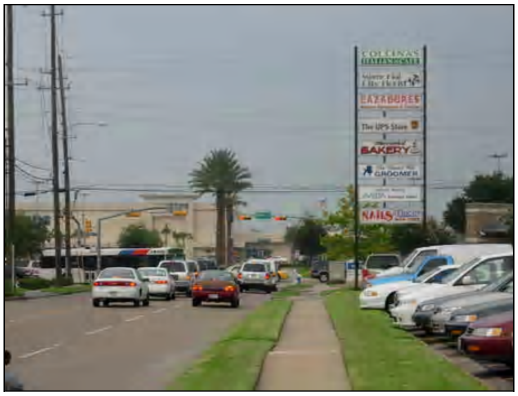

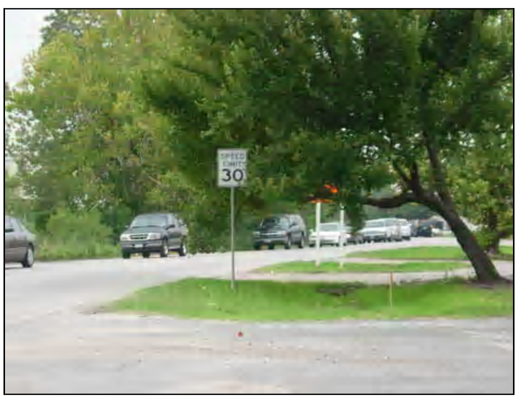

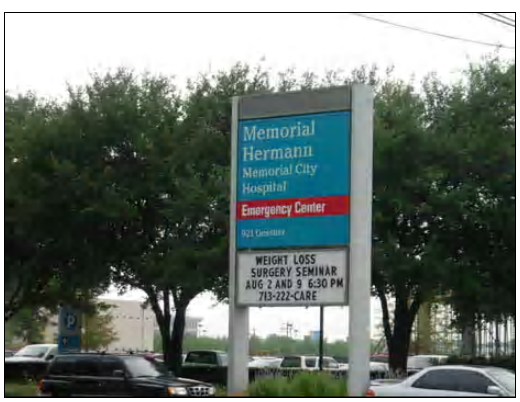

MEMORIAL CITY TAX INCREMENT REINVESTMENT ZONE (TIRZ)

EAST – WEST MOBILITY IMPROVEMENT STUDY

October 9, 2006

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY

ENGINEERS
ARCHITECTS
SOLUTIONS

East – West Mobility Improvement Study

Prepared for:

Memorial City
Tax Increment Reinvestment Zone
(TIRZ)

Prepared by:

Lockwood, Andrews & Newnam, Inc.
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2925 Briarpark Drive
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October 9, 2006

LAN Project #120-10308-000

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EXECUTIVE SUMMARY

This study presents the results of a geometric and traffic operational analysis of various identified roads providing east-west circulation in the vicinity of the Memorial City Tax Increment Reinvestment Zone (TIRZ) portion of the City of Houston, Texas. The purpose of the study is two-fold. The first purpose is to analyze the incremental costs and benefits of three road improvement projects in the adopted Transportation Improvement Plan for the TIRZ. These improvements are: the extension of Kingsride Lane from Gessner Road to Barryknoll Drive, the completion of Town & Country Way from the Beltway 8 northbound frontage road to Gessner Road, and the construction of Clarey Lane from the Beltway 8 northbound frontage road to Bunker Hill Road. The second intent of the study is to examine other, easily implemented projects that could be accomplished to also assist with improving east-west mobility.

A traffic operational analysis was conducted within the study area for the Year 2015, assessing the implications of building each of the three improvements identified above using various Measures of Effectiveness (MOEs) for AM and PM peak hour conditions. LAN employed SYNCHRO 6 traffic software to simulate these improvements and to calculate the MOEs. Network level MOEs included: total delay (hours), average number of stops encountered by all vehicles, average travel speed (mph), total travel time by all vehicles (hours), total distance traveled by all vehicles (miles), and the number of vehicles not served (i.e., vehicles traveling no distance during the simulated peak hour). Since part of the analysis included an examination of other, short term, improvements beyond the three build alternatives, it became necessary to look at the performance of particular intersections within the various networks through the evaluation of Levels of Service (LOSs) at these locations.

First, an overall network of collector streets and connections to various large land uses was modeled. This network was then broken apart into smaller "no build" networks for each of the three alternatives to be tested. The existing road conditions in each network were revised to reflect the completion of relevant projects within the study area as found in the Capital Improvement Plan (CIP) for the City of Houston (see Table 4.3 for a listing of these CIP projects by relevant build alternative). Note here that the realignment of Kingsride Lane is already a CIP project. It is therefore assumed to be open to traffic for both the build and no build conditions in the evaluation of the Town & Country Way alternative. Traffic count data, obtained in March/May of 2006, was projected to Year 2015 conditions using historic growth rates. Other locations in the networks were ascribed data through the careful examination of the counts available with the need to obtain some uniformity in demand (i.e., "balance") between intersections in mind. Build alternatives were then developed, traffic was redistributed to take advantage of the new infrastructure, and then rebalanced. Network level MOE output information could then be evaluated. Additionally, LAN staff inventoried locations where deficiencies remain unresolved by construction of the build alternatives.

Field investigations of these problem locations yielded a series of short term improvement strategies that included elements such as new signals, additional dedicated turn lanes, free flow right turns, and a possible through truck prohibition. Additional, more detailed, studies were also recommended. Most of these strategies could be modeled with the SYNCHRO 6 networks. Additional model runs were made for each of the no build and build alternative networks with the presumed completion of these short range improvements taken into consideration. The results of the additional analyses were most encouraging. In all cases, delays were reduced and total travel time decreased with respect to both (build and no build) scenarios.

After the benefits of the build alternatives, as measured by the changes in various MOEs, were tabulated, estimations were made of the dollar value of such societal benefits realized over the period of one year. The SYNCHRO 6 model can produce delay reductions and travel time savings to be expected for a typical AM or PM weekday peak hour. However, it became necessary to develop a methodology to conservatively extrapolate this to an estimation of overall annual delay reduced and travel time saved. These figures could then be ascribed dollar values based on previous work that researched the cost of an hour of vehicle travel applicable to local conditions.

In order to generate a benefit/cost comparison for each of the build alternatives, planning level cost estimates for their construction were prepared. Staff prepared preferred alignments that would be used to identify impacts to individual properties and atypical construction requirements along the three build alternative corridors. In the course of preparing these alignments, it was determined that recent construction made the Town & Country Way alignment between Frostwood Drive and Gessner Road infeasible. This being the case, the build alternative for analysis purposes was truncated at Frostwood Drive. Engineering, right-of-way and construction costs were tabulated for all alternatives and then compared to the annual dollar benefit to society realized through reduced delay in order to develop benefit/cost ratios.

Of the three build alternatives, the Kingsride Realignment was the most cost beneficial and least costly to pursue. Its completion is recommended. Town & Country Way, on the other hand, did not yield much improvement over the current network, particularly due to the fact that the more expensive, eastern portion does not relieve any existing congested conditions without a direct connection to Gessner Road. LAN staff went back and conducted a separate analysis of the western portion of Town & Country Way that indicated that there is independent utility in making this direct connection to the Beltway 8 northbound frontage road. Its completion is also recommended. Lastly, the analysis showed that Clarey Lane, if constructed, would prove to be cost beneficial in terms of reduced delay. However, given the high cost and substantial impacts of constructing this road, coupled with the fact that less costly improvements can be constructed along Westview Road that would provide analogous benefits; the report does not recommend constructing Clarey Lane at this time. Accommodations in conjunction with development in the area should, however, should be made to support its eventual construction.

INTRODUCTION

This report presents the results of a geometric and traffic operational analysis of various identified roads providing east-west circulation in the vicinity of the Memorial City TIRZ portion of the City of Houston, Texas. Lockwood, Andrews & Newnam, Inc. (LAN) was authorized to perform this study under a contract for engineering and program management services with the Memorial City Redevelopment Authority. The study area is bounded by Westview Road to the north (serving a populated area south of Long Point Road), Bunker Hill Road to the east, Memorial Drive to the south and Beltway 8 (a.k.a. the Sam Houston Tollway) to the west (see Figure 2-1 below).

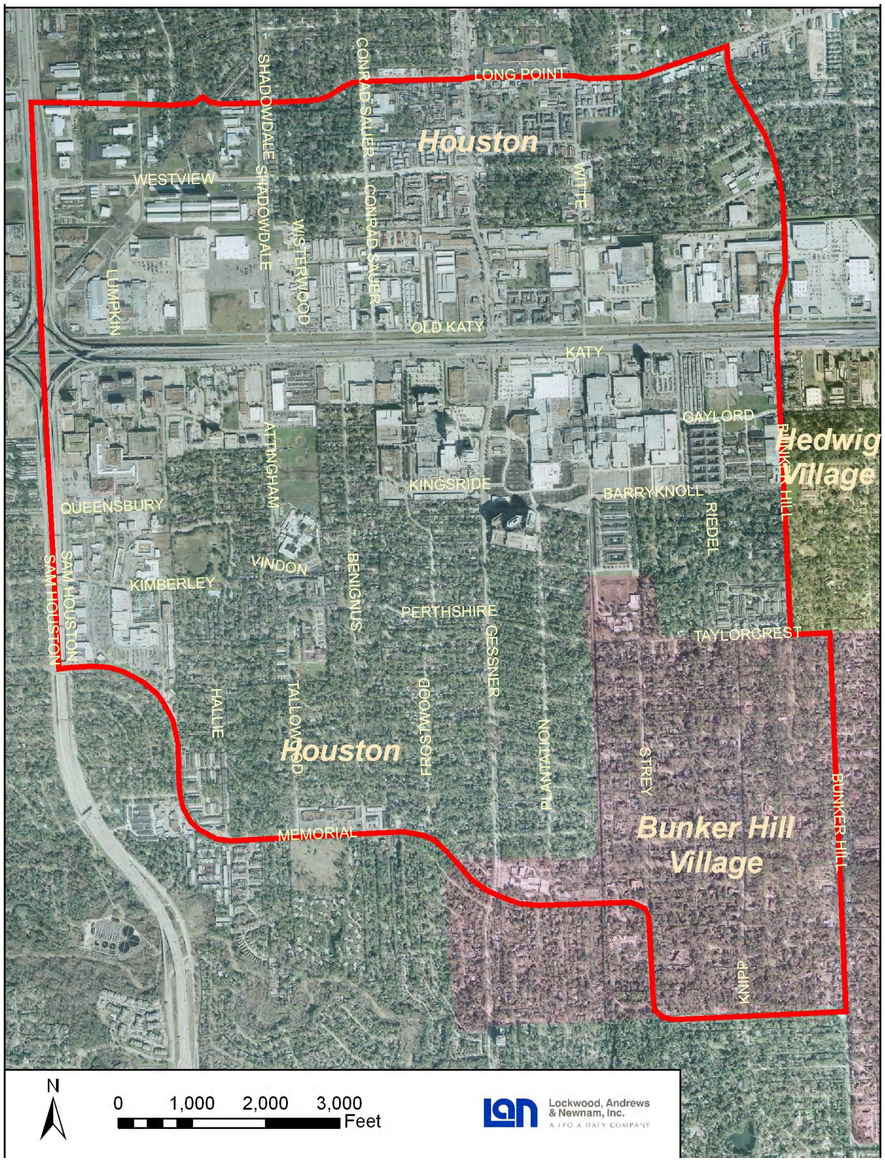


Figure 2-1 – Memorial City Study Area

The purpose of this study is two-fold. The first purpose is to analyze the incremental costs and benefits of three road improvement projects in the adopted Transportation Improvement Plan for the TIRZ. These improvements are: the extension of Kingsride Lane from Gessner Road to Barryknoll Drive, the completion of Town & Country Way from the Beltway 8 northbound frontage road to Gessner Road, and the construction of Clarey Lane from the Beltway 8 northbound frontage road to Bunker Hill Road. These conceptual corridors are depicted in Figure 2-2 below. The second intent of the study is to examine other, easily implemented projects that could be accomplished to also assist with improving east-west mobility.

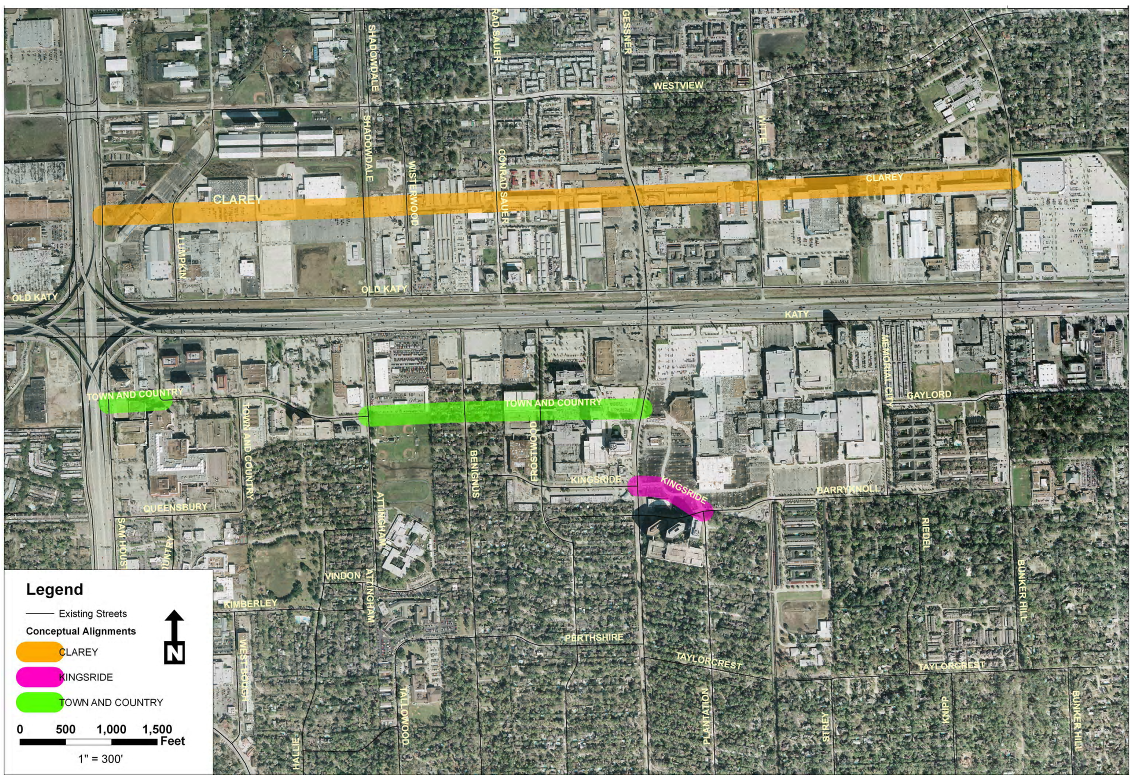


Figure 2-2 – Conceptual Build Alternatives

The study tasks included field investigation, data collection and computer based traffic simulation to evaluate existing traffic conditions and analyze the impact of various alternatives that were identified within the study area. For the purposes of this study, traffic conditions were projected to the year 2015. Traffic growth projections for Gessner Road, Westview Road, Bunker Hill Road, and the I-10 EB Frontage Road came from annualized growth rates based upon HGAC 2025 forecasts. Projections for other count locations were based upon these growth rates.

Synchro models were developed to simulate the performance of each of the three Build alternatives mentioned above for the AM and PM Peak hour conditions. Unresolved deficiencies for the Year 2015 were catalogued and evaluated with an examination of field conditions in order to develop the recommendations for additional improvements. Low cost strategies included the provision of: turn lanes, free flow right turn movements, dual left turn movements, signalization, and revised signing and striping to improve traffic flow. Planning level cost estimates were derived for the build alternatives to go along with the results of the Synchro analyses in order to develop an appreciation for the most cost effective build options to pursue.

PROJECT BACKGROUND

As part of its ongoing mission to preserve, conserve and redevelop the Memorial City activity center, the TIRZ board, through the adoption of its project and financing plan (dated August 11, 1999), identified the need to address traffic congestion and access to major thoroughfares as being of major importance in order to maintain the area's economic vitality. Specifically, the lack of alternative east – west routes to the I-10 corridor through the TIRZ area was highlighted as a major concern, owing to its congested conditions and impending reconstruction. The plan cites a prior traffic analysis that highlighted the fact that I-10 was, at the time, carrying nearly 300% of its design capacity. The net effect of taking no action to address this concern would be an overloading of local trips on the I-10 frontage roads, coupled with an increase in cut through traffic in the residential areas surrounding the TIRZ, and decreased economic competitiveness for the affected businesses.

The Transportation Improvement Plan portion of the adopted TIRZ plan included a number of new east – west thoroughfares. North of I-10, a new road called Clarey Lane was proposed that would extend from the Beltway 8 northbound frontage road to Bunker Hill Road, intersecting every north – south route along the way, including a future Shadowdale Drive connection to the I-10 westbound frontage road. South of I-10, two extensions of Town & Country Way were proposed that would create a continuous facility extending from the Beltway 8 northbound frontage road to Gessner Road. Further south, a direct connection between Kingsride Lane at Gessner Road and Barryknoll Drive at Plantation Drive would create a continual facility extending from Benignus Road to Bunker Hill Road.

Since the adoption of the TIRZ plan, a 2001 traffic study of the TIRZ identified the following priority projects:

Table 3.1: 2001 Priority Projects for TIRZ Area

Project	Description
Gessner Road	• Widen to eight lanes (120 ft ROW)
Bunker Hill Road	• Widen to four lanes with a continuous left turn lane (90 ft ROW) – I-10 to TIRZ boundary • Widen to four lanes (60 ft ROW) – TIRZ boundary to Westview
Old Katy Lane	• New four lane street (60 ft ROW) – Beltway 8 to Bunker Hill Road
Town & Country Way	• Complete as four lane street (60 ft ROW) – Beltway 8 to Gessner Road

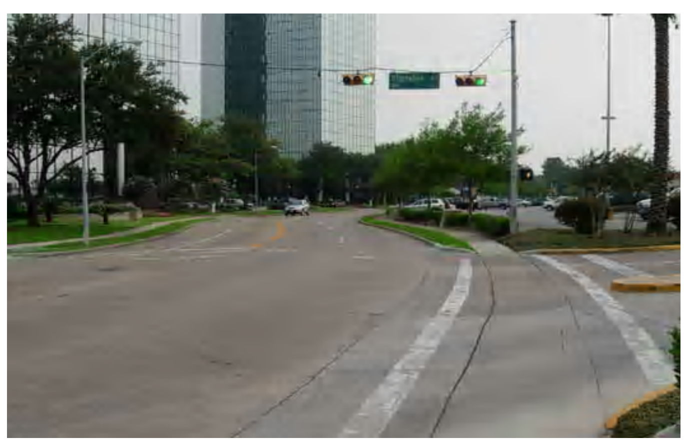
Project	Description
Kingsride Lane/Barryknoll Realignment	• Complete as four lane street (60 ft ROW) – Gessner Road to Plantation Drive (including the abandonment of existing Barryknoll between Gessner and Plantation)
Westview Road	• Complete from Lumpkin Road to Shadowdale Drive
Shadowdale Drive	• Widen to four lanes (60 ft ROW) between I-10 westbound frontage road and Old Katy Lane)
Frostwood Drive	• Widen to four lanes (60 ft ROW)

Note in the above table that the referenced alignment for Old Katy Lane matches the Clarey Lane alignment depicted in the TIRZ plan.

Presently, the Capital Improvement Program (CIP) for the TIRZ includes construction funding for the widening of Gessner Road south of I-10, as well as for Bunker Hill Road. Funds were earmarked to construct the Kingsride/Barryknoll improvement. Additional funds were provided for coordinating City of Houston and TxDOT signals after the I-10 reconstruction project, and to widen portions of Witte Road and Lumpkin Road.

With the construction of the Gessner Road and Bunker Hill Road widening projects advancing, and the ability to construct the Kingsride/Barryknoll connection assured, the CIP for the TIRZ also included funds for further engineering studies, design, right of way acquisition and construction of future east –west mobility improvements. LAN has been contracted to evaluate the relative costs and benefits of the Town & Country Way, Clarey Lane and Kingsride/Barryknoll improvements to help define the nature of this work.

The **Kingsride/Barryknoll realignment** is planned to be a new, four lane connection between the Kingsride – Gessner intersection and the Barryknoll – Plantation intersection. It will require reconfiguration of the Memorial City Mall property, as these intersections now provide direct access to the mall and a number of parking spaces will be lost in making the right-of-way available for the realignment.



The **Town & Country Way** project would extend the existing four-lane, undivided road westward to the Beltway 8 northbound frontage road and eastward to Gessner Road. In evaluating this planned road, it was determined that further development of the Memorial Hermann Memorial City Hospital has made a portion of the eastern end of this alignment between Gessner Road and Frostwood Drive infeasible to construct.

The **Clarey Lane** project would create a new east – west route extending from the Beltway 8 northbound frontage road eastward to Bunker Hill Road. Clarey Lane would serve to replace the two-way Old Katy Lane, being reconstructed as an expanded westbound frontage road for I-10, as well as a relief route for Westview Road. Clarey Lane is initially assumed to be a two-lane, undivided road. It's alignment makes use of existing Georgibelle Drive and platted, but unbuilt, portions of Larston Drive in the vicinity of Beltway 8 and Lumpkin Road. Figure 3-1 depicts these roads in their assumed alignments.

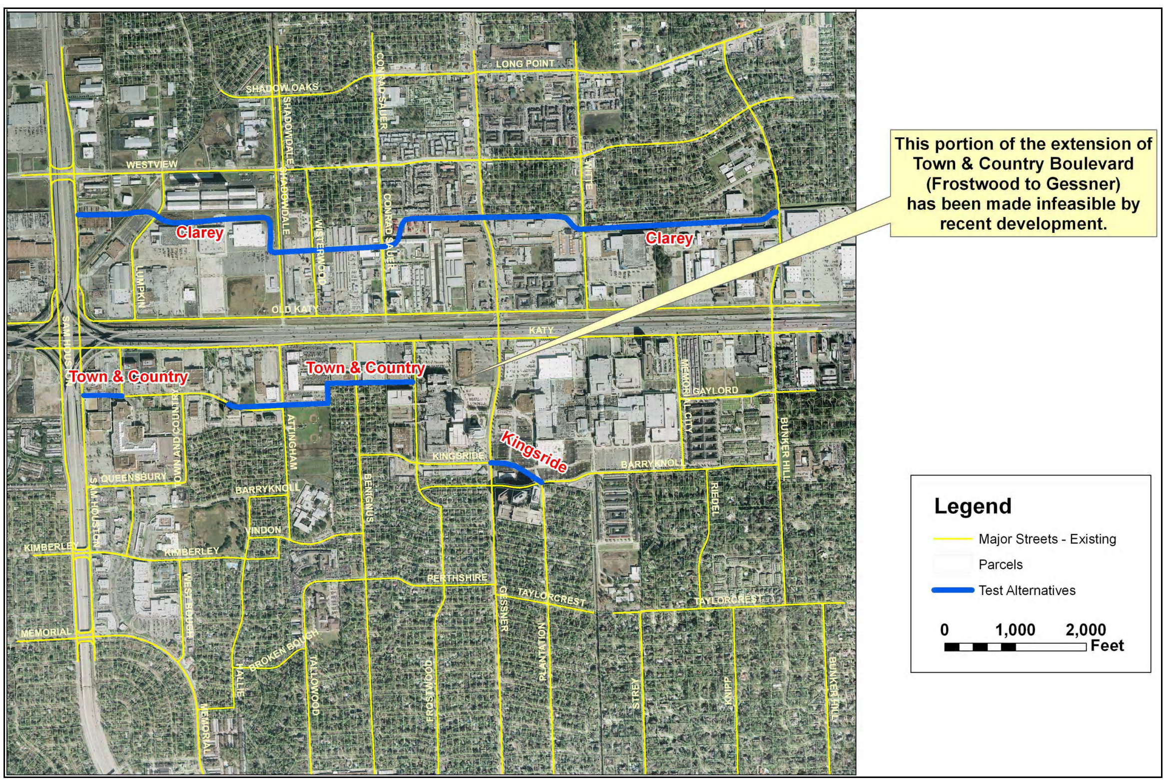


Figure 3-1 – Build Alternative Alignments

Planning level cost estimates were prepard for each of the three build alternatives so that benefit/cost comparisons could be developed. While the TIRZ CIP project does not include any funds for land acquisition, LAN assumed that right-of-way will need to be acquired by the project in order to generate a true comparison of the benefit/cost ratios between the alternatives. Other assumptions implicit in the cost estimates include the following:

- Curb and gutter construction is assumed for the Kingsride realignment and Town & Country Way projects.
- Shoulder and ditch construction is assumed for the Clarey Lane project.
- Signal modifications and demolition add $100,000 to the construction cost of Kingsride.
- Realigning an existing portion of Town & Country to avoid impacting HISD facilities adds $50,000.
- Clarey Lane will require signals at Gessner and Bunker Hill Roads. Together with resurfacing Georgibelle, these factors raise the construction cost of the project by $320,000. Two stormwater detention ponds will need to be enclosed at a cost of $4,365,000. An existing drainage channel will need to be enclosed at an assumed cost of $2,200,000.
- Construction costs are factored up 25 percent to account for contingencies.
- Lastly, engineering costs reflect roughly 10 percent of total project cost.

Table 3-2 depicts the cost estimates used for the build alternatives.

Table 3.2: Build Alternative Cost Estimates

	Kingsride Realignment	Town & Country Way*	Clarey Lane
Engineering	$140,000	$1,815,000	$2,045,000
Right-of-Way	$450,000	$13,770,000	$8,710,000
Construction	$790,000	$2,575,000	$9,740,000
TOTAL	**$1,380,000**	**$18,160,000**	**$20,495,000**

* the western extension of Town & Country Way was calculated to cost roughly $1,815,000 and the eastern extension was calculated to cost roughly $16,350,000.

DATA COLLECTION

During March 2006, LAN collected 24-hour traffic volume counts and peak period (i.e., 7:00 to 9:00 AM and 4:00 to 6:00 PM) turning movement counts at a number of prescribed locations. Although analyzing the dynamics of ramps to and from Beltway 8 and I-10 was beyond the scope of this study, additional 24-hour counts along the eastbound I-10 frontage road and its associated ramps were collected in May between Beltway 8 and Benignus Drive. The results of these observations are compiled in Section 1 of the Technical Appendix to this report. The following locations were surveyed:

Table 4.1 Daily Traffic Volumes

Street	Location	Date Collected	24-Hour Volume
EB Barryknoll	Gessner to Plantation	3/15/06	6,899
WB Barryknoll	Plantation to Gessner	3/15/06	8,102
EB Westview	Lumpkin to Shadowdale	3/15/06	5,994
WB Westview	Shadowdale to Lumpkin	3/15/06	5,259
EB Barryknoll	West of Gessner	3/29/06	2,063
EB Kingsride	West of Gessner	3/29/06	7,469
NB Gessner	South of Barryknoll	3/21/06	15,655
NB Gessner	South of Hospital	3/21/06	17,065
SB Gessner	North of Kingsride	3/21/06	15,851
SB Gessner	North of Hospital	3/21/06	17,982
WB Barryknoll	East of Gessner	3/21/06	10,463
WB Kingsride	East of Gessner	3/21/06	1,796
EB I-10 Entrance Ramp	At Benignus	5/3/06	11,139
EB I-10 Exit Ramp	At Town & Country	5/3/06	12,697
EB I-10 Frontage Road	Direct Connect from SH 8	5/3/06	9,470
EB I-10 Frontage Road	At Attingham	5/3/06	28,942
EB I-10 Frontage Road	At Benignus	5/3/06	25,587
EB I-10 Frontage Road	At Town & Country	5/3/06	15,754

Table 4.2 AM & PM Peak Hour Turning Movements

Intersection	Date Collected	AM Peak Hour	PM Peak Hour
Attingham at Town & Country	3/15/06	7:30 – 8:30	4:15 – 5:15
Attingham at Vindon	3/16/06	7:30 – 8:30	4:45 – 5:45
Bunker Hill at Westview	3/14/06	7:15 – 8:15	4:45 – 5:45
Gessner at Barryknoll	3/22/06	7:30 – 8:30	5:00 – 6:00
Gessner at Kingsride	3/21/06	7:30 – 8:30	5:00 – 6:00
Gessner at Mall/Hospital	3/21/06	7:45 – 8:45	5:00 – 6:00
Gessner at Mall	3/21/06	8:00 – 9:00	5:00 – 6:00
Lumpkin at Westview	3/14/06	7:15 – 8:15	4:45 – 5:45
Witte at Westview	3/14/06	7:15 – 8:15	4:15 – 5:15

In addition to these counts, LAN staff had access to year 2001 data from the traffic study previously commissioned by the TIRZ.

ANALYSIS

A traffic operational analysis was conducted within the study area for the Year 2015, assessing the implications of building the Kingsride Lane Realignment, the extension of Town & Country Way, and the construction of Clarey Lane using various Measures of Effectiveness (MOEs). LAN employed Synchro 6 traffic software to simulate these improvements and to calculate the MOEs. Synchro 6 is a software package used for modeling and optimizing traffic signal timings. Through the use of Synchro 6, LAN could effectively examine the interaction between multiple signalized and unsignalized intersections and their collective ability to process anticipated traffic volumes.

First, an overall network of collector streets and connections to various large land uses was modeled. This network was then broken apart into smaller "no build" networks for each of the three alternatives to be tested, as shown in Figures 4-1 through 4-3 below. These networks were constructed to simulate road conditions that are anticipated to exist in the year 2015. In order to accomplish this, the existing road conditions were first modeled, then revised to reflect the completion of relevant CIP projects listed for the TIRZ. Improvements that could be modeled consist of the following:

Table 4.3 Modeled CIP Projects

Location	Improvement	Kingsride	Town & Country	Clarey
Gessner:I-10 to Barryknoll	Widen to 8 lanes	✓	✓	✓
Bunker Hill: Long Point to I-10	Widen to 4 lanes			✓
New alignment east of Gessner	Kingsride Relocation		✓	
Throughout study area	Coordinate signals	✓	✓	✓

Note here that the realignment of Kingsride Lane from Gessner Road to Barryknoll Lane is already a CIP project. As can be seen from the above table, the Kingsride Realignment is assumed to be open to traffic for both the build and no-build conditions in the evaluation of the Town & Country Way alternative.

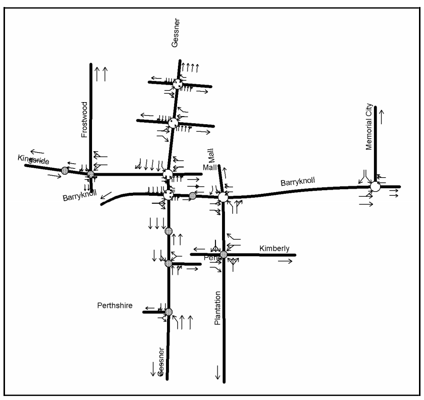


Figure 4-1 – Kingsride Base Network

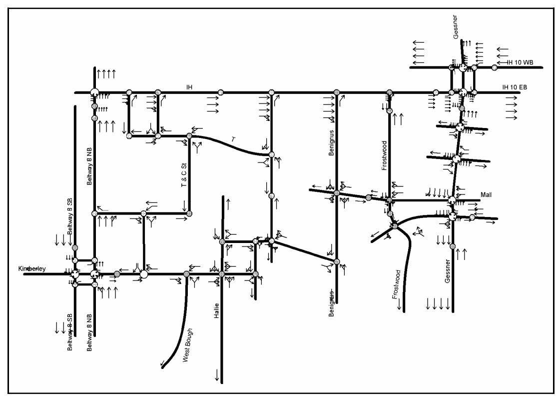


Figure 4-2 – Town & Country Base Network

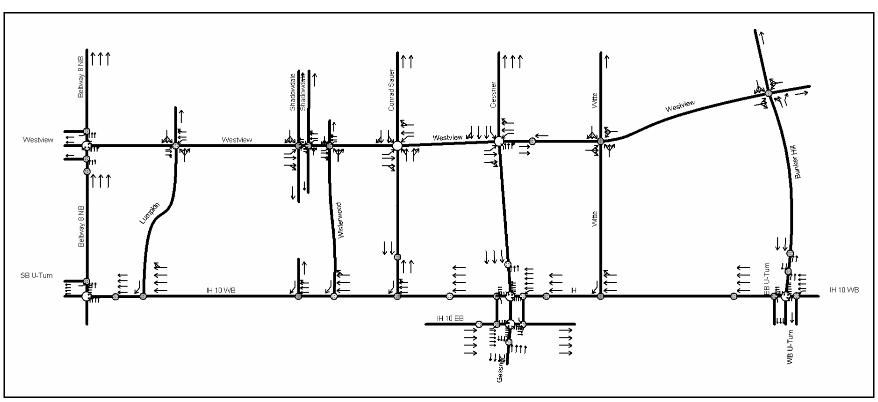


Figure 4-3 – Clarey Base Network

No Build networks were then developed for the AM and PM peak hour conditions anticipated to occur in 2015. Traffic volumes were projected from the aforementioned count data using historic growth rates. Other locations in the networks were ascribed data through the careful examination of the counts available with the need to obtain some uniformity in demand (i.e., "balance") between intersections in mind.

Network level MOEs included: total delay (hours), average number of stops encountered by all vehicles, average travel speed (mph), total travel time by all vehicles (hours), total distance traveled by all vehicles (miles), and the number of vehicles not served (i.e., vehicles traveling no distance during the simulated peak hour). Since part of the analysis included an examination of other, short term, improvements beyond the three build alternatives, it became necessary to look at the performance of individual intersections within the various networks. Traditionally, this is accomplished through the evaluation of Levels of Service (LOSs). The Highway Capacity Manual 2000 (HCM 2000) contains analysis procedures that provide meaningful measures of effectiveness concerning average vehicle delay and LOS. A general explanation of the concept of LOS is that it is similar to grades in school; A is the best, F the worst. **LOS D is generally considered acceptable for peak hour operations in urban areas**.

Signalized intersection LOS is defined in terms of delay, which is a direct and/or indirect measure of driver discomfort, frustration, fuel consumption, and increased travel time. The LOS have been established based on driver acceptability of various delays; delay for each approach lane group is calculated based on a number of factors including lane geometrics, percentage of trucks, peak hour factor, number of lanes, signal progression, volume, signal green time to total cycle time ratio, roadway grades, parking conditions, and pedestrian flows.

Because delay is a complex measure, its relationship to capacity is also complex. Analysis was performed using the microcomputer program Synchro 6, which uses the procedures set forth in the HCM 2000. In general, overall intersection levels of service A to D are typically deemed acceptable, while an overall LOS E or F is unacceptable. The overall intersection LOS is computed as a weighted average of the vehicle delay; therefore, an intersection may have an overall LOS C or D and have individual movements that are LOS E or F.

Table 4.4 summarizes the LOS that is appropriate for different levels of average control delay and a qualitative description for each. The HCM 2000 uses the criteria of average control delay, which includes initial deceleration, delay, queue move-up time, stopped delay, and final acceleration delay. The threshold between LOS E and LOS F is considered the "capacity" of the lane group in question.

Table 4.4: Signalized Intersection LOS Criteria

LOS	Control Delay Per Vehicle (sec)	LOS Description
A	≤10	Good progression and short cycle lengths, most vehicles do not stop
B	> 10 and ≤ 20	Good progression and / or short cycle lengths, more vehicles stop
C	> 20 and ≤ 35	Fair progression and / or longer cycle lengths, some cycle failures
D	> 35 and ≤ 55	Congestion becomes noticeable, high volume to capacity ratio
E	> 55 and ≤ 80	Limit of acceptable delay, poor progression, long cycles, and/or high volume to capacity ratio
F	> 80	Unacceptable to drivers, oversaturated conditions, volume greater than capacity, poor progression and long cycle lengths

Build alternative networks were examined to determine locations where LOS E and F conditions continued to exist for both signalized and unsignalized conditions. Individual approaches and lane groups within approaches were further scrutinized to determine the principal reasons for the persistence of the inadequate conditions. LAN staff took this information back to the study area to observe conditions in the field and formulate strategies for further improvements. Although some of these problems reflect relatively intractable conditions relating to either the magnitude of the demands involved or the physical constraints of the location (or both), there were a number of instances where modest additional improvements can be identified that would improve peak period travel conditions. These improvements have been catalogued and additional simulation efforts have been made to quantify their benefits in terms of the same network level MOEs.

At the end of the exercise, we must recognize that the Synchro 6 analysis is intended to enhance, rather than supplant, sound engineering judgment based on thorough familiarity with the study area. Moreover, the TIRZ area and its environs is a fairly developed collection of commercial centers, office, industrial and institutional uses, and residential communities. The complex interaction between these specific transportation improvements and surrounding land uses needs to be considered. This includes potential property impacts of new or expanded roads, community issues (such as cut through traffic and emergency vehicle accessibility), as well as the ramifications of increasing traffic with the absence of improvements upon the overall quality of life of residents, business owners and other road users.

RESULTS

Kingsride Realignment -

Table 5.1 summarizes the network level MOEs for the AM and PM peak hour conditions. Since the road network is congested well beyond these two peak hours and traffic volumes are expected to increase, the congestion benefits of the improvement are more pronounced than would be indicated by strict interpretation of the MOE table. Although average travel speeds do not increase appreciably and the number of stops actually increased, it is apparent that more vehicles are being accommodated while the total distance they traveled did not increase significantly (i.e., the realignment provides a more direct route for some trips, making the average trip length shorter). Total delay decreases as well, even though more vehicles are being accommodated, so we can infer that average delay per vehicle has decreased significantly.

Table 5.1 Kingsride MOEs

Measure	AM No Build	AM Build	PM No Build	PM Build
Total Delay (hr)	1,148	1,061	605	573
No. of Stops	13,364	14,484	14,675	15,671
Average Speed (mph)	3	3	6	6
Total Travel Time (hr)	1,288	1,201	744	712
Distance Traveled (mi)	4,184	4,190	4,164	4,187
No. of Unserved Vehicles	670	211	428	239

In order to gauge the cost effectiveness of the various build scenarios, a simplified benefit/cost comparison was undertaken. The cost of vehicle travel was assumed to be $22/hour, based upon recent studies performed by the Texas Transportation Institute (TTI) and Consumer Price Index (CPI) data.

The amount of congestion relief occurring in the peak hours was extrapolated to an annual total. Delay reduction included the reduction in delay experienced by all vehicles being processed in the build versus no build networks. Therefore, it must also add in the reduction in the number of unserved vehicles during this period. Starting with the AM and PM peak hour delay reductions and travel time savings, it was found that that the average ratio of the peak hour volume to 24-hour volume for the 2006 count locations, weighted by the 24-hour traffic volume, indicated that 8.78 percent of daily traffic occurs within the peak hour. To be conservative, the averaged AM and PM delay reduction was used, along with the 8.78 percent figure to extrapolate daily reductions and savings. Further, recognizing that the conditions examined are weekday conditions, these figures were multiplied by 250 to recognize the number of weekdays occurring per calendar year (less holidays). Table 5.2 summarizes this benefit/cost comparison for the Kingsride

Realignment project. As can be seen from this table, the societal benefits, in terms of delay reduced, appear to significantly outweigh the capital cost of the project, even if the right-of-way needed to be acquired.

Table 5.2 Kingsride Benefit/Cost Comparison

	Delay Reduced	
	Hours	**Value**
AM Peak Hour	546	$12,012
PM Peak Hour	221	$4,862
Annual	1,091,970	$24,025,000
Benefit/Cost Ratio	**17.4**	

Town & Country Way -

Table 5.3 summarizes the network level MOEs for the AM and PM peak hour conditions. As can be seen from the table, conditions deteriorate in the simulation for the AM peak hour for nearly all measures of effectiveness. However, the PM peak hour condition has reduced delays, increased average speed, lower total travel time, and fewer unserved vehicles. In the AM peak hour, the predominant traffic movement that the Town & Country corridor serves is eastbound; whereas, in the PM peak hour, traffic is predominantly westbound. There are two main reasons why the corridor performs better in the PM condition than the AM condition. First, the I-10 eastbound frontage road provides a high capacity, nearby alternative for eastbound traffic. Second, as mentioned in the initial description of this project, the assumed eastern limit of the project was revised from Gessner Road to Frostwood Drive due to recent development along the original alignment; this negated the benefit of bypassing the failing Frostwood at Kingsride and Gessner at I-10 eastbound frontage road intersections. Conversely, in the westbound direction, the I-10 eastbound frontage road does not provide the same benefit as a parallel route. In addition, the extension of Town & Country Way does afford a direct connection to the northbound Beltway 8 frontage road that would otherwise only be reachable via Queensbury Lane or Kimberley Lane.

Establishing this new corridor has the ramifications of creating new, stop sign controlled intersections along previously free flowing portions of Attingham Drive, Benignus Road, and Frostwood Drive. The results of the Synchro 6 analysis indicate that the impacts of adding the delays associated with these new intersections outweigh the benefit of creating this parallel corridor for the AM peak hour, but not the PM peak hour. The beneficial effects are more pronounced in the PM peak hour than the deleterious effects are in the AM peak hour.

Table 5.3 Town & Country MOEs

Measure	AM No Build	AM Build	PM No Build	PM Build
Total Delay (hr)	932	1,035	1,596	1,451
No. of Stops	34,011	36,423	39,636	41,938
Average Speed (mph)	9	9	6	7
Total Travel Time (hr)	1,310	1,420	1,955	1,815
Distance Traveled (mi)	12,382	12,603	11,754	11,900
No. of Unserved Vehicles	2,394	2,411	3,084	2,690

The benefit/cost comparison for the extensions of Town & Country Way is predicated upon the same assumptions that were used to assess the Kingsride realignment project. The question to be answered is, given the anticipated cost of the project and the net effects of the AM and PM peak hour conditions, does this improvement appear to be cost effective? Table 5.4 summarizes this evaluation. If the annual societal benefit in delay reduction is used as the measure of cost effectiveness, then the project does not appear to be cost effective. However, there may be property access, cut through traffic, or other factors that would need to be considered over and above this analytical approach in making such a determination. Certainly, from a traffic operations standpoint, the Kingsride realignment project is much more cost effective than the Town & Country extensions project.

Table 5.4 Town & Country Benefit/Cost Comparison

	Delay Reduced	
	Hours	**Value**
AM Peak Hour	-120	-$2,640
PM Peak Hour	539	$11,858
Annual	596,526	$13,125,000
Benefit/Cost Ratio	**0.72**	

Town & Country Way, Western Segment -

The pronounced cost of the eastern extension of Town & Country Way to Frostwood Drive, coupled with the additional multi-way stop intersections it creates, and the congested nature of the existing Frostwood/ Kingsride and Gessner/I-10 Eastbound Frontage Road intersections, all contribute to lowering the benefit/cost ratio for this project. In response, a separate benefit/cost comparison was conducted for just the western extension to the Beltway 8 Northbound Frontage Road. The intersection of the feeder roads for northbound Beltway 8 and eastbound I-10 is very heavily traveled, approaching unacceptable conditions during peak periods. Presently, the ongoing I-10 reconstruction project has disrupted traffic patterns in this area, resulting in periodic lengthy queues. By extending Town & Country Way to the northbound frontage road, traffic between the frontage road and the commercial area fronting I-10 can avoid this intersection without following a more circuitous route.

Table 5.5 presents the results of the Synchro 6 analysis of a modified Alternative 2 that only includes the western extension to the Beltway 8 northbound frontage road. Although the improvement is not nearly as beneficial during the PM peak hour, it is counterbalanced by the increased performance of the network during the AM peak hour. Delay decreases, average travel speed increases, as well as total distance traveled, under this scenario as vehicles process more quickly through the network with fewer stops.

Table 5.5 Town & Country Western Segment MOEs

Measure	AM Build	PM Build
Total Delay (hr)	916	1,570
No. of Stops	33,387	39,688
Average Speed (mph)	10	6
Total Travel Time (hr)	1,295	1,930
Distance Traveled (mi)	12,418	11,779
No. of Unserved Vehicles	2,394	3,059

The benefit/cost comparison for the western segment is shown in Table 5.6. It is apparent from these computations that the western segment is indeed more cost effective to construct, rather than the complete extension to Frostwood Drive. In terms of delay, the annual societal benefits do appear to outweigh the construction cost of the project. It should also be noted that fully 70 percent of the project cost of the western segment is identified to be right-of-way acquisition. If all or a portion of these costs can be defrayed, then the benefit/cost ratio will increase.

Table 5.6 Town & Country Western Segment Benefit/Cost Comparison

	Delay Reduced	
	Hours	**Value**
AM Peak Hour	16	$352
PM Peak Hour	51	$1,122
Annual	95,387	$2,099,000
Benefit/Cost Ratio	**1.16**	

Clarey Lane -

Table 5.7 summarizes the network level MOEs for the AM and PM peak hour conditions. The impacts of the construction of Clarey Lane upon peak hour conditions are positive, but modest, during the AM peak hour. They are significantly more beneficial, however, during the PM peak hour. This is somewhat counterintuitive, considering the additional westbound capacity available from the I-10 westbound frontage road. The benefits associated with Clarey Lane are a reflection of the generally higher levels of congestion experienced during the PM peak hour than during the AM peak hour. It also stems from the fact that the poorest performing intersections are not along the frontage road, but rather along Westview Road. The construction of Clarey Lane appears to be beneficial from the standpoint of deflecting trips from the Westview Road corridor, thereby relieving these deficiencies to some degree.

Table 5.7 Clarey MOEs

Measure	AM No Build	AM Build	PM No Build	PM Build
Total Delay (hr)	686	676	2,747	1,237
No. of Stops	26,310	34,300	34,718	41,846
Average Speed (mph)	10	11	4	8
Total Travel Time (hr)	1,023	1,018	3,167	1,665
Distance Traveled (mi)	10,627	10,819	13,186	13,430
No. of Unserved Vehicles	1,671	1,668	2,439	1,753

Although the PM peak hour benefits of the Clarey Lane project are substantial, the cost to construct this project is as well. The benefit/cost comparison in Table 5.8 indicates that the societal benefits of reduced delay seem to outweigh the cost by a considerable amount. In comparing the three projects, it would seem that the Clarey Lane improvement is more beneficial relative to its cost than the Town & Country Way project, but perhaps not as much as the Kingsride realignment, given that projects incremental level of delay reduction and low cost.

Clarey Lane would serve an important role in providing an alternate route for circulation between Beltway 8 and Bunker Hill Road through non-residential properties. However, its impact on those properties needs to be taken into consideration. Given the fact that other, less costly, improvements to the Westview Road corridor are feasible, it may be best to pursue improvements to that corridor first and work with the development community to construct Clarey Lane in piecemeal fashion in order to minimize the disruption associated with establishing this new corridor.

Table 5.8 Clarey Benefit/Cost Comparison

	Delay Reduced	
	Hours	**Value**
AM Peak Hour	13	$286
PM Peak Hour	2196	$48,312
Annual	3,144,932	$69,190,000
Benefit/Cost Ratio	**3.38**	

Short Range Improvements –

At the conclusion of the evaluation of the three build alternatives, LAN was tasked with investigating other, less costly improvements to study area roads that would result in improved operating conditions. Table 5.9 summarizes the intersections that continue to exhibit LOS E or F operating conditions, within the Synchro 6 analysis for the three build alternatives. The table further inventories the specific lane groups/approaches and times of day where these deficiencies are encountered.

As can be seen from the table, the Kingsride Lane corridor east of Benignus Road and the Gessner Road corridor south of the I-10 westbound frontage road have numerous deficiencies; these corridors serve the most intense development patterns in the study area. In addition, gateway intersections to the study area (i.e., Kimberley and Westview at Beltway 8, Westview at Bunker Hill and Barryknoll at Gessner) all fail during the PM peak hour. Lastly, the heavy eastbound and westbound through movements along the I-10 frontage roads will produce lengthy delays for the side street approaches that are currently stop sign controlled. The frontage road intersections with Gessner Road also fail as the Gessner Road left turn movements vie for green time with other high volume movements.

This inventory of unresolved deficiencies became the basis for a field investigation of existing traffic operations. The intent was to develop a series of recommendations for short range, low cost improvements that would ease traffic flow throughout the study area, recognizing that east –west mobility is improved by addressing bottleneck conditions along the studied roads.

Table 5.9 AM & PM Unresolved Deficiencies

Intersection	AM Deficiencies	PM Deficiencies
Westview at Beltway 8 NB Frontage Road		EB Left Turn, NB Thru
Westview at Bunker Hill		EB, WB, NB, SB
I-10 WB Frontage Road at Conrad Sauer	SB Right Turn	SB Right Turn
I-10 WB Frontage Road at Gessner		WB Thru, NB Left Turn
I-10 EB Frontage Road at Attingham	NB Right Turn	
I-10 EB Frontage Road at Benignus	NB Right Turn	
I-10 EB Frontage Road at Gessner	SB Left Turn	EB Left Turn, SB Left Turn
Kingsride at Benignus		WB
Kingsride @ Frostwood	WB, NB, SB	WB, NB, SB
Kingsride @ Gessner	EB, SB Left Turn, SB Thru, NB Left Turn	EB, SB Left Turn, SB Thru
Barryknoll @ Gessner	EB, WB, NB Thru	EB, WB, NB Left Turn, NB Thru
Kimberley @ Beltway 8 NB Frontage Road		WB Thru, NB Thru

Table 5.10 summarizes the short range improvements that were developed to address the Year 2015 deficiencies, based upon existing conditions and planned road improvements. Two signals are recommended for warrant analysis. Three intersections with the I-10 frontage roads exhibited large levels of side street delay. In these instances, converting the stop approaches to channelized, free flow movements with acceleration lanes would be beneficial to allow this traffic to merge with the frontage roads, which are traveling at free flow speeds. Additional turn lanes were considered at four other signalized intersections.

These improvements were analyzed using Synchro 6. Beyond these improvements, three additional studies need to be pursued. One is the need for a through truck ban to serve the intersection of Kingsride Lane and Benignus Road. This intersection is currently controlled by a multi-way stop condition and a traffic circle. Converting the intersection to a true roundabout would improve the traffic flow and address the future PM peak hour deficiency. However, converting the stop approaches to yield and channelizing them would be disruptive to the residential character of the se streets. Further, while observing this intersection, LAN staff noted single unit trucks "shorting the intersection" (i.e., turning left in front of, rather than beyond the traffic circle). It is apparent that most truck types are not able to track properly around the traffic circle and choose to make this maneuver into the opposing travel lane. If the traffic circle is to remain, this condition needs to be addressed.

The second traffic study needed pertains to the intersections of Kingsride Lane and Barryknoll Drive with Gessner Road. Northbound and southbound left turning traffic competes with the opposing through movement for green time at these intersections. The Kingsride Realignment may offer the opportunity to better accommodate some of these left turning movements through the combined intersections in order to best manage these competing demands. Lastly, a similar situation exists at the Gessner Road intersections with the I-10 frontage roads where high volume northbound and southbound left turning movements degrade the operating conditions of these intersections. Tight physical constraints and development patterns limit the options available to address these deficiencies. A thorough investigation of these conditions needs to precede a more detailed analysis of alternative traffic operations, and is beyond the scope of this study.

Table 5.10 Short Range Improvement Strategies

	Intersection	Strategy
1	Westview at Beltway 8 NB Frontage Road	* dual EB left turn lanes * WB right turn lane
2	Westview at Bunker Hill	signalization
3	I-10 WB Frontage Road at Conrad Sauer	free flow SB right turn
4	I-10 WB Frontage Road at Gessner	[further study]
5	I-10 EB Frontage Road at Attingham	free flow NB right turn
6	I-10 EB Frontage Road at Benignus	free flow NB right turn
7	I-10 EB Frontage Road at Gessner	[further study]
8	Kingsride at Benignus	consider banning through trucks
9	Kingsride @ Frostwood	signalization
10	Kingsride @ Gessner	* add EB left turn lane * keep shared LT/through lane
11	Barryknoll @ Gessner	* provide shared LT/through and through/RT lanes EB approach
12	Kimberley @ Beltway 8 NB Frontage Road	* NB right turn lane * WB right turn lane

The results of the SYNCHRO 6 analyses substantiated the benefits of implementing the short range improvements. Each of the no build and build networks were reexamined for both the AM peak hour and PM peak hour conditions. In all cases, delays were reduced and total travel time decreased with respect to both scenarios. Since there were no short range improvements unique to the Kingsride Realignment alternative, cumulative delay reduction and travel time savings effects of the short range improvements were obtained from examination of the benefits incurred within the Town & Country and Clarey simulations. The benefits for the no build condition are summarized in Table 5.11.

Table 5.11 Short Range Improvements Benefits

	Delay Reduced	
	Hours	**Value**
AM Peak Hour	436	$9,592
PM Peak Hour	933	$20,526
Annual	**1,949,032**	**$42,880,000**

Cost information for the various short range improvements was not obtained as part of this study.

RECOMMENDATIONS

As was stated in the last chapter, the costs and benefits of the various build alternatives must be augmented by additional considerations, such as the context of the proposed road improvements in relation to their surroundings and the opportunity cost of taking no action to address increasingly congested road conditions. In some respects, the East – West Mobility Study is very timely for the TIRZ, as the I-10 reconstruction project and various development and redevelopment initiatives are calling into question the feasibility and practicality of some of the road improvements recommended in the original project plan and recognized in the 2001 traffic study.

The one candidate build alternative that has, to date, advanced into the Capital Improvement Plan for the TIRZ is the realignment of Barryknoll and Kingsride at Gessner. Although there are no funds identified in the FY 2006 -2011 CIP for land acquisition, the project appears to be well justified from a benefit/cost perspective, even when land acquisition is taken into consideration. It is therefore recommended that the TIRZ pursue this project for construction. Efforts should be made to coordinate this work with the Gessner Road widening project so that a unified public outreach effort can be made that will minimize confusion during the periods of construction for both projects. Moreover, the Kingsride realignment project should be expanded to include the design and construction of turn lane improvements to both intersections (as recommended in the short range improvement section), as well as a detailed engineering analysis of alternative means to address left turn deficiencies at both intersections.

Conversely, the Town & Country Way extension project, as originally envisioned, appears to not be nearly as well justified from a benefit/cost perspective as other alternatives considered. Given the large negative impacts of the project, from the demolition of active commercial properties to the loss of public parkland, and the reduced benefits associated with the truncation of the corridor at Frostwood Drive, the construction of this road as envisioned can not be recommended at this time. However, when the western extension of Town & Country Way is severed from the eastern extension in the analysis, the benefits in terms of hours of delay reduced per year outweigh the capital cost of the project. This is significant in that the westward extension helps relieve increasingly congested conditions at the nearby intersection of the frontage roads, as well as provides improved accessibility to an area poised for redevelopment. If this extension can be accomplished jointly with the redevelopment effort, then its cost effectiveness will be greatly enhanced.

While the Clarey Lane corridor may be cost beneficial to construct, the magnitude of the cost and the localized nature of the benefits call into question the appropriateness of pursuing this particular improvement to address deficiencies in its vicinity. The remaining two-lane portions of the Westview Road corridor are the locations where future deficiencies will be improved with the opening of Clarey Lane. This being the case, it appears that improvements to the Westview Road corridor itself would be more cost beneficial and less disruptive. Public right-of-way appears to exist already to allow this corridor to be expanded. There are also no major storm drainage features or residential rear lot issues along Westview Road as there are for the

Clarey Lane alignment. Deferring construction of Clarey Lane beyond the time period of future work to Westview Road, however, should not be construed as advocating the removal of this proposed road from the Transportation Improvement Plan. Rather, the ability to improve Westview Road to accommodate Year 2015 traffic provides an opportunity to evaluate Clarey Lane as part of long range planning for the TIRZ and its environs as a pretext for updating the Transportation Improvement Plan in its entirety. The TIRZ should therefore work with the City of Houston to improve the Westview Road corridor in lieu of pursuing the Clarey Lane project at this time.

The supplemental evaluation of short range improvements was useful in that it indicated there were opportunities to benefit the network through minor modifications, as well as through the establishment of new roads on new alignments. The analyses for these improvements shows that their cumulative benefits to the road network are on par with most of the candidate build alternatives. These improvements can also be perceived as more readily implementable in two ways. First, they deal with improving isolated intersections in largely commercial areas, resulting in less anticipated potential for public opposition. Second, they are severable in that each improvement has an incremental usefulness in improving traffic flow. If one or more of the improvements do not advance, then the remaining projects are still justified based on their individual benefits.

As one might anticipate, neither the short range improvements nor the candidate build alternatives completely address anticipated road network deficiencies for the Year 2015 and beyond. Additional studies should be conducted to look at various locations in more detail. These studies are identified within the overall Summary of Recommendations depicted in Table 6.1. In some cases, these studies reemphasize the importance of the Gessner Road corridor within the study area. The biggest impediment to the proper functioning of that corridor, assuming successful completion of planned and ongoing construction projects, will be the high volume of left turning traffic at the I-10 frontage road as well as Kingsride and Barryknoll intersections. Creative means to accommodate or redirect these movements for these locations that recognize the unique constraints of each setting need to be developed.

Lastly, changing development patterns and priorities for road improvements need to be reflected in an update of the Transportation Improvement Plan for the TIRZ. This update should look further into the future than 2015, taking full advantage of planning work done to date at the city and regional level. An update of the TIRZ plan would be helpful in setting project priorities for revenue bond projects, as well as in providing feedback to subsequent city and regional planning activities. Recognizing the HOV component of the reconstructed I-10 corridor and the large trip generating commercial and institutional land uses in the study area, the TIRZ plan update can also address the issue of true multi-modal planning. Memorial City Mall is identified as a Transit Center, with an ultimate high level of bus service as well as light rail service identified in the Metro Solutions plan put forward by the Metropolitan Transit Authority.

Table 6.1 Summary of Recommendations

Recommendation	Considerations
Kingsride Realignment	• Coordinate public outreach with Gessner widening project • Incorporate short range improvements to Kingsride & Barryknoll • Study alternative means to address heavy left turn movements
Town & Country Way – extend westward to SH 8 NB Frontage Road	• Investigate public-private partnership in conjunction with redevelopment efforts in this vicinity
Short Range Improvements	• Pursue design, funding and implementation of improvements • Investigate truck ban for Benignus Road near Kingsride Lane • Study alternative means to address heavy left turn movements for Gessner/I-10 frontage road intersections
Clarey Lane	• Work with the City of Houston to identify and advance improvements to Westview Road. • Establish a dialogue with land owners regarding reservations for future development of the preferred alignment
TIRZ Project Plan	• Update the Transportation Improvement Plan