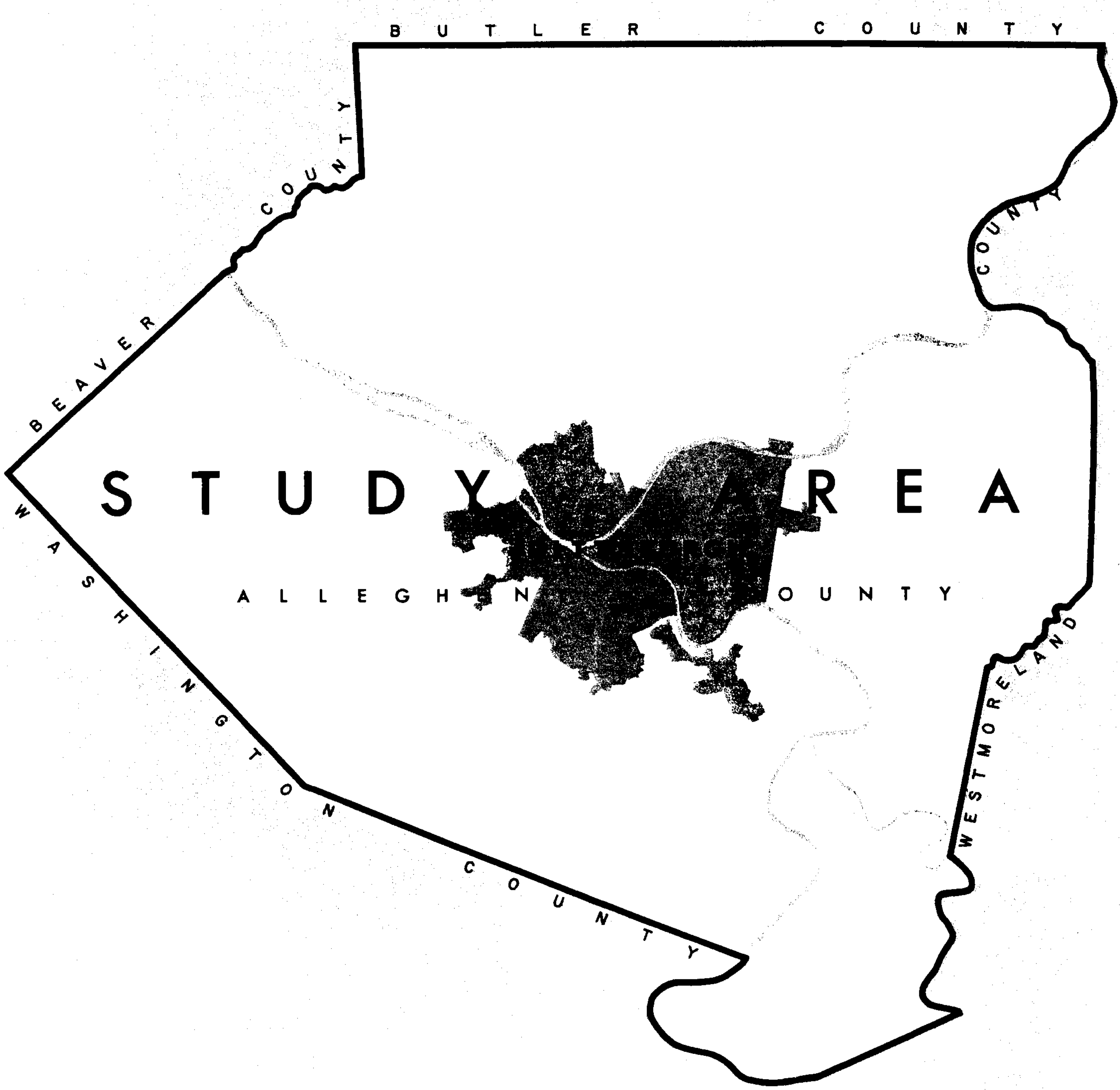

The area covered in the rapid transit study consists of Allegheny County which is made up of 129 separate municipalities. The County includes 745 square miles of which 47 percent is presently developed. The study area's population in 1965 was approximately 1,670,000 and is expected to expand to over 2 million by 1985.

PORT AUTHORITY OF ALLEGHENY COUNTY
Pittsburgh Pennsylvania

ALLEGHENY COUNTY RAPID TRANSIT STUDY

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DAVID W. CARMICHAEL

December 18, 1967

Judge Loran L. Lewis
Chairman of the Board
Port Authority of Allegheny County
121 Seventh Street
Pittsburgh, Pennsylvania 15222

Dear Judge Lewis:

In accordance with the terms of our contract with the Port Authority of Allegheny County, dated October 27, 1965, we present herewith the findings of our study concerning rapid transit in Allegheny County. The purpose of this study was to formulate an optimum long-range rapid transit system for the county, to evaluate types of rapid transit appropriate to such a system, and to report upon the desirability and financial prospects of such a system. The report contains five chapters, as follows:

I. Introduction
II. Data Gathering and Projections to 1985
III. Formulating a Mass Transportation System
IV. Testing Alternatives - Steel Wheel vs. Rubber Tire
V. Staging and Priorities

Chapter I is concerned with the evolution of Allegheny County's present transportation system, a review of previous pertinent studies, the scope and procedures of the current study, and the constitution of the Technical Committee which reviewed the study progress and reported to the Port Authority Board when major decisions were required for continuation of the work.

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Chapter II is concerned with the data gathered and its projection to 1965 and 1985 levels. Pertinent data included population and job volumes and distribution, land use, a home interview travel survey of the origin and destination of trips and their modes, purposes and timing, existing and programmed highways, existing public transportation, travel times by modes, auto ownership and other social economic factors.

Chapter III is concerned with the formulation of a very long-range 92-mile rapid transit system, its routes, stations, patronage potential, and its relation to the county's total transportation system. The result of this phase of the study was the conclusion that a 60-mile system would be adequate to serve the County's needs to 1985 and that a more extensive system should not be undertaken at this time. Also in this chapter, the routes of the 60-mile system are described.

In Chapter IV, the pertinent information concerning a steel-wheeled system for the 60-mile program is developed and summarized. The information includes route descriptions, station locations, estimates of the cost of fixed construction, patronage potential, equipment costs, revenue potential, and the cost of operation and maintenance. Also described are the salient features of a modern electric-powered automated rail system. In Chapter IV, the same information for a rubber-tired Transit Expressway System is summarized and the salient features of that system are described. The two systems are compared at the end of the chapter.

Chapter V of our report contains suggestions for staging the 60-mile rapid transit system, and sets forth priorities for viable increments if the ultimate financial planning so requires.

The results of the studies recorded in this report were progressively reported to the Technical Committee and the Port Authority in a series of interim briefings and technical memoranda.

In September 1967, the Port Authority Board recommended construction of a Transit Expressway demonstration pilot project. The purpose of this project will be to investigate conclusively the potential of that concept before reaching a decision for a county-wide system. The Transit Expressway has been developed in Allegheny County, and as such, is a community project. The desire to probe its potentialities to conclusion is wholly understandable.

In accordance with the instructions of the Port Authority and the Technical Committee, this report, as submitted, brings the work under our contract to a close.

Very truly yours,

PARSONS, BRINCKERHOFF, QUADE & DOUGLAS

W. S. Douglas

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CONTENTS
(cont'd)

ILLUSTRATIONS

ILLUSTRATIONS
(cont'd)

I. INTRODUCTION

Transportation Opportunities

At a time when almost all major American cities are experiencing the problems of declining central cores, traffic strangulation, urban sprawl, slums, air and water pollution, and civil disturbances, they have been, paradoxically enough, enjoying a high level of prosperity and the greatest urban and suburban development ever witnessed. The American city today faces the opportunity and the challenge of having to completely rebuild, within the next generation, to a size twice as large as at present. To meet this opportunity and challenge, billions of dollars will be needed to replace, correct, and provide the necessary facilities for the rapidly changing urban economy, society and technology. Most of today's cities have grown in response to yesterday's social and economic demands; few were planned in anticipation of the changes in city size, land use and demands for transportation that have taken place. The obsolescence of today's cities, and the nature of our new society, are much discussed and debated. However, it is certain that tomorrow's city could and should be designed to provide greater efficiency and mobility, and a far better place in which to live, work, shop and play. To reach this goal will require the efforts of economists, social scientists, urban planners, environmental designers, engineers, and professionals of other disciplines, working together with a common purpose to achieve community action.

The private automobile is the dominant transportation mode of the current era and will continue to be so for many years to come. The comfort, privacy and convenience of door-to-door transportation by automobile is well known. No other mode of transportation approaches it in flexibility, speed and convenience during off-peak periods and for short trips. However, the mass movement of people by motor vehicle to and from home and work during the rush hours along principal corridors of travel and in the central business district has created the daily problem of traffic congestion. Untold losses of time and money brought about by such congestion are the result of this critical urban transportation problem. Although the automobile has provided the mobility for the growth of cities, it has concurrently brought about varying degrees of stagnation in the central city cores. While research and development can and must continue, the dominant problem of urban transportation - getting from home to work and back again - is not one of technology but one of economics and management. Its solution will require energy and imagination.

The concensus has grown that all transportation modes will have to be considered as part of an effective urban transportation system. It is recognized that traffic congestion cannot be relieved without a revitalization of public transportation in terms of high standards of speed, comfort, and convenience that will attract substantial numbers of potential patrons from their private automobiles. Many cities will have to be restructured to fit some new or previously unused complex of mass transportation, and this factor can be one of the major opportunities and challenges for rebuilding our cities. Whatever form future public transportation may take, it will require extensive grade-separated rights-of-way.

The cost of exclusive rights-of-way for public transportation, completely separated from all other traffic, will be immense - hundreds of millions of dollars for each major metropolitan area concerned. These costs will not be recoverable from fares. The justification for such transportation must lie therefore in the essential role it will occupy in the total transportation system, and in the opportunities it will provide to guide the future growth of an area.

Evolution of Pittsburgh's Transportation

The history and growth of Pittsburgh parallels quite closely the history and development of the diverse modes of transportation of the area. The strategic location of the city, its natural waterways, and its rich mineral deposits all combined to create an industrial center which today requires a heavy concentration of all freight-carrying modes of transportation. The development patterns of the Pittsburgh region, from 1890 to the forecast development for the year 2000, are shown on Fig. I-1, following this page.

Early Settlement and Transportation. From Pittsburgh's very inception, transportation played a major role in the growth and development of the city and the surrounding areas. The city's location at the confluence of the Allegheny, Ohio and Monongahela Rivers played an important role in the settlement and growth of the central and western United States. The waterways represented a vital gateway to the broad interior of the continent, which in turn provided Pittsburgh with profitable trade and market-outlet routes for both local and long-distance shipping.

DEVELOPMENT PATTERN

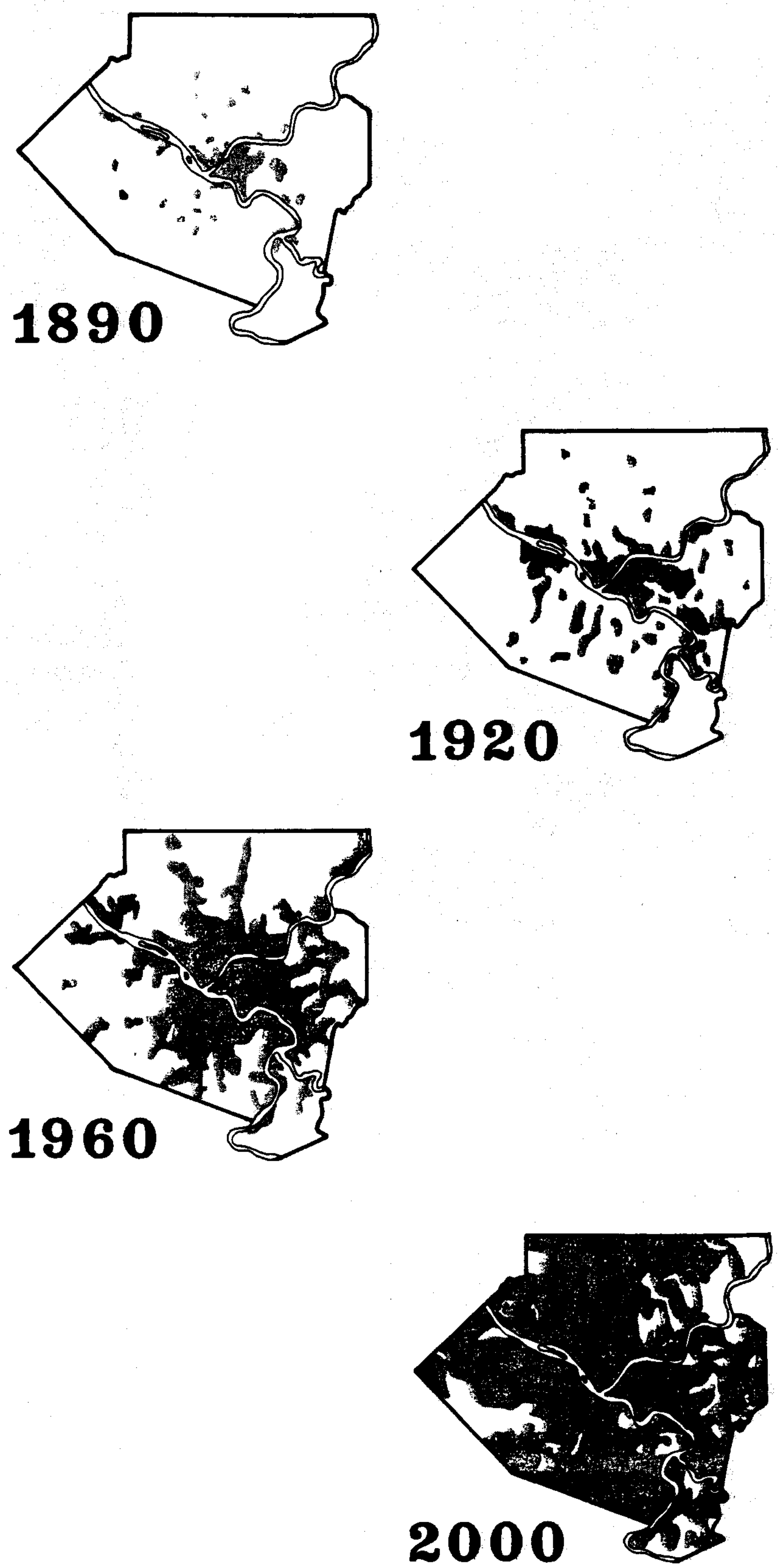


Fig. I-1

After the Revolutionary War, Pittsburgh's role, viewed from a national standpoint, changed significantly. The area that had been considered the western outpost of the nation changed to the eastern-most settlement of a vast and growing territory. By 1783, the city's population was slightly more than 300. The next two decades saw a ten-fold increase, and by 1817, a total of 259 factories produced $2.5 million in goods in a single year - an impressive figure for the time.

At this time, newer towns to the West began to make modest inroads in Pittsburgh's competitive leadership because of their close proximity to many of the newer consuming markets. However, the first Pennsylvania Turnpike which was completed in 1820 significantly reduced transit time for loaded wagons. The new turnpike provided a compensating effect which helped Pittsburgh regain its role of importance and helped bolster the local economy. By 1820, Pittsburgh was changing from a commercial center, with an economy based on farm produce and general commerce, to one in which the commercial foundation was beginning to rest on heavy manufacturing.

Railroad Transportation. Short rail lines had existed for two decades before they entered Pittsburgh, although their extent and tonnage-carrying capabilities were relatively insignificant compared to Pittsburgh's heavy-tonnage-outlet needs for long-distance market penetrations. River transport met those needs. Then in 1852, the Pennsylvania Railroad and the Baltimore and Ohio Railroad raced each other to complete their tracks to the Ohio River. In that year, the Pennsylvania Railroad sent its first train to Pittsburgh; the Baltimore and Ohio Railroad reached Wheeling a few weeks afterward. Two years later, the Pennsylvania Railroad had a through line from Philadelphia. Pittsburgh grew and prospered, and the production of ships, iron, coke, textiles, glass, machinery, food products, whiskey and mineral products taxed the labor resources of the day. By 1860, the industrial production represented a modest but certain harbinger of the Pittsburgh that was to come. The area by then had a work force of 23,000.

Proximity of bituminous coal to the area's steelmaking facilities was highly beneficial, although it was scarcely the dominant factor in Pittsburgh's emergence as the leading steel center of the country. Rather, it was principally because of a good and continuing labor supply and the city's accessibility to consuming markets. Market accessibility was assured first by economical water transportation and then by railroad transportation.

Public Transportation. Horse-car railways, appearing in 1859, were the first means of mass transportation, with inclined railways and electric trolleys following. New residential areas opened up and suburbs developed along trolley lines, which followed a predominantly radial pattern because of the hilly terrain.

The arrival of the mass-produced automobile was to revolutionize the daily life of most working people, change the downtown face of all metropolitan cities, and eventually transfer a large volume of retail spending to growing suburban centers. Pittsburgh was no exception to this socio-economic change. While Pittsburgh witnessed an economic growth between 1919 and 1929 that lagged somewhat behind the national average, the construction of single- and multiple-family units was substantial. In the main, this growth occurred well beyond the settled areas of the day. Pittsburgh's South Hills was opened for full development after the Liberty Tunnels were completed in 1924 to connect with a new bridge leading to the downtown section of the city. South Hills, a residential location made feasible by the automobile, which was an outlying area in the 1920's, has long since achieved contiguity with the city. Future expansion, continuing at the outer edges of this earlier development, has placed increased burdens on transportation.

The Decline in Public-Transportation Commuting. From the mid-1920's until World War II, commuter rail service accounted for a considerable volume of passenger traffic. Reasonably fast and frequent rail service was provided up and down the Beaver, Monongahela, and Allegheny Valleys on each side of the three rivers. Commuters traveled as far as 30 miles from their homes to work. Trolley service was equally good in all parts of the city, as well as to and from adjoining towns and boroughs.

But the privacy, comfort, convenience and the speed of door-to-door travel by private automobile, the obvious preference of travelers for this mode of travel during the 19-year period from 1945 to 1964, and the drastic decline in use of public transit that followed, made it doubtful in what form public transportation would survive as an urban travel mode. The question as to whether the commuters deserted the rail lines, or whether the carriers discouraged their travel by poor scheduling and antiquated equipment, is unimportant at present. Of importance is the fact that by 1955, the competition from private autos caused a drastic curtailment in rail-commuter trains, and, a few years later, their virtual disappearance.

Since the beginning of the Twentieth Century, Pittsburgh recognized the growing problems of transportation, and several studies of the area's transit facilities were made. Many of these studies were quite thorough and detailed, and a number of them recommended fast and comfortable rapid transit systems. For the lack of financing, political-faction agreement and/or public support, no system was ever built.

A 1906 study proposed a system of underground railways which included a downtown loop with a radial line to the east and several intermediate stub lines extending north and across the Allegheny River. The proposal recommended that the subway facilities be made available to all independent streetcar companies then operating in the city.

In 1910 and 1917, additional studies were undertaken which concluded by recommending construction of rapid transit systems.

In 1919, it appeared that rapid transit might become a reality in Pittsburgh when the city's voters approved a $20 million bond issue, $6 million of which was earmarked for the construction of rapid transit facilities. However, because of political disagreement as to where the lines should be located, the construction was to be limited to the First and Second Wards.

In 1923, the Citizens Committee on City Planning released a report which recommended two single-track subway loops in the Central Business District (CBD), to be used by streetcars until such time as radial subway lines could be built to the east, north and south sections of Pittsburgh.

In 1925, six years after the passage of the 1919 bond issue, the City Traffic Commission presented a report recommending a subway in the First and Second Wards, to be built with the $6 million in bond issue revenue. The proposal called for a subway under Fifth Avenue and Sixth Street between Chatham Street and Duquesne Way.

A year later, the City Traffic Commission presented a plan to the Mayor and City Council which recommended an additional $30 million bond issue to finance a proposed North Side to East Liberty subway and Grant Street streetcar-subway.

In 1929, the Pennsylvania Railroad's plan to build a new passenger terminal at 13th Street and Penn Avenue spurred officials to reconsider rapid transit service in the Golden Triangle. By 1934, no transit agreement had been reached and the City Council vacated the remainder of the 1919 bond issue.

Additional studies were made in 1941, 1949, and 1951, and in 1961 a study was made which resulted in recommendations for two high-speed, automated lines - one in the Oakland-East Liberty corridor and the other in the Castle Shannon corridor.

It is noteworthy that these studies show congestion as a problem of varying intensity since 1900, and that all proposals recommended lines in essentially the same corridors. While tunnels, parkways, and multi-storied parking garages have been constructed to meet the ever-increasing vehicular movement to and from Pittsburgh's downtown business district, traffic congestion in the central city and in all neighboring suburbs remains a big problem that has as its causative factor the preference for the private automobile over public transportation.

Recent Pittsburgh Developments

To understand transportation developments and requirements of Allegheny County, some knowledge of the recent history of the Pittsburgh area is essential. Pittsburgh emerged at the close of World War II, plagued by smoke, floods, and deterioration. No new construction had taken place in its CBD core for nearly two decades, and forty per cent of the CBD was blighted or vacant. Veterans on leave from the war found the city unbearably grim, and many did not return to their hometown after the war. Big corporations with headquarters in Pittsburgh found it difficult to attract executive and managerial talent. Changing market factors and technology produced drastic unemployment and out-migration of population.

These changes made the future of the community a matter of serious concern to Pittsburgh's leaders. In early 1943 a meeting of Pittsburgh's top industrialists, leaders of labor, civic organizations and local educational institutions was held to determine what could be done to save the city and bring unity and a fresh approach to community action. From this meeting emerged a new civic organization, the Allegheny Conference on Community Development, and a new civic action formula which would provide the necessary backing to advance community projects.

The extraordinary coalition of local government officials, industrialists and business leaders threw its energy into the solving of the region's wide range of ills. The new city improvement and rebuilding program brought about, with dramatic success, the control of smoke and floods, the redevelopment of the Point, the Gateway Center and the Lower Hill, as well as the construction of highways, bridges and tunnels. Pittsburgh became the mecca for planners and visitors from abroad who were interested not only in the successful examples of wide-ranging applications of redevelopment programs, but more importantly in the unprecedented uniting of the top power structures that exist in every community.

Out of these early accomplishments came a heightened awareness of the complexity and magnitude of the job remaining to be done. A number of Allegheny Conference studies showed the need for State Legislation to bring into being wholly-new City and County agencies, authorities and commissions, such as the Urban Redevelopment Authority, the Parking Authority, the Housing Authority and many others, empowered to attack local problems on a broad scale.

In the field of Public Transit, the Board of County Commissioners of Allegheny County in May 1952 appointed a Transportation Committee to study various forms of mass transportation, and their financial implications. In May 1953 that study report recommended the public acquisition of the thirty or more privately-owned, separately-operated bus and streetcar companies, and the unification of these facilities under one Authority.

On April 6, ~~1965,~~ 1956 the General Assembly of Pennsylvania passed an enabling Act authorizing Port Authorities for various cities. This Act conferred the right of eminent domain, empowered the authorities to borrow money and issue bonds and to plan, acquire, construct and operate port facilities. The Port Authority of Allegheny County was established under this Act and convened for the first time on January 17, 1958.

In 1958, the Allegheny Conference on Community Development initiated a study for the improvement of the transit situation. The report from that study recommended that new legislative authority be obtained to create a Transit Authority with the powers to purchase, consolidate and coordinate all forms of mass transportation within Allegheny County, and with the exclusive right of owning and operating a mass transportation system within the county.

In lieu of creating a new Authority, the existing 1956 Act was amended on October 7, 1959, by the General Assembly to expand the powers of the Port Authority to include the right to own and operate mass transportation facilities.

In June 1960, the Port Authority engaged the firm of Coverdale and Colpitts to make a study of an Integrated System of Transit for Allegheny County including the estimated cost for acquisition of the existing transit companies, the estimated revenues and the financial feasibility of the system. The report from that study recommended public acquisition of 33 privately-owned bus and street car companies. and in September 1961 the Port Authority presented its Plan and Recommendations to the Board of County Commissioners for an Integrated System of Mass Transportation. On March 8, 1963, they presented a supplemental report on the Estimated Cost and Financing of the Integrated System.

In 1958, the Pittsburgh Area Transportation Study was established by joint agreement of the Pennsylvania Department of Highways, the City of Pittsburgh and Allegheny County. The broad objectives of that study were to develop an integrated plan of major highways and mass transportation for 1980 based on a comprehensive study and projection of land uses, population and vehicle travel. Two study reports were presented - November 1961 and February 1963. These reports concluded that the area lacked modern freeway and rapid transit facilities. It cited lack of limited access highways and the less than 20 miles of freeway for some 1.5 million residents as major contributions to congested conditions of the street system, and stated that the 28 to 30 operating transit companies, with inefficient route coordination, lack of transfer privileges, and imbalance of transit service, were incapable of providing adequate public transportation with existing operations.

The reports from that study, which were by far the most comprehensive factual analysis of the communities' overall transportation needs, recommended a 210-mile freeway plan and a 16-mile rapid transit system.

In March 1964, the Port Authority exercised the rights of eminent domain to assume control of the Pittsburgh Railways Company, and in August 1964, through successful negotiations which began in 1962, completed the acquisition of the remaining 32 transit companies which were to be consolidated into the Port Authority System.

In 1964, the Rapid Transit Committee of the Port Authority commissioned the Mellon-Pittsburgh Carnegie Corporation (MPC) to develop a plan for a demonstration commuter project utilizing the Pennsylvania Railroad and Budd Rail Diesel Cars (RDC) for service between Pittsburgh and Trafford. The report from that study concluded that the system would operate at a loss and did not appear to be suited to provide an efficient, economic, modern rapid transit system for Allegheny County. The report further commented that the nature and extent of rapid transit that would be needed to fulfill the demands of an integrated mass transportation system, and the essential contribution to such a system through utilization of the rights-of-way of existing railroads, were questions to which answers were critically needed. These answers could only be obtained through the study and development of a comprehensive rapid transit plan.

In late 1964, the Port Authority Board ordered a feasibility study of a rapid transit system which might be put into operation by 1973. Subsequently, the Port Authority retained Parsons, Brinckerhoff, Quade & Douglas to undertake a feasibility study of a rapid transit system for Allegheny County in sufficient depth, and to provide the necessary information to permit the Port Authority Board to make a determination of public policy.

The study was financed by an appropriation made by the Commonwealth of Pennsylvania under General Assembly legislation of June 1965, establishing a grant program for the betterment of mass transit facilities throughout the Commonwealth. The responsibility for administration of the program was under the Department of Community Affairs.

Purpose and Scope of Study

In September 1965, the Port Authority of Allegheny County authorized Parsons, Brinckerhoff, Quade & Douglas to undertake a study to determine the feasibility of rapid transit for Allegheny County, based on anticipated patronage, order-of-magnitude estimates of capital costs and operating costs; to formulate a rapid transit plan; and recommend a stage construction program to serve the needs of the City of Pittsburgh and the residents of Allegheny County to the year 1985.

It is emphasized that the cost estimates included in this study are sufficiently detailed for determination of public policy with respect to the facilities to be provided to achieve more efficient transportation services, to encourage a more orderly land development, and to provide greater mobility for the region's residents.

Once an initial project is selected as the first stage of a regional rapid transit system, more definitive engineering beyond the scope of these studies will have to be undertaken in support of a specific financing program. Subsequently, final plans must be prepared in advance of right-of-way acquisition and construction bids.

The rapid transit plans formulated and evaluated herein were developed taking into consideration projections of land use, population, and economic factors. They have been fully coordinated with the 1985 Highway Plans developed by the City, County and Regional Planning agencies for Allegheny County.

The 1958 home interview survey and forecasts of future trip generation and distribution, as well as auto ownership and passengers per trip, and similar data, developed by the Pittsburgh Area Transportation Study formed the basis for the study of forecasts of passenger utilization. This information was brought up to date for use in the modal split program in testing transit corridors and for determining the number of trips that may be diverted from private automobiles.

In the study, several alternative transit routes were evaluated. The principal transit corridors were identified and alternative locations for rapid transit routings serving the downtown and the residential suburban areas of the community were established. Preliminary plans were prepared and evaluated to determine the most practical and desirable rapid transit routes as a basis for estimating cost and service.

An important objective of the study program was to make a comparative evaluation of a regional rapid transit system utilizing steel-wheeled vehicles running on steel rails and a system serving the same corridors and stations using rubber-tired vehicles similar to the Westinghouse Transit Expressway.

In summary, the purpose and scope of the rapid transit study as originally defined in the Consultant's contract was to:

1. Formulate an optimum long-range rapid transit system as one component of the total area transportation system.

2. Evaluate types of rapid transit.

3. Test the economic prospects of the long-range system at appropriate future years - 1975 and 1985 - in terms of:

   a. Potential patronage
   b. Potential gross revenues
   c. Cost of operations
   d. Potential net operating revenues
   e. Cost of fixed construction
   f. Cost of equipment

4. Phase or program the long-range system guided by the findings in (3) above.

5. Measure the economic desirability of the rapid transit program in quantitative terms to the extent practicable, and otherwise in qualitative terms.

6. Refine estimates of costs and revenues for the first phase system to the degree necessary for determination of public policy.

7. Determine the tax impact on the citizens of the County for various alternative methods of financing.

8. Formulate appropriate suggestions for implementation.

The study organization and work program was divided into four phases:

1. Gather data and prepare projections to 1985.

2. Layout and test an extensive system at the 1985 level.

3. Develop an optimum long-range system and test alternative types of rapid transit.

4. Refine a first stage of the optimum long-range system and test at the 1975 level.

Study Procedures

To insure an efficient scheduling of all phases of the study over the 20-month period, a Program Evaluation Review Technique (PERT) Chart which indicated the schedule of work activities was developed. The purpose of this was to indicate the inter-relation of the various agencies involved in the study, and to highlight critical points at which decisions in regard to continuation of the study should be made.

The major work elements of the four phases of the study included:

Phase I - Data Gathering and Projections

1. Organize the total project and prepare a schedule of work activities and budget.

2. Review available reports, plans, and data pertinent to the study.

3. Collect base maps and available geologic, soil, ground water, and flood information.

4. Review the methods and procedures for use in updating Pittsburgh Area Transportation Study (PATS) data on:

    a. population
    b. jobs
    c. land use
    d. trip generation
    e. transit riders

5. Establish the location and extent of the highway system for 1975 and 1985 levels.

6. Collect available data and conduct surveys on the operation of the major highway system. Data to include:

    a. travel speeds
    b. travel volumes
    c. capacity of major crossings
    d. screen line counts and controls

7. Establish procedures, and expand PATS data for 1965, 1975 and 1985 levels on:

    a. population distribution
    b. jobs and automobiles per household

c. trip generation
d. zone-to-zone trip movements

8. Prepare procedures and conduct surveys of the existing transit riders and level of service.

9. Prepare and code a zone map and highway network for use in the assignment of transit riders.

10. Establish the criterion and performance standards for a competitive rapid transit system.

11. Prepare and code base maps for testing a rapid transit network.

Phase II - Test an Extensive System at 1985 Level

This phase consists of laying out and testing an extensive network of rapid transit routes and, through successive alternative assignments, determine the strongest and most feasible corridors for rapid transit.

1. Lay out an extensive area-wide rapid transit system, taking into account:

    a. major travel desires
    b. service to the downtown area
    c. construction and right-of-way costs
    d. local planning
    e. previously proposed routes and locations
    f. existing railroad rights-of-way

2. Using the PATS trip production and distribution data, test an assignment using the present population distribution and trip generation and check:

    a. trip patterns and distribution
    b. peak and off-peak hour trips
    c. transit rider trips
    d. total vehicle and person trips

3. Estimate the rapid transit patronage for the system in (1) above, for the 1985 level, taking into consideration:

    a. trip makers that do not have a driver's license or access to a car
    b. trip purpose and length

c. trips to the central business district and other major points of generation
d. relative door-to-door travel time and trip costs by automobile and by rapid transit

4. Determine the most feasible corridors of rapid transit patronage from the extensive network, through a series of successive testing of alternative combinations of routes.

Phase III - Develop an Optimum System and Test Alternative Types of Rapid Transit

This phase consists of defining the optimum long-range rapid transit system, refining the patronage estimates for the 1985 level, and testing alternative types of rapid transit systems.

1. Refine the patronage estimates for the optimum long-range rapid transit network for the 1985 level.

2. Refine the routes and delineate in the degree necessary to determine type of construction.

3. Prepare order-of-magnitude estimates of construction costs, right-of-way acquisitions, equipment costs, and operating costs.

4. Test and evaluate the economic prospects of the optimum long-range rapid transit network in terms of:

    a. potential patronage and gross revenues
    b. cost of operations
    c. net operating revenues
    d. cost of equipment and fixed construction

5. Evaluate alternative types of rapid transit systems and make comparable estimates of:

    a. patronage
    b. performance standards
    c. revenue and operating costs
    d. capital cost

6. Taking into account the estimates called for above, the possible tax impact, and the benefits, determine the optimum long-range rapid transit network and the appropriate type of system upon which to base the estimates of a First Stage System.

Phase IV - Refine a First Stage of the Optimum System

This phase consists of refining the patronage estimates for the optimum long-range Rapid Transit Network and a First Stage System for the target years 1975 and 1985, using, if available, results of new regional home interview survey and planning data.

1. Determine the benefits of all kinds that may be derived from the rapid transit system, and weigh the economic desirability in terms of:

    a. savings in travel time and delay
    b. abatement of congestion
    c. possible elimination of more streets, bridges, tunnels, parking garages
    d. possible impact on land use and real estate

2. Refine the route selections, delineate route in appropriate graphic form.

3. Refine station locations, prepare plans for stations, including transfer and parking facilities and develop typical plans for structures and at-grade construction.

4. Prepare estimates of:

    a. special rapid transit facilities
    b. cost of power and communications
    c. fare collection
    d. typical fares and travel time between stations
    e. train control and schedules

5. Determine the tax impact on citizens of the county, taking into account refined estimates and alternative methods of financing.

6. Formulate and prepare appropriate recommendations and a phasing program for both the optimum long-range Rapid Transit Network and the First Stage System.

7. Prepare appropriate summary and comprehensive reports and provide assistance in presenting the program to legislative bodies, cooperating agencies and the general public.

Study Schedule

This study was originally scheduled to be completed in April 1967. However, in November 1966, following completion of the first three phases of the rapid-transit study and a presentation of the conclusions reached at that time, the Port Authority Board suspended any further work on Phase IV, and authorized a further planning study to be undertaken by the Transportation Research Institute of Carnegie-Mellon University, with assistance from Parsons, Brinckerhoff, Quade & Douglas. This supplemental study was identified as Alternative Phase III and was to include as its primary purposes:

1. A study of alternative methods of distributing rapid transit riders in the Central Business District, through the use of an aerial distributor loop system in the CBD with one or more major transfer terminals. The study would be led by Transportation Research Institute in defining the aerial structure, the vehicle, station locations, and the major transfer terminals. Parsons, Brinckerhoff, Quade & Douglas would have the responsibility for determining construction and operational feasibility, and for the evaluations and comparisons of the aerial loop system to the basic subway system in terms of patronage, level of service, capital cost and operating cost.

2. A study in considerable depth by Transportation Research Institute of an alternative to the steel-wheel system and Transit Expressway system as identified by PBQ&D. This study would explore the possible application of an uncoupled-grid system concept for rapid transit service in Allegheny County and determine the implications of extensive use of aerial construction to replace subway and tunnel construction in terms of reduced cost for rapid transit and community acceptance.

In September 1967, following the completion of the Alternative Phase III study, the Port Authority Board recommended construction of a demonstration pilot project of the Westinghouse Transit Expressway on presently-owned Port Authority trolley right-of-way in the South Hills corridor. The demonstration project would be considered a possible forerunner of a full-scale Transit Expressway system for Allegheny County, and would test on a full-scale service, passenger-carrying and fare-paying basis the feasibility of Transit Expressway as a new tool for solving the transportation problems of urbanized areas.

The Port Authority Board subsequently directed Parsons, Brinckerhoff, Quade & Douglas to suspend all work on the rapid transit study and to assemble the study data developed to date for use in the development of the Westinghouse demonstration pilot project.

This present report has been completed in accordance with the request of the Port Authority Board to make the results of the study available. In the report, the studies, investigations, analysis and findings up to Phase III, including the comparisons of the Alternative Phase III study, are described. It also includes staging of the 60-mile regional rapid transit system in terms of priority of successive viable increments.

Five interim technical reports had been previously prepared by the Consultant at various points in the study. These reports, listed below, are included in a separate volume.

1. Proposed Route Location - Downtown Subway Loop, November 1965.

2. Development of Extensive Rapid Transit Test System, February 1966.

3. Evaluation of Selective Rapid Transit Routings and Station Locations for the Golden Triangle, June 1966

4. Phase III-A - Downtown Distribution - Aerial Loop System versus Forbes-Crosstown System, June 1967

5. Operating and Maintenance Cost - Conventional Steel-Wheel System versus Westinghouse System, September 1967

Participating Agencies

In carrying on the overall rapid transit study, close coordination was maintained between Parsons, Brinckerhoff, Quade & Douglas and the staffs of the Port Authority, the City Planning Department, the County Planning Department, and the Southwestern Pennsylvania Regional Planning Commission, as well as other local officials from various agencies and municipalities in Allegheny County. Throughout the study, all these staffs participated in numerous conferences, discussions, and exchanges of data.

A Rapid Transit Technical Coordinating Committee, composed of the agencies and representatives listed below, guided the work of the Consultant and assured coordination of transportation planning, and City, County and Regional planning. The Technical Committee held monthly and bi-monthly meetings with Parsons, Brinckerhoff, Quade & Douglas to review study progress; to discuss procedures, development of transit plans, operating standards, and evaluation of alternative transit systems; and to approve and authorize continuation of work at major points of decision. Members of the Rapid Transit Technical Coordinating Committee are:

Leland Hazard, Committee Chairman	Member of Port Authority Board
H. H. Geissenheimer, Committee Secretary	Director of Planning and Schedules, Port Authority of Allegheny County
William R. O. Froelich	Executive Director, Southwestern Regional Planning Commission
LeRoy L. Little	Executive Director, Allegheny County Planning Department
Edward E. Smuts	Deputy Director, Pittsburgh City Planning Department
O. Donald Miles	Urban Coordinator, Pennsylvania Department of Highway
Richard S. Rhodes	Vice President, M. P. C. Corp.
Dr. James P. Romualdi	Director, Transportation Research Institute, Carnegie-Mellon University

The Committee was later expanded to include:

Joseph C. Barr, Jr.	Secretary, Pennsylvania Department of Community Affairs
Burrell Cohen	Executive Director, Stadium Authority of Pittsburgh

Harold S. Jensen	Director of Real Estate, Special Projects, Pennsylvania Railroad
John T. Mauro	Executive Director, Department of City Planning
Merritt A. Neale	Executive Director, Public Parking Authority

Previous Reports and Data

Since the beginning of the Twentieth Century several studies of existing land use, historical growth, demographic and economic projections, physical geography constraints, travel and transportation facilities and other factors bearing on the urban development of Allegheny County have been made. All the reports and data of importance to the rapid transit study were assembled for review and provided the starting point for the detailed transit studies.

Of particular importance to the rapid transit study was the comprehensive study of land use and transportation completed in February 1963 by the Pittsburgh Area Transportation Study. This study provided extensive information on travel demands, origin and destination and socio-economic data, trip generation, travel characteristics, vehicle ownership and occupancy, population distribution, and projections of future travel. The findings of that study resulted in the recommendation of a 210-mile Freeway Plan for Allegheny County for the year 1980. Many of the technical personnel from that study were subsequently absorbed into the Southwestern Pennsylvania Regional Planning Commission, which is presently involved in a four-year Land Use and Transportation Study. That study will provide the necessary data for testing the previously-proposed 1980 Freeway Plan, the proposed 1985 Rapid Transit Plan to be developed by the present Parsons, Brinckerhoff, Quade & Douglas study, and the various alternatives to allow for regional growth in formulating a comprehensive transportation policy for Allegheny County and the Six-County Region.

Economic studies and planning activities in Pittsburgh, Allegheny County and the Six-County Region have been extensive, and of good quality, and have been the foundation on which the area's improvement and revitalization program has been developed. Covering virtually every aspect of urban life – land use, highways, parking, recreation, housing, refuse disposal, industrial sites and mass transportation - the information contained in selected reports furnished insight into the problems of the communities. Certain historical data, planning statistics, and proposals for mass transportation were used directly in the course of this study.

Some of the agencies which participated in or prepared some of the previous reports included: the Pennsylvania Economic League, the Pittsburgh Chamber of Commerce, the Regional Industrial Corporation, the Pittsburgh Regional Planning Commission, and the Southwestern Regional Planning Commission.

Some of the economic studies that were found to have particular interest to the rapid transit study included:

> Market Study of the Golden Triangle, 1960 to 1980, prepared for the Pittsburgh Regional Planning Association by Larry Smith & Company in 1961.
>
> Plan for Pittsburgh's Golden Triangle, prepared by Pittsburgh Regional Planning Association in 1962.
>
> Economic Study of the Pittsburgh Region, Volumes I, II and III, prepared by Pittsburgh Regional Planning Association in 1963.
>
> State of the Region '64, prepared by Southwestern Pennsylvania Regional Planning Commission.
>
> Alternative Regional Development Patterns, 1965; Industrial Land, 1965; Physical and Man-Made Features of the Region, 1963, prepared by Southwestern Regional Planning Commission.

Revised population and employment projections for the years 1965 and 1985 were prepared by the City and County Planning Departments for use in the rapid transit study. In addition, all available and pertinent topographical mapping, aerial photos and physical data necessary for identifying and evaluating route alignments were collected from the various local and governmental agencies. Information on existing and proposed trackage for the railroads and the Pittsburgh Railways trolley lines was obtained. Geologic, soil, groundwater and river information was also obtained.

The Consultant collected other data to supplement that obtained from local sources. This included a comprehensive maximum load point and transfer survey of transit passengers and a travel-time survey check for peak-hour driving conditions on principal highways. Data was also collected on transit operations in other cities, on factors influencing choice in mode of travel, and on construction unit costs for various systems. Reference is made to these data in appropriate sections of this report.

II. DATA GATHERING AND PROJECTIONS

Influences of Land Use and Travel Patterns

In 1754, forty-three men built the first stockade in Pittsburgh at the junction of the three rivers which is now Point State Park and part of the Gateway Development in the Golden Triangle. Today over one and a-half million people live in Allegheny County and by 1985 it is expected that the area will grow a modest 17 percent and house a population of over two million.

During the past two hundred years of growth, the topography of Allegheny County, characterized by sharp ridges, narrow valleys and slopes generally too steep to permit development, has been one of the major influences in conditioning and constraining development patterns.

The relationships of topography, employment, population, land use and travel patterns are vital considerations in planning and developing a transportation network, particularly rapid transit systems. The location of employment, commercial and financial centers, cultural, educational and social institutions and recreational facilities determine the patterns of travel for such activities as employment, shopping, business and pleasure trips.

In order to relate these factors to the requirements of transportation, it is essential to evaluate existing conditions as an indication of the development patterns which have emerged and the travel patterns they generate. The study of these relationships provides a picture of where the general corridors of added transportation capacity should be placed. Coupled with existing and projected travel volumes and land development, they provide the basis for selecting the appropriate mode and the required capacity of the proposed systems.

Much of the basic data on land uses and alternative development patterns used in this study were derived from existing published and unpublished material of the Southwestern Pennsylvania Regional Planning Commission, Pittsburgh Regional Planning Association, and the Pittsburgh Area Transportation Study. In addition, the distributions of existing and future projections of employment and population were provided by the City and County Planning Departments.

Metropolitan Area Land Use. The six-county Southwestern Pennsylvania Region, which is composed of Allegheny, Armstrong, Beaver, Butler, Washington and Westmoreland counties, encompasses a total area of 4,500 square miles, of which only about 10 percent is developed land. Industrial land, providing employment for one-third of the area's work force, occupies only 0.3 percent of land in the Region. Some 39 percent of the remaining land cannot be developed, 25 percent having slopes 25 percent or greater, and the other 14 percent consisting of freeways, waterways and strip mines. This leaves 51 percent of the land in the six-county region available for development.

Allegheny County has an area of 745 square miles out of which 26 percent has slopes 25 percent or greater, and therefore not capable of being developed. In 1958, the major land uses in Allegheny County were as follows:

	Percent	Square Miles
Residential	13.6	101
Manufacturing	1.2	9
Transportation	9.0	67
Outdoor recreation	2.4	18
Other non-agricultural	3.7	28
Total non-agricultural	29.9	223
Agricultural	16.7	124
No apparent use*	27.8	207
Remaining developable area	25.6	191

*Includes 192 square miles of land which slopes greater than 25 percent and 15 square miles of water area.

No other physical feature has had more influence upon the pattern of development of the Region than has topography. Areas of relatively flat land are scattered throughout the Region, with large areas of predominantly flat land situated in northern Allegheny County. The following listing of the four predominant geographic subareas of Allegheny County describes their general topographic characteristics, and indicates the extent to which they influence development.

Southern Allegheny

Defined by Chartiers and Monongahela valleys and rugged topography to the south.	Varied topography with moderately rolling and some relatively flat areas good for development. Moderate limitation on development.

Western Allegheny

Delineated by Ohio and Chartiers Valley.

Predominately rolling and creviced with stream bed ravines. Moderate limitations on development. Severe limitations on development in some portions due to strip mining.

Northern Allegheny

Delineated by Ohio, Allegheny Valley.

Moderately to gently rolling with relatively flat areas. Southern part of the subarea deeply cut by intermittent valley streams. Upper part relatively good for urban uses, with moderate to little restraint on development.

Eastern Allegheny

Delineated by Monongahela and Allegheny valleys.

Moderately rolling with areas of relatively flat land. Moderate limitation on development.

The general development pattern of the Region can be described as consisting of Pittsburgh as the core, and concentrations of urban population radiating outward along six major corridors as follows: along the Ohio, Monongahela and Allegheny Rivers; the Chartiers Creek valley and Route 19 serving the South Hills area and connecting to Washington; the corridor to the east along the main line of the Pennsylvania Railroad and Route 30; and the less intense but rapidly developing corridor along Route 8 to Butler. This existing pattern of urban development is dominant, and indicates how the County grew and the direction in which it is continuing to expand today.

Although projections of land use for 1985 indicate certain small shifts in the pattern of development, essentially there is little change in the overall pattern that is currently emerging. These patterns represent a large value of invested capital, both public and private. It is unlikely that any major shifts in activity will occur except over long periods of time.

Population. An examination of the major changes in population over the past thirty years clearly indicates the present development pattern. Between 1930 and 1940, increases in population of 25 percent occurred predominantly in the suburban ring around the City of Pittsburgh, particularly in the southern part of Allegheny County. Areas of declining population were spotty, but predominantly in the river valley communities. In the period between 1940 and 1950 growth continued in the suburban ring around Pittsburgh, and also started along transportation corridors to Butler, Washington and Greensburg.

The City of Pittsburgh increased slightly from approximately 672,000 to 677,000 people, while Allegheny County increased about 9 percent from 1.4 million to 1.5 million.

In the decade between 1950 and 1960, the growth continued along the major transportation facilities, toward Westmoreland, Butler, Washington and Beaver. This growth plus the changes to 1965 strengthened the regional corridor pattern of development. Areas of declining population remain consistent with the previous decades, in the valley communities and the City of Pittsburgh.

The population of the City of Pittsburgh decreased approximately 15 percent from 677,000 to 572,000 during the period of 1950-1965. Much of this decrease reflected the general decentralization activities and pressures placed on residential development in the suburban areas. Heavy growth in the southern part of Allegheny County can be largely attributed to the opening of Liberty Tunnels, Fort Pitt Tunnels and the Parkway-West. Other improvements to highways such as Route 22 and Parkway-East explain the rapid population increase in eastern Allegheny County.

During this period Allegheny County experienced an increase in population of approximately 10 percent from 1.52 million to 1.67 million. The loss in Pittsburgh of 104,000 was more than accounted for in the overall gain in Allegheny County of 155,000 persons. The graph on Fig. II-1 shows the comparison of population trends for Pittsburgh, Allegheny County and the Commonwealth of Pennsylvania. It is noteworthy that both Allegheny County and the Commonwealth of Pennsylvania are registering steady population gains, while the City of Pittsburgh has remained essentially stable. The projected population figures are discussed under another section.

Employment. The relationships of population distribution over residential areas and the location of principal centers of employment are dominant factors in developing a long-range rapid-transit system.

These relationships were developed by Pittsburgh Area Transportation Study home interview travel survey in 1958. It was found that 43 percent of all persons' trips with destinations in Allegheny County are to homes. Trips to work account for 21 percent of all trips. Trips for other purposes include 12 percent for personal business; 9 percent for social recreation; and 15 percent for school, shopping or eating.

The small portion of trips with purposes other than work or to home indicates the strong influence of the home and the work place as generators of travel. In fact, when both ends of all trips are considered, 97 percent of all trips are either home- or work-connected.

Experience has shown that although most freeways provide excellent service during most of the day, they become severely congested during peak travel periods, when large numbers of persons travel between home and work. Thus, it is apparent that a rapid-transit system must link employment centers with residential areas, since the home to work moment is the critical contribution to transportation demand.

The graph on Fig. II-1 shows the comparison of the existing and projected employment for Pittsburgh, Allegheny County and the Commonwealth. Examination of this data and past trends shows steady employment growth for the City of Pittsburgh and Allegheny County to 1950 which reflects the area's historical development and rise to industrial prominence. Periods of temporary high unemployment occurred which were cyclical in nature, and are characteristic of the sensitivity of the manufacturing of metals and durable goods to national economic activity in general. However, in the 1950's this prosperous employment atmosphere began to deteriorate, reaching its lowest point during the recession of the late 1950's. The Pittsburgh Renaissance, with the revitalization of the Golden Triangle and the development of the Gateway Center, was one of the major influences which brought about a reversal of this trend and started area employment back on its upswing. Today Pittsburgh ranks third in the nation as a headquarters center for industry and is exceeded in number of headquarters companies only by New York and Chicago.

Special emphasis was placed on analyzing work trips, since they constitute the greatest potential patronage for rapid transit. The data on employment and population supplied by the City and County Planning Departments are based on a continuation of the existing transit system and were distributed by major civil divisions in the county and census tracts and wards within the City of Pittsburgh.

For purposes of analysis and study, the job distributions were further identified by traffic zones and eight major corridors in the County and the City. Additionally, since the central business district is of such major importance, this area was examined in greater detail and was divided into 23 districts and 72 blocks. While a more detailed description of the eight corridors will be covered in a following section of this report, for purposes of orientation and comparisons of population and jobs they are generally identified below along with the percentage of 1965 population and jobs:

Corridor	General Area	1965 Distribution Population (Percentage)	1965 Distribution Jobs (Percentage)
I	Ohio River Boulevard	3	2
II	North Hills - East Street Valley	5	2
III	Northeast - Saxonburg Boulevard	4	3
IV	East Hills - Allegheny Valley	14	6
V	Southeast - Mon-Yough Valley	15	13
VI	Southeast - Route 51	9	9
VII	South Hills - Route 19	9	4
VIII	West - Chartiers Creek Valley	7	6
	City of Pittsburgh	34	55
	Total area	100	100

From this analysis, several corridors stand out as major concentrations of population and employment; more important, however, is the fact that in spite of the declining percentages the largest employment and population concentration in the Allegheny County area is and will continue to be in Pittsburgh and its downtown area. This can be more clearly seen in Fig. II-2, Distribution of Person Trip-Ends for 1985.

Travel Desires

In order to relate the factors of land use, population and employment distribution to the requirements of transportation, it is necessary to investigate the travel patterns they generate. This factor is a major concern in developing a rapid transit network particularly in the heavily urbanized area. Travel desires between major trip generation areas show the demand between points of origin and destination without regard to street or highways, and indicate the general corridors in which transportation facilities should be placed.

It is axiomatic that the routes and station location of a rapid-transit system will have an impact on the general distribution and density of development. However, due to the topographic constraints characteristic of Allegheny County, and well-established patterns of development, the basic travel patterns of 1965 will not change much by 1985. The major change will be in volume of trips. Other considerations, primarily of a social and environmental nature, such as the use of transit as a stimulus in promoting growth and development, reflect planning data provided by the City and County Planning agencies for future growth and development.

The basic travel information used in this analysis was the previously prepared 1958 trip generation data and 1980 projections from the Pittsburgh Area Transportation Study, which were brought up to date by the Consultant to reflect conditions in 1965 and projections to 1985.

Origins and Destinations. To determine the volume of travel and the extent of the test system, trip distribution data was examined and plotted in several ways. Total person trips and existing transit-trip data between several major destination areas and all other major destination areas were identified and plotted. Figure II-2 illustrates the distribution pattern of total person trips (both origin and destinations) for 1985. The greatest concentration of trips is in the City of Pittsburgh and is generally centered around the CBD. A second major concentration of trip ends is centered around Oakland and East Liberty.

Trip origins were also examined for 1965 and 1985 on a district basis, and are shown on Fig. II-3, Person Trip Origins by Traffic Districts, 1965 and 1985. In each instance, the pattern remains the same, the only difference being in the volumes. These plots were based on average weekday trip volumes without regard to trip purpose.

To confirm the location of volume build-up, various flow maps were prepared by civil divisions, traffic zones and corridors which indicated by varying bandwidths the patterns of trip desire lines between points of origin and destination. When plotted and arranged in this manner, they also provide an indication of corridor demand.

Figure II-4, CBD Trip Volumes by Corridor, shows the volume buildup by major corridors for 1985 trips to the CBD.

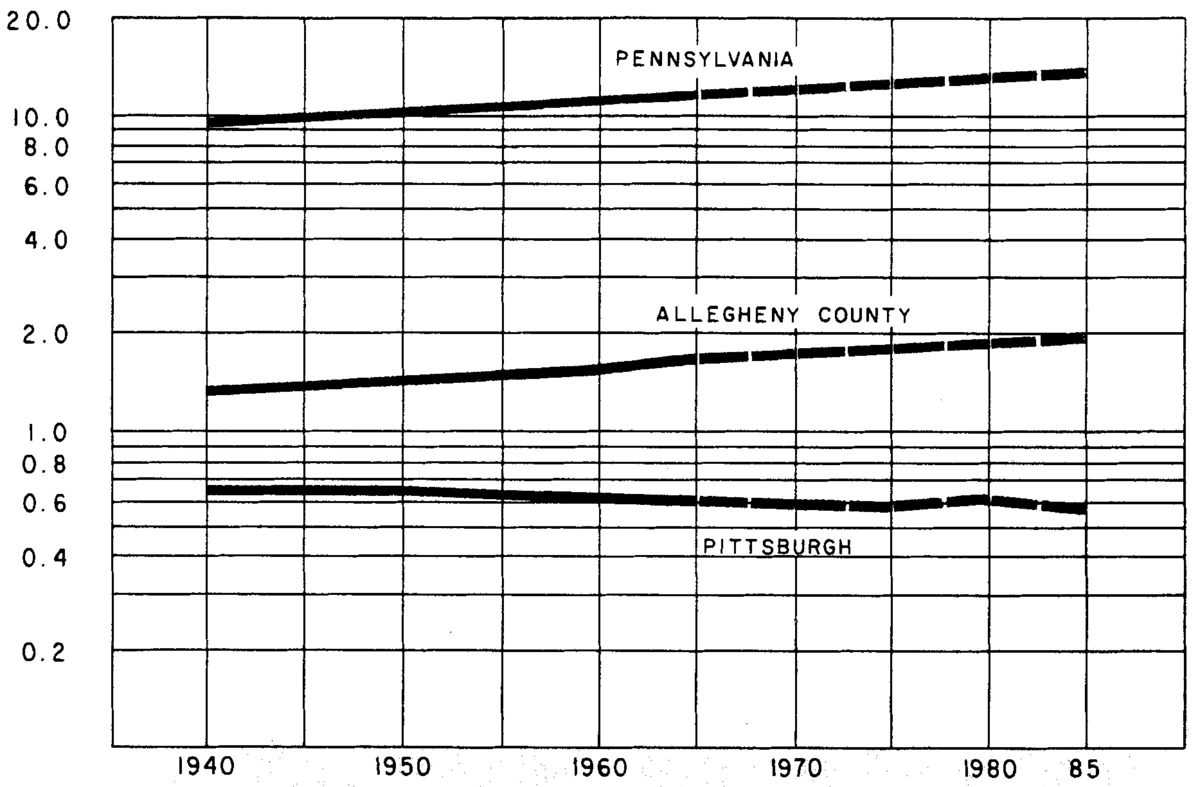
The following tabulation indicates the distribution of total trip ends for 1985 by major corridor:

Corridor	General Area	Trips Origins and Destinations (Percentage)
I	Ohio River Boulevard	4
II	North Hills - East Street Valley	8
III	Northeast - Saxonberg Boulevard	3
IV	East Hills - Allegheny Valley	11
V	Southeast - Mon-Yough Valley	12
VI	Southeast - Route 51	9
VII	South Hills - Route 19	10
VIII	West - Chartiers Creek Valley	9
	City of Pittsburgh	34
		100

Trip Generation. Trip generation rates are affected by the social and economic characteristics of an area and are related to population distribution, family income, automobile ownership, employment densities, transit travel cost and the completed highway network. The Pittsburgh Area Transportation Study determined that net residential density and average car ownerships were the two most reliable indicators of future trip generation in Allegheny County. In general, trip productions increased as net residential density decreased, or as average car ownership increased.

In recent years a considerable amount of research has been conducted into factors influencing the choice travel mode. Such variables as trip purpose, relative auto and transit travel times and costs, transit headways and number of transfers, auto ownership, family income and residential and employment densities are all highly correlated in the decision.

TRENDS IN POPULATION
MILLIONS OF PEOPLE



TRENDS IN EMPLOYMENT
MILLIONS OF JOBS

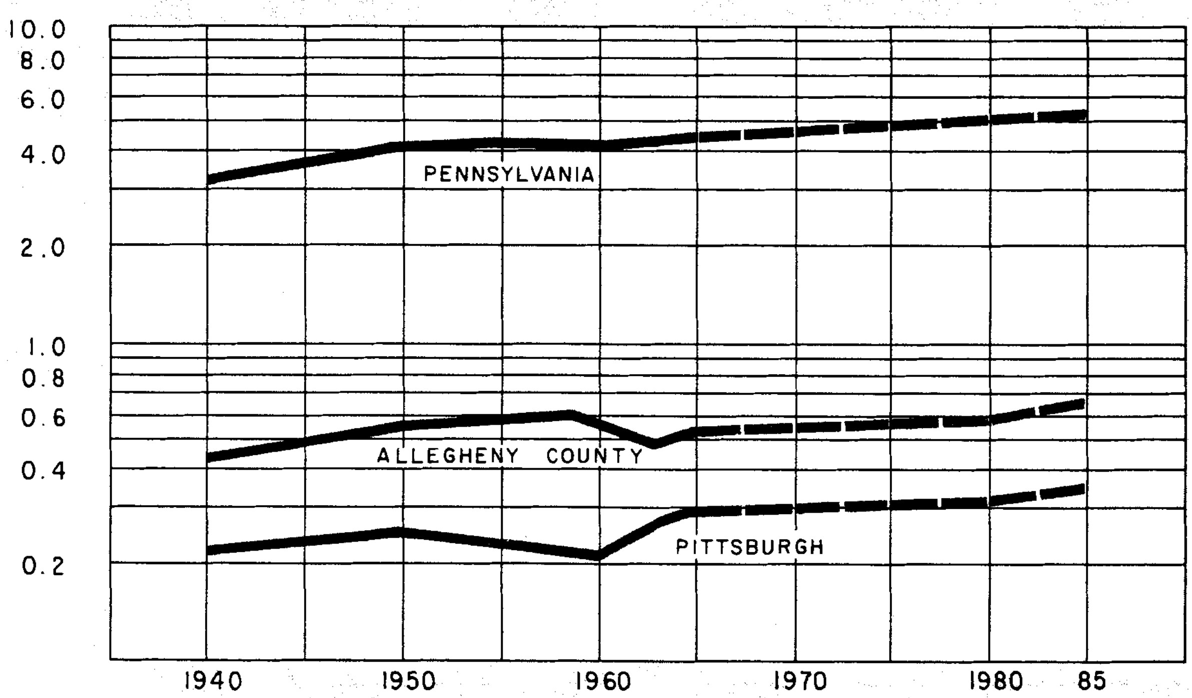
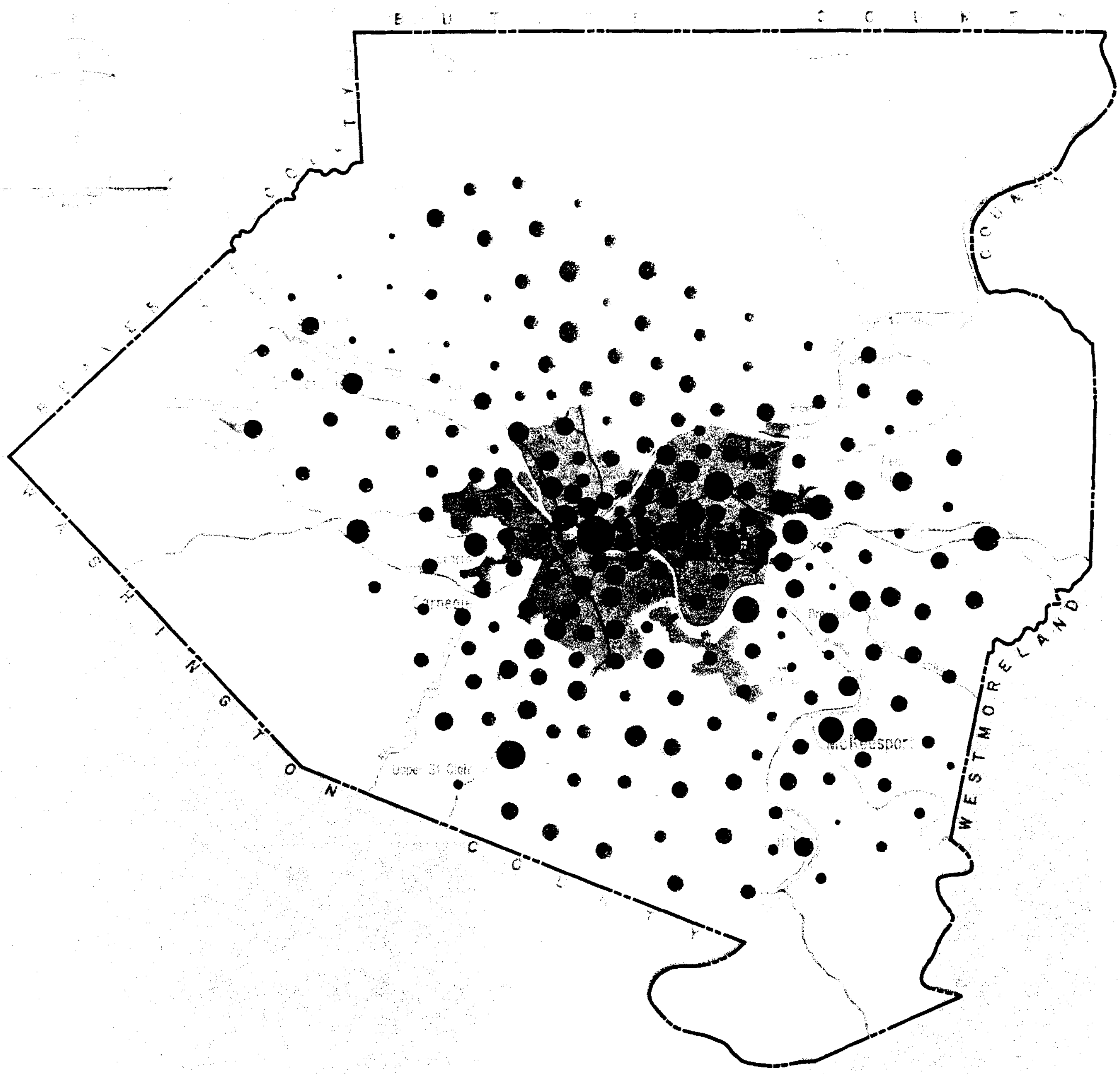
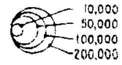


Fig. II-1



LEGEND

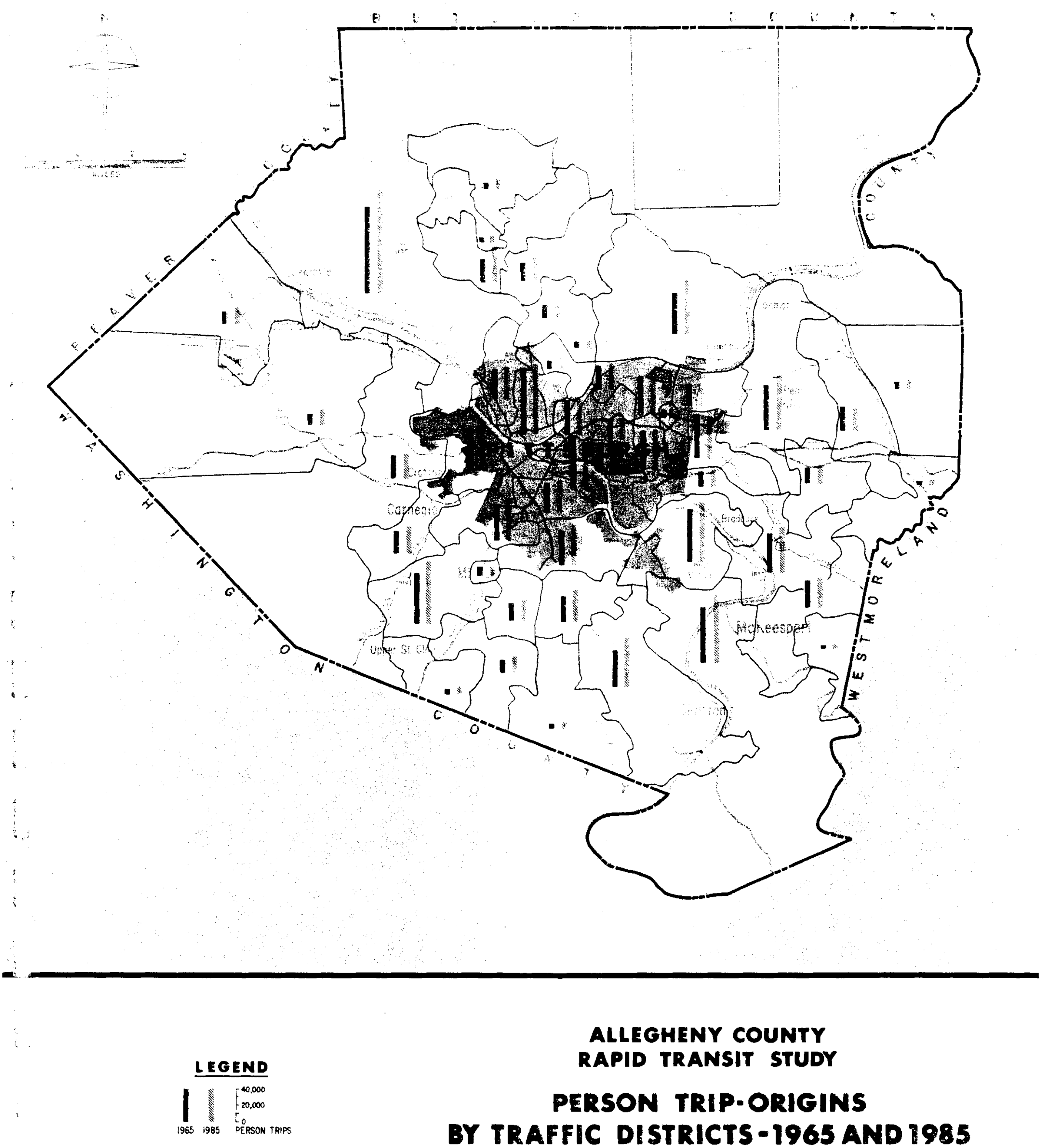


HIGHWAY AND ARTERIAL STREET

ALLEGHENY COUNTY RAPID TRANSIT STUDY

DISTRIBUTION OF PERSON TRIP-ENDS-1985

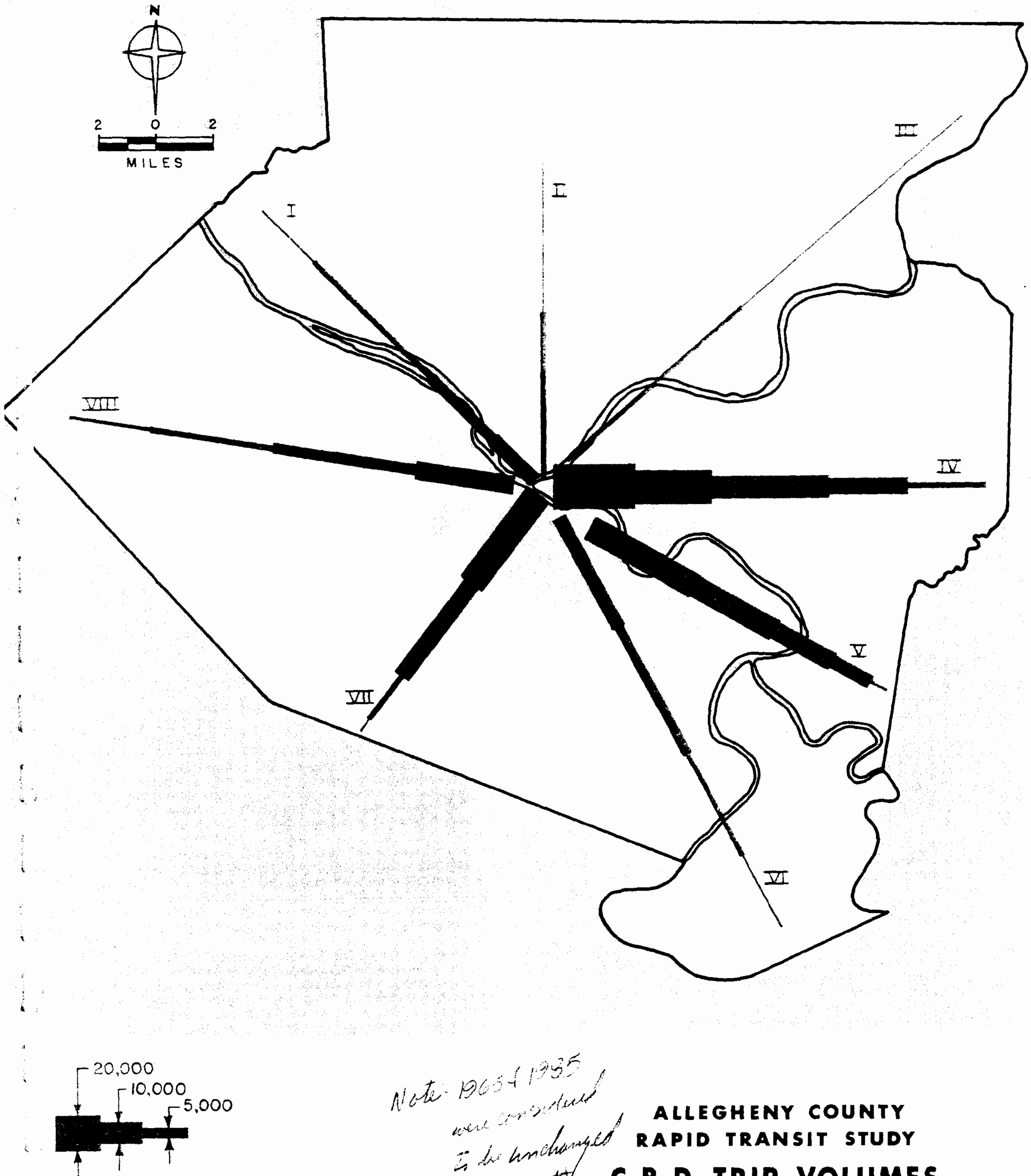
Fig. II-2



ALLEGHENY COUNTY
RAPID TRANSIT STUDY

PERSON TRIP-ORIGINS BY TRAFFIC DISTRICTS - 1965 AND 1985

Fig. II - 3



Note: 1965 & 1985 were considered to be unchanged in distribution

ALLEGHENY COUNTY RAPID TRANSIT STUDY

C.B.D. TRIP VOLUMES BY CORRIDOR

Fig. II - 4

In Allegheny County the most significant factor found to influence transit users was average vehicle ownership. The propensity to use transit also differed significantly for different trip purposes. The greatest propensity to choose transit was found for those making work trips to the CBD during peak periods. From the 1958 travel data it was found that of the 2.6 million person trips per day 81 percent were made by automobile and 18 percent by mass transit. Truck and taxi trips accounted for the remainder. In examining trips to the CBD it was found that almost 51 percent of all persons with a destination in the Golden Triangle used public transit. Transit trips to the CBD constituted 60 percent of all transit trips in Allegheny County.

1965 and 1985 Projections

Population and employment dynamics determine the magnitude of future trip volumes between the traffic analysis zones in the Pittsburgh Metropolitan Area. The modes of travel used depend on the ease of movement by the various facilities and the relative availability of the private automobile. This availability is measured by vehicle ownership rates for each analysis zone. Accurate methods of determining 1965 and 1985 population, employment, and vehicle registration data were necessary to estimate the demand for travel by rapid transit.

Historical trends formed the basis for both the Consultant's estimates and the projections by the local planning agencies. These trends were identified from past census publications, state and local statistical reports, and analyses made by private interests. The 1965 and future estimates were primarily supplied by the local planning agencies, but the Consultant independently estimated and forecast population and vehicle registration data for use as control totals. As expected, there was close agreement between the separate projections.

Most of the projections conformed to census tracts and had to be converted to the Pittsburgh Area Transportation Studies' traffic analysis zones. A listing provided the distribution of population by census tract to these zones in addition to describing the zones' capacities to absorb growth.

Distribution of Population and Jobs. In 1965, there were 1,670,000 people living in Allegheny County including the 588,000 residents in the City of Pittsburgh. By 1985, Allegheny County population is expected to increase to 2,000,000 while the city's population will

forecasting technique

ALLEGH CO. — CITY OF PGH — CBD

Pop + 330,000 (+19.8%) (SPRPC +25%) — 5000 (−0.85%) (SPRPC 0)

Emp + 127,000 (+23.6%) +64,000 (+21.5%) (SPRPC +48%) +17,000 (+16.5%) (42.4% SPRPC) decrease slightly to 583,000. Employment in Allegheny County is expected to increase from its 1965 level of 538,000 jobs, including 297,000 in the city, to 665,000 jobs in 1985. Employment in the city is expected to increase to 361,000 jobs by 1985. The CBD will show an increase of 17,000 jobs from 103,000 in 1965 to 120,000 in 1985.

The Pittsburgh Area transportation Study found that trip generation was determined by the number of occupied dwelling units and net residential densities in each zone. Therefore, the Consultant used the changes in occupied dwelling units to calculate the factors needed to update the 1958 trip file. Mathematical models described the change in the number of persons per occupied dwelling unit for 1965 and 1985, and a 1965 Post Office vacancy-survey aided in the determination of occupied dwelling units. For 1965 updating factors, the number of dwelling units in each zone was calculated directly from housing start and demolition data by census tract, while the 1985 factors were derived from population projections converted to occupied-dwelling-unit data by using an exponential extrapolation for persons per occupied dwelling unit.

The 1985 population projections by census tract supplied by the Pittsburgh Department of Planning were calculated by linear extrapolation of past trends modified by known future development and expected residential densities. The census tracts for Allegheny County outside of the city were projected by the County's Planning Commission and were based on continuation of historical trends, land-holding capacities and known future development. The Consultant also projected this data and used existing master plans, state planning agency estimates, and mathematical derivations. All projections were compared, and the final estimate was a consensus between the County's Planning Commission and the Consultant.

The City's Department of Planning estimated present employment with a ten percent sample of wage tax receipts, and projected employment levels to 1985 using the Regional Economic Study, market analysis of job clusters, and known future development. The CBD employment projections were derived from known future development, office-employee growth trends, and compatibility with the CBD Master Plan. Office employees account for the major proportion of CBD employment growth. The County's Planning Commission projected 1985 employment by a direct survey of employers and their development plans. Employment data was then converted to the traffic analysis zones for both 1965 and 1985 by direct overlay to city land use maps and the County's employment dot maps. The distribution of 1985 population and jobs by major corridors is shown in the following table as well as the percent increase from 1965 to 1985:

Corridor	General Area	1985 Distribution Population	1985 Distribution Jobs	Increase from 1965 Population	Increase from 1965 Jobs
		(Percentage)			
I	Ohio River Boulevard	3	2	21	16
II	North Hills-East Street Valley	7	3	66	43
III	Northeast-Saxonburg Boulevard	4	3	15	26
IV	East Hills-Allegheny Valley	16	8	26	52
V	Southeast-Mon-Yough Valley	14	11	2	11
VI	Southeast-Route 51	10	8	27	4
VII	South Hills-Route 19	10	4	33	53
VIII	West Chartiers Creek Valley	7	6	24	28
	City of Pittsburgh	29	55	-1	21
	Total	100	100	100	100

As in the previous analysis of 1965 population and job distributions by major corridors, the City of Pittsburgh, while declining in population, will retain the major concentrations of population and jobs and is expected to make significant gains in employment. From this analysis, certain patterns are clearly evident: the areas outside of Pittsburgh will continue to grow in residential population, and trends toward development of suburban corridor communities are also likely to continue because of topography constraints. While the City of Pittsburgh will retain a major concentration of the 1985 population, its principal role will be in providing concentrated areas of employment; commercial, industrial and financial centers; and cultural, educational and social institutions such as in the CBD and in Oakland, Allegheny Center, Lower Hill, the proposed Penn Park Development and other centers.

Where urban activities are concentrated, as in the central business districts which house large daytime populations, travel demands in the peak periods require large transportation capacity for maximum ingress and egress. Consequently, those routes connecting residential areas with the downtown area afford the greatest opportunities for the construction and operation of rapid transit service. Based on this analysis, terminal points for rapid transit station locations and for the fixed routes to be tested were selected.

TRENDS IN AUTO REGISTRATION

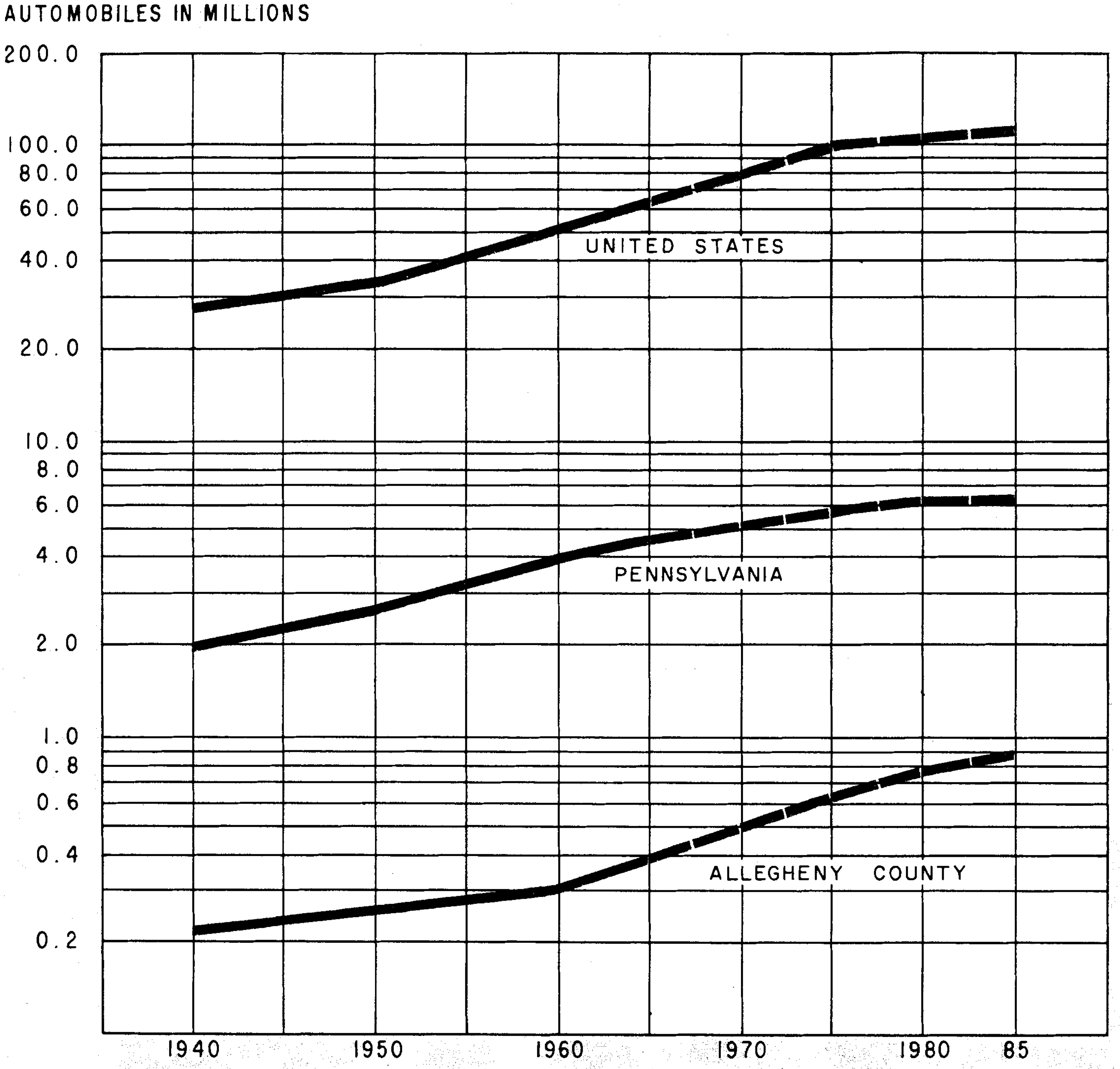


Fig. II-5

Vehicle Ownership. Motor vehicle registration rates and vehicle miles of travel have undergone tremendous growths in the past 20 years, as shown on Fig. II-5, Trends in Auto Registration. The Automobile Manufacturers Association reports that registered vehicles increased from 31 million in 1945 to over 89 million by 1965, which reflects an increase of 190 percent or an average growth rate of 9 percent per year. Motor vehicle miles of travel increased from 250 billion vehicle-miles in 1945 to 888 billion vehicle-miles in 1965, reflecting an increase of 260 percent or a growth rate of 20 percent per year. It has been conservatively estimated that vehicle registrations can be expected to increase by 80 percent in urban areas in the next 20 years. Similarly, motor vehicle travel is expected to increase to 1.5 trillion vehicle-miles by 1985, and 61 percent of this travel is expected to take place in the urban areas. Figure II-5 shows the comparison of automobile registration trends to 1985 for Allegheny County, the Commonwealth and the United States.

In 1958, there was 0.899 vehicle per occupied dwelling unit in Allegheny County. By 1960, this figure had risen to 0.903 and it climbed to 0.969 by 1964. PATS estimated that there would be 1.23 vehicles per occupied dwelling unit by 1980. It was found that an exponential curve closely approximated this trend and it was, therefore, extrapolated to 1985 to obtain the corresponding figure for that year. Using this curve and the occupied dwelling-unit information previously developed, a vehicle ownership rate was developed for each of the traffic analysis zones used in the Study. This information was subsequently used to factor changes in transit necessity riders in the County.

Transit Necessity Riders. Information obtained from the PATS 1958 home interview survey indicated that there were approximately 474,000 transit riders at that time, and that 85 percent of these transit patrons were necessity riders, i.e., persons who were dependent upon public transit for their transportation. Of these 474,000 passengers, approximately 105,000 were passengers on school buses in suburban communities and were not of interest to this Study. These trips, therefore, were deducted from the trip file for the Transit Study, leaving a total 1958 public mass transit ridership figure of 369,000 passengers. Ridership checks in 1965 indicated that transit patronage in Allegheny County had decreased to 306,000 passengers daily after adjusting for transfers. Of these 306,000 passengers, more than 95 percent were transported on Port Authority Transit (PAT) vehicles, the remaining passengers being carried by independent bus companies and commuter railroads.

The PATS study showed a close correlation between transit necessity riders and zero-car households – those households having no automobiles. Zero-car households have been decreasing at the rate of about one percent per year, and a high degree of correlation (0.945) was established between zero-car households and necessity transit patronage. Several methods for predicting future necessity patronage were examined, but after each was thoroughly analyzed it was decided that the most accurate indicator of necessity ridership was the zero-car household. Therefore, a 1965 necessity trip factor was developed for each traffic-analysis zone based on the zone's proportionate deviation from the average percentage of zero-car households for Allegheny County in 1965; and this factor was, in turn, adjusted for 1985 based on that year's zero-car household projections for the County. After having developed the necessity trip factors, it was necessary to calculate similar factors for choice riders.

<u>Choice Travel</u>. For transit planning purposes it is essential that choice and necessity trips be projected separately since the characteristics of these trips are vastly different. Necessity transit riders are restricted in the amount and type of travel which they can make because they are restricted in their travel to areas served by public transit, and their trips must be made in conformance with schedules fixed by the transit companies. Choice travelers, as the name implies, have the opportunity to choose their mode of travel and consequently can dictate their own schedules and thereby provide themselves with much more flexible travel opportunities. Consequently, most choice transit riding occurs in the normal morning and evening peak hours when mass transit service is most frequent. Similarly, most choice transit trips are oriented to the CBD and other large concentrated employment centers when adequate public transit services are provided.

Previous research has indicated that choice transit travel growth is related to zonal population and to CBD employment growth. At this point the population and employment projections developed previously were used to develop choice trip factors for 1965 and 1985. It was found that for Allegheny County, population growth and CBD employment growth exerted nearly equal influences on choice transit growth. A separate choice factor was developed for each traffic analysis zone for 1965 and 1985.

After all trips in the County had been estimated for 1965 and 1985, according to necessity or choice, the necessity trips were assigned directly to the proposed transit network. The choice trips, however, were subjected to a "diversion" or "modal split" process with only a part of them actually being assigned to the transit system. The relocation of estimated future choice travel demand to proposed highway and rapid transit systems, requires the development and use of a mathematical model which relates the explicit relationship between choice of travel mode and the characteristics of both the trip maker and the transportation system. This process is known as modal split and provides a computerized decision-making process to predict a trip maker's choice between auto and mass transit, and to test a number of alternative systems operating under varying assumed conditions. This diversion process is discussed in detail in Chapter III under the heading of "Patronage Estimates."

III. FORMULATING A MASS TRANSPORTATION SYSTEM

In order to formulate and evaluate a regional rapid transit system for Allegheny County, it was necessary to identify the major travel corridors and postulate an extensive system of routes. These routes then had to be tested for patronage potential, taking into account projections of population, employment and land use. This system was designated the "Test Network." The procedures employed in formulating and evaluating the system and its component routes are presented in this section of the report. After the evaluation, a regional system of lesser extent to serve needs until approximately the year 1985 was identified for further study.

Since the term mass transportation includes a wide range of types of systems and levels of service, a brief review of some of these is presented to provide a plane of reference for the development of the test system.

Types of Mass Transportation Systems

Mass transportation systems consist of two basic types - those restricted to fixed right-of-way and roadways, such as railroads and rapid transit, and those not restricted to a fixed right-of-way, such as buses. Each of these modes of transportation is discussed separately in the following paragraphs.

Commuter Railroads. Commuter railroad service has met with the most success in the larger older cities, notably New York, Boston, Philadelphia and Chicago, where extensive commuter service is still provided by private railroads. It has played a significant role in Allegheny County also. However, commuter rail travel has come under increasing economic pressure, largely due to the burden of increased wage rates, fringe benefits and restricting operating rules and the necessity of large allocations of equipment and personnel to serve needs for only four hours daily.

The trend among rail carriers, with a few exceptions, has been to withdraw progressively from commuter service. Equipment has become antiquated, and schedules infrequent and unreliable. Where state and federal regulatory bodies have permitted, in some areas service has been abandoned entirely. There are exceptions to this trend in the west and midwest, and in the east also, where programs of subsidizing the railroads have been developed by local and state governments.

Advantages of commuter rail systems include exclusive rights-of-way, capacity for moving large volumes of passengers, and comfort. Most roads, for example, offer a seated ride to all patrons. Disadvantages lie in high operating cost; poor CBD distribution, with reliance on other modes to complete trips; low rates of acceleration and deceleration; long distances between stations; and the necessity of sharing rights-of-way with through-passenger and freight trains. In most cities, including Pittsburgh, it is necessary for trains to dead-end in or near the downtown area. Commuter service on railroads in the Pittsburgh area has declined to the point where it does not play a significant role in the transportation system.

Local and Express Buses. Local buses have a long history of providing most of Allegheny County's public transportation. Presently, they are rapidly supplanting the remaining trolley lines. These buses provide service to and from the CBD, for feeder and crosstown movements, and for certain off-route school and industrial travel. They have the advantages of flexibility in route and schedules, relatively low capital costs, and the capability of providing feeder services to other modes of transportation.

Disadvantages lie in their relatively low speed over city streets, narrow vehicles for seating passengers, lack of potential for automation, and resultant high operating costs.

Express buses traveling in mixed traffic are in widespread use and have met with some measure of success. Buses in this type of service normally pick up and discharge passengers in local neighborhood areas, and then proceed to the CBD or other major generating point over a high-speed highway facility without making any stops. They are able, at best, to equal auto speeds while on the freeway, and are somewhat slower over local portions of the route. Service to intermediate points en route to the CBD is impractical unless stations or turnouts are located along the freeway to permit passenger interchange.

A second type of express bus service uses exclusive bus lanes or busways to and from the CBD. Stations are provided at stragetic points along the exclusive lanes where passenger interchange can occur. Buses can remain in these lanes for the entire length of their trips, or they can leave the lanes at selected points and provide local neighborhood distribution. This type of system has potential for providing higher speeds than the "mixed traffic" alternative, but it requires a greater capital expenditure – in some cases, one that approaches that of a conventional rail system in the same configuration. Planning, financing and construction of these exclusive lanes must be coordinated with original highway construction, or such separate facilities have to be built later at much greater cost.

Trolleys have historically played a major role in Allegheny County's public transportation system. Although they have been gradually replaced with buses, the three routes which include substantial separate rights-of-way – Castle Shannon, Library and Drake – are some of the most heavily patronized lines in the PAT system. The trolley's service is impaired where it must compete for space with heavy street traffic, such as in the Golden Triangle and other major commercial centers. Some cities, particularly Boston in this country, have placed trolley lines underground in the downtown area. This has achieved a medium capacity and medium speed service without the necessity of fixed construction costs outside the downtown areas that a rapid transit service entails.

Rapid Transit. The term "rapid transit" is generic, and covers a number of different types of systems, and variations within systems. For the purpose of this report, rapid transit is defined as a system of public transport, operating on its own exclusive grade-separated rights-of-way, incapable of operation away from its guideway, and capable of high average rates of speed. Rapid transit may be provided in single vehicles or in trains of several vehicles linked together.

Rapid transit, as defined above, includes such systems as conventional rail rapid transit and various types of rubber-tired systems such as the Westinghouse Transit Expressway and the Paris and Montreal Metros. It also includes various types of supported and suspended "monorails", and such innovative systems as "StaRRcar" and Teletrans and variations thereof. The latter seek to overcome the limitations of corridor rapid transit, and the transfer from private motor vehicle or bus that it entails, by providing small cars that supply an approximation of door-to-door service.

Some of the unconventional types of systems that have been conceived or proposed as solutions to the growing problem of metropolitan transportation are listed below:

The Alweg. A supported monorail of the saddleback type of which demonstration projects have been built in Japan, Europe and America. The train is rubber-tired and centerguided along a concrete beam. Serious consideration is being given by the developer to substituting steel wheels for the rubber tires on the drive wheels.

The SAFEGE. This consists of an overhead suspended type designed by French interests who have built short lines in Japan and France. The rubber-mounted trucks operate in a closed, box-like girder and are guided by horizontal, rubber-tired wheels.

Westinghouse Transit Expressway. The Westinghouse system is a supported concrete-tracked roadway over which electrically powered, bus-like coaches operate singly or in trains. Designed for aerial, at-grade, or underground operation, the two-mile installation at South Park has been tested for over a year and has undergone test evaluation, a part of the federally-aided demonstration project.

Two other proposed systems, which depart from the concept of multi-passenger vehicles operating in trains and might be considered as automated taxis, are:

Alden StaRRcar System. This proposed system consists of small, electrically-powered cars designed to operate in grade-separated guideways at high speeds, and over conventional streets at slower speeds using battery power.

Teletrans System. This system employs a linear-induction motor with which it is proposed to propel small electric cars seating two or three passengers on an exclusive enclosed roadway above or below grade. The passenger selects his destination and the vehicle is automatically routed to this point.

Capital costs for any system of rapid transit are high. In fact, depending on the type of construction, costs of final construction may be higher per passenger than for any other form of transportation. However, costs of operation are relatively low, making it possible over a wide range of patronage for rapid transit systems to recover operating and equipment costs. Rapid transit systems are highly inflexible, and require feeder buses and automobiles to supplement their service to an entire community. Conversely, rapid transit has the capability of moving large volumes of people over a single right-of-way, at high constant speeds, and with a high level of passenger comfort.

Rapid transit systems, as being designed today, offer substantial improvements over the existing systems with which most persons are familiar – the subways and els in New York, Chicago and Philadelphia. New technology permits smooth computer-controlled rides, quiet operation, lighter and more aesthetic structures, and pleasing vehicle appearance and appurtenances.

It is expected that any system of trunk line rapid transit cited in the foregoing has the basic capability to handle the passenger volumes foreseen in Allegheny County. Since any system should be capable of operating on, under, or above the surface, depending on physical conditions and neighborhood environment, continuous structure, as is necessary in overhead monorail types, becomes a decided cost disadvantage. Also, in most regional systems, there is need for branch lines and yards. This makes necessary a fast and easily workable switch – a requirement some untraditional systems cannot fulfill.

For the development and evaluation of the test network, the general characteristics of the steel-wheeled rail rapid system were assumed. The evaluation was based primarily on the anticipated patronage and physical feasibility. The only other pertinent characteristics were speed, acceleration and maximum grade and curvature. During the subsequent phase of the study, for the 1985 system, the Westinghouse Transit Expressway was studied in equal depth with the rail system and compared therewith.

Major Travel Corridors

From data developed earlier in the study, and from reports and information prepared by other agencies, the major travel patterns in the area were identified. These became the basis for determining rapid transit routes of the Test Network. Of primary importance in this phase of the work was consideration of the role of the Central Business District as a trip generator. Consideration was also given to alternative patterns of future development that had been examined by the Southwest Pennsylvania Regional Planning Commission.

Corridors Defined. The study area was divided into eight major corridors for the purpose of grouping trips, defining study areas, and projecting test lines. The focal point of these corridors, the Central Business District, is the portion of the city between the Allegheny River, the Monongahela River and the Crosstown Boulevard. The eight corridors branching from the CBD are described below.

Corridor I - Ohio River. This corridor is bounded by the Ohio River on the south, Perrysville Avenue on the east, and the Allegheny County line on the north and west. The major arterials located within this corridor are the Ohio River Boulevard and California Avenue.

Corridor II - North Hills. The North Hills corridor is bounded by Perrysville Avenue on the west, William Flinn Highway on the east, the Allegheny River on the south, and the Allegheny County line on the north. Major arterials within this corridor are Perrysville Avenue, McKnight Road, East Street and East Ohio Street.

Corridor III - Allegheny Valley. This corridor is bounded by the William Flinn Highway on the west, the Allegheny River on the south, and the Allegheny County line on the north and east. Major arterials serving this corridor are Freeport Road, William Flinn Highway, and Saxonburg Boulevard.

Corridor IV - Wilkinsburg-East Hills. This corridor is bounded by the Allegheny River on the north, the PRR main line, the Monongahela River, and the boundary between North Versailles Township and McKeesport on the south. The portion of this corridor east of Wilkinsburg was further divided into three sub-corridors. Corridor 4-a is composed of the area between the Allegheny River and Saltsburg Road. Corridor 4-b is bounded by Saltsburg Road on the north, and the William Penn Highway on the south. Corridor 4-c is bounded by the William Penn Highway on the north, and the PRR main line, the Monongahela River, and the boundary between North Versailles Township and McKeesport on the south. Major arterials within this corridor are Penn Avenue, Liberty Avenue, Butler Street, Allegheny River Boulevard, Lincoln Highway, Saltsburg Road, Frankstown Road, and portions of the Parkway East.

Corridor V - Monongahela Valley. This corridor is bounded by Corridor IV on the north, the Monongahela River and Route 885 on the west, and the Allegheny County line on the east and south. Major arterials located within this corridor are Forbes Avenue, Fifth Avenue, Braddock Avenue, Monongahela Boulevard, Bigelow Boulevard, Center Avenue, and the inner portion of the Parkway East.

Corridor VI - Pleasant Hills. This corridor is bounded by Route 885 on the east, Routes 88 and 51 on the west, the Allegheny County line on the south, and the Monongahela River on the north. Major arterials within this corridor are Route 51 and Brownsville Road.

Corridor VII - South Hills. This corridor is bounded by Corridor VI on the east, the Parkway West, the eastern boundary of Carnegie, and the Norfolk Western Railroad on the west. Major arterials include West Liberty Avenue, Banksville Road, Greentree Road and the inner portions of the Parkway West.

Corridor VIII - West End. The West End corridor is bounded by Corridor VII on the east, the Ohio River on the north, and the Allegheny County line on the west and south. Major arterials within this corridor are Carson Street, Routes 60, 22, and 30, and portions of the Parkway West.

Importance of CBD. The Central Business District has traditionally been the focal point of transit service in Allegheny County. In the downtown area, the street and parking systems are inadequate to handle the surface vehicles required to serve the heavy concentrations of employment and shopping within the CBD.

In 1958, on a typical weekday, according to the Pittsburgh Area Transportation Study, 146,500 person trips had destinations within the Central Business District. Of this total, 78,300 person trips, or 53 percent of all downtown trips were made by transit. In 1965, approximately 100,000 transit trips were made to the Central Business District. Projections for 1985 indicate that approximately 140,000 transit trips will have destinations in the Golden Triangle. This is assuming, of course, that a regional rapid transit system will be built by 1985 to attract riders from the various patronage corridors within the Study Area.

78,300 → 140,000
+ 61,700 (+79%)

Travel patterns within the Study Area generally follow a corridor pattern and are predominantly radial in nature. In the Pittsburgh metropolitan area, for instance, 82 percent of all transit trips are made on radial bus or trolley lines. Of the total transit trips made on radial lines, 41 percent have destinations within the CBD. Transit trips approximate only 22 percent of the total trips within the Study Area, but 53 percent of the CBD trips. In 1965, transit trips to the Central Business District amounted to 35 percent of the total transit trips within the metropolitan area. As public transportation becomes more efficient and parking costs and traffic congestion continue to increase, the role of transit will become increasingly important to the future growth and development within the CBD.

Alternative Patterns of Development. A major consideration in any transportation study is the interaction of the proposed transportation system with proposed community development plans. This is an extremely important aspect since, if given proper attention in planning, the result can be a comprehensive regional plan with the transportation system and the community development plan complementing each other. The Southwestern Pennsylvania Regional Planning Commission (SPRPC), in a report entitled "Alternative Regional Development Patterns", examines several alternative development plans for their region which includes Allegheny County and the five counties which surround it - Armstrong, Beaver, Butler, Washington and Westmoreland. Four alternatives were considered in their analysis and each was analyzed with regard to topography, the pattern of existing development, public open space and recreation, and transportation facilities and natural resources. A brief discussion of each alternative follows:

Continuation of Present Trends. This alternative, as the title implies, suggests that development in the region be continued in the same manner as it has in the past. This is characterized by low density suburban growth and dispersed commercial and employment centers with travel in the area being largely dependent upon the highway network. If this trend is permitted to continue, almost all of Allegheny County will be covered by low density development, leaving little land for agricultural or recreational facilities in the center of the region. This type of development is undesirable from a transportation standpoint because it requires an extensive street and highway system that is almost impossible to serve effectively by public transportation.

Regional Cities. If this alternative were chosen, a number of relatively autonomous but inter-dependent cities, each having a population of 100,000 to 150,000 people, would be formed around the county seats and other selected areas in the region. This scheme would provide substantial open areas and would curb urban sprawl. It would require stringent land control regulations. Such a regional development would require a highway system of reasonable extent and could be served efficiently by mass transit.

Corridor Communities. This alternative would encourage the development of numerous communities and small towns along major transportation corridors in the region. It would leave large areas between the corridors open for agricultural and recreational development. Moreover, it would provide great potential for maximum utilization of rapid transit and freeway facilities by persons commuting from the corridor communities to employment and commercial centers in the Pittsburgh core area.

New Towns. This plan would propose a series of new towns of 25,000 to 50,000 people to be located near existing urban centers, and to be dependent upon the urban centers for major sources of employment and other facilities. The new towns would be linked to the existing urban centers by extensive highway facilities. Mass transit service for this type of diverse development would be difficult to provide. Like the Regional Cities alternative, this scheme would require rigid land controls.

After each alternative had been evaluated, they were ranked in this order of desirability and adaptability to the SPRPC Region by the Planning Committee:

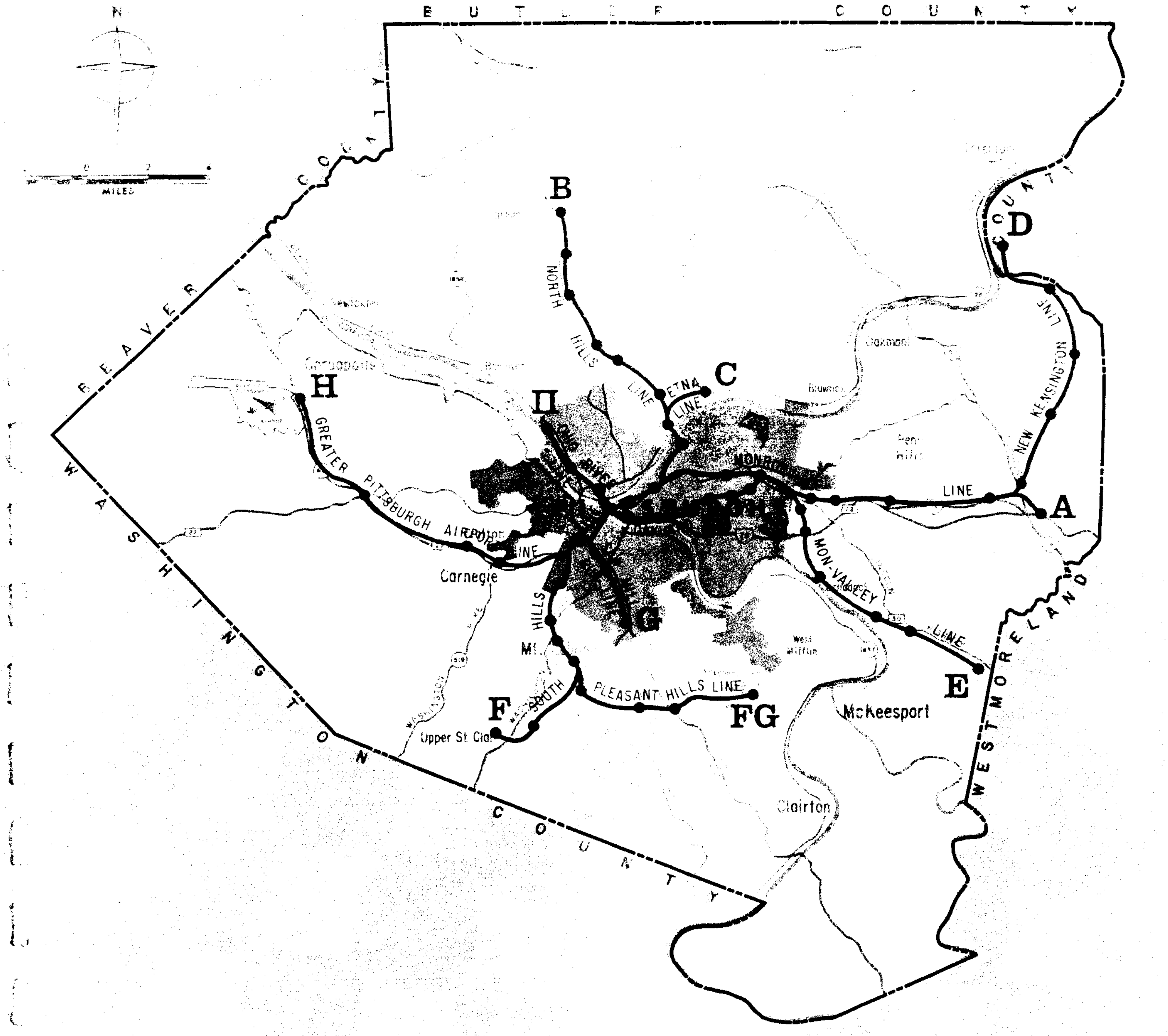
1. Corridor Communities
2. New Towns
3. Regional Cities
4. Continuation of Present Trends

Consequently, the planning committee recommended that the Corridor Communities alternative be adopted for future development planning in the region because it offered an opportunity to emphasize and enhance the present pattern of regional growth and provides maximum opportunity for utilizing a total regional transportation system for guiding growth. This type of development provides a mutually advantageous relationship between the transportation and community development plans. Not only does the corridor development concept facilitate the transportation network, but the regional transportation plan can be developed so as to guide the community development in an orderly and controlled fashion in the corridors. If this plan is implemented, it should not cause any major changes from a transportation planning point of view because the major transit corridors, as they are now defined, are greatly limited by topographic constraints and would not, therefore, be expected to change significantly.

Selecting the Test Network

After having defined the major travel corridors and travel patterns, a number of preliminary networks were developed and located which would test the patronage attraction in each corridor and the maximum extent of rapid transit required. In selecting the network for Allegheny County, as well as in the Golden Triangle, each alternative was evaluated on the basis of construction feasibility and cost, operating characteristics, accessibility, and compatibility with proposed community development and transportation plans. The network selected for testing provided sufficient coverage of the area so that the true patronage potential of an extensive rapid transit system could be obtained. A plan of the Test Network consisting of 92 miles of routes and 56 stations is shown on Fig. III-1, 92-Mile Rapid Transit Test System.

Preliminary Route Selection. The purpose of the preliminary route selection was to establish a very extensive county-wide rapid transit network as a basis for measuring rapid transit patronage potential in Allegheny County. This, in turn, was to be used to establish the required extent of a system to fulfill 1985 needs. In developing preliminary alternative routings, the Consultant was guided by previous studies and reports prepared for the area; by discussions with the Technical Committee, planning agencies and other public and private bodies; by the experience of other cities; and by the extensive travel and other data that had been developed in the course of this study. The routings were planned taking into consideration the present and proposed highway network, railroad alignment, existing and abandoned street car rights-of-way, present and future land use, topography, and other existing and proposed major facilities.



LEGEND

- RAPID TRANSIT
- STATION
- **A** ROUTE DESIGNATION
- HIGHWAY AND ARTERIAL STREET

ALLEGHENY COUNTY
RAPID TRANSIT STUDY

92-MILE
RAPID TRANSIT TEST SYSTEM

Fig. III - 1

To achieve high average speeds and dependable schedules, a rapid transit system must be located on exclusive rights-of-way completely separated from conflicts with automobiles, railroads, and pedestrians. Preliminary geometric criteria for the system were established in order to develop an alignment and profile compatible with the rugged terrain of Allegheny County. These criteria, which assume modern rail rapid transit systems, were selected to insure safety and speeds competitive with the private automobile, and comfortable riding characteristics. Some of these criteria are as follows:

Maximum speed	70 mph
Average operating speed with stops	35-40 mph
Maximum acceleration	3 mph/second
Maximum grades	
Desirable	4 percent
Absolute	6 percent
Minimum curvature	
Desirable	800 ft. radius
Absolute	500 ft. radius
Vehicle size	
Length	70 feet
Width	9 feet 6 inches
Height	10 feet 6 inches

Preliminary route selection and station locations were concerned with two characteristic areas: (1) the downtown and densely populated urban areas, and (2) the outlying suburban areas. The preliminary routings to serve these areas assumed the distinct characteristics of what might be designated as urban and suburban systems. The reasoning behind these line designations is explained in greater detail in a following section on the selection of station locations.

The downtown area was analyzed to determine the most feasible method of penetration, to identify the principal areas to be served, and to determine the present and anticipated development plans. Each alternative routing in the CBD was analyzed both as a separate unit and as a component part of the total rapid transit network. The various CBD alternatives were evaluated from the standpoint of engineering and cost, total system operations, service characteristics, accessibility, and community acceptance.

The suburban areas were analyzed to determine possible rapid transit corridors, the most practical alignment in these corridors, interception of major highways, present and future land use, least disruption of the communities, and location of accessible and feasible station sites.

The corridors defined were then analyzed and alternative routings and station locations were developed within these corridors. Various types of construction as well as the approximate right-of-way requirements were investigated and evaluated. The disruption of the community by the line location was also studied.

Selection of Stations. Station selection, an important step in planning a rapid transit system, requires analysis of many factors. Some are the factors directly related to the operation of the rapid transit facility, and others are more related to social and community values. Some aspects of station selection can be evaluated by the Consultant quite readily by quantitative methods and judgment gained from previous experience in other cities. However, many other decisions must be reached on the basis of community plans and attitudes and must, therefore, emanate from policies formulated by community officials acting in the capacity of advisors to the Consultant. Input to the Consultant on these matters was received from the Technical Committee and its members.

Station spacing is dependent upon density of development and characteristics of service desired. These vary from one metropolitan area to another. Close station spacing minimizes the distance between the patron's point of origin and his boarding of a rapid transit train. However, it increases travel time on the transit system. Thus, close station spacing not only affects passenger service, but also increases both operating costs and the capital cost of fixed construction and equipment. It is impractical to generalize about station spacing which, in fact, can only be established by balancing all the factors involved for a particular route under study. Such a balancing of all factors was the basis of establishing station spacing in the test network.

The line connecting Ben Avon and Homewood, by way of Manchester, Allegheny Center, Downtown, Oakland and Squirrel Hill, passes through areas of dense urban development and was, therefore, designated the "Urban Line." Close station spacing was selected on this line to accommodate as many walk-in patrons as practicable. The remaining lines were designated "Suburban Lines" and were designed to serve the less-densely developed suburban areas around Pittsburgh with higher speeds and longer distances between stations. The Urban

Line configuration was initially laid out with stations approximately one mile apart, allowing schedule speeds averaging 35 miles per hour. The Suburban Line stations were spaced slightly more than one and one-half miles apart, with schedule speeds of almost 41 miles per hour. It is emphasized that these spacings were adopted for patronage testing purposes only and were reconsidered in subsequent planning. The station locations should be re-examined periodically throughout the planning and development of the stages of the rapid transit system so that current community developments may be coordinated with it.

Among other factors to be considered in station location is the availability of property for a station and for related facilities such as parking lots or garages. In the Pittsburgh area, topography played a vital role in the choice of station sites. In the densely populated neighborhoods, it was assumed that most patrons would travel to the rapid transit system by walking or by feeder buses; therefore, no parking facilities were planned. This substantially reduced the land area required. In suburban areas, however, it is expected that the majority of rapid transit patrons will drive to the stations. This will necessitate adjacent parking lots or garages. Availability of land is critical in many areas where large parking demands are anticipated.

Since the formulation of the test network, several plans have developed which will have an impact on station locations. The major projects include the proposed Midtown Plaza and United States Steel Building in the upper portion of the Golden Triangle, a new sports stadium and the Allegheny Center commercial complex on Pittsburgh's North Side, the proposed Penn Park development in the city's Strip District and the Pittsburgh Board of Education's plan to construct five "super high schools" to serve the entire city. At the present time, the Southwestern Pennsylvania Regional Planning Commission is undertaking a comprehensive land use and transportation planning study in the region. The results of this study will probably propose significant changes in the land-use patterns and in the transportation network of the area. These planned developments will undoubtedly dictate changes in the proposed rapid transit station locations in order to provide maximum interchange between the transit and highway facilities in the Region, a factor of great importance in securing patrons, particularly in suburban areas, for the rapid transit facilities and providing the much needed balance between the auto and transit modes of transportation.

Among the other factors to be considered in station location is the suitability of a specific location for a station and for such related facilities as parking lots or garages. In the Pittsburgh area, topography played a vital role in the choice of physical station sites. In the densely populated neighborhoods adjacent to several of the stations, it was assumed that most patrons would gain access to the rapid transit system by walking or riding on feeder buses; therefore, no parking facilities were planned, and this substantially reduced the land area required. However, in the suburbs it was felt that the majority of the rapid transit patrons would drive to the stations, which would require adjacent parking lots or garages to be built. Station-site location became critical in many areas where large parking demands were anticipated.

Rapid transit stations should enhance neighborhood environments, and can provide a focus for neighborhood improvement or renewal. It is emphasized that such considerations can be exceedingly important in achieving acceptability of a rapid transit system. Thus, they deserve close attention by system designers acting with the counsel and guidance of local planning officials.

Description of Routes. The extensive rapid transit system which evolved from the preliminary patronage and route location analysis is shown in Fig. III-1. The total system would contain 92.0 miles of double track lines and 56 stations. The Urban System would account for 9.1 miles of the system and serve 11 stations, two of which would be common to the Suburban System (Market Square and Dahlem). The average station spacing on the Urban Line is 0.8 mile. The Suburban System would account for the remaining 83 miles, serving 47 stations with an average station spacing of 1.8 miles. The total system would consist of 11 lines. A brief description of each follows:

Urban System

Route I - Golden Triangle to East Liberty (5.5 miles). This line would serve Oakland, Shadyside and East Liberty and would connect with the Suburban System at each end with common stations at Market Square and Dahlem Street. Beginning at Market Square, the line, primarily in subway, would follow Forbes Avenue to the Crosstown Expressway. It would then follow Fifth Avenue east and Denniston and Dahlem Streets north to its junction with Suburban Line A in East Liberty. Intermediate stations would be located at Grant Street, Dinwiddie Street, DeSoto Street, Craig Street, Wilkins Avenue and Shady Avenue.

Route II - Golden Triangle to McKees Rocks Bridge (3.6 miles). This line would begin at the common Market Place Station, pass under the Allegheny River in the vicinity of Stanwix Street and proceed west along the north side of the Pennsylvania Railroad and California Avenue parallel to the Ohio River to its terminus at the McKees Rocks Bridge. Intermediate stations would be located at Cremo Street and at U.S. Route 19.

Suburban System

Route A - Golden Triangle to Monroeville (16 miles). Beginning at Market Square, the line would follow Liberty Avenue and the Pennsylvania Railroad right-of-way to Wilkinsburg. It would continue then at-grade and in tunnel through Churchill and Penn Hills and then along the Parkway-East to the north side of Garden City, Monroeville and University Park. Intermediate stations would be located at Tenth Street, 31st Street, Negley Avenue, Dahlem Street, Pitt Street, Montier Street, Rodi Road and Garden City.

Route B - Branching from Line A to Ingomar (10.6 miles). This line would branch from Line A east of the 21st Street Station and follow Spring Way to 44th Street on aerial and at-grade construction. It would then turn north crossing the Allegheny River on a high-level bridge passing through Millvale to Babcock Boulevard, along Babcock Boulevard to Three Degree Road and then on private right-of-way to Ingomar. Intermediate stations would be located at Butler Street, Lincoln Avenue, Wible Run Road, McKnight Road, Siebert Road, Three Degree Road and Perrymount Drive.

Route C - Branching from Line B to Etna (1.8 miles). Branching from Line B in the vicinity of Emma Street in Millvale, the line would follow Seavey Road and Soose Road on aerial construction, then would go into a tunnel under Shaler Crest to Etna. Only one station would be served on this line located at Spring and Church Streets in Etna.

Route D - Branching from Line A to New Kensington (10.4 miles). Branching from Line A at Garden City, primarily at-grade, the line would follow a northeasterly direction through Plum Borough to Greensburg Road, then it would run generally along Pucketa Creek to the Pennsylvania Railroad and along

Moss Alley and the railroad on aerial construction to the New Kensington CBD. Stations would be located intermediately at Plum Creek and Route 380, New Texas and Old Leechburg Roads, Sardis and Old Leechburgh Roads and at Route 366 and Peacock Inn Road.

Line E - Branching from Line A to East McKeesport (9.4 miles). As proposed, this line would branch from Line A in Homewood and follow the Pennsylvania Railroad to Braddock where it would then proceed alongside or in the median of a proposed freeway to Jacks Run Road. Intermediate stations would be located at Rebecca Street, Swissvale Avenue, Braddock Avenue, Turtle Creek Valley and Fifth Avenue.

Line F - Golden Triangle to Route 19 at Clifton (10.4 miles). Starting from the common Market Square Station in the Golden Triangle, this line would cross over the Monongahela River and enter Saw Mill Run Boulevard through the existing Wabash Tunnel. It would then proceed through a new tunnel to Banksville Road which it would follow through Dormont before turning east in a tunnel through Mt. Lebanon. The remainder of the line would follow the PAT right-of-way to Castle Shannon and the Drake right-of-way to Clifton. Intermediate stations would be located at Saw Mill Run Boulevard, Wenzell Avenue, Bower Hill Road, Shady Drive, Castle Shannon Boulevard, and Fort Couch Road.

Line FG - Branching from Line F to Allegheny County Airport (7.8 miles). Branching easterly from Line F at Washington Junction, this line would follow the PAT Library right-of-way of Bethel Church Road where it would cross over Library Road to run along the south side of the Montour Railroad which it would follow to Route 51 where it would shift to the north side of Lebanon Church Road and into the Allegheny County Airport. Stations would be located intermediately at Bethel Church Road, Brownsville Road and Glenburn Drive.

Line G - Branching from Line F to Overbrook (3.2 miles). This line would branch from Line F at the Wabash Tunnel and follow the existing Shannon right-of-way along Saw Mill Run to Library Road. Only two stations are proposed on this line, one at the existing trolley yard at Warrington Avenue and the other at the southern terminus at Library Road.

Line H - Branching from Line F to Greater Pittsburgh Airport (13.4 miles). This line would branch from Line F along Banksville Road at Crane Avenue and then climb westerly to a tunnel under Greentree Road from which it would emerge into Whiskey Run. It would join the Parkway West near Carnegie and follow it to its western terminus at the Greater Pittsburgh Airport. Intermediate stations would be located at Carnegie, Baldwin Road and Route 22-30.

Assumed Operating Characteristics. The proposed Urban Line would operate through the densely populated areas of the city and would have relatively close station spacing. The Suburban Line would serve the outlying communities with longer station spacing to insure higher average speeds. Train lengths would vary throughout the day depending on the passenger demand. All operations would originate at a terminal station and proceed into and through the CBD to the terminal station on the other side of the CBD. Schedules from all lines would be coordinated to provide minimum headways of 90 seconds in the CBD during the peak hours of the day.

Yards and shops would be located at Homewood for the Urban Line, and at Rankin, Monroeville, and North Hills for the Suburban Line. All major repairs would be performed at the Homewood yards and shops. Minor repairs and cleaning of vehicles would be done by all yards and shops.

To provide a well-balanced transportation system, an efficient feeder bus system must complement the rapid transit network. For this purpose, rapid transit schedules would be coordinated with feeder bus schedules to insure minimum transfer time and maximum passenger convenience.

To maintain the high speed and frequent service necessary to attract patronage, automatic train control will be adopted for the system. All normal train operations will be controlled from a centrally-located computer or several smaller computers in various locations throughout the system. An operator would be assigned to the head of each train to maintain a constant, visual inspection of the right-of-way. The operator would also observe the automatic train operation to insure that it is functioning properly. In the event of any unforeseen emergency, the operator will take over control of the train.

Fare collection will utilize the latest innovations in automatic fare-collection equipment. The fare collection system should be simple to comprehend and adaptable to a fully graduated fare. Passengers would purchase their tickets and admit themselves to the rapid transit system on a self-service basis.

Patronage Estimation

One of the most important, but probably least understood elements of a transit study is the process of patronage estimation. Patronage estimates form the foundation for determining the feasibility of the proposed transit network, since revenues, operating cost, functional design and level of service are all dependent upon anticipated patronage. In fact, the only element of the system which is not directly related to patronage is construction cost.

Several area-wide transportation studies have been undertaken in many metropolitan areas all over the country in the past 15 years including the Pittsburgh Area Transportation Study. These studies, however, being primarily concerned with the automobile mode of urban travel, have contributed very little to the problem of transit patronage estimation. It was not until the San Francisco Bay Area Rapid Transit Study that significant contribution has been made to the subject. This contribution has been further augmented by subsequent transit studies in such cities as Atlanta, Washington and Baltimore.

In the following sections, a general discussion of the patronage assignment process will be presented as adopted for the Allegheny Study.

Choice-Necessity Riders Defined. Transit riders can be classified into two general groups - choice riders and necessity riders. Choice riders are defined as those having a driver's license and an automobile available for their use. Necessity riders are those who do not possess a driver's license or do not have an automobile available to them. Necessity riders, therefore, are compelled to use some form of public transportation. Choice riders have the option of using their automobiles or mass transit.

As previously cited, automobile ownership has been steadily increasing in the past 20 years. As automobile ownership increases, the number of families without a car decreases, which perforce decreases the number of necessity transit riders. This gradual decrease in the number of necessity riders is largely responsible for recent declines in mass transit patronage. However, it is reasonable to assume that eventually the decline in necessity riders will diminish and that their number will tend to stabilize. There will always be a number of children and elderly or handicapped citizens who are unable or unwilling to drive.

Factors Affecting Choice. The choice rider has many factors to consider in deciding whether to use his automobile or mass transit system. Many persons really have no true choice because they need their automobiles for their work or they live in remote areas not served by public transportation. Those persons who literally have a choice must evaluate several factors, some of which are tangible and easily quantified and others which are less tangible and more difficult to quantify.

Some of the more tangible factors include cost of travel, time required, walking distances at each end of the trip, type of trip, and the frequency of service provided by mass transit. Some of the intangible factors involved are comfort, cleanliness of transit facilities, dependability of service, and the individual's personal attitudes.

Studies have been conducted in which choice tripmakers have been interviewed to determine their reasons for choosing one mode of travel over another. The results of these studies indicate that time is the most important consideration for most people in deciding on a mode of travel. Comfort is second. Cost is considered to be of lesser importance in the decision. In estimating patronage for a future transit system, however, all of these factors must be considered.

Method of Determining Diversion. The basic elements in estimating patronage of choice travelers are daily person trips between different geographical zones in the study area and diversion curves. A diversion curve is a graphical representation of the division of patrons in terms of percentage between competing forms of transport – in this case, rail rapid transit, bus transit, and automobile. Typical diversion curves used are shown on Fig. III-2, Transit Diversion Curves.

Previous studies have indicated that the major variables to be recognized in diversion curves are the type of trip, the time the trip is made, the population density of residential land and the origin and destination of trip. A definite relationship does exist between residential population density and the amount of transit patronage, but after transit patrons were segregated into necessity and choice riders, the density factor ceased to be of important significance. Therefore, the following factors only were incorporated in the diversion curves which were used for the Allegheny County area:

1. Time of day of trip, rush hour or non-rush hour.
2. Origin and destination of trip, CBD or non-CBD.
3. Type of trip, work or non-work.
4. Type of transit used, bus, rapid transit or combination of both.

Since there is currently no form of rapid transit in the Allegheny County area, diversion curves had to be modified to reflect this fact. Previous studies of travel characteristics of transit patrons as observed in actual operating rapid transit systems in Philadelphia provided the necessary information for adjusting the diversion curves used for this study.

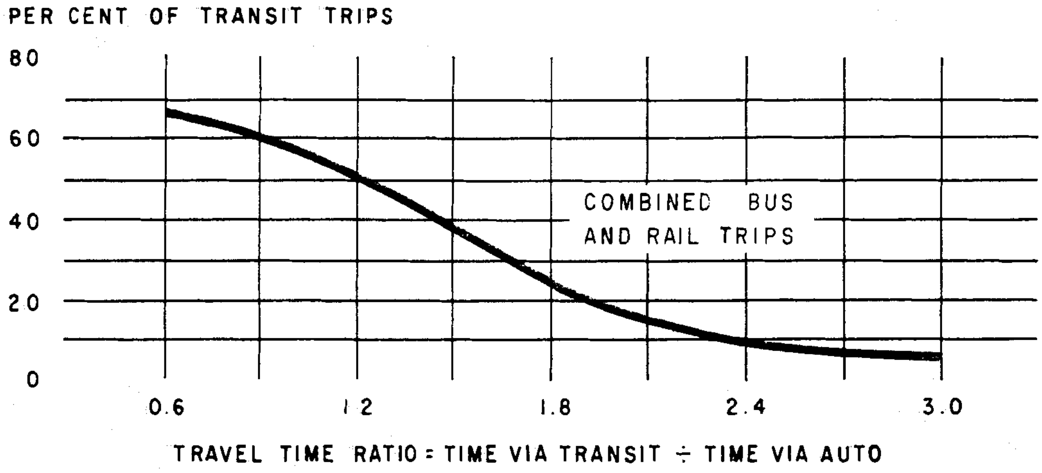
Computer Assignments. In order to utilize diversion curves, it is necessary to know travel time via transit and travel time via automobile for each zone-to-zone movement. The choice traveler may make his trip entirely by automobile or by a number of combinations which include mass transit. He may utilize bus or rapid transit facilities for the entire trip, a combination of bus and rapid transit, or a combination of automobile and rapid transit with or without a bus trip at the end of his journey. In the latter case, he may drive his automobile to a rapid transit station, make the major portion of his journey by rapid transit and if desirable use a bus for local access to his destination.

Transit travel times for surface transit lines were obtained from PAT schedules and supplemented where necessary by running time checks made by the Consultant. Highway travel times were developed from an extensive travel time survey undertaken by the Consultant and supplemented in some areas by travel time information obtained from the Pittsburgh Area Transportation Study.

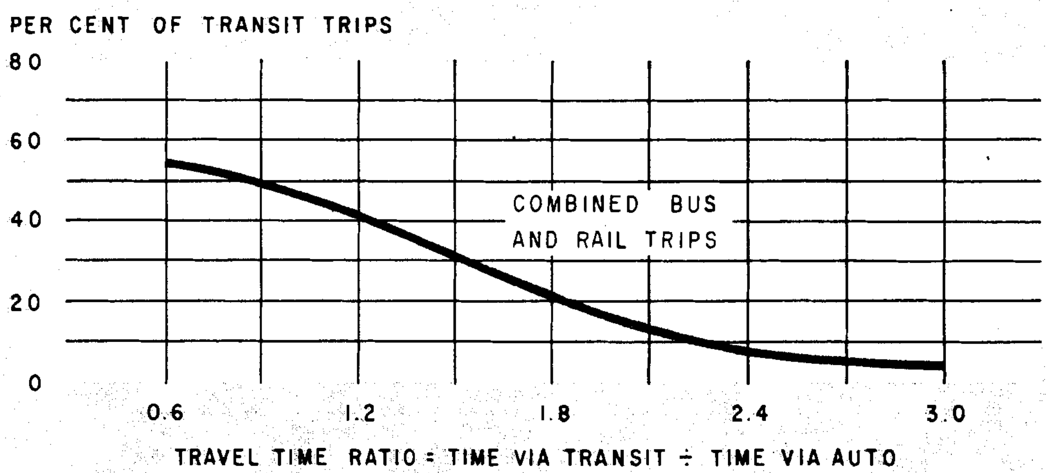
Because of the complexity of the computations involved in the assignment process, electronic computers were used for performing calculations. To accomplish this, a network of links and nodes was drawn to symbolize the highway and transit systems. The following are definitions of the major components of this symbolic or "link-node" network:

TRANSIT DIVERSION CURVES

HOME BASED WORK TRIPS TO OR FROM C.B.D.



HOME BASED NON-WORK TRIPS TO OR FROM C.B.D.



HOME BASED WORK TRIPS TO OR FROM NON-C.B.D.

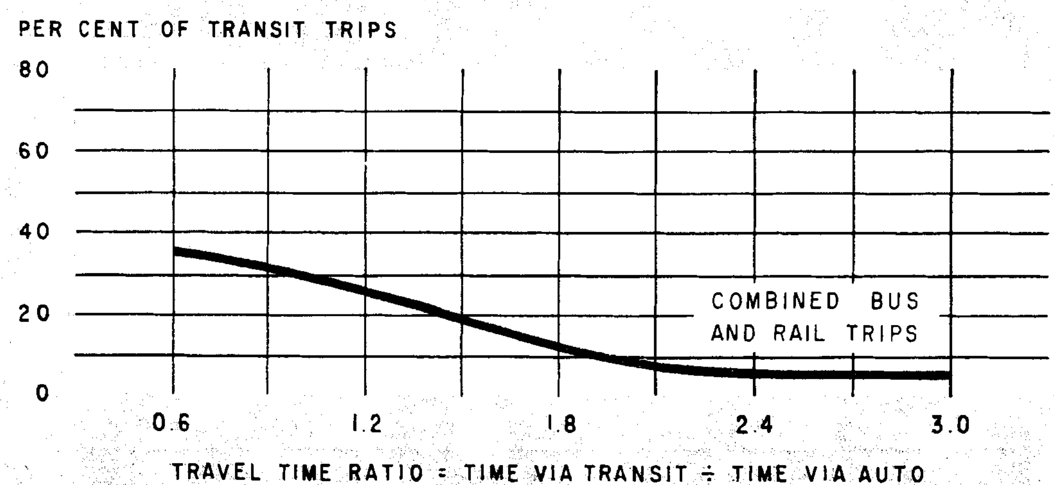


Fig III-2

Link. A section of the network defined by a node at each end. Each link is identified by means of the code numbers of the two nodes it connects. Each link has a travel time and distance associated with it.

Node. A point representing the intersection of two or more routes, or a point of access to, or egress from, a route.

Zone Centroid. A type of node which is assumed to represent the origin or destination of all trips bound to or from a zone.

Travel times and distances were computed for each link in the link-node network.

Sequence of Computations. Figure III-3 illustrates the sequence of computations involved in passenger volume estimates for the rapid transit system. Transit time and distances over the links of the link-node network were first key punched and then introduced into the computer memory. The computer then calculated highway and transit zone-to-zone travel times for both peak and non-peak time periods. Concurrently, zone-to-zone trip tables for choice travelers were constructed from the updated PATS trip data. These were:

1. Home-to-work trips in the peak periods
2. Home-to-non-work trips in the peak periods
3. Home-to-work trips in the non-peak periods
4. Home-to-non-work trips in the non-peak periods

At this point, the zone-to-zone highway and transit travel times were compared by the computer and the zone-to-zone choice trips were apportioned between auto and transit in accordance with the diversion curves described previously. The auto trips, being of no further use for transit planning study, were discarded at the conclusion of the diversion process. The choice transit trips were then adjusted for non-home based travel, balanced and assembled into one trip table representing 24-hour zone-to-zone choice transit travel. At this point, the 24-hour choice transit trips were assigned to the proposed transit network. Necessity riders were assigned directly to the transit network. Because no diversion process was necessary, only one necessity trip table was prepared. That was for 24-hour zone-to-zone necessity trips. The last step in the assignment consisted of adding the zone-to-zone choice and necessity transit travel tables together to form a table of total 24-hour zone-to-zone transit trips. These trips were then assigned to travel between stations of the proposed transit network. It was these assignments which formed the basis for the patronage evaluation of the proposed transit network.

System Evaluation

Pertinent factors in the evaluation of a rapid transit system include level of service, convenience, capital and operating costs, patronage potential, environmental compatibility and impact on the community. Level of service includes consideration of convenience to transit patrons of station location, access to stations by feeder transit lines and highway facilities, adequacy of parking, and frequency and speed of service. Capital costs include right-of-way costs, construction costs, and the cost of purchasing rolling stock. Operating costs include the costs of operating and maintaining the transit system after construction. A careful analysis is required to determine whether the proposed system will attract enough patrons to pay for its operation and warrant its construction. Environmental compatibility and community impact are important considerations also. All of these factors were considered in evaluating the various alternatives analyzed by the Consultant.

Downtown Distribution. A critical part of formulating a rapid transit system is developing the configuration of the routes through the central business district. Intensive study is required in this connection to provide optimum station locations which will serve the greatest number of patrons with the least cost and disruption to the community. CBD is the area which is the destination of a majority of patrons on the transit system, but it is also the area where right-of-way, construction and utility relocation costs are the greatest. In addition, large numbers of people and businesses are affected by the closing of streets during the construction phase of the project. In the initial phase of this study, several months were spent in examining alternative downtown routes with respect to factors discussed previously.

Many configurations such as three- or four-leg systems, lines which stub-ended in the CBD, and others which intersected were studied. However, only the four-legged interconnected systems with continuous through service provided adequate passenger distribution. As the result of these studies, two major alternative downtown alignments emerged, and each was tested in detail. The configuration of these two alignments is shown in Fig. III-4, Downtown Alternatives - Phase II.

Alternative Alignments. The first major alternative downtown alignment, the Market-Liberty-Forbes System, would consist of an Urban Line subway under Forbes Avenue with stations at Grant Street and Market Square, and a Suburban Line running along Liberty and Market Streets with stations at 10th Street and Liberty Street and at Market Square connecting with the Urban Line at this point. Estimates were made based on the Suburban Line being either in subway or on aerial structure. The second alternative would consist of an Urban Line under Fifth Avenue with stations at Midtown Plaza and Market Square, and a Suburban Line in the Pennsylvania Railroad right-of-way parallel to the Crosstown Expressway with stations at Midtown Plaza and the site of the present Pennsylvania Railroad Station. Interchange between the two lines would be provided at the Midtown Plaza Station.

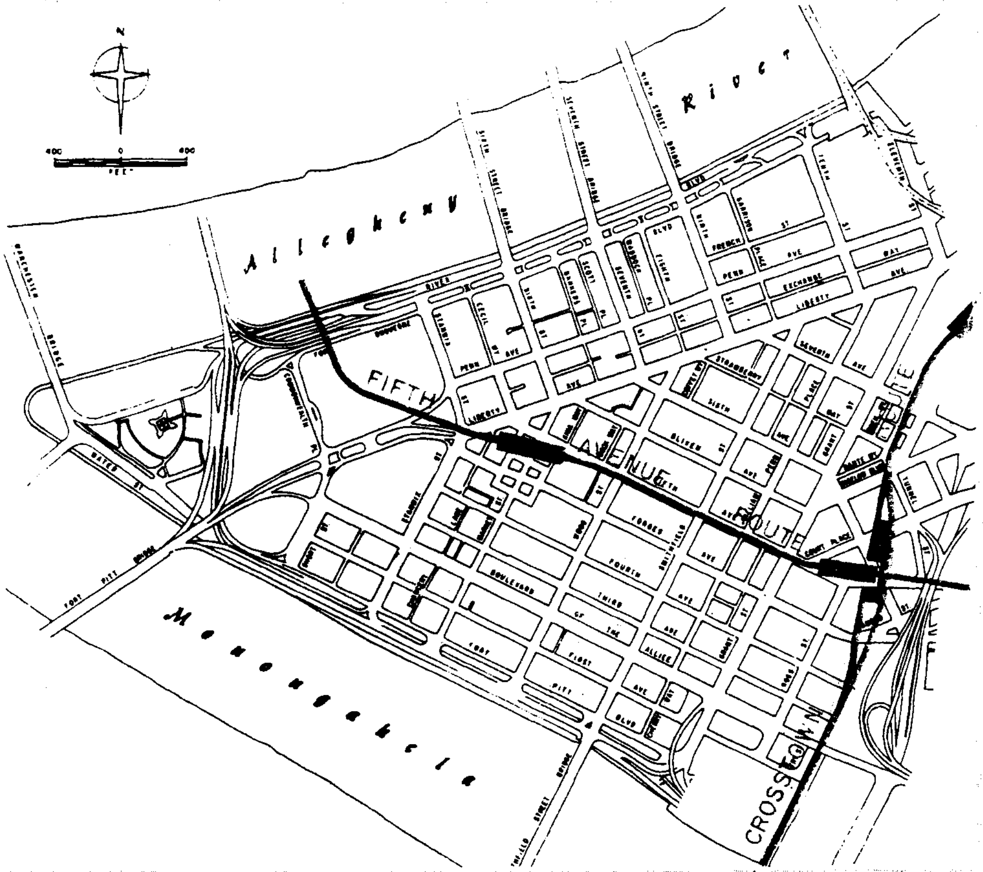
Patronage Analysis. A comparison was made between the Market-Liberty-Forbes configuration and the Fifth-Crosstown System using 23 downtown zones. This and similar later comparisons isolated downtown trips and analyzed the distribution resulting from different alignments based on the assumption that a change in alignment of the downtown lines would not introduce total trip time variations of a significant amount to cause an increase or decrease in the number of choice trips diverted to transit. From a service viewpoint, several significant statistics emerged. The following tabulation shows the average percentage distribution of passengers using each station on the two systems, assuming that travelers use stations involving minimum travel time for their trips:

	Market Square	Midtown Plaza	Liberty
Market-Liberty-Forbes System	56%	26%	18%
Fifth-Crosstown System	54%	31%	15%

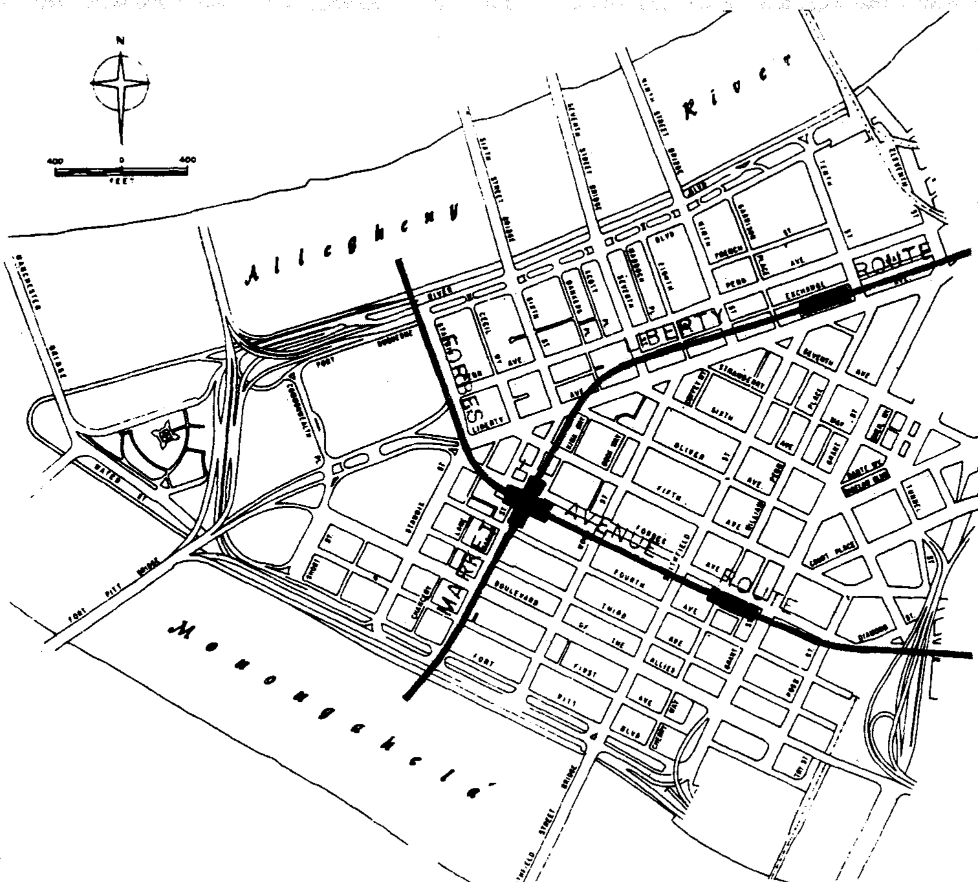
Further analysis showed that the Market-Liberty-Forbes system stations served 35.2 percent of the CBD destinations within 500 feet and 91.7 percent within 1,000 feet. The Fifth-Crosstown stations served 14.6 percent of the CBD destinations within 500 feet and 72.7 percent within 1,000 feet. Finally, it was found that in order to minimize downtown walking time, the Fifth-Crosstown alignment required twice the number of transfers required on the Market-Liberty-Forbes System.

Selecting the Optimum Downtown System. In addition to the patronage analysis described above, a detailed estimate of right-of-way, construction, operating, and maintenance costs was prepared for each of the three major downtown alternatives. A summary of right-of-way and construction costs is shown in the following tabulation:

DOWNTOWN ALTERNATES PHASE II



FIFTH AVENUE – CROSSTOWN ROUTE



MARKET, LIBERTY–FORBES AVENUE ROUTE

Fig. III-4

	Cost of Construction (millions)	Cost of Right-of-Way (millions)	Total (millions)
Market-Liberty-Forbes System			
Urban Line	$ 42.9	$10.4	$ 53.3
Suburban Line - Aerial	30.5	13.3	43.8
Suburban Line - Subway	69.2	13.3	82.5
Total - Aerial Alternative	$ 73.4	$23.7	$ 97.1
Total - Subway Alternative	$112.1	$23.7	$135.8
Fifth-Crosstown System			
Urban Line	$ 58.8	$15.5	$ 74.3
Suburban Line	41.7	6.6	48.3
Total	$100.5	$22.1	$122.6

An examination of the preceding table reveals that the Market-Liberty-Forbes configuration represents the extremes in construction and right-of-way costs with the Suburban Line aerial alternative being the least expensive and the subway alternative being the most costly. The Fifth-Crosstown System lies in between at a total cost of $122.6 million.

From an operational standpoint, the cost of operating and maintaining the Market-Liberty-Forbes and the Fifth-Crosstown systems would be almost identical. The Market-Liberty-Forbes subway-aerial alternative would afford a construction cost saving of $25.5 million. In addition, the Market-Liberty-Forbes configuration provided a higher level of service and convenience. However, the Rapid Transit Technical Committee, acting on the advice of the City Planning Department, felt that the Fifth-Crosstown system, while providing a lower quality of service with respect to the present downtown configuration, offered the best possibilities for shaping future development in the Golden Triangle and at the same time provided minimum of disruption to present downtown activities. After further evaluation, a Forbes-Crosstown system was selected for the basic down alignment for all subsequent comparisons.

Characteristics of Radial Lines. As discussed previously, the system selected for testing consisted of eleven line segments totaling approximately 92 miles with 56 stations. Four of the lines would extend into the CBD with the remaining seven lines being branches from these four trunk lines. All of the lines would be, however, radial in nature in that service provided on each of them would connect all of their stations with Downtown Pittsburgh and, in actual operation, these eleven lines would be combined into pairs to provide through-service continuity.

A computer assignment of patronage was made to this 92-mile system at the 1965 and 1985 levels. The results of these assignments revealed the following distribution of patrons among the lines:

I - Golden Triangle to East Liberty	12.3%
II - Golden Triangle to McKees Rocks Bridge	15.4%
Route A - Golden Triangle to Monroeville	25.4%
Route B - Branching from Line A to Ingomar	5.7%
Route C - Branching from Line B to Etna	1.8%
Route D - Branching from Line A to New Kensington	1.4%
Route E - Branching from Line A to East McKeesport	3.4%
Route F - Golden Triangle to Route 19 at Clifton	24.2%
Route FG - Branching from Line F to Allegheny County Airport	4.1%
Route G - Branching from Line F to Overbrook	4.4%
Route H - Branching from Line F to Greater Pittsburgh Airport	1.9%
Total	100.0%

These results, when examined in more detail, showed, as expected, that patronage on the lines through densely populated areas was higher than that obtained in low-density suburban areas. Furthermore, the longer lines have higher patronage potentials because they serve more stations, provided they traverse densely developed areas en route to their suburban terminals. This is illustrated by the relatively low patronage potential of the New Kensington, Etna and Greater Pittsburgh Airport Lines. These lines combined would carry only 5.1 percent of the total system patronage. The Monroeville Line, the longest on the system, would carry one-fourth of the total system patronage, as would the South Hills Line. The Oakland and Ohio River Lines would carry a combined 27.7 percent. The remaining 17.6 percent would be carried by the North Hills, County Airport, Mon-Valley and Saw Mill Run Lines.

Further examination of the assignment results revealed that 40.0 percent of the total rapid transit system patrons would either start or end their trips in the Golden Triangle. Of the total patronage entering the CBD, 35.6 percent would enter on the South Hills, Pleasant Hills, Greater Pittsburgh Airport and Saw Mill Run Lines; 34.2 percent would enter on the Monroeville, North Hills, Etna, Mon-Valley and New Kensington Lines; 16.6 percent would enter on the Ohio River Line; and 13.6 percent would enter on the Oakland Line. Analysis of 1965 PAT transit ridership characteristics revealed that 17.6 percent of the average daily patronage could be expected in the peak hour and in the peak direction on radial routes of this nature, and this relationship was employed in subsequent system design calculations.

Speeds. Travel times by rapid transit would be considerably faster than an equivalent auto travel time during the peak period. A trip could be made by rapid transit from Ben Avon to the CBD in 9.5 minutes, from Homewood to the CBD in 10.5 minutes, from North Hills to the CBD in 14 minutes, from South Hills Village to the CBD in 14.5 minutes, from Etna to the CBD in 9.5 minutes, from Carnegie to the CBD in 8.5 minutes, from Rankin to the CBD in 14.5 minutes, from the Allegheny County Airport to the CBD in 15 minutes, and from Monroeville to the CBD in 19 minutes. Average speeds on the rapid transit system would average 35 to 45 miles per hour including station stops.

Circumferential Line Potentials. The analysis of the origin and final destination of all transit trips, and an evaluation of the Port Authority patronage, has indicated that the major travel patterns within Allegheny County are radial in nature rather than circumferential. The economic growth of Allegheny County has followed the rivers and valleys to form several distinct corridors of travel patterns. These corridors generally follow some type of topographical boundary such as a river or a major valley as typified by the East Street Valley or the Mon-Valley along Second Avenue. Industry, commercial establishments, and most of all, people, have settled along these travel corridors. There has been very little development, particularly industrial, on the crests of the numerous hills; therefore, there is very little travel between corridors or travel of a circumferential nature. The advent of the shopping centers within the major suburban municipalities has also increased the radial type movement and further diversified the travel patterns. The residential development within the suburbs has generally followed the major arterial highways and contributed to the radial nature of home-to-work transit trips. Of the total transit trips within the County today, nearly 54 percent either originate or end in the Central Business District. If the Oakland area were included, the trips originating or ending in this metropolitan area would be approximately 60 percent of all transit trips. By the same token, crosstown trips amount to less than 5 percent of the total transit trips. The lack of major crosstown arterials, the topography, and the industrial and commercial growth of the area discourage any attempt to promote a circumferential transit system. The deeply instilled travel patterns all support a radial-type transit system maximizing the corridor type growth of the County.

Selecting a Regional System for 1985 Conditions

Patronage potential at the 1985 level, rapid transit construction and operating costs, the proposed highway program, and the community planning considerations provided the basis for determining the extent of a rapid transit system economically desirable by 1985 in Allegheny County. These evaluations led to the following considerations:

1. The patronage on the New Kensington Branch fell within a range which could be served efficiently by buses, so it was abandoned from further study.

2. The line branching to University Park could not be justified beyond Monroeville, so the line was shifted slightly to the south and ended in Monroeville.

3. It was found that it would not be feasible to build the Mon-Valley Line beyond Rankin, so it was discontinued beyond that point.

4. The line in the North Hills to Ingomar was found to be non-supporting beyond the Siebert Station; therefore, it was terminated at that point.

5. The Greater Pittsburgh Airport Line could not be justified for much of its length and thus was terminated at Carnegie. The volumes carried between the Airport and Carnegie were more suited to an express-bus type operation.

6. The Ohio River Line, however, showed considerable potential for extension and was, therefore, extended through Bellevue and into Ben Avon.

7. The South Hills Line exhibited little potential beyond Fort Couch Road and, therefore, was terminated at that point.

8. An analysis was made of circumferential travel desires between stations on the County Airport Branch and stations on the South Hills Line and it revealed little potential desire for this kind of service. However, there was a substantial attraction between the County Airport Branch and the Saw Mill Run Branch stations and the Golden Triangle. This suggested making the County Airport Line an extension of the Saw Mill Run Line rather than a branch from the South Hills Line.

9. Certain construction and operational difficulties were anticipated with regard to the Oakland Line to East Liberty. As a result, it was shifted to the south, east of Oakland, through the Squirrel Hill area and into a common station with the Suburban Line at Homewood. In addition to providing what was felt to be a higher level of service, this alignment is desirable from an operational standpoint because main yards and shops would be located in Homewood.

10. The length and alignment of the Etna Branch would remain essentially the same.

11. The downtown alignment and station locations were changed from the Market-Liberty-Forbes configuration to the Forbes-Crosstown configuration as discussed in a previous section.

These modifications made to the 92-mile test system reduced it to approximately 60 miles which is desirable for 1985 levels. A patronage assignment was then made to the 60-mile system, and refined route location surveys were made. As a result of the patronage assignment, route location work, and meetings with local planning officials, a station was added to the Ohio River Line at Brighton Road to serve a proposed super high school. Furthermore, the alignment of the Oakland Line was shifted to the north, east of the Oakland area in order to provide more convenient service to the transit patrons in that area. With these two additional modifications, the extent and configuration of the 60-mile 1985 rapid transit system was established.

The system selected is shown in Fig. IV-1, 60-Mile Rapid Transit System, in the following chapter. The total system contains 60 miles of double track and 43 stations, with the Urban Lines accounting for 12.75 miles and 14 stations, two of which are common to the Suburban Lines. The remaining 47.35 miles of track form the Suburban System which serves 31 stations including the two common stations at Midtown Plaza and Homewood. A brief description of each line and the stations it serves will be given at this point. A much more detailed description of the system will be given in Chapter IV.

Urban System

Ohio River Line (6.41 miles). This line would extend from the common station at Midtown Plaza in the Golden Triangle along the north side of the Ohio to Ben Avon. Intermediate stations would be located at Market Square, Allegheny Center, Brighton Road, Marshall Avenue, Termon Avenue and Bellevue.

Oakland Line (6.34 miles). This line would connect the two common stations at Midtown Plaza and at Homewood by way of Oakland and Squirrel Hill. Intermediate stations would be located at Dinwiddie Street, Semple Avenue, Bellefield Avenue, Murray Avenue and Braddock Avenue.

Suburban System

Monroeville Line (13.96 miles). This line would extend from the common station at Midtown Plaza to an outer terminus at Monroeville. The line would provide intermediate service with stations at 24th Street, Baum and Center, East Liberty, Homewood, Penn Hills and Churchill.

Mon-Valley Line (2.62 miles). The Mon-Valley Line would branch from the Monroeville Line east of the Homewood Station and follow the Pennsylvania Railroad right-of-way into Rankin with intermediate stations at Wilkinsburg and Swissvale.

North Hills Line (8.01 miles). This line would branch from the Monroeville Line east of the 24th Street Station and serve stations in Lawrenceville, Millvale, Reserve, West View and North Hills.

Etna Line (1.69 miles). The Etna Line would branch from the North Hills Line approximately midway between the Millvale and Reserve Stations. The line would contain only one station located in Etna.

South Hills Line (9.41 miles). This line would connect the Midtown Plaza Station with a station located at Fort Couch Road in Bethel Park. Stations served in between are located at South Hills Junction, Banksville, McFarland Road, Mt. Lebanon, Castle Shannon and Bethel.

Carnegie Line (2.77 miles). Branching from the South Hills Line south of the Banksville Station, this line would provide service to one station located in Carnegie.

County Airport Line (8.89 miles). The County Airport Line would branch from the South Hills Line south of the South Hills Junction Station and run south into Whitehall and then would turn east to its terminus at the Allegheny County Airport. Intermediate stations would be located at Overbrook, Whitehall, Streets Run Road and Pleasant Hills.

It was this 60-mile system which was used as the base for further comparisons and economic evaluations. The results of these evaluations and detailed descriptions of the system will be presented in Chapter IV.

and Market Square, and a Suburban Line running along Liberty and Market Streets with stations at 10th Street and Liberty Street and at Market Square connecting with the Urban Line at this point. Estimates were made based on the Suburban Line being either in subway or on aerial structure. The second alternative would consist of an Urban Line under Fifth Avenue with stations at Midtown Plaza and Market Square, and a Suburban Line in the Pennsylvania Railroad right-of-way parallel to the Crosstown Expressway with stations at Midtown Plaza and the site of the present Pennsylvania Railroad Station. Interchange between the two lines would be provided at the Midtown Plaza Station.

Patronage Analysis. A comparison was made between the Market-Liberty-Forbes configuration and the Fifth-Crosstown System using 23 downtown zones. This and similar later comparisons isolated downtown trips and analyzed the distribution resulting from different alignments based on the assumption that a change in alignment of the downtown lines would not introduce total trip time variations of a significant amount to cause an increase or decrease in the number of choice trips diverted to transit. From a service viewpoint, several significant statistics emerged. The following tabulation shows the average percentage distribution of passengers using each station on the two systems, assuming that travelers use stations involving minimum travel time for their trips:

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Further analysis showed that the Market-Liberty-Forbes system stations served 35.2 percent of the CBD destinations within 500 feet and 91.7 percent within 1,000 feet. The Fifth-Crosstown stations served 14.6 percent of the CBD destinations within 500 feet and 72.7 percent within 1,000 feet. Finally, it was found that in order to minimize downtown walking time, the Fifth-Crosstown alignment required twice the number of transfers required on the Market-Liberty-Forbes System.

Selecting the Optimum Downtown System. In addition to the patronage analysis described above, a detailed estimate of right-of-way, construction, operating, and maintenance costs was prepared for each of the three major downtown alternatives. A summary of right-of-way and construction costs is shown in the following tabulation:

	Cost of Construction (millions)	Cost of Right-of-Way (millions)	Total (millions)
m			
	$ 42.9	$10.4	$ 53.3
l	30.5	13.3	43.8
ιy	69.2	13.3	82.5
tive	$ 73.4	$23.7	$ 97.1
ative	$112.1	$23.7	$135.8
	$ 58.8	$15.5	$ 74.3
	41.7	6.6	48.3
	$100.5	$22.1	$122.6

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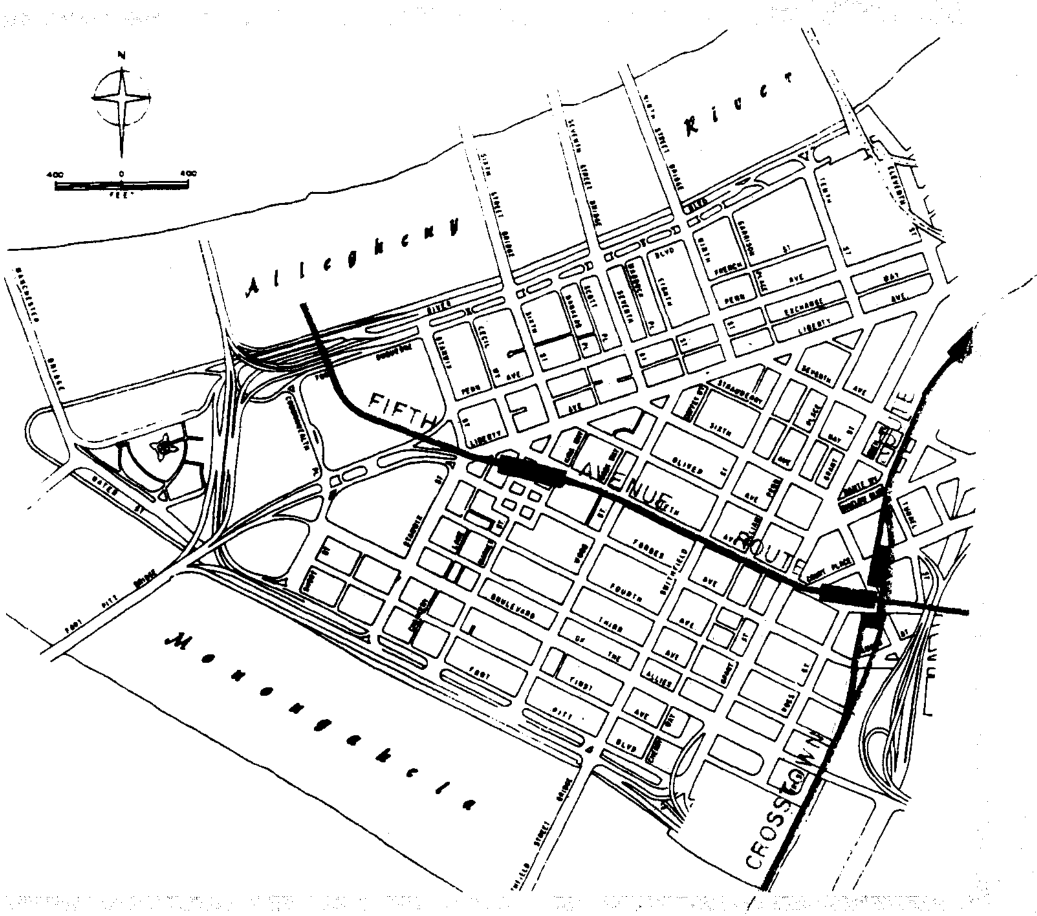
ıts the extremes in construction and right-
n Line aerial alternative being the least
rnative being the most costly. The Fifth-
ween at a total cost of $122.6 million.

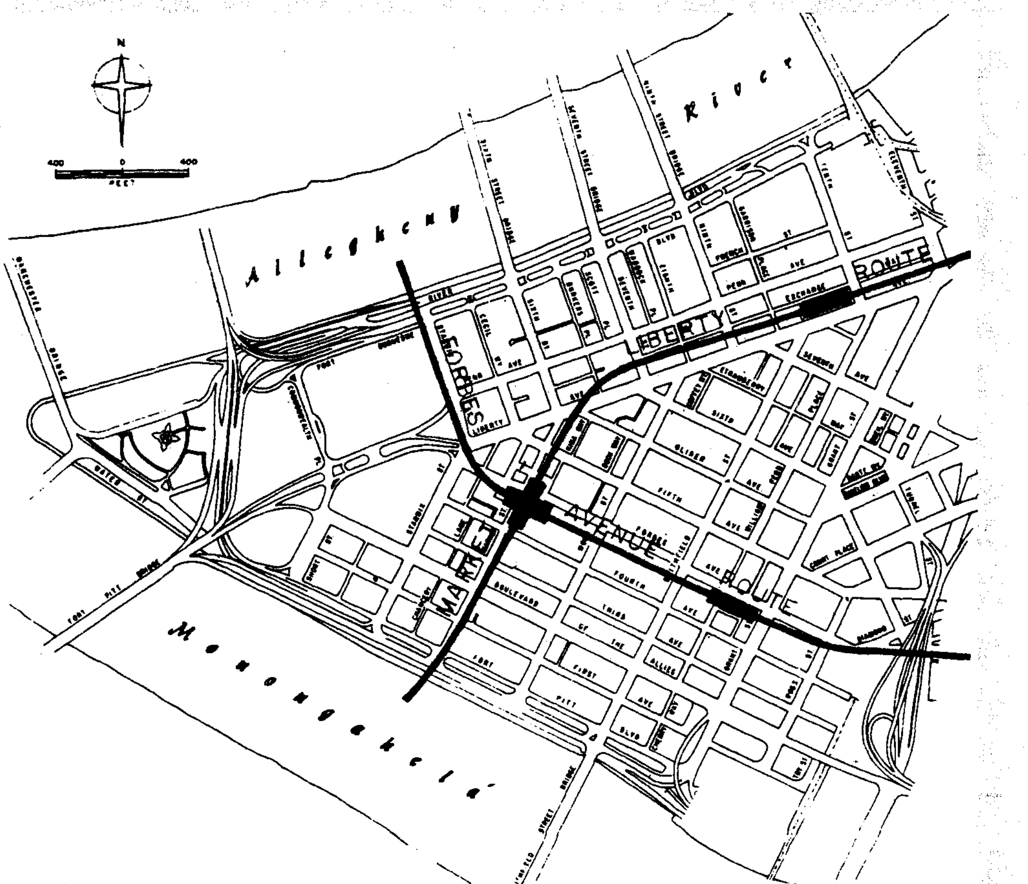
tandpoint, the cost of operating and main-
rbes and the Fifth-Crosstown systems
ıe Market-Liberty-Forbes subway-aerial
struction cost saving of $25.5 million. In
Forbes configuration provided a higher
ce. However, the Rapid Transit Technical
ce of the City Planning Department, felt
m, while providing a lower quality of ser-
nt downtown configuration, offered the
future development in the Golden Triangle
minimum of disruption to present down-
evaluation, a Forbes-Crosstown system
n alignment for all subsequent comparisons.

ial Lines. As discussed previously, the
nsisted of eleven line segments totaling
6 stations. Four of the lines would extend
ıg seven lines being branches from these
ıes would be, however, radial in nature
h of them would connect all of their
ırgh and, in actual operation, these
d into pairs to provide through-service

DOWNTOWN ALTERNATES PHASE II



FIFTH AVENUE – CROSSTOWN ROUTE



MARKET, LIBERTY–FORBES AVENUE ROUTE

Fig. III-4

IV. TESTING ALTERNATIVES — STEEL WHEEL VS. RUBBER TIRE

In the previous chapters, the rapid-transit study work program through Phase II is described. The principal objective and end result of that work was to identify the major corridors, test alternative rapid transit networks through computer assignment, and identify the locations and extent of a rapid-transit network for 1985.

The 60-mile network described in Chapter III is shown on Fig. IV-1, 60-Mile Rapid Transit System. The stations for this 60-mile rapid transit system are shown on Fig. IV-2. The routings reflect current and proposed land uses, anticipated street improvements and new highways, as well as present and projected travel, population, and job distributions. From the evaluations of various alignments, it is concluded that the recommended routings would provide an optimum level of service. They would serve most major areas of concentrated commercial activity such as the CBD, Allegheny Center, Oakland, East Liberty, Mt. Lebanon, Pleasant Hills and important industrial areas within reasonable distance of job locations. They would provide a desirable influence in shaping the pattern of community development.

In this Chapter the criteria developed during the study, which alternative types of system would have to meet, are summarized. The recommended routes for the two systems compared are described and illustrated. In addition, the cost of fixed construction, operating characteristics, patronage potential, revenues and operating cost are compared. Also presented are the results of a study of the application of the Transit Expressway to a CBD passenger distribution system.

System Criteria

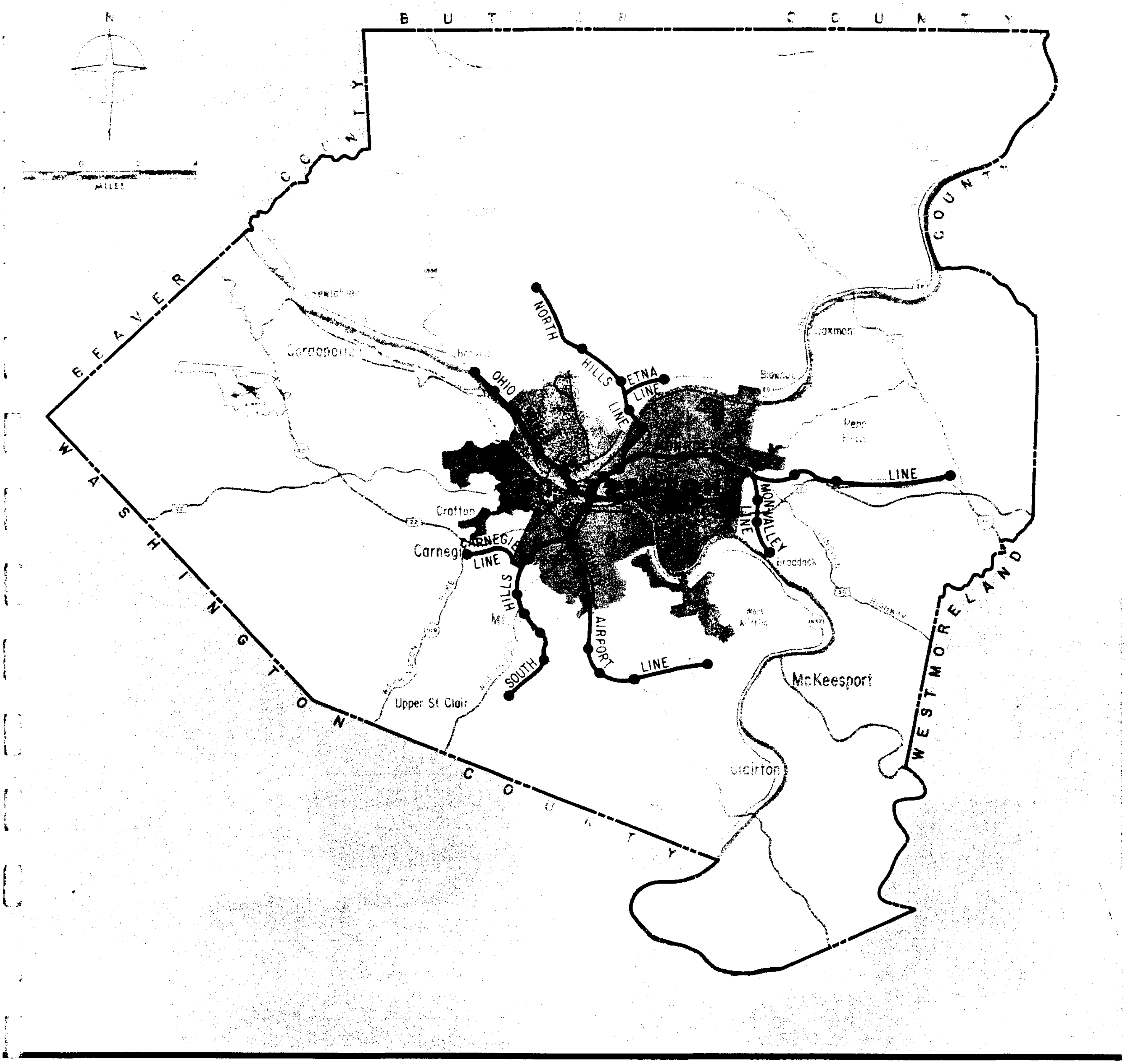
To secure the most feasible and desirable transit system, it was necessary to establish criteria that alternative systems of transit would have to meet. They are:

1. Maximum speed capability 70 mph.
2. Average schedule speed (including station stops) 35 to 40 mph.
3. Acceleration 3.0 to 3.5 mph/sec.
4. Deceleration 2.0 to 3.5 mph/sec.
5. Capability of scheduled headways of 90 seconds.
6. Maximum station stop time 20 seconds.
7. Capacity (ultimate expansion): Suburban System, 30,000 passengers per track per hour; Urban System, 20,000 passengers per track per hour.

8. Transverse seating.
9. Adequate seat dimension.
10. Provide seats for majority of passengers, allowing for 25 percent of standees during the peak periods.
11. No passengers standing longer than 10 minutes during peak periods.
12. Adequate ventilation, heating, air conditioning and lighting.
13. Low interior noise levels.
14. Smooth riding qualities.
15. Inter-car passenger circulation.
16. Intercommunication system linking passengers, vehicles and system control.
17. Exterior sound levels compatible with sound prevailing in the area through which the system passes.
18. Fail-safe operations.
19. Automatic train control.
20. Easy evacuation of train in case of emergency.
21. Dependable and quick-acting switching system.
22. Lightweight equipment.
23. Interchangeability of equipment between lines.
24. Electrical propulsion system.
25. Adaptability to subway, aerial and at-grade construction.

Previous studies by PBQ&D and other engineering firms for systems in San Francisco, Los Angeles, Baltimore and Washington, D.C., have shown that none of the systems now in operation, or adequately tested and developed, could improve on steel-wheel transit in passenger comfort, community acceptability, or economy, when designed to equivalent standards, with the possible exception of the Transit Expressway System.

The basic concept of Transit Expressway is a rubber-tired vehicle supported on two axles and guided by horizontal rubber-tired wheels bearing against a guide beam. The vehicles are 28 feet long and capable of being operated singly or in trains. The system is to be fully automated. A 1, 75-mile test track consisting of a closed single guideway loop was constructed in 1964-66 at South Park in Allegheny County by the Westinghouse Company, under contract with the Port Authority of Allegheny County. The work was carried out with funds made available partly by the Department of Housing and Urban Development and partially by local interests.



LEGEND

RAPID TRANSIT

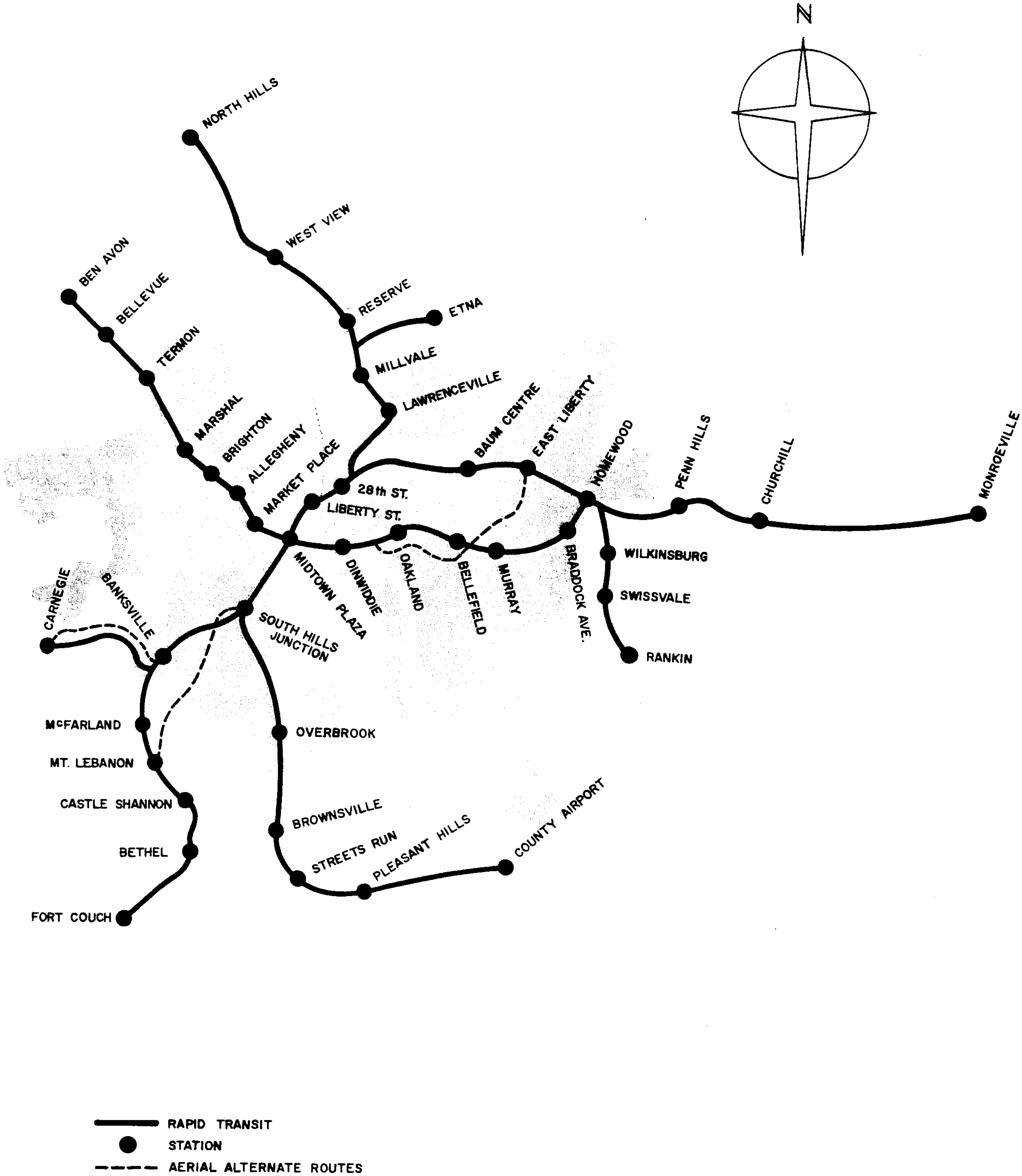
STATION

HIGHWAY AND ARTERIAL STREET

ALLEGHENY COUNTY
RAPID TRANSIT STUDY

60-MILE
RAPID TRANSIT SYSTEM

Fig. IV-1



STATIONS FOR 60-MILE RAPID TRANSIT SYSTEM

Fig. IV-2

The Allegheny County Port Authority also retained the Mellon Pittsburgh Carnegie Corporation (MPC) to monitor the test program and to prepare an evaluation of the results. A comprehensive evaluation has been published by MPC, which identifies various areas in need of further study for testing and developing, such as switching. In general, it is indicated that under certain circumstances the Transit Expressway System may be competitive with or an improvement on modern steel wheel systems, taking into account construction cost, operations, and passenger and community appeal.

Types of Construction

Rapid transit construction generally falls into three categories: on-grade, aerial or underground. On-grade or graded construction involves track on the surface of the ground, on embankments, or depressed in cuts. Other traffic, such as motor vehicle, railroad or pedestrian, which crosses the right-of-way, are carried on special structures over or under the rapid transit roadbed. This type of construction is appropriate over routes where intersecting traffic is at a minimum, and usually, it is the least costly of the three types of development.

Aerial or overhead construction involves track elevated above the ground on continuous structure, thus permitting surface traffic to pass underneath. This type of construction is generally more costly than at-grade construction, in the ratio of 7 to 3. Along sections of aerial construction, linear parks can be developed and the local area improved and beautified.

Underground construction is used where the cost of right-of-way is prohibitive, and where elevated or on-grade construction is unacceptable in the environment. These conditions usually prevail in major CBD's. The underground structures are constructed by tunnelling or by open-cut and backfill methods known as cut and cover.

Tunnelling is usually used where the transit system is deep beneath streets, rivers, buildings or ground surface. Deep tunnelling does not disturb the streets, the utilities, or the ground surface. Cut and cover construction is usually undertaken where the transit system is planned at shallow depths under city streets, and involves high costs for removal and underpinning of utilities, for street restoration, and for traffic maintenance. Underground construction is generally the most expensive.

This line originally was considered to be constructed by cut and cover through the Oakland business district. However, because of the disruption of traffic, utility relocation, and street restoration cost, the grade line was lowered so that the line could be constructed by tunnelling. An aerial line was also studied through Oakland and was rejected at the request of the City Planning Department because of the unacceptability of aerial construction in Oakland. This line is a total of 6.3 miles in length including seven stations with a possible future station site at Craft Avenue.

The principal areas served by this line are the Upper CBD, Oakland and Squirrel Hill areas. The stations are: Midtown Plaza, Dinwiddie, Oakland, Bellfield, Murray, Braddock, and Homewood. Parking is provided at the stations where necessary. Parking is provided at the following locations:

Station	Spaces Required	Type of Facility
Oakland	250	Underground garage
Murray	400	Surface garage
Braddock	200	Surface garage

Urban System - Ohio River Line. The Ohio River Line begins as a tunnel structure in private right-of-way east of Grant Street and is located on the south side of Forbes Avenue to Market Square; the line turns northward, remaining in tunnel under Stanwix Street to the south side of the Allegheny River crossing the Allegheny River in a subaqueous tube to Robinson Street, and continues northward in tunnel through Allegheny Center to West Park Avenue, where it emerges and continues at-grade along the north side of the Pennsylvania Railroad Fort Wayne tracks. The line leaves the railroad alignment in the vicinity of St. Ives Street and continues westward largely on aerial structure along north side of California Avenue to Baldridge Street, where it crosses California Avenue and continues on aerial structure along north side of the Ohio River Boulevard to Ben Avon, where the line terminates. This line has some of the most complicated and costly construction segments of the system: the crossing of the Allegheny River by subaqueous tube, construction in the CBD and the high-level structures along Ohio River Boulevard. This line is a total of 6.4 miles and consists of seven stations, some providing parking facilities where necessary. The plan and profile for this line are shown on Figs. IV-7 through IV-9.

The principal areas served by this line are Avalon, Ben Avon, Bellevue, Manchester, Allegheny Center Stadium, and the lower CBD. The stations are as follows: Ben Avon, Bellevue, Termon, Marshall, Brighton, Allegheny, and Market Place.

Parking is provided at the following stations:

Stations	Spaces Required	Type of Facility
Ben Avon	1,800	Surface garage
Bellevue	1,400	Surface garage
Termon Station	500	Surface lot
Marshall	500	Surface lot and garage

Suburban System - Monroeville Line. The Monroeville Line starts at the Pennsylvania Railroad Tunnel at Forbes Avenue and follows the railroad right-of-way through the proposed U.S. Steel Building to Seventh Street, and is at-grade to the existing railroad station. The line continues eastward on the railroad right-of-way to the Bloomfield bridge area and then continues along the north side of the railroad right-of-way to the Homewood-Wilkinsburg area. The line leaves the right-of-way and traverses Wilkinsburg on aerial structure to Wood Street. The line continues eastward in tunnel along north side of Hill Avenue to Swissvale Avenue where the line emerges on aerial structure and turns northeast along Montier Street and Laketon Road to Marie and Sloan Streets. The line then continues in tunnel to a point just west of the Churchill Country Club and then along the edge of the golf course on aerial structure to the north side of the Parkway-East. The line continues on aerial structure and at-grade to its terminal station in Monroeville. The plan and profile for this line are shown on Figs. IV-10 through IV-14.

This line was estimated based on a location alongside the Pennsylvania Railroad. Possible future plans to abandon railroad service along this alignment could make it possible to effect considerable savings by locating this line in its place. This line is a total of 14.0 miles and consists of nine stations with parking facilities provided where necessary.

The principal areas served by this line are: Homewood, Wilkinsburg, Penn Hills and Monroeville. The stations are as follows: Midtown Plaza, 28th Street, Baum-Centre, East Liberty, Homewood, Penn Hills, Churchill and Monroeville.

Parking is provided at the following stations:

Station	Spaces Required	Type of Facility
Homewood	200	Surface lot
Penn Hills	400	Surface lot
Churchill	400	Surface lot
Monroeville	1,000	Surface lot

A minor storage repair shop is planned at the end of this line. The major repair and overhaul shops for the total system are located at Homewood.

Suburban System - Mon-Valley Line. The Mon-Valley Line is a branch off the Monroeville Line which begins at the Homewood Station and follows alongside the Pennsylvania Railroad right-of-way on aerial structure to Rankin, where the line terminates.

The principal areas served by this line are Wilkinsburg, Edgewood, Swissvale, and Rankin. The line is a total of 2.6 miles and consists of three stations: Wilkinsburg, Swissvale, and Rankin. The plan and profile for this line are shown in Fig. IV-15.

Parking is provided at the following stations:

Station	Spaces Required	Type of Facility
Wilkinsburg	300	Surface garage
Swissvale	300	Surface garage
Rankin	600	Surface lot

Suburban System - North Hills Line. This line begins at the 28th Street station and continues through Lawrenceville on aerial and at-grade structure to the Allegheny River. The line crosses the river on bridge and aerial structure through Millvale to Evergreen Road. The line follows Evergreen Road to Hausen Street and crosses North Avenue. Then on aerial structure at-grade along Babcock Boulevard through Reserve Township to Three Degree Road at Keown Station where the line terminates. The line construction is mostly aerial structure and at-grade.

The principal areas served by this line are: Lawrenceville, Millvale and the West View Area. The line is 8.0 miles long and has four stations: Lawrenceville, Millvale, Reserve, and West View. The plan and profile for this line are shown on Figs. IV-16 through IV-18.

Parking is provided at the following stations:

Station	Spaces Required	Type of Facility
Lawrenceville	400	Surface lot
Millvale	300	Surface lot
Reserve	900	Surface lot
West View	600	Surface garage and lot
North Hills	1,100	Surface garage and lot

Suburban System - Etna Line. The Etna line branches from the North Hills line at Hansen Street going north on at-grade and aerial structure along Seavey Road to Fenway Road and then in tunnel to the north of Etna, where the line terminates.

This line is very costly because of the long tunnel necessary to penetrate into the Route Eight valley. The principal areas served are: Etna and Route Eight and Saxonburg Boulevard corridors. This line is 1.7 miles long and has only one station located at Etna. The plan and profile for this line is shown on Fig. IV-19.

Suburban System - South Hills Line. The South Hills line begins at Forbes Avenue and Pennsylvania Railroad tunnel and goes south, using the existing railroad right-of-way, and then across the Allegheny River on a new bridge or the existing railroad bridge that would require additional new construction.

The line penetrates under Mt. Washington in a new two-track tunnel to South Hills Junction. It continues southward on aerial structure and in tunnel to Cape May Avenue. At Cape May Avenue, the line turns westward in tunnel under Broadway in Beachview to Banksville Road. The line is located along the north side of Banksville Road on aerial structure and at-grade to Helen Drive. At Helen Drive the line continues in subway under Beverly Road turning in a southerly direction under Mt. Lebanon to emerge south of Washington Road. The line utilizes the Port Authority right-of-way at this location and continues southward on the Castle Shannon-Clearview Loop right-of-way to Castle Shannon. The line then continues on the Drake and Library trolley right-of-way to Fort Couch Road, where the line terminates.

Extensive tunnel portions of this line under Mt. Washington, Beechview and Mt. Lebanon add a considerable amount of cost, especially at the Mt. Lebanon area, where tunnelling was preferred by the local planning agencies. Aerial structures crossing the Allegheny River, and Banksville Road south of South Hills Junction, are major structures which require special design.

This line is 9.4 miles long and has seven stations to serve the area. The principal areas served by this line are: South Hills Junction, Dormont, Mt. Lebanon and Castle Shannon. The plan and profile for this line are shown on Figs. IV-20 through IV-23.

Stations are: South Hills Junction, Banksville, McFarland, Mt. Lebanon, Castle Shannon, Bethel, and Fort Couch.

Parking is provided at the following stations:

Station	Spaces Required	Type of Facility
Banksville	1,500	Surface garage
McFarland	900	Surface garage
Mt. Lebanon	1,100	Surface garage
Castle Shannon	500	Surface lot
Bethel	500	Surface lot
Fort Couch	800	Surface lot

Suburban System - County Airport Line. The County Airport Line branches off the South Hills at South Hills Junction and turns eastward on aerial structure into the existing Port Authority streetcar right-of-way just west of Bausman Street. The line continues on the streetcar right-of-way to Davis Street and then begins descending into the median of the proposed future LR-247, Saw Mill Run Boulevard Highway. The rapid transit line then continues at-grade eastward along the south side of the westbound Reflectorville Road to Whited Street. It is then located in the median of the LR-247 Freeway and continues at-grade in the median of the proposed freeway to Caste Village Shopping Center. The line leaves the proposed highway location and continues southeastward on aerial structure along Weyman Run Road to Baptist Road. The line continues east across Baptist Road to the west side of Dover Drive, where it makes a transition into tunnel under Whitehall Boro and emerges in the vicinity of Felix Street just west of Brownsville Road. The line continues at-grade and on aerial structure to Brownsville Road and Streets Run Road and then along the north side of the Montour Railroad to the east side of Route 51. The line then crosses the Montour Railroad and continues at-grade and on aerial structure along the north side of Lebanon Church Road to the County Airport where the line terminates.

A major segment of this line is proposed to be installed in the median of the proposed LR-247 Freeway. The tunnel under Whitehall Boro is considered to be the least disruptive to the community. The alignment along north side of the Montour Railroad can be altered to the south side as an alternative location. The County Airport line is 8.9 miles long and consists of five stations: Overbrook, Whitehall, Streets Run, Pleasant Hills, and County Airport. The plan and profile for this line are shown on Figs. IV-24 through IV-26.

Parking is provided at the stations as follows:

Station	Spaces Required	Type of Facility
Overbrook	700	Surface garage and lot
Whitehall	300	Surface lot
Streets Run	1,100	Surface garage
Pleasant Hills	900	Surface garage
County Airport	700	Surface lot

Suburban System - Carnegie Line. The Carnegie Line branches off the South Hills Line at the Banksville Station and turns northward in tunnel under Greentree Road to Whiskey Run Road. The line continues west at grade and on aerial structure along Whiskey Run Road to Wise Road. The line then continues westward in tunnel to Chestnut Street in Carnegie. From Chestnut Street the line continues on aerial structure to East Main Street, where the line terminates.

This line traverses very rough terrain requiring two long tunnels. The Carnegie Line is 2.8 miles long and has one station. The principal areas served by this line are Carnegie, Bridgeville, and the Parkway-West corridor. A 600-car surface garage is included at the Carnegie Station. The plan and profile for this line are shown on Fig. IV-27.

Transit Expressway System - Route Descriptions

The 60-mile system of routes that were previously outlined could be operated with either the steel-wheeled system or the Transit Expressway Rubber-tired System. This was confirmed through the use of the Westinghouse computerized Train Performance Program. Both systems tested equally well and in some aspects the Transit Expressway System exceeded the performance of the steel-wheeled system in overall average speed.

However, the Transit Expressway's inherent ability to negotiate somewhat steeper grades and sharper curves than possible with a steel-wheeled system, offers the opportunity to reduce construction cost through the elimination or shortening of tunnels and the substitution of aerial structure. Because of the precipitous terrain in Allegheny County, the amount of tunnelling and subway required for the Transit Expressway System is approximately 14 percent of the system's mileage as compared with 20 percent for the steel-wheeled system.

During the summer of 1966, representatives of Transportation Research Institute, Westinghouse Electric Corporation, and the Consultant reviewed in the field and in the office the routine alignments and the detailed plans and profiles to determine where modification in the alignments could be made that would result in a reduction in construction cost.

The following design criteria, which reflected the capabilities of the Transit Expressway System were established for this review:

1. Vehicle: The Transit Expressway vehicle width was increased to 9 feet 6 inches, to be comparable to the steel-wheel system. The vehicle length was not changed from the prototype vehicle (28 feet). The vehicle height remained unchanged (10 feet 2 inches).

2. Propulsion: Motor ratings were increased from 60 hp to 100 hp to permit full system operation and maximum line speeds to 70 mph.

3. Horizontal Alignments:

   a. Tangent length

desirable min.	200 feet
absolute min.	100 feet
absolute min. approaching station	1.5 x car length

   b. Circular curves

desirable min.	150 feet
absolute min.	75 feet
desirable min. length	100 feet

4. Vertical Alignment:

   a. Grades

desirable max.	6 percent
absolute max.	8 percent

b. Tangent length

desirable min.	200 feet
absolute min.	100 feet

c. Vertical curves

minimum length	AASHO Standards

5. <u>Stations</u>: Length 450 feet. Station facilities would be the same for both systems.

The following descriptions summarize the alternatives that were explored, rejected, or adopted. Plans and profiles were subsequently prepared for the revised system, and estimates of construction and right-of-way cost were prepared to the same level of detail as the steel-wheeled system using unit construction cost figures which were developed especially for the Transit Expressway System.

<u>Urban System - Oakland Line</u>. This portion of the Urban Line through Oakland and Squirrel Hill is approximately 6.3 miles long. The major change was the use of aerial structure in place of 0.4 miles of cut-cover subway along Colwell Street and replacing one subway station with an aerial station.

This line begins as a tunnel structure east of Grant Street under the County Jail. It continues easterly under Forbes Avenue, remaining in tunnel to Hooper Street. The line begins making a transition across Watson, Fifth, and Magee Streets to a location along the south side of Colwell Street. This portion of the line is the same for both systems. The line continues alongside Colwell Street and begins making the transition, using an 8 percent grade, to aerial structure. The line crosses under Pride Street and becomes aerial just east of Price Street. The line continues on aerial structure alongside Colwell Street across Wyandotte, Rising, DeRaub, Moultrie, Orr, and Kirkpatrick Streets. The line then makes the transition back into tunnel structure east of Kirkpatrick Street. The remainder of the line to its terminal at the Homewood Station is the same as for the steel-wheeled system.

Further study was done by Richardson-Gordon & Associates and Transportation Research Institute for more extensive use of aerial structure in Oakland. That alignment will be covered in another section of this Chapter.

Urban System - Ohio River Line. This line is approximately 6.4 miles long and is essentially all at-grade and aerial construction. There is approximately 0.3 of a mile of subway and tunnel approaching the Allegheny River including the subaqueous tube. No changes were made in this line. The plan and profile for this line are shown on Figs. IV-7 through IV-9.

Suburban System - Monroeville Line. This line is approximately 14 miles in length and consists of 70 percent at-grade and 15 percent aerial construction, with the remainder in tunnel. There were two tunnels on this line which totaled approximately 0.7 miles. A suitable alternative for one tunnel was found and the second tunnel was shortened by using a steeper approach grade. Approximately 66 percent of the tunnelling was eliminated on this line.

The Monroeville Line starts at the Pennsylvania Railroad Tunnel at Forbes Avenue and follows the railroad right-of-way through the proposed U.S. Steel Building to Seventh Street, and then at-grade to the existing railroad station. The line continues eastward on the railroad right-of-way to the Bloomfield bridge area and then continues along the north side of the railroad right-of-way to the Homewood-Wilkinsburg area. The line up to this point is the same for either system. The line then continues eastward on aerial structure to Wood Street and crosses to the south side of Hill Avenue. The line continues at-grade and on aerial structure on private right-of-way along the south side of Hill Avenue to Swissvale Avenue, crossing over Center, Mill, and Coal Streets. The line then turns northeast crossing over Swissvale and Glenn Avenues to a location along the south side of Park Avenue. The line continues at-grade and on aerial structure along the south side of Park Avenue, Montier Streets, and Laketon Road, to Marie Street. The line continues on aerial structure across Sloan, Calfant, Boggs, and Elizabeth Roads. The line makes the transition to tunnel at McNary Road crossing under Graham and Blackridge Roads and then emerges from tunnel east of Osage Drive. The line from this point to its terminal is the same for either system.

The plan and profile for this line are shown on Figs. IV-10 through IV-14.

Suburban System-Mon-Valley Line. This line is approximately 2.6 miles long and is entirely on aerial structure. It is possible that at-grade construction could be used for either system, but major revisions to the arterial street systems in two communities would be required and the line was costed as aerial for both systems. Further study and coordination with these communities should be made regarding the type of construction and effect of the transit line on the street system. The plan and profiles are shown on Fig. IV-15.

Suburban System - North Hills Line. This line is approximately 8 miles long and is a mixture of 35 percent at-grade and 54 percent aerial structure. There were no modifications found for this line.

The plan and profiles are shown on Figs. IV-16 through IV-18.

Suburban System - Etna Line. This line is approximately 1.7 miles long and is equally mixed with at-grade, aerial structure, and a tunnel 0.6 miles long. Many alternative routings were explored to eliminate this tunnel, but no feasible alignment was found. One alternative which required a 9 percent grade was considered and dropped as being operationally unfeasible.

The plan and profile for this line are shown on Fig. IV-19.

Suburban System - South Hills Line. This line is approximately 9.4 miles long and consists of 55 percent at-grade and 12 percent aerial construction. There were three tunnels on this line totaling 2.7 miles. Suitable alternative routings were found for two of these tunnels and the total tunnel length was reduced by 42 percent. Two stations were changed from subway to aerial stations. The elimination of one of these tunnels required aerial construction through the Mt. Lebanon business district and over Washington Road. This section of aerial structure has not been checked by the local planning agencies and actual implementation may require additional tunnelling.

The South Hills Line begins at Forbes Avenue and Pennsylvania Railroad tunnel and goes south using the existing railroad right-of-way, and then across the Allegheny River on a new bridge or the existing railroad bridge, which would require some new construction.

The line continues under Mt. Washington in a new two-track tunnel to South Hills Junction. At this point the line is the same for either system.

The line then continues at-grade and on aerial structure on the existing Beechview trolley right-of-way to the south side of Brookside Avenue. The line continues on aerial structure across Cape May Avenue to a transition into tunnel. The line continues westward in tunnel under Broadway in Beechview to Banksville Road. The line is then located along the north side of Banksville Road on at-grade and aerial structure to Helen Drive. The line continues westward on aerial structure to Arden Street and then turns south, crossing over Beverly Road. The line continues southwest on aerial structure alongside Ralston and Coolidge Streets, crossing Rae Avenue, Shady Drive, Academy Avenue, Cedar Boulevard, Florida Avenue, Washington Road, Central Street, Cornell Street and Castle Shannon Boulevard. The line from this point to its terminal is the same for either system. The plan and profile for this line are shown on Figs. IV-20 through IV-23.

Further study was done by Richardson-Gordon & Associates and Transportation Research Institute for more extensive use of aerial structure through Beechview and Dormont. That alignment will be covered in another section of this Chapter.

Suburban System - County Airport Line. This line is approximately 8.9 miles long and consists of 61 percent at-grade and 21 percent aerial construction. There is a tunnel 0.4 mile long through Whitehall. A number of alternative routings were explored but no feasible one was found. The plan and profile for this line are shown on Figs. IV-24 through IV-26.

Suburban System - Carnegie Line. This line was approximately 2.8 miles in length and consists of 50 percent at-grade, 7 percent aerial structure and the remainder 43 percent tunnel. This line contained approximately 6,000 feet of tunnel. A completely new alignment was found which utilized aerial construction and eliminated all of the tunnel. While an additional 1.2 miles of line was required, a significant saving in construction cost was realized.

The Carnegie Line branches off the South Hills Line at the Banksville Station and turns northward on aerial structure along the east side of Potomac Avenue to Hillview Street. The line then turns westward crossing over Potomac Avenue to locate on the south side of Greentree Road. This line continues on aerial structure alongside Greentree Road to Manorview Road. The line then crosses over Greentree Road to the north side of Cochran Road. The line continues on aerial structure alongside Cochran Road to Hope Hollow Road. The line continues alongside Hope Hollow Road to the Pennsylvania Railroad at Washington Avenue. The line continues on aerial structure alongside the railroad to locate between First and Second Streets in Carnegie, where the terminal station is located. The plan and profile for this line are shown on Fig. IV-27.

Further study was done by Richardson-Gordon & Associates and Transportation Research Institute to identify a new line which will not penetrate the Greentree and Scott Township residential areas with aeri structure. That alignment will be covered in another section of this chapter.

STEEL-WHEELED SYSTEM

SUMMARY OF CONSTRUCTION COSTS

	Miles	Track & Structures	Stations & Parking	Yards & Shops	Electrification Train Control	Utility Relocation	Engineering & Contingencies	Right-of-way	Total
URBAN LINES									
Oakland Line	6.34	$ 62,713,000	$ 33,780,000	$ 0	$10,178,000	$ 1,718,000	$ 32,517,000	$ 8,526,000	$149,432,000
Ohio River Line	6.41	31,287,000	30,577,000	0	10,254,000	1,404,000	22,056,000	17,895,000	113,473,000
SUBURBAN LINES									
Monroeville Line	13.96	34,569,000	27,400,000	4,517,000	22,656,000	4,009,000	27,945,000	23,072,000	144,168,000
Mon Valley Line	2.62	6,617,000	8,575,000	312,000	4,262,000	881,000	6,194,000	5,685,000	32,526,000
North Hills Line	8.01	24,905,000	12,618,000	312,000	10,983,000	2,220,000	15,312,000	9,030,000	75,380,000
Etna Line	1.69	12,501,000	3,375,000	0	2,292,000	204,000	5,511,000	887,000	24,770,000
South Hills Line	9.41	43,159,000	27,873,000	0	13,454,000	1,997,000	25,945,000	6,346,000	118,774,000
Carnegie Line	2.77	19,314,000	4,517,000	0	3,447,000	316,000	8,278,000	1,651,000	37,523,000
County Airport Line	8.89	22,466,000	21,011,000	0	11,920,000	1,927,000	17,197,000	3,967,000	78,488,000
TOTAL	60.10	$257,531,000	$169,726,000	$5,141,000	$89,446,000	$14,676,000	$160,955,000	$77,059,000	$774,534,000

TRANSIT EXPRESSWAY - RUBBER TIRES

SUMMARY OF CONSTRUCTION COSTS

	Miles	Track & Structures	Stations & Parking	Yards & Shops	Electrification Train Control	Utility Relocation	Engineering & Contingencies	Right-of-way	Total
URBAN LINES									
Oakland Line	6.34	$ 59,417,000	$ 32,198,000	$ 0	$10,179,000	$ 1,711,000	$ 31,051,000	$ 8,526,000	$143,082,000
Ohio River Line	6.41	31,530,000	30,623,000	0	10,254,000	1,404,000	22,143,000	17,895,000	113,849,000
SUBURBAN LINES									
Monroeville Line	14.03	30,615,000	27,536,000	6,778,000	22,746,000	3,180,000	27,256,000	21,908,000	140,019,000
Mon Valley Line	2.62	5,496,000	8,601,000	713,000	4,262,000	881,000	5,986,000	5,356,000	31,295,000
North Hills Line	8.01	23,599,000	12,661,000	713,000	10,983,000	2,220,000	15,053,000	9,029,000	74,258,000
Etna Line	1.69	12,437,000	3,384,000	0	2,292,000	204,000	5,495,000	1,107,000	24,919,000
South Hills Line	9.63	32,799,000	25,799,000	0	13,767,000	2,221,000	22,376,000	8,010,000	104,972,000
Carnegie Line	3.96	7,746,000	4,034,000	0	4,713,000	1,318,000	5,343,000	3,961,000	27,115,000
County Airport Line	8.89	23,470,000	21,039,000	0	11,920,000	1,927,000	17,507,000	3,966,000	79,829,000
TOTAL	61.58	$227,109,000	$165,875,000	$8,204,000	$91,116,000	$15,066,000	$152,210,000	$79,758,000	$739,338,000

STEEL-WHEELED SYSTEM

SUMMARY OF CONSTRUCTION COST
(by type of construction)

	Limits		Totals			Line Construction									
						At-Grade		Aerial		Cut-Cover		Tunnel		Major Structure	
	From	To	Miles	Stations	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
URBAN LINES															
Oakland Line	Downtown	Homewood	6.34	7	$149,432,000	0.69	$ 4,219,000	0.46	$ 3,594,000	1.49	$32,955,000	2.96	$ 55,264,000	0.19	$ 1,825,00
Ohio River Line	Downtown	Ben Avon	6.41	7	113,473,000	2.58	13,556,000	1.64	11,217,000	0.15	4,270,000	1.04	27,901,000	0.44	4,783,00
SUBURBAN LINES															
Monroeville Line	Downtown	Monroeville	13.96	9	144,168,000	9.62	40,459,000	1.86	11,674,000	0.27	8,804,000	0.72	13,975,000	0.77	21,685,00
Mon Valley Line	Homewood	Rankin	2.62	3	32,526,000	0	0	2.38	15,690,000	0	0	0	0	0	0
North Hills Line	28th Street	3 Degree Rd.	8.01	5	75,380,000	2.98	19,716,000	4.30	26,827,000	0	0	0	0	0.33	4,741,00
Etna Line	Millvale	Etna	1.69	1	24,770,000	0.46	1,723,000	0.38	2,183,000	0	0	0.78	15,140,000	0	0
South Hills Line	Downtown	Ft. Couch Rd.	9.41	7	118,774,000	4.46	15,454,000	1.16	8,011,000	0.35	6,790,000	2.25	39,202,000	0.63	5,111,00
Carnegie Line	Banksville	Carnegie	2.77	1	37,523,000	1.36	5,301,000	0.21	1,402,000	0.07	1,360,000	1.04	22,129,000	0	0
County Airport Line	South Hills Jct.	County Airport	8.89	5	78,488,000	5.43	19,037,000	1.91	10,762,000	0.29	5,426,000	0.43	7,610,000	0.43	3,247,00
	TOTALS		60.10	45	$774,534,000	27.58	$119,465,000	14.30	$ 91,360,000	2.62	$59,605,000	9.22	$181,221,000	2.79	$41,392,00
	% TOTAL				100.0%		15.4%		11.8%		7.7%		23.4%		5.3%

TRANSIT EXPRESSWAY - RUBBER TIRES

SUMMARY OF CONSTRUCTION COST
(by type of construction)

	Limits		Totals			Line Construction									
						At-Grade		Aerial		Cut-Cover		Tunnel		Major Structure	
	From	To	Miles	Stations	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
URBAN LINES															
Oakland Line	Downtown	Homewood	6.34	7	$143,082,000	0.77	$ 4,910,000	0.73	$ 4,902,000	1.22	$27,890,000	2.89	$ 54,036,000	0.19	$ 1,824,00
Ohio River Line	Downtown	Ben Avon	6.41	7	113,849,000	2.58	14,835,000	1.64	10,114,000	0.16	4,232,000	1.04	28,078,000	0.44	4,784,00
SUBURBAN LINES															
Monroeville Line	Downtown	Monroeville	14.03	9	140,019,000	8.97	39,963,000	3.32	18,258,000	0.14	6,503,000	0.25	5,388,000	0.63	21,719,00
Mon Valley Line	Homewood	Rankin	2.62	3	31,295,000	0	0	2.38	14,233,000	0	0	0	0	0	0
North Hills Line	28th Street	3 Degree Rd.	8.01	5	74,258,000	2.98	21,521,000	4.30	23,324,000	0	0	0	0	0.33	4,742,00
Etna Line	Millvale	Etna	1.69	1	24,919,000	0.46	1,939,000	0.38	2,065,000	0	0	0.78	14,959,000	0	0
South Hills Line	Downtown	Ft. Couch Rd.	9.63	7	104,972,000	4.70	18,398,000	2.16	13,953,000	0.34	6,597,000	1.20	19,793,000	0.67	5,161,00
Carnegie Line	Banksville	Carnegie	3.96	1	27,115,000	0.66	3,630,000	3.23	17,140,000	0	0	0	0	0	0
County Airport Line	South Hills Jct.	County Airport	8.89	5	79,829,000	5.43	21,985,000	1.91	9,361,000	0.30	5,288,000	0.43	7,511,000	0.43	3,242,00
	TOTALS		61.58	45	$739,338,000	26.55	$127,181,000	20.05	$113,350,000	2.16	$50,510,000	6.59	$129,765,000	2.69	$41,472,00
	% TOTAL				100.0%		17.2%		15.4%		6.8%		17.6%		5.6%

Capital Cost

The estimates of cost for the fixed facilities are order-of-magnitude and reflect the construction prices prevailing in Allegheny County during the first half of 1967. These costs do not include an allowance for escalation, as the schedule of funding or construction of the project is not known. The estimates are based on the alignments and types of construction indicated on the foregoing graphics, showing the plans and profiles for both the steel-wheeled system and the Transit Expressway System.

Quantities of construction materials for typical line structures of the system were made by comparison with similar typical designs for each type of construction required. Quantities for special transit structures were also determined on the same basis. Plans and working drawings for both standard and special structures were developed in sufficient detail so that the determination of quantities of construction materials required would be of the same order-of-magnitude for both systems.

Station costs were developed in a similar manner for at-grade, aerial, and underground stations. Fare collection equipment, escalators, platform areas, and parking requirements were predicated upon patronage estimates.

The cost of parking facilities, both at grade, and in some cases multi-level, was determined from average costs for similar facilities constructed in Pittsburgh and in Allegheny County.

The unit prices for the Transit Expressway System were developed from data supplied by Westinghouse Electric Corporation and were adjusted to reflect construction requirements and current local conditions.

The cost estimates for both systems are summarized for each line in the following tables and for the following cost classifications: (a) track and structure, (b) stations and parking, (c) yards and shops, (d) electrification and control, (e) utility relocation, and (f) rights-of-way.

Description of Major Cost Classifications

Track and Structure. This includes all items required for the line segments between stations, such as standard and special structures, underpinning, sheeting, piling, excavation, embankment, dewatering, street relocation, traffic maintenance, drainage, transit roadbed and running surface.

Stations and Parking. This includes all the items necessary to construct the stations of the rapid transit system and to provide for the interface of stations with other transit modes. Some of these items are clearing, excavation, fill, dewatering, underpinning, sheeting, piling, drainage, decking, traffic control, street restoration, escalators, stairs, platforms, lighting, station heating and cooling, signing, fencing, paving, transit roadbed and running surface, architectural treatment, and fare collection facilities.

Yards and Shops. This includes site preparation, transit roadbed and running surface, switching facilities, shop buildings and equipment, lighting, and administrative buildings.

Electrification and Train Control. This includes the electrical system necessary to furnish power for train propulsion and control, and the centralized computer complex. Some of the items included are sub-stations, power distribution, telemetering, third rail, grounding, telephone, maintenance, radio, station PA system, power for mechanical equipment and automatic fare collection equipment.

Utility Relocation. This covers relocation of utility installations displaced, such as storm sewers, sanitary sewers, water distribution systems, steam lines, gas lines, electrical systems and communication systems.

Engineering and Contingencies. This includes the costs necessary to design the system and any items of construction not foreseen in the major elements of work. A factor of 30 percent of the total cost of the major elements of construction was used for this item. As stated previously, estimates are based on current unit prices and no attempt has been made to provide for inflation or changes in cost of construction in the future.

Right-of-Way Costs. This includes demolition costs and a contingency factor which were estimated by a local licensed real estate appraiser and consultant, and reflect current real estate values in the Pittsburgh area. No attempt has been made to estimate the amount that might be realized from the resale of the unused portions of the transit right-of-way acquired or from air-right development.

Not included in the cost estimates is the allowance to be made in any financial plan for pre-operating expenses. Such expenses are estimated to be from $7 to $10 million, depending on the initial extent of the system selected. These expenses would include the cost of recruiting and training of personnel, testing of system components and administration and development of a new rapid transit division of the Port Authority Transit prior to revenue service.

The following is a comparison of the unit costs for typical line construction for the steel-wheeled system and the Transit Expressway System:

At-Grade. The at-grade structure required by the Transit Expressway is more extensive than the steel-wheeled system. The special roadways and center I-beam for vehicle guidance is a special purpose structure and required for all types of construction. The cost for the steel-wheeled, at-grade structure, not including earthwork and site preparation, is $60 per linear foot and $126 per linear foot for the Transit Expressway. The cost difference is $66 per linear foot.

Aerial. The aerial structure was evaluated for a two-track section. The costs include all work necessary for the complete structure, including track or roadways, but does not include electrification and train control equipment, screening or acoustic treatment, if required. The cost for the steel-wheeled, aerial structure is $462 per linear foot. The cost for the Westinghouse system is $340 per linear foot. The cost difference is $122 per linear foot.

Subway. The cut-and-cover subway costs were computed for two types of subway construction: (1) Soldier Pile Method, and (2) Sheet Pile Method. Each system was evaluated on the same basis. The subway construction cost includes the basic structure complete with the tracks or roadway, but does not include the electrification and train control, ventilation, utility or street restoration. The cost for the Soldier Pile Method for the steel-wheeled system is $2,260 per linear foot and $2,224 per linear foot for the Transit Expressway System. The cost difference for the Soldier Pile is $36 per linear foot.

The cost for the Sheet Pile Method of subway construction is $2,600 per linear foot for the steel-wheeled system and $2,564 per linear foot for the Transit Expressway. The cost difference is $36 per linear foot.

Tunnel. The tunnel construction for both systems was evaluated on the same basis. No core borings or geological study was made of the tunnel sites as part of the Study. Single track tunnels for both systems would be 16 feet in diameter. The costs include those for lighting, walkway, drainage, and the track or roadway structure. It does not include the ventilation, portal, electrification and train control. Tunnel cost for the steel-wheel system is $2,305 per linear foot and $2,271 per linear foot for the Transit Expressway. The total cost difference is $34 per linear foot.

The total construction cost for the steel-wheeled system as shown in the tables is $774,534,000 and the cost for the Transit Expressway System is $739,338,000. These figures indicate a cost difference of $35,196,000 less for the Transit Expressway System. This difference is small and probably within the range of accuracy of either estimate.

The summary table below shows the total costs of both systems by major types of construction. These costs do not include stations.

SUMMARY OF COST BY CONSTRUCTION TYPES

	Steel-Wheeled		Transit Expressway	
At-grade	27.6 mi.	$119,465,000	26.6 mi.	$127,181,000
Aerial	14.3 mi.	91,360,000	20.1 mi.	113,500,000
Cut-Cover	2.6 mi.	59,605,000	2.2 mi.	50,510,000
Tunnel	9.2 mi.	181,221,000	6.6 mi.	129,765,000
Major Structure	2.8 mi.	41,392,000	2.7 mi.	41,472,000

Operating Characteristics

The Consultant's evaluation of the two systems indicated that both systems are capable of meeting the requirements of rapid transit service for Allegheny County in terms of speed, headway, level of service, comfort and capacity.

The design of cars for the steel-wheeled system incorporates refinements which mitigate inertia forces exerted during changes in acceleration. In the Transit Expressway System, the use of rubber tires and the design of the vehicle suspension provides passenger comfort equivalent to that of the steel-wheeled cars. Studies made for San Francisco, Toronto and Washington, D. C. have demonstrated that the use of sound-deadening materials, baffling, and proper design of both vehicles and fixed structures can reduce noise of the steel-wheeled system to levels approximating that of rubber-tired systems.

Comparable amenities would be included in terms of seating, aisle space, design, and appointments of car interiors in both systems. Air conditioning of the vehicles would also be provided in both systems.

Operating and Train Consist. Based on estimates of 1985 passenger use, and hourly distribution of passenger trips similar to that experienced on existing bus and trolley lines, a schedule of rail rapid-transit operation was prepared for a typical weekday, for the various periods of the day, and for Saturday and Sunday. It was assumed that rail rapid transit would be in operation daily from 5:00 a.m. until 1:00 a.m. On weekends and holidays, train operation would be scheduled to meet patronage demand, with headways ranging from 5 minutes to 20 minutes.

During the peak periods, the Suburban system schedule provides for an operation on a 90-second headway close to the CBD and a 6-minute headway in the outlying areas. During the base period, headways are lengthened to 2.5 minutes close to the CBD and to 10 minutes in the outlying areas. During the off-peak night time periods, the operation would be adjusted according to patronage use with headways of 12 minutes in the outlying areas. The Urban line schedule provides for an operation on a 2-minute headway during the peak period and 5-minute headways during the base period. During the off-peak night time periods, headways of 10 minutes would be used on the Urban System.

Train consists would vary throughout the day according to projected passenger use, and are based on a loading criteria of 125 percent of seating capacity in the peak, 85 percent in the base, and 75 percent in the off-peak evening periods. The schedule for the North Hills-County Airport line and the Monroeville-South Hills line provides for an average of four-car trains during the peak hours with a maximum of six-car trains during the AM and PM peak 20-minute periods for the steel-wheeled system. The schedule for these lines provides for an average of ten-car trains and a maximum of fourteen-car trains for the Transit Expressway System. The Rankin-Whitehall and Etna-Carnegie lines would operate with two- and four-car trains during the peak periods for the steel-wheeled system and with five- to ten-car trains for the Transit Expressway System. The Urban system schedule provides for two- and four-car trains during the peak periods for the steel-wheeled system and for five- to ten-car trains for the Transit Expressway System.

Distances and running times between stations for each system were determined through the use of the Westinghouse Continuous Train Performance Program. Both the steel-wheeled system and the Transit Expressway System would average 35 to 40 miles per hour between stations, including times for station stops.

The proposed schedules, travel times, route miles, and anticipated passenger volumes during the peak periods provided the basis for estimating the total annual operating miles and hours, as well as the equipment requirements for 1985 for each system. These figures are summarized below:

	Annual Car Miles	Annual Train Hours	Required Equipment
Steel-Wheeled System	15,249,600	236,300	199 cars (70 ft. long)
Transit Expressway System	36,582,900	236,300	460 cars (30 ft. long)

The estimate of equipment requirements includes an allowance for spares and recognizes the less efficient passenger capacity for small vehicles.

Minor maintenance and storage facilities have been tentatively located at Homewood for the Urban Line and at the terminals of the Rankin, North Hills and Monroeville Lines. Major repairs and periodic overhaul shops for both lines are tentatively located in the vicinity of the Homewood station. There are several alternative locations and arrangements possible in that area which would require coordination at a later date with the Pennsylvania Railroad, the City of Pittsburgh or other local municipalities.

Switching. There are five main line switching points on the 60-mile Countywide system, together with a number of emergency cross-overs, yards and shops where track switches are required. The steel-rail supporting and guiding structure offers a simple and economical solution. These switches require only the movement of switch points. For the Transit Expressway system there is yet to be developed a functional switching device capable of providing sustained high speed, heavy duty use. Because of the center guidance beam, it is necessary that complete track structures be moved in order to effect switching between tracks.

Automatic Operation. Both the steel-wheeled system and the Transit Expressway System would include the most up-to-date and complete computerized train-control systems. Estimates of operating cost, both with and without on-board train attendants, have been made for both systems as part of this study. Various cost savings resulting from advancing technology in automatic switching, electronic cab signals, automatic fare collection, two-way radio and closed-circuit television have been taken into consideration for both systems.

the Transit Expressway vehicle provides a safety disc which will engage the flange of the guidance beam to prevent the vehicle from leaving the trackways. Derailment could only occur in the event of a shearing off of the guidance mechanism.

The safety performance of the rubber-tired wheel used in conjunction with the conventional flanged wheel has likewise been highly satisfactory. In the first three years' use on the Paris subways, tire failures on the two test trains occurred approximately once a month and corresponded to approximately 2.25 million miles of travel. Even with tire failures, safety and reliability were not affected. Trains with flat tires were run at normal speed to the end of the line where the tire was changed.

There is less basis for evaluating the performance of rubber tires operating on exposed concrete beams. Experience with the ALWEG installation at Seattle has demonstrated the necessity of maintaining a surface of uniform roughness at locations where braking or accelerating forces are transmitted. It was also demonstrated that on wet girder surfaces, or on those coated with a film of dust and moisture, the rubber-tired wheels would spin at acceleration rates above 2.4 mphps. Seattle Transit, now operating the installation, has limited maximum speed to 45 mph and acceleration to 2.2 mphps. The use of rubber tires on transit systems which are exposed to the weather needs further testing and development.

Equipment Characteristics

Steel-Wheeled System. Rapid-transit equipment for the steel-wheeled system would consist of modern lightweight vehicles. Each vehicle would be powered by four 150-hp d.c. traction motors, capable of speeds up to 70 miles per hour. Acceleration and deceleration rates of 3.0 to 3.5 miles per hour per second would be required to meet high-speed performance and maintain a 90-second headway between trains. Passenger comfort would be maintained with specific restraint on the intensity of gravity forces which causes jerk during acceleration changes. This would result in a smooth ride comparable to that of a modern elevator.

size of steel wheel car

It is proposed that the vehicles would be 70 feet long, 9 1/2 feet wide, 10 1/2 feet high to seat 72 passengers. It should be noted that there is economy in vehicle costs and in maximizing car lengths to practical limits. For steel-wheeled systems, this limit is between 70 and 85 feet. The empty vehicle is estimated to weigh approximately 56,000 pounds, which is equivalent to 76 pounds per square foot of car, 780 pounds per seat, or 800 pounds per linear foot of car.

Improvements and cost reduction for d.c. power supply components have been identified and support the selection of a 1,000-volt d.c. system for the steel-wheeled system. These consist of solid-state chopper-controlled motors, power pickup and distribution rail, silicon rectifiers, and substation distribution system, which have been developed by equipment suppliers at the BARTD Diablo Test Track.

Transit Expressway System. Rapid transit equipment assumed for the Transit Expressway System evaluation was based on the South Park Demonstration Project in Allegheny County. Certain changes to the system recommended in the M.P.C. report were accepted as developable and operationally feasible, even though they have not been tested in actual operation. The vehicle was specified to be 9 1/2 feet wide instead of the 8 1/2 foot width of the South Park vehicle.

size of TERL car

Transit Expressway cars for this Study were assumed to be 30 feet long, a limitation imposed by the rubber tires, 9 1/2 feet wide, 10 feet high, to seat 28 passengers. While two rows of longitudinal seats were provided on the demonstration vehicle, transverse seating is generally recommended and would be possible without significant changes other than width in the present vehicle design.

High-speed operation, equal to the steel-wheeled vehicle, would be provided through the use of two 100-hp motors. Full system voltage operation and continuous positive grounding of the vehicle body were not provided for in the demonstration project; however, these features are to be tested in the planned extension of the local test project and would be available for any public system. Refinements to the vehicle suspension and the propulsion-drive train necessary to provide a system capable of safe, dependable operation to 70 miles per hour appears to be obtainable. It is understood that continuing study is being given to alternative methods.

The empty car is estimated to weigh approximately 21,500 pounds which is equivalent to 84 pounds per square foot of car, 770 pounds per seat, or 710 pounds per linear foot of car.

The present transfer table switch is large, slow in operation and costly. The vehicle speed for the diverging movement would be restricted to approximately 20 miles per hour. The size of the transfer switch is approximately 22 by 50 feet for a 150-foot radius turn. The size would restrict the location of switches to at-grade construction and limit their use in tunnels and on aerial structure.

Both power demand and power consumption for rapid transit depend upon energy required:

1. To accelerate equipment
2. To overcome friction
3. To overcome air resistance

It has been stated previously that for equal width cars, weight per square foot of train or per seat of the Transit Expressway approximates that of steel-wheeled vehicles. Power requirements for acceleration, therefore, are approximately equal for both systems.

Power to overcome air resistance is also equal for both systems.

However, considerably more power is required for the Transit Expressway vehicle to overcome friction and rolling resistance than required for the steel-wheeled vehicle. Based upon tests at South Park, this may be in the ratio of 5 1/2 or 7 to 1. In summary, it is probable that power for Transit Expressway may average 20 percent to 25 percent more than for steel-wheeled trains of the same width.

Patronage Potential

The success of a proposed rapid transit system and the ability of the system to attract patronage from the private automobile during peak periods of the day depends on the accessibility and the level of service provided. Experience in other cities has shown that speed or average door-to-door trip time is directly related to patronage attracted. Both the steel-wheeled system and Transit Expressway system will provide equivalent levels of service in terms of speed, headway and comfort. Consequently, the patronage attraction developed through modal-split assignments would apply to either system. The projection of 1965 patronage shows that there would be a 20 percent increase in patronage by 1985.

Line and Station Volumes. The 60-mile system consists of nine lines and 43 stations. The assignment to the 60-mile rapid transit system revealed the following 24-hour 1985 distribution of patrons among the lines.

Line	Volume	Percent
Ohio River	66,000	24
Oakland	38,000	14
South Hills	40,000	15
Monroeville	67,000	25
North Hills	23,000	9
Mon-Valley	10,000	4
Carnegie	4,000	1
County Airport	19,000	7
Etna	4,000	1
Total	271,000	100

The distribution of these 271,000 daily rapid transit patrons along each of the individual lines is shown graphically in Fig. IV-29, Passenger Flow Diagram - 60-Mile Rapid Transit System. The two Urban Lines account for 38 percent of the rapid transit patronage and the seven Suburban Lines carry the remaining 62 percent. The Ohio River and Monroeville Lines each account for approximately one-fourth of the total system patronage. The Oakland and South Hills lines carry 29 percent, split approximately equally among them, and the remaining 22 percent is carried by the North Hills, Mon-Valley, Carnegie, County Airport and Etna lines. As expected, patronage is directly related to line length and, therefore, the number of stations served.

The average number of patrons passing through a station daily on the 60-mile system, exclusive of the downtown stations was slightly over 8,000. Generally, station volumes tended to be slightly higher at line terminal stations which act as collection points for large tributary areas. Stations where the rapid transit lines intersected major highway facilities also exhibited similar characteristics. Stations serving business and commercial areas served the greatest numbers of patrons. The East Liberty Station on the Monroeville Line can be expected to serve over 26,000 daily patrons in 1985. This is the heaviest station volume on the system, outside the downtown area. Over 22,000 patrons could be expected to pass through the Oakland Station and 17,000 through the Murray Avenue Station in Squirrel Hill on the Oakland Line. Similarly, the daily patronage volume assigned to the Allegheny Station serving Allegheny Center on the Ohio River Line was 19,000.

Trips to the Central Business District. As expected and illustrated by Fig. IV-28, patronage on the rapid transit lines increases steadily as they approach the Golden Triangle. This volume accumulation reaches its peak or "maximum load point" at the edge of the CBD. Here, at these points, all branches come together to bring large volumes of patrons into the CBD. These "throats" are the critical points which dictate to a great extent the train consist and frequency of service requirements for the entire system. Examination of the 60-mile system assignment indicated that 53 percent or 142,000 of the total rapid transit system patrons either started or ended their trips in the Golden Triangle. Of the total patronage entering and leaving the CBD through the four maximum load points, 31 percent or 44,000 used the South Hills, County Airport, and Carnegie lines; 39 percent or 55,000 used the Monroeville, North Hills, Etna, and Mon-Valley lines; 16 percent or 23,000 used the Ohio River Line and 14 percent or 20,000 used the Oakland Line. Analysis of 1965 PAT transit ridership characteristics revealed that 18 percent of the average daily patronage could be expected in the peak hour, peak direction, on radial routes of this nature and this relationship was employed in subsequent design calculations.

Revenues and Operating Costs

Although the recommended transit plan must be integrated with a network of complementary and feeder buses, this part of the report is concerned with estimates of annual revenues, operating and maintenance expenses and the capital cost of vehicles for the 60-mile rapid-transit system. Estimates of revenues and cost are based on 1967 price levels. Escalation to account for rising prices is not included. The schedules, travel times, route miles and anticipated passenger volumes provided the basis for estimating the total annual operating miles and hours, as well as the equipment requirements for 1985 for each system.

Estimated Operating Expense. In estimating the operating costs for the steel-wheeled system and the Transit Expressway System, the various functions to be performed were determined and the manpower necessary to accomplish these functions were estimated.

The manpower estimates are based on the physical and operating characteristics of each system. The estimates for the Transit Expressway System are based on the Transit Expressway Report which was prepared by the M. P. C. Corporation and the various reports and memoranda concerning the operation of the system, which were prepared by the staff of the Westinghouse Electric Corporation. The wage rates used, which include the present welfare and fringe benefits, are applicable to Western Pennsylvania and the experience of the Port Authority. The proposed salaries used are based on the general levels of salary in the transit industry and are related to the responsibility of the job.

A detailed description of the development of operating and maintenance costs for both the steel-wheeled and Transit Expressway systems are included in a separate report prepared during this Study.

A few items, however, require special emphasis:

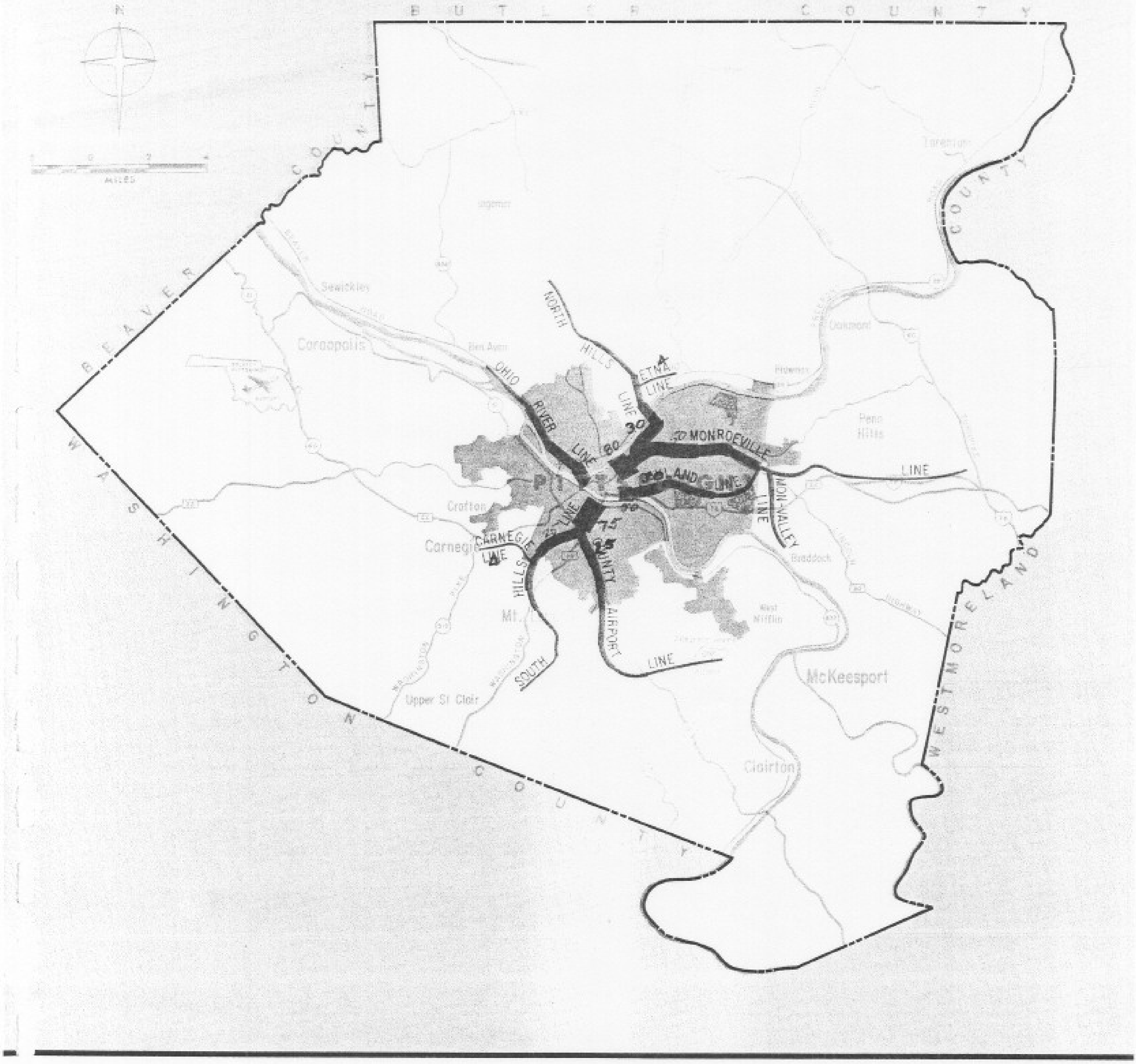
Amortization of Revenue Equipment. A total of 199 vehicles, at a cost of $185,000 each, would be required to operate the steel-wheeled system. Therefore, a total capital investment of $36,815,000 would be required. Assuming a 20-year amortization at a 6 percent interest rate, the annual cost of vehicle financing would be $3,221,000.

For the Transit Expressway System, 460 vehicles, costing $128,000 each, would be required for operation of the county-wide system. The total capital investment would be $58,880,000. Assuming 20-year amortization at a 6 percent interest rate, the annual cost of vehicle financing would be $5,133,000.

Depreciation. Since it is assumed that equipment purchases would be financed from system revenues, accrual for depreciation is limited to capital and replacement needs other than vehicles. These annual needs for the 60-mile system are estimated to be 3 percent of the annual revenue.

Summary of Cost. Assuming a single attendant on each train, the annual operating costs are estimated to be $12,247,000 for the steel-wheeled system and $13,456,000 for the Transit Expressway System. Without attendants, the annual operating cost would be $10,817,000 for the steel-wheeled system and $12,025,000 for the Transit Expressway System.

The following tables summarize the total annual cost for each system by the various accounts, including amortization of equipment and depreciation. All costs have been rounded to the nearest thousand.



ALLEGHENY COUNTY
RAPID TRANSIT STUDY

PASSENGER FLOW DIAGRAM
60-MILE RAPID TRANSIT SYSTEM

LEGEND

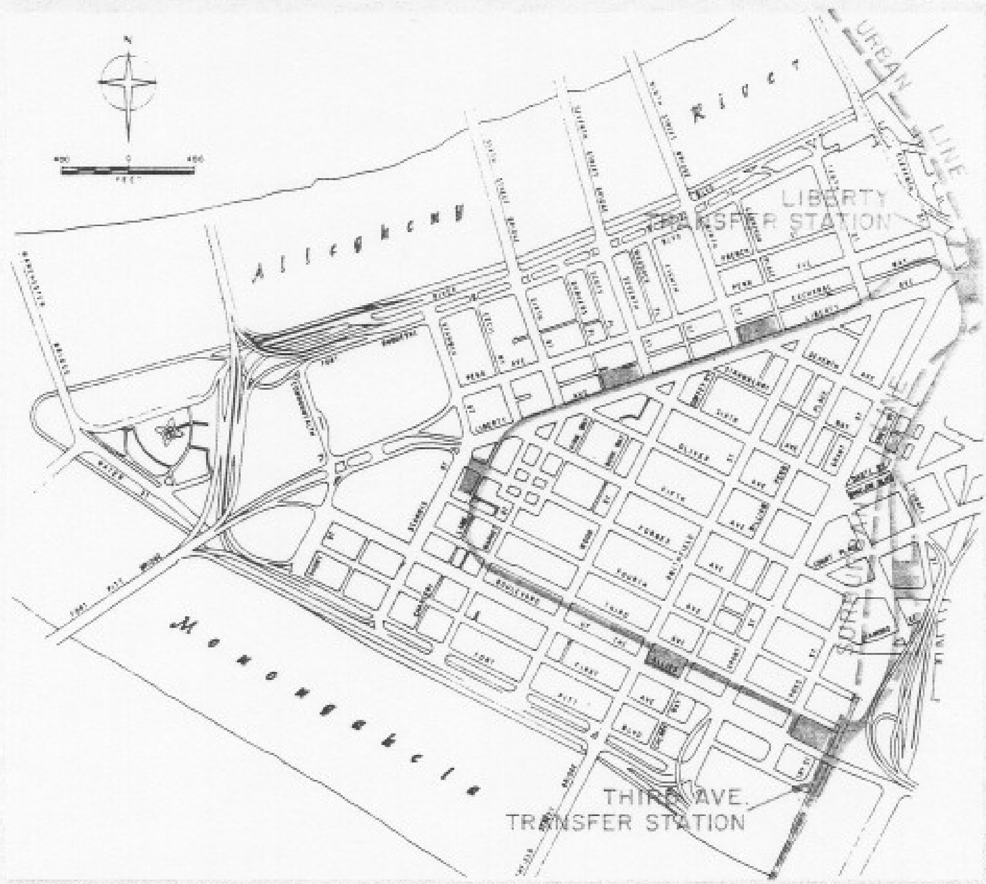
100,000
50,000
25,000
10,000

HIGHWAY AND
ARTERIAL STREET

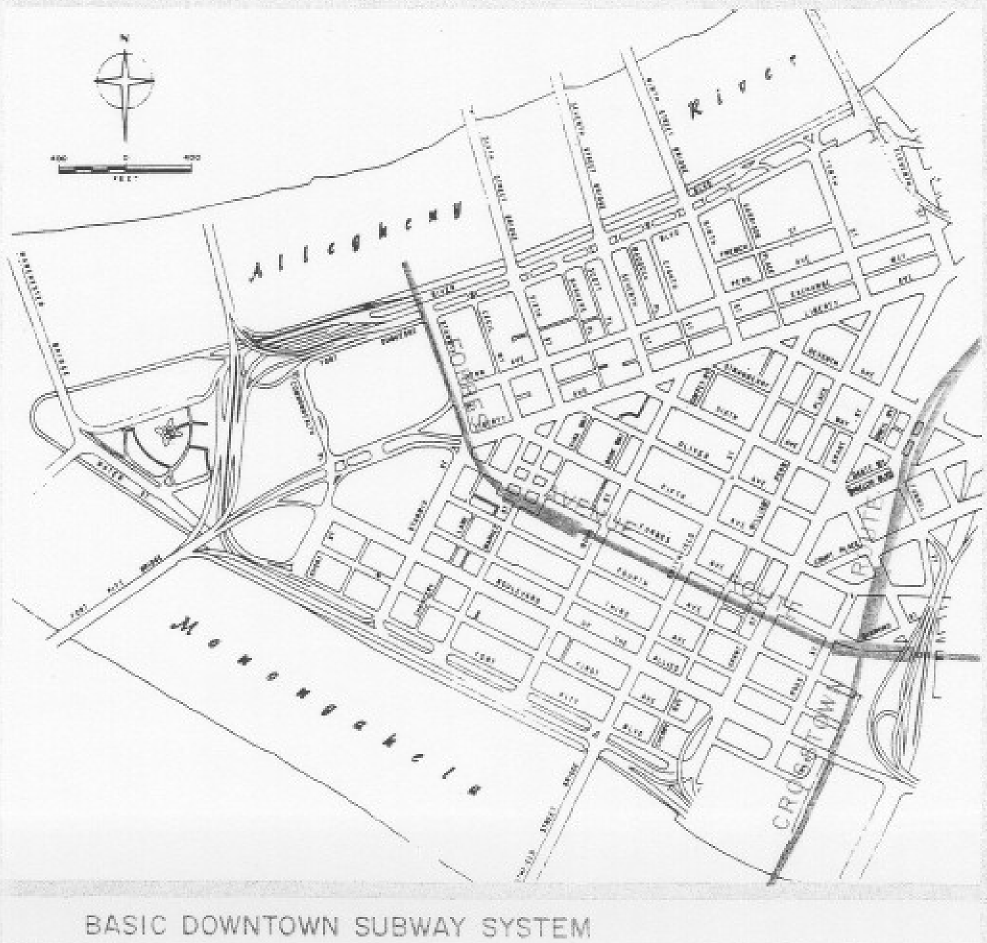
Fig. IV - 23

DOWNTOWN ALTERNATES I PHASE

III-A



AERIAL DISTRIBUTOR LOOP SYSTEM



BASIC DOWNTOWN SUBWAY SYSTEM

Account	System	System
Maintenance of Way & Structures	$1,328,000	$1,489,000
Maintenance of Equipment	1,167,000	2,044,000
Power Costs	1,596,000	1,766,000
Provision of Service	5,700,000	5,700,000
Injuries and Damages	451,000	451,000
General and Administrative	2,005,000	2,005,000
Sub-total (Operating Cost)	12,247,000	13,456,000
Amortization of Vehicles	3,210,000	5,133,000
Depreciation of Capital Equipment	652,000	652,000

Summary of Total Annual Costs Without Train Attendants

Account	Steel-Wheeled System	Transit Expressway System
Maintenance of Way & Structures	$1,328,000	$1,489,000
Maintenance of Equipment	1,167,000	2,044,000
Power Costs	1,596,000	1,766,000
Provision of Service	4,270,000	4,270,000
Injuries and Damages	451,000	451,000
General and Administrative	2,005,000	2,005,000
Sub-total (Operating Cost)	$10,817,000	$12,025,000
Amortization of Vehicles	3,210,000	5,133,000
Depreciation of Capital Equipment	652,000	652,000
Total Annual Cost	$14,679,000	$17,810,000

Revenues. After examining patronage volumes for the 60-mile rapid-transit system, a fare structure was devised which is quite similar to the present PAT fare structure. The proposed fare structure consists of an inner or basic fare zone which covers the area within six miles of the Golden Triangle in all directions. The basic fare charged for trips in this zone was assumed to be 30 cents. All stations on the Urban Line would be included in the basic fare zone. On the Suburban System the basic fare zone would encompass the West View Station on the North Hills Line, the Homewood Station on the Monroeville Line, the Etna and Carnegie Stations, the Whitehall Station on the County Airport Line and the Castle Shannon Station on the South Hills Line. Beyond the basic fare zone, five-cent zone charges would be assessed at two-mile increments up to a maximum fare of 50 cents, which would be the fare for a trip from Monroeville to the Golden Triangle or any point within the basic fare zone. However, the maximum fare from any point on the system to the Golden Triangle would not exceed 35 cents except from the Churchill or Monroeville Stations on the Monroeville Line.

Assuming the foregoing rate structure, the annual revenues would be $21,700,000 for the anticipated number of passengers that were estimated to use the system in 1985. This figure would apply to either the steel-wheeled or Transit Expressway systems.

Based on the present day levels of costs, wages, and fares, the Consultant's studies indicated that the 60-mile rapid transit system would provide a moderate net operating income and that this net income would be sufficient to cover interest and amortization on vehicles. The following table summarizes annual revenues and operating costs for both systems for operations with and without attendants. The costs and revenues are based on seasoned operations at the 1985 level of patronage.

Yes, but feeder bus fares are all attributed to rapid transit

With Attendants

	Steel-Wheeled System	Transit Expressway System
Gross Operating Revenues	$21,700,000	$21,700,000
Operating Expenses	12,899,000	14,109,000
Net Operating Revenues	8,801,000	7,591,000
Interest and Amortization on Vehicles	3,210,000	5,133,000
Operating Margin	5,591,000	2,458,000

Without Attendants

	Steel-Wheeled System	Transit Expressway System
Gross Operating Revenues	$21,700,000	$21,700,000
Operating Expenses	11,469,000	12,678,000
Net Operating Revenues	10,231,000	9,022,000
Interest and Amortization on Vehicles	3,210,000	5,133,000
Operating Margin	7,021,000	3,889,000

The operating income would be sufficient to cover a revenue bond issue for the purchase of vehicles.

Other Alternatives - Maximum Use of Aerial Construction

During the course of the Study, the Consultant was requested by the Port Authority to participate in additional studies of alternate types of construction and downtown distribution.

In November 1966, at the request of the Port Authority Board, the Transportation Research Institute began a separate study of possible cost reductions that would result through use of the Transit Expressway for an Allegheny County rapid transit system. Subsequent preliminary estimates prepared by the Transportation Research Institute ranged from $415 million to $555 million for the 60-mile system. These cost estimates, which reflected a possible reduction of 28 percent to 46 percent over the cost of a steel-wheeled system, were based on the use of an 8 1/2-foot wide vehicle and maximum use of aerial construction. In June 1967, Richardson-Gordon & Associates on subcontract to Transportation Research Institute, examined three corridors in depth to determine the possible minimum cost of a Transit Expressway System with maximum use of aerial construction. The corridors studied were:

1. South Hills
2. Carnegie
3. Oakland

The plan and profile sheets as well as the detail cost estimates prepared for the steel-wheeled system in these corridors were furnished to Richardson-Gordon & Associates for their work and review. Several meetings were held to review and agree on methods of estimating. The following is a description of the alternatives that were identified for these corridors and cost estimates arrived at by Richardson-Gordon & Associates. The location and extent of these alternative routes are shown on Fig. IV-2.

South Hills Corridor

The essential difference in this line was the use of the existing trolley tunnel through Mt. Washington, the use of the Beechview trolley right-of-way through Mt. Lebanon and Dormont, and the change to aerial structure from South Hills Junction to Castle Shannon Boulevard.

The line begins as an aerial structure on the south side of the Monongahela River at the Pennsylvania Railroad bridge. The line continues south on the present railroad alignment and into a new tunnel in Mt. Washington that connects to the existing trolley tunnel. The line continues south to South Hills Junction utilizing the trolley tunnel.

The line then continues on aerial structure across Saw Mill Run Boulevard and then southeast on the at-grade section on the side of the hill to Beechview. The line continues south on aerial structure along Beechview Boulevard to Hampshire Avenue, and in the center of Broadway, following the Beechview trolley route to Greenmont Street. The line continues south on aerial structure on private right-of-way to Washington Road. The line makes a transition to a subway crossing under Washington Road emerging to aerial structure along Shady Drive to join the Clearview loop trolley right-of-way at Castle Shannon Boulevard. The alignment from this point to the terminal at Fort Couch Road is the same as that used for the steel-wheeled system.

Carnegie Corridor

This line is generally in the same corridor as the steel-wheeled system and differs in alignment to permit aerial construction in place of tunnel construction.

The Carnegie Line is a branch of the South Hills Line and begins in the vicinity of the Beechview Swimming Pool. The line continues, utilizing at-grade and aerial construction, in a westerly direction along the south side of Crane Avenue to the vicinity of Methyl Avenue in Beechview. The line turns southward on the steep slopes along the east side of Banksville Road to Coast Avenue, where the line crosses on aerial structure over Banksville Road to continue along the west side of Banksville Road. The line in this area is in the same location as the steel-wheeled system. The line is on aerial structure and turns northward just west of Carnahan Road to the vicinity of Greentree Road. The line continues northward in tunnel under Greentree Road to Whiskey Run Road where the line turns westward along Whiskey Run Road to the south side of the Parkway-West. The line continues on aerial structure along Parkway-West to the east side of Carnegie where it leaves the Parkway to continue at-grade into Carnegie along Chestnut Street to East Main Street where the line terminates.

Oakland Corridor

The line studied by Richardson-Gordon & Associates is in a different corridor from the one which was selected by the City Planning Department and, subsequently, included in the comparison of a steel-wheeled system and the Transit Expressway System. It is, however, on the same alignment of an earlier route which was studied by Parsons, Brinckerhoff, Quade & Douglas and provides a comparison of the cost saving using aerial construction compared with subway and tunnel construction.

The Oakland Line was studied by Richardson-Gordon & Associates from Pride Street to the Dahlem Street station, and is on aerial structure beginning at Pride Street just south of Colwell Street and continues eastward along the south side of Colwell Street to the vicinity of Wyandotte Street. The line continues eastward along the north side of DeRuad Street leaving De Ruad Street to cross over Moultrie, Orr, and Kirkpatrick Streets to Beelen Street. The line continues eastward, on at-grade and aerial structure along the northside of Beelen Street, to a point opposite the Board of Public Education Building where the line crosses Beelen Street to a location on the steep side hill along the north side of Fifth Avenue. The line continues eastward along the north side of Fifth Avenue to the vicinity of Robinson Street where it crosses Fifth Avenue on aerial structure and continues eastward to cross over Forbes and Craft Avenues into the Port Authority's property along the south side of Forbes Avenue. The line continues eastward on aerial structure and private right-of-way along south side of Roguois Way to McKee Place. The line continues on aerial structure eastward on private right-of-way approximately 200 feet south of Forbes Avenue to the vicinity of Oakland Avenue where the line turns southeastward to an intersection with Bouquet Street, just southwest of Forbes Field.

The line continues southeastward over the steep side hill into the ravine behind the southside of Forbes Field and Schenley Park. The line continues on aerial structure, along the north side of the Pittsburgh Junction Railroad under Schenley Bridge, crossing the Railroad east of Schenley Bridge, to turn northeastward on side hill along the east side of the Railroad to a crossing at Forbes Avenue. From the south side of Forbes Avenue, the line continues underground in subway and tunnel northeastward on private right-of-way to intersect with Fifth Avenue and Morewood Avenue. The line crosses Fifth and Morewood Avenues, turns eastward on private right-of-way, gradually making a transition from the north side of Fifth Avenue to a location on the north side of Kentucky Avenue. The line emerges from the underground subway structure to an aerial structure east of South Aiken Avenue and continues on aerial structure eastward on private right-of-way along the north side of Kentucky Avenue to the vicinity of Shady Avenue. The line turns northeastward on aerial structure across Shady Avenue over private right-of-way crossing Howe, Denniston, and Marchand Streets to a location along the east side of Renning Street. The line continues northeastward on aerial structure over Penn Avenue to intersect with the Monroeville Line at which point the line terminates.

The estimate of savings through maximum use of aerial structures and steeper grades for the corridors studied described above were:

South Hills Line	$ 33,389,000
Carnegie Line	19,237,000
Oakland Line	64,604,000
Total savings	$117,230,000

By applying the difference in construction cost between aerial and subway or tunnel construction to the remainder of the system, Richardson-Gordon & Associates estimated that approximately $160 million could be saved by using the 8 1/2-foot Transit Expressway vehicle and maximizing aerial construction.

This Study can be viewed as a careful analysis of the economics of aerial construction over subway and tunnel construction and as an indication of possible maximum and minimum cost of rapid transit based on the extent of community acceptance and commitment to aerial construction. Additionally, similar order-of-magnitude savings would be realized through use of aerial construction for the steel-wheeled system in these same corridors.

Alternative Downtown Distribution

In November 1966, the Transportation Research Institute of Carnegie Institute of Technology submitted a report to the Port Authority Board on a preliminary study of an alternative method of distributing rapid transit patrons in the downtown area using the Transit Expressway system. The TRI report concluded that a detailed study should be made using a single-tracked aerial loop system, constructed adjacent to buildings and cantilevered out over the sidewalks. Five or six aerial stations were to be located at the major points of CBD trip concentrations. While the aerial distributor loop would be separate and independent from the regional system, it would provide for transfers to the regional rapid-transit system at a transportation terminal or terminals located in the base of the Golden Triangle adjacent to the Crosstown Freeway and the Pennsylvania Railroad right-of-way.

Construction of such a system offered the possibilities of: (1) reducing the high cost of constructing a subway system in the downtown area, (2) providing a higher level of service to passengers, and (3) reducing walking time and total trip time.

This section will present the findings of that investigation. The two systems are compared quantitatively on the basis of:

1. Level of service
2. Operating and maintenance cost
3. Construction and right-of-way costs.

The questions of community acceptance of aerial construction for the downtown system, compatibility with present and future development, environmental fit, and aesthetics, are beyond the scope of this specific study and in fact were assigned to TRI with guidance to be provided by the City Planning Department.

The work to be accomplished in this study was broken down into eight areas.

1. System objectives and criteria
2. Route location studies
3. Urban design and station locations
4. Patronage and operations studies
5. Structural design studies of loop construction
6. Functional layouts and station plans

7. Construction and right-of-way estimates
    (a) Basic system
    (b) Distributor system
8. Operating and maintenance cost estimates.

Study responsibilities were divided into four primary areas and assigned in the following manner:

1. PBQ&D, TRI and City Planning were jointly responsible for developing the system, environmental objectives and the general criteria used in developing and evaluating the system.

2. TRI and City Planning were responsible for the selection of the specific routing for the distributor as well as the loop stations and transfer station locations.

3. TRI was responsible for the conceptual design of the loop structure and its components.

4. PBQ&D was responsible for determining engineering feasibility, construction methods, preparation of cost estimates, patronage use and comparisons of service.

System Objectives and Criteria. It was recognized that the planning and success of a regional transportation system is relative to the degree of fit or integration between the system and the urban complex, which required a system-environmental approach to planning.

The first phase of this process involved identification of the elements of interest to either the system or its environment and the development of the system's objectives. Appropriate objectives for an urban transit system were considered to be the following:

1. Minimize trip travel times between origin and destination.
2. Maximize passenger comfort and convenience.
3. Minimize operating cost of the system.
4. Maximize use and revenues of the system.
5. Minimize construction and right-of-way costs.
6. Maximize use and integration of planned redevelopment projects.

In this form, the objectives provide the connection between the system and the environment; thus, the optimum system is one which best meets the objectives.

The following criteria were used in developing the Loop System:

Aerial Distributor Stations

1. Stations to be off-street on private right-of-way based on 6-car trains; however, cost estimates were to be based on a 4-car train length.

2. The distributor stations would emphasize function.

3. Primary function is to provide shelter and convenience for passengers moving between platforms and street level.

4. Design is not to foreclose future connection to above- or below-ground system of pedestrian walkways and malls.

5. Stations would not be equipped for fare-collection equipment. The Distributor Loop System would be free to the public.

6. Stations would not be heated or air conditioned, and rest rooms would not be provided.

7. Stations would be enclosed at platform level but not at the sidewalk level.

8. Stations would be well lighted at both the platform and street level.

9. Attendants, as well as radio communication system and closed-circuit TV surveillance system, would be provided at each station.

Aerial Structure

1. Designed to accommodate the Transit Expressway vehicle.

2. Columns adjacent to building rather than at the curb edge.

3. Roadway to be cantilevered over the sidewalks.

4. Aerial structure and columns would not be attached to existing buildings.

5. Roadway to be enclosed at bottom to protect pedestrians from splash and oil drips.

6. Aerial structure to provide high level of continuous lighting.

7. Power and communication pick-up to be modified to provide emergency walkway.

8. Provision to be made for emergency by-pass tracks for the storage of vehicles.

Vehicle

1. Design to be basically similar to the present Transit Expressway vehicle.

2. Car length 30 feet, width 7-1/2 to 8 feet.

3. Doors on one side for loading and unloading, end doors for emergency use.

4. Vehicle capacity of 100 passengers, based on 2.0 sq. ft. per standing passenger and seats (16) on one side.

Operation

1. Peak period headway 60 seconds and variable up to 2 minutes.

2. Speeds based on Westinghouse train performance program analysis.

3. Acceleration and deceleration 2.5 mph.

4. Ten-second dwell time at distributor station and 20 seconds at transfer station.

5. Distributor system operated from 6:00 a.m. to 10:00 p.m.

Distribution Loop Selected for Comparison. The Transportation Center, originally proposed as an eight-level structure and envisioned as the focal point for all downtown transportation activities, was to be located in the eastern fringe of the Golden Triangle on the two city blocks bounded by Sixth Avenue, Fifth Avenue, Tunnel Street and Bigelow Boulevard.

With respect to the Allegheny County Rapid Transit System, all of the regional (urban-suburban) lines, as well as the Distributor Loop, were routed through the Transportation Center. All downtown rapid transit trips would terminate at this station and patrons would either transfer to the aerial distributor system to complete their downtown trip or walk from that station to their destinations.

Numerous questions were raised concerning: the functional practicality of a single station for all the rapid transit lines serving the CBD; the ability of the Distributor Loop System, as proposed, to provide sufficient capacity to handle the anticipated passenger loads; and the ability of the distributor system to handle increased patronage beyond 1985.

While the foregoing discussion does not enumerate all the problem areas of the Distributor Loop concept, it does indicate the more serious limitations which required a further and more detailed examination.

Subsequent study examined specific routes and station sites for the Aerial Distributor System, examined alternative locations for the Urban Line to fit the various distributional configurations, examined alternative Transportation Terminal sites, developed a suitable design for the distributor structure, and developed the 1985 Design Day passenger travel to the CBD and peak period factors. From this work, two alternatives emerged which differed in that one was single Transportation Center plan, and the other included two Transportation Centers. The location of the aerial distributor line and stations were the same for either system. However, the location and method of construction for the Urban Line was significantly different for these two alternatives.

The Urban Line for the single-terminal plan would be on aerial structure for its entire length from Dinwiddie Street to the North Side. This line would be on private right-of-way along the south side of Forbes Avenue from Marion Street to the Crosstown Freeway.

The Urban Line for the two-station plan would be a cut-and-cover and tunnel line until it reaches the Pennsylvania Railroad station; then, it too would be aerial through the Penn Park Development Project to the North Side.

For the purpose of selecting one of these alternatives, TRI tested both distributor systems on their computer program and determined that the level of service for the two-station plan was slightly better than that of the single-station plan. Similarly, preliminary order-of magnitude estimates of construction and right-of-way cost were determined for both alternatives. At that time, it was estimated that the two-station plan would cost approximately $5 million more to construct. The two-station alternative was selected for evaluation and comparison to the Basic System.

Comparisons of Level of Service

The following is a description for the basis of comparison and the result of analysis of level of service for the Basic Downtown System and the Aerial Distributor Loop System.

The Assignment of patronage to the systems and stations were based on Minimum Trip Time and Minimum Walk Time.

Walking distances and paths to all stations were based on the existing street system. Numerous walk paths from each station to all zones were examined to determine the shortest path. Walking speed was assumed to be 4.0 feet/second.

The patronage figures used are the 1985 annual average weekday volumes (AAWD) taken from the PBQ&D second assignment. Their volumes have been factored for Peak Design Day, Peak Period and Equivalent Design Hour Volume.

In the preparation of cost estimates for the rapid transit transfer terminals and loop stations, an anlysis of passenger movements within each station was made to determine the number of escalators and stairways required, size of station platforms, size and location of fare collection facilities and mezzanine levels. Plans were used to determine the time required in transferring to each system, as well as the time paths from the rapid transit station platforms to the street surface.

The train speeds used were based on the Westinghouse Electric Corporation train performance program. Program input parameters are; motor characteristics, horizontal track alignment and grades, train resistance and car loadings, gear ratios and wheel diameter, number of stations and dwell time, and acceleration and deceleration. The computer output provides information on: schedule speeds, trip time, power consumption in kilowatt hours per vehicle mile, and other similar data.

These data output were also used in computing the power cost for the two systems.

Station Usage and Transfers. In examining the figures on station use for the Basic System it was found that the Midtown Station had a greater use than either the Market or Liberty Station. It was also found that the percent of use at each station did not change greatly for either the Minimum Walk or the Minimum Time Analysis.

The Market Square station provides distribution to the apex of the Golden Triangle either directly from the station site or through a series of underground pedestrian walkways, possibly integrated in the lower level of the buildings. The Midtown Plaza station site provides distribution to the Grant Hill area and the Chatham Center and Civic Arena area either directly from the station site or through a series of underground pedestrian walkways. The Liberty Station site provides distribution to the Grant-Liberty area and the proposed Penn Park Development project either directly from the station site or through use of underground pedestrian walkways.

The Analysis of transfer movements showed that 23 percent to 34 percent of the total passengers on downtown destination trips would require a transfer to complete the trip.

The following table summarizes the percent of transfers by line at the Midtown station.

Summary of Transfers - Midtown Station

Line	Station Destination	Minimum Walk Analysis	Minimum Time Analysis
Suburban to Urban	Market Square	37%	26%
Urban to Suburban	Liberty	20%	12%
Total	Both	34%	23%

The advantages that this system offered to the downtown trip maker was the opportunity of remaining in the train on which he arrived, remaining in his seat, and being able to choose between two stations located at two different points in the Triangle. Passengers could transfer to either the Urban or Suburban train at the Midtown Plaza station for direct delivery to the third station, or third point of the Golden Triangle, if they so desired, or walk from either of the two stations to their destination. Another advantage that this system offered was its unobtrusiveness in the downtown environment. These two alternatives are shown in Fig. IV-29.

In examining the figures on station use for the Distribution Loop, it was found that the five aerial loop stations provided a balanced distribution only under the Minimum Walk analysis, whereas the Minimum Time path resulted in a significant reduction in use of the Ninth Street Station. It was also found that the combined surface use of the two major transfer stations, Liberty and Fourth Avenues, was only 13 percent for the Minimum Walk path, which increased significantly to 43 percent for a Minimum Time path.

Analysis of transfer movements at stations showed that 60 percent to 88 percent of the total downtown passengers would be required to transfer to the distributor loop system with 29 percent to 38 percent of these transfers taking place at the Liberty Avenue station and 30 percent to 50 percent being made at the Fourth Avenue station.

The following table summarizes the percent of transfers by line at each station.

Summary of Transfers - Loop System

Line	Minimum Walk Analysis	Minimum Time Analysis
Liberty Avenue Station		
Suburban to loop	15%	10%
Urban to loop	92%	71%
Fourth Avenue Station		
Suburban to loop	72%	44%
Urban to loop	0	0
Transfers both Stations	88%	60%

The above figures show that major portions of the rapid transit patronage will be required to transfer to complete their downtown trip on the distributor loop system.

This heavy transfer requirement is, of course, inherent in the concept of the system and could be considered one of the goals of the system if maximum use of the loop is to be attained. Conversely, the basic system attempts to distribute passengers to the CBD with a minimum of transferring.

Summary of Trip Time. In order to simplify the numerous comparisons made in the preceding analysis, a bar chart showing a typical trip on each system was prepared. This chart shows what portion of the trip is spent in walking, riding, and transferring.

MIN-TIME

	Ride	Transfer	Street	Walk	Total
Basic System	0.8	0.7	1.7	4.9	8.1 Min
Loop System	1.4	1.4	1.3	3.7	7.8 Min

MIN-WALK

	Ride	Transfer	Street	Walk	Total
Basic System	1.0	0.9	1.8	4.6	8.3 Min
Loop System	2.4	2.1	1.0	3.1	8.6 Min

It can be seen from these bar charts that there is 0.3 minute difference in total trip time between the two systems. Also that there is a difference of 1.2 to 1.5 minutes in walk time between the two systems. This amounts to a 290 to 360-foot longer walk for the basic system than for the Loop. It shows further that when considering time not on the train, and in computing the on-feet time in transferring, getting to the street, and walking, the time difference between the two systems is 0.6 to 1.1 minutes.

Operation and Maintenance Cost

Estimates of operating and maintenance costs for the Aerial Distributor Loop are based on the estimates of costs for the operations of a Westinghouse system on the full 60-mile county-wide system.

Service would be based on a 17-hour day with train consists varying from two-car trains to four-car trains in the peak, with headways varying from one minute in the peak period to two minutes in the base and evening hours. Forty cars would be required to operate the proposed schedule for the loop.

Estimated Operating Expenses. Estimated operating expenses for the Distributor Loop would amount to $808,000 per year. If it were deemed necessary to have an attendant on board each train, the annual cost would increase to $1,106,000. These operating costs would be in addition to the operating costs of the county-wide system and are based on 1967 cost levels.

Amortization of Revenue Equipment. The operation of the CBD Distributor Loop would require 40 vehicles and at a cost of $150,000 each, this represents a total investment of $6,000,000. Based on a 20-year amortization at a 6 percent interest rate, the annual charge for amortization would be $523,000.

Depreciation. Accrual for depreciation was based on 3 percent of revenue for the regional system, but since the Distributor Loop would have no revenue, another means of computing depreciation was necessary. Thus, depreciation was estimated at 5 1/2 percent of the total operating expenses for the loop. This amounted to $44,400 per year.

Summary of Costs. The following table is a summary of the total annual cost for the Aerial Distributor Loop System. These costs would be in addition to the normal operating cost for the full 60-mile rapid-transit system.

Account	Cost without Attendant	Cost with Attendant
Maintenance of Way and Structures	$ 60,000	$ 60,000
Maintenance of Equipment	79,000	79,000
Power Costs	81,000	81,000
Provision of Service	331,000	630,000
Injuries and Damages	43,000	43,000
Administrative and General	214,000	214,000
Sub-total (Operating Cost)	$ 808,000	$1,107,000
Interest and Amortization of Vehicles	523,000	523,000
Depreciation of Capital Equipment	44,000	44,000
Total Annual Cost	$1,375,000	$1,674,000

Construction and Right-of-Way Cost. The following table is a summary of the construction and right-of-way cost for the two alternative downtown systems:

	Cost (Millions)		
	Construction	Right-of-Way	Total
Basic System			
Urban Line	$76.6	$12.3	$ 88.9
Suburban Line	21.0	4.6	25.6
Total	$97.6	$16.9	$114.5
Aerial Distributor Loop			
Urban Line	$54.3	$22.0	$ 76.3
Suburban Line	17.8	6.3	24.1
Loop Line	16.1	11.5	27.6
Total	$88.2	$39.8	$128.0

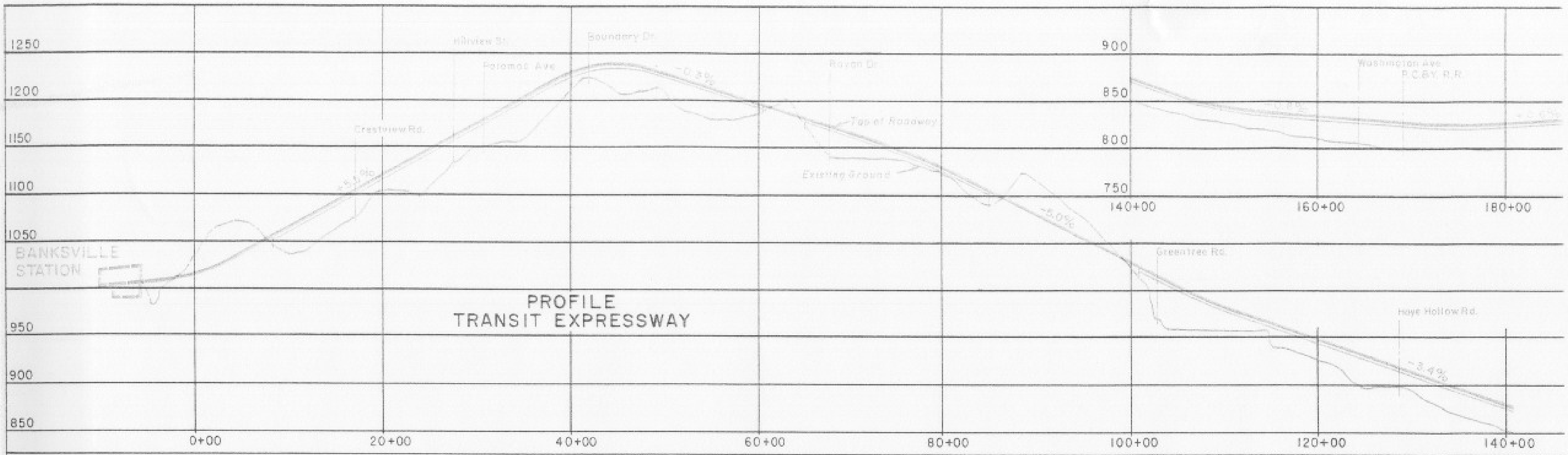
The estimates of construction cost for the Urban and Suburban Lines for the Aerial Distributor Loop are based on using a steel-wheeled system. This provides a relative comparison of cost differences for the Loop System vs. the Basic Subway System. It should be noted that the costs indicated for the Loop are based on the design proposed by TRI. It is felt that a reduction in cost could be realized with a modified design of the structure.

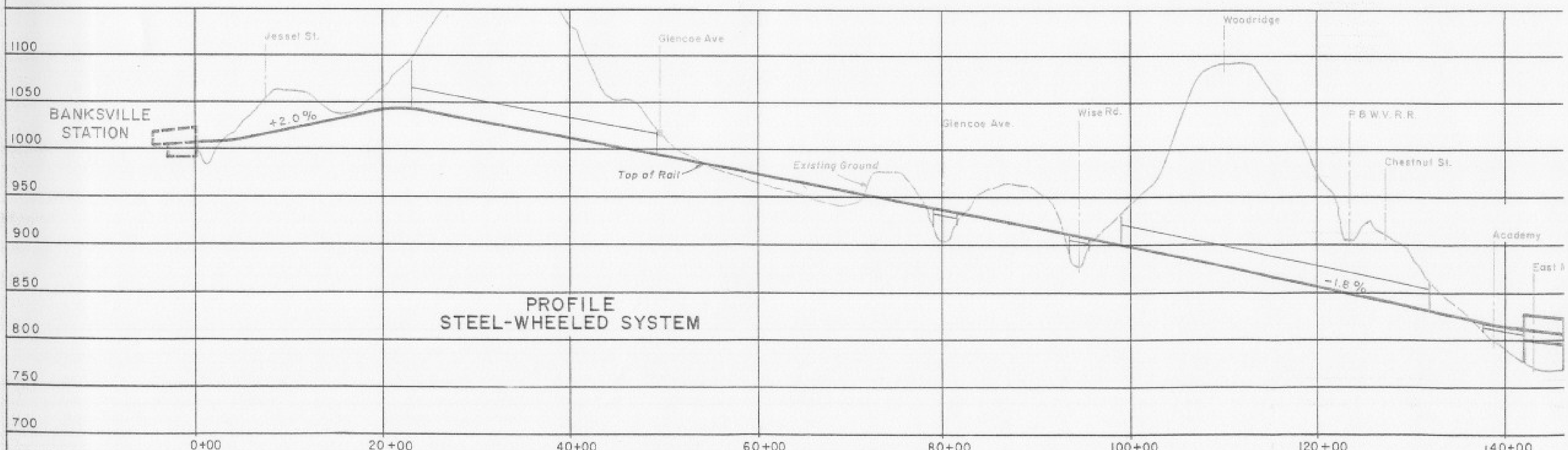
Community Acceptance. With respect to community acceptance of either system, we consider it essential that rapid transit in major CBDs be in subway, or otherwise elevated along off-street rights-of-way where it may be appropriately landscaped, or integrated with new buildings. Similarly, we consider that subway is not required in residential and commercial areas where off-street rights-of-way are available in the median strips of freeways or wide boulevards, or elsewhere where surface or elevated construction can be landscaped and harmonized with the environment. Cost estimates for both Transit Expressway and steel-wheeled transit have been predicated on these principles. With respect to Transit Expressway, advantage was taken of the steeper grades and sharper curves permitted by this system. This has made it possible to plan for shorter tunnels and, in some cases, shorter subways for Transit Expressway as compared to the routes of the rail system.

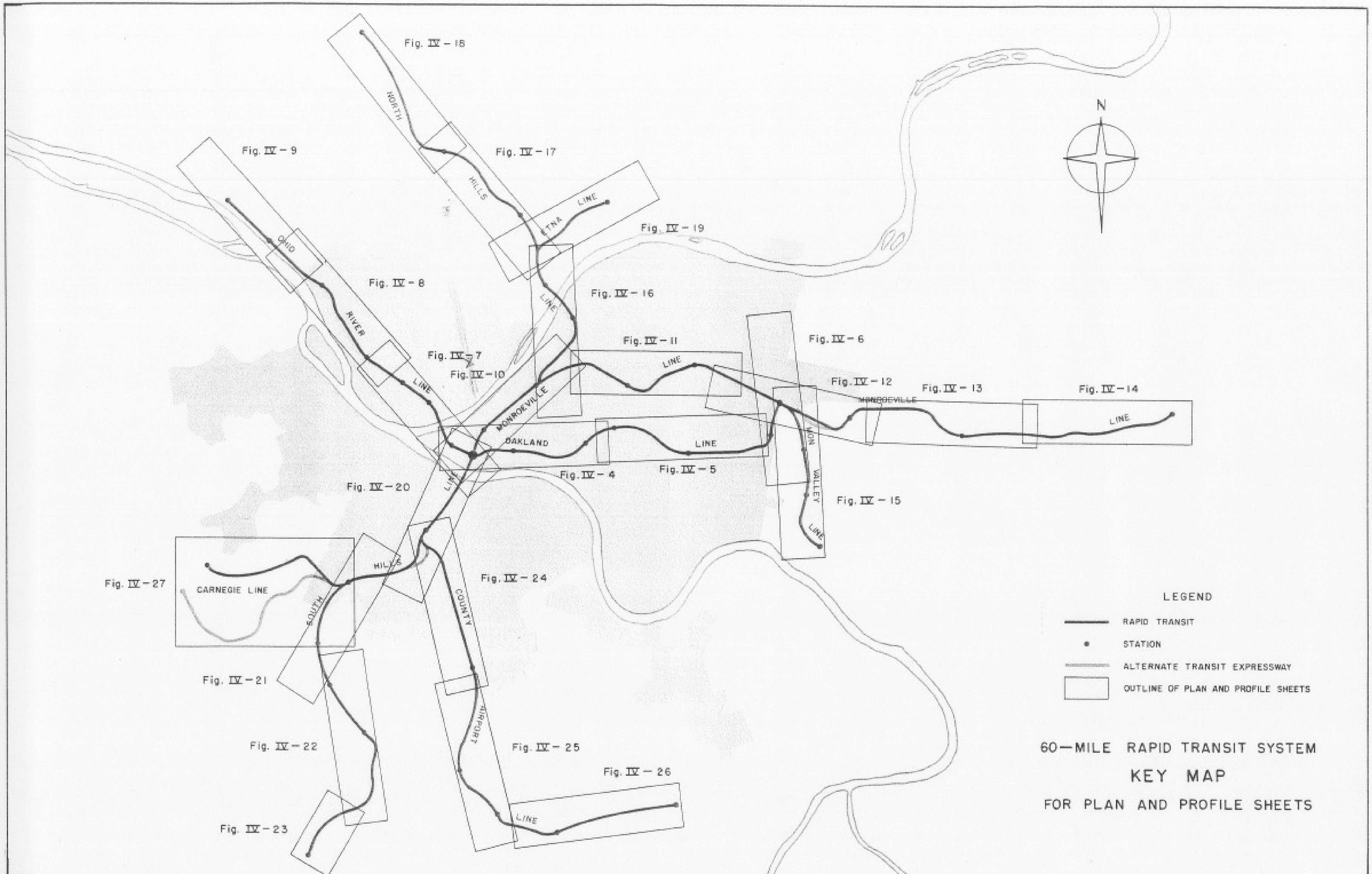
Financial Prospects. It is considered that the Transit Expressway system and the steel-wheeled system have equal potential for patronage and revenues. The cost of fixed construction of Transit Expressway for a 60-mile system is estimated to be about four and one-half percent of $775 million, or $35 million less than the cost of fixed construction for a modern rail system. Assuming six percent interest and 40-year amortization, this would reduce annual debt service for final construction by $2, 300, 000.

Earlier in this chapter, the suggestion was made that as much as an additional $160 million in the cost of fixed construction might be saved by a much more extensive use of aerial construction than that on which our estimates are predicated. Assuming six percent interest and 40-year amortization, this would reduce annual debt service for final construction by an additional $10, 000, 000. The acceptance of the application of such aerial construction is an element to be tested and demonstrated by a trial operation serving commuters in one corridor of the Pittsburgh area.

The cost of equipment for Transit Expressway is substantially higher (as much as $20 million to $25 million) than that for a rail system equipped with 200 seventy-foot vehicles. Based on amortizing the cost of vehicles over a 20-year period at six percent interest, the annual interest and amortization


PROFILE
TRANSIT EXPRESSWAY
BANKSVILLE STATION
Hillview St.
Boundary Dr.
Crestview Rd.
Top of Roadway
Existing Ground
-5.0%
Greentree Rd.
Washington Ave.
1250
1200
1150
1100
1050
950
900
850
900
850
800
750
0+00
20+00
40+00
60+00
80+00
100+00
120+00
140+00
160+00
180+00


PROFILE
STEEL-WHEELED SYSTEM
BANKSVILLE STATION
Jessel St.
Glencoe Ave
+2.0%
Top of Rail
Existing Ground
Glencoe Ave.
Wise Rd.
Woodridge
P.& W.V. R.R.
Chestnut St.
-1.8 %
Academy
1100
1050
1000
950
900
850
800
750
700
0+00
20+00
40+00
60+00
80+00
100+00
120+00
140+00

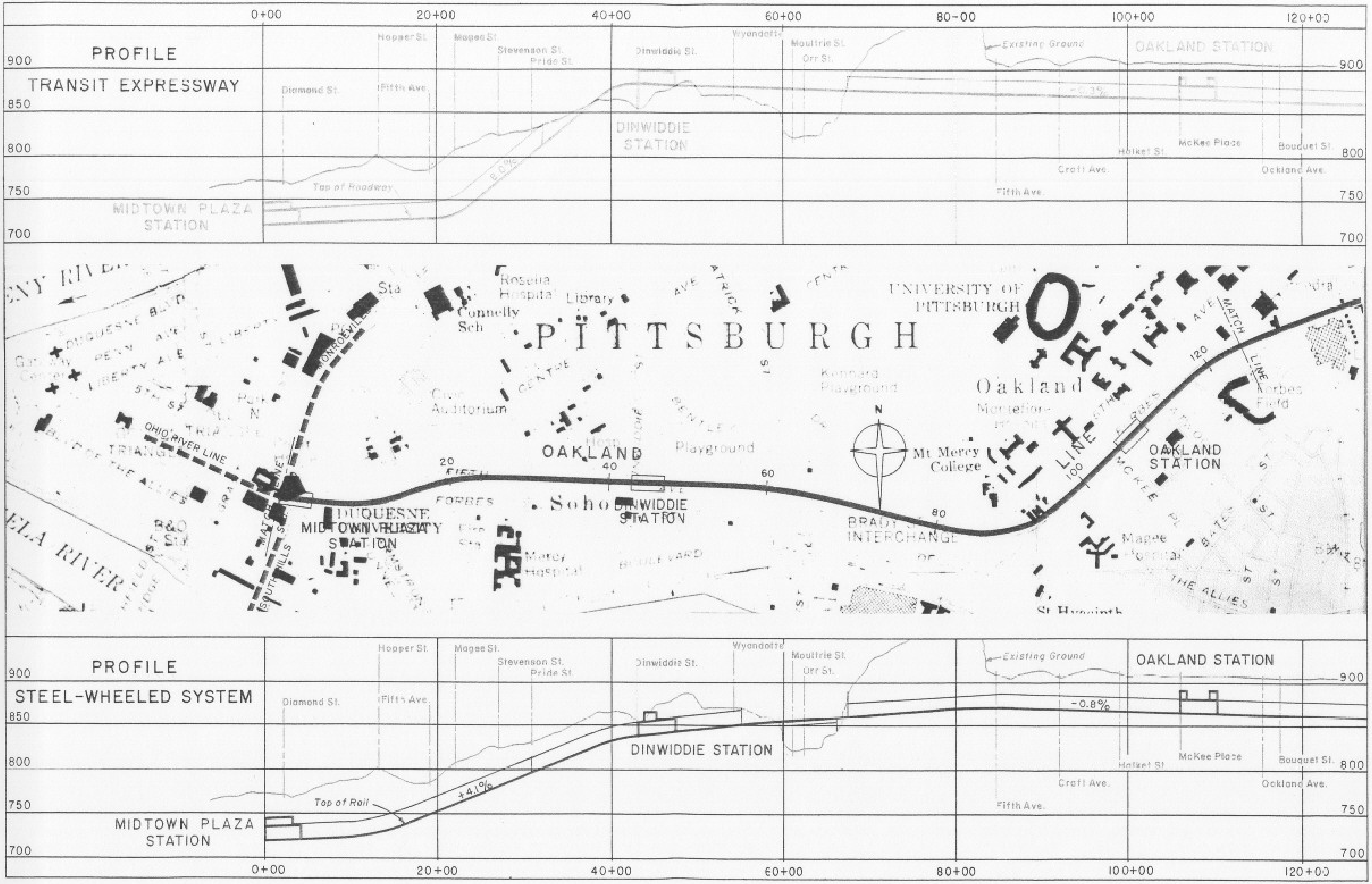


60—MILE RAPID TRANSIT SYSTEM

KEY MAP

FOR PLAN AND PROFILE SHEETS

Fig. IV-3



PROFILE
TRANSIT EXPRESSWAY
0+00
20+00
40+00
60+00
80+00
100+00
120+00
900
850
800
750
700
Hopper St.
Magee St.
Stevenson St.
Pride St.
Dinwiddie St.
Wyandotte
Moultrie St.
Orr St.
Existing Ground
OAKLAND STATION
Diamond St.
Fifth Ave.
DINWIDDIE STATION
Top of Roadway
MIDTOWN PLAZA STATION
Halket St.
McKee Place
Bouquet St.
Craft Ave.
Oakland Ave.
Fifth Ave.
PITTSBURGH
UNIVERSITY OF PITTSBURGH
Library
Connelly Sch
Civic Auditorium
OAKLAND
Oakland
OHIO RIVER LINE
DUQUESNE
MIDTOWN PLAZA STATION
DINWIDDIE STATION
Soho
Mt. Mercy College
BRADY ST INTERCHANGE
OAKLAND STATION
Magee Hospital
Mercy Hospital
Forbes Field
Playground
St. Hyacinth
N
PROFILE
STEEL-WHEELED SYSTEM
Top of Rail
+4.1%
-0.8%
DINWIDDIE STATION
MIDTOWN PLAZA STATION

Fig. IV - 4

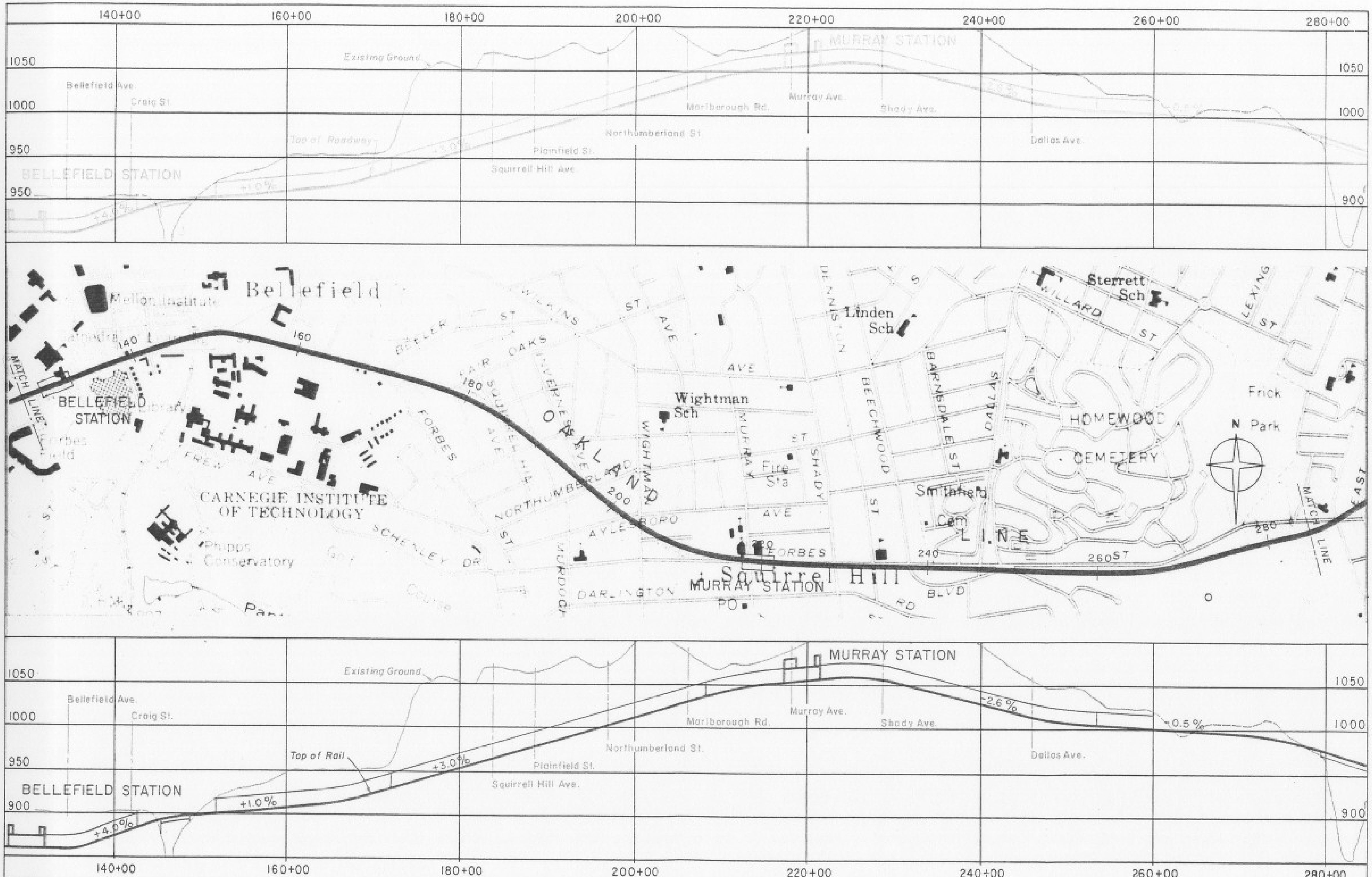

140+00
160+00
180+00
200+00
220+00
240+00
260+00
280+00
1050
1000
950
900
MURRAY STATION
Existing Ground
Bellefield Ave.
Craig St.
Marlborough Rd.
Murray Ave.
Shady Ave.
Northumberland St.
Plainfield St.
Squirrel Hill Ave.
Dallas Ave.
Top of Roadway
BELLEFIELD STATION
+1.0%
+3.0%
+4.0%
-2.6%
-0.5%
Bellefield
Mellon Institute
BELLEFIELD STATION
MATCH LINE
CARNEGIE INSTITUTE OF TECHNOLOGY
Phipps Conservatory
SCHENLEY DR
FORBES
AVE
FAIR OAKS
BEELER ST
NORTHUMBERLAND ST
AYLESBORO
DARLINGTON
OAKLAND
WIGHTMAN
Wightman Sch
MURRAY
Fire Sta
SHADY
DENNISTON
Linden Sch
BEECHWOOD
BARNSDALE ST
DALLAS
Sterrett Sch
WILLARD ST
LEXINGTON ST
HOMEWOOD CEMETERY
Frick Park
N
Smithfield Cem
L I N E
Squirrel Hill
MURRAY STATION
PO
BLVD
RD
Top of Rail

Fig. IV - 5

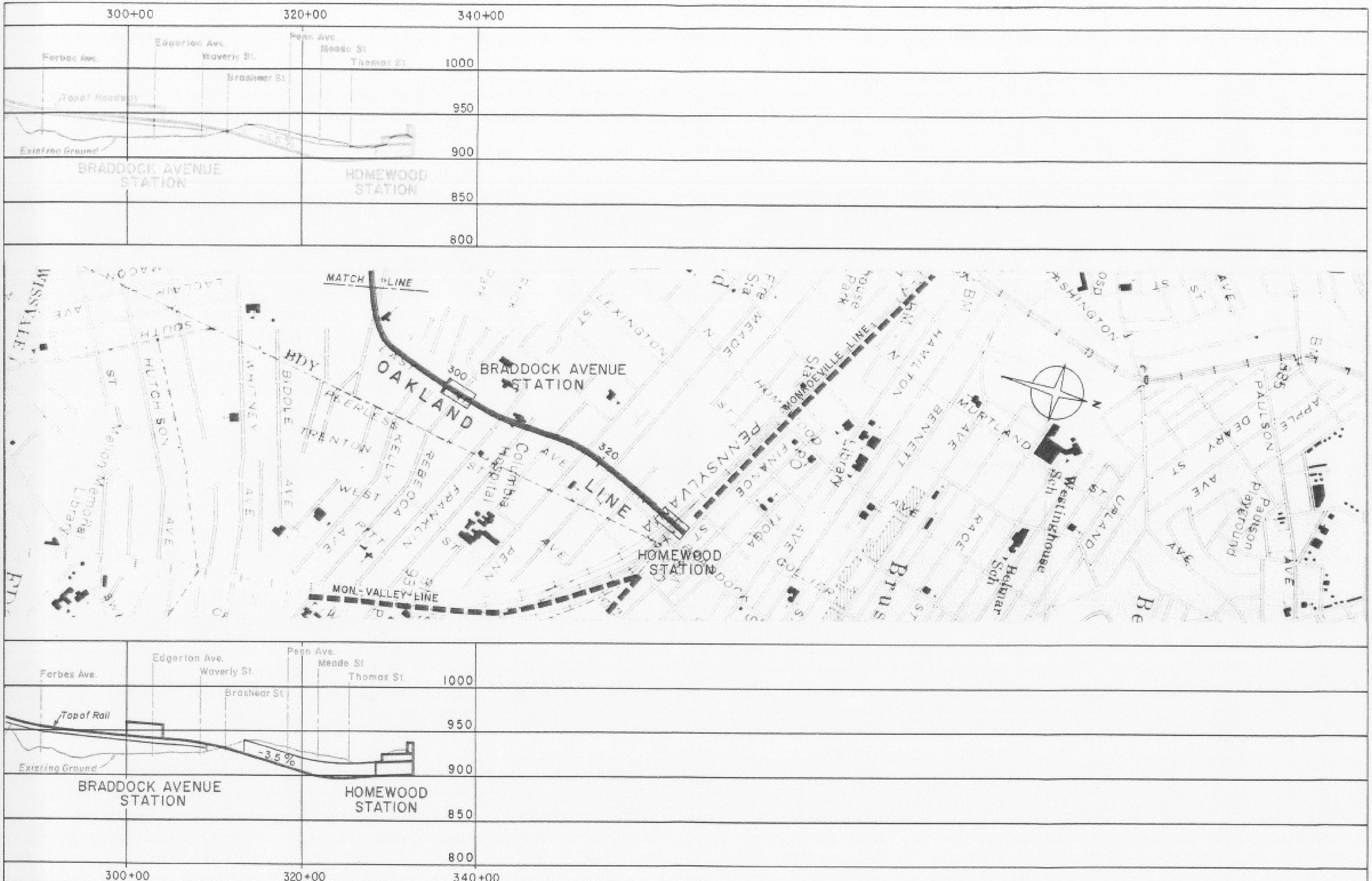
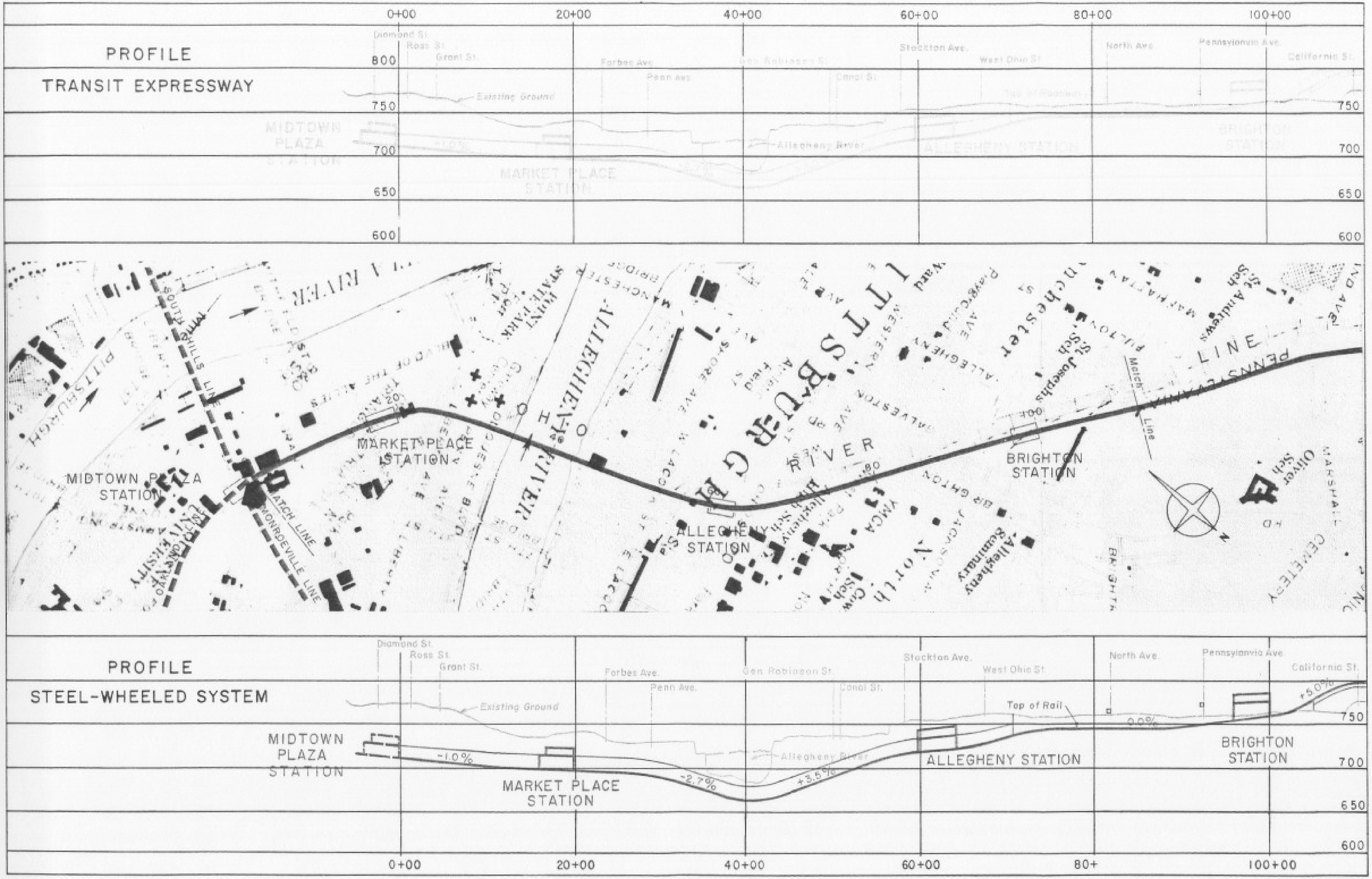

300+00
320+00
340+00
Forbes Ave.
Edgerton Ave.
Waverly St.
Brashear St.
Penn Ave.
Meade St.
Thomas St.
1000
950
900
850
800
Top of Rail
Existing Ground
-3.5%
BRADDOCK AVENUE STATION
HOMEWOOD STATION
MATCH LINE
BRADDOCK AVENUE STATION
OAKLAND
300
320
PENNSYLVANIA
LINE
MONROEVILLE LINE
MON - VALLEY LINE
HOMEWOOD STATION
Westinghouse Sch
Belmar Sch
Paulson Playground
Columbia Hospital
Library
LEXINGTON
MEADE
HAMILTON
BENNETT
MURTLAND
UPLAND
DEARY
PAULSON
APPLE
FRANKLIN
REBECCA
KELLY
PEERLESS
TRENTON
WEST
BIDDLE
WHITNEY
HUTCHSON
SOUTH
PENN
FINANCE
TIOGA
RACE

Fig. IV-6



PROFILE
TRANSIT EXPRESSWAY
0+00
20+00
40+00
60+00
80+00
100+00
Diamond St.
Ross St.
Grant St.
Forbes Ave.
Penn Ave.
Gen. Robinson St.
Canal St.
Stockton Ave.
West Ohio St.
North Ave.
Pennsylvania Ave.
California St.
Existing Ground
Allegheny River
800
750
700
650
600
MIDTOWN PLAZA STATION
MARKET PLACE STATION
ALLEGHENY STATION
BRIGHTON STATION
MIDTOWN PLAZA STATION
MARKET PLACE STATION
ALLEGHENY STATION
BRIGHTON STATION
PENNSYLVANIA LINE
SOUTH HILLS LINE
MONROEVILLE LINE
MATCH LINE
Match Line
OHIO RIVER
ALLEGHENY RIVER
PITTSBURGH
NORTH
PROFILE
STEEL-WHEELED SYSTEM
Diamond St.
Ross St.
Grant St.
Forbes Ave.
Penn Ave.
Gen. Robinson St.
Canal St.
Stockton Ave.
West Ohio St.
North Ave.
Pennsylvania Ave.
California St.
Existing Ground
Top of Rail
Allegheny River
-1.0%
-2.7%
+3.5%
0.0%
+5.0%
MIDTOWN PLAZA STATION
MARKET PLACE STATION
ALLEGHENY STATION
BRIGHTON STATION
750
700
650
600
0+00
20+00
40+00
60+00
80+
100+00

Fig. IV-7

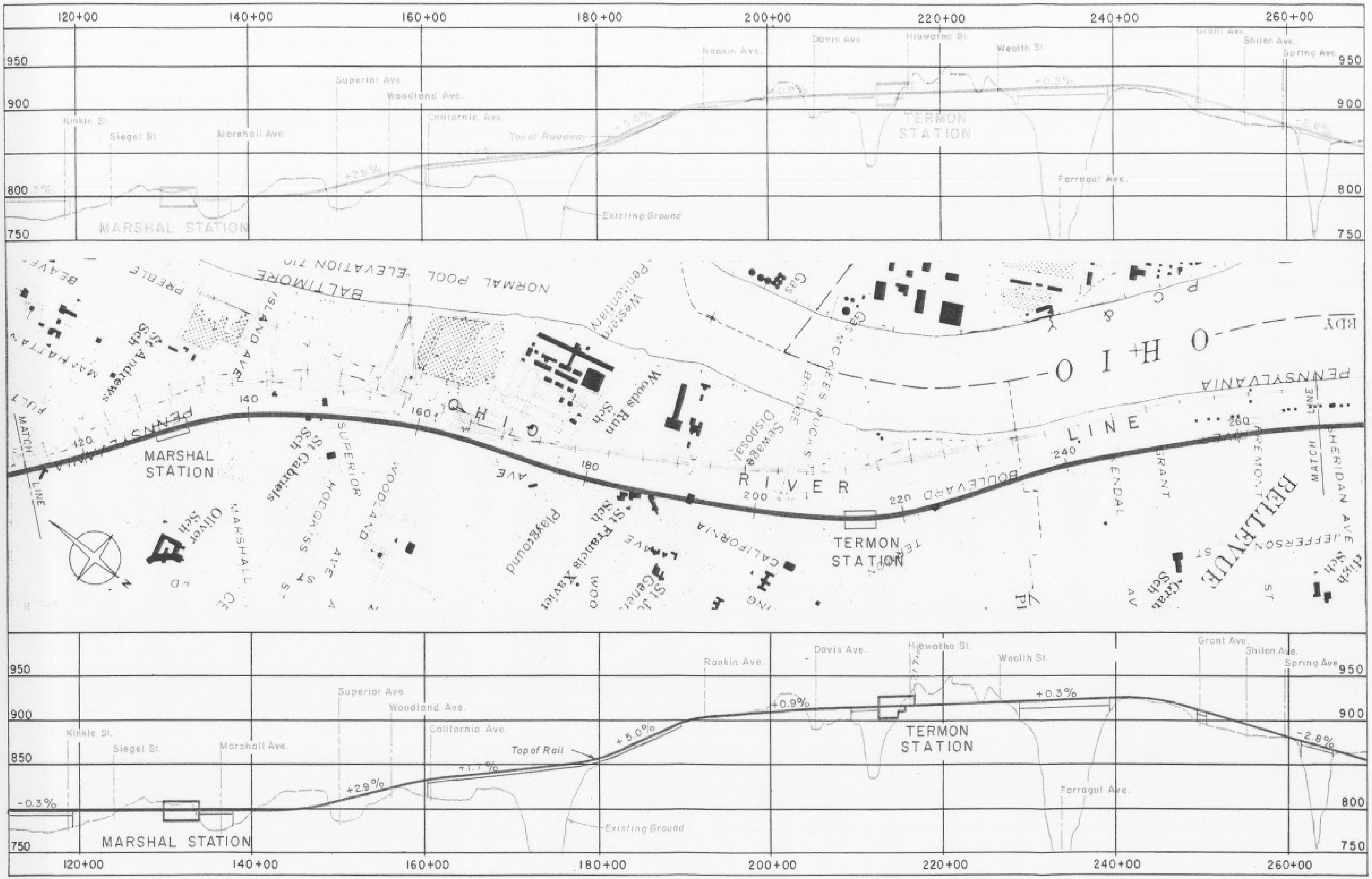
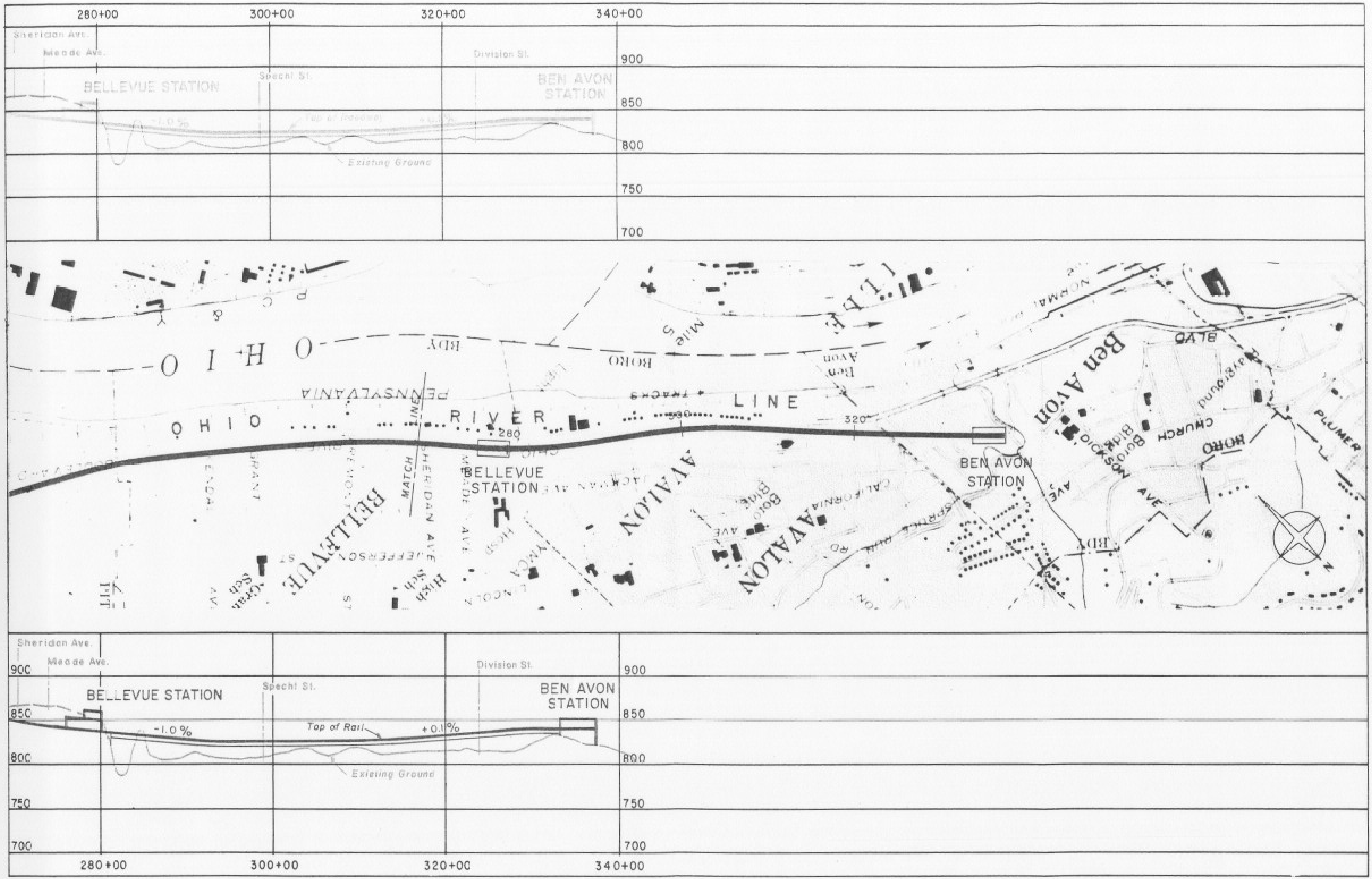
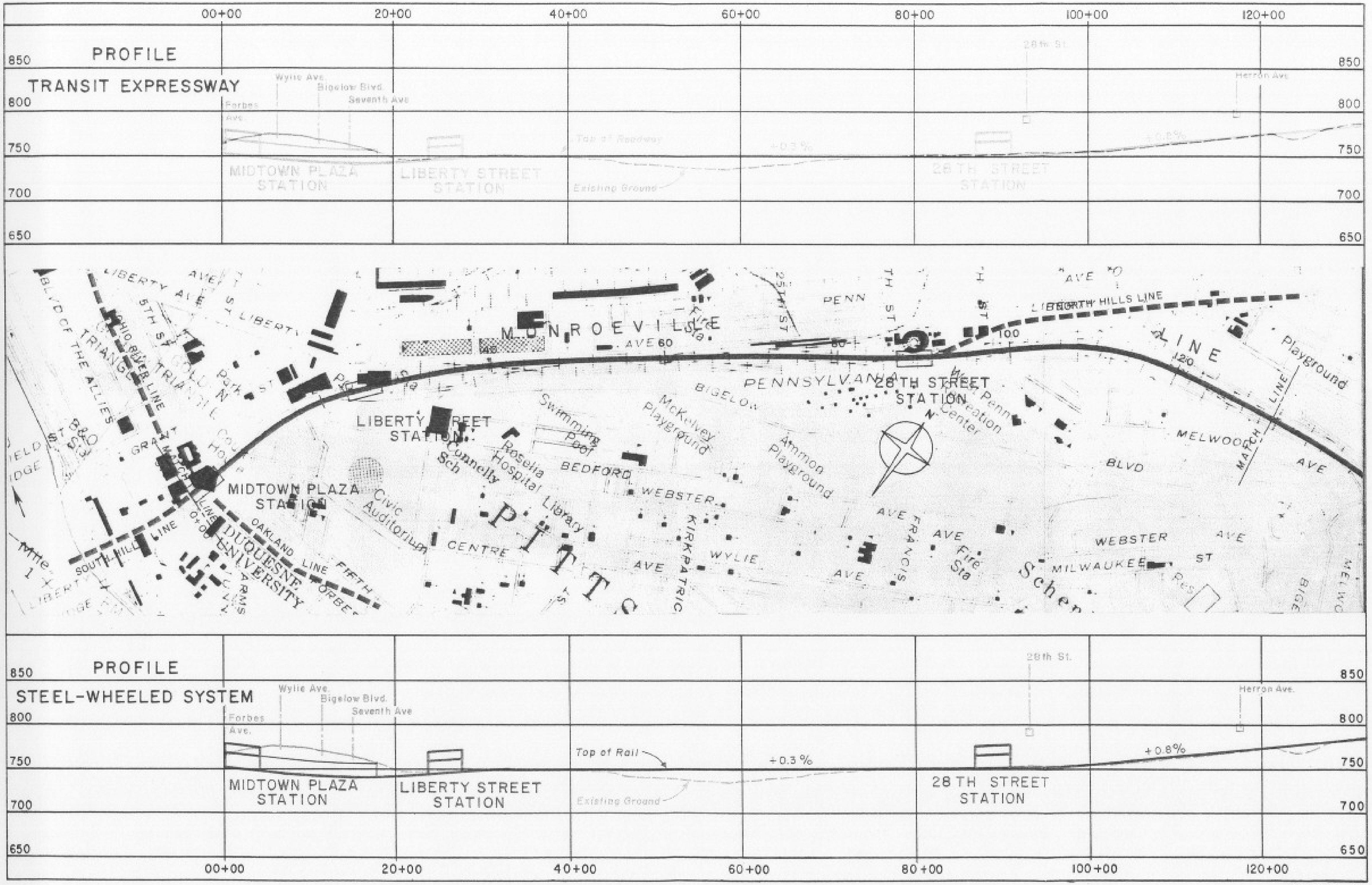

120+00
140+00
160+00
180+00
200+00
220+00
240+00
260+00
950
900
800
750
Kinkle St.
Siegel St.
Marshall Ave.
Superior Ave.
Woodland Ave.
California Ave.
Top of Roadway
Rankin Ave.
Davis Ave.
Hiawatha St.
Wealth St.
Grant Ave.
Shilon Ave.
Spring Ave.
Farragut Ave.
Existing Ground
MARSHAL STATION
TERMON STATION
+2.9%
+5.0%
+0.9%
+0.3%
-2.8%
NORMAL POOL ELEVATION 710
BALTIMORE
PREBLE
ISLAND AVE
St Andrews Sch
MANHATTAN
MATCH LINE
PENNSYLVANIA
MARSHAL STATION
St Gabriels Sch
SUPERIOR
HODGKISS
WOODLAND
Oliver Sch
MARSHALL
Playground
Western Penitentiary
Woods Run Sch
St Francis Xavier Sch
OHIO
RIVER
Sewage Disposal
MC KEES ROCKS BRIDGE
Gas
CALIFORNIA
TERMON STATION
BOULEVARD
LINE
O H I O
PENNSYLVANIA
KENDAL
GRANT
BELLEVUE
FREMONT
SHERIDAN AVE
JEFFERSON
High Sch
Grant Sch
MATCH LINE
RDY
P
950
900
850
800
750
Kinkle St.
Siegel St.
Marshall Ave.
Superior Ave.
Woodland Ave.
California Ave.
Top of Rail
Rankin Ave.
Davis Ave.
Hiawatha St.
Wealth St.
Grant Ave.
Shilon Ave.
Spring Ave.
Farragut Ave.
Existing Ground
-0.3%
+2.9%
+1.7%
+5.0%
+0.9%
+0.3%
-2.8%
MARSHAL STATION
TERMON STATION
120+00
140+00
160+00
180+00
200+00
220+00
240+00
260+00

Fig. IV - 8



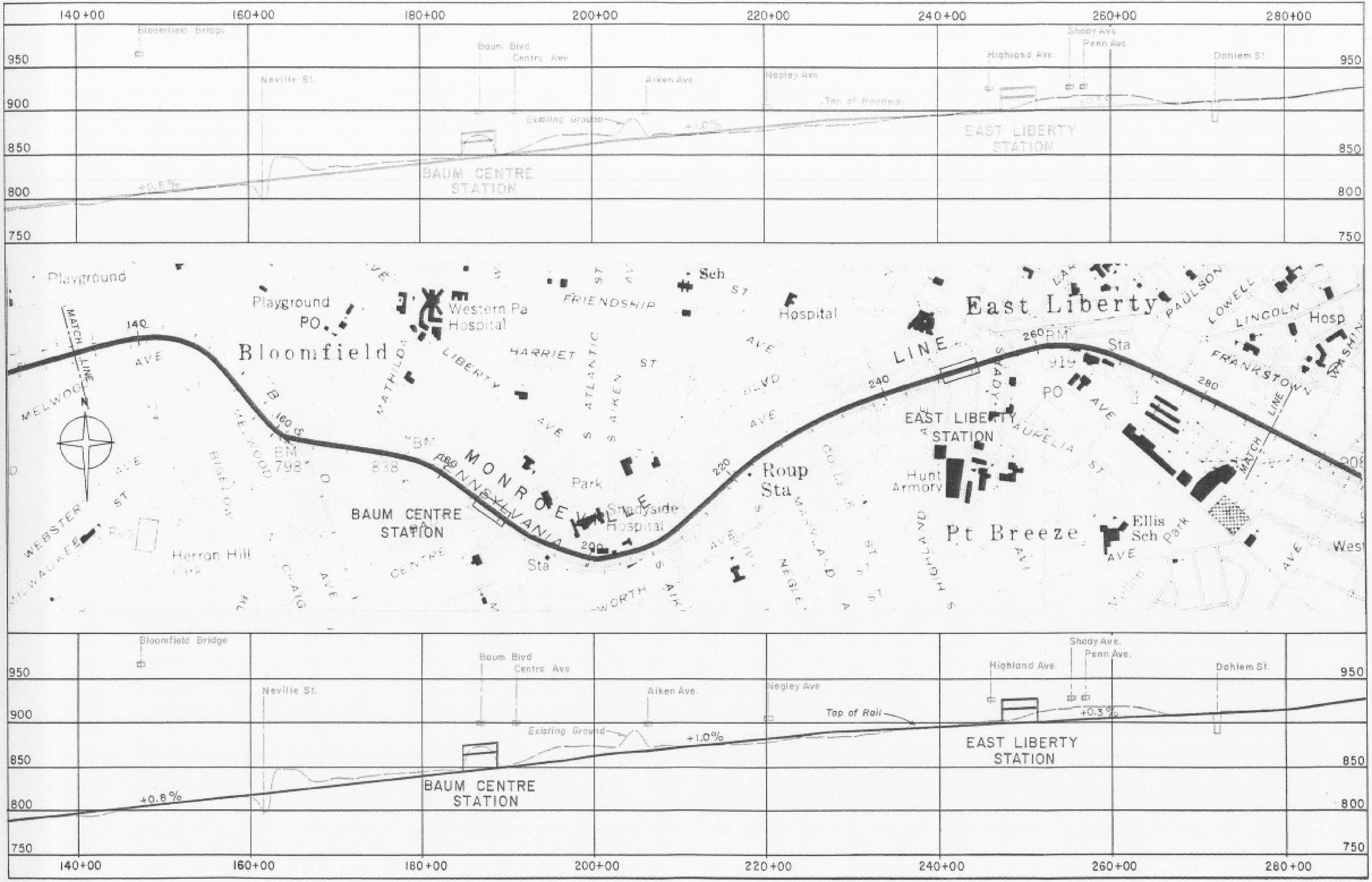
280+00
300+00
320+00
340+00
Sheridan Ave.
Meade Ave.
Specht St.
Division St.
BELLEVUE STATION
BEN AVON STATION
-1.0%
+0.1%
Top of Rail
Existing Ground
900
850
800
750
700
OHIO RIVER
PENNSYLVANIA
LINE
BORO
BDY
Ben Avon
BELLEVUE STATION
BEN AVON STATION
BELLEVUE
AVALON
Ben Avon
MATCH LINE
SHERIDAN AVE
MEADE AVE
JEFFERSON
CALIFORNIA
DICKSON AVE
CHURCH
PLUMER
BLVD
YMCA
LINCOLN
High Sch
Boro Bldg.
Mile 5

Fig. IV-9



PROFILE
TRANSIT EXPRESSWAY
00+00
20+00
40+00
60+00
80+00
100+00
120+00
850
800
750
700
650
Forbes Ave.
Wylie Ave.
Bigelow Blvd.
Seventh Ave
28th St.
Herron Ave.
Top of Roadway
Existing Ground
+0.3 %
+0.8%
MIDTOWN PLAZA STATION
LIBERTY STREET STATION
28 TH STREET STATION
LIBERTY AVE
5TH ST
OHIO RIVER LINE
GOLDEN TRIANGLE
BLVD OF THE ALLIES
GRANT
MIDTOWN PLAZA STATION
LIBERTY STREET STATION
DUQUESNE UNIVERSITY
OAKLAND LINE
SOUTH HILLS LINE
FIFTH
FORBES
MONROEVILLE
AVE
PENN
NORTH HILLS LINE
LINE
PENNSYLVANIA
28TH STREET STATION
BIGELOW
McKelvey Playground
Swimming Pool
Roselia Hospital
Connelly Sch
Library
Civic Auditorium
BEDFORD
WEBSTER
CENTRE
KIRKPATRICK
WYLIE
Ammon Playground
FRANCIS
Fire Sta
MELWOOD
BLVD
WEBSTER
MILWAUKEE
ST
Playground
MARCH LINE
PITTS
Mile 1
PROFILE
STEEL-WHEELED SYSTEM
Top of Rail
Existing Ground
+0.3 %
+0.8%
MIDTOWN PLAZA STATION
LIBERTY STREET STATION
28 TH STREET STATION

Fig. IV-10



140+00
160+00
180+00
200+00
220+00
240+00
260+00
280+00
950
900
850
800
750
Bloomfield Bridge
Neville St.
Baum Blvd
Centre Ave
Aiken Ave.
Negley Ave
Highland Ave.
Shady Ave.
Penn Ave.
Dahlem St.
Existing Ground
Top of Rail
+0.8%
+1.0%
+0.3%
BAUM CENTRE STATION
EAST LIBERTY STATION
Playground
Playground
PO
Bloomfield
Western Pa Hospital
FRIENDSHIP
HARRIET
LIBERTY
MATHILDA
ATLANTIC
AIKEN
Sch
ST
Hospital
AVE
BLVD
East Liberty
LINE
PAULSON
LOWELL
LINCOLN
Hosp
FRANKSTOWN
MATCH LINE
MELWOOD
WEBSTER
MILWAUKEE
Herron Hill Park
BIGELOW
CRAIG
CENTRE
MONROE
PENNSYLVANIA
Park
Shadyside Hospital
Sta
Roup Sta
Hunt Armory
Pt Breeze
Ellis Sch
AURELIA
HIGHLAND
NEGLEY
WORTH
BM 798
838
BM 919
140
160
180
200
220
240
260
280

Fig. IV-11

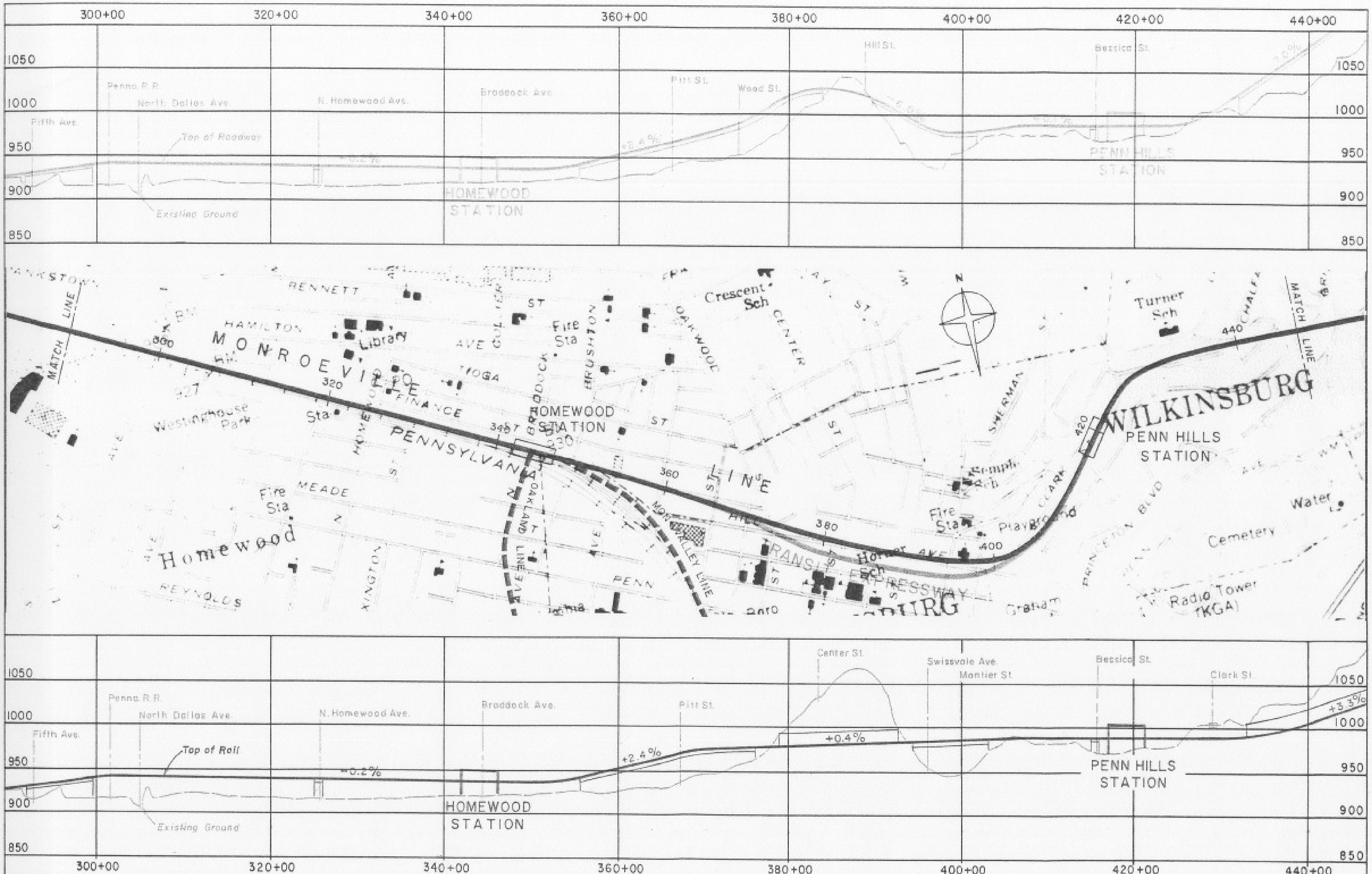

300+00
320+00
340+00
360+00
380+00
400+00
420+00
440+00
1050
1000
950
900
850
Penna. R.R.
North Dallas Ave.
Fifth Ave.
Top of Roadway
Existing Ground
N. Homewood Ave.
Braddock Ave.
HOMEWOOD STATION
Pitt St.
Wood St.
Hill St.
Bessico St.
PENN HILLS STATION
+2.4%
MATCH LINE
MONROEVILLE
Homewood
Westinghouse Park
Library
Fire Sta
HOMEWOOD STATION
PENNSYLVANIA
LINE
WILKINSBURG
PENN HILLS STATION
Crescent Sch
Turner Sch
Cemetery
Radio Tower (KGA)
Playground
Water
N
Top of Rail
+0.4%
+3.3%
-0.2%
Center St.
Swissvale Ave.
Mortier St.
Clark St.

Fig. IV-12

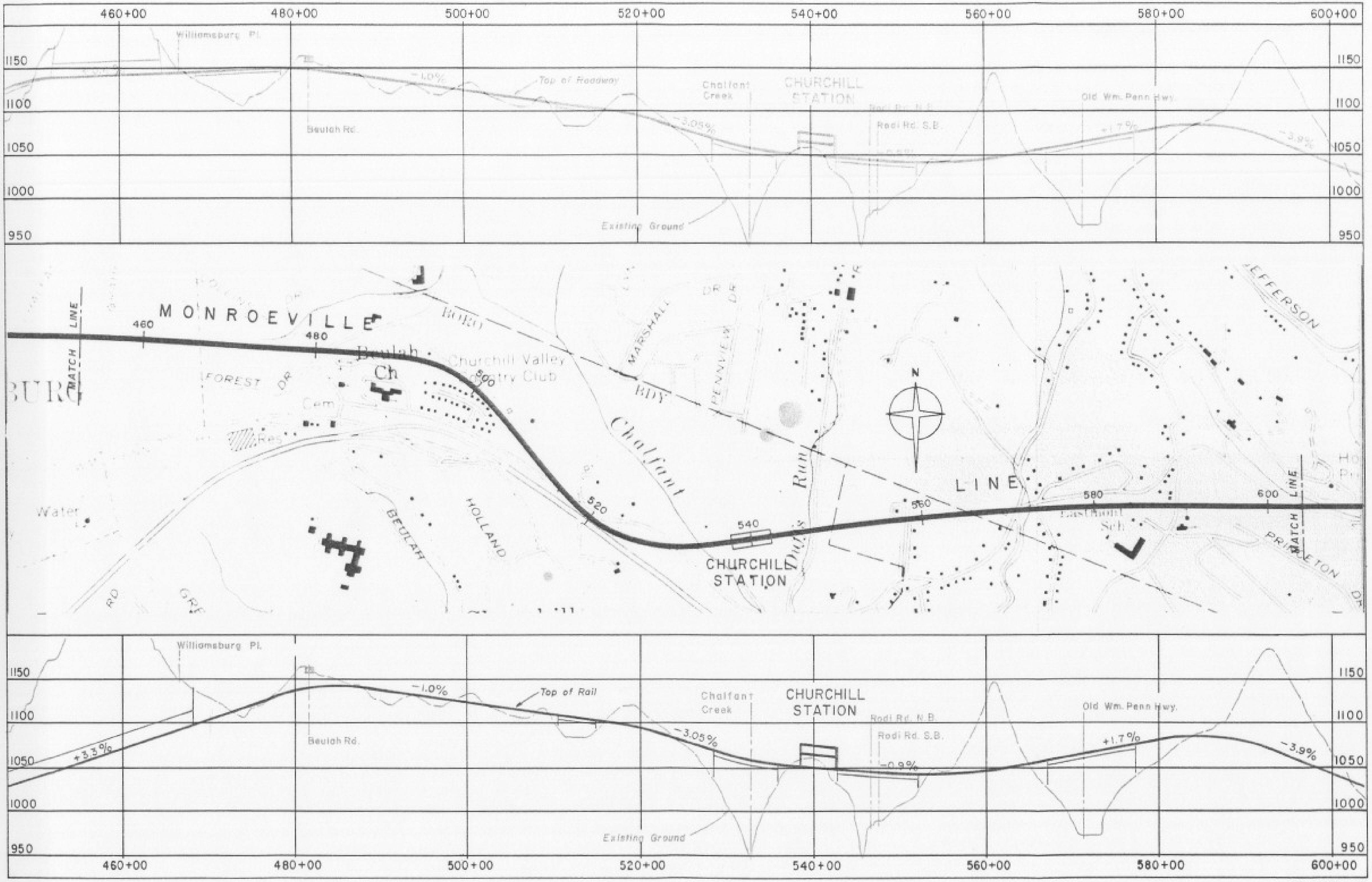

460+00
480+00
500+00
520+00
540+00
560+00
580+00
600+00
1150
1100
1050
1000
950
Williamsburg Pl.
Beulah Rd.
-1.0%
Top of Roadway
Chalfant Creek
CHURCHILL STATION
Rodi Rd. N.B.
Rodi Rd. S.B.
-3.05%
Old Wm. Penn Hwy.
+1.7%
-3.9%
Existing Ground
MATCH LINE
MONROEVILLE
460
480
500
520
540
560
580
600
Beulah
Ch
Churchill Valley Country Club
FOREST DR
Cem
Res
Water
BORO
BDY
MARSHALL
PENNVIEW DR
Chalfant
Run
BEULAH
HOLLAND
CHURCHILL STATION
LINE
N
JEFFERSON
PRINCETON DR
Top of Rail
+3.3%
-0.9%

Fig. IV-13

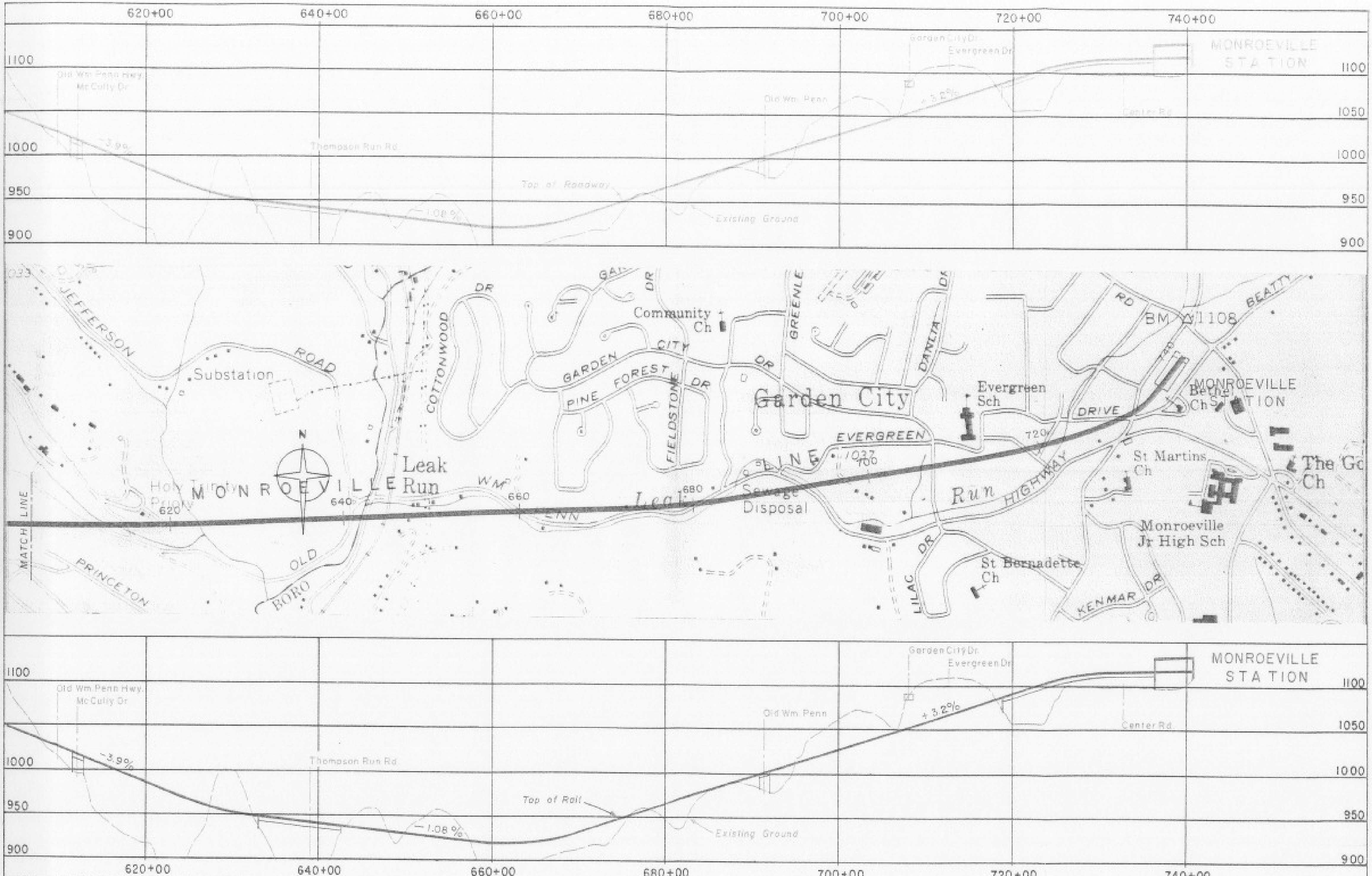
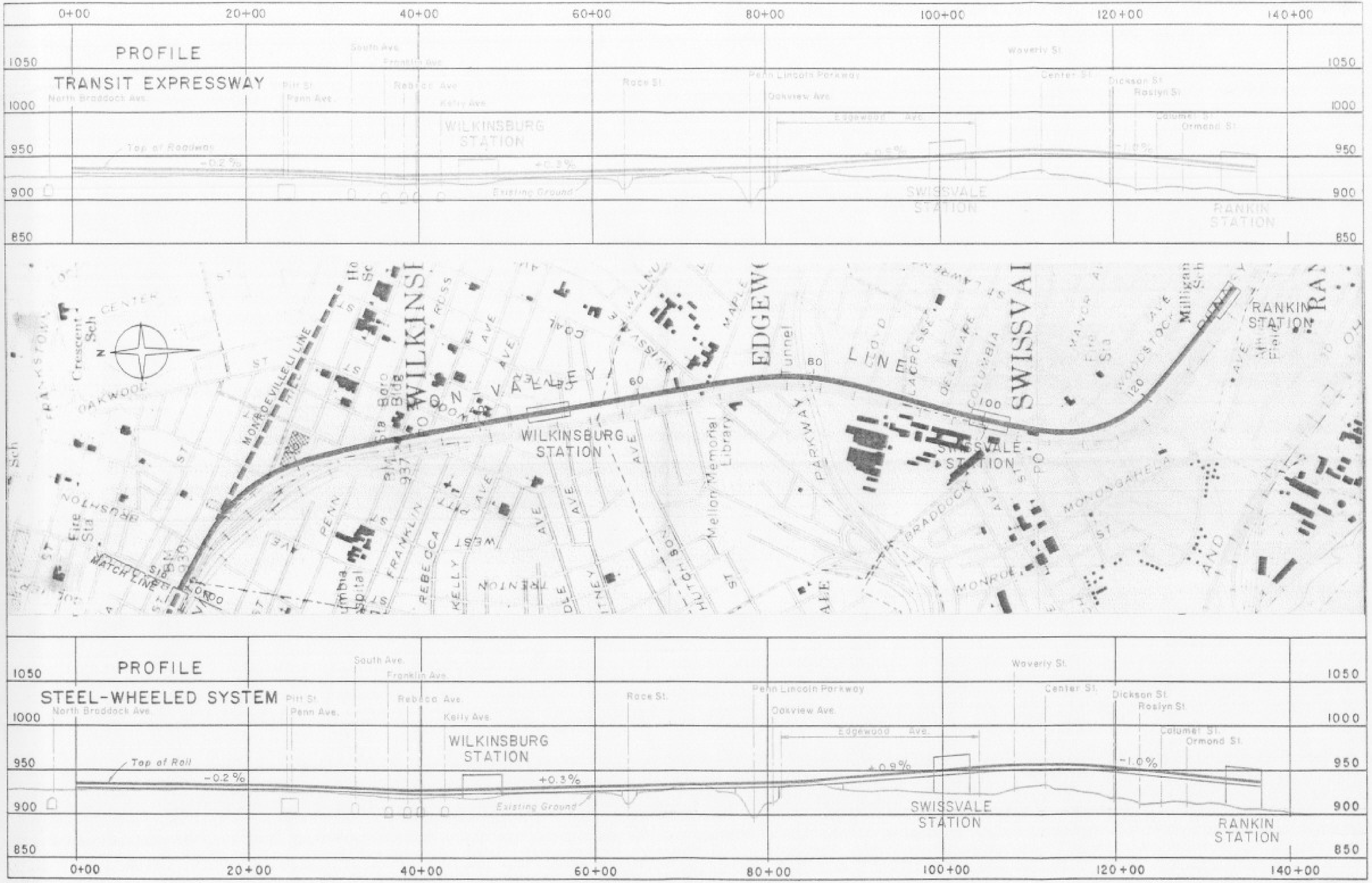
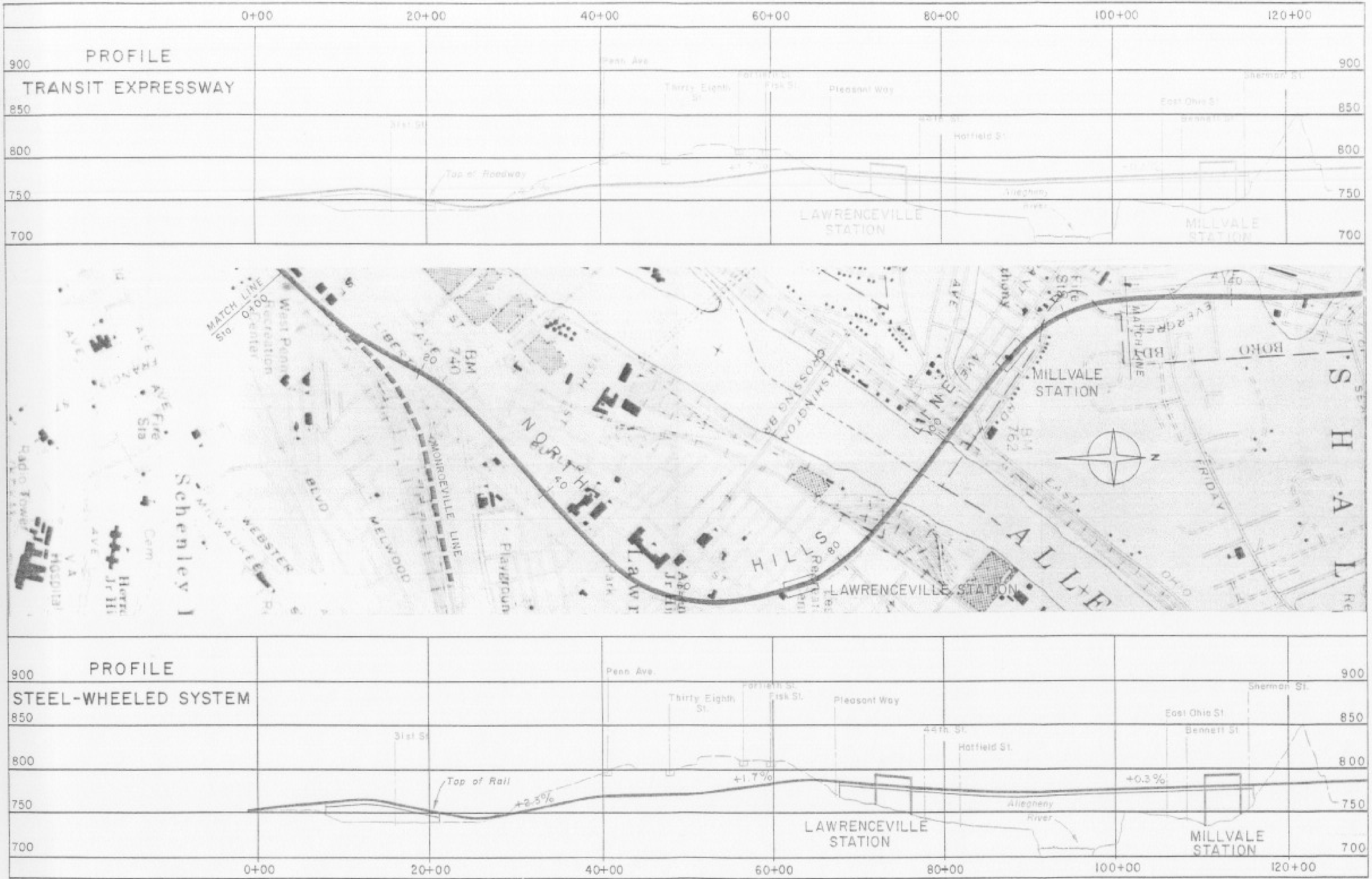

620+00
640+00
660+00
680+00
700+00
720+00
740+00
1100
1050
1000
950
900
MONROEVILLE STATION
Garden City Dr.
Evergreen Dr.
Old Wm Penn Hwy.
McCully Dr.
Old Wm Penn
Center Rd.
Thompson Run Rd.
Top of Roadway
Existing Ground
-3.9%
-1.08 %
+3.2%
JEFFERSON
ROAD
Substation
COTTONWOOD
DR
GARDEN
CITY
PINE
FOREST
FIELDSTONE
DR
Community Ch
GREENLE
DAHLIA
Garden City
EVERGREEN
Evergreen Sch
DRIVE
BM 1108
BEATTY
RD
MONROEVILLE STATION
Bethel Ch
St Martins Ch
The Go Ch
Monroeville Jr High Sch
St Bernadette Ch
KENMAR DR
LILAC DR
HIGHWAY
Run
Leak Run
Sewage Disposal
LINE
Holy Trinity Priory
MONROEVILLE
MATCH LINE
PRINCETON
OLD
BORO
WM
PENN
620
640
660
680
700
720
1037
N
Top of Rail
Existing Ground
-3.9%
-1.08 %
+3.2%

Fig. IV-14



PROFILE
TRANSIT EXPRESSWAY
WILKINSBURG STATION
SWISSVALE STATION
RANKIN STATION
Top of Roadway
Existing Ground
-0.2 %
+0.3 %
+0.9%
-1.0%
North Braddock Ave.
Pitt St.
Penn Ave.
South Ave.
Franklin Ave.
Rebecca Ave.
Kelly Ave.
Race St.
Penn Lincoln Parkway
Oakview Ave.
Edgewood Ave.
Waverly St.
Center St.
Dickson St.
Roslyn St.
Calumet St.
Ormond St.
MATCH LINE
PROFILE
STEEL-WHEELED SYSTEM
Top of Rail

Fig. IV-15



PROFILE
TRANSIT EXPRESSWAY
0+00
20+00
40+00
60+00
80+00
100+00
120+00
900
850
800
750
700
LAWRENCEVILLE STATION
MILLVALE STATION
Top of Roadway
MATCH LINE
Sta 0+00
MILLVALE STATION
LAWRENCEVILLE STATION
BM 740
BM 762
MONROEVILLE LINE
MELWOOD
BLVD
WEBSTER
MILWAUKEE
Schenley
HILLS
NORTH
FRIDAY
OHIO
EAST
WASHINGTON CROSSING BR
West Penn Recreation Center
V A Hospital
Playground
PROFILE
STEEL-WHEELED SYSTEM
Penn Ave.
Thirty Eighth St.
Fortieth St.
Fisk St.
Pleasant Way
31st St
44th St.
Hatfield St.
East Ohio St.
Bennett St.
Sherman St.
Top of Rail
+2.3%
+1.7%
+0.3%
Allegheny River
LAWRENCEVILLE STATION
MILLVALE STATION

Fig. IV-16

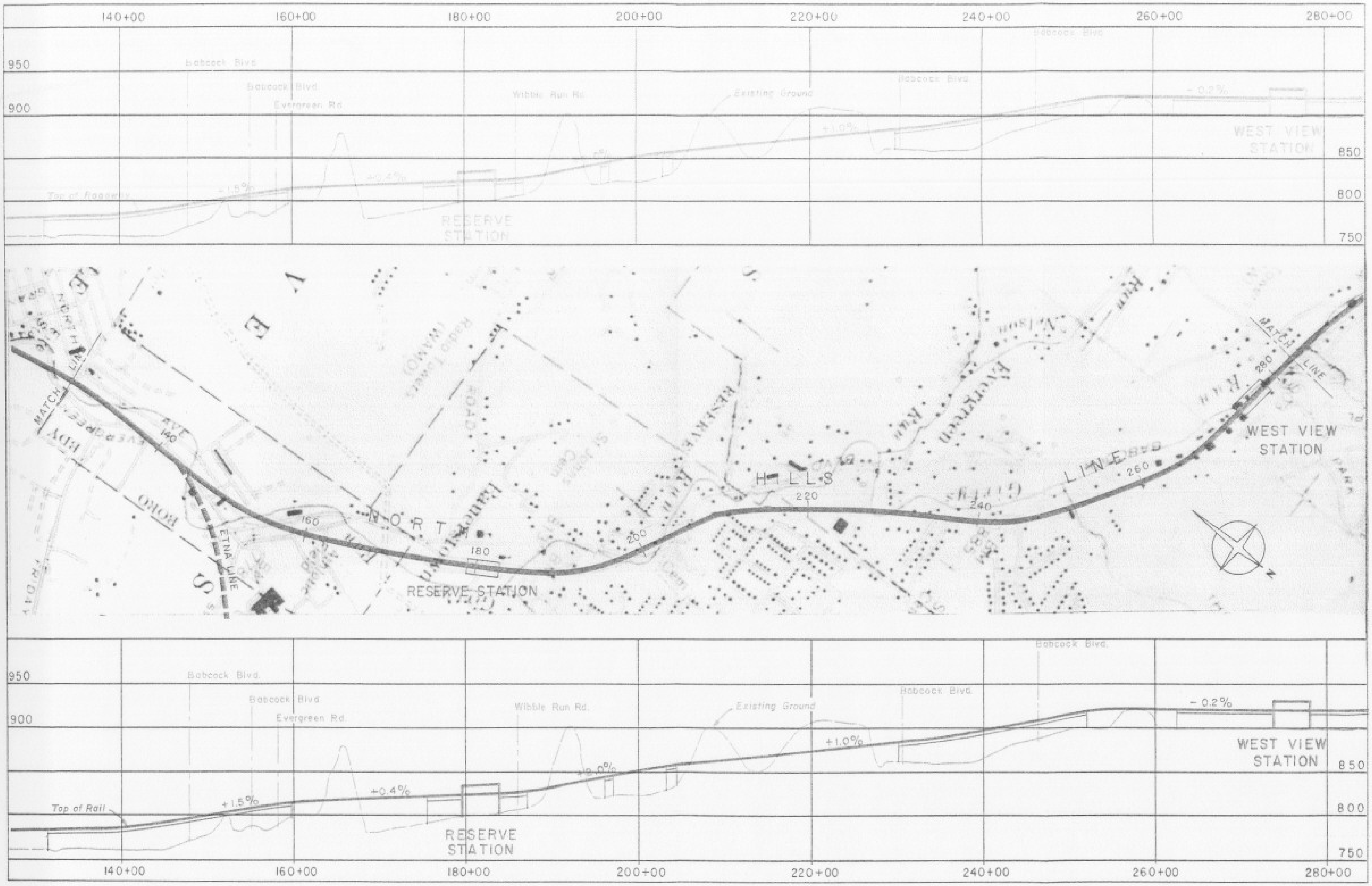
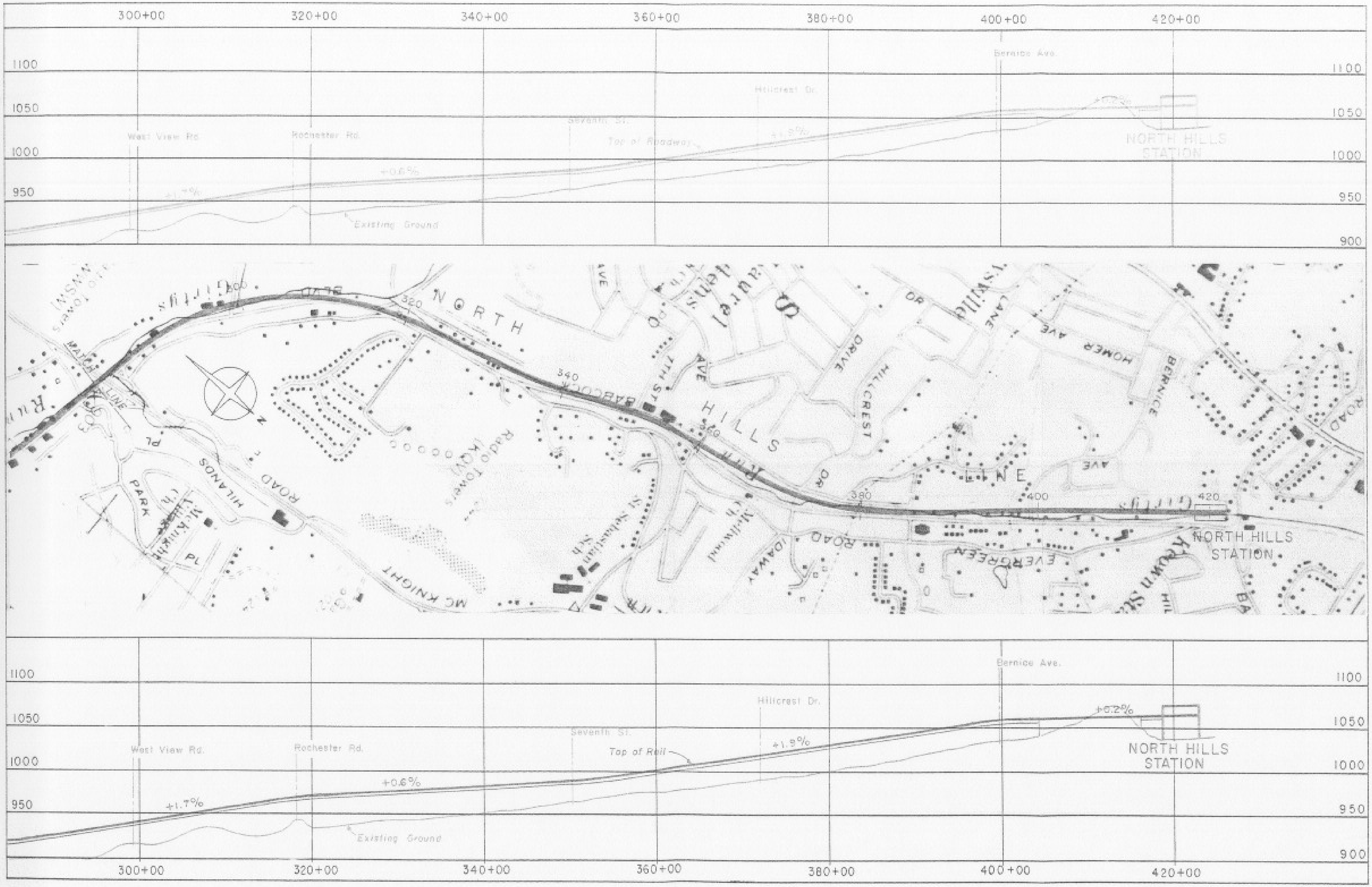

140+00
160+00
180+00
200+00
220+00
240+00
260+00
280+00
950
900
850
800
750
Babcock Blvd.
Babcock Blvd.
Evergreen Rd.
Wibble Run Rd.
Existing Ground
Babcock Blvd.
Babcock Blvd.
-0.2%
+1.0%
+0.4%
+1.5%
Top of Rail
RESERVE STATION
WEST VIEW STATION
MATCH LINE
ETNA LINE
NORTH HILLS
LINE
RESERVE STATION
WEST VIEW STATION
140
160
180
200
220
240
260
280

Fig. IV-17



300+00
320+00
340+00
360+00
380+00
400+00
420+00
1100
1050
1000
950
900
West View Rd.
Rochester Rd.
Seventh St.
Hillcrest Dr.
Bernice Ave.
+1.7%
+0.6%
+1.9%
+0.2%
Top of Roadway
Top of Rail
Existing Ground
NORTH HILLS STATION
NORTH HILLS LINE
BABCOCK
MATCH LINE
HILLCREST DRIVE
BERNICE AVE
HOMER AVE
EVERGREEN ROAD
IDAWAY
MC KNIGHT ROAD
HILANDS
PARK PL
7TH ST
Radio Towers (KQV)
St Sebastian Sch
Mellwood Ch
McKnight Village

Fig. IV-18


PROFILE
TRANSIT EXPRESSWAY
0+00
20+00
40+00
60+00
80+00
100+00
900
850
800
750
700
Emma St.
Evergreen Ave.
Hansen St.
Franklin St.
Seavy Rd.
Soose Rd.
+2.9%
-1.6%
Top of Roadway
Crescent St.
Existing Ground
ETNA STATION
ETNA
LINE
ETNA STATION
MILLVALE
SHALER
Cherry City
SEAVEY RD
PARKER
BORO BDY
BUTLER
KITTANNING
ROAD
Sharps Hill
St Marys Cem
Playground
All Saints Sch
DEWEY
MATCH LINE
NORTH HILLS LINK
PROFILE
STEEL-WHEELED SYSTEM
Emma St.
Evergreen Ave.
Hansen St.
Franklin St.
Seavy Rd.
Soose Rd.
+2.9%
-1.6%
Top of Rail
Crescent St.
Existing Ground
ETNA STATION

Fig. IV-19

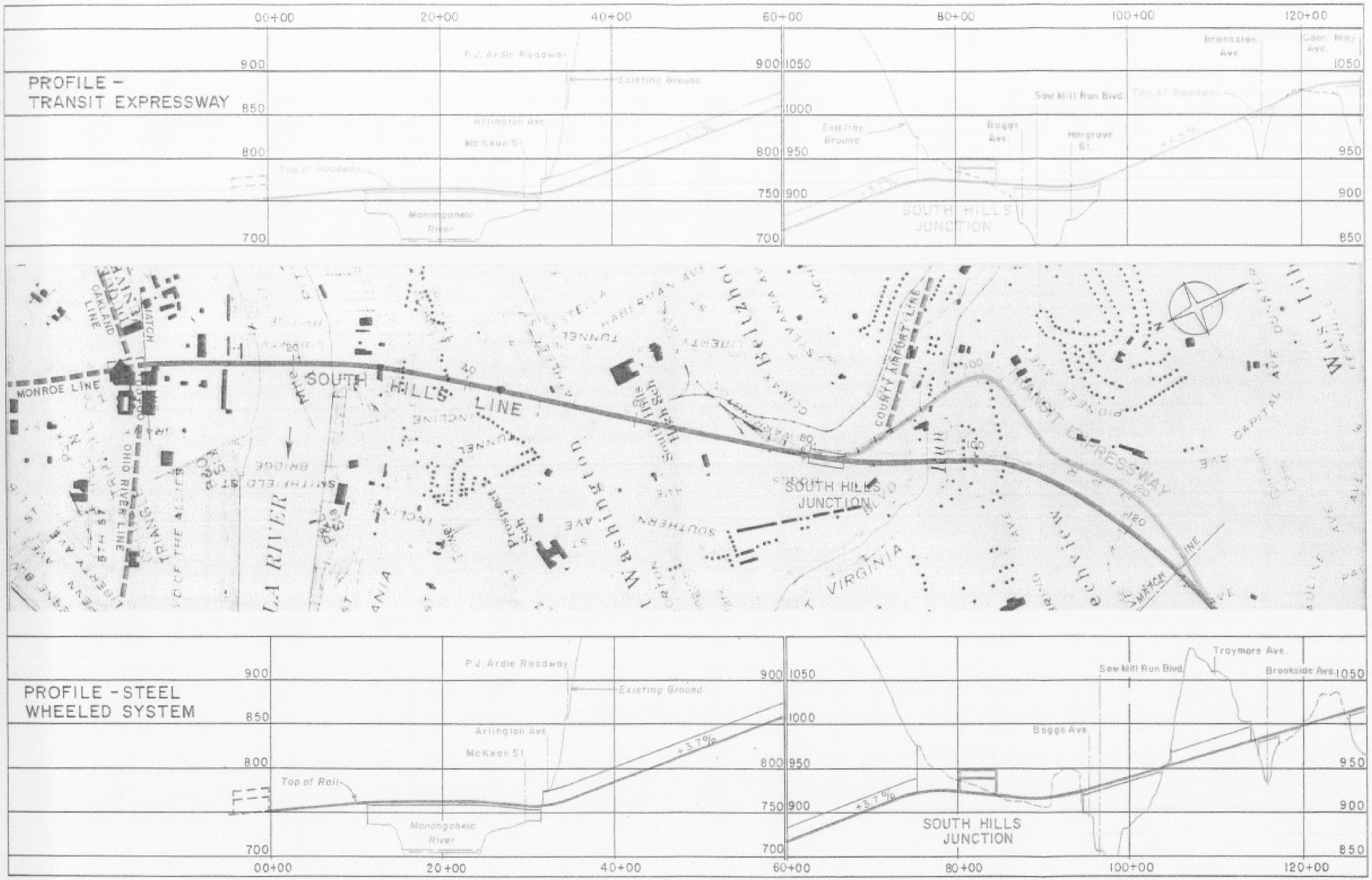
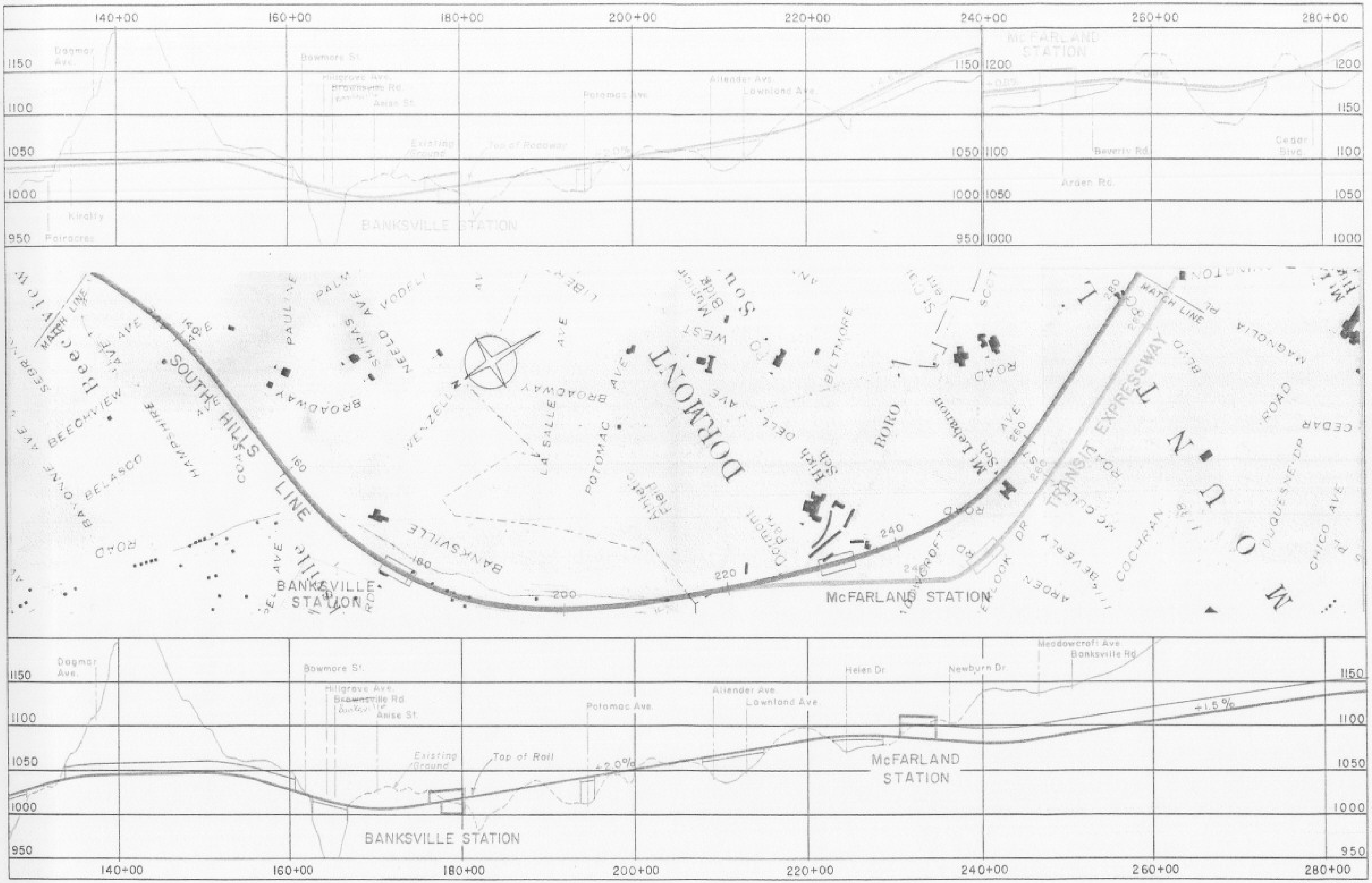

PROFILE - TRANSIT EXPRESSWAY
P.J. Ardie Roadway
Existing Ground
Arlington Ave
McKean St
Top of Roadway
Monongahela River
Existing Ground
Boggs Ave.
Hargrove St.
Saw Mill Run Blvd.
Brookside Ave.
SOUTH HILLS JUNCTION
MONROE LINE
OAKLAND LINE
OHIO RIVER LINE
SOUTH HILLS LINE
COUNTY AIRPORT LINE
TRANSIT EXPRESSWAY
SOUTH HILLS JUNCTION
VIRGINIA
SOUTHERN
PROFILE - STEEL WHEELED SYSTEM
P.J. Ardie Roadway
Existing Ground
Arlington Ave
McKean St
Top of Rail
+3.7%
Monongahela River
Boggs Ave
Saw Mill Run Blvd.
Traymore Ave.
Brookside Ave.
SOUTH HILLS JUNCTION

Fig. IV-20



140+00
160+00
180+00
200+00
220+00
240+00
260+00
280+00
1150
1100
1050
1000
950
1200
McFARLAND STATION
Dagmar Ave.
Bowmore St.
Hillgrove Ave.
Brownsville Rd.
Anise St.
Potomac Ave.
Allender Ave.
Lownland Ave.
Existing Ground
Top of Roadway
+2.0%
Beverly Rd.
Cedar Blvd.
Arden Rd.
Kiralfy
Fairacres
BANKSVILLE STATION
SOUTH HILLS LINE
MATCH LINE
BEECHVIEW
BELASCO
BAYONNE AVE
HAMPSHIRE
COAST
PAULINE
SHIRAS AVE
NEELD
BROADWAY
WENZELL
LA SALLE AVE
POTOMAC AVE
DORMONT
BILTMORE
DELL AVE
WEST
BORO
Mt. Lebanon
TRANSIT EXPRESSWAY
MAGNOLIA
CEDAR
DUQUESNE DR
CHICO AVE
COCHRAN
BEVERLY
ARDEN
MEADOWCROFT
ROAD
BANKSVILLE
160
180
200
220
240
260
280
BANKSVILLE STATION
McFARLAND STATION
Dormont Park
Helen Dr.
Newburn Dr.
Meadowcroft Ave
Banksville Rd.
Top of Rail
+1.5%

Fig. IV-21

SOUTH HILLS LINE
TRANSIT EXPRESSWAY
MT. LEBANON STATION
CASTLE SHANNON STATION
BETHEL STATION
Washington Junction
Hillcrest
MATCH LINE
Existing Ground
Top of Rail
Mt. Lebanon Blvd.
McCully Rd.
Connor Rd.
Poplar Pl.
-3.0%
-0.6%
+1.3%
+1.0%
+2.8%
+1.5%
300+00
320+00
340+00
360+00
380+00
400+00
420+00
440+00
1200
1150
1100
1050
1000

Fig. IV-22

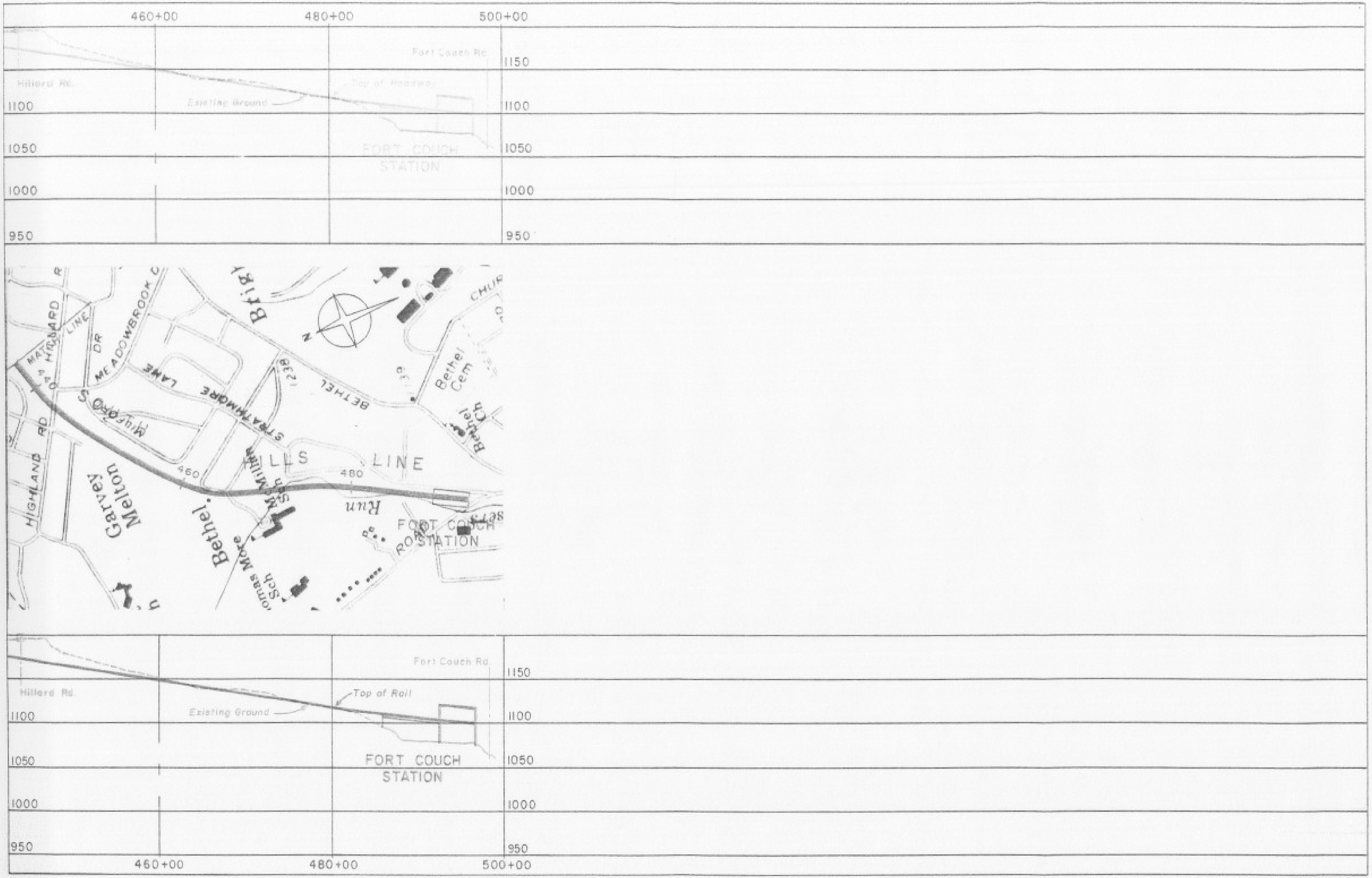

460+00
480+00
500+00
Fort Couch Rd.
Hillard Rd.
Existing Ground
Top of Rail
FORT COUCH
STATION
1150
1100
1050
1000
950
HIGHLAND RD
MEADOWBROOK
STRATHMORE
LANE
BETHEL
HILLS
LINE
Garvey
Melton
Bethel
Run
Bethel Cem
440
460
480

Fig. IV-23

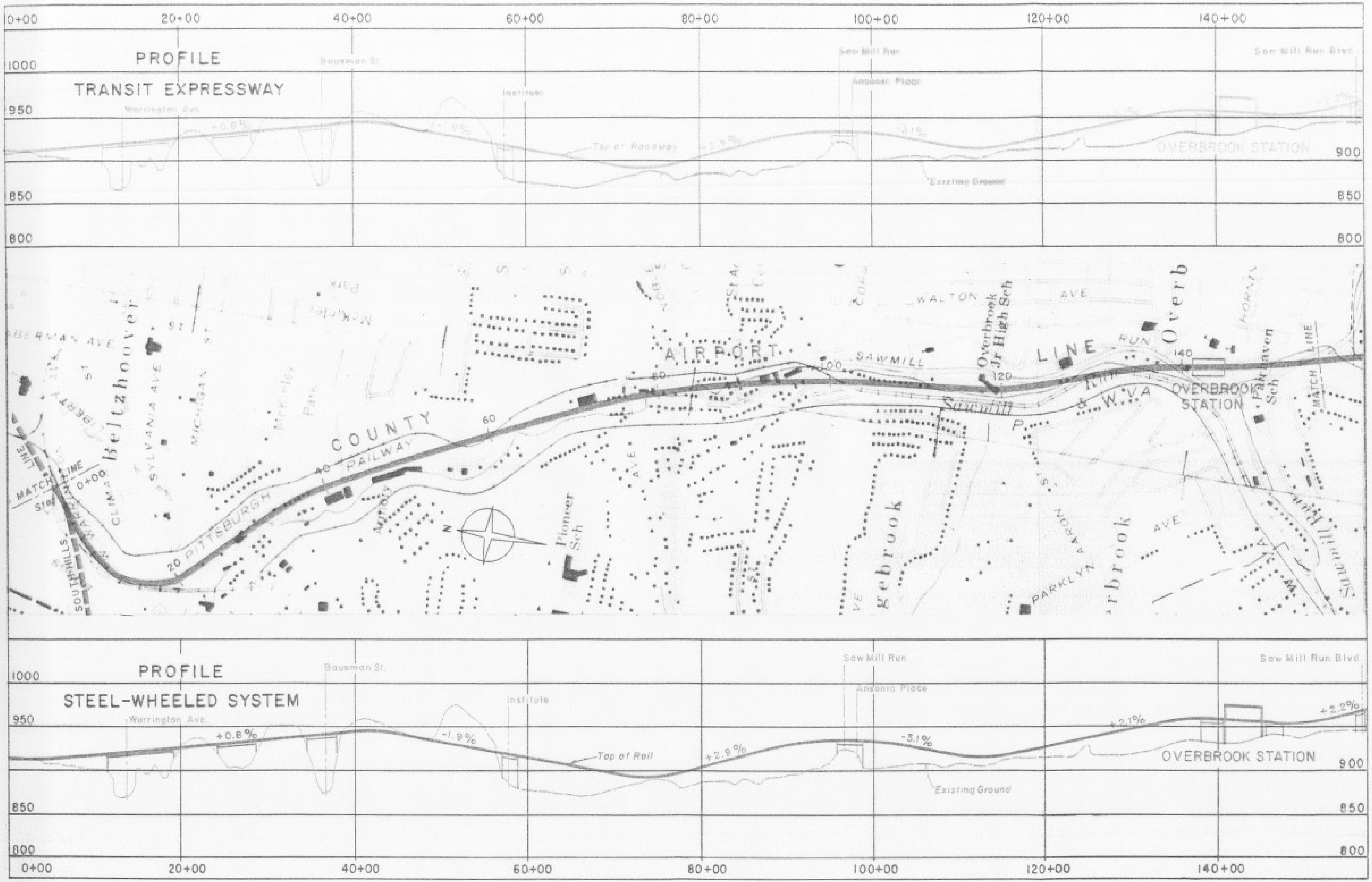

PROFILE
TRANSIT EXPRESSWAY
Bausman St.
Warrington Ave.
Institute
Saw Mill Run
Ansonia Place
Saw Mill Run Blvd.
+0.8%
-1.9%
Top of Roadway
+2.9%
-3.1%
Existing Ground
OVERBROOK STATION
AIRPORT
SAWMILL
LINE
RUN
COUNTY
RAILWAY
PITTSBURGH
OVERBROOK STATION
MATCH LINE
Pioneer Sch
Overbrook Jr High Sch
WALTON AVE
P. & W. VA.
PARKLYN
AVE
PROFILE
STEEL-WHEELED SYSTEM
Bausman St.
Warrington Ave.
Institute
Saw Mill Run
Ansonia Place
Saw Mill Run Blvd.
+0.8%
-1.9%
Top of Rail
+2.9%
-3.1%
+2.1%
+2.2%
Existing Ground
OVERBROOK STATION
0+00
20+00
40+00
60+00
80+00
100+00
120+00
140+00
1000
950
900
850
800

Fig. IV-24

160+00
180+00
200+00
220+00
240+00
260+00
280+00
300+00
1150
1100
1050
1000
950
Brownsville Rd.
Wyman Rd.
Curry Rd.
Streets Run Rd.
Brownsville Rd.
Top of Rail
+1.7 %
+3.5 %
+2.1 %
Existing Ground
BROWNSVILLE ROAD STATION
STREETS RUN STATION
MATCH LINE
COUNTY
AIRPORT
LINE
PITTSBURGH
WHITEH
BALD
ARLYN
RD
ADOBE RD
OVERLAND
SOM RD
160
180
200
220
240
260
280
300

Fig. IV-25

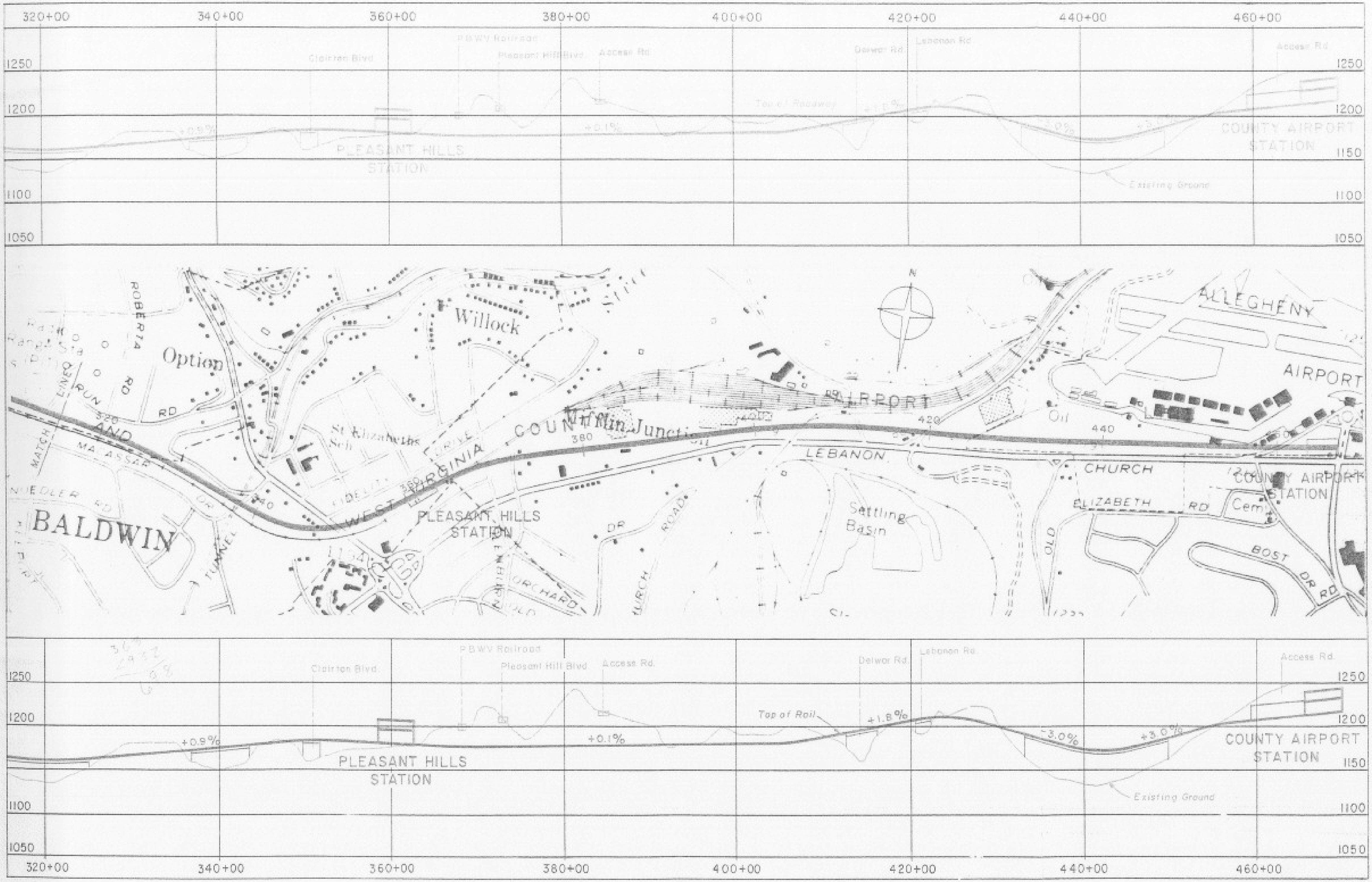

320+00
340+00
360+00
380+00
400+00
420+00
440+00
460+00
Clairton Blvd.
P B W V Railroad
Pleasant Hill Blvd.
Access Rd.
Delwar Rd.
Lebanon Rd.
Access Rd.
Top of Rail
+0.9%
+0.1%
+1.8%
-3.0%
+3.0%
PLEASANT HILLS STATION
COUNTY AIRPORT STATION
Existing Ground
1250
1200
1150
1100
1050
Willock
Option
BALDWIN
ALLEGHENY
AIRPORT
LEBANON
CHURCH
ELIZABETH RD
Settling Basin
Cem.
BOST DR
ORCHARD
WEST VIRGINIA
N

Fig. IV-26

V. STAGING AND PRIORITIES

Implementation of a regional rapid transit system for Allegheny County must of necessity require a considerable number of years. The 60-mile system described in the foregoing chapter is a project of great complexity involving an investment of three quarters of a billion dollars at current cost levels for right-of-way and fixed construction. Financing costs will add measurably to this figure and in addition rising construction costs must be taken into consideration.

This report summarizes the results of a study the purpose of which was to establish the general feasibility of a regional rapid transit system, to identify a practicable configuration for the system, and to identify the cost of fixed construction, expected patronage, revenues, and operating costs.

It is essential for the continued growth and economic development of the community to develop and adopt a long-range transportation program, including highways, rapid transit, and supporting transit service. Further, it is necessary to determine the public issues and goals in transportation preference, the financial capacity to provide rapid transit, and the community acceptance and extent of commitment to aerial construction.

Before construction of a rapid transit system for Allegheny County can be started, it is recognized that many steps must be taken by the Port Authority and responsible leaders in the community. First, a long-range system which is consistent with the goals and projected development of the area must be adopted. Following this, an initial project that could be operated as a viable first stage of the system, and that would offer a significant reduction in highway congestion should be selected. At the time the initial project is selected, a financing program should be developed and accepted so that a decision on construction of the system can be made in accordance with the availability of funds. However, in the interim, the present bus system can be expanded to newly-developed residential areas and connect to express bus service on major freeways. An aggressive program for construction of major parking facilities adjacent to freeways on future rapid transit station sites would encourage greater transit use and would help develop transit corridors in advance of the rapid transit system.

Since the Port Authority has proceeded with the demonstration project of the Transit Expressway in the South Hills corridor, no decision will be made on the type of system to be used for the regional rapid transit system in the near future. Once this decision is made, however, it will be necessary to determine an initial project consistent with the long range system to be adopted by the Port Authority. In order to assist in this determination, the 60-mile system has been analyzed by the Consultant and a general staging program for the regional system has been developed.

Factors Considered

Ultimately, the regional system will serve the major travel corridors in Allegheny County and provide service to those sections of the County that are expected to be urbanized by 1985. The procedures used in developing the 60-mile system from the more extensive 92-mile Test System provide for the possibility of extending these lines further into the County if development progresses at a more rapid rate than anticipated.

The patronage expected for the proposed system was estimated at the current level — if the system were in operation today — and at the 1985 level. The station-to-station passenger volumes were analyzed and were taken into consideration in determining the staging. Destinations in the CBD were a prime factor in selecting the initial phases of the system; however, these had to be considered within the framework of operations.

The estimated construction costs for both the basic steel-wheeled system and the Transit Expressway rubber-tired system were summarized by station-to-station increments so that the cost of various line segments could be determined. The estimated costs of the suggested stages are, therefore, shown for both types of systems.

Staging of a rapid transit system as outlined in the following pages would permit useable sections of the lines to be placed in service as they are constructed. Provision would have to be included in the initial stages for yards, shops and turn-backs so that the system could be operated as a complete entity. As the system is increased and extended, operations will have to be adjusted to fit both the needs and the increased capacity. Feeder bus service will similarly have to be adjusted and rerouted to adapt to the incremental growth of the system.

Description of Stages

Figure V-1 shows the five suggested stages for implementation of the 60-mile system which were developed after consideration of the factors described above. The table following indicates the limits of the various stages by station-to-station segments, the mileage included, and the estimated construction and right-of-way cost at today's level of costs for both the steel-wheeled and rubber-tired Transit Expressway Systems.

No specific target years have been indicated since a detailed schedule cannot be determined until a system has been adopted and a financing program developed. Preoperating costs of $7 million have been added to Stage I to cover such items as training of personnel, system component testing, and administration of the rapid transit system prior to revenue service.

	Length (miles)	Estimated Cost Steel-wheeled System	Estimated Cost Transit Expressway System
Stage I			
Midtown Plaza to Churchill	10.3	$120,900,000	$115,800,000
Midtown Plaza to Pleasant Hills	8.5	82,800,000	83,700,000
Preoperating costs		7,000,000	7,000,000
Total	18.8	210,700,000	206,500,000
Stage II			
28th Street to North Hills	8.0	75,400,000	74,300,000
S. Hills Jct. to Ft. Couch	7.8	97,000,000	83,300,000
Total	15.8	172,400,000	157,600,000
Stage III			
Midtown Plaza to Homewood	6.3	149,400,000	143,100,000
Midtown Plaza to Termon	4.1	78,400,000	78,700,000
Total	10.4	227,800,000	221,800,000
Stage IV			
Homewood to Rankin	2.6	32,500,000	31,300,000
Termon to Ben Avon	2.3	35,100,000	35,100,000
Churchill to Monroeville	3.7	23,300,000	24,300,000
Pleasant Hills to County Airport	2.0	17,385,000	17,700,000
Total	10.6	108,300,000	108,400,000
Stage V			
Millvale to Etna	1.7	24,800,000	24,900,000
Banksville to Carnegie	2.8	37,500,000	27,100,000
Total	4.5	62,300,000	52,000,000

A brief description of the components of the various stages and the items of major interest are discussed in the following sections.

Stage I. Stage I comprises the Monroeville Line - Midtown Plaza to Churchill; the South Hills Line - Midtown Plaza to South Hills Junction; and the County Airport Line - South Hills Junction to Pleasant Hills.

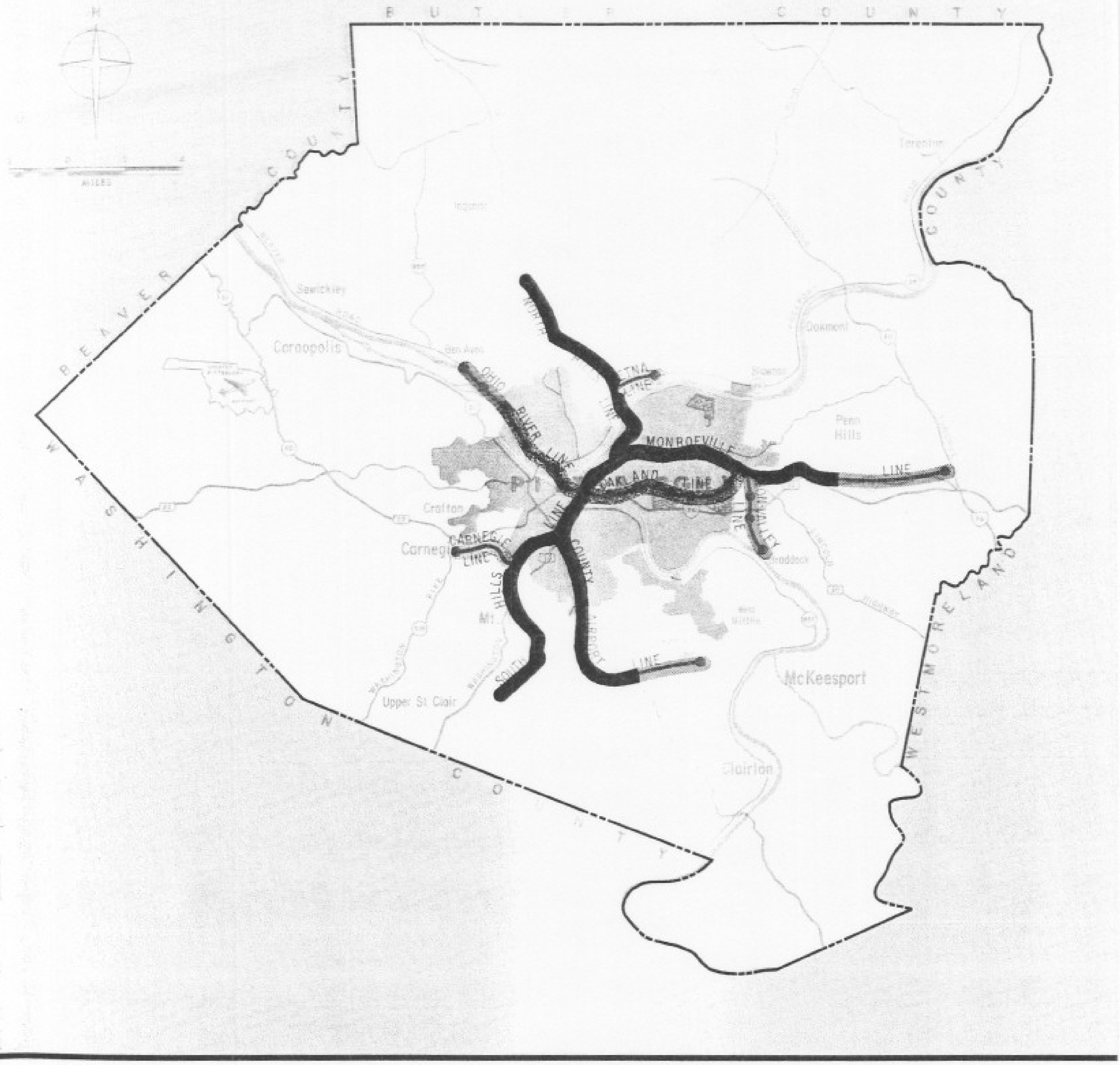
The Monroeville Line extends from the CBD to Churchill, following the Pennsylvania Rail Road right-of-way as far as Homewood. It serves the communities of East Liberty, Wilkinsburg, and intercepts traffic bound for the Pittsburgh CBD on the Parkway East at the Churchill Station. On this line in the vicinity of Homewood the major yards and shops, as well as the Administrative Building for the Allegheny County rapid transit system, could be located. The extension of this line to Monroeville would be accomplished in Stage IV.

The section of the South Hills Line as far as South Hills Junction and the County Airport Line to Pleasant Hills serves the important transit corridor to the southeast. The traffic on Routes 88 and 51 are intercepted at Overbrook Station - presently a station on the Castle Shannon streetcar line - and at Pleasant Hills, respectively. It is important to note that streetcar service to Beechview, Dormont and Mt. Lebanon, through the Mt. Washington trolley tunnel, can remain in service during this stage of construction. This line would be extended to the County Airport in Stage IV.

With the completion of Stage I, the Pittsburgh CBD would be served by two stations, Midtown Plaza and Liberty, located at the base of the Triangle between Grant Street and the Crosstown Boulevard. Transit service to the lower Triangle would be provided by buses until completion of the CBD system in Stage III.

Stage II. Stage II comprises the North Hills Line - 28th Street to North Hills, and the South Hills Line - South Hills Junction to Fort Couch.

The North Hills Line intercepts Route 28 traffic at Millvale Station and McKnight Road traffic at Westview Station. The line would serve a rapidly growing residential area with stations located along the Babcock Boulevard-Evergreen Road corridor. The portion of the South Hills Line in Stage II serves many of the residential areas presently served by the only remaining trolley lines in Allegheny County. The line also intercepts Route 19 traffic at Banksville and McFarland Stations and serves the Washington Road corridor.



ALLEGHENY COUNTY RAPID TRANSIT STUDY

LEGEND

- STAGE I
- STAGE II
- STAGE III
- STAGE IV
- STAGE V
- HIGHWAY AND ARTERIAL STREET

CONSTRUCTION STAGING 60-MILE RAPID TRANSIT SYSTEM

Fig. V-1

Stage III. Stage III comprises the Oakland Line - Midtown Plaza to Homewood, and the Ohio River Line - Midtown Plaza to Termon.

The Oakland Line serves the densely-populated urban residential areas of Oakland and Squirrel Hill, as well as the cultural, educational and medical complexes within these areas. At its terminus, a transfer to the Monroeville Line can be provided by means of a common station at Homewood. Access to the yards and shops is also provided for vehicles on the Urban Line.

The Ohio River Line serves the lower portion of the triangle - thus completing the Pittsburgh CBD system and the Allegheny Center development and proposed stadium. The Termon Station intercepts Ohio River Boulevard traffic and serves the residential areas to the northwest. Also served by this station are McKees Rocks and surrounding areas across the Ohio River. The remaining portion of the Urban System would be undertaken in Stage IV.

Stage IV. Stage IV comprises the Mon Valley Line - Homewood to Rankin; the Ohio River Line - Termon to Ben Avon; the Monroeville Line - Churchill to Monroeville; and the County Airport Line - Pleasant Hills to County Airport.

The Mon Valley Line serves the residential communities of Edgewood and Swissvale and provides an interface with bus service to the Monongahela Valley industrial areas in the vicinity of Rankin, Braddock, Homestead, Turtle Creek and McKeesport. The portion of the Ohio River Line completes the Urban System and serves directly the area of Bellevue and Ben Avon. The extension of the Monroeville Line provides direct service to the Monroeville area and has the capability of intercepting Route 22 and Pennsylvania Turnpike traffic destined for the areas served by the rapid transit system. The extended County Airport Line intercepts Lebanon Church Road traffic from McKeesport and provides for an interface with other transportation modes to serve the industrial areas to the east.

Stage V. Stage V comprises the Etna Line - Millvale to Etna, and the Carnegie Line - Banksville to Carnegie.

The Etna Line intercepts Route 8 and Butler Valley traffic. If the area develops and a demand is generated, this line could be extended north along Route 8 into Butler Valley. The Carnegie Line provides service to the community of Carnegie and surrounding area. It is also the start of a possible rapid transit route to serve the Greater Pittsburgh Airport. Construction of both of the lines in Stage V will be costly due to the severe terrain encountered, and their future capabilities for extension will depend on the rate of growth in the corridors to be served.