Sakonnet River Bridge
Rehabilitation or Replacement Project

DRAFT ENVIRONMENTAL IMPACT STATEMENT & SECTION 4(f) STATEMENT

Volume IIb

Fish Resources Study

SakonnetRiverBridgeReconstructionProject

EnvironmentalImpactStatement

TechnicalMemorandum

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Introduction

The Rhode Island Department of Transportation in conjunction with Commonwealth Engineers and Consultants, Inc. is assessing the potential impacts of replacing or repairing the Sakonnet River bridge which carries Route 24 over the Sakonnet River (Figure 1). The highway crosses from Tiverton, Rhode Island on the eastern shore to Aquidneck Island which comprises the towns of Portsmouth, Middletown, and Newport, Rhode Island. Immediately to the north of the Sakonnet River Bridge is an abandoned railroad crossing consisting of an east and west causeway and a swing bridge fixed in an open position. Removal of the swing bridge and the causeways are being considered as part of the assessment of the highway bridge. This report addresses potential concerns related to fish and shellfish resources in the vicinity of the Bridge under five alternative plans.

The Sakonnet River together with Mount Hope Bay at its northern end is one of three interconnected passages comprising Narragansett Bay (see Hicks 1959, Olsen et al. 1984, and Desbonnet and Lee 1991, for example). The fish resources of Narragansett Bay have been and continue to be reasonably well studied although work has not necessarily focused on or even included the Sakonnet River. Ichthyoplankton were sampled and described by Herman 1963, MRI 1974, Bourne and Govoni 1988, Keller and Klein-MacPhee 1991). Ichthyoplankton continue to be sampled in the Providence River (MRI 2000a), Mount Hope Bay (MRI 2000b), and at other locations throughout the Bay (Klein-MacPhee, URI Graduate School Of Oceanography, personal communication). Studies of finfish populations residing on or near bottom have been conducted by the Graduate School Of Oceanography at one location in West Passage continuously since 1959 (Jeffries and Johnson 1974, Jeffries and Terceiro 1985, Jeffries et al. 1988, 1989). The Rhode Island Division of Fish and Wildlife completes both a seasonal (spring, fall) and monthly trawl survey in the Bay (Lynch1998) as well as a shallow-water seine survey monthly from June through October (Powell 1991). The seasonal trawl time series dates back to 1972, the monthly trawl survey back to 1990, and the seine survey back to 1986. At the head of the Bay year-round monthly trawl surveys are completed as part of the Brayton Point power plant studies (see MRI 2000b for example). Those studies date back to 1971 and include shallow-water seine surveys from March through October. Data available from these studies provide information on the abundance and seasonal distribution of fish likely to be affected by any work conducted on the Sakonnet River bridges.

Site Description

The Sakonnet River highway bridge is supported by seven piles which are in the 1,300-foot wide River itself (Figure 2). The navigation channel beneath the Bridge is 119 feet in width (Edwards and Kelcey 2000) with a mean low water depth of approximately 45 feet. The existing railroad causeway to the north is composed of large rocks and boulders with steep sides descending to the river bed. Horizontal clearance between the east and west causeways is approximately 400 feet. Based on a survey completed by Marine Research (MRI) divers on August 30, September 8, and September 28 the bottom in shallow water on either side of the causeway is largely composed of rock which appears to have originated from construction of the causeways. At a depth of approximately

40 feet below mean low water, on both sides of the causeway the substrate is composed of fine sediments. North of the causeway small patches of blue mussels were noted. Similar bottom was observed south of the railroad causeway except near Riverside Marina on the east side where large mussel mats were noted. The bottom around the swing portion of the railroad bridge where currents were strong contained very little fine sediment. Rocks and pilings associated with the causeways, railroad bridge, and the piles of the highway bridge offered substrate for large numbers of mussels, hydroids, anemones, and starfish (Figure 3, 4). Tautog, cunner, and black sea bass were noted to be numerous. Striped bass, scup, Atlantic silverside, Atlantic menhaden, and crevalle jack were also observed by divers.

Fish Resources

The Sakonnet River is a key passageway from the upper Bay to Rhode Island Sound although 68-70% of the water exchange to Mount Hope Bay occurs through the much wider passage under the Mount Hope Bridge to the west (Hicks 1959, Spaulding et al. 1987). Table 1 presents a listing of the 118 species of fish which have been recorded in Mount Hope Bay over the course of studies for the Brayton Point Power Station. Those that are resident in the Bay year round as well as those that occur seasonally on a regular basis or as strays from more southern waters are indicated. Each of these species can be expected to move through the Sakonnet River passage at least from time to time.

Species of particular interest or concern, those that can be expected to move through the Sakonnet River regularly and are valuable from a recreational and or commercial standpoint, include tautog, winter flounder, river herring, American shad, rainbow smelt, striped bass, and bluefish.

<u>Tautog</u>

The Sakonnet River Bridge and in particular the adjacent railroad bridge are popular with recreational fishermen. In association with monitoring studies in Mount Hope Bay, MRI personnel pass the Sakonnet River bridges twice daily approximately ten times per month during March through May. During the remaining months of the year round-trip passage is made about three times per month. Beginning in late March 2000 MRI personnel began recording information on the presence of recreational fishermen using the area. Fishermen were first noted in late April and individuals were present every time personnel passed the bridges from that time until this report was prepared in September (Table 2). Shore and boat-based fishermen regularly used the area (see also Edwards and Kelcey 2000). While not observed on the same day, as many as 17 shore-based fishermen were recorded on a single occasion (May 25) and as many as 10 were noted fishing from 5 boats (May 8).

Based on the habitat present and discussions with personnel at Riverside Marine which maintains a bait and tackle shop in Tiverton, the majority of, if not all, recreational fishermen noted around the bridges were targeting tautog, also known as blackfish. In addition to being relatively abundant there, the bridge supports and railroad bridge causeway provide a convenient place for small boats to tie up in the swift tidal current and for shore-based fishermen to obtain access to deep water near the center of the River.

The tautog is a coastal species ranging from New Brunswick to South Carolina, and is most abundant between Cape Cod and the Delaware Capes (Bigelow and Schroeder 1953; Cooper 1966). They are relatively slow growing and long-lived. Cooper (1967) recorded a maximum age of 34 years and Bigelow and Schroeder (1953) reported that a record fish measuring 36.5 inches in length and a weight of 22.5 pounds was landed in New York. Small juvenile tautog appear to prefer vegetated habitat where they are typically green in color (Nichols and Breder 1927, Able et al. 1989, Sogard and Able 1991, Able and Fahay 1998). The distribution of larger juveniles and adults is limited primarily to inshore areas that are in close association with rocks, wrecks, pilings, jetties, or other bottom discontinuities which provide protection from predators (Olla et al. 1974, 1979, Olla and Studholme 1975, Briggs 1977), thus explaining their abundance around the Sakonnet River bridges. Mussels provide a key food source for tautog (Olla et al. 1974) and these animals are typically found attached to rocks, pilings and other structures. A diver survey around the base of the railroad bridge indicated that the rocky bottom and the piles and bridge supports there were densely covered with blue mussels.

Tautog are active only during the daytime. At night they become inactive and remain in close proximity to shelter where they may be found lying on their sides (Olla et al. 1974). Adult tautog migrate onshore in spring and to deeper water offshore in autumn in response to changes in water temperature (Stolgitis 1970; Cooper 1966, Olla et al. 1974). Olla et al (1974) reported that only older tautog moved offshore for the winter while the younger fish remained inshore in a torpid state. Fishermen note that catch in the Sakonnet River declines during July and August. They attribute the decline to warm water temperatures and fish seeking deeper cooler locations.

Winter Flounder

The winter flounder is a right-sided benthic flatfish ranging from northern Labrador to Georgia (Leim and Scott 1966). It occurs from inshore estuaries to the offshore fishing banks. Movements of winter flounder generally consist of migrating to deeper, cooler water in summer, returning to shallow, near-shore areas in fall, apparently in response to changes in water temperature (McCracken 1963). Based on a ten-year tagging study, Howe and Coates (1975) showed that flounder north of Cape Cod displayed relatively localized movements confined to inshore waters. Fish south of Cape Cod dispersed in spring and summer in a southeasterly direction generally beyond the territorial limit. Juvenile winter flounder have been found to eat a wide variety of invertebrate food items while adults eat primarily polychaete worms, amphipods and isopods, pelecypods, and plant material but, in a series of studies, 14 phyla and 260 species were identified in the stomachs of winter flounder (MacPhee 1978). Winter flounder mature when two to three years of age (Perlmutter 1947) but in the northern areas of its range may not mature until age VI or VII (Kennedy and Steele 1971). Spawning occurs at night (Breder 1922) in inshore waters once per year from November to June depending on geographic location, generally from February through April in Narragansett Bay.

Eggs are demersal and adhesive, and require 5 to 33 days to hatch over a temperature range of 2 to 12C (Scott 1929; Rogers 1976; MRI 1986). Ichthyoplankton sampling completed in 1977 (MRI 1979) suggested that winter flounder spawn in the Sakonnet River. While adults may spawn there others move through the basin to spawning grounds in Mount Hope Bay, the Taunton River, Lee River, and Cole River.

Anadromous Species

Fish which spend much of their life in the ocean but migrate into freshwater to spawn include the alewife, blueback herring, American shad, and rainbow smelt. The Taunton River basin at the head of Mount Hope Bay provides important habitat for these species but numerous other tributaries are utilized as well. The alewife resources of the Taunton River basin receive considerable assistance from state fishery biologists and citizen groups. Alewife were stocked in the basin as recently as 1994 (Phillips Brady, Massachusetts Division Of Marine Fisheries, personal communication). In addition to the alewife, considerable effort has been expended to establish blueback herring runs to the Taunton River Basin (Phillips Brady, personal communication). The Taunton River watershed Alliance and Fishway Stewardship Programs are instrumental in repairing and maintaining fishways at various sites in the basin in efforts to maintain and enhance local stocks (see for example Doherty 1993). American shad once utilized the Taunton River although a significant sole supporting fishery apparently did not develop (Mansueti and Kolb 1953). The Massachusetts Division of Marine Fisheries conducted a survey of potential shad spawning grounds in the Taunton River in the late 1960's (Reback and DiCarlo 1972). Members of these anadromous species can be expected to pass through the Sakonnet River round trip as adults during their respective spawning runs and again as juveniles emigrate on their return to the sea. Rainbow smelt move upstream during late winter (February-April), alewives during early spring (April, May), blueback herring and American shad during late spring (May, June).

Striped bass, Bluefish, Scup, Black Sea bass

While the waters around the bridges are perhaps best known for tautog, recreational fishermen also land striped bass, bluefish, scup, and black seabass there. Each of these species moves through the area on a seasonal basis primarily between April and October. Striped bass are actually anadromous but there is no known spawning population in the Narragansett Bay system. Juvenile and adult bass and bluefish move into the upper Bay in spring and summer to feed where they remain until autumn. Scup migrate primarily inshore and offshore occupying coastal waters including large, deep-water estuaries during summer where they contribute to the recreational fishery. Like many species found in New England waters, black sea bass migrate seasonally inshore and northward in spring, offshore and southward in the fall. Consistent with their presence around the bridges, both scup and sea bass are typically found over rocky bottom and around wrecks, pilings, and artificial reefs where they bottom feed on crabs, lobsters, shrimp and mollusks (Bigelow and Schroeder 1953, Cupka et al. 1973, Musick and Mercer 1977, Morse 1978, Grosslein and Azarovitz 1982, Steimle and Figley 1996, Able and Fahay 1998).

In general, tautog and other fishes are abundant in the waters surrounding the Sakonnet River Bridge and the abandoned railroad bridge because there is abundant cover and food there. Cover exists in the form of hard structure provided by the rock causeways, the many support piles for the railroad bridge, and to a lesser degree those supporting the highway bridge. Tidally driven currents through the narrow channel are strong. The nearly continual water exchange transports food not only to fish but also to the mussel population and other members of the fouling community. Currents also maintain relatively high water quality while the abundant cover provides areas for fish to find refuge from the currents and therefore conserve energy while not actively feeding.

Ichthyoplankton

Fish eggs and larvae are seasonally abundant in Narragansett Bay. From 1972-1992 when year-round sampling was conducted in Mount Hope Bay, 68 species of fish were represented by eggs and larvae (Table 1). When ichthyoplankton sampling was conducted throughout Narragansett Bay between June 1972 and August 1973, 42 species were represented in the collections (Bourne and Govoni 1988). More recently Keller and Klein-MacPhee (1991) collected 38 species in Bay-wide ichthyoplankton collections. Table 3 shows the temporal occurrence of species collected from Mount Hope Bay in 1992, a typical one-year period in which samples were taken at five locations with 0.505-mm mesh bongo nets. Sampling was completed monthly during January and February, every four to five days from March through August and again monthly from September through December (MRI 1993). The number of species represented in the catch ranged from 2 in January to 18 in July. While each of these species may not spawn directly in the Sakonnet River basin, each of these types of fish eggs and larvae can be expected to be found there as they drift about during their respective period of occurrence.

Based on sampling in Mount Hope Bay, densities of pelagic fish eggs range from near zero from November through January to several thousand per 100 m^3 of water in June and July (Figure 4). While pelagic eggs are uncommon during the autumn and winter months, fish such as sand lance, sculpin, rock gunnel, and winter flounder spawn then but deposit demersal adhesive eggs which do not normally drift about in the water column. Larval fish densities typically range from less than 10 per 100 m^3 of water during the months of September through January up to as many as 1000 per 100 m^3 of water or more during the summer months (Figure 5). A focused winter flounder study completed in 1993 (MRI 1994) indicated that winter flounder larvae were more abundant in the Sakonnet River then in East Passage suggesting that adults spawn in that basin.

Shellfish Resources

The waters of the Sakonnet River in the vicinity of both the highway and railroad bridges are permanently closed to the harvesting of shellfish (Edwards and Kelcey 2000). The area is closed because of contamination from the Taunton River and Fall River sewage treatment facilities to the north and because of the high density of boats in the basin (Arthur Gans, Rhode Island Department Of Environmental Management, personal communication). While shellfishing in the area of the bridges is not allowed, animals do reside there and contribute seed to the surrounding waters. On the 28th of September 2000 a shellfish survey was completed around the Sakonnet Bridge causeway. A biologist conducted sub-tidal shellfish sampling at each of the eight locations shown in Figure 6 concurrent with acquiring sediment core samples for grain size analysis. A 1/4-square meter frame was randomly placed on the sediment and all shellfish removed and counted. Four 1/4-meter samples were obtained at each of the eight locations.

The quahog (*Mercenaria mercenaria*) was the only species encountered at Stations 1 through 7 with densities of 1 per m^2 or less. At Station 5 a density of 81 per m^2 was found (Table 4). The bottom at Station 8 was carpeted with blue mussels as was the entire rocky shoreline of the causeway itself. There was a particularly heavy set of blue mussels region-wide during the 2000 season and this area reflects conditions in similar habitats throughout upper Narragansett Bay.

Additional sampling was completed in the intertidal areas located on the north and south shoreline areas located at the shoreward ends of the causeway. These are indicated by letters A-D on Figure 6. Similar to the sub-tidal survey, four 1/4 m^2 quadrats were excavated to a depth of 20 cm at the mean low-water line and at an intertidal location approximately mid-way down the slope for a total of eight samples per location. No shellfish were found at these locations except in samples taken near the mean low-water line on the beach at the southwest corner of the causeway (location A, Figure 6, Table 5). At this spot a total of 8 quahogs were found in the four 1/4 m^2 samples.

Project Impacts

Five alternative plans dealing with the Sakonnet Bridges were considered with regard to fish and shellfish resources in the surrounding waters:

1. No build
2. Rehabilitate existing bridge.
3. New highway bridge along existing alignment, temporary bridge over widened rail causeway.
4. New bridge to north along rail causeway alignment.
5. New bridge to south.

Alternative 1. <u>No-Build Alternative</u>

Under this alternative the existing highway bridge would remain unchanged, repairs to it being completed as necessary to maintain the structure. Under each of the five alternatives including 'No Build' the U. S. Coast Guard has indicated that consideration should be given removal of the railroad bridge causeways back to the natural shoreline, and it is understood that the railroad swing bridge is to be removed independently of any other plans.

If repairs to the highway bridge support piles became necessary in the course of maintaining the Bridge, some temporary disruption of habitat might occur but it would likely affect limited areas occupying a small percentage of the available habitat. Removal of the existing railroad bridge, the array of piles surrounding it, and all or a portion of the causeways would remove a large percentage of the hard bottom structure with which juvenile and adult tautog and their preferred food associate. The cover and food available to other species such as sea bass, scup, and cunner would be removed. If removal of the railroad bridge does not involve complete removal of the surrounding rocky substrate, some fish habitat would likely remain. Singularly or combined however, removal of the railroad bridge and its causeway would very likely reduce or eliminate the recreational tautog fishery at that location. According to personnel at the Riverside Marine tackle shop near the eastern base of the Bridge, the area is currently one of the best if not the best location in the State of Rhode Island for tautog fishing. Although boat-based fishermen will continue to have access to the area, shore-based fishermen would no longer be able to reach deep water in the center of the River if the causeways were removed. That would affect landings of striped bass, bluefish, winter and summer flounder and other species in addition to tautog. As noted in the navigation study report (Edwards and Kelcey 2000), removal of the causeways would expose the Tiverton Basin to northerly winds off Mount Hope Bay. That would change the character of the basin and likely alter the abundance and distribution of many fish species. While an effect is difficult to predict, the increased exposure to northerly winds and the turbulence which would likely result could negatively impact winter flounder spawning which appears to be productive in the River.

Mitigation - Since the Sakonnet River Bridge would simply be repaired as necessary, no mitigation measures would be required under this alternative. Removal of the existing railroad bridge, the array of piles surrounding the swing portion of the bridge, and the causeways could be mitigated by creating replacement structured, hard bottom. Maintaining at least a portion of the existing habitat could be achieved by not removing the causeways. The Sakonnet River navigation channel is 119 feet in width through the Sakonnet Basin. Horizontal clearance between the Sakonnet River Route 24 highway bridge piles is 172 feet (Edwards and Kelcey 2000). The channel width is also limited to approximately 500 feet through the Old Stone Bridge passage located 0.8 nautical miles south of the Sakonnet River Bridges. Passage through the River by larger vessels would be limited by that constriction regardless of the future width between the railroad causeways. Current distance between the railroad causeways is approximately 400 feet so that removal of the swing portion of the railroad bridge together with the western trestle portion would allow a navigation channel approximately 280 feet wider then the present 119 feet. Retaining the existing causeways would maintain the protection they afford to the basin from northerly winds, maintain the fisheries habitat they provide and allow continued access to the navigation channel by shore-based fishermen.

If the causeways are removed, the loss of habitat associated with them could be replaced to some extent by building rock reefs nearby. The loss of access to the river channel by shore-based fishermen could also be mitigated with a fishing pier. The combination of rock structure, piles, and strong currents presently available at the site appears somewhat unique and likely would be difficult to replicate without affecting navigation. Nonetheless rock habitat could be created nearby preferably in advance of removal of the abandoned rail bridge and its causeways. That would allow time for fouling organisms to become established on new surfaces and permit fish to quickly move there during removal of the railroad bridge and causeways. Artificial reefs are widely believed to improve fishing by both aggregating fishes and by increasing natural production (Bohnsack and Sutherland 1985, Bohnsack 1989). Artificial reef studies completed elsewhere indicate that fish rapidly occupy new reef structures (Turner et al. 1969, Klima and Wickham 1971, Solonsky 1985, Alevizon and Gorham 1989, Bohnsack 1989, Branden et al. 1994). Tagging studies associated with new and established reefs indicate that fish readily redistribute from suboptimal habitat to newly available structure (Solonsky 1985). Turner et al (1969) reported that fish appeared on newly constructed reefs 'within hours' of their completion.

A carefully designed fishing pier would allow shore-based fishermen access to deeper waters near mid-river following removal of the railroad causeways and could be integrated with location of replacement habitat to improve access to it. A fishing pier would offer a different fishing experience compared with fishing from the existing causeways, more urban relative to existing conditions perhaps, but would make the River more accessible to a wider array of fishermen. A pier could also be designed to provide fishing opportunities for the handicapped.

Alternative 2. <u>Rehabilitate Existing Bridge</u>

Under this alternative the existing Sakonnet River Bridge would receive major repairs which might include alterations to the existing support piles. Repair or replacement of those piles could require installation of coffer dams. Any work conducted on the underwater surfaces of the piles would result in temporary loss of fouling organisms and temporary displacement of some fish. Fouling organisms would likely become reestablished in a short period of time depending upon when repairs were completed. In Mount Hope Bay, during the summer season, hydroids have been noted to completely cover hydrographic equipment and the underside of buoys in as little as one month. Blue mussels can be expected to set and grow to a length of about one inch during the summer. Fish would very likely return in a similarly short period.

Under this alternative, present plans include removal of the railroad bridge and could potentially include removal of both causeways back to the natural shoreline. Impacts of removal of these structures were discussed under the no-build alternative.

Mitigation - See mitigation measures presented under Alternative 1.

Alternative 3. New Bridge on the Existing Alignment

Construction of a new bridge on the existing alignment would require demolishing the existing Route 24 bridge. To handle transportation over the Sakonnet River during the bridge demolition and replacement period traffic would be diverted to a temporary bridge constructed on the abandoned railroad alignment. To handle vehicular traffic during that time the railroad causeways would be widened with additional fill and the swing bridge would be replaced with a fixed, temporary bridge. Once the new highway bridge is completed the temporary bridge and causeways would be removed back to the natural shoreline. The expected detour period is three years.

Demolition of existing Sakonnet River highway bridge - Removal of the existing highway bridge would include removal of the stone support piles to a depth of five feet below the River's substrate. Underwater explosive charges would be used to facilitate removal. Submerged charges have the potential to cause injury and mortality to resident fish and invertebrates. Pressure waves generated during explosive use have a negative impact on fish, particularly those with swim bladders (see for example Aplin 1947, Hubbs and Rechnitzer 1952, Falk and Lawrence 1973, Sverdrup et al. 1994). Shock waves may cause internal organs such as the kidney, liver, spleen, gonads, and sinuses to rupture or hemorrhage. Pressure changes may also cause mortality among fish eggs and larvae (Kostyuchenko 1973, Wright 1982) and the byproducts of detonation may include toxic compounds (Wright and Hopky 1998). According to Wright (1982) and Wright and Hopky (1998), detonation of explosives is believed to have a negligible effect on the morality rate of shellfish and crustaceans such as lobsters but sub-lethal effects are not well studied. A thorough discussion of the effects of underwater explosions on fish related to removal of the Old Jamestown Bridge (Route 138) spanning the west passage of Narragansett Bay appears in Archibald et al. (1995).

Removal and reconstruction of the Sakonnet Bridges may include unavoidable production of underwater noise such as in the use of pile driving and other heavy equipment. Since water is approximately two orders of magnitude denser than air, sound travels faster and further in water than in air. Transmission is further enhanced by reflection of sound waves from the water's surface and from the basin's bottom (Hoar and Randall 1971). It is well established that fish hear (Blaxter et al. 1981, Popper and Platt 1993, and others). Their response to sound has been studied as a possible deterrent to entrainment and impingement at power plant intakes (Dunning et al 1992, Nester et al. 1992, Ross et al. 1993, Popper and Carlson 1998). Some studies have been completed on the potential effects of intense sounds on the sensory system of fishes. Popper and Clark (1976) reported that four-hour exposures to 149 dB at several frequencies caused temporary measurable shifts in hearing thresholds lasting 2 to 4 hours. In spite of repeated daily exposure to high intensity sound for several weeks, no permanent behavioral evidence to suggest hearing loss was detected. Other investigators have exposed fish to intense sounds ranging from 180 to 204 dB for periods ranging from 1 to 5 hours (Enger 1981, Denton and Gray 1993, Cox et al.1986a,b, 1987). With these exposures sensory hair cells may sustain some damage. In response to those studies Hastings et al (1996) exposed fish to pure tones at intensities as high as 180 dB for a one-hour period. Examination of ear sensory hair cells showed damage limited to small regions of the inner ear which was inconsistent among test fish.

The cited studies suggest that even intense sounds if intermittent such as produced by a pile driver would not be damaging to fishes' sound receptors even if they chose to remain in the vicinity of construction. Studies conducted with intense sound at power plant intakes suggest that some avoidance can be expected. In reality any new construction related to bridge replacement would be conducted within a cofferdam where sound would be transmitted to air and not directly to the surrounding water. Noise-related impacts unrelated to explosive use are therefore expected to be minimal.

Regardless of the method used to remove them, replacement of the highway bridge piles will disrupt available tautog habitat in those areas. The new bridge may require fewer piles, somewhat reducing available pile-associated habitat. In relatively short time however, particularly during the warmer months, fouling organisms will become reestablished on the submerged surfaces of the new piles. As the fouling community redevelops additional cover and food will become available.

Applied Science Associates (ASA 2001) assessed, through modeling, potential sediment transport and deposition resulting from reconstruction activities. Model runs assumed release of 11.6 g/s (0.026 lb/s), which is equivalent to 1 ton/day of varying sediment sizes ranging from very fine sand, silt and clay. Three release locations were considered separately for configurations with and without the causeways. A continuous sediment release, constant during a 5-day simulation period, was chosen to simulate the construction activities. Maximum thickness of deposited fine grain sediment was 0.01 - 0.4 mm near the release site. Including rapid settling coarse sand or gravel in the simulations increased the sediment layer to 0.75 mm for an area of 1,620 m^2. Maximum sediment transport was found in the near field at concentrations of 0.12 - 0.55 mg/L and would likely be lower in practice due to the use of cofferdams during construction.

In their literature review and assessment of suspended sediments and fisheries impacts, Newcombe and Jensen (1996) reported exposure concentrations ranging from 10 mg/L to 330,000 mg/L. At the low end some changes in depth preference were observed. Concentrations of less than 1 mg/L are below levels observed in lower Mount Hope Bay (ASA 2001) and therefore unlikely to produce a detectable effect on fish.

Temporary Bridge - Impacts associated with removal of the abandoned railroad bridge were discussed under Alternative 1. Widening the existing railroad causeways to support two lanes of traffic during the demolition and rebuilding phases of bridge replacement would be accomplished by adding fill. Sheet pile could be required to stabilize the shoreline. The addition of fill material would cover the existing fouling community eliminating the mussel beds and other organisms upon which tautog and other fishes thrive. If the submerged fill were to consist of large stone, clean habitat would probably be created and some of the local fish population might remain. Since mussels and other fouling organisms would be buried by the new fill, food supply would be eliminated until the fouling community reestablished. If sheet piling is necessary for roadway stability, fish habitat along the causeways would be greatly limited during the construction period since smooth submerged surfaces void of cover and supporting little food would be created. If the causeways are removed following bridge reconstruction, then destruction of the causeway habitat for the temporary detour could be of little importance other then the fact that it would occur two years sooner than under Alternatives 4 and 5. Under Alternatives 4 and 5 the rail causeways would not be used for a detour and would be scheduled for removal after construction of a new highway bridge. Fisheries habitat along the causeways would therefore remain in its current condition during the two-year construction period.

Mitigation - To minimize potential for demolition-related injury and mortality to resident and migratory fish in the vicinity of the Sakonnet River Bridge the recommended approach would be to conduct any demolition involving submerged explosives during the late fall, early winter. This time period would be particularly important to protect tautog, which have a swim bladder and would therefore be sensitive to pressure induced injuries. The preferred window would be after the majority of seasonally migrant and resident summer species have moved to deep, lower Bay or offshore waters and before winter flounder move toward the upper Bay for their spawning season. The months of November and December are recommended as the preferred work window.

To mitigate the effects of temporarily converting the causeways to roadway, ultimately removing the causeways and the railroad bridge, replacement habitat could be established elsewhere in the Sakonnet River. This was discussed above under Alternative 1.

Alternative 4. <u>New Bridge To The North Of Existing Bridge</u>

Under Alternative 4 a new highway bridge would be constructed between the existing highway bridge and the abandoned railroad bridge. The railroad causeways would not be needed for a temporary highway. Once the new bridge is completed under this alternative, the old highway bridge and the abandoned railroad bridge and perhaps the causeways would be removed. The expected construction period is two years.

As support piles are constructed for the new bridge prior to removal of the existing bridge, additional fish habitat would likely be created. The quality of that habitat would improve with time as the fouling community develops on the new support surfaces and would likely replace existing habitat lost when the old bridge is removed. Impacts and mitigation related to subsequent removal of the existing highway bridge, the railroad bridge, and the causeways were covered above.

Alternative 5. <u>New Bridge To The South Of Existing Bridge</u>

Under Alternative 5 a new highway bridge would be constructed south of the existing highway bridge. Once the new bridge is completed the old highway bridge and the abandoned railroad bridge and causeways would be removed. The expected construction period is two years.

As support piles are constructed for the new bridge, additional fish habitat will likely be created as in the case of Alternative 4. The quality of that habitat will improve with time as the fouling community develops on the new support surfaces. Impacts and mitigation related to subsequent removal of the existing highway bridge, the railroad bridge, and the causeways were covered above.

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