# Chapter Five: Transportation Impacts

## What Impacts Will the Transit Alternatives Have On the Transportation system?

The MAX Alternative and Light Rail Alternative have significantly different effects, or impacts, on the transportation system in the North/South Corridor. Generally these alternatives will result in significant improvements in transit service in terms of increased ridership and transit system user benefits. These are positive impacts. The alternatives also have implications for traffic and access throughout the Corridor.

### Transportation Impacts

This section describes the impacts of the transit alternatives on the existing transportation system in the Corridor. The impacts described include both the impacts on the existing transit service and the roadway impacts.

The effects the alternatives have on the transportation system are important factors in the evaluation of the alternatives and the determination of future strategies.

## What Impacts Will the Alternatives Have On Existing Transit?

The existing transit system in the Corridor varies from a high level in terms of geographic coverage and service frequency in the portion of the Corridor south of the Missouri River to limited transit service north of the Missouri River. To an extent the transit service levels reflect development patterns and demographics, as well as historical patterns of transit usage.

The MAX Alternative and Light Rail Alternative have significant implications for transit service in the Corridor, particularly for the Corridor north of the Missouri River. For purposes of clarifying the differences among the alternatives, the MAX Alternative and the Light Rail Alternative are compared to the existing transit system and the No Build Alternative in the following sections.

## What Geographical Areas are Served by the Proposed Alternatives?

All of the alternatives will maintain approximately the same geographical coverage as exists today, and would exist with the No Build Alternative. Figures 5-1, 5-2, and 5-3 show the extent of the geographical coverage for each of the alternatives.

## What Will the Hours Of Operation Be and the Frequency of Service?

### *No Build Alternative*

Currently transit service in the south part of the Corridor operates daily with service available on the major KCATA routes from 4:00 am to 1:00 am. These routes include:

- MAX,
- #25 Troost,
- #71 Prospect,
- #53/54 Armour Swope Park/Paseo,
- #51 Broadway
- #27 27th Street,
- #31 31st Street
- #39 39th Street.

Other routes in the south part of the Corridor have somewhat reduced service schedules.

Service frequencies range from 10 to 30 minutes during the peak periods, and 10 to 60 minutes during off peak times.

Transit service north of the Missouri River is much more

Figure 5-1: No Build Alternative

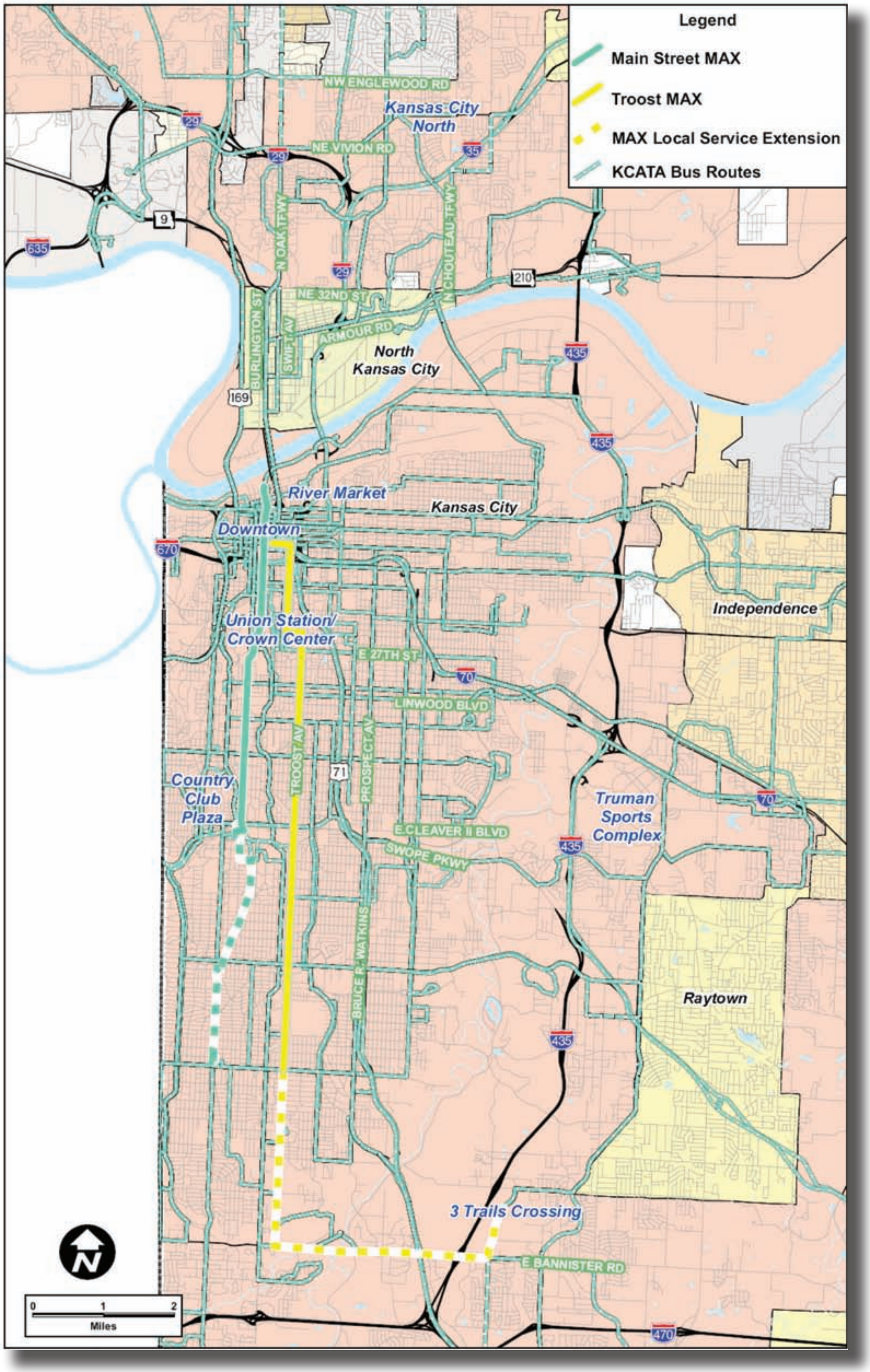


Figure 5-2: MAX Alternative

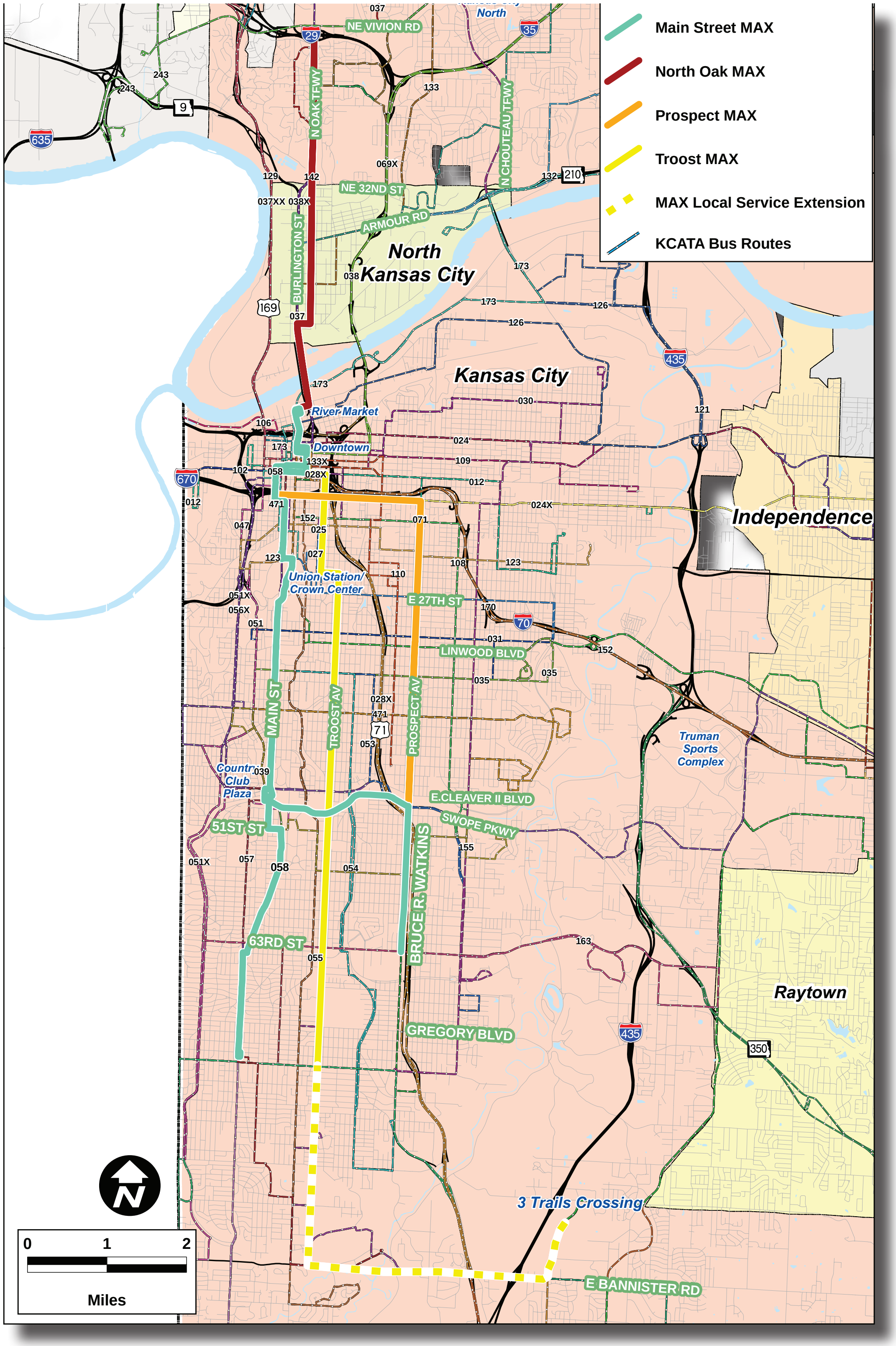
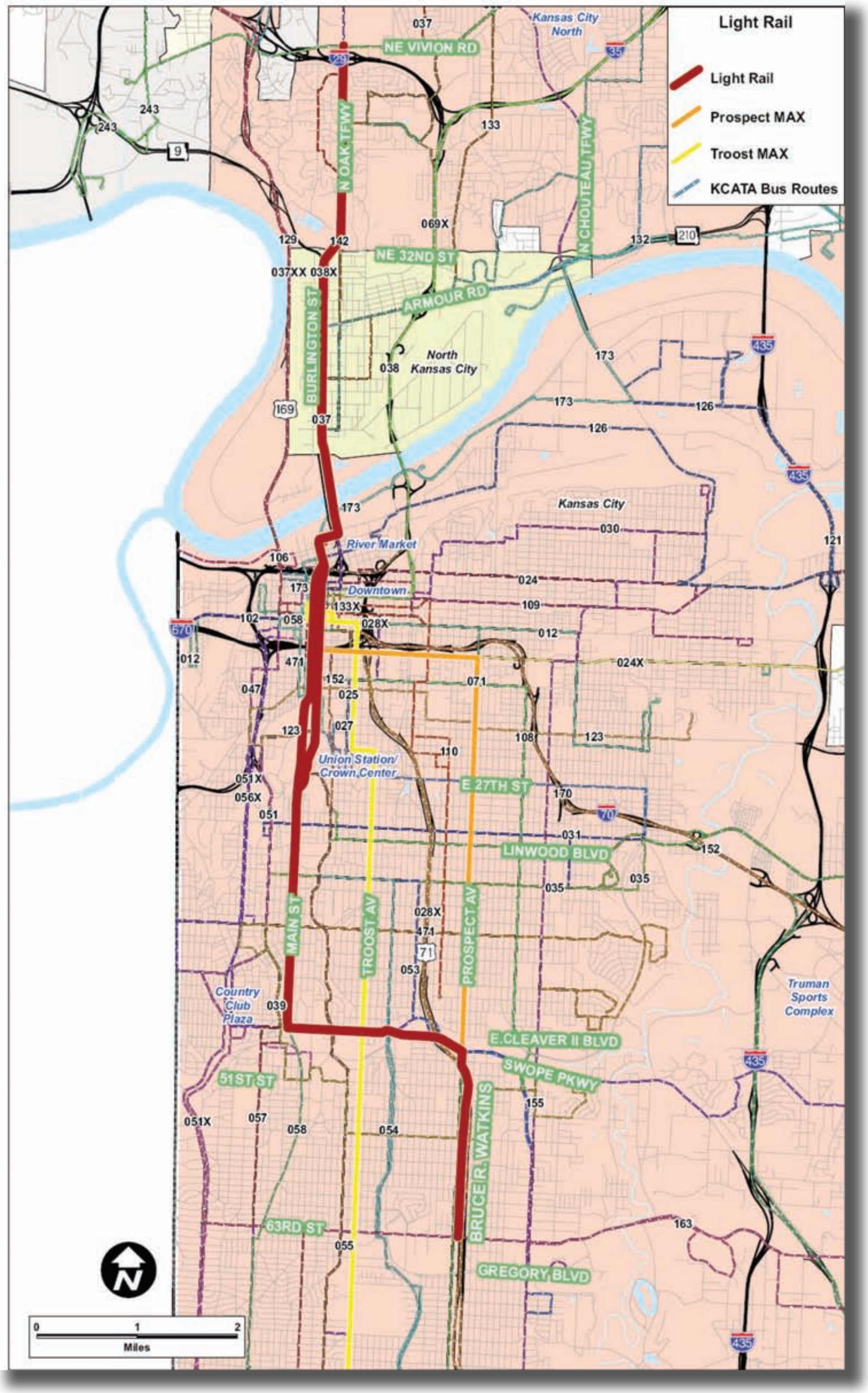


Figure 5-3: Light Rail Alternative



limited. Most of the service is oriented to the weekday peak periods; three routes operate seven days per week. Night service is not provided except on one route (229); several routes operate into the early evening, approximately 7 pm.

Service frequencies range from 20 to 60 minutes during the peak periods, and 30 to 60 minutes during off peak times.

## MAX Alternative

The MAX Alternative service would operate daily with service hours that are consistent with the existing Metro bus operations service. MAX service would operate from 4:00 am to 1:00 am seven days per week.

For preliminary planning purposes, MAX Alternative service headways are assumed to be 10 minutes during the peak periods and from 15 to 60 minutes during off-peak periods. Table 5-1 shows the service plan for the modified Main Street MAX. The Main Street MAX route would be operated as a branch route, with 10 to 15 minute headways on the main portion of the route from downtown to the Plaza and 20 to 30 minute headways on the branches to Waldo and 63rd and Prospect.

Table 5-2 shows the service plan for the North Oak MAX. MAX service would operate between downtown and Barry Road although MAX enhancements such as stations and roadway enhancements would extend only as far north as Vivion Road. This is a service plan similar to the existing Main Street MAX with the service extension to Waldo.

Table 5-3 shows the service plan for the Prospect MAX operating between downtown and 75th Street.

Table 5-1: Main Street MAX Service Levels

| Period | 3rd & Grand to 48th & J.C. Nichols Parkway | | | | 48th to 75th & Wornall and 63rd & Prospect | | | |
|---|---|---|---|---|---|---|---|---|
| | Span | Headways | Saturday | Sunday | Span | Headways | Saturday | Sunday |
| early AM | 4 - 6 am | 15 | 15 | 15 | 4 - 6 am | 30 | 30 | 30 |
| AM peak | 6 - 9 am | 10 | 10 | 10 | 6 - 9 am | 20 | 20 | 20 |
| midday | 9 am - 3 pm | 10 | 10 | 10 | 9 am - 3 pm | 20 | 20 | 20 |
| PM peak | 3 pm - 6 pm | 10 | 10 | 10 | 3 pm - 6 pm | 20 | 20 | 20 |
| evening | 6 pm - 9 pm | 15 | 15 | 15 | 6 pm - 9 pm | 30 | 30 | 30 |
| night | 9 pm - 1 am | 15 | 15 | 15 | 9 pm - 1 am | 30 | 30 | 30 |

*Source: HNTB*

Table 5-2: North Oak MAX Service Levels
Downtown to North Oak and Barry Road

| Period | Span | Headways | Saturday | Sunday |
|---|---|---|---|---|
| early AM | 4 - 6 am | 30 | 30 | 30 |
| AM peak | 6 - 9 am | 10 | 20 | 20 |
| midday | 9 am - 3 pm | 20 | 20 | 20 |
| PM peak | 3 pm - 6 pm | 10 | 20 | 20 |
| evening | 6 pm - 9 pm | 30 | 30 | 30 |
| night | 9 pm - 1 am | 30 | 30 | 30 |

*Source: HNTB*

Table 5-3: Prospect Service Levels
Downtown to 75th and Prospect Avenue

| Period | Span | Headways | Saturday | Sunday |
|---|---|---|---|---|
| early AM | 4 - 6 am | 30 | 30 | 30 |
| AM peak | 6 - 9 am | 10 | 20 | 20 |
| midday | 9 am - 3 pm | 20 | 20 | 20 |
| PM peak | 3 pm - 6 pm | 10 | 20 | 20 |
| evening | 6 pm - 9 pm | 30 | 30 | 30 |
| night | 9 pm - 1 am | 30 | 30 | 30 |

*Source: HNTB*

## *Light Rail Alternative*

Light rail service would operate daily with service hours that are consistent with the existing Metro bus service. Light rail service would operate daily from 4:00 am to 1:00 am. For preliminary planning purposes, light rail service headways are assumed to be at a level equal to the most frequent Metro bus routes. Table 5-4 shows the assumed service headways for the LRT Alternative.

Table 5-4: Preliminary Light Rail Service Levels

| Period | Span | Hours | Headways | Saturday | Sunday |
|---|---|---|---|---|---|
| early AM | 4 - 6 am | 2 | 30 | 30 | 30 |
| AM peak | 6 - 9 am | 3 | 10 | 15 | 15 |
| midday | 9 am - 3 pm | 6 | 10 | 15 | 15 |
| PM peak | 3 pm - 6 pm | 3 | 10 | 15 | 15 |
| evening | 6 pm - 9 pm | 3 | 15 | 15 | 15 |
| night | 9 pm - 1 am | 4 | 30 | 30 | 30 |

*Source: HNTB*

## Are There Travel Time Savings With the Proposed Alternatives?

Both the MAX Alternative and the Light Rail Alternative would have generally faster running times than most of the existing bus service because of fewer bus stops and transit priority measures such as transit signal priority (TSP). MAX and light rail would have only a slight improvement in running times compared to the existing Main Street MAX because Main Street MAX currently has reduced stops and TSP.

The relative travel times for transit users would vary as a result of the reconfiguration of transit routes and the introduction, or elimination, of transfers for some trips within the Corridor. For example, transit trips from the Northland to the Country Club Plaza require a transfer with the existing transit system. The LRT Alternative would provide a “one seat ride” between the Northland and the Plaza thus reducing the travel time. However, transit trips from the Waldo/Brookside area that are currently made on the Main Street MAX would have an increase in travel time with the LRT Alternative because a transfer would be required between the feeder bus route from Waldo/Brookside to light rail at the Plaza.

Table 5-5 shows a comparison of transit travel times for several origin-destination pairs.

Table 5-5: MAX and LRT Travel Time Comparison with Existing Routes (minutes)

| Origin/Destination | Existing | MAX | LRT |
|---|---|---|---|
| Plaza to Downtown | 19 | 19 | 16 |
| Meyer & Prospect to Downtown | 39 | 31 | 27 |
| Meyer & Prospect to Plaza | 22 | 14 | 8 |
| Vivion to Downtown | 15 | 14 | 16 |
| Vivion to Plaza | 39 | 38 | 31 |

*Source: HNTB*

As shown, LRT has an advantage over MAX for some of these trips, although in the heavily traveled Main Street corridor between the Plaza and Downtown the advantage is only three minutes (16 percent savings). The advantage for some trips, such as Meyer and Prospect to the Plaza is a substantial 14 minutes (43 percent savings).

Travel times in the Corridor were evaluated using the MARC regional demand forecasting model for both the MAX Alternative and the Light Rail Alternative. Also the travel times evaluation used the unweighted and weighted travel times. In transit planning, transfers and time waiting for a transit vehicle are regarded as having a greater weight than in-vehicle time. This reflects the inconvenience of transferring and waiting for transit service, as perceived by transit users. Transfers are assigned a nine-minute increment of travel time and wait time is weighted by a factor of 2.0 in the computation of total travel time. The 14-mile LRT Alternative was used for the analysis of travel times.

This analysis is preliminary and will be refined as the demand forecasting model is refined. However the analysis is sufficient to provide an idea of how transit travel times would be affected by the alternatives.

Figures 5-4 through 5-11 show the results of this analysis for trips to the Country Club Plaza and to the downtown area. As shown, the LRT Alternative actually results in an increase in travel times to downtown for the south part corridor, particularly south of the Country Club Plaza. The MAX Alternative would reduce travel

Figure 5-4: Changes in In-Vehicle Travel Time with TSM Alternative - Destination: Country Club Plaza

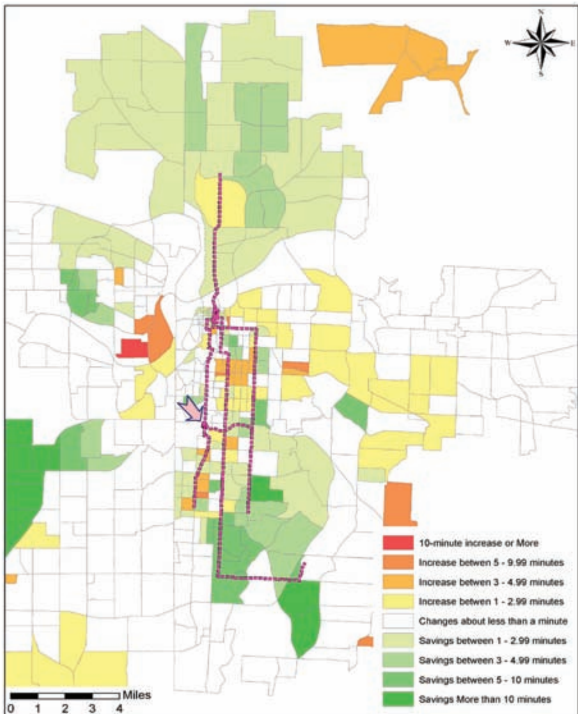



Figure 5-5: Changes in Weighed Travel Time with TSM Alternative - Destination: Country Club Plaza

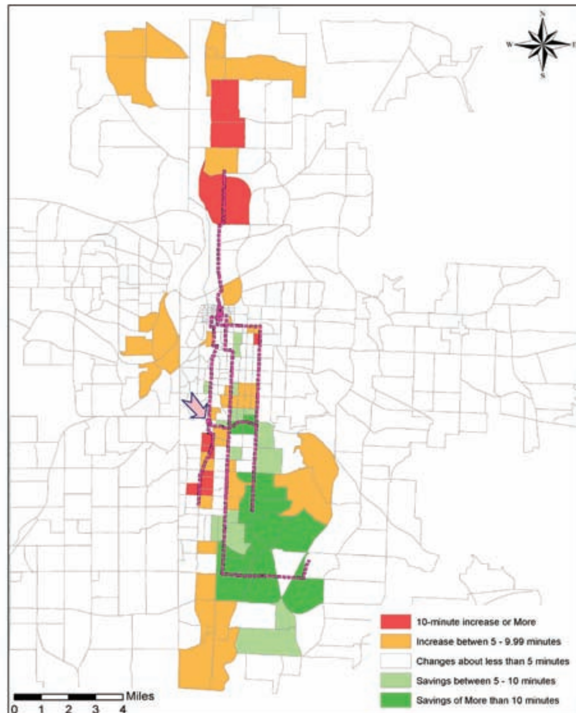



Figure 5-6: Changes in In-Vehicle Travel Time with LRT Alternative - Destination: Country Club Plaza

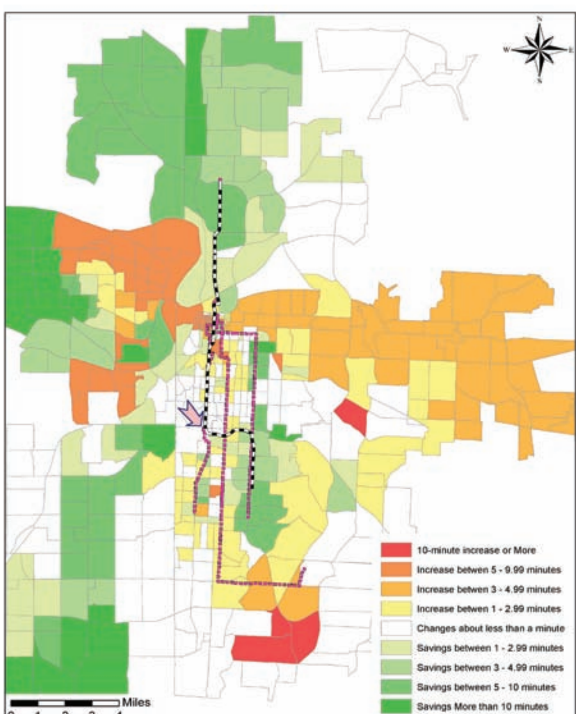



Figure 5-7: Changes in Weighed Travel Time with LRT Alternative - Destination: Country Club Plaza

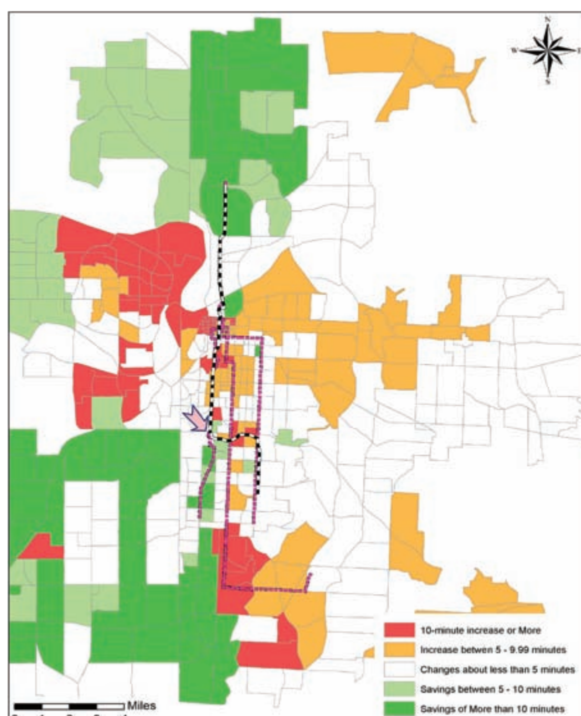


Figure 5-8: Changes in In-Vehicle Travel Time with TSM Alternative - Destination: Downtown

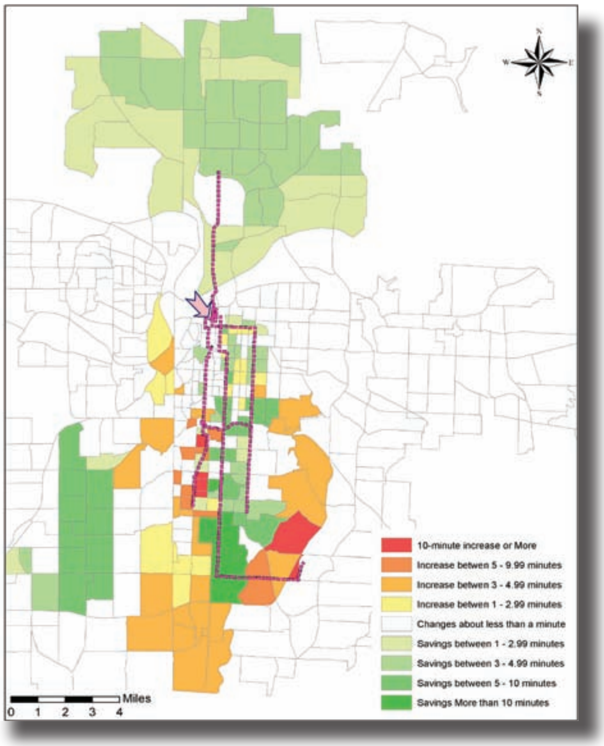



Figure 5-9: Changes in Weighed Travel Time with TSM Alternative - Destination: Downtown

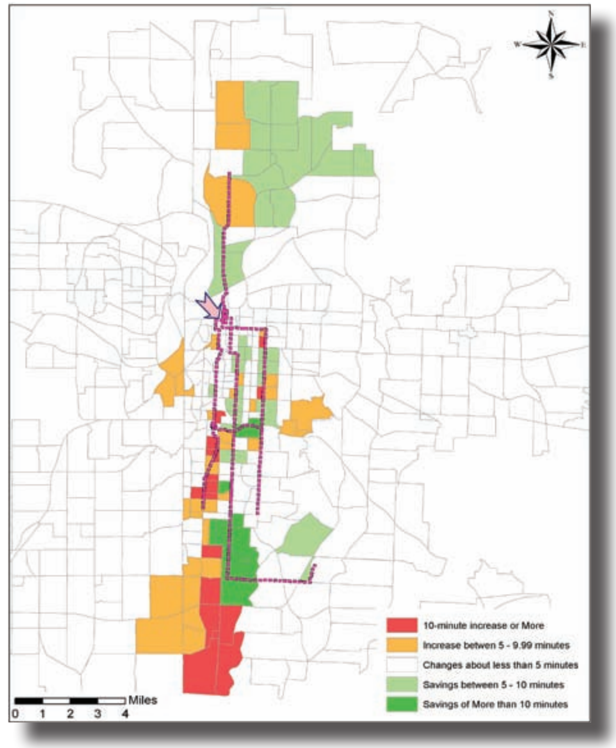



Figure 5-10: Changes in In-Vehicle Travel Time with LRT Alternative - Destination: Downtown

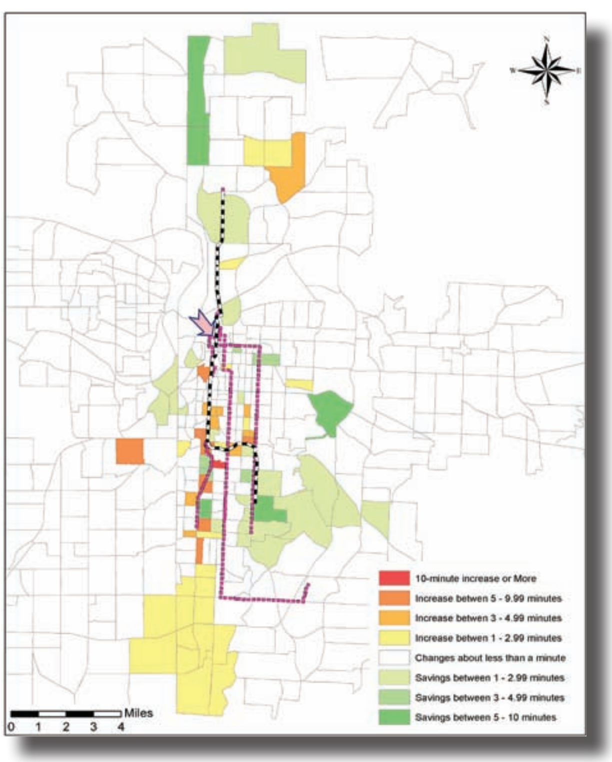
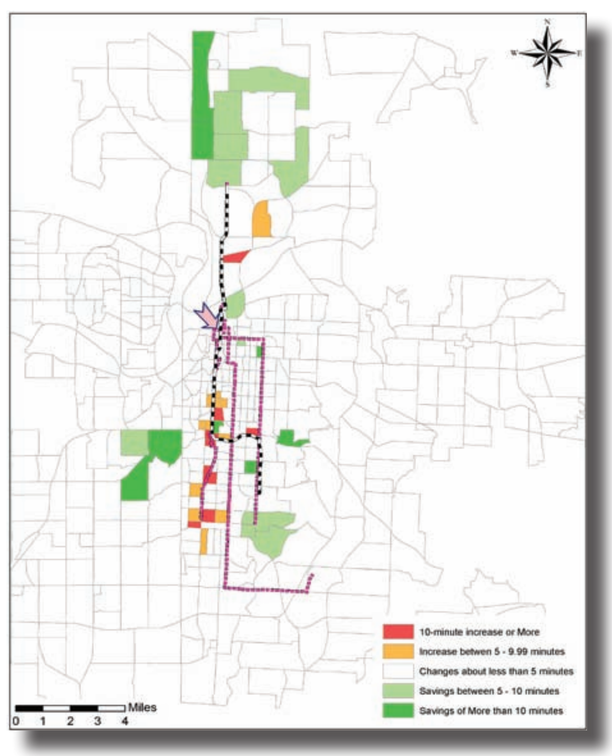



Figure 5-11: Changes in Weighed Travel Time with LRT Alternative - Destination: Downtown



times for most of the Corridor. For trips destined to the Country Club Plaza, travel times are expected to be similar to current travel times.

## Are There Any Additional Benefits the Alternatives Will Provide?

### *Transfers*

Both the MAX Alternative and the Light Rail Alternative would result in improved transit service as a result of reducing required transfers. Transfers are generally regarded as a reduction in transit quality due to increased time and inconvenience, and the uncertainty transfers introduce to the transit trip with the risk of missed connections. The negative effects of transfers can be mitigated through measures such as timed or guaranteed transfer connections, and improvements to the physical environment by having transfers take place at transit centers or other areas designed for passenger interchanges.

The MAX Alternative would reduce the number of required transfers compared with the existing transit system and the No Build Alternative by virtue of the Main Street MAX branch from Prospect Avenue to Main Street at 47th Street. Passengers boarding along Prospect Avenue who now have to transfer between one or more buses to access destinations in the Country Club Plaza area, along Main Street or at Crown Center would have a one seat ride.

Table 5-6: Transfer Analysis*

| Alternative | Total Transfers |
|---|---|
| No Build (current) | 900 |
| MAX Alternative | 50 |
| LRT Alternative 14-mile Alignment | 440 |
| LRT Alternative 6-mile Alignment | 1,330 |

* Note: The table includes only transfers that can be affected by the configuration of the alternatives under consideration. Transfers common to all alternatives, such as transfers from east Kansas City to one of the north-south routes or transfers from other routes made in downtown, are not included.

Otherwise the MAX Alternative route configuration is the same as the existing transit system and the effects on transferring would be negligible.

The Light Rail Alternative would reduce the number of required transfers compared with the existing transit system and the No Build Alternative because of the through routing of the LRT line between the Northland and areas south of the Central Business District. Passengers originating in the Northland traveling to destinations to the south would have a one-seat ride on LRT as would passengers originating in the south traveling to destinations in the Northland. As with the MAX Alternative, the Light Rail Alternative would reduce the number of required transfers compared with the existing transit system and the No Build Alternative by virtue of the LRT branch from Main Street to Prospect Avenue along Brush Creek.

The Light Rail Alternative would introduce required transfers for passengers boarding along Wornall Road and Brookside traveling to destinations north of 47th Street. These passengers now have a one-seat ride on the existing Main Street MAX.

Although it is not possible to quantify the reduction in transfers precisely because of the method used for ridership estimation, the reduction in transfers were approximated using existing KCATA ridership and transfer data. The total number of existing transferring passengers affected by the MAX and Light Rail alternatives is estimated to be 900 per day. The MAX Alternative would reduce this number by 850. The Light Rail Alternative would eliminate all 900 transfers, but introduce an estimated additional 450 daily transfers. These additional transfers are riders who now use MAX from the Brookside or Waldo areas north to destinations in Midtown or the downtown area. With the LRT alternatives, MAX will become a feeder route to the Plaza area LRT station, requiring the transfer. Table 5-6 summarizes the estimated transfers for the No Build, MAX and two versions of the LRT alternatives.

### *Reliability*

Both the MAX Alternative and the Light Rail Alternative would improve the reliability of transit service because of increased operation in reserved transit lanes and increase use of TSP. The MAX Alternative would improve reliability along Prospect Avenue and North Oak/Burlington compared with existing operations.

The Light Rail Alternative would improve reliability along the entire LRT alignment. Most of the alignment would be in reserved transit lanes and LRT would have a higher level TSP.

No attempt was made to quantify the improvements in reliability. KCATA does not have a problem with reliability and on time performance in the Corridor currently.

## How Many People Will Utilize the Proposed Transit Alternatives?

The regional demand travel forecasting model maintained by the Mid America Regional Council (MARC) was not used for the Alternatives Analysis because light rail and BRT were not included in the model. In the interest of moving forward with the project and preparing estimates to support local decision-makers, ridership forecasts for the Light Rail Alternative were developed using the Aggregate Rail Ridership Forecasting (ARRF) model. The ARRF model was developed to evaluate ridership potential in cities that do not have rail transit. The ARRF model is a sketch planning procedure that can give only general indications of ridership potential by extrapolating from experience with new rail lines in other metro areas. The ARRF model is not acceptable to FTA for the ridership estimates required for the New Starts program. The ARRF model was not used for the MAX Alternative.

Ridership for the MAX Alternative was estimated using the experience of Main Street MAX. Detailed passenger counts were conducted and an on board survey of MAX passengers was performed to determine demographic characteristics. This information was applied to the routes proposed as part of the MAX Alternative as a basis of the ridership estimates. Table 5-7 shows ridership estimates for the MAX Alternative.

Table 5-7: MAX Alternative Ridership Estimates
Daily Boardings

| Route/Corridor | Ridership Estimate Range | |
|---|---|---|
| | Low | High |
| Main - Waldo/Prospect | 8,000 | 9,000 |
| North Oak | 2,000 | 3,000 |
| Prospect | 5,000 | 6,000 |
| TOTAL | 15,000 | 18,000 |

*Source: HNTB*

Table 5-8 shows ridership estimates produced by the ARRF model for the Light Rail Alternative segments.

Table 5-8: Light Rail Alternative Ridership Estimates
Daily Boardings

| Segment | Ridership Estimate Range | |
|---|---|---|
| | Low | High |
| River Market to 51st & Brookside | 10,000 | 14,000 |
| Vivion Road to 51st & Brookside | 13,000 | 19,200 |
| Vivion Road to Watkins and Meyer | 15,000 | 22,000 |

*Source: HNTB*

The Light Rail Alternative includes MAX on Prospect Avenue from Swope Parkway into downtown. Prospect MAX ridership was estimated in the range of 3,000 to 4,000 daily trips. When comparing ridership estimates for the MAX Alternative and the Light Rail Alternative it is important to include the ridership estimated for Prospect MAX for a fair comparison.

## What Impacts Will the MAX Alternative Have On Traffic?

The purpose of the traffic analysis is to evaluate the traffic impacts related to the alternatives. The MAX Alternative will not have significant traffic or parking impacts because operation would be in mixed traffic in accordance with existing traffic control. Traffic patterns would not be altered and access would not be restricted as a result of the MAX Alternative. Thus the traffic analysis focused on the LRT Alternative.

## How Were the Traffic Impacts Evaluated?

The Light Rail Alternative would operate as a street running system.

Street running transit refers to a passenger rail or bus system that operates entirely within the public roadway on surface streets and highways. The vehicles may operate in mixed traffic, or in separate reserved lanes. The LRT lanes would be at-grade, and distinguished by pavement markings, colored pavement and/or a low curb. The vehicles would operate primarily with standard traffic control devices (e.g., traffic signals).

The purpose of this task is to evaluate the viability of LRT operation on select roadways in the Corridor, and the impacts on traffic at a preliminary screening level for the Alternatives Analysis. This includes a general evaluation of the effect of street running LRT on traffic operations and a general assessment of the effects on roadways in the Corridor and outside the LRT Corridor. A detailed analysis of traffic operations would need to be performed during the preliminary engineering phase of the project.

The study methodology was developed with the City of Kansas City, Missouri Public Works and Planning staff. At the initial start of the project, several meetings were held to discuss the types of analysis to be completed, as well as the key intersections that needed to be analyzed in this phase of the project.

The following alternatives were evaluated. Both AM and PM peak hour conditions were evaluated.

- Existing Conditions – represents 2005 land use and the existing street network.
- 2030 No Build – represents forecasted traffic demand using the existing street network plus committed projects and 2030 land use.
- 2030 Build – represents the LRT alignment being considered plus 2030 land use.

Table 5-9 shows the Build alignment that was analyzed. Lanes were not reduced on Troost or Prospect for the MAX service. These alternatives were developed to

Table 5-9: Intersection Volumes

| | | Count | 2030 No Build | 2030 Build |
|---|---|---|---|---|
| **Kansas City North** | | | | |
| North Oak n/o 42nd | 2-Way Lanes NB PM Peak | 1,619 | 4<br>2,326 | 4<br>2,326 |
| Burlington s/o Armour | 2-Way Lanes SB PM Peak | 2,666 | 6<br>3,400 | 6<br>3,400 |
| **Kansas City South** | | | | |
| Grand s/o Pershing | 2-Way Lanes SB PM Peak | 1,035 | 4<br>1,000 | 2<br>800 |
| Main n/o Linwood | 2-Way Lanes SB PM Peak | 1,259 | 6<br>2,100 | 4<br>1,700 |
| Main n/o 39th | 2-Way Lanes SB PM Peak | 1,430 | 6<br>1,900 | 4<br>1,600 |
| Main n/o 47th | 2-Way Lanes SB PM Peak | 1,122 | 6<br>1,500 | 4<br>1,300 |
| Cleaver II e/o Troost | 2-Way Lanes EB PM Peak | 1,103 | 4<br>1,100 | 4<br>1,100 |
| **Parallel Network** | | | | |
| Broadway n/o 31st | 2-Way Lanes SB PM Peak | 1,251 | 4<br>1,500 | 4<br>1,500 |
| Gillham n/o 27th | 2-Way Lanes SB PM Peak | 1,100 | 4<br>1,100 | 4<br>1,100 |
| Gillham s/o 39th | 2-Way Lanes SB PM Peak | 1,144 | 4<br>1,200 | 4<br>1,200 |
| Soutwest Tfwy. n/o 39th | 2-Way Lanes SB PM Peak | 1,774 | 6<br>2,100 | 6<br>2,100 |

*Source: HNTB*

evaluate the impact LRT could have on the street network if lanes were reduced due to LRT.

## *Travel Demand*

The Kansas City, Missouri travel demand model was used as a tool to develop forecasted traffic growth. The City's travel model is a TransCAD peak hour model with 2030 land use. Traffic growth percentages were developed by using the City's model and calculating the difference between the base model (2005) and 2030 No Build or Build conditions. Traffic growth was then applied to existing traffic counts.

The following table shows the existing traffic count, 2030 No Build and 2030 Build traffic volumes for the study intersections. The table also shows the number of lanes for the two alternatives, and the roadways that would be reduced in the Build Alternative. Analysis of the parallel network to the Build alignment was done to identify adverse affects the Build Alternative may have to the street network outside of the study corridor. Based on the travel demand modeling, traffic could shift off the roadways LRT would use, due to the capacity reduction, and the traffic could be distributed evenly to the parallel street network.

Traffic analysis was performed at a planning level to better understand the impacts of LRT on the existing and future street network. Intersection and roadway level of service was used to assess the transportation system at this study phase. Table 5-10 shows the thresholds for intersection level of service (LOS). The City of Kansas City, Missouri has set LOS D as the lowest desired LOS.

Table 5-10: Signalized Intersection Level of Service Thresholds

| | Level of Service (LOS) | Signalized Intersection Avg. Delay (sec/veh) | Arterial Travel Speeds |
|---|---|---|---|
| Desirable | A | ? 10 Seconds | > 21 mph |
| | B | < 20 Seconds | > 16-21 mph |
| | C | < 35 Seconds | > 10-16 mph |
| | D | < 55 Seconds | > 7-10 mph |
| Undesirable | E | < 80 Seconds | > 5-7 mph |
| | F | > 80 Seconds | < 5 mph |

*Source: HCM Urban Street LOS by Class III (HCM 2000, Exhibit 15-2), Highway Capacity Manual, 2000*

# What Were the Results of the Traffic Analysis?

## *Northland and South of CBD Traffic Analysis*

Several key intersections in the study area were analyzed by using the volumes calculated from the City's TransCAD model, the intersections were analyzed using Synchro. Three conditions were analyzed including Existing, 2030 No Build and 2030 Build. Existing conditions were analyzed to identify intersections that are currently operating at undesirable level of service (LOS E or F). Both AM and PM peak hours were analyzed. Figures 5-12 and 5-13 show the locations analyzed and their corresponding levels of service.

The intersections of 47th and Main during the AM Peak, and Pershing and Grand during the PM Peak are the only intersections that operate at a worse LOS in the Build versus the No Build. However, the projected operation at LOS D, which is an acceptable LOS. The LOS improved in the AM Peak at the intersection of Linwood and Main from a LOS E in the No Build to a LOS D in the Build. None of the intersections operate a LOS F in the AM or PM for any of the alternatives. Several intersections due operate at LOS E, which are 42nd and North Oak, Armour and Burlington, Linwood and Main in the PM Peak, and 31st and Broadway in the AM Peak.

## *CBD Traffic Analysis*

In order to test traffic operations along Grand Boulevard, within the downtown freeway loop, with LRT, the City of Kansas City's downtown loop 2010 VISSIM model was used to analyze shifts in traffic patterns and impacts to intersection level of service. The 2010 VISSIM model was used, because a 2030 model has not been developed yet. The intent was to determine if 2010 traffic could still operate acceptably if capacity in the Grand

Figure 5-12: AM Level of Service, Existing and 2030 LRT Alternative

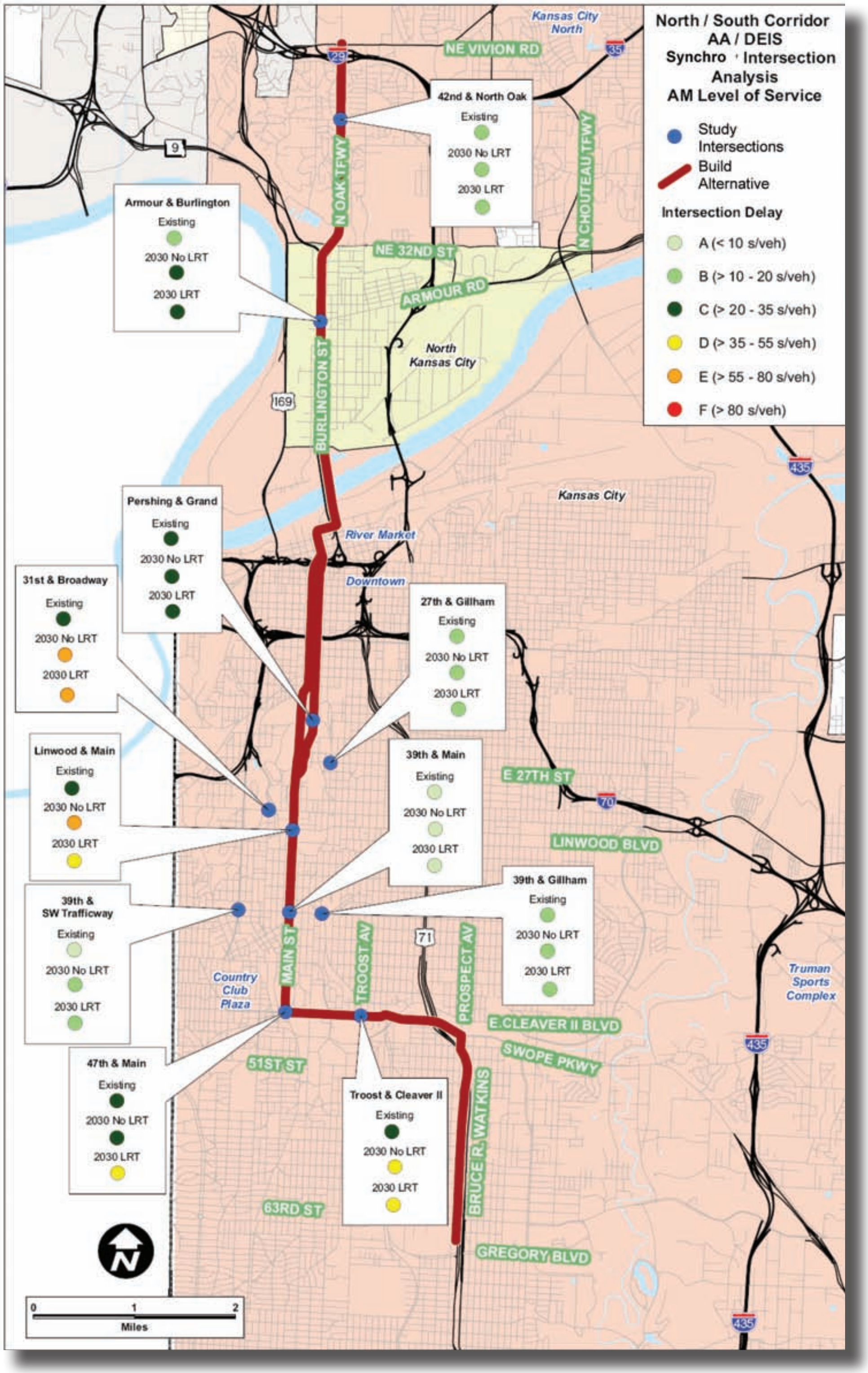
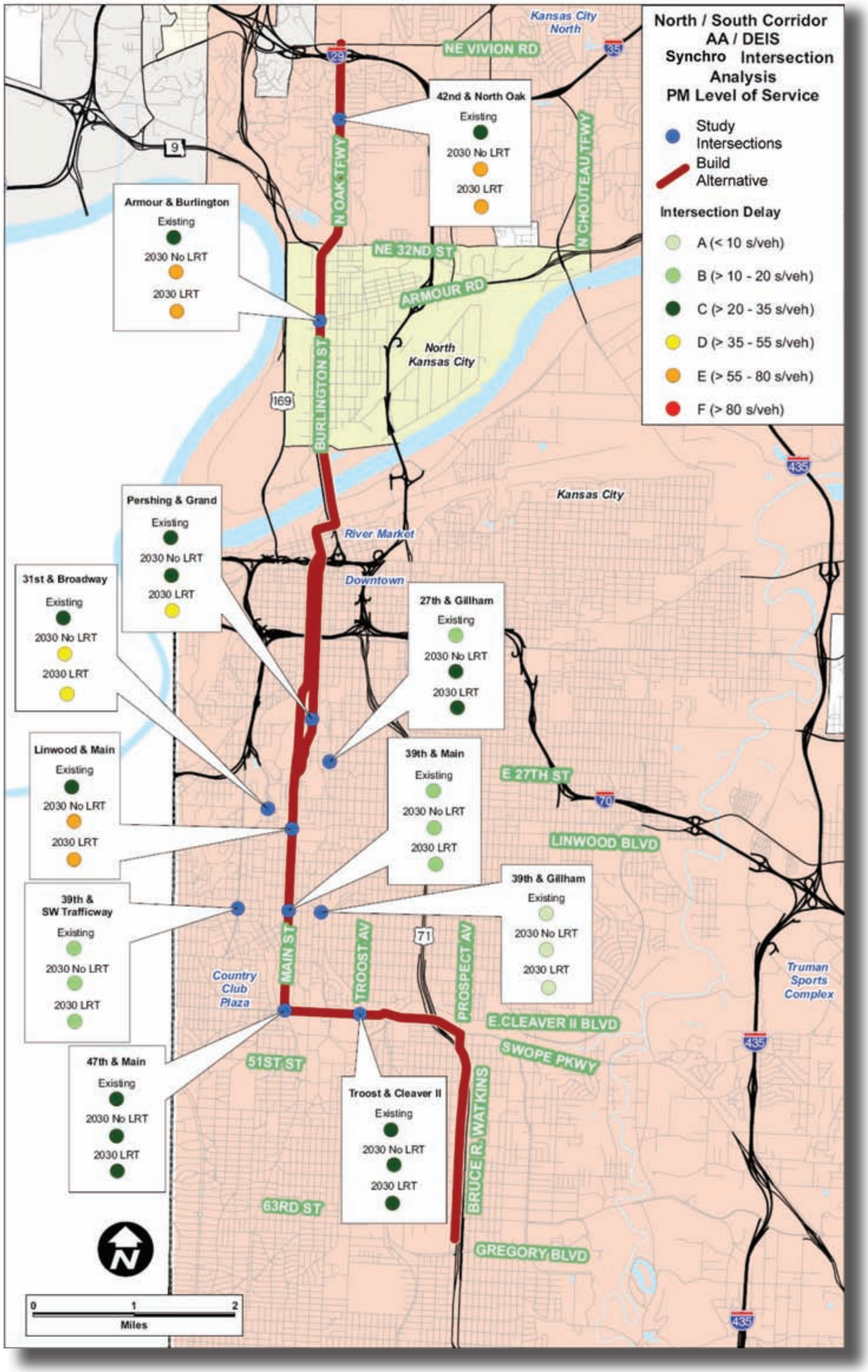


Figure 5-13: PM Level of Service, Existing and 2030 LRT Alternative



Boulevard corridor was reduced. Additionally, traffic signal plans would have to be changed and access would have to be modified to accommodate LRT.

It was assumed that LRT would operate in the middle lanes of Grand Boulevard and that there would be two general purpose lanes for traffic in each direction between Independence and South Truman Road through downtown. Mid-block full-access locations along Grand Boulevard would be right in-right out. Also, all signals in the Corridor were modified to north/south split phasing in order to accommodate left turns across the LRT tracks. The Main Street MAX BRT route was removed, but otherwise all bus routes remained as they were in 2005 with all routes along Grand Boulevard intact.

With the Build Alternative, the analysis showed that while intersection delay along the Grand corridor increased at all but one intersection, the resulting delay and LOS were still acceptable by City standards; all intersections operated at LOS C or better for existing and both future conditions. The intersection at Grand Boulevard and South Truman Road may have a higher actual intersection delay than reported because of its location on the edge of the VISSIM network. Delay and turning movement counts for vehicles on the northbound approach were not calculated by the model.

As stated previously, vehicles shifted within the model to adjust to the new traffic patterns along Grand Boulevard. These changes in turning movement volumes can be seen in the attached exhibit labeled differences located at the end of this document. The reduction in capacity in the corridor tended to reduce traffic on Grand Boulevard and increase traffic on the cross-streets and parallel streets. At the same time, the restricted access at mid-block driveways increased turning movement volumes downtown since some vehicles would have to make more turns and travel around the block to get to their destinations.

The volume of buses and frequency of stops in the Corridor did not negatively impact traffic even with the reduced capacity on Grand Boulevard. There is enough reserve capacity in the downtown area to absorb the effects of buses making frequent stops. These results for the base 2010 model and the 2010 build model are found in Figures 5-14 and 5-15.

## What Are the Impacts to Parking Along the LRT Alignment?

The impact of on-street parking eliminations were evaluated for the Build Alternative. The study team inventoried, in the summer of 2008, current on-street parking spaces and identified parking spaces that are likely to be lost due to the development of LRT. Some of the streets that currently have on street parking may need to have the on street parking removed to maintain roadway capacity.

The three roadways that were surveyed include Grand Boulevard from Pershing Road to Truman Road, Main Street from Grand Boulevard to 47th Street, and Walnut Street from 20th Street to 6th Street. The following table 5-11, summarizes the number of spaces by road for both sides of the roadway. These are the number of spaces that could be eliminated if LRT is implemented. During future phases of this project, the matter of mitigating the loss of parking will be addressed.

Table 5-11:. Existing On Street Parking Spaces

| Boundary Streets | Location | West | East |
|---|---|---|---|
| Pershing to Truman | Grand Boulevard Total | 94 | 65 |
| 47th to Grand | Main Street Total | 166 | 211 |
| 20th St. to 6th St. | Walnut Street Total | 94 | 93 |
| | Total | 354 | 369 |

*Source: HNTB, Field Data Collection August 2008*

Figure 5-14: CBD Level of Service, Committed Projects plus LRT, 2010

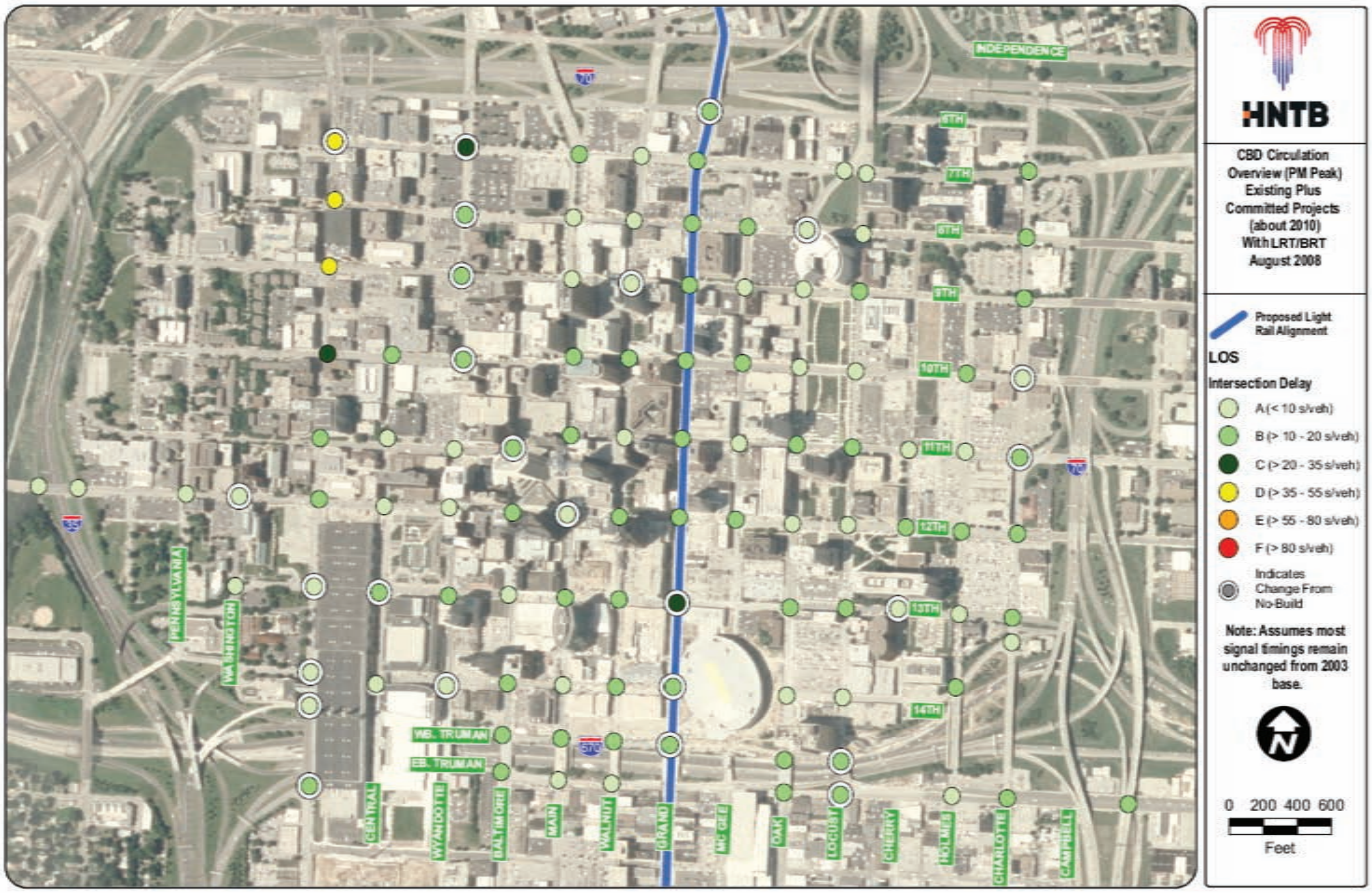



Figure 5-15: CBD Corridor Travel Speed, Committed Projects plus LRT, 2010

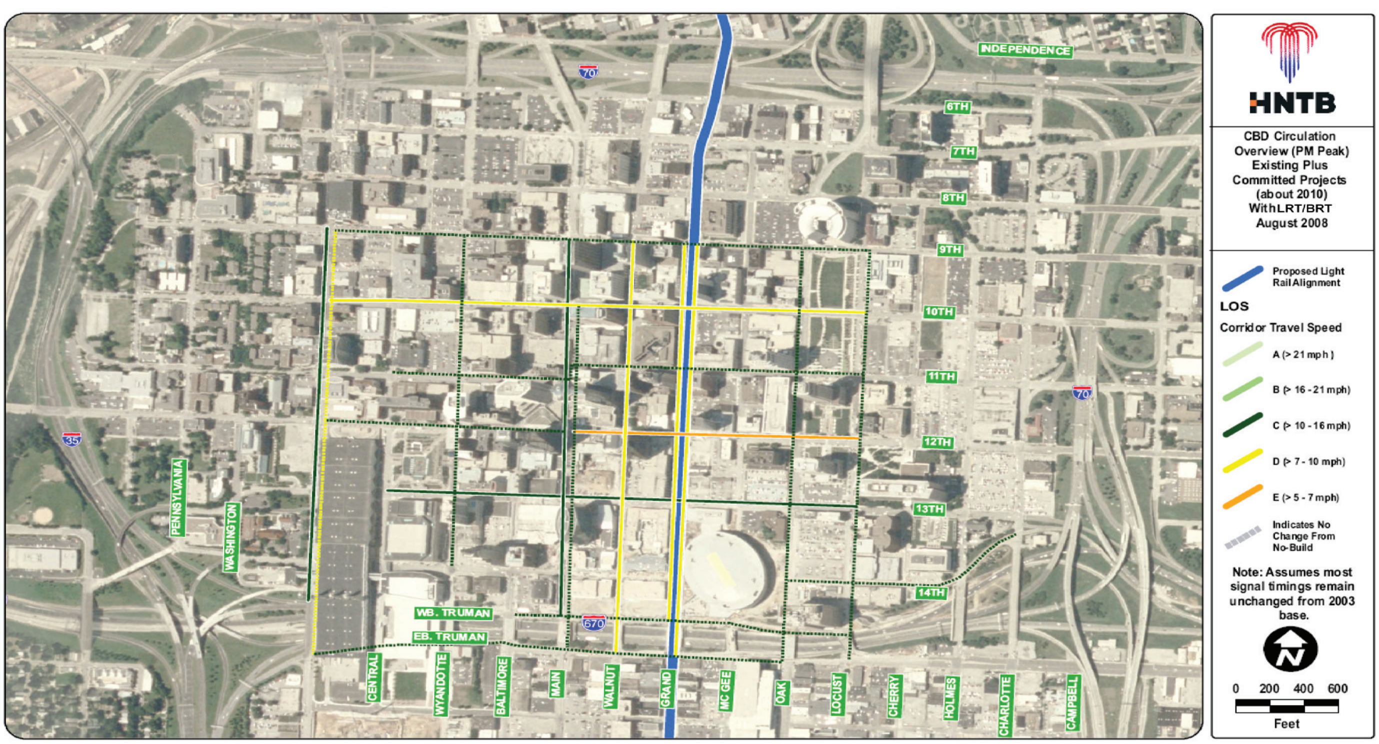
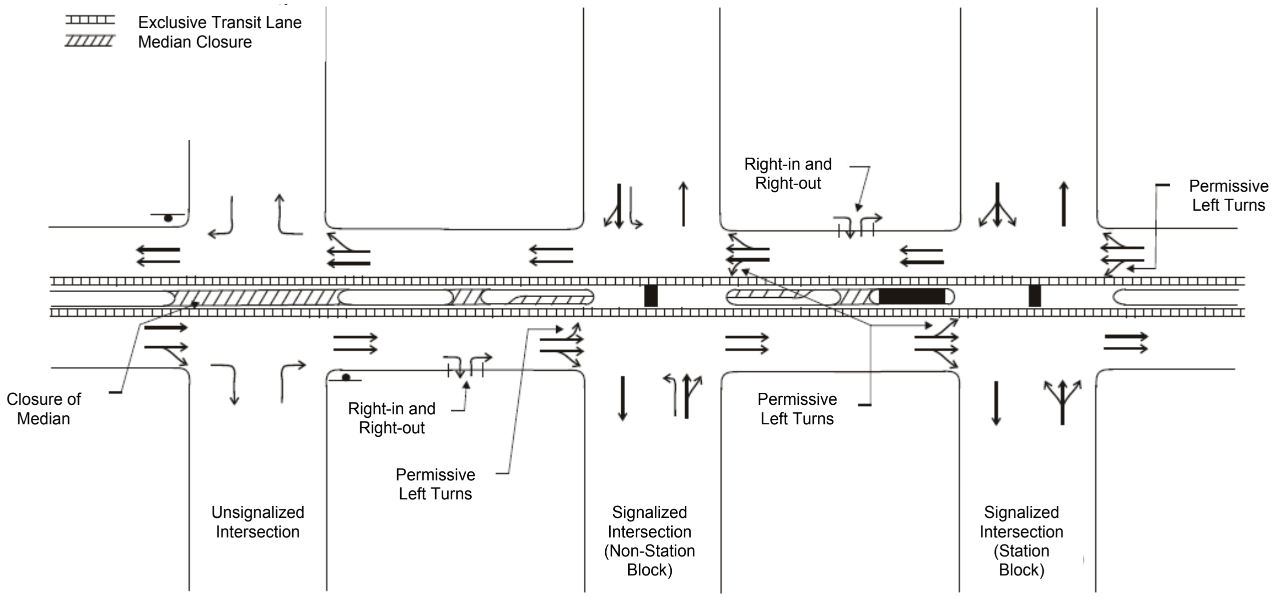


Figure 5-16: Figure Center Running LRT/BRT and Potential Impact to Roadway Operations




- On-street Parking Removed
- Exclusive Right-turn Removed
- Exclusive Left-turn Lanes Removed
- Right-turns on Red Allowed
- Medians Closed to Cross Streets and Driveways
- Only Right-in/Right-out Access Allowed at Cross Streets and Driveways
- Addition of Transit Signal Prioritization
- Stations Incorporated into the Median

## How is Access to Properties Along the LRT Alignment Impacted?

The study team inventoried, in the summer of 2008, the locations of driveways to businesses on roadways that LRT would be operating on. This was done to evaluate any negative impacts caused by the addition of LRT.

A majority of the driveways along the Corridor will need to be converted to right in right out because of the Build Alternative running in the median of the roadway. Figure 5-16 shows the impact LRT will have on roadway operations and access. An assessment of driveways was completed to determine whether all properties would have adequate access after LRT is built. After surveying the roadways, graphics were made to show the locations of driveways and the types of businesses. This information will be used during preliminary engineering.

## Are There Safety Impacts with the LRT Alternative?

Traffic and LRT operations were reviewed in six cities with light rail systems to determine their safety experiences and measures taken to improve safety. The cities reviewed were: Baltimore, Calgary, Portland, Sacramento, Houston, and San Francisco. Light rail vehicle operations in these cities are carried out at speeds at or below 35 mph and are classified as either semi-exclusive or non-exclusive alignments.

## *Types of Collisions*

Illegal left and right turns across LRT tracks are a primary source of collisions between LRVs and motor vehicles. Houston experienced a high number of collisions between METRORail vehicles and motor vehicles during its first month of LRT operations. All of these collisions appear to have been caused by improper or illegal turns or other driver errors. Despite traffic signs and signals designed to control the location and timing of left-turn movements along the rail line, several motorists turned into or in front of oncoming LRVs.

Right angle collisions are the second most frequently experienced with the exception of San Francisco where right angle collisions were first and turns in front of LRVs were second.

Another type of conflict point is generated when LRVs turn in front of motor vehicles. This type of collision is generally the third highest occurrence in traffic. Other accident types are side swipes, grade crossings (semi-exclusive right-of-way), and failure of motor vehicle operator to obey traffic control signals or other devices such as special signage, striping or raised pavement markers. Pedestrians are also involved in accidents by their own neglect, motor vehicles reacting to LRV operations, and LRV related collisions.

## *Issues and Concerns*

In Baltimore, 89 percent of the total accidents occurred in the Central Business District. This high percentage is typical for downtown areas with non-exclusive alignments. Semi-exclusive and exclusive alignments are protected and generate fewer accidents than non-exclusive alignments.

Where LRT systems are new to a city, the greatest concern would be motorists failing to comply with traffic signs, signals and barriers. When vehicles in a platoon are used to traveling in progression, and are quickly pre-empted by an LRT phase, motorists may be inclined to disobey signals that seem to come at an unusual time in their progression.

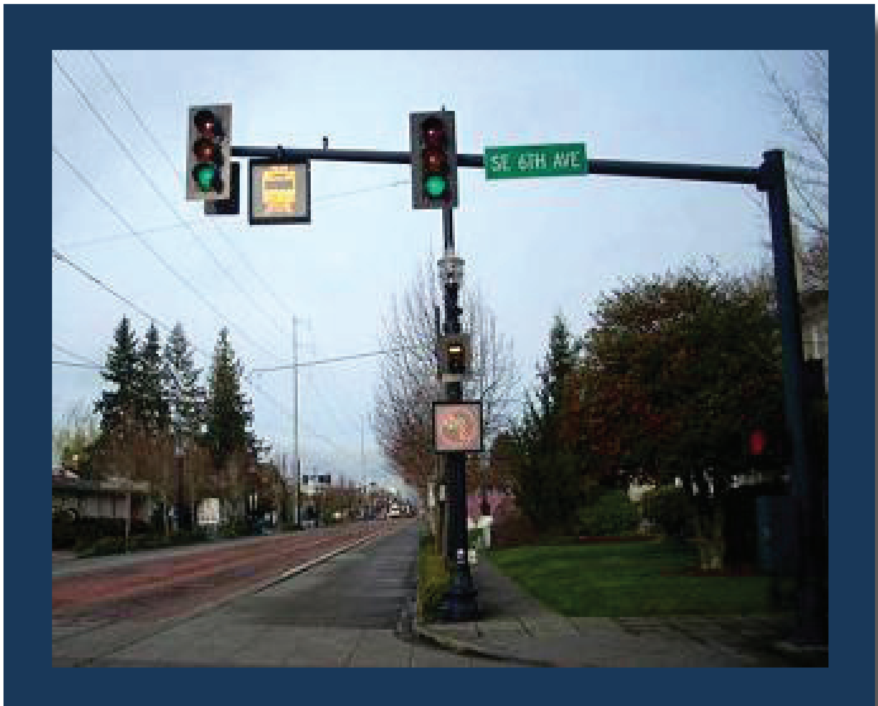
Where motorists are accustomed to a leading-left phase but has a new LRT system in place, a median-aligned LRV from the opposing direction pre-empts the left turn arrow, and motorists may violate the red signal indication.

Where left turns were once permitted before the LRT system was installed, a newly-installed passive NO LEFT TURN sign may easily be violated.

## What are Some Safety Improvement Measures?

Simple measures are implemented to alleviate some of these safety problems between motor vehicles and LRVs. Where LRVs pre-empt a standard traffic signal

Figure 5-17 : PTW Signs for an Approaching LRT Train (Portland)



that is part of a coordinated grid system, an active, internally illuminated part-time warning (PTW) sign with a red flashing train symbol can warn cross-street traffic of the increased risk associated with violating a red traffic signal (Figure 5-17).

Where an LRV pre-empts the normal lead left phase motorists are used to, an LRT phase can be implemented to actuate an all-red phase until the LRV passes through the intersection and checks out by way of detection releasing the phase only after the LRV has passed through.

Employing a variety of design features and public education programs can reduce unsafe movements by drivers along the LRT alignment. METRORail in Houston has successfully implemented solutions to improve safety, including extensive operator training, active public education and outreach programs.