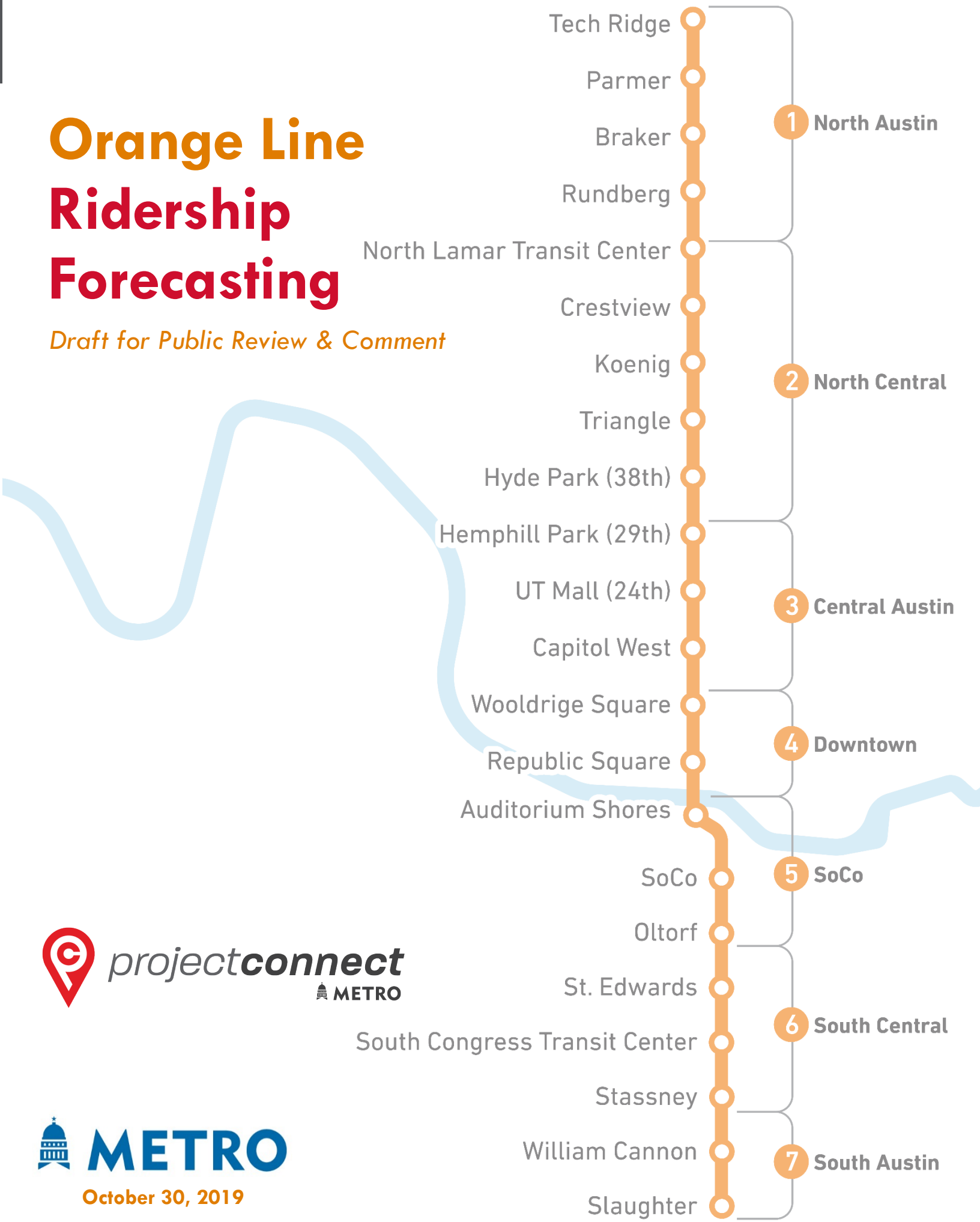
Orange Line Ridership Forecasting

Draft for Public Review & Comment



projectconnect
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Ridership Forecast Overview

The modeling team worked collaboratively with Capital Metropolitan Transportation Authority (CMTA) to develop and execute a ridership forecasting methodology that employed the complementary use of both the Capital Area Metropolitan Planning Organization (CAMPO) Travel Demand Model (CAMPO model)[1] and the CMTA STOPS-based model. Utilizing this "dual modeling" approach yielded a range of results that reflect the comprehensive analysis of travel behavior and travel markets at varying levels of detail. It also ensured a range of forecast results that support both local decision-making and a potential Federal Transit Administration (FTA) Capital Investment Grant (CIG) application. The results allowed the project team to provide decision makers with thorough information on the possible outcomes and tradeoffs associated with the performance of the various project configurations and the system as a whole.

The purpose of using two separate models is not to calibrate and achieve similar results but to compare the ridership results and document the variance between the two models. This enabled the project team to establish a range between the two models and add confidence buffers for risk analysis. It also allowed the team to make a decision about which model is better suited to carry forward for use on the Orange Line Corridor Project.

After careful review and analysis of all the modeling results the modeling team coordinated closely with CMTA staff and the Orange Line modeling team and all parties agree that the CMTA STOPS-based model should be utilized to develop transit ridership forecasts. STOPS is a stand-alone ridership model specifically created by FTA to evaluate new transit projects. STOPS is similar to a conventional four-step model that evaluates zone-to-zone travel markets based on socio-economic characteristics. FTA has calibrated and validated STOPS using actual ridership experience from fixed-guideway transit projects across the United States including bus rapid transit (BRT), light rail transit (LRT), commuter rail and streetcar modes. The Orange Line Corridor STOPS model uses the 2015 Capital Metro Origin-Destination (OD) Survey to inform local transit travel behavior and uses Census Transportation Planning Products data to inform non-transit travel behavior. STOPS also utilizes demographic data from the CAMPO model to understand existing development and growth projections in the Austin area. The CAMPO model is not tailored to forecast transit ridership on modes that do not exist in the base year, whereas STOPS pulls from the experience of other regions that have implemented projects on such modes. As the FTA-preferred model, it was determined by the project team that the CMTA STOPS-based model is better suited to forecast transit ridership and should be carried forward for use on the Orange Line Corridor Project.

The methodology and process of the ridership effort are laid out in this memo and a range of results using various queries are provided. The high level project results from the CMTA STOPS-based model for Orange Line Corridor Project are presented in Figure 1 and Figure 2 as a range of results with the lower end representing a Bus Rapid Transit (BRT) operating profile and the higher end representing a Light Rail Transit (LRT) operating profile.

[1] CAMPO Alternatives Analysis Model licensed from CAMPO

Figure 1: STOPS Ridership Forecast Orange Line 2028

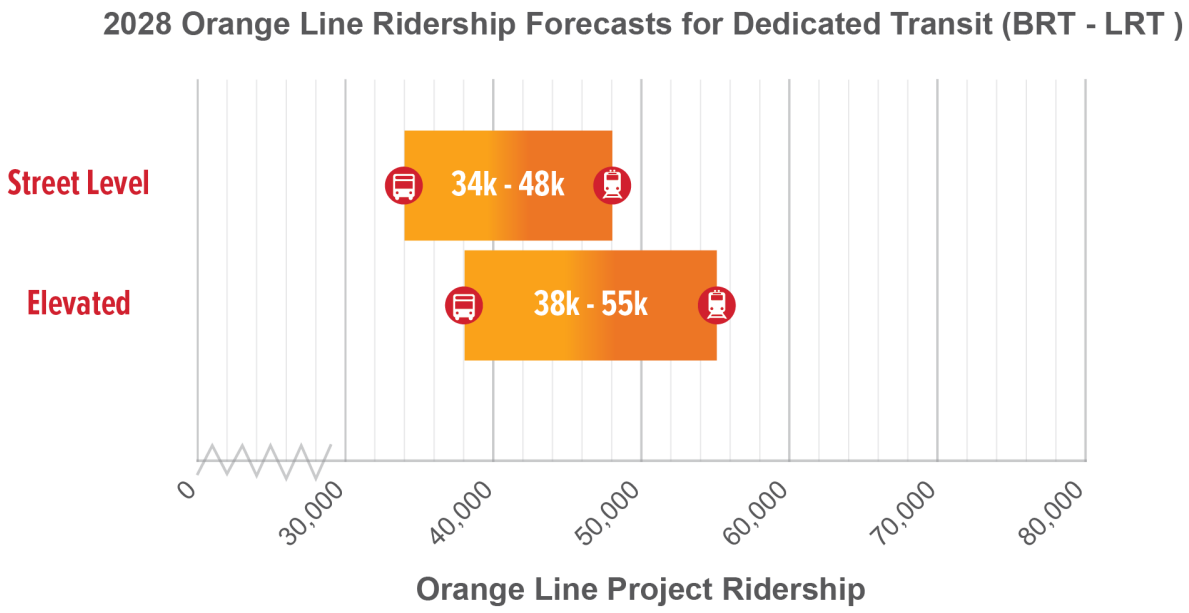
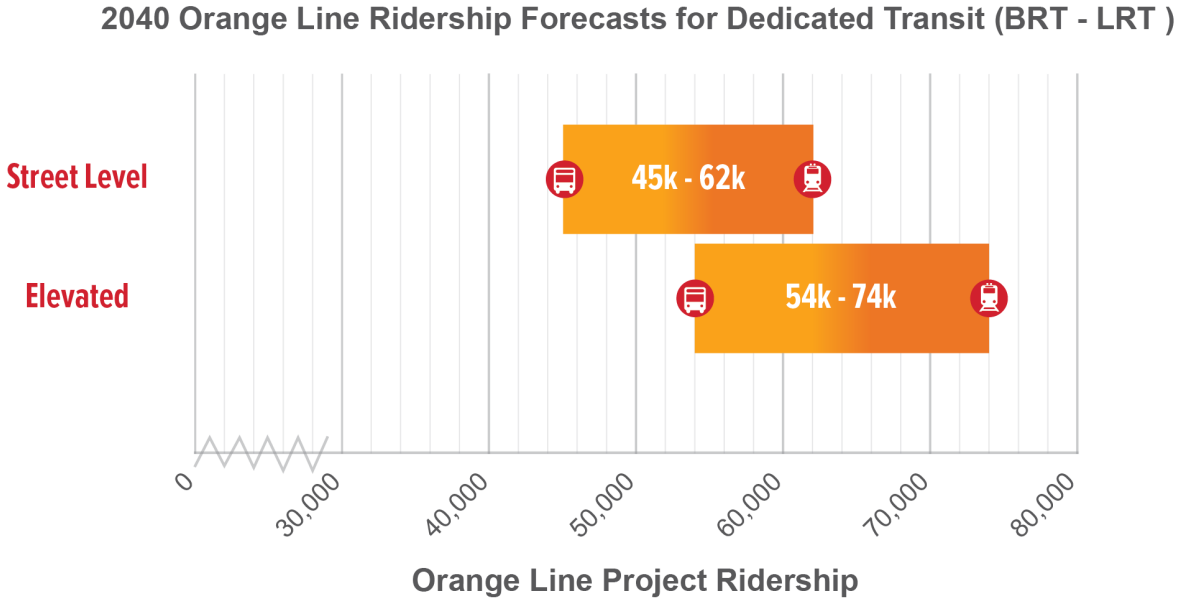


Figure 2: STOPS Ridership Forecast Orange Line 2040



Project Overview

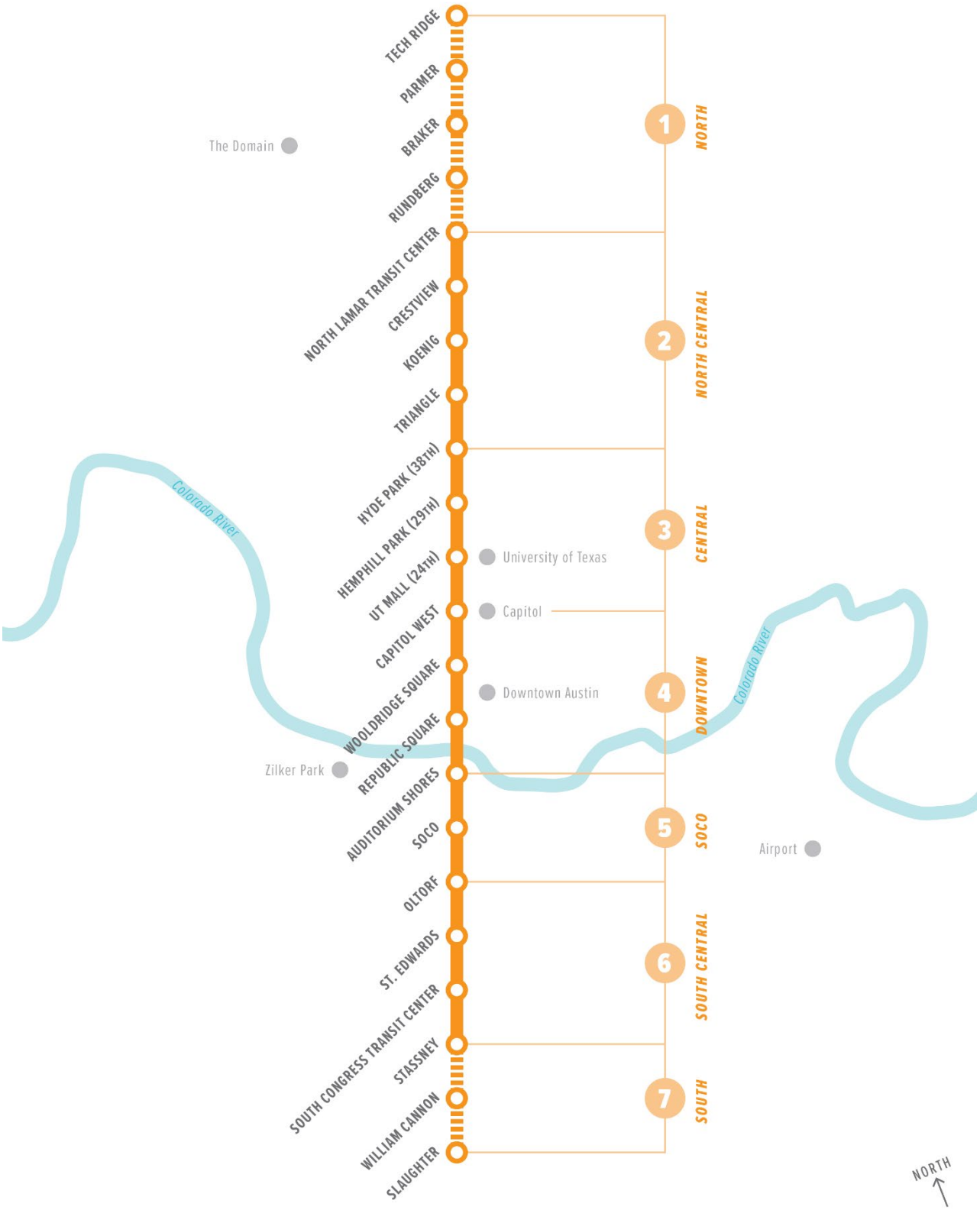
Project Connect is the community's plan for a high capacity transit (HCT) system of reliable and frequent transit operating in a congestion-proof environment free from other traffic. This plan will connect people, places, and opportunities in an affordable, efficient, and sustainable way.

The Project Connect Long Term Vision Plan includes two dedicated pathway HCT corridors, seven BRT light corridors, two commuter rail corridors, eight commuter bus corridors, and downtown circulator corridors, as well as numerous enhancement projects. Together, this "program of projects" constitutes a cohesive HCT system that will deliver real mobility solutions and benefits for the Austin region in concert with the underlying fixed route network and other complementary mobility programs and services.

The focus of this ridership report is the Orange Line dedicated transitway HCT corridor, which is a 21-mile corridor that Capital Metro's MetroRapid 801 currently serves from Tech Ridge at the northern extent to Southpark Meadows near Congress Avenue and Slaughter Lane at the southern extent. Figure 3 illustrates the corridor segments and potential stations.

This ridership report provides ridership forecasts that will be used as one of the criteria to inform the evaluation process and ultimately help identify the locally preferred alternative (LPA) for the proposed Orange Line corridor.

Figure 3: Orange Line Corridor



Model Calibration

CMTA STOPS-based model

The CMTA STOPS-based model is a calibrated model from the previous phase of Project Connect. Model calibration consisted of several iterative runs where results were validated by comparing route and station boardings to values from the survey. If results were not satisfactory, a calibration technique was applied, and another run was attempted. The techniques used to improve calibration results are listed below:

- Districts definition: The STOPS districts were created with the purpose to optimize the model results, with district areas being defined by a logical approach (smaller districts in the downtown area and a district for the University of Texas).
- Stops Station Groups: Groups were created based on Mode (Bus, MetroRapid, Red Line, and University Shuttles) and district. University Shuttle groups were further divided to improve boardings– this included the creation of a specific group for circular campus routes.
- STOPS parameters: STOPS was run with the following Group Calibration setting:
    - Group Calibration by OD Matrix Adjustment (Type 10), which included a survey-based trip table.
- Transfer Penalties: With the purpose to adjust station boardings for the MetroRapid and Red Line routes and downtown bus ridership, transfer penalties were applied.
- Park and Ride (PNR) Capture Area: The PNR capture area, also used to adjust station boardings by changing the PNR type to approximate observed capture areas.

For this phase of the project, STOPS version 2.50 was used updating the previous version 2.01. Additional work was done updating the station groups to better match the observed ridership. Model inputs were updated to match the outputs from the current version of the CAMPO model.

Visibility Factor

The STOPS model has the Fixed Guideway Setting (FGS) built in to differentiate the attractiveness of different modes of travel. The FGS is often referred to as the visibility factor. For the Orange Line Build Scenarios, each of the forecasts present a range of FGS of 0.3, 0.6, and 0.8. The FGS of 0.3 and 0.6 provide a comparison to earlier Project Connect System Planning forecasts. The forecasts with FGS of 0.8 assumes 100% fixed guideway. For these forecasts, there is no difference in assumptions (run times, headways, etc.) other than the variation in the FGS. FTA reviews the plausibility of forecasts on an individual project-by-project basis, and if/when an Orange Line forecast is submitted for review, FTA concurrence on visibility factors (and thus final accepted forecasts) could be materially different. Thus, it is recommended that a full range of forecasts be carried forward.

CAMPO Alternatives Analysis model

The Capital Area Metropolitan Planning Organization (CAMPO) maintains a calibrated / validated regional urban travel demand model (TDM) referred to as the CAMPO model. The model provides decision makers with a picture of the future travel demand on the regional transportation system. The TDM also provides information on how proposed transportation projects can address the identified needs of the region. For this effort the CAMPO model is referred to as the CAMPO Alternatives Analysis Model (CAMPO AA Model) per CMTA's license agreement with CAMPO.

Validation refers to the process of using a calibrated model to estimate travel for the base year and comparing the model's output to observed travel data. The objective of the validation is to produce an accurate and sensitive forecasting process that is well-suited to the region's planning objectives and mission. Validation of the CAMPO AA Model and most travel demand models primarily focuses on the assignment portion of the model because, as the last step in the modeling process, the validation of the assignment (highway and transit) tends to reflect the reasonableness of previous model

steps. However, each model step in the CAMPO AA Model has been independently validated and documented.

The process ensures the transit supply (service, access/egress assumptions, and path choices) is reasonably and accurately represented in the model and the alternative specific constants are able to replicate observed shares in the model. The constants were iteratively modified until modeled data matched well with observed data for each market – a combination of trip purpose, transit mode, and mode of access.

For transit assignment, it is important that the travel times in the model accurately represent real world travel times. The CAMPO AA Model uses a delay function to determine transit speed on a link, which accounts for delay on the links for pick-up/drop-off of passengers and acceleration/deceleration of the vehicle. The delays were calibrated by area type, facility type, and transit mode and validated by observed data.

The resulting model provides a realistic and reliable predictor of magnitude and pattern of future travel in the CAMPO region and serves as a useful and informative tool for performing travel forecasts and analyses of proposed transportation projects.

Mode-Specific Constants

Similar to the STOPS model, the CAMPO AA Model uses a range of 'asserted' mode-specific constants for the fixed guideway (BRT/LRT) mode based on accepted FTA best practice guidelines, judgment, and experience with existing constants for other modes in the CAMPO AA Model. The mode-specific constants for the fixed guideway mode were estimated using the constants for the Express Bus mode as the lower limits and the constants for the Commuter Rail mode as the upper limits. The range represents the 85th and 95th percentiles.

Scenarios

Below is a description of each modeling scenario and a high-level overview of the key assumptions used to define the scenario. All the Build Scenarios used the No Build as a base to code the build configurations and to adjust the underlying network to help optimize the scenario. This methodology was used for both the CMTA STOPS-based model and the CAMPO AA Model, but each used different mechanics that were appropriate based on model requirements.

All Build Scenarios assume a fully dedicated fixed guideway for the project. The modes being evaluated for the project are BRT and LRT. Due to the project being fully dedicated fixed guideway, the only difference between the two modes is the fact that it would be either steel wheels running on metal tracks or rubber tires running on concrete transitway. There would be differences in terms of capacity that the ridership results will help identify and inform recommendations to help mitigate any issues related to carrying capacity.

Since both modes have the same assumptions in terms of variables with model sensitivity impacts (i.e. travel time, headways, station locations) both the CMTA STOPS-based model and the CAMPO AA Model are using a range of Fixed Guideway Settings (FGS) that will help capture the attractiveness of the project. These FGS produce varied results in terms of ridership and differ by model as described in the Model Calibration section.

Transit Scenario Inputs

The travel demand model defines transit scenarios based on mode characteristics and operational parameters including headways (frequency of service), travel time between stations, dwell time at each station location, and transit fare. Scenarios were developed for two modes: BRT and LRT. Headways were assumed to be 10 minutes during peak periods and 10 minutes during off-peak periods. Transit fares were set at the equivalent of Capital Metro fares for general transit modes discounted to 2010 model base year dollars. Dwell times and travel times between stations were based on a detailed operations plan developed for each mode by the project team. For the No Build and TSM, travel times and speed estimates were estimated from the CAMPO AA model. The transit service parameters for the scenarios are shown in Appendix A.

No Build

The No Build alternative shows the "do nothing" option. The system routes are maintained as they are today and the MetroRapid 801 is represented as the project route for the study area. The stop-level ridership for this alternative has been grouped into the proposed Orange Line stations to be able to compare station-to-station ridership forecasts.

Table 1: No Build Project Details

Alternative	**No Build**	
Configuration	Existing MetroRapid 801	
Stations	28*	
Travel Time (min:sec)**	Northbound (NB)	Southbound (SB)
	71:34	74:48
Headway (min)	Peak	Off Peak
	10	10

* Orange Line Stations were consolidated to 22 for the project for station-level reporting
** Travel Time estimates for PM Peak from the CAMPO AA model

TSM

The Transit Systems Management (TSM) alternative presents the plan for system service improvements informed by the CMTA board-approved Connections 2025 plan. This scenario used Connections 2025 as a starting point and coordinated with CMTA staff to inform which roadway improvements and transit service changes will be implemented before 2028. The TSM identifies improvements to two existing MetroRapid routes (801 and 803) as well as the introduction of two new MetroRapid routes (804 and 820). The details for the TSM can be seen in the TSM Memo.

Table 2: TSM Project Details

Alternative	TSM	
Configuration	Existing MetroRapid 801	
Stations	28*	
Travel Time (min:sec)**	Northbound (NB)	Southbound (SB)
	71:22	74:49
Headway (min)	Peak	Off Peak
	10	10

* Orange Line Stations were consolidated to 22 for the project for station-level reporting
** Travel Time estimates for PM Peak from the CAMPO AA model

Build – Configuration A

Configuration A of the Build Scenarios is defined by a combination of both elevated and street level guideway configuration for much of the alignment. The configuration would result in low ROW acquisition, low impact to existing traffic, and high operational efficiency. There would be a high cost and visual impact associated with the configuration.

Table 3: Build – Configuration A Project Details

Alternative	Build A	
Configuration	Elevated / Street Level	
Stations	22	
Travel Time (min:sec)	Northbound (NB)	Southbound (SB)
	41:52	42:33
Headway (min)	Peak	Off Peak
	10	10

Build – Configuration B

Configuration B of the Build Scenarios is defined by a street level guideway configuration for most of the alignment. The configuration would result in high impacts on ROW acquisition, high impact to existing traffic, high utility impact, and high construction impacts. There would be potentially lower costs and a low visual impact associated with the configuration as compared to configuration A.

Table 4: Build – Configuration B Project Details

Alternative	Build B	
Configuration	Street Level (small portion is Elevated)	
Stations	22	
Travel Time (min:sec)	Northbound (NB)	Southbound (SB)
	52:11	52:45
Headway (min)	Peak	Off Peak
	10	10

Ridership Forecast Results

This section highlights the results of the ridership forecasting from the CAMPO AA model and STOPS models for the Orange Line study. Summary tables provide an overview of the ridership for the corridor across the scenarios. Each scenario also has detailed ridership for sections and stations.

Summary

Tables 5-9 provide the ridership results for the scenarios of the Orange Line, including ridership by section, route type, and systemwide. These results include both the CAMPO AA and STOPS models discussed. A range of CAMPO and STOPS model settings were used to demonstrate the range of ridership results. This range of results can provide context to the ridership with the lower end representing a Bus Rapid Transit (BRT) operating profile and the higher end representing a Light Rail Train (LRT) operating profile. The STOPS ranges include in Tables 6, 8 and 9 are inclusive of a 0.6 FGS.

All ridership forecasted values have been rounded to the nearest hundreds consistent with best practice, please note that this means that reported subsets (station level ridership, route type, etc.) may not sum to the totals (Line or system ridership).

Orange Line Corridor

Table 5: CAMPO AA Model 2040 Orange Line Ridership by Section

	No Build	TSM	Build A - Elevated		Build B – Street Level	
Percentile of Constants			85%	95%	85%	95%
North	1,500	1,500	6,100	6,600	5,900	6,400
North Central	3,200	3,100	9,800	10,700	9,300	10,100
Central	1,400	1,200	5,200	5,600	4,900	5,300
Downtown	1,600	1,400	4,100	4,500	3,500	3,800
Soco	500	500	4,000	4,300	3,600	3,900
South Central	2,400	2,000	8,300	9,000	7,200	7,900
South	1,600	1,400	4,400	4,800	4,200	4,600
Project Ridership*	12,300	11,100	41,900	45,400	38,500	41,900

*The Project Line is the 801 for No Build and TSM and the Orange Line Configuration for the Build Scenarios

Table 6: STOPS Orange Line Ridership by Section

Year	**2028**				**2040**			
	Build A - Elevated		**Build B – Street Level**		**Build A - Elevated**		**Build B – Street Level**	
Visibility Factor	0.3	0.8	0.3	0.8	0.3	0.8	0.3	0.8
North	7,500	10,700	6,200	8,600	10,900	15,300	8,600	11,800
North Central	7,100	9,700	6,700	8,600	10,700	13,800	9,400	11,600
Central	8,300	13,000	7,400	10,800	10,700	15,300	9,500	13,000
Downtown	5,500	8,200	5,800	8,700	7,900	11,800	7,700	11,100
Soco	1,400	1,900	1,100	1,800	1,700	2,600	1,300	2,400
South Central	4,100	5,400	3,100	4,000	5,500	6,800	3,900	4,900
South	4,700	6,100	3,400	5,100	6,200	8,100	4,800	6,800
Project Ridership*	38,600	55,000	33,700	47,600	53,600	73,700	45,200	61,600

System Ridership

Table 7: CAMPO AA Model 2040 System Ridership

	No Build	TSM	Build A - Elevated		Build B – Street Level	
Percentile of Constants			85%	95%	85%	95%
High Frequency Routes	52,400	46,400	51,100	51,100	50,800	50,900
MetroRapid Routes	18,500	26,700	6,400	6,200	6,500	6,400
Local Routes	40,600	41,900	39,300	39,300	39,200	39,200
Metroflyer Routes	2,700	2,400	2,400	2,400	2,500	2,500
Limited or Express Routes	1,800	1,600	1,400	1,300	1,400	1,400
Metrorail (Red Line)	2,900	4,900	2,400	2,300	2,500	2,400
Special Routes	5,900	6,100	5,200	5,200	5,200	5,200
UT Shuttles	0	0	19,000	18,800	19,100	19,100
Round Rock Transit Routes	3,300	3,500	3,400	3,500	3,400	3,400
Orange Line	--	--	41,900	45,400	38,500	41,900
CapMetro System	148,900	153,900	172,600	175,500	169,400	172,300

Table 8: STOPS 2028 System Ridership

Year	**2028**				
	No Build	**Build A - Elevated**		**Build B – Street Level**	
Visibility Factor		0.3	0.8	0.3	0.8
High Frequency Routes	58,600	60,400	63,500	58,500	62,000
MetroRapid Routes	19,300	5,200	5,300	5,600	5,500
Local Routes	37,700	35,100	35,800	35,000	35,400
Metroflyer Routes	900	800	800	800	800
Limited or Express Routes	1,700	1,200	1,100	1,300	1,300
Metrorail (Red Line)	6,200	7,300	7,000	8,300	8,000
Special Routes	600	500	500	500	500
UT Shuttles	21,000	18,700	17,000	18,000	16,700
Round Rock Transit Routes	100	200	300	200	200
Orange Line	--	38,400	55,000	33,600	47,700
CapMetro System	146,100	167,800	186,300	161,800	178,100

Table 9: STOPS 2040 System Ridership

Year	2040				
	No Build	Build A - Elevated		Build B – Street Level	
Visibility Factor		0.3	0.8	0.3	0.8
High Frequency Routes	80,100	82,400	87,300	80,700	85,400
MetroRapid Routes	25,500	7,400	7,700	8,000	7,900
Local Routes	46,100	42,100	43,700	42,200	43,200
Metroflyer Routes	800	700	700	700	700
Limited or Express Routes	2,300	1,800	1,600	1,800	1,900
Metrorail (Red Line)	10,700	13,800	13,200	15,000	14,500
Special Routes	1,000	800	800	800	800
UT Shuttles	19,600	17,200	16,000	16,800	15,800
Round Rock Transit Routes	100	200	300	200	200
Orange Line	--	53,800	73,600	45,300	61,600
CapMetro System	186,200	220,200	244,900	211,500	232,000

No Build

The following tables show the results from the ridership forecasts done for the No Build Scenario in the CAMPO AA Model.

Table 10: No Build 2040 CAMPO AA Station Level Boardings

Segment	Station*	Boardings
North	Tech Ridge	300
	Parmer	400
	Braker	300
	Rundberg	600
North Central	North Lamar Transit Center	1,300
	Crestview	800
	Koenig	600
	Triangle	600
Central	Hyde Park	400
	Hemphill Park	100
	UT Mall	800
Downtown	Capitol West	300
	Wooldridge Square	300
	Republic Square	1,000
SoCo	Auditorium Shores	400
	SoCo	200
South Central	Oltorf	600
	St Edwards	600
	South Congress Transit Center	1,300
South	Stassney	500
	William Cannon	500
	Slaughter	600

**Stations represent ridership at 801 stops near proposed project stations*

TSM

The following tables show the results from the ridership forecasts done for the TSM Scenario in the CAMPO TDM.

Table 11: TSM 2040 CAMPO AA Station Level Boardings

Segment	Station*	Boardings
North	Tech Ridge	300
	Parmer	400
	Braker	300
	Rundberg	600
North Central	North Lamar Transit Center	1,300
	Crestview	700
	Koenig	600
	Triangle	400
Central	Hyde Park	300
	Hemphill Park	100
	UT Mall	700
Downtown	Capitol West	300
	Wooldridge Square	200
	Republic Square	900
SoCo	Auditorium Shores	300
	SoCo	100
South Central	Oltorf	400
	St Edwards	600
	South Congress Transit Center	1,000
South	Stassney	500
	William Cannon	500
	Slaughter	500

**Stations represent ridership at 801 stops near proposed project stations*

Build

The following sections outline the results for each configuration of the Orange Line from the CAMPO AA and STOPS models. The expected station level ridership by direction for STOPS in 2028 is represented with an additional illustration that provides context to the grade of each station, street level or elevated.

Build – Configuration A

The tables represent the results from the Configuration A, which has an elevated and street level configuration. The STOPS Station level ridership is represented in *Figure 4* for the expected 2028 opening year values.

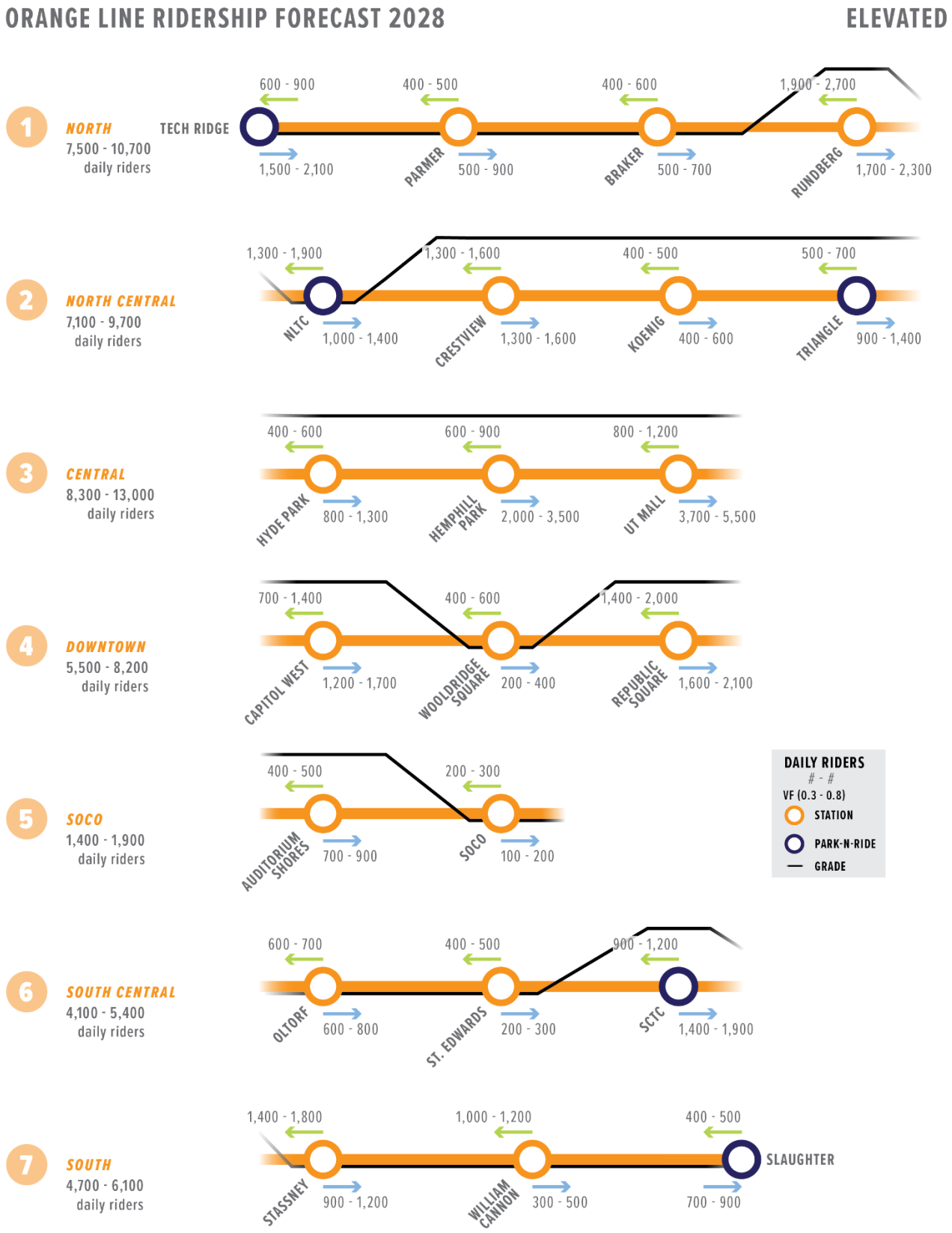
Table 12: Build – Configuration A 2040 CAMPO AA Station Level Boardings

		CAMPO Model Settings	
Segment	Station	85%	95%
North	Tech Ridge	1,500	1,600
	Parmer	1,000	1,100
	Braker	1,300	1,400
	Rundberg	2,200	2,400
North Central	North Lamar Transit Center	3,500	3,800
	Crestview	2,300	2,400
	Koenig	1,200	1,400
	Triangle	1,800	1,900
Central	Hyde Park	2,200	2,300
	Hemphill Park	1,500	1,700
	UT Mall	3,300	3,600
Downtown	Capitol West	2,100	2,300
	Wooldridge Square	1,200	1,300
	Republic Square	3,400	3,700
SoCo	Auditorium Shores	2,500	2,700
	SoCo	800	900
South Central	Oltorf	1,500	1,700
	St Edwards	1,200	1,200
	South Congress Transit Center	3,600	3,900
South	Stassney	1,600	1,700
	William Cannon	1,200	1,300
	Slaughter	1,000	1,100

Table 13: Build – Configuration A STOPS Station Level Ridership

Segment	Station	2028 Visibility Factor 0.3	2028 Visibility Factor 0.8	2040 Visibility Factor 0.3	2040 Visibility Factor 0.8
North	Tech Ridge	2,100	3,000	3,400	5,000
	Parmer	900	1,400	1,200	1,700
	Braker	900	1,300	1,400	2,000
	Rundberg	3,600	5,000	4,900	6,600
North Central	North Lamar Transit Center	2,300	3,300	3,200	4,700
	Crestview	2,600	3,200	4,800	5,400
	Koenig	800	1,100	1,200	1,600
	Triangle	1,400	2,100	1,500	2,100
Central	Hyde Park	1,200	1,900	1,300	2,100
	Hemphill Park	2,600	4,400	3,400	5,100
	UT Mall	4,500	6,700	6,000	8,100
Downtown	Capitol West	1,900	3,100	2,200	3,800
	Wooldridge Square	600	1,000	1,000	1,300
	Republic Square	3,000	4,100	4,700	6,700
SoCo	Auditorium Shores	1,100	1,400	1,400	2,000
	SoCo	300	500	300	600
South Central	Oltorf	1,200	1,500	1,600	1,900
	St Edwards	600	800	800	1,000
	South Congress Transit Center	2,300	3,100	3,100	3,900
South	Stassney	2,300	3,000	3,000	3,900
	William Cannon	1,300	1,700	1,700	2,300
	Slaughter	1,100	1,400	1,500	1,900

Figure 4: Orange Line STOPS Station Level Ridership Forecast 2028: Build – Configuration A



Build – Configuration B

The tables represent the results from the Configuration B, which has a street-level configuration. The STOPS Station level ridership is represented in *Figure 5* for the expected 2028 opening year values.

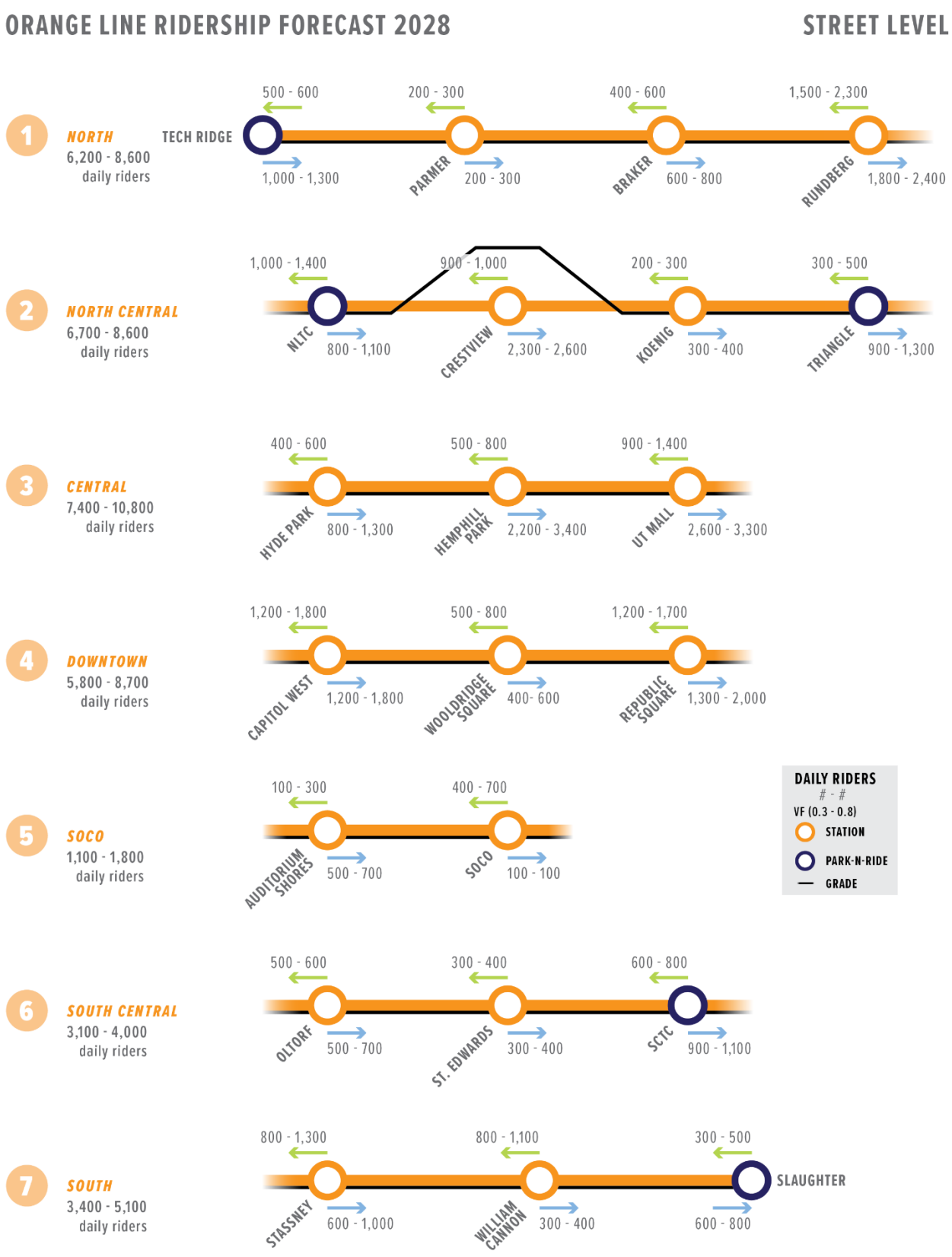
Table 14: Build – Configuration B 2040 CAMPO AA Station Level Boardings

		CAMPO Model Settings	
Segment	Station	85%	95%
North	Tech Ridge	1,400	1,600
	Parmer	1,000	1,000
	Braker	1,200	1,300
	Rundberg	2,100	2,300
North Central	North Lamar Transit Center	3,300	3,600
	Crestview	2,100	2,300
	Koenig	1,100	1,200
	Triangle	1,700	1,800
Central	Hyde Park	1,900	2,100
	Hemphill Park	1,500	1,600
	UT Mall	3,000	3,300
Downtown	Capitol West	1,700	1,900
	Wooldridge Square	1,300	1,400
	Republic Square	2,800	3,000
SoCo	Auditorium Shores	2,200	2,400
	SoCo	800	900
South Central	Oltorf	1,400	1,500
	St Edwards	1,000	1,100
	South Congress Transit Center	3,200	3,500
South	Stassney	1,500	1,700
	William Cannon	1,200	1,300
	Slaughter	900	1,000

Table 15: Build – Configuration B STOPS Station Level Ridership

Segment	Station	2028 Visibility Factor 0.3	2028 Visibility Factor 0.8	2040 Visibility Factor 0.3	2040 Visibility Factor 0.8
North	Tech Ridge	1,500	1,900	1,800	2,500
	Parmer	400	600	700	1,000
	Braker	1,000	1,400	1,600	2,100
	Rundberg	3,300	4,700	4,500	6,200
North Central	North Lamar Transit Center	1,800	2,500	2,400	3,500
	Crestview	3,200	3,600	5,100	5,400
	Koenig	500	700	700	1,000
	Triangle	1,200	1,800	1,200	1,700
Central	Hyde Park	1,200	1,900	1,300	2,000
	Hemphill Park	2,700	4,200	3,300	4,600
	UT Mall	3,500	4,700	4,900	6,400
Downtown	Capitol West	2,400	3,600	2,500	3,600
	Wooldridge Square	900	1,400	1,300	1,900
	Republic Square	2,500	3,700	3,900	5,600
SoCo	Auditorium Shores	600	1,000	800	1,500
	SoCo	500	800	500	900
South Central	Oltorf	1,000	1,300	1,300	1,600
	St Edwards	600	800	1,000	1,200
	South Congress Transit Center	1,500	1,900	1,600	2,100
South	Stassney	1,400	2,300	2,000	3,000
	William Cannon	1,100	1,500	1,500	2,100
	Slaughter	900	1,300	1,300	1,700

Figure 5: Orange Line STOPS Station Level Ridership Forecast 2028: Build – Configuration B

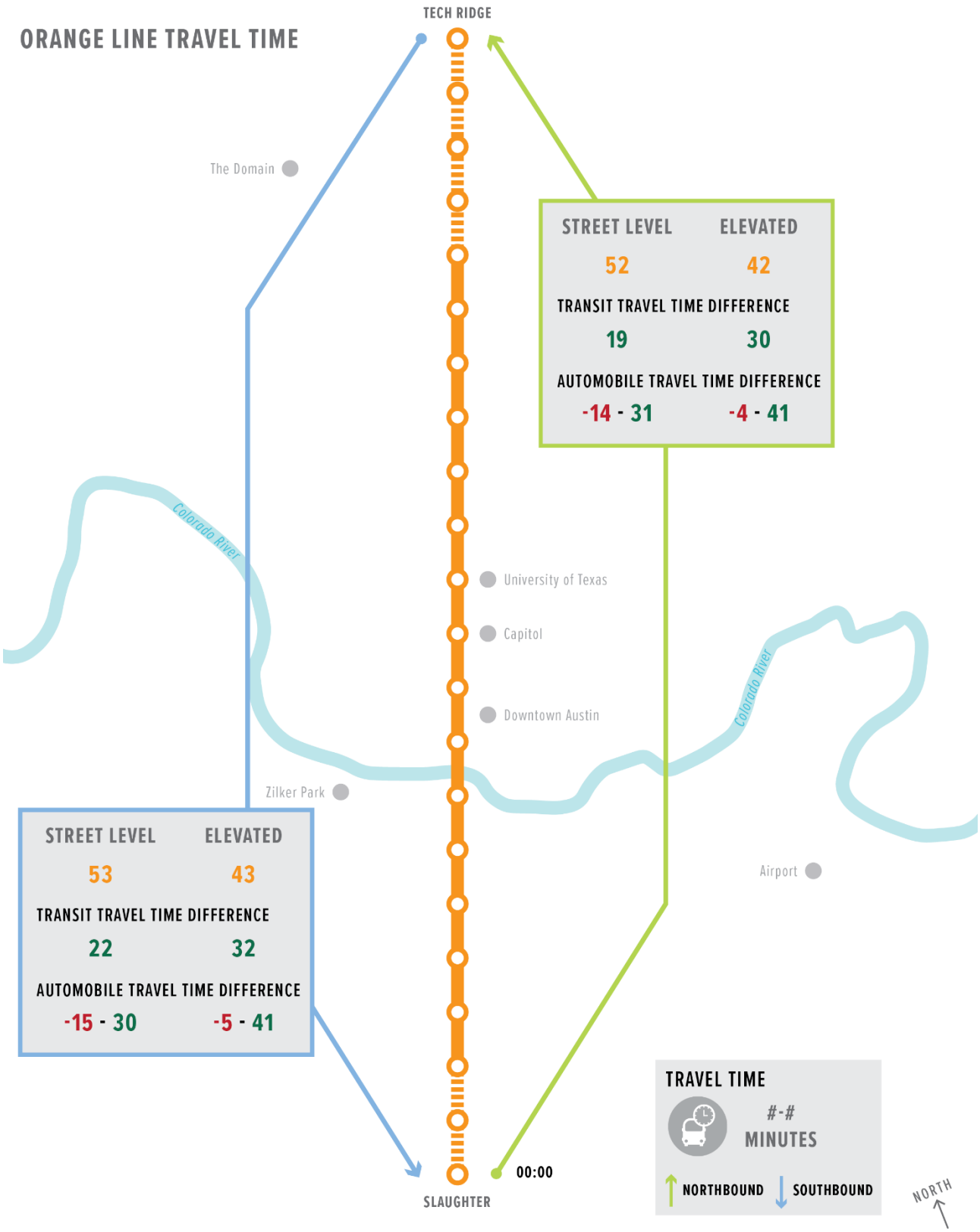


Travel Time

The Orange Line operates in a dedicated transitway which provides reliable and frequent transit in a congestion-proof environment that provides potential travel time savings for riders. The expected one-way travel time for the Orange Line is around 42 to 43 minutes for the Elevated (Build A) scenario and around 52 to 53 minutes in the Street Level (Build B) scenario. In the No Build scenario, the MetroRapid 801 that operates in mixed traffic on the project corridor shows one-way travel times between 71 and 75 minutes. With the build scenarios there are potential transit travel time savings in the range of 19 to 32 minutes. For automobile users, estimated travel times during peak hours are in the range of 38 to 83 minutes for a one-way trip between Tech Ridge and Slaughter. This travel time range is estimated from the average of northbound and southbound travel time during AM and PM peak hours collected from Google Maps. The travel time by automobile can be 4 to15 minutes faster than the Orange Line, however, depending on traffic conditions the Orange Line has the potential to be up to 30 to 41 minutes faster for users.

The travel time comparison statistics can be found in Figure 6.

Figure 6: Orange Line Travel Time Comparison



Conclusion

The Orange Line Corridor as a part of Project Connect represents one of the two proposed dedicated transitways. This report reveals the benefits in terms of ridership and travel time savings that will result from this investment. The transitway will provide reliable and frequent transit operating in a congestion-proof environment that the entire Capital Metro System will benefit from. The range in results will depend on the configuration and the mode for the Orange Line. The results of this memo are summarized in the key findings below:

- The Orange Line only had one route alignment with scenarios representing various operating configurations. Build A represented the elevated configuration and provides the highest ridership results due to faster running times achieved through grade separation.
- Regardless of the operating configuration, both scenarios represent operating on a dedicated transitway and produce significant increases in ridership along the corridor ranging from a 175% to 351% increase for the 2028 opening year along the corridor compared to the expected 2028 ridership for the No Build MetroRapid 801 that operates in mixed traffic, based on potential diversions from other routes due to constants and visibility factors.
- The operational enhancements of the Orange Line result in a premium service that is attractive at the system level and benefits the system level ridership resulting in 11% to 28% increase for the 2028 opening year compared to the No Build system level ridership.
- The Orange Line will represent 21% to 30% of the system level ridership for the 2028 opening year build scenarios.
- Build A Station Demand: At the station level, the highest ridership activity occurs at the following individual stations:
    1. UT Mall
    2. Rundberg
    3. Republic Square
- Build B Station Demand: At the station level, the highest ridership activity occurs at the following individual stations:
    1. UT Mall
    2. Rundberg
    3. Crestview
- Based on the findings in the Special Market Analysis in Appendix B, Orange Line annual ridership could potentially increase by 2%.

Appendix A

Table A-1: No Build CAMPO AA Model Inputs

No Build		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
MetroRapid	801 North Lamar/Congress	Existing	10	10	--	--
MetroRapid	803 Burnet/ South Lamar	Existing	10	10	--	--
MetroRapid	804 7th Street	--	--	--	--	--
MetroRapid	820 Riverside/Manor	--	--	--	--	--
Metrorail	550 MetroRail Red Line	Existing	30	60	--	--
LRT	Orange Line	--	--	--	--	--
BRT	Orange Line	--	--	--	--	--
High Frequency Route	4 Montopolis	Existing	15	15	--	--
High Frequency Route	20 Manor Rd./Riverside	Existing	15	15	--	--
High Frequency Route	333 William Cannon	Existing	15	15	--	--
High Frequency Route	7 Duval/Dove Springs	Existing	15	15	--	--
High Frequency Routes	2, 10, 17, 18, 300, 311, 325, 335	Existing	15	15	--	--
Local Routes	1, 3, 5, 6, 19, 30, 201, 214, 228, 233, 237, 243, 271, 310, 315, 318, 322, 323, 324, 333A, 337, 339, 345, 350, 383, 392	Existing	15 - 60	30 - 60	--	--
Metroflyer	103, 105, 111, 135, 142, 171	Existing	20 - 30	0	--	--
Limited or Express Route	935, 980, 981, 982, 985, 987, 990	Existing	15 - 55	0 - 60	--	--
Special Route	410, 411, 412, 465, 466, 470, 481, 483, 484, 485, 486, 490, 492, 493	Existing	0 - 60	0 - 35	--	--

No Build		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
UT Shuttle	**640, 641, 642, 656, 661, 663, 670, 671, 672, 680**	Existing	0 - 13	8 - 20	--	--
Round Rock Transit	**50, 51, 52**	Existing	60	0 - 60	--	--

Table A-2: TSM CAMPO AA Model Inputs

TSM		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
MetroRapid	**801 North Lamar/Congress**	New alignment	10	10	24	Service would operate on North Lamar to Howard/Tech Ridge.
MetroRapid	**803 Burnet/ South Lamar**	New alignment	10	10	24	Route 803 will terminate in the north at the proposed Kramer Station (i.e. Broadmore Station). Route will no longer deviate to travel within the JJ Pickle Research Campus. Route will cross the First Street Bridge instead of the Lamar Boulevard Bridge; south from Guadalupe St./Lavaca St. the route will continue via 1st St., Barton Springs Rd., and Lamar Blvd. Route's southern terminus has been extended south; traveling south on S Lamar Blvd. the route will terminate at Slaughter Ln and Manchaca St.
MetroRapid	**804 7th Street**	New Route	10	10	24	Route will travel through downtown on 7th Street. Route would terminate in the east at the new CARTS Eastside Bus Plaza at 5th Street and Shady Lane. The west terminus would be at UT Gateway Apartments (5th and Campbell). Proposed MetroRapid would use consolidated stations identified in the Project Connect Long Term Vision Plan.
MetroRapid	**820 Riverside/Manor**	New Route	10	10	24	Route will operate from Austin Bergstrom International Airport in southeast Austin and serve Riverside Drive. Service through Downtown will be made via the Guadalupe St./Lavaca St. couplet and Dean Keeton St. before continuing on Manor Rd. The route's northern terminus will be the Delco Center park and ride. Proposed

TSM		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
						MetroRapid would use consolidated stations identified in the Project Connect Long Term Vision Plan.
Metrorail	**550 MetroRail Red Line**	Improved Frequency	15	15	18	Service will become more frequent between Kramer and Downtown, with service every 15 minutes all day.
LRT	**Orange Line**	--	--	--	--	--
BRT	**Orange Line**	--	--	--	--	--
High Frequency Route	**4 Montopolis**	Modified with new MetroRapid	30	30	18	Increase headway to 30 minutes and reduce service span to operate from 6:00 a.m. – midnight. Operate as an underlying local service for proposed MetroRapid 804. Reduce service span to operate from 6:00 a.m. – midnight.
High Frequency Route	**20 Manor Rd./Riverside**	Modified with new MetroRapid	30	30	18	Increase headway to 30 minutes and reduce service span to operate from 6:00 a.m. – midnight. Operate as an underlying local service for proposed MetroRapid 820. Reduce service span to operate from 6:00 a.m. – midnight.
High Frequency Route	**333 William Cannon**	Existing	15	15	--	--
High Frequency Route	**7 Duval/Dove Springs**	Existing	15	15	--	--
High Frequency Routes	**2, 10, 17, 18, 300, 311, 325, 335**	Existing	15	15	--	--
Local Routes	**1, 3, 5, 6, 19, 30, 201, 214, 228, 233, 237, 243, 271, 310, 315, 318, 322, 323, 324, 333A, 337, 339, 345, 350, 383, 392**	Existing	15 - 60	30 - 60	--	--
Metroflyer	**103, 105, 111, 135, 142, 171**	Existing	20 - 30	0	--	--
Limited or Express Route	**935, 980, 981, 982, 985, 987, 990**	Existing	15 - 55	0 - 60	--	--
Special Route	**410, 411, 412, 465, 466, 470, 481, 483, 484,**	Existing	0 - 60	0 - 35	--	--

TSM		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
	485, 486, 490, 492, 493					
UT Shuttle	640, 641, 642, 656, 661, 663, 670, 671, 672, 680	Existing	0 - 13	8 - 20	--	--
Round Rock Transit	50, 51, 52	Existing	60	0 - 60	--	--

Table A-3: Build CAMPO AA Model Inputs

Build		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
MetroRapid	801 North Lamar/Congress	Removed	--	--	--	--
MetroRapid	803 Burnet/ South Lamar	Existing	10	10	--	"Operating in MetroRapid dedicated guideway Nortbound alongside Lavaca from 3rd to 17th & Southbound alongside Guadalupe from 17th to 4th.
MetroRapid	804 7th Street	Operating in mixed traffic the rest of the alignment.	--	--	--	--
MetroRapid	820 Riverside/Manor	--	--	--	--	--
Metrorail	550 MetroRail Red Line	--	--	--	--	--
LRT	Orange Line	Existing	30	60	--	--
BRT	Orange Line	Build scenarios	10	10	23	Operating in Orange Line dedicated guideway
High Frequency Route	4 Montopolis	Build scenarios	10	10	23	Operating in Orange Line dedicated guideway
High Frequency Route	20 Manor Rd./Riverside	Existing	15	15	--	--
High Frequency Route	333 William Cannon	Existing	15	15	--	--
High Frequency Route	7 Duval/Dove Springs	Minor Modification	15	15	--	East side of route straightened out along Wm. Cannon to provide connection between apartments and the Pleasant Hill Station (shorter by 0.5 mi. and 2 minutes*)

Build		Alignment	Frequency		Span	Configuration
Service Type	Route Numbers / Name		PEAK	OFF PEAK		
High Frequency Routes	**2, 10, 17, 18, 300, 311, 325, 335**	Minor Modification	15	15	--	South end rerouted along Meadow Lake, Blue Meadow, and Bluff Springs to cover portion of route vacated by change to 333 (longer by 0.5 mi. and 2 minutes*)
Local Routes	**1, 3, 5, 6, 19, 30, 201, 214, 228, 233, 237, 243, 271, 310, 315, 318, 322, 323, 324, 333A, 337, 339, 345, 350, 383, 392**	Existing	15	15	--	--
Metroflyer	**103, 105, 111, 135, 142, 171**	Existing	15 - 60	30 - 60	--	--
Limited or Express Route	**935, 980, 981, 982, 985, 987, 990**	Existing	20 - 30	0	--	--
Special Route	**410, 411, 412, 465, 466, 470, 481, 483, 484, 485, 486, 490, 492, 493**	Existing	15 - 55	0 - 60	--	--
UT Shuttle	**640, 641, 642, 656, 661, 663, 670, 671, 672, 680**	Existing	0 - 60	0 - 35	--	--
Round Rock Transit	**50, 51, 52**	Existing	0 - 13	8 - 20	--	--

Appendix B

Special Markets Analysis

Introduction/Background

A planned special event is a public activity with a scheduled time, location, and duration that may impact the normal operation of the surface transportation system due to increased travel demand and/or reduced capacity attributed to event staging. The term planned special event is used to describe these activities because of their known locations, scheduled times of occurrence, and associated operating characteristics.

Planned special events include sporting events, concerts, festivals, and conventions occurring at permanent multi-use venues (e.g., arenas, stadiums, racetracks, fairgrounds, amphitheaters, convention centers). They also include less frequent public events such as parades, fireworks displays, bicycle races, sporting games, motorcycle rallies, seasonal festivals, and milestone celebrations at temporary venues. Special events specific to the Austin area would include events such as South by Southwest (SXSW), Austin City Limits (ACL), and University of Texas sporting events.

Transit services are best at serving large groups of travelers going to one or a few destinations along concentrated corridors of demand in concentrated peaks (TRB, 1998). Most, if not all, special events are highly concentrated in both location and time period, which makes them perfectly suited for transit services. Special event services have been identified by the TRB research team to be one of the 13 service concepts that were effective in increasing transit ridership in various metropolitan environments (TRB, 1998).

Travel demand models are most typically used to forecast future travel demand along both highway and transit corridors. However, travel demand model forecasts do not typically capture ridership from special market activities due to being calibrated based on household travel surveys of local residents and transit on-board surveys conducted during typical weekday operations. The potential special event transit ridership in most cases must be assessed "off-model", since the special events are not captured by the typical travel demand model. The Capital Area Metropolitan Planning Organization (CAMPO) travel demand model does not model special event transit ridership by default. As such, the following sections provide summaries of "off-model" case studies showing the potential ridership increase due to a special event.

Case Studies

Fayetteville Arkansas (ATG, February 2014)

The Fayetteville area includes several special market events including University of Arkansas sporting events, the Walmart annual shareholder meeting, and a three-day festival held in downtown Fayetteville. The study developed event transit share data and calculated potential ridership due to the special event.

For the purpose of this study, Alliance Transportation Group (ATG) researched similar assessments that were undertaken in other areas of the country and found that average transit shares in areas where bus and rail transit were available ranged anywhere from less than 5% to over 30%, largely dependent on the type of event and venue. Included in this was the very comprehensive assessment completed by the Maricopa Association of Governments (MAG), *2010 Special Events Travel Forecasting Model and Collection of Special Events Data*[2].

[2] *Accessible at: https://www.azmag.gov/Documents/TRANS_2013-03-01_Special-Events-Travel-Forecasting-Model-and-*

The MAG data was analyzed by venue with consideration to availability and proximity to bus and rail transit services to ensure that a direct comparison of study area venues could be undertaken. The resulting average transit share by type of event was determined for use with the special market information identified within the Fayetteville study area. **Table 1** below shows the results.

Table B-*1*: Fayetteville Special Event Transit

Event	Annual Events	Week-day	Week-end	Single Day Participants	Annual Visitors	Transit Share	Visitors choosing Transit
Bikes Blues & BBQ	1 (4 days)	x	x	40,000	160,000	18%	28,800
University of Arkansas Baseball Games	33	x	x	8,000	264,000	10%	26,400
University of Arkansas Basketball Games	18	x	x	18,000	324,000	5%	16,200
University of Arkansas Football Games	*5*		x	75,000	375,000	12%	45,000
University of Arkansas Graduation	1		x	10,000	10,000	9%	900
Walmart Annual Shareholders Meeting	1	x		30,000	30,000	9%	2,700
Total							120,000

The study showed a potential addition of 120,000 annual transit riders resulting from the special events in the Fayetteville, Arkansas region.

Minneapolis / St. Paul - MetroTransit[3]

Data gathered by MetroTransit from September 1st through September 3rd, 2016 demonstrated the substantial effects on the transit system when special events and transit service coincide with one another. Record ridership was observed during the defined time frame as the Minnesota State Fair, Vikings, Twins, Gophers, and Saints home sporting events occurred simultaneously. MetroTransit saw its highest single-day ridership in recent memory when fairgoers mixed with commuters and sports fans across the transit system. Nearly 370,000 rides were taken systemwide on Thursday, Sept. 1, with more than 117,000 rides on the Blue and Green light rail transit lines. This marked a single-day light rail ridership record for the system. The Blue Line had its busiest day ever, with nearly 59,000 rides. MetroTransit also provided a record number of express bus and regular route riders to and from the Minnesota State Fair, serving 16 percent of the fair's record 1.9 million visitors. Roughly 632,500 rides were provided to and from the fairgrounds. Average weekday ridership on the A Line was just over 6,100 during the State Fair – a 42 percent increase compared to the August pre-State Fair average.

[3] *Accessible at: https://www.metrotransit.org/big-events-lead-metro-transit-to-record-ridership*

The MetroTransit data shows the magnitude of ridership increase due to several special events occurring concurrently.

Austin Texas (ATG, October 2014)

To capture some of the potential special event market activity, ATG reviewed Capital Metro ridership data for the MetroRapid and MetroRail transit service during special events. In cases where expanded or extended service was provided, MetroRapid and MetroRail service experienced significant increases in ridership of 25% to 50% over typical levels. Using these increases as a benchmark and assuming extended service is provided for special events, ATG used attendance information provided by Capital Metropolitan Transportation Authority (CMTA) on permitted special events throughout the year, the number of event days, and the increased rate of MetroRapid and MetroRail ridership to estimate special event ridership increases. In addition to the base ridership, an increase of approximately 103,000 riders per year was estimated due to special events.

Sketch level, "back of the envelope" estimates for special market trips for the new urban rail service are shown in **Table 2**. These estimates were computed based on inferences drawn from known MetroRapid ridership during the month of March 2014, MetroRail ridership during SXSW 2014, and SXSW attendance estimates. **Table 2** shows high and low-end estimations for annual special event trips. The high-end estimate was 19.8 million "visitors", which assumed the inclusion of anyone who visits downtown Austin (including locals making trips from Georgetown who are already included in the model). This estimate represented the higher end of the spectrum due to possible double counting of surrounding area resident trips that were at least partially accounted for in the travel demand model. The low-end estimate was 5.5 million "event attendees". The low-end estimate was much more conservative due to the possibility of excluding visits to other non-permitted venues (Blanton, Capitol Complex, etc.) and thereby understating potential trips.

Table B-2: Austin Special Event Transit

	Event	Ridership
MetroRapid - March Weekdays (*Source: CMTA)	Average Non-event	5,775
	Average SXSW	8,158
	Additional Weekday Daily during SXSW (avg)	2,382
MetroRapid - March Saturdays (*Source: CMTA)	Average non-event	3,293.6
	Average SXSW	5,031.4
	Additional Saturday Daily during SXSW (avg)	1,737.9
MetroRail SXSW 2014 Ridership (Total, 8 days) (*Source: CMTA)	Weekday (6 days)	41,546
	Saturday (2 days)	13,018
	Total	54,564
MetroRail Assumed Typical March Ridership	Weekday (6 days)	29,412
	Saturday (2 days)	8,522
	Total	37,934
MetroRail Assumed Increased Special Market Trips (Total, 8 days)	Weekday (6 days)	12,134
	Saturday (2 days)	4,496
	Total	16,630
2014 SXSW Estimated Attendance *(*Source: Austin Transportation Department)*		400,000
MetroRail trips per SXSW attendee (8-day period)		0.04
MetroRail trips per SXSW attendee per day		0.01
Austin Visitors *(*Source: Downtown Destination Report (08/04/2013))*		19,800,000
Austin Special Event attendees *(*Source: Austin Transportation Department)*		5,500,000
Assumed Annual MetroRail trips (Austin Visitors)		102,900
Assumed Annual MetroRail trips (Austin Special Event Attendees - assumes each attendee stays 3 days)		85,750

Although the study above cannot decisively demonstrate ridership on a new transit service, it does provide an estimate of potential increases to MetroRail transit ridership due to special events.

Current Austin Special Events Transit Ridership

With the latest available data, the special events' impacts on transit ridership in the Austin area can be analyzed. The average weekday and weekend ridership during special events were compared with the typical weekday and weekend ridership to estimate the increased transit ridership due to special events. The 2018 monthly transit ridership data were downloaded from the Capitol Metro website. The event attendee's information was provided by Visit Austin.

Table B- shows the MetroRail and Route 801 ridership change during 2018 South by Southwest (SXSW) and 2018 Austin City Limits (ACL) Music Festival. Table B- shows the summary of ridership change on the MetroRail Red Line and Route 801 during the two events. The additional transit trips by event attendees per day are different across route and events. Yet, the total additional ridership by the two events are similar on the Red Line and Route 801 with more than 55,000 rides as shown in Table B-. Table B- also shows the total additional ridership by SXSW and ACL is 3.03% of the total annual regular ridership on the two routes with an average of 0.018 additional transit trips per attendee per day. Since Route 801 is to be replaced by the Orange Line, a similar rail service as Red Line, it is reasonable to assume that the two lines will share similar ridership increases during special events, which is approximately a 3% increase of the combined total annual regular ridership on the Red Line and Orange Line. Note that only two special events (SXSW and ACL) were considered in the analysis. Transit ridership increases due to other special events were not isolated and have already been averaged into the regular ridership which essentially increased the base regular ridership. Therefore, the ridership increase due to various special events throughout the year will be even higher than the numbers for the two events only. Thus a 2% increase, shown in Table 4 for Route 801, on the Orange Line annual regular ridership due to special events is a conservative estimate.

Table B-3: Red Line and Route 801 Ridership Change During 2018 SXSW and 2018 ACL

	Red Line		Route 801	
	SXSW	ACL	SXSW	ACL
Typical Weekday Ridership[4]	2,653	2,653	8,947	8,947
Typical Weekend Ridership[5]	1,462	1,462	12,138	12,138
Average Weekday Ridership during the Event Month	3,833	3,019	9,381	10,641
Average Weekend Ridership during the Event Month	4,861	3,258	13,141	15,991
Ridership Increase during the Event Month	39,556	15,602	13,560	42,214
Event Attendees	432,500	450,000	432,500	450,000
Event Days	8	6	8	6
Ridership Increase Per Event Attendee Per Day	0.0114	0.0058	0.0039	0.0156

[4] The typical weekday ridership was calculated as the average weekday ridership throughout the year excluding March and October when the special events took place and December when the holiday affects ridership.

[5] The typical weekend ridership was calculated as the average weekend (Saturday and Sunday combined) ridership throughout the year excluding March and October when the special events took place and December when the holiday affects ridership.

Table B-4: Ridership Change During 2018 SXSW and 2018 ACL

	Red Line	Route 801	Total
Total Annual Ridership	807,871	2,964,112	3,771,983
Increased Ridership due to SXSW and ACL	55,158	55,774	110,932
Annual Regular Ridership	752,713	2,908,338	3,661,051
% of Special Event Ridership Increase to Annual Regular Ridership	7.33%	1.92%	3.03%
Average Transit Trip Per Event Attendee (SXSW&ACL) Per Day	0.0086	0.0098	0.018

The Austin visitors in 2014 were about 19.8 million with an estimated 5.5 million total special event attendees including 400,000 SXSW attendees. The 2018 Austin visitors increased to 29.8 million and about 435,000 SXSW attendees. Based on the growth on SXSW attendees, the 2018 special event attendees can be conservatively estimated as around 5.95 million. Applying the average transit trip per event attendee per day of 0.018 to 5.95 million attendees, shows the total additional transit ridership due to special events is about 107 thousand. This is very close to the 111 thousand which is the estimated total increased ridership on the Red Line and Route 801developed based on the 2018 observed ridership data shown in Table 4. This suggests that an average of 0.018 transit trip per event attendee per day is a reasonable estimate for special event transit trips on the Red Line and Route 801.

Conclusion

Transit ridership increases due to a special event on a new or proposed route can be difficult to quantify. However, inferences can be made to estimate the magnitude of the effect on the transit system by using available data and existing studies from either the local area or comparable metropolitan areas. The Fayetteville case study shows that approximately 9% of the total annualized transit ridership could potentially be attributed to special events. The Minneapolis/St. Paul ridership data demonstrates that in circumstances where several special events occur together, the overall ridership on the specific routes servicing the special event corridor can increase dramatically, upwards of 42%. Using the SXSW and ACL event data in Austin as a model, the Orange Line annual ridership could potentially increase by 2% or about 0.01 trips per special event attendee per day due to special events.

These potential increases in ridership highlights the necessity to plan for the occurrence of special events. Providing additional services specific to the event may be a solution to alleviate the probable roadway congestion associated with the event as well as increasing transit revenue.

References

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