

3 Alternatives to the Proposed Action

3.1 No Action Alternative

The No Action Alternative consists of no additional work to the Project as detailed in the FONSI signed September 16, 2011.

3.1.1 Scour Protection

Under the No Action Alternative, the Project would consist of rehabilitation of the three structures carrying Route 72 over Hilliards Thorofare, West Thorofare, and East Thorofare without scour protection.

Work associated with the No Action alternative would still consist of pier cap rehabilitation, piling protection system, a new bearing support system, deck repairs including an overlay on the existing deck slab, and reconfiguring the deck and lane configuration to provide accommodations for pedestrian and bicycle use. The No Action would leave the Thorofare Bridges susceptible to scour.

3.1.2 Public Waterfront Access Improvements

Under the No Action Alternative, public waterfront access would be provided through a combination of new sidewalks and public parking facilities allowing pedestrian access to existing bulkheads and access to a portion of the Edwin B. Forsythe National Wildlife Refuge consistent with the previously approved plans.

3.2 Scour Countermeasure Design Alternatives

3.2.1 Scour Alternative 1: Bridge Rehabilitation with Scour Countermeasures

As part of this alternative analysis, several construction methods were considered for scour countermeasures for the Thorofare Bridges including Marine Mattress, Articulated Concrete Block Mattress, A-Jacks, and Riprap (eg. course stone).

Of the five (5) scour design alternatives considered all have the same footprint but vary according to the type and thickness of material used, and the extent to which bed preparation prior to installation is required.

3.2.1.1 Scour Alternative 1A and 1B - Marine Mattress

The Marine Mattress is a low profile armoring alternative with total depths ranging between six and twelve inches. The armoring system consists of stone filled geogrids made from high strength plastic materials that are UV protected. The typical size of each mattress is 20 feet by 5 feet and creates a large stable and protective mass during scour events.

Marine Mattresses are significantly more flexible than other similarly manufactured products. Due to the flexibility of the grid and the nature of the aggregate fill, the marine mattress is able to conform to small irregularities, which reduces the need for in-water preparation of the subgrade.

At the pile bents, special detailing would be required due to the limited space available. To provide protection in the space around individual piles, either Riprap (course stone) or grout bags would be used.

Alternative 1A consists of the use of Riprap to fill the void in and around each pile. Riprap placed between the piles would extend beyond the top of the marine mattress, and also extend above the bay bottom elevations from 2009 (see Figure 3-1).

Alternative 1B would utilize grout bags, as an alternative to Riprap, placed flush with the marine mattress to fill the void in and around the piles, helping to maintain the bay bottom elevation (see Figure 3-2).

3.2.1.2 Scour Alternative 1C - Articulated Concrete Block Mattress

Articulated Concrete Block Mattress (ACBM) is a low profile, hard armoring alternative with total depths of approximately 5-8 inches. In order to adequately anchor and stabilize these mats, the leading edges must be buried with 3.5 feet of Riprap. The material is composed of preformed concrete blocks that interconnect through a combination of forms and/or cables.

The blocks are able to bend to some degree along their adjoining faces allowing the system to conform to minor changes in the subgrade while maintaining a protective cover. However, for installation, the subgrade needs to be smooth with little to no abrupt changes in order for the ACBM to perform as designed.

At the pile bents, special detailing would be required due to the limited space available. This would likely require the use of Riprap or grout bags to protect these areas.

Since the undermining of ACBM will reduce its effectiveness, as noted above, the perimeter edges of the ACBM must be anchored by excavating a trench and burying the edges with Riprap (see Figure 3-3).

3.2.1.3 Scour Alternative 1D - A-Jacks

A-Jacks are tetrahedral shaped concrete armor units which interlock into a flexible, permeable matrix. The A-Jacks system dissipates energy and resists the erosive forces of flowing water allowing the system to protect against scour.

The total height of an A-Jack is 24 inches but typically rests on an angle on top of a coarse aggregate bedding layer with a minimum overall height of 16 inches above the bedding layer (see Figure 3-4). The subgrade preparation for A-Jacks is not as extensive as ACBM as the entire unit is not designed to be in contact with the substrate material, and is intended to be silted up over time.

Special detailing would be required in the limited available space around the piles to prevent damage which would likely require the use of Riprap to protect these congested areas. Due to concerns regarding stability of the existing bridge foundations, excavation prior to installing A-Jacks is not feasible. As such, A-Jacks would have to be installed above the existing bed elevation which may reduce water depths and impair navigation.

3.2.1.4 Scour Alternative 1E - Riprap

Riprap is the most traditional method to protect against scour and consists of large stones sized to prevent the loss of material. This project would require stones averaging 12 inches in size that rest upon a coarse aggregate bedding layer for a total of 4 feet 6 inches of protection (see Figure 3-5).

Riprap is the simplest method of construction for this site, but the depth required makes it very unfavorable due to the potential for environmental and navigational impacts in Manahawkin Bay. Loose Riprap is also considered a temporary scour countermeasure and would require continual monitoring after storm events.

3.2.1.5 Preferred Scour Countermeasure Design Alternative

Marine Mattress has the thinnest profile and requires minimal bed preparation prior to installation. Utilization of grout bags to provide scour protection in around the individual piles results in the least amount of placement of fill material within the waterway. As such Marine Mattress with Grout Bags (Alternative 1B) is recommended as the Preferred Scour Protection Design. A relative comparison of the various design alternatives is included in Table 3-1.

Table 3-1:
 Comparison of Scour Countermeasure Design Alternatives

Scour Countermeasures Comparison Matrix											
Scour Countermeasure Alternative	Subgrade Preparation	Depth ² / Need for Excavation	Constructability	Durability	Future Maintenance	Environmental Impact	Adaptability	Approximate Limits (SY)	Unit Cost (\$/SY)	Weighted Score	Rank
Weighted Score Multiplier	1.00	1.50	1.50	1.50	1.50	2.00	1.50	-	-	-	-
Articulated Concrete Block Mattress (ACBM) ¹	Extensive Preparation	5 to 8 inches	Difficult placement with low headroom and between piles	Resilient concrete elements, toe-in points require monitoring	Required at toe-in points	Some excavation for toe-ins and largest limits	Vulnerable to bed condition changes	22,000	\$150	26.00	3
	{1}	{5}	{2}	{4}	{2}	{2}	{1}				
A-Jacks	Moderate Preparation	1.5 to 2 feet	Difficult placement with low headroom	Resilient concrete elements	Moderate monitoring	Some excavation over entire area, typical limits	Susceptible to bed condition changes	19,000	\$350	28.00	2
	{3}	{2}	{2}	{5}	{3}	{2}	{2}				
Riprap	Minimal Preparation	4.5 feet	Easiest to install within project constraints	Stones can become dislodged	Requires Regular Maintenance	Most excavation, typical limits	Moderate performance with changed conditions	19,000	\$210	23.50	4
	{5}	{1}	{4}	{1}	{1}	{1}	{4}				
Marine Mattress	Reduced Preparation	6 to 12 inches	Difficult placement with low headroom and between piles	Exposed geogrid at shallow locations may wear	Minimal monitoring	No excavation anticipated ³ , typical	Moderate performance with changed conditions	19,000	\$140	39.50	1
	{4}	{4}	{2}	{3}	{4}	{5}	{4}				

Note:
 {1} - Indicates Rating for Parameter, a score of 5 indicates optimal performance, a score of 1 indicates poor performance

Footnotes

- 1 - Approximate quantity and unit costs are adjusted for ACBM to account for Riprap toe-in required at the edges of the countermeasure
- 2 - Depth includes coarse aggregate bedding layer for ACBM and Riprap, the range shown for A-jacks represents the likelihood of eliminating the bedding layer
- 3 - Based on manufacturer recommendations, no excavation for installation of Marine Mattress is proposed