

# Durham/Raleigh – Highway Cap Evaluation

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### Overview

Working with the Regional Transportation Alliance (RTA), HDR evaluated numerous locations in the Durham and Raleigh areas to determine the feasibility of incorporating a Highway Cap (Cap) to reconnect communities. Locations were studied along the NC-147 Freeway, Interstate 40, Interstate 885, and Interstate 440. On November 8, 2024, Richard Hancock and Roger Eaton with HDR toured numerous potential Cap sites alongside Joe Milazzo II, PE executive director of RTA. Sites were viewed in three different locations: The City of Durham, Research Triangle Park, and the North Hills area near Raliegh. This report provides background on Cap structures, details on Cap design criteria, summarizes site visits, and provides a recommendation on suitable locations for further evaluation.

### Highway Cap Background

According to the U.S. Department of Transportation, 475,000 households were displaced between 1957 and 1977 to make way for federal interstate construction. Over the last decade, cities are seeking methods to reconnect those communities that were separated long ago.

In many cities, the interstate roadways were constructed through densely populated areas and, in an effort to minimize the required right of way, the roadways were constructed in "cuts" resulting in the roadway having large retaining walls along each side. With this construction style, the city was left severed by the "depressed" roadway with only limited locations providing vehicular connections over the interstate.

For cities that have this condition, new Cap structures can be built over the depressed roadway sections to reconnect the communities. Under this scenario, long stretches of the roadway could be covered to provide new green space containing amenities selected by the community.

A couple examples of this type of Cap are shown below:



Pictured above is the I-579 Urban Open Space Cap in Pittsburgh, PA. Here a 3-acre park was constructed between two existing vehicular bridges over the interstate roadway to reconnect the downtown core of the city with the Hill District neighborhood.



Pictured above is Klyde Warren Park in Dallas, TX. Here a 5.4-acre park was constructed over the freeway between four existing vehicular bridges to reconnect downtown Dallas with the Uptown Arts District. The roadway decks for two of these existing bridges are shown at the top and bottom of this photo.

Numerous cities across the United States currently have projects in the planning, design, or construction phases using this concept.

## Highway Cap Criteria

As highway Caps are relatively new in the engineering world, there is no standard criteria established for their design. As such, criteria from other well-established associations is used to develop site specific design criteria for each project/location. There are three primary documents that can be used to develop the design criteria as follows:

- National Fire Protection Association (NFPA) 502 *Standard for Road Tunnels, Bridges, and Other Limited Access Highways*
- American Association of State Highway and Transportation Officials (AASHTO) *LRFD Bridge Design Specifications.*
- National Tunnel Inspection Standards (NTIS), 23 CFR Part 650 Bridges, Structures, and Hydraulics Subpart E *National Tunnel Inspection Standards*

If building structures are including on top of the Cap, additional building-related standards such as ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures would apply.

Different portions of these documents can be referenced to develop the criteria.

One of the most important aspects of a Cap structure is the length of coverage over the interstate/freeway. In accordance with NFPA 502, this determines the classification of the Cap and has the greatest effect on the complexity and cost of the structure. The NFPA 502 standard establishes four tunnel categories based on three coverage lengths (L) measured along the roadway:

- Category X: L <300 feet
- Category A: L >300 feet and <1,000 feet
- Category B or C: L >1,000 feet

All categories require evaluation according to NFPA 502, however, if the coverage length can be kept below the 300-foot limit (Category X), typical bridge design criteria would likely govern the design. If the coverage length is greater than 300 feet but less than 1,000 feet (Category A), an indepth engineering analysis would need to be performed to determine what tunnel criterion would need to be incorporated into the design. From past experience, tunnel lighting criteria would need to be met at a minimum. Once the coverage length is over 1,000 feet (Categories B and C), extensive engineering analysis is required and tunnel systems become mandatory.

### Durham – Raleigh Sites

#### **Durham Sites:**

Three sites were visited along NC-147 in Durham as shown below on the map.



Based on the topography of area surrounding the NC-147 roadway through Durham, the freeway was not built in a "depressed" style as discussed previously. The freeway rather traverses through the city using minor cut and fill construction that utilizes structures over and on the freeway to provide connectivity of the street system. This complicates the selection for a location of a Cap and led to the evaluation of locations near existing overpass structures as the most practical sites.

Each site was evaluated for suitability of a Cap based on the surrounding amenities, the topography, and the geometry of the freeway.



Cap Site 1 – South Alston Avenue over NC-147

- Combining the Cap with the west side of the existing South Alston Avenue Bridge would be preferred at this site.
- The grading along NC-147 tapers quickly away from the existing bridge along the southern side limiting the cap length.
- There are no buildings near the ramps which lessens concerns with ROW and utility conflicts.
- NC-147 has a wide grass median which makes construction easier.
- Walls along the ramp on the south end of the Cap could be required.
- The existing interchange ramps limit direct access to the Cap. Therefore, pedestrian crossings over the ramps would need to be improved to provide safe access to the Cap.

#### Cap Site 2 - Fayetteville Street over NC-147



- The existing interchange ramps limit direct access to the Cap. Therefore, pedestrian access over the ramps would need to be studied to improve accessibility and safety.
- Combining the Cap(s) with mobility improvements along Fayetteville Street would be a major component for the success of this site.
- The length of the Cap structures along the freeway is limited by the ramps associated with the interchange and the limited vertical clearance of the existing bridge over the freeway (~20' minimum along the north end of the bridge).
- The curvature of the interstate complicates the geometry of the Cap structure.
- NC-147 has a wide grass median which makes construction easier.
- A Cap can be constructed on either side of the existing overpass bridge or on both sides as depicted above.



Cap Site 3 – South Mangum Street over NC-147

- Pedestrian access over the connector roads would need to be studied to improve accessibility and safety.
- Combining the Cap(s) with mobility improvements along South Mangum Street would be a major component for the success of this site.
- The length of the Cap(s) along the freeway is limited by the western ramps associated with the interchange, the geometry of the connector roads to the east, and the limited vertical clearance of the existing bridge over the freeway (~20' minimum along the south end of the bridge).
- NC-147 has a wide grass median which makes construction easier.
- A Cap can be constructed on either side of the existing overpass bridge or on both sides as depicted above.

### **Research Triangle Park Sites**

Three sites were visited along Interstate 885 and Interstate 40 as shown below on the map.



Based on the topography of area surrounding I-885 and I-40, the interstates were not built in a "depressed" style as discussed previously. The interstates rather traverse through the research park in somewhat flat rural areas using minor cut and fill construction that utilizes structures over the interstate to provide connectivity of the local roadway network. This complicates the selection for a location of a Cap and led to the evaluation of locations near existing interchange structures as the most practical sites.

Each site was evaluated for suitability of a Cap based on the surrounding amenities, the topography, and the geometry of the interstate interchange.

Cap Site 1 – TW Alexander Drive over Interstate 885:



- Combining the Cap with the north side of the existing TW Alexander Road Bridge and the trail system would be best at this site.
- There are no buildings or other facilities visible near the site along the Interstate which lessens concerns with ROW and utility conflicts.
- I-885 has a wide grass median which makes construction easier.
- As the site contains a diamond interchange, impacts are anticipated.
- Grading along I-885 tapers quickly away from the existing bridge on the western side limiting the Cap coverage along the Interstate.
- The presence of the interchange ramps complicates site grading, usable space for the Cap, and pedestrian access to the Cap.

Cap Site 2 – East Cornwallis Road over Interstate 885:



- Combining the Cap with the south side of the existing East Cornwallis Road Bridge and the trail system would be an advantage at this site.
- As the interchange is located on only the north side of the bridge, no impacts to the interchange are anticipated.
- There are no buildings or other facilities visible near the site along the Interstate which lessens concerns with ROW and utility conflicts.
- I-885 has a wide wooded median which makes construction easier.
- The span lengths for the Cap would be relatively long or walls along the interstate would be required. This increases the depth of the cap structure and limits the type of amenities that can be placed on the cap.
- Grading along I-885 tapers quickly away from the existing bridge along the western side requiring a large amount of fill.
- Limiting the interstate coverage length to 300' has advantages.
- The existing sign structure over the I-885 northbound lanes would need to be relocated prior to the Cap.

Cap Site 3 - Davis Drive over Interstate 40:



- Combining the Cap with the existing Davis Drive Bridge along the west side and tying the trail system into the cap would be an advantage at this site.
- As the grading along I-40 tapers quickly away from the existing bridge along the southern side limiting the interstate coverage length to 300' has advantages.
- I-40 has a narrow median with substandard shoulders which makes the site challenging for construction.
- The presence of the existing building in the southwest quadrant makes grading for the Cap a challenge while maintaining the building's ground floor.
- The existing sign structure over the I-40 eastbound lanes would need to be relocated prior to the Cap.

#### Raleigh – North Hills Sites

Two sites were visited along Interstate 440 as shown below on the map.



Based on the topography of area surrounding I-440, the interstate was not built in a "depressed" style as discussed previously. The interstate rather traverses through the North Hills area using minor cut and fill construction that utilizes structures over the interstate to provide connectivity of the local roadway network. This complicates the selection for a location of a Cap and led to the evaluation of a location near an existing overpass structure and a location near a proposed pedestrian structure as potential sites.

Each site was evaluated for suitability of a Cap based on the surrounding amenities and the topography.

Cap Site 1 - Apostles Raleigh church area at North Hills over Interstate 440



- Providing a Cap over I-440 near the "North Hills Apartments" along the Church at North Hills Roadway would be very challenging.
- The median along I-440 is minimal with ~27' between travels lanes.
- There are buildings and roadways in close proximity to the narrow Interstate ROW.
- The grading along I-440 is only slightly higher than the Interstate roadway with only 10' between Interstate roadway and top of ground along the Church at North Hills Street making clearance for the Cap nearly impossible without significant impacts to the surrounding facilities.

Cap Site 2 – Lassiter Mill Road over Interstate 440



- Combining the Cap with the east side of the existing Lassiter Mill Road Bridge would be best at this site.
- As the site is tightly constrained by residential and commercial properties on all four quadrants, the Cap would have very limited coverage along the Interstate.
- Grading along I-440 tapers quickly away from the existing bridge further limiting the Cap coverage along the Interstate.
- The median along I-440 is minimal with ~27' between travels lanes complicating construction of the pier.
- The span lengths associated with the Cap would be long. This combined with the ~22' of vertical clearance associated with the existing bridge limits the useful space above the structure for amenities.

### Recommendations

In Durham, the South Mangum Street site is recommended for further evaluation for a Cap due to the connection to existing amenities, the geometry of NC-147, the flexibility for multiple Caps, and the potential to extend the usable green space along NC-147 toward South Roxboro Street. The South Alston Avenue site is less desirable as the grading along NC-147 tapers quickly away from the existing bridge along the southern side limiting the Cap coverage, retaining walls along the ramp on the south end of the Cap could be required, and impacts to interchange ramps would be required as they limit direct access to the Cap. The Fayetteville Street site is the least desirable as impacts to the interchange ramps, East Pettigrew Street, and potentially the railroad would be required as they limit direct access to the Cap; the length of the Cap coverage along the freeway is limited by the ramps and site grading, and the horizontal curvature of the interstate complicates the geometry of the Cap structure.

In the Research Triangle Park, the East Cornwallis Road site is recommended for further evaluation for a Cap due to the flexibility of the site to create a large connected green space and the configuration of the existing interchange eliminates impacts to the interstate. The TW Alexander Drive site is less desirable as impacts to the ramps of the diamond interchange are anticipated, there is limited Cap coverage along the Interstate, and pedestrian access to the Cap is limited. The Davis Drive site is the least desirable as the grading along I-40 tapers quickly away from the existing bridge limiting the Cap coverage, I-40 has a narrow median with substandard shoulders which makes construction difficult, and the existing building in the southwest quadrant drastically limits the connectivity of the Cap.

At the North Hills area, no site is recommended for further evaluation for a Cap due to the poor clearance above the interstate, narrow interstate median, and the substantial impacts to existing properties. The addition of a wide sidewalk/multi-use path along the eastern side of the Lassiter Mill Road Bridge could be investigated to provide improved connectivity of the area.