

UNLV Multimodal Transportation Hub Feasibility Study



JUNE 2009





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Purpose and Need

Introduction

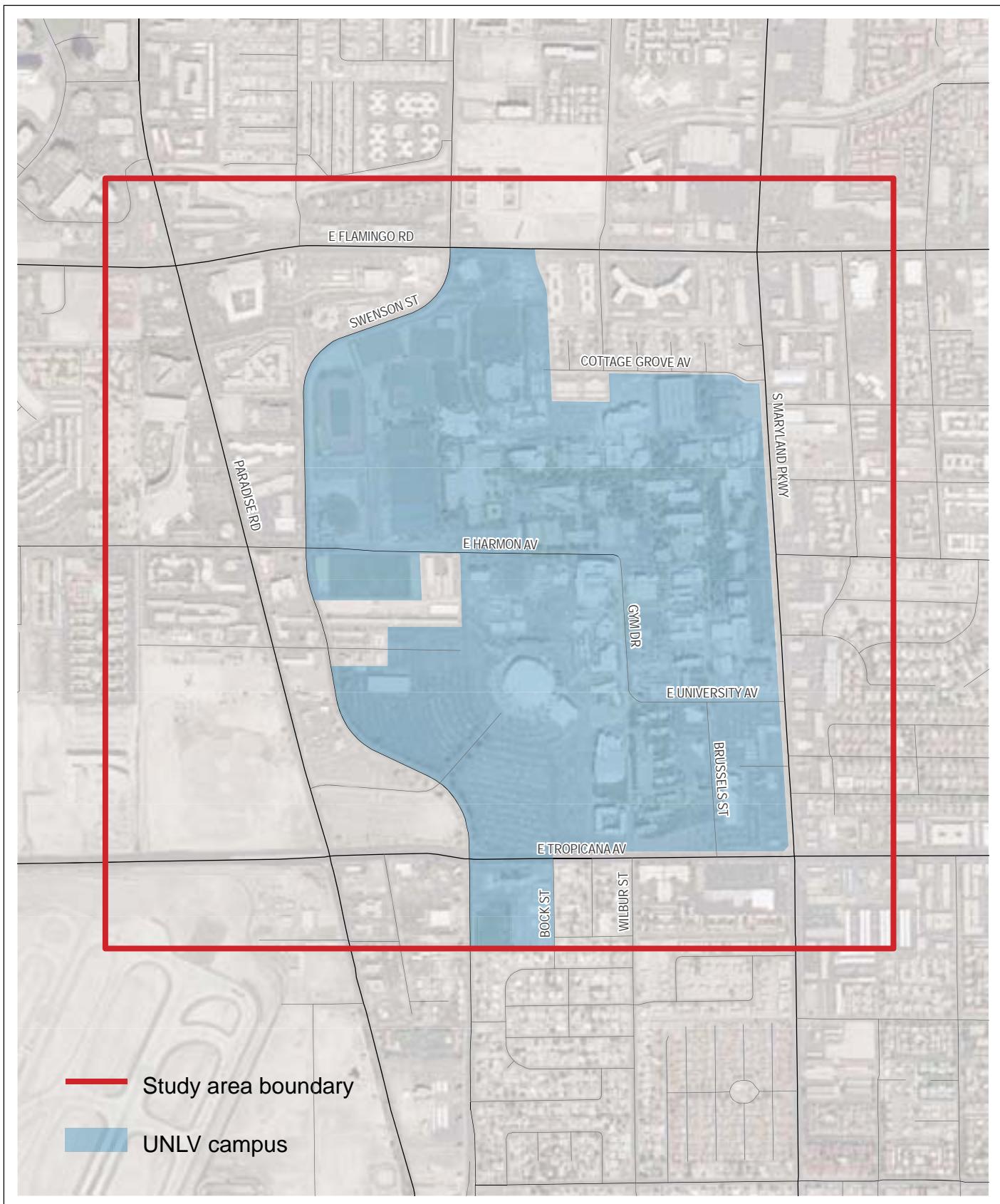
The University of Nevada, Las Vegas (UNLV) is located on a 350-acre campus just east of the Las Vegas "Strip". Over 30,000 students, faculty and staff attend or work at the campus in over 220 academic undergraduate and graduate programs. The campus and surrounding areas have experienced exponential growth in recent years and enrollment numbers continually outpace projections. The original 13,000 square feet of building space on campus in 1957 has grown to over four million square feet today and future projections have that doubling to eight million square feet.

The campus is surrounded on all four sides by principal arterial streets; therefore, expansion to meet future growth must occur through vertical development. On-campus student housing is extremely limited, and most students commute to classes. Parking on campus is limited, and most students park on a large surface lot near the extreme southwest side of the campus. UNLV is continuing to construct large high-rise parking structures to meet future demand; however, many students would choose to ride public transportation to/from campus if the service was more frequent and served interior destinations within the campus itself.

Background

The Regional Transportation Commission of Southern Nevada (RTC) is the Metropolitan Planning Organization (MPO) for the Las Vegas Urbanized Area. Also, RTC is the public mass transportation provider within Clark County, Nevada. Currently, RTC provides a number of different transit services throughout its service area, including the MAX Bus Rapid Transit (BRT) system, the DEUCE circulator bus, and the conventional bus network known as Citizens Area Transit (CAT). The RTC regional long range plan, transit development plan and several corridor-specific plans call for expansion of the successful MAX BRT service operating along North Las Vegas Boulevard. Corridors where rapid transit services are planned or under development include: Sahara Boulevard, Las Vegas Boulevard (south), Flamingo Boulevard, and Maryland Parkway. The latter will serve the UNLV campus and may terminate there, depending on access to McCarran International Airport. RTC is also investigating the possibility of rapid transit service on Harmon to serve the large City Center development on the "Strip". Conceivably, this service on Harmon could be routed through the UNLV campus, provide east-west rapid transit service and connect to other north-south rapid transit lines, particularly the Maryland Parkway service.

RTC has identified the UNLV campus as an area in need of improved transit service and connectivity for students, faculty, staff and visitors. Existing CAT bus routes circumnavigate the campus along the peripheral arterial roads and provide multiple stop locations adjacent to the campus; however, no service or stop locations exist within campus. Due to the rather large size of the campus, this external placement of transit stops results in walk distances averaging approximately one half mile or greater to many campus destinations.



STUDY AREA MAP
FIGURE 1



UNLV supports RTC's desire to improve transit accessibility and connectivity to campus and additional efforts to improve the sustainability of travel to, from and within campus. Providing increased transit mobility and accessibility to interior campus destinations will increase the attractiveness of transit for student trips. These improvements could potentially lead to a shift in travel behavior and help balance the transportation mode choice to, from and within campus. Creating a central location for all modes to come together and interface is a key component of this strategy and which is currently not provided on campus.

If an RTC rapid transit service were connected to the campus, it could also serve trips to and from the Thomas and Mack Center and Cox Pavilion during special events. Typically, these events draw large crowds and could be served very efficiently by rapid transit, thus increasing overall system ridership and alleviating automobile congestion

Purpose of the Current Study

In recognition of the advantages of improving public transportation service to the UNLV campus and providing a terminal for interconnection of various services, RTC and UNLV commissioned this feasibility study in October 2007. The purpose of this study was to "complete a transit terminal feasibility study, alternative site selection analysis, and basic conceptual layout planning for a transportation center within property owned by the University of Nevada, Las Vegas".

Proposed Project (Proposed Action)

Continued growth in demand for student and faculty trips to/from the UNLV campus from all areas of the Las Vegas Valley will support the investment in rapid public transportation services into and through the campus. These services will be most effective if they connect with other RTC regional services and the UNLV Campus Shuttle at a single location on-campus.

The proposed action is the construction of a multi-modal transportation center at an optimum location on the UNLV campus and completion or improvement of campus roadways to allow operation of rapid transit vehicles through the campus. The site selected for the multi-modal transportation center must allow ease of walk access to important destinations on-campus and permit connectivity of north-south and east-west RTC rapid transit routes. The multi-modal transportation center and roadway improvements must be planned and designed to accommodate future RTC rapid transit vehicles, including articulated busses. Due to the constricted nature of most campus roadways, special emphasis must be given to ensure efficient and safe bus movements through the campus and at intersections. The route selected should serve key campus destinations including the Thomas and Mack Center, Cox Pavilion, and UNLV facilities within easy walking distance from University Avenue. The multi-modal facility must meet both Federal Transit Administration and RTC standards.

Purpose of the Proposed Action

The Proposed action offers a number of benefits to the UNLV and the regional transportation system. Among these are the following;

- The proposed action will improve mobility in the vicinity of the UNLV campus and the adjacent and nearby arterials roadways by providing an alternative to automobile trips, thereby reducing demand and congestion and improving the overall level of service.
- Construction of a multimodal transportation center at UNLV permits the connectivity of rapid public transportation routes at this location and increases mobility for transit patrons.



- Providing rapid transit service directly onto the UNLV campus will greatly increase the transit mode share for campus trips.
- Increased transit use for student and faculty trips will decrease the demand for additional parking as the campus population grows, thereby saving both space and capital funds for other purposes.
- The proposed rapid transit service can provide an important alternative to automobile travel for special events held on campus, thereby reducing automobile congestion.

Need for the Proposed Action

The need for the proposed action is based on projected growth in the number of students that will commute to the UNLV campus in the future and the opportunity to serve the campus with rapid transit service planned in arterial corridors adjacent to the campus.

CURRENT CONDITIONS - PUBLIC TRANSPORTATION SERVICE TO UNLV

Currently, CAT provides four fixed routes that serve UNLV:

- Route 201 (Tropicana Avenue);
- Route 202 (Flamingo Road);
- Route 108 (Swenson Street and Paradise Road); and
- Route 109 (Maryland Parkway).

These four CAT routes provide a relatively high level of east-west and north-south transit service to campus. Nearly all four routes serving UNLV provide 24-hour service and average headways range between 15 and 20 minutes. Table 1 below shows these service characteristics.

Table 1: RTC CAT Routes Serving UNLV

| CAT Route | Direction | Span of Service | Average Frequency | Average Weekday Ridership | Weekday Ridership @ UNLV Stops | Estimated UNLV % of Total Line Ridership |
|-----------|-------------|-----------------|-------------------|---------------------------|--------------------------------|--|
| 108 | North/South | 22 hours | 20 minutes | 4,420 | 932 | 21.0% |
| 109 | North/South | 24 hours | 15 minutes | 14,356 | 3,117 | 21.7% |
| 201 | East/West | 24 hours | 20 minutes | 10,200 | 1,479 | 14.5% |
| 202 | East/West | 24 hours | 15 minutes | 12,163 | 2,804 | 23.1% |

A total of 40 bus stops are provided from the four CAT routes to UNLV. A ridership analysis of these stops shows that approximately 8,300 passengers use the four fixed route services at these stop locations. This activity equates to approximately 20% of each line's total ridership. Nearly half of all this transit activity occurs at the stops located at the intersections of Maryland Parkway and Flamingo Road and Maryland Parkway and Tropicana Avenue. These intersections represent the gateway points for westbound service on the 201 and 202 routes, and northbound and southbound service on the 109. These stops also facilitate heavy transfer activity from the north-south routes to/from the east-west routes that may not necessarily be UNLV riders. Figure 2 and 3 show boardings and alightings by stop location at the UNLV stops.



The highest single boarding locations for the UNLV stops occurred at Maryland Parkway and Flamingo Road on route 202's westbound service and Maryland Parkway and Tropicana Avenue on the northbound 109 service. Nearly 2,000 daily boarding occurred at these two locations from these two routes, 23% of all boarding activity for UNLV stops. The top alighting activity locations were also located at these two stops for the corresponding services operating in the opposite direction. These findings show a strong ridership market west of campus along the route 202 (Flamingo Road) corridor and north of campus on the 109 (Maryland Parkway) corridor. Appendix A shows detailed ridership for the UNLV stops.

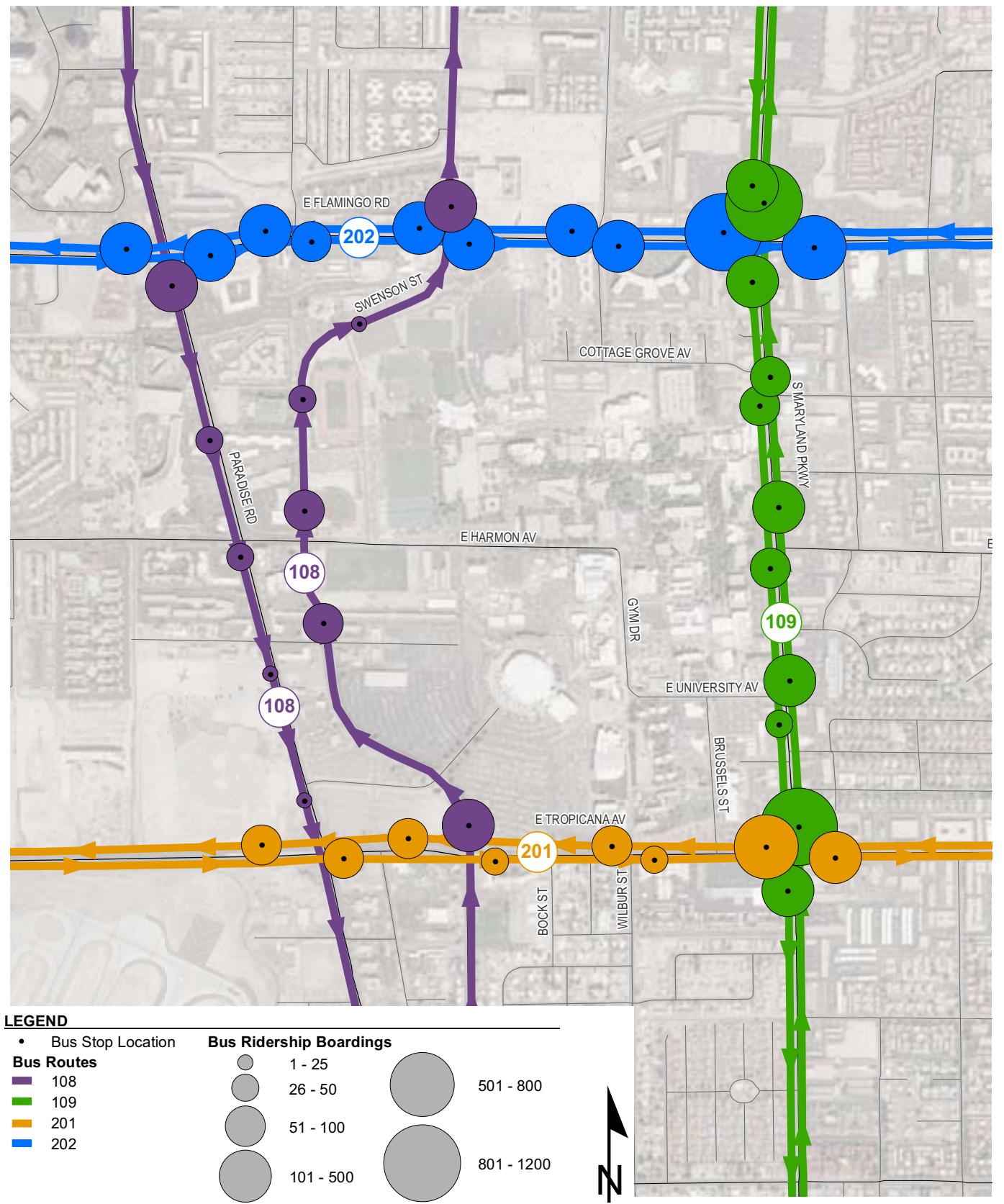
CURRENT CONDITIONS - CAMPUS TRAVEL PATTERNS

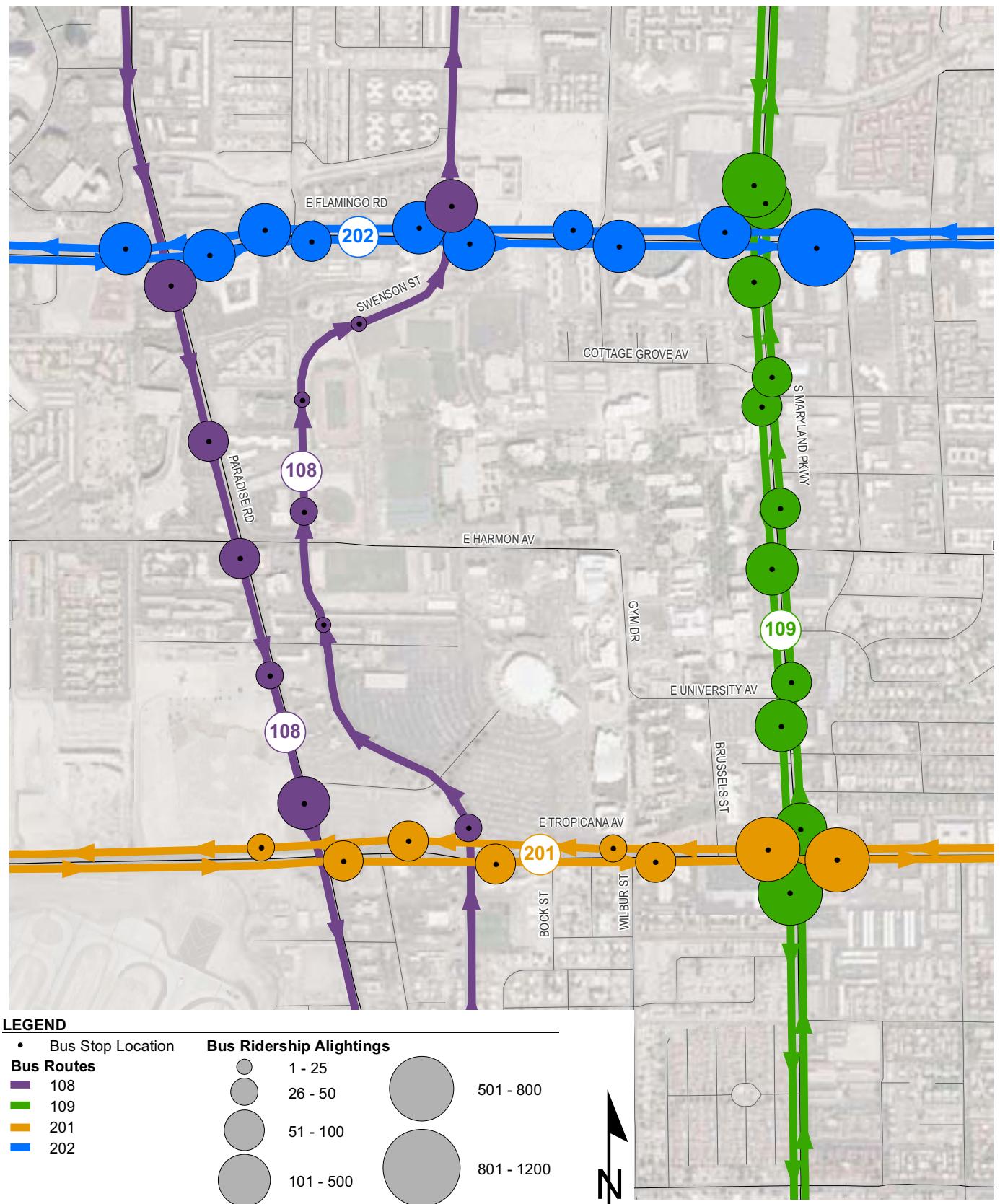
While an increase in campus population will contribute to the institutional success of the University, challenges have developed in planning for this growth. One of these challenges is accommodating the future travel demands to, from and within campus for students, faculty, staff, and visitors. The predominant growth pattern that has occurred within many areas of Clark County is urban sprawl. This has resulted in a high percentage of auto use and increased trip lengths and travel times for student and faculty home-campus trips. Inadequate transit service that requires multiple transfers and travel times comparable to the automobile discourages a greater transit mode share. Planning that focuses on accommodating future auto access to the University may be unsustainable given the scarcity of land for campus development and future roadway congestion.

Another factor supporting auto use is the low percentage of students living on campus and the high dispersion of students living off campus. Over 90% of UNLV students do not live on campus, resulting in its designation as a commuter campus. Figure 4 shows the home location of students living off campus by zip code. This figure shows the dispersed nature of UNLV students and the overall commute distances that support auto use. This student body settlement pattern, coupled with the surrounding sprawl development, has resulted in a high daily drive-in population to the campus.

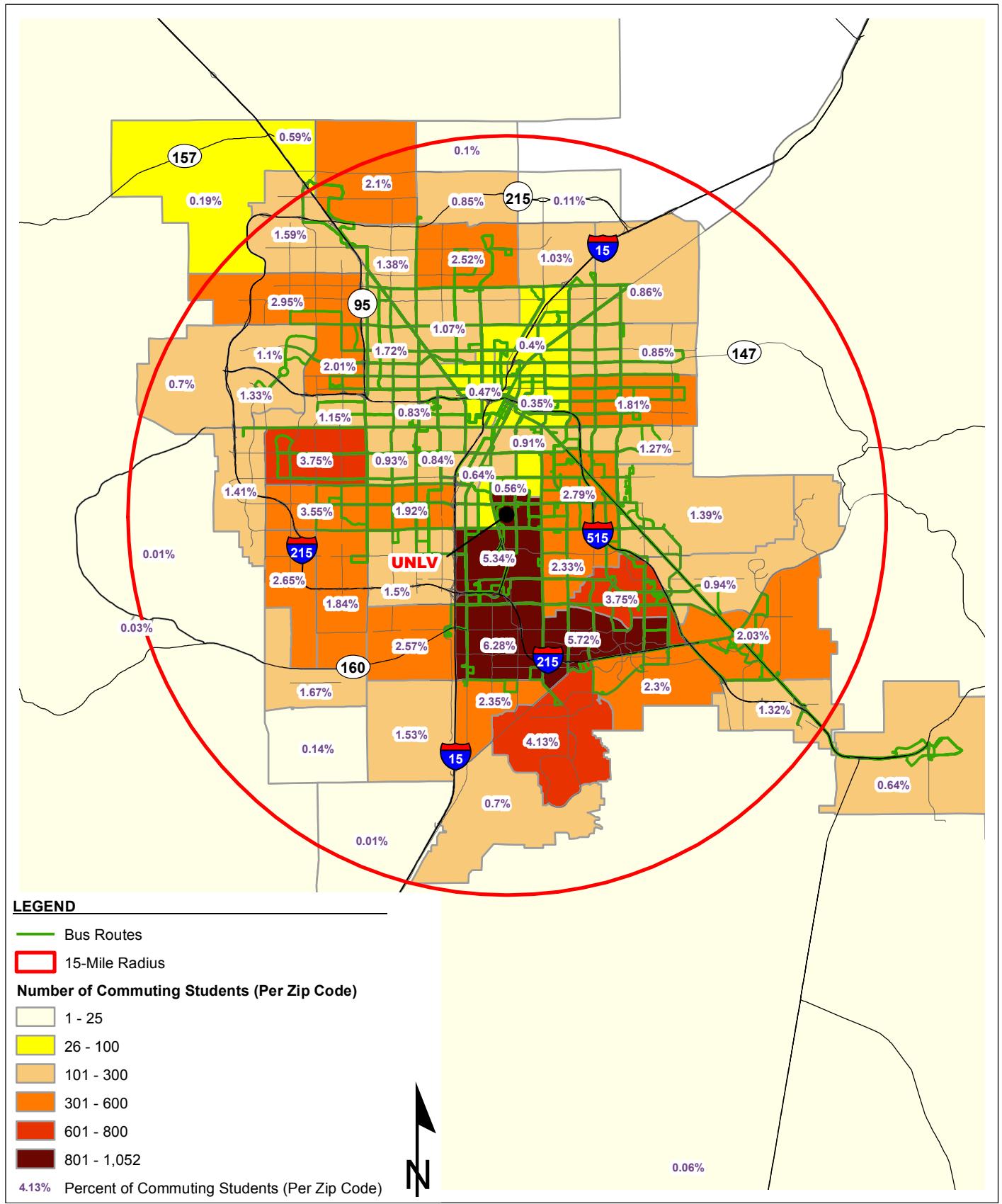
CURRENT CONDITIONS - SURROUNDING ROADWAY NETWORK

The surrounding roadway network is currently designed to support high amounts of auto travel to campus. The campus is bordered by four major arterials; Flamingo Drive to the north, Tropicana Avenue to the south, Maryland Parkway to the east and the Harmon - Swenson one-way couplet to the west. These major arterials provide plentiful motorized access to campus for the surrounding neighborhoods and regional communities.





RTC CAT BUS RIDERSHIP ALIGHTINGS
FIGURE 3





CURRENT CONDITIONS - CAMPUS CIRCULATION

While auto and bus access to campus may be plentiful, access within campus is primarily restricted to non-motorized modes. Cross campus circulation in any direction for motorized modes is not possible with the current roadway network. Harmon Avenue provides the most penetration to the central campus terminating at the "I" metered parking lot behind the Lied Library. Other access roads from motorists on campus include University Road and Brussels Street in the southeast portion of campus and Tarkanian Way and Thomas and Mack Drive in the southwest corner of campus near the Thomas and Mack area.

The majority of parking lots and structures are located on the periphery of campus, requiring motorists to switch to pedestrians once parked and on campus. This arrangement coupled with the limited internal access for motorists creates a pedestrian- and bicycle-oriented environment within campus. An interconnected series of pathways and bikeways allows a high level of circulation within the limits of the surrounding arterials roads.

UNLV also provides a free campus shuttle for all student, faculty, staff, and visitors called "The Ride". A total of five handicapped accessible cut-a-way vehicles are available, each with a total seated capacity of 22 passengers. One route operates in the southwest quadrant of campus, linking together a number of large parking lots including the Thomas and Mack Center lots and free lots and the Lied Library located at the central portion of campus. A total of 15 stops are available along the route that weaves approximately two and half miles through campus. The limited street network found internally on campus restricts accessibility to the academic areas of campus but does use Harmon Avenue to access the central area of campus near the library.

Service on "The Ride" is provided year-round, but on a limited schedule during semester breaks. It operates on 8-10 minutes frequencies during the hours of 7:00 AM – 10:30 PM Monday through Thursday and 7:00 AM – 5:30 PM on Friday. Saturday and Sunday service is not provided and the shuttle is not in operation when school is out of session.

In 2007, the shuttle carried 133,856 passengers, a 66% increase over 2006. On average this ridership equates to between 600-700 riders per day. Since the service is still relatively new, the full ridership potential of the service may not be reached for a few more years.

Relationship to Other Plans and Projects

While the multi-modal facility should be designed to meet current needs, the ability to serve future travel needs is even more important. Considerations for future plans and projects by both RTC and UNLV are a critical step toward identifying a preferred placement of a future multi-modal hub. The ever-changing transportation and land use characteristics on and around campus makes these considerations especially important.

To accommodate future regional transportation needs, RTC has identified a series of improvements to the regional transit network. The backbone of this future service is the designation of a Regional Fixed Guideway (RFG) that will connect the communities of Henderson, Las Vegas and North Las Vegas with the Las Vegas Resort Corridor. The system will consist of rubber tire transit vehicles integrated with the following elements to create a rapid transit system:

- Level platform boarding





- High capacity vehicles with multi-door access
- Dedicated running way
- Off-board fare collection
- Specially designed and branded stations and platforms.

The proposed alignment of the RFG is shown in Figure 5. This future line haul transit network will be supplemented with a series of Bus Rapid Transit (BRT) routes that will feed into the system at critical nodes. Among these BRT routes proposed for future consideration are the Flamingo (east-west) and Maryland Parkway (north-south) routes, both of which run adjacent to UNLV. Harmon Ave, another east-west corridor just south of Flamingo, has also been considered by RTC staff which would directly link Westside neighborhoods, the City Center¹ project, the Las Vegas Strip, UNLV, and neighborhoods to the east.

As earlier stated, UNLV is expected to nearly double its on-campus building square footage while not increasing in total land area. In order to accomplish this, UNLV must develop more vertically in a true urban style, and develop all available, underutilized or vacant land.. As the University intensifies its development on-campus, adjacent properties along the border arterials are also expected to densify and take on a more urban form. This development is likely to involve mixed-uses including residential, commercial, and expanded retail.

Three future UNLV projects that will likely interface in some way with the future multi-modal terminal are:

- The Maryland Parkway Midtown Project
- Tropicana Parking Structure
- University Road Extension

The Midtown Project located along Maryland Parkway is anticipated to significantly change the eastern gateway to the campus and a large stretch of the streetscape between Flamingo and Tropicana. The development east of Maryland Parkway will include primarily mixed-used facilities incorporating commercial and residential units. The streetscape will be transformed to be more pedestrian friendly and encourage transit use. Options are currently being explored for dedicated transit lanes along this stretch of Maryland Parkway.

The Tropicana Parking Structure is in its initial stages of design and construction. Phase 1 of the structure will occupy the northern portion of the Red Lot and include nearly 1,000 spaces on five levels. This project is expected to be in operation by the end of 2009. Phase 2 of the structure will be located on the southern portion of the Red Lot and be equal in size. A direct connection is expected to be included that would link these facilities and allow circulation between the two structures.

UNLV has protected right-of-way for a future extension of University Road that would connect to Tarkanian Way and the surface parking lots just south of the Thomas and Mack Center. This new roadway would be the only interior road that would traverse through campus. Although not fully defined, passage along this new roadway would likely be limited to transit and service/emergency vehicles only.

¹ The City Center project will include 4,800 hotel rooms, 2,650 residential units and approximately 500,000 square feet of retail, dining and entertainment space.





Development and Evaluation of Alternatives

The process used to identify and screen potential transit hub locations included five steps and resulted in the following outcomes:

- Step 1: Identification of All Potential Sites (Total Sites = 13)
- Step 2: Opportunities and Constraints Screening (Total Sites = 5)
- Step 3: Public Outreach #1 (Total Sites = 5)
- Step 4: Evaluation Criteria Screening (Total Sites = 3)
- Step 5: Circulation and Operations Analysis (Total Sites = 1)

These steps were carried out together with the Technical Working Group (TWG) which consisted of representatives from RTC, UNLV, Clark County and the consulting team. This group met formally every month along with special meetings as deemed necessary by the project team. This process began in November 2007 and concluded in November 2008 with selection of a Locally Preferred Alternative (LPA).

Below is a brief summary of the actions taken at each TWG meeting.

- 12/14/17 – Kick-off meeting to formalize study scope and identify role of TWG
- 02/01/08 – Development of Alternatives
- 03/19/08 – Outreach #1 Results (public scoping session) and Screening of Alternatives
- 04/17/08 – Initial conceptual site plans for screened alternatives
- 05/21/08 – Refined site plans for screened alternatives and selection of TWG preferred site
- 11/06/08 – Final concept for LPA

The time spent between May of 2008 and November of 2008 was spent meeting with various parties from UNLV and RTC to receive the needed support for the TWG's preferred site. Full support of this selection by all parties resulted in the identification of the LPA and the development of an interlocal agreement.

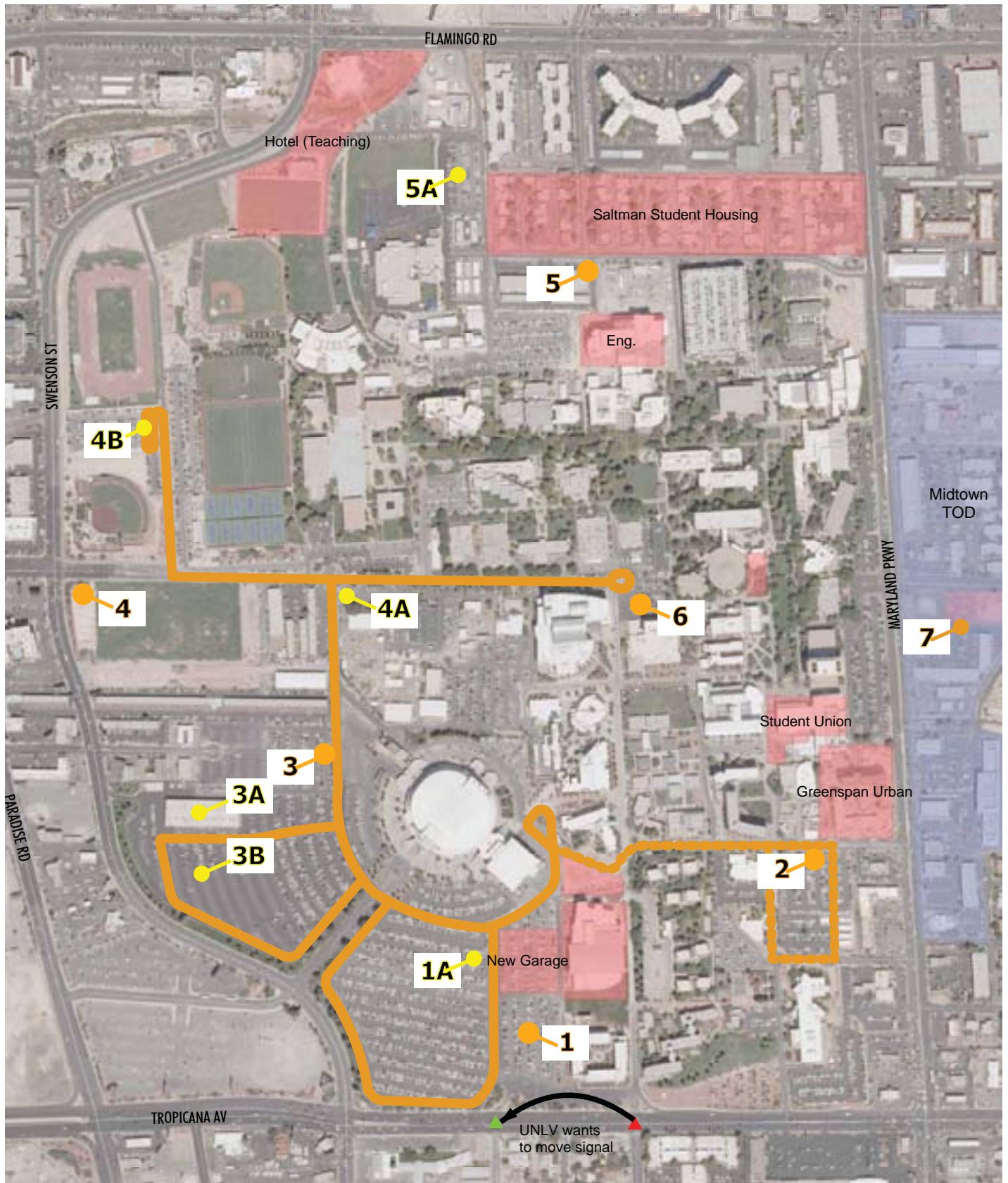
Step 1: Identification of All Potential Sites

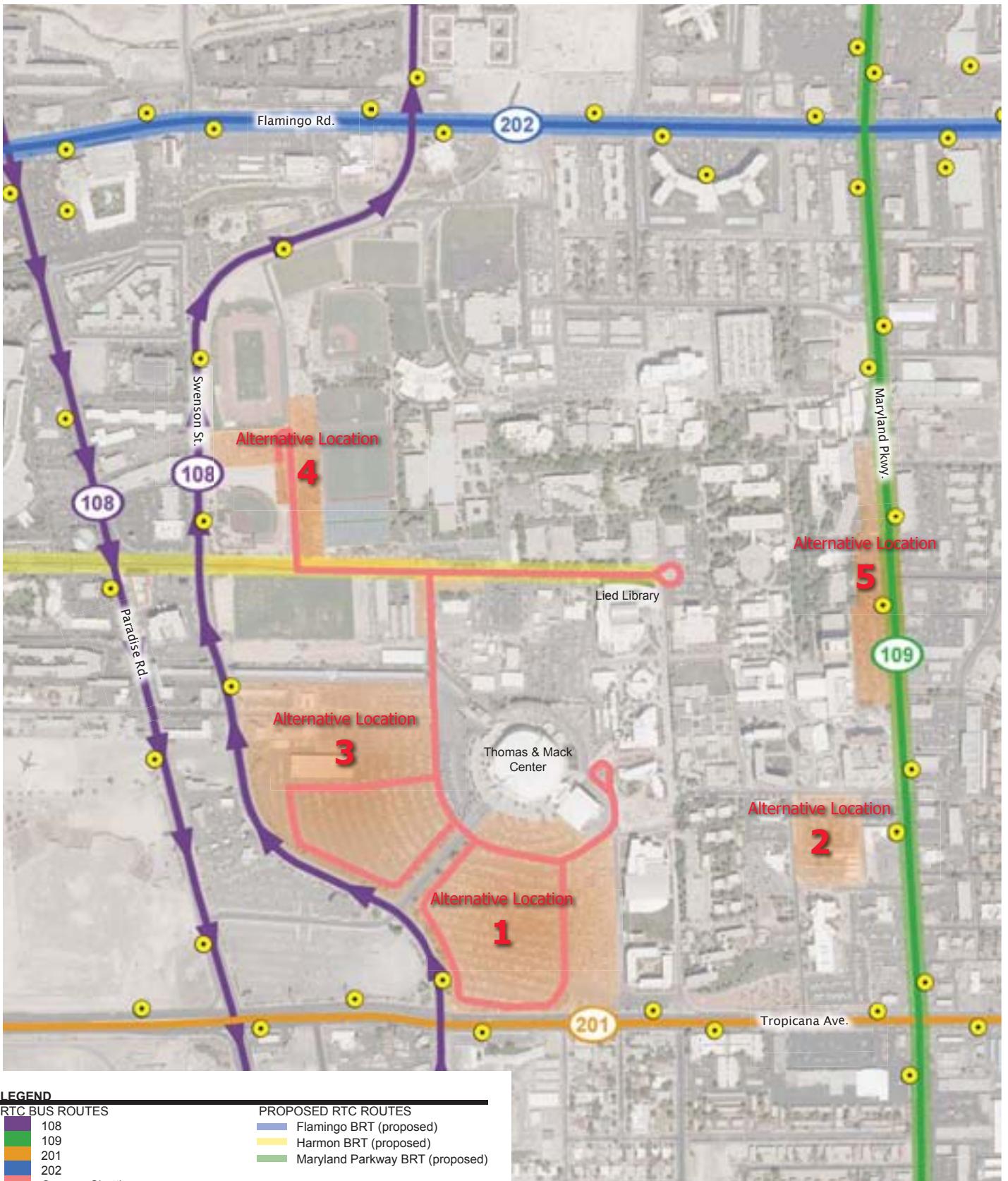
The first meeting of the TWG presented the existing conditions results summarizing the current transit service and relevant planning activities in and around campus. The group was then asked to identify all potential locations for the transit hub facility on a blank aerial map of the campus. A total of 13 sites were identified and grouped into seven sites based on their location within campus. These sites are shown in Figure 6.

Step 2: Opportunities and Constraints Screening

The 13 sites were then analyzed to determine major opportunities and constraints associated with placing a transit facility on that location. This process was completed at the second the TWG meeting with input from all representatives. Factors considered in this process included distance from the center of campus, access to existing transit services and availability of land. Site alternatives were filtered and repackaged down to five options which are shown in Figure 7.







Step 3: Public Outreach Meeting 1

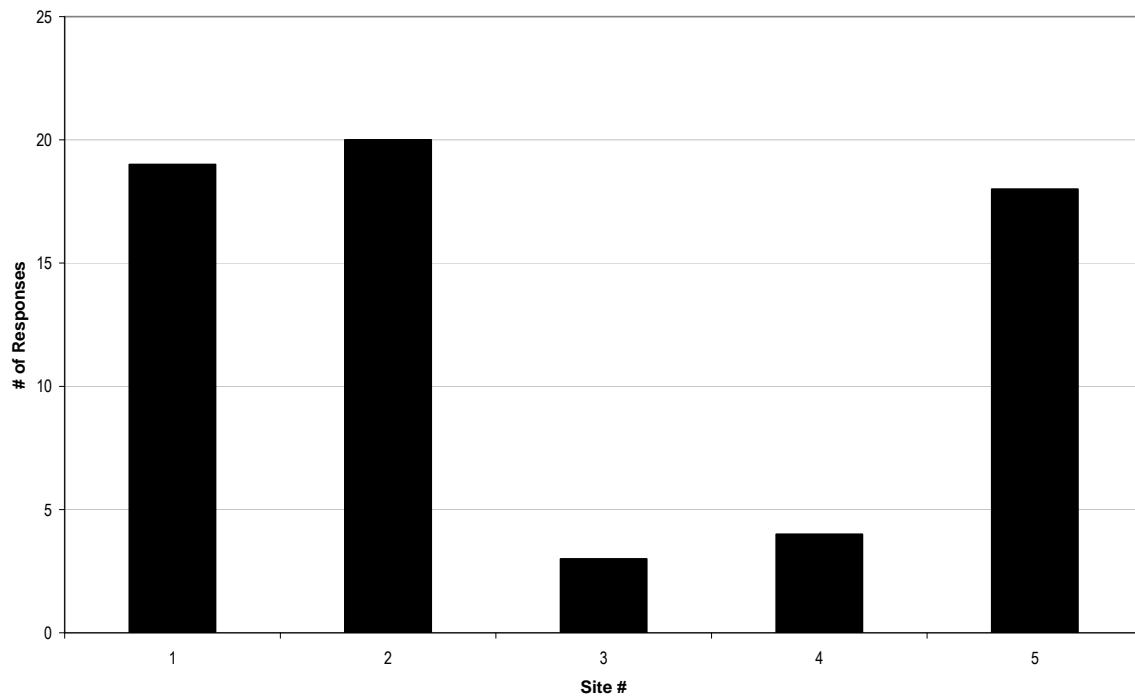
The five site alternatives identified in Step 2 were then taken to the public for input and comment. This public outreach process served three primary functions. First, it asked campus users where they reside and how they commute to campus. Second, it allowed users of the campus to identify the features they would like to see in a future transit facility. Third, it allowed input on a desired location of the facility. One page questionnaires, along with five poster boards, were used to obtain this input. These materials are shown in Appendix B.

To receive this input from the UNLV population the project team, including representatives from RTC, UNLV and the consultants, held a two day event at the UNLV Student Union. The event was publicized on the RTC website, in the UNLV student paper and through flyers distributed around the campus. Five poster boards were created to give participants background information on the study and nature of a transit facility. A questionnaire was also developed to obtain valuable input from the participants.

In total, over 50 respondents shared their thoughts and concerns with the consulting team. Each participant spent between 10-20 minutes with the team member, providing a great deal of useful information to be carried into the next step.

Question 10 on the survey asked students to select the most appropriate location of a future transit facility from the five sites identified in Step 2 and shown in Figure 7. The results from this question are shown in Figure 8 and indicate Sites 1, 2 and 5 as favorable and 3 and 4 as unfavorable. The complete survey results can be found in Appendix B.

Figure 8: UNLV Outreach Site Preference



Step 4: Evaluation Criteria Screening

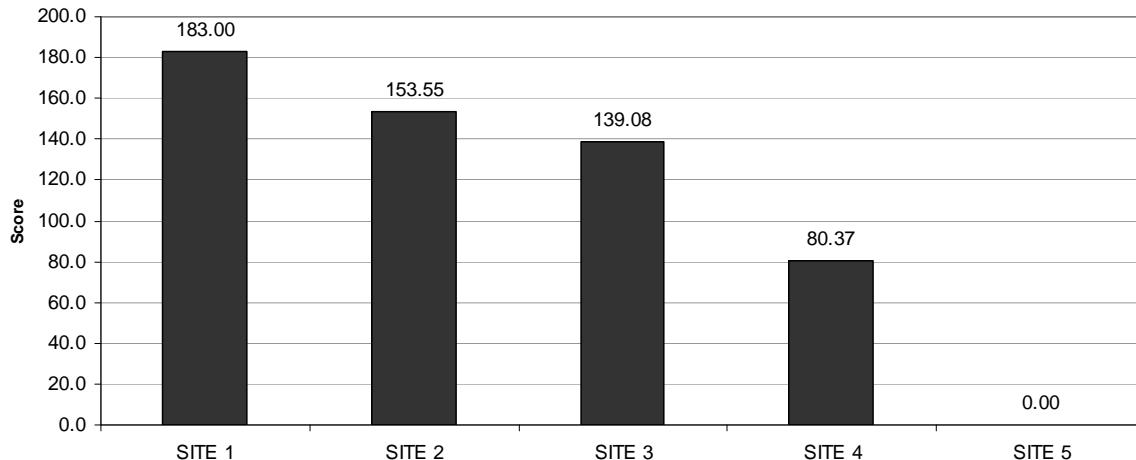
The five site alternatives along with the results from the Student Survey were taken to the third TWG meeting. This meeting asked the group to screen and select the top three sites based on a series of evaluation criteria. These criteria were developed to support the future planning efforts of the RTC and UNLV, while observing the overall feasibility of implementation of the project. Twenty-one different criteria were assigned to four general categories including:

- Connectivity
- Integration with Surroundings
- Implementation
- Sustainability (Community and Campus)
- Operational Considerations

Appendix C provides a description of each of the 21 criteria.

This meeting was an interactive session and allowed the TWG to assign scores and weighting to each of the criteria. The results of the scoring and weighting of each site is shown in Appendix C. Figure 9 shows results of this process and show Sites 1 and 2 as the top ranking sites.

Figure 9: Evaluation Criteria Results - Site Selection



Discussion at this meeting also identified Site 5 as infeasible due to development constraints and recent proposals for future transit operations along Maryland Parkway that would significantly constrain the development of a facility on this site. In addition, Site 1 was expanded to the east to include the areas surrounding the roadway between the Student Services Building and the Student Recreation Center. The final two sites, sites 1 and 2, were then carried forward to the next step of analysis.

Step 5: Circulation and Operations Analysis

Three concepts for each site were taken into step five and assessed to determine the transportation circulation impacts and the transit operation impacts on the site alternatives. This analysis took into account the operations of transit, personal automobiles, campus/commercial vehicles, bikes and pedestrians. This analysis was primarily qualitative, examining locations where these modes were in conflict with each other and how accessible each of the sites would be for existing and future transit operations. A detailed traffic study was performed on the preferred alternative and is described in the section to follow.



TRANSIT CENTER DESIGN SPECIFICATIONS

Preliminary design requirements were identified for existing, 2015, and 2030 operating conditions during this step of the Alternatives Analysis process. Table 2 shows the number of peak hour buses using the facility under the existing (2008), 2015, and 2030 conditions. Based on five minute headways for UNLV shuttles and 5-10 minute headways on RTC services, the facility should accommodate up to 12 and 26 buses per hour, respectively.

Table 2: Anticipated Transit Center Service (Near term and Future)

| Operator | Route Name | Peak Direction Buses 7 AM - 10:30 PM | | | Off Peak Direction Buses 10:30 PM - 7 AM | | | Service Type |
|----------|-------------------|---|------|------|---|------|------|--------------|
| | | 2008 | 2015 | 2030 | 2008 | 2015 | 2030 | |
| UNLV | "Ride" | 8 | 12 | 12 | 0 | 0 | 0 | Through |
| | Headway (minutes) | 8 | 5 | 5 | 0 | 0 | 0 | |
| | Subtotal UNLV | 8 | 12 | 12 | 0 | 0 | 0 | |
| | RTC | Harmon Express | 4 | 6 | 8 | 2 | 2 | |
| | Headway | 15 | 10 | 8 | 30 | 30 | 30 | |
| | RTC | Maryland Pkwy Express | 6 | 8 | 12 | 3 | 3 | |
| RTC | Headway | 10 | 8 | 5 | 20 | 20 | 20 | Terminating |
| | "Zoom" | 4 | 4 | 6 | 1 | 1 | 1 | |
| | Headway | 15 | 15 | 10 | 60 | 60 | 60 | |
| | Subtotal RTC | 14 | 18 | 26 | 6 | 6 | 6 | |

Based on the 2030 estimates for peak hour buses and arrival/departure patterns of these vehicles, the facility design should support six berths. Table 3 shows the assumptions made to arrive at the future requirement of six berths.



Table 3: Bus Berth Estimates

| 2008 | Service Type | Inbound / Outbound Max Buses | Dwell Time / Bus (min) | Buses / Berth / Hr | Inbound Berths | Outbound Berths | Total Berths |
|---------------|--------------|------------------------------|------------------------|--------------------|----------------|-----------------|--------------|
| UNLV | Through | 8 | 3 | 20 | 1 | 1 | 2 |
| Harmon | Through | 8 | 5 | 12 | 1 | 1 | 2 |
| Zoom | Through | | | | | | |
| Maryland Pkwy | Terminating | 6 | 10 | 6 | | 1 | 1 |
| Total 2008 | | | | | | | 5 |

| 2015 | Service Type | Inbound / Outbound Max Buses | Dwell Time / Bus (min) | Buses / Berth / Hr | Inbound Berths | Outbound Berths | Total Berths |
|---------------|--------------|------------------------------|------------------------|--------------------|----------------|-----------------|--------------|
| UNLV | Through | 12 | 3 | 20 | 1 | 1 | 2 |
| Harmon | Through | 10 | 3 | 20 | 1 | 1 | 2 |
| Zoom | Through | | | | | | |
| Maryland Pkwy | Terminating | 8 | 10 | 6 | | 2 | 2 |
| Total 2015 | | | | | | | 6 |

| 2030 | Service Type | Inbound / Outbound Max Buses | Dwell Time / Bus (min) | Buses / Berth / Hr | Inbound Berths | Outbound Berths | Total Berths |
|---------------|--------------|------------------------------|------------------------|--------------------|----------------|-----------------|--------------|
| UNLV | Through | 12 | 3 | 20 | 1 | 1 | 2 |
| Harmon | Through | 14 | 3 | 20 | 1 | 1 | 2 |
| Zoom | Through | | | | | | |
| Maryland Pkwy | Terminating | 12 | 10 | 6 | | 2 | 2 |
| Total 2030 | | | | | | | 6 |

Conservative estimates were used for the type of fleet using the facility. All RTC berths were designed to accommodate 60' articulated vehicles and all UNLV berths were designed to accommodate 40' vehicles. Based on the flexibility of the design, a parallel curb design was selected for the facility. Independent arrival/departure of vehicles was also included. Space to layover vehicles was not a requirement of the design but was added where available.

TRANSIT CENTER LAYOUTS

Step four took the final two sites alternatives forward to the layout phase to gage the interaction of transit and the future roadway network. This step in the assessment process took into account right of way constraints, existing and future traffic control and circulation, bike and pedestrian access and connectivity with the rest of campus including future structures.



Design schemes for both of the sites went through an iterative process before final concepts were agreed upon for each location. The first phase on concepts looked at how a transit facility would interface with the existing and future roadways and facilities on campus. Designs were explored that had the facility integrated with future UNLV facilities and those that were independent of future facilities. This resulted in seven concepts on the two sites as shown in Appendix D.

These seven concepts were discussed at the fourth TWG meeting and opportunities and constraints were identified for each. The most critical concerns with the initial concepts were as follows:

- Shared use of the facility with the future parking structure on both sites would force the need for a two hour separation without sprinklers or a one hour separation with sprinklers.
- A transit facility on site 1 should allow for either a western or northern entry to the future garage.
- Recent development of a surface lot would not allow a bus bay on the north side of University (site 2)

Based on the TWG comments, the seven concepts were then reworked into five alternatives. Two concepts were developed for Site 1 with one showing a western entry to the new parking structure and the other showing a northern entry. Alternative roadway configurations were designed for Site 1 which took into account the existing network and future UNLV planning projects. Two concepts were also developed for site 2 which showed two entry alternatives to a future parking structure directly south of a multi-modal facility. One concept was developed for Site 1D. These five final alternatives are included in Appendix E.



Selection of the Locally Preferred Alternative (LPA)

The alternatives analysis task identified five transit facility concepts on two different sites within the UNLV campus. These concepts for Sites 1 and 2 were presented at the 5th meeting of the TWG along with advantages and disadvantages of each. Concepts for Site 1 were eliminated due to the concurrent planning efforts of a parking facility on that footprint and the complexities and limitations that design provided to a dedicated transportation facility. The decision to include a bus pullout adjacent to the new parking structure at Site 1 but use Site 2 as a dedicated transportation hub gave this location the preferred site status. This selection was discussed and shared with upper RTC management and the Vice President and President of UNLV at follow-up meetings and agreement was reached by all parties.

In the end, Site 2 was selected based on a number of factors. Site 2:

- Rated high in transit connectivity and had the least impact on rerouting of existing RTC and UNLV transit services. The site allows the most convenient transfer location for east/west (future Harmon service) and north/south (existing 109 and future 109 express) RTC services. The site's location on the eastern edge of campus makes it a natural turnaround location for UNLV campus shuttle vehicles.
- Rated highest in conformity with adjacent development and conformity with the existing surroundings. The site does not contain any existing facilities or near-term plans for facilities.
- Has maximum shared-used potential with future UNLV facilities and parking structures. The existing parking use can easily be transferred to a structure facility integrated in a future phase of development.
- Rated best in terms of bike and pedestrian connectivity. The site is less than a quarter mile to the heart of campus and no more than a half mile from all main campus facilities
- Has an available footprint to accommodate all future needs of the transportation facility. The site allows adequate space to accommodate all future transit and transportation service and potential layovers for transit vehicles.

Conceptual Site Plan

A conceptual site plan was then developed for Site 2 to better understand the feasibility of design and operations at the location and to identify any potential impacts such as traffic circulation that this location may present. Using the transit center design specifications identified in the previous section, a two-dimensional site plan and three-dimensional concept sketch was developed.

The site plan developed as part of the multi-modal transportation hub project includes three parts:

- The transit facility including bus loading/unloading areas and passenger wait areas
- Interior transit facility to include transit-supportive uses
- A future parking structure for approximately 1,000 vehicles.

The transit facility would be controlled by RTC and used by both RTC and UNLV services. The interior space would also be controlled by RTC with shared occupancy by UNLV. The future parking structure would be a separate UNLV project likely completed as a future phase when funds become available.

Figures 10 and 11 show the conceptual site plan with various options for the structure parking and interior transit space on the south portion of the site. This transit facility plan shows the island transit center design



with a parallel curb along University Drive and another parallel curb loading zone to the south with available interior space.

This interior space shown adjacent to the south curb loading area could be flexible in its use but would likely contain transit-supportive uses operated by either UNLV or RTC. Preliminary thoughts for uses of this space include:

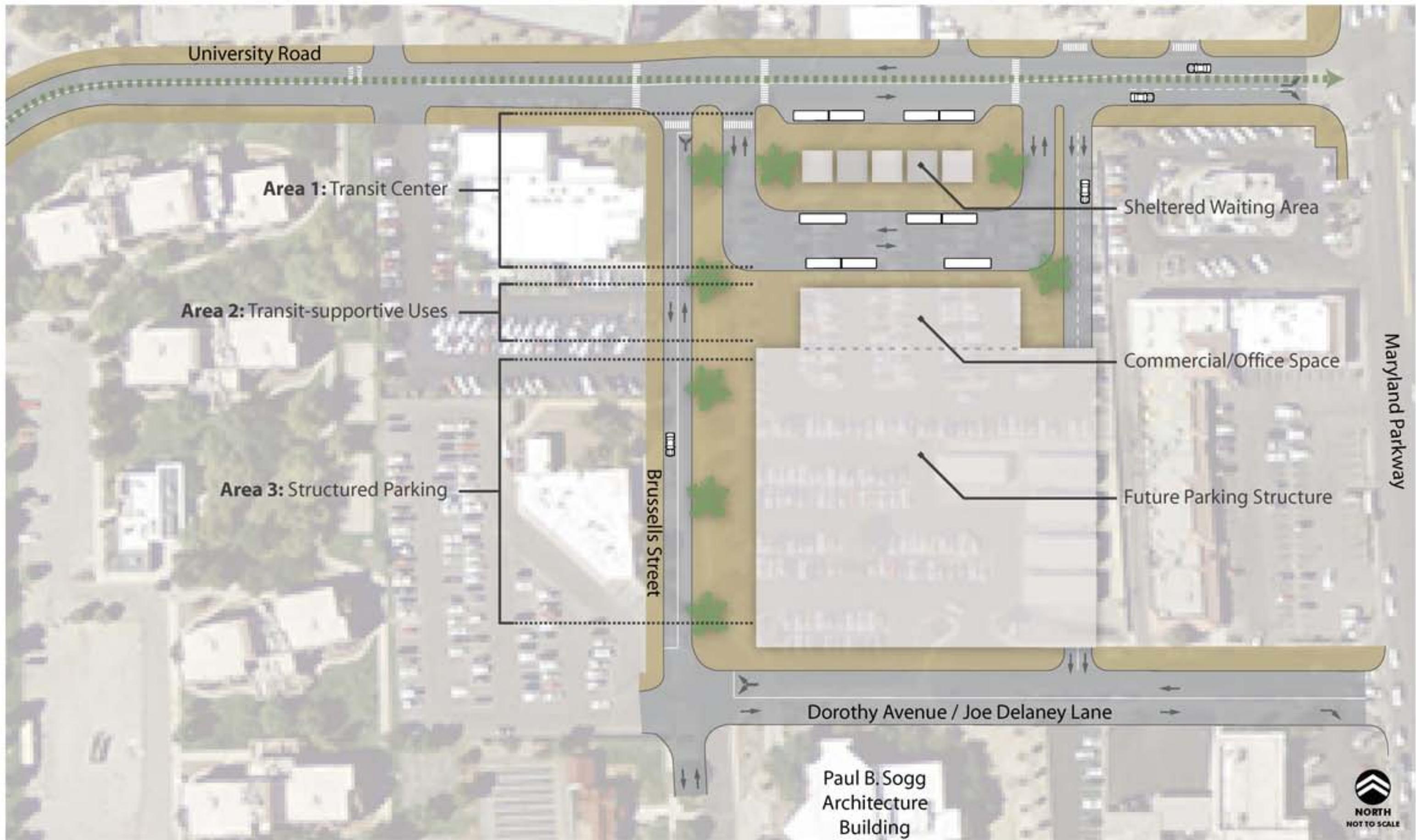
- Office space for UNLV transportation services and campus security
- Bike station including covered storage for bicycles, maintenance or self repair area, and/or locker and showering facilities.
- Commercial/retail uses such as coffee shop, juice bar, convenience store or newsstand
- Interior internet hot-spots with wireless connections and computer workstations to allow waiting passengers to check email and browse the internet

Current UNLV master planning activities envision a future parking structure on this site. This was originally planned for the northwest corner of Maryland Parkway and University Dr (north of Site 2) in the 2004 UNLV Campus Master Plan but was relocated later following the development of the Greenspun Building on this site. Structured parking is viewed as a complimentary use for a transportation facility but would be constructed as its own project. However, the conceptual design of the transportation facility was done in such a way as to accommodate this future structure and circulation to and from the facility. Figures 10 and 11 provide two options for integrating the transit facility, the interior transit-supportive space and the structured parking facility on the same site.

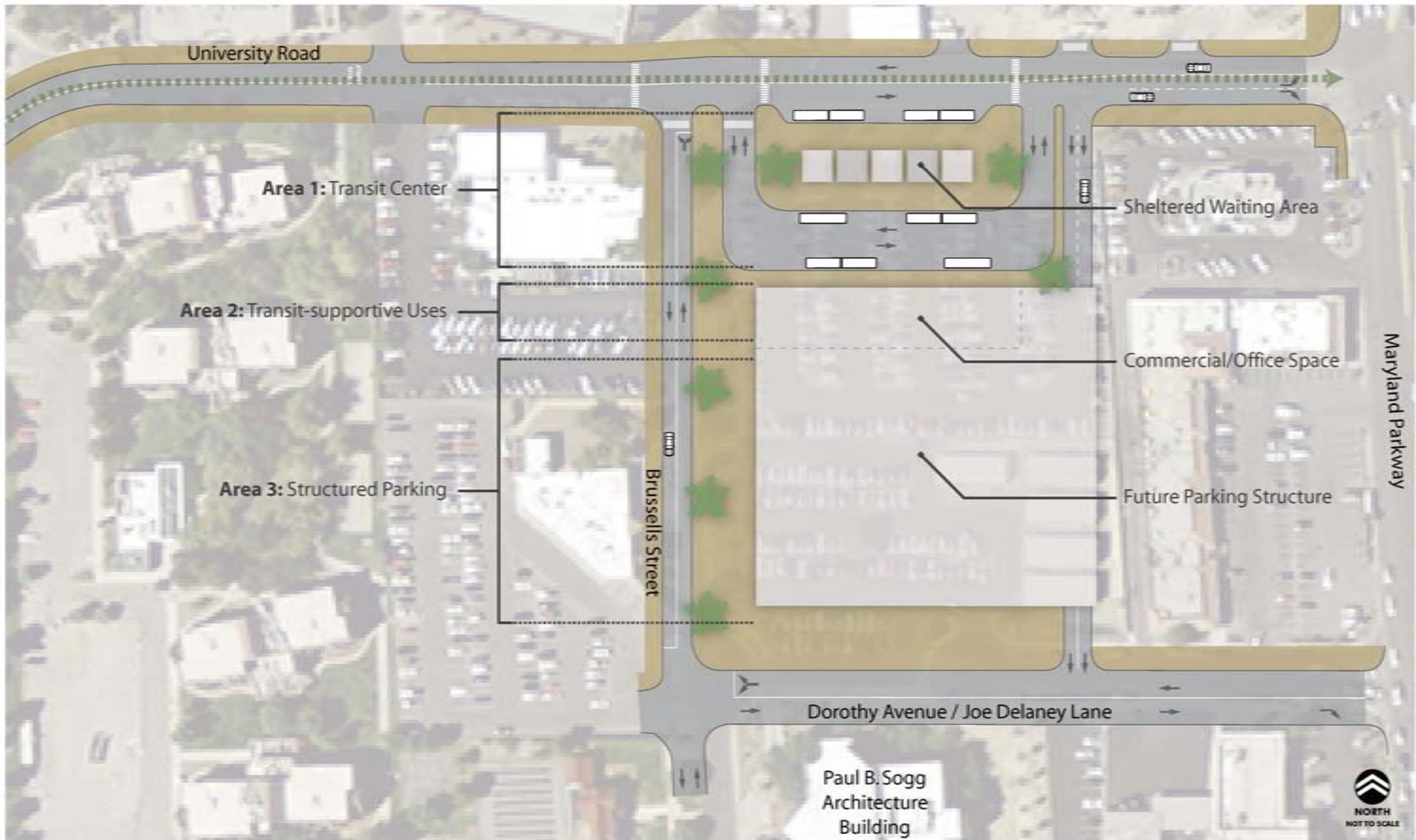
Figure 10 shows the interior space detached from the structure but adjacent while Figure 11 shows a completed integrated design. International building code does require a two hour separation of these uses if no sprinklers are provided in the parking structure or a one hour separation with sprinklers which will need to be considered when selection of a final concept is done². It is assumed that either concept would allow the interior transit space to be built along with the transit facility in one phase of development and a second phase to be complete at a future time which would include the parking structure.

Figures 12-14 show three dimensional views of the conceptual layouts. These images do not necessarily accurately depict architectural styles and landscaping concepts but do show relative size and scale of the facility in the context of the existing surroundings.

² 2006 IBC, Sections 302, 406 and 508.



TRANSIT CENTER OPTION 1
FIGURE 10



TRANSIT CENTER OPTION 2
FIGURE 11



Figure 12: Conceptual Front View (looking south)



Figure 13: Conceptual Isometric View (looking southeast)



Figure 14: Conceptual Station Level View (looking west)

Public Outreach Meeting 2

The conceptual site plans were presented at an open house session held on December 4th, 2008 in the Student Union on the UNLV campus. Representatives from RTC, UNLV and the consulting team were on hand to discuss the site plans and answer questions that were raised by the general public. In total over 30 participants spent time reviewing the poster boards and interacting with the project team on the concepts. Feedback obtained at this session was mostly positive and support was received for the conceptual plan but also for increased transit service to the campus.

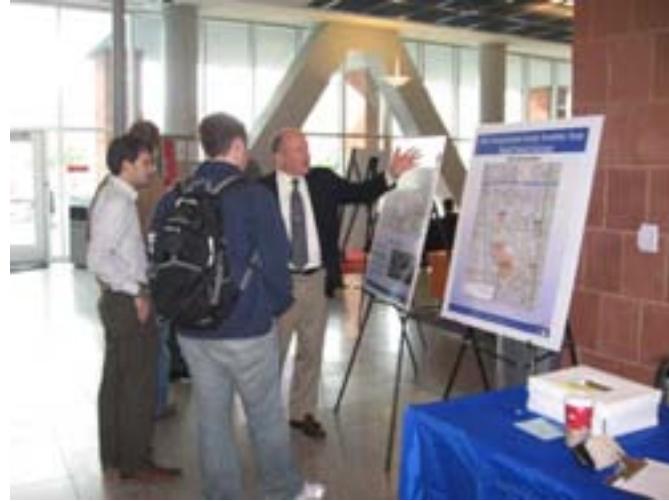


Figure 15 UNLV Public Meeting 2

Anticipated programming associated with the project was also discussed with participants including future operations, future vehicle specifications and fare medium. Strong support was received for an integrated transit pass to the student ID which would allow the ID to function as a flash pass. The class pass program which would allow free transit rides through fees collected during registration was also strongly supported. Operational improvements including improved frequency and more reliable service was mentioned by participants as a real need within the existing service. The articulated MAX vehicle shown on the display materials was also widely accepted as an attractive vehicle for the service.



Implementation Plan

Following identification of the locally preferred alternative, the following steps were taken to identify steps leading toward implementation of the facility and rapid transit service to the UNLV campus.

RTC – UNLV Interlocal Agreement

During the period June-September 2008, a series of meetings was held between senior management of RTC and UNLV to validate the selection of the preferred route for RTC rapid transit service through the campus and the selection of Site 2 as the preferred location for the multimodal facility.

These meetings culminated in general agreement on the cooperative steps necessary and in a formal interlocal agreement between RTC and UNLV to cooperate in developing the rapid transit service and the multimodal center.

Campus Improvements Needed for Rapid Transit Service

To allow RTC service to operate a rapid transit service on campus, a number of improvements are needed independent of the multi-modal hub. Figure 16 shows the proposed alignment of a rapid transit service that would operate on campus and identification of the on-campus improvements. These improvements include:

- The extension of University Road through campus
- Establishment of bus stops on campus
- Roadway improvements along Tarkanian (between Harmon and Thomas and Mack).

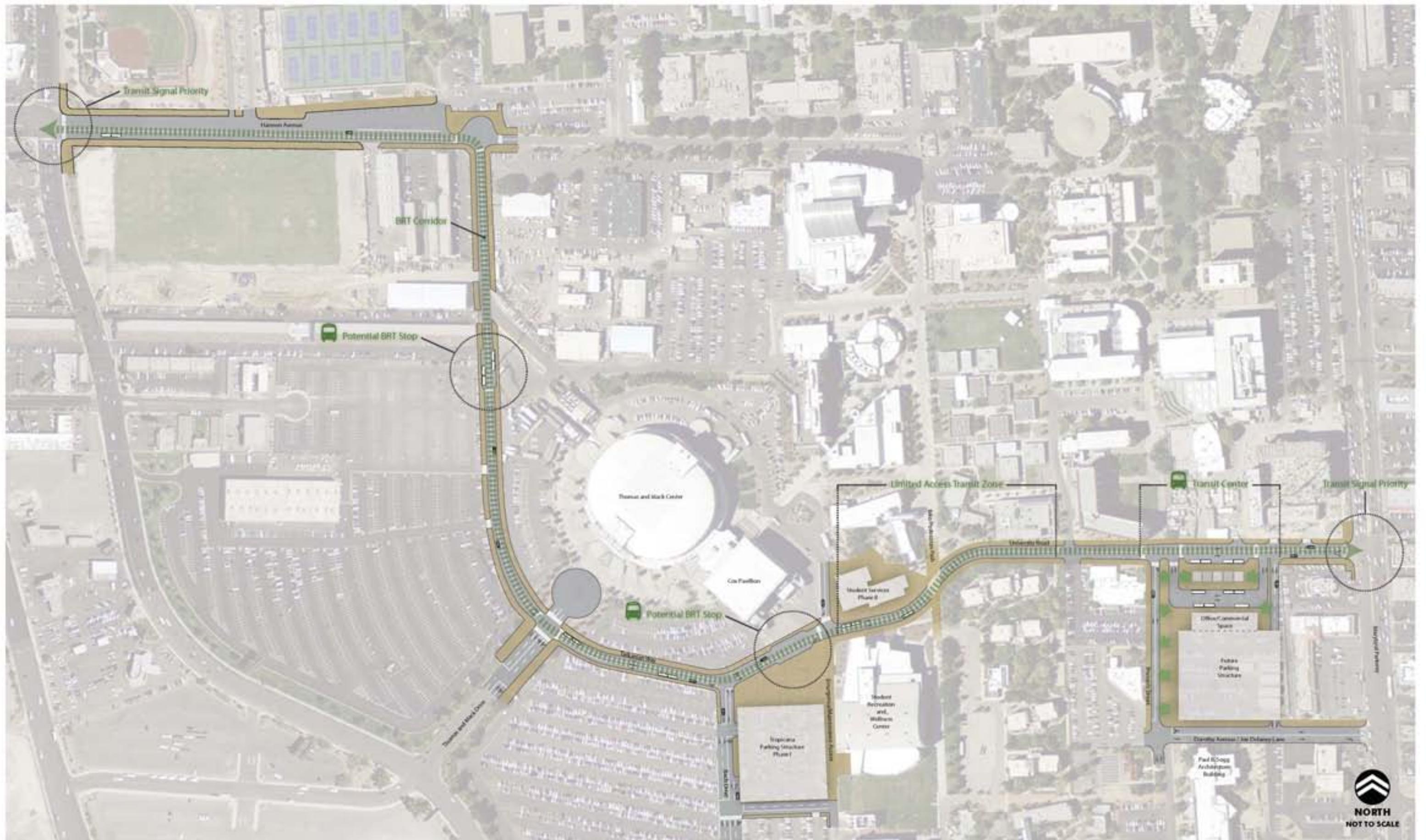
In addition, a number of other measures would be desirable to implement but are not absolutely critical to the operations of the service. These include:

- Traffic signalization improvements at Swanson and Harmon and Maryland Parkway and University
- Establishment of a "class pass" program between UNLV and RTC
- Add real-time bus tracking technology to UNLV transit services
- Improve bike access to and around campus.

UNIVERSITY AVENUE EXTENSION

The existing University Road on campus terminates just east of the Student Services Complex and does not provide through-campus access. The proposed rapid transit corridor would need to traverse campus from east to west. University Road is the likely connector and right of way has been preserved by the university to allow this extension to occur. Since this extension would traverse through a heavy pedestrian and bike activity area on campus, it is proposed to limit access along this extension to only transit and university service vehicles. This would allow the area to retain its friendly environment for non-motorized travel.

UNLV should consider special paving treatments to retain the welcoming environment for pedestrians and cyclists. The new roadway should have more of a "mall" feel than a roadway environment. The 16th Street Mall in Denver is a good example of how high volume, low speed transit can co-exist with pedestrians and cyclists.



BRT CORRIDOR
FIGURE 16



Figure 17: Transit Only Mall (Denver, CO)

ESTABLISH BUS STOPS ON CAMPUS

In addition to the multi-modal transit hub, UNLV will likely need one or two additional bus stops on campus to allow students easy access to all UNLV destinations. Figure 16 shows two appropriate locations for bus stop placements which include one just north of the new Tropicana Parking Structure and one just west of Thomas and Mack along Tarkanian Way. These stops should be designed consistent with RTC's bus design guidelines and accommodate articulated buses.

ROADWAY IMPROVEMENTS ALONG TARKANIAN

Tarkanian Way between Harmon and Thomas and Mack is designed as a drive lane through a parking lot. It is recommended that improvements occur to this section to improve the safety of pedestrians and transit operations. The first improvement includes removal of the existing speed humps which conflict with transit operations.

The existing speed humps act to control speed through this corridor and their removal will need to be offset with additional traffic calming. It is recommended that the roadway through this section be redesigned to reduce the width of the drive lanes and incorporate curb and gutter and a landscaped median. This treatment could be completed without major impacts to the existing parking due to the significant right of way on the exiting roadway.



Figure 18: Existing Tarkanian Way Roadway (looking northbound from Thomas and Mack)

TRAFFIC SIGNALIZATION IMPROVEMENTS

Transit operations entering and exiting campus will do so at two signalized intersections. These intersections handle high volumes of traffic resulting in significant delay and wait times for traffic. To assist the transit operations entering and exiting campus, traffic signal priority (TSP) should be added to these signalized locations. TSP would allow the transit vehicle to extend or activate an early green phase when approaching a given intersection, thus reducing delays due to signalization.

ESTABLISH A CLASS PASS PROGRAM

UNLV and RTC should explore an arrangement that would allow all students and staff to pay a small fee to receive free transit passes on all RTC services. Similar programs across the county which are often termed “class pass” programs typically add a small fee to all student registration fees which spreads out the cost of providing service to the larger student body population. The free transit pass adds incentive to ride RTC services and makes the travel option less expensive than the driving alternative.

ADD REAL-TIME BUS TRACKING TECHNOLOGY TO UNLV SERVICES

Typical transit riders in campus settings such as UNLV are well educated riders with a high level of access to technology. Providing real-time bus tracking will allow riders to accurately predict arrival and departure of RTC services on the UNLV campus. This information should be displayed both at the stops using dynamic display boards and available online. Online services would be available for students to access transit arrival information via a handheld device or on a personal computer.

IMPROVE BIKE ACCESS TO AND AROUND CAMPUS

The future multi-modal transit hub will likely include space for bicycle storage and amenities for cyclists such as a repair facility and showering facilities. To encourage use of this mode to campus, improvements should be made to the existing bicycle network on and off campus. Currently, bike lanes are only provided on roadways to campus from the south and the east. Those accessing campus from the north and west are forced to battle high volume roadways that are dangerous for cyclist.



On-campus use of bicycles should also be encouraged and a plan should be complete for accommodating this mode on campus. This plan should include additional and improved storage facilities such as bike lockers. All RTC buses serving UNLV should also be equipped with the maximum number of bicycle racks.

Capital Cost Estimate

RTC has indicated a desire to apply Section 5307 formula funds to complete the project. Accordingly, and to facilitate the budgeting process, the consultant team prepared a planning level cost estimate to complete the necessary roadway improvements for safe and efficient rapid transit service and to complete the shared-use multimodal facility structure.

The construction costs estimates were based on common quantities in roadway projects including the quantities that commonly carry the majority of the cost associated with roadway construction such as pavement. Other items that are not major costs, or can not be estimated without further design, are handled on a contingency. Unit costs are based on research of past construction projects and then applied to the quantities. Once the major construction has been addressed the contingency is added along with non-construction such as design (plans), environmental and administrative costs. The sum of these costs with the actual construction cost becomes the preliminary construction cost estimate.

This estimate does not allocate the costs identified to either RTC or UNLV; rather, it is a summation of typical costs for comparable facilities based on current year (2008) materials and labor. This cost estimate is sufficient for capital programming at approximately a 75% level of confidence based on current year dollars. It should be updated for current labor and material costs based on a more complete design and year of expenditure (YOE) dollars in the future.

The total capital cost estimate for both the Multi-Modal Transit Hub and the necessary roadway improvements on campus is estimated to be \$6.8 million. A breakdown of these costs by quantity is included as Appendix E.

MULTI-MODAL HUB

The multi-modal facility costs include the cost to construct the off-street bus loading area, passenger waiting area and interior transit center space. The transit center includes approximately 6,336 sq. feet of interior space to be used for transit-related uses. The estimated cost of this facility including all roadway improvements for the off-street facility is estimated to be approximately \$4.3 million.

ROADWAY IMPROVEMENTS

The roadway improvements for the UNLV RTC Center are made up of upgrades to the existing roadway system and some new roadway construction. The cost estimate was divided into four areas:

- Area 1: Harmon Ave and Tarkanian Way - Tarkanian Way and Thomas and Mack Drive
- Area 2: Thomas and Mack and Tarkanian Way including the intersection to the new student Center
- Area 3: Tarkanian Way from the new student center to existing University Road
- Area 4: University Road improvements up to Maryland Parkway
- Area 5: Brussels between University Road and Joe Delaney Drive

There were no anticipated roadway improvements necessary between Harmon and Swenson and Harmon and Tarkanian Way.





Area 1 improvements were an upgrade curb and gutter section with sidewalk to separate it from the parking lots. Area 2 has the same improvements as Area 1. Area 3 has some of the same improvements seen in areas 1 and 2 but also include the new roadway construction to make the connection to existing University Road. Area 4 is a mill, overlay and restriping of existing University road. Area 5 includes roadway construction to add a travel lane along Brussels.

The estimated cost of all on-campus roadway improvements associated with the project is estimated to be approximately \$2.5 million.

**Appendix A: Detailed Stop by Stop CAT Ridership (UNLV Stops)**

| Route | Stop Location | Ons | Offs | Total | |
|-------|---------------|--------------------------|------|-------|-------|
| 108 | NB | Swenson & Tropicana | 230 | 28 | 258 |
| | | Swenson & Naples | 74 | 15 | 89 |
| | | Swenson & Harmon | 70 | 30 | 100 |
| | | Swenson & Embassy Suites | 29 | 9 | 38 |
| | | Swenson & Schwartz | 6 | 1 | 7 |
| | | Swenson & Flamingo | 311 | 113 | 424 |
| | Total NB | | 720 | 196 | 916 |
| | | | | | |
| | 0 | | | | |
| | SB | Paradise & Flamingo | 121 | 233 | 354 |
| | | Paradise & Hard Rock | 30 | 65 | 95 |
| | | Paradise & Harmon | 34 | 94 | 128 |
| | | Paradise & Naples | 21 | 32 | 53 |
| | | Paradise & Tropicana | 6 | 136 | 142 |
| | Total SB | | 212 | 560 | 772 |
| | Total 108 | | 932 | 756 | 1,688 |

| Route | Stop Location | Ons | Offs | Total | |
|-------|---------------|--------------------------------|-------|-------|-------|
| 109 | NB | Maryland & Tropicana | 930 | 207 | 1,137 |
| | | Maryland & University | 146 | 51 | 197 |
| | | Maryland & Harmon | 266 | 61 | 327 |
| | | Maryland & Rochelle | 100 | 75 | 175 |
| | | Maryland & Flamingo | 887 | 493 | 1,380 |
| | Total NB | | 2,329 | 887 | 3,216 |
| | | | | | |
| | SB | Maryland & Flamingo (nearside) | 163 | 709 | 872 |
| | | Maryland & Flamingo (farside) | 261 | 284 | 545 |
| | | Maryland & Cottage Grove | 72 | 73 | 145 |
| | | Maryland & Harmon | 84 | 221 | 305 |
| | | Maryland & University | 30 | 311 | 341 |
| | | Maryland & Tropicana | 178 | 701 | 879 |
| | Total SB | | 788 | 2,299 | 3,087 |
| | Total 109 | | 3,117 | 3,186 | 6,303 |



| Route | | Stop Location | Ons | Offs | Total |
|-------|----|---------------------------|-------|-------|-------|
| 201 | EB | Tropicana & Paradise | 95 | 57 | 152 |
| | | Tropicana & Swenson | 29 | 94 | 123 |
| | | Tropicana & Wilbur | 32 | 84 | 116 |
| | | Tropicana & Maryland | 489 | 574 | 1,063 |
| | | Total EB | 645 | 809 | 1,454 |
| | WB | Tropicana & Maryland | 613 | 610 | 1,223 |
| | | Tropicana & Thomas & Mack | 73 | 35 | 108 |
| | | Tropicana & Swenson | 75 | 57 | 132 |
| | | Tropicana & Paradise | 73 | 47 | 120 |
| | | Total WB | 834 | 749 | 1,583 |
| | | Total 201 | 1,479 | 1,558 | 3,037 |

| Route | | Stop Location | Ons | Offs | Total |
|-------|----|-----------------------|-------|-------|-------|
| 202 | EB | Flamingo & Paradise | 339 | 227 | 566 |
| | | Flamingo & Palo Verde | 91 | 95 | 186 |
| | | Flamingo & Swenson | 118 | 216 | 334 |
| | | Flamingo & Claymont | 118 | 186 | 304 |
| | | Flamingo & Maryland | 507 | 848 | 1,355 |
| | | Total EB | 1,173 | 1,572 | 2,745 |
| | WB | Flamingo & Maryland | 1,026 | 370 | 1,396 |
| | | Flamingo & Cambridge | 108 | 87 | 195 |
| | | Flamingo & Swenson | 203 | 280 | 483 |
| | | Flamingo & Palo Verde | 111 | 220 | 331 |
| | | Flamingo & Paradise | 183 | 190 | 373 |
| | | Total WB | 1,631 | 1,147 | 2,778 |
| | | Total 202 | 2,804 | 2,719 | 5,523 |



Appendix B: Public Outreach Materials

Survey (front and back)

UNLV Multi-Modal Transit Hub Feasibility Study

- | | |
|--|--|
| <p>1. Please enter your home address Zip Code _____</p> <p>2. How many trips do you make to Campus each week? _____</p> <p>3. Considering your trip to Campus today, please check the mode you used:</p> <p><input type="checkbox"/> Drove alone <input type="checkbox"/> Carpoled <i>If you carpoled, how many were in your car? _____</i></p> <p><input type="checkbox"/> Transit <i>If you rode bus, which route did you take? _____</i></p> <p><input type="checkbox"/> Biked <input type="checkbox"/> Walked</p> <p>4. What percentage of weekly trips to Campus are made with the above selected mode? _____ %</p> <p>5. Please indicate any other modes regularly used to access Campus</p> | <p>6. What was your primary reason for choosing the mode of travel selected in Q3?</p> <p>7. Have you ever taken the bus? Yes _____ No _____ <i>If yes, which routes?</i></p> <p>8. Have you ever taken the bus to campus? Yes _____ No _____ <i>If yes, which routes?</i></p> <p>9. If you currently do not take transit to campus, are there ways to improve or enhance service where you would consider using it regularly? If so, please list.</p> <p>10. Based on your use of campus, which site selection seems the most appropriate for a multi-modal transit facility? (refer to map(s) located on the back of this survey) 1 _____ 2 _____ 3 _____ 4 _____ 5 _____</p> <p>Why?</p> <p>11. Please indicate certain amenities or features that you would like to see incorporated into a multi-modal transit facility that would improve your commute to and around Campus. (use the back if needed)</p> |
|--|--|



Page 1

$\mu_1 + \mu_2 = \mu_3$, $\mu_1 - \mu_3 = 0.717 \times 10^{-3}$

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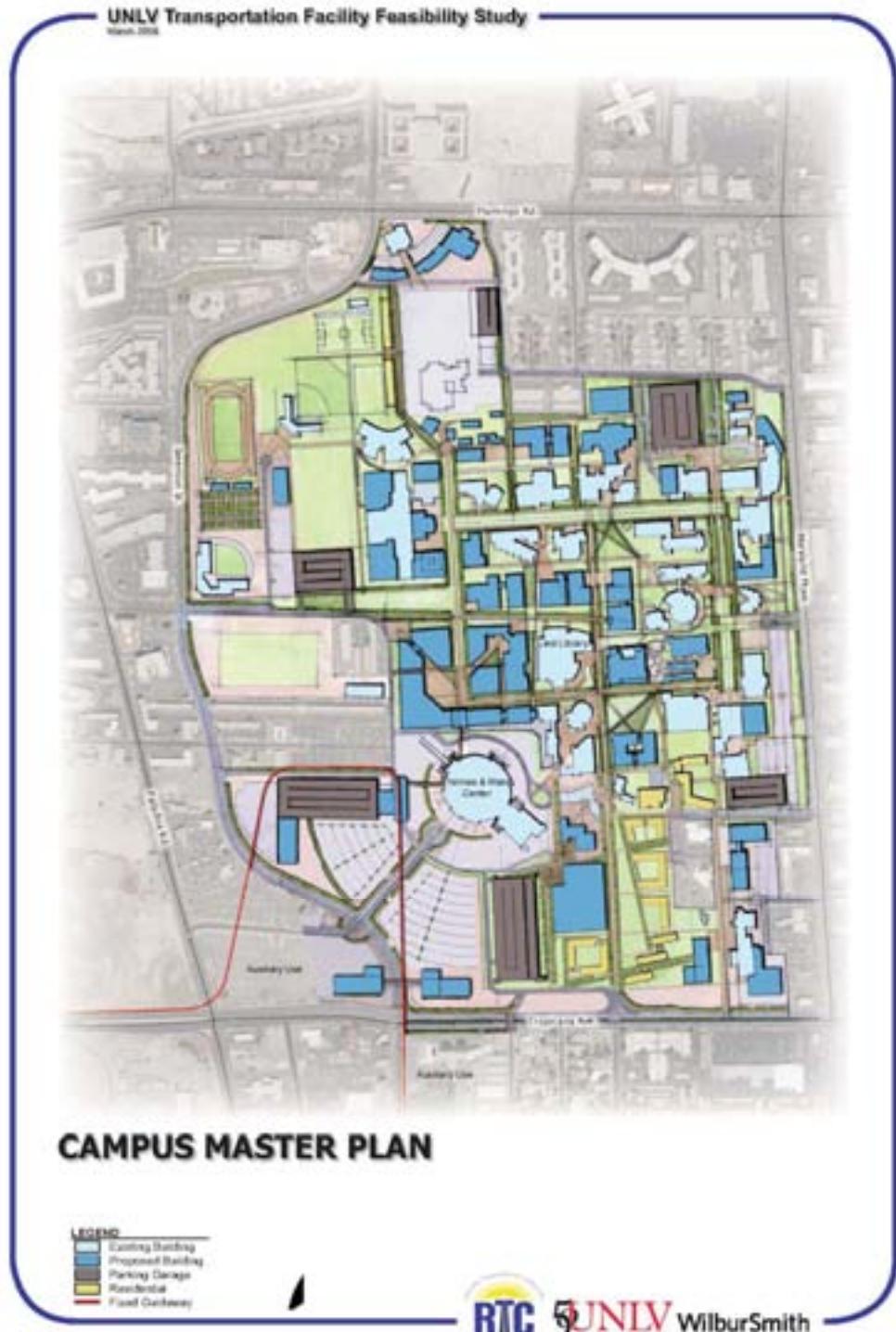
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Page 3



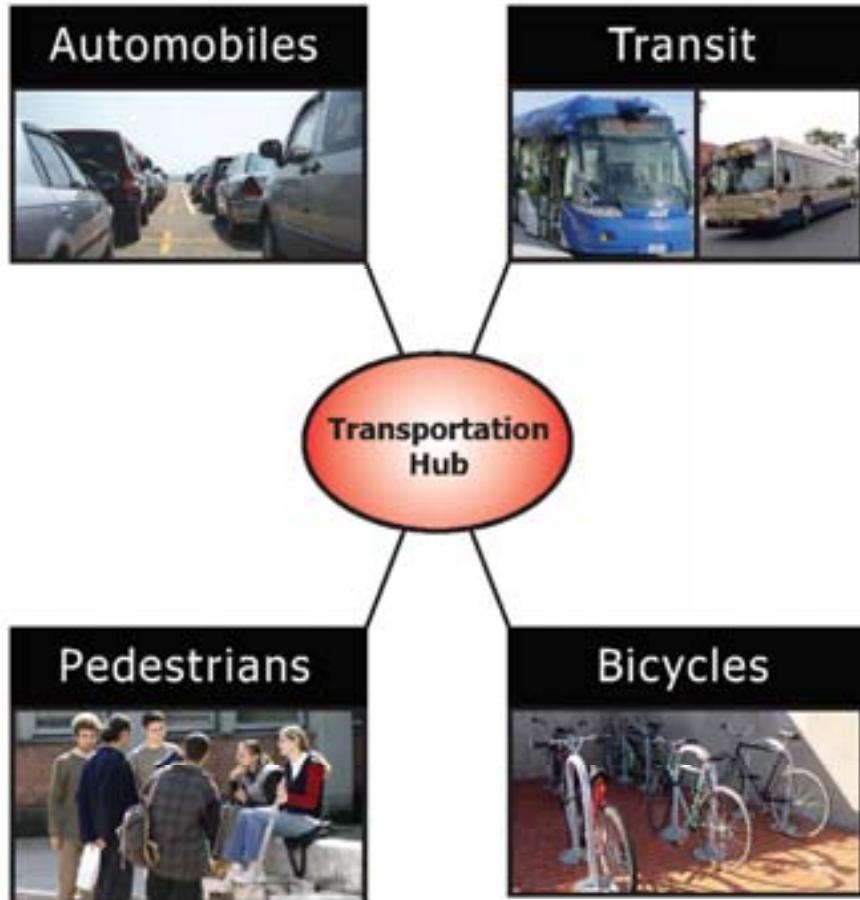
Display Board #1



Display Board #2

UNLV Transportation Facility Feasibility Study
March 2008

Study Objective: Conduct a transit terminal feasibility study, alternative site selection analysis, and basic conceptual layout planning for a transportation center at the University of Nevada, Las Vegas (UNLV).



The proposed transportation center will look to provide a central location for all transportation on campus with an emphasis on current and future transit needs. Included in these transportation options would be: transit, bikes, pedestrians, and automobiles.

STUDY OBJECTIVE

Display Board #3

UNLV Transportation Facility Feasibility Study
Key Attributes of Transit Facilities:

- Good access/egress to facility and internal circulation at the facility
- Strong connectivity between various modes (auto, transit, bike, walk)
- Shelter from sun and rain
- Seating and lighting
- Information/wayfinding (kiosk or staffed)
- Bike storage/facilities (lockers, pods, bike station)
- Pedestrian crossings and links to campus
- Parking (structure or lot) located adjacent to facility
- Potential space for a taxi stand
- Kiss and ride for passenger drop-offs
- Supportive commercial/retail or food vending
- Driver facilities


KET ATTRIBUTES OF TRANSIT FACILITIES

Display Board #4

UNLV Transportation Facility Feasibility Study March 2008

Site Alternative 1

Site Summary:
The Alternative 1 is located in the existing "Red" and "Blue" parking lots south of the Thomas and Main Center. Primary access to auto and bus would be from University Drive (via southbound one-way access from Martin Avenue and Pecos) and Main Drive (via west). Potential expansion of University Avenue from the east would allow further internal connectivity.

Advantages:

- Development Site (Raw Land)
- Adjacent to Thomas and Main Center
- Adjacent to Future Parking Structure
- Serviced by existing UNLV Double Route

Disadvantages:

- Serviced by CR Route 301 (transient)
- Does not serve existing or future BRT routes
- Significant walking distances to northern campus

Site Alternative 2

Site Summary:
The Alternative 2 is located in the existing "C" parking lot at the southern corner of campus. Primary access to auto and bus would be from Hospital Parkway via University Drive (via east) with secondary access from Hospital Avenue (west). Potential expansion of University Avenue from the west end above to be bidirectional connectivity.

Advantages:

- Development Site (Raw Land)
- Near Main Hospital Parkway BRT Corridor
- Minor walking distance to Dining Hall and other activity centers

Disadvantages:

- Long distance to CR Route 301 (transient)
- Not served by existing BRT routes
- Significant walking distances to northern campus

Site Alternative 3

Site Summary:
The Alternative 3 is located in the existing "W" and "White" parking lots at the southern corner of campus near the Thomas and Main Center. Primary access for auto and bus would be from University Drive (via Thomas and Main Drive (via southbound)) with secondary access from Hospital and Thomas Way (west). Potential expansion of University Avenue to be bidirectional connectivity & through Pecos via University Avenue.

Advantages:

- Development Site (Raw Land)
- Serviced by Existing UNLV Double Route
- Conforms Auto and UNLV Main Park Transportation Center Concept

Disadvantages:

- Serviced by CR Route 301 (transient parking)
- Serviced by existing UNLV Double Route (via west)
- Significant walking distances to West of Campus

Legend:

- 1/4 Mile Radius
- 1/2 Mile Radius
- Roadway Extension (proposed)

Block Locations:

- Route 108 Block
- Route 109 Block
- Route 201 Block
- Route 202 Block

CR and UNLV Transit Routes:

- CR Route 108
- CR Route 109
- CR Route 301
- CR Route 302
- CR Route 303
- UNLV Routes (No. 108)

Proposed Transit Routes:

- University BRT (proposed)
- University BRT (proposed)
- Hospital/Parkway BRT (proposed)

Transit and Auto Access / Signage:

-
-
-

Display Board #5

UNLV Transportation Facility Feasibility Study March 2008

Site Alternative 1

Site Summary:
The Alternative 1 is located in the existing "Red" and "Blue" parking lots south of the Thomas and Main Center. Primary access to auto and bus would be from University Drive (via southbound one-way access from Martin Avenue and Pecos) and Main Drive (via west). Potential expansion of University Avenue from the east would allow further internal connectivity.

Advantages:

- Development Site (Raw Land)
- Adjacent to Thomas and Main Center
- Adjacent to UNLV Parking Structure
- Direct to existing UNLV Double Route

Disadvantages:

- Separation of CAT Route 311 (transient)
- Does not serve existing CAT 311 route
- Significant walking distances to northern campus

Site Alternative 2

Site Summary:
The Alternative 2 is located in the existing "C" parking lot at the southern corner of campus. Primary access to auto and bus would be from Hospital Parkway via University Drive (via east) with secondary access from Martin Avenue (west). Potential expansion of University Avenue from the west end above to be considered.

Advantages:

- Development Site (Raw Land)
- Near Main Hospital Parkway CAT Corridor
- Minor walking distance of 0.8 miles (one way) to other activity centers

Disadvantages:

- Direct deviation to CAT Route 311 (transient)
- Not served by existing CAT 311 route
- Significant walking distances to northern campus

Site Alternative 3

Site Summary:
The Alternative 3 is located in the existing "W" and "White" parking lots at the southern corner of campus near the Thomas and Main Center. Primary access for auto and bus would be from University Drive (via Thomas and Main Drive (west and south)) with secondary access from Hospital and Thomas Way (west). Potential expansion of University Avenue to be considered connecting to Hospital Parkway via University Avenue.

Advantages:

- Development Site (Raw Land)
- Direct to Existing UNLV Double Route
- Conforms Auto and UNLV Weather Park Transportation Center Concept

Disadvantages:

- Deviations for CAT Route 102 (Transient Parkers)
- Secondary Hospital/Campus Roads (Southbound Avenue 0.5 miles)
- Significant walking distances to West of Campus

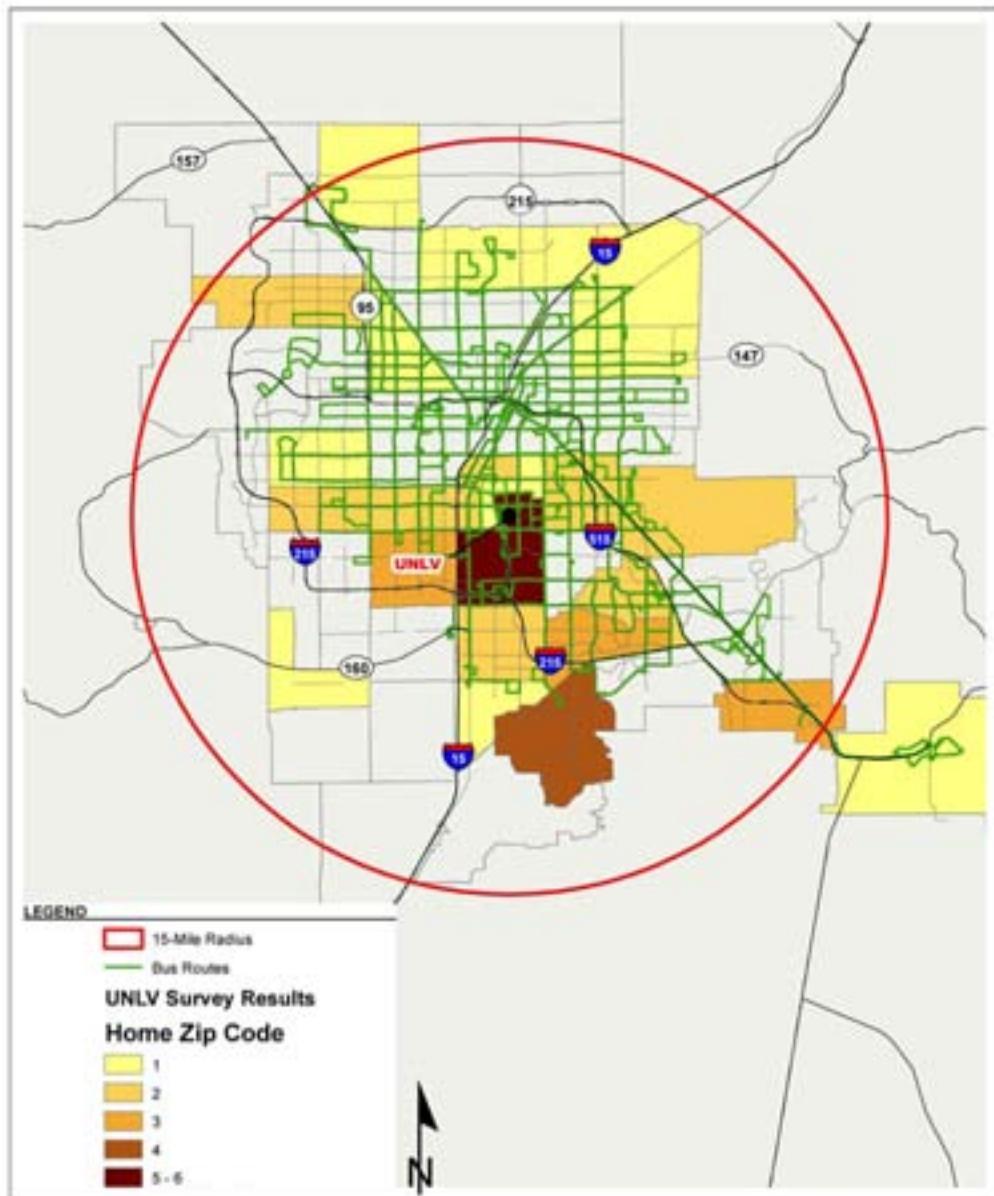
Legend:

- 1/4 Mile Radius
- 1/2 Mile Radius
- Roadway Extension (proposed)

| Block Locations | CAT and UNLV Transit Routes | Proposed Transit Routes |
|-------------------|-----------------------------|-----------------------------------|
| ● Route 102 Block | — CAT Route 102 | — Heritage BRT (proposed) |
| ● Route 108 Block | — CAT Route 108 | — University BRT (proposed) |
| ● Route 211 Block | — CAT Route 211 | — Hospital Parkers BRT (proposed) |
| ● Route 212 Block | — CAT Route 212 | — Trans and Auto Access (Transit) |
| | — CAT Route 311 | |
| | — CAT Route 311 (transient) | |

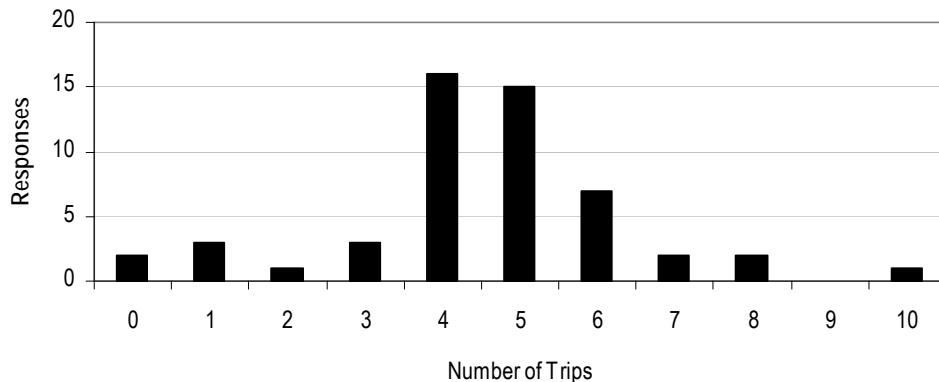
Survey Results:

Q1: Please enter your home zip code.



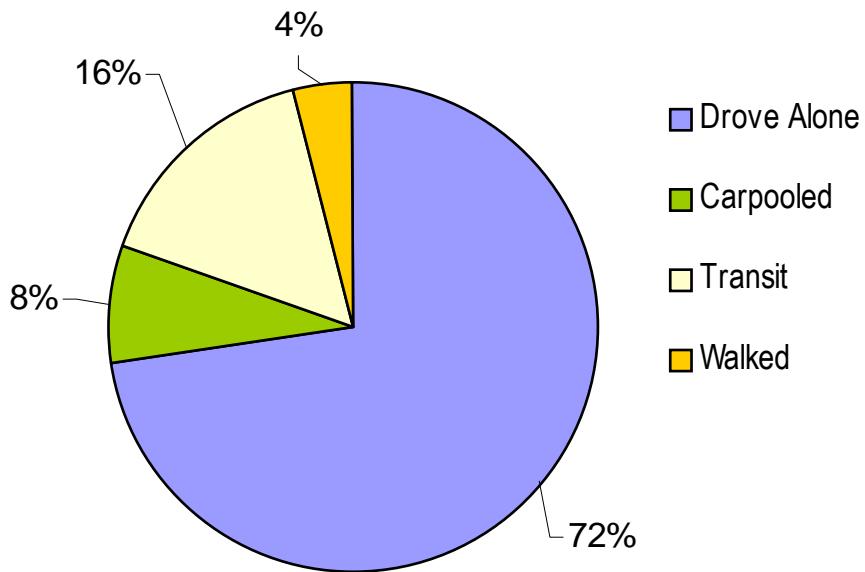
Q2: How many trips do you make to campus each week?

Weekly Trips



Q3: Considering your trip to campus today, please check the mode you used:

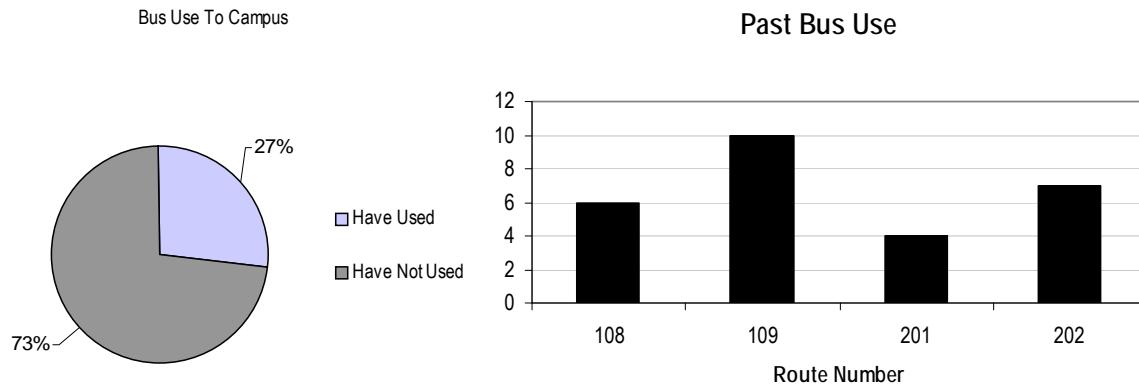
Mode Split



Q6: What was your primary reason for choosing the mode of travel selected in Question 3?

- Drove Alone
 - I need to trip chain during the day (drop off kids, go to work off campus, etc.)
 - Convenience/Speed
- Carpooled
 - Save money and gas
 - Ease – I live with other students
- Transit
 - Don't own car
 - Gas prices
 - Traffic conditions
- Walked
 - Can't drive (disabled)
 - Live on campus

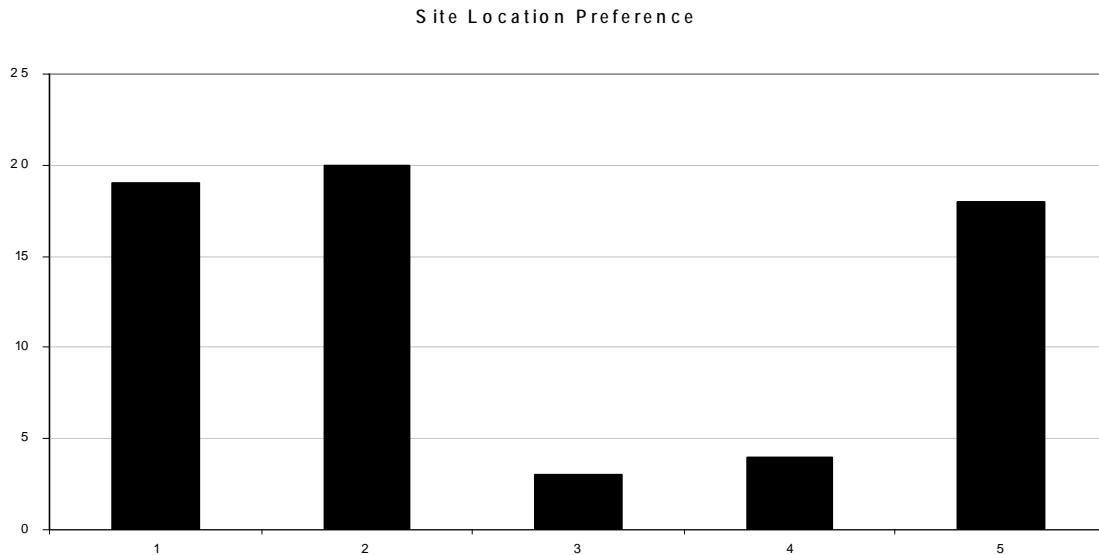
Q8: Have you ever taken the bus to campus? If yes, which routes?



Q9: If you currently do not take transit to campus, are there ways to improve or enhance service where you would consider using it regularly? If so, please list.

- More direct routes – currently too many transfers
- Faster, more reliable service
- More information on routes
- More internal bus circulation – reduce walking distance to final destinations on campus
- Introduce light rail

Q10: Based on the campus maps your use of campus, which site selection seems the most appropriate for a multi-modal transit facility?



Q11: Please indicate certain amenities or features that you would like to see incorporated into a multi-modal transit facility that would improve your commute to and around campus.

- Real-time next bus information
- Seating
- Ticketing Machines
- Food (donuts/coffee, snack vending machines)
- Adequate lighting, blue light security phone
- Secure bike storage
- Bike library system
- Wi-Fi / computer work stations
- Climate control
- Taxi stand

Appendix C: Evaluation Criteria Summary, Scoring and Results

CONNECTIVITY

Transit Connectivity (RTC/UNLV): Transit Connectivity refers to the ability of the facility to allow transit passengers to easily transfer between transit operations including any of the RTC routes and the UNLV campus shuttle. Ultimately, the facility's location should allow a *seamless* transfer between these transit services.

Pedestrian Access: The facility should be located within an easy walk of most major trip generators on campus. Typical walking distances range from $\frac{1}{4}$ mile to $\frac{1}{2}$ a mile depending upon the user and external environment conditions.

Bike Access: Bikes are a key part to a multi-modal network and their consideration is important to the design of the facility. Its location should be accessible for bicyclists who choose to store their bikes in a possible locker facility or allow those who bring bikes onboard the transit vehicle to access other areas of campus. Distances typically considered comfortable for biking are higher than average walking distances.

Park and Ride Potential: A true multi-modal facility would accommodate the potential to have parking adjacent to the transit, bike, and walk modes designed for at the facility. An integrated design could strengthen the utilization of the facility and reduce overall construction costs.

Connectivity with Monorail (potential future extension): The existing Las Vegas monorail system currently terminates at the MGM Hotel and Casino on Las Vegas Boulevard and Tropicana Avenue at the southern edge of the strip. Future expansion plans for the system show it continuing south and connecting to the McCarran Airport, with a potential station at or near the UNLV campus. Opportunities to have connectivity to the monorail are dependent upon the project's implementation and the selected alignment.

INTEGRATION WITH SURROUNDINGS

Conformity with Existing Surroundings: The existing surroundings of the selected site needs to conform with and support the proposed use of the multi-modal facility and result in minimal land use conflicts. This includes noise, traffic control, air quality, and any other disruptions that may be attributed to the proposed facility.

Conformity with UNLV Master Plan: The UNLV Master Plan calls for significant change and development in the years to come and the placement of this facility should be an integral part of this plan.

Conformity with Adjacent Development: As UNLV continues to expand, development surrounding the campus will also experience change. Site selection should conform with any development that is proposed adjacent to the campus.

Patron Safety: The placement of the facility should ensure adequate patron safety, especially during off-peak hours on campus. While many design qualities of the facility can improve the safety qualities, the location itself plays a significant part in the perceived safety for potential users.

IMPLEMENTATION

Time Required to Implement: Different site alternatives could result in different development schedules. Any empty/underutilized location may allow a facility to be constructed in a shorter duration than a site with an existing use present. Integration of the facility into other development plans and projects may also result in a lengthier development schedule or a phased construction.

Environmental Permitting: The selected site should be able to pass environmental clearance to allow the construction of the facility in a timely manner.

Physical Size of Footprint: The selected site should allow adequate room for the required components of the facility. The facility will need to be able to accommodate both the RTC fleet and UNLV campus shuttles at the facility. While detailed estimates for the total number of bays are not finalized, the footprint should be able to accommodate multiple vehicles without impacting circulation.

Cost: The associate cost of the facility (dependent upon its location) is based on the improvements to the site and the removal of existing facilities. In general, an empty site would be less costly to build than a site with an existing facility in place.

Shared-Use Potential: Based on the future projections of the campus Master Plan, a multi-modal site selection that is within a walkable distance to the internal campus area should maximize the use of the land in which it occupies. A vertical design that would allow other transit-supportive uses to occupy the same facility or one directly adjacent would be desirable for the University and users of the facility.

SUSTAINABILITY (COMMUNITY AND CAMPUS)

Supports Transit Ridership by UNLV Students/Staff: The selected site should be located in a manner that supports an increase in transit ridership. This can be achieved in a number of different ways including bringing passengers closer to their trip origins/destinations, improving efficiency of transfers, improving overall comfort of the transit riding experience and improving mobility options throughout campus.

Supports Bike/Pedestrian Activity by Students/Staff: Walking and riding bikes are feasible mobility options in campus and high-density environments. These modes are also among the most sustainable options of transportation. Enhancing the experience of bikers and pedestrians and promoting use of these transportation options should be considered in the selection of the facility's placement. Safety of these users is also a significant factor in its placement. The ability for the facility's location to minimize conflict between vehicles and pedestrians/cyclists should be assessed during the planning stages.

Promotes Non-Motorized Access to UNLV by Non-Students/Staff: The UNLV campus is used not only by students and staff but also by the greater Las Vegas community. The Thomas and Mack center hosts a number of large events that bring outsiders to the campus primarily during the weekend or off-peak campus hours. The proposed location of the facility should take the transportation needs of this population and other non-UNLV students/staff into consideration.

OPERATIONAL CONSIDERATIONS

Ease of Access and Egress for Transit: The location of the facility should accommodate a relatively high volume of transit vehicles to easily navigate from the surrounding arterials to the facility. Turning radii for all transit vehicles, including articulated and double-decker vehicles should be considered.

Impacts on Traffic Network: The preferred site location should minimize conflict with the traffic network by providing adequate space for off-street bus bays. Additional signalization that is required to accommodate



new transit or auto movements to the facility also could potentially reduce the performance of the traffic network.

Rerouting of Existing RTC Transit Operations: There are currently four routes that serve the UNLV campus (108, 109, 201, 202) and three possible future BRT routes are proposed to run along Flamingo, Harmon and Maryland Parkway. Minimizing deviation of the existing routes proposed to serve the facility should be considered.

Rerouting of Existing UNLV Transit Operations: Currently, UNLV campus shuttles operate primarily in the southwest corner of campus and serve the larger parking areas. Expansion of campus transit service is restricted by the limited internal roadway network on campus. Facility placement may impact the operations of this service which should be considered during the site evaluation stages.

Appendix D: Traffic and Circulation Analysis

The UNLV Multi-Modal Hub project is anticipated to have relatively minor environmental impacts. Due to the nature of the project, traffic and circulation will be affected under project conditions, and thus a traffic and circulation study was completed to determine if any significant impacts would occur as a result.

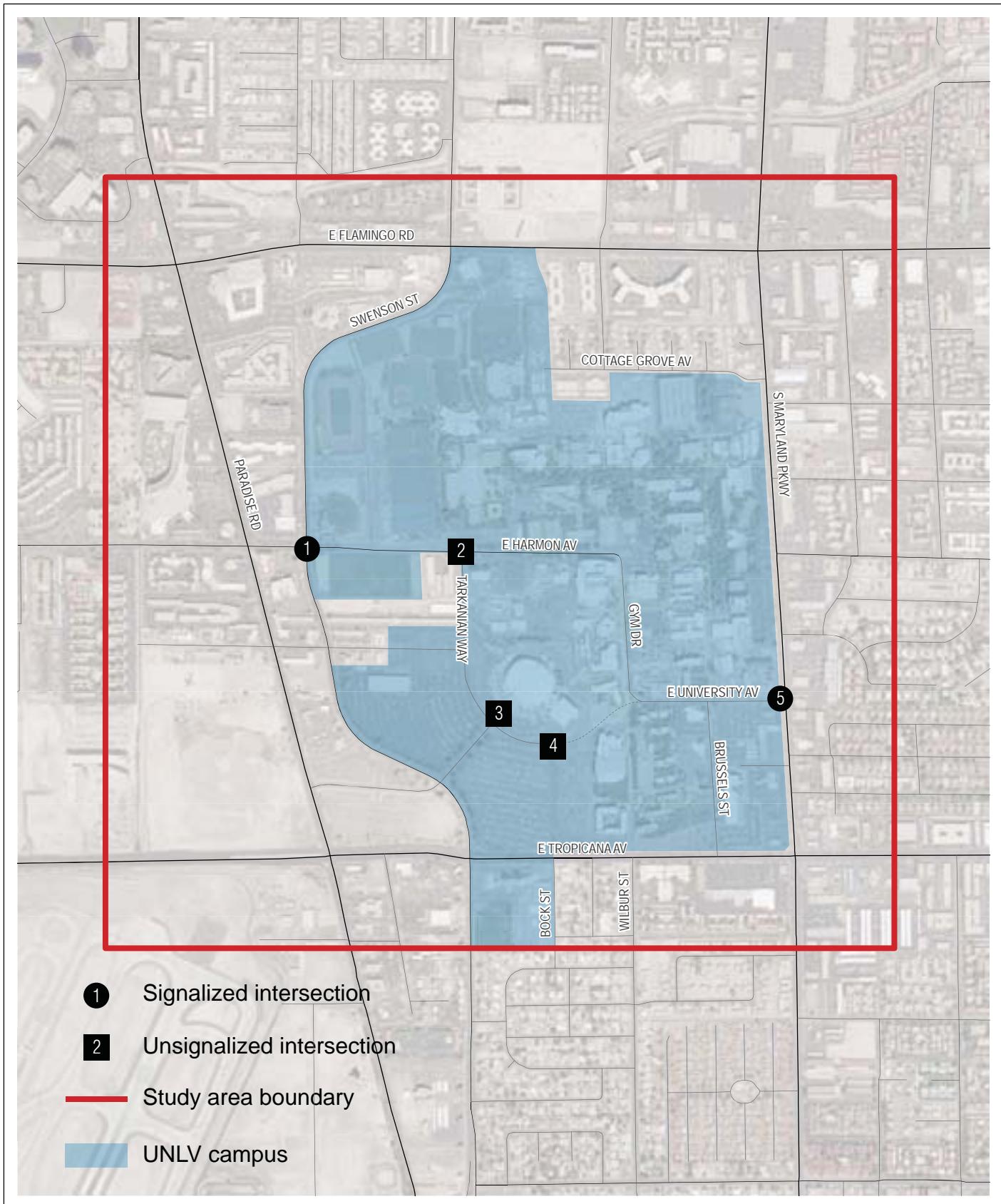
Study Area

The study area defined for the traffic and circulation analysis included five study intersections located in the vicinity of the proposed project. Figure D1 shows the locations of these intersections.

STUDY INTERSECTIONS

The following provides a brief description of the study intersections.

1. Harmon Avenue/Swenson Street intersection is a four-way signalized intersection. The eastbound approach along Harmon Avenue has a left turn lane, with a storage length of about 100 feet, and two through lanes. The westbound approach has a through lane and a shared through-right lane. Along Swenson Street, the northbound approach is one-way and has three left turn lanes, one through lane, and one shared through-right lane. The southbound approach has a left turn lane and two right turn lanes.
2. Harmon Avenue/Tarkanian Way intersection is a three-way unsignalized intersection. The northbound approach along Tarkanian Way is stop-controlled and has a shared left and right turn lane. Along Harmon Avenue, the westbound approach has a shared through-left lane. The eastbound approach is stop-controlled and has a shared through-right lane.
3. Tarkanian Way/Thomas and Mack Drive intersection is a four-way unsignalized intersection. The east- and westbound approaches along Tarkanian Way are stop-controlled and each has one shared left-through-right lane. Along Thomas and Mack Drive, the northbound approach has a shared through-left lane and a right turn lane, while the southbound approach has a shared left-through-right lane.
4. Tarkanian Way/Back Drive intersection is a three-way unsignalized intersection. The northbound approach along Parking Lot Road is stop-controlled and has a left turn and a right turn lane. Along Tarkanian Way, the eastbound approach has a through-right lane, and the westbound approach has a through-left lane.
5. University Road/Maryland Parkway intersection is a three-way signalized intersection. The eastbound approach along University Road has a left turn and a right turn lane. Along Maryland Parkway, the northbound approach has one left turn lane and three through lanes, while the southbound approach has two through lanes and one shared through-right lane.



**STUDY AREA MAP
FIGURE D1**

ADJACENT STREET SYSTEM

The vicinity of the proposed project site includes a few major arterials and several campus access roads. Brief descriptions of these roadways are provided below.

Harmon Avenue is an east-west arterial that runs through the western half of campus and terminates in central campus. It has two travel lanes in each direction and a two-way left turn lane median, and is approximately 80 feet wide. The current posted speed limit is 35 mph east of campus, and 25 mph within campus.

Maryland Parkway is a north-south arterial that runs along the eastern edge of campus. Within the study area, it has three travel lanes in each direction, with left-turn pockets at most intersections, and a two-way left turn lane median. It is approximately 100 feet wide, and the current posted speed limit is 30 mph.

Swenson Street is a north-south arterial that runs along the western edge of campus. North of Harmon Avenue, the road has two lanes in each direction, with a two-way left turn median. South of Harmon Avenue, the road becomes one-way in the northbound direction, ranging from four to five travel lanes. The road is approximately 80 feet wide, and the current posted speed limit is 35 mph.

University Road is an east-west campus roadway that runs west from Maryland Parkway and terminates within campus. West of Parking Lot Road, it has one travel lane in each direction, and no median, and on the other side the eastbound direction widens to two lanes.

Tarkanian Way is a north-south campus roadway that connects from Harmon Avenue and runs south into the main campus parking lot, where it curves into an east-west direction. It has one travel lane in each direction, and no median.

Thomas and Mack Drive is a campus roadway that runs in the northeast-southwest direction through the main campus parking lot, and intersects with Swenson Street, where it curves into an east-west direction, ending at Paradise Road. North of Swenson Street, the roadway has two lanes in each direction, with a two-way left turn median, and on the other side, it has one lane in each direction with no median.

Bach Drive is a campus roadway that runs through the main campus parking lot, continuing from Tarkanian Way, running south and then curving east to connect with East Tropicana Avenue. It has two travel lanes in each direction, and no median.

Methodology

The existing and future transportation network was analyzed using the VISSIM micro simulation application. This computer-based modeling tool allows a comprehensive multi-modal network to be modeled to determine if any impacts result when changes are made to the existing network or if future volumes are reached. The decision to select the VISSIM application was done due to the multi-modal characteristics of the project and the network. Campus settings traditionally have high volumes of transit, pedestrian and bike volumes which can be overshadowed by analysis applications that focus on traffic operations. VISSIM was selected as the appropriate tool for this analysis due to its enhanced ability to model detailed user behavior and priority settings within the transportation network. The three-dimensional animation options also provide a better understanding for policy makers and the general public on how future transportation will function.



Existing traffic volumes and roadway geometry inputs to the VISSIM network were collected on site during November and December of 2008. Vehicles counts as well as pedestrian counts were completed for the five study intersections. Future 2030 volumes were taken from the 2006 Maryland Parkway –UNLV Community Realignment Plan which used the RTC Regional Planning Model to estimate future traffic conditions. In calculating the 2030 volumes from 2005 counts, the regional model assumed a 3.31% growth for the first ten years, 2.31% growth for the subsequent 10 years, and 1.31% growth for the final five years. This uniform growth is due to future development assumptions in the area and largely based on the Mid-Town UNLV project which will likely have a significant effect on the traffic patterns in the area.

Since the Maryland Parkway-UNLV Community Realignment Plan study did not include 2030 traffic volumes for on-campus intersections, assumptions were made using the entry/exit volumes generated at the gateway intersections (Swenson/Harmon and University/Maryland Parkway). Using UNLV's master plan, estimates were made for future on-campus parking generators and entry/exit volumes were appropriately distributed to these locations. Additional traffic on the network after this traffic was distributed was assigned to the internal network based on the existing distributions of traffic on campus. This methodology assumes that traffic circulating on campus will not grow at the same rates of traffic external to campus but turning movements at the gateway locations will be consistent with the regional forecasts.

Traffic operations of the study intersections were evaluated using Level of Service (LOS) calculations. LOS is a qualitative description of the performance of an intersection based on the average delay per vehicle. Intersection levels of service range from LOS A, which indicates free flow or excellent conditions with short delays, to LOS F, which indicates congested or overloaded conditions with extremely long delays.

SIGNALIZED INTERSECTIONS

Level of Service for signalized intersections was calculated using the Highway Capacity Manual 2000 (HCM 2000) methodology. The LOS is based on the average delay (in seconds per vehicle) for the various movements within the intersection, which was determined using the VISSIM software. A combined weighted average delay and LOS are presented for each of the signalized intersections. The average delay for signalized intersections is correlated to the level of service designations as shown in Table D1.

Table D1: Level of Service Criteria – Signalized Intersections

| Level of Service | Description of Operations | Average Delay ⁽¹⁾ |
|------------------|---|------------------------------|
| A | Operations with very low delay occurring with favorable progression and/or short cycle length. | ≤ 10.0 |
| B | Operations with low delay occurring with good progression and/or short cycle lengths. | 10.1 – 20.0 |
| C | Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear. | 20.1 – 35.0 |
| D | Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable. | 35.1 – 55.0 |
| E | Operations with high delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered to be the limit of acceptable delay. | 55.1 – 80.0 |
| F | Operation with delays unacceptable to most drivers occurring due to over saturation, poor progression, or very long cycle lengths. | ≥ 80.1 |

Source: Highway Capacity Manual, Transportation Research Board, 2000

(1) Delay presented in seconds per vehicle

UNSIGNALED INTERSECTIONS

The LOS rating for unsignalized intersections, as specified using the Highway Capacity Manual 2000 methodology, is based on the weighted average control delay expressed in seconds per vehicles as illustrated in Table D2 .

Table D2: Level of Service Criteria – Unsignalized Intersections

| Level of Service | Description of Operations | Average Delay ⁽¹⁾ |
|------------------|---|------------------------------|
| A | No Delay for stop-controlled approaches. | ≤ 10.0 |
| B | Operations with minor delays. | 10.1 – 15.0 |
| C | Operations with moderate delays. | 15.1 – 25.0 |
| D | Operations with some delays. | 25.1 – 35.0 |
| E | Operations with high delays, and long queues. | 35.1 – 50.0 |
| F | Operations with extreme congestion, with very high delays and long queues unacceptable to most drivers. | ≥ 50.1 |

Source: Highway Capacity Manual, Transportation Research Board, 2000

(1) Delay presented in seconds per vehicle

Existing Traffic Conditions

Existing traffic conditions were evaluated for the morning (7:00AM to 9:00AM) and evening peak hour (4:00PM to 6:00PM) using the VISSIM software. It should be noted that existing peak hour traffic volumes at the key intersections were developed from intersection turning movement counts conducted in November and December 2008. Traffic movements were counted and recorded in 15 minute intervals during the peak periods. These counts were then analyzed to determine the peak hour traffic volumes.

A total of five (5) intersections were analyzed under existing conditions, of which two (2) are signalized, two (2) are Side-Street Stop-Controlled, and one (1) is Two-Way Stop-Controlled.

The existing lane configurations and peak hour turning movement volumes were used to calculate the levels of service for the five study intersections under existing peak hour conditions. These lane geometries and turning movements are shown in Figure D2 and Figure D3. The results of the existing LOS analysis for the AM and PM peak periods are presented in Table D3.

Under existing conditions, all five study intersections operate at LOS D or better during both the AM and PM peak period.

Table D3: Intersection Operations – Existing Conditions

| # | Intersection | Control ⁽¹⁾ | AM | | PM | |
|---|-------------------------------------|------------------------|-------------|-----|-------------|-----|
| | | | Delay (sec) | LOS | Delay (sec) | LOS |
| 1 | Harmon Avenue/Swenson Street | Signal | 41.4 | D | 53.2 | D |
| 2 | Harmon Avenue/Tarkanian Way | SSSC | 5.8 | A | 10.4 | B |
| 3 | Tarkanian Way/Thomas and Mack Drive | TWSC | 2.8 | A | 6.6 | A |
| 4 | Tarkanian Way /Bach Drive | SSSC | 4.6 | A | 3.9 | A |
| 5 | University Road/Maryland Parkway | Signal | 17.2 | B | 17.7 | B |

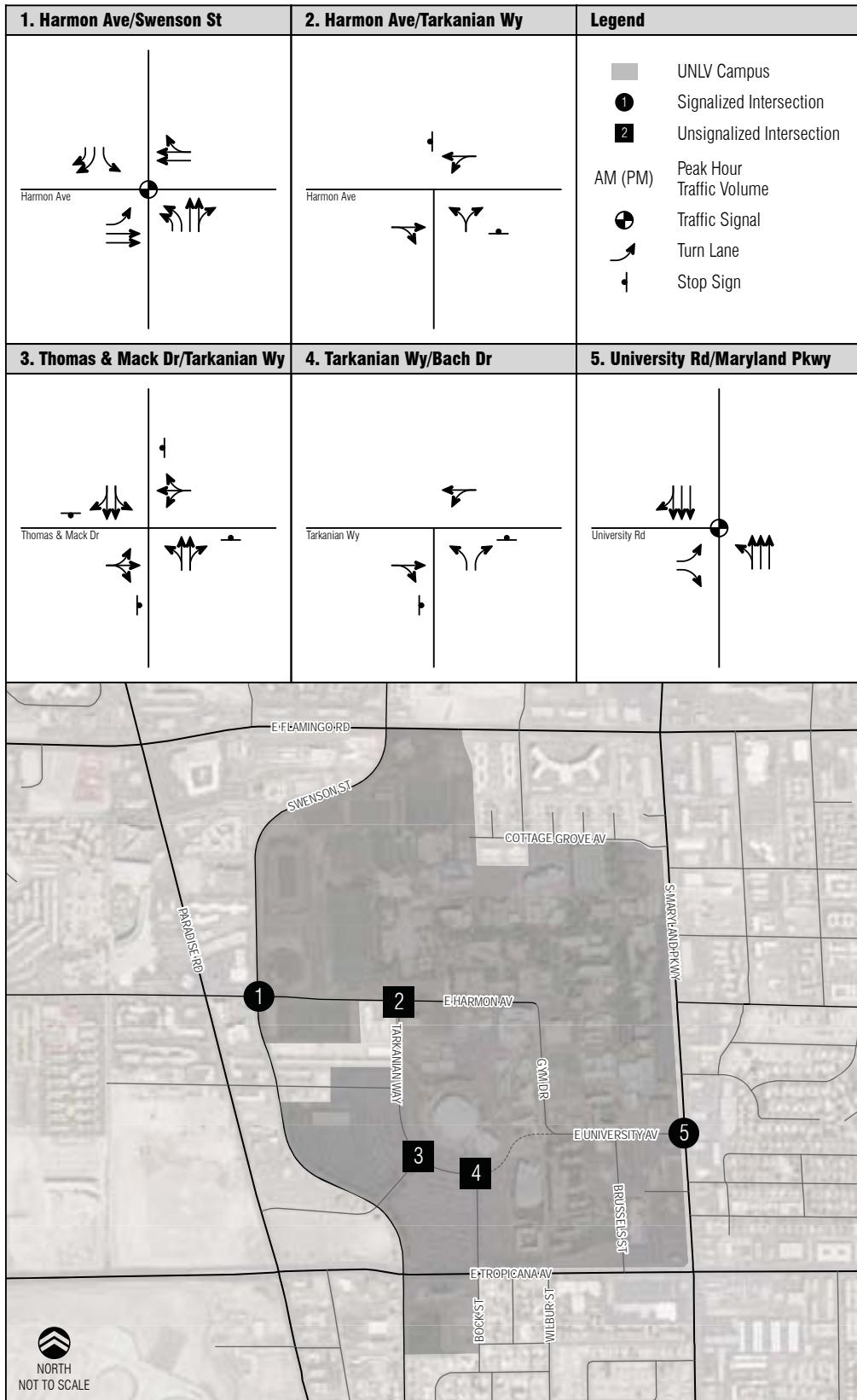
Source: Wilbur Smith Associates, 2009

(1) AWSC: All-Way Stop-Control

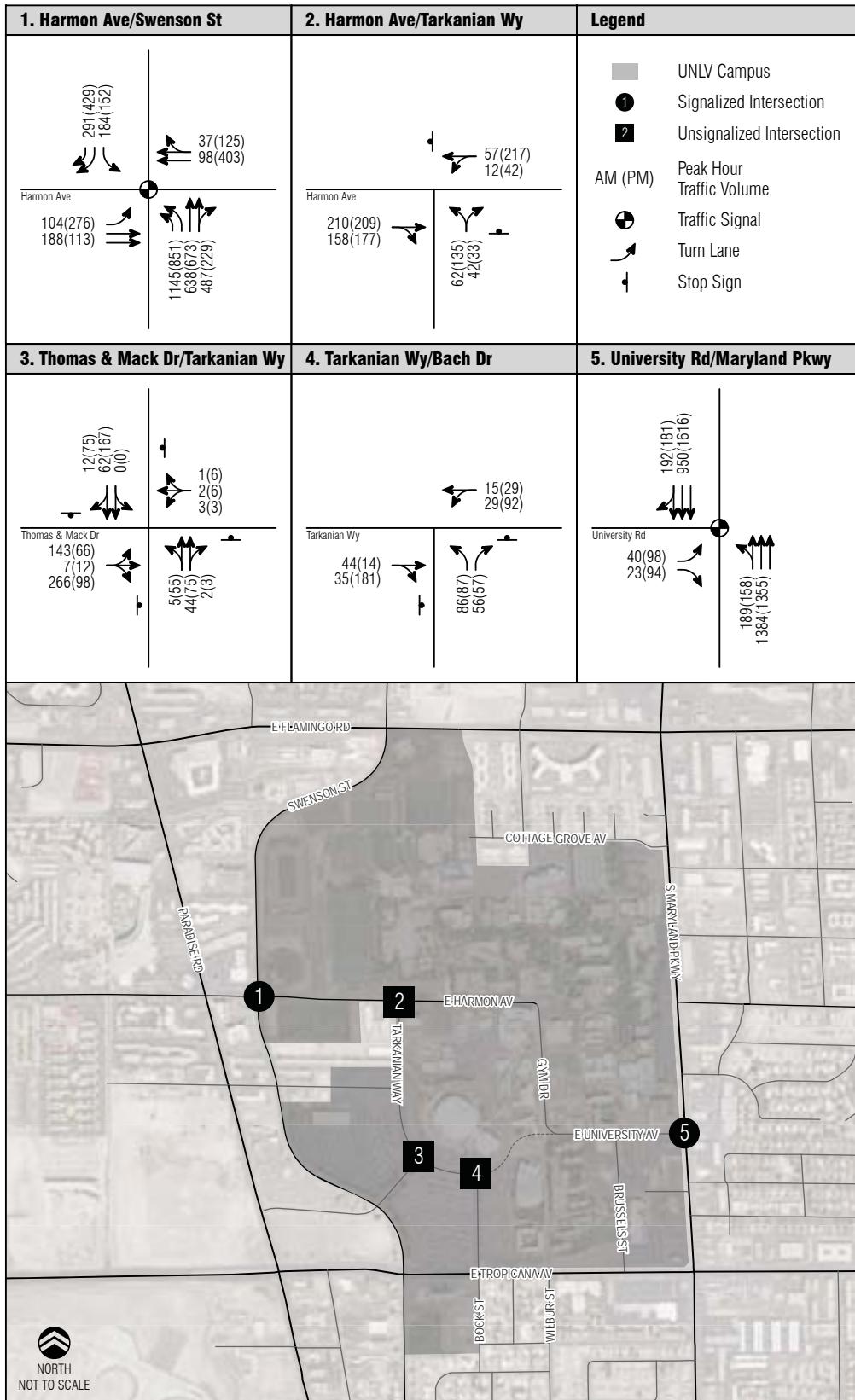
TWSC: Two-Way Stop-Control

SSSC: Side-Street Stop-Control

Bold indicates intersection operates under unacceptable conditions



EXISTING ROADWAY CONFIGURATIONS
FIGURE D2





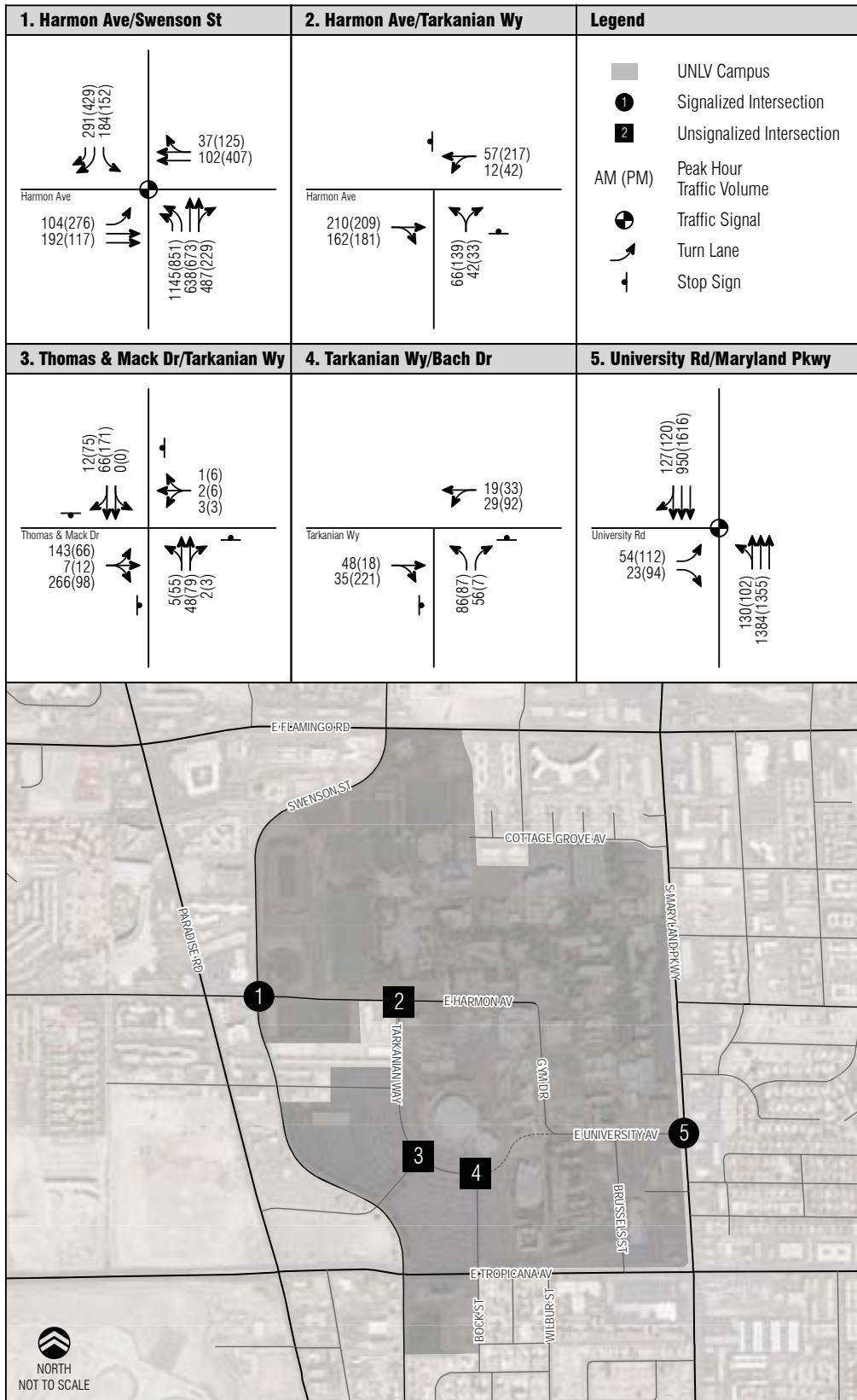
EXISTING PLUS PROJECT CONDITIONS

Traffic conditions were evaluated under existing plus project conditions to identify potential impacts to traffic operations as a result of the project. Significant impacts resulting from the proposed project are identified by comparing traffic operations under the existing plus project scenario to existing conditions. However, the proposed project includes some changes to the roadway network, which are summarized below.

A number of changes were made to the existing network which resulted from the implementation of the project. These modifications are shown in Figure 16 and include:

- The construction of the multi-modal transit facility. This proposed facility is shown in Figures 10-14 and includes two entry/exit driveways along University Road between Maryland Parkway and Brussels to access the transit area and one new driveway to access the parking area to the south of the transit facility. It is also assumed that the project will remove nearly half of the existing parking on Lot U, thus reducing peak hour volumes proportionally due to the reduced supply.
- A reconfiguration of Brussels from a one-way southbound roadway to a two-way roadway with one northbound and one southbound lane.
- The extension of University Road to the west to connect to the existing Red Lot. The roadway extension would traverse between the Student Services Building and the Student Recreation Center.

The introduction of the project will add transit service through campus which will result in a slight increase in traffic on campus from the new RTC transit services. The Harmon rapid service would add four (4) new eastbound and westbound movements at all study intersections. The Maryland Parkway and "Zoom" service would add another 10 turning movements at the University and Maryland Parkway intersection. These new volumes are shown in Figure D4.



**EXISTING PLUS PROJECT CONDITIONS
PEAK HOUR VOLUMES
FIGURE D4**

The existing plus project lane configurations and peak hour turning movement volumes were used to calculate the levels of service for the five (5) study intersections under existing peak hour conditions. Traffic volumes were determined by adding proposed BRT traffic volumes during the peak hour along the corridor at the study intersections. The results of the LOS analysis for existing plus project conditions during the AM and PM peak periods are presented in Table D4.

Table D4: Intersection Operations – Existing plus Project Conditions

| # | Intersection | Control ⁽¹⁾ | AM | | PM | |
|---|-------------------------------------|------------------------|-------------|-----|-------------|-----|
| | | | Delay (sec) | LOS | Delay (sec) | LOS |
| 1 | Harmon Avenue/Swenson Street | Signal | 42.2 | D | 60.1 | E |
| 2 | Harmon Avenue/Tarkanian Way | SSSC | 6.0 | A | 11.4 | B |
| 3 | Tarkanian Way/Thomas and Mack Drive | TWSC | 3.1 | A | 7.7 | A |
| 4 | Tarkanian Way /Bach Drive | SSSC | 5.5 | A | 3.6 | A |
| 5 | University Road/Maryland Parkway | Signal | 15.6 | B | 17.9 | B |

Source: Wilbur Smith Associates, 2009

(1) AWSC: All-Way Stop-Control

TWSC: Two-Way Stop-Control

SSSC: Side-Street Stop-Control

Bold indicates intersection operates under unacceptable conditions

Compared to the existing conditions, the plus project shows only one significant impact on operations. This impact is at Harmon and Swenson during the PM conditions where the LOS drops from D to E. This drop in LOS is coupled with a change in vehicle delay from 53.2 seconds in the existing condition to 60.1 seconds in the plus project condition.

All other intersections showed a relatively minor change with the introduction of the project. University Road and Maryland Parkway showed an improved in average delay. This change was due to the reduced traffic volumes due to a reduction in parking supply at Lot U from the implementation of the project.

Under the plus project conditions eastbound BRT service is estimated to take 5.5 minutes to traverse campus (Swenson – Maryland Parkway) while westbound is estimated to take 6.0 minutes. These estimates include two stops on campus and all delay related to traffic control and pedestrian/vehicular congestion. These relatively slow travel times reflect the pedestrian/bike oriented areas of campus where the transit service would operate and should be considered in the planning of any new Harmon service.

Table D5: Arterial Operations – Existing plus Project Conditions

| Intersection | AM | | PM | |
|---|-------------------|-------------|-------------------|-------------|
| | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) |
| Harmon/Tarkanian/University (eastbound) | 5.5 | 10.4 | 5.5 | 10.4 |
| Harmon/Tarkanian/University (westbound) | 5.8 | 10.0 | 6.2 | 9.3 |

2030 CONDITIONS

The 2030 condition includes three new parking garages on campus with storage capacity of approximately 2,000 vehicles. These include the Tropicana Garage (Phase 1 and 2), a new garage north of Harmon between Swenson and Tarkanian, and a new garage south of University Road between Maryland Parkway and Brussels. Some level of preliminary or conceptual design work has been completed on the later two garage listed above.

Using the Maryland Parkway-UNLV Community Realignment Plan findings and the preliminary or conceptual planning work done on the parking structures, the following network configuration changes were added in the 2030 scenario:

- Maryland Parkway loses a through travel lane in the northbound and southbound direction;
- Tarkanian and Bach switch the stop control from the northbound and eastbound movements to the westbound movement. A travel lane is removed from the northbound direction and added to the southbound movement;
- An off-street transit stop is added along Tarkanian, just north of the Tropicana Parking Garage; and
- Joe Delaney Lane is extended west to Brussels.

The 2030 intersection geometries are shown in Figure D5.

The 2030 traffic conditions modeled includes a number of future growth assumptions and development projects on campus. As described in the methodology section, future traffic volumes at the gateway intersections to campus were taken from the Maryland Parkway-UNLV Community Realignment Plan which used the RTC Regional Planning Model to estimate future traffic activity. This model accounts for all future land use changes including the Mid-Town UNLV project and future campus enrollment targets. Internal traffic was then distributed based future parking garage locations and the on existing traffic movements. Figure D6 shows the 2030 peak hour volumes.

The 2030 lane configurations and peak hour turning movement volumes were used to calculate the levels of service for the five (5) study intersections under 2030 peak hour conditions. The results of the LOS analysis for 2030 conditions during the AM and PM peak periods are presented in Table D6.

Table D6: Intersection Operations – 2030 Conditions

| # | Intersection | Control ⁽¹⁾ | AM | | PM | |
|---|-------------------------------------|------------------------|-------------|-----|-------------|-----|
| | | | Delay (sec) | LOS | Delay (sec) | LOS |
| 1 | Harmon Avenue/Swenson Street | Signal | 74.5 | E | 95.6 | F |
| 2 | Harmon Avenue/Tarkanian Way | SSSC | 6.1 | A | 13.1 | B |
| 3 | Tarkanian Way/Thomas and Mack Drive | TWSC | 3.5 | A | 9.5 | A |
| 4 | Tarkanian Way /Bach Drive | SSSC | 7.9 | A | 8.1 | A |
| 5 | University Road/Maryland Parkway | Signal | 16 | B | 19.5 | B |

Source: Wilbur Smith Associates, 2009

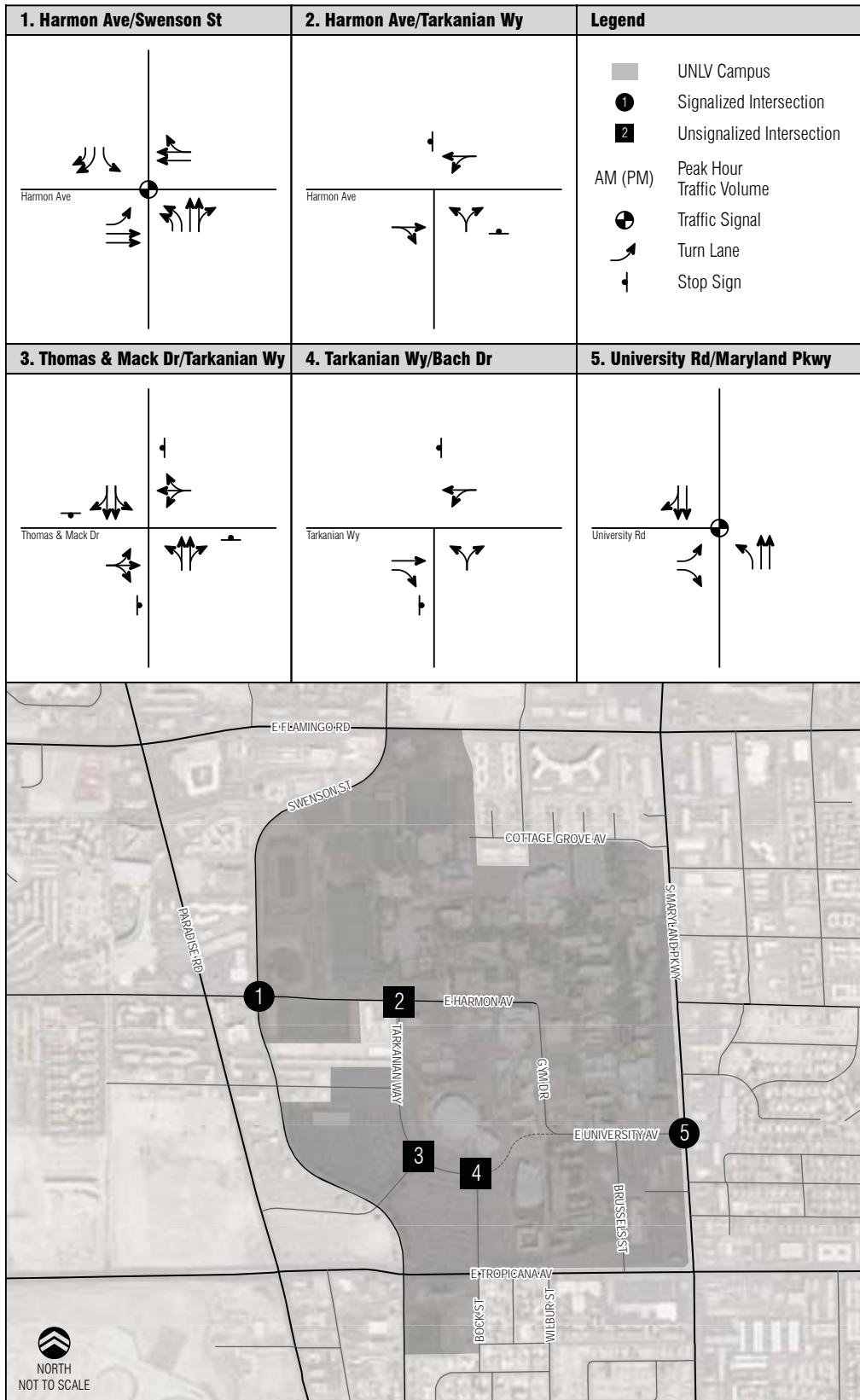
(1) AWSC: All-Way Stop-Control

TWSC: Two-Way Stop-Control

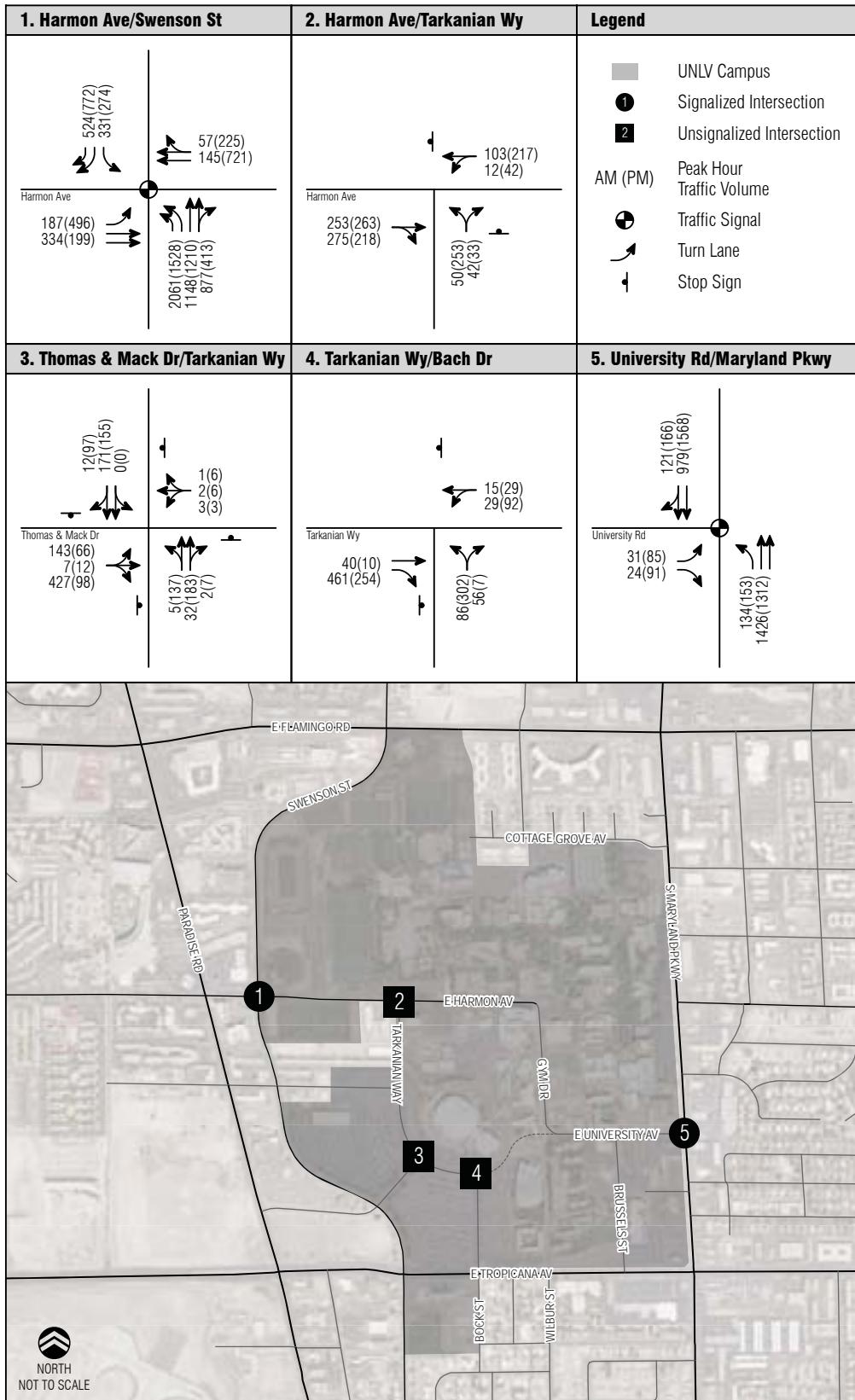
SSSC: Side-Street Stop-Control

Bold indicates intersection operates under unacceptable conditions

The results show relatively good intersection performance on campus but LOS E and F at Harmon Avenue and Swenson Street. This is reflective of the poor operating conditions in the existing scenario at this intersection.



2030 ROADWAY CONFIGURATIONS
FIGURE D5



2030 CONDITIONS PEAK HOUR VOLUMES
FIGURE D6

2030 Plus Project Conditions

The 2030 plus project lane configurations and peak hour turning movement volumes were used to calculate the levels of service for the five (5) study intersections under 2030 plus project peak hour conditions. The results of the LOS analysis for 2030 plus project conditions during the AM and PM peak periods are presented in Table D7.

Table D7: Intersection Operations – 2030 plus Project Conditions

| # | Intersection | Control ⁽¹⁾ | AM | | PM | |
|---|-------------------------------------|------------------------|-------------|-----|-------------|-----|
| | | | Delay (sec) | LOS | Delay (sec) | LOS |
| 1 | Harmon Avenue/Swenson Street | Signal | 76.2 | E | 96.5 | F |
| 2 | Harmon Avenue/Tarkanian Way | SSSC | 6.4 | A | 13.6 | B |
| 3 | Tarkanian Way/Thomas and Mack Drive | TWSC | 3.9 | A | 10.4 | B |
| 4 | Tarkanian Way /Bach Drive | SSSC | 8.9 | A | 8.8 | A |
| 5 | University Road/Maryland Parkway | Signal | 16.4 | B | 19.6 | B |

Source: Wilbur Smith Associates, 2009

(1) AWSC: All-Way Stop-Control

TWSC: Two-Way Stop-Control

SSSC: Side-Street Stop-Control

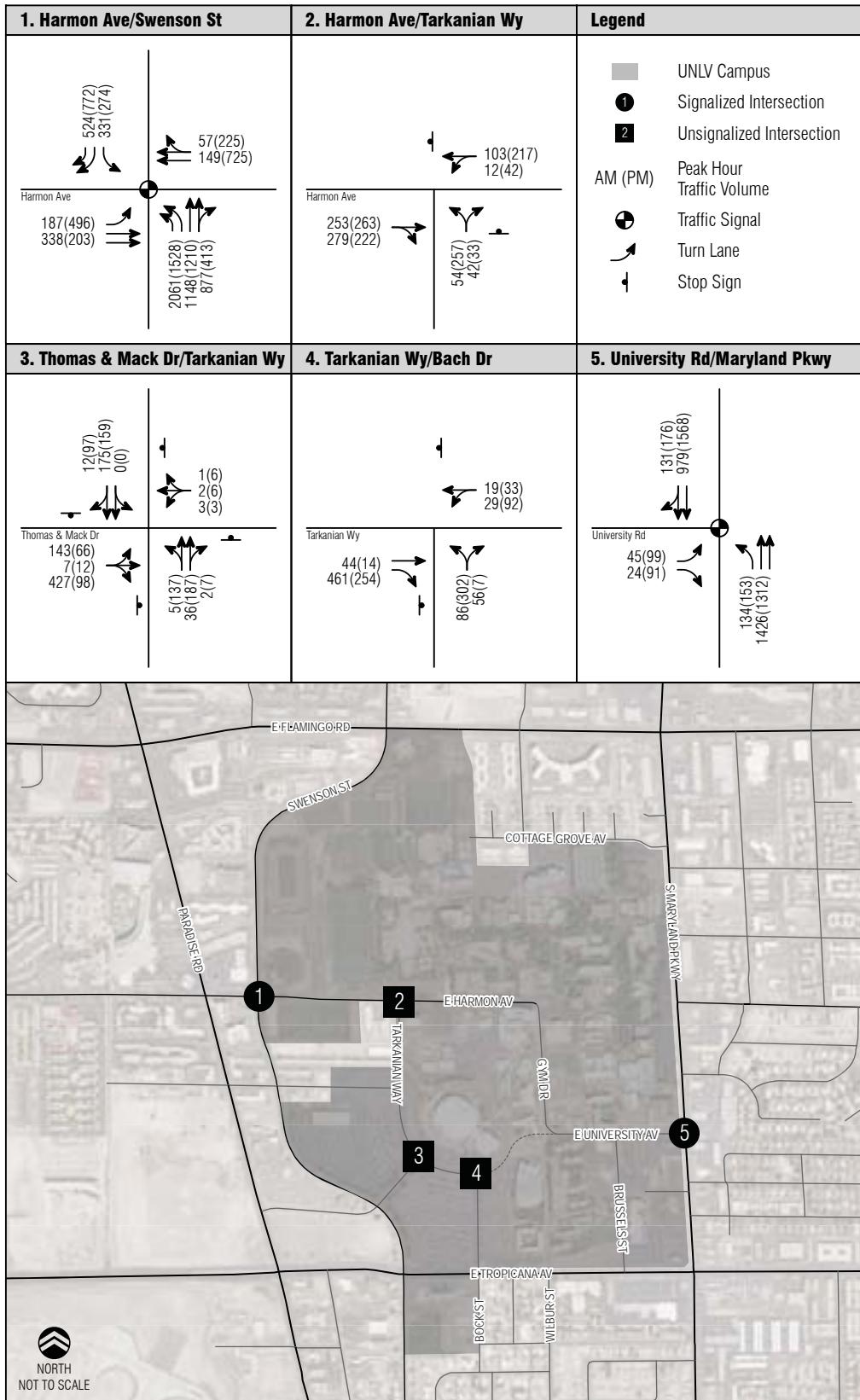
Bold indicates intersection operates under unacceptable conditions

The addition of the project traffic in the 2030 plus project scenario has very little impact on future traffic operations. While delay per vehicle did slightly increase at all intersection, only one case resulted in drop in LOS. This occurred at the intersection of Tarkanian Way and Thomas and Mack where the LOS went from A to B.

Table D8 shows the estimated 2030 travel times through campus with the project. The results show very little change over the existing plus project in both travel time and speed. This small change is due to little auto growth on campus and the restrictions on auto access using University Ave. through campus.

Table D8: Arterial Operations – 2030 plus Project Conditions

| Intersection | AM | | PM | |
|---|-------------------|-------------|-------------------|-------------|
| | Travel Time (min) | Speed (mph) | Travel Time (min) | Speed (mph) |
| Harmon/Tarkanian/University (eastbound) | 5.8 | 10.0 | 5.9 | 9.7 |
| Harmon/Tarkanian/University (westbound) | 5.9 | 9.8 | 6.6 | 8.7 |



**2030 PLUS PROJECT CONDITIONS
PEAK HOUR VOLUMES
FIGURE D7**

Appendix E: Capital Cost Estimates

Table E1: Estimated Multi-Modal Transit Hub Costs

| Item Description | Units | Quantity | Cost |
|---|-------|----------|--------------|
| Capital Improvements | | | |
| Remove Curb and Gutter | LF | 550 | \$2,750 |
| Remove Concrete Sidewalk | SF | 1,100 | \$2,200 |
| Remove Concrete Pavement | SY | 5,250 | \$78,750 |
| Landscaping | LS | 1 | \$150,000 |
| AC Surface Course | TON | 258 | \$19,882 |
| AC Binder | TON | 368 | \$26,920 |
| Hot Laid Asphalt Aggregate | TON | 442 | \$36,513 |
| Graded Aggregate Base Course | SY | 2,944 | \$47,106 |
| Liquid Asphalt Binder | TON | 54 | \$18,711 |
| Curb and Gutter | LF | 1,425 | \$64,125 |
| Earthwork | CY | 2,944 | \$26,497 |
| Asphalt Removal | SY | 988 | \$6,422 |
| Transit Building (6,336 Sq. Ft.) | LS | 1 | \$1,679,783 |
| Canopy | EA | 4 | \$248,000 |
| Bench | EA | 12 | \$12,000 |
| Trash/Recycling Receptacles | EA | 6 | \$9,000 |
| LCD Display Monitors | EA | 6 | \$4,800 |
| Security Cameras | EA | 2 | \$10,000 |
| Monument Sign | EA | 1 | \$25,000 |
| Stop Flag Signs | EA | 8 | \$4,000 |
| 150-Watt Light Assembly | EA | 4 | \$8,000 |
| SUBTOTAL Capital Costs | | | \$ 2,630,459 |
| Contingencies (30%) | | | \$ 789,138 |
| TOTAL CAPITAL COSTS | | | \$ 3,419,597 |
| Support Costs | | | |
| Planning/Pre-Design (5%) | | | \$ 170,980 |
| Final Design (8%) | | | \$ 273,568 |
| Environmental Clearances & Mitigation (5%) | | | \$ 170,980 |
| Construction Admin. (10%) | | | \$ 341,960 |
| SUBTOTAL Support Costs | | | \$ 957,487 |
| GRAND TOTAL (Rounded to the nearest \$1,000) | | | \$ 4,377,000 |

Table E2: Estimated UNLV Roadway Improvement Costs

| Item Description | | | Area 1 | | Area 2 | | Area 3 | | Area 4 | | Area 5 | | Total | |
|---|-------|----------|------------------|----------|------------------|----------|------------------|----------|------------------|----------|------------------|----------|--------------------|----------|
| | Units | Quantity | Cost | Quantity |
| Capital Improvements | | | | | | | | | | | | | | |
| AC Surface Course | TON | 404 | \$31,171 | 343 | \$26,453 | 203 | \$15,686 | 425 | \$32,829 | 110 | \$8,489 | 1,375 | \$114,627 | |
| AC Binder | TON | 38 | \$2,798 | 37 | \$2,731 | 214 | \$15,634 | 34 | \$2,521 | 88 | \$6,462 | 324 | \$30,145 | |
| Hot Laid Asphalt Aggregate | TON | 46 | \$3,795 | 45 | \$3,704 | 256 | \$21,205 | 41 | \$3,419 | 106 | \$8,764 | 389 | \$40,887 | |
| Graded Aggregate Base Course | SY | 306 | \$4,896 | 299 | \$4,779 | 1,710 | \$27,356 | 276 | \$4,411 | 707 | \$11,307 | 2,590 | \$52,748 | |
| Liquid Asphalt Binder | TON | 25 | \$8,663 | 22 | \$7,623 | 34 | \$11,781 | 25 | \$8,663 | 15 | \$5,198 | 106 | \$41,927 | |
| Curb and Gutter | LF | 2,910 | \$130,950 | 1,686 | \$75,870 | 1,235 | \$55,575 | 345 | \$15,525 | 726 | \$32,670 | 6,176 | \$310,590 | |
| Sidewalk (4" thick) | SF | 14,249 | \$99,743 | 8,185 | \$57,295 | 5,530 | \$38,710 | 1,628 | \$11,396 | 300 | \$2,100 | 29,592 | \$209,244 | |
| Earthwork | CY | 102 | \$5,100 | 299 | \$14,950 | 570 | \$28,496 | 570 | \$28,496 | 236 | \$11,778 | 1,541 | \$88,820 | |
| Asphalt Removal | SY | 306 | \$1,989 | 338 | \$2,199 | 1,710 | \$11,114 | 1,069 | \$6,951 | - | - | 3,423 | \$22,252 | |
| Milling | SY | 4,310 | \$20,255 | 4,586 | \$21,552 | 613 | \$2,881 | 613 | \$2,881 | 550 | \$2,585 | 10,121 | \$50,153 | |
| Roadway Striping | LF | 3,189 | \$11,162 | 3,937 | \$39,370 | 1,026 | \$3,591 | 2,480 | \$8,680 | 470 | \$1,645 | 10,632 | \$64,448 | |
| Concrete Removal | SY | - | - | - | - | - | - | 147 | \$736 | 308 | \$1,540 | 147 | \$2,276 | |
| Remove Curb and Gutter | LF | - | - | - | - | - | - | 250 | \$6,250 | 770 | \$19,250 | 250 | \$25,500 | |
| Concrete Median | SY | - | - | 40 | \$1,745 | - | - | 147 | \$6,473 | - | \$0 | 187 | \$8,218 | |
| Landscaping | LS | 1 | \$25,000 | 1 | \$25,000 | 1 | \$25,000 | 1 | \$25,000 | - | \$25,000 | 4 | \$125,000 | |
| Drainage | MI | 0.27 | \$27,000 | 0.17 | \$17,000 | 0.12 | \$12,000 | 0.20 | \$20,000 | 0.09 | \$9,000 | 1 | \$85,000 | |
| Erosion Control | LS | 1 | \$6,750 | 1 | \$4,250 | 1 | \$3,000 | 1 | \$5,000 | 1 | \$2,250 | 4 | \$21,250 | |
| Signage | LS | 1 | \$8,000 | 1 | \$15,000 | 1 | \$3,000 | 1 | \$10,000 | 1 | \$5,000 | 4 | \$41,000 | |
| Signal Modification | LS | - | - | - | - | - | - | 1 | \$10,000 | - | - | 1 | \$10,000 | |
| Traffic Control | LS | 1 | \$38,727 | 1 | \$31,952 | 1 | \$27,503 | 1 | \$19,923 | 1 | \$15,304 | 4 | \$133,409 | |
| SUBTOTAL Capital Costs | | | \$425,998 | | \$351,474 | | \$302,531 | | \$229,152 | | \$168,340 | | \$1,477,494 | |
| Contingencies (30%) | | | \$127,799 | | \$105,442 | | \$90,759 | | \$68,745 | | \$50,502 | | \$443,248 | |
| TOTAL CAPITAL COSTS | | | \$553,797 | | \$456,916 | | \$393,290 | | \$297,897 | | \$218,842 | | \$1,920,742 | |
| Support Costs | | | | | | | | | | | | | | |
| Planning/Pre-Design (5%) | | | \$27,690 | | \$22,846 | | \$19,664 | | \$14,895 | | \$10,942 | | \$96,037 | |
| Final Design (8%) | | | \$44,304 | | \$36,553 | | \$31,463 | | \$23,832 | | \$17,507 | | \$153,659 | |
| Environmental Clearances & Mitigation (5%) | | | \$27,690 | | \$22,846 | | \$19,664 | | \$14,895 | | \$10,942 | | \$96,037 | |
| Construction Admin. (10%) | | | \$55,380 | | \$45,692 | | \$39,329 | | \$29,790 | | \$21,884 | | \$192,074 | |
| SUBTOTAL Support Costs | | | \$155,063 | | \$127,936 | | \$110,121 | | \$83,411 | | \$61,276 | | \$537,808 | |
| GRAND TOTAL (Rounded to the nearest \$1,000) | | | \$709,000 | | \$585,000 | | \$503,000 | | \$381,000 | | \$280,000 | | \$2,459,000 | |

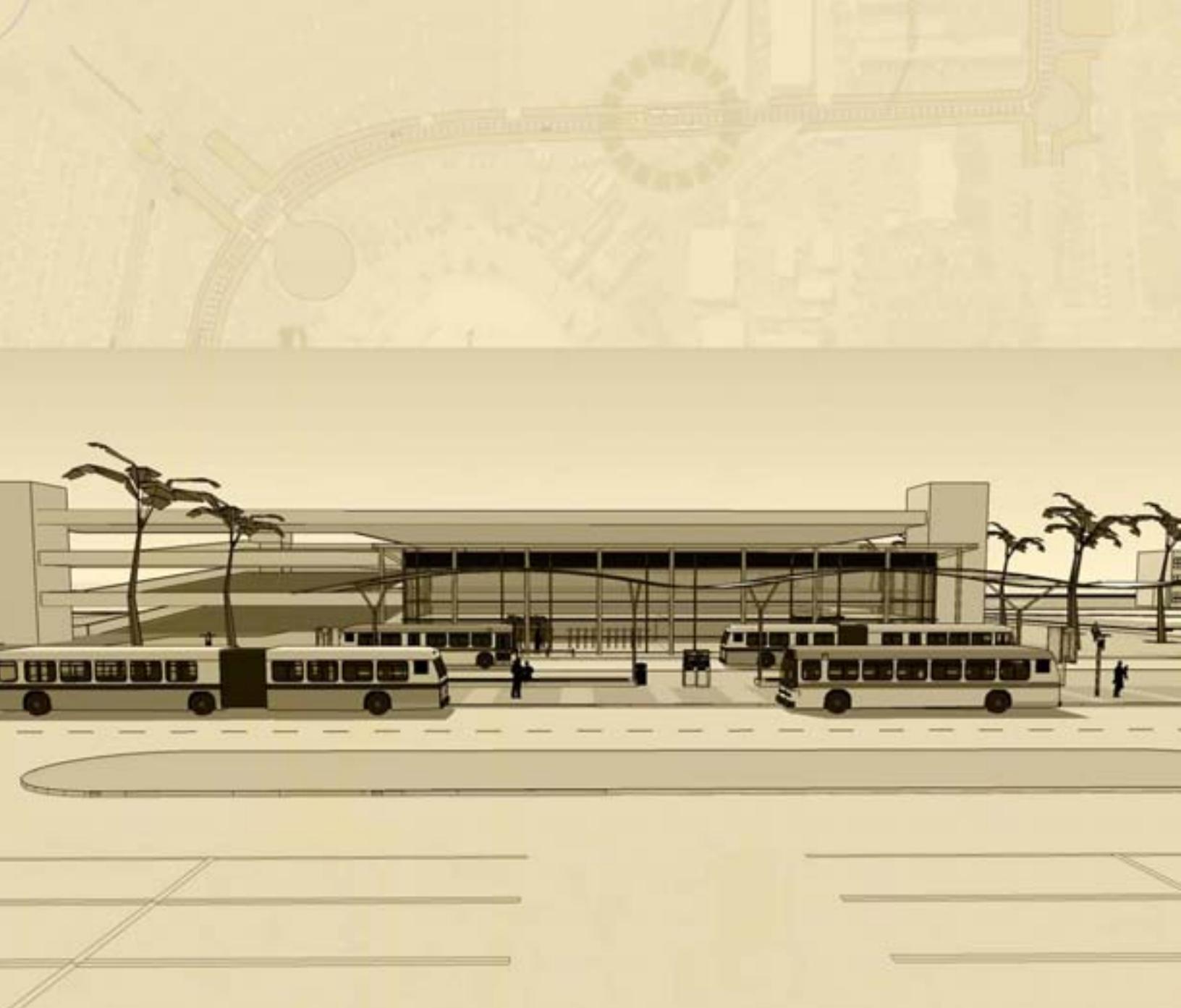
Area 1 - Harmon Avenue – Swenson to Thomas and Mack Drive

Area 2 - Thomas and Mack and Harmon Avenue Intersection to Student Services Phase III

Area 3 - Student Services Phase III to Existing University Road Tie

Area 4 - Existing University Road Tie to Maryland Parkway

Area 5 - Brussels Street Improvements



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