Transportation Technical Report
Kansas City Downtown Streetcar Project

September 20, 2012

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1. INTRODUCTION

The purpose of this technical report is to document environmental impacts related to transportation, if any, associated with the Kansas City Downtown Streetcar Project. Topics addressed in this report include:

- *Traffic:* Vehicular traffic capacity and intersection operations.
- *Transit:* Bus system operations (and, under the Build scenario, streetcar operations and ridership).
- *Parking/Loading:* On-street and off-street parking and loading availability and accessibility, including time-of-day and other restrictions.
- *Pedestrians:* The pedestrian environment along the corridor, as measured by the city's walkability principles.
- *Bicycles:* The general bicycle environment along the corridor, as well as bicycle parking.
- *Freight:* Conditions for large vehicles delivering freight along the corridor.

For the purposes of this analysis, the study corridor (shown in **Figure 1**) runs along Main Street from Pershing Boulevard to 7th Street, along Delaware Street to 5th Street, and in a counterclockwise loop around the City Market along 5th Street, Grand Avenue, 3rd Street, and Delaware Street.

Figure 1: Study Corridor

2. EXISTING CONDITIONS

2.1 Traffic

Corridor Characteristics

Figure 2 schematically illustrates the existing roadway and intersection geometry throughout the study corridor. The general characteristics of the streets comprising the corridor are described below.

Main Street is a primary north-south arterial street within downtown Kansas City. It is a spine road serving the heart of the Kansas City central business district, and also intersects with numerous important east-west streets over the two-mile study corridor. Within the Downtown Loop (the CBD area bounded by I-35, I-670, I-70 and US-71), Main Street varies in width from three to five through lanes (both directions combined), with parking on both sides in many, but not all, areas. There are few intersections with dedicated turn lanes. A southbound bus lane is marked from near 10th Street to the southern edge of the Downtown Loop. However, this lane is typically used by both buses and the general public even during the hours it is officially in operation. At the north edge of the Downtown Loop, Main Street becomes Delaware Street and passes over I-70 to connect with the River Market area. Delaware Street continues north to 2nd Street. South of the Downtown Loop, Main Street carries between two and three southbound lanes and between one and three northbound lanes, depending on the location. Part of this section of the corridor also has a marked southbound bus lane and there is parking on one or both sides for part of this section. The speed limit on Main Street is 35 mph.

Delaware Street has three distinct segments in the study area. Between 7th Street and Independence Avenue (crossing I-70), Delaware Street carries two lanes in each direction (with no parking). Between Independence Avenue and 5th Street, Delaware Street carries one lane in each direction (no dedicated turn lanes) with parking allowed on the west side of the street. Between 5th Street and 3rd Street, Delaware Street is one lane southbound, with diagonal parking on the west side.

5th Street is the southern boundary of the City Market, and carries one lane in each direction with no dedicated turn lanes. Parking is allowed intermittently on both sides of the street. Along the study corridor, 5th Street is signal-controlled at Grand Boulevard and stop-controlled at both Delaware Street and Walnut Street.

3rd Street is the northern boundary of the City Market, and carries one lane in each direction with no dedicated turn lanes. Parking is allowed on both sides of the street through most of the study corridor. There are no existing signalized intersections along this portion of 3rd Street.

Grand Boulevard, in the study corridor, is the eastern boundary of the City Market, and currently carries one through lane in each direction, with no dedicated turn lanes except at the intersection with Third Street. Parking is allowed on both sides of the street.

There are several major east-west highways and cross-streets connecting to the study corridor:

- ***I-70*** is major interstate highway, connecting Kansas City with significant distant metropolitan areas such as Denver and St. Louis. In the downtown Kansas City area, I-70 functions as the six-lane northern portion of the Downtown Loop (this segment is also designated as I-35), with several

closely spaced interchanges serving downtown – including a diamond interchange at Delaware Street, with Independence Avenue and 6th Street serving as one-way outer roads.

- ***I-670*** is an interstate that forms the seven-lane southern portion of the Downtown Loop, with much less access to local streets than I-70 (and no direct access to Main Street). Truman Road North and South serves as a one-way outer-road pair, with ramp access at either end of the Downtown Loop.

- ***10th Street*** (one-way eastbound east of Main Street, two-way west of Main Street) and ***11th Street*** (one-way westbound): This pair carries traffic to and from a series of I-70/US-71 freeway ramps at the east edge of the Downtown Loop, as well as local destinations east of the Downtown Loop.

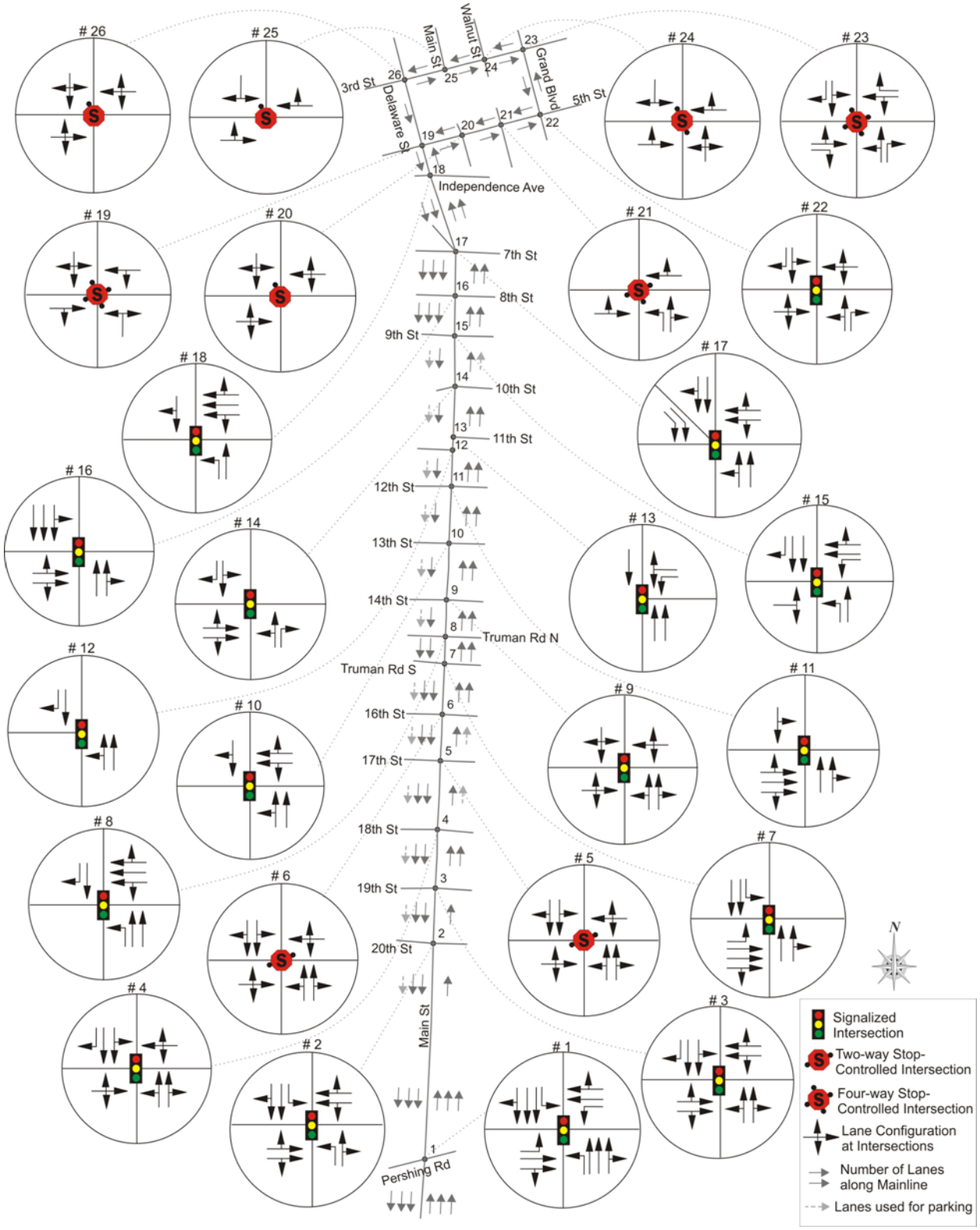
- ***12th Street*** (one-way eastbound) and ***13th Street*** (one-way westbound): Of these two streets, 13th Street carries the larger volume of traffic because it has a direct ramp connection from I-70 westbound (on the east side of the Loop). 12th Street provides the only full-access interchange on the west side of the Downtown Loop.

- The one-way ***Truman Road*** sections that parallel I-670 at the south edge of the Downtown Loop provide another key pair of directional routes, with ramps to and from I-670.

- South of the Downtown Loop, ***19th Street*** (extending from Southwest Boulevard) and ***20th Street*** provide important connections to/from the west. ***22nd Street*** provides a key link to the east (US-71 and beyond) and Pershing Road connects locations at the southern end of the corridor.

Traffic control varies along the corridor. Within the River Market area, only the intersections of 5th Street/Grand Boulevard (#22) and Delaware Street/Independence Avenue (#18) are currently signalized. Within the Downtown Loop, all study intersections are currently signalized. South of the Downtown Loop, all study intersections are currently signalized except Main Street/16th Street (#6) and Main Street/17th Street (#5).

Figure 2: Existing Roadway/Intersection Geometry



Traffic Volumes

Figure 3 illustrates existing traffic volumes throughout the study corridor.

Based on recent traffic counts, daily traffic volumes on Main Street within the Downtown Loop are in the low 7,000s both south of 9th Street and just north of I-670. At the south end of the study corridor, just north of Pershing Road, Main Street carries approximately 13,400 vehicles per day. It should be noted that Main Street and Walnut Street split just south of 20th Street (Walnut Street is one-way northbound), so that is a location where the through volume on Main Street changes noticeably.

Intersection turning-movement volumes are shown in **Figure 3** for the a.m. and p.m. peak hours at each of the 26 study intersections in the study corridor. In general, peak-hour volumes on Main Street are fairly modest, with single direction peak-hour segment through volumes ranging from as low as 115 vehicles to as high as 794 vehicles (ironically, both are in the vicinity of 8th Street). Close study of the figure also gives a sense of temporal directional patterns (northbound vs. southbound) on Main Street:

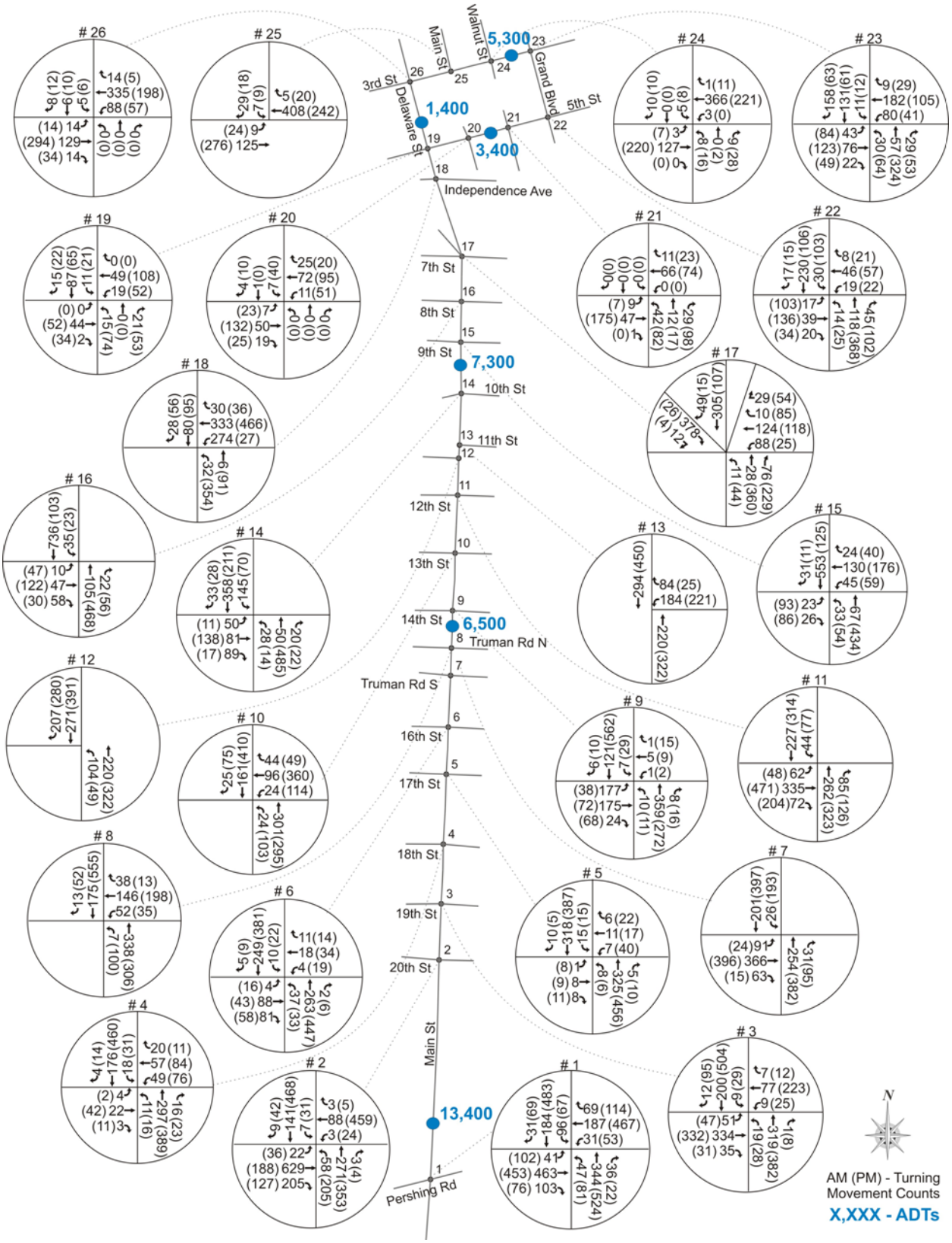
- In the Crossroads area, traffic volumes tend to be directionally balanced, ranging from 200 to 450 vehicles in each direction during the a.m. peak hour and 400 to 600 vehicles in each direction during the p.m. peak hour.
- Within the Downtown Loop, directionality is much stronger, but includes a reversal in the vicinity of 11th Street. South of that point, traffic is skewed more heavily southbound in the p.m. peak (toward I-670) and similarly (although to a lesser degree) northbound (away from I-670) during the a.m. peak hour. North of 11th Street, traffic exhibits a pronounced skew in the opposite directions: northbound (toward I-70) during the p.m. peak hour, and southbound (away from I-70) during the a.m. peak hour.

Downtown Signal Coordination

Within the Downtown Loop, the majority of the traffic signals (including those on Main Street) are part of a pre-timed coordinated system. The Main Street signals typically run 70-second cycle lengths during all time periods. However, from 13th Street to Truman Road, 90-second cycle lengths are used in the midday and afternoon time periods (including the p.m. peak period).

The Truman Road signals on Main Street run 60-second cycles during the morning and overnight time periods and 90-second cycles during the midday and afternoon time periods. From south of Truman Road to 20th Street, the signals on Main Street are actuated and coordinated with cycle lengths of 60 seconds during entire day. Pershing Road at Main Street runs an 80-second cycle length during all time periods.

Figure 3: Existing Traffic Volumes



Operational Analysis - Methodology

For each intersection, the operating conditions were evaluated using an adaptation of the methods described in the 2010 Highway Capacity Manual (HCM) – known as the percentile delay method – implemented by the Synchro software analysis program. The output from this method includes both operating characteristics, such as delays and queues, and level of service for the facility. Level of service (LOS) is an A-through-F rating system, with LOS A indicating free-flow conditions with little or no vehicle delay and LOS F indicating break-down conditions with significant congestion and long delays. For a downtown area such as this, LOS D or better is considered acceptable. For signalized intersections, LOS and delay are traditionally reported as an average of the entire intersection. In this report, overall intersection delay is used as the threshold of acceptability, but individual movements that fall below this level are also noted for consideration during later phases of the project.

For unsignalized intersections, only the stopping and yielding movements have delay associated with them, and the HCM method delay/LOS for the worst movement are reported.

Table 1: Existing Levels of Service, Study Intersections*

	A.M. Peak		P.M. Peak	
	Delay	LOS	Delay	LOS
1. Main/Pershing	23.4	C	26.1**	C
2. Main/20th	17.9	B	16.3	B
3. Main/19th	14.2	B	17.7	B
4. Main/18th	11.5	B	22.1	C
5. Main/17th	*16.9*	*c*	*25.7*	*d*
6. Main/16th	*16.9*	*c*	*20.7*	*c*
7. Main/Truman (S)	11.2	B	15.5	B
8. Main/Truman (N)	9.1	A	28.8	C
9. Main/14th	14.9	B	23.7	C
10. Main/13th	12.1	B	22.3	C
11. Main/12th	12.5	B	14.2	B
12. Main/11th (S)	1.6	A	1.4	A
13. Main/11th (N)	7.4	A	10.0	A
14. Main/10th	12.4	B	25.8	C
15. Main/9th	16.0	B	19.7	B
16. Main/8th	18.2	B	11.5	B
17. Main/7th	29.1	C	18.5	B
18. Delaware/Independence	11.5	B	24.3	C
19. Delaware/5th	*7.9*	*a*	*9.1*	*a*
20. 5th/Main	*9.7*	*a*	*12.5*	*b*
21. 5th/Walnut	*7.8*	*a*	*9.4*	*a*
22. 5th/Grand	11.8	B	15.2	B
23. 3rd/Grand	*14.9*	*b*	*33.7*	*d*
24. 3rd/Walnut	*12.6*	*b*	*12.1*	*b*
25. 3rd/Main	*11.8*	*b*	*11.3*	*b*
26. 3rd/Delaware	*16.1*	*c*	*15.0*	*c*

**Italicized intersections with lower-case LOS values are unsignalized, and the delay/LOS reported are for the worst movement at the intersection.*

***One or more individual movements at the intersection operate at LOS E or worse.*

Source: HDR Engineering, Inc.

Operational Analysis - Results

Table 1 summarizes the results of the operational analysis for existing conditions. (Note: italicized, lower-case letters represent unsignalized intersections.) As the table indicates, all of the study intersections currently operate at LOS D or better. During the p.m. peak hour, the intersection of Main Street and Pershing Boulevard (Intersection #1) operates at LOS C, but the eastbound left-turn movement operates at LOS E. This is not considered an unacceptable condition, but is noted for consideration during later phases of the project.

2.2 Transit

Key Transit Nodes

Downtown Kansas City is, fittingly, the convergence point for many local and regional transit routes. The study corridor is home to three important collection/distribution points in Kansas City Area Transportation Authority's (KCATA) system:

- Located at the northeast end of the study corridor, the 3rd/Grand park-and-ride lot is an important connection point for auto commuters to disperse to the downtown area. The lot includes approximately 185 parking stalls, and is well-used. It is also located diagonally across from the City Market, and serves as an important weekend parking and transit connection to the Market. **Figure 4** and **Table 2** identify the transit routes that access the 3rd/Grand park-and-ride lot.

- Located near the center of the Downtown Loop, The 10th and Main Transit Center is the primary downtown transit hub, serving numerous routes as shown in **Figure 4** and **Table 2**. This outdoor transit center includes a pull-through for buses. There are shelters both on the site as well as on Main Street just north of 10th Street.

- At the southern end of the study corridor, Union Station is a historic refurbished passenger train station, currently serving primarily as an entertainment/tourism destination with some office uses as well. Several bus routes stop on the east side of Union Station (See **Figure 4** and **Table 2**), and a covered aerial pedestrian bridge ("the Link") is provided to Crown Center. Union Station is also the stopping point for Kansas City's Amtrak routes.

Existing Transit Routes

Transit routes have very recently changed throughout the KCATA system (July 1, 2012). **Figure 4** illustrates the transit routes in the downtown area and near the study corridor, and **Table 2** provides some operational details. Two routes currently run north/south along most of the corridor: Main Street MAX (a Bus Rapid Transit (BRT) system with frequent headways and stops roughly every four blocks), and Route 51.

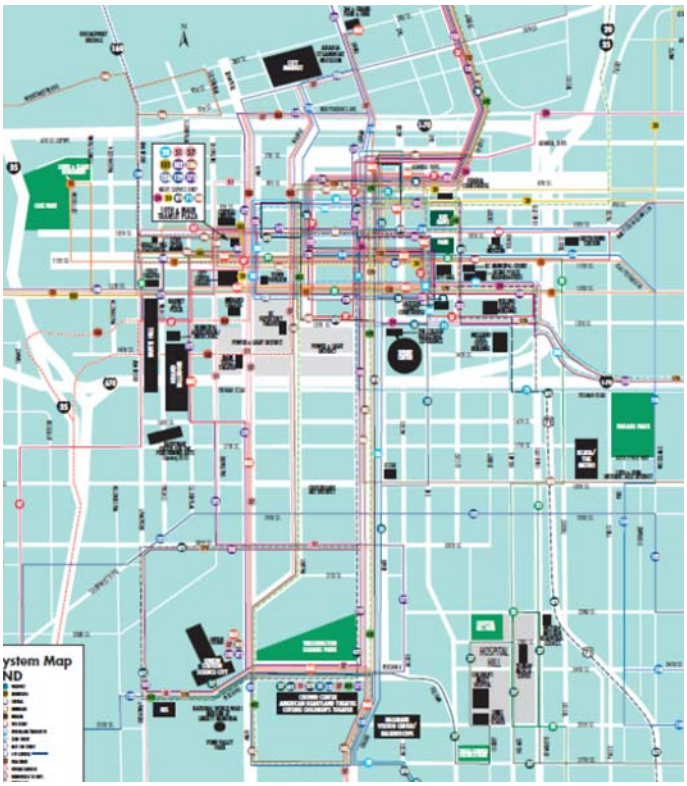
In addition, a large number of bus routes serve the major transfer points along the study corridor. These bus routes are listed in **Table 2.**

Three other routes providing service to eastern portions of downtown (and further south) also have stops very near the corridor (and are shown in **Table 2**): Troost MAX (BRT service with operating characteristics similar to Main Street MAX), Route 25, and Route 12.

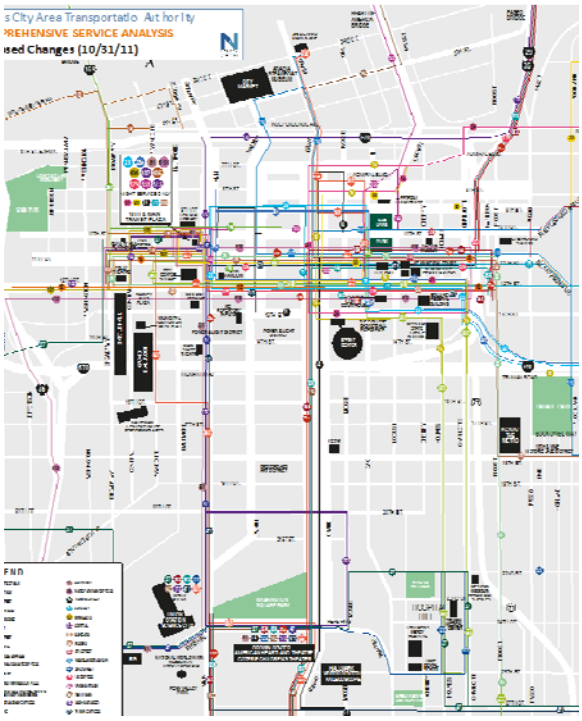
According to KCATA, 11,000 to 12,000 KCATA passengers travel into the downtown (including Crown Center) every weekday.

Figure 4: Existing Transit Routes

Downtown Service Patterns Prior to 7/1/12*



CSA-Recommended Changes*



**The two maps are not meant to be read in detail; rather, they are to give a sense of the concentration of routes downtown and the streamlining proposed with the CSA.*

Current Routes along/near the Study Corridor

Table 2: Transit Routes Along, Connecting with, and Near the Study Corridor

Rte	Name	Study Corridor Interface	Connects…	Frequency (minutes)		
				Peak	Midday	Eve
Routes traveling along portions of the study corridor						
Main Street MAX		Main Street in the Crossroads area	Crown Center (and points much further south) to the River Market area	10	10	15
51	Broadway	Main Street from 20th Street to 10th Street.	Southern Ward Parkway and 10th/Main	20	45	--
Routes serving major transfer points within study corridor						
24	Independence	10th/Main (nights)	Independence MetroCenter	15	15	30
27	27th Street	10th/Main; Union Station	31st/Van Brunt to Downtown via 27th Street, 22nd Street, West Pennway, Summit Street, and Broadway	30	30	60
28	Blue Ridge	10th/Main	Longview Square via Blue Ridge Boulevard, 47th Street, US-40, and I-70	30	60	60
28X	Blue Ridge Express	10th/Main	Express route generally serving same area as Route 28	30	--	--
30	Northeast	10th/Main	Northeast	20	60	--
47	Roanoke	10th/Main	KU Med Center, Truman Sports Complex, Blue Ridge Crossing	20-30	45	--
51X	Ward Parkway Express	10th/Main	Country Club Plaza, Ward Parkway Center, Red Bridge Shopping Center	30	--	--
54	Armour-Paseo	10th/Main	Ward Parkway Center	30	30	60
69X	Liberty Express	Union Station	Liberty via I-35	25-30	--	--
71	Prospect	10th/Main	Prospect Ave, Research Medical Center	10	10-15	30
101	Minnesota/State Ave.	10th/Main	Downtown KCK, KCK Community College, Providence Medical Center, Village West Shopping Center	30	30	60
102	Central Avenue	10th/Main	KCK, Bethany Medical Center, Indian Springs Transit Center	30	60	--
106	Quindaro	10th/Main	Downtown KCK, Quindaro, Indian Springs Transit Center	30	30	60
108	Indiana	10th/Main	Swope Park, Zoo	30	30	60
110	Woodland/Brooklyn	3rd/Grand	18th & Vine, Brooklyn Ave.	60	60	--
123	23rd Street	Union Station	18th & Vine, 23rd & Wheeling Ave.	65	65	--
126	East 5th Street	10th/Main	Northeast Industrial District	60	60	--
129	I-29 Express	10th/Main	KCI Airport	15-30	60	--
142	North Oak	Union Station	Metro North Mall, St. Luke's Northland Hospital, Boardwalk Square Metrocenter	20	60	--
152	Lee's Summit/ Raytown Express	10th/Main; Union Station	via Route 350	30*	--	--
170	Blue Springs Express	Union Station	Blue Springs Park-and-Ride, I-70 Commuter lots	5-30*	--	--
173	Casino Cruiser	10th/Main; Union Station; 3rd/Grand	Isle of Capri, Harrah's, and Ameristar casinos, Worlds of Fun	65	65	60
471	71 Hwy. Express	Union Station	Red Bridge Rd. & Grandview Rd. via US-71	30	--	--
Routes with stops very near the study corridor						
Troost MAX		11th/12th Street couplet just east of Main Street	to/from the Bannister/Drury park-and-ride and Downtown	10	10	30
25	Troost		to/from 83rd/Troost and Downtown	30	30	10-30
12	12th Street		West Bottoms (Kemper Arena) and areas along 12th Street/Truman Road near Van Brunt Blvd.	15	15-20	60

**Peak direction only*

Source: Nelson\Nygaard, KCATA, and HDR Engineering, Inc.

Very Near-Term Changes

KCATA has recently conducted a Comprehensive Service Analysis (CSA), which has resulted in a series of recommended changes throughout KCATA's service area, some of which have already been implemented (and are incorporated into the foregoing discussion). Additional CSA-related changes affecting downtown routes are planned for October 2012. The following are relevant to this corridor:

- ***12 (12th Street):*** The current route will be split into two separate routes. The portion that is along the streetcar corridor will not be touched and will remain Route 12. To the east, the new route (Route 15) will operate along Truman Road.
- ***30 (Northeast):*** The route will be extended to the Northeast Industrial District, replacing the current Route 126 service. Service hours will be adjusted as well.
- ***47 (Roanoke):*** The route will be jointly redesigned with Route 51. Route 47's current eastern routing (Blue Ridge Crossing to Plaza) will be joined with Route 51's current northern segment (Plaza to Crown Center/downtown via Broadway).
- ***51 (Broadway):*** The route will be jointly redesigned with Route 47. Route 51's current southern routing (Ward Parkway Center to Plaza) will be joined with Route 47's current northern routing (Plaza via KU Med to downtown). The route will also be extended south from Ward Parkway Center via Ward Parkway and Bannister Road to serve Linden Hills and connect with Troost MAX.
- ***71 (Prospect):*** The route will be adjusted to operate along 11th and 12th Streets.
- ***123 (23rd Street):*** The route will be realigned to provide service through Hospital Hill along 22nd Street, and to the Westside neighborhood along Southwest Blvd to 31st Street.
- ***126 (East 5th Street):*** The route will be discontinued.
- ***247 (Westside MetroFlex):*** Service will be discontinued and replaced with a combination of Routes 27 and 123.

As will be discussed in subsequent sections of this document, the CSA is currently examining and recommending service changes downtown that will further increase efficiency and improve service.

2.3 Parking and Loading

On-street Parking

On-Street parking exists along much of the corridor. With many large and small businesses directly fronting the corridor streets, most blocks have on-street parking (generally time-restricted on weekdays, but unrestricted on weekends) on both sides. **Figure 5** illustrates on-street parking provisions on a block-by-block basis; **Table 3** includes more details of the parking in the area. General characteristics are described below:

- In the Crossroads area, Main Street provides a fairly consistent roadway cross-section, with 1- or 2-hour parking generally allowed on both sides of the street in the outside travel lane during off-peak hours (these vary).
- Within the Downtown Loop, the narrower street width results in less space for on-street parking. There is very little parking on the west side (with 14th-13th being the only full block of parking), and limited parking on the east side (with 13th-12th being the only full block).
- In the River Market area, parking (time-restricted) is allowed along most of the alignment.

Although a comprehensive parking usage analysis has not been conducted along the study corridor, a 2012 downtown parking assessment commissioned by the City found the following average parking occupancy rates in sampled portions of three downtown areas for weekday mid-days:

- CBD: 47.8%
- Crossroads: 69.0%
- River Market: 50.1%

On weekends, parking demand can be heavier surrounding special events, such as the City Market area, but capacity is typically available within reasonable walking distances.

Loading Zones

There are three curbside areas within the corridor that are specifically designated as loading zones (also shown in **Figure 5**):

- Main Street between 8th and 9th Street, east side
- Main Street between 9th and 10th Street, east side (after 6 p.m.)
- Main Street between Truman Road South and 16th Street, west side (7 a.m. – 4 p.m.)

Businesses in the area frequently use loading areas on side streets or in private parking/loading areas, some with access to Main Street.

Figure 5:
Existing On-Street Parking/Loading (Weekday)

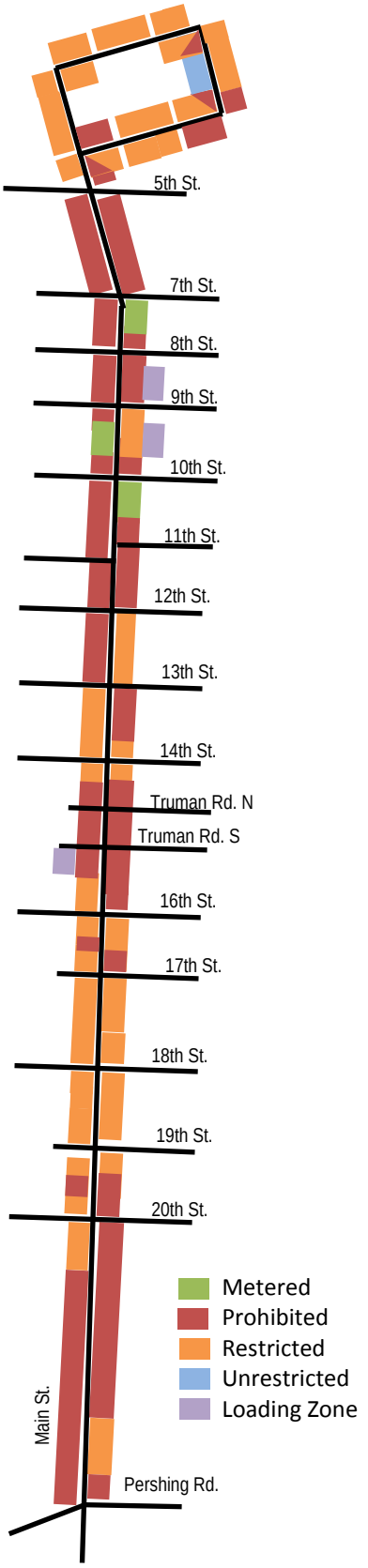


Table 3: On-Street Parking Provisions by Block (Weekday)

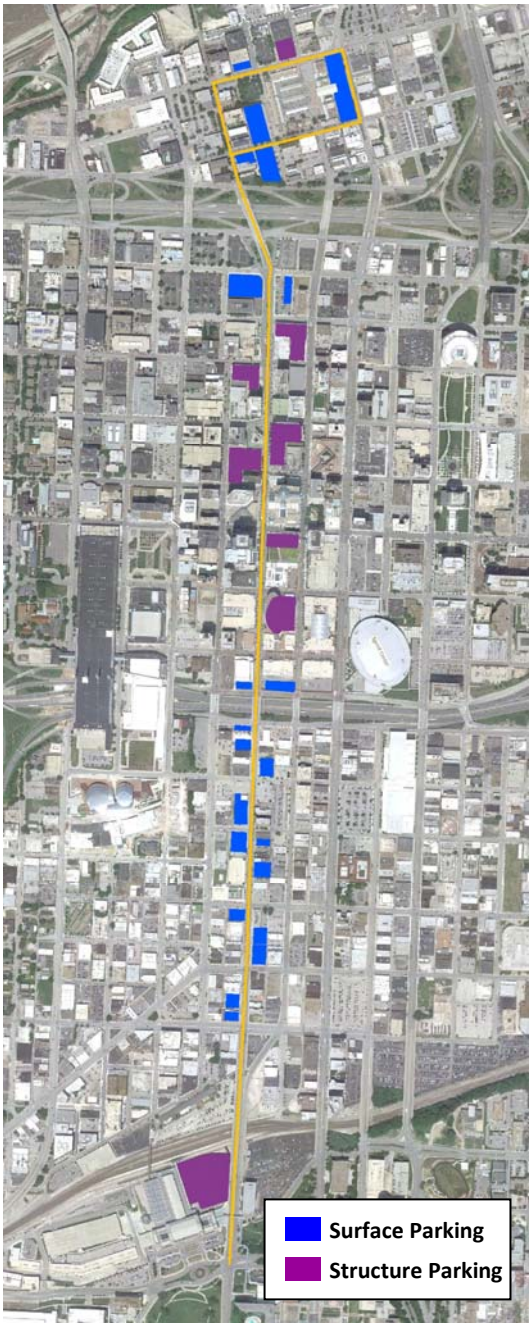
	West Side (SB)	East Side (NB)
Main Street		
Pershing – 20th	300' 2 hr. parking from 7AM-4PM; no parking remainder of section (viaduct)	350' 1 hr. parking from7AM-6PM in front of 2301 Main; no parking remainder of section
20th – 19th	200' 1 hr. parking from 7AM-4PM; no parking remainder of section	50' 1 hr. parking from 9AM-6PM; no parking remainder of section
19th – 18th	1 hr. parking from 7AM-4PM entire length	1 hr. parking from 9AM-6PM
18th – 17th	2 hr. parking from 7AM-4PM entire length	2 hr. parking from 9AM-6PM
17th – 16th	250' 2 hr. parking from 7AM-4PM; no parking remainder of section	200' 2 hr. parking from 9AM-6PM; no parking remainder of section
16th – Truman S	150' 2 hr. parking from 7AM-6PM; no parking remainder of section	No parking
Truman S – Truman N	No parking (bridge)	No parking (bridge)
Truman N – 14th	100' 2 hr. parking from 9AM-4PM; no parking remainder of section	100' 2 hr. parking from 9AM-4PM; no parking remainder of section
14th – 13th	2 hr. parking from 9AM-4PM entire length	100' 2 hr. parking from 9AM-4PM; no parking remainder of section
13th – 12th	No parking	2 hr. parking from 9AM-4PM entire length
12th – 11th	No parking	No parking
11th – 10th	No parking	200' 1 hr. metered parking from 7AM-4PM; no parking remainder of section
10th – 9th	150' 30 min. metered parking from 9AM-6PM; no parking remainder of section	200' 2 hr. parking from 7AM-4PM; no parking remainder of section
9th – 8th	No parking	No parking
8th – 7th	No parking	Metered parking no restrictions
Delaware Street		
7th – 6th	No parking	No parking
6th – 5th	2 hr. parking from 7AM-6PM entire length	No parking
5th –3rd	Head-in diagonal 2 hr. parking from 7AM-6PM	No parking (one-way SB)
Grand Boulevard		
5th – 3rd	Parking (no restrictions) entire length	400' 4 hr. parking from 7AM-6PM; no parking remainder of section

	North Side (WB)	South Side (EB)
3rd Street		
Delaware – Main	2 hr. parking from 7AM-6PM entire length	2 hr. parking from 7AM-6PM entire length
Main – Grand	2 hr. parking from 7AM-6PM entire length	2 hr. parking from 7AM-6PM entire length
5th Street		
Delaware – Grand	2 hr. parking from 7AM-6PM entire length except between Delaware and Main	2 hr. parking from 7AM-6PM entire length except between Walnut and Main

Off-Street Parking

There are multiple surface lots and parking garages along the study corridor. The primary concern related to this study is access to these lots that could potentially be affected by streetcar improvements. **Figure 6** shows the locations of these off-street parking lots. As would be expected, the structures have many more parking spaces than the surface lots, meaning that the traffic volumes entering and exiting these lots (especially during the peak hours) are also higher. Most notably, the block of Main Street between 10th Street and 11th Street has parking structures on both sides, and thus turning movements to and from Main Street on this segment can be heavy during the peak hours. Because there are no mid-block left-turn lanes along this (or almost any other) portion of Main Street, inbound left turns can create lane blockages during peak hours.

Figure 6:
Off-Street Parking
with Direct Access to Study Corridor



2.4 Pedestrians

Evaluation Methodology

The Kansas City Walkability Plan (LSA Associates, Inc., adopted March 2003) established five pedestrian level of service (LOS) measures to assess the walkability of the city, a community, a neighborhood, or a specific project, generally defined as follows for the purposes of this assessment:

- ***Directness:*** actual walk time compared to the minimum walk time characterized by a grid network.
- ***Continuity:*** completeness of the pedestrian system with the avoidance of gaps, and integration with the project and surrounding uses; also includes ADA issues, separation of the sidewalk from the roadway with a landscaped buffer/planters, and maintenance issues.
- ***Street Crossings:*** number of lanes to cross plus pedestrian crossing features such as crosswalks, pedestrian signal features, lighting, median refuge areas, and curb ramps. Signalized and unsignalized crossings are evaluated, as are midblock crossings.
- ***Visual Interest and Amenities:*** aesthetic appearance of the facilities, including presence of landscape/hardscape, parkways, medians, street lights, and adjacent uses, as well as the maintenance of the facilities.
- ***Security:*** visual line of sight, street lighting, and separation from vehicles.

For the purposes of this evaluation, the corridor was divided into five districts, as follows:

1. **Union Station/Crown Center** – represented by the area south of the Main Street viaduct (over the KCT railroad tracks) to Pershing Road.
2. **Crossroads Arts District** – represented by the area between I-670 (Truman Road South) and the Main Street Viaduct.
3. **Power & Light District** – represented by the area between 12th Street and I-670 (Truman Road South).
4. **Financial District/North Loop** – represented by the area between I-70 and 12th Street.
5. **River Market** – represented by the area between 3rd Street and I-70.

Evaluation Results

Each district was rated for each pedestrian LOS measure on a scale of **good/fair/poor**. While the Walkability Plan uses a rating scale from A to F, the good/fair/poor rating simplifies the scale, with LOS A-B representing good, LOS C representing fair, and LOS D-F representing poor. **Table 4** summarizes the evaluation for existing conditions. The findings are described in more detail below.

Table 4: Existing Conditions – Pedestrian Assessment

District	Limits	Pedestrian Level of Service				
		Directness	Continuity	Street Crossings	Visual Interest & Amenities	Security
Union Station/ Crown Center	Pershing Rd to RR Tracks	Good	Good	Fair	Good	Good
Crossroads Arts District	RR Tracks to Truman Rd South	Good	Fair	Fair	Poor	Fair
Power & Light District	Truman Rd South to 12th St	Good	Good	Good	Good	Good
Financial District/ North Loop	12th St to I-70	Good	Good	Fair	Fair	Good
River Market	I-70 to 3rd St	Good	Good	Fair	Good	Good
Overall Alignment		**Good**	**Good**	**Fair**	**Fair**	**Good**

Directness: The directness of the pedestrian network in each district is assessed as **good**, because each area has a grid network within one-quarter mile of the corridor.

Continuity: The corridor features a complete sidewalk system, with only a few minor sidewalk gaps in the system off of the corridor, primarily on the side streets. For this reason, the corridor generally received **good** ratings, although one specific area received a lesser rating of fair. The Crossroads Arts District has more maintenance issues with cracked, broken, and overgrown sidewalks compared to other districts. The maintenance issues, as well as more numerous ADA issues in this district, led to a rating of **fair**.

Street Crossings: Street crossings along the corridor can generally be rated as **fair**. The widths and crossing distances vary along the corridor. The corridor includes marked crosswalks, countdown pedestrian signals, and curb ramps. Street crossings were assessed as **fair** in most districts because while features are provided to help pedestrians cross the street, there is room for improvement in many locations. Many crosswalk markings are faded, some pedestrian signals do not provide countdown indications, and a few signalized intersections do not provide any pedestrian signals at all. The majority of intersections use a single curb ramp per corner, and many ramps do not have detectable warnings. The district with the most complete street crossings is the Power & Light District.

Visual Interest and Amenities: Although the aesthetic appearance of the pedestrian facilities along the corridor could generally be rated overall as fair, the ratings within the various districts range from good in the Union Station/Crown Center, Power & Light, and River Market Districts, to fair in the Financial District/North Loop, to poor in the Crossroads Arts District. Lighting, landscaping, and maintenance also contribute to these ratings.

Security: Security is generally judged to be good, based on lighting, and generally unobstructed lines of sight. Further, while most of the sidewalks are located at the back of curb and the majority of the corridor does not have planters or landscape buffers, the widths of the sidewalks and frequent presence of on-street parking provide sufficient separation from traffic.

Overall, four of the five districts received more ratings of “Good” than any other type of rating. The exception is the Crossroads Arts District, which received one “Good” rating, three “Fair” ratings and one “Poor” rating.

2.5 Bicycles

The bicycling environment has been assessed based on two measures: the general bicycle environment and connections, and existing bicycle parking facilities. Like the pedestrian analysis, the bicycle analysis is divided into five districts.

General Bicycle Environment: No designated or exclusive bicycle facilities are provided today on the corridor or any of the cross-streets, with the exception of recently implemented Bike Route signs on 3rd Street. Although the current configuration would likely only attract experienced, confident cyclists, the environment is fair for bicycling. The multi-lane configuration in particular makes it easier for motorists to pass cyclists, even those that are controlling a lane.

Bicycle Parking/Sharing: The level of existing bicycle parking is a good measure of the overall bicycle friendliness of the corridor. **Figure 7** shows traditional bicycle parking locations in the corridor (as reported by kcbike.info). There are 30 designated secure bike parking locations in the corridor, and an additional 39 locations within one block on either side of the corridor.

However, in addition to these traditional bike parking locations, a significant recent bicycle enhancement has been made downtown, and specifically at several points along the study corridor, with the implementation of Kansas City B-Cycle, a bike-sharing system serving Downtown with 12 stations and 90 bicycles. (See **Figure 8.**)

Kansas City B-Cycle offers a two-step system: users purchase an access pass (available options: daily, weekly, monthly, and yearly), which in turn allows them to "check out" a bicycle from any station for a small fee per half-hour (with the first half-hour free). There are currently three stations along the study corridor:

- 3rd/Grand: 10 docks
- 10th/Main: 10 docks
- Union Station: 14 docks

There are four additional stations within 2 blocks of the corridor:

- 12th/Wyandotte: 11 docks
- 13th/Grand: 15 docks
- 20th/Grand: 11 docks
- Crown Center: 13 docks

Kansas City B-Cycle uses GPS to track riders and provide bicycle and dock availability in real-time with a mobile app. Kansas City B-Cycle was implemented in early July 2012.

Figure 7: Bicycle Parking in the Downtown Area

Source: http://kcbike.info/maps/parking

Figure 8: B-Cycle Locations

Source: http://www.kc.bcycle.com

Evaluation Results

The bicycle evaluation results for the study corridor are summarized in **Table 5.** As mentioned above, the general bicycle environment is considered fair throughout the corridor. Bicycle parking is considered good near Union Station/Crown Center (largely due to the addition of B-Cycle), poor in the Crossroads District, and fair in the remainder of the corridor – for an overall corridor rating of fair.

Table 5: Existing Conditions – Bicycle Assessment

District	Limits	Bicycle Level of Service	
		Bicycle Parking	Bicycle Environment/ Connections
Union Station/ Crown Center	Pershing Rd to RR Tracks	Good	Fair
Crossroads Arts District	RR Tracks to Truman Rd South	Poor	Fair
Power & Light District	Truman Rd South to 12th St	Fair	Fair
Financial District/ North Loop	12th St to I-70	Fair	Fair
River Market	I-70 to 3rd St	Fair	Fair
Overall Alignment		Fair	Fair

2.6 Freight

Kansas City does not have a designated truck routing system; the only general regulatory restriction on trucks is on the City's Boulevard system – which, on the study corridor, would include the short segment of Grand Boulevard between 3rd Street and 5th Street. Therefore, on all other portions of the study corridor, trucks are not explicitly prohibited.

According to recent count data, truck volumes on Main Street within the study corridor vary from 6 to 8 percent of weekday daily traffic. In the River Market, truck percentages are generally lower (3 to 5 percent) with the exception of 3rd Street, which has a truck volume of approximately 12 percent of daily traffic. **Table 6** includes truck percentage data.

Table 6: Existing Conditions – Truck Percentages

3rd – Walnut to Grand	12%
5th – Main to Walnut	4%
Delaware – 4th to 5th	3%
Main	
9th to 10th	7%
14th to Truman	6%
North of Pershing	8%

Source: City of KCMO and HDR Engineering, Inc.

Most of the truck traffic on Main Street is likely related to deliveries, and so loading is important for businesses along this route. On-street loading zones were identified previously in this document.

The heavier truck percent on 3rd Street has historically been a cause for concern among local residents and businesses. Industrial truck traffic from the West Bottoms area is known to use this route to connect to I-35 via Front Street, as well as other destinations to the north and east.

Within the Downtown Loop, as is typical in constrained urban downtown areas, curb radii are generally tight and truck turns are difficult. Existing curb radii generally fall in the 10- to 15-foot range. It should be noted that during times when on-street parking is prohibited, truck left turns from east-west cross-streets onto the sections of Main Street with two lanes in a given direction are slightly easier because trucks can make a wider turn into the outside lane.

3. EFFECTS OF ALTERNATIVES CONSIDERED

3.1 No-Build Alternative

The No-Build Alternative assumes the proposed streetcar facilities would neither be constructed nor operate in the corridor. The Year 2015 was selected as the evaluation year in order for the No-Build Alternative to be directly comparable to the Streetcar Alternative, which is expected to have an opening year of 2015. As described in this section, the primary changes expected between existing conditions and 2015 are modest traffic growth, changes to existing bus transit service, and potential ADA-compliance improvements to sidewalks.

No-Build Alternative: Traffic Effects

In the future, weekday traffic volumes on the corridor are expected to increase due to continued downtown development and re-development. However, by 2015, traffic is not expected to increase by more than six percent. Thus, the current volumes with some modest background growth have been used for a planning-level traffic operations analysis.

In addition, there are downtown transportation initiatives underway that would affect north-south circulation in the corridors adjacent to Main Street. Walnut Street (parallel to Main Street a block to the east) is expected to be converted to two-way operation between 6th Street and 12th Street, as is Baltimore Avenue (a block to the west) between 9th Street and 12th Street. Both segments currently operate as one-way northbound facilities. For the purposes of this analysis, both of these conversions were assumed to be in place by 2015 under any scenario. To account for the effects of any diversion/redistribution between the three routes, KCMO's travel demand model was run for existing conditions with the conversions in place. These redistribution effects were added to the growth effects described above.

Figure 9 illustrates the peak-hour traffic volumes used for the 2015 No-Build operational analysis.

Table 7 summarizes the results of the operational analysis for 2015 No-Build conditions. Two intersections are forecasted to operate unacceptably:

- *Main Street/10th Street (Intersection #14):* The intersection is forecasted to operate at LOS E during the p.m. peak hour. The critical movement is the southbound shared through-left movement, which is projected to operate at LOS F.

- *3rd Street/Grand Boulevard (Intersection #23)*: The northbound shared through-left movement at this unsignalized intersection is forecasted to operate at LOS E during the p.m. peak hour.

Four of the study intersections (#1, #8, #15, and #17), projected to operate at acceptable levels of service, have one or more individual movements forecasted to operate at LOS E or worse. These are not considered unacceptable conditions, but are noted as discussed earlier in the methodology.

Figure 9: 2015 No-Build Traffic Volumes

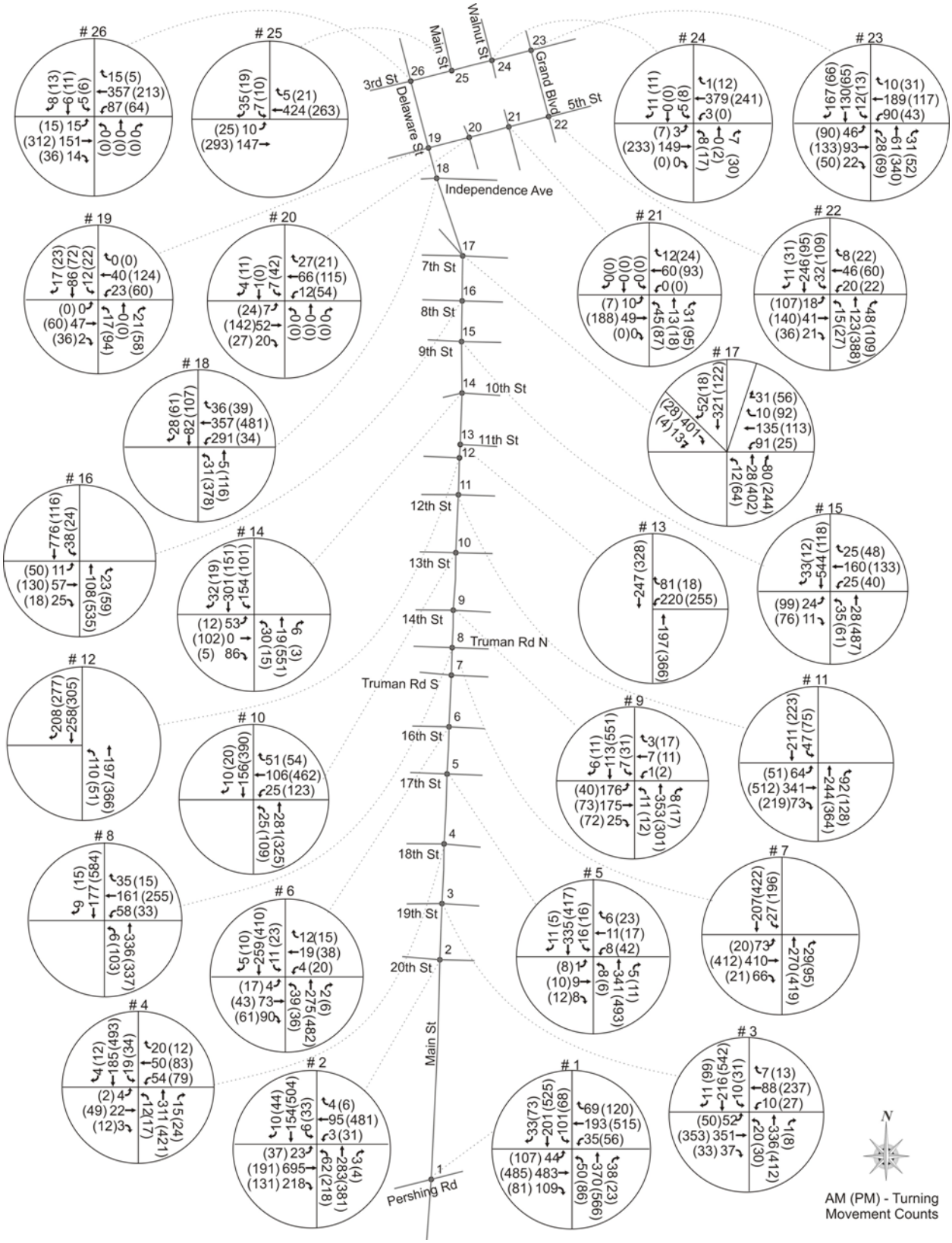


Table 7: 2015 No-Build Levels of Service at Study Area Intersections*

	Existing Conditions				No-Build Conditions			
	A.M. Peak		P.M. Peak		A.M. Peak		P.M. Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1. Main/Pershing	23.4	C	26.1**	C	24.0	C	27.2**	C
2. Main/20th	17.9	B	16.3	B	21.2	C	19.7	B
3. Main/19th	14.2	B	17.7	B	14.4	B	19.6	B
4. Main/18th	11.5	B	22.1	C	11.9	B	23.6	C
5. Main/17th	*16.9*	*c*	*25.7*	*d*	*17.8*	*c*	*30.7*	*d*
6. Main/16th	*16.9*	*c*	*20.7*	*c*	*16.2*	*c*	*22.9*	*c*
7. Main/Truman (S)	11.2	B	15.5	B	11.6	B	16.0	B
8. Main/Truman (N)	9.1	A	28.8	C	8.7	A	35.7**	D
9. Main/14th	14.9	B	23.7	C	14.9	B	22.2	C
10. Main/13th	12.1	B	22.3	C	12.0	B	20.3	C
11. Main/12th	12.5	B	14.2	B	12.5	B	13.0	B
12. Main/11th (S)	1.6	A	1.4	A	2.0	A	4.2	A
13. Main/11th (N)	7.4	A	10.0	A	10.2	B	9.5	A
14. Main/10th	12.4	B	25.8	C	10.3	B	55.6	E
15. Main/9th	16.0	B	19.7	B	16.0	B	34.5**	C
16. Main/8th	18.2	B	11.5	B	19.3	B	12.2	B
17. Main/7th	29.1	C	18.5	B	32.4**	C	20.5	C
18. Delaware/Independence	11.5	B	24.3	C	11.7	B	30.9	C
19. Delaware/5th	*7.9*	*a*	*9.1*	*a*	*7.9*	*a*	*9.6*	*a*
20. 5th/Main	*9.7*	*a*	*12.5*	*b*	*9.7*	*a*	*13.0*	*b*
21. 5th/Walnut	*7.8*	*a*	*9.4*	*a*	*7.8*	*a*	*9.6*	*a*
22. 5th/Grand	11.8	B	15.2	B	12.0	B	15.5	B
23. 3rd/Grand	*14.9*	*b*	*33.7*	*d*	*16.4*	*c*	*45.2*	*e*
24. 3rd/Walnut	*12.6*	*b*	*12.1*	*b*	*13.2*	*b*	*12.5*	*b*
25. 3rd/Main	*11.8*	*b*	*11.3*	*b*	*12.0*	*b*	*11.7*	*b*
26. 3rd/Delaware	*16.1*	*c*	*15.0*	*c*	*17.0*	*c*	*16.0*	*c*

**Italicized intersections with lower-case LOS values are unsignalized, and the delay/LOS reported are for the worst movement at the intersection.*

***One or more individual movements at the intersection operates at LOS E or worse.*

Source: HDR Engineering, Inc.

No Build Alternative: Transit Effects

As part of the aforementioned CSA, KCATA is currently developing plans regarding downtown bus transit (in addition to the very near-term changes planned for October 2012) – and it is anticipated that these plans would be in place by 2015 regardless of the implementation of the Streetcar Project. The major objective for the reconfiguration of downtown bus service is to make it simpler and more understandable, with the following guiding principles:

- Circulation patterns should be simple so that passengers can easily learn and remember where to catch the bus.
- Transfers should be possible between any two downtown routes without walking farther than across the street, or one block in cases where bus service operates on one-way pairs.
- Transit should operate on streets that are compatible with high levels of bus service.
- Ideally, downtown routes should serve both the Financial and Government Districts.
- Services that operate from the same origin area (e.g. north, south, east, west.) should use the same alignment downtown so that passengers can easily use all routes that serve their destination.

To achieve the above**,** currently contemplated service reconfiguration plans include the following elements:

- Operate nearly all local routes to one of three major locations in Downtown Corridor: (1) 10th/Main Transit Center, (2) East Village, or (3) Crown Center (exceptions would be the two MAX routes that operate through the Financial and Government districts (as well as Route 12 [12th Street], Route 109 [9th Street], and Route 25 [Troost Local] which would mirror Troost MAX service).
- Use 11th Street and 12th Street for most east-west service.
- Configure routes so that transfers are possible between all routes (between most routes at 11th Street/Grand Boulevard and 12th Street/Grand Boulevard).
- Most routes that operate from the east and northeast would operate via 11th Street and 12th Street to the 10th/Main Transit Center.
- Most local routes from the Northland would operate to the 10th/Main Transit Plaza.
- Most express routes from the Northland would operate via the Financial and Government Districts via Grand Boulevard to Crown Center.
- Most routes from the south would operate to the 10th/Main Transit Plaza (but layover on 7th Street).
- Most routes from the west would operate to East Village.

These service plan proposals are still under study and will undergo a public process.

No Build Alternative: Parking and Loading Effects

The City is developing a parking management strategy designed to optimize parking regulations downtown. This would certainly include modifying time restrictions on many corridors, potentially including Main Street. Ultimately, the City is interested in converting "part-time" parking/loading on many downtown corridors to either "full-time" parking/loading or "full-time" traffic lanes. The primary motivation for such a modification would be to provide motorists (especially unfamiliar motorists) with consistent expectations regarding the status of the outside lane, regardless of time of day.

The priority and timeline for any individual roadway section remains to be determined by the City, so at the time of preparing this technical report, it is unknown how much, if any, of the study corridor would have been converted by 2015. It is assumed that parking and loading regulations in this corridor would not have been changed by 2015 in the No-Build condition.

There are also no known changes forthcoming related to off-street parking conditions.

Based on this analysis, parking and loading conditions would remain unchanged in the No-Build condition.

No Build Alternative: Pedestrian Effects

A recent agreement between the City of Kansas City, Missouri and the United States Department of Justice (DJ 204-43-195, July 25, 2012), has relevance to pedestrian conditions along the corridor by the year 2015. The agreement is a settlement regarding ADA compliance issues, and has several components, but its sidewalk component is of particular relevance here. This portion of the agreement has several provisions (abbreviated here):

- By July 2013, the City would have developed a written process for soliciting/receiving input from persons with disabilities regarding the accessibility of its sidewalks.
- By July 2018, the City would have implemented curb ramps (or sloped areas), compliant with applicable standards, at all intersections and level pedestrian walkways constructed or altered since January 26, 1992.
- By October 2013, The City would begin including curb ramps (or sloped areas), compliant with applicable standards, with all new construction or alteration of intersections or pedestrian walkways.

The priority and timeline for any individual roadway section remains to be determined by the City, so at the time of preparing this technical report, it is unknown how much, if any, of the study corridor would be upgraded to compliance by 2015. It is assumed that no accessibility improvements would have been made in the study corridor by 2015 under the No-Build condition.

No Build Alternatives: Bicycle Effects

Bicycle Routes

The future of Kansas City's bicycle routes is guided by the *BikeKC* plan. The plan includes over 600 miles of planned bicycle facilities throughout the city. By the end of 2012, a significant portion of these facilities would be implemented. **Figure 10** illustrates the *BikeKC* routes that would be implemented in the downtown area; the figure also shows the study corridor for context. In 2010, the anticipated signed bike routes were upgraded with hazard mitigation treatments (bike-friendly sewer grates, etc.) in order to prepare for the upcoming implementation.

Three of these *BikeKC* segments overlap with the study corridor:

- 3rd Street, Delaware Street to Grand Boulevard
- Grand Boulevard, 3rd Street to 5th Street
- Main Street, 11th Street (N) to 11th Street (S)

Several routes also cross or intersect the study corridor:

- 5th Street (intersects, but does not cross, Grand Boulevard from the east)
- 11th Street (crosses Main Street westbound, with a jog onto Main Street as discussed above)
- 12th Street (crosses Main Street eastbound)
- 19th Street (crosses Main Street eastbound/westbound)
- 20th Street (crosses Main Street eastbound/westbound)

Figure 10: *BikeKC* Plan Near-Term Implementation - Downtown

Source: City of KCMO and HDR Engineering, Inc.

The City is currently assembling funding to develop a Bicycle Master Plan that would further enhance the *BikeKC* plan, including an engineering component that would evaluate the physical feasibility of different facility types along bicycle routes. It is expected that this Master Plan would be in place by 2015, but that no additional bicycle-related improvements would have been made downtown beyond those shown in **Figure 10**.

Bicycle Parking

The City has received federal funding to expand bicycle parking in the Downtown area, which could add 25 or more racks – some potentially on or near the corridor. It is anticipated that this program would be unveiled toward the end of 2012; specifics are still being developed.

The B-Cycle bike-sharing program is also expecting to expand in the future, although there are no definite plans or funding sources identified at this time. More locations in the downtown area may be pursued, but for the purposes of a 2015 analysis, no new facilities are assumed.

No Build Alternative: Freight Effects

At the time of preparation of this document, there are no known changes affecting freight and loading on the study corridor for the 2015 No-Build scenario – except for the effects of the conversion of Walnut Street and Baltimore Street to two-way operations, which could increase freight delivery flexibility on those two streets and thereby potentially reduce some freight movements on Main Street.

3.2 Streetcar Alternative

Other documents have defined the Streetcar Alternative in detail, but key elements relevant to this analysis are as follows:

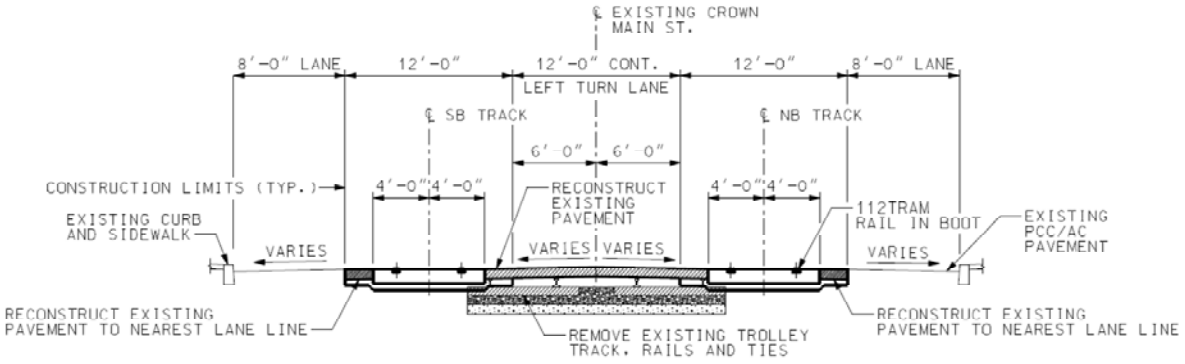
- The approximately 2-mile streetcar route (3.9 miles round-trip) would run from Union Station/Crown Center (Main Street just north of Pershing Road) to the River Market (3rd Street/Grand Boulevard), routed along Main Street to Delaware Street with a counterclockwise loop around the City Market on 5th Street/Grand Avenue/3rd Street/Delaware Street. The route would have 11 stops: Union Station (Main Street just north of Pershing Road - center stop), Main Street/20th Street (both sides), Main Street/18th Street (both sides), Main Street/16th Street (both sides), Main Street/14th Street (both sides), Main Street/12th Street (both sides), Main Street/10th Street (both sides), Main Street/8th Street (both sides), 5th Street/Walnut Street (eastbound only), 3rd Street/Grand Boulevard (westbound only), and Delaware Street/4th Street (southbound only).

- Proposed hours of operation, and frequency, would be as shown below:

Days	Hours	Frequency (mins)
Monday - Thursday	6 AM – 9 PM	10
	9 PM – 12 AM	20
Friday and Saturday	6 AM - 2 AM	10
Sundays	8 AM - 9 PM	20

- The streetcar vehicles would run in mixed traffic, with rails embedded in the vehicular travel lanes, for the majority of the route except the portion between 20th Street and Pershing Road, where they would run in the median. Stops would be on the outside (curb side) and generally on the far side of the intersection, except for the Union Station stop, which would be in the median north of Pershing Road. Below is a typical section in the Crossroads area.

- The streetcar vehicles are expected to be able to carry approximately 100-120 passengers.



- The Streetcar improvements would convert much of the Main Street portion of the route (from 9th Street to 20th Street) to a 3-lane cross section (one through travel lane in each direction plus a center turn lane, plus dedicated parking – often on both sides). Right-turn lanes would also be added at spot locations as determined necessary.

Streetcar Alternative: Traffic Effects

The streetcar vehicles would travel in a standard drive lane for most of the route. The streetcar would affect roadway capacity in a manner similar to a bus traveling in the drive lane, including lane blockages during passenger boarding and alighting – an approximate 20-second dwell time.

As described previously – in conjunction with the implementation of the streetcar, the geometry of Main Street would be modified to convert "part-time" parking to "full-time" parking along the majority of the corridor. Generally, Main Street would be converted to a three-lane travel section (one lane in each direction plus a center turn lane). **Figure 11** illustrates the proposed lane configuration along Main Street and at each of the study intersections.

In addition to the geometric changes, traffic control modifications are proposed with the streetcar:

- At the three currently unsignalized locations where the streetcar would need to make a turn (Delaware Street/5th Street, 3rd Street/Delaware Street, 3rd Street/Grand Boulevard – all in the River Market area), signalization is assumed under Build conditions. In addition, the intersection of Main Street/16th Street is proposed for signalization, since a stop will be located near it and additional control would be useful.
- There are also two locations at which signals are proposed to be removed: The intersections of Main Street with 8th Street and 9th Street. Traffic volumes are low enough that these intersections do not appear to warrant signalization, and removing the signals would reduce delays along the study corridor. The justification for these removals would be further analyzed and refined as design moves forward.
- A transit-only phase would need to be implemented at the intersection of 20th and Main Street, to allow northbound streetcars to move from the median to the mainline through lane.

Signal timing and operational strategies at a more global level would also need to be modified in conjunction with the proposed streetcar. As the downtown continues to resurge, there are larger efforts being initiated to develop a broad transportation strategy involving one-way conversions, signal coordination, signal removals, parking management, highway access, and more. Such downtown-wide planning efforts are beyond the scope of this analysis, but it is important to be aware of them in performing a focused analysis of Build conditions along the study corridor. Certain elements of this wide-scale planning (two-way conversions on Walnut Street and Baltimore Avenue) were incorporated into the traffic analysis due to their proximity to the study corridor.

The effects of the proposed conversion of Main Street to a three-lane section were tested using the City's travel demand model. The model predicts that a portion of the traffic on Main Street would shift to other routes in the area; **Figure 12** shows the resulting volumes remaining on Main Street. At the model level, adjacent parallel streets (Walnut Street, Baltimore Avenue) were examined and it was found that no street would be expected to increase to a volume-to-capacity (v/c) ratio (measuring the ratio of the amount of traffic carried by a street to that street's traffic-carrying capacity) substantially above 0.80 as a result of the streetcar alternative; therefore, it was considered reasonable to keep the study focus on Main Street.

Figure 11: 2015 Streetcar Alternative – Roadway/Intersection Geometry

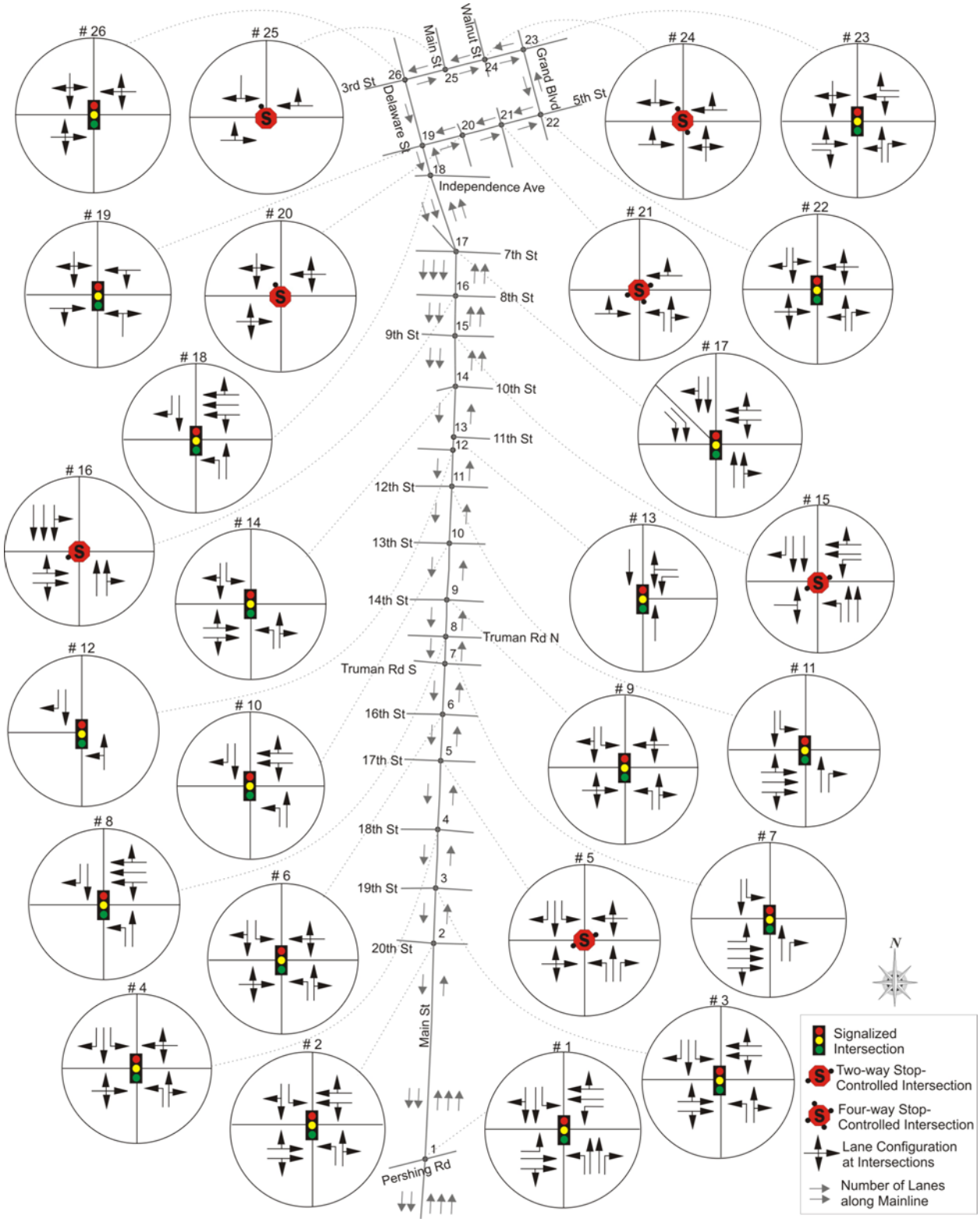
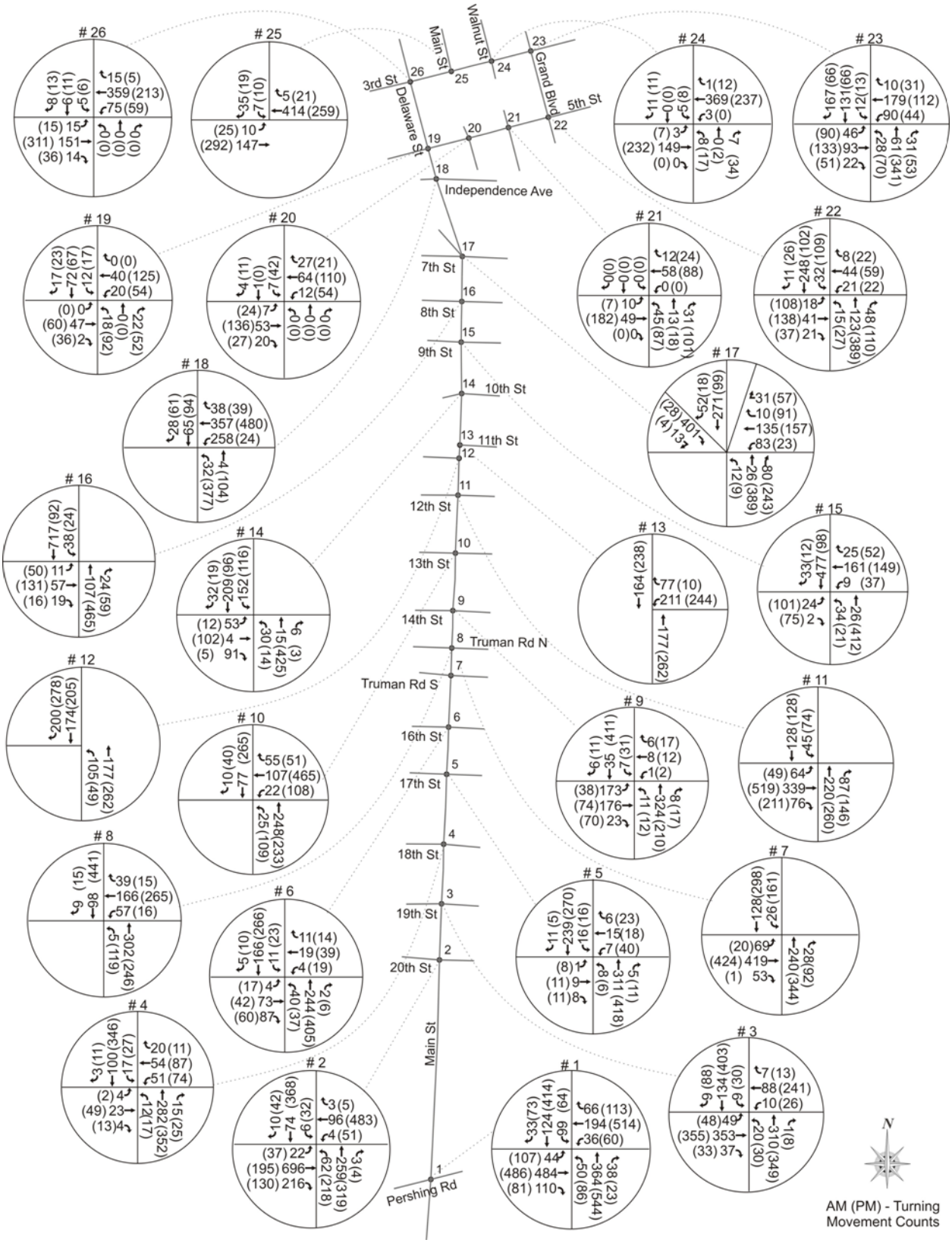


Figure 12: 2015 Streetcar Alternative – Peak-Hour Turning-Movement Volumes



To estimate the effects of the streetcar on traffic operations, the anticipated headways (10 minutes per direction) and dwell times (20 seconds) for the proposed streetcar were incorporated into the percentile-delay method as all-red signal phases (such that 30 percent of cycles would include such a phase). At this time, a definitive strategy for signal timing/coordination along the corridor, including integration with the entire downtown signal system, has not been established by the City (although it is being discussed). For the purposes of this analysis, semi-actuated signals were assumed, with most lanes running to their maximum green times (some turns were modeled as actuated); this approach is fairly conservative in that it does not assume a tightly-coordinated Main Street. With Transit Signal Priority (TSP) implemented at each intersection, several operational strategies could be applied, and this modeling approach was used to represent a middle ground.

Table 8 summarizes the results of the operational analysis for the Streetcar Alternative in comparison with those of the No-Build scenario. As the table shows, the reductions in throughput capacity are generally predicted to be offset by the volume shifts previously described, and all study intersections are forecasted to operate at LOS D or better (and almost all at LOS C or better). The two intersections projected to operate unacceptably under No-Build conditions would improve to acceptable levels of service, one (Main Street/10th Street – Intersection #14) due to volume shifts and the addition of a left-turn lane, and one (3rd Street/Grand Boulevard – Intersection 23) due to signalization. Other intersections would similarly benefit from volume shifts, left-turn lane additions, and a modified corridor-wide signal-timing strategy. At two of the study intersections (#1 and #17), individual movements would operate at LOS E; as discussed before, these are not considered impacts but are noted for future reference during the design phase.

The three-lane section would also improve access and safety for left-turning vehicles on Main Street.

In general, the streetcar would be designed to maximize safety in its interactions with traffic. The streetcar would run with traffic, and would follow the same rules of the road as vehicles – except at locations where special transit-only signal phases would be added to facilitate safe streetcar movements (mainly turns). Streetcar operators would be required to meet applicable safety training and performance criteria.

The streetcar would not be expected to have a substantial impact on emergency response services. On either end of Main Street (north of 9th Street and south of 20th Street), multiple through lanes in each direction would allow emergency vehicles to pass the streetcar at any time. In the three-lane sections, the center turn lane would provide a potential area for emergency vehicles to bypass streetcars. Inside the Downtown Loop and in the River Market area, the situation would be somewhat similar to the situation encountered under existing conditions with a bus traversing the corridor. The inclusion of transit preemption on the signals throughout the corridor could also allow the inclusion of emergency vehicle preemption, enhancing response times. There are no emergency vehicle stations located directly on the corridor; thus, it is anticipated that emergency responders would generally travel the corridor only for emergencies specifically on the corridor. Parallel routes (such as Grand Boulevard) are also available for north-south emergency vehicle travel.

Table 8: 2015 Streetcar Alternative Levels of Service, Study Intersections*

	2015 No-Build Conditions				2015 Streetcar Alternative			
	A.M. Peak		P.M. Peak		A.M. Peak		P.M. Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1. Main/Pershing	24.0	C	27.2**	C	20.8	C	27.0**	C
2. Main/20th	21.2	C	19.7	B	28.5	C	25.1	C
3. Main/19th	14.4	B	19.6	B	13.7	B	16.7	B
4. Main/18th	11.9	B	23.6	C	21.1	C	24.0	C
5. Main/17th	*17.8*	*c*	*30.7*	*d*	*13.3*	*b*	*15.5*	*c*
6. Main/16th	*16.2*	*c*	*22.9*	*c*	17.4	B	22.6	C
7. Main/Truman (S)	11.6	B	16.0	B	11.8	B	20.5	C
8. Main/Truman (N)	8.7	A	35.7**	D	12.3	B	24.2	C
9. Main/14th	14.9	B	22.2	C	26.2	C	22.2	C
10. Main/13th	12.0	B	20.3	C	12.6	B	18.2	B
11. Main/12th	12.5	B	13.0	B	17.9	B	18.5	B
12. Main/11th (S)	2.0	A	4.2	A	*3.7*	*a*	*1.8*	*a*
13. Main/11th (N)	10.2	B	9.5	A	18.0	B	24.0	C
14. Main/10th	10.3	B	55.6	E	14.7	B	27.7	C
15. Main/9th	16.0	B	34.5**	C	*26.0*	*d*	*21.8*	*c*
16. Main/8th	19.3	B	12.2	B	*24.2*	*c*	*18.0*	*c*
17. Main/7th	32.4**	C	20.5	C	32.9**	C	13.8	B
18. Delaware/Independence	11.7	B	30.9	C	11.4	B	17.8	B
19. Delaware/5th	*7.9*	*a*	*9.6*	*a*	10.0	A	10.5	B
20. 5th/Main	*9.7*	*a*	*13.0*	*b*	*9.5*	*a*	*12.5*	*b*
21. 5th/Walnut	7.8	a	9.6	a	*7.6*	*a*	*9.3*	*a*
22. 5th/Grand	12.0	B	15.5	B	11.7	B	15.1	B
23. 3rd/Grand	*16.4*	*c*	*45.2*	*e*	18.2	B	20.0	B
24. 3rd/Walnut	*13.2*	*b*	*12.5*	*b*	*11.7*	*b*	*11.6*	*b*
25. 3rd/Main	*12.0*	*b*	*11.7*	*b*	*11.9*	*b*	*11.4*	*b*
26. 3rd/Delaware	*17.0*	*c*	*16.0*	*c*	22.8	C	16.6	B

**Italicized intersections with lower-case LOS values are unsignalized, and the delay/LOS reported are for the worst movement at the intersection.*

***One or more individual movements at the intersection operates at LOS E or worse.*

Source: HDR Engineering, Inc.

Streetcar Alternative: Transit Effects

Additional local bus service changes that would be required with the implementation of streetcar service would be minor, and largely related to stop location issues. It is expected that the basic route structure could remain the same. However, in some locations – particularly in the vicinity of the 10th and Main Transit Plaza along Main Street between 10th Street and 12th Street – some bus stops might need to be shifted. Joint use of stops by streetcar service and local bus service (Routes 47 and 51) would also be desirable. In addition, some potential conflicts between bus and streetcar service could be avoided by shifting some bus service between 10th Street and 12th Street from Main Street to Walnut Street.

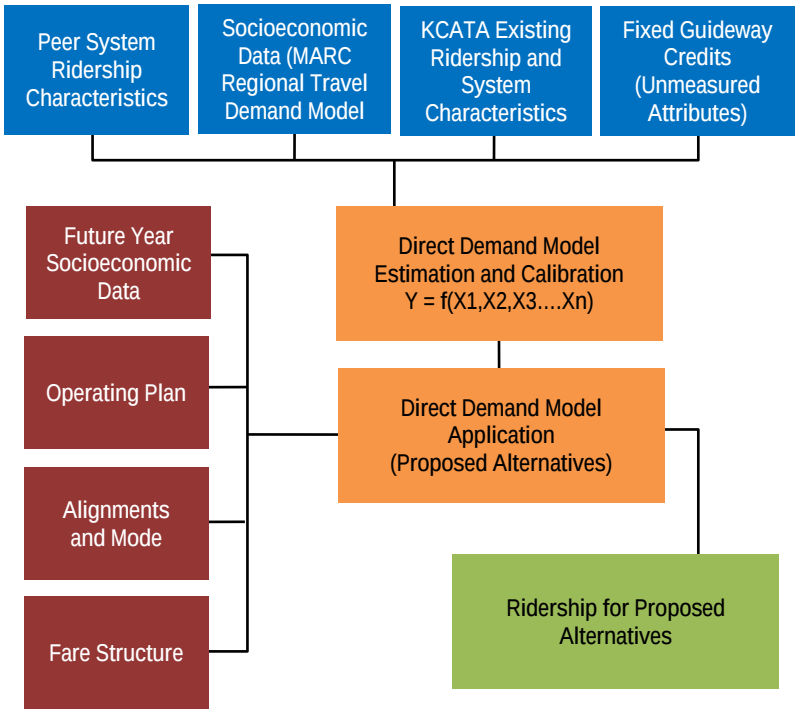
Streetcar Ridership Methodology

Transit ridership for a given route depends on various factors including:

- socio-economic characteristics,
- site conditions,
- transit supply variables,
- stop locations, etc.

A sketch-level direct-demand model was developed in order to observe the relationship of these variables with transit ridership and develop an instrument that could be applied to predict ridership for future conditions. A key underlying assumption is that observed transit usage in the area is an indicator of future transit usage. Multivariate regression analysis was conducted using existing ridership data obtained from KCATA, and socioeconomic data extracted from the Mid-America Regional Council (MARC) regional travel demand model, in order to develop a linear functional form that expresses ridership as a function of population, employment, and hotel-motel rooms within a quarter-mile of the proposed Streetcar alignment. Peer-system ridership characteristics and fixed-guideway credits associated with unmeasured variables were utilized to develop mode-specific coefficients. **Figure 13** shows the overall model development and application process. **Figure 14** graphically illustrates existing the transit boarding and alighting data that was used in the model development.

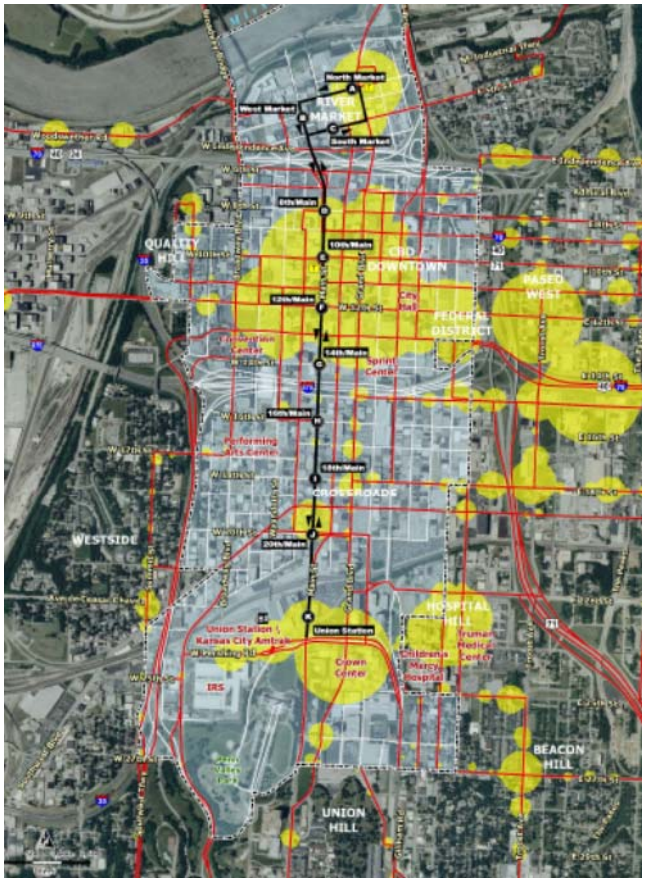
Figure 13: Direct Demand Ridership Modeling Methodology



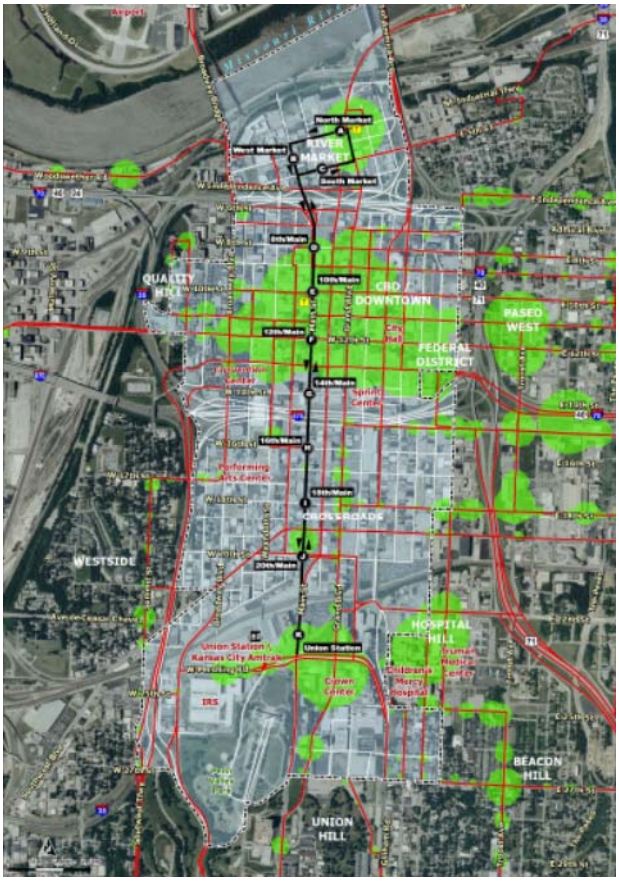
Source: HDR Engineering

Figure 14: Existing KCATA Boardings and Alightings – Downtown Area

Boardings



Alightings



Source: HDR Engineering

Streetcar Ridership Results

Once developed, the model was applied in order to generate opening year (2015) ridership forecasts for a typical weekday, as shown in **Table 9**. The ridership forecasts are based on MARC's adopted land-use projections. The opening year (2015) ridership potential of the alignments are compared to the existing peer systems in **Figure 15**.

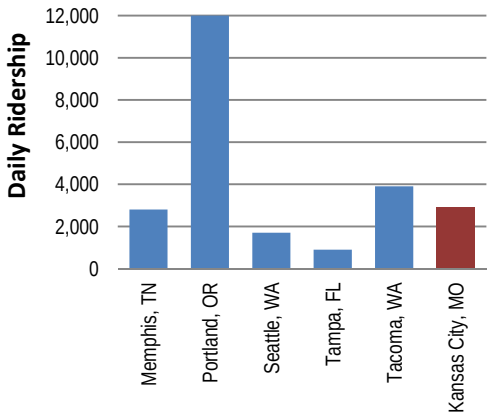
It is important to mention that the ridership forecasts are conservatively low in the sense that event-related riders have not been adequately captured in this analysis. A large event-related transit ridership market exists in the study area which was not analyzed due to the lack of readily available data. Several private charter and shuttle buses currently serve the event patrons traveling between hotels and venues. The ridership of the proposed system may increase substantially depending on how these event-related transit services are configured when the Streetcar Project is in operation. Also, the analysis assumed that the existing Main Street MAX would be re-routed to Grand Boulevard within the study area. However, it has not been decided whether this route shift is desirable or could be achieved given that there has been a substantial investment in the corridor and the MAX could potentially complement the Streetcar Service better as currently configured. Coordination with local stakeholders and FTA would be required to reach a decision on the integration of the Streetcar and MAX services. Similarly, some of the KCATA local bus routes may be modified to feed the Streetcar system as opposed to providing competing services. These opportunities will be further investigated and analyzed in the subsequent phase of the CSA and will include public and stakeholder feedback. It is also important to note that the ridership forecasts were not developed to satisfy FTA New Starts/Small Starts requirements; additional analysis would be required following FTA forecasting guidelines if FTA Section 5309 funds were to be pursued for the Streetcar Alternative.

Table 9:
Opening Year (2015) Ridership Forecasts By Streetcar Stop

3rd/Grand	51
5th/Walnut	43
4th/Delaware	25
8th/Main	208
10th/Main	499
12th/Main	811
14th/Main	248
16th/Main	84
18th/Main	141
20th/Main	243
Union Station	333
Total	**2,686**

Source: HDR Engineering, Inc.

Figure 15:
Opening Year Ridership Comparison with Existing Peer Systems



Source: HDR Engineering, Inc.

The streetcar is not expected to have a substantial negative effect on ridership on the existing bus system; it is intended to complement the largely commute-based system by providing a local circulation component.

Streetcar Alternative: Parking and Loading Effects

On-street

Much of Main Street will be converted from a four-lane street with no dedicated turn lanes to a three-lane street with dedicated turn lanes and dedicated on-street parking. On many parts of Main Street, the outer travel lanes currently allow parking during off-peak periods only. With the Streetcar Project, over 4,000 feet of Main Street would have a reconfigured cross-section that would allow dedicated on-street parking at all times of day, not just during off-peak periods – increasing the total hours of parking availability (see **Table 11**). Approximately 1,745 feet of parking would be lost due to the addition of platforms at Streetcar stops, right-turn lanes and track design needs. This loss is not considered an impact because additional parking capacity is available on Main Street, on nearby cross-streets, and in surface and structured parking lots throughout the corridor. During the final design phase, design features would be considered to ensure that parking and access to businesses would be maintained.

Off-street

By adding a center turn lane to the majority of Main Street, the Build alternative would improve access to existing off-street parking, for left turns both into and out of parking lots and structures.

Loading Zones

The three loading zones in the corridor are not expected to be impacted by the Streetcar Project. The only loading zone near a Streetcar stop is on the east side of Main Street north of 10th Street. It is anticipated that the loading function can be preserved in conjunction with the adjacent stop.

Streetcar Alternative: Pedestrian Effects

The project would result in alterations at all 26 of the study intersections along the corridor, which, consistent with the aforementioned agreement between the City of Kansas City and the Department of Justice, would require improvements at each of the intersections to comply with applicable accessibility guidelines. Thus, the Build alternative would accelerate the implementation of the agreement in this corridor.

Streetcar systems have been described as “pedestrian accelerators” because they work best when serving relatively short trips in dense urban corridors. With stops every two blocks, the streetcar would improve the pedestrian environment and enhance connectivity for those who choose to walk in the downtown area.

The streetcar stop platforms would all be designed to maximize accessibility. The system is being planned to meet current ADA standards for boarding (both 10-inch platforms, with bridge plates, and 14-inch platforms are being considered). Minimizing dwell times by minimizing boarding times also factors into this decision.

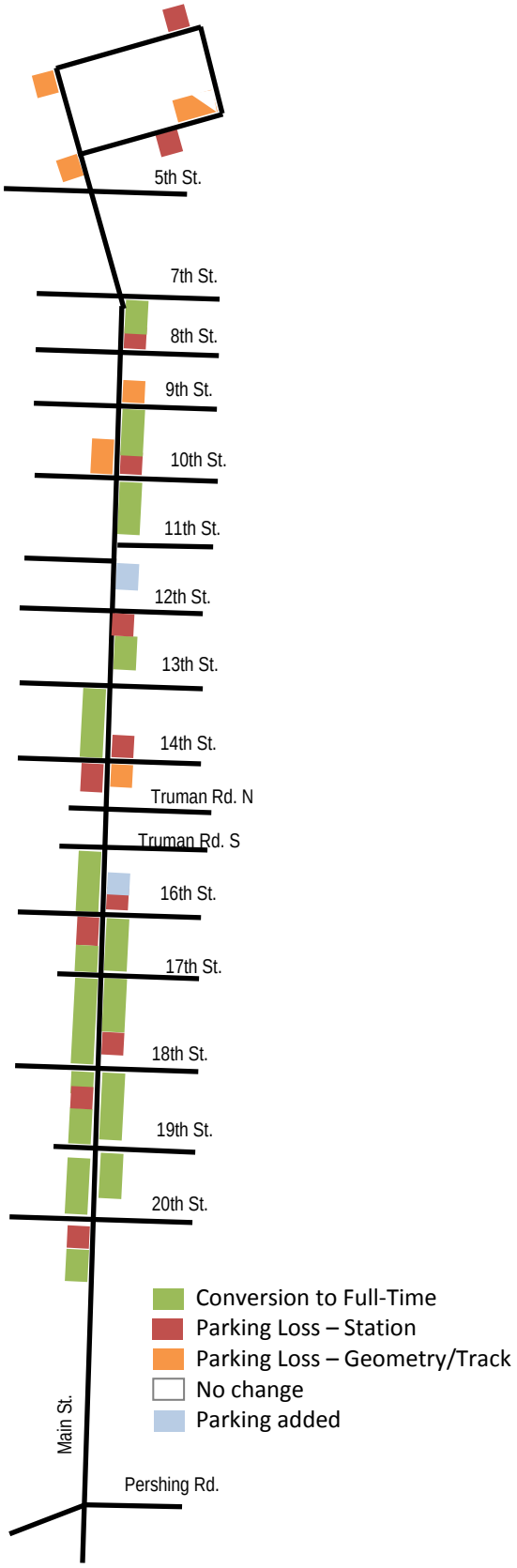
An additional feature of the Streetcar alternative is the inclusion of curb bulb-outs at several intersections along the corridor. Several of these are in conjunction with the proposed stops, and some are “stand-alone” features at corners. At corners, these bulb-outs would have the effect of reducing the intersection width, thereby decreasing pedestrian crossing times.

Finally, it is proposed that the stop at Union Station would be accessed via new signalized mid-block crosswalks from either side of Main Street.

Table 10: On-Street Parking Effects – Streetcar Alternative

Block	Net Parking Gains/(Loss) (ft)*	Parking Converted to All-Day (ft)*
Main Street		
Pershing – 20th	(120)	150
20th – 19th	0	570
19th – 18th	(110)	510
18th – 17th	(110)	940
17th – 16th	(110)	560
16th – Truman S	280	200
Truman S – Truman N	0	0
Truman N – 14th	(300)	0
14th - 13th	(110)	410
13th - 12th	(80)	140
12th - 11th	140	0
11th - 10th	0	350
10th - 9th	(230)	260
9th - 8th	(160)	0
8th - 7th	(120)	0
7th - 6th	0	0
6th - 5th	(180)	0
5th Street		
Delaware – Main	0	0
Main – Walnut	(115)	0
Walnut – Grand	(250)	0
Grand Boulevard		
5th – 3rd	0	0
3rd Street		
Grand – Walnut	(90)	0
Walnut – Main	0	0
Main – Delaware	0	0
Delaware Street		
3rd – 5th	(80)	0
Total	**(1745)**	**4090**

**A typical on-street parking space is approximately 20 feet.*



Source: HDR Engineering, Inc.

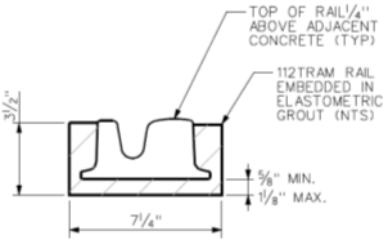
Streetcar Alternative: Bicycle Effects

The proposed streetcar is expected to affect bicycle travel in multiple ways, as described below.

The streetcar is currently planned to accommodate bicycles on-board (rather than on external racks as with the existing bus system), and level or near-level boarding would facilitate boarding and de-boarding of bicyclists. Thus, bicyclists with portions (or all) of their routes along the corridor would have the option to use the streetcar for that portion of their trip.

On the three segments where existing or planned bike routes coincide with the study corridor, the design would need to carefully consider conflicts between bicycle tires and rail flangeway. A grooved rail section (see **Figure 16**), which includes a formed steel flangeway (groove), is the desired rail section for areas subject to bicycles and other narrow-tired vehicles. A grooved rail provides a minimum flangeway width (approximately 1-5/8 inches) that is less than alternatives such as a tee rail with a snap-in boot (2-1/4 inches). This approach would minimize the amount of hazard to bicycles, but bicycle safety will remain an important design consideration. Following is a discussion of each of these potential conflict locations:

Figure 16: Typical Grooved Rail Section



Source: HDR Engineering, Inc.

- On Main Street at the 11th Street "jog", the current concept shows the centerline of the streetcar tracks a lane width (parking lane northbound and turn lane southbound) away from the curb. This design would provide more than enough clearance for cyclists to ride to the right of the streetcar with enough distance to allow perpendicular crossings and avoid the tire-in-track conflict. Pavement markings should be considered to clarify the use of the street section.

- On Grand Boulevard between 3rd Street and 5th Street, the current concept shows striping the 44-foot cross-section with two 14-foot lanes and an 8-foot parking lane in each direction. Narrowing the through lanes to 11 or 12 feet, and shifting them to the west, could allow the addition of a 4- to 6-foot buffer adjacent to the parking lane on the east side, providing clearance for northbound bicycle travel. (Since the streetcar tracks would only travel northbound on this section, additional adjustments for southbound bicycle traffic would be unnecessary.)

- On 3rd Street between Grand Boulevard and Delaware Street, the streetcar would only travel in the westbound lane. In addition to the westbound track, the presence of a streetcar stop just west of Grand Boulevard would present a challenge for bicycles. There are at least three options that could be pursued to address this issue:

  (1) Convert the stop to a center platform, and adjust lane geometries along 3rd Street to provide a bike-appropriate buffer between the westbound parking lane and the westbound streetcar tracks.

  (2) Re-route westbound bicycle traffic to an alternate parallel route – either 2nd Street or 5th Street.

  (3) Provide a bicycle bypass lane between the stop and the sidewalk.

Where planned bike routes cross the study corridor, no negative effects are expected. Bikes crossing at (or close to) right angles with streetcar tracks should not experience difficulty with such maneuvers; the "tire-in-track" issue is minimized at right-angle crossings.

As the route planning is still at the conceptual stage, stop amenities are yet to be refined. However, it is possible that bicycle parking racks could be included at or near stops, further enhancing intermodal connectivity.

As mentioned in the Existing Conditions analysis, the existing sections of Main Street with two lanes for a given direction can be considered more "bike friendly" because they afford motorists opportunities to pass bicycles traveling in vehicle lanes. Note that this only applies for the times of day when the outside lane acts as a drive lane and not a parking lane. The Build condition would alter this condition from 10th Street to 20th Street, creating permanent on-street parking and generally eliminating this opportunity to pass. However, Main Street is not a designated bike route, and therefore this situation would not be considered a substantial impact.

Streetcar Alternative: Freight Effects

With the conversion of existing parking/loading zones to "full-time" operations, the times of day available for loading would increase. The provision of a center turn lane may also afford additional opportunities for delivery vehicles (but only at strategic, safe locations) – the feasibility of such a concept would need to be investigated as detailed design progresses.

The addition of curb bulbouts at intersections, and narrowed pavement sections for stops, could make turns onto Main Street from the side streets more difficult for larger vehicles along some areas of the proposed alignment. However, with careful delivery planning, and given that the Downtown Loop provides access from all four cardinal directions, it is assumed that delivery vehicles would still have adequate routes to serve businesses along the corridor. During the design phase, the designer would need to work with the City and business stakeholders to make adjustments where necessary to facilitate deliveries.

4. TRANSPORTATION SUMMARY

Traffic

The streetcar would affect traffic in a manner similar to a bus traveling in the drive lane, including lane blockages during passenger boarding and alighting with an approximate 20-second dwell time. Generally, Main Street would be converted to a three-lane travel section (one lane in each direction plus a center turn lane), and some traffic control features would change. There is adequate capacity on Main Street to accommodate the Streetcar operating in mixed traffic, and no substantial project-related impacts were identified related to vehicular traffic. The three-lane section would improve access and safety for left-turning vehicles on Main Street. The current conceptual level of design has taken into account preserving access to adjacent properties along the alignment, so all current access would be preserved, some with modifications.

Impacts: None

Mitigation Required: None

Transit

No substantial project-related impacts were identified related to transit. The project is an enhancement to the downtown transit system, and a potentially important connection to the future regional transit system. Local bus service changes would be minimal and largely related to stop location issues. In some locations along Main Street, some bus stops might need to be shifted. Joint use of stops by streetcar service and local bus service is desirable to facilitate easy transfers. The streetcar is expected to carry nearly 2,700 riders per day in 2015 (opening year).

Impacts: None

Mitigation Required: None

Parking/Loading

No substantial project-related impacts were identified related to parking, loading and access. With the Streetcar Project, over 4,000 feet of Main Street would have a reconfigured cross-section that would allow dedicated on-street parking at all times of day, not just during off-peak periods – increasing the total hours of parking availability. Approximately 1,745 feet of parking would be lost due to the addition of platforms at Streetcar stops, right-turn lanes and track design needs. This loss is not considered an impact because additional parking capacity is available on Main Street, on nearby cross-streets, and in surface and structured parking lots throughout the corridor. By adding a center turn lane to the majority of Main Street, the Streetcar alternative would improve access to existing off-street parking, for left turns both into and out of parking lots and structures.

Impacts: None

Mitigation Required: None

Pedestrians

No substantial project-related impacts were identified related to pedestrians. The project would benefit pedestrians by improving downtown circulation and assisting with implementing accessibility compliance along the corridor. With stops every two blocks, the streetcar would improve the pedestrian environment and enhance connectivity for those who choose to walk in the downtown area. The project would result in alterations at all 26 of the study intersections along the corridor, which, consistent with the agreement between the City of Kansas City and the Department of Justice, would accelerate compliance with applicable accessibility guidelines. The stop platforms would all be designed to maximize accessibility. The system is being planned to meet current ADA standards for boarding (both 10-inch platforms, with bridge plates, and 14-inch platforms are being considered). An additional feature of the Streetcar alternative is the inclusion of curb bulb-outs at several intersections along the corridor. At corners, these bulb-outs would have the effect of reducing the intersection width, thereby decreasing pedestrian crossing times.

Impacts: None

Mitigation Required: None

Bicycles

No substantial project-related impacts were identified related to bicycles. The Streetcars are planned to accommodate bicycles on-board (rather than on external racks as with the bus system), and level or near-level boarding would facilitate boarding and de-boarding of bicyclists. Where the streetcar route coincides with existing or planned bicycle routes, the design team will work with the bicycle community to ensure that the final design functions safely for both the streetcar and bicycles.

Impacts: None

Mitigation Required: None

Freight

No substantial project-related impacts were identified related to the Streetcar Alternative. With the conversion of existing parking/loading zones to “full-time” use, the times of day available for loading would increase. Curb radii and turning radii will be designed for the appropriate design vehicle.

Impacts: None

Mitigation Required: None