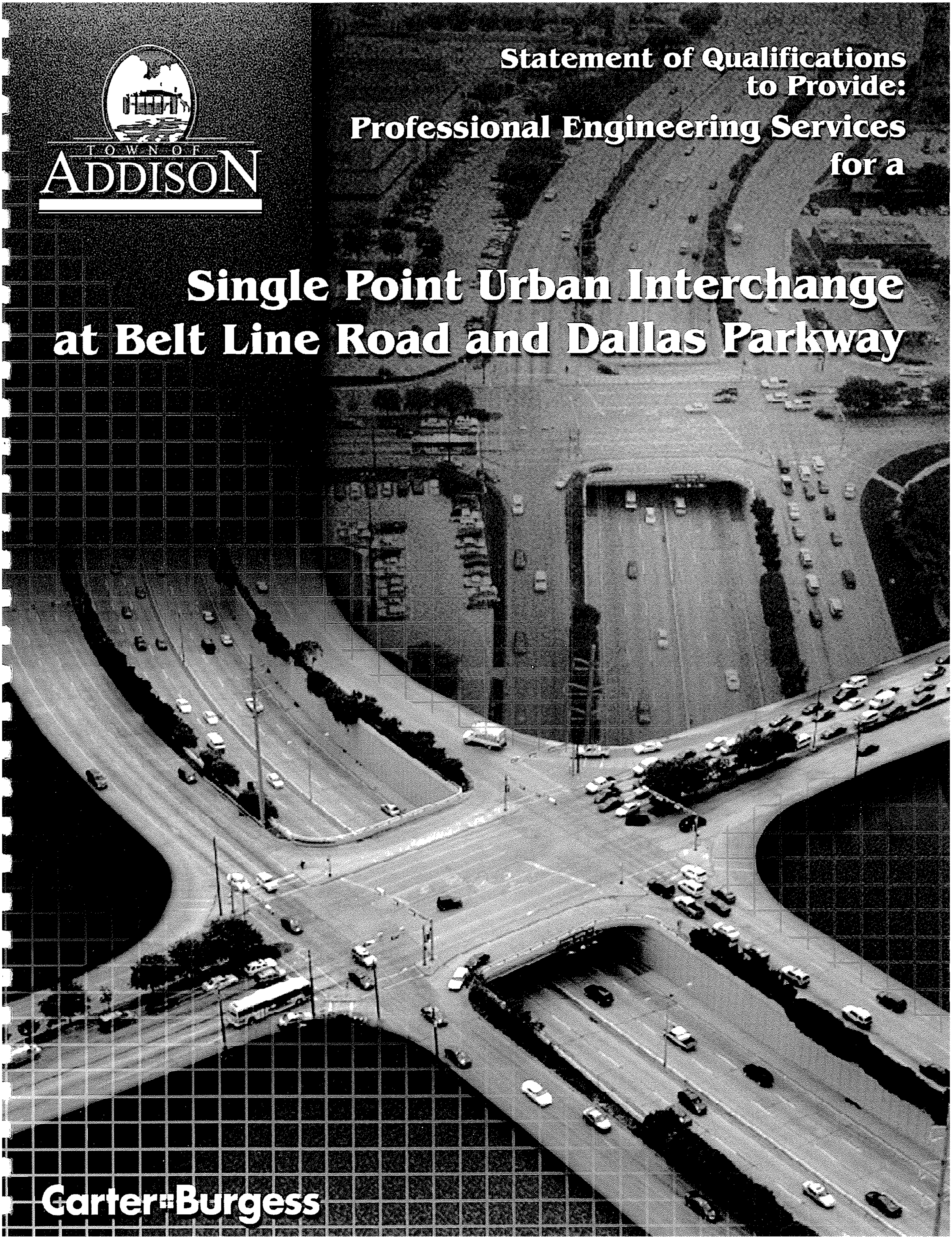
TOWN OF ADDISON

Statement of Qualifications to Provide: Professional Engineering Services for a

Single Point Urban Interchange at Belt Line Road and Dallas Parkway



Carter::Burgess

Carter-Burgess

EVALUATION CRITERIA FOR ENGINEERING

		POINTS	MULTIPLIER	SCORE
1.	The firm's experience, as well as proposed subcontractors, in successfully performing similar assignments, in scope and size, for others within the last five (5) years, by personnel still on the firm's staff. Prime and Sub have worked together before.	0 – 10	8X 4	32
2.	Professional background of key personnel and experience in engineering, surveying, project administration, and resident project representation. The firm's current staff, both in size and related experience, is qualified to provide the desired service. Indicate length of time key employees have been with the firm as well as their home office location.	0 – 10	8X 4	32
3.	Location of main office and/or branch office that will provide services and experience in the local area.	0 – 10	8 1	8
4.	Management approach to this project. (Include QA/QC, schedule and budget programs).	0 – 10	5X 1	5
5.	Technical approach to this project. (Include computer capacity).	0 – 10	9X 1	9
6.	Previous clients, for similar projects express satisfaction with the firm's work (Short listed firms only, if necessary).	0 – 10	2	
7.	Oral presentation (short listed firms only, if necessary).	0 – 10	4	

Project Approach – Alt Analysis; Public/Agency Involvement; Detailed Design.
Jim Lee – Ariz – Prelim Design may be OK.

Ped issues –

U-turn issues

Constructability –

Use precast elements

Toll road does not need to be lowered.

Brown & Root

EVALUATION CRITERIA FOR ENGINEERING

	POINTS	MULTIPLIER	SCORE
1. The firm's experience, as well as proposed subcontractors, in successfully performing similar assignments, in scope and size, for others within the last five (5) years, by personnel still on the firm's staff. Prime and Sub have worked together before.	0 – 10	7 x 4	28
2. Professional background of key personnel and experience in engineering, surveying, project administration, and resident project representation. The firm's current staff, both in size and related experience, is qualified to provide the desired service. Indicate length of time key employees have been with the firm as well as their home office location.	0 – 10	7 x 4	28
3. Location of main office and/or branch office that will provide services and experience in the local area.	0 – 10	7 x 1	7
4. Management approach to this project. (Include QA/QC, schedule and budget programs).	0 – 10	9 x 1	9
5. Technical approach to this project. (Include computer capacity).	0 – 10	9 x 1	9
6. Previous clients, for similar projects express satisfaction with the firm's work (Short listed firms only, if necessary).	0 – 10	2	____
7. Oral presentation (short listed firms only, if necessary).	0 – 10	4	____

Only one SPUI and it did not have frontage roads.
Most professional staff in Houston

Kimley Horn – Traffic Counts

HDR

EVALUATION CRITERIA FOR ENGINEERING

		POINTS	MULTIPLIER	SCORE
1.	The firm's experience, as well as proposed subcontractors, in successfully performing similar assignments, in scope and size, for others within the last five (5) years, by personnel still on the firm's staff. Prime and Sub have worked together before.	0 –10	5x 4	20
2.	Professional background of key personnel and experience in engineering, surveying, project administration, and resident project representation. The firm's current staff, both in size and related experience, is qualified to provide the desired service. Indicate length of time key employees have been with the firm as well as their home office location.	0 – 10	5 x 4	20
3.	Location of main office and/or branch office that will provide services and experience in the local area.	0 – 10	9 x 1	9
4.	Management approach to this project. (Include QA/QC, schedule and budget programs).	0 –10	7 x 1 =	7
5.	Technical approach to this project. (Include computer capacity).	0 – 10	10 x 1	10
6.	Previous clients, for similar projects express satisfaction with the firm's work (Short listed firms only, if necessary).	0 – 10	2	____
7.	Oral presentation (short listed firms only, if necessary).	0 – 10	4	____

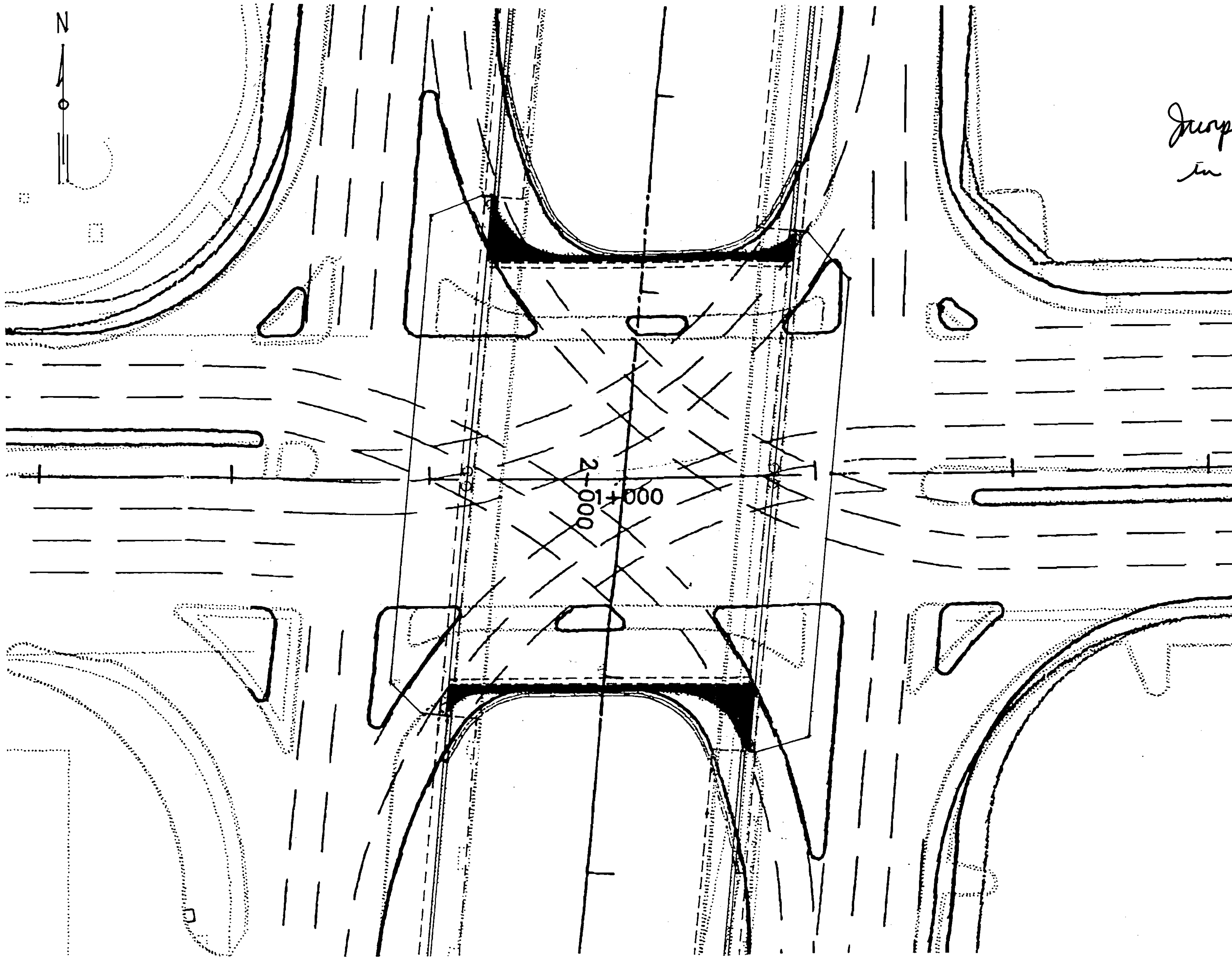
No Spur experience

Bridge Design experience – 3 Bridges named in experience

WilburSmith – Traffic Experience – OK

Step ① - Demo

Incorporate a ped. bridge in with the new structure



PLAN

SCALE: NONE

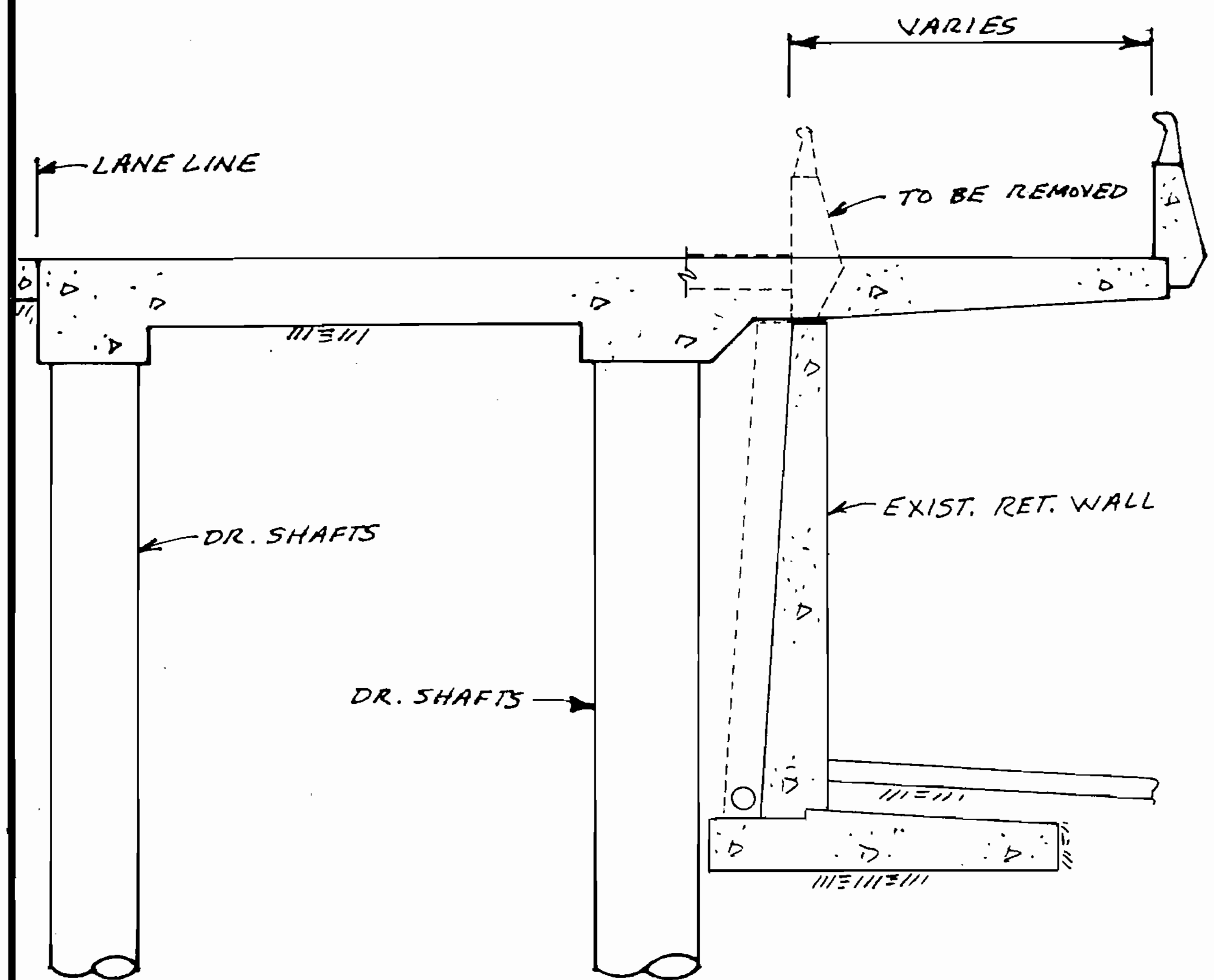
SINGLE POINT URBAN INTERCHANGE
BELT LINE ROAD AT DALLAS PARKWAY

ADDISON

Brown & Root Services
Eng'd by Halliburton Tech Services, Inc

Designed :
Checked :
Drawn :
Checked :

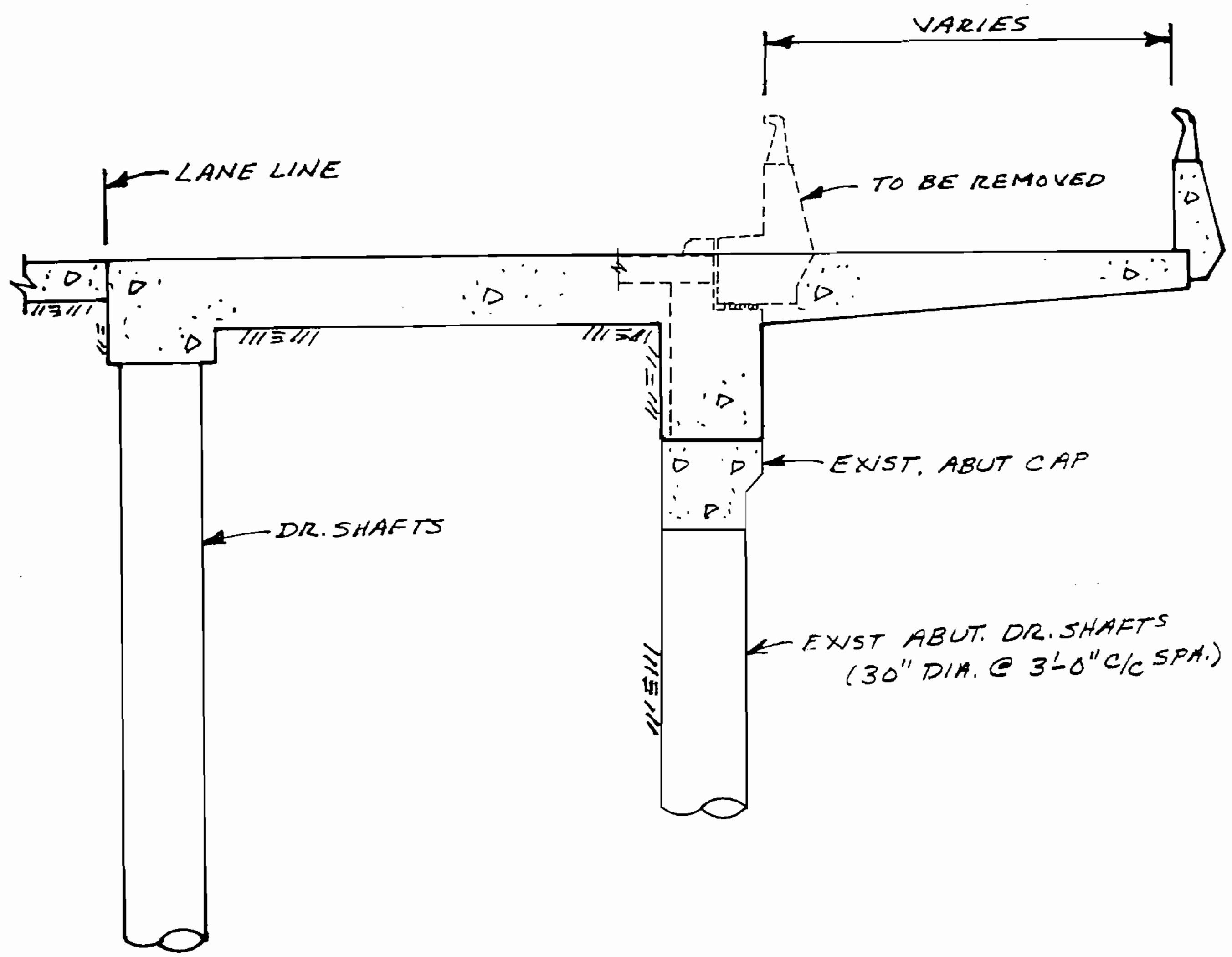
NO. | REVISION | BY | DATE



SECTION A-A

PROPOSED WIDENING AT EXISTING RETAINING WALL

SCALE: NONE



SECTION B-B

PROPOSED WIDENING AT EXISTING BRIDGE CORNER

SCALE: NONE

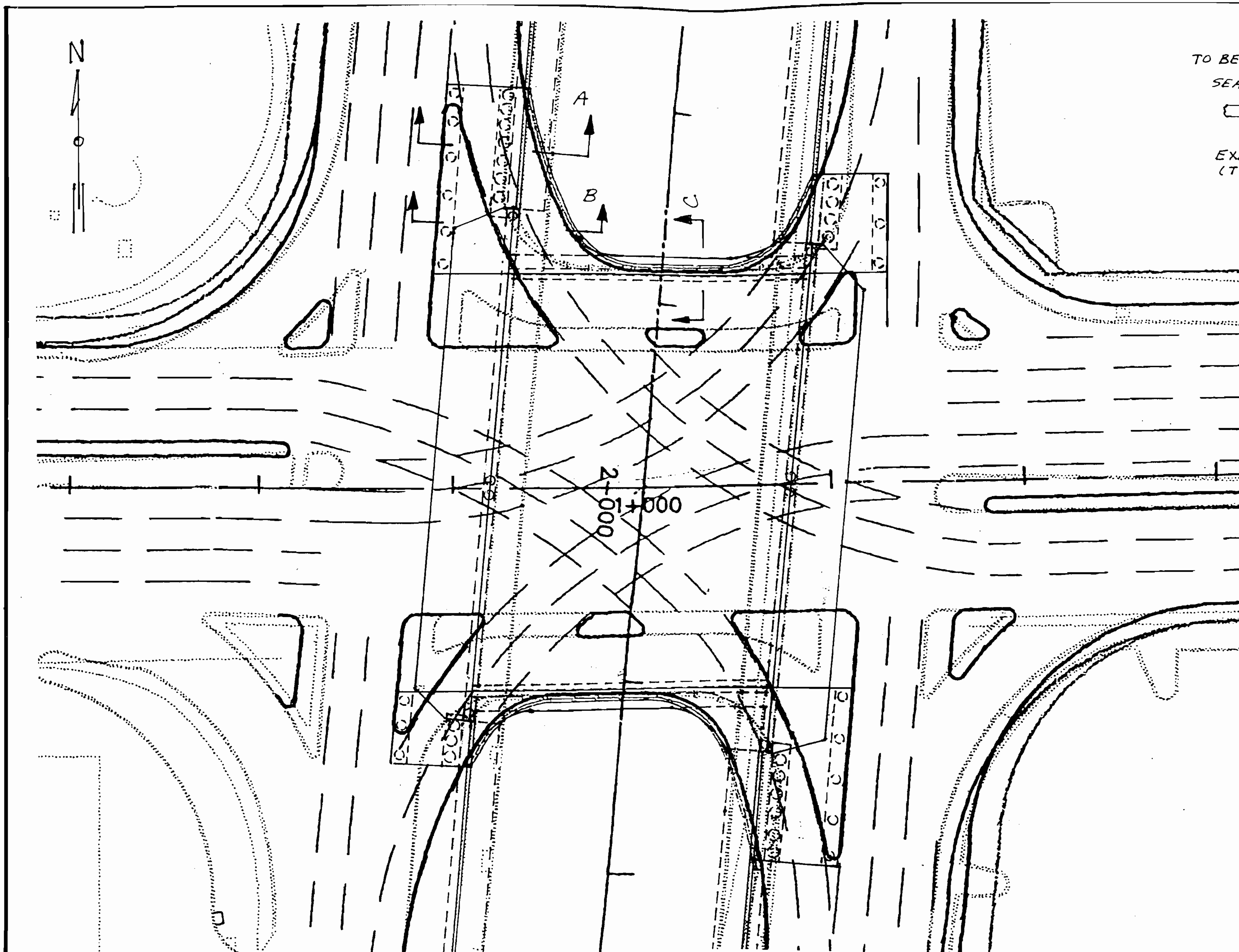
SINGLE POINT URBAN INTERCHANGE
BELT LINE ROAD AT DALLAS PARKWAY

ADDISON

Brown & Root Services
Eng'd by Halliburton Tech Services, Inc

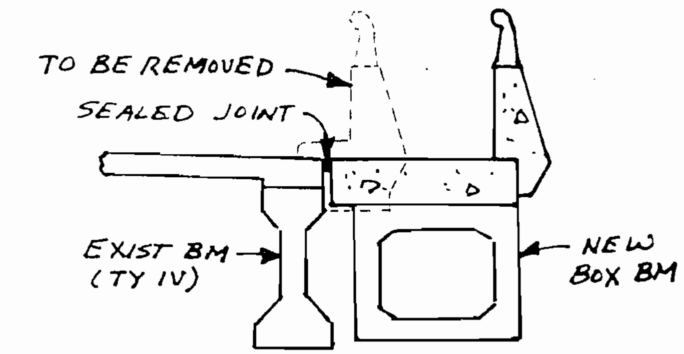
Designed :
Checked :
Drawn :
Checked :

NO. | REVISION | BY | DATE



PLAN

SCALE: NONE



SECTION C-C

SCALE: NONE

SINGLE POINT URBAN INTERCHANGE
BELT LINE ROAD AT DALLAS PARKWAY

ADDISON

Brown & Root Services
Eng'd by Halliburton Tech Services, Inc

Designed :
Checked :
Drawn :
Checked :

NO.	REVISION	BY	DATE

Carter::Burgess

7950 Elmbrook Drive
Suite 250
Dallas, Texas 75247
Phone: 214.638-0145
Fax: 214.638.0447

April 27, 2001

Mr. Steven Z. Chutchian, P.E.
Assistant City Engineer
Town of Addison
16801 Westgrove
Addison, Texas 75001

RE: Statement of Qualifications to Provide Professional Engineering Services for a Single Point Urban Interchange at Belt Line Road and Dallas Parkway

Dear Mr. Chutchian:

Carter & Burgess, Inc., is pleased to submit this proposal for planning and engineering services to convert the Belt Line Road interchange to a Single Point Urban Interchange (SPUI). Our team has been assembled to address the specific issues of converting the traditional diamond interchange to a SPUI. Carter & Burgess is strong in the design and construction of complex urban highways and structures. Key members of the design team each had significant roles in the design of Section M of North Central Expressway including the complex bridges and cantilevered frontage roads, retaining walls and multi-stage traffic control sequences. These same key designers recently completed the design of the IH 35E/SH 190 (President George Bush Turnpike) interchange in Carrollton. This hands-on experience is critical to success for design of such a tightly restricted and high-volume location as Belt Line Road over the Dallas North Tollway.

This type of interchange is used in many locations throughout the country and it will be the first in North Texas. As such, we believe it is important that the Town of Addison select a consultant team that has not only strong urban highway design experience, but one that is equally strong in the planning and design of the SPUI interchange and particularly those with frontage roads and U-turns. We offer such a team with our partner Lee Engineering. Lee Engineering is presently analyzing the four-phase SPUI (the fourth phase is the frontage road movement) in a research project for the Arizona Department of Transportation. This research will survey SPUI's and analyze accident patterns to recommend design modifications and improvements.

Bruce Russell, P.E., will be Project Manager. He was Project Manager for the design of Section M. His design team includes Tony Kimmey, P.E., for roadway and Art Hunter, P.E., for structures. Both were responsible for similar duties on Section M. Tony Kimmey was Project Manager for the IH 35E/SH 190 (PGBT) interchange and Bruce and Art had significant roles. Jim Lee, P.E., Ph.D., will be responsible for Alternatives Analysis. He will lead a multi-disciplinary team to evaluate various alternatives and determine how each best matches up with the goals set for the project. The SPUI is very effective at moving vehicles through interchanges. However, frontage roads and U-turns can detract from this performance and pedestrian movements add a special challenge. Mr. Lee's team will address these seemingly competing issues to determine an appropriate alternative.

We have included Quality Counts, a DBE firm, as a subconsultant to fulfill goals for DBE participation for DART LAP-CMS funds. We commit to meet these goals.

We look forward to your favorable review of our qualifications and the opportunity to further discuss our proposal with you. Please contact us for additional information.

Sincerely,
Carter & Burgess, Inc.

Bruce S. Russell, P.E.
Vice President

TABLE OF CONTENTS

Section 2
Project Team

The Town of Addison continues to be one of the fastest growing areas within the Dallas/Fort Worth Metroplex. With that exciting growth comes the tough challenge of meeting the transportation needs of its citizens and the business community.

Carter & Burgess has teamed with Lee Engineering for the planning and design of the proposed improvements to Belt Line Road at the Dallas North Tollway. This project will require a team well-experienced not only with complex highway design and construction, but one with practical knoweldge of the SPUI-type interchanges. Our Team brings that experience. Carter & Burgess is the region's leading highway design firm having recently completed the complex Section M of North Central Expressway and the IH 35E/SH 190 (President George Bush Turnpike) Interchange. Lee Engineering is presently analyzing SPUI interchanges for the Arizona DOT with special emphasis on the SPUI with frontage roads. Carter & Burgess and Lee Engineering have worked together on traffic engineering projects throughout the region including DART and various private clients.

Disadvantaged Business Enterprise (DBE)
It is our understanding that the DBE goal for this project is 15% where DART-LAP/ CMS monies are used. We will include Quality Counts, Inc. on this project to meet this goal. We have an established, successful working relationship with Quality Counts.

Carter & Burgess, Inc.
Founded in 1939, Carter & Burgess has been in business in the Dallas/Fort Worth Metroplex for 62 years. With a staff of over 2,800 professionals including engineers, architects, planners, landscape architects, and environmental scientists, we are truly a multidisciplinary firm. In 2001, the firm was ranked Number 30 in *Engineering News Record's* Top 500 Design Firms, and Number 16 among the Top Transportation Firms in the Nation.

Carter & Burgess maintains one of the largest staffs of transportation professionals in Texas, with more than 200 employees experienced in all facets of transportation planning and engineering. The Carter and Burgess Dallas Transportation Division is a group of professionals who specialize in the areas of schematic design/planning, roadway design, structural engineering, hydraulic design, traffic engineering and environmental studies. Our transportation team includes senior engineers who have previously worked with all levels of local, state and federal agencies, including the Town of Addison.

As prime consultant, Carter & Burgess will provide direction and oversight for the project and lead in the production of key work tasks. Mr. Bruce Russell, P.E. will be the primary point of contact for the Town of Addison, and will lead the coordination with other State and local agencies, as required.

Lee Engineering, LLC

Lee Engineering, LLC, is a civil engineering firm dedicated to providing traffic engineering and transportation planning services to federal, state and local agencies, private clients and other design professionals. Founded in 1988, Lee Engineering has built a reputation on the ability to integrate transportation planning and traffic engineering expertise with technical know-how to produce powerful, customized decision making tools. The Lee Engineering staff is multi-disciplinary, with expertise in traffic engineering, transportation planning, geographic information systems, and transportation research. These skills enable Lee Engineering to provide customized products tailored specifically to meet the clients' needs. They will be providing services out of their local office, located at 17440 Dallas Parkway, Suite 204, Dallas, Texas 75287.

Quality Counts, Inc. (DBE)

Quality Counts, Inc. specializes in traffic engineering, data collection and traffic analysis. Quality Counts capabilities include conducting 24-hour and peak hour turning movement counts, vehicle classification and occupancy studies, data collection for radar studies, travel time studies, field inventory studies, traveler information surveys, and a variety of aspects associated with parking studies. Established in April, 1986 with the primary goal of providing professional services through through responsding to client needs in a timely, economical, efficient, and courteous manner. Since that time Quality Counts has performed work for both public and private clients throughout Texas and Oklahoma. They will be providing services out of their local office, located at 9951 Tanglevine Drive, Dallas, Texas 75238.

Location of Office Where Work Will Be Performed

Carter & Burgess will be providing services out of our local Dallas office located at 7950 Elmbrook Drive, Dallas, Texas 75247.

Section 3
Project Team Experience

Carter & Burgess, Inc.

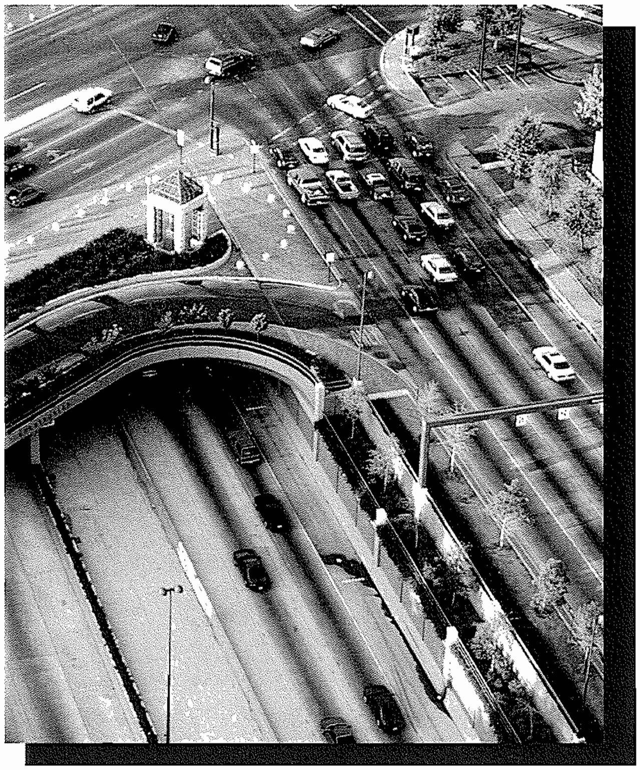
The Carter & Burgess Team has participated in the design of many similar projects. We have chosen the following projects to illustrate our specific experience with the major issues that will be facing the Town of Addison during the reconstruction of the Belt Line Road/Dallas Parkway intersection: reconstruction of an intersection within a constrained right-of-way; maintenance of traffic on an urban arterial that is critical to local access and circulation; and multi-jurisdictional coordination.

US 75 North Central Expressway Reconstruction - Section M
Dallas, Texas

Originally designed for 75,000 vehicles per day, North Central Expressway was one of the nations most congested freeways. The Texas DOT established concepts for a new freeway with significant urban design features. Capacity was increased on the 9.3-mile corridor from 4 up to 10 lanes. By 1990, the congested corridor carried over 500,000 vehicles each day.

Carter & Burgess was responsible for the widening of a two-mile segment. Design elements included geometric design, paving, grading, drainage, utilities, bridges and retaining walls. The large volume of daily and seasonal traffic was a critical concern for construction staging and sequencing. Constructability issues influenced design elements including shallow depth concrete box bridges to minimize excavation and temporary bridges to maintain traffic on cross streets. The traffic control plans involved two main traffic moves and 17 unique stages of construction.

Construction phasing and traffic maintenance placed special emphasis on constructability and the use of structure types that could be built with minimum traffic disruption. Constrained ROW and intricate intertwining of 15 access lanes, ramps and main lanes produced complicated curved and skewed bridge geometrics. Bridge types included



post-tensioned, cast-in-place concrete box girders and precast concrete box girders. Existing and proposed underground utilities, drainage tunnels and conduits created potential conflicts between utility lines, structure columns and foundations. Buildings and retaining wall foundations posed similar conflicts, requiring close attention to existing features, bridge layouts and column locations.

The reconstructed $114 million expressway was completed under budget and a year ahead of schedule and was the recipient of the National CEC Engineering Excellence Grand Award for Transportation projects as well as the State CEC Eminent Conceptor Award for Engineering Excellence.

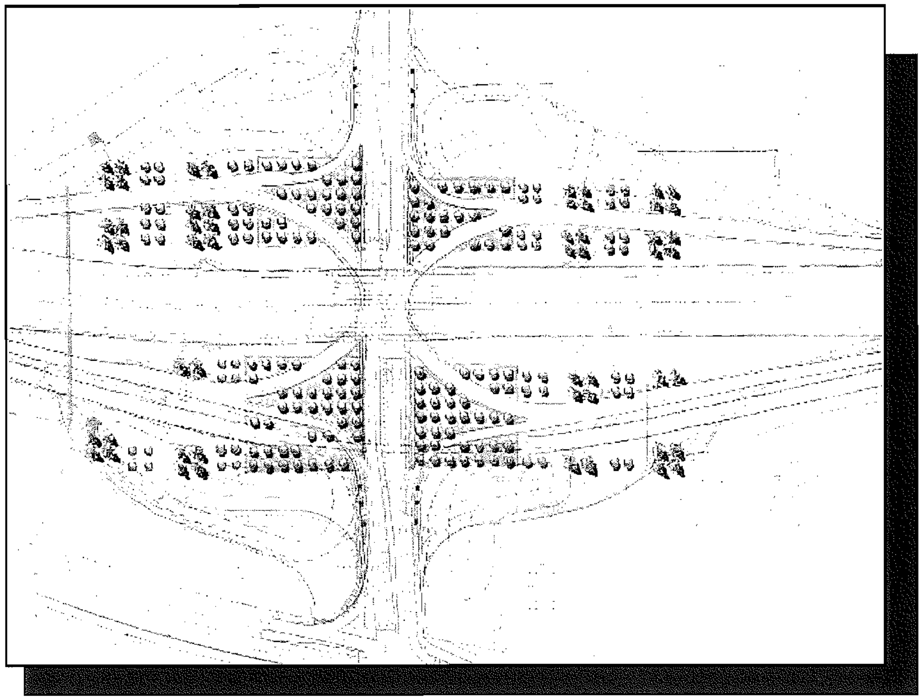
Project Cost: $114,000,000
Completion Date: 1999
Key Team Members: Bruce Russell, Tony Kimmey, Art Hunter
Client: Charles Tucker, P.E., Texas Department of Transportation, ph. 214-320-6100

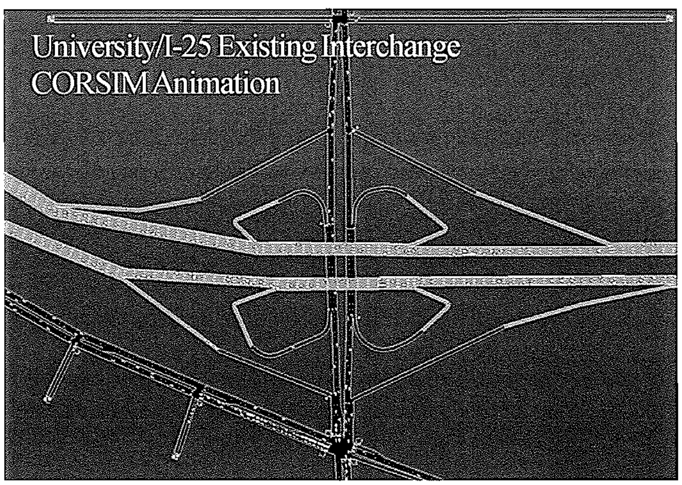
University Boulevard Single Point Urban Interchange
Denver, Colorado

No frontage Roads

Carter & Burgess performed an analysis of the University Boulevard Interchange with I-25 as part of the Southeast Corridor PE / EIS. A single point urban interchange was proposed to replace the existing tight cloverleaf in the constrained right-of-way. An LRT station was proposed just north of the interchange as part of the project's new LRT system. Existing traffic volume data was collected for the interchange and at adjacent intersections along University Boulevard. Future traffic volumes were projected for the area using the Denver Regional Council of Governments planning model for two analysis years - Opening Day and 2020. Station traffic was also considered in the build scenarios.

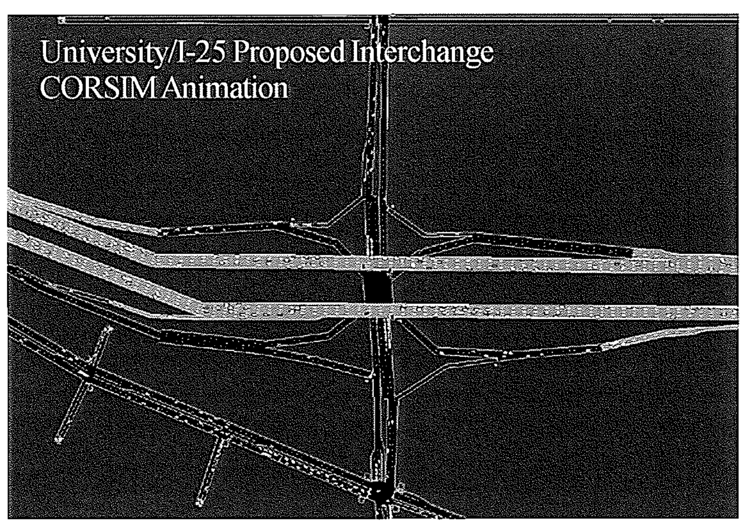
Basic capacity analyses were performed for each intersection using methodologies from the current Highway Capacity Manual, and a full microscopic simulation of the interchange and adjacent intersections was undertaken using CORSIM to more accurately model queue lengths. The CORSIM model was calibrated to existing volume, speed, and queue conditions. The future signal timings and offsets were developed using Signal97 and Transyt-7F, and these data were used in the future CORSIM runs. The results of the analyses indicated that the Single Point Urban interchange would provide for adequate traffic operations in future years. Problems were identified at several local intersections due to station traffic, and mitigation





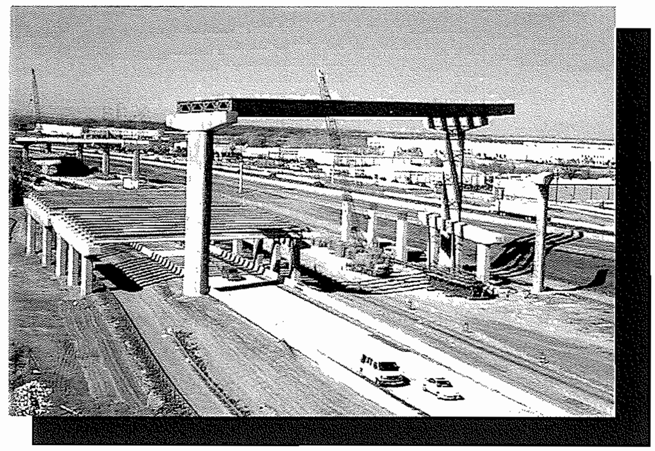
measures, such as supplemental turn lanes and modifications to signal timing, were added to the design.

Project Cost: $ 14,355
Completion Date: 2001
Key Team Members: Paul Brown
Client: City and County of Denver, Cathy Ewing, ph. 720-865-4006



IH 35E/SH 190 (President George Bush Turnpike) Interchange
Carrollton, Texas

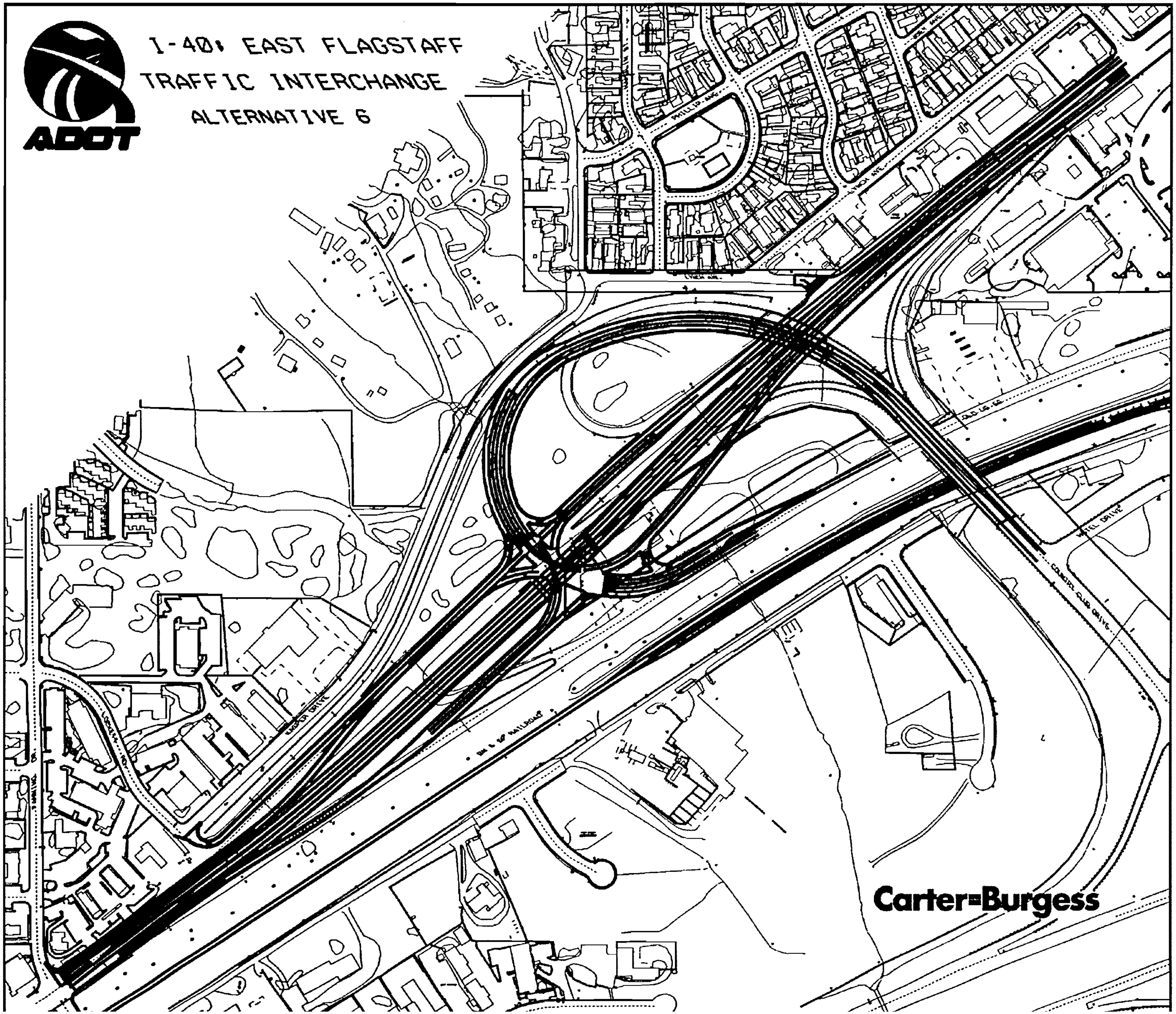
Carter & Burgess designed and prepared plans, specifications and cost estimates for a new multi-level, directional interchange, adjacent roadways and drainage improvements. The first phase of the project is to be constructed by TxDOT and the second phase by the North Texas Tollway Authority. The new interchange links the President George Bush Turnpike (PGBT), a new, fully-access controlled corridor serving northern Dallas and southern Collin and Denton counties, with the established IH 35E corridor. Key project elements include design scheduling, interchange schematic design, horizontal and vertical alignments, impacts on area traffic during construction, layout and design of bridge and wall structures, drainage studies of Furneaux Creek and the Elm Fork of the Trinity River, preparation of plans, specifications and estimates, and coordination with the City of Carrollton, NTTA, TxDOT, COE, FEMA and FHWA.



Project Cost: $ 112,000,000
Completion Date: 2001
Key Team Members: Bruce Russell, Tony Kimmey
Client: (Phase One) Charles Tucker, P.E., Texas Department of Transportation, ph. 214-320-6100
(Phase Two) Jerry Hiebert, North Texas Tollway Authority, ph. 214-461-2029

East Flagstaff Traffic Interchange Design Concept Report
Flagstaff, Arizona

This project involved the reconstruction of an interchange between a five-lane major arterial and a four-lane roadway (B-40) that connects to I-40. This interchange is the easterly connection of Flagstaff, Arizona to I-40 and is in close proximity to a regional shopping mall. The recommended alternative involved the construction of a SPUI with B-40 serving as the crossroad and the major arterial serving as the mainline. Geometric design was taken to the 30% level to assure proper geometry complicated by the curvelinear crossroad and mainline geometry. One specific design feature included creating a frontage road downstream from the crossroad to provide local business access. The accompanying figure depicts this project.


I-40: EAST FLAGSTAFF
TRAFFIC INTERCHANGE
ALTERNATIVE 6
PHILLIP AVE.
LYNCH AVE.
COUNTRY CLUB DRIVE
MOTEL DRIVE
OLD US 66
BN & SF RAILROAD

Project Cost: $ 14,000,000
Completion Date: July 2001
Key Team Members: Paul Black
Client: Arizona Department of Transportation, George Wallace, ph. 602-712-7467

Lee Engineering, LLC

Four Phase SPUI Research Project
Phoenix, Arizona

Considerable research has been performed over the past 10 years on the operational characteristics of the Single Point Urban Interchange (SPUI), although little research has been performed relative to the accident history of this interchange form. The little safety research available indicates that there is no significant difference between the SPUI and the diamond interchange with respect to safety. However, when compared to the diamond interchange, the SPUI does seem to be more prone to rear-end and sideswipe accidents, but it seems less prone to right angle accidents.

The four phase single point urban interchange (4ΦSPUI) is an even more uncommon configuration, though several have been constructed recently in the Phoenix area. This is the SPUI with a continuous frontage road through movement, the fourth phase. The addition of the frontage road through movements add significantly to the size of the conflict area. The stop bar to stop bar separation along the crossroad and be in excess of 350 feet. Several of these interchanges have recently become operational, and there have been reports of challenges associated with the opening of these interchanges.

The selection of the 4ΦSPUI over the other interchange forms was based largely on calculated operational efficiencies, assumed cycle length, assumed easier coordination with adjacent City signals, and anticipated construction and right-of-way cost savings.

The objectives of the research project being conducted by Lee Engineering are to: evaluate the 4ΦSPUI based on available accident data and conflict analysis techniques, right-of-way and construction costs, and operating efficiency; compare the performance of the 4ΦSPUI, and the conventional diamond interchange; evaluate current 4ΦSPUI and diamond interchange design assumptions and operation, and recommend design and/or operational changes to enhance performance; and evaluate the interchange form selection (predesign) process and recommend changes where appropriate.

Project Cost: $ 137,000
Completion Date: Ongoing
Key Team Members: Jim Lee, Jody Short
Client: Arizona Department Of Transportation, Frank McCullagh, ph. 602-712-3132

Dallas County CMAQ
Dallas, Texas

This project involved signal coordination analysis, intersection analysis, preliminary signal timing optimization, and preparation of PS&E for 38 signals in Dallas County.

Project Cost: $ 500,000
Completion Date: Ongoing
Key Team Members: Jody Short
Client: Dallas County, Jack Loggins, ph. 214-747-6336

TxDOT Fort Worth District Signal Design
Fort Worth, Texas

Prepared signal design plans for approximately 160 locations in the cities of Bedford, Cleburne, Colleyville, Euless, Fort Worth, Grapevine, Haltom City, Hurst, Jacksboro, Lake Worth, Mineral Wells, North Richland Hills, River Oaks, Stephenville, and Weatherford, Texas. Submittals included complete PS&E with specifications, notes and estimates in TxDOT text file format.

Project Cost: Varies Per City
Completion Date: 2001
Key Team Members: Jody Short
Client: Texas Department of Transportation, Roy Parikh, ph. 817-370-6617

FM 1709 Signal Timing
Southlake, Texas

This project required the development of coordinated traffic signal plans for eleven signals on FM 1709. Tasks included data collection of 24-hour and peak period turning movement counts, before and after travel time runs (25% travel time saving), intersection analysis, AM, PM, and off-peak timing plan generation using Synchro and PASSER II, and in-field fine tuning for a 16-intersection arterial. Synchro was utilized as an interface to PASSER II. Signal timing plans have been updated on this arterial three times in the last three years because of the rapid development in the area and significant increase in traffic volumes. A spread spectrum radio close loop system was also designed for this arterial. Assisted TxDOT in implementing and fine tuning of signals. Timing plans were provided for future signals within the system.

Project Cost: $ 22,000
Completion Date: 1998
Key Team Members: Jody Short
Client: City of Southlake, Charlie Thomas, ph. 817-481-5581

Grand Avenue Signal Timing Study
Phoenix, Arizona

The purpose of this study was to analyze the existing traffic signal phasing and timings of 26 traffic signals (three groups) along Grand Avenue between 51st Avenue and Loop 303, and to propose and test recommended new phasing, revised intersection signal timings, and new/revised system timings for these signals. Developed and coordinated signal timing plans for each intersection using Synchro. Travel time/delay runs were conducted to determine the effectiveness of the intersection and system timings. Accident analysis for each of the six-approach intersections were performed 12 months following the final implementation of the signal timings.

Project Cost: $ 75,335
Completion Date: 1999
Key Team Members: Jim Lee
Client: Arizona Department of Transportation/AZTech, Joe Spadafino, ph. 602-712-7545

Lemmon/Mockingbird/Inwood Mobility Improvements - Phase I
Dallas, Texas

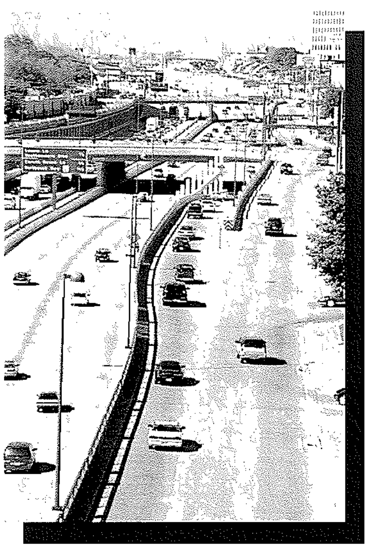
Lee Engineering served as a subconsultant to identify and evaluate street and intersection improvements in the Lemmon, Mockingbird, and Inwood corridors near Love Field. TRAF-NETSIM and PASSER II were used extensively to assist in the identification of traffic operations problems and potential solutions that could be expected given the implementation of the proposed improvements. Provided data collection including existing traffic signal timing data, turning movement counts, existing and future link traffic volumes, bus route information, and proposed roadway improvements. Other tasks included optimization of signal timing, prepared metric schematic drawings of proposed improvements, prepared environmental report, developed construction cost estimates, and provided air quality and noise assessments utilizing Caline3/Mobile5A and Stamina 2.0.

Project Cost: $ 90,000
Completion Date: Ongoing
Key Team Members: Jody Short
Client: DART, Keith Smith, ph. 214-749-3278

Section 4
Key Personnel

The Carter & Burgess Team provides the Town of Addison with strong, experienced project leadership and transportation engineering expertise in our Project Manager, Bruce Russell, P.E. and our assigned staff. Our Team offers the Town of Addison a group of transportation, planning and environmental professionals who have extensive experience in all the design tasks anticipated for this contract. Supporting these key individuals is the largest planning and design staff in North Texas.

The following paragraphs provide brief summaries of the relevant experience of our key personnel. All of the staff listed on the Project Organization Chart will be available to begin work on the project immediately upon notice to proceed. Additional information concerning education, licensing, and relevant project experience for the identified persons is provided in the detailed resumes included at the end of this proposal.



Project Manager

Bruce Russell, P.E. will serve as **Project Manager** for this project. Mr. Russell has more than 25 years of experience in the design and management of major highway, arterial and thoroughfare projects. He will be the Town of Addison's single point of contact and will be available throughout the project duration. His experience includes general transportation and thoroughfare planning, schematic development, preliminary engineering design, construction sequencing and staging plans, analysis of traffic pattern impacts, pavement condition and traffic signal inventories, circulation studies, environmental anlaysis, sign inventories, high accident location analyses formulation of capital improvements programs, and preparation of plans, specifications and estimates. His relevant project experience includes: US 75 North Central Expressway-Section M in Dallas, IH 35E/SH 190 Interchange in Carrollton, and DART Southeast Corridor in Dallas.

Project Team

Jim Lee, P.E., Ph.D., will be responsible for leading the **Alternatives Analyses** for this project. He is the President and founder of Lee Engineering, LLC. Mr. Lee has over 30 years of experience in traffic engineering and transportation planning. He is currently managing a research project of the Four Phase SPUI for the Arizona Department of Transportation examining the operational efficiencies, cost, and accident experience at four phase single point urban interchanges. He has served as project manager on several signal system projects including the City of Lubbock signal system feasibility study, City of Phoenix signal system feasibility study, Town of Gilbert signal system design, City of Lakewood signal system expansion study, and City of Albuquerque ATMS project. He has served as a District Traffic Engineer for the State of Oklahoma as well as City Traffic Engineer for Amarillo and Beaumont, Texas.

TOWN OF ADDISON

Legend
(1) Carter & Burgess, Inc.
(2) Lee Engineering, LLC
(3) Quality Counts, Inc. (DBE)

Project Manager
Bruce Russell, P.E. [1]

Project Director
Phil Deaton, P.E. [1]

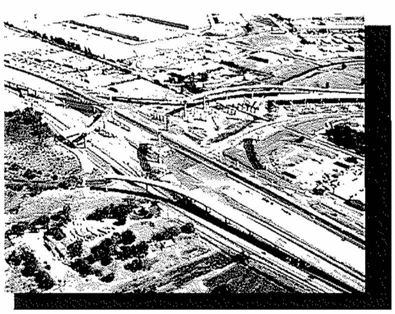
Alternatives Analyses
Jim Lee, P.E., Ph.D. [2]

- SPUI Design Alternatives
  - Tony Kimmey, P.E. [1]
  - Paul Brown, P.E. [1]
  - Paul Black, P.E. [1]
- Structural Alternatives
  - Art Hunter, P.E. [1]
- Traffic Analysis
  - Jody Short, P.E. [2]
- Aesthetic Design
  - Larry O'Flinn, ASLA [1]
- Data Collection
  - Linda Larkins [3]

Engineering Design
Tony Kimmey, P.E. [1]

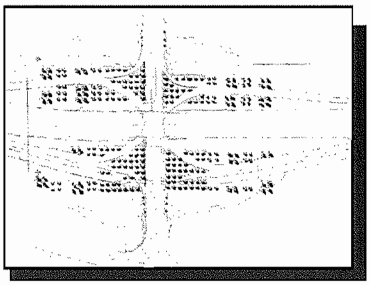
- Roadway Design
  - Tony Kimmey, P.E. [1]
- Drainage and Utilities
  - Alex Martinez, P.E. [1]
- Structural Design
  - Art Hunter, P.E. [1]
- Traffic Design
  - Jody Short, P.E. [2]
- Surveys and Right of Way
  - ~~Gordon Perry, RPLS~~ [1]
    Bill Boden RPLS

Public Involvement
Bruce Russell, P.E. [1]



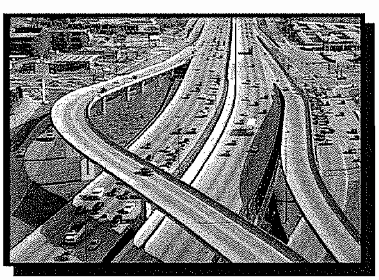
Tony Kimmey, P.E. will be leading the **Engineering Design, Roadway Design, and SPUI Design Alternatives** for this project. He has 16 years of roadway planning and design experience with a focus on projects in the North Texas area for the past 12 years. This experience includes schemaitc development, preliminary and final design, coordination of construction document preparation, develop of project construction cost estimates, performance of quality assurance/quality control functions, and construction management. Over the last five years he has been project manager and lead engineer for the design of several projects in the Metroplex that involved significant and complex highway construction, including: Section M portion of North Central Expressway in Dallas; the IH 35E/SH 190 Interchange in Carrollton; and Dallas North Tollway Extension in Dallas.

Alex Martinez, P.E., will be responsible for **Drainage and Utilities**. Mr. Martinez has more than 17 years of experience in management, design and construction of civil engineering projects. Mr. Martinez has extensive experience in the preparation of plans, specifications and estimates (PS&E) for paving, drainage, water, sanitary sewer and erosion control projects. His project experience includes roadway work with both municipalities and governmental agencies such as the City of Dallas, City of Carrollton, City of Mesquite, City of Denton, City of Farmers Branch, Town of Highland Park and the City of University Park, as well as the Texas Department of Transportation (TxDOT).



Paul Brown, P.E., will assist in the **SPUI Design Alternatives** efforts. Mr. Brown has more than 12 years of experience in traffic engineering and transportation planning services. His traffic engineering responsibilities include project management along with traffic analyses, parking studies, trip generation and distribution evaluations. Mr. Brown's transportation efforts involve close work with railroads to determine the commuter capabilities of existing freight lines. He also provides commuter demand analyses and conceptual station plans. Mr. Brown also presents project information before government agencies and other public forums.

Paul Black, P.E., will also assist in the **SPUI Design Alternatives** efforts. Mr. Black brings over 28 years of diverse experience in all phases of transportation projects. For over 14 years, Mr. Black was a civil engineer with the Arizona Department of Transportation. He served as project engineer for a wide variety of transportation projects including the design of Interstate 10 between 99th Avenue and 59th Avenue and for the design of Loop 202 from 24th Street to 40th Street. Whether the task is reconstructing two-lane highways to four-lane divided highways, the design of all new freeway and interchange work or rural highway design and earthwork, Mr. Black's adaptable, common sense approach combined with the dedication to thoroughly know the client's needs and the job up-front provides the broadbased expertise that provides Carter & Burgess customized experience in transportation design in the Southwest.



Art Hunter, P.E., will be resonsilble for **Structural Alternatives**. Mr. Hunter has more than 21 years of experience in the design of transportation and civil work structures. His experience includes structural analysis and design, preparation of plans and specifications, economic anlysis and reports, and administratio of construction contracts. His experience with new bridge design includes pedestrian, highway, railroad and transit projects. He has designed both simple and continuous span concrete and steel bridges. His projects have involved blending seemingly incopatible criteria as construction phasing, aesthetics, complex geometrics into functional, economical and award winning projects. Some of his relevant project experience includes: US 75 North Central Expressway-Section M in Dallas; Renner Road in Richardson, and the post-tensioned elevated intersections of the Dallas North Tollway at LBJ Freeway.

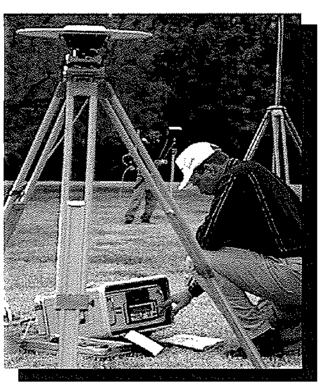
Jody Short, P.E., will be resonsible for **Traffic Analyses**. He has over 13 years of experience on a variety of projects in transportation and traffic engineering. He has served as project manager and project engineer on numerous traffic engineering design/

studies projects including the operational analysis of proposed roadway facilities and the preparation of PS&E for signals and signing. He has conducted operational analyses for alternative interchange configurations at the intersection of Park Boulevard and Preston Road in Plano, Midway at Arapaho in Addison, and several interchanges along SH 121 between Lewisville and the Dallas North Tollway.

He is currently serving as project manager on Lee Engineering's TxDOT Fort Worth District On-Call Traffic Engineering Services contract. Assignments include various traffic analyses, signal design, signal timing and signing design. He also served as project manager on the Dallas County CMAQ projects which included PS&E for 38 signals including signing and pavement markings, intersection capacity and level of service analysis, and traffic control system analysis and design. Mr. Short has completed over 15 signal timing projects including projects from the State of Texas' Traffic Light Synchronization (TLS) Program.

Larry O'Flinn will contribute to the **Aesthetic Design** plans for the project. Mr. O'Flinn has over 23 years of experience in all aspects of planning and landscape architecture with emphasis on site-specific development projects. His experience ranges from initial program development to detailed site design to construction documents and construction management. Recent project experience involves landscape/streetscape and linear parks along roadways, which integrate landscaping, signage, and street and pedestrian lighting into the roadway construction project.

Linda Larkins will provide **Data Collection** services. Ms. Larkins established Quality Counts in 1986 and has over 13 years experience in data collection for traffic engineering studies. She has conducted numerous speed studies using a radar gun and tube counters, turning movement counts for traffic signal warrant analyses and intersection analyses, field and inventory studies, 24-hour approach counts, vehicle and classification counts, travel time studies, parking studies, and traveler information surveys.



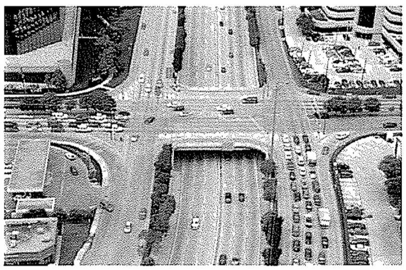
Gordon Perry, RPLS, will be responsible for the **Survey and Right of Way** tasks for this project. Mr. Perry has over 16 years of surveying experience with a focus on projects in the North Texas area over the past 10 years. He has significant experience in the key areas of utilizing GPS surveying techniques in both "Static" and "Real Time Kinematic" (RTK) modes for creating project control networks; researching public records for documentation of property ownership; collecting field monumentation of existing property boundaries; resolving conflicts between field and recorded property boundaries; preparing parcel plats, legal descriptions and right-of-way maps; and setting monumentation for new right-of-way acquisition.

Phil Deaton, P.E., will serve as **Principal-In-Charge**. Mr. Deaton has over 30 years of experience in the planning, design, construction and management of major civil and multidiscipline projects, with an emphasis on hydraulic and hydrologic analyses. He will oversee the project and make sure the full resources of the firm are available. He is Principal in charge of the Dallas office and oversees day-to-day activities. He joined the firm in 1984 and is a Senior Vice President.

Section 5

Project Approach

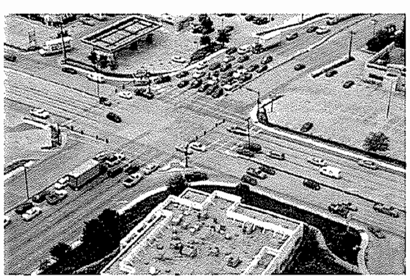
The conversion of the Belt Line Road interchange at the Dallas North Tollway to a single point urban interchange is a challenging assignment. The Carter & Burgess approach to this assignment is based on three fundamental points. First, the team must have a good understanding of the operational characteristics of SPUI interchanges and how they actually function. Team member, Lee Engineering, is presently performing research for the Arizona Department of Transportation on the SPUI with a particular emphasis on those types with frontage roads, just like the Belt Line Road interchange. We have included at the end of this section an excerpt from that study that elaborates on the design and operational issues of the four phase SPUI.



Second, the team must be able to translate the operational features into a design that can be constructed. Carter & Burgess has recently prepared designs for converting a cloverleaf interchange to a SPUI for University Avenue at I-25 in Denver and for a new SPUI at I-40 in Flagstaff, Arizona.

And third, the team must understand complex highway construction that is necessary along the heavily traveled Belt Line Road and Dallas North Tollway. Carter & Burgess was responsible for design of Section M of North Central Expressway including design and construction techniques similar to what may be expected at this location. Project Manager Bruce Russell was responsible for that design. Design leader Tony Kimmey was responsible for retaining wall designs and structural designer Art Hunter was lead structures engineer for that project. All will bring that relevant experience to this assignment.

Management Approach

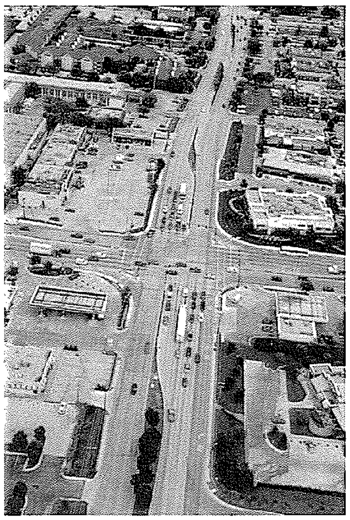


Bruce Russell will be Project Manager directly responsible to Addison for the project. He has organized the team in two functional areas. First is the Alternatives Analysis phase. In this phase, led by Mr. Jim Lee, P.E., Ph. D., functional and operational alternatives will be developed and evaluated. This work will include those alternatives previously studied and new alternatives to address the overall goals for the interchange. The alternatives analysis team includes engineers with experience in design of urban interchanges, structural engineers to evaluate the design and construction implications of various alternatives, and traffic engineers to evaluate how progression along Belt Line Road and the frontage roads is affected. During this phase aesthetic enhancements for the interchange and for Belt Line Road enhancements will be evaluated.

The second team is the engineering design team led by Tony Kimmey, P.E. Mr. Kimmey was responsible for designs for North Central Expressway and was recently Project Manager for the IH 35E/SH 190 interchange, a $93 million construction project. This design team will include members from the alternative evaluation team and additional designers.

We anticipate that there will be extensive coordination with the property and business owners in the area. Project Manager Bruce Russell will be responsible for representing the team in public involvement.

Key Issues



Successful projects are measured by how well the team understands and can address key issues. This team has identified the following as key issues. A more robust examination of the issues related to the four phase SPUI may be found in the Lee Engineering research excerpt at the end of this section.

Operations. SPUI interchanges are very efficient at handling large volumes of traffic, especially large left-turn movements like at Belt Line Road. This efficiency comes from reducing conflict points and in efficiently managing signal green time. At Belt Line Road there are frontage roads (through movements) that lengthen the signal cycle. U-turns and pedestrian movements introduce additional conflict points. All these factors affect SPUI operations. The effects must be evaluated versus the expected operational gains and cost of the conversion of the interchange.

Pedestrian Movements. By their very nature, SPUI interchanges are designed to maximize the movement of vehicles. The interchanges typically have wide areas that pedestrians must cross. Vehicles approach from far reaches of the interchange and pedestrians may find it hard to judge speed and direction. It is not uncommon that pedestrians take significantly longer time to cross a SPUI.

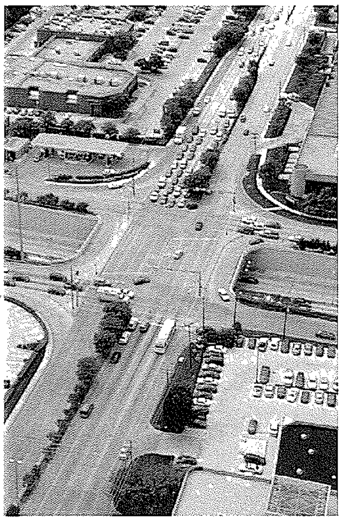
Driver Expectations. Most interchanges that drivers in North Texas encounter are typical diamond interchanges and include U-turns, commonly known as "Texas U-turns." Left turns in these types of interchanges occur on the right of the opposing left turn movement. In the SPUI interchange these movements occur without conflict and to the left of the opposing left turn, much like a standard four-leg intersection. Only drivers don't expect that kind of movement at a freeway-like interchange as Belt Line Road. For this reason, engineering designers must anticipate that driver confusion may be greater.

Aesthetic Treatment. Belt Line Road is a major thoroughfare in Addison and Dallas. Modifications to the interchange must be sympathetic to and incorporate aesthetic treatments planned for adjacent areas.

Business Impacts. Businesses adjacent to the interchange will be sensitive to changes in traffic patterns, right-of-way and construction impacts. The design team must be capable of presenting the benefits and disbenefits of the various alternatives.

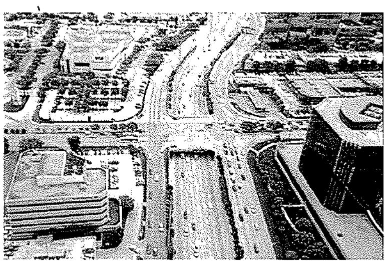
Agency Coordination. This interchange lies in Dallas, affects businesses in Addison and Dallas, impacts the Dallas North Tollway, and is along a regional road, Belt Line Road, developed by Dallas County. Funding includes DART LAP funds. Each agency has an interest in what happens to "their" asset.

Technical Approach



We have reviewed the concepts previously produced for this interchange. Each has its own merits; however, we believe that a thorough review of these concepts must be made to ensure that the many long-range planning goals for this part of Addison will be met and enhanced by these modifications. The single point urban interchange is a very effective design to enhance the movement of vehicles through an intersection or interchange. This increased efficiency comes at the expense of other movements including pedestrian movements. Including frontage road movements requires additional green time. Including u-turn movements adds potential conflict points. And the novelty of this interchange compared to the traditional diamond interchanges throughout the region can cause drive confusion, particularly with left turn movements.

We believe a thorough review of the alternatives developed to date is warranted. The alternatives should include evaluation of additional criteria including pedestrian movement and potential aesthetic enhancements in conjunction with on-going planning efforts for the corridor. The first phase of the project will be an alternatives analysis phase. In this phase the team will develop alternatives for the interchange, looking at roadway designs related to turning radii, U-turns and frontage road arrangements. During this phase the team will work with the city to ensure that adjacent property owners concerns are understood and addressed. Participating agencies concerns must also be addressed. Alternatives will be evaluated and ranked on criteria jointly developed with the city and the project team.



Once the selected alternative is determined, the team will then develop detailed design plans for the proposed improvements. Because so much of the widened structure will overhang the Dallas North Tollway, the designs must be coordinated with the North Texas Tollway Authority. Typically, portions of the bridge superstructure would be cast-in-place construction; however, because of restricted space and large traffic volumes; such construction techniques may not be feasible. Precast beams may be more appropriate. In this case, larger parts of a bridge structure may be have to be constructed to achieve the additional room for the large left turn radii found in SPUI's.

Understanding of Four-Phase SPUI Design and Operations

The following is an excerpt from a recent study performed by Lee Engineering of the four-phase SPUI. This excerpt forms the basis of their study of this type of SPUI presently being conducted for the Arizona DOT. Because this is an excerpt, references as noted in the text are not included. However, most issues noted in this overview apply to the Belt Line Road SPUI analysis.

The single-point urban interchange (SPUI) has been the subject of intensive study during the past 15 years. Major studies (*1, 2, 3, 4*) have been conducted for several state departments of transportation (DOTs), including Arizona DOT, Texas DOT, Virginia DOT, and Michigan DOT. A major study (*5*) was also conducted for the National Cooperative Highway Research Program (NCHRP), acting on behalf of the American Association of State Highway and Transportation Officials (AASHTO). The findings from these studies have primarily focused on the SPUI but have also offered comparisons of it to other intersection and interchange forms (e.g., high-type at-grade intersection (AGI) and tight-urban diamond interchange (TUDI)). These studies have also focused on SPUIs that are not associated with frontage road systems along the major roadway. This latter focus was dictated primarily by the fact that few such frontage-road SPUIs existed at the time of the studies.

9.1.1 Objective

The objective of this section is to document a critical review of the literature on the topic of SPUIs with frontage road service. This review identifies a range of issues related to this type of SPUI application. To provide proper context for the discussion, the review also includes discussion of the TUDI with frontage service (the present Belt Line Road interchange). Such context is also provided through discussion of the SPUI without frontage road service; however, this type of interchange is not the focus of this discussion.

9.1.2 Definitions

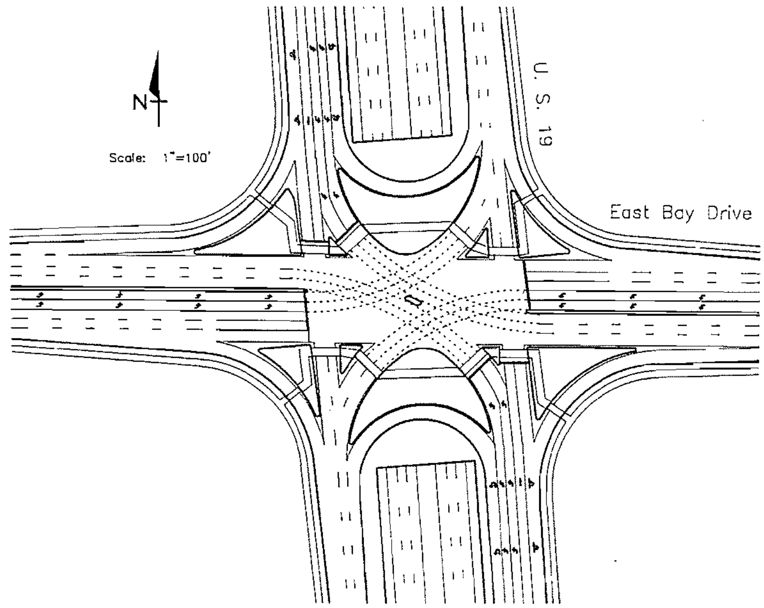
4-Phase SPUI. In a 1991 report, Messer *et al.* (*5*) found that there were 36 operational SPUIs of which 25 (69%) did not have frontage roads. The 11 SPUIs found to have frontage roads were noted to fall into one of two categories:

1. Frontage roads combined with on/off ramp terminals, or
2. Frontage roads offset from the on/off ramp terminals.

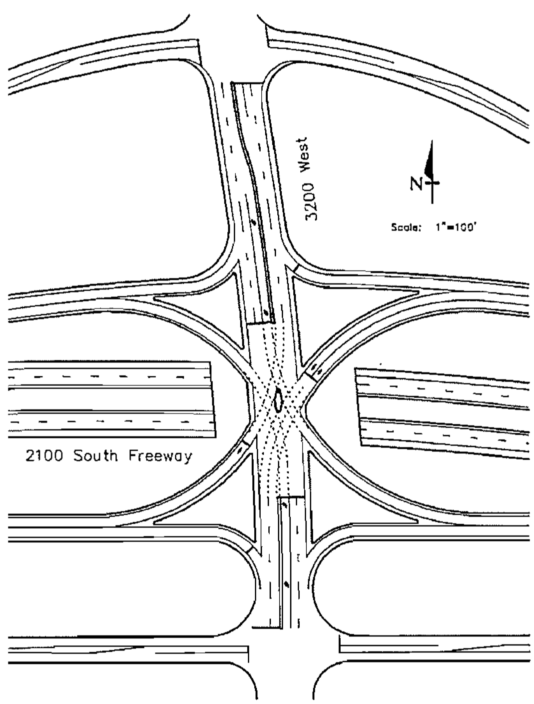
These two interchange forms are also shown in Figure 9-1. The second category was found at only three (8%) of the SPUIs. In contrast, eight (22%) of the SPUIs had the frontage roads combined with the on/off ramp terminals.

The SPUI where the frontage roads are combined with the on/off ramp terminals uses NEMA 8-phase control and operates with four basic phases, one typical phasing arrangement is shown in Figure 9-2. *This type of SPUI/frontage road design is referred to herein as the 4ΦSPUI.*

Figure 9-1. Alternative frontage road arrangements at the SPUI.

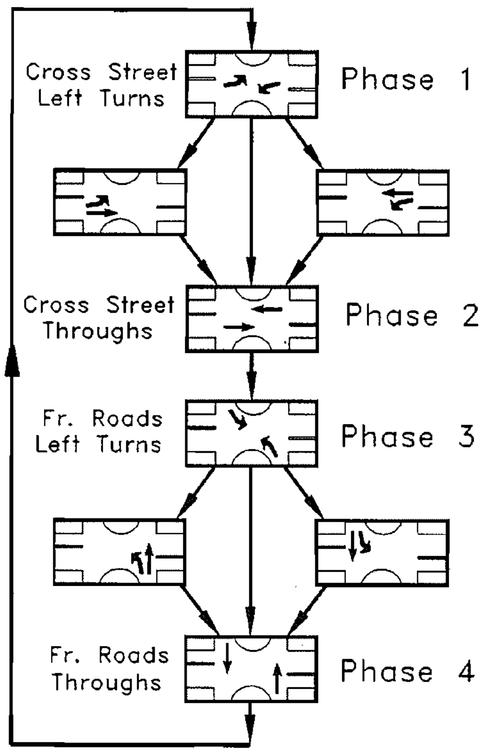


a. Frontage roads combined with on/off ramp terminals (4ΦSPUI). (no scale)



b. Frontage roads offset from on/off ramp terminals. (no scale)

Figure 9-2. 4-Phase SPUI Operation.

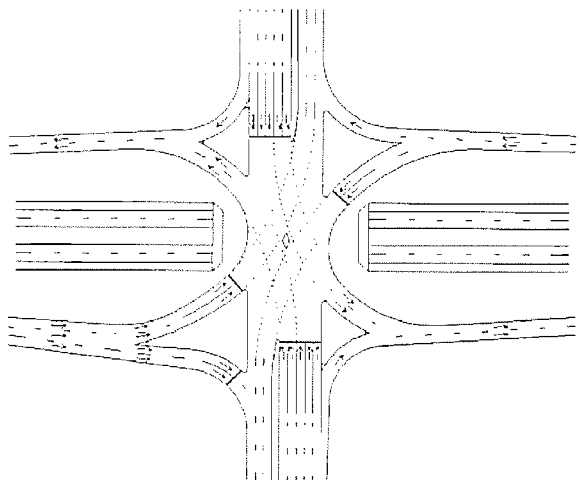


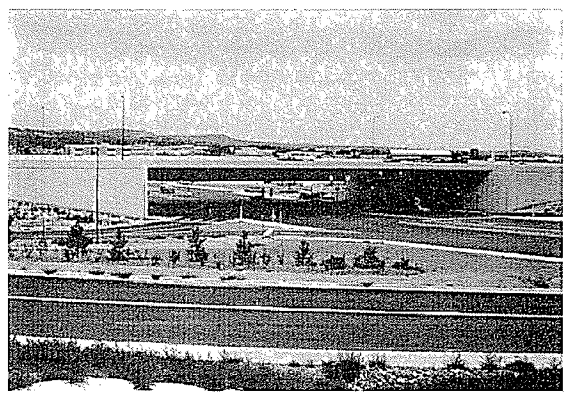
The phasing shown in Figure 9-2 represents the use of Phases 3 and 4 to serve the off-ramp traffic. Initially, Phase 3 serves the left-turn movements simultaneously in a leading left arrangement. Overlap phases are available when left-turn demands are unbalanced (i.e. unequal in volume). Finally, Phase 4 provides for the simultaneous service of the frontage road through movements. Other phase sequences are possible when conditions require. For example, lagging left-turn phasing may be used if enhances traffic progression along the cross street. Also, split (or directional) phasing may be used to serve each off-ramp in succession when severe alignment skew reduces the separation of the ramp left-turn paths to unsafe distances.

Issue 1. It is not clear what frontage-road phase sequence is most appropriate for a given set of traffic and geometric conditions as there is currently no formal guidance in this regard.

Overpass vs. Underpass SPUI. Another means of describing SPUIs relates to the relationship between the to intersecting alignments. One type of SPUI has the major roadway through movements passing above the ramp/cross-road intersection. This is termed an overpass SPUI, as shown in Figure 9-3. All eight of the 4ΦSPUIs observed by Messer *et al.* (*5*) had the overpass design.

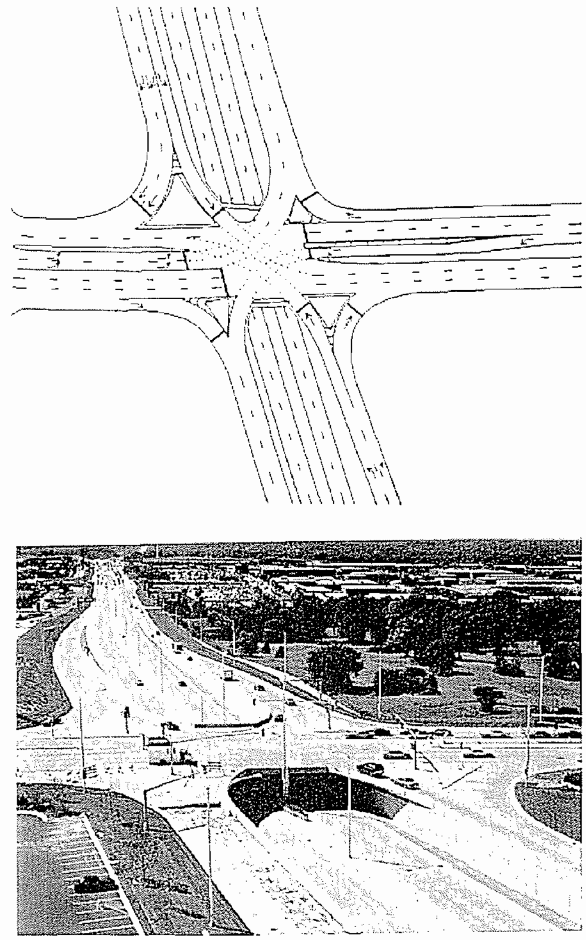
Figure 9-3. Overpass SPUI.





Those SPUIs that have the major road through movement passing under the ramp/cross-road intersection are called underpass SPUIs. This type of SPUI is shown in Figure 9-4. The advantage of the underpass SPUI (relative to the overpass SPUI) is that the intersection conflict area is relatively open, well lit, and resembles that of other high-type at-grade intersections. Dorothy *et al.* (*4*) noted these advantages in a recent observational study of SPUIs in six states. The disadvantage of the underpass design is that requires a more complicated (i.e., expensive) bridge structure, the parapet walls associated with the bridge railing tend to block sight lines for ramp traffic, and the open conflict area appears unnecessarily expansive (and possibly more intimidating) than that found at the overpass SPUIs.

Figure 9-4. Underpass SPUI.



Issue 2. There appear to be significant operational, safety, and cost impacts associated with the choice of overpass versus underpass SPUI design. These significance of these issues may be heightened when combined with frontage road systems.

9.2 Interchange Geometry

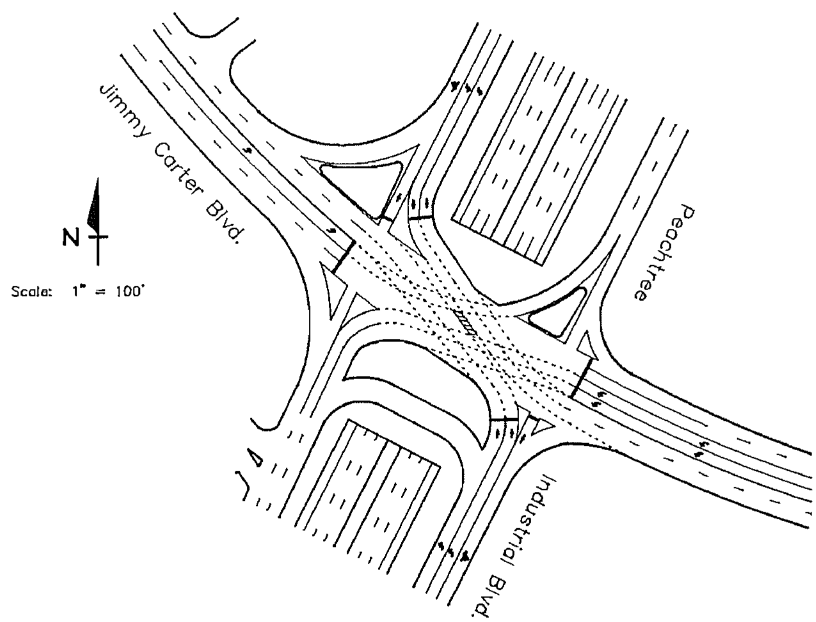
9.2.1 Left-Turn Path Geometry

Messer *et al.* (*5*) found that the geometry of the cross road and off-ramp left-turn paths tends to have one of two designs:

1. Simple radius, or
2. Three-centered compound.

For the off-ramp, the left-turn path begins at the point of curvature (PC) on the off-ramp tangent. The ramp geometry then curves in accordance with one of the two aforementioned curve designs until it reaches the cross road. Thereafter, it is effectively traced through the intersection conflict area by skip-stripe lane lines until it comes tangent with the cross road alignment (PT). The cross-road left-turn path follows a similar arrangement; however, it starts on the cross road with skip-stripe lane lines and ends on the on-ramp as part of the on-ramp geometry. The simple radius design at a 4ΦSPUI was shown previously in Figure 9-1a. The three-centered compound curve is shown in Figure 9-5.

Figure 9-5. Use of compound curve left-turn paths at a 4ΦSPUI.



Turn paths with compound curvature are often considered because they can minimize interchange cost by allowing for a reduced bridge length. Bridge length is of particular concern for the 4ΦSPUI as it tends to be associated with U-turn lanes which, in and of themselves, dictate an increase in bridge size. The impact of these U-turn lanes on bridge length can be visualized by examination of Figures 9-1a and 9-5. Other issues related to U-turn lanes at 4ΦSPUIs are discussed in the next section.

In spite of their potential cost savings, the compound curve design used at SPUIs is generally contrary to the curve design procedures recommended in Chapter 3 of the AASHTO document, *A Policy on Geometric Design of Highways and Streets* (*6*) (Green Book). More importantly, it is contrary to driver expectancy during curve driving as it requires significant and unusual steering input to track the various radii along the path. Observation of driver behavior at the 4ΦSPUI shown in Figure 9-5 confirmed these problems as drivers were noted to make dangerous deviations from the path (to the extent that they would be traveling in the oncoming traffic lanes).

Issue 3. Compound curvature in the left-turn paths may not be as safe or efficient as would paths consisting of a simple radius. The potential need (as perceived by designers) for compound curvature may be increased when U-turn lanes are provided.

9.2.2 U-Turn Lanes

The SPUI shown in Figures 9-1a and 9-5 also illustrate the provision of U-turn lanes at a 4ΦSPUI geometry. It should be noted that the U-turn lanes that are shown in these figures are consistent with TUDI design when used in a frontage road system. Such systems tend to be associated with significant U-turn volumes, especially when commercial developments are found along the frontage road system.

Messer *et al.* (*5*) found that about 19 percent of the SPUIs had U-turn lanes. In each case, the lanes were used where one-way frontage roads existed. The advantage of U-turn lanes is that they remove U-turning traffic from the signalized traffic streams and thereby reduce delay to the U-turn movements as well as other signalized movements. The disadvantage of these lanes is that they increase the cost of the bridge structure by increasing its total length.

Issue 4. The cost-effectiveness of U-turn lanes at 4ΦSPUIs, in terms of the added cost of the bridge structure relative to the operational benefits they provide, is not well known.

Another disadvantage of U-turn lanes may be the increased potential for conflict at the point where the U-turn lane traffic merges with the on-ramp/frontage road traffic. This problem stems from the acute angle between the U-turn lane and the cross-road left-turn path feeding the subject on-ramp. This angle is so acute that it requires U-turn drivers to make a 125 degree head rotation in order to verify the safety of the merge maneuver. Such a rotation is quite difficult and observations are that it is often omitted, thereby leading to frequent conflicts. This problem may partially explain why Garber and Smith (*3*) found that there are significantly more crashes on SPUI on-ramps than TUDI on-ramps.

Issue 5. U-turn lanes that follow the designs shown in Figures 9-1a and 9-5 may increase crash potential at 4ΦSPUIs because of acute merge angles. It may be possible that design modifications can improve this situation.

9.2.3 Conflict Area

The size of the conflict area at a SPUI is quite large relative to the AGI and TUDI design alternatives. This large size has several disadvantages associated with it including poor driver guidance and relatively long change intervals (discussed in Section 9.3). These disadvantages tend to become more problematic as the size of the conflict area increases.

At the 4ΦSPUI, the addition of the frontage road through movement increases the dimension of the conflict area. This increase in width ranges from 50 to 150 ft and is approximately equivalent to the width of the cross section of the frontage road through traffic lanes. The size of this conflict area can be visualized by comparison of both Figures 9-1 and 9-4.

With regard to driver guidance, Dorothy *et al.* (*4*) report that the larger clearance distances caused several problems. Specifically, drivers were observed to stop for the wrong (but visible) signal indication. They were also observed to get lost within the conflict area. Messer *et al.* (*5*) observed cross road drivers occasionally traveling through the interchange in the through lane only to make a sharp left turn at the far-side of the conflict area (much as would be done for a left-turn at a TUDI). Other observations also indicate that frontage road drivers sometimes turn left from the through lanes rather than the left-turn lanes.

Issue 6. The large size of the 4ΦSPUI conflict area may increase driver confusion regarding the appropriate travel path. It is possible that efforts to reduce the size of the conflict area (perhaps through channelization) may improve driver guidance.

9.3 Interchange Operations

9.3.1 Change Interval, Lost Time, and Capacity

Traffic movements at the SPUI are generally recognized by the profession to require more lengthy change intervals (i.e., yellow warning plus all-red clearance) than corresponding movements at AGIs or TUDIs. This trend is a result of the larger conflict area associated with the SPUI relative to the AGI and TUDI designs. A consequence of larger change intervals is reduced capacity because much of the change interval represents time that is unavailable to serve vehicles (i.e., lost time). The 4ΦSPUI is particularly sensitive to the impact of change interval requirements. This sensitivity stems from the greater size of the conflict area.

Bonneson (*7*) examined the change intervals and lost times for typical four typical intersection and interchange scenarios. The results of this examination are summarized in Table 9-1.

Table 9-1. Signal Change Interval Duration.

Scenario	Major/Frontage Road		Cross Road		Cycle Total (s)
	Left	Through	Left	Through	
At-Grade Intersection (AGI)	7.2	6.1	7.2	6.1	26.6
Small SPUI without Frontage Roads	7.9	na	8.0	7.7	23.6
Large SPUI without Frontage Roads	8.6	na	8.9	8.3	25.8
Large SPUI with Frontage Roads	9.7	6.4	9.0	9.3	34.4

Note: Based on an 85th percentile approach speed of 45 mph.
Large SPUI has stop bar to stop bar separation of 270 ft.
na - not applicable

It should be noted that all change interval times were computed using the methodology proposed by the Institute of Transportation Engineers (ITE) as a recommended practice. This methodology is described in Reference *8*. It should also be noted that this methodology yields left-turn change intervals that are somewhat longer than those found at most signalized intersections. However, this methodology was used as it represents the only formally recommended method for determining change intervals.

The data in Table 9-1 indicate that the change interval duration is generally larger for the SPUI than for the AGI (in this instance, the TUDI would have similar change interval durations). More importantly, the Large SPUI with Frontage Roads (i.e, 4ΦSPUI) has the largest change intervals (due to the large size of the conflict area). This finding, plus the fact that the fourth-phase adds another interval of lost time, leads to the logical conclusion that the 4ΦSPUI has significant lost time relative to other intersection or interchange forms. In fact, the amount of lost time is so significant that some engineers (*5, 9, 10*) have questioned whether the 4ΦSPUI is more efficient than other geometric alternatives. Messer *et al.* (*5*) indicate that at least one agency has found that using lagging off-ramp left-turns has the potential to reduce the size of the change interval for some phases.

Issue 7. The number and duration of the change intervals associated with the 4ΦSPUI may restrict its capacity such that its benefit (relative to the TUDI) may be limited to right-of-way savings only. An examination of factors affecting change interval length and resulting lost time is needed to mitigate this problem, if possible.

9.3.2 Signal Coordination

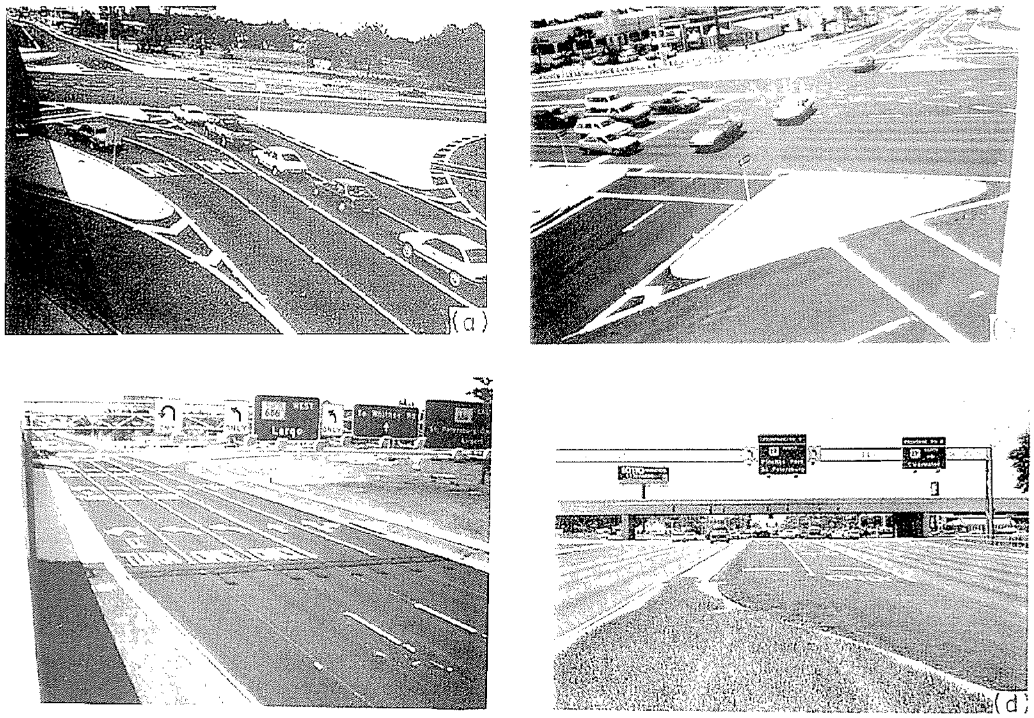
A recent survey by Garber and Smith (*3*) indicated that a large percentage of engineers believe that the SPUI is much easier to coordinate with adjacent signalized intersections on the cross road (relative to the TUDI). The justification for this claim is that the SPUI has only one signalized junction whereas the TUDI has two, closely-spaced junctions. On the other hand, Dorothy *et al.* (*4*) report that the long cycle length associated with the SPUI (relative to adjacent intersections) tends to make coordination difficult. This problem may be particularly acute for the 4ΦSPUI as its lengthy change intervals and fourth phase tend to make cycle lengths extremely long (even when compared to other SPUIs).

Issue 8. The long cycle length associated with some 4ΦSPUIs tends to make it difficult to coordinate with adjacent signalized intersections. Methods are needed for improving the coordination capability of the 4ΦSPUI given its propensity for lengthy change intervals.

9.3.3 Positive Guidance

As alluded to in a previous section, the 4ΦSPUI conflict area can be significant. This relatively open expanse of pavement has been found to be confusing to motorists which sometimes leads to erratic maneuvers (*4, 5*). Messer *et al.* (*5*) suggest that overhead advance signing and recurrent pavement markings (i.e., lane use arrows) on the interchange approach appear to have had some success at 4ΦSPUIs. Both Dorothy *et al* (*4*) and Messer *et al.* (*5*) indicate that signal head position and lens visibility are key sources of positive guidance for the SPUI driver. The signing and marking treatments used at one 4ΦSPUI are shown in Figure 9-6.

Figure 9-6. Overhead advance signing and pavement markings used at one 4ΦSPUI.



Issue 9. It is possible that driver guidance through the 4ΦSPUI could be enhanced and erratic maneuvers reduced through the use of effective overhead advance signing and recurrent lane use pavement markings. The optimum positioning of signal heads and the use of programmable and/or directional lenses may also improve driver guidance.

9.3.4 Pedestrian Considerations

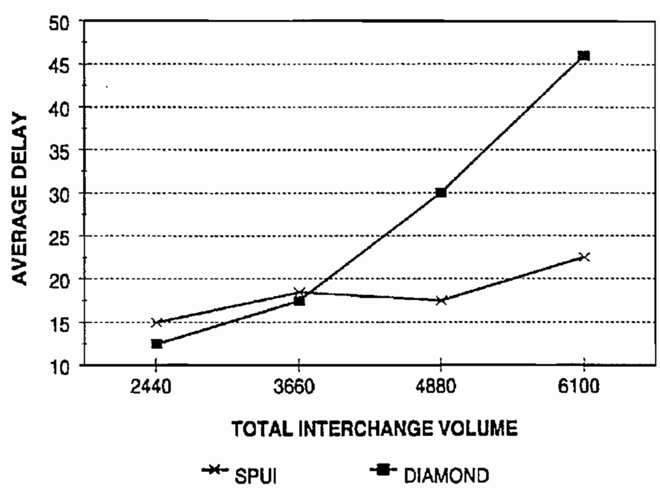
At the 4ΦSPUI, pedestrians crossing the cross road can easily be accommodated by serving them concurrently with the adjacent frontage road phase. However, the excessive width of the cross road in the vicinity of the SPUI generally results in an excessively long pedestrian crossing phases. Although the pedestrian phase may be actuated and not called each cycle, when it is called it can be disruptive to traffic progression for several cycles thereafter. In addition, the long pedestrian phase tends to greatly exceed that needed for the frontage road phase. As a result, pedestrian service is very inefficient at the 4ΦSPUI. In fact, Messer *et al.* (*5*) report that only one of seven 4ΦSPUIs that they observed had pedestrian service across the cross road.

Issue 10. Provision of pedestrian service in the 4ΦSPUI signalization using traditional methods may tend to be disruptive to overall interchange operation. Alternative methods that do not disrupt progression or increase motorist delay need to be identified and evaluated.

9.3.5 Flexibility of Signal Phase Sequence

Simulation studies by both Fowler (*11*) and by Garber *et al.* (*3*) indicate that the SPUI tends to operate with lower delay than the TUDI for most traffic volume patterns. Fowler suggested that the SPUI would operate more efficiently than the TUDI unless traffic demands on the cross road and on the off-ramps were imbalanced. Garber found that the SPUI operated with lower delay than the TUDI except when traffic demands were relatively low. The relationship between delay and total interchange volume found by Garber is shown in Figure 9-7.

Figure 9-7. Delays associated with the SPUI and the TUDI as a function of volume.



Issue 11. There is evidence that the SPUI signal phase sequence may be more flexible (i.e., efficient over a wide range of volume patterns) than the TUDI phase sequence (i.e., 3-phase or 4-phase). This attribute should make the SPUI better able to provide good service for a wide range of traffic volumes (as would result from normal fluctuations occurring during the day). It should also increase the SPUIs effectiveness relative to the costs of signal timing maintenance. At present, it is not known whether this flexibility extends to the 4ΦSPUI.

Appendix

Resumes

TOWN OF ADDISON

BRUCE RUSSELL, P.E.
Project Manager
Carter & Burgess, Inc.

Education
B.S., Civil Engineering, 1975, Texas A&M University

Professional Registration
Registered Professional Engineer, 1984, TX, 55389

Years with Carter & Burgess: 17
Office Location: Dallas

Professional Experience
Mr. Russell has more than 25 years of experience in the design and management of major highway, arterial and thoroughfare projects. His experience includes general transportation and thoroughfare planning, schemaitc development, preliminary engineering design, construction sequencing and staging plans, analysis of traffic pattern impacts, pavement condition and traffic signal inventories, circulation studies, environmental anlaysis, sign inventories, high accident location analyses formulation of capital improvements programs, and preparation of plans, specifications and estimates.

Relevant project experience includes:

- US 75 (North Central Expressway) Section M, Dallas, TX; Project Manager. Managed this $114 million urban freeway reconstruction project consisting of 1.9 miles of freeway widening from 4 to 8 lanes including geometrics, paving, grading, drainage, utilities, bridges and retaining walls. Project entailed depressing mainlanes and reconstructing cross-street bridges. Recipient of CEC National Grand Award for Engineering Excellence.

- IH 35E /SH190 (President George Bush Turnpike Interchange), Carrollton, TX; Project Director. Designed and prepared plans, specifications and cost estimates for the interchange, adjacent roadways and drainage improvements. The turnpike is a new, full-access controlled corridor serving northern Dallas and southern Collin and Denton counties. Key project elements include design scheduling, interchange schematic design, horizontal and vertical alignments, drainage studies of Furneaux Creek and the Elm Fork of the Trinity River, storm water pollution prevention, and impacts on traffic.

- IH 35E/FM 407 Interchange, Lewisville, TX; Project Director. Provided planning, environmental studies, schematic layouts and PS&E for the reconstruction of the interchange. This project involved reconfiguring the current interchange layout of FM 407 passing over IH 35E to taking IH 35E over an at-grade extension of FM 407. Challenges for this project include detouring along IH 35E to provide 6 mainlanes and 4 frontage road lanes during construction and detouring access to IH 35E during the removal of the existing bridge.

- SH 121 Bypass (I-35E to Denton Tap Road), Lewisville, TX; Project Manager. Major interchange project including two miles of frontage road improvements along I-35E and SH 121 and the first phase of a three-level diamond interchange with direct connecting ramps to the interstate. The project reconstructed about 1-mile of interstate highway and replaced the 540-foot Timber Creek Relief Structure.

TOWN OF ADDISON

TONY KIMMEY, P.E.
Engineering Design, Roadway Design, SPUI Design Alternatives
Carter & Burgess, Inc.

Education
B.S., Civil Engineering, 1983, Texas A&M University

Professional Registration
Registered Professional Engineer, 1990, TX, 67156

Years with Carter & Burgess: 8
Office Location: Dallas

Professional Experience
Mr. Kimmey has more than 16 years of roadway planning and design experience with a focus on TxDOT projects in the North Texas area for the past 12 years. Throughout his career in transportation engineering, he has performed numerous projects involving route studies and PS&E and has managed highway planning and design projects that involved reconstruction in both rural and urban areas. He has gained valuable experience in almost every aspect of highway project development including schematic development, environmental analysis, preliminary and final design, coordination of construction document preparation, development of project construction cost estimates, performance of quality assurance/quality control functions, and construction management.

Relevant project experience includes:

- IH 35E/SH 190 (President George Bush Turnpike Interchange) Interchange, Carrollton, TX; Project Manager. Provided plans, specifications and cost estimates for construction of full 4-level interchange at IH 35E and proposed SH 190 including adjacent roadways and drainage improvements; which will be constructed in 2 separate phases. Key project elements include design scheduling, interchange schematic design, horizontal and vertical alignments, drainage studies of Furneaux Creek and the Elm Fork of the Trinity River, storm water pollution prevention, and impacts on traffic. Project challenges included hydraulic analysis of Furneaux Creek and the Elm Fork of the Trinity River, major detouring at IH 35E traffic during construction, scheduling and coordination with the City of Carrollton, the Corps of Engineers, FEMA, FHWA and the Texas Turnpike Authority.

- US 75 (North Central Expressway) Section M, Dallas, TX; Project Engineer. Designed horizontal and vertical geometry and approximately 5 miles of retaining walls for the middle section of North Central Expressway, from Southwestern Boulevard to Walnut Hill Lane. The project involved providing plans, specifications and cost estimates for 1.9 miles of freeway reconstruction to widen the existing freeway from four to eight lanes. The project included the design of the interchange at Northwest Highway and the preparation of the traffic control and construction phasing plans.

- North Dallas Tollway Extension, Section 8, Dallas, TX; Project Engineer. Coordinated the completion of PS&E for the 2-mile extension of the existing six-lane urban tollroad from Frankford Drive in Dallas to FM 544 in Plano. Project included a fully directional interchange with SH 190.

TOWN OF ADDISON

JIM LEE, P.E., PH.D.
Alternatives Analysis
Lee Engineeering, LLC

Education
Ph.D., Civil Engineering, 1979, University of Oklahoma
M.Eng., Civil Engineering, 1969, Pennsylvania State University
B.S., Civil Engineering, 1967, University of New Mexico

Professional Registration
Registered Professional Engineer, TX

Years with Lee Engineering: 13
Office Location: Dallas

Professional Experience
Mr. Lee has over 30 years of experience in traffic engineering and transportation planning. He is currently managing a research project of the Four Phase SPUI for the Arizona Department of Transportation examining the operational efficiencies, cost, and accident experience at four phase single point urban interchanges. He has served as project manager on several signal system projects including the City of Lubbock signal system feasibility study, City of Phoenix signal system feasibility study, Town of Gilbert signal system design, City of Lakewood signal system expansion study, and City of Albuquerque ATMS project. He has served as a District Traffic Engineer for the State of Oklahoma as well as City Traffic Engineer for Amarillo and Beaumont, Texas.

Relevant project experience includes:

- Four Phase Single Point Urban Interchange; Phoenix, Arizona. Project involves examining the operational efficiencies, cost, and accident experience at four phase single point urban interchanges.

- Comprehensive Plan; Plano, Texas. As project manager, worked with city staff, an 18-member citizens' committee and two other consulting firms to prepare a new comprehensive plan for a city of 110,000 people in the Dallas metropolitan area, which is projected to be 350,000 people by 2010. Utilized the MICROTRIPS transportation planning model to test various thoroughfare plans.

- Phoenix Signal System Economic/Feasibility Study. Project principal for a study to recommend a central computerized signal system to replace the City's 20 year old UTCS system.

- Shea Boulevard Study. Project principal on corridor study to determine relationship between possible future land uses and associated transportation requirements. Land use trending projected using ARC/INFO GIS. Traffic projections developed using a regional TRANPLAN model. Coordinated work with a Technical Advisory Committee and a Citizens Advisory Committee.

- GIS System Development - Project manager for development, use and integration of the Clark County (NV) geographical information system into the transportation planning program of the Regional Transportation Commission.

TOWN OF ADDISON

LARRY O'FLINN, ASLA
Aesthetic Design
Carter & Burgess, Inc.

Education
B.S., Landscape Architecture, 1977, Texas A&M University

Professional Registration
Registered Landscape Architect, 1977, TX, 696

Years with Carter & Burgess: 16
Office Location: Fort Worth

Professional Experience
Mr. O'Flinn has over 23 years of experience in all aspects of planning and landscape architecture with emphasis on site-specific development projects. His experience ranges from initial program development to detailed site design to construction documents and construction management.

Relevant project experience includes:

- Addison Town Park, Addison, TX; Landscape Architect. Responsible for the revitalization of Town Park. Worked closely with town staff to sensitively phase in new materials and new park improvements. Restoration efforts included the removal and replacement of the pedestrian perimeter walkways, reconfiguration of the playground area, perimeter fence removal/restoration, and a pedestrian safety lighting program. Redesign and construction efforts were carefully executed to preserve the mature existing plant material and the original masonry.

- Renner Road Improvements Landscape Study, Richardson, TX; Project Director. Design and coordination of all landscape architectural treatments for 3.5 miles of major thoroughfares including roadway routing, tree preservation, lake design, interface of roadways with two major creeks, street lighting, medians and 40-foot parkway.

- Renner Road West Phase II, Richardson, TX; Landscape Architect. Road alignment studies linear park system design, landscape, signage, street and pedestrian lighting for 3 miles of proposed 6-lane thoroughfare west of U.S. 75.

- Renner Road West Phase III & Prairie Creek Detention Area, Richardson, TX; Landscape Architect. This project involved the design of twin 800-foot long bridge structures to carry Renner Road over the Rowlett Creek floodway in northeastern Richardson. Each bridge accommodates two lanes of traffic, as well as an 8-foot wide bicycle/pedestrian way.

- Les Lacs Linear Park Phase I, Addison, TX; Landscape Architect. Phase I along Marsh Lane, Beltway Drive and the south easement park: trail system, landscape, irrigation and grading.

- Les Lacs Linear Park Phase II 14.5-Acre Tract, Addison, TX; Landscape Architect. Provided design services for second phase of Les Lacs Linear Park System including design of playground, trail system, picnic pavilion, volleyball and basketball courts, security lighting, pond improvements, tree planting, parking lot and irrigation.

TOWN OF ADDISON

ALEX MARTINEZ, P.E.
Drainage & Utilities
Carter & Burgess, Inc.

Education

B.S., Civil Engineering, 1982, Texas A&M University
A.A., Basic Studies, 1980, Laredo Junior College

Professional Registration

Registered Professional Engineer, TX, 64169

Years with Carter & Burgess: 4
Office Location: Dallas

Professional Experience

Mr. Martinez has more than 17 years of experience in management, design and construction of civil engineering projects. Mr. Martinez has extensive experience in the preparation of plans, specifications and estimates (PS&E) for paving, drainage, water, sanitary sewer and erosion control projects. His project experience includes roadway work with both municipalities and governmental agencies such as the City of Dallas, City of Carrollton, City of Mesquite, City of Denton, City of Farmers Branch, Town of Highland Park and the City of University Park, as well as the Texas Department of Transportation (TxDOT).

Relevant project experience includes:

- Chaparral Road, Allen, TX; Project Manager. Provided alignment study, hydraulic study and plan preparation for extension of Chaparral Road for 1,500 LF including a 250 foot bridge across Cottonwood Creek.

- Denton Drive Water Utilities, Dallas, TX; Civil Engineer. Provided design and utility coordination of 26,400-linear feet of 8-inch to 54-inch water mains and 3,100-linear feet of 8-inch to 12-inch sanitary sewer mains in advance of paving improvements to Denton Drive from Mockingbird Land to Webb Chapel extension.

- Eagle Drive & Collins Street Drainage Improvements, Denton, TX; Project Manager. Drainage study and PS&E for relief storm sewer system along Maple, Myrtle, Eagle and Collins Street.

- Eagle Drive & Collins Street Phase I, Denton, TX; Project Manager. Performed drainage and traffic analysis to determine scope of work for Phase II of project.

- Josey Lane (Frankford Road to Peters Colony Road), Carrollton, TX; Project Manager. Provided plans and contract documents for reconstruction of Josey Lane from Frankford Road to Peters Colony Road. Included paving and drainage improvements, bridge improvements and utility replacements.

- Josey Lane (Valwood Parkway to Fyke Road), Farmers Branch, TX; Project Manager. Prepared plans, specifications and estimates for total reconstruction of Josey Lane, including paving, drainage, water and sewer utilities.

TOWN OF ADDISON

PAUL BROWN, P.E.
SPUI Design Alternatives
Carter & Burgess, Inc.

Education

B.S., Civil Engineering, 1990, Polytechnic University
M.S. Course Work, 1996, Polytechnic University
1997 Highway Capacity Manual Update, 1999, McTrans Center

Professional Registrations

Registered Professional Engineer, NY, 073057

Years with Carter & Burgess: 3
Office Location: Denver

Professional Experience

Mr. Brown has more than 12 years of experience in traffic engineering and transportation planning services. His traffic engineering responsibilities include project management along with traffic analyses, parking studies, trip generation and distribution evaluations. Mr. Brown's transportation efforts involve close work with railroads to determine the commuter capabilities of existing freight lines. He also provides commuter demand analyses and conceptual station plans. Mr. Brown also presents project information before government agencies and other public forums.

Relevant project experience includes:

- Southeast Corridor Design/Build Program, Denver, CO; Senior Traffic Engineer. Worked closely with area municipalities to develop Method of Handling Traffic section of the design-build RFP. Tasks included evaluating impacts of potential roadway closures, conducting workshops with municipal representatives to determine needs and desires and drafting related RFP text.

- Southeast Corridor Project, PE/EIS, Denver, CO; Senior Traffic Engineer. Managed traffic data collection effort for the entire 20-mile corridor. Supervised existing & future year traffic analyses for the expressway, interchanges and potential light rail stations throughout the corridor. Conducted microscopic simulation (CORSIM) for one interchange/station area, including redesign of a cloverleaf interchange as a single-point urban interchange.

- South Third Street Corridor Study, Missoula, MT; Senior Traffic Engineer. Managed traffic analyses for this one-mile corridor on the south side of Missoula. Work elements included capacity, signal warrant and crash analyses. Results of these analyses were used to help the project team determine the appropriate roadway cross-section throughout the corridor.

- Inter-Regional Corridor Alternative Analysis, Salt Lake City, UT; Commuter Rail Planner. Responsible for investigation, analysis, and concept development for commuter rail options in the 120 mile Provo-Salt Lake City-Ogden corridor in Utah.

TOWN OF ADDISON

PAUL BLACK, P.E.
SPUI Design Alternatives
Carter & Burgess, Inc.

Education
B.S., Civil Engineering, 1972, Arizona State University

Professional Registration
Registered Professional Engineer, 1976, AZ, 10768

Years with Carter & Burgess: 2
Office Location: Phoenix

Professional Experience
Mr. Black brings over 28 years of diverse experience in all phases of transportation projects. For over 14 years, Mr. Black was a civil engineer with the Arizona Department of Transportation. He served as project engineer for a wide variety of transportation projects including the design of Interstate 10 between 99th Avenue and 59th Avenue and for the design of Loop 202 from 24th Street to 40th Street.

Relevant project experience includes:

- East Flagstaff TI Design Concept Report (ADOT). Project involved the reconstruction of an interchange between a five-lane major arterial and a four-lane roadway (B-40) that connects to I-40. This interchange is the easterly connection of Flagstaff, Arizona to I-40 and is in close proximity to the regional shopping mall. The recommended alternative involved the construction of a SPUI with B-40 serving as the crossroad and the major arterial serving as mainline. Geometric design was taken to the 30% level to assure proper geometry complicated by curvilinear crossroad and mainline geometry. One specific design feature included creating a frontage road downstream from the crossroad to provide local business access.

- Red Mountain Freeway (Loop 202) (24th Street to 40th Street)(ADOT). Project involved the design of two miles of elevated eight-lane divided freeway in central Phoenix metropolitan area. Freeway typical section included three lanes in each direction plus HOV lanes and a concrete median barrier. Interchanges included the east half of a single point urban interchange (SPUI) at 24th Street and a full SPUI at 32nd Street and a half diamond interchange at 40th Street. Freeway profile was rolling elevated and included a structure over a relocated irrigation canal east of 32nd Street.

  These two SPUIs were the first to be designed by ADOT. The design of the east half of the interchange at 24th Street involved the coordination with another consultant to insure proper geometry fit. The design of the 32nd Street SPUI was complicated by a skewed intersection, about 25 degrees, and tight right-of-way on the south side of the freeway. Ramp geometry near the crossroad involved compound curves with large radii near the crossroad and small radii away from the crossroad to keep the ramp as close as possible to the mainline freeway. The skew of the crossroad made ramp geometry asymmetrical and more difficult to design.

TOWN OF ADDISON

ART HUNTER, P.E.
SPUI Design Alternatives
Carter & Burgess, Inc.

Education
M.S., Civil Engineering, 1989
B.S., Civil Engineering, 1978

Professional Registration
Registered Professional Engineer, 1983,TX, 53138

Years with Carter & Burgess: 13
Office Location: Dallas

Professional Experience
Mr. Hunter has more than 21 years of experience in the design of transportation nd civil work structures. His experience includes structural analysis and design, preparation of plans and specifications, economic anlysis and reports, and administratio of construction contracts. His experience with new bridge design includes pedestrian, highway, railroad and transit projects. He has designed both simple and continuous span concrete and steel bridges. His projects have involved blending seemingly incopatible criteria as construction phasing, aesthetics, complex geometrics into functional, economical and award winning projects.

Relevant project experience includes:

- US 75 (North Central Expressway) Section M, Dallas, TX; Structural Engineer. Supervised design of seven ramp bridges with spans of 70 to 125 feet, cantilevered frontage roads and four bridges of precast, prestressed and post-tensioned concrete box beams mixed in the same superstructure cross-section. Recipient of CEC National Grand Award for Engineering Excellence.

- IH 35E/SH 190 (President George Bush Turnpike Interchange), Carrollton, TX; Structural Engineer. Supervised design of about 3,300 feet of dual main-lane bridges. Width varied from 70 to 118 feet. AASHTO Type IV prestressed beam and steel plate girder spans range from 90 to 145 feet. The two and three column concrete bents consist of 4-by-8-feet columns, spaced about 50 feet on center supported on drilled shaft foundation. Design features include complex geometry, ramp transitions, bridge design, quality control, final plans, specifications and estimates.

- Renner Road East Phase V, Richardson, TX; Structural Engineer. Provided plans, specifications and estimates for the westbound lanes, including the bridge over Rowlett Creek. The 800-foot bridge includes 400-foot continuous slab units, notched end precast prestressed concrete box beams with slope facia on exterior beams, and hammer head piers with inverted-T cap.

- Dallas North Tollway Extension, Dallas, TX; Structural Engineer. Design of 4,800 linear feet of bridge structures including design of simple span, notched end, prestressed concrete beam and two continuous 3-span steel plate girder bridges (115, 158, and 112 feet spans).

JODY SHORT, P.E.
Traffic Analysis
Lee Engineering, LLC

Education
M.S., Civil Engineering, 1989
B.S., Civil Engineering, 1978

Professional Registration
Registered Professional Engineer, TX

Years with Lee Engineering: 4
Office Location: Dallas

Professional Experience
He has over 13 years of experience on a variety of projects in transportation and traffic engineering. He has served as project manager and project engineer on numerous traffic engineering design/studies projects including the operational analysis of proposed roadway facilities and the preparation of PS&E for signals and signing. He has conducted operational analyses for alternative interchange configurations at the intersection of Park Boulevard and Preston Road in Plano, Midway at Arapaho in Addison, and several interchanges along SH 121 between Lewisville and the Dallas North Tollway.

Relevant project experience includes:

- Dallas County CMAQ. Traffic Signal Designs in Balch Springs, Dallas, Garland, Mesquite, and Richardson.
- TxDOT Fort Worth District Signal Design plan preparation for approximately 160 locations in Bedford, Cleburne, Colleyville, Euless, Fort Worth, Grapevine, Haltom City, Hurst, Jacksboro, Lake Worth, Mineral Wells, North Richland Hills, River Oaks, Stephenville, and Weatherford, Texas. Submittals included complete PS&E with specifications, notes and estimates in TxDOT text file format.
- FM 1709 Traffic Signal System Evaluation in Southlake, Texas including the development and maintenance of coordinated signal timing plans for the AM, Noon, and PM peak hours; identification of potential future locations for traffic signals; and recommended changes to lane configurations.
- Operational Analysis at the intersection of Midway and Arapaho in Addison.
- Traffic Light Synchronization studies in Dallas, Brownwood, Wichita Falls, Fort Worth, and North Richland Hills, Texas.
- Operational Analysis of Proposed Preston Road Overpass at Park Blvd. using CORSIM to quantify benefits in Plano, Texas.

TOWN OF ADDISON

GORDON PERRY, RPLS
Survey and Right of Way
Carter & Burgess, Inc.

Education
A.S., Surveying, 1983, Lansing Community College

Professional Registration
Registered Professional Land Surveyor, 1996, TX, 5185

Years with Carter & Burgess: 6
Office Location: Dallas

Professional Experience
Mr. Perry has more than 16 years of experience in land surveying across the State of Texas. He has performed surveying services for a wide range of projects with a focus on aerial mapping and land acquisition projects over the past 10 years. His leadership and hands-on experience in all aspects of a project ensures the overall quality and correctness of the project deliverables. He has significant experience in creating aerial mapping control networks, researching ownership documentation, collecting boundary evidence, boundary analysis, preparation of boundary surveys, legal descriptions, parcel plats and right-of-way maps. Mr. Perry also specializes in the utilization of Global Positioning Systems (GPS) techniques in both "Static" and "Real Time Kinematic" (RTK) modes for creating gedetic networks, project control networks, locating boundary evidence, establishing property boundaries, and topographic surveying.

Relevant project experience includes:

- Texas Department of Transportation aerial mapping projects by GPS:
  US Highway 67, Dallas County, project length 13 miles. Project Manager.
  US Highway 175, Dallas County, project length 15 miles. Project Manager.
  IH 35E, Dallas County, project length 6 miles. Project Manager.
  Plano Hike and Bike Trail, Collin County, 5 miles. Project Manager.

- Texas Department of Transportation Control Networks / Right-of-Way Mapping projects:
  State Highway 114, Denton, County. Establishment of the survey control network by GPS for the location and mapping of the existing and proposed right-of-way. The creation of parcel plats and legal descriptions for acquisition parcels. Project length 7 miles.
  Interstate 30, Dallas, County. Establishment of the survey control network for the location and mapping of the existing and proposed right-of-way. The creation of parcel plats and legal descriptions for acquisition parcels. Project length 13 miles.
  State Highway 77, Denton, County. Establishment of the survey control network for the location and mapping of the existing and proposed right-of-way. The creation of parcel plats and legal descriptions for acquisition parcels. Project length 5 miles.

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