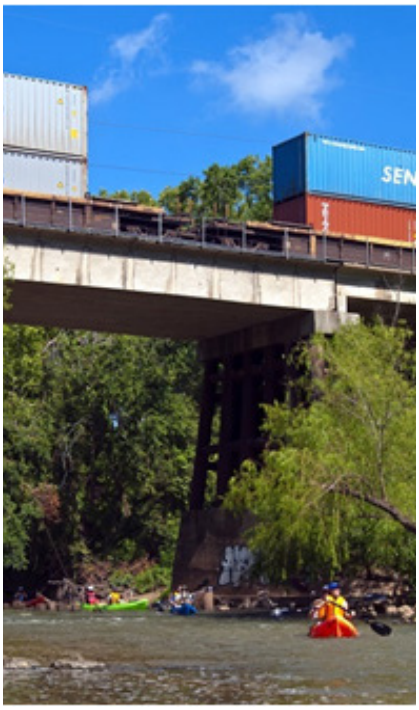


CAPITAL - ALAMO CONNECTIONS STUDY

EXECUTIVE SUMMARY

February 2019

CAMPO CAPITAL AREA METROPOLITAN PLANNING ORGANIZATION CENTRAL TEXAS

AAMPO

Texas Department of Transportation

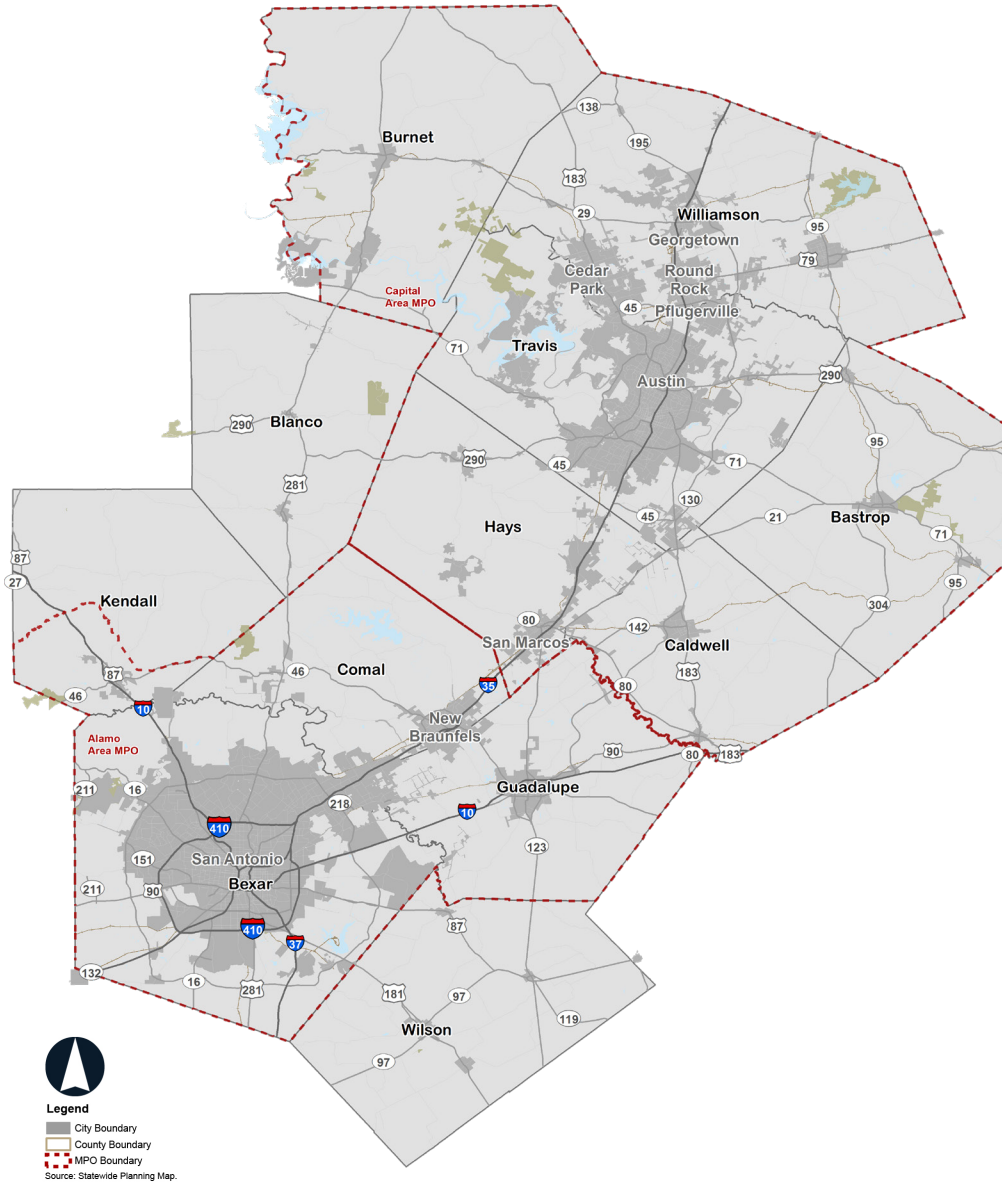
The Capital-Alamo Connections Study

The Capital Area Metropolitan Planning Organization (CAMPO) and the Alamo Area Metropolitan Planning Organization (AAMPO) in partnership with TxDOT initiated a study to develop bi-regional strategies to enhance mobility within the greater Austin-San Antonio region. These strategies were developed using a two-pronged approach: a comprehensive technical analysis and an extensive stakeholder engagement process which included a series of workshops with MPO's committees and regional leadership as well as interviews with key regional transportation influencers and decision-makers.

PURPOSE OF THE CAPITAL- ALAMO CONNECTIONS STUDY

Growth in Central Texas warrants the need for both freight and passenger transportation improvements that better link the Austin and San Antonio regions. This study identifies inter-regional travel patterns, assesses current market conditions, and defines future transportation needs to inform the development of strategies that address mobility between regions.

CAPITAL- ALAMO CONNECTIONS STUDY AREA



The study area centers on the I-35 corridor but includes major parallel facilities, as well as portions of the 12 counties surrounding them.

GOAL OF THE STUDY :

Develop a regional strategy to enhance mobility and identify

infrastructure, policy and technology solutions

OUTCOME OF THE STUDY:

An implementation plan organized into short-, mid-, and long-term strategies and staged out to 2045.

Study Rationale

Accelerated Growth

San Antonio and Austin's combined population in 2045 is forecasted to be comparable to that of the DFW Metroplex today.

Do we currently have a mobilty network that could address such population growth?

Emerging Megaregion

The growth of Austin, San Antonio and the communities in between enhance the notion of a single Austin-San Antonio corridor of development.

How can this growth be leveraged towards better economic and funding opportunities?

Urgent Demands

With the 3rd most congested roadway in the state being I-35 in Downtown Austin, and with 25 other Top 100 Congested roadways, there is a need to address current mobility concerns.

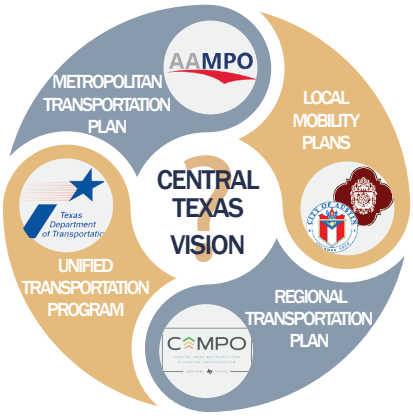
How do we address congestion along our major roadways?

Sources: 1. Census Bureau CB18-50, 2.TDC 2014, 3. TxDOT, Graphics: JACOBS, Freepik

Study Partners

AAMPO and CAMPO have a rich history of coordination on transportation related efforts. These efforts are documented as far back as 1996 with discussions for regional planning of future corridors. Currently, the MPOs coordinate on all major planning efforts - most notably - their Arterial Thoroughfare Plan Updates and Long Range Transportation Plans.

The Capital-Alamo Connections Study partnership grew out of the creation of a Executive Steering Committee that provided input and guidance throughout the study. The committee was comprised of the MPO Directors and staff, TxDOT Directors from Environmental Affairs Division (ENV) and Transportation Planning and Programming Division (TPP) as well as Transportation Planning & Development Directors and staff from the San Antonio and Austin TxDOT Districts. Coordination with other TxDOT divisions and sections, including Traffic Operations, Freight and Rail was also ocurred as appropriate.



Broader coordination for multi-regional issues provides opportunities to:

- Maximize existing infrastructure.
- Increase efficiency.
- Improve service.
- Increase transportation options.

Study Schedule

The Capital-Alamo Connections Study was initiated in early 2017. The study had an original intended duration of one year, which was later extended to accommodate stakeholder interviews, MPO workshops and other coordination. Stakeholder outreach and coordination began in fall/winter 2017 and continued throughout the study. Stakeholder coordination included meetings with key transportation influencers and decision-makers in the region. Additionally, workshops were held with the MPOs' Transporation Policy Boards and Technical Advisory Committees of as well as leadership from both the MPOS and TxDOT.

Spring/Summer 2017

TECHNICAL ANALYSIS

Data Collection and Current Conditions Analysis

Activities

TPB/TAC Status Update 1

Fall/Winter 2017

STAKEHOLDER OUTREACH LAUNCH

Presentation of Early Findings and Initiation of Stakeholder Coordination

Activities

Joint MPO TPB Workshop 1

Stakeholder Interviews

Spring 2018

DEVELOPMENT OF STRATEGIES

Assimilation of Stakeholder Input and Development of Proposed Strategies

Activities

TPB/TAC Status Update 2

AAMPO & CAMPO TAC Workshop 1

Regional Leadership Workshop 1

Summer/Fall 2018

REFINEMENT OF STRATEGIES

Refinement of Proposed Statregies

Activities

AAMPO & CAMPO TAC Work-shop 2

Regional Leadership Workshops 2 & 3

TPB Status Update 3

Winter 2018

DRAFT PLAN DEVELOPMENT

Development of Draft Strategy Plan and Identification of Priorities

Activities

Joint MPO TPB Workshop 2

January 2019

STUDY COMPLETION

Presentation of Strategy Plan to MPOs for Consideration

Capital-Alamo Transportation Strategy

What we heard...

Study partners identified stakeholders to participate in the analysis of the region's current conditions and to identify challenges/needs that could shape study recommendations. The team conducted a series of one-on-one interviews and workshops to get input on what might be feasible among all potential solutions. The total number of comments per category received through these interviews is shown in the graphic below. The most common issues and oppportunities expressed by stakeholders were: Use of technology, increase in local transit services, and high-way improvements.

	CHALLENGES	NEEDS	COMMENTS
INFRASTRUCTURE	Making mobility options convenient Political will and capital Physical constraints Hurdles to cooperation Existing system connectivity	Multimodal options Optimization of existing facilities Improved regional connectivity Creative funding solutions Flexible infrastructure	205
POLICY	Better coordination with freight industry New funding strategies Cultural shift in mobility preferences Project delivery processes Inconsistent policies	Land use and transportation alignment State investment & Federal funding Positive growth outlook Corridor preservation Consistency in priorities	192
TECHNOLOGY	Uncertainty about the future Defining infrastructure requisites Public- Private Partnerships Accelerated technology progression Public perception	More understanding of new technologies Implementation of new technologies More coordination with industry Consideration of potential implications in existing infrastructure	88

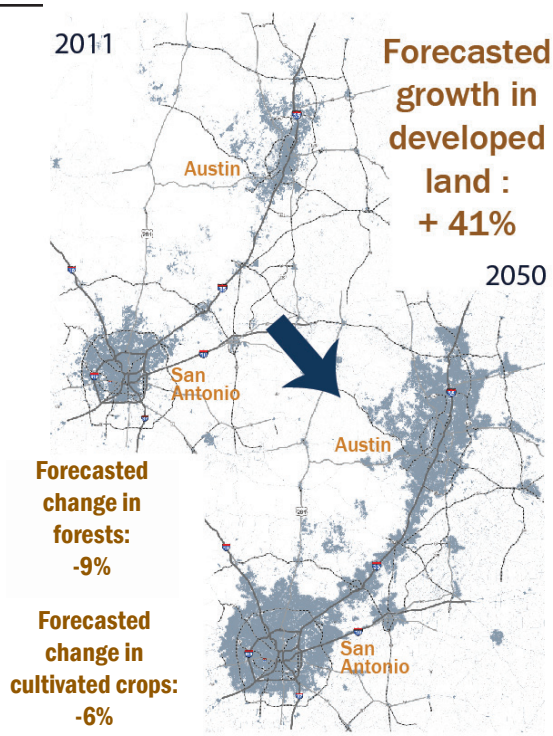
As of April 20, 2018

Regional Growth Patterns

To better understand regional growth patterns and movements, data related to population, land use conditions, passenger and freight were obtained from various sources and analyzed in terms of their current as well as future (2050) magnitudes. The graphics that follow summarize key findings from these analyzes.

According to the ESRI* Green Infrastructure Application, the study area's currently undeveloped land will see significant change by the Year 2050. The percent of land covered by housing and business development will increase due to high growth on the region. New developed lands are forecasted to concentrate along the I-35 corridor with notable changes in and around the localities of San Marcos and New Braunfels as well as the Austin and San Antonio metro areas.

*ESRI is an international supplier of geographic information system (GIS) software, web GIS and geodatabase management applications



Source: Comparing National Land Cover Database (NLCD) 2011 to the Clark Labs' Predicted NLCD 2050. http://www.esri.com/about-esri/green-infrastructure

Regional Movements

I-35

Analysis of trips from ramp to ramp along I-35 depicts a high number of local and short movements, especially in Austin and San Antonio.

A significant number of trips only use I-35 to travel one or two interchanges.

- **North Austin**: Around 20% of the trips in Round Rock travel only to the next ramp
- **South Austin**: Ramps are used mostly for local trips. However, they also generate trips travelling as far as Downtown San Antonio and Round Rock
- **Selma New Braunfels**: Trips mostly travel to North San Antonio (Loop 1604 & I-410 N)
- **North San Antonio**: 36% of trips that start at Loop 1604 only travel to I-410 N
- **Dwtwn San Antonio**: 73% of trips from W. Cesar Chavez travelling north travel for 2 interchanges. 47% of those travelling south only go to US 90

13% of freight entering I-35 North of Austin travels through the entire region.

US 281

Travel on US 281 outside of San Antonio appears to serve longer-distance travel.

- **Johnson City**: Significant number of trips on US 281 go from US 290 N to US 290 S and vice versa
- **Bulverde**: Around 50% of the trips entering at FM 1863 NB exit at SH 46
- **San Antonio**: Most of the San Antonio Area northbound trips exit at I-410 N

Up to 82% is headed to or stops in the study area.

SH 130

Analysis of destinations for trips originating at each SH 130 interchange indicate heavy usage of the north end of the corridor.

- **North Austin**: A large number of the trips originating north exit at SH 45
- **South Austin**: SH 71 attracts the majority of trips from both directions
- **Lockhart**: The majority of the trips getting on the corridor past SH 21 are headed to I-10. 50% of trips starting at US 183 end at SH 142

22% of freight entering I-35 South of San Antonio travels through the entire region.

Sources: 4.Streetlight GPS/LBS Data September 2017- JACOBS Graphics

A significant number of **weekday trips** that start **within** the Austin and San Antonio metro areas **remain local** to those areas.

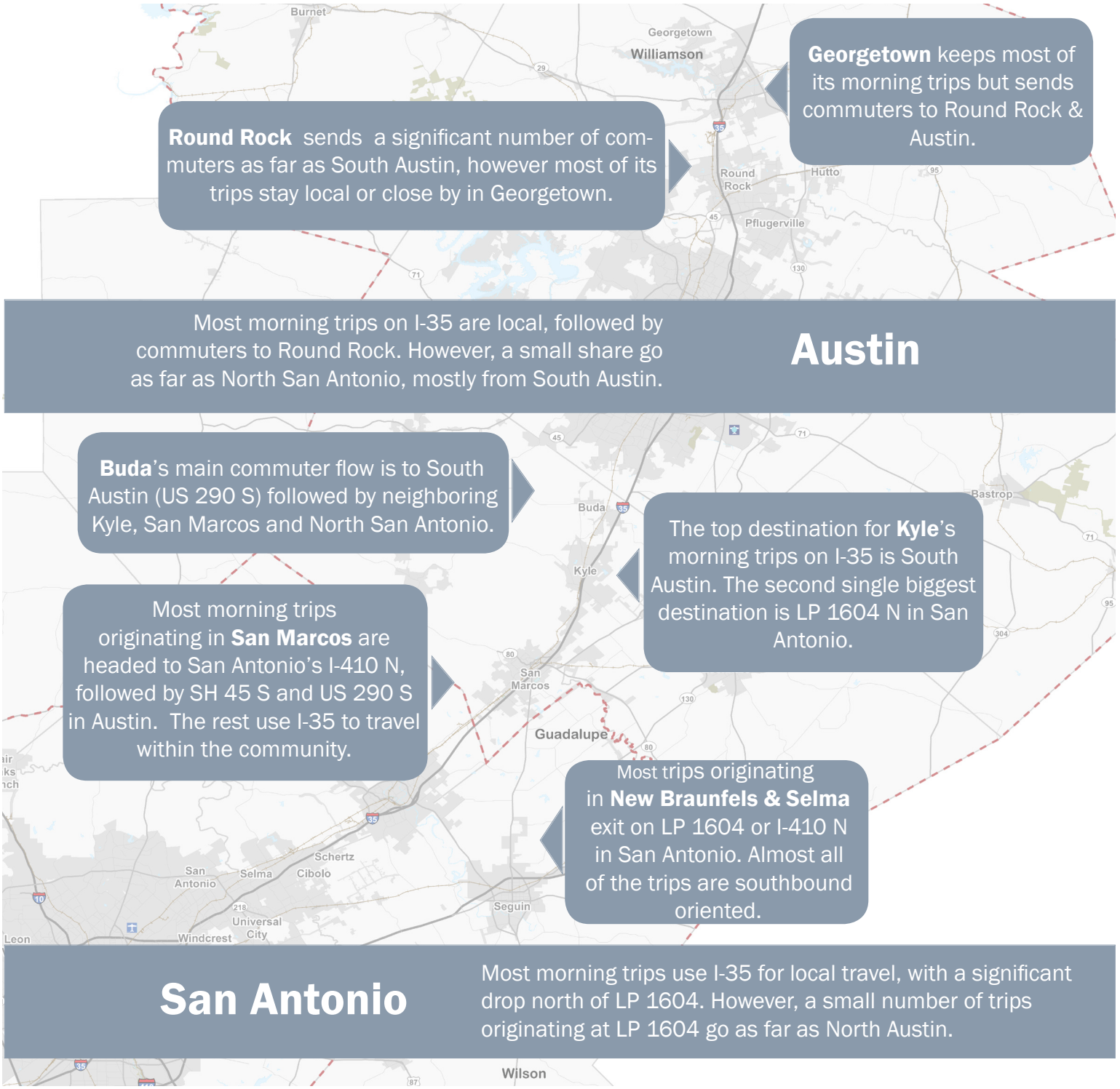
Weekday trips originating in communities like **San Marcos and New Braunfels tend to travel** to nearby communities

The number of **trips headed outside** the Austin and San Antonio **metro areas are similar on weekdays and weekends.**

Results suggest some of the congestion on these main corridors is a response to lack of arterial connections. Local improvements and alternatives could achieve much in addressing regional demands.

Where are people commuting to?

To identify regional needs and potential connectivity opportunities, information on trips travelling along I-35 every weekday morning between the hours of 6 am and 10 am was analyzed. Corridor movements are shown in the following results:



Georgetown keeps most of its morning trips but sends commuters to Round Rock & Austin.

Round Rock sends a significant number of commuters as far as South Austin, however most of its trips stay local or close by in Georgetown.

Austin

Most morning trips on I-35 are local, followed by commuters to Round Rock. However, a small share go as far as North San Antonio, mostly from South Austin.

Buda's main commuter flow is to South Austin (US 290 S) followed by neighboring Kyle, San Marcos and North San Antonio.

The top destination for **Kyle**'s morning trips on I-35 is South Austin. The second single biggest destination is LP 1604 N in San Antonio.

Most morning trips originating in **San Marcos** are headed to San Antonio's I-410 N, followed by SH 45 S and US 290 S in Austin. The rest use I-35 to travel within the community.

Most trips originating in **New Braunfels & Selma** exit on LP 1604 or I-410 N in San Antonio. Almost all of the trips are southbound oriented.

San Antonio

Most morning trips use I-35 for local travel, with a significant drop north of LP 1604. However, a small number of trips originating at LP 1604 go as far as North Austin.

Sources: 5. Streetlight GPS Data September 2017- JACOBS Graphics

Travel data suggests local trips contribute to congestion for commuter travel within the corridor. Therefore, implementing transportation solutions to provide alternative travel options for short trips would be beneficial.

First Joint MPO TPB Regional Workshop

On November 1, 2017, the Transportation Policy Board (TPB) members from both the AAMPO and the CAMPO were invited to participate in a joint regional visioning workshop.

Purpose

Presenting an overview of the early findings of the study and discussing an overall Long-Range Regional Vision

Structure

AAMPO + CAMPO + Texas Department of Transportation

WHAT DID WE NEED TO DO?

Needs and challenges faced by both MPOs in terms of infrastructure, technology, and policy improvements

26 TPB members in attendance

20 AAMPO + 6 CAMPO
56 additional attendees & representatives

WHAT DID WE ACCOMPLISH?

A SET OF NEEDS AND CHALLENGES TO BE USED AS INPUT TO DRAFT IMPROVEMENT STRATEGIES

MPO TAC Workshops

On February 23 and March 5, 2018, the Technical Advisory Committee (TAC) members from AAMPO and CAMPO were invited to participate in coordinated workshops with TxDOT.

Purpose

Presenting results and analysis of the first joint TPB workshop and gathering detailed input on potential infrastructure, policy, and technology recommendations

Structure

AAMPO + CAMPO + Texas Department of Transportation

WHAT DID WE NEED TO DO?

Present results of the stakeholder outreach efforts, Identify potential infrastructure, policy and technology recommendations.

33 TAC members in attendance

15 AAMPO + 18 CAMPO
19 additional attendees & representatives

WHAT DID WE ACCOMPLISH?

A SET OF TECHNOLOGY, POLICY, AND TECHNOLOGY CONSIDERATIONS FOR THE REGION

Joint MPO TAC Workshop

In order to ensure the relevancy and efficacy of a set of proposed strategies, a joint Technical Advisory Committe (TAC) workshop was held on October 2nd, 2018, allowing TAC members from both MPOs to review and refine the universe of strategies proposed at the time.

Purpose

Advance cooperation efforts and strive to accomplish a joint vision through complementary regional strategies

Structure

AAMPO + CAMPO + Texas Department of Transportation

WHAT DID WE NEED TO DO?

- Review main topics of stakeholder outreach
- Review technical analysis work
- Refine strategies and tactics based on TAC members' technical and local knowledge
- Ensure that strategies are relevant and feasible for both regions

28 TAC members in attendance

10 AAMPO + 18 CAMPO
32 additional attendees & representatives

5 Strategy-focused workshop groups

Regional Coordination	ICM & ITS	Modal Options	Priority Transportation Corridors	Arterial Improvements

Tasked with review and refinement of proposed strategies and associated tactics by group.

WHAT DID WE ACCOMPLISH?

DEFINED 59 STRATEGIES AND 115 TACTICS FOR PRIORITIZATION BY TPBs

Main outcomes from each group discussion are included below

Regional Coordination	ICM & ITS	Modal Options	Priority Transportation Corridors	Arterial Improvements
- More regular coordination - More data sharing - More communiction & interaction	- Support ongoing initiatives - Be flexible so as to respond to technology changes - Accelerate implementation of these strategies	- Emphasis on movement of people AND goods - More and better service - Better system integration	- Coordinate with ICM & ITS strategies - Focus on connecting San Marcos & New Braunfels - Reference and support existing initiatives	- Be mindful of local needs - Emphasize multimodality - Accelerate implementation of these strategies

Second Joint MPO TPB Regional Workshop

A joint Transportation Policy Board (TPB) workshop was held on December 5th, 2018 allowing members from both MPOs to prioritize the implementation timeframe of each strategy defined by the TACs during the previous workshop.

Purpose

Presenting the full set of proposed strategies to the TPB members for their consideration and prioritization

Structure

AAMPO + CAMPO + Texas Department of Transportation

WHAT DID WE NEED TO DO?

Ensure that implementation timeframes for all strategies are feasible for both regions

21 TPB members in attendance

15 AAMPO + 6 CAMPO
34 additional attendees & representatives

WHAT DID WE ACCOMPLISH?

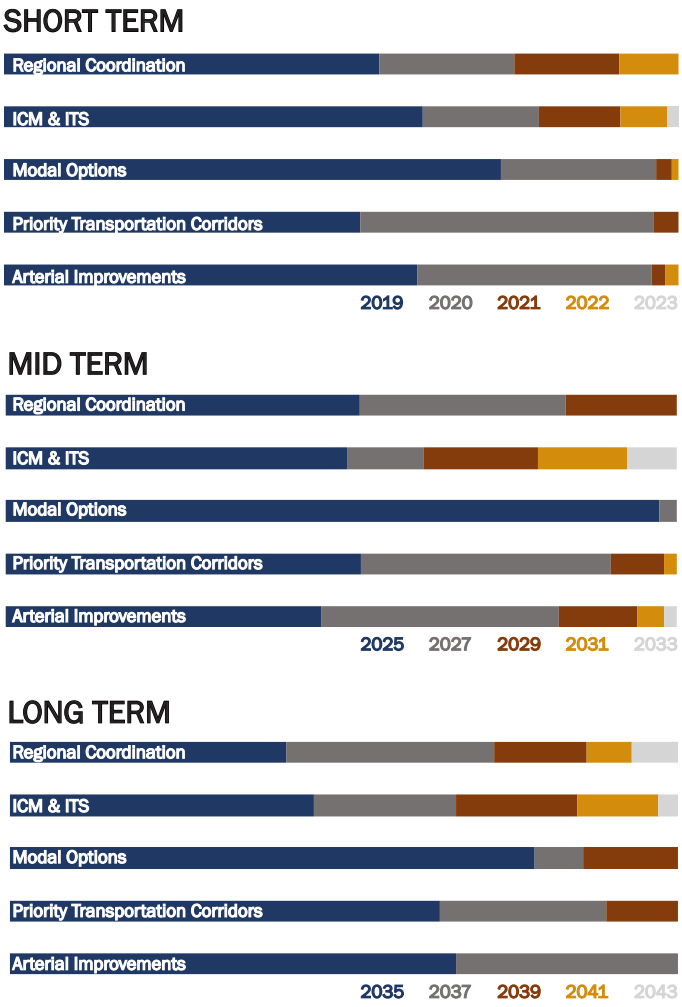
Participants expressed a general desire to advance strategies for all the groups and start implementation as soon as possible. However, participants were cognizant about potential challenges and how these might not allow progress in their preferred timeframe.

OTHER CONSIDERATIONS

- Electric vehicle charging stations need to be considered as part of the multimodal efforts
- Improvements triggering economic development need additional consideration to minimize congestion
- A more detailed analysis is needed to address the potential impacts of building additional highway capacity near the City of New Braunfels, Seguin and the center of Guadalupe County. Especially if these entail potential additional connections between SH 130 and I-35

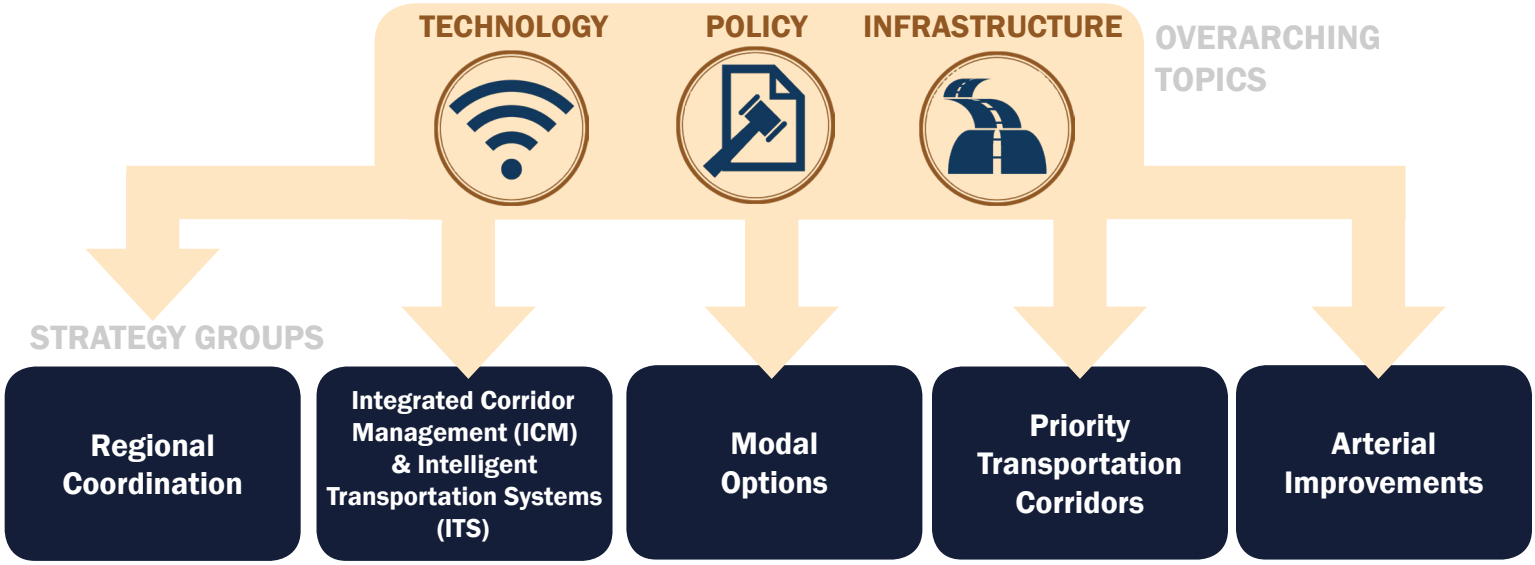
The stacked bar charts to the right depict the trend of the results from the strategies prioritization workshop. The length of each bar segment represents the number of people favoring each strategy group per year as the preferred implementation time for its strategies.

In general, there is a desire to have strategies move forward as soon as possible within each timeframe.



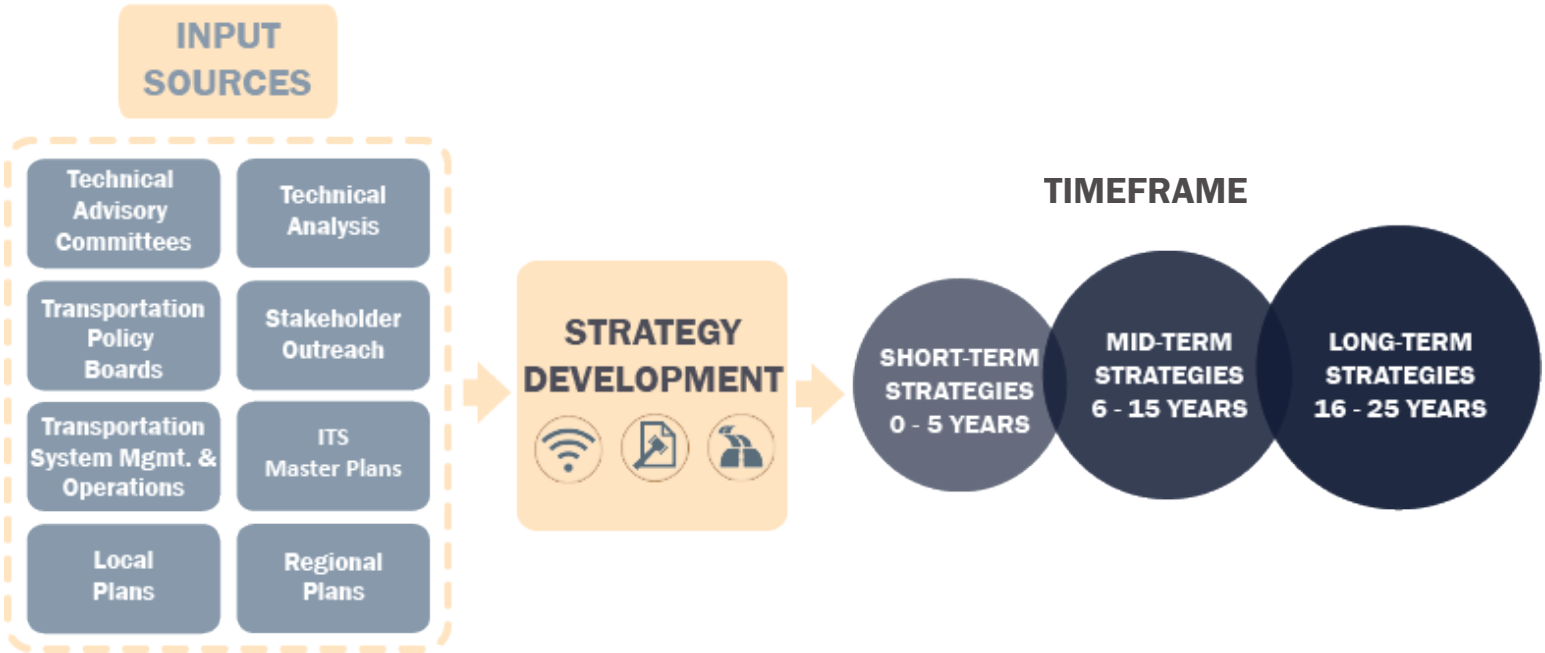
Capital-Alamo Connection Study Strategies

Feedback gathered in stakeholder engagement efforts from the Capital Alamo Connections Study was grouped into 3 main overarching themes: Technology, Policy and Infrastructure. Additionally, a technical analysis identified five main areas of focus for solutions to address current needs.



Strategy Development

Strategies were developed by reviewing current transportation plans and programs from each MPO and local jurisdiction within the study area, incorporating input from the MPO Transportation Policy Boards and Technical Advisory Committees, and gathering ideas from local Stakeholders. The resulting strategies are organized into short-, mid-, and long-term implementation timeframes.



Study Strategies Table Structure

The following section provides detailed descriptions of the Capital-Alamo Connections Study Strategies. The graphic below provides the structure and definitions for the strategy tables.

STRATEGY
Defines the recommended improvement strategy

TIMEFRAMES
Specific timeframes, Short- (0- 5 years), Mid- (6-15 years) and Long- (16-25 years) Term, have been designated to program needed improvements through coordinated actions

TACTICS
Provides initial guidance on how to implement the recommended strategies

UNDERWAY
Denotates tactics where progress is being made through prior or current efforts

Strategy	Tactics	Topics	Potential Partners		Coord.
SHORT TERM (2019-2024)					
Formalize interagency coordination efforts	Continue bi-regional cooperation on matters of common interest, particularly related to longer distance transport needs, by establishing a regular bi-regional update between MPOs		CAMPO, AAMPO, TxDOT, Cities, Counties, Transit Agencies	●	
	Draft a document to establish future shared goals				
	Identify potential "Early Win" projects that can encourage membership participation in additional efforts			●	
	Develop a coordinating body out of initial interagency coordination efforts				

OVERARCHING TOPICS
Refers to the three main themes defined during the outreach efforts: Technology, Policy, and Infrastructure. These overarching topics provide an additional framework for the implementation of the recommended strategies

RECOMMENDED POTENTIAL LOCAL PARTNERS
Identifies the expected agencies and stakeholders recommended to participate in the implementation of the identified strategies

STRATEGY COORDINATION
Denotes tactics which have been identified as requiring coordination with other strategy groups for optimal effectiveness

Regional Coordination Strategies

Transportation agencies use a range of alternatives to improve coordination while retaining jurisdictional control. Some of the benefits of regional coordination between agencies include: promoting the efficient use of local resources, creating consistent transportation solutions, and maximizing the strengths of existing agencies, among others.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Formalize interagency coordination efforts	Continue bi-regional cooperation on matters of common interest, particularly related to longer distance transport needs, by establishing a regular bi-regional update between MPOs		CAMPO, AAMPO, TxDOT, Cities, Counties, Transit Agencies	●	
	Draft a document to establish future shared goals				
	Identify potential "Early Win" projects that can encourage membership participation in additional efforts			●	
	Develop a coordinating body out of initial interagency coordination efforts				
Create a joint website to document coordination efforts	Share information about transportation efforts carried out by each agency		CAMPO, AAMPO, TxDOT	●	
	Publicize past coordination efforts and ongoing success			●	
Develop a bi-regional travel demand model	Hold workshops on regional growth assumptions and travel impacts		CAMPO, AAMPO		
	Track demographic and travel trends, as well as emerging demands			●	
Define bi-regional objectives for improvement of mobility and connectivity	Share performance measures and objectives		CAMPO, AAMPO		ICM & ITS
Define performance measures dealing with mobility between the regions	Develop combined performance measures that focus attention on cross-jurisdictional travel issues based on current regional performance measures.		TxDOT, CAMPO & AAMPO TACs		
Formalize an agreement to share planning data and shared performance measures among the two MPOs, local govemernments and transit agencies	Share current performance data and measurement approaches		CAMPO, AAMPO, TxDOT		ICM & ITS
	Share growth assumptions and regional travel demand model results				
	Define and track performance measures that are relevant to all communities, such as I-35 travel time reliability				
MID TERM (2025-2035)					
Create a policy-level cooperative body between both regions including representatives from all members of the Capital-Alamo Connections Study partnership.	Foster interlocal agreements between neighboring jurisdictions to develop shared transportation policies relevant to specific projects		CAMPO, AAMPO	●	
	Hold regular meetings of decision-makers from both regions to promote project level cooperation			●	

Regional Coordination Strategies, Cont.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
Implement bi-regional solutions to improve mobility and connectivity	Execute coordinated strategies for short- and long-range planning for projects of a bi-regional or bi-jurisdictional basis		CAMPO, AAMPO, Transit Agencies		
	Perform project prioritization process for bi-regional impacts				
Create a bi-regional technical committee focused on topics of shared concern	Focus on areas that affect both regions jointly, such as freight movement, rural transit, passenger rail, and emerging technologies		CAMPO, AAMPO, TxDOT	●	
	Facilitate conversations and agreements with public and private stakeholders to improve mobility in the region			●	
	Coordinate studies and shared planning documents related to specific transportation projects of mutual interest				
LONG TERM (2036-2045)					
Develop Combined Planning Documents	Collaborate on the development of a shared long-range transportation plan		CAMPO, AAMPO, Transit Agencies		
	Facilitate continued partnerships with transit agencies across existing service boundaries				Modal Options

ICM & ITS Strategies

Integrated Corridor Management (ICM) and Intelligent Transportation Systems (ITS) strategies provide guidance on how to make a more efficient use of current transportation infrastructure and make travel more reliable by relying on coordinated, multijurisdictional operations, which will be crucial to adapting to emerging technologies.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Coordinate Emergency Roadside Assistance Programs Throughout Region	Achieve continuous roadside assistance on I-35 corridor between San Antonio and Georgetown		TxDOT, CAMPO & AAMPO TACs		
	Coordinate dispatching between operators in each TxDOT District and local jurisdictions				Regional Coord.
Define regional priorities for corridor management	Establish an ICM and ITS Task Force to coordinate local Traffic Management groups and define regional prioirities for emergency response as well as incident and construction management		TxDOT, CAMPO & AAMPO TACs		Regional Coord.
	Coordinate and develop interregional efforts related to emergency response and incident management, construction management, and ITS systems				Regional Coord.
	Prioritize areas that would benefit from regional systems coordination				

ICM & ITS Strategies, Cont.

Strategy	Tactics	Topics	Potential Partners		Coord.
Map existing and planned ITS systems, owners, and inter-agency agreements	Review ITS Master Plans for Austin and San Antonio Districts		TxDOT, CAMPO & AAMPO TACs		
	Review local systems maintained by major cities in the region				
	Identify gaps or incompatabilities between the systems				
Coordinate Austin and San Antonio District Transportation System Management & Operations (TSMO) activities	Find opportunities to coordinate plans between areas		TxDOT, CAMPO & AAMPO TACs		Regional Coord.
	Where TSMO coordination is required, establish procedures for engaging across jurisdictional boundaries			●	
	Share innovations and project successes between regions				
Identify data sources for operations performance measures dealing with mobility between the regions	Identify new or existing technologies that could enable mobility tracking between regions		TxDOT, CAMPO & AAMPO TACs		
	Identify existing road technologies and new technologies that support performance measure tracking				
Implement an Interregional, Integrated Corridor Management System for I-35	Develop corridor management strategies, such as active traffic management, traveler information systems, demand management, and incident management		TxDOT, CAMPO & AAMPO TACs		
	Engage stakeholders, including TxDOT Districts, local cities, emergency responders, and transit agencies in regular meetings and workshops			●	Regional Coord.
Coordinate regional travel information systems across jurisdictional boundaries	Provide relevant information for regional through-travel online, through device-based services (Waze, Google Maps, etc.), and on variable messaging signs		TxDOT, Working Groups	●	
	Extend the reach of broadcasted travel time comparisons on major facilities, such as I-35, US 281, and SH 130, targeting freight and passenger traffic decision points				
MID TERM (2025-2035)					
Support the pursuit of opportunities to fund or pilot innovative technology deployments for interregional mobility	Identify federal & private grant funding opportunities		TxDOT, CAMPO & AAMPO TACs		
	Continue the development industry relationships to pursue public-private partnerships				
	Consider the impacts of emerging technologies, such as freight mobility, passenger information systems, and incident management , and create Working Groups for each.				Regional Coord.
	Support local initiatives to establish pilot technology deployment programs				

ICM & ITS Strategies, Cont.

Strategy	Tactics	Topics	Potential Partners	●	Coord.
Improve use of ICM during early coordination of construction activities and major planned disruptions across region	Alert travelers to disruptions of travel through the regions		TxDOT, Working Groups	●	
	Identify alternative routes and alert passengers of incidents using V2X (Vehicle-to-Everything) technologies				
Develop Regional Incident Management Plan and process for regular updates	Integrate existing plans from Capital and Alamo Area regions		TxDOT, Working Groups		
	Define protocols for coordinated incident response between regions				
	Enable 'Closest to' dispatching across jurisdictional boundaries				
Refine local ITS systems and coordinate operations with Traffic Management Centers	Promote ITS integration in new local roadway construction		TxDOT, Working Groups	●	
	Develop agreements between local system owners and TxDOT			●	Regional Coord.
Support data gathering for early deployment of connected vehicles systems along major travel corridors	Gather information on roadway conditions, vehicle speed, and traveler type in central repositories		TxDOT, Working Groups	●	
Create framework and opportunity to share operations data and coordinate monitoring & performance management targets	Develop data sharing agreements for archived operations data		TxDOT, Working Groups		
	Align performance metrics				Regional Coord.
	Make operations data available for short- and long-range planning			●	
LONG TERM (2036-2045)					
Establish redundancy in Regional Traffic Management Centers	Manage and coordinate ITS systems, incident response, integrated corridor management		TxDOT, Working Groups		
	Develop system interoperability and shared management capabilities			●	
Deploy technologies to support connected vehicle systems along major travel corridors	Use ITS systems to facilitate vehicle-to-infrastructure (V2I) and vehicle-to-everything (V2E) communication technologies		TxDOT, Working Groups		
	Provide information to connected vehicle operators on system status, traffic, and disruptions				
Use emerging technology to move people and goods within the regions	Implement pilot programs leading to full deployment of emerging technologies		TxDOT, Working Groups		
	Focus on improving safety and efficiency of travel in the region with connected and autonomous vehicle technology				

Modal Options Strategies

During stakeholder coordination efforts by CAMPO and AAMPO in partnership with TxDOT, Transportation Policy Board (TPB) and Technical Advisory Committee (TAC) Members suggested improving modal options throughout the region. Stakeholders stressed the importance of advancing local, commuter, and region-wide options for multiple transportation modes.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Implement Regional Intercity transit services	Broker new or additional intercity service, such as the Buda - Austin Commuter Route or CARTS - Interurban Coach Routes		CapMetro, VIA, ART, CARTS, Local Govts., TxDOT	●	
	Implement a New Braunfels - San Antonio Commuter Transit Route			●	
	Conduct summits among transit providers. Identify and eliminate obstacles between urban and rural transit systems				Regional Coord.
Further regular interregional transit cooperation	Annual coordination on intercity markets and service expansion plans		Cap-Metro, VIA, ART, CARTS		Regional Coord.
	Develop consistent policy goals and needs assessment methods to facilitate easier inter-agency bi-regional cooperation				Regional Coord.
	Technical knowledge transfer meeting for transit providers			●	Regional Coord.
	Maintain web links between all transit providers				
Discuss how the public sector could assist private companies to move freight more safely and efficiently	Discuss operational needs and opportunities		UP Rail, Trucking Companies, Shippers, TxDOT, CAMPO, AAMPO, Local Govts.	●	
	Identify further opportunities to grade separate arterials and rail freight operations				Arterials
Consider coordination schemes to enhance freight movements throughout the region	Conduct regular re-evaluation of freight origins and destinations to adjust freight considerations in the mid-term		CAMPO, AAMPO, TxDOT and UP Rail		
	Participate in freight-centric studies on long range freight bypass needs and truck parking facilities				Regional Coord.
Establish a Transit Coordination Task Force focusing on service borders	Create rules for the sharing of ridership info and service adjustments		Cap-Metro, VIA, ART, CARTS		
	Create web-based clearinghouse for long-term plans and services information				

Modal Options Strategies, Cont.

Strategy	Tactics	Topics	Potential Partners		Coord.
Identify potential interregional joint transit service routes	Study potential end-to-end interregional transit service		Cap-Metro, VIA, ART, CARTS		Priority Corridors & Arterials
	Study potential interregional Park-and-Ride locations				Priority Corridors & Arterials
MID TERM (2025-2035)					
Expand regional commuter transit options	Support the establishment of additional fixed-route flex-schedule regional routes by rural transit providers per Alamo Area and Capital Area Transit Human Service Transportation Plans		CAMPO, AAMPO, ART, CARTS	●	
	Develop a funding strategy for megaregion rural transit.				
	Hold a bi-annual interregional discussion on service updates				Regional Coord.
Promote potential interregional bicycle routes and new long-distance bikeways	Connect regional bicycle networks along highways		TxDOT, CAMPO, AAMPO, Local Govts.		
	Coordinate regional bicycle routes with transit agencies for connectivity				
	Use regional technical partnerships to promote, fund, and construct interregional bikeway connections				
	Incorporate permanent bicycle and pedestrian count equipment into new bikeways				
Consider possible rail and trucking enhancements	Create truck parking information systems and develop parking supplies if needed that aligned with statewide plans		UP, TxDOT Districts, National Truck Stop Association, Local Govts.		Priority Corridors
	Support network enhacement for all modes				Priority Corridors & Arterials
	Develop a Regional Rail Strategy for the movement of people and goods				Regional Coord.
	Foster preservation of right-of-way along corridors				Arterials
LONG TERM (2036-2045)					
Establish an interregional Transit Coalition	Extend Rural Transit Coordination into an interregional Transit Coalition		Cap-Metro, VIA, ART, CARTS, TxDOT		
Participate in interregional coordination for rail freight relief efforts	Provide assistance as requested to private sector with implementation of their freight rail relief strategies		UP, Amtrak, TxDOT, AAMPO, CAMPO		
	If surplus rail freight capacity is created, discuss opportunities for alternative uses of increased rail capacity in the region				

Priority Transportation Corridors Strategies

Strategies were identified to help improve mobility along the three major north-south corridors in the region, I-35, US 281 and SH 130. No further strategies are recommended for SH 130 at the present time. The planned widening of SH 130 from SH 71 to SH 45 in Austin and existing capacity will accommodate anticipated future demands.

Strategy	Tactics	Topics	Potential Partners		Coord.
SHORT TERM (2019-2024)					
Enable future technology enhancements	Define minimum ITS requirements for major Priority Transportation Corridors		TxDOT, CAMPO, AAMPO		ICM & ITS, Arterials
	Introduce installation requirements for technology integration in new expansion projects along Priority Transportation Corridors				
	Leverage technology to help travellers effectively plan trips				
Support improvements that address local deficiencies along I-35	Determine I-35 frontage road segments operating deficiently		TxDOT, CAMPO, AAMPO	●	
	Inventory and evaluate I-35 ramps for optimal configuration and move forward with the delivery of an access ramp conversion program				
Complete requirements for expansion of I-35	Develop environmental and Preliminary Engineering for expansion of I-35 between the Austin to San Antonio metro areas		TxDOT, CAMPO, AAMPO	●	
Reduce safety concerns at local intersections with high crash concentrations along US 281	Implement safety improvements at local intersections in Bexar County		TxDOT, CAMPO, AAMPO	●	
	Determine and implement safety improvements at local intersections in Comal, Burnet and Blanco Counties				
MID TERM (2025-2035)					
Maximize I-35 frontage road efficiency	Continue the implementation of a frontage road operation and upgrade program		TxDOT, CAMPO, AAMPO	●	
Further the US 281 roadway structure update program	Construct a new Guadalupe River Bridge (SB)		TxDOT, AAMPO	●	
Increase capacity on US 281	Construct a 4-lane divided highway from the Comal County Line to the Burnet County Line.		TxDOT, AAMPO, CAMPO, Local Govts.		
	Support the implementation of the US 281 Improvement Program by ensuring the existing ROW supports ultimate construction needs.				
	Construct a 4-lane freeway in Comal County				
	Study the feasibility of Park and Pool locations along US 281 in Bexar, Comal and Blanco Counties				
Improve regional mobility west of Austin and San Antonio	Reconstruct the US 281 /SH 71 intersection as a free-flowing interchange		TxDOT, CAMPO		
	Reconstruct the US 281 /US 290 S intersection as a free-flowing interchange		TxDOT		

Priority Transportation Corridors Strategies , Cont.

Strategy	Tactics	Topics	Potential Partners		Coord.
Increase safety on US 281	Develop interchanges at Mustang Vista Rd, Casey Rd, FM 311, Jumbo Evans Blvd, Rebecca Creek Rd and FM 306 in Bexar County		TxDOT, AAMPO, CAMPO, Local Govts.		
	Conduct a regional crash hotspot analysis every 5 years to evaluate safety concerns				
	Improve intersections with high crash histories including RM 473 West, RM 473 East, John Price Road, and RM 32				
LONG TERM (2036-2045)					
Increase I-35's person and freight throughput	Improve I-35 to acommodate higher demands		TxDOT, CAMPO, AAMPO		
Increase capacity on US 281	Construct a 4-lane freeway from FM 306 (North of Comal County Line) to SH 71 in Burnet County		TxDOT, Local Govts.		
Reorganize long-range traffic through City of Blanco	Develop long term solutions for traffic on US 281 through the City of Blanco				

Arterial Improvement Strategies

In workshops held with the TACs from both MPOs, stakeholders identified the limited availability of alternatives to I-35 for movement within the corridor. The following Arterial Improvement Strategies work to provide options for local movement and routing alternatives, especially in the event of an incident on I-35.

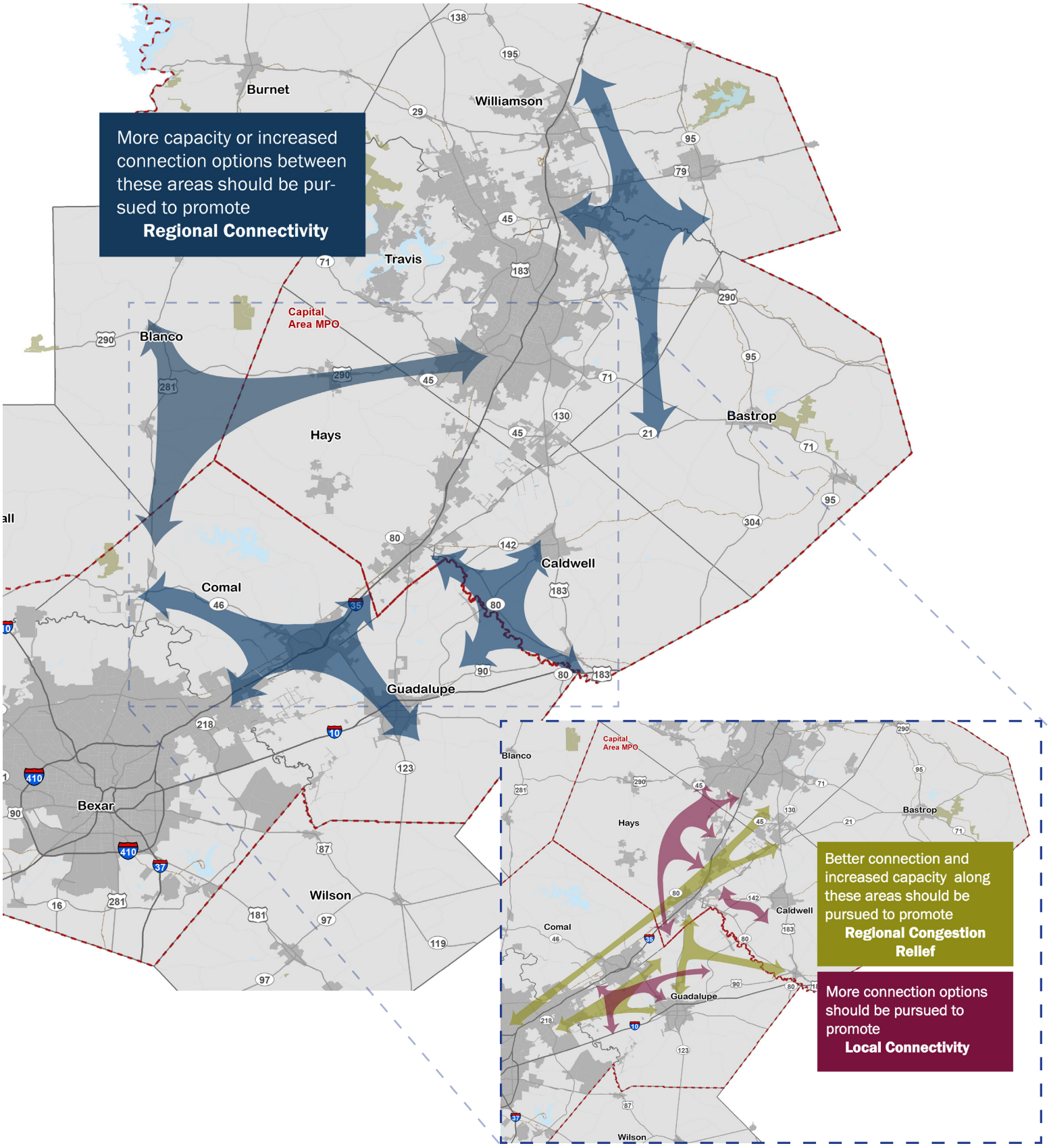
Strategy	Tactics	Topics	Potential Partners		Coord.
SHORT TERM (2019-2024)					
Designate an interregional arterial network	ID network of arterials designated as routes for main local movements and I-35 relief operations		TxDOT, CAMPO, AAMPO, Local Govts.		
	Begin feasibility studies for existing & future needs on each of the identified arterials			●	
Develop a prioritization framework to aid local officials in prioritizing future investments	Develop arterial performance measures and an information exchange protocol for sharing of the resulting measurements		TxDOT, CAMPO, AAMPO, Local Govts.		
	Develop an investment monitoring tool for arterial improvements				
Coordinate connection of planned arterial improvements in regional, local, and county thoroughfare plans	Initiate arterial improvement coordination between MPOs, cities and counties, focusing on cities whose ETJs cross county and MPO boundaries		CAMPO, AAMPO, Local Govts.	●	Regional Coord.
	Support local corridor preservation and corridor management activities for identified routes			●	
MID TERM (2025-2035)					
Develop interregional arterial network	Construct improvements to existing arterials		TxDOT, Local Govts, CAMPO, AAMPO	●	
	Conduct planning and engineering for new arterial connections			●	

Arterial Improvement Strategies, Cont.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
Prioritize corridor preservation and access management efforts	Integrate planned arterials with local growth plans		CAMPO, AAMPO, Local Govts, TxDOT		
	Identify and preserve right-of-way for new arterial connections			●	
	Perform access management along local arterials to ensure adequate mobility and safety			●	
Integrate management and operations of designated arterials into I-35 corridor management strategies	Identify areas of opportunity and overlap between local transportation Incident Management Plans		CAMPO, AAMPO, Local Govts, TxDOT	●	
Develop an improvement plan for designated arterials	Prioritize safety improvements on existing arterials		TxDOT, CAMPO, AAMPO, Local Govts.	●	
	Identify and prioritize potential new arterial connections			●	
Coordinate the connection of local arterial ITS systems with regional ITS master plans	Support existing local ITS efforts and traffic management systems on arterials through knowledge and resource sharing		CAMPO, AAMPO, Local Govts, TxDOT	●	ITS & ICM
	Integrate local arterial ITS and TxDOT-managed systems				ITS & ICM
	Develop a regional strategy for smart multimodal corridors, including installation of ITS technology and variable message road signs for motorists				ITS & ICM
	Create an interregional arterial rerouting plan for incidents along major regional connections and integrate recommendations into local incident management plans and ITS protocols				ITS & ICM
LONG TERM (2036-2045)					
Equip arterials with connectivity capabilities to accommodate emerging technologies	Provide ITS connectivity along smart multimodal corridors		TxDOT, CAMPO, AAMPO, Local Govts.		ITS & ICM / Modal Options
	Implement maintenance practices that support smart multimodal corridors				ITS & ICM / Modal Options
Nurture the extension of the local and relief arterial networks to enhance mobility and connectivity between growing regions	Reassess the performance of the interregional arterial rerouting plans in a bi-annual basis based on established arterial performance measures		CAMPO, AAMPO, Local Govts, TxDOT		Regional Coord.
Continue to promote use of local arterials to facilitate interregional multimodal connectivity	Coordinate with regional bicycle networks and regional transit service routes to promote use of major arterials as regional multimodal corridors		CAMPO, AAMPO, Local Govts, TxDOT		Modal Options

Arterial Improvement Strategies Map

The following maps identify the potential areas and characteristics of the arterial improvement strategies to be implemented in the region according to stakeholder input and technical assessment of needs.



The Path Forward

This study and its outreach efforts have demonstrated that there is a need and desire for the Capital-Alamo region to address mobility challenges collaboratively and in coordination with other planning partners. As population continues to grow, the geographic distinctions between the Austin and San Antonio metro areas are expected to decrease. There will be a greater need in the future to coordinate planning efforts, particularly regarding transportation facilities and services that link the two regions. A series of well-coordinated policies, strategies and improvements will be required to enhance the mobility in the region contingent on the investment of resources by planning partners. It falls to all of the study partners to integrate the strategies from this study into their planning efforts.

CAPITAL - ALAMO CONNECTIONS STUDY

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Capital-Alamo Connections Study

Transportation Planning & Programming Division, TxDOT

In partnership with

February 2019

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Table of Contents

Appendix List

Appendix A - Emerging Technologies Memorandum

Appendix B - Regional Transportation Planning Coordination: A primer for the Capital-Alamo Coordination Study

Appendix C - Stakeholder Analysis of Findings Report

Appendix D - Capital-Alamo Connections Study: Origins, Destination and Travel Patterns

Appendix E - Capital-Alamo Connections Study: Freight Analysis

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1. Introduction

The Capital Area Metropolitan Planning Organization (CAMPO) and the Alamo Area Metropolitan Planning Organization (AAMPO) in partnership with TxDOT initiated a study to develop bi-regional strategies to enhance mobility within the greater Austin-San Antonio region. These strategies were developed using a two-pronged approach: a comprehensive technical analysis and an extensive stakeholder engagement process which included a series of workshops with MPO's committees and regional leadership as well as interviews with key regional transportation influencers and decision-makers.

The following report describes the study process, technical findings, and stakeholder engagement and input that contributed to the development of short-, mid-, and long-range strategies for enhancing mobility in the region.

1.1 Study Background

The Austin-San Antonio region has experienced exceptional growth in the past 20 years which is projected to continue well into the future. With that exceptional growth come the challenges associated with increased traffic and congestion and quality of life issues. As part of planning to address these challenges, the region undertook studies from 2003 to 2016, in coordination with the Lone Star Rail District, to explore passenger rail that would service Austin, San Antonio and the communities in between. However, changes with potentially available rail right-of-way halted further development of the Lone Star Rail project.

With the ending of the Lone Star Rail project, an opportunity was presented in late 2016 for the region's transportation planning partners to coordinate on other potential solutions to enhance mobility in this developing mega-region. The Capital-Alamo Connections Study was initiated in early 2017, and an Executive Steering Committee was created which was comprised of the two MPO directors and staff, TxDOT directors and staff from Environmental Affairs Division (ENV), Transportation Planning & Programming Division (TPP), as well as Transportation Planning & Development directors and staff from the TxDOT San Antonio and Austin Districts. The Executive Steering Committee provided guidance and input throughout the study. Coordination with other TxDOT division and sections, including Traffic Operations, Freight, and Rail also occurred regularly. During the study, this broad coordination for multi-regional issues allowed for collaboration on transportation options and approaches to enhance mobility and connectivity between the regions.

While this was a concerted effort to develop bi-regional strategies, CAMPO and AAMPO have coordinated with increasing frequency as the two regions have grown closer together. See Section 5, Figure 13 of this report for a list of coordination efforts between the two MPOs.

1.2 Study Area

The study area is composed of the 10 counties in the CAMPO and AAMPO planning area and two adjacent counties as depicted in Figure 1. The study area was developed to encompass all major connections between Austin and San Antonio which includes I-35, US 281 and SH 130. See Table 1 for a list of counties by MPO.

Figure 1 Study Area

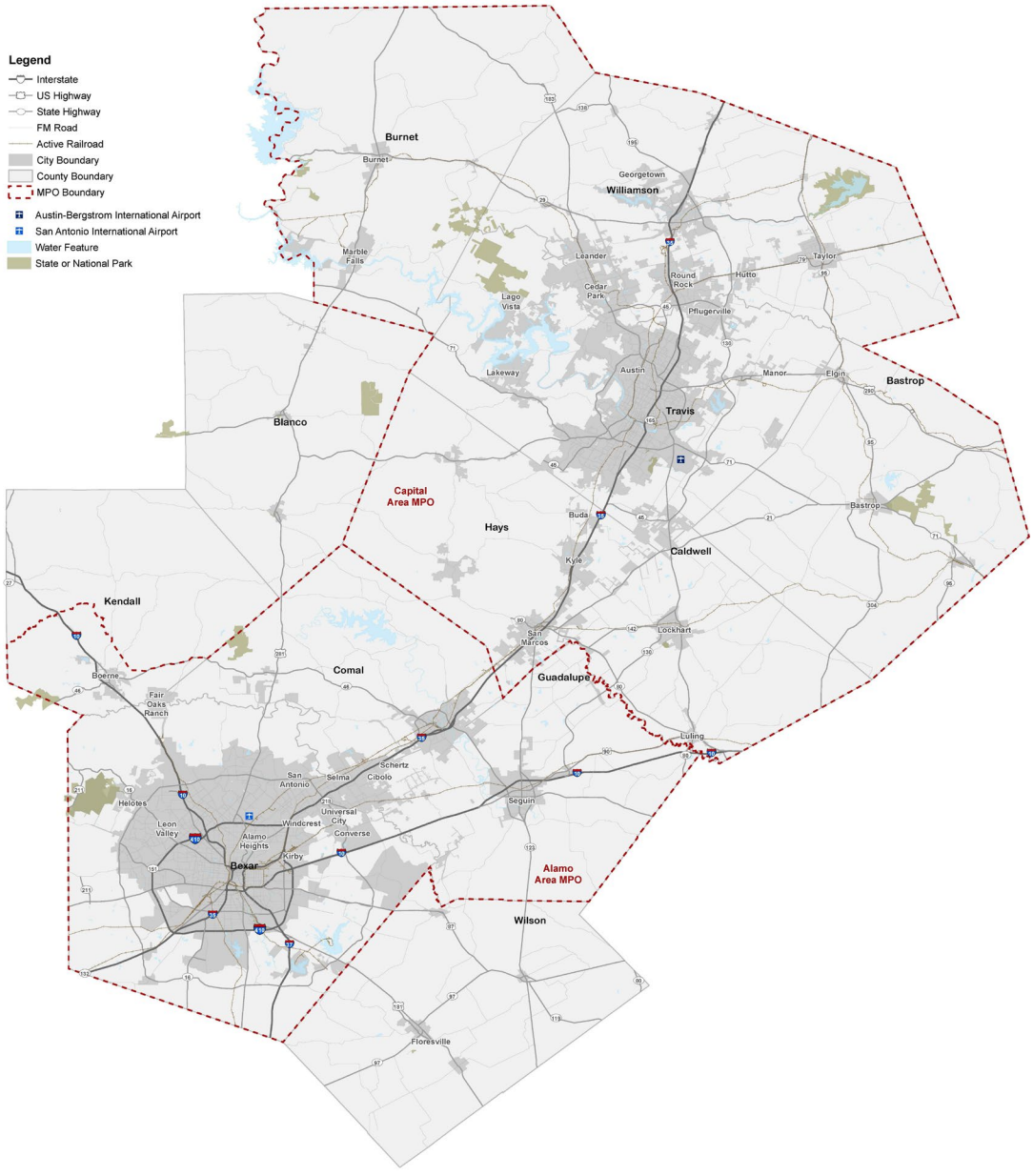


Table 1 - Counties per MPO

AAMPO	CAMPO
Bexar	Hays
Comal	Travis
Guadalupe	Caldwell
Kendall*	Bastrop
Wilson*	Williamson
Blanco*	Burnet

**Counties partially or not under official MPO jurisdiction.*

Although generally acknowledged that most travel between the Austin and San Antonio metropolitan areas occurs along I-35, the study took a broader look of the entire bi-regional area including, but not limited to the Interstate corridor. Even with I-35's role as the primary transportation connection between regions, movement in the area needs to be addressed at a system level. The Executive Steering Committee concluded the analysis of an expanded study area, which includes all areas affected by growth, would be more beneficial for a long-term planning approach.

The expanded regional scope permitted:

- An understanding of growth patterns in the region beyond the areas adjacent to I-35
- The involvement of a wide range of stakeholders with varying transportation perspectives, needs, and concerns
- An assessment of additional regionally significant corridors (e.g. SH 130, US 281)
- Fostering and promoting greater bi-regional coordination and cooperation
- Development of comprehensive recommendations in terms of **infrastructure, policy, and technology.**

As population continues to grow, the geographic distinctions between the Austin and San Antonio metro areas may lessen. There will be a greater need in the future to coordinate planning efforts at the MPO level, particularly regarding transportation facilities and services that link the two regions. By engaging the entire 12-county region, this study effort promoted the importance of bi-regional coordination and acknowledged that mobility management is not limited to just one jurisdiction or agency.

1.3 Study Purpose & Goal

With the increase in growth and traffic congestion in the region, cooperation on solutions development and alignment of infrastructure investment has become a focus. The purpose of the Capital-Alamo Connections Study is to develop a shared vision and path forward for addressing increasing growth and traffic congestion in the region.

An initial meeting was held with both MPO Transportation Policy Boards on November 1st, 2017 where transportation needs and challenges were discussed. At this meeting, an overarching study goal along with objectives, was discussed and validated. The study goal is to develop a regional strategy to enhance mobility and identify infrastructure, policy, and technology solutions for the Greater Austin-San Antonio region. Objectives included the following:

- Enhance existing transportation services and facilities.
- Provide additional, reasonable, and economically feasible transportation options.
- Address the diverse needs of the traveling public.
- Enhance multimodal opportunities in the region.
- Address sub-regional travel patterns
- Work with partners throughout the region.
- Use a comprehensive and coordinated improvement approach.
- Address the influence of local travel patterns on regional congestion.

STUDY GOAL

Develop a regional strategy to enhance mobility and identify infrastructure, policy and technology solutions for the Greater Austin-San Antonio region.

The study goal defines three main areas of action: infrastructure, policy, and technology. The study partners recognized the need to perform coordinated actions in these three areas. Infrastructure improvements are meant to address current and immediate needs - but those to be implemented in the future must have a policy framework today that facilitates their future implementation. As for technology, the rapid changes in the transportation arena both open possibilities to leverage efficiencies and present challenges planning for a future we are currently unable to define.

More broadly, this study is not focused on a single solution, and the outcome is not dependent on a single jurisdiction solving all of the regional needs. Instead, it is intended to be the foundation on which local, regional, and State transportation initiatives can be organized over the coming years to create cooperative solutions.

1.4 Study Rationale

The Central Texas region is grappling with the effects of population growth, low density development patterns and the associated increase in traffic/congestion that make coordinated long range planning a necessity to help preserve the economic prosperity and vitality of the region.

Accelerated Growth

The accelerated growth of the Central Texas region. Texas as a whole has experienced tremendous growth over the past decade. Statewide, Texas has added 12.6% more people since the 2010 Census, which is one of the

highest growth rates in the nation.[1] Counties in the study area having been topping national growth listings throughout the past decade, both for population totals and percentage growth. Most recently, San Antonio's Comal and Kendall Counties along with Austin's Hays County were named among the national 10-fastest growing counties in 2017. Williamson County, north of Austin, landed on the same list in past years. Additionally, Bexar County, home of the Alamo, was the 7th county in the nation with the most people added in 2017. More details on the current and expected population of these regions can be found later in the regional assessment of this report.

Comal, Kendall and Hays counties were among the 10 fastest-growing counties in the US during 2017

Population growth is classified as an indicator of a healthy local economy, which the state has been recognized for, and Central Texas is a leader in this expansion. It is the role of this study to find transportation strategies that help the region coupe with its challenges and develop its possibilities.

Emerging Megaregion

Central Texas constitutes a part of an emerging megaregion. A megaregion is a large network of metropolitan regions that share several environmental and infrastructure systems, economic linkages and land use patterns. Several counties in the study area are recognized by the Federal Highway Administration (FHWA) as a branch of the Texas Triangle Megaregion. This southern megaregion envelopes 101 counties in the state and is generally recognized as the area enclosed by the sections of I-35, I-45 and I-10 connecting Texas' biggest cities: Houston, Dallas-Ft. Worth, San Antonio and Austin. The Texas Triangle is characterized by an extensive established region with development being driven by the explosive growth of smaller communities.[2]

The geographical proximity of the Austin and San Antonio metro areas, coupled with their development patterns and those of intermediate communities make the "merging" development pattern more apparent. In 2017, Texas State Demographer Lloyd Potter stated the I-35 corridor hints at a future pattern of continuous land use development from

"An apparent merging of population density along I-35 corridor as the metro areas continue to grow".
-Texas State Demographer

[1] https://www.forbes.com/sites/chuckdevore/2018/05/22/texas-laps-california-in-job-and-population-growth/#3262e19f73f3

[2] http://www.america2050.org/upload/2010/09/2050_Defining_US_Megaregions.pdf

the State Capital to the home of the Alamo. This study aims to provide a framework for coordination of regional transportation efforts at a higher planning scale to prepare for this future.

Urgent Demands

Growing demands on the extensive transportation network connecting the regions. A growing population and concentrated development patterns have created increased traffic demands on the regional transportation system. Growth-induced traffic has landed 28 roadway segments in the study area within the TxDOT's 100 Top Most Congested Highways in the State. Seven of these segments are located along I-35, US 281 and SH 130, their main north-south connections. I-35 in Downtown Austin with an average daily traffic of 207,725 vehicles per day[3], is already congested to the point of being recognized as the 3rd of the Top 100 Most Congested Highways in the state. Other connections, while not on the statewide list, are also nearing capacity or having efficiency challenges. More details on the current and expected traffic conditions in the region can be found later in this report (Chapter 3).

Efforts to reduce pressure in the system include an TxDOT's extensive improvement program for I-35, expansion plans for several major facilities, and technology-based efficiencies. However, the space available for traditional capacity building is finite. Given today's demands, accommodating the expected regional growth within the existing transportation network could represent one of the biggest challenges to the region. It is the role of this study to identify the actions necessary to help address these challenges.

Seven segments on the North-South connections between Austin and San Antonio are in the Top 100 Most Congested Highway Segments

[3] Statewide Planning Map. 2017 Data. Accessed. 12/2018

2. Study Structure

TxDOT in partnership with AAMPO and CAMPO took a broad view of mobility challenges and potential solutions for the bi-regional area. The population within and between the regions is experiencing accelerated growth; this will lead to demands on current infrastructure in excess of current improvement plans. Without additional investments and solutions, roadway congestion will continue to spread, and the quality of life will be affected. The large, diverse geographic area requires a range of strategies.

2.1 Level of Planning

This study includes an over-arching look at the conditions of the region with regard to mobility, and provides a set of high-level but implementable strategies which were categorized and prioritized to span the 25-year planning period.

- **Short-term** recommendations span 0 to 5 years, and include support for many efforts already underway or funded,
- **Mid-term** recommendations span the period from 6 to 15 years, and
- **Long-term** recommendations identify strategies to be implemented from 16 to 25 years in the future.

Recommendation categories contain a range of tactics for implementation, intended to build on each other and complement other transportation improvements. The intent is to provide a broad base of solutions that work together, rather than standalone efforts.

While TxDOT, CAMPO and AAMPO spearheaded this study, implementation of the strategies may fall within the jurisdiction of member agencies. Many recommendations stress the need for greater coordination between agencies. Local partners and involved parties are designated for each strategy, and many require cross-agency planning and execution.

2.2 Study partners and stakeholders

As previously discussed, the Capital-Alamo Connections Study is a joint effort between the TxDOT, AAMPO, and CAMPO. As the central authority for overseeing roadways, aviation, rail, and public transportation throughout the state, TxDOT provided management, staff time and funding resources for the development of this study.

MPOs, including AAMPO and CAMPO, are regional agencies tasked with overseeing transportation planning and the allocation of federal transportation funding to areas with populations greater than 50,000. As such they are responsible for all transportation planning and implementation within their jurisdictions. AAMPO and CAMPO provided

leadership, staff time, knowledge repositories and most importantly access to their committee members, which were all crucial to the success of this effort.

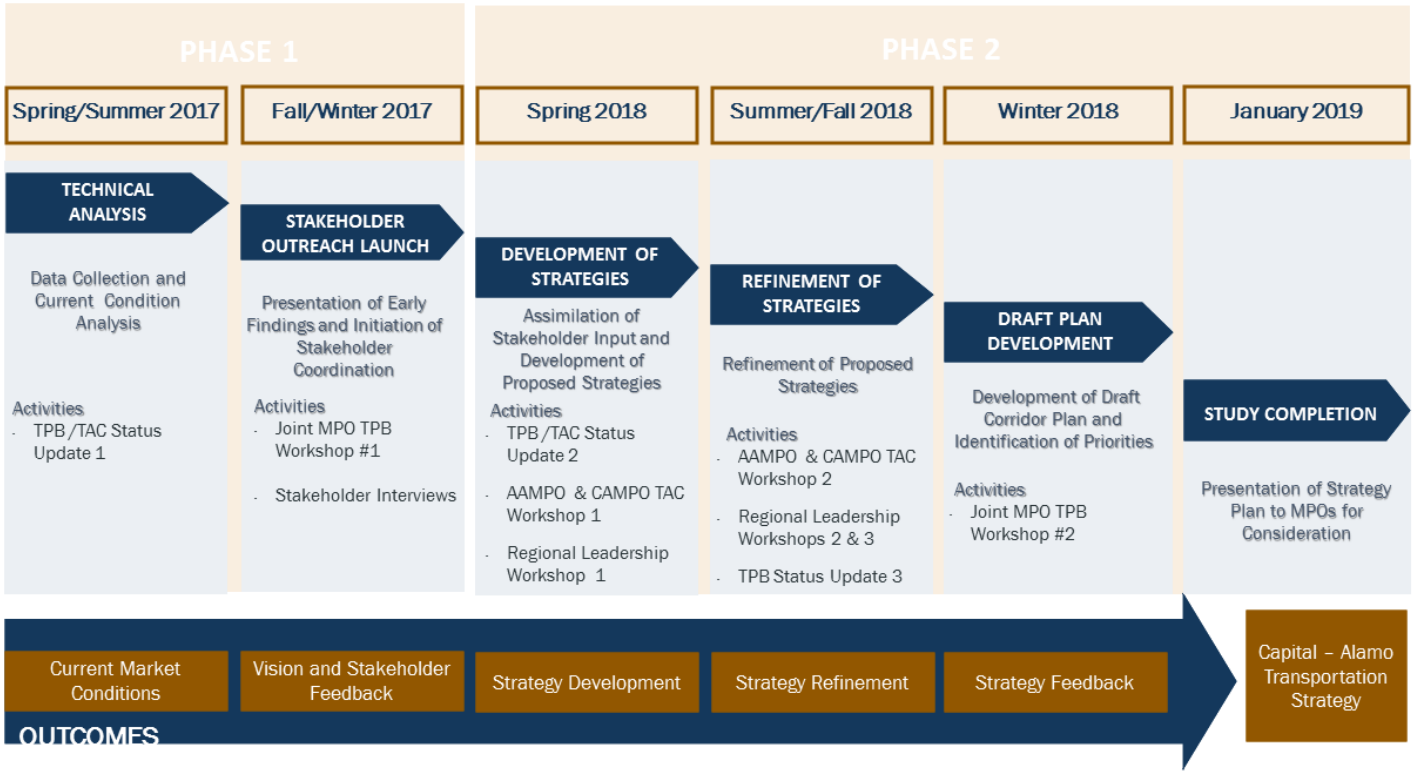
Other stakeholders in the study process included county officials for all counties within MPO jurisdiction, city officials, public transit providers (Capital Metro, VIA, CARTS, and Alamo Regional Transit), Regional Mobility Authorities (Alamo RMA, Central Texas RMA), research agencies (Southwest Research Institute) and transportation technology companies (such as Chariot and Google). For a comprehensive list of stakeholders refer to Appendix C.

The three partner agencies came together to assess the mobility challenges from a broad base of transportation planning and funding. Partnership is necessary to bring together the right combination of municipalities, elected officials, transportation leaders, and funding partners to induce change across the two regions. The study also provided an opportunity to grow and formalize the current communication and coordination efforts between the participating agencies.

2.3 Schedule

The Capital-Alamo Connections Study was initiated in early 2017. The study had an original intended duration of one year, which was later extended to accommodate stakeholder interviews, MPO workshops and other coordination. Data collection and analysis began in Spring 2017 and ran through Fall 2017, with updates as appropriate. Stakeholder outreach and MPO workshops began in Fall 2017, occurring at key points in the study through Winter 2018. Figure 2 depicts an overview of the study schedule along with the activities performed and the outcomes defined during each stage.

Figure 2 - Study Schedule



2.4 Methodology

The study methodology was comprised of two main elements:

1. Technical Analysis – Review and analysis of technical information and data to provide an outline of current and expected regional conditions, and
2. Stakeholder Input – Consideration of empirical information sources obtained through a process of stakeholder involvement

Conclusions and insights from both input streams were combined with research into best practices, funding mechanisms, as well as emerging trends and technologies to produce regional transportation strategies to meet the purpose and goal of the study.

The following describes the input and steps involved in developing the strategies.

(a) Regional Evaluation

The Executive Steering Committee aided in gathering the latest information regarding their current and long-range estimates for key topics including:

- Population and employment data for diagnosis of the population trends, and geographical and economic implications;

- Land cover, distribution and available right-of-way (ROW) to assess the development patterns of the region;
- Traffic demands from both the travelling public and the freight industry to determine the level of remaining capacity in the existing transportation network;
- Trip origins and destinations to define main movements and by extension potential routing options to differentiate or address them in better ways;
- Travel times, congestion indexes and safety factors to assess bottlenecks and points of major impact;
- Multimodal options and initiatives to create a more balanced, efficient and equitable transportation system;
- Environmental features which must be considered;
- Planned and programmed initiatives and improvements to identify gaps in service and synergies between expected improvements.

The regional evaluation and definition of the study framework were the focus of the first phase of this study. However, individual analyses were carried forward and updated throughout the second phase in response to newly available data or information.

(b) Stakeholder Engagement

The study team led a series of one-on-one interviews with key stakeholders whose input was requested in terms of their personal perception of needs and challenges for the regional well-being of the transportation network. The interviews were complemented by a first series of workshops with the two MPO Transportation Policy Boards (TPB) and Technical Advisory Committees (TAC) members meant to acquaint them with the insights of the ongoing technical effort and solicit validation for the data analysis conclusions. These discussions with stakeholders revealed insights not readily available in databases. Workshops with MPO and TxDOT leadership also occurred, providing further guidance and insight into the data and strategy development. Their work is documented in Chapter 5 - Stakeholder Engagement.

(c) Strategy Assessment

Based on the technical assessment and input from the stakeholder outreach effort, and MPO and leadership workshops, a set of initial strategies were developed.

AAMPO and CAMPO TPB Chairmen, Commissioner Kevin Wolff and Will Conley along with MPO Directors, Isidro Martinez and Ashby Johnson, led a subsequent assessment of a preliminary strategy universe which provided a primer for MPOs members to consider, modify, and further craft the strategies. A second round of workshops provided the setting for MPOs to collectively refine these regional strategies. MPO TAC members were asked to

create and recommend a final set of strategies for TPB consideration and prioritization based on their appropriateness and feasibility.

(d) Regional Strategic Program

The final set of regional transportation strategies, with corresponding implementation timeframes resulting from data and inputs described above, were presented to the MPO TACs and TPBs in January 2018 for acceptance. These strategies are located in Chapter 7. This program is meant as a guide for inclusion in MPO planning efforts.

2.5 Guiding Considerations

While this study took a wide-ranging view of potential mobility improvements by including potential policy, technology and infrastructure solutions, the study team was guided by overarching policies and opportunities which impact the scope of the recommendations, among which include the following:

Tolling

State-level policies affect transportation planning and funding. Tolling has been an effective way to leverage funding for roadway facilities in recent years, either for new facilities or managed lanes (which use tolling to mitigate congestion and provide a reliable trip option). In 2017, however, the offices of Texas's Governor and Lt. Governor specified that no new toll projects would be planned in the State. Tolling remains an unlikely project delivery option at this time, with state leaders seeking other methods to secure additional transportation funds. For this reason, recommendations related to tolling have not been included in this study, although managed capacity is still an option to manage traffic flow using other methods including but not limited to HOV lanes, dedicated bus lanes, etc.

Land Use Planning Authority

During the outreach efforts *(See Chapter 5 & Attachment D)*, many stakeholders discussed the linkages between land use and transportation, the costs and/or difficulties incurred when development occurs haphazardly, and a desire for greater integration between land-use planning in the counties and State transportation investments. Comments were received regarding the need for land-use planning controls outside the municipal boundaries which would seek to guide development in tandem with regional transportation improvements. Within current Texas law, however, land use authority only can occur within

the municipal boundaries. Similarly, Senate Bill 6[4] requires landowner or voter approval for annexations in the State's largest counties, limiting cities' annexation and growth management authority under specific conditions as outlined in the bill.

It was outside the scope of this effort to address the larger State policy of land-use planning authority, but greater coordination between government agencies is encouraged to bring greater investment efficiencies.

Passenger Fixed Guideway (Rail)

This study included a review of emerging technologies that may one day revolutionize the way that passengers could be transported through the corridor. All of the data from the Lone Star Rail District efforts was reviewed and updated as necessary to assess the current state of rail potentials. However, several factors became clear during these considerations. First, the existing rail infrastructure is owned by Union Pacific, and at this time the private company is not interested in accommodating more passenger services on a profitable freight line that is nearing capacity.

Second, the State of Texas does not have funding available to introduce passenger rail services in this area. While both regional governments are interested in passenger rail as a long-term solution, pressing investments for shorter distance services within both urban areas must be the priority for their limited resources.

Third, a review of existing markets using cell phone data revealed that the existing Austin-San Antonio travel market is extremely limited. There may be latent demand in long distance trips by rail (and as the two regions grow together, this market is likely to expand), but there is not a sustainable market at this time.

[4] TX SB 6 | 2017 | 85th Legislature 1st Special Session - https://legiscan.com/TX/text/SB6/id/1644616/Texas-2017-SB6-Enrolled.html

3. Regional Assessment

To better understand regional movements, passenger and freight data were obtained from various sources and analyzed in terms of their current as well as future magnitudes. Such data included existing and forecasted population and employment totals and densities, traffic volumes, activity centers, crash histories, transit services and usage information, trip origins and destinations, planned and programmed improvements, environmental features, as well as truck and rail freight movements. A synopsis of the relevant findings for the topics of greater significance is provided in the following chapter along with a brief assessment of the impact each has on the overall mobility in the region. Phase 1 of this effort investigated all aforementioned topics with the appropriate level of detail. In summary, travel demand for the study area is expected to grow, further reducing travel time reliability and adversely affecting system performance.

3.1 Population and Economic Growth

(a) POPULATION

The Austin-San Antonio Region is expected to grow to over 3.9 million by 2045, or even as much as 8.4 million when considering the full 12-county study area. [5] Even with development patterns for both cities pointing to north-oriented growth, the continued explosive expansion of the intermediate counties points to the shrinking of the physical separation between the two metro areas.

The suburban and surrounding counties of the region are experiencing growth in numbers that are nationally significant. Medium sized communities with thriving economies, like San Marcos and New Braunfels, are showing signs of higher population densities with forecasts pointing to this trend continuing. The two regions are expected to coalesce into one of the anchors of the Texas Triangle megaregion, potentially attracting more population into the area, which could in turn present an even greater challenge to the efficient movement of people and goods.

[5] CAMPO & AAMPO Population Forecasts 2045. Census Bureau Population Estimates 2016

Figure 3 - Population Expected Growth

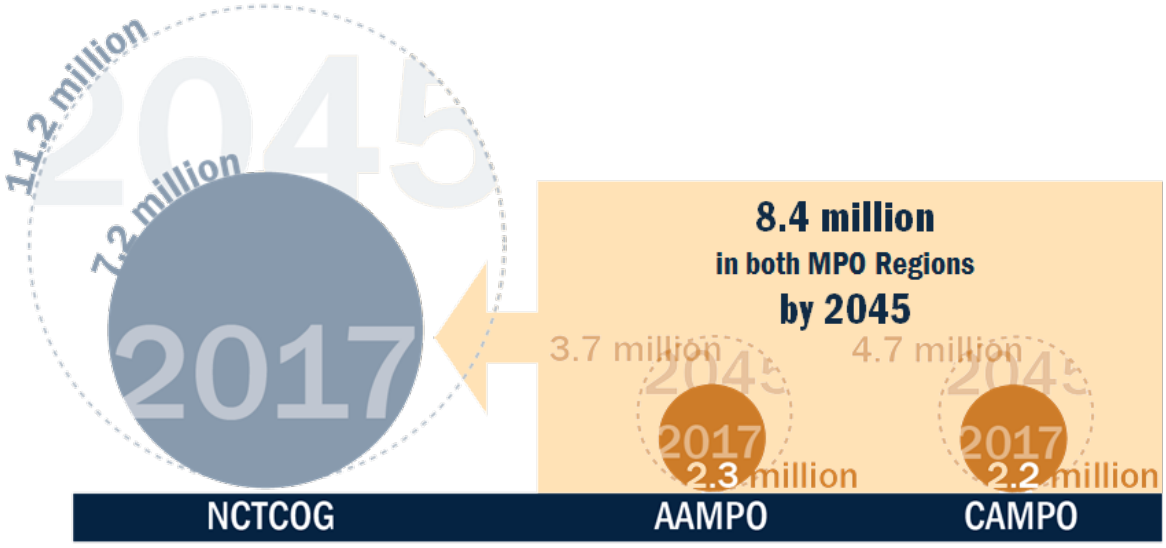


Figure 3 depicts a comparison between the current and expected populations of the Austin-San Antonio Metropolitan areas and that of the Dallas-Fort Worth (DFW) metro. By 2045, the Austin-San Antonio region could be comparable to, or bigger than, the current DFW metropolitan region. However, today's DFW population is served by a highway and rail system that is four times the size of the Capital-Alamo Connections Study area.

While DFW has major transportation deficiencies, the current size of the Capital-Alamo transportation (existing and committed) network suggests that travel deficiencies will be even more serious when Central Texas approaches DFW's size. Growth of this magnitude will require an extensive and proactive transportation improvement program to address its needs.

Land development patterns present other challenges and opportunities. In 2010, according to the Census Bureau, 57% of the population in the study area lived within 5 miles of the I-35 corridor. In 2045, it is estimated the same population will hover at 53%. This explosive localized regional growth combined with a significantly constrained transportation network will create significant stress on regional facilities and on I-35 specifically.

Over 50% of the population in the study area lives within 5 miles of the I-35 corridor, both today and in the future.

(b) EMPLOYMENT

Employment was used as the main economic indicator for the region's performance. Employment data from the CAMPO and AAMPO demographic databases were used to estimate current and forecasted employment densities within the study area based on data in the MPO traffic models. The information was used in concert with top employer locations to identify potential travel patterns and activity centers. The highest employment densities

are currently located along the I-35 corridor in both MPOs; although Austin houses another high-density employment center along the US 183 corridor. In San Antonio, the highest densities are found west of I-35 as well as along the I-10 and US 281 corridors.

Employment concentrates near I-35 for most communities. Other concentrators include I-10 and US 281 in San Antonio, and US 183 in Austin.

In 2040, forecasts anticipate new significant centers of employment in Round Rock and Cedar Park as well as higher employment densities in San Marcos, New Braunfels and Buda. These findings are consistent with expected expansion of these intermediate communities. Future employment growth in the San Antonio region is expected to increase north and north east of the city. This will undoubtedly add to the pressures on the central aisle of the region.

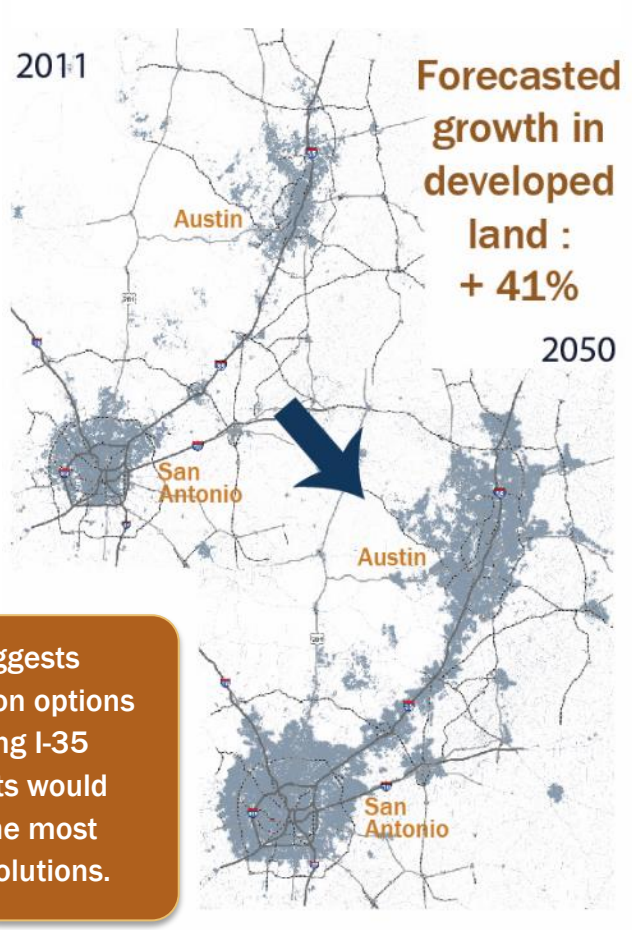
3.2 Land Use and Right-of-Way

(a) Land Cover

Land use data[6] was mapped to better understand where developed land and open land are located as well as where potential future development could be anticipated. Developed land in the region is expected to increase by 41% by 2050[7] in keeping with trends established by population and employment forecasts. New developed lands are anticipated to concentrate along the I-35 corridor with notable changes in and around the localities of San Marcos and New Braunfels. Most of the land used for this increase is estimated to come from previously open land.

The prognosis of the regional growth models points to the physical separation between metro areas shrinking as

Figure 4 – Current and Expected Land Cover



Data suggests transportation options addressing I-35 movements would provide the most effective solutions.

[6] Land data was obtained from the National Land Cover Database (NLCD) 2011.

[7] Comparing National Land Cover Database (NLCD) 2011 to the Clark Labs' Predicted NLCD 2050. http://www.esri.com/about-esri/greeninfrastructure

depicted by Figure 4. This trend will have an impact in the communities between the two metropolitan areas which are emerging growth poles themselves. The combined impact on the conglomeration of our cities, the demands we will make of them and the demand we put on their transportation systems will drastically reduce the effectiveness and efficiency of the entire system if major improvements are not made.

(b) RIGHT OF WAY (ROW)

Assessment of ROW availability in comparison to existing and future population and development densities, points to the need for immediate corridor preservation efforts. TxDOT provided ROW information was evaluated for the main roadways, highways and interstates in the study area as depicted in Figure 5.

Existing ROW for I-35 in urban areas is severely constrained, meaning it is already utilized. However, the corridor maintains some room for expansion (Max. ROW 420 ft) in areas between the major metros. Parallel facilities were also evaluated with the following results: US 281, located 10 to 30 miles west of the central development path, has ROW availability throughout. However, it currently does not have extensive spare roadway capacity and is being encroached or landlocked by land developments. SH 130 has the highest provision of ROW (Av. ROW 470 ft – Max. ROW 700 ft) and a roadway capacity comparable to that of I-35. Nevertheless, it is located 10 to 15 miles east of the central development path and its tolled nature might deter usage. Right-of-Way for east-west connections are similarly constrained especially for those facilities within city limits despite having bigger ROW provisions.

ROW and capacity for other modal options led to consideration of the Union Pacific (UP) rail line paralleling I-35. The UP-Railroad ROW is somewhat constrained and corridor expansion is restricted by adjacent land uses. With a single track available, logistical challenges including scheduling or capacity allocation may become more commonplace. Results from this analysis suggest future system improvements considerations will require proactive corridor preservation efforts along all regional facilities.

3.3 Environmental Constraints

To obtain an overall understanding of environmentally sensitive areas and the potential effect of regional transportation improvement options on them, general environmental information was extracted where available. Major environmental constraints were located and assigned a 500-foot (ft) influence radius. Figure 6 represents the environmental constraints and resource concentrations of greatest concern. As shown, the majority of these environmental features are located to the west of the study area and throughout the Hill Country.

Figure 5 - Right of Way Availability

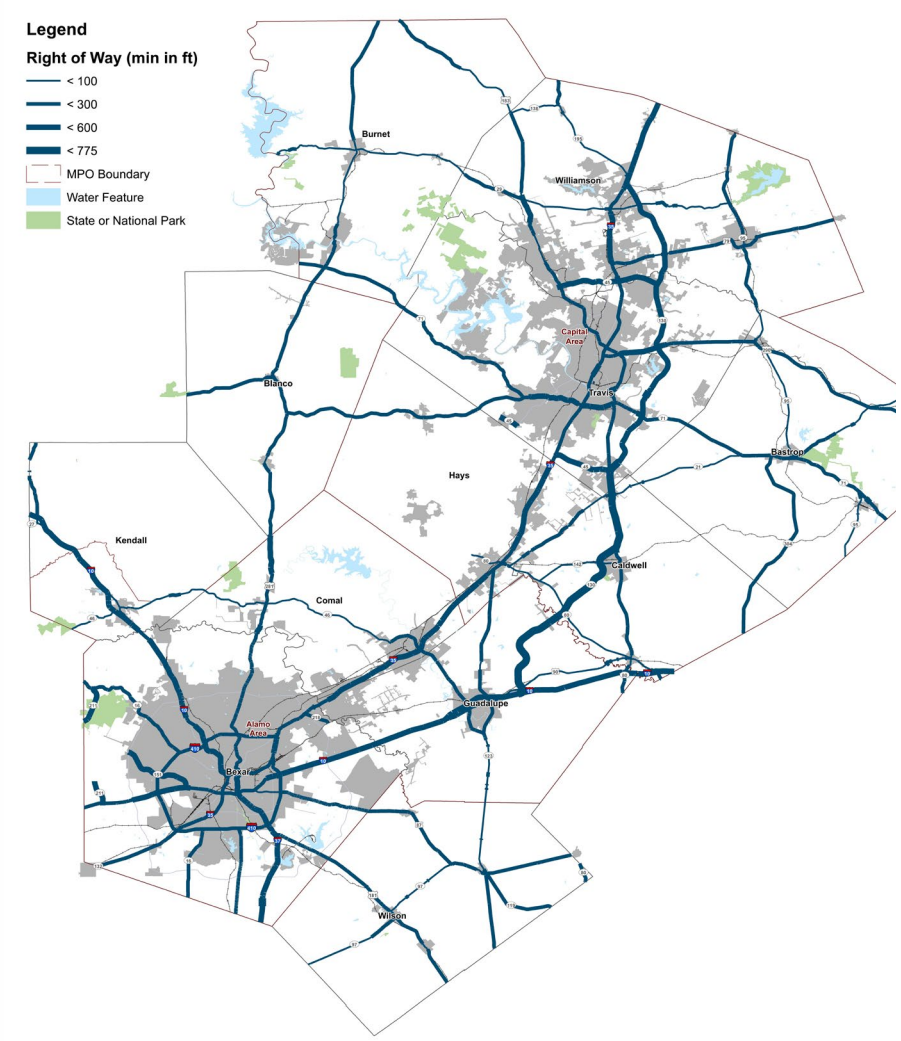
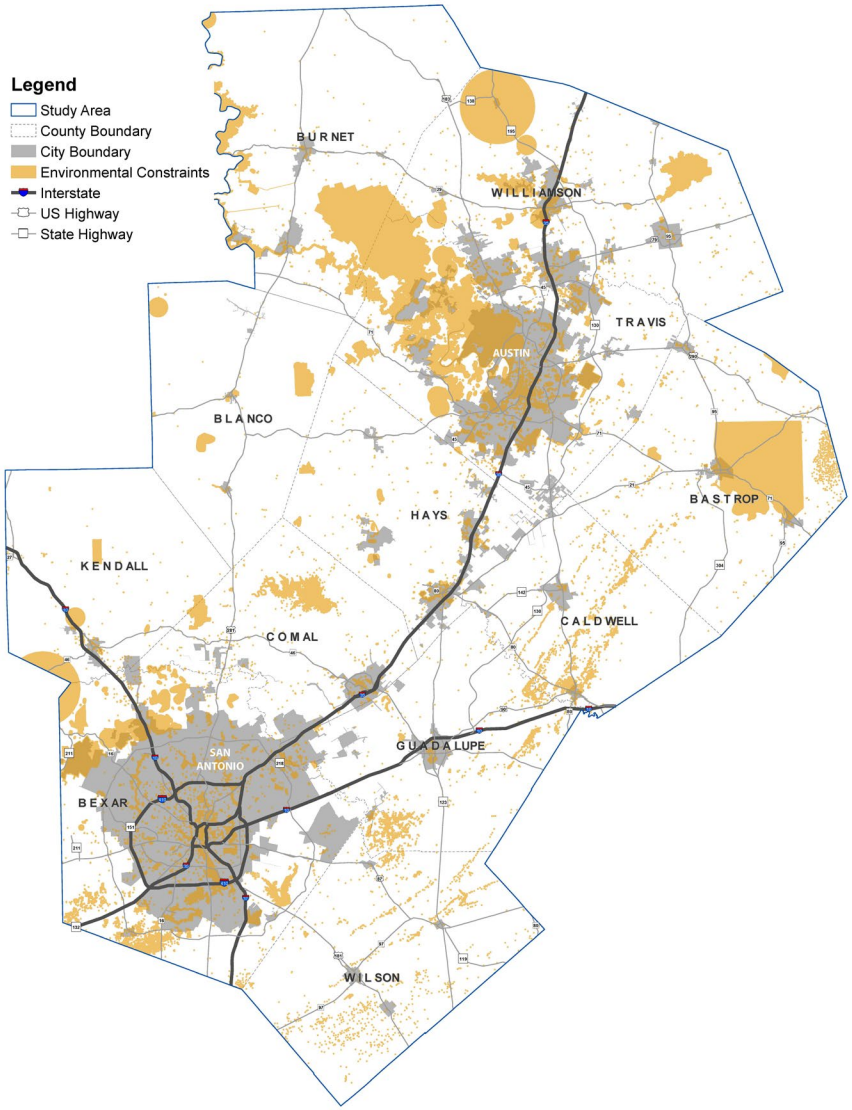


Figure 6 – Environmental Feature Heat Map

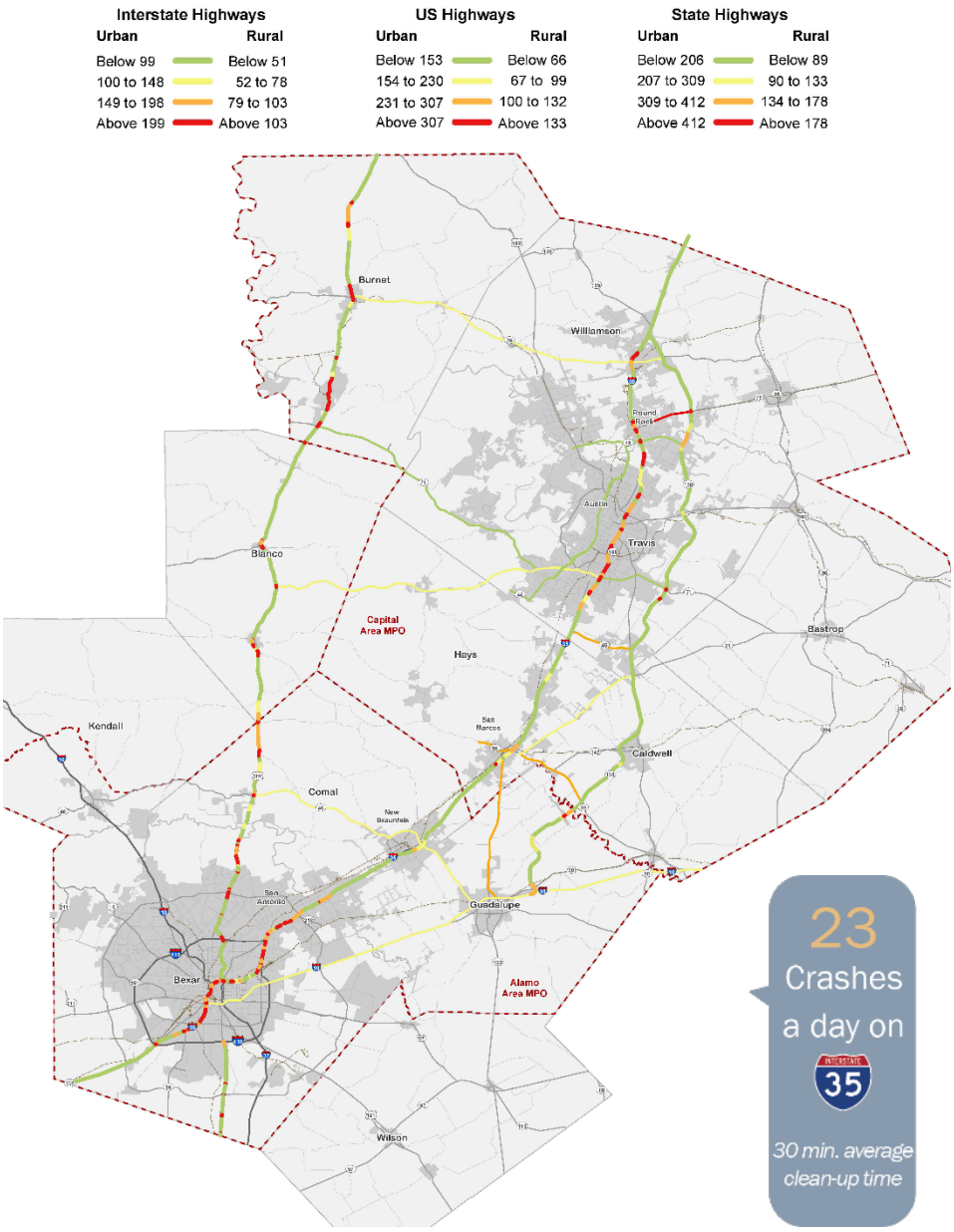


These concentrations could trigger more stringent requirements for implementation of any proposed improvement. As such improvements on the west side of the study area would probably require longer development times than similar improvements to the east. Additionally, environmental features usually pose conservation concerns for surrounding communities.

3.4 Safety

Providing a safe and reliable transportation network, which is a principle TxDOT goal, requires the identification of crash concentrations to formulate appropriate solutions. Crash histories within the study area were analyzed based on TxDOT's Crash Records Information System (CRIS) data for the last five years of available data 2012-2016 at the time.

Figure 7 - Crash Rates



(a) Crash Frequencies

The highest concentration of crashes in the region occurred along I-35 (9.5%), reporting an average crash rate 20% higher than the statewide average. However, the majority of these crashes (78%) are Property-Damage-Only crashes. Approximately 1% lead to fatalities or incapacitating injuries. However, an average of 23 crashes per day on I-35 routinely creates delays and further congestion.

Concentrations of crashes on I-35 coincide with segments with the most traffic. As depicted by Figure 7, its rural sections

generally experience lower frequencies of collisions. Findings suggest concentrated efforts to improve designs at particular intersections and urban highway clean-up could be the most efficient strategy for reducing the severity if not number of crashes.

Other major north-south highways, principally SH 130 & US 281, also have localized segments that exceed the statewide average, mostly in relation to busy intersections, but not to the same extent as I-35. However, this suggests that for I-35, SH 130 and US 281 to operate in a safer manner intersection improvements and faster response to incidents should be implemented. Moreover, east- west connections (i.e. US 71, SH 46 & SH 123) potentially serving as collector facilities for county-originated traffic also present elevated crash rates. Specific corridor studies may be needed to address those corridors.

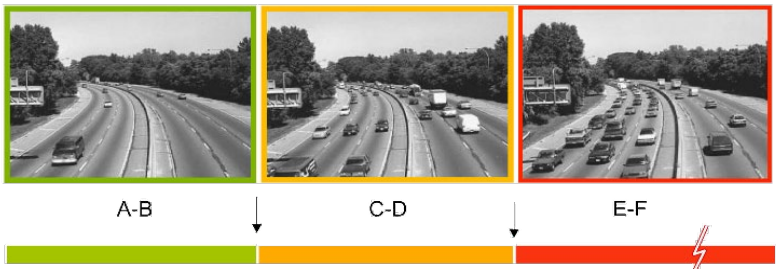
3.5 Travel Demand & Congestion

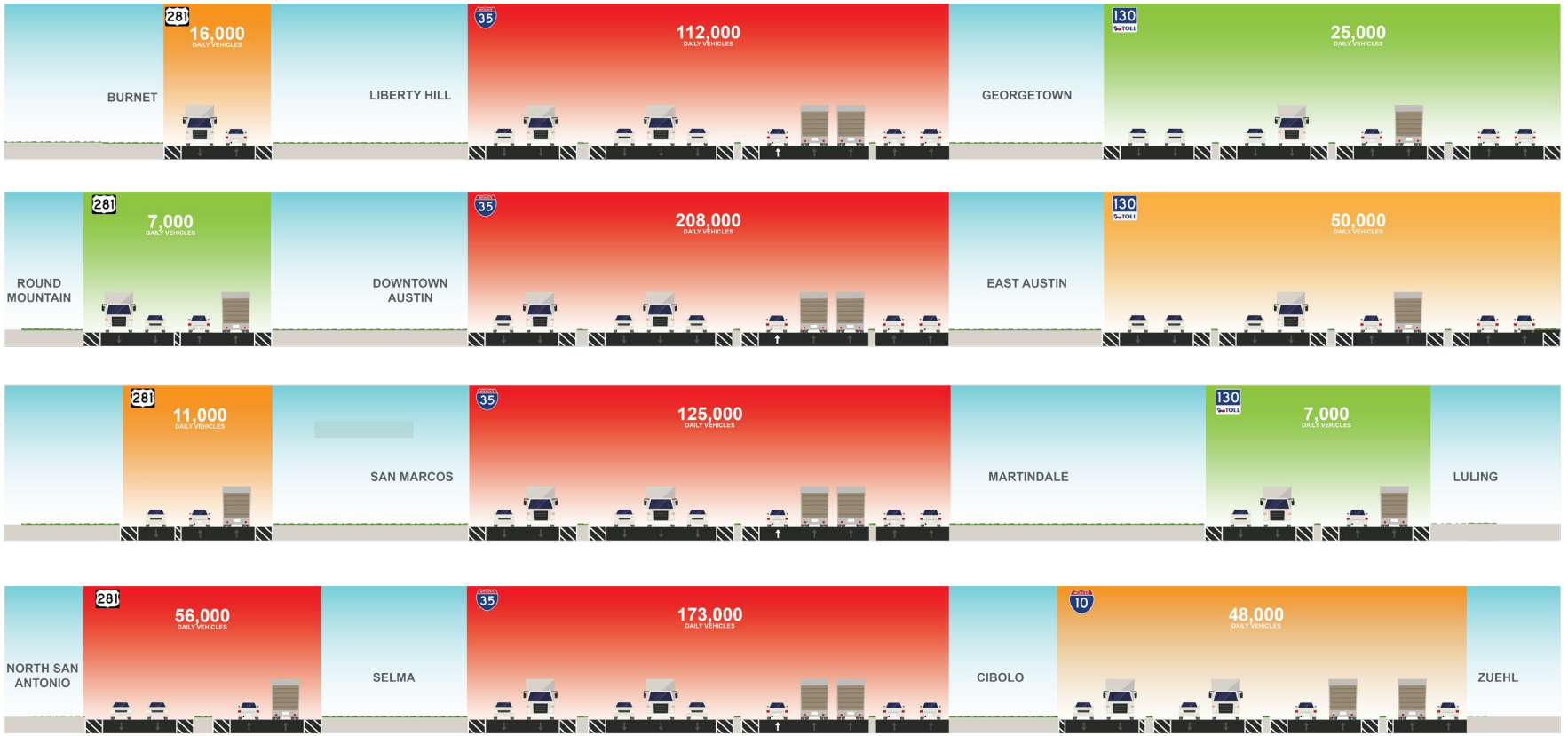
Traffic data and congestion metrics were collected to better understand which facilities are or could face future challenges in providing adequate travel conditions.[8] The capacity of a roadway to handle a certain volume of traffic while maintaining reliable travel times is measured through Level of Service (LOS). Higher traffic volumes usually correspond to a drop in LOS level which in turn signals higher levels of congestion. Figure 8, illustrates average traffic totals for all three major north-south connections in the region in relation to their existing cross sections at selected locations. Color coding indicates which locations are experiencing undesirable levels of congestion.

Average Annual Daily Traffic (AADT), as collected by TxDOT for 2017, reveals I-35 is the most heavily used north-south facility in the region with an average of more than 100,000 daily vehicles. Some urban sections of I-35 for the same year experienced upwards of 200,000 vehicles a day. Parallel facilities to I-35 also experience congestion. Regardless of its lower traffic counts, US 281 experiences congestion through towns, and particularly as it enters the San Antonio metro area. SH 130 is experiencing heavier usage but only experiences congestion through Austin's metropolitan area.

[8] AAMPO 2040 Metropolitan Transportation Plan, CAMPO 2040 and 2045 Metropolitan Transportation Plan, TxDOT Roadway Inventory (2016) and National Performance Management Research Data Set (NPMRDS)

Figure 8 - Level of Service – Samples of Level of Service and Average Daily Traffic (2017) thorough major Facilities in the Region

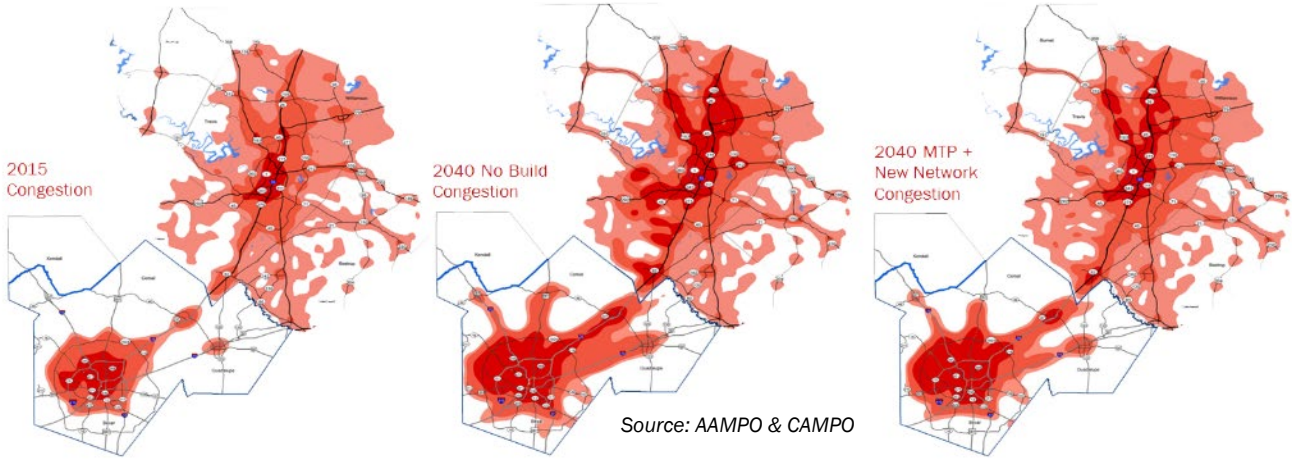




High traffic volumes have deteriorated the travel experience through parts of the region. Average speeds[9] point to issues with travel time reliability, revealing average peak period operating speeds though urban sections of I-35 and US 281 in Comal and Bexar counties that fall below 55 mph.

In 2015, the MPOs conducted an assessment by forecasting the effects of their respective 2040 Metropolitan Transportation Plans (MTP) on existing levels of congestion. As showcased in Figure 9, congestion levels are expected to rise even if the entire MTP programs of both regions are completed.

Figure 9 - MPO Congestion Analysis (2015)



Source: AAMPO & CAMPO

Even with the region's extensive roadway network, its main connections are already burdened with increased traffic, most of which is shouldered by I-35. Given the forecasted demands the regional road system will experience even more difficulties in accommodating the region's future mobility needs.

3.6 Travel Patterns

Travel patterns were identified to define the main regional movements as well as those that could benefit the most from targeted transportation improvements. A variety of sources[10] were used to determine micro-regional movements and better identify potential markets. A preliminary analysis using Bluetooth® data collected by sensors deployed throughout I-35,

[9] INRIX 2015, NPMRDS January 2017

[10] Bluetooth TTI data 2016, Streetlight Insight September 2017.

depicted a preponderance of movements within the Greater Austin region. Other regional movements included traffic exchanges between the San Antonio and Austin metro areas, San Marcos to Austin-Georgetown as well as Kyle-Buda to Austin-Georgetown. However, the existing Bluetooth® sensor coverage at the time of this analysis was considered less than ideal. A subsequent analysis using StreetLight® InSight data was performed in order to complement the assessment and better understand travel behaviors from community to community as well as along major corridors. StreetLight InSight® collects locational data from interconnected devices, such as cell phones, which can be combined with census data to describe the origin and destination of traffic, demographics, potential modes, and estimated speeds. This data, recognized for its superior locational accuracy, provides a representative sample so that traveler behaviors can be better understood.

A regional analysis of movements between city limits was performed for morning and afternoon peak traffic periods, producing the following results:

- The majority of trips originating from the Greater Austin and San Antonio regions remain within their respective communities which makes them relatively short in distance.
- Trips originating in intermediate communities along the I-35 corridor (i.e. San Marcos & New Braunfels) tend to travel to nearby communities.
- Weekend trips depict more travel to unincorporated areas in the counties, but percentages remain close to those observed on weekdays.

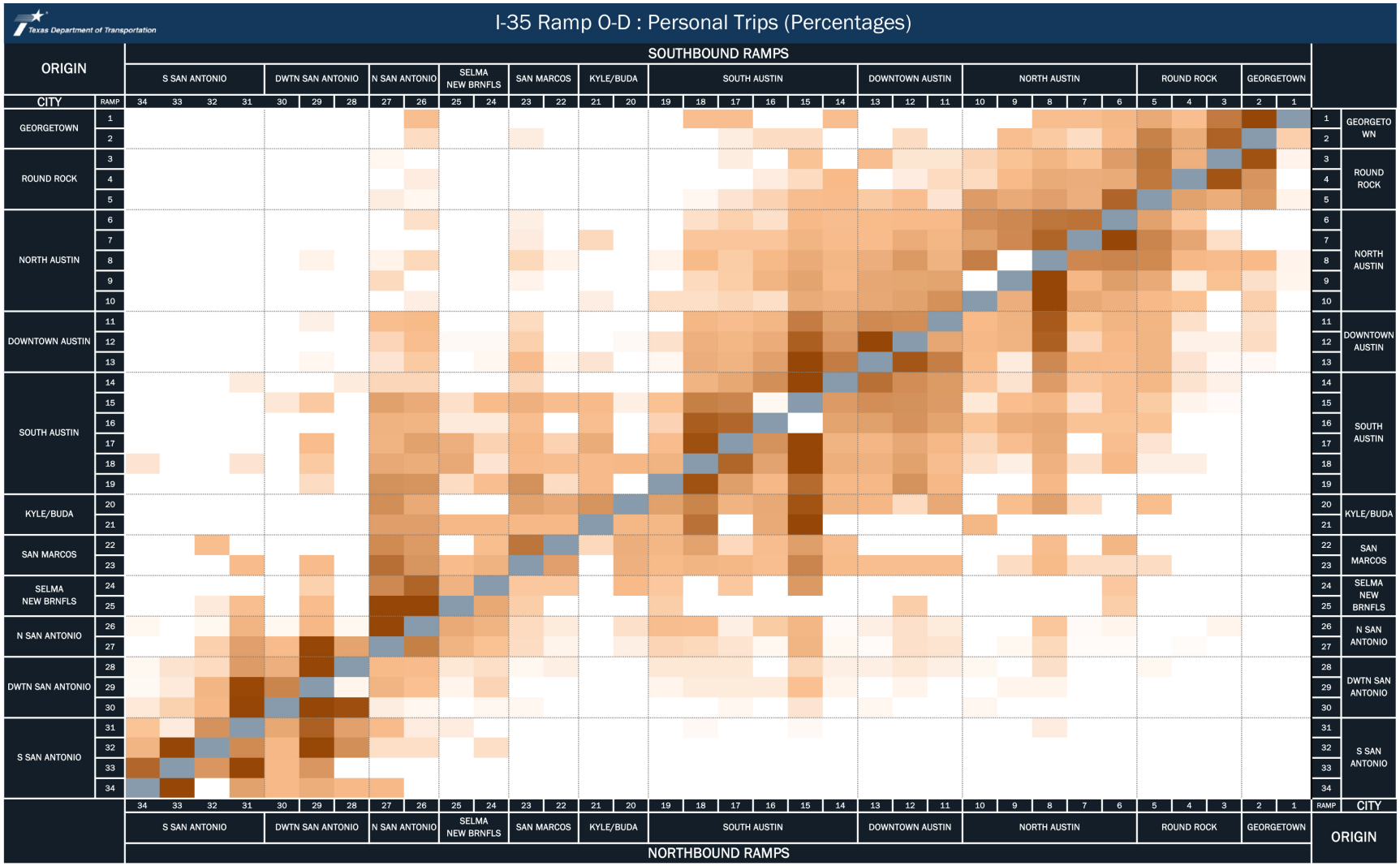
Analysis of this data would suggest that providing more transportation options within MPO boundaries connecting these major movements could mitigate existing congestion along major corridors. For more details on this analysis refer to Appendix D.

(a) Main Corridors Ramp Travel Patterns

Travel patterns along main north-south corridors were also investigated using StreetLight® Data. The locational accuracy of the data set allowed for the determination of origins and destinations for travelers based on enter and exit ramps at major intersections used to access I-35, US 281 and SH 130.

Assessing the ramp usage along I-35, analysis found a considerable number of vehicles traveling on the Interstate are only using it for a relatively short distance as depicted by Figure 10. Forty to seventy percent of the traffic in Austin, San Antonio, Round Rock and Georgetown, is only travelling 3 or 4 exits on the Interstate. Furthermore, locations in South Austin (US 290), Downtown San Antonio (I-10) and Round Rock (SH 45 N) produce considerable numbers of trips from one interchange to the next. This would suggest that having more local transportation options or expanding local arterial connections may help alleviate some of the heaviest congestion on I-35.

Figure 10- I-35 Ramp Origin - Destination Results for Personal Trips (Percentages)



Similar analysis along other corridors revealed the US 281 corridor is serving its intended purpose as a long-distance connection, but only once it exits the north end of San Antonio. SH 130, even as a tolled facility, reports heavy usage at its north end which is why this portion is currently being widened. Several other points of interest were highlighted by the analysis as depicted in Table 2 - Corridor Travel Pattern Findings.

Table 2 - Corridor Travel Pattern Findings.

Travel Pattern Localized Findings			
Region	Interstate 35	US Highway 281	State Highway 130
North	While experiencing the largest number of short trips, South Austin also attracts or produces some of the longest trips	The facility is heavily used through its dual designation with US 290	SH 71 in South Austin is a major destination to trips from both directions of SH 130
Central	Selma and New Braunfels interacts mainly with San Antonio through the LP 1604 & I-410 N connections	Half of trips entering the corridor at FM 1863 are headed to SH 46	Southbound travel past SH 21 is mostly headed for I-10
South	Almost half of trips Southbound from Downtown San Antonio only go to SH 90	US 281, through San Antonio, is heavily used as a connection to I-410 North	The facility is partially used as a loop around Lockhart.

Travel patterns determination at this level of analysis proved very beneficial in the identification of major movements along principal corridors, however the nature of the data now available for planning purposes can prove even more useful for efforts to address and redirect travelers by local partners.

(b) Metropolitan Commuting Patterns

The journey to work is one of the most significant in the daily distribution of traffic share. To identify regional needs and potential connectivity opportunities, information on work flows and morning commute travel patterns (6 -10 am) was analyzed.

The Census Bureau provides two different datasets related to worker flows: the Longitudinal Employer-Household Dynamics (LEHD) Origin- Destination Employment Statistics (LODES) and the American Community Survey (ACS) Journey to Work.[11] The source of information for each of these products is different so changes in results are expected, however in coordination, they can be used to define spatial, economic, and demographic conditions as they relate to journey-to-work travel flows. The following describes findings for both sources and strives to explain reasons for their variation.

LODES is based on employment administrative data linked to residence information from annual federal data, to produce labor market statistics. The information, which represents 95% of employment nationwide [12], can illustrate worker flows at a variety of geographical levels. There is some allegorical information that suggests the use of administrative records may somewhat skew results as some employment records amass multi-location employment (example a chain of convenience stores) in the headquarters location instead of being distributed through the corridor. LODES data estimates the percentage of bi-regional commuters for both MSA between 4 and 5%, as depicted by Table 3.

Table 3 – LODES Summary of Austin & San Antonio Regional Commuter Flows

Home Zone	Work Zone				Home Zone	CACS Regional Commuters	
	Austin - Round Rock	San Antonio - New Braunfels	Other locations	Total		Share of workers	Share of Local Employment
Austin - Round Rock	729,840	42,386	139,464	911,690	Austin - Round Rock	4.65%	5.96%
San Antonio - New Braunfels	56,753	793,600	128,300	978,653	San Antonio - New Braunfels	5.8%	4.48%
Other locations	164,946	110,304					
Total	951,539	946,290					

Source: US Census Bureau - Longitudinal Employer-Household Dynamics (LEHD) Origin- Destination Employment Statistics (LODES)

ACS Journey to Work Survey, unlike LODES, is based on a survey distributed to a population sample, who answer the question *"At what location did this person work last week?"* The dataset is released every 5 years detailing worker flows based on the 5-year American Community Survey. The latest available dataset at the time of this study represented the

[11] https://lehd.ces.census.gov/data/ & https://www.census.gov/programs-surveys/acs/

[12] LODES does not cover the self-employed, military employment, the U.S. Postal Service, and informal employment

2009-2013 ACS. As this is a cross-sectional data set, the responses may not represent all typical travel patterns not to mention there are limits to how well the information is represented since it is based on a sample. However, the dataset depicts an even lower percentage of workers commuting between these two metropolitan areas. Table 4 illustrates the results based on ACS estimates.

Table 4 – ACS Summary of Austin & San Antonio Regional Commuter Flows

Home Zone	Work Zone				Home Zone	CACS Regional Commuters	
	Austin - Round Rock	San Antonio - New Braunfels	Other locations	Total		Share of workers	Share of Local Employment
Austin - Round Rock	857,132	8,787	24,087	890,006	Austin - Round Rock	0.99%	1.59%
San Antonio - New Braunfels	14,239	949,300	22,442	985,981	San Antonio - New Braunfels	1.44%	0.90%
Other locations	25,029	17,148					
Total	896,400	975,235					

Source: US Census Bureau - 2009-2013 ACS Journey to Work

Given the different measurement techniques, an assumption can be made on the total commuter flows between the two metropolitan areas hovering between 1 – 6% of all work trips according to Census data. Trip purpose studies generally indicate that home-based travel to work usually accounts for approximately 20 percent of all trips on the transportation system. As a result, we would assume long distance commuter traffic in our study area amounts to a range of 0.2 to 1.2% of total traffic. While this falls within the low end of the census estimate, it is consistent with the analysis results.

Additionally, previous findings appear consistent with data reported by StreetLight® on intercity travel for morning peak-period traffic. According to an analysis conducted on morning travel for September 2017, the Austin and San Antonio Metropolitan area exchange around 0.2 percent of all morning traffic.

Other results from the analysis of StreetLight® data on morning commutes indicate large movements between immediately neighboring communities like Georgetown – Austin (22%) Georgetown - Round Rock (17%), Round Rock - Austin (47%), Buda – Austin (52%) and New Braunfels - San Antonio (20%). Communities at the center of the study area present more diversified commuting patterns. Kyle remains a big producer of commuter trips, but its trip distribution is divided between Austin (38%), San Marcos (13%) and Buda (6%). Finally similar to the big metropolitan areas, San Marcos retains the majority of its morning

commuters but has a diversified regional commuter pattern with commuters travelling to Austin (8%), Kyle (6%), New Braunfels (4%) and San Antonio (4%).

All of these data were used to quantify the number of long-range commuters travelling between the MPOs, as the findings indicate their share of the morning commute is not as significant as previously thought. Improvements to the travel time reliability in the region might spark a greater exchange of commuters between major communities, which could be served by transportation alternatives such as improve transit service provision.

(c) Current Mode Share

The Census Bureau also reports the current mode share, or percentage of morning commuter trips taken by each available transportation mode, as a metric for transportation planning considerations.

In 2015, the Census Bureau reported most of the morning commuter trips in the study area being done by driving a personal vehicle alone (79%). Although the trend is consistent with the national average (76.6%), Austin reports only 72% of its population commuting by single personal vehicle.[13]

Figure 11 - Commuter Mode Share

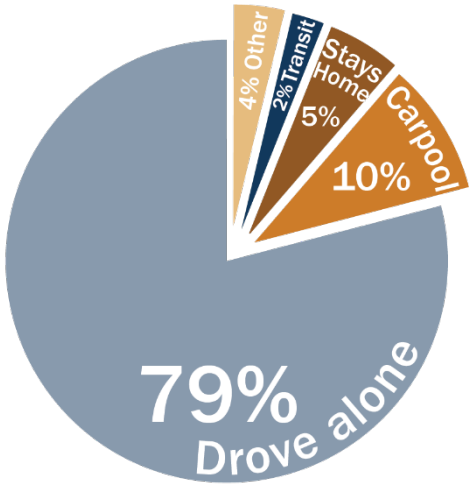


Figure 11 illustrates the average commuter share for different modes in bi-regional the study area. In comparing these percentages with national averages some observations are highlighted.

- Carpooling is reported at higher averages than the national average, especially from the City of Kyle.
- The Capital Area MPO reports considerably higher numbers of telecommuters than both the national average and the Alamo Area MPO.
- Public transit use remains lower than the national average, even scoring below walking and biking as a primary mode.

A shift in mode share within the study area will require initiatives that strengthen options beyond driving alone and trigger efficiencies in the existing transportation network.

[13] Census Bureau "Travel to Work" (ACS 1-year estimate).

3.7 Freight Demand

Freight data was collected to better understand freight needs and how they affect mobility of people and goods in the region. According to the 2016 Texas Rail Plan Update, *"the compound annual growth rate (CAGR) rates suggest a doubling (98.9%) of rail freight tons, and a near tripling (183.7%) of rail car movements before the year 2040".* [14] Analysis was performed separately for rail and highway-based freight for the sake of thoroughness, with findings as follows.

(a) TRUCK FREIGHT

Recognizing the importance of freight traffic in the region, especially as it refers to I-35, a StreetLight® GPS-based data analysis of commercial traffic origins and destinations was performed allowing for the identification of truck freight traffic throughout the region.

Findings show more than 8 out of 10 truck movements within the study area use I-35 today and approximately 5% of all trucks traveling through at least part of the I-35 corridor use either I-410 or SH 130 as relief routes through urbanized areas.

Figure 12 illustrates the most significant commercial movements on I-35 in a directional basis. Approximately 22% of commercial traffic entering the I-35 corridor south of San Antonio travels through the entire region with 13% making the same trip in the opposite direction. The aforementioned percentages in association with 2016 traffic counts at the north and south ends of the study area, indicate that approximately 3,000 trucks a day travel the I-35 corridor without stopping. Given the nature of the data collected by StreetLight®, these percentages indicate that a preponderance of commercial trips are making at least one stop in their way through the region, at which point they should be classified as part of local traffic for at least a segment of their trip.[15]

Although the calculated percentages of freight traffic on I-35 are not as high as expected, the annual volume of freight between San Antonio and Georgetown in 2010 according to the Texas Freight Plan was calculated to be between 5 Million to 10 Million tons and it was expected to escalate to between 10 Million and 25 Million tons per year by 2040.

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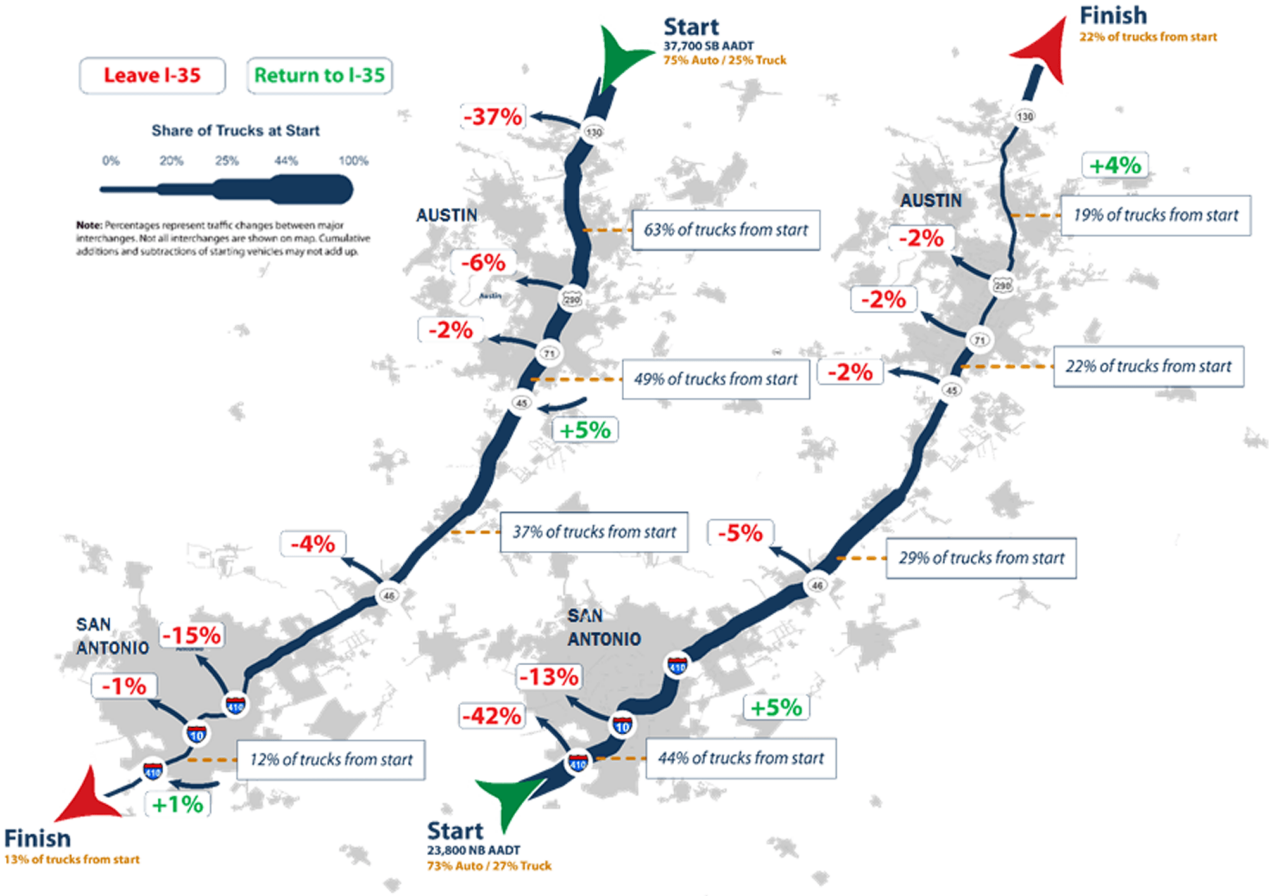
[14] 2016 Texas Rail Plan Update, Chapter2, P.104. http://ftp.dot.state.tx.us/pub/txdot-info/rail/2016-rail-plan/chapter-2.pdf

[15] StreetLight® considers a new trip has started every time a vehicle has not moved more than 5 meters (16.4 ft) in 5 min.

Figure 12 - Commercial Through Trips on I-35



(b) RAIL FREIGHT

Currently the Austin – San Antonio region handles an excess of between 5 to 10 million tons of rail freight tonnage through the most significant regional rail line. The UP line connecting the two metros areas is part of the heavily-used rail corridor connecting Laredo and the Upper Midwest. This single-track freight rail line represents the most viable option for rail transportation possibilities for the area. The existing line currently serves AMTRAK passenger traffic in addition to its freight operations, however approximately 2/3 of all passenger service delays on the line are due to prioritized freight operations. This is another indication of the high level of freight activity on the line. [16] [17]

[16] 2016 State Rail Plan. Chapter 2. p.59 http://ftp.dot.state.tx.us/pub/txdot-info/rail/2016-rail-plan/chapter-2.pdf

[17] Performance or forecasting data for rail lines is proprietary. The data for this rail line is not readily available from UP and maybe differ from other data sources like TRANSEARCH data. However, the 2016 Rail Plan Update suggests that rail operations will be at or over current capacity by 2040.

Improvement strategies could include adding frequent sidings for passing, double-tracking, rail on parallel or new alignments, and even a freight bypass, as a means to expand freight rail operations. However, most possibilities are hindered by the fluctuating existing ROW (60 – 200 ft) and would require extensive coordination and cooperation with the privately-held rail lines. The location of the main line, through heavily-developed and populated areas also adds safety concerns to the daily operations of the system. The rail line features 88 at grade rail crossings and a relatively sharp curve near the Lamar Blvd Bridge in Downtown Austin, which reduces speed significantly.

Currently there are no publicly available plans for a relief route for the region's rail system. The need for such improvement options to remain available at some future date necessitates further studies and the continued cooperation of local authorities and private entities.

3.8 Modal Options

Current transit data was obtained from Capital Metro (CapMetro), VIA Metropolitan Transit (VIA), the Capital Area Rural Transportation System (CARTS), and Alamo Regional Transit (ART) to better understand how those systems work and are intended to expand within the region. Both San Antonio and Austin have large fixed- route public transit services which are equipped to serve the role of local transportation connections. These systems serve movements mainly within the major metros with reduced service in the outlining communities between Austin and San Antonio.

In Austin, CapMetro operates a series of local bus routes (frequent-stop service & express routes) with an average of 100,000 trips per day. This service connects various Park & Ride lots into central and downtown Austin, the UT campus and several other employment centers. In addition, CapMetro operates a commuter rail line between the northwest suburbs and downtown with an average daily ridership of 3,300 people in the first quarter of 2017. For residents outside of the CapMetro service area, CARTS provides regional transportation for a 7,200-square-mile area surrounding Austin. CARTS offers limited traditional bus service, non-emergency medical transportation and other services of varying frequency for an average weekday ridership of 2,300 people in 2017.

In the San Antonio urban area, VIA operates 93 bus routes serving the majority of Bexar County. The Metro, Frequent Service, Skip (limited stop), Express and VIA routes carried an average of 116,000 person trips a day in 2017. Rural on-demand transit service for San Antonio is provided by ART, which serves 12 rural counties - Atascosa, Bandera, Comal, Frio, Gillespie, Guadalupe, Karnes, Kendall, Kerr, Medina, McMullen, and Wilson. ART provides demand response (dispatchers must be called at least 24 hours prior to the desired trip to schedule service on a first-come-first serve basis) transportation as well as connection to the

VIA service network. In the first quarter of 2017, ART provided an average of 4,000 person trips a day.

Ridership for all systems is in line with national averages of transit use but there is a regional desire to better leverage transit provision. Although, there is no national standard for what population densities can support alternative transportation modes, the Federal Transit Agency in their recent New Start program suggested that densities of 8,000 or more people per square mile are more likely to be able to support multimodal investments. Population densities corresponding to these guidelines within the study area are better positioned to be served by modal options. These areas are located within LP 1604 in San Antonio, along both Metro portions of I-35 and north of the US 183 corridor in Austin.[18]

3.9 Contributing Studies and Plans

Agencies throughout the two regions provided data to aid in the understanding of how their near- and long-term plans address existing and future congestion issues. Expected growth and its associated challenges have sparked interest in efforts beyond the region's current solutions, not just more improvements, but on bi-regional cooperation that could create more benefits through coordination of adjoining projects.

(a) Previous Regional Initiatives

The Lone Star Rail Project (LSTAR), overseen by the Lone Star Rail District, studied the potential development of a passenger rail line between Austin and San Antonio. Environmental studies began in 2009, focusing on a plan to relocate the Union Pacific Railroad, converting the existing rail line to passenger rail. The LSTAR study ended in 2016. Data from this study was collected and evaluated, however most of the information was out of date or was LSTAR specific and not relevant to this study. The remaining data was updated using new census data and new AAMPO and CAMPO Metropolitan Transportation Plans.

(b) County & City Plans

Transportation improvement plans for each of the local governments in the study area were collected to better understand how these proposed improvements address the needs of the Austin-San Antonio Region. The Hays County Bond Program (2016), The Hays County Transportation Master Plan (2012), the Travis County Capital Improvement Program and

[18] https://www.planetizen.com/node/77132/its-time-talk-about-national-minimum-urban-density-standards; https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/NewStartsPolicyGuidance.pdf

Bond Capital Improvement Program (2017), the Comal County Major Thoroughfare Plan (2010), the Williamson County Bond (2016), the Caldwell County Transportation Plan (2013), the San Marcos Transportation Master Plan (2018) as well as the current city thoroughfare plans were collected through this effort. Transportation Improvement Plans for cities in the study area were also collected including the San Antonio Bond and Multimodal Transportation Plan as well as the 2018 Austin Strategic Mobility Plan. The MPO Regional Arterials Plans were under development during this study and are therefore not included as a source.

(c) Metropolitan Transportation Plans (MTP) & Unified Transportation Program (UTP)

The AAMPO and CAMPO Metropolitan Transportation Plans (2040 and 2045), as well as TxDOT's Statewide Transportation Improvement Program and Unified Transportation Program, were obtained to evaluate the projected improvements in the region. In total, nearly $6 billion of highway improvements are anticipated on I-35 by the year 2040, funding notwithstanding. Investments in other major north-south corridors (e.g. SH 130 & US 281) and connections are not as sizable, totaling less than $1 billion.

(d) Incident Management Plans & Transportation System Management and Operations (TSMO)

The goal of Incident Management Plans is to ameliorate congestion exacerbated by traffic incidents such as crashes, load spills, and vehicle breakdowns by expediting the detection, response and clear up time of traffic incidents in the quickest and safest manner. Both MPOs are currently developing and approving new Traffic and Regional Incident Management Plans for their jurisdictions. These plans should be considered at the time of their approval.

In lieu of these documents, the CACS study team collected information on existing and planned localized intervention incident management response initiatives. The Highway Emergency Response Operator (HERO) Roadside Assistance Program in Austin, is a partnership between TxDOT and CAMPO, intended to assist drivers and aid in the cleanup of minor crashes along main metro corridors with a view to reduce delay times and incidence of secondary crashes. It has been met with considerable success and has been recently expanded. A similar initiative, the Work Zone Warning Initiative powered by Austin's Mobility35 data collection program, concentrates on promoting awareness of construction zone activities along I-35.

San Antonio launched the Wrong Way Initiative in 2011 sponsored by TxDOT with cooperation of local public agencies. The initiative, led by a multiagency task force, has generated advances in identification of hotspots, countermeasures and enforcement practices. Pilot projects for sections of US 281 and I-35 have been already implemented with considerable success. Both programs are part of the upcoming incident management plan updates.

Transportation System Management and Operations (TSMO), on the other hand, is a statewide initiative to address current safety and congestion challenges. Through the establishment of the TSMO Strategic Plan, TxDOT aims to improve mobility by creating a system of operating procedures and regional partnerships that prioritize mobility through the application of technology and other innovative techniques.

(e) Long Range Plans

Transportation and Thoroughfare plans for the two regions were also collected to understand gaps in the network associated with changes in jurisdiction and opportunities for better network integration. The study team collected the Kyle Transportation Master Plan, the Buda Transportation Master Plan 2013 and the Hays County Thoroughfare Plan 2016 for the Capital Area MPO. Future plans for the Alamo Area Capital Area were collected including the Schertz Thoroughfare Plan 2017, the Guadalupe County Thoroughfare Plan 2017, the San Marcos 2035 Thoroughfare Plan as well as the Seguin Transportation Master Plan 2017.

3.10 Key Takeaways

The following includes the key takeaways from the data analysis presented to the stakeholders, which were carried forward into the development of strategies.

I-35 is the PRIMARY regional connection

- ✓ It has the highest AADT (4:1), highest truck traffic and worst congestion in the area.
- ✓ Population and Employment concentrations are located in close proximity to I-35.

The market is US

- ✓ Local trips and short-range commuters are the main users of regional roadways.
- ✓ Metro-to-metro commuter trips are relatively low, but they may be a latent market.

Bet on the central corridor for development

- ✓ Development patterns suggest that the I-35 corridor is the backbone of future growth between the regions.
- ✓ Population distribution and lack of ROW suggest a need for corridor preservation to enhance the support network for the central corridor.

Freight traffic on I-35 is generally NOT through traffic

- ✓ Eight out of 10 truck movements within the study area use I-35 today.
- ✓ There is only between 18-22% of trucks travelling all the way through the study area.

Local improvements can do much to improve quality of life

- ✓ Operational improvements can help alleviate localized problem spots.
- ✓ Safety and operational improvement of rail crossings, and bottleneck intersection could have regional impact.

Communities are invested in MORE collaboration

- ✓ Expansion of coordination efforts through the last decade and increased interest in partnerships by regional agencies points to a recognition of opportunities and benefits to regional cooperation.

4. Stakeholder Engagement

Stakeholder engagement was an integral part of the Capital- Alamo Connections Study. Stakeholder outreach occurred throughout the study process. Input provided by stakeholders confirmed and expanded on the needs and challenges within the study area as defined in the technical analysis, ensuring it provided an understanding of the physical, financial, and political feasibility of potential recommendations. For a detailed account of these efforts refer to Appendix C – Stakeholder Engagement Analysis of Findings Report.

4.1 Approach and Timeline

The stakeholder involvement effort of the study aimed to communicate the purpose of the study, gather relevant data and information regarding needs and challenges, and create a feedback loop between meetings. Feedback was solicited on the overall study approach, the identification of additional stakeholders, as well as the development and definition of potential strategies to address transportation needs.

Key goals of the stakeholder involvement included:

- Identify stakeholders,
- Establish and maintain interactive communication with stakeholders,
- Provide easily accessible, relevant, and meaningful information to stakeholders,
- Consider all reasonable input from stakeholders, and
- Provide stakeholders with the opportunity to participate in the development of the study and to be fully engaged and informed throughout the study process.

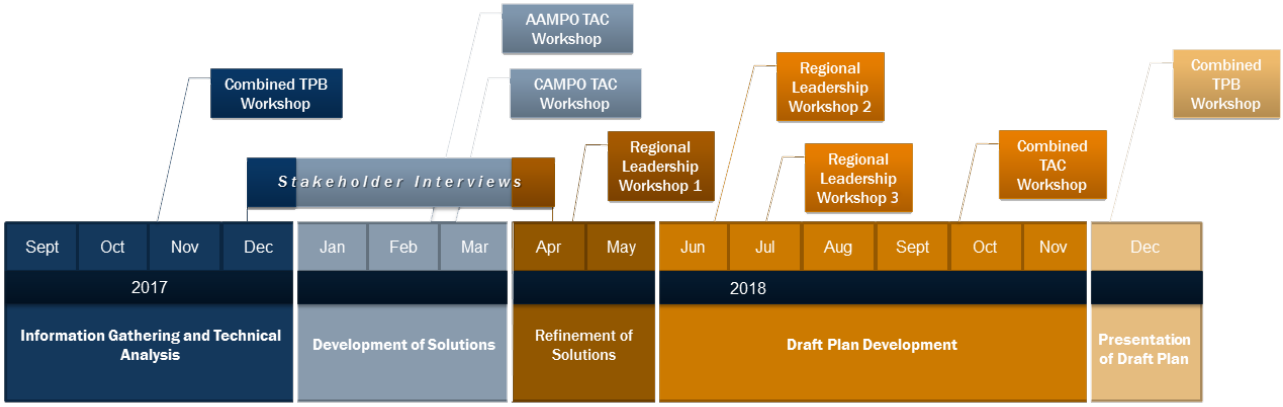
The study team worked closely with organizations and individual stakeholders to incorporate their input into the study recommendations. The study, aimed at providing overarching bi-regional strategies, did not include general public outreach as part of the process given its high-level nature. As solutions continue to be developed, it is anticipated that public input will be sought through the planning processes of the respective agencies involved.

Figure 13 illustrates the overall project timeline and stakeholder outreach process. The stakeholder engagement process utilized various strategies to inform and gather input from stakeholders including:

i. Project website, including study background, purpose, and schedule
ii. One-on-one stakeholder meetings/interviews
iii. Workshops with MPO TAC members
iv. Workshops with Regional Leadership at TxDOT and MPOs
v. Workshop with MPO TPB members

vi. Regular updates at monthly MPO TPB and TAC meetings
vii. Targeted updates to key stakeholders via email, including study data pamphlets, fact sheets, and maps

Figure 13 Stakeholder Outreach Schedule



4.2 Individual Stakeholder Outreach

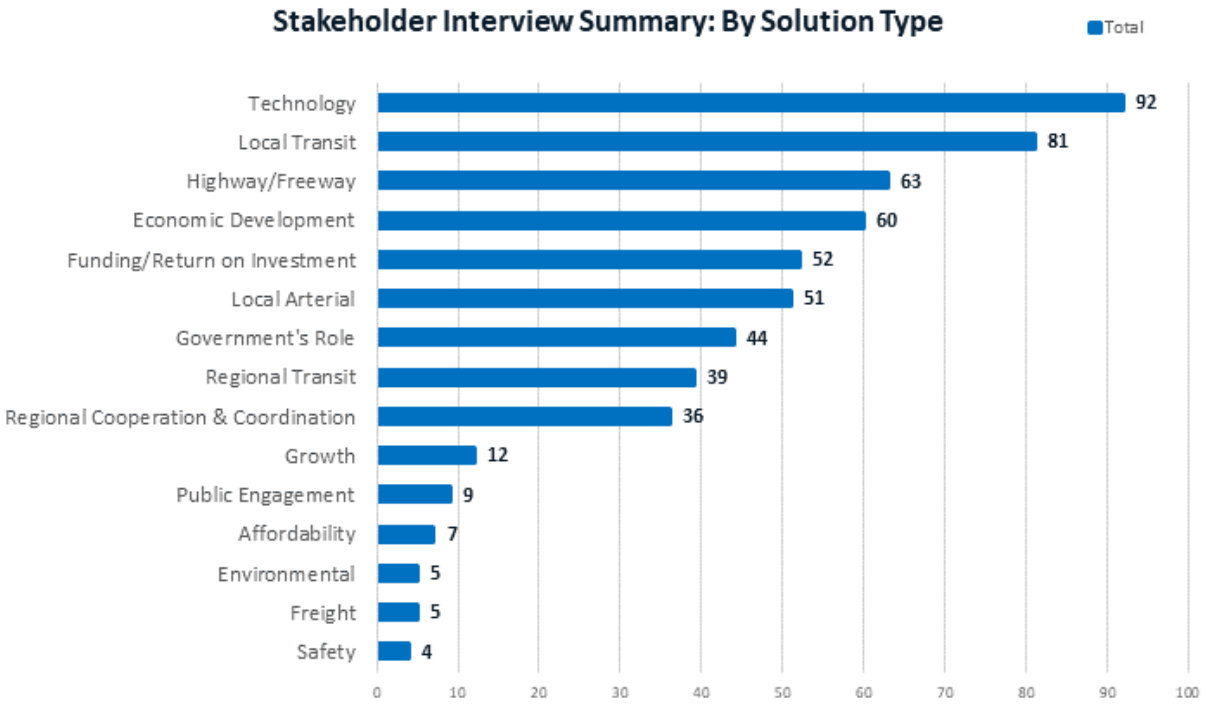
The project team conducted individual stakeholder interviews with key transportation influencers and decision makers within the study area: City managers, County commissioners, Transportation Policy Board members, transit agencies, key peer entities, and technology companies. The purpose of the interviews was to understand various perspectives on challenges and opportunities related to infrastructure, policy, and technology improvements.

A list of potential stakeholders was developed and updated throughout the interview process. Twenty-six interviews were held between December 2017 and April 2018. A general list of questions was developed that remained consistent throughout all interviews, although the structure of each discussion was conversational and varied based on stakeholder interests.

The stakeholder interview process was intended to reflect input from decision makers within the two regions and provide insight as to how people in leadership positions think about bi-regional transportation issues. The discussion regarding impacts of increasing transportation challenges and potential solutions gave the project team a sense of the political feasibility of prospective solutions. In total, 560 comments were recorded which were consolidated into a list of key themes.

Figure 14 below depicts the number of comments received related to each topic area. The highest scoring categories were technology and local transit.

Figure 14 Stakeholder Interview Theme Summary



4.3 Joint Transportation Policy Board (TPB) Workshop 1

On November 1, 2017, an introductory joint workshop was held for Transportation Policy Board members of both CAMPO and AAMPO at the New Braunfels Civic Center. The intent of the workshop was to present an overview of the study; receive input on transportation needs and challenges; and begin a discussion on infrastructure, policy, and technology solutions within the two regions. Attendees participated in two main activities during the workshop:

- Discussion of an overall Long-Range Vision for the bi-regional area. Board members were asked to list top challenges and opportunities both singularly and jointly for their regions.
- Discussion of specific Regional Needs and Challenges. Board members engaged in round-table discussions on infrastructure, policy, and technology needs and challenges.

During the workshop, stakeholders expressed the need for expanded multimodal transportation options, greater coordination between land use and transportation, concern regarding congestion and delay along I-35, lack of funding options for transportation improvements, and the lack of political will to pursue major investments.

4.4 CAMPO and AAMPO Technical Advisory Committee Workshops

Workshops were held for the Technical Advisory Committees (TACs) of both CAMPO and AAMPO on February 23, 2018 and March 5, 2018 respectively. These workshops presented the results and analysis from the first combined TPB workshop. Both committees received the same presentation materials and activities. The workshops were structured to gather detailed input on potential infrastructure, policy, and technology recommendations.

Attendees engaged in three activities during the workshops:

- An **Infrastructure** micro-charrette, where team members discussed existing and planned projects in each region, as well as any gaps/opportunity areas. On infrastructure, both groups recommended improved connectivity between main transportation corridors, and identified a need for long-distance transit using potentially dedicated lanes.
- A **Policy** "circles and soup" exercise encouraged TAC members to consider the level of influence that MPO organizations and the State have on various policy considerations. In this realm, both groups expressed a need to formalize regional coordination and improve regional thoroughfare planning and corridor preservation. They also expressed a desire for broader land-use regulation and planning authority, more flexibility in funding between modes.
- A **Technology** preference survey, which asked attendees to rank their preferences for existing or emerging technologies based on what they believe to be their appropriateness for the study area. In this regard, both TACs generally placed higher importance on Integrated Corridor Management & Information Technology Systems (ICM & ITS) as well as transit-related solutions, and less importance on technologies emerging from the private sector.

4.5 Leadership Workshops

The team hosted three workshops attended by TxDOT, CAMPO and AAMPO leadership. These workshops were intended to provide direction in developing the overall study documentation and finalizing study recommendations.

The first workshop was held on April 30, 2018. It included an overview of progress to date along with input collected from the MPO TAC workshops. Group discussion focused on tolling, rail or other high-capacity transportation modes between the Austin and San Antonio regions, land-use policy, and next steps as these remain at the forefront of the public consciousness.

The second and third workshops were held on June 29 and July 30, 2018 respectively. They included follow-up discussions on the overall plan documentation, presentation, and recommendation categories.

4.6 Joint TAC Workshop

On October 2nd, 2018, TACs from both MPOs came together for the first Joint Technical Advisory Committee meeting in the region. The objective of the workshop was to present a shared point of reference for recent study findings as well as to provide a vetting opportunity for proposed strategies. Participants were grouped based on their areas of expertise and interest.

Figure 15 – Welcome address at the Capital-Alamo Joint TAC Workshop

The workshop was hosted by both MPO directors, who emphazised the importance of the input these groups could bring into shaping transportation strategies. The joint TACs analysed and worked on 59 strategies and 117 tactics divided into 5 main topical groups. Each group proceeded to review and modify the draft listing of strategies and their corresponding tactics as assigned to their table.

Modifications and additions to the proposals included more inclusive and specific language changes to make strategies more action oriented and include more local partners. TAC members required a higher level of coordination between the strategy groups themselves and strategies that supported a more formalized bi-regional relantionship. Reconfiguration of several tactics in order to fast track some of their elements was also requested.On the topic of technology and intelligent road management the group decided to move away from specific technologies in order to remain flexible to future changes.

4.7 Joint TPB Workshop 2

On December 5, 2018, a second workshop was held for Transportation Policy Board members. The intent of the workshop was to present the full set of proposed strategies as developed by the TAC members and study team for consideration and prioritization by the members of the TPB.

During the workshop, TxDOT representatives presented a review of the study definition and rationale, emphasizing the dimension of the expected regional growth and its potential impacts to the regional transportation network. The workshop also included a brief overview of the study schedule and its progress and findings from the regional movement analysis (refer to Chapter 3 for more details). Attendees were also provided with an update on coordination efforts developed through the series of workshops previously discussed. The presentation concluded with a brief address by the MPO directors who outlined current and recent bi-regional coordination efforts.

Figure 16 – Prioritization Exercise at Joint TPB Workshop 2

The workshop section of the program focused on a prioritization exercise allowing attendees input into the pre-vetted strategies and their prioritization. Results highlighted the desire to advance improvement strategies as soon as possible. Comments by attendees focused on providing new ways to connect SH 130 and I-35 and the need to consider the economic development aspects of such improvements.

4.8 Summary of Themes

Throughout the engagement process, the project team received a wide range of comments with several key themes emerging as top issues for stakeholders. These include the following:

- **Bi-regional coordination.** It discussed large-scale infrastructure improvements, land use and transportation policy, funding, etc. Stakeholders saw benefits in increased and formalized coordination between agencies to implement necessary improvements. These interactions also allowed the opportunity to highlight the work already being done in close coordination with other agencies.
- **ICM & ITS.** A top interest for TAC and TPB members, ICM involves maximizing the use of existing infrastructure through technology and improved coordination between modes, recognizing the importance of utilizing innovative practices.
- **Local transit.** Stakeholders throughout the study area expressed interest in improving transit options, such as line-haul bus service and more options for last-mile connections. While long-distance (regional) transit options were important and desired, stakeholders remain concerned with serving shorter-distance trips.

- **Improvements to I-35.** As the corridor recognized as the central connection between the San Antonio and Austin metro areas, I-35 was discussed in terms of managed capacity, transit options, new connection points, incident response times and general expansion.
- **Funding.** Funding availability was a key concern for many stakeholders, including elected officials and government agencies. Many were seeking greater flexibility in funding across modes, more funding options or expressed interest in innovative funding strategies.

These themes resurfaced throughout the process, in terms of technical analysis and development of recommendations providing overall context and direction for the study.

5. Regional Strategy Development

As a wide-ranging bi-regional study, the Capital-Alamo Connections Study identifies high-level recommendations that combine the needs of both CAMPO and AAMPO by aligning with plans that have already been developed to provide a consistent bi-regional strategy and overarching direction.

Recommended strategies from the study have been grouped into categories and are prioritized within the 25-year MPO planning horizon.

- **Short-term** recommendations run from now to 5 years, and include support for many efforts already underway or funded,
- **Mid-term** recommendations span the time period from 6 to 15 years
- **Long-term** recommendations will be implemented between 16 to 25 years.

Although TxDOT, CAMPO and AAMPO guided this study, implementation of the recommended strategies may fall within the jurisdiction of individual MPO member agencies and surrounding communities.

5.1 Strategy Structure

The Capital-Alamo Regional Strategy is organized in five thematic groups that address the concerns and aspirations of the partners in this effort: Priority Transportation Corridors, Integrated Corridor Management (ICM) & Intelligent Transportation Systems (ITS), Arterial Improvements, Modal Options and Regional Coordination.

Strategies were developed by reviewing current transportation plans and programs from each MPO and local jurisdiction within the study area, incorporating input from MPO groups, gathering contributions from local stakeholders and integrating further technical analysis. The most notable considerations of current efforts for each strategy group are included below.

Figure 17 - Strategy Inputs

5.2 Regional Coordination

Collaboration between MPOs and TxDOT was the backbone of this study but it has not been the first instance of cooperation in the region. MPOs provided a historical record of their coordination efforts, as depicted in Figure 18. This history showcases the need and willingness to work with regional partners. Coordination across transportation planning boundaries is an ongoing concern as expressed by stakeholder outreach results. While these areas have made great strides in this respect, there are still several avenues to regional coordination that could be used moving forward.

Presently in addition to this study, the MPOs are coordinating long-range plans for the arterial networks, bicycle and pedestrian networks as well as safety and incident response improvements.

The FHWA framework for regional models of cooperation recognizes the need for regions to coordinate on asset and congestion management, economic development and most relevant to this effort: transportation planning efforts including freight and transit services. The framework also defines the main elements of a successful regional cooperation structure. CAMPO and AAMPO excel at establishing a culture of collaboration, allowing a diversity of opinions and fostering a bi-regional relationship. However, both agencies have expressed a willingness to allow coordination at all levels of the organization which will require formalization of current efforts and the start of technically based exchanges.

Regional Coordination Strategies were developed based on the federal framework previously discussed as well as research into best national practices as outlined in Appendix B. They aim to move regional coordination efforts from ad-hoc efforts like the present study to a

level of cooperation that can allow the development of joint planning documents. Strategies are meant to build on each other, from formalization and sharing of current practices through information sharing and objective definitions into coordinated committees focusing on specific action topics.

Results of the Strategy Plan as a whole are largely dependent on continued communication and collaboration between regional parties, making the Regional Coordination Strategies the cornerstone of continued success.

(a) Opportunities to Leverage Partnerships, Funds and Assets

The growth of the Austin and San Antonio regions may lead to greater opportunities to leverage funding and partnerships for the benefit of the whole. High-growth regions with low cost of living, high quality of life and an educated workforce are quickly adding population and employment opportunities that can bring considerable influence to decisions related to locating, funding, or financing private or public sector projects such as those listed below.

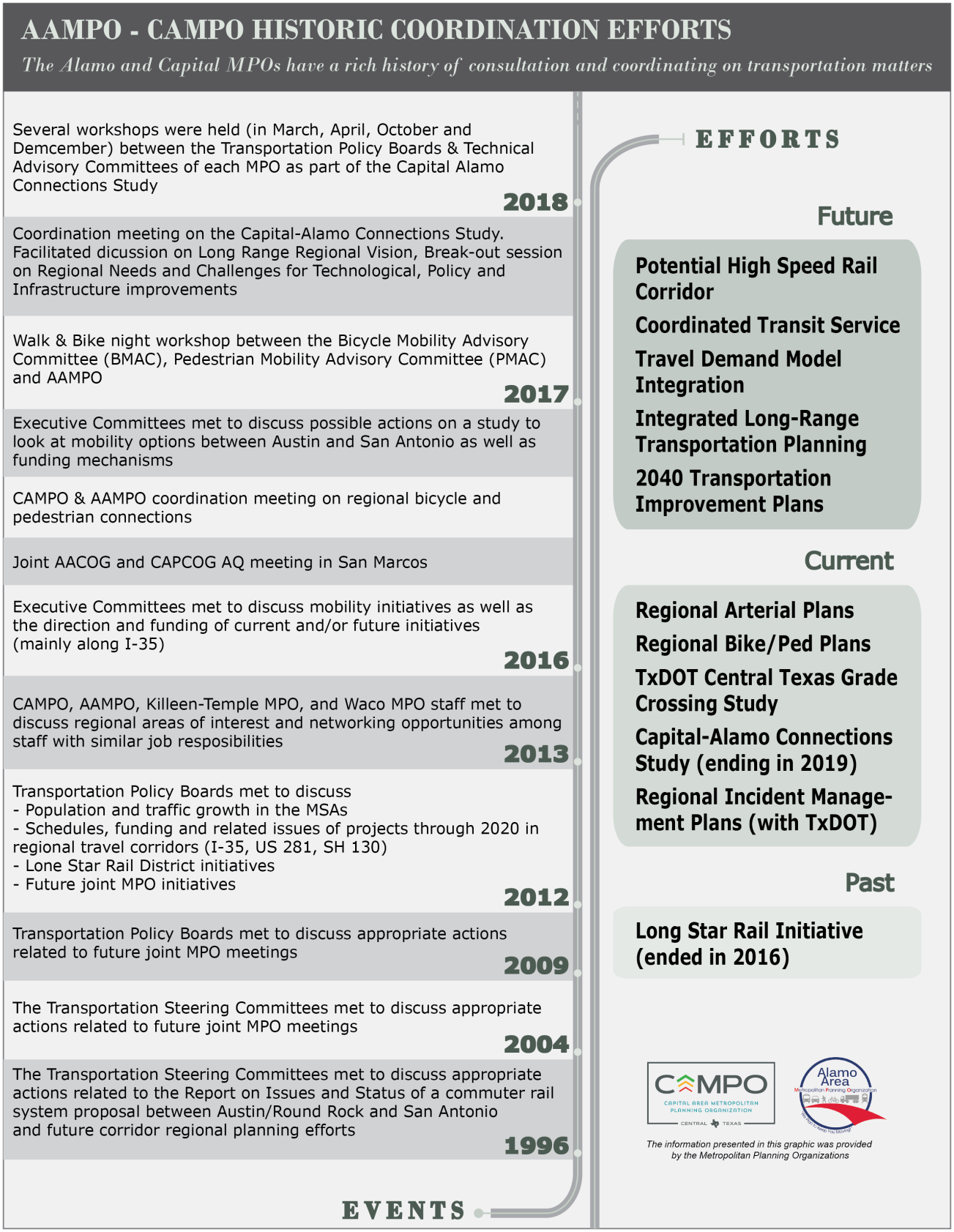
- Big- scale employment generators (e.g. recruiting corporate headquarters, international businesses),
- Federal funding for transportation and other infrastructure improvements,
- Economic diversification,
- Major airports, and
- National sports teams.

Greater cooperation and partnership between regions could lead to collaboration on major endeavors. The federal funding process for transportation or other infrastructure projects is highly competitive. Authorities look for certain attributes and characteristics as well as a track record of successful partnerships to award competitive grant funding. These attributes include:

- Agreement and participation among all levels of government,
- Local match funds or partnerships between regions leading to expanded local funding opportunities that demonstrate commitment,
- Community support built through coordination in messaging and public involvement, and
- Coordination between entities involved in the planning, implementation, operation, and ongoing maintenance or monitoring of projects.

As congestion increases within these regions, smaller-scale improvements will be unable to mitigate safety and delay concerns. Expanded coordination, collaboration, and funding partnerships will open up greater opportunities for large-scale improvements within the infrastructure, policy, and technology arenas.

Figure 18 - Alamo Area and Capital Area MPO Coordination Timeline



5.3 Integrated Corridor Management (ICM) and Intelligent Transportation Systems (ITS)

Stakeholders expressed a desire to increase the efficiency of the existing transportation network as a primary and short-term objective. The implementation of new ICM & ITS systems and the integration of existing ones will provide broader regional benefits. The TxDOT spearheaded the development of a Transportation Systems Management & Operations (TSMO) Statewide Plan, released in late 2017, outlining the state standard for management and operation of ICM systems. The TxDOT Austin District has a recently released TSMO plan. However, development of other TxDOT district specific plans is being developed in a tiered-fashion that is focused on tool and system implementation of most interest to each District.

There are several corridor-based programs for ICM implementation at the statewide level. The Texas Connected Freight Corridors, sponsored by TxDOT, seeks to support the eventual deployment of automated vehicles in Texas by building the first stage of "connected infrastructure along the primary Interstate system". The vehicle-to-infrastructure (V2I) communication pilot program will allow data collection from 1,000 especially-outfitted commercial vehicles which will be used in the first step towards the creation of in-vehicle warning systems for pedestrian/animal presence, queue, road and weather conditions.

Other ongoing opportunities to further ICM efforts include local ITS systems deployed by the cities of Austin & San Antonio.

Analysis of current efforts and best-practices allow for the identification of six ICM priority areas for the Capital-Alamo study area: ITS capital improvements, ICM systems and emergency response and incident management, active traffic monitoring, traveler information systems and demand management. Even with current local advancements in all these areas, main challenges remain coordination, consistency and continuity of objectives and system integration.

Strategies in this group focused on improving communication and data exchange between jurisdictions for both traffic management and incident response. Short term strategies focus on actions that define and clarify terms and objectives across boundaries as well as joint research into current technological advances. The objective is to create a level playing field of knowledge for the entire region, which can serve as a framework for technological cooperation and future system redundancies.

5.4 Modal options

According to technical analysis and stakeholder contributions, currently the main challenges to the movement of goods in the region are the high level of traffic in both the rail network and the highway system, coupled with a lack of alternative routes.

Transit provision and technologies were investigated as part of the development of modal options strategies. Analysis of transit service areas, provision structures, historical ridership totals, and system integration levels pointed to the existence of well-developed urban transit agencies in the metropolitan areas. As a result, strategies were developed focused on continued investments in urban areas. However, based on differences in service provision strategies, strategies for rural transit agencies centered on better coordination.

Regional gains could be achieved by developing opportunities in transit services across regions. Currently intercity options are lacking. The scope of rural transit services linked to each metropolitan area is inconsistent, and there are no agreements in place to allow for system transfer at jurisdictional boundaries. However, travel pattern analysis determined that there is a market of localized trips which could benefit from increased modal options across jurisdictions. Currently such services are not widespread, and they do not exist between the two regions. Information sharing between non-associated transit agencies occurs in an ad-hoc manner and on a case-by-case basis.

Short range strategies for providing modal options were developed to support transit service expansion to immediate suburban communities, with additional recommendations to research technological advancements that can spark system efficiencies. Much like the ICM & ITS strategies, multimodal options require better integrated platforms to allow an efficient exchange between systems. The ultimate objective in the long-term is to provide a pathway towards the potential implementation of integrated megaregion transit service by phasing improvements to regional transit systems and optimizing the points of integration.

5.5 Priority Transportation Corridors

Interstate 35, State Highway 130 and US Highway 281 were named as Priority Transportation Corridors by this study based on their capacity, regional reach as well as their role as main north-south connections. Each of these facilities has extensive rural segments and urban portions through major communities in this study area, however they remain entirely under TxDOT jurisdiction.

I-35 is a major national connection as well as the main regional connection in the study area. A statewide effort to identify needs and solutions for the entire corridor was completed in 2011 (I-35 Corridor Advisory Committee ‘My35’ Plan) which has led to improvements in

many segments of the corridor statewide. The Mobility35 Program in the Austin area and other I-35 projects in the San Antonio area stem from that effort and aim to expand the interstate capacity and improve safety on the corridor as quickly as funding and project development allows.[19] In the study area, the Austin and San Antonio TxDOT Districts are actively working on improvements to relieve congestion along I-35 which are included in the MPO Transportation plans.

SH 130 was built as the regional fast-moving alternative to the I-35 corridor and while it continues to function in this capacity, study findings support the conventional wisdom suggesting it now serves a considerable amount of "local trips" through some of its sections.[20] As a response to increased demand, capacity expansions are underway for the northern segments of SH 130. At the southern end of the region, stakeholders believe that additional links to I-35 could improve the use of SH 130 for regional mobility and improve access to adjacent communities.

US 281 has two main initiatives underway. The first one addresses improvement of various roadway structures and the second defines a long-range improvement program, both of which depend mostly on state allocated funding. The objective of the US 281 improvement program is to increase safety and address several congestion hotpots north of San Antonio, in Blanco and around Marble Falls where the facility is burdened by local trips. However, the analysis of current and forecasted conditions after improvements are completed highlights opportunities to advance improvements with bigger regional benefits.

Development of strategies for this group of priority corridors focused on infrastructure improvements and implementation of supporting policy. As such, short-term strategies focus on basic infrastructure analysis and inventory to prioritize localized improvements at safety deficient intersections and support the completion of the I-35 improvement program in both the San Antonio and Austin Districts. Strategies for the mid- and long-term periods are meant to complement on early improvements and further address capacities.

Strategies dealing with the improvement of any of these corridors will be the responsibility of TxDOT, supported by the MPOs. The local implications of any improvement will require collaboration and buy-in from local governments.

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[19] http://www.my35.org/

[20] https://www.txdot.gov/inside-txdot/media-center/local-news/austin/039-2018.html

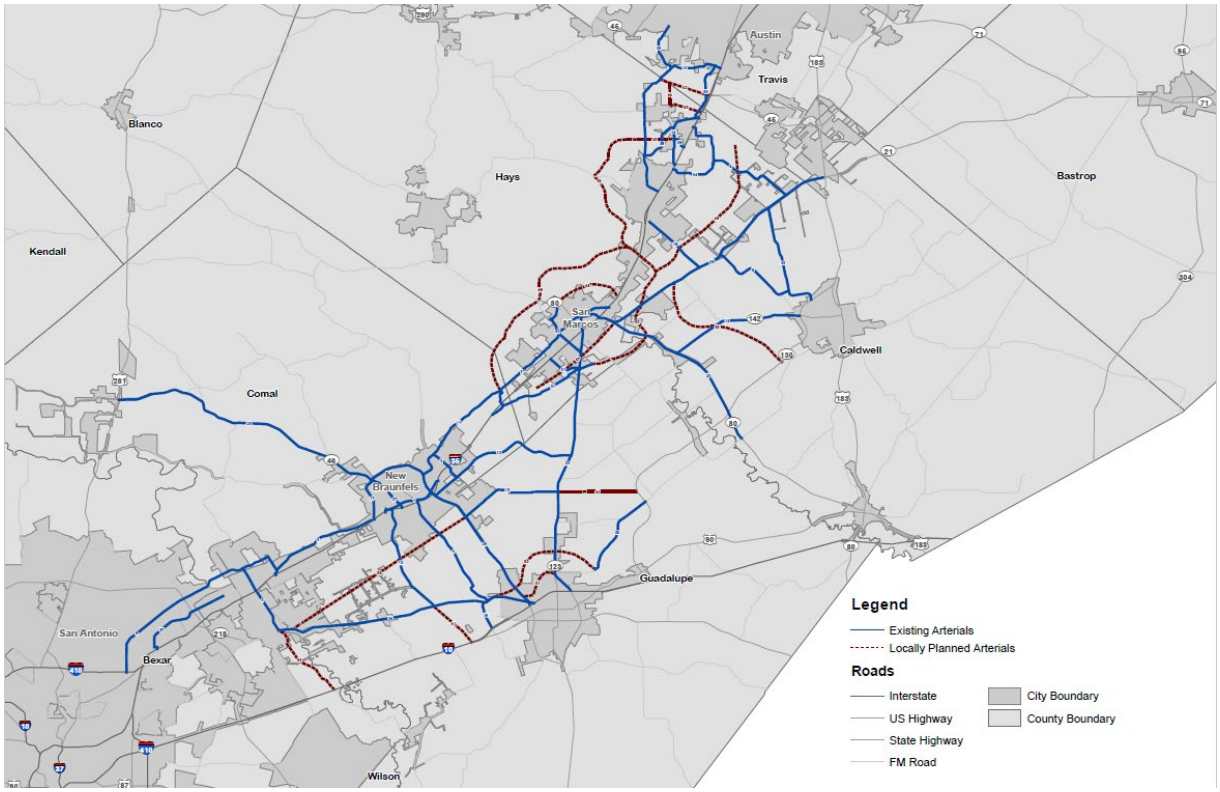
5.6 Arterial Improvements

Technical analysis and input from regional stakeholders made evident the need for a more extensive and better-connected transportation network. This is particularly necessary to support movement along priority corridors in case of sudden congestion as well as to address local movements. Efforts were concentrated on the space between the San Antonio and Austin metropolitan areas to facilitate better integration at the jurisdictional boundaries.

The Executive Steering Committee for this study, recommended concentrating on the improvement of arterial options in the “gap” between the two metropolitan area boundaries and MPO TAC members identified a total of 26 local facilities currently providing north-south alternative connections. These facilities include a total of 235 miles that could provide relief to I-35, with local entities planning another potential 30 miles of new construction in facilities considered in the long term. Refer to Figure 19 - Existing and Planned Local Arterials for the existing and planned local arterials between the Austin and San Antonio areas at the time of the analysis.

Improvements to these facilities that increase efficiency and throughput of various modes could face significant environmental and funding challenges if they require ROW expansions or alignment changes, making early identification of strategic local connections a priority to implement a proactive bi-regional arterial strategy.

Figure 19 - Existing and Planned Local Arterials



In response to the concern expressed by both MPO's about the potential best use of their arterial network in the development of the region, a need-identification framework was developed to pin point those facilities that would have not only a local access benefit but could alleviate congestion on a larger scale.

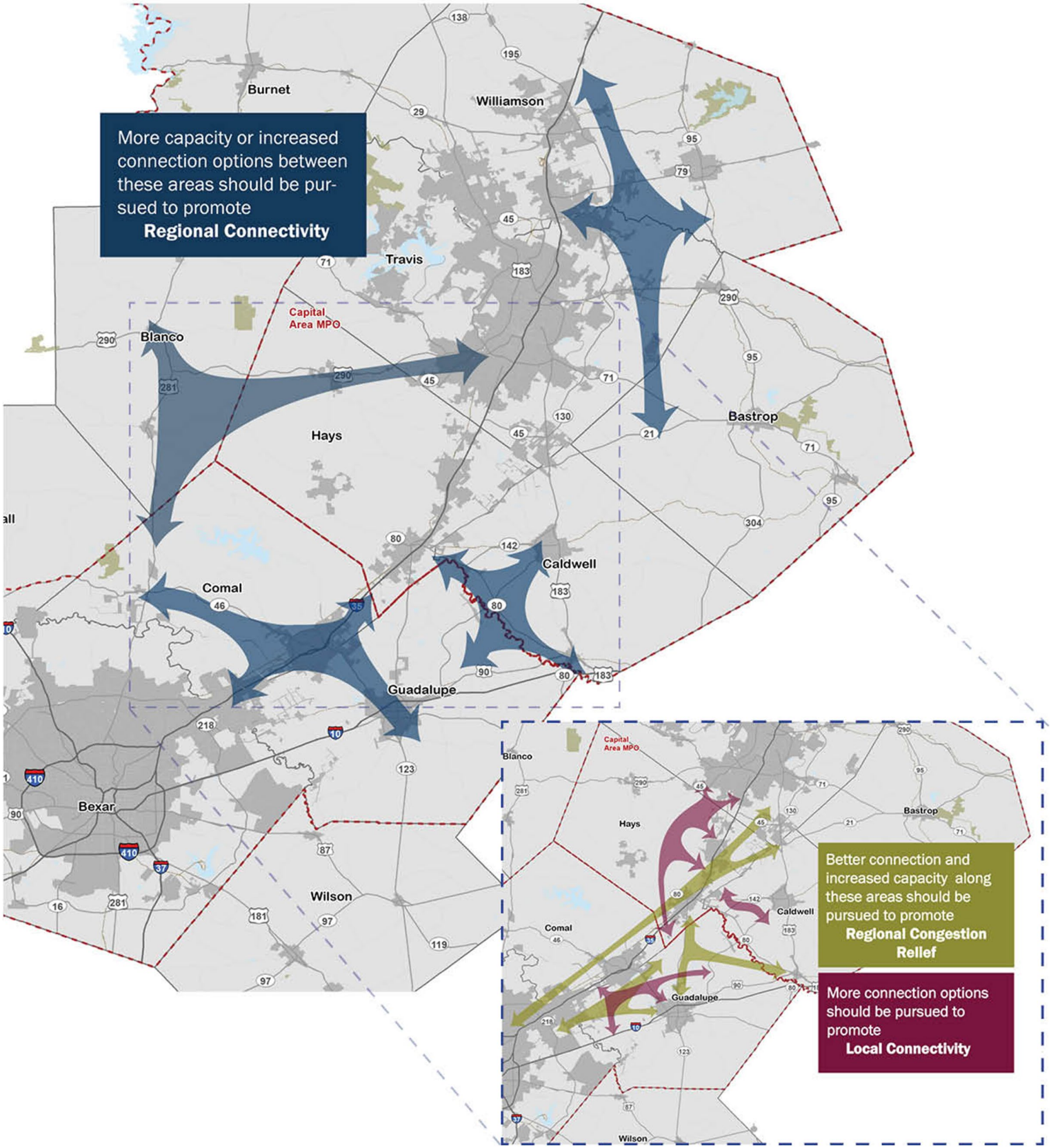
The following factors were used in the technical review of all arterials included in local and county transportation plans, as well as conceptual and generalized alignments of future facilities proposed by MPO TACs:

- Current & Future Travel Volumes
- AADT
- Peak and Directional Factors
- Existing Cross Section & Length
- Crashes Histories (Totals & Rates)
- Environmental Constraints
- Construction Risks
    - Environmental Risks
    - Community Support & Impacts

The compiled information for an expanded universe of 55 relevant arterials was weighted and scored based on preferences expressed by the MPOs. These results permitted the crafting of a general regional recommendation for arterial improvements, as depicted in Figure 20, identifying which type of objectives should be applied to arterials groups addressing different types of movements.

The Executive Steering Committee and Regional Leadership contributed to the refinement of these overall recommendations prior to their review and approval by the TACs and TPBs.

Figure 20 - Arterial Improvement Regional Strategies



6. Regional Strategy

The Regional Strategic Plan outlines the strategies recommended for enhancing the mobility between the Capital - Alamo area. The following chapter defines these strategies and details the actions and entities involved in their realization.

6.1 Regional Strategic Plan

The Capital-Alamo Regional Strategic Plan is arranged by thematic groups and recommended timeframes. The attributes accompanying each of the strategies represent the following:

Timeframe

Specific timeframe designated for each strategy to program needed improvements through coordinated actions

Strategy

Definition of the recommended improvement strategy.

Tactics

Provides an initial guidance on actions to be implemented to achieve the recommended strategies.

Overarching Topics

Refers to the three main improvement themes as defined by outreach efforts: Technology (), Policy (), and Infrastructure (). These overarching topics provide an additional framework for the implementation of the recommended strategies.

Potential Local Partners

Identifies the potential agencies and stakeholders expected to coordinate to implement the recommended strategies. Since they may require may cross-agency planning and execution.

Underway ()

Denotes tactics where progress is already being made through prior or current efforts.

Strategy Coordination

Denotes tactics which have been identified as requiring coordination with other strategy groups for optimal effectiveness.

a. Regional Coordination Strategies

Transportation agencies use a range of alternatives to improve coordination while retaining jurisdictional control. The following delineates the Capital- Alamo Connections Study strategies geared towards strengthening and expanding regional cooperation.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Formalize interagency coordination efforts	Continue bi-regional cooperation on matters of common interest, particularly related to longer distance transport needs, by establishing a regular bi-regional update between MPOs		CAMPO, AAMPO, TxDOT, Cities, Counties, Transit Agencies	×	
	Draft a document to establish future shared goals				
	Identify potential "Early Win" projects that can encourage membership participation in additional efforts			×	
	Develop a coordinating body out of initial interagency coordination efforts				
Create a joint website to document coordination efforts	Share information about transportation efforts carried out by each agency		CAMPO, AAMPO, TxDOT	×	
	Publicize past coordination efforts and ongoing success			×	
Formalize an agreement to share planning data and shared performance measures among the two MPOs, local governments and transit agencies	Share current performance data and measurement approaches		CAMPO, AAMPO, TxDOT		ICM & ITS
	Share growth assumptions and regional travel demand model results				
	Define and track performance measures that are relevant to all communities, such as I-35 travel time reliability				
Develop a bi-regional travel	Hold workshops on regional growth assumptions and travel		CAMPO, AAMPO		

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
demand model	impacts				
	Track demographic and travel trends, as well as emerging demands			×	
Define bi-regional objectives for improvement of mobility and connectivity	Share performance measures and objectives		CAMPO, AAMPO		ICM & ITS
Define performance measures dealing with mobility between the regions	Develop combined performance measures that focus attention on cross-jurisdictional travel issues based on current regional performance measures.		TxDOT, CAMPO & AAMPO TACs		
MID TERM (2025-2035)					
Create a policy-level cooperative body between both regions including representatives from all members of the Capital-Alamo Connections Study partnership.	Foster interlocal agreements between neighboring jurisdictions to develop shared transportation policies relevant to specific projects		CAMPO, AAMPO	×	
	Hold regular meetings of decision-makers from both regions to promote project level cooperation			×	
Implement bi-regional solutions to improve mobility and connectivity	Execute coordinated strategies for short- and long-range planning for projects of a bi-regional or bi-jurisdictional basis		CAMPO, AAMPO, Transit Agencies		
	Perform project prioritization process for bi-regional impacts				
Create a bi-regional technical committee focused on topics of shared concern	Focus on areas that affect both regions jointly, such as freight movement, rural transit, passenger rail, and emerging technologies		CAMPO, AAMPO, TxDOT	×	
	Facilitate conversations and agreements with public and private stakeholders to improve mobility in the region			×	

Strategy	Tactics	Topics	Potential Partners		Coord.
	Coordinate studies and shared planning documents related to specific transportation projects of mutual interest				
LONG TERM (2036-2045)					
Develop Combined Planning Documents	Collaborate on the development of a shared long-range transportation plan		CAMPO, AAMPO, Transit Agencies		
	Facilitate continued partnerships with transit agencies across existing service boundaries				Modal Options

b. Integrated Corridor Management (ICM) & Intelligent Transportation Systems (ITS)

ICM & ITS Strategies provide guidance on how to make a more efficient use of the current transportation infrastructure and make travel more reliable by relying on coordinated, multijurisdictional operations, which will be crucial to adapting to emerging technologies.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Coordinate Emergency Roadside Assistance Programs Throughout Region	Achieve continuous roadside assistance on I-35 corridor between San Antonio and Georgetown		TxDOT, CAMPO & AAMPO TACs		
	Coordinate dispatching between operators in each TxDOT District and local jurisdictions				Regional Coord.
Define regional priorities for corridor management	Establish an ICM and ITS Task Force to coordinate local Traffic Management groups and define regional priorities for emergency response as well as incident and construction management		TxDOT, CAMPO & AAMPO TACs		Regional Coord.
	Coordinate and develop interregional efforts related to emergency response and incident management, construction management, and ITS systems				Regional Coord.
	Prioritize areas that would benefit from regional systems coordination				
Map existing and planned ITS systems, owners, and interagency agreements	Review ITS Master Plans for Austin and San Antonio Districts		TxDOT, CAMPO & AAMPO TACs		
	Review local systems maintained by major cities in the region				
	Identify gaps or incompatibilities between the systems				
Coordinate Austin and San Antonio District Transportation	Find opportunities to coordinate plans between areas		TxDOT, CAMPO & AAMPO TACs		Regional Coord.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
System Management & Operations (TSMO) activities	Where TSMO coordination is required, establish procedures for engaging across jurisdictional boundaries			×	
	Share innovations and project successes between regions				
Identify data sources for operations performance measures dealing with mobility between the regions	Identify new or existing technologies that could enable mobility tracking between regions		TxDOT, CAMPO & AAMPO TACs		
	Identify existing road technologies and new technologies that support performance measure tracking				
Implement an Interregional, Integrated Corridor Management System for I-35	Develop corridor management strategies, such as active traffic management, traveler information systems, demand management, and incident management		TxDOT, CAMPO & AAMPO TACs		
	Engage stakeholders, including TxDOT Districts, local cities, emergency responders, and transit agencies in regular meetings and workshops			×	Regional Coord.
Coordinate regional travel information systems across jurisdictional boundaries	Provide relevant information for regional through-travel online, through device-based services (Waze, Google Maps, etc.), and on variable messaging signs		TxDOT, Working Groups	×	
	Extend the reach of broadcasted travel time comparisons on major facilities, such as I-35, US 281, and SH 130, targeting freight and passenger traffic decision points				
MID TERM (2025-2035)					
Support the pursuit of opportunities to fund or pilot innovative technology	Identify federal & private grant funding opportunities		TxDOT, CAMPO & AAMPO TACs		
	Continue the development industry relationships to pursue public-private partnerships				

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
deployments for interregional mobility	Consider the impacts of emerging technologies, such as freight mobility, passenger information systems, and incident management, and create Working Groups for each.				Regional Coord.
	Support local initiatives to establish pilot technology deployment programs				
Improve use of ICM during early coordination of construction activities and major planned disruptions across region	Alert travelers to disruptions of travel through the regions		TxDOT, Working Groups	×	
	Identify alternative routes and alert passengers of incidents using V2X (Vehicle-to-Everything) technologies				
Develop Regional Incident Management Plan and process for regular updates	Integrate existing plans from Capital and Alamo Area regions		TxDOT, Working Groups		
	Define protocols for coordinated incident response between regions				
	Enable 'Closest to' dispatching across jurisdictional boundaries				
Refine local ITS systems and coordinate operations with Traffic Management Centers	Promote ITS integration in new local roadway construction		TxDOT, Working Groups	×	
	Develop agreements between local system owners and TxDOT			×	Regional Coord.
Support data gathering for early deployment of connected vehicles systems along major travel corridors	Gather information on roadway conditions, vehicle speed, and traveler type in central repositories		TxDOT, Working Groups	×	
Create framework and opportunity to share	Develop data sharing agreements for archived operations data		TxDOT, Working Groups		

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
operations data and coordinate monitoring & performance management targets	Align performance metrics				Regional Coord.
	Make operations data available for short- and long-range planning			×	
LONG TERM (2036-2045)					
Establish redundancy in Regional Traffic Management Centers	Manage and coordinate ITS systems, incident response, integrated corridor management		TxDOT, Working Groups		
	Develop system interoperability and shared management capabilities			×	
Deploy technologies to support connected vehicle systems along major travel corridors	Use ITS systems to facilitate vehicle-to-infrastructure (V2I) and vehicle-to-everything (V2E) communication technologies		TxDOT, Working Groups		
	Provide information to connected vehicle operators on system status, traffic, and disruptions				
Use emerging technology to move people and goods within the regions	Implement pilot programs leading to full deployment of emerging technologies		TxDOT, Working Groups		
	Focus on improving safety and efficiency of travel in the region with connected and autonomous vehicle technology				

c. Modal Options

The need and desire for improvement of modal options in a regional manner was a consistent message throughout the study process, Participants stressed the importance of advancing local and commuter, and region-wide options for multiple transportation modes.

Strategy	Tactics	Topics	Potential Partners		Coord.
SHORT TERM (2019-2024)					
Consider coordination schemes to enhance freight movements throughout the region	Conduct regular re-evaluation of freight origins and destinations to adjust freight considerations in the mid-term		CAMPO, AAMPO, TxDOT and UP Rail		
	Participate in freight-centric studies on long range freight bypass needs and truck parking facilities				Regional Coord.
Implement Regional Intercity transit services	Broker new or additional intercity service, such as the Buda - Austin Commuter Route or CARTS - Interurban Coach Routes		CapMetro, VIA, ART, CARTS, Local Govts., TxDOT	×	
	Implement a New Braunfels - San Antonio Commuter Transit Route			×	
	Conduct summits among transit providers. Identify and eliminate obstacles between urban and rural transit systems				Regional Coord.
Further regular interregional transit cooperation	Annual coordination on intercity markets and service expansion plans		CapMetro, VIA, ART, CARTS		Regional Coord.
	Develop consistent policy goals and needs assessment methods to facilitate easier interagency bi-regional cooperation				Regional Coord.
	Technical knowledge transfer meeting for transit providers			×	Regional Coord.
	Maintain web links between all transit providers				

Strategy	Tactics	Topics	Potential Partners	⟳	Coord.
Discuss how the public sector could assist private companies to move freight more safely and efficiently	Discuss operational needs and opportunities		UP Rail, Trucking Companies, Shippers, TxDOT, CAMPO, AAMPO, Local Govts.	×	
	Identify further opportunities to grade separate arterials and rail freight operations				Arterials
MID TERM (2025-2035)					
Establish a Transit Coordination Task Force focusing on service borders	Create rules for the sharing of ridership info and service adjustments		CapMetro, VIA, ART, CARTS		
	Create web-based clearinghouse for long-term plans and services information				
Expand regional commuter transit options	Support the establishment of additional fixed-route flex-schedule regional routes by rural transit providers per Alamo Area and Capital Area Transit Human Service Transportation Plans		CAMPO, AAMPO, ART, CARTS	×	
	Develop a funding strategy for megaregion rural transit.				
	Hold a bi-annual interregional discussion on service updates				Regional Coord.
Identify potential interregional joint transit service routes	Study potential end-to-end interregional transit service		CapMetro, VIA, ART, CARTS		Priority Corridors & Arterials
	Study potential interregional Park-and-Ride locations				Priority Corridors & Arterials
Promote potential interregional bicycle routes and new long-	Connect regional bicycle networks along highways		TxDOT, CAMPO, AAMPO, Local		
	Coordinate regional bicycle routes with transit agencies for				

Strategy	Tactics	Topics	Potential Partners		Coord.
distance bikeways	connectivity		Govts.		
	Use regional technical partnerships to promote, fund, and construct interregional bikeway connections				
	Incorporate permanent bicycle and pedestrian count equipment into new bikeways				
Consider possible rail and trucking enhancements	Create truck parking information systems and develop parking supplies if needed that aligned with statewide plans		UP, TxDOT Districts, National Truck Stop Association, Local Govts.		Priority Corridors
	Support network enhancement for all modes				Priority Corridors & Arterials
	Develop a Regional Rail Strategy for the movement of people and goods				Regional Coord.
	Foster preservation of right-of-way along corridors				Arterials
LONG TERM (2036-2045)					
Establish an interregional Transit Coalition	Extend Rural Transit Coordination into an interregional Transit Coalition		CapMetro, VIA, ART, CARTS, TxDOT		
Participate in interregional coordination for rail freight relief efforts	Provide assistance as requested to private sector with implementation of their freight rail relief strategies		UP, Amtrak, TxDOT, AAMPO, CAMPO		
	If surplus rail freight capacity is created, discuss opportunities for alternative uses of increased rail capacity in the region				

d. Priority Transportation Corridors

Strategies immediately following identify actions to help improve mobility along I-35, US 281 and SH 130; the 3 main corridors connecting north-south through the two regions are included below. Strategies for SH 130 are not recommended at this point in time, given the planned widenings in northern Austin which is expected to provide capacity to accommodate future demands. However, study into additional connections to SH 130 is an area of interest and potential future study.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Enable future technology enhancements	Define minimum ITS requirements for major Priority Transportation Corridors		TxDOT, CAMPO, AAMPO		ICM & ITS, Arterials
	Introduce installation requirements for technology integration in new expansion projects along Priority Transportation Corridors				
	Leverage technology to help travelers effectively plan trips				
Support improvements that address local deficiencies along I-35	Determine I-35 frontage road segments operating deficiently		TxDOT, CAMPO, AAMPO	×	
	Inventory and evaluate I-35 ramps for optimal configuration and move forward with the delivery of an access ramp conversion program				
Complete requirements for expansion of I-35	Develop environmental and Preliminary Engineering for expansion of I-35 between the Austin to San Antonio metro areas		TxDOT, CAMPO, AAMPO	×	
Reduce safety concerns at local intersections with high crash concentrations along US 281	Implement safety improvements at local intersections in Bexar County		TxDOT, CAMPO, AAMPO	×	
	Determine and implement safety improvements at local intersections in Comal, Burnet and Blanco Counties				

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
MID TERM (2025-2035)					
Maximize I-35 frontage road efficiency	Continue the implementation of a frontage road operation and upgrade program		TxDOT, CAMPO, AAMPO	×	
Further the US 281 roadway structure update program	Construct a new Guadalupe River Bridge (SB)		TxDOT, AAMPO	×	
Increase capacity on US 281	Construct a 4-lane divided highway from the Comal County Line to the Burnet County Line.		TxDOT, AAMPO, CAMPO, Local Govts.		
	Support the implementation of the US 281 Improvement Program by ensuring the existing ROW supports ultimate construction needs.				
	Construct a 4-lane freeway in Comal County				
	Study the feasibility of Park and Pool locations along US 281 in Bexar, Comal and Blanco Counties				
Improve regional mobility west of Austin and San Antonio	Reconstruct the US 281 /SH 71 intersection as a free-flowing interchange		TxDOT, CAMPO		
	Reconstruct the US 281 /US 290 S intersection as a free-flowing interchange		TxDOT		
Increase safety on US 281	Develop interchanges at Mustang Vista Rd, Casey Rd, FM 311, Jumbo Evans Blvd, Rebecca Creek Rd and FM 306 in Bexar County		TxDOT, AAMPO, CAMPO, Local Govts.		
	Conduct a regional crash hotspot analysis every 5 year to evaluate safety concerns				
	Improve intersections with high crash histories including RM 473 West, RM 473 East, John Price Road, and RM 32				

Strategy	Tactics	Topics	Potential Partners		Coord.
LONG TERM (2036-2045)					
Increase I-35's person and freight throughput	Improve I-35 to accommodate higher demands		TxDOT, CAMPO, AAMPO		
Increase capacity on US 281	Construct a 4-lane freeway from FM 306 (North of Comal County Line) to SH 71 in Burnet County		TxDOT, Local Govts.		
Reorganize long-range traffic through City of Blanco	Develop long term solutions for traffic on US 281 through the City of Blanco		TxDOT, Local Govts.		

e. Arterial Improvements

Regional stakeholders identified limited availability of alternatives to main transportation corridors, which are imperative given the number of local trips being made in the region. The following Arterial Improvements Strategies work to provide options for local movements and routing alternatives, especially in the event of an incident on I-35.

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
SHORT TERM (2019-2024)					
Designate an interregional relief arterial network	ID network of arterials designated as relief routes for local movements and I-35 relief operations		TxDOT, CAMPO, AAMPO, Local Govts.		
	Begin feasibility studies to assess existing & future needs and conditions on each of the identified relief arterials			×	
Develop an improvement plan for designated relief arterials	Prioritize improvements on existing relief arterials		TxDOT, CAMPO, AAMPO, Local Govts.	×	
	Identify and prioritize potential new arterial connections			×	
Develop a prioritization framework to aid local officials in prioritizing future investments	Develop arterial performance measures and an information exchange protocol for sharing of the resulting measurements		TxDOT, CAMPO, AAMPO, Local Govts.		
	Develop an investment monitoring tool for arterial improvements				
Coordinate connection of planned arterial improvements in regional, local, and county thoroughfare plans	Initiate arterial improvement coordination between MPOs, cities and counties, focusing on cities whose ETJs cross county and MPO boundaries		CAMPO, AAMPO, Local Govts.	×	Regional Coord.
	Support local corridor preservation and corridor management activities for identified routes			×	

Strategy	Tactics	Topics	Potential Partners	↻	Coord.
MID TERM (2025-2035)					
Develop interregional relief arterial network	Construct improvements to existing relief arterials		TxDOT, Local Govts, CAMPO, AAMPO	×	
	Conduct planning and engineering for new arterial connections			×	
Coordinate the connection of local arterial ITS systems with regional ITS master plans	Support existing local ITS efforts and traffic management systems on arterials through knowledge and resource sharing		CAMPO, AAMPO, Local Govts, TxDOT	×	ITS & ICM
	Integrate local arterial ITS and TxDOT-managed systems				ITS & ICM
	Develop a regional strategy for smart multimodal corridors, including installation of ITS technology and variable message road signs for motorists				ITS & ICM
	Create an interregional arterial rerouting plan for incidents along major regional connections and integrate recommendations into local incident management plans and ITS protocols				ITS & ICM
Prioritize corridor preservation and access management efforts	Integrate planned arterials with local growth plans		CAMPO, AAMPO, Local Govts, TxDOT		
	Identify and preserve right-of-way for new arterial connections			×	
	Perform access management along local arterials to ensure adequate mobility and safety			×	
Integrate management and operations of designated arterials into I-35 corridor management strategies	Identify areas of opportunity and overlap between local transportation Incident Management Plans		CAMPO, AAMPO, Local Govts, TxDOT	×	

Strategy	Tactics	Topics	Potential Partners		Coord.
LONG TERM (2036-2045)					
Equip arterials with connectivity capabilities to accommodate emerging technologies	Provide ITS connectivity along smart multimodal corridors		TxDOT, CAMPO, AAMPO, Local Govts.		ITS & ICM / Modal Options
	Implement maintenance practices that support smart multimodal corridors				ITS & ICM / Modal Options
Continue to promote use of local arterials to facilitate interregional multimodal connectivity	Coordinate with regional bicycle networks and regional transit service routes to promote use of major arterials as regional multimodal corridors		CAMPO, AAMPO, Local Govts, TxDOT		Modal Options
Nurture the extension of the local and relief arterial networks to enhance mobility and connectivity between growing regions	Reassess the performance of the interregional arterial rerouting plans in a bi-annual basis based on established arterial performance measures		CAMPO, AAMPO, Local Govts, TxDOT		Regional Coord.

6.2 Next Steps

This study and its outreach efforts have demonstrated there is a need and desire for the Capital-Alamo region to address mobility challenges collaboratively and in coordination with other planning partners. As population continues to grow and development expands, the geographic distinctions between the Austin and San Antonio metro areas are expected to decrease. There will be a greater need in the future to coordinate planning efforts, particularly regarding transportation facilities and services that link the two regions. A series of well-coordinated strategies for policy, technology and infrastructure solutions will be required to meet the growing demands and enhance the mobility in this emerging megaregion. Such strategies presented in this study, developed and coordinated in partnership with CAMPO and AAMPO, provide a path forward toward addressing those demands. It falls to all the study partners to integrate the strategies from this study into their planning efforts.

Appendix A

Emerging Technologies Memorandum

Capital – Alamo Connections Study

Emerging Technologies

Capital Alamo Connection Study

Transportation Planning and Programming – TxDOT Austin

February, 2018

TABLE OF CONTENTS

Introduction

This paper is not about providing recommendations; it is about listing opportunities. What used to be a fanciful future as seen in cartoons and Science Fiction like The Jetsons or Star Trek now looms at the edge of our present. We are on a collision course with the most radical changes in transportation that the world has ever seen. It's not radical in terms of *what* it is, as humans have dreamed of all of these technologies and strategies for decades. It is radical in terms of *how quickly* it will become fully operational, and a part of our lives. The automobile appeared in the early 1900's as a toy, but did not truly begin to shape society until after WWII. This next set of innovations will not take 40 years to alter our transportation systems, they have already started.

With the emergence of technologies such as driverless cars, flying cars, smart highways, drones, and high-speed transit modes, there is an opportunity to explore new ways to provide mobility for our future. In addition to these new alternatives to consider, there are a number of objectives that should be addressed in every transportation project today. The focus is no longer on simply widening highways and adding more cars; practitioners now aim to reduce congestion by moving people more efficiently, reducing greenhouse gas emissions, as well as improving reliability and safety. The main goal is to move people and goods in a faster, safer, and more reliable manner by finding a balance in the interaction with all other technologies.

These emerging modes could transform the way we plan for and evaluate alternative transportation improvements along major transportation corridors. One example is I-35 between Austin and San Antonio, also known as the Capital-Alamo Corridor. Planners and engineers need to understand a new technology's potential, as well as limitations, in order to create comprehensive transportation solutions. Decision-makers need to be informed about the applications of such technologies in other areas including its main benefits and disadvantages, to effectively weigh their potential contribution in providing transportation solutions.

This paper presents a summary of the emerging technologies that are of key interest to transportation practitioners today, and that can potentially provide long-term solution(s) to the Capital-Alamo Connection Study. The listed technologies can be grouped into four main categories based on the required right-of-way (ROW) and operation. The groups are 1) Smart Highways and Integrated Corridor Management, 2) Connected and/or Autonomous Technologies, 3) High-Speed Dedicated-Path Technologies, and 4) Air Transportation.

Smart Highways and Integrated Corridor Management

Advancements in this category focus on the improvement of current highways by either repurposing existing lanes or installing new devices that allow improved connectivity and lay the groundwork for future communication between vehicles and transportation infrastructure. Such technologies include Smart Highways, which involve installing

connectivity features under or within pavement, and Integrated Corridor Management (ICM), which involves using technology to improve flow of traffic on highways.

Smart Highways

Smart highways encompass technologies that are integrated into roadway pavement. These technologies can, among other things, generate solar energy, improve autonomous car operations, improve lighting, and/or monitor road conditions.

One example of a smart highway technology is the Smart Pavement™ which consists of precast concrete sections embedded with digital technology and fiber optics to permit communication with vehicles and the internet. This provides real-time information to drivers about traffic, roadway conditions, and crashes. Smart Pavements will also create connectivity between the roadway and autonomous vehicles, providing navigational aids while capturing traffic and usage data.

This technology is being tested in several states (including Missouri and Kansas); and some private entities are entering into long-term agreements with local DOTs to test and implement it on roadways. One example is Colorado DOT which is currently working with the private entity Integrated Roadways to install smart pavement that detects run-off-the-road incidents, and automatically summons aid in such circumstances.

Another smart highway technology is the Solar Roadway. The Wattway project, which opened has been tested on a section of I-85 in Georgia, and the SR3 in Idaho, are prominent examples. Both projects are testing solar-powered highways to capture energy from a large surface area and use that energy to generate power for roadway lighting, as well as for electric vehicle charge stations. The technology is still in the testing stages to address issues related to its durability, efficiency, and cost.

Integrated Corridor Management

ICM is a tool to enhance mobility, traffic flow, and travel time reliability while maximizing the use of existing transportation infrastructure. A number of strategies have been deployed in locations around the country to manage highway traffic by controlling flow from ramps, varying speed limits on highways, and repurposing lanes. ICM strategies rely on comprehensive information about current conditions on the roadway such as congestion levels and incidents. The following section describes some of these tools.

Ramp Metering design

The benefits of ICM rely on its *management*. Different strategies are used to control the amount of flow and improve mobility along a freeway. The implementation of managed lanes depends on the type of facility, objectives of the project, availability of ROW, current operational characteristics, and

environmental/public concerns.

Ramp Metering

Ramp metering controls the flow of traffic from a ramp onto a freeway. It operates by releasing vehicles individually at a rate that is dependent on the main-lane traffic volume and speed at a given time. Some of the main benefits of ramp metering include improved traffic flow and reduced congestion, improvement in mobility along the freeway, increased safety, reduction in vehicle emissions and fuel consumption. This method is considered one of the most cost-effective ICM tools since its benefit-to-cost of implementation ratio is relatively high.

Variable Speed Limits

Variable speed limits on I-270 in St. Louis, MO

This strategy involves the installation of dynamic speed message signs on gantries over each lane of traffic that alert drivers of upcoming congestion. Vehicles can travel more efficiently by obeying recommendations on travel speeds. The variable speed limit tool is thought to be most effective when congestion is impending and when slowing down would improve traffic flow by limiting stop-and-go movements. It also has major safety benefits as it alerts drivers of the need to slow down before they encounter the queue of stopped vehicles ahead. This strategy can be used in conjunction with other ICM technologies such as temporary shoulder use and variable message signs.

The University of Missouri in collaboration with the Missouri DOT experimented with this strategy on I-270, a major four-lane highway in St. Louis. The results were mixed, highlighting some of the method's drawbacks such as an increase in queue lengths (39 to 53 percent) and travel times (4 to 8 percent), and some of its benefits which include a major drop in rear-end collisions and overall improvement in safety. The study also noted a 20 percent decrease in lane changing conflicts.

Lane Management

Lane management involves the separation of one or more lanes from general purpose lanes on a freeway segment. Examples include High-Occupancy-Vehicle (HOV) Lanes, value-priced lanes, High-Occupancy Toll (HOT) lanes, and exclusive or special use lanes. Lane management relies on different factors including:

- Pricing including constant pricing as seen in traditional toll lanes or congestion pricing which involves surcharges at peak periods.


Mopac Express Lanes in Austin, TX

- Vehicle eligibility which restricts lane usage to certain vehicles such as trucks or HOV
- Access control such as express lanes with limited access over long stretches of the freeway to improve traffic flow.

Some managed lanes use a number of these factors simultaneously. For example, the Mopac Express Lanes in Austin, TX allow free access to public transit vehicles while all other vehicles pay a variable toll. Other approaches involve combining vehicle eligibility and access control so that there are transitways or busways which are separated by a barrier with limited access. This method has been deployed in several parts of the country including Texas highways. The toll version of this strategy has been considered for portions of I-35 but current policy does not support it. Non-revenue use of such lanes for longer distance traffic, or in future years to support strictly autonomous vehicle use could be beneficial.

Dynamic Shoulder Use

Dynamic Shoulder Use on I-35W in Minneapolis (Source: FHWA)

The FHWA defines dynamic (also known as part-time or temporary) shoulder use as the conversion of highway shoulders to travel lanes during some hours of the day as a congestion relief strategy. This strategy provides additional capacity when it is needed and preserves the use of shoulders as refuge areas during non-peak hours. The benefits of this approach include reduction in delay and congestion. It entails relatively low construction costs, but potentially higher maintenance costs compared to other methods due to the need for ongoing maintenance of the shoulders if thinner pavement designs were used in the original construction.

There are a variety of dynamic shoulder use options including:

- Left/Right Shoulder Open where the shoulder is used as a general purpose lane
- Vehicle Use Options which restrict the types of vehicles using the shoulder, such as limiting use to transit vehicles and HOV, or prohibiting trucks
- Speed Control Options which adjust the speed of the managed lane for safe merging operations

Dynamic shoulders have been implemented in several cities in the US, including Minneapolis, Miami, and Chicago with lengths varying from one to 290 miles. The most common implementation is bus-on-shoulder. General purpose dynamic shoulder use has been implemented on I-35W in Minneapolis (2009) and I-66 in Fairfax County, VA (2015).

Arterial Signal Coordination

This strategy involves the coordination of traffic signal timing patterns to smooth traffic flows by reducing stops and delays. It is usually applied on corridors with closely-spaced

intersections (<0.25 miles) and can be used to coordinate transit headways. The system is fully-responsive to traffic volumes. Agencies can implement this strategy on a small corridor, a limited grid, or region-wide. It usually requires coordination between local and state entities.

Connected and/or Autonomous Technologies

Connectivity and autonomous technologies are poised to reshape the mobility landscape and promise to make travel safer, more efficient, and more enjoyable. While these technologies are often lumped together, they actually describe two parallel innovations that can work together to transform the interactions between people, vehicles, and the infrastructure they move on.

Connectivity describes communications between vehicles (V2V), between vehicles and the infrastructure (V2I), and between vehicles and the internet (vehicle-to-cloud, or V2C). This communication is enabled by sensors embedded in vehicles, on transportation infrastructure, and/or on travelers, such as Bluetooth and cellular devices. This technology can be used, among other things, to communicate on-road conditions to integrated corridor management systems, safety systems of surrounding vehicles, and to on-demand mobility services such as Uber and Lyft.

Automation, on the other hand, describes a range of vehicle technologies that work to enhance or replace human-controlled vehicle operation. Automated vehicles are enabled by connectivity technologies used to gather information on road network conditions and communicate with other vehicles, as well as environmental sensors such as cameras, RADAR, and LiDAR mounted on vehicles. The Society of Automotive Engineers has identified five levels of vehicle automation that range from limited automation technologies requiring full driver engagement. The lowest level includes currently available features such as adaptive cruise control and advanced braking. On the opposite end of the spectrum, full automation will require no driver input during operation.

In tandem, connectivity and automation have a number of existing and potential benefits for mobility. They include:

- Reductions in crash rates by 90%, according to some[1]. These will include an end to human errors caused by alcohol or drug impairment as well as distracted driving.
- Reduction in congestion due to fewer incidents, smoother braking, fine speed adjustments, and reductions in traffic shockwave propagation leading to reduction in congestion. Cooperative adaptive cruise control, an automated vehicle technology,

[1] Fagnant, D.J and Kara Kockelman. “Preparing a nation for autonomous vehicles”

deployed at 10, 15, and 90 percent market-penetration levels will increase lanes' effective capacities by 1, 21, and 80 percent respectively[2].

- On-demand mobility, providing access for those who cannot or choose not to drive.

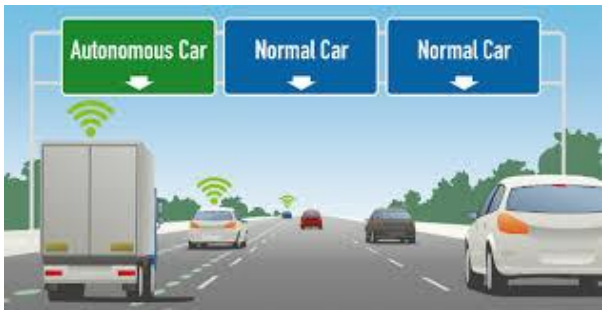
Some of the potential drawbacks of these technologies include:

- An increase in per-capita VMT. As CAVs enable travelers to spend time they previously dedicated to driving on other tasks, the perceived cost of travel time will decrease, encouraging people to travel further and more frequently.
- The possibility of hacking, malicious tampering, privacy violations, and other security threats.
- Uneven deployment of automation technologies could create conflicts with human-operated vehicles.

The following sections provide a summary of several emerging connected and autonomous (CAV) modes that will affect the way we plan for the Capital-Alamo corridor. Such technologies include autonomous intercity buses, shared autonomous vehicles, driverless shuttles, and truck platooning.

Freeway Implications

In Iowa, the Department of Transportation is conducting a Planning and Environmental Linkages (PEL) study for a 300-mile segment of the I-80 corridor. Traffic forecasts indicate a current need to expand the facility to six lanes in the near future and by 2040 the need for additional two-lanes, for a total of eight lanes.



Dedicated CAV lane

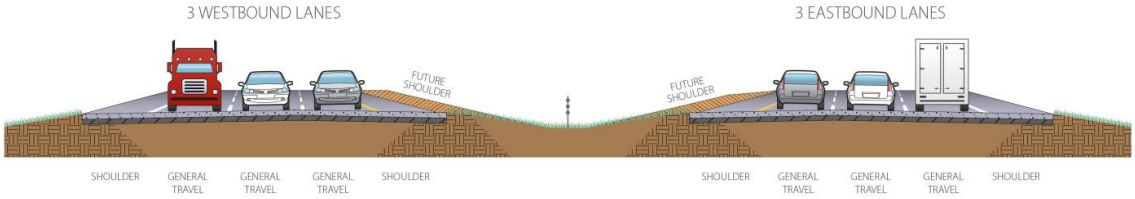
The PEL study identified the potential of CAV integration to eliminate the future need for an eight-lane facility. The adopted strategy is to build a six-lane facility initially with typical 12-foot lanes and full depth shoulders. As CAVs are integrated into the corridor, the typical section would be restriped to two 12-foot lanes and two 10-foot lanes capable of handling CAVs. This approach would save the Department billions of dollars in future capacity expansion, and provide improved infrastructure opportunities for the integration of these new techn\gies. Planners in Denver, Colorado (C-470), Seattle (I-5), and Wisconsin (I-94) are contemplating the same approaches to freeway expansion.

The following graphics present conceptual designs of the I-80 CAV lane implementation. The near-term expansion to a 60-ft. roadbed in each direction of travel (featuring the standard 3-

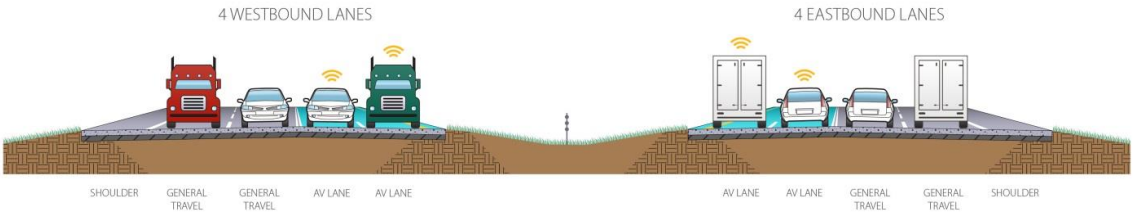
[2] Shaladover, S., Dongyan, S., and Xiao-Yun, L. "Impacts of cooperative adaptive cruise control on traffic flow"

12 ft. travel lanes flanked on both sides by 12-ft. shoulders) could be converted into a four-lane freeway (two standard vehicle lanes of 12 ft. each and two 10-ft. lanes for CAVs).

The narrower lanes for CAV vehicle use would recognize the more precise and consistent driving pattern of computerized steering in CAVs. The 60-ft. roadbed would not need to be expanded, as the inside shoulder could shrink to just four feet. A similar approach could be explored for reconfiguring I-35 between Austin and San Antonio.



Typical six-lane freeway with standard lane and shoulder widths (Iowa DOT)



Reconfigured six-lane section to handle two CAV lanes and two standard lanes (Iowa DOT)

Autonomous Intercity Bus

Intercity buses such as Megabus and Greyhound have been operating across the nation and in Texas for many years now providing discounted trips between the several cities. With the rise of CAVs, public interest, or at least acceptance is slowly shifting towards autonomous intercity buses. In addition to the major safety benefits that would result from that shift, the quality of the ride would likely improve with smoother braking and acceleration efforts, while reducing travel times and creating a more reliable service. China and Singapore are now the leaders in the testing of this potential mode.

Autonomous Intercity Bus Service – Singapore

Initial testing has relied on retrofitting standard buses into autonomous buses and driving them on urban transit corridor. Singapore's Land Transport Authority (LTA) is exploring this new technology to expand the transportation network capacity without the need for major infrastructure investments. A joint effort by LTA and NTU Transport Research Centre focuses on the development of a hybrid vehicle that is scheduled to begin public trials in 2018. Initially, the bus will run a route of less than one mile, which will be extended if the trial goes well; ultimately these buses are expected to travel between cities by integrating longer routes and dynamic routing within the next 10 years. Recent announcements indicate that a joint effort between NTU and Volvo has been initiated in to test electric autonomous buses in Singapore by 2019.

Yutong Autonomous Bus – China

The Yutong Autonomous Bus has been under development and testing for three years. It recently completed a 20-mile long circuit trip between Zhengzhou and Kaifeng in Henan Province, in regular traffic without any human assistance. The bus traveled at a speed of 40 mph through 26 signalized intersections and was able to change lanes and overtake vehicles. The technology is still under development and no information is available on its anticipated completion.

Yutong Autonomous Bus

Shared-Use Modes

While CAV will transform the way we operate vehicles, it is also likely that trends in vehicle technology will reshape vehicle ownership and use entirely. Shared-use mobility describes several emerging alternatives to vehicle ownership. One approach, car sharing, involves subscribing to a service that enables users to access vehicles on-demand from fixed locations. Car-sharing companies include Zip Car and Car2Go. Another common approach is the one used by transportation management companies (TMCs) like Uber and Lyft. These companies enable drivers to use their own vehicle to connect to people needing rides via on-demand smartphone applications. Another emerging trend in shared-use is fixed route services, such as Chariot, UberPool, and Lyft Line. These services use vans and larger vehicles to provide alternatives to transit services.

With the emergence of fully-automated vehicles, these companies are to reduce costs by automating their vehicles. Uber, for example, has made a commitment to invest in 24,000 autonomous Volvo cars to create its first driverless fleet and has begun testing in early 2018. Recent studies[3] indicate that Shared Autonomous Vehicles (SAV) are expected to enter our market within the next 10 years and change not only the way we travel but our car ownership patterns as well. In the context of the Capital-Alamo corridor study, SAVs can be seen as a last-mile solution for trip making. They can also be expanded to intercity travel with the help of I-35 AV-oriented improvements such as dedicated lanes.

Driverless Shuttles

Another last-mile CAV technology is the driverless shuttle. These vehicles are expected to run short distances on fixed routes serving designated stops. The vehicles have a capacity of five to ten passengers. This technology has been tested primarily on college campuses and

[3] Collie, B., et al. “The Reimagined Car: Shared, Autonomous, and Electric Vehicle”

compact office developments. Some are even being tested on low-speed urban segments. The following are some examples of these tests.

EZ10 by EasyMile – Various locations

The EZ10 has been running on highways since 2008 and has transported over 1.5 million passengers in several locations around the world. It can carry up to 12 passengers, six standing and six seated. Trials have been completed in Singapore, and Helsinki, Finland, and the vehicles are now in full service. Testing has begun in Sophia Antipolis, France; Lausanne, Switzerland; and Concord, CA. The vehicle can be deployed in 'metro' mode where it stops at all stations, the 'bus' mode where it only stops upon request, and the 'on demand' mode which can be called like a taxi.

EZ10 by EasyMile

"Harry" by Oxbotica – London, UK

The new driverless shuttle, "Harry", is being tested in a residential neighborhood in London along a two-kilometer riverside route on the Greenwich Peninsula. The main aim is to test the vehicle in a high-pedestrian environment at a speed of 10 mph, with abilities to stop immediately when something is in its path.

The Harry driverless shuttle

Arma by Navya – Las Vegas, NV

Trials on the Arma started in January, 2017. The shuttle was initially set to run at 12 mph on the less congested streets of Las Vegas. After successful tests in November, the service was expanded to the busy Las Vegas Strip. To better cater to the shuttle service, traffic lights and signals were updated so they could communicate with the vehicle. The shuttle currently runs along a three-stop route on the South Las Vegas Boulevard and Fremont Street in the city's Innovation District between 11AM and 7PM, six days a week.

The Arma operating in Las Vegas

Truck Platooning

Truck platooning is an example of a CV technology that could, but does not have to, rely on autonomous abilities. Truck platoons are composed of two or more closely spaced trucks (separated by as little as 10 ft) traveling together. The technology relies on the ability of each truck to connect to the truck in front of it or to other trucks in the same "pack". Some of the

benefits of truck platooning include the reduction in fuel consumption of 10 to 15 percent per vehicle, increased safety resulting from V2V communication, travel efficiency, increased driver convenience and comfort, smoother acceleration and braking which reduces damages to fragile cargoes, and a significant reduction in emissions. Researchers at Auburn University estimate that platooning would improve traffic flows once truck market penetration reaches 60 percent.

There have been several trials performed to test truck platooning technology, including test by the US Army in live traffic in 2016 and a test of video- and radar-enabled platooning conducted by the US DOT's Exploratory Advanced Research program. Several private sector pioneers have emerged in the field of vehicle platooning. The most prominent is Peloton Technology, which has raised $18.4 million and anticipates roll-out of its platooning technology by the end of 2018. Peloton has already tested its' system on 15,000 miles of highway in six states.

The Texas A&M Transportation Institute (TTI) began assessing truck platooning in Texas in 2015 and has performed successful test runs on its campus[4]. The next phase, which is anticipated to be completed in 2019, involves testing the technology on Texas highways. Trunk Platooning is being monitored by the American Trucking Association but has not yet been endorsed, as it has only been tested off road and on track in controlled conditions. Cyber hacking and the safety of live testing of platoons has caused some states, such as Missouri, to be hesitant about the technology. However, nine states including Texas have cleared this technology through legislation or administrative approval, and an additional 20 states have expressed interest in platooning testing trials. Truck platooning is expected to be operatational on our roads within five to ten years.

Capital-Alamo Implications

With regards to the Capital-Alamo Corridor, CAVs will play a role in improving mobility and safety as well as reducing congestion and travel times. Capacity increases are anticipated due to the smaller headways and the reduction in crash/incidents that will lead to significantly lower travel times. This could be enough to serve anticipated traffic growth on I-35, without the need for major expansion once there is full market penetration. Truck platoons are expected to improve efficiency and mobility of freight across the study area. SAVs and driverless shuttles will act as another last-mile solution for intra-city travel, which is essential for encouraging people to use more efficient forms of transportation in the larger study area.

While acknowledging that many of these technologies are far from full deployment, decision makers in the corridor should consider the range of possible impacts these technologies will have on mobility. Policies and regulations need to be set in place and infrastructure

[4] Texas A&M Transportation Institute. "Follow the Leader: Two-Truck Automated Platoon Test is a Winner" (2016)

improvements, such as the installation of Dedicated Short-Range Communication (DSRC) devices and smart pavements, need to be implemented to make use of the full potential of CAVs. Dedicated lanes may need to be initially considered on freeways such as I-35 while the use of these technologies ramps up. At this early stage, the Capital-Alamo corridor is an ideal area to test CAV technology for inter-city travel."

High-Speed Dedicated-Path Technologies

This section describes a number of dedicated-path technologies including high-speed rail, MagLev, Hyperloop, and the Freight Shuttle. What these emerging technologies have in common is the need for a dedicated, fixed guideway on which passengers and/or freight are moved. While some of these technologies can be readily implemented, others such as the Hyperloop, are still being tested and researched to eliminate any potential safety issues and provide optimum designs in terms of speed and cost.

High-Speed Rail and MagLev

High-Speed Rail (HSR) already operates in several countries. Its primary use is to move people between large population centers separated by long distances, at speeds ranging between 120 and 250 mph. New forms of HSR have been developed such as MagLev to provide a smoother and faster ride.

High-Speed Rail Applications

The Acela Express (operated by Amtrak) in the Northeast, currently the only HSR line in the US, links Boston, New York City, Philadelphia, and Washington, D.C. The California HSR, being designed to link the five largest cities in California, is constructing its first operating segment between Merced and Bakersfield, in 2021.

The Shanghai MagLev Train, first commercial MagLev line operating since 2003.

The Texas-Oklahoma Passenger Rail Study (TOPRS) proposes a HSR line between Oklahoma and Mexico. A preliminary EIS has been completed for this project and the findings indicate that the best location for this service would be east of SH 130 with a stop near the Austin-Bergstrom International Airport and another stop in San Antonio. Funding for this project remains undetermined.

Also in Texas, the privately-owned Texas Central Partners, LLC is designing a HSR line between Dallas and Houston known as the Texas Bullet Train. The line provides service to up to 400 passengers every 30 minutes. Despite the completion of the EIS for this project, State legislative actions regarding the provision of ROW for the project has been negative.

Maglev Applications

The MagLev train is a form of HSR that uses magnetic repulsion to levitate the train and propel it forward on a specified guideway therefore creating minimal friction between the vehicle and the track and resulting in a smoother, quieter ride. The power required to levitate the vehicle is relatively low allowing most of the energy to be used to overcome wind drag. This results in significantly higher speeds than traditional rail technologies, making the MagLev the world's fastest trains with a record speed of 374 mph.

The proposed Texas Bullet Train between Dallas and Houston

Both high speed and low speed MagLev trains are in operation today. While there are several low speed systems currently being used throughout the world, high speed systems are only found in Japan, Korea, and China. Plans are underway to expand MagLev systems in each of these countries. Companies such as American Maglev, TransRapid, MagnaMotion, and The Northeast MagLev (TNEM) have focused on developing the technology in the United States; but all have been faced with the lack of legislative and financial support.

Positives & Negatives of HSR

+ Proven technology – it has been implemented in the US and other parts of the world
+ Attention and interest - it continues to receive public interest due its success
+ State interest – the technology is already being considered in Texas
+ Terrain – requires flat terrain which makes it suitable for Texas
– Cost – the capital and operating costs could be high
– Uncertainty – in safety, security, operational longevity, and maintenance requirements
– Operation – high speeds can only be achieved with long station spacing, meaning smaller communities between Austin and San Antonio could not be served.

Speed/Radii[5]
125 MPH / 7,000'
150 MPH / 10,000'
186 MPH / 16,600'
200 MPH / 18,000'
220 MPH / 22,000'
250 MPH / 28,000'

Capital-Alamo Implications

With an HSR implemented within the study corridor, a reduction in congestion might be expected due to the diversion of passenger traffic from personal vehicles. However, the implementation of this technology in the State in the near future is not certain due to the

[5] Turning radius (converted from meters to feet)

Texas legislative opposition.

Most recently, the Texas Senate and House Transportation Committees filed a total of 25 pieces of legislation during the 2017 session that could hinder a private company's ability to build a HSR line from Dallas to Houston. Specifically, the bills focused on prohibiting the use of eminent domain for HSR ROW, prohibiting the use of state funds for a privately-owned HSR line, and prohibiting state agencies from using state funds for planning, constructing, and operating HSR in the state. While only those bills prohibiting state funding of private initiatives were enacted into law, legislative hurdles will continue to be a concern in the implementation of new high-speed and costly technologies in Texas.

Hyperloop

The Hyperloop technology involves the movement of freight and passengers in pods through reduced pressurize tubes. By reducing pressure inside the tube, wind resistance is lowered, resulting in higher speeds. The pods are levitated on a pocket of air or magnetic repulsion within the tubes and are propelled using motorized fans. Latest designs of the Hyperloop feature pods with capacities of 8 to 28 passengers. Anticipated speeds for this technology are significantly higher than any existing rail system, up to 780 mph, and headways are estimated to be between 30 to 90 seconds, which is equivalent to 1,260 to 3,360 passengers per hour per direction.

Hyperloop Applications

The Hyperloop was first introduced to the public in 2012 by Elon Musk, and efforts have been made to open-source the design to attract other groups who could contribute to the improvement of the concept. Some of the most prominent Hyperloop efforts include:

Hyperloop Pod Competition by Space X

SpaceX, an Elon Musk company, is building a one-mile long subscale track at its headquarters in Hawthorne, CA. In 2016, it open-sourced the Hyperloop technology to 27 teams from across the world in the first Pod Competition aimed to advance the development of functional prototypes and encourage innovation by challenging teams to design and build the best high-speed pod. Due to successful designs that resulted from the first competition, a second competition was scheduled for 2017 and 2018 focusing on maximizing speed, safe deceleration, and propulsion.

Elon Musk's SpaceX Competition

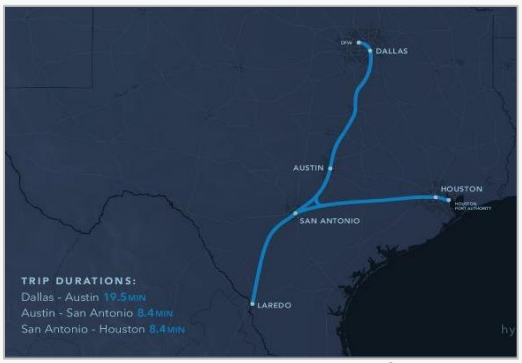
Hyperloop One

Hyperloop One is a Los Angeles-based company that has built a 1,640-foot long full-scale test track. It conducted its first pod motor tests in 2016 and has completed full-scale tests in 2017. The company is currently developing routes for their system in five different countries and has set a goal to be moving cargo by 2020 and passengers by 2021.

They Hyperloop One Model

Hyperloop Texas

In January 2017, Hyperloop Texas was one of the 35 participating teams in the first SpaceX competition. Hyperloop Texas consisted of a 640-mile route called The Texas Triangle that would connect Dallas, Austin, San Antonio, Houston, and Laredo.



The Texas Triangle Hyperloop Concept

Positives & Negatives

Speed/Radii
22 MPH / 67’
67 MPH / 600’
130 MPH / 2,400’
310 MPH / 13,200’
450 MPH / 26,700’
780 MPH / 82,000’

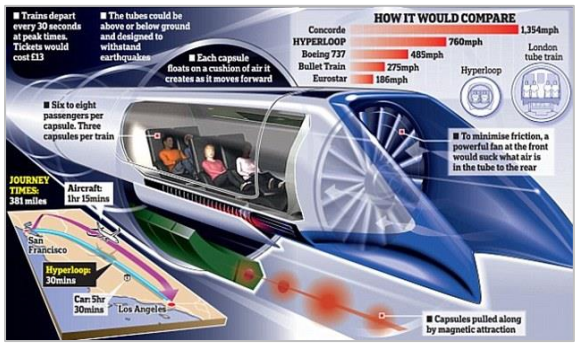
+ High speed – designers say the speed of a Hyperloop pod can exceed the speed of air transportation and other high speed rail transit modes.
+ Flat terrain – the technologies requires a flat terrain which is compatible with parts of the study corridor terrain.
+ Small physical footprint – the physical footprint of a Hyperloop system could be considerably smaller than traditional wheel-on-rail systems due to its ability to contain most of the operating system within a tube/track.
+ Worldwide public interest – the technology continues to receive large investments in research and development worldwide.
+ State interest – significant funding and research is being expended on the technology with a Texas design team (Hyperloop Texas) being one of the finalists in the design competition.
– Still being tested – the technology is currently only at the full-scale beta test phase; requiring extensive research and development before public use.
– Large turning radii – moving through a tube at such high speeds requires very gradual turns or changes in elevation. By comparison, the maximum grade for a 70 mph highway is 1,800 ft.
– Cost – large expenses expected for construction and maintain such a technology.

– Uncertainty – in the technology's safety, security, cost, operational longevity, and maintenance.

Capital-Alamo Implications

Given that the technology could serve the movement of freight as well as passengers, the application could directly impact mobility in the project corridor by taking both freight and passenger traffic off of I-35. The terrain in the corridor is relatively level which is suitable for the installation of the Hyperloop tubular system; however, very large horizontal curves might be needed to accommodate the high speeds of the train which are not compatible with existing highway designs.

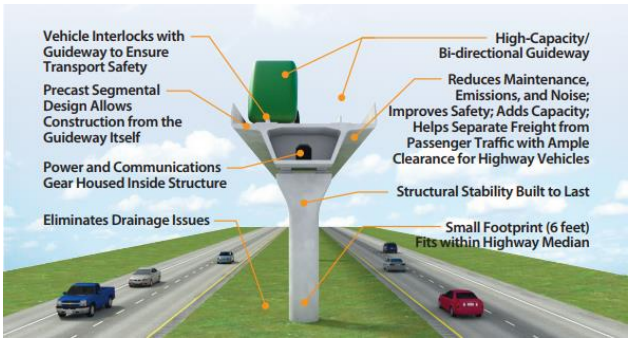
The hope that this technology could create a positive impact in the project area within the reasonable future is optimistic. Beyond the physical and financial hurdles to its implementation, the Texas legislative process must be considered. While most bills that negatively impact the development of non-highway related transportation infrastructure have failed to date, legislative hurdles must be considered when evaluating the viability of developing Hyperloop or any other dedicated path mode of transportation in the state of Texas.



The Hyperloop Vision

Autonomous Freight Shuttle System

The autonomous Freight Shuttle System (FSS) is designed to accommodate high density traffic between origins and destinations that are less than 500 miles apart, such as between seaports, ports of entry, and major urban centers. FSS can carry up to 54-foot long containers thus relieving truck traffic on roadways. The technology exhibits cruising speeds of 65 mph, has an energy efficient electric mechanism, and has fully autonomous operation. Each shuttle, carrying a single tractor-trailer or container, moves on an elevated, dedicated guideway and uses proven technologies.



Freight Shuttle System Guideway (Source: TTI)

The FSS was initially designed in 1998 by TTI. In 2005, Freight Shuttle International (FSI), LLC was formed to pioneer the development of this technology. In 2016, the Alpha FSS transporter was completed, tested, and unveiled to the public.

Freight Shuttle System prototype (Source: TTI)

FSS can be operated within existing ROW or on private property. The system needs less than ten feet of ROW on the ground. Construction of FSS is envisioned to use a prefabricated system that is constructed from the top of the deck, creating minimal impact on traffic during construction. Since the shuttles travel on an elevated ROW, there is minimal interaction with other vehicles, improving safety and reliability both for general travelers and for users of the freight service. FSI expects to run shuttles 24 hours a day with headways of as little as 10 seconds. Thus, each directional guideway could serve the equivilent of 360 trucks per hour.

For a privately funded FSS, there could be opportunity for revenue capture by public agencies via agreements for the right to operate in public ROW. Public-private partnerships provide opportunities for a long-term relationship and return on investment.

The Freight Shuttle System Applications

The FSS was identified by the US Treasury Department as a beneficial project for the Zaragosa Port of Entry in El Paso, TX. The proposed FSS would move cargo containers across the border via a dedicated bridge. The system would be nearly 12 miles long and cost over $1 billion dollars. The goal is to secure private funding to cover the majority of the cost. The technology is expected to also have a significant impact on expanding capacity at the Zaragosa Bridge corridor, thus reducing congestion and delay. Part of the congestion reduction would be achieved via use of special scanners to speed up the customs clearances of each container.

Positives & Negatives

+ Technology is ready for market application – successful low-speed testing was completed in 2016
+ Reduction in corridor congestion – by diverting the transportation of some goods from trucks to the shuttle
+ Reduction in traffic conflicts – due to the elevated guideway
+ Reduction in truck-generated pavement damage
+ Lower emissions – due to the use of electric motors
+ Reduction of medium-distance truck trips – since it covers medium freight movements which are usually performed by long distance trucks
+ Speed and reliability in delivery – due to autonomous operation, independent from other transporters
+ Privately financed, operated, and maintained

- Lack of flexibility – due to fixed route of elevated track with limited access/egress points
- ROW needs create conflicts with existing transportation systems or land uses
- Need for intermodal transfers – at the first and last mile connections

Capital-Alamo Implications

In the context of the Capital-Alamo Corridor, the FSS could be used to reduce truck congestion, infrastructure maintenance costs, and highway construction needs. Since the study corridor is shorter than the 500-mile maximum service length for the FSS, the shuttle could be suitable for the transportation of freight between the different intermodal facilities, along an elevated ROW above or parallel to I-35. The technology has been fully vetted through proof-of-concept tests and the opportunity for public-private partnerships provides potential for funding outside of the traditional highway funds.

Air Transportation

This section introduces aerial modes that could potentially divert traffic from highways by moving people and freight along more direct routes. Such modes include passenger aerial systems for single or multiple passengers, as well as delivery drones that cater to last-mile freight provisions. Despite the larger-scale success of this technology in the form of commercial airplanes, legislative hurdles are likely to hinder the smaller-scale use of this mode for personal travel due to security and safety concerns.

Passenger Aerial Systems

Passenger aerial systems encompass a variety of modes and include human and automated piloting. The most common example of a passenger aerial system is the flying car, which can operate like a traditional airplane, using a runway, or take off and land vertically. No flying car technology is currently ready for mass production, though several companies expect their technologies to be operational by 2020. One company, Terrafugia, has already begun taking orders to reserve some of its vehicles for future purchase.

Driverless aerial passenger vehicles have been developed and are being tested in at least three locations – China, the USA (Nevada), and Dubai. Such vehicles are designed to carry one passenger weighing no more than 220 lbs. and traveling over a distance not exceeding 30 miles before recharging. Early planning is also underway for multiple passenger Unmanned Aerial Systems (UAS) that could act as a form of mass transit. Though this mode has not yet been fully developed, it is planned to operate as an unmanned commercial airline flight (no pilot) and is expected to enter testing soon. The driving force behind this testing is major airline companies including Boeing and Airbus. UAS helicopters have been developed and are currently in use to serve the military.

Another form of aerial travel is the Aerial Ropeway Transit (ART), also known as the Gondola Lift. ART is now being introduced in urban environments as a relatively affordable and reliable automated alternative to moving people between two fixed points. Currently, the longest ART is 3.5 miles long and is located in Hong Kong.

AeroMobil 4.0 by AeroMobil

This flying car hybrid was first shown to the public in April 2017 at Top Marques Monaco show. It is currently taking preorders that will ship in 2020, at a price of $1.3 to $1.7 million. The company plans to produce 500 vehicles. The Slovakian-designed vehicle uses a runway for take-offs and landings but is in compliance with existing regulatory frameworks for cars and airplanes. It is a two-seated vehicle that can transform from car to plane in under 3 minutes. It can accommodate a driving range of 700 km (434 mi) and a flight range of 750 km (466 mi) at 75 percent of its top speed. On the ground, the hybrid can reach a top speed of 100 mph and a speed of 220 mph in air. It has safety features that help it glide down to Earth with the help of a parachute in the event of loss of power.

AeroMobil in airplane mode

AeroMobil in car mode

Lilium Jet by Lilum

Designed and conceived in Munich, the Lilium jet is an all-electric personal jet/air taxi that operates through vertical takeoff and landing. It is currently being tested remotely but is not planned to be autonomous. Reportedly, the vehicle can travel 186 miles at speeds up to 186 mph. The company plans to offer a five-seat version of the vehicle after the two-seat model has been successfully operated.

The Lilium jet will require a large network of small, landing pads in and around urban areas for safe takeoff and landing. The idea is that individuals would not need to own a unit but could simply pay per ride like a conventional taxi. The expectation is for the public to be able to book flights by 2025.

Lilium Jet testing lab in Munich

Lilium Jet in flight

The Transition by Terrafugia

The Transition®, designed by the Massachusetts-based company Terrafugia, is another flying car design that features some autonomous capabilities to improve safety but would be controlled by a pilot. Similar to other designs, the vehicle is a two-seater and is meant to operate as a regular automobile on ground and as an airplane in air with the ability to transition from one mode to the other in under a minute. It uses unleaded automotive gasoline and has a flight range of 400 miles with a top speed of 100 mph. The vehicle is expected to be operational by 2020.

The Transition Vehicle in car mode

Ehang 184 by Ehang, Inc.

The Chinese company, Ehang, first unveiled the Ehang 184 Autonomous Aerial Vehicle in 2016. Unlike the previously mentioned flying cars, the Ehang 184 is a fully autonomous self-driving aerial vehicle that can carry a single person weighing up to 220 lbs. and can travel at speeds up to 63 mph. The vehicle can travel a maximum distance of 30 miles before it needs recharging. The vehicle is equipped with safety features that allow it to land safety even if its rotor arms stop working, and is connected to a remote control center as backup. Dubai is looking to use these vehicles in the near future as taxis. The price of each ranges between $200,000 and $300,000.

The Ehang 184 unveiled in 2016

Flying Taxis by Uber

Uber is teaming up with the governments in Dallas-Fort Worth and Dubai to test its flying taxis. It is also working with real estate firms such as Hilwood Properties in Dallas to identify sites where it can build takeoff and landing pads, called “vertiports”, as well as charging stations. It is in the process of negotiating with five aircraft manufacturers to produce its electric vehicles with vertical takeoff and landing capabilities. The company aims to demonstrate its first flying taxis in 2020.

Uber’s vertiports and charging stations

Pop.Up by Airbus and Italdesign

First unveiled at the Geneva Autoshow in 2017, Pop.Up is a combination of a self-driving car and a drone. The idea is that the passenger would travel in a self-driving electric capsule that can either attach to a chassis with wheels or be picked up by a drone powered by a battery in times of congestion while the chassis remains on the ground and completes the trip on its own. The capsule also has the ability to connect to a train or Hyperloop to complete a trip. The designers of this technology aim to complete a functional system within a 10-year timeframe.

The Pop.Up chassis on wheels and drone

Aerial Ropeway Transit (ART)

This aerial modes has been around for decades, carrying passengers to ski slopes and high-elevation touristic locations. Now this mode is being applied to urban settings worldwide. The cabins can transport up to 200 passengers at a time and the system is fully powered by electricity and diesel engines for backup in the event of power outage.

The Mi Teleférico in Las Paz, Bolivia (2014)

Previously thought suitable only in rugged terrains, this form of transport is now being considered for urban commute of all types due to its small footprint, energy efficiency, and low construction cost. Moreover, the ART does not need to follow existing roadways which may lead to more efficient routing. The longest ART today is 3.5 miles and is limited to single fixed routes with no branching.

Proposed New York East River Skyway between Brooklyn and Lower East Side Manhattan

Capital-Alamo Implications

While personal aerial vehicles could transport people within the Capital-Alamo corridor at much higher speeds (particularly if congestion continues to build), there is still a great deal of uncertainty regarding the application of these modes. ART is the only technology ready for implementation, and it would be applied to last-mile transportation services between major transportation hubs and nearby concentrations of jobs or housing. If that is the case, the anticipated benefits would be found in an urban setting and would not necessarily serve travel across the entire study area.

On the other hand, personal aerial vehicles (PAVs), owned by individuals, could permit travel within the larger study area. However, PAVs, like all the aerial technologies discussed here, would require proper infrastructure like air traffic control systems and new regulations on

how and where such transports could be operated to ensure safety and security. These topics are not currently being addressed by lawmakers locally or nationwide.

Freight Aerial Systems

A number of companies, such as UPS, Ford, DHL, and Amazon have begun investigating the application of unmanned aerial systems for last-mile freight deliveries. Such concepts usually include a combination of delivery trucks and drones that in combination transport packages to individual homes and businesses. The consensus is that the application of UAV delivery is still years away as it is still limited by several factors such as range of travel, payload, weather conditions, security, and other regulations.

Ford Autolivery by Ford Motor Company

The Ford Autolivery model combines self-driving trucks with Unmanned Aerial Vehicles (UAV) that nest inside the truck and are released to perform last-mile deliveries to a recipient's front door. This technology is still in its early stages of testing.

Ford Autolivery Concept

DHL Parcelcopter by Deutsche Post DHL Group

First tested in 2013 by DHL in Germany, the Parcelcopter succeeded in completing a 12 km test trip to deliver urgent pharmaceutical goods from mainland Germany to a nearby island. It was tested again in 2016 in severe alpine conditions where it had to adapt to rapidly changing weather and severe temperature fluctuations. Most recently, the Parcelcopter has succeeded in completing tests involving five-mile long flights completed in approximately eight minutes. The trip would normally take more than 30 minutes by car. The technology will continue to be tested.

DHL Parcelcopter Unmanned Aerial

Amazon Prime Air by Amazon

Amazon has recently designed a drone delivery system to transport packages to customers in 30 minutes or less. The service, known as Prime Air, aims to shorten delivery times significantly, improving service, reducing safety concerns, and making delivery more efficient. The first successful tests of the service were performed in the United

Amazon Air Prime Service

Kingdom in December, 2016. The current system can carry packages of up to 5 lbs. and is only permitted to be used during daylight hours under clear weather conditions.

UPS Parcel Delivery by United Parcel Service Ropeway

UPS began testing drone deliveries in February, 2017 in Tampa, FL. Their drone service is designed to make short trips between a parked delivery truck and recipients' front door. The current drones can fly up to 30 minutes and recharge at docking stations housed in the UPS vehicle. Their weight capacity is still undetermined. UPS anticipates great savings and improvements in efficiency equivalent to $50 million per year.

UPS Drone Delivery Service

Capital-Alamo Implications

The main benefits of freight aerial systems will be experienced in urban areas in the context of last-mile package delivery to concentrations of receivers. Given the maximum payload that can be carried by such vehicles and limited distances they can travel, longer distance service is not feasible at this time. More corridor-wide delivery of goods will require substantial policy and operational improvements to be implemented.

Conclusion and Recommendations

The plans we are developing today for the next 25 years must make allowances for some or all of the technologies mentioned in this paper. Smart Highways and Integrated Corridor Management must begin integration immediately. Such strategies can slow the growth of congestion in the near time and cater to growing forecasted demands in the future.

CAVs will be operational before we can make full provision for their use, but by the mid-term of this plan, their impact - both for good (improved safety) and potentially bad (increased demands for travel by automobile) will be keenly experienced. The creation of smart technology that permits vehicles and transportation infrastructure to communicate with each other must be in place. The adoption of existing highways to harness the benefits of CAV will also be necessary.

High-Speed Dedicated-Path Technologies are largely already available, but neither the Federal nor State Government has the financial resources to pay for them. Private sector interests could pursue these services, but will only do so as they make economic sense for the private companies. They do not make economic sense today.

New forms of air Transportation are exciting, and have some immediate application for last-mile connections (ART and drone freight deliveries in particular). But passenger aerial

systems are going to require major investments in new air traffic control systems and a slew of regulations/policies governing how they can be used. Combined with their forecasted cost, their impact on the transportation system will not be experienced for a long time.

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Appendix B

Regional Transportation Planning Coordination

A primer for Capital – Alamo Connections Study

MEMO

6/13/2018

To: Roger Beall
Transportation Planning and Programming Division (TPP), TxDOT Austin

Through: Susan Chavez
TPP, TxDOT Austin

From: Michael Sexton
Jacobs Engineering

Subject: Regional Transportation Planning Coordination: A primer for the Capital-Alamo Coordination Study

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Coordination across jurisdictional boundaries is an ongoing concern in growing regions. While MPOs were established to coordinate transportation planning and programming at a regional level, the initial designation of MPOs in the 1970s have remained relatively fixed nationwide despite changes in regional growth and development. As once-separate regions begin to grow together, transportation organizations have taken several approaches to address areas of overlapping concern.

This white paper is an input to the ongoing work of the Capital-Alamo Connections Study. This study is TxDOT's effort to foster a collaborative transportation planning process for Austin, San Antonio, and the communities in between. Though these two metropolitan areas are still distinct today, their boundaries are frequently crossed by travelers. The urgency to work together on issues of shared concern is expected to increase as growth and traffic congestion increase. This paper summarizes some of the most commonly-used coordination strategies and provides examples of the use of these strategies between different regions and MPOs throughout the U.S.

Regional Coordination Framework

Agencies use a range of alternatives to improve coordination while retaining jurisdictional control. Some of the benefits of regional coordination between transportation agencies include the following:

- Promote the efficient use of local resources and align decisions with regional goals
- Create consistent transportation solutions for a region's travelers, including passengers and freight carriers
- Acknowledge that transportation issues are not limited by jurisdictional boundaries
- Maximize the strengths of existing agencies, their goals, and their organizational structures

Figure 1 illustrates the range of coordination approaches currently used by transportation agencies that do not require a modification of their internal governance structures.

Figure 1: Transportation Agency Coordination Approaches

The following sections will describe each approach to coordination and provide illustrative examples.

Ad Hoc

In many cases, regional coordination is initiated by a single issue that brings agencies together in an ad hoc manner. In this form of coordination, transportation agencies work together on a single project with limited or no formal agreement. This approach to coordination is flexible, highly focused, and is not expected to continue beyond the limits of the single project. Many of the successful examples of regional coordination outlined in the *Selected National Examples* section began as ad hoc efforts.

The I-25 Denver-Colorado Springs Connection PEL, an ongoing study, is an example of a single project that crosses MPO boundaries. This effort is being led by the State but requires MPO engagement.

Forums for Ongoing Dialog

Continuous regional coordination is often the result of long-term dialog between regional transportation agencies in order to define areas of shared concern. Forums for ongoing dialog involve periodic meetings of regional transportation agencies wherein each shares information on its current projects; discusses topics of regional interest, such as economic development; and works to identify opportunities to collaborate in the future. This type of coordination is continuous, occurring at fixed intervals, and formalized, often through a joint resolution signed by each member agency. It often results in the creation of task forces or working groups to further develop ideas.

One example of this type of coordination is the Central Jersey Transportation Forum, a meeting of decision makers who discuss cross-jurisdictional transportation issues. Over the years, several task

forces have formed to develop ideas introduced at the Forum, such as smart growth and bus rapid transit.

Joint Planning Tasks

Once agencies build trust and identify areas of collaboration, there is the opportunity to begin working together on specific transportation planning tasks. The Federal Highway Administration (FHWA) has identified the following transportation topics that are often coordinated across jurisdictional boundaries:

- Air Quality and Environmental Planning
- Asset Management
- Congestion Management
- Economic Development
- Environmental Justice Analysis
- Freight Planning
- Safety Planning
- Transit Planning
- Regional Planning

The specific form of coordination will depend on the overlapping concerns identified by the agencies. In some cases, the joint planning tasks are highly technical. The two MPOs in Raleigh-Durham, NC have collaborated on a land use scenario planning exercise and a travel demand model. Other regions coordinate on studies for specific planning areas identified through formalized coordination efforts, such as the *I-75 Regional Corridor Transportation Use Evaluation* by the West Central Florida MPOs Chairs Coordinating Committee. In the examples listed in the *Selected National Examples* section, coordinated joint planning tasks are based on detailed memorandums of understanding that provide detail on the agencies involved and their roles as co-producers of a document or technical product.

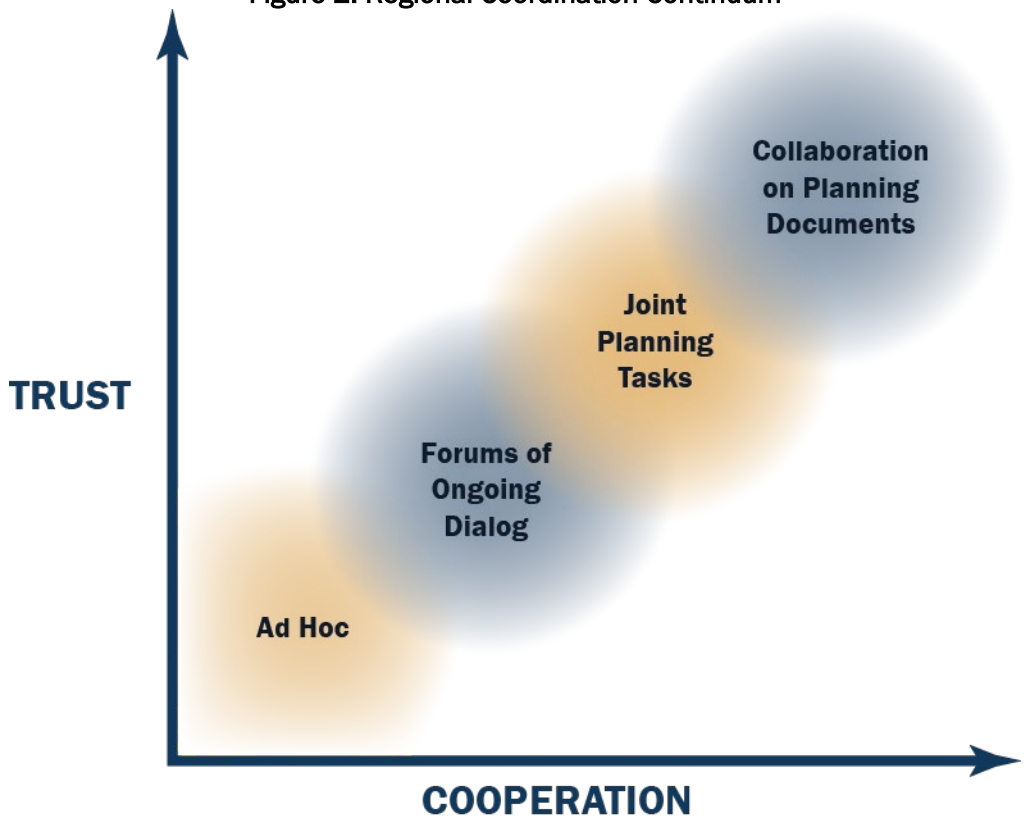
Combined Planning Documents

Regional transportation coordination becomes urgent as urbanized areas begin to grow together. In several cases nationwide, MPOs that hold jurisdiction over a single Consolidated Metropolitan Statistical Area (CMSA) work to produce shared planning documents. CMSAs are geographical areas that include multiple core cities and their surrounding areas with strong economic and transportation linkages. Where multiple MPOs exist in a single CMSA, coordination is required across transportation planning activities to effectively address regional needs. In some cases, multiple MPOs co-produce regional core planning documents. In other cases, regions focus on long-range planning efforts, with MPOs retaining their own short-range plans (TIPs). In the Raleigh-Durham Triangle Region, for example, two MPOs have collaborated on Metropolitan Transportation Plans since 2007 while continuing to author individual TIPs. In other cases, regions create shared planning documents that supplement plans for each MPO area. While MPOs in Southeast Florida still produce their own long-range planning documents, they also collaborate on a consolidated long-range plan to identify projects of regional significance.

Continuous Coordination

Regional coordination involves improving transportation outcomes through partnerships across existing jurisdictional boundaries. Each of the alternative approaches presented exists on a continuum of trust and cooperation. Each step builds trust and mutual understanding that form the basis for further partnership between agencies. Figure 2 illustrates this process.

Figure 2: Regional Coordination Continuum



The next section provides selected examples of ongoing or recent regional coordination efforts across the nation. As mentioned previously, many of these strategies began as Ad Hoc efforts and evolved into other types of coordination frameworks with earned trust and cooperation. Regions with no currently-set framework for coordination can begin using an Ad Hoc approach through coordination on a single project that crosses jurisdictional boundaries. With improved trust, cooperation, and proper funding, the coordination between the agencies can be transformed into a more formally-structured framework over time. Enhancing coordination between agencies can be supported by adopting practices of previous successful efforts, outlined in the FHWA's "Regional Models of Cooperation Handbook" (pp. 11-12):

- Fostering relationships between agencies at all levels, from technical staff to decision makers, that builds trust and understanding
- Working to define mutual benefits and overlapping areas of interest
- Allowing both formal and informal coordination
- Building a culture of coordination that encourages working across jurisdictional boundaries
- Making room for differences of opinion
- Ensuring that all members have opportunities to participate

Regional Transportation Coordination – Selected National Examples

I-25 PEL - Denver – Colorado Springs

https://www.codot.gov/projects/I25COSDEN

WHO IS INVOLVED:

Colorado Department of Transportation (CDOT), Denver MPO and Colorado Springs MPO.

TYPE OF COORDINATION:

Ad-Hoc

TOPICS DISCUSSED:

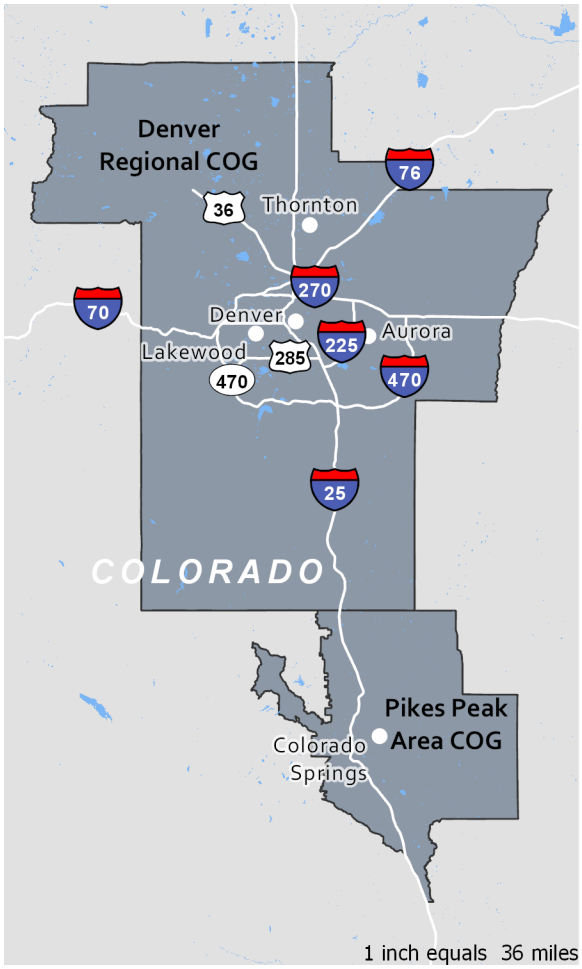
Identify, define and prioritize projects based on the corridor's greatest needs. Identify significant environmental constraints. Clarify project costs and identify necessary financing and funding options to implement improvements.

TYPE OF AGREEMENT:

CDOT initiated a planning and environmental linkages (PEL) study to identify immediate and longer-term solutions to this vital stretch of highway, which connects Colorado Springs and the Denver South area.

MAJOR SUCCESSES:

None to date. Ongoing I-25 PEL: Colorado Springs Denver South Connection.



Joint Policy Advisory Council (JPAC) in Arizona
http://www.jpacaz.org

WHO IS INVOLVED:

Maricopa Association of Governments (MAG), the Pima Association of Governments (PAG), the Central Arizona Governments (CAG) and the Sun Corridor Metropolitan Planning Organization (SCMPO).

TYPE OF COORDINATION:

Forum for Ongoing Dialog

TOPICS DISCUSSED:

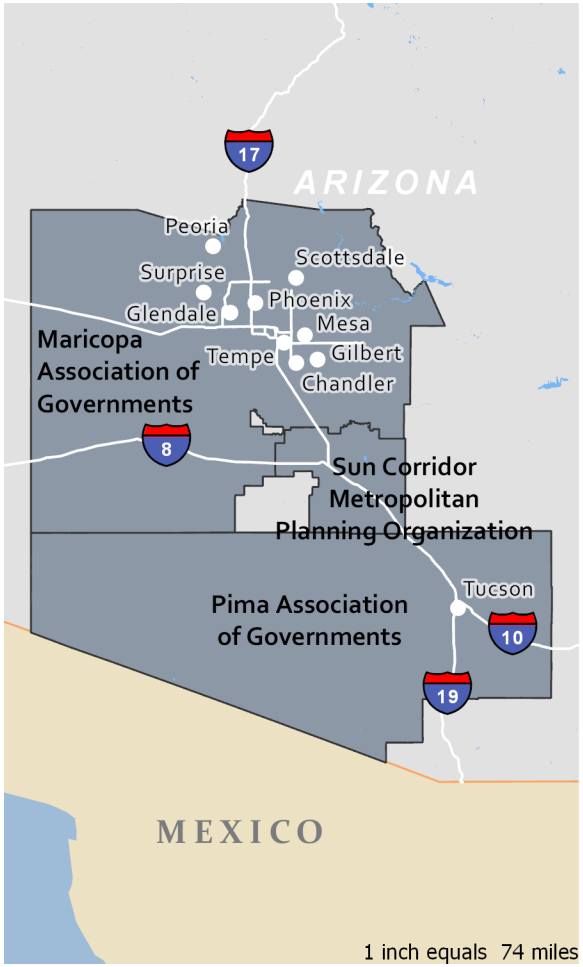
Was established to identify mutually agreed upon goals and interests, provide guidance on possible technical assistance and joint planning activities, and enhance the communication and cooperation among the policymakers in these regions.

TYPE OF AGREEMENT:

Resolution of Planning Coordination

MAJOR SUCCESSES:

The Sun Corridor Economic Development for the Global Economy (EDGE) Program and Annual Leadership Meeting



Southeast Florida Transportation Council (SEFTC)
http://seftc.org/

WHO IS INVOLVED:

MPOs from the Miami-Dade, Broward, and Palm Beach Counties

TYPE OF COORDINATION:

Ah-Hoc, Forum for Ongoing Dialog, Joint Planning Tasks, Combined Planning Documents

TOPICS DISCUSSED:

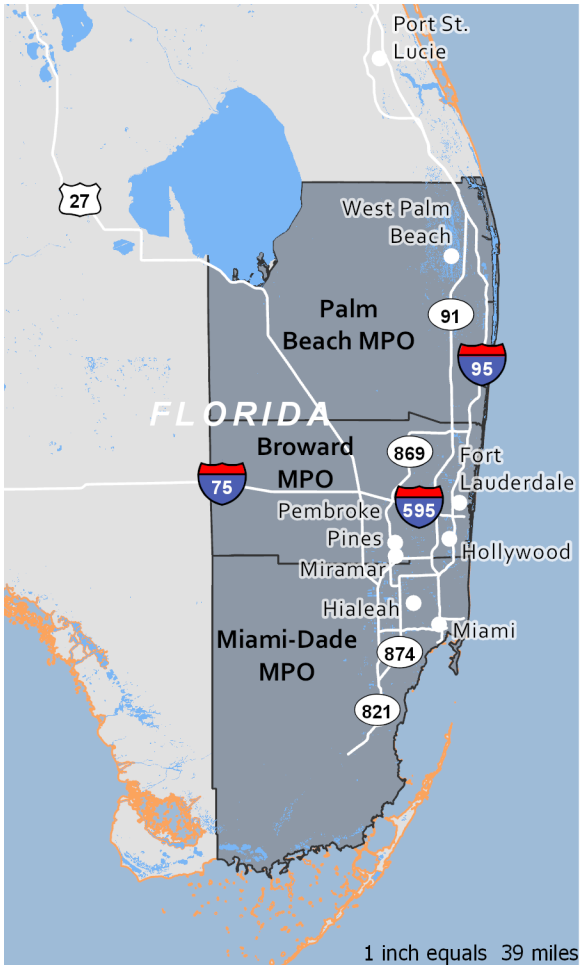
Regional long range transportation plans, regional project prioritization and selection process, regional public involvement process, performance measures to assess the effectiveness of regional coordination.

TYPE OF AGREEMENT:

An interlocal agreement between the three parties was completed in 2005 paving the way for the first SEFTC meeting in January 2006.

MAJOR SUCCESSES:

SMART Plan, Public Participation Subcommittee, Freight Participation Subcommittee, Tri-Rail Coastal Link Partnership MOU, Universal Fare Card Resolution, I-95 Express Bus



West Central Florida MPOs Chairs Coordinating Committee (CCC)

http://tbarta.com/en/chairs-coordinating-committee/about/chairs-coordinating-committee

WHO IS INVOLVED:

Hernando/Citrus MPO, Hillsborough MPO, Pasco MPO, Pinellas MPO, Polk TPO, Sarasota/Manatee MPO, FDOT District One and Eleven, Central Florida Regional Planning Council, Southwest Florida Regional Planning Council, Florida's Turnpike Enterprise, Tampa Bay Regional Planning Council and Council Board-Council Member, Tampa Bay Area Regional Transportation Authority

TYPE OF COORDINATION:

Join Planning Tasks, Combined Planning Documents

TOPICS DISCUSSED:

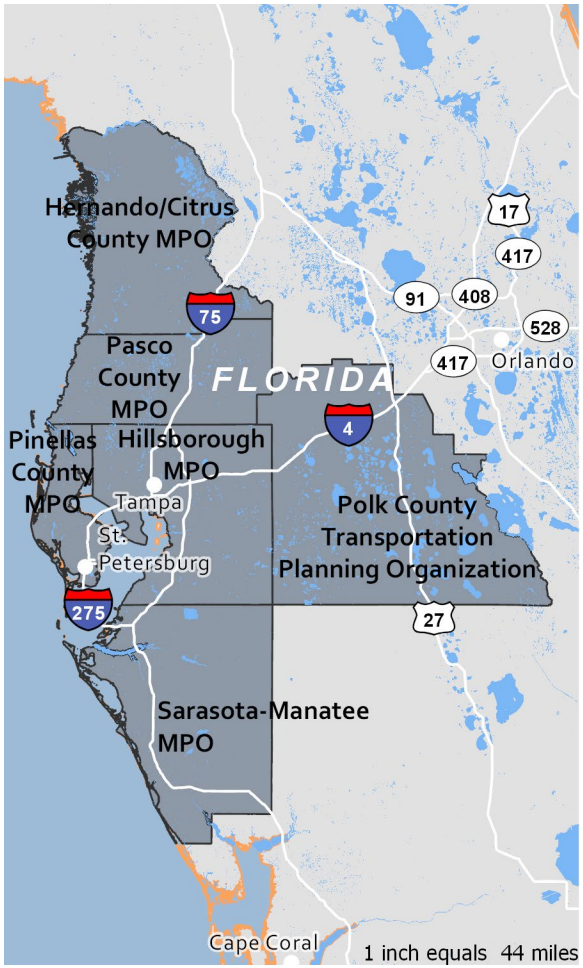
Was established to coordinate projects deemed regionally significant, review regionally significant land use decisions, review all proposed regionally significant projects affecting more than one MPO, and institute a conflict resolution process throughout the West Central Florida region.

TYPE OF AGREEMENT:

Established in 1993 by State statute

MAJOR SUCCESSES:

The Transportation Regional Incentive Program (TRIP) and West Central Florida Regional Roadway Network. Since 2010, the CCC has contracted TBARTA to provide organization and administrative services for the functions of the TBARTA MPOs CCC.



Joint Policy Advisory Committee (JPAC) in Utah

http://wfrc.org/committees/joint-policy-advisory-committee/

WHO IS INVOLVED:

Wasatch Front Regional Council (WFRC), Cache Metropolitan Planning Organization (CMPO) in Cache County, Dixie Metropolitan Planning Organization (DMPO) in Washington County, Mountainland Association of Governments (MAG) in Utah County, Utah Department of Transportation (UDOT), and Utah Transit Authority (UTA).

TYPE OF COORDINATION:

Forum for ongoing Dialog

TOPICS DISCUSSED:

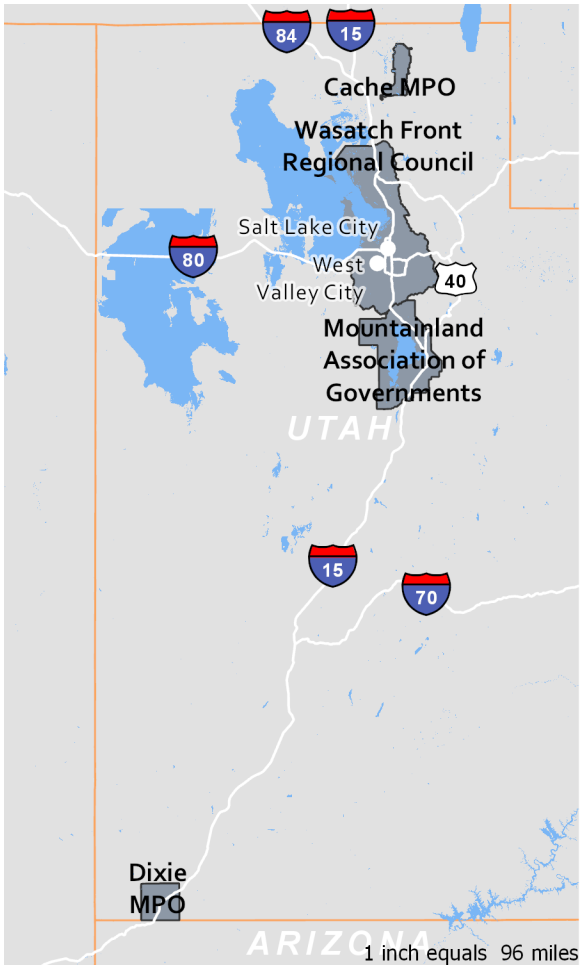
State and federal transportation legislation, roadway and transit safety, traffic management, and active transportation.

TYPE OF AGREEMENT:

Memorandum of Agreement

MAJOR SUCCESSES:

JPAC coordinates the development of the four MPO's long-range transportation plans, as well as UDOT's plans for the rural areas. This coordination leads to the development of Utah's Unified Transportation Plan.



Central Jersey Transportation Forum (CJTF)

https://www.dvrpc.org/Committees/CJTF/

WHO IS INVOLVED:

Three NJ counties: Mercer, Middlesex, Somerset. This partnership is facilitated by the Delaware Valley Regional Planning Council (DVRPC) and North Jersey Transportation Planning Authority (NJTPA) and coordinated with New Jersey Department of Transportation (NJDOT).

TYPE OF COORDINATION:

Forum for Ongoing Dialog

TOPICS DISCUSSED:

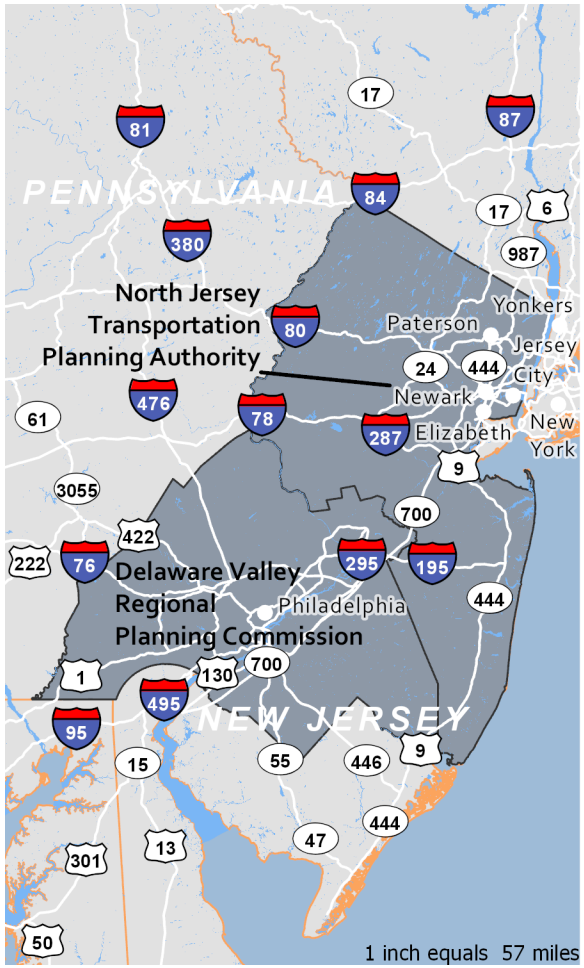
Several organizations meet to coordinate, discuss transportation and land use issues, and implement solutions. The key issues it addresses are east-west access; improving coordination of transportation and land use in this high growth, congested area; and developing a bus rapid transit project.

TYPE OF AGREEMENT:

A long-standing voluntary gathering of mayors and their representatives, county and state leaders, and representatives from major employers and non-profit organizations.

MAJOR SUCCESSES:

Smart Growth Best Practices Brochure, Advance the Route 1 Bus Rapid Transit, Annual CJTF Planned Projects Status Reports.



North Carolina Research Triangle Cooperative Long-Range Planning

http://www.campo-nc.us/transportation-plan/2045-metropolitan-transportation-plan

WHO IS INVOLVED:

NC Department of Transportation, Durham-Chapel Hill-Carrboro Metropolitan Planning Organization, Capital Area Metropolitan Planning Organization, Triangle J Council of Governments, and GoTriangle

TYPE OF COORDINATION:

Joint Planning Tasks, Combined Planning Documents

TOPICS DISCUSSED:

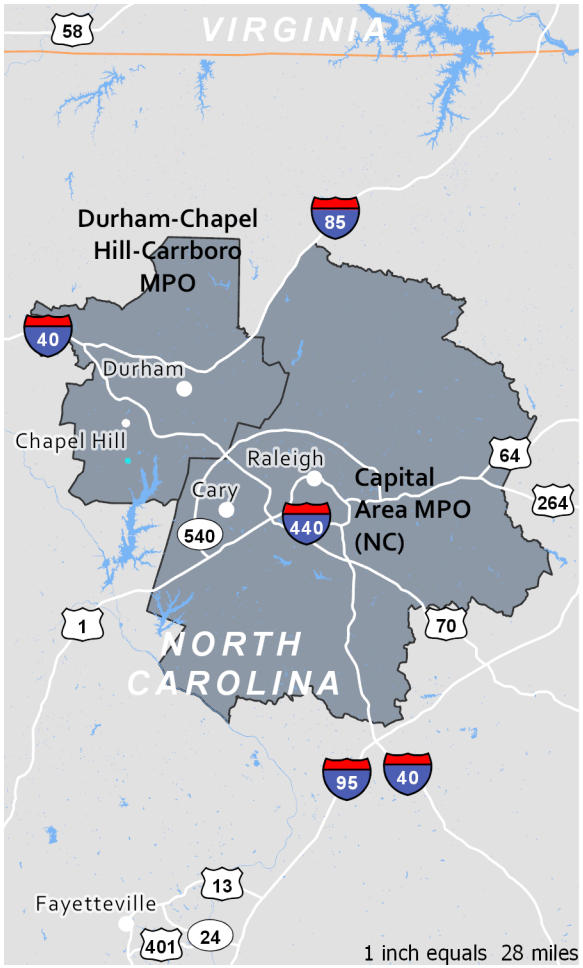
MPOs and transit providers in the Raleigh-Durham region in North Carolina have been collaborating on a series of regional planning efforts that have culminated in a 2035 Long-Range Transportation Plan and 2040 Metropolitan Transportation Plan. Other joint efforts include air quality analysis, a regional travel demand model, a freight plan, and a scenario planning exercise.

TYPE OF AGREEMENT:

Memorandum of Agreement

MAJOR SUCCESSES:

Triangle Region Freight Plan, Triangle Transportation Demand Management Program, Land Use Scenario Planning Tool (CommunityViz), Triangle Regional Model, Joint MTP



Appendix C

Stakeholder Engagement Analysis of Findings Report

Capital – Alamo Connections Study

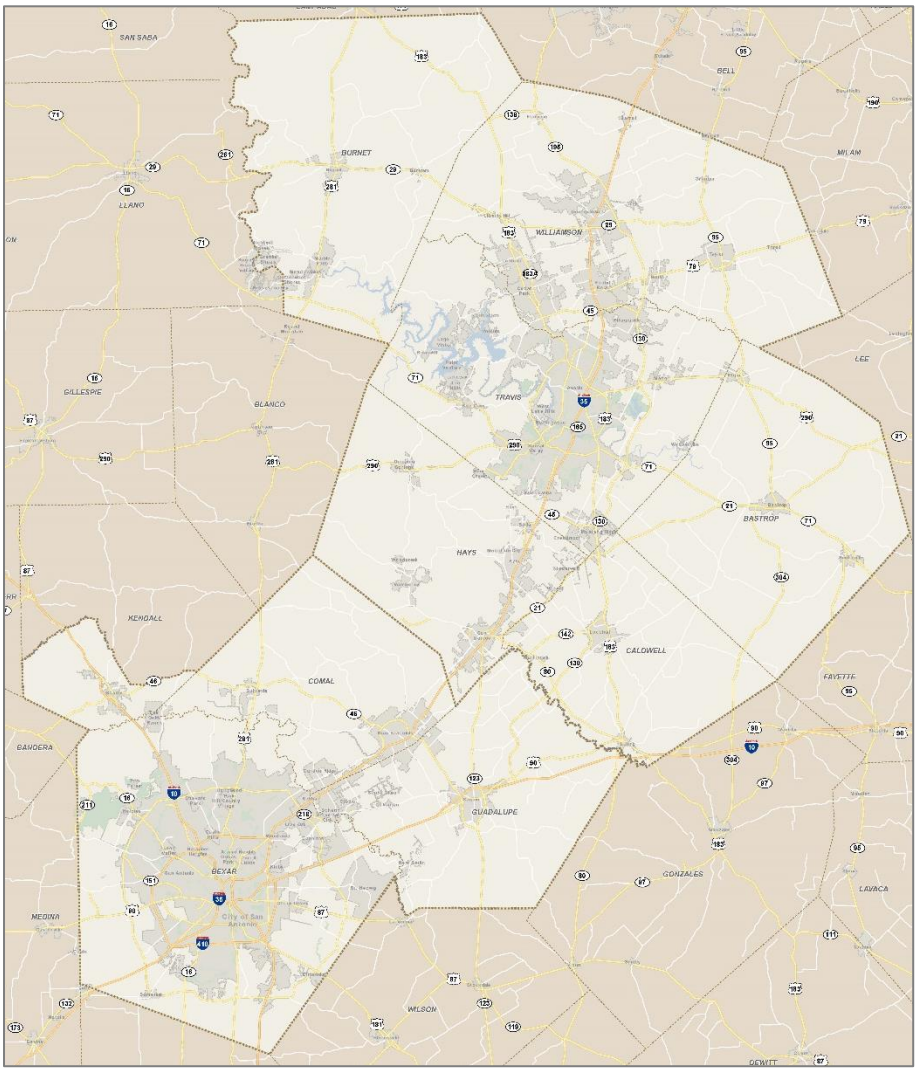
Table of Contents

1 Goals of Stakeholder Outreach

1.1 Goals

Stakeholder outreach is a key component of the Capital-Alamo Connections Study (Study). The Study team is seeking input from stakeholders in developing a regional strategy for mobility improvements within a 12-county area between the greater Austin-San Antonio regions. Stakeholders will help the team to understand needs and challenges in the Study Area; help develop potential solutions within the infrastructure, policy, and technology arenas; and provide input on the physical, financial, and political feasibility of potential recommendations. This report outlines the Study's approach to stakeholder involvement, and a summary of key findings from the outreach process. **Figure 1** below depicts the Study Area.

Figure 1. Capital Alamo-Connections Study Area



1.2 Agency Partners

The Study is a joint effort between the Texas Department of Transportation (TxDOT), the Alamo Area Metropolitan Planning Organization (AAMPO), and the Capital Area Metropolitan Planning Organization (CAMPO).

TxDOT is the central authority for overseeing roadways, aviation, rail, and public transportation in Texas. TxDOT provides overall management and funding for the Study.

AAMPO is the Metropolitan Planning Organization (MPO) for the San Antonio region, including Bexar, Comal, Guadalupe, and a portion of Kendall Counties. MPOs are regional agencies tasked with overseeing transportation planning and the allocation of federal transportation funding to areas with populations greater than 50,000.

CAMPO is the MPO for the greater Austin region, including Bastrop, Burnet, Caldwell, Hays, Travis, and Williamson Counties.

Together, the three agencies identified key stakeholders to engage in the Study.

1.3 Stakeholders

TxDOT, AAMPO and CAMPO identified a wide range of stakeholders to participate in the process and shape the final strategies identified to improve mobility in the Study area. Input was sought from all 12 counties. The effort aimed at including infrastructure, technology, and policy experts who would help the team to develop a well-rounded set of proposed mobility improvements.

Key stakeholders for the Study include:

- County officials from Bastrop, Bexar, Blanco, Burnet, Caldwell, Comal, Guadalupe, Hays, Kendall, Travis, Williamson and Wilson Counties.
- City officials from key cities within the Study Area.
- Regional Mobility Authorities (Alamo RMA, Central Texas RMA).
- Public transit providers including Capital Metro, VIA Metropolitan Transit, Capital Area Rural Transportation System (CARTS), and Alamo Regional Transit (ART).
- TxDOT Districts (Austin, San Antonio).
- Private sector entities with technical or policy expertise.

Standing MPO committees formed the core of the outreach process. AAMPO and CAMPO were guided by stakeholders from across the Austin-San Antonio region, providing direction on transportation planning, policy and funding matters. Members of these groups have considerable transportation influence, as well as existing connections to each agency. As such, they are a natural starting place for stakeholder outreach.

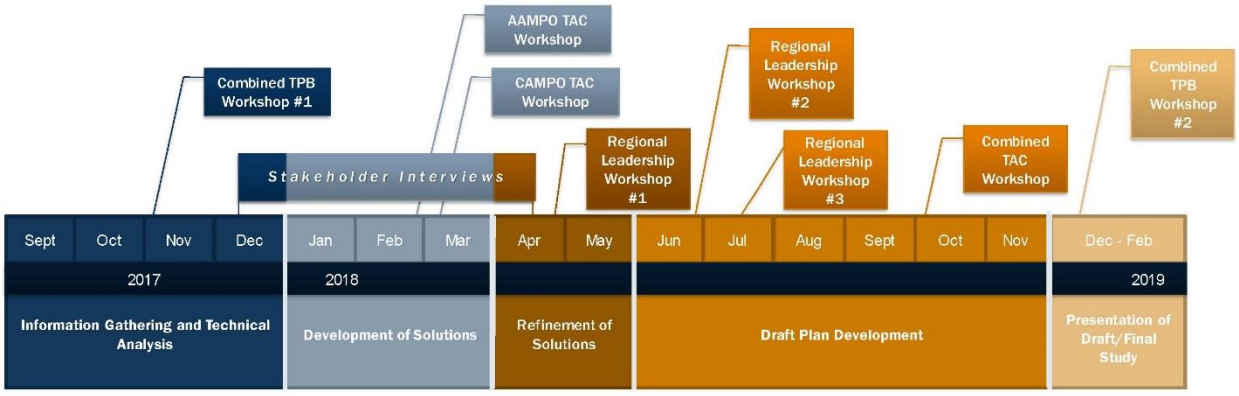
MPO Transportation Policy Boards: Both AAMPO and CAMPO are governed by their respective Transportation Policy Boards (TPBs), which are comprised of elected officials and other transportation decision makers across the regions. TPB members are key stakeholders for the Study, due to their high level of influence, knowledge on transportation issues, and existing connection to the MPOs.

MPO Technical Advisory Committees: Technical Advisory Committee (TAC) members advise the AAMPO and CAMPO Policy Boards, and include high-level technical staff from cities,

counties, transit agencies, TxDOT, and other transportation interests. TAC members bring valuable on-the-ground information on current plans, unmet needs, trends, and issues key to their organizations.

Overall, the Study team has received input from over 30 organizations within the Study Area, which provided valuable insight into the priorities and coordination efforts among stakeholders. More information is available in Sections 3 and 4, Workshops and Stakeholder Interviews respectively. A schedule showing the development of the Study with key committee and stakeholder involvement is shown in **Figure 2.**

Figure 2. *Committee and Stakeholder Outreach Schedule*



2 Involvement Strategies

The Study team utilized a variety of outreach methods to communicate with stakeholders, including online and printed materials, workshops, updates, and one-on-one stakeholder meetings.

2.1 Publications and Document Availability

2.1.1 Webpage[1]

The project has a dedicated website on txdot.gov, keyword search "Capital-Alamo Connections Study". The website includes:

- Information about the background and purpose of the Study; and
- Expected outcomes of the Study;
- Additional Study information and resources, including maps, documents, and meeting summaries.

Information on the webpage has been updated at key milestones throughout the process.

2.1.2 Print

Multiple printed documents have been distributed to members of the 30+ organizations, including:

- Data analysis summaries;

[1] https://www.txdot.gov/inside-txdot/projects/studies/statewide/capital-alamo-connections.html

- Maps; and
- PowerPoint presentations discussing Study progress and stakeholder involvement.

The project team developed large-format maps for use during one-on-one stakeholder meetings, allowing participants to geographically identifying current plans, future plans, or gaps in the transportation network. Stakeholders were provided copies of recent data analysis materials and project background for their review.

2.1.3 Targeted Updates to Key Stakeholders

Over the course of the Study, materials were developed as targeted updates for stakeholders on Study progress. These included:

- "Prezi" overview of proposed technology options; and
- Multi-page pamphlets with consolidated travel data and analysis.

2.2 Meetings

2.2.1 Technical Advisory Committees (TACs)

TxDOT provided the Executive Directors of the two MPOs, AAMPO and CAMPO, regular informal updates on the progress of the Study they could present at their TAC meetings at key milestones. Representatives from TxDOT attended and presented to the TACs throughout the process as requested and gathered feedback from the TAC members on process, approach, outcomes and project timing. The TACs served as the primary conduit for input and feedback on the Study as technical representatives of these regional planning bodies. In this way, they contributed substantially to the final product.

2.2.2 Transportation Policy Boards (TPB)

Executive Directors of the two MPOs provided an update on the progress of the Study at their TPB meetings at key milestones. The respective policy boards served in an agency partner role, guiding the process and approach and engaging in the Study to ensure it met the project objectives. During regular policy board updates, the project team received input and guidance from the TPB on how to most effectively advance the effort and support to address regional mobility challenges.

3 Workshops

3.1 Combined Transportation Policy Board – Project Initiation Workshop Summary

The Study team hosted a joint workshop for members of both AAMPO and CAMPO's TPB members. The workshop was held at the New Braunfels Civic Center on November 1, 2017. The intent of the workshop was to present an overview of the Study; receive input on transportation needs and challenges; and begin the discussion on infrastructure, policy, and technology implications within the two regions.

The former TxDOT Director of Project Planning and Development, Lauren Garduño and Corridor Planning Director at that time, Roger Beall delivered an introduction and brief presentation on Study progress to date. Mr. Beall reviewed current and forecasted growth rates and travel demand for the Austin and San Antonio regions; demographics; traffic congestion and travel times along I-35; and freight needs. Attendees were then invited to participate in exercises to solicit input on needs and challenges.

Exercise 1: Discussion on Long-Range Vision. At the beginning of the workshop, each board member was asked to fill out a survey asking the following questions:

a) What do you consider to be the main transportation problems for your region?
b) What would you like to see your region become in the next 25 years?

The Study team used Board member responses to develop word clouds unique to each region. Next, board members were encouraged to share their responses with the group, providing additional ideas and thoughts to create a joint word cloud for both regions. Top concerns identified during this exercise regarding current transportation problems included:

- Lack of transportation options (including limited mode choices – lack of transit).
- Lack of political will, which hinders project development and coordination within and between regions.
- Lack of coordination between land use and transportation.
- Congestion and delay along Interstate-35 (I-35).
- Lack of funding and need for improved/alternative funding strategies.

When discussing goals for the future, top priorities included:

- Increasing multimodal transportation options.
- Improving freight management.
- Integrating new technologies.
- Maximizing use of existing transportation resources/right-of-way.
- Considering environmental implications of future development/transportation options.

Exercise 2: Discussion on Regional Needs and Challenges. Next, the group moved to a round-table discussion about the needs and challenges facing each region in terms of infrastructure, policy and technology. After each table completed discussion on the three main themes, facilitators reported out the highlights of the discussion, including:

- **Infrastructure:** Board members focused on maximizing utilization of existing facilities and discussed the lack of east-west connectivity in the region. They recommended separating freight from passenger travel and recognized that innovative technologies could help to optimize construction, operation, maintenance, and infrastructure management. Multimodal transportation options, such as accessible and convenient transit services, were also goal areas for many board members.
- **Policy:** Discussion centered on policy needs and challenges which encouraged development of multimodal options (shifting away from private automobile use), as well as policies which allowed for additional/more flexible funding streams. Board members recognized the need for coordinated land use and transportation planning at a regional level, and they emphasized the importance of early right-of-way acquisition by appropriate agencies along major facilities for future improvements. They noted the difficulty of long-term transportation planning when state and federal transportation policies and priorities frequently change (e.g. tolling).
- **Technology:** Board members discussed their excitement about new technologies and other innovations in the transportation field; however, they cautioned against expecting technology to solve a majority of the region's mobility challenges. Many attendees felt they were not fully informed on technologies under development and stressed the need for case studies and "lessons learned" from implementation in other regions. The team noted that technology companies are part of the Study's stakeholder outreach process.

Following closing remarks, Lauren Garduño mentioned future workshops and regular opportunities for board members to stay engaged and provide input, including contact information for each MPO and TxDOT.

3.2 Technical Advisory Committee (TAC) Workshops

In late February/early March 2018, the Study team hosted workshops for members of AAMPO and CAMPO's Technical Advisory Committees. The workshops were held separately but contained the same content and activities. Project team members were then able to assess similarities and differences between the input received from the groups.

Regarding technology, both TACs generally placed higher importance on Integrated Corridor Management (ICM) and Transit-related solutions, less importance on technologies emerging from the private sector and had differing views on automated and connected vehicle innovations. The AAMPO TAC showed more interest in infrastructure for connected vehicles, while the CAMPO TAC showed greater interest in autonomous modes.

Related more specifically to infrastructure, both groups identified better connectivity between the I-35 and I-10 Corridors that could allow through-freight to travel away from congested urban areas. While this was a common theme, AAMPO TAC members focused on SH 46 (north) and Loop 1604 (south) as ways to get around San Antonio, while CAMPO TAC members addressed US 183 as a possible connector to get around Austin. Similarly, both groups identified a need for long-distance transit using dedicated lanes, including managed lanes on

I-35. In this case, AAMPO TAC discussed using buses and Park-and-Rides for serving the entire corridor between Austin and San Antonio, while CAMPO TAC discussed identifying bus and rail solutions making intercity connections within their region. Both groups also identified a need for better connectivity to SH 130 via New Braunfels and San Marcos.

In the realm of policy, both groups expressed value in formalizing regional thoroughfare planning and corridor preservation, improving regional coordination and broader authority for land use regulation and planning, and discouraged limiting funding sources to specific modes, supporting the establishment of a State policy on tolling. More detail on individual outcomes can be found in the workshop summaries below.

3.2.1 AAMPO Technical Advisory Committee – Workshop Summary

The AAMPO TAC workshop was held on February 23, 2018, at the TxDOT San Antonio District Office (the TAC's regular meeting space). Following introductions, TAC Chair Jonathan Bean and Roger Beall provided opening remarks. Project team members delivered an overview of stakeholder outreach to date and emphasized the need for a broad, high-level perspective during the discussion portion. They also discussed data on regional travel movements gleaned from StreetLight data sources[2], which revealed a large proportion of short passenger trips along I-35 (freight vehicles make longer trips).

Exercise 1: Technology Preference. TAC members were asked to rank their preferences for existing or emerging technologies based on their appropriateness for the Study Area. Team members directed the TAC to a large sheet showing a description of each technology option and an initial ranking of the option's potential for capacity enhancements, availability for implementation, difficulty of permitting or construction, compatibility with other technologies, and financial feasibility. Attendees were each given an equal amount of dot stickers to place on the technologies they preferred. Results from the exercise (**Table 1**) show a strong preference for ICM as well as mass transit improvements, including implementing commuter rail. Emerging technologies such as hyperloop or delivery drones generated less interest. Final tallies are shown below.

[2] https://www.streetlightdata.com/?streetlightdata_com

Table 1. *Results from Exercise 1 at AAMPO TAC Workshop*

Technology	Votes
ICM	21
Commuter Rail	15
Improve Transit	16
Intercity Bus	10
Shared-Use Modes	9
CV Infrastructure	8
Truck Platooning	4
High Speed Rail	3
AV Infrastructure	2
Freight Shuttle	2
Driverless Shuttles	1
Delivery Drones	1
Hyperloop	0

Exercise 2: Infrastructure Micro-Charrette. Project team members rolled out large-format maps showing the entire Study region. TAC members broke into two groups to discuss existing and planned projects in both the AAMPO and CAMPO regions and identified additional opportunities to improve mobility between the two urbanized areas. The attendees were provided with markers and sticky notes to add their ideas to the maps.

Key ideas from the discussion included:

- The possibility of managed lanes (perhaps including automated/connected vehicles and/or freight prioritization) along I-35.
- A truck bypass connecting I-10 on both sides of San Antonio, possibly via SH 46.
- New or expanded high-capacity corridors along I-35 and US 281, possibly with a long-distance transit focus including Park-and-Ride and intermodal stations.
- Expanded transportation options between I-35 and I-10 and between LP 1604 and SH 46.
- Improved connectivity between the I-10/SH 123/SH 130 corridors east of San Antonio
- Regarding the CAMPO region, TAC members suggested a possible loop facility west of Austin and high-capacity transit corridors along MoPac. They also emphasized improving connectivity between Austin and San Antonio using the US 281 and US 290 corridors.

Exercise 3: Circles and Soup (Policy Considerations). After a short break, TAC members moved on to discuss policy needs in the Study Area, and the level of involvement the MPO organizations have in addressing those needs. TAC members wrote suggested policy changes on sticky notes and placed them in one of three categories below – policies over which the region's MPO and member organizations have control; policies which the region can influence; and policies which are outside of the region's field of action.

Policies which the region can help move forward:

- Implementing campaigns to improve the transportation knowledge of local decision makers and citizens.
- Increasing regional cooperation.
- Fully utilizing impact fees and other funding sources.
- Updating local thoroughfare plans to meet regional needs.
- Considering alternative routes to congested roadways.

Policies which the region can influence but does not directly control:

- Encouraging the implementation of mobility projects with user-based fees (including regional toll policy).
- Modifying existing land use and development regulations to support regional connectivity.
- Partnering with appropriate entities for funding and construction of grade-separated rail crossings

Policies which are outside of the region's field of action:

- Federal funding policies.
- Reducing/streamlining environmental regulations for transportation projects.
- Increasing fuel taxes or finding alternatives to fuel taxes (e.g. VMT tax).
- Legislation allowing flexibility in funding allocations for transportation modes.
- Legislation to better address land use planning and zoning issues.

After a brief update on stakeholder interviews held to date, Roger Beall closed the workshop by providing a draft schedule of upcoming activities.

3.2.2 CAMPO Technical Advisory Committee – Workshop Summary

The CAMPO TAC workshop was held on March 5, 2018 at the CTRMA Board Room (the TAC's regular meeting space). Following introductions, TAC Chair Ed Polasek and Roger Beall provided opening remarks. Project team members delivered the same overview of stakeholder outreach to date, regional travel movements, and need for high-level perspectives as was provided for the AAMPO workshop.

Exercise 1: Technology Preference. TAC members were presented with the overview of technology options and asked to select their preferences with dot stickers. Attendees were each given an equal amount of dot stickers to place on the technologies they selected. Results were similar to the AAMPO workshop (**Table 2**); participants showed a strong preference for ICM and mass transit improvements, including commuter rail. Final tallies are shown below.

Table 2. *Results from Exercise 1 at CAMPO TAC Workshop*

Technology	Votes
ICM	16
Commuter Rail	18
Improve Transit	17
Intercity Bus	12
Shared-Use Modes	9
CV Infrastructure	3
AV Infrastructure	9
Driverless Shuttles	10
Truck Platooning	6
Freight Shuttle	6
High Speed Rail	3
Delivery Drones	0
Hyperloop	0

Exercise 2: Infrastructure Micro-Charrette. Using large-format maps of both the AAMPO and CAMPO regions, TAC members formed into two groups to discuss existing and planned projects in both regions and identified additional opportunities to improve mobility.

Key ideas from the discussion included:

- Amtrak or other commuter rail service along the existing Union Pacific corridor.
- Opportunities for intercity bus service.
- New commuter rail service along existing rail alignments, such as connections between Austin and Elgin, Taylor, and Marble Falls.
- Other high-capacity transit routes.
- Managed lanes along I-35 for express/autonomous buses.
- Opportunities for new controlled-access roadway facilities.
- Expansion and/or extensions of existing facilities.
- Improvements and new alignments within the San Marcos area and connecting to cities to the north, including a bypass to the west of I-35.
- For the AAMPO region, suggestions included new corridors between I-10 and I-35 (including a bypass around Luling) and a truck relief route for I-10 around San Antonio, possibly following SH 46.

Exercise 3: Circles and Soup (Policy Considerations). TAC members then moved on to the discussion of policy needs in the Study Area, and the level of involvement the MPO organizations can have in addressing those needs. Comments included:

Policies which the region can help move forward:

- Improving land use regulations to support transit use, such as reducing parking requirements, increasing densities, and improving subdivision regulations to encourage connectivity.
- Finding alternative funding strategies for transportation improvements.
- Implementing transportation demand management policies, programs and projects.
- Increasing emphasis on corridor preservation.

Policies which the region can influence but does not directly control:

- Providing regional support for Amtrak efforts to expand service, and managed lanes on I-35.
- Developing a policy framework for emerging technologies.
- Granting counties increased land use regulation authority.
- Corridor preservation between adjacent jurisdictions.
- Increasing funding flexibility to support multimodal transportation improvements.

Policies which are outside of the region's field of action:

- Legislation allowing flexibility in funding allocations for transportation modes.
- State policy on tolling.
- Reducing/streamlining environmental or regulations for transportation projects.
- Regional land use planning authority.

After a brief update on stakeholder interviews held to date, Roger Beall closed the workshop by providing a draft schedule of upcoming activities.

3.3 Regional Leadership Workshops

3.3.1 Workshop #1 Summary

The project team held a Regional Leadership Workshop on April 30, 2018, at the New Braunfels Civic Center. The workshop brought together TxDOT, AAMPO, and CAMPO leaders (including the chairs of both TPBs) to discuss next steps in the Study process. TxDOT and the consultant team presented an overview of progress to date, including stakeholder outreach, data collection and findings, and the input collected from the TAC workshops held in February and March of 2018. Workshop attendees were encouraged to discuss the process to date, and provide input on potential infrastructure, policy, and technology recommendations.

Group discussion focused on several key topics which informed the development of final project recommendations, particularly those which have served as political "hot-button" issues within recent years. Workshop attendees provided their thoughts on:

- Tolling (along with other potential uses of managed lanes).
- Rail or other high-capacity transportation between the Austin and San Antonio regions.
- Land use policy.
- Next steps on developing and presenting the plan to the Texas Transportation Commission (TTC).

The project team agreed to develop and flesh out key aspects of the plan for further review with the leadership group and TTC Chairman, then revisit the findings with TAC members in a joint meeting in summer 2018.

3.3.2 Workshop #2 Summary

The project team held the second Regional Leadership Workshop on June 29, 2018 at the New Braunfels Civic Center. As with the prior workshop, this workshop brought together project agency stakeholders including TxDOT, AAMPO, and CAMPO leaders (including the chairs of both TPBs) to discuss next steps in the Study process. TxDOT and the consultant team presented on progress to date which included a review of the study presentation, strategy groups and details, draft report, and next steps for returning to the CAMPO and AAMPO TACs and TPBs.

Group discussion was focused on the recommendations that were included in the draft report and the prioritization of these recommendations. Workshop attendees provided their thoughts on:

- Ensuring the presentation and draft report provide the background, data and process to give context to the recommendation and frame the study correctly.
- Identify what strategies are already in the MPO plans vs. new ideas in the list of strategies.
- Taking a broader look with the arterial strategies to indicate general corridors that would be beneficial since both MPOs are currently working on arterial plans.
- Simplifying the descriptions of the strategy details and renaming them tactics.
- Next steps on presenting the plan to the TTC Chairman.

3.3.3 Workshop #3 Summary

The project team completed the Regional Leadership Workshop series with a third and final discussion on July 30, 2018 at the New Braunfels Civic Center. To ensure consistency, the workshop included the same stakeholders that had been invited to the prior two workshops, TxDOT, AAMPO, and CAMPO leadership, including both chairs of the TPBs. The objectives for this last event were to:

- provide a summary of the changes made as requested in the prior Leadership Workshop
- highlight the key messages for the presentation to the TTC Chairman
- layout a high-level schedule, approach and key messages to advance the project through the respective TAC and TPBs.

3.4 Combined Technical Advisory Committee – Workshop Summary

The project team held a joint TAC workshop on October 2, 2018 at the San Marcos Activity Center. The meeting was held from 10am to 12pm at a location in between Austin and San Antonio to encourage attendance. The Executive Directors of the respective MPOs kicked off the workshop with an overview of the workshop objectives setting the tone for collaboration at the technical level. The meeting was well attended by representatives of both TACs. TAC

attendees chose their seating on a first come, first served basis according to their topic of interest. The consultant team then facilitated a discussion of each strategy and its associated timing. The attendees were actively engaged in discussing and debating each topic and associated strategy. They brought their knowledge and expertise to the table discussions with specific thoughts and ideas that were incorporated into the recommendations. The recommendations from this workshop were then presented to the TPB Workshop on December 5, 2018 for input and further refinement. The approach was well received by the attendees and demonstrated the value of regular coordination between our communities.

3.5 Combined Transportation Policy Board – Project Conclusion Workshop Summary

The project team held a second Joint Transportation Policy Board meeting on December 5, 2018, at the New Braunfels Civic Center to conclude the Study and gather final thoughts from the respective policy boards. The workshop brought together TxDOT, AAMPO, and CAMPO leaders to discuss next steps in the Study process. TxDOT and the consultant team presented an overview of progress to date, including stakeholder outreach, data collection and findings, and the input collected from the TAC workshops held in April and October 2018. The workshop summarized the key findings and strategies of the draft Study. Workshop participants were asked to provide input on draft infrastructure, policy, and technology strategies and the prioritization of these strategies by participating in one of four smaller workshop group discussions.

The strategies were organized into five main topic areas (**Table 3**) under the Technology, Policy and Infrastructure focus areas. Each topic included a series of short-, mid-, and long-term strategies that were developed in a way that is consistent with transportation plans from each MPO and local jurisdictions within the Study Area. Input on the development of these strategies also came from the prior workshops with TPB and TAC, as well as feedback from the stakeholder interviews discussed in Section 4.

A total of 60 short-, mid-, and long-term strategies were divided into the five topic areas in **Table 3.** Each of the four groups focused on strategies under a single topic area at a time, then were asked to use dot stickers to illustrate how they would prioritize short-term, followed by mid-term, then long-term strategies related to each topic. In the end, tallies of priorities under each topic area were combined across all four groups.

Table 3. *Definitions of Strategy Topic Areas and Outcomes from Workshop #7*

Strategy Topic Areas	Definitions and Outcomes
Regional Coordination	*Strategies that promote the efficient use of local resources, creating consistent transportation solutions, and maximizing the strengths of existing agencies.* • Building a bi-regional travel demand model and aligning objectives and performance measures for bi-regional mobility and connectivity is a priority. • Some concern over being able to accomplish those in the short-term. • General consensus to formalize bi-regional coordination of planning and policy development.
ITS & ICM	*Strategies that provide guidance on making more efficient use of current transportation infrastructure to make travel more reliable through coordinated, multijurisdictional operations that are adaptable to emerging technologies.* • Short-term priority to understand all the systems that are in place and how they are related before starting to integrate systems. • Establish clear procedures for how corridor management is coordinated across both regions.
Modal Options	*Strategies that focus on advancing alternative travel modes for local and interregional mobility of people and freight.* • Generally, projects that support deployment of interregional transit services were prioritized over ways to improve the movement of freight. • Consensus over the need for more regular regional intercity transit services.
Priority Corridors	*Strategies that focus on improving local and interregional travel safety and mobility along I-35 and US 281.* • Main priority in the short-term is to address local congestion and safety along I-35 and US 281. • Agreement that in the long-term there will be a need to increase capacity in these corridors. • Less consensus that these strategies should come before those under other topic areas.
Arterials	*Strategies that focus on advancing alternatives to I-35 for local movement and routing within the corridor, especially in the event of an incident on I-35.* • General support for an interregional relief arterial network and coordinating between localities to accomplish this. • Less consensus that these strategies should come before those under other topic areas.

4 Stakeholder Interviews

4.1 Process Overview

Stakeholder interviews for the Study were conducted by the consultant team and TxDOT. Stakeholder Interviews have been conversations with key transportation influencers and decision makers: city managers, commissioners, traffic engineering managers, transportation board members, transit agencies, key peer entities, and technology companies. The purpose is to get their perspective on the primary challenges and opportunities in the Study's three areas of focus, infrastructure, policy, and technology.

The desired outcomes of Stakeholder Interviews were as follows:

- To get an understanding of their primary concerns within the Study Area.
- Obtain feedback on where they might see some opportunity to make meaningful change in the short, mid-term, and long-term timeframes.
- Get specific feedback on how they think infrastructure can be addressed within the Study Area.
- Get a sense of various policy changes or positions that they think could address transportation challenges within the Study Area.
- Understand how they see emerging technology as a solution for transportation in the Study Area.
- Continue to build relationships with stakeholders to ensure they understand TxDOT and the MPOs are listening to their input.

A list of potential stakeholders was developed and remained a working document based on interviews that could be booked given the Study's time-frame. AAMPO preferred to work through the TAC on the front end of the Study and focus stakeholder interviews on those individuals with knowledge and understanding at the project and policy making level at the DOT, MPOs, and cities, and counties. Additional interviews were added as requested by TxDOT or an interviewee, particularly when information could aid with technical analysis for the Study. A complete listing of the stakeholders interviewed for this Study can be found in **Appendix A.**

4.2 Stakeholder Interview Summary

Notes were taken at each meeting and each comment or theme recorded. Comments were then compiled into a database and categorized using the following key in **Table 4.**

Table 4. *Definition of Focus Areas and Solution Types*

Focus Areas	Definition
Infrastructure	Focus of comment was to build a specific project.
Policy	Focus of comment was to change a policy or procedure, or an approach that should be adopted.
Technology	Focus was to use new software or hardware to provide transportation solutions.
Solution Types	**Definition**
Affordability	Comment focused on the cost of living related to longer commutes.
Economic Development	Comment focused on land use, growth, jobs, housing, and the impact of transportation investments on the economy.
Environmental	Comment focused on limiting growth through preservation of green space.
Freight	Comment focused on truck or freight rail operations.
Funding/Return on Investment	Comment focused on funding for transportation solutions.
Government's Role	Comment focused on governance and jurisdictional limitations.
Growth	Comment focused generally on growth of population, housing, employment and travel demand.
Highway/Freeway	Comment centered around a TxDOT facility or specific policy that impacts highways.
Local Arterial	Comment focused on increasing arterial road connections.
Local Transit	Comment focused on new or existing metropolitan bus, rail, vanpool, or micro-transit service.
Regional Transit	Comment focused on new or existing regional bus, rail, vanpool, or micro-transit service.
Public Engagement	Comment focused on public dialogue and stakeholder involvement.
Regional Cooperation & Coordination	Comment centered around a TxDOT facility or specific policy that impacts highways.
Safety	Comment related to crashes or design concerns.
Technology	Comment focused on real-time data, fiber optic network across counties, timed lights, etc.
Summaries	**Definition**
Simple summary statement of comment; solution geared.	

While this compilation of stakeholder comments may not provide a scientific analysis, it does reflect input from decision makers within the region, including public officials and industry experts. This information provides a general outlook for how people in leadership positions are thinking of transportation issues in terms of their impacts and identifies what they are thinking in terms of potential solutions to those issues. It also provides the project team with a sense of what might be politically feasible among the potential solutions identified through the technical analysis. In total, 560 comments were recorded and logged.

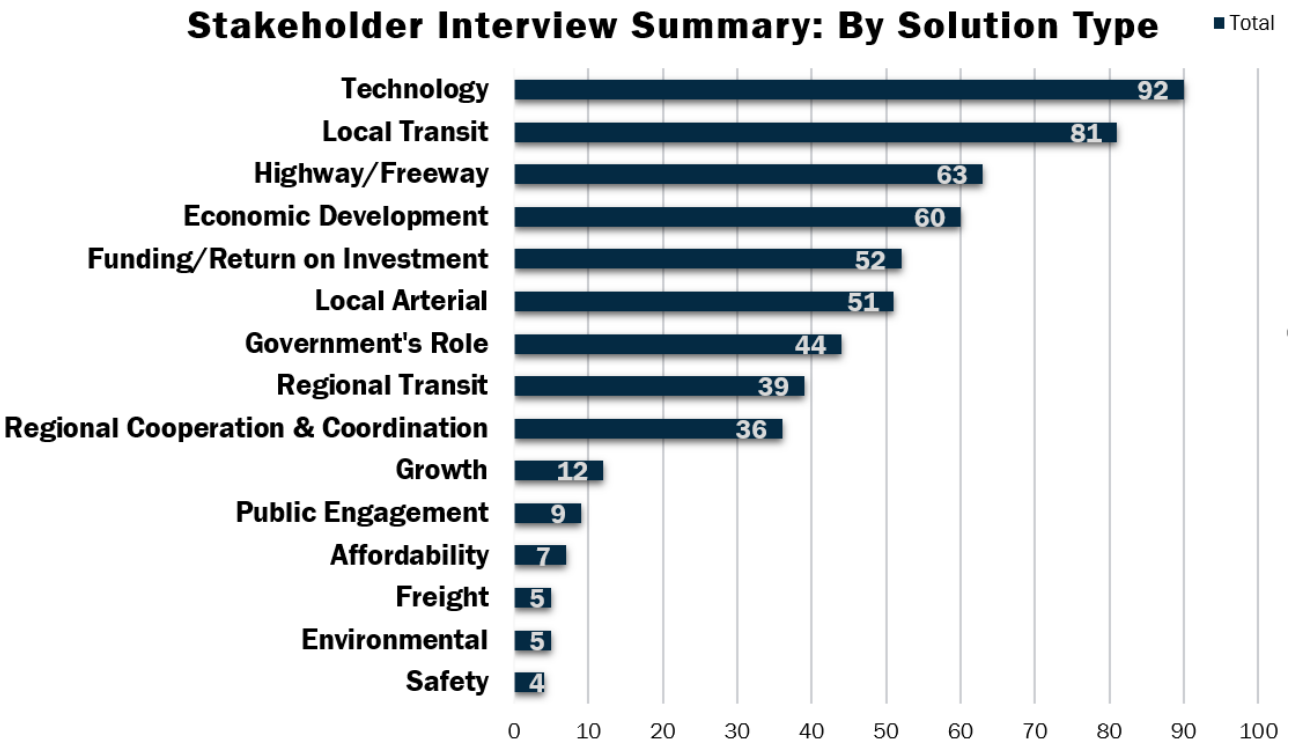
The graph in **Figure 3** indicates that popular topics among many stakeholders included Technology and Local Transit solutions as ways to either manage increasing congestion or address apparent choke points in the transportation network. Technology is a broad solution type covering everything from ITS improvements along major roadways linked to real-time data management, to making the roadway infrastructure compatible with emerging technologies such as autonomous and connected vehicles. This also covered accommodations for a variety of shared mobility options like ride-hailing services or car sharing, as well as telecommuting and general ICM solutions.

Local transit comments primarily addressed general improvements to bus service, dedication of right-of-way for increased transit reliability, coordination of mass transit investment and land use planning, and the use of Park-and-Rides along highways with transit connections to major employment centers. Where local transit comments primarily addressed improving the quality and reliability of transit connectivity in metropolitan areas facilitated by VIA and Capital Metro, regional transit comments covered longer-distance multi-jurisdictional trips, and connections between rural and urban areas that may be provided by CARTS, ART, or a new service provider/service agreement. Bus and rail modes were discussed as potential transit solutions, though each project would have to be studied further to determine the appropriate mode for delivering the service.

Other common topics of discussion included improvements to the highway network and solutions that were directly supportive of economic development. These were particularly common among stakeholders from rural and suburban communities. Highway network solutions ranged from adding capacity and preservation of right-of-way, to making entirely new connections within the network. Economic development comments identified direct impacts of congestion on the economy, and offered suggestions for improving connections between markets, changing specific land development policy and generating public revenue through value capture.

Other major topics of discussion addressed a variety of funding ideas and sources as well as improving local arterial networks. Stakeholders were generally supportive of trying to use all the funding tools available with the understanding that existing sources are limited while demand for greater investment is high. Comments related to improving capacity and connectivity within the local arterial network generally identified an opportunity to create redundancy in the overall transportation network and covered several specific roadway improvements within a stakeholder's respective jurisdiction.

Figure 3. *Topics of Solution Type among Interviewed Stakeholders*



Regional cooperation was a general topic of discussion among many stakeholders. This did not necessarily focus on one particular entity failing to cooperate with another, but instead acknowledged opportunities for several entities to improve how they communicate, share information and deliver projects. While some solution types such as growth, freight and safety among others did not appear to be as widely discussed, it is true that most of the 560 comments could be categorized under a number of solution types. It is not that these topics were less important, rather, they may be addressed by making systematic changes suggested as part of other solutions covered in the stakeholder discussions.

The findings from this stakeholder involvement provide several ideas from transportation officials and other key decision makers within the Study Area. This is meant to provide support and reference for the technical analysis as well as identify opportunities for follow-up on further information once preliminary recommendations are made. Findings from this engagement effort were shared at the Joint AAMPO/CAMPO TAC Workshop in October 2018 as well as the follow-up Policy Board Briefings.

Appendix A: Completed Stakeholder Interviews

MTG #	DATE	NAME	TITLE	ENTITY
1	Dec. 20, 2017	Gary Hudder	Transportation Director	City of Round Rock
2	Jan. 3, 2018	Gerald Daugherty	Precinct Three Commissioner	Travis County
3	Jan. 4, 2018	Morgan Cotton Steve Manilla Charlie Watts Cathy Stephens Scheleen Walker	Director, Public Works County Executive Travis County Transportation and Natural Resources (TNR), Senior Planner Travis County Transportation and Natural Resources, Senior Planner Long Range Planning Manager	Travis County
4	Jan. 17, 2018	Dale Ross	Mayor	City of Georgetown
5	Jan. 23, 2018	Jacque Thomas Edward Theriot Ken Schawe	County Engineer County Commissioner County Judge	Caldwell County
6	Jan. 24, 2018	Wade Cooper	Chair, Board Member	Capital Metro
7	Jan. 29, 2018	Jeff Travillion	Precinct One Commissioner	Travis County
8	Jan. 29, 2018	Mike Heiligenstein	Executive Director	Central Texas Regional Mobility Authority
9	Jan. 30, 2018	Clara Beckett	County Commissioner	Bastrop County
10	Jan. 30, 2018	Victor Gonzales	Mayor	City of Pflugerville
11	Feb. 7, 2018	John Thomaides Jamie Lee Case	Mayor City Clerk	City of San Marcos
12	Feb. 9, 2018	Clay Smith Brian Buchanan	ATD Director Senior Vice President of Development	VIA Metropolitan Transit

MTG #	DATE	NAME	TITLE	ENTITY
13	Feb. 13, 2018	Todd Hemingson	Executive Vice President Planning & Development at Capital Metro	Capital Metro (CAPMETRO)
14	Feb. 16, 2018	Sarah Eckhardt	County Judge	Travis County
15	Feb. 23, 2018	Steve Adler	Mayor	City of Austin
16	Feb. 28, 2018	Brigid Shea	Precinct 2 Commissioner	Travis County
17	March 2, 2018	Mike Frisbie	City Engineer/Director	City of San Antonio
18	March 5, 2018	Brendon Harrington	Director of Transportation	Google
19	March 8, 2018	Dave Marsh	General Manager	Capital Area Rural Transportation System (CARTS)
20	March 9, 2018	Tom Nuckols	County/District Attorney Div Dir	Travis County
21	March 21, 2018	Diane Rath Sean Scott Ernest Reich Stella Garcia	Executive Director Alamo, Regional Transit Director Constable Pct. 2	Alamo Regional Transit, Alamo Area Council of Governments (ART/AACOG)
22	March 21, 2018	John-Michael Cortez	Assistant to the Mayor. Transportation, CodeNEXT & Affordable Housing	City of Austin
23	April 5, 2018	Jason JonMichael	Director Transportation Department Assistant Director - Smart Mobility at City of Austin	City of Austin
24	April 24, 2018	John Esparza	President & CEO	Texas Trucking Association
25	April 25, 2018	Josh Johnson Steve Dellenback	Director Vice President R&D	Southwest Research Institute
26	April 26, 2018	Zack Bujnoch	Enterprise Sales	Chariot

*The AAMPO TAC, as per direction from the AAMPO Transportation Policy Board, served as the primary contact for the San Antonio region.

Appendix D

Origins, Destination and Travel Patterns

Capital – Alamo Connections Study

MEMO

1/19/2018

To: Roger Beall
TxDOT, Transportation Planning & Programming (TPP) Division

Through: Susan Chavez
TxDOT, TPP Division

From: Michael Sexton
Jacobs Engineering Group Inc.

Subject: Capital-Alamo Connections Study: Origins, Destination and Travel Patterns

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The Capital-Alamo Connections Study (CACS) spans a region of 12 counties covering the entire Capital Area MPO (CAMPO) and Alamo Area MPO (AAMPO). Rapid growth in the region is evident and congestion on major north-south connections such as I-35, US 281, and SH 130 is expected to increase if no improvements are made. There is a need to better understand travel patterns in the region and identify the main origins and destinations of travelers using these corridors. This memo summarizes the Origin-Destination (OD) analysis completed for the study area using two sources of data, Bluetooth® data and StreetLight® data.

Bluetooth Data Analysis

Through a collaboration between TxDOT and Texas A&M Texas Transportation Institute (TTI), several Bluetooth readers had been installed along I-35 extending from Loop 1604 north of San Antonio to SH 195 north of Georgetown. Whenever a vehicle passes by a Bluetooth reader, its unique anonymous identification code is captured. The resulting data is generated in the form of an OD matrix showing the number of vehicles captured between every pair of Bluetooth readers along the corridor. Evidently, the same vehicle traveling between several readers will be counted several times and special data manipulation is performed to eliminate any double counting. For this study, the readers were then aggregated based on the urban area they are in. The result is an OD matrix with the percentage of trips observed between every pair of urban areas highlighting those with the highest number of trips traveling between them. **Figure 1** presents the results of the OD magnitudes obtained using Bluetooth® data.

General Observations

The resulting data shows a very low percentage of through trips (less than 1%) between North San Antonio and North Georgetown. Moreover, the highest percentages of trips were observed between closely-spaced urban areas along I-35. This may indicate that most trips along I-35 are short-distance and/or local trips within the communities and only a few are traveling along the entire length of the corridor.

Limitations of the Bluetooth® Data

Several limitations were identified related to the Bluetooth data including:

- The data does not differentiate between northbound and southbound movements along the corridor.
- The data does not differentiate between different types of vehicles (trucks versus personal vehicles).
- The reader placement stopped north of San Antonio at the time of this study and therefore did not cover the entire study area. No OD analysis could be performed *within* the San Antonio urban area either.
- Readers were placed on one side of the Interstate with most readers closer to the northbound direction and only a few on the southbound side. This indicates potential bias for one direction of travel.
- Due to the dependence of the reader on the Bluetooth signal in the vehicle, situations where the signal in the vehicle is blocked (for example if a truck happens to be driving parallel to the vehicle while it passes a reader) prevented the reader from counting that vehicle, thus apparently skewing the results.
- A small number of the Bluetooth readers seemed to be non-functional and generated zero readings.
- Data was limited to the readers placed along I-35 therefore no OD matrices could be generated for other major north-south corridors in the region such as US 281 and SH 130.
- The readings rely on the presence of a phone device in the vehicle that has a Bluetooth signal. Travelers with no Bluetooth signal or phone device were therefore not captured.
- Data can only be obtained during periods the Bluetooth Antennas are in operation.

StreetLight Data Analysis

To verify the observations made using the Bluetooth data, and to resolve several limitations identified with the Bluetooth data collection, another data source was obtained through a private data vendor, StreetLight®, to generate similar OD matrices for the major urban areas and corridors in the region.

StreetLight data is based on two sources of data, 1) Location-Based Services (LBS) which rely on phone apps that use and have location-based services enabled, and 2) GPS devices embedded in vehicles. StreetLight data does not rely on any actual readers installed along the corridor. This is reported to eliminate issues related to signals being lost on certain portions of the highway. Moreover, the dataset separates commercial vehicles (trucks) from personal vehicles providing a clearer picture of the different types of travel patterns. Data was obtained for the month of September 2017. Both LBS and GPS data sources were used simultaneously to generate OD matrices for the different vehicle types. The analysis also examined weekday- versus weekend-trips and different times of day (AM Peak, PM Peak, Off-peak). This memo focuses on personal vehicle travel analysis. Commercial vehicle results are presented in the Freight Analysis section of the main report.

Two types of analyses were performed. The first one considered the different urban areas in the study region based on their city limits to be the origins and destinations and examined travel between them regardless of the route taken. The second analysis examined travel along the three major north-south corridors in the region, I-35 (from south of San Antonio to North of Georgetown), US 281 (from south of San Antonio to SH 29 towards Georgetown), and SH 130 (the entire facility length from I-10 on the south to I-35 north of Georgetown). Corridor analyses were performed by placing analysis “gates” along the highways and at major entrance and exit ramps along I-35.

General Observations

Urban Area OD Analysis

The first analyses examined travel patterns between and within the major urban areas in the region including San Antonio, New Braunfels, San Marcos, Kyle, Buda, Austin, Round Rock, and Georgetown. **Figures 2 and 3** show the results of the analysis for an average weekday and weekend respectively. Peak hours were also examined as shown in **Figures 4 and 5**.

General Observations

- A significant number of weekday trips that start within the Austin and San Antonio metro areas remain within those areas.
- Trips between Austin and San Antonio constitute only 1% of all trips in the region.
- There is a number of weekday trips from smaller urban areas to the nearest larger urban area. Examples include New Braunfels to San Antonio and Round Rock to Austin. These trips constitute a smaller percentage during weekend days.
- The number of trips headed outside the Austin and San Antonio metro areas are similar on weekdays and weekends.
- The highest percentage of trips originating in Georgetown remain within Georgetown with a percentage going to Round Rock and Austin.
- Round Rock has a significant percentage of trips commuting to north and south Austin, yet local trips still constitute the largest percentage of travel originating there.
- Buda and Kyle's main commuter flow is to South Austin followed by neighboring areas such as San Marcos and north San Antonio.

Corridor OD Analysis

Similarly, a corridor OD analysis was performed on the three main north-south corridors in the region. The aim of this analysis was to identify the main entrance and exit points of vehicles on each of the highways. Special consideration was given to eliminate any double counting of vehicles. In the case of I-35, analysis "gates" were placed at each entrance and exit ramp and an OD matrix was generated for the different locations. **Figure 6** presents a heat map of the OD weekday results for the I-35 corridor. The results suggest that most trips along these highways are local trips, and that the congestion observed is possibly due to the lack of arterial connections. Local improvements and alternative routes could help in alleviating at least some of these regional demands.

General Observations

- The analysis of trips along I-35 ramps depicts a high number of local and short movements, especially in Austin and San Antonio, with a very low percentage of trips traveling between the two large urban areas. This verifies the results observed using Bluetooth data where less than 1% of trips traveled between north San Antonio and Georgetown.
- A significant number of trips only use I-35 to travel between one or two consecutive interchanges.
- Travel on US 281 outside of San Antonio appears to serve longer-distance travel.
- Analysis of destinations for trips originating at each SH 130 interchange indicates heavy usage of the north end of the corridor.

Conclusion

An OD analysis was performed to better understand travel patterns and major origins and destinations in the study area. Two data sources were used, Bluetooth® and StreetLight®, which rely

on different devices such as a Bluetooth signal, phone app location services, and vehicle-embedded GPS devices. The results show that most trips traveling in the north-south direction in the region are local trips originating and ending within the same urban area. Only 1-2% of trips are long-distance regional trips traveling between San Antonio and Georgetown. There are also several weekday trips going from the smaller urban areas to the nearest larger urban area, probably consisting of home-based work trips. The results show that, today, the congestion is locally produced rather than long-distance. The lack of appropriate alternative routes and arterials concentrates the local north-south movements on a few major facilities in the region such as I-35. With the anticipated growth in the region, these patterns may change, and more long-distance trips traveling through the length of the study area could be expected. However, the focus today should be identifying solutions to solve local travel demands/congestion.

Figure 1: Urban Area OD Analysis using Bluetooth Data

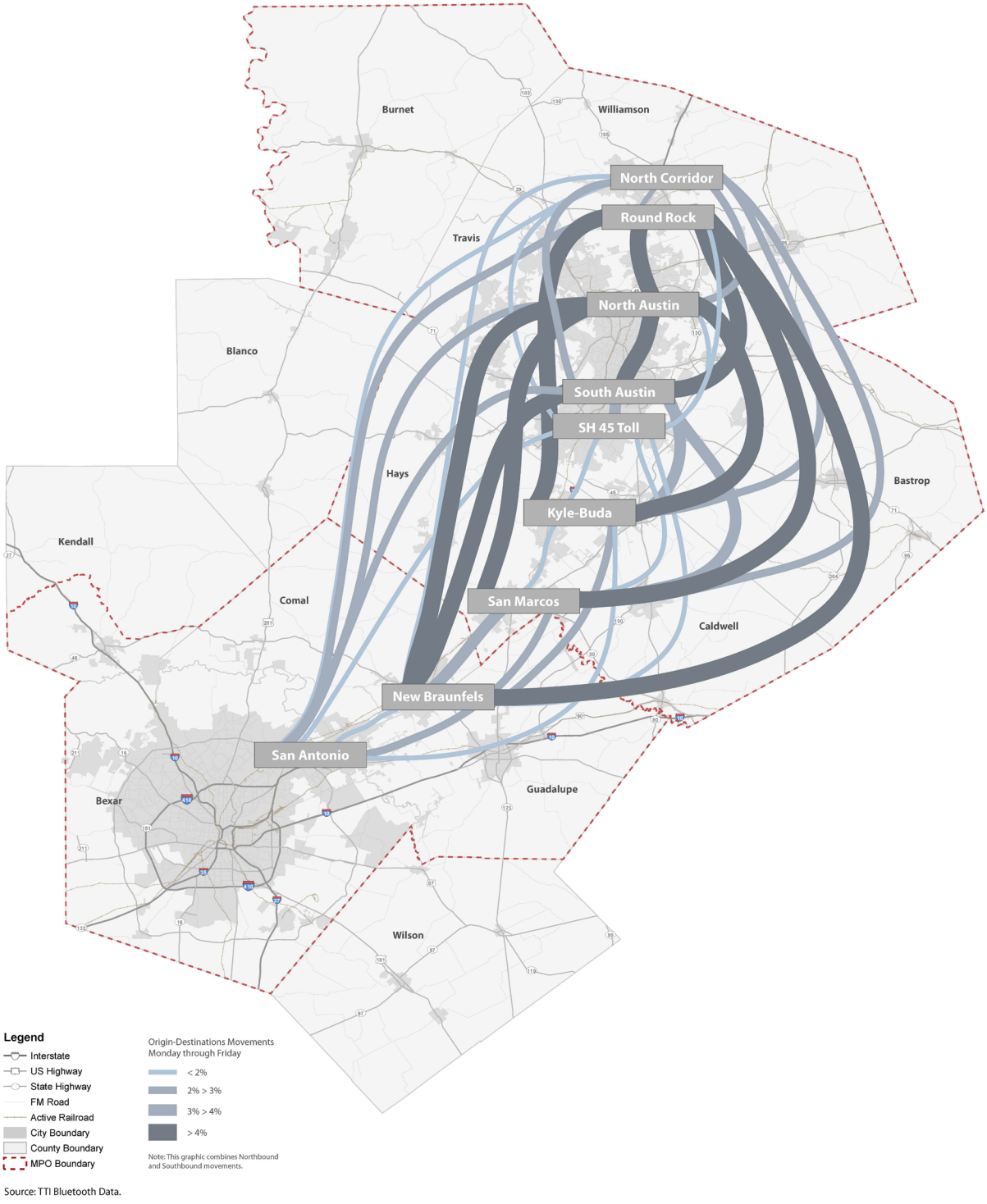


Figure 2: Urban Area OD Analysis Weekday using StreetLight Data

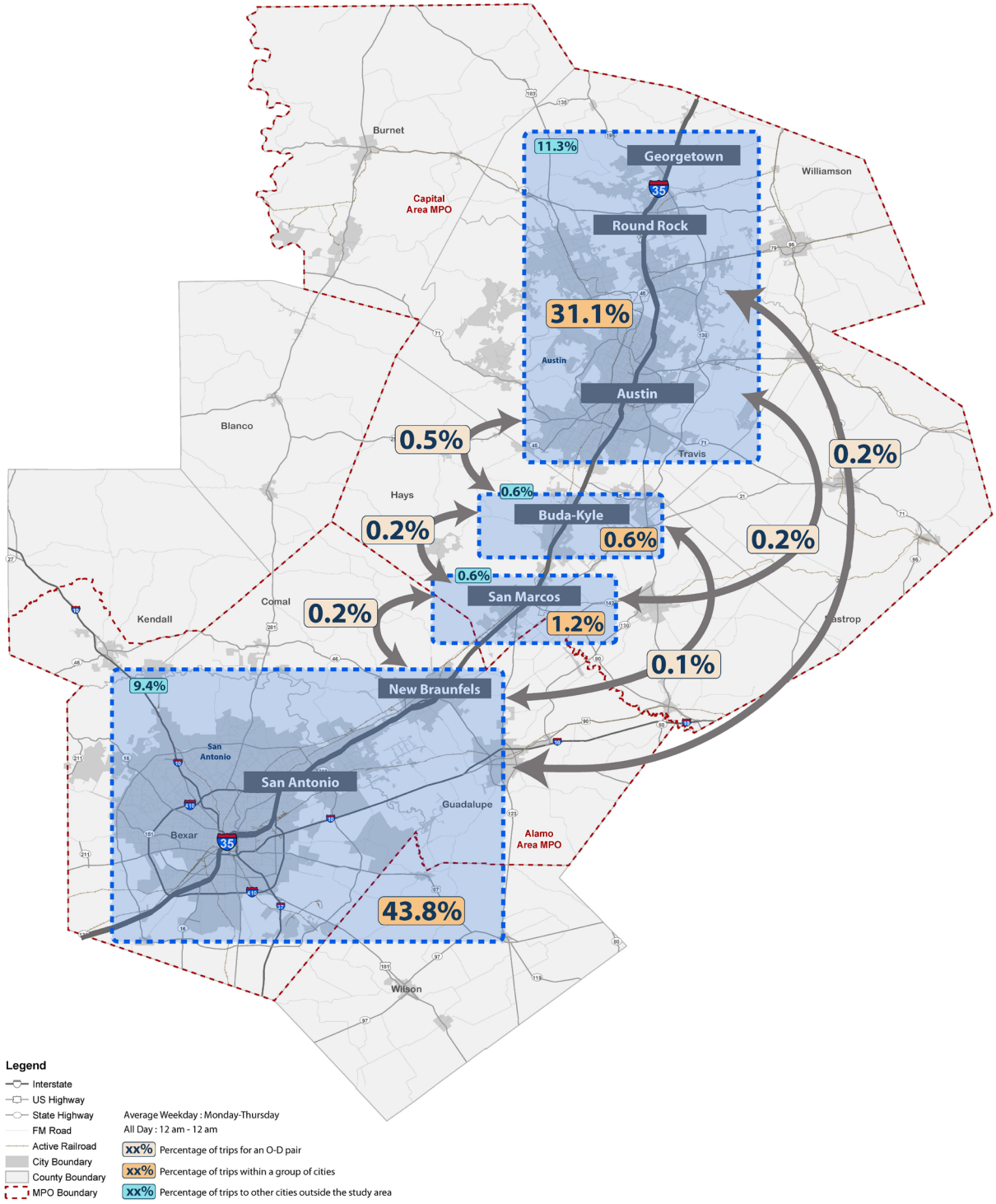


Figure 3: Urban Area OD Analysis Weekday using StreetLight Data

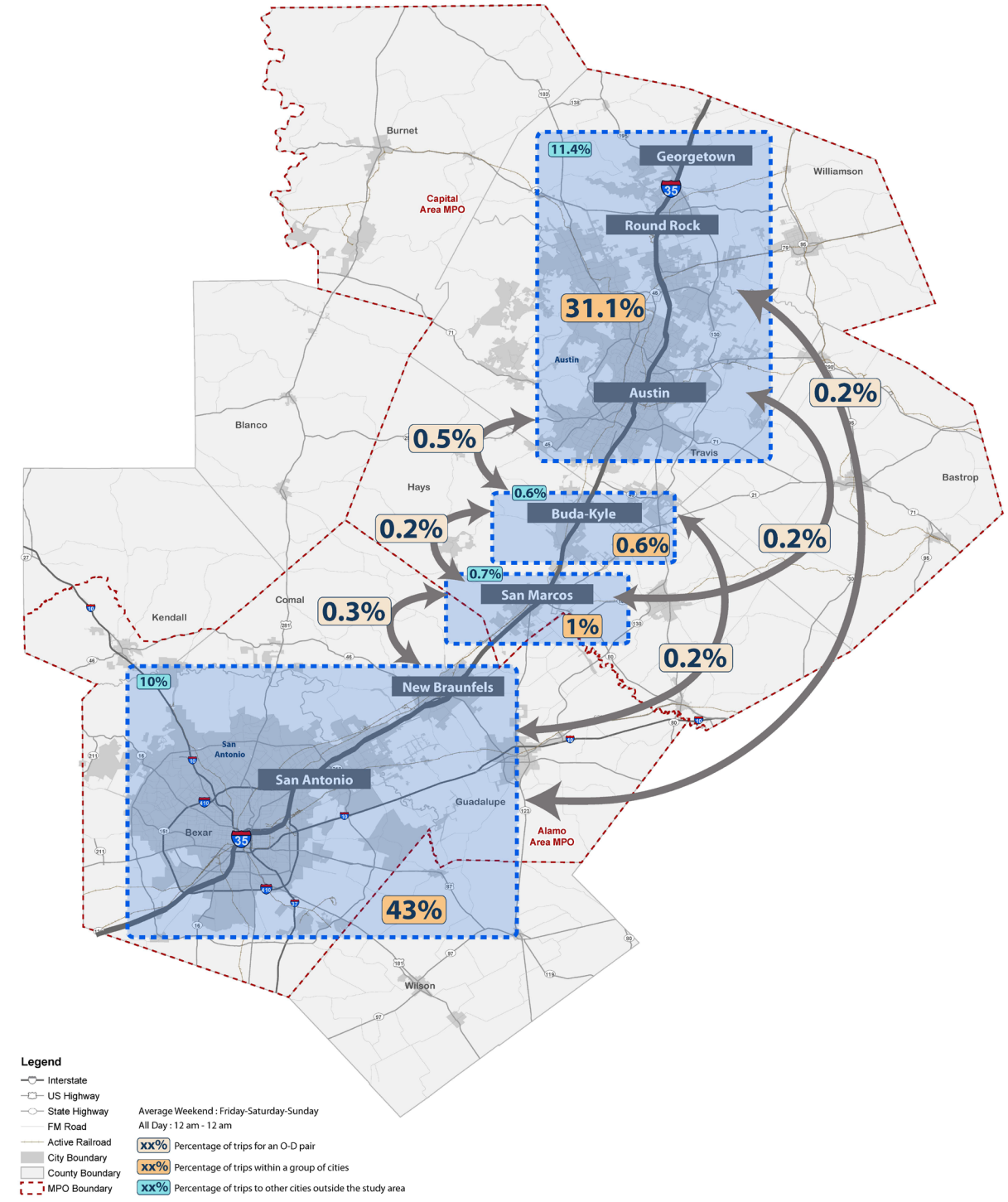


Figure 4: Urban Area OD Analysis AM Peak using StreetLight Data

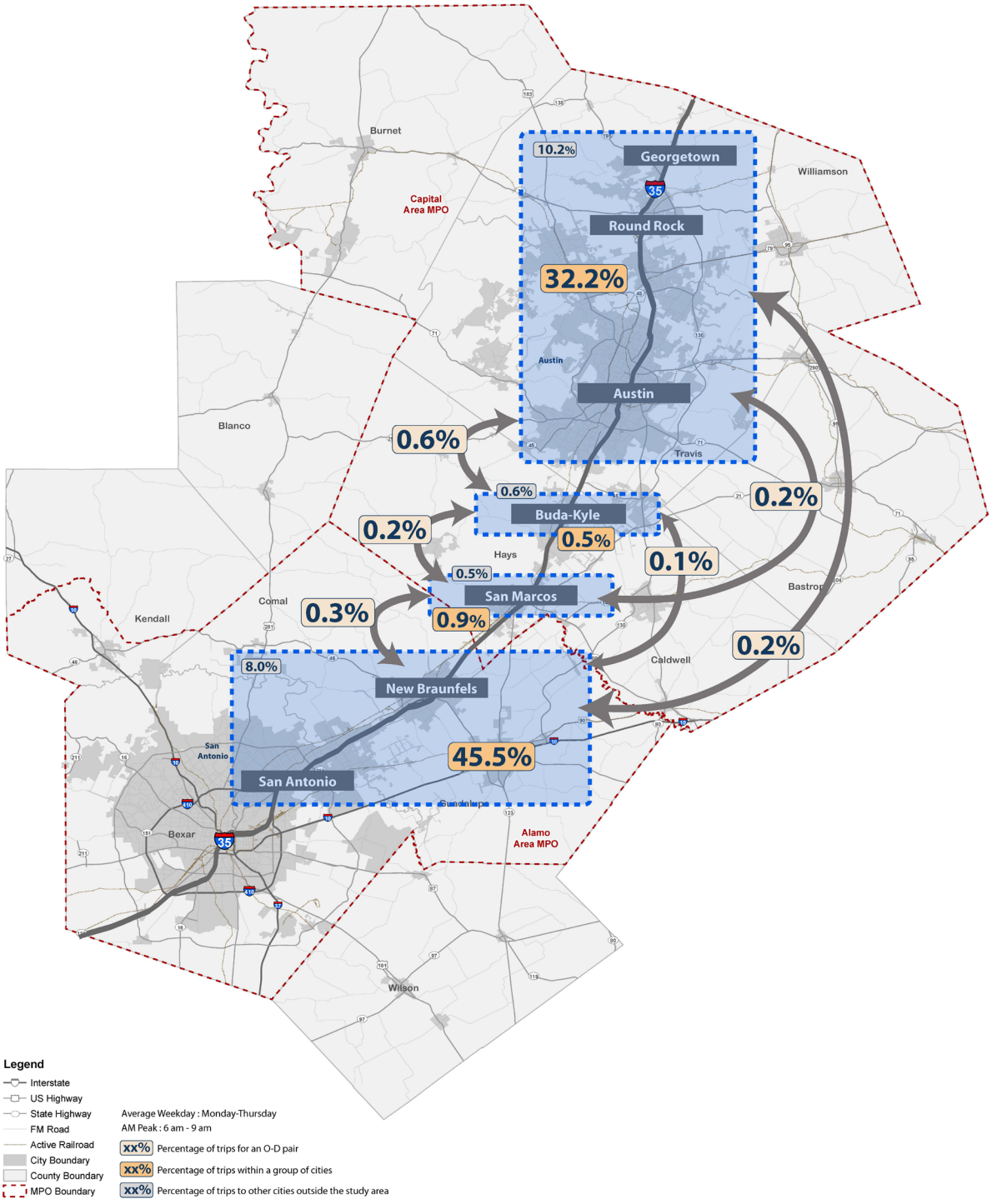


Figure 5: Urban Area OD Analysis PM Peak using StreetLight Data

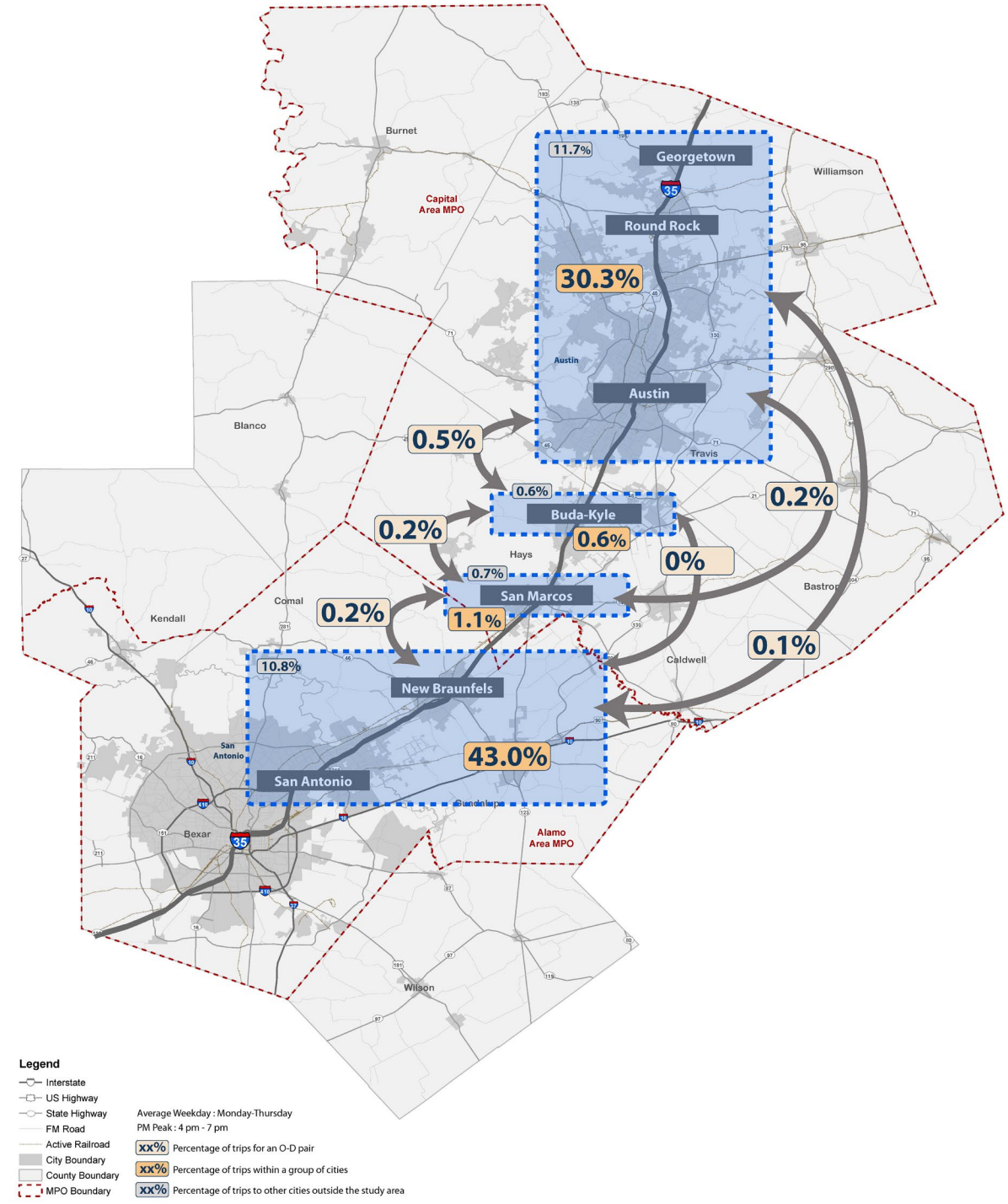
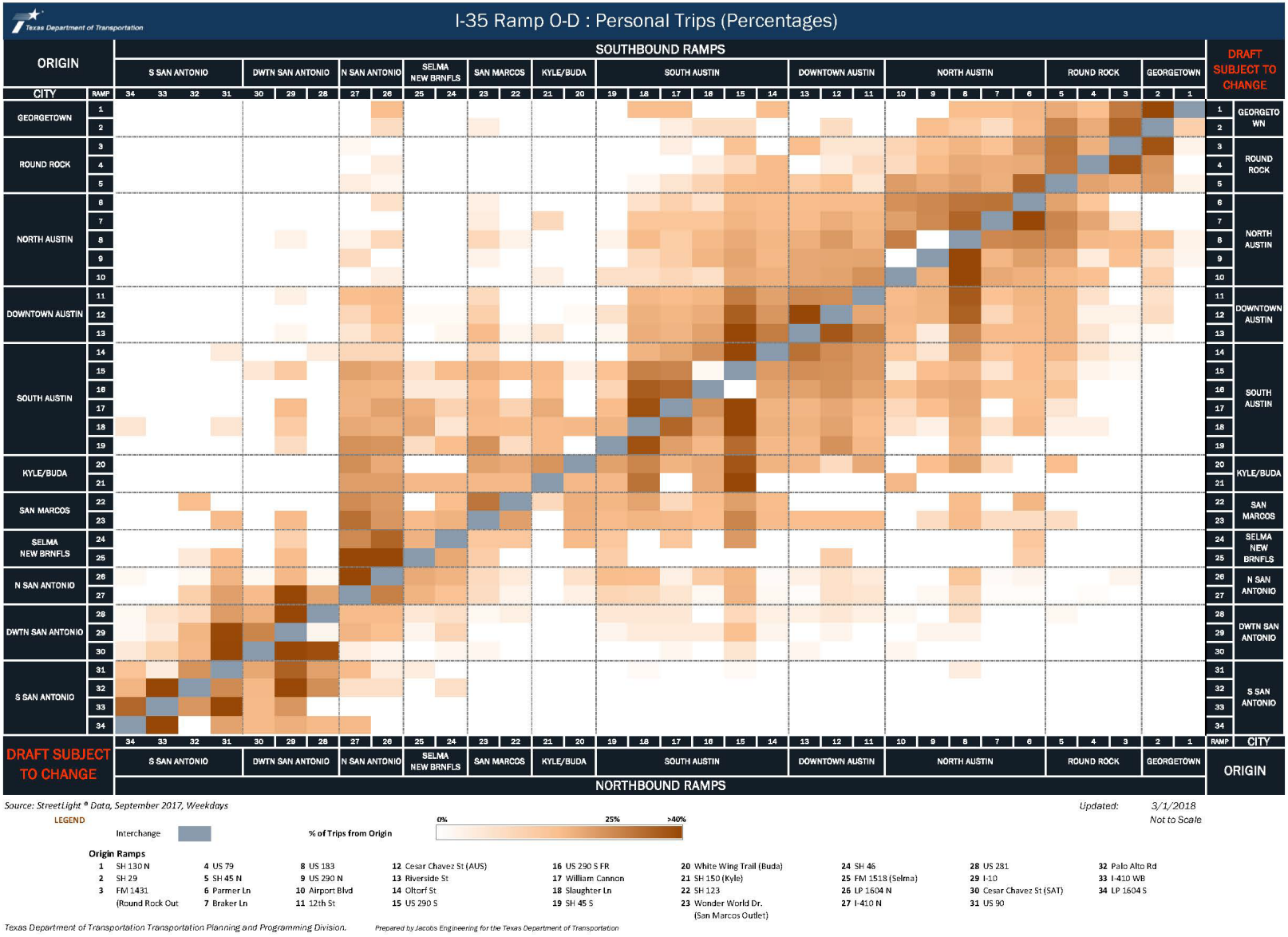


Figure 6: I-35 Ramp OD Analysis Heat Map using StreetLight Data



Appendix E

Freight Analysis

Capital – Alamo Connections Study

MEMO

2/1/2019

To: Roger Beall
TxDOT, Transportation Planning & Programming (TPP) Division

Through: Susan Chavez
TxDOT, TPP Division

From: Michael Sexton
Jacobs Engineering Group Inc.

Subject: Capital-Alamo Connections Study: Freight Analysis

The I-35 segment through the Capital-Alamo Connections Study (CACS) region is one of the most critical corridors for the movement of freight in the State, because it is part of the facility connecting

the Mexican border in Laredo to the Upper Midwest. It is therefore imperative to understand freight movements in the region and specifically on I-35. For this purpose, two data sources were used, 1) TxDOT TRANSEARCH 2010 data to identify major commodity movements by truck and rail, and 2) StreetLight® data to study truck travel patterns and major origins and destinations of trucks traveling along the I-35 corridor.

Commodity Movements

For a better understanding of commodity flows in the region, the TRANSEARCH 2010 database was used to obtain aggregated data on number of trucks and rail tons originating and going to the study region. The following sections summarize the main observations obtained from this data.

General Observations

Trucks

- Approximately 9.1 Million trucks originate from the study area every year.
- The highest number of trucks originating from the region annually are from Bexar (42%) and Travis (23%) counties.
- Approximately 63% of trucks originating from the region stay in the region while 34% go to other areas in Texas. Similarly, the highest percent (62%) of trucks going to the region originate within the region and 32% come from other areas in Texas.
- Top destinations of trucks originating from the region and travelling outside the state are Oklahoma City and Little Rock.
- In terms of commodity groups, the top three commodity groups both originating and terminating in the region are shipping containers, nonmetallic minerals, and clay, concrete, glass or stone.
- The total number of through trucks in the region annually is 16.3 million, with approximately half of the trucks crossing from one Texas region to another, and 28% originating in Texas

but travelling to other US States. Trucks to Mexico and from Mexico to Texas and other US States make up 11% of the total number of trucks passing through the region.

Rail

- Approximately 14.6 Million rail tons originate from the region every year.
- Approximately 92% of rail tons originating from the region go to other areas in Texas. Only 7% are destined to regions outside Texas, but most importantly only 1% remain within the study area.
- The top three counties in the region from which rail tons originate are Comal (52%), Bexar (24%), and Burnet (8%) counties.
- The top three commodities exported from the study region by rail are nonmetallic minerals, clay, concrete, glass, or stone, and transportation equipment. The top three commodities imported to the study region by rail are coal, transportation equipment, and chemicals or allied products.
- Approximately 10.6 Million tons of rail freight end up in the study region annually, with more than 88% destined to Bexar County.
- Approximately 95% of rail tons destined to the study region come from other states with only 4% coming from other Texas areas, and 1% originating from the study area itself.

Truck Travel Patterns and OD Analysis

Data obtained from StreetLight® for the month of September 2017 was used to determine travel patterns and major origins/destinations along I-35. The analysis was accomplished by placing analysis "gates" at the major interchanges along I-35 as well as on the main lanes. **Figures 1 and 2** present the results of this commercial truck OD analysis for the northbound and southbound trips respectively.

The results show that only 22% and 13% of trucks travel through the entire corridor without making a stop in the study area in both the northbound and southbound directions respectively. These long-distance trips are of importance due to their potential of being shifted to other modes such as rail. However, such a low percentage will not contribute to a large shift. Approximately 45% of trips peel off at I-410 in San Antonio in the northbound direction, possibly continuing to I-10 east. Similarly, in the southbound direction, a significant percentage (~ 37%) of trucks originating north of the corridor peel off at SH 130. These trips can potentially be served by alternate routes parallel to I-35, thus relieving congestion on some portions of the highway.

Figure 1: Northbound Commercial Truck Movement on I-35

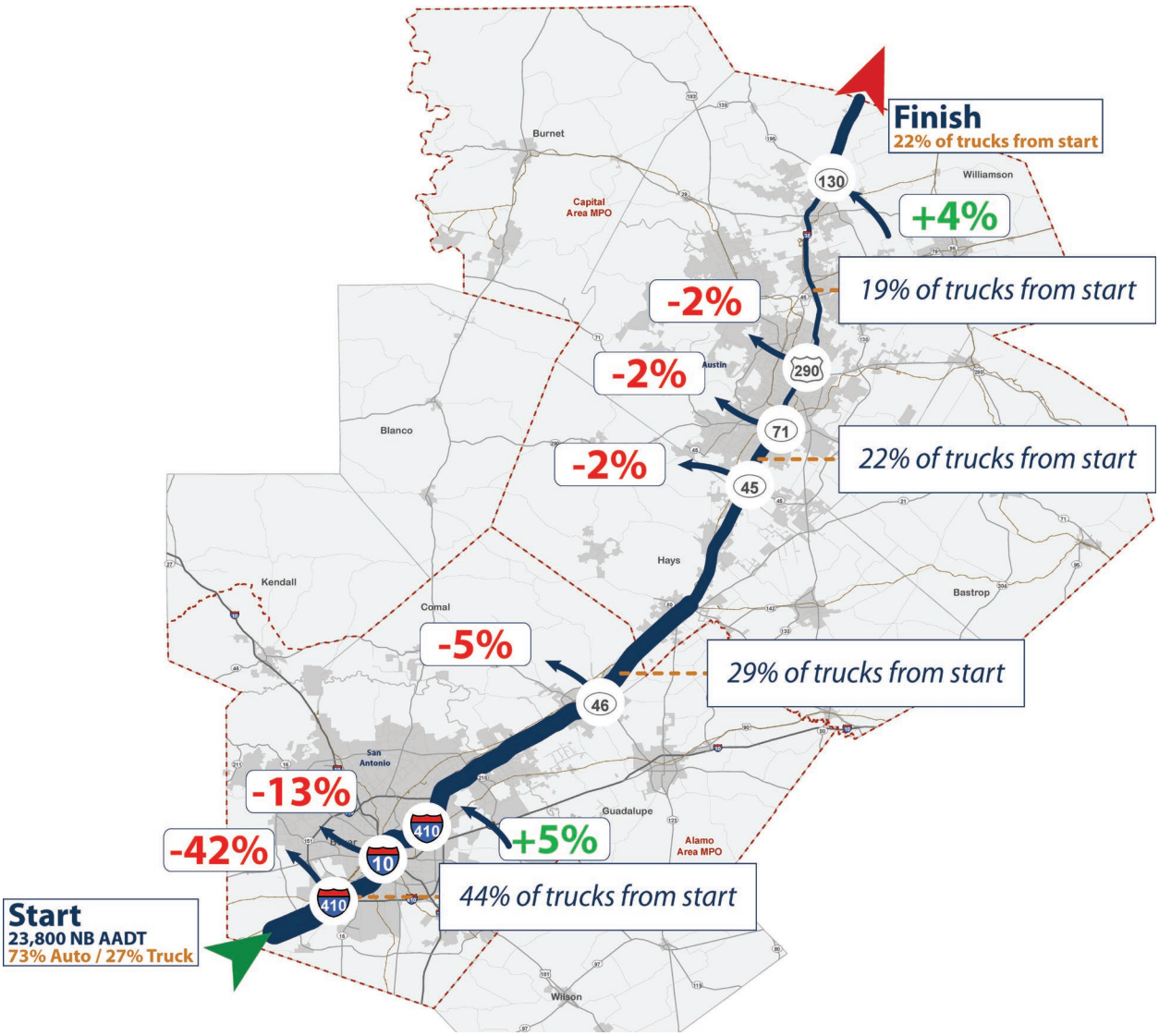


Figure 2: Southbound Commercial Truck Movement on I-35