01.31.2020

Memo: Fatal Flaw Assessment and Preliminary Ridership Forecasts

To
Crystal Odum (CAMPO)
Joel Strickland (FAMPO)

From
J. Scott Lane

CC
Matt Miller
Ryan White

Re
Technical Memorandum No. 2: Fatal Flaw Assessment and Preliminary Ridership Estimates

The following is a revision to the first draft of a summary of the detailed existing conditions and obstacles to creating passenger rail service in the study corridor, as well as the preliminary base ridership estimates. The revisions, which were made based on a walk-through of the preliminary information shared with FAMPO-CAMPO staff in a meeting conducted on January 28th as well as written comments received on Friday, January 31st, included clarifying language used in the operational analysis; mapping additions and revisions; and some wording changes to the ridership forecasting section.

The following table of contents describes each section of this revised technical memorandum.

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Operational Assessment: Overview

The assessment of the two study corridors (refer to Figure 1 on the next page) necessarily made several assumptions. These assumptions are described in brief, below; similar assumptions are shown at the outset of each of three detailed sections of the fatal flaw assessment as well (Fayetteville, Selma, and Raleigh stations).

The service type (commuter versus regional) has not been determined. The Ridership and Revenue Study evaluates demand for each service type. It is assumed that at least one roundtrip between Raleigh and Fayetteville occurs each day. Similarly, the locomotive and passenger equipment type has not been determined at this point in the study. It is assumed that push-pull operations will be utilized. Hence, turning locomotives will not be required for each trip. The length of the trainsets is unknown at this point and may vary depending on passenger demand. These two assumptions about service type and train locomotion hold true for every part of the assessment that follows.

The average length of local and through freights utilizing the corridors vary. The freight operations along the Western Corridor appear to be local in nature with trains operating out of Raleigh and serving businesses along the Norfolk Southern (NS) and VF-Lines. The freight operations along the Eastern Corridor appear to be a combination of local and regional. Along the H-Line, the freight operations are primarily local in nature, with local freight trains serving customers between Raleigh and the NS Selma Yard. Along the A-Line, the freight operations appear to be regional in nature, with the majority of trains operating between major yards along the Eastern Seaboard.

Class One railroads are required by federal regulation to allow intercity passenger rail service. Freight railroads are not required by law to allow commuter rail service; therefore, agreements must be negotiated between the railroad owner and the operator of the proposed passenger service.

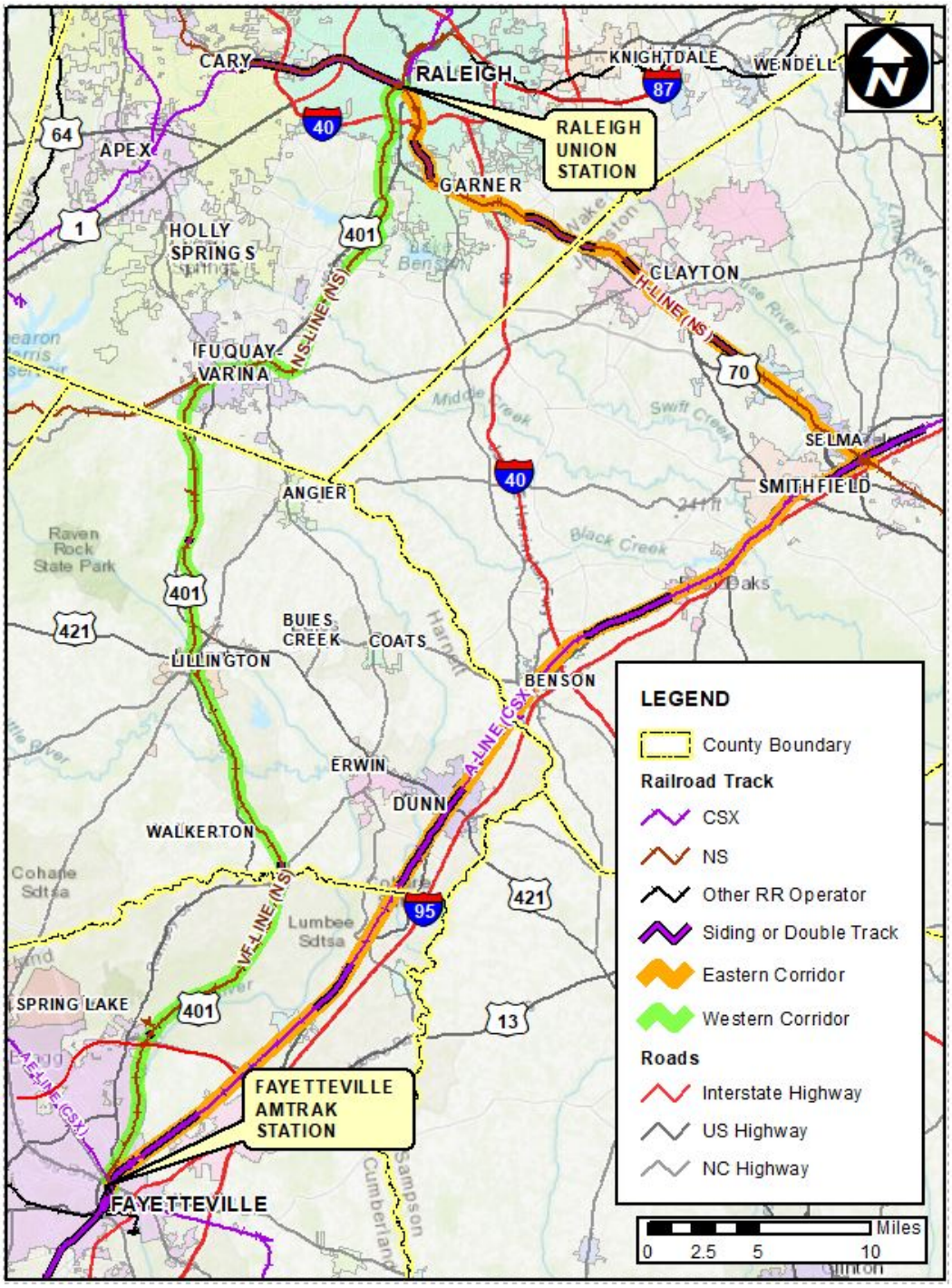

Figure 1. Study Area / Corridors

Operational Assessment: Western Corridor

The Western Corridor consists primarily of the NS VF-Line between Fayetteville and Fuquay-Varina and the NS NS-Line between Fuquay-Varina and Raleigh. Trains operating along this corridor will also use portions of the CSX AE and A-Lines to access the Fayetteville Amtrak Station and portions of the NS H-Line to access Raleigh Union Station.

Western Corridor Infrastructure

The corridor extends approximately 61.5 miles between the Fayetteville Amtrak Station and Raleigh Union Station. The Western Corridor is primarily single tracked with a total of five sidings ranging in length from approximately 1,127 feet to 3,200 feet. The sidings are spaced approximately 10 miles apart. The corridor is primarily FRA Class 2 track with a maximum authorized track speed of 25-miles per hour (mph) for freight and passenger trains. There are two, 10mph segments along the corridor: Cape Fear River Bridge in Lillington which is a non-moveable structure, and Hillsboro Street in Fayetteville where the railroad tracks run down the center of the street. There is no existing intercity passenger rail service along this corridor.

Raleigh-area Operational Concerns

Lack of Direct Access to Raleigh Union Station - There is not direct access to the station platform from the NS-Line. Currently, all access to the station platform is via the H-Line. Access to/from Raleigh Union Station would require a two-phase time-consuming forward/backing maneuver that would require the engineer to walk between the locomotive and cab-control car on multiple occasions.

Fayetteville-area Operational Concerns

Lack of Direct Access to the Fayetteville Amtrak Station - There is not direct access to the station platform via the VF-Line and AE-Line. The only access to the station platform is via the A-Line. Access to/from the Fayetteville Amtrak Station would require a three-phase, time consuming forward/backing maneuver that would require the engineer to walk between the locomotive and cab-control car on multiple occasions.

Limited Operating Speeds - The NS Timetable notes a maximum speed of 10mph along the VF-Line while trains are traveling down Hillsboro Street in downtown Fayetteville.

Other Operational Concerns

Overall Corridor Speed - North of Hillsboro Street in the Fayetteville, the VF-Line has a maximum authorized speed of 25mph for freight and passenger trains. Maximum operating speeds along the NS-Line is also 25mph. There is also a 10mph restriction on the Cape Fear River Bridge in Lillington. All services evaluated in the Peer Review have an average start to finish speed of greater than 34mph.

Corridor Capacity - The corridor is primarily single tracked with five sidings ranging in length from approximately 1,127 feet to 3,200 feet, spaced approximately 10 miles apart. The Western Corridor averages one-to-two freight trains per day (Raleigh to Fayetteville local). If freight trains operating along the corridor are longer than any of the sidings, they would not be able to fit into the sidings along the corridor. If trains need to pass each other, the shorter passenger trains would be required to occupy the sidings while the longer freight train passes, causing them to incur delays.

Operational Assessment: Eastern Corridor

The Eastern Corridor consists of the CSX A-Line between Fayetteville and Selma and the NS H-Line between Selma and Raleigh.

The corridor extends approximately 75.5 miles between the Fayetteville Amtrak Station and Raleigh Union Station.

Eastern Corridor Infrastructure

The A-Line segment consists of a single main track with five double-tracked segments along its length to allow same and opposite direction passing. The length of the siding range from 2.45 miles to 10.9 miles. Additionally, the sidings are spaced an average of 4.5 miles apart. The H-line is primarily single-tracked with four sidings between Raleigh and Selma, ranging from 0.7 to 3.4 miles in length. The corridor is constructed to FRA Class 4 track standards with a maximum authorized track speed of 79 mph for passenger trains (Amtrak timetable speed) along the A-Line and H-Line. The lowest authorized speeds are 45 mph in Clayton (along the H-Line) and Dunn (along the A-Line) and 35 mph through downtown Fayetteville.

Raleigh-area Operational Concerns

None – Raleigh Union Station is designed to support intercity and commuter rail operations along the H-Line.

Selma-area Operational Concerns

Lack of Direct Access between the A and H-Lines - There is not a direct connector between the A and H-Lines for trains traveling between Fayetteville and Raleigh. Access between the lines currently require a three-phase time consuming forward/backing maneuver that would require the engineer to walk between the locomotive and cab-control car on multiple occasions.

Fayetteville-area Operational Concerns

None – The Fayetteville Amtrak Station is designed to support intercity rail operations along the A-Line.

Common Operational Challenges

A-Line Capacity Impacts (Fayetteville)

Northbound trains waiting on passengers to board will occupy Track 1, which provides access to the station, prior to their departure. Additionally, southbound passenger trains would need to occupy Track 1 while dropping passengers when they arrive from Raleigh. Trains occupying Track 1 while serving the Station reduces the A-Line to a single-track main line through downtown Fayetteville between MP A209.6 and MP A207.6.

Passenger trains serving Fayetteville Station also prevents northbound CSX freight trains from accessing the Milan Yard lead track. Thus, if a northbound freight train needs to access the yard, it must continue north on Track 2 past Milan Yard and CP N. Milan onto the single tracked section of the A-Line. The train must cross the single-track Cape Fear River Bridge and continue north until the last car or pushing locomotive clears the switch at CP North Milan. Once the switch is clear, the train will reverse direction and enter the Milan Yard lead track from the north.

NCDOT Rail Division noted that CSX may require dual platforms at Fayetteville Station if additional passenger service is implemented as a means to provide the railroad with the flexibility to have passenger trains utilize either track depending on freight operational needs.

The presence of Hillsboro Street and the Airborne and Special Operations Museum is a significant obstacle to enabling the installation of a second platform at the Fayetteville Amtrak Station.

Fayetteville Station Parking

The Fayetteville Amtrak Station currently lacks parking for passenger rail patrons. Amtrak patron parking was relocated to the Airborne and Special Operations Museum due to the construction of the new downtown Fayetteville baseball station.

Multimodal Connectivity

Connectivity to FAST buses will be via a short walk to the FAST Transit Center between Franklin Street and W. Russell Street.

Lack of Available Raleigh-area and Fayetteville-area Train Storage

Between the morning departures and evening arrivals, the train sets would need to be stored off the mainline tracks. The NCDOT Rail Division noted there is currently no capacity at the Capital Yard Maintenance Facility to store additional train sets. Likewise, there is currently not a location in the Fayetteville area identified for storing and servicing the train sets. Therefore, potential sites would need to be identified and evaluated for suitability. From the Peer Review, the project team notes that peer systems store railcars in a variety of places. Some bought portions of existing railyards from railroads, others use tail track extensions.

The following table (Figure 2) summarizes anticipated issues and evaluates each by route. The colors below the West and East Route columns indicate the relative level of severity of the concern.

- =Major Concern Likely to Require Mitigation
- =Moderate Concern Requiring Additional Investigation, Probable Mitigation
- =No Concern at this Time
- =Not Applicable to this Alternative

	West Route	East Route	■=Major Concern Likely to Require Mitigation ■=Moderate Concern Requiring Additional Investigation, Probable Mitigation ■=No Concern at this Time ■=Not Applicable to this Alternative
Station Access			
Raleigh Union Station			A two-phase maneuver would be required for passenger trains using the Western Route to access and depart the Raleigh Union Station. This maneuver would require the engineer to walk between the locomotive and the cab-control car multiple times.
Fayetteville Amtrak Station			A complicated, time-consuming, three-phase maneuver would be required for passenger trains using the Western Route to access and depart the Fayetteville Amtrak Station. This maneuver would require the engineer to walk between the locomotive and the cab-control car multiple times.
Multi-Modal Connectivity			
Raleigh Union Station			Raleigh Union Station is currently directly served by existing GoRaleigh Transit bus service. A new bus terminal was recently approved for development next to the station.
Fayetteville Amtrak Station			The FAST Transit Center is located one block south of the Fayetteville Amtrak Station. In the current configuration, rail passengers would have to cross both tracks, walk down Hillsboro Street, and cross Hay and Franklin Streets to make connections at the FAST Transit Center.
Corridor Capacity			
Raleigh Union Station			Trains conducting the two-phase maneuver to access/depart Raleigh Union Station will impact operations at Boylan Wye as the passenger train would have to maneuver up and down two legs of the wye, limiting the ability of other trains to operate through the surrounding track network.
Fayetteville Amtrak Station			At the Fayetteville Amtrak Station, the A-Line has a dual track configuration. AM and PM passenger trains will need to occupy Track 1, reducing A-Line to one through track. Limited opportunities to add a third track or additional platform due to parallel streets along both sides of the A-Line through downtown.
Mainline			The Western Corridor is primarily single track. Sidings are average 2,000 feet in length and are spaced an average of 10 miles apart. The Western Corridor averages 1 – 2 freight trains per day (Raleigh to Fayetteville local). If freight trains are longer than the sidings, they would not be able to utilize the sidings along the corridor. This would require passenger trains to sit in the sidings while allowing freight trains to pass, causing them to incur delays. The Eastern Corridor has adequate capacity to support current freight and passenger operations. Existing sidings are long enough to accommodate all trains utilizing the corridor. However, if additional passenger trains operations are implemented, the additional trains will likely conflict with existing freight and intercity passenger rail service, requiring the addition of sidings or double-tracking existing segments.
Operational Speeds			Maximum authorized speed along the Western Corridor is 25mph. Additionally, 10mph maximum speeds are required along Hillsboro Street in downtown Fayetteville and at the Cape Fear River Bridge north of Lillington. All services evaluated in the Peer Review have an average operating speed of greater than 34mph.The maximum authorized passenger train speed along the Eastern Corridor is 79mph.
Storage and Maintenance Facility Location			
Raleigh and Fayetteville Station Areas			A location for storing and/or maintaining trains designated for the Raleigh to Fayetteville service has not been identified. The NCDOT Rail Division noted that there is currently no capacity at the Capital Yard Locomotive and Railcar Maintenance Facility to store additional locomotives or rail cars. A location will need to be identified at both locations and evaluated for suitability. The size and function of the facility will be dictated by the operations plan for the service, the amount of equipment to be stored, and the level of maintenance to be conducted. (For example, prior to the construction of the Charlotte Locomotive and Railcar Maintenance Facility, NCDOT's Charlotte-area maintenance "facility" consisted of a single, approximately 630'-long siding adjacent to the Tryon Street Station. The "facility" included modular buildings for parts and equipment storage and a place for the train crew to sign-in, receive briefings, and keep personal items. Fueling operations also occurred at the site via mobile fuel trucks. However, major maintenance operations occurred in Raleigh at Capital Yard.)
Passenger Parking			
Raleigh Union Station			There is existing and planned parking decks in the vicinity of Raleigh Union Station, which should provide adequate parking for patrons.
Fayetteville Amtrak Station			The Fayetteville Amtrak Station currently lacks parking to support additional rail patron parking. Amtrak patron parking was relocated to the Airborne and Special Operations Museum due to the construction of the new downtown Fayetteville baseball station.
A-Line/H-Line Transition (Selma)			There is not a direct connector between the A and H-Lines for trains traveling between Fayetteville and Raleigh. Access between the lines would require a three-phase, time consuming, forward/backing maneuver that would require the engineer to walk between the locomotive and cab-control car on multiple occasions. The maneuver will also require crossing the A-Line along the H-Line. Additional delays may be incurred while waiting to cross and enter the A-Line due to the higher train volumes along the A-Line.

Figure 2. Route Issue Summary Table.

Operations Detail: Fayetteville Station Area

There are several assumptions that were made in the planning-scale assessment of the Fayetteville station area conditions. First, the service type (commuter versus regional) has not been determined. The Ridership and Revenue Study will evaluate demand for each service type. It is assumed that at least one roundtrip between Raleigh and Fayetteville occurs each day. Similarly, the locomotive and passenger equipment type has also not been determined at this point in the study. It is assumed that push-pull operations will be utilized. Hence, turning locomotives will not be required for each trip. The length of the trainsets is unknown at this point and may vary depending on passenger demand.

The average length of local and through freights utilizing the corridors vary. The freight operations along the Western Corridor appear to be local in nature with trains operating out of Raleigh and serving businesses along the Norfolk Southern (NS) and VF-Lines. The freight operations along the Eastern Corridor appear to be a combination of local and regional. Along the H-Line, the freight operations are primarily local in nature, with local freight trains serving customers between Raleigh and the NS Selma Yard. Along the A-Line, the freight operations appear to be regional in nature, with the majority of trains operating between major yards along the Eastern Seaboard.

Class One railroads are required by federal regulation to allow intercity passenger rail service. Freight railroads are not required by law to allow commuter rail service; therefore, agreements must be negotiated between the railroad owner and the operator of the proposed passenger service. Furthermore, the location of the Fayetteville-area train storage and maintenance facility has not been identified.

Passenger connections to FAST buses will require a short walk to the FAST Transit Center between Franklin Street and West Russell Street.

Fayetteville Train Station Area Track Infrastructure

The CSX A-Line has a dual-track configuration in the vicinity of the Fayetteville Station. The dual-track configuration extends from Control Point (CP) S. Hope Mills – mile post (MP) A218.6 to CP N. Milan – MP A207.6. Track 1 is the easternmost track and Track 2 is the westernmost track. Milan Yard is the primary CSX yard in the Fayetteville area. It is located approximately one mile north of the Fayetteville Amtrak Station along the east side of the A-Line.

Between Hay Street and Rankin Street, the A-Line is sandwiched between the north and southbound one-way pair section of Winslow Street. North of Hay Street, Hillsboro Street and the Airborne and Special Operations Museum occupy the land along the west side of the A-Line. A double crossover is located at A&R Crossing (MP A210.6) to allow trains to change between Track 1 and Track 2.

A&Y Junction (MP A209.6) is the crossing of the CSX A and AE-Lines and is located just north of the Fayetteville Amtrak Station. A connector track from the AE-Line parallels Track 1 the north of A&Y Junction and becomes the lead track to Milan Yard. A single crossover between Track 1 and the Milan Yard lead track is located just north of the Rowan Street overpass. For northbound local freight trains, the access to the Milan Yard lead track is only provided via Track 1.

The AE-Line intersects the NS VF-Line approximately 660-feet north west of A&Y Junction. The NS VF-Line extends from the AF-line and continues north down the center of Hillsboro Street for 2,500-feet before veering off along its own alignment. The station platform is served by Track 1.

Figures 3 and 4 illustrate the Fayetteville station area conditions previously described.

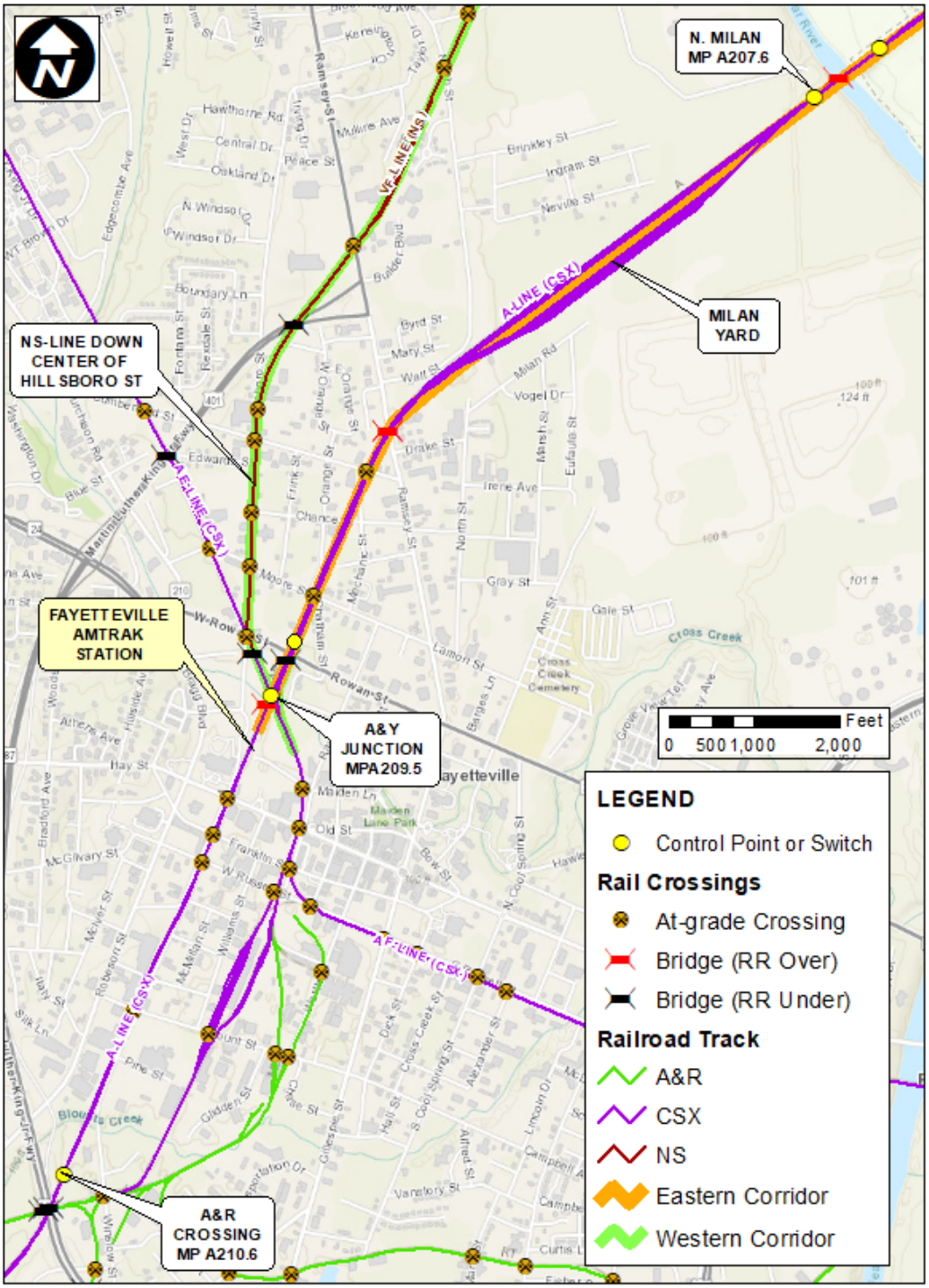

Figure 3. Fayetteville Area Rail Infrastructure.

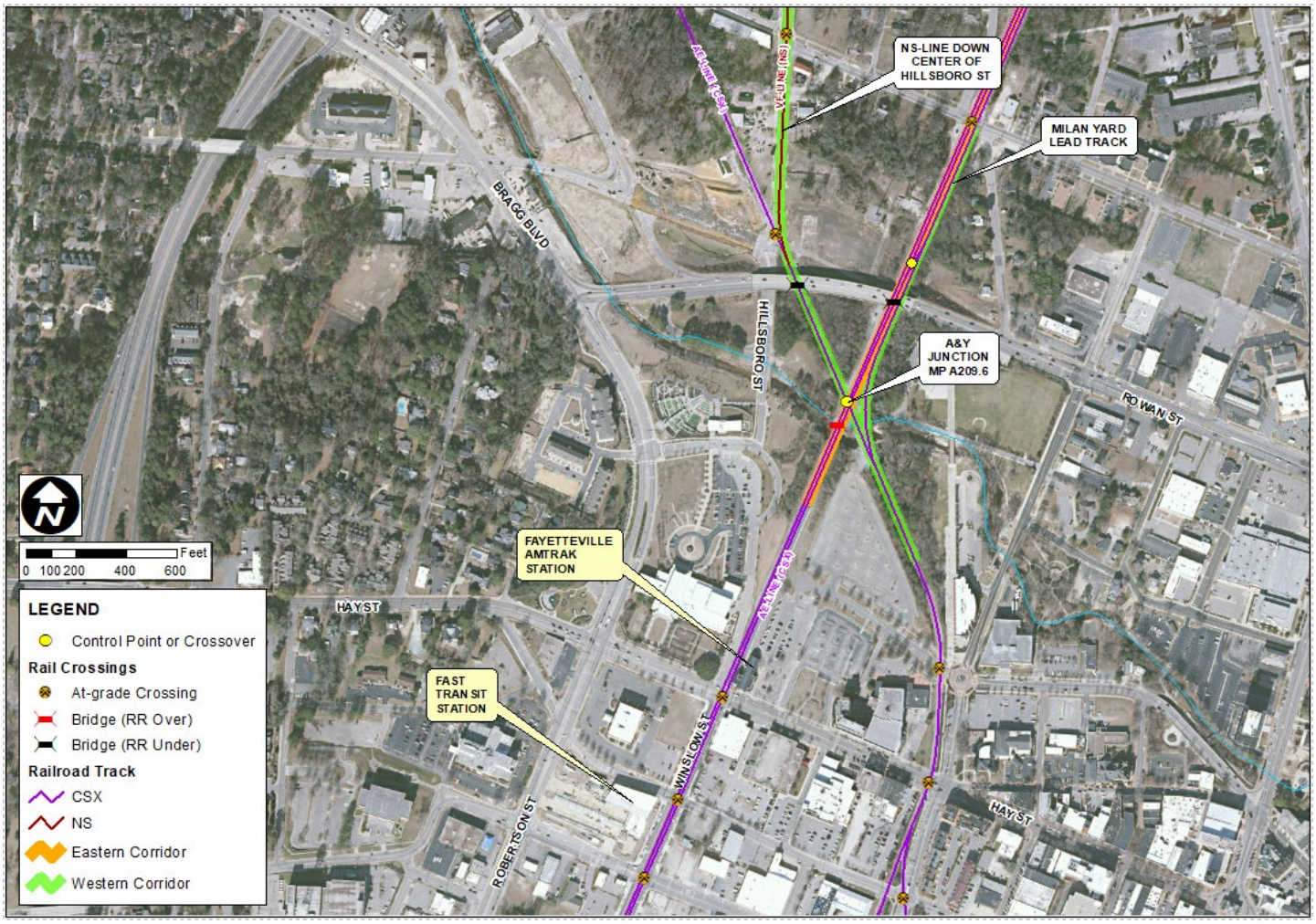

Figure 4. Fayetteville Station Area.

Fayetteville Station Access

Common Operational Challenges

Passenger trains will occupy Track 1 while passengers are getting on and off the trains during various times of the day. These trains serving the station would reduce the A-Line to a single-track main through downtown Fayetteville between MP A209.6 and MP A207.6. This operation also prevents northbound CSX freight trains from accessing the Milan Yard via the Milan Yard lead track. Thus, if a northbound freight train needs to access the yard it must continue north on Track 2 past Milan Yard and CP North Milan onto the single-track section of the A-Line. The train must cross the single-track Cape Fear River Bridge and continue north until the last car or pushing locomotive clears the switch at CP North Milan. Once the switch is clear, the train will reverse direction and enter the Milan Yard lead track from the north.

NCDOT Rail Division staff noted that CSX may require dual platforms at Fayetteville Station if additional passenger service is implemented as a means to provide the railroad with the flexibility to have passenger trains utilize either track depending on freight operational needs. The presence of Hillsboro Street and the Airborne and Special Operations Museum is a significant obstacle to enabling the installation of a second platform at Fayetteville Station or adding rail capacity.

Parking service is also a concern at this location. The Fayetteville Amtrak Station currently lacks parking for additional patrons. Amtrak patron parking was relocated to the Airborne and Special Operations Museum due to the construction of the new downtown Fayetteville baseball station.

Eastern Route Operational Concerns

None - The existing route is currently utilized by three daily Amtrak roundtrips; the Auto Train, Palmetto, and Silver Meteor. The Auto Train is the only one that does not stop at the Fayetteville Amtrak Station.

Western Route Operational Concerns

Passenger trains to/from Raleigh via Fuquay-Varina and Lillington would access the Fayetteville Amtrak Station (and the A-Line) via the NS VF-Line and the CSX AE-Line at A&Y Junction.

Lack of a Direct Connection to the Fayetteville Amtrak Station - The only connection between the A-Line and the AE-Line is in the eastern quadrant of A&Y Junction. This configuration prevents passenger trains from directly traveling between the Fayetteville Amtrak Station and the VF-Line via the AE-Line. The following six-phase maneuver would be conducted in order for northbound trains to utilize the Western Corridor (the maneuver would be reversed for southbound trains accessing the Fayetteville Amtrak Station via the Western Corridor).

1. Northbound trains would travel north on Track 1 and utilize the crossover to access the Milan Yard lead track.
2. Once the last car (locomotive or cab control car) clears the switch, the train will need to travel south and access the AE-Line, east of the A&Y Junction. The engineer will need to leave the lead locomotive and walk to the cab control car to conduct the backing maneuver.

3. The train will then travel south (in reverse) along the Milan Yard lead track and enter the AE-Line.
4. Once the switch is cleared, the train will then need to travel north on the AE-Line. The engineer will have to leave the cab control car and walk to the lead locomotive.
5. Once the train is ready to progress north towards Raleigh, the train will need clearance from the CSX dispatcher to cross the A-Line.
6. Once the A-Line is cleared, the train will then veer from the AE-Line onto the NS VF-Line.

Limited Speeds along Hillsboro Street - The NS Timetable notes a maximum speed of 10mph along the VF-Line while trains are traveling down Hillsboro Street. North of Hillsboro Street, the VF-Line has a freight maximum speed of 25mph.

The table on the following page (Figure 5) summarizes these impacts and their potential for negatively influencing the ability of the Fayetteville station area to support passenger rail operations.

	West Route	East Route	■=Major Concern Likely to Require Mitigation ■=Moderate Concern Requiring Additional Investigation, Probable Mitigation ■=No Concern at this Time ■=Not Applicable to this Alternative
Station Access			A complicated three phase maneuver would be required for passenger trains using the Western Route to access and depart the Fayetteville Amtrak Station. This maneuver would require the engineer to walk between the locomotive and the cab-control car multiple times.
Multi-modal Connectivity			The FAST Transit Center is located one block south of the Fayetteville Amtrak Station. In the current configuration, rail passengers would have to cross both tracks, walk down Hillsboro Street, and cross Hay and Franklin Streets to make connections at the Transit Center.
Capacity Impacts			At the Fayetteville Amtrak Station, the A-Line has a dual track configuration. Passenger trains occupying Track 1 reduces the A-Line to one through track. Limited opportunities to add a third track or dual platform due to streets paralleling the A-Line on both sides through downtown.
Operational Speeds			Western route must travel down center of Hillsboro Street for approximately 2,500 feet from just north of the AE-Line transition. Authorized speed is 10mph. North of Hillsboro Street, the authorized track speed is 25mph to Cape Fear River Bridge (27 miles). All services evaluated in the Peer Review have an average operating speed of greater than 34mph.
Station Parking			The Fayetteville Amtrak Station currently lacks parking spaces to support additional rail patron parking. Amtrak patron parking was relocated to the Airborne and Special Operations Museum due to the construction of the new downtown Fayetteville baseball stadium.

Figure 5. Summary Table: Fayetteville Station Access.

Operations Detail: Raleigh Station Area

As with the Fayetteville station area review, the Raleigh Station Area review made several assumptions to facilitate the preliminary planning analysis of operations. The first is again that the service type (commuter versus regional) has not been determined. It is assumed that at least one roundtrip between Raleigh and Fayetteville occurs each day. Similarly, the locomotive and passenger equipment type has not been determined at this point in the study, but it is assumed that push-pull operations will be utilized. Hence, turning locomotives will not be required for each trip. The length of the passenger trainsets is unknown at this point and may vary depending on passenger demand.

The average length of local and through freight trainsets utilizing the corridors vary. The freight operations along the Western Corridor appear to be local in nature with trains operating out of Raleigh and serving businesses along the Norfolk Southern (NS) and VF-Lines. The freight operations along the Eastern Corridor appear to be a combination of local and regional. Along the H-Line, the freight operations are primarily local in nature, with local freight trains serving customers between Raleigh and the NS Selma Yard. Along the A-Line, the freight operations appear to be regional in nature with the majority of trains operating between major yards along the Eastern Seaboard.

Class One railroads are required by federal regulation to allow intercity passenger rail service. Freight railroads are not required by law to allow commuter rail service; therefore, agreements must be negotiated between the railroad owner and the operator of the proposed passenger service. It should be noted that Raleigh Union Station is currently served by GoRaleigh Transit bus service. A new bus terminal was recently approved for development next to the station.

Raleigh Union Station Area Track Infrastructure

The track infrastructure surrounding Raleigh Union Station is referred to as the Boylan Wye. The single-track NS-Line runs along the northwest leg of the Wye and continues north to NS' Glenwood Yard north of Downtown Raleigh. The CSX S-Line enters Boylan Wye from the north as a track paralleling the NS-Line before turning westerly, forming the west leg of the wye and merging with the NS H-Line as a multi-track section heading towards Cary. The NS H-Line enters Boylan Wye from the southeast and continues in a westerly direction, forming the southern leg of the Boylan Wye and continuing westward towards Cary and Durham as a dual track line with the S-Line. A connector track from the H-Line extends from CP Hunt (MP H81.3) forming the eastern leg of the wye connecting to the NS-Line and the S-Line just north of the Morgan Street overpass (CP Southern Junction MP NS 232.4). The NS-Line crosses the H-Line at CP Boylan (MP 80.9).

The combined NS H-Line/CSX A-Line extends west of Raleigh in a four-track configuration. The two northernmost tracks serve as the two main tracks, while the two southern tracks serve as the NS Prison Yard. A connector track extends east from the NS-Line at CP Boylan and ties into the Prison Yard Lead, which then merges into the H-Line just south of the southernmost station track. Currently, two intercity passenger station tracks serve Raleigh Union Station's center island platform. The station includes a dedicated space for a future passenger platform and track that lies between the station building/concourse and the northernmost station track. W. Hargett Street crosses over the NS Line, S-Line, and East Leg of the wye at-grade just north of the station. The South Boylan Avenue overpass crosses over the NS-Line, H-Line, and the S-Line, just east of CP Boylan. West Cabarrus Street crosses the H-Line and the east leg of the Wye at grade, just east of CP Hunt (refer to Figures 6 and 7).

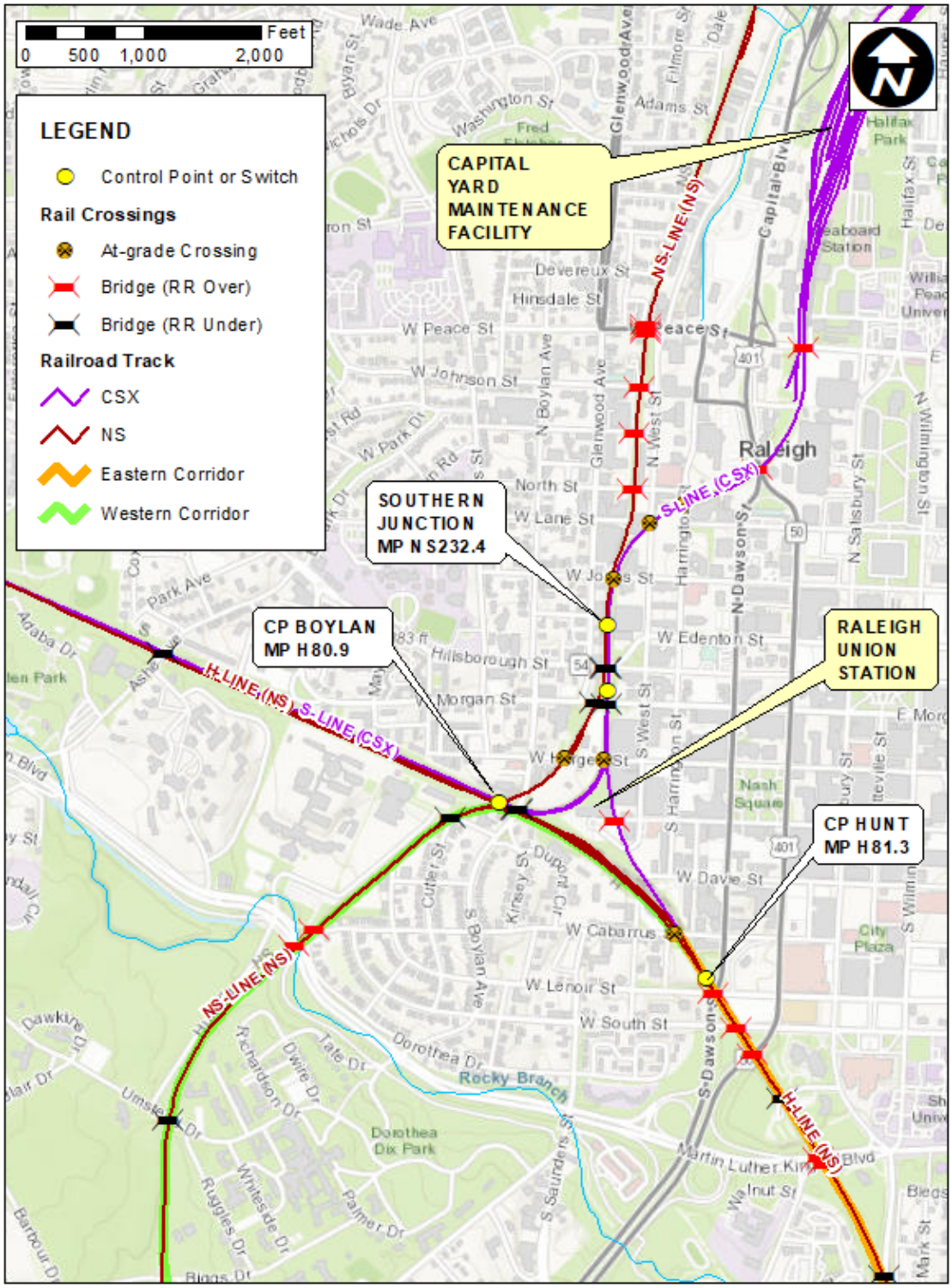

Figure 6. Raleigh Area Rail Infrastructure

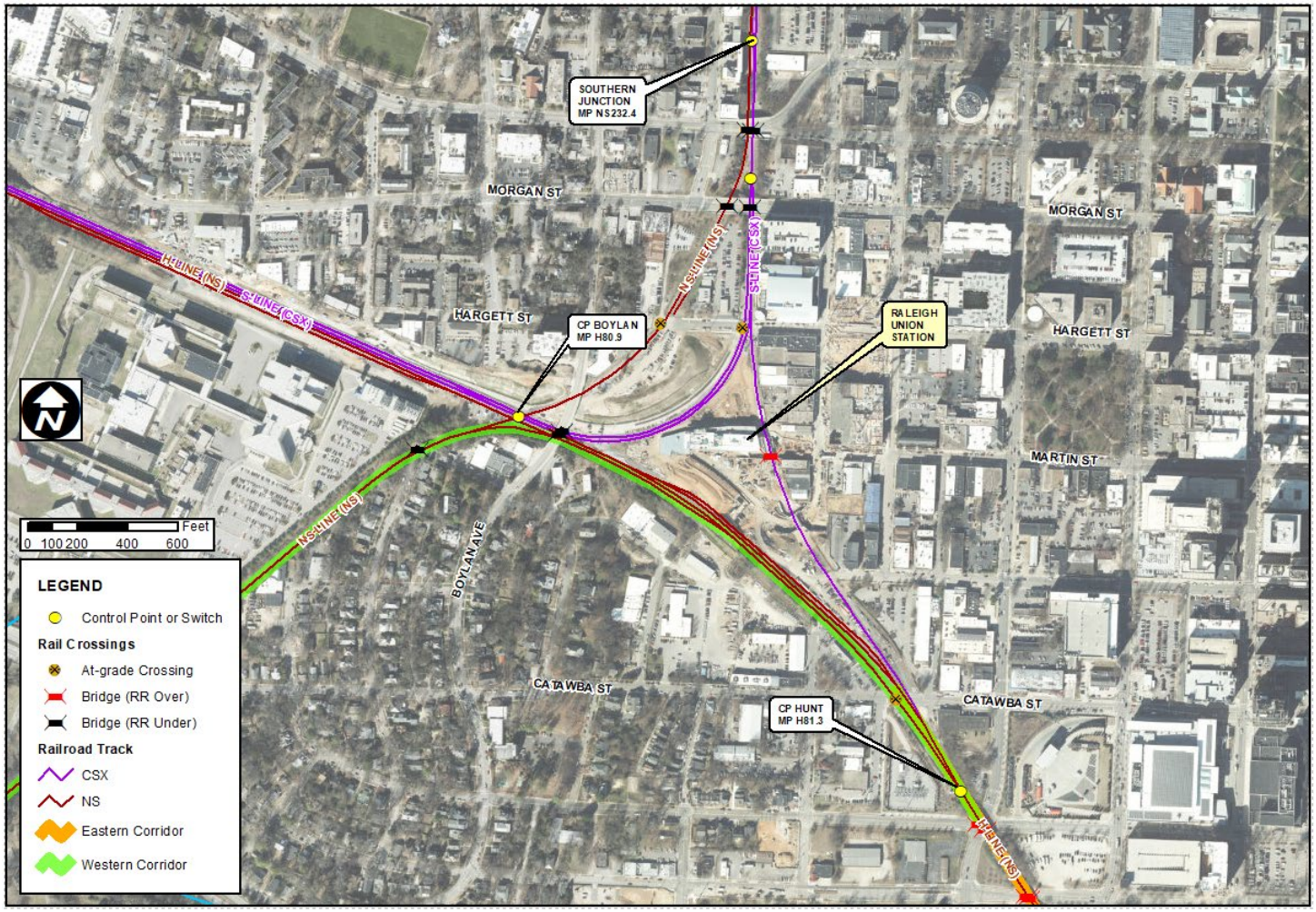

Figure 7.Raleigh Station Area.

Raleigh Union Station Access

Common Operational Challenges

NCDOT Rail Division staff noted the current configuration of the Capital Yard Maintenance Facility would not allow for the storage of additional passenger train sets between morning and afternoon operations. A storage location for the new train sets will need to be identified and evaluated for suitability.

Eastern Route Fatal Flaws

None – Raleigh Union Station is currently configured for intercity passenger and future commuter train access directly from the H-Line.

Western Route Fatal Flaws

Lack of Direct Connection to Raleigh Union Station - There is not direct access to the station platform from the NS-Line. The only access to the platform is via the H-Line. Trains from the NS-Line would have to execute the following maneuver in order to access the Raleigh Union Station platforms. This maneuver would be reversed in the evening.

(1) Northbound AM trains would use the connector track between the NS-Line and the Prison Yard Lead to enter the H-Line at CP Hunt.
(2) The train would continue eastbound until the last car clears the interlocking at CP Hunt.
(3) Once the last car has cleared the switch, the train reverses into the station platform

Low Authorized Track Speeds - Along the Western Route, the authorized track speed is 25mph to Cape Fear River Bridge (33 miles) in Lillington.

Figure 8 on the next page summarizes these concerns and their relative impact on the potential for passenger rail operations.

	West Route	East Route	■=Major Concern Likely to Require Mitigation ■=Moderate Concern Requiring Additional Investigation, Probable Mitigation ■=No Concern at this Time ■=Not Applicable to this Alternative
Station Access			A two - phase maneuver would be required for passenger trains using the Western Corridor to access and depart the Raleigh Union Station. This maneuver would require the engineer to transition between the locomotive and the cab-control car multiple times, causing the trains to incur delays.
Multi-modal Connectivity			Raleigh Union Station is currently directly served by existing GoRaleigh Transit bus service. A new bus terminal was recently approved for development next to the station.
Capacity Impacts			The current and proposed track configuration eliminates the need for trains serving the station to occupying the H-Line main tracks. Thus, there are no foreseen major capacity-related impacts in the vicinity of Raleigh Union Station.
Operational Speeds			Along the Western Route, the authorized track speed is 25mph to Cape Fear River Bridge (33 miles). All services evaluate in the Peer Review have an average operating speed of greater than 34mph.
Station Parking			There is existing and planned parking decks in the vicinity of Raleigh Union Station which should provide adequate parking for patrons.

Figure 8. Raleigh Station Area Summary Table.

Operations Detail: Selma Station Area

As noted previously for the other operational assessments of stations, the service type (commuter versus regional) has not been determined, with the ridership/revenue forecasts in this and subsequent studies playing a major role in the evaluation of each service type. It is assumed that at least one roundtrip between Raleigh and Fayetteville occurs each day of operation. Also as noted, the locomotive and passenger equipment type has not been determined at this point in the study; for the purposes of this study push-pull operations were assumed negating the need for turning locomotives or maneuvers. The length of the trainsets is unknown at this point and may vary depending on passenger demand.

The average length of local and through freights utilizing the corridors vary. The freight train operations along the Western Corridor appear to be local in nature with trains operating out of Raleigh and serving businesses along the Norfolk Southern (NS) and VF-Lines. The freight operations along the Eastern Corridor appear to be a combination of local and regional. Along the H-Line, the freight operations are primarily local in nature, with local freight trains serving customers between Raleigh and the NS Selma Yard. Along the A-Line, the freight operations appear to be regional in nature, with the majority of trains operating between major yards along the Eastern Seaboard.

The Selma Amtrak Station (Selma Station) will serve as the passenger station for the Smithfield-Selma area. It is noted that the area with the highest concentration of employment in the area is farther south towards Smithfield. As previously noted, Class One railroads are required by federal regulation to allow intercity passenger rail service, while freight railroads are not required by law to allow commuter rail service. Therefore, agreements must be negotiated between the railroad owner and the operator of the proposed passenger service.

Trains traveling between Raleigh and Fayetteville will transition between the H and the A-Lines in Selma. Under the existing scenario, the H-Line platform will likely be utilized by passenger trains traveling between Raleigh and Fayetteville.

Selma Area Track Infrastructure

The single-track NS H-Line runs east to west. The dual track CSX A-Line runs north to south. This dual track section of the A-Line runs from CP N. Smithfield (MP A164.4) to CP S. Micro (MP A157.9). A double crossover is located at CP N. Selma (MP A160.0). The two lines cross at Selma Interlocking (NS MP H109.4/CSX MP A161.0).

Connector tracks are located in the northwest and northeast quadrants Selma Interlocking. Yard tracks and the loop track serving the Bailey Feed Mill is located in the southeast quadrant of the interlocking and are unavailable for passenger train use. There is currently no connector track in the southwest quadrant. Selma Housing Authority property occupies the southwest quadrant. The Selma Amtrak Station is located in the northwest quadrant and has three platforms: H-Line, A-Line, and northwest quadrant. The NS Selma Yard is located along the H-Line approximately 3,300 feet east of the Selma Interlocking.

Figures 9 and 10 illustrate the conditions described in the text.

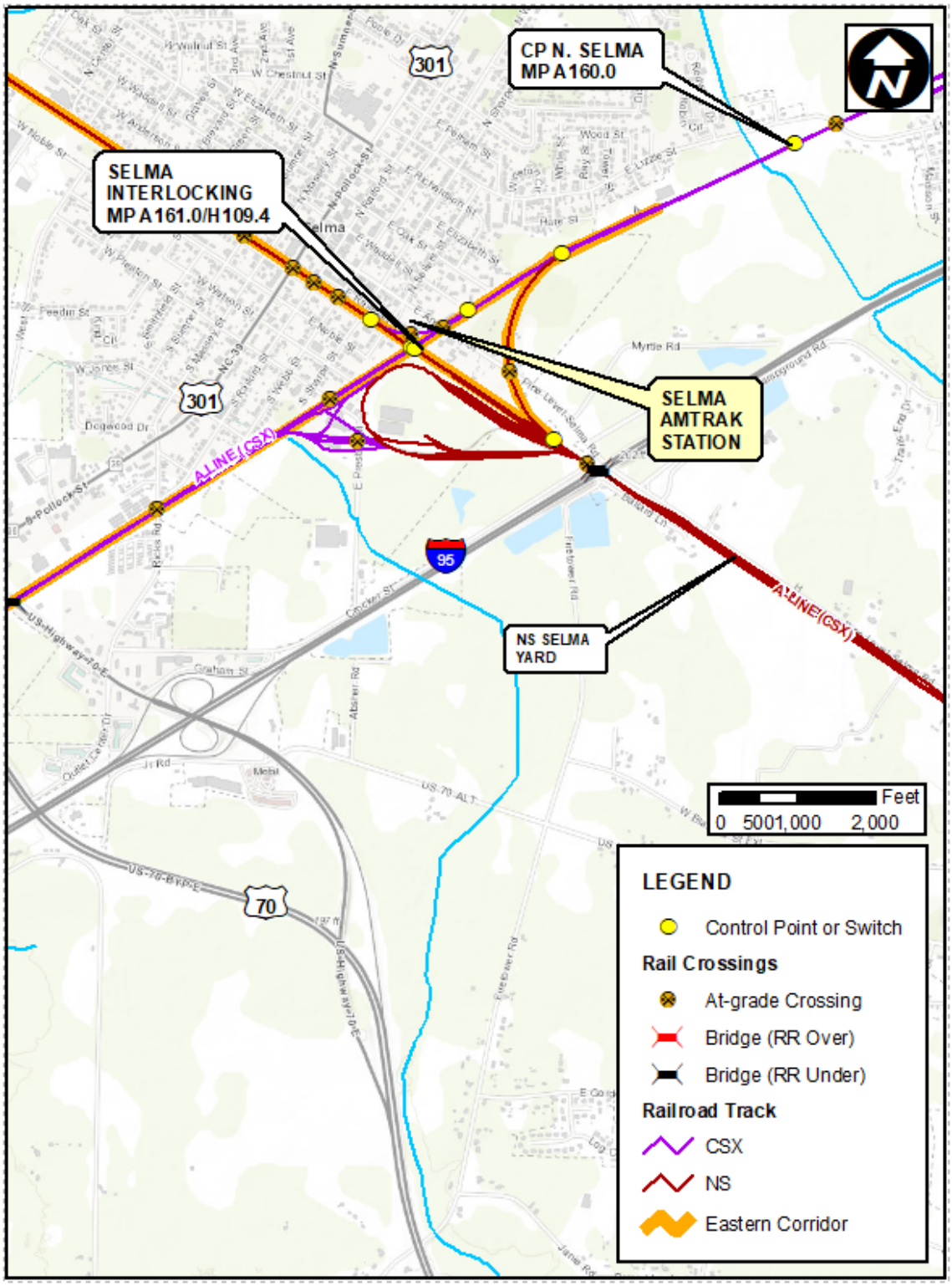

Figure 9. Selma Area Rail Infrastructure.

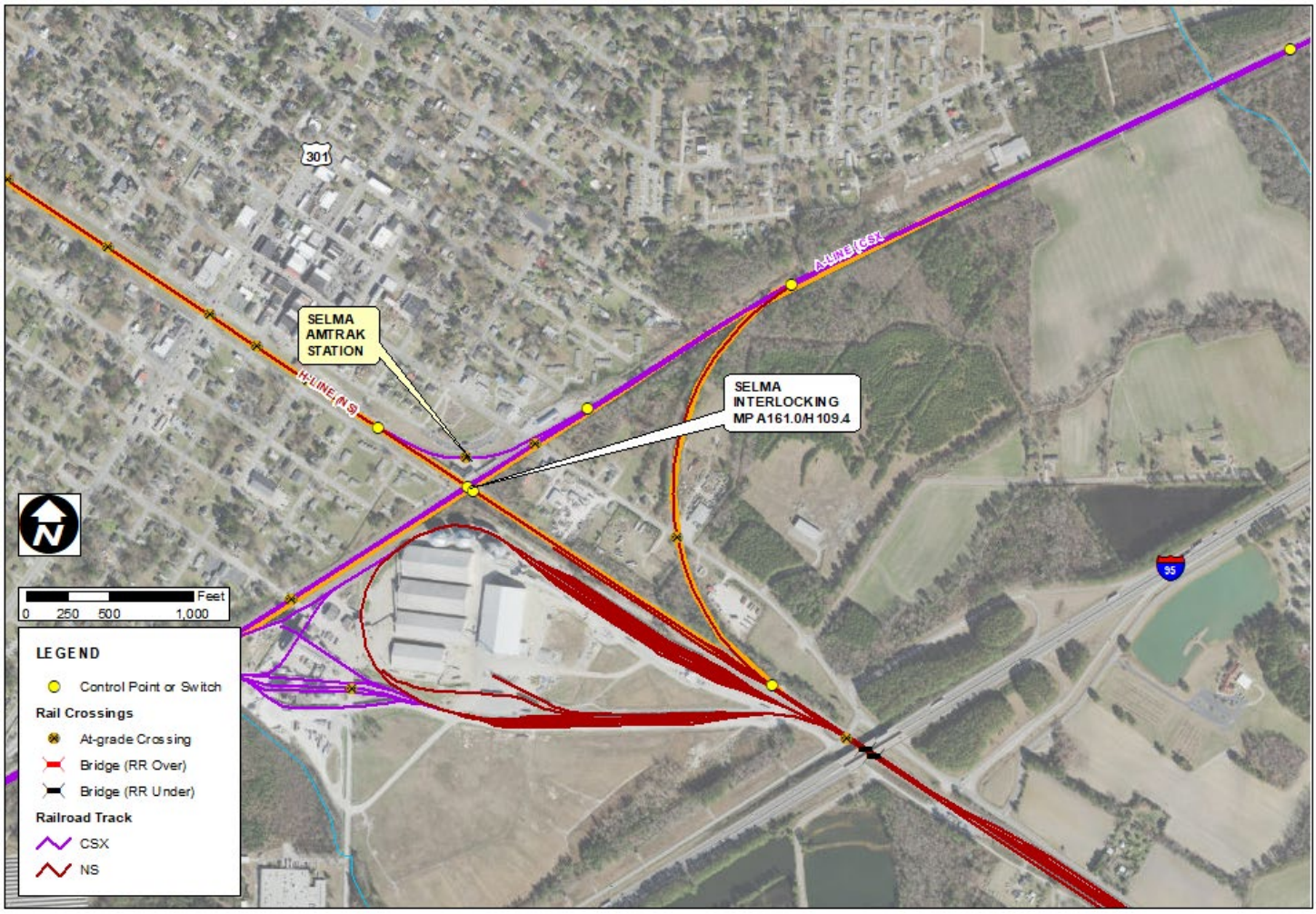

Figure 10. Selma Station Area.

Operational Challenges

The principle concern in Selma is the complex transition between the H-Line and the A-Line. The lack of a connector track in the southwest quadrant requires a complex and time-consuming maneuver in order for trains to transition between the A and H-Lines. Passenger trains would use the connector track in the northwest quadrant to transition between the A and H-Lines. NCDOT recently took a Piedmont train from Raleigh to Fayetteville and back and the following seven-stage maneuver was required to transition from the A-Line to the H-Line on the northbound trip, with the maneuver reversed when trains are traveling southbound to Fayetteville.

1. NB trains would utilize Track 1 as they approach Selma Interlocking.
2. NB trains would continue on Track 1, crossing over H-line as they approach the connector track in the northeastern quadrant of the diamond.
3. NB trains would continue north until the cab control car clears the switch to the connector track.
4. Once the switch is cleared, the conductor would walk from the lead locomotive to the cab control car and reverse the train through the switch and down the connector track to the H-Line.
5. The train would continue reversing along the connector track and onto the H-Line.
6. Once the switch is cleared, the conductor will stop the train and walk to the lead locomotive and progress the train forward along the H-line to the crossing of the A-Line. The train would await approval from the CSX dispatcher to cross the A-Line and progress towards Raleigh.
7. Upon approval to cross the A-line, the train would progress towards Raleigh, stopping at the H-line platform while ensuring the cab control car clears the A-Line.

CSX controls dispatching at Selma Interlocking. Additionally, the A-Line is the busier of the two lines, which would mean that trains would likely experience delays crossing and entering the A-Line.

The table on the following page (Figure 11) describes and summarizes the relative degree of impact to potential passenger rail operations in the Selma station area.

	East Route	■=Major Concern Likely to Require Mitigation ■=Moderate Concern Requiring Additional Investigation, Probable Mitigation ■=No Concern at this Time ■=Not Applicable to this Alternative
Station Access		The Selma Amtrak Station has three platforms, H-Line, A-Line, and along the connector track in the NW quadrant. Passenger trains will be able to access station platforms regardless of the A-Line/H-Line transition method chosen.
Capacity Impacts		If the H-Line platform is utilized, it is possible that trains serving the platform could foul the A-Line (block the tracks or impact signals requiring trains to stop). This could require operational changes for CSX freights and Amtrak trains utilizing the A-Line to reduce delays.
Operational Speeds		The complex maneuver to transition between the A and H-Lines would require multiple stops and starts in addition to the stop to serve the Selma Amtrak Station.
Other: A-Line/H-Line Transition		Transitioning between the A-Line and the H-Line would require a complicated and time consuming two or three phase maneuver. This maneuver would require the engineer to walk between the locomotive and the cab-control car on multiple occasions, adding to the time required to conduct the maneuver.
Station Parking		Parking is available at the station. Additionally, there is an adjacent parcel that could potentially be purchased to accommodate parking expansion for passengers.

Figure 11. Selma Station Area Summary Table.

Preliminary Ridership Forecasts

This study is intended to provide forecasts of passenger use of a Fayetteville to Raleigh rail line. Use is typically measured in ridership or boarding counts; the project team estimated station-level boarding counts. To do so, the project team is developing a series of statistical models. The use of statistical models to predict transportation phenomena is well established. The term 'Sketch Modeling' was popularized by TCRP 16 – 'Transit and Urban Form', but it is also referred to as 'direct ridership modeling' or 'direct demand modeling'. The application of direct demand models to ridership was suggested in a Rand Corporation report in 1968 (Kraf & Wohl 1968)[1].

'Sketch' models measure a forecasted (future) or estimated (current) number of boardings per location. They are also known as 'station-level' or 'stop-level' models. Sketch models have also been used to forecast travel at new stations (Preston & Wardman 1988)[2]; they compare favorably with competing methods (Preston 1991)[3] for rail journeys. Many of the early applications of direct ridership modeling was by consultants. Direct demand modeling was also applied to BART, a heavy rail system in California to provide station-level ridership predictions[4]. A direct demand ridership model for St. Louis MetroLink[5] was developed to overcome deficiencies in the local travel demand model6. A direct demand ridership model was developed and applied to Santa Monica[7] for bus on highways. A similar model was applied to predicting BRT ridership in Los Angeles[8].

Methods and Data Used in the Fayetteville-Raleigh Passenger Rail Study

For this study, the project team applied the '7D-variable' approach to modeling transportation behavior. It is a widely used representing the way in which urban form affects travel behavior.

Figure 12 on the following page describes the seven "D" variables.

D-Variable	Measurement
Density	Density is always measured as the variable of interest per unit of area. The area can be gross or net, and the variable of interest can be population, dwelling units, employment or building floor area. Population and employment are sometimes summed to compute an overall areal density per areal unit (e.g., persons per square mile).
Diversity	Diversity measures pertain to the number of different land uses in a given area and the degree to which they are balanced in land area, floor area, or employment. Entropy measures of diversity, wherein low values indicate single-use environments and higher values more varied land uses, are widely used in travel studies. Job-to-housing or jobs-to-population ratios are less frequently used.
Design	Design measures include average block size, proportion of four-way intersections and number of intersections per square mile. Design is also occasionally measured as sidewalk coverage (share of block faces with sidewalks); average building setbacks; average street widths; or numbers of pedestrian crossings, street trees or other physical variables that differentiate pedestrian-oriented environments from car-oriented ones.
Destination Accessibility	Destination accessibility measure ease of access to trip attractions. It may be regional or local. In some studies, regional accessibility is simply distance to the central business district. In others, it is the number of jobs or other attractions that can be reached within a given amount of travel time, which tend to be highest at central locations or along high-speed transportation facilities.
Distance to Transit	Distance to transit is usually measured as an average of the shortest street routes from the residences of workplaces to the neatest rail station or bus stop. Alternatively, it may be measured as transit route density, distance between transit stops or the number of stations per unit area. Frequency, quality of routes, and quality of transit service are often overlooked.
Demand Management	Demand management represents additional (financial) costs of travel. It tends to be measured in terms of tolls, fares, and (especially) parking prices.
Demographics	Descriptions of the population that provides the likely market for transit patronage. Demographic variables like age, car ownership, and income levels are frequently used to try to help assess the likelihood of transit usage in a population.

Figure 12. Description of the 7D Variables.

This study used a cross-sectional research design to compare models including both built environment and transit system data, to determine which variables effectively predict ridership. The outcome variable is boarding counts at each proposed station. Data from the Decennial Census, the American Community Survey, and the Longitudinal Employer-Household Dynamics (LEHD) program is being used to calculate Density, Diversity and Design variables. Following Ewing, et al (2015)[9], the built environment characteristics of stations were measured

at four different buffer distances: two miles, mile, half-mile, and quarter-mile for each variable. To prevent endogeneity (double counting) between buffer totals, larger buffers are broken into 'donuts' (torus shapes) around the central buffer. Euclidian (straight line, or "as-the-crow-flies" distance) buffers were used for the preliminary ridership forecasts. Drive-time buffers may be tested later, but research suggests that buffers created from travel times along a network do not offer measurably better predictions.

Direct-demand models have been favorably cited as being able to capture built-environment / transit interactions such as distance decay (Cervero 2006);[10] reduced proximity reduces interaction, the probability/frequency of transit use is typically the inverse of distance to a station – persons who live near the station are exponentially more likely to use commuter rail.[11] Additional primary data collection is ongoing, including WalkScore (as a design variable), distance to the tallest commercial structure (as a proxy for destination accessibility); and, depending on data availability, bus stop / route area density.

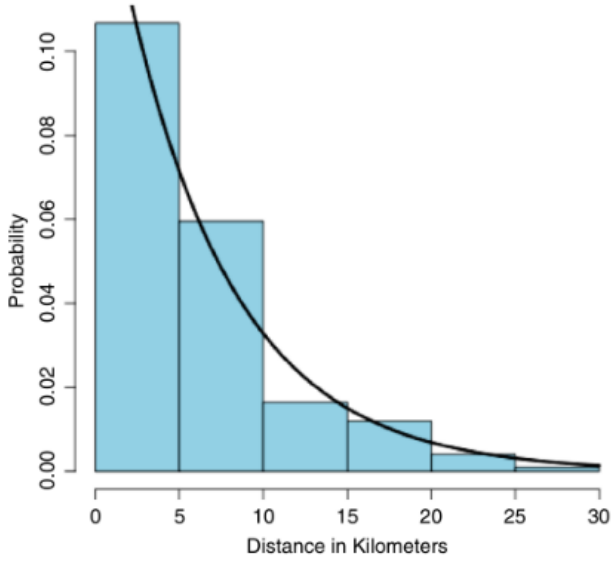

FIGURE 2 Distance decay of station service population ($p = 0.157e^{0.157x}$).

Figure 13. Distance Decay Function (Montreal)

Data availability is often a limiting factor in constructing sketch models, which require rigorous calibration[12]. Not all agencies can or are willing to provide station-level boarding counts. However, the project team has obtained station-specific boarding counts for 2017 from 14 agencies, representing approximately 750 commuter rail stations out of approximately 1,350 total stations active in the U.S. The project team has also obtained boarding counts (annual) for 528 Amtrak stations. In future iterations of modeling it may be possible to determine a scaling factor, or it may be a superior alternative to produce two different models—one for commuter rail (peak/hourly service) and one for Amtrak-type service.

Application to Preliminary Ridership Forecasts

Ridership forecasting for passenger rail service (and other modes of travel) is inherently uncertain. Ridership on transit services is subject to external forces like the state of the economy or fuel prices that are hard to predict and generally outside the control of any agency ("externalities"). The approach that is being taken by the Fayetteville-Raleigh Passenger Rail Study is to consider current and recent ridership on existing services, particularly with respect to the characteristics of those services, how they are likely to relate to a service that is feasible for this project, and the specific characteristics around each station area.

Station area characteristics in the forecast model are described by the '7D" variables outlined by Reid Ewing and other practitioners on the Metro Analytics project team. Each variable may

explain a part of the choice of using the station and service. Each of the 7D variables described in Figure 12 was operationalized in the model as follows.

- **Density** is an areal measure of the amount of population, jobs and households. The model uses population data from the 2017 American Community Survey (ACS), but because the smallest unit of geography for which both are available is the block group, and so the project team considers block-level (finer-grained geography) statistics from the Decennial Census (2010) block population as an input variable. Housing density from 2010 was also considered. Finally, the project team modeled activity density, activity density, which is the sum of population density and employment density. For employment, the most recent and consistently available year is 2017 LEHD data.
- **Diversity** refers to the mix of uses. The project team modeled this as the jobs to population ratio but may calculate an employment entropy variable using LEHD data.
- **Design** refers to 'Urban Design'. The project team modeled a number of variables, including average census block size (in acres) within a buffer as well as intersection density. The project team also included the Walk Score of the station as a variable.
- **Destination Accessibility** measures ease of access to trip destinations. Measuring access to all destinations is difficult and complicated, so most published research quantifies it using relative centrality as a metric—proximity to the center of the metropolitan region. More advanced analyses also include a metric for the magnitude of the central region. It has been well-known for decades that the size of the (Central Business District (CBD) has significant effect on commuter rail ridership. Ways to operationalize what constitutes 'downtown' are highly variable. The study uses the location of the tallest commercial center-- while the tallest structure may not be the exact center of the CBD, it is likely close by, and then buffer that distance by a half-mile.
- **'Distance to Transit'** included variables for both the presence and quality of transit. Due to the amount of primary data collection required, the project team's efforts to model this have been limited to a single variable – number of trains per day. During ongoing model development, the project team intend to add variables for factors such as transit centers and park and ride lots, which improve access to transit stations, increasing the 'reach' of those stations to non-proximate users.
- **Demand Management** represents additional (financial) costs of travel. It tends to be measured in terms of tolls, fares and parking prices. For this D-variable, the median hourly rate for daily parking for the downtown areas, derived from the INRIX company's parking data: www.parkme.com/raleigh-nc-parking. For example, the typical hourly parking rate from this data source is $2.00 for Raleigh and $0.50 for Fayetteville.
- **Demographics** refer to demographic characteristics of persons or households. In the context of this analysis, the primary demographic variable of interest is income. Research on commuter rail typically shows middle income populations don't use commuter rail. The ACS provides data on income in three categories – low, middle, and high. The number of low- and high-income persons near each station (distance-weighted) as a demographic variable is used in this model. Income questions were omitted from the 2010 Decennial Census, so minimal other data is available. The Current Population Survey provides data, but only at the state level, and therefore not useful for this study. The project team used the income category variables available through the LEHD. Age and race variables are sometimes included in similar models—

the young and old are generally more likely to ride transit as car ownership and use decline at both ends of the age spectrum.

Modeling Approach

The modeling approach used is incremental and will continue to add more data to refine the predictive equation. Preparing the same variables at different stations is time-consuming, especially given the need for consistent data processing to ensure rigor. The Fayetteville-Raleigh Passenger Rail study model development efforts have prioritized variables that can be calculated using existing secondary data sets—the density, diversity and design variables, and the inclusion of demographic control variables. Primary data collection is time-consuming, expensive, and will be engaged only when research suggests the variables are both important and independent of other D-variables. Parsimony between variables is an important guideline – built environment variables are highly correlated and direct ridership models are often limited because limited degrees of freedom (resulting from small sample sizes) means only a few variables can be included. This relationship between sample size and model confidence represents a serious limitation that can only be overcome by adding additional samples.

Research suggests the following variables influence rail use in a meaningful and statistically significant way: CBD size, station distance to CBD, number of daily trains, population and employment densities, housing units, housing density, land use mix, number of parking stalls at stations/park-and-ride stop capacity, number of feeder bus routes, status as a terminal station, distance to nearest station, regional connectivity, weather (heating/cooling degree days), network centrality, and percent renters. While not included in the correlational model, changes in price and service frequency were strong predictors over time. Research also suggests that different income groups have different access modes, and consequently different access distances: wealthy commuters tend to drive to stations more often, while less-wealthy commuters bike or bus to the station. The statistical modeling approach has been to specify a model with all variables, and then proceed iteratively by removing the least significant variables. At each iteration, removed variables are then compared to residual outputs from the model to determine if removal of other variables has increased its significance.[13]

The existing statistical models developed by TCRP 16[14] are problematic because they are based on data from different contexts than those exhibited in the FAMPO/CAMPO study corridors. The sampled date from TCRP 16 is typically from established commuter rail systems that are now part of a network of rail and “feeder” services. This new model is based on a sample of commuter rail systems build during the ‘New Starts’ era and more representative of the proposed Fayetteville to Raleigh commuter service. The project team has included the outputs from a TCRP model as an ‘optimistic’ scenario—what a reasonable estimate would be if the corridor had been a commuter railroad representing a best-case. In contrast, the pessimistic case represents the addition of a single Amtrak-style train, such as through the extension of one of the current Piedmont daily trains.

Preliminary Ridership Forecasts

The only variable tested in the model that is statistically significant is population within two miles. It is also the input variable most highly correlated with boarding counts. This finding is consistent with published literature, but as additional cases are added other variables may become significant.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.451e+01  2.785e+01  -0.880  0.39368
pop17        3.488e-03  8.996e-04   3.878  0.00167 **
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 51.12 on 14 degrees of freedom
Multiple R-squared:  0.5178,    Adjusted R-squared:  0.4834
F-statistic: 15.04 on 1 and 14 DF,  p-value: 0.001674
```

Figure 14. Amtrak / Population-Based Statistical Model Parameters.

In contrast, the application of the TCRP-based model suggests much higher numbers, but it is also based on a number of assumptions: available parking at each station; 30mph travel speed; half-hour peak service frequency (headway); treatment of Fayetteville and Raleigh as a single metro region; and 8% of households not owning a car. The model developed by Lane[15] is calculated as follows in Figure 15.

Average Weekday Boardings per Non-CBD Station = 13.9031	
2.417	Main Coefficient
1.069	If parking present
0.51	If station is transportation or trunk
0.0515	Travel speed (mph) to downtown
-0.0155	Travel time to CBD
0.0083	Train frequency (headways)
0.0018	Stations (e.g., size of system)
2.38658E-10	Size of metro area
0.265	Size of station area population
-1.173 zero-car households/households with cars within 2 miles of station	Car ownership
0.0000628 x jobs within half-mile	Size of station area employment
0.0871 x miles to nearest station	Distance to nearest station

Figure 15. TCRP (Lane) Update Model Parameters.

As noted previously, this model is based on similarity to existing 'legacy' commuter rail systems such as the MBTA and SEPTA systems. Total ridership that results from the application of this model to the Fayetteville-Raleigh study area is an unlikely outcome since, in addition to commuter rail, the home regions also have well-developed rapid transit networks facilitating transfers from commuter rail which expands the effective catchment areas at both ends of trips.

A comparison of the boarding count forecasts for the two models is shown in Figure 16.

Western Route			Eastern Route		
Models:	*Pop/Amtrak*	*TCRP 16*	*Models:*	*Pop/Amtrak*	*TCRP 16*
Raleigh	268	2,100	Raleigh	268	2,100
Garner West	91	429	Garner East	124	573
Wake Tech	85	426	Clayton	51	472
Fuquay-Varina	103	422	Selma	30	479
Lillington	13	331	Benson	26	184
Fayetteville North	40	159	Dunn	22	163
Fayetteville Center	58	250	Fayetteville Center	58	250
Totals	**658**	**4,117**		**578**	**4,221**

Figure 16. Preliminary Boarding Count Forecasts (two models).

For the population-only (Amtrak data) model, there is approximately one boarding for every 286 persons within two miles of each station, suggesting boarding counts that are substantially below peer commuter rail systems.

However, based on the review of peer systems these numbers still seem infeasibly high, especially for initial operations. The railway will be run on a freight railway through some urbanized areas that generally post-date the commuter rail area, and through other places with sprawling and sometimes still-rural metropolitan region without existing public transportation. The total change in marginal accessibility will be relatively small, and existing land uses will take decades to respond to the change in transportation accessibility. However, the Amtrak/population model likely understates the utility of the proposed line for commuting travel (including reverse commuters) and the capacity of connections to local bus services to increase catchment area. Finally, 'terminal' stations have boarding forecasts that are often underpredicted as they have larger catchment areas.

Bounding the Model Outcomes

While the sketch models provide order-of-magnitude boarding forecasts, model results were also checked against control totals from local travel demand models, existing Amtrak service, Streetlight Data, and LEHD Origin-Destination Employment Statistics (LODES).

Analysis of existing Amtrak service suggests that while neither route distance nor mean speeds strongly correlate with ridership, the number of trains per day is relevant (Figure 17).

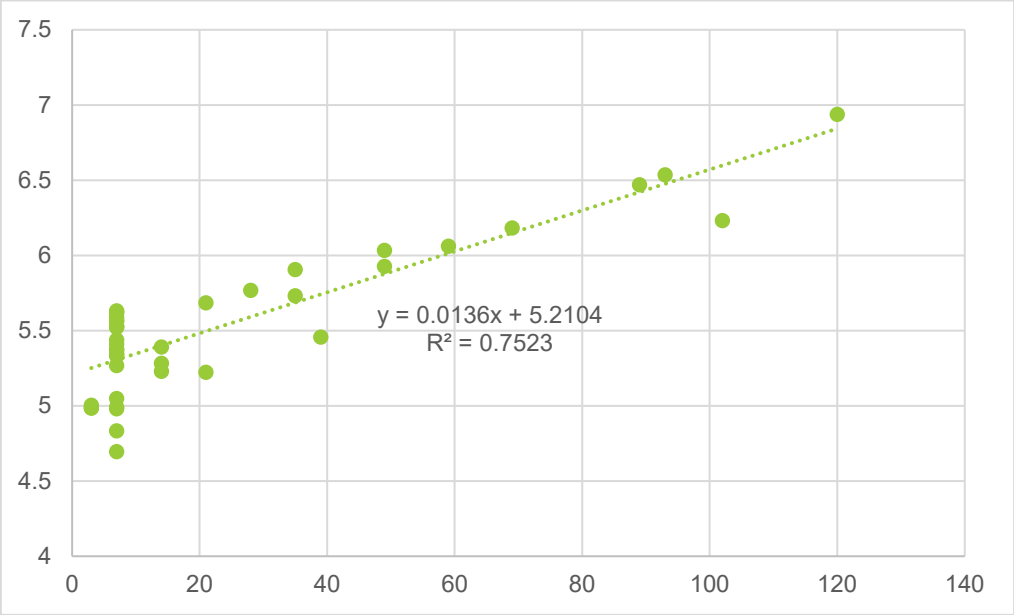

Figure 17. Amtrak Trains/Week v. Passengers (log)

However, there is tremendous variability for trains that come only once a day, suggesting other factors play a significant role.

Using LODES data, the project team also analyzed the number of workers living within a median access distance (two miles) of a commuter rail station and working within walking distance (half-mile). Figure 18 provides an estimate of the number of current commuters (not trips) that could ride the proposed rail line near the corridors and near just the stations.

	Variable	FV (West)	Selma (East)
Corridor	Live	83,066	28,956
	Both	10,952	4,964
	Work	98,005	80,721
Station	Live	60,921	56,815
	Both	5,612	4,560
	Work	77,979	49,811

Figure 18. LODES Estimates of Potential Commuters in the Corridor.

To have ridership proportional to peer commuter rail systems such as the Nashville Music City Star (1,200 average daily riders), the Western Route would need to capture about 10% of that market and the Eastern Route about 13%.

Finally, initial analysis of Streetlight data suggests that there are an estimated 230 trips originating from within two miles of the Fayetteville station area with destinations inside the I-440 Beltline. The values are based on adjusted estimates from an approximately 20% sample travelers with cell phone making trips through the study region.

Additional refinements to both the preliminary estimate and bounding the optimistic-pessimistic ranges of outcomes will continue to be the focus of future refinements to the forecast methods.

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Appendix A. Glossary of Terms

Consist. Term describing the length of a train set (including locomotive) or a document kept at point of origin and advanced to next consisting point listing the train makeup in standing order, the number of passenger and freight cars, commodities, and a summary of the train including tonnage and train length.

Dispatch / Dispatcher. Act of, or employee responsible for, directing and monitoring the movement of trains.

Euclidean (Distance). The straight-line distance from point to another, without considering topography, traffic, or other barriers.

LEHD (Longitudinal Employer-Household Dynamics). A dataset created in a partnership between the US Census Bureau and states that describes employment characteristics at various geographic levels. The data is built primarily from Unemployment Insurance (UI) earnings data and the Quarterly Census of Employment and Wages (QCEW), and censuses and surveys.

LODES (LEHD Origin-Destination Employment Statistics). Annual data on locations and characteristics of workers by residence and workplace, and home-to-work flows compiled from federal administrative records. The data source covers 90% of all U.S. workers, describing home-to-work flows between Census Blocks.

INRIX (company). A private company specializing in the collection and distribution of vehicle positioning data for use in analytical and operational services.

Motive Equipment. Referring to the locomotive or engine that propels the train set.

Passenger Equipment. Referring to the units in the train set that are used for traveler accommodation.

Push-Pull. Any configuration of train sets whereby motive force can be applied from the front ("pull") or the rear ("push"); this may be accomplished using a control car or two locomotives, for example. This configuration may negate the need for complex turning maneuvers at turn-around points.

Yard. A system of tracks other than main tracks and sidings. A yard is used for making up trains, storing cars, and other purposes.

Note: Some definitions sourced from CSX train dictionary (*www.csx.com/index.cfm/about-us/company-overview/railroad-dictionary/?i=Y*).

Appendix B. Key Stakeholder Interview Notes

Interview: NCDOT Rail Division
Date of Interview: January 9, 2020

Attendees:
Craig Newton – Facilities Engineer Consultant (Stations)
Neil Perry – Planning Manager
John Dees – Rail Freight Planning Consultant
Ryan White – Stantec Consulting Services Inc.

Summary of Conversation
In accordance with the scope of services and in preparing the fatal flaw analysis, Ryan White with the project team met with the NCDOT Rail Division's Operations and Planning staff to discuss operational concerns about passenger rail in the two study corridors.

Below is the summary of the questions and answers received as the notes were taken during this meeting. This material has already been largely incorporated into the fatal flaw analysis in the main body of the technical report.

Raleigh Union Station

1. During the development of RUS, was there every any consideration for passenger service via the NS-line to Fayetteville via Fuquay-Varina?
    - Initially there was a plan to realign the S-Line [from the north of RUS] directly to the NS-line [south of RUS]. Currently, there is a connector track between the NS-line and the Prison Lead track
    - There was consideration for a GoTriangle platform along the south side of the H-Line [near the location of the since removed Amtrak Station]. NCRR owns the property. RUS is currently set up for an extension of the underground concourse under the H-line.
2. Besides the addition of the commuter platform, what other modifications would need to occur at RUS to accommodate commuter operations?
    - RTC modeling would be required in order to ensure train movements are coordinated and determine if any additional track modifications are required. We believe the existing track geometry works. Intercity platforms are four-foot high. Would need to coordinate with GoTriangle regarding likely equipment type which would dictate platform requirements. Noted, Go-Triangle would like to have 25-in high [low boarding] passenger equipment.
    - Stairwell and elevator shaft constructed for commuter platform
3. W/o push-pull, multiple backing moves would be required for commuter trains from the NS-line access the RUS commuter platforms. What are your thoughts? How would this conflict with intercity operations during morning and afternoon rush hours?
    - Noted trains would operate in push-pull.
    - Noted approximately 12 trains per day east of Raleigh along the H-Line. Some felt this number was still high. Includes 4 existing Amtrak trains (2 westbound and 2 eastbound)
4. Studies have been done for commuter service to Wake Forest. How would commuter trains from northern Wake County RUS….via the future SEHSR platform?

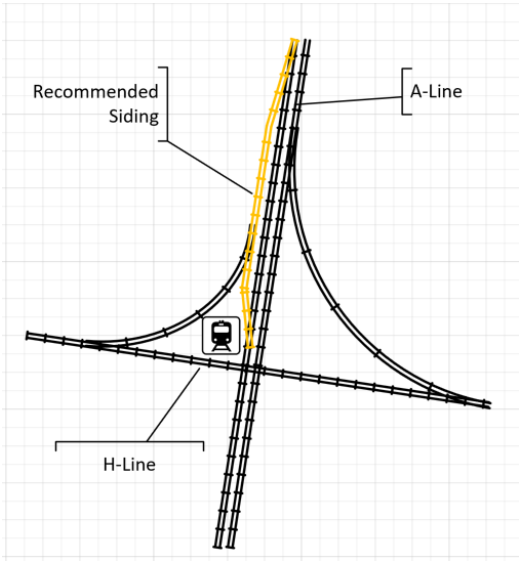
- Joint SEHSR/Wake Forest Commuter Rail Platform along NW leg of the Boylan Wye. Would require replacement of the Morgan Street Bridge.

5. Is there capacity at Capital Yard for maintenance of commuter rail equipment?
   - No storage capacity at Capital Yard for holding trains during mid-day. Would need to identify a location to store train sets during mid-day.
6. Other thoughts or concerns about RUS
   - Stairwell and elevator shaft constructed for commuter platform

Selma

1. Without a connector in the SW quad, commuter trains would utilize the existing H-line platform before/after making the turnaround move to transition from between the A/H-lines. Allan Paul noted challenges. Would third main in this area simplify the dispatching?
2. If a train is serving Selma using the H-line platform, does the proximity of the locomotive (when facing east) or the last car (when facing) to the A-Line diamonds require the dispatcher to not allow traffic on track 2 of the A-line to pass?
   - CSX to likely play role in determining which platform is used.
   - Less than 100 feet of A-line platform is usable.
   - When the Palmetto services Selma, the H-Line is blocked.
   - NCRR is most likely owns the right to the diamond. Trains serving the H-line would have the right to foul the diamond.
   - Recommend siding along A-line in NW quadrant*****5-10 minutes for PTC to reinitialize when changing ends with push-pull equipment. Trains could use the curved platform. However, trains may use the A-line platform is Amtrak is serving the station.
2. Has there been any studies regarding adding a connector in the SW quadrant?
   - No studies
3. What are your thoughts about a loop track in the NE quadrant to eliminate the need to impact Selma Housing Authority property.
   - >17.5-degree curve would be required (700' diameter loop). Not preferred.
4. What are your thoughts on an alternative location for commuter service in the Smithfield-Selma area?

- Open to consideration
- What's the status of the lot just north of the Selma parking lot for additional parking? Would NCRR consider parking within the corridor
- CSX would likely recommend dual platform station.



Fayetteville

1. Assumption is that the Fayetteville Amtrak Station would serve as the commuter rail station. Connectivity to the FAST Transit Station would be via a short walk. Would major modifications be required at Fayetteville to convert it to commuter services?
   - Consider the Cape Fear & Yadkin Valley RR Station.325 Franklin Street
   - Limited parking at the Amtrak station due to conversion of parking to baseball stadium
2. The only wye location found was via the connector to the A&R in downtown Fayetteville. Are you aware of any other locations?
   - Push-pull locomotive system the wye not needed
3. What are your thoughts of constructing a platform adjacent to the FAST Transit Center along track 2 and using that as the commuter station?
   - Trains awaiting at the platform at Fayetteville Station prevents NB access to the Milan Yard lead track and the downtown CSX Yard.
   - Would require removal of Winslow Street. With double track…you would likely need dual platforms in order to provide CSX with flexibility in utilizing both lines.
4. The Fayetteville CSS noted a new connection between the NS VF line and the A-line in NW Fayetteville. Were any additional studies done on this connection?
   - No additional studies to date.

Additional Notes

- Both corridors are being considered for inclusion into STI prior to study complete. Rail will use order-of-magnitude costs
- Phase II of the study will provide more accurate cost estimating.
- Requested explanation of R-R Modeling methodology.

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