel that will occur on expressways from 38 percent to 52 percent. The extra cost in money would be some $10 billion. The shift of traffic to expressways—with attendant time and accident savings—would be worth the cost, but the increase in the total amount of travel in the Region from 250 million vehicle-miles of travel to some 300 million is an added item that can be viewed as a benefit—or as a cost—depending on one's values.

This type of advanced analysis should be expanded to cover the Atlantic Region as a whole, and its results injected into the public discussion of impending highway planning decisions.



SECOND REGIONAL PLAN REPORTS

THE LOWER HUDSON (December 1966; 80 p.)

The potential of the Hudson River Valley below the George Washington Bridge as a public amenity—one example of how to meet the conflict between preserving nature and the growth of a metropolis. $5.00 ($3.50 member price)

THE REGION'S GROWTH (May 1967; 143 p.)

Projections of jobs by type, population, households and income for the New York Metropolitan Region, 1965-2000, with a section on world urbanization and the Atlantic Urban Region. $15.00 ($10.00 member price)

PUBLIC PARTICIPATION IN REGIONAL PLANNING (October 1967; 72 p.)

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WASTE MANAGEMENT (March 1968; 107 p.)

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JAMAICA CENTER (April 1968; 73 p.)

Prototype study of a major urban center: the possibilities, design, transportation and process of developing Jamaica, Queens, with a summary of arguments for large centers, particularly in the old Core of the Region. $7.00 ($5.00 member price)

PUBLIC SERVICES IN OLDER CITIES (May 1968; 56 p.)

Costs of public services needed to break the cycle of poverty and improve living conditions for all income groups in older cities, with recommendations for financing them. $7.00 ($5.00 member price)

URBAN DESIGN MANHATTAN (April 1969; 130 p.)

Design principles for attractive and efficient centers of urban activities, with examples applied to Midtown Manhattan. As an exhibit, this study was shown in New York, Milan (Italy) and Philadelphia to widespread acclaim and is embarking on a national tour under the Smithsonian Institute. (Available to members only for $7.00; available to non-members at bookstores or from Viking Press for $17.50.)

SECOND REGIONAL PLAN DRAFT AND SUPPLEMENTS

THE SECOND REGIONAL PLAN: A Draft for Discussion (November 1968; 104 p.)

Interrelated proposals on locating jobs, colleges and other large activities, on housing, poverty and old cities, parks, nature in the metropolis, urban design and transportation to guide current development decisions—for public comment in 1969 before the final plan. $3.00 ($2.00 member price)

THE FUTURE OF NASSAU COUNTY (March 1969; 30 p.)

(a supplement to The Second Regional Plan: a draft for discussion) Development decisions facing Nassau County and how Second Regional Plan concepts might apply. Statistics and projections on employment population, housing. $1.50 ($1.0 member price)

THE FUTURE OF ORANGE COUNTY (April 1969; 22 p.)

(a supplement to The Second Regional Plan: a draft for discussion) How a predominantly rural area can shape development as it urbanizes to achieve the best of the urban world while retaining the best of its rural past. $1.50 ($1.00 member price)

THE FUTURE OF BERGEN AND PASSAIC COUNTIES (May 1969; 36 p.)

(a supplement to The Second Regional Plan: a draft for discussion) Alternatives for locating major urban facilities and meeting transportation, housing and open space needs in this suburban and "old-city" area of the Region. $1.50 ($1.00 member price)

REGIONAL PLAN NEWS

Issues 70 (September 1962) through 90 (September 1969) $2.00 per copy ($1.50 member price; #90 available only to members).

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BOOKSHELF

U.S. National Advisory Commission on Civil Disorders. SUPPLEMENTAL STUDIES FOR THE NATIONAL ADVISORY COMMISSION ON CIVIL DISORDERS. New York: Frederick A. Praeger, 1968. 248 pp. $10.00.

When the Kerner Commission made public its report in 1968, it made reference to three supplemental studies being conducted under its auspices. The findings of those three investigations are presented in this book. "Racial Attitudes in Fifteen American Cities" is the result of an interview survey of 5,000 Negroes and whites in 15 major cities, and of white suburbanites. The interviews were designed to detect Negro views of racial issues, white beliefs about Negroes, and attitudes on the uses of violence. The second study, "Between White and Black; The Faces of American Institutions in the Ghetto" catalogs the attitudes and experiences of the policemen, educators, social workers, merchants and employers who provide services and jobs to the ghetto, and who are, to the slum dweller, the image of American institutions. "Who Riots? A Study of Participation in the 1967 Riots" attempts to dispell inaccurate notions about the people who riot by analyzing participation, primarily through survey and arrest data.

Although these reports are considerably more detailed and statistically oriented than the Report of the National Advisory Commission on Civil Disorders, they would make interesting reading for anyone who wanted to go beyond the summary report.

Bradford, Amory. OAKLAND'S NOT FOR BURNING. New York: David McKay Company, Inc., 1968. 248 pp. $5.50.

This book is a first-hand account of Mr. Bradford's experiences in establishing a government-financed job development and training program for ghetto residents in Oakland, California in 1966. It describes in narrative style the frayed tempers, bureaucratic complications and frustrations inherent in such a program and recommends new procedures for federal and local action programs in similar cities. Upon completion of the Oakland assignment, Mr. Bradford became a consultant to the Greater Jamaica Development Corporation in New York.

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Report on the development of the New York Metropolitan Region

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