

Bus/Rail Interface Report



*Prepared by Veolia Transportation
and Sun Tran as Addendum A to the
Comprehensive Operational Analysis*

January 2014

Executive Summary

Two previous studies were conducted of the potential integration between Sun Tran fixed routes partially operating within the service area of the planned Sun Link streetcar alignment. The initial study was conducted as part of the City of Tucson's (COT) Major Investment Study in August 2005. It identified potential changes to three (3) Sun Tran routes. A second study, completed in early 2013 per a request from the Tucson Department of Transportation identified potential cost savings based upon changes to six (6) Sun Tran routes. At the time of the previous studies, detailed segment or stop-by-stop ridership data was not available through the Sun Tran fare and data collection system. Through the collection and analysis of current Sun Tran ridership data, this report identifies the potential impacts of the previous recommendations to ridership.

As a result of the analysis of the aggregate ridership data, this report recommends changes to routes 9, 20, 109X and the discontinuance of the Downtown Loop resulting in estimated net annual cost savings of \$516,000 to \$536,000. Of the total, \$393,500 to \$409,500 would be saved by the COT and \$122,500 to \$127,000 by the Regional Transportation Authority (RTA). These estimated cost savings are in addition to the estimated cost savings provided through the January 2014 Comprehensive Operational Analysis (COA) recommendations.

Analyzing data and developing recommendations based upon that data are primary service planning functions; but it should be recognized that there are other equally important steps in determining routing designed to meet the riding public's needs. Input from the public and governing entities is required as well, and it is recommended that ample public outreach be conducted to garner public comments.

It is further recommended that a future review of all Sun Tran route productivity data and Sun Link ridership data be conducted no sooner than one year after active streetcar revenue service. Conducting this future study at that time will enable the COT to learn of any changes in transit travel patterns resulting from the streetcar service and from any implementation of recommendations from the COA.

The Department of Transportation also requested Sun Tran to identify additional bus service changes to achieve a target budget. The Target Budget Service Review will be provided as a separate report.

Purpose

During the planning process for new fixed-guideway (rail) systems, reviews are typically conducted to determine several interface factors between the existing public transit fixed route system and the planned rail service. There are several reasons for the review, including:

- Determining if there are adequate connections available between the two systems (i.e. fixed route and the planned rail service);
- Preparation of data per a Federal Transit Administration (FTA) requirement to conduct a "before" fixed route ridership report months prior to the implementation of new rail service. The "before" study will subsequently be used for comparison to "after" studies required at certain periods of active rail revenue service, evaluating the impact of the rail service upon the fixed route bus system;

- Identification of areas of duplicated service and providing an assessment of any potential justifications for the duplicated service to be continued. Also determine if opportunities exist for reallocation of resources; and if areas of duplication could be used for other transit needs;
- Determining, through equity analyses, whether the new rail service impacts minority or low-income populations in a discriminatory manner; and
- Ensuring that adequate fixed route and neighborhood connectors exist at each end of a planned rail corridor to “feed” the rail system with passengers.

The aforementioned purposes apply to the current (COT) request to review the Sun Tran/Sun Link interface, with the exception of the last one. Streetcar rail service differs significantly from light rail service where light rail more typically is a longer line connecting the fringe urban and nearby suburban areas at both ends of its terminating points to core high destination areas within the core urban area. The planned Sun Link streetcar service is a relatively short alignment (3.9 miles) connecting the University of Arizona (UA) to downtown Tucson and west of Interstate 10 in an area currently under development at its western terminus. The primary difference in these two types of rail services relevant to this review is that the streetcar service, unlike typical light rail service, is designed as a neighborhood circulator. The streetcar service is not designed to attract passengers from beyond the Sun Tran service area to travel to points within the service area.

Background

Initial planning undertaken by the COT in the development of the streetcar alignment determined that there is full connectivity between Sun Tran routes and the planned Sun Link service. Ridership data was collected for the relevant Sun Tran routes and included in the required FTA “before” rail study. Areas of transit service duplication have been identified and, as part of this review, justifications for the continuation of duplicated service and any recommendations for service reductions within this corridor are reported in a separate section of this report. Sun Tran, at the request of the COT, conducted a Sun Link Pre-Revenue Service Implementation Fare and Service Equity Analysis, which was approved, by Mayor and Council on January 8, 2014. This analysis concluded that no negative impact resulted from the planned implementation of Sun Link, based upon the fare level, service level and integration with Sun Tran as presented at the time of the analysis. The analysis report also indicated that an update would be undertaken should there be changes in the plans reviewed.

University of Arizona Bus Interface Report, August 4, 2005

As part of the City of Tucson Major Transit Investment Study, S. R. Beard & Associates conducted a review of transit connectivity to the planned Sun Link streetcar alignment, and addressed specifically the integration of the planned system to the Sun Tran fixed route system at the University of Arizona (UA). This study concluded that Sun Tran routes operating within the streetcar service area could be replaced by the streetcar service. Some of those routes currently serving both the UA and the downtown Ronstadt Transit Center (RTC) would terminate at a UA transfer point and no longer serve the downtown area. The study recommended that the Route 9 terminate at the UA, and implementation of a new Route 9 express service was recommended. The study concluded that the recommendation for Route 9 would force a transfer to the streetcar to reach downtown, in the off-peak hours, with the expected change only affecting a small number of passengers.

In addition to the recommended changes in Route 9 the study recommended that Sun Tran Routes 1 and 4 would no longer serve downtown Tucson or the RTC. The study reviewed ridership data from a November 2003 route profile report available at that time. The data indicated a higher percentage of the total average daily boardings and alightings occurred at the RTC than at the UA. The study also concluded that the impact of forced transfers to Sun Tran passengers would be lower than the 31% of ridership as indicated by the data, if additional Route 9 service would be implemented. The report summarized that its recommendations would result in a smaller RTC, which then could accommodate additional service should the Regional Transportation Authority (RTA) be approved. The report from this study, entitled University of Arizona Bus Interface, August 5, 2005, is provided in APPENDIX A to this report.

In early 2013, Tucson's Department of Transportation requested that Sun Tran determine potential cost savings resulting from restructuring of certain routes to terminate at the UA, and no longer travel to or from downtown Tucson. These routes were 1, 3, 4, 5, 6, and 9. As requested, Sun Tran staff provided estimated cost savings and ridership data available at that time. Total potential estimated annual cost savings were reported at \$430,110, and ridership data, which indicated that ridership boardings and alightings within the affected area of these routes varied from 17.7% to 48.5%. The financial and ridership data is provided in APPENDIX A to this report. An alternative to this request was also evaluated, involving Routes 4 and 5 only. Total potential estimated annual cost savings of \$1,151,108 was reported. The estimated annual cost savings of both of these reviews included COT and RTA savings.

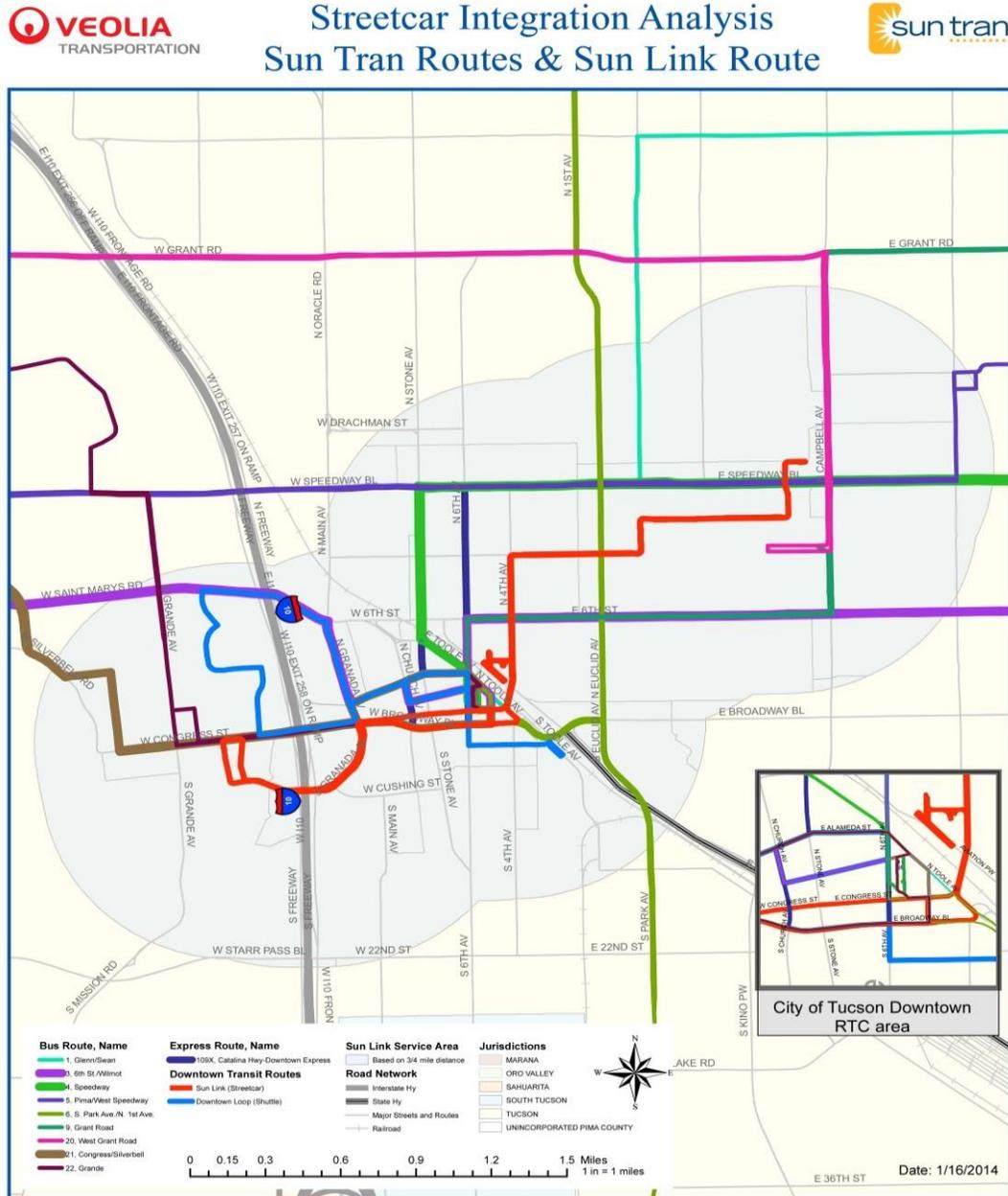
Bus/Rail Interface Review Process

Both of the aforementioned planning documents were studied to initiate this Bus/Rail Interface Report. Additionally, it was determined that detailed ridership data should be reviewed to achieve a more exact indication of potential impacts upon existing Sun Tran ridership. At the time that the 2005 University of Arizona Bus Interface Report was published, Sun Tran's fare collection and data system did not provide stop-by-stop boarding information. The only ridership data providing boarding and alighting numbers within the affected area were limited to a "snapshot" achieved through data collections one or two times during a year when a data collector would ride the entire route and report boardings and alightings on a stop-by-stop basis.

For this Bus/Rail Interface Report, ridership data of boardings and alightings within the affected area as indicated by Automatic Passenger Counter reports for the month of April 2013 and on-board data collection in Fall/Winter 2013 was used. Additional data was available from the onboard survey report, provided by Moore and Associates in early December 2013. The relevant data gleaned from that report is contained in Origin-Destination maps. The full report resulting from the onboard survey was provided as part of the COA in January 2014. The current Origin-Destination maps from those routes reviewed in previous studies are provided in APPENDIX B.

Detailed data was collected by data collectors from September through December providing a more comprehensive view of the ridership patterns of these routes. Data collectors were onboard trips during the collection period to chart passenger boardings and alightings. With this data, Veolia and Sun Tran staff compiled the estimated number of impacted trips should the previous restructuring

recommendations be implemented. The estimated number is based on the percentage of trips that would require transfers to complete their trip.



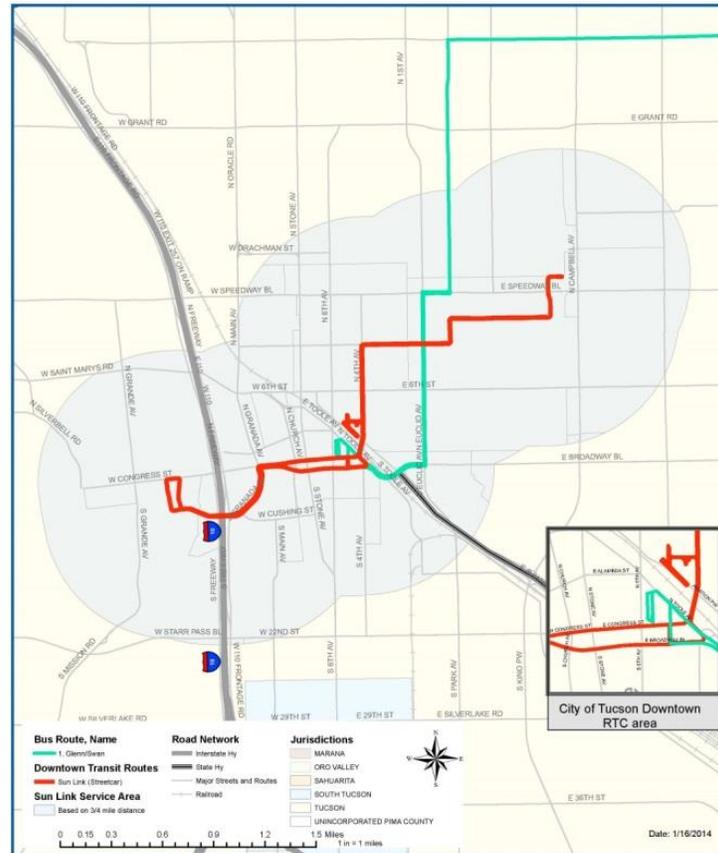
Sources: City of Tucson GIS, Information Technology
 Sun Tran Routes & Bus Stops, Scheduling & Service Development

Map is for illustrative purposes only
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Previous Recommendations

Route 1 Glenn Street/ Swan Road

Previous Recommendation: Restructure Route 1, terminating it at the UA and discontinuing the segment between UA and the downtown Ronstadt Center.



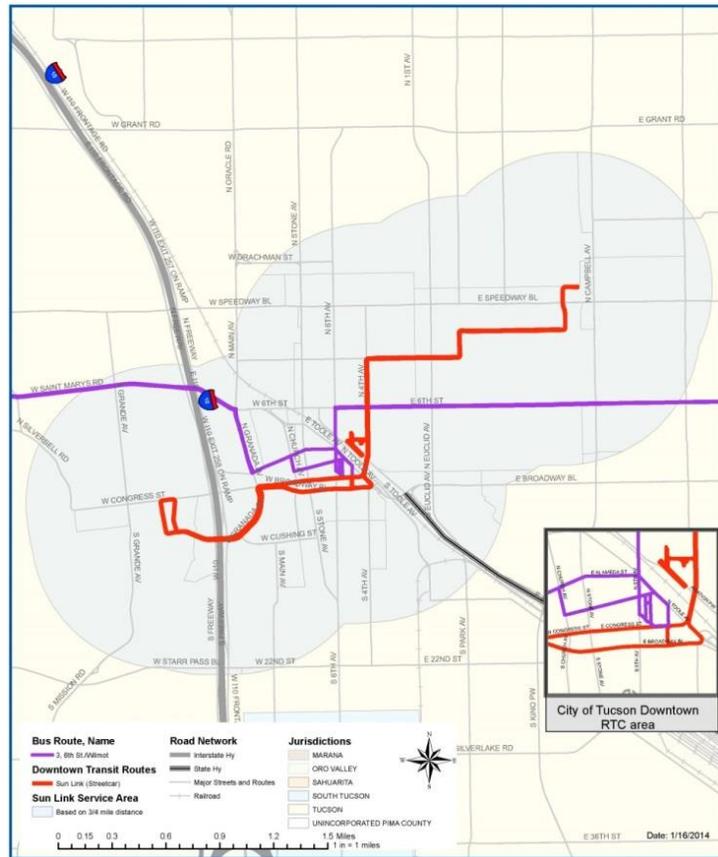
Current Data and Determinations: Discontinuing the route segment would impact this route as follows:

- Potential Annual Cost Savings - COT \$86,411 RTA \$ 2,718
 - Potential Savings based upon a reduction of 21,476 annual miles operated
- Of the total 2026 northbound daily average passenger boardings and alightings, 92, or 4.5% occurred at the UA
- Of the total 2256 southbound daily average passenger boardings and alightings, 98, or 4.3% occurred at the UA.
- Potential Impact to Transfer Access :
 - Number of routes with direct transfers reduced by 18
 - System transfer opportunities reduced by 43%
- A change was made to this route in 2012 due to streetcar construction, which lessened its duplication of service area. This change did not negatively affect ridership and it was continued upon the construction completion.

- Through the COA, route restructuring is recommended for this route, discontinuing service along a non-productive segment, and the COA recommendation represents estimated annual cost savings of \$160,000.

Route 3 Wilmot Road/ 6th Street

Previous Recommendation: Restructure Route 3, by staying on 6th Street and St. Mary's avoiding Downtown Tucson.

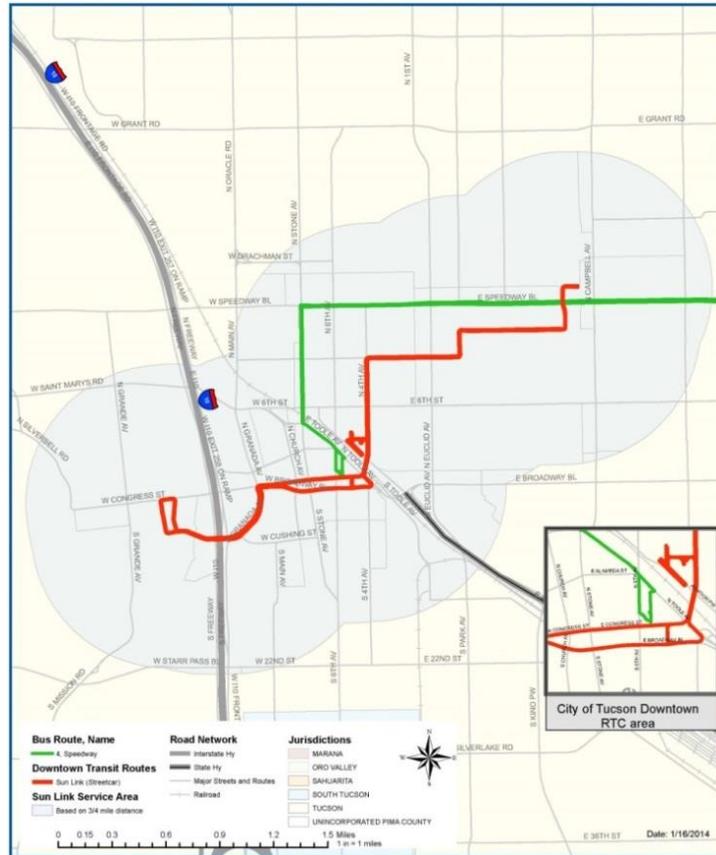


Current Data and Determinations: Discontinuing the route segment would impact this route as follows:

- Potential Annual Cost Savings - COT \$158,530 RTA \$ 6,778
 - Potential Savings based upon a reduction of 39,833 annual miles operated
- Of the 4438 total westbound daily average passenger boardings and alightings, 310, or 6.9% occurred at the UA.
- Of the 4857 total eastbound daily average passenger boardings and alightings, 331, or 6.8% occurred at the UA.
- Potential Impact to Transfer Access :
 - Number of routes with direct transfers reduced by 26
 - System transfer opportunities reduced by 36%
- Operating concern identified in previous recommendation:
 - Active freight rail grade crossing along 6th
- Significant changes to the Route 3 are recommended through the COA. The potential savings of the COA recommendations is \$400,000.

Route 4 Speedway

Previous Recommendation: Reroute Route 4 from its current terminal at the Downtown Ronstadt Transit Center and operate an expanded new segment via West Speedway to Pima Community College West.



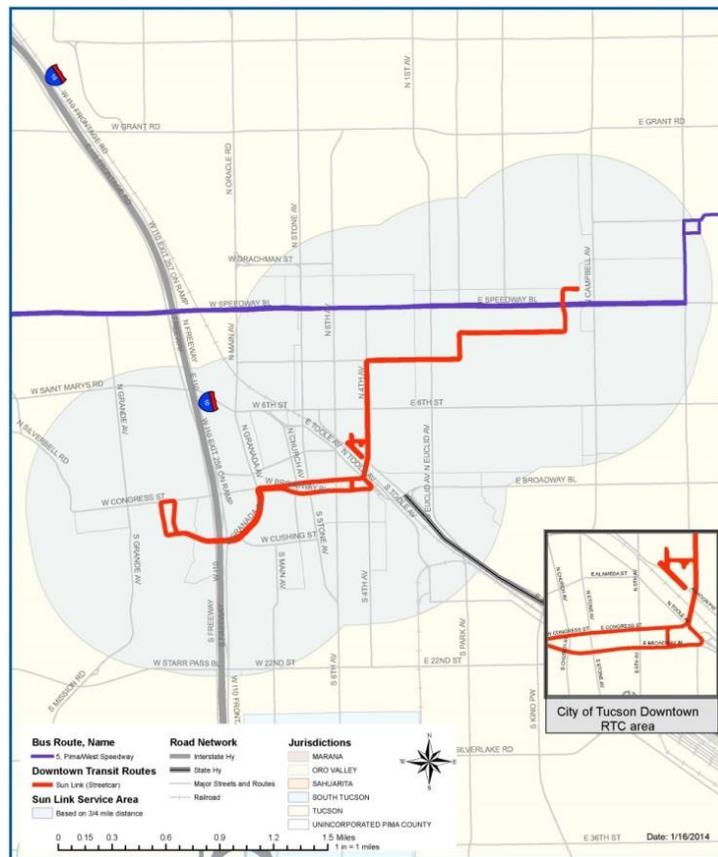
Data and Determinations: Discontinuing the route segment would impact this route as follows:

- Potential Annual Cost Savings - COT \$ 0 RTA \$ 0
- Potential Annual Additional Costs- COT \$596,249 RTA \$39,072
- Potential Annual Cost Savings – Alternative Proposal COT \$393,244 RTA \$25,769
 - Additional costs based upon an increase of 153,089 annual miles operated (original consideration)
 - Potential Savings based upon a reduction of 100,967 annual miles operated (alternative consideration)
- The original consideration presents significant additional costs due to increasing the frequency of the Route 4 to areas west of downtown Tucson served by the current Route 5. The current Route 5 demand does not reflect the need for this frequency increase.
- Of the total 5471 westbound average daily passenger boardings and alightings, 534, or 9.7% occurred at the UA.
- Of the 5568 eastbound daily average passenger boardings and alightings, 632, or 11.3% occurred at the UA.
- Potential Impact to Transfer Access :

- Number of routes with direct transfers reduced by 7
- System transfer opportunities reduced by 17%
- The alternative recommendation made in 2013 addressed Routes 4 and 5 differently, with no changes being made to Route 5 and Route 4 terminating at the UA. Due to the high number of passengers onboard and traveling beyond the UA in both directions, terminating the route at this location would pose significant potential impacts upon current ridership.

Route 5 Pima Street/ W Speedway

Previous Recommendation: Restructure route 5 from its current terminal at Pima Community College West and operate to the UA Mall.



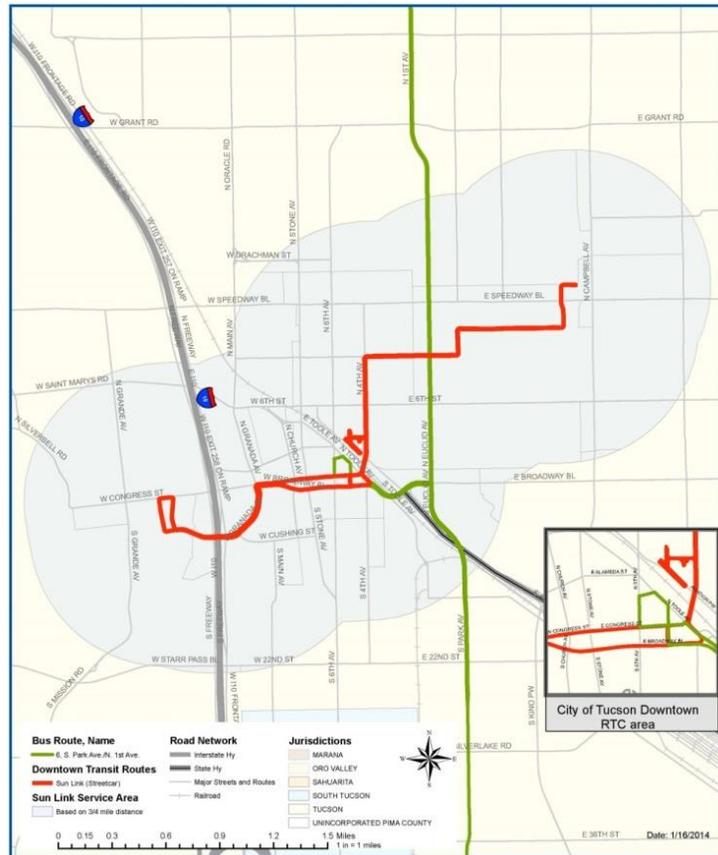
Data and Determinations: Discontinuing the route segment would impact this route as follows:

- Potential Annual Cost Savings - COT \$300,221 RTA \$ 33,115
 - Potential Savings based upon a reduction of 80,322 annual miles operated (original consideration)
 - The Alternative Proposal to Routes 4 and 5 left Route 5 unchanged
- Of the total 1401 westbound average daily passenger boardings and alightings 195, or 13.9% occurred at the UA.
- Of the total 1240 eastbound average daily passenger boardings and alightings 186, or 15% occurred at the UA.
- Potential Impact to Transfer Access :

- Number of routes with direct transfers reduced by 2
- System transfer opportunities reduced by 5%
- No changes were recommended to the route in the COA because it was determined that the current service level is appropriate for the service demand.

Route 6 Park Ave/ 1st Ave

Previous Recommendation: Restructure Route 6, discontinuing the segment between UA and the downtown Ronstadt Transit Center.



Data and Determinations: Discontinuing the route segment would impact this route as follows:

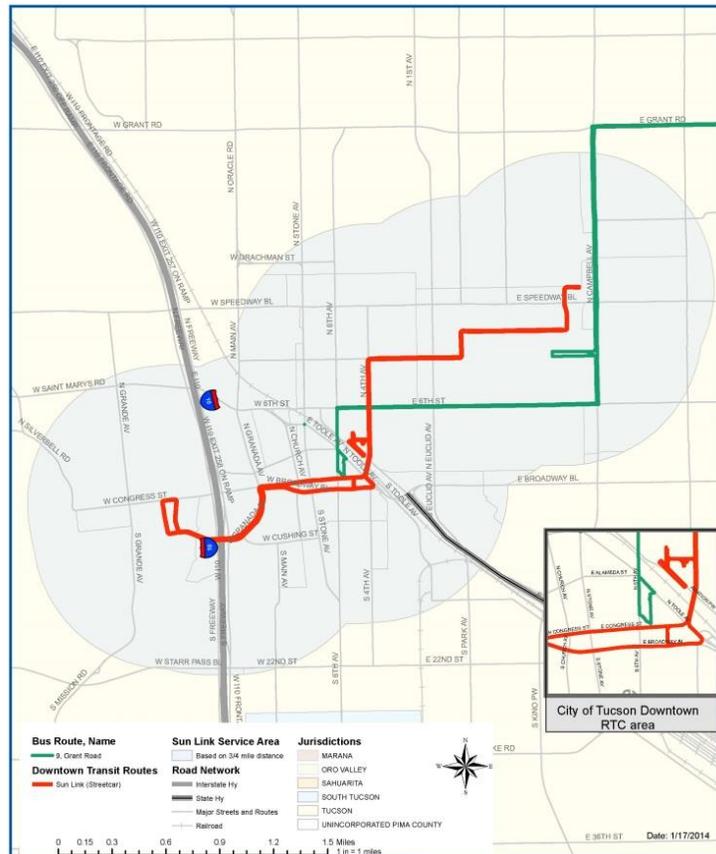
- Potential Annual Cost Savings - COT \$170,229 RTA \$ 14,829
 - Potential Savings based upon a reduction of 44,609 annual miles operated
- Of the total 5515 northbound daily average passenger boardings and alightings 353, or 6.4% occurred at the UA.
- Of the total 5338 southbound daily average passenger boardings and alightings 327, or 6.1% occurred at the UA.
- Potential Impact to Transfer Access :
 - Number of routes with direct transfers reduced by 13
 - System transfer opportunities reduced by 31%
- Operationally, the recommendation represented favorable trip travel time improvements by discontinuing the downtown segment of service. However, passenger data collection

demonstrated that this segment is highly use by current ridership, posing significant potential impacts.

- Recommendations were made through the COA to split Route 6 so that the segment north of downtown would operate with a different frequency than would the proposed southern segment of the service, which the COA recommends as a separate route.
- The recommendations of the COA result in estimated net annual savings of \$113,000.

Route 9 Grant Road

Previous Recommendation: Restructure Route 9, terminating it at the UA and discontinuing the segment between UA and the downtown Ronstadt Transit Center.



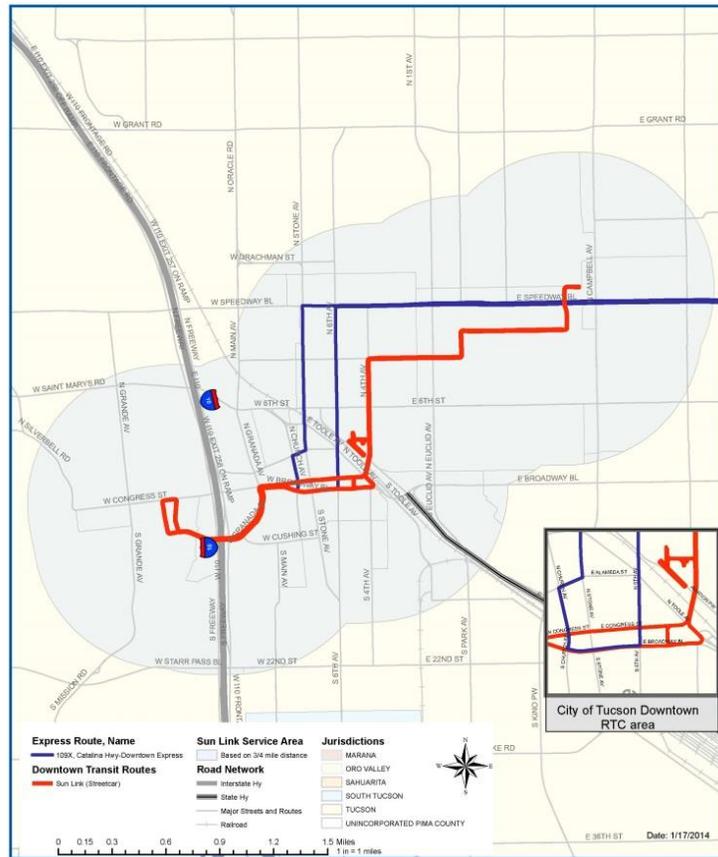
Data and Determinations: Discontinuing the route segment would impact this route as follows:

- Potential Annual Cost Savings - COT \$245,228 RTA \$ 47,302
 - Potential Savings based upon a reduction of 470,489 annual miles operated
- Of the 2645 total westbound daily average boardings and alightings 320, or 12 % occurred at the UA.
- Of the 2522 total daily average boardings and alightings 265, or 10.5% occurred at the UA.
- Potential Impact to Transfer Access :
 - Number of routes with direct transfers reduced by 18
 - System transfer opportunities reduced by 43%

Route 9 Grant Road- Express Service (Route 109X)

Previous Recommendation: Restructure Route 9 creating express trips for peak travel to downtown Tucson.

Data and Determinations: Since the initial study was conducted, the RTA was approved and one of the results was the creation of the Route 109X express route. The initial study did not specify the specific route or times of trips for the recommended new route.



Additional Routes, not included in previous recommendations

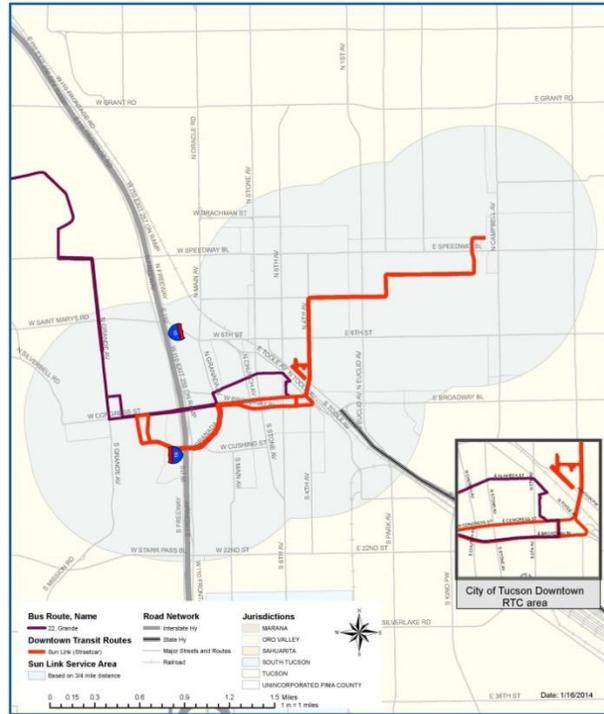
Routes 21 and 22 are fixed routes with segments which operate within the alignment, from downtown Tucson to the western alignment of the streetcar. The COA recommended restructuring of these two routes, combining them into one route resulting in cost savings.

The Downtown Loop is a free connector service operating on a thirty minute looping cycle within the streetcar alignment. These three routes have been reviewed and are included in the conclusions and recommendation made through this report.

Route 21



Route 22



Downtown Loop



Conclusions

The data analyzed through this study indicates that a significant number of passengers are potentially impacted through the previous recommendations. Potential impacts determined through a review of current data include:

- The majority of trips aboard the six (6) routes previously reviewed do not originate or terminate at the UA
- The percentage of total daily average passenger boardings and alightings upon the six (6) routes originating or terminating at the UA is 8.4%

The conclusion reached through this data is that a significant number of passengers either would be forced to make a transfer instead of traveling the full trip aboard one bus, or would have to make a second transfer using three buses for trips that currently use two. It is generally accepted within the transit industry that reducing the number of transfers required in a passenger trip helps attract transit passengers. It is also accepted that the more similar travel times for a passenger trip by transit and the travel time of a private automobile, the greater the potential to attract passengers and to increase passenger usage of transit. The previously recommended service configuration added the number of transfers that may be required to complete current trip patterns. Potentially, this could result in passengers who have other transportation options available to them not to ride Sun Tran or Sun Link. Passengers who have no other options may continue to ride public transportation, but potentially face longer trip times due to additional transferring.

The six (6) identified routes do not all serve the same location within the UA, and passengers transferring from one route to another should the routes terminate there would vary. For example, from the closest existing bus stop on Speedway Boulevard / Warren Underpass to the new streetcar stop on 2nd Street is just short of one quarter (1/4) mile or one third (1/3) mile from the UA Mall to the stop on 2nd Street. If the routes to transfer included walking from Speedway to 6th Street or the UA Mall to Euclid Avenue, the ranges are from just over one-half (1/2) mile to three-quarters (3/4) mile without taking into account the pedestrian access routes through campus around buildings and other obstacles; the actual distance walked would be closer to one mile. Terminating current routes would require at least one new bus stop to be implemented on the UA campus to facilitate transfers of less than one block. Additionally, if you are not familiar with the UA campus the new stop should be visible from both the streetcar and bus stops (Cherry Avenue at 2nd Street).

A specific transit-industry-accepted elasticity model for the potential decrease in ridership as a result of forcing additional transfers and increasing the passenger trip time by transit was not identified as part of this review. The actual potential decrease in ridership is an unknown factor and it cannot be concluded what percentage of cost savings, which could be realized through these recommendations, would be offset by decreased fare revenues.

Regulatory Requirement

Another consideration, which was not present at the time of the previous recommendations, is the requirement to conduct a service equity analysis to determine if the bus/rail integration has a discriminatory impact on minority and low-income populations. A service equity analysis would conclude whether restructuring Sun Tran routes to integrate with the Sun Link streetcar service would have a disparate impact, on the basis of race, color or national origin, or disproportionate burden to low-income populations. A service equity analysis includes public outreach, to gain public input upon the review, its conclusions and any mitigating alternatives identified should disparate impact or disproportionate burden result.

Impact upon the COA Recommendations

The COA recently completed includes recommendations in service levels and route restructuring, including recommendations to the Sun Tran routes operating within the streetcar alignment. The COA's recommendations were based upon market demand, with Origin-Destination mapping of each route. The Origin-Destination maps for the routes reviewed as part of this study are included in APPENDIX B. Should the previous recommendations be implemented, several of the primary cost savings recommendations from the COA will no longer be possible. Another analysis would be required to determine the extent to which the cost savings identified in the COA are impacted upon integrating the previously recommended changes to the six (6) routes with those made in the COA.

Estimated COA annual cost savings is \$1,570,000 to \$1,630,000 COT and \$915,000 to \$952,000 RTA and the recommendations largely do not require an additional transfer to customers though some may choose to take a different route to reach their destination. Significant increases in travel times are not anticipated through the COA recommendations. The recommendations detailed below could be implemented without affecting the COA recommendations and without reducing the potential COA cost savings.

Recommendations

- Based upon the aforementioned considerations, it is not recommended to terminate the six (6) routes at the UA.
- This review studied routes 21 and 22, which have segments located within the western portion of the streetcar alignment. However, the COA recommendations include a combination of these two routes and further restructuring is not recommended at this time.

Recommendations in routing structure and service levels are made, to include:

Route 9 Grant Road

Route 109X Catalina Highway- Downtown Express

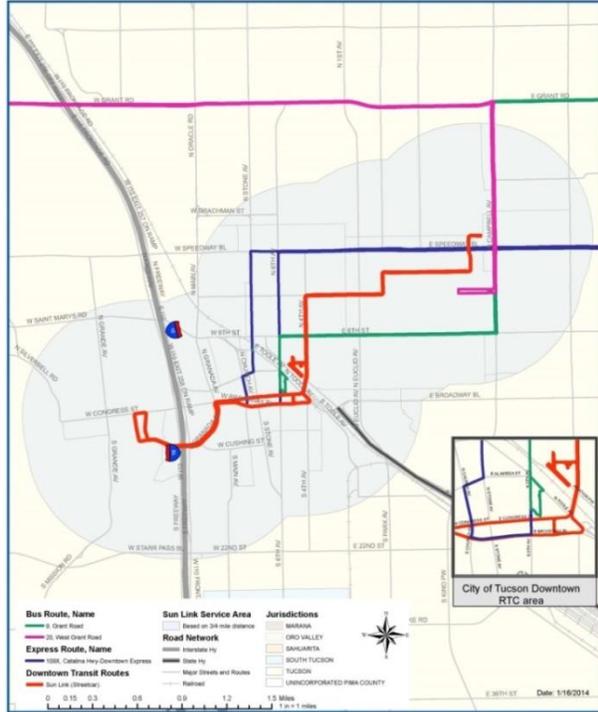
Route 20 West Grant/ Ironwood Hill

Restructure Routes 9 and 20 by combining them, increasing service hours of Route 109X and operating Route 109X in reverse peak direction.

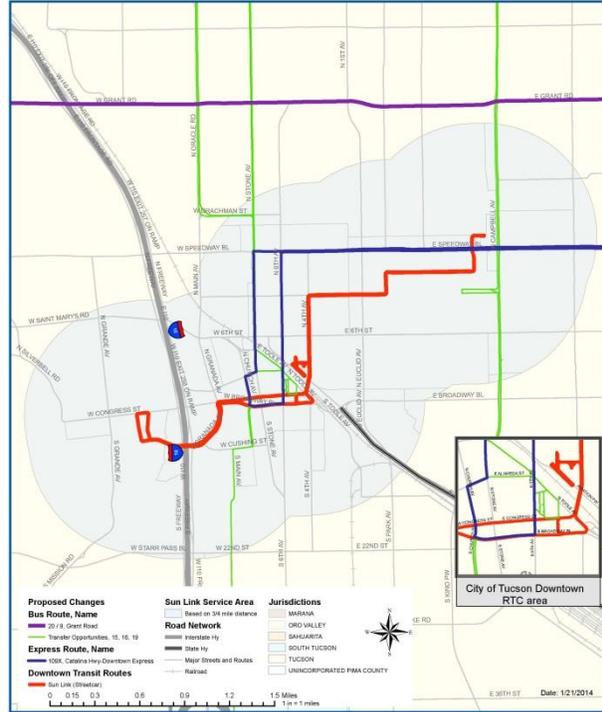
- 1) To address overlap with the Sun Link Streetcar, Route 9 is recommended to merge with Route 20 and operate via West Grant Road to Ironwood Hill Drive. Service will operate every 30 minutes weekdays and hourly weeknights and on weekends. Direct service to the UA and downtown Tucson will no longer be provided. Customers wishing to travel to UA will have to ride an expanded Route 109X or continue riding a Route 9 and transfer at Campbell Avenue to Route 15. Customers wishing to travel downtown will have to ride Route 109X or transfer to Route 16 at Oracle Road, Route 19 at Stone Avenue or connect to the Sun Link streetcar after transferring to reach UA.
- 2) Route 109X is recommended to have expanded service hours and operate in the reverse peak direction. Current service allows for three (3) morning and three (3) afternoon trips. Proposed service will offer 4 morning round trips and 6 afternoon round trips. The larger number of trips in the afternoon is due to a longer period of high demand in the afternoon. The COA already recommended making additional stops on Route 109X to attract additional customers.

This recommendation results in estimated net annual cost savings of \$467,000 to \$485,500 and significantly reduces the potential of forced transfers to current Sun Tran passengers from the previous recommendations.

Existing Routes 9, 20 and 109X



Recommended Routes 9, 20 and 109X

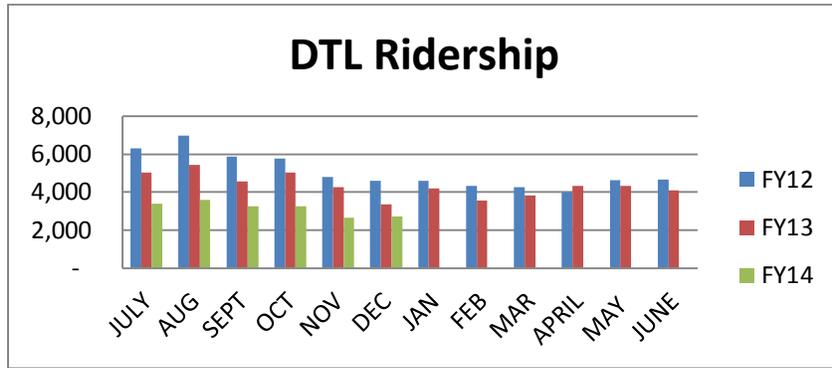


Downtown Loop

With the opening of the Sun Link streetcar in summer 2014, the Downtown Loop will become a duplicative service with many of the Downtown Loop’s major stops within walking distance of Sun Link or existing Sun Tran service. Two stops, Pima Community College, Community Campus and the Community Resource Center, are across the Santa Cruz River along Bonita Avenue and are outside of walking distance to Sun Link or Sun Tran. As part of the COA recommendations, it was proposed that the new Route 21 be rerouted to serve the Bonita Avenue Corridor, serving the two major Downtown Loop generators.

Downtown Loop ridership decreased in fiscal year 2013 from fiscal year 2012, with further reductions being experienced thus far in fiscal year 2012. In July 2013, the Department of Economic Services office, a primary destination along the loop closed and this stop was discontinued. The route was also affected by streetcar construction forcing significant detours.

It is recommended that the Downtown Loop be discontinued once the streetcar service is activated and Sun Tran system route changes are made. Currently, this service is provided through a federal grant which provides 50% of the cost to operate it. The savings included in this report is the 50% portion of Downtown Loop costs not offset by grant funds.



JUL-DEC			
Ridership	FY12	FY13	FY14 - YTD
Total Passengers	34,323	27,636	18,869
Total Expenses	\$ 44,441	\$ 44,873	\$ 44,031
Service Hours	13,860	13,860	13,970
Revenue Miles	11340	11340	11430
Deadhead Miles	2520	2520	2540
Total Miles	13860	13860	13970

Summary of Recommendations

The recommendations to Routes 9, 20, 109X and the Downtown Loop result in estimated net annual cost savings of \$ 516,000 to \$536,000. Of the total, \$393,500 to \$409,500 would be saved by the COT and \$122,500 to \$127,000 by the RTA. These estimated cost savings are in addition to the estimated cost savings provided through the COA recommendations.

Appendix A

- *City of Tucson Major Transit Investment Study: University of Arizona Bus Interface, August 4, 2005 (S. R. Beard & Associates)*
- *Sun Link – Sun Tran Interface 03/19/2013 (Sun Tran Staff)*



City of Tucson Major Transit Investment Study

UNIVERSITY OF ARIZONA BUS INTERFACE

August 4, 2005



TRANSPORTATION CONSULTANTS



Table of Contents

UNIVERSITY OF ARIZONA BUS INTERFACE	2
1.0 INTRODUCTION	2
2.0 EXISTING CONDITIONS	2
3.0 BUS INTERFACE ALTERNATIVE	5
4.0 BUS INTERFACE EVALUATION	7
5.0 CONCLUSION	8
APPENDIX A	9

Figures

Figure 1: Potential Transit Alignments	3
Figure 2: Existing UA Transit Service	4
Figure 3: UA Bus Interface.....	6

Tables

Table 1: Existing UA Transit Service	4
Table 2: Ronstadt Transit Center and UA Bus Interface.....	5
Table 3: Sun Tran Route Profile Report – Downtown vs. UA	7



University of Arizona Bus Interface

This report describes the interface between Sun Tran and the proposed high capacity transit system that will serve the University of Arizona campus.

1.0 INTRODUCTION

The City of Tucson Department of Transportation (TDOT) is developing a high capacity transit connection between major activity centers in the central core, including downtown Tucson, the Río Nuevo area, the 4th Avenue/Main Gate business districts, the University of Arizona (UA), and the Arizona Health Sciences Center (AHSC). This project is referred to as the City of Tucson Major Transit Investment Study and is currently in the Alternatives Analysis phase of study. Transit modes being evaluated for this study include rapid bus circulator and modern streetcar. The transit alignments being evaluated are illustrated in Figure 1.

Multi-Modal Connections

The proposed major transit investment will add a new type of transit service to the City of Tucson's urban core. The high capacity transit system will operate every 10 minutes, 18 to 20 hours per day and will be accessible via connecting Sun Tran bus service. Transfers between rapid bus circulator/modern streetcar and Sun Tran can be made throughout the system but will be primarily focused in the region's two largest activity centers: downtown Tucson and the UA campus. These locations will function as "bookends" at either end of the rapid bus circulator/modern streetcar line and will be connected by frequent transit service.



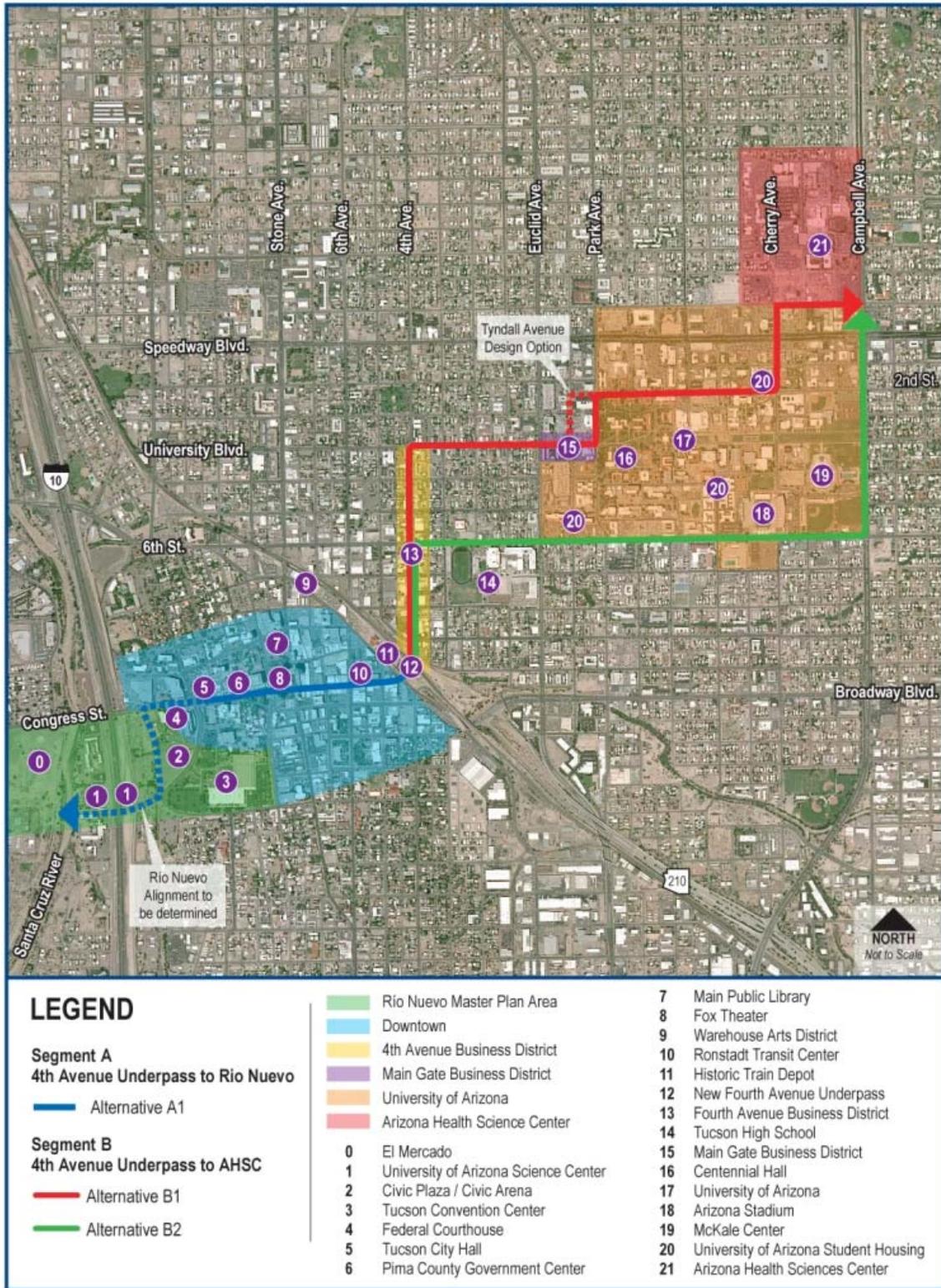
The Ronstadt Transit Center in downtown Tucson will be the larger of the two transit facilities and will provide connections to much of Sun Tran's service area. The UA transfer point will be smaller but will provide connections between University-bound bus service and the rapid bus circulator/modern streetcar system.

2.0 EXISTING CONDITIONS

Sun Tran currently serves the UA by fixed route local (8 routes) and express (4 routes) bus service. Some of these routes stay exclusively on the local street network while others operate on the UA campus mall between Campbell Avenue and Cherry Avenue and serve a bus stop adjacent to McKale Center. The Sun Tran bus routes serving the UA are described in Table 1 and illustrated in the Sun Tran map in Figure 2.



Figure 1: Potential Transit Alignments



Source: S.R. Beard & Associates, 2005.

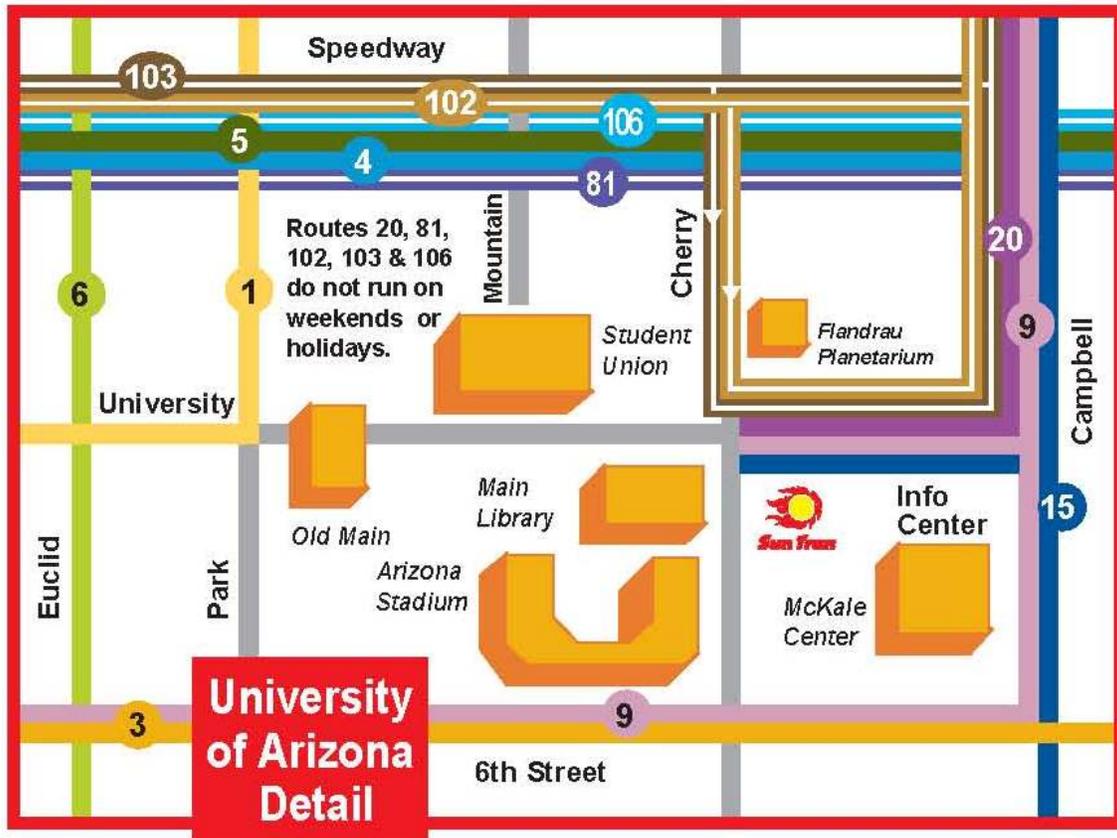


Table 1: Existing UA Transit Service

Route	Weekday Frequency			Service Hours
	Peak	Off-Peak	Evening	
1 (Glenn/Swan)	30	30	60	6am - 10pm
3 (6 th St./Wilmot)	15	30	60	5am - 10:45pm
4 (Speedway)	10	15	30	5am - 10:45pm
5 (Pima/W. Speedway)	30	30	n/a	5:30am - 7:30pm
6 (S. Park Ave./N. 1 st Ave.)	15	30	30	4:30am - 8:30pm
9 (Grant)	30	30	60	4:45am - 9:45pm
15 (Campbell)	15	15	30	5:30am - 10pm
20 (W. Grant/Ironwood Hills)	30	30	n/a	6:30am - 6:30pm
81 (Tanque Verde Express)	2 trips	n/a	n/a	Peak direction only
102 (Ina Rd. Express)	3 trips	n/a	n/a	Peak direction only
103 (Oldfather Express)	2 trips	n/a	n/a	Peak direction only
106 (Swan Express)	1 trip	n/a	n/a	Peak direction only

Source: Sun Tran, 2005.

Figure 2: Existing UA Transit Service



Source: Sun Tran, 2005.



3.0 BUS INTERFACE ALTERNATIVE

Implementation of the proposed rapid bus circulator/modern street system will allow the reconfiguration and reallocation of some Sun Tran service in the study area. Some of the routes currently serving downtown Tucson would be replaced by the rapid bus circulator/modern streetcar line and instead be rerouted to serve the UA transfer point. Efficiencies resulting from the reconfiguration of routes would be reallocated to express bus service.

For example, the Route 9 currently operates between Grant Road and downtown Tucson via the UA on Campbell Avenue and 6th Street. Given the level of investment being made between the University and downtown with the rapid bus circulator/modern streetcar system, it would be possible to terminate the Route 9 at the UA instead of downtown since more of the riders are headed to the UA in the first place. Those passengers destined for downtown Tucson are primarily riding the bus in the peak hour and therefore the new Route 9 could be supplemented by a Route 9 express that serves downtown Tucson in the peak hour only. This operating scenario would force a transfer to the rapid bus circulator/modern streetcar to reach downtown in the off-peak but this is expected to impact a small number of passengers.

Under the proposed bus interface alternative, Routes 1, 4, and 9 would no longer serve the Ronstadt Transit Center in downtown Tucson and would instead terminate at the UA campus. Routes 4 and 9 would be supplemented by new express bus service to downtown that operates in the peak hour only. The benefits of terminating the Routes 1, 4, and 9 at the UA campus on are twofold:

- The UA would be served by high level of bus service that would connect seamlessly with rapid bus circulator/modern streetcar. These connections would occur at multiple locations throughout the UA campus and offer improved access for students, faculty, staff, and visitors and would supplement the existing UA transfer point located on the UA mall at the east end of campus.
- The new Ronstadt Transit Center, which will be smaller in size (12 bus bays) than the existing facility, will be able to accommodate potential service increases that would result if the proposed RTA plan is approved by voters in 2006 since the Routes 1, 4, and 9 would no longer serve downtown.

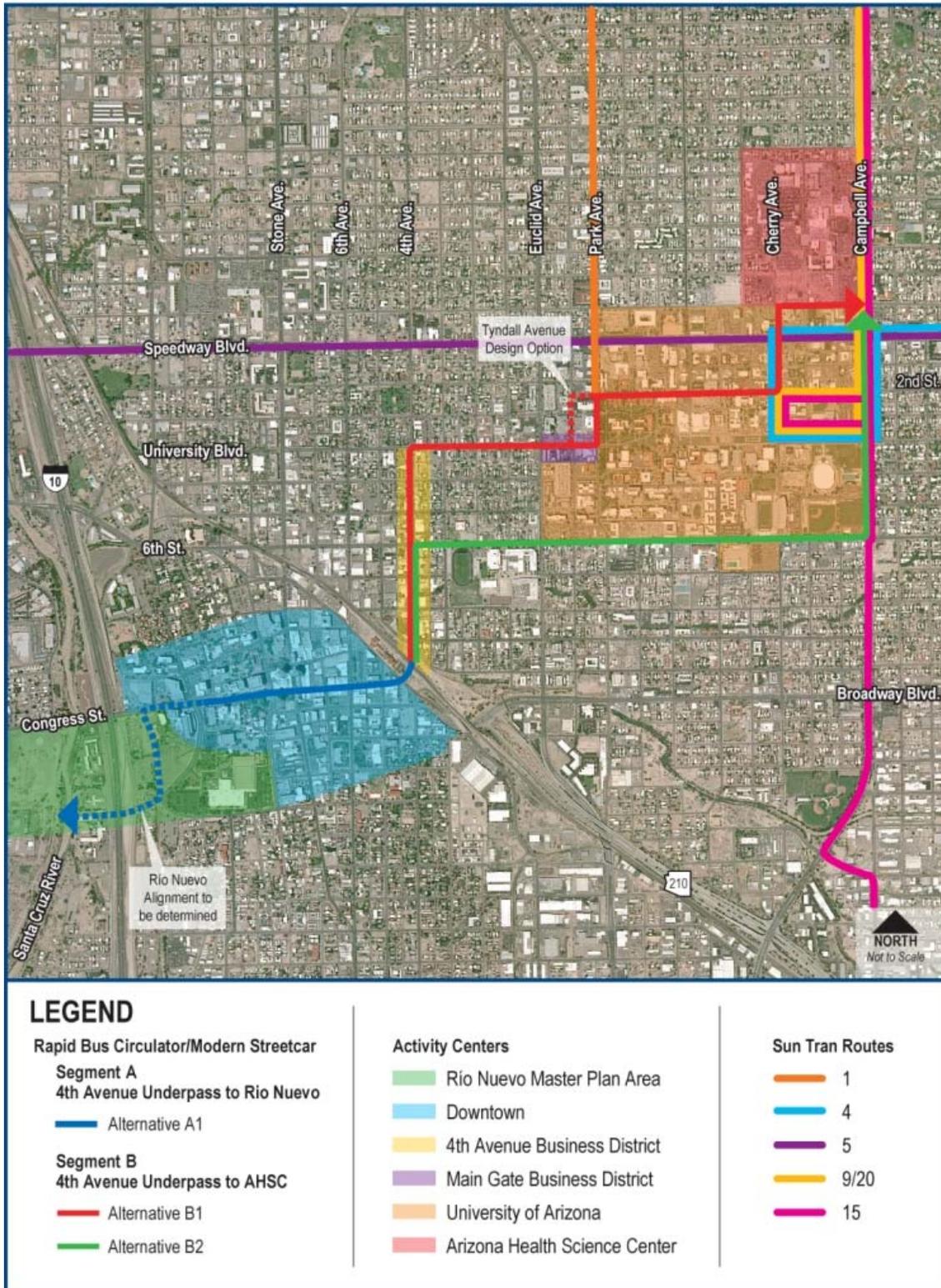
The local Sun Tran bus routes serving the Ronstadt Transit Center and the UA transfer point are described in the Table 2 while UA bus interface is illustrated in Figure 3.

Table 2: Ronstadt Transit Center and UA Bus Interface

Ronstadt Transit Center		UA (Multiple Locations)
2 (Cherrybell/Country Club)	16 (12 th Ave./Oracle Road)	1 (Glenn/Swan)
3 (6 th Street/Wilmot)	19 (Stone)	4 (Speedway)
6 (S. Park Ave./N. 1 st Ave.)	21 (W. Congress/Silverbell)	5 (Pima/W. Speedway)
7 (22 nd St.)	22 (Grande)	9 (Grant)
8 (Broadway/6 th Ave.)	23 (Mission)	15 (Campbell)
10 (Flowing Wells)		20 (W. Grant/Ironwood Hills)



Figure 3: UA Bus Interface



Source: S.R. Beard & Associates, 2005.



4.0 BUS INTERFACE EVALUATION

The section evaluates the impact of terminating the Routes 1, 4, and 9 at the UA, since it will force a transfer to reach downtown in the off-peak (peak hour service would be supplemented by new express bus service). The percentage of riders on Routes 1, 4, and 9 that are headed to the UA versus downtown can be determined using a Sun Tran route profile report, which lists the number of boardings and alightings by bus stop. The results of the Sun Tran route profile report from November 2003 are summarized in Table 3. The entire table is included as Appendix A.

Table 3: Sun Tran Route Profile Report – Downtown vs. UA

	Percentage of Trips Checked			
	All Day		Peak Hour	
	On	Off	On	Off
Route 1 Inbound				
UA Total	2%	12%	1%	16%
Ronstadt Total	0%	19%	0%	18%
Route 1 Outbound				
Ronstadt Total	31%	0%	32%	0%
UA Total	12%	3%	11%	3%
Route 4 Inbound				
UA Total	8%	19%	8%	20%
Ronstadt Total	0%	25%	0%	24%
Route 4 Outbound				
Ronstadt Total	31%	0%	29%	0%
UA Total	19%	8%	21%	7%
Route 9 Inbound				
UA Total	13%	18%	11%	19%
Ronstadt Total	0%	31%	0%	28%
Route 9 Outbound				
Ronstadt Total	40%	0%	40%	0%
UA Total	15%	12%	14%	11%

Source: Sun Tran Route Profile Report, November 2003.

The route profile table above is helpful in understanding the impact of terminating the Route 1, 4, and 9 at the UA. For example, the data for the inbound Route 9 (to downtown) shows that a larger percentage of riders get off the bus at the Ronstadt Transit Center (31 percent) than at the UA (18 percent). However, approximately 13 percent of the total riders check also boarded at the UA. Given the short distance between the UA and downtown Tucson, it is assumed the majority of the riders boarding at the UA exited the bus downtown. In the future, these passengers would be served directly by the rapid bus circulator/modern streetcar system. Therefore, the total number of thru passengers that would be forced to transfer would be much lower than the 31 percent number at Ronstadt indicates, especially since the Route 9 would be supplemented by peak hour express bus service.



5.0 CONCLUSION

Under the proposed bus interface alternative, Routes 1, 4, and 9 would no longer serve the Ronstadt Transit Center in downtown Tucson and would instead terminate at the UA campus. This configuration will provide additional transit service coverage and frequency in the central core. The benefits of the proposed bus interface alternative are as follows:

- The UA would be served by seamless connections between the rapid bus circulator/modern streetcar and Sun Tran at multiple locations on campus.
- Eliminating the Routes 1, 4, and 9 from downtown will allow the new Ronstadt Transit Center to be smaller in size (12 bus bays) and accommodate potential RTA service frequency increases.
- Routes 4 and 9 would be supplemented by new express service to downtown that would provide a faster trip time than what exists in the corridors today.
- The bus interface alternative will force a transfer from Routes 1, 4, and 9 to reach downtown in the off-peak for a small number of riders. This forced transfer will be outweighed by the new transit service connections outlined above.



APPENDIX A

The following table provides the all day and peak hour boardings and alightings for all Route 1, 4, and 9 trips checked as part of the Sun Trans route profile report (November, 2003).

	All Day Total		Morning Peak		Evening Peak		Peak Hour Total		All Day Total		Peak Hour Total	
	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
Route 1 Inbound												
Park/Speedway	2	37	0	20	1	5	1	25				
Park/2nd St	2	25	0	13	1	1	1	14				
Park/University	1	17	0	8	0	0	0	8				
University/Tyndall	1	3	0	0	0	0	0	0				
University/Euclid	5	0	1	0	1	0	2	0				
UA Total	11	82	1	41	3	6	4	47	2%	12%	1%	16%
Ronstadt	0	128	0	33	0	22	0	55				
Ronstadt Total	0	128	0	33	0	22	0	55	0%	19%	0%	18%
Route 1 Inbound Total	668	663	164	159	140	141	304	300				
Route 1 Outbound												
Ronstadt	209	0	15	0	72	0	87	0				
Ronstadt Total	209	0	15	0	72	0	87	0	31%	0%	32%	0%
University/Tyndall	12	12	0	2	7	3	7	5				
Park/University	34	5	0	0	11	1	11	1				
Park/Speedway	33	5	2	0	10	2	12	2				
UA Total	79	22	2	2	28	6	30	8	12%	3%	11%	3%
Route 1 Outbound Total	680	685	81	79	195	195	276	274				
Route 4 Inbound												
Speedway/Campbell	89	180	20	54	27	32	47	86				
Speedway/Warren Underpass	24	57	2	26	9	4	11	30				
Speedway/Highland Overpass	22	106	1	48	6	7	7	55				
Speedway/Olive Underpass	43	91	4	26	14	10	18	36				
Speedway Euclid	33	83	7	16	7	21	14	37				
UA Total	211	517	34	170	63	74	97	244	8%	19%	8%	20%
Ronstadt	0	661	0	115	0	176	0	291				
Ronstadt Total	0	661	0	115	0	176	0	291	0%	25%	0%	24%
Route 4 Inbound Total	2670	2655	571	575	657	660	1228	1235				



	All Day Total		Morning Peak		Evening Peak		Peak Hour Total		All Day Total		Peak Hour Total	
	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
Route 4 Outbound	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
Ronstadt	828	0	136	0	217	0	353	0				
Ronstadt Total	828	0	136	0	217	0	353	0	31%	0%	29%	0%
Speedway/Euclid	94	43	12	1	31	13	43	14				
Speedway/Olive Underpass	115	38	8	5	52	2	60	7				
Speedway/Highland Underpass	94	30	2	13	47	5	49	18				
Speedway/Warren Underpass	52	26	3	9	23	5	26	14				
Speedway/Campbell	156	92	27	15	52	24	79	39				
UA Total	511	229	52	43	205	49	257	92	19%	8%	21%	7%
Route 4 Outbound Total	2677	2727	391	393	831	844	1222	1237				
Route 9 Inbound	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
Campbell/Adams	28	20	4	8	11	1	15	9				
Campbell/Speedway	13	45	2	11	1	11	3	22				
UA Mall	40	92	2	27	16	7	18	34				
6th St/Cherry	5	6	2	1	0	3	2	4				
6th St/Highland	14	2	2	2	2	0	4	2				
6th St/Fremont	11	8	0	2	5	1	5	3				
6th St/Park	24	11	0	1	4	3	4	4				
6th St/Euclid	9	21	0	13	2	0	2	13				
UA Total	144	205	12	65	41	26	53	91	13%	18%	11%	19%
Ronstadt	0	349	0	37	0	98	0	135				
Ronstadt Total	0	349	0	37	0	98	0	135	0%	31%	0%	28%
Route 9 Inbound Total	1131	1115	203	200	284	288	487	488				
Route 9 Outbound	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off
Ronstadt	476	0	114	0	91	0	205	0				
Ronstadt Total	476	0	114	0	91	0	205	0	40%	0%	40%	0%
6th St/Euclid	5	5	1	1	0	1	1	2				
6th St/Park	15	15	1	3	6	2	7	5				
6th St/Santa Rita	4	3	0	1	2	0	2	1				
6th St/Highland	9	4	0	1	3	1	3	2				
6th St/Cherry	3	5	1	2	1	1	2	3				
Campbell/6th St	4	4	1	0	0	1	1	1				
UA Mall	86	45	1	12	31	6	32	18				
Campbell/Speedway	28	28	5	5	6	6	11	11				
Campbell/Adams	20	42	2	9	9	6	11	15				
UA Total	174	151	12	34	58	24	70	58	15%	12%	14%	11%
Route 9 Outbound Total	1180	1227	234	247	283	294	517	541				

Potential Sun Tran/Sun Link Interface

Background:

As part of streetcar planning efforts in 2004 – 2006, potential streetcar/fixed route bus interface recommendations were made in a study authored by Matthew Taunton of HDR Engineering (City of Tucson Major Transit Investment Study; University of Arizona Bus Interface. August 4, 2005). The purpose of these recommendations was to optimize the efficiency of the system upon implementation of the Modern Streetcar by eliminating redundant service through the University of Arizona and downtown Tucson.

TDOT requested that Sun Tran staff provide ridership data, and potential cost savings represented by the proposed changes to the following fixed route service:

Route 1 - Glenn / Swan
Route 3 - 6th St. / Wilmot
Route 4 - Speedway

Route 5 - Pima / W. Speedway
Route 6 - S. Park Ave, / N. 1st Ave
Route 9 - Grant

In addition, staff was to identify other matters of considerations, either concerns or improvements that could be expected with the changes.

Streetcar Interface Considerations, common for all specified routes:

- Each of these changes, whether taken separately or as a whole, will require an Environmental Justice Analysis and/or a Service Equity Analysis as required by Title VI requirements.
- An inter-government agreement (IGA) between the City of Tucson (COT) and the University of Arizona (UA) will be needed to address the additional buses on Cherry Ave. and waiting time at the UA Mall transit stop. Additional seating and accommodations may need to be addressed in the passenger wait areas.
- Public hearings to modify (increase or decrease) the bus service segments identified would be required.
- System-wide, Sun Tran has achieved scheduling efficiencies by interlining routes. Potential savings may be reduced if additional resources or operating costs are needed to disconnect any weekend interlines.

- RTA savings equates to a loss of operating revenue. While the amounts are separated, by City of Tucson (COT) and RTA, RTA savings may have a negative impact on overall COT savings.
- It is recognized across the country that persons can be best attracted to public transportation when direct destination or connections are available. When the need to transfer is increased, passenger use can be projected to decrease.
- Sun Tran fare and automated data collection systems provide limited stop-by-stop information. Sun Tran will be able to gather and analyze significantly more detail of data upon the planned implementation of the smartcard fare technology and the expanded use of Automatic Passenger Counters.
- The study did not address those passengers boarding east of UA who are traveling downtown, and the recommended changes would require those passengers to add another transfer to complete their trip. To determine the negative impact this would have upon ridership of the affected routes, an on-board survey may have to be undertaken. An on-board survey is planned as part of the COA to be conducted this year.

Criteria used:

Miles are based on the planned May 2013 schedule for existing frequencies and needed resources, using fiscal years 2013 and 2014 for service days. Ridership data was collected using the August 2012 schedule and data from July 1, 2012 through June 30, 2013 as observed by data collectors.

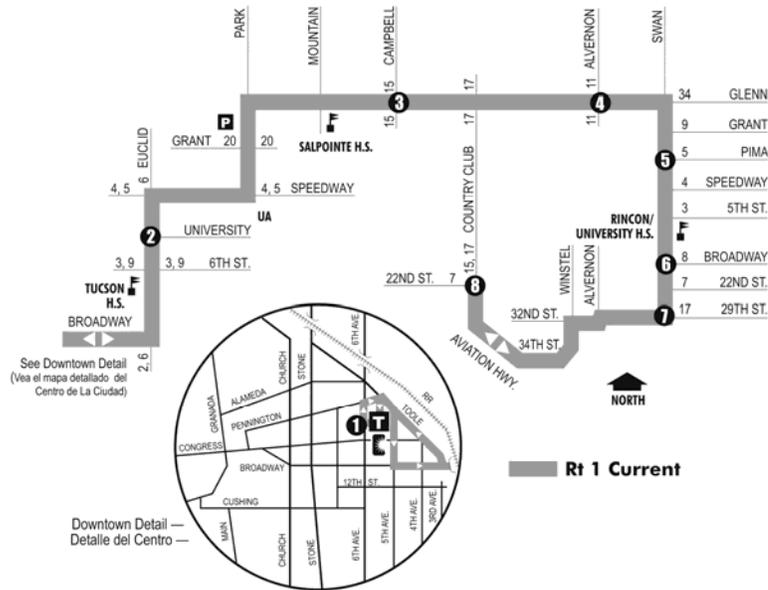
Individual Route Data:

Route 1 (Glenn/Swan) – Study recommendation: Terminate at the UA and eliminate travel to downtown.

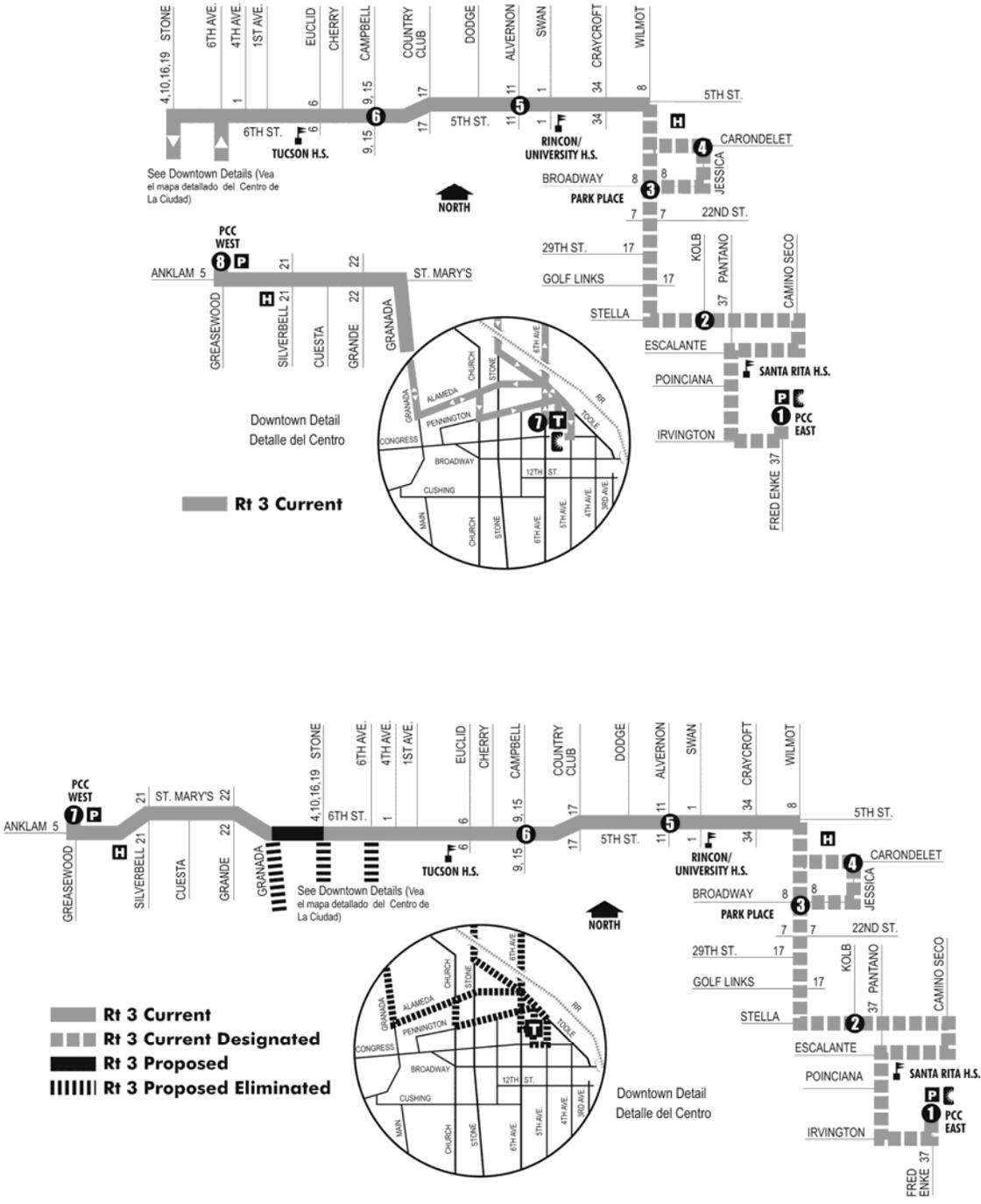
- Eliminating the portion of this route from the west side of the of the University of Arizona (UA) and downtown (RTC) would save:
 - City of Tucson (COT) 20,821.81 miles
 - Regional Transit Authority (RTA) 655.05 miles
 - Total 21,476.85 miles
- Anticipated savings:
 - City of Tucson (COT) \$ 86,411

- Regional Transit Authority (RTA) \$ 2,718
- Total savings \$ 89,129

- Estimates reached by analyzing ridership data currently available indicate that 17.7 percent of all boardings are within the affected area
- Estimates reached by analyzing ridership data currently available indicate that 16.2 percent of all deboardings are within the affected area
- Currently, Route 1 passengers can directly transfer to 31 routes or 73.81 percent of the fixed route system. Upon implementation of the recommended change, Route 1 passengers will have direct transfers to 13 routes or 30.95 percent of the entire system.
- It should be noted that significant long-term detours were implemented to Route 1 due to streetcar construction. The Route 1 is no longer on the direct streetcar corridor, and continues to connect the downtown to points east of the university.



- Estimates reached by analyzing ridership data currently available indicate that 22.07 percent of all deboardings are within the affected area
- Currently, Route 3 passengers can directly transfer to 42 routes or 73.81 percent of the fixed route system. With the recommended change, Route 3 passengers will have direct transfers to 16 routes or 38.10 percent of the entire system.



Route 4 (Speedway) – Study recommendation: The route remains on Speedway and does not enter downtown, combining current routing of the Route 4 and Route 5 on W. Speedway to Pima Community College – West Campus, eliminating duplicative service on Speedway between Campbell and Stone Ave.

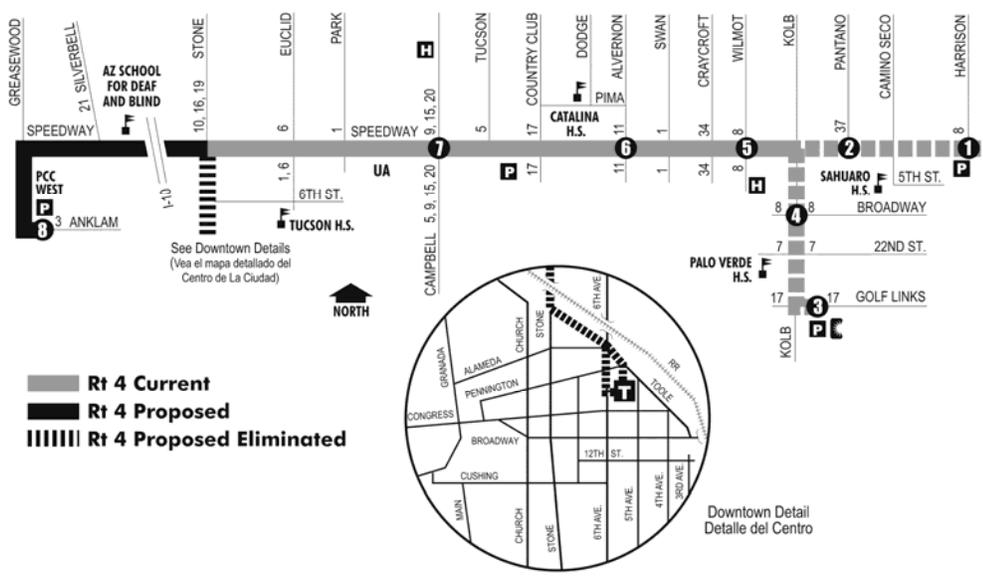
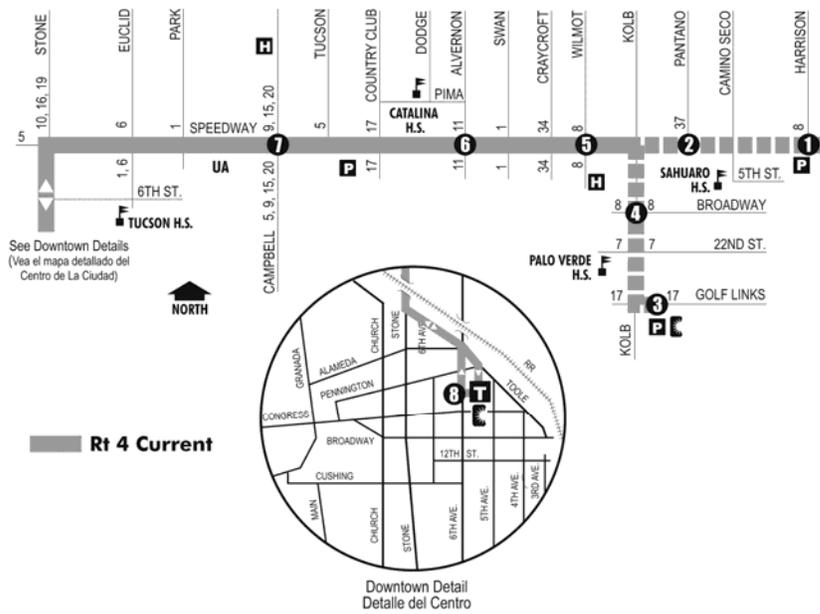
- Expanding the Route 4 on W. Speedway, eliminating duplicative service on Stone Ave between Speedway to downtown (RTC) would increase

○ City of Tucson (COT)	143,674.39 miles
○ Regional Transit Authority (RTA)	9,415 miles
○ Total	153,089.39 miles

- Anticipated cost is:

○ City of Tucson (COT)	\$ 596,249
○ Regional Transit Authority (RTA)	\$ 39,072
○ Total increase	\$ 635,321

- Estimates reached by analyzing ridership data currently available indicate that 32.6 percent of all boardings are within the affected area
- Estimates reached by analyzing ridership data currently available indicate that 34.2 percent of all deboardings are within the affected area
- Currently, Route 4 passengers can directly transfer to 32 routes or 76.19 percent of the fixed route system. With the recommended change, Route 4 passengers will have direct transfers to 25 routes or 59.52 percent of the entire system.



Route 5 (Pima/W. Speedway) – Study recommendation: Combine Route 4 and Route 5 on W. Speedway, terminating the route at the UA Mall.

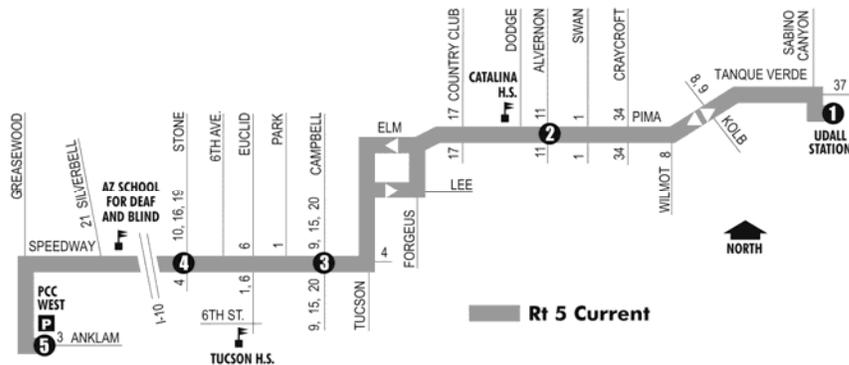
- Eliminating the portion of this route from Speedway west of the University of Arizona would save:

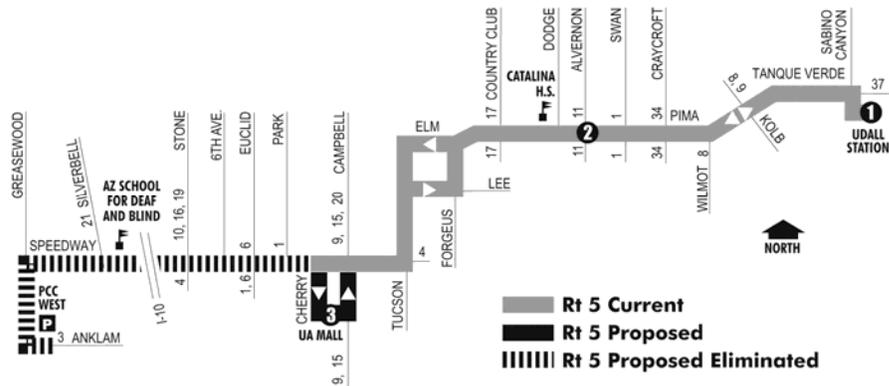
○ City of Tucson (COT)	72,342.49 miles
○ Regional Transit Authority (RTA)	7,979.55 miles
○ Total	80,322.04 miles

- Anticipated savings:

○ City of Tucson (COT)	\$ 300,221
○ Regional Transit Authority (RTA)	\$ 33,115
○ Total savings	\$ 333,336

- Estimates reached by analyzing ridership data currently available indicate that 45.5 percent of all boardings are within the affected area
- Estimates reached by analyzing ridership data currently available indicate that 48.8 percent of all deboardings are within the affected area
- Currently, Route 5 passengers can directly transfer to 16 routes or 38.10 percent of the fixed route system. With the recommended change, Route 5 passengers will have direct transfers to 14 routes or 33.33 percent of the entire system.



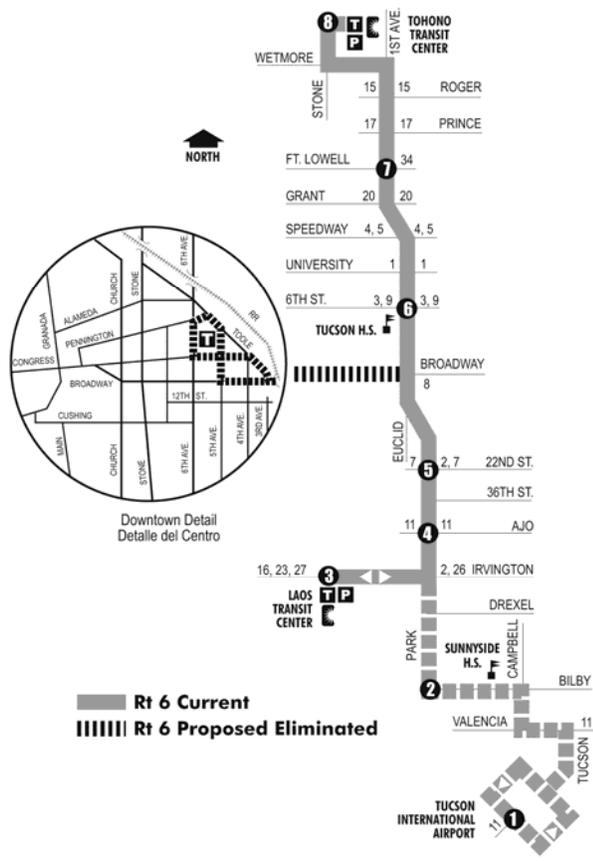
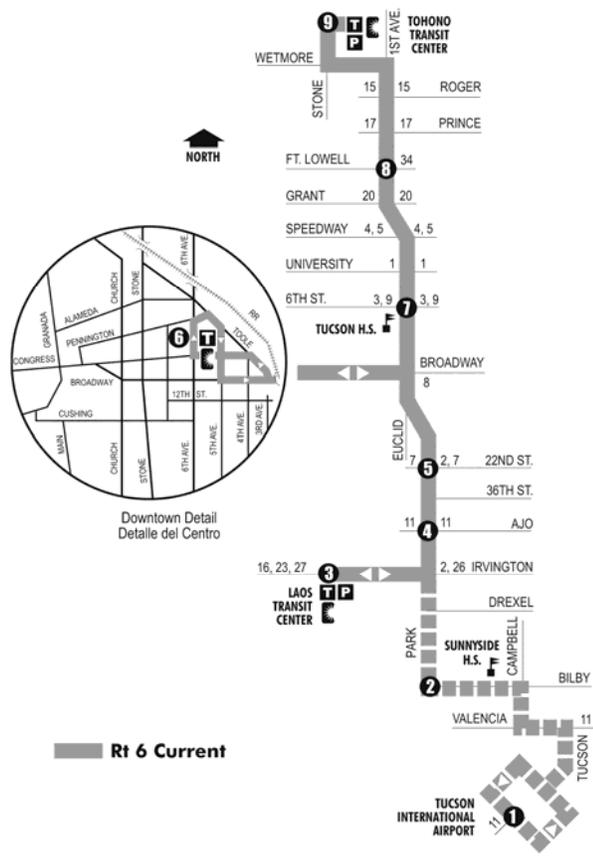


Route 6 (S. Park Ave. /N. 1st Ave) – Study recommendation: Maintain the route on Euclid and do not detour to the downtown RTC.

- Eliminating the portion of this route from Euclid and downtown (RTC) would save:
 - City of Tucson (COT) 41,035.98 miles
 - Regional Transit Authority (RTA) 3,573.19 miles
 - Total 44,609.17 miles

- Anticipated savings:
 - City of Tucson (COT) \$ 170,299
 - Regional Transit Authority (RTA) \$ 14,829
 - Total savings \$ 292,531

- Estimates reached by analyzing ridership data currently available indicate that 15.20 percent of all boardings are within the affected area
- Estimates reached by analyzing ridership data currently available indicate that 17.42 percent of all deboardings are within the affected area
- Currently, Route 6 passengers can directly transfer to 38 routes or 90.48 percent of the fixed route system. With the recommended change, Route 6 passengers will have direct transfers to 25 routes or 59.52 percent of the entire system.

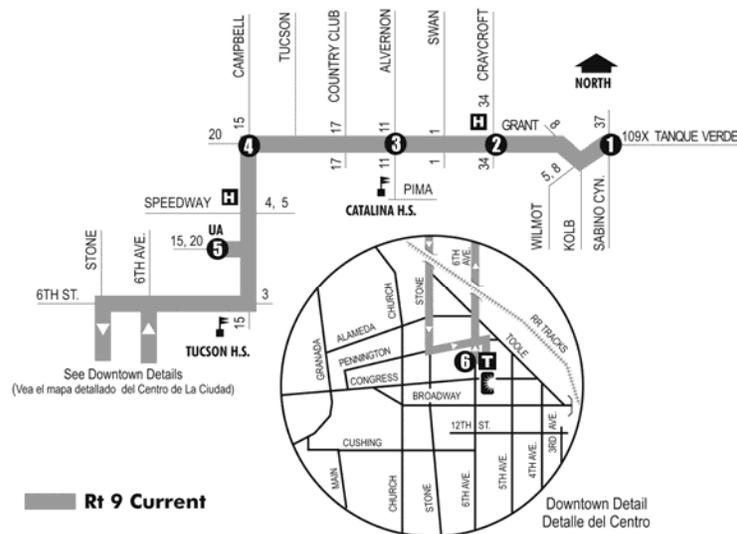


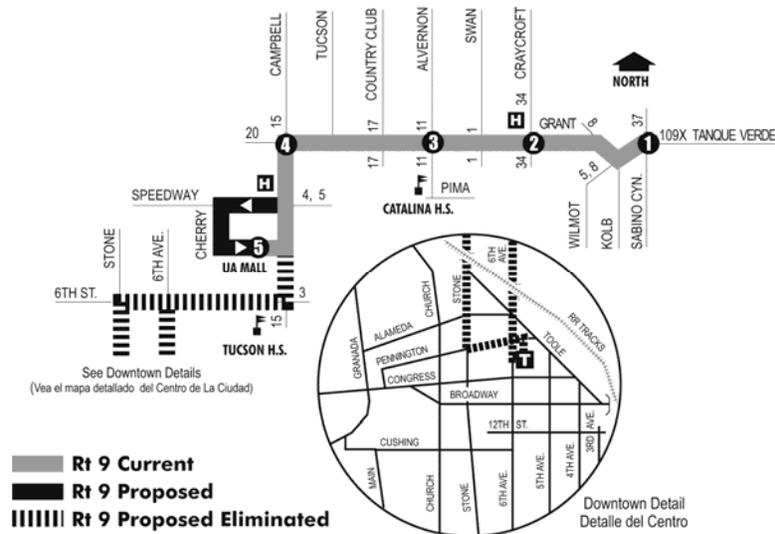
Route 9 (Grant) – Study recommendation: Terminate at UA and eliminate travel into downtown.

- Eliminating the portion of this route from downtown (RTC) and terminating it at the mall area of the University of Arizona (UA) would save:
 - City of Tucson (COT) 59,091.16 miles
 - Regional Transit Authority (RTA) 11,398.12 miles
 - Total 70,489.28 miles

- Anticipated savings:
 - City of Tucson (COT) \$ 245,228
 - Regional Transit Authority (RTA) \$ 47,302
 - Total savings \$ 292,5310

- Estimates reached by analyzing ridership data currently available indicate that 35.9 percent of all boardings are within the affected area
- Estimates reached by analyzing ridership data currently available indicate that 33.9 percent of all deboardings are within the affected area
- Currently, Route 9 passengers can directly transfer to 31 routes or 73.81 percent of the fixed route system. With the recommended change, Route 9 passengers will have direct transfers to 13 routes or 30.95 percent of the entire system.





Summary

Removing the specified routes from downtown represents a potential savings in miles operated annually of 109,641.03, (87,816.97 for the City of Tucson and 15,824.06 for the Regional Transportation Authority).

It represents a potential savings in costs of \$ 430,110, (\$ 364,440 for the City of Tucson and \$ 65,670 for the Regional Transportation Authority).

These changes would affect 58 percentage of the area routes' ridership. These riders may need to change their travel patterns and add a transfer to complete their trips. Likewise, overall transferability for passengers of these routes would be reduced by 59.22 percent.

TDOT and Sun Tran are conducting a Comprehensive Operational Analysis (COA) and a passenger survey with travel pattern questions during 2013. It is suggested that as part of this analysis, data be gathered that may more clearly identify the potential changes in ridership should these routes no longer travel directly downtown and recommendations be finalized pursuant to the COA results.

Appendix B

*2013 Onboard Transit Survey, City of Tucson
Origin & Destination Maps (Moore & Associates, 2013)*

Exhibit G.3 Sun Tran – Route 1

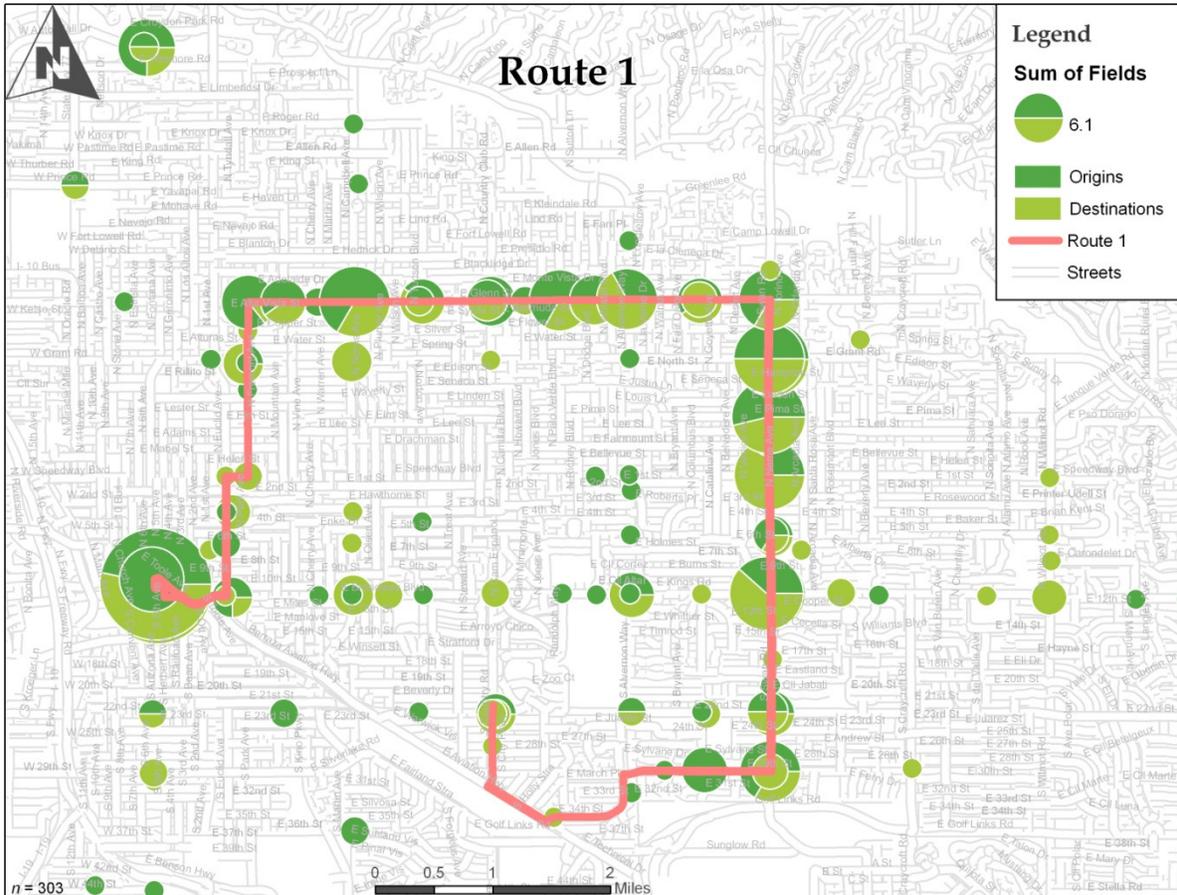
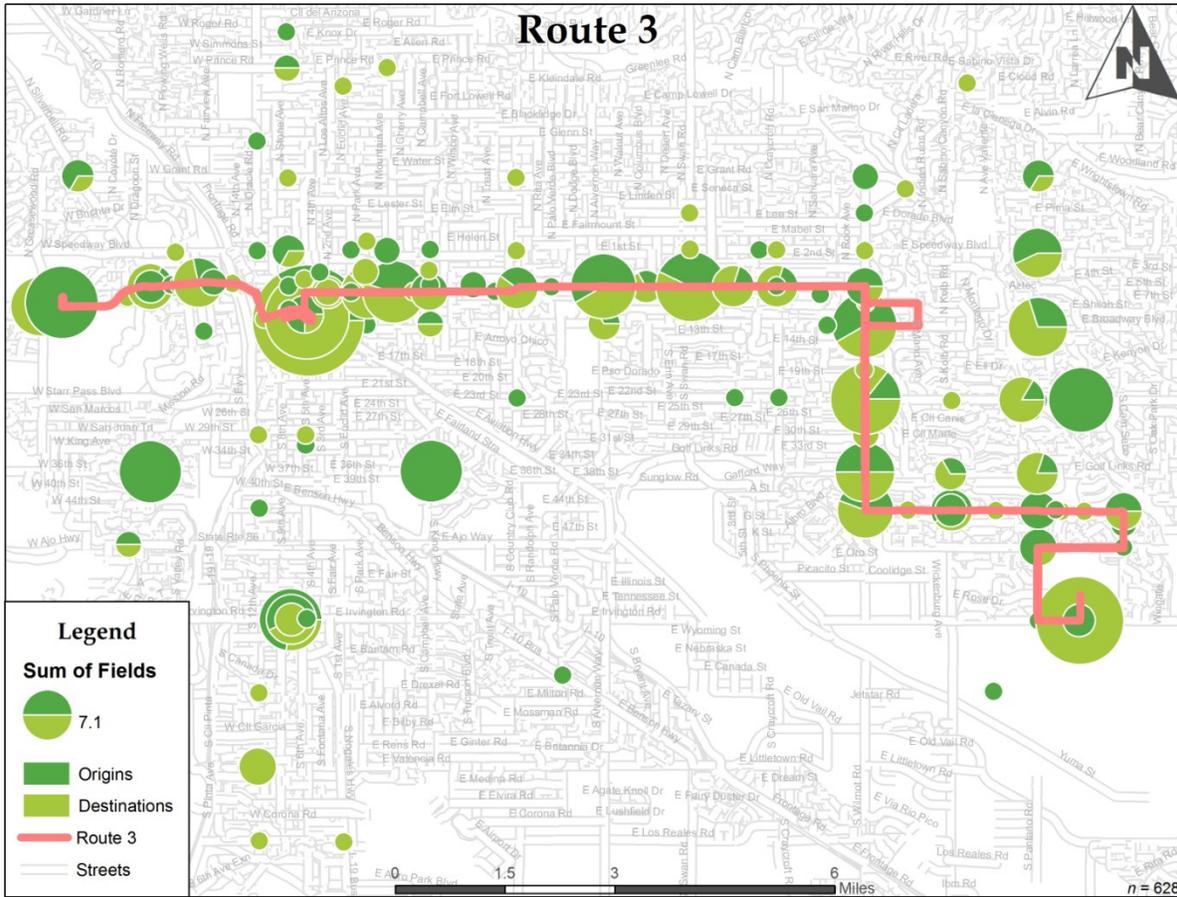


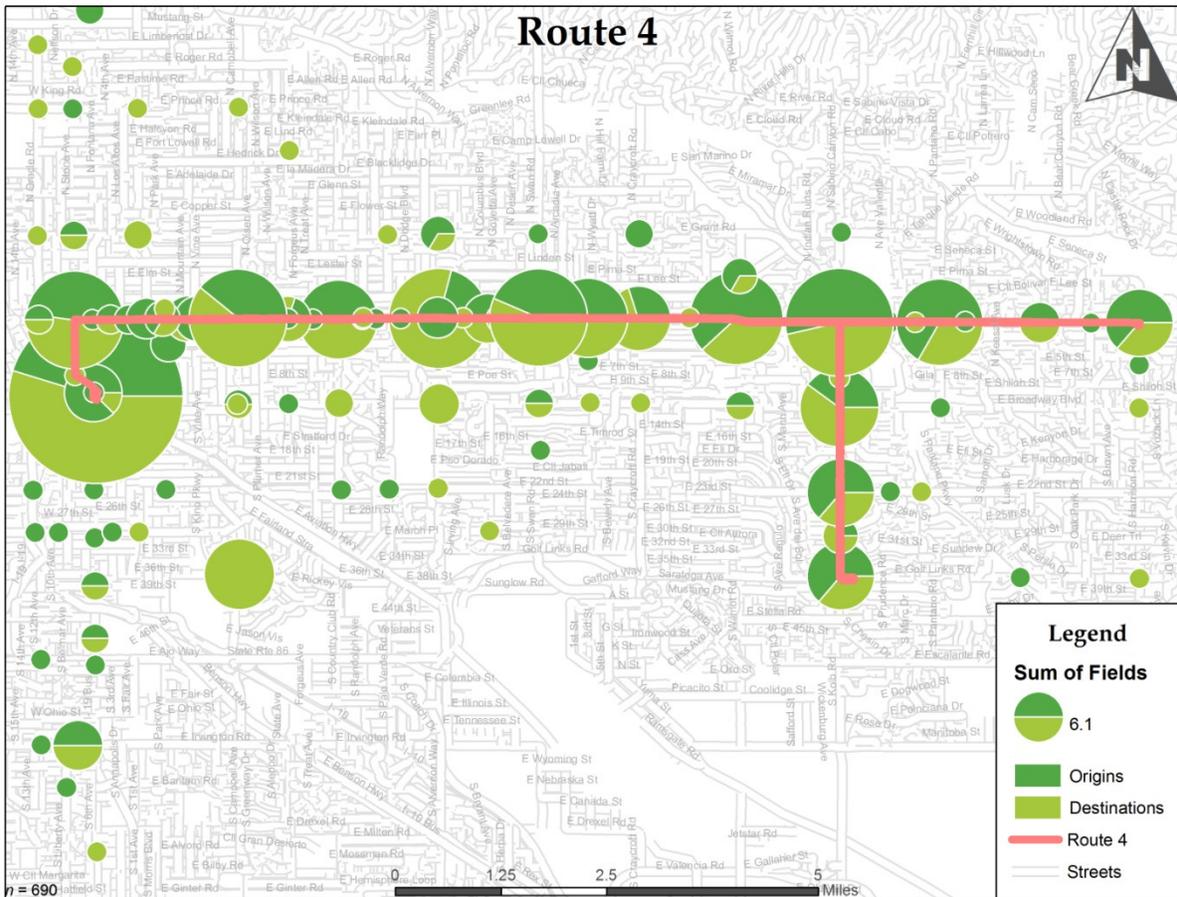
Exhibit G.5 Sun Tran – Route 3



G-7



Exhibit G.6 Sun Tran – Route 4



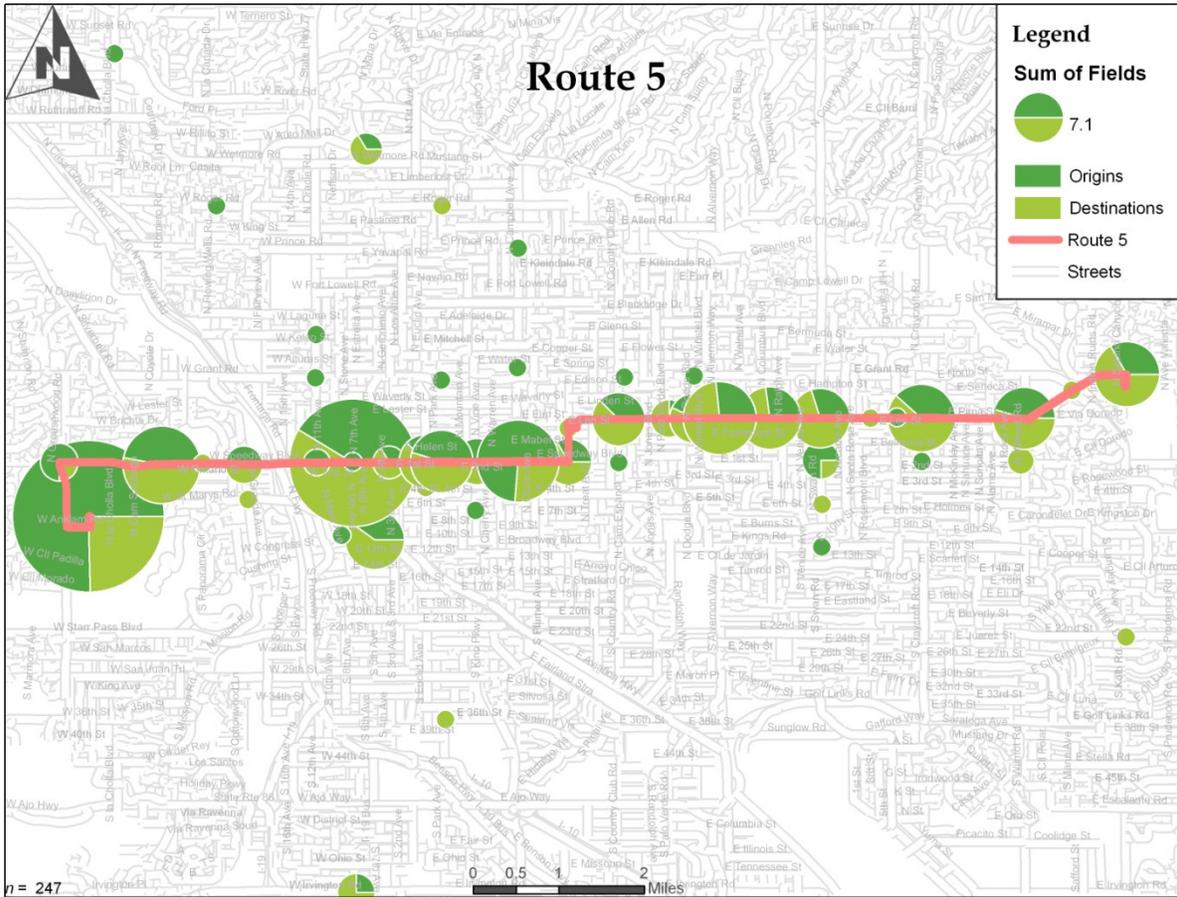


Exhibit G.8 Sun Tran – Route 6

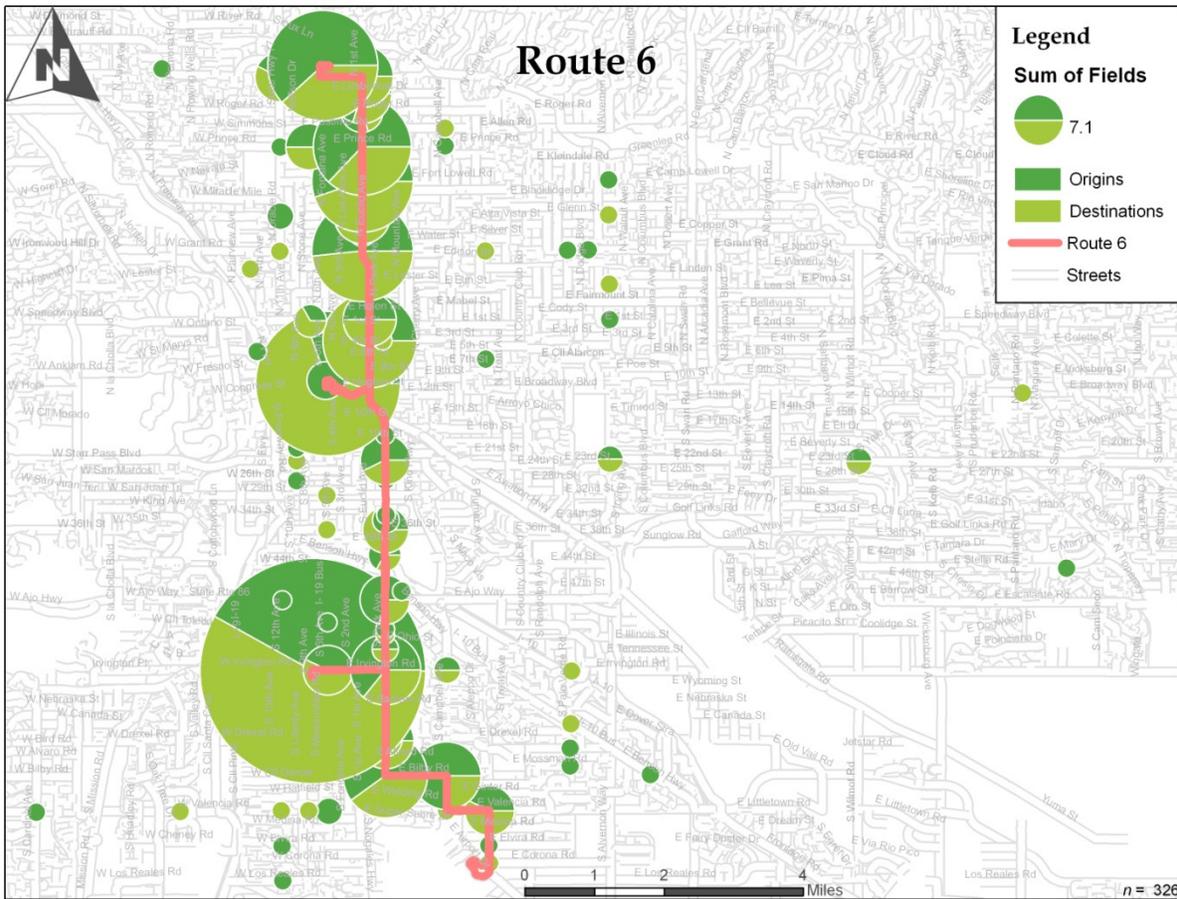


Exhibit G.11 Sun Tran – Route 9

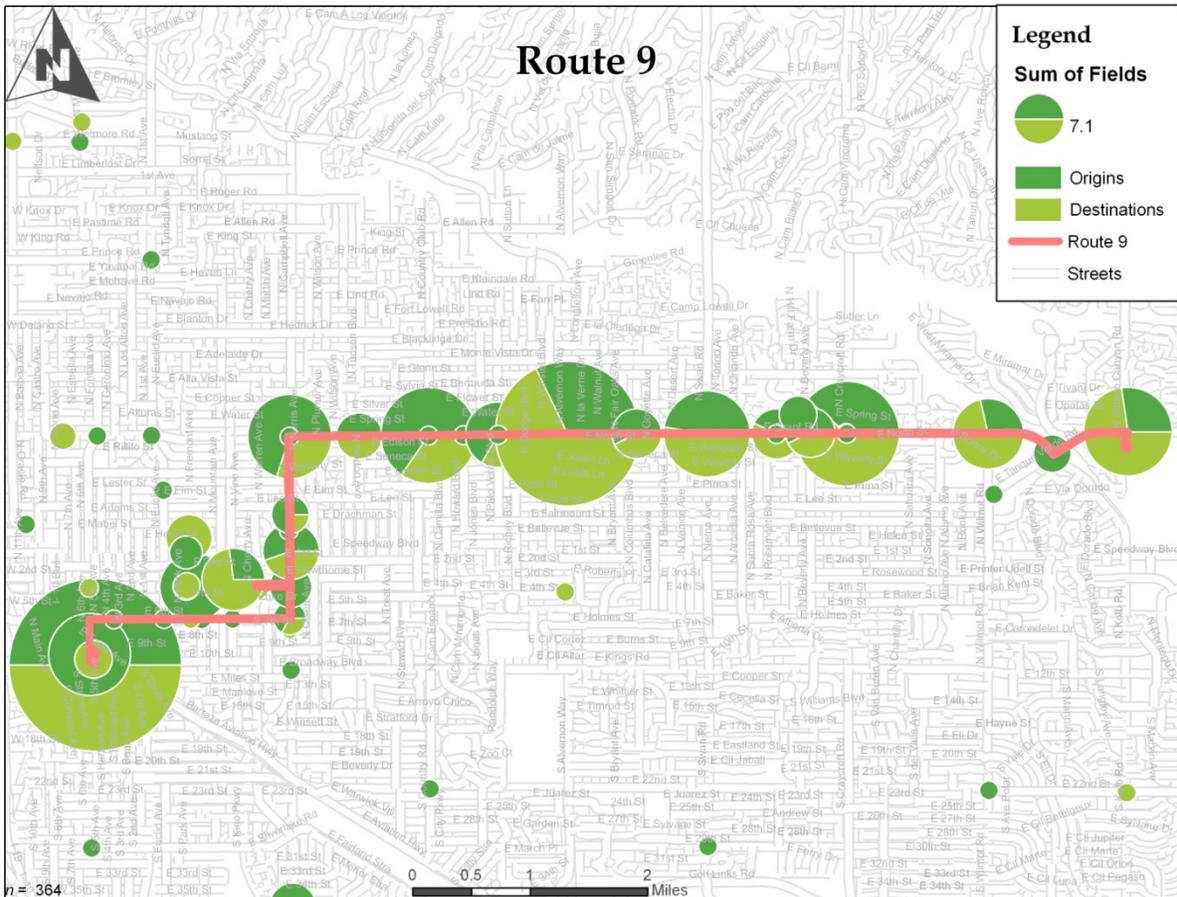


Exhibit G.18 Sun Tran – Route 20



G-20



Exhibit G.19 Sun Tran – Route 21



G-21



Exhibit G.38 Sun Tran Express – Route 109X

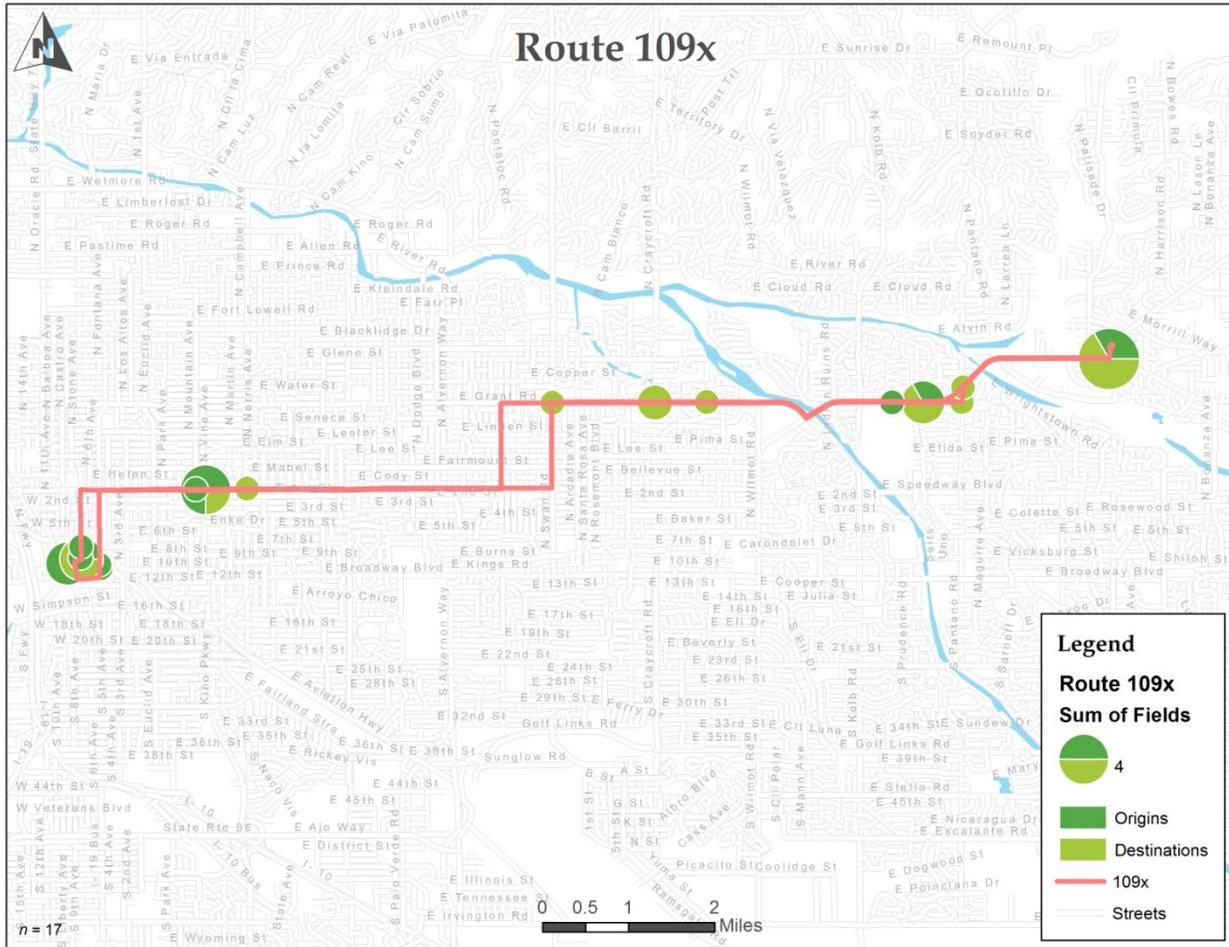


Exhibit G.44 Downtown Loop



G-46

