

PHASE II REPORT

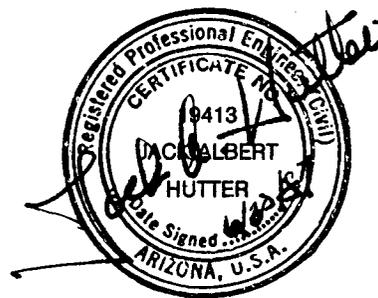
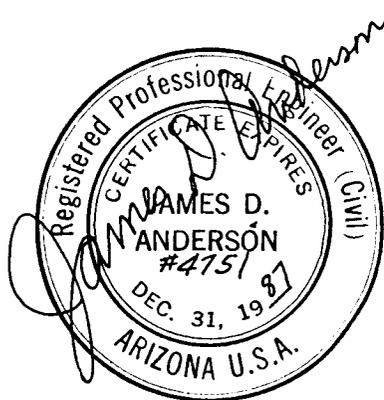
# I-10 CORRIDOR REFINEMENT STUDY

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## DEVELOPMENT AND ASSESSMENT OF ALTERNATIVE IMPROVEMENT SCHEMES



ARIZONA  
DEPARTMENT OF TRANSPORTATION



Submitted by

**DMJM**

in association with

JACK E. LEISCH & ASSOCIATES

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<b>EXHIBIT NO.</b>	<b>TITLE</b>	<b>PAGE</b>
C-1	ALTERNATIVE C-1 .....	*
C-2	ALTERNATIVE C-2 .....	*
C-3	ALTERNATIVE C-3 .....	*
D-1	ALTERNATIVE D-1 .....	*
D-2	ALTERNATIVE D-2 .....	*

\*The single line alternative plans are appended in a separate package.

## I. INTRODUCTION

### SCOPE OF STUDY

The overall objective of this study is to review and assess future design and operational features of I-10 relative to a recent recommendation that the collector-distributor roadway system, proposed from Baseline Road to the Hohokam Expressway, be extended westward to the I-10/I-17 interchange. The limits of the study include the following freeway corridor segments as shown on Figure 1:

- I-10 from Buckeye Road to Southern Avenue.
- I-17 from 16th Street to the I-10 Interchange.

The I-10 Corridor Refinement Study employs a systems approach comprised of the following three integrated phases:

- I. Analysis of Future Operations.
- II. Development and Assessment of Alternative Improvement Schemes.
- III. Refinement of Selected Alternatives.

The following report documents the work completed during Phase II of the project, which includes the development and assessment of alternative improvement schemes and recommendation of the preferred alternatives. As an introduction to this work, a brief summary of the results of Phase I follows:

### STUDY BACKGROUND

Phase I of this study presented a geometric and operational assessment of the currently programmed improvements on I-10 from Buckeye Road to 40th Street and the recommended improvements from 40th Street to Southern Avenue. This evaluation formed the basis for determining the adequacy of the programmed improvements to accommodate the forecasted design year traffic and the need for

# STUDY AREA

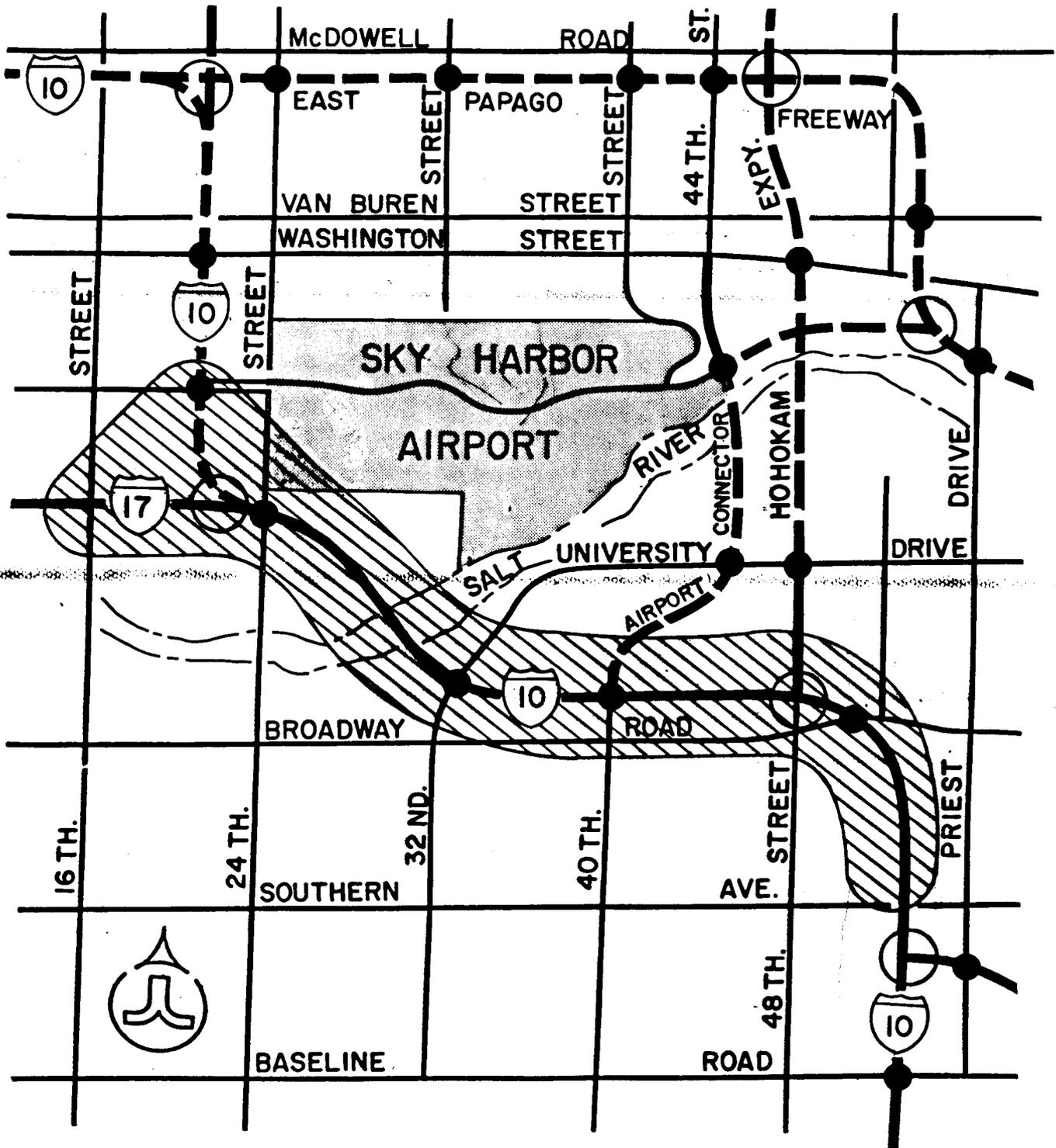
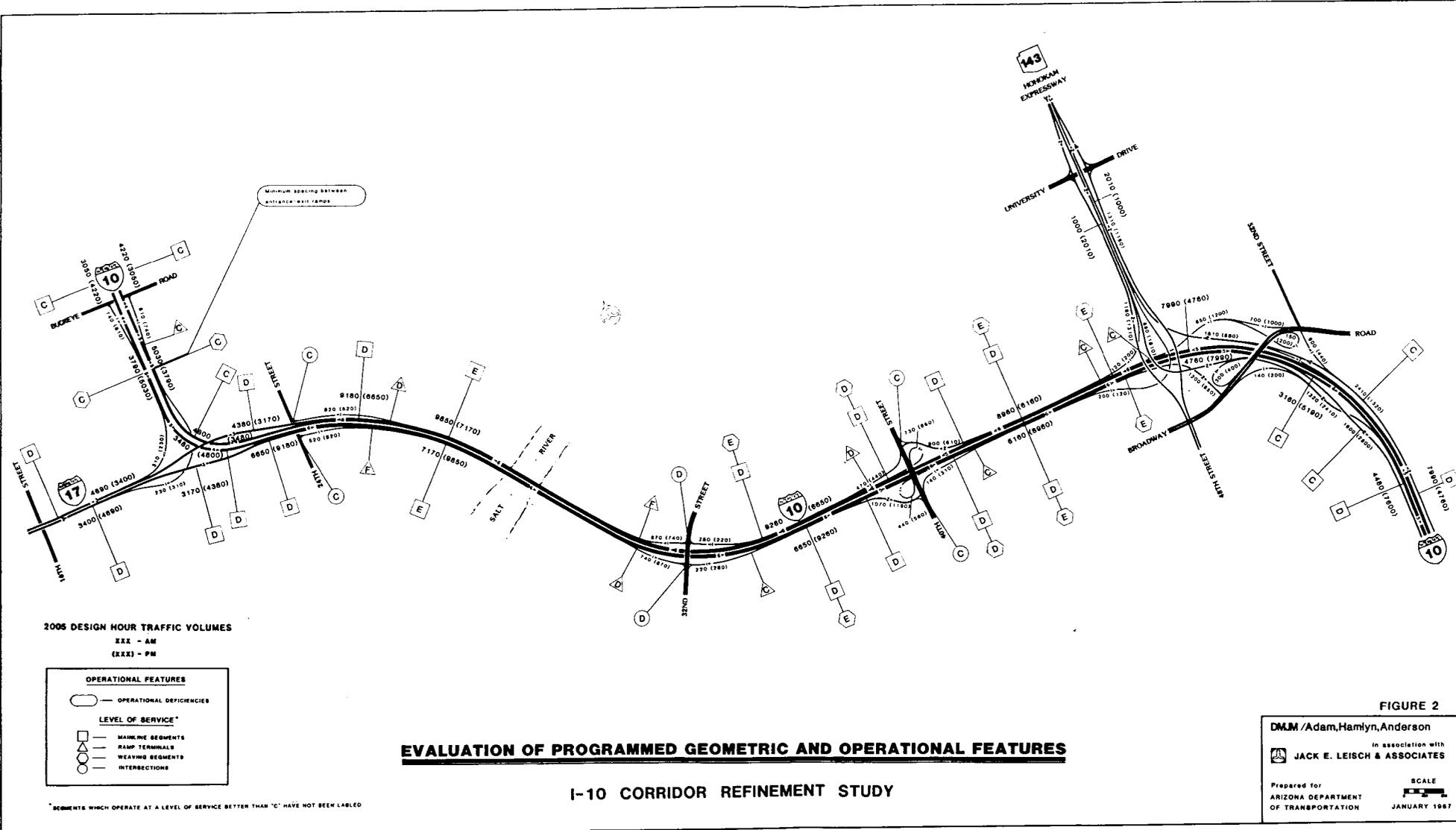


FIGURE 1

future modifications and/or extension of the C-D road system. A level of service (LOS) analysis was performed for each of the freeway segments, ramp junctions and weaving areas for the 2005 design year. As illustrated on Figure 2, segments of the I-10 Corridor which would experience future operational deficiencies (LOS E & F) include:

- I-10 Eastbound, 24th Street to the Hohokam Expressway.
- I-10 Westbound, the Hohokam Expressway to 24th Street.

Phase I of this study recommended that the C-D road system should be incorporated into the long-range improvement plan (15-20 years hence) for the I-10 corridor from the I-17 T.I. to the Superstition Freeway.



## II. DEVELOPMENT OF FUTURE DESIGN FRAMEWORK

The objective of this phase of the study is to develop and assess a number of design concepts including collector-distributor roadways, the most viable of which would have the ability to respond to the future traffic and operational requirements documented in Phase I of the study.

### PLANNING CONSIDERATIONS

#### Future Highway Plan

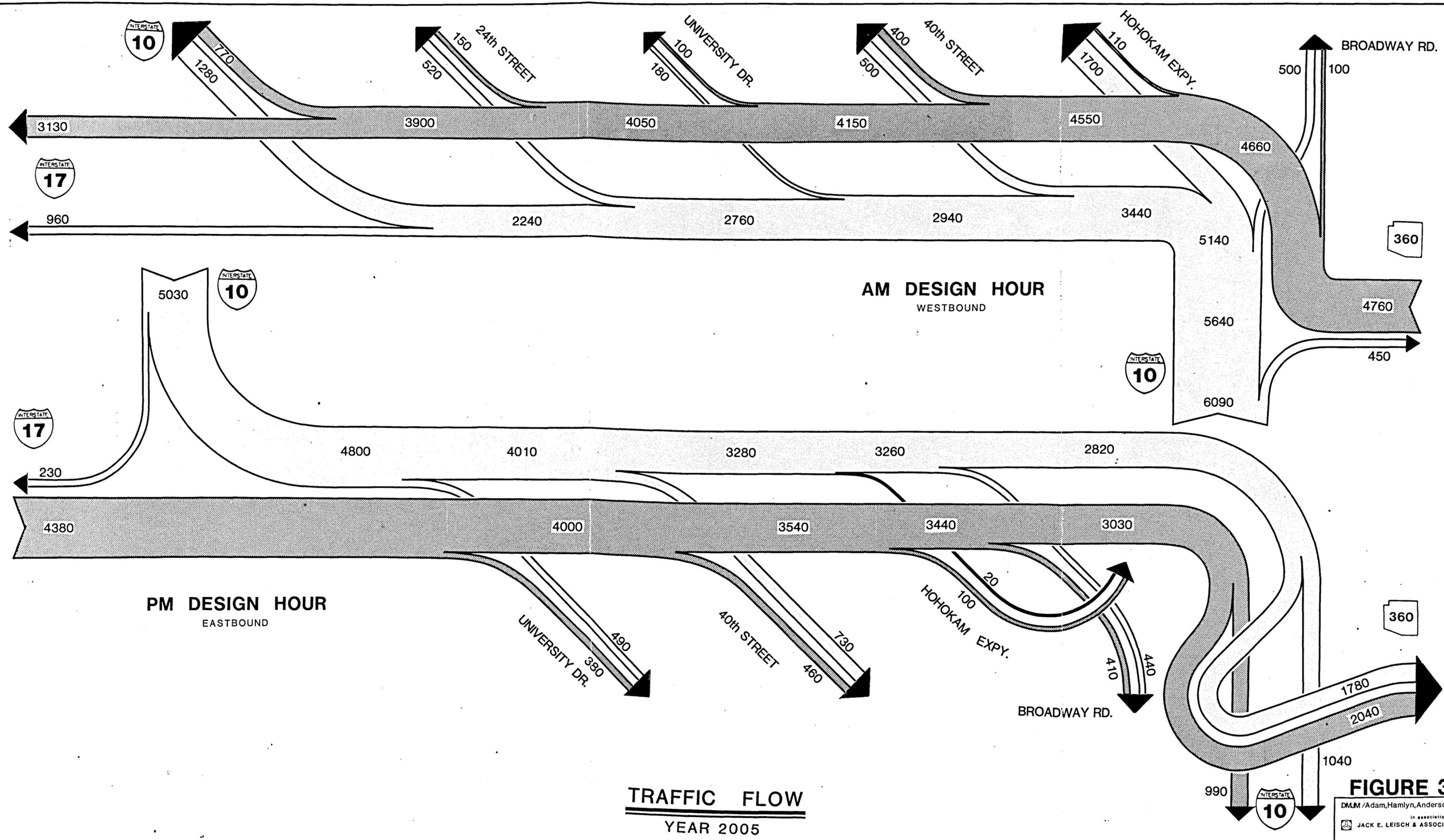
The most current ADOT freeway and expressway corridor plan (existing, under construction, located and planned facilities) was used as a basis for development of the Year 2005 traffic assignments.

#### Year 2005 Traffic Assignments

Traffic volumes for the year 2005 were developed from the data output of the MAG 2005-64 transportation planning model. Design hour volumes (AM and PM) were developed using current traffic volume data to determine the peak hour directional distribution of traffic (D) and the peak hour volumes as a percent of daily volume (K) as a basis for calibrating the 2005 average daily traffic projections. The design hour volumes were applied to the Alternative C-D Road concepts which are presented in Section III, Overview of Concept Development.

#### Corridor Traffic Flow Patterns

In addition to the Year 2005 trip assignments, MAGTPO provided two sets of selected link assignments for the corridor. These data were calibrated to represent westbound AM and eastbound PM design hour traffic flow through the I-10 corridor. These design hour traffic flow volumes are graphically displayed in Figure 3.



**TRAFFIC FLOW**  
YEAR 2005

**FIGURE 3**  
DMM / Adam, Hamlyn, Anderson  
in association with  
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ARIZONA DEPARTMENT  
OF TRANSPORTATION  
MAY 1987

The upper figure represents AM design hour flow from Superstition Freeway east of its junction with I-10, with destinations to the west on I-10; and traffic flow from I-10 south of its junction with Superstition Freeway, with destinations to the west on I-10. This projection illustrates that 3,400 vehicles or approximately 60 percent of the westbound traffic flow from the I-10 link would desire to exit at Broadway Road, the Hohokam Freeway, 40th Street, University Drive, or 24th Street; while only 860 vehicles, or approximately 18 percent of the westbound flow from the Superstition Freeway link would have destinations to these exits.

The lower figure represents the PM design hour flow from I-10 north of its junction with I-17 with destinations to the east on I-10; and traffic flow from I-17 west of its junction with I-10, with destinations to the east on I-10. This projection illustrates that 1,990 vehicles or approximately 41 percent of the eastbound traffic flow from the I-10 link would desire to exit at University Drive, 40th Street, the Hohokam Expressway or Broadway Road; while 1,090 vehicles or approximately 25 percent of the eastbound traffic flow from the I-17 link would have destinations to these exits.

These selected link assignment flows portray how different design concepts may operate in the future. These flow patterns served as a basis for the development of the C-D road concepts and the placement of the transfer roadways between the core and C-D roadways. Since a high percentage of the I-10 traffic entering this section of the corridor desires to exit at one of the service interchanges along the route, it is desirable that transfer roadways from the core roadways to the C-D roadways be located in the vicinity of the Superstition T.I. for westbound I-10 traffic and in the vicinity of the I-10/I-17 T.I. for eastbound I-10 traffic to minimize weaving on the core roadways.

#### Future Public Transportation

High Occupancy Vehicle (HOV) lanes are currently being constructed adjacent to the median barrier in both directions on I-10 in the section between the Papago Freeway and 40th Street. Contract plans currently being prepared

extend the HOV lanes from 40th Street to Southern Avenue. Future plans call for extending the HOV lanes eastward on I-10 to a point beyond Baseline Road. An additional assignment of this study is to investigate the feasibility of connecting the HOV lanes to the Superstition Freeway as well as continuing them to the east on I-10. Single line plans (400' scale) illustrating this concept are presented in Section IV, Description of Alternatives.

#### OPERATIONAL CRITERIA AND DESIGN STANDARDS

In addition to the preceding planning considerations, operational criteria and basic design standards, as listed in Figures 4a, 4b and 4c, were established. These standards and criteria serve as an additional guide which specifies the geometric and operational features to be present in the alternative concept plans. The design standards and operational criteria were developed based on current AASHTO Policy, are consistent with ADOT policies, and reflect engineering experience with similar rehabilitation design projects.

**OPERATIONAL CRITERIA  
(CORE/C-D ROAD SYSTEM)**

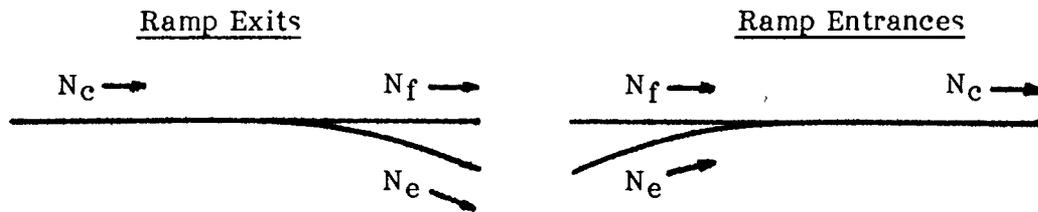
BASIC LANE ARRANGEMENTS

<u>C-D</u>	<u>CORE</u>	<u>CORE</u>	<u>C-D</u>
3	4	4	3
2	5	5	2

ROUTE CONTINUITY - Provided for I-10

LANE CONTINUITY - 3 Lanes Each Direction  
(Including HOV Lane)

LANE BALANCE



GENERAL FORMULA

$$N_c = N_f + N_e - 1$$

MAXIMUM

$$N_c = N_f + N_e$$

MINIMUM

$$N_c = N_f + N_e - 1$$

INTERCHANGE AND RAMP CONNECTIONS

<b>Ramp Connections To</b>	<b>From Collector Street</b>	<b>From Arterial Street</b>	<b>From Freeway</b>
Core Roadways	Never	Occasionally	Usually
C-D Roadways	Always	Usually	Occasionally

FIGURE 4a

EXITS AND ENTRANCES

CORE ROADWAY - Right Only

C-D ROADWAY - Right for Service Interchanges  
 Left for Transfer Roads and Okay for System Interchange

RAMP SEQUENCE

	<u>CORE</u>		<u>C-D</u>	
En-En or Ex-Ex	1000	ft	800	ft
Entrance-Exit	2000	ft	1500	ft
Exit-Entrance	600	ft	500	ft

SIGNING

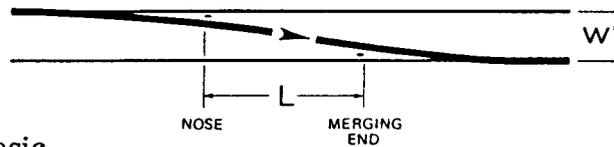
One Panel 6 message units

Two Panels 9 message units

Three Panels Avoid Using

TRANSFER ROADS

GORE TO GORE SPACING



L = 200' Basic  
 L = 400' Preferred

NUMBER OF INTERCHANGES SERVED

One - Minimum  
 Two - Usually  
 Three - Maximum

FIGURE 4b

# BASIC DESIGN STANDARDS

Feature	Freeway	Transfer Road	Collector-Distributor	Ramps	Arterial Streets and Frontage Roads
<b>Alignment</b>					
Design Speed	60 mph	55 mph	50 mph	30 mph	40 mph
Maximum Horizontal Curve	5°	6°	8°	system 8° service 24° loop 38°(150')	10°
Maximum Grade	3.5%	4%	5%	system 4.5% service 6.5%	6%
Vertical Clearance	16'	16'	16'	16'	16'
Stopping Sight Distance	525'-650'	450'-550'	400'-475'	400'-475'	275'-325'
Decision Sight Distance	1000'	NA	800'	800'	NA
Maximum Superelevation	0.10 ft/ft	0.10 ft/ft	0.10 ft/ft	0.10 ft/ft	0.10 ft/ft
Lane Drop Taper	70:1	NA	50:1	50:1	NA
<b>Cross Section</b>					
Lane Width	1 lane 2 or more lanes	NA 12'	NA 12'	16' 12'	16' 12'
Shoulder Widths	1 lane 2 lanes 3 or more lanes	NA 10'R,4'L 10'R,10'L	NA 10'R,10'L 10'R,10'L	10'R,4'L 10'R,10'L 10'R,10'L	10'R,4'L 10'R,4'L 10'R,10'L
Median Width	with median barrier without median barrier	20' 40'	NA NA	20' NA	NA NA
Median Slope	protected unprotected	3:1 6:1	NA NA	NA NA	NA NA
Side Slope	protected unprotected	2:1 6:1	NA NA	2:1 6:1	NA NA
<b>Entrance Terminals</b>					
Curvature at Merging End	3°	3°	4°	4°	NA
Taper Length	900' (1° convergence)	900' (1° convergence)	700' (1°30' convergence)	700' (1°30' convergence)	NA
<b>Exit Terminals</b>					
Curvature at Nose	3°	3°	4°	4°	NA
Taper Length	550' (3° diverge)	550' (3° diverge)	450' (4° diverge)	450' (4° diverge)	NA

NA = NOT APPLICABLE

FIGURE 4c

### III. OVERVIEW OF CONCEPT DEVELOPMENT

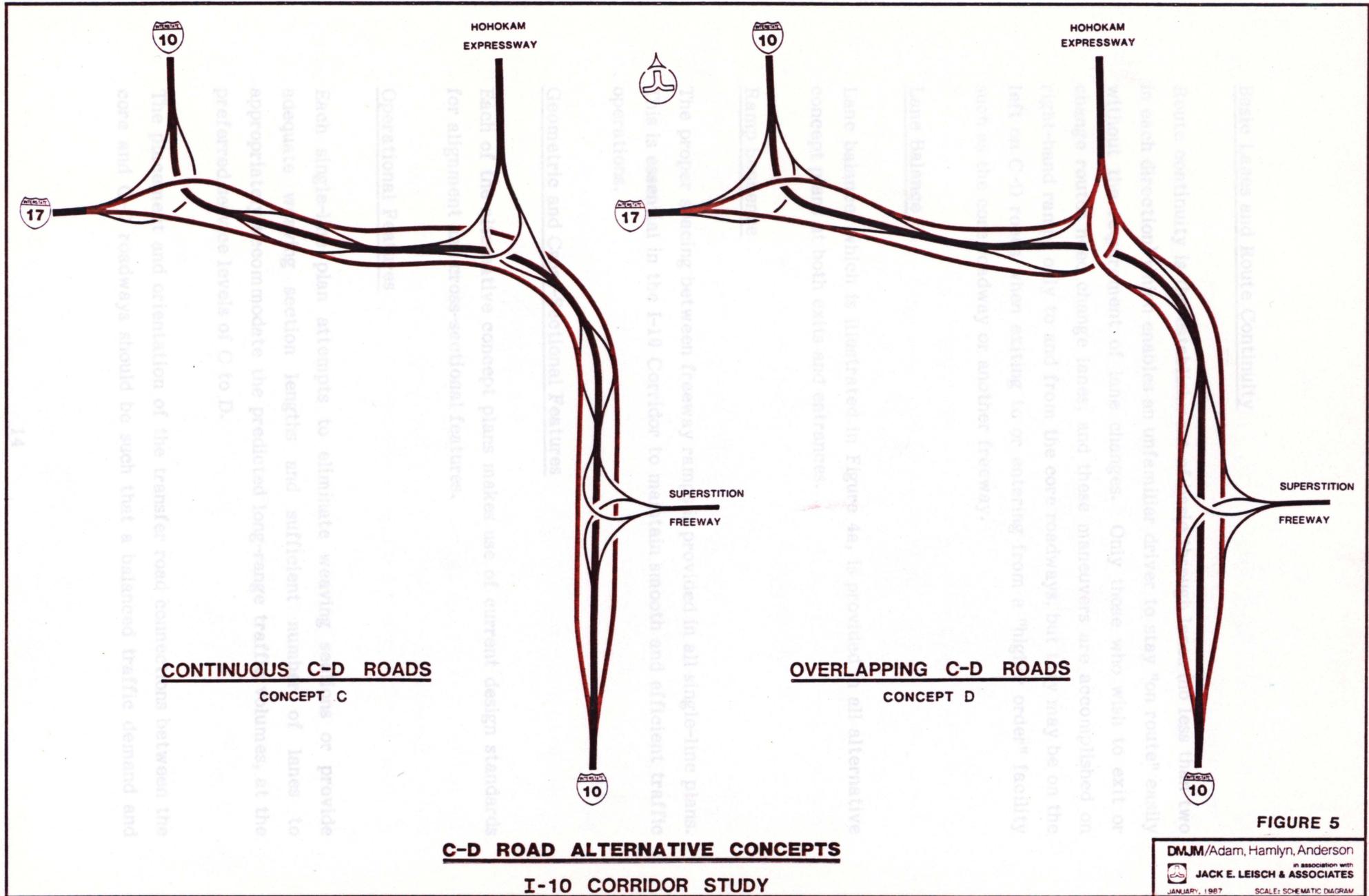
Based on the evaluation of the programmed facilities and the established planning/design framework, alternative design concepts were created, from which 400'-scale "single-line" sketches were developed. In developing these alternatives, the limits of the study on the I-10 corridor were extended from Southern Avenue to Baseline Road, since it was necessary to revise the geometry of this segment for some of the alternative concepts. The two categories of C-D road system concepts used as a basis for developing a wide array of single line design schemes, as portrayed on Figure 5, are:

- Concept C — A continuous C-D road system extending on the I-10 Corridor from the I-10/I-17 interchange to the Superstition Freeway T.I.
- Concept D — An overlapping C-D road system extending on the I-10 Corridor from the I-10/I-17 interchange to the Superstition Freeway T.I., which is discontinuous at the Hohokam Expressway.

A wide array of single-line design schemes were drawn to test the ability of each concept to fulfill the requirements of the planning/design framework. From these, five "single-line" plans were selected for development. For each concept developed, the basic design criteria were applied. These criteria were presented previously in Figures 4a-4c and are summarized here related to alternative development.

#### BASIC DESIGN CRITERIA

Certain primary operational, safety and geometric features were considered as basic requirements and were incorporated into all alternative plans. The basic design criteria which were employed are described below.



**C-D ROAD ALTERNATIVE CONCEPTS**

**I-10 CORRIDOR STUDY**

**FIGURE 5**

DMJM/Adam, Hamlyn, Anderson  
 in association with  
**JACK E. LEISCH & ASSOCIATES**  
 JANUARY, 1987 SCALE: SCHEMATIC DIAGRAM

### Basic Lanes and Route Continuity

Route continuity is the establishment of basic through lanes (no less than two in each direction) which enables an unfamiliar driver to stay "on route" easily without the requirement of lane changes. Only those who wish to exit or change routes need change lanes, and these maneuvers are accomplished on right-hand ramps only to and from the core roadways, but they may be on the left on C-D roads when exiting to or entering from a "higher order" facility such as the core roadway or another freeway.

### Lane Balance

Lane balance, which is illustrated in Figure 4a, is provided in all alternative concept plans at both exits and entrances.

### Ramp Sequence

The proper spacing between freeway ramps is provided in all single-line plans. This is essential in the I-10 Corridor to maintain smooth and efficient traffic operations.

### Geometric and Cross-Sectional Features

Each of the alternative concept plans makes use of current design standards for alignment and cross-sectional features.

### Operational Features

Each single-line plan attempts to eliminate weaving sections or provide adequate weaving section lengths and sufficient number of lanes to appropriately accommodate the predicted long-range traffic volumes, at the preferred service levels of C to D.

The placement and orientation of the transfer road connections between the core and C-D roadways should be such that a balanced traffic demand and

level of service be achieved both on the core roadways and the C-D roadways. Operational flexibility should be provided by the transfer road connections to provide motorists the option of using the core or C-D roadways under circumstances of major shifts in traffic patterns caused by special events and/or congestion caused by incidents resulting in lane blockage.

### Lane Arrangement

A total of seven basic lanes are required in each direction on I-10 to accommodate Year 2005 design hour volumes at LOS C to D. The general arrangement of the number of lanes to be employed on the C-D and core roadways will be 2-5-5-2 or 3-4-4-3. Auxiliary lanes are required on some segments of the core roadways and the C-D roadways to achieve lane balance and/or to provide an adequate Level of Service in weaving sections.

## GENERAL DESCRIPTION OF ALTERNATIVE CONCEPTS

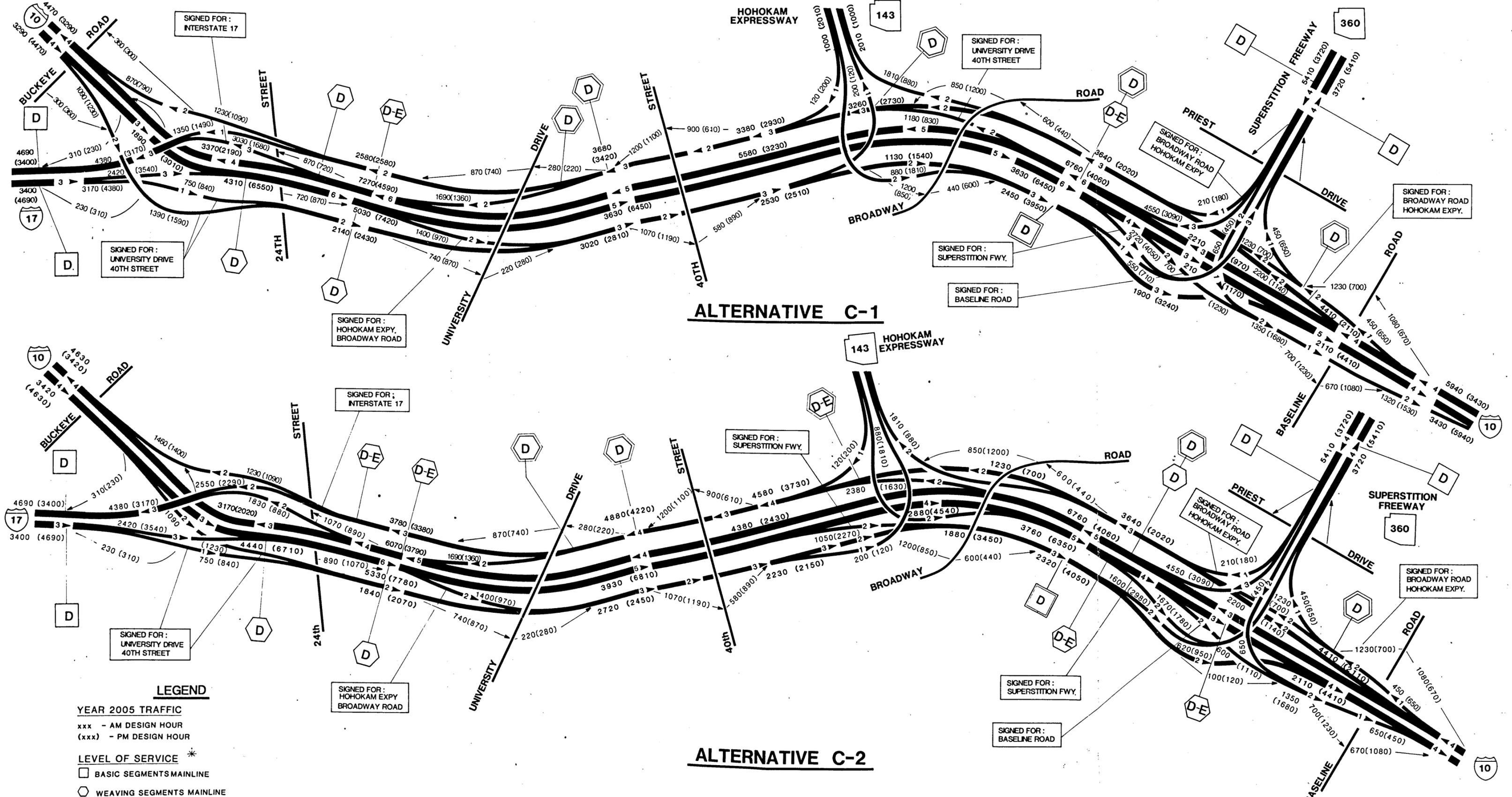
The five concept alternatives which were developed represent two categories:

- Alternatives C-1, C-2 and C-3 are based on a continuous C-D road system in the I-10 Corridor extending from the I-10/I-17 interchange to the Superstition Freeway; and
- Alternatives D-1 and D-2 are based on an overlapping C-D road system in the I-10 Corridor, extending from the I-10/I-17 interchange to the Superstition Freeway, but discontinuous at the Hohokam Expressway.

These concepts are portrayed in schematic diagrams on Figures 6, 7 and 8. The following features are illustrated:

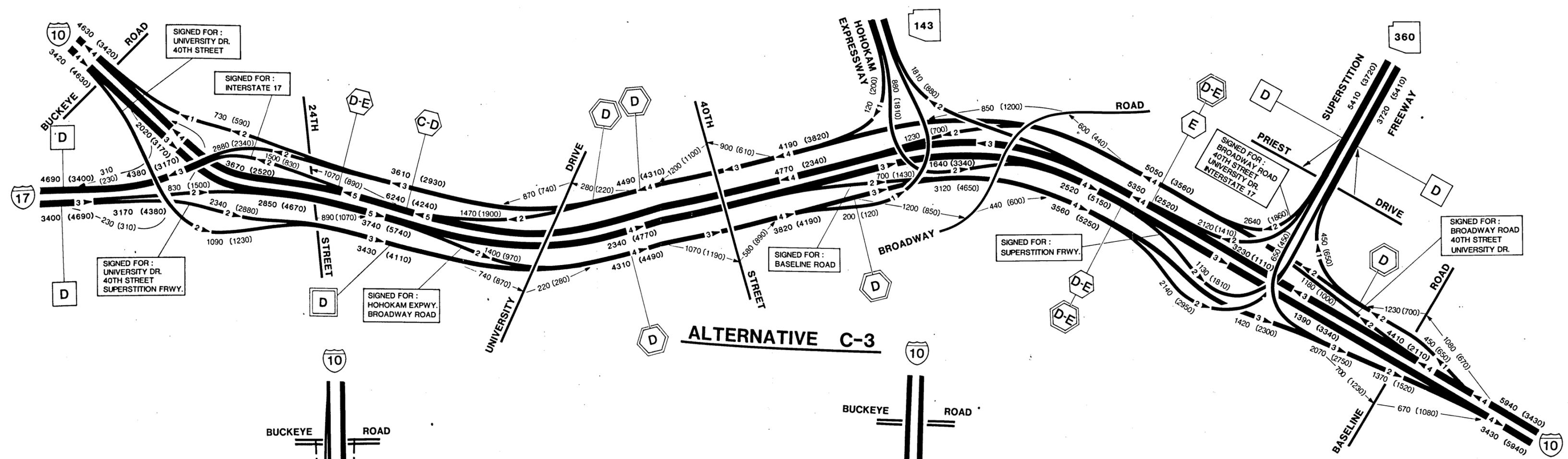
- General arrangement of core roadways, C-D roadways, ramps and transfer roadways.

- Number of lanes on core and C-D road segments, major ramps and transfer roadways.
- AM and PM design hour volumes on core and C-D road segments ramps and transfer roadways.
- Level of Service for core roadway segments, weaving sections and C-D roadways. (Segments operating at LOS C or better are not identified.)
- Guide signing for destinations at major ramps and transfer roadways.



**SCHEMATIC REPRESENTATION OF CONCEPT ALTERNATIVES**

**FIGURE 6**



**ALTERNATIVE C-3**

**LEGEND**

**YEAR 2005 TRAFFIC**

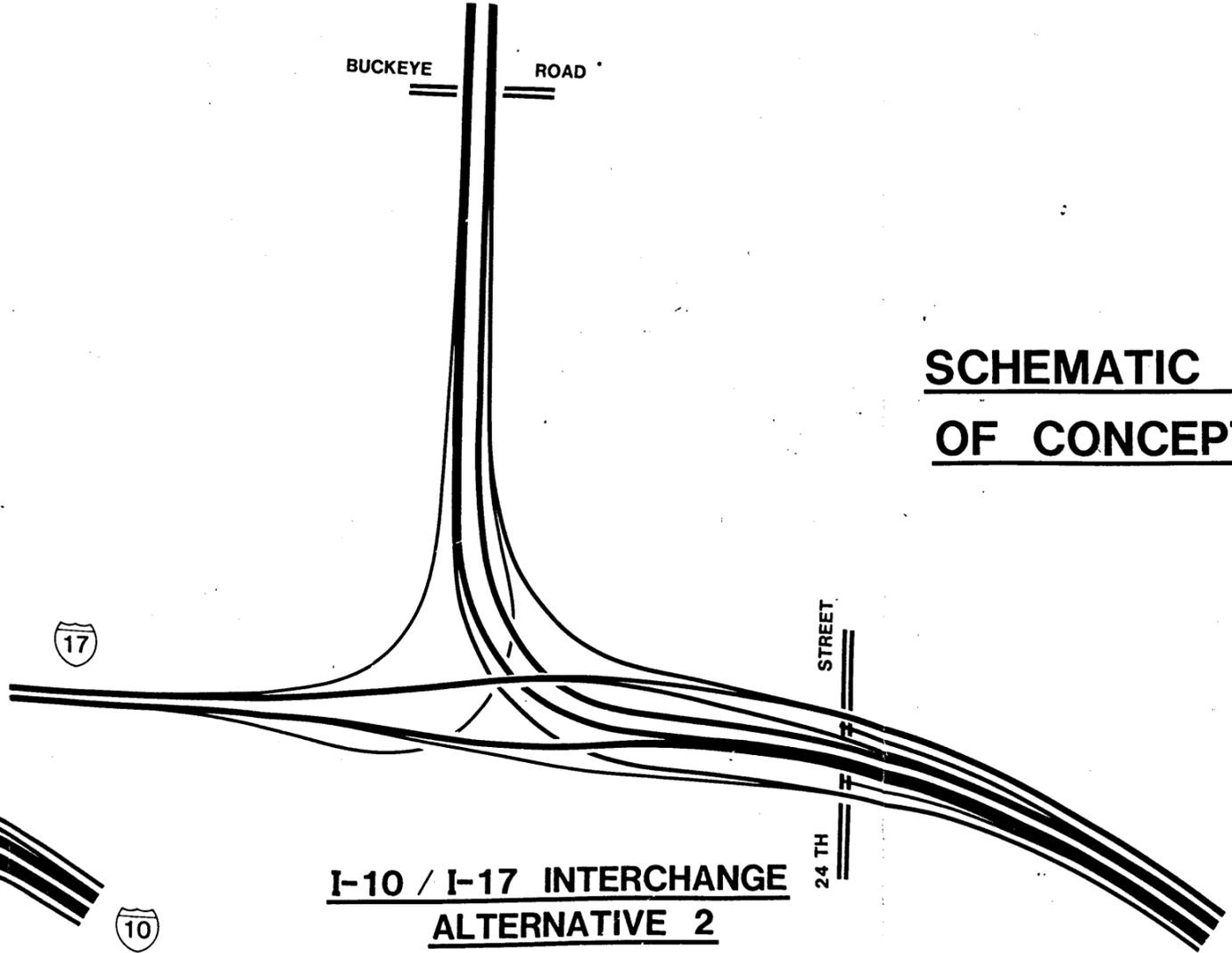
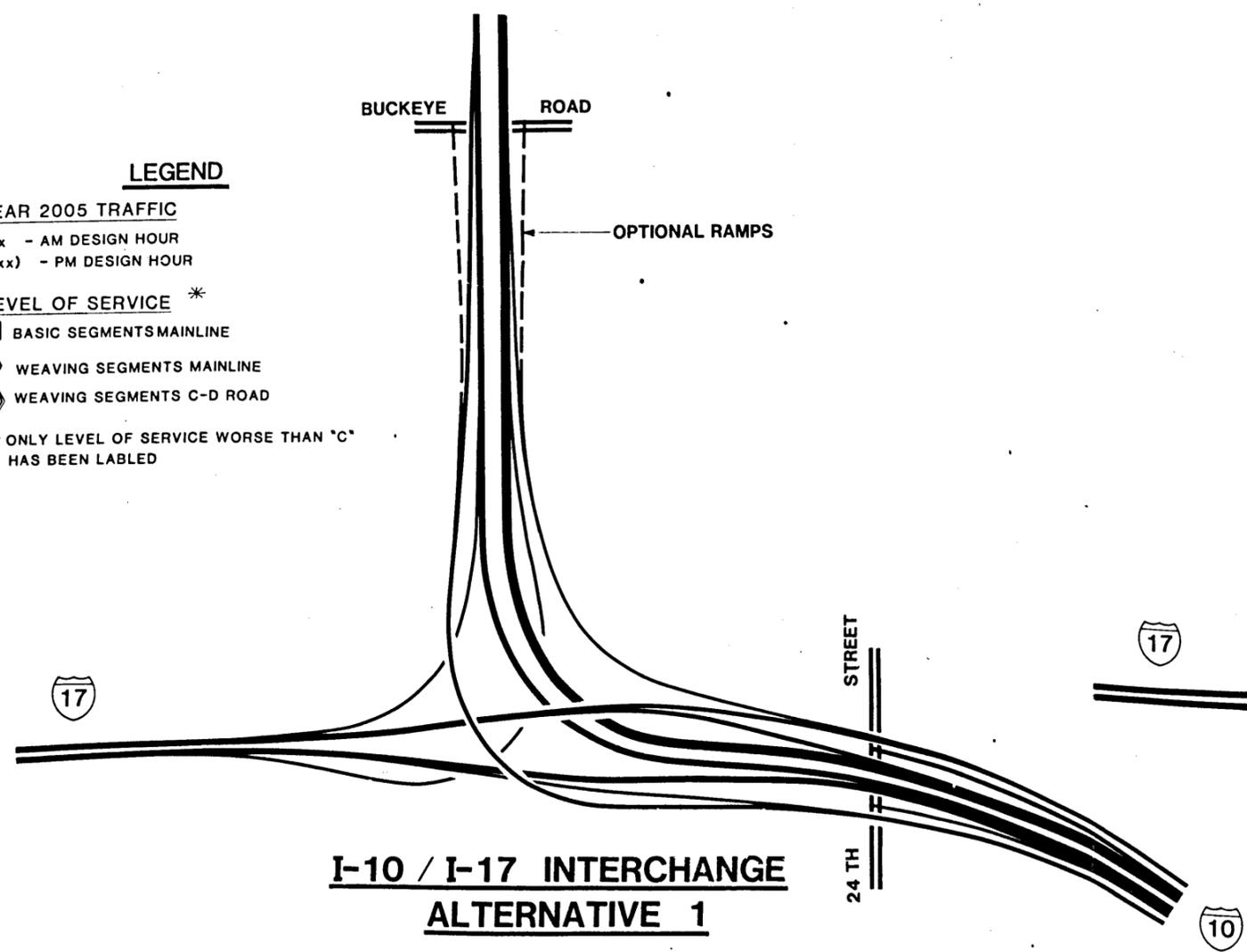
xxx - AM DESIGN HOUR  
 (xxx) - PM DESIGN HOUR

**LEVEL OF SERVICE \***

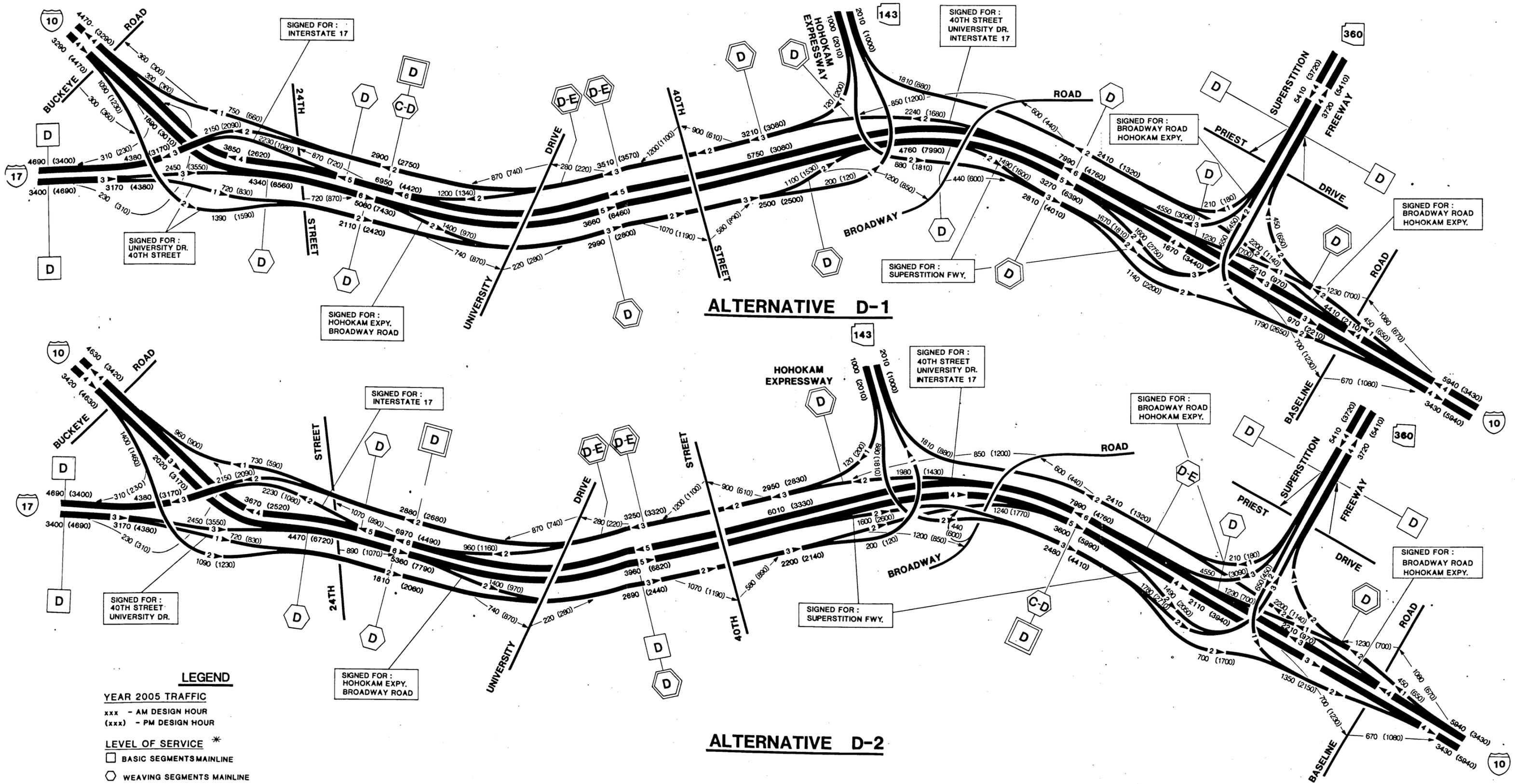
- BASIC SEGMENTS MAINLINE
- WEAVING SEGMENTS MAINLINE
- ⬡ WEAVING SEGMENTS C-D ROAD

\* ONLY LEVEL OF SERVICE WORSE THAN 'C' HAS BEEN LABELED

**SCHEMATIC REPRESENTATION OF CONCEPT ALTERNATIVES**



**FIGURE 7**



**ALTERNATIVE D-1**

**ALTERNATIVE D-2**

**LEGEND**

- YEAR 2005 TRAFFIC**  
 xxx - AM DESIGN HOUR  
 (xxx) - PM DESIGN HOUR
- LEVEL OF SERVICE \***
- BASIC SEGMENTS MAINLINE
  - WEAVING SEGMENTS MAINLINE
  - ⬡ WEAVING SEGMENTS C-D ROAD
- \* ONLY LEVEL OF SERVICE WORSE THAN "C" HAS BEEN LABELED

**SCHMATIC REPRESENTATION OF CONCEPT ALTERNATIVES**

**FIGURE 8**

#### IV. DESCRIPTION OF ALTERNATIVE PLANS

The "single-line" alternatives for the I-10 Corridor were developed at a scale of 1" = 400' as overlays to the aerial mosaics. The plans show the horizontal alignment of each roadway including number of lanes and interchange configurations, along with ramp terminal locations and tapers, weaving lengths and ramp sequences. The five "single-line" plans (Exhibits C-1, C-2, C-3, D-1 and D-2) are appended to this report.

#### SUMMARY OF FEATURES

A matrix summarizing the principle features of each of the alternatives is presented in Figure 9. The following features which are tabulated are reviewed in detail in the discussion of the five alternatives.

##### Lane Arrangements for Core and C-D Roadways

- Continuous Lanes
- Basic Lanes
- Actual Number of Lanes (basic and auxiliary)

##### Service Interchanges

- Interchange Location
- Interchange Type
- Access Via Core or C-D Roadway

##### Number of Transfer Roadways Serving 1, 2, 3, or 4 Destinations

##### Operational Flexibility (Optional Use of Core vs. C-D)

- Complete
- Complete/Restricted
- Partial/Interrupted

##### Level of Service

- Basic Freeway Segments (Core Roadways)
- Weaving Sections
- C-D Roadways

**I - 10 CORRIDOR REFINEMENT STUDY  
DESCRIPTION OF ALTERNATIVE CONCEPTS**

SEGMENT	LANE ARRANGEMENT (C-D/CORE) EB/(C-D/CORE) WB	LANE ARRANGEMENT			INTERCHANGES			TRANSFER ROADS TO 1, 2, 3, OR 4 DESTINATIONS				OPERATIONAL FLEXIBILITY	LEVEL OF SERVICE				COMMENTS		
		CONTINUOUS	BASIC	ACTUAL	LOCATION	TYPE	ACCESS	1	2	3	4		SEGMENT	CORE ROADWAY EB	CORE ROADWAY WB	C-D ROADWAY EB		C-D ROADWAY WB	
C-1	I-10/I-17 To University	1-3-3-1	2-5-5-2	2-6-6-2	Buckeye 24th Street	Half-Diamond	C-D	7	6	0	0	Complete/ Restricted	24th St. - University	D	D-E	C	C	● 3 Lane Exit West-bound to I-17.	
	University To Hohokam Exp.	1-3-3-1	2-5-5-2	3-5-5-3	University 40th Street	Diamond	C-D						University - 40th Street	C	C	C	D		● 3 Lane Exit East-bound to S.R. 360.
	Hohokam Exp. To S.R. 360	1-3-3-1	2-5-5-2	3-5-6-3	Hohokam Broadway	Directional	C-D						40th Street - Hohokam	C	C	C	D		
	Baseline				Parclo A	C-D	Hohokam - Superstition	C	D-E	D	D								
C-2	I-10/I-17 To University	1-3-3-0	2-5-4-3	2-6-5-3	Buckeye 24th Street	None	—	8	4	1	0	Complete/ Restricted	24th St. - University	D	D-E	C	C	● EB Traffic to SR 360 partially assigned to C-D road @ Hohokam Expressway.	
	University To Hohokam Exp.	1-3-3-0	2-5-4-3	3-5-4-4	University 40th Street	Half-Diamond	C-D						University - 40th Street	C	C	C	D		● WB Traffic to I-17 partially assigned to C-D road @ Hohokam Expressway.
	Hohokam Exp. To S.R. 360	1-3-3-0	2-5-4-3	3-5-5-3	Hohokam Broadway	Directional	C-D/Core						40th Street - Hohokam	C	C	C	D-E		
	Baseline				Parclo A	C-D	Hohokam - Superstition	D-E	D	D	D								
C-3	I-10/I-17 To University	2-3-3-2	3-4-4-3	3-5-5-3	Buckeye 24th Street	None	—	7	2	3	1	Complete	24th St. - University	C	D-E	C	C	● EB I-17 to SR 360 routed on C-D road.	
	University To Hohokam Exp.	2-3-3-2	3-4-4-3	4-4-4-4	University 40th Street	Half-Diamond	C-D						University - 40th Street	C	C	D	D		● WB SR 360 to I-17 routed on C-D road.
	Hohokam Exp. To S.R. 360	2-3-3-2	3-4-4-3	4-4-4-4	Hohokam Broadway	Directional	C-D/Core						40th Street - Hohokam	C	C	D	C		
	Baseline				Parclo A	C-D	Hohokam - Superstition	D-E	E	D-E	D-E								
D-1	I-10/I-17 To University	0-3-3-0	2-5-5-2	2-6-6-2	Buckeye 24th Street	Half-Diamond	C-D	8	4	1	0	Partial/ Interrupted	24th St. - University	D	D	C	D	● EB Traffic to SR 360 partially assigned to C-D road @ Hohokam Expressway.	
	University To Hohokam Exp.	0-3-3-0	2-5-5-2	3-5-5-3	University 40th Street	Diamond	C-D						University - 40th Street	C	C	D	D-E		● WB Traffic to I-17 partially assigned to C-D road @ Hohokam Expressway.
	Hohokam Exp. To S.R. 360	0-3-3-0	2-5-5-2	3-5-6-2	Hohokam Broadway	Directional	C-D						40th Street - Hohokam	C	C	D	D		
	Baseline				Parclo A	C-D	Hohokam - Superstition	C	D-E	D	C								
D-2	I-10/I-17 To University	0-3-3-0	2-5-5-2	2-6-6-2	Buckeye 24th Street	None	—	7	4	2	0	Partial/ Interrupted	24th St. - University	D	D	C	D	● EB Traffic to SR 360 partially assigned to C-D road @ Hohokam Expressway.	
	University To Hohokam Exp.	0-3-3-0	2-5-5-2	3-5-5-3	University 40th Street	Half-Diamond	C-D						University - 40th Street	D	C	D	D-E		● WB Traffic to I-17 partially assigned to C-D road @ Hohokam Expressway.
	Hohokam Exp. To S.R. 360	0-3-3-0	2-5-5-2	3-5-6-2	Hohokam Broadway	Directional	C-D						40th Street - Hohokam	D	C	C	D		
	Baseline				Parclo A	Core/C-D	Hohokam - Superstition	C-D	D-E	D	C								

FIGURE 9

## ALTERNATIVE C-1

In this alternative, the basic cross section of the core roadways on I-10 would remain basically the same as the programmed segment between Buckeye Road and 40th Street and the recommended first phase improvements between 40th Street and the Superstition Freeway. Five basic lanes (including the HOV lane) would be maintained in each direction on the I-10 Core road from the I-17 T.I. to the Superstition Freeway T.I. An auxiliary lane is provided in each direction between most adjacent interchanges to insure proper lane balance and adequate LOS in weaving sections. Three continuous lanes would be provided in each direction on I-10 throughout the entire length of the project.

Provisions would be made for two basic lanes in each direction on the collector-distributor (C-D) roadway from the I-17 T.I. to the Superstition Freeway T.I. Auxiliary lanes are included in some segments to maintain lane balance on the C-D road systems. This plan would provide one continuous lane in each direction on the C-D roads throughout the entire length of the project. All service interchanges are accessed via the C-D road system with the exception of the 24th Street T.I.

The transfer roadways between the core and C-D roadway are strategically located to minimize weaving on the core roadways and provide balanced travel demands and levels of service between the core roadways and the C-D roadways. In addition, each transfer road would serve a maximum of two interchange destinations, providing for simplified and concise guide signing on the I-10 Corridor. This alternative has complete, but partially restricted, operational flexibility providing motorists the optional use of the core or C-D roadways during periods of major shifts in traffic flow patterns or lane blockage caused by vehicle incidents or maintenance operations. All transfer roadways are two lanes wide except those between I-17 and the C-D roadways at the west end of the project and between the Superstition Freeway and the C-D roadways at the east end of the project, which are one lane wide. This limits major shifts of traffic to and from the C-D road system if incidents occur near to two extremities of the Corridor.

A relatively uniform level of service (LOS C to D) is provided throughout the length of the Corridor on both the core and C-D road systems. Exceptions are the

westbound segments of the I-10 core roadway between the Superstition Freeway and the Hohokam Expressway and between University Drive and 24th Street, which would operate at LOS D to E.

The primary attribute of this alternative is that no major reconstruction would be required on I-10 core roadways and the I-10/I-17 interchange during the implementation of the C-D road system. This plan would cause minimum disruption to traffic flow on I-10 during this phase of the work.

In this alternative, the connection from eastbound I-10 to eastbound on the Superstition Freeway passes through the interchange at the third level, which minimizes the right-of-way and building acquisition on the west side of I-10. In the initial phase of construction, this would appear as a first and third level interchange until the second level ramp connection from westbound Superstition Freeway to eastbound I-10 is constructed during a later phase. The interchange could be designed to locate the eastbound I-10 connection to eastbound Superstition Freeway at the second level of the interchange, requiring the acquisition of additional right-of-way and three buildings on the west side of I-10.

A potential disadvantage of this alternative is the three lane exit to the Superstition Freeway from eastbound I-10, and to northbound I-17 from westbound I-10. Operating experience on existing freeways indicates that three lane exits are subject to excessive vehicle turbulence and potential backups in the traffic stream during high volume conditions.

#### ALTERNATIVE C-2

In this alternative, the configuration of the lanes on the core roadways on I-10 would have to be modified to accommodate the C-D road system. Five basic lanes (including the HOV lane) would be maintained on the I-10 core roadway in the eastbound direction, with two basic lanes on the C-D roadway. Four basic lanes would be required on the core roadway in the westbound direction with three basic lanes on the C-D roadway. An auxiliary lane is provided in each direction on the core roadways between the I-17 T.I. and University Drive, and on the westbound core roadway between the Superstition Freeway and the Hohokam Expressway. An

auxiliary lane is also provided on the westbound C-D roadway between the Hohokam Expressway and University Drive. Three continuous lanes would be provided in each direction on the I-10 core roadway throughout the entire length of the project. There would be one continuous lane in the eastbound direction and no continuous lanes in the westbound direction on the C-D road system. All service interchanges are accessed via the C-D road system with the exception of the following: Ramp connections to Buckeye Road are eliminated; 24th Street accessed via the core roadways; and the eastbound access to I-10 from the Hohokam Expressway via the core roadway.

Twelve of the transfer roadways/ramps would serve a maximum of two interchange destinations, while one would serve three interchange destinations. In order to avoid a three-lane exit from the westbound I-10 core roadway to I-17, the westbound transfer ramp to the C-D roadway in the vicinity of the Hohokam Expressway would be signed for destinations to I-17 as well as 40th Street and University Drive. In addition, an eastbound transfer ramp to the C-D roadway provided at this location, signed for the Superstition Freeway, eliminates the need for a three-lane exit from the eastbound I-10 core roadway to the Superstition Freeway.

This alternative has complete, but partially restricted, operational flexibility providing motorists with the optional use of the core or C-D roadways during periods of shifts in traffic flow patterns or lane blockage. All transfer roadways have two lanes with the exception of the connections from the Superstition Freeway to the westbound C-D roadway and from eastbound I-17 to the C-D roadway which are one-lane transfer roadways.

A relatively uniform level of service (LOS C to D) is provided throughout the length of the corridor on both the core and C-D road systems, except the following segments which would operate at LOS D to E: I-10 westbound core roadway from University Drive to 24th Street; I-10 eastbound core roadway between the Hohokam Expressway and the Superstition Freeway; and the westbound C-D roadway between the Hohokam Expressway and 40th Street.

The configuration of the I-10/I-17 interchange in this alternative differs from the other four alternatives and requires moderate reconstruction of the interchange. The eastbound I-10 connection to the C-D roadway passes under the eastbound and westbound ramps to I-17, requiring the reconstruction of the ramp from eastbound I-17 to eastbound I-10. At the Superstition T.I., the ramp from eastbound I-10 to eastbound Superstition Freeway passes through the interchange at the second level.

### ALTERNATIVE C-3

In this alternative, the cross section of the lanes on the core roadways on I-10 would require modification to accommodate the C-D road system. Four basic lanes (including the HOV lane) would be provided in each direction on the I-10 core roadways from the I-17 T.I. to the Superstition Freeway T.I. An auxiliary lane would be provided in each direction between I-17 and University Drive. Three continuous lanes would be available in each direction on the I-10 core roadway throughout the entire length of the project.

The C-D roadways would have three basic lanes in each direction from the I-17 T.I. to the Superstition Freeway T.I. An auxiliary lane would be provided in each direction between University Drive and the Superstition Freeway. This plan would provide two continuous lanes in each direction on the C-D road system throughout the entire length of the project. All service interchanges are accessed via the C-D road system with the exception of the 24th Street T.I. and the Hohokam Expressway ramps to and from the east on I-10.

The transfer roadways between the core and C-D roadways are strategically located to minimize weaving on the core roadways and to equalize the travel demands and levels of service between the core roadways and the C-D roadways. Nine transfer roadways would serve a maximum of two interchange destinations, three transfer roadways would serve three interchange destinations, and one transfer roadway would serve four destinations. At the I-10/I-17 T.I. eastbound traffic from I-17, having destinations to the Superstition Freeway, is transferred immediately (signed) to the C-D roadway. This eliminates the need for a three-lane exit from the eastbound I-10 core roadway to the Superstition Freeway. Similarly, traffic westbound to I-17 from the Superstition Freeway is transferred

immediately onto the C-D roadway, thus eliminating the need for a three-lane exit from the westbound I-10 core roadway to I-17. Therefore, the core roadways basically accommodate I-10 traffic while the C-D roadways accommodate the I-17/Superstition Freeway traffic and provide access to the service interchanges.

This alternative has complete and unrestricted operational flexibility, providing users the optional use of the core or the C-D roadways during periods of shifts in traffic flow patterns and lane blockage caused by traffic incidents and maintenance operations. All transfer roadways between the core and C-D roadways are two lanes wide.

A relatively uniform level of service (LOS C to D) is provided throughout the length of the corridor on both the core and C-D road systems, with the exception of the following segments, which would operate at LOS D to E: I-10 westbound core roadway from University Drive to 24th Street; and the I-10 eastbound core roadway between the Hohokam Expressway and the Superstition Freeway.

#### ALTERNATIVE D-1

The cross section of the I-10 core roadways in this alternative would remain basically the same as the programmed segment between Buckeye Road and 40th Street and the recommended first phase improvements between 40th Street and the Superstition Freeway. Five basic lanes (including the HOV lane) would be maintained in each direction on the I-10 core roadways from the I-17 T.I. to the Superstition Freeway T.I. An auxiliary lane is provided in each direction between the I-17 T.I. and University Drive and on the westbound core roadway between Superstition Freeway and the Hohokam Expressway. Three continuous lanes would be provided in each direction on the I-10 core throughout the entire length of the project.

In this alternative, the C-D road system is discontinuous at the Hohokam Expressway. Two basic lanes would be provided in each direction on the C-D roadway in the sections between the I-17 T.I. and the Hohokam Expressway T.I. and between the Hohokam Expressway T.I. and the Superstition Freeway T.I. Auxiliary lanes are planned in both directions on the C-D roadways in the segments from

University Drive to the Hohokam Expressway and in the eastbound direction from the Hohokam Expressway to the Superstition Freeway. There is no lane continuity on the C-D road system on the overall length of the corridor. All service interchanges are accessed via the C-D road system with the exception of 24th Street and Baseline Road.

Twelve of the transfer roadways/ramps would serve a maximum of two interchange destinations, while one would serve three destinations. The westbound transfer ramp to the C-D roadway in the vicinity of the Hohokam Expressway would be signed for destinations to I-17 as well as 40th Street and University Drive to eliminate the need for a three-lane exit from the I-10 core road to I-17. In addition, an eastbound exit ramp to the C-D roadway, signed for destination to the Superstition Freeway (located at the Hohokam Expressway) would eliminate the need for a three-lane exit from the eastbound I-10 core road to the Superstition Freeway. Since the C-D road system is not continuous, only partial and interrupted operational flexibility is provided by this alternative.

A relatively uniform level of service (LOS C to D) is provided throughout the length of the corridor on both the core and C-D road system, with the exception of the following segments, which would operate at LOS D to E: the I-10 westbound core roadway from the Superstition Freeway to the Hohokam Expressway; and the westbound C-D road from 40th Street to University Drive.

The configuration of the I-10/Superstition Freeway system interchange differs from the previous described alternative. The westbound transfer road east (south) of the Superstition Freeway T.I. connects the C-D road with the I-10 core road instead of continuing onto the C-D road. The eastbound transfer road at the Superstition Freeway T.I. extends onto the C-D road instead of connecting to the I-10 core roadway. This alternative would require additional right-of-way at this interchange.

#### ALTERNATIVE D-2

This alternative is identical to Alternative D-1 in terms of geometrics, lane arrangements, and operational characteristics in the segments between the I-17

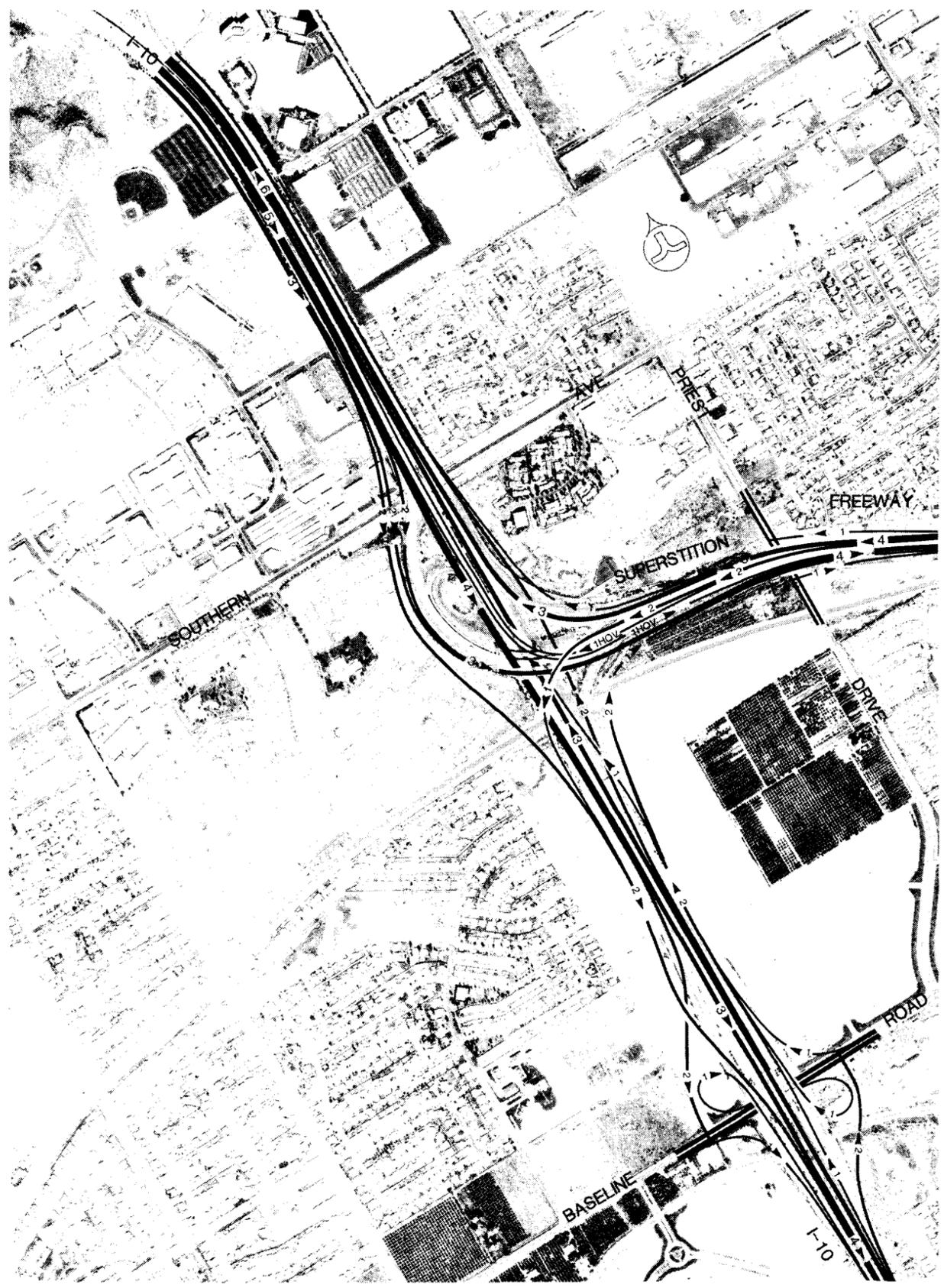
T.I. and the 40th Street T.I. and between Broadway Road and Baseline Road. In this alternative, ramp connections to Buckeye Road are not provided and the configuration of the transfer ramps at the Hohokam Expressway T.I. is modified. In Alternative D-1, the eastbound transfer ramp from the C-D road connects to the I-10 core roadway west of the Hohokam Freeway and the westbound transfer ramp from the I-10 core road to the C-D road begins east of the Hohokam Freeway. This configuration creates a weaving section on the eastbound I-10 core roadway. In Alternative D-2, the two transfer roadways are overlapped by means of a basket-weave configuration. This arrangement eliminates the weaving section on the eastbound I-10 core road at the expense of a higher construction cost.

### ALTERNATIVE HOV LANE CONNECTIONS

A preliminary investigation of the feasibility of connecting the High Occupancy Vehicle (HOV) lanes in the median of I-10 to the Superstition Freeway was developed in concept form. Two "single-line" schemes were developed, which are compatible with each of the five I-10 corridor plan alternatives, and are illustrated in Figure 10.

#### Alternative 1

This lower cost alternative utilizes ramp connections between the HOV lanes in the median of I-10 and the median lane on the Superstition Freeway, which exit on the left and enter on the left. The roadways on both I-10 and the Superstition Freeway would have to be bowed out to accommodate the HOV ramp connections. In the eastbound direction on I-10, the HOV lane ramp to the Superstition Freeway exits on the left near the same point where the two-lane ramp from the I-10 core road to the Superstition Freeway exits to the right. In the westbound direction on the Superstition Freeway, the right hand junction near Priest Drive splits to the westbound I-10 core road and the westbound C-D road, while the left-hand junction splits to the eastbound I-10 C-D road and the HOV lane to the westbound I-10 core road. The signing at these bifurcations would be extremely complex and could be confusing to the driver.



ALTERNATIVE 1



ALTERNATIVE 2

**HIGH OCCUPANCY VEHICLE LANE CONCEPTS**  
 SUPERSTITION T.I.

**FIGURE 10**

DMJM / Adam, Hamlyn, Anderson  
 in association with  
 JACK E. LEISCH & ASSOCIATES  
 Prepared for  
 ARIZONA DEPARTMENT  
 OF TRANSPORTATION  
 MAY 1987

## Alternative 2

In the eastbound direction on I-10, the HOV ramp connection to the Superstition Freeway exits on the left, approximately 1,800 feet prior to the two-lane ramp from the I-10 core road to the Superstition Freeway. In the westbound direction on the Superstition Freeway, the HOV ramp connection to westbound I-10 exits on the left approximately 1,000 feet in advance of the right exit ramp to Priest Drive. Locating the HOV ramps sufficiently in advance of major bifurcations at the Superstition T.I. would simplify the guide signing and the navigation requirements of the motorist. This alternative would significantly increase the right-of-way acquisition and construction costs.

It is questionable whether either of these alternatives would be cost effective or improve traffic operations on the HOV lanes or the main lanes through this interchange. Construction and right-of-way costs, particularly on the Superstition Freeway, would be excessive. Further study would be required to determine how far to the east that the Superstition Freeway would have to be widened to an eight-lane facility to accommodate the HOV lanes. It is recommended that these concepts not be pursued further because of the excessive cost and seemingly low demand for the HOV lanes along the Superstition Freeway.

## V. COMPARATIVE ASSESSMENT OF ALTERNATIVES

The five selected alternatives were compared on the basis of operations, costs, ease of implementation, and environmental impacts. These four major categories were divided into ten characteristics for which each of the alternatives were assessed. Each of the characteristics were given a scale value, the sum of which is 100. The rating scale for each item ranges from 5 to 10, with 10 being the best. The maximum possible score for any alternative is 1,000. The results of this evaluation are shown in Figure 11. Alternatives C-1 and C-3 received significantly higher ranking than the other alternatives.

### ALTERNATIVE C-1

The principal advantages of Alternative C-1 are:

- No major reconstruction would be required at the I-10/I-17 system interchange.
- The cross section of the core roadways on I-10 would remain basically the same as the programmed segment between Buckeye Road and 40th Street and the recommended first phase improvements between 40th Street and the Superstition Freeway.
- The C-D road system could be constructed with minimum disruption to traffic flow on the I-10 core roadways.
- Three continuous lanes would be provided in each direction on the core roadways and one continuous lane in each direction on the C-D roadways.
- Complete, but partially restricted, operational flexibility would provide drivers the optional use of the core or C-D roadways.

**I-10 CORRIDOR REFINEMENT STUDY**

**ALTERNATIVE RANKINGS**

ALTERNATIVE	SCALE VALUE	CONTINUOUS						DISCONTINUOUS			
		Rating	C-1 Weighted Value	Rating	C-2 Weighted Value	Rating	C-3 Weighted Value	Rating	D-1 Weighted Value	Rating	D-2 Weighted Value
<u>OPERATIONAL (40)</u>											
CAPACITY/LOS	(10)	8	80	7	70	7	70	8	80	8	80
FLEXIBILITY	(10)	7	70	7	70	9	90	5	50	5	50
LANE CONTINUITY	(10)	8	80	7	70	9	90	6	60	6	60
GEOMETRIC ALIGNMENT	(5)	8	40	8	40	9	45	8	40	8	40
GUIDE SIGNING	(5)	9	45	8	40	7	35	8	40	8	40
<u>COSTS (25)</u>											
CONSTRUCTION	(15)	8	120	7	105	7	105	7	105	6	90
R.O.W.	(10)	7	70	6	60	7	70	7	70	7	70
<u>IMPLEMENTATION (25)</u>											
STAGING - CONSTRUCTION	(15)	9	135	7	105	8	120	8	120	8	120
MAINTENANCE OF TRAFFIC	(10)	9	90	7	70	8	80	8	80	8	80
<u>ENVIRONMENTAL (10)</u>											
IMPACT ON DEVELOPMENT	(10)	7	70	6	60	7	70	6	60	6	60
<b>(POSSIBLE: 1000) TOTAL</b>	<b>(100)</b>		<b>790</b>		<b>690</b>		<b>775</b>		<b>705</b>		<b>690</b>

**FIGURE 11**

- A reasonably uniform level of service (LOS C to D) would be provided on both the core and C-D roadway systems over the entire length of the corridor, with the exception of two segments of the core road, which would operate at LOS D to E.

A potential disadvantage of Alternative C-1 is the three-lane exit to the Superstition Freeway from eastbound I-10 and the three-lane exit to I-17 from westbound I-10. Operating experience on existing freeways indicates that three-lane exits are subject to vehicle turbulence and potential backups in the traffic stream during high-volume conditions.

### ALTERNATIVE C-3

The principal advantages of Alternative C-3 are:

- No major reconstruction would be required at the I-10/I-17 system interchange.
- Two-lane exits would be provided from the westbound I-10 core roadway to I-17 and from the eastbound core roadway to the Superstition Freeway.
- The ramp from eastbound I-10 to the Superstition Freeway, located at the second level of the interchange is best suited to the proposed phasing of construction of the I-10/Superstition Freeway system interchange.
- Three continuous lanes would be provided in each direction on the core roadways and two continuous lanes in each direction on the C-D roadways.
- Complete and unrestricted operational flexibility would provide drivers the optional use of the core or C-D roadways.

- A reasonably uniform level of service (LOS C to D) would be provided on both the core and C-D roadway system over the entire length of the corridor, with the exception of the two segments of the core road and two segments of the C-D road which would operate at LOS D or E.

One relative disadvantage of Alternative C-3 as compared to Alternative C-1 would be the necessity to implement minor changes in the programmed cross sections of the I-10 core roadways, which would slightly increase construction and maintenance of traffic costs.

## VI. SUMMARY AND RECOMMENDATIONS

From the alternatives assessment, it is apparent that Alternatives C-1 and C-3 demonstrate a number of attributes which are significantly better than the other alternatives. Alternative C-1 retains the basic cross-section of the core roadways on I-10 as currently planned and programmed, and the C-D road system could be constructed with minimum disruption to the traffic flow on the core roadways. This alternative would provide complete, but partially restricted, optional use of the core or C-D roadways during periods of congestion or lane blockage. A potential disadvantage is the three-lane exit to the Superstition Freeway from eastbound I-10 and the three-lane exit to I-17 from westbound I-10. Alternative C-3 would provide three continuous lanes in each direction on the I-10 core roadways and two continuous lanes in each direction on the C-D roadway. Complete and unrestricted operational flexibility would provide drivers the optional use of the core or C-D roadways. In Alternative C-3, two-lane exits would be provided from westbound I-10 to I-17 and from eastbound I-10 to the Superstition Freeway. The necessity to implement minor changes in the programmed cross-sections of the I-10 core roadways for this alternative would result in slightly higher construction and maintenance of traffic costs than that of Alternative C-1.

Based on the findings of this study, it is recommended that the following actions be taken:

1. Proceed with Phase III of the study for further engineering design refinements of Alternatives C-1 and C-3.
2. The Scope of Work be expanded to include the following tasks on the I-10 Corridor from Buckeye Road to Baseline Road:
  - a. Functional plans to be completed at a scale of 1" = 100'.

- b. Profile sheets be prepared for all mainline roadways, C-D roadways, and ramps.
  - c. Prepare representative cross-sections.
  - d. Graphical representation of right-of-way requirements tied to stationed offsets from the centerline of I-10.
3. Further evaluation of HOV lane connections to the Superstition Freeway not be carried forward into Phase III.