PHASE II REPORT

I-10 CORRIDOR STUDY
40TH STREET TO BASELINE ROAD

ARIZONA DEPARTMENT OF TRANSPORTATION

Submitted by

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I. Introduction

I. INTRODUCTION

The overall objectives of this study are to develop a rehabilitation plan which not only corrects the existing geometric and operational deficiencies, but will also accommodate future traffic requirements, and to prepare a phased construction plan for rehabilitation within the framework of a long-range plan.

The I-10 Corridor Study employs a systems approach comprised of four integrated phases as detailed in Figure 1. The four project phases are:

I. Analysis and Evaluation of Existing Facility
II. Development of Alternative Improvement Schemes
III. Refinement of Selected Alternatives
IV. Development of Improvement Plan and Report

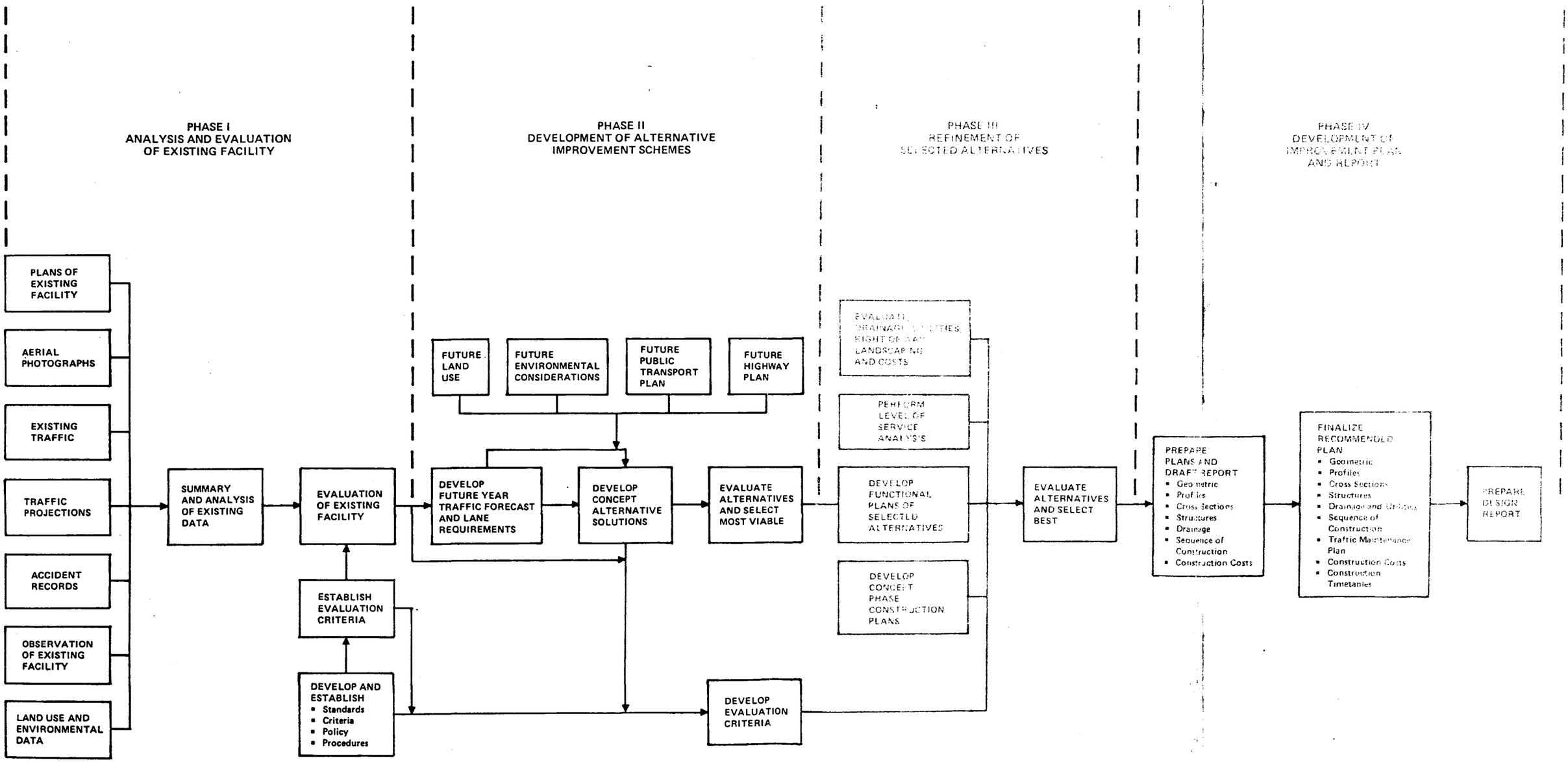
The following report documents the work completed during Phase II of the project, which includes the development of alternative improvement schemes. As an introduction to this work, a brief summary of the Phase I Report on the Analysis and Evaluation of Existing Facility, submitted to the Arizona Department of Transportation (ADOT) during November 1985, is presented as follows:

SUMMARY OF PHASE I REPORT

The first report documented the work accomplished in the analysis and evaluation of the existing I-10 corridor from 40th Street to Baseline Road and the Superstition Freeway from I-10 to Rural Road. The major topics treated in this report were:

- A detailed inventory and analysis of the geometric and operational features of the system;

PHOENIX-CASA GRANDE HIGHWAY 40TH STREET—BASELINE ROAD CORRIDOR STUDY



SCOPE OF WORK FLOWCHART

- An evaluation of the existing geometric and operational features and performance measures of the freeway system;

- Determination of the 1985 peak hour traffic volumes and levels of service provided on the basic freeway segments and ramps; and

- A summary of findings and conclusions.

Inventory and Analysis Procedures

A detailed inventory of the geometric and operational features of the corridor was conducted to serve as a basis for determining existing deficiencies and as an aid in the develoment of alternative improvement schemes. From the analysis of the geometric and operational characteristics, related performance measures were developed for the individual freeway segments. The information sources which were utilized included plans of the existing facilities, a field inventory of geometric and operational features of freeway segments and interchanges, video tapes of the roadways, aerial photographs, accident data, land use and environmental data, speed-delay runs and field observations of traffic operations during peak traffic periods.

Level of Service Evaluation

Based upon daily and hourly traffic volume data provided by ADOT and the City of Tempe, 1985 AM and PM peak hour traffic were developed for all segments of the freeway system. Capacity analyses were performed using these data and levels of service were determined for the basic freeway segments, weaving sections, and ramps. Virtually all freeway segments are currently performing at or near capacity (Level of Service D or E) due primarily to an inadequate number of lanes. The only segments operating at Level of Service C or better are on I-10 south of the Superstition Freeway. Virtually all ramps in the study area are operating at or near capacity. In many cases this is due to the high density of vehicles in lane 1 on

the freeway mainline, rather than inherent deficiencies in ramp design or sequencing.

Evaluation of the System

Evaluation criteria were established based on the 1984 AASHTO design standards to appraise the quality of the design and operational features of the existing facilities. The following elements were considered in the evaluation:

Geometric Features

- Horizontal Alignment
- Stopping Sight Distance
- Cross Section
- Exit and Entrance Design

Operational Features

- Lane Continuity
- Lane Balance
- Ramp Sequence
- Signing

Performance Measures

- Accident Experience
- Level of Service
- Operating Speed

A set of graphical displays were prepared of the geometric and operational features for each segment of the facility in comparison to its performance measures which demonstrated the relationship between existing design features and the performance of the facility. These evaluation exhibits clearly identified freeway segments having poor ratings for a number of the geometric, operational and performance elements. The evaluation was valuable in determining the extent of the existing deficiencies and as input to the development of short-term and long-term improvement concepts.

Evaluation Findings

Virtually all sections of this freeway system are operating at or near capacity during peak periods. The addition of mainline freeway lanes would not, in itself, resolve the existing or future operational problems. The modification of interchanges may be necessary to correct the deficiencies in lane continuity, lane balance and ramp sequence, and to eliminate critical weaving sections.

Specific deficiencies other than the inadequate number of lanes on I-10 which have the most profound effect on capacity, safety, and operations include: the inadequate design of exit and entrance ramps; the sequencing of consecutive loop ramps on mainline I-10 at 48th Street and Broadway Road; the lane drop at the westbound I-10 exit to Broadway Road; and the geometric deficiencies at the major system interchange of I-10 with the Superstition Freeway. These deficiencies and their effect on the performance of the facility will be compounded when the Hohokam Freeway is completed.

PHASE II EXECUTIVE SUMMARY

A list of tasks accomplished in Phase II, Development of Alternative Improvement Schemes, is presented in the Scope of Work Flowchart, Figure 1. The major elements included in the following sections of this report are:

Future Planning Framework

The first major task in this phase of the study was the development of a future planning framework which was used in conjunction with the existing facility evaluation as a guide in developing concept improvement alternatives. The following inputs were employed:

- Future Highway Plan
- Future Year (2005) Traffic Forecasts and Lane Requirements

- Future Land Use and Environmental Considerations
- Public Transport Plans

Design Standards and Operational Criteria

In addition to the planning framework, a set of rehabilitation design standards and operational criteria were established, which serve as an additional guide in developing the alternative concept plans. The development of these standards and criteria were based on current AASHTO policies, ADOT practices, and on recent engineering experience with similar rehabilitation design study projects.

Development of Alternative Concept Plans

A wide array of single-line alternative plans were developed to test the adaptability of each concept to fulfill the requirements of the planning/design framework.

Concept Alternatives Evaluation

The planning/design criteria were applied to each concept and alternative single-line plan to test their efficiency in meeting the established requirements. In addition, a working meeting was held with representatives of ADOT, the City of Phoenix, and the City of Tempe to further review and evaluate the concept alternatives. Three basic corridor design concepts, each containing alternative interchange designs, were selected for further consideration and refinement.

II. Development of Future Design Framework

II. DEVELOPMENT OF FUTURE DESIGN FRAMEWORK

The first major task in Phase II of the study was the development of a future planning and design framework. It was used in conjunction with the existing facility evaluation in developing the concept improvement plans. A number of planning considerations were used as inputs to the development of the planning and design framework. These included: 1) the proposed future highway plan; 2) the projected design year (2005) traffic assignment; 3) future freeway corridor lane requirements; 4) corridor traffic flow patterns; 5) future land use and environmental considerations; and 6) future public transportation (HOV lane) plans.

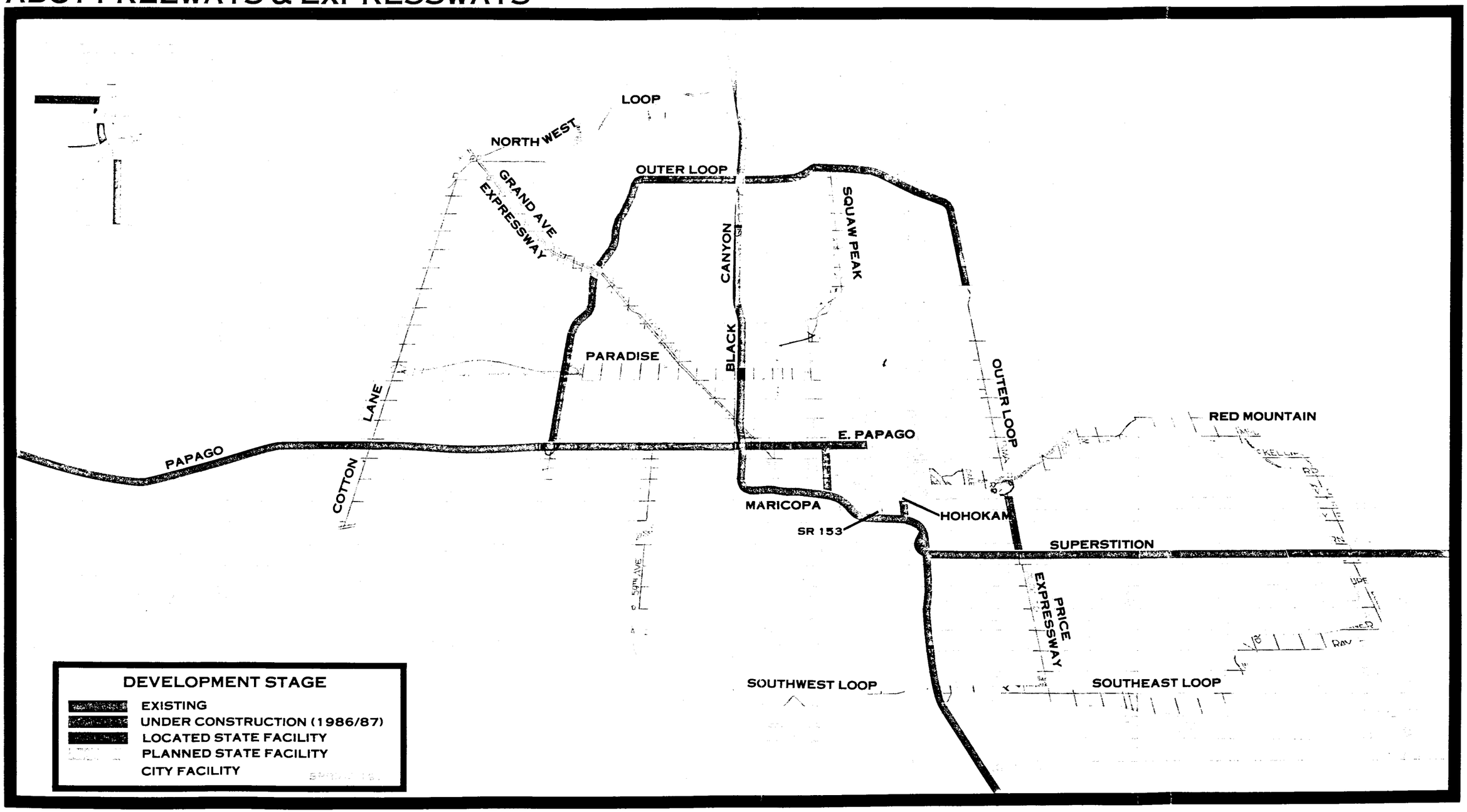
FUTURE HIGHWAY PLAN

A transportation corridor plan to meet year 2005 travel demands has been developed by ADOT. The recommended freeway and expressway corridors (existing, planned, under construction, and under contract) are illustrated in Figure 2. All major projected additions and improvements to the existing highway network were considered in the development of the year 2005 traffic assignments.

Year 2005 Traffic Assignments

A vehicle trip assignment model, which included average daily link volume and turning movement volume data for the year 2005, was prepared by the Maricopa Association of Governments - Transportation Planning Office (MAGTPO). These volumes were applied to the I-10/Superstition Freeway corridor under study. Using these data as a basis, AM and PM design hour volumes were developed using the 1985 traffic data, directional distribution (D) and the ratio of peak hour to 24 hour flow (K) to calibrate the year 2005 average daily traffic projections. The design hour volumes were applied to the freeway corridor system, providing a balanced

ADOT FREEWAYS & EXPRESSWAYS



assignment on the freeway mainline links and ramps. These traffic assignments are presented in Figure 3.

Future Lane Requirements

Figures 4 and 5 illustrate the future lane requirements, based on the design-hour volume projections. They were developed through capacity analyses for uninterrupted flow conditions. Figure 4 details the lanes required in each direction for Level of Service C and Level of Service E for each freeway segment between interchanges.

Figure 5 illustrates the lane requirements in terms of basic lanes and auxiliary lanes to provide a balanced system and was used as a guide in developing the design concept alternatives. As shown in Figure 5, the basic and auxiliary lane requirements for each direction of travel are as follows:

I-10 Eastbound

- Papago Freeway to Superstition Freeway - 5 Basic Lanes
- Superstition Freeway to Elliot Road - 4 Basic Lanes
- 40th Street to Elliot Road - 1 Auxiliary Lane between Interchanges

I-10 Westbound

- Elliot Road to Superstition Freeway - 4 Basic Lanes
- Superstition Freeway to Papago Freeway - 5 Basic Lanes
- Elliot Road to 40th Street - 1 Auxiliary Lane between Interchanges

Superstition Freeway Eastbound

- I-10 to Rural Road - 3 Basic Lanes
- I-10 to Rural Road - 1 Auxiliary Lane between Interchanges

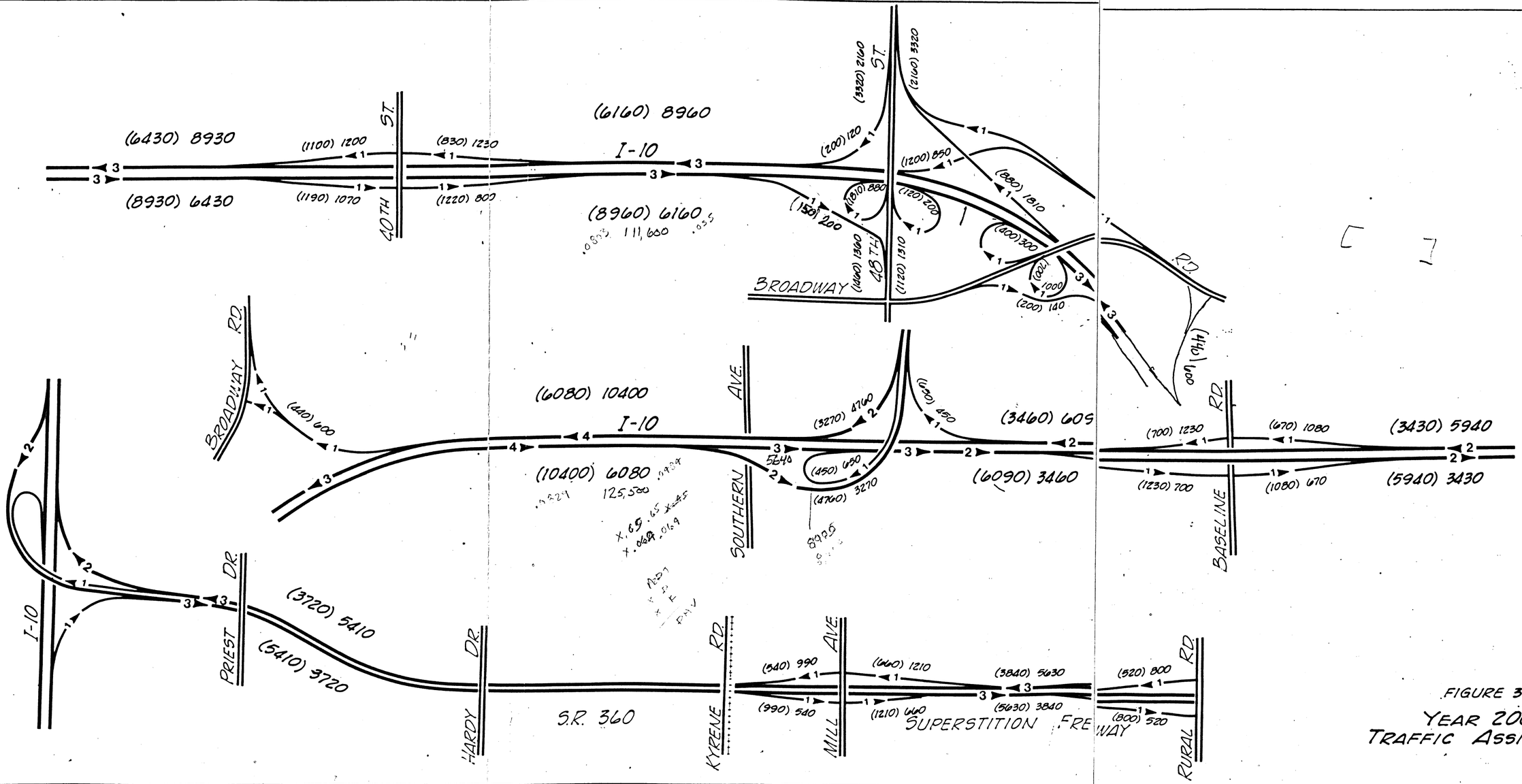


FIGURE 3
YEAR 2005
TRAFFIC ASSIGNMENT

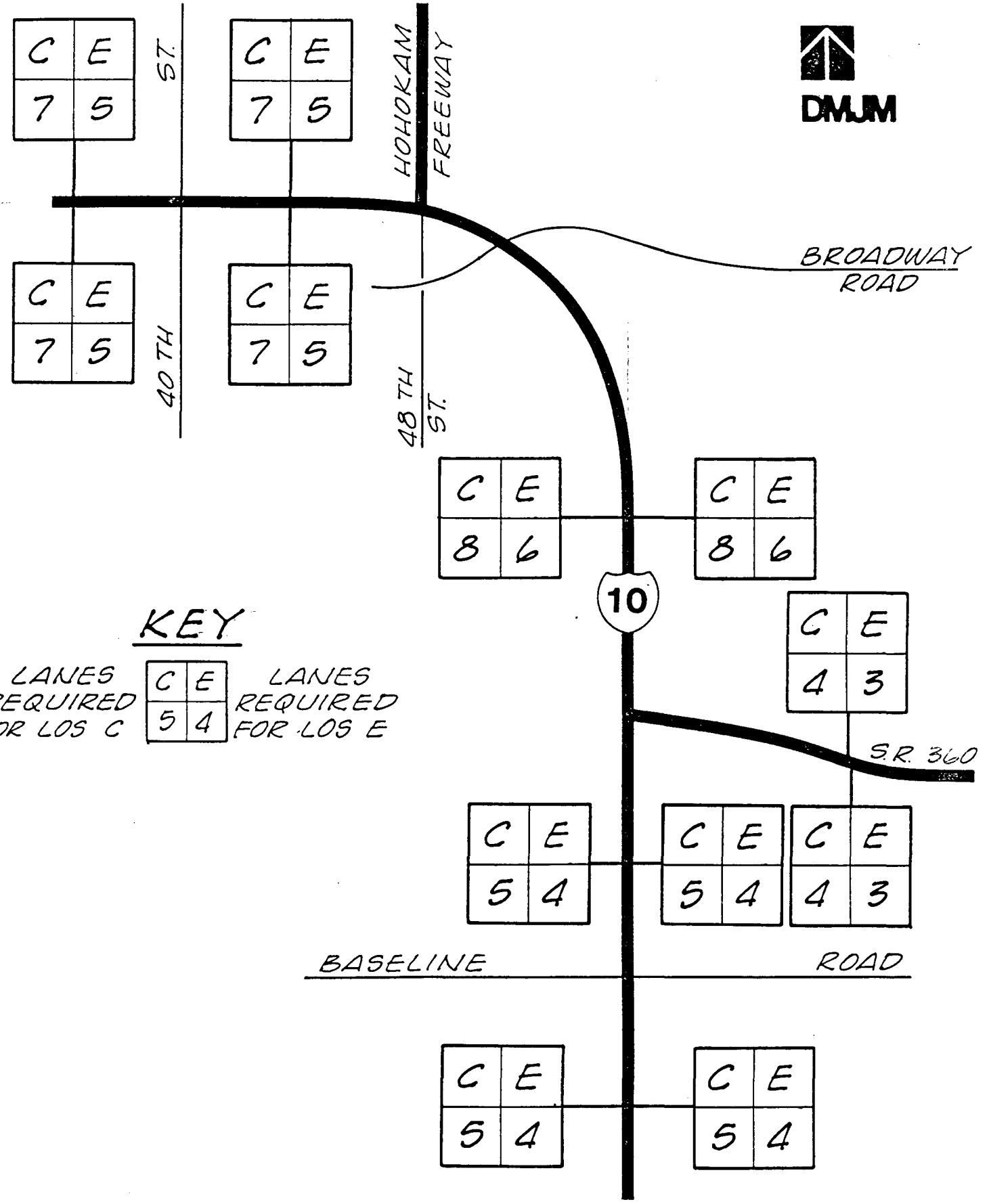


Figure 4

LEVEL OF SERVICE AND LANE REQUIREMENTS

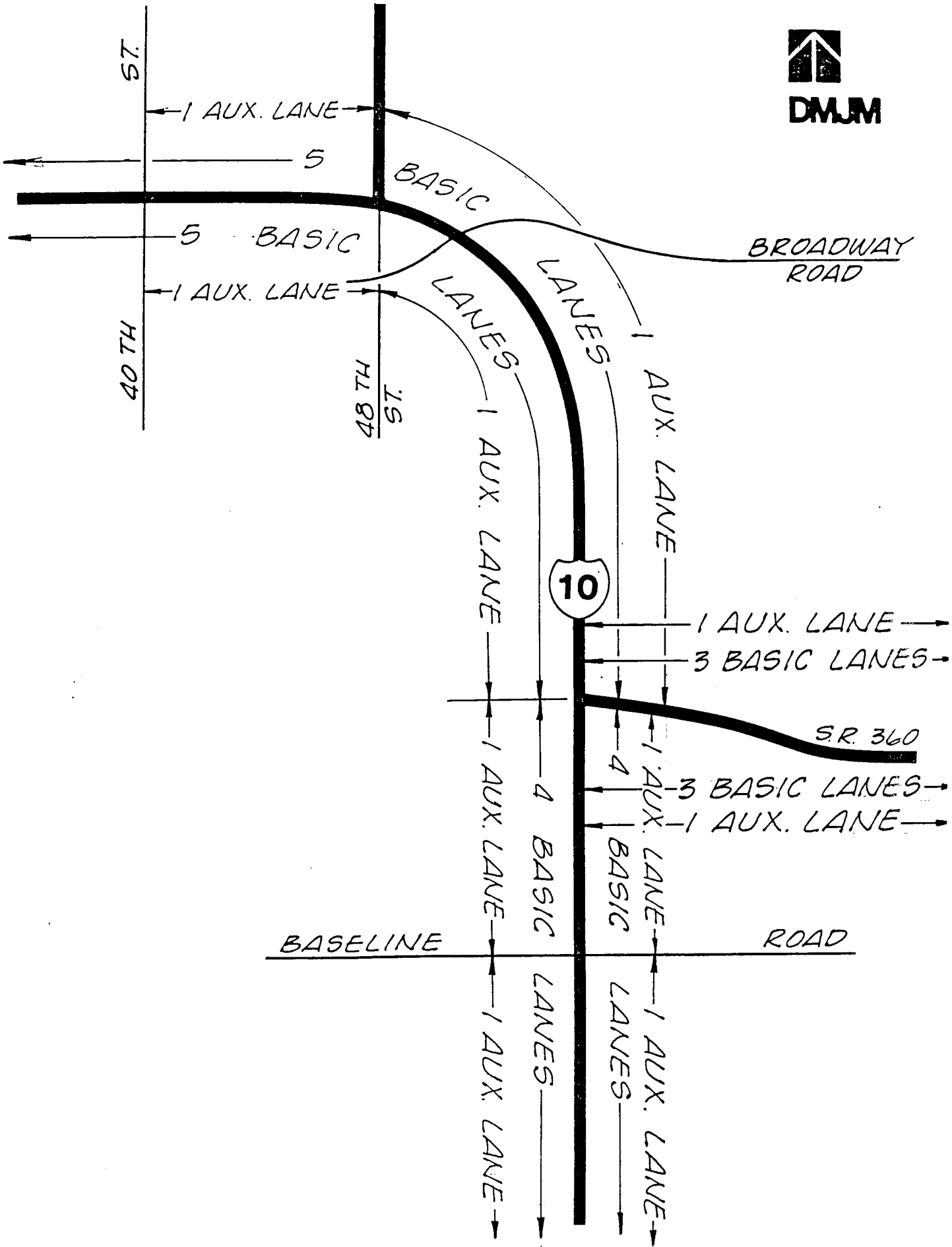


Figure 5

LANE REQUIREMENTS

BASIC LANES & AUXILIARY LANES

Superstition Freeway Westbound

- Rural Road to I-10 - 3 Basic Lanes
- Rural Road to I-10 - 1 Auxiliary Lane Between Interchanges

Corridor Traffic Flow Patterns

In addition to the year 2005 vehicle trip assignment, MAGTPO prepared a selected link assignment for the corridor. The selected links included traffic flow on the Superstition Freeway east of its junction with I-10, with destinations to the west on I-10; and traffic flow on I-10 south of its junction with the Superstition Freeway, with destinations to the west on I-10. These data were calibrated by application of the year 2005 trip assignments and the 1985 count data to represent westbound AM peak hour traffic flow through these selected links. These year 2005 traffic flow volumes are graphically displayed in Figure 6.

This projection illustrates that 2880 vehicles or approximately 51 percent of the AM peak traffic flow westbound from the I-10 link would desire to exit at Broadway Road, the Hohokam Freeway or 40th Street; while only 760 vehicles or 16 percent of the flow westbound from the Superstition Freeway link would have destinations to these exits. This portrays how different design concepts may operate in the future. An improvement scheme that is developed primarily on providing additional lanes in the I-10 corridor would experience a substantial amount of lane changing in the section between the Superstition Freeway and the Hohokam Freeway. A concept that utilized collector-distributor (C-D) roads should basically provide C-D road connections from I-10 south of the Superstition Freeway junction to the interchange with Broadway Road and the Hohokam Freeway.

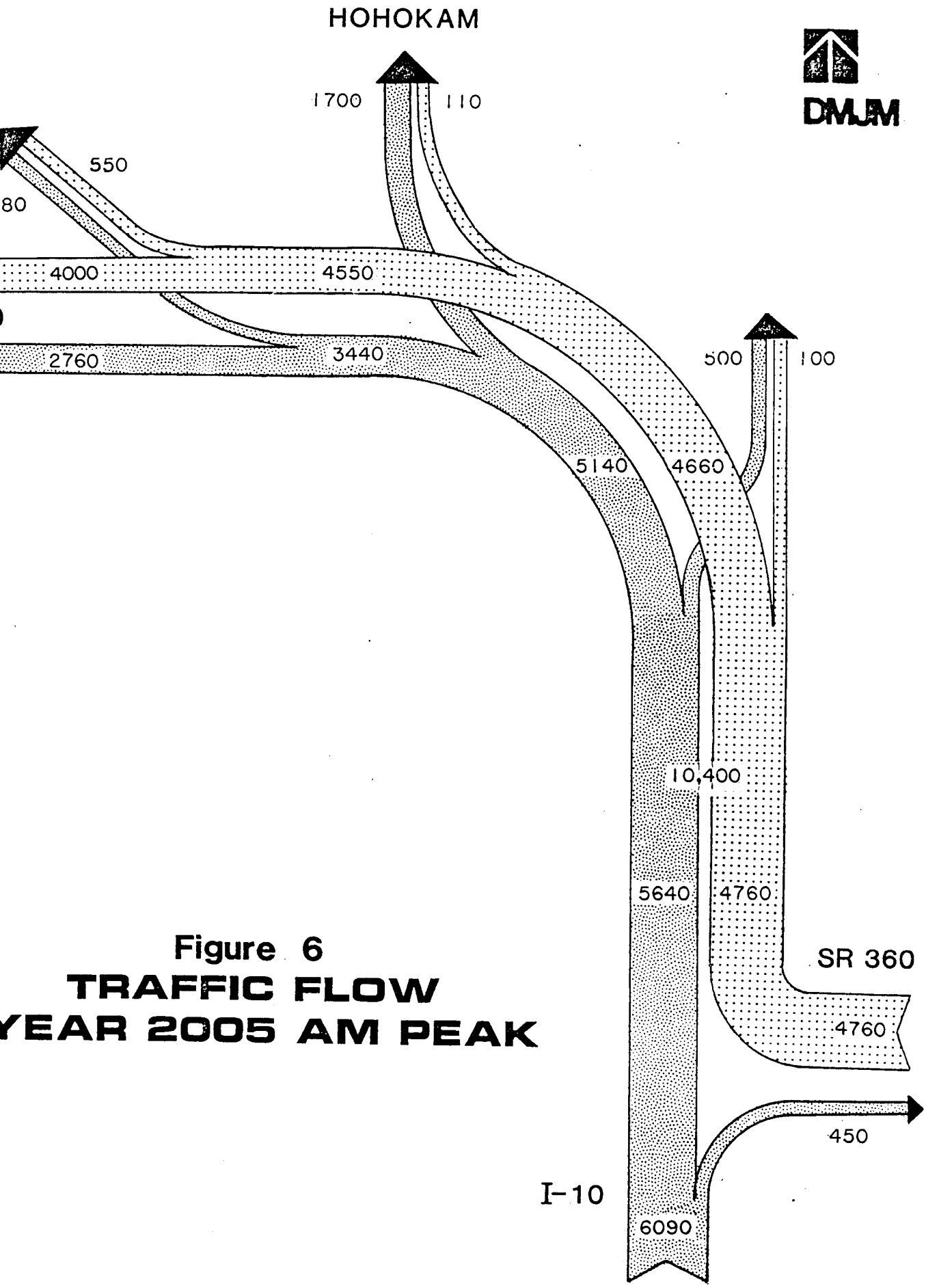


Figure 6
TRAFFIC FLOW
YEAR 2005 AM PEAK

Future Land Use

Future land use information was one of the inputs to the ADOT Transportation Corridor Plan and to the year 2005 traffic assignments prepared by MAGTPO. Consultations with representatives of ADOT, MAGTPO, the City of Phoenix, and the City of Tempe provided further insights into locations of presently developing and planned land activities. Environmentally sensitive areas (cemetaries, athletic fields, etc.) along the corridor were also identified.

Future Public Transportation

High Occupancy Vehicle (HOV) lanes are currently being constructed on a section of I-10 between the Papago Freeway and 40th Street. The HOV lane is located adjacent to the median barrier in both directions on I-10, with a 10-foot shoulder on the median side, a 12-foot HOV travel lane and a 6-foot buffer to the lanes on the freeway mainline. A typical cross section is presented in Figure 7. One of the assignments of this study is to investigate the feasibility of extending the HOV lanes eastward along I-10 and/or along the Superstition Freeway. The City of Phoenix Public Transportation Department has developed preliminary plans for a potential "Park and Ride" facility in the southwest quadrant of the I-10/Baseline Road interchange. Other sites to the south along I-10, in the vicinity of Ahwatukee, are also being investigated.

It is recommended that consideration be given to initially extending the HOV lanes eastward to a point beyond Baseline Road and then merging them back into the freeway mainlines. From the concept design investigation, it appears feasible to construct fly-over ramps to provide a direct connection between the I-10 HOV lanes and the proposed Park and Ride Facility. This design is detailed in one of the concept alternative plans presented later in this report.

The provision of HOV lane connections to the Superstition Freeway has a low probability of implementation. The demand for public transportation (bus and carpools) has not been quantified at this time, and is not a part of this study. The major system interchange between I-10 and the Superstition Freeway will require a

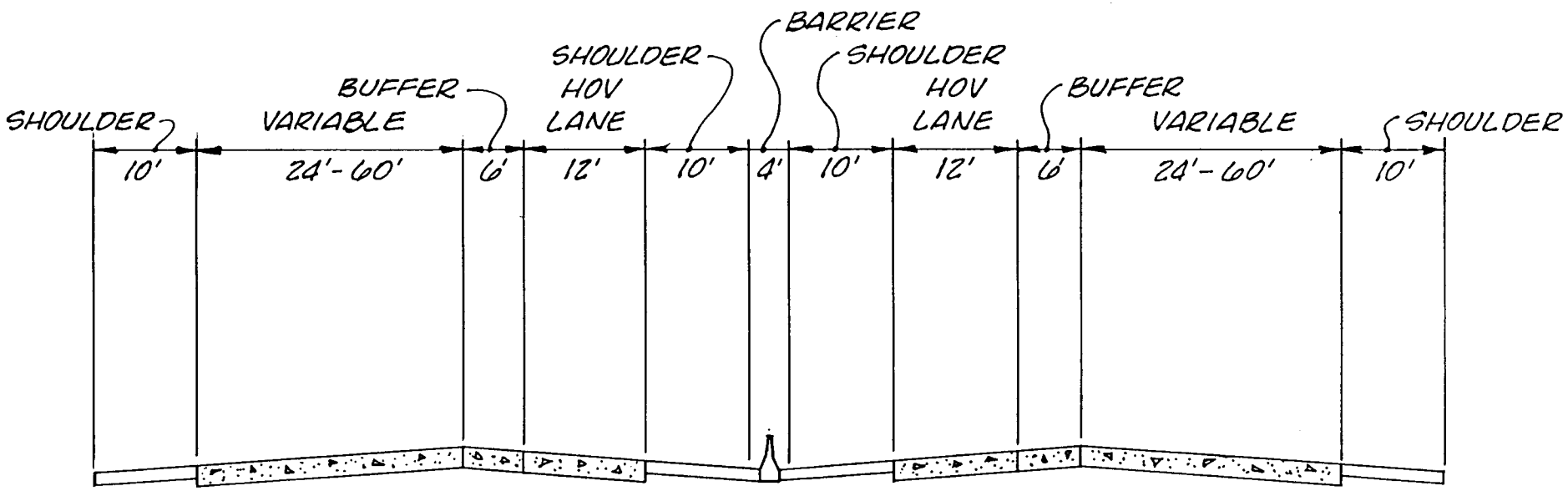


Figure 7

I-10 TYPICAL SECTION

relatively complex interchange to accommodate future travel demand safely and efficiently. The addition of an HOV lane connection to the Superstition Freeway would denigrate the quality of operations of this major system interchange and/or require excessive expenditures for construction and right-of-way. In addition, the restraints imposed by the existing right-of-way and the pumping stations along the Superstition Freeway at the intermediate interchanges further reduce the feasibility of such a plan.

OPERATIONAL CRITERIA AND DESIGN STANDARDS

In addition to the preceding planning considerations, operational criteria and a set of basic design standards, as listed in Figures 8a and 8b, 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 and, ultimately, the rehabilitation plan. The design standards and operational criteria were developed based on current AASHTO policy, are consistent with ADOT practice, and reflect recent engineering experience with similar rehabilitation design projects.

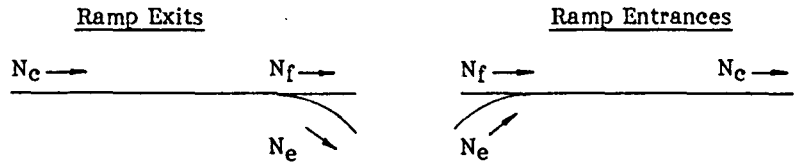
Route Continuity — Provided for I-10

Lane Continuity

I-10 — 3 ~~2~~ Lanes ~~(~~Each Direction~~)~~ (Including HOV)

Lane Balance

Ramp Exits		Ramp Entrances	
N_c →	N_f →	N_f →	N_c →
	N_e ↘	N_e ↗	



GENERAL FORMULA	MAXIMUM	MINIMUM
$N_c = N_f + N_e - 1$	$N_c = N_f + N_e$	$N_c = N_f + N_e - 1$

okay — Left for transfer Roads and for system ramps

~~All Right-Hand~~ Exits and Entrances — Provided

Right only {Right for Service Interchanges

Ramp Sequence ~~(I-10 and Superstition Freeway Traveled Way)~~	Core	C-D
En-En or Ex-Ex	1000 ft	800
Entrance-Exit	2000 ft	1500
Exit-Entrance	600 ft	500

Signing

One Panel	6 message units
Two Panels	9 message units
Three Panels	~~Avoid~~ Using only when absolutely required

Other

- o Minimization of right-of-way requirements
- o Minimization of social, economic, and environmental impacts.
- o The assurance that the rehabilitation plan can be implemented in independent phases without major problems and by maintaining traffic within the I-10 and Superstition Freeway corridors during construciton except in extreme cases.

FIGURE 8a

OPERATIONAL CRITERIA

Feature	Freeway (Core Loading)	Collector-Distributor	Ramps	Arterial Streets and Frontage Roads
Alignment				
Design Speed	60 mph	50 mph	30 mph	40 mph
Maximum Horizontal Curve	5°	8°	system 8° service 24° loop 42 (125')	10° intersections 15°
Maximum Grade	3.5%	5%	system 4.5% service 6.5%	6%
Vertical Clearance	16'	16'	16'	16'
Stopping Sight Distance	525'-650'	400'-475'	400'-475'	275'-325'
Decision Sight Distance	1000'	800'	800'	NA
Maximum Superelevation	0.10 ft/ft	0.10 ft/ft	0.10 ft/ft	0.10 ft/ft
Lane Drop Taper	~~70:1~~ 50:1	~~50:1~~ 40:1	~~50:1~~ 30:1	NA
Cross Section				
Lane Width 1 lane	12'	~~16'~~ NA	~~16'~~ 12'	12'
2 or more lanes	12'	12'	12'	12'
Shoulder Widths				
1 lane	-	~~10'R,4'L~~ NA	~~10'R,4'L~~ 6, 2	10'(no curb)
2 lanes	NA ~~10'R,4'L~~	10'R,~~4'L~~ 10	8 ~~10'R,4'L~~	NA
3 or more lanes	10'R,10'L	NA 10	10 ~~NA~~ 10	NA
Median Width				
with median barrier	20'	20'	NA	NA
without median barrier	40'	NA	NA	NA
Median Slope				
protected	3:1	NA	NA	NA
unprotected	6:1	NA	NA	NA
Side Slope				
protected	2:1	2:1	2:1	NA
unprotected	6:1	6:1	6:1	NA
Entrance Terminals				
Curvature at Merging End	3°	4°	4°	NA
Taper Length	900' (1°~~convergence~~)	700' (1°30'~~convergence~~)	700' (1°30'~~convergence~~)	NA
Exit Terminals				
Curvature at Nose	3°	4°	4°	NA
Taper Length	550' (3° diverge ~~convergence~~)	450' (4°~~convergence~~)	450' (4°~~convergence~~)	NA

NA = NOT APPLICABLE

FIGURE 8b
BASIC DESIGN STANDARDS

III. Overview of Concept Development

III. OVERVIEW OF CONCEPT DEVELOPMENT

Based on the evaluation of the existing facilities and the established future planning/design framework, alternative design concepts were created from which 400' scale "single-line" plans were developed. A wide array of single-line alternative design schemes were drawn to test the ability of each improvement concept to fulfill the requirements of the planning/design framework.

For each concept and alternative single-line plan developed, basic design improvment criteria were established and applied. These are outlined first, prior to the detailed description of alternative plans in the following chapter.

BASIC DESIGN IMPROVEMENT CRITERIA

Certain primary operational, safety and geometric improvements were considered a basic requirement and were incorporated, where possible, into all alternative plans. Concepts employing these improvements are taken to be superior (as they comply with AASHTO criteria) to those not conforming or partially conforming to the criteria. The basic design improvement criteria which were employed are described below.

Establishment of Basic Lanes and Route Continuity

Route continuity is the establishment of basic through lanes (no less than 2 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.

Lane Balance

Lane Balance, which is illustrated in the preceding section on Operational Criteria (Figure 8a), 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 especially difficult, but essential, in the I-10 Corridor.

Geometric and Cross-Sectional Features

Each of the alternative concept plans makes use of current design standards for alignment features and median and shoulder widths.

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 design service levels of C to D.

GENERAL DESCRIPTION OF SINGLE-LINE PLANS

The single-line alternatives for the mainline freeway sections 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, interchange configurations along with ramp terminal locations and tapers, weaving lengths and ramp sequences. To analyze the effectiveness of each plan to provide adequate

capacity, year 2005 AM and PM peak hour traffic was assigned to the roadways and ramps of each alternative plan. The corresponding lane arrangement requirements were then detemined.

The wide range of design concepts that were created can be categorized into three basic corridor improvement plans. The three basic plans which are portrayed in sketch form in Figure 9 are categorized as follows:

Alternative A

This design alternative provides additional lanes on all the freeway mainline segments to increase the traffic-carrying capacity of the I-10 Corridor. The design achieves lane and route continuity, lane balance and improved geometric and cross-sectional features to provide a uniform design and level of service along the entire system. The provision of direct connections for the major movements between I-10 and the Hohokam Freeway and simplification of the intermediate interchange with Broadway Road improves the ramp sequence and eliminates weaving in this critical section of I-10. The major system interchange of I-10 with the Superstition Freeway was redesigned to current standards with direct connections for all movements. The plan does not eliminate one of the current operational limitations, i.e., the significant lane changing movements on I-10 between the Superstition Freeway and the Hohokam Freeway.

Alternative B

This alternative features 5 basic lanes and 2-lane, collector-distributor (C-D) roads in each direction on the I-10 Corridor between the Superstition Freeway and the Hohokam Freeway. The C-D road system provides direct connections from I-10 south of the Superstition Freeway to Broadway Road and the Hohokam Freeway, thus eliminating lane changing in this segment of I-10. Major system interchanges are provided at I-10 with the Hohokam and I-10 with the Superstition Freeway, with direct connections for all movements.

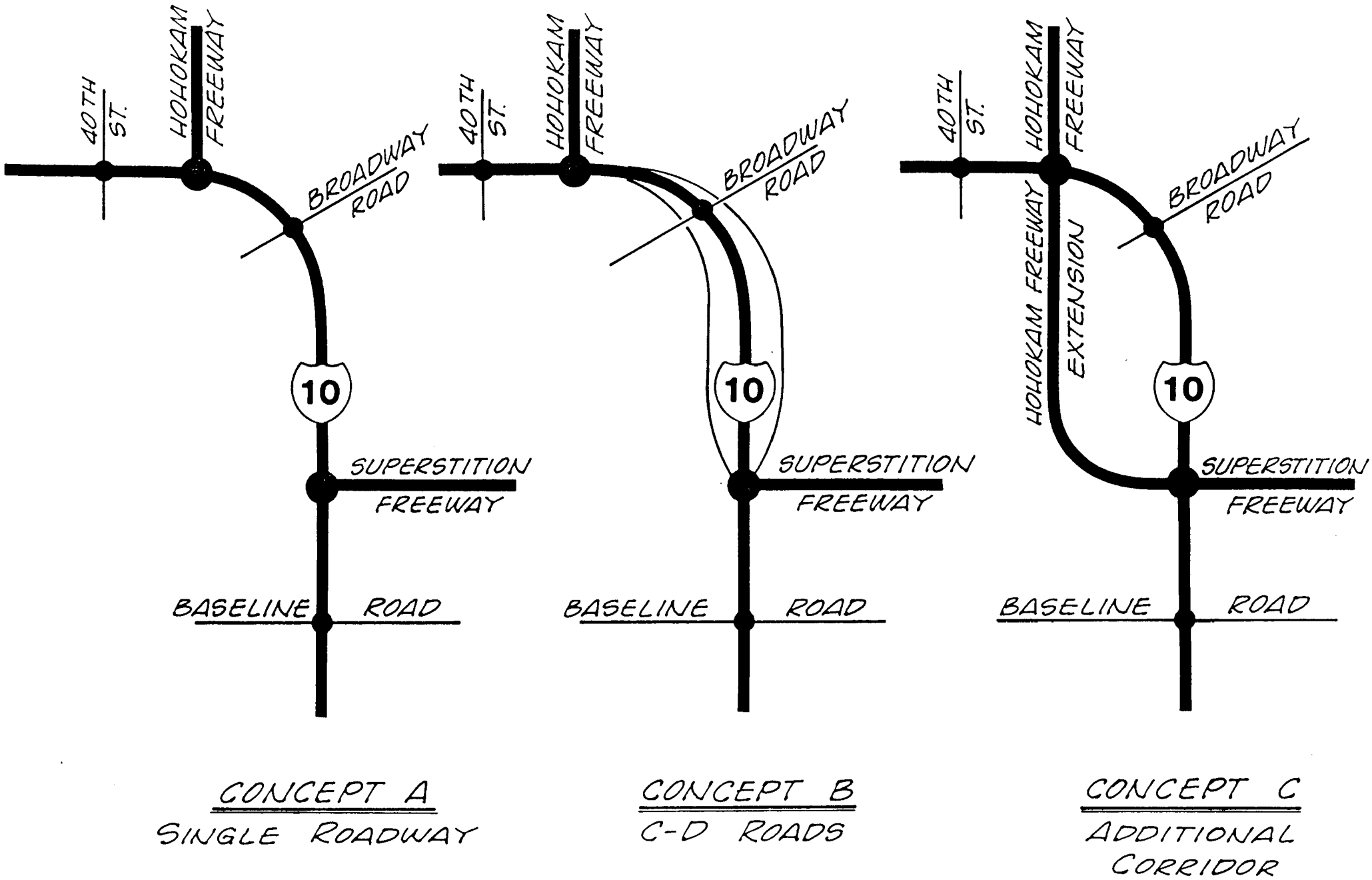


Figure 9

CONCEPT ALTERNATIVES

Alternative C

In this plan, 5 basic lanes are provided in each direction in the I-10 Corridor, with the collector-distributor system located in the 48th Street Corridor. This plan provides similar operational features as Alternative B, in that eastbound and westbound movements between I-10 south of the Superstition Freeway and the Hohokam Freeway are separated from the I-10 mainline through movements.

IV. Description of Alternative Plans

IV. DESCRIPTION OF ALTERNATIVE PLANS

Numerous single-line alternative plans were developed based on the evaluation of existing facilities and the future design framework. The alternatives ranged from minimal improvements to extensive and complex solutions which change the existing configuration considerably. The alternatives tended to fall into three categories: minor improvements along I-10 and at the interchanges; development of a C-D road system along I-10; and major improvements including the extension of the Hohokam Freeway to the Superstition Freeway.

From the many alternatives developed, one plan was selected in each of the three categories to be discussed and evaluated. From these three, one alternative was selected as the preferred alternative based on the following criteria:

- The ability of the plan to correct existing deficiencies based on the design standards and operational criteria.
- The ability of the plan not only to accommodate future traffic, but also to handle changes in traffic patterns should they occur.
- Minimization of right-of-way requirements.
- Minimization of environmental impacts.
- The ability of the plan to be implemented in independent phases without major problems and to allow maintenance of traffic within the corridor during construction.

The three alternative single-line plans (scale 1" = 400') are appended to this report.

ALTERNATIVE A

In Alternative A, the basic configuration of I-10 remains the same. Additional lanes would be provided on I-10, resulting in five basic lanes in each direction between 40th Street and the Superstition Freeway, with an auxiliary lane in each direction between adjacent interchanges. The six lanes in each direction would include one HOV lane. I-10, south of the Superstition Freeway, would consist of four basic lanes in each direction, and one auxiliary lane between interchanges.

The Hohokam Freeway would be realigned so that its southern terminus would begin and end with ramps from I-10. Realigned to the outside of the Hohokam Freeway, 48th Street would terminate at University Drive. Northbound 48th Street traffic would use the entrance ramp at University Drive to enter the Hohokam Freeway. Southbound Hohokam Freeway traffic wishing to continue on 48th Street would use the exit ramp at University Drive. To provide for these movements, the single point diamond design (urban interchange) would have to be reconfigured to a standard diamond design, which would permit through movements from the ramps. The existing loop ramps at 48th Street would be eliminated and direct connections to and from the north provided. The eastbound I-10 exit to southbound 48th Street would be eliminated, but traffic could use the new exit ramp to Broadway Road to access 48th Street. Access would also be provided to University Avenue to and from the east on I-10 via the connections from the I-10/Hohokam Freeway ramps.

The alignment of Broadway Road would remain the same, although the structure over I-10 would have to be rebuilt to allow for widening on I-10 and ramp realignments. The eastbound I-10 loop ramp to Broadway Road would be removed and a new single exit ramp for eastbound and westbound Broadway Road traffic would be constructed. The loop ramp from westbound Broadway Road to eastbound I-10 would be realigned and would join the realigned eastbound Broadway Road ramp to eastbound I-10 before they both merge with I-10. A loop ramp connecting eastbound Broadway Road to westbound I-10 would be constructed and would merge with the realigned westbound Broadway Road ramp to westbound I-10 before joining I-10 as an exclusive entrance. The westbound I-10 exit to Broadway Road

would be realigned so that it intersects with 52nd Street. This design would provide improved access to the commercial development adjacent to 52nd Street.

An auxiliary lane would be added to the Superstition Freeway in each direction. The freeway would be realigned from immediately east of Priest Drive to its junction with I-10 to allow for the construction of a half-diamond interchange at Priest Drive and the reconstruction of the I-10/Superstition Freeway interchange with minimal encroachment on the development north of the Superstition Freeway.

At Baseline Road and I-10, two alternative interchange designs have been developed: a simple diamond interchange and a partial cloverleaf interchange with loop ramps in the northwest and southeast quadrants. In either design, the ramps to and from the west would be extended outside the eastern I-10 connections to the Superstition Freeway. This would provide adequate ramp spacing and would eliminate the weaving section between the Superstition Freeway and Baseline Road. With this design there would be no direct access between Baseline Road and the Superstition Freeway. This movement would be handled through the new interchange at Priest Drive. The partial cloverleaf interchange would be more desirable since it would more efficiently accommodate the heavy left turn volumes and only require a two-phase signal operation.

There are also several alternative designs at 40th Street. The existing diamond configuration could be maintained, a loop ramp could be added in the southwest quadrant, or the interchange could be converted to a partial colverleaf with loop ramps in the northeast and southwest quadrants. Although the partial cloverleaf interchange would be the best operational solution, existing development in the northeast quadrant might prohibit this configuration. The diamond and partial cloverleaf designs are shown on the Alternative A single-line plan appended to this report.

ALTERNATIVE B

The major feature of Alternative B is the addition of a 2-lane, collector-distributor road along both sides of I-10 between the Superstition Freeway and the Hohokam Freeway. Additional mainline lanes would also be added to I-10, resulting in a 12-lane section from 40th Street to the Hohokam Freeway and a 10-lane section from the Hohokam Freeway to the Superstition Freeway. To provide the right-of-way needed for the C-D design and to avoid impacting the Double Butte Cemetary, approximately 2,000 feet of mainline I-10 would be realigned.

In the eastbound direction, the 2-lane C-D road would begin just before Broadway Road and provide a direct connection to the Superstition Freeway. An additional 2-lane exit ramp from eastbound I-10 would join the C-D road to form the eastbound lanes of the Superstition Freeway. This would provide two, 2-lane exits for the heavy movement from eastbound I-10 to the Superstition Freeway. In the westbound direction, the 2-lane C-D road would begin just south of the Superstition Freeway and be joined by a one-lane ramp from the Superstition Freeway. A one-lane ramp would exit at Broadway Road and the C-D road would merge with the eastbound ramp from I-10 to form the northbound lanes of the Hohokam Freeway. The advantage of the C-D road design is twofold: in the westbound direction the lane changing along I-10 is eliminated by exiting the traffic destined for Broadway Road and the Hohokam Freeway before the Superstition entrance and, in the eastbound direction, the C-D road reduces lane changing and eliminates the need for a 3-lane exit by providing an auxiliary exit for the Superstition Freeway prior to the Hohokam entrance.

The reconfiguration of 48th Street and the Hohokam Freeway would be similar to that in Alternative A. As discussed previously for Alternative A, this would require that the single point diamond interchange at University Drive be reconfigured to a standard diamond design. The Hohokam Freeway would begin with ramps from I-10, with 48th Street being realigned to the outside of the Hohokam Freeway and terminating at University Drive. The only difference from Alternative A is the elimination of the ramp connections to and from the east to the 48th Street and University Drive interchange.

At Broadway Road, the reconfiguration is also similar to Alternative A, with a few exceptions. To accommodate the realignment of I-10, Broadway Road would be realigned to just north of its present location. The loop ramp located in the southwest quadrant would pass over Broadway Road and join the ramp from the Hohokam Freeway. The ramp from eastbound Broadway Road to eastbound I-10 would also join the Hohokam ramp before the merge with I-10. The loop ramp located in the northeast quadrant would directly join I-10, while the ramp from westbound Broadway Road would be designed as an exclusive entrance and add a lane to westbound I-10.

As in Alternative A, the Superstition Freeway would be realigned from just east of Priest Drive to its junction with I-10 and be widened to 4 lanes. Ramps to and from the east would be added at Priest Drive. The loop ramp from the Superstition Freeway to eastbound I-10 would be realigned as a directional ramp.

A connection from westbound Superstition Freeway to the westbound C-D road would be added. The Superstition Freeway ramps to and from the east on I-10 would join the ramps to and from Baseline Road before splitting into their respective connections. This design would provide access between Baseline Road and the Superstition Freeway.

At Baseline Road, eastbound I-10 could be realigned to permit construction of direct HOV connections to the proposed park-and-ride facility in the southwest quadrant. The configuration at Baseline Road could either be a diamond or a partial cloverleaf. The partial cloverleaf interchange would provide better operation and safety, but would increase the right-of-way impacts in the southeast and northwest quadrants.

The alternatives described in Alternative A for 40th Street would also apply to Alternative B. The diamond interchange would require the least amount of right-of-way, but the capacity of the ramp terminals would remain the same as presently exists. While a partial cloverleaf interchange would require taking some buildings, it would greatly relieve congestion. The alternative with one loop ramp placed in

the southwest quadrant would be a compromise between the two, taking a small amount of right-of-way and yet providing relief from some of the congestion. The single loop and partial cloverleaf interchanges are shown on the Alternative B single-line plan appended to this report.

ALTERNATIVE C

In Alternative C, I-10 would remain on essentially the same existing alignment. However, it would be widened to a 12-lane cross-section between 40th Street and the Hohokam Freeway and to a 10-lane cross-section between the Hohokam and Superstition Freeways.

The major difference between Alternative C and the other alternative is the extension of the Hohokam Freeway to the Superstition Freeway, and the upgrading of the Superstition Freeway/I-10 interchange. Presently, the southern end of the Hohokam Freeway terminates at I-10. In Alternative C, the Hohokam Freeway would be extended along the existing 48th Street corridor and terminate at the Superstition Freeway/I-10 interchange. By providing this connection, traffic from the east on I-10 wishing to access the Hohokam Freeway and vice versa, would be removed from the existing congested I-10 Corridor between the Superstition Freeway and the Hohokam Freeway.

Limited service would be provided to I-10 traffic by the reconstructed Hohokam Freeway/I-10 interchange. Only Hohokam Freeway traffic to and from I-10 to the west would be accomodated. Similarly, Hohokam Freeway traffic to and from I-10 to the east would do so at the Superstition Freeway interchange. Eastbound I-10 traffic desiring access to the Superstition Freeway could make use of the southbound Hohokam Freeway or continue eastbound on I-10 and exit at the I10 /Superstition Freeway interchange. The two-exit design would relieve congestion within the I-10 corridor. This design would increase both the capacity and the flexibility of the overall system.

The Broadway Road interchange would be considerably reduced. The westbound Broadway Road ramps providing access onto I-10 would be retained, but realigned to conform to the new freeway configuration. A directional ramp would replace the eastbound I-10 loop ramp to Broadway Road. No changes to the westbound I-10 exit ramp to Broadway Road would be required in Alternative C.

As in Alternatives A and B, the Superstition Freeway would be realigned from just east of Priest Drive to its connection with I-10. A half-diamond interchange would be constructed at Priest Drive, providing access to and from the east. Two-lane ramps from eastbound I-10 and the Hohokam freeway would join to form the eastbound lanes of the Superstition Freeway. The westbound lanes of the Superstition Freeway would terminate with the ramp connections to I-10 and the Hohokam Freeway.

Alternative C provides a partial cloverleaf interchange at Baseline Road with ramp connections to and from the Hohokam Freeway and I-10. The Baseline Road ramp connections to and from I-10 on the west take place beyond the Superstition freeway ramps to eliminate the weaving section. An alternative diamond design was also developed for this interchange. The interchange alternatives for 40th Street described in Alternatives A and B would also apply to Alternative C.

At University Drive, the existing single point diamond interchange would be reconfigured to a standard diamond design. Within this concept, an alternative which could be considered is the total reconstruction of the interchange to provide for 3-lanes northbound and southbound on the Hohokam Freeway.

TRAFFIC ASSIGNMENTS AND LEVEL OF SERVICE

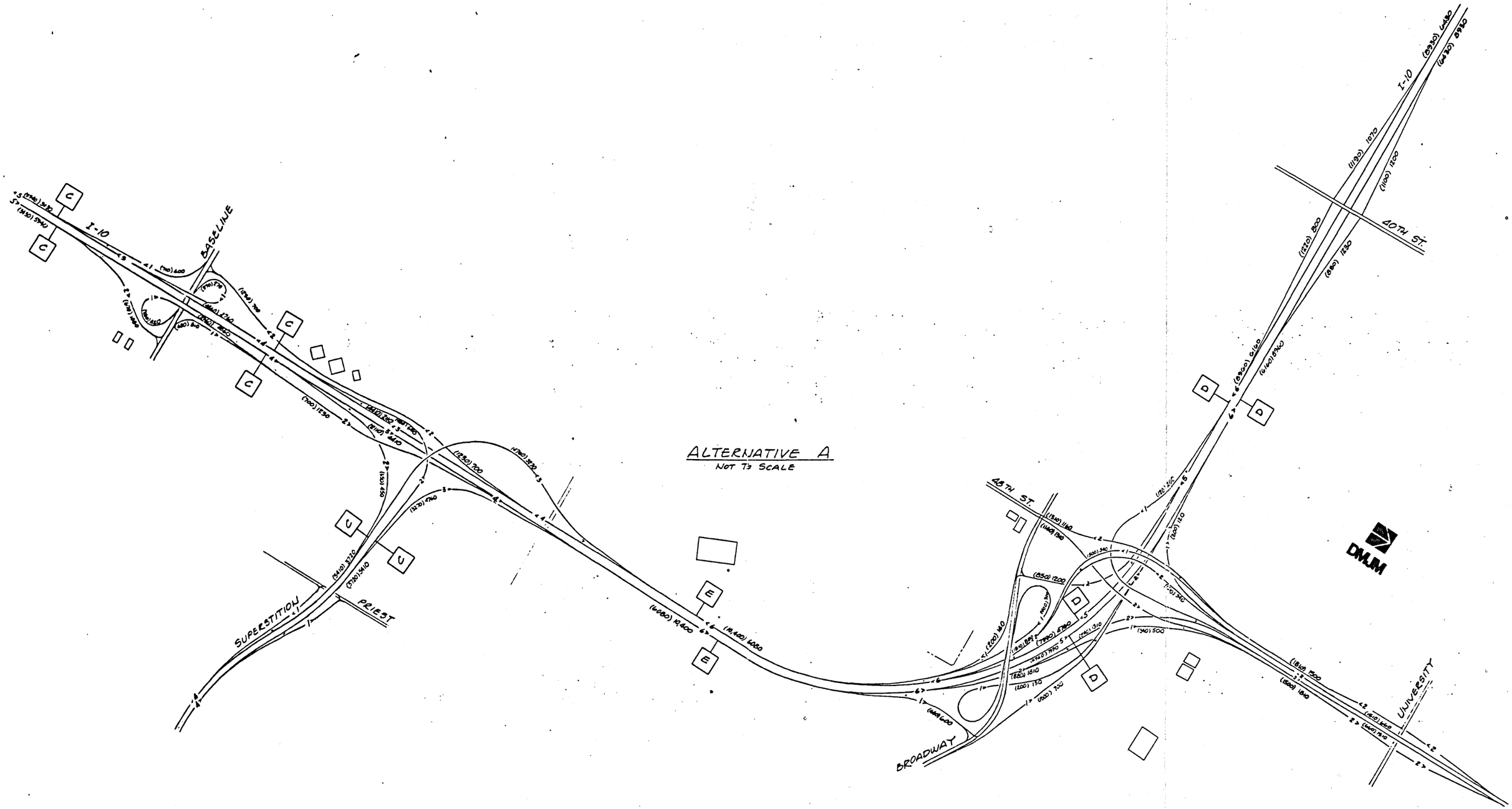
The year 2005 traffic assignments, lane arrangements, and resulting levels of service (LOS) for the three alternative improvement plans are displayed on Figures 10 through 12.

In Alternative A (Figure 10) the levels of service for the freeway segments in both directions are:

- The Superstition Freeway, Mill Avenue to Junction I-10 — LOS C
- I-10, Elliot Road to Baseline Road — LOS C
- I-10, Baseline Road to the Superstition Freeway — LOS C
- I-10, Superstition Freeway to the Hohokam Freeway — LOS E
- I-10, The Hohokam Freeway to 40th Street — LOS D

In Alternative B (Figure 11) the levels of service for the freeway mainline sections and collector-distributor roads are:

- The Superstition Freeway, Mill Avenue to 1-10 — LOS C
- I-10, Elliot Road to the Superstition Freeway — LOS C
- I-10, Baseline Road to the Superstition Freeway — LOS C
- I-10 Mainline, The Superstition Freeway to the Hohokam Freeway — LOS D
- I-10 Collector-Distributor Roads, The Superstition Freeway to the Hohokam Freeway — LOS C
- I-10 , The Hohokam Freeway to 40th Street — LOS D



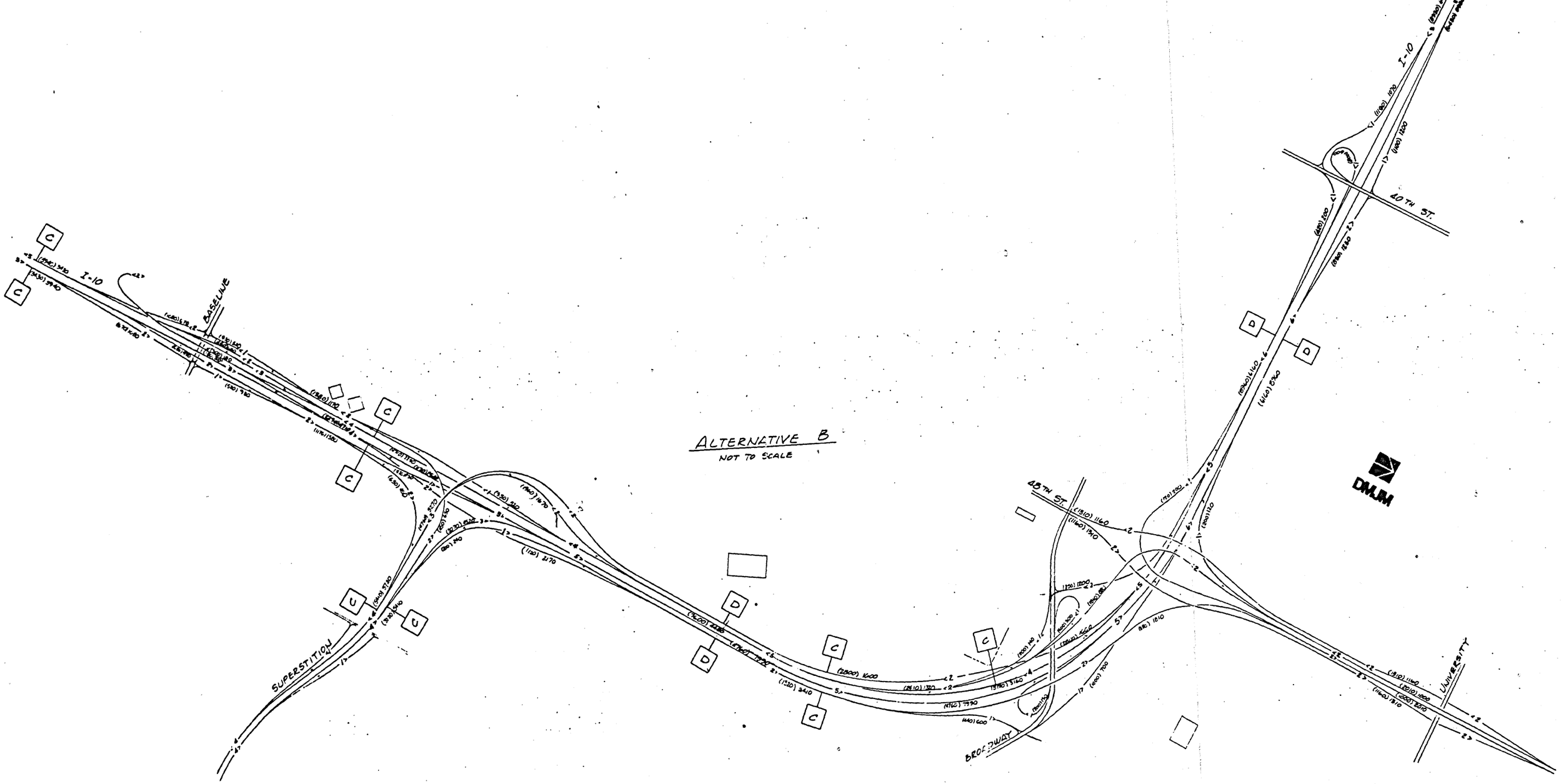
LEGEND

DESIGN HOUR VOLUME (PM) AM

LEVEL OF SERVICE [C]

ALTERNATIVE A
YEAR 2005
TRAFFIC ASSIGNMENT
AND LEVEL OF SERVICE

FIGURE 10

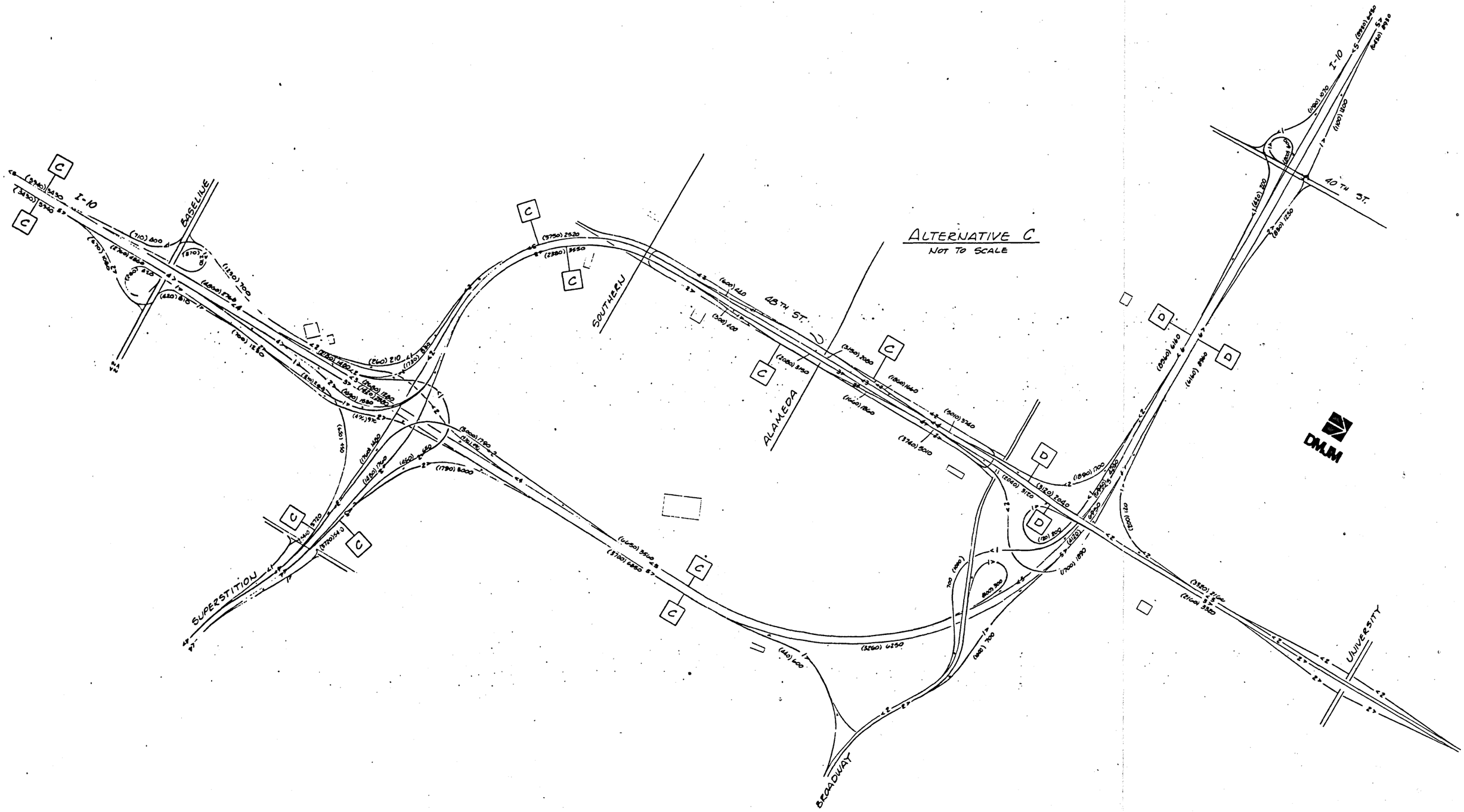


LEGEND

DESIGN HOUR VOLUME (PM) AM
LEVEL OF SERVICE C

ALTERNATIVE B
YEAR 2005
TRAFFIC ASSIGNMENT
AND LEVEL OF SERVICE

FIGURE 11



LEGEND

DESIGN HOUR VOLUMES (PM) AM

LEVEL OF SERVICE C

ALTERNATIVE C
YEAR 2005
TRAFFIC ASSIGNMENT
AND LEVEL OF SERVICE

FIGURE 12

In Alternative C (Figure 12), the levels of service for the freeway mainline section and the collector-distributor roads are:

• The Superstition Freeway, Mill Avenue to I-10	LOS C
• I-10, Elliot Road to the Hohokam Freeway	LOS C
• I-10, the Hohokam Freeway to 40th Street	LOS D
• The Hohokam Freeway Extension, The Superstition Freeway to I-10	LOS C
• The Hohokam Freeway Extension, I-10 to University Drive	LOS D

INITIAL PHASE CONSTRUCTION

As part of the phased construction plan, a generalized short-term improvement plan was developed. Some of the improvements recommended in the Initial Design Concept Report developed by ADOT in June 1984, were incorporated into this plan. One recommended improvement involves removing the eastbound I-10 to northbound 48th Street loop ramp and providing for this movement as a left-turn off the eastbound I-10 to southbound 48th Street ramp. This would eliminate the short weaving section between the two existing loop ramps. An additional improvement would remove the westbound Broadway Road loop ramp to eastbound I-10 loop ramp and allow left turns onto the existing eastbound Broadway Road ramp to eastbound I-10. The short weaving section between the loop ramps would then be eliminated. An additional lane to the outside of eastbound I-10 would be added, resulting in four lanes plus one HOV lane in the median.

In the westbound direction, the recommended improvements are somewhat different from those contained in the Initial Design Concept Report. Currently, there are 4 lanes on I-10 from the Superstition Freeway to the lane drop at Broadway Road. One recommended improvement would be to relocate the Broadway Road exit ramp approximately 1,500 feet to the west and provide a 2-lane exit intersecting at Broadway Road and 52nd street. This would lengthen the

weaving section between the Superstition Freeway and Broadway Road and provide lane balance. Four lanes, including the HOV lane, would go through on westbound I-10 and a one-lane exit would be provided at 48th Street. The westbound entrance ramp from Broadway Road would be realigned at Broadway Road to just west of the new 52nd Street intersection and would become an added lane on westbound I-10.

An additional recommended first phase improvement would realign the Superstition Freeway from just east of Priest Drive to its junction with I-10. Three lanes in each direction would be operated at this time and the exit and entrance ramps on the east side of Priest Drive would be constructed. The eastbound I-10 exit to the Superstition Freeway would be realigned and widened to three lanes. The Superstition Freeway exit to westbound I-10 would also be widened to three lanes. Additional capacity at the Baseline Road interchange would be developed, desirably by converting the existing diamond interchange to a partial cloverleaf interchange with ramps tieing directly to I-10 in the initial phase.

The preceding text provides a generalized description of initial phase construction concepts. In Phase III of the study, more detailed initial phase plans will be developed for the selected alternative.

V. Alternatives Evaluation

V. ALTERNATIVES EVALUATION

The three selected alternatives were compared on the basis of operations, safety, costs, ease of implementation, and environmental impacts. These five major catagories were divided into eight characteristics for which each of the alternatives were evaluated. The results of this evaluation are shown in Figure 13.

The capacity and level of service of the existing corridor would be slightly improved in Alternative A. While the capacity of I-10 would be improved through the provision of additional lanes and the removal of lane drops, excessive lane changing would remain in the segment of I-10 between the Superstition Freeway and the Hohokam Freeway. Alternative B would provide an improved level of service and more operational improvements than Alternative A. The provision of collector-distributor roads would increase the corridor capacity and eliminate the weaving/lane changing in the Superstition/Hohokam Freeway segment of I-10. Alternative C would greatly improve the capacity and level of service of the corridor by separating Hohokam Freeway/I-10 traffic maneuvers from the Superstition/I-10 traffic. The additional capacity would be provided by extending the Hohokam Freeway along 48th Street to the Superstition Freeway.

The flexibility of the alternatives in terms of adjusting for varying traffic patterns was evaluated. Alternative A rates only fair to poor in adjusting to patterns other than those forecast since it basically maintains the existing configuration. Alternative routing to avoid breakdowns along the mainline or ramps could not be easily accomplished. Alternative B would provide more flexibility since the C-D roads allow an additional outlet for mainline traffic. Alternative C provides the most flexibility with the creation of an additional freeway corridor to handle future traffic variations.

The operations and safety of each alternative were evaluated and found to be an improvement over the existing conditions. Alternative A provides slight

ALTERNATIVE / CHARACTERISTIC	A (SINGLE ROADWAY)	B (C-D ROADS)	C (HOHOKAM EXTENSION)
CAPACITY/LOS	FAIR	FAIR/GOOD	GOOD
FLEXIBILITY	FAIR/POOR	FAIR/GOOD	GOOD
OPERATIONS/SAFETY	FAIR	GOOD	GOOD
STAGE CONSTRUCTION/ TRAFFIC MAINTENANCE	GOOD	FAIR/GOOD	FAIR/POOR
PHASED DEVELOPMENT	GOOD	FAIR	POOR
CONSTRUCTION COSTS	LOW	MODERATE	HIGH
R.O.W. REQUIRED	LOW	MODERATE	HIGH
ENVIRON. IMPACT	LOW	MODERATE	HIGH

Figure 13

ALTERNATIVES EVALUATION

improvements by removing lane drops and lengthening weaving sections. Operational and safety improvements in Alternative B include the removal of the multiple lane changing maneuvers from I-10 through the incorporation of the C-D road system and the provision of an additional exit for the heavy movement from eastbound I-10 to the Superstition Freeway. Lane drops have been eliminated in this alternative as well as in Alternative C. By providing additional exits for the Superstition Freeway/I-10 traffic and removing the heavy weaving volume from I-10, the operational flexibility and safety of Alternative C is greatly improved over existing conditions.

Stage construction and traffic maintenance during construction would be fairly easily accomplished in Alternative A. Traffic should be able to be maintained on existing roadways while realignment takes place. Because of the realignment of I-10 in Alternative B, it may be more difficult to maintain traffic during construction. The C-D roads may be used as temporary connections for some movements while ramps are being reconstructed. In Alternative C, the reconfiguration of the Superstition Freeway/I-10 interchange will pose major problems for traffic maintenance and stage construction.

The initial phase plan fits well with Alternative A. The recommended improvements could easily be adapted to fit the ultimate improvement plan without much realignment or reconstruction. The initial phase plan could work with Alternative B, but some additional improvements would be needed in order to accommodate this alternative. In Alternative B, I-10 would be realigned from 48th Street to just east of Broadway Road. Rather than widen I-10 along its existing alignment and reconstruct it later, Broadway Road would have to be realigned also. The ramps would have the same configuration as the initial phase plan, but would have to be modified to fit the realignment.

The initial phase improvement plan can be used with Alternative C, but is less compatible than with Alternatives A and B. Alternative C radically changes the existing configuration; consequently, it is virtually impossible to do minor construction which can be utilized later in the implementation of Alternative C.

As expected, the construction costs increase with the level of improvement over the existing configuration. The order of magnitude costs for the three alternatives are estimated at: $124,000,000 for Alternative A; $158,000,000 for Alternative B; and $208,000,000 for Alternative C.

These relative cost estimates do not include right-of-way costs due to the variations in designs that could be developed for each of the alternatives (such as retaining walls versus flat side slopes). Such design decisions will materially affect the amount of right-of-way required. It is obvious, however, that right-of-way costs for Alternative C would be substantially greater than those for the other alternatives. More detailed construction and right-of-way costs will be developed with the refinement of alternatives in Phase III of the study.

The amount of right-of-way required and the environmental impacts would also increase with the level of improvement. Alternative A, since it stays fairly close to the existing configuration, has the least impact on the right-of-way and environment. Alternative B would have a greater impact because the addition of the C-D roads would place paved highways closer to existing development. Alternative C would have the largest impact since it virtually eliminates the trailer park opposite the Superstition Freeway and would take a substantial amount of right-of-way along the west side of 48th Street.

VI. Summary and Recommendations

VI. SUMMARY AND RECOMMENDATIONS

From the alternatives evaluation it is apparent that Alternative B demonstrates a number of attributes which are significantly better than the other alternatives. Alternative B provides additional lane capacity and improved levels of service over Alternative A. Further, it also eliminates weaving (excessive lane changing) in the critical section of I-10 between the Superstition Freeway and the Hohokam Freeway, thus providing a high level of operations and safety that is not found in either the existing configuration or in Alternative A. Traffic maintenance during construction and phased development can be accomplished under this alternative with only moderate disruption of traffic flow. Alternative C has attributes similar to those described for Alternative B, but at a much higher cost. Furthermore, it is not adaptable to a reasonable level of traffic maintenance during construction or to phased development. Alternative C also requires an extensive amount of additional right-of-way and would have a significant environmental impact on land use within the corridor.

Based on the analysis conducted in Phase II, it is recommended that Alternative B be considered the most viable alternative for further refinement. During Phase III, in addition to the specified study tasks, more detailed alternative designs and evaluations will be prepared for the interchange of I-10 with 40th Street, I-10 with Baseline Road, and the Hohokam Freeway with University Drive.

VII. Alternative Plans