Section 6: Conceptual Operating Plans

As discussed at the end of Section 5, an end product for the ridership forecasting effort was to identify two gateway corridors for more detailed analysis. These "prototype" corridors would form the basis in developing costs information for the remaining services. The Transit Study Committee identified Gateway 1 (Martin Luther King Jr. Boulevard) and Gateway 3B/3C (US 15/501 via Franklin and via Estes to Carolina North) corridors to be developed further. Gateways 4 and 5 under the Low and High Investments were not targeted because the committee believed that those corridors would be studied through a regional transit planning process that was occurring at the time of this study.

This section presents a conceptual operating plan for enhanced transit service in the two selected corridors in the Chapel Hill/Carrboro area. The scope of the operating plan is limited to a conceptual level. It includes a running way definition, ridership estimate, station and vehicle description, and operating parameters (i.e. span of service, fleet size, headway, running time). Based on this operating plan, generalized service parameters for the remaining gateway routes as well as for the enhanced local bus service are also presented. Finally, ridership and gateway park and ride information is presented for the "low investment" scenario discussed earlier in Sections 4 and 5.

6.1 Martin Luther King Jr. Blvd., Gateway 1

The Martin Luther King Jr. Boulevard is served by a BRT route 1 (also referred to as Gateway 1).

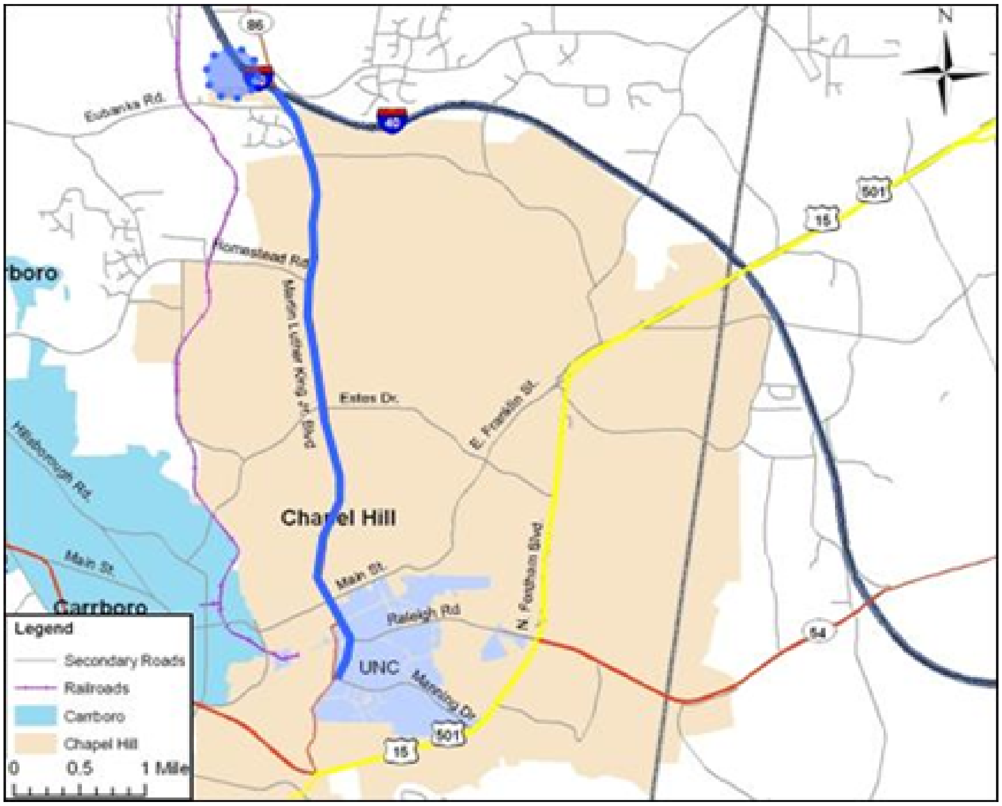
6.1.1 BRT Gateway 1

BRT Route 1 extends from a park-and-ride station near the intersection with I-40 to Manning Drive at the University of North Carolina (UNC) in downtown Chapel Hill. The entire alignment for this BRT route is presented in the Figure 6-1.

Key trip generators for this corridor are the park-and-ride lot near I-40, which will generate trips from commuters that live in the outer areas of Chapel Hill, and the Carolina North mixed-use development. Key trip attractors for this corridor are employment, school, and shopping developments in downtown Chapel Hill and Carolina North. This route is expected to carry approximately 9,800 trips per day in the low investment build scenario. About 70 percent of this ridership is projected to be generated by park-and-ride activity primarily at the Gateway at I-40 and Martin Luther King Jr. Boulevard. This level of demand will require about 4,100 parking spaces at this gateway. While regional ridership impacts were not modeled, the number of parking spaces, nonetheless, reflects demand net of regional riders.

Figure 6-2 (on page 6-3) shows a conceptual site plan for Gateway 1. The illustration shows the park-and-ride facility along with ancillary development that would be encouraged to occur at the gateway independent of the BRT project itself. This concept site plan is later evaluated for potential land development in Section 7 of this study. See Figure 7-2 on page 7-2.

Figure 6-1: Gateway 1—Martin Luther King Jr. Blvd. BRT



6.1.2 Ridership

It is important to note that the ridership results presented for each corridor are from the model runs, which include the entire service network of BRT services as well as an increased local bus network. *If the corridors are to be implemented separately, a new model run with isolated corridors must be conducted.*

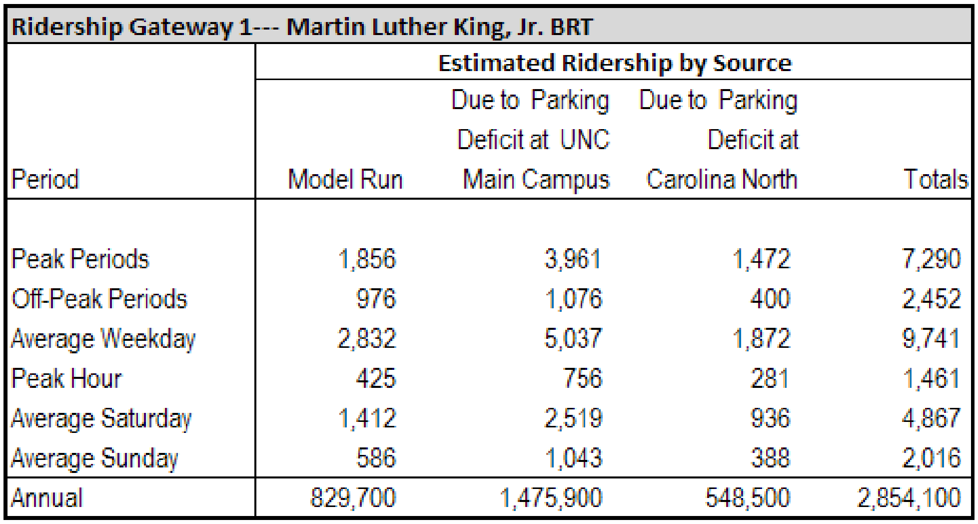
Total ridership for this operating plan presented in this section is focused on the BRT service, which carries approximately 9,700 passengers. See Section 5 for details on this ridership projection.

The table below shows ridership results for the BRT Route 1 on the corridor. It was assumed that peak hour ridership was 15 percent of daily ridership. Using industry norms, the team established that Saturday and Sunday ridership is approximately 50 percent and 20 percent of Weekday ridership respectively.

Figure 6-2: Conceptual Gateway 1 Site Plan with Joint Development

Source: Crosby Schlessinger Smallridge, LLC

Table 6-1: Gateway 1 Ridership by Period of Day and Day of Week



Ridership Gateway 1--- Martin Luther King, Jr. BRT				
	Estimated Ridership by Source			
Period	Model Run	Due to Parking Deficit at UNC Main Campus	Due to Parking Deficit at Carolina North	Totals
Peak Periods	1,856	3,961	1,472	7,290
Off-Peak Periods	976	1,076	400	2,452
Average Weekday	2,832	5,037	1,872	9,741
Peak Hour	425	756	281	1,461
Average Saturday	1,412	2,519	936	4,867
Average Sunday	586	1,043	388	2,016
Annual	829,700	1,475,900	548,500	2,854,100

6.1.3 Running Way

As mentioned, BRT Gateway 1 extends from the park-and-ride station near I-40—its specific location is still to be determined after further study—to the UNC and hospital area. The running way will consist of two dedicated bus lanes on Martin Luther King Jr. Blvd. from Eubanks south to Estes. Thereafter the service would operate in mixed traffic. As seen in Figure 6-3 MLK is generally a five-lane facility with a center turn lane. Also seen in Figure 6-3, conceptually, how the running way would be designed. One travel lane is converted to BRT use with one more lane added to MLK. The center turn lane is eliminated except at signalized intersections where a left turn lane will be provided. Figure 6-4 shows sections A and B from Figure 6-3 represented on aerial images of MLK and are intended to display what the BRT improvements could look like. Finally, all traffic signals (17 in total) along MLK would be designed for signal priority activated by the buses.

6.1.4 Stations

Locations and Types

Three types of stations are proposed: small, medium, and large. Each station should be classified into one of these categories according to demand and the shelter size would be placed accordingly. Stations with 30 or less peak hour boardings are considered "small", those with 31 to 74 peak hour boardings as "medium", and those with 75 or more peak hour boardings as "large." Stations located at the gateway park-and-ride facilities will have special stations and are noted as such in the table below.

Stations are intended to consume 100 feet of curb space and, where possible, be located on the far side of intersections. That is, after the intersection, out of the path of right turning automobiles.

Figure 6-3: Existing and Improved Martin Luther King Jr. Boulevard Running Way

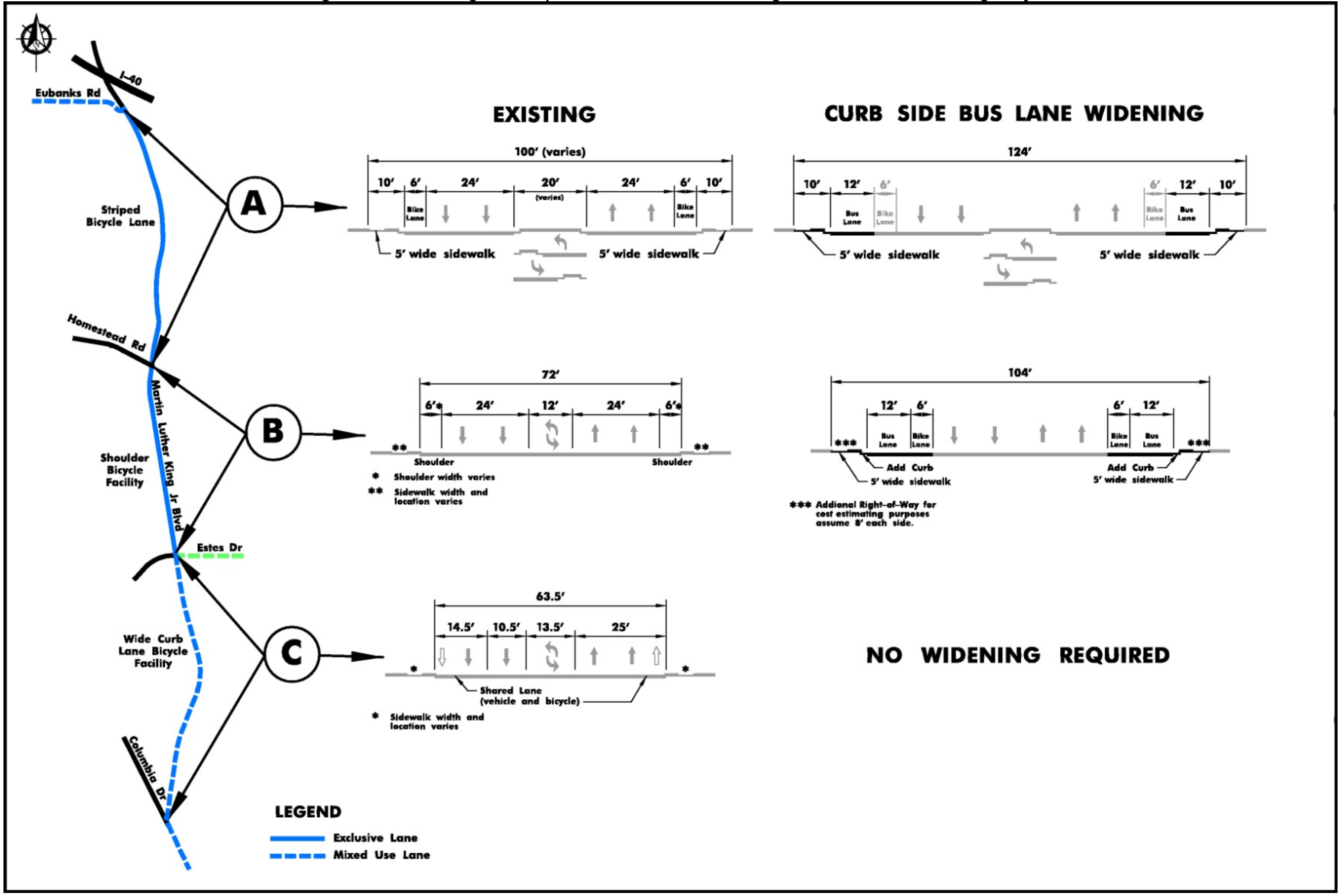


Figure 6-4: Conceptual Design of Running Way on Martin Luther King, Jr. Blvd.

Section A (see Figure 6-3)

Section B (see Figure 6-3)

Table 6-2: Gateway 1(Martin Luther King Jr. Blvd.) Station Locations and Sizing

Inbound	
Station	**Station Size**
MLK Jr. Blvd at I-40	P&R
MLK Jr. Blvd at Northwood Dr	M
MLK Jr. Blvd at Westminster Dr	M
MLK Jr. Blvd at Stateside Dr	M
MLK Jr. Blvd at Brookstone Apts (south of Homestead Rd)	M
MLK Jr. Blvd at Critz Dr	M
MLK Jr. Blvd at Horace Williams Rd (Carolina North)	M
MLK Jr. Blvd at Estes Dr	M
MLK Jr. Blvd at Longview St	L
Columbia at Franklin St	M
Pittsboro St at Newman Center	M
Pittsboro St at Credit Union	M
Manning Dr at UNC Hospitals	M
Outbound	
Station	**Station Size**
MLK Jr. Blvd at I-40	P&R
MLK Jr. Blvd at Northwood Dr	M
MLK Jr. Blvd at Riggsbee Trailer Ct	S
MLK Jr. Blvd at Stateside Dr	M
MLK Jr. Blvd at Homestead Rd	M
MLK Jr. Blvd at Taylor St (Citgo)	M
MLK Jr. Blvd at Horace Williams Rd (Carolina North)	L
MLK Jr. Blvd at Estes Dr	M
MLK Jr. Blvd at Millcreek	M
Columbia at Franklin St	L
S Columbia St at Sitterson Hall	L
S Columbia St at Carrington Hall	L
Manning Dr at UNC Hospitals	L
P&R= Park and Ride; S=Small; M=Medium; L= Large	

Features/amenities

The project team identified a standard set of amenities and an optional set of amenities to include at each station location. These amenities are discussed below. The shelter and all other amenities should be specifically designed for the BRT system aiming for consistency and a unique image that may be provided by using similar materials, color scheme, and design style in all elements.

All BRT stations should be named (as is the case with rail stations) to raise the visibility and permanence of the system. The names of the stations could initially be the crossing streets. However, if there are widely recognized places near the station, naming the station after the place is an alternative. If the place is a commercial organization, a funding opportunity arises. Many transit agencies sell their station names to commercial institutions which obtain advertising benefits in exchange for maintenance or a fixed fee.

Various proposed amenities, including the bulletin board, public and emergency phones, customer information, station sign, and vending machines, can be incorporated into one element specifically designed for the BRT system.

This reduces the number of independent elements on the sidewalk and the element itself may become a sign of the BRT stations.

Standard amenities

The set of standard amenities presented here are recommended for deployment at all BRT stations. Some amenities play a more important role at particular stations. For example, bike racks play a more important role at locations near low density single-family housing areas than in downtown stations.

<u>Shelter</u>

The main element of the BRT station will be the shelter, which provides comfort to waiting customers, including weather protected seating and customer information. Three types of shelter prototypes are proposed—large, medium, and small—to provide more opportunities to adjust to the demand levels. The larger prototypes are expected to be deployed in downtown Chapel Hill and Carrboro and at the stations with heavy transfer activity. The station design should be such that the shelters may be built with standard construction materials to avoid high initial and maintenance costs.

As an example, the figure below shows a station sign and shelter of the MAX BRT service in Kansas City.

Figure 6-5: Shelter and Station Sign for the MAX BRT Service in Kansas City

<u>Station sign</u>

Station signs are of great importance to BRT systems: they provide visibility, consistency, and a rail-like image to station areas. Station signs are particularly important in BRT corridors if the shelters (the other main BRT infrastructure at station areas) are not consistent across all stations (i.e. because existing shelters are used). Station names should be determined for each BRT location and displayed on the station sign. Local stops may also have signs with a similar design to the BRT to provide a consistent image on the corridor.

<u>Renovated sidewalks</u>

Sidewalks along the MLK and US 15/501 – Franklin corridors and especially areas near the stations require renovation to provide a safe and attractive environment and to encourage walk access to BRT stations. Pedestrian-friendly sidewalks should include high curbs (to avoid cars), well-designated and safe walking areas, and street furniture. The street furniture may be specifically designed for the BRT system to help provide a system image. Below are descriptions of the street furniture elements that could be part of the standard BRT amenities.

Pedestrian lighting
In addition to its main purpose of providing light at night time, pedestrian lighting has the potential to:

- Play a key role in conveying the system image if it is designed specifically for the BRT system and in accordance with the design of other elements in the system, and
- Delineate the pedestrian area making it safer and more pleasant.

Benches
Benches may also play a role in conveying a system image if designed according with other BRT elements, but their main purpose is to transform sidewalks from traveling infrastructures to meeting facilities. Benches allow users to remain at sidewalks and plazas, using them as meeting and leisure areas, which invigorate public space.

Trash cans
Uniform trash cans with a consistent design related to the other elements help to raise the visibility of the stations and maintain the image of the BRT system.

Newspaper dispenser boxes
Newspaper dispensers are a desirable amenity for any transit station. Their design and deployment is usually done by the newspaper provider. However, a standard newspaper dispenser may be designed and enforced by the transit agency to maintain uniformity and consistency in the street furniture of the system.

Customer Information

System information: Static information about the BRT system, including routes, stations, schedule, span of service, and fares.

Real-time information: Dynamic information displaying estimated time of arrival of next bus, such as the *NEXTbus* system already used by CHT.

*Map of area: M*ap of the area around the station that includes all streets, main buildings, offices, and stores.

Bike racks

A simple bike rack should be provided at all stations. However, some stations may need a more robust bike rack (weather protected) facility to store bikes. These improved facilities should be deployed in stations located in lower density residential neighborhoods to encourage residents from farther distances to ride to the BRT station.

Bulletin board

Bulletin boards are an effective way of providing neighborhood identity to residential areas and communicating with commuters in downtown stations.

Emergency and public phone

Installing emergency phones at all BRT stations may increase the public's perception of safety. Emergency phones should be linked to the operations control center and the police. The phones may also serve to alert the control center of service disruptions. Public phones may be deployed as well; their cost should be marginal if emergency phones are being implemented. The phone booth could be designed specifically for the BRT system instead of using standard phone booths to help raise the visibility of the system.

Optional Amenities

The optional amenities presented here are recommended for deployment at certain stations according to their characteristics. For example, while vending machines and restrooms may only be provided at the higher volume transfer stations, security cameras may be deployed at stations located in areas with potential safety and security issues.

Vending machines

Vending machines are a great way to provide food and services to users without the risk and costs of facility maintenance. Vending machines are recommended for high volume, key transfer stations.

Security cameras

In addition to their main purpose of monitoring the stations from a safety standpoint, security cameras also provide the operations control center an important tool to monitor the system from a service standpoint and react to unexpected situations. Security cameras also increase the public's perception of safety in the system. Security cameras may be deployed at high ridership stations and at stations located in areas with safety concerns.

Closed Circuit TV

Closed Circuit TV may be implemented in stations with high ridership. The TV system serves to communicate with the passengers. Communications include ongoing information about the system, the city, etc., and unexpected events that may warrant an alert to the customers. Ongoing programming at stations may also help reduce the waiting time penalty perception because users entertain themselves while waiting for the bus.

Restrooms

Restrooms tend to be avoided in most on-street bus stations because of the maintenance burden they impose on the agency and their infrastructure requirements. However, larger transfer facilities such as park & ride stations usually provide restroom services. If bathrooms are implemented, it is recommended to contract out their operation and maintenance. Poorly maintained bathrooms rapidly deteriorate the positive perception of a facility.

6.1.5 Vehicles

Type

Articulated vehicles such as the new ones operating in the area (see figure below) are proposed to serve the BRT services. These articulated buses have capacity for 120 people.

Figure 6-6: New CHT Articulated Buses

Fleet size

The number of vehicles required to operate the BRT Gateway 1 route is presented in the following table. The number of operational vehicles required was calculated for the most critical time of the day, the morning peak hour. A spare ratio of 15 percent was assumed (with rounding up to the next integer). See Table 6-3.

Table 6-3: Gateway 1 Vehicle Requirement

Fleet Size	
	BRT Gateway 1
Operational vehicles	9
Spare vehicles	2
Total Fleet Size	11

Assumptions:

Vehicle capacity	120 passengers
Peak headway	5 min
Peak hour ridership	15% of daily ridership
Recovery time	15% of running time
Spare ratio	15% of peak requirement.

Amenities/on-board features

BRT services are expected to provide passengers a more comfortable and convenient ride than conventional bus service. On-board Intelligent Transportation Systems (ITS) play a key role in achieving this objective. The recommended features on-board the vehicle are the following:

- On-board equipment for Transit Signal Priority (TSP) system
- On-board equipment for Automatic Vehicle Location (AVL) systems
- Automated annunciation and signage system
- Automatic Passenger Counter (APC) system

All of the systems mentioned in the previous list are described in more detail in the ITS chapter.

6.1.6 Service Plan

Span of Service
The proposed span of service is shown in Table 6-4 below:

Table 6-4: Gateway 1 Service Span

Span of Service	
	BRT Gateway 1
Weekdays	6 am – 11 pm
Saturdays	8 am – midnight
Sundays	10 am – 6 pm

Headways
The proposed frequency of service is shown in Table 6-5.

Table 6-5: Gateway 1 Frequencies

Frequency of Service		
	BRT Gateway 1	
	Peak	Off-peak
Weekdays	5 min	8 min
Saturdays	20 min	30 min
Sundays	30 min	30 min

Revenue Vehicle Hours
The estimated weekday revenue-vehicle-hours for this service are approximately 120.

Fare and fare structure
The BRT service is proposed to be free as the existing CHT local routes. Parking fees should also be comparable to the standard fee for other CHT services.

Integration with other services
The proposed BRT services rely heavily on the proposed underlying local network. Most of the existing local routes would have to be redesigned for the build scenarios to act as feeders for the BRT services. In this case, with a free fare system, fare integration is not a concern. However, special attention must be given to scheduling to provide timed-transfer possibilities between feeder and BRT express routes. A general description of the local network is provided later in this section.

6.2 US 15/501 via Franklin with Estes, Gateway 3B and 3C[17]

The US 15/501 Franklin-Estes Corridor is served by BRT routes 3B and 3C

6.2.1 BRT Gateway 3 Components

Gateway 3 has two branches and is described below and shown in Figure 6-7. Both branches share the same gateway park-and-ride facility. See Figure 6-8 (on page 6-15) which shows a preliminary conceptual sketch of Gateway 3. Later, in Section 7 of this report, this site is evaluated for build out potential. See Figure 7-10 (on page 7-7). In many ways, the future vision for this gateway would be similar to the one shown earlier for Gateway 1 in Figure 6-2. The total number of park and ride spaces (for both branches) is just over 5,000. This estimate takes into account people entering the community using regional transit service.

BRT Routes 3B
BRT route 3B extends from the park-and-ride near the intersection between US 15/501 and Interstate 40 to Manning Drive at the University of North Carolina (UNC) in downtown Chapel Hill.

Key trip generators for this corridor are the park-and-ride lot near I-40, which will generate trips from commuters that live in the outer areas of Chapel Hill, as well as commercial and residential developments along the alignment. Key trip attractors for this corridor are employment, school, and shopping developments in downtown Chapel Hill and along the alignment. This route is expected to carry about 3,000 trips per day and generate demand for nearly 1,400 park and ride spaces.

BRT Routes 3C
BRT route 3C extends from the park-and-ride near the intersection between US 15/501 and Interstate 40 to Carolina North via Estes Dr.

Key trip generators for this corridor are the park-and-ride lot near I-40, which will generate trips from commuters that live in the outer areas of Chapel Hill, and residential developments at Carolina North. Key trip attractors for this corridor are employment, school, and shopping developments at Carolina North. This route is expected to also carry approximately 7,500 trips per day in the build scenarios. This would generate the need for just over 3,600 park and ride spaces.

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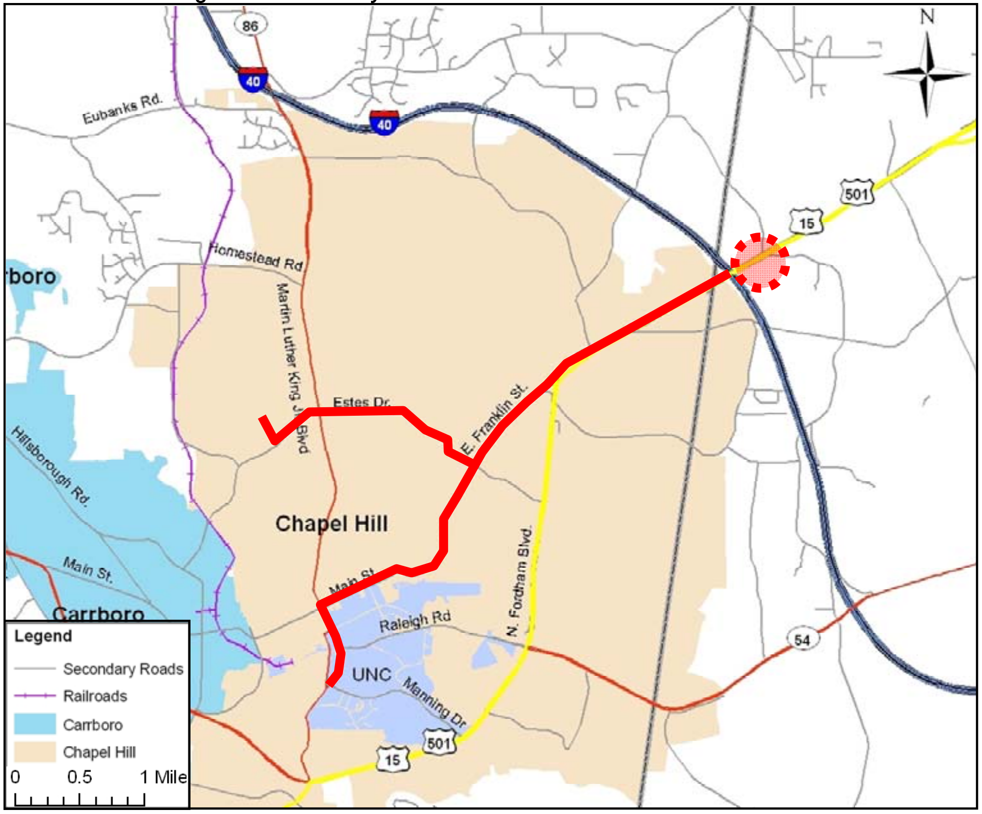
[17] In Section 4 this gateway was originally introduced as Gateway 2B.

Figure 6-7: Gateway 3B/C—US 15/502 via Franklin with Estes



6.2.2 Ridership

It is important to note that the ridership results presented for each corridor are from the model runs, which included the entire service network of BRT services. *If the corridors are to be implemented separately, a new model run with isolated corridors must be conducted.*

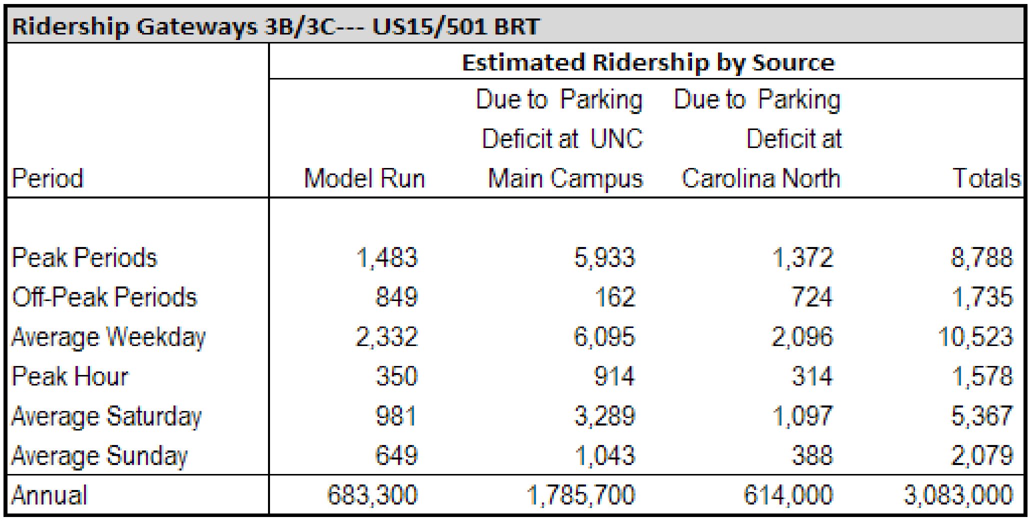
Total ridership for the 3B/3C corridor is around 10,500 trips per day with corridor 3C carrying 70 percent of this at approximately 7,500 trips per day.

The table below shows ridership results for the BRT Routes 3B and 3C. It was assumed that peak hour ridership was 15 percent of daily ridership. Using current ridership data from CHT, the team established that Saturday and Sunday ridership is roughly 50 percent and 20 percent of Weekday ridership respectively.

Figure 6-8: Conceptual Gateway 3 Site Plan with Joint Development

Source: Crosby Schlessinger Smallridge, LLC

Table 6-6: US 15/501 Gateway Ridership



Ridership Gateways 3B/3C--- US15/501 BRT				
	Estimated Ridership by Source			
Period	Model Run	Due to Parking Deficit at UNC Main Campus	Due to Parking Deficit at Carolina North	Totals
Peak Periods	1,483	5,933	1,372	8,788
Off-Peak Periods	849	162	724	1,735
Average Weekday	2,332	6,095	2,096	10,523
Peak Hour	350	914	314	1,578
Average Saturday	981	3,289	1,097	5,367
Average Sunday	649	1,043	388	2,079
Annual	683,300	1,785,700	614,000	3,083,000

6.2.3 Running Way

As mentioned, BRT Gateway 3 extends from the park-and-ride station near I-40—its specific location is still to be determined after further study—to the UNC and hospital area via the Franklin branch and to Carolina North via Estes Drive branch. The running way will consist of two dedicated bus lanes on US 15/501 from about I-40 south to the Franklin Split at US 15/501 and Fordham. Thereafter the service would operate in mixed traffic on Franklin as well as on Estes Drive. As seen in Figure 6-9, US 15/501 is generally a four-lane facility with a center turn lane. Also seen in Figure 6-9, conceptually, is how the running way would be designed. Figure 6-10 shows an aerial representation of the running way improvements (section A from Figure 6-9) on US15/501 at Sage Road. All traffic signals (21 in total) along US 15/501 and Estes would be designed for signal priority activated by the buses.

6.2.4 Stations

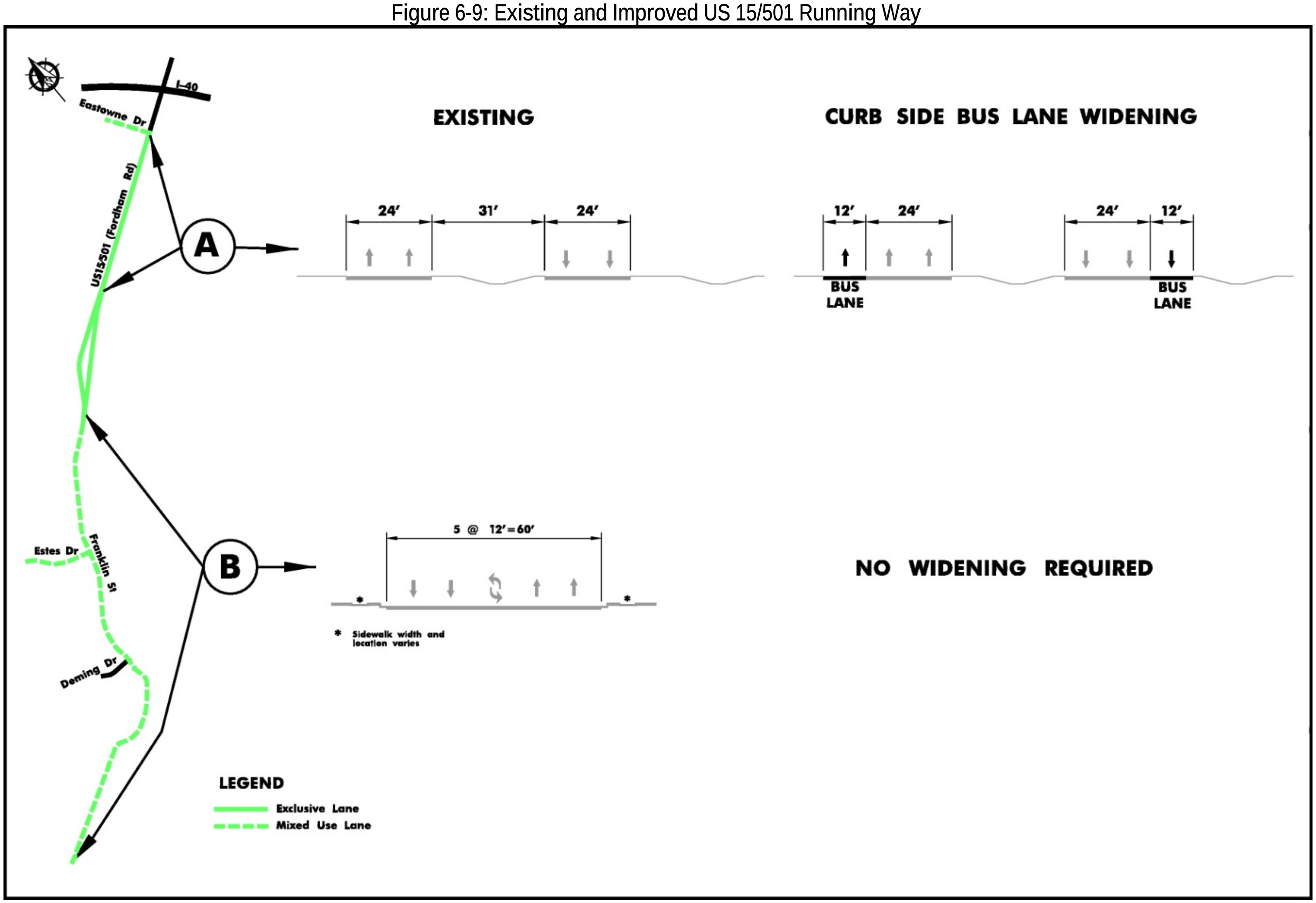
Locations and Types

As with the discussion for Gateway 1 earlier, three types of stations are proposed: small, medium, and large. Each station should be classified into one of these categories according to demand, and the shelter size would be placed accordingly. Stations with 30 or less peak hour boardings are considered "small", those with 31 to 74 peak hour boardings as "medium", and those with 75 or more peak hour boardings as "large." Stations located at the gateway park-and-ride facilities will have special stations and are noted as such in the table below.

Stations are intended to consume 100 feet of curb space and, where possible, be located on the far side of intersections. That is, after the intersection, out of the path of right turning automobiles.

Table 6-7 shows station sizing for this corridor.

Figure 6-9: Existing and Improved US 15/501 Running Way



Note: Estes branch of US 15/501 Gateway 3 BRT would be mixed traffic with no running way improvements.

Figure 6-10: Conceptual Design of Running Way on US15/501 at Sage Road

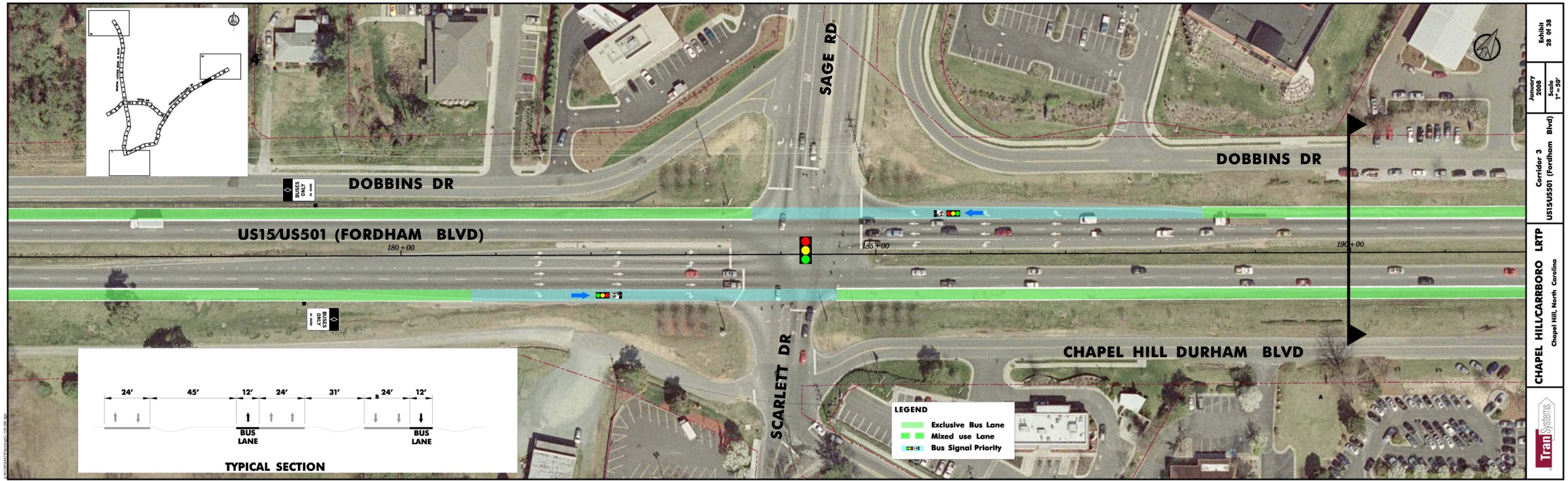


Table 6-7: Gateway 3(US 15/501) Station Locations and Sizing

Inbound	**Low Investment**
Station	**Station Size**
US 15 at I-40	P&R
East Franklin St at Booker Creek Greenway	S
East Franklin St at Elliott Rd	S
East Franklin St at Franklin Woods	M
East Franklin St at Estes Dr	M
East Franklin St at Vet Hospital (across from Plant Rd)	S
East Franklin St at Elizabeth St	M
East Franklin St at Carolina Ave	S
East Franklin St at Hillsborough St	S
Franklin St at Columbia St	M
Pittsboro St at Newman Center	M
Pittsboro St at Credit Union	M
Manning Dr at UNC Hospitals	L
Estes Dr at Philips MS & Park	S
MLK at Piney Mountain Rd	S
Carolina North	M
Outbound	**Low Investment**
Station	**Station Size**
US 15 at I-40	P&R
East Franklin St at Eastgate Shopping Center	M
East Franklin St at Elliott Rd	M
East Franklin St at #1520	M
East Franklin St at Estes Dr	S
East Franklin St at Plant Rd	S
East Franklin St at Elizabeth St	M
East Franklin St at Glendale Dr	S
East Franklin St at Raleigh St	S
Franklin St at Columbia St	M
S Columbia St at Sitterson Hall	M
S Columbia St at Carrington Hall	M
Manning Dr at UNC Hospitals	L
Estes Dr at Philips MS & Park	S
MLK at Piney Mountain Rd	S
Carolina North	L

Features/amenities

As with the Gateway 1 discussion, the project team identified a standard set of amenities and an optional set of amenities to include at each station location. These amenities, which also apply to Gateway 3, were discussed earlier on pages 6-7 through 6-10.

6.2.5 Vehicles

Articulated vehicles such as the new ones operating in the area (see figure below) are proposed to serve the BRT services. These articulated buses have capacity for 120 people.

Figure 6-11: New CHT Articulated Buses

Fleet size

The number of vehicles required to operate the BRT 3 route is presented in the following table. The number of operational vehicles required was calculated for the most critical time of the day, the morning peak hour. A spare ratio of 15 percent was assumed.

Table 6-8: Gateway 3 Vehicle Requirement

Fleet Size		
	BRT 3B	BRT 3C
Operational vehicles	6	6
Spare vehicles	1	1
Total Fleet Size	7	7

Assumptions:

Vehicle capacity	120 passengers
Peak headway	5 min
Peak hour ridership	15% of daily ridership
Recovery time	15% of running time
Spare ratio	15%

Amenities/on-board features

BRT services are expected to provide passengers a more comfortable and convenient ride than conventional bus service. On-board Intelligent Transportation Systems (ITS) play a key role in achieving this objective. The recommended features on-board the vehicle are the following:

- On-board equipment for Transit Signal Priority (TSP) system
- On-board equipment for Automatic Vehicle Location (AVL) systems
- Automated annunciation and signage system
- Automatic Passenger Counter (APC) system

All of the systems mentioned in the previous list are described in more detail in Appendix B.

6.2.6 Service Plan

Span of Service

The proposed span of service is shown in the table below:

Table 6-9: Gateway 3 Service Span

Span of Service	
	BRT 3B and 3C
Weekdays	6 am – 11 pm
Saturdays	8 am – midnight
Sundays	10 am – 6 pm

Headways

The proposed frequency of service is shown in the headway table below[18].

Table 6-10: Gateway 3 Frequencies

Frequency of Service		
	BRT 3B and 3C	
	Peak	Off-peak
Weekdays	5 min	8 min
Saturdays	20 min	30 min
Sundays	30 min	30 min

Revenue Vehicle Hours

The estimated weekday revenue-vehicle-hours for this service are approximately 60 for BRT 3B and 48 for BRT 3C.

Fare and fare structure

The BRT service is proposed to be free as the existing CHT local routes. Parking fees should also be comparable to the standard fee for other CHT services.

Integration with other services

The proposed BRT services rely heavily on the proposed underlying local network. Most of the existing local routes have been redesigned for the build scenarios to act as feeders for the BRT services. In this case, with a free fare system, fare integration is not a concern. However, special attention must be given to scheduling to provide timed-transfers possibilities between feeder and BRT express routes.

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[18] Note that this is the combined frequency for both branches leaving Gateway 3. Each branch's headway would be about double of the combined headway. Thus, the peak headway of 3B alone would be 10 minutes as would the stand alone headway of 3C.

6.3 Summary Operating Plans for Other Gateway and Local Services

Basic operating and service data were developed for both the remaining gateway services as well as the local service. More detailed plans for these two groups of services were beyond the scope of this study. However, the operating and service data will be used later to develop cost information.

6.3.1 Other Gateways

The remaining gateway services were not developed to the same degree as the two preferred corridors. However, basic service and operating data was generated to support a system level cost analysis. This data is shown in Table 6-11 below.

Table 6-11: Summary Operating Statistics for Other Gateway Services

Service	**Frequency** *(weekdays mins)*		**Days of Operation**	**Service Day** *(hours)*	**Peak Vehicle Requirement***	**Vehicle Hours**		**Gateway Parking Spaces**	**Estimated Daily Ridership**
	Peak	Off Peak				Daily	Annual		
GW 3A I40 to UNC via US 15/501	10	15	Mon-Sun	17	9	97	28,591	3,226	5,222
GW 4 via NC 54	5	8	Mon-Sun	17	12	126	34,770	5,457	9,319
GW 6 via US15/501 South	10	15	Mon-Sun	17	11	120	34,664	1,436	5,014
GW 7 to Carolina North	10	15	Mon-Sun	17	7	80	23,040	671	1,049
GW 7 to UNC Main Campus	10	15	Mon-Sun	17	9	97	28,591	70	760
GW 7 Total	10	15	Mon-Sun	17	16	177	51,631	741	1,808
GW 8 to Carolina North	10	15	Mon-Sun	17	10	103	30,121	565	1,998
GW 8 to UNC Main Campus	10	15	Mon-Sun	17	8	97	28,591	162	1,760
GW 8 Total	10	15	Mon-Sun	17	18	200	58,712	727	3,759

**Includes spares, does not include ADA paratransit vehicles.*

Service frequencies on weekends would be 20-minute peak and 30-minute off-peak. Gateway services 3A and 4 would be expected to use articulated vehicles as planned for Gateways 1 and 3B/C and shown earlier in Figure 6-6 and Figure 6-11. The remaining gateways would utilize standard forty-foot vehicles.

6.3.2 Local Services

In Section 5 of this report, the local bus network as modeled was defined. After further analysis, a number of the local bus routes were seen as relatively low in productivity (i.e., number of riders per revenue hour) and eliminated as part of this 2035 LRTP. In addition, the original model showed weekday peak and off-peak frequencies of 10 and 20 minutes respectively (see ridership results in Table 5-3 on page 5-13). In order to reduce the potential operating and capital costs associated with the local service, the frequencies were revised to 15 and 30 minutes respectively. The revised routes with relevant operating statistics are shown in Table 6-12. Figure 6-12 shows a map of these routes, distinguishing between existing routes and routes to be added. The low investment scenario ridership shown in Table 6 13 is simply the model run results shown earlier in Table 5-3 without the eliminated routes. In Table 5-3, local daily ridership is 43,184 which compares with 40,203 daily riders in Table 6 13. Since frequencies are also reduced it would be logical to assume that ridership would also be lower. Without an additional model run with the revised local network, the new ridership due to lower frequencies is difficult to determine. As this LRTP moves towards implementation, then the local ridership levels should be forecasted again.

Table 6-12: Revised Local Bus Network Operating Assumptions

	Weekday					Saturday			Sunday		
LOCAL ROUTE	Peak Headway	Offpeak Headway	Vehicles Required	Vehicles Required	Revenue Hours	Peak Headway	Offpeak Headway	Revenue Hours	Peak Headway	Offpeak Headway	Revenue Hours
CHT A :Weiner-MLKBlvd	15	30	5	3	63	20	30	52	30	30	24
CHT Base 1 Carr N	15	30	6	3	69	20	30	56	30	30	24
CHT Base 3 Estes-Carrboro	15	30	4	2	46	20	30	36	30	30	16
CHT Base 4 Laurel Hills	15	30	5	3	63	20	30	52	30	30	24
CHT Base 8 UNC Exp	15	30	3	2	40	20	30	36	30	30	16
CHT CL :WaldenGrnflds-UNCHosp	15	30	5	3	63	20	30	52	30	30	24
CHT CM :FamPrac-JonesFerry	15	30	4	2	46	20	30	36	30	30	16
CHT CW :Pittsboro-JonesFerry	15	30	3	2	40	20	30	36	30	30	16
CHT D :Providence-SmithLevel	15	30	5	3	63	20	30	52	30	30	24
CHT F :ColonyWoods-McDougle	15	30	7	4	86	20	30	68	30	30	32
CHT G :Briarcliff-BookerCreek	15		9	5	109	20	30	88	30	30	40
CHT HUX :UNCHosp-HedrickBldg	15	30	3	2	40	20	30	32	30	30	16
CHT HW 3B Feeder	15	30	2	1	23	20	30	20	30	30	8
CHT J :SGreensboro-RockCrkApt	15	30	6	3	69	20	30	52	30	30	24
CHT M :UnivMall-CrestCole		45		1	11	20	30	16	30	30	8
CHT MOD 1	15	30	7	4	86	20	30	68	30	30	32
CHT MOD 21	15	30	7	4	86	20	30	72	30	30	32
CHT MOD 8 -1	15	30	3	2	40	20	30	32	30	30	16
CHT MOD 8 -2	15	30	3	2	40	20	30	32	30	30	16
CHT MODV	15	30	5	3	63	20	30	52	30	30	24
CHT N :EstsParkApt-FamilyPract	15	30	3	2	40	20	30	36	30	30	16
CHT RU :Columbia-FamilyPract	15	30	2	1	23	20	30	20	30	30	8
CHT S :UNCHosp-HedricBldg	15	30	3	2	40	20	30	32	30	30	16
CHT SU	15	30	2	1	23	20	30	20	30	30	8
CHT T :UNCHosp-ECHHghSch	15	30	6	3	69	20	30	56	30	30	24
CHT U :BowlesDr-FranklinSt	15	30	2	1	23	20	30	16	30	30	8
CHT V :Meadowmont-SVillage	15	30	5	3	63	20	30	52	30	30	24
Totals			115	67	1,427			1,172			536
Spares *(20 percent)*			23								
Gand Total			138								

Figure 6-12: Revised Local Bus Network (Reduced Service)

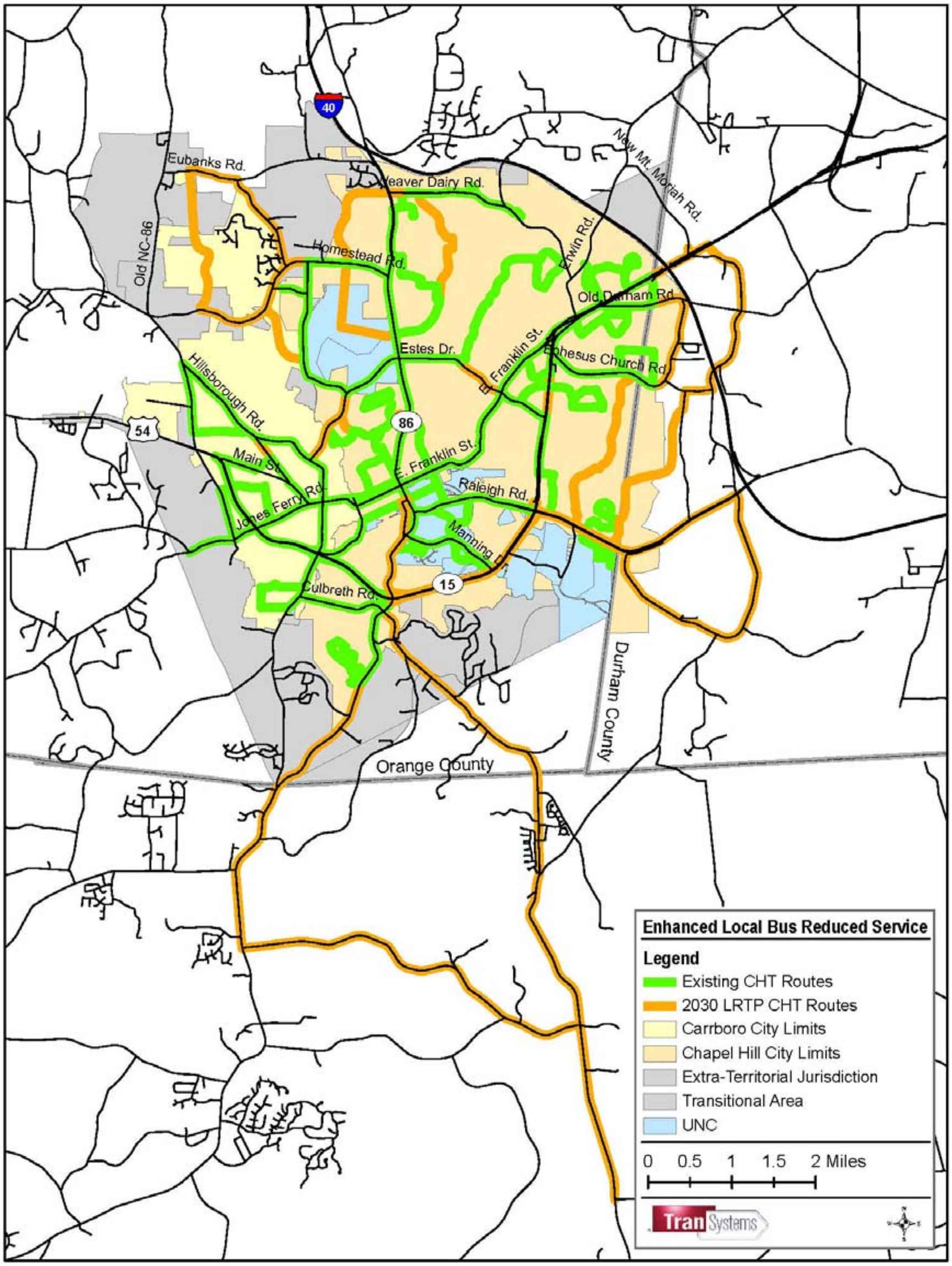

Table 6-13 shows revised ridership as a result of reducing the routes but not the frequencies.

Table 6-13: Revised Local Network Ridership

Route Name	Low Investment		
	Peak	Off Peak	Total
CHT A :Weiner-MLKBlvd	2,227	1,956	4,183
CHT Base 1 Carr N	979	957	1,936
CHT Base 3 Estes-Carrboro	545	568	1,113
CHT Base 4 Laurel Hills	293	360	652
CHT Base 8 UNC Exp	399	322	721
CHT CL :WaldenGrnflds-UNCHosp	967	1,103	2,070
CHT CM :FamPrac-JonesFerry	611	596	1,207
CHT CW :Pittsboro-JonesFerry	439	619	1,058
CHT D :Providence-SmithLevel	2,053	1,739	3,792
CHT F :ColonyWoods-McDougle	781	829	1,610
CHT G :Briarcliff-BookerCreek	1,230	1,223	2,453
CHT HS :VarsityTheater-Hghsch	190	113	302
CHT HUX :UNCHosp-HedrickBldg	457	18	475
CHT HW 3B Feeder	319	232	551
CHT J :SGreensboro-RockCrkApt	699	693	1,391
CHT MOD 1	572	655	1,227
CHT MOD 21	1,005	1,077	2,082
CHT MOD 8 -1	230	487	717
CHT MOD 8 -2	751	166	916
CHT MODV	1,110	829	1,939
CHT N :EstsParkApt-FamilyPract	436	637	1,073
CHT RU :Columbia-FamilyPract	297	366	664
CHT S :UNCHosp-HedricBldg	888	565	1,452
CHT SU	394	626	1,020
CHT T :UNCHosp-ECHHghSch	1,341	1,460	2,801
CHT U :BowlesDr-FranklinSt	459	598	1,057
CHT V :Meadowmont-SVillage	1,017	724	1,741
Total Chapel Hill Boardings	20,688	19,516	40,203

6.4 Intelligent Transportation Systems (ITS)

Intelligent Transportation Systems (ITS) involve the application of advanced technologies to transit service passenger information and other purposes. The use of ITS applications help further "brand" and enhance services. It is anticipated that this use of technology would be an integral part of gateway services. Appendix B of this study reviews a number of technologies that could be included in the gateway service.

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Section 7: Transit Supportive Development

Experience from around the country suggest that success for transit service depends on many factors, of which one is planning for and bringing about appropriate and coordinated development. Appropriate means a mix of development – housing, retail, office – and a relatively high level of density. The other key factors include provision of an attractive, safe and inviting pedestrian environment, and the use of public space integrated with the transit station and commercial space to create a "sense of place." This type of development can be called Transit Supportive Development or TSD.

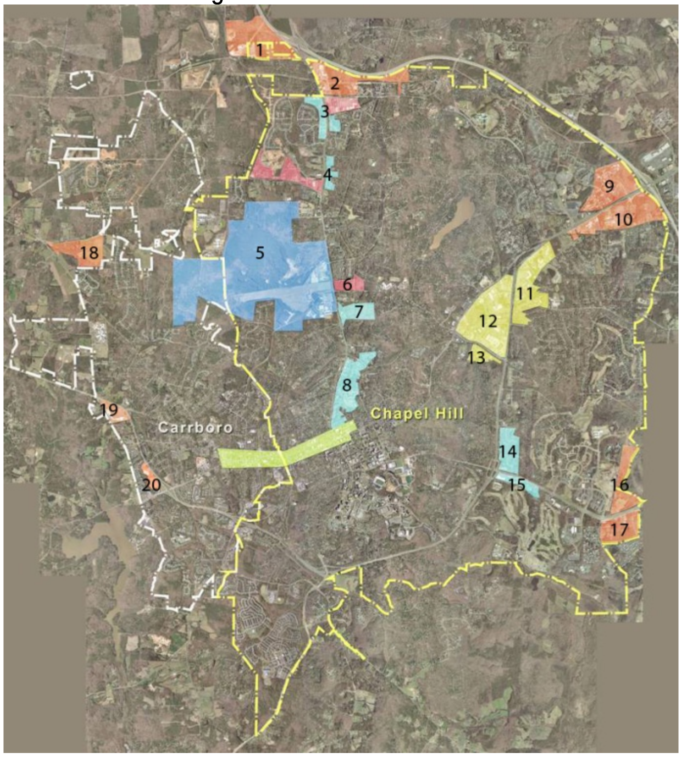
The development and implementation of a TSD strategy is not only essential for the future success of transit it is also an integral criterion in the federal government's evaluation of Small Starts and Very Small Start funding proposals (to be discussed in Section 8). The FTA rates higher projects in communities with robust land use policies which include TSD regulations.

This section presents the findings of a TSD build-out analysis provided by Crosby | Schlessinger | Smallridge (CSS). The purpose of this analysis was to assess the potential for transit supportive development at key sites along the proposed transit corridors.

7.1 Build-out Analysis

Working with the towns of Chapel Hill and Carrboro, 20 sites were identified as potential locations for TSD. These sites represent properties that are located on potential transit corridors, that are suitable for development or redevelopment and that are large enough to accommodate a mixed-use development. The sites are shown on Figure 7-1 below.

Figure 7-1: TSD Sites



For each property, the gross and net developable area was determined. The “gross” developable area was defined as the approximate total square footage of land within each site boundary, including all land parcels, public rights-of-way, easements, and water bodies. The build-out analysis was based on the “net” developable area, which was defined as the total square footage after subtracting water bodies and related buffer zones (lakes, streams, and rivers), highway buffer zones, major roads, property with buildings assumed to remain, and land located within a floodway. The site areas are shown in Figure 7-2 through Figure 7-22 below. Site boundaries are shown in purple; water bodies are shown in blue; buffer areas are shown in green; floodways are striped; buildings and roadways to remain, and portions of the site too isolated for development, are shown in white. The Net Developable Area is shown in yellow. For two of the sites, Sites 10 and 17, two options for the Net Developable Area were evaluated. Site 5, the Carolina North property, was not included in the Build-Out Analysis, because a master plan for that site was developed separately by the University of North Carolina (see Section 7.3).

In discussions with representatives from the Town Planning Departments, a land use mix and development density was defined for each property, based on the surrounding land use patterns, site configuration and planning objectives.

Successful transit-oriented development requires that development occur at densities that encourage pedestrian activity and support transit. For this build-out analysis, 15 units per acre was used as the minimum density; with 25 units per acre used for some properties. Fifteen units per acre is a generally accepted minimum residential density. Assuming 2.5 parking spaces (in surface lots) per 1,000 square feet of development, a Floor Area Ratio (FAR) of .55 can be achieved with a single story retail building and a Floor Area Ratio of 1.0 can be achieved with a five-story office building. These FARs were used as the minimum densities for the build-out analysis. A FAR of 1.2 was used as the high-end density for both retail and office use.

Based on the land use mix and development density defined for each site, the resulting number of residential units and square footage of office and retail space was calculated. These calculations are shown in Table 7-1. These are gross calculations, and do not account for irregular site configuration.

Figure 7-2: Site 1

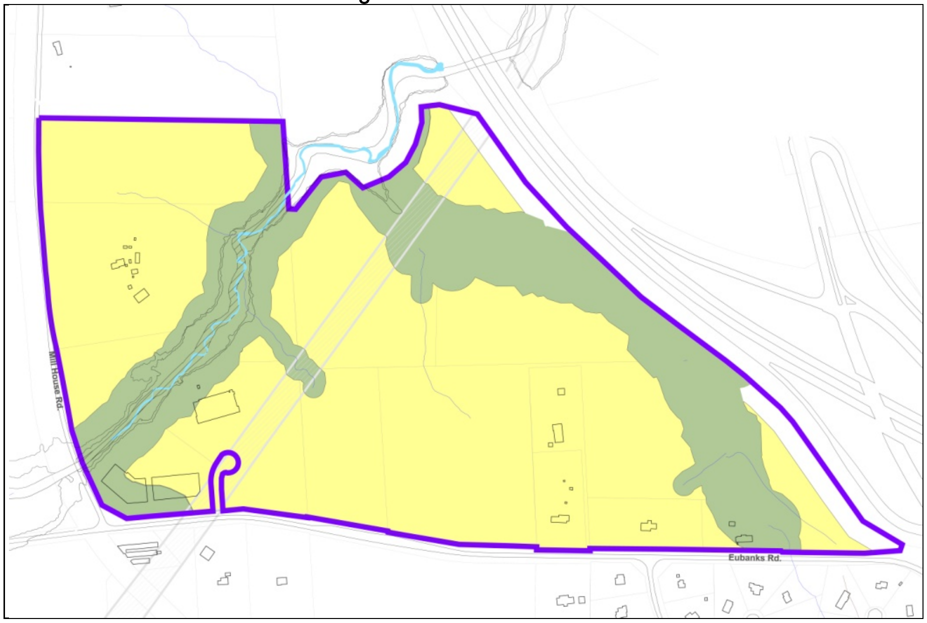


Figure 7-3: Site 2

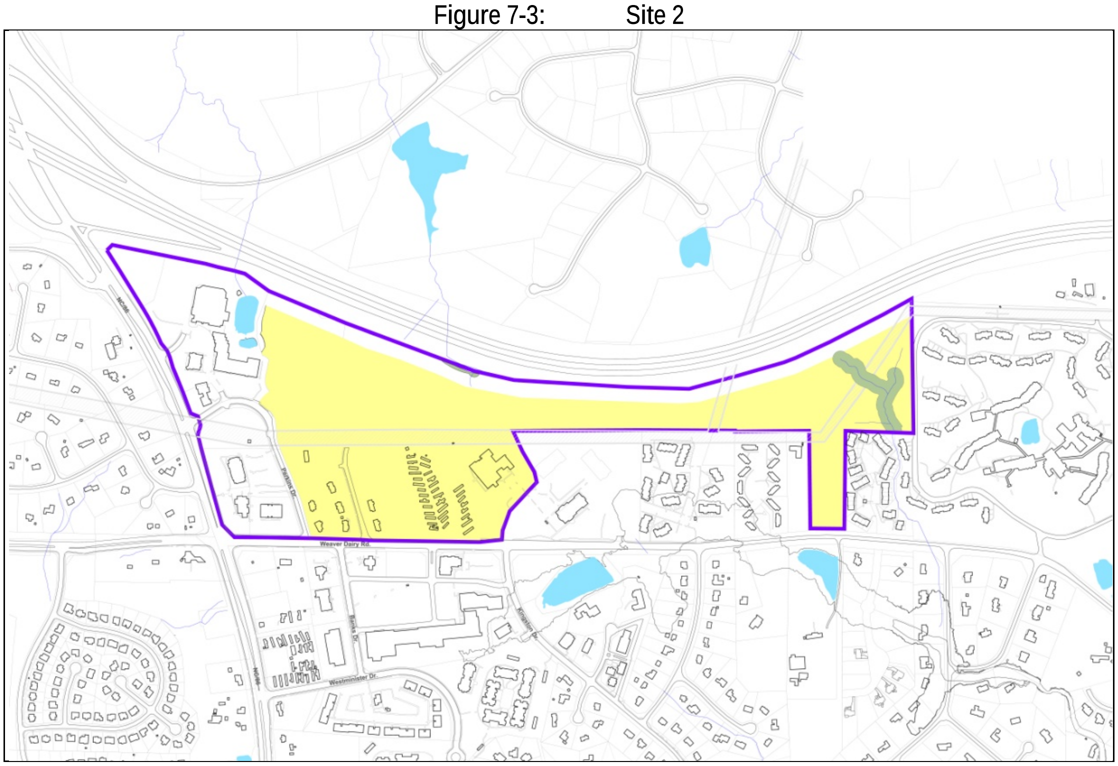


Figure 7-4: Site 3

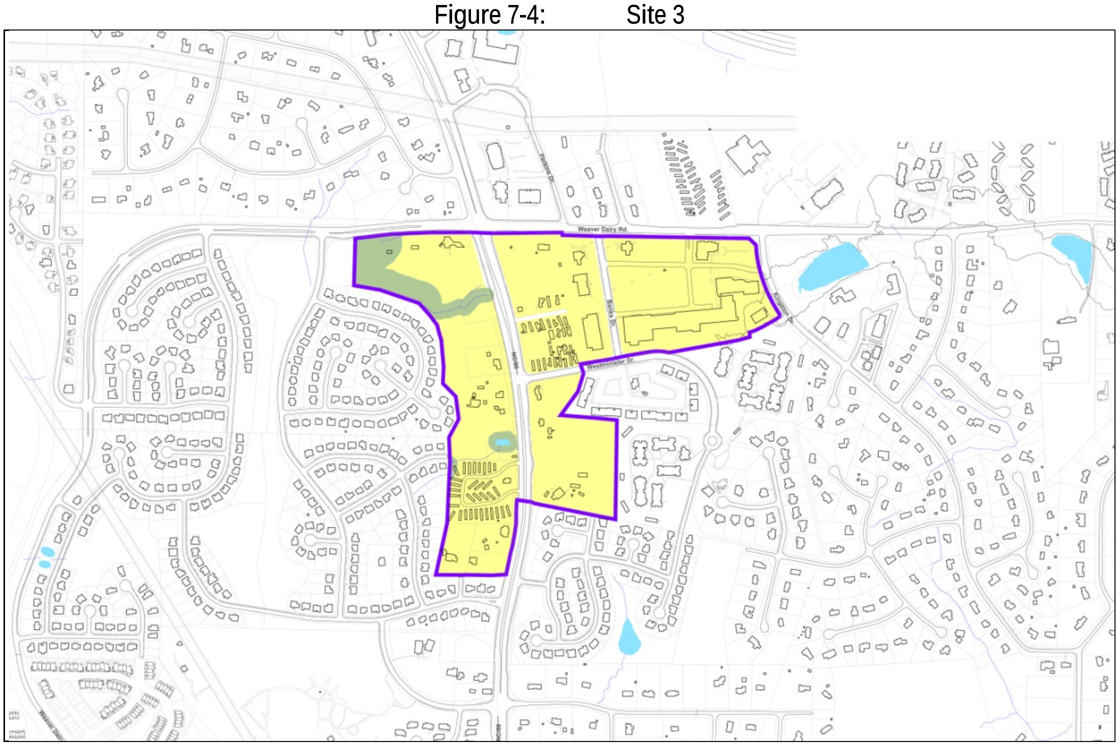


Figure 7-5: Site 4

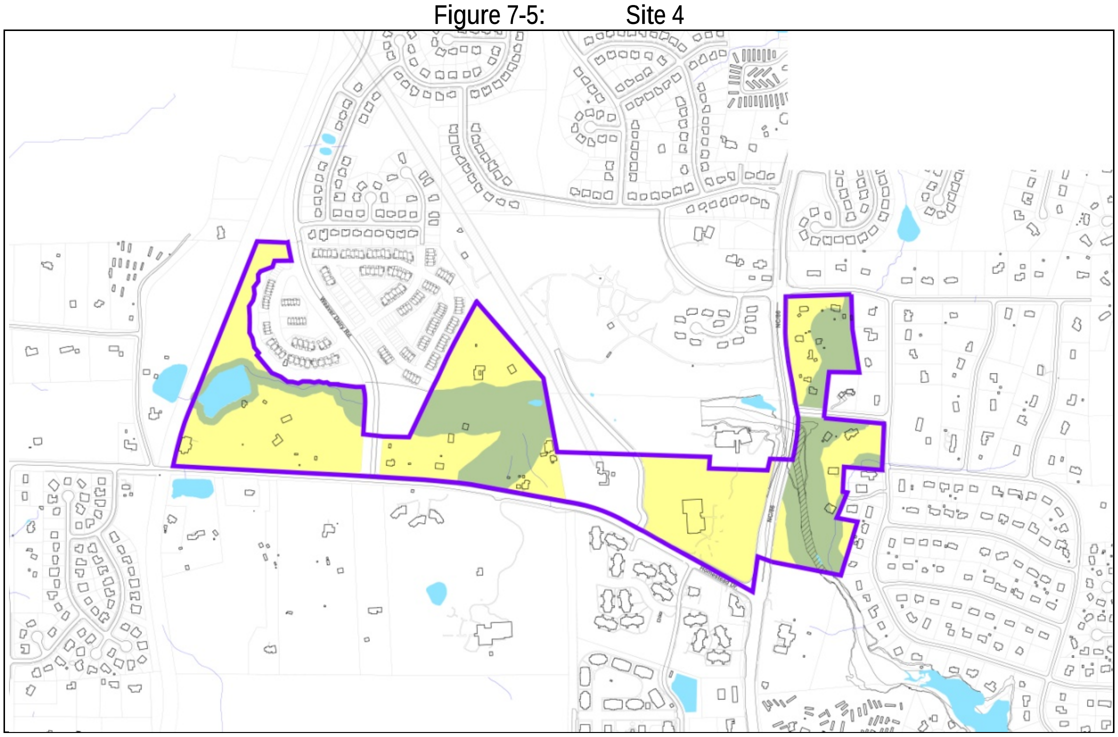


Figure 7-6: Site 6

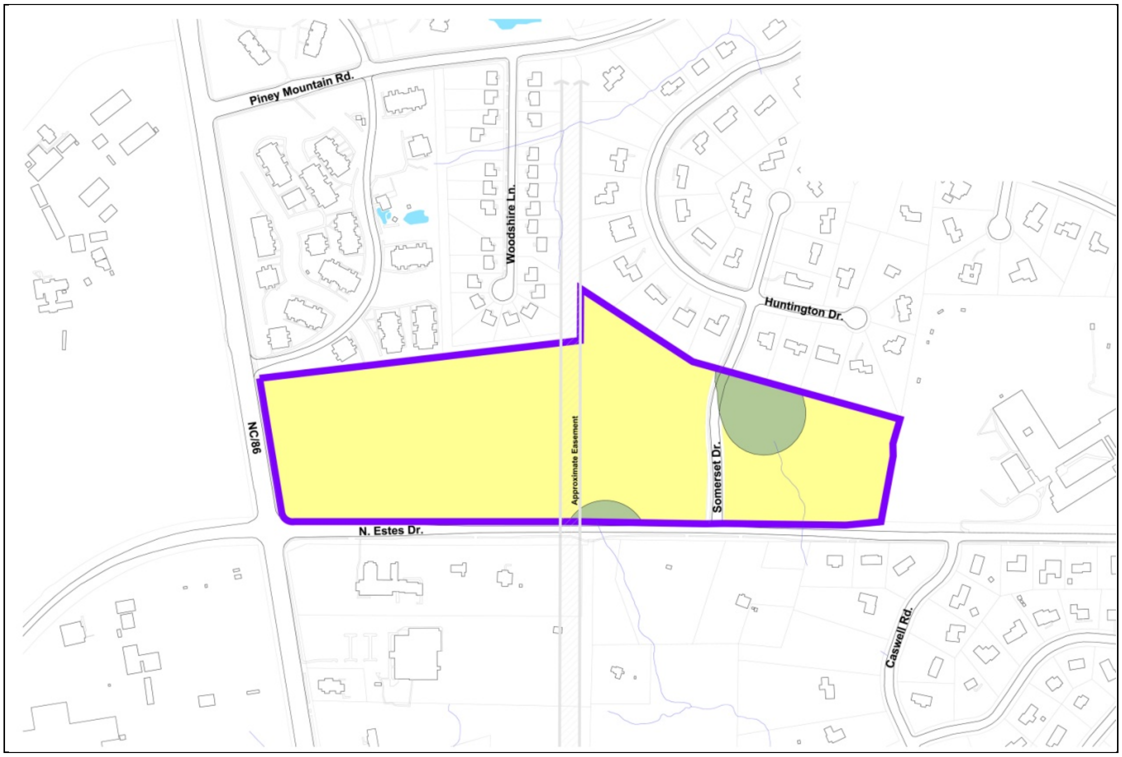


Figure 7-7: Site 7

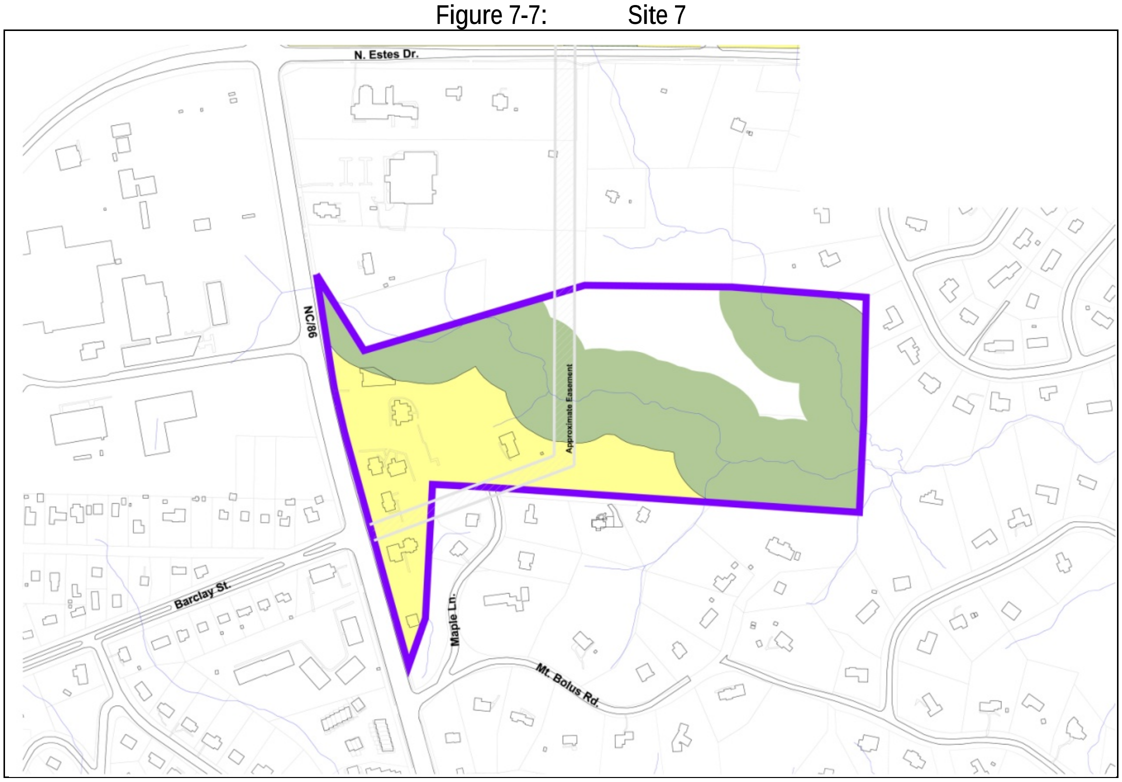


Figure 7-8: Site 8

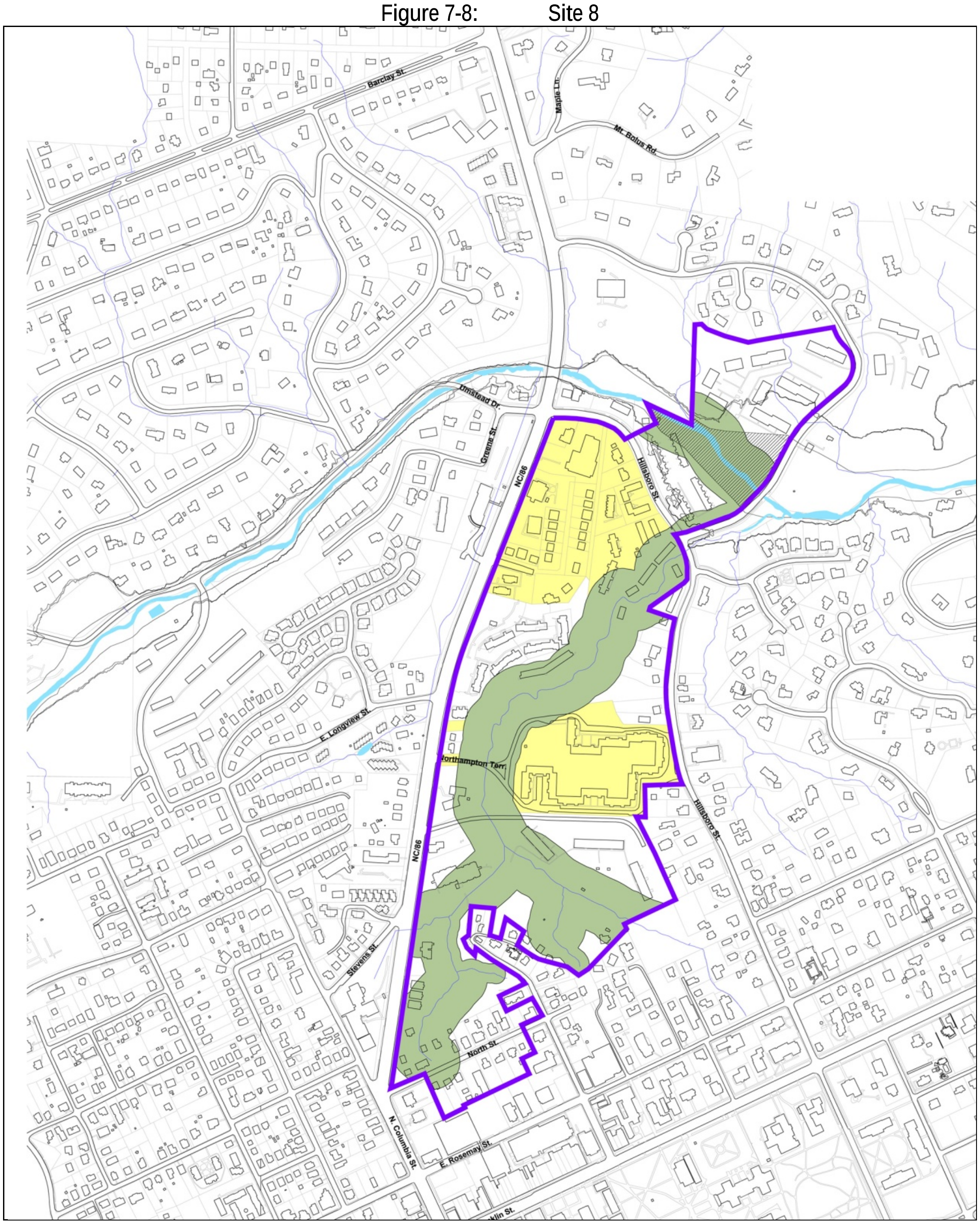


Figure 7-9: Site 9

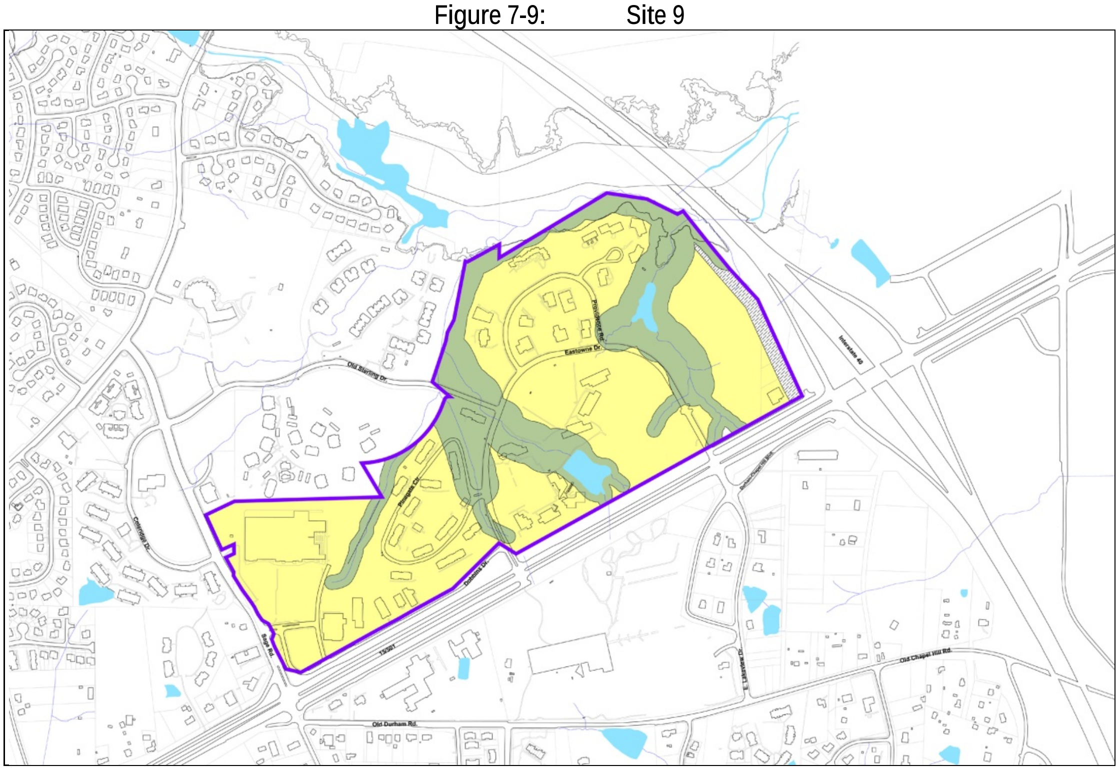


Figure 7-10: Site 10a

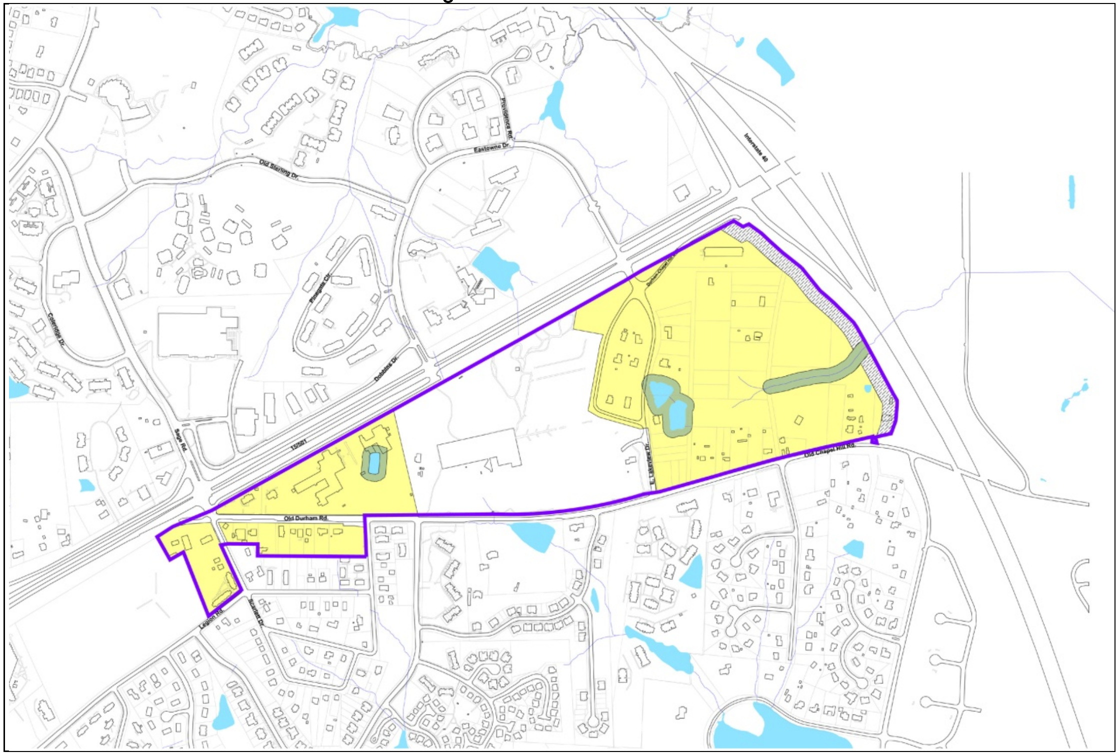
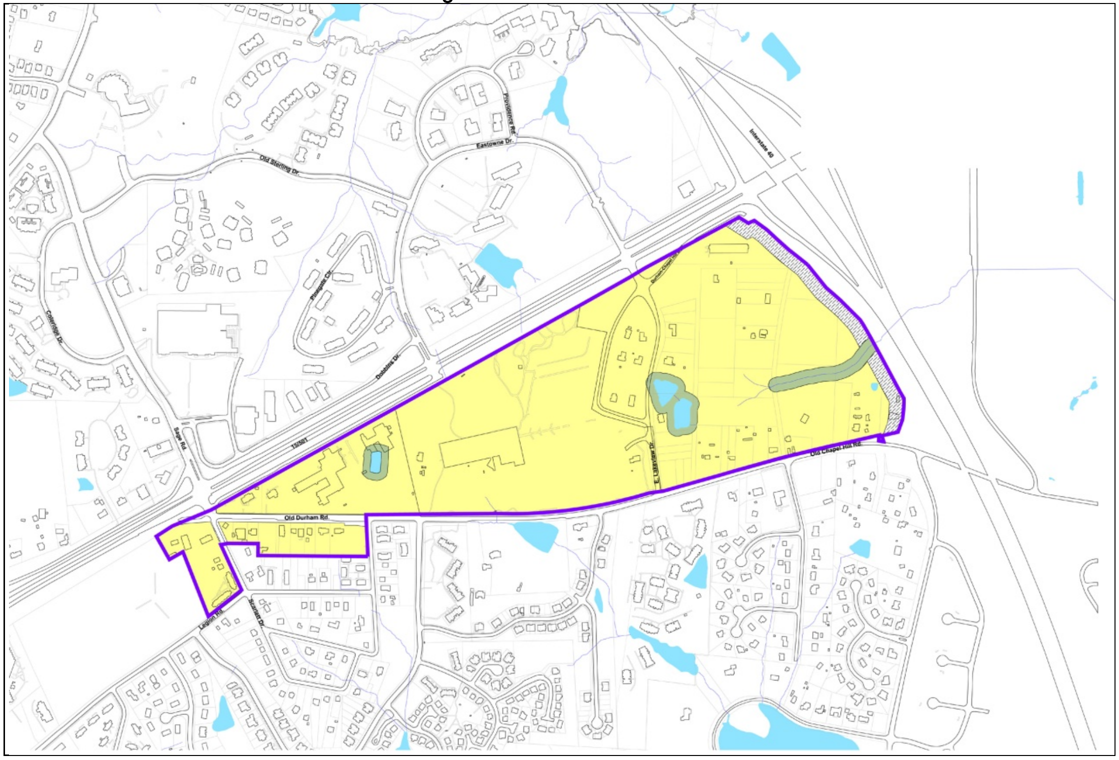


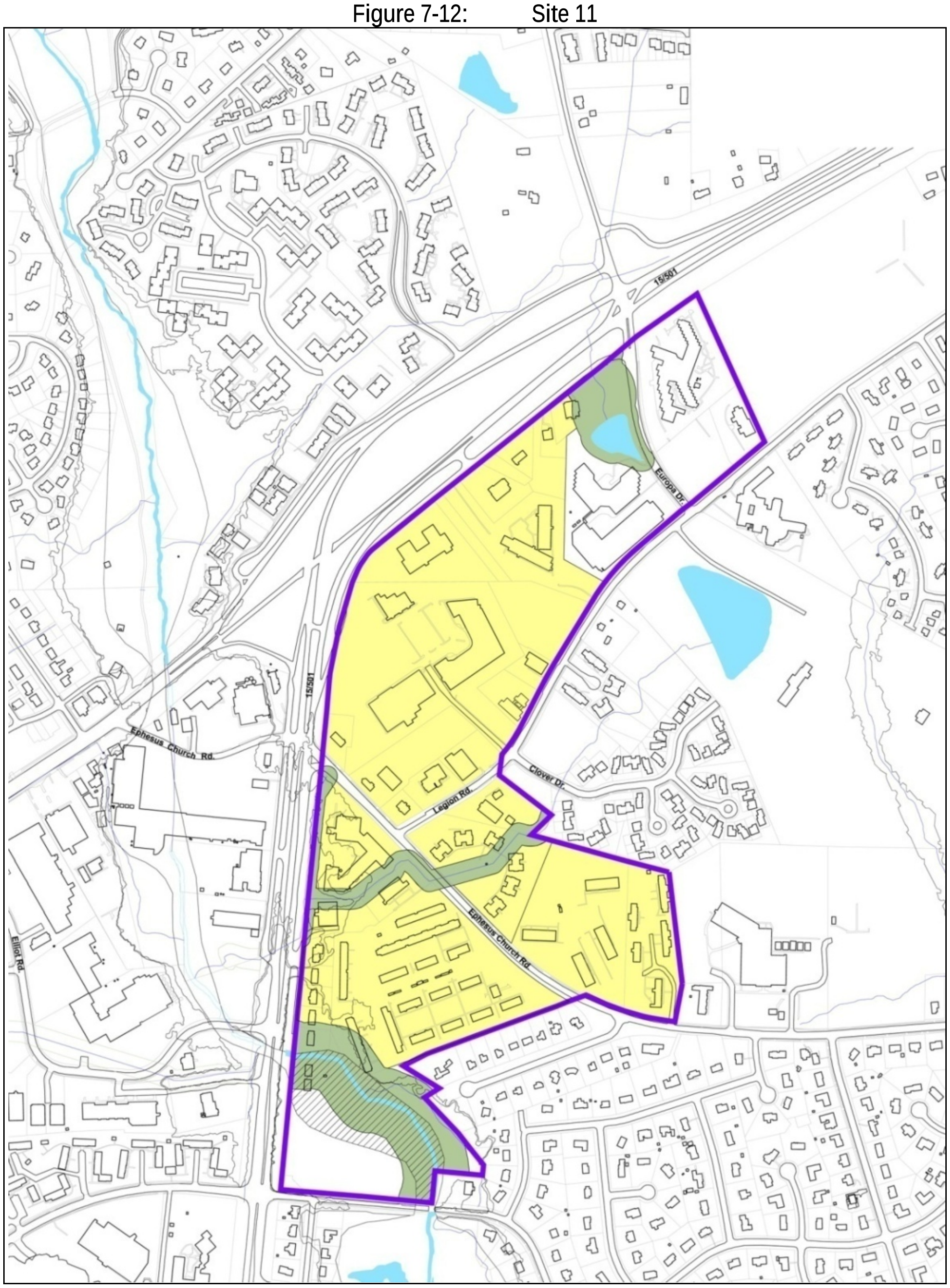
Figure 7-11: Site 10b



Site 10 includes a station along the proposed Chapel Hill to Durham Light Rail line. Figure 7-11a provides a conceptual plan for the parcels in the proposed station area.

Figure 7-11a: Conceptual Plan for Parcels in the Proposed Station Area

Figure 7-12: Site 11



Site 11 includes the Rams Plaza shopping center, which has been identified as a potential transit station area along a possible BRT corridor from I-40 to the University of North Carolina main campus. Figure 7-12a provides a conceptual plan for the redevelopment of Ram's Plaza.

Figure 7-12a: Conceptual Plan for Redevelopment of Ram's Plaza

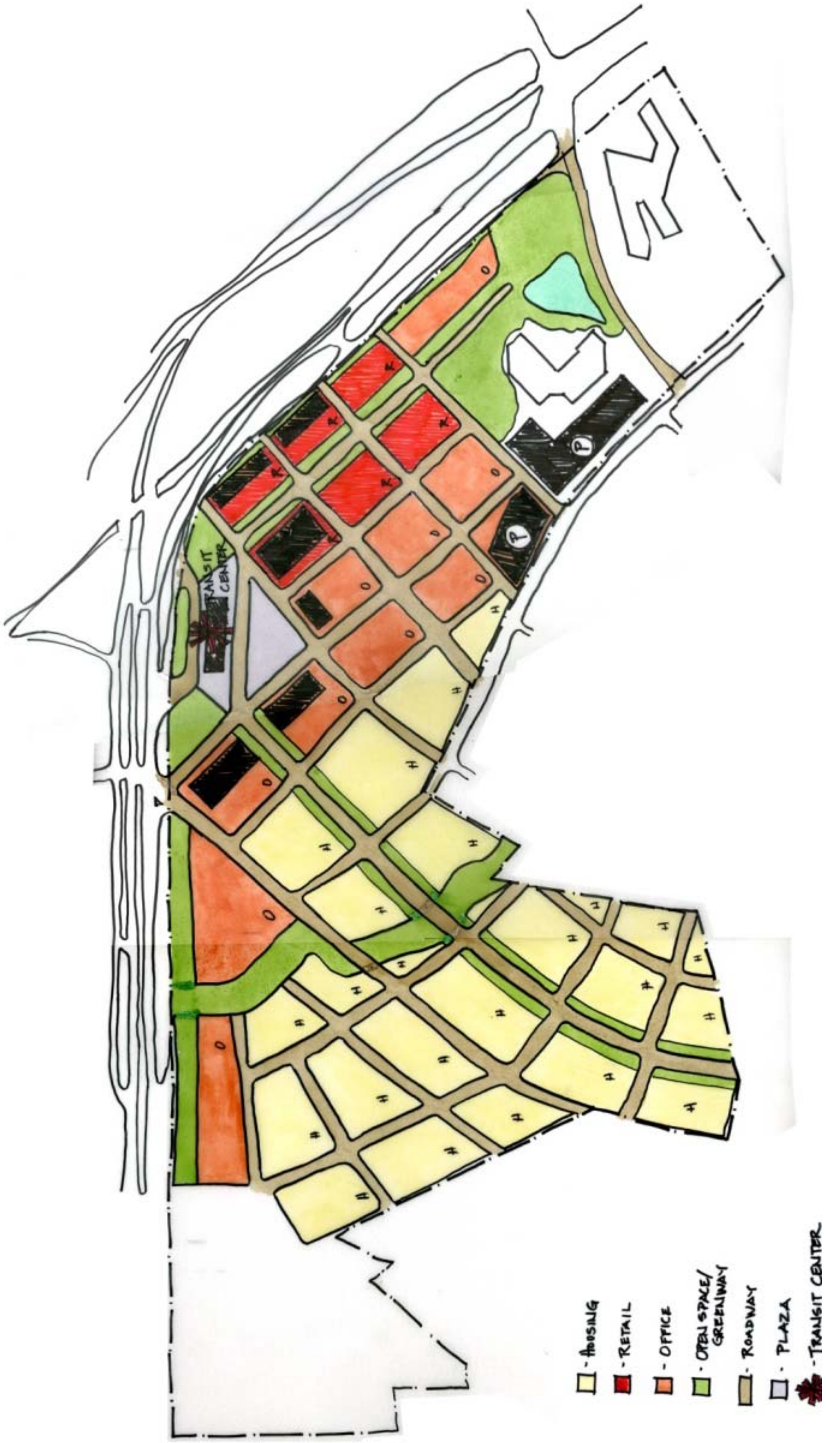


Figure 7-12a: 1

Figure 7-13: Site 12

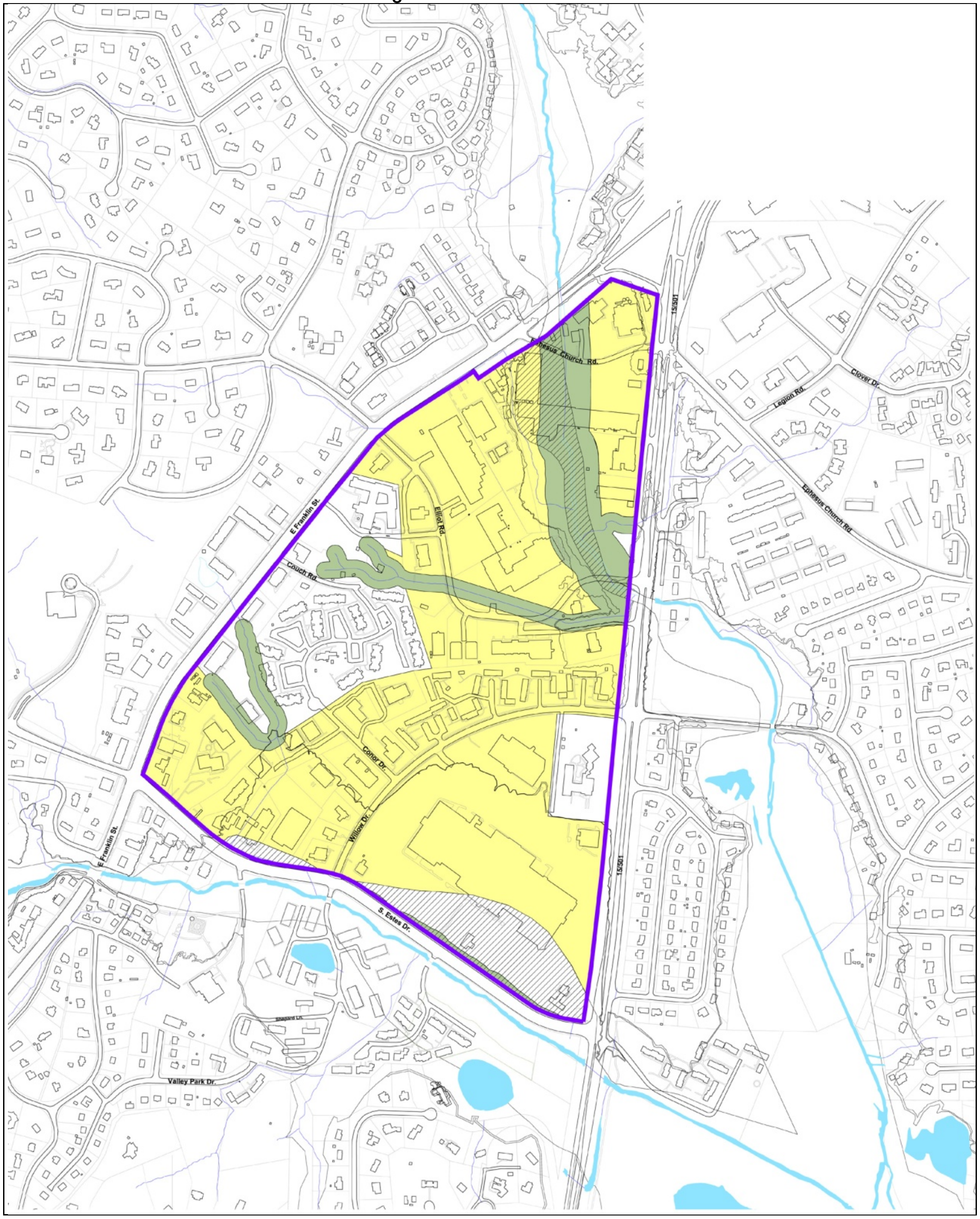


Figure 7-14: Site 13

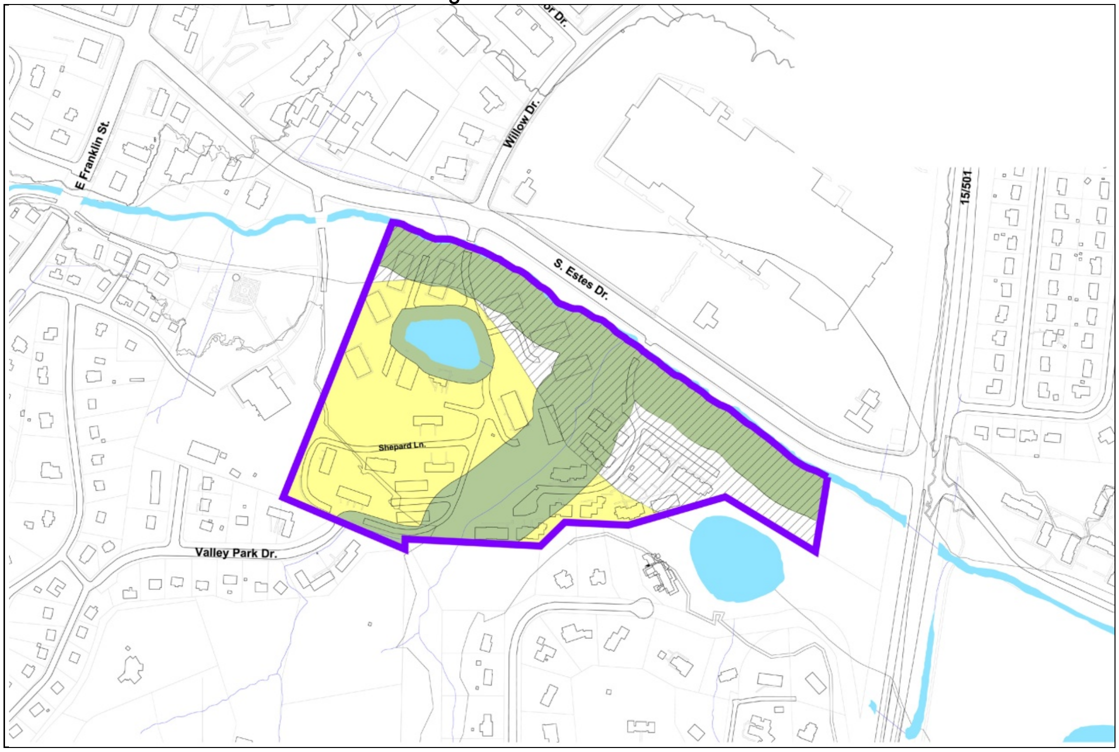


Figure 7-15: Site 14

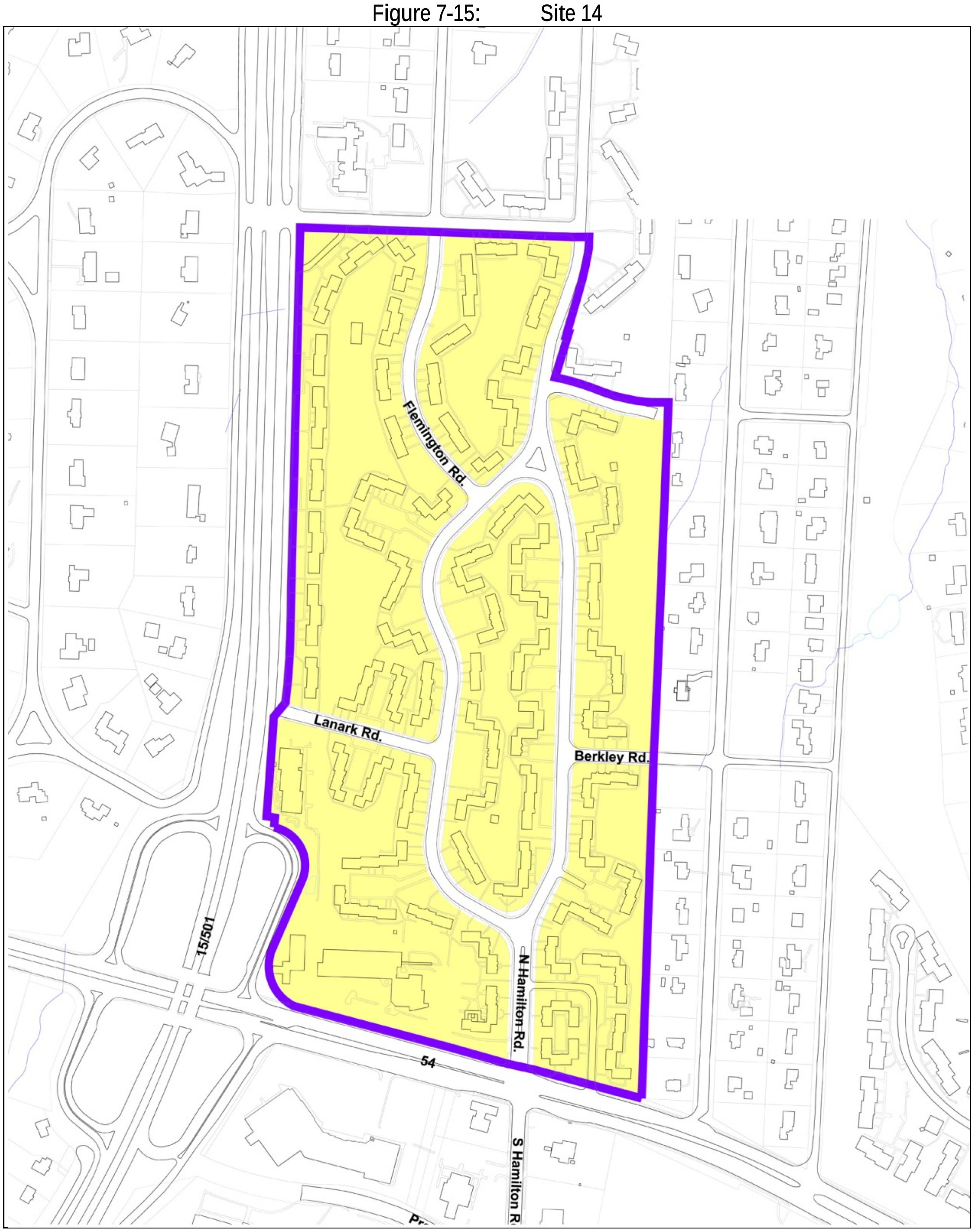


Figure 7-16: Site 15

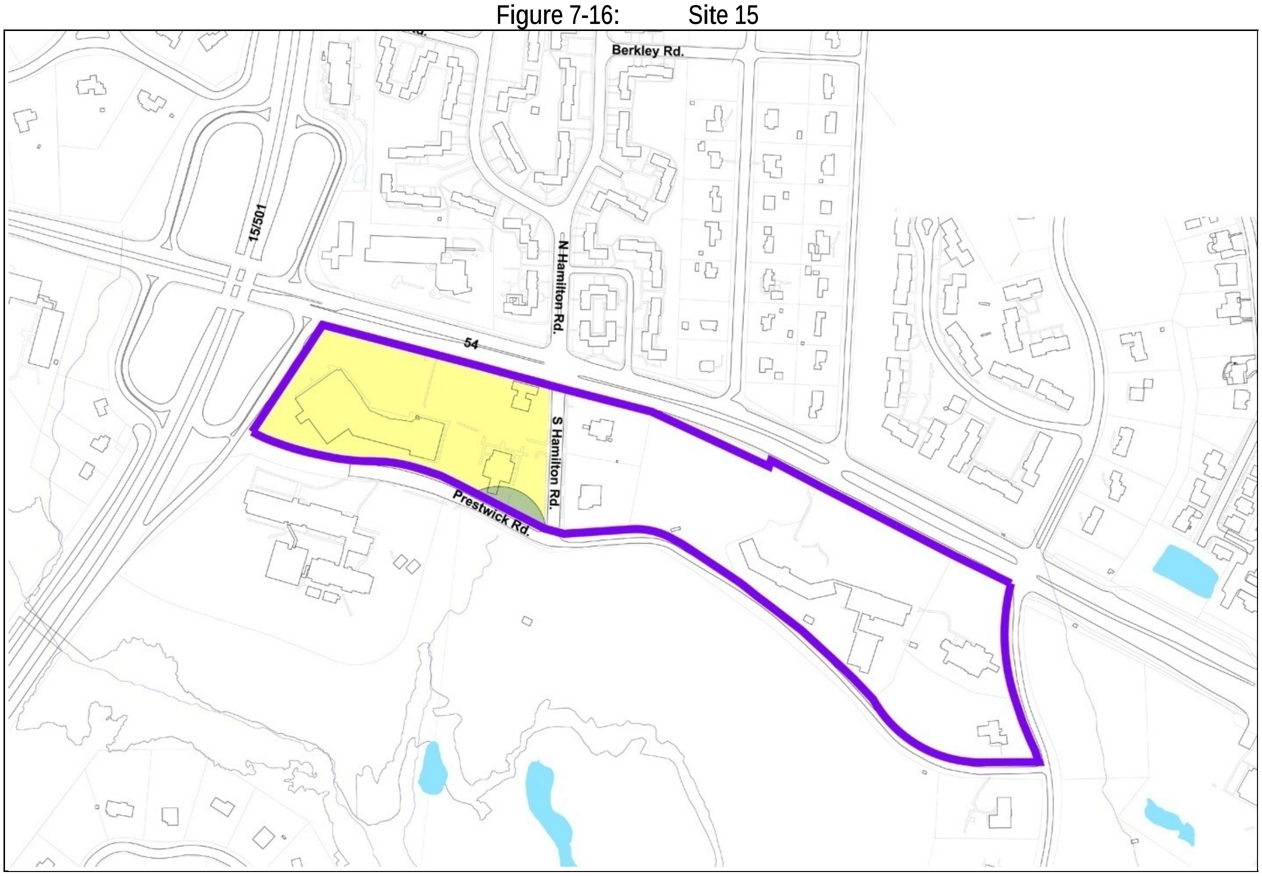


Figure 7-17: Site 16

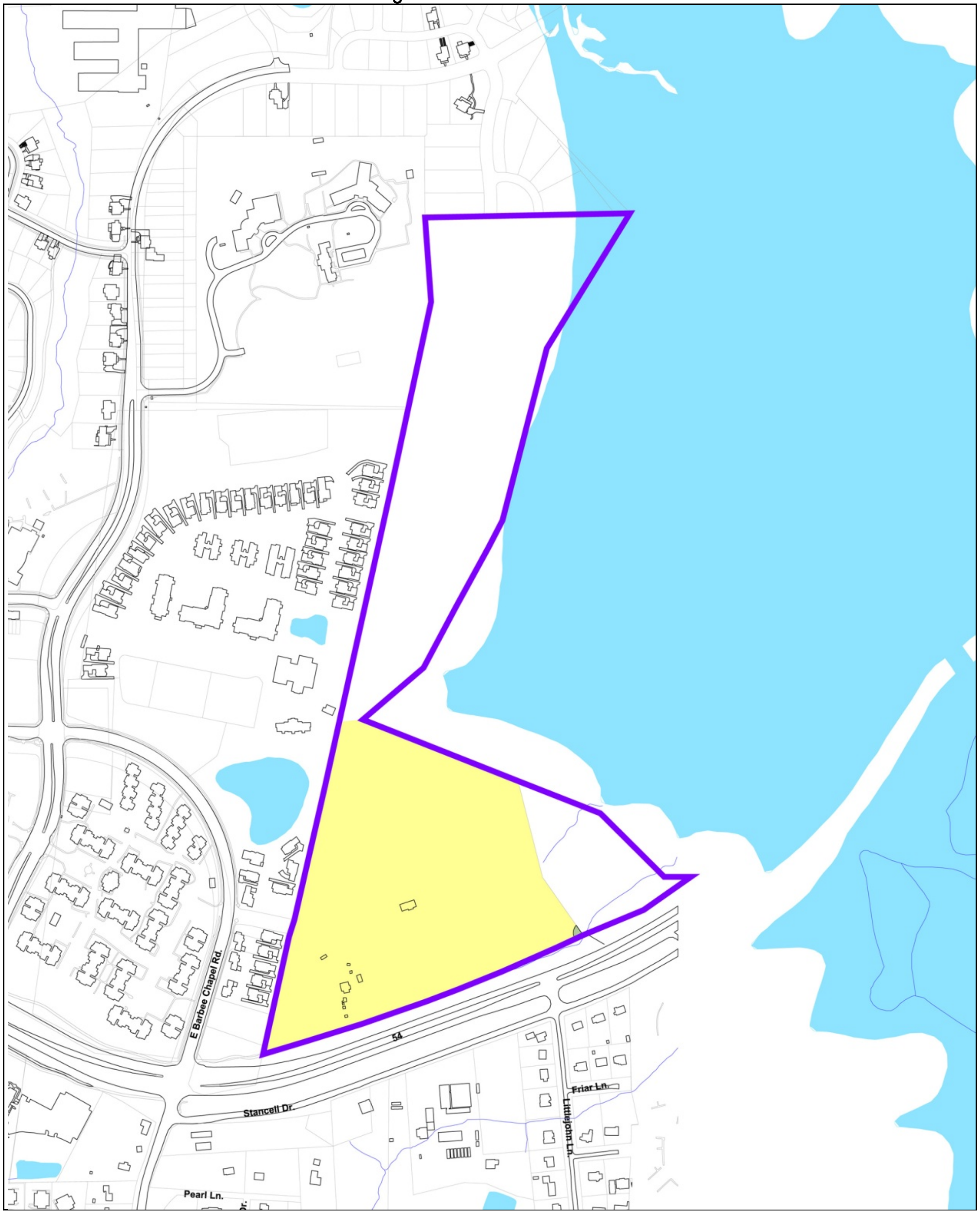


Figure 7-18: Site 17a

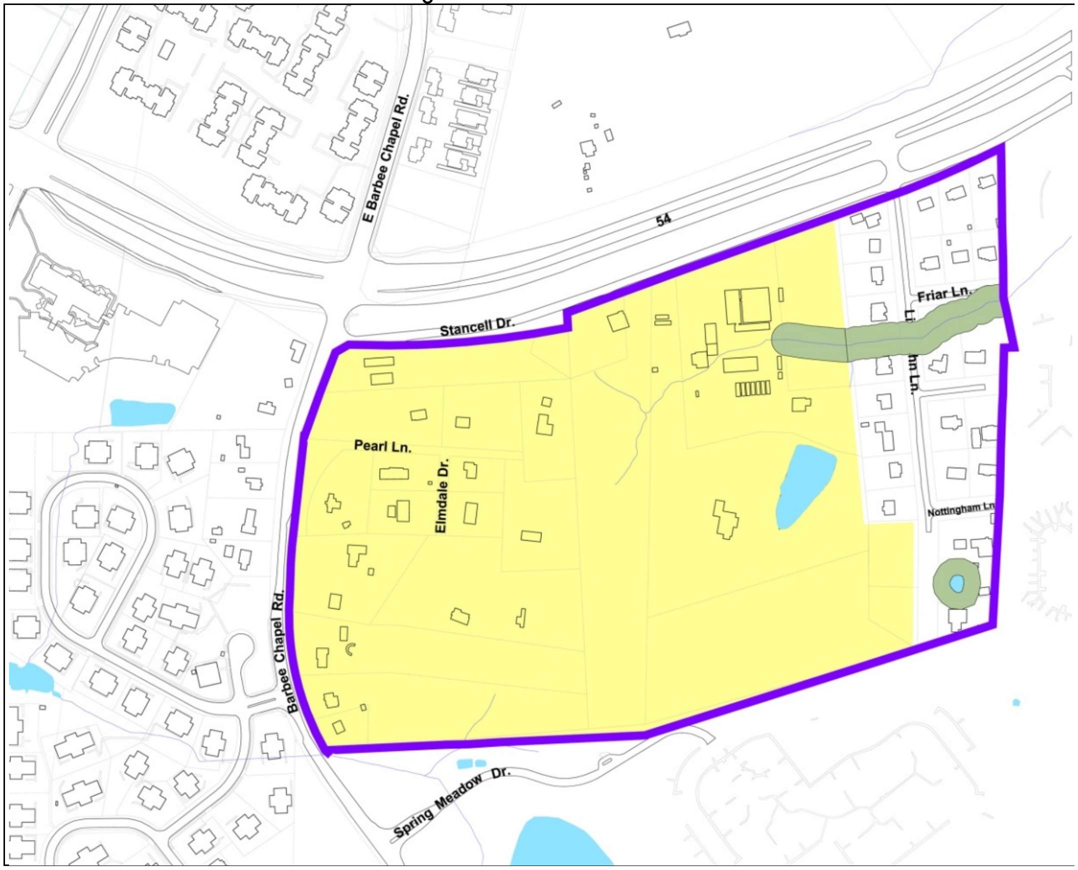
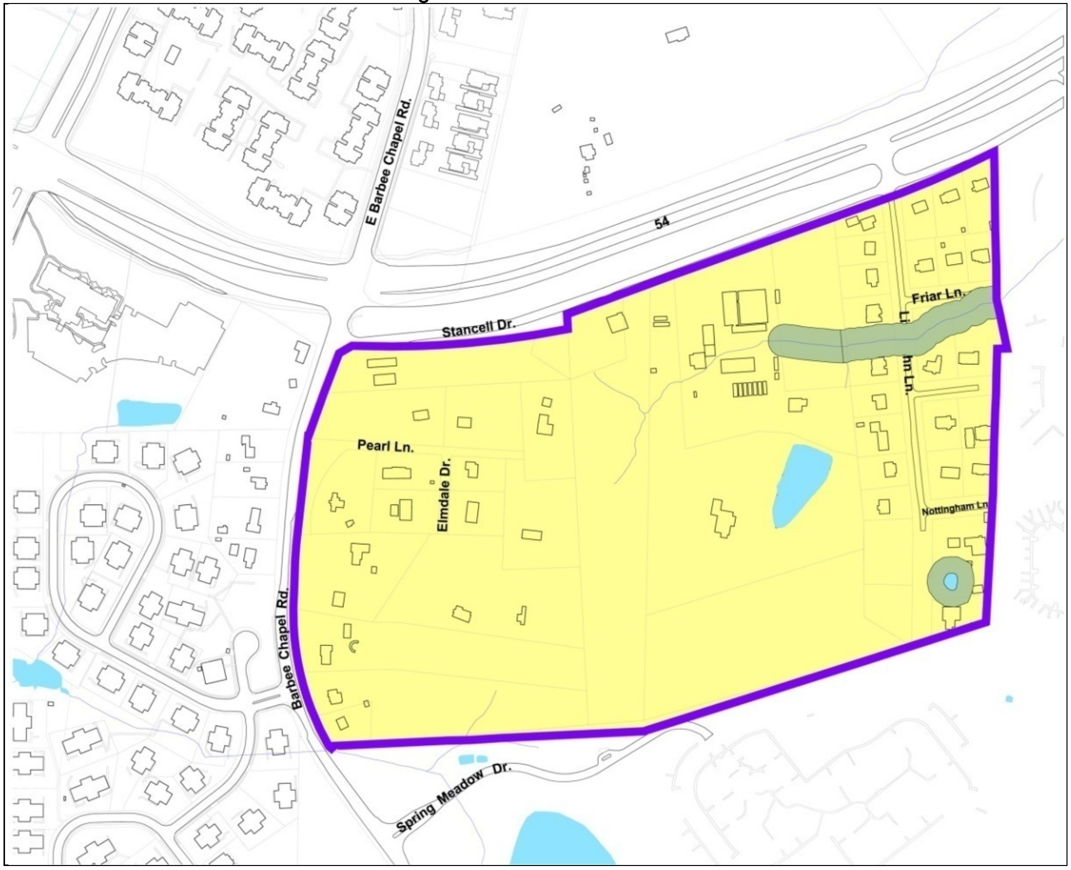


Figure 7-19: Site 17b



Figures 7-19a-c include conceptual designs for Site 17 of an internal road network, transit service and land use plan following suggested design guidelines which include:

- Buildings at street edge
- Active street frontages
- Parking behind buildings
- Street grid
- Small blocks
- Transit near center of site
- Useable, purposeful open space
- Retail between park & ride and transit center

Figure 7-19a shows a conceptual street grid for Site 17. Figure 7-19b shows a conceptual transit service plan with routes from the west shown in red and routes from the east shown in blue. Two parking garages (blue) provide parking for park and ride. Figure 7-19c illustrates a transit plaza flanked by commercial buildings (red) and two park & ride garages (gray), with office uses (pink) on the northern portion of the site and residential uses (yellow) on the southern portion.

Figure 7-19a: Conceptual Street Grid for Site 17

Figure 7-19b: Conceptual Transit Service Plan for Site 17

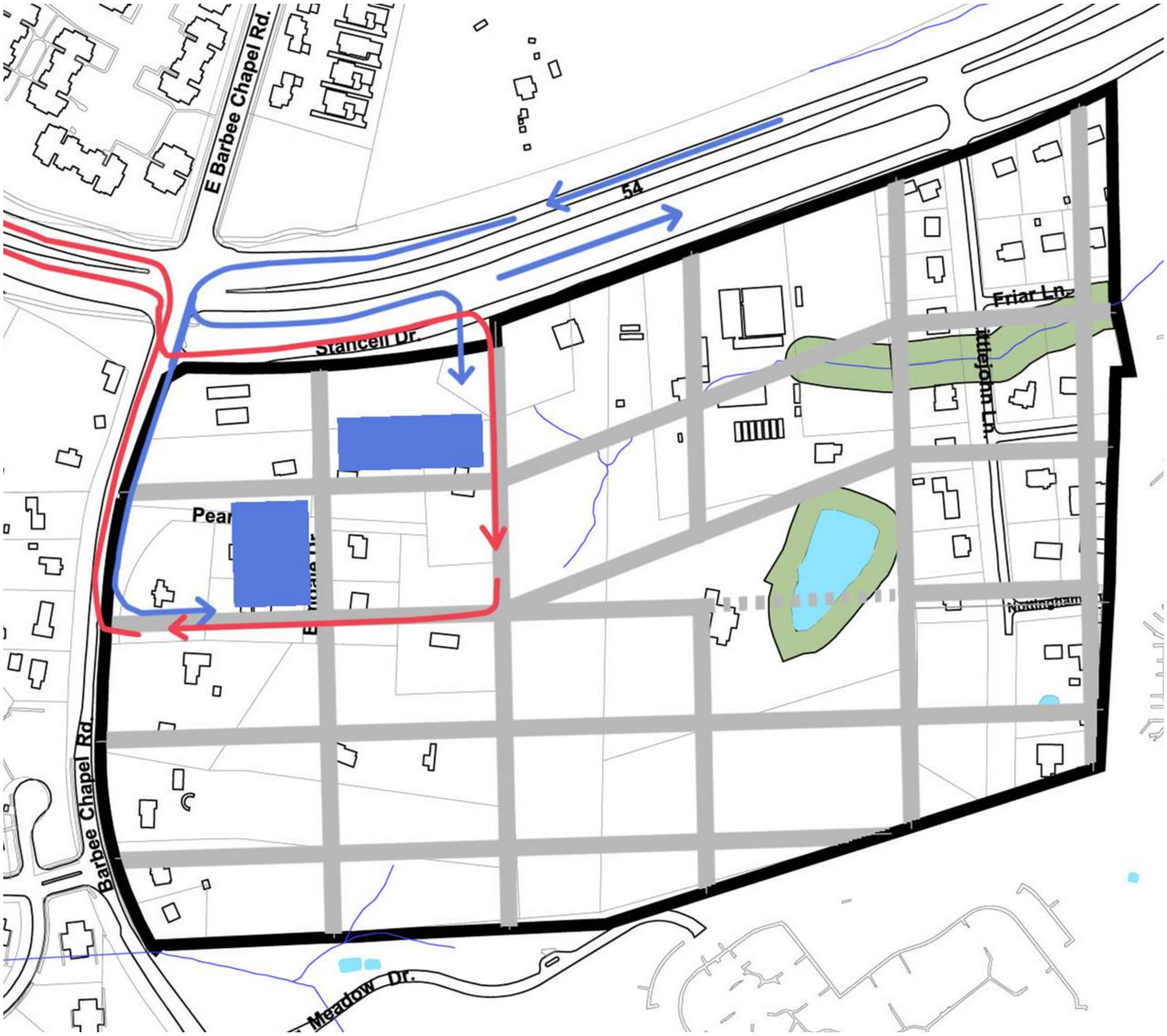


Figure 7-19c: Conceptual Land Use Plan for Site 17

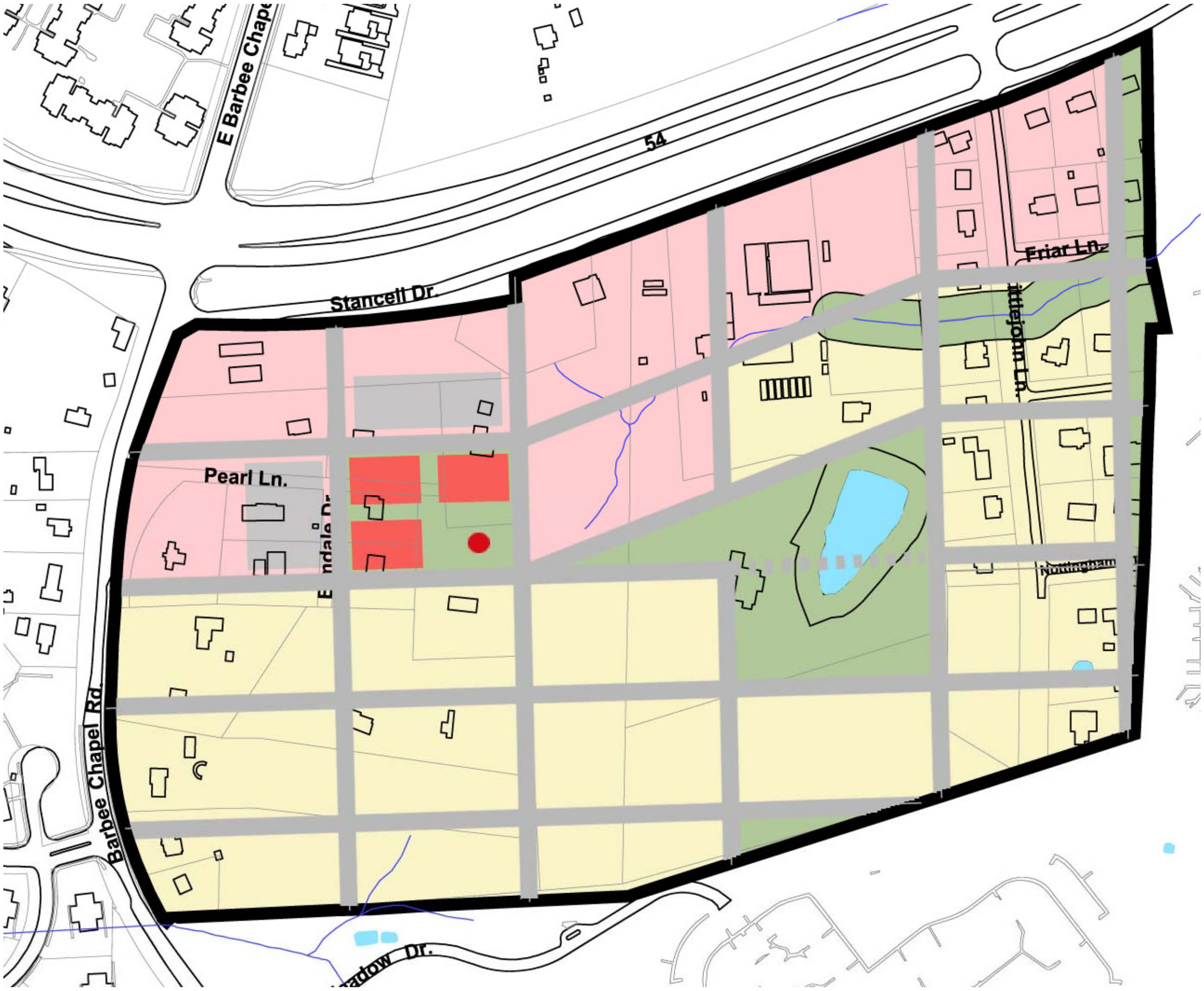


Figure 7-20: Site 18

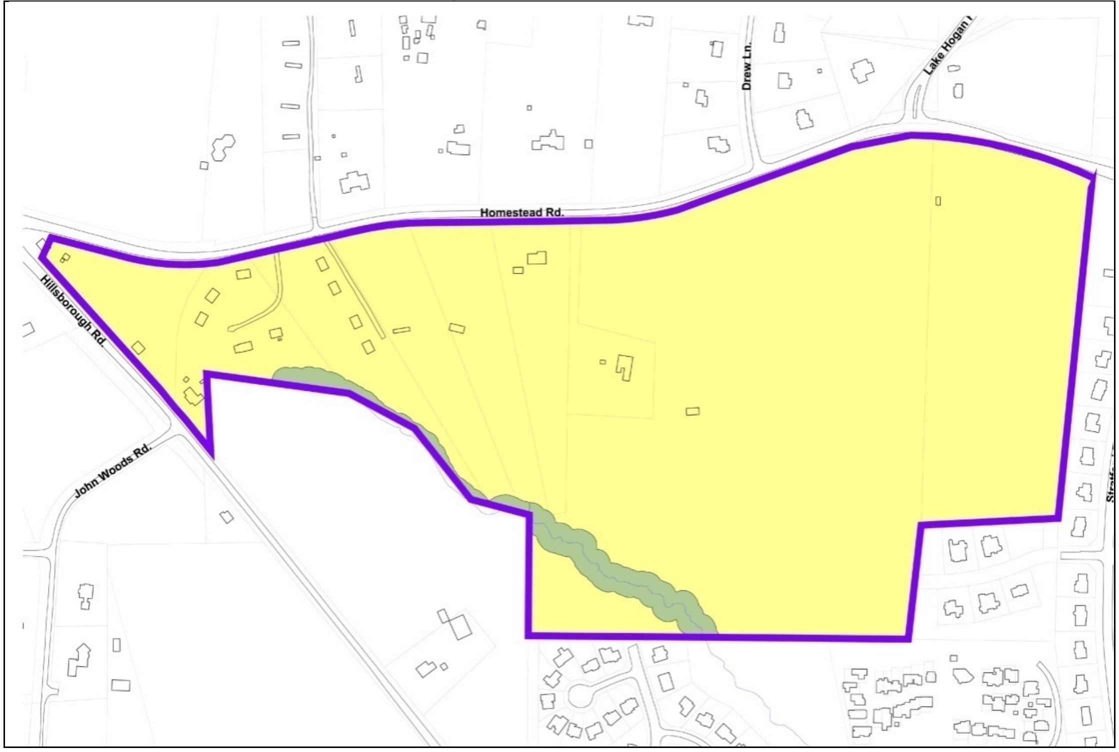


Figure 7-21: Site 19

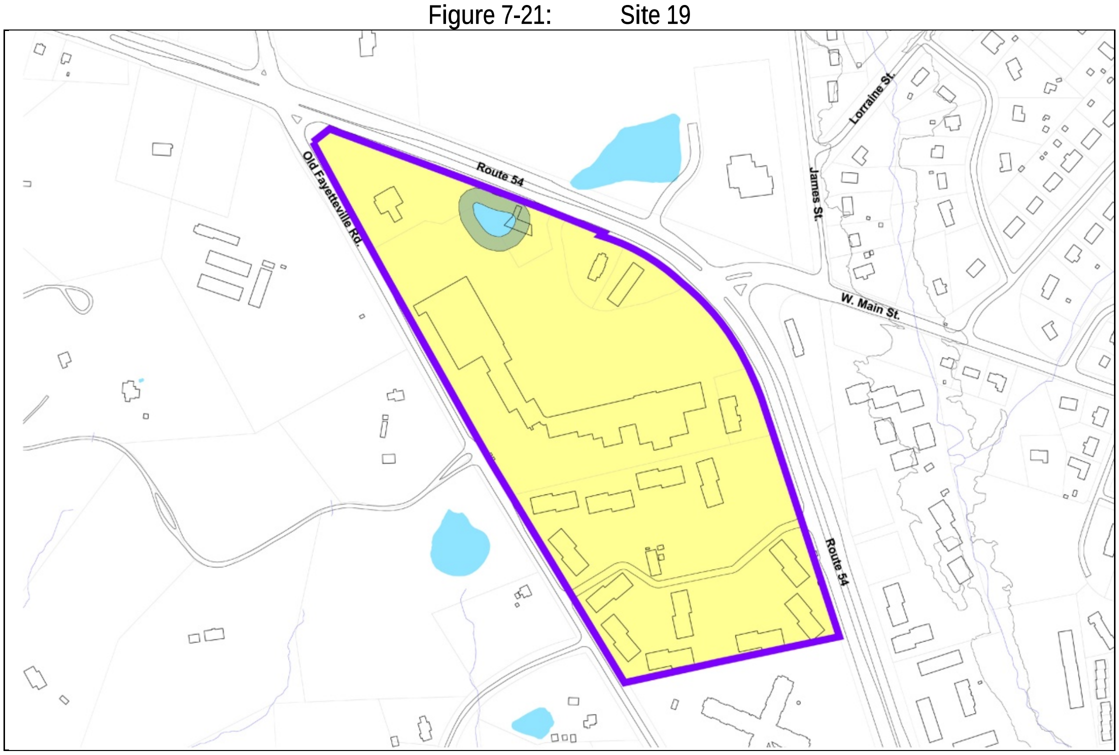


Figure 7-22: Site 20

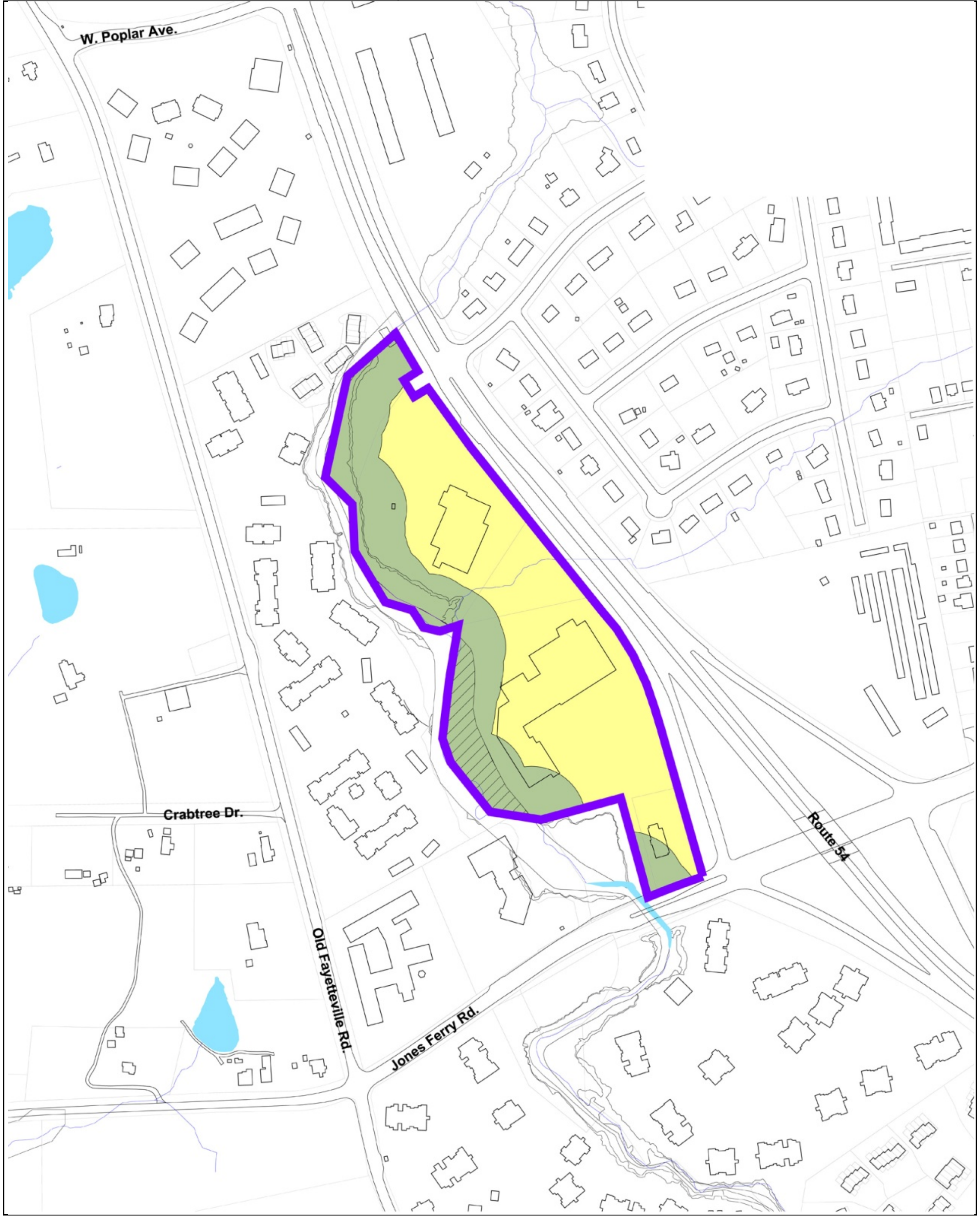


Table 7-1: Build-0ut Calculations

Site	Gross Acreage	Buildable Acreage	Development Program			Residential Units @ 25 units/ Acre	Residential Units @ 15 units/ Acre	Office SF@ FAR 1.2	Retail SF @ FAR 1.2	Office SF @ FAR 1.0	Retail SF @ FAR .55
			Residential	Office	Retail						
1*	127.0	77.8	1061 units	120,000 sf	127,000 sf		1061	144,000	277,891	120,000	127,000
2*	100.0	55.4	359 units	200,000 sf	73,000 sf		359	240,000	159,273	200,000	73,000
3*	69.0	60	758 units	60,000 sf	417,000 sf		758	72,000	909,818	60,000	417,000
4*	66.5	39.6	204 units		8,000 sf		204				8,000
5	Carolina North										
6	29.0	26.7	80%	10%	10%	409	75	139,384	139,384	116,154	63,884
7	32.0	15.9	80%	20%		319		166,607	-	138,839	
8	91.0	55.7	70%	10%	20%	975		291,325	582,651	242,771	267,048
9	133.0	102.2	50%	25%	25%	1277		1,335,190	1,335,190	1,112,659	611,962
10a	124.0	78.0	75%	10%	15%	1463		407,722	611,582	339,768	280,309
10b	124.0	117.0	75%	10%	15%	2194		611,582	917,374	509,652	420,463
11	107.0	68.0	50%	20%	30%	850		710,899	1,066,349	592,416	488,743
12	173.0	129.9	25%	38%	38%	812		2,546,959	2,546,959	2,122,466	1,167,356
13	29.0	20.1	100%			502					
14	60.0	50.0	50%	20%	30%	625		522,720	784,080	435,600	359,370
15	24.0	7.1		25%	75%			92,687	278,060	77,239	127,444
16	58.0	58.0	50%	38%	12%	725		1,152,075	363,813	960,062	166,748
17a	63.0	49.6	50%	30%	20%	620		777,807	518,538	648,173	237,663
17b	63.0	60.6	50%	30%	20%	758		950,305	633,537	791,921	290,371
18	91.0	82.9	50%	20%	30%		622	866,670	1,300,005	722,225	595,835
19	38.0	38.0	50%	20%	30%	475		397,267	595,901	331,056	273,121
20	17.0	7.2	75%	13%	13%	135		47,045	47,045	39,204	21,562
Total	1432 acres	1022-1072 acres	12-13,000 units	8.3-10.3 mil sf	5.3 - 12 mil sf	9,200-10,000 units	3,100 units	9.9-10.3 mil sf	11.5-12 mil sf	8.3-8.6 mil sf	5.3-5.5 mil sf

**Calculations for Sites 1-4 based on development of detailed site plans shown in Figures 23-25*

For parcels 1 – 4 and 18, conceptual site plans were developed to illustrate potential Transit Supportive Development (see Figure 7-23 through Figure 7-27) and the design guidelines detailed in Appendix C. The site plans for parcels 1-4 (Figures 7-23 through 7-26) were developed as part of the Chapel Hill Northern Small Area Plan. Figure 7-27 was developed as part of this Long Range Transit Plan in coordination with the Town of Carrboro.

Figure 7-23: Illustrative Plan for Site 1 (Eubanks and Millhouse Roads)

Site 1 is located on the north side of Eubanks Road, just west of I- 40 and east of Millhouse Road. The drawing illustrates a mixed-use development with residential over retail uses clustered along the main entry road leading to a transit center and two parking garages. Office buildings are located adjacent to the transit center. The remainder of the site is developed for residential use, with bridges providing pedestrian and vehicular connections across the creek buffer zone to additional residential development on the west side of the property. Parking garages serving park-and-ride passengers, as well as retail, office and residential uses, buffer the residential uses from traffic noise on I-40. The build-out calculations for the site plan illustrated above are as follows:

Gross Acreage	*Buildable Acreage*	*Residential Units*	*Office SF*	*Retail SF*
127	77.8	1061	120,000	127,000

Figure 7-24: Illustrative Plan for Sites 2 and 3 (Weaver Dairy Road and Martin Luther King Jr. Blvd.)

Site 2 is located north of Weaver Dairy Road, south of I-40 and east of Martin Luther King Jr. Blvd. (NC 86) This plan includes residential over retail uses along Weaver Dairy Road, with residential development in the interior of the site and office uses along I-40. Site 3 includes property south of Weaver Dairy Road, on both sides of Martin Luther King Jr. Blvd. Residential over retail uses flank Weaver Dairy Road and Martin Luther King Jr. Blvd. An entry road from Weaver Dairy Road leads to a retail and office complex, and connects this development to the office development in Site 2. Residential use is clustered further south along both sides of Martin Luther King Jr. Blvd. The build-out calculations for the site plan illustrated above are as follows:

Site 2:

Gross Acreage	*Buildable Acreage*	*Residential Units*	*Office SF*	*Retail SF*
100	55.4	359	200,000	73,000

Site 3:

Gross Acreage	*Buildable Acreage*	*Residential Units*	*Office SF*	*Retail SF*
69	60	758	60,000	417,000

Figure 7-25: 3-D Rendering of Site 3 (Weaver Dairy Road and Martin Luther King Jr. Blvd.)

Source: Crosby Schlessinger Smallridge, LLC

This view looking southwest to the corner of Weaver Dairy Road and Martin Luther King Jr. Blvd. illustrates a lively pedestrian plaza leading into the site, with attractive tree-lined sidewalks on both Weaver Dairy Road and Martin Luther King Jr. Blvd. The BRT stop on Martin Luther King Jr. Blvd. includes seating and a “real-time” information display.

Figure 7-26: Illustrative Plan for Site 4 (Homestead Road and Martin Luther King Jr. Blvd.)

Site 4 is located on the north side of Homestead Road, both east and west of Martin Luther King Jr. Blvd. Because the property is surrounded by residential uses, and the developable area is broken up into relatively small parcels, the conceptual plan for this site includes only residential use. A wide, tree-shaded sidewalk links the TSD sites to a BRT stop on Martin Luther King Jr. Blvd. The build-out calculations for the site plan illustrated above are as follows:

Gross Acreage	*Buildable Acreage*	*Residential Units*
66.5	39.6	204

Figure 7-27: Illustrative Plan for Site 18 (Carrboro, Homestead and Old NC 86)

Site 18 is located in Carrboro, south of Homestead Road and east of Old NC 86. The site plan illustrates a cluster of office and retail uses flanking a central plaza along Homestead Road. Residential development to the south of this commercial core connects to the adjacent residential neighborhoods to the south. The western end of the site is maintained as a large community park, reflecting the character of the adjacent farmland. The build-out calculations for the site plan illustrated above are as follows:

Gross Acreage	*Buildable Acreage*	*Residential Units*	*Office SF*	*Retail SF*
91	82.9	684	225,000	87,500

7.2 Design Guidelines

To implement the TSD strategy, a set of design guidelines this presented in this LRTP. The purpose of these TSD Design Guidelines is to ensure that new development around transit stops/stations/corridors supports transit use, encourages ridership, reduces auto dependency and leverages the transit investment. These design guidelines support the Town of Chapel Hill's existing Design Guidelines and are supplemental to those Guidelines. The guidelines establish basic principles that include pedestrian oriented design features, the features and quality of building materials, and standards for principle corridors that promote "eyes on the street" that provide a sense of safety. The design guidelines are presented in Appendix C.

7.3 Review of Carolina North Master Plan

CSS, during the course of the LRTP development, engaged in discussions with the Town of Chapel Hill and the University of North Carolina regarding the general design of the Carolina North Master Plan and proposed transit services. CSS provided feedback on the preliminary design which, it was understood, is still evolving. The Town and the University were in the process of drafting a development agreement, and the TSD principles in this report are recommended to be incorporated into that agreement.

In an October 23, 2008 conference call attended by the Town, the University and CSS, the group discussed the possible impacts of routing some or all of the Martin Luther King, Jr. Blvd. bus service into the Carolina North campus via the "C" Road (See Figure 7-28). The group also discussed the need for a transit focus area along the Martin Luther King, Jr. Blvd. busway and the connection to Martin Luther King, Jr. Blvd. of the east/west transitway through Carolina North. The University confirmed that their planning for Carolina North did envision the extension of the east/west transitway to Martin Luther King, Jr. Blvd. and the development of a transit focus area along Martin Luther King, Jr. Blvd., although the current Master Plan does not include that designation. It was anticipated that the buildings adjacent to Martin Luther King, Jr. Blvd. would have a research focus or be private sector development rather than academic uses.

The group agreed that preserving flexibility in the overall design of the Carolina North Master Plan to accommodate bus service along both the "C" Road and Martin Luther King, Jr. Blvd. should be a goal. It was anticipated that the release of the recommendations of the Chapel Hill Long Range Transit Plan would result in continuing refinement of the specific transit services along Martin Luther King, Jr. Blvd. and the "C" Road.

The University agreed that the designation of a transit focus area along Martin Luther King, Jr. Blvd. should be included in the next version of the Carolina North Master Plan. It was agreed that a joint staff working group, including representatives from the Town and University, should be directed to begin discussions of how best to implement bus rapid transit along Martin Luther King, Jr. Blvd. and how that system could be integrated into the Carolina North Master Plan. In addition it was agreed that a more well-defined parcel at the intersection of Martin Luther King, Jr. Blvd. and the east/west transitway be designated for a future transit station, possibly with a waiting area and transit supportive uses integrated into one of the new buildings on Martin Luther King, Jr. Boulevard.

Figure 7-28: Carolina North and "C" Road

Source: Base map of Carolina North, University of North Carolina.

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Section 8: Financial Plan

This section discusses the financial aspects of the two preferred High Investment corridors developed in Section 6. These corridors are the Martin Luther King Jr. Blvd. (Gateway 1) and US 15/501 (Gateway 3 serving downtown Chapel Hill and the UNC Main Campus via Franklin and Carolina North via Estes). In addition, similar information is provided for the remaining corridors including operating and capital costs. This section not only develops cost estimates but also reviews key federal funding processes. This section then concludes with a summary of capital and operating costs for the enhanced local system.

8.1 Capital and Operating Costs

A key piece in determining the financial viability of a transit high investment is the cost of that investment. Once the costs are known, the dollars needed to pay for the investment can be better determined. At that point the community can weigh whether the investment is worth the expenditure. There are two broad groups of costs associated with implementing and operating either or both of the preferred corridors as well as the other corridors identified as "gateway" services. These costs are either capital or operating. All costs below are shown in constant 2008 dollars. Constant 2008 dollars are used to give a sense of scale of the investment when compared with current transit investments. Future analyses should use inflated dollars.

8.1.1 Capital Costs

The introduction of BRT in the above corridors will prove to be a highly capital intensive undertaking. There are five main capital cost categories. They are:

1. *Running Way improvements*—which include adding travel lanes, signal priority, and other enhancements to the street in which the BRT service would operate.
2. *BRT Station improvements*—which would be upgraded versions of the standard bus stops with shelters now in use by CHT.
3. *Gateway Park-and-Ride facilities*— which are parking facilities to intercept people entering the community who will park their vehicles and board the BRT to their final destination.
4. *Vehicles*—which are primarily the BRT vehicles.
5. *Operating Facility and Miscellaneous*—which include additional vehicle storage and maintenance areas at CHT's main operating base.

Running Way Improvements
Each of the infrastructure levels includes two basic cost structures; construction costs and service costs. The construction costs consist of physical construction activities as well as utility adjustments and/or relocations, as well as right-of-way costs. Because of the planning level stage of the concepts, utilities are treated as a percentage cost. Right-of-way is estimated at a cost per square foot, based upon a typical existing right-of-way and a typical proposed right-of-way width, both of which may experience significant differences during the survey and design stage. The construction category includes elements such as removals, pavement, curb and gutter with drainage, sidewalk, traffic signal priority for transit vehicles as well as a percentage for miscellaneous items. A contingency of 35% is also applied which is appropriate for a planning-level estimate with only minimal quantities available for take-off.

A service element is also itemized in the cost structure. Services consist of survey and special services such as geotechnical investigations, as well as preparing design and right-of-way plans, and construction inspections. Typically these services are expressed as a range of values based upon construction costs. For simplicity, a typical industry percentage of 21% has been used, yet it can be adjusted to reflect a range of probable costs. These elements comprise program costs that reflect institutional management to implement the project, beyond simple construction costs.

The construction costs are applied on a unit cost per mile, or in the case of pavement on a per lane-mile cost. Consequently construction costs are a function of construction length. Traffic signal prioritization is quantified as each for every existing traffic signal along the route that the running way occurs. This occurs along segments where transit runs in a "mixed" format with other vehicles. Consequently, two running way lengths are recorded, one for the total project cost (including mixed traffic) and a construction cost length, where only physical construction would occur.

As discussed in Section 6, Gateway 1, running way improvements assumes a six lane cross section from about I-40 to Estes Drive and mixed traffic (with signal priority, no widening) from Estes to Rosemary Street. For Gateway 3—also a six lane cross section to the Franklin Street split with continuation mixed traffic (with signal priority, no widening) thereafter. The Estes Drive leg (from Franklin to Carolina North) would also be mixed traffic (with signal priority, no widening). The overall 2008 cost per mile (including construction, design and other fees, and a contingency) for Gateway 1 is about $6.5 million (about $36.1 million total cost) and over $4 million (about $22 million total cost) for Gateway 3. Pure construction cost per mile (actual estimated cost without service fees and contingency) is estimated to be $4.8 million per mile for MLK and $2.83 million for the US 15/501 gateway. The main difference in these costs is that Franklin portion of the US 15/501 running way has less cost for curb, gutter, and sidewalks than MLK. Further, MLK is adding *two* new travel lanes north of Homestead.

BRT Station Improvements

There are three levels of BRT station improvements contemplated for the two corridors. The station improvements relate to size (small, medium, large) which is determined by projected boardings at a given location. Each station, regardless of size, consists of:

- Covered Shelter (Figure 8-1 for illustration of a sample BRT station)
- Information kiosk (which would include real-time bus arrival information)
- Trash receptacles (including signage)
- Newspaper boxes
- Bike racks
- Emergency Phones
- Security camera/CC TV
- Benches (outside shelter)

Actual amenities at each location will depend on the amount of right-of-way available. For budgeting purposes, the above mix of amenities is assumed for all stations. A more detailed engineering review will be needed to establish costs for each station.

Figure 8-1: Sample BRT Station

Depending on the size of the station, the cost of each station ranges from about $110,000 for a small station to $178,000 for a large station. TranSystems estimated the number of each type of station for the two preferred gateway services by estimating boardings at each location. Costs are in 2008 dollars and are based on TranSystems experience in recently developing conceptual costs for BRT stations in Albany, New York where we are engaged in design services.

Gateway Park-and-Ride Facilities

The hallmark of each of the BRT plans is to intercept commuters at the boundaries of the Towns of Chapel Hill and Carrboro. The main destination for many of these people will be either the main campus of UNC or the new Carolina North development. For the projected ridership to occur parking at both the main campus and Carolina North will either by design or actuality be limited to the point where people will need to park remotely. This will require a substantial number of peripheral parking at the gateway points.

Conceptually, the parking facilities would be parking decks so that the overall footprint of the parking facility is minimized. About 4,070 spaces would be needed for the I-40 and Martin Luther King Jr. Blvd. Gateway and about 5,330 at the US 15/501 and I-40 Gateway. A cost of $20,250 per parking space is assumed which include design fees but not land costs.

If regional service to Chapel Hill/Carrboro is expanded, the number of parking spaces at the gateways could potentially be reduced. Regional services include bus service operated by the Triangle Transit Authority (TTA) that would bring commuters beyond community boundaries into Carrboro and Chapel Hill. As those plans are not finalized no estimate of the potential reduction in spaces is included in the cost estimate.

Vehicles

Both of the BRT corridors are anticipated to utilize diesel fueled articulated vehicles. Based on recent delivery of such vehicles to Chapel Hill Transit, the unit cost for a BRT vehicle is assumed to be $864,000 (including a thirty percent contingency).

Operating Facility and Miscellaneous

It is uncertain whether the current CHT facility would be able to handle the additional maintenance work associated with the BRT service along with other system expansions. At a minimum, additional work shift for vehicle mechanics would likely be needed to handle the new vehicles. However, additional maintenance bays could also be required. The cost estimates for the gateway services assumes that the current garage will not need to be expanded. This issue should be re-visited as CHT expands its services creating more demand for vehicle maintenance space.

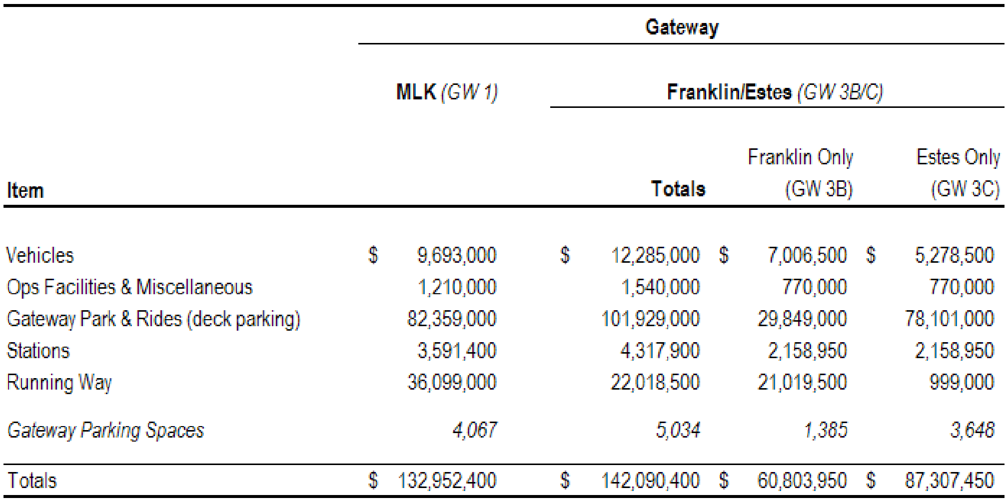
On the other hand, vehicle parking space is presently at capacity with the current fleet. To provide additional storage space for 11 to 14 new vehicles associated with each of the BRT lines costs for adding vehicle parking (with canopied covered) is estimated to be $100,000 per vehicle or $1.1 to $1.4 million for each BRT line.

Finally, an additional $110,000 to $140,000 in miscellaneous costs is assumed to account for the need for supervisory vehicles as well as other costs.

Summary

Table 8-1 below summaries capital costs for both BRT corridors. All capital costs are projected (in 2008 dollars) to range from about $133 million to just over $142 million. As can be seen from the table, well over half the costs is associated with the Gateway Park-and-rides. Table 8-2 shows similar costs (in 2008 dollars) for the remaining gateway services. Note that Gateways 3A and 4 would be operated with articulated vehicles with the Gateways 6, 7, and 8 using standard forty-foot vehicles. The unit cost of the 40-foot vehicles is $445,000 (including a thirty percent contingency).

Table 8-1: Preferred Gateway Corridor Capital Costs—2008 Dollars



	Gateway			
	MLK *(GW 1)*	**Franklin/Estes** *(GW 3B/C)*		
Item		**Totals**	Franklin Only (GW 3B)	Estes Only (GW 3C)
Vehicles	$ 9,693,000	$ 12,285,000	$ 7,006,500	$ 5,278,500
Ops Facilities & Miscellaneous	1,210,000	1,540,000	770,000	770,000
Gateway Park & Rides (deck parking)	82,359,000	101,929,000	29,849,000	78,101,000
Stations	3,591,400	4,317,900	2,158,950	2,158,950
Running Way	36,099,000	22,018,500	21,019,500	999,000
Gateway Parking Spaces	*4,067*	*5,034*	*1,385*	*3,648*
Totals	$ 132,952,400	$ 142,090,400	$ 60,803,950	$ 87,307,450

Table 8-2: Other Gateway Service Capital Costs—2008 Dollars

				GW 7 (Hillsborough Road)			GW 8 (NC 54 Northwest)		
Item	**GW 3A I40 to UNC via US 15/501**	**GW 4 via NC 54**	**GW 6 via US15/501 South**	**GW 7 Total**	GW 7 to Carolina North	GW 7 to UNC Main Campus	**GW 8 Total**	GW 8 to Carolina North	GW 8 to UNC Main Campus
Vehicles	$ 7,965,000	$ 10,557,000	$ 5,089,500	$ 7,411,500	$ 3,260,250	$ 4,151,250	$ 8,397,000	$ 4,644,000	$ 3,753,000
Ops Facilities & Miscellaneous	990,000	1,320,000	1,210,000	1,760,000	880,000	880,000	1,980,000	990,000	990,000
Gateway Park & Rides (deck parking)	65,332,000	110,497,000	29,079,000	14,997,000	13,475,000	1,522,000	14,720,000	11,438,000	3,282,000
Stations	2,259,200	2,259,200	847,200	1,976,800	988,400	988,400	1,694,400	847,200	847,200
Running Way	30,996,000	28,228,500	7,335,900	15,672,150	7,836,075	7,836,075	12,837,825	6,418,913	6,418,913
Gateway Parking Spaces	*3,226*	*5,457*	*1,436*	*741*	*671*	*70*	*747*	*577*	*170*
Totals	$ 107,542,200	$ 152,861,700	$ 43,561,600	$ 41,817,450	$ 26,439,725	$ 15,377,725	$ 39,629,225	$ 24,338,113	$ 15,291,113

8.1.2. Operating Costs

In Section 6, conceptual operating plans were developed for the two preferred corridors, the Martin Luther King Jr. Blvd. (Gateway 1) and US 15/501 (Gateway 3 serving downtown Chapel Hill and the UNC Main Campus via Franklin and Carolina North via Estes). Table 8-3 summarizes key operating variables for the preferred corridors. Table 8-4 shows similar information (presented earlier in Table 6-11) for the remaining gateway services. Both tables present the number of gateway parking spaces and daily ridership for the "low investment" scenario discussed in Section 4.

Table 8-3: Summary Operating Statistics for Preferred Gateway Services

Service	**Frequency** *(weekdays mins)*		**Days of Operation**	**Service Day** *(hours)*	**Peak Vehicle Requirement***	**Vehicle Hours**		**Gateway Parking Spaces**	**Estimated Daily Ridership**
	Peak	Off Peak				Daily	Annual		
GW 1--Martin Luther King Jr., Blvd	5	8	Mon-Sun	17	11	120	33,240	4,067	9,741
GW 3B/C--US 15/501 (via Franklin/Estes)	5	8	Mon-Sun	17	14	143	41,745	5,034	10,522
GW 3B (via Franklin)	10	15	Mon-Sun	17	8	80	23,040	1,385	2,973
GW 3C (via Estes)	10	15	Mon-Sun	17	6	63	18,705	3,648	7,549

**Includes spares, does not include ADA paratransit vehicles.*

Table 8-4: Summary Operating Statistics for Other Gateway Services

Service	**Frequency** *(weekdays mins)*		**Days of Operation**	**Service Day** *(hours)*	**Peak Vehicle Requirement***	**Vehicle Hours**		**Gateway Parking Spaces**	**Estimated Daily Ridership**
	Peak	Off Peak				Daily	Annual		
GW 3A I40 to UNC via US 15/501	10	15	Mon-Sun	17	9	97	28,591	3,226	5,222
GW 4 via NC 54	5	8	Mon-Sun	17	12	126	34,770	5,457	9,319
GW 6 via US15/501 South	10	15	Mon-Sun	17	11	120	34,664	1,436	5,014
GW 7 to Carolina North	10	15	Mon-Sun	17	7	80	23,040	671	1,049
GW 7 to UNC Main Campus	10	15	Mon-Sun	17	9	97	28,591	70	760
GW 7 Total	10	15	Mon-Sun	17	16	177	51,631	741	1,808
GW 8 to Carolina North	10	15	Mon-Sun	17	10	103	30,121	565	1,998
GW 8 to UNC Main Campus	10	15	Mon-Sun	17	8	97	28,591	162	1,760
GW 8 Total	10	15	Mon-Sun	17	18	200	58,712	727	3,759

**Includes spares, does not include ADA paratransit vehicles.*

In calculating operating costs, a rate per vehicle hour was used for the fixed-route, BRT, portion of the service. In addition, an assumption regarding costs for additional ADA complementary paratransit was made as well. For the both BRT and ADA paratransit services, a rate of $87 per revenue hour was used. This cost factor was based on Chapel Hill Transit's (CHT) 2008-2009 budget. The rate not only includes expenses directly related to operations (e.g., driver wages, fuel, maintenance) it also includes administrative and management overhead expenses. As the BRT service would involve a significant increase in service, it is assumed additional overhead expenses would be borne by CHT. It should be noted that parallel local services, operating in the same corridor as the BRT services would be reduced presenting a cost savings. These savings have not been reflected above since it is assumed the local transit resources would be redirected elsewhere within the community in order to enhance the local bus system.

Finally, additional ADA paratransit is assumed since a significant number of new riders are projected for the services.[19] While many of these new riders will access the service via the gateway park-and-ride facilities it is also anticipated that some of these riders will have disabilities which will limit their ability to access the BRT vehicle or to access their final destination from a BRT drop off point. Thus, some of these new riders will need complementary ADA paratransit service. For the purposes of this analysis the current proportion of CHT ADA revenue hours to fixed-route revenue hours is assumed to hold for the new BRT service. That ratio is 10.9 percent. Thus, ADA services associated with the BRT service are calculated to be 10.9 percent of BRT revenue hours. The operating cost per hour of $87 per hour is used since CHT runs both services in house. It should be added that ADA services might be saved because of the possible reduction of local bus service that currently operates in parallel with the BRT lines. With BRT service, less local service would be needed thus less ADA service. These savings should be considered in future studies.

Based on the above assumptions, the first year annual operating cost (in 2008 dollars) for the Martin Luther King Jr. Blvd. (Gateway 1) service is projected to be $3.21 million. For the US 15/501 (Gateway 3B and 3C) would be $4.03 million (also in 2008 dollars). Both of these costs assume both the base operations as described in Section 6 as well as an assumption for complementary ADA paratransit service.[20]

8.2 Funding Options

There are four main sources of funding that are typically used for public transit services in North Carolina. They are:

1. Passenger fares—which are charges to people who ride the service.
2. Federal grants and innovative financing—are from a variety of grant programs
3. State grants—the State of North Carolina through its Department of Transportation (NCDOT) also has a number of operating and capital funding programs.
4. Local funds—can be from general funds and dedicated taxes.

For CHT all of the above are viable options with the possible exception of passenger fares. Currently, the CHT is fare free. It is assumed that any future BRT system would likewise be fare free. Thus, passenger revenue is not considered a funding source for the BRT service.

8.2.1 Federal Grants

The FTA provides financial assistance through capital grants under a variety of programs for which elements of the BRT lines are eligible. As CHT is in an urban area with a population in excess of 200,000 people, none of the federal funds can be used strictly for operating assistance.[21] Principal among these programs, and the sections of the statute that govern them, are:

- Large Urban Areas Formula Grants (Section 5307)
- New Starts and Small Starts (5309)
- Clean Fuels Program (5308)

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[19] Under ADA regulations, complementary paratransit service is not required for commuter express services. While an argument might be made that the BRT service is commuter oriented, the ADA component is assumed nonetheless.

[20] Any cost savings by reducing overlapping local service in the preferred corridors have not been taken into account.

[21] Some expenses, such as preventative maintenance, are considered capital expenses for FTA purposes though they are operating in nature. The application of these dollars to BRT preventative maintenance is a possibility assuming CHT is not already using all of its current 5307 funding.

- Bus and Bus Facilities (5309, 5318)

In addition, each federal budget often contains "earmarked" transit projects that are sponsored by state Congressional delegations and are mandated by statute in the budget. The administration of such projects is handled under the regular funding program guidelines of the FTA, with the exception that the projects are not subject to FTA discretionary project selection.

Table 8-5 summarizes typical federal funding programs that could potentially be used for the BRT lines. More discussion regarding "New Starts and Small Starts" takes place below.

Other Federal Sources

The below federal funds are generally available for capital purposes only.

"Innovative funding" - For the past several years, the FTA has placed an emphasis on "innovative" financing. A review of several projects often cited as "innovative" suggest that the experience to date has been limited. The major "innovation" that appears to be common among these projects is the use of multiple sources of Federal funding programs, and some small amount of private funding and borrowing.

Federal support of borrowing for capital projects is a relatively new element of transit funding. Since the creation of the FTA and is predecessor UMTA, most projects have been funded by a combination of Federal assistance and local share of project costs on a "pay as you go" basis.

"Flexible Funding"- The U. S. Department of Transportation can fund transit projects through "transfers" of federal highway funds that are allocated to states, but which states and local governments agree to use for transit projects instead of highways. Usually the forfeited or delayed highway projects are in the same urban area as the preferred transit project.

The Federal Highway Administration funds a variety of categories of highway construction funds. The Federal budget allocates these funds to states by categories. Certain of these funds may be used for either transit or highways.

The decisions to forgo highway projects for in favor of transit projects do not increase the amount of Federal Assistance. In some cases it reduces or increases the total funding, depending on the percentage of federal share that govern the federal program from which the highway project funds are transferred. The amount that is transferred does not change, but the local matching percentage can change, since the FTA funding ratio is generally 80/20, while Federal highway funding shares range from 50 percent to 90 percent.

Table 8-5: Summary of FTA Funding Programs

Section	Appropriation	Funding	Eligible Costs	Federal Share
5307 - Large Urban Cities	Funds remain available for obligation for three years	Allocated by formula	Virtually all capital and some operating facility and vehicle costs, some vehicle maintenance costs	Not to exceed 80%
5308 Clean Fuels Program	Funds remain available for obligation for three years	Discretionary	Limited to non-attainment areas. Supports clean fuel and advance propulsion technologies	Not to exceed 80%
Bus and Bus Facilities (5309, 5318)	Funds remain available for obligation for three years	Discretionary, although Congress usually earmarks all funds	Buses, bus rehabs, bus facilities, tools, shop equipment terminals, park-and-ride facilities, fare boxes, radios, supervisory vehicles, preventive maintenance	Not to exceed 80%
5309 *New Starts*	Funds remain available for obligation for three years	Governed by Full Funding Agreements. Discretionary, although Congress usually earmarks all funds	New fixed guideway systems and extension to current ones, including light rail, heavy rail, people movers bus-ways and HOV lanes	Not to exceed 80% Typically 50%
Small Starts	Funds remain available for obligation for three years	Governed by Project Construction Grant Agreements. Discretionary, although Congress usually earmarks all funds	Fixed and non-fixed guideway projects under $250 million total	Max $75 Million
Very Small Starts	Funds remain available for obligation for three years	Governed by Project Construction Grant Agreements. Discretionary, although Congress usually earmarks all funds	Fixed and non-fixed guideway projects under $50 million total meeting specific criteria	Not to exceed 80%

These "flexible funding" decisions follow the same process as other major metropolitan transportation investment decisions in an urban area:

- "Transfer" decisions transit are made by state and local officials, as a part or the metropolitan planning process
- Some projects to be funded by "transfers" must meet eligibility criteria for some non-transit programs

- Projects may be administered by FHWA or the FTA, whose processes are not the same
- "Transferring" generally means that some non-transit project will be cancelled or postponed
- Funds generally come from federally legislated programs that have set budgetary allocations to the state that are not increased by the transfer.

Among the Federal funding sources that can be "transferred" to transit are:

- CMAQ funds, limited to projects in urban areas that are non-attainment air quality regions. CMAQ funds can be used either for capital and/or operations. The operational aspect can only be used for up to three years to fund a service that would reduce emissions.
- STP, (surface transportation program) for many kinds of transit projects
- National Highway System (NHS) funds, for highway related transit projects in NHS corridors, such as park-and-ride facilities, car and van pool projects, and bus terminals.

8.2.2 State (NCDOT) Grants[22]

The State of North Carolina, through its Department of Transportation (NCDOT), has a number of funding programs for urban areas which include Carrboro/Chapel Hill. Generally, NCDOT provides matching funds for some of the above federal programs. These funds are for capital purposes. Specifically:

- *New Starts and Small Starts (Section 5309)*—up to 25 percent of the cost of design and construction costs. The level of state participation depends on the worthiness of the project, available state funds and the level of federal participation.
- *Bus and Bus Facilities (Section 5309)*—one half of the local match (up to 10 percent) can be provided by NCDOT.
- *Large Urban Area Formula (Section 5307)*—funds from this program that are used for planning and non-routine capital purchases can have one half of the local match (up to 10 percent) can be provided by NCDOT.

Other potential sources of funding applicable from NCDOT include:

- *State Maintenance Assistance Program (SMAP)*—which are funds currently used by CHT and are for operations. These funds are allocated to North Carolina communities based on a pre-determined formula. The funds are used to subsidize operating costs. It is possible that some of the BRT operating costs may use SMAP funds if the Town receives a higher allocation because of the additional service represented by the gateway lines.
- *Urban/Regional Technology Program*—provides either 90 percent state funds or half of local match when using federal Section 5307 funds to finance advanced technology projects. This is a capital funding source.

8.2.3 Local Funding

An array of local funding options exists to fund the BRT projects. For example, a variety of local taxing mechanisms (which can be used for capital or operating expenditures) such as:

- Property taxes
- Special assessments (e.g., licensing fees)
- Bonding (general obligation, revenue)
- Tax Increment Financing (TIF)
- Certificates of Participation (COPs)

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[22] This information is largely from the NCDOT web site.

- Special service districts
- Funding from the University (via student fees)

Currently, just over half of the Town of Chapel Hill's general fund is financed from property taxes. Another option that is receiving some attention in the Triangle region is a local option sales tax for public transit.

Currently, the North Carolina General Assembly is considering House Bill 2363 which would grant the state's counties the ability to seek voter approval for a half cent sales tax for public transit. The Triangle's Regional Transportation Alliance estimates that Orange County could generate $5.3 million from such a tax.[23] It is not clear how the tax revenue would be assigned to Chapel Hill/Carrboro. However, if the tax is distributed based on taxable sales, 77.5 percent of the transit tax funds could flow to Chapel Hill/Carrboro.[24] This amounts to $4.1 million annually. Proceeds from the tax could be used to subsidize operations or used to retire bonds that would be used to acquire the capital assets of the BRT service including vehicles, stations, facilities, and running way improvement

Development Related Funding Options[25]
Two types of development related financing mechanisms were examined:

- Transit Impact Fees
- Value Capture Techniques
    - Transit Improvement District
    - Tax Increment Financing

Transit Impact Fees
Impact Fees have been in use since the 1920's. The premise behind Transit Impact Fees is that the cost of infrastructure projects needed to support growth is financed with impact fees based on some measurement of a development's impact on future needs. Impact fees are not intended to be used for operational expenses or to pay for capital improvements to correct an existing deficiency or shortfall. It is important to prove that impact fees will be used exclusively to support growth-induced projects. Projects that support only current needs are the responsibility of existing residents. Projects that serve both existing and future needs should be financed from impact fees and other sources.

Precedents for the use of Impact Fees for transit projects include:

- San Francisco
- Broward County, FL
- Teton County, WY

Durham, North Carolina, has used impact fees for nine uses, but not for transit.

Transit Impact Fees have been found to be a legal financing mechanism if the jurisdiction meets a "rational nexus" test. To meet this test, the jurisdiction must:

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[23] Per Joe Milazzo II, PE of the RTA and based on November 2006 to November 2007 sales.

[24] According to the North Carolina Department of Revenue, in fiscal year 2007-2008, taxable Orange County sales amounted to about $972 million. Of this, $753 million were generated together in Chapel Hill and Carrboro.

[25] This section presents findings from a review of alternative financing options used by other government agencies and transit authorities to finance transit improvements. The review was conducted by Crosby | Schlessinger | Smallridge, LLC, and included web research as well as conversations with several agencies regarding their experience with financing options. This review is meant as an introduction to various financing mechanisms; a decision on which options may be desirable, or on how any individual option could be implemented in Chapel Hill, would require more detailed analysis.

- Show how development created the need for the infrastructure

- Identify the cost of providing the necessary infrastructure

- Base the fee amount on the extent to which the new development benefits from the new infrastructure

Transit authorities have used a variety of methods for calculating the appropriate fee. In Teton County, Wyoming, for example, a very simple calculation was used. The service was planned to start in 2005. The desired service was defined and an estimate was made of the number of people to be served. The projected cost of the service was then divided by the number of people served to determine a cost per person. Fees were then charged based on the number of persons per unit (e.g., residents per residential unit) or employees per square foot of development times the cost per person. Outbound trips were allocated to nonresidential development and inbound trips were allocated to residential development.

In San Francisco, California, MUNI began using Impact Fees since 1981. The fees are limited by statute to cover the cost of additional peak period service into, through and within greater downtown, over and above levels provided by MUNI in 1981 (e.g., incremental operating costs for expanded express bus service to downtown). The formula uses a 45-year presumed building life. It assumes that more development results in increased congestion on streets, thus increasing route times and cost. The goal is that a constant relationship be developed between the amount of non-residential development in the city and the number of revenue service hours MUNI provides. This coverage ratio concept is a court-tested, common approach to determining a minimum level for public services. This relationship can be expressed as the number of MUNI revenue service hours provided divided by the number of trips generated by non-residential uses. The cost of providing service for 45 years was divided by the projected square feet of development to determine a cost per square foot. The fee charged is the cost per square foot times the square feet of new development. Payment is due on the earliest of either the date of 50 percent occupancy or the date of issuance of the first temporary permit of occupancy.

The money can be used for:

- Capital costs associated with establishing new transit routes
- Expanding transit routes
- Increasing service on existing transit routes
- Procurement of related items such as rolling stock, design and construction of bus shelters, stations, tracks and overhead wires
- Operation and maintenance of rolling stock associated with new or expanded transit routes or increases in service on existing routes
- Capital or operating costs required to add revenue service hours to existing routes
- Related overhead costs

Impact fees typically do not generate enough revenue to fully fund a large scale project. Also, since fees are entirely dependent upon new development, they are highly speculative and not easily bondable.

Other Issues

Other issues for consideration raised by public entities employing transit impact fees include the following:

- Calculate costs over an adequate time period: Calculating the costs over a short time period can result in inadequate funding for capital and operating expenses. MUNI uses a 45-year time horizon.

- Carefully define the service to be provided: Broward County, FL was required to continue operating bus routes with very limited ridership because the exact routes (rather than level of service descriptions) were described in the calculations.

- Recalculate fees periodically to keep up to date: Capital and operating costs increase over time; fees should be recalculated at regular intervals to ensure that they are adequate.

- Money collected, but not spent within a reasonable time period, must be refunded: The time limit is frequently set out in the enabling legislation. Once the impact fees have been implemented, there is a need to provide accurate accounting of fees collected and the use of those fees. California's law requires that fees be expended, or committed, within five years of collection.

- To reduce the burden of impact fees on transit-supportive development or TSD, Santa Clara County, CA uses a sliding scale impact fee. Trip generation numbers used to determine fees are reduced for mixed-use development within 2000 feet of a transit facility that introduce financial incentives like discounted transit passes.

Value Capture

Value Capture techniques attempt to capture some of the increase in value due to the improvement which benefits the properties impacted. Assessment districts are special property taxing districts where the cost of infrastructure is paid for by properties that are deemed to benefit from the infrastructure. These assessments can be applied to the full value of the subject property, or a TIF technique can be used in which bonds are issued to finance public infrastructure improvements, and are repaid with dedicated revenues from the increment in property taxes as a result of such improvements. These techniques have traditionally been used in conjunction with rail service, which is assumed to have a greater positive impact on property values than bus service.

Two key issues concerning the use of value capture techniques include:

1. Does the increase in value go to the local jurisdiction or to the transit agency? The important question is whether the increase in value can be specifically used for transit.

2. How much of the increased value can be taken before developers lose interest? If too much of the increased value is taken, and developers lose interest, the technique will be self-defeating – there will be no development to support the transit service.

Transit Improvement Districts (or Assessment Districts)

Assessment districts are special property taxing districts where the cost of infrastructure is paid for by properties that are deemed to benefit from the infrastructure. Examples of assessment districts include:

- WMATA (Washington Metropolitan Area Transit Authority) Red Line: property owners within 200' of a new infill station at New York Ave. will pay annual assessments for 20 years to retire $25 million in general obligation bonds.

- Santa Clara County: The Valley Transportation Authority used an assessment district to fund construction of a station in Sunnyvale.

Tax Increment Financing

Tax increment financing (TIF) is a technique in which bonds are issued to finance public infrastructure improvements, and repaid with dedicated revenues from the increment in property taxes as a result of such improvements. TIF establishes a base-year tax level for a district. Any taxes generated above that base-year amount through increases in property values are earmarked for use within the same district for improvement projects or services. Examples include:

- Chicago: 129 TIF districts cover 30 percent of city land. TIF can be used for public transit infrastructure (but not operations) and Transit Oriented Development, and half the city's TIF districts include stations.

- Arlington Heights IL: Used two TIF districts to rebuild its downtown with very high residential densities around the commuter rail station, funding infrastructure and providing gap financing as an incentive to developers.

- Portland, OR: Portland OR has used TIF to fund transit investments such as the Portland Streetcar and the MAX Yellow Line. TIF revenues accounted for 22% ($19.7 million) of the total Streetcar cost. The additional property taxes are collected within two Urban Renewal Areas. For the MAX Yellow Line, the City of Portland provided $30 million in General Fund notes that must be repaid with TIF revenues generated by an Urban Renewal Area.

Other Options
Two other options for financing transit improvements mentioned in the literature include:

- Granting density bonuses to developers who contribute to rail implementation.

- Assessing property values over time and taxing windfall changes at a higher marginal rate to fund infrastructure and put redevelopment pressure on underused properties.

There were no examples of where these options had been tried.

8.2.4 Conclusions

In developing either or both of the BRT lines, all of the above funding sources are available. However, the Small Starts program would offer a potentially new source of federal funding that the Towns, to this point, have been not utilized. Both Transit Impact Fees and Value Capture Techniques could also be employed to help fund the recommendations in this Long Range Plan. These options, however, would only fund a portion of the project, and most have been implemented primarily for rail projects. A decision on which options may be the most desirable, or on how any individual option could be implemented in Chapel Hill, would require more detailed analysis.

8.3 Small Starts and Very Small Starts

Funding for fixed guideway projects, as contemplated for Gateway 1 and Gateway 3 BRT, could potentially come from FTA's Section 5309 –Capital Investment Grants (i.e., New Starts and Small Starts) program authorized under SAFETEA-LU. The program also called New Starts has three basic programs:

1. "Traditional"
2. Small Starts
3. Very Small Starts

The "Traditional" program is intended to fund relatively large fixed guideway projects such as urban area commuter rail, light rail, and similar technologies. *Small Starts* is intended to fund projects which cost less than $250 million using no more than $75 million in Section 5309 funding. *Small Starts* projects can be a corridor project which is at least 50 percent fixed guideway and/or be a corridor-based bus project with key design elements. *Very Small Starts* projects can also be bus based but cost less than $50 million and, among other things, be in a corridor which currently has 3,000 daily riders. To receive funding from these programs, the given projects must score an acceptable level on criteria developed by the Federal Transit Administration (FTA). Based on the cost estimates in Section 7.1 above for the targeted corridors, it would appear that *Small Starts* would be an appropriate funding mechanism for the Chapel Hill/Carrboro community to consider though *Very Small Starts* is a possibility if the proposed gateway services are scaled back. The balance of this section discusses how funding works under the *Small Starts* and *Very Small Starts* programs.

8.3.1 Small Starts and Very Small Starts Project Qualifications[26]

A Small Starts (SS) project must cost less than $250 million with no more than $75 million in FTA Section 5309 funding. In addition to having at least 50 percent of the project length being a fixed guideway in the peak period, it can also involve a corridor-based bus service with:

- Significant bus stops or stations
- Signal priority
- Low-floor vehicles
- Branding of service
- Minimum of a 10 minute peak and 15 minute off-peak service frequency.
- Service day of 14 hours.

As currently conceived, both the gateway corridor services would meet these basic criteria.

However, with some adjustments, one or both of the gateway services could also qualify for Very Small Starts (VSS) as well. Project requirements for VSS are the same as for Small Starts but in addition include:

- Existing corridor ridership must exceed 3,000 daily riders
- Project cost is less than $50 million
- Project costs less than $3 million per mile excluding vehicles.

According to the town of Chapel Hill, only Gateway 1 meets the 3,000 daily ridership threshold. The gateway project would need to be scaled back in order to meet the $50 million maximum project cost and keep under the $3 million cost per mile.

Table 8-6 presents the current capital costs for the full build out of both gateway projects in 2035. The project capital costs for Gateways 1 and 3B/C is about $132 million and $142 million respectively. The project cost per mile is for each gateway is respectively $22.2 million and $18.8 million. These amounts exceed the VSS cost thresholds.

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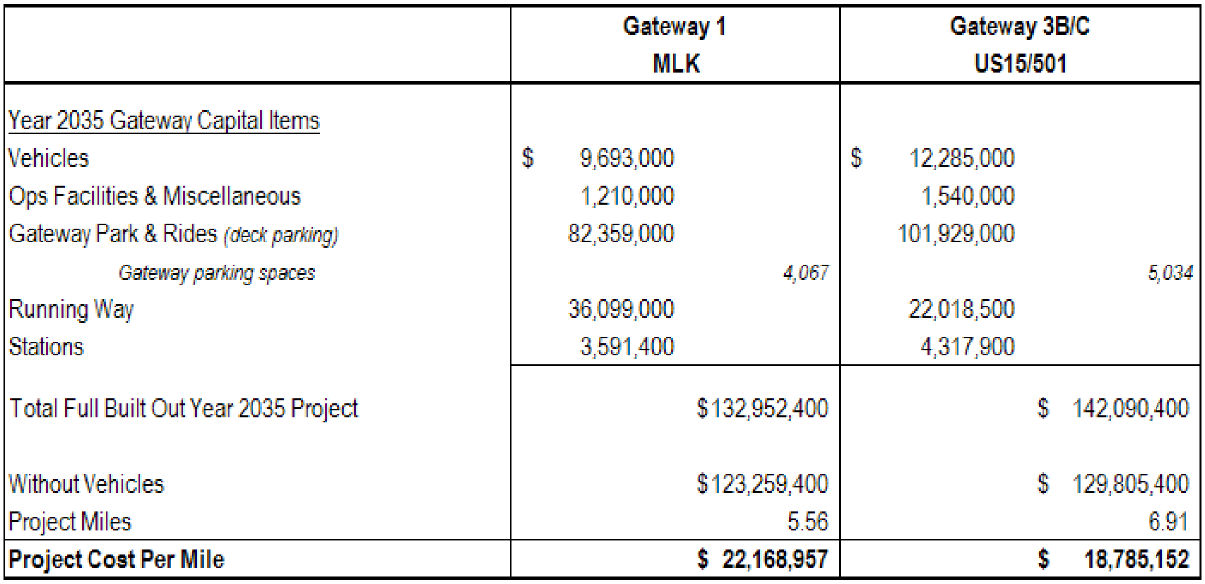
[26] This section is derived from FTA's Small Starts Fact Sheet.

Table 8-6: 2035 Preferred Gateway Projects—2008 Dollars



	Gateway 1 **MLK**	**Gateway 3B/C** **US15/501**
Year 2035 Gateway Capital Items		
Vehicles	$ 9,693,000	$ 12,285,000
Ops Facilities & Miscellaneous	1,210,000	1,540,000
Gateway Park & Rides *(deck parking)*	82,359,000	101,929,000
Gateway parking spaces	*4,067*	*5,034*
Running Way	36,099,000	22,018,500
Stations	3,591,400	4,317,900
Total Full Built Out Year 2035 Project	$132,952,400	$ 142,090,400
Without Vehicles	$123,259,400	$ 129,805,400
Project Miles	5.56	6.91
Project Cost Per Mile	**$ 22,168,957**	**$ 18,785,152**

Revising Target Year of Projects to Achieve Very Small Starts Cost Thresholds

An opportunity to bring either or both of the gateway projects within the VSS funding thresholds would be to revise the project target years to 2025. Year 2025 ridership and park-and-ride needs would be likely less than what is needed in 2035 thereby reducing some of the costs of the service.[27] Table 8-7 shows the results for the Gateway 1. The tables compare the 2035 plan (presented above) with a revision for a 2025 horizon year. The 2025 calculations are very preliminary but serve to illustrate that financing for either gateway project could possibly fall more into the VSS levels. The scenario also assumes the project length is increased to include travel to Cameron Road. The ridership and park-and-ride space requirements assume that by 2025, that only 25 percent of 2035 demand is realized. Further, the park-and-ride facility is assumed to be a surface lot instead of a parking deck. Finally, as discussed earlier on page 8-1, all capital costs except for running way improvements for 2025 assume a 35 percent contingency factor as well as a 21 percent factor for design and project management costs.

As can be seen in the Table 8-7, Gateway 1 (under the 2025 horizon year) could fall below the $50 million investment and $3 million per mile cost thresholds. It is likely that further cost reductions (including operating costs) can be realized by reconciling the level of local service overlapping the gateway operations (and assuming the services are not redeployed elsewhere). This can be done by truncating local services at the respective corridors to be feeders or reducing their frequencies. By reducing the needed vehicles and operating levels of the local services, significantly lower costs of Gateway 1 could be achieved, thus creating a VSS eligible project Thus, presuming existing corridor ridership can be found to meet the Very Small Starts criterion (3,000 existing riders); VSS would be a viable funding option.

The discussion below includes an analysis of funding opportunities under Small Starts and Very Small Starts.

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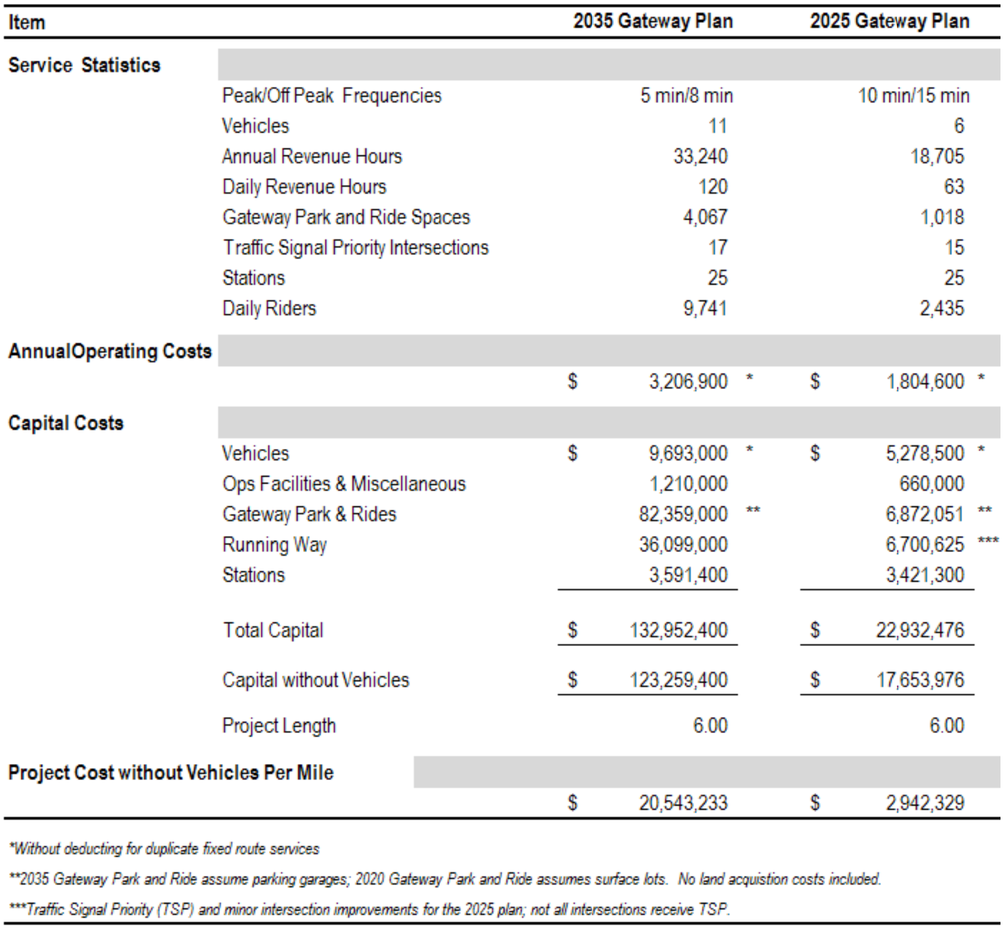
[27] Depending on the extent of the implementation of restrictive parking policies these ridership levels could be considerably less than 2035 ridership.

Table 8-7: 2025 Gateway 1—Martin Luther King Jr. Blvd. Implementation—2008 Dollars



Item		2035 Gateway Plan	2025 Gateway Plan
Service Statistics			
	Peak/Off Peak Frequencies	5 min/8 min	10 min/15 min
	Vehicles	11	6
	Annual Revenue Hours	33,240	18,705
	Daily Revenue Hours	120	63
	Gateway Park and Ride Spaces	4,067	1,018
	Traffic Signal Priority Intersections	17	15
	Stations	25	25
	Daily Riders	9,741	2,435
AnnualOperating Costs			
		$ 3,206,900 *	$ 1,804,600 *
Capital Costs			
	Vehicles	$ 9,693,000 *	$ 5,278,500 *
	Ops Facilities & Miscellaneous	1,210,000	660,000
	Gateway Park & Rides	82,359,000 **	6,872,051 **
	Running Way	36,099,000	6,700,625 ***
	Stations	3,591,400	3,421,300
	Total Capital	$ 132,952,400	$ 22,932,476
	Capital without Vehicles	$ 123,259,400	$ 17,653,976
	Project Length	6.00	6.00
Project Cost without Vehicles Per Mile			
		$ 20,543,233	$ 2,942,329

**Without deducting for duplicate fixed route services*

***2035 Gateway Park and Ride assume parking garages; 2020 Gateway Park and Ride assumes surface lots. No land acquistion costs included.*

****Traffic Signal Priority (TSP) and minor intersection improvements for the 2025 plan; not all intersections receive TSP.*

8.3.2 Approval Process and Criteria

For a qualified project to be awarded Small Starts (SS) or Very Small Starts (VSS) funding it needs to go through a three step process.[28] In advancing from one step to another, it must receive FTA approval. FTA approval is based on how well the project scores on pre-defined criteria (which are discussed below).

The three step process is:

1. *Alternatives Analysis (AA)* – An AA is an intense planning study that takes a detailed look at a given corridor to determine a Locally Preferred Alternative (LPA) to serving that corridor with transit. Any new transit modes are compared with a baseline condition. An AA has intensive public involvement as well as a thorough examination of alternative modes. In the case of Chapel Hill/Carrboro, the AA would have to demonstrate that the BRT (or some other fixed guideway technology) is viable when evaluated by key criteria (discussed below) including cost effectiveness. In addition, the LPA must be locally adopted, be included on the MPO's long range plan, and successfully complete NEPA scoping. Before engaging in an AA, the towns will need to prepare documentation that demonstrates the feasibility of the corridor under investigation. This document is submitted to the FTA for comment. While FTA does not formally approve of

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[28] At the time this LRTP was published, FTA is evaluating changes to the weighting of criteria in the Alternatives Analysis process.

communities to enter into an AA study, AA sponsors will need to satisfy FTA comments on this submitted documentation. This Long Range Transit Plan can be a significant part of that documentation. Note that Small Starts and Very Small Starts funding are not available for AAs. Funding for AAs can some from discretionary funding, from the area's Section 5303 and 5307 allocations or other sources (separately or in combination). Once the AA is complete (and recommends an LPA that warrants Small Starts or Very Small Starts funding) it needs to be approved by the FTA before the project can advance to "project development." Very Small Starts projects also need an AA but the level of study would not be as intense. For example, a VSS process would not rely on ridership forecasting thus present time and money savings when compared to the Small Starts process.

2. *Project Development*---presuming the project advances beyond the AA, the next step is to design the project from preliminary engineering (PE) to the final design level. At the end of this stage, the project is again evaluated to see if the score received after AA holds up. Small Starts and Very Small Starts funding is available for the project development stage. A VSS project would likely have the same design challenges as a SS project since both have similar running way and station improvements. However, the VSS gateway surface park-and-ride lots would be less design intensive than the similar deck parking facilities for the SS services.

3. *Project Construction Grant Agreement*—presuming the project development scores shows a viable project the next step is the execution of a Project Construction Grant Agreement (PCGA) that will govern the completion of the project. The PCGA provides construction funding under either Small Starts or Very Small Starts depending on the process undertaken.

Table 8-8 shows the basic capital financing (in 2008 dollars) of the preferred BRT lines (for 2035) if the communities were to be successful in obtaining Small Starts funding. Two levels of federal funding are shown—one with 80 percent federal funding and the other at 50 percent federal funding. While projects may be eligible for 80 percent funding, projects with lesser federal participation can be viewed more favorably in the Small Starts process. Table 8-10, on page 8-21, shows a similar funding analysis for the other gateway services.

As seen in Table 8-8, the federal share of either BRT project at the maximum 80 percent would provide between $106.4 and $113.7 million in financing. Note that this federal funding level exceeds the $75 million federal funding limit for Small Starts projects. The difference could be made up by other federal funding sources described above. The State could provide 10 percent of the financing or between $13.3 and $14.2 million. The remaining funding, equal to the State share would need to be provided by the community.

Table 8-9 shows the preferred project funding levels under the reduce project scenario presented earlier in Table 8-7 for the Very Small Starts funding program.

8.3.3 Alternatives Analysis

The funding shown in Table 8-8 and Table 8-9 do not include the cost of an Alternatives Analysis (AA). An AA (under Small Starts) for either corridor could cost about $1 million. For Very Small Starts an AA would cost about $500,000 to $750,000. Eighty percent of this could be paid for from the community's Section 5307 allocation and/or from Section 5339. Ten percent could come from the State leaving about $100,000 to be paid from local funds under Small Starts and $75,000 under Very Small Starts. If the US 15/501 corridor is to be the subject of an AA, NCDOT may be reluctant to help pay for the study. Since the corridor has already been the subject of two previous AAs, NCDOT believes further investment of state funds may not be warranted.

Table 8-8: Small Starts Federal Funding Scenarios for 2035 Preferred Gateway Services—2008 Dollars

	Gateway			
	MLK *(GW 1)*	**Franklin/Estes** *(GW 3B/C)*		
Item		**Totals**	Franklin Only (GW 3B)	Estes Only (GW 3C)
Vehicles	$ 9,693,000	$ 12,285,000	$ 7,006,500	$ 5,278,500
Ops Facilities & Miscellaneous	1,210,000	1,540,000	770,000	770,000
Gateway Park & Rides (deck parking)	82,359,000	101,929,000	29,849,000	78,101,000
Stations	3,591,400	4,317,900	2,158,950	2,158,950
Running Way	36,099,000	22,018,500	21,019,500	999,000
Gateway Parking Spaces	*4,067*	*5,034*	*1,385*	*3,648*
Totals	$ 132,952,400	$ 142,090,400	$ 60,803,950	$ 87,307,450
Maximum Federal Participation				
Federal (80%)	$ 106,361,920	$ 113,672,320	$ 48,643,160	$ 69,845,960
State (10%)	$ 13,295,240	$ 14,209,040	$ 6,080,395	$ 8,730,745
Local (10%)	$ 13,295,240	$ 14,209,040	$ 6,080,395	$ 8,730,745
Low Federal Participation				
Federal (50%)	$ 79,771,440	$ 85,254,240	$ 36,482,370	$ 52,384,470
State (25%)	$ 26,590,480	$ 28,418,080	$ 12,160,790	$ 17,461,490
Local (25%)	$ 26,590,480	$ 28,418,080	$ 12,160,790	$ 17,461,490

Table 8-9: 2025 Project Very Small Starts Funding Scenarios—2008 Dollars

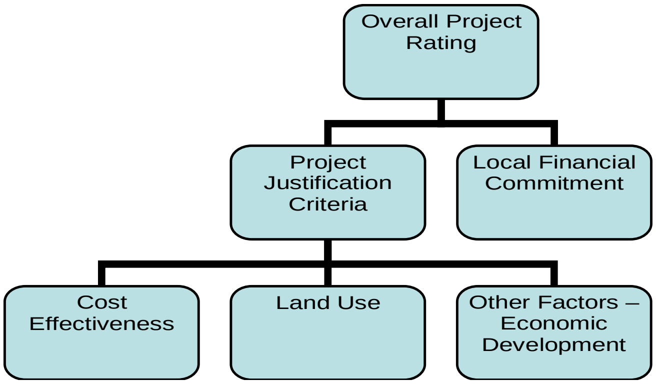
Funding Levels		**Gateway 1 MLK**
Maximum Federal Participation		
Federal	80%	$ 18,345,981
State	10%	2,293,248
Local	10%	2,293,248
Totals		$ 22,932,476
Low Federal Participation		
Federal	50%	$ 11,466,238
State	25%	5,733,119
Local	25%	5,733,119
Totals		$ 22,932,476

8.3.4 Criteria for Small Starts and Very Small Starts Funding[29]

The decision to advance a project into design (project development) and receive Small Starts (SS) or Very Small Starts (VSS) funding is made by the FTA following satisfactory completion of an AA (and presuming the AA recommends a SS or VSS worthy project). The project must satisfy a number of criteria and receive at least a "medium" overall project rating. All criteria are rated on a five point scale (Low, Medium-Low, Medium, Medium-High, and High).

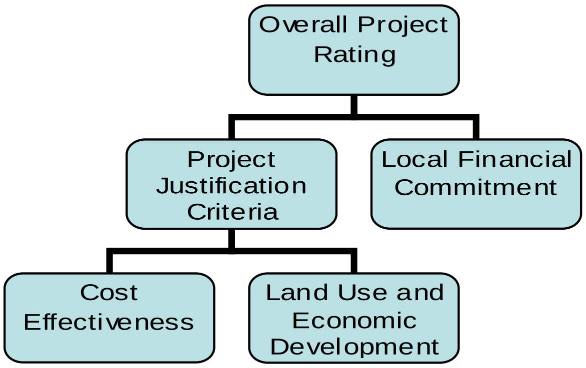
Evaluation criteria are in two groups. First group consists of project justification criteria. The second group addresses local financial commitment. The ratings of these two groups are averaged to yield the overall project rating. Sub-criteria are similarly rated on a five point scale and averaged Figure 8-2 and Figure 8-3 illustrate the evaluation criteria for SS and VSS respectively. Both are similar except VSS shows a collapsing of land use and economic development criteria under project justification. The weighing of these criteria are under review at the time of report publication.

Figure 8-2: Small Starts Project Rating Criteria



Source: Small Starts Fact Sheet, Federal Transit Administration

Figure 8-3: Very Small Starts Project Rating Criteria



Source: Very Small Starts Fact Sheet, Federal Transit Administration

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[29] This section is based on Appendix B of FY 2009 *Annual Report on Funding Recommendations*, Federal Transit Administration, 2008.

Table 8-10: Small Starts Federal Funding Scenarios for Other 2035 Gateway Services—2008 Dollars

				GW 7 (Hillsborough Road)			**GW 8 (NC 54 Northwest)**		
Item	**GW 3A I40 to UNC via US 15/501**	**GW 4 via NC 54**	**GW 6 via US15/501 South**	**GW 7 Total**	GW 7 to Carolina North	GW 7 to UNC Main Campus	**GW 8 Total**	GW 8 to Carolina North	GW 8 to UNC Main Campus
Vehicles	$ 7,965,000	$ 10,557,000	$ 5,089,500	$ 7,411,500	$ 3,260,250	$ 4,151,250	$ 8,397,000	$ 4,644,000	$ 3,753,000
Ops Facilities & Miscellaneous	990,000	1,320,000	1,210,000	1,760,000	880,000	880,000	1,980,000	990,000	990,000
Gateway Park & Rides (deck parking)	69,516,000	113,538,000	29,546,000	14,997,000	13,475,000	1,522,000	14,720,000	11,438,000	3,282,000
Stations	2,259,200	2,259,200	847,200	1,976,800	988,400	988,400	1,694,400	847,200	847,200
Running Way	30,996,000	28,228,500	7,335,900	15,672,150	7,836,075	7,836,075	12,837,825	6,418,913	6,418,913
Totals	$ 111,726,200	$ 155,902,700	$ 44,028,600	$ 41,817,450	$ 26,439,725	$ 15,377,725	$ 39,629,225	$ 24,338,113	$ 15,291,113
Maximum Federal Participation									
Federal (80%)	$ 89,380,960	$ 124,722,160	$ 35,222,880	$ 33,453,960	$ 21,151,780	$ 12,302,180	$ 31,703,380	$ 19,470,490	$ 12,232,890
State (10%)	$ 11,172,620	$ 15,590,270	$ 4,402,860	$ 4,181,745	$ 2,643,973	$ 1,537,773	$ 3,962,923	$ 2,433,811	$ 1,529,111
Local (10%)	$ 11,172,620	$ 15,590,270	$ 4,402,860	$ 4,181,745	$ 2,643,973	$ 1,537,773	$ 3,962,923	$ 2,433,811	$ 1,529,111
Low Federal Participation									
Federal (50%)	$ 67,035,720	$ 93,541,620	$ 26,417,160	$ 25,090,470	$ 15,863,835	$ 9,226,635	$ 23,777,535	$ 14,602,868	$ 9,174,668
State (25%)	$ 22,345,240	$ 31,180,540	$ 8,805,720	$ 8,363,490	$ 5,287,945	$ 3,075,545	$ 7,925,845	$ 4,867,623	$ 3,058,223
Local (25%)	$ 22,345,240	$ 31,180,540	$ 8,805,720	$ 8,363,490	$ 5,287,945	$ 3,075,545	$ 7,925,845	$ 4,867,623	$ 3,058,223

Overall Project Rating

The overall project rating is an average of the “project justification” and “local financial commitment” ratings for SS. For VSS projects, meeting the project criteria stated earlier, automatically receive a “medium” for project justification as explained below. Thus, for VSS projects only the local financial commitments score needs to be analyzed anew.

Project Justification

Under SS, there are three “sub-criteria” for project justification. These sub-criteria are each scored and averaged together to establish the overall project justification rating.

1. *Cost Effectiveness* is a measure of cost per user benefit. User benefit is a calculation based on travel time savings as measured in hours. The FTA has set monetary thresholds for each rating level. For example, projects with a cost per user benefit of $11.99 or less are scored as “high” for cost effectiveness. Projects with costs of $30 or more per user benefit are rated “low.”
2. *Land Use rates* the communities current land use patterns, transit supportive policies, and efforts to implement such policies.
3. *Other Factors—Economic Development* is currently not well defined and is a project sponsor’s opportunity to extol the benefits of a project through a “Making the Case” document. The project should be solving some transportation problem (such as reducing congestion) and the project sponsor can present information accordingly. At this time, a score of “other factors” is not rolled up into the project justification score. Rather, it is used as supplemental information in evaluating the overall project justification.

For VSS, projects automatically receive a “medium” for cost effectiveness and a “medium” for a combined land use and economic development (“other factors”) criterion.

Local Financial Commitment

This category relates to the financial viability of the project and is applied to both SS and VSS projects. Three criteria, which are scored using the above five point scale, make up this assessment:

1. The soundness of the local financing plan
2. Operating and Maintenance costs for the project that are 5 or less percent of current agency operating budget.
3. The agency being in good financial condition.

It should be noted that (as stated in item 2) the 5 percent of operating and maintenance cost threshold is intended to be a trigger for a more thorough financial analysis. Those projects at or below the 5 percent cost threshold have a lesser financial analysis than projects which exceed the 5 percent threshold. Exceeding the 5 percent threshold is not necessarily a “show stopper.” Under either SS or VSS scenarios, the preferred gateway services operating costs (before deducting any costs associated with local services overlapping the gateway services) exceed the five percent threshold.

8.3.5 Qualitative Assessment for Small Starts Funding

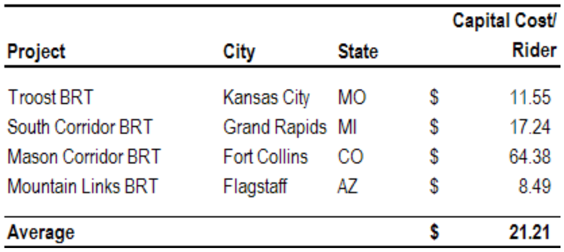
Given the general level of the planning to date on the above BRT projects insufficient quantitative data exists to be able to give a definitive assessment as to the prospects in obtaining Small Starts or Very Small Starts funding. The data necessary for this assessment comes out of an Alternatives Analysis (AA) process. However, the Chapel Hill/Carrboro/UNC community needs to be in position to determine whether either or both BRT projects are worthy enough to pursue an AA. Thus some kind of qualitative assessment can help guide the community in this decision.

No matter, it is ultimately FTA's decision about the funding worthiness of projects. Below is an attempt to give a very high level assessment of the projects' prospects for meeting the necessary "medium" rating to be recommended for funding for SS and VSS.

Project Justification

- *Cost Effectiveness*—the calculation of user benefits typically occurs during the AA process. As such, the calculation of user benefits was beyond the scope of this study and no data exists. However, if capital cost per rider is a very rough surrogate for cost effectiveness, then Gateway 1 BRT has a capital cost per rider of $46.56 and Gateway 3 (both segments) $53.10. This compares, as seen in Table 8-11, to the similar statistic of these FY 2009 Small Start projects recommended to go into "project development":

Table 8-11: FY2009 Recommended Small Start and Very Small Starts Projects (Project Development)



Project	City	State	Capital Cost/ Rider
Troost BRT	Kansas City	MO	$ 11.55
South Corridor BRT	Grand Rapids	MI	$ 17.24
Mason Corridor BRT	Fort Collins	CO	$ 64.38
Mountain Links BRT	Flagstaff	AZ	$ 8.49
Average			**$ 21.21**

As can be seen, the Chapel Hill/Carrboro projects are well above the average though in line with the Fort Collins project. It should be noted that much of the capital cost for Chapel Hill/Carrboro's projects relate to the parking garages at the gateways. If those could be disconnected from either project (for Small Starts funding) the capital cost per rider could be cut in half and be in line with the group average. Disconnection of the garages would also drop the needed federal contribution below $75 million for Small Starts projects. Cost effectiveness might potentially be ranked "medium."

For Very Small Starts project (by revising the project horizon year to 2025 and meeting the ridership threshold) would automatically receive a "medium" score.

- *Land Use*—given the Towns' attention to create transit supportive development (partly the work of this study) this area may be ranked high; at least, perhaps, "medium-high."

- *Other*-given that no firm guidance exists for this criterion scoring for this criterion is wide open. With the objective of the gateway services to divert UNC and Carolina North commuters to park on the Towns' periphery, perhaps a good case can be made for mitigating congestion on local roads and thereby supporting economic development. Rating could be "medium-high."

Under VSS the land use and "other" are essentially combined. They would automatically receive a "medium."

Based on the above highly qualitative analysis, the project justification would be "medium" or "medium-high."

Local Financial Commitment

Generally the community is assumed to be in good financial condition so at least a "medium" rating would therefore be anticipated.

Overall Project Rating

It is conceivable that the BRT projects could possibly be rated a “medium”, thus it is not beyond the realm of possibility that either Gateway 1 or Gateway 3B/C as conceived above could be eligible for Small Starts or Very Small Starts funding. As stipulated earlier, an AA study will need to be done to determine user benefits to provide the other data necessary to evaluate the viability of either project. In addition, much of the ridership projected for the BRT services depends upon diverting commuters to the Gateway park-and-ride facilities. Very restrictive campus parking policies will be needed to accomplish this diversion. Further, the parking facilities might need to be disconnected from the portion of the transit project seeking Small Starts funding. Given the limitations of the current regional travel demand model in predicting the transit effect of restricted parking, an analysis of the impact of such policies needs to be done to determine if they would generate sufficient transit ridership as assumed for the gateway services. Finally, as stated before, a VSS eligible project would need to meet the 3,000 existing ridership in the corridors threshold.

8.4 Enhanced Local Bus Operating and Capital Costs

The local bus operating plan presented in Section will require and expansion in operating levels, vehicles and facilities. These costs are show in the table below.

Table 8-12: Local Bus Operating and Capital Costs (2008 Dollars)

Item	Amount (2008 Dollars)	
Operating Cost		
Fixed Route	$ 39,198,500	
ADA Paratransit	4,269,600	
Total	$ 43,468,100	
Capital Cost		
Expansion Vehicles		
Fixed	$ 26,430,300	
ADA	3,024,000	
		$ 29,454,300
Operations Facility Expansion		$ 16,588,000
Passenger Amenities		$ 3,000,000
Total		$ 49,042,300

The assumptions for the table include:

- About 451,000 annual revenue hours of service at $87 per revenue hour.
- ADA paratransit about 11 percent of fixed route revenue hours of service.
- Expansion vehicles are 52 vehicles above the 86 fixed route vehicles in 2006 and assume a mixed of standard forty-foot vehicles and articulated vehicles (85 percent, 15 percent respectively). The ADA fleet adds 10 vehicles above the 13 in service in 2006.

- The facility expansion assumes a cost of $290,000 per expansion fixed route vehicle to augment the current facility storage and maintenance space. Ten percent above this cost is assumed for miscellaneous needs associated with a facility expansion including equipment and supervisory vehicles.
- Passenger amenities have no assumptions but are intended to include waiting shelters and benches for the system in general.

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Section 9: Implementation Plan

This section recommends actions to be taken to make this 2035 Long Range Transit Plan (LRTP) a reality. While this LRTP offers a wide range of services not all can be implemented at once. This section sets priorities and defines a course of action to move these priorities forward.

9.1 Initial Services

Sections 6 and 7 of this LRTP developed the two top gateway corridors to a higher level of specificity. These were Gateway 1—Martin Luther King, Jr. Boulevard (MLK) and Gateway 3 (US 15/501). It is recommended proceeding with Gateway 1—MLK as the first gateway service to be implemented. The rationale for selecting MLK over Gateway 3 (US 15/501) is:

- The US 15/501 corridor is presently the subject of regional planning. The Special Transit Advisory Commission (STAC)[30] among others is investigating the viability of this corridor for fixed guideway transit. As such it will be more complicated to review than MLK because of the multiple players involved. MLK would have much more limited number of participants. Namely, UNC, the Towns of Chapel Hill and Carrboro as well as NCDOT. The US 15/501 corridor would have these same players as well as the City of Durham and Triangle Transit.
- Plans for Carolina North are moving forward. Coordinating these with a new BRT service would be timely. Carolina North BRT stations, roadway improvements, as well as defining on-campus parking levels in favor of a gateway parking facility can be made on a new canvas instead of remaking a corridor already well developed as is the US 15/501 corridor.
- The route offers the best ridership potential and has a higher likelihood in qualifying for Small Starts or Very Small Starts funding under the New Starts program.

As Gateway 3 is studied, either as a standalone project or as part of a regional discussion, it should look beyond the Chapel Hill/Carrboro community boundaries. In deference to regional planning, no terminal point in Durham is suggested here. However it could be downtown Durham and Duke University. Extension of the serving into Durham is recommended to be considered because any advanced study and service would likely be more feasible in a partnership with Durham. In this way, the cost of a gateway park-and-ride facility could be reduced by intercepting Durham riders in Durham rather than at Chapel Hill's boundary. Further, ridership potential and funding opportunities might possibly be enhanced.

As planning progresses on these initial services, the community can begin to access the build out of the remaining services defined in this LRTP.

9.2 Action Steps

The following actions are needed to move the MLK service forward:

The Chapel Hill/Carrboro LRTP should be presented to the public for input and review process. It should be noted that elements of this LRTP, at the time of this writing, are being incorporated into the Carolina North transportation impact assessment.

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[30] Formerly known as the Joint MPO Special Transit Advisory Commission, STAC is a creation of the two Metropolitan Planning Organizations (MPOs) serving in the Raleigh-Durham region. The MPOs are the Durham Chapel Hill Carrboro MPO and the Capital Area MPO.

The respective governing bodies of the Towns of Chapel Hill, Carrboro, and UNC should review and adopt this LRTP.

Short Range Transit planning anticipating this LRTP should move forward. CHT should engage in short range planning that anticipates this plan.

Prepare Alternatives Analysis (AA) justification and have it reviewed by the FTA
This LRTP would be the basis of that justification. The AA is discussed in Section 8. As discussed in Section 8 both Small Starts and Very Small Starts processes could be followed depending on whether Chapel Hill/Carrboro desire to plan and implement the 2035 BRT service or a nearer term service (such as 2025). The longer term service would likely follow Small Starts and a nearer term service Very Small Starts.

Conduct Parking Policy Study
A key component of this LRTP is the implementation of parking policies at UNC main campus and at Carolina North that compel travelers to park at the gateways. About seventy percent of the ridership forecasted for the Gateway services is a result of restrictive parking policies. The implication of such polices as well as a better estimation of their potential in generating ridership is not fully understood. As seen in Section 5, only a simple off model approach was used in this LRTP. Much more work is needed to craft a policy that is better defined and its ramifications better understood. The goal of a parking study is to determine what policies are needed to be implemented by either or both the Towns and University to make the gateway concept work. At that point, the collective community can decide if it is willing to undertake those policies.

The parking study would have these core tasks:

- Survey of existing parkers targeted to be moved to periphery
- Creation of a model algorithm that integrates as part of the TRM.
- Outreach to affected stakeholders

The cost of this study is roughly estimated to be $250,000 to $350,000.

Begin process to acquire funds
While the above parking study is being executed, the community should begin the process to acquire funding for the AA. The sources of funding could be regional transit planning dollars or the region could vie for dedicated AA funding.

Conduct AA and submit to FTA
It is recommended that the results of the parking policy study be understood before the AA is conducted. The community should be sure that restrictive policies will actually be feasible---feasible in terms of affecting the needed ridership levels and feasible in that the stakeholders would be willing to implemented the needed restrictions.

If the parking study is favorable, one of the steps could proceed:

1. *Small Start* process would take about 18 months to complete an AA and cost between $1 million to $1.5 million depending on modeling efforts needed.
2. *Very Small Start* process would take about 12 months to complete an AA and estimated to cost from $500,000 to $750,000.
3. If both corridors look promising consider a second AA if first corridor is approved for project development.

Advancing the Project

As discussed in Section 8, the following steps would proceed presuming FTA approves of the AA project. Each step below will require FTA approval before execution:

- Execute Project Development
- Project Construction Grant Agreement
- Begin service

Timeline

Attached are two tentative schedules in which the above events can take place. The first schedule (Figure 9-1) assumes following a Small Starts process and the second (Figure 9-2) a Very Small Starts process. As seen in Figure 9-1, the Small Starts process could take up to seven and a half years before service is operating. This timeline is compressed a bit under Very Small Starts. Figure 9-2 shows a six year period of implementation. It is possible these timelines can be further compressed if the communities wished to forego funding under New Starts (using Section 5307 funding or other sources instead). The AA could be reduced in time and engineering (as under project development) could be made faster as well.

Figure 9-1: Small Starts Implementation Time Line

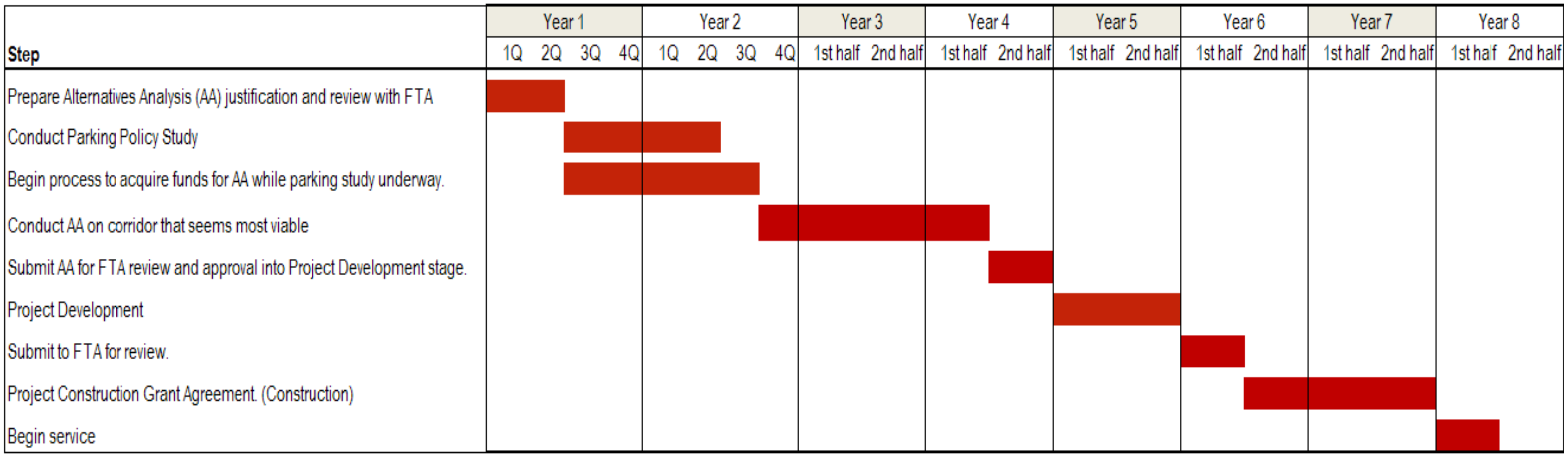
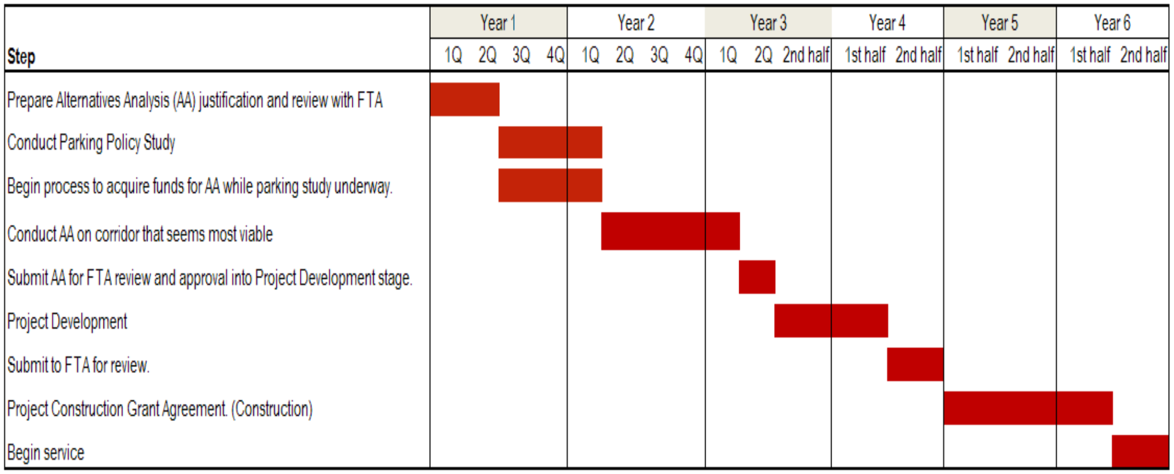


Figure 9-2: Very Small Starts Implementation Time Line



Appendix A: Technical Review of Triangle Regional Model

This appendix reviews the structure of the TRM. The TRM employs a traditional four-step travel demand model framework. The model contains separate, sequential modules for trip generation, trip distribution, mode split, and trip assignment.

Trip Generation

The TRM trip generation step includes several submodels: 1) to estimate household trip productions by trip purpose; 2) to estimate and remove nonmotorized trips; 3) to estimate trips to school by university students; and 4) to estimate trip attractions by TAZ. Each of these submodels is described below.

Household Trip Production

The TRM household trip production submodel computes the number of daily person trips produced by each household in the study area, categorized by five trip purposes:

Home-based work;

Home-based shopping;

Home-based grade school (K-12);

Home-based other; and

Nonhome-based.

Unlike more traditional trip production models, which compute average (aggregate) trip rates by TAZ using a two- or three-way cross classification procedure, the TRM model computes (disaggregate) trip rate probabilities for each household in the study area, using a logit model formulation.

Thirteen separate logit models were developed for five trip purposes and three person types: adult worker; adult nonworker; and child (no work trip models were developed for adult nonworkers or children). The variables used in the models include:

Household size (1, 2, 3, 4, 5, 6+);

Household income (four income ranges);

Number of workers (0, 1, 2, 3+);

Number of children (0, 1, 2, 3+);

Number of autos (0, 1, 2, 3+);

Area type (dummy variable indicating urban, suburban, or rural land use density); and

Accessibility (a composite measure of the total employment (or population) in each attraction TAZ divided by the square of the distance from the home TAZ to the attraction TAZ, summed over all TAZs).

The models were recalibrated using trip data from the 1994 Home Interview Survey conducted for the Triangle Region that was expanded to 2002. Based on the model calibration results, the most influential variables were household income, presence of one or more children, and number of autos available. The accessibility variable was not significant in any of the trip production models, and the urban density proxy was minimally influential only for the home-based shopping and home-based other trip purposes.

The models were applied to each household in a TAZ, based on the household's sociodemographic characteristics, and the results were aggregated across all households in the TAZ to produce zonal trip rates by purpose. The distributions of households by sociodemographic characteristics within each TAZ were calculated using a series of distribution curves, based on the 2000 Census Public Use Microdata Sample (PUMS). The curves show, for an average zonal value of a demographic variable (e.g., workers per HH), what proportion of households in that TAZ are likely to have 0, 1, 2, or 3+ workers.

The use of disaggregate logit models for household trip production provide a more robust segmentation of trips by household demographic characteristics, including auto availability, compared to more traditional zonal-based averages.

Nonmotorized Trip Model

The trip production models estimate total person trips by purpose for all travel modes, including auto, transit, and nonmotorized (walk and bike). A follow-on model is then applied to separate motorized and nonmotorized trips. This model also uses a logit formulation and four variables: auto availability; HH income; area type; and accessibility (as described above). The nonmotorized models are applied to each household and trip purpose to estimate the probability that a household trip would be nonmotorized. These probabilities, summarized to the TAZ level, estimate the share of trip productions that are nonmotorized by purpose and by five income/auto availability stratifications. The five market stratifications are:

Households with no automobile (all income levels);

Low-income households (HH income under $20,000);

Medium-income households (HH income under $100,000) with fewer autos than workers;

Medium-income households (HH income under $100,000) with more autos than workers; and

High-income households (HH income at least $100,000).

These nonmotorized shares are then subtracted from total trip productions, leaving only motorized (auto and transit) trips for subsequent modeling stages.

The variables in the nonmotorized trip model enable forecasts to account for the influence of development density and regional accessibility on the share of nonmotorized travel by TAZ. Improvements to the nonmotorized model are being developed under a separate contract with the Durham-Chapel Hill-Carrboro (DCHC) Metropolitan Planning Organization (MPO), including consideration of inclusion of network attribute variables.

Trip Attraction Model

The TRM trip attraction model is a more conventional, aggregate model that estimates the number of trips attracted to each TAZ, by trip purpose. Separate trip attraction models were calibrated for each trip purpose using linear regression and the following zonal summary variables, aggregated into 30 districts: total employment; nonretail employment, retail employment, total households, and total population. University beds and student households were added to total population and total households, respectively.

Aggregate trip attractions are stratified by purpose and by the five income/auto availability markets, corresponding to those used for trip productions, using a set of attraction share models. The attraction share models include a constant term and separate accessibility measures for highway, transit with walk access, and transit with drive access. The attraction share models are relatively sensitive to the accessibility measures and to the income/auto availability markets. Consequently, trip attractions by TAZ can vary widely depending on the transportation system scenario and the distribution of households by market segment within each TAZ.

University Student Trips

A separate trip production model is used to estimate university student trips based on implied trip rates derived from a 1995 North Carolina State University (NCSU) home interview survey. This methodology is documented in a June 29, 2006, memo from Elizabeth Harper to Joe Huegy.[31]

University student trips are not distributed along with household-based trips in the trip distribution stage. Instead, trip productions are assigned to TAZs based on student residences, and trip attractions are based on the share of university employees working in a TAZ relative to the total number of university employees in all TAZs for a university. The resulting production/attraction trip table is then added to other trip tables coming out of trip distribution for use in mode split.

Given the unique characteristics and travel behavior of university students, development of a separate trip table for university student trips seems reasonable. However, the original trip table developed for the TRM included both motorized and nonmotorized trips, which resulted in University trip rates that were about three times greater than they should have been, going into the (motorized) mode split model. These higher trip rates could inflate both the overall volume of (auto and transit) trips and the transit mode share in those corridors that have a high population of University students and employees.

Trip Distribution

The TRM uses a destination choice model, rather than the more traditional gravity model formulation. The destination choice model enables use of a greater number of variables beyond simple impedance, but also requires a calibration process that implicitly considers each TAZ as a potential destination choice.

Separate trip tables are developed for each of the five trip purposes and income/auto availability markets, requiring the development and calibration of 25 separate destination choice equations. The impedance measure used in the equations is a composite of auto and transit travel times between the production TAZ and a potential attraction TAZ. The relative weight given to transit travel times varies by trip purpose and income/auto availability market (e.g., the transit weight on composite impedance for HBW trips by 0-car HH is 0.6, but is 0.0 for HBW trips by high income HH).

Trips are further stratified by peak versus off-peak period, based on the percentages of each trip purpose that occur in the peak versus off-peak periods (e.g., 79.5 percent of HBW trips occur in the peak period, compared to only 44.3 percent of shopping trips). Although not explicitly stated in the documentation, it appears that these time-of-day splits could be used to adjust the impedance measure for the destination choice equations (e.g., the impedance measure for peak period trips uses peak period transit and highway times, while off-peak trips use an impedance measure based on off-peak transit and uncongested highway times.) This allows considerable flexibility in modeling the effects of alternative peak and off-peak transit configurations on destination choice behavior.

The TRM also uses four special trip attraction models to account for higher trip attraction rates in certain TAZs than would be predicted based on normal employment factors. The special generator types include:

- University employment;
- Shopping center employment;
- Airport employment; and
- Hospitals.

Factors were developed for each special generator and trip purpose category and represent the increase in trips to a TAZ containing a special generator (e.g., shopping trips to a TAZ containing a shopping center have a factor of 1.34,

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[31] "TTA University Student Trip Tables," memo from Elizabeth Harper to Joe Huegy, June 29, 2006.

meaning that 34 percent more shopping trips are attracted to that TAZ over other TAZs with comparable employment levels).

Mode Choice

The TRM mode choice submodel consists of 12 nested logit models, one for each of six trip purposes (the five purposes emerging from the destination choice model plus home-based university trips, described in the trip production section), and two time periods: peak and off-peak. The peak period models use peak highway and transit travel times, while the off-peak model uses midday travel times.

The mode choice models include three levels of nests to define travel modes. The primary level splits total person trips into highway (auto) versus transit trips (all nonmotorized trips were removed in the trip generation model).

The second level splits highway trips into three submodes: drive alone; shared ride; and auto intercept, where auto intercept is defined as an auto trip to a parking lot close to the final destination, but which requires transit to "shuttle" the trip maker to their final destination. Transit trips also are split into three submodes: local bus; express bus; and urban rail. The urban rail mode is included for future forecasting purposes.

The third level splits highway shared ride trips into 2 versus 3+ persons per vehicle. Transit modes are split based on three modes of access: walk; park-and-ride; and kiss-and-ride. The network coding for transit includes up to three sets of paths for each transit mode, reflecting these alternative access modes. As part of the network coding, 34 parking lots have been explicitly coded into the highway and transit networks.

The mode choice models include the following level-of-service variables:

- In-vehicle travel time;
- Initial wait time;
- Transfer wait time;
- Walk time;
- Drive time;
- Automobile operating cost; and
- Parking cost.

In addition to these level-of-service variables, the mode choice models include mode-specific constants that vary by income/auto availability market group, trip purpose, and time-of-day (peak versus off-peak).

The overall nested logit model structure and included level of service variables provide considerable flexibility to reflect different transit options and service levels. In addition, the TRM mode choice model includes two rather unusual features, which further enhance its ability to address alternative transit scenarios.

The first feature is the inclusion of an auto-intercept mode under the highway alternative. This allows the model to specifically address close-in park-and-ride shuttle bus services offered by the Universities to students and faculty. There are 34 parking lots specifically coded into the model. These designated parking lots are treated as intermediate destinations for the auto intercept mode. The mode choice model requires the designation of these lots and the designation of the limited set of destination zones that are served by the shuttle service.

The second feature is the inclusion of a "free fare" transit service variable, which is consistent with empirical evidence that provision of free transit service attracts a higher level of ridership than would be estimated based simply on a transit fare level of zero.

Trip Assignment

The TRM highway assignment model uses a multiclass user equilibrium procedure to assign the highway trips coming out of the mode choice model. Household and university student trip tables are aggregated across trip purposes, merged with trip tables for commercial vehicles, internal-external and through trips, and stratified by time-of-day into three travel periods: a.m. peak; p.m. peak; and off-peak. The user equilibrium model uses a conical volume-delay function for dealing with highway capacity restraints.

The transit assignment uses a standard TransCAD transit path-finding algorithm and stratifies transit trips into two travel periods: peak and off-peak.

Feedback

The documentation for the TRM does not provide much detail on feedback between the model components, but the structure of level-of-service variables used in mode choice and trip distribution clearly supports an iterative feedback procedure in which the highway and transit congested travel times resulting from the assignment model can be used to adjust level-of-service and system impedance variables used upstream in the mode and destination choice models.

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Appendix B: Intelligence Transportation Systems (ITS) for Gateway Services

Intelligent Transportation Systems (ITS) encompasses a wide range of applications including Automatic Vehicle Location, Global Positioning System (GPS), mobile data terminals (MDT) in vehicles, signal priority, real-time information, advanced fare collection system, etc. The BRT corridors in Chapel Hill/Carrboro could include many of these elements. The specific design should be addressed in later phases of the project.

The following transit-ITS technologies will help improve the BRT's efficiency, reliability, convenience, and safety.

Transit Signal Priority

A transit signal priority (TSP) system is technology that can extend the green phase of a traffic signal or can turn the signal green earlier than scheduled so that a bus may pass through an intersection more quickly. By giving signal priority to transit buses, transit travel times and delay times are shortened, translating into more convenience to the passengers and cost savings for the agency. It has also been shown that transit signal priority can allow the agency to reduce the number of trips on a route without affecting its level of service.

Furthermore, signal priority can reduce or eliminate "bunching," a situation in which one or more buses closely follow another on the same route as a result of the first bus running late (especially when headways are short).

There are several TSP technologies available and several methods of initiating a signal priority request. A basic TSP system consists of an emitter on a bus, and a receiver at a particular signalized intersection (in many cases, signal control will need to be upgraded to accommodate priority phasing).

CAD/AVL/GPS

An AVL system determines the location of each vehicle that is equipped with appropriate hardware and software. The most popular technology currently used to determine location in an AVL system is the global positioning system (GPS). GPS is a constellation of satellites orbiting the earth. If a GPS receiver has line of sight to at least four satellites to receive their position information, it can determine its location on earth. This location can then be communicated from the receiver (located on a transit vehicle) to central dispatch.

Central dispatch can view equipped BRT vehicle locations on a map, in addition to displaying specific information about each vehicle (e.g., vehicle number 7926 is being driven by Edward Smith and is currently operating Block 411). An AVL system serves as the backbone to many transit ITS applications. For example, deploying an AVL system will facilitate deploying automatic annunciation, vehicle component monitoring, automatic passenger counting (APC), and signal priority systems.

Two additional features of AVL systems that would be applicable to the BRT service are a silent alarm/covert microphone, which the operator can activate in case of emergency, and engine/component monitoring, which can sense (and automatically report to maintenance) when specific components or engine conditions are outside the normal range (e.g., engine temperature goes beyond the acceptable limit for that particular engine type).

AVL systems are usually integrated with a computer-aided dispatch (CAD) system. A CAD system can manage a voice and data communication system by (1) automatically selecting appropriate channels for specific types of communications; (2) allowing operations/dispatch to select a specific vehicle, group of vehicles or all vehicles to receive messages; and (3) facilitating emergency response in the case of an incident.

Mobile Data Terminals (MDTs) – also sometimes referred to as Mobile Data Computers (MDCs) – which can be located in each vehicle near the operator, are an integral part of this aspect of a CAD system since they facilitate data transfer between the vehicle and operations/dispatch. MDTs usually have a small screen that displays text messages, along with a keypad that contains either pre-coded keys (e.g., pick-up/drop-off, request to talk, maintenance, and incident) or keys that can be flexibly programmed. The use of MDTs for data communication tends to reduce the volume of voice communication since much of the information transmitted between operators and dispatch can be coded.

Mobile Data Terminal

Real Time Passenger information

Automated Annunciation/Signage System

An automated annunciation/signage system provides useful in-vehicle information to riders concerning their trips and facilitates compliance with the Americans with Disabilities Act (ADA). A key feature of these systems is the use of AVL system data to provide location information to the on-board software, which determines the appropriate announcement/display. Most transit agencies that are implementing these systems are supplying some combination of audio and visual information about next stop, major intersection/point of interest, and transfer points to achieve both objectives. Other in-vehicle information that could be displayed/announced using an annunciation/signage system includes:

Automated Annunciation/Signage System

- Promotional announcements for Chapel Hill Transit or area establishments;
- Static transfer/connection information;
- Real-time transfer status information; and
- News, weather, sports scores, etc.

A recent additional capability of some annunciation/signage systems is the integration of bus destination signs with AVL systems to ensure that the destination information displayed on an external destination sign is legible and audible. By automating the changes, this integration takes away from the vehicle operator the responsibility to manually change the destination sign.

En-Route Traveler Information System

Just as travelers benefit from information before embarking on their trip, information provided en route is no less critical. When transit vehicles run off schedule, travelers may wonder if/when the next bus will arrive and experience anxiety. Providing real-time arrival time at stations and/or stops has been shown to alleviate traveler anxiety. Chapel Hill Transit already provides this type of information on local routes using the NextBus system. It is expected for the BRT stations to be equipped with this same type of technology.

En-Route Traveler Information System

Providing en-route transit information plays a significant role in keeping travelers informed about the status of their vehicle and directing them to the right stops, platforms, and bays. Real-time, or dynamic, information describing current transit operations includes updates on delays, incidents, and service diversions along transit routes, as well as estimated vehicle arrival and departure times for stops along the routes.

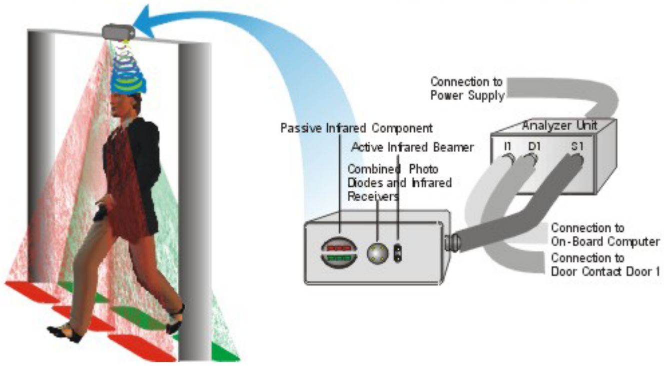
The proposed BRT system can benefit greatly from the deployment of a real-time bus information system. With the proposed headways of 10 and 20 minutes during peak periods and midday, respectively, a real-time bus arrival information system will help reduce passengers' anxiety. With a number of feeders being proposed to connect with the BRT system at various stops, a real-time bus arrival information system may also provide information about feeder vehicles.

Automatic Passenger Counter (APC)

Automatic passenger counters (APCs) automatically count passengers as they board and alight transit vehicles. With the introduction of GPS-based AVL systems, the integration of APC systems with AVL will provide CHT with bus-stop level ridership data. This differs from using farebox counts, which only provide a count of the number of people entering at a particular location and total passenger counts over some time interval.

An APC system creates an electronic record at each bus stop, typically including the following information: stop location; stop date/time; time of doors opening/closing; number of passenger boardings; and number of passengers alighting. Usually, these records are grouped by trip. APC data can be collected on-board the vehicle and downloaded via floppy disk, PCMCIA card, or infrared transmission in the garage. It can alternatively be transmitted in real-time over the data communication system.

Automatic Passenger Counter (APC)



Two basic technologies are used for passenger counting. Treadle mats count passengers by sensing foot pressure as passengers traverse the bus steps while boarding or alighting. Another approach is to use infrared sensors to count people passing a certain point in the doorway. Two types of sensors are commonly used: horizontal and vertical beam tracking. The horizontal beam method requires at least two beams, located at waist-height, projected across the boarding and alighting area at each door. An infra-red beam system counts a boarding or alighting depending on the order of beam interruption. The vertical beam system is mounted above the door and is capable of tracking thermal mass movement.

Although treadle mat APC systems have been used for many years, they have some inherent problems in adverse weather. Sensors imbedded in the treadle mats tend to malfunction due to rain and/or snow. Horizontal infrared beam tracking, while more reliable than treadle-mat technology, has its own problems. Horizontal beam systems require the use of at least two beams at each door, and each beam need to be aligned accurately with their respective receivers. If any of the beams is not aligned properly, the system will fail to count passengers. Moreover, horizontal beam systems are prone to having the sensors inadvertently blocked by objects (e.g., jacket, umbrella). The vertical beam system offers the best solution to counting passengers while at the same time avoiding the issues of the other two technologies. However, the vertical beam system may be a little more expensive.

One important feature of APCs is the ability to accurately “stamp” the data with the exact bus stop location and time of day. We recommend that the APC system be interfaced with the AVL system – a common approach. Interfacing APC with AVL also helps eliminate the need to rely on operator input for when the route starts/ends. This will increase the accuracy and reliability of the APC data.

APC systems are often implemented to reduce the cost of manual data collection and National Transit Database reporting requirements. The data can also be used for route scheduling (e.g., by identifying the maximum load point, loading profiles, optimizing locations for short-turn patterns). An APC system will help assist CHT in recognizing if there is a need to add additional vehicles, or vehicles with larger capacity, to handle the overloading.

Transit operators typically deploy APC equipment on about 15 to 20 percent of their vehicles and then rotate the vehicles on different routes as needed. However, as APC equipment has become less expensive, agencies are beginning to consider comprehensive APC deployment. This avoids the need to ensure the assignment of APC-equipped vehicles to specific routes that need to be surveyed.

Appendix C: Transit Supportive Development Design Guidelines

I. Introduction/Purpose

As stated in Section 3.5.4 of the Chapel Hill Land Use Management Ordinance:

> *The transit oriented development district encourages a mixture of residential, commercial, and employment opportunities within identified light rail station or other high capacity transit areas. The district allows for a more intense and efficient use of land at increased densities for the mutual reinforcement of public investments and private development. Uses and development are regulated to create a more intense built-up environment, oriented to pedestrians and bicycles, to provide a density and intensity that is transit supportive. The development standards of the zone also are designed to encourage a safe and pleasant pedestrian and bicycle environment near transit stations by encouraging an intensive area of shops and activities, by encouraging amenities such as benches, kiosks, and outdoor cafes, and by limiting conflicts between vehicles and pedestrians and bicycles. It is the intent of this section that a TOD district be restricted to areas within one half mile of a transit station, which area is equivalent to a typical 10-minute walking distance.*

The purpose of these Transit Supportive Design (TSD) Guidelines is to ensure that new development around transit nodes supports transit use, encourages ridership, reduces auto dependency and leverages the transit investment. Another goal of TSD is to provide a mix of residential and commercial uses and activities to create a “sense of place,” with active street life, safety, convenience and amenity.

For the purposes of these design guidelines, the following definitions apply:

- Transit Node: Location on a transit corridor where a transit vehicle stops, and riders get on and off.
- Transit Station: Transit node with sufficient activity to warrant a building to serve passengers going to and from transit nodes: program elements within the building could include passenger waiting area, information/ticketing desk, restrooms, and transit-supportive retail such as coffee, news, flower and drycleaning stands.
- Transit Corridor: A series of transit nodes and stations linked by transit service.

These guidelines support the town’s existing Design Guidelines and are supplemental to those Guidelines. In cases where these TSD guidelines are in conflict with the Town’s existing Design Guidelines, these TSD guidelines should take precedence.

Excerpts from the Town’s existing Design Guidelines are shown in italics.

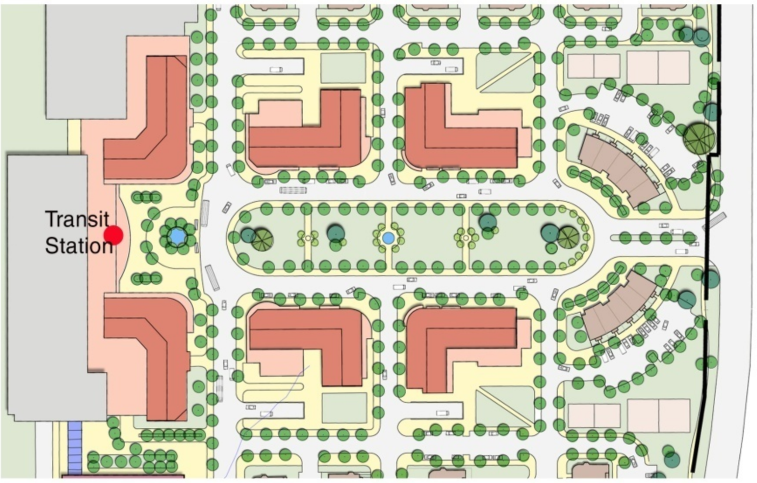
II. General Principles

A. A Small Area Plan should be developed for each transit node to ensure that the design and land use mix around each node supports transit use and incorporates these guidelines.

B. TSD site plans should include small blocks and multiple pedestrian routes with clear sight lines to transit stations.

C. The design of stations, landscaping and the surrounding pedestrian environment should incorporate high quality materials, including plant, paving and building materials, as well as street furniture such as benches, lights and trash receptacles. The designs should address maintenance issues to ensure that station areas remain attractive and well-kept over the long-term. Stations should incorporate real-time information displays and bicycle racks.

D. Primary routes (i.e., not smaller residential streets) – both streets and pedestrian/bikeways - to transit nodes should have active uses to provide "eyes on the street" and an engaging pedestrian environment.



E. Transit nodes should have high visibility on and from major roadways and from within the TSD developments.

F. Topography, hills, streams and other defining site characteristics should be incorporated into TSD site design. But, sightlines to transit stations along principal streets connecting new development to transit stations should be maintained.

G. The defining qualities of Chapel Hill's vernacular architecture (including elements such as stone walls, pitched roofs, variegated roof lines) should be reflected in the design of TSD developments.

H. Development at transit nodes should include a mix of residential and commercial uses (in close proximity or in the same building) at moderate to high densities (see Density Guidelines below).

I. Parking areas should be located behind buildings and screened with landscaping.

III. Guidelines Relevant to All TSD Sites

A. Building Design

- Articulate building forms to reflect the existing scale of residential and smaller commercial buildings. Provide variegated roof lines to add architectural interest.

- Buildings should be designed to create an interesting, active and safe pedestrian environment. Active ground-floor uses are encouraged. Where possible, buildings should be designed to accommodate various uses over time. If market conditions do not support ground floor retail, buildings should be designed to be easily retrofitted to accommodate retail at a later date.

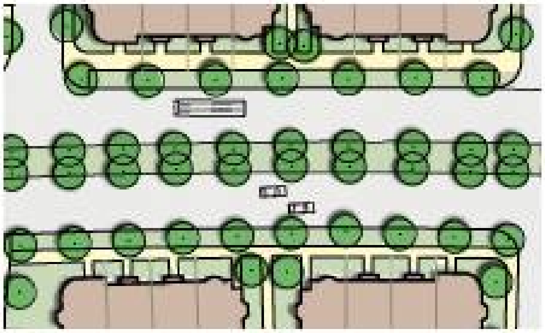
- A minimum of 60% of the ground floor facades of non-residential uses should be glazed and transparent to allow views into commercial establishments and to provide “eyes on the street.”

- Each commercial use or tenant should have an individual entrance from the street to create more on-street pedestrian activity.

- At small commercial sites with two or more businesses, inclusion of a public plaza facing the street, with outdoor seating is encouraged where appropriate. These are especially desirable at intersections where there are major transit stations.

B. Site Design

- Development should be designed to enhance or create a physical character that is pedestrian friendly, convenient for transit patrons accessing stations on foot, safe and pleasant. This should be accomplished through siting buildings at the sidewalk edge, or with setbacks parallel to the street (transit corridor) and using landscape elements that reinforce the street edge.



- Particular attention should be paid to creating opportunities to walk from transit to nearby retail stores and housing developments. Streets in station areas should be as narrow as possible to facilitate pedestrian crossings without impeding traffic circulation. Slowing traffic will also allow drivers to take note of new development and hopefully entice them to stop and shop. Within station areas, streets should be designed for people, vehicles and businesses. Sites should be developed with small rectilinear blocks and multiple pedestrian routes with clear site lines to transit stations.

- Sidewalks should be separated from moving traffic by planting strips, tree lawns and/or on-street parking. Street trees will frame the sidewalk space and improve the visual character of the station area for pedestrians, transit users and drivers. On-street parking also provide convenient access to retail. On TSD streets perpendicular to gateway corridors, consideration should be given to creating wider pedestrian/bikeway sidewalks (12') lined on both sides with shade streets. These sidewalks are the "feeders" for both pedestrians and cyclists who live or work on the perpendicular corridors and are commuting via a gateway transit service.

- Loading and service areas should be sited behind buildings with landscaping and/or decorative fencing to screen views from adjacent streets and pedestrian ways.

- Existing topography, streams and other defining site characteristics should be incorporated into the TSD site design.

- *Most of Chapel Hill's major streams are designated as greenways. It is intended that one function of these greenways is to link various centers of activities – schools, parks, commercial areas and employment areas (Comprehensive Plan Design Guidelines, p.5).* Where possible, pedestrian connections should be provided between transit stops/centers and greenways.

- *Local Streets should recreate "village-like" qualities through use of design elements including: winding, tree-lined lanes (Comprehensive Plan Design Guidelines, p.10).* In TSD developments, it is preferable for the streets to be developed in a grid or modified grid pattern, to provide multiple routes to transit.

- *Transitions and entries: A 20- to 40-foot transitional zone consisting of special landscaping and paving materials should be provided along building edges to separate pedestrian and vehicular traffic as well as introduce the visitor or user to the main entrance (Comprehensive Plan Design Guidelines, p.25).* On principal TSD corridors, buildings should be set closer to the street to support active streets and "eyes on the street." There should be a maximum of 20 feet from the building face to back of sidewalk (see Section G).

C. Parking

- Vehicle Parking should be sited on-street, behind buildings and in parking decks to minimize surface lots. Parking ratios within TSD districts should be reduced, to encourage and acknowledge increased transit usage. Parking spaces are limited to a maximum of 1.6 spaces per unit. 1.25 spaces per unit is the goal where shared parking is achieved. Parking spaces should be sold or rented separately from residential units to allow flexibility in accommodating tenant/unit owner parking requirements. There should be a minimum of .5 spaces per unit, although it would be possible for an individual unit owner to purchase 0 spaces.

- *Height of a parking structure is limited to three decks above grade. Parking structures should be less prominent than the buildings they serve. (Comprehensive Plan Design Guidelines, p. 13).* In some cases, to achieve desired TSD densities on a site, parking structures of greater than three decks may be required. In all cases, however, the parking structure should be less visually prominent than the adjacent buildings.

- Bicycle parking should be provided in a secure, visible location at all new TSD developments and at all stations.

D. Connectivity

- New developments should provide clear, attractive pedestrian and bicycle routes from transit stops to existing neighborhoods.

- Clear, attractive connections should be provided between transit stops and existing open space, bikeway and greenway systems.

E. Safety and Security

- Where possible, ground floor retail or other active ground floor uses should be integrated with transit stops to provide "eyes on the station" for security purposes.

- Streets connecting neighborhoods to transit corridors should be lined with buildings to provide "eyes on the street."

F. Transportation Amenities

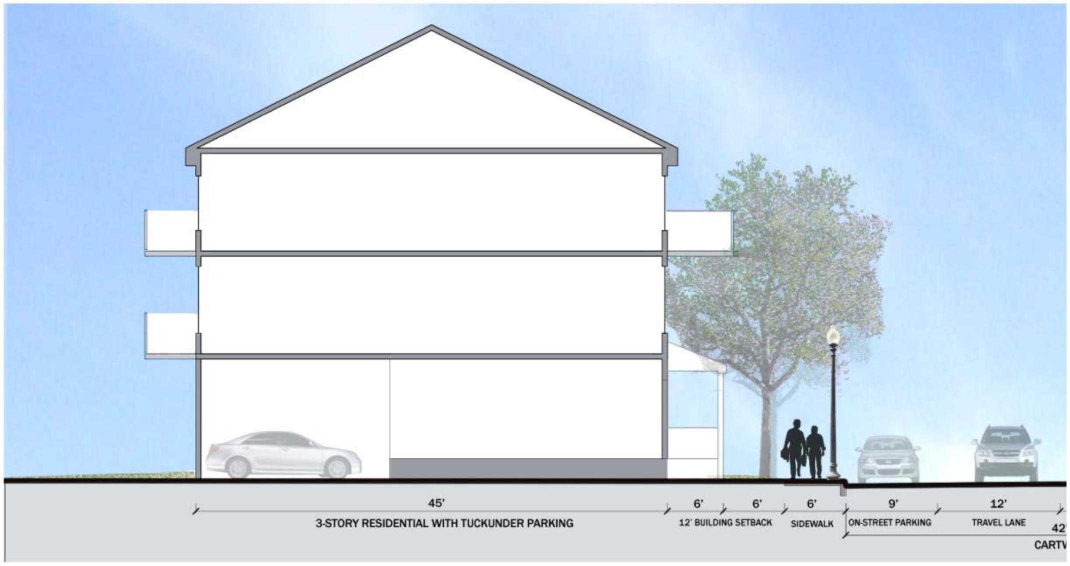
- Transit stops should be integrated into identifiable neighborhood "nodes" at key intersections on the major corridors.

- Transit shelters, signage, landscaping and pedestrian paving should be developed at a scale and architectural quality that reflects the importance of major transit stops. The use of alternative energy sources (such as solar) to provide power at transit stops is strongly encouraged.

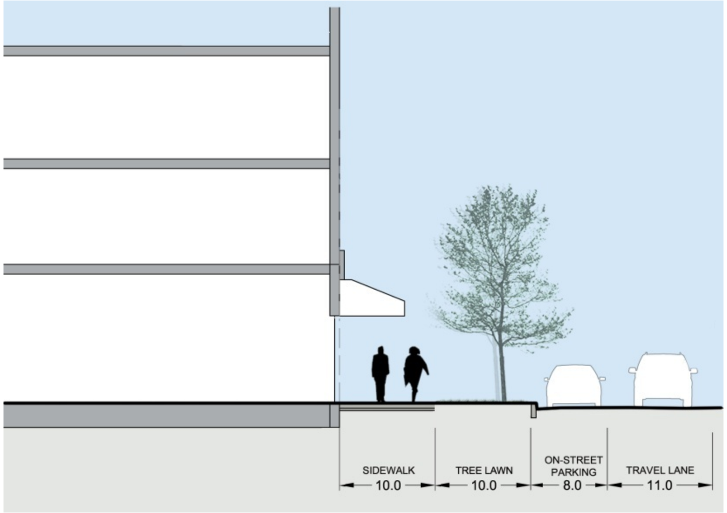
G. Pedestrian and Bicycle Mobility

- Design uniform tree lawns, sidewalks and building setbacks that reflect the scale of the street: These dimensions will vary, but should be in the following range:

    - Major Transit Corridor: Martin Luther King, Jr. Blvd.:
        - Sidewalk: 10-12'
        - Tree Lawn: 10-12'
        - Building Setback from Back of Sidewalk: 5-20'



- Secondary Streets: Eubanks, Weaver Dairy Road and Homestead:
    - Sidewalk: 8-10’
    - Tree Lawn: 10’
    - Building Setback from Back of Sidewalk: 0-10’



- Residential Streets: these streets serve as feeder pedestrian and bicycle corridors:
    - Sidewalk: 6-7’
    - Tree Lawn: 4-5’ minimum (could be greater)
    - Building Setback from Back of Sidewalk: 0-10’

H. Density Guidelines

1. Residential: Minimum of 15 units/acre; maximum of 25 units/acre
2. Office Floor Area Ratio should be in the range of .75 – 1.2
3. Retail Floor Area Ratio should be in the range of .55 – 1.2
4. Buildings should be a maximum of seven to eight stories (75 to 100’) and a minimum of three stories (35 to 40’). The heights allow for higher ground floor ceiling heights to accommodate retail and restaurant uses.

III. Guidelines Specific to Individual TSD Typologies

Potential TSD sites can be divided into the following categories, each with specific issues: It is difficult to assign specific densities (residential densities, Floor Area Ratios and parking ratio) to individual typologies, as they relate more to convenience to transit than to typologies. For example, densities should be at the high end of the density ranges above at the core of a gateway site, immediately adjacent to the transit station, while other parts of the site with less convenient transit access may be in the mid or low range. Assigning one density to a typology would ignore the differences in externalities both between individual sites within one typology and across any individual site.

A. **Gateway Properties**: Gateway properties are those lots that are located at transit “gateways” as defined by the Chapel Hill/Carrboro Long Range Transit Plan. Typically, Gateway properties will accommodate a Park and Ride facility to serve a transit center internal to the site.

1. Park and ride facilities should be fully integrated into a vibrant mixed-use development.

2. Park & Ride decks should be located such that patrons walk by/through the retail zone en route to/from the transit center.

3. New buildings should be sited parallel to the existing transit corridor, providing entrances and windows overlooking the sidewalk and transitway.

4. Garages should be developed to serve multiple purposes, including transit park and ride, residential, retail and office uses.

5. Shared parking should be employed for counter-cyclical uses (e.g., residential and office)

B. **Properties Parallel to a Transit Corridor**: Properties parallel to a transit corridor can be easily served by transit stops along the transit corridor. Typically, transit vehicles will not need to circulate through the property and all of the site will be within a short walk of a transit stop.

1. Transit vehicle cut-outs should be provided at major stops.

C. **Property Perpendicular to a Transit Corridor**: Parcels perpendicular to a transit corridor, depending on the depth of the lot, will require more careful attention to pedestrian routes to transit stops. There may be a need/desire to locate a transit stop within the interior of the site.

1. Wide, well-landscaped, tree-shaded sidewalks perpendicular to the transit corridor should be provided to connect people to transit stops and adjacent bike stations.

D. **Shopping Mall/Commercial Areas**: The shopping mall/commercial center properties tend to be large, irregularly shaped, and located on more than one major transit route. Because these parcels may be redeveloped over time, with some mix of old and new structures at any given time in the process, site plans need to be designed in such a way that TSD principles are adhered to at each phase of development.

1. Incremental mall modifications should be staged to establish and maintain safe and direct pedestrian connections to transit stops

E. **Downtown**: Design guidelines for Downtown TSD parcels closely follow the March 2000 Downtown Chapel Hill Small Area Plan Guidelines. The key design goal articulated in that report – “Buildings should be located and designed so that they provide visual interest and create enjoyable, human-scale spaces” – strongly corresponds to TSD principles.

1. Integrate good urban design principles: active ground floor uses; high degree of transparency on the ground floor; continuous street wall; wide, well-landscaped sidewalks; individual store entrances.

2. Integrate transit stops and passenger waiting areas into the frontage at select building locations (major transit stops). Transit supportive uses (convenience retail, cafes, drugstores, coffee shops, dry cleaners, etc.) should be incorporated into building frontages at major transit stops (in preference to uses such as telephone company retail outlets, hard and soft goods, realty offices, etc).