FINAL DRAFT REPORT
The Feasibility and Constructability Study of the Replacement/Rehabilitation of the Brent Spence Bridge

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I. BACKGROUND

The Feasibility and Constructability Study of the Replacement/Rehabilitation of the Brent Spence Bridge (the Study), contracted in 2003 by the Kentucky Transportation Cabinet (KYTC), was overseen by a Bi-State Management Team (BSMT) that included the Ohio Department of Transportation (ODOT), and the Federal Highway Administration's (FHWA) offices from both states.

The Brent Spence Bridge carries both Interstate 71 and Interstate 75 (I-71 and I-75)over the Ohio River and is a vital link of the interstate, regional, and local transportation system. It opened to traffic in 1963 and was designed to carry three 12-foot travel lanes on two decks in each direction. The northbound traffic is carried on the lower deck and the southbound traffic is carried on the upper deck. To accommodate increasing traffic levels, the lane configuration of the bridge was modified in 1985 to provide four 11-foot travel lanes in each directing. The re-configuration provides only minimal shoulders on the left and right sides.

The bridge currently operates at Level of Service F during peak travel periods. High traffic volumes and substandard design have resulted in a very high accident rate on the bridge and approaches. The total accident rate on the bridge is 8.5 times the Kentucky interstate rate.

Based on FHWA criteria for the National Bridge Inventory, the bridge is classified as functionally obsolete. This rating is due primarily to the substandard width of the lanes and shoulders which are below the minimums acceptable for interstate highways. A Bridge Condition Report completed in 1996 concluded that the calculated remaining fatigue life was less than 12 years.

The genesis of this Study was two Major Investment Studies (MIS) commissioned by the Ohio – Kentucky – Indiana Regional Council of Governments (OKI) for the I-71 and I-75 corridors. A Scoping Study to address problems with the bridge was conducted by Burgess & Niple, Ltd. (B&N) and supported by subconsultant American Consulting Engineers, PLC (American) in 1998. This was a part of a larger major investment study for the I-71 corridor from the Cincinnati/Northern Kentucky International Airport to Kings Island. The scope of service included exploration of various strategies and analysis of the fatigue life. A series of alternatives was developed including No-Build, Rehabilitation, and various Build Alternatives. Alternatives were evaluated by a local stakeholder committee.

A second analysis of the remaining fatigue life was done as an addendum for the study. Both analyses were calculated using the procedures in the AASHTO *Guide Specification for Fatigue Evaluation of Steel Bridges*. The addendum, as provided for in the Guide Specifications, calculated the remaining fatigue life as 16 years using a procedure put forth in a Transportation Research Board report

(*Fatigue Evaluation Procedures for Steel Bridges* – National Cooperative Highway Research Program Report 299 dated 1987).

A subsequent MIS for the I-75 corridor from Piqua, Ohio to the I-71/I-75 interchange in northern Kentucky known as the North South Transportation Initiative (NSTI) commenced in 2001. An early strategy resulting from this MIS process was the advancement of a replacement/rehabilitation analysis of the Brent Spence Bridge under KYTC and ODOT guidance. Because limited engineering was performed in the MISs and the complex urban setting of the project, KYTC and ODOT decided to explore the feasibility and constructability of this project prior to embarking into a potentially expensive and arduous National Environmental Protection Act (NEPA) and Preliminary Engineering (PE) process. A Congressional appropriation was secured in 2002 for the Study. After a qualification-based selection process the B&N/American/Parsons team was authorized to commence work on a 30 month Feasibility and Constructability Study of the Replacement/Rehabilitation of the Brent Spence Bridge in May 2003.

The scope of the Study included:

- Limited analysis of restricting trucks on the bridge
- Limited analysis of a new crossing near Anderson Ferry
- Field testing critical truss members to determine fatigue life
- Development of the replacement/rehabilitation concepts for five and seven lane crossings

Analysis of restricting trucks on the bridge yielded the conclusion that this concept was not a viable alternative worth developing because of unfavorable regional implications on a number of travel corridors and increased users' cost.

Analysis of a new crossing linking I-275 to U.S. 50 at Anderson Ferry concluded that a new crossing was not a viable alternative worth developing because of the limited number of trips it diverted from the Brent Spence Bridge.

The field testing of critical truss members to determine fatigue life yielded the conclusion that the previous calculations did not reflect what these members were actually experiencing and that they have infinite fatigue life. This task was undertaken concurrent with the development of replacement/rehabilitation concepts for the bridge.

The development of replacement/rehabilitation concepts to accommodate initially five lanes of traffic in each direction began with the identification of parameters that included: avoidance of environmental red flags, maintenance of traffic, keeping access to Cincinnati and Covington, and additional engineering criteria. Upon the completion of the environmental red flag mapping task six feasible concepts were identified that met the parameters. Upon review with the BSMT

team one concept was dropped due to large community impacts and perceived high cost of construction. Based on an initial review of traffic projections the BSMT requested the investigation of seven lanes in each direction using the same conceptual alignments. All five replacement/rehabilitation concepts with some modification proved feasible. They range in cost from $901 million to $1.555 billion.

Because the feasibility question was answered early in the Study and given continuing regional support for the project, the BSMT elected to accelerate completion of the feasibility study and advance into the official NEPA and PE process.

II. PROBLEM STATEMENT

At the outset of the Study, a problem statement was drafted, reviewed, and commented on by the BSMT and revised accordingly (June 2003). The following narrative was the statement developed to guide the Study.

The Brent Spence Bridge (BSB), opened in 1963, carries two interstate highways (I-75 and I-71) over the Ohio River between Cincinnati, Ohio and Covington, Kentucky. I-75 is one of the nation's busiest north-south interstate routes, beginning in Miami/Dade County, Florida and extending northward through Detroit, Michigan where it connects with Canadian Highway 401, a major highway linking Detroit with Toronto and Montreal. The highway serves as one of the busiest and longest continuous interstate trade corridors in North America. I-71 begins in Louisville, Kentucky, where it connects to I-64 (which runs to the west to St. Louis, Missouri) and I-65 (terminating at Mobile, Alabama), and continues northeast to Cincinnati, Columbus, and Cleveland. I-71 and I-75 share the same alignment for approximately 18 miles in Northern Kentucky, including the BSB.

The double-deck truss structure originally was designed for three 12-foot traffic lanes in both directions. In 1985, in response to increasing traffic and congestion, the shoulders were eliminated and the lanes were narrowed to create a fourth lane. This effectively increased capacity 25 percent to 100,000 vehicles per day (VPD). However, the lane widths do not meet desired standards and the lack of shoulders does not provide space for disabled vehicles.

Today, traffic totals approximately 150,000 VPD, which includes upwards of 30,000 trucks. Traffic projections indicate the bridge will be carrying approximately 200,000 VPD in 20 years. The bridge currently operates at Level of Service F during peak hours. Thus, the length of delays while traveling I-71 and I-75 across the river will continue to worsen. Since these freeways carry national, regional, and local traffic, the increasing congestion will also cause negative economic consequences.

With the increasing traffic demands, especially truck freight caused by the "just-in-time" method of production, there are concerns relating to the structure's condition. In 1996, an analysis of the bridge's theoretical fatigue life indicated a remaining useful fatigue life of 12 to 16 years. The National Bridge Inventory listed the BSB as functionally obsolete. A central concern of any rehabilitation strategy would be the issue of increased life versus the capacity of the facility (both during the rehabilitation and afterward).

The latest analysis of accidents occurring on the bridge is also a cause of concern. For the period between January 1992 and October 1997, the accident rates for both injuries/fatalities and property damage only accidents were 954.4 accidents per 100 millions of vehicles miles of travel (MVMT). This is in comparison to the 112 accidents per MVMT for Kentucky's interstates. Thus, any reconstruction/ replacement of the BSB should minimize any geometric design exceptions relating to speed, lane/shoulder width, merge/taper rates, etc.

This Study is undertaken to answer the following questions:

- Is it feasible to replace the Brent Spence Bridge at or near its existing location?
- Can the existing Brent Spence Bridge be rehabilitated to provide additional service life and/or capacity?
- How could traffic be maintained while the I-71/I-75 Brent Spence Bridge is being replaced or rehabilitated?
- What are the limits of the approach work under various replacement/rehabilitation scenarios?
- What are the costs of the various rehabilitation or replacement scenarios and the associated approach work?
- Are there any environmental "fatal flaws" that preclude certain options from advancing?
- What are the type, size, location and costs of recommended alternatives?

III. CONSIDERATIONS AND OBJECTIVES

In addition to the 1998 Scoping Study and subsequent problem statement, the following considerations and objectives guided the development of concepts:

- Avoiding potential environmental "Fatal Flaws"
  - Potentially lengthy time to resolve disposition of Longworth Hall
  - UST/HazMat likely will be an issue since the project is located in major urban area
- Maintenance of traffic

- Relative costs (i.e. High, Moderate, Low)
- Operations
- Access to Cincinnati and Covington
- Impacts on existing buildings
- Utility impacts
- Minimize design exceptions
- Eliminate left-hand exits
- Minimize weaves
- Five through lanes with full shoulders

IV. TRUCK DIVERSION STUDY

The original scope for the Study included a separate Truck Diversion Study to evaluate the traffic impacts and costs of prohibiting all through trucks on the Brent Spence Bridge. The Ohio-Kentucky-Indiana Regional Council of Governments' (OKI) 2030 Travel Demand Model and the ITS Deployment Analysis System (IDAS) software were used to perform the analyses.

The Study methodology was an iterative process that, as each model run was made, the data was reviewed to determine if the truck shift would create additional unacceptable problems. The scenarios modeled were as follows:

- Initially, trucks were prohibited on only the Brent Spence Bridge. Using this scenario, approximately 86 percent of the trucks that had been using Brent Spence switched to using the Clay Wade Bailey Bridge. The remaining 14 percent dispersed among the other Ohio River bridges.
- Next, truck trips were prohibited from using both the Brent Spence and Clay Wade Bailey bridges. This shifted slightly less than 44,000, or 97 percent, of the Brent Spence and Clay Wade Bailey truck trips onto the Roebling Suspension Bridge.
- In the third iteration, trucks were prohibited from the Brent Spence, Clay Wade Bailey, and Roebling Suspension bridges. Truck trips again shifted to the next Ohio River crossings. In this scenario, the Taylor Southgate Bridge carried 74 percent, or 35,000 truck trips and I-471 had an additional 9,900 truck trips, or 21 percent, of what had originally been crossing the Ohio River on one of the three prohibited bridges.
- At this point, it appeared that trucks were using the Taylor Southgate Bridge to cross the Ohio River and then the $4^{th}/5^{th}$ Street and 12^{th} Street bridges in Kentucky to cross the Licking River. Trucks were prohibited from using the Taylor Southgate Bridge in addition to the three that were already prohibited. The 35,000 truck trips went to the Interstate bridges (I-471, Combs-Hehl, and I-275 West), eliminating problems on the Ohio River bridges but barely affecting the two Licking River bridges.

- Since prohibiting the trucks on the Taylor Southgate Bridge still created problems for the two Licking River bridges, truck trips were then prohibited from the 4th/5th Street Bridge and the 12th Street Bridge and allowed access to Taylor Southgate.

The final numbers and prohibitions used in the Study were compared to the 2030 Base in the Truck Diversion Study documentation. (See Appendix B)

To calculate costs, the trip tables were imported into the IDAS software and runs were completed for the 2030 Base and truck diversion alternatives. IDAS outputs provided information concerning in-vehicle travel time, travel time reliability, fuel consumption, and number of accidents. The results are incorporated in Appendix B.

The conclusions that can be reached from this Study are: 1) the issue of banning trucks from the Brent Spence Bridge has regional implications on a number of travel corridors, and; 2) such prohibitions will increase costs to the users.

The banning of trucks on the Brent Spence Bridge will move existing truck traffic to the adjacent bridges which will affect the vehicular traffic already using those bridges. The banning of trucks will require enforcement that will be hard to maintain. The removal of truck traffic will have a short-term reduction in vehicles on the Brent Spence Bridge, but by the year 2030 the non-truck traffic volumes will exceed the current total traffic volume if the percent of trucks remains constant at 20 percent of the total traffic. The removal of the trucks will not address the problems identified for lane width, number of lanes based on traffic volumes, no shoulders, the ramp configuration, and the bridge's useful life. As the number of vehicles increases the safety issues will continue. Therefore the BSMT concluded that this option was feasible, but not a prudent solution because it did not address volume, safety, and bridge condition issues.

V. ANDERSON FERRY CROSSING

The purpose of this work element was to perform a preliminary study of a new Ohio River crossing approximately six miles west of the existing Brent Spence Bridge and near the Cincinnati/Northern Kentucky International Airport (CVG). The Study was to evaluate traffic ramifications and construction costs of the potential new transportation facility.

Two alternative alignments were studied—one that connected near to the KY 3076 (Mineola Pike) interchange with I-275 east of CVG and one that connected to the KY 212 interchange (CVG Interchange) with I-275. Both alignments terminated at the same location on U.S. 50 just west of Anderson Ferry and included an interchange with U.S. 50. The estimated construction cost of the

alternatives (not including any right of way or utility relocations) ranged from $80 million to $95 million.

The traffic impacts were determined by utilizing the OKI 2030 transportation model to compare a 2030 network that was modified to include a new crossing with the results of the 2030 baseline model. The results show that by 2030, the Anderson Ferry crossing would carry slightly more than 35,000 vehicles trips in a 24-hour period, diverting only 16,000 vehicle trips from the Brent Spence Bridge. Of the total vehicle trips on the new crossing, 4,000 were truck trips with half of that amount diverting from the Brent Spence Bridge. As with the truck safety study, the new bridge to the west will divert only a portion of the traffic necessary to allow the Brent Spence Bridge to handle traffic based on its current configuration. The safety, geometrics, and the bridge's useful life will not be addressed by construction of a new bridge 6 miles to the west. With the model predicting most traffic on the Brent Spence Bridge is national and regional, the new bridge does not address the through interstate traffic volume.

It was concluded by the BSMT that this option while feasible did not address the Brent Spence Bridge problems. Appendix C contains the Anderson Ferry Study.

VI. LOAD RATING AND FATIGUE STUDY

A critical element of the Study was to perform a load capacity rating and fatigue life analysis of the main truss members of the bridge. The bridge was designed in 1961 and erection was completed in 1963. The truss and approach structures originally were configured to carry six lanes of traffic which was changed in 1985 when the Kentucky approach spans were widened and the roadway reconfigured to carry an additional lane of traffic on both decks. Some truss members were also strengthened based on a structural rating and fatigue analysis performed in 1983. This analysis was performed in accordance with the fatigue specification applying to new bridges and was prior to the 1990 issuance of the *AASHTO Guide Specification for Fatigue Evaluations of Existing Steel Bridges*.

The 1983 analysis indicated that six truss members in each anchor span (24 total due to symmetry) had the highest live load-stress ranges and, using the methodology available at the time, exceeded the allowable stress ranges for riveted members. It was recommended that these members be closely inspected and that the rivets in one member be replaced with high-strength bolts. The rivets were replaced with bolts in 1985. This member was also instrumented with strain gages with results reported in early 1985. The results of the instrumentation were considered inconclusive due to equipment problems during field measurement.

In light of the above factors and concerns about the remaining fatigue life of the structure, a load capacity rating and fatigue life analysis was performed from

March 2004 to June 2004. (During this period the development of the alternatives described below continued.) Using the mathematical model for load capacity rating, truss members with the highest stress ranges were identified. The electronic strain gages were installed on these members and calibration load tests were preformed using two trucks of known weight while the bridge was closed to other traffic. Strain gage readings were then collected for a two-week period under normal traffic conditions.

The results of the load rating indicated that the primary truss members are suitable for safely carrying four lanes of HS 20-44 (i.e. 72,000 pound truck) loading on each deck. Results of the instrumentation and fatigue analysis indicate that the primary truss members have an infinite fatigue life. The full report can be found in Appendix E.

VII. DESCRIPTIONS OF CONCEPTUAL ALTERNATIVES

The following is a description of each conceptual alternative studied.

The alternatives were initially developed during a day-long workshop including personnel from the BSMT and consultant team (See Appendix F). Alternative 3 (New West and New Interchange) was dropped by the BSMT from further consideration after initial development because of its potential impacts, costs, and its failure to address the problem statement and parameters developed for the Study. A cursory review indicated that maintenance of traffic, impacts to existing buildings, and its relative costs were substantially greater than the other alternatives. Additionally, this concept presents greater potential impacts associated with hazardous materials sites, wetlands, low-income housing, and community cohesion in the historic neighborhood of Lewisburg in Covington, Kentucky. The schematics of the five alternatives developed for the Study are located in Appendix F.

The initial conceptual alternatives were developed to carry five lanes of traffic in both directions across the river. Satisfied that these concepts were possible and after reviewing the initial 2030 traffic being developed during the late summer of 2004, KYTC and ODOT decided to expedite the completion of the study and to explore seven lanes in both directions. The initial alternatives were adjusted accordingly and are described in the following narrative.

The descriptions of the conceptual alternatives also include a discussion of the strategy for the maintenance of traffic (MOT). The following guiding principals were used when developing conceptual MOT strategies for each alternative. Mainline interstate highway and auxiliary road (ramp) traffic flow will be maintained using the following general steps:

- Build all proposed driving lane pavements (with supporting structure or grade and drain construction) which lie outside the boundaries of the existing roadway pavement and shoulder area.
- By using transitional pavement links, which could be either proposed improvements or temporary construction, connect most or all of the driving lane surfaces of the existing pavements to the newly constructed proposed roadway pavements. These transitional links, if temporary, should occupy area not in conflict with proposed improvement areas remaining to be constructed.
- Divert traffic from the "existing pavement to remain" to the improvements outlined in step one via the transitional links.
- Construct permanent pavement and other proposed improvements in the general area of the transitional links.
- Reroute traffic to the newly completed permanent roadway pavement portion of the improvements in the area of the transitional links.
- Remove the remaining transitional links and complete the construction of any remaining roadway construction items that lie outside of the permanent roadway pavement.

Alternate No. 1 Rehab + I-75 West

The preliminary concept known as "Rehab + I-75 West" consists of the construction of new approach bridges and a 1,800+/- foot-long span bridge across the Ohio River located from 700 to 900 feet west of the existing Brent Spence Bridge. The existing Brent Spence Bridge would also be structurally rehabilitated and reconfigured to facilitate only residual local traffic and I-71 through traffic via Fort Washington Way. The numbers of traffic lanes on the rehabilitated bridge would be reduced from the four lanes currently in service. The rehabilitated Brent Spence Bridge would also maintain the connections required to indirectly accommodate through I-75 traffic north and south bound across the Ohio River.

The new bridge and roadway would be sized adequately to carry I-75 through traffic and connected, without constrictions, to the existing I-75/I-71 roadway near 12th Street in Kentucky and Liberty Street in Ohio. Local connection infrastructure to surface streets on both sides of the river would be maintained; however, I-75 through traffic volumes would be absent from the traffic volume currently experienced at these local connection areas. The existing southern approaches to the proposed bridge would be widened to allow for seven lanes in each direction with full shoulders on either side. Five lanes would carry I-75 traffic across the proposed bridge and two lanes would continue to carry I-71 and local traffic across on the existing Brent Spence Bridge.

Alternate 1 generally leaves the existing facility in place and provides an alternative for I-75 traffic to avoid the existing Ohio River crossing and the

southern-most access points to Cincinnati. The relocated I-75 crosses west of the existing bridge and ties in with I-75 just north of Ezzard Charles Drive in Ohio.

The confined nature of the existing facility, when combined with the additional lanes provided by Alternate 1, affects the ability to keep all existing ramp movements open for the ultimate configuration.

In Ohio, the southbound exit ramp to Gest Street, in the vicinity of Ezzard Charles Drive would be closed. This impact, however, may be mitigated by widening the exit ramp to Western Avenue, just north of Ezzard Charles Drive. Additionally, some intersection re-configuration may be justified to connect Western Avenue and Freeman Avenue at Gest Street, since this ramp is the southbound I-75 connection to U.S. 50.

Also in Ohio, the existing Freeman Avenue to northbound I-75/Winchell Avenue ramp would be closed with Alternate 1; however, this movement would be maintained by constructing a new ramp from Freeman Avenue

The last closure anticipated by Alternate 1 is related to subdivision impact, just south of 12th Street in Kentucky. An existing alley that fronts the interstate would be impacted by a relocated ramp and would be relocated or closed.

In order to construct Alternate 1, some traffic movements would be impacted during various construction phases. Many movements would suffer short-term impacts required for setting overpass bridge beams; however, the only long-term impact would affect Crescent Avenue in Kentucky. It would be closed to allow reconstruction at a lower grade.

In Ohio, reconstruction of the Freeman Avenue to northbound I-75/Winchell Avenue tie-in (relocated northbound I-75 would pass through the area) would probably require a shorter term closure.

The position of Alternate 1, being relocated from the existing facility, minimizes traffic impacts during construction. The majority of the facility, including most of the bridges, could be constructed while traffic remains in the existing configuration.

In Kentucky, the northbound exit ramp to 12th Street and the connector to Pike Street would be constructed to allow room for the new northbound I-75 construction. The southbound side, similarly, requires the southbound exit to Pike Street, the connector to 12th Street and the southbound entrance ramp to I-75 be completed prior to other southbound construction.

The remaining I-71/I-75 construction could be accomplished with minimal impact. A lane reduction would probably be required to complete the tie-ins.

In Ohio, reconstruction of the dual Ezzard Charles Drive bridges over I-75 must be reconstructed early in the process. Traffic could be maintained either by reconstructing both bridges part-width, or by shifting two-way traffic to either bridge, while replacing the other. That construction could accompany any widening of the southbound exit ramp to Western Avenue and other modifications of the local street network in the area.

With the preliminary construction accomplished, the tie-ins would be completed. The Freeman Avenue to northbound I-75/Winchell Avenue area could be phase constructed to minimize traffic disruption. The I-75 tie-ins would probably require a reduction in travel lanes to allow for completion.

Alternate No. 2 New East + I-75 West

The concept known as "New East + I-75 West" consists of the construction of new approach bridges and a 1,800+/- foot long span bridge across the Ohio River located from 700 to 900 feet west of the existing Brent Spence Bridge. The existing Brent Spence Bridge would be replaced with a new structure able to facilitate the residual local traffic and I-71 through traffic via Fort Washington Way. This new long span replacement structure for the Brent Spence Bridge would be approximately 1600 feet long located immediately east of the existing bridge. The number of traffic lanes on the New East Bridge could be less than the four lanes currently in service on the Brent Spence.

The New East Bridge would also maintain the connections required to indirectly accommodate through I-75 traffic north and south bound across the Ohio River. Surface street connections on the Kentucky side would have to be rebuilt and the approach roadway structures located at either end of the New East Bridge would have to be modified to suit the shifted alignment. The new I-75 West Bridge and roadway would be sized adequately to carry I-75 through traffic and connected, without constrictions, to the existing I-75/I-71 roadway near 12th Street in Kentucky and Liberty Street in Ohio. Local connection infrastructure to surface streets on both sides of the river, although rebuilt on the Kentucky side, would be maintained; however, I-75 through traffic volumes would be absent from the traffic volume currently experienced at these local connection areas. The existing southern approaches to the bridges would be widened to allow for seven lanes in each direction with full shoulders on either side. Just south of the proposed bridges, the roadway would split into five lanes carrying I-75 traffic across the west bridge and a minimum of two lanes carrying I-71 and local traffic across the east bridge.

Alternate 2 could be described as Alternate 1 "plus." It provides the same relocated I-75, to the west as Alternate 1, but also includes replacement of the

Brent Spence Bridge. The replacement bridge is to the east of the existing and would re-connect to the existing ramps.

The only ultimate closures required for Alternate 2 are the same as noted for Alternate 1. They are repeated below.

The temporary closures noted for Alternate 1 will also apply to Alternate 2. An additional temporary closure that applies to Alternate 2 is expected for the southbound I-71 connection to 5th Street in Covington. While the southbound I-75 (through downtown Cincinnati) exiting traffic could be maintained from the existing Brent Spence Bridge, the I-71 traffic cannot. The closure would be required during removal of the existing approach structure and construction of a new bridge to connect southbound I-71 to the existing ramp. The southbound I-71 exit to Pike Street should remain open.

The Alternate 2 construction phasing is based on the likely circumstance of the Alternate 1 portion being constructed first. The two facilities can be constructed independently, but construction of the Alternate 1 portion first would minimize the traffic volumes on the existing facility. This reduction in traffic volume would improve the maintenance of traffic for replacement of the Brent Spence Bridge.

The phasing required for the I-75 portion of Alternate 2 would be as discussed for Alternate 1, except for that work required for the replacement of the Brent Spence Bridge.

The new bridge is to be constructed on the east side of the existing bridge, and ramps re-connected with the minimum modification possible. Construction would begin with the eastern-most lanes on the northbound side, and proceed westward until the southbound tie-ins are completed.

Alternate No. 3 New West + New Interchange (Dropped from further consideration)

The concept known as “New West + New Interchange” consists of the construction of new approach bridges and a 1,800+/- foot-long span bridge across the Ohio River. The new bridge would be located from 700 to 900 feet west of the existing Brent Spence Bridge. The existing Brent Spence Bridge, and its attendant approach bridges and access ramps would be removed.

The number of traffic lanes on the “New West” bridge would probably be five lanes north bound and five lanes south bound, in order to carry I-75, I-71, and local traffic across the river. Immediately north of the northern end of the bridge, a directional split would carry I-71 traffic over and eastward to a connection to I-71 via Fort Washington Way. The New West Bridge would also require new

surface street connections (ramps). Surface street connections on the Kentucky side would have to be built generally in the same configuration as what currently exists. The approach roadway structures located at either end of the New West Bridge would be removed.

Local connection infrastructure to surface streets on the Ohio side would be replaced using a massive interchange located on the "New West" alignment in the Queensgate area approximately 2,500 to 4,500 feet north of the riverbank. This interchange would replace many of the existing local access connections along I-75 from the western end of Fort Washington Way to the Freeman Avenue overpass. The existing I-75 freeway, ramp, and overpass area would be abandoned and allowed to change to other uses. The existing freeway approaches to the project area would be widened to allow for five lanes in each direction with full shoulders on either side.

This concept was eliminated by the project team during the course of this evaluation for a variety of reasons. These reasons included concerns related to existing infrastructure in Cincinnati, as well as factors associated with bridge capacity and projected travel demand through the study area. However, cursory environmental findings further support the elimination of this alternative. Alternative 3 presents greater potential impacts associated with hazardous materials sites, wetlands, low-income housing, and community cohesion in the historic neighborhood of Lewisburg in Covington, Kentucky. Direct impacts would have included approximately five Resource Conservation and Recovery Act (RCRA) sites, 12 Underground Storage Tanks (USTS), two Emergency and Remedial Response sites, seven potential wetlands locations, and potential impacts to a Housing and Urban Development (HUD) -assisted housing project known as Union Baptists Page Towers. While it may be possible to avoid directly impacting some of these resources, local infrastructure concerns coupled with cost and environmental impacts was enough justification to disregard this alternative as part of the overall engineering feasibility study.

Alternate No. 4 Single Bridge Replacement (I-75 widening in Ohio)

The concept known as "Single Bridge Replacement" consists of the construction of a new long span bridge approximately 1,600 feet long located immediately adjacent to and east of the existing Brent Spence Bridge. This new structure would be able to facilitate I-75, I-71 and local traffic, using seven lanes both north and south bound. The Single Bridge Replacement would require much of the existing approach structure to be modified or rebuilt. Surface street connections on the Kentucky side would have to be rebuilt and the approach roadway structures at either end of the Single Bridge would have to be modified to suit the shifted alignment. Local connection infrastructure to surface streets on both sides of the river, although rebuilt on the Kentucky side, would be located where they are now. The existing southern approaches to the proposed bridge would be

widened to allow for seven lanes in each direction with full shoulders on either side. At the northern end of the proposed bridge the roadway would split into five lanes carrying I-75 and local traffic north and two lanes carrying I-71 and local traffic east into Fort Washington Way.

This alternate generally calls for the widening of the existing Kentucky and Ohio approach roadways to the Brent Spence Bridge and the replacement of the Brent Spence Bridge with a new bridge carrying seven lanes north and south bound across the Ohio River.

While maintaining existing interstate traffic patterns, construction of the proposed river crossing bridge would commence. During that construction, temporary bridges intended to carry traffic crossing over I-75 north of the Ohio River would also be constructed. These crossing bridges include 6th Street, 7th Street, 9th Street, Lynn Street, Freeman Avenue, Ezzard Charles Drive, Liberty Street, and Findlay Street. Temporary decrease or loss of capacity on these crossing roads would be expected.

As traffic on these cross roads is maintained on temporary bridges, the main and approach spans of these existing cross road bridges would be removed, then possibly elevated and lengthened to accommodate the proposed widening of I-75 beneath. This cross road bridge reconstruction would intermittently slow traffic and/or restrict numbers of lanes of through traffic on I-75 and local access ramps.

All other construction of proposed mainline and auxiliary road structure, grade, drainage, and partial width pavements lying outside of the existing road pavements would be constructed. This type of construction would include the elevated I-71 approach bridges connecting the proposed Ohio River Bridge to Fort Washington Way.

Any other relocated or widened roadway alignment that is proposed to be built at, or close to, the same grade as adjacent existing pavements would also be constructed at this time. These include most of the “at grade” (not elevated on bridges) mainline I-71 and I-75 pavements in Ohio and Kentucky, the Pike Street, 12th Street and 5th Street ramps in Kentucky and 6th Street, Western Avenue, and Freeman Avenue ramps in Ohio. Short term and temporary shutdown or restriction of these ramps would be expected

The transitional ties between the proposed Ohio River Bridge and the elevated approach bridges in Kentucky and Ohio would call for the “one lane at a time” type of stage construction of these structures. This type of MOT scenario would cause minor delays and congestion for the duration of the link construction period.

Various constrictions and delays along the mainline route is expected, but at no time is the mainline I-75/I-71 through route expected to be shut down as a result of normal construction operations.

Alternate No. 5 Double Bridge Replacement (Elevated I-75 Roadways in Ohio)

The concept known as "Double Bridge Replacement" consists of the construction of two new long span bridges approximately 1,600 feet long each, located immediately adjacent to and east of the existing Brent Spence Bridge. The western bridge would carry I-71 and local traffic. The eastern-most bridge would carry I-75 traffic only. On the Ohio side, the I-75 alignment would be extended via elevated roadway along, and above, the existing I-75 alignment and tie to existing I-75 near Liberty Street. Each elevated roadway would likely use four lanes north and south bound.

This alternate would require much of the existing approach structure to be modified or rebuilt. I-71/I-75 on the Kentucky side would be widened to the east, minimizing impact on the west side and keeping the surface network intact. Surface street connections on the Kentucky side, east of the interstate, would have to be rebuilt. The approach roadway structures located at either end of the bridge would have to be modified to suit the shifted main bridge alignments. The existing freeway approaches to the project area would be widened to allow for seven lanes in each direction with full shoulders on either side.

Alternate 5 provides a replacement bridge to the east of the existing Brent Spence Bridge, on the existing corridor. In Kentucky, it generally shifts the facility to the east side, minimizing impacts to the west. In Ohio, it follows the existing corridor and maintains the connections with I-75 and downtown Cincinnati. It then uses separate elevated northbound and southbound roadways to carry the additional traffic volumes to just north of Ezzard Charles Drive where it merges with existing I-75.

The only permanent ramp closure anticipated with Alternate 5 is the southbound I-75 exit ramp to Western Avenue, just north of Ezzard Charles Drive. The proximity of the elevated roadway limits the available vertical clearance at that location. The impact of this ramp closure could be mitigated by widening the exit ramp just north of this location and Western Avenue, if deemed necessary.

A temporary closure that applies to Alternate 5 is expected for the southbound I-71 connection to 5th Street in Covington. While the southbound I-75 exiting traffic could be maintained from the existing Brent Spence Bridge, the I-71 traffic cannot. The closure would be required during removal of the existing approach structure and construction of a new bridge to connect relocated southbound I-71/I-75 to the existing ramp. The southbound I-71 exit to Pike Street should remain open.

In Kentucky, Alternate 5 provides a similar facility as presently exists, only wider. The widening is to occur on the east side, while leaving the west side intact. This design dictates that the improvements on the east side be constructed first, beginning with the ramps and the 12th Street – Pike Street connector. The new northbound lanes would be constructed next, part-width, until the northbound is complete. The southbound lanes would then be reconstructed, also part-width, until complete.

In Ohio, much of the elevated roadway construction could be completed independently of the Kentucky phasing, with minimal impact on traffic. The tie-ins at I-75 should begin with the northbound I-75 to northbound I-71 (eastern most) ramp and proceed westward. The I-75 tie-ins at the northern project terminus must be coordinated with the Kentucky tie-in phasing.

Alternate No. 6 Rehab + I-75/I-71 West

The concept known as "Rehab + I-75/I-71 West" consists of the construction of new approach bridges and a 1,800+/- foot-long span bridge across the Ohio River located from 700 to 900 feet west of the existing Brent Spence Bridge. The existing Brent Spence Bridge would also be structurally rehabilitated and reconfigured to facilitate residual local traffic. The number of traffic lanes on the rehabilitated bridge would probably be reduced from the four lanes currently in service. The rehabilitated Brent Spence Bridge would also maintain the connections required to indirectly accommodate I-75 traffic north- and south-bound across the Ohio River.

The new bridge and roadway would be sized adequately to carry both I-75 and I-71 through traffic and connected, without constrictions, to the existing I-75/ I-71 roadway near 12th Street in Kentucky. Immediately north of the northern end of the bridge, a directional split would carry I-71 traffic over and eastward to a connection to I-71 via Fort Washington Way.

Local connection infrastructure to surface streets on both sides of the river would be maintained; however, I-75 and I-71 through traffic volumes would be absent from the traffic volume currently experienced at these local connection areas. The existing southern approaches to the proposed bridge would be widened to allow for seven lanes in each direction with full shoulders on either side. The proposed bridge would carry five lanes across the river and split just at the northern end of the proposed bridge, with three lanes carrying I-75 traffic north and two lanes carrying I-71 traffic eastward toward Fort Washington Way. At least three lanes, capable of carrying I-75, I-71, and local traffic, will be maintained on the existing Brent Spence Bridge.

Since the majority of new roadway construction would be located over existing roadways, and/or away from the existing I-75/I-71 corridor, and the existing Brent Spence Bridge is to remain in service, MOT for this alternative should be relatively easy to implement. All roadway and bridge construction over and/or outside of existing roadways may take place without major influence on surface streets or current interstate traffic flow. Required approach roadway bridges to be built over the existing surface streets and interstate corridor may cause minor delays or temporary reduction in numbers of lanes.

After these non-conflicting roadways are constructed, transitional links from existing to newly constructed mainline roadways (I-75 and I-71) may be added. The preliminary design of this alternative is such that these transitional links would be simply at-grade extensions of both the existing and proposed pavements. The existing pavements would be widened at grade to connect seamlessly to the proposed roadways. Once the connection is made and pavement remarked, traffic would be re-routed to the new alignments.

The local access ramps to 12th Street, Pike Street and 5th Street would be constructed in a similar way. These ramps would be constructed independent of the existing ramp traffic and then widened at grade to make a connection to the existing ramps. Since the existing I-75/I-71 corridor is not being altered in Ohio, local access to surface streets there would not be disturbed.

Due to the redundant nature of this alternate mainline travel would be expected to continue nearly uninterrupted and undiminished during construction. Minor delays of short duration could be expected during the mainline transitional link tie-in process. No existing surface street access should be permanently lost or diminished and only short duration of loss or disruption of through and local access travel is expected during the construction process.

VIII. ENVIRONMENTAL OVERVIEW

As part of this Study, a desktop review of available community demographics, cultural and natural resources - related information was compiled from a variety of sources for the study area. The study area is approximately 4,000 feet wide, centered on I-75, and extends from Harrison Avenue and Hopple Street on the north and to just west of the Kyles Lane on the south. Other critical factors such as potential navigational challenges and permitting issues were cursorily reviewed relative to the conceptual alternatives.

A relative comparison of the five conceptual alternatives shows that Alternatives 4 and 5 (Single Bridge Replacement and Double Bridge Replacement (Elevated I-75 Roadways in Ohio)) have the lowest overall potential environmental impacts. Table 3 is a relative comparison between the conceptual alternatives. The

affected resource categories are not weighted by their value; thus; "low," "moderate," and "high" express the same significance across resources categories. "Low" represents the fewest impacts to a given resources when compared to all other conceptual alternatives. "Moderate" indicates that the amount of impacts associated with a given alternative falls between the amount of impacts associated with other conceptual alternatives. "High" represents the greatest possible impacts to a given resource category when compared to all other conceptual alternatives. "High" does not imply significant or severe impacts relative to a threshold value or regulatory interpretation.

Table 1: Summary of Environmental Impacts**

Resource Category	Relative Rating of Potential Impacts				
	Alternative 1	**Alternative 2**	**Alternative 4**	**Alternative 5**	**Alternative 6**
Cultural Resources	Moderate	Moderate	Low	Moderate	Moderate
Hazardous Material Sites	Moderate	Moderate	Low	Moderate	Moderate
Parks	Moderate	Moderate	Low	Moderate	Moderate
Wetlands	Moderate	Moderate	Low	Low	Moderate
Community Cohesion	Low	Low	Low	Low	Low
Environmental Justice	Low	Low	Low	Moderate	Low
Noise and Air	N/A*	N/A	N/A	N/A	N/A
Navigation/Permits	Moderate	Moderate	Low	Low	Moderate

* N/A indicates no discernable difference in the level of impacts as no data was available or analyzed

** Based on secondary source data and no regulatory agencies coordination other than that indicated in Appendix A

All five conceptual alternatives are viable from a planning standpoint. While some of the conceptual alternatives incur varying levels of impacts to different environmental resources, it is the conclusion of this evaluation that no major "show stoppers" exist based on secondary source data. However, primary research and data collection related to threatened and endangered species may warrant a different conclusion upon further investigation.

The complete environmental overview is included in Appendix A.

IX. ESTIMATED COSTS

Construction Costs

The Consultant Team took a two-pronged approach to the construction cost estimating task. This approach was taken in recognition that the conceptual alternatives are very preliminary and that this would give KYTC and ODOT a range of costs. All estimates were developed to reflect costs in the year 2004.

One approach, using national cost data, assessed the project from a constructability (that is, contractor's) perspective. This approach developed conceptual quantities of work and/or allowances for the conceptual cost estimate. Where quantities of work were developed, unit prices were used for the individual items. Where quantities of work could not be developed at this stage (a major portion of the estimate), allowances as a lump sum or percentages of total cost were used. The allowances are based upon broad experience in complex highway and major over-water bridge projects. After an initial review of the Alternatives, Alternative Four was used as a "baseline" for the assessment of alternatives from a cost and constructability standpoint.

The second approach, from the development of the conceptual alternatives, used local (Kentucky and Ohio) cost data applied to quantities developed similar to approach one. For example, estimated pavement costs were developed by taking the area of new pavement in square yards and applying a unit cost to cover all pavement and subgrade costs, guardrail, markings, signage, lighting, and underdrains. Also, utility relocation costs were given a "place-holder" of $100 per square yard of right-of-way in recognition that many underground issues may arise given the age of the city and many industries existed prior to the construction of the Interstates. For the "bypass" alternates (One, Two, and Five), $4 million was included for electrical transmission tower relocations.

The following table presents only the construction costs of the five conceptual alternatives. The variation in Alternates One, Two and Five reflects assumptions made on portions of the approaches to the main span being primarily fill or bridges. This was done to represent "worst case" scenarios in regard to potential environmental and site constraints that may affect the final design solution. The consultant team was also requested to develop cost estimates for the five-lane solutions explored earlier in the study. Additional costs for the total construction program are described later in this section.

Construction Cost Range ($ Millions in 2004)		
Alternate	**Seven Lanes**	**Five Lanes**
Alternate #1 – Rehab and I-75 West	$667.5 - $721	$474 – $541
Alternate #2 – New East & I-75 West	$750 - $923	$578 - $702
Alternate #4 – Single Bridge Replacement	$553.4 - $560	$426 - $431
Alternate #5 – Double Bridge Replacement	$747.9 - $909	$577 - $692
Alternate #6 – Rehab & I-75/I-71 West	$707 - $729	$535 - $557

Real Estate and Relocation Cost Development

The real property values utilized for this estimate are the most recent "appraised value" indications from the Auditor's and Property Valuation Administrator's records in the appropriate jurisdictions. The procedures utilized by the appraisers in the development of these values are considerably less detailed than those prescribed for appraisals utilized for acquisition by a public agency. Absent the detail and the lack of multiple approaches to valuation found in a tax appraisal, one could logically conclude that the values derived from auditors' records are not reflective of market value. This is particularly true of specialty use properties such as hotels.

As a contingency, increasing the tax value of the properties, other than the hotels, by 30% should approximate market value. In valuing the hotel properties one would have to factor in occupancy rates and other market driven measures. Utilizing a rule of thumb of $100,000 per room, it appears that the hotels are largely under-valued from what is shown in the public record.

Relocation Assistance estimates for the residential properties utilized the current statutory limit for replacement housing and an allowance for move cost. The nonresidential move costs were derived by a variety of methods ranging from personal experience to budgeting guidance provided by a commercial mover. The smaller commercial establishments could likely qualify for the statutory limit on income in lieu of moving cost. Where photographs were available of the buildings, a judgment was made regarding the potential applicability of this payment or if a larger move cost would be incurred. For office buildings, the budgeting factor of $1.50/sq ft of floor space was used to estimate move cost. For hotels, the commercial moving company's budget factor is $400/room. The average cost to relocate an auto dealership of any size and sophistication seems to be $100,000. Without the ability to go on site, much of the other move cost estimation relies on the professional judgment of an individual experienced in Relocation Assistance. As directed by KYTC and ODOT these estimates were increased by 15%.

Finally, as per ODOT Guidelines, a factor of 12.9% (derived from the Consumers Price Index [CPI]) was added to the right-of-way costs to reflect future costs when acquisition occurs.

The following table gives the range of right-of-way plus relocation costs for each alternative. Where only one number is given, that alternate did not impact any of the "unique properties" (e.g., hotels) whose valuation is questionable given current market conditions.

Real Estate and Relocation Costs ($ Millions in 2004)		
Alternate	**Initial Valuation**	**Valuation with CPI**
Alternate #1 – Rehab & I-75 West	$28.8	$32.3
Alternate #2 – New East & I-75 West	$53.4 - $82.7	$60.29 - $93.37
Alternate #4 – Single Bridge Replacement	$23.5 - $52.8	$26.53 – $59.61
Alternate #5 – Double Bridge Replacement	$58.84- $108.24	$66.43 - $122.2
Alternate #6 – Rehab & I-75/I-71 West	$26.5	$29.92

Contingencies and Reserves

Because of the preliminary nature of the engineering of the alternatives a contingency factor of 30 percent of the construction cost was selected to reflect this fact. It was also determined that an estimate for construction reserves should be included in the estimate to account for additional work required (e.g., differing site conditions, material price increases, etc.) while the project is under construction. The table below summarizes these costs.

Contingencies Cost Range (7 Lane Solution) ($ Millions in 2004)		
Alternate	**Contingencies**	**Construction Reserve**
Alternate #1 – Rehab & I-75 West	$200- $216	$33
Alternate #2 – New East & I-75 West	$225 - $277	$37
Alternate #4 – Single Bridge Replacement	$166 - $168	$28
Alternate #5 – Double Bridge Replacement	$224 - $273	$37
Alternate #6 – Rehab & I-75/I-71 West	$212 - $219	$35

Project Development

Project development costs (environmental documentation and engineering, KYTC and ODOT construction management, and third-party construction management costs) were estimated based on recent experience on other "mega projects." The following table summarizes these additional costs, and a table showing the range of total estimated costs follows the development costs.

Project Development Costs (7 Lane Solution) ($ Millions in 2004)				
Alternate	**Environmental And Engineering**	**KYTC/ODOT Construction Management**	**Third Party Construction Management**	**Total**
Alternate #1 – Rehab & I-75 West	$63.4 - $68.5	$40.1 - $43.3	$53.4 - $57.7	$156.9 - $169.5
Alternate #2 – New East & I-75 West	$71.3 - $87.7	$45 - $55.4	$60 - $73.8	$176.3 - $216.9
Alternate #4 – Single Bridge Replacement	$52.6 - $53.2	$33.2 - $33.6	$44.3 - $44.8	$130.1 - $131.6
Alternate #5 – Double Bridge Replacement	$71.1 - $86.4	$44.9 - $54.5	$59.8 - $72.7	$175.8 - $213.6
Alternate #6 – Rehab & I-75/I-71 West	$67.2 - $69.3	$42.4 - $43.7	$56.6 - $58.3	$166.2 - $171.3

Total Cost Estimate (7 Lane Solution) ($ Millions in 2004)	
Alternate #1 – Rehab & I-75 West	$1,058 - $1,172
Alternate #2 – New East & I-75 West	$1,242 - $1,547
Alternate #4 – Single Bridge Replacement	$901 - $947
Alternate #5 – Double Bridge Replacement	$1,244 - $1,555
Alternate #6 – Rehab & I-75/I-71 West	$1,156 - $1,193

Finally, an estimate of the escalation of construction costs due to inflation was developed. This assumed that the midpoint of construction would be in the year 2017. The escalation of costs range from approximately $183 million to $305 million.