COST ESTIMATION METHODOLOGY

Introduction

Project Costing Guidelines were issued by the PMC to provide a uniform approach to the costing of alternatives for the Tier 2 studies yet allowing flexibility to make refinements as warranted. These guidelines were reviewed by INDOT and Federal Highway Administration (FHWA) both at the Indiana Division Level and FHWA Headquarters during their development and this latest guidance seeks to reflect a logical approach to development of the range of costs for alternatives and a reflection of current bid costs.

The Project Management Consultant (PMC) analyzed projects that were bid in 2008-2009, and developed a methodology that would closely replicate the actual bidding to be expected when Plans Specifications and Estimate (P.S. & E.) are available at the end of design.

This methodology initially used projects bid in 2004 for the DEIS for this project. The unit costs associated with itemized bid tabulations (bid tabs) were updated in 2007 using current INDOT data. See Appendix D of the DEIS for documentation of the DEIS cost estimating methodology.

In the late summer of 2009, the PMC analyzed bids on various projects that were let from September 2008 through June 2009 to assess the effect of recent bid history on the unit prices to be used in the development of costs for this FEIS. The updated methodology is intended to provide an estimate comparable to actual bids obtained from plans already "on the shelf". Since the timing of the Tier 2 Final Environmental Impact Studies varies by section, and issues of funding are not fully resolved, it is not possible at this point in time to schedule all the various construction contracts. Accordingly, after the costs were developed based on the methodology stated below, they were adjusted to Year 2010 dollars. After the Tier 2 studies are completed, INDOT and FHWA will continue to project these costs out into the future and as funding becomes available to complete the construction of I-69 from Evansville to Indianapolis are refined.

Section 1. Roadway Construction Cost

Methodology.

To determine the unit prices, the official bid tabulations of 17 Roadway Contracts described as "new construction", and 18 bridge or road-bridge combination contracts (containing a total of 28 individual bridges), awarded by INDOT from September 2008 through June 2009 (see Tables 1and 3), were reviewed.

Table 1 – Recently Awarded Roadway Construction Contracts

Contract Number	Letting Date	Roadway	Project Description	Contract Award Amount (Millions)
IR-30114	09/04/08	US 31	New Road Construction	$24.4
IR-30844	09/04/08	SR 25	New Road Construction	$10.5
IR-27845	11/19/08	US 231	New Road Construction	$29.9
IR-28976	03/11/09	PR 641	New Road Construction	$10.1
IR-30115	03/11/09	Lilac and Tyler Roads (Marshall Co.)	New Road Construction	$2.3
IR-30160*	03/11/09	US 24	New Road Construction	$24.7
SR-29135	03/25/09	US 33	New Road Construction	$10.1
IR-30298	04/08/09	PR I-69	New Road Construction	$13.6
IR-31322	04/15/09	I-69	New Road Construction	$8.0
SIR-30025	04/29/09	US 136	New Interchange and Bridges	$13.8
IR-30116	05/06/09	US 31	New Road Construction	$4.5
R-31726	05/06/09	Elkhart CR 17	New Road Construction	$7.3
SIR-30106* SIR-31948*	05/20/09 05/20/09	US 31 (PCCP) US 31 (HMA)	New Road/Bridge Constr New Road/Bridge Constr	$11.3 $11.1
SIR-30843*	05/20/09	SR 25	New Road/Bridge Constr	$29.6
IR-30029	05/27/09	I-65	New Interchange Construction	$8.2
IR-31879	05/27/09	Kenilworth Road (St. Joseph Co.)	New Road Construction	$2.2
R-31668	05/27/09	126th Street (Hamilton Co.)	Road Construction	$10.2

*4-Lane Divided Rural Highway, Construction Cost greater than $10 million, awarded in the past 6 months

Of the 17 Roadway Contracts, the unit prices from the four construction contracts awarded within the past 6 months having a construction cost greater than $10 million and that have similar features to the proposed I-69 (e.g. 4-lane, divided, rural highway) as indicated by an asterisk (*) in Table 1 were analyzed to develop the unit prices. The average unit prices obtained from the four contracts listed in Table 1 (2009 dollars) were projected to 2010 dollars using a one year of inflation at 3.5%.

The cost estimating model presents a range of costs based on different design criteria value assumptions. The low cost criteria reflect a median width of 60 feet, a clear zone value of 30 feet, and the use of full depth asphalt pavement with asphalt shoulders. The initial criteria reflect a median width of 84 feet, a clear zone value of 35 feet, and use of concrete pavement for travel lanes and shoulders on the mainline and interchange ramps.

Roadway construction costs are divided into six (6) categories: pavement; earthwork; drainage; miscellaneous; percentage costs; and Trns-port Estimator items. Unit prices were used to estimate the construction cost for the pavement, earthwork, drainage and miscellaneous items; percentages were used to estimate the construction cost for the percentage items (mobilization

and demobilization, construction engineering, and other minor item costs). Construction cost for the Trns-port Estimator items were estimated where appropriate.

Alternative design criteria were incorporated in order to provide a range of construction costs. Both the initial and low-cost criteria satisfy design standards in INDOT's Design Manual (IDM). Table 2 enumerates the differences between the initial and low cost criteria.

Pavement. The pavement cost analysis used forecasted traffic volumes (for the Year 2030) to determine the number of mainline travel lanes required at various locations. For cost estimating purposes, the total length (in linear feet) of each type of lane configuration (i.e. 4, 6, 8, or 10-lane) was calculated.

Based on the forecasted traffic volumes for each potential interchange, the number of lanes required for each ramp was determined. For cost estimating purposes, the total length (in linear feet) for each type of ramp configuration (i.e. 1 or 2-lane) was calculated.

Other roadways (e.g. frontage roads, realigned roads, improvements to existing roadways, etc.) which will need to be constructed or substantially reconstructed were identified. Based on forecasted traffic volumes, the number of lanes required for these roadways was determined. For cost estimating purposes, the total length (in linear feet) for each type of roadway configuration (i.e. 2 or 4-lane) was computed.

Pavement costs were developed under the low cost criteria using full depth asphalt pavement items, and the initial criteria used concrete pavement items for the mainline and interchange ramps pavements. Asphalt pavement was utilized for the other roadways for the initial and low cost scenarios.

Table 2 – Initial vs. Low Cost Criteria

Cost Element	Initial Criteria	Low Cost Criteria	Notes
Pavement Type			
Mainline I-69	Concrete Travel Lanes with Concrete Shoulders	Asphalt Travel Lanes with Asphalt Shoulders	
Interchange Ramps	Concrete Travel Lanes with Concrete Shoulders	Asphalt Travel Lanes with Asphalt Shoulders	
Other Roadways	Asphalt Travel Lanes with Asphalt Shoulders	Asphalt Travel Lanes with Asphalt Shoulders	No change from initial to low cost criteria
Mainline I-69 Median Shoulder Paved Width	6 feet	4 feet	
Earthwork			
Median Width (Mainline I-69)	84 feet (including median shoulders)	60 feet (including median shoulders)	
Clear Zone Width (Mainline I-69)	35 feet (from edge of travel lane)	30 feet (from edge of travel lane)	
Minimum Grade	0.50%	0.00%	Providing the lower minimum grade can lead to reduction in earthwork
Structures less than 20' - Mainline I-69	Longer structure required (compard to low cost criteria) due to wider median and clear zone	Shorter structure required (compared to initial criteria) due to narrower median and clear zone	
Clearing Right-of-Way	Greater area (compared to low cost criteria) due to wider median and clear zone	Less area (compared to initial criteria) due to narrower median and clear zone	
Seeding	Greater area (compared to low cost criteria) due to wider median and clear zone	Less area (compared to initial criteria) due to narrower median and clear zone	
Pavement Markings			
Mainline I-69	Preformed Plastic	Thermoplastic	
Interchange Ramps	Preformed Plastic	Thermoplastic	
Other Roadways	Thermoplastic	Thermoplastic	No change from initial to low cost criteria

Earthwork. The projects analyzed estimated earthwork requirements by identifying appropriate construction techniques at different locations. These techniques included: common excavation (all unconsolidated, overburden soil); common excavation with friable (rippable) rock (use of additional equipment above normal excavating procedures); and common excavation with hard rock (blasting or other removal techniques required). Once the appropriate earthwork technique was identified, and a profile grade established, earthwork quantities were calculated and an earthwork cost was estimated by using the appropriate unit prices.

Existing ground cross sections along with a proposed roadway template were used to calculate the earthwork quantities by the average end area method. For cost estimating purposes, ditch depths on the outside of the roadway were set a minimum of two (2) feet deep, a fifteen percent (15%) shrinkage factor was used and a 30% swell factor was used for rock fills.

Templates for the low cost criteria and initial criteria were run using refined profiles to estimate earthwork volumes. Consequently, the earthwork quantities vary depending on the criteria being applied.

Drainage. Structures over 20 feet in length are evaluated as bridges and are discussed below. Pipes at least 48 inches in diameter and culverts with spans less than 20 feet are included in this section. Preliminary hydraulic analysis identified the location and size of the drainage structures. Appropriate unit prices were used to estimate costs and the summation of the costs of these drainage elements represents the "structures less than 20 feet" cost in the methodology. The lengths of pipes and culverts were adjusted to reflect different design criteria; applying the low cost criteria results in shorter pipes and culverts.

Another component of the overall drainage costs are underdrains, which drain the subgrade under the pavement to extend the pavement life. Unit costs were determined per lineal foot of underdrains, and included the costs for the following items: six inch (6") perforated underdrain pipe; geotextiles placed within the excavated underdrain trench; aggregate used to backfill the underdrain trench; six inch (6") underdrain outlet pipe; and outlet protectors at 650 foot spacing. The unit price assumed one (1) longitudinal underdrain run; therefore for standard divided typical sections (rural or urban) four (4) runs will be necessary: one (1) on each outside edge of pavement and one (1) on each inside (median) edge of pavement. For an urban typical section with a concrete median barrier, three (3) underdrain runs will be necessary: one (1) on each outside edge of pavement and one (1) next to the median barrier. In this FEIS, unit costs were updated for the rural sections, but not for the urban sections. Since Section 3 does not have any urban sections, these unit costs were not updated. They will be updated in later EIS which analyze projects with urban sections.

Miscellaneous. Quantities were estimated for the following miscellaneous items: Clearing Right-of-Way (lump sum); Maintenance of traffic (various methods on a per number (EACH) basis and a lump sum); square yards (SYS) of Subgrade Treatment; lineal feet (LFT) of pavement markings, square yards (SYS) of seeding and sodding; and lineal feet (LFT) of fencing. If necessary, estimates also were made of quantities of these items: lineal feet (LFT) of concrete median barrier; number (EACH) of traffic signals; and number (EACH) of interchange signing and lighting installations.

Estimates assume that the Subgrade Treatment extends to a point two (2) feet outside the paved shoulder width. Additionally, Subgrade Treatment will be utilized under all pavement (i.e. mainline, ramps, other roadways) in both cut and fill sections.

Linear feet (LFT) of fencing (farm field or chain link) were estimated for the right-of-way line on each side of the mainline; therefore, two (2) rows of fencing are required.

Linear feet (LFT) of Median Barrier were estimated including the following: 45" high, standard, concrete median barrier; H-5 inlets at 500 foot spacing; and twelve inch (12") INDOT Type 2 (storm sewer) pipe. Median barrier is used only in urban sections where providing at least a sixty foot (60') depressed median would result in significantly increased impacts.

Numbers (EACH) of Traffic Signals were estimated, including all necessary components (signal heads, signal poles, detector loops, controller/cabinet, etc.) to construct a traffic signal at a four-legged intersection. Proposed traffic signal locations (e.g. ramps of an urban diamond interchange, intersections of proposed access/frontage roads, etc.) were identified.

Numbers (EACH) of Interchange Signing and Lighting were estimated, including all necessary components (sign trusses, cantilevers, panel signs, light masts, luminaries, wiring, etc.). Appropriate signing and lighting costs were estimated based on the type and location of interchange.

Percentage Costs. The following costs were estimated as a percentage of the total project construction cost: mobilization and demobilization; construction engineering (performed by the contractor, not construction inspection); and other minor costs (e.g. signage, temporary erosion control, etc). Through the bid tab analysis performed at the DEIS stage, the following percentages were determined:[1]

- Mobilization and demobilization is 5.5% of construction costs,
- Construction engineering is 1.6% of construction costs, and
- Other minor costs are 10% construction costs.

These percentage costs total 17.1% of total construction costs. The remaining 82.9% is the total of pavement, earthwork, drainage and miscellaneous costs.

[1] These percentages were determined in the cost estimating procedures used in the DEIS. In the smaller number of projects evaluated to update the costs for the FEIS, the sum of the percentages for mobilization/demobilization and construction engineering was 6.8%, versus 7.1% used previously. The 7.1% previously established for mobilization/demobilization and construction engineering was not modified.

Trns-port Estimator Items. INDOT provided a copy of the American Association of State Highway and Transportation's Officials' (AASHTO's) Trns-port Estimator (construction cost estimating) program. A list of INDOT Standard Pay Items for roadway costs was used in the five previous categories. However, these pay items are not all inclusive. Where other items are needed for a construction cost estimate, they are added on a case-by-case basis. Examples of these additional items include mechanically stabilized earth walls, paved side ditches, curbs, and guardrail.

The following parameters were used with the Trns-port Estimator Program to obtain costs for these additional items. These items are not included in other categories, and are added on a case-by-case basis as needed.

- Specification (Spec) Year: 06 (2006)
- Letting Date: 2/28/09
- Unit System: E (English)
- Work Type: G300 New Road Construction
- Highway Type (EEAC to identify appropriate type)
    - INTR Interstate Rural
    - INTU Interstate Urban
- Urban/Rural Type (EEAC to identify appropriate type)
    - R Rural
    - U Urban
- Season: Spri Spring
- County: EEAC to identify appropriate county

Engineering judgment was used to judge the reasonableness of each unit price supplied by the Trns-port Estimator program.

Geotechnical/Karst Construction. In addition to the six (6) categories listed above, additional costs will be incurred for construction in areas to address geotechnical issues related to subsidence and karst features.

Subsidence due to mining. There are on-going investigations of soil conditions in areas where coal mines have existed. There will be additional costs to address subsidence in previously-mined areas. The costs to address these geotechnical considerations were developed and added to the costs of each alignment segment.

Karst-related costs. The PMC analyzed costs of previous INDOT projects in areas with karst features to estimate karst-related increases in construction costs. This analysis showed that, on average, construction in areas with karst features leads to an increase of five percent (5%) in roadway construction costs. It is reasonable to assume that such practices in karst areas will be relatively similar and that the impact on the total bid price will remain close to the five percent (5%) value. In areas with karst features, this methodology adds 5% to roadway costs (see next

paragraph). Note: there will be no construction in karst areas in Section 3. The total of this line item will be cost to address geotechnical issues believed in this Section.

Roadway Construction Cost Calculation. A spreadsheet was written in Microsoft® Office Excel format to calculate the construction cost estimates. The "Roadway" worksheets estimated the construction costs for the pavement, earthwork, drainage, miscellaneous and percentage costs items. The total of these costs is called the Worksheet Roadway Cost. In order to arrive at the total roadway cost, Trns-port Estimator cost items were added separately, if applicable. Finally, an additional 5% of the "Roadway"(worksheet) is added for projects in areas with karst features. The "Total Section Costs" worksheet estimates the total Roadway Construction Cost. The Roadway Construction Cost is the sum of the Worksheet Roadway Cost, the Trns-port Estimator Items Cost and the Karst Cost (Roadway Construction Cost = Worksheet Roadway Cost + Trns-port Items Cost + Karst Cost).

The spreadsheet provides Year 2009 construction costs in the "Total Section Costs" worksheet.

Construction Year. To provide a consistent basis for comparison, all construction costs are reported in Year 2010 dollars. Section 3 of this appendix describes how the Year 2009 costs provided by this methodology are adjusted to Year 2010 dollars.

Section 2. Bridge Construction Cost

Typical Bridge Construction Cost.
18 bridge or road-bridge combination contracts (containing at total of 28 individual bridges), awarded by INDOT from September 2008 through June 2009 were reviewed. See Table 3 for the listing of contracts reviewed.

Table 3 – Recently Awarded Bridge Construction Contracts

Contract Number	Letting Date	Roadway	Feature Crossed
B-29705	02/11/09	Huron and Williams Rd (Lawrence Co.)	East Fork White River
B-30926	02/11/09	Canal Road (Vigo Co.)	Thompson Ditch
IB-28950	02/11/09	Howard CR 50 N	US 31
SB-29950	02/27/09	US 40	White Lick Creek
IR-30160 (5 bridges)	03/11/09	US 24	Norfolk Southern Railroad, Sampson Rd, Woodburn Rd (EB), Woodburn Rd (WB), Bull Rapids Road (o/US 24)
IB-30838	03/11/09	Tippecanoe CR 500 E	SR 25 and Norfolk Southern Railroad
IB-30471	03/11/09	Hanna Ave (Hamilton Co.)	I-465
SB-29015	03/25/09	Locust Rd (St. Joseph Co.)	US 20
SR-29135	03/25/09	US 31	Yellow Creek
IR-30298 (3 bridges)	04/08/09	I-69	Trib. Pigeon Creek, Pigeon Creek (NB), Pigeon Creek (SB)
R-31726 (2 bridges)	05/06/09	Elkhart CR 17	CR 30, CR 32
IB-30841	05/06/09	Tippecanoe CR 800 E	SR 25 and Norfolk Southern Railroad

Table 3 – Recently Awarded Bridge Construction Contracts

Contract Number	Letting Date	Roadway	Feature Crossed
IB-30837	05/06/09	Tippecanoe CR 300 N	SR 25 and Norfolk Southern Railroad
SB-29731	05/20/09	SR 312 (Chicago Ave)	Indiana Harbor Canal
SB-28901	05/20/09	US 52	Norfolk Southern Railroad
SIR-30106	05/20/09	Howard CR 100 S	Relocated US 31
SIR-30843 (4 bridges)	05/20/09	SR 25	Sugar Creek, CR 900 N, Unnamed Creek, Bridge Creek
R-31668	05/27/09	126th Street (Hamilton Co.)	Mud Creek

These 18 projects were analyzed to estimate bridge costs as unit costs per square foot of bridge surface.

This cost includes all items needed for the project. These items include reinforced concrete bridge approaches. Costs of bridges over waterways include bank treatments (riprap, geotextiles, slopewalls, etc.). MSE walls are included in this study, but estimated separately from the deck square footage cost. Earthwork and guardrail costs were not included in these costs. These items are a part of the roadway cost estimate.

The bridge areas were determined using anticipated out-to-out bridge lengths and out-to-out bridge widths. The unit cost was multiplied by the area of the bridge (in square feet) to estimate its cost.

Unit costs for complex bridges will be determined as detailed in the Project Guidance Manual, drawing upon the analysis described below.

For the purposes of this analysis, the items that can be attributed to the bridge construction were isolated from the other items in the construction contracts to obtain a bridge-only cost. This analysis determined that the costs of bridges with MSE walls and bridges without MSE walls varied significantly and therefore, the bridge projects with MSE walls were further analyzed, and the cost of the MSE wall was calculated separately from the cost of the bridge. Based on this analysis a lower per square foot bridge cost for bridges with MSE walls is proposed as compared to bridges with spill-through slopes; however, the added cost of the MSE walls will offset some of the savings. Table 4 summarizes the analysis. It compares the unit prices used in the DEIS cost estimates for Sections 2 and 3 with those obtained from the analysis of more current construction bids.

Table 4 – Bridge Square Foot Cost Comparison

Item	DEIS Tier 2 Methodology Unit Price (2007 Dollars)	DEIS Tier 2 Methodology Unit Price (Inflated to 2009 Dollars)	Average Unit Price from Contracts Listed in Table 2 (2009 Dollars)
Initial Criteria (spill-through slopes)	$110	$118	$99.20
Low Cost Criteria (MSE walls)	$110	$118	$87.80
MSE Wall Cost	$170,000/bridge	$182,000bridge	$216,000/bridge

Complex Bridge Construction Cost. Complex bridges will be required in single point interchanges, directional interchanges or over major waterways. Four such projects were analyzed to estimate the costs of such bridges.

Indianapolis International Airport (Midfield Terminal) Interchange at I-70, Indianapolis, Indiana: Three complex bridges were included in this new directional interchange. These bridges are Cast-In-Place Continuous Post Tensioned Box Girder bridges. The bridge carrying an eastbound ramp over I-70, an interchange ramp and collector-distributor routes is seven spans, with a total length of 1354 feet. The longest span length is 220 feet. The width of this bridge is typically 53'-4" but varies at select locations. The bridge carrying an eastbound ramp over I-70 and eastbound & westbound collector-distributor routes is four spans, with a total length of 820'-7". The longest span length is 221'-8". The width of this bridge is typically 53'-4" but varies at select locations. The bridge carrying a westbound ramp over two westbound collector-distributor routes is two spans, with at total length of 347 feet. The longest span length is 169'-4". The width of this bridge typically is 37'-4", but varies. This project was let in May 2003. Its cost was adjusted to bring it to Year 2009 dollars, based on the US Department of Labor Producer Price Index for Highway and Street Construction. The three bridges were similar in nature, and their square foot cost was determined to be $216/ft^2 in Year 2009 dollars.

SR 66 (Lloyd Expressway) over Green River Road, Evansville, Indiana: Twin structures were built to carry SR 66 over Green River Road. The previous diamond interchange was replaced with an urban single point interchange. The bridges are Continuous Post-Tensioned Bulb Tee Beam bridges. They are three single-span bridges, with a total length of 96.762 m (317.5 feet). The longest span length is 41.509 m (136.2 feet). The width of each bridge is 17.207 m (56.5 feet). As is typical with Single Point interchanges, sight distance is a critical design element. Therefore a more complex substructure configuration was required in the design of this bridge. The square foot cost of these bridges was determined to be $134/ft^2 in Year 2009 dollars.

This bridge was built in phased construction. Temporary sheeting and shoring was required to stabilize the portion of the roadway that was open to traffic. This project was let in November 2002. Its cost was adjusted to bring it to Year 2009 dollars based on the US Department of Labor Producer Price Index for Highway and Street Construction. The square foot cost of these bridges (in Year 2009 dollars) was $134/ ft^2 without the temporary sheeting and shoring and $181/ft^2 including temporary sheeting and shoring.

Emerson Road over I-465, Indianapolis, Indiana: This structure was built to carry Emerson Road over I-465. The previous diamond interchange was replaced with an urban single point interchange. The bridge is a Continuous Composite Steel Plate Girder bridge. It has two spans, with a total length of 48.751 m (160 feet). Each span length is 24.0 m (78.7 feet). The width of the bridge varies from 75.058 m (246.3 feet) at the end bents to 43.07 m (141.3 feet) at the pier. This bridge is complex in nature because the Emerson Road intersection passes over I-465. Since the focal point of this interchange is on the bridge, the geometry of this bridge is unusual. The project was let in February 1999. Its cost was adjusted to bring it to Year 2009 dollars, based on the US Department of Labor Producer Price Index for Highway and Street Construction. The square foot cost of this bridge was determined to be $192/ft^2 in Year 2009 dollars.

I-465 / I-74 Interchange, Indianapolis, Indiana: Four bridges were included in the I-465 / I-74 Interchange contract. Three of these bridges are within this Directional Interchange, and were studied as complex structures. In this contract, each of these bridges was designed and detailed twice (generally one design used Steel Girders, and the other design used one of two concrete bridge types, Prestressed Concrete or Cast-in-Place Concrete Box Girders). The contractor bidding on this project was then given the responsibility to determine the most economical bridge for each of these three structures. For each bridge, the top three bidders based their bids on the same bridge option as shown below:

The bridge carrying the southbound I-465 to eastbound I-74 ramp over I-465 is an elevated ramp, and I-74 is a Continuous Composite Curved Steel Plate Girder bridge. It has eleven spans, with a total length of 522.064 m (1712.8 feet). The longest span length is 60.5 m (198.5 feet). The width of this bridge is 12.0 m (39.4 feet). The square foot cost of this bridge was determined to be $134/ft^2 in Year 2009 dollars.

The bridges carrying I-74 over I-465 are Continuous Composite Prestressed Concrete Bulb Tee Beam bridges. These bridges have three spans, with a total length of 97.967 m (321.4 feet). The longest span length is 40.7 m (133.5 feet). The widths of these bridges vary. The Westbound structure width varies, 16.7 m (54.8 feet) to 17.244 m (56.6 feet). The Eastbound structure width varies, 16.7 m (54.8 feet) to 17.897 m (58.7 feet). The square foot cost of these bridges was determined to be $104/ft^2 in Year 2009 dollars.

The bridge carrying the westbound I-74 to southbound I-465 ramp over I-74, I-465 and a collector-distributed route is a Continuous Composite Curved Steel Plate Girder bridge. It has nine spans, with a total length of 358.054 m (1174.7 feet). The longest span length is 52.304 m (171.6 feet). The width of this bridge is 12.0 m (39.4 feet). The cost of this bridge was determined to be $118/ft^2 in Year 2009 dollars.

This project was let in January 2001. Its cost was adjusted to bring it to Year 2009 dollars, based on the US Department of Labor Producer Price Index for Highway and Street Construction.

Where the need for a complex structure was identified, preliminary layout of the location of the complex structure including spans and pier locations was determined. Using this layout, the parameters (span lengths, required clearances, construction depth, etc.) were used to determine

the most economical type of structure for the location. Once the structure type was identified, the costs associated with these example complex structures as well as any other project information found for similar structures, was used to determine the square foot cost to be used for the bridges studied. This determination of the structure size and type was submitted to the PMC for approval. Costs ranged from $104 to $216 per square foot in 2009 dollars.

The bridges at the I-69 / US 231 interchange were analyzed as complex structures due to the long span lengths and their location in a single point diamond interchange (under one interchange option). In order to provide adequate sight distance at this interchange, the span lengths generally need to be longer and the pier layout more complex than is typical to allow vehicles exiting from I-69 to see under the bridge and view approaching traffic on US 231. After determining the preliminary layout of these structures and reviewing other similar projects, it was determined that a cost of $150/ft^2 in 2009 dollars would be appropriate for these structures.

For these complex structures, the pay items and bid information are not represented in the Estimator program. The pay items are unique and do not directly correspond to information provided in the program. Similarly, no information for these unique bridge types is provided in the Indiana Design Manual. Thus, in order to determine the year 2009 equivalent cost for complex bridges, the unit costs for the complex projects studied were adjusted based on the producer price index.

Construction Year. The cost model gives these costs in year 2009 dollars. For comparison purposes, costs were inflated to the Year 2010. See Section 3 of this appendix below for information on how costs were inflated to provide Year 2010 costs.

Section 3. Reporting Year Cost Adjustments

Construction Year. The cost methodology provides a base Year 2009 cost. Both the Year 2009 Roadway Cost, as well as the Year 2009 Bridge Costs, were increased at an annual rate of 3.5% to provide Year 2010 costs. The 3.5% per year cost increase rate is the standard inflation value used by INDOT in its 2007 Long Range Plan Update to estimate project costs in future years.

Design Modifications. At the onset of a large project, the scope of both design and construction may not be easily definable. Additionally, even if there is a clearly defined scope, the scope may change during project development due to unforeseen circumstances. These potential design modifications can materially affect the final cost of the project. The Year 2010 construction costs for both roadway and bridges were adjusted to account for design modifications. Roadway and bridge costs were increased by 2 to 4 percent to account for possible design modifications.

Construction Change Orders. After projects are bid there may be increased costs for changes that are specified during construction. These “change orders” result in increases in construction costs. These changes can occur due to unforeseen field conditions and/or quantities that exceed those estimated (e.g. driving piles longer than anticipated). The Year 2010 construction costs for both roadway and bridges were increased by 2.5% to 5% to account for potential change orders.

Section 4. Design Costs

Highway Design Engineering. The cost for Highway Design Engineering is a percentage of the Roadway Construction Cost described in Section 1 (above). Different percentages were used for construction in urban and rural areas. For rural areas, Highway Design Engineering is estimated as 4-5% of the Roadway Construction Cost. Due to the potential for more design complexities within an urban area, Highway Design Engineering in urban areas is estimated as 7-8% of the Roadway Construction Cost. Other development cost including permitting, supplemental surveying, utility coordination, geotechnical investigations, etc were investigated. It was determined that 1 % of the roadway construction cost would be added to the design engineering cost to reflect these added development costs. Given the rural nature and relative lack of complexity in this Section, this 1% factor was added to the lower end of the previously-established 4% design engineering cost. This provides an estimate of design engineering as 5% of roadway construction cost.

Bridge Design Engineering. The cost for Bridge Design Engineering is a percentage of the Bridge Construction Cost described in Section 2 (above). The Bridge Design Engineering is estimated at 7-8% of the Bridge Construction Cost. It was determined that 1% of the bridge construction cost would be added to the design engineering costs to account for geotechnical investigations. Given the rural nature and relative lack of complexity in this Section, this 1% factor was added to the lower end of the previously-established 7% design engineering cost. This provides an estimate of design engineering as 8% of bridge construction cost.

Right-of-Way Engineering and Services. The cost for Right-of-Way Engineering & Services is developed as a part of the Right-of-Way Cost described in Section 6 (below). The Right-of-Way Engineering & Services is the administrative cost listed in that section.

Section 5. Construction-Agency Administration Cost

In order to oversee construction activities, INDOT incurs additional costs which are difficult to quantify precisely. These costs include, but are not limited to: construction inspection, general project administration (e.g. reproduction of construction plans and contract documents), and public outreach. To account for these costs, 7.5 percent of the total constructed cost has been added to the cost estimate.

Section 6. Right-of-Way Cost

Relocation and Right-of-way Acquisition Cost Methodology. The projected relocation and right-of-way acquisition costs include right-of-way costs for acreage and improvements required for actual construction, relocation costs, costs for acquiring structures and improvements due to lost access, and administrative fees. These costs were estimates based on field surveys. A windshield survey was conducted to evaluate the properties that would be impacted by the various working alignments.

The properties were categorized into ranges of values as shown on Table 5. The following statement regarding relocation procedures will be included in each Tier 2 EIS: "Final right-of-

way requirements have not yet been determined and are only estimated at this time. A home or business was considered displaced if it was located within the project right-of-way or if reasonable access to the property could not be maintained. The displacement of structures is estimated based upon predicted right-of-way requirements. These costs and relocation numbers are for comparison purposes only. They could change after more precise right-of-way requirements have been determined."

The costs shown in Table 5 will be adjusted in each Section to reflect local circumstances. These detailed cost estimate tables were used for estimation purposes only and are in the project file. The total right of way and relocation costs are reported in the EIS. Explanations of items in the table are included in the notes following the table:

Table 5 – Relocation and Right-of-Way Cost (Example)

I-69 Section X
Date:

TYPE	NUMBER (Properties)	COST	NUMBER RELOCATEES	ADMINIS TRATIVE FEE	RELOCATION COSTS	TOTAL COST
Residential-Sp	1	$10,000 (-)	1	$10,000	$20,000	$40,000
Residential-1	1	$10,000	1	$10,000	$20,000	$40,000
Residential-2	1	$20,000	1	$10,000	$20,000	$50,000
Residential-3	1	$50,000	1	$10,000	$20,000	$80,000
Residential-4	1	$75,000	1	$10,000	$20,000	$105,000
Residential-5	1	$100,000	1	$10,000	$20,000	$130,000
Residential-6	1	$125,000	1	$10,000	$20,000	$155,000
Residential-7	1	$150,000	1	$10,000	$20,000	$180,000
Residential-8	1	$200,000	1	$10,000	$20,000	$230,000
Residential-9	1	$250,000	1	$10,000	$20,000	$280,000
Residential-10	1	$300,000	1	$10,000	$20,000	$330,000
Residential-XXX	1	$600,000	1	$10,000	$20,000	$630,000
Farm Homestead	1	$300,000	1	$10,000	$20,000	$330,000
Multi-Family Housing	5	$35,000	1	$10,000	$8,000	$193,000
Church-1	1	$250,000	1	$10,000	$*	$
Church-2	1	$400,000	1	$10,000	$*	$
Church-3	1	$500,000	1	$10,000	$*	$
Gas Station	1	$500,000	1	$10,000	$*	$
Gas Station/Conv Store	1	$750,000	3	$10,000	$*	$
Specialty		$400,000	1	$10,000	$*	$
Commercial-1	1	$100,000	1	$10,000	$*	$
Commercial-2	1	$150,000	1	$10,000	$*	$
Commercial-3	1	$200,000	2	$10,000	$*	$
Commercial-4	1	$250,000	2	$10,000	$*	$
Commercial-5	1	$300,000	2	$10,000	$*	$
Commercial-6	1	$400,000	2	$10,000	$*	$
Commercial-7	1	$500,000	2	$10,000	$*	$
Commercial-8	1	$750,000	2	$10,000	$*	$
Bill Boards	1		1	$10,000	*	$

TYPE	NUMBER (Properties)	COST	NUMBER RELOCATEES	ADMINIS TRATIVE FEE	RELOCATION COSTS	TOTAL COST
Special (Large facility)		$0	0	$10,000	*	$0
Damages	NA	$3,500,000	0		*	$3,500,000
SUB-TOTAL						$
	Area (AC)			Unit Cost ($/AC)		
Aggregate Land Value Estimate		1		$10,000		$10,000
Unimproved Parcel Estimate**	10			$10,000		$100,000
SUB-TOTAL						$
TOTAL						**$**

* To be determined by estimator.
** Includes additional parcels and parcels without significant structures. This includes unimproved farmland, pasture and forest.

Notes for Table 5:

1) Cost estimates are in Year 2007 dollars. Final reported costs are given in 2010 dollars. The section following these notes explains how these adjustments were made.

2) This study assumes that the Administrative Fee per parcel is $10,000. The estimates for multi-family and commercial relocatees are modified based on individual circumstances. The Administrative Fee of $10,000 per parcel covers the cost of R/W Services. Right-of-way services include appraisals, reviews, buying, recording and property management. This figure is an estimate based on recent INDOT right-of-way acquisitions.

3) A relocation cost estimate of $20,000 per single-family residential relocation and $8,000 for each residential unit in a multi-family development is used as an average cost. This fee includes differential housing payments, closing expenses and other residential relocation benefits. This figure is an estimate based on recent INDOT relocation costs. The figure was revised if local circumstances warranted.

4) Utility-related costs for impacts to large transmission lines, service structures and substations include only land values. Actual utility relocation costs were estimated as part of construction costs, as described in Section 7.

5) Billboards are included in the R/W estimate and considered as individual parcels. Large business signs that are located on the business site are included as a part of the property acquisition at that site.

6) Commercial and industrial properties are considered to have sites large enough to support the only existing improvements. Excess land associated with a particular facility is included under aggregate land values.

7) Working farms are evaluated as businesses, separate from the household relocations. A farm is considered to be separate business relocation.

8) For illustrative purposes the commercial/office/industrial section is divided into eight (8) categories. These were adapted to suit the section being studied.

9) Commercial/office/industrial parcels may also include additional relocatees, such as tenants and related businesses.

10) Landlocked parcels and damaged parcels (where acquisition involves a portion of the property) are grouped under Damages. Landlocked parcels, land and homes without legal access to a road or highway are considered as being purchased. Parcels that are damaged by loss of value or utility such as parking, setbacks and other losses are noted and included under Damages.

11) Since analysis at the NEPA stage has limited title information, the estimator may have included additional parcels in the estimate to address possible title uncertainty. The estimator made this determination using the best available information.

12) Unimproved right-of-way is included in the aggregate land section. The aggregate land value is a weighted average of the land to be acquired within each section. The aggregate land value estimate is an average of the different land types (commercial, agricultural, residential, etc.) weighted and combined to derive a weighted average rate.

13) This will be a limited access facility. Access rights will be acquired as part of the project. Therefore any damages incurred were included in the right-of-way cost estimates.

Tier 2 Studies R/W Reporting Cost Adjustments. The value of property along with administrative costs and costs for relocation services were obtained in the Year 2007 and noted as the present value. For the Tier 2 studies, the values were adjusted to their expected value in the year 2010. Additional information was obtained to make projections of future property values for southwest Indiana.

For Tier 2 I-69 Sections 2 through 4, a 4.0% per year increase was applied to the Year 2007 total right-of-way and relocation costs to obtain Year 2010 costs. In Sections 5 and 6, a 4.5% per year increase was used.

These are average percent per year increases for the various types of property along the corridor, i.e., residential, farmland, developing land etc. It also is necessary to account for increases in administrative costs and relocation services associated with property acquisitions. These costs

are not increasing at the same rate as property values. INDOT estimates that these costs are increasing at approximately 1% per year.

In late 2009, the numbers used for inflation in the DEIS were reevaluated to determine if these assumptions were still accurate. The years 2005 through 2009 saw extreme price fluctuations in farmland values, with double digit increases in land values between 2005 and 2008, only to be followed by downturns or flat prices in late 2008 and 2009. Looking back historically on farmland values in Indiana, the average percent increase per year for the time period from 1975 to 2009 is between 3.5 and 4.0%. (Source: Indiana Land Values and Cash Rent, Craig L. Dobbins – Department of Agricultural Economics, Purdue University, reports from 2003 through 2009). The housing price indexes as determined by the Federal Housing Finance Agency for the three major metropolitan areas within the I-69 Corridor have also shown major fluctuations between 2005 and 2009. For the past 4 years, Bloomington has shown an average 3% increase per year, Evansville a 0.9% increase and Indianapolis a 1% increase per year. The 10 year housing price index from 1997 through 2006 which showed an average yearly increase between 4 and 5% for the project corridor is a more typical rate of increase for Indiana. Based upon these observations, it was decided that the yearly inflation rate of 4% for sections 1 through 4 and 4.5% for sections 5 and 6 should remain unchanged from the DEIS.

Following are the sources for the inflation rates used in the estimations above:

1) Office of Federal Housing Enterprise Oversight - 10 year House Price Index (1997-2006) for Indiana (including the Evansville, Bloomington and Indianapolis MSA's).
Bloomington MSA - 4.2% yearly increase in House Price Index for past 10 years
Indianapolis MSA - 4.1% yearly increase
Evansville MSA - 4.9% yearly increase
Indiana - 4.5% increase

2) Indiana Land Values and Cash Rent, Craig L. Dobbins - Department of Agricultural Economics, Purdue University, 2003 – 2009.
Percent Change in land values for top and average land (representative year):
Southwest Indiana - 3.5% to 5.3% (includes Vanderburgh, Gibson, Pike, Daviess and Greene Counties)
Southeast Indiana - 3.1% to 6.1% (includes Morgan and Monroe Counties)
Central Indiana - 6.3% to 6.4% (includes Johnson and Marion Counties)

3) INDOT Production Management Division - Real Estate (Estimates for administrative costs and relocation services) assume about a 1% increase per year. These costs make up about 10 to 20% of the total right-of-way and relocation cost.

The adjustments of R/W and relocation costs were determined by multiplying the Year 2007 cost by a factor to estimate their cost in Year 2010 dollars. For Sections 1 through 4, an adjustment factor of 1. 125 (3 years at 4%) was used. For Sections 5 and 6, an adjustment factor of 1.141 (3 years at 4.5%) will be used.

Section 7. Utility Relocation Costs

There has been ongoing coordination with local utilities regarding potential conflicts with their facilities. Where it was determined that a major utility (e.g. electric transmission lines, gas transmission pipelines, etc.) would need to be relocated due to the proposed construction, and if the relocation is determined to be eligible for reimbursement (i.e. the utility company has an easement for its facilities), then an estimated relocation cost was determined through consultation with that utility. The total cost of all necessary relocations for each alternative studied is the Utility Relocation Cost. Relocation costs developed for the Year 2007 were escalated and reported in 2010 dollars. Utility relocation costs in 2007 dollars were increased by 20% to show costs in 2010 dollars. About 11% of this is estimated by applying the INDOT construction inflation rate (3.5%/year) described in Section 3 of this appendix. The rest is a contingency to account for more refined plans that will be determined during design, for impacts to additional facilities which could not be identified at this time, or for new facilities built in the project area prior to the construction of the project. This approach would have given an increase in utility relocation cost of about 7% from 2007 to 2009. Given the level of design detail at this stage, it was deemed unnecessary to attempt to determine new costs for 2009.

Section 8. Mitigation Costs

The PMC was responsible for providing guidance regarding mitigation information (cost, amount, location, etc.) for all mitigation that will take place outside of the proposed right-of-way for each section (e.g. wetland mitigation, core forest mitigation, etc.). Much of this base information for determining costs was provided by INDOT. This section's study identified potential mitigation measures and associated costs for each proposed alternative, as well as mitigation that is to be applied to account for impacts within the section. Mitigation costs are estimated for entire sections, since they cannot meaningfully be broken down by subsection. See FEIS Chapter 7.4 for a discussion on these mitigation costs.