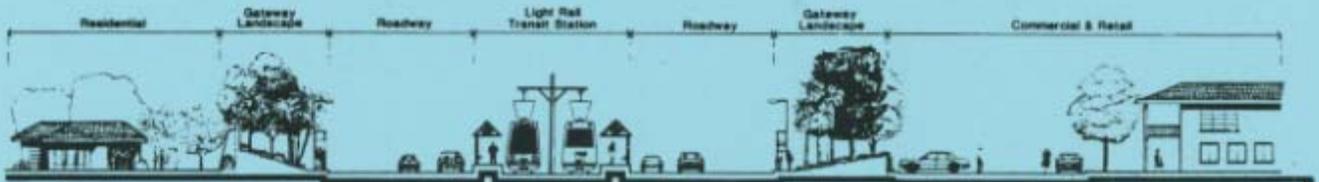


DRAFT FINAL REPORT

Broadway Corridor Transportation Study



**The City of Tucson
Department of Transportation**

Submitted by :
**Parsons Brinckerhoff
Quade & Douglas, Inc.**

In association with:
**Rillito Consulting Group, Inc.
COMSIS Corporation
Rogers, Gladwin & Harmony, Inc.
Gene D. Cox Company
RGA Engineering Corporation**

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David G. Marshall	Transportation Planner
Ellen Saltzman	Transportation Planner
Christina Avenetti	Secretary, Transportation Planning and Programming Division
Jim Begley, Eugene Caywood	Citizen Transportation Advisory Committee

EXECUTIVE SUMMARY

**BROADWAY CORRIDOR STUDY PHASE I
FINAL REPORT**

Prepared For:

THE CITY OF TUCSON

Prepared By:

PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

In Association With:

**RILLITO CONSULTING GROUP
ROGERS GLADWIN & HARMONY, INC.
COMSIS CORPORATION
GENE COX AND ASSOCIATES
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February, 1987

D R A F T

This project was financed in part by a grant from the
U.S. Department of Transportation Urban Mass Transportation Administration

EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

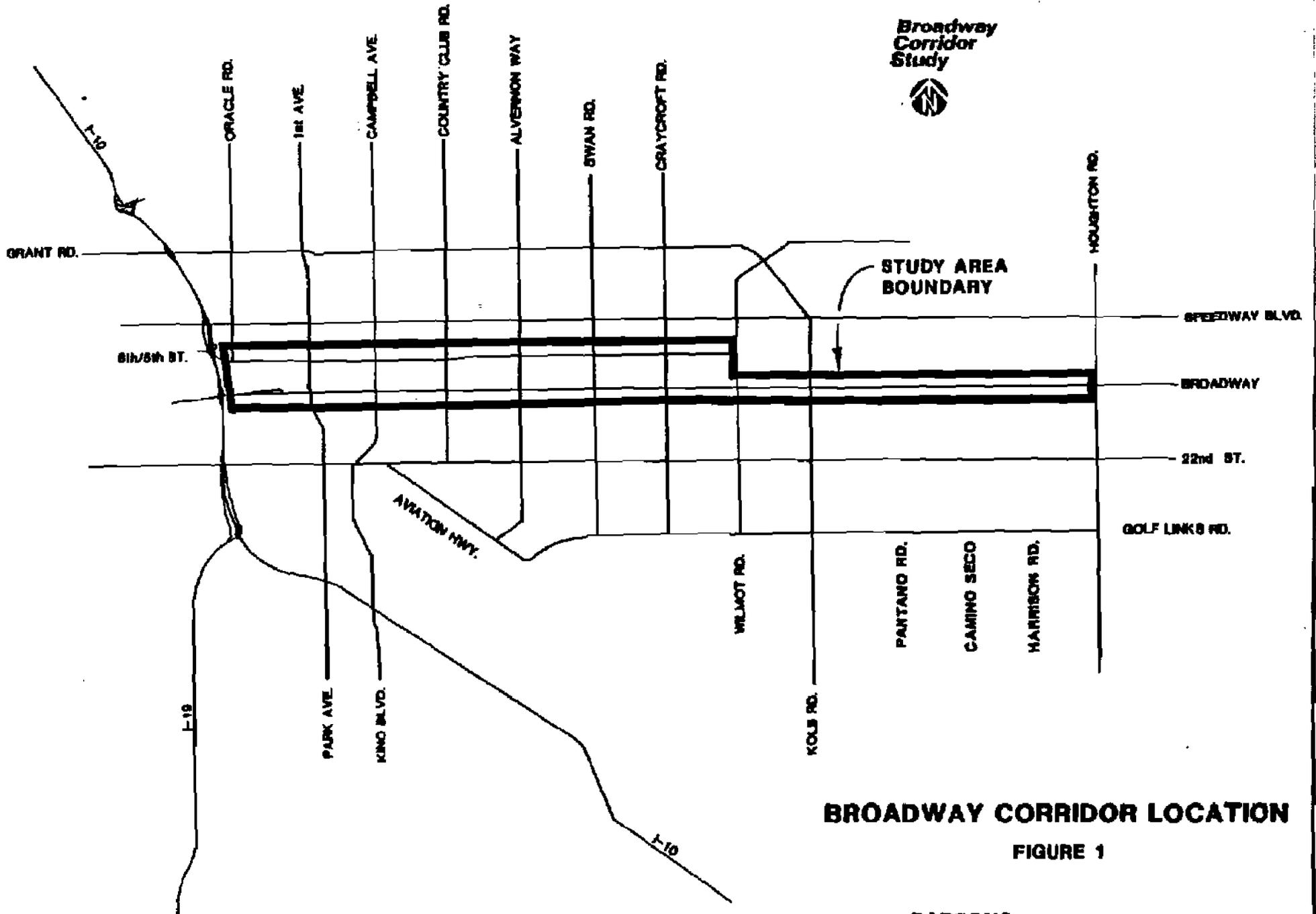
INTRODUCTION

The purpose of the Broadway Corridor Study was to identify transit, roadway, and transportation system management alternatives which will accommodate Year 2005 travel needs. The Pima Association of Governments' population and employment forecasts and the adopted Regional Transportation Plan components and goals were used as a basis for the study. In addition to meeting transportation needs, the comprehensive nature of the Broadway Corridor Study also includes an analysis and study of urban design themes and methods for improving pedestrian movement. Concepts were developed for landscaping and buffering schemes within the context of the Urban Land Institute/American Institute of Architects identification of Broadway as a Gateway Route and the concepts developed by the Urban Design Commission for Pima County.

As illustrated in Figure 1, the study corridor is one mile wide, centered on Broadway Boulevard and extending from I-10 on the west to Houghton Road on the east, a distance of twelve miles. The study also included 5th/6th Streets from Stone Avenue to Wilmot Road. In the section of Broadway Boulevard between I-10 and Euclid Avenue, only the transit concepts were evaluated since the roadway concepts were previously adopted during the Aviation Corridor Study and the Downtown Circulation and Parking Study.

The Broadway Corridor Study was sponsored by the City of Tucson, administered by the City Department of Transportation, and financed through a grant from the Urban Mass Transportation Administration (UMTA) and by the City of Tucson.

**Broadway
Corridor
Study**



BROADWAY CORRIDOR LOCATION

FIGURE 1

EXISTING CONDITIONS

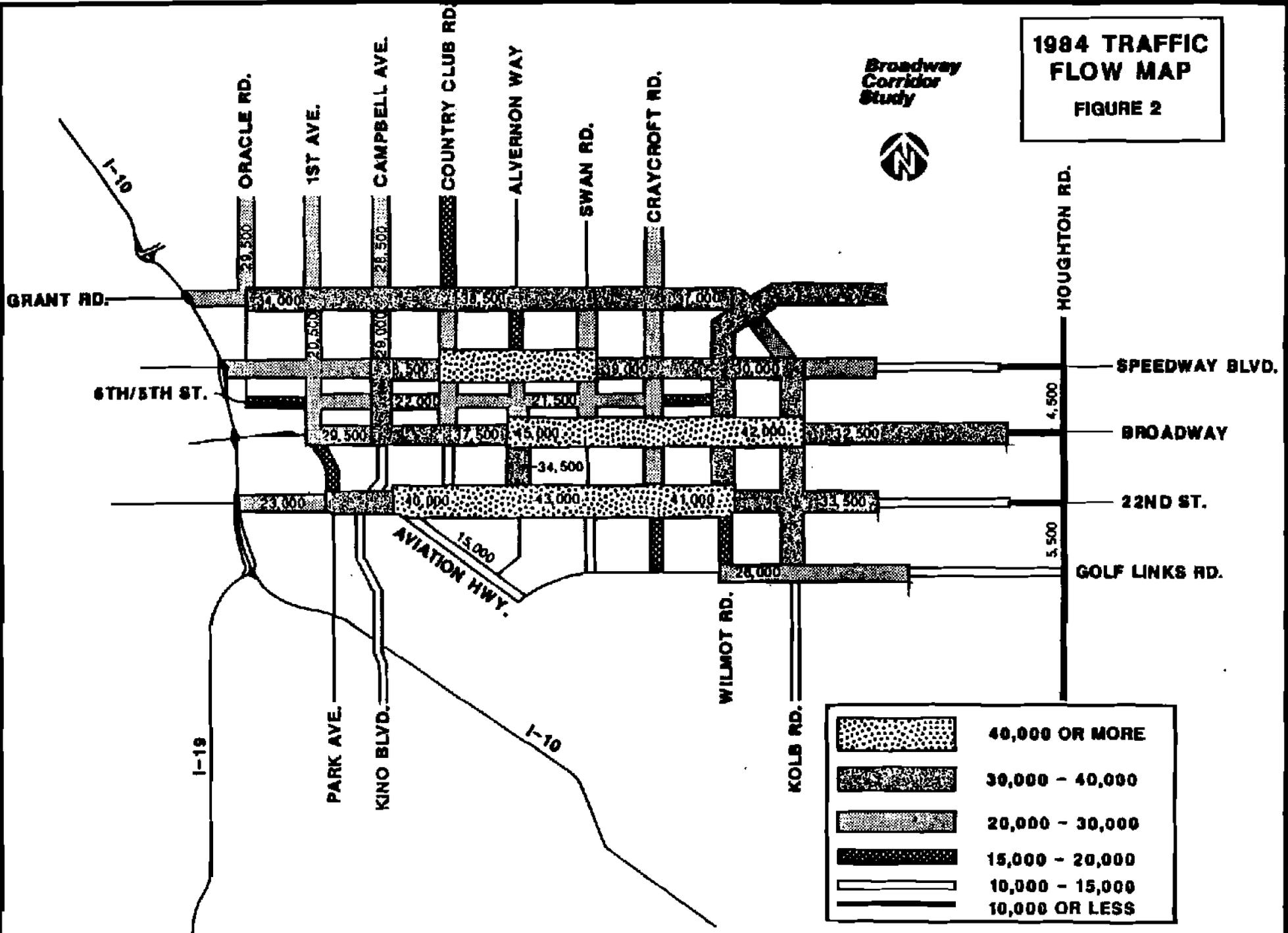
The Broadway Corridor comprises a wide assortment of transportation system management concepts and design themes. The corridor varies from a two-lane roadway to six travel lanes plus two diamond lanes. The right-of-way varies from 70 feet to 200 feet. Reversible travel lanes operate to increase peak-period capacities on Broadway Boulevard between Euclid Avenue and Country Club Road and on 5th/6th Streets between Stone Avenue and Alvernon Way. Present auto occupancy on Broadway Boulevard during the peak period is approximately 1.2 persons per auto. Today, Broadway Boulevard has average daily traffic (ADT) volumes ranging from 9,000 on the far east end to 45,000 midtown, with 30,000 ADT on the west end. Intersection levels of service vary from "B" to "F" during the peak hours. In addition, 5th/6th Street is presently carrying 16,000-22,000 ADT with peak-hour intersection levels of service in the "B" to "F" range as well. Figure 2 is a traffic flow map of streets in and adjacent to the Broadway Corridor.

There are many design themes within the Broadway Corridor. The corridor connects a network of major activity centers and borders a variety of established residential neighborhoods. The urban texture along Broadway is varied and includes residential uses, historic buildings, strip commercial, neighborhood commercial, and regional commercial uses, and less-developed areas. A variety of landscaping treatments ranging from natural desert to heavily landscaped areas using natural and non-desert plant pallettes, to areas of little or no landscaping exist in the corridor. The City of Tucson has constructed and maintains a system of landscaped medians, which enjoy popular support, from Country Club Road to Camino Seco.

Future public transit requirements were also a major component of the corridor study. In FY 1984-85, the existing Route 8 (part of which runs along Broadway Boulevard) carried approximately 26% of the SunTran system's total daily ridership and was by far the most productive route with 34% of the costs covered by farebox revenues. This compares to a systemwide farebox recovery ratio of 27%. Regular transit is also supplemented by peak-period express transit service in the corridor.

1984 TRAFFIC FLOW MAP
FIGURE 2

Broadway Corridor Study



COMMUNITY PARTICIPATION

Community participation was a major element of the study. The components of the community participation (CP) program included the formation and involvement of a Community Coordination Forum comprised of 35 individuals representing neighborhood, business, and community interests in the corridor; the distribution of a public information brochure and other materials; the conduct of several workshops and public meetings; and the attendance at over 40 neighborhood and community group meetings as identified in Table 1. For each of the public meetings and for the neighborhood meetings held December 10-17, 1986, approximately 25,000 notices were mailed to residents and businesses within the Broadway Corridor. Total attendance for all meetings has exceeded 1,600 individuals to date. The evolution of the study reflects the input received from the community as issues were identified and addressed.

TABLE 1

NEIGHBORHOOD AND COMMUNITY GROUP MEETINGS

DATE	ATTENDANCE ⁽¹⁾	GROUP
10-30-85	3	Modern Transit Society of Tucson
12-19-85	7	Modern Transit Society of Tucson
2-2-86	(65)	Broadmoor Neighborhood
2-12-86	(15)	Business representatives between Tucson Boulevard and Country Club Drive
2-25-86	(40)	San Clemente Neighborhood
3-12-86	10	Sam Hughes Neighborhood
3-20-86	50	Rosemont West Neighborhood
4-11-86	52	Tucson High Twelve Club
5-6-86	15	Miles and San Antonio Neighborhoods
5-13-86	11	Business representatives and property owners between Campbell Avenue and Country Club Drive
5-14-86	6	Business representatives and property owners between Euclid Avenue and Campbell Avenue
5-16-86	3	Business representatives and property owners between I-10 and Euclid Avenue

(1) Numbers in () are approximate.

TABLE 1
NEIGHBORHOOD AND COMMUNITY GROUP MEETINGS
(Continued)

DATE	ATTENDANCE(1)	GROUP
6-4-86	(10)	Citizen's Advisory Planning Committee
6-11-86	(15)	Sam Hughes Neighborhood
6-19-86	(15)	Colonia Solana Neighborhood
6-25-86	(5)	Modern Transit Society of Tucson
7-24-86	(65)	Design Forum, American Institute of Architects
9-10-86	40	ASCE, Student Chapter, U of A
9-11-86	3	Developers to discuss land use/LRT relationships
9-25-86	4	Pie Allen Neighborhood
9-26-86	(10)	Architectural Review Board
10-1-86	45	Lions Club
10-12-86	39	Broadmoor and Sam Hughes Neighborhoods
10-14-86	14	Pantano East and Houghton Neighborhoods
10-15-86	31	El Encanto and Colonia Solana Neighborhoods
10-16-86	65	San Clemente, El Montevideo, and Howell School Neighborhoods
10-17-86	3	American Institute of Architects
10-20-86	27	Casa Loma, Glen Heather, Kingston Knoll/Green Hills, San Raphael Pool, and Vista del Sahuaro Neighborhoods
10-21-86	23	Wilshire Heights, Highland Vista, Rosemont West, and Loma Linda Neighborhoods
10-23-86	38	Miles East & West, Rincon Heights, Pie Allen, Iron Horse, and Barrio San Antonio Neighborhoods
11-13-86	1	Downtown Development Corporation
11-21-86	4	American Institute of Architects
11-23-86	23	Broadmoor and Sam Hughes Neighborhoods
12-3-86	30	Residents in Vista del Sahuaro Coalition at Kolb Avenue and Broadway Boulevard
12-10-86	67	All Neighborhoods
12-15-86	70	All Neighborhoods
12-15-86	(35)	Kiwanis Club of the Desert
12-17-86	30	All Neighborhoods
1-19-87	(55)	El Encanto and Colonia Solana Neighborhoods
1-22-87	50	Rosemont West
1-29-87	26	Southern Arizona Transportation Council
2-4-87	22	Citizen's Advisory Planning Committee
2-24-87	--	South Tucson Lions Club
2-25-87	--	Armory Park Neighborhood
3-11-87	--	Citizen's Transportation Advisory Committee

(1) Numbers in () are approximate.

In addition to documenting the comments of the public at each informational meeting, questionnaires were distributed at the July, October, and December public meetings in an effort to further assess public sentiment on several issues. The results of these questionnaires are presented in Table 2. Generally, the survey responses indicated that the public was very supportive of improving the appearance of Broadway through the provision of rail transit (LRT), although only 30-40% indicated that they might actually use any transit provided in the Corridor. Finally, there appears to be significant acceptance of grade separated intersections. Further documentation and discussion is presented in the document text.

TABLE 2
RESPONSE FORM SUMMARIES

MEETING DATE/QUESTION	AGREE	DISAGREE	NO ANSWER
<u>July 9, 1986 Public Meeting</u>			
(Total Responses: 152)			
1. Upgrade appearance of Broadway	77%	23%	—
2. Favor landscaping and buffering	88%	32%	—
3. Prefer grade separations over congestion	66%	34%	—
4. Like LRT system concept	47%	53%	—
5. Might use 2-3 times per week for work trips:			
Bus	29%	71%	—
LRT	30%	70%	—
Monorail	19%	81%	—
6. Might use 2-3 times per week for shopping/ recreation trips:			
Bus	29%	71%	—
LRT	39%	61%	—
Monorail	35%	65%	—
<u>October 1986 Neighborhood Meetings</u>			
(Total Responses: 185)			
1. Landscaping concepts are acceptable	70%	30%	—
2. Like concept of providing noise walls	79%	21%	—
3. Residual right-of-way should be used for:			
Landscaped buffer	76%	24%	—
Private redevelopment	26%	74%	—
Purchase by adjacent property owners	51%	49%	—

TABLE 2
RESPONSE FORM SUMMARIES
(Continued)

MEETING DATE/QUESTION	AGREE	DISAGREE	NO ANSWER
December 1986 Neighborhood Meetings			
(Total Responses: 134)			
1. Grade separations (GSI) are acceptable	72%	25%	3%
2. Design of GSI as in model is acceptable	70%	21%	9%
3. A mix of commercial and residential uses on Broadway is acceptable	71%	19%	10%
4. Increase transit use through more density	44%	22%	34%

DEVELOPMENT OF ALTERNATIVES

A list of fifteen preliminary transit, roadway, and transportation systems management (TSM) alternatives were identified as potentially feasible for meeting the future transportation needs in the Broadway Corridor. For each preliminary alternative, concept-level cost estimates and operational characteristics were identified and presented to the members of the Community Coordination Forum and separately to the general public for their consideration and input. Based on technical considerations and public input, a refined list of alternatives was developed for detailed study.

The nine alternatives developed for detailed study included four transit alternatives, three roadway construction alternatives, one TSM alternative, and a "Do Nothing" alternative for comparison. Excluding the "Do Nothing" alternative, each alternative also included a "Base" condition which involves expanding the transit system significantly, access modifications to improve roadway capacity, and minor intersection improvements. The nine alternatives evaluated in detail were:

1. Do Nothing - No improvements except implement Short Range Transit Plan
2. Base Conditions - High Bus Improvements and TSM
3. Reversible 5th/6th Street and Base Conditions
4. Intersection Widening and Base Conditions
5. Widen Broadway and Base Conditions
6. Grade Separations and Base Conditions

7. High Occupancy Vehicle (HOV) Lanes and Base Conditions
8. Light Rail Transit (LRT) and Base Conditions
9. Automated Guideway Transit (AGT) (monorail) and Base Conditions

TRAVEL DEMAND FORECASTING

Travel demand forecasts for the Year 2005 were developed for each alternative based on the adopted population and employment projections for the region and on the assumption that all components of the adopted Regional Transportation Plan would be achieved. In this analysis each regional transportation facility (roadway and transit), including Broadway, is carrying only its "fair share" of regional travel and not attracting travel from other facilities. By the Year 2005, regional population is projected to increase to 1.1 million and regional employment to 460,000 jobs. In the Broadway Corridor, population is forecasted to increase 44% by the Year 2005, while employment is forecasted to increase 106%.

Two types of travel forecasts were conducted. Vehicular trip making by link was developed by the Pima Association of Governments/Transportation Planning Division. Transit trip making was developed using the pivot point procedure which uses a mathematical formula and trip making variables based on criteria identified in the 1983 SunTran survey affecting mode choice as it relates to transit usage.

Prior to the forecast of future travel, transit and roadway operational plans were developed for each alternative. The operational plans identified transit routings and headways and roadway configurations and capacities as they related to each alternative tested.

ANALYSIS OF ALTERNATIVES

Roadways

Level of service is a technical term used to denote the ability of a roadway to accommodate traffic volumes. Levels of service range from "A" to "F", with levels of service "D" or better are generally considered acceptable for urban roadways during

peak travel times, and levels "E" or "F" considered unacceptable. Based on the traffic forecasts, Table 3 shows the p.m. peak-hour level of service for each major intersection on Broadway Boulevard and on 5th/6th Street for each of the alternatives.

Based on the information in Table 3, the only alternatives that provide acceptable levels of service at most intersections are Alternatives 4 and 6. In Alternative 4, intersections were widened as necessary and in order to provide an acceptable level of service. To achieve an acceptable level of service, Broadway Boulevard would have to be widened to 14 to 16 lanes at the intersections proposed for the widening. Alternative 6 provides for grade separations on Broadway Boulevard at Euclid, Campbell, Alvernon, Swan, Craycroft, Wilmot, and Kolb. Although acceptable levels of service are provided at the intersections, the number of existing lanes on Broadway Boulevard between Euclid and Campbell are not adequate to accommodate the forecast link traffic volumes. Therefore, Alternative 6, by itself, does not provide an acceptable level of service for traffic volumes throughout the length of Broadway. However, if Alternative 6 is combined with either Alternative 5, 7, or 8, adequate capacity is provided.

TABLE 3
YEAR 2005 PM PEAK HOUR INTERSECTION LEVEL OF SERVICE

INTERSECTION	ALTERNATIVE NUMBER								
	1	2	3	4	5	6	7	8	9
Broadway/Euclid	F	F	F	D	F	D	F	F	F
Broadway/Campbell	F	F	E	D	F	D	F	F	F
Broadway/Country Club	D	D	C	D	D	D	D	D	D
Broadway/Alvernon	F	F	F	D	F	D	F	F	F
Broadway/Swan	F	F	F	D	F	D	F	F	F
Broadway/Craycroft	F	F	F	D	F	D	F	F	F
Broadway/Wilmot	F	F	F	D	E	D	E	E	E
Broadway/Kolb	F	F	F	D	F	D	F	F	F
Broadway/Camino Seco	A	A	A	A	A	A	A	A	A
Broadway/Harrison	F	F	F	D	A	A	A	A	A
Broadway/Houghton	F	F	F	D	A	A	A	A	A
6th/Euclid	E	E	E	E	E	E	E	E	E
6th/Campbell	F	F	F	F	F	F	F	F	F
5th/Country Club	B	B	B	B	B	B	B	B	B
5th/Alvernon	E	D	E	D	D	D	D	D	D
5th/Swan	E	E	E	E	E	E	E	E	E
5th/Craycroft	D	D	E	D	D	D	D	D	D
5th/Wilmot	E	E	E	E	E	E	E	E	E

The alternatives are:

1. Do Nothing - No improvements except implement Short Range Transit Plan
2. Base Conditions - High Bus Improvements and TSM
3. Reversible 5th/6th Street and Base Conditions
4. Intersection Widening and Base Conditions
5. Widen Broadway and Base Conditions
6. Grade Separations and Base Conditions
7. High Occupancy Vehicle (HOV) Lanes and Base Conditions
8. Light Rail Transit (LRT) and Base Conditions
9. Automated Guideway Transit (AGT) (monorail) and Base Conditions

Transit

Based on the results of the travel demand forecasting, the daily transit trips and transit boardings by alternative are shown in Table 4 along with the existing ridership. The number of transit trips is the total number of individuals using transit. Whereas, the number of boardings is larger and includes individuals who transfer from one transit vehicle to another. The "boardings" are considered to be "riders".

Alternative 1 projects the increased transit ridership attributable to implementation of the short-range transit plan and to increases in population and employment by the Year 2005. The increase represents a 65% increase in total daily transit boardings.

The increased boardings under Alternative 2 represent the changes that can be anticipated if an improved level of bus transit service is provided. When compared to Alternative 1, a 20% increase in transit boardings occurs.

The numbers under Alternatives 8 and 9 can be compared to Alternative 2 to measure the difference in transit riders between bus service and a high technology system such as LRT and/or AGT systems. The LRT system with a spur line to the University of Arizona (Alternative 8B) provides the highest ridership, which is a 11% increase over the improved bus service. It should be noted that with Alternatives 8 and 9, a local bus on Broadway Boulevard is required to transport passengers to and from the major transit stations which are approximately one mile apart.

TABLE 4
ESTIMATED WEEKDAY TRANSIT RIDERSHIP FOR YEAR 2005

ALTERNATIVE	TOTAL DAILY TRANSIT TRIPS	TOTAL DAILY TRANSIT BOARDINGS	PERCENT INCREASE IN BOARDINGS	
			OVER 1985	OVER ALT. 2
Existing (1985)	29,000	35,400	--	--
1 (SRTP)	48,900	58,300	65	--
2 (Base-High Bus & TSM)	53,400	69,800	97	--
3 (5th, 6th one way)	53,100	69,800	97	--
*4 (Intersection Widening)	53,400	69,800	97	--
5 (Widening Broadway)	53,400	69,800	97	--
6 (Grade Separations)	53,400	69,800	97	--
7A (Bus/HOV, 6 lanes)	53,300	71,300	101	2
7B (Bus/HOV, 4 lanes)	53,300	71,300	101	2
7C (Bus/HOV plus U of A)	53,900	71,300	101	2
8A (LRT)	57,400	75,800	114	9
8B (LRT plus U of A)	58,700	77,200	118	11
9A (AGT)	56,100	74,400	110	7
9B (AGT plus U of A)	56,300	74,600	111	7

Analysis of LRT

From the onset of the Broadway Corridor Study, public interest in transit, particularly light rail transit (LRT), was substantial. As the study progressed, it became necessary to ensure that opportunities were not precluded if the City of Tucson was to proceed with an LRT system in the Broadway Corridor at some point in the future. In order to gain further insight on how light rail transit is being implemented, information was obtained from cities where light rail transit has either been constructed or is presently being evaluated. Table 5 identifies various demographic and system characteristics pertaining to nine cities including the City of Tucson.

An LRT system on Broadway was evaluated as part of the corridor study. The system that was modelled for ridership characteristics and cost estimations operated between Kolb Road and I-10 with stops at Kolb Road, Park Mall, Williams Center, Swan Road, El Con Mall, Campbell Avenue, 6th Avenue, Church Street, and Central Avenue. The system operated with two-car trains having a seated capacity of 200, 10-minute headways, and a connection to the University of Arizona.

The location of the Southern Pacific Railroad and Aviation Parkway, in the area of Broadway Boulevard, required additional analysis in order to identify options for providing a direct and efficient connection between an LRT system on Broadway and the downtown transit center. Three options were identified as illustrated in Figure 3. Based on preliminary engineering evaluations and discussions with the Tucson Department of Transportation, Option A was identified as meeting the system needs most efficiently. It has an estimated construction cost of \$20 million in 1986 dollars.

The recommended option would have the LRT system drop below grade on Broadway at Euclid; turn north and cross SR 210, the SPRR, and Toole Avenue in a tunnel and return to grade in the area of the downtown transit center. The LRT system would be incorporated into the downtown transit center at 6th Avenue and Pennington Street and then proceed west on Pennington in an exclusive mall environment to the governmental complex and to a storage and maintenance facility east of I-10. Figure 4 illustrates the recommended alignment in the downtown.

Finally, several LRT alignments were evaluated which would extend the system east to Pantano Road and/or have the system operate on the north side of Broadway between El Con Mall and Euclid Avenue rather than in the median. Preliminary analysis indicates that the extension to Pantano Road could increase ridership modestly. An evaluation of the alignment on the north side of Broadway between El Con Mall and Euclid Avenue suggests that the operational, pedestrian, noise, visual impacts, and access problems outweigh the cost and other benefits. However, both concepts should be evaluated more fully in the next study phase.

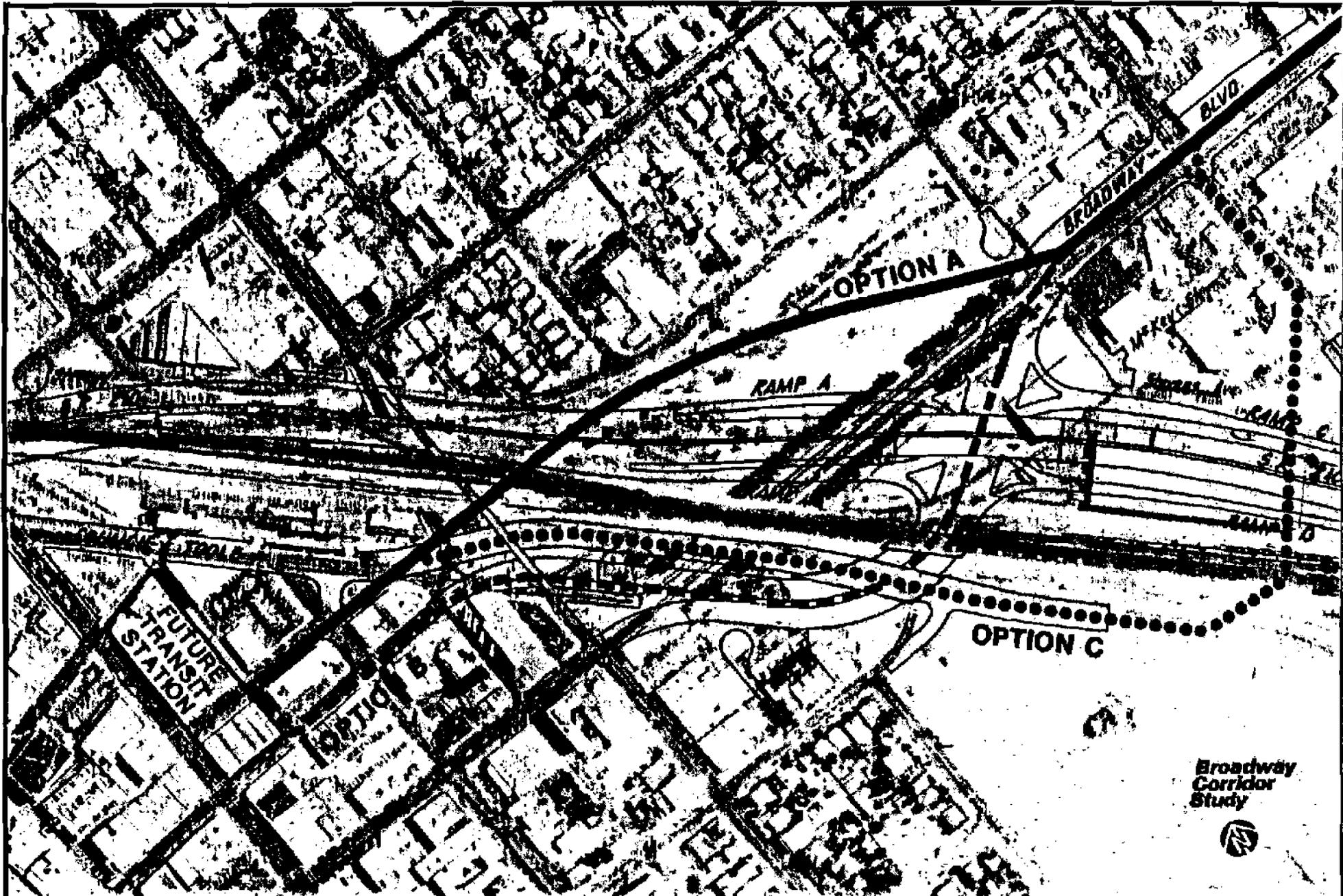


FIGURE 3
ALTERNATIVE LRT ALIGNMENTS TO THE CBD

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TABLE 5
COMPARISON OF CITIES WITH, OR EVALUATING, LRT SYSTEMS

CITY	EXISTING POPULATION*		DOWNTOWN EMPLOYMENT		LRT SYSTEM CHARACTERISTICS				HOW FUNDED
	CITY	METRO AREA	PRESENT	PROJECTED	STATUS	LENGTH	PROJECTED	ACTUAL	
Austin, TX	345,000	0.5 million	41,000	48,000	AA/DEIS Underway	8-25 mi.	15-24,000	-	TBD
Denver, CO	492,000	1.6 million	110,000	160,000	Prel. Studies	46 mi	70,000	-	TBD
Milwaukee, WI	636,000	1.4 million	85,000	100,000	Prel. Studies	14 mi	-	-	TBD
Portland, OR	366,000	1.2 million	115,000	125,000	Open 1986	15 mi	16,000	22,000	ISF
Sacramento, CA	276,000	1.0 million	80,000	--	Open 1987	15 mi	28,000	-	ISF
Salt Lake City, UT	164,000	0.9 million	51,000	81,000	AA/DEIS Underway	13 mi	22,000	-	TBD
San Diego, CA	876,000	1.9 million	55,000	82,000	Open 1982	16 mi	26,000	22,000	State
San Jose, CA	630,000	1.3 million	14,000	43,000	Open 1988	20 mi	40,000 20,000**	-	State/ Federal
Tucson, AZ	331,000	0.5 million	13,000	27,000	Prel. Studies	8 mi	22,000	-	TBD

* 1980 Census

** Revised Opening Day Estimate

ISF Interstate Substitution Funds

TBD To Be Determined; no funding source available at present.

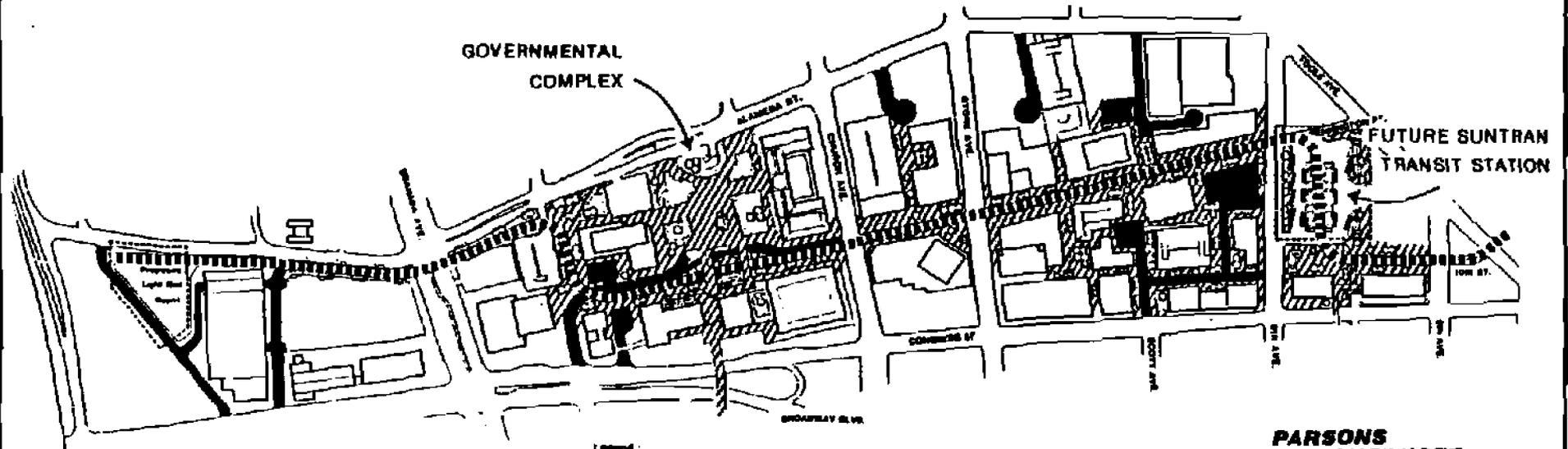
PENNINGTON STREET TRANSIT MALL

FIGURE 4

TYPICAL SECTION OF PENNINGTON



LIGHT RAIL & PEDESTRIAN MALL



- Legend:
- LIGHT RAIL LINE
 - AUTO CIRCULATION
 - //// PEDESTRIAN CIRCULATION



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LANDSCAPING AND BUFFERING

The urban design elements for landscaping the Broadway Corridor are consistent with the ULI/AIA report for Broadway Boulevard, the Urban Design Commission's Report, and the Major Streets and Routes Plan. The four main elements of the landscaping plan developed for the Broadway Corridor are:

- 1) transit and pedestrian nodes,
- 2) a landscape theme which connects the transit nodes along the corridor,
- 3) walls to buffer neighborhoods and mitigate traffic noise, and
- 4) a design to channel the views of the mountains.

The transit and pedestrian nodes occur at major intersections, commercial areas, and/or transit stations. They should have a strong sense of place or identity reinforced by the repeated use of a plant pallett and speciality paving materials. Figure 5 illustrates a typical intersection concept with LRT.

The mid-section landscaping theme, as illustrated in Figures 6 and 7, would be designed to connect the nodes and create a landscaping theme which responds to the vegetation changes, architecture, and character of the adjoining neighborhoods.

In the section between Euclid Avenue and Columbus Boulevard, where some existing property fronting on Broadway Boulevard would be removed to accommodate widening, adjacent residential areas would be buffered by a 30-foot landscaping strip. Walls and berming would be used to buffer and reflect road noise and, along with the landscaping concepts, to improve the aesthetics and identity of Broadway. The height of the noise walls would be determined based on a series of location-specific detailed noise analyses conducted at the time of project implementation.

Median treatments are also a critical concern of the public. Figure 8 illustrates three options for incorporating a transit system with the median. It should be noted that the options are based on preliminary engineering and involve operational trade-offs. Further study and public input are necessary prior to a definitive selection and design. As in all landscaping elements, emphasis would be placed on the use of native and drought tolerant plants and materials to minimize water consumption.

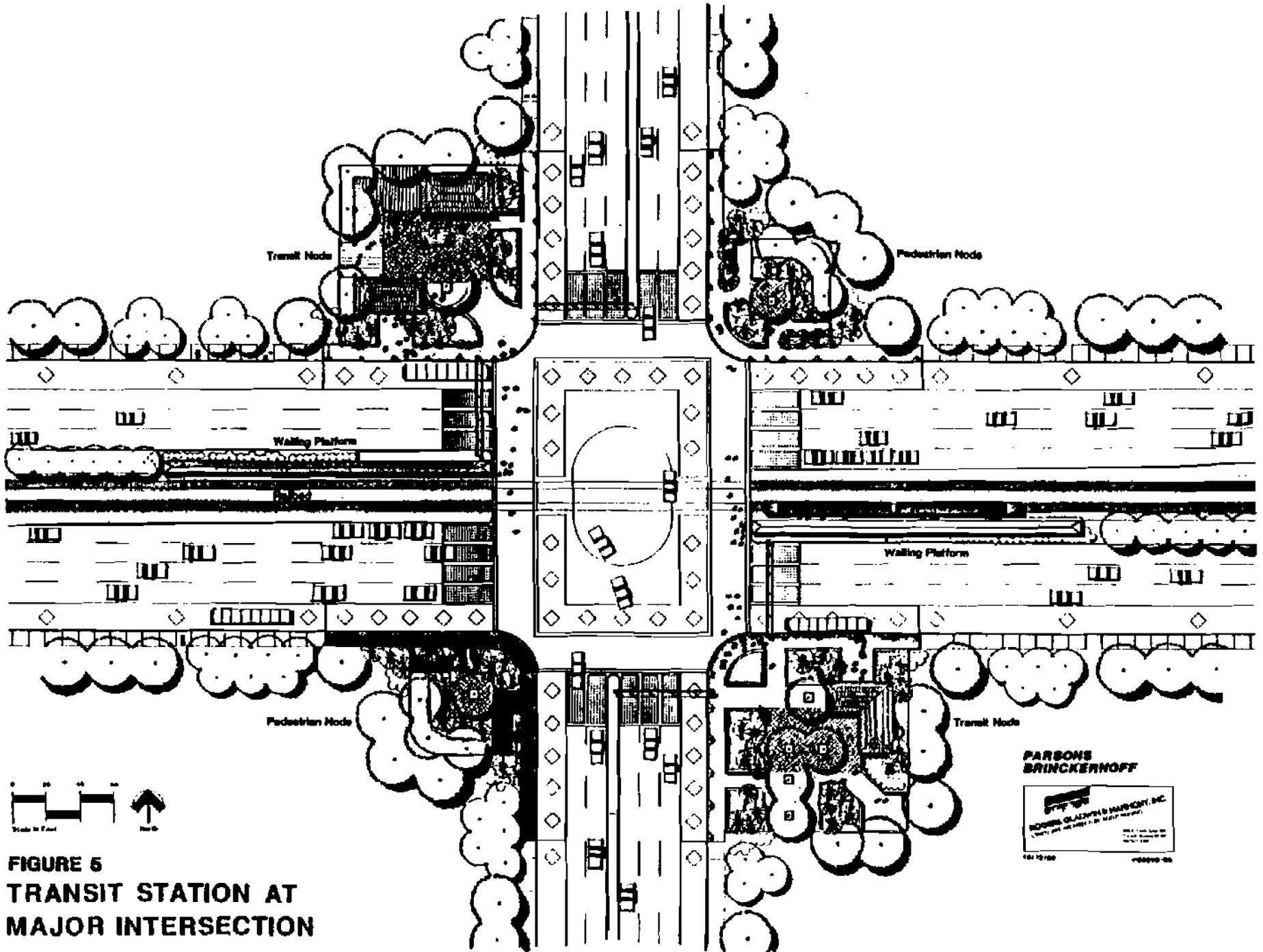
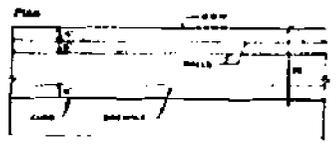
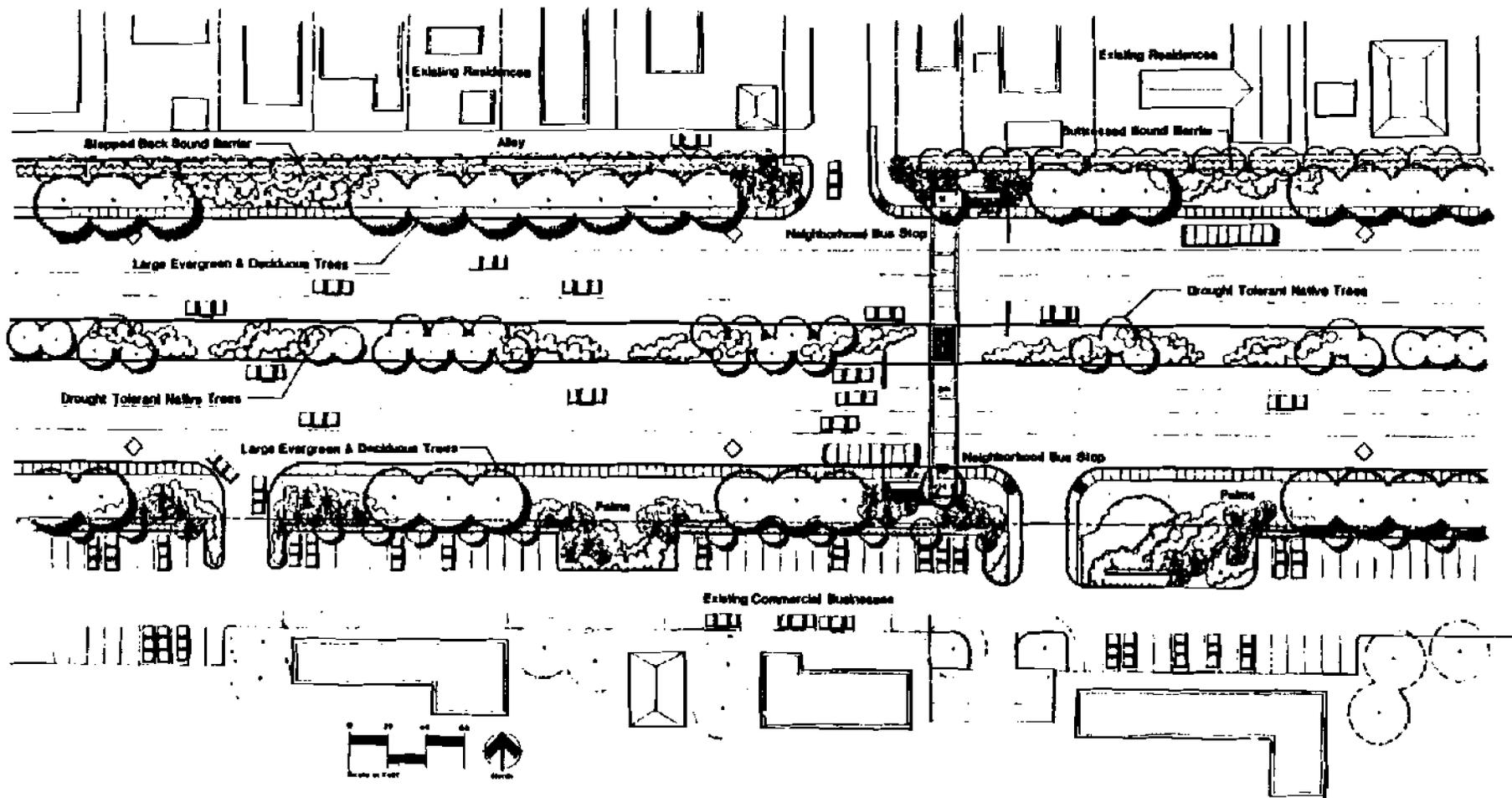
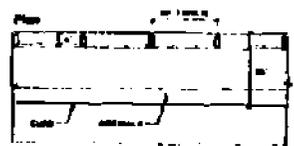


FIGURE 5
TRANSIT STATION AT
MAJOR INTERSECTION



Concept "A" - Stepped Back Walls



Concept "B" - Butressed Wall

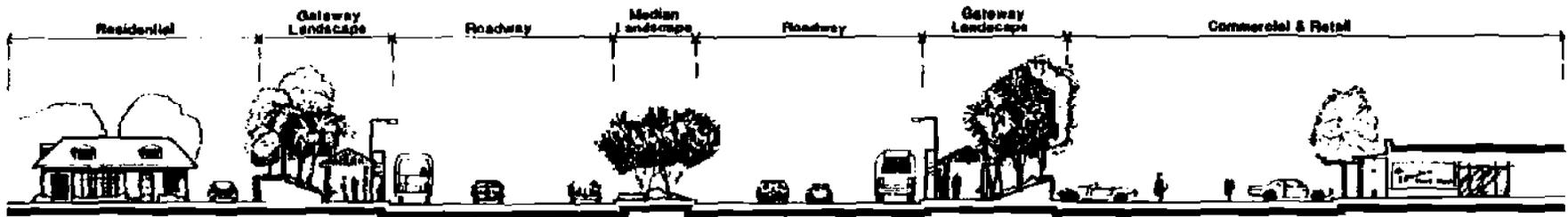


NEIGHBORHOOD SOUND BARRIERS

**LANDSCAPE CONCEPT PLAN FOR
BROADWAY BOULEVARD**

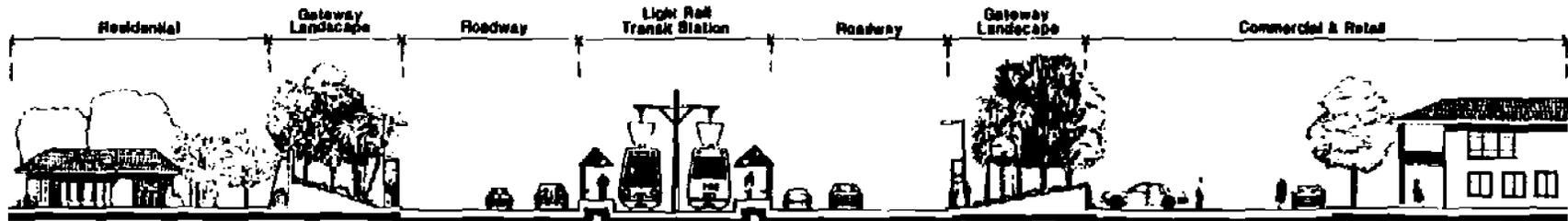
FIGURE 6

**PARSONS
BRINCKERHOFF**



SECTION "A"

BUS TRANSIT OPTION



SECTION "B"

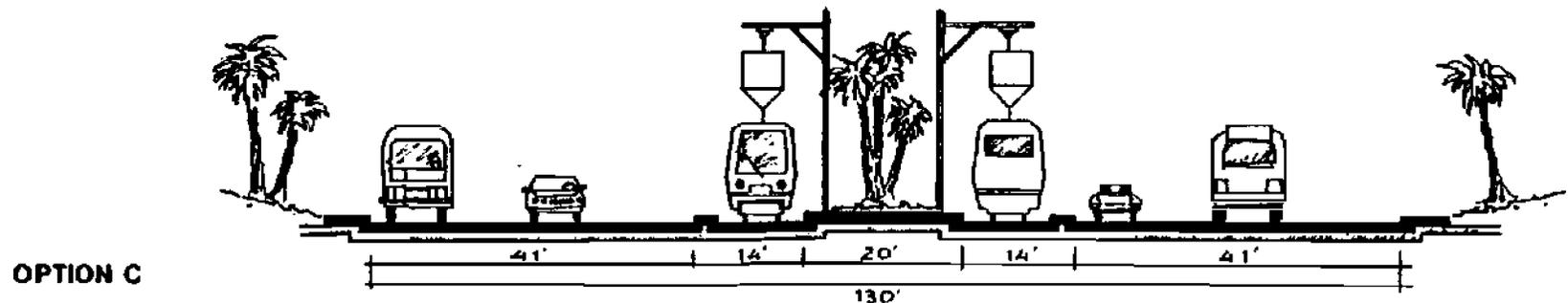
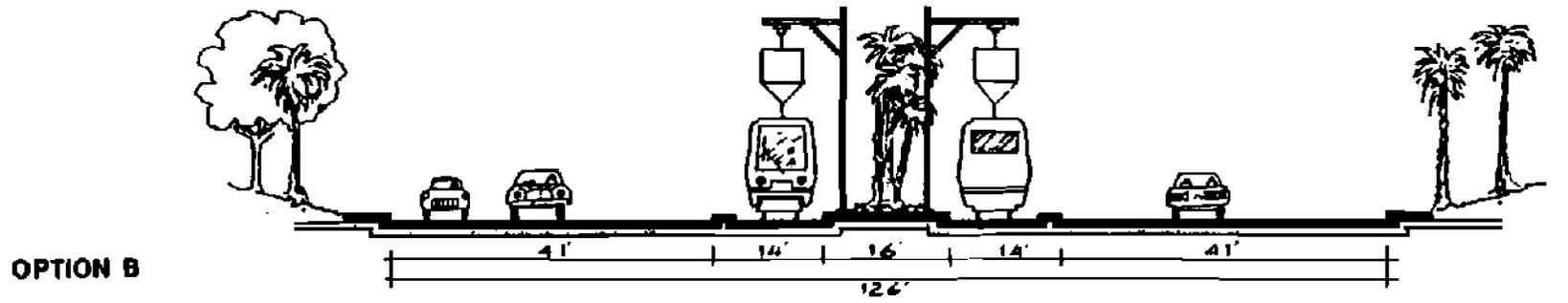
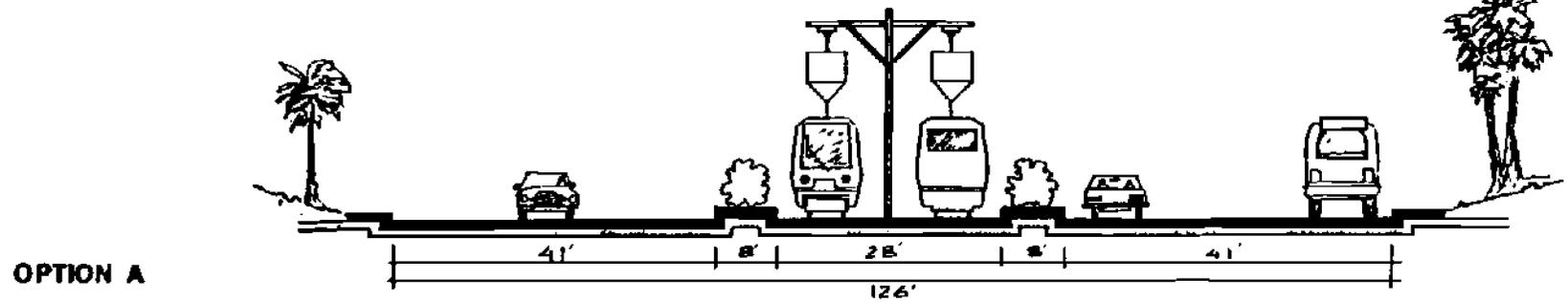
LIGHT RAIL TRANSIT OPTION

CROSS SECTION OF LANDSCAPE PLAN

FIGURE 7

**PARSONS
BRINCKERHOFF**





ALTERNATIVE MEDIAN TREATMENTS WITH LRT

FIGURE 8

COST ESTIMATES

The costs associated with each alternative include right-of-way and relocation, roadway construction, landscaping costs, transit capital and transit operating, and total project cost.

Except for the "Do Nothing" alternative, all of the alternatives require the acquisition of right-of-way between Euclid Avenue and Columbus Boulevard in order to accomplish the necessary design. Minimum requirements for widening are illustrated in Figure 9 and are based on the adopted Major Streets and Routes plan. The 150' minimum right-of-way width is required to accommodate future corridor travel with any of the transit components. This right-of-way width is typical between Columbus Boulevard and Camino Seco, but additional right-of-way is required between Euclid Avenue and Columbus Boulevard.

Table 6 identifies the right-of-way costs attributable to widening the necessary section between Euclid and Columbus plus a section just east of Wilmot. These costs are shown in 1986 dollars and were calculated by a certified appraiser as part of this study.

TABLE 6

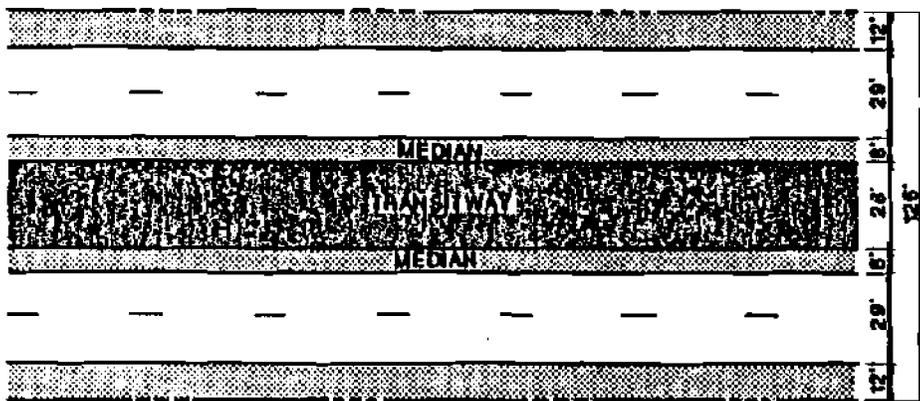
APPRAISER'S MARKET VALUE ALONG BROADWAY

(Cost in 1986 \$ Millions)

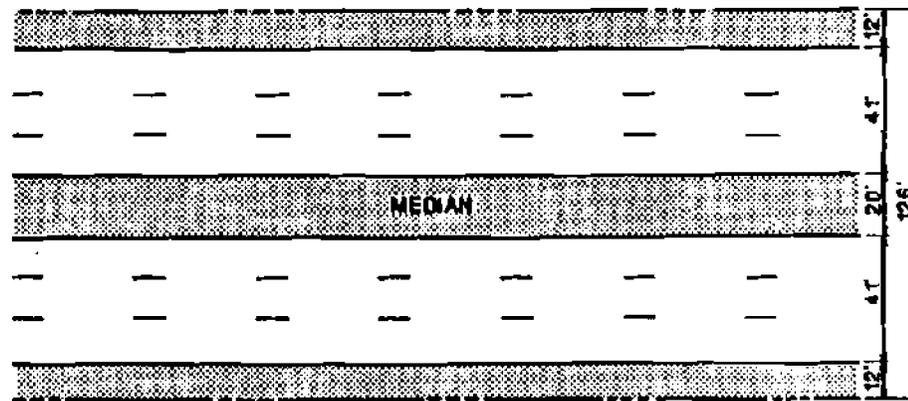
AREA ALONG BROADWAY	RIGHT-OF-WAY	RELOCATION
Northside Euclid to Country Club	\$ 33.5	\$ 2.0
Southside Euclid to Country Club	40.0	-NA-
Northside Country Club to Dodge	3.9	0.2
Southside Dodge to Columbus	2.6	0.1
Southside Melville to Longfellow	1.9	0.3

126' RIGHT OF WAY

*Brooklyn
Corridor
Study*

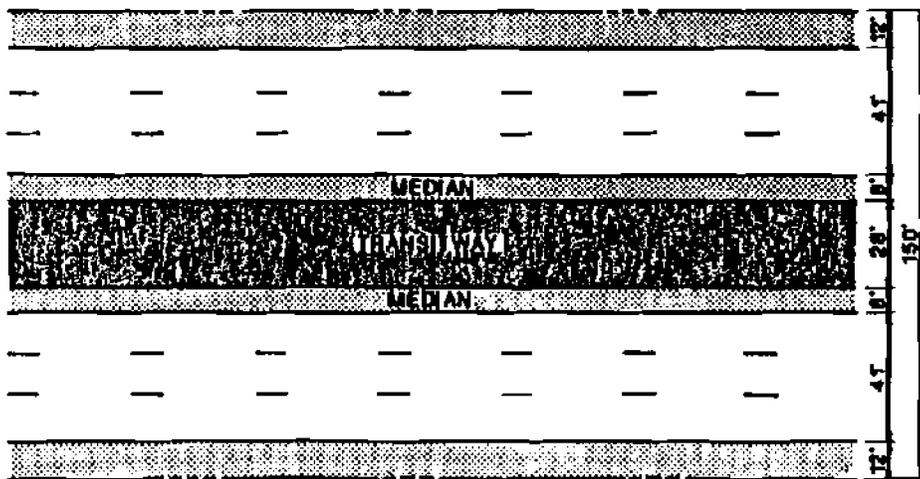


TRANSITWAY

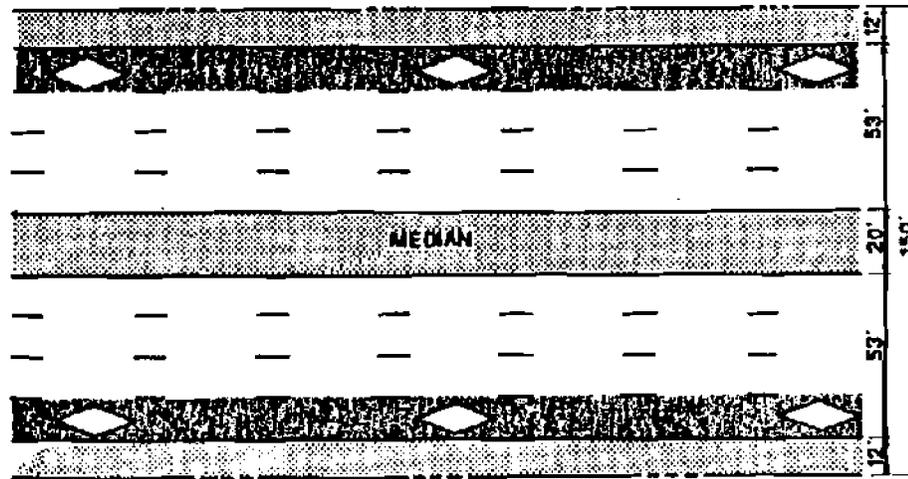


6 LANES DIVIDED

150' RIGHT OF WAY



TRANSITWAY



DIAMOND LANES

PARSONS
BRINCKERHOFF

ROW AND CROSS-SECTION REQUIREMENTS

FIGURE 9

Roadway construction costs of \$430,000 per lane mile in 1986 dollars, including design and construction, are estimated for the Broadway Corridor based on unit pricing for similar work. Additionally, the estimated cost of constructing a grade separation intersection (Alternative 6, where the cross street is under Broadway Boulevard) is \$7 million per location in 1986 dollars. Table 7 presents the estimated roadway construction costs for each alternative.

TABLE 7
ESTIMATED ROADWAY CONSTRUCTION COSTS

ALTERNATIVE	COST IN 1986 DOLLARS
1 S RTP	\$ 0
2 Base Conditions (High Bus & TSM)	0
3 5th/6th One-Way	800,000
4 Intersection Widening	13,600,000
5 Widen Broadway	12,800,000
6 Grade Separations (GSI)	42,000,000
7A Bus/HOV, 6 Lanes	13,100,000
8A LRT	15,900,000
9 AGT	12,800,000

Until recently, landscaping and residential buffering has been viewed as a non-necessity or "frill" component of transportation projects. More recently, these components have been reevaluated. The recognition has occurred that these are key aspects of a project and work towards the preservation and enhancement of the quality of life for both the users and neighbors of a new facility. The transit nodes and connecting links described previously will improve the appearance of Broadway Boulevard dramatically. Table 8 shows the cost estimate of these elements.

The total transit capital costs are presented in Table 9 and are based on a series of operational and cost assumptions documented in the text.

TABLE 8
LANDSCAPING COSTS
(1986 Dollars)

LANDSCAPE COST FOR MID-SECTIONS

Landscape, Irrigation and Grading (per acre)	\$ 77,300	
70 Acres of Landscaped Right-of-Way		\$ 5,411,000
Sound Wall, Cost Per Linear Foot	322	
Additional Grading of 6' of Earth for Noise Abatement	26	
Total Cost Per Linear Foot	348	
13,500 Linear Feet of Sound Wall		4,698,000
TOTAL COST FOR MID-SECTIONS		\$10,109,000

INTERSECTION COST ESTIMATES

Bus Shelters	\$158,000	
Food Service	113,000	
Hardscape and Landscape for Nodes	774,000	
Intersection Paving	488,000	
TOTAL COST PER INTERSECTION		\$ 1,533,000

TABLE 9
TRANSIT CAPITAL COSTS
(1986 \$ Thousands)

Alternative	Guideway Construction		Station/ Terminals	Special PNR Lots	Vehicles		Maintenance Facilities		Total
					Buses	LRT/AGT	Buses	LRT/AGT	
1	\$ -	\$ -	\$ 1,600	\$ 5,075	\$ -	\$ 1,740	\$ -	\$ 8,415	
2,4	-	-	8,000	15,400	-	5,280	-	28,680	
3	-	-	8,000	15,750	-	5,400	-	29,150	
5	-	-	8,000	15,400	-	5,280	-	28,680	
6	-	-	8,000	15,400	-	5,280	-	28,680	
7A	-	1,300	8,000	17,500	-	6,000	-	32,800	
7B	-	1,300	8,000	17,500	-	6,000	-	32,800	
7C	-	1,400	8,000	20,125	-	6,900	-	36,425	
8A	76,300	4,000	8,000	12,950	16,000	4,440	5,600	127,290	
8B	80,800	4,400	8,000	12,075	26,000	4,140	9,100	144,515	
9A	152,600	10,000	8,000	12,425	13,000	4,260	5,200	205,485	
9B	161,600	11,000	8,000	12,075	23,000	4,140	9,200	229,015	

The total capital cost for each alternative includes right-of-way and relocation, roadway construction, and transit capital costs. Table 10 presents the estimated capital cost for each alternative.

TABLE 10
TOTAL CAPITAL COSTS
(1986 \$ Thousands)

ALT	ROW & RELOCATION	ROADWAY & LANDSCAPING COST	TRANSIT CAPITAL COST	TOTAL CAPITAL COST
1 - SRTP	\$ 0	\$ 0	\$ 8,400	\$ 8,400
2 - High Bus/TSM	0	22,100	28,700	50,800
3 - 5th/6th	0	22,900	29,200	51,100
4 - Widen Int.	32,700	35,700	28,700	97,100
5 - Widen B'way.	44,500	34,900	28,700	108,100
6 - GSI	1,000	64,100	28,700	93,800
7A - HOV/6 L	44,500	54,400	32,800	131,700
7B*				
7C - HOV/U of A	44,500**	54,400	36,400	135,300
8A - LRT	44,500	57,200	127,300	229,000
8B - LRT, U of A	44,500**	57,200	144,500	246,200
9A - AGT	44,500	54,000	205,500	304,000
9B - AGT, U of A	44,500**	54,000	229,000	327,500

*Not Applicable

**Transitway from Broadway to the U of A assumed to occur within existing ROW.

Table 11 illustrates the annualized capital costs for each alternative using the U.S. Department of Transportation guidelines which include a 10% discount rate for capital and construction costs and an economic life of 12 years for bus facilities, 20 years for roadway facilities and landscaping, 30 years for rail facilities, and 100 years for right-of-way. The total annualized costs also include the annual transit operation and maintenance cost estimates which are based on a series of assumptions documented in the text.

TABLE 11
TOTAL ANNUALIZED COSTS
(1986 \$ Thousands)

ALT	ANNUAL O&M COSTS	ANNUAL ROW & RELOCATON COSTS	ANNUAL TRANSIT CAPITAL COSTS	ANNUAL ROADWAY CONSTRUCTION COSTS	TOTAL ANNUAL COSTS
1 - SRTP	\$15,100	\$ 0	\$1,100	\$ 0	\$16,200
2 - Bus/TSM	18,400	0	3,800	2,600	24,800
3 - 5th/6th	18,500	0	3,800	2,700	25,000
4 - Widen Int.	18,400	300	3,800	4,200	26,700
5 - Widen B'way	18,400	500	3,800	4,000	26,700
6 - GSI	18,400	0	3,800	7,500	29,700
7A - HOV/6 L	18,900	500	4,200	6,400	30,000
7B*					
C - HOV/U of A	19,500	500	4,800	6,400	31,200
8A - LRT	19,900	500	14,500	6,700	41,600
8B - LRT/U of A	21,400	500	16,400	6,700	45,000
9A - AGT	20,400	500	23,600	6,300	50,800
9B - AGT/U of A	22,800	500	26,600	6,300	56,200

*Not Applicable

FUNDING

The sources of funding available to the City of Tucson for capital projects include Highway User Revenue Funds (HURF), revenue bonds repaid with HURF monies, general obligation bonds financed through property and sales taxes, state and federal monies, assessment district fees, and other miscellaneous sources. Table 12 illustrates the five-year capital improvement program (CIP) expenditures for the entire City Transportation Department based on the adopted Five Year CIP. For more detail, see the City of Tucson Adopted Five Year Capital Improvement Program, Fiscal Years: 1986-87 through 1990-91. By law, expenditures match revenues.

TABLE 12
FIVE YEAR CIP SUMMARY
(1986 \$ Thousands)

	FISCAL YEAR					TOTAL
	1986-87	1987-88	1988-89	1989-90	1990-91	
EXPENDITURES & REVENUES	\$52,000*	\$52,303	\$48,892	\$49,132	\$43,012	\$245,339

* Adopted FY 1986-87 capital budget.

Under present funding conditions, construction of any of the Broadway Corridor Study alternatives will require anywhere from 30% to 100% of the present capital budget for the entire City Transportation Department for each year necessary to amortize the project. Moreover, the annual cost for operation and maintenance of the transit component of the alternatives (\$15.1 to \$22.8 million) exceeds the present transit operating expenditures of \$13.6 million in FY 1986-87.

Implementation of any of the proposed alternatives in the Broadway Corridor will require additional funding sources for both construction and operation, or a reallocation of capital expenditures.

Federal monies through the Urban Mass Transportation Administration (UMTA) may be available for the transit components if the UMTA Project Development process is followed. The process requires that for detailed study, certain threshold criteria be met, and that the UMTA Project Development process be followed prior to selection of Tucson as a fixed guideway candidate city. The UMTA Project Development process is illustrated in Figure 10. Preliminary analysis shows that the Broadway Corridor LRT alternative does meet the threshold criteria for further study and UMTA involvement in the Project Development process. This study would constitute a portion of the System Planning phase. However, a regionwide systems study may be necessary to identify Broadway as the paramount transit corridor in the future.

URBAN MASS TRANSPORTATION ADMINISTRATION (UMTA) PROJECT DEVELOPMENT PROCESS

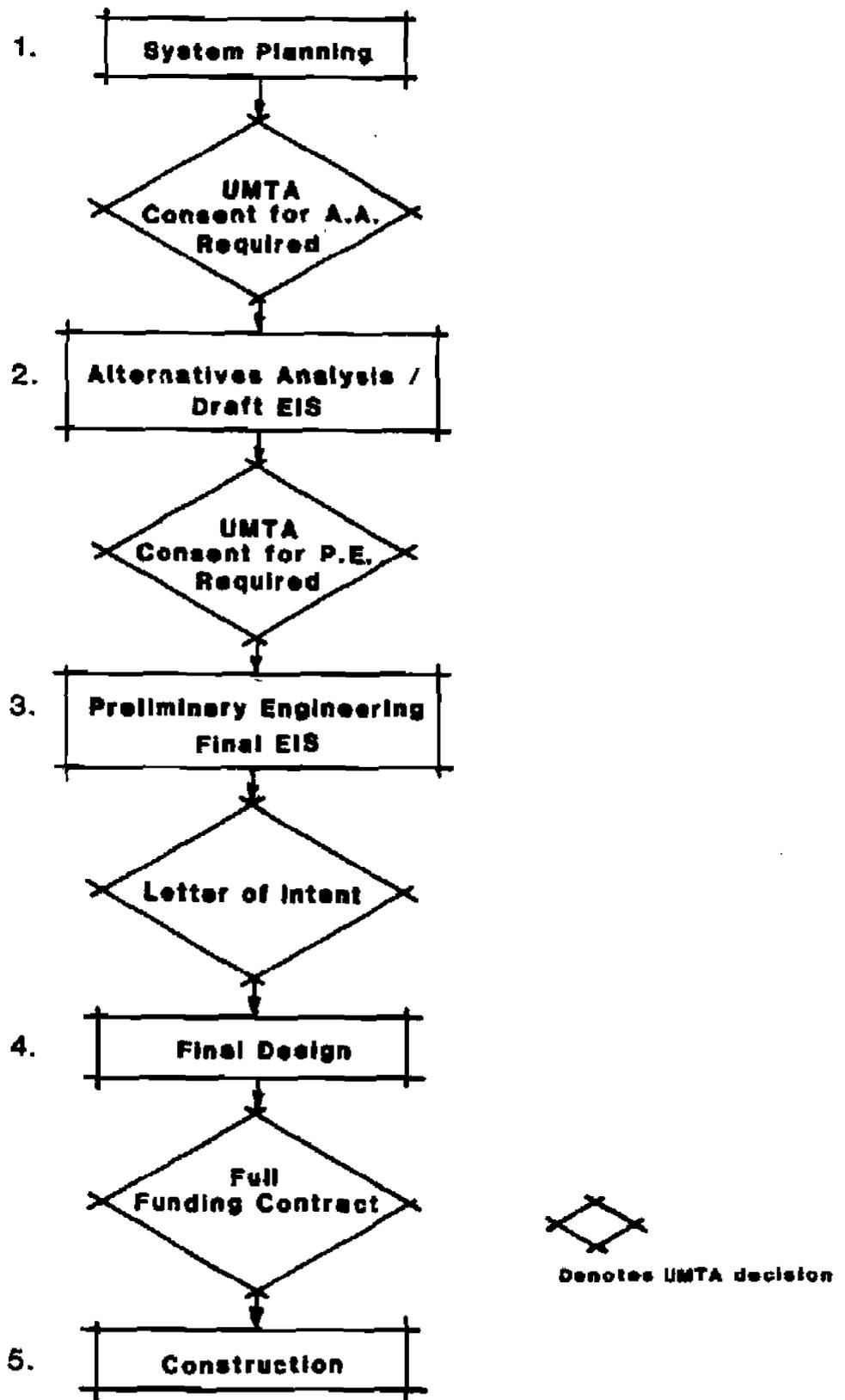


FIGURE 10

Assuming funding was available to study the corridor following the federal guidelines, there are no guarantees that funding would be available for construction of a fixed guideway system. Since the early 1980's, the amount of Section 3 discretionary new start funds available has averaged nationwide about \$400 million a year. These funds have been allocated to between 8 and 12 projects annually, with another 20 to 30 projects going unfunded. The pressure for diminishing federal transit resources requires that UMTA ensure that limited resources be utilized in the most prudent and cost-effective manner. Therefore, there are no guarantees that Tucson would be able to fund a fixed guideway system with any federal monies. Additionally, local financial commitment is a factor used to order projects that rate similarly in terms of cost-effectiveness. The statutory minimum requirement is 20% local monies. However, it has been proposed by Congress that if federal funding for a fixed guideway is required, suggests a non-federal match of 50% is required.

Additional local monies could be raised through property or sales taxes or possibly other sources. The City of Tucson does have the option to bypass the federal system altogether and use state and local monies (assuming they were available) to fund construction of a fixed guideway system. This has occurred in San Diego with the construction of the South Line LRT system at a total capital cost of approximately \$118 million. However, it should be noted that this relatively low cost was accomplished in part by utilizing existing railroad right-of-way and tracks for much of the route distance. For this system, nearly 90% of the capital funding was derived from California State gas tax revenues (State Transit Assistance Act). The remainder was obtained from state sales tax revenues (Transportation Development Act).¹

Current state legislation permits Pima County residents to vote on increasing the sales tax by one-half cent with the revenues dedicated to both transit and road improvements. This source of monies would facilitate implementation of any of the transit alternatives. However, at this time, the transit one-half cent election cannot occur until after the passage of a one-half percent increase in the sales tax dedicated almost entirely to roadway improvements.

¹San Diego Trolley: The First Three Years, SANDAG, November 1984, pg. 10.

FINDINGS

The findings of the Broadway Corridor Study are summarized as follows:

- The metropolitan population and employment is projected to double over existing levels by the Year 2005.
- Of the nine alternatives studied, no single alternative alone meets the future transportation needs of the corridor.
- If Alternative 6 (grade separations and the transit component of Alternative 2) is combined with Alternative 5 (widen Broadway Boulevard), or Alternative 7 (HOV lanes), or Alternative 8 (LRT), or Alternative 9 (AGT), the Year 2005 travel demands will be met.
- On the response forms received from the December 1986 public meetings, 72% of the respondents favored grade-separated interchanges as a method to provide adequate roadway capacity.
- On the response forms received from the July 1986 public meeting, the LRT system concept received a 47% favorable response. Between 19% and 35% of the respondents noted that they would use some form of transit (bus, LRT, or AGT) two to three times per week for work or shopping/recreation trips.
- No matter which transit technology is selected, the section of Broadway Boulevard between Euclid Avenue and Columbus Boulevard will need to be widened to a minimum 150' right-of-way to accommodate the transit component and projected traffic volumes. The right-of-way costs associated with this are approximately \$46 million in 1986 dollars.
- In order to minimize right-of-way (ROW) costs and disruption to historic buildings, the section of Broadway Boulevard between Euclid Avenue and Country Club Road should be widened on the north side and the entire roadway shifted to the north to provide additional ROW on the south side for landscaping, improved parking, access control opportunities, and redevelopment of properties.

Preliminary plans for developing a divided roadway with a transitway in the center are shown at the end of this report. Also presented at the end of this report are illustrations of the various landscaping, transit technology, and grade separation model concepts which were developed as an integral component of the Broadway Corridor Study.

- Landscaping and residential buffering are key components of the corridor package, and a minimum 30' area adjacent to residential neighborhoods should be used for buffering homes which are not presently adjacent to the roadway.
- Public opinion on the use of residual right-of-way varies. However, there was a clear consensus that there should be no rezonings to allow higher density development.
- The LRT transit technology (Alternative 8) meets the UMTA minimum requirements for further study.
- Without new sources of funding or a major revision of the capital improvement program, the City of Tucson does not have the resources to implement any of the alternatives necessary to meet Year 2005 travel needs in the Broadway Corridor.