

NC 73 Superstreet & Bridges Design

NC 115 ULI TAP Study

NC 73 Superstreet Design

Northwest T-Fare Study

Northeast Parkway

Multi-Modal  
Superstreet Analysis  
*NCDOT Initiative*

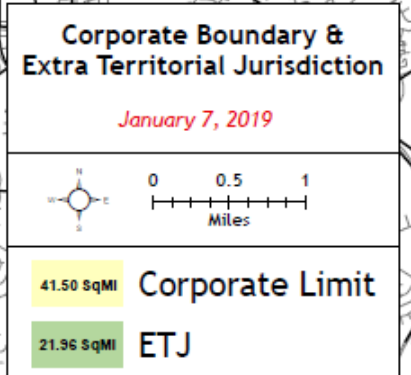
Bikeway Plan

Downtown Transportation  
System Plan

Parks Recreation Master Plan

North Corridor Study  
*Complete: 4 possible stations*

North Corridor BRT Plan  
*RFQ to be sent*



Description

Who

When



## 4.2 I-77 BRT

The I-77 Express Lanes project is under construction. Two express lanes will operate in each direction between Brookshire Freeway (Exit 11) and Catawba Avenue (Exit 28), and one express lane will be added in each direction between Catawba Avenue and NC 150 (Exit 36). The express lanes will maintain travel speeds of at least 45 mph during peak travel times, using pricing to regulate traffic volumes. CATS transit vehicles are allowed unrestricted access to the express lanes.

With the addition of express lanes on I-77, CATS plans to operate bus service to its existing park-and-ride locations using the new lanes. Further enhancements to these initial strategies to utilize the express lanes to improve reliability and passenger experience define this alternative, including the following elements:

- All day service including nights and weekends
- Four new park and rides and two new express lane direct connects
- Integrated BRT stations into mixed use developments that also incorporate emerging mobility technologies for first/last mile connections.

This alternative was not considered in previous studies for the North Corridor, because utilizing express lanes was not an option available to CATS. Details about the I-77 BRT alternative are described in the following subsections.

### 4.2.1 Proposed Corridor Infrastructure

As shown in Figure 15, the I-77 BRT alternative extends along I-77 from I-277 (Exit 11) to Langtree Road (Exit 31), and potentially beyond to Exit 36 (NC 150). The following conceptual station locations and related infrastructure elements are proposed in the I-77 BRT alternative:

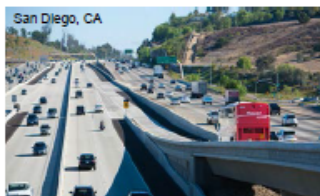
- **New or Expanded Park and Rides/Stations**
  - Mt. Mourne
  - Davidson
  - Cornelius
  - Huntersville NorthCross
  - Huntersville Gateway
  - Hambright
  - Northlake
- **New Direct Connects / Access Improvements:**
  - Cornelius (bus access to station)
  - Huntersville NorthCross (direct connect)
  - Huntersville Gateway (direct connect)
- **Use of Existing Direct Connects:**
  - Hambright
  - Lakeview
- **On-Street Transit Prioritization/Amenities:**
  - Center City Charlotte

The existing Northlake Mall park-and-ride could be enhanced with a connection via Lakeview Road and local connection to Hambright Road.

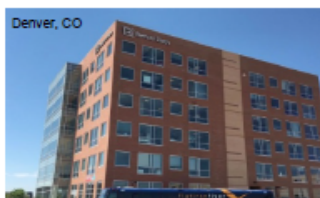
### Key Components of I-77 BRT Alternative



Use of express lanes for guideway



New ramps to provide direct access to stations

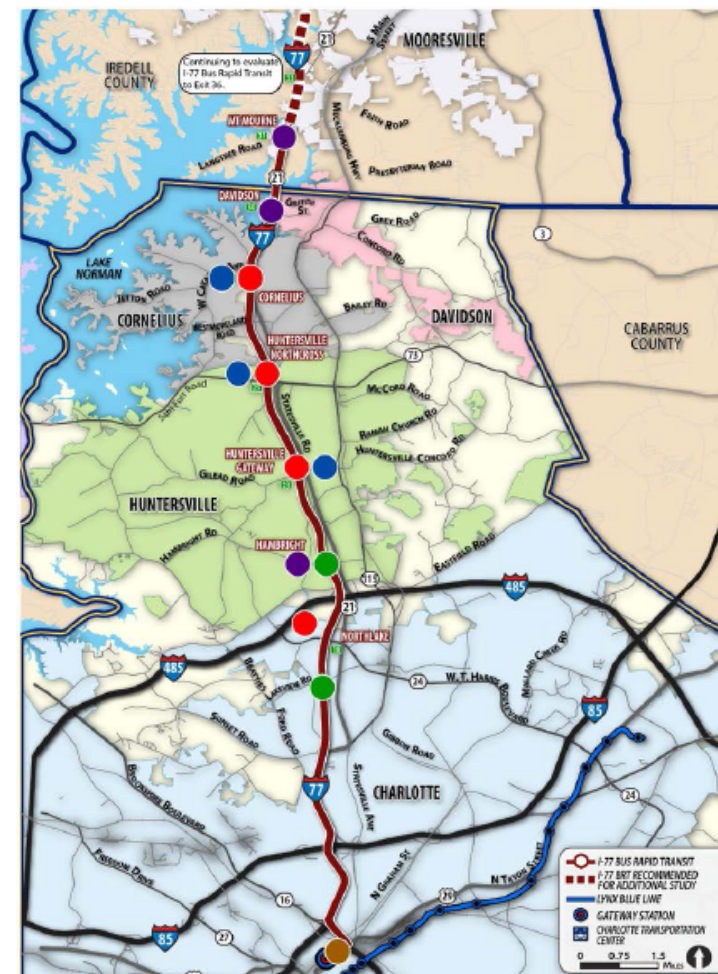


Stations functioning as local mobility and development hubs



Robust service plan

Figure 15: I-77 BRT Corridor Alignment



### 4.2.3 Types of Stations

Based on similar freeway-based BRT projects in other areas, three station types were identified for possible implementation: inline (shoulder) stations, offline stations, and online (median) stations. The different station types are distinguished by a number of design and operational factors, including the impact of each type of station configuration on pedestrian walk-time or conversely bus drive-time. Below are key characteristics of the station types under consideration.

#### Inline (Shoulder) Station

- Platform on dedicated ramp or on shared ramp
- Dedicated parking for riders on one or both sides of the interstate
- Connection between stations and parking via grade separated pedestrian path



#### Offline Station

- Use of direct access ramps into express lanes streamlines access in and out of express lanes (time savings)
- Direct access ramps serve a local road, but not as congested as a full interchange
- Could use new direct access ramps or use existing interchange ramps
- Close walk access from adjacent park-and-ride, but bus must detour from the freeway



#### Online (Median) Station

- Center island design saves space but forces standard buses to cross over (as shown in the photo to the right)
- Side platforms require more space and infrastructure
- Emphasis on minimizing in-vehicle travel time
- Walk access from points beyond the freeway corridor



### 4.2.4 Potential Station Locations

Selecting station locations is a balance between supporting the desires of the goals of the local community with the need to make a corridor-wide investment that maximizes the benefits to transit. To tailor strategies to fit with each town, individual stakeholder workshops were conducted in September 2018 with staff and officials from Mooresville, Davidson, Cornelius and Huntersville. To expand to a corridor-wide conversation and verify direction from the September workshops, a follow-up meeting with staff from all four towns was held in November 2018. Key guiding principles from the discussions of station character were identified as follows:

Balance a corridor strategy with the desires of communities to make transit successful

Coordinate transit investments with other planning initiatives to maximize benefits of transit

Tailor strategies to fit with the neighborhood: Every station plan should be unique to the station

Below are the general guidelines considered for identifying desirable locations for the potential BRT stations.

"Best" Features of BRT Station Node:

- Ability to construct direct connect ramps to I-77 express lanes
- Station location near I-77 express lanes
- Station location at existing park-and-ride locations where practical
- Station nodes are not spaced too closely together (ideally 2-3 miles apart)

As part of the infrastructure planning process, coordination with NCDOT regarding the implementation of new bus-only slip ramps or direct connects to I-77 express lanes will be vital. Stations that include direct connect ramps to I-77 express lanes allow the proposed transit service to maximize efficiency when entering and exiting I-77. In addition, new direct connect ramps would be open to non-transit users of the express lanes, increasing overall access to the express lanes. The design of individual bus access improvement projects along the corridor will need to advance as station locations are further refined but a "package of projects" can be implemented incrementally if necessary.

Possible station locations were further refined based on the existing context of the corridor and the characteristics of the neighborhoods and communities surrounding the potential locations. For concept development purposes, preference was given to locations where existing park-n-ride facilities are currently located and spacing between each station to allow for efficient service was also considered. Stations are intended to operate as local mobility and development hubs within the context of the surrounding neighborhoods and the proposed station sites were identified with this in mind.

Land use and population density details for the areas along the I-77 BRT corridor are illustrated in Appendix C and Appendix D, respectively.



## 4.2.5 Other Examples of Freeway-Based BRT

A number of U.S. cities operate Bus Rapid Transit (BRT) or express buses within managed highway lanes (also referred to as express lanes or High Occupancy Toll (HOT) lanes). While many U.S. cities allow express buses to operate within high-occupancy vehicle (HOV) lanes on highways, at least five cities (Seattle, Denver, Minneapolis, San Diego, and Los Angeles) provide examples of BRT service in limited access lanes with in-line transit stations and dynamic congestion management. All these projects were advanced as part of a cooperative effort involving both the state highway agency and local transit agency; one also included a private partner. Additionally, these services provide precedents on how the implementation of BRT can advance both mobility and land use goals. Additional information from other freeway-based BRT projects is included in Appendix E.

The Flatiron Flyer BRT operates on US 36 between Denver and Boulder, Colorado with six different routes serving six stations. Many of the stations served by the Flatiron Flyer BRT are inline (shoulder) stations. Details about the service can be found in the graphics to the right. Similar to the proposed operating scheme for BRT on I-77, the Flatiron Flyer BRT includes a mix of services with some routes serving all stations and some only stopping at select stations.

The Rapid Express BRT service operating on I-15 in San Diego, CA is similar to the proposed I-77 BRT service in that it operates on a major expressway corridor of comparable length. While the Rapid Express service only has four express routes and the I-77 BRT service is proposed to have seven, both include local bus connections and park-and-ride facilities at off-line stations, maximizing connectivity to surrounding areas.

The frequency of both the Flatiron Flyer and Rapid Express BRT services were also referenced to review the frequency of service operated elsewhere. Service frequency is an important factor in gaining ridership on a BRT service. The Flatiron Flyer BRT serves its riders with 4- to 15-minute peak frequency and 15-minute off-peak frequency while the Rapid Express BRT service operates with a 10- to 15-minute peak frequency.

Although the Flatiron Flyer and Rapid Express BRT services are not identical to the proposed I-77 BRT service, both are successful precedents of BRT implemented in express lanes on heavily commuted corridors. A robust "family" of services, high service frequency, and connections to surrounding areas are characteristics of the services in Denver and San Diego that the proposed operations of the I-77 BRT service is, in part, modeled after in an attempt to also create an efficient and successful service.

Regarding land use goals, several of the Flatiron Flyer stations are linked to surrounding development. Broomfield is an example of a station that has been more fully integrated into surrounding development, with an adjoining shared parking garage, bus transfer facility, and mixed-use development. The development of the Broomfield station over time (as well as the construction of the US 36 express lanes) is illustrated in the series of images shown in Appendix F.

### Precedent: Flatiron Flyer BRT on US 36 (Denver)

#### • Transit Service

- 6 stations
- 6 routes
  - Some express
  - Some serve all stations
  - Some stop on-street in Boulder and downtown Denver
- 4 to 15 min. peak frequency
- 15 min. off-peak frequency (3AM – 1AM)
- Branded coach buses

#### • Ridership

- 45% increase over prior service (due in part to increased frequency)



### Precedent: Rapid Express on I-15 (San Diego)

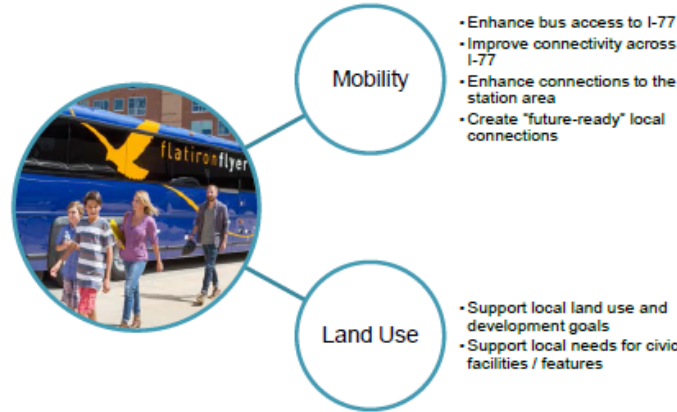
#### • Transit Service

- 4 express routes operate on I-15, but diverge onto other roads, still making limited stops
- 10-15 minute peak frequency
- Some service peak-only and some all-day 5AM to 1AM
- Local bus connections and park-and-ride available at off-line stations
- Branded vehicles
- Up to an hour time savings between Escondido and Downtown San Diego
- Cost = \$238M (stations, parking garages, vehicles, transit signal priority on connecting arterials)



#### 4.2.6 Impacts on Land Use

Stations developed as part of the I-77 BRT alternative can incorporate land use strategies that are designed in such a way as to adapt to local planning goals. With the implementation of the I-77 BRT alternative, there is an opportunity to create transit-oriented development around station areas that includes compact and active development centers surrounding the transit stations, and lower density development spreading out from this center. The transit-oriented development around the stations can incorporate a mix of uses and increased density where desired, attracting transit riders to the station area and allowing more people to access the transit service. Alternatively, if local communities desire less of an impression on existing land use, offering a simple connection to the BRT service without a substantial station may achieve this goal. The surrounding land use can vary widely depending on the desire of the community.



The LYNX Red Line commuter rail, presents different opportunities regarding land use around station areas. While the I-77 BRT alternative has the ability to change land use around station areas, advancing the I-77 BRT alternative, or any option other than the LYNX Red Line commuter rail, requires new considerations on land use planning in a corridor other than the "O" Line corridor.

Just as the characteristics of the communities and neighborhoods surrounding the stations along the proposed I-77 BRT alternative are different and unique, the station area plans should also be unique to fit the desired context and

goal of the community. Station design and land use planning strategies for the station areas are flexible and should be tailored to reflect individual community goals. Individual stakeholder workshops were conducted in September 2018 with staff and officials from Mooresville, Davidson, Cornelius and Huntersville to tailor station area strategies to fit with each town. A follow-up meeting with staff from all four towns was held in November 2018 to verify the opportunities and goals that were discussed in September.

The existing conditions and potential opportunities for I-77 BRT stations for each of the towns are depicted in Figure 18 through Figure 29. These graphics provide a starting point for developing conceptual station area frameworks at potential station locations.

#### 4.2.7 Connectivity to Stations

For the I-77 BRT alternative to have an impact on land use, connectivity to its station areas is vital. Strong multi-modal connections (for pedestrians, bicyclists, and motorists) improve access to the station area and subsequently the transit service, creating support for the desired land use goals of the community. Improving first- / last-mile connections to the stations will provide comfortable and easy transfers for passengers and allow the areas surrounding the stations to fully develop as intended. The terms "first mile" and "last mile" are phrases that are used to describe the initial and final leg of a transportation trip. The "first mile" is the way that a passenger would access the stations before boarding transit at the station (i.e. as a pedestrian on foot, cyclist on bicycle, or driver in a personal automobile). The "last mile" is the way that a passenger accesses his or her final destination after departing transit at the station.

The concept of creating "Mobility Hubs" should be explored as part of station development for the I-77 BRT project. Mobility Hubs include flexible station design to accommodate connections by a variety of modes and technologies, including emerging technologies. Station areas along the I-77 corridor provide a unique opportunity to explore connectivity using emerging technologies such as autonomous shuttles. Connections to the historic downtown areas, nearby business parks, and other activity hubs could be considered using current and emerging technologies.

The viability of autonomous shuttles is advancing rapidly. The Denver Regional Transit District (RTD) recently initiated a demonstration project with an autonomous shuttle connecting a commuter rail station to a nearby business park. This project is one of the first to feature autonomous shuttles operating on a public street.

Mobility Hubs and their potential application to an I-77 BRT project are discussed in greater detail in Section 5.



Flexible station design adaptable to multiple modes



Improved local bicycle and pedestrian connections



A "future ready" system adaptable to changing technologies



Figure 24: Town of Huntersville Existing Conditions Analysis (1 of 3)

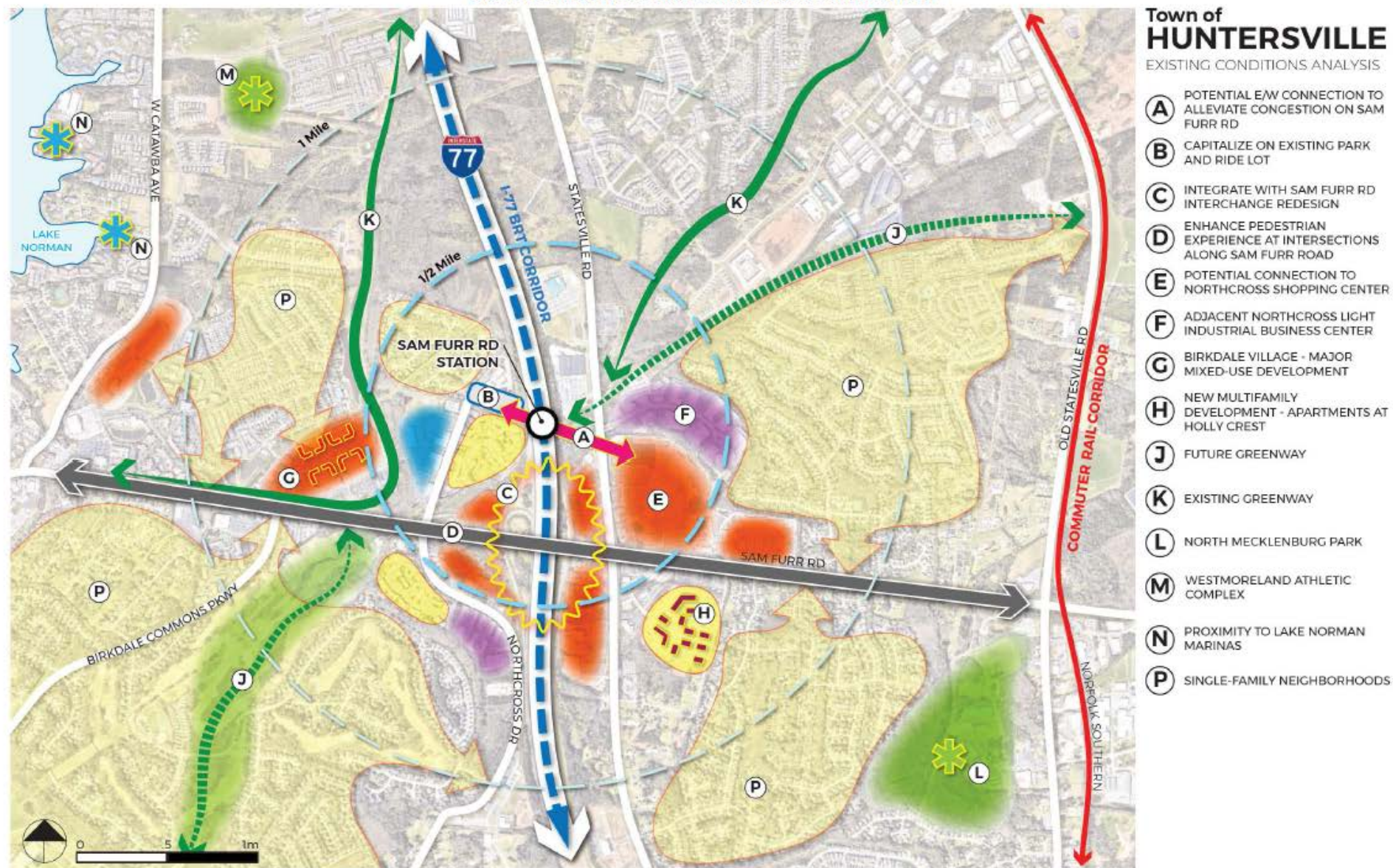
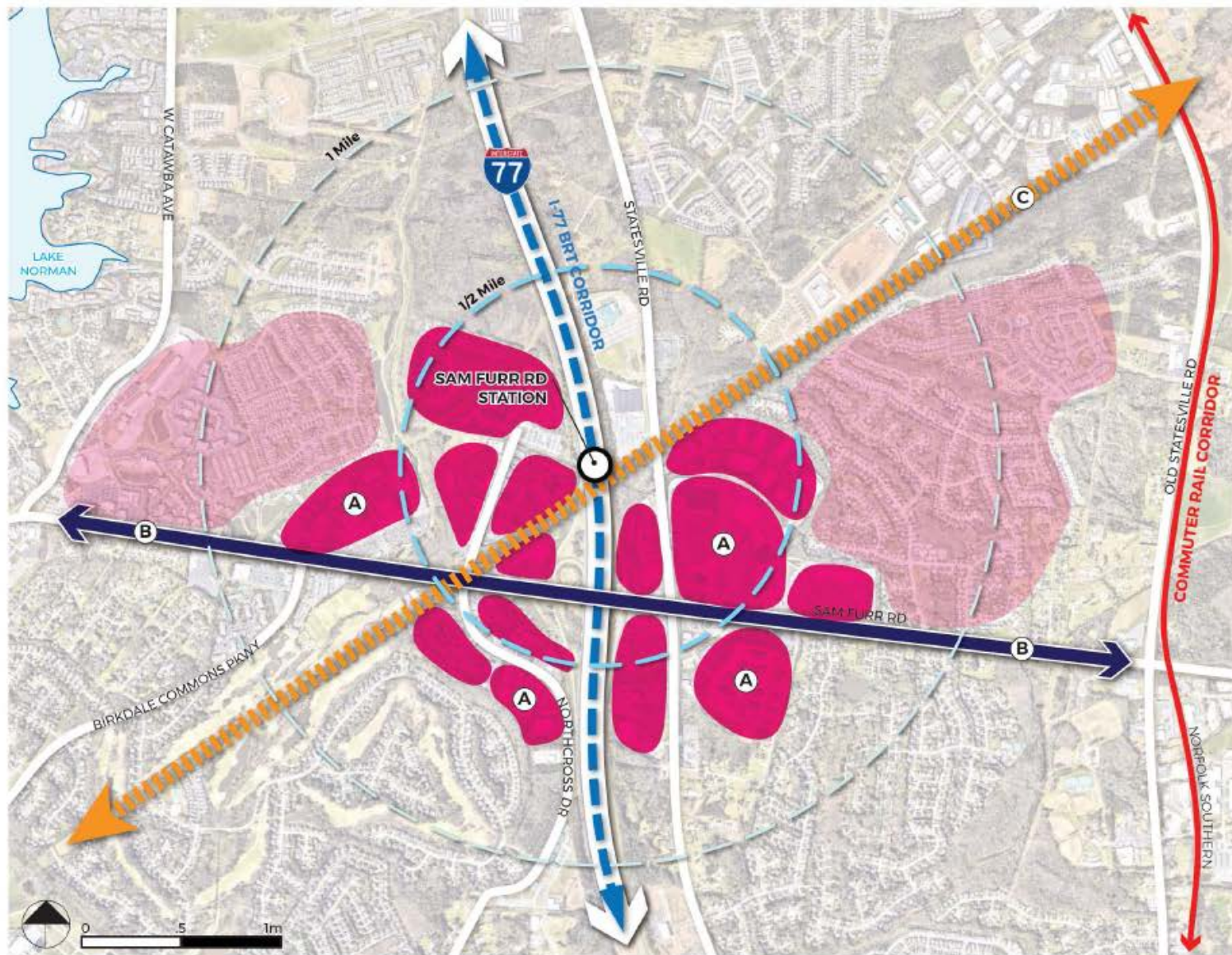




Figure 25: Town of Huntersville Issues Analysis (1 of 3)



## Town of HUNTERSVILLE

ISSUES ANALYSIS

- (A) STATION AREA IS NEARLY BUILT-OUT WITH HIGH-QUALITY AND RECENT DEVELOPMENT
- (B) EAST-WEST CONNECTIVITY LIMITED TO SAM FURR RD
- (C) POWER LINE CORRIDOR MUST BE CONSIDERED IN PLANNING PROCESS



Figure 68: Northcross Station Area Strategies Concept

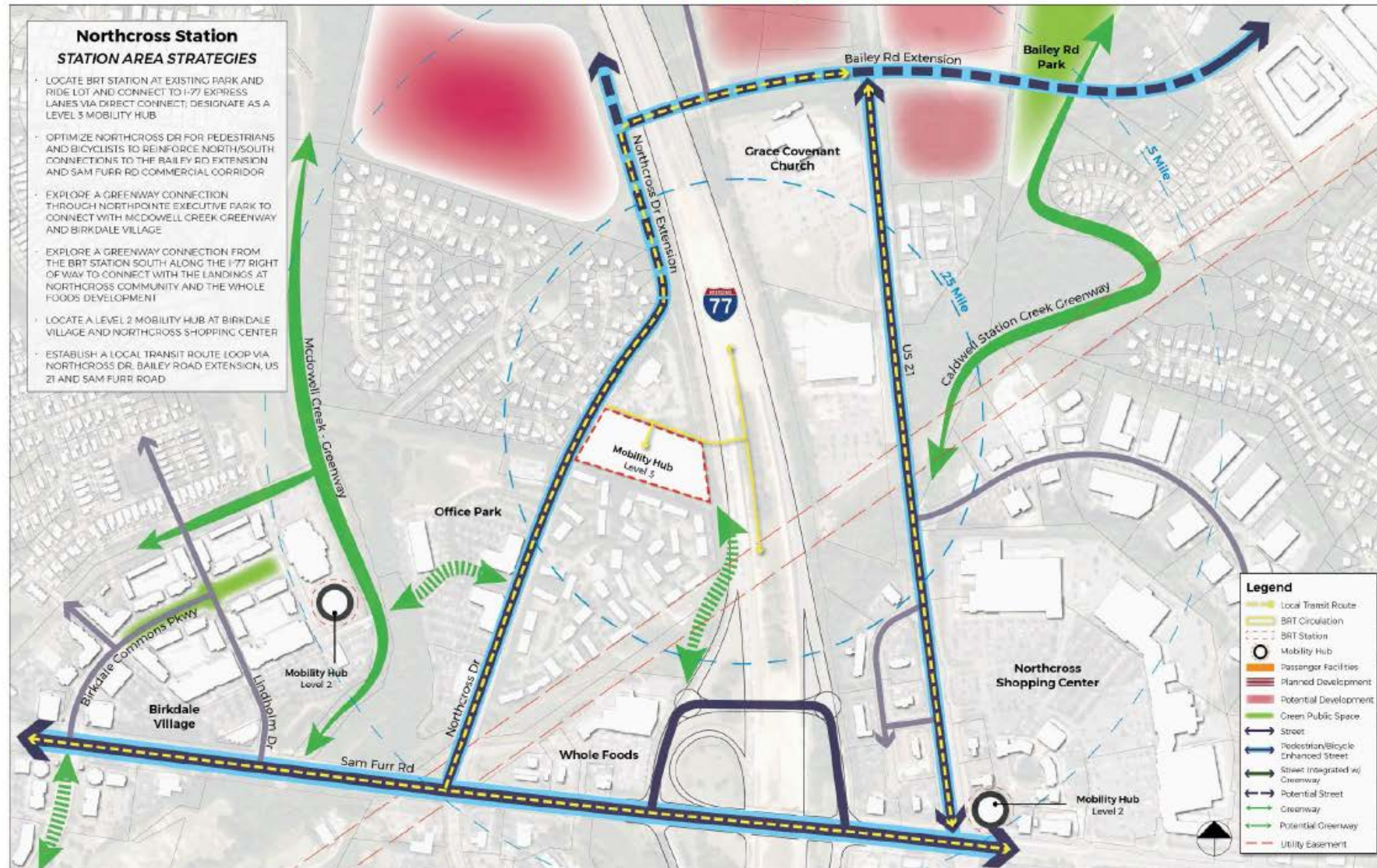




Figure 69: Stumptown Station Area Strategies Concept

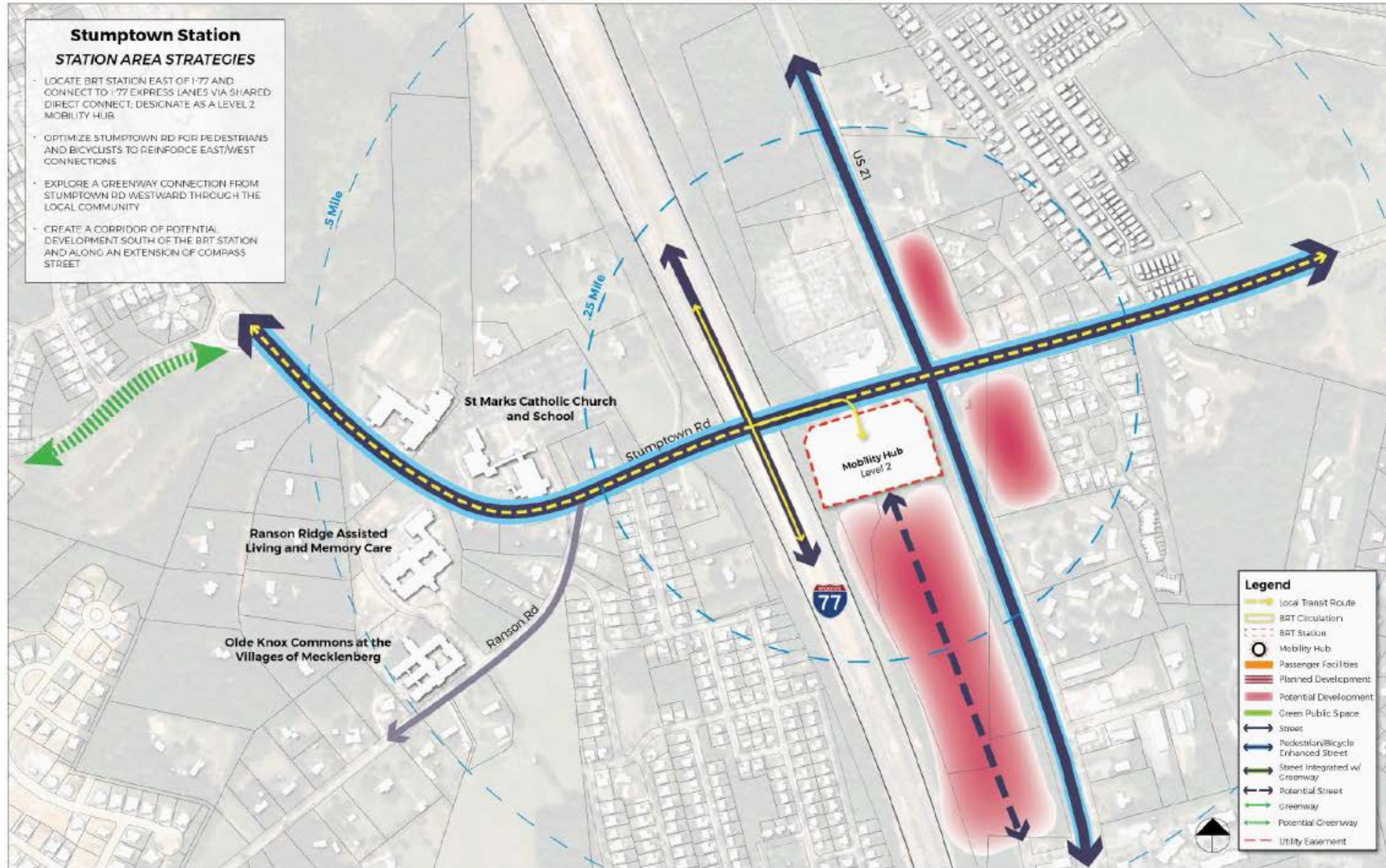




Figure 26: Town of Huntersville Existing Conditions Analysis (2 of 3)

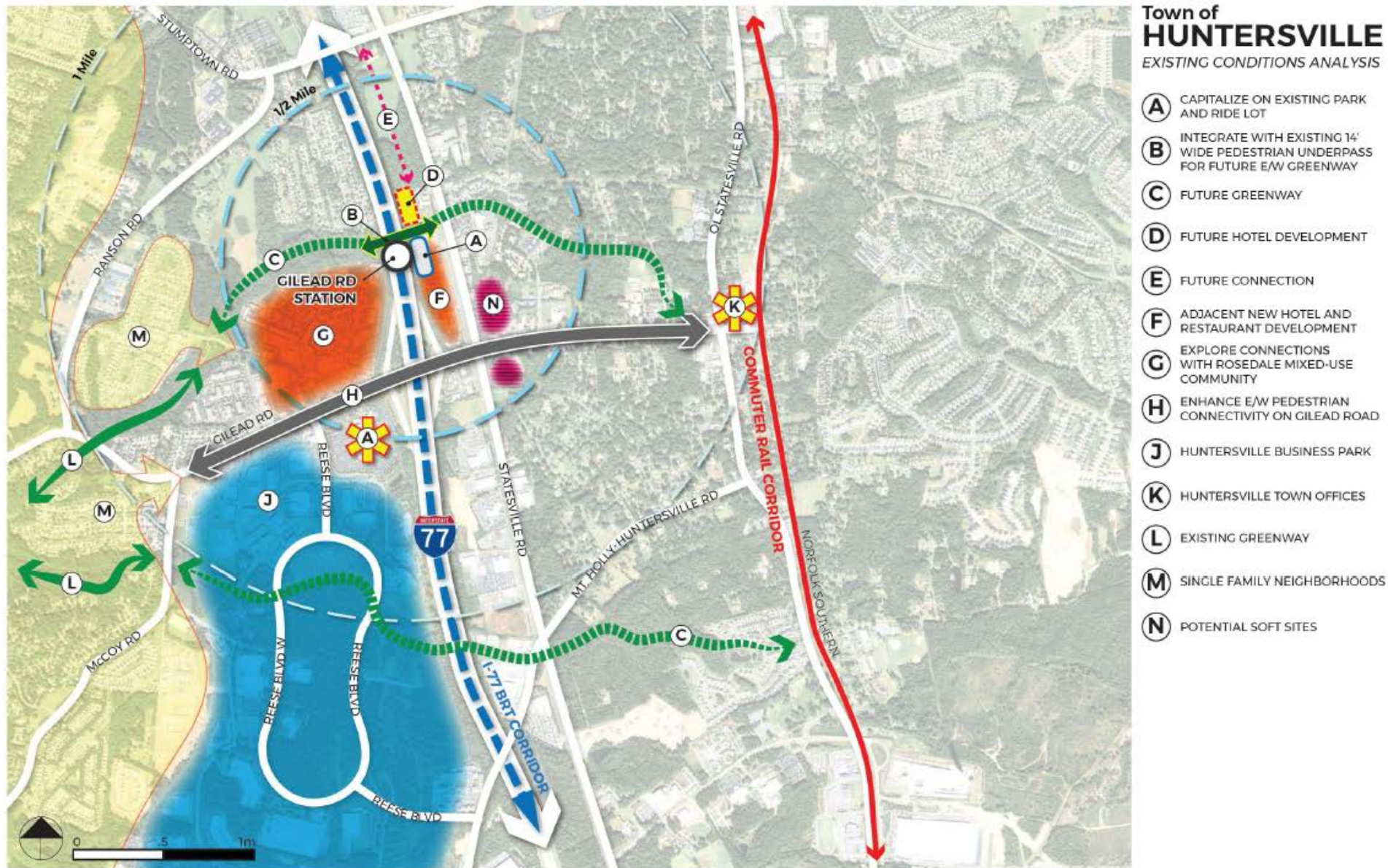
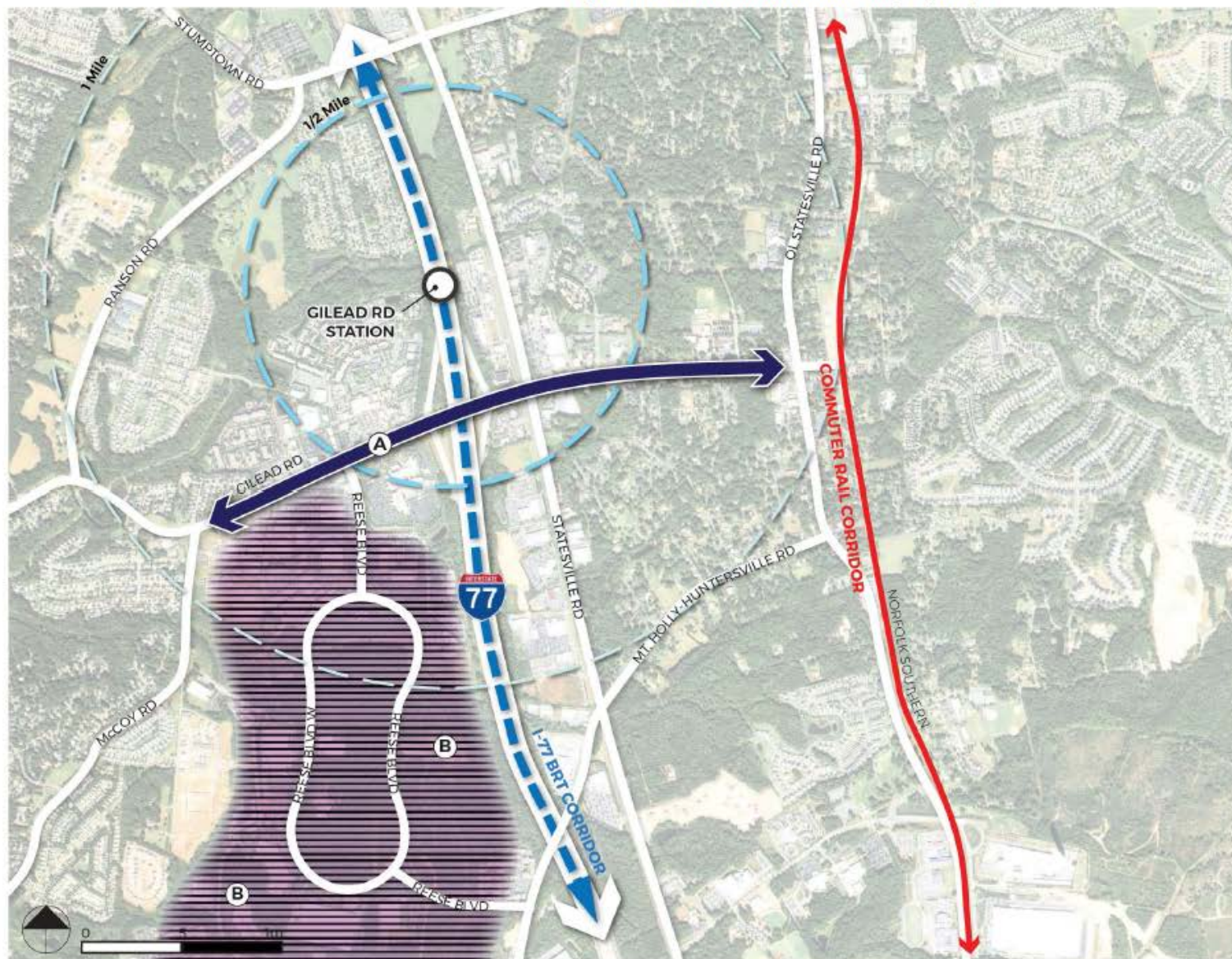




Figure 27: Town of Huntersville Issues Analysis (2 of 3)



## Town of HUNTERSVILLE

### ISSUES ANALYSIS

- A** EAST/WEST CONNECTIVITY  
WITHIN STATION AREA LIMITED  
TO GILEAD RD
- B** SPRAWLING BUSINESS PARK  
NOT CONDUCTIVE TO EFFICIENT  
TRANSIT CONNECTIVITY



Figure 70: Huntersville Gateway Station Area Strategies Concept

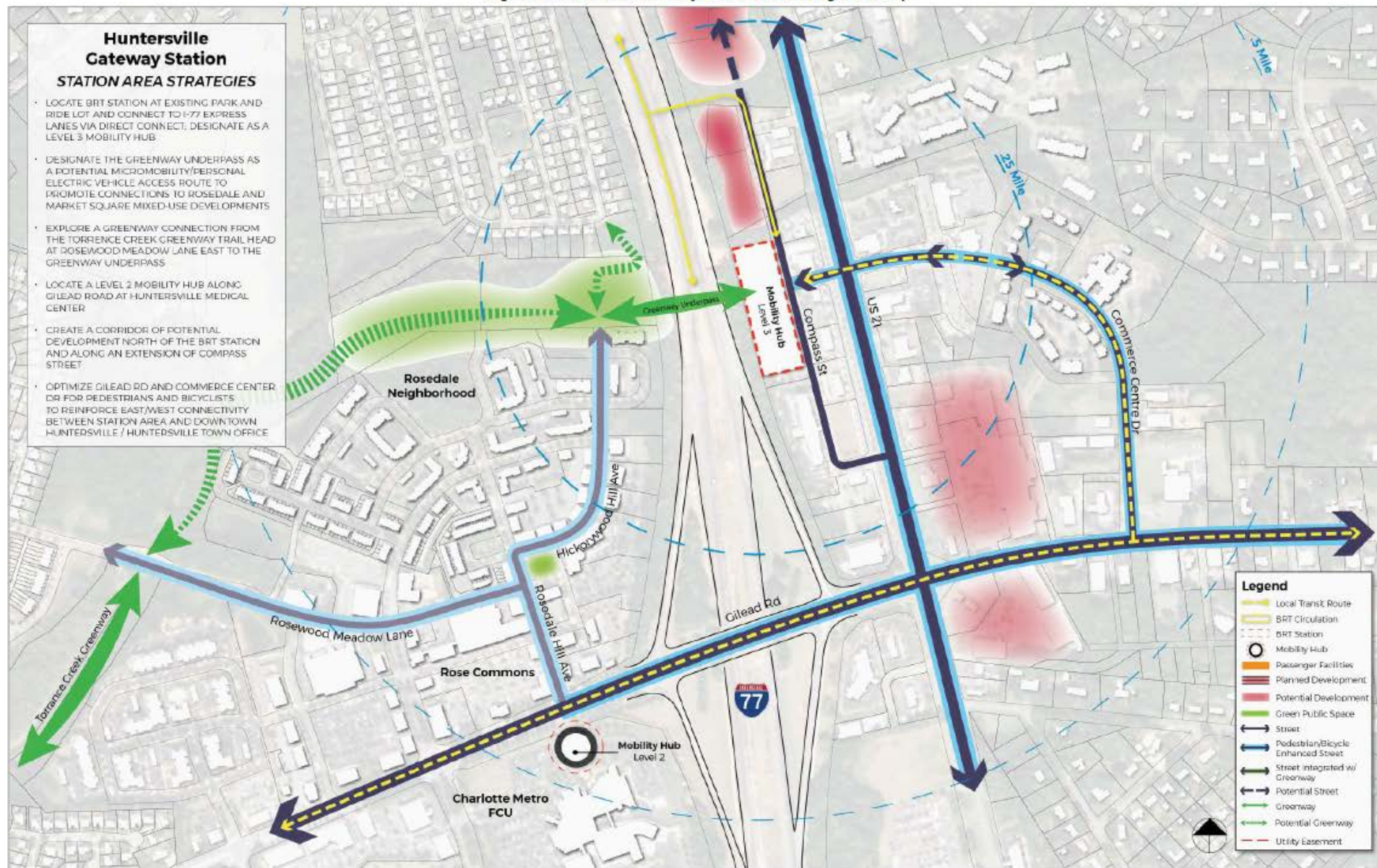




Figure 28: Town of Huntersville Existing Conditions Analysis (3 of 3)

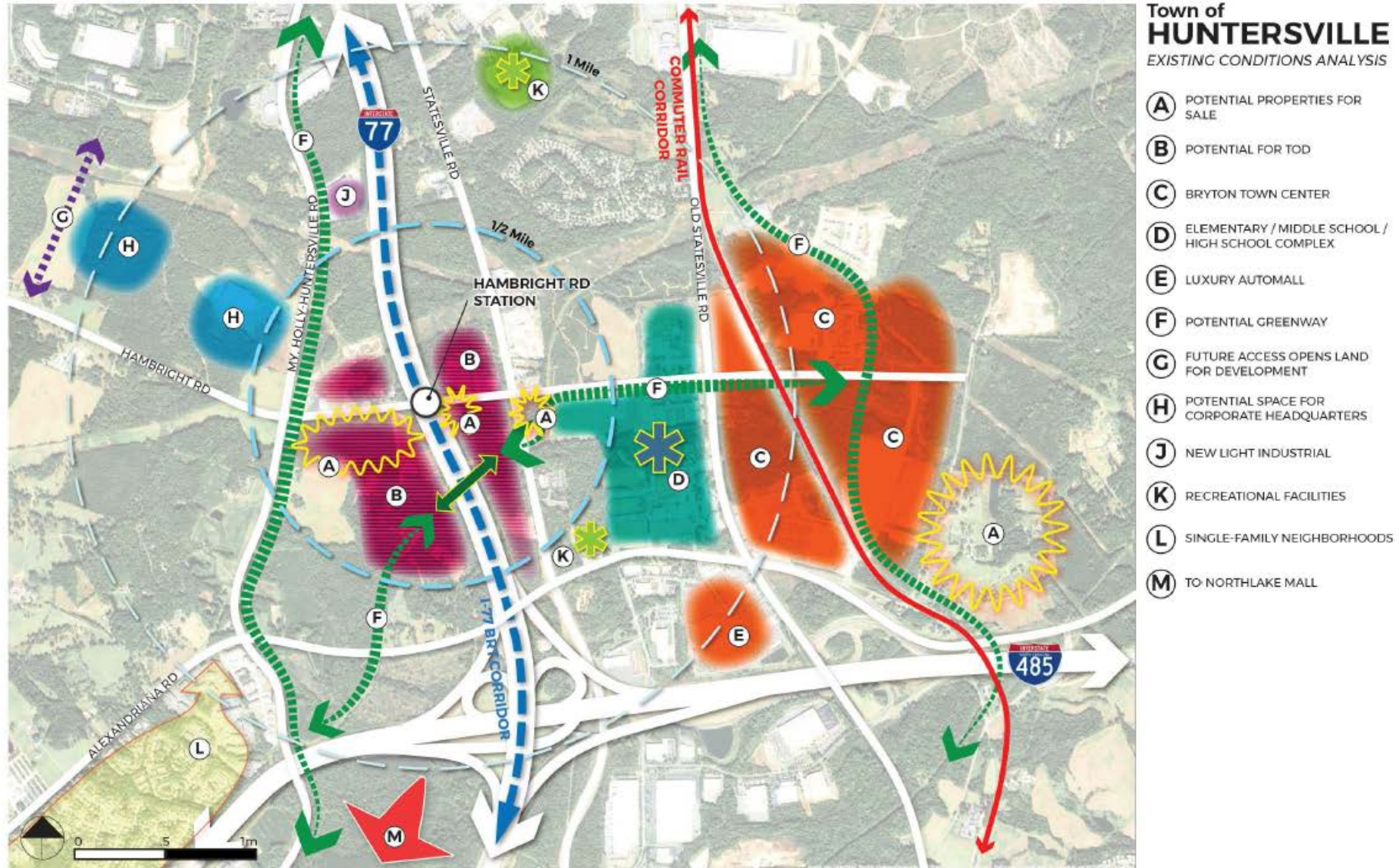
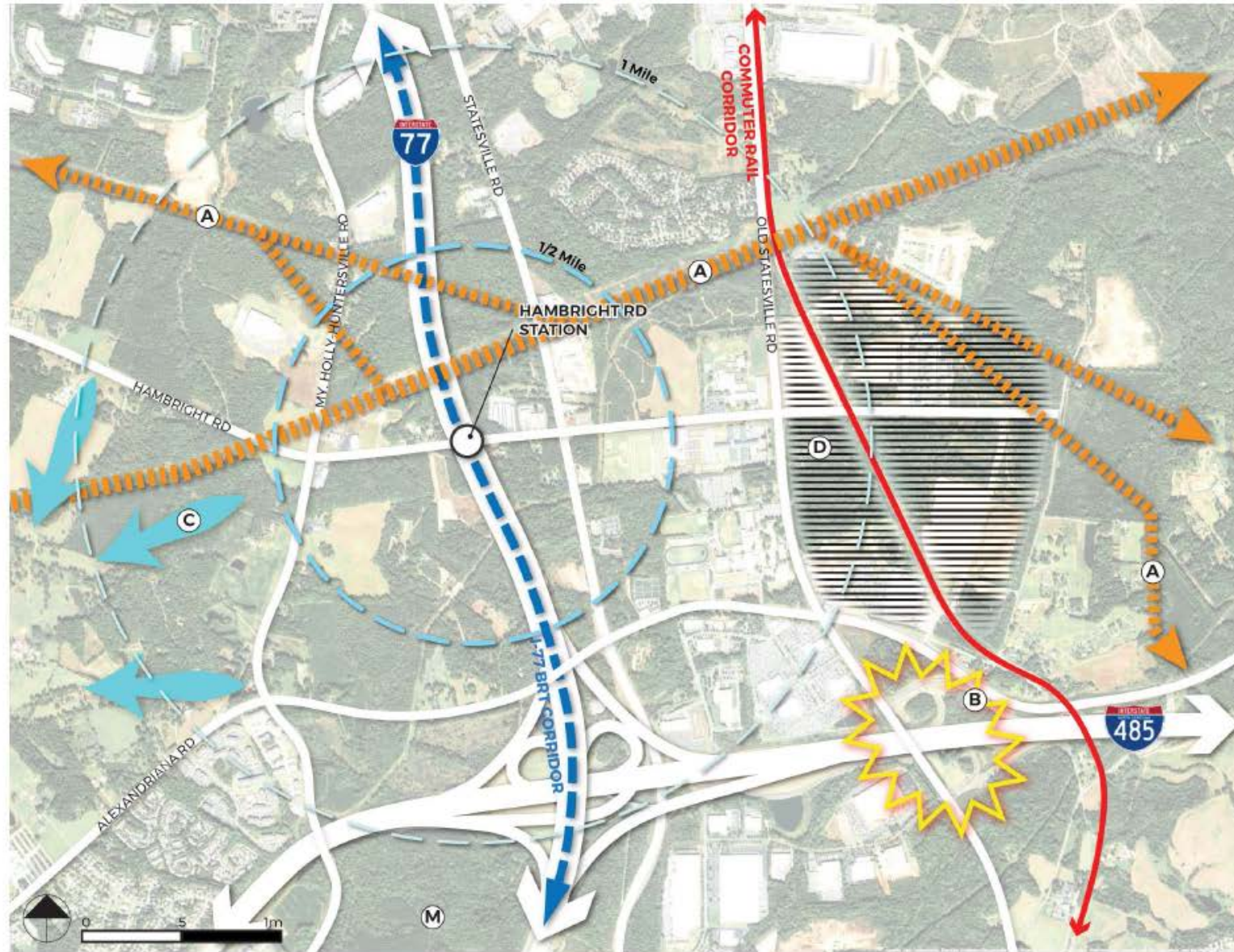




Figure 29: Town of Huntersville Issues Analysis (3 of 3)



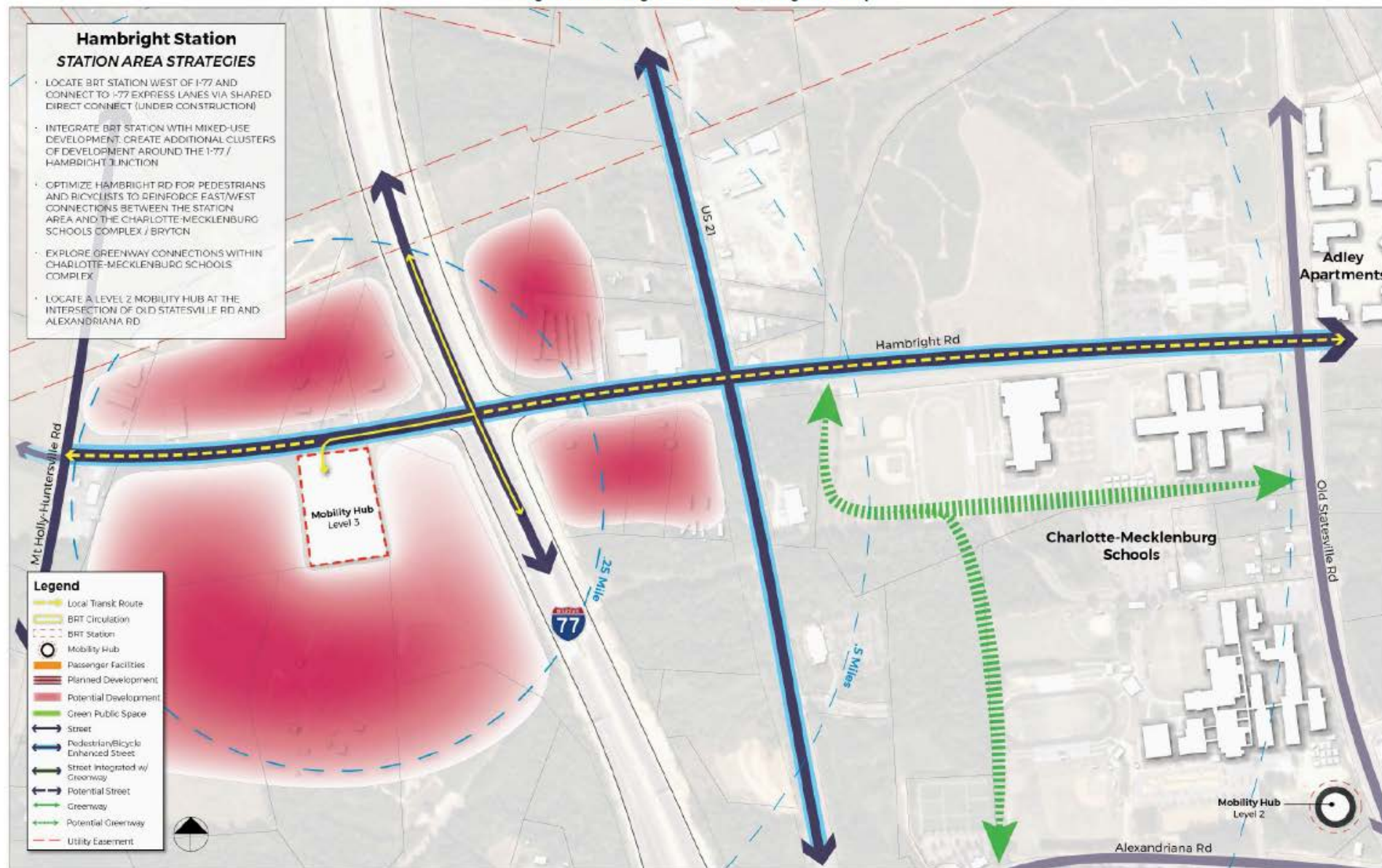
## Town of HUNTERSVILLE

ISSUES ANALYSIS

- (A) NEW DEVELOPMENT MUST CONSIDER POWER LINE CORRIDORS
- (B) HAMBRIGHT RD ACCESS FROM INTERSTATES CURRENTLY LIMITED TO OLD STATESVILLE RD
- (C) LIMITED DEVELOPMENT OPPORTUNITIES WITHIN CRITICAL WATERSHED
- (D) PARK AND RIDE FACILITIES NOT AVAILABLE WITHIN BRYTON



Figure 71: Hambricht Station Area Strategies Concept





## APPENDIX F: FLATIRON FLYER PRECEDENT

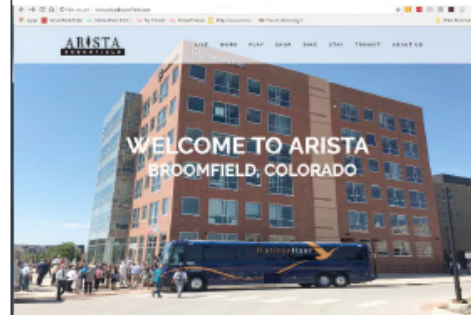
The Flatiron Flyer is an 18-mile bus rapid transit service connecting Denver and Boulder, Colorado. The service operates in express lanes along US Highway 36 and includes 6 routes and 6 stops along the corridor. Launched in January 2016, the Flatiron Flyer provides passengers with a range of services including a non-stop option operating from Boulder to Denver and an option that makes stops at all 6 stations. The Flatiron Flyer receives an average of 14,428 passengers per weekday, which is a 45% increase in ridership from the previous bus service offered on the US Highway 36 corridor.

The Broomfield Station on the US Highway 36 corridor is one of the stations used by the Flatiron Flyer service. The Flatiron Flyer uses express lanes on US Highway 36 to reach the in-line station and a park-n-ride facility is provided on the west side of the highway. This station helps connect the transit service with the surrounding area and it has spurred redevelopment immediately surrounding the station. New mixed-use, hotel, and retail development has occurred in the area surrounding the park-n-ride facility.

Broomfield Station



Mixed-Use Development near Station



Area Surrounding Station



### Broomfield Station:

- 200+ acres located halfway between Denver and Boulder
- Anchored by mid-sized concert / events venue
- 2.6M sq ft. of commercial development planned - hotel / office / retail uses
- 850 residential units planned
- Integrated BRT station, featured prominently in marketing material



## Flatiron Flyer – Broomfield Station



**March 2006**

Prior to interstate improvements and undeveloped land.



**April 2006**

Construction begins on the roadway network.



**April 2007**

Construction on roadway network continues, construction of park-n-ride facility begins.



**March 2008**

Construction on roadway network continues, park-n-ride facility is completed, and redevelopment around station begins.





**July 2010**

In-line station is constructed; redevelopment of station area continues.



**October 2012**

Redevelopment of station area continues; hotel and mixed-use development are constructed.



**October 2014**

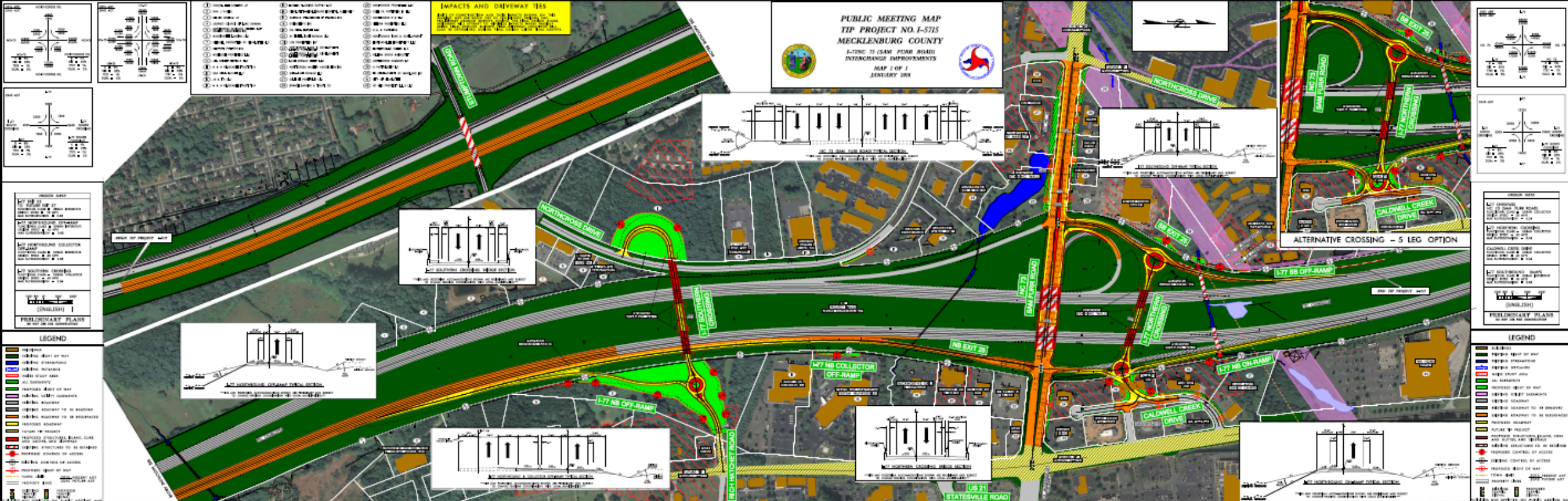
Addition of express (managed) lanes on US Highway 36 in progress.



**June 2017**

Service begins in 2016, express lanes on US Highway 36 are completed, and majority of station area development is complete.









Reduce Commuting Costs



Improve Water Quality



Support Local Farms



Grow Jobs Closer to Home



Increase Housing Choices



Increase Transportation Choices



Maximize Return on Public Investment



Improve Air Quality



Improve Access to Parks and Open Space



Support Our Communities



