cutbacks. Aerial surveys are a useful modern tool for quickly inventorying the possibilities of a route change. Photos taken from about 7,000-ft elevation provide a good scale for counting buildings and estimating heights, which in turn provide a base for population and riding estimates.

In the planning of a new route, one problem to be solved is that of the terminal. In Chicago, we almost always will need an off-street turnaround complete with passenger waiting area, employee toilet, and phone. If more than 1 bus route is to share a turnaround, the design must provide an operating lane at the loading point for each route plus a bypass lane that will be used by a bus from any route to pass any of its leaders.

Other standards to be met by route changes consider the pavement widths, strengths, geometry at turns, traffic controls, and limitations involved.

Potential new traffic is perhaps the most important criterion affecting a route change. The best available estimating techniques are more art than science, but they can be applied by an experienced planner with great effectiveness. In Chicago, the probable attraction to transit for every housing or working unit is related to its distance from the route under consideration. An estimating basis is provided by the calculated riding habits actually experienced on an existing route in an area of comparable density and economic status.

To further define the potential of a new line, CTA planners ask industries along the route to respond to questionnaires that inventory facts about the number of employees (male, female, skilled, unskilled, white collar, blue collar), the number of visitors, the availability of parking, and the 1-year anticipated changes in these figures. Suggestions as to possible solutions are invited from parties requesting change, with indications of order or preference when more than one alternative is presented.

When service extension proposals are being made as a consequence of a request from outside of CTA, typically from an industry that recently relocated to an outlying area and feels that transit is obligated to follow it, the existence of systematic analysis procedures from the industry provides reassurance that the proposal is receiving fair consideration.

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Planning is a rational process directed toward attaining objectives. The Southeastern Wisconsin Regional Planning Commission (SEWRPC), as part of its regional land use-transportation planning program, formulated a set of regional development objectives as a basis for land use and transportation plan design, test, and evaluation. Of a total of 15 specific development objectives, 8 related to land use development and 7 to transportation system development. One of the latter related directly to transit service; it called for "a balanced transportation system providing the appropriate types of transportation service needed by the various subareas of the region at an adequate level of service." Two additional transportation system development objectives related indirectly to transit service in that they dealt with a reduction of accident exposure and with the alleviation of traffic congestion and reduction of travel time between component parts of the region.

To be useful in the regional planning process, the objectives had to be sound logically and related in a demonstrable and, when possible, measurable way to alternative physical development proposals. The objectives were, therefore, refined by the formulation of a corresponding set of guiding planning principles and a supporting set of specific development standards for each objective. This refinement allowed the objectives to be related to physical development plan proposals and thus used in the processes of plan design, test, and evaluation.

The following definitions indicate the purpose of each of these elements (1):

1. Objective. A goal or end toward the attainment of which plans, policies, and programs are directed.
2. Principle. A fundamental, primary, or generally accepted tenet used to support objectives and prepare standards and plans.
3. Standards. A criterion used as a basis of comparison to determine the adequacy, correctness, and suitability of plan proposals to attain objectives.
4. Plan. A design that seeks to achieve agreed-on objectives.

The objective states what is to be achieved, the principle states why the objective is valid, and the standard states how the objective can be met.

TRANSPORTATION SYSTEM DEVELOPMENT STANDARDS

The supporting transportation system development standards fall into 2 groups: comparative and absolute standards. The comparative standards, as the term implies, serve only as a basis for the comparison of alternative transportation plans. Minimizing the vehicle-miles of travel is an example of such a comparative standard. There is no "desirable" value for this standard. Simply, the alternative plan that generates the lowest vehicle-miles of travel will best meet this standard.

Absolute standards are measurable in terms of a maximum, minimum, or desirable numeric value. A desirable operating speed for a specific type of highway facility is an example of such an absolute standard.

Transportation System Plan Design

The development of a transportation system plan involves a systematic process of, first, identifying the deficiencies in the existing and committed system by comparing various elements against the applicable standards; second, postulating improvements and additions to the existing and committed system to alleviate these deficiencies; and, third, testing the postulated improvements to determine whether they do in fact alleviate the deficiencies.

In the testing process, the total person travel demand expected to be generated within the planning area in the plan design year is estimated and divided into portions expected to use the 2 basic modes available, the automobile and public transit. These 2 segments of the total travel demand are then assigned to specific routes within the highway and transit systems. At this point, the transportation systems planner must determine whether the postulated facility improvements should be included as part of the total transportation plan. The transportation system development standards are designed to facilitate this determination.

Overriding Considerations

In the preparation of regional transportation plans and in the application of the transportation system development standards, 2 overriding considerations exist. First, the facilities included in each transportation plan must constitute a complete and integrated system. It is not possible to determine the manner in which the individual facilities composing a system interact from application of the transportation system development standards per se. This must be done through quantitative test and evaluation of the proposed system by the use of traffic simulation models.

Second, an overall evaluation of each transportation system plan must be made with respect to cost. The cost of meeting the standards must necessarily be considered in order to ensure plan feasibility. If the attainment of one or more standards is beyond the available financial resources, either the standards must be lowered or additional financial resources sought.

Thus, decisions made and results reached in one phase of the planning process have ramifications in other phases of the process. The objectives to be achieved and their supporting standards dictate the design of the plan; but the design of the plan and its cost may also cause modifications in the objectives and standards as initially formulated. Also, the decision to change some element of the land use plan may necessitate modification of the transportation plan; and conversely the decision to change some elements of the transportation plan may necessitate modification of the land use plan.

Furthermore, community development objectives are not static but are subject to change over time. These changes must be monitored and suitable revisions in the plan made to ensure that the needs of the people are met by the plan design.

TRANSIT PLANNING

In the recent past, transit planning has been a relatively neglected phase of the overall urban transportation planning process. To some extent this has been due to the relatively minor role that transit plays in many smaller urban areas. But this somewhat cursory treatment of transit planning has also been due, in part, to the lack of a well-developed planning methodology for accomplishing the task.

The design of a transit system is a more difficult task than the design of a highway system, at least within southeastern Wisconsin. The basic highway design problem within the region consists of providing the traffic capacity required to eliminate deficiencies in the existing and committed system and to meet anticipated travel demand while still maintaining an operational system and not destroying environmental amenities. In contrast to the highway system, the existing transit system in southeastern Wisconsin has more than adequate capacity to carry the existing and potential passenger demand. Moreover, transit system capacity determinants, such as frequency of service and type of equipment, are more readily variable so that the capacity of this system is much more flexible than is that of the arterial street and highway system. The design of a transit system thus becomes a problem of creating demand for service rather than that of supplying system capacity to meet an existing demand. This makes it particularly important that the designer understand who will use the system and why.

Users of a transit system can be divided into 2 groups: those who must use transit (captive riders) and those who choose to use transit (choice riders). The captive riders cannot use the automobile to satisfy their travel needs because either a car is not available to them or they are not able to drive. In the design of a transit system, the provision of service to these captive riders is an important concern. The choice riders decide to use the transit system because such use in some way is more advantageous to them than the use of an automobile. If a transit system is to attract these riders, transit service must compete favorably with the service provided by the highway system. The success that a transit system may achieve in diverting choice trips from highway facilities will, to a considerable extent, determine the balance that will exist within the region between highway and transit utilization. This ability to divert choice trips thus becomes a second important concern in the design of a transit system.

In that the passenger loads on transit routes and facilities within the region seldom reach the capacity of the routes and facilities, there is no technique available in transit system design equivalent to the capacity deficiency analysis used in highway system design by which transit improvement proposals can be developed. Furthermore, because highway facilities are generally available throughout the entire region, an automobile trip can always find a route to and from all areas of the region. In contrast, transit service is not available throughout the entire region, and a transit trip consequently cannot be readily made to or from all areas. Since the number and the location of transit trips are dependent in part on the availability of transit service, no technique is, therefore, readily available to determine what the potential transit demand in any area of the region may be without first postulating new transit routes.

Four questions thus arise in transit system design:

1. Where should new transit routes be provided?
2. What types of service should be provided for each route?
3. What quality of service should bc provided for each route?
4. How much will the service cost?

A fifth question, concerned with who should pay for the transit service, is not a technical question to be treated in the design process but, rather, a policy question to be answered through the political process. It will not be treated here.

As already noted, the transit system design will determine the extent to which transit service will reduce the need for additional highway facilities. These 4 questions were, therefore, considered in the formulation of transit system development objectives and standards for southeastern Wisconsin, but were considered separately for local and rapid transit.

Local Transit Standards

Local transit service was defined as the transportation of persons by buses operating in relatively frequent service over prescribed surface streets on regular schedules (2, p. 20). In long-range area-wide planning, it is extremely difficult and of questionable value to plan a local bus system to the detail of setting headways and determining schedules. The operating companies or agencies are generally in a better position to determine the modifications in local service that are required to meet changing needs. The following standards in support of the basic transit system development objective, however, served as a guide in planning for local transit service.

1. Local transit service should be provided for all routes within the region where the minimum potential average weekday passenger loading equals or exceeds 600 passengers per day per bus. (A transit route may be serviced by a single bus if it can make a round trip in 1 hour or less. If either the route length or the potential revenue-passengers increase, additional buses may be required to service the route.) Local transit service area radius was considered to be ¼ mile in high-density residential areas and ½ mile in medium- and low-density residential areas.
2. Local transit routes should be provided at intervals of no more than ½ mile in all high-density residential areas. (A high-density area contains 10,000 to 25,000 persons per gross square mile or from 22.9 to 59.2 persons per net residential acre. A medium-density area contains 3,500 to 9,999 persons per gross square mile or from 7.3 to 22.8 persons per net residential acre. A low-density area contains 350 to 3,499 persons per gross square mile or from 0.5 to 7.2 persons per net residential acre.)
3. Maximum operating headways for all local transit service throughout the daylight hours (6 a.m. to 8 p.m.) should not exceed 1 hour.
4. The average distance between local transit stops should not be less than 660 ft for local transit service.
5. Loading factors for local transit service should not exceed the following:

Headways on Route (min)	Maximum Loading Factor for Periods Exceeding 10 Min (percent)
10	100
5 to 10	125
< 5	140

6. Transit routes should be direct in alignment, have a minimum number of turning movements, and be arranged to minimize transfers and duplication of service.

7. The proportion of transit ridership to the central business district of each urbanized area within the region should be maintained at least at the present level and increased if possible.

Rapid Transit Standards

Rapid transit service was divided into 3 subcategories, defined as follows (1, p. 20):

1. Modified rapid transit is the transportation of persons by buses operating over freeways in mixed traffic.
2. Bus rapid transit service is the transportation of persons by buses operating over exclusive freeway lanes or exclusive and fully grade-separated rights-of-way to provide high-speed service.
3. Rail rapid transit service is the transportation of persons by single- or dual-rail trains operating over exclusive and fully grade-separated rights-of-way to provide high-speed service.

If the rapid transit system is to alleviate the demand on highway facilities, especially during peak hours, it must provide service attractive enough to divert choice trips from the use of the automobile. The service must be attractive with respect to both route location and speed. In rapid transit system design, therefore, it becomes necessary to provide a high enough level of service to attract sufficient ridership to justify provision of the service and to reduce the demand for highway facilities. To accomplish this objective, the rapid transit plan finally developed for southeastern Wisconsin made maximum use of the extensive freeway system proposed for the region (Fig. 1). This freeway system supplies wide areal coverage and occupies the corridors of highest travel demand within the region (Fig. 2).

In the rapid transit plan development, high-speed transit service was initially proposed for all highway corridors exhibiting a high travel demand; no prejudgments were made of the type of transit service to be provided. For planning design purposes, however, proposing only the location of these rapid transit routes was not sufficient; quantitative tests of the proposals were also necessary to determine whether they would indeed serve the purpose for which they were intended and to determine what type and quality of service should be provided. These initial proposals were, therefore, tested by a set of simulation models (1, 2, 3) to determine whether the potential utilization would be sufficient to justify incorporation into the final plan.

The following standards were formulated to aid in the rapid transit plan design, test, and evaluation (1, Table 2):

1. Transit service of an appropriate type should be provided for all routes within the region where the minimum potential average weekday revenue passenger loading equals or exceeds the following values:

Transit Service	Min Potential Avg Weekday Revenue-Passengers	Transit Service Area Radius (miles)
Modified rapid transit		
6 a.m. to 8 p.m.	600/day/bus	3
Limited	300/4 hr/bus	3
Bus rapid transit	21,000/day/preempted freeway lane	3
	For separate right-of-way, see Figure 3	3
Rail rapid transit	See Figure 4	3

2. Maximum operating headways for all transit service from 6 a.m. to 8 p.m. should not exceed 1 hour.

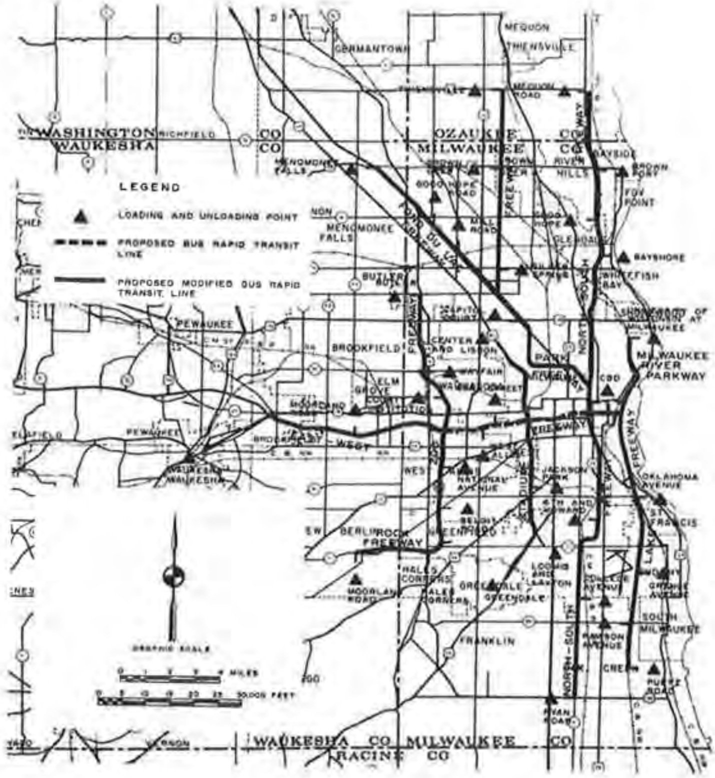


Figure 1. Proposed regional bus rapid transit system for 1990.

Figure 2. Regional average weekday traffic in 1990.

Figure 3. Threshold service for bus rapid transit.

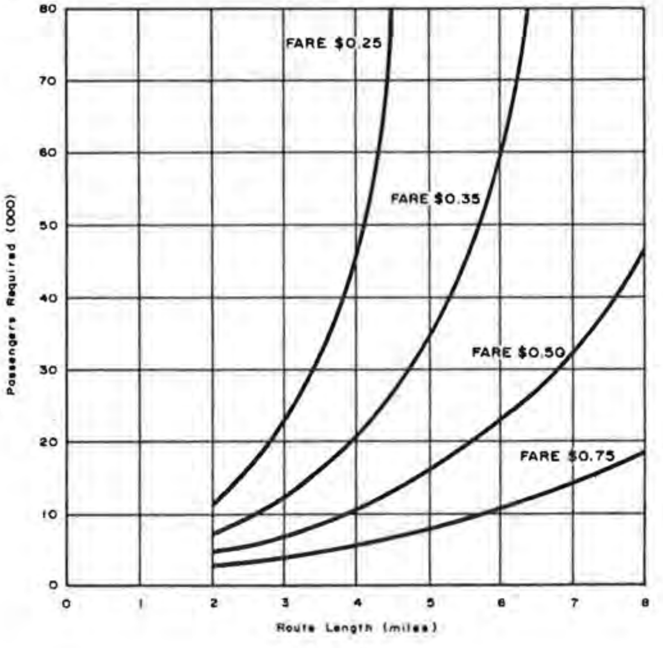
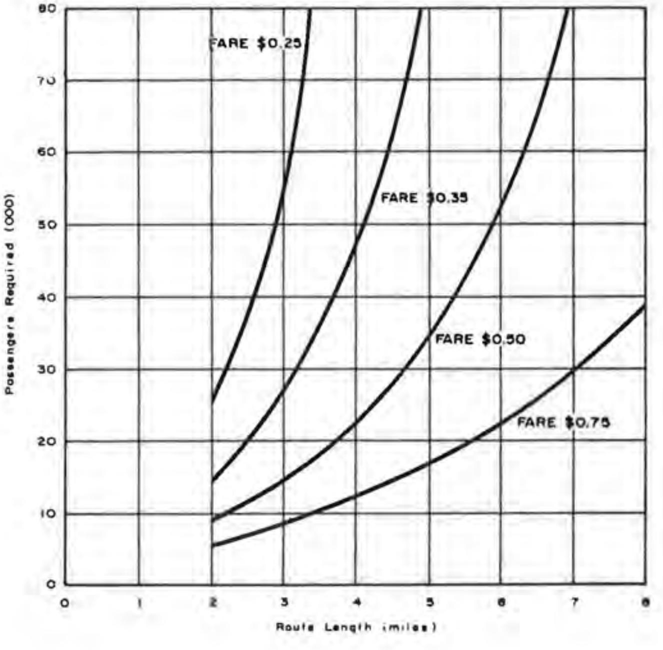


Figure 4. Threshold service for rail rapid transit.



3. The average distance between transit stops should not be less than the following:

Transit Service	Avg Distance Between Stops
Modified rapid transit	No stops between terminal areas
Bus rapid transit	2 miles (for line-haul sections)
Rail rapid transit	2 miles (for line-haul sections)

4. Maximum loading factors should not exceed 100 percent for periods greater than 10 minutes.

5. Transit routes should be direct in alignment, have a minimum number of turning movements, and be arranged to minimize transfers and duplication of service.

6. The proportion of transit ridership to the central business district of each urbanized area within the region should be maintained at least at the present level and increased if possible.

7. Modified rapid transit or rapid transit service should be provided as necessary to reduce peak loadings on arterial streets and highways in order to maintain a desirable level of transportation service between component parts of the region.

8. Parking should be provided at transit stations to accommodate the total parking demand generated by trips that change from automobile to transit modes.

DERIVATION OF RAPID TRANSIT THRESHOLD SERVICE WARRANTS

Standard 1 can be termed a rapid transit threshold service warrant, for it specifies the minimum potential revenue-passenger loading that would justify initiation of rapid transit service. The warrants were set on the basis of analyses that require additional description. Two cases were involved: One case concerns the preemption of freeway lanes (analyzed on a quite simple, purely rational basis), and the other concerns the construction of exclusive facilities (analyzed on an economic basis).

Preemption of a Freeway Lane

One method of providing bus rapid transit service is to use a freeway lane exclusively for the operation of buses. In April 1964, the director of planning for the U.S. Bureau of Public Roads stated (4): "Many factors are involved in a decision to reserve a lane for buses, even during peak hours. The Bureau of Public Roads takes the position that such a reservation is reasonable if the usage by bus passengers exceeds the number of persons that would normally be moved in the same period in passenger cars."

On an average weekday basis, the number of persons carried by automobile in a freeway lane can be computed as follows (5):

Urban Design Capacity	Vehicles per Day
6 lanes	85,000
1 lane	14,200

Therefore, if it can be demonstrated that 14,200 × 1.5 (average car occupancy) or 21,000 passengers per day can be carried by the buses, justification is sufficient for preempting a lane of freeway. (The determination of daily vehicular capacity is a complex problem involving many factors, including specific peak-hour volumes, directional split, design geometrics, and distribution of traffic by lane. The foregoing computations, therefore, represent an approximation based on average conditions within the region.)

Bus Rapid Transit on Separate Right-of-Way

The cost of providing transit service is equal to the sum of the operating and capital costs. The method used to pay for the service—fares with public subsidy—does not alter the true cost of providing the service. Therefore, a series of threshold service warrant curves were developed specifying the number of passengers paying an "equivalent fare" required to justify the institution of rapid transit service. The equivalent fare was defined as the amount that each transit passenger would have to pay if the total cost of the transit service was to be recovered from the fare box. In this manner, the true cost of providing the service was estimated. The threshold service warrant curves thus provide a common basis for the evaluation of alternate courses of pricing policy; they are an aid in system design as well.

Formula Development

The threshold service warrant curves were drawn from computations based on the assumption that the sum of the system operating and capital costs are to be paid by the passenger revenue generated by the system. More specifically,

$$\text{Passenger revenue} = \text{operating costs} + \text{capital costs} \tag{1}$$

$$\text{Total daily passenger revenue} = \text{equivalent fare} \times \text{number of busloads per day} \times \text{avg number of passengers per bus} \tag{2}$$

$$\text{Total daily operating costs} = \text{operating cost per bus-mile} \times \text{number of busloads per day} \times \text{length of busway} \times 2 \tag{3}$$

$$\text{Total daily capital costs} = \text{length of busway} \times (\text{daily capital cost for right-of-way and construction per mile of busway} + \text{daily maintenance per mile of busway}) + \text{daily capital cost for terminal construction} \tag{4}$$

If X = number of busloads per day, L = length of busway, F = equivalent fare, operating cost per bus-mile, including depreciation of rolling stock and supporting yards and shops = 56 cents per bus-mile, average number of passengers carried per busload = 26 per bus, daily capital costs for line right-of-way and construction per mile at a 6 percent rate of return plus daily maintenance costs per mile of busway = \$901 per mile per day, and daily operating costs = $0.56(X)(L)(2) = 1.12XL$, then Eq. 1 can be rewritten

$$26XF = 1.12XL + 901L + 31 \tag{5}$$

Equation 5 can be solved for X (the number of busloads per day on the route), which is multiplied by the average number of passengers carried per bus to yield the number of revenue passengers required at a specified fare to justify the service.

In the calculation of the data for the construction of threshold service warrant curves, fares of 25, 35, 50, and 75 cents were used. Route lengths varied from a minimum of 2 miles to that length at which the revenue-passenger loads required exceeded 80,000 per day. The final curves developed are shown in Figure 3.

Cost Data

In the development of the threshold service warrant curves for a bus rapid transit system, the following construction, maintenance, and operating costs were used.

1. The average cost of acquiring land through developed portions of Milwaukee County was determined on the basis of past experience to be about \$150,000 per acre,

including costs of acquiring and razing existing buildings and structures. A typical cross section for a 2-lane exclusive bus roadway was postulated (Fig. 5), which requires approximately 15 acres of land per mile of roadway, resulting in an estimated cost for right-of-way acquisition of $2,250,000 per mile.

2. The cost of constructing the roadway was estimated as follows:

Item	Dollars per Mile
Portland cement concrete pavement with valley gutters	150,000
Storm sewerage	50,000
Fencing	25,000
Earthwork utility relocation, sodding, and seeding	180,000
Grade separation structures (2 per mile)	200,000
Subtotal	605,000
Engineering, surveys, and contingencies	45,000
Total	650,000

3. The cost of constructing a transit bus terminal at the downtown end of the line was estimated at $100,000.

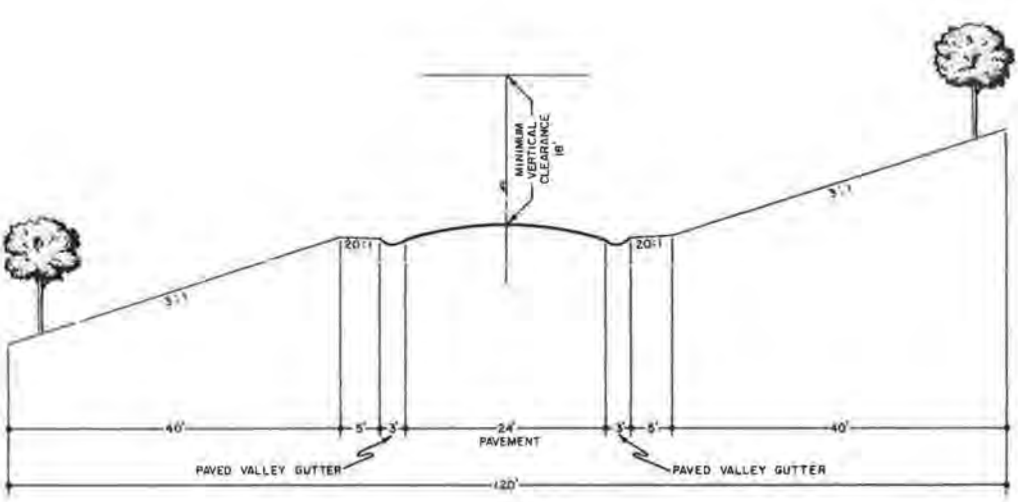
4. The cost of maintaining the busway, including snow removal, was estimated at $1,500 per lane-mile per year or $3,000 per route-mile per year.

5. The cost of a standard 52-seat, air-conditioned bus capable of 60- to 70-mph running speeds was estimated at $27,750. Using a 6 percent interest rate, a 12-year service life, and a 5 percent allowance for downtime, the annual cost was estimated at approximately $3,444 per bus.

6. The total cost of the necessary yards and shops for equipment storage and maintenance was estimated at $5,000 per bus. At a 6 percent interest rate, a 25-year service life, and a 5 percent allowance for downtime, the annual cost was estimated at approximately $411 per bus.

7. The total operating costs, including equipment maintenance, fuel, conducting transportation, traffic, and general overhead, were estimated at 45.6 cents per bus-

Figure 5. Typical busway cross section.



mile. Depreciation on buses and supporting yards and shops was estimated at 10.7 cents per bus-mile, giving a total operating cost of approximately 56 cents per bus-mile.

The capital costs were divided into 3 categories: fixed facility costs that vary directly with route length, such as right-of-way, construction, and maintenance; fixed facility costs that are independent of route length, such as a central terminal; and rolling stock and costs that can be associated with the number of buses, such as yards and shops. The first 2 categories of costs were used to calculate the daily capital cost. The third category was included in the operating costs as depreciation. This was consistent with the plan proposal that a public agency construct the busway and lease its operation to a private transit corporation.

8. Daily capital costs were computed before the threshold service warrant curves were calculated. The present-worth method was used, for which the formula is

$$R = P \frac{i(1 + i)^n}{(1 + i)^n - 1}$$

where

R = annual rate necessary to retire principal and pay interest,
P = present worth of investment,
i = interest rate, and
n = number of years to retire principal.

The interest rate was set at 6 percent based on the concept that an economical public project should have a return at least as high as a private investment. The number of years to return the principal was set differently for each component of the proposed system based on the estimated physical life of the component. A return period of 25 years (except for maintenance) was used in the following calculations of daily costs

Item	Total Cost	Annual Cost
Right-of-way	2,250,000	176,078
Construction	650,000	50,849
Maintenance	—	3,000
Total		229,867
Terminal	100,000	7,823

The amounts were divided by 255 average annual weekdays to yield approximately \$901 per mile per day for the first 3 items and approximately \$31 a day for the terminal.

Rail Rapid Transit

Formula Development

The rail rapid transit threshold service warrant curves were computed by using the same basic equations used in computing the bus rapid transit curves. The following equations were developed:

$$\text{Passenger revenue} = \text{operating costs} + \text{capital costs} \quad (6)$$

Total daily passenger revenue = equivalent fare × number of carloads per day × avg number of passengers per carload (7)

Total daily operating costs = operating cost per car-mile × number of carloads per day × length of rail line × 2 (8)

Total daily capital costs = length of rail line × (daily capital cost for right-of-way and construction per mile of rail line + daily maintenance cost per mile of rail line) + ½(length of rail line - 2) (daily capital cost for each line station) + 2 (daily capital cost for each terminal station) (9)

If X = number of carloads per day, L = length of rail line, F = equivalent fare, operating cost per car-mile, including depreciation of rolling stock and supporting yards and shops = 73 cents per car-mile, average number of passengers carried per carload = 28 per car, daily capital cost for line right-of-way and construction per mile at a 6 percent rate of return plus daily maintenance costs per mile of rail line = $1,456 per day, daily capital costs for each line station (one every 2 miles) at a 6 percent rate of return = $168 per line station per day, daily capital costs for each terminal station (2 required) at a 6 percent rate of return = $322 per terminal station per day, and daily operating costs = 0.73(X) (L) (2), then Eq. 6 can be rewritten as

$$\begin{aligned} 28XF &= 1.46XL + L(1{,}456) + \tfrac{1}{2}(L - 2)(168) + 2(322) \\ &= 1.46XL + 1{,}540L + 476 \end{aligned} \qquad (10)$$

Equation 10 can be solved for X (the number of carloads per day on the rail line), which is multiplied by the average number of passengers carried per car to yield the number of revenue passengers required at a specified fare to justify the service.

In the calculation of the data for the construction of threshold service warrant curves, fares of 25, 35, 50, and 75 cents were used. Route lengths varied from a minimum length of 2 miles to that length at which the revenue-passenger loads required exceeded 80,000 per day. The final curves developed are shown in Figure 4.

Cost Data

The following construction, maintenance, and operating costs were used in developing the threshold service warrant curves for a rail rapid transit system:

1. The same approach was used to estimate the rail system right-of-way cost as was used for the bus system. The estimated cost of right-of-way acquisition for the rail system was $2,250,000 per mile.
2. The cost of constructing the rail line was estimated as follows:

Item	Dollars per Mile
Double track line	225,000
Storm sewerage	50,000
Fencing	25,000
Earthwork, utility relocation, sodding, and seeding	180,000
Grade separation structures (2 per mile)	600,000
Electrification	500,000
Signalization	450,000
Subtotal	2,030,000
Engineering, surveys, and contingencies	210,000
Total	2,240,000

3. The cost of constructing a rail terminal at each end of the rapid transit rail line was estimated at an average of $1,050,000 per station, including crossovers and storage sidings. The construction cost of line stations at 2-mile intervals along the rail line was estimated at $550,000 per station including 250 linear feet of platform.

4. The total cost of maintaining the rail line, including snow removal, was estimated at $10,000 per track-mile per year or $20,000 per line-mile per year for a double-track line.

5. The cost of a rapid transit rail car was estimated at $80,000 per car. Based on a 6 percent interest rate, a 25-year service life, and a 5 percent allowance for downtime, the annual cost was estimated at $6,571 per car.

6. The total cost of the yards and shops for equipment storage and maintenance was estimated at $8,000 per car. Again, based on a 6 percent interest rate, a 25-year service life, and a 5 percent allowance for downtime, the annual cost was estimated at $657 per car.

7. The total operating costs, including equipment maintenance, power, conducting transportation, traffic, and general overhead were estimated at 53 cents per car-mile. Depreciation on cars and supporting yards and shops was estimated at 20 cents per car-mile, giving a total operating cost of 73 cents per car-mile.

The capital costs of rail rapid transit were also divided into 3 categories as were those of bus rapid transit.

8. The threshold service warrant curves were calculated after certain costs were reduced to a daily basis. The present-worth method used for bus rapid transit was used. The interest rate was 6 percent, and the period of time required to return the principal was set at 25 years for each component of the rail system based on the estimated physical life of the component.

Item	Total Cost	Annual Cost
Right-of-way	2,250,000	176,017
Construction	2,240,000	175,235
Maintenance	—	20,000
Total		371,252
Terminal station	1,050,000	82,142
Line station	550,000	43,026

Based on an annual average of 255 weekdays, daily costs are $1,456 per mile for right-of-way, construction, and maintenance; $322 for each terminal station, including crossovers and storage sidings; and $168 for each line station.

SUMMARY AND CONCLUSION

The objectives and standards, including threshold service warrants for rapid transit service and the supporting cost data described here, were developed for long-range area-wide planning purposes. As such, they are necessarily preliminary and will require refinement as the recommendations contained in the now adopted regional transportation plan are implemented. It is anticipated that the first major refinement will be carried out as preliminary engineering plans are prepared for the busway recommended in the adopted plan.

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