6 Environmental Criteria

The TZB Rehabilitation and Replacement Options have been evaluated using several key environmental criteria. The criteria encompass both the natural and built environment. The evaluation is focused on impacts within the study area bounded on the west by South Broadway in South Nyack and on the east by South Broadway in Tarrytown.

6.1 Displacements and Acquisitions

Bridge options that extend beyond the existing ROW are likely to require the acquisition of private or public property. Acquisition that is of a minor character (e.g., a sliver alongside a rear yard) may not require the displacement of the property's occupants. However, when acquisition is of a scale that affects structures or denies access to the property, displacement may be a necessary consequence. There are also situations where use of a property is required but may be only in the form of an easement (e.g., permanent easement for a tunnel below ground). Alternatively, such easements may be only temporary, for the period of construction (e.g., to gain access to build a retaining wall). Owners of property, subject to acquisitions and easements, are compensated at fair market rates, and those displaced are also eligible for relocation assistance.

These criteria identify and characterize those properties where there is a potential for displacement of occupants and/or activities, as well as where partial acquisitions or easements are anticipated. Given the uncertainty of the exact extent of such partial acquisitions/easements at this stage of the engineering design, these acquisitions are expressed as *minor*, *moderate*, or *major* in this assessment.

Drawings showing the locations of anticipated easements, acquisitions and displacements are included in Appendix A for all Rehabilitation and Replacement Options.

6.1.1 TZB Rehabilitation Options

Rockland

Among the options, Rehabilitation Option 1 would alter the roadway in Rockland the least. A new Pedestrian and Bicycle Path on the north side of the bridge would have a landing at River Road. Reconfiguration of the Thruway maintenance area and its access roadways would occur but there is no anticipated acquisition or displacement associated with this option. There is a potential for some minor easements associated with retaining walls (affecting four residential properties), noise walls (affecting an additional four residential properties) and the small sitting area on the east side of South Broadway.

Rehabilitation Options 2, 3 and 4 would all have similar impacts and involve:

- Acquisition of a part of Elizabeth Place Park, including the access way to the park. This impact is associated with a widening of the highway and reconfiguration of Interchange 10. The reconfiguration of the interchange may allow for additional land to be provided to the park and, thereby result in a net benefit to the park. Any effects to parkland would be considered *major* because of the requirements for a Section 4(f) analysis.
- Displacement of one residence at the corner of Elizabeth Place and South Broadway (306 South Broadway), would be a consequence of the reconstruction of the Broadway Bridge over the Thruway and the need to provide a reconfigured access to Elizabeth Place.
- Reconfigured access to Elizabeth Place would also require a *minor* acquisition from an adjacent residence on South Broadway (308 South Broadway), relocating its driveway.
- Construction of retaining walls on the south side of I-287 the would require temporary and permanent easements of a sliver of land (approximately 4 feet x 170 feet) of property along Ferris Lane from the residence at 321 South Broadway (a potentially national register-eligible historic resource), and from a residence at 10 Ferris Lane (approximately 15 feet x 240 feet), a potentially national register-eligible historic resource. As potentially eligible resources, these easements would be subject to Section 106 Effects Analysis of the National Historic Preservation Act (NHPA) and Section 4(f) of the US Department of Transportation Act. This evaluation is described further in Section 6.2, Historical and Archaeological Resources.
- Potential for *minor* easements on the north side of the Thruway at Bradford Mews and 78 Smith Avenue in order to construct a retaining wall and noise wall.
- *Minor* acquisition from the rear yard of a residence at 79 Smith Avenue associated with the reconstruction of the Broadway Bridge.

Westchester

No displacements or acquisitions are anticipated under Rehabilitation Option 1. This option would alter the roadway in Westchester the least among the four Rehabilitation Options. Provision of a new walkway on the north side of the bridge would have a landing that would connect to the proposed Riverwalk and to Van Wart Avenue.

Displacements are also not anticipated under Rehabilitation Option 2, 3 and 4. However, for Options 2, 3 or 4, acquisitions are associated with the provision of a BRT or LRT ramp to Tarrytown Station. This would require:

- Acquisition of a strip of property (approximately 20 feet x 560 feet) affecting The Quay condominium. The acquisition of The Quay property would displace one of two tennis courts serving residents.
- The "303" office building would also be subject to acquisition of property (approximately 10 feet x 20 feet) at a corner of its parking area; no parking would be displaced. Potential construction easements may also be required from the "303" offices for a retaining wall.

The "303" office building would also be subject to minor acquisition of property at two corners of its parking area (one of approximately 10 feet x 20 feet and the other of approximately 40 feet x 240 feet). No parking would be displaced.

6.1.2 Replacement Options

In Rockland, the three Replacement Options have generally similar impacts and are also similar to those for Rehabilitation Options 2, 3 and 4. The differences are noted below.

- Replacement Option 1 would require the additional acquisition of a sliver of one residential property (1 River Road)
- Replacement Options 2 and 3 would require only an easement at this location.

Replacement Options in Westchester affect similar locations to the Rehabilitation Options

- All Replacement Options may provide a bus roadway or LRT to Tarrytown Station under one of their modal alternative configurations (3, 4B, 4C and 4D). This would result in minor ROW impacts to The Quay for the construction of a retaining wall and temporary easement of their tennis courts.
- A small corner of the "303" office parking would be acquired for the bridge on-ramp under all options.

6.1.3 Comparison of Options

All options, except Rehabilitation Option 1, have generally similar acquisition and displacement impacts and provide little differentiation among the options (Table 6-1, page 58). For all options (except Rehabilitation Option 1), only one residential property would be displaced.

6.2 Historical and Archaeological Resources

The potential for direct impacts is the principal screening criterion used to measure the effects of each option on historic architectural and archaeological resources. For this analysis, differentiators among options are focused on the concept that direct impacts increase as the scale of the options increases.

Section 106 of NHPA defines a project's direct impacts as activities that may alter the characteristics of an historic or archaeological resource that qualifies for inclusion in the National Register of Historic Places in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Direct impacts include:

- Physical destruction or damage to all or part of a property.
- Alteration of a property that is not consistent with the Secretary of the Interior's Standards for Treatment of Historic Properties.
- Removal of a property from its historic location.
- Change of the character of the property's use or physical features within the property's setting that contribute to its historic significance.

Section 110 of NHPA requires that federal agencies exercise a higher standard of care when considering undertakings that may directly and adversely affect National Historic Landmarks (NHLs). The law requires that agencies, "to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to such landmark." Furthermore, agencies should consider all prudent and feasible alternatives to avoid an adverse effect on an NHL.

In addition to Sections 106 and 110 of NHPA, Section 4(f) of the US Department of Transportation Act stipulates that the FHWA and other DOT agencies cannot approve the use of an historic property (i.e., NHLs; National Register-listed property; National Register-eligible property; recommended National Register-eligible property) or public park unless there is no feasible and prudent alternative to the use, and the action includes all possible planning to minimize harm. Permanent direct impacts to such cultural resources may be considered a Section 4(f) use, and therefore, must also be analyzed in accordance with Section 4(f) to ensure that there is not a feasible and prudent alternative to such a use. A Section 4(f) analysis for historic architectural resources will be included in the DEIS.

In terms of historic architectural resources, this analysis examined impacts of bridge options on five categories of resources, including:

- NHLs.
- National Register-listed resources.
- Resources determined eligible for listing on the National Register by the New York State Historic Preservation Office (NYSHPO).
- Resources surveyed for this project in accordance with Section 106 and to be recommended as eligible for listing in the National Register, pending NYSDOT and NYSHPO review.
- Finally, ongoing survey work has identified additional resources that may be eligible for listing in the National Register but these are still being evaluated.

In terms of archaeological resources, this analysis examined impacts of bridge options on previously identified archaeological resources as well as on areas determined to be archaeologically sensitive as a result of research conducted as part of the Section 106 compliance survey for this project. It should be noted that for areas determined to be archaeologically sensitive, the Phase 1B presence or absence subsurface testing survey has not yet been completed for Rockland or Westchester County. The purpose of the Phase 1B subsurface testing is to determine whether the location *actually* contains archaeological resources as opposed to whether such resources may *potentially* exist at the location.

6.2.1 National Register-Eligible TZB

The TZB was constructed, from 1952 to 1955, to carry NYSTA (I-87/I-287) over the Hudson River. In 2003, NYSHPO determined the TZB to be eligible for listing in the National Register, under criteria A and C for its historic and structural significance. In 2006, the FHWA included the TZB on the list of 22 features in New York considered to be nationally and exceptionally significant features of the federal interstate highway system. The 3.1-mile-long bridge crosses the Hudson River at its second-widest point, and connects Rockland and Westchester Counties. In terms of historic significance, the TZB influenced patterns of habitation, travel, employment, and commercial/industrial development in both counties. The TZB is also a crucial part of the New York State Thruway, considered the longest toll highway system in the United States.

In terms of structural significance, the design of the TZB is unique. It is the longest bridge in New York and has the world's ninth largest cantilever span, which measures 1,212 feet and forms part of the thru-truss Main Spans. It was also the first permanent bridge in the US to be constructed, in part, on eight Buoyant Caissons that support a portion of the West Deck-Truss Spans and the Main Spans. The Buoyant Caissons serve as air cushion supports, since the Hudson River bottom below the Buoyant Caissons consists of mud and silt for 250 feet before bedrock. The 40-foot-high Buoyant Caissons vary in size, with the largest weighing 25,000 tons. They were constructed upriver from the TZB, in a natural clay pit 32 feet below the river surface, and are examples of innovative engineering. Once they were completed, the clay pit, which was the world's largest natural dry dock at the time, was flooded and they were floated downriver into place.

The TZB retains a high degree of historic integrity. Contributing structural elements of the bridge include its Causeway; West Deck-Truss and Main Spans, most of which rest atop Buoyant Caissons; East Deck-Truss Span; and East Trestle Span. See Appendix D for a detailed description of the TZB and its contributing structural elements.

Since construction of the TZB in the 1950s, major alterations have included: replacement of the decking in the East Deck-Truss Span; reconfiguration of the six-lane deck to accommodate a seventh lane; installation of an automatic lane changer (the movable barrier); reconfiguration of the Tarrytown Toll Plaza; and replacement of the pier bent-protection system. In 2008-09, the concrete deck; supporting steel stringers; bearings; hold-down bolts; fascia beams; safety fence; and outer walkway of the outer two lanes of the Causeway and West Deck-Truss Span were replaced. Drainage improvements were also undertaken. In 2004, prior to commencement of this work, NYSHPO concurred with NYSTA that the deck replacement project would have no adverse effect on the TZB. It is anticipated that the same work will occur along the Main Span and remaining lanes of the Causeway and West Deck-Truss Span soon.

	Rehabilitation Options				Replacement Options		
	Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**
Rockland							
Displacements	None	One residence	One residence	One residence	One residence	One residence	One residence
Acquisitions	• Elizabeth Place Park	• Elizabeth Place Park • Part of 2 residences	• Elizabeth Place Park • Part of 2 residences	• Elizabeth Place Park • Part of 2 residences	• Elizabeth Place Park • Part of 2 residences	• Elizabeth Place Park • Part of 2 residences	• Elizabeth Place Park • Part of 2 residences
Easements	• At Bradford Mews • 9 residences	• At Bradford Mews • 9 residences	• At Bradford Mews • 9 residences	• At Bradford Mews • 9 residences	• At Bradford Mews • 9 residences	• At Bradford Mews • 9 residences	• At Bradford Mews • 9 residences
Westchester							
Displacements	None	None	None	None	None	None	None
Acquisitions	None	Part of The Quay Part of “303” office	Part of The Quay Part of “303” office	Part of The Quay Part of “303” office	Part of The Quay Part of “303” office	Part of The Quay Part of “303” office	Part of The Quay Part of “303” office
Easements	None	The Quay & “303” office	The Quay & 303” office	The Quay & “303” office	The Quay & “303” office	The Quay & “303” office	The Quay & “303” office

Table 6-1

Summary of Potential Property Impacts

6.2.2 Rehabilitation Options

Historical Resources

The National Register-eligible TZB would be directly impacted by all Rehabilitation Options. The Causeway would be replaced under all Rehabilitation Options. In addition, Options 1 and 2 would alter the Main Span, with Option 2 resulting in the greatest changes. Additionally, Options 3 and 4 would alter the Main Span and change the TZB's appearance by constructing a supplemental bridge to the north.

In Rockland County, Rehabilitation Option 1 would require temporary construction easements from two recommended National Register-eligible properties (78 Smith Avenue and 321 South Broadway) (Figure 6-1, page 61 and Table 6-2, page 60). Option 1 would also result in temporary and permanent easement impacts to a recommended National Register-eligible property (10 Ferris Lane) and the River Road Historic District. Options 2, 3 and 4 in Rockland County would acquire permanent partial acquisitions from a recommended National Register-eligible property (10 Ferris Lane) and the River Road Historic District. Options 2, 3 and 4 would also result in temporary and permanent easements from a recommended National Register-eligible property (321 South Broadway) and the River Road Historic District, and a temporary easement from 78 Smith Avenue.

In Westchester County, Options 1, 2, 3 and 4 would directly impact the recommended National Register-eligible Irving Historic District by creating a new Pedestrian and Bicycle Path access point to the district. In addition, Options 2, 3 and 4 would directly impact a yet-to-be evaluated building occupied by NYSTA. Furthermore, Options 1, 2, 3 and 4 would directly impact the yet-to-be evaluated Hudson River Line via a strip taken to facilitate construction of a river walkway (Figure 6-2, page 61 and Table 6-2, page 60).

Archaeological Resources

In Rockland County, all options would impact previously identified New York State Museum (NYSM) Site 6402 (Figure 6-1, page 61). However, Rehabilitation Option 1 would have the fewest direct impacts to potential archaeological resources, while Options 3 and 4 would have the most direct impacts. Under Options 2, 3 and 4, direct impacts would occur to archaeologically sensitive Elizabeth Place Park and the front and side yard areas of two structures on Elizabeth Place and Broadway.

In Westchester County, there are no previously identified sites that would be directly impacted by any of the Rehabilitation Options. There would, however, be areas of archaeological sensitivity that would be directly impacted. Option 1 would have the fewest direct impacts to potential archaeological resources while Options 2, 3 and 4 would have additional direct impacts. For these three options, archaeologically sensitive areas would be impacted by the construction of the BRT or CRT and other elements north of the I-287 ROW, west of Broadway.

Within the Hudson River, the various Rehabilitation Options would directly impact the bed of the river, and therefore, any potential archaeological resources that may be present. Research on the archaeological potential of the Hudson River bottom, is on-going as part of the Section 106 compliance study for this project. However, to date, no previously identified archaeological resources have been located.

	Rehabilitation				Replacement		
Environmental Consideration	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**
Rockland Landing	Temporary direct impacts to 2 recommended NRE properties[1] Temporary and permanent easement impacts to 2 recommended NRE properties	Direct impacts to 2 recommended NRE properties Temporary and permanent easement impacts to 2 recommended NRE properties Temporary direct impact to 1 recommended NRE property	Direct impacts to 2 recommended NRE properties Temporary and permanent easement impacts to 2 recommended NRE properties Temporary direct impact to 1 recommended NRE property	Direct impacts to 2 recommended NRE properties Temporary and permanent easement impacts to 2 recommended NRE properties Temporary direct impact to 1 recommended NRE property	Direct impacts to 3 recommended NRE properties Temporary direct impact to 1 recommended NRE property	Direct impacts to 3 recommended NRE properties Temporary direct impacts to 2 recommended NRE properties	Direct impacts to 3 recommended NRE properties Temporary direct impacts to 2 recommended NRE properties[7]
Westchester Landing	Direct impact to 1 recommended NRE property Direct impact to 1 yet-to-be evaluated property[2]	Direct impact to 1 recommended NRE property Direct impact to 2 yet-to-be evaluated properties	Direct impact to 1 recommended NRE property Direct impact to 2 yet-to-be evaluated properties	Direct impact to 1 recommended NRE property Direct impact to 2 yet-to-be evaluated properties	Direct impact to 1 recommended NRE property Direct impact to 2 yet-to-be evaluated properties	Direct impact to 1 recommended NRE property Direct impact to 2 yet-to-be evaluated properties	Direct impact to 1 recommended NRE property Direct impact to 2 yet-to-be evaluated properties
Tappan Zee Bridge	Direct impact to NRE TZB	Direct impact to NRE TZB	Direct impact to NRE TZB	Direct impact to NRE TZB	Direct impact to NRE TZB	Direct impact to NRE TZB	Direct impact to NRE TZB

[1]Recommended NRE resources must be reviewed by NYSDOT/NYSTA and MNR and submitted to NYSHPO for concurrence.
[2]Yet-to-be evaluated resources include historic resources that should be surveyed and evaluated for National Register eligibility in accordance with Section 106. It is anticipated that these resources will be evaluated in the near future.

Table 6-2

Summary of Potential Direct Impacts to Historic Architectural Resources

Figure 6-1

Cultural Resources at Rockland Landing

Figure 6-2

Cultural Resources at Westchester Landing

6.2.3 TZB Replacement Options

Historical Resources

In Rockland County, Replacement Options 1, 2 and 3 would acquire land from three properties. These include recommended National Register-eligible properties (10 Ferris Lane and 321 South Broadway) and the River Road Historic District. A temporary easement would also be acquired from recommended National Register-eligible 78 Smith Avenue for wall construction. Furthermore, under Replacement Options 2 and 3, a temporary easement would also be required from the River Road Historic District (Figure 6-1, page 61 and Table 6-2, page 60).

In Westchester County, Replacement Options 1, 2 and 3 would directly impact three historic architectural resources. These include the recommended National Register-eligible Irving Historic District by the creation of a new Pedestrian and Bicycle Path access point to the district, the yet-to-be evaluated Hudson River Line by way of a strip taken to facilitate construction of a river walkway; and the yet-to-be evaluated building occupied by NYSTA (Figure 6-2, page 60 and Table 6-2).

Under all Replacement Options within the Hudson River, the National Register-eligible TZB would be removed and replaced, resulting in an unavoidable direct impact. Furthermore, under all Replacement Options, elements that may contribute to the significance of the TZB in Westchester County would be removed.

Archaeological Resources

In Rockland County, Replacement Options 1, 2 and 3 would have direct impacts to previously identified and potential archaeological resources.

Under all three bridge Replacement Options, previously identified NYSM Site 6402 in Rockland County, would be directly impacted. Potential archaeological resources in areas of archaeological sensitivity would also be directly impacted under the various Replacement Options.

Under all three options, the areas of archaeological sensitivity that may be directly impacted include Elizabeth Place Park, the front and side yards of two structures on Elizabeth Place and Broadway and the yard areas of seven structures along the southern I-287 ROW between Broadway and Bight Road. The direct impacts in this area include takings within and outside of the I-287 ROW for road widening, construction of new access roads, construction of a Pedestrian and Bicycle Path and a retaining wall.

In Westchester County, there are no previously identified archaeological sites that would be directly impacted by any of the bridge Replacement Options. There are, however, areas of archaeological sensitivity that would be directly impacted under the various Replacement Options. For all three Replacement Options, potential archaeological resources may be directly impacted by one or more of the following: a new on-ramp from Broadway to I-287, the river walkway on the north and south sides of I-287, a new administration building, maintenance facility, traffic circles and transit connections.

Within the Hudson River, the various bridge Replacement Options would directly impact the bed of the river, and therefore, any potential archaeological resources that may be present. Research on the archaeological potential of the Hudson River bottom is ongoing as part of the Section 106 compliance study for this project. To date, no archaeological resources have been identified.

6.2.4 Comparison of Options

Rehabilitation and Replacement Options would directly impact the TZB and historic buildings in several ways. Impacts to the TZB are discussed in Section 6.2.5. Impacts to historic buildings include acquisition of property, acquisition of temporary and permanent easements, and acquisition of temporary easements.

Upon consideration of all Rehabilitation and Replacement Options, bridge Rehabilitation Option 1 would have the fewest direct impacts to previously identified and potential archaeological resources in both Rockland and Westchester Counties.

With respect to bridge rehabilitation, Options 3 and 4 would have the most extensive direct impacts to previously identified and potential archaeological resources in Rockland and Westchester Counties while Option 2 would have the less such impacts than either of those options.

In Rockland County, Replacement Options 1, 2 and 3 would result in comparable direct impacts to previously identified and potential archaeological resources. Option 3 would have the most extensive impacts to potential archaeological resources in Westchester County.

In general, Replacement Options would have greater impact on both previously identified and potential archaeological resources, than Rehabilitation Options. In particular, bridge replacement Option 3 would have the greatest direct impact of all Replacement and Rehabilitation Options considered, while bridge Rehabilitation Option 2 would have the least.

With respect to direct impacts to potential resources on the Hudson River bed, generally speaking those options that disturb the river bed the most would have the greatest potential for impact. Based on the extent of construction, replacement Option 1 could have the greatest number of direct impacts to potential archaeological resources on the river bottom, while Rehabilitation Option 2 could have the least. However, it should be noted that the geoarchaeological survey of the river has yet to be completed. The survey will include the analysis of geophysical data and sediment samples for a determination of the potential for buried shoreline deposits or former stable surfaces that could yield archaeological deposits.

6.2.5 Impacts to National Register-Eligible TZB

All Rehabilitation and Replacement Options directly impact the National Register-eligible TZB. While the Rehabilitation Options would alter the contributing structural elements of the TZB, including the Causeway, East and West Deck Truss Spans, Main Span, and Buoyant Caissons, the Replacement Options would permanently remove the TZB.

A detailed evaluation of the impacts of Rehabilitation Options on the TZB, in accordance with Section 106 and Section 4(f), is included in Appendix D. As indicated in Appendix D, the Rehabilitation Options would result in an adverse effect to the TZB, as defined by Section 106. Appendix D also illustrates that the Rehabilitation Options result in a Section 4(f) use of the National Register-eligible TZB, because they alter contributing structural elements of the TZB and cannot be developed in accordance with the *Secretary of Interior's Standards for Rehabilitation.* Finally, Appendix D concludes that no prudent alternatives have been found that avoid use of the TZB.

Appendix D provides a basis for consultation with NYSHPO, lead agencies and other consulting parties to mitigate the adverse effects of replacing the TZB in accordance with Section 106 and Section 4(f). Results of the consultation process, including proposed mitigation plans, will be included in the DEIS.

6.3 Parklands and Section 4(f)

Potential effects to parklands are an important consideration because they would typically require an analysis under Section 4(f) of the Transportation Act. This analysis would require, among other elements, an assessment of avoidance options. A requirement that no other feasible and prudent option exists is required, unless the park operator concurs that the impacts to the affected resource are de minimis and/or that there would be a net benefit to the resource as a result of the project.

There is one affected park in the area of the TZB landings (Elizabeth Place Park) and a small (unnamed) seating area across from this park on South Broadway, in South Nyack, Rockland County. These small neighborhood resources (approximately one acre), would be affected by all but one of the Rehabilitation and Replacement Options, by requiring acquisition of a strip of its northern boundary with the Thruway. The one exception is Rehabilitation Option 1, which does not require roadway widening at this location. All the other options require some roadway widening and reconfiguration of Interchange 10. The reconfiguration of the interchange, however, is anticipated to result in excess property. This could become part of an expanded Elizabeth Place Park. In conclusion, with the exception of Rehabilitation Option 1, this criterion is not a differentiator among bridge Rehabilitation and Replacement Options.

6.4 Hudson River Ecosystems and Water Resources

The project area of the Hudson River is a productive estuary. It provides regionally significant ecological values and functions for many species including anadromous, estuarine and certain marine species that are dependent on the river for spawning, nursery, feeding and overwintering activities. The proposed TZB options are within a US Fish and Wildlife Service designated Significant Habitat of the New York Bight Watershed and up river from a New York State Significant Coastal Habitat (*i.e.,* Piermont Marsh). These significant habitats are of regional importance, based on the ecological values they provide to fish, invertebrates, birds and wildlife. In particular, striped bass, American shad, Atlantic tomcod, white perch, Atlantic sturgeon, bay anchovy, shortnose sturgeon, blue crab, several species of herring, bluefish and peregrine falcons are among the important fauna in this reach of the Hudson River.

These resources are managed under a variety of Federal and State laws, regulations and orders: Clean Water Act, Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, Rivers and Harbors Act, Coastal Zone Management Act, New York State Environmental Conservation Law and Federal Executive Order 11990 (Protection of Wetlands, Fish and Wildlife Coordination Act), among others. Many of the statutes referenced here require approvals be obtained from Federal and State regulatory agencies. Examples of such approvals include the following: Rivers and Harbors Act Section 9 and 10 permits, Clean Water Act Section 404 permit, New York State Section 401 Water Quality Certification and New York State Coastal Consistency Determination, among others.

Criteria have been developed to evaluate the bridge options in terms of potential impact to Hudson River ecosystems and water resources. Consideration is given to the degree that threatened and endangered species, fisheries resources, essential fish habitat, water quality and New York State or US Fish and Wildlife significant coastal habitats may be affected by construction and/or operational impacts. Project construction activities that may affect aquatic habitats include placement of fill and the construction of piers, bulkheads and cofferdams. Future operational impacts include shading of river habitat and discharges of stormwater from roadway surfaces. At the current level of design, it is not possible to evaluate the potential impacts from some construction activities such as movements of barges, tugs and work boats. The criteria selected for use in this comparison are as follows:

- **Permanent Impacts -** The criterion for permanent impacts is based on the number of acres of impacted river bottom. Estimates of permanent impacts were based on the area (in acres) of river bottom that would be permanently impacted by the construction of the cofferdams (which include the area permanently impacted by the piers, pier fender systems and ice protection measures) in the river. The greater the area of permanent impacts generated by an option the greater the potential for impacts to the river. Other components of all of the options include the construction of bulkheads and docking facilities. However, these other construction activities and the associated permanent impacts would be the same for all of the options and, therefore, are not considered in this document since they are not differentiators.
- **Temporary Impacts -** The criterion for evaluating temporary impacts is based on the number of acres of impacted river bottom. Estimates of temporary impacts were based on the extent (in acres) of river bottom that would be temporarily disturbed during construction work due to the construction of platforms, trestles and mooring facilities. The greater the area of temporary disturbance generated by an option, the greater would be the potential impacts to the river. It should be noted that temporary impacts could also occur as a result of bridge foundation removal under both the Rehabilitation and Replacement Options. Details of foundation removal are not defined at this time but it is expected that given the substantial foundation work inherent in the Rehabilitation Options (causeway replacement, complete caisson removal, and strengthening of existing cofferdams) that those options would involve a comparable scale of temporary impacts to river habitat
- **Shading of River Bottom** - The criterion for evaluating bridge shading is based on the area of new deck installed for each of the options. Shading of river habitats reduces the amount of algae growth. Algae are an important food source for fish and shellfish. A weighted evaluation factor was applied that assumes the spans with lower elevations over the water create more shading per unit deck area than those at greater elevations above the river. It is also assumed that the bridge deck area is an appropriate measure of the impact. The location and size of the shadow changes as the sun angle changes throughout the daylight hours and over the change of seasons; however, this variation is assumed not to be a significant in this analysis. The weighting factors applied to the bridge structures are: Causeway = 1.0; approach spans = 0.75; and the Main Span = 0.5. The larger the bridge deck and the closer to water level, the greater would be the shading effect.
- **Sediment Resuspension** - Sediment is put into suspension in the water column by natural events (e.g., storms) and by human activities such as in-river construction work and vessel operations. Suspended sediment has the potential to disrupt fish migration and chemical contamination in disturbed sediment can be released to the water column and accumulate in fish and shellfish tissues. The resettlement of suspended sediment can cause a direct physical impact by smothering aquatic plants and animals on the river bottom. The criterion related to sediment resuspension is the number of sheet pile cofferdams that would be installed to facilitate bridge foundation construction. While installing sheet piling for cofferdams can be though of as a mitigation measure in one sense, the actual installation process has the potential to resuspend sediment.
- **Acoustic Impacts** - Acoustic emissions to the Hudson River would occur during construction activities, primarily related to the driving of piles. High levels of acoustic energy released during pile driving have the potential to directly injure or kill fish. Reductions in the level of acoustic energy released to the water column can be achieved by driving the piles within a dewatered cofferdam or by other means. This criterion considers the number of piles to be driven for a particular bridge option. The more piles in an option the greater the potential impact to Hudson River fish.
- **Vertical Habitat Area -** The marine growth that currently is found encrusting the piers and pilings of the TZB provides habitat for fish and other organisms, thus supporting the ecological values and functions of the river. The criterion developed for this analysis evaluates the area of permanent vertical surface underwater for the piers, pilings and Buoyant Caissons. The greater the surface area for marine growth in an option, the greater would be the ecosystem value.
- **Water Quality** - Water quality impacts to the Hudson River would result from the quality of stormwater that would be discharged during long-term operation of the TZB. Pollutants in stormwater run-off come from several sources, including: vehicular traffic, snow-clearing and maintenance operations, settlement of airborne pollutants and leaching of petroleum compounds from asphalt pavement. While pollutant loadings may vary between travel lanes and shoulders, the shoulders themselves are not insignificant sources of contaminants due to the leaching of petroleum compounds from asphalt pavement, settlement of airborne pollutants and snow-clearing operations. Furthermore, the Department of Environmental Conservation's stormwater design manual considers all impervious surfaces equally for the purpose of sizing water quality treatment systems, regardless of how the surface is used. Therefore, potential water quality impacts are assessed based on bridge deck area; the larger the bridge deck area, the greater the volume of contaminants discharged to the river.

6.4.1 TZB Rehabilitation Options

All Rehabilitation Options replace the existing Causeway and structurally upgrade the Main Span. Since Option 1 provides no transit capability, it has the smallest footprint over water and, therefore, the least potential impact to river resources. Option 2 would widen the Main Span, resulting in greater impacts than Option 1, in terms of permanent habitat impacts, shading, acoustic emissions and water quality. Options 3 and 4 provide a supplemental structure to the north of the existing bridge. Option 4 includes CRT and, therefore, requires a more robust supplemental bridge structure than Option 3 and would have greater in-river impacts than Option 3 in terms of shading, acoustic emissions and water quality. Options 3 and 4 would require the greatest number of cofferdam installations as part of foundation construction and would, therefore, have highest sediment resuspension potential.

6.4.2 TZB Replacement Options

As is the case with the Rehabilitation Options, the bridge Replacement Options have a range of configurations reflecting the transit mode being incorporated in their design. Replacement Option 1 would have less new structure in the river than Replacement Options 2 and 3 because it does not provide for CRT system. Consequently, Replacement Option 1 has potentially lower impacts to river resources than Replacement Options and 3 in terms of permanent fill, impacts to water quality and construction acoustic emissions. The overall width of Replacement Option 1 is the same as Replacement Option 3; both of these options are 76 feet narrower than Replacement Option 2. Consequently, of the Replacement Options, Option 2 would potentially have greatest impact to river resources in terms of water quality, shading and construction phase acoustic emissions.

6.4.3 Comparison of Options

The assessment of potential aquatic impacts provided herein is a comparison of relative effects, and not of absolute impacts. Thus, when it is indicated that the permanent impacts of Replacement Option 2 are potentially greater than those of Rehabilitation Option 1 (14 acres as compared to 8 acres), a judgment is not being made as to whether or not either impact level may be acceptable or whether or not the value of the permanently lost habitat is comparable on a per acre basis. Rather, the area of permanent fill is being used as an indicator of the potential scale of impacts on a relative basis. It should be noted, however, that the impact criteria presented (e.g., acres of permanent fill) are known to be those that regulatory agencies and ecologists usually consider when they review a proposed project.

The ecological comparison of bridge options (Table 6-3) is based on the criteria described above. In general, options that have a larger footprint over the river have potentially greater relative impacts. Thus, Replacement Option 2, which incorporates CRT, has the largest footprint over the river and the most expansive foundation system of the options being considered. Consequently, it shows the largest potential for in-river effects based on several of the selected criteria. However, in the case of sediment resuspension, the rehabilitation options generally have greater potential to resuspend river sediments as a result of the larger number of sheet pile cofferdams that would be installed for these options. Thus, Rehabilitation Options 3 and 4 would require the greatest number of cofferdams and would potentially have the most significant potential for sediment resuspension. Since only the Causeway is replaced under Rehabilitation Option 1, it generally has the lowest potential ecological impacts of the options evaluated. However, it is the only option that would not provide for a transit system across the Hudson River.

Once actual impacts are known (and presented in the DEIS), it will be possible to devise mitigation strategies that offset the various effects of constructing and operating either a rehabilitated or replacement bridge. The bridge options evaluated, herein, provide a range of opportunities for implementing measures that either mitigate impacts or enhance habitat values. Among these are methods to reduce acoustic emissions to the water column, methods to minimize sediment resuspension (e.g., using turbidity barriers) and opportunities to install sub-aqueous structures that enhance aquatic habitat.

6.5 Visual Resources

Effects on visual resources are not considered a differentiator among bridge options at this time. Because the design of the Main Span over the navigational channel has not yet been completed (the major feature of the TZB), it is premature to rank bridge options for visual impacts at this time.

From the perspective of the bridge approach/landing areas, the potential effects of the various bridge options are generally comparable for options that provide equivalent transit capability. Options that accommodate a CRT system would have an approximately 25’ higher profile at the Rockland County shoreline than would options that accommodate BRT, independent of whether a bridge rehabilitation or replacement option is being selected. Therefore, from the perspective of the bridge approach/landing areas, impacts to visual resources and effects on viewers are not considered a differentiator among bridge options with comparable transit capabilities.

Following the more complete design of the bridge, particularly its prominent Main Span over the navigational channel, the effects on visual resources and viewer groups will be fully described and assessed in the DEIS.

	Rehabilitation				Replacement		
Screening Criteria	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**
Area of river habitat permanently impacted by piers (acres)	8	10	10	11	11	14	11
Area of river habitat temporarily impacted (acres)	4	4	4	4	4	4	4
Shading of river bottom (acres)	41	56	55	61	67	84	68
Sediment Resuspension (number of cofferdams installed)	60	60-95	120	100	70	70	45-80
Level of in-water acoustic emissions (# of piles)	888	1,588	1,604	1,408	1,660	2,279	1,524
Area for encrusting marine growth (acres)	6.3	7.0	7.0	7.7	3.6	4.6	4.0
Water quality (acres of deck area)	45	63	62	71	77	98	79

Table 6-3

Ecological Comparison of Bridge Options

6.6 Summary of Environmental Criteria

A summary of the comparison of options in terms of the environmental criteria presented in this chapter follows:

Land Use

Since local land use policy documents do not address planning for the TZB, consistency with these policies is not considered a differentiator among Rehabilitation or Replacement Options.

Acquisitions and Displacements

All options except Rehabilitation Option 1 have generally similar impacts. With this exception, this criterion provides little differentiation among the options.

Parklands and Section 4(f)

Except for Rehabilitation Option 1, which does not require roadway widening at Broadway in South Nyack, all other options require some roadway widening and would consequently involve acquisition of a portion of Elizabeth Place Park.

Historic and Archaeological Resources

While multiple historic properties would be directly impacted by the Rehabilitation and Replacement Options, the National Register-eligible TZB would be subject to the most significant impacts. Under the Replacement Options, the TZB would be replaced with a contemporary structure that meets current bridge and highway design criteria. This would result in an adverse impact to the TZB as defined in Section 106 of NHPA. Rehabilitation Options 1 and 2 would alter contributing structural elements of the TZB via construction of a Causeway to the north under both options and widening the Main Span to the north and south under Option 2. Rehabilitation Options 3 and 4 would alter the appearance of the TZB by construction of a supplemental bridge to the north. A detailed evaluation of the impacts of Rehabilitation Options on the TZB, in accordance with Section 106 and Section 4(f), is included in Appendix D.

There is little difference, in terms of direct impacts, to terrestrial archaeological resources among any of the options. The differences among the options relate to impacts to potential archaeological resources on the river

bottom. Theoretically, those options with the most construction in the river would have the greatest impact on such resources. However, to date, no archaeological resources have been identified.

Hudson River Ecosystems and Water Resources

Since Rehabilitation Option 1 does not accommodate transit, it would potentially have fewer ecological impacts than the other options. Overall, Rehabilitation Options would have somewhat lower potential effects on river resources than would Replacement Options for the criteria that were evaluated. However, Rehabilitation Options 3 and 4 would have somewhat greater potential for resuspending river sediment during bridge foundation construction than would the other options. Generally, few differences among Rehabilitation and Replacement Options were found and it is expected that potential impacts can be effectively managed by selection of appropriate construction techniques and implementation of suitable mitigation measures.

Visual Resources

From the perspective of visual impacts at the bridge approach/landing areas, bridge options with comparable transit accommodations provide comparable profiles. Therefore, impacts to visual resources and viewers at the approaches/landings are not considered a differentiator among the bridge options.

6.7 Other Evaluation Criteria

Other criteria, notably Air Quality and Noise, were not included as they are not differentiators among options with comparable transit modes.