# Bonner Bridge - NC 12 Transportation Management Plan
# Phase II

## Pamlico Sound Bridge Corridor Cost Analysis

for

**NC 12 Replacement of Herbert C. Bonner Bridge**
**(Bridge No. 11) over Oregon Inlet**

TIP Project No. B-2500
Dare County, North Carolina

North Carolina Department of Transportation

**Final Report- Revised**
**October 24, 2012**

# Executive Summary

# Summary

## Purpose of Report

During the development of Phase II of STIP Project B-2500 (Replacement of the Herbert C. Bonner Bridge – NC 12 Transportation Management Plan), NCDOT was asked by the US Army Corps of Engineers (USACE) to provide an updated cost estimate and construction timeline for the Pamlico Sound Bridge Corridor (PSBC), an alternative that had been studied during the project's NEPA process. The USACE also requested that NCDOT identify any additional revenue sources that may be used to fund the project, outside of those previously identified during the NEPA process. The USACE and the Federal Highway Administration (FHWA) agreed that NCDOT should provide this information before moving forward with Phase II of the project.

In order to address the USACE's request, the department conducted a review of the costs and funding sources associated with the PSBC and STIP Project B-2500. This work included the following tasks:

- A review of all cost estimates for the PSBC developed during the project's NEPA process. This review included all construction, right-of-way, operations, and maintenance costs associated with the PSBC.
- Development of an updated (2012) cost estimate for the PSBC, accounting for changes in unit construction material prices, inflation, and in the design requirements and recommendations for a bridge in the PSBC. As part of this effort, NCDOT solicited independent construction cost estimates of the PSBC from three national contracting firms with experience in bridge construction projects. The product of this work is a list of costs associated with the construction and maintenance of the PSBC for the project's 50-year life.
- Using the updated cost estimates for the PSBC, NCDOT reviewed all federal and state funding sources that can be used to fund STIP Project B-2500 and determined the impact of the PSBC on the department's transportation budget.

Using the information listed above, NCDOT re-evaluated whether the PSBC is a reasonable and practicable alternative for STIP Project B-2500 and whether the determination of practicability that is included in the May 2010 Environmental Assessment is still valid. The following report is a summary of this effort.

## Overview of Cost Estimate History

Since the initial development of the PSBC in 2002, NCDOT has prepared a series of estimates that account for the costs associated with the actual construction of the PSBC, the purchase of property currently within the PSBC, and the operation and maintenance of a bridge within the PSBC over the project's 50-year life. These cost estimates (for the two alternatives within the PSBC) are summarized in **Table 1**.

**Table 1a. PSBC Curved Rodanthe Terminus**

| Year | Reason | Construction Cost | | Operations and Maintenance[2] | Right-of-Way |
|---|---|---|---|---|---|
| | | Low | High | | |
| 2003 | Preliminary Cost | $294,300,000 | | NA | $5,601,000 |
| 2005 | SDEIS | $416,800,000 | | $1,200,000 | $6,890,000 |
| 2007 | SSDEIS | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |
| 2007 | Verification | $997,000,000 | | NA | NA |
| 2008 | FEIS[1] | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |
| 2009 | Section 4(f)[1] | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |
| 2010 | EA & ROD[1] | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |

**Table 1b. PSBC Intersection Rodanthe Terminus**

| Year | Reason | Construction Cost | | Operations and Maintenance[2] | Right-of-Way |
|---|---|---|---|---|---|
| | | Low | High | | |
| 2003 | Preliminary Cost | $292,600,000 | | NA | $2,102,000 |
| 2005 | SDEIS | $414,200,000 | | $900,000 | $5,245,000 |
| 2007 | SSDEIS | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |
| 2007 | Verification | $997,000,000 | | NA | NA |
| 2008 | FEIS[1] | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |
| 2009 | Section 4(f)[1] | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |
| 2010 | EA & ROD[1] | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |

[1]No new estimates prepared; document utilized the SSDEIS estimate.

[2]All costs through 2060.

NCDOT reviewed each construction cost estimate prepared for the PSBC and the assumptions associated with each estimate. The changes in the construction cost estimates typically occurred for the following reasons:

- Changes in unit prices associated with bridge construction (the department estimates the construction cost of a bridge based on a cost per square foot of bridge deck), primarily due to inflation;
- The application of design-build, construction risk, and other inflationary factors, which were updated with each estimate based on other similar project bids nationwide; and
- Changes in design assumptions for a bridge in the PSBC, including the bridge's dimensions and terminus options.

The construction costs of the PSBC alternatives substantially increased between the 2005 SDEIS and 2007 SSDEIS. NCDOT revised the construction cost estimates prior to the SSDEIS based on both feedback from several contracting and consulting industry representatives who attended the Bonner Bridge Constructability Workshop in August 2006 as well as data on continuing inflationary pressure. The

SSDEIS estimate reflected changes to the unit construction material prices and the addition of design-build inflation factors to account for this construction delivery method. In order to determine the reasonableness of the SSDEIS construction cost estimate, NCDOT hired Finley Engineering in 2007 to conduct an independent preliminary construction cost estimate of the PSBC; the Finley Engineering estimate ($997 million) was consistent with those prepared by NCDOT.

The operations and maintenance cost estimates for the PSBC, which included the maintenance of the bridge and roadway portions of the project as well as traffic operations equipment recommended for long bridges, also increased substantially between the 2005 SDEIS and 2007 SSDEIS. The 2005 estimate was found to not adequately account for the inspection and maintenance effort that would be required for a 17.5-mile structure. The 2007 estimate was developed on a unit (per-mile) basis in order to account for the length of the structure and included the cost of annual bridge inspections and maintenance as well as a one-time major bridge rehabilitation during the 50-year project life.

The SSDEIS construction, right-of-way, and operations and maintenance cost estimates were not updated for the 2008 FEIS because the department still considered them valid. In 2009, FHWA determined that the PSBC was not a feasible and prudent avoidance alternative under Section 4(f) because the construction and maintenance of the PSBC presented a unique problem of extraordinary magnitude for the state of North Carolina. Therefore, the PSBC would not be carried forward for further detailed study. Following this decision, NCDOT did not prepare any further updated cost estimates for the PSBC prior to the approval of the December 20, 2010 Record of Decision (ROD).

## Post-Record of Decision Cost Estimates

Following the approval of the ROD, NCDOT determined that it was necessary to update the construction cost estimates for the PSBC in order to address agency concerns on the implementation of Phase II of STIP Project B-2500. NCDOT's first post-ROD construction cost estimate for the PSBC ranged between $573 million and $629 million for the Curved Rodanthe Terminus option and between $569 million and $625 million for the Intersection Rodanthe Terminus option (2011 dollars). The updated estimate was based on unit material costs and contingency factors that were only updated to account for inflation and bids on other comparable design-build projects. These new costs were between 39% and 55% lower than those estimates last developed for the SSDEIS. Because of the magnitude of the price decrease and the scope of the PSBC, NCDOT sought an independent review of the construction cost estimates, similar to the independent verification conducted by Finley Engineering in 2007.

NCDOT selected three consulting firms (AECOM Technical Services of NC, Michael Baker Engineering, and Armeni Consulting Services) with experience in the design and estimation of bridge replacement and design-build projects to provide new construction cost estimates for the PSBC. Each firm was asked to provide two estimates for the PSBC: the first, a simple update of the 2007 Finley Engineering estimate, accounting for current unit material prices only; the second, a more detailed update of the Finley Engineering estimate that accounts for both material price inflation and any changes in design and construction requirements (based on the B-2500 Phase I Final RFP) that were not included in the

original estimate. NCDOT provided each contractor with a copy of the Finley Engineering estimate and design details of the PSBC; they were not provided copies of any previous detailed NCDOT construction cost estimates.

A summary of the estimates provided by the three firms is included in **Table 2**; details on each firm's estimate are included in **Appendices C** and **D**.

**Table 2. Summary of 2012 Contractor Estimates for the PSBC**

| Firm | Task 1[1] | Task 2 |
|---|---|---|
| AECOM | $699,968,092 | $1,068,068,482 |
| Armeni | $749,868,482 | $1,017,719,740 |
| Baker | $809,258,154 | $1,024,832,643 |

[1]As shown in **Table 1**, Finley Engineering's original verification estimate, completed in 2007, was $997 million.

NCDOT then used the estimates from AECOM, Armeni, and Baker to develop a new construction cost estimate for the PSBC. The unit structure costs that are used in the NCDOT estimate are averages of the three contractor estimates and the winning design-build bid for Phase I of the project. In addition, the design-build escalation factor that was not included in the first post-ROD estimate was included in the revised estimate, based on input from the three firms. The revised NCDOT construction cost estimate is summarized in **Table 3**.

**Table 3. 2012 PSBC Cost Estimate**

| Cost Estimates | Alternative | | | |
|---|---|---|---|---|
| | Curved Rodanthe Terminus | | Intersection Rodanthe Terminus | |
| Construction | $878 million | $1.15 billion | $876 million | $1.146 billion |
| Operations and Maintenance[1] | $379 million | | $379 million | |

[1]All costs associated with a 50-year project life.

This estimate is between 6% and 18% lower than the construction cost presented in the FEIS. By using the input from three independent contractors and the existing bid on B-2500 Phase I, it is a reasonable estimate for the PSBC.

NCDOT also reassessed the operations and maintenance cost estimates associated with the 50-year life of the project; these costs include those associated with maintenance of the roadway approaches, annual inspection and maintenance of the bridge, one major bridge rehabilitation, and traffic operations equipment recommended for long structures. The estimated 50-year operations and maintenance cost for both alternatives within the PSBC is $379 million; 90% of this cost is the inspection, maintenance, and rehabilitation costs associated with the 17.5-mile bridge.

## Finance Analysis

STIP Project B-2500 is eligible for federal transportation funding under the federal Bridge Program, the National Highway System program, the Surface Transportation Program, and the Equity Bonus program. Approximately 80% of the initial construction cost of STIP Project B-2500 will be paid for using federal transportation dollars. The remaining 20% of the construction cost will be funded with state transportation dollars through the North Carolina Highway Trust Fund. The North Carolina Highway Fund will be used to fund the ongoing maintenance and inspection of the project after it is constructed.

The State Transportation Improvement Program (STIP) is the department's schedule for all major transportation improvement projects and their anticipated cost for a period of seven years. For the next STIP cycle (2014-2020), NCDOT estimates that $8.327 billion will be available to the department. The state's Equity Formula requires that STIP funds be distributed equitably among the department's 14 divisions using a formula that factors population and the number of intrastate highway miles requiring improvements. Based on the Equity Formula calculation for the next STIP period (2014-2020) and on funds remaining from previous STIP periods, NCDOT's Division 1 (the 14-county area within which STIP Project B-2500 is located) is estimated to have $953 million available for the seven-year STIP.

**Table 4** summarizes the construction, operations, and maintenance costs associated with the PSBC for a 50-year project life.

**Table 4. PSBC Construction, Maintenance, and Right-of-Way Cost Estimate (50-year project life)[1]**

| | **Curved Rodanthe Terminus** | | **Intersection Rodanthe Terminus** | |
|---|---|---|---|---|
| | **Low** | **High** | **Low** | **High** |
| Construction | $878 million | $1.15 billion | $876 million | $1.146 billion |
| Bonner Bridge Demolition | $10 million | | $10 million | |
| Right-of-Way[2] | $6,890,000 | | $5,245,000 | |
| Operations (Installation) | $5,085,000 | | $5,085,000 | |
| ***Subtotal (Initial STIP project)*** | **$900 million** | **$1.172 billion** | **$896 million** | **$1.166 billion** |
| Operations and Maintenance (Ongoing, 50-years) | $374 million | | $374 million | |
| **Total** | **$1.274 billion** | **$1.546 billion** | **$1.270 billion** | **$1.540 billion** |

[1] Does not include costs associated with wetland and SAV mitigation, which would be funded at the time of construction. Estimate does not include the additional non-highway public costs assessed in the SSDEIS and FEIS.

[2] SSDEIS estimate.

NCDOT would need to have between $900 million and $1.172 billion over the four-year estimated construction period to fund the Curved Rodanthe Terminus option and between $896 million and $1.166 billion available over the same period to fund the Intersection Rodanthe Terminus option. In view of the $953 million estimated to be available between 2014 and 2020, construction of the PSBC

would require at least 94% of the Division 1 budget for those years; that funding would have to be available not just within the seven-year STIP period, but specifically during the life of the construction contract. The estimated high cost of the PSBC would exceed the amount available to Division 1 by $219 million. The percentage of the total budget required would increase if NCDOT does not receive all of the revenue it estimates receiving for the 2014-2020 STIP. If the PSBC were implemented, and assuming the contract awarded was consistent with the department's low estimate for the project, only a few small bridge replacements or other small projects could be funded in Division 1 during the STIP period.

Previous NEPA documentation for STIP Project B-2500 determined that the use of alternative financing for the PSBC is not a viable option for this project. There is no new information on additional revenue sources or legislative changes that would alter this conclusion.

## Conclusions

The combined up-front construction, right-of-way, bridge demolition, and operations costs associated with the PSBC would require the use of at least 94% of the total Division 1 budget for the 2014-2020 STIP cycle, which would require NCDOT to postpone almost all planned projects in Division 1 until after 2020. This assumes that the winning bid for the PSBC is consistent with the department's low cost estimate for the project. Even if demolition of the existing Bonner Bridge and the installation of operations equipment were postponed to the next STIP period, the PSBC would still require at least 93% of the Division 1 budget. Construction of the PSBC would require the department to defer much needed maintenance improvements throughout the Division for a significant period of time. A decision to build a bridge within the PSBC is not reasonable in consideration of the projected bridge costs and the uncertainty in the Division 1 projected budget.

Phasing the construction of the PSBC over a longer time period is not a reasonable option, since the new bridge could not be opened to traffic until construction of the entire bridge was completed. Given that the existing bridge has an extremely low sufficiency rating and is rapidly approaching the end of its service life, phasing the completion of the project over multiple STIP periods is not an acceptable option for the department.

While there is uncertainty as to the amount of future federal and state revenues available to NCDOT's transportation program budget, there are no indications that the department's financial resources will increase to the level necessary to support the construction of the PSBC and allow the department to meet the most basic project needs of Division 1. The federal MAP-21 legislation, enacted in 2012, provided Federal funding at levels similar to those in recent years under the previous SAFETEA-LU legislation. Therefore, the construction of a bridge in the PSBC would still present a unique problem of extraordinary magnitude to NCDOT, reaffirming the conclusions in the 2009 Revised Final Section 4(f) Evaluation and the 2010 Environmental Assessment that the PSBC is neither a prudent nor practicable alternative.

NCDOT conducted an analysis of possible innovative financing options for the PSBC during the NEPA process for STIP Project B-2500; there are no innovative financing options (loans, bonds, tolls) that would entirely support the construction cost of the PSBC.

Based on the information gathered during this inquiry, the department's conclusion that the PSBC is not a prudent or practicable alternative, based on its construction cost and the potential impacts to the department's budget, remains valid.

# A Review of Cost Estimates for the Pamlico Sound Bridge Corridor Alternatives

# A Review of Cost Estimates for the Pamlico Sound Bridge Corridor Alternatives

## Introduction

The Pamlico Sound Bridge Corridor (PSBC) alternatives were first developed in 2002 for STIP Project B-2500 on the basis of several screening criteria; the development of the PSBC is discussed in detail in the project's Final Environmental Impact Statement (FEIS). The NEPA/Section 404 Merger Team selected the PSBC to be studied in detail in the SDEIS on February 12, 2003.

The PSBC begins on Bodie Island near the existing northern terminus of Bonner Bridge, extends into the Pamlico Sound, bypasses the PINWR and ends north of the emergency ferry dock in Rodanthe (FEIS Figure 2-11). There are two alternatives within the corridor, which differ only at their southern terminus: the ***Pamlico Sound Bridge Corridor with Curved Rodanthe Terminus*** rejoins NC 12 via a curve that connects the bridge directly with NC 12 in Rodanthe (FEIS 2-90); and the ***Pamlico Sound Bridge Corridor with Intersection Rodanthe Terminus***, which ends at a signalized intersection north of the Liberty Service Station (FEIS 2-90). A bridge in the PSBC would be approximately 17.5 miles (28.2 kilometers) in length; if constructed, it would be one of the longest bridges in the world.

This section documents the construction, operations and maintenance cost estimates that have been prepared for the PSBC since its development in 2002. These cost estimates are summarized in **Table 1**.

**Table 1a. PSBC Curved Rodanthe Terminus**

| Year | Reason | Construction Cost | | Operations and Maintenance[2] | Right-of-Way |
|---|---|---|---|---|---|
| | | Low | High | | |
| 2003 | Preliminary Cost | $294,300,000 | | NA | $5,601,000 |
| 2005 | SDEIS | $416,800,000 | | $1,200,000 | $6,890,000 |
| 2007 | SSDEIS | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |
| 2007 | Verification | $997,000,000 | | NA | NA |
| 2008 | FEIS[1] | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |
| 2009 | Section 4(f)[1] | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |
| 2010 | EA & ROD[1] | $933,500,000 | $1.4 billion | $356,400,000 | $6,890,000 |

**Table 1b. PSBC Intersection Rodanthe Terminus**

| Year | Reason | Construction Cost | | Operations and Maintenance[2] | Right-of-Way |
|---|---|---|---|---|---|
| | | Low | High | | |
| 2003 | Preliminary Cost | $292,600,000 | | NA | $2,102,000 |
| 2005 | SDEIS | $414,200,000 | | $900,000 | $5,245,000 |
| 2007 | SSDEIS | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |

| | | | | | |
|---|---|---|---|---|---|
| 2007 | Verification | $997,000,000 | | NA | NA |
| 2008 | FEIS[1] | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |
| 2009 | Section 4(f)[1] | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |
| 2010 | EA & ROD[1] | $929,100,000 | $1.4 billion | $356,100,000 | $5,245,000 |

[1]No new estimates prepared; document utilized the SSDEIS estimate.

[2]All costs through 2060.

## Initial Estimates

### *Construction*

NCDOT first estimated the construction cost of the PSBC in 2003 to be $260,000,000 (January 16, 2003 estimate). NCDOT assumed the following in developing the construction cost estimate:

- The low-rise portion of the bridge (non-navigation zone) was priced at a unit cost of $55/ft$^2$ for sections constructed from a barge and $60/ft$^2$ for sections constructed from a temporary work bridge. This unit price was based on recent (as of 2003) NCDOT contracts issued for projects that involved long bridges, including the Chowan River project and the Virginia Dare Memorial Bridge project, both of which had unit costs ranging $50-$55 per square foot of structure. The estimates assumed that work bridges would be required within the areas of Pamlico Sound that contain SAV or SAV habitat, most likely at each end of the PSBC; outside of those areas, NCDOT assumed that construction from a barge could be used.
- The high-rise portion of the bridge (navigation area) was priced at $180/ft$^2$.
- The total length of the project, according to the estimate, was 17.1 miles. Approximately 3.2 miles of the project (the northern and southern approaches) would be constructed from a work bridge; the work bridge itself was priced at a cost of $25/ft$^2$. The remainder of the bridge would be constructed from barges.
- The width of the bridge deck was 36 feet, allowing for two 12-foot travel lanes and two 6-foot shoulders.
- A construction contract time of 4 years.

NCDOT later revised the construction cost estimate for the PSBC to account for the two Rodanthe terminus alternatives within the corridor; the estimated cost was updated to $294,300,000 for the Curved Rodanthe Terminus option and $292,600,000 for the Intersection Rodanthe Terminus option (October 17, 2003 estimate). The only assumptions that changed from the previous estimate were an increase in bridge length to 17.5 miles (with an additional 0.7-1.0 miles of roadway approach work) and a 4-foot increase in the total width of the bridge deck (to account for 8-foot shoulders on both sides of the bridge).

### *Operations and Maintenance*

As of 2003, NCDOT had not yet estimated the operations and maintenance costs of the PSBC.

***Right of Way***

NCDOT would be required to purchase the properties in Rodanthe that would be impacted by either of the Rodanthe terminus options for the PSBC. NCDOT's initial estimates of the right-of-way acquisition cost for the PSBC included $5,061,000 for the Curved Rodanthe Terminus option and $2,102,000 for the Intersection Rodanthe Terminus option (October 2, 2003 estimate).

## 2005 Supplemental Draft Environmental Impact Statement (SDEIS)

The following table summarizes the PSBC estimates presented in the 2005 SDEIS.

**Table 2. 2005 ESTIMATED COSTS OF PAMLICO SOUND BRIDGE- SDEIS**

| Cost Estimates | Alternative | |
|---|---|---|
| | Curved Rodanthe Terminus | Intersection Rodanthe Terminus |
| Construction | $416.8 million | $414.2 million |
| Operation / Maintenance[1] | $1.2 million | $900,000 |
| Right-of-Way | $6,890,000 | $5,245,000 |

[1]Developed through the year 2060.

***Construction***

NCDOT updated the construction cost estimates of both PSBC alternatives prior to the publication of the SDEIS in September 2005; the construction cost for the Curved Rodanthe Terminus option was estimated at $416,800,000 while the Intersection Rodanthe Terminus option was estimated at $414,200,000 (March 22, 2005 estimate). The 2005 estimates were generated by updating the October 2003 estimate to account for inflation only; NCDOT did not conduct any further review of the unit prices included in the estimate.

The inflation adjustment resulted in the following changes to the unit prices:

- $55/ft$^2$ increased to $89/ft$^2$ for low-rise portion constructed from a barge;
- $60/ft$^2$ increased to $97/ft$^2$ for low-rise work portion constructed from a work bridge; and
- $180/ft$^2$ increased to $292/ft$^2$ for segmental high-rise construction (navigation section).

Because the purpose of the 2005 estimate was only an adjustment for inflation, there were no changes made to the design or construction assumptions included in the estimate.

***Operations and Maintenance***

NCDOT first estimated the operations and maintenance costs for the PSBC over the project's 50-year design life in 2005; the operations and maintenance costs were estimated to be between $900,000 and $1,200,000, depending upon the Rodanthe terminus option.

***Right of Way***

NCDOT updated its right-of-way cost estimates for the PSBC in 2005; the new estimates account for changes in the number of residences and land values since the 2003 estimate. The estimated costs were $5,245,000 for the Intersection Rodanthe Terminus option and $6,890,000 for the Curved Rodanthe Terminus option (July 21, 2005 estimate).

## 2007 Supplement to the 2005 SDEIS (SSDEIS)

The following table summarizes the PSBC estimates presented in the 2007 SSDEIS. The SSDEIS construction costs are based on an estimate originally developed in September 2006 and updated in February 2007.

**Table 3. ESTIMATED COSTS OF PAMLICO SOUND BRIDGE- SSDEIS**

| Cost Estimates | Alternative | | | |
|---|---|---|---|---|
| | Curved Rodanthe Terminus | | Intersection Rodanthe Terminus | |
| Construction | $933.5 million | $1.4 billion | $929.1 million | $1.4 billion |
| Operation / Maintenance[1] | $356.4 million | | $356.1 million | |
| Right-of-Way | $6,890,000 | | $5,245,000 | |

[1]Developed through the year 2060.

***Construction***

Several months prior to issuance of the SSDEIS, NCDOT determined that the construction cost estimates were in need of further revision and refinement. The department's updated preliminary construction cost estimates ranged from $916,500,000 to $1,397,500,000 for the Curved Rodanthe Terminus option and $913,100,000 to $1,392,100,000 for the Intersection Rodanthe Terminus option (September 13, 2006 estimate).

The September 2006 estimate reflected several revisions and changed assumptions from the SDEIS estimate. The department re-evaluated the unit prices used on the estimates for all of the alternatives for Project B-2500 largely based on feedback from both the contracting and consulting industry representatives who attended the Bonner Bridge Constructability Workshop in August 2006 as well as data on continuing inflationary pressure. Assumptions made in 2005 that related to economies of scale

were determined to be invalid and eliminated from the estimate. Additionally, NCDOT determined that the PSBC would be constructed under a Design-Build contract (as opposed to traditional Design-Bid-Build project delivery method) due to the project's scope and unique construction challenges. The estimate was revised to include inflation factors traditionally associated with Design-Build contracts, including inflation for all preconstruction activities that will be included in the contract and a 10% risk and additional inflation in prices that would occur between contract award and the acquisition of permits and commencement of construction.

The September 2006 estimate also includes, for the first time, a "low" and "high" estimate to account for the amount of segmental bridge superstructure that a contractor may opt to use in construction of a bridge in the PSBC. Previous estimates had only accounted for segmental construction in the navigation section of the PSBC, but contractors may opt to use segmental bridge girders for a higher percentage of the bridge in order to streamline construction of the bridge. Using a cost range was also designed to help the department account for other variables that influence construction costs; these variables are summarized in Section 2.3.1.1 of the SSDEIS.

NCDOT made the following revisions to the unit prices in the September 2006 "low" estimate (as compared to the SDEIS estimate):

- $\$89/ft^2$ adjusted to $\$140/ft^2$ for low-rise conventional work from a barge;
- $\$97/ft^2$ adjusted to $\$130/ft^2$ for low-rise conventional work from a work bridge;
- $\$292/ft^2$ for segmental high-rise (navigation) construction adjusted downward to $\$252/ft^2$ to be consistent with other segmental bridge construction contracts;
- $\$25/ft^2$ for the work bridge adjusted to $\$30/ft^2$.

The following revisions to the unit prices were made to the "high" estimate:

- $\$89/ft^2$ adjusted to $\$220/ft^2$ for low-rise work from the barge;
- $\$97/ft^2$ adjusted to $\$210/ft^2$ for low-rise work from the work bridge.

The September 2006 estimate did not reflect any changes to the design of the PSBC alternatives.

NCDOT revised the estimates in February 2007 prior to the publication of the SSDEIS (February 12, 2007 estimate); the SSDEIS then presented these revised high and low construction cost estimates. For the Curved Rodanthe Terminus alternative, the total construction cost estimate ranged from a low of $933.5 million to a high of $1.4 billion. For the Intersection Rodanthe Terminus, the total construction cost estimate ranged from a low of $929.1 million to a high of $1.4 billion. The final SSDEIS estimate included costs for vehicle "turnout" areas that were recommended during the 2006 safety analysis of comparable long bridges. Vehicle "turnout" areas have a wider shoulder section for use by emergency vehicles and others in accident situations and are intended to minimize traffic disruption. A turnout was added for each 3-3.5 mile section of bridge for both the PSBC and all other project alternatives at a cost of $10,080,000 each.

***Operations and Maintenance***

NCDOT updated the road and bridge operations and maintenance cost estimate for the PSBC in 2006; the estimate included costs for recommended traffic operations equipment as well as annual maintenance of the roadway approach sections and the bridge structure. The operations and maintenance estimate for the Curved Rodanthe Terminus option was $356.4 million; the Intersection Rodanthe Terminus option was priced at $356.1 million. The increase in operations and maintenance costs was primarily due to the substantial increase in the estimates for maintenance of the bridge itself; the department realized that the previous estimates did not adequately account for the amount of time and effort needed to inspect and maintain a 17.5-mile structure. The revised estimates were developed on a unit (per-mile) cost in order to account for the length of the structure and included both the annual inspection and maintenance of the structure as well as a one-time major rehabilitation of the bridge during the 50-year project life.

***Right of Way***

The right-of-way cost estimates for the PSBC were not updated for the SSDEIS.

## 2007 Estimate Verification (Finley Engineering)

Prior to the approval of the SSDEIS, Finley Engineering, a national bridge construction contractor, was hired to perform an independent preliminary construction cost estimate for both the PSBC and the Parallel Bridge Corridor alternatives that included bridges. Using the construction material quantities provided by NCDOT (based on the current design of the PSBC), Finley Engineering generated a new cost estimate for a bridge in the PSBC (the estimate did not distinguish between the two PSBC alternatives). Finley used the designs of the new I-10 bridge in Pensacola and the I-10 bridge over Lake Pontchartrain to generate detailed quantities to augment those provided by NCDOT while also using past industry experience to determine the most common component types that a contractor would bid for these types of projects. Finley's cost estimate for the PSBC, at $997 million, was consistent with those prepared by NCDOT in 2007.

The Federal Highway Administration (FHWA) conducted its own assessment of the NCDOT and Finley Engineering cost estimates. Staff from FHWA headquarters with expertise in bridge design and construction reviewed both the NCDOT and Finley Engineering estimates and determined that they were reasonable, and that they would likely increase over time due to the increase in the cost of construction materials. The 2007 independent analysis of the construction cost estimates was detailed in the minutes to the June 20, 2007 Merger Team meeting (minutes dated July 3, 2007).

## 2008 Final Environmental Impact Statement (FEIS)

Because NCDOT typically considers as valid cost estimates that are no greater than two years old, the construction cost estimates for the Pamlico Sound Bridge Corridor were not updated for the 2008 FEIS. The construction, operations and maintenance, and right-of-way cost estimates presented in the 2007 SSDEIS remained unchanged and were acceptable for inclusion in the 2008 FEIS.

## 2009 Revised Final 4(f) Evaluation; 2010 Environmental Assessment; 2010 Record of Decision

In the 2009 Revised Final 4(f) Evaluation, FHWA assessed whether the PSBC could be considered a "feasible and prudent avoidance alternative" under Section 4(f) of the Department of Transportation Act of 1966. An "avoidance alternative" is one that avoids the use of 4(f) properties, such as historic sites or publicly-owned parks, recreation centers, and wildlife refuges, and it "does not cause other severe problems of a magnitude that substantially outweighs the importance of protecting the Section 4(f) property" (23 CFR 774.17).

Appendix G of the 2009 Revised Final 4(f) Evaluation details FHWA's decision that the PSBC would not be a "feasible and prudent avoidance alternative." The core reasons underlying that decision were as follows: the construction costs of the PSBC would be of extraordinary magnitude in consideration of the funding available to NCDOT; implementation of the PSBC in a single construction contract would create a unique maintenance problem of extraordinary magnitude for NCDOT as it would have to defer much needed improvements on the remainder of the state highway system; and the PSBC would also result in severe impacts to the ability to access the PINWR. (EA, App. B-159). FHWA used the construction, operations and maintenance, and right-of-way costs included in the 2008 FEIS in its Revised Final 4(f) Evaluation.

Based upon the feasible and prudent analysis conducted by FHWA and documented in the 2009 Revised Final 4(f) Evaluation, FHWA determined that the Pamlico Sound Bridge Corridor was not a feasible and prudent avoidance alternative, and therefore, would not be carried forward for further detailed study following the 2009 Revised Evaluation. This decision was further documented in the EA. Based on this decision, an updated construction cost estimate for the Pamlico Sound Bridge Corridor was not developed for inclusion in the 2010 Environmental Assessment (EA) or the Record of Decision (ROD).

## Bonner Bridge Demolition

The SSDEIS and FEIS included a separate line item cost for the demolition and removal of the existing Bonner Bridge. This cost was estimated at $4 million (2006 dollars). As discussed in the FEIS, the demolition cost could vary greatly depending upon the disposal site for the bridge components.

# NCDOT Construction Cost Estimate Process

# NCDOT Construction Cost Estimate Process

## General Process

NCDOT employs professional staff to generate periodic construction cost estimates for all of its projects. The department's process for estimating construction cost is both technical and subjective, based on professional experience and judgment, with a data analysis that considers anticipated risks and contingencies.

A project's construction cost depends upon its proposed scope, design, and location. NCDOT first uses the design of the project to generate a list (including the quantity) of the different types of material or activity that will be required for construction (clearing and grubbing, bridge deck, pavement markers, etc.). Unit prices for each line item are then generated based on historical bid data and other statistical project parameters. The unit cost of each line item accounts for both the price of the materials needed and for the labor required to perform the task.

Once the subtotal cost for all line items is summed, a percentage of the subtotal is then added to the estimate to account for contractor mobilization at the project site. Additional contingency factors (a percentage of the overall cost) are then applied to an estimate to account for future change orders that may occur due to incorrect quantities or unit costs, the possibility of unknown conditions or events, and unforeseen project requirements, all of which can vary based on the project's location and scope. The application of contingency factors allows the department to establish realistic project budgets that account for potential risks. **Table 4** lists potential risk factors of project construction that may need to be accounted for in a construction cost estimate.

**Table 4. Construction Risk Factors**

| | |
|---|---|
| Schedule time (extra cost for expedited work, timing restrictions, time of year, A+B bids) | Project setting – remoteness, urban or rural setting, physical constraints, |
| Unknown risks/potential change orders | Environmental issues and/or mitigation needs |
| Availability of materials | Geotechnical issues |
| Availability of contractors | Potential for poor soil conditions |
| Project size | Railroad, utility issues |
| Traffic control issues | |

If the department determines that a project should be constructed using the Design-Build delivery method (the contractor is responsible for both the final design and construction of the project, as opposed to just the project's construction), an additional contingency factor is included in the construction cost estimate. The design-build factor accounts for the cost of additional preliminary

engineering, environmental analysis, and permitting work that will be required by the contractor prior to the start of construction. This factor is adjusted for inflation up to the mid-point of the overall contract to account for any changes that may occur in material prices during that time and depends upon the anticipated total contract length. The design-build inflation factor is based on bids for other design-build contracts that NCDOT has received for projects statewide and is updated regularly.

Two methods are generally used to develop construction cost estimates: historical (bid-based) estimating or cost-based estimating.

***Historical (Bid-Based) Estimating Process***

Historical or bid-based estimating is the most prevalent method practiced by state agencies across the country.[1] This method uses data from recently awarded contracts nationwide as a basis to determine the unit prices for each line item. NCDOT maintains databases with years of historical data for different project types and locations. An estimator can access the data to adjust a project's unit prices to account for project site specifics (project scope, location, geography, material quantities and availability, schedule, market conditions) and potential risks.

Historical or bid-based estimating can utilize a square foot cost approach, a quantities approach, or a combination of the two. The square foot approach means that an estimate is based on the dimensions of the project- a square foot unit cost is applied to the area (length multiplied by width) of a bridge or roadway section. The quantity approach assigns unit costs for each material involved in the operation (asphalt, pavement markings, etc.). NCDOT typically uses the square foot approach when estimating the cost of bridge projects. Bridge costs per deck area (usually in dollars per square foot) are derived using bid data for typical bridge types and span lengths together with location characteristics (over land or water). Since the cost per square foot of bridge deck area varies based on the type of structure itself, the department often uses a range of unit costs for the bridge deck.

***Cost-Based Estimating***

Cost-based estimating requires dividing each project into the individual tasks necessary to complete the project. A cost estimate is then developed for each task. Each task estimate normally consists of six basic elements: Time, Equipment, Labor, Material, Overhead and Profit. Since contractors generally utilize a Cost-Based Estimating approach to prepare bids, this method may provide more accurate costs to support a contract award or rejection as well as any future price negotiations with the contractor after contract award. Properly prepared cost-based estimates require significantly more effort, time, and skill to prepare than historic bid-based estimating. Even agencies that routinely utilize cost-based estimates typically do so for only those items that comprise the largest dollar value of the project. In order to successfully implement cost-based estimating, the estimators must have expertise in construction

[1] **"A Practical Guide to Estimating"** Prepared by: AASHTO Technical Committee on Cost Estimating, July 9, 2009.

methods, including the use of equipment, manpower, material and scheduling. Detailed records of actual equipment and manpower production rates on past construction contracts are also helpful for providing data from which to base estimating assumptions for contracts being let.

***Pamlico Sound Bridge Corridor Estimates***

Major projects such as the PSBC pose challenges (scope, location, availability of materials, haul distance, etc.) that exceed the historical estimate data available to the department. However, even for a project of this magnitude, NCDOT still considers the historical or bid-based estimate method as a reasonable method to provide a preliminary construction cost estimate. NCDOT can, as needed, utilize data from independent contractors to develop a reasonable construction cost estimate of projects of the magnitude of the PSBC.

## Conventional versus Segmental Bridge Type

The unit price used to estimate the cost of the bridge portion of a project is dependent in part upon the type of superstructure assumed in the design. The PSBC, as with other bridge alternatives across Oregon Inlet, could utilize a conventional superstructure, a segmental superstructure, or a combination of the two.

A conventional superstructure typically includes a series of precast (formed offsite) I-beam girders (concrete or steel) on top of which the bridge deck is cast. The girders can be mass produced offsite in order to lower their cost. The deck is then cast in place on top of the girders, forming the superstructure into a single unit. While this type of superstructure is lower in cost and may be faster to construct, it may require the use of multiple temporary work bridges or barges to install both the girders and to cast the deck, potentially increasing the temporary construction impacts to the environment.

A segmental superstructure consists of a concrete hollow box girder, the top of which is the bridge deck itself. The box segments are precast offsite and must be assembled at the construction site. Because each box segment must precisely connect with the next, contractors traditionally opt to precast these segments closer to the actual construction site in order to ensure quality. While more expensive than conventional girders, segmental spans can be precast at longer lengths than traditional I-beam girders and are therefore ideal for navigation sections of bridges (the longer span lengths minimize the amount of bridge substructure that has to be located within the navigable waterway). The use of segmental bridge sections also allows the contractor to assemble a section of the bridge, then use that section as the work bridge from which to attach the next box segment. This minimizes, if not eliminates, the need for work bridges or as many barges in that section.

In its estimates, NCDOT assumed that the section of a bridge in the PSBC that would span the navigable section of the inlet would be constructed with a segmental superstructure due to the height of the

bridge[2] and the ability to form longer span lengths with a segmental superstructure. The remainder of the bridge would be constructed using conventional I-beam girders. A contractor could opt to use a segmental superstructure for a longer section of the bridge depending upon the method of construction that the contractor opts to use.

Additional information about the superstructure assumptions for the PSBC can be found in Section 2.9 of the FEIS.

## Design-Build Construction

NCDOT constructs projects using one of two project delivery methods: design-bid-build or design-build. The design-bid-build process, also referred to as a "traditional letting," involves awarding a contract for the project's construction only after NCDOT completes the final design of the project, receives all environmental permits, and acquires all right-of-way. By contrast, the design-build method awards a single construction contract that also includes the project's final design, the preparation of environmental permit applications, and the determination of the final right-of-way needed for the project (NCDOT will still acquire the right-of-way). A design-build committee within NCDOT determines which projects will be constructed using the design-build delivery method. According to the department's Design-Build Policy and Procedures document (October 2011), a project may considered for design-build if it falls within at least one of the following categories:

1. "Projects where design and construction need to be expedited for the public good or to capitalize on advanced or specific funding opportunities.
2. Emergency Projects.
3. Projects with complex constructability or traffic phasing issues.
4. Projects affording opportunities for innovation.
5. Unusual projects that do not lend themselves to normal design-bid-build procedures."

In addition, new location projects, large interstate widening or rehabilitation projects, projects with heavy traffic volume, and large or unique bridge projects are particularly suited to the design-build process.

The PSBC, due to its scope and location on two coastal barrier islands, includes construction challenges and potential for innovation that would best be served through the design-build delivery method. Therefore, the PSBC would be constructed through the design-build process. NCDOT began including a design-build escalation factor in its construction cost estimates for the PSBC and other alternatives for project B-2500 in 2006, during the time that NCDOT was developing its design-build program.

[2] The U.S. Army Corps of Engineers has required that the portion of the bridge over the navigable waters within Oregon Inlet provide at least 70 feet of clearance above the mean high water line.

# Post-Record of Decision Construction Cost Estimates

# Post-Record of Decision Construction Cost Estimates

Following the approval of the December 20, 2010 Record of Decision (ROD), NCDOT updated the construction cost estimates for the Pamlico Sound Bridge Corridor (PSBC) in part to address agency concerns on the implementation of Phase II of STIP Project B-2500. The post-ROD estimate process included an independent verification process similar to that conducted by Finley Engineering in 2007.

## November 2011 Estimate

**Table 5** summarizes the construction cost estimate that NCDOT developed in November 2011. A "low" and "high" cost for each alternative was prepared, consistent with previous estimates for the PSBC.

**Table 5. 2011 PSBC Construction Cost Estimate**

| Cost Estimates | Alternative | | | |
|---|---|---|---|---|
| | Curved Rodanthe Terminus | | Intersection Rodanthe Terminus | |
| Construction | $573 million | $629 million | $569 million | $625 million |

NCDOT generated the new cost estimate for the PSBC by updating the unit prices in the SSDEIS construction cost estimate, which was completed in February 2007. The square-foot bridge unit cost, other material unit costs, and the contingency and design-build factors were updated based on inflation and the most recent historical bid prices on other design-build projects. No changes were made to the design of the PSBC alternatives for the purposes of this estimate.

In the SSDEIS estimate, NCDOT assumed two sets of unit structure prices to determine the "high" and "low" construction costs of the PSBC, in part to allow for the use of segmental bridge construction outside of the high-rise navigation section. For the 2011 estimate, only one set of unit structure prices was used. The "high" and "low" estimate was developed instead by varying the preliminary engineering and risk inflation factors that are applied to all design-build estimates; this method of determining the cost estimate range was supported by design-build project bids that NCDOT received since 2007. As a result, the revised 2011 estimate reflected the following changes to unit prices and inflation factors:

- Due to the economic downturn that began in 2008, the unit square-foot bridge costs dropped an average of 25% from those used in the SSDEIS "low" estimate. The unit cost for low-rise construction from a barge decreased from $\$140/ft^2$ to $\$100/ft^2$, while the unit cost for low-rise construction from a work bridge decreased from $\$130/ft^2$ to $\$95/ft^2$. The segmental, high-rise (navigation) construction unit cost dropped from $\$252/ft^2$ to $\$180/ft^2$. The changes in unit prices are illustrated by the Construction Cost Index (Appendix A).
- In previous design-build construction cost estimates, NCDOT listed a separate escalation factor to account for the escalation of material costs through the mid-point of construction. However, design-build project bids did not support the use of a separate escalation factor for this risk.

Instead, escalating costs were considered to be included in the high/low risk factors typically assigned design-build projects, and the separate line item for cost escalation to mid-construction was eliminated. For the "low" estimate, a 5% preliminary engineering cost and a 5% risk factor were included in the estimate; the "high" estimate includes a 10% preliminary engineering cost and 10% risk factor.

The estimate does not account for the following design considerations:

- A Corrosion Protection Plan was not accounted for in this estimate. The Corrosion Protection Plan, stipulated in the B-2500 Phase I Final Request for Proposals (RFP) (see p. 59) prescribes the minimum corrosion protection measures to be used on this project with the intent to provide a minimum 100 year service life. This plan was not accounted for in this estimate and could add as much as 10% to the total cost.
- Also, while cast-in-place deck slabs as primary structural members, precast girders with an integrally cast deck and/or voided slabs (cored slabs or box beams), were not allowed in the B-2500 Final RFP, no ruling had been made at the time concerning the Pamlico Sound Corridor Bridge (outside the Oregon inlet area), and contributed to the low range unit costs. The use of cored slabs could reduce the unit structure cost to approximately \$80-85/$ft^2$.
- Some economy of scale and savings through innovation (similar to the use of the building gantry system that was developed for the Washington Bypass bridge project) were also anticipated for a 17.5-mile long bridge. The estimate was lowered approximately 5% to account for potential innovation.

The November 2011 estimate (**Appendix B**) priced the construction of the Curved Rodanthe Terminus Option at \$573 million - \$629 million and the Intersection Rodanthe Terminus option at \$569 million - \$625 million. These new costs were between 39% and 55% lower than those developed for the SSDEIS. Because of the magnitude of the price decrease and the scope of the PSBC, NCDOT conducted another independent review of the construction cost estimates.

## 2012 Estimate Verification

NCDOT selected three consulting firms with experience in bridge replacement and design-build projects to provide new construction cost estimates for the PSBC. The three firms – AECOM Technical Services of NC, Michael Baker Engineering, and Armeni Consulting Services – have extensive experience estimating major bridge construction projects. Each firm was asked to provide two cost-based construction estimates: the first was a simple update of the 2007 Finley Engineering estimate to account for current unit prices; the second was a more detailed update of the Finley Engineering effort to include changes in design and construction requirements (based on the B-2500 Phase I Final RFP) that were not included in the original estimate.

Because the focus of this assessment was on the 17.5 miles of bridge within the PSBC, the firms did not distinguish between the two Rodanthe terminus options within the corridor. Instead, each firm provided a single estimate for the PSBC itself.

***Task 1***

NCDOT first asked each of the three firms to update the 2007 Finley Engineering estimate only to account for inflation and other changes in unit construction quantity prices. To complete the first construction cost estimate, NCDOT provided each of the three teams with the following information:

- The 2007 Finley Engineering construction cost estimate;
- The original Scope of Services for the Finley Engineering estimate;
- A summary of the construction quantity assumptions made by Finley Engineering in developing its estimate;
- The preliminary design (structure plans) of the Parallel Bridge (Phase I); and
- A copy of all transmittal correspondence between NCDOT and Finley Engineering.

In addition, each firm was provided with copies of the B-2500 2008 Final Environmental Impact Statement for additional detail on the PSBC. The firms were not provided copies of any detailed NCDOT construction cost estimates for the project.

The firms were instructed to update each unit price to current (2012) dollars and to use the new unit prices and construction quantities to develop a new cost estimate. Each firm was to note any potential concerns with the quantity information provided and to estimate an additional design-build inflation factor that would incorporate additional cost due to preliminary engineering work, risk, and the construction schedule/ delivery method. The firms were instructed not to revise the preliminary design of the PSBC or to otherwise make any changes in the design assumptions for the purposes of this estimate.

***Task 2***

NCDOT then asked each firm to submit a new estimate for the PSBC; this estimate should account for changes in design standards, department design requirements, and any design changes that the firm may recommend in 2012 that may not have been in place at the time of the 2007 Finley Engineering estimate. The unit costs associated with each quantity should be adjusted accordingly. While the firms were asked to specify these design recommendations, they were not allowed to prepare any new designs for the PSBC.

The firms were asked to account for costs of the following items in their estimates:

- A corrosion protection plan consistent with that included in the B-2500 Phase I RFP-Structures Scope of Work; the intent of this plan was to provide a minimum 100 year bridge service life;
- A revised navigation (high-rise) zone as found in the B-2500 Phase I Final RFP;

- A fishing pier, as stipulated in the B-2500 Phase I Final RFP. Each firm could opt to use a portion of the existing Bonner Bridge for this fishing pier, or construct a new pier;
- A new structure that combined the use of conventional and segmental construction, as was used in the winning bid for B-2500 Phase I. The Finley Engineering estimate assumed entirely segmental construction;
- The latest foundation assumptions. The firms could opt to use the Finley Engineering estimate for all segmental construction, or the winning Phase I bid for a combination of conventional/segmental construction. Additional foundation recommendations were provided by NCDOT's Geotechnical Engineering Unit;
- The use of dredging for up to 8 miles of the 17.5-mile alternative (as stated in the FEIS);
- Finley Engineering's estimate for the inclusion of conduit for ITS and telephone lines on the new structure. Separate utility relocation costs were not required;
- Based on a review of the B-2500 Phase I Final RFP, the winning bid design, and engineering technical memorandums prepared during the planning process, include any other possible major cost-inducing factors that may need to be added to the scope of work that are not included in the Finley Engineering estimate; and
- Any effect of the Davis-Bacon Act, which mandates that contractors and subcontractors working on federally funded or assisted contracts pay their laborers and mechanics no less than the locally prevailing wages and benefits for corresponding work on similar projects in the area .

***Results***

A summary of the estimates from each of the three firms is included in **Table 6**.

**Table 6. Summary of 2012 Contractor Estimates**

| Firm | Task 1 | Task 2 |
|---|---|---|
| AECOM | $699,968,092 | $1,068,068,482 |
| Armeni | $749,868,482 | $1,017,719,740 |
| Baker | $809,258,154 | $1,024,832,643 |

A detailed summary of each firm's estimates for Task 1 is in **Appendix C** and Task 2 is included in **Appendix D**.

The Task 1 estimates, while higher than that developed by NCDOT in November 2011, were lower than that developed by Finley Engineering in 2007. The lower estimates are likely due to the impacts of inflation on construction materials prices, which in large part have decreased due to the impacts of the global recession. However, the Task 1 estimate likely underestimates the true construction cost of the PSBC, as it does not account for design assumptions and requirements that have changed since 2007.

The estimates prepared under Task 2 are within the range of those used in the SSDEIS in 2007 and FEIS in 2008. The validity of the Task 2 estimates is further supported by the fact that they reflect the design

requirements included in the B-2500 Phase I contract. They reflect a combination of conventional and segmental bridge construction, which is consistent with the winning bid for B-2500 Phase I. The high range of the SSDEIS estimate reflected entirely segmental construction, which is done at a higher cost than conventional construction.

### June 2012 Estimate

NCDOT utilized the estimates from AECOM, Armeni, and Baker to develop a new construction cost estimate for the PSBC. NCDOT used a blend of the unit costs in each estimate to develop a new bid-based construction cost estimate. Each of the unit structure costs used in the NCDOT estimate were an average of four estimates, including those from the three firms and the winning design-build team for Phase I of the project. The unit structure prices were revised from the November 2011 estimate to the following:

- Low-rise construction from a barge was raised from $\$100/ft^2$ to $\$130/ft^2$;
- Low-rise construction from a work bridge was raised from $\$95/ft^2$ to $\$125/ft^2$; and
- High-rise (navigation section) construction was raised from $\$180/ft^2$ to $\$375/ft^2$.

In addition, the separate escalation factor for design-build projects that had been removed from the November 2011 estimate was again included based on input from the three firms. Each firm independently pointed out that while this cost escalation may not exist on other design-build projects across the state, the construction of the PSBC is anticipated to exceed the typical two-year construction period of other design-build projects; therefore, a cost escalation to the mid-point of construction should be included. NCDOT included a 3% per year escalation to account for the time between 2012 and the mid-point of actual construction; this escalation accounts for the time needed to revise any planning documents in order to account for the PSBC (2 years), time needed to complete the final design and to acquire permits and right-of-way (1.5 years), and the first half of project construction (2.5 years). This additional design-build escalation was included only in the "high" estimate for the PSBC alternatives. The "low" estimate included only the preliminary engineering and risk factors that were assumed appropriate for design-build projects in the November 2011 estimate.

The revised cost estimates developed in June 2012 are listed in **Table 7** and are included in **Appendix E**.

**Table 7. 2012 PSBC Construction Cost Estimate**

| Cost Estimates | Alternative | | | |
|---|---|---|---|---|
| | Curved Rodanthe Terminus | | Intersection Rodanthe Terminus | |
| Construction | $878 million | $1.15 billion | $876 million | $1.146 billion |

The construction cost of the PSBC decreased between 6% (low estimate) and 18% (high estimate) since the cost was last published in the 2008 FEIS. By comparison, the winning bid on B-2500 Phase I was $216 million, approximately 18% lower than the low Phase I estimate reported in the 2010 EA ($265 million). The highest bid received for B-2500 Phase I was $307 million, approximately 3% lower than the high

Phase I estimate reported in the EA ($315 million). Therefore, the observed cost differences between the 2008 FEIS and the June 2012 estimates are credible based on the bids received in 2011 for Phase I of the project.

This estimate is only for the final design and actual construction of the PSBC; it does not include removal of the existing Bonner Bridge, new right-of-way within Rodanthe, or the installation of any traffic operations equipment that may be required for the new bridge. The cost also does not include future maintenance of the bridge.

## Bonner Bridge Demolition

The demolition and removal of the existing Bonner Bridge was not included in the construction cost estimates for the PSBC. However, each of the three independent contractors (AECOM, Armeni, and Baker) provided an estimate for the demolition of the bridge; the estimates from the three firms range between $9,687,528 and $11,924,550. In addition, the design-build team that was awarded the B-2500 Phase I contract estimated $8,531,090 for demolition and removal of the existing bridge, not including the approximate 1,000-foot section at the southern end that will be retained as a fishing pier.

Based on these estimates, NCDOT has assumed a $10 million cost for demolition and removal of the existing Bonner Bridge.

# Operations and Maintenance Cost Estimates

# Operations and Maintenance Cost Estimates

As previously discussed, NCDOT last developed estimates for the operations and maintenance costs associated with all of the detailed study alternatives for STIP Project B-2500, including the Pamlico Sound Bridge Corridor (PSBC), in preparation of the SSDEIS. These estimates included those costs associated with:

- Bridge operations, specifically those for the installation and maintenance of equipment to monitor traffic and weather conditions on the new facility;
- Maintenance of the existing roadway during construction and of the new roadway sections following project completion; and
- Maintenance, inspection, and rehabilitation costs associated with new bridges.

The purpose of this section is to review the SSDEIS analysis of the operations and maintenance costs associated with the PSBC and to update those assumptions and costs to 2012 standards. All of the estimates discussed herein assume that construction of the PSBC began in 2009 and was completed in 2012 (four full years of construction); all recurring operations and maintenance costs were estimated through 2060.

The original SSDEIS analysis included additional estimates for potential public costs associated with the PSBC, including alternate Refuge access, removal of the terminal groin, and other items. Those public costs are not assessed here.

## Operations

In the SSDEIS analysis, NCDOT proposed the use of several types of Intelligent Transportation Systems (ITS) that would assist in monitoring traffic and weather conditions on the bridge. These systems are intended to address safety concerns associated with all of the bridging alternatives by allowing NCDOT to identify traffic and weather conditions that could disrupt travel conditions on the bridge. These systems are similar to those used on long bridges in other parts of the country.

For the PSBC, NCDOT recommended the inclusion of closed circuit television cameras, overhead dynamic message signs, highway advisory radio, wind speed sensors, incident management patrols, portable traffic signals, and 511 traveler information signs. The SSDEIS estimate prepared by NCDOT's Transportation Mobility and Safety Unit estimated that the initial installation cost of these systems to be $5.275 million, with an additional annual maintenance cost of $596,472 (2006 dollars).

NCDOT updated this estimate in 2012; the total initial installation cost was revised to $5.085 million, with a revised annual maintenance cost of $551,140. There were no changes made to the amount or type of recommended operations equipment.

## Roadway Maintenance

Though the PSBC is primarily a bridging alternative, it does include roadway sections at both ends of the project, including the connection to existing NC 12 within Rodanthe. These roadway sections would require regular annual maintenance and additional pavement rehabilitation, both of which should be considered as part of the maintenance cost of the project. In addition to the new roadway sections, NCDOT also estimated the cost of maintaining the current NC 12 roadway prior to the completion of construction of the PSBC. The estimate of the current roadway maintenance included costs for repairing the roadway following storm events. The estimated roadway maintenance cost for both the existing and future roadway was estimated on a per-mile basis and is based on historical roadway maintenance efforts on existing NC 12.

The SSDEIS maintenance estimate developed in 2006 includes the following assumptions:

- Construction of the PSBC would last four years, during which maintenance of the existing NC 12 roadway would be required. Regular maintenance of the 12.9 mile section of existing roadway at $10,000 per mile would cost $129,000 annually.
- An additional storm-related maintenance cost of $553,000 per year was added to this total. No storm-related roadway maintenance costs were included for the PSBC once construction was completed.
- Once construction of the PSBC was complete, the new roadway (0.37 miles for the Curved Rodanthe Terminus option, 0.12 miles for the Intersection Rodanthe Terminus option) would also require annual maintenance at $10,000 per mile, with an additional pavement rehabilitation (resurfacing) every 12 years at a cost of $150,000 per mil.

Using these assumptions, the SSDEIS roadway maintenance cost estimate (all costs through 2060) was $3,130,800.

NCDOT reviewed these roadway maintenance assumptions and estimates in 2012 and determined that no changes to the roadway maintenance estimates were required.

## Bridge Maintenance

NCDOT requires that all bridges undergo inspection and maintenance on an annual basis. Depending upon their size and location, bridges also may require a major rehabilitation at least once during their estimated life. For the PSBC, NCDOT developed an annual maintenance and inspection cost as well as an estimate for one major rehabilitation during the project's 50-year design life. Each of these costs is based on the square foot area of the bridge.

For the SSDEIS, NCDOT's Structures Management Unit estimated a cost of $1.6 million for annual bridge inspections, with an additional $3.3 million required for annual maintenance. In addition, NCDOT

estimated that $76.7 million would be required for one major rehabilitation of the bridge during the project's design life. This estimate assumed segmental construction of the bridge.

NCDOT reviewed these bridge maintenance assumptions and estimates in 2012 and determined the following changes (to account for inflation since the SSDEIS estimate):

- The annual bridge inspection cost should be increased to $1.8 million;
- The annual maintenance cost should be increased to $3.5 million; and
- The estimated cost for one rehabilitation increased to $84 million.

## Conclusions

**Table 8** summarizes the total operations and maintenance costs for each of the alternatives within the PSBC.

**Table 8. PSBC Operations and Maintenance Costs**

| Item | Curved Rodanthe Terminus | Intersection Rodanthe Terminus |
|---|---|---|
| **Annual Roadway Maintenance** | $696,800 | $576,800 |
| **Pavement Rehabilitation (resurfacing)** | $222,000 | $72,000 |
| **Operations Equipment- Initial Installation and Periodic Replacement** | $9,945,000 | $9,945,000 |
| **Operations Equipment- Annual Maintenance** | $26,454,720 | $26,454,720 |
| **Storm-Related NC 12 Maintenance (during bridge construction)** | $2,212,000 | $2,212,000 |
| **Bridge Inspection, Maintenance, 1 Bridge Rehabilitation** | $339,461,337.60 | $339,461,337.60 |
| **Total** | **$378,991,857.60** | **$378,721,857.60** |

The bridge maintenance, inspection, and rehabilitation costs of the PSBC are the most significant portion of the PSBC Operations and Maintenance costs; they are estimated at 90% of the total operations and maintenance cost of the PSBC.

# Project Finance Options and Analysis

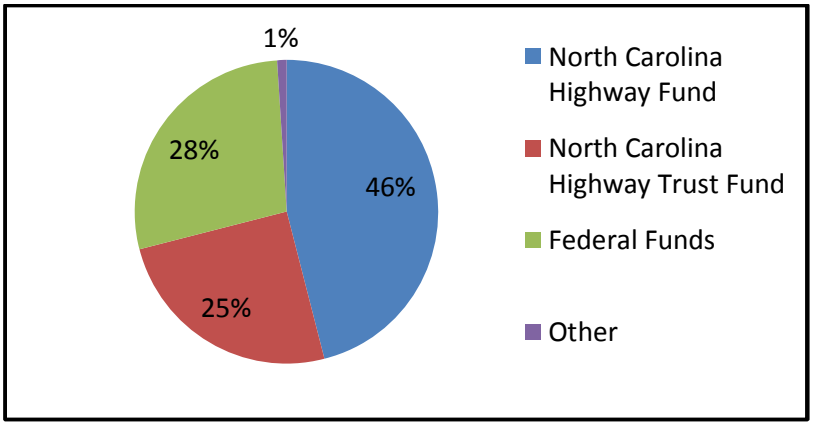
# Project Finance Options and Analysis

Once the construction, operations, and maintenance cost estimates for the Pamlico Sound Bridge Corridor (PSBC) had been updated, NCDOT next analyzed the impacts of the PSBC on the department's projected budget. This section includes a review of the anticipated available federal and state funding sources and a determination of whether the PSBC could be funded, based on what is known today about available revenues.

## Highway Program Funding Sources

NCDOT's State Fiscal Year (SFY) 2011-12 transportation program budget, excluding turnpike financing, was comprised of three major funding sources: 28% of the total funding from designated Federal Funds; 25% from the North Carolina Highway Trust Fund; 46% of the total funding from the North Carolina Highway Fund; and 1% from other various resources.

**Figure 1**. NCDOT Transportation Program Funding Sources




These general categories of funding are described in more detail below.

### *Federal Programs*[1]

Federal funds include federal highway dollars, general fund dollars, and other funds that go towards transit, rail, and airport projects. There are several programs or sources through which federal funding is available: Interstate Maintenance, which makes up 12% of federal funds; the National Highway System (NHS), which makes up 25% of federal funding; the Surface Transportation Program, which makes up 30% of federal funding; and the Bridge Program, which makes up 16% of federal funding. Some of the other programs include the Appalachian Development Highways (4%), Congestion Mitigation and Air Quality (3%), and the Highway Safety Improvement Plan (3%).

[1] Programs are those available prior to the implementation of MAP-21, which is discussed later in this section.

Interstate Maintenance (IM)
These funds are restricted for use on existing Interstate facilities. STIP Project B-2500 is **not eligible** for this funding source because it is not classified as an interstate.

Appalachian Development Highways (APD)
APD funds are restricted to use for the construction, reconstruction, or improvement of highways on the designated Appalachian Development Highway System (ADHS). These highways are located in the Appalachian Region. STIP Project B-2500 is **not eligible** for this funding source because it is not a part of the ADHS.

Bridge Program (BR)
These funds are used for projects that have been programmed primarily based on a Bridge Maintenance statewide structure condition priority listing. Where operational problems exist, NCDOT may adjust the priorities. STIP Project B-2500 is **eligible** for this funding source.

National Highway System (NHS)
Funds are restricted for projects that are a part of the NHS. Types of eligible work on the NHS include: construction, reconstruction, resurfacing, restoration, and rehabilitation of segments of the NHS; operational improvements for segments of the NHS; highway safety improvements for segments of the NHS; and other activities as defined by federal regulations. STIP Project B-2500 is **eligible** for this funding source.

Congestion, Mitigation and Air Quality (CMAQ)
Funding is allocated to air quality (AQ) non-attainment and maintenance areas based on AQ factors and population. Non-attainment areas are those areas that do not or previously have not met air quality standards for ozone, carbon monoxide, particulate matter, and nitrogen dioxide. STIP Project B-2500 is **not eligible** for this funding source.

Surface Transportation Program (STP)
The STP program has many sub-categories each with different rules. The major sub-categories are **Enhancements** (funds restricted to transportation enhancement activity); **Urban/Direct Attributable** (funds restricted to urbanized areas); and **Non-Urban/Any Area** (fund allocation subject to prioritization). STIP Project B-2500 is **not eligible** for funds in the **Enhancement or Urban/Direct Attributable** categories; however, it is **eligible** for **Non-Urban/Any Area** funding.

Highway Safety Improvement Program (HSIP)
HSIP funds may be used to carry out highway safety improvement projects on any public road or publicly owned bicycle or pedestrian pathway or trail. Programming decisions are made based on benefit/cost analyses which consider accident history and statewide exposure indices. STIP Project B-2500 is **not eligible** for this funding source.

Equity Bonus (EB)
The Equity Bonus ensures that each state receives a specific share of the aggregate funding for major highway programs. Every state is guaranteed at least a specified percentage of that State's share of contributions to the Highway Account of the Highway Trust Fund. STIP Project B-2500 is **eligible** for this funding source.

High Priority Projects (HP)
Funds are restricted to specific projects identified in federal transportation bills. Programming decisions are made by the U.S. Congress. STIP Project B-2500 is **not eligible** for this funding source.

***State Programs***

North Carolina Highway Trust Fund
There are three major programs under the North Carolina Highway Trust Fund (N.C. Gen. Stat. Chap. 136, Art. 14): the Intrastate Highway System, Urban Loops, and the Mobility Fund (N.C. Gen. Stat. §136-187). Monies are restricted to projects specifically designated by the North Carolina Legislature.

STIP Project B-2500 is **eligible** for federal-aid matching funds under the Highway Trust Fund program; however, the Highway Trust Fund can only be used for the matching funds that the State must pay on any federally funded project (usually 20% of the project's total cost). The State Legislature determined in 2003 that this was an appropriate use of the Highway Trust Fund.

North Carolina Highway Fund
The Highway Fund is made up of funding from state gas tax, motor vehicle registration fees, and title fees. These funds are for use on highway construction and maintenance, the State Highway Patrol, the Division of Motor Vehicles, public transportation, and rail programs. The State Legislature determines how the Highway Fund is used, including which construction projects can use monies from the fund. The construction of STIP Project B-2500 has **no funding appropriation** from this funding source. However, the future maintenance of the new facility constructed under B-2500 would use monies from the Highway Fund.

## State Transportation Improvement Plan – Programming

The State Transportation Improvement Program (STIP) as described in N.C. Gen. Stat. § 143B-350(f)(4), is a schedule – approved by the NCDOT Board of Transportation – of all major transportation improvement projects and their anticipated cost for a period of 7 years into the future. It places projects in order according to priority, indicating when the right-of-way acquisition and construction phases of a project are slated to begin and the cost of each phase. STIP Project B-2500 was originally included on the STIP in the late 1980s, once NCDOT identified the current Bonner Bridge as a structure that needed to be replaced. At the time, the project was identified through a statewide bridge project prioritization process, which rated potential bridge replacement projects using a number of factors including the age of the structure, its current condition, and its life expectancy. Since the original

identification of STIP Project B-2500, the Bonner Bridge has continued to deteriorate despite continual maintenance efforts; therefore, it is still included on the STIP.

The amount of money available for any given STIP cycle is estimated based on an annual reassessment of available federal and state revenues. Based on revenues received to date and the constraints attached to each federal and state funding source, the department forecasts how much revenue will likely be available for the next ten years. This is a consensus forecast developed in conjunction with the North Carolina Office of State Budget and Management.

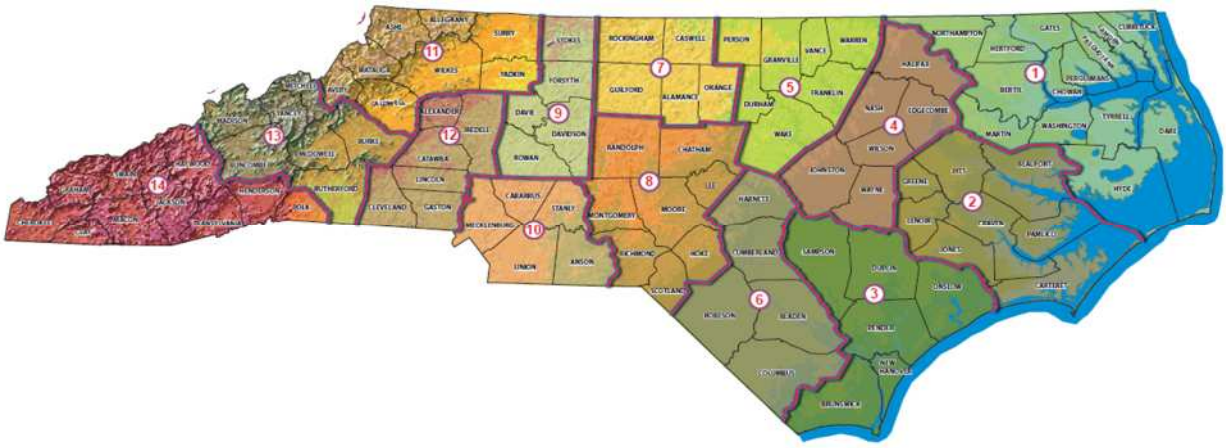
Based upon the amount of revenue projected to be available to the department for STIP construction projects, NCDOT estimates that $8.327 billion will be available to NCDOT for the years 2014-2020, the next STIP cycle. However, this amount is a draft projection and is subject to change based on actual collected revenues. The proposed STIP will be out for public review and comment for approximately eight months. The Board of Transportation will be asked to approve the 2014 – 2020 STIP in the Summer of 2013.

***Equity Formula***

Once the total amount of funds available for the entire STIP has been determined, the state's Equity Formula is used to determine how much money is available within each of the department's 14 transportation divisions. The Equity Formula was created in 1989 by the General Assembly (N.C. Gen. Stat. § 136-17.2A). It requires that STIP funds be distributed equitably among regions of the State. The 14 divisions of NCDOT are organized into 7 Distribution Regions. Monetary distribution is based 50 percent on the population of a region, 25 percent on the number of miles of intrastate highways left to complete in a region, and the remaining 25 percent is distributed equally among the regions for the STIP. Federal Congestion Mitigation, Air Quality improvement program funds, Urban Loop funds, and competitive and discretionary federal grants are exempt from the Equity Formula.

STIP Project B-2500 is in Dare County, North Carolina, which is part of NCDOT Division 1 (see **Figure 2**). Division 1 includes the following additional counties: Bertie, Camden, Chowan, Currituck, Gates, Hertford, Hyde, Martin, Northampton, Pasquotank, Perquimans, Tyrrell, and Washington. Under N.C. Gen. Stat. § 136-17.2, Distribution Region A is comprised of the counties of both Division 1 and Division 4. Division 4 includes Edgecombe, Halifax, Johnston, Nash, Wayne, and Wilson counties.

**Figure 2**. NCDOT Transportation Divisions



Based on the Equity Formula calculation (N.C. Gen. Stat. §136-17.2A) at this time (September 2012), NCDOT anticipates that Division 1 will be allocated $642,000,000 for right-of-way acquisition and construction in the STIP covering years 2014 through 2020. In addition, equity adjustment calculations are performed to ensure that each Division has received its share of equity funds since year 2000 (N.C. Gen. Stat. 136-17.2A(h)). Based on this calculation, it is anticipated that an additional $311,000,000 may be allocated to Division 1 for the years 2014 through 2020. This additional funding is available when projects are delayed within a Division and the funding is not shifted to other projects. Therefore, the total allocation to Division 1 for the seven-year period is estimated to be $953,000,000. **Table 9** summarizes the funding available to each transportation Division for 2014-2020.

**Table 9. Draft 2014-2020 Equity Formula Calculation (September 2012)**

| DIVISION | MILES TO COMPLETE INTRASTATE SYSTEM AS OF 6/30/11 | | CURRENT CERTIFIED POPULATION (2010) | POPULATION PERCENT | CONSTRUCTION PROGRAM ALLOCATION | CONSTRUCTION PROGRAM ALLOCATION 2014-2020 | OVER/UNDER ALLOCATIONS FROM PRIOR PERIOD FY 2000-2011 | REVISED PROGRAM ALLOCATION 2014-2020 |
|---|---|---|---|---|---|---|---|---|
| 1 | 169.4 | 21.12% | 264,607 | 2.76% | 8.44% | $642 | $311 | $953 |
| 2 | 63.2 | 7.88% | 492,231 | 5.13% | 6.32% | $480 | ($19) | $461 |
| 3 | 52.9 | 6.59% | 671,633 | 7.01% | 6.94% | $527 | $47 | $574 |
| 4 | 23.4 | 2.92% | 582,210 | 6.07% | 5.55% | $422 | ($58) | $364 |
| 5 | 57.3 | 7.14% | 1,403,857 | 14.64% | 10.89% | $828 | ($20) | $808 |
| 6 | 45.7 | 5.70% | 670,201 | 6.99% | 6.71% | $510 | $110 | $619 |
| 7 | 79.5 | 9.91% | 893,881 | 9.32% | 8.93% | $678 | $118 | $796 |
| 8 | 92.3 | 11.51% | 510,716 | 5.33% | 7.33% | $557 | $164 | $721 |
| 9 | 19.2 | 2.39% | 742,793 | 7.75% | 6.26% | $476 | ($60) | $416 |
| 10 | 26.6 | 3.32% | 1,393,248 | 14.53% | 9.88% | $751 | $22 | $773 |
| 11 | 56.3 | 7.02% | 372,524 | 3.89% | 5.48% | $417 | $43 | $459 |
| 12 | 18.9 | 2.36% | 735,332 | 7.67% | 6.21% | $472 | $109 | $581 |
| 13 | 79.8 | 9.95% | 497,409 | 5.19% | 6.87% | $522 | ($26) | $496 |
| 14 | 17.7 | 2.21% | 355,585 | 3.71% | 4.19% | $319 | ($12) | $306 |
| TOTALS | 802.2 | 100.00% | 9,586,227 | 100.00% | 100.00% | $7,599 | $729 | $8,327 |

The updated 10-year work plan released by the department in September 2012 caused adjustments in the 2014-2020 STIP to reflect changes in project schedules and revenue forecasts. The total estimated STIP allocation increased from $7.673 billion in the prior revenue forecast to $8.327 billion in September

2012 due to changes in projected future state and federal revenues. The prior revenue forecast and STIP allocation assumed that the state motor fuel tax rate would remain constant starting in state fiscal year 2014. The current (September 2012) revenue forecast assumes that the state motor fuel tax rate would be variable, adjusting based on the wholesale price of gasoline and diesel. This change in assumption increased the STIP funding allocation. However, as it is the prerogative of the State Legislature to override the variable motor fuel tax rate (as it did for a five-year period), the amount of state revenue available to the department could change and thus impact the 2014-2020 STIP revenue allocation. NCDOT will continue to re-evaluate the state and federal revenue forecasts and determine their impacts to the 2014-2020 STIP allocation.

***Highway Appropriation and Cash Flow Management***

Appropriations made for transportation projects are subject to provisions in federal and state law and budget acts. Per NC Gen. Stat. § 143C-6-11, transportation project funds shall be budgeted, expended, and accounted for on a "cash flow" basis. Although NCDOT estimates the amount available for any given STIP cycle, the entire amount is not provided to NCDOT at the beginning of the cycle. Instead, NCDOT receives a portion of the total STIP appropriation annually. To manage transportation projects on a cash-flow basis, the department has established management controls as well as financial reports supported by statistical models that allow NCDOT to estimate the cash that will be available each year of the STIP cycle. Transportation project contracts are planned and limited so that payments due at any given time will not exceed the cash available to pay them. Therefore, if revenues fall short of projections, a new project is introduced on the STIP, or a current STIP project is found to cost more than previously estimated, NCDOT may not only have to delay projects in that particular Division, but also on a statewide basis in order to maintain enough cash to fund the project.

## Alternative Financing

NCDOT has received comments during the life of the STIP Project B-2500 that, due to the limited amount of money available for the project through the traditional transportation funding process, the department should pursue innovative financing for the project at either the federal or state level. FHWA and NCDOT previously discussed other financing options and their applicability to STIP Project B-2500 in the October 2009 Revised Final Section 4(f) Evaluation (Evaluation). As discussed in the Evaluation, state legislation requires that, in order to convert an existing route to a toll facility, a free alternative route must be available. NC 12 from Bodie Island is currently the only free route available to access Hatteras Island. Further, a toll analysis conducted by the department concluded that toll revenues would not support the debt service of required bonds.

Other financing and loan programs, such as Public-Private Partnerships, Transportation Infrastructure Finance and Innovation Act (TIFIA) loans, and others, require a project to have an outside stream of revenue in order to guarantee a return on investment. As the project will not be tolled, state bonds would have to be issued against future state revenues, which would require a statewide public referendum. In the past, the State has been able to issue similar bonds for programmatic-level

transportation efforts across the state, but not for a single project. The Evaluation includes an analysis of the potential use of a TIFIA loan to fund the PSBC.

A portion of the current finance plan for Project B-2500 involves the use of federal-aid backed GARVEE bonds. These bonds allow project finance based on future federal-aid apportionments. The total amount of GARVEE debt is capped by State law. Current GARVEE capacity would not allow this mechanism to fully fund construction of the PSBC. Approximately $70 million in GARVEE bond funds are programmed for use on STIP Project B-2500.

At a state level, the most recent example of alternate project financing is the Interstate 85- Yadkin River Bridge project, which was exempted from the state's Equity Formula under the Mobility Fund legislation that was enacted in 2009. Projects that could receive monies from the Mobility Fund, and therefore be exempt from the state Equity Formula, must be projects that "relieve congestion and enhance mobility," as is stated in the general statute. STIP Project B-2500 is not eligible for this funding source.

## Operation & Maintenance Finances

Routine maintenance of the PSBC would be funded through Division 1's share of the North Carolina Highway Fund, rather than the STIP funding sources used in construction. The Highway Fund is not subject to the Equity Formula; however, the department calculates the amount available to each division based on several factors, including the amount of roads and bridges within a Division, their condition, and that Division's total population. In 2011-2012, $970.9 million was available to the department for highway maintenance projects statewide, with an additional $214.2 available for bridge preservation projects. In some cases, major road or bridge maintenance projects can be funded under the STIP, depending upon the availability of maintenance funds and the projected cost of the maintenance needed. Most recently, NCDOT implemented STIP Project B-5014 to conduct extensive maintenance on the existing Bonner Bridge.

As of 2012, even without a 17.5-mile bridge in place, Division 1 is already experiencing a shortage of maintenance funding, in part due to the number of bridges within the division that currently require more frequent maintenance because of their location within the harsh coastal environment. If the PSBC was constructed, its initial impact on the division's maintenance budget would likely not be remarkable; however, that impact would grow over time, becoming significant as additional rehabilitation and maintenance is needed over the project's life.

The initial cost of installing ITS and other operational safety improvements (vehicle turnouts, etc.) will be included in and funded under the initial construction contract of STIP Project B-2500. However, future maintenance of these ITS and other improvements would likely be funded from the Division 1 maintenance budget.

## Impact Analysis

**Table 10** lists the total estimated construction, operations, and maintenance costs for the PSBC over the next 50 years that were discussed in previous sections.

**Table 10. PSBC Construction, Maintenance, and Right-of-Way Cost Estimate (50-year project life)**[1]

| | Curved Rodanthe Terminus | | Intersection Rodanthe Terminus | |
|---|---|---|---|---|
| | **Low** | **High** | **Low** | **High** |
| Construction | $878 million | $1.15 billion | $876 million | $1.146 billion |
| Bonner Bridge Demolition | $10 million | | $10 million | |
| Right-of-Way[2] | $6,890,000 | | $5,245,000 | |
| Operations (Installation) | $5,085,000 | | $5,085,000 | |
| ***Subtotal (Initial STIP project)*** | **$900 million** | **$1.172 billion** | **$896 million** | **$1.166 billion** |
| Operations and Maintenance (Ongoing, 50-years) | $374 million | | $374 million | |
| **Total** | **$1.274 billion** | **$1.546 billion** | **$1.270 billion** | **$1.540 billion** |

[1] Does not include costs associated with wetland and SAV mitigation, which would be funded at the time of construction. Estimate does not include the additional non-highway public costs assessed in the SSDEIS and FEIS.

[2] SSDEIS estimate.

The first four line items in **Table 10** (Construction, Bonner Bridge Demolition, Right-of-Way, and Operations equipment installation) would all be funded through the initial STIP project; this would require NCDOT to have between $900 million and $1.172 billion available over the four-year estimated construction period to fund the Curved Rodanthe Terminus option and between $896 million and $1.166 billion available over the four-year estimated construction period to fund the Intersection Rodanthe Terminus option.

NCDOT currently forecasts that $8.327 billion will be available for the 2014-2020 STIP; based on the state Equity Formula, $953 million of this total will be available for projects in Division 1. These sums are based on revenues anticipated during the STIP cycle. Due to uncertainty with state and federal budgets, the amount of revenue available to the department, and thus the total 2014-2020 STIP allocation, is subject to change.

At a minimum, the PSBC would utilize 94% of the Division 1 budget for 2014-2020; the estimated high cost would exceed the amount available to Division 1 by $219 million, which is 23% of the Division's budget. These percentages would change, likely increasing, if NCDOT does not receive all of the revenue it estimates receiving for 2014-2020. If the PSBC were selected for project B-2500, no other major construction project in Division 1 could be implemented until after the 2020 fiscal year. A few bridge replacements or other small projects could be funded during the STIP period only if the contract awarded for the PSBC was consistent with the department's low estimate for the project. Even if the

demolition of the existing bridge and the installation of traffic operations equipment were postponed until the next STIP period, the initial construction cost and right-of-way acquisition would still require at least 93% of the Division 1 budget for 2014-2020. Given the diverse construction, safety, bridge replacement, and maintenance needs in the 14 counties that comprise Division 1, this is not a reasonable course of action for NCDOT. Division 1 currently has over 100 highway, bridge replacement, and safety improvement projects included on the 2014-2020 STIP, including over 87 miles of roadway widening projects on the major US and NC routes within the Division.

In addition to the projected budget constraints, the implementation of the PSBC could impact other projects across the state, as the department would have to maintain a sufficient cash balance in order to pay the contractor while the project is under construction. The department would be required to delay other projects statewide based upon the amount of cash actually available.

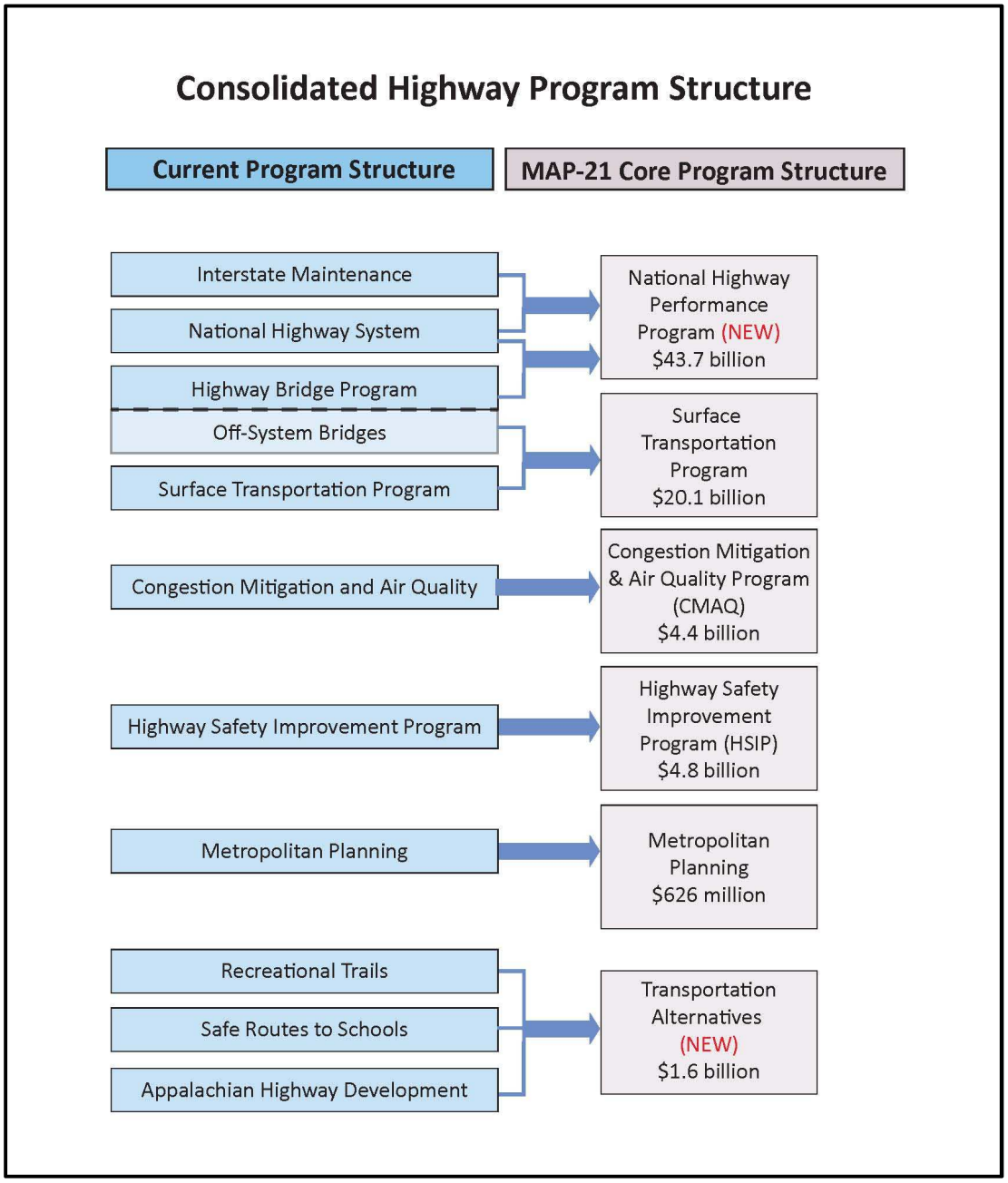
As has been discussed in previous NEPA documentation for the project, the use of alternate innovative financing for the PSBC is not a viable option to fully fund this project. In order to reduce the impacts of the PSBC on the Division 1 2014-2020 STIP program, the department would have to pursue alternative financing for at least a portion of the cost. However, the alternative financing methods available to the department require an outside stream of revenue in order to repay the investment. The department has not identified an outside revenue stream (for example, through bonds) that could make alternative financing a viable option.

If the PSBC were constructed, NCDOT estimates that a minimum of $5.9 million would be required annually to maintain the roadway approaches and the new bridge. That annual maintenance number would increase by $84 million for a one-time major bridge rehabilitation project during the 50-year project life. Unless STIP funds could be secured for the bridge rehabilitation project, all of the maintenance costs would have to be funded via the state Highway Fund.

## MAP 21

On July 6, 2012, President Obama signed into law the Moving Ahead for Progress in the 21st Century (MAP 21) Act, which authorized federal transportation funding for fiscal years 2013 and 2014. NCDOT has not yet determined how MAP 21 will impact its funding allocation process or the amount of funds that MAP 21 is expected to provide to the department; however, the department does not expect a significant increase in federal funding availability. MAP 21 consolidates the Federal Fund programs (listed earlier in this section) from which NCDOT receives funds; however, this consolidation does not include any new eligibility criteria and is therefore not expected to impact the amount of money available for STIP Project B-2500. **Figure 3** illustrates the changes to the Federal Funds program.

**Figure 3**. MAP 21 Highway Funding Program Structure *(Source: AASHTO)*



# Conclusions

## Conclusions

NCDOT has assessed the construction, right-of-way, operations and maintenance, and other costs associated with the Pamlico Sound Bridge Corridor (PSBC) since its initial development in 2002. FHWA and NCDOT concluded during the NEPA process for STIP Project B-2500 that an alternative within the PSBC should not be implemented due to the magnitude of the construction costs associated with the PSBC and the impact of those costs on NCDOT's highway program.

Following publication of the project's Record of Decision, NCDOT reassessed its estimates for the PSBC. The updated costs of the PSBC are shown in **Table 11**.

**Table 11. PSBC Cost Estimate (50-year project life)**

| | **Curved Rodanthe Terminus** | | **Intersection Rodanthe Terminus** | |
|---|---|---|---|---|
| | **Low** | **High** | **Low** | **High** |
| Construction | $878 million | $1.15 billion | $876 million | $1.146 billion |
| Bonner Bridge Demolition | $10 million | | $10 million | |
| Right-of-Way[1] | $6,890,000 | | $5,245,000 | |
| Operations (Installation) | $5,085,000 | | $5,085,000 | |
| ***Subtotal (Initial STIP project)*** | **$900 million** | **$1.172 billion** | **$896 million** | **$1.166 billion** |
| Operations and Maintenance (Ongoing, 50-years) | $374 million | | $374 million | |
| **Total** | **$1.274 billion** | **$1.546 billion** | **$1.270 billion** | **$1.540 billion** |

[1]SSDEIS estimate.

Based on the construction cost estimate developed in June 2012, the construction cost of the PSBC decreased between 6% (low estimate) and 18% (high estimate) since the cost was last published in the 2008 Final Environmental Impact Statement (FEIS). The costs of operating and maintaining a bridge in the PSBC increased approximately 5% from what was estimated in the FEIS.

The estimated construction cost is based on material prices and contingency estimates from three contractors with extensive experience in bridge construction. Given the magnitude of the PSBC, it is reasonable to seek input from contractors with this type of project experience. This approach has allowed NCDOT to produce a reasonable estimate of the alternative because it was developed utilizing the most current information available regarding material, equipment, and labor costs from three independent sources. In addition, the department used the winning design-build bid for Phase I of STIP Project B-2500 to account for the possibility of a bid that is lower that the department's estimates.

At the current time, NCDOT projects that approximately $953 million will be available for all highway and bridge projects in Division 1 in the 2014-2020 STIP cycle. However, if actual state and federal revenues differ from current forecasts, then the amount available to the entire STIP program, and to the Division, could change. Based upon the most recent estimates, the combined up-front construction,

right-of-way, bridge demolition, and operations costs associated with the PSBC would use at least 94% of the Division 1 budget, which would require NCDOT to postpone almost all planned projects in Division 1 until after the 2014-2020 STIP cycle is complete. Division 1 would only be able to program a series of small bridge replacement or other projects between 2014 and 2020 if the PSBC were to be constructed; that conclusion assumes that the winning bid for the PSBC is consistent with the department's low cost estimate for the project. The department cannot rely on the possibility of a low contractor construction bid to make the PSBC less of a burden on the Division 1 budget. Even if demolition of the existing Bonner Bridge and the installation of operations equipment were postponed to the next STIP period, the PSBC would still require at least 93% of the Division 1 budget. Implementation of the PSBC would therefore create a unique maintenance problem of extraordinary magnitude for the department, as it would have to defer much needed maintenance improvements throughout the Division for a significant period of time. A decision to build a bridge within the PSBC is not reasonable in consideration of the projected bridge costs and the Division 1 budget.

Phasing the construction of the PSBC is not a reasonable option, since the new bridge could not be opened to traffic until construction of the entire bridge was completed. This would take multiple STIP periods to complete. While this could be considered a reasonable course of action for projects that provide *additional* access to a destination, it is not reasonable for a project that provides the *only* free access to a destination, as would be the case here. Given that the existing bridge has an extremely low sufficiency rating and is rapidly approaching the end of its service life, phasing the completion of the project over multiple STIP periods is not an acceptable option for the department.

While there is uncertainty as to the amount of future federal and state revenues available to NCDOT's transportation program budget, there are no indications that the department's financial resources will increase to the level necessary to support the construction of the PSBC and allow the department to meet the most basic project needs of Division 1. Therefore, the construction of a bridge in the PSBC would still present a unique problem of extraordinary magnitude to NCDOT, reaffirming the conclusions in the 2009 Revised Final Section 4(f) Evaluation and the 2010 Environmental Assessment that the PSBC is neither a prudent nor practicable alternative.

In addition to the initial construction cost of the PSBC, NCDOT estimates that a minimum of $5.9 million would be required annually to maintain the roadway approaches and the new bridge. That annual cost would increase by $84 million for a one-time major bridge rehabilitation project during the 50-year project life. Maintenance of the PSBC would have to be funded through the state Highway Fund.

NCDOT conducted an analysis of possible alternative financing options for the PSBC during the NEPA process for STIP Project B-2500; there are no alternative financing options (loans, bonds, tolls) that would entirely support the construction cost of the PSBC. Based on the department's experience to date in pursuing innovative financing, the department would also not be able to get enough innovative financing to fund even a portion of the PSBC.

There is no new information on additional revenue sources or legislative changes that alter the conclusions in the 2009 Revised Final Section 4(f) Evaluation or the 2010 Environmental Assessment. Based on the information gathered during this inquiry, the department's conclusion that the PSBC is not a prudent or practicable alternative, based on its cost and the potential impacts to the department's budget, remains valid.