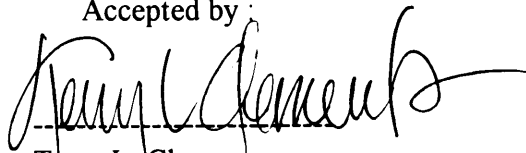


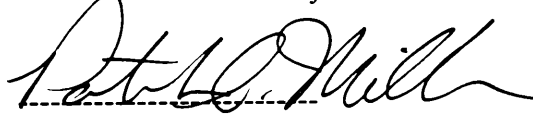
PERSONAL RAPID TRANSIT
FOR
BLACKSBURG, VIRGINIA

"This Senior Project is submitted in partial fulfillment of the requirements for the Bachelor of Landscape Architecture Degree in the College of Architecture and Urban Studies at Virginia Polytechnic Institute and State University."

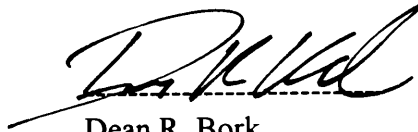
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Art/Arch

Acknowledgments

I would like to extend my sincere thanks to Assistant Professor Terry L. Clements for her constructive advice and assistance that helped me complete this project. I would also like to thank Associate Professor Dean R. Bork and Dr. Patrick A. Miller for their assistance and suggestions for this project.

Parker L. Little
May 6, 1994

PLANNING FOR 2001

PRT AS A TRANSPORTATION GOAL

FOR VIRGINIA TECH

A STUDY INTO THE ISSUES INVOLVING A NEW
FORM OF TRANSPORTATION INTO CAMPUS

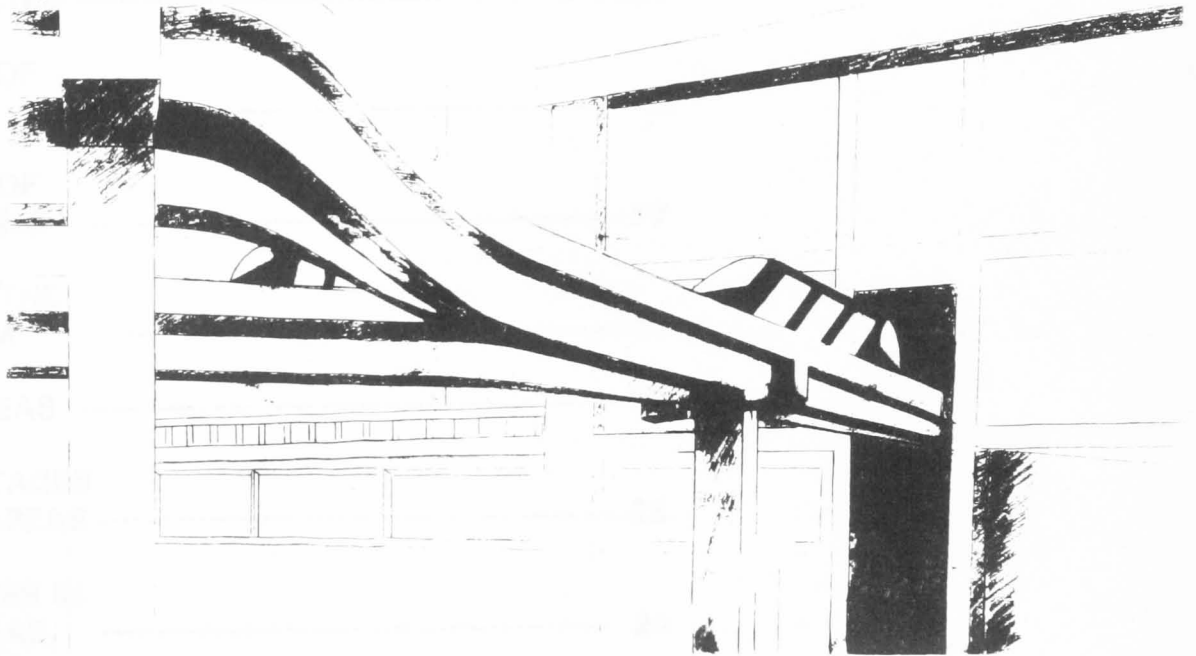


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Major campuses in Virginia will soon face transportation problems from the expected twenty - five percent increase in the student population in the year 2001. The sudden increase in the number of students will be caused by the 'baby bommers' children - the 'bommlets' who will be seeking higher education opportunities at colleges and universities. The large university of Virginia Tech and the adjoining town of Blacksburg must work in cooperation with planners, developers and government agencies for the projected increases in off-campus housing and transportation demands.

This project is a study into the transportation issues and land use changes associated with developing a Personal Rapid Transit system (PRT) and the projected off-campus student housing increases that will effect Blacksburg and Virginia Tech after the year 2000.

PRT is a transportation system that moves people in separately operating vehicles that travel on a guideway. Vehicles "float" on an air cushion as horizontal side - wheels move the electrically run vehicle along the guideway. Each vehicle is computer operated from a control station and is user demand - responsive for passenger destination requests. Transportation service is available all the time by user demand that makes travel more convenient than other modes of commuter transit.

The establishment of a PRT system as an alternative form of transportation into the Virginia Tech campus from high - density off-campus housing would help alleviate the projected transportation increases for a selected area. A PRT system would help to reduce the dependency on cars and buses as a method of commuting to campus because of the PRT's appealing characteristics as a safer, cleaner, quieter and faster method of travel. In comparison, buses are slow, noisy, pollute the air and have negative social aspects that greatly reduce the number of potential riders. (2)

Public transit ridership could be increased if a new, faster, safer and pollution free form of transportation for the off-campus commuters within Blacksburg is developed instead of using the existing buses as a method of transportation.

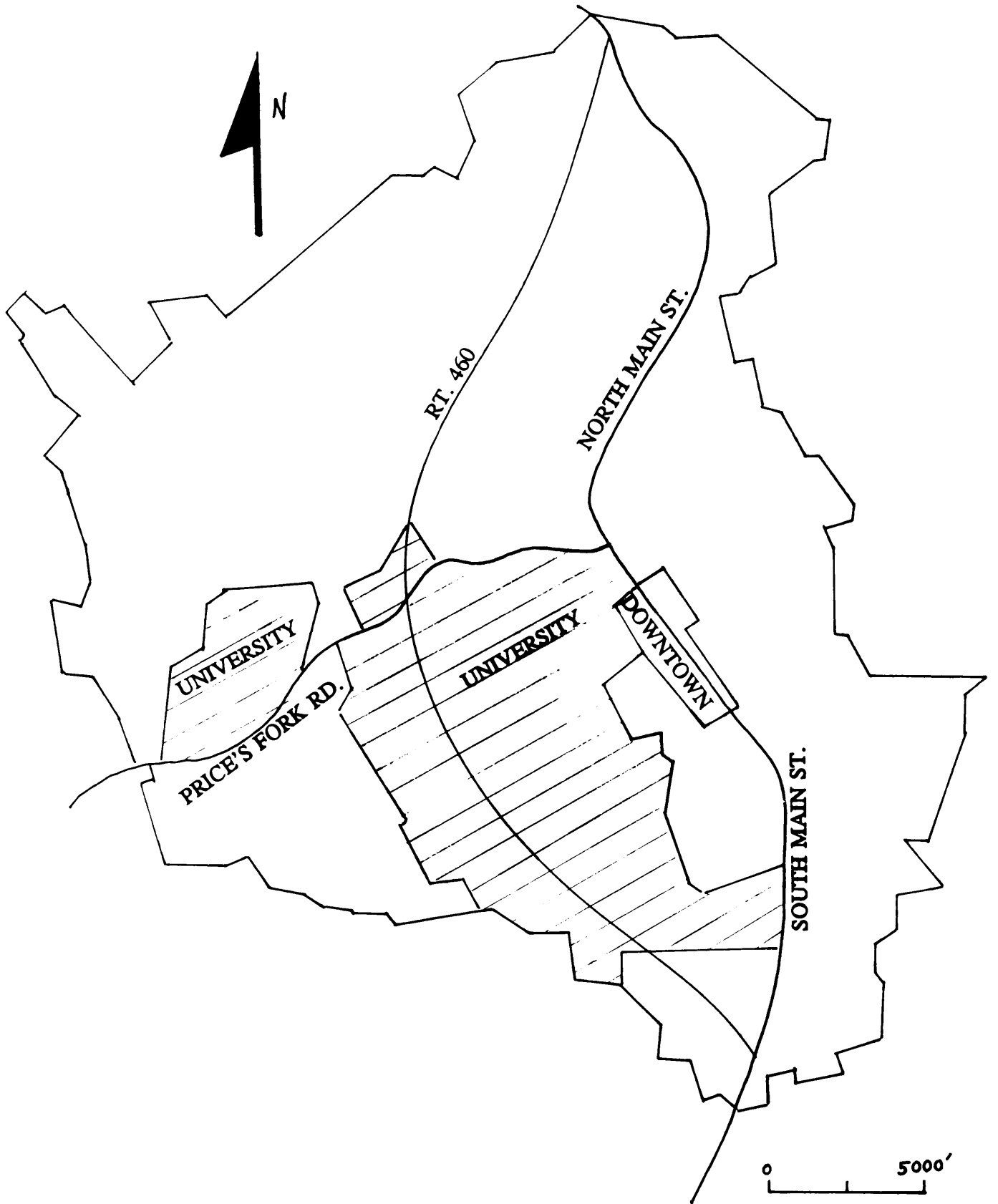
A personal rapid transit system would enhance the quality and efficiency of the urban transportation and circulation infrastructure of the town's peripheral areas with the projected housing developments and improve transportation and circulation of the downtown area of Blacksburg and the Virginia Tech campus. Transportation can be improved by establishing a PRT system that would reduce the number of vehicles used to commute to campus, link major areas of off-campus student destination points on campus with areas of high density housing and link commercial shopping areas.

A PRT system could reduce additional parking spaces from being built by reducing the number of commuting vehicles and improve air quality by reducing air polluting sources.

Driving vehicles or walking near moving vehicles is hazardous. Traffic deaths in Virginia rose from 827 in 1992 to 868 in 1993. Of that number, 90 pedestrians were killed by vehicles in 1992 and 113 in 1993. Commuting to and from campus by car, bike or by foot does involve the possibility of injury or death. The risk of injury or death from a PRT system is much lower due to safety designs.

With a PRT system the typical urban sprawl patterns can be altered by concentrating projected off-campus housing in high density nodes along the PRT route. This would create a landscape that has a variety of spatial forms and uses, and prevent the wasteful consumption of bucolic areas within the town limits.

The expansion of off-campus housing in Blacksburg formed from a central core and outward to expanding peripheral areas where building and housing costs are low and along local arterials leading outward from the center of town. Because of Blacksburg's location along the eastern continental divide, the eastern edge of town abruptly drops down into the Roanoke River Basin from the dividing ridge. This topography restricts the expansion of the eastern portion town, because the location and construction of additional water utilities for new housing in this area would be more costly. And with Virginia Tech's expansive landholdings, development is more likely to continue spreading westward on the gentle topography along Price's Fork Road. MAP 1

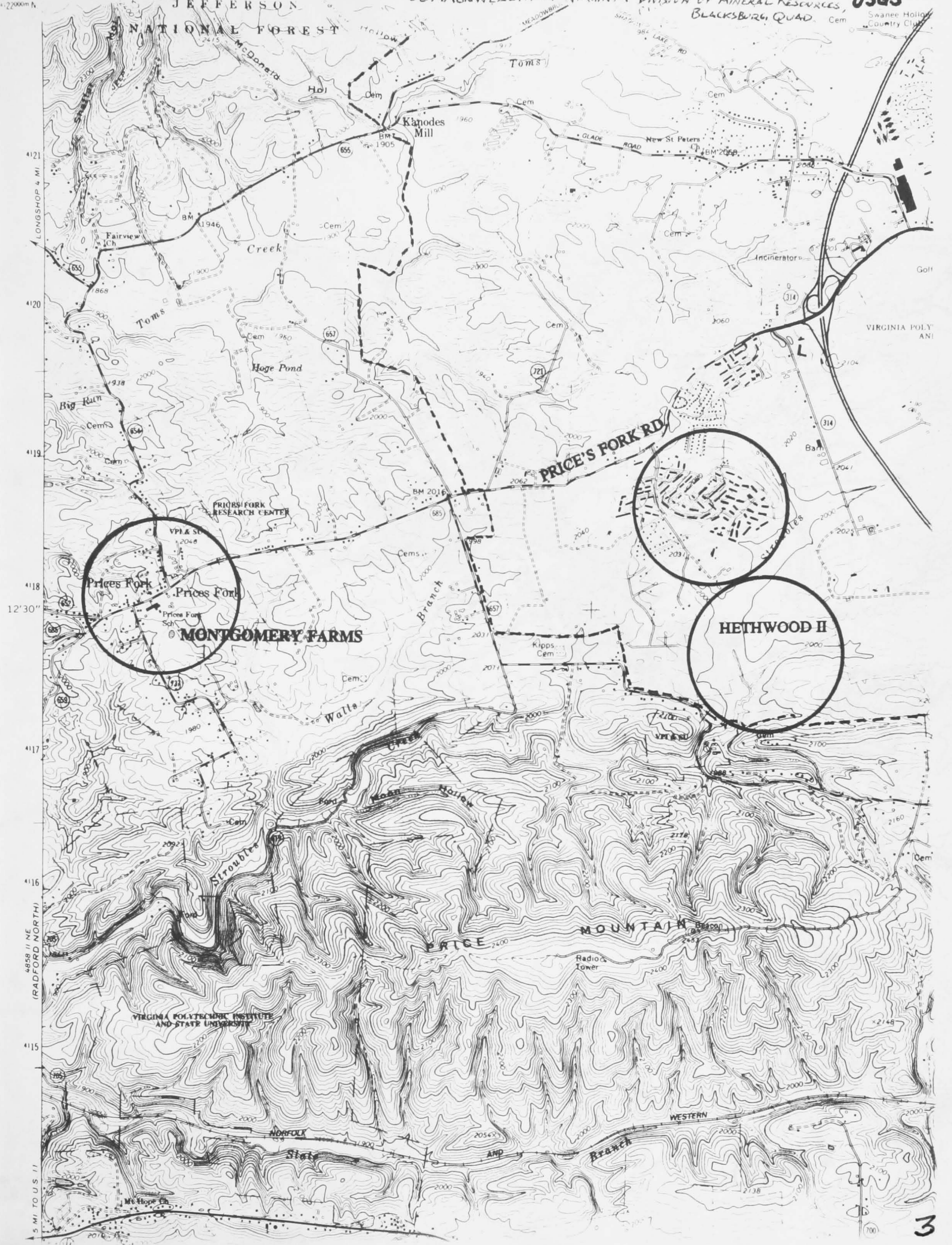


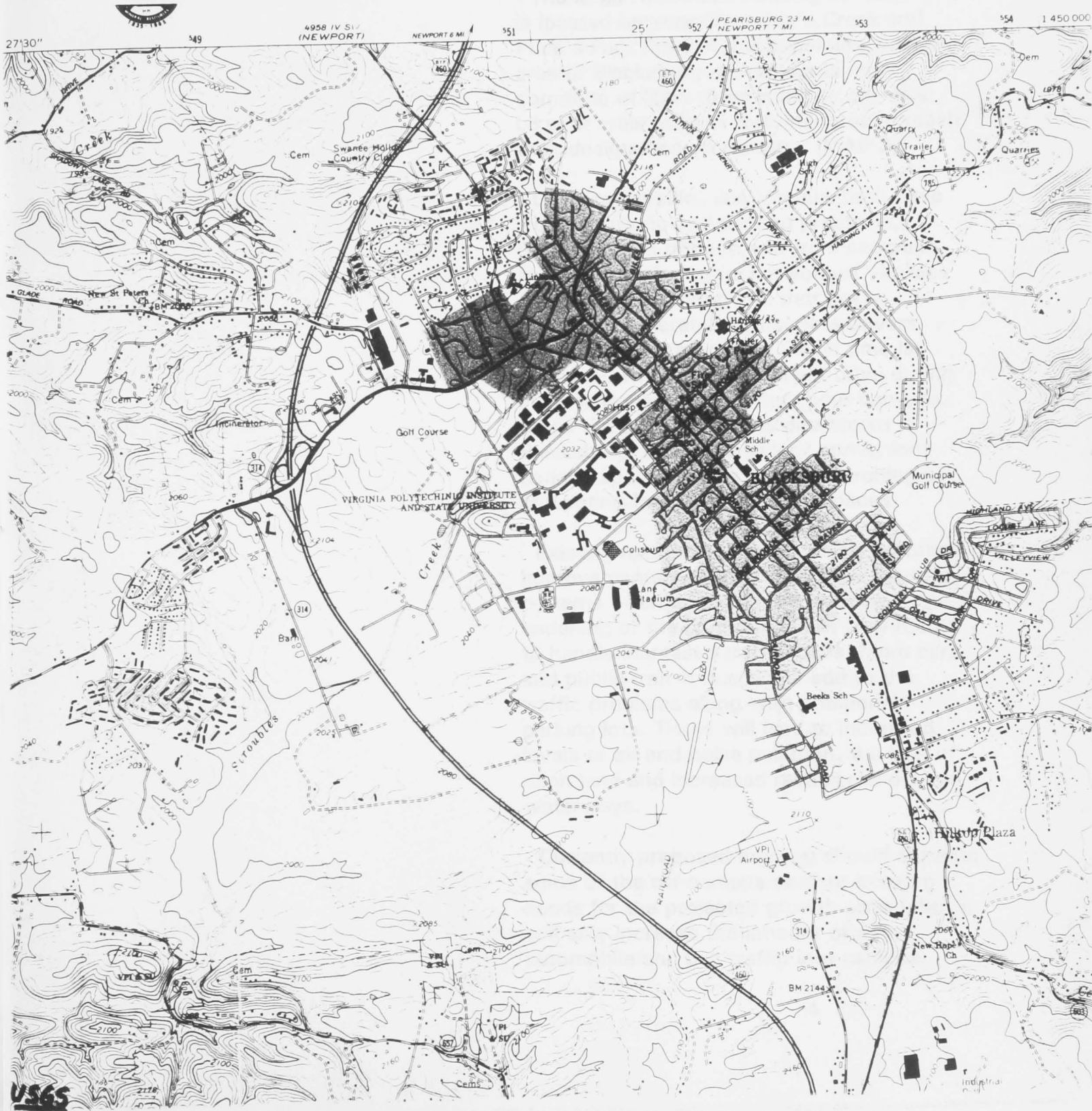
BLACKSBURG

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Swanee Hollow Country Club

JEFFERSON NATIONAL FOREST





The large Hethwood housing development is located between Strouble's Creek and Price's Fork Road in this expanding western area of Blacksburg and students must commute at least three miles by car, bus, bike, or walk at least forty minutes to reach their designation on campus. (MAP 3)

Large universities like Virginia Tech have frequent traffic and parking problems. Students who drive to and from campus must thread through a network of vehicles on roads and parking lots that are sometimes operated by careless drivers, making travel hazardous. Travel time is increased when students must drive during inclement weather and rush hour backups. Since the campus adjoins downtown Blacksburg, there is a lack of convenient parking spaces due to people searching or competing for limited parking spaces.

Existing methods of making transportation improvements typically will follow existing patterns of urban expansion by road widening or the construction of new roads to handle increased traffic loads. More cars and public transit buses will add to the traffic problems along with additional parking lots. These will lead to increased levels of air and noise pollution, the loss of open land and increased rainfall run-off into waterways.

Currently proposed housing should alleviate some of the off-campus student housing needs for the projected growth phase, but it will only increase the amount of daily automobile and bus traffic into campus.

The establishment of a PRT system as an alternative form of transportation would link distant off-campus students to campus with a faster and safer method of transportation. Any new transportation system must be competitive with existing methods of transportation in order to be successfully established. The appeal of a faster method of local commuter transportation exhibited by PRT creates competition for existing modes of transportation. PRT could provide a competitive edge over other methods of transportation in an urban setting because of its shorter travel time and convenient accessibility to the user. With a PRT system, students can be transported directly from distant housing areas into a main off-campus student destination area on campus.

A PRT system would create new spatial and visual patterns, since it saves more open areas than the typical urban sprawl development patterns that consume vast areas of the rural landscape. New urban growth patterns can be created to save undeveloped land or agricultural space if development is concentrated in nodes along the route. By creating housing nodes with higher densities than are now used (19 units per acre), typical high density housing would not sprawl across the open agricultural lands. Parking lots at commercial areas can be reduced in size, limiting the consumption of land since some patrons would use the PRT.

Greenways, bike routes, walking paths and open spaces for experiential enjoyment can be incorporated along with coexisting agricultural practices. Walking paths and bike routes within the greenways can be linked to PRT stations that can provide convenient access.

PRT GOALS

In order to establish a PRT system, objectives for the plan are stated, needs are determined, data is gathered, land use activities are outlined, growth or change in activities is forecast and plans or proposals are presented to illustrate the need for a PRT system. Traffic estimates, designation nodes, the route between the designation points and the overall PRT plan needs to be related to an economic/investment goal to establish a PRT system.

The large economic expenditures required to implement a PRT system demand that the developers must demonstrate that the investment can produce an economic gain. Economic gains can be accomplished with the completion of a PRT system that will provide opportunities for new high density housing and new commercial areas at planned locations along the route. Projections for increasing population must demonstrate need for new channels of transportation to new or expanding housing and commercial areas.

OUTLINE OF THE PRT OBJECTIVES

- 1 Provide an alternative channel of transportation, instead of commuter dependability on automobiles and public transit buses.**
- 2 Create a competitive form of commuter transportation to campus by providing a faster, safer, quieter, more convenient and a cleaner type of transportation instead of the current types of vehicles.**
- 3 Reduce the level of projected traffic increases by establishing a preferable method of transportation instead of automobiles and buses.**
- 4 Prevent wasteful urban sprawl by providing and reinforcing high density housing at nodes along PRT route to save open agricultural land within the town limits for greenways.**
- 5 Provide access to commercial areas, to high density housing areas, to the main campus destination for off-campus students and to downtown Blacksburg with station stops provided for each location.**
- 6 Awareness and protection of aesthetic areas, historic sites, housing and recreational areas is necessary to prevent disruption of scenic qualities and activities.**

CASE STUDIES OF PRT SYSTEMS

Different PRT systems were selected and compared for efficiency in cost and travel time, contextual relationship to the architecture of university buildings and suitability to the user group for the area proposed to be developed. Then, desirable elements from the selected PRT systems are chosen, information is evaluated, and goals and plans are refined.

Four PRT systems were chosen to illustrate working elements that would be suitable for a university setting.

The Duke University PRT system in Durham, North Carolina links two facilities on campus. The system was completed in 1980 at a cost of \$ 5.9 million and can transport 5,000 people a day between a parking area and two medical facilities. The total length of the route is 0.6 miles including a 560 foot spur that provides service to a parking facility. Four vehicles run continuously on two tracts to stations at the medical lobbies and to the parking area. The vehicles are small "buses" that lack wheels and are "floated" by air that is forced out from underneath each "bus". This semi-public system is for patients, visitors and staff. The route incorporates attractive black iron fencing for safety with an adjoining walkway through a landscaped area. (11)

The West Virginia University PRT system at Morgantown, West Virginia is larger than the Duke University PRT. This system traverses over 3.6 miles of rugged terrain and links downtown and the separated campus. The system has five stations each being located about every half-a-mile, 73 PRT "cars", 8.7 miles of single guideway and transports approximately 18,000 people a day. With a maximum speed of 30 mph, the average speed is 14 mph including station stops. Travel time between the first and end station is 10.5 minutes. Total cost for Phase 1 in 1975 was \$ 104 million and Phase II in 1979 cost \$ 63.6 million. The WVU system was the first center city PRT. Cost overruns were a result of the installation of a new system, extra labor costs, extra foundation work for the rugged terrain and redesigning components to make a reliable system. Also, failure to create definitive engineering plans and the rush to meet demonstration deadlines caused the system to be more costly than expected.

The WVU PRT has guideways that are either on ground level or elevated. The elevated guideway piers are concrete with steel superstructure framing. To prevent ice and snow accumulation on route a system of pipe grids under the guideway carries a mixture of ethylene-glycol antifreeze and hot water. Heating plants with manual and automatic switches control the heating system if ice or snow is to occur.

Each PRT "car" is six feet wide, eight feet nine inches high and fifteen feet six inches wide long. Cars seat eight and have standing room for thirteen people. All cars are automatically controlled from a control station computer. The computer controls

stopping, switching, door operations, station displays, and responds to vehicle destination requests from the user.

Stations are in close proximity to university facilities to provide easy passenger access. Off line routes serve the stations and alternative by-pass routes save time by allowing vehicles to pass. Elevators are located at the stations to provide access for the handicapped.

The Buffalo to SUNY at Buffalo, New York PRT is a five mile route that was modeled in 1984 after the Pittsburg demonstration system. Vehicles are rubber tired to reduce noise pollution and the use of truck hardware reduced construction costs. The system is electrically operated to reduce air pollution. Snow and ice accumulation on the guideways is prevented by frequent operation of the system. An average of 23,000 people use the PRT each day. The vehicles travel an average of 30 mph including station stops.

The Tampa to Harbor Island PRT in Florida was completed in 1985 and transports people half-a-mile from a downtown station to a residential development with shops, offices and hotels in ninety seconds. Two cars travel at a maximum speed of 35 mph on a guideway that has a five hundred foot dual by-pass. Each car is forty feet long, eight feet wide and nine feet high and carries one hundred people. Cost estimate is \$ 7.3 million with an operation cost of about \$ 500,000 a year.

ANALYSIS OF THE CASE STUDIES

The selection of elements from the PRT systems was based upon the need to create a system that would be the least expensive, the most efficient in travel time, lowest in operating costs and had desirable elements or features that would have a contextual relationship to physical elements on the Virginia Tech campus. A rapid transit system needs to be competitive in travel time to existing methods of transportation (cars and public transit buses), be aesthetically pleasing, safer, comfortable and an attractive method of transportation for users.

The "Transit Expressway" from downtown Buffalo to SUNY at Buffalo, New York personal rapid transit was selected for its lower construction costs, highest average speed, including station stops, low operating costs and its competitiveness with other types of public transportation. This system is most effective in providing connections to public bus transit facilities in a downtown area. Direct access into residential areas is not provided with this PRT.

The Tampa to Harbor Island PRT was selected for its completion ahead of schedule, vehicle size, guideway by-passes, low construction cost, its alternating route through the city's infrastructure and its connection to a residential area. This PRT is most effective in transporting large numbers of people from downtown to a residential area with the highest average speed. This would be a suitable model for a Blacksburg PRT.

The Duke University PRT was chosen for its connection to public transit bus facilities, guideway support design and landscaping elements adjacent to the route. It is suitable to the user group with lower ridership numbers and smaller size vehicles. Because of the system's small size it would not be effective in transporting large numbers of students.

The West Virginia PRT was selected for its pedestrian access to stations, the location of the route on existing right-of-ways along roads to save space and reduce costs, planning to reduce environmental impact and a design to prevent the accumulation of ice and snow on the guideways. This system was not efficient in travel time, but allowed access to campus areas over rugged terrain and provided service to large numbers of students. The WVU PRT connected areas of downtown to student destination points throughout campus, thus it would be suitable for Blacksburg and Virginia Tech. The bubble shaped design of the guideway did not relate to any element along the route making the PRT route a separate element on the landscape.

SITE SELECTION PROCESS

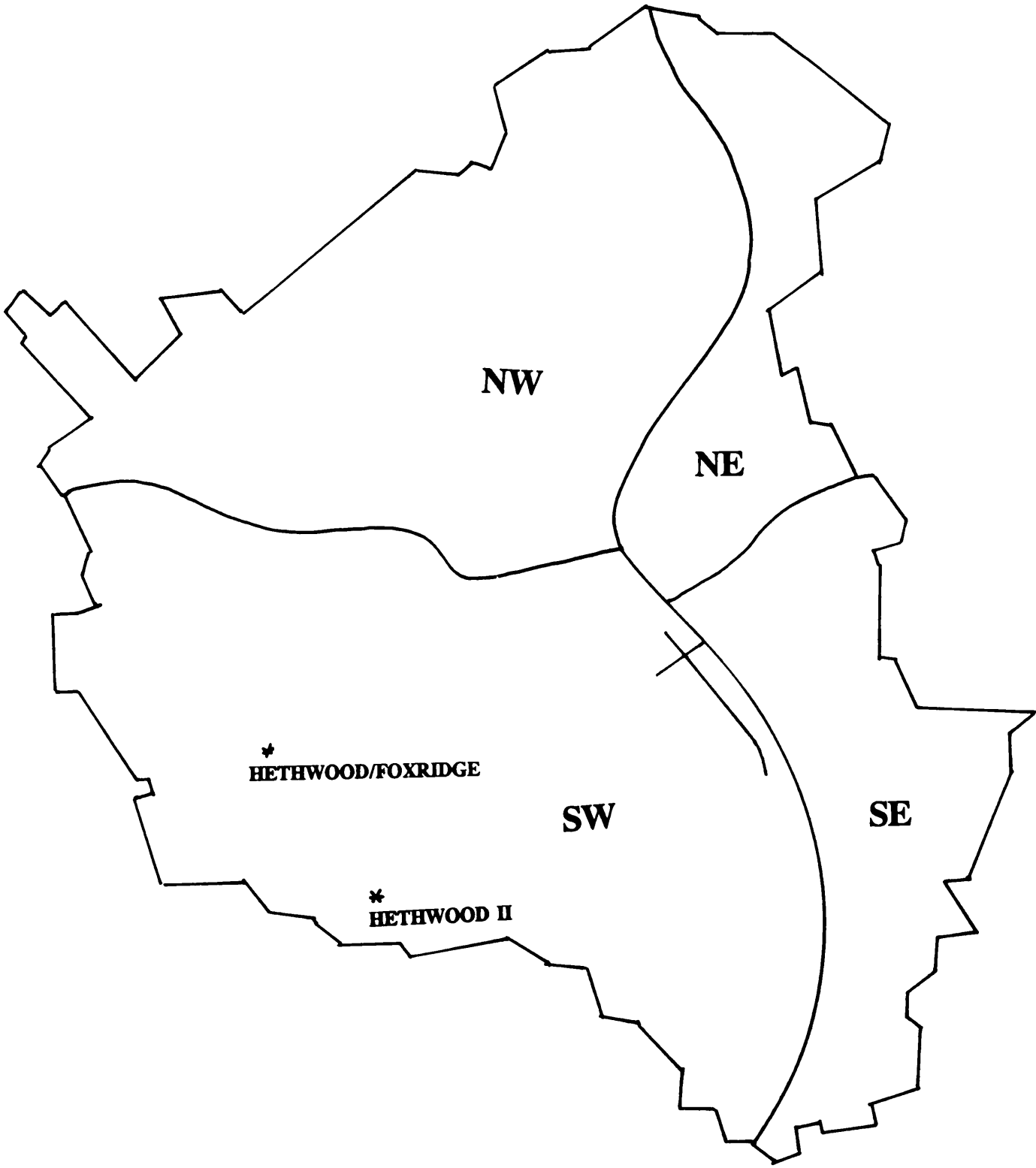
All areas within and adjacent to Blacksburg were examined to identify variations in land uses and projected land use changes. Areas with existing and planned high density housing and areas of planned and existing commercial activity would be selected for a PRT connection to a major off-campus student destination on campus and downtown.

The northeast section of Blacksburg contained 2,969 people in 1988 with a population growth rate of 2.8 percent a year. The area is zoned to allow a maximum of ten housing units per acre. Commercial areas are along North Main Street.

The northwest section of town contained 8,324 people in 1988 with an average growth rate of 2.9 percent a year. Commercial activity is along North Main Street and at the University Mall.

The southeast section of town had 6,817 people in 1988 with an average population increase of 3.4 percent a year. The most commercial growth was along South Main Street.

The southwest section of Blacksburg had a population of 17,564 people in 1988 with an annual growth rate of 2.4 percent. Commercial areas are east of Draper Road and north of Miller Street in downtown, and Hethwood Village and Gables Shopping area. The large proposed Hethwood housing development is located in this area. This area is zoned to allow a maximum of 19 housing units per acre. (16) (MAP 2)



**STUDY AREAS
OF BLACKSBURG**

Daily traffic counts and projections for Price's Fork Road that leads into campus from the Hethwood Development are :

1990 = 10,675

2001 = 13,270

2013 = 16,103

Figures are from the Virginia Department of Transportation in 1994.

AREA SELECTED FOR A PRT

Of the four sections of Blacksburg examined, the southwest section had the largest concentration of people, the largest multi-family housing complex (Hethwood), the largest proposed multi-family development (Hethwood II), the greatest distance to commute to campus from a large housing area (three miles), high traffic projections, and only one traffic route (Price's Fork Road) to campus via Price's Fork Road and alternate Route 460. These factors outweighed the data from all other areas of Blacksburg for a PRT system.

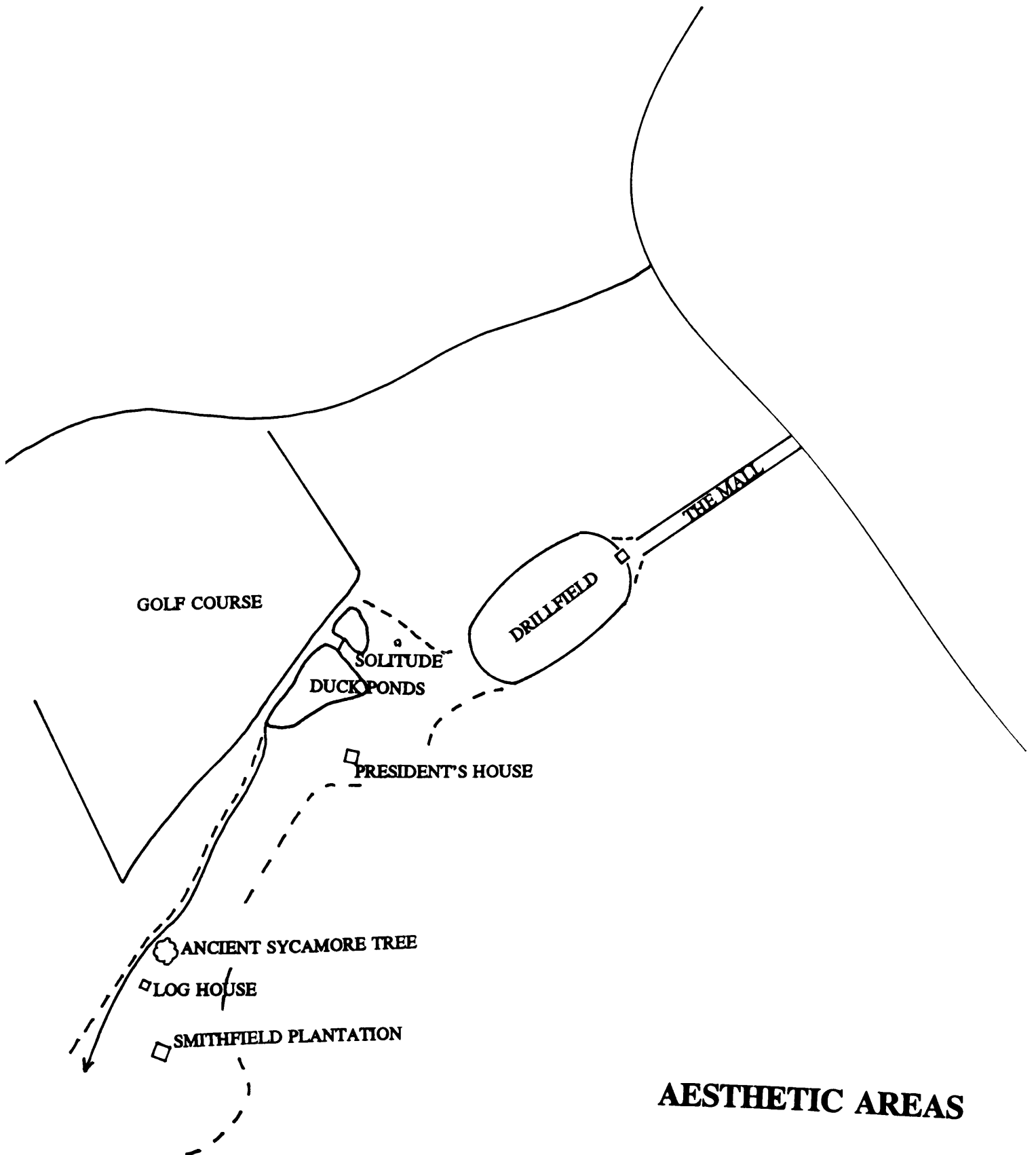
The area selected for a rapid transit route in the southwest section of Blacksburg has open space for the town to expand. Unlike other sections of town, development is not restricted by topography. The topography has allowed the Hethwood complex to grow. With the proposed 1991 Hethwood II complex, the local arterials carrying capacities will be exceeded or road widening or the construction of new roads will have to occur to carry the projected traffic loads.

SELECTION OF A PRT ROUTE Areas of Constraint

Within the southwest section of Blacksburg, open agricultural lands will be consumed for housing and commercial development if traditional development patterns are followed. The aesthetic qualities of these bucolic areas can be preserved by limiting the types of development on agricultural lands. The preservation of farming practices can allow aesthetic qualities of cropland, pastures, grazing animals and rustic vistas to remain adding to the richness and diversity of the area. By developing high density housing in concentrated nodes along the PRT route, most of the open land can be saved as greenways with existing agricultural practices located within an urban environment.

In order to preserve the bucolic character of the open spaces, a PRT route would circumvent the agricultural lands by following fence rows or edges of fields. By designing a PRT route to travel along existing borders, edges or fence lines of agricultural land, a PRT route will not break these spaces into smaller less functional farm units. The remaining open lands can be seen as contrasting visual agricultural greenway parks within a growing urban setting.

Other areas to preserve are the aesthetic areas on campus or adjacent to campus that have visual or recreation qualities. The entrance Mall that leads to campus from Main Street, the Mall, the Pylons, the Drillfield, the Duck Pond area including Solitude House, the President's House, Smithfield Plantation and the golf course are areas that were selected to be protected from locating a PRT route. (MAP4)



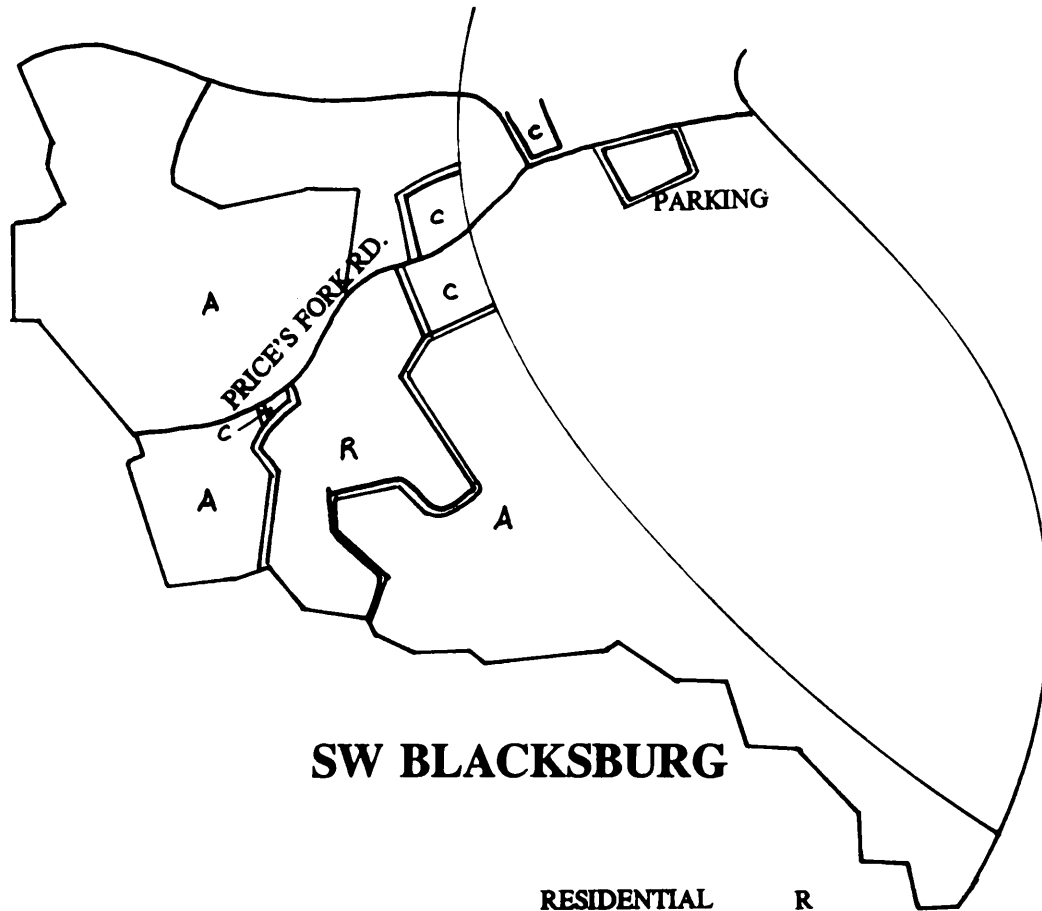
Also, residential areas need to be protected to maintain their visual, spatial and social characteristics to maintain a neighborhood as a cohesive unit and to prevent a PRT route from dividing the structure of residential areas. Any historic sites or buildings, any houses and academic or commercial buildings would be avoided by a PRT route. The design of a PRT route allows the route to meander through obstacles on the landscape, avoiding most built elements and reducing the need to demolish any existing structures.

Parking lots would be avoided by a PRT route, since the cost of elevating the guideways with piers above parking areas would be expensive.

Areas for Opportunities

The areas of the southwest section of Blacksburg that were selected for the location of a PRT route were highway right-of-ways, edges of residential areas, edges of parking lots, edges of commercial land and edges or fence lines of agricultural land. The selection of these edges would have a reduced impact on the functioning of the units and reduced construction costs since there would be little need for elevated guideways, the purchase of valuable land and the costly demolition of structures.
(MAP 5)

OPPORTUNITY EDGES



SW BLACKSBURG

RESIDENTIAL	R
AGRICULTURAL	A
COMMERCIAL	C

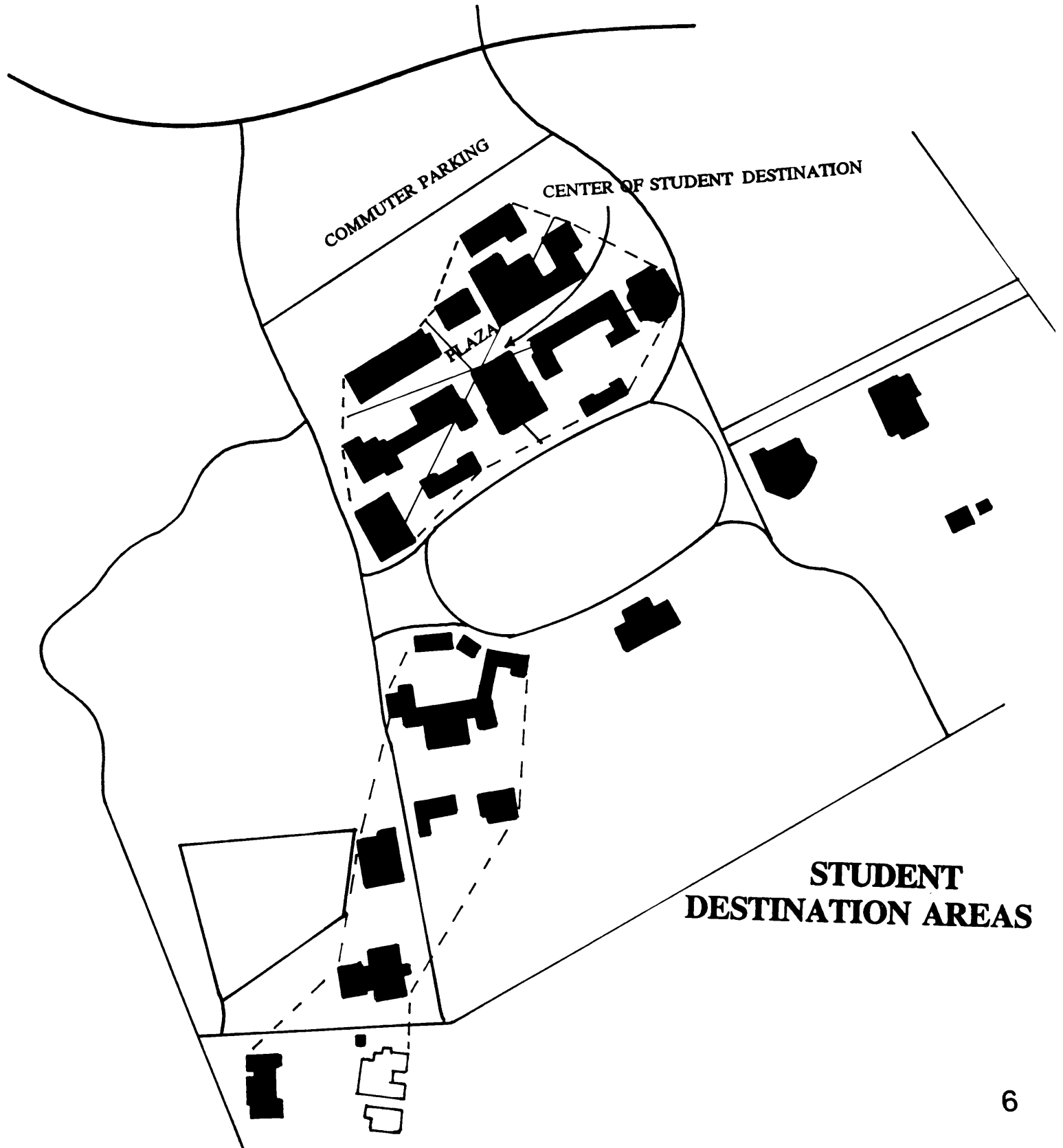
SELECTION OF STATION SITES

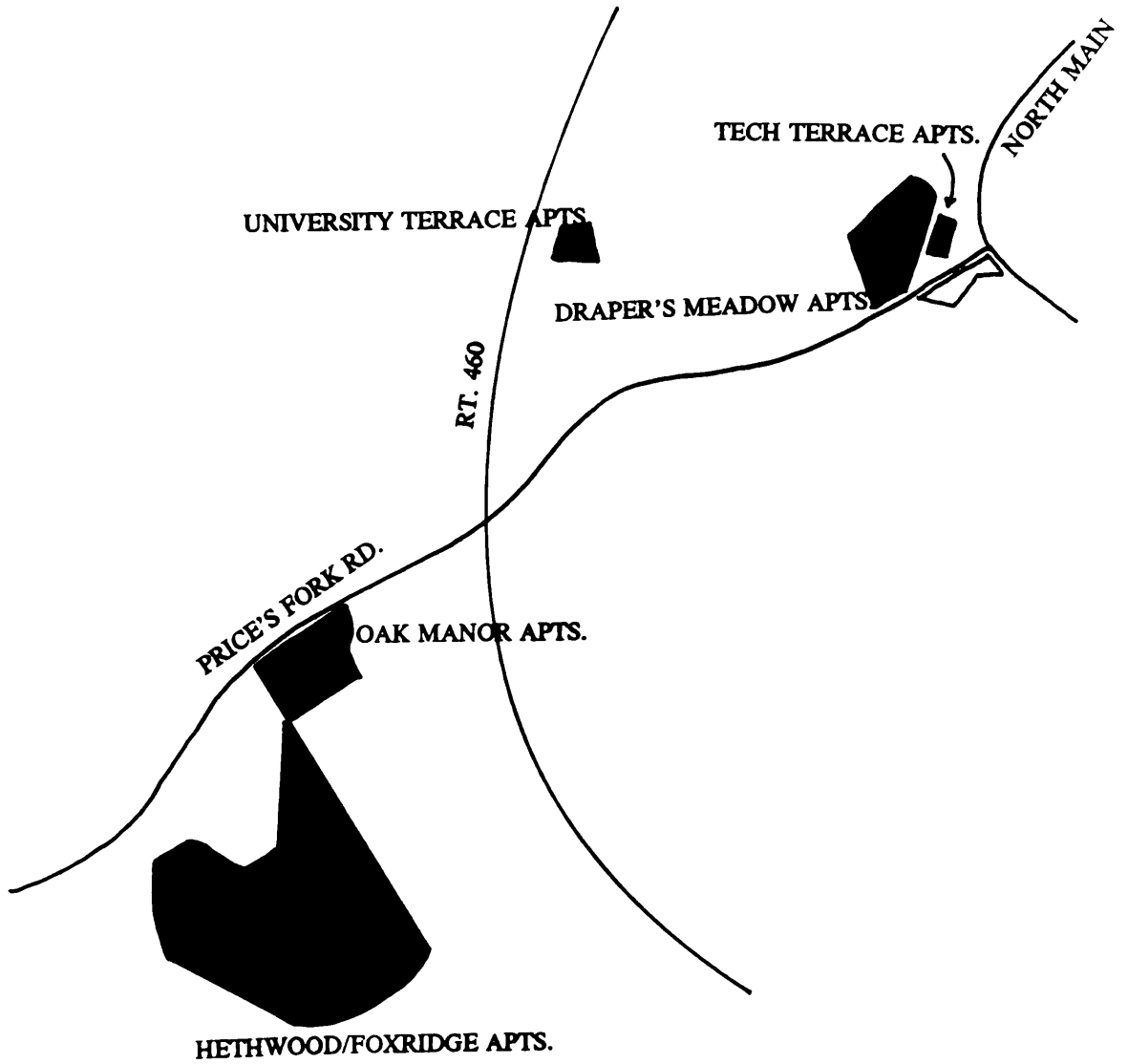
Site selection for the PRT stations was determined by locating destination areas of off-campus students. Destination areas on campus were located by mapping the academic buildings. A center point of the main area of academic buildings was centered near Cowgill Plaza. This area was chosen for the location of a PRT station because it is a central destination point on campus for students. A smaller area of academic buildings was located in a narrow strip between the south end of the Drillfield and the greenhouses. This is a smaller destination area for students than the area around Cowgill Plaza and the walking distance would be convenient to the Cowgill Plaza area PRT station. (MAP 6)

Areas of high density housing were located to determine the major locations of the off-campus students. Three areas of high density housing were located within the southwest section of Blacksburg. The center of the Hethwood/Foxridge housing area was located to determine a central pedestrian access point for a PRT station. Oak Manor, Tech Terrace/Draper Meadow and University Terrace Apartments were selected for their high density and proximity to commercial nodes. (MAP 7)

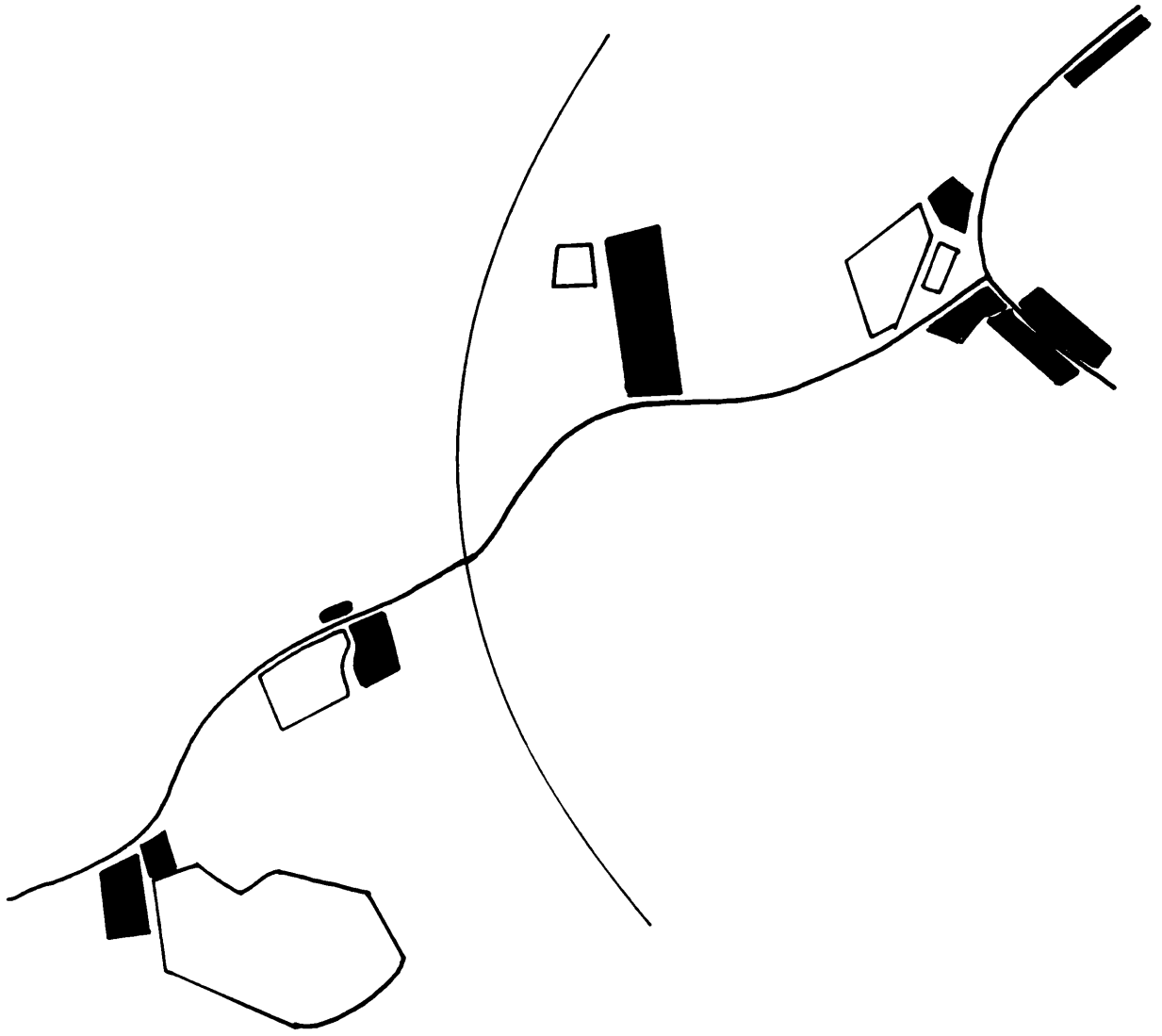
Areas of commercial activity near high density housing were selected for a PRT station to provide service to two destination areas at one convenient location.

The Triangle commercial development was chosen for a PRT station for its convenience to North Main Street commercial areas, the planned Collegiate Square shopping mall, Tech Terrace Apartments and Draper Meadow Apartments (that have the potential for high density housing). (MAP 7B)



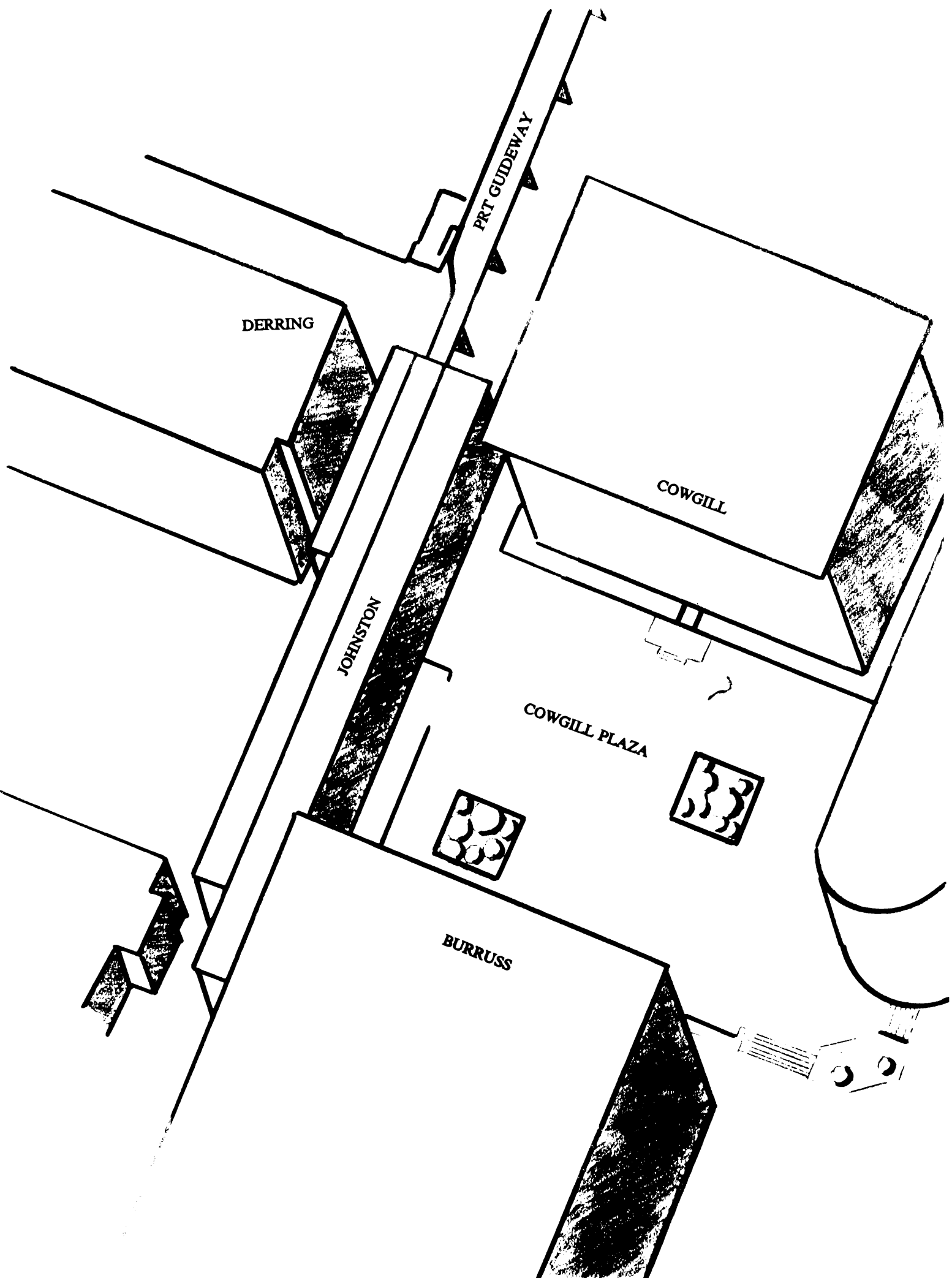


HIGH DENSITY HOUSING



□ **HIGH DENSITY HOUSING**

■ **COMMERCIAL AREAS**



DERRING

PRT GUIDEWAY

JOHNSTON

COWGILL

COWGILL PLAZA

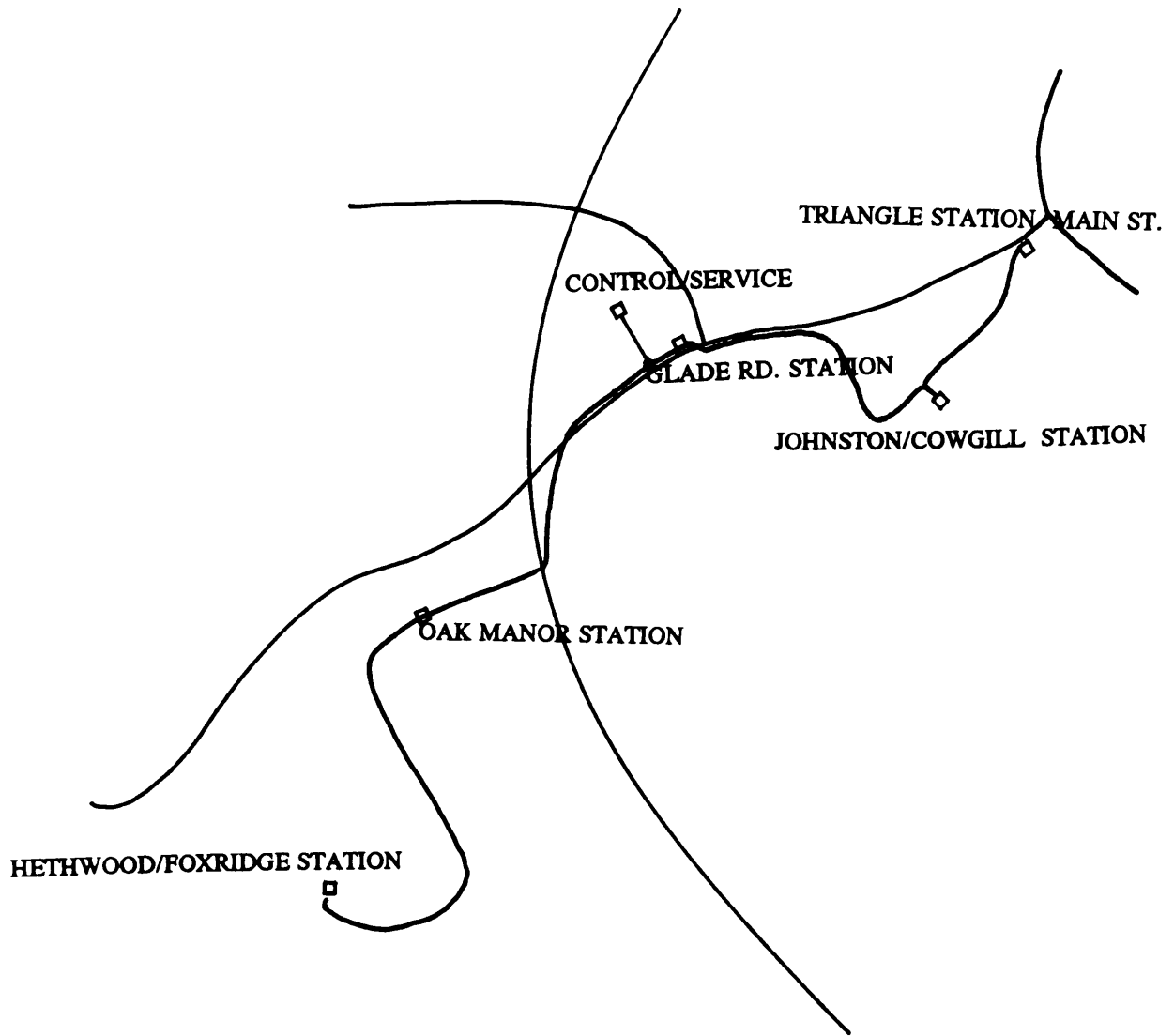
BURRUSS

Other PRT station locations were selected for convenient walking distance between station stops, access to commercial nodes and proximity to nearby high density housing areas. The station stop at the intersection of Glade road and Price's Fork Road is close to the University Mall shopping area and high density housing of the University Terrace Apartments. Another station stop was provided behind Oak Manor Apartments and adjacent to the planned commercial development west of Rt. 460. (MAP 8)

The computer control station and service garage was selected about midway along the PRT route for convenient access throughout the system and the station is offset on a 350 foot side spur North of Price's Fork Road between Glade Road and Rt. 460 to prevent visual distractions to users of the PRT and Price's Fork Road. (MAP 8)

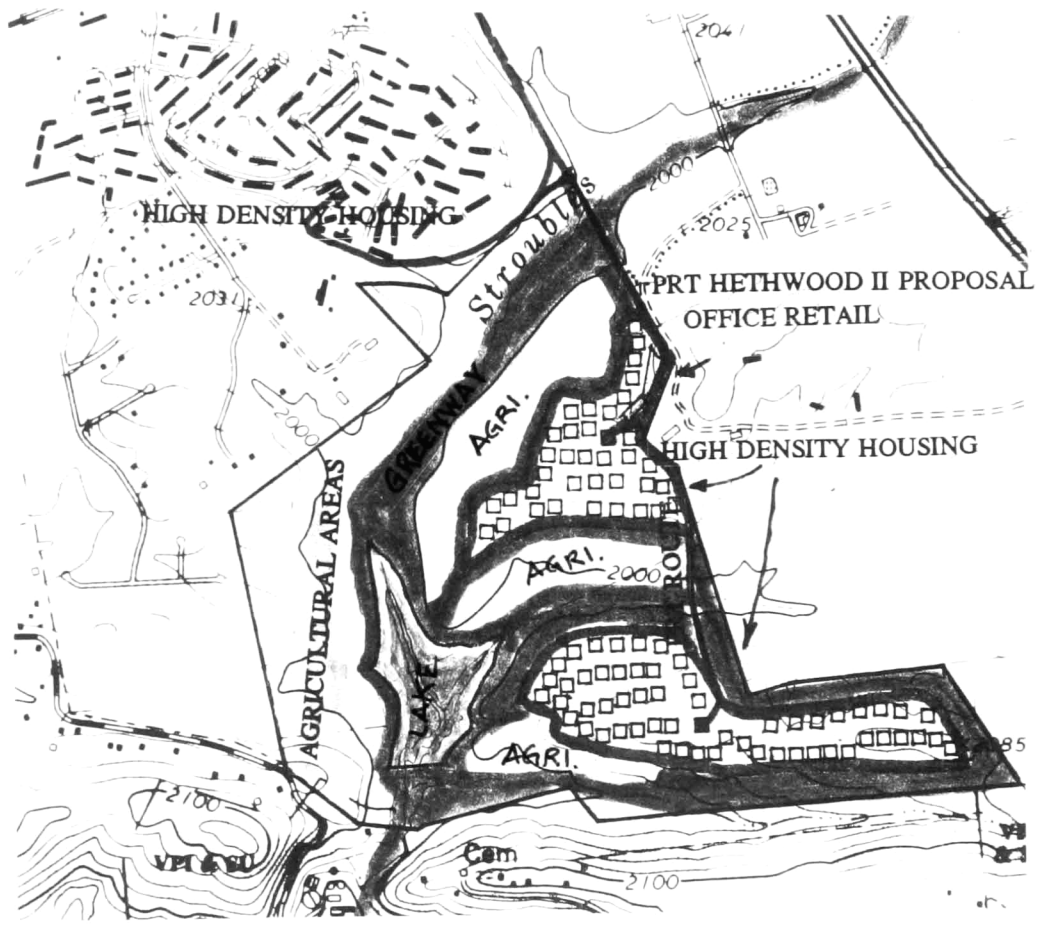
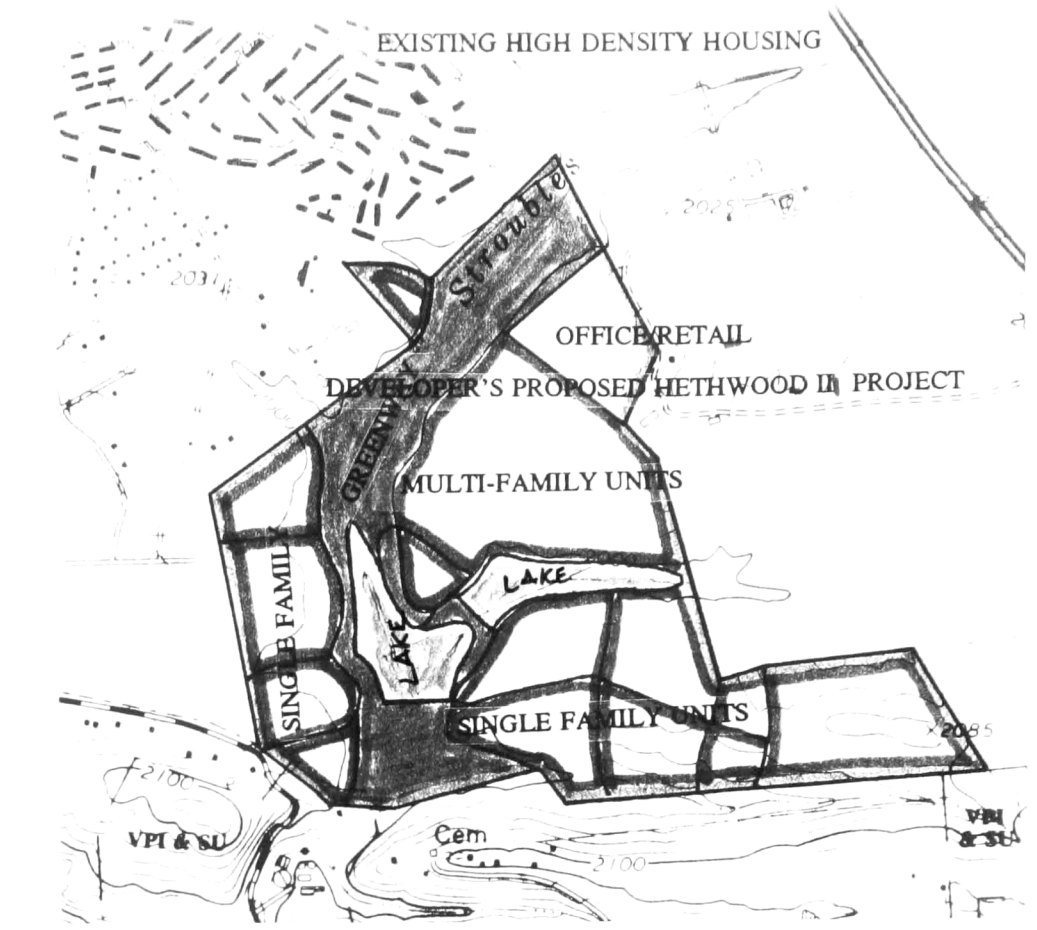
FUTURE PRT STATIONS

The proposed Hethwood II area can be developed to function with the transportation advantages of the PRT system with concentrated high density housing, recreational areas and a shopping mall. The proposed Hethwood II site is on agricultural land and if the development is planned as a concentrated high density housing development radiating outward around a centrally located PRT station much of the agricultural land can be saved as open space for greenways with coexisting agricultural/recreational potentials. Pedestrian access to the PRT station would be convenient, since the entire development can be planned with the PRT as the central concept guiding the housing development. (MAP 9)



PRT ROUTE

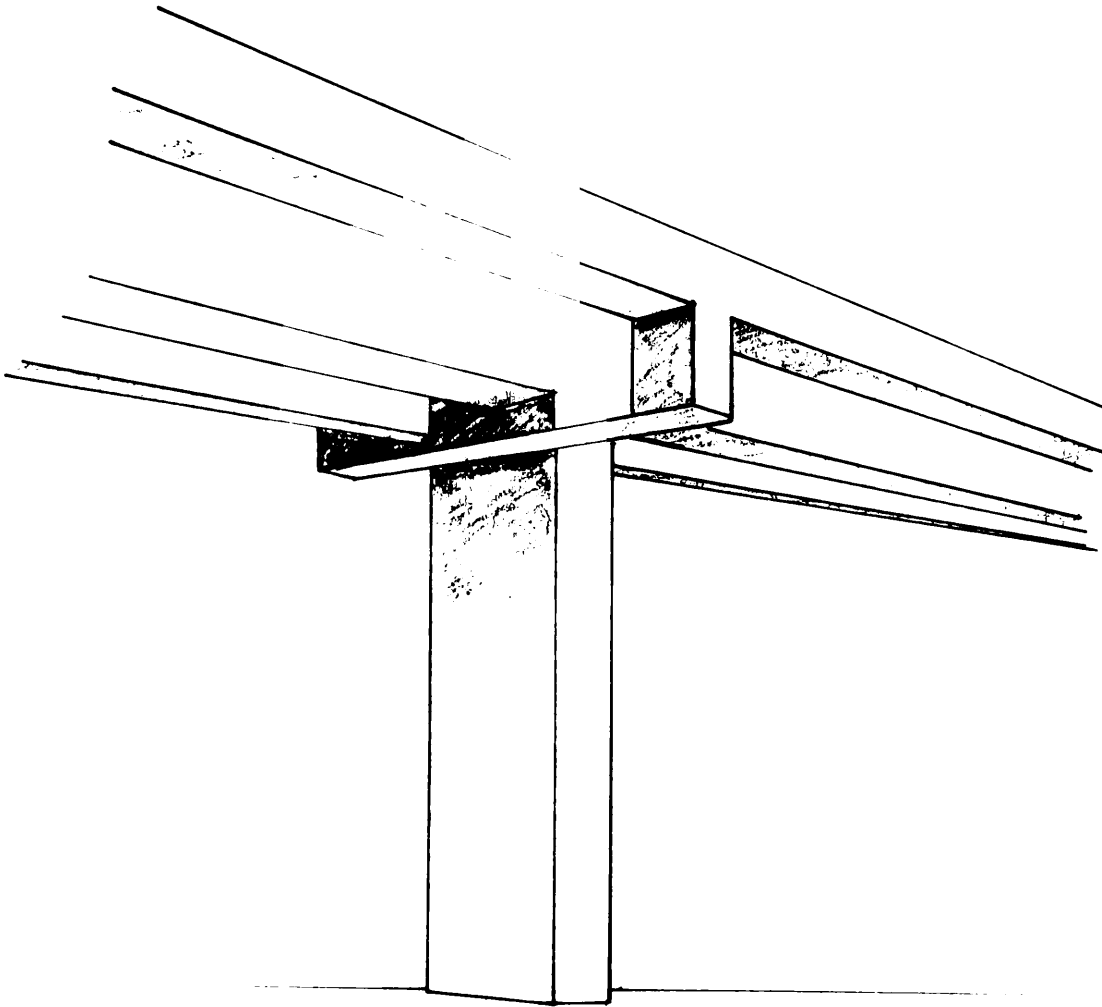
EXISTING HIGH DENSITY HOUSING



DESIGNING THE VIRGINIA TECH PRT

The guideway supports of the Duke PRT were selected for the Virginia Tech PRT, since there is a contextual relationship to physical elements on the Virginia Tech campus - The Pylons and structural elements of Cowgill Hall. The design of the Virginia Tech PRT station was established by incorporating the guideway features with its Pylon - like supports and the adjacent features of Cowgill and Derring Hall to create a harmonious and complementary balance of design elements. (ILLUS. A)

Since the Virginia Tech PRT station at Cowgill Plaza is a major circulation node for a PRT entrance and exit onto campus, the design of the station needs to reflect a symbolic image of a gateway on campus for the passenger. This can be accomplished with using monumental art forms such as sundial pylons that will symbolically identify the site as a transportation gateway on campus as the Pylons are the focal point at the main entrance to campus. Art forms on campus that show the traveler the image of gateway to campus were incorporated into monumental sundials to also show the relationship with time to a transportation place at exterior spaces or plazas of the PRT station. The Pylons were chosen to illustrate a continuing pattern and a connection to the PRT stations with the repeating pylon - like guideway supports. (ILLUS. B)



**PIER &
GUIDEWAY** DUKE UNIVERSITY DESIGN

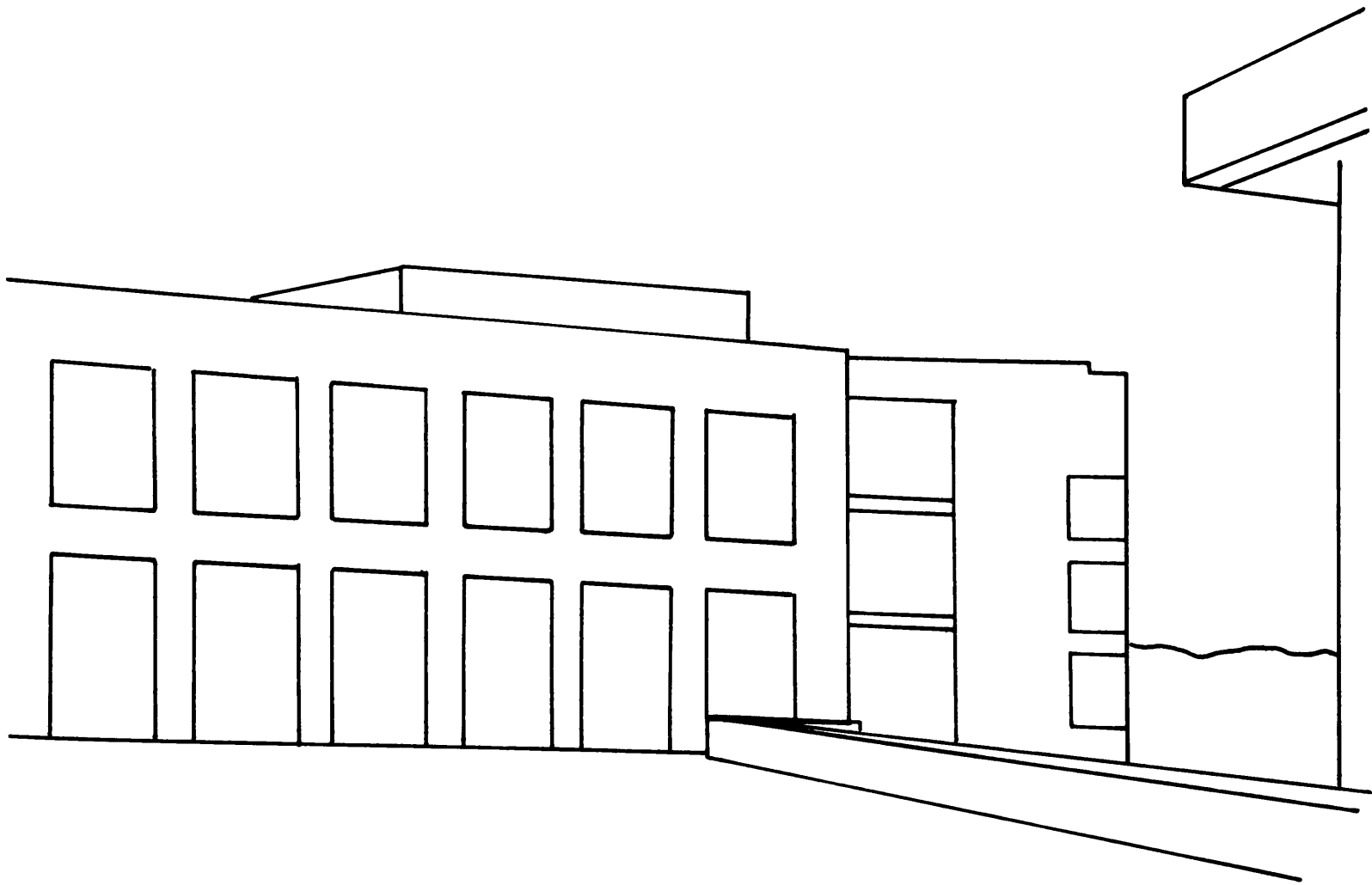
ILLUS. A



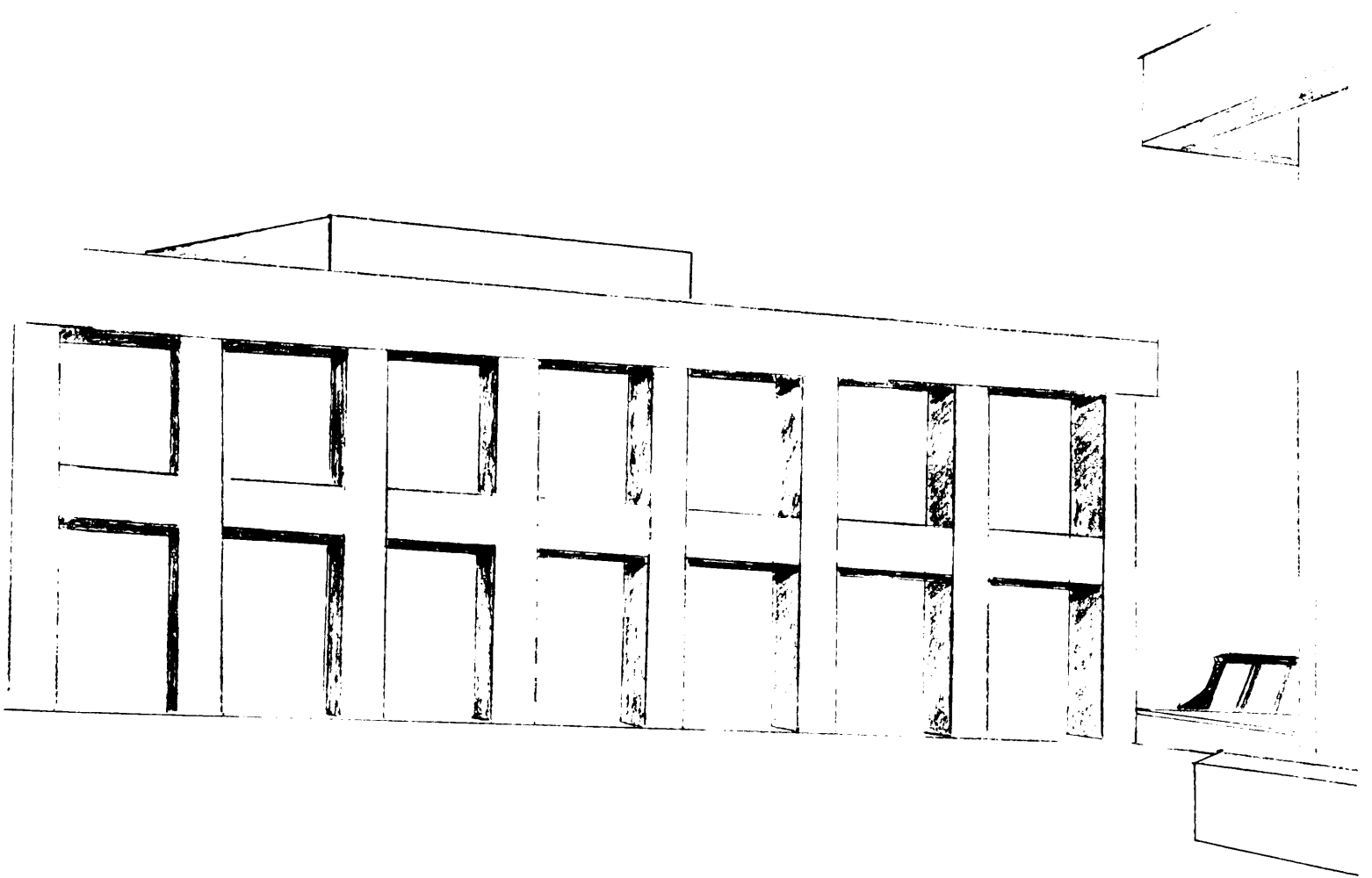
VIRGINIA TECH

PYLONS

ILLUS. B



EXISTING



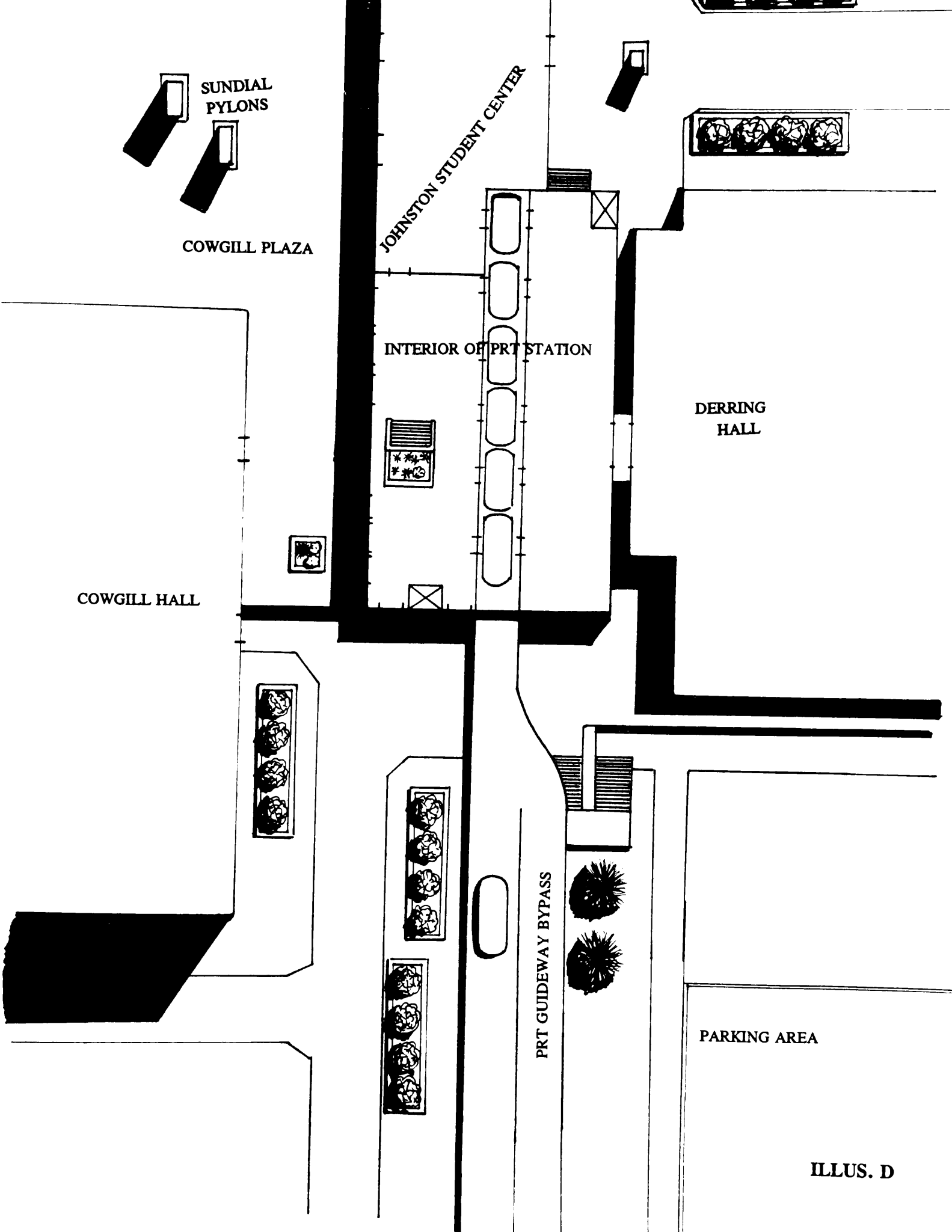
ILLUS. C

The entire exterior of Johnston Student Center facing Cowgill Plaza was changed to show the relationship to the PRT guideway support forms and to create a pattern of vertical elements of the pylon - like structures. (ILLUS. C)

The location of the Virginia Tech PRT station adjoining the Johnston Student Center needs to incorporate space for the entrance of PRT vehicles that are eight feet wide, nine feet high and twenty feet long. The dimensions of the vehicles was based upon a hybrid between the Tampa PRT and the WVU PRT vehicles. The lobby space needs to accommodate the peak number of users for six cars entering every eight minutes. Each vehicle can hold a maximum of 38 people, unloading 228 people every time segment. The vehicles enter into the center of the station, dividing the station into two separate lobbies. A 75 x 25 foot space would hold 250 people on the southwest vehicle exit side of the PRT station. A 90 x 18 foot space would hold 225 people on the northeast vehicle side of the PRT station. A total of 456 people can transfer through the station in eight minutes. On each side of the vehicle lane 114 people could exit on either side of the vehicle lane into the lobbies, allowing space for circulation to and from the vehicles.

(ILLUS. D)

Three 500 foot guideway by-passes along the PRT route allow vehicles to pass and re-align to save travel time. Three smaller by-pass sections are located at each end point of the route. One 200 foot by-pass is located next to Cowgill Hall, the Triangle (Collegiate Square) and Hethwood. Guideway length varies depending on the location, the 500 foot sections are designed to allow for higher travel speeds of the vehicles. Single guideways are twelve feet wide to accommodate the eight foot wide vehicles with lateral exterior guide wheels.



SUNDIAL
PYLONS

COWGILL PLAZA

JOHNSTON STUDENT CENTER

INTERIOR OF PRT STATION

DERRING
HALL

COWGILL HALL

PRT GUIDEWAY BYPASS

PARKING AREA

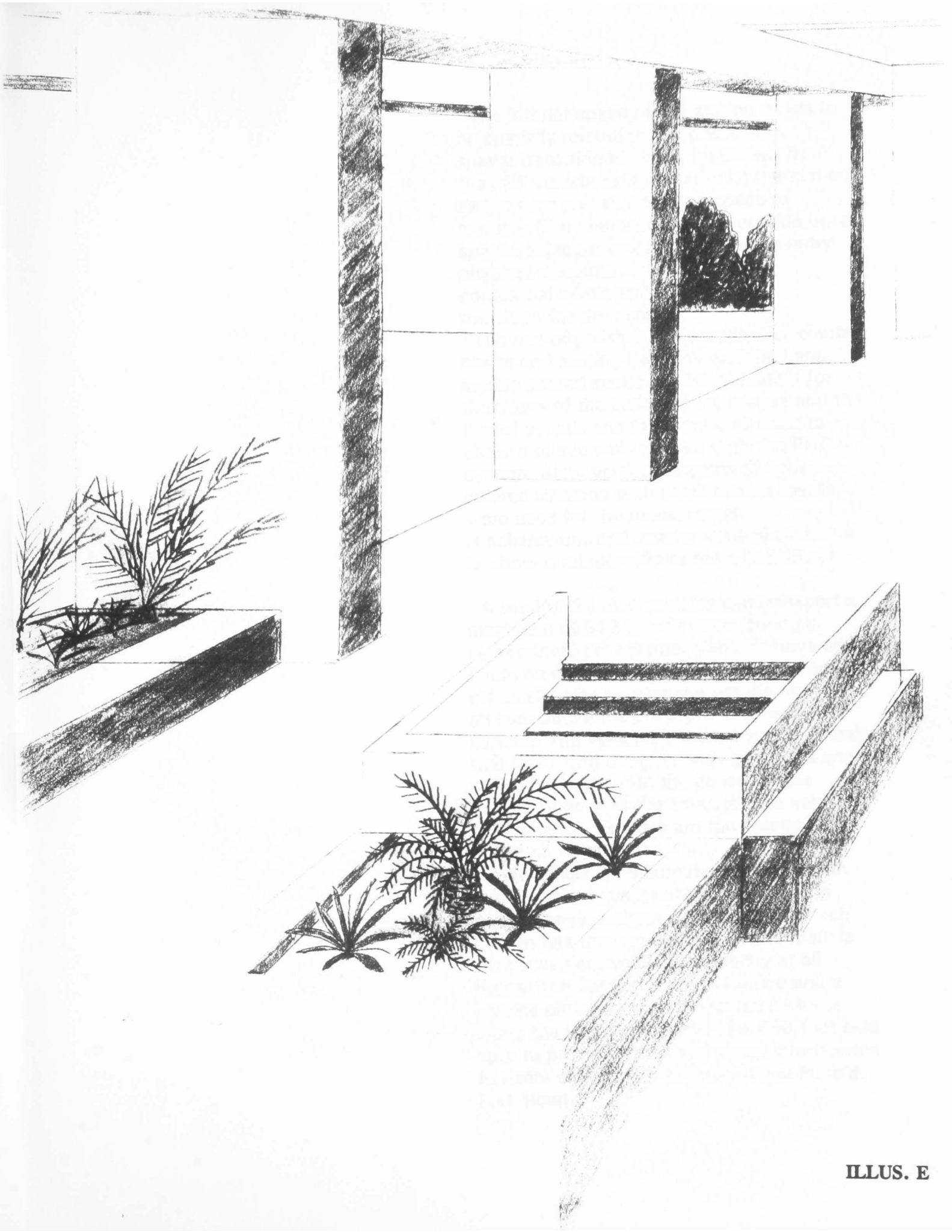
ILLUS. D

Support columns are narrow box shaped concrete structures that elevate the concrete guideway over roads, over sections of lower topography (to maintain less than a ten per cent grade), over streams and above 100 year floodplains. Guideways must be 16.5 feet above roadways and parking lots for tractor-trailer clearance. (ILLUS. A)

The total guideway length of the route from the Johnston PRT station to the PRT station at the Foxridge section of Hethwood is 3.5 miles. Vehicles average 30 mph. and travel about one half-a-mile in one minute. It would take seven minutes to travel a 3.5 mile distance including station stops with the PRT. In comparison, the public transit buses take at least twice the time to travel the same distance. And commuting time to and from campus by automobile is faster than bus, but travel time varies due to peak travel hour back ups. Stations are located about every one half-a-mile apart to allow for convenient walking distances. Average walking distance is less than one forth - a - mile for the passenger to walk to the PRT station.

The stations for commercial and housing nodes need to reflect the same elements as the new Johnston PRT station so the user can identify each station as a continuous system linking the connection points along the PRT route. (ILLUS. C)

Areas of pedestrian circulation exist at each PRT station interior and exterior spaces, and the opportunity for social interaction can be provided by designing areas for meeting other people. This can be accomplished by designing areas for spatial relationships for the users at each PRT station - seating areas along interior walls, planter boxes with seats. (ILLUS. E)



ILLUS. E

The interior space of the station needs to be spatially related to the passenger. A spatial transition needs to be shown from the PRT vehicle to the interior of the station as the user moves from one space to another. The station interior to outside open spaces adjacent to the station and nearby physical elements need to exhibit a contextual relationship and a visual transition for the user.

The use of polished dark granite for planter boxes and seating benches, polished and square scored sections of light marble for the floors of the inside of the station and the use of cycads and ferns were all used to show a relationship to time with the PRT system. Also, vertical columns of light colored siltstone with small marine fossils were used for the monumental sundial/pylons and interior vertical elements to show a relationship to time. (ILLUS. E)

A total of 24 PRT vehicles can transport a maximum of 912 transit riders during an eight minute time frame. Vehicles have air ducts on each side with fans blowing air out off small holes to raise the vehicle one half an inch above the concrete guideway surface. The vehicles have horizontal wheels that ride along the guideway guiderails and an electric current in the center of the guideway powers the activates the vehicle's components. Vehicles are run quietly and cause no air pollution.

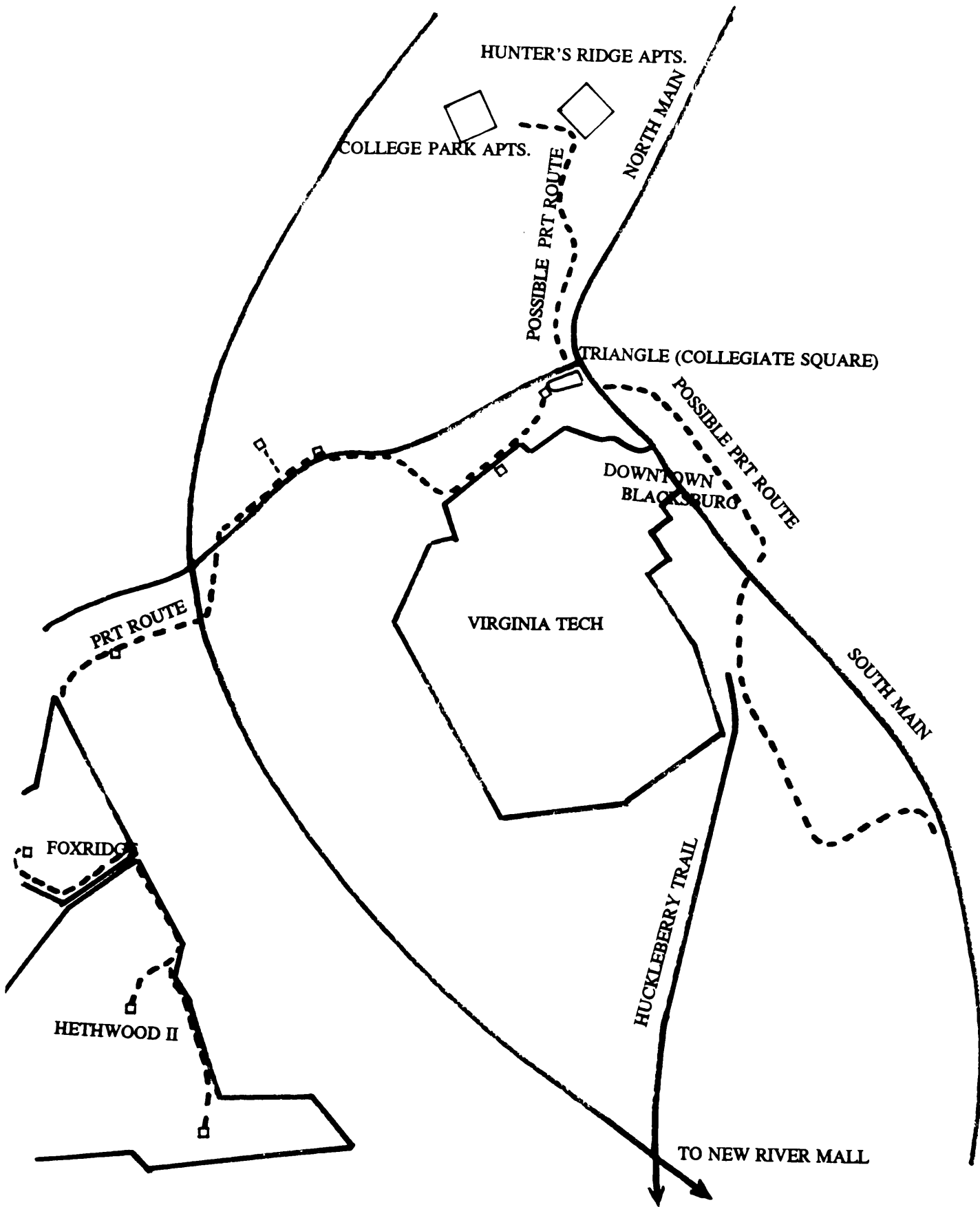
Each vehicle is computer operated with designation request panels, allowing the rider to have designation control and each station has user on demand control panels for convenient vehicle availability at all hours. The computer control office and a service garage station is located midway along the route at the end of a 660 foot side spur to prevent travel and visual interference to users of the main PRT route and Price's Fork Road.

FUTURE PRT CORRIDORS AND STATIONS

Potential areas for future PRT corridors that were not included in this study include a connection from the proposed Hethwood II PRT station westward to the growing housing areas around the village of Price's Fork in Montgomery County. Also, areas in need of an economic boost along South Main Street can be linked to PRT connections on campus, to the Huckleberry Trail with its bike route connection to the New River Mall in Christiansburg and to downtown Blacksburg. Also, a connection from campus to the Triangle shopping mall to North Main Street commercial areas and high density housing areas of Hunter's Ridge, College Park and Terrace View could be possible, however these areas in town are infilled and the location of a route would be costly. (MAP 11)

DISADVANTAGES IN AREAS OF URBAN INFILL

Problems occur when locating a PRT system in urban areas that have become built-up. Since these areas are lacking enough space to locate a route and station, higher costs of purchasing land and the demolition of structures and homes could create local opposition. Locating a PRT system into areas of urban decay does not guarantee that there will be enough economic gains for a return investment, resulting in regional opposition to an already costly project.



ADVANTAGES IN AREAS OF URBAN INFILL

The advantages of establishing a PRT system in areas of urban infill are the redevelopment of neglected commercial areas, construction of new high density housing units, renovation of decaying structures and the overall economic boost to the area - if the PRT location is planned for areas that have the potential to return an investment on the expenditure outlays for the project. Open space that is saved from less needed parking space, can be used for small urban parks for people to enjoy and as visual contrast to urban structures.

FUNDING

Due the high costs involved in establishing a PRT route, funds need to be located by the PRT development agencies to pool enough capital to get the program running. Also revenues need to be generated to maintain the operation of the system once the PRT is completed. Funding is available from several sources: the Federal Demonstration Grant Programs, the Urban Mass Transportation Administration and state transportation outlays. Revenues for the maintaince and operation can be generated from state taxes and student university comprehensive fees.

COST ESTIMATES

Cost for a PRT system is reduced each time a system is constructed, due to the knowledge gained from past errors in design and construction and a more efficient design and construction method. The WVU PRT system cost \$104 million for 2.25 miles of double guideway and stations in 1975. In comparison, the Tampa PRT project construction costs were \$14.6 million per mile in 1985. Based upon the Tampa PRT cost with added construction and design experience that would lower costs, and inflation that would raise the cost, today's cost may be around \$14 million per mile or \$39 million for a 3.5 mile route including stations.

GREENWAYS ALONG THE PRT ROUTE

The large tracts of agricultural land within Blacksburg can become integral components within the urban setting for contrasting visual and experiential enjoyment. With the establishment of a PRT system, housing can be located in concentrated nodes at a PRT station to save open agricultural land that would otherwise become a part of the typical urban sprawl that takes over the landscape. These remaining open agricultural spaces can be used as visual greenways with bike routes and walking paths through adjacent greenways to recreational sites and new high density housing clusters. MAP 90

Greenways can encourage tourism, increase property values, protect the cultural/agricultural identity of the local area, become educational experiences for children and adults, provide habitats for wildlife, improve environmental awareness and the monitoring of the greenway by local citizens for pollution problems, provide a scenic landscape for hiking, jogging, biking and the leisure enjoyment of nature.

SUMMARY AND CONCLUSIONS

In summary, the benefits of establishing a PRT for an area are numerous. PRT provides convenience, safety, reduced travel time, direct transportation to major destination points, more land to be saved for parks or greenways, redevelopment of old urban areas, economic boost to selected areas, reduced commuter traffic, and helps solve problems associated with an increasing population.

The negative aspects of PRT are mostly economic. Construction costs are very high, the system provides service to a selected area of town thus creating a lack of convenience to some residents. Also, locating PRT in areas of urban infill can drive up the cost with demolition and land purchases. Local opposition and no guarantee for a return investment on the PRT project can discourage its introduction.

Before establishing PRT, citizens, government agencies, planners and developers must determine that the needs and not the desires are guiding force for making PRT a reality for an urban area. The need for a PRT must clearly demonstrate that the total cost will not create a financial loss, but will enhance the economy of the area and provide solutions to transportation problems associated with an increasing population.

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