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VALUE FOR MONEY ANALYSIS

TECHNICAL FEASIBILITY REVIEW AND FINDINGS MEMO

FEBRUARY 5, 2013

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EXECUTIVE SUMMARY

In October 2012, the technical feasibility review of the Brent Spence Bridge (BSB) Project was kicked off with a three-day Practical Design/Value Engineering Workshop with several of HNTB's top bridge, road, traffic, geotechnical, construction and tolling experts. One of the primary objectives of the workshop was to produce technical ideas, particularly those of "high-value" that could be evaluated further for use in the Quantitative Value for Money (VfM) study. A "high-value" idea was considered one that could easily be implemented and potentially provide significant savings in project costs or delivery, with minimal risk or additional negative impacts.

Following the Practical Design/Value Engineering Workshop, four river bridge alternative concepts were evaluated as part of the technical feasibility review. They were identified as Alternatives "123", "125", "126", and "22" with each having a different arrangement of bridges crossing the Ohio River. Alternative "123", which was selected to advance further for comparison with Alternative "I" in the VfM study, consists of two new river bridges, one on either side of the existing BSB. The new river bridges are single-level network tied arch structures with 870' main-span. All of the alternative river bridge concepts proposed to replace the existing BSB versus the rehabilitation proposed in preferred Alternative "I". The review found that single-level bridges that are shorter and with plumb ribs and cable lines are preferable in terms of fabrication costs, schedule, staging, and safety. It was also found that replacement of the existing BSB truss superstructure is preferable to rehabilitation because of the high cost of replacing the entire floor system, painting the existing truss and uncertainty with future operations and maintenance costs.

In conjunction with the alternative river bridge concepts above, four alternative roadway concepts were evaluated to varying degrees do determine feasibility and impacts. A high-level evaluation was also done on a fifth alternative roadway concept (#85) that proposed to shift I-75 in Ohio to the west and follow Freeman Avenue. Like the alternative bridge concepts, more emphasis was given to the evaluation of Alternative "123" to better determine its technical feasibility, costs, and impacts as compared to preferred Alternative "I". Alternative "123" proposes to carry the same number of lanes across the river (16 lanes) as preferred Alternative "I". However, unlike preferred Alternative "I", both I-75 and I-71 cross the Ohio River on the two new five-lane single-level network tied arch bridges on both sides of the existing BSB and three-lanes of local traffic in each direction are carried on the new network tied arch double-decker superstructure on the existing BSB piers. In addition to the general arrangement of river bridges, the primary differences with Alternative "123" as compared to preferred Alternative "I" include:

- Changes in access to and from the interstate and local systems. See Appendix 6.9 for a comparison of access points between preferred Alternative "I" and Alternative "123".) The notable access changes include:
  - The use of a single-point urban interchange at KY 5th Street for the local system.
  - The southbound collector-distributor (C-D) lanes do not have slip ramp access to southbound I-75/I-71 just south of KY 5th Street. The access point in Kentucky from the southbound C-D lanes to southbound I-75/I-71 is further south near KY 12th Street.
  - Traffic on KY 9th, KY 5th, and KY 4th Streets in Covington wanting to access northbound I-71 must use the local street grid system from the west to the east side I-71/I-75 where a slip ramp is provided just north of Pike Street.
  - The on-ramp from KY 4th Street to the northbound local river crossing is not provided due to vertical geometry issues and impacts that would be caused east along KY 4th Street to achieve a practical tie in point.

- In Ohio, access is not provided from the intersection of OH 3rd Street and Clay Wade Bailey Bridge connection to northbound I-75 and from the southbound C-D system to this intersection due to conflicts with existing substructure units on the northbound local ramp to OH W 5th Street that is proposed to be retained.

- Additional ROW and environmental impacts to the east of the existing BSB in Ohio and Kentucky. ROW east of the existing BSB would be required from approximately KY 5th Street to just north of OH 3rd Street to construct Alternative "123". Also, a portion of the section 6(f) replacement land for Goebel Park in Kentucky at KY 5th Street that was agreed upon during the Environmental Assessment would be impacted and require identification of alternative replacement land.

The following table summarizes the estimated initial construction costs[1] in current year (2012) dollars for preferred Alternative "I" and Alternative "123":

	Preferred Alternative "I"	Alternative "123"	Cost Difference between "I" and "123"
Kentucky approach	$ 422,047,220	$ 390,577,085	$ 31,470,135
Ohio approach	$ 599,770,319	$ 539,265,997	$ 60,504,322
River Bridges	$ 514,119,245	$ 309,346,688	$ 204,772,557
	$ 1,535,936,784	**$ 1,239,189,770**	**$ 296,747,014**

In regards to life-cycle costs, the median Net Present Value comparison below shows that by choosing to implement Alternative "123" as compared to preferred Alternative "I", approximately $371 million of savings in current year dollars could be realized before residual values are deducted and $177 million savings net of the residual values.

Median Net Present Value of Agency Costs & Savings									
	Kentucky Approach		Ohio Approach		River Bridges		Total Costs & Savings		
	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Savings
NPV Before Residual	$ 541	$ 498	$ 757	$ 730	$ 651	$ 348	$ 1,950	$ 1,577	$ 371
NPV, Net of Residual	$ 396	$ 381	$ 524	$ 498	$ 348	$ 211	$ 1,269	$ 1,092	$ 177
(Current Year Dollars in Millions)									

With estimated savings like these, Alternative "123" could help right-size the BSB Project while still achieving the purpose and need. However, when compared to preferred Alternative "I", this alternative does have differences in local access and traffic operations on both sides of the river and additional ROW, utility, and environmental impacts east of the existing BSB that should be considered when deciding whether to advance this alternative concept further. If the decision is made to stay with preferred Alternative "I", there are some concepts in Alternative "123" that could help make the project better and cheaper such as using a network

[1] *The initial construction costs include incidentals costs and design contingency percentage used for the applicable segment in the FHWA Cost Estimate Review spreadsheet dated February 2012.*

tied arch with plumb ribs, 12' outside and 8' inside shoulders, and an 870' main-span for the New River Bridge. These concepts are is estimated to save approximately $189 million in initial construction costs as compared to the two tower cable-stay option that was identified in the March 2012 BSB FHWA Cost Estimate Review. Also, allowing flexibility in the procurement documents for a contractor or concessionaire to have the option of replacing the existing BSB versus rehabilitating could save the agencies and/or concessionaire from being burdened with unpredictable and expensive long-term operations and maintenance costs.

Regardless if Alternative "123" is chosen to advance further, the following are environmental-related items that need to be kept in mind during the next steps of the BSB Project:

1. Any changes attributable to varying impacts resulting from Alternative "123" could be addressed in a re-evaluation of the EA.
2. Introducing tolling will primarily require additional environmental justice, noise and air quality analysis.
3. Additional analysis in historic districts could be required depending on traffic diversion.
4. The level of impacts will determine whether or not an EIS is required.
5. Additional public involvement will be required for any project changes.
6. FHWA requested ODOT and KYTC provide the approach to obtaining environmental approval when the path for the project is chosen.
7. If there is a chance an EIS will be required, the environmental process should begin right away so as to eliminate any delay if it is required.
8. A re-evaluation of the EA is expected to take one year. An EIS is expected to take nine months longer.

1. BACKGROUND

The existing BSB began carrying I-75 and I-71 over the Ohio River in 1963 with a design capacity of 80,000 vehicles per day. Fifty years later, the daily traffic volumes on the BSB are roughly double the design capacity with a large percentage of commercial trucks (FHWA FONSI, 2012). These factors, along with other geometric deficiencies, are causing noticeable user-delay and safety impacts on this major trade corridor and river crossing. Promptly addressing these issues is imperative to enhance the economic prosperity, quality of life, and the movement of goods and people in and around the greater Cincinnati/Northern Kentucky region and the nation. However, resolving the congestion and safety problems at the BSB will require substantial financial investments as demonstrated by the EA that was conducted by the Ohio Department of Transportation (ODOT), Kentucky Transportation Cabinet (KYTC), and Federal Highway Administration (FHWA) to evaluate and decide upon an environmentally preferable alternative.

In August 2012, the FHWA issued a Finding of No Significant Impact (FONSI) for the BSB Project's current preferred Alternative "I". The major improvements of the current preferred Alternative "I" include:

- 7.8 miles of interstate reconstruction and local road improvements from 5,000 feet south of the midpoint of the I-71/I-75 and Dixie Highway interchange in Kentucky to 1,500 feet north of the midpoint of the I-75 and Western Hills Viaduct interchange in Ohio
- A new double-deck river crossing west (downstream) of the existing BSB that carries three lanes of northbound I-75 and three lanes local southbound on the lower deck and three lanes of southbound I-75 and two lanes of southbound I-71 on the upper deck. The new river bridge options include:
  - Tied-arch; simply supported with inclined arch ribs
  - Cable-stayed; two towers with three vertical legs per tower
  - Cable-stayed; one tower with two vertical legs
- Rehabilitation of the existing BSB that carries two lanes of northbound I-71 NB on the upper deck and 3 lanes of local NB on the lower deck
- Introduction of a collector-distributor (C-D) system for local traffic in both directions from near KY 12th Street in Kentucky to Ezzard Charles Drive in Ohio.

The total project cost for preferred Alternative "I" (engineering, right-of-way, utilities, and construction) in year of expenditure dollars at a 70% confidence level is estimated to be $2.76 billion ($1.27 billion for Ohio and $1.49 billion for Kentucky). The construction of the entire project is estimated to take just under eight (8) years to complete starting in early 2015. (FHWA FONSI, 2012)

With an estimated total project cost over $2.5 billion, the BSB Project is one of the largest transportation projects being considered in the United States. With this in mind, ODOT hired HNTB to conduct a VfM study to help them and KYTC make an informed decision on the optimal delivery and financing approach for the BSB project. The initial task of the study included a technical feasibility review to evaluate and identify alternative bridge and roadway concepts that could help right-size the BSB Project, determine the optimum delivery approach, and achieve the following project goals:

- Improve traffic flow and level of service;
- improve safety;
- correct geometric deficiencies, and
- maintain connections to key regional and national transportation corridors. (ODOT/KYTC PAVR, 2011)

2. TECHNICAL FEASIBILITY REVIEW

With the above objectives in mind, HNTB conducted a high-level technical review that focused primarily on the feasibility and impacts of various "high-value" road and bridge ideas that were generated at the Practical Design/Value Engineering Workshop.

2.1 PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP

From October 17th to 19th, 2012, HNTB technical experts gathered in HNTB's Cincinnati office to conduct a high-level evaluation to generate technical ideas that would help deliver a project that was more affordable, timely, and safer. (For the full report, see Appendix 6.1). Prior to the workshop, a "Fish Finder" evaluation tool was created to help identify and focus participant efforts on the largest concentration of fish or, in this case, the project components that comprise the largest percentage of the total project costs. The components with the biggest cost are the river and approach bridges which totaled almost two-thirds of the estimated construction costs. Using the results of the "Fish Finder" to focus their evaluation efforts, the HNTB experts came up with over 120 ideas that had some potential to make the BSB Project better, faster, cheaper, and safer. A number of these ideas were agreed upon by participants as having a "high-value". A "high-value" idea was considered one that could easily be implemented and potentially provide significant savings in project costs or delivery, with minimal risk or additional negative impacts. The "high-value" ideas at the workshop were focused primarily on:

- The reduction of overhead crossings in Ohio;
- separation of local and interstate traffic crossing the river;
- use of network tied arch bridges for navigation span only; and
- use of single-level bridges instead of double-decker bridges.

After the Practical Design/Value Engineering workshop, the "high-value" ideas, along with other alternative concepts, were evaluated for technical feasibility and to better define the impacts each may have on the project as compared to preferred Alternative "I".

2.2 DESIGN PARAMETERS AND EVALUATION APPROACH

During the Practical Design/Value Engineering Workshop, a practical design strategy was discussed as a way to utilize design parameters that allow flexibility and are sufficient to improve the transportation system without being excessive. For example, one element that was implemented during the evaluation of the alternative technical concepts was the use of the posted speed as the design speed. This is allowed by FHWA through the AASHTO Green Book and does not reduce the benefits of the project nor violate the purpose and need. This practical approach helps save significant construction and maintenance costs by optimizing various design elements including the horizontal and vertical alignments, K-values, sight distances, and clear zone. Another example is the vertical clearance under bridge overpasses. The minimum clearance, which is at least one-foot lower than the desirable, allows for optimization of the vertical alignments and has a significant impact on construction and maintenance costs for bridges and retaining walls. The Design Criteria table in Appendix 6.2 was developed to show the proposed versus the revised design criteria using the posted speed as the design speed.

2.3 ALTERNATIVE CONCEPTS

The alternative concepts highlighted in this section were preliminarily assessed to varying degrees in regards to feasibility which primarily included evaluation of geometric layout for approximate construction cost differentials, ROW impacts, qualitative tolling and traffic concepts, and potential changes to the environmental footprint and documentation.

2.3.1 RIVER BRIDGE ALTERNATIVE CONCEPTS

The tied arch bridge from preferred Alternative "I" as proposed in the March 2011 Bridge Type Selection Report was selected as the baseline for comparing the river bridge alternative concepts. The tied-arch option was selected for the baseline alternative primarily because this had the lowest estimated construction cost of the three bridge options in the BSB Project's February 2012 FHWA Cost Estimate Review workshop spreadsheet. In regards to the final bridge type(s) that will be advanced to construction, the BSB Project's March 2011 Bridge Type Selection Report notes that the final selection will occur at a later time and will be decided by ODOT and KYTC in consultation with FHWA and the public. Based on past experience with complex bridges, the lower cost of the tied arch as compared to the cable stay options is logical for a 1,000 foot main-span which was proposed for the bridge options. The baseline alternative consists of the following:

- Rehabilitation of the existing double-decker BSB that would carry three-lanes of northbound local traffic on the lower deck and two-lanes of northbound I-71 traffic on the upper deck; and
- Construction of a new double-decker 1,000 foot main-span basket-handle tied arch bridge west (downstream) of the existing BSB. The new double-decker river bridge would carry a total of eleven lanes; three lanes of local southbound traffic and three lanes of northbound I-75 on the lower deck and three lanes of southbound I-75 and two lanes of southbound I-71 on the upper deck.

For the baseline alternative the following are risks associated with reusing the existing BSB superstructure:

1. The existing BSB is 50 years old and classified as functionally obsolete due to capacity, sight distance, and safety concerns with its current configuration. (FHWA/ODOT/KYTC, brentspencebridgecorridor.com) Retaining the existing BSB in service would provide KYTC and ODOT with the risk of being burdened with unpredictable and more costly operations and maintenance costs into the future. If a concessionaire has responsibility for the long-term operations and maintenance of the existing BSB, this risk will likely be reflected in their cost proposal.
2. Due to the age of the existing BSB and the fact that it is a cantilevered steel truss, there is a risk of the existing bridge being taken out of service due to service, strength, or fatigue deficiencies. The superstructure has a number of critical connections that must remain in good condition for the bridge to stay in service. A fatigue study with instrumentation to measure in-plane stresses was conducted in 2004 which determined that the primary truss members had infinite fatigue life. These results overturned a previous report in 1996 which claimed only 12 to 16 years of fatigue life remained. The 2004 study is rational and in line with industry practice which normally finds that the actual stresses in the truss are lower than an analytical model would predict. This is due to the deck and truss joint behaving more like a moment connected truss as opposed to a typical pin connected truss. Furthermore, the code equations have shown to be conservative in their prediction of remaining fatigue life. However, the 2004 study did not evaluate out-of-plane behavior at the connections, nor the remaining life of the floor beams and stringers. This issue should be studied and the risk could be mitigated by replacing the floor system.
3. In the inspection reports, it has been noted that there are 1/4" wide cracks in Pier 2 approximately 25 feet below water elevation. The report also noted that these cracks are not a risk to the bridge, but both

river piers are covered with biological debris. The biological debris should be removed and an assessment of the pier should be conducted to eliminate this risk or to attribute a dollar amount to mitigate this risk.

4. Due to close proximity of the existing and new BSB footings, settlement of the existing footing may occur during construction. Monitoring of settlement of the pier footings may be needed during and after construction.
5. The existing river pier foundations are shown on the contract plans with two alternates; 1) caisson and 2) tremie footing built within a cofferdam. To date, HNTB has not been able to validate which alternate was built. This needs to be determined through more record search or by explorative drilling. A structural analysis of the foundation should be done assuming a tremie footing prior to explorative drilling if the record search returns no definitive answer on the foundation type built. This will better allow an informed decision on the type of exploratory drilling needed.

Since the existing foundations are founded on rock and the proposed foundations will more than likely be too, scour impacts may be irrelevant. However, for all the alternatives, a detailed hydraulic review should be completed and scour investigated to determine if the proposed pier locations in conjunction with the existing piers is an improvement or detriment to scour.

Four new river bridge alternatives were evaluated as part of the technical feasibility review. The review focused on technical concepts that were considered worthy of further evaluation as part of the overall VfM study. See Appendix 6.3 thru 6.7 for conceptual general plan and elevation plans of the four river bridge alternatives.

After the Practical Design/Value Engineering Workshop, HNTB received permission from ODOT to reach out to the Unites States Coast Guard (USCG) in St. Louis to determine whether or not a revision to the pier locations that would facilitate a shorter main-span than the 1,000 foot that was specified for the new river bridge in the BSB Project's March 2011 Bridge Type Selection Report. Per the USCG, tow boat pilots hug the Kentucky Bank as they navigate downstream when lining up for the next bridge. Therefore, they need for any proposed downstream bridge left descending pier to be placed toward the Kentucky bank slightly. Any upstream bridge would need the right descending pier to be placed toward the Ohio bank. On January 2, 2013, HNTB received email confirmation from the USCG that they and the navigation industry approve of the revised pier locations shown in the Clear Navigation Channel Limits plan found in Appendix 6.8. Furthermore, a clear zone was specified on the drawing to allow the final design to have some flexibility in pier placement. The revised pier locations will shorten the main-span to 870-feet and provide significant cost savings on the project since the length of the complex bridge(s) has been reduced by 130 feet.

The four new river bridge alternative concepts included:

1. *Alternative "123"* consists of reusing the existing BSB piers and replacing the superstructure with a new double-decker tied arch, and two new single-level network tied arch bridges with 870-foot main-spans; one east (upstream) and one west (downstream) of the existing BSB. The new BSB double-decker superstructure would carry six-lanes of local traffic, three 11' lanes in each direction. The two new river bridges would carry a total of ten-lanes, five-lanes of I-75 and I-71 in each direction. The condition of the existing BSB substructure would need to be more thoroughly evaluated during the detailed design to confirm the piers are suitable to support a new superstructure.
2. *Alternative "125"* consists of two nearly identical single-level network tied arches (three-arch system) with one new bridge to the east (upstream) of the existing BSB and replacement of the existing BSB superstructure with an eight-lane single level network tied arch utilizing the existing piers which would be widened to accommodate the new wider superstructure. The new river bridge crossing east (upstream) of the existing BSB would be an eight-lane 870-foot main-span network tied arch bridge. As

for the replacement superstructure on the existing BSB piers, in addition to confirming the suitability of the substructure to support a new wider superstructure during the detailed design phase, the pier widening may require removing the top portion of the existing pier to allow the pier to be made into a hammerhead shape to support the wider superstructure. A steel pier truss could also be used for the pier widening method. This method would allow the substructure to be widened while the existing bridge remains in service which would shorten the duration that the existing BSB crossing would need to be out of service.

3. *Alternative "126"* consists of a new single-level tied arch bridge (four-arch rib system) west (downstream) of the existing BSB. This alternative is comparable to the baseline alternative except that the new bridge is a single-level versus the double-decker bridge proposed in the BSB Project's March 2011 Bridge Type Selection Report. Also, the existing BSB truss would be replaced with a double-decker tied arch superstructure.
4. *Alternative "22"* is similar to Alternative "123" except that the two single-level tied arch bridges are proposed east (upstream) of the existing BSB with different lane configurations to optimize local traffic movement. This alternative consists of replacing the existing BSB superstructure with a double-decker network tied arch bridge and constructing two new 870' main-span network tied arches; one with five-lanes and one with three-lanes. This alternative has fewer lanes (14) crossing the river than the other three alternatives which have a total of sixteen-lanes.

The four alternatives above use a single-level versus a double-decker superstructure on the new alignments for the following reasons:

- The approach bridges are simplified, closer to the ground and shorten the interchange bridges on both sides of the river.
- Single-level bridges are easier, more efficient and quicker to build than double-decker bridges.
- There is less opportunity for debris from nesting birds, wind and other means to cause corrosion.
- Maintenance and inspection is more efficient and effective due to simple connections and standard details.
- Fewer shoulders are required which reduces the total width required for the complex bridge. As a result, more construction and maintenance costs can be saved.

Also, a network tied arch superstructure was selected over other tied arch and bridge types due to the following benefits:

- Form meets function. The most pleasing bridge visually is the one that fits and is the most efficient for the site. At this location, a network tied arch is the most efficient and therefore the most economical bridge.
- In the last decade, there has been significant design advances made in network tied arches. The cables, arch ribs and the tie girders work as an integral system allowing the arch ribs and tie girders to be lighter members, which reduces fabrication costs. This has been realized through more advanced modeling that is now available.

Arches can be constructed much more efficiently, for fewer man hours and more safely as they are routinely built on the ground or barges then floated in and raised to their bearing elevation.

In addition to the benefits noted above for a single-level and tied arch bridge, the following are advantages and disadvantages of the four alternative bridge concepts:

Advantages	Alt "123"	Alt "125"	Alt "126"	Alt "22"
Maintenance of Traffic (MOT) similar to the base alternative with regards to the re-use of the existing bridge if the rehabilitation is not too extensive and impactful to traffic.			✓	
Compared to the base alternative, the new network tied-arch bridge has the advantage of simplified construction, detailing, and design which facilitates a more efficient solution from a time and cost perspective.	✓	✓	✓	✓
The piers are more in line with the existing versus staggered as in the base alternative. The hydraulic flow will improve the backwater for a "no rise" requirement.	✓	✓	✓	✓
The new river bridge aesthetics are improved as the longitudinal truss in the double-decker bridges adds clutter and obstructs the view through the structure.	✓	✓	✓	✓
The arch ribs for the new river bridge are proposed to be plumb instead of inclined which simplifies and speeds up the fabrication and erection of the arches	✓	✓	✓	✓
The new superstructure on the existing substructure will provide a minimum of 75 years of service life and will lower the life cycle costs.	✓	✓	✓	✓
Three BSB bridges provide motorist with more options to cross the river which will help minimize mobility impacts if a bridge or lane closure is needed for maintenance, emergency, or rehabilitation purposes.	✓			✓
Since all new river bridges are tied arches, the fabrication of them could be identical which helps reduce costs of design, detailing, fabrication and erection due to repetition efficiency.	✓	✓		✓

Disadvantages	Alt "123"	Alt "125"	Alt "126"	Alt "22"
The single-level river bridge in this alternative is wider than the double-decker bridge in the base alternative.			✓	
Inspection access requires a longer reach from a snooper or an increased amount of inspection walkway.	✓	✓	✓	
Compared to the baseline alternative, major rehabilitation or replacement of the existing BSB within a 50-year concession period is not very likely.	✓	✓	✓	✓
Two new bridges east of the existing BSB pushes the work closer to the Clay Wade Bailey Bridge which reduces the maneuverability of fabricated pieces and, as a result, will likely have negative impacts on the efficiency of construction progress.				✓

2.3.2 ROADWAY ALTERNATIVE CONCEPTS

Using preferred Alternative "I" as a benchmark for comparison, a number of alternative roadway concepts were identified and evaluated to determine their technical feasibility and potential to deliver a project that could be more affordable while achieving the purpose and need. The premise of preferred Alternative "I" is building a new river crossing west (downstream) of the existing BSB that carries and separates southbound I-75, southbound I-71, southbound local, and northbound I-75 traffic. In addition, preferred Alternative "I" proposes to rehabilitate the existing BSB that will carry northbound local traffic on the lower deck and northbound I-75 traffic on the upper deck. The number of lanes proposed in preferred Alternative "I" by movement over the river is as follows:

	# of Lanes	
Route	**SB**	**NB**
I-75	3	3
I-71	2	2
Local	3	3
Total =	8	8

On land, preferred Alternative "I" introduces a C-D system for local traffic and access into and out of downtown Covington and Cincinnati. The C-D system extends from just south of KY 12th Street paralleling I-71/I-75, crosses the Ohio River on the new and existing BSB, and then runs adjacent to I-75 in Ohio to just south of Ezzard Charles Drive.

The five primary alternative roadway concepts that were evaluated to varying degrees for technical feasibility included:

1. ***Alternative "123"*** includes a new five-lane single-level network tied-arch bridge on both sides of the existing BSB that will carry I-75 and I-71 while replacing the existing BSB with a new double-decker bridge on the existing substructure units to carry three-lanes of local traffic in each direction. By maintaining the existing horizontal and vertical alignments of the existing BSB, this alternative allows several approach bridges on the Ohio side to be retained with some rehabilitation work to extend their service life.
2. ***Alternative "125"*** is a spin-off of Alternative "22" below. This alternative attempts to resolve some of the capacity issues with Alternative "22" while incorporating cost savings in the approach bridges where feasible. A new single-level tied arch bridge east (upstream) of the existing BSB was proposed to carry all eight-lanes of interstate and local traffic in the northbound direction. However, unlike Alternative "22", this alternative replaces the superstructure of the existing BSB with a new single-level tied arch bridge on the existing substructure with all eight-lanes of interstate and local traffic in the southbound direction. This alternative provides a clean and less cluttered solution with the same number (16) of lanes crossing the river as preferred Alternative "I". Additionally, like Alternatives "123", "126", and "22", this alternative uses a C-D system much like preferred Alternative "I". The exit and entrance ramp connections in Kentucky to KY 4th and 5th Streets provided in preferred Alternative "I" are retained. Likewise, similar downtown connections to Cincinnati are provided with this alternative. Also, this alternative replicates preferred Alternative "I" in Kentucky from the interchange at Dixie Highway to 12th Street or in Ohio from 6th Street (US 50) to Western Hills Viaduct and has similar connections from the interstate and local system to downtown Covington and Cincinnati. As compared to Alternative "123" and

preferred Alternative "I", the construction limits of this alternative extend further east (upstream) of the existing BSB. This causes more right-of-way impacts on both sides of the river, particularly in Kentucky, which makes it less desirable than Alternative "123". Conversely, there is very minimal impact to the entire west side of the BSB Project limits on the Ohio side including the Duke Energy substation, Longworth Hall, and the UPS facility. Additionally, this alternative salvages much of the existing I-75 infrastructure between OH 3rd and 9th Streets including existing overpasses at OH 5th, 6th, 7th, and 9th Streets.

3. ***Alternative "126"*** has the same arrangement of river bridges as preferred Alternative "I" except the new double-decker bridge is replaced with a single-level network tied arch that will carry northbound and southbound I-75, southbound I-71 and local traffic. Since this alternative has wider construction limit than preferred Alternative "I" west of the existing BSB, a major disadvantage is the additional right-of-way and historical property impacts to Longworth Hall in Ohio and the Lewisburg Historic District in Kentucky. Also, connecting the new single-level river bridge to both bounds of I-75 and southbound I-71 and local traffic would be more complicated and costly than the other alternatives. As a result, this alternative wasn't advanced as far as the other alternative roadway concepts.
4. ***Alternative "22"*** was conceived from an effort to salvage as much of the existing infrastructure on the Ohio side as possible. This alternative proposed to put all interstate traffic on two new single-level tied arch bridges east (upstream) of the existing BSB and proposed to replace the existing BSB with a new double-decker tied arch that would carry both interstate and local traffic. Like Alternative "125", this alternative had a wider construction footprint east of the existing BSB which impacted more ROW on both sides of the river. Also, the fourteen combined lanes crossing the river is two lanes short of the sixteen lanes proposed in preferred Alternative "I" which made this alternative less desirable than Alternative "123".
5. ***Alternative "85"*** proposed to shift I-75 west from the current alignment starting just south of Ezzard Charles Drive in Ohio. At this location, the new I-75 alignment would follow the existing Freeman Avenue alignment and tie into I-71, US 50, and SR 264 with a full interchange where the existing interchange of US 50, SR 264 and Freeman Avenue is located. South of the full interchange, I-75/I-71 would be combined and continue to follow Freeman Avenue and Mehring Way until crossing the Ohio River on a new single-level bridge west of the existing BSB. Crossing the Ohio River on a skew, I-75/I-71 would touchdown on the Kentucky side within the proposed footprint of preferred Alternative "I" which is just west of the existing BSB. Some of advantages of this alternative include the potential for significant savings in construction costs, time, and user-delays since most of I-75 on the Ohio side could be built off-line and the existing I-75 infrastructure and most of the local overpasses north of I-71 up to Ezzard Charles Drive could be eliminated. Another big advantage is that the property where the existing infrastructure is removed could be reclaimed and redeveloped by the city of Cincinnati.

After HNTB presented alternative roadway and bridge concepts ("123", "125", "22", and "85") at the Tolling Considerations Workshop at the ODOT District 8 office on November 27, 2012, the consensus amongst the ODOT and KYTC participants was to advance Alternative "123" for comparison with preferred Alternative "I" in the VfM study. As a result, following the tolling workshop further evaluation of Alternative "123" was done to better determine its feasibility, costs, and impacts while evaluation of the other alternative roadway concepts noted above discontinued shortly after.

Like preferred Alternative "I", the numbers of lanes in Alternative "123" by movement over the river are as follows:

	# of Lanes	
Route	SB	NB
I-75	3	3
I-71	2	2
Local	3	3
Total =	8	8

However, from a roadway perspective, as shown in the plan view exhibits in Appendices 6.10 and 6.11, Alternative "123" differs from preferred Alternative "I" by utilizing the existing BSB alignment for both northbound and southbound local lanes and utilizing two new river bridges on each side of the existing BSB that carry southbound I-75/I-71 on the west (downstream) alignment and northbound I-75/I-71 on east (upstream) alignment.

Additionally, there are differences in "direct" access of the local and interstate systems between preferred Alternative "I" and Alternative "123". The difference in access points are summarized in the Access Point Matrix in Appendix 6.9. The notable differences in access for Alternative "123" are as follows:

- Improved overall access to northbound and southbound local access lanes at KY 4th and 5th Streets with a SPUI interchange at KY 5th Street.
- The southbound C-D lanes do not have slip ramp access to southbound I-75/I-71 just south of KY 5th Street. The access point in Kentucky from the southbound C-D lanes to southbound I-75/I-71 is further south near KY 12th Street.
- Traffic on KY 9th, 5th, and 4th Streets in Covington wanting to access northbound I-71 must use the local street grid system from the west to the east side of I-71/I-75 where a slip ramp is provided just north of Pike Street.
- The on-ramp from KY 4th Street to the northbound local river crossing in preferred Alternative "I" is not provided due to vertical geometry issues and impacts that would be caused east along KY 4th Street to achieve a practical tie in point.
- In Ohio, access is not provided from the intersection of OH 3rd Street and Clay Wade Bailey Bridge connection to northbound I-75 and from the southbound C-D system to this intersection. This access can only be accomplished with the corresponding replacement of the northbound local ramps from the existing BSB to OH W 5th Street. The replacement of these existing ramps is contrary to the general concept of Alternative "123" which is to preserve as much of the existing BSB approaches as possible, thereby deferring the replacement cost to a future date. Also, if tolling is utilized, this access to and from the Clay Wade Bailey Bridge could be problematic for tolling diversion.

Another difference between preferred Alternative "I" and Alternative "123" is the right-of-way and environmental impacts east of the existing BSB on both sides of the Ohio River. In Kentucky, as shown in Appendix 6.12, Alternative "123" has ROW impacts at the Radisson Hotel, Lexus Dealership, and Holiday Inn properties. For the Radisson Hotel and Lexus Dealership properties, the impacts to parking could be offset by removing the KY 4th Street ramp and re-aligning KY 4th Street. This modification would open up property currently occupied by the ramp and KY 4th Street. KYTC could potentially use this excess property in negotiations with each property owner for the potential expansion of parking at each business. Appendix 6.12 also depicts the estimated impacts to the section 6(f) replacement land for Goebel Park in Kentucky that was agreed upon during the EA phase. The new roadway alignments east of northbound I-71/I-75 in Alternative "123" are anticipated to impact approximately one (1) acre of the replacement land. On the Ohio side, the new approach bridges east of the existing BSB will span over property currently occupied by an aggregate material storage yard, hot-mix asphalt plant, and indoor single-level storage facility.

For Alternative "123", an operational analysis was performed for intersections in Covington along the I-71/I-75 corridor using Synchro with simulation in SimTraffic. The two areas analyzed included:

1. KY 4th and 5th Streets from Crescent Avenue to Main Street
2. C-D and local street intersections (Jillians Way (northbound) and Bullock Street (southbound)) from 12th Street to 4th Street.

Assuming construction begins in 2015 and continues for approximately five years, the opening year would be approximately 2020. Therefore, design year traffic twenty (20) years after opening day was run for 2040. Generally, the peak hour volumes used are six (6) percent higher than the 2035 certified traffic volumes. This is based on the growth projections for this period resulting from OKI travel demand model runs. The following is a summary of the findings from the operational analysis of Covington for Alternative "123":

SPUI with 4th and 5th Streets:

- The northbound leg of the SPUI onto the interstate needs three (3) lanes with two (2) lanes for the eastbound left turn lanes and a free flow lane for the westbound right turn lane.
- Some signal phasing and lane usage were revised on the existing street network including:
    - Signal phasing at Main Street intersections
    - Lane usage on Philadelphia Street and signal phasing at the 5th Street intersection.
- For AM volumes, the southbound single left turn from Crescent Avenue to 5th Street needs to be further investigated to see what the impacts would be to provide dual left turn lanes.
- For the PM volumes, the two (2) intersections on Main Street are close to or over capacity. This is an existing condition as the volumes used in the model are comparable to the certified traffic. The southbound volumes were adjusted to reflect the no-build condition since the connections at the Clay Wade Bailey Bridge/3rd Street intersection are not provided to northbound I-75 and from the southbound C-D system from southbound I-75.
- Operationally for both AM and PM volumes, the SPUI works well.
- For the SPUI, all LOS are D or better and v/c ratios are 0.88 and below.
- With the revised lane usage on Philadelphia Street, the north approach of the intersection with 5th Street would need to be investigated further to see if additional ROW is needed for lane alignment through the intersection.

C-D and local street intersections, Jillians Way and Bullock Street:

- Operationally the northbound on-ramp north of Pike Street needs to be two-lanes in order to prevent lane volume imbalances at the traffic signal at Pike Street and Jillians Way.
- The simulation was initially run using the lane usage from the IMS Addendum with long queues developing at the following locations:
    - Pike Street in both directions approaching the Interstate.
    - Westbound 12th Street at Jillians Way

  - Northbound Jillians Way at 12th street (off-ramp approach)

- By adding additional lanes to the approaches of the above intersections, capacity through the signalized intersections was increased and queue lengths were reduced substantially. The addition of the lanes appears feasible with respect to ROW but more detailed investigation would be required.

A high-level comparison of the advantages and disadvantages of preferred Alternative "I" and Alternative "123" can be found in Appendix 6.13.

In addition to the alternative roadway concepts noted above, some other high to medium-value ideas generated at the Practical Design/Value Engineering Workshop were evaluated at a conceptual level to have a general understanding of their feasibility. All of these concepts would apply to both preferred Alternative "I" and Alternative "123". A few of them, such as reduced/reconfigured lane requirements and alternatives to the Dixie Highway and Kyles Lane interchanges in Kentucky, are documented in the Practical Design Workshop Report. These alternative concepts warrant further consideration when the procurement documents are advanced in the next project phase. However, within the context of the VfM study, less emphasis was given to these concepts since they would not significantly influence construction costs, ROW and environmental impacts, traffic operations, or potential revenue

2.4 CONSTRUCTION SEQUENCING AND MOT CONCEPTS

The MOT phasing for preferred Alternative "I" was established assuming a Design-Bid-Build (DBB) delivery method that would be delivered independently across both Kentucky and Ohio, but assuming that each side would be delivered at or around the same time frame. If the delivery method changes to a Design-Build (DB) or P3 arrangement and the contract packaging is also modified (i.e. one large project versus multiple packages), the changes to the staging and MOT will essentially be the same for both alternatives. For the purpose of the construction phasing and MOT analysis, Alternative "123" was evaluated assuming comparable delivery constraints to preferred Alternative "I". For preferred Alternative "I", the project was divided into four primary construction phases, similar to that proposed for Alternative "123". The construction between KY 12th Street and OH 9th Street must be interdependent as the construction of the new river bridges and approach structures are dependent on each other for MOT. The construction south of KY 12th Street and north of OH 9th Street can be done independent of the middle section, however, lane continuity needs to be addressed if they are constructed independent of the rest of the project.

2.4.1 CONSTRUCTION PHASE DURATIONS

Both preferred Alternative "I" and Alternative "123" are expected to be constructed in four primary phases that would be completed in a total of approximately five years assuming an alternative delivery approach such as a DB or P3 arrangement and eight years under a conventional DBB delivery method. The individual phases do not need to be completely linear as there are numerous activities across both phases, particularly off-line construction, that can be initiated and constructed concurrently. Furthermore, the timeframes to construct each phase of the project will be influenced by many factors as identified in the BSB Project's MOT Tech Memo dated May 6, 2011. The factors include but are not limited to:

1. MOT requirements
2. Weather, including Ohio River elevation
3. Available labor, equipment, and material resources
4. Work area constraints, including access and storage areas

5. Volume of traffic
6. Political directives, including allowable work hours
7. Number of construction contracts, including DB
8. Pavement type

For the purpose of this maintenance of traffic analysis, standard practice construction methods and durations for the above mentioned factors were utilized, unless noted otherwise.

2.4.2 CONSTRUCTION AND MOT PHASING

As noted above, the construction and MOT phasing is expected to be divided into four primary phases. The phases will require numerous sub-phases as well as several impacts to connections. The following is a general summary by phase of work along with a brief discussion of the impacts for each alternative.

2.4.2.1 Phase 1

Phase 1 will have numerous sub-phases but the work is being combined into one due to the extensive time it will require to construct the new river bridge(s) over the Ohio River. The new river bridge(s) will require approximately 2.5 to 3.5 years from start to end. This estimated duration is based upon past experiences with similar long structures over major rivers, combined with recent relevant estimates for the construction of the new Ohio River Bridges as part of the Louisville River Bridges projects between Kentucky and Indiana. The following are anticipated sequences for construction of the river bridge(s):

Preferred Alternative "I": The proposed double-decker river bridge would be built offline west (downstream) of the existing BSB. Once completed, traffic would be switched onto the new bridge along with introducing temporary approach bridges to maintain the northbound local and I-71 connections. The existing BSB would then be rehabilitated. During Phase 1, both the Linn Street and Ezzard Charles Drive overpasses in Ohio will be constructed while maintaining traffic at the Freeman Avenue interchange. Also, during Phase 1, the OH 7th Street and OH 9th Street viaducts reconstruction should follow the Linn Street overpass reconstruction to maintain a detour route across I-75.

Alternative "123": There are three potential options regarding the construction of the river bridges which is complicated by the replacement of the existing BSB superstructure:

a. Stick Build Option: The new single-level network tied arch river bridges west (downstream) and east (upstream) of the existing BSB would be built off-line and then floated in place. Once completed, traffic would be moved to the new bridges, and then the existing BSB superstructure would be demolished and stick built between the bridges.
b. Transverse Slide: The new river bridge west (downstream) of the existing BSB would be built offline first concurrently with the foundations and substructure of the new bridge east (upstream) of the existing BSB. The new double decker superstructure for the existing BSB would be built and supported temporarily on a combination of new upstream piers and false work and traffic would be moved to the new superstructure in its temporary location. Then the existing BSB would be demolished and the piers prepared for the new superstructure. The new BSB superstructure would then be slid into place (duration of approximately 1 week). Finally the new river bridge east (upstream) bridge would be built.
c. Float Double Decker "through the gap": The New River Bridge west (downstream) of the existing BSB would be built offline first and some of the traffic would be allowed to flow on this new bridge once completed. The new double decker superstructure and the new upstream bridge would be built on barges

offsite. The new upstream bridge would be built entirely except the navigation span (Arch Span). During a 2 week closure, the existing BSB truss would be demolished (at least the navigation span portion), the new double decker arch floated into place and set on the bearings, and the new upstream arch would then be floated into place and set on the bearings. At this point traffic would be allowed on the upstream and downstream bridges while the existing BSB rehabilitation is completed.

Each of these options has slight variations to traffic impacts and costs, and will warrant more in-depth evaluation during the next phase of the project to solidify the preferred methodology and specification flexibility for construction sequencing and MOT that will be included in the procurement documents. The Stick Build Option is likely the most expensive while the Transverse Slide is likely the least expensive.

While the river bridge construction is on-going, the remaining work identified in Phase 1 will be completed for both alternatives. This work includes construction of offline approach roadway and bridge work that connect the new bridge alignments to the new upstream (and downstream for Alterative "123") bridges and the phased construction of the new connections to 5th Street in Covington.

For both alternatives, the southbound I-71/I-75 exit ramp to KY 5th Street will be closed along with the KY 4th Street ramp to I-71/I-75 during Phase 1. Access to KY 5th Street will be restored during Phase 2. Also during Phase 1, the I-71 and US 50 traffic links with I-75 will remain in place. During Phase 1, the I-75 southbound ramp to OH 5th Street will remain open during the closure of the I-75 southbound ramp to OH 7th Street. During all phases, either the southbound OH 5th Street ramp or the OH 7th Street ramp will be maintained.

2.4.2.2 Phase 2

For preferred Alternative "I", Phase 2 work will largely consist of the local streets and interchanges in both Kentucky and Ohio. Phase 2 is envisioned to largely take place at the same time as Phase 1 work. The same is true for Alternative "123", however, because there is more off-line construction possible within Alternative "123", the phases are discussed separately.

Preferred Alternative "I": The I-71 traffic connections with I-75 will remain in place, however, the US 50 connections with I-71 and I-75 will be closed. To maintain the US 50 links with I-71 and I-75 as long as possible, a MOT sub phase needs to be incorporated that involves the partial removal of the overpass structures for OH 5th Street and OH 6th Street located along the west side of the I-75 corridor. These overpasses are in the way of completing the roadway pavement improvements required for MOT in Phase 3. A temporary crossover in Ohio will be constructed to replace the KY Pike Street exit from I-75 southbound. The temporary crossover will provide access from I-75 southbound to the new KY 5th Street and KY 9th/Pike Streets exit ramps. The reconstruction of the Linn Street and OH Ezzard Charles Drive overpasses need to be coordinated with the reconstruction of the OH Freeman Avenue Interchange. Upon completion of these Linn Street and Ezzard Charles Drive overpasses in Phase 1, Linn Street and Ezzard Charles Drive will be the detour route during the closure of the Freeman Avenue interchange.

Alternative "123": The activities functionally mirror those identified in Phase 2 of preferred Alternative "I" with several slight modifications. The crossovers identified in preferred Alternative "I" will actually be simplified or eliminated by maintaining traffic to either side of the existing BSB. Also, bringing portions of the Phase 3 work identified below forward, specifically portions of the I-75 reconstruction within the areas of the local bridge work in Ohio should be considered to accommodate the modified locations of piers and medians in Alternative "123".

For both alternatives, the Western Hills Viaduct Interchange construction in Ohio cannot begin until the Hopple Street Interchange is complete. The Hopple Street Interchange is the next interchange north that will be reconstructed as part of the Mill Creek Expressway Project and is expected to be complete in the fall of 2015.

The total duration of Phases 1 and 2 combined will be approximately 3.5 years. The critical path item during Phases 1 and 2 will be the construction of the new river bridge(s) over the Ohio River. The remaining structures and roadway construction can be accomplished with significant float during the 3.5 years to minimize disruptions to traffic.

2.4.2.3 Phase 3

For each alternative, Phase 3 essentially consists of Interstate reconstruction.

Preferred Alternative "I": In Phase 3, the southbound I-75 traffic will be diverted to the new widening on the west side of the I-75 corridor and the lower deck of the new bridge over the Ohio River. In addition, the new structures north of US 50/OH 6th Street will have been completed and will be open to traffic, including the critical connection at OH 7th Street. This allows the US 50/OH 6th Street viaduct to be closed, as well as the closure of southbound access to I-71/Fort Washington Way (FWW). The southbound I-71 movement from FWW/OH 3rd Street to southbound I-75 will be closed. During the closure of this ramp, southbound I-71 traffic will be detoured to southbound I-471. The northbound I-71 connection to FWW/OH 2nd Street will remain open. This MOT plan opens a large work area between the relocated southbound I-75 and the existing northbound I-75 in both Ohio and Kentucky. Northbound access from I-71/I-75 to downtown Covington will be maintained.

A significant amount of structures work will be completed in Phase 3. This includes the following structures (identified in the BSB MOT Tech Memo dated May 5, 2011:

1. Center portion of I-75 over Orchard Drive
2. Center portion of I-75 over Rivard Drive
3. SB portion of I-75 between KY 12th Street and Pike Street
4. SB portion of I-75 over KY 9th Street
5. Remainder of approaches to the new Ohio River Bridge
6. I-71 to US 50
7. Fort Washington Way to US 50
8. SB I-75 to OH 5th Street
9. US 50 to OH 5th Street
10. Northern portion of SB 75 to FWW
11. Northern portion of SB I-75 to OH 2nd Street
12. Northern portion of US 50 to FWW
13. Northern portion of US 50 to OH 2nd Street
14. I-75 NB and SB approaches
15. SB I-75 to Clay Wade Bailey Bridge
16. Clay Wade Bailey Bridge to NB I-75
17. FWW to SB I-75
18. OH 3rd Street to SB I-75
19. US 50 to FWW

20. OH 6th Street viaduct

Alternative "123": This phase will be very similar to preferred Alternative "I" but will track more closely with activities identified in Phase 2. The primary difference with this phase compared to preferred Alternative "I" is that both northbound and southbound I-75 traffic will be diverted to their final configurations. Phase 3 focuses primarily on completion of the final local connections to the existing BSB location and the connections to and from the Clay Wade Bailey Bridge (15 and 16 above) are not included as part of preferred Alternative "123".

In addition to the structures work, there will be a substantial amount of grade work including the reconstruction of the center of I-75 throughout the corridor in both Kentucky and Ohio. Reconstruction of the Western Hills Viaduct interchange is anticipated to begin in this phase. Using accelerated construction rates experienced on other projects, Phase 3 will take approximately two years to complete.

2.4.2.4 Phase 4

Preferred Alternative "I": The final phase of construction occurs with both northbound and southbound I-75 traffic utilizing the new Ohio River Bridge. The remaining work is located on the east side of the I-75 corridor. Phase 4 includes all structures work east of the existing I-75, as well as the remaining work at the Western Hills Viaduct. Rehabilitation of the existing BSB and the construction of the associated bridge approaches will be performed during this phase. The northbound I-71 connection to FWW/OH 2nd Street will be closed and all I-71 traffic will be detoured to I-471.

In Phase 4, access from Pike Street to northbound I-71/I-75 in Covington will be closed due to the rehabilitation of the existing BSB and associated construction. The Clay Wade Bailey Bridge will become the primary access route for local traffic in Covington to access northbound I-71 and I-75. From the Clay Wade Bailey Bridge connection, access to northbound I-71 will be via OH 2nd Street. Access to northbound I-75 will be via a new temporary ramp connection at the intersection of OH 3rd Street and Clay Wade Bailey Bridge connection. The new temporary ramp connection will provide a direct ramp connection to I-75 northbound. During Phase 4, a new temporary ramp connection from I-75 southbound to the intersection of OH 3rd Street and Clay Wade Bailey Bridge connection will also utilized to provide access to the Cincinnati riverfront area and to the city of Covington. Phase 4 will be completed within approximately 2.5 years.

Alternative "123": Phase 4 involves work within approximately the same footprint as Phase 4 of preferred Alternative "I". This phase requires the rehabilitation of the existing structures to remain within the Ohio approach interchange as well as the completion of any work at the northern and southern project limits. This phase of construction will be accomplished utilizing part-width construction techniques to minimize traffic disruptions. These activities can be initiated prior to completion of Phase 3, and can be reasonably completed between one or two construction seasons.

The total duration for the I-75 corridor reconstruction is estimated to be eight years utilizing standard construction methods and durations. The actual duration will be influenced by the factors previously listed above. Expedited construction techniques can be utilized to minimize the durations for each phase and roadway closures. Once final design is completed, including the size and type of the various structures, a refined construction duration estimate will need to be determined utilizing a more detailed critical path schedule. It is also recommended that contractor input be obtained to assist in identifying areas where the design, MOT, and construction sequencing can be modified to improve the efficiency and progress of construction.

2.5 ENVIRONMENTAL REVIEW

As noted before, preferred Alternative "I" was evaluated in an Environmental Assessment for the Brent Spence Bridge Replacement/Rehabilitation Project. It was identified as the preferred alternative in a FONSI signed by the FHWA on August 9, 2012. An assessment of the environmental impacts of Alternative "123" were made by comparing a preliminary project footprint (construction limits) to the footprint for preferred Alternative "I", as identified in the FONSI. In addition, an analysis was conducted to determine environmental documentation requirements should tolling be incorporated into the project.

As shown in red flag maps in Appendix 7.16, the construction limits for Alternative "123" would generally fall within the footprint for preferred Alternative "I" with the exception of the Ohio River crossing and the adjacent areas. For the purposes of the NEPA documentation, Alternative "123" should be considered a refinement of the preferred alternative described in the FONSI. Therefore, a re-evaluation of the Environmental Assessment would be prepared to address changes to the project design and associated impacts. The existing FONSI could then be updated, or a new FONSI issued. The re-evaluation would focus on areas where changes in the impacts are expected.

Based on the preliminary footprint, Alternative "123" is not expected to change impacts to:

- Neighborhood and Community Cohesion
- Community Facilities
- Displacements and Relocations
- Economy and Employment
- Environmental Justice
- Wetlands
- Farmland
- Regulated Materials
- Cultural Resources
- Section 4(f) Resources
- Visual Resources
- Indirect and Cumulative Effects

Alternative "123" would involve constructing three bridges across the Ohio River, which would impact approximately a total of 250 feet along the river. The environmental commitments listed in the FONSI would be met:

- The highest point of the bridge shall be at least 300 feet +/- above the Normal Pool Elevation of the Ohio River (EL. 456.36).
- The highest point of the bridge shall be less than 420 feet +/- above the Normal Pool Elevation of the Ohio River (EL. 456.36).
- The minimum provided under clearance shall be no lower than that provided by the existing BSB.
- The bridge main-span shall provide sufficient length to insure that substructure units are outside of the main span piers of the existing BSB.

- If a double deck design is provided, a 25-foot minimum vertical clearance shall be provided above the bottom deck roadway surface.

However, the re-evaluation would address the length of impact along the Ohio River as well as changes to the project footprint within the regulated floodplain. Coordination with the agencies with jurisdiction over these resources would also be required.

The bridges for Alternative "123" would span areas designated as potential Indiana bat habitat on the Kentucky bank of the Ohio River. However, more detailed study is required to determine if these areas would be impacted on a temporary or permanent basis. Impacts to Indiana bat habitat as well as mussel species within the Ohio River would be addressed in the re-evaluation.

Alternative "123" would result in revised roadway and ramp configurations immediately north and south of the Ohio River, including a new Single Point Urban Interchange (SPUI) for the local roadways at KY 5th Street in Covington, Kentucky. A traffic analysis of the new ramp configurations is substantially complete. Once fully completed, the street network within the City of Covington would be evaluated to assure that acceptable operations would be maintained. Subsequently, both the noise and air quality analyses for the project would be updated. Any changes in the findings of the analyses would be addressed in the re-evaluation of NEPA document.

Alternative "123" would not result in changed impacts to identified Section 4(f) or Section 6(f) resources. However, Alternative "123" would impact a portion of the area identified as replacement land for impacts to Goebel Park, a Section 6(f) resource. New replacement land would need to be identified, evaluated, and coordinated with the city of Covington and the National Park Service. These changes would be addressed in the NEPA re-evaluation.

If Alternative "123" is chosen to advance beyond the conceptual stage, a detailed traffic analyses should be completed to determine the changes in traffic volumes and travel patterns in Ohio and Kentucky. Once completed, the indirect and cumulative impacts assessment would be re-visited. Any changes to the secondary and cumulative impacts resulting from altered access and/or traffic patterns would be addressed in the NEPA re-evaluation.

Additional public and stakeholder involvement would also be required for Alternative "123". Specific issues that would be addressed during public and stakeholder involvement would be changes in access in Covington and the design of the river crossing (network tied-arch design). The public and stakeholder involvement would be documented in the re-evaluation.

3. COST FORECASTING

3.1 INITIAL COST

In order to achieve an equal comparison with preferred Alternative "I", the segments and unit prices in the BSB Project's February 2012 FHWA Cost Estimate Review spreadsheet were utilized to help derive the initial construction costs for the alternative roadway concepts. Also, the incidental costs and design contingencies specified for each segment in the spreadsheet were included in the initial construction cost estimates for the roadway and bridge concepts. For Alternative "123", the following segments had differences in estimated construction costs:

- KY-4: New Ohio River Bridge (split 80% Kentucky and 20% Ohio)
- KY-8: Rehabilitation of the Existing Brent Spence Bridge
- KY-7: I-75 Reconstruction from the South Termini of the 12th Street Interchange to the New Bridge over the Ohio River
- OH-7: I-75 Reconstruction from the New Bridge over the Ohio River to North of Linn Street
- OH-4: 7th/8th/9th Street Interchange and 6th Street North Reconstruction

For areas outside of these segments, the estimated construction costs in the spreadsheet were utilized since there were no differences between preferred Alternative "I" and Alternative "123". For the alternative roadway concepts, the elements that were estimated primarily included the major items of work (i.e. approach bridges, pavement, earthwork, and retaining walls)

For the alternative river bridge concepts, HNTB has provided design and construction services for several network tied arch bridges in recent years. The contract bid item prices from these bridges along with published unit bid price tables from ODOT and KYTC were used to develop the initial cost estimate for the New River Bridges. The unit costs were adjusted to account for site conditions, construction staging, proximity to fabrication plants, and also the complexity of the double-decker configuration including maintenance of traffic during construction. After adjustments were made, the estimates were further simplified to capture the total price in terms of major high-cost components which include the deck, arch rib and floor system, cables, bearings and joints, and, substructure concrete volumes. Like the cost estimate for preferred Alternative "I", a design contingency of 20% was included in all estimates. A review of the preferred Alternative "I" cost estimate shows that the cost given in the aforementioned spreadsheet are reasonable for the inclined tied arch and two-tower cable stay bridge options.

The following table summarizes the estimated initial construction costs[2] in current year (2012) dollars for preferred Alternative "I" and Alternative "123":

[2] *The initial construction costs include incidentals costs and design contingency percentage used for the applicable segment in the FHWA Cost Estimate Review spreadsheet dated February 2012.*

	Preferred Alternative "I" [3]	Alternative "123"	Cost Difference between "I" and "123"
Kentucky approach	$ 422,047,220	$ 390,577,085	$ 31,470,135
Ohio approach	$ 599,770,319	$ 539,265,997	$ 60,504,322
River Bridges	$ 514,119,245	$ 309,346,688	$ 204,772,557
	$ 1,535,936,784	**$ 1,239,189,770**	**$ 296,747,014**

3.2 LIFE CYCLE COST ANALYSIS

A critical part of the decision matrix for selecting an alternative is life cycle costs. Therefore, a comparison was done between preferred Alternative "I" and Alternative "123" over a 50-year analysis period. In short, Alternative "123" provides substantial savings when compared to preferred Alternative "I" over the 50-year analysis period for the Kentucky approach, Ohio approach and river bridges. The Life Cycle Cost Analysis (LCCA) of Alternative "123" demonstrates a net present value of the savings before subtracting residuals of $371 million and a net present value of the savings, net of residuals of $177 million through lane reconfigurations that separate interstate and local traffic along with river bridge refinements that reduce original construction and future capital maintenance costs when compared to preferred Alternative "I". There is a 70% probability that Alternative "123" would decrease the life-cycle costs before subtracting the residual value of the facility by at least $355 million in current year dollars and by at least $164 million net of the residual value.

3.2.1 THE ANALYSIS PROCESS

HNTB completed the LCCA in accordance with the FHWA's technical guidance regarding Life Cycle Cost Analysis. This guidance includes two major components: 1) agency costs and 2) user costs. User cost differences were not calculated for this LCCA.

3.2.2 AGENCY COSTS

Agency costs are comprised of projected expenditures for construction costs as well as major maintenance expenditures that extend the facility's service life. Table 1 includes the median agency costs for both alternatives of all three components of the proposal in 2012 dollars (CY$), the 1) Kentucky approach, 2) Ohio approach, and 3) river bridges. The treatments for construction costs were analyzed as occurring in Year 0. If these construction costs were spread over a five year construction period, the change to the LCCA calculations would be immaterial to the results of the LCCA.

[3] *The river bridges costs for Alternative I include the cable-stayed option (Alternative 3 - two-tower, three vertical legs/tower) from the March 2011 Bridge Type Selection Study.*

Table 3-1: Median Costs and Savings Resulting from Alternative "123"

Median Agency Costs & Savings									
	Kentucy Approach		Ohio Approach		River Bridges		Total Costs & Savings		
Year	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Savings
0	$ 421	$ 390	$ 599	$ 539	$ 474	$ 309	$ 1,495	$ 1,238	$ 258
1 - 10	$ 2	$ 2	$ 2	$ 2	$ 40	$ (0)	$ 43	$ 4	$ 40
11 - 20	$ 12	$ 12	$ 18	$ 26	$ 1	$ 1	$ 31	$ 39	$ (8)
21 - 30	$ 26	$ 23	$ 33	$ 39	$ 8	$ 14	$ 67	$ 76	$ (9)
31 - 40	$ 52	$ 39	$ 88	$ 80	$ 22	$ 21	$ 162	$ 140	$ 21
41 - 50	$ 54	$ 56	$ 49	$ 85	$ 142	$ 9	$ 245	$ 150	$ 95
Sub-Total Before Residual	$ 567	$ 522	$ 789	$ 771	$ 687	$ 354	$ 2,044	$ 1,647	$ 397
Residual Value	$ (188)	$ (152)	$ (300)	$ (299)	$ (382)	$ (172)	$ (870)	$ (623)	$ (247)
Total	$ 379	$ 371	$ 489	$ 471	$ 306	$ 182	$ 1,173	$ 1,024	$ 149
(Current Year Dollars in Millions)									

Alternative "123" will require the owner to spend $548 million less in year-of-expenditure (YOE) dollars during the 50-year analysis period. This amount is the future value of the $397 million of savings when inflated by the Federal Government's estimate of long-term inflation.

The median values of the remaining serviceable life (residual value) at the end of the analysis period in CY$ dollars for items included in the agency costs are $870 million for preferred Alternative "I" and $623 million for Alternative "123". The residual reflects the remaining useful life of the construction and maintenance treatments performed.

3.2.3 COST SAVINGS FROM ALTERNATIVE "123"

As shown in Table 2, the LCCA identified two treatment groups where a large difference of cost or occurrence interval will exist between preferred Alternative "I" and Alternative "123". The treatments that have the largest effect on life-cycle costs are the items for the river bridges. Alternative "123" provides for $347 million of lower expenditures in CY$ by using network tied-arch single-level bridges with shorter main span lengths. These enhancements reduced the amount of complex bridge as compared to the preferred Alternative "I" which is the most costly component of the new river bridges.

The next largest savings for the owner, amounting to $92 million in CY$, is from the land bridge construction expenditures that would occur during the analysis period. Alternative "123" proposes to have local traffic only on the existing BSB that will be upgraded with a new double-deck superstructure. This configuration allows the re-use of numerous existing land bridges that could be retained on the Ohio side as compared to preferred Alternative "I".

Table 3-2: Treatments with Differences

Treatment Differences					
	Preferred Alternative "I"		Alternative "123"		
Treatment	Performance Year	Most-Likely Cost	Performance Year	Most-Likely Cost	Most-Likely Savings
River Bridge - New PB Double Decker Bridge	0	$474	N/A	N/A	
River Bridge - Existing BSB Rehab	2	$40	N/A	N/A	
River Bridge - New Future BSB Arch	50	$92	N/A	N/A	
River Bridge - Approach w/ Future Bridge (5+6)	50	$44	N/A	N/A	
River Bridge - New Mainspan Bridge 1 & 2	N/A	N/A	0	$122	
River Bridge - Approaches	N/A	N/A	0	$96	
River Bridge - Engineering	N/A	N/A	0	$30	
River Bridge - Existing Mainspan	N/A	N/A	0	$55	$347
New Land Bridges - Original Construction	0	$619	0	$491	
1963 Land Bridges - Full Replacement (Tier 3)	N/A	N/A	50	$36	$92
(Current Year Dollars in Millions)					

3.2.4 MEDIAN NET PRESENT VALUE

The Net Present Value (NPV) is the value of all future cash flows discounted back to current year dollars per FHWA guidance. The median NPV of the total life-cycle costs analyzed for preferred Alternative "I" and Alternative "123" are $1.95 billion and $1.58 billion, respectively before residual values are deducted when using a median real discount rate of 0.44%. The chosen discount rate is based on a composite of high-quality, long-term municipal bond rates for Ohio and Kentucky discounted by the Federal Government's estimate of long-term inflation. The median NPV of the total life-cycle costs analyzed for preferred Alternative "I" and Alternative "123" are $1.27 billion and $1.09 billion, respectively after residual values are deducted. This median NPV comparison shows that by choosing to implement Alternative "123", the owners will save $371 million in current year dollars before residual values are deducted and save $177 million net of the residual values (see Table 3).

Table 3-3: Median Costs and Savings Resulting from Alternative "123"

Median Net Present Value of Agency Costs & Savings									
	Kentucky Approach		Ohio Approach		River Bridges		Total Costs & Savings		
	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Preferred Alternative "I"	Alternative "123"	Savings
NPV Before Residual	$ 541	$ 498	$ 757	$ 730	$ 651	$ 348	$ 1,950	$ 1,577	$ 371
NPV, Net of Residual	$ 396	$ 381	$ 524	$ 498	$ 348	$ 211	$ 1,269	$ 1,092	$ 177
(Current Year Dollars in Millions)									

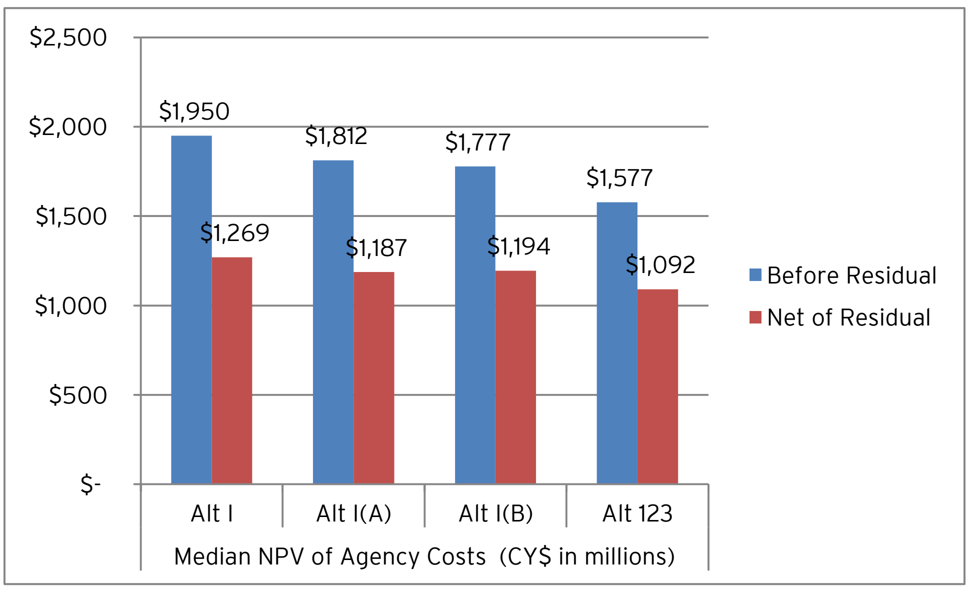
All LCCA should, at a minimum, be subjected to a deterministic sensitivity analysis. A primary drawback of the deterministic sensitivity analysis, however, is that the analysis gives equal weight to any input value assumption, regardless of the likelihood of occurrence. Instead, we performed a risk analysis where we associated input value assumptions with a probability of occurrence. FHWA encourages this use of risk analysis using Monte Carlo Simulation for LCCA.

Life cycle costs were also estimated to determine what the savings could be in current year dollars for the following two scenarios as compared to Alternative "I":

- Alternative I (A): River Bridge was revised to a network tied arch with 870' main span with 12' outside and 8' inside shoulders. There were no changes to the estimated approach costs in Kentucky and Ohio for Alternative "I".
- Alternative I (B): Above including the replacement of the existing BSB superstructure versus rehabilitation. The superstructure replacement would be a double-decker network tied arch on the existing piers with three 11' lanes, 8' outside shoulder, and 4' inside shoulder.

As shown in Figure 1, in comparison to Alternative "I" using the costs for the two tower cable-stay option for the New River Bridge, choosing to implement Alternatives I (A) could save approximately $138 million before residuals are deducted and $82 million net of the residuals. Whereas, implementing Alternative I (B) could save approximately $173 million before residuals are deducted and $75 million net of the residuals.

Figure 3-1: Median Net Present Values of Alternatives I, I(A), I(B), and "123" before residuals are deducted and net of residuals



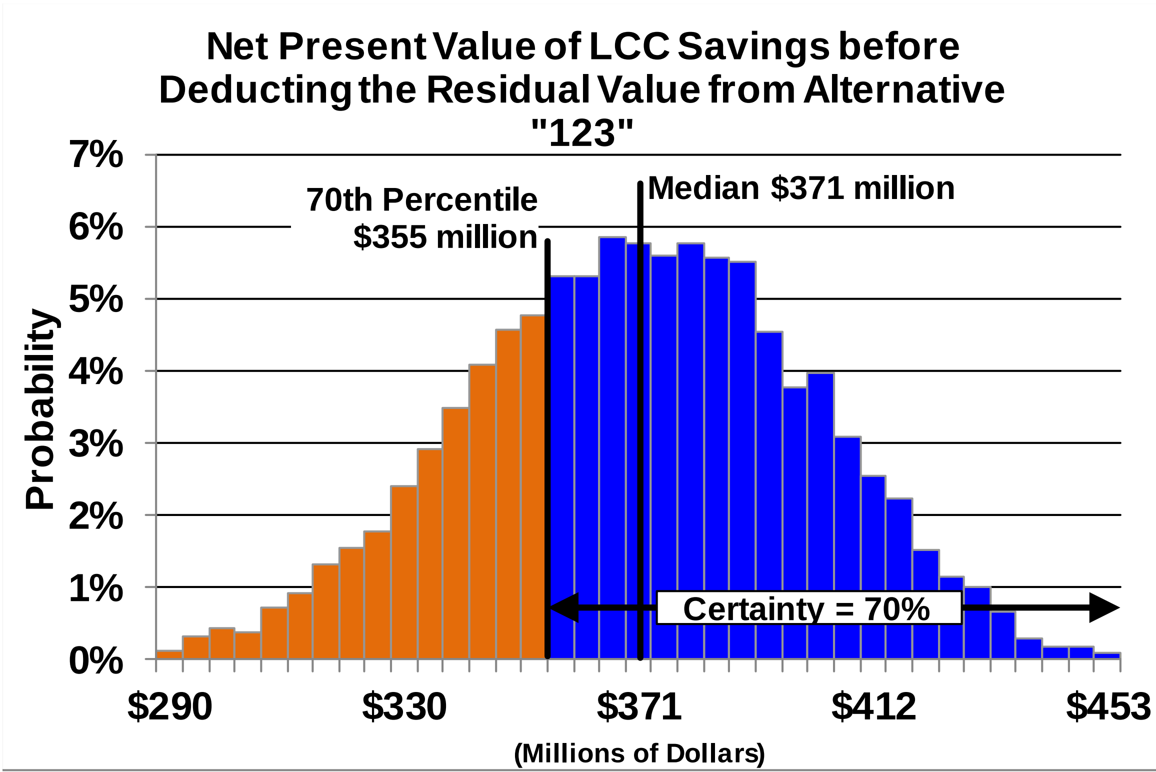
3.2.5 RISK ANALYSIS

Risk provides probabilistic descriptions of uncertain future outcomes. It also exposes areas of uncertainty typically hidden in the traditional deterministic approach to forecasting.

Up to this point, we have stated all LCCA output values at the median values derived from the analysis. From this point forward, the NPV amounts presented have an associated probability.

Figure 2 presents the risk analysis NPV results for the life-cycle cost savings before deducting the residual value from implementation of Alternative "123" and their associated probabilities.

Figure 3-2: Net Present Value of Life-Cycle Cost Savings before Deducting the Residual Value from Alternative "123" with Associated Probability



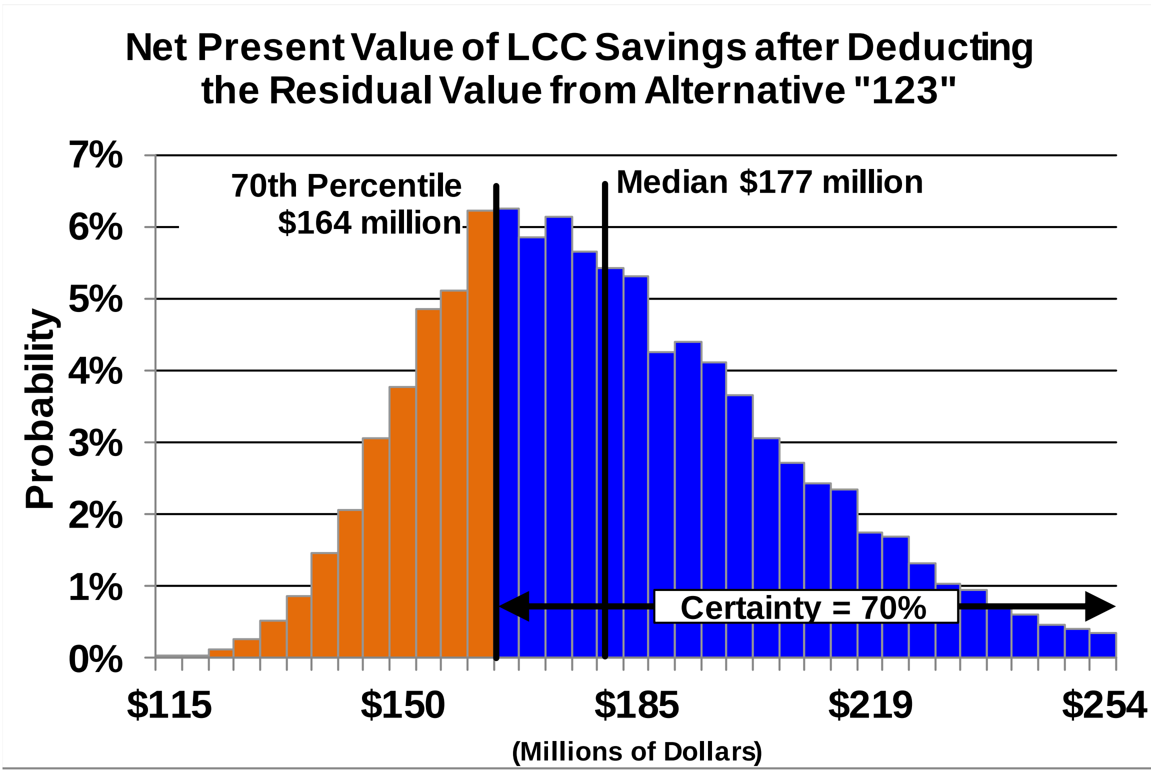
Net Present Value	
Percentile	Savings
0	$473
10	$410
20	$397
30	$388
40	$380
50	$371
60	$364
70	$355
80	$346
90	$332
100	$272

(Dollars in Millions)

The results can be interpreted using this example: "There is a 70 percent probability that Alternative "123" would lower the NPV of life-cycle costs before deducting the residual value of the facility by at least $355 million in current year dollars." The 70th percentile offers a conservative 70 percent level of confidence so the decision maker can gain comfort with the decisions they base on the analysis.

Figure 3 presents the same information on a net of residual value basis.

Figure 3-3: Net Present Value of Life-Cycle Cost Savings after Deducting the Residual value from Alternative "123" with Associated Probability



Net Present Value	
Percentile	Savings
0	$296
10	$218
20	$203
30	$193
40	$184
50	$177
60	$171
70	$164
80	$158
90	$150
100	$113

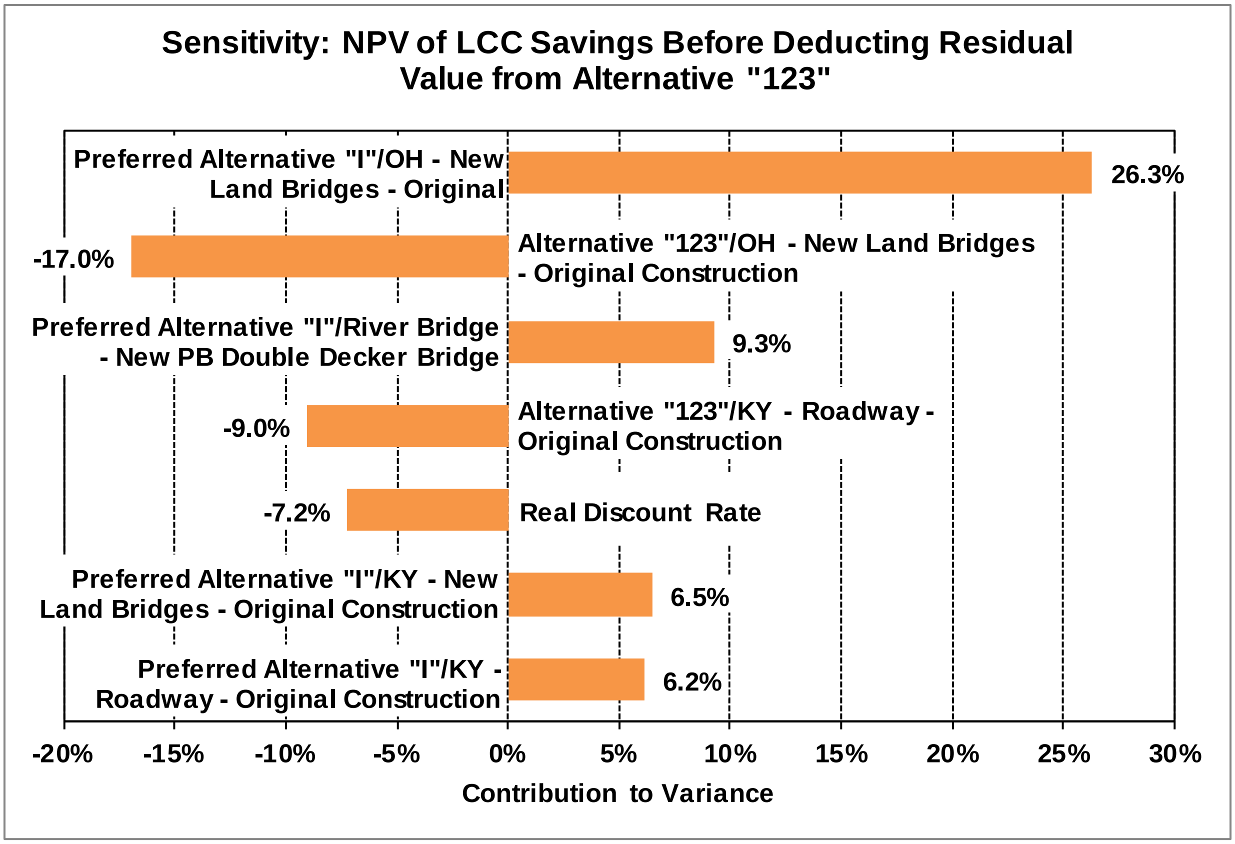
(Dollars in Millions)

3.2.6 STATISTICAL SENSITIVITY ANALYSIS

A statistical sensitivity analysis was derived from the risk analysis using Monte Carlo Simulation. Presenting the sensitivities in a chart, as a percentage of the contribution to the variance of the target forecast, makes it easier to answer questions such as "What percentage of the variance or uncertainty in the target forecast is due to any specific treatment's characteristics?". This statistical sensitivity analysis enables the user to quickly determine which controllable assumptions should be reexamined first to determine if the owner can glean greater savings from any individual treatment. The Real Discount Rate is generally assumed to be not controllable.

Figure 4 shows these statistical sensitivities with the assumptions that have the largest effect on the uncertainty of the NPV of savings before deducting residual values, the target forecast associated with this chart.

Figure 3-4: Statistical Sensitivity Analysis for the Net Present Value of the Savings before Deducting the Residual value for Alternative "123"



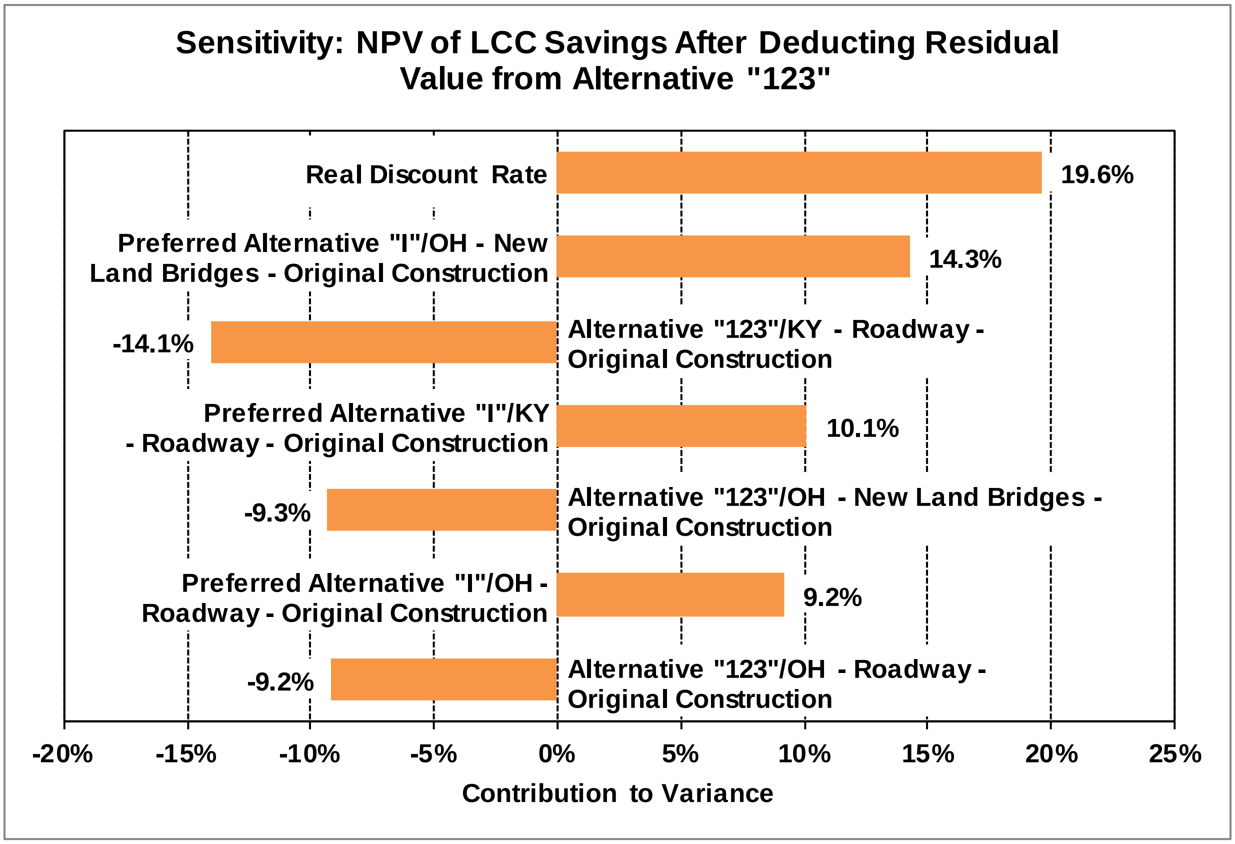
The treatment for the Construction of the "New Land Bridges in Ohio" for preferred Alternative "I" ($405m in CY$) contributes 26.3% of the variance in the forecasted savings before deducting the residual value. Since this is a positive percentage, if the cost of the "New Land Bridges in Ohio" for preferred Alternative "I" increases, the amount the owner should expect to save by choosing Alternative "123" also increases. This treatment should receive the most focus to reduce the cost and the associated risk surrounding the cost of the treatment.

The treatment with the second largest contribution to variance of -17.0% is the "New Land Bridges in Ohio" for Alternative "123" ($340m in CY$). The negative contribution percentage reveals to us that as the cost of this treatment is reduced, the savings associated with choosing Alternative "123" will increase. This treatment should receive a significant amount of focus to the reducing the cost and associated risk surrounding the treatment.

The remaining treatments can be interpreted in the same way as the first two while acknowledging a decreasing importance as moving down the chart.

Figure 5 shows these statistical sensitivities with the assumptions that have the largest effect on the uncertainty of the NPV of savings after deducting residual values, the target forecast associated with this chart.

Figure 3-5: Statistical Sensitivity Analysis for the Net Present Value of the Savings after Deducting the Residual value for Alternative "123"



When residual costs are introduced into the calculation of estimated saving to be experienced by choosing Alternative "123", the Real Discount Rate has the most contribution to the variance (19.6%) of this target forecast, though as mentioned earlier, this assumption is generally not controllable.

4. NEXT STEPS

With estimated cost savings of approximately $370 million in current year dollars before residuals are deducted, Alternative "123" could help right-size the BSB Project while still achieving the purpose and need. However, when compared to preferred Alternative "I", this alternative does have differences in local access and traffic operations on both sides of the river and additional ROW, utility, and environmental impacts east of the existing BSB that should be considered when deciding whether to advance this alternative concept further. If the decision is made to stay with preferred Alternative "I", there are some concepts in Alternative "123" that could help make the project better and cheaper such as using a network tied arch with plumb ribs, 12' outside and 8' inside shoulders, and 870' main-span for the New River Bridge. If incorporated, these concepts are estimated to save approximately $189 million in initial construction costs as compared to the two-tower cable stay option that was identified in the March 2012 BSB FHWA Cost Estimate Review. Also, allowing flexibility in the procurement documents for a contractor or concessionaire to have the option of replacing the existing BSB versus rehabilitating could save the agencies and/or concessionaire from being burdened with unpredictable and expensive long-term operations and maintenance costs.

Regardless if Alternative "123" is chosen to advance further, the following are environmental-related items that need to be kept in mind during the next steps of the BSB Project:

1. Any changes attributable to varying impacts resulting from Alternative "123" could be addressed in a re-evaluation of the EA.
2. Introducing tolling will primarily require additional environmental justice, noise and air quality analysis.
3. Additional analysis in historic districts could be required depending on traffic diversion.
4. The level of impacts will determine whether or not an EIS is required.
5. Additional public involvement will be required for any project changes.
6. FHWA requested ODOT and KYTC provide the approach to obtaining environmental approval when the path for the project is chosen.
7. If there is a chance an EIS will be required, the environmental process should begin right away so as to eliminate any delay if it is required.
8. A re-evaluation of the EA is expected to take one year. An EIS is expected to take nine months longer.

5. REFERENCES

1. FHWA FONSI for the Brent Spence Bridge Replacement/Rehabilitation Project, August 2012
2. ODOT/KYTC Preferred Alternative Verification Report for the Brent Spence Bridge Replacement/Rehabilitation Project , May 2011
3. FHWA Cost Estimate Review Spreadsheet, February 2012
4. FHWA Brent Spence Bridge Replacement/Rehabilitation Project Cost Estimate Review Final Report, March 2012
5. BSB Project MOT Technical Memorandum, May 6, 2011

6. APPENDICES

APPENDIX 6.1 PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

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BRENT SPENCE
BRIDGE CORRIDOR

DRAFT

PRACTICAL DESIGN/ VALUE ENGINEERING WORKSHOP REPORT

October 17-19, 2012 – Cincinnati, OH

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

U.S. Department of Transportation
Federal Highway Administration

HNTB

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1. INTRODUCTION

1.1. OVERVIEW OF PRACTICAL DESIGN/ VALUE ENGINEERING WORKSHOP

The Brent Spence Bridge (BSB) Project must be right-sized before the Ohio Department of Transportation (ODOT) can determine its optimal delivery approach, including the best funding and financing strategy. A reference concept and technical provisions must meet ODOT's technical and performance requirements while encouraging private sector innovation and value. Owners, contractors and concessionaires are interested in creating a job that they can build faster and more economically while managing risk. For example, a less complex project can be built more quickly and for less money.

To these ends, HNTB facilitated a Practical Design/ Value Engineering Workshop (PD/VEW) — a variation on traditional value engineering exercises. The primary objectives of the PD/VEW were to:

- Provide a high-level evaluation by select HNTB experts to generate technical ideas for delivering the BSB Project quickly, economically and safely.
- Conduct a field visit and have discussions with representatives from ODOT, the Kentucky Transportation Cabinet (KYTC) and the Federal Highway Administration (FHWA) to better understand the existing BSB corridor, and the opportunities and constraints from the information gathered during the Preliminary Engineering (PE)/ National Environmental Policy Act of 1969 (NEPA) phase of the Project Development Process (PDP).
- Generate technical ideas, particularly those of "high value," which will be evaluated further for use in the *Quantitative Value for Money* analyses and report.

The workshop activities can be categorized in three parts: pre-workshop activities, workshop activities and post-workshop activities.

1.2. PRE-WORKSHOP ACTIVITIES

HNTB's PD/VEW leadership created a project "Fish Finder" (**Appendix A, Page A6**), named for the device

fishermen use to locate the largest concentrations of fish so their efforts can be most productive. HNTB's Fish Finder helps identify the BSB Project's biggest costs, schedule-drivers and areas of risk, allowing subject matter experts to focus their reviews on the areas of maximum opportunity.

For the BSB Project, the "Fish Finder" shows that structures and roadways components comprise a significant portion of the overall project cost, while other items such as right of way (ROW) and utilities comprise a relatively small portion of the overall project cost. Therefore, PD/VEW participants focused on structure and roadway elements.

Among the biggest "fish" identified for the BSB Project are the River Bridge; approach and interchange bridges; and roadway (with associated pavement, embankment, walls and maintenance of traffic (MOT)). Several of HNTB's top bridge, road, traffic, geotechnical, construction and tolling experts were brought together at the PD/VEW and focused primarily on these project components, which presented the greatest opportunities to complete the project cheaper, faster and better.

Before the workshop, the participants were given available project information, including a wide variety of studies; information about the current state of the project; current site conditions; projected traffic data; and related environmental or political commitments.

1.3. WORKSHOP ACTIVITIES

The PD/VEW took place over three days in HNTB's Cin-

A HIGH-VALUE IDEA MAY BE ONE THAT COULD EASILY BE IMPLEMENTED AND POTENTIALLY PROVIDE SIGNIFICANT SAVINGS IN PROJECT COSTS OR DELIVERY, WITH MINIMAL RISK OR ADDITIONAL NEGATIVE IMPACTS.

cinnati office (see **Appendix A, Pages A1-A6** for the list of attendees, agenda and workshop handouts).

Day 1 included a project overview by workshop leaders and representatives from FHWA, ODOT and KYTC; a review of the Fish Finder process; and a visit to the project site.

Day 2 included breakout sessions with the HNTB technical experts to generate ideas for making project design and construction more efficient and effective.

Day 3 was spent presenting, categorizing and assigning preliminary values to the ideas generated during Day 2.

The preliminary value designations – high, medium and low – helped determine which ideas would be selected for further study.

1.3.1. VALUE DESIGNATIONS

The value designations were assigned based on an idea's potential benefit to the project combined with the difficulty and/or likelihood of its implementation.

A high-value idea may be one that could easily be implemented and potentially provide significant savings in project costs or delivery, with minimal risk or additional negative impacts. Conversely, a low-value idea is one that, although it could provide a significant cost reduction, may also require the acquisition of more Section 4(f) property; may be difficult to implement; may negatively impact the project schedule; and, as a result, would be unlikely to advance beyond the conceptual level.

The team was encouraged to come up with as many ideas as they could. The goal of the PD/VEW was to unearth as many high-value ideas as possible; however, even a low-value idea could serve as inspiration for another stronger idea.

During the breakout sessions, participants generated ideas utilizing two different approaches:

- Clean-sheet ideas
- Practical design improvements

1.3.1.1. Clean-Sheet Ideas

The clean-sheet ideas approach is intended to provide a fresh look at the project. Essentially "wipe the slate clean," and reimagine the project without any constraints. Often, projects pick up different elements over the years from different influencers – consultants, owners or third parties. A clean-sheet approach is unencumbered by these elements and therefore can provide concepts that address only the project purpose and need.

1.3.1.2. Practical Design Improvements

The practical design improvement approach acknowledges that the project has reached its present scope and design for a variety of reasons, but it focuses on making improvements to the project through design alterations, modifications to the owner's standards, or incorporating other design and construction modifications.

1.3.2. ALTERNATIVES CONSIDERED

The HNTB team considered many alternatives from both the clean-sheet ideas and practical design improvements approaches, including:

- Typical section modifications.
- Alignment (horizontal or vertical) modifications.
- Alternate layouts (interchange, structures, etc.) or material types.
- Alternate structure types and methodologies.
- Shoring methods or foundation types.

- Retaining and reusing existing components such as bridges, pavement or drainage structures.
- Schedule-saving construction methods, operational modifications or materials acquisition.
- Reducing contractor risk through engineering design, or owner/third-party relationships.
- Increased owner value such as reduced future maintenance, or improved safety for users during and after construction.

1.4. POST-WORKSHOP ACTIVITIES

After the workshop, each idea generated by the HNTB team was reviewed. The preliminary low-, medium- and high-value idea designations assigned during the workshop were reevaluated to ensure that the team was advancing the most highly valued concepts. To complete the post-workshop activities, the high-value ideas will be evaluated further to help determine their technical feasibility and level of positive and negative impacts each may have on the schedule, performance, and delivery of the overall project.

2. WORKSHOP OUTCOMES

2.1. CONDITIONS AND CONSTRAINTS

HNTB, ODOT, KYTC, and FHWA PD/VEW participants conducted a field review to observe the configuration and conditions of the existing BSB corridor. Additionally, during the workshop and in the field, participants discussed the constraints outlined in the various studies and technical documents that were developed during the PE/NEPA phase of the PDP. The following conditions and constraints were noted and discussed:

2.1.1. ROADWAY

- The Interstate pavement and shoulders on the Kentucky side appear to be in good condition.
- The Interstate pavement and shoulders on the Ohio side appear to be in fair to poor condition.
- Any changed impacts to Section 4(f), Section 6(f) and/or historic resources would require additional coordination with agencies and stakeholders. Any such changes could lead to modifications to the existing Memoranda of Agreement (MOAs), updated coordination documents and reevaluation of the environmental document. Up to 12 months may be needed to complete changes to the MOAs for Section 4(f), Section 6(f) and historic resources.
- The 5% grade south of the BSB slows trucks, which in turn slows overall traffic flow.
- The I-71 and I-75 mainlines are posted at 55 mph. A design speed of 60 mph was used for mainline during the PE/NEPA phase of the PDP.
- The desirable vertical underclearance for an overpass structure is 17′-0″ in Ohio. The minimum vertical underclearance for most locations is 15′-6″ and can be less than this over some local streets.
- Other vehicular bridges crossing the Ohio River, such as the Clay Wade Bailey Bridge, may have unused capacity for local traffic.
- The signage for drivers northbound into Cincinnati is difficult to read because it is mounted on the underside of the existing BSB top deck.
- The 4th Street-to-northbound on-ramp in Kentucky is very steep and immediately puts vehicles in a weave situation with I-71 northbound.
- The proposed project has an approved Finding of No Significant Impact (FONSI). Alternatives that require an Environmental Impact Statement (EIS) will significantly delay the schedule.
- ODOT and KYTC need to determine the number of lanes that a contractor would be required to maintain during construction on the various routes.
- The preferred Alternative I requires the removal of a portion of the east end of Longworth Hall.
- The city of Cincinnati was opposed to reducing east-west connectivity and the Queensgate alternative, which proposed to shift I-75 to the west of its current location.
- UPS in Ohio requested the preferred alternative not have a detrimental impact on the company's property, particularly parking.

See **Appendix E, Pages E1-E8** for the design exceptions for preferred Alternative I that are specified in the Preferred Alternative Verification Report (PAVR).

2.1.2. BRIDGE

- The existing BSB is in need of extensive rehabilitation including full painting, deck improvements and structural steel repairs. The bridge is currently considered functionally obsolete due to substandard deck geometry and underclearances.
- The existing overpass bridges on the Kentucky side are generally in fair to good condition, with numerous locations of substandard underclearance. Live load-carrying capacity appears to meet the current requirement of an HL-93 vehicle.
- The existing overpass bridges on the Ohio side are generally in satisfactory to very good condition with scattered locations of substandard underclearances and deck geometry. Live load-

carrying capacity generally meets previous design vehicle HS-20, but would not meet the current requirement of a HL-93 vehicle.

- The existing approach bridges on the Kentucky side are generally in fair condition and are functionally obsolete due to deck geometry and underclearances.

- The existing approach bridges on the Ohio side are generally in fair condition and are functionally obsolete due to deck geometry and underclearances.

- The BSB main span shall provide sufficient length to ensure that substructure units are outside of the main span piers of the existing BSB.* Since the workshop, HNTB has had discussions with the U.S. Coast Guard (USCG) Bridge Office in St. Louis about the main span length and location of piers to satisfy the needs of navigation. In early January 2013, verbal confirmation was received from Dave Orzechowski, USCG, that Alternative 123 is acceptable if the main spans of the proposed bridges are 870 feet and the piers are lined up as follows:

  1) Downstream bridge: right descending pier in line with existing BSB bridge pier; left descending pier outside of the existing BSB bridge pier (toward the Kentucky bank), and

  2) Upstream bridge: left descending pier in line with existing BSB bridge pier; right descending pier outside of the existing BSB bridge pier (toward the Ohio bank).

- Trusses have already been dismissed through the public process and will not be allowed. The FONSI states that the only valid structure types are tied arch or symmetrical cable-stay structures.

- The highest point of the bridge shall be at least 300′ +/- above the Normal Pool Elevation of the Ohio River (EL. 456.36′)*. This elevation is flexible, especially if the existing bridge is removed.

- The highest point of the bridge shall be less than 420′ +/- above the Normal Pool Elevation of the Ohio River (EL. 456.36′)* If this elevation is exceeded, a reevaluation of Section 106 of the MOA would be required, which could take as long as 12 months.

- The minimum provided underclearance shall be no lower than that provided by the existing BSB.*

- If a double deck design is provided, a minimum 25′ vertical clearance above the bottom deck roadway surface is required.*

- Select existing truss members have been strengthened.

- A fatigue evaluation performed on the existing southbound structure determined that it has infinite fatigue life; however, the fatigue evaluation considered only the standard American Association of State Highway and Transportation Officials (AASHTO) specification study of one-truck and in-plane stresses. Generally, fatigue issues stem from out-of-plane stresses. This study warrants revisiting because a less-than-infinite life would require fatigue retrofits to extend the bridge life.

- There are 2″-12″ diameter gas mains crossing the Ohio River parallel to and approximately 60′ east of the existing BSB.

- Numerous parking lots are under the bridges, especially on the Ohio side, for which vendors have acquired lease agreements from ODOT.

- The preferred Alternative I requires relocating the Duke Energy substation that is now just west of the existing BSB.

2.2. PRACTICAL DESIGN IDEAS

Low-cost and low-impact ideas were identified as part of the development of value-based ideas to reduce cost while achieving the fundamental project goals and objectives. These practical design ideas may not have significant benefits when considered individually, but if combined they could produce a higher value to the overall project. The ideas identified that represent value opportunities include the following:

- **Add Truck Climbing Lanes** – Due to steep grades in some locations such as the I-75/I-71 southbound

** Information from the FONSI for the Brent Spence Bridge Rehabilitation Project dated 8/09/12.*

lanes south of the river, the addition of truck climbing lanes could improve levels of service (LOSs) and allow a reduction in the basic number of lanes. One disadvantage of this opportunity is the potential for additional impacts to Section 4(f), 6(f) and historic resources on the Kentucky side.

- **Reduce Number of Lanes over River** – The current number of lanes shown in the recommended plan is 16 lanes (8 in each direction). It appears that 13 to 14 lanes would achieve an acceptable LOS, depending on the ultimate allocation of lanes by bridge and route.

- **Reduce Number of Lanes in Kentucky** – There are 12 lanes between 12th Street and Kyles Lane. Six lanes may be needed southbound due to the steep grade, but 5 lanes northbound may be acceptable.

- **Widen Existing Pavement in Kentucky (No Full-Depth Reconstruction)** – Cost savings and MOT benefits could result from reusing existing pavement wherever possible.

- **Use Posted Speed as Design Speed** – Using the posted speed as the design speed could reduce earthwork quantities, bridge lengths, retaining wall lengths and ROW impacts due to optimum profile and horizontal curve adjustments.

- **Take Advantage of Criteria Reduction with Switch from Interstate Traffic to Local Traffic** – Segregating Interstate traffic from local traffic could reduce design criteria for some roadways and reduce construction costs.

- **Flip Shoulders on Ramps to Improve Horizontal Stopping Sight Distance** – Wherever a left-side shoulder has to be widened to provide adequate sight distance and the left-side shoulder width is less than the right-side shoulder width, consider using the wider shoulder on the left side to minimize bridge widths.

- **Tie Barrier Size/Type to Design Speed** – Rather than using a tall barrier appropriate for high-speed roadways, match the barrier height to the design speed to reduce barrier costs.

- **Reduce Pavement Thickness Based on Actual Utilization** – Analyze truck volumes by lane and design pavements accordingly.

- **Use Minimum Required Vertical Underclearance** – Particularly in the multilevel system interchange areas, slightly reducing the required vertical underclearance can lower the elevation of crossing roadways with valuable construction cost savings. In Ohio, the minimum vertical underclearance for most locations is 15′ 6″, and can be even less over some local streets.

The above practical design ideas and others from the workshop are denoted with a "P" in the "Ideas and Innovations Matrix" in **Appendix B**.

2.3. HIGH-VALUE IDEAS: ROADWAY

The ideas categorized as "Roadway" were generally ideas unrelated to structures, such as the river crossing, dry bridges and walls. The roadway ideas instead were focused on geometry, alignment, interchange configuration, traffic operations and MOT. Particular focus was on the mainline and interchanges, which are considered major schedule and cost-drivers.

Workshop participants reviewed and referred to Alternative I, which currently is the preferred alternative, and they also reviewed previous concepts considered during Step 5 of the ODOT PDP that were not carried forward. This gave the team a framework of what had been considered in the past and illustrated the project's progression to where it is today.

Two basic roadway cost-saving concepts were prevalent during the workshop and categorized as high-value concepts, including:

1. **Reduce reconstruction of overhead crossings on the Ohio side.**

2. **Separate Interstate traffic from local traffic.**

Variations on these two concepts are discussed below.

2.3.1. REDUCE RECONSTRUCTION OF OVERHEAD CROSSINGS ON THE OHIO SIDE

The existing overhead structures provide connections to nearly every local street in the Cincinnati street grid. During the planning phase, city of Cincinnati officials said the Interstate is detrimental to east-west connec-

SIGNIFICANT COST SAVINGS COULD BE ACHIEVED BY REUSING THE EXISTING RAMPS AND INTERCHANGE BRIDGES. SEVERAL INNOVATIONS PROPOSE SOME TYPE OF REUSE.

tivity within the city, and they have requested improvements in this area. The current preferred Alternative I provides the same connections but at a great cost and a significant increase in construction time.

Alternative I maintains all local street east-west connections over I-75 at 5th, 6th, 7th, 9th and Linn streets, and Ezzard Charles Drive in Cincinnati. Workshop participants identified this area as having opportunities for innovation (see **Innovation Nos. 12, 47, 88, 120** and **124** in the "Ideas and Innovations Matrix," **Appendix B**). In addition to improving the operations of the roadway system, reducing the number of connections could significantly reduce the $100 million in associated capital costs specified in the PAVR document and the future maintenance costs.

Innovation No. 124 suggests that reconstructing overpasses (bridges, walls, etc.) is a major cost-driver on the Ohio side of the project area. Eliminating the number of overpasses by designing a frontage road system (**Figure 1, Page 8**) that fits into the existing city of Cincinnati grid system will save money and time.

The east-west overpass at 6th Street would be a two-way street, and it would connect US 50 to downtown. Likewise, Linn Street and Ezzard Charles Drive (farther north) would retain overpasses. This would eliminate three overpass structures and related construction costs and time.

The concept is not unfamiliar to Cincinnati because it creates a system similar to the one used at Ft. Washington Way. Advantages of the concept include significant cost and time savings; disadvantages include potential opposition from the city of Cincinnati and the amount of time it could take to garner stakeholder acceptance.

Other advantages and disadvantages for **Innovation No. 124** are shown in the "Ideas and Innovations Matrix" in **Appendix B, Page B8**. Further policy discussions will be needed before advancing this idea beyond the preliminary concept stage.

2.3.2. SEPARATE INTERSTATE TRAFFIC FROM LOCAL TRAFFIC

The existing interchanges near the Ohio River bridges currently include most of the desired local street connections. The proposed configuration of the roadways across the river requires significant reconstruction of the ramps and bridges, particularly on the Ohio side.

Significant cost savings could be achieved by reusing the existing ramps and interchange bridges. **Innovation Nos. 6, 16, 22, 104** and **123** propose some type of reuse by using the existing bridge for all local connections, whereas a new bridge, or bridges, would be constructed to serve only I-75/I-71 traffic. Conversely, if I-75 and I-71 use the existing bridges, many of the system ramps could possibly be reused.

Although the concept of separating local traffic from the Interstate or express traffic is included in the current plan, the plan combines Interstate and local traffic on double-stack bridges. The resulting combination of roadways creates the need to reconstruct many of the interchange ramps and associated bridges.

The following is a brief overview of some of the concepts to separate local and Interstate traffic:

- **Innovation No. 22** would build the new bridge to the east of the existing for I-75/71 traffic reusing the ramps and existing infrastructure where possible. The Interstate mainline bridge would be a flat bridge (see section **2.4. HIGH-VALUE IDEAS: BRIDGE** and **Appendix C, Page C1** for a preliminary sketch of this concept) lining up I-75 northbound and southbound to the existing alignment sooner in Ohio than currently proposed. The advantage of this alternative is that it preserves much of the existing overpasses at 5th, 6th, 7th and 9th streets. It also avoids the Duke Energy substation and Longworth Hall to the west. One of the disadvantages of this alternative is the need to relocate the existing 2"-12" diameter gas mains located just east of the existing BSB.

Figure 1: Frontage Road Concept in Cincinnati

- **Innovation No. 85** shifts the mainline I-75 west, which would allow for an interchange with US 50 along Freeman Avenue (see **Appendix C, Pages C5-C6** for a preliminary sketch of this concept). Inspired by the Queensgate alternative considered several years ago for its removal of I-75 through-traffic from the corridor, this alternative appears to offer less significant impacts to existing businesses, ROW or environmentally sensitive areas than the Queensgate alternative impacted. Following existing Freeman Avenue, the new I-75 through movements would snake through the west side of downtown Cincinnati. I-71 would be maintained in place on the existing bridge, thereby simplifying the interchange north of the BSB or tieing into the new I-75 and US 50 interchange. Several opportunities exist with this alternative to rehabilitate and reuse the existing infrastructure, which could result in significant cost and time savings. Moving I-75 and possibly I-71 through traffic out of the congested downtown Cincinnati CBD would improve the geometry and safety of this heavily traveled Interstate corridor, and it would help simplify wayfinding signage approaching and leaving the bridge from both sides of the river. The construction phasing of the I-75 and 71 corridors would also be advantageous, since much of the new I-75 alignment could be built offline. In addition, the new river crossing, carrying I-75 alone, could be smaller and more affordable than the currently proposed alternative. Some of the disadvantages with this option include the potential for resistance from the local stakeholders who opposed the Queensgate alternative, additional impacts to section 4(f), 6(f), and historic resources, and having the new bridge cross the river on a skew. Up to 12 months may be needed to complete changes to the MOAs for the Section 4(f), Section 6(f) and historic resources.

- **Innovation No. 123** proposes to isolate local traffic to the existing bridge and connecting roadways. Interstate movements would be accommodated by simple (flat) bridges with separate northbound and southbound roadways located east and west of the existing bridge (see **Appendix C, Pages C7-C8** for a preliminary sketch of this concept). The separate roadways would connect to system ramps for I-75 and I-71 separate from the existing ramps. The objective would be to preserve as many of the existing ramps and bridges as possible for the local connections. There may be advantages to locating the bridges differently while still maintaining the basic concept. **Innovation No. 123** would not increase the ROW impacts west of the existing bridge; however, the northbound roadway east of the existing bridge would probably require relocating the existing 2"-12" diameter gas mains. Also, the best transition for the Interstate roadways south of the river would be to provide grade separations (braided roads) with the local roadways to place the Interstate roadways on the inside of the corridor. The higher truck volumes associated with the Interstate highways then would not conflict with the local ramp connections at the interchanges in Kentucky north of 12th Street. Further study is needed to determine to what extent the Interstate lanes are physically separated from the local lanes at this location.

2.3.3. LANE REQUIREMENT CONSIDERATIONS

Several key movements will determine overall system delay for traffic moving through the project area on I-75 and I-71. These areas present the greatest opportunity to right-size the project in terms of reduced/reconfigured lane requirements. The areas identified as the highest potential for lane reduction/reconfiguration were:

- The bridges across the Ohio River and the merges and diverges between I-75 and I-71.
- The 5% grade through the "Cut in the Hill."
- The configuration of Dixie Highway and Kyles Lane Interchanges.

2.3.3.1. Bridges across the Ohio River

Any traffic analysis for the river bridge will be influenced by ramp connections at interchanges immediately north and south of the river. Our evaluation of the 2035 forecasted travel demand for the I-75 mainline and I-71 southbound ramps north of the river shows a required 3 lanes and 2 lanes, respectively. The Interstate traffic southbound would likely require a 5-lane section with a drop to 4 lanes occurring as quickly as possible before the bridge main span to minimize river bridge cost. A traffic microsimulation analysis is recommended by the Highway Capacity Manual (HCM) for these types of lane drop situations. Four lanes is required for both south-bound and northbound I-75/I-71 express lanes across the Ohio River, and that will provide a LOS D operation for 2035 design peak-hour traffic.

Major system ramp diverges on the north side of the river should typically be 4 lanes to 3 lanes for I-75, and continuous 2 lanes for I-71, for both southbound and northbound movements.

Three lanes in each direction for the local only roadways across the Ohio River will provide a LOS D operation for 2035 design peak-hour traffic.

2.3.3.2. Five Percent Grade through the "Cut in the Hill"

The existing traffic analysis used a planning methodology based on "level terrain" to achieve the identified LOS E for the proposed 6 lanes. When the 5% up-grade south of the existing bridge is considered, it would appear that 7 lanes southbound may be needed to provide LOS E. If the I-75/I-71 southbound traffic (express lanes) is separated from the local traffic south of 12th Street, the express lanes would require 4 lanes to maintain LOS E operation. The local southbound traffic would require 3 lanes to maintain a minimum LOS E operation, but would actually achieve a LOS D during the PM peak hour. A total 6 lanes would be adequate to accommodate Interstate and local traffic in the northbound direction.

2.3.3.3. Dixie Highway/Kyles Lane Interchange Alternatives

The preferred alternative for the Dixie Highway-Kyles Lane interchange configurations shows a collector-distributor (C-D) system with full pavement replacement for mainline and ramps, and the replacement and widening of the Dixie Highway and Kyles Lane bridges. As part of the development of value-based ideas to reduce cost while achieving the fundamental project goals and objectives, the identification of low cost and low impact ideas that would contribute to savings were identified.

Innovation No. 81 was identified that represents value opportunities at the above interchanges through a variety of options including the following:

- Replace with a braided ramp system to eliminate the northbound and southbound weave. For northbound, maintain the existing exit ramp to Dixie Highway and braid the C-D road with the entrance ramp (with short, simple span bridge), then potentially use a slip ramp before Kyles Lane and maintain the existing entrance ramp from Kyles Lane. Similarly, for southbound, maintain the existing exit ramp to Kyles Lane and braid the C-D road with the entrance ramp, then potentially use a slip ramp before Dixie Highway and maintain the existing entrance ramp from Dixie Highway. Like the other options above, the primary goal of this option is to preserve as much of the existing infrastructure as possible, which helps reduce construction costs. See **Appendix C, Page C2** for a preliminary sketch of this concept.
- Maintain the proposed C-D system design but shifts the C-D roads to the outside either over (with short, simple span bridges) or under (with box culverts) Dixie Highway and Kyles Lane. This option would reduce construction costs by preserving most, if not all, of the existing infrastructure at these two locations which was observed to be in a state of good repair. See **Appendix C, Page C3** for a preliminary sketch of this concept).
- Replace with a split diamond interchange configuration involving the northbound exit to Dixie Highway and entrance from Kyles Lane, and southbound exit to Kyles Lane and entrance from Dixie Highway, and no access between the crossroads. This option would also reduce construction costs by preserving most, if not all, of the existing crossroad bridges, crossroads and ramps. See **Appendix C, Page C4** for a preliminary sketch of this concept.

For each of these interchange options, as well as the river bridge lanes and the number of lanes through the "Cut in the Hill," traffic capacity would need to be confirmed for adequacy of lanes on the mainline, ramps and C-D roads. However, continued evaluation of these alternatives, including an in-depth traffic analyses, will only be conducted after an initial screening of the alternative concepts is completed.

2.4. HIGH-VALUE IDEAS: BRIDGE

2.4.1. USE NETWORK TIED ARCHES FOR NAVIGATION SPAN ONLY

The idea of using network tied arches stems from the general philosophy that the bridge type needs to fit the site, and that form should meet function. In this span range (830') the network tied arch generally would be the most economical structure solution. At this span range, a tied arch is going to be comparable to a cable-supported structure in dollars per square foot; however a tied arch would reduce the length of complex bridge by 50% when compared to a cable-stayed option. Assuming the cable- or arch-supported section is about $800 per square foot of deck area, and the shorter approach spans are $250 per square foot, a savings of about $120 million (present-day dollars) would be realized by using the tied arch-supported structure instead of the cable-supported structure. These costs need to be studied further to determine an actual projected total project cost for planning purposes.

2.4.2. USE SINGLE-LEVEL BRIDGES INSTEAD OF DOUBLE-DECKER BRIDGES

The idea of using single-level bridges instead of double-decker bridges has several advantages. Single-level bridges will generally reduce the number of shoulders required. Therefore, the square footage of the deck is greatly reduced. If the proposed double-decker was 12 lanes on one level instead of two, it would save about 58' of deck width, or 22% of the deck. This change alone would save between $50 million to $75 million (present-day dollars, range stated as it depends on bridge type) for the river portion of the bridge.

Single-level bridges would simplify the connection to the interchanges on each side of the river and will generally shorten the length of those bridges, thereby reducing project cost. This needs to be studied further to determine project savings, but initial estimates indicate that it could reduce the project cost by $50 million to $150 million (present-day dollars). A bridge on a single level provides the ability to sign the movements clearly, thereby providing a safer venue for the travelling public.

Lastly, it would provide a more visually pleasing river structure as the longitudinal trusses necessary for a double-decker bridge are eliminated.

2.4.2.1. Bridge Types for the Single-Level Bridges

2.4.2.1.1. Network Tied Arch

Several advances have been made in the design of tied arches in the past decade. The introduction of network cables has added redundancy as well as structural efficiency, allowing the rib sections to be reduced. Depending on span length and width of bridge, an I-shaped section could be considered, further reducing costs. The construction methods employed to build arches also facilitates rapid replacement (float-ins) and provides for safer construction methods as the workers are constructing the structure closer to the ground. For a float in, the arches will need to be built in the adjacent pools, as their height will not allow them to be floated underneath the existing bridges even at low pool.

2.4.2.1.2. Flat Slab Cable-Stayed

For an 830' span length and a bridge that is in the 60' wide range, a flat slab cable-stayed bridge should be considered. The omission of floor beams and stringers greatly simplifies construction and can reduce construction costs. The ability to cast the backspans in place and simplified connections of the cable anchorages has several advantages. This system is still expected to cost somewhere between the costs of an arch and a traditional cable-stayed structure. But, if it is important to the stakeholders of the project to have the aesthetics associated with cables, this option could be considered or incentivized in the RFP.

2.4.2.1.3. Traditional Cable-Stayed Bridge

If a traditional cable-stayed bridge is considered, the following technologies should be allowed and encouraged: a semi-fan cable arrangement; vertical hollow pylons; and longitudinal post-tensioning only in areas where it is required. Other techniques that have been used widely in the recent past include the use of drilled shafts; multicolumn bents for the rest piers; using the next approach span for "ballast"; vertical saddles; and matching the edge girder depth to the floor beam depth to simplify detailing.

2.4.3. GENERAL ARRANGEMENT OF RIVER BRIDGES

See **Appendix D, Pages D1-D5** for general arrangements of river bridges and general suggestions of how to widen the substructure of the existing river piers. The drawings include:

- New Single-Level Bridge in addition to the existing double-decker bridge. The advantages to this option are discussed above (less shoulders, shorter approach bridges and safety).

- Two Single-Level Bridges (replace existing superstructure): This option has the same advantages as the above, but with all lanes at the same level. In addition, it may have significant advantages when considering lifecycle costs for the next 50 years. This needs to be investigated more thoroughly.

- Three Single-Level Bridges (new superstructure): Same advantages as above, with the additional benefit of having significant capacity to decommission the existing bridge and build the new superstructure without reducing the existing through traffic capacity.

Rough Expected Lifecycle Cost Savings when putting a new superstructure on the existing substructure is a total approximate savings of $115 million (in 2012 dollars), not including the opportunity for enhanced revenue from tolling. This rough estimate warrants further study to determine the actual value of replacement to the owner.

3. NEXT STEPS

The PD/VE workshop introduced more than 100 technical ideas that conceptually appear to make the BSB project design even better, faster, cheaper and safer than the current preferred Alternative I.

Based on discussions among workshop participants and ODOT and KYTC representatives, as an initial phase of the post-workshop analysis, the HNTB team subject matter experts grouped these ideas according to one of three value designations: high, medium and low. The value designations were assigned based on an idea's potential benefit to the project combined with the difficulty and/or likelihood of its implementation.

Based upon the information reviewed and findings discovered during the workshop, the HNTB team will study in more detail the high-value ideas to achieve the following outcomes from the post-workshop activities:

- Additional detailed analysis of each high-value idea to verify technical feasibility and level of positive and negative impacts on the schedule, performance, financing and delivery of the overall project.
- More detailed cost breakdowns for each high-value idea, including a comparison of increased and decreased costs to implement the proposed idea instead of the preferred alternative.
- Collaboration with traffic and revenue modelers to verify and further develop tolling model scenarios based on high-value ideas that would positively impact potential toll revenues compared to the preferred alternative.
- Additional conceptual analysis of each medium-value idea to verify technical feasibility and how/whether to accommodate the ideas into a procurement process.

These post-workshop activities are expected to be substantially complete by January 2013.

BRENT SPENCE BRIDGE PROJECT

PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

APPENDIX A: WORKSHOP MATERIALS

BRENT SPENCE
BRIDGE CORRIDOR

Workshop Materials: Sign-In Sheet

Brent Spence Bridge - Practical Design Workshop
October 17 -19, 2012
Sign In Sheet

Attendee	Company/Focus	17-Oct	18-Oct	19-Oct
Paul Huston	HNTB/PM	X	X	X
Scott Campbell	HNTB/Management	X	X	X
Kurt Codutti	HNTB/Management	X	X	X
Rob Turton	HNTB/Bridge	X	X	X
John Brestin	HNTB/Bridge	X	X	X
Marco Rosignoli	HNTB/Bridge	X	X	X
Ted Zoli	HNTB/Bridge		X	
Finn Hubbard	HNTB/Bridge	X	X	X
Rich Bloch	HNTB/Bridge	X	X	X
Ken Ishmael	HNTB/Construction	X	X	X
Bob Fisher	HNTB/Construction	X	X	X
John Anderson	HNTB/Geotech	X	X	X
Matt Riegel	HNTB/Geotech	X	X	X
John Siwula	HNTB/Geotech	X	X	X
Matt Simon	HNTB/MOT	X	X	X
Jason Rhoades	HNTB/MOT/Road		X	X
Charlie Dodge	HNTB/Road	X	X	
Dale McGregor	HNTB/Road	X	X	X
Jake Stremmel	HNTB/Road	X	X	X
Jeff Dailey	HNTB/Tolls	X	X	
Brad Guilmino	HNTB/Tolls		X	X
Bill Wiedelman	HNTB/Traffic	X	X	X
Amit Thomas	HNTB/Traffic	X	X	X
Mike Wawszkiewicz	ODOT/Central Office Innovative	X	—	X
Stefan Spinosa	ODOT/District 8 PM	X	—	X
Steve Mary	ODOT/District 8 Dist Dep Director	[initials]	—	[initials]
Rob Hans	KYTC\Chief District Engineer		—	X
Stacee Hans	KYTC\PM	X	—	X
Dave McDougall	HNTB	X	X	X
Andy Thompson	FHWA	X	—	
Joe Vogel	ODOT DB	X		X

BRENT SPENCE
BRIDGE CORRIDOR

Workshop Materials: Agenda (Page 1 of 2)

AGENDA
BRENT SPENCE BRIDGE
Practical Design/Value Engineering Workshop
October 17 -19, 2012 – Cincinnati, OH

DAY 1 – Field Visit (12:00 pm to 5:00 pm)

Introductions	30 minutes
Review of Project Goals and Ground Rules	30 minutes
Project Overview	30 minutes
Review of Fish Finder	30 minutes
Field Visit	2½ hours
Reconvene to discuss Field Observations	30 minutes

DAY 2 – Innovation Sessions

Morning Breakout Session (8:00 am to 12:00 pm) 4 hours

Name	Core Discipline	Name	Core Discipline	Name	Core Discipline
Session 1 - Thursday AM		***Focus on Innovative Ideas (Clean Sheet Approach)***			
Rob Turton *	Bridge	Charlie Dodge *	Road	Matt Simon *	Road
John Brestin	Bridge	Dale McGregor	Road	Jason Rhoades	Road
Marco Rosignoli	Bridge	John Anderson	Geotech	Matt Riegel	Geotech
Ted Zoli	Bridge	Bill Wiedelman	Traffic	John Siwula	Geotech
Finn Hubbard	Bridge	Jeff Dailey	Tolls	Amit Thomas	Traffic
Rich Bloch	Bridge	Jake Stremmel	Project	Kurt Codutti	Project
Scott Campbell	Project	Bob Fisher	Construction	Paul Huston	Project
Ken Ishmael	Construction			Brad Guilmino	Tolls

* Indicates breakout session spokesperson

Lunch (12:00 pm to 12:30 pm) ½ hour

Present morning ideas (12:30 pm to 1:00 pm) ½ hour

Workshop Materials: Agenda (Page 2 of 2)

Afternoon Breakout Session (1:00 pm to 5:00 pm) 4 hours

Session 2 - Thursday PM ***Focus on Innovative Ideas and Practical Design***

Name	Core Discipline	Name	Core Discipline	Name	Core Discipline
John Brestin *	Bridge	Jason Rhoades*	Road	Bill Wiedelman*	Traffic
Rob Turton	Bridge	Matt Simon	Road	Paul Huston	Project
Marco Rosignoli	Bridge	Charlie Dodge	Road	Scott Campbell	Project
Ted Zoli	Bridge	Dale McGregor	Road	Jake Stremmel	Project
John Anderson	Geotech	Ken Ishmael	Construction	Amit Thomas	Traffic
Matt Riegel	Geotech	Bob Fisher	Construction	Jeff Dailey	Tolls
John Siwula	Geotech	Finn Hubbard	Bridge	Kurt Codutti	Project
		Rich Bloch	Bridge	Brad Guilmino	Tolls

* Indicates breakout session spokesperson

Present Afternoon ideas (5:00 pm to 5:30 pm) ½ hour

DAY 3 – Innovation Sessions

Morning Breakout Session (8:00 am to 10:00 am) 2 hours

Session 3 – Friday AM ***Focus on Innovative Ideas along with ODOT Practices***

Name	Core Discipline	Name	Core Discipline	Name	Core Discipline
Scott Campbell*	Project	Jake Stremmel*	Project	Paul Huston *	Project
Rob Turton	Bridge	John Brestin	Bridge	Matt Simon	Road
Dale McGregor	Road	Jason Rhoades	Road	Charlie Dodge	Road
Matt Riegel	Geotech	John Siwula	Geotech	John Anderson	Geotech
Kurt Codutti	Project	Bob Fisher	Construction	Ken Ishmael	Construction
Finn Hubbard	Bridge	Rich Bloch	Bridge	Marco Rosignoli	Bridge
Jeff Dailey	Tolls	Bill Wiedelman	Traffic	Amit Thomas	Traffic
		Brad Guilmino	Tolls		

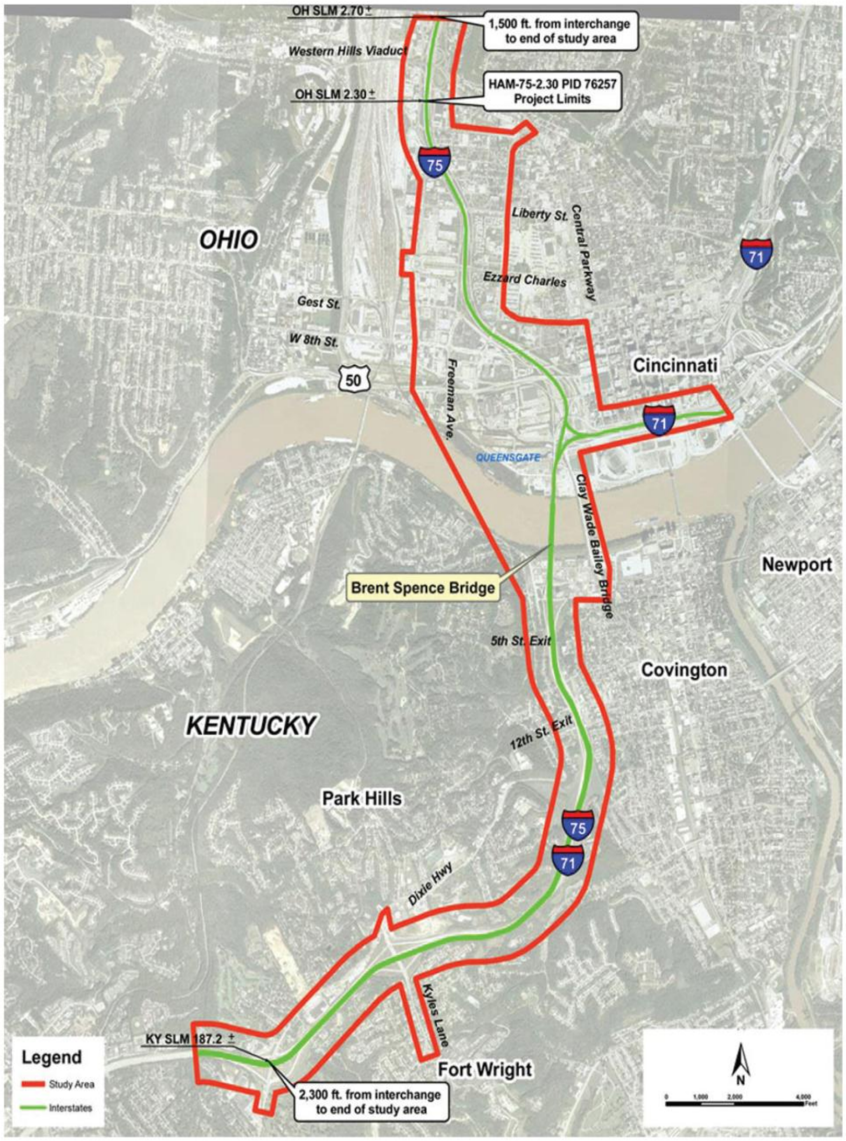
* Indicates breakout session spokesperson

Review morning ideas (10:00 am to 10:30 am) ½ hour

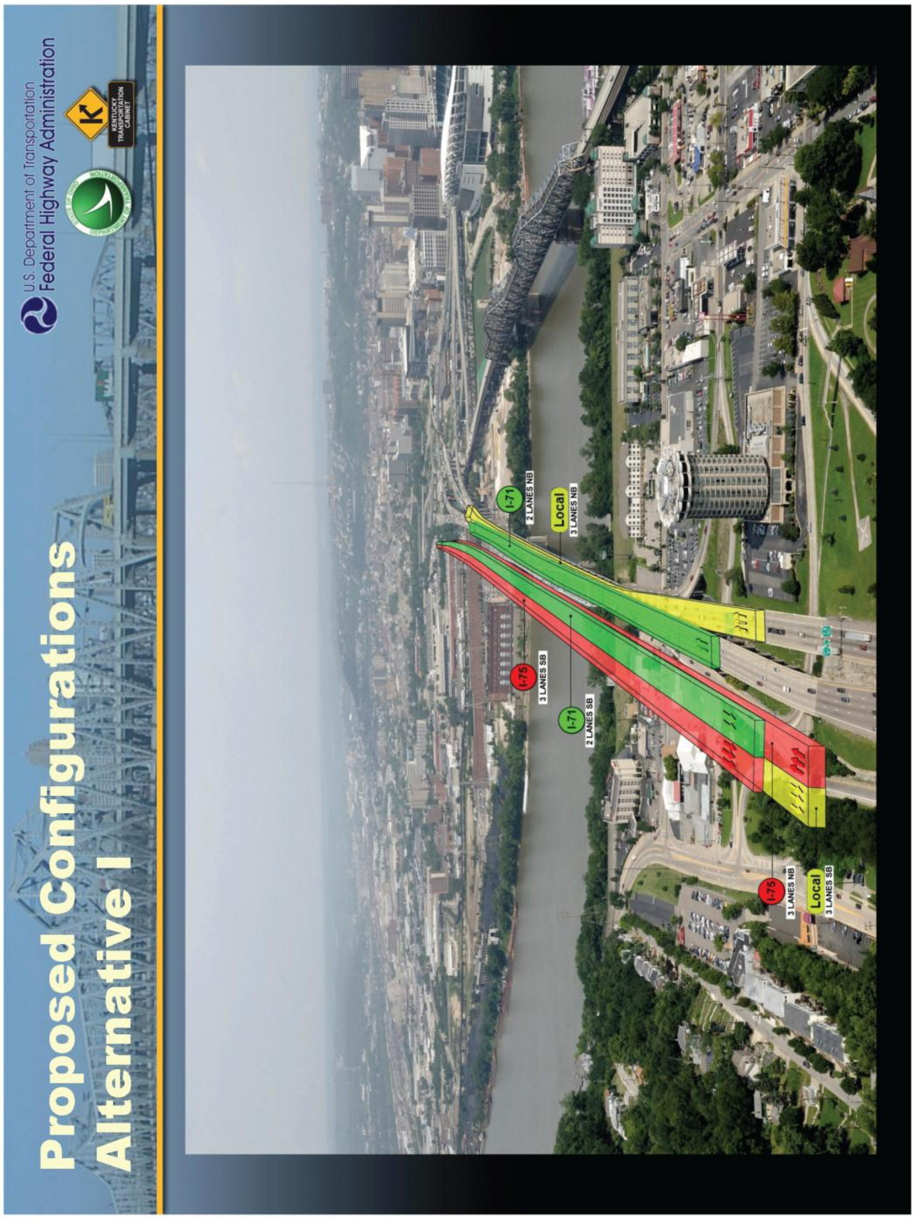
Collate ideas and follow-up tasks (10:30 am to 12:00 pm) 1½ hours

Workshop Materials: Handout 1 – Study Area

Brent Spence Bridge Study Area



Workshop Materials: Handout 2 – Preferred Alternative 1



Workshop Materials: Handout 3 – “Fish Finder”

THE "FISH FINDER"
Preliminary Cost / Schedule / Risk Analysis

Project: Brent Spence Bridge Project
Estimated Construction Cost = $ 1,391,800,000

Updated: 17-Oct-12

Project Component	Estimated Percent of Component Cost		Potential Cost/ Schedule/ Risk Saving Innovation Opportunity or Strategy	Est. Max. Cost Saving Potential Reduction Percentage (0-100%) (from Component)	VE Revised Component Cost Percentage	Estimated Owner's Cost (rounded)	Estimated Maximum Cost Savings (rounded)	Estimated VE Cost (Owner's less VE) (rounded)	Schedule Driver (Y/N)?	Construction Risk Driver (Y/N)?
Structures		73%								
River Bridge	34%				34%	$345,600,000	$0	$345,600,000		
Rehab existing	3%				3%	$31,800,000	$0	$31,800,000		
Approach bridges	52%				52%	$528,800,000	$0	$528,800,000		
Walls	10%				10%	$104,300,000	$0	$104,300,000		
Noise Barriers	1%				1%	$8,800,000	$0	$8,800,000		
					0%	$0	$0	$0		
Major Component Subtotals	*100%*			*0.0%*	*100.0%*	*$1,019,300,000*	*$0*	*$1,019,300,000*		
Roadway		17%								
Pavement	28%				28%	$64,500,000	$0	$64,500,000		
Drainage	10%				10%	$22,400,000	$0	$22,400,000		
Earthwork	27%				27%	$63,400,000	$0	$63,400,000		
Traffic control	9%				9%	$20,000,000	$0	$20,000,000		
MOT	3%				3%	$6,900,000	$0	$6,900,000		
Lighting	5%				5%	$11,500,000	$0	$11,500,000		
Incidentals (incl addt'l MOT)	19%				19%	$43,200,000	$0	$43,200,000		
					0%	$0	$0	$0		
Major Component Subtotals	*100%*			*0.0%*	*100.0%*	*$231,900,000*	*$0*	*$231,900,000*		
Other		10%								
ROW	40%				40%	$56,600,000	$0	$56,600,000		
Utilities	59%				59%	$83,400,000	$0	$83,400,000		
non-highway demo	0%				0%	$600,000	$0	$600,000		
					0%	$0	$0	$0		
					0%	$0	$0	$0		
					0%	$0	$0	$0		
Major Component Subtotals	*100%*			*0.0%*	*100.0%*	*$140,600,000*	*$0*	*$140,600,000*		
Project Totals		**100%**		***0.0%***		***$1,391,800,000***	***$0***	***$1,391,800,000***		

Other Non-Cost Schedule / Risk Drivers:

Non-Cost Project Component		Potential Schedule/ Risk Saving Innovation Opportunity or Strategy	Schedule Driver (Y/N)?	Construction Risk Driver (Y/N)?
Coast Guard Coordination / Approvals				
City of Cincinnati Coordination / Approvals				
FAA Approvals				
USACE Permit Approvals				
City of Covington Coordination / Approvals				

BRENT SPENCE BRIDGE PROJECT

PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

APPENDIX B: IDEAS AND INNOVATIONS MATRIX

APPENDIX B: IDEAS AND INNOVATIONS MATRIX

Ideas and Innovations Matrix: Page 1 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
1	Roadway	Truck Climbing Lanes on SB in KY	Increases safety and traffic flow on SB by keeping trucks in their own lane	Requires geometric and signing modifications to implement effectively; likely to increase cost. May have additional impacts to section 4(f), 6(f), and historic resources that would require more time to for coordination to revise the MOAs and re-evaluation of the environmental document	P
2	Systems	Reduce Number of Lanes over River	Reduces construction costs and long term bridge maintenance.	Potentially reduces level of service	P
3	Systems	Reduce Number of Lanes in KY	Reduces construction costs and ROW impacts	Potentially reduces level of service	P
4	Procurement	Phased Implementation	Under a P3 concession procurement, this allows improvements to be phased in based on need, not predetermined scope and schedule.	Extends implementation over a longer period.	P
5	Procurement	MAP 21 - Reconfirgure so maximimum number of lanes are tollable	Most revenue potential; potential of new BSB; adding shoulders back in could reestablish the amount of free lanes	Political acceptance	
6	Roadway	Existing Bridge Service Local / New Bridge serve thru Traffic or vise versa	Earlier decision point for drivers (thru versus local) improves traffic flow. Easier to sign. Allows for dynamic tolling on thru facility. Reduces cost of direct ramp connections on Ohio side with I-75/I-71.	Elimination of direct connections may require improvements on local intersections to handle capacity.	H
7	Systems	Consider Managed Lanes (Reversible, HOT, HOV)	Increases level of service on general purpose lanes by removing thru traffic. Allows for dynamic tolling.	Likely will not be effective without a wider range managed lane system	L
8	Procurement	Toll Local Lanes @ reduced cost	Additional revenue; political compromise; minimize evasion and impacts to existing system	MAP-21 authority; political acceptance; implementation plan	H
9	Procurement	(Toll Local Zip codes) Toll All Lanes, including locals	Revenue maximization; ease of implementation; eliminates connectivity of partially tolled plans	Political acceptance; diversion potential affecting existing network	H
10	Procurement	Toll all bridges in town	Can maximize revenue; can create most efficient traffic flows; can minimize diversion (traffic and cost benefits); can result in lowest BSB toll rates; enhances social justice by tolling all; creates a network; mitigates	MAP 21; political acceptance; increases toll technology capital and ops costs	H
11	Structures	Salvage more exist structures on OH side	Saves cost by reusing existing bridges that are in good condition.	Will require design exceptions due to clearances and geometrics;	M

Page 1 of 8

Ideas and Innovations Matrix: Page 2 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
12	Systems	Reduce / Consolidate X-St Bridges in OH	Reduces construction impacts to traffic on mainline. Reduces number of bridges and retaining walls and future maintenance costs. Increases ROW for development opportunities.	Reduces east-west connectivity. May require improvements on local intersections to handle capacity. Potential for oppostion from city of Cincinatti and increase in time to get stakeholder acceptance.	H -->L
13	Roadway	Move 75 Thru lanes/bridge further west (similar to Queensgate option)	See #85	See #85	H -->L
14	Procurement	Use "Other" River Bridges to equalize movements and reduce some ramp movements in interchange	Could reduce the needed capacity of BSB, thereby reducing cost; reduces cost of ramps;	Capital costs to modify connectivity of "other" bridges; other bridges have limited connectivity and access	L
15	Systems	Remove some system to system interstate moves @ core of I/C - Force them to use C/Ds to make moves	Reduces cost by eliminating approach structures and pavement while simplifying MOT	Eliminates movements.	M
16	Systems	Keep existing system entirely intact for local connections, only add new req'd thru lanes	Reduces number of thru lanes. Conducive for tolling options as it separates thru from local.	Design exceptions for existing infrastructure	H
17	Roadway	Tear down Dunn-Humby building to optimize Interchange geometrics and reduce cost	Optimizes geometrics. Helps minimize design exceptions. Increases safety.	Loss of valuable property.	M
18	Structures	One new bridge on each side of Brent Spence to optimize connectors in Interchange and reduce cost	Built in the clear	Cost, Gas line, Geometrics	M
19	Roadway	Create Truck Only Lanes and toll them	See #6	See #6	P
20	Roadway	Move SB merge points further south in KY past the Cut in the Hill		Adds scope, changes project limits	L
21	Roadway	Regrade Cut in the Hill for flatter grades and make Express	Increases safety	Cost	M
22	Roadway	Put new Bridge East of Brent Spence in line with I-75 to salvage existing local street	Saves existing infrastructure on OH side. Avoids Duke Energy substation. Avoids Longworth Hall.	Need to verify geometry will work. Potential design exceptions. ROW impacts. Potential new environmental impacts	M
23	Structures	Remove Existing BSB Superstructures truss and build new bridge on exist foundations	See #29	See #29	H
24	Procurement	Developer control assests that generate revunue. If BSB is not replaced and is non-tolled, exclude from the P3	P3 bidders will add significant O&M or replacement costs for existing BSB; allows bidders to only be responsible for the facilities it is operating; cleanest for P3 arrangement; allows for the continued use of BSB; allows for free local tolling on existing	Public owners retain risk of existing BSB;	
25	Procurement	Reassess traffic projections & assignment, optimize the number of lanes for each movement and consider phasing and tolling	Saves near-term capital costs by only constructing required lanes	Requires additional buildout in future; phased approach could complicate P3 construct	H

Ideas and Innovations Matrix: Page 3 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
26	Procurement	Evaluate cost benefit of reconstructing/replacing the BSB (additinional revenue potential of tolling all lanes and O&M savings)	Maximizes revenue potential; could save costs of O&M; minimizes risk of existing BSB condemnation	Replaces BSB while some life is left on bridge	H
27	Structures	Build New River Crossing Bridge near Airport @ Mineola - Connect to US 50 for alternate route downtown	Everything is offline - significant reduction in congestion at spaghetti bowl	Re-opens FONSI	L
28	Structures	Replace the lower level deck/floorbeams with shallower sections (seated lower on the truss chords)	Greatly improves driver visibility for NB traffic on existing bridge.	Greatly increases cost for existing bridge rehabilitation.	L
29	Structures	Replace Existing Super Structure Only (verify fdns ok maybe widening)	Reduced Life Cycle Cost - likely reduction in bid in P3 environment	Higher First Cost	H
30	Structures	Replace Existing in entirety (1 or 2 new)	Everything is built in the clear, no question about condition of substructure	Substructure is in good condition	L
31	Structures	Build new Bridge offline and close exist for rehab (detour 71). The conceptual MOT plan already investigated this idea.	MOT - very little disruption to traffic	expense of cross-overs	H
32	Structures	New Bridge type - tied arch: Build offline and float in. Minimize length of "complex bridge" (no backspans). Existing bridge is 830' mainspan for 800 nav channel. No sidechannel requirements. Ht of arch restricts offline to adjacent pools (new & exist)	Saves significant dollars, aesthetically pleasing. Form meets function		H
33	Structures	Triple decker on exist foundations (elim fdns in river?)	Eliminates need to build new substructure in river, tighter footprint	All the disadvantages of a double decker intesified: Longer approach bridges, signage is complicated. Poor Aesthetics.	L
34	Structures	Twin new arch supers (830' spans): 8 lanes each - facilitates cost and schedule considerations (verify capacity/condition of exist fdns)	Saves significant dollars, aesthetically pleasing. Form meets function		H
35	Structures	Triple deck on new alignment with demo of existing			L
36	Structures	Approach bridge - PC or Stl Girders			P
37	Structures	Approach Bridge - Stretch spans toelim piers			P
38	Structures	Approach bridge - Rehab vs replace (stack alt)			P
39	Structures	Keep CS on lower level of exist & decommission top level, put I-71 NB on new single level bridge…toll new bridge w "free" CDs on exist br…w/ new CD bridge in future			L
40	Procurement	Keep CD & Interstate on separate facilities/separate procurements	Cleaner to have a smaller P3 procurement for just tolled facility; allows public flexibility to allow free or higher connectivity	Smaller transaction	H
41	Procurement	Procurement issue that takes adavantage of "best value" vs "lowest cost" (CJV can get credit for valuable alt)			P
42	Procurement	Tolling policy ---> differential rates to control leakage	Charging non-transponder customers a higher rate encourages transponder penetration thereby reducing transaction costs and leakage		
43	Roadway	Queensgate alt looks best from bridge perspective / ops---> FONSI issue?			L
44	Structures	Dbl deck Alts to consider castellated trusses for longitudinal frames	great idea, but there is not much benefit to studying it		L
45	Structures	Land bridges: Segmental Plate girdgers, PC girders, Stl tubs (tight radius curves)	Cost - when worked in conjunction with roadway geometry		H
46	Structures	Reconfig required if reuse mainspan from Alt I			

Ideas and Innovations Matrix: Page 4 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge | 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
47	Roadway	Reduce connectivity at spaghetti bowl	Reduces construction impacts to traffic on mainline. Reduces number of bridges and retaining walls and future maintenance costs	Reduces east-west connectivity. Eliminates direct connections from mainline to local. May require improvements on local intersections to handle capacity. Potential for local opposition. May take additional time to gain stakeholder acceptance.	H -->L
48	Systems	Westernhillls viaduct access ramp: Eliminate or Develop alts			L
49	Roadway	Run CD thru end spans rather than replace (both Dixie & Kyles)	Saves initial cost by maintaining bridge in place.	May increase future maintenance costs by keeping older bridge in service.	M
51	Structures	Use Single level bridge vs. double deck	single level options have the benefit of reducing number of shoulders, length of approach bridges, a safer system and improved aesthetics	Larger footprint, potential for additional ROW	H
52	Structures	less wide shoulders, less pavement, less sq ft bridge, less ret walls. Need further policy discussion with ODOT prior to advancing this idea.	This is practical design - best value, MoDOT has had significant success in stretching their budgets with this approach	violates standards	M
53	Structures	Piles instead of shafts	good idea .... Not worth studying		L
54	Roadway	Relocate the gas line (2x12")			L
55	Structures	Widen Exist pier (see sketch)	works in conjunction with replacing the superstructure - need to study to get cost		H
56	Structures	Arches: Use Networked cables, I-shaped Rib, Use lifting towers on barges, float in low, FB and stringers, strings (framed in) / Composite tie, Basket handles (Aesthetoics +10%), 2-60' wide arches + Existing, 3x75' arches -> 15 lanes	works in conjunction with replacing the superstructure - need to study to get cost		H
57	Structures	Arches: Grid Deck, Lt Wt Concrete, HPC, Weathering Steel, Knuckle Detailing, (Blennerhassett, Champlain), Arch Rib (Conc Filled Pipe)	good idea .... Not worth studying		L
58	Structures	Flat Slab Cable Stayed: 3 x 70 Bridges, CIP on Backspan, Traveller main span, semi fan cables, hollow towers, stress from deck, no saddles in tower	Should study to get a cost		H
59	Structures	Cable Stay - Semi Fan, Match E.G Depth to F.B., long. PT only in Tension Regions, Saddles/Keep Cables Vert., Vertical Pylons, Avoid Ballast by "pushing in" end piers - Use approach spans, Hollow Pylons, Drilled Shafts (Cap) - River Pier Fntn, Multi Column Bent @ Rest Pier	good idea .... Not worth studying		L
60	Structures	Segmental - Uniformity of X-section-->clean up geomoetry, Gantry - Mainline, Beam/Winch--> Flyovers/Ramps, Overlay the segments	worth moderate study to price		M
61	Structures	Pier spacing on Approaches w/ Tied Arch	works in conjunction with replacing the superstructure - need to study to get cost		H
62	Structures	Gentle Curveys-->P/C & Steel work	works in conjunction with spaghetti bowls improvements - should study		M
63	Structures	Twin - One Level Arches--$800/ft--> CS or Arch, Dbl Deck=200 ft, single deck = 160 ft, $250 Approachs COST SAVINGS: $320 - $170 = $150M	Need to Determine more accurate cost		H
64	Structures	New Super on Existin Sub (Main River Unit)	covered above		H
65	Structures	Rehab Aproaches vs Replace Approaches w DBL Decks = Saves $40M	works in conjunction with replacing the superstructure - need to study to get cost		H

Ideas and Innovations Matrix: Page 5 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
66	Procurement	P3: Legislation to Toll: - KY - Ability and Enforcement (leakage)	Tolling legislation necessary for procurement; enforcement critical to maintain revenue and bankability; allows for procurement acceleration; reduces public subsidy	Political acceptance	H
67	Procurement	P3: Prefer the entire project - Has to be large	Larger project is the most attractive to bidders	Makes phasing difficult; larger cost so larger public subsidy	
68	Procurement	Leave open so more options for existing BSB; points for replacement of existing	Replacement of BSB might increase value; cost savings can be outweigh original scope	Limits control of public agencies	H
69	Procurement	P3: Duration of 50 years+	50 years is the sweet spot for concessions	Present valuce calculation doesn't provide much value over 50 years	
70	Procurement	P3: Tolling--> Meters for local/thru traffic		KY doesn't want it	
71	Procurement	DB: Non - Prescriptive Perfomance Spec = $$$	Flexibility increases value; cost savings can be outweigh original scope	Limits control of public agencies	H
72	Procurement	DB: Give Credit for Deleting BSB ($100M)			H
73	Procurement	DB: Reward Aeisthetics --> Advisory Committee (KCIcon)			H
74	Procurement	DB: Fixed Price/Flexible Scope			H
75	Procurement	DB: One on One Meetings			H
76	Procurement	DB with more Control Ideas: Dynamic DB (70% dwgs), ATCS, DBB w/ATCs, One Step, Reward for removing Dbl Deck (Safety)			
77	Procurement	DBB: Segment Project: KY - OH - River Bridge (Separate River Bridges)			
78	Procurement	DBB: DBB w/ATCs			
79	Procurement	DBB: Lane Rentals			
80	Procurement	DBB: Tolls ---> Work through a segment that is "Tollable"			
81	Roadway	Modify C/D system @ Dixie & Kyles (Save Existing Bridges) - move CD ramps outside and either over/under, Frontage Road/Split Diamond, Braided Ramps (see onion skin)	Reduces construction impacts to traffic on mainline and crossroads. Utilizes the life of the existing bridges. Level of Service on mainline will not be impacted. Depending on the option, can save construction cost and time.	Depending on option, may require modifications to the IJR, less direct access, and additional bridges to maintain.	H
82	Roadway	Widen Existing Pavement in KY (no full depth reconstruction)	Reduces construction costs by salvaging existing pavement.		H
83	Systems	Eliminate Lanes north of Kyles to 12th St based on Traffic Volumes			M
84	Roadway	Reduce 5% grade on KY side with Profile Adjustment and/or split grades (truck impact)(repeat)	Increases safety	Cost	M

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Ideas and Innovations Matrix: Page 6 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
85	Roadway	Shift new Alignment west for I-75 traffic, maintain I-71 traffic in place - Shift I/C North, West and use existing road corridor. Reconstruct I/C with 50, tie system connection between 75 and 71 using 50 corridor.	Signficant cost savings could be achieved along with significant economic development opportunities for the city of Cincinatti. Although on a skew, using a flat tied arch bridge maybe cheaper than the double-decker proposed in the preferred alternative due to the reduction in total number of lanes, shoulder widths, and having a single deck versus a double deck. Many existing I-71 interchange elements can be rehabilitated instead of replaced. Significantly reduces new infastructure within congested construction area immediately downtown - reduces construction cost as a result. Improved geometrics, improved safety. Potential phased construction opportunity with I-71 and I-75 corridors developed separately. Separates complicated/confusing system movements - will be easier for drivers to navigate. I-75 corridor and bridge crossing would be constructed offline, lessening the construction impact to drivers, businesses, civic events. The N/S corridor on the OH side of the river would carry fewer lanes, making it a less divisive element of the downtown infastructure. The cross connection structures would be shorter and less expensive.	Skewed river crossing increases the length. Potential impacts to businesses along I-75 corridor. This alignment is an improved variation of an alignment that was previously studied and rejected by the City. Potential for local opposition, difficulty acquiring stakeholder acceptance, and additional impacts to section 4(f), 6(f), and historic resources	H -->M
86	Roadway	Flip I-75 and I-71 alignments			M
87	Systems	Utilitize the CWB Bridge as the C/D Bridge, widen and shirft new alignment to the east (repeat)			L
88	Roadway	Reduce/Eliminate low-volume connections on Ohio side - Combine bridges, eliminate 4th to NB ramp (see onion skin)	Reduces construction impacts to traffic on mainline. Reduces number of bridges and retaining walls and future maintenance costs. Increases ROW for development opportunities.	Reduces east-west connectivity. Eliminates direct connections from 4th to NB. May require improvements on local intersections to handle capacity.	H -->L
89	Structures	use fill plugs to eliminate bridge spans			M
90	Roadway	Western Hills Viaduct - Roundabout - CD System (see onion skin)			L
91	Structures	Build one new bridge, tear down old, consider life cycle costs			M
92	Structures	Build river crossing new airport, connect to US 50 to reduce truck volumes			L
93	Procurement	Break out Kyles lane I/C and south as DBB ($200M)			M

Ideas and Innovations Matrix: Page 7 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
94	Procurement	Add Tolled E/W Connections (existing connection to west side of city currently only served by Western Hills Viaduct, 8th Street Viaduct, Hopple Street Viaduct, & US 50)	Look for additional revenue options, if additive to the system of tolling new movements. May help city of Cincinatti fund replacement of Western Hills Viaduct.	new revenue must outweigh the cost; political ability of new tolling; connectivity abilities	H
95	Procurement	Retro Actively introduce managed lanes farther north (say to I-275)	Ability to generate additional revenue; tolling for new interstate capacity is allowed	Requires additional tolling approval; additional tolling along the corridor in additional to the bridge	H
96	Procurement	Utilize toll credits for Federal Match	Allows states to meet local match if this is a problem		
97	Procurement	Phase Implimentation of modified queensgate option to allow completion of ES w/o delaying start			L
98	Procurement	Defer from Linn St to the north ($170M)	Saves initial construction cost	Complete project need not being met.	L
99	Roadway	Use Design Speed = Posted Speed			P
100	Roadway	Take Advantage of Criteria reduction w/switch from interstate to local			P
101	Roadway	Flip shoulders on ramps to reduce width/improve HSSD			P
102	Roadway	Tie Barrier Size/Type to design speed			P
103	Roadway	Reduce Pavement thickness based on actual utilization			P
104	Roadway	Keep local traffic on existing bridge w/ thru traffic on new	Earlier decision point for drivers (thru versus local) improves traffic flow. Easier to sign. Allows for dynamic tolling on thru facility. Reduces cost of direct ramp connections on Ohio side with I-75/I-71.	Elimination of direct connections may require improvements on local intersections to handle capacity.	H
105	Procurement	Optimize construction phasing for revenue/lower construction cost	Full funding not required upfront; build additional bridge/lanes as needed; test tolling elasticity and revenue potential on a smaller scale; allows time to pursue other enviro approvals	Difficult to include future build scenarios in one P3; large bundled project is attractive to bidders;potentially lose economies of scale;	H
106	Roadway	Utilize other state standards			P
107	Roadway	Use minimum vertical underclearance. In Ohio, the minimum vertical underclearance for most locations is 15' 6" and can be less than this over some local streets.			P
108	Procurement	Forget tolling existing bridge --> Garner public support for the "New" tolled bridge, maybe managed lane, Bus Lanes	Could potentially allow KY legislature to approve faster this February if some local tolling is free	Reduces revenue; reduces ultimate control over project	
109	Roadway	Design Speed = Post Speed			P
110	Procurement	Performance Based - Design to LOS not # of lanes	Saves near-term capital costs by only constructing required lanes	Requires additional buildout in future; phased approach could complicate P3 construct	H
111	Procurement	Staged pavement construction, Bid Alt Pavement Designs, Bid years of Life			H
112	Procurement	Include Maintenance Plan in Evaluation Criteria			
113	Procurement	Design /Build to Budget (phased per funding) (include min perf rqmts)			
114	Procurement	Order of Events --> Segmented Contracts, Who do you toll first?, Commuters=Biggest Bang $$$			
115	Roadway	Bus on Shoulder, other transit options			L
116	Systems	HOV/Managed Lanes			M

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Ideas and Innovations Matrix: Page 8 of 8

Practical Design Workshop - Ideas and Innovations

Project: Brent Spence Bridge — 11/16/2012

Innovation Number	Discipline / Major Cost Element	Proposed Design Innovation	Advantages	Disadvantages	Priority (High=H, Medium=M, Low=L, Practical Design = P)
117	Procurement	Commuters get a break if they car pool	Could reduce the number of lanes required; allows some free movements for carpools; discount only for registered carpoolers can help overall revenue collection if everyone else is tolled	Reduces a small amount of revenue	H
118	Systems	Think in terms of moving people not cars, more modern approach			M
119	Systems	Consolidate the crossings - local streets (repeat)	Reduces construction impacts to traffic on mainline. Reduces number of bridges and retaining walls and future maintenance costs	Reduces east-west connectivity. May require improvements on local intersections to handle capacity. Potential for oppostion from city of Cincinatti and increase in time to get stakeholder acceptance.	H --> L
120	Roadway	Eliminate the C-D system and use Frontage Concept (repeat)	Consolidates access points to/from downtown from the corridor. Simplifies the local access points, making the I/C easier to navigate. Similar to Ft Washington Way concept - familiar facility.	Reduces east-west connectivity. Many local intersection required. Potential for oppostion from city of Cincinatti and increase in time to get stakeholder acceptance.	H --> L
121	Procurement	Allow Concession to include Land rights for "Freed" property. Most of the L/A R/W is under easement from the city of Cincinatti.			L
122					
123	Roadway	Express lanes: Build new 4 lane bridge on west side, build new 3 lane bridge east side, Rehab Exist to be 3 top/3 bottom for locals (Bill & Dales' idea) see onion skin	Allows for utilization of existing connections in Ohio or other innovations to reduce cosntruction impacts and cost. Allows for effective implementation of truck climbing lanes on inside lane of SB on Kentucky side for improved safety and traffic flow. Allows for reduction of lanes over the River for reduced construction cost and long term bridge maintenance. Allows for utilizing existing bridge substructure to build new bridge in place.	Need to verify geometry on Kentucky side will work. East side bridge may result in additional ROW and new environmental impacts. Elimination of direct connections may require improvements on local intersections to handle capacity.	H
124	Roadway	Frontage road system on OH spaghetti bowl rather than C-D. Fits into City grid. Eliminates numerous overpass crossing structures. (see onion skin)	Reduces construction impacts to traffic on mainline. Reduces number of bridges and retaining walls and future maintenance costs	Reduces east-west connectivity. Eliminates direct connections from mainline to local. May require improvements on local intersections to handle capacity. Potential for opposition from city of Cincinatti and increase in time to get stakeholer acceptance.	H --> L

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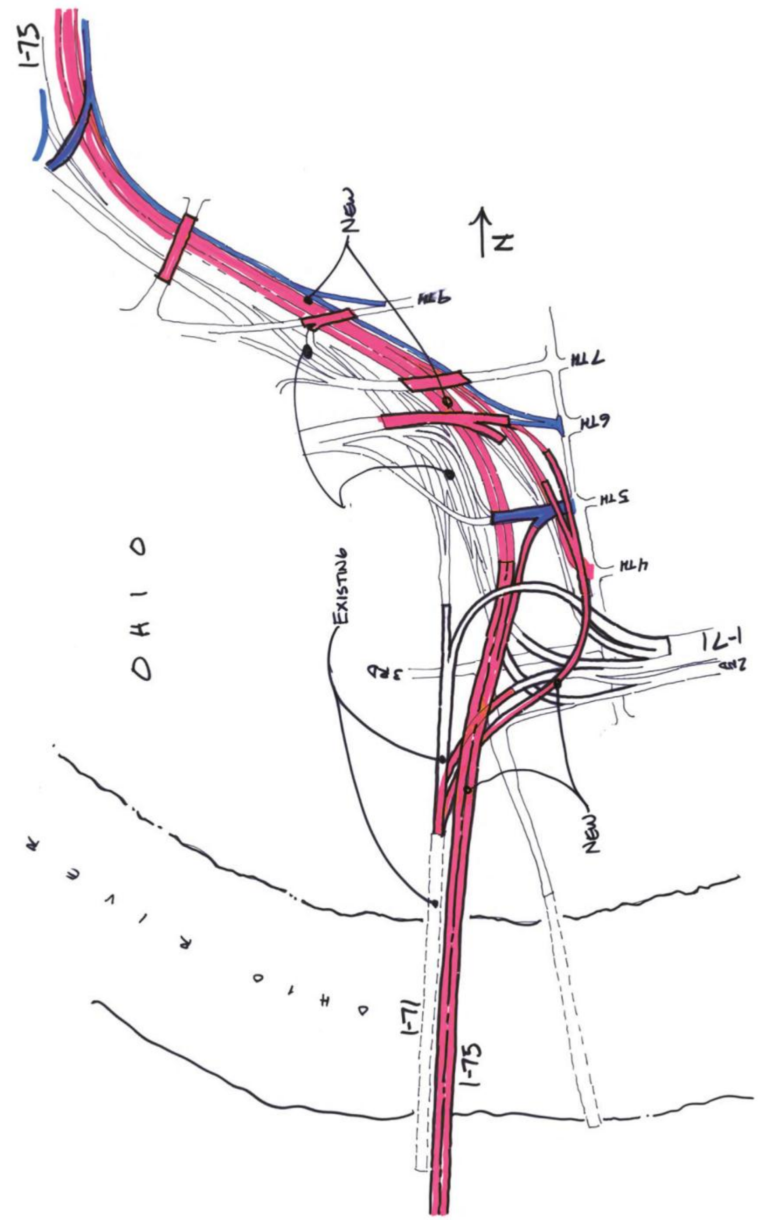
BRENT SPENCE BRIDGE PROJECT

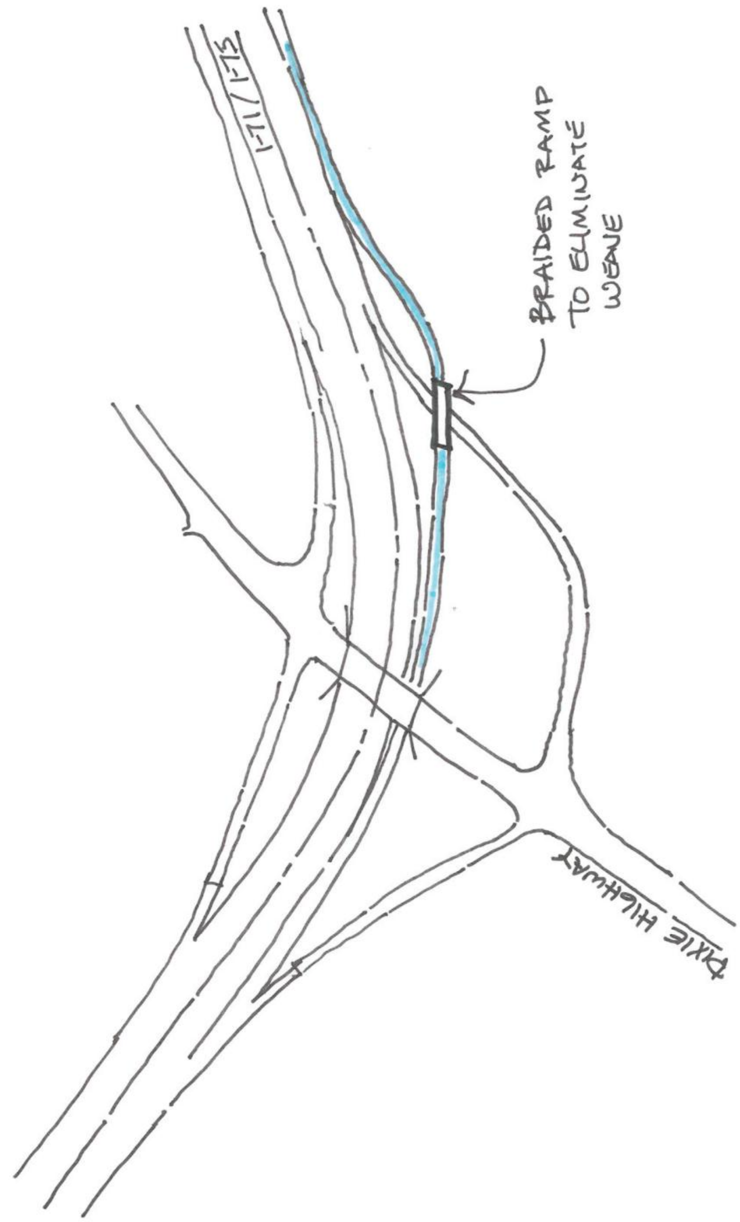
PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

APPENDIX C: INNOVATION CONCEPTS

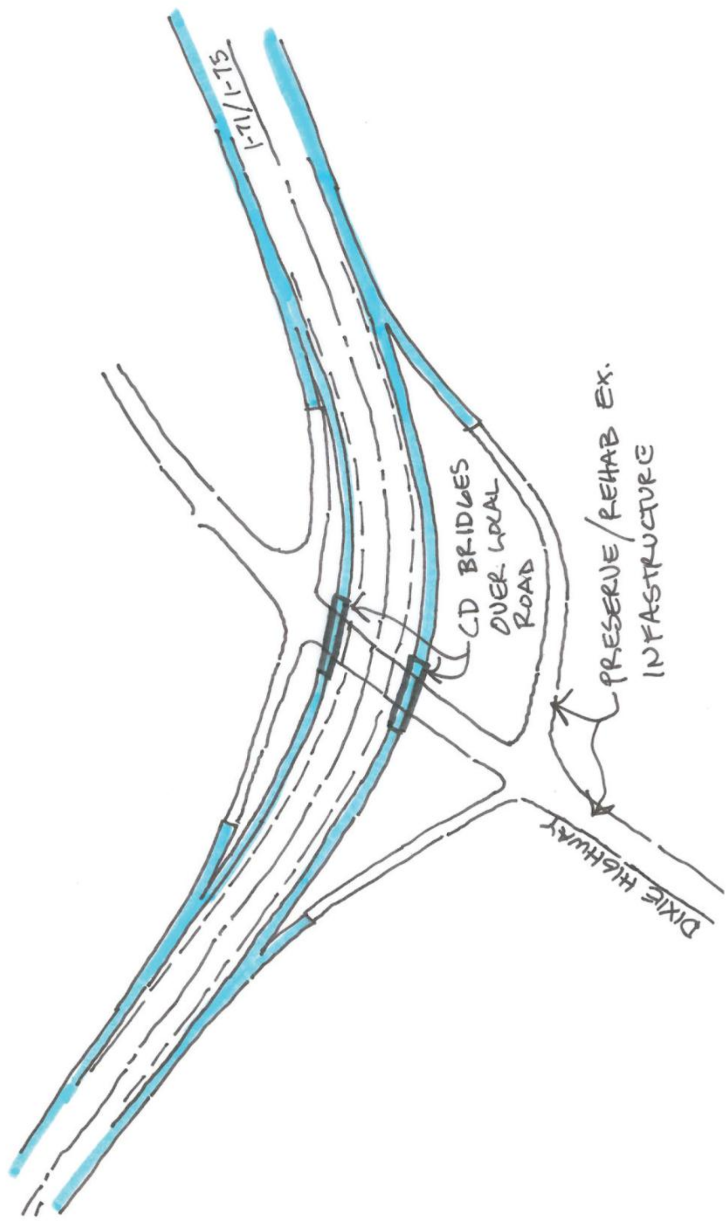
Innovation No. 22 East Concept



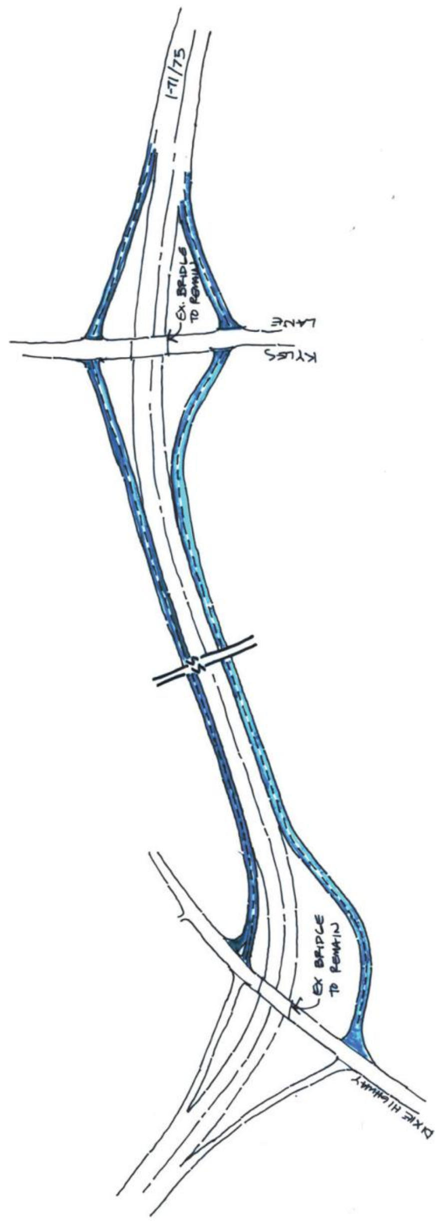
Innovation No. 81 Braid Concept



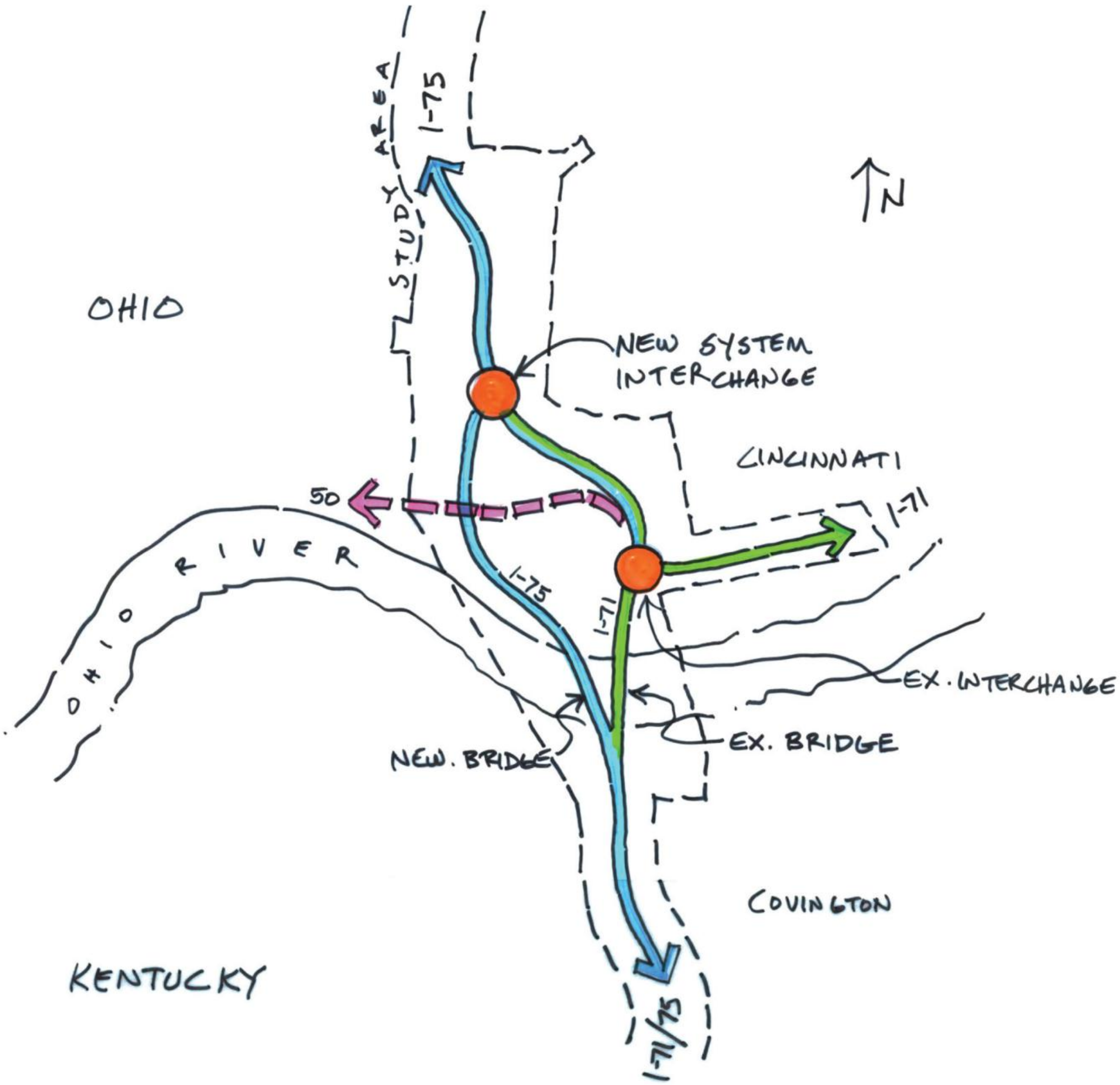
Innovation No. 81 C-D Bridges Over Concept



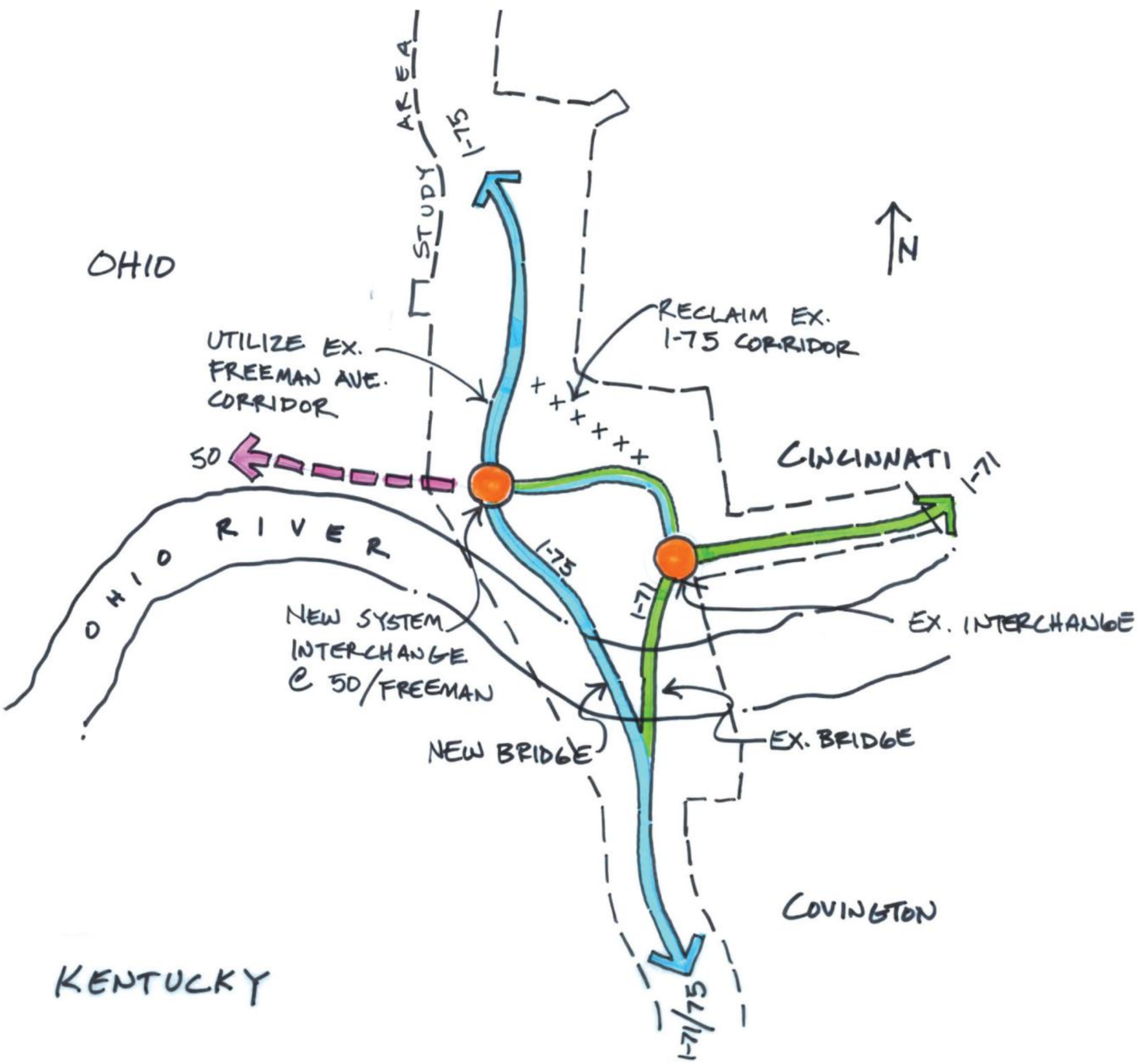
Innovation No. 81 Split Diamond Concept



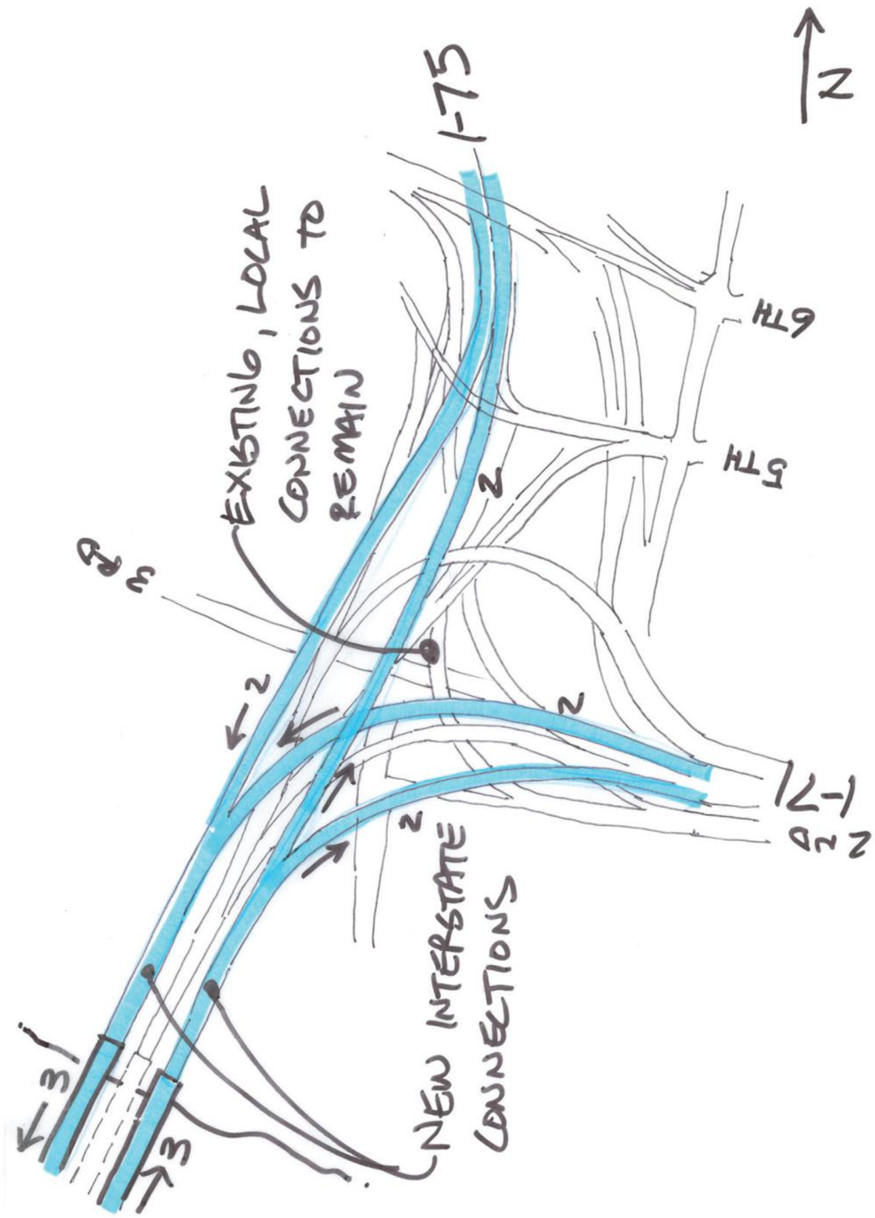
Innovation No. 85 Move Interchange North Concept



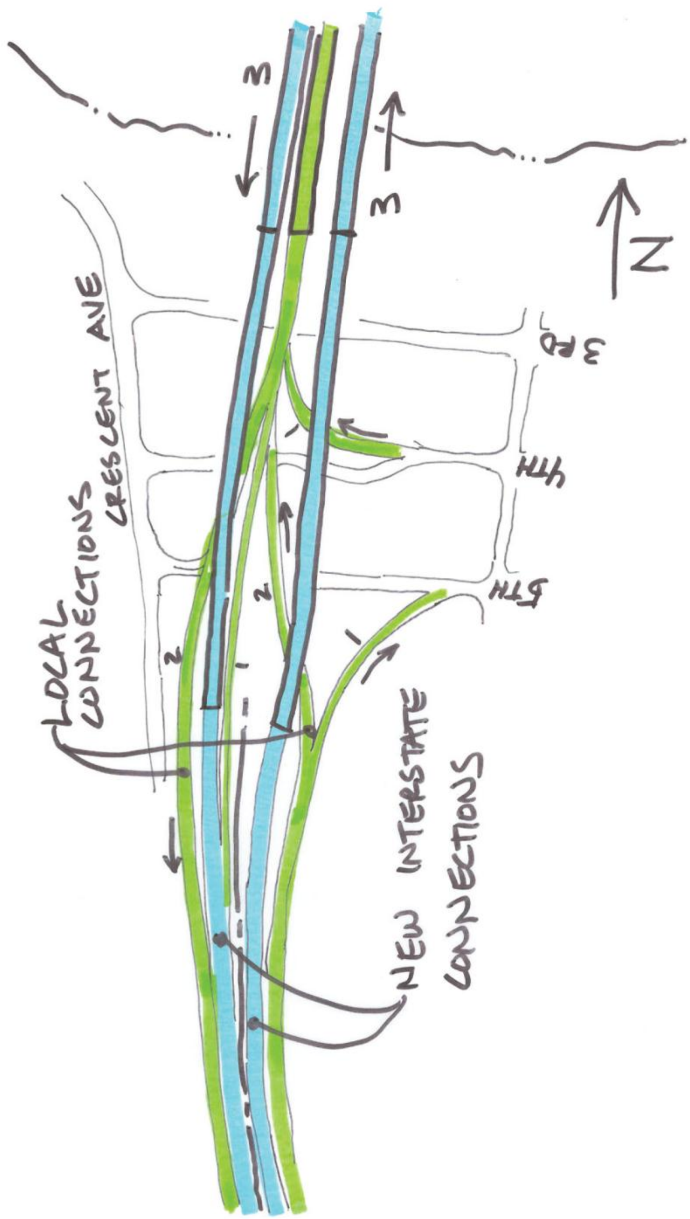
Innovation No. 85 Move Interchange West Concept



Innovation No. 123 Express Lanes Concept – Part 1



Innovation No. 123 Express Lanes Concept – Part 2



BRENT SPENCE BRIDGE PROJECT

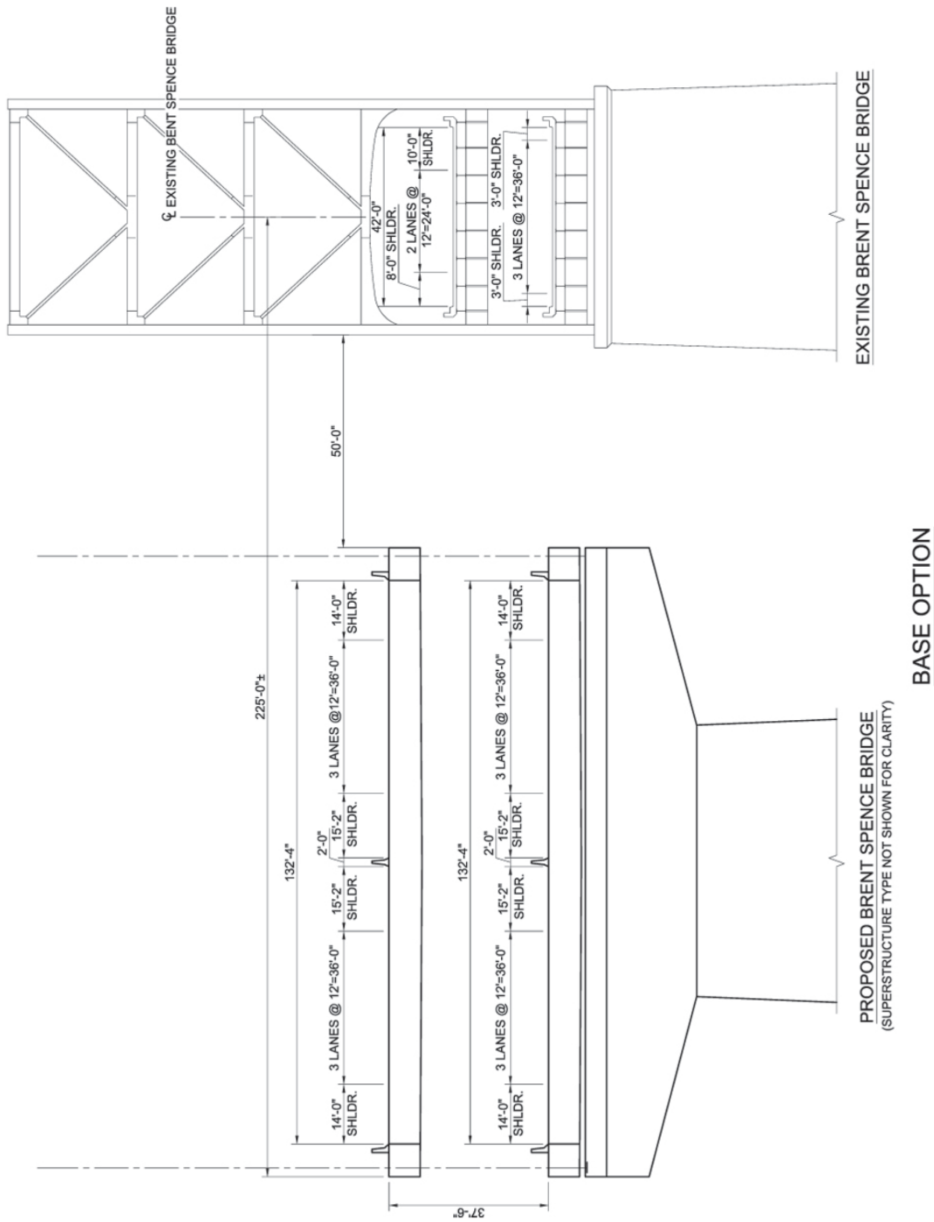
PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

APPENDIX D: BRENT SPENCE BRIDGE OPTIONS

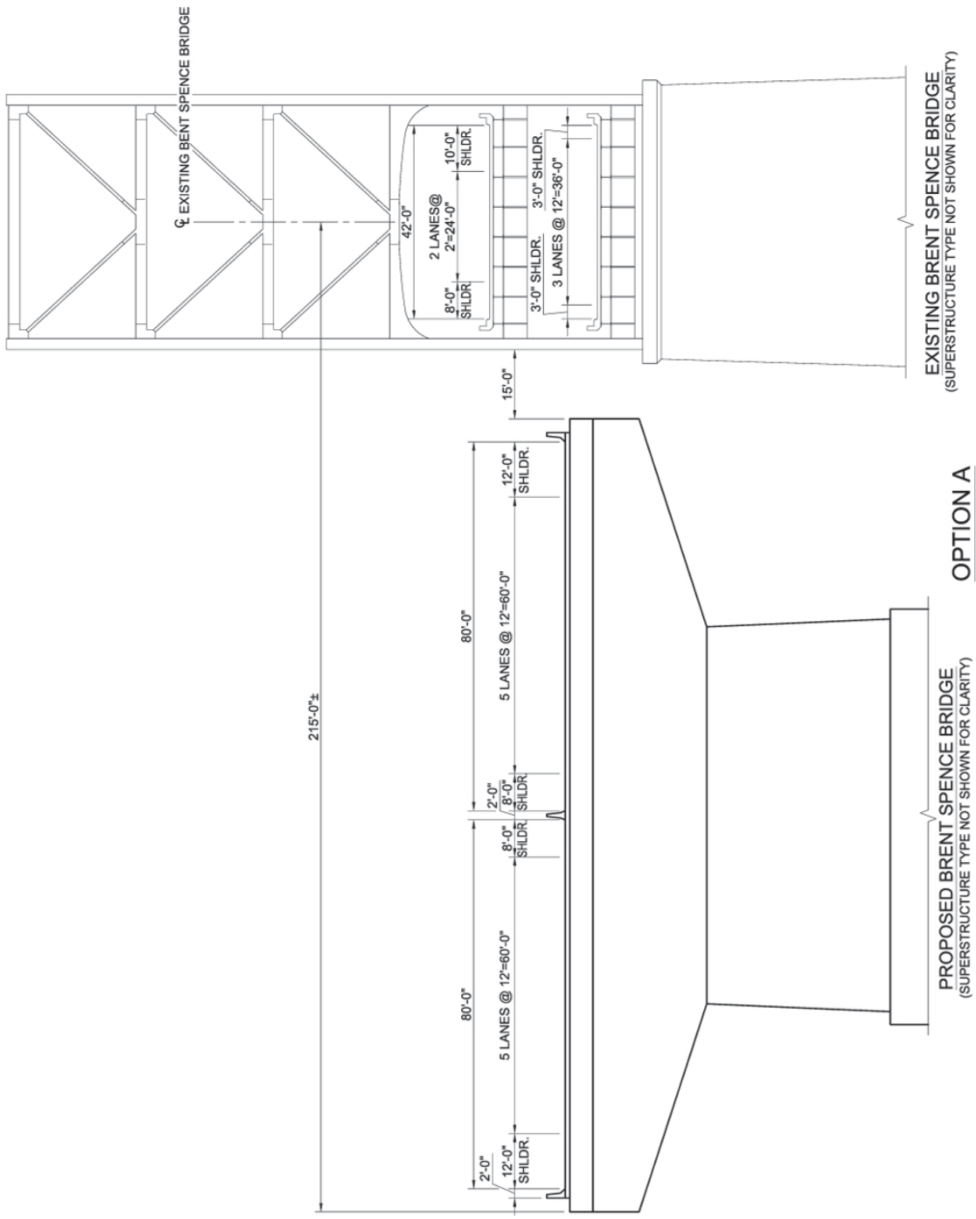
BRENT SPENCE BRIDGE CORRIDOR

D-1

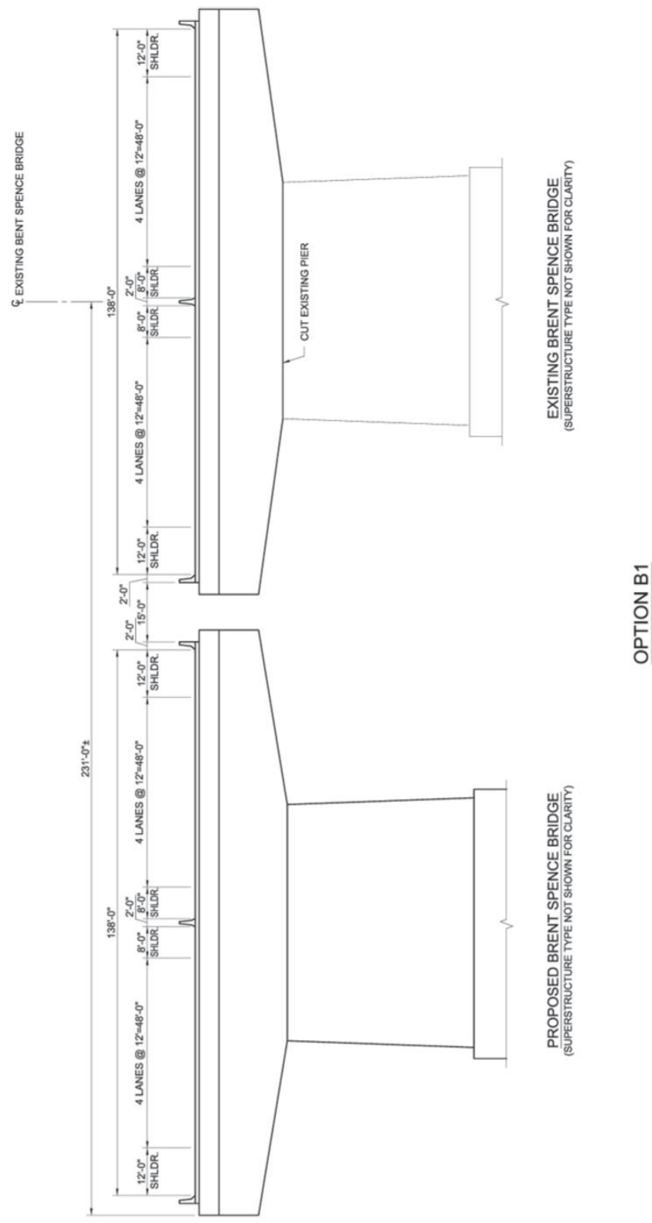
Brent Spence Bridge – Base Option



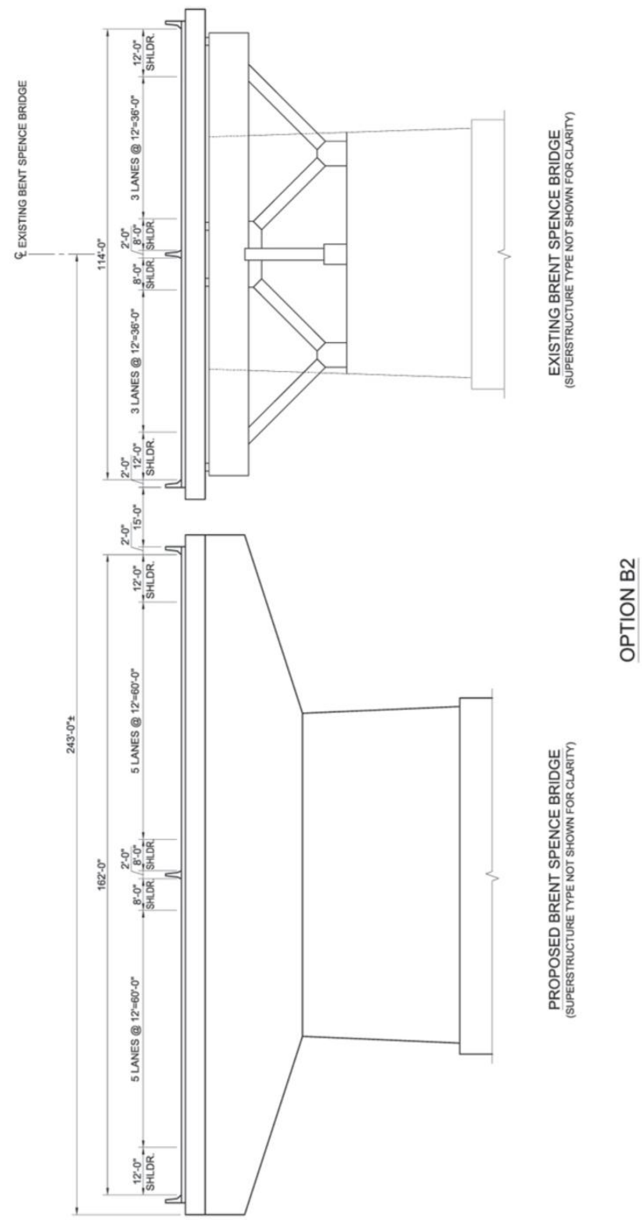
Brent Spence Bridge – Option A



Brent Spence Bridge – Option B1

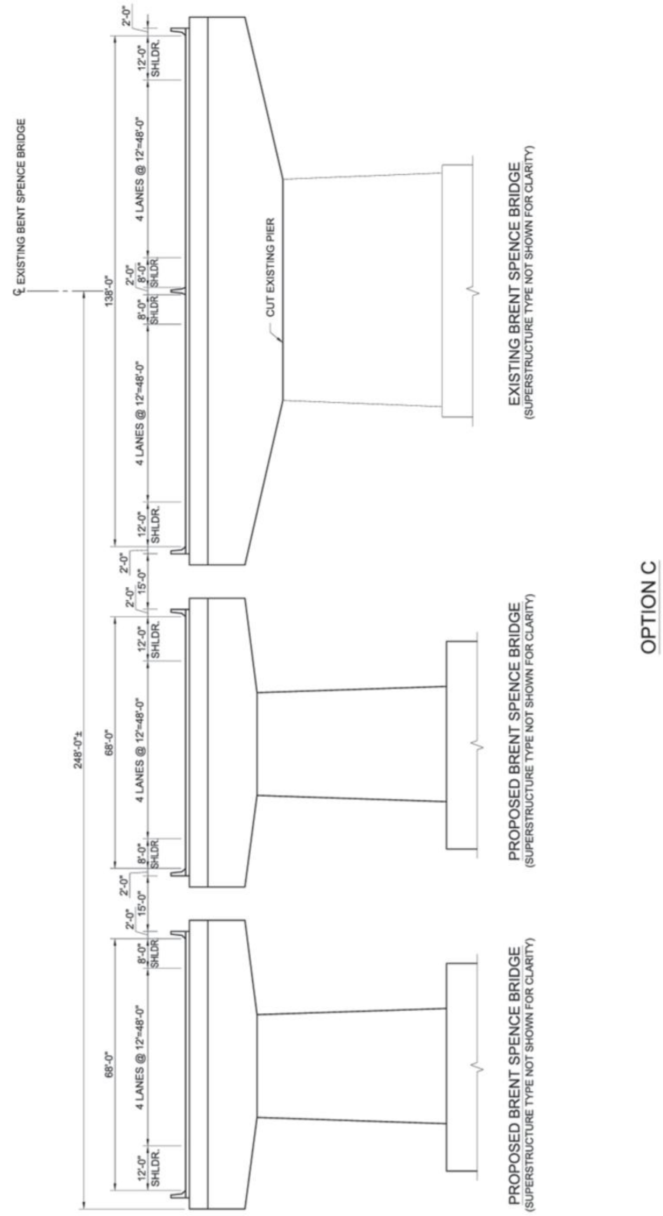


Brent Spence Bridge – Option B2



APPENDIX D: BRENT SPENCE BRIDGE OPTIONS

Brent Spence Bridge – Option C



BRENT SPENCE BRIDGE CORRIDOR

PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

D-6

BRENT SPENCE BRIDGE PROJECT

PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

APPENDIX E: BRENT SPENCE BRIDGE DESIGN EXCEPTIONS – ALTERNATIVE I

BRENT SPENCE BRIDGE CORRIDOR

Brent Spence Bridge Design Exceptions – Alternative I: Page 1 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal Dc (Maximum)	Horizontal SSD (Minimum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason(s) For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
Interstate 75 (OH)	CURVE NO. 5 PI Sta. 24+98.87 (Horiz.)	Y	1	57 mph (60)		526' (570')			44 mph	• The line of sight for the northbound inside lane is impeded by the median barrier and the southbound outside lane a the bridge parapet. • The proposed 12' median shoulder (minimum) needs to be widened to 20' to meet the needed sight distance. • The median shoulder width was discussed with the Office of Roadway Engineering and a guideline was given to cap the width at 12'. This is due to several factors; expense, excessively wide shoulders can confuse drivers and be used as a passing lane, and collecting debris.	• Widen the inside shoulder for the I-75 NB. This can be accomplished by either linearly transitioning the shoulder or separating the NB and SB horizontal alignments. The two profiles will be different as well and bifurcated barrier will be required. This will impact the potential connection from Clay Wade Bailey Bridge to I-75. • If this potential connection from Clay Wade Bailey Bridge is to be maintained, all NB alignments will need to shift to the East potentially causing vertical clearance issues with US 50 WB and I-71 SB. This would potentially impact the Dunnhumby Building also. • If using a flatter curve, 5 structures (businesses) could potentially be impacted and additional impacts to Longworth Hall would be needed. • A design speed of 55 MPH would also fix this design exception.	• Add Signage/ Lighting
	Sta. 23+00 to Sta. 27+00 (Southbound Only)	Y	2					6.0% (Downgrade)		• A grade of 6.0% (5.0 % max) needed to achieve clearance over the existing railroad/I-71 SB to SB CD Road and under I-71 SB to SB CD Road to maintain a 60 mph design speed. The 6.0 % grade has a tangent length of 150'.	• Shift SB CD Road alignment further West so that the lower deck does not cross under the upper deck until after the existing railroad. This would increase the impact to Longworth Hall and could potentially impact 4 additional buildings and parking.	
	CURVE NO. 6 PI Sta. 33+88.15 (Horiz.)	Y	3	51 mph (60)		443' (570)			50 mph	• The line of sight for the inside lane is impeded by the median barrier. • The proposed 12' median shoulder needs to be widened to 25' to meet the needed sight distance. • The median shoulder width was discussed with the Office of Roadway Engineering and a guideline was given to cap the width at 12'. This is due to several factors; expense, excessively wide shoulders can confuse drivers and be used as a passing lane, and collecting debris. • 55 mph would require a 17' minimum shoulder.	• Widen the inside shoulder for the I-75 NB. This can be accomplished by either linearly transitioning the shoulder or separating the NB and SB horizontal alignments. The two profiles will be different as well and bifurcated barrier will be required. This will impact the potential connection from Clay Wade Bailey Bridge to I-75. • If this potential connection from Clay Wade Bailey Bridge is to be maintained, all NB alignments will need to shift to the East potentially causing vertical clearance issues with US 50 WB and I-71 SB. This would potentially impact the Dunnhumby Building also. • If using a flatter curve, 5 structures (businesses) could potentially be impacted and additional impacts to Longworth Hall would be needed.	• Add Signage/ Lighting
	CURVE NO. 9 PI Sta. 65+12.82 (Horiz.)	Y	4	52 mph (60)		463' (570)			40 mph	• The line of sight for the outside lane is impeded by the roadside barrier. • The proposed 12' outside shoulder needs to be widened to 20' to meet the needed sight distance. • 55 mph would require a 15' shoulder (standard minimum shoulder is 12').	• The ramp from Freeman Ave to I-75 NB and Winchell Ave would have to shift to the East. This would impact the property on the SE corner of Ezzard Charles Drive and Winchell Ave. • There is also a potential impact to a 60" combined sewer under Winchell Ave. • The Freeman Ave to Winchell Ave bridge and the Ezzard Charles Drive bridges would need to be lengthened to span the additional pavement width. • If using a flatter curve, this could potentially impact 8 structures, relocate 3 local roads (Ezzard Charles Drive EB and WB, Winchell Ave.), cut off 2 local roads (West Court Street and Freeman Ave to I-75 NB).	• Add Signage/ Lighting
I-75 SB Baseline at Ezzard Charles	CURVE NO. 16 PI Sta. 65+22.36 (Horiz.)	Y	5	54 mph (60)		488' (570)			40 mph	• The line of sight for the inside lane is impeded by the median barrier. • The proposed 12' median shoulder needs to be widened to 20' to meet the needed sight distance. • The median shoulder width was discussed with the Office of Roadway Engineering and a guideline was given to cap the width at 12'. This is due to several factors; expense, excessively wide shoulders can confuse drivers and be used as a passing lane, and collecting debris. • 55 mph would require a 13' shoulder (standard minimum shoulder is 12').	• Widen the inside shoulder of the I-75 SB. This can be accomplished by either linearly transitioning the shoulder or separating the NB and SB horizontal alignments The Northbound lanes would remain the same. This location will have a bi-furcated barrier section. • By changing the SB baseline, the Southbound CD Road would need to move further to the SW which would change three other alignments (I-75 SB to Freeman Ave, Western Ave. to SB CD Road and Gest Street). Gest Street was already narrowed down to 3 lanes and this will narrow it even further. • If using a flatter curve, this could potentially impact 8 structures and 3 local roads (Western Ave, Gest St., and part of Freeman Ave.).	• Add Signage/ Lighting

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - MAINLINE

Brent Spence Bridge Design Exceptions – Alternative I: Page 2 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal Dc (Maximum)	Horizontal SSD (Minimum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason(s) For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
I-71 Southbound (OH)	CURVE NO. 24 PI Sta. 16+31.45 (Horiz.)	Y	6	50 mph (60)	6° 30' 00" (4° 15' 00")				35 mph	• Curve needed to tie into existing Fort Washington Way footprint, avoid Dunnhumby building, and to tie into proposed new bridge before bridge abutment.	• Using Fort Washington Way (I-71 SB) as a fixed tie in point, a 4 degree curve will require the new Ohio River Bridge crossing the river to move about 250' to the West. • Additional potential impacts from this alignment change would include going through the Duke Energy substation. In addition, the I-75 centerline would also need to shift West possibly impacting half of the Longworth Hall and an additional 5 structures just to the west of I-75 between 3rd Street and 9th Street which include two Duke Energy buildings, two UPS buildings, and the former Harriet Beecher Stowe Elementary School (Fox 19) building. • The curves (super transitions) from these alignment changes may also extend onto the new Ohio River Bridge.	• Add Signage/Traffic Control Devices
	CURVE NO. 24 PI Sta. 16+31.45 (Horiz.)	Y	7	42 mph (60)		339' (570)			35 mph	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width. • 50 mph would require a 20' shoulder (standard minimum shoulder is 12').	• Widen inside shoulder to match the proposed bridge width (3 lanes and 14' shoulder). • A flatter curve is not possible without introducing a curve starting around Plum Street and extending onto the new bridge which would also need to move west as described above. Some connections may potentially become a problem doing this (i.e. US 50) and using the existing bridge would be very difficult.	• Add Signage/ Lighting
		Y	8					Shoulder Width		• Allows for a deceleration lane to be added to exit from I-71 SB to SB CD Road within the existing footprint of Fort Washington Way (4' left shoulder, 6.5' right shoulder for about 700').	• Widen pavement width on outside of I-71 SB (Fort Washington Way) from Elm Street to Central Ave. This will impact the Elm Street bridge and reduce the 3rd Street on ramp to SB CD Road to 1 lane from 2 lanes.	• Add Signage/ Lighting
	Sta. 20+00 to Sta. 32+00	Y	9					5.9 % (Upgrade)		• A grade of 6.0% (5.0 % max) needed to achieve clearance over the existing railroad/I-71 SB to SB CD Road and under I-71 SB to SB CD Road to maintain a 60 mph design speed. • This grade matches the existing profile set during the Fort Washington Way project. It allows for clearance over Plum Street, flood wall, future rail lines.	• A flatter grade of 5.0 % would create a clearance problem over the NB CD Road to 5th Street resulting in the potential of this connection being cut off.	
I-71 Northbound (OH)	CURVE NO. 20 PI Sta. 14+44.56 (Horiz.)	Y	10	50 mph (60)	6° 30' 00" (4° 15' 00")				45 mph	• Curve needed to tie into existing bridge abutment and still tie in with US 50 EB before entering Fort Washington Way.	• Using Fort Washington Way (I-71 NB) as a fixed tie in point and trying to tie into the existing bridge, several connections would be lost. Connections off of the NB CD Road from Kentucky to I-71 NB and to 2nd Street would be lost. Clearance over the existing railroad may also be an issue coming off of the bridge if the existing profile is to be maintained. • Another option using Fort Washington Way (I-71 NB) as a fixed tie in point and trying to tie into the new Ohio River Bridge, a 4 degree curve will require the new Ohio River Bridge crossing the river to move about 250' to the West if we were to maintain all connections. Other connections including I-75 NB and SB, and NB CD Road would need to be investigated on whether their connections could be maintained.	• Add Signage/Traffic Control Devices
	CURVE NO. 20 PI Sta. 14+44.56 (Horiz.)	Y	11	44 mph (60)		358' (570)			41 mph	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width. • 50 mph would require a 20' shoulder (standard minimum shoulder is 12').	• Widen inside shoulder with a pavement taper on the bridge. • A flatter curve tying into the existing bridge is not possible without introducing a curve starting around Plum Street and extending onto the existing bridge. Second Street would need to be relocated along with the flood wall. Connections off of the NB CD Road from Kentucky to I-71 NB and to 2nd Street would be lost.	• Add Signage/ Lighting
	Sta. 25+00 to Sta. 29+00	Y	12					6.0 % (Downgrade)		• A grade of 6.0% (5.0 % max) needed to achieve clearance over Plum Street for pedestrians. The 6.0 % grade has a tangent length of about 300'. • This grade matches the existing profile set during the Fort Washington Way project. It allows for clearance over Plum Street, flood wall, future rail lines.	• A flatter grade of 5.0 % could potentially create a clearance problem over US 50 WB and 3rd Street.	
US 50 EB	CURVE NO. 47 PI Sta. 109+73.97 (Horiz.)	Y	13	40 mph (50)	10° 30' 00" (6° 45' 00")				30 mph	• Curve needed to achieve clearance over SB CD Road and under US 50 to 5th Street	• See US 50 WB impacts.	• Add Signage/Traffic Control Devices
	CURVE NO. 47 PI Sta. 109+73.97 (Horiz.)	Y	14	36 mph (50)		261' (425)			30 mph	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width. This potentially could reduce clearances over SB CD Road to 2nd Street to below minimum.		• Add Signage/ Lighting

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - MAINLINE

Brent Spence Bridge Design Exceptions – Alternative I: Page 3 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal Dc (Maximum)	Horizontal SSD (Minimum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason(s) For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
US 50 WB	CURVE NO. 53 PI Sta. 114+02.58 (Horiz.)	Y	15	40 mph (50)	10° 30' 00" (6° 45' 00")				35 mph	• Curve needed to achieve clearance over I-75 NB and under US 50 to 5th Street	• Design exceptions 9, 10, 11, 12, and 13 need to be treated as a whole in order to fix. To design an alignment to maintain a 50 mph design speed (existing US 50 posted speed West of I-75), the geometry would follow the proposed alignment shown for US 50 EB/SB CD to 2nd Street. US 50 EB would parallel US 50 WB in order to tie into existing US 50 lanes through Fort Washington Way to the East causing some connections to be lost. • Connections that could potentially be lost would include: 1) US 50 EB to 5th Street, 2) I-75 SB to I-71 NB from I-75 mainline lanes, 3) SB CD Road to potential Clay Wade Bailey Bridge, 4) US 50 WB to Gest Street, 5) Linn Street to US 50 EB (would be significantly impacted if not cut off) which is beyond our current project limits. • SB CD Road alignment would shift West approximately 200' which would impact the former Harriet Beecher Stowe Elementary School (Fox 19) building in addition to their parking garage and the UPS warehouse would also now be impacted in addition to their parking. In addition, the Duke Energy buildings North of 3rd Street, Longworth Hall, and the Duke Energy substation along the river will have additional impacts. • The new Ohio River Bridge would need to be either moved west or widened to accommodate the taper of the SB CD Road into the I-71 SB to SB CD Road ramp which would not come together soon enough to tie into the current bridge typical section and abutment limits. • The horizontal sight distance can not be fixed with out taking the alignment for US 50 west from Fort Washington Way along 3rd Street.	• Add Signage/Traffic Control Devices
	CURVE NO. 53 PI Sta. 114+02.58 (Horiz.)	Y	16	34 mph (50)		242' (425)			30 mph	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width. This potentially could reduce clearances over I-75 NB to below minimum.		• Add Signage/ Lighting
	CURVE NO. 56 PI Sta. 128+38.49 (Horiz.)	Y	17	40 mph (50)	10° 30' 00" (6° 45' 00")				35 mph	• Curve needed to avoid Dunnhumby building and achieve clearance under I-71 SB		• Add Signage/Traffic Control Devices

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - MAINLINE

APPENDIX E: BRENT SPENCE BRIDGE DESIGN EXCEPTIONS – ALTERNATIVE I

Brent Spence Bridge Design Exceptions – Alternative I: Page 4 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal Dc (Maximum)	Horizontal SSD (Minimum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason(s) For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
Interstate 75 (OH)	CURVE NO. 5 PI Sta. 24+98.87 (Horiz.)	Y	1	57 mph (60)		526' (570')			44 mph	• The line of sight for the northbound inside lane is impeded by the median barrier and the southbound outside lane a the bridge parapet. • The proposed 12' median shoulder (minimum) needs to be widened to 20' to meet the needed sight distance. • The median shoulder width was discussed with the Office of Roadway Engineering and a guideline was given to cap the width at 12'. This is due to several factors; expense, excessively wide shoulders can confuse drivers and be used as a passing lane, and collecting debris.	• Widen the inside shoulder for the I-75 NB. This can be accomplished by either linearly transitioning the shoulder or separating the NB and SB horizontal alignments. The two profiles will be different as well and bifurcated barrier will be required. This will impact the potential connection from Clay Wade Bailey Bridge to I-75. • If this potential connection from Clay Wade Bailey Bridge is to be maintained, all NB alignments will need to shift to the East potentially causing vertical clearance issues with US 50 WB and I-71 SB. This would potentially impact the Dunnhumby Building also. • If using a flatter curve, 5 structures (businesses) could potentially be impacted and additional impacts to Longworth Hall would be needed. • A design speed of 55 MPH would also fix this design exception.	• Add Signage/ Lighting
	Sta. 23+00 to Sta. 27+00 (Southbound Only)	Y	2					6.0% (Downgrade)		• A grade of 6.0% (5.0 % max) needed to achieve clearance over the existing railroad/I-71 SB to SB CD Road and under I-71 SB to SB CD Road to maintain a 60 mph design speed. The 6.0 % grade has a tangent length of 150'.	• Shift SB CD Road alignment further West so that the lower deck does not cross under the upper deck until after the existing railroad. This would increase the impact to Longworth Hall and could potentially impact 4 additional buildings and parking.	
	CURVE NO. 6 PI Sta. 33+88.15 (Horiz.)	Y	3	51 mph (60)		443' (570)			50 mph	• The line of sight for the inside lane is impeded by the median barrier. • The proposed 12' median shoulder needs to be widened to 25' to meet the needed sight distance. • The median shoulder width was discussed with the Office of Roadway Engineering and a guideline was given to cap the width at 12'. This is due to several factors; expense, excessively wide shoulders can confuse drivers and be used as a passing lane, and collecting debris. • 55 mph would require a 17' minimum shoulder.	• Widen the inside shoulder for the I-75 NB. This can be accomplished by either linearly transitioning the shoulder or separating the NB and SB horizontal alignments. The two profiles will be different as well and bifurcated barrier will be required. This will impact the potential connection from Clay Wade Bailey Bridge to I-75. • If this potential connection from Clay Wade Bailey Bridge is to be maintained, all NB alignments will need to shift to the East potentially causing vertical clearance issues with US 50 WB and I-71 SB. This would potentially impact the Dunnhumby Building also. • If using a flatter curve, 5 structures (businesses) could potentially be impacted and additional impacts to Longworth Hall would be needed.	• Add Signage/ Lighting
	CURVE NO. 9 PI Sta. 65+12.82 (Horiz.)	Y	4	52 mph (60)		463' (570)			40 mph	• The line of sight for the outside lane is impeded by the roadside barrier. • The proposed 12' outside shoulder needs to be widened to 20' to meet the needed sight distance. • 55 mph would require a 15' shoulder (standard minimum shoulder is 12').	• The ramp from Freeman Ave to I-75 NB and Winchell Ave would have to shift to the East. This would impact the property on the SE corner of Ezzard Charles Drive and Winchell Ave. • There is also a potential impact to a 60" combined sewer under Winchell Ave. • The Freeman Ave to Winchell Ave bridge and the Ezzard Charles Drive bridges would need to be lengthened to span the additional pavement width. • If using a flatter curve, this could potentially impact 8 structures, relocate 3 local roads (Ezzard Charles Drive EB and WB, Winchell Ave.), cut off 2 local roads (West Court Street and Freeman Ave to I-75 NB).	• Add Signage/ Lighting
I-75 SB Baseline at Ezzard Charles	CURVE NO. 16 PI Sta. 65+22.36 (Horiz.)	Y	5	54 mph (60)		488' (570)			40 mph	• The line of sight for the inside lane is impeded by the median barrier. • The proposed 12' median shoulder needs to be widened to 20' to meet the needed sight distance. • The median shoulder width was discussed with the Office of Roadway Engineering and a guideline was given to cap the width at 12'. This is due to several factors; expense, excessively wide shoulders can confuse drivers and be used as a passing lane, and collecting debris. • 55 mph would require a 13' shoulder (standard minimum shoulder is 12').	• Widen the inside shoulder of the I-75 SB. This can be accomplished by either linearly transitioning the shoulder or separating the NB and SB horizontal alignments. The Northbound lanes would remain the same. This location will have a bi-furcated barrier section. • By changing the SB baseline, the Southbound CD Road would need to move further to the SW which would change three other alignments (I-75 SB to Freeman Ave, Western Ave. to SB CD Road and Gest Street). Gest Street was already narrowed down to 3 lanes and this will narrow it even further. • If using a flatter curve, this could potentially impact 8 structures and 3 local roads (Western Ave, Gest St., and part of Freeman Ave.).	• Add Signage/ Lighting

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - MAINLINE

BRENT SPENCE
BRIDGE CORRIDOR

PRACTICAL DESIGN/VALUE ENGINEERING WORKSHOP REPORT

Brent Spence Bridge Design Exceptions – Alternative I: Page 5 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal Dc (Maximum)	Horizontal SSD (Minimum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason(s) For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
3rd Street WB (OH) to SB CD ROAD		N										
3rd Street/Clay Wade Bailey to I-75 NB		N										
US 50 WB to GEST ST.		N										
6th Street WB (OH) to US 50 WB		N										
4th Street WB (OH) to NB CD ROAD		N										
NB CD ROAD to US 50 WB (Directional Ramp)	CURVE NO. 63 PI Sta. 22+70.83 (Horiz.) (NB CD Road)	Y	29	44 mph (50)		354' (425)			N/A	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width. • 50 mph would require a 17' shoulder (standard minimum shoulder is 10').	• Widen the inside shoulder. This may impact the clearance over 4th Street to NB CD Road ramp.	• Add Signage/ Lighting
	CURVE NO. 66 PI Sta. 33+69.33 (Horiz.) (Directional Ramp)	Y	30	40 mph (45)	11° 45' 00" (8° 00' 00")				35 mph	• Curve needed to tie into 6th Street to US 50 WB and clear 4th Street to NB CD Road.	• A flatter curve could require the 4th Street NB on ramp to be relocated from its current alignment creating weaving on the NB CD Road. The ramp from US 50 WB to Gest Street potentially could be cut off also if US 50 WB would also need to be flattened.	• Add Signage/Traffic Control Devices
	CURVE NO. 66 PI Sta. 33+69.33 (Horiz.) (Directional Ramp)	Y	31	33 mph (45)		238' (360)			32 mph	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width. • 45 mph would require a 26' shoulder (standard minimum shoulder is 4', a 6' shoulder is used).	• Widen the inside shoulder. • A flatter curve could require the 4th Street NB on ramp to be relocated from its current alignment creating weaving on the NB CD Road. The ramp from US 50 WB to Gest Street potentially could be cut off also if US 50 WB would also need to be flattened.	• Add Signage/ Lighting
NB CD ROAD to 5th Street EB (OH)		N										
NB CD ROAD to I-71 NB (Directional Ramp)	Sta. 27+80 Rt (I-71 NB)	Y	32					Shoulder Width	N/A	• < 8' min due to flood wall. • A 39:1/acceleration lane taper Sta. 14+75 to Sta. 30+00 (I-71 NB) is needed to minimize the impact to the flood wall/I-71 (FWW) and maintain a 4' minimum shy line from the roadside barrier.	• If a 50:1 taper is used I-71 in the trench will need to be widened just to maintain a 4 foot shoulder.	
	Sta. 9+50	Y	33					6.69 % (Upgrade)		• A grade of 6.69% (5.0 % max) needed to achieve clearance under I-71 NB (upper deck) and yet tie into I-71 NB before entering the Fort Washington Way trench and to clear the existing railroad. The 6.69% grade does not have a tangent length, the vertical curves are reverse curves.	• A flatter grade would violate railroad clearance if existing vertical curve on the existing bridge is to be maintained.	
NB CD ROAD to 2nd Street EB (OH)		N										
6th Street WB (OH) to WINCHELL AVE		N										
9th street to 6th connector to Winchell		N										
Gest St/Freeman Ave to Winchell Ave		N										
Gest St/Freeman Ave (OH) to I-75 NB		N										
SB CD ROAD to 7th Street (OH)		N										

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - RAMPS

Brent Spence Bridge Design Exceptions – Alternative I: Page 6 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal Dc (Maximum)	Horizontal SSD (Minimum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason(s) For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
SB CD RD to Gest St/Freeman Ave		N										
Western Ave (OH) to SB CD ROAD		N										
SB CD ROAD to 5th Street (OH)		Y	34					7.5% upgrade		• Sta. 26+10 to Sta. 32+60 (Vertical, 7.0% max) a grade of 7.5% is needed to achieve clearance under US 50 WB and over I-75 SB to I-71 NB.	• Flattening the vertical curve will impact the clearance over I-75 SB to I-71 NB. Either the SB CD Road to 5th Street or I-75 SB to I-71 NB alignment will potentially be cut of and traffic will need to be directed another way. • If the connections are to be maintained, raising the US 50 WB profile would be an alternate but there may be a potential that US 50 WB to Gest Street may be cut off due to the higher profile. Changing the profiles for NE CD Road to US 50 WB and 6th Street to US 50 WB will also need to be investigated.	• Add Signage/Traffic Control Devices
SB CD ROAD to 2nd ST. (OH)		N										
SB CD ROAD to 3rd ST. (OH)		N										
8th Street (OH) to SB CD ROAD		N										
US 50 EB to SB CD ROAD	CURVE NO. 85 PI Sta. 108+02.34 (Horiz.)	Y	35	40 mph (45)	10° 45' 00" (9° 00' 00")				N/A	• Diverging curvature per table 505-2a is not met.	• Flattening the curve in gore area could increase impacts to the UPS warehouse, cut off on ramp from Linn Street, and create a pavement taper on the new Ohio River Bridge.	• PI Sta. 29+81.48 (Horiz.) Exit Geometry
	CURVE NO. 85 PI Sta. 108+02.34 (Horiz.)	Y	36	34 mph (45)		246' (360)			N/A	• The line of sight for the inside lane is impeded by the bridge parapet. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure width.	• Widen shoulder which could potentially increase impact to the UPS Building and increase retaining wall heights.	• Add Signage/Traffic Control Devices
US 50 EB to 2ND ST (OH)		N										
US 50 EB to 5TH ST (OH)		N										

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - RAMPS

Brent Spence Bridge Design Exceptions – Alternative I: Page 7 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-71/I-75/US 50 INTERCHANGE	Curve PI	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal SSD (Minimum)	Horizontal Dc (Maximum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
Third Street (OH)		N										
Central Avenue (OH)		N										
Seventh Street (OH)		N										
Ninth Street (OH)		N										
Linn Street (OH)		N										
NB CD ROAD to Winchell Ave (Local)	PI Sta. 65+75.00 (Vertical)	Y	37	31 mph (40)			39 (44) - crest		N/A	• Curve needed to be able to tie profile in from NB CD Road to Winchell Ave.	• To fix, the horizontal alignment would need to be adjusted for three connections (NB CD Road to Winchell Ave., 6th Street to Winchell Ave., and W. Court Street.). • Moving these alignments could potentially impact 7 structures along Winchell Ave. and W. Court Street.	• Add Signage/ Lighting • Vertical Curve 2.0 times the minimum length needed.
	PI Sta. 69+20.00 (Vertical)	Y	38	31 mph (40)			39 (64) - sag		N/A	• Vertical curve used to match existing profile.	• Fill in the sag point which may impact neihboring apartment building.	• Add Signage/ Lighting • Vertical Curve 2.0 times the minimum length needed.
					Existing posted speed limit on Winchell Ave. is 40 mph							
Gest Street (OH)	CURVE NO. 192 PI Sta. 14+34.53 (Horiz.)	Y	39	30 mph (40)	207' (305)				33 mph	• The line of sight is impeded by a roadside barrier and retaining wall. • The proposed shoulder needs to be widened to meet the needed sight distance therefore increasing the structure length of 7th and 9th streets.	• Widen shoulder using a pvement taper. • Flattening the curve could potentially impact a hotel parking garage. • Extend overhead bridges to set abutments outside of the clear zone so that ne barrier is needed.	• Add Signage/ Lighting
John St.		N										
West Court St.		N										
Ezzard Charles WB		N										
Ezzard Charles EB		N										

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - SIDEROADS

Brent Spence Bridge Design Exceptions – Alternative I: Page 8 of 8

Brent Spence Bridge
Design Exceptions - Alternative I

I-75/I-71	Station	Design Exception	D.E. Number	Design Speed Met (Required)	Horizontal SSD (Minimum)	Horizontal Dc (Maximum)	Vertical Curvature - K (Minimum)	Other	Design Speed Existing	Reason For Design Exception	Potential Impact(s) to Eliminate Design Exceptions	Potential Mitigation Solutions
SB I-75 to Kyles Lane	Sta. 445+00	Y	40					Grade		• Proposed ramp grade is 8.1 percent due to right of way considerations.	• Extending the beginning of ramp futher south and thus widening the right of way limits required for the connection to the existing elevtion at the ramp terminal.	• This steep slope is less than 500 feet long and provides an exit ramp to Kyles Lane on which traffic has to decelerate.
NB CD Road	Existing Bridge (Lower Deck)	Y	41					Lane Width		• 11' lanes needed to utilize the existing bridge width.	• Replace the existing bridge and rebuild structure to accommodate a wider section.	• Will be maintaining one 12' lane on the lower bridge deck.
	Existing Bridge (Lower Deck)	Y	42					Shoulder Width		• A minimum 4' left shoulder and an 8' right shoulder are needed to maintain 3 through lanes and utilize the existing bridge width.	• Replace the existing bridge and rebuild structure to accommodate a wider section.	

N/A = Not Applicable
D.E. = Design Exception
Design Speed for Interstate is 60 mph and ramps per 503-1

Alt I D.E. Summary - Kentucky

APPENDIX 6.2 DESIGN CRITERIA TABLE

DESIGN CRITERIA – OHIO ±

Design Feature	Mainline			Directional Ramp[1]			Service Ramp[2]			Local Street		
	60 mph	55 mph	Figure	60/45 mph	55/45 mph	Figure	50/40/30 mph	48/40/28 mph	Figure	25-40 mph	25, 30, 35 mph (posted)	Figure
Horizontal alignment												
Max centerline deflection w/o horizontal curve	1°00'	1°00'	202-1E	1°00' 1°45'	1°45' 2°15'	202-1E	1°15' 2°15' 3°45'	1°15' 2°15' 3°45'	202-1E	2°15'	5°30' 3°45' 2°45'	202-1E
Maximum degree of curve	4°15'	5°30'	202-2E	4°15' 9°00'	5°30' 9°00'	202-2E 202-10E	6°45' 11°45' 24°45'	6°45' 11°45' 24°45'	202-2E 202-10E	10°45'	37°00' 22°45' 15°30'	202-9E
Max curve w/o super	0°33'	0°39'	202-3E	0°33 0°57'	0°39' 0°57'	202-3E 202-10E	0°47' 1°10' 1°58'	0°47' 1°10' 1°58'	202-3E 202-10E	7°42'	2°42' 1°58' 1°29'	202-9E
Max superelevation (e_{max})	6.00%	6.00%	202-8E	6.00%	6.00%	202-8E 202-10E	6.00%	6.00%	202-8E 202-10E	4.00%	4.00%	202-9E
Spiral length	≥ Length of Runoff	≥ Length of Runoff	---	---	---	---	---	---	---	---	---	---
Vertical alignment												
Maximum grade[3]	4%	5%	203-1E	6%	6%	203-1E	6%	6%	203-1E	10%	11% 10% 10%	203-1E
Max vertical deflection w/o a vertical curve	0.30%	0.40%	203-2E	0.30% 0.55%	0.40% 0.55%	203-2E	0.45% 0.75% 1.30%	0.45% 0.75% 1.30%	203-2E	0.75%	1.85% 1.30% 0.95%	203-2E
Pavement cross slopes (normal)	0.016	0.016	301.1.5	---	---	---	---	---	---	---	---	---
Use of spirals	D > 3°	D > 3°45'	202-11 202-5	---	---	---	---	---	---	---	---	---
Transition length/rate (drop line)	L= 60 x Lane Width	L= 55 x Lane Width	301.1.4	---	---	---	---	---	---	---	---	---
Pavement slope transition	222:1 max	213:1 max	202-4E	222:1 max 185:1 max	213:1 max 185:1 max	202-4E	200:1 max 172:1 max 152:1 max	200:1 max 172:1 max 152:1 max	202-4E	172:1	143:1 152:1 161:1	202-4E
Grade point position	Inside Edge	Inside Edge		Inside/ Outside Edge	Inside/ Outside Edge		Inside/ Outside Edge	Inside/ Outside Edge		Outside Edge	Outside Edge	

DESIGN CRITERIA – KENTUCKY ¥

Design Feature	Mainline			Service Ramp[2]			Local Street			Notes
	60 mph	55 mph	Exhibit	50/40/30 mph	48/40/28 mph	Exhibit	30 mph	25 mph (posted)	Exhibit	
Horizontal alignment										
Max centerline deflection w/o horizontal curve	n/a	n/a		n/a	n/a		n/a	n/a		
Maximum degree of curve	1205'	965'	3-23 161	835' 510' 275'	835' 510' 275'	3-22 159	300'	300'	3-21 157	
Max curve w/o super	12000'	10000'	3-23 161	8000' 6000' 3500'	8000' 6000' 3500'	3-22 159	3500'	2200'	3-21 157	
Max superelevation (e_{max})	8.00%	8.00%		6.00%	6.00%		4.00%	4.00%		
Spiral length	Length of Runoff	Length of Runoff		---	---	---	---	---	---	
Vertical alignment										
Maximum grade[3]	4%	5%	8-1 510	5%	6%	Pg 833	11%	11%		1% steeper may be used in extreme cases or for one-way downgrades.
Max vertical deflection w/o a vertical curve	n/a	n/a		n/a	n/a					Min. distance between deflections is 100' for speed> 50 MPH, 50' for speed < 50 MPH.
Pavement cross slopes (normal)	2.00%	2.00%		---	---	---	---	---	---	
Use of spirals	e > 3.0%	e > 3.0%		---	---	---	---	---	---	
Transition length/rate (drop line)	L = 50:1 to 70:1	L = 50:1 to 70:1		---	---	---	---	---	---	
Pavement slope transition	222:1 max	213:1 max	3-27 170	200:1 max 172:1 max 152:1 max	200:1 max 172:1 max 152:1 max	3-27 170	152:1	143:1	3-27 170	For methods of transition see: 202-5, 202-5a, 202-5b, 202-5c, 202-5d, 202-6.
Grade point position	Inside Edge	Inside Edge		Inside/ Outside Edge	Inside/ Outside Edge		Outside Edge	Outside Edge		

Design Feature	DESIGN CRITERIA – OHIO ±												DESIGN CRITERIA – KENTUCKY ¥									Notes
	Mainline			Directional Ramp[1]			Service Ramp[2]			Local Street			Mainline			Service Ramp[2]			Local Street			
	60 mph	55 mph	Figure	60/45 mph	55/45 mph	Figure	50/40/30 mph	48/40/28 mph	Figure	25-40 mph	25, 30, 35 mph (posted)	Figure	60 mph	55 mph	Exhibit	50/40/30 mph	48/40/28 mph	Exhibit	30 mph	25 mph (posted)	Exhibit	
K-values																						
Crest vertical curve	151	114	203-3E	151 61	114 61	203-3E	84 44 19	75 44 15	203-3E	44	12 19 29	203-3E	151	114	3-76 274	84 44 19	75 44 15	3-76 274	19	12	3-76 274	
Sag vertical curve[4]	136	115	203-6E	136 79	115 79	203-6E	96 64 37	89 64 32	203-6E	64	26 37 49	203-6E	136	115	3-79 280	96 64 37	89 64 32	3-79 280	37	26	3-79 280	
Sight distance																						
Stopping sight distance (vertical curves)	570' min.	495' min.	201-1E	570' 360'	495' 360'	201-1E	425' 305' 200'	400' 305' 180'	201-1E	305'	155' 200' 250'	201-1E	570' min	495' min.	3-1 112	425' 305' 200'	425' 305' 200'	3-1 112	200'	155'	3-1 112	
Minimum passing sight distance	---	---	---	---	---	---	---	---	---	1470'	900' 1090' 1280'	201-3E	---	---	---	---	---	---	1090'	900'	3-7 124	
Intersection sight distance	---	---	---	---	---	---	---	---	---	445' LT 385' RT	280'/240' 335'/290' 390'/335'	201-5E	---	---	---	---	---	---	335' LT 290' RT	280' LT 240' RT	9-55 665 9-58 668	See Fig. 201-4 also.
Decision sight distance	1150' (B) 1280' (E)	1030' (B) 1135' (E)	201-6E	1150' (B) 1280' (E) 800' (B) 930' (E)	1030' (B) 1135' (E) 800' (B) 930' (E)	201-6E	910' (B) 1030' (E) 690' (B) 825' (E) 490' (B) 620' (E)	910' (B) 1030' (E) 690' (B) 825' (E) 490' (B) 620' (E)	201-6E	690' (B) 825' (E)	490' (B) 620' (E) 590' (B) 720' (E)	201-6E	1150' (B) 1280' (E)	1030' (B) 1135' (E)	3-3 116	910' (B) 1030' (E) 690' (B) 825' (E) 490' (B) 620' (E)	910' (B) 1030' (E) 690' (B) 825' (E) 490' (B) 620' (E)	3-3 116	490' (B) 620' (E)	490' (B) 620' (E)	3-3 116	
Clearances (new & reconstructed)																						
Lateral On Bridge (≥ 200' long) & (≤ 200' long)	12' Rt. 12' Med. ≤ 2 lanes 12' Rt./ 4' Lt.	12' Rt. 12' Med. ≤ 2 lanes 12' Rt./ 4' Lt.	302-1E	**1-Lane/ 2-Lane** 8' Rt./ 12' Rt. 6' Lt./ 6' Lt.	**1-Lane/ 2-Lane** 8' Rt./ 12' Rt. 6' Lt./ 6' Lt.	303-1E	8' Rt. 6' Lt.	8' Rt. 6' Lt.	Fig 303-1E	**Uncurbed /Curbed** 4'-10'/ 1'-2'	**Uncurbed /Curbed** 4'-10'/ 1'-2'	301-4E	12' Rt. 12' Med.	12' Rt. 12' Med.	Pg. 765	8' Rt. 6' Lt.	8' Rt. 6' Lt.	Pg. 765	**Uncurbed /Curbed** 4'-10'/ 1'-2'	**Uncurbed /Curbed** 4'-10'/ 1'-2'		12' accommodates future MOT. 4' lateral on median allowed on four-lane alternative.
Vertical	17.0' Pref. 15.5' Min.	17.0' Pref. 15.5' Min.	302-1E	17.0' Pref. 15.5' Min.	17.0' Pref. 15.5' Min.	302-1E	17.0' Pref. 15.5' Min.	17.0' Pref. 15.5' Min.	302-1E	15.0' Pref 14.5' Min.	15.0' Pref 14.5' Min.	302-1E	17.5' Pref. 16.0' Min.	17.5' Pref. 16.0' Min.	Pg. 511	17.5' Pref. 16.0' Min.	17.5' Pref. 16.0' Min.	Pg. 511	17' Pref. 14.5' Min	17' Pref. 14.5' Min	Pg. 511	

Design Feature	DESIGN CRITERIA – OHIO ±												DESIGN CRITERIA – KENTUCKY ¥									Notes
	Mainline			Directional Ramp[1]			Service Ramp[2]			Local Street			Mainline			Service Ramp[2]			Local Street			
	60 mph	55 mph	Figure	60/45 mph	55/45 mph	Figure	50/40/30 mph	48/40/28 mph	Figure	25-40 mph	25, 30, 35 mph (posted)	Figure	60 mph	55 mph	Exhibit	50/40/30 mph	48/40/28 mph	Exhibit	30 mph	25 mph (posted)	Exhibit	
Clear zone	(>6000 ADT)			(>6000 ADT)			(>6000 ADT)			(>6000 ADT)												
Foreslope 6:1 or Flatter	30'	23'	600-1E	30' 19'	23' 15'	600-1E	19' 15' 15'	19' 15' 15'	600-1E	15'	15'	600-1E	30'	22'	3.1 3-6§	22' 15' 15'	22' 15' 15'	3.1 3-6§	15'	15'	3.1 3-6§	
Foreslope steeper than 6:1 to 4:1	30'	29'	600-1E	30' 26'	29' 17'	600-1E	26' 17' 17'	26' 17' 17'	600-1E	17'	17'	600-1E	40'	26'	3.1 3-6§	26' 17' 17'	26' 17' 17'	3.1 3-6§	17'	17'	3.1 3-6§	
Backslope 6:1 or flatter	27'	23'	600-1E	27' 21'	23' 15'	600-1E	21' 15' 15'	21' 15' 15'	600-1E	15'	15'	600-1E	27'	22'	3.1 3-6§	22' 15' 15'	22' 15' 15'	3.1 3-6§	15'	15'	3.1 3-6§	
Backslope steeper than 6:1 to 4:1	25'	21'	600-1E	25' 19'	21' 15'	600-1E	19' 15' 15'	19' 15' 15'	600-1E	15'	15'	600-1E	25'	20'	3.1 3-6§	20' 15' 15'	20' 15' 15'	3.1 3-6§	15'	15'	3.1 3-6§	
Backslope steeper than 4:1	21'	17'	600-1E	21' 15'	17' 15'	600-1E	15' 15' 15'	15' 15' 15'	600-1E	15'	15'	600-1E	21'	16'	3.1 3-6§	15' 15' 15'	15' 15' 15'	3.1 3-6§	15'	15'	3.1 3-6§	
Lanes																						
Number of thru lanes	>3 (by alt)			2 or 1			2 or 1			Varies			>3 (by alt)			2 or 1			Varies			
Lane width	12'		301-4E	12' (2-lane) 16' (1-lane)		303-1E	12' (2-lane) 16' (1-lane)		303-1E	12' 11' (Min.)		301-4E	12'			12' (2-lane) 15' (1-lane)			12'			
Shoulders																						
Treated width	12' Rt. 12' Med. ≤ 2lanes 12' Rt 4' Med	12' Rt. 12' Med. ≤ 2lanes 12' Rt 4' Med	301-3E	10'Rt./ 4'Lt. 6'Rt/ 4'Lt.	10'Rt./ 4'Lt. 6'Rt./ 4'Lt.	303-1E[5]	6'Rt./ 3'Lt.	6'Rt./ 3'Lt.	303-1E	2' Curb & Gutter	2' Curb & Gutter	301-4E	12' Rt. 12' Med.	12' Rt. 12' Med.		6'Rt./ 4'Lt.	6'Rt./ 4'Lt.		2' Curb & Gutter	2' Curb & Gutter		12' accommodates future MOT. 4' median shoulder allowed on four-lane alternative.
Graded width with barrier or foreslopes steeper than 6:1	17' Rt. 17' Med.	17' Rt. 17' Med.	301-3E	15'Rt./ 9'Lt. 11'Rt./ 9'Lt.	15'Rt./ 9'Lt. 11'Rt./ 9'Lt.	303-1E[5]	15'Rt./ 9'Lt. 11'Rt./ 9'Lt.	15'Rt./ 9'Lt. 11'Rt./ 9'Lt.	303-1E	---	---	---	See Clear Zone Criteria	See Clear Zone Criteria		See Clear Zone Criteria	See Clear Zone Criteria		---	---	---	Two lane (top) One lane (bottom)
Graded width w/o barrier and foreslopes 6:1 or flatter	12' Rt. 12' Med.	12' Rt. 12' Med.	301-3E	10'Rt./ 6'Lt. 8'Rt./ 6'Lt.	10'Rt./ 6'Lt. 8'Rt./ 6'Lt.	303-1E[5]	10'Rt./ 6'Lt. 8'Rt./ 6'Lt.	10'Rt./ 6'Lt. 8'Rt./ 6'Lt.	303-1E	---	---	---	See Clear Zone Criteria	See Clear Zone Criteria		See Clear Zone Criteria	See Clear Zone Criteria		---	---	---	Two lane (top) One lane (bottom)
Normal barrier offset[7]	14' Rt. 14' Med. 12' Rt. & Med. if Conc Barr		301-3E or 10' Rt./4' Lt. for ≤ 2 lanes w/ Conc Barr	12'Rt./ 6'Lt. 8'Rt./ 6'Lt.	12'Rt./ 6'Lt. 8'Rt./ 6'Lt.	303-1E	12'Rt./ 6'Lt. 8'Rt./ 6'Lt.	12'Rt./ 6'Lt. 8'Rt./ 6'Lt.	303-1E	4' Min.	4' Min.	602.1.5.1	14' Rt. 14' Med.	14' Rt. 14' Med.	Pg. 319	8'Rt./ 6'Lt.	8'Rt./ 6'Lt.		4' min.	4' min.		Two lane (top) One lane (bottom)
Assumed median width	30'	30'	---	---	---	---	---	---	---	---	---	---	30'	30'	---	---	---	---	---	---	---	
Shoulder pavement cross slopes (normal)	4%	4%	301-8	4%	4%	301-8	4%	4%	301-8	4%	4%	301-8	4%	4%	Pg. 320	4%	4%	Pg. 320	4%	4%	Pg. 320	

Design Feature	DESIGN CRITERIA – OHIO ±												DESIGN CRITERIA – KENTUCKY ¥									Notes
	Mainline			Directional Ramp[1]			Service Ramp[2]			Local Street			Mainline			Service Ramp[2]			Local Street			
	60 mph	55 mph	Figure	60/45 mph	55/45 mph	Figure	50/40/30 mph	48/40/28 mph	Figure	25-40 mph	25, 30, 35 mph (posted)	Figure	60 mph	55 mph	Exhibit	50/40/30 mph	48/40/28 mph	Exhibit	30 mph	25 mph (posted)	Exhibit	
Terminal classification																						
Freeway terminal	---	---	---	High speed	High speed	503-2aE 503-3aE	High speed	High speed	503-2aE 503-3aE	---	---	---	---	---	---	---	---	---	---	---	---	
	---	---	---	Low speed	Low speed	503-4aE 503-4bE	Low speed	Low speed	503-4aE 503-4bE	---	---	---	---	---	---	---	---	---	---	---	---	
	---	---	---	C-D	C-D	504-1E 504-2E	C-D	C-D	504-1E 504-2E	---	---	---	---	---	---	---	---	---	---	---	---	
	---	---	---	Multi-entrance	Multi-entrance	505-1aE 504-2E	Multi-entrance	Multi-entrance	505-1aE 504-2E	---	---	---	---	---	---	---	---	---	---	---	---	
	---	---	---	Multi-exit	Multi-exit	505-2aE 505-2bE	Multi-exit	Multi-exit	505-2aE 505-2bE	---	---	---	---	---	---	---	---	---	---	---	---	

± Ohio geometric design criteria provided in the current ODOT Location and Design Manual, Volume 1.

¥ Kentucky geometric design criteria provided in the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide and the AASHTO "Green Book" (A Policy on Geometric Design of Highways and Streets, Fifth Edition).

§ American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide.

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1 For Directional Ramps, top line indicates upper range speed (60 MPH), second line indicated middle range speed (45 MPH).

2 For Service Ramps, top line indicates upper range speed (50 MPH), middle line indicates middle range speed (40 MPH), and bottom line indicates lower range speed (30 MPH).

3 Grades may be increased by 1percent for freeways in developed areas where a flatter grade is precluded.

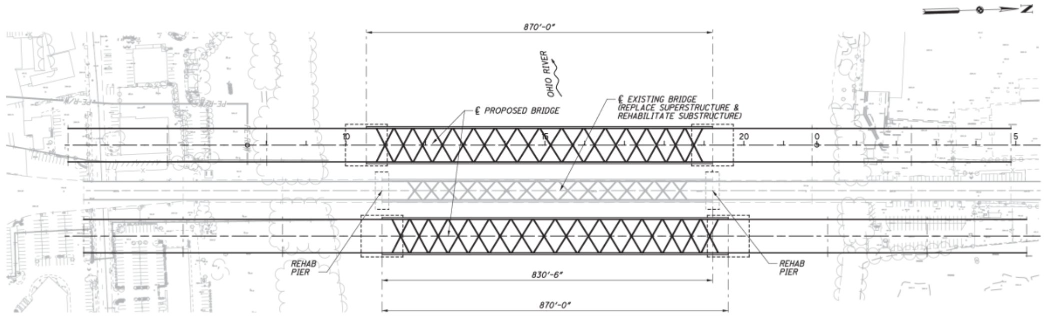
4 Where street lighting is present, the minimum length of sag vertical curve is three times the speed.

5 For three lanes or more use: 10-foot right/ 10-foot left

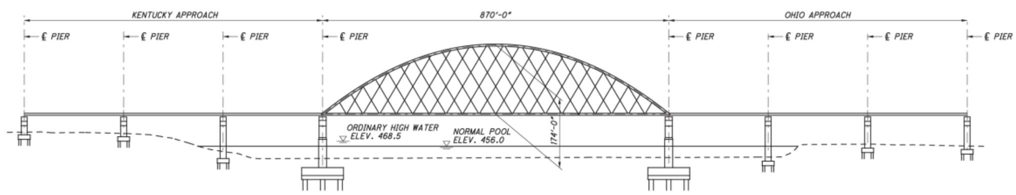
6 Local streets may have different criteria as required by the City of Cincinnati.

7 For the Interstate inside shoulder widths, use an offset of 15' to the inside E/P.

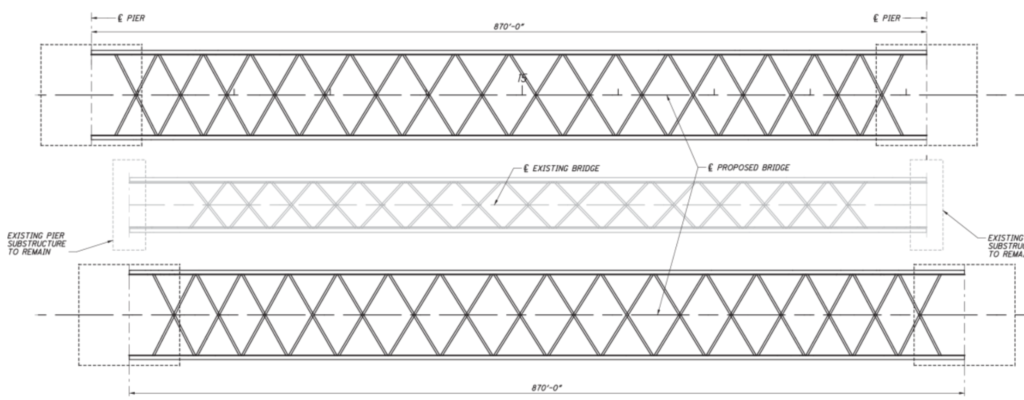
APPENDIX 6.3 CONCEPTUAL GENERAL PLANS & ELEVATION PLANS FOR ALTERNATIVE "123" RIVER BRIDGE CONCEPTS (PROPOSED BRIDGE)



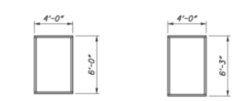
PLAN



PROPOSED BRIDGE ELEVATION

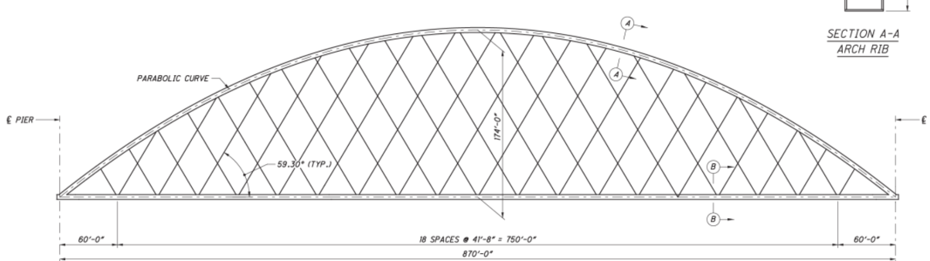


PLAN

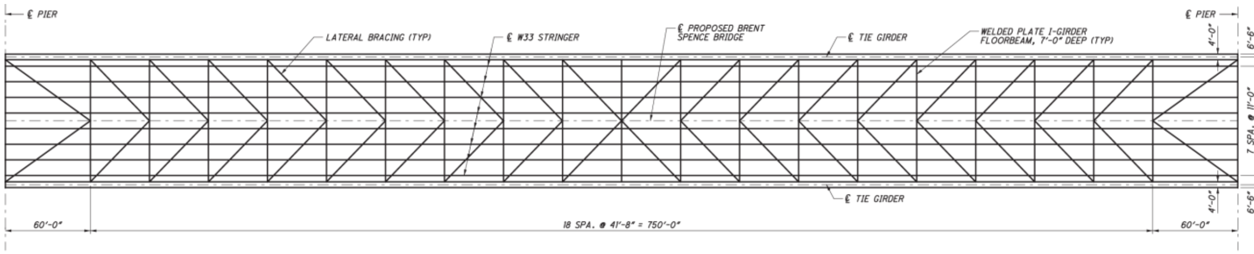


SECTION A-A ARCH RIB

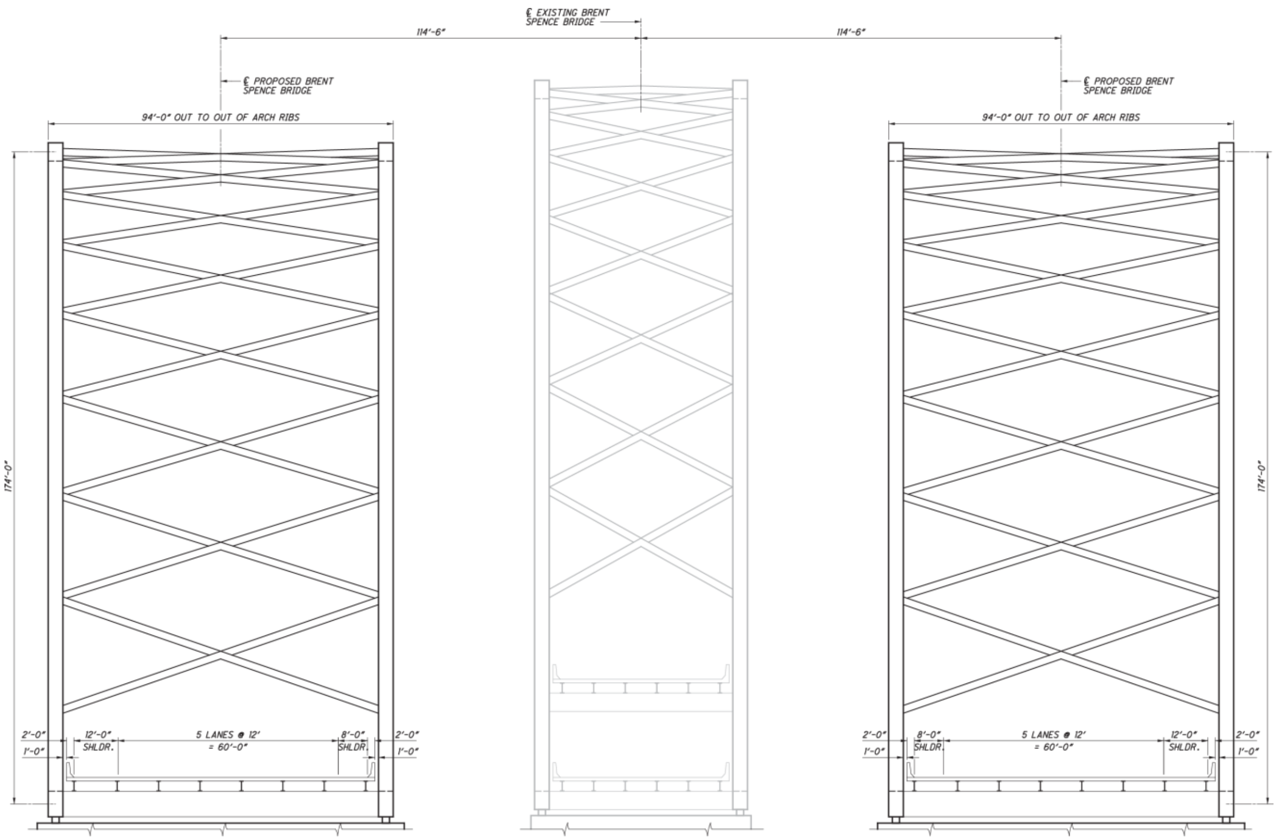
SECTION A-A TIE GIRDER



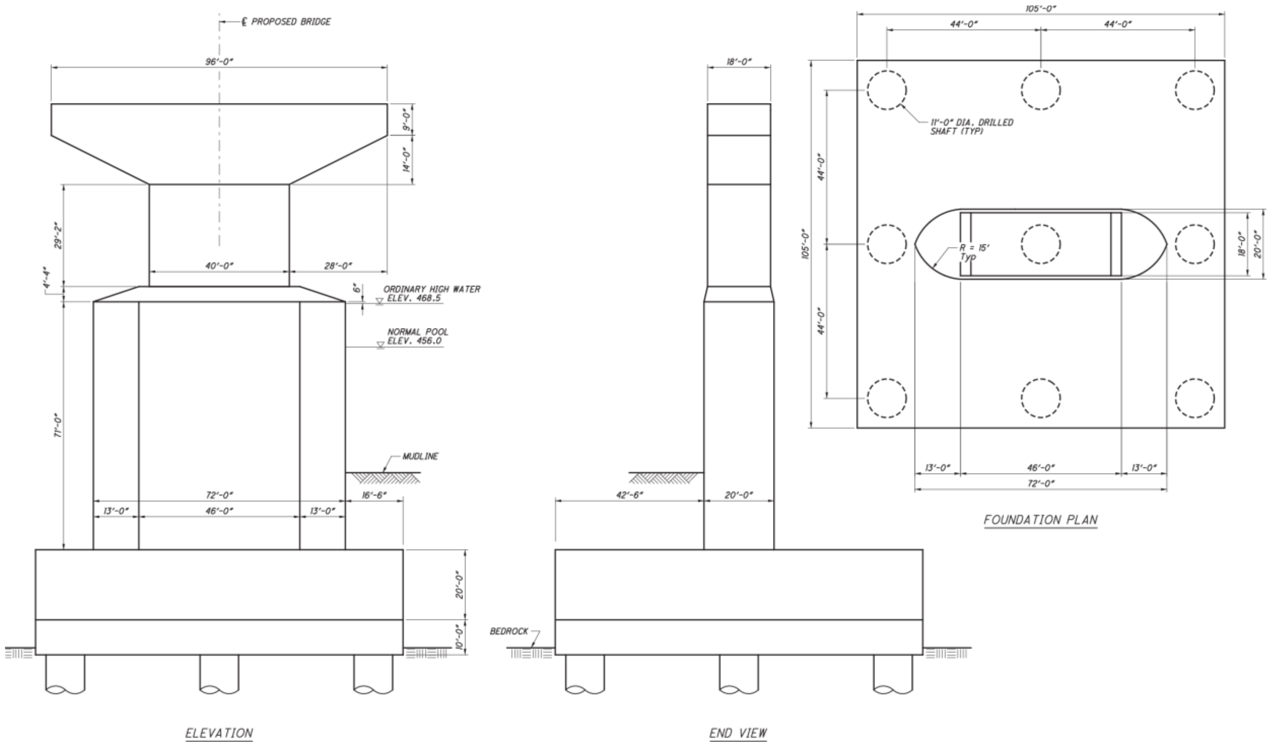
PROPOSED BRIDGE ELEVATION



FRAMING PLAN
PROPOSED BRIDGE

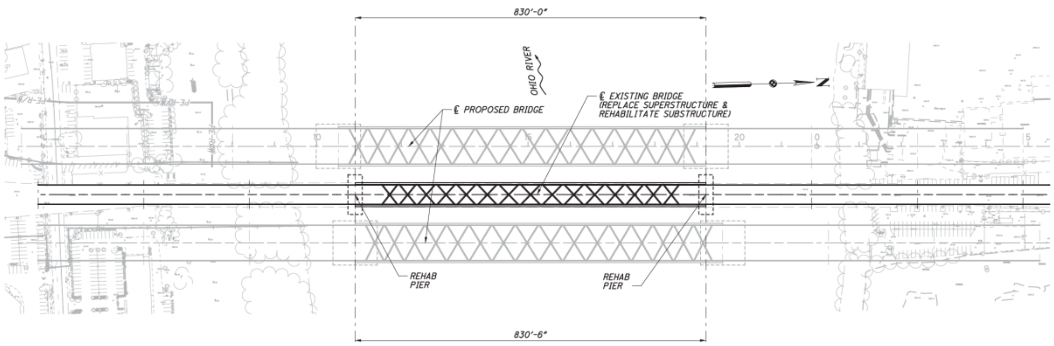


TYPICAL SECTION
PROPOSED BRIDGE

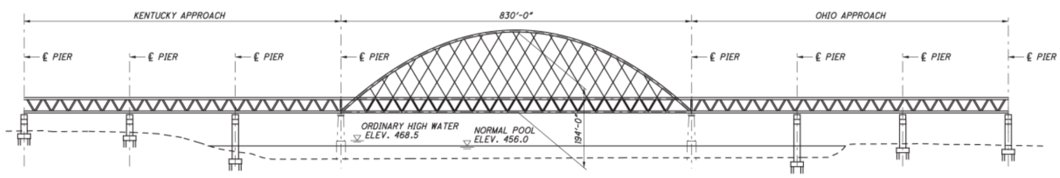


PROPOSED BRIDGE

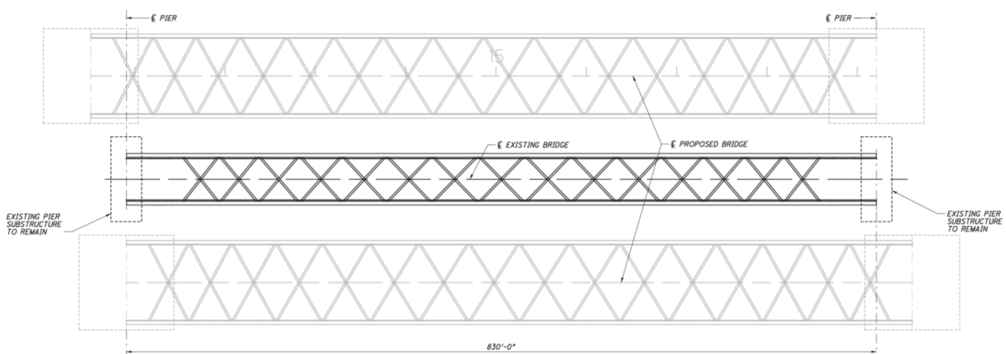
APPENDIX 6.4 CONCEPTUAL GENERAL PLAN & ELEVATION PLANS FOR ALTERNATIVE "123" RIVER BRIDGE CONCEPTS (REHABILITATED EXISTING BRIDGE



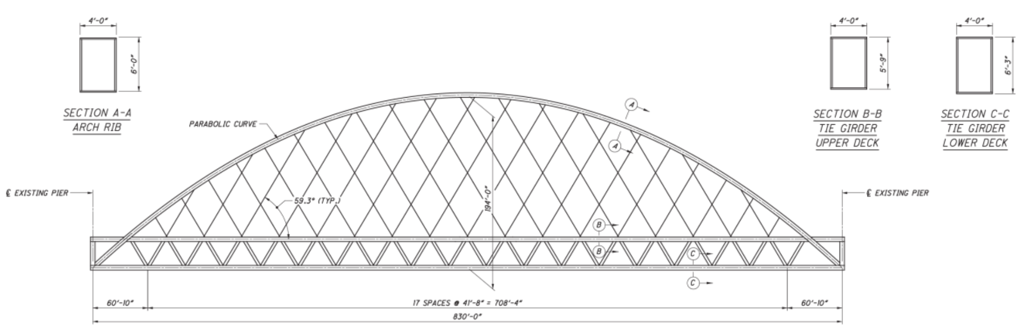
PLAN



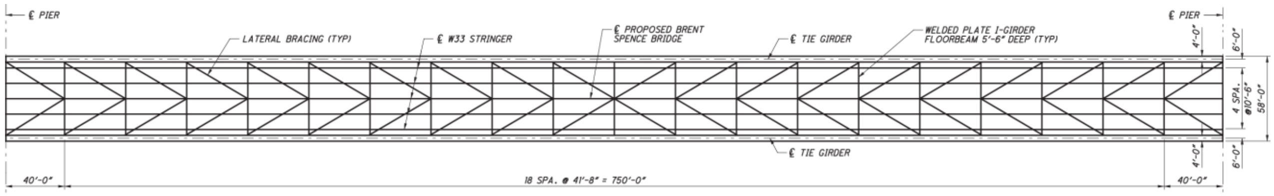
REHABILITATED EXISTING BRIDGE ELEVATION



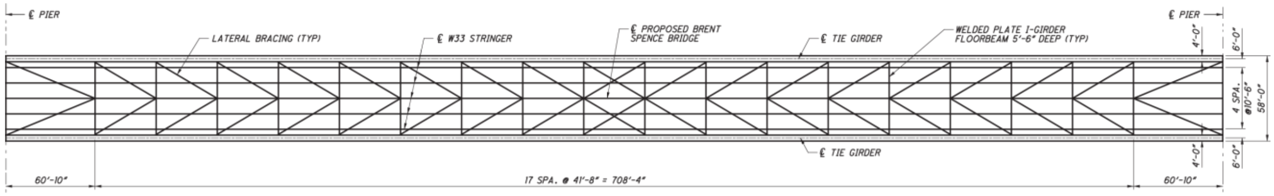
PLAN



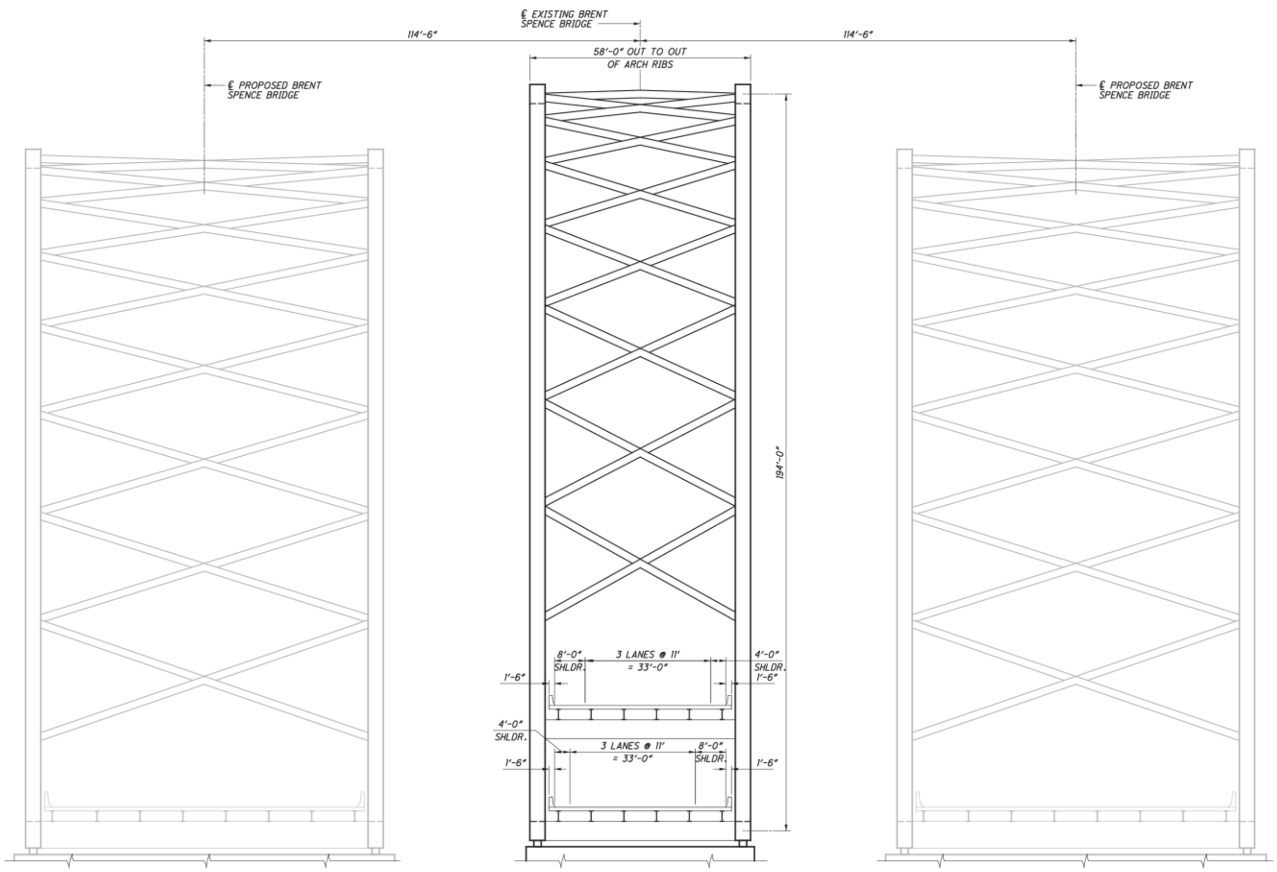
REHABILITATED EXISTING BRIDGE ELEVATION



UPPER DECK FRAMING PLAN
EXISTING BRIDGE

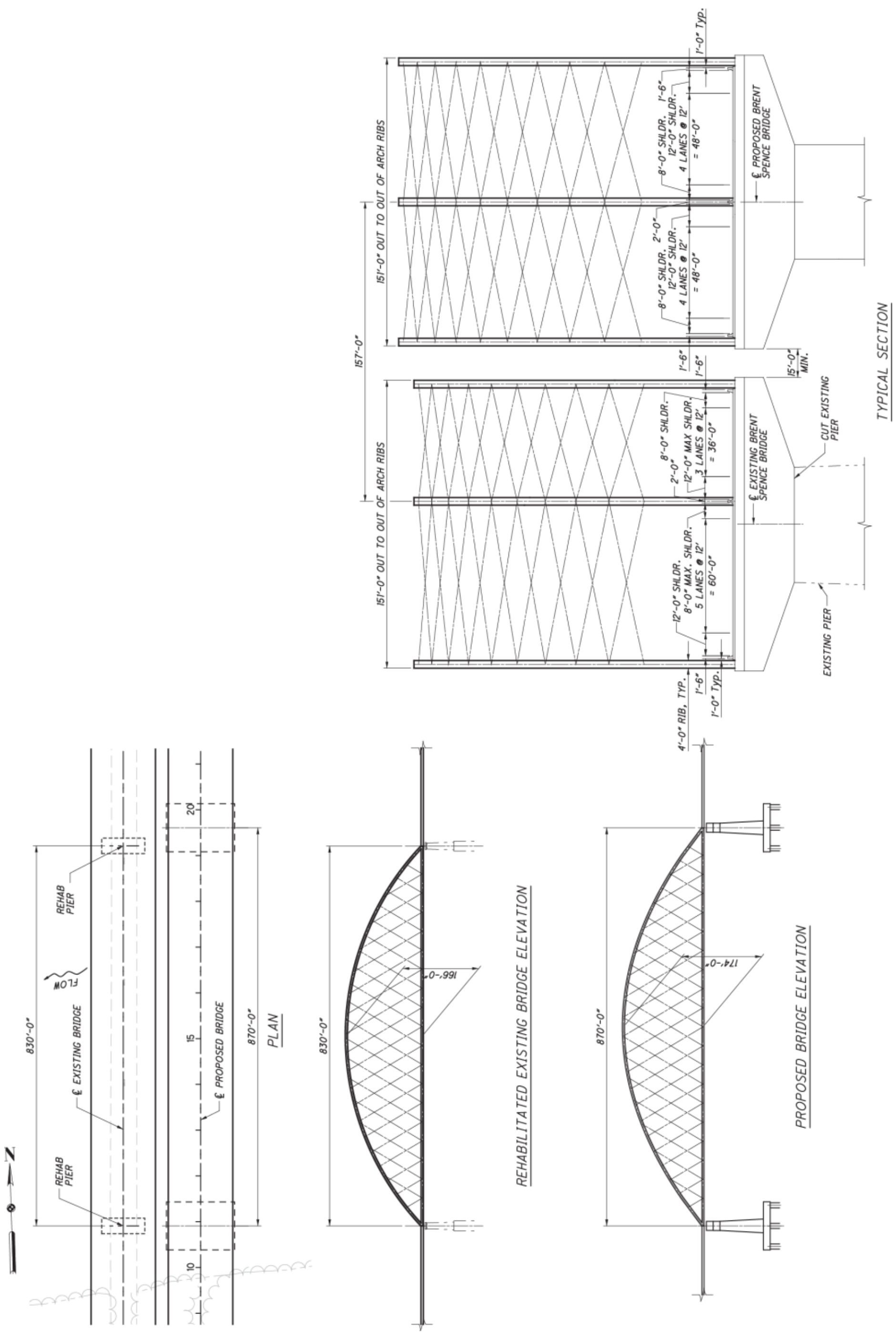


LOWER DECK FRAMING PLAN
EXISTING BRIDGE

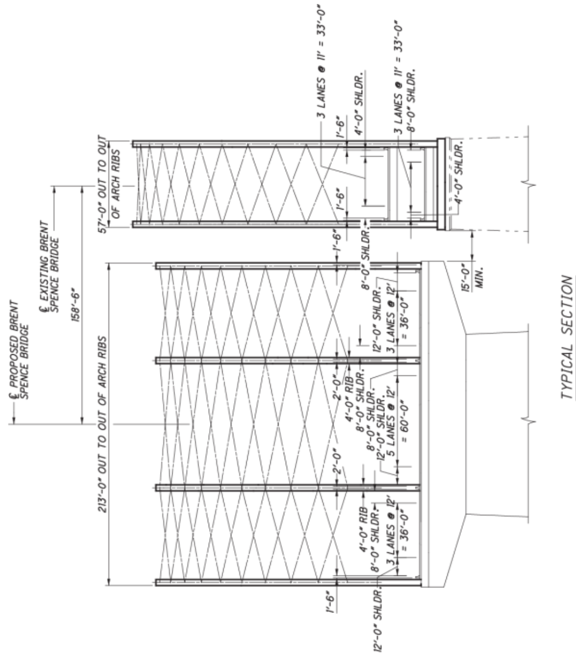


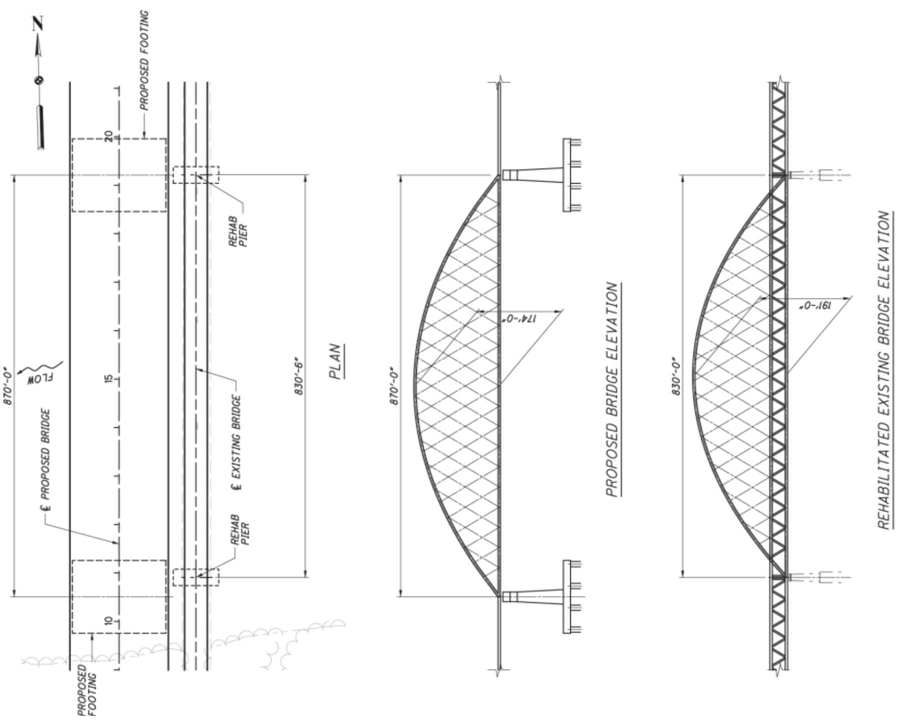
TYPICAL SECTION
EXISTING BRIDGE

APPENDIX 6.5 CONCEPTUAL GENERAL PLAN & ELEVATION PLANS FOR ALTERNATIVE "125" RIVER BRIDGE CONCEPTS

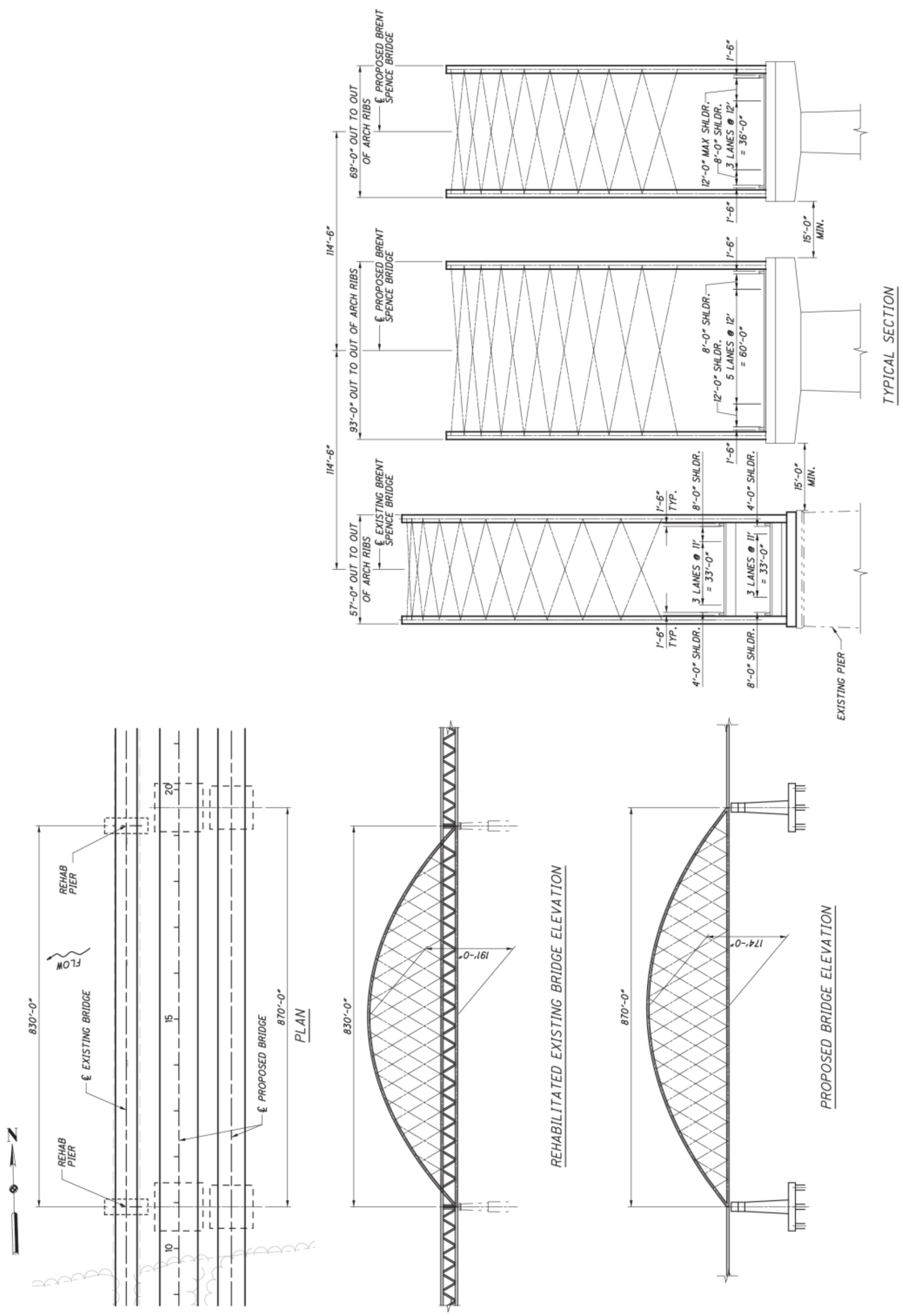


APPENDIX 6.6 CONCEPTUAL GENERAL PLAN & ELEVATION PLANS FOR ALTERNATIVE "126" RIVER BRIDGE CONCEPTS

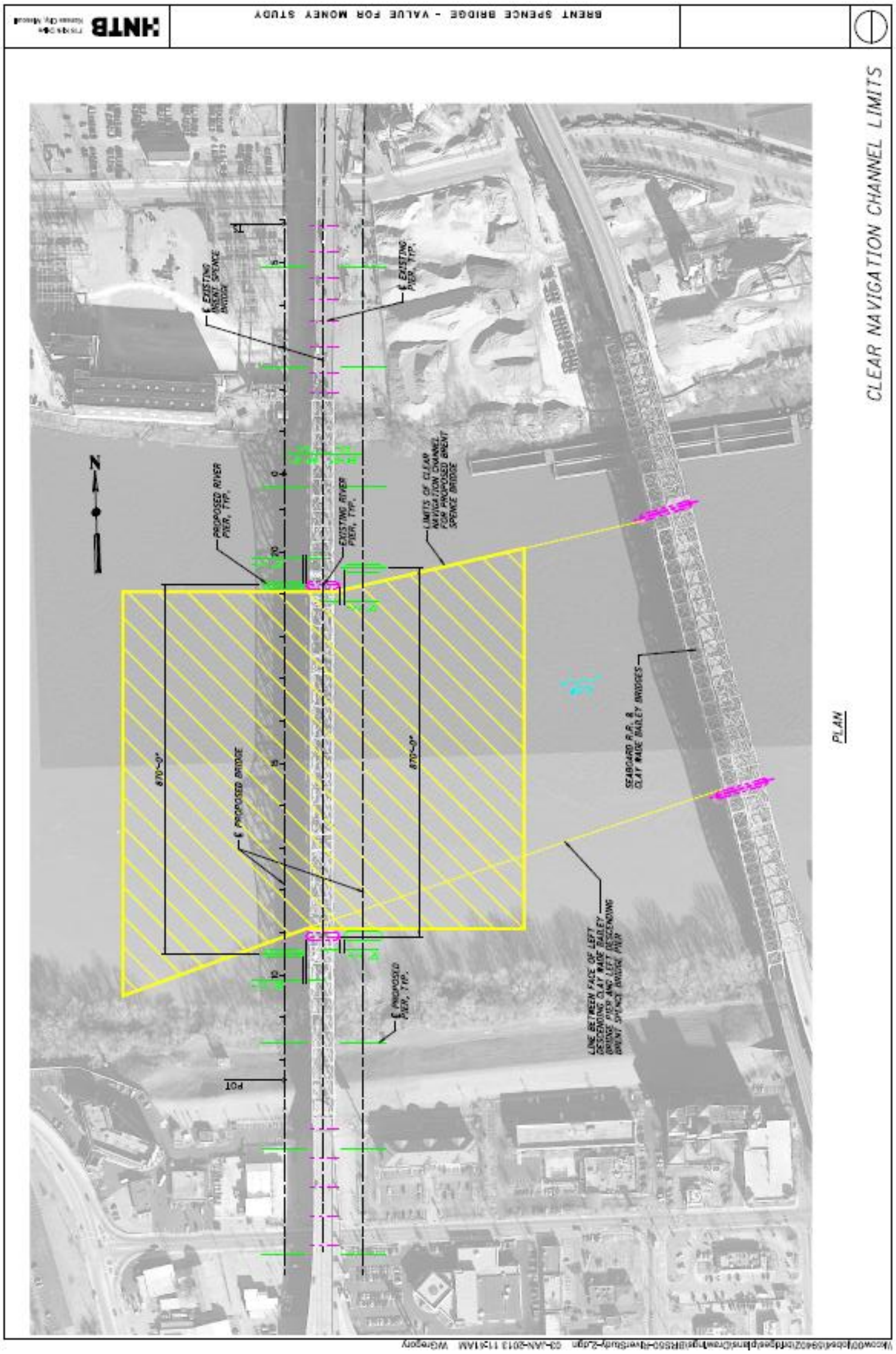




APPENDIX 6.7 CONCEPTUAL GENERAL PLAN & ELEVATION PLANS FOR ALTERNATIVE "22" RIVER BRIDGE CONCEPTS



APPENDIX 6.8 CLEAR NAVIGATION CHANNEL LIMITS PLAN (JAN 2013)



APPENDIX 6.9 ACCESS POINT MATRIX FOR ALTERNATIVES "I" AND "123"

Direct Access Point	Via	Alt I Yes/No	Lanes	Via	Alt 123 Yes/No	Lanes	Remarks
NB I-75/I-71 Local CD Lanes developed South of KY 12th Street		Y	2			2	
NB Local CD Lanes							
to KY 12th Street	CD Lanes to Local Streets	Y	1 to 4	CD Lanes to Local Streets	Y	1 to 4	
to Pike Street	Local Streets	Y	5	Local Streets	Y	5	
to KY 9th Street	Local Streets	Y	3	Local Streets	Y	3	
to KY 5th Street	Local Streets	Y	2	Local Streets	Y	2	Alt 123 through SPUI configuration.
from KY 12th Street	Local Streets to 2 Slip Ramps	Y	1	Streets to CD over KY 5th Street	Y	2	
from Pike Street	Local Streets to 2 Slip Ramps	Y	1	Streets to CD over KY 5th Street	Y	2	
from KY 9th Street		**N**		Streets to CD over KY 5th Street	Y	1	
from KY 5th Street		**N**		SPUI	Y	1	
from KY 4th Street	Ramp	Y	1	4th Re-Route to SPUI	Y	1	
to OH 2nd Street	Ramp	Y	1	existing ramp	Y	1	
to I-71 NB	Ramp	Y	1		**N**		9th, 4th and 5th Streets in KY do not have *direct* access to I-71 NB. They have access to NB C-D System to I-75 and indirect access to I-71 NB via SB local street grid.
to OH 5th Street	Ramp	Y	1 to 2	Ramp	Y	1 to 2	
to WB OH 6th Street (US 50)	Ramp	Y	1	Ramp	Y	1	
to Winchell Avenue	I-75 NB Ramp	Y	1	Ramp	Y	1	
to NB I-75	I-71 SB/OH 4th Street Ramp	Y	1	Ramp	Y	2	
NB I-71 Lanes only							
from KY 12th Street	Local Streets to Slip Ramp	Y	1	Local Streets to Slip Ramp	Y	1	
from Pike Street	Slip ramp	Y	1	Slip ramp	Y	1	

KEY: Denotes OH side access | Denotes KY side access

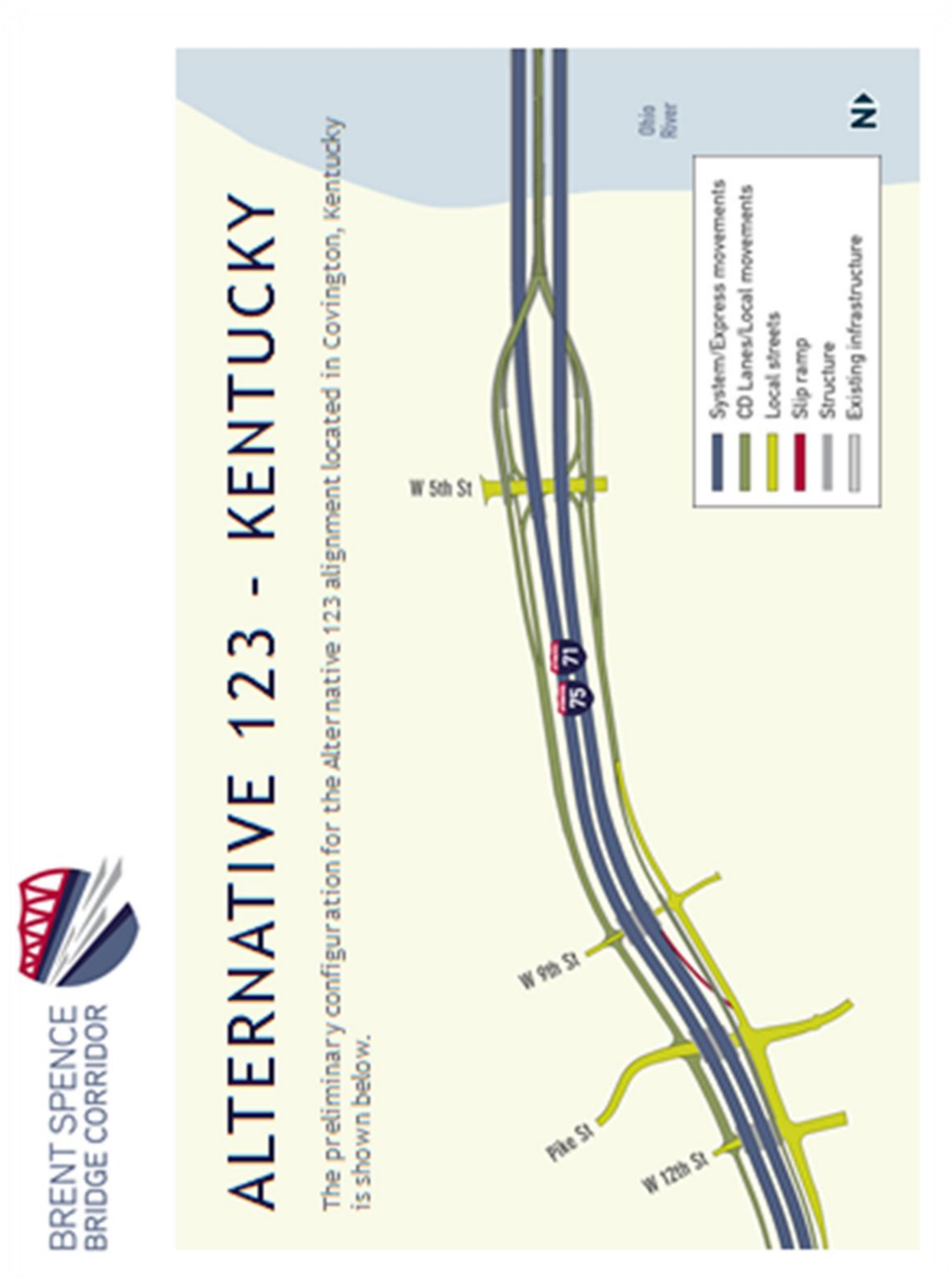
Direct Access Point	Via	Alt I Yes/No	Lanes	Via	Alt 123 Yes/No	Lanes	Remarks
NB I-75 Lanes only							
from 3rd Street/ CW Bailey Bridge	Ramp	Y	1		**N**		Use of existing BSB Approach substructure for NB Local C-D Lanes currently precludes this movement. Said structure could be reconstructed to span this area and possibly allow for connection.
from I-71 SB	System Ramp	Y	1	System Ramp	Y	1	
from OH 4th Street	via I-71 SB System Ramp	Y	2 to 1	I-71 SB System Ramp	Y	2 to 1	
from OH 6th (US 50 WB)	via Winchell Slip Ramp	Y	1	Winchell Slip Ramp	Y	1	
from OH 9th Street	via Winchell Slip Ramp	Y	1	Winchell Slip Ramp	Y	1	
from NB Local CD Lanes	via CD North of Linn	Y	2	CD North of Linn	Y	1	
SB I-75 Local CD Lanes developed South of Ezzard Charles Drive		Y	4		Y	4	
SB Local CD Lanes							
to EB OH 7th Street	Ramp from CD	Y	1	Ramp from CD	Y	1	
to EB OH 5th Street	Ramp from CD	Y	1	Ramp from CD	Y	1	
from Western Avenue	Ramp	Y	1	Ramp	Y	1	
to 3rd Street/ CW Bailey Bridge	Ramp from CD	Y	1		**N**		Use of existing BSB approach substructure for NB Local C-D Lanes currently precludes this movement. Said structure could be reconstructed to span this area and possibly allow for connection.
to EB OH 2nd Street	Ramp from CD	Y	1	Ramp from SB I-75 Through Lanes	Y	1	
from US 50 EB	Ramp	Y	1	Ramp	Y	1	
to 71 NB				Direct Ramp	Y	2	Alt I access through SB I-75 through.
from I-71 SB	Ramp	Y	1	Ramp	Y	1	
from WB OH 3rd Street	Ramp	Y	1	Ramp	Y	1	
to KY 5th Street/ Crescent Avenue	Ramp	Y	1	Ramp via SPUI	Y	1 to 2	
to I-75/I-71 SB	Ramp	Y	2	Local Streets to Ramp	Y	2 to 1	Alt 123 connects South of 12th Street.

KEY: Denotes OH side access | Denotes KY side access

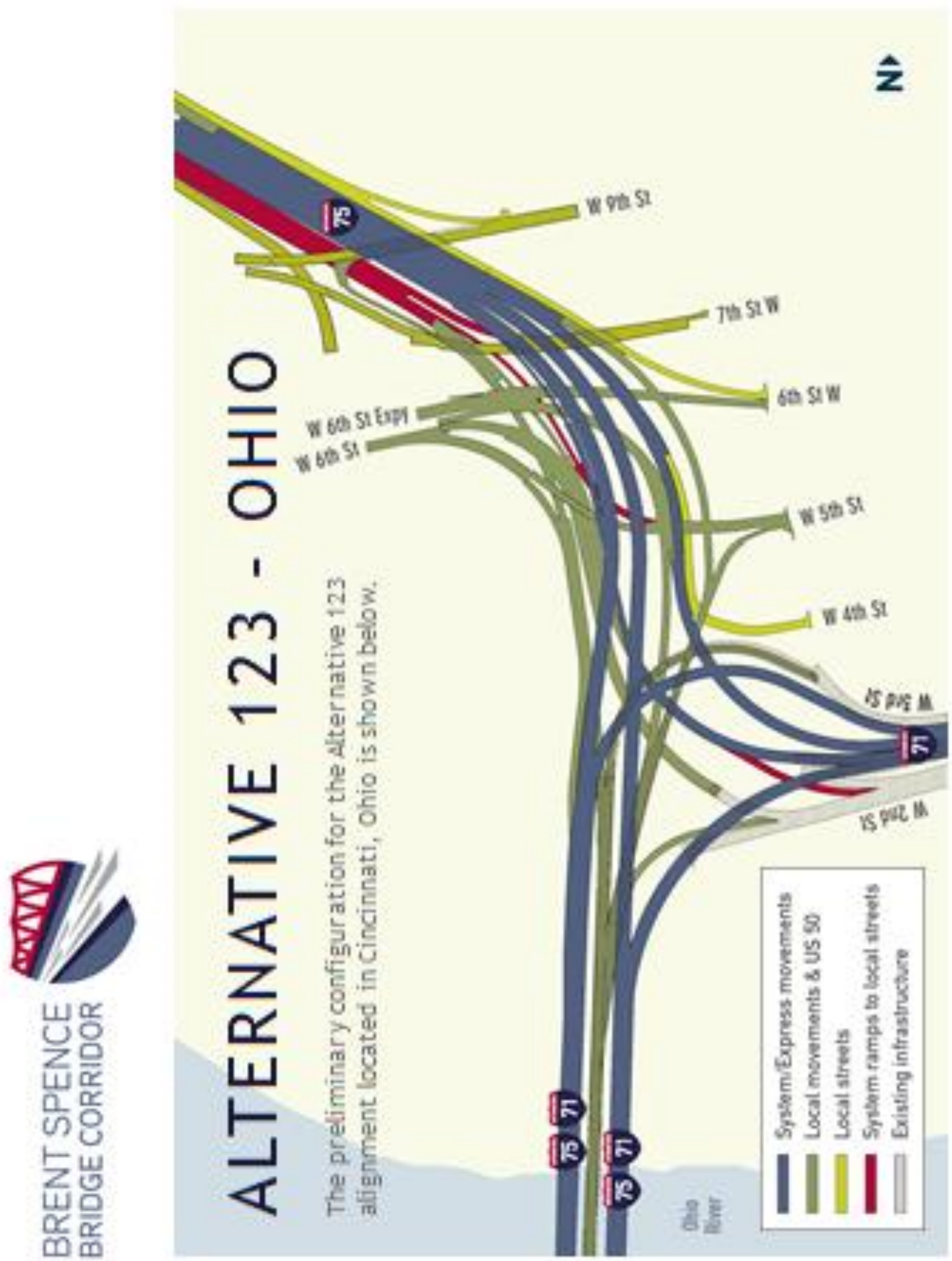
Direct Access Point	Via	Alt I Yes/No	Lanes	Via	Alt 123 Yes/No	Lanes	Remarks
SB Local CD Lanes (continued)							
to 9th Street	Ramp to Local Streets	Y	2 to 1	CD to Local Streets	Y	4 to 3	
to Pike Street	Ramp to Local Streets	Y	2 to 1	Local Streets to Ramp	Y	3	
to 12th Street	Ramp to Local Streets	Y	2 to 1	Local Streets to Ramp	Y	4	
SB I-75 Lanes only							
to I-71 NB	System Ramp	Y	1	System Ramp	Y	2	
from I-71 SB	System Ramp	Y	2	System Ramp	Y	2	
I-75/I-71 SB Lanes Only							
OH SB Local Lanes Merge Point	Ramp on KY side just South of 5th.	Y	2	Ramp on KY side just south of 12th.	Y	1	
from KY 4th Street	Local Streets to Ramp	Y	2	SPUI to Local Streets to Ramp	Y	2	
from KY 5th street		**N**		SPUI to Local Streets to Ramp	Y	1	
from Crescent Avenue	Local Streets to Ramp	Y	1	SPUI to Local Streets to Ramp	Y	1	
from KY 9th Street	Local Streets to Ramp	Y	3 to 1	Local Streets to Ramp	Y	3 to 1	
from Pike Street	Local Streets to Ramp	Y	3 to 1	Local Streets to Ramp	Y	3 to 1	
from KY 12th Street	Local Streets to Ramp	Y	3 to 1	Local Streets to Ramp	Y	4 to 1	
Through Local Movements on KY Side							
12th-Pike-9th-4th/ 5th-Crescent Streets	Local street Network NB & SB	Y	Varies	Local street Network NB & SB	Y	Varies	
WB OH 8th Street	Street Through	Y	2	Street Through	Y	2	
EB 8th Street to EB 7th Street	Street Through	Y	2	Street Through	Y	2	
EB 6th Street to EB 5th Street (US 50)	Street Through	Y	1	Street Through	Y	1	
EB 6th Street (US 50) to EB 2nd Street	Street Through	Y	1	Street Through	Y	1	

KEY: Denotes OH side access | Denotes KY side access

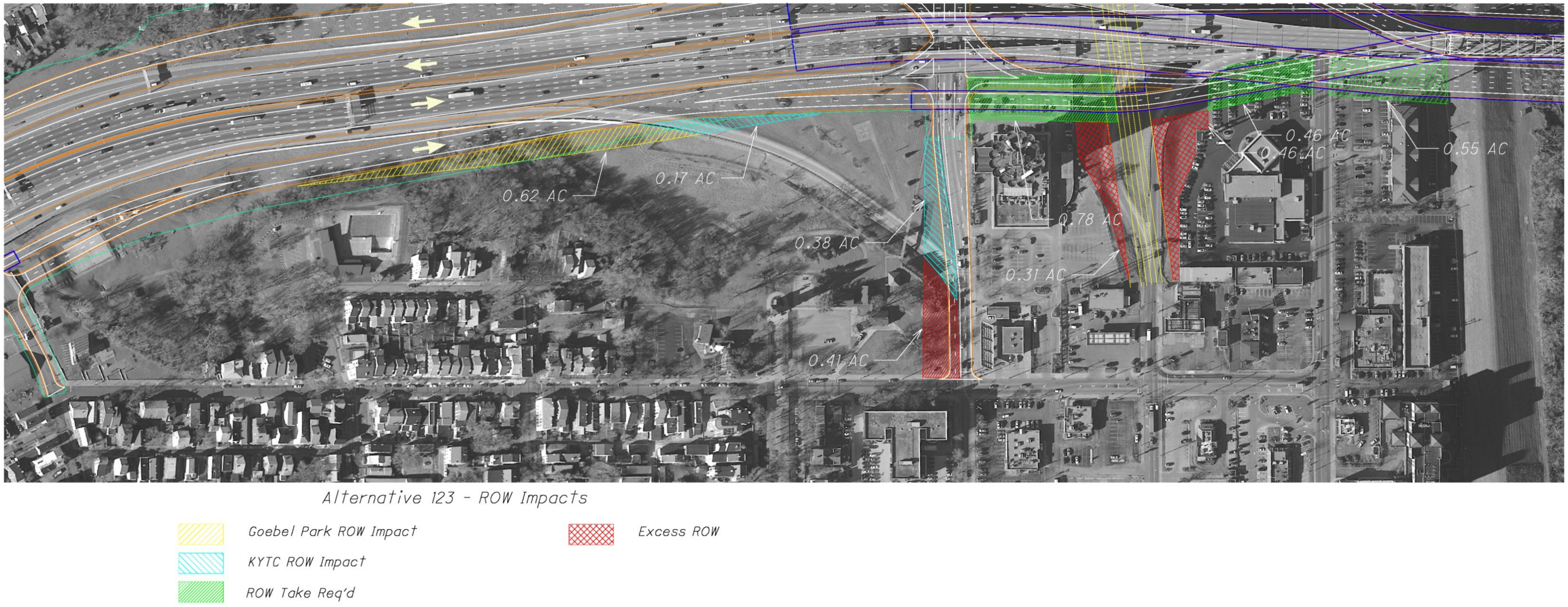
APPENDIX 6.10 ALTERNATIVE "123" – KENTUCKY

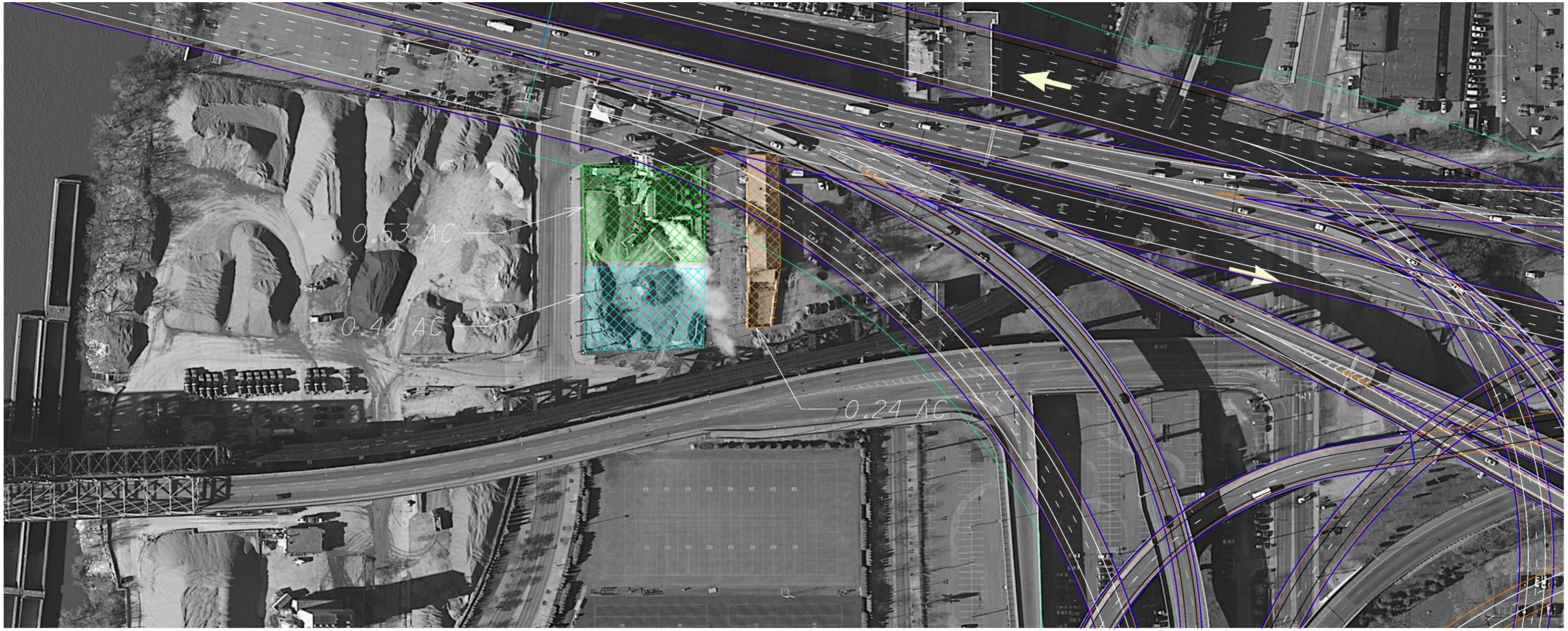


APPENDIX 6.11 ALTERNATIVE "123" – OHIO

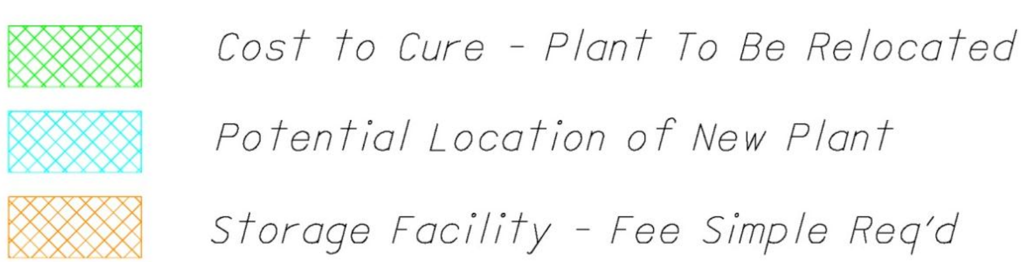


APPENDIX 6.12 ROW IMPACTS OF ALTERNATIVE "123"





Alternative 123 - ROW Impacts



APPENDIX 6.13 COMPARISON OF PROS/CONS OF ALTERNATIVE "I" & "123" ROW IMPACTS

PROS

Alternative 123 | BOTH Alternative 123 & Alternative I | Alternative I

KENTUCKY

Collector-distributor (C-D) system allows more efficient and effective accessibility and movement for local traffic.

Provides direct access to 5th Street from NB I-75/I-71.

Provides direct access to SB I-75/I-71 at 12th Street.

Provides direct access to NB I-75/I-71 at Pike Street.

Provides indirect access via C-D system to 5th, 9th, Pike, and 12th streets from SB I-75.

Provides indirect access via C-D system to 12th, Pike, 9th, and 5th streets from NB I-75/I-71.

Provides direct access from 4th Street to NB local river crossing.

Provides direct access for 9th, 5th and 4th Streets to NB I-71.

RIVER BRIDGES

Increases capacity and improves safety on local and Interstate systems by increasing total number of lanes across the river from 8 (4 lanes combined in each direction) to 16 (5 Interstate and 3 local lanes in each direction).

New single-level tied arch bridges save construction cost and time; eliminate tunnel effect; enhance sign visibility; and are closer to the ground, helping shorten Interstate connections.

Separates local and Interstate traffic, which improves the safety and operations of both systems and is more conducive for tolling.

Simple connections and standard details improve maintenance and inspection work.

OHIO

C-D system allows more efficient and effective accessibility and movement for local traffic.

Provides direct access to 2nd Street from SB I-75.

Provides direct access to Freeman Avenue from SB I-75 and from Freeman Avenue to NB I-75.

Provides indirect access to NB I-75 from 3rd Street.

Existing Ohio approach structures that connect from existing Brent Spence Bridge to numerous local roads can be re-used due to their acceptable condition and geometry to carry local traffic.

Provides indirect access to/from Clay Wade Bailey Bridge to NB/SB I-75.

CONS

Alternative 123 | BOTH Alternative 123 & Alternative I | Alternative I

KENTUCKY

Eliminates direct access to NB I-75 from 12th Street to Ohio River. Access provided by C-D system.

Eliminates direct access to SB I-75 from 9th Street to Ohio River. Access provided by C-D system.

Local access from 4th Street to Ohio River redirected to 5th Street interchange.

More of 5th Street will be reconstructed.

Local access from 4th Street to Ohio River redirected to 5th Street interchange.

More of 5th Street will be reconstructed.

Eliminates direct access from 9th, 5th and 4th Streets to NB I-71.

RIVER BRIDGES

Right-of-way impacts west of the existing Brent Spence Bridge.

Requires additional right of way east of (upstream from) existing Brent Spence Bridge.

Likely requires replacement of two 12" diameter gas distribution lines east of existing Brent Spence Bridge.

The existing Brent Spence Bridge could have an additional 25-50 year service life with reduced traffic and significant rehabilitation. Replacement of the existing BSB would not capitalize on this potential.

Proposed new double-deck River Bridge requires more deck area and median barrier, which costs more to purchase and to maintain over the service life.

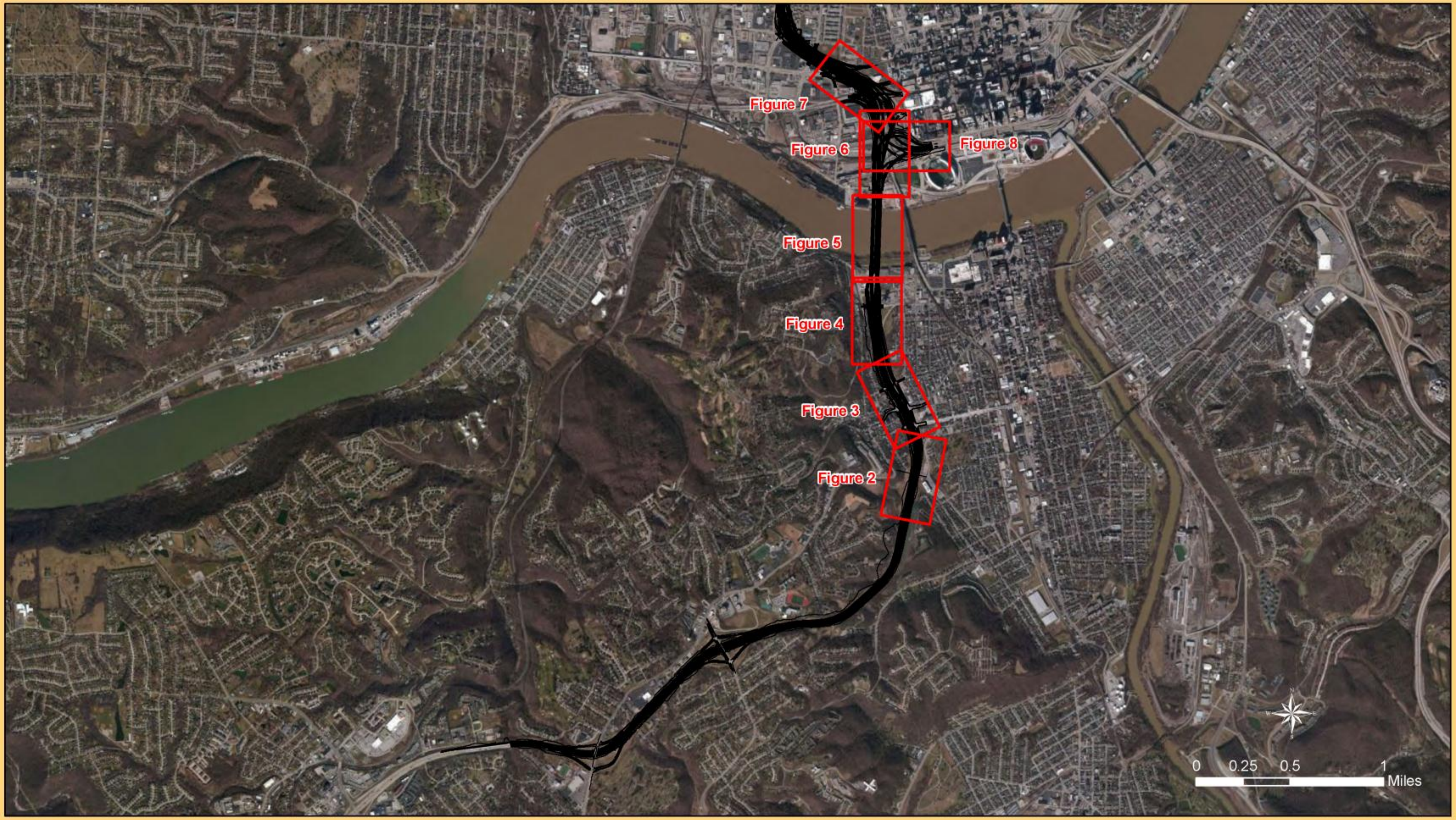
OHIO

Eliminates direct access to NB I-75 from Ohio River to just south of Ezzard Charles Drive. Access provided by C-D system.

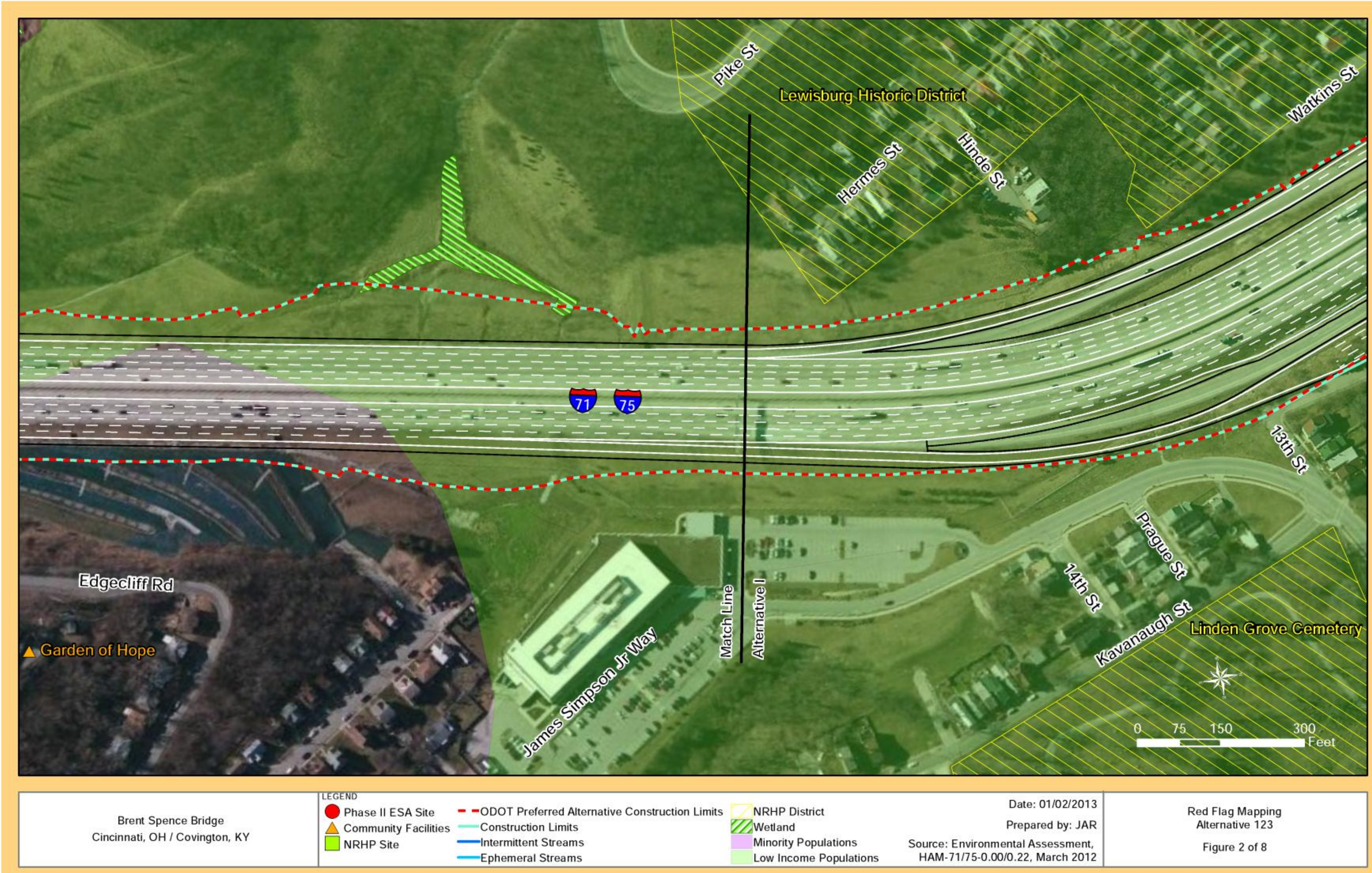
Eliminates direct access to SB I-75 from Western Hills Viaduct to Ohio River. Access provided by C-D system.

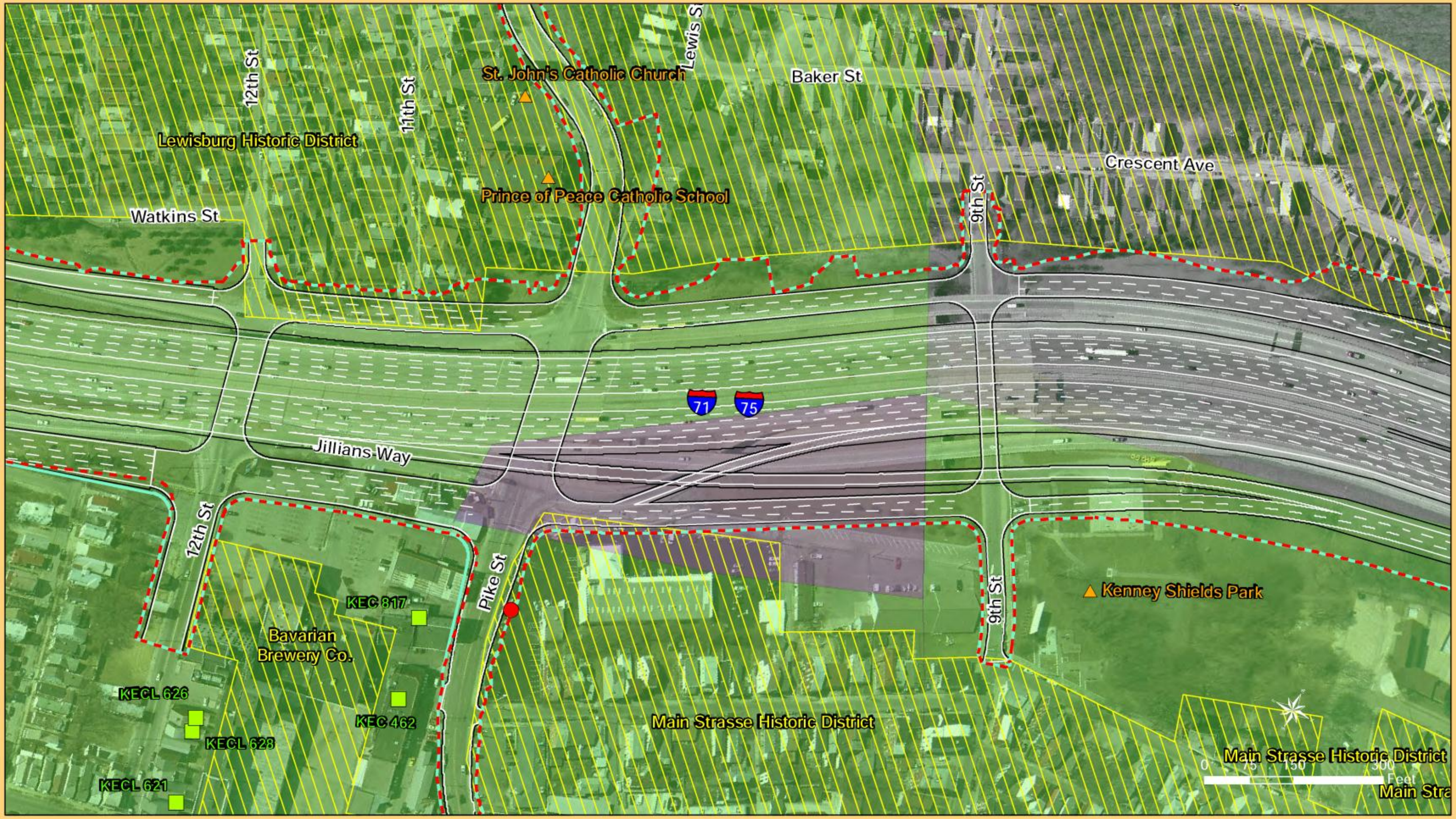
Direct access to/from Clay Wade Bailey Bridge to NB and SB I-75 is not considered feasible due to ramp conflicts.

APPENDIX 6.14 ENVIRONMENTAL RED FLAG MAP FOR ALTERNATIVE "123"



Brent Spence Bridge Cincinnati, OH / Covington, KY	Legend Figure Location Alternative 123	Date: 01/02/2013 Prepared by: JAR Source: Environmental Assessment, HAM-71/75-0.00/0.22, March 2012	Red Flag Mapping Alternative 123 Figure 1 of 8


Pike St
Lewisburg Historic District
Watkins St
Hermes St
Hinde St
71
75
13th St
Prague St
14th St
Kavanaugh St
Linden Grove Cemetery
Edgecliff Rd
Garden of Hope
James Simpson Jr Way
Match Line
Alternative I
0 75 150 300 Feet
Brent Spence Bridge
Cincinnati, OH / Covington, KY
LEGEND
Phase II ESA Site
Community Facilities
NRHP Site
ODOT Preferred Alternative Construction Limits
Construction Limits
Intermittent Streams
Ephemeral Streams
NRHP District
Wetland
Minority Populations
Low Income Populations
Date: 01/02/2013
Prepared by: JAR
Source: Environmental Assessment,
HAM-71/75-0.00/0.22, March 2012
Red Flag Mapping
Alternative 123
Figure 2 of 8



Brent Spence Bridge Cincinnati, OH / Covington, KY	LEGEND Phase II ESA Site Community Facilities NRHP Site ODOT Preferred Alternative Construction Limits Construction Limits Intermittent Streams Ephemeral Streams NRHP District Wetland Minority Populations Low Income Populations	Date: 01/02/2013 Prepared by: JAR Source: Environmental Assessment, HAM-71/75-0.00/0.22, March 2012	Red Flag Mapping Alternative 123 Figure 3 of 8

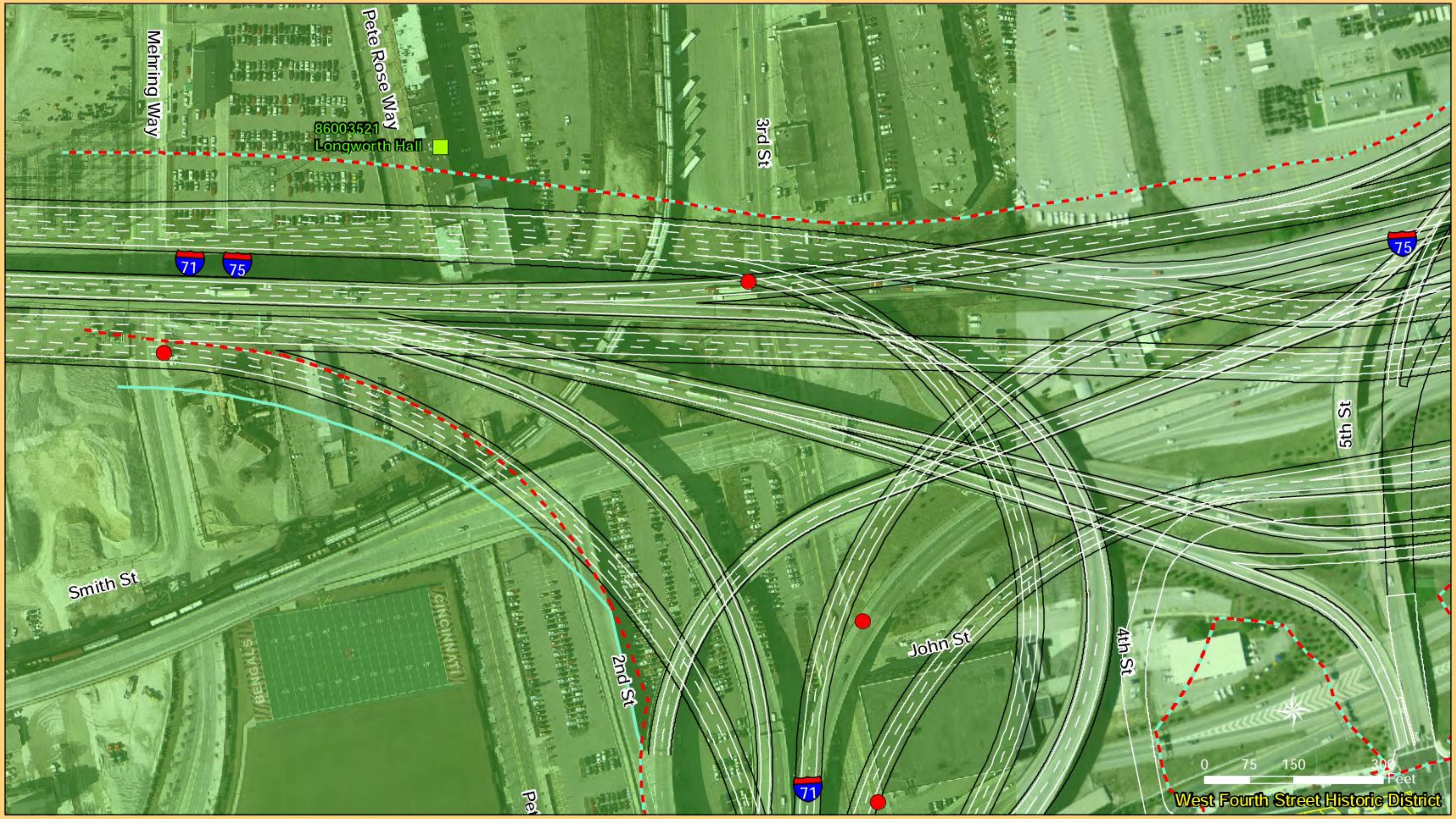
Brent Spence Bridge Cincinnati, OH / Covington, KY	LEGEND Phase II ESA Site Community Facilities NRHP Site	ODOT Preferred Alternative Construction Limits Construction Limits Intermittent Streams Ephemeral Streams	NRHP District Wetland Minority Populations Low Income Populations	Date: 01/02/2013 Prepared by: JAR Source: Environmental Assessment, HAM-71/75-0.00/0.22, March 2012	Red Flag Mapping Alternative 123 Figure 4 of 8

Brent Spence Bridge
Cincinnati, OH / Covington, KY

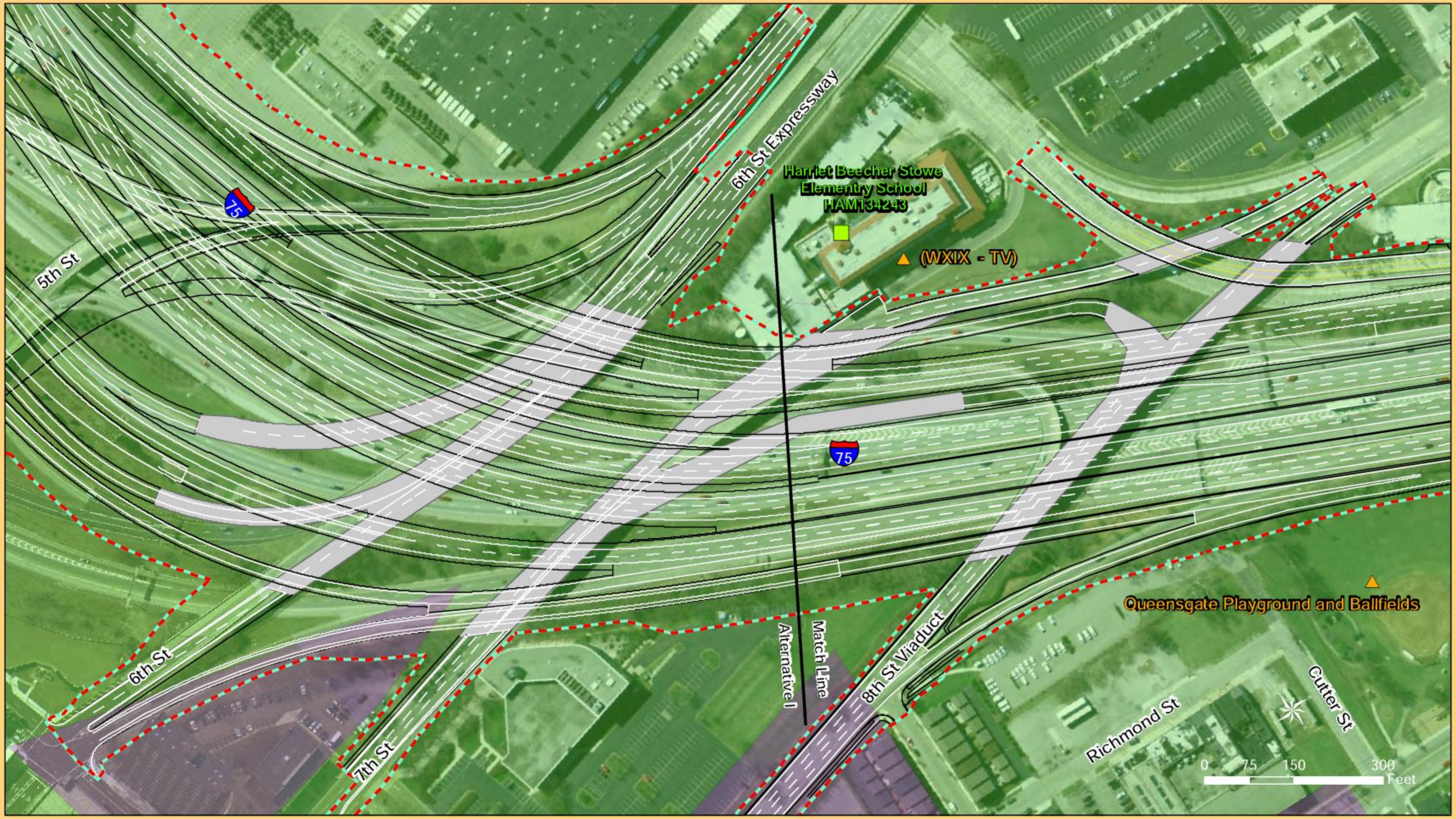
LEGEND
- Phase II ESA Site
- Community Facilities
- NRHP Site
- ODOT Preferred Alternative Construction Limits
- Construction Limits
- Intermittent Streams
- Ephemeral Streams
- NRHP District
- Wetland
- Minority Populations
- Low Income Populations

Date: 01/02/2013
Prepared by: JAR
Source: Environmental Assessment, HAM-71/75-0.00/0.22, March 2012

Red Flag Mapping
Alternative 123
Figure 5 of 8



Brent Spence Bridge Cincinnati, OH / Covington, KY	LEGEND Phase II ESA Site Community Facilities NRHP Site	ODOT Preferred Alternative Construction Limits Construction Limits Intermittent Streams Ephemeral Streams	NRHP District Wetland Minority Populations Low Income Populations	Date: 01/02/2013 Prepared by: JAR Source: Environmental Assessment, HAM-71/75-0.00/0.22, March 2012	Red Flag Mapping Alternative 123 Figure 6 of 8



Brent Spence Bridge
Cincinnati, OH / Covington, KY

LEGEND
- Phase II ESA Site
- Community Facilities
- NRHP Site
- ODOT Preferred Alternative Construction Limits
- Construction Limits
- Intermittent Streams
- Ephemeral Streams
- NRHP District
- Wetland
- Minority Populations
- Low Income Populations

Date: 01/02/2013
Prepared by: JAR
Source: Environmental Assessment,
HAM-71/75-0.00/0.22, March 2012

Red Flag Mapping
Alternative 123
Figure 7 of 8