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# Coastal Defense Megaprojects in an Era of Sea-Level Rise: Politically Feasible Strategies or Army Corps Fantasies

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## **Appendix S1. A Tale of Two Army Corps Megastructures: Rhode Island's Fox Point and Narragansett Bay Hurricane Barriers**

Since the early 19<sup>th</sup> century, Congress has assigned the responsibility to the federal government to either undertake or assist in the development of water resource projects (John Lonnquest et al. 2014). This eventually included assigning inland flood protection duties to the U.S. Army Corps of Engineers (Joseph L. Arnold 1988). However, the Army Corps did not specifically get involved in flood protection on the coastline until after World War II [The Corps was involved in two projects in the early twentieth century (Table 2) but studying coastal flood protection was not officially added to their jurisdiction until 1955 (Public Law 71, 84<sup>th</sup> Congress, 1<sup>st</sup> Session)], following a series of destructive and deadly hurricanes in New England and elsewhere in the U.S. Between 1956 and 1964, over \$4 million dollars of federal money (unadjusted) was spent on studying hurricanes, flooding, and planning and designing coastal flood protection in New England (Providence Journal 1964a). At the time, the Army Corps' New England Division Engineer called the effort, "one of the biggest joint federal, state and local flood control operations in the country" (Goodrich 1956). Ultimately, five Army Corps projects were constructed in the region, including the Fox Point Hurricane Barrier, completed in January 1966 at a cost of \$16.2 million and that still sits across the Providence River, 1.4 km south of downtown Providence, adjacent to the Providence River Bridge that carries Interstate 195 (Morang 2016) (Fig. 1). The Fox Point Barrier currently protects roughly 1.1 km<sup>2</sup> of downtown Providence and \$2 billion worth of property (Kuffner 2019) against a storm surge of 6.25 m (above mean sea level)[Or about 5.0 m above MHHW (after adjusting for SLR), roughly the height of the 1000-yr event, not accounting for waves](Engineering News-Record 1963). The project benefit-cost ratio was given as 2.37 (Secretary of the Army 1958). The barrier currently protects roughly 1.1 km<sup>2</sup> of downtown Providence and \$2 billion worth of property (Kuffner 2019). However, the Army Corps cannot unilaterally conceive, design, and implement a flood protection project. With the support of a non-federal sponsor, the Corps' job is to present an engineering solution and economic facts as a basis for decision. The decision to move forward with a given project is up to the public, local and state government, and Congress (Samet 2009). For example, after a project has been formulated by the Corps, the public can pressure elected officials to support or oppose it.

The Fox Point and Narragansett Bay storm surge barriers were among the first coastal flood protection public works megaprojects proposed in the U.S. (Morang 2016). They both possessed an imposing physical presence, a combined price tag of over \$100 million dollars (unadjusted, 1966 USD) and required substantial involvement of public resources. Because it was constructed and the political process is well-documented leading up to breaking ground on the project, the Fox Point Barrier is a good case for understanding when, why, and how flood protection megaprojects get implemented in the U.S.

Knowing why some projects get built is as at least as useful as knowing why they failed to get built. While the Fox Point Barrier achieved broad public support and eventually broke ground, the Narragansett Bay Barriers did not make it past the planning stage. While the Fox Point barrier served those in Rhode Island's capital city, the Narragansett Bay Barriers were a USACE flood protection project designed to provide flood protection for cities and towns in and

around Narragansett and Mt. Hope Bays (Fig. 2). The Chief Engineer of the USACE's New England Division described the Bay barriers as, "unrivaled in scope and magnitude by any similar project in the world – a project equally as imaginative as the St. Lawrence Seaway or the International Passamaquoddy Tidal Power Project, and a project that has...posed some of the most challenging problems of professional engineering research"(Hurricane Tidal Flood Protection in Narragansett Bay 1959). The project was comprised of three massive rock barriers with an ungated, navigational opening large enough to allow sufficient maritime travel, but small enough to constrict the flow of storm surges into the bay. The East barrier was planned for across the eastern bay passage in the vicinity of Castle Hill in Newport, Rhode Island, the West barrier was planned for across the western bay passage at Bonnet Shores, and the third barrier was to be placed across the Sakonnet River between Tiverton and Portsmouth. Both the East and West barriers were to have 40 sluice gates to reduce the current velocity through the navigational opening and to lessen any impact on the normal tidal interchange and flushing of Narragansett and Mt. Hope Bays. Supplemental levees were planned for Bonnet Shore, Mackerel Cove, and Castle Hill. Unlike the Fox Point barrier, the lower bay project did not completely close off the waterway. As such, it merely attenuated storm surge coming into Narragansett Bay [Local officials were required to notify residents at least once a year that the barriers did not provide complete protection from hurricane tidal surges]. The USACE estimated that the barriers would eliminate 93 percent of the damage from future hurricanes. The projected cost was \$90 million (unadjusted), and the projected benefit-cost ratio was reported to be 1.4, a little more than half of that of the Fox Point project (Secretary of the Army 1966).

During the late 1950s and 1960s, several Army Corps plans for hurricane protection elsewhere in Rhode Island failed to break ground (Fig. S1), in part due to public opposition. This group of stalled projects included the Narragansett Bay Hurricane Barriers, a proposed \$90 million dollar effort (unadjusted) designed to provide flood protection for cities and towns in and around Narragansett Bay (Fig. 2). The Narragansett Bay Hurricane Barrier plan was described by the Chief Engineer of the Corps' New England Division as, "unrivaled in scope and magnitude by any similar project in the world – a project equally as imaginative as the St. Lawrence Seaway or the International Passamaquoddy Tidal Power Project, and a project that has...posed some of the most challenging problems of professional engineering research"(Hurricane Tidal Flood Protection in Narragansett Bay 1959).

In the 1950s and 60s, the Army Corps was largely viewed as a construction-oriented organization with a strong commitment to economic development (Mazmanian and Nienaber 1979; US National Research Council 2011). It was heavily involved with the construction of megaprojects (Altshuler and Luberoff 2003; Flyvbjerg, Bruzelius, and Rothengatter 2003). Altshuler & Luberoff (2003) describe period of the Rhode Island hurricane barriers as the "great mega-project era" (1950s to late 1960s)(Altshuler and Luberoff 2003), a period of "unprecedented" federal investment in public works (e.g., urban renewal, highway construction, and airport development). During this time, public confidence in government was high, and because they aimed at generating economic activity, many of these megaprojects were supported by businesses, labor groups, and the media. However, megaprojects often entail significant threats to some interests and values, even as they promise great benefits to others. By the mid 1960s, it became apparent that many of these projects were negatively

impacting communities and the natural environment. The Army Corps and their projects were a frequently cited offender (Douglas 1969; Drew 1970; Mazmanian and Lee 1975; Porter, Jr. 1971; Reuss 1971; Sargent, Jr. 1972; St. Louis Globe-Democrat 1971).

Prior to the mid 1960s, the Army Corps' megaproject planning process largely consisted of local proponents, the Army Corps, and project allies in Congress. It was more or less exclusionary to project opponents and communities. Engineers were often the only experts involved in deciding both how to define the flood problems communities were experiencing and also the objectives and goals of the plan to address the problem. Additionally, alternative plans were rarely produced. Oppositional viewpoints from concerned publics began to disrupt the Army Corps' megaprojects that had previously appeared to be unstoppable in other parts of the country. This movement led to a number of project turndowns by governors and other state authorities, the Narragansett Bay Hurricane Barrier being one of them (Isé 1965).

In this article, we use several archive materials to reconstruct the series of events that led to the conception and design of both the Fox Point and Narragansett Bay Hurricane Barriers, the decision to move forward with the Fox Point project, and the eventual decision to halt and shelve the Narragansett Bay project.

#### *A period of active hurricane activity in New England creates demand for flood protection*

Records of coastal storms hitting Rhode Island date back to 1635. Over this nearly 400-year timeframe, various levels of hurricane activity have come and gone. The most recent busy period occurred between the late 1930s through the early 1960s (Boose, Chamberlin, and Foster 2001) (Fig. S2). While previous storms came and went without any substantial government intervention to prevent loss of life and economic damage, this most recent period saw the first serious and sustained involvement of the federal government in managing coastal floods. As damages mounted, national interest in managing hurricanes and coastal floods grew (Dunbar Jr. 1955a).

In September 1938, the "Great New England Hurricane" became the first major storm in over 120 years to ravage Rhode Island, the previous storm being the "Great September Gale" of 1815 [The word "hurricane" was not yet used in American English at the time of the storm]. The '38 storm caused \$57.8 billion in damage to New England (2017 normalized USD\$)(R. M. Brown 1938; Weinkle et al. 2018). and was particularly devastating to Rhode Island. Much of downtown Providence flooded in the '38 storm, and damages there accounted for roughly one-third of the state's total (Hurricane Tidal Flood Protection in Narragansett Bay 1959). Over 250 Rhode Islanders drowned (U.S. Army Engineer Division, New England 1963). Just six years later, another hurricane ravaged the region, the "Great Atlantic Hurricane" of 1944. The '44 storm was not a destructive, causing just \$19.6 billion in damage (2017 normalized USD\$) across several east coast states, including Rhode Island (Weinkle et al. 2018). While Rhode Island began to consider flood protection after the '44 storm (Providence Journal 1954d), serious and sustained government action did not occur until the next major hurricane, a decade later.

On August 31<sup>st</sup>, 1954, Hurricane Carol brought devastating floods again to Rhode Island (Fig. S3)(Brooks and Chapman 1945). More destructive than the 44' storm but not as damaging

or deadly as the 38' storm, Hurricane Carol caused roughly \$23.5 billion in damage across New England (2017 normalized USD\$) and killed 19 in Rhode Island alone (Hale 1955a). The destruction in Rhode Island amounted to roughly 7.4% of the state's GDP at the time (Statement of Honorable John E. Fogarty, U.S. Representative of the Second Congressional District of Rhode Island before the committee of Public Works in Support of H.R. 2185, a bill to authorize modifications of local participation in flood control projects 1959). Much of the damage came as a result of severe flooding throughout Narragansett<sup>1</sup> and Mt. Hope Bays (Secretary of the Army 1966)[Narragansett Bay is a coastal estuary consisting of 456 km<sup>2</sup> of total water area and about a dozen islands of various sizes. Roughly 26 cities and towns (17 in Rhode Island and 9 in Massachusetts) dot the shoreline of Narragansett Bay. Providence, the capital, and most populated city of Rhode Island, sits at the head of the bay, while the city of Newport lies at the entrance to the east passage. Narragansett Bay is noted for its shell fishing industry, prevalence of vacation homes, boaters, and being home to a large naval base in Newport. President Eisenhower's Summer White House was also located in Newport in 1958 and 1960 (Hitchcock, "The Age of Eisenhower: America and the World in the 1950s"). Just over a week and a half after Carol, Hurricane Edna struck neighboring Massachusetts. At the time, the 1954 hurricane season ended up being the most damaging in U.S. history (N. Brown 1954).

#### *Elected officials in Rhode Island loudly demand for federal coastal flood protection*

The demand for the construction of permanent flood protection emerged locally in the days following Hurricane Carol and quickly made its way up through the ranks of elected officials: from local and state officials to Congress and eventually the U.S. President. The Providence City Planning Commission was the first governing body to act. Just one week after the hurricane, the Planning Commission asked Mayor Walter H. Reynolds to request help from Rhode Island Governor Dennis J. Roberts, who then wrote to President Eisenhower (Providence City Planning Commission 1954; Roberts 1954). In his letter to President Eisenhower, Gov. Roberts inquired if the president had the authority to direct the Corps to conduct a, "...prompt, preliminary survey of the construction and other means needed to protect Rhode Island Shore areas." [Governor Roberts justified the request by citing Public Law 875 of the 81<sup>st</sup> Congress, which facilitates federal assistance in developing state and local plans to cope with major disasters.] In the same letter, Gov. Roberts also mentioned that he would ask the Rhode Island congressional delegation to introduce a resolution in Congress to authorize a thorough study of flood protection. Gov. Roberts emphasized the specific goal of protecting downtown Providence (Roberts 1954). The Rhode Island congressional delegation ultimately heeded both the Governor's and the public's demands for flood protection (Providence Journal 1958a). Congressman John E. Fogarty wrote in his replies to letters from the public calling for action, "... (flood control) is uppermost in the minds of the Rhode Island congressional delegation..." (Fogarty 1955) and, "...I will certainly do everything I possibly can to see to it that the United States Government gives the City of Providence and the State of Rhode Island every possible assistance" (Fogarty 1954). In the weeks and months after Carol, Gov. Roberts also instructed the Rhode Island Development Council to produce a report on how to best manage recurring hurricane damages (Rhode Island Development Council 1955; Roberts 1954). [The Rhode Island Development Council report ultimately drew together inputs from federal agencies, several consulting engineering organizations, and the Rhode Island Development

Council's own staff. The Rhode Island Development Council report compared and evaluated them as the basis for proposing a solution of the flood problem.] Specifically, on the Governor's mind were permanent flood defenses. He said, "[t]he enormity of the loss suffered by our people justifies a substantial investment in (permanent) protection"(Providence Journal 1954a).

#### *Local businesses lead the public in the call for flood solutions*

Elected officials were not the only ones demanding that something be done about recurring flooding in both Providence and elsewhere in the state. Several waterfront property owners (Residents of Touisset 1954), business associations such as Chambers of Commerce (Gilbane 1954), and individual businesses in and outside of Providence (Quinn, Jr. 1954) wrote to the Rhode Island congressional delegation expressing a strong desire for government action on the flood issues, including those that specifically called for building permanent flood protection infrastructure (Providence Journal 1954f). After Hurricane Carol and the previous '38 and '44 storms, downtown Providence had developed a reputation for being vulnerable to costly coastal floods. Local businessmen, industrialists, and property owners wanted to avoid repeat events in the future. Some businesses went as far as proclaiming that unless action was taken, the financial risk from flooding would be too great for them to continue to do business in downtown Providence (Providence Journal 1954c). In the first few months after Carol, the Providence Chamber of Commerce passed a resolution calling for an official plan for flood control, "at the earliest possible time", and the need for flood control to be, "kept upper-most in our minds until a control project becomes a reality"(Providence Chamber of Commerce 1954). In response, the Chamber of Commerce sponsored a series of public meetings to publicize flood control projects and keep citizens informed and engaged in discussions (Gilbane 1954). A hurricane protection committee was also formed by Mayor Reynolds, comprising of nine business and industrial leaders to study potential hurricane protection options (Providence Journal 1955i).

After Hurricane Carol, local businesses in downtown Providence were very motivated to push for permanent, government-provided flood protection. First, affordable public flood insurance was not yet available. While a congressional effort was made in the late 1950s for a federally backed flood insurance program (Dunbar Jr. 1955b; Evening Bulletin 1955a; Providence Journal 1955f, 1957b, 1957a; Smith 1955), it would not emerge until 1968. [The National Flood Insurance Program was established by the National Flood Insurance Act of 1968 (NFIA, 42 U.S.C. §4001 et seq.) (J. T. Brown 2016)] Private insurance was often not available, but in cases where it was, premiums were reported to be "exceedingly high"(Evening Bulletin 1955a). Second, federal disaster aid in the 1950s was much more meager than it is today. In the wake of Carol, President Eisenhower appropriated just \$1.5 million in federal disaster aid to Rhode Island (Shanley 1954), while total damages were in excess of \$200 million (both figures unadjusted)(Hale 1955a). Relief amounted to just 6% of total damages, much less than the government assistance that accompanied recent hurricane disasters (US National Research Council 2014). Third, building-by-building interim flood protection measures employed by businesses proved to be expensive. In Providence, the use of temporary sandbag barricades, the installation of pumps and generators, the relocation of some businesses to higher ground, and the flood-proofing of basements and first floors all totaled more than \$1 million

(unadjusted). Some of these costs were incurred during every hurricane season after Carol (Hale 1955a). A permanent tidal dam was seen as a way to provide long-term economic relief to these businesses (Cray 1955; Providence Journal 1955d). Gov. Roberts echoed the sentiments of many Providence business owners, “[p]eople cannot be expected to make large capital investments in an area where their investments are threatened by recurring disaster. The only thing we can do to make Rhode Island safe for the investment we need — is to begin actual construction to prevent flooding of our river valleys and shores”(Evening Bulletin 1955c).

### *The need for swift action on hurricane protection*

Not only was there a wide-spread desire for action, but there was also demand for any project to move forward quickly. The imminency of another devastating storm flooding Providence and other parts of Rhode Island was often expressed in *The Providence Journal-Bulletin* throughout the planning phase for both the Fox Point and Narragansett Bay Barriers (Providence Journal 1955g, 1955h, 1956a, 1960a). During the planning of the Fox Point and Narragansett Bay Hurricane Barriers, close calls with other hurricanes continually put Rhode Islanders and elected officials on edge, specifically Hurricanes Connie, Diane, and Ione (1955), Cindy (1959), Donna (1960), Esther (1961), and Ginny (1963) (Providence Journal 1955d, 1955e, 1955c, 1960c, 1960a, 1961b, 1963). Speaking to the Senate Public Works Committee in April of 1955, Gov. Roberts said, "We must have a complete study and adequately documented, authoritative engineering recommendations at the earliest possible date...we cannot tell how soon the next major hurricane will strike...the record shows that on average, severe tropical storms have struck the North Atlantic coast every three to four years...with full scale hurricanes every eleven years"(Roberts 1955).

While plans for hurricane barriers were discussed after Carol, it was also anticipated that involvement of both the Army Corps and Congress would lead to a long and slow “obstacle course” for any project (Dunbar Jr. 1956; Hale 1954d, 1954e, 1955b). It was locally known that it took 19 years and multiple disasters to begin flood control for the Blackstone River in the Woonsocket Valley (Providence Journal 1959b). The desire for quick action was so much so that many private engineering firms and state and town officials came forward with proposals in the event the federal government was not able to get involved in construction in a timely manner (Editorial 1954; Hale 1954f; Providence Journal 1954c, 1954g, 1954e). The president of a Providence engineering firm proclaimed, “[t]he Army people are great hydraulic engineers...but they are very busy. I think it would take them from five to eight years to complete the project once it had been authorized while private engineers, I believe, could have it completed in four years”(Providence Journal 1954d).

There was little public objection voiced against the presented plans devised by private engineers, particularly for Providence. However, some criticism was aimed at an early proposal crafted by two engineers (Dahl and Anderson) for a series of barriers at the head of Narragansett Bay. The arguments against were: 1) that such a monumental effort might detract from building flood protection in Providence as soon as possible (Editorial 1954), 2) that residents might be unwilling to cover a bond issue of tens of millions of dollars (unadjusted) to finance the project, and 3) that increases in the currents at the entrance to the bay may lead to opposition from the Navy and recreational boaters (Hull 1955). Some experts suggested further

study would be needed for such a project (Hale 1954b). In hindsight, these initial concerns regarding the Narragansett Bay proposal were a harbinger that the project was doomed to fail.

The idea of Providence and Rhode Island proceeding with flood protection without the Corps' help had precedent. Providence had previously considered a privately funded proposal for the construction of a barrier in downtown Providence as recently as the year before Carol. However, it was reported that state officials were "skeptical" and ultimately decided against pursuing the idea (Providence Journal 1954f; Tillman 1954). With that experience in mind, Rhode Islanders seemed committed to taking action instead of letting the issue "die" as had occurred after the storms in 1938 and 1944 (Providence Journal 1954d). *The Providence Journal* wrote, "...the biggest immediate danger facing the barrier project is public apathy fostered by the passage of time and the absence of storm threats. It took 20 years to get action on river flood projects that might have made Hurricane Diane a harmless rainstorm. The bay project deserves a better fate than death by disinterest"(Providence Journal 1956a). The Corps also knew that time was not on their side for getting something built. Lt. Col. Miles L. Wachendorf, the Assistant New England Division Engineer, said, "...experience shows that the public in the past has had a tendency to lose interest in flood control as the last major disaster fades in their memory"(Providence Journal 1956b).

#### *The Army Corps enters coastal flood protection*

The aftermath of Hurricane Carol eventually led to Congress adding coastal flood protection to the Corps' list of authorized duties. The Corps was a natural choice for involvement in coastal flood protection for multiple reasons [Unless directed by Congress to take action, local interests are required to initiate help from the USACE. The USACE cannot act unilaterally]. First, the Corps had decades of experience with inland flood protection.(Evening Bulletin 1955d) In the months following Hurricane Carol, *The Providence Journal* highlighted Army Corps projects in Hartford (Connecticut) and Cincinnati (Ohio) as examples of urban flood protection success stories (Hale 1954c, 1954a). Additionally, the Rhode Island General Assembly noted that the Corps has the "...staff, the know-how, and the experience to make the necessary studies and to formulate and carry out an effective protective program". The Rhode Island Development Council also recommended that "...every effort be made to secure promptly the definitive study of the entire hurricane flooding problem in the State, which can best be done by the USACE"(Rhode Island Development Council 1955). Second, at the time, roughly 90% of the cost of inland flood protection built by the Corps was paid for by the federal government, an attractive approach when considering that the proposed flood protection solutions in Rhode Island were projected to run into the tens to hundreds of millions of dollars (unadjusted)(Providence Journal 1956a). Third, the fact that any surge barrier project would alter navigable waters required the Corp to issue a permit<sup>2</sup>, thus making it a federal issue. Fourth, Narragansett Bay was home to naval installations at Newport, Quonset Point, and Davisville (Providence Journal 1955b)[See Rivers and Harbors Appropriations Act of 1899, 30 Stat. 1121, 1151 (codified in 33 U.S.C. § 401) ("It shall not be lawful to construct or commence the construction of any bridge, causeway, dam, or dike over or in any ... navigable water of the United States until the consent of Congress shall have been obtained . . . ."); An Act to Provide Security for the Lives of Passengers on Board of Vessels Propelled by Steam, 5 Stat. 304 (1838)



(providing that “it shall not be lawful for the owner . . . of any steamboat . . . to transport any goods, wares, merchandise or passengers, in or upon ... navigable waters of the United States . . . without having first obtained . . . a license”). For these reasons, the Rhode Island congressional delegation was unanimous in its conclusion that there was a federal interest and responsibility in coastal flood protection which affected the navigable waters of Narragansett Bay and its tributaries.

In the 1950s, the Corps had little prior experience with coastal flood protection (Evening Bulletin 1955d)[The Corps was involved in two projects in the early twentieth century (Table 2) but studying coastal flood protection was not officially added to their jurisdiction until 1955 (Public Law 71, 84<sup>th</sup> Congress, 1<sup>st</sup> Session)], and more generally, very little was scientifically known about the characteristics of hurricane-induced flooding and storm surge, especially in Narragansett Bay, where limited records of tidal data existed (Evening Bulletin 1955b). Furthermore, Rhode Island’s hurricane protection problem was described by the New England Division’s chief engineer, Brig. Gen. Robert J. Fleming, Jr., as “unique”, declaring that there is “...no problem I know of anywhere in the world like that of Narragansett Bay, where you have an inverted funnel pointed like a dagger at a built-up industrial area”(Providence Journal 1955a). Joseph R. Brennan, chief of planning of the Corps’ civil works section, noted that the agency had never built tidal protection -- only river protection -- and mentioned that the authority of the Corps to engage in tidal flood control had not yet been clearly established. Brennan noted that new legislation was needed to specifically allow surveys of tidal flood measures and construction of tidal flood structures. Two precedents for coastal flood control were cited – the Galveston Sea Wall (Texas) and levees around Lake Okeechobee (Florida). However, those projects proceeded under beach erosion and navigation laws, respectively, not flood control (Hale 1954d).

In the spring of 1955, multiple bills were introduced in Congress an effort to initiate and fund a large, interim hurricane survey, which included authorization for the Army Corps to investigate coastal flood protection. The authors of this study did not find evidence that suggests that there was strong opposition to carrying out a survey on flood protection, at least not locally. Some members of Congress objected to not having their state included in the hurricane survey bill. South Carolina Senator Strom Thurmond wanted his state to also receive Corps’ attention after being heavily ravaged by Hurricane Hazel (Dunbar Jr. 1955a). A bill was ultimately passed and signed into law by President Eisenhower on June 16, 1955 (Public Law 71, 84<sup>th</sup> Congress; or P.L. 71-84).

Public Law 71-84 addressed the issues of scientific understanding and the Corps’ authority to undertake coastal studies. More specifically, Public Law 71-84 called for an interim hurricane survey to compile data on the behavior and frequency of hurricanes, improve hurricane warning services along Atlantic and Gulf coasts, and to give the Corps the authority to examine both the technical feasibility and economic justification for hurricane protection measures in Rhode Island and Massachusetts, including storm surge barriers, levees, and seawalls. The hurricane survey began the following month (Providence Journal 1955j). Notably, the bill did not yet place the responsibility of paying for hurricane protection on the federal government; this was left for later debate. Today, P.L. 71-84 is still invoked to authorize

examination and surveys of coastal and tidal areas in the U.S. In response to this new authority, the New England Division Engineer proclaimed, "...the protection of coastal areas from hurricane induced tidal inundation constitutes a revolutionary development in flood control in the U.S."(Hurricane Tidal Flood Protection in Narragansett Bay 1959).

After about a year and three months of study, the Corps presented an initial draft of plans for two projects, a storm surge barrier at Fox Point and a series of rock barriers in lower Narragansett Bay (Pawtucket Times 1956). Storm surge barriers were not the only proposed solution in the months following Carol. Also discussed was re-zoning and retreating from the coastline (Providence Journal 1954b), temporary flood protection measures (e.g., sandbags), and flood proofing lower levels of buildings, the latter two done building-by-building. Congress also attempted and failed to establish a public flood insurance program (Providence Journal 1957a).

#### *Public input on the Corps' storm surge barriers*

Vocal public opposition to the Fox Point and Narragansett Bay barrier projects did not become widely apparent until the Army Corps formally revealed them to the public. Holding public hearings is standard Corps practice before projects are eligible to continue towards receiving congressional authorization. In all Army Corps projects – both historically and presently – the public is given a chance to provide comment in such forums (Luther 2008; Mazmanian and Nienaber 1979). Public interest shown at these hearings is an important factor in congressional consideration of project approval and financing, and meeting transcripts commonly accompanied the engineering reports to Congress (Providence Journal 1956c). In addition to these standard hearings, engineers from the New England Division of the Corps attend numerous gatherings of service clubs and other civic and private organizations to speak on the survey and the various plans of protection that were being studied (Providence Journal 1956d; Secretary of the Army 1966). Congressman Fogarty also arraigned a cruise of the bay barrier sites with Corps engineers, members of the House Public Works Subcommittee, the Navy, the Rhode Island Development Council, and various local marine interests (Providence Journal 1956k). Roughly a week before the public hearings were held, the Rhode Island Hurricane Survey Advisory Committee voted in favor of the Corps' plans, but concluded that more study should be undertaken in order to ascertain the effects of lower bay barrier construction (Isé 1956).

Public hearings were held in Providence, Newport, and Fall River (Massachusetts) in October 1956. In total, nearly 380 people attended the meetings (Secretary of the Army 1966). Henry Isé, Chief of Rhode Island's Division of Harbors and Rivers, noted that, "[i]t is very important for the success of this project that we get as good a turnout as possible. A poor turnout, I know, would have a very bad effect in Washington"(Providence Journal 1956c). In addition to business owners and other members of civil society, those in attendance included the New England Division's Chief Engineer, Gov. Roberts, members of the Rhode Island congressional delegation, Mayor Reynolds, and engineers who headed the survey of Narragansett Bay (Providence Journal 1956i). In Providence alone, more than 200 people turned out for the two-and-a-half-hour hearing that included 17 presentations. Senator Pastore

said the turnout was, “one the finest expressions of good citizenship I have seen in many a day”(Providence Journal 1956h).

### *Public reception to Fox Point and Bay Barriers*

Public feedback for both projects was mixed. An overwhelming (but not unanimous) majority urged immediate construction of the Fox Point Barrier, while the reception for the Bay barriers was lukewarm. The only recorded dissenter for the Fox Point project was the Allens Avenue Businessmen’s Association, a group of 122 Providence businesses. They opposed the Fox Point Dam because their properties were not in the proposed protection zone. The Association instead advocated for an alternative design that included their properties, many of which were heavily impacted by flooding from hurricane Carol (Dinsmoor 1956).

Several concerns were raised regarding the Bay barriers. Among them were related to the effects of the barriers on maritime navigation, water quality, salinity, fish and wildlife, and recreational activities in the bay (Providence Journal 1956g). The presented studies at the hearings had been heavily focused on engineering design; little attention was given to assessing environmental impacts. As such, there was almost no scientific support available for arguments that the public could make to use against the barriers, particularly in light of their potential effects on marine life. This caused displeasure among many attendees. Several wanted assurance that the barriers would not ruin commercial and sport fishing in Narragansett Bay (both shell and finfish). As such, further study was recommended, particularly for impacts on marine life, which had been noticeably underfunded and understudied. In an op-ed in *The Providence Journal*, Donald J. Zinn of the Rhode Island Wildlife Federation noted that, “... the Corps thus far has a generally sad record with their more or less public-wishes-be-damned policy when it has come to a question of dam construction versus natural resources.” Zinn pointed out the imbalance of preliminary study funds for a biological investigation from the U.S. Fish and Wildlife Service (\$6,000) and Corps’ budget (\$500,000; both unadjusted)(Zinn 1956). *The Evening Bulletin* also raised concerns about marine life, “...until questions about the effect of the dam on marine life are answered satisfactorily hundreds of residents of this state are bound to oppose construction of a dam that might put them out of business or ruin a major source of salt-water recreation. The way things are going right now, it will be impossible to find out what the effect will be until plans are so far along the way that construction will be the next step. Let’s get the answers now and re-draw preliminary plans, if necessary, to save that marine life”(Evening Bulletin 1956b). Leaders in the seafood industry also called for more studies of the barrier’s effect on natural resources (Blount 1956).

While the environmental impact of the Narragansett Bay barriers was subject to heavy scrutiny, these concerns were noticeably absent from discussions around the Fox Point project. One possible reason is that, unlike Narragansett Bay, the Providence River was already heavily polluted. A report on pollution of the waters in Rhode Island from 1946 indicated that the water around Providence had attained “grossly polluted” levels, the highest category on the report’s pollution assessment scale. In the same report, most of the water in Narragansett Bay was assigned to the cleanest water category (Rhode Island State Department of Health 1946). Reports in 1955 also indicated pollution issues. In early 1955, it was mentioned that the Providence River was too polluted to be used for the cooling condensers on the Narragansett

Electric Company's South Street Station, a coal-fired power plant adjacent to the proposed site of the Fox Point Barrier (Cool 1955). By 1956, dramatic improvements in sewage treatment had reduced the amount of effluence being fed into the Woonasquatucket and Moshassuck that emptied into the Providence River. But even after these efforts, there still remained in the river what was called, "the problem of foul morass of mud and trash"(Providence Journal 1956j).

Maritime navigation concerns associated with the Bay barrier's East Passage were also raised by the Navy (Evening Bulletin 1956a). It was believed that an opening in one of the barriers in the initial design would not be wide and deep enough to accommodate some of the Navy's largest ships. The night of the Corps' Newport hearing, the Newport City Council voted (5-2) to turn down the Bay barrier project, citing infrequent use of flood protection (i.e., floods are rare) and daily use of the East Passage by the Navy. The Newport City Council instead favored the construction of roughly two miles of dikes and seawalls along the Newport Harbor line (Cyganowski 1956). Other calls for barrier alternatives were made elsewhere in the state (Providence Journal 1956f), and some individuals even preferred no government action. A former sewer commissioner from Warren, RI wrote in an op-ed, "I'd much rather take my chances on hurricanes without barriers. Anyone living close to the bay who stands to suffer damage from hurricanes should take steps to prevent such damage and leave the barriers for the birds"(Cyganowski 1956). It was concluded that the USACE's plans for the Narragansett Bay barriers required more study, particularly the impact of the barriers on marine life (Providence Journal 1956i). Almost a full eight years would pass before a more complete study was ready to be presented to the public. In the meantime, the Fox Point barrier would advance towards breaking ground.

#### *Public support for bond referendums to pay for local share of Fox Point Barrier*

After a long, up-hill battle in Congress (Providence Journal 1958a) (Fig. S4), the Fox Point hurricane barrier was authorized in 1958 (Providence Journal 1958b), roughly two years after the public hearings. After the hearings, several Army Corps and congressional hurdles needed to be cleared prior to project authorization, including arriving at a 70-30 federal-local cost sharing agreement (Providence Journal 1958c, 1958a) [As of 2020, the federal-local cost sharing split for structural coastal projects is 65%-35% (per the Water Resources Development Act of 1986), but in extreme cases the full cost has been paid for by the federal government (e.g., the Lake Borgne storm surge barrier outside of New Orleans, Louisiana, constructed after Katrina)]. Following authorization, another three years of detailed engineering by the Corps would occur before construction of the Fox Point barrier would begin. Additionally, two state and local referendums were needed to issue government bonds that would pay for the 30 percent non-federal share of the project. In November 1959, Providence voters showed just how seriously they wanted flood protection. A special election was held, and Providence overwhelmingly voted to approve three bond issues to pay for \$4.6 million (unadjusted) of the non-federal share (voter support margin was 6 to 1). The turnout was admittedly meager (slightly less than 9 percent of Providence's eligible voters). Mayor Reynolds expressed disappointment at the lack of voter interest. He said it represented "terrible apathy" towards such important matters (Providence Journal 1959a). A year later, all of Rhode Island was eligible to vote to approve a state bond needed to pay the remaining local share of the hurricane barrier (Providence Journal

1960b). However, this time there was some public opposition to supporting the state referendum by communities outside of Providence who would not directly benefit from the Fox Point Hurricane Barrier. Central Falls City Council asked legislators and citizens of Blackstone Valley to band together against the Fox Point Hurricane Barrier. The opposition was intended to be retaliation against the state for failing to give relief to higher sewer rates in the Valley, which had come from the construction and maintenance of a new Valley sewer system (Evening Bulletin 1959). In a firm rebuke, *The Providence Journal* editorial board argued the Fox Point situation was different. *The Journal* asserted that protecting Providence meant protecting the economic heart of the state, therefore the Fox Point Barrier was simply not a local issue but rather one the entire state must support (Providence Journal 1959c, 1960d). In the lead up to the statewide referendum, an “all-out” campaign was waged to generate state-wide approval for the Fox Point Barrier. The state received a timely reminder of how badly flood protection was needed just before the election when a half-million dollars in damages from Hurricane Donna occurred in downtown Providence (Evening Bulletin 1960). Ultimately, the \$1.75 million bond issue was approved by state voters (Providence Journal 1960b), and the Fox Point Hurricane Barrier broke ground in July 1961 (Providence Journal 1961a). It was completed five years later in March of 1966 (Fig. S1).

*After further study, Bay barriers again ready for public scrutiny*

After nearly eight years of further study, the Corps released revised plans for the Bay barriers in late 1963 (U.S. Army Engineer Division, New England 1963). The Fox Point and Bay barrier Army Corps hearings in 1956 had concluded that the Bay barrier project required more study to 1) determine the effects of the Lower Bay Barriers on natural resources, 2) to secure further data on velocities through the navigation openings, and 3) to further study the design of the barrier foundations (Peter C. Hyzer 1964b; U.S. Army Engineer Division, New England 1963). The Army Corps’ updated plans were designed to meet the objections that had been previously voiced (Providence Journal 1964c). Brig. Gen. Peter C. Hyzer, the new Chief of Engineers of the New England division of the Corps, wrote, “During the eight years we have studied this proposal, primary consideration has been given to determining the possible effects of the barriers and to refining the design so as to eliminate or minimize those found to be undesirable” (Peter C. Hyzer 1964a). Ultimately, more than 15 barrier plans were considered at 25 different locations throughout Narragansett Bay using a 1:1000 horizontal and 1:100 vertical scale model (Fig. S5) (Hurricane Tidal Flood Protection in Narragansett Bay 1959; Providence Journal 1956e). The final three barrier locations were selected as a result of 1) extensive testing of changes in the tidal flow, 2) recommendations by the Navy, and 3) economic assessment of alternative structures (P. C. Hyzer 1964). The most significant changes focused on minimizing the restriction of the normal tidal flow in and out of the bay in order to limit impacts on marine life and boating. The final designs used navigational openings whose width had been doubled and also incorporated dozens of sluice gates that would close when high water was forecast. Overall, the openings in the barriers had been increased by 270 percent over the old plan (Providence Journal 1964c). The Corps insisted that the new design would not have an impact on marine life since they claimed the same volume of water would flow in and out during each tidal cycle (Evening Bulletin 1964e). However, the larger navigational openings meant that protection afforded by the barriers would be reduced. As a result, local officials would be

required to notify residents at least once a year that the barriers did not provide complete protection from hurricane tidal surges (Secretary of the Army 1966). The estimated cost of the revised barrier plans was \$90 million (unadjusted).

Assessments performed by other federal agencies that accompanied the Corps' report were either inconclusive (i.e., suggested more study required) or found adverse impacts were likely. The U.S. Public Health Service determined that the barriers would not have a noticeable effect on the water quality in the upper region of Narragansett Bay but said that more study was needed to reach a confident conclusion on possible increases in pollution in the lower portion of the Bay (Secretary of the Army 1966). Studies on marine life were less supportive of barrier construction. The U.S. Fish and Wildlife Service claimed that the Corps' revised plan had the potential to, "...significantly alter the aquatic environment and adversely affect the finfish and shellfish resources of the area." The U.S. Fish and Wildlife Service also concluded that the proposed barriers could have an adverse effect on recreational boating in the lower Bay due to increased tidal currents (Nelson 1965).

Despite the mixed reviews from other federal agencies, the Corps continued to claim that the new design would not adversely impact the bay. In a letter to Congressman Fogarty, New England Division Engineer Brigadier General Seymour A. Potter, Jr. wrote, "The problems of effects on pollution and water quality, fisheries and wildlife...have been satisfactorily resolved...the lower bay barriers would cause no important effect on water quality, oxygen and pollution in the bay...[and] the U.S. Fish and Wildlife Service, concluded that the overall impact of the Lower Bay barriers on fishery resources would be small"(Potter Jr. 1961). John B. McAleer, the head of the Corps' hurricane unit, stressed that there would not be a change in the volume of water entering and leaving the bay each tidal cycle. As such, McAleer argued that no change in flushing time, salinity, or temperature would result. He cited experiments with the Corps' scale model of the Bay (Evening Bulletin 1964a). Brig. Gen. Hyzer also claimed that the effects of the barriers would be dwarfed by that of the normal seasonal changes within the bays (Providence Journal 1964c). Despite the Corps' attempt to cast doubt on the findings of the other agencies, opposition to the revised plans not only remained, but it also grew louder.

#### *Revised Narragansett Bay barrier plans met with overwhelming public opposition*

Public hearings were once again held to inform local interests of the Corps' updated plans for the Bay barriers (Providence Journal 1964c). The hearings took place in April 1964 in Newport, Providence, and Swansea (Massachusetts). A total of 611 people attended (232 in Newport, 237 in Providence, and 142 in Swansea)(Secretary of the Army 1966), a markedly higher turnout than the previous hearings in 1956, which had also included consideration for the Fox Point Hurricane Barrier. While the Fox Point project was received with near unanimous support at the hearings in 1956, this time the Bay barrier project was met with near unanimous opposition. In addition to the hearings, opposition also was expressed through letters to the Governor, the Rhode Island congressional delegation, and the Corps. Senator Pastore reported he had received letters to his office at a rate of at least 10 to 1 against the barriers. Congressman Fernand J. St. Germain said he answered at least 200 letters from Rhode Island residents opposed to the project and had received none in favor (Van Dusen 1964). Brig. Gen. Hyzer also reported that more than 300 letters from Rhode Islanders had been received at the

Corps' New England office in Waltham, Massachusetts (Providence Journal 1964b). In addition to letters, a number of editorials and op-eds were printed in *The Providence Journal-Bulletin*, most of them sounding off against the barriers. Generally, grievances were similar to those expressed at the earlier Corps hearings, namely objections over the impact on recreational boating, tides, pollution, marine life, and the high cost of the non-federal share of the project (Evening Bulletin 1964e, 1964b, 1964f; Providence Journal 1964e).

Even before barriers were formally introduced and discussed at the public hearings in April 1964, several boaters (both professional and amateur) spoke out against the project (Davis, Jr. 1965; Dawson 1964; Hagglund 1964; Upham 1964; Whitehead, Jr. 1964), including those who had called for flood protection in the wake of Hurricane Carol in 1955 (Cobb 1955). Many boaters did not believe the Corps' claim that the currents in the openings in the new barrier design would not exceed three knots for a mean tide and four knots during a high tide (the latter being roughly double the existing velocity)(Evening Bulletin 1964f, 1964a; Providence Journal 1964c). Preston R. Gladding, a Barrington, Rhode Island resident and a naval architect and partner in the Gladding-Hearn Shipbuilding Corporation believed that the Corps' calculations were, "...ridiculously less than foreseen by local pilots...", and contended that high velocities and turbulence of flowing water would make passing through any of the three navigational openings extremely dangerous and at times virtually impossible, except for large ships. Rhode Island Governor John H. Chafee, himself a sailor, also bluntly opposed the barrier plan, "I am against it. I vote no" (Evening Bulletin 1963). The Corps admitted that the top tide velocities would pose problems for sailboats but pointed out that the conditions would not be dissimilar from those of the approach to Galilee in Point Judith Pond, a popular Rhode Island sailing spot (Evening Bulletin 1964a). Halsey Herreshoff, crewman of the 1958 champion America's Cup sailing team and of the famous Bristol yacht-building family, believed the barriers would constrict the tidal flow into the Bay and create currents that would be, "too strong for most sailboats to navigate"(Evening Bulletin 1964c, 1964g). The America's Cup had taken place in Newport since 1930 and was again slated to host the event in 1964. At the time, Narragansett Bay was described as the "yachting center of the world"(Dyer 1964). Herreshoff stated that he personally would recommend that future America's Cup races be held elsewhere if the barriers were built (Providence Journal 1964e). A counter point to the yachtsmen's claims was made by the Corps. The Corps claimed that yacht races were often held in Long Island Sound, where water velocities were sometimes 50% greater than those projected to occur in the area of the barrier's navigational openings (Evening Bulletin 1964a).

In addition to impacts on recreational boating, many cited concerns related to the barrier's potential to cause ecological damage to the Bay. Conservationists and marine biologists echoed the U.S. Fish and Wildlife's conclusions (Nelson 1965). Dr. Theodore J. Smayda, a marine biologist at the University of Rhode Island Narragansett Marine Laboratory (a yachtsman (Providence Journal 1964e) and also an assistant to the U.S. Fish and Wildlife service in their report to the Corps), argued that the barriers should not be built until more is known about potential impacts on marine life. Dr. Smayda believed that the barriers could warm the waters in the bay in the summertime, lead to decreases in salinity that could cause the bay to freeze over in the winter, increase the number of red tides in the bay, and also cause additional shellfish pollution (Evening Bulletin 1964a; Providence Journal 1964c). In an editorial in *The*

*Providence Journal*, Smayda claimed that, “[e]ven the most minute changes (e.g., a degree or two of temperature change) could have profoundly adverse effects in an ecology in which all factors operate in the most delicate balance.” On a morning radio broadcast, Dr. Nelson Marshall, professor of oceanography at the University of Rhode Island, questioned the Corps’ conclusions regarding possible changes in sedimentation on the bottom of the bay, and described the revised plans as, “at best, a gamble”(Evening Bulletin 1964e). Dr. Marshall also opposed the barriers on esthetic grounds (Evening Bulletin 1964a).

However, other experts believed that there was little to worry about regarding impacts on marine life. Julian H. Gibbs, a chemistry professor at Brown University, spoke in favor of the barriers at one of the Corps’ hearings, arguing that tidal exchange in the bay would not be reduced. Additionally, Ralph A. Schmidt, a regional supervisor of river basin studies for the U.S. Fish and Wildlife Service, also supported the conclusion that marine life would not be harmed (Providence Journal 1964e). But these counter arguments were very much in the minority. Alfred L. Hawkes, Executive Director of the Audubon Society of Rhode Island, noted that there was, “almost no agreement among engineers and biologists we rely upon as to the real effects of these barriers”(Hawkes 1964). Overall, it was clear that most believed Rhode Island could not afford to run the risk of irreversible ecological damage to Narragansett Bay. Too much was simply at stake. Just months before the Army Corps’ hearings, a University of Rhode Island-Kingston study estimated that Narragansett Bay was valued at being worth \$145 million (unadjusted) annually to the state of Rhode Island (Rorholm 1963).

The risk of ecological harm also threatened the Narragansett Bay shellfish and finfish industry. Businesses spoke out to oppose the barriers both loudly and often, including those who had originally desired flood protection (Linehan 1955). In a letter to Congressman Fogarty, Frederick H. Richardson, Vice President of Blount Seafood Corporation noted that his corporation had suffered “very severe damage” from Carol, but still opposed construction of the barriers because he felt that “[the] cure would be worse than the disease.” Richardson said, “We have thus far been able to recover from hurricane damage, but we would be put out of business completely if our bay is ruined for shellfishing”(Richardson 1964). At the hearings in 1956, the Blount Seafood Corporation did not outright oppose the project, but did express desire for further study of barrier impacts (Blount 1956). The Rhode Island Shellfish Industry opposed the construction of the barriers until, “it is proven conclusively by Biologists, Bacteriologists and the U.S. Fish & Wildlife Service, that erection of said Barriers will not be detrimental to the natural resources of Narragansett Bay”(Rhode Island Shellfish Industry 1956). Francis B. Manchester of Manchester Seafoods, Inc. wrote, “...I would rather take the risk of storm damage than risk the possible pollution of our Bay Areas, the loss of fishes in our Bays and Rivers, and the damage to our shellfish due to increased silting, pollution, and reduced salinity. We deal directly with approximately one hundred fishermen during the year, and I do not know of one who is in favor of these proposed barriers”(Manchester 1964).

Opposition also emerged from residents with waterfront properties who stated that they were aware of the risks of living on the water and simply did not want the government’s help. In several op-eds and letters to Rhode Island’s congressional delegation, residents noted that they had experienced disastrous flooding from both the ‘38 Storm and Hurricane Carol but



decided they would rather take their chances with having a repeat disaster than degrade their experience of living on Narragansett Bay. In an op-ed in *The Providence Journal*, Irving C. Sheldon took a stand against the barriers and claimed that, “[t]hose who would be protected by the barriers are those who invested in locations with full knowledge that they were taking a chance on water damage from hurricanes” (Sheldon 1964). In another case, a Rhode Island resident wrote to Congressman Fogarty, “...I’ve recently bought a house on the water, which was partially flooded in the 1954 hurricane, but I am not asking Uncle Sam to bail me out” (Henderson 1964). The Narragansett Bay Home Owners Association said it would be better to “accept the possibility of a devastating storm once or twice every hundred years rather than tamper with Narragansett Bay” (Evening Bulletin 1964d). Some residents also attempted to discredit the need for flood protection by claiming that wind was the most damaging peril associated with hurricanes in Rhode Island (Sheldon 1964).

Those who opposed the bay barriers were not necessarily against all flood damage reduction measures. Many gave suggestions for alternative solutions. For example, the Audubon Society of Rhode Island proposed re-zoning, purchasing of endangered areas for public recreational facilities and open space, obtaining easements to limit or control development in the flood plain, and encouraging private property owners to maintain the natural state of their lands (Hawkes 1964). Byron Blount of Blount Seafood Corporation mentioned that he was not opposed to certain types of safety measures to reduce flood damage, but barriers that he believed threatened the conditions of the bay were, “out of the question” (Blount 1964). In an editorial in *The Evening Bulletin*, it was mentioned that, “...much can be done in those communities to prevent flood damage without a dam, as in zoning to prevent building in flood-prone, low-lying areas” (Evening Bulletin 1964f). In lieu of barriers, Barrington, Rhode Island resident Preston R. Gladding proposed improved weather forecasting and warnings, federal flood insurance, temporary barriers erected on a seasonal or ad hoc basis, and shore-based protection measures that provide local protection without changing tidal flow patterns (Evening Bulletin 1964a). The Newport Redevelopment Agency also suggested that new building developments incorporate private flood mitigation as opposed to relying on large public projects like the bay barriers (Providence Journal 1964d).

Some opposed to the Bay barriers expressed that they had supported the Corps’ Fox Point project. *The Providence Journal* editorial board was a strong supporter of the Fox Point barrier, but cautioned against the Bay barriers without further certainty of their environmental impacts (Evening Bulletin 1964f, 1964b). They asserted that the Fox Point project was a different situation because it protected downtown Providence, “at no risk of any kind to marine life or boating” due to the water above the barrier not being, “suited for boating or marine life” (Evening Bulletin 1964f). *The Providence Journal* also described the Fox Point Hurricane Barrier as, “badly wanted”, and claimed there was no active desire in any community around Narragansett Bay or Mt. Hope Bay, for a \$90 million dollar (unadjusted) series of barriers (Providence Journal 1975). Others made similar comparisons. In an op-ed, Irving C. Sheldon noted that the Fox Point Barrier is entirely different because it protects a business center that affects the livelihood of a majority of Rhode Islanders (Sheldon 1964), and in a letter to Brig. Gen. Hyzer, a Providence resident wrote that he has, “...always rooted for the Fox Point Dam”, but was opposed to the Bay Barriers (Unknown 1964). Manchester Seafoods also noted no

objection to the Fox Point Barrier (Manchester 1964). Some also argued that hurricane damage in the future should be much less serious if the Fox Point barrier would prove to be effective given that a large part of damage from the '38 storm and Hurricane Carol was in Providence (McGowan 1964). Without given a reason, Governor Chafee also doubted that the Bay barriers would receive the same statewide appeal that the Fox Point project did (Providence Journal 1965b).

Despite the overwhelming opposition, there were supporters of the Bay barrier project. The Allens Avenue Businessmen's Association (Providence Journal 1964e) was the lone reported supporter at the Corps' Providence hearing (Dinsmoor 1956). They were a group of 122 Providence businesses who had voiced opposition to the Fox Point Barrier proposal at the 1956 meeting (Providence Journal 1956i) because they had been left out of the planned protection area. After widening the navigational opening of the East barrier, the Navy became supportive of the revised plan (Providence Journal 1964d), and at the meeting held in Swansea, residents representing the shores of Mt. Hope Bay and the banks of the Taunton River expressed a desire and willingness to support the project (Secretary of the Army 1966). In an op-ed, a resident of Fall River, Massachusetts argued that opponents of the Bay barriers need to recall the disastrous effects of both Carol and the '38 storm and then "re-examine their position" (Conroy 1964).

*Despite public opposition, the Corps advances plans for Narragansett Bay barriers*

Even in the face of strong public opposition, the Corps continued to advance the Bay barrier project (Fig. S6). Rhode Islanders took note and continued to voice their objections. Charles B. McGowan of the Narragansett Bay Home Owners Association said, "...it is impossible to understand the position taken by the Corps in the face of practically unanimous local opposition" (Providence Journal 1965c). Some even began to attack the Corps as an organization. The public vocalized their issues with the Corps' presentations and lackluster rapport with those in the community. Some even interpreted the Corps actions as subversive tactics intentionally performed to get their projects built. For example, after clear public disinterest, the Corps floated the possibility that the barriers could be fully paid for by the federal government (Providence Journal 1964e), although when questioned on the matter, Brig. Gen. Hyzer admitted that he was "not yet sure" how to recommend the full financing (Evening Bulletin 1964g). This particular gesture was interpreted by some as a ploy to generate public support. A resident from Barrington expressed his displeasure in a letter to the Army Corps, "I resent the biased presentation of the project...the presentation turns out to be a massive campaign to force the barrier upon us; distorted opinions and exaggerated damage figures compiled by persons whose main concern is to assure themselves of continued employment. Your agency should serve the taxpayers, not force your will upon us (at our expense)" (Thomas 1964). The Narragansett Bay Home Owners Association said that the Corps' studies on the effect of the barriers on natural resources were, "superficial and completely inadequate for the purpose" (McGowan 1964). Dr. Nelson Marshall, an oceanographer, suggested that a scientific body "completely neutral" make a "more thorough cost-benefit analysis" (Evening Bulletin 1964e). In an op-ed in *The Providence Journal*, Robinson C. Locke wrote, "It is frightening that government bureaucrats against the wishes of the people concerned, are still trying to force an

unpopular project upon us... After months of hearings on this matter around the bay it would seem that the Army engineers would realize that the great majority of people do not want this noble experiment forced down their throats. To me this is far from a democratic move" (Locke 1965). Lincoln Cone, a representative of the American Merchant Marine Institute (an association of steamship companies) took issue with the Corps because they had not consulted with his institute on the possible effects of the barriers, despite the obvious potential to impact the commercial shipping industry (Evening Bulletin 1964g). However, not all were critical of the Corps. Some commended them for presenting "an extremely honest appraisal" of the barriers (Boss 1964).

Brig. Gen. Hyzer had written about his frustrations with the public to Congressman Fogarty, arguing that those opposed to the projects were filled with "misconceptions, lack of understanding and fears." Brig. Gen. Hyzer contended that some of the opposition had come from those who had previously supported the barriers, "I am puzzled that memories are so dimmed that few now appear to want the protection which, in 1956, they considered so necessary in the bay areas." He believed these fears were a largely a result of "misunderstood engineering and technical considerations" (Peter C. Hyzer 1964a). In an attempt to clear up any confusion, Brig. Gen. Hyzer wrote a summary, published by *The Providence Journal*, in which he, in question and answer format, responded to ten of the most common complaints and fears that had been expressed about possible long-term adverse effects of the barrier system (Providence Journal 1964b). He also questioned why the opposition was so strong when the purpose of the Lower Bay barriers was the same as that of the Fox Point project – to reduce hurricane damage (P. C. Hyzer 1964). The Corps accepted only two valid points made by the public during the hearings, 1) that the barriers were expensive and 2) that the barriers would increase the tidal velocities through the ungated navigation openings in the East and West Passages (Evening Bulletin 1964a). The Corps continued to insist that no other changes would take place in the bay if the barriers were installed.

In the wake of the opposition, Brig. Gen. Hyzer saw three options, 1) drop the project if opposition continued, 2) request funds for further studies, or 3) go ahead and recommend construction under the belief that the expressed public opposition does not reflect a regional consensus (Evening Bulletin 1964g). Brig. Gen Hyzer believed the latter to be true, and he decided to advance the plans in the hope that a clearer understanding of the "purposes and effects" of the project would come to light upon congressional authorization. The Board of Engineers for Rivers and Harbors agreed stating, "[i]n similar cases, these problems are resolved as the purposes and effects of the plan become more clearly understood. Although full support of the plan is not now apparent, authorization of the plan by Congress would be a major step in this direction"(Young 1965).

While the Corps was able to advance the project for approval from the Board of Engineers for Rivers and Harbors (Young 1965), they were well aware that support from elected officials would be needed prior to receiving congressional authorization. Brig. Gen Hyzer admitted that he had become "quite concerned" about this particular step (Peter C. Hyzer 1964a). Unlike the Fox Point project, not a single Rhode Island congressional delegate promoted the Narragansett Bay barriers. The members of the congressional delegation were

quite alarmed by the mail they were receiving at their offices. Senator Pastore described the response as, “heavy and overwhelmingly opposed”. Congressman Fernand J. St. Germain said, “...I see no reason for promoting or pushing for the construction of this barrier.” Senator Claiborne Pell had similar thoughts, “...I do not believe a project of this sort should go ahead unless a majority of the community wishes it.” Congressman Fogarty said that because an estimated \$26-27 million dollars (unadjusted) would be required from local sources (30 percent share), he “[would] let the people decide” if the project should go ahead. Senator Pastore agreed, “[w]ithout [the willingness of the public to share the cost], I don’t think it’s got a ghost of a chance” (Van Dusen 1964).

#### *After state officials object, the Bay barrier plans are shelved*

The lack of public support ultimately doomed the Narragansett Bay barrier project. Upon receiving approval by the Army’s Chief of Engineers, the next step was for the Corps to obtain comments from state officials in both Rhode Island and Massachusetts. The Rhode Island congressional delegation believed that the decision on the barrier should be made by the state government since the state would be required to put up most of the local share of the cost (Providence Journal 1965a). Ultimately, the State of Rhode Island requested that the construction of the bay barriers be postponed until, “citizens of the state have expressed approval of the project.” In a letter to the Army’s Chief of Engineers, Henry Isé, the Chief of the Rhode Island Board of Engineers and Rivers and Harbors, wrote, “There is considerable fear among a great number of people in Rhode Island that the proposed barriers would adversely affect navigation, the quality of water inside the barriers, fish and wildlife resources of the state, and recreation in the bay. Grave doubts have also been expressed by many citizens regarding the efficiency of the project to provide sufficient protection and damage reduction to justify the large financial outlay necessary for construction and maintenance. In view of the widespread opposition to what is considered by many a ‘questionable project’, it is extremely doubtful that appropriation of funds for the local share of the cost would be approved. Therefore, the State of Rhode Island hereby urgently requests that no construction of the hurricane barriers be undertaken until such time as the citizens of the state have expressed approval of the project. Such approval has not been given to date” (Isé 1965).

The defeat of the Bay barriers was celebrated by *The Providence Journal-Bulletin* (Fig. S7), but the editorial board cautioned that Rhode Islanders should not be, “too rough on the Army Engineers”, for it was many of them who had so desperately called for the Corps’ help in undertaking the studies which led to the barrier proposal that was so widely disliked. *The Journal* wrote, “Rhode Islanders should not completely close their minds to the possibility that the day may come when some kind of a hurricane barrier at the mouth of the bay is feasible and desirable... Another blow like the doubleheader the state received 11 years ago might change a lot of minds”(Providence Journal 1965d). The Army Corps’ Chief of Engineers, Lt. Gen. William F. Cassidy, responded to Isé’s letter and stated that his report to congress will, “recommend that no project be authorized for the lower Narragansett Bay Area at this time.” Lt. Gen. Cassidy stated that future authorization would be dependent on upon future local agreement for participation (Providence Journal 1966; Secretary of the Army 1966).

#### *A failed attempt at a revival*

In the late 1960s and early 1970s, the Army Corps came under national scrutiny for an increasingly poor track record of giving little consideration to the natural environment and also to sustaining decision-making protocols that ignored oppositional viewpoints (Douglas 1969; Drew 1970; Mazmanian and Lee 1975; Porter, Jr. 1971; Reuss 1971; Sargent, Jr. 1972; St. Louis Globe-Democrat 1971). Ultimately, the amassing of project failures similar to the Narragansett Bay Hurricane Barriers across the U.S. started an organizational shift within the Corps that was further solidified with the passage of the National Environmental Protection Act (NEPA) in 1970 (Mazmanian and Nienaber 1979). The NEPA allowed for citizens and other groups to secure significant litigation powers (who have otherwise had no direct say in projects) and also facilitated transparency in terms of the potential negative impacts of projects through environmental impact statements. The added complexity to project planning did not completely dissuade the Army Corps from considering the projects once again.

In the mid-1970s, the lower Narragansett Bay hurricane barrier project re-emerged as possibly being included in a new \$6.1 million-dollar (unadjusted) round of Corps water resource studies. The plan was to update the project to meet new environmental protection standards in the event that interest in the project re-emerged (Frederiksen 1975), a possibility foreseen by some groups that opposed the project. Both the Narragansett Bay Home Owners Association and the Jamestown Protective Association were worried that the barriers, “might be authorized in a moment of panic after a severe storm or as a boondoggle”(Providence Journal 1965e). The mentioning of the Bay barrier project did not go unnoticed. In an editorial in *The Providence Journal*, the Corps was accused of acting in their own self-interest to use tax-payer dollars to make grandiose plans for projects no one wants. The editorial further stated there was no “whisper of desire” from anyone to take a second look at the barriers and described the original Army Corps plan as “...ultimately never generat[ing] any support in the cities and towns the dams were supposed to protect”(Providence Journal 1975).

While Rhode Islanders have endured just a few hurricanes since the 1960s, none have come close to causing destruction on the level of the Great New England Hurricane of 1938 or Hurricane Carol. If another disastrous storm strikes, the Narragansett Bay Barrier plans might get pulled from the shelf, dusted off, and debated once again. The mid-century experience serves to remind the U.S. Army Corps of Engineers, Rhode Islanders, and their elected officials of the political challenges in bringing about coastal flood protection megaprojects.

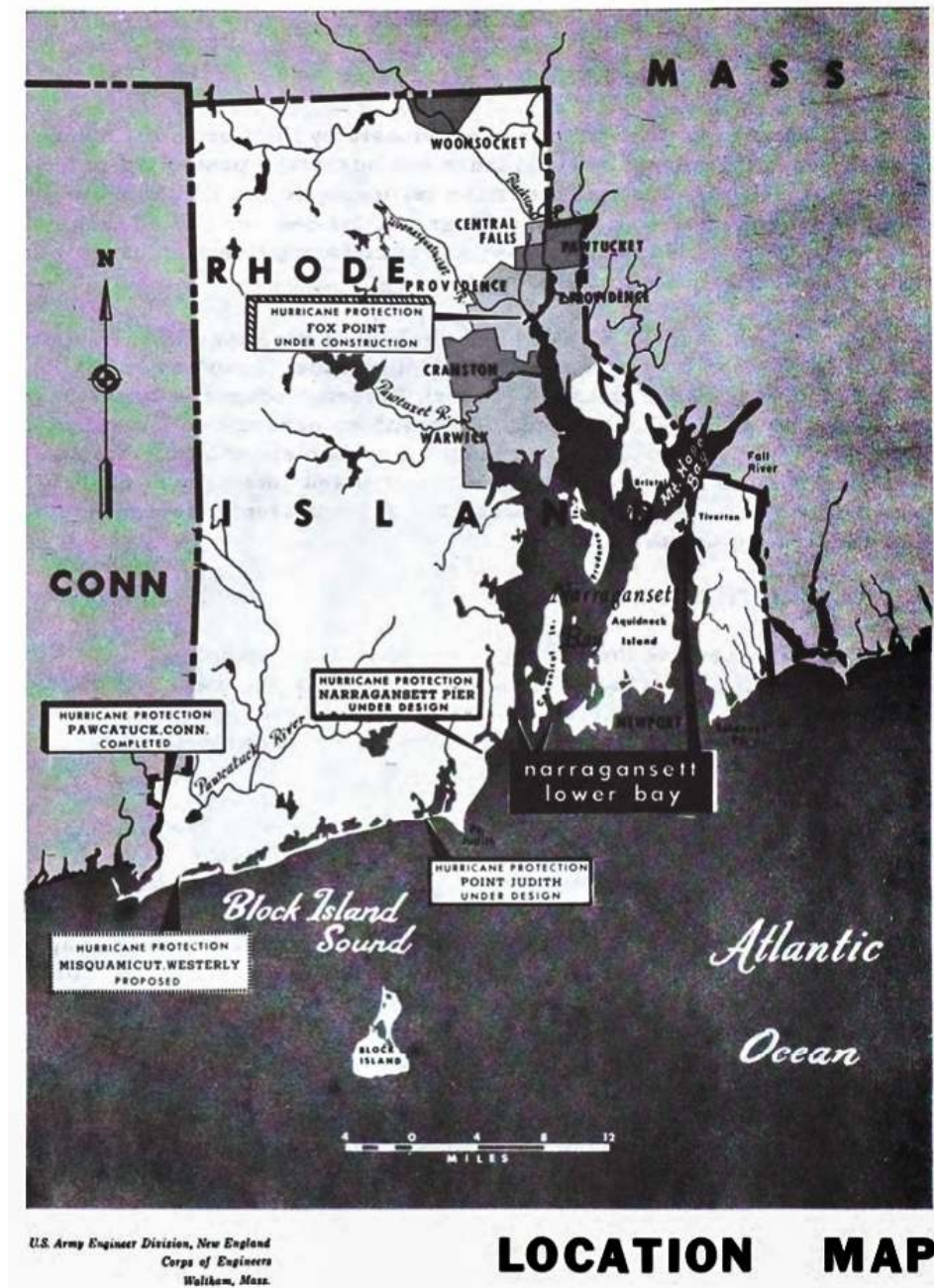
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### Replication Materials

Scans of all archive documents used are available on Zenodo (<https://doi.org/10.5281/zenodo.4429944>)



**Figure S1.** A map showing coastal flood protection projects in Rhode Island in the early 1960s that, at the time, were either under design, had been proposed, or were currently under construction. (Reprinted from GPO 1966.)

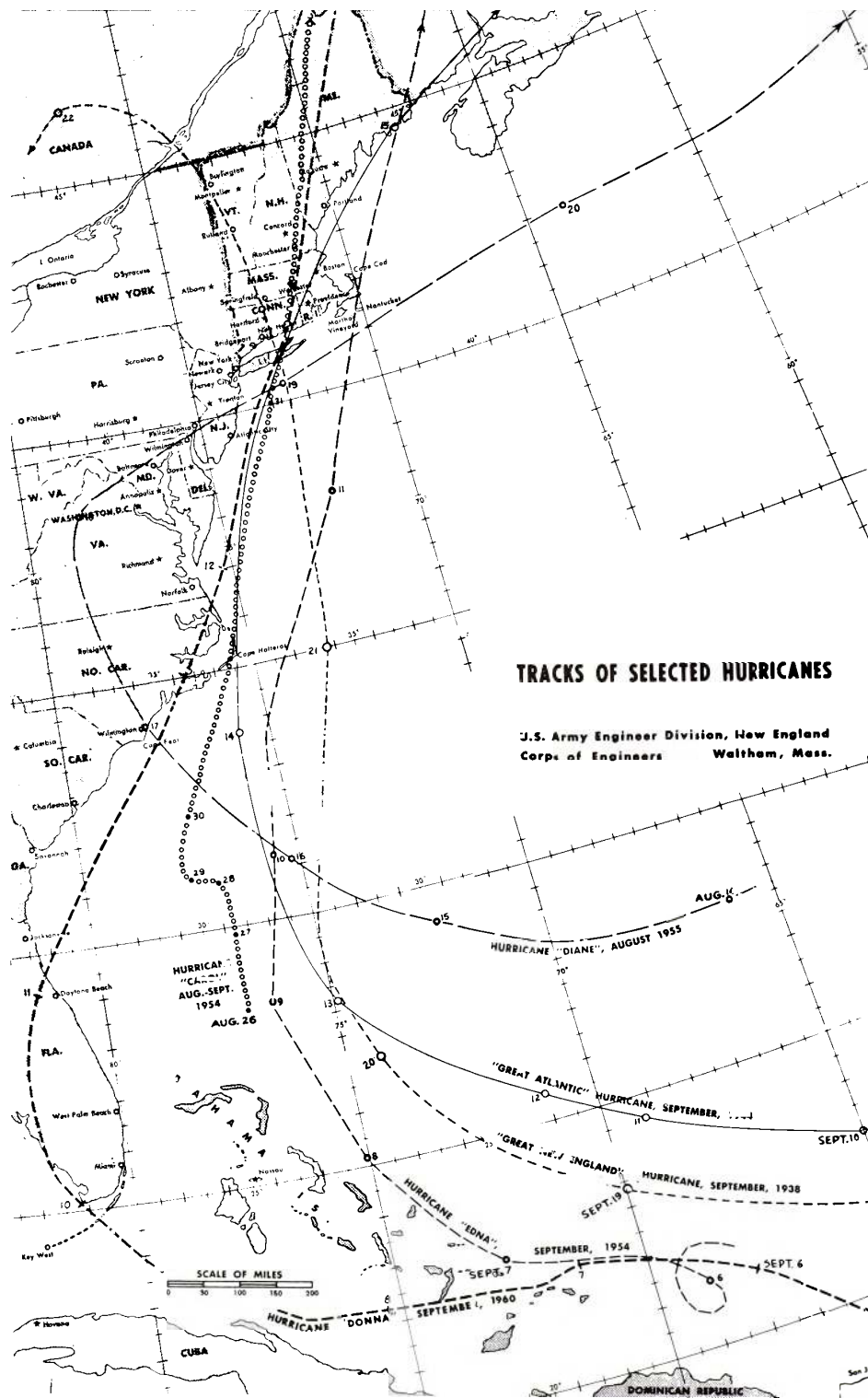


Figure S2. Tracks of hurricanes impacting New England (1938 to 1960). (Reprinted from GPO 1966.)



A.



B.



C.



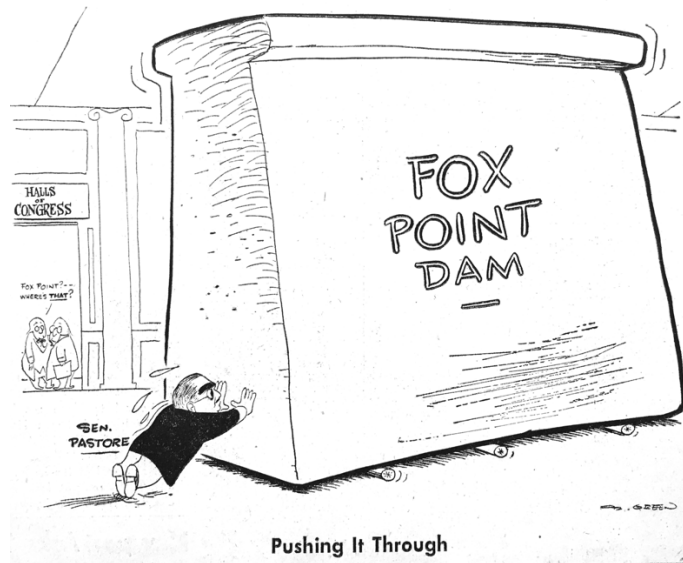
D.



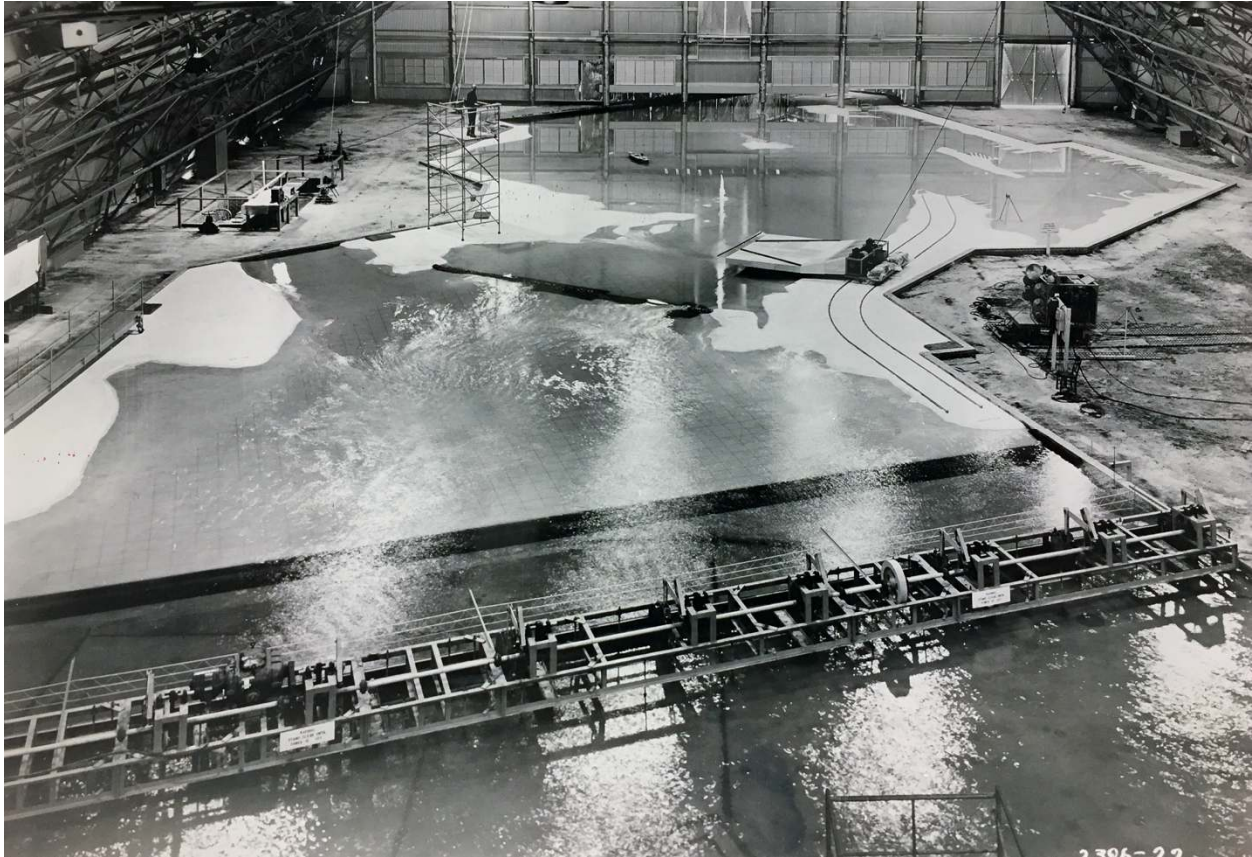
**Figure S3.** A) Flooding in downtown Providence, Rhode Island during Hurricane Carol on August 31, 1954; B) Flooded offices of *The Providence Journal-Bulletin*; C) Photo of flooding in downtown Providence, Rhode Island looking up Westminister Street towards the business section; D) Aerial photo of destruction from Hurricane Carol in Oakland Beach, Rhode Island.



(Source: "Hurricane Carol Lashes Rhode Island", Published by The Providence Journal-Bulletin 1954, © Providence Journal – USA TODAY NETWORK.)



**Figure S4.** A political cartoon depicting the struggle that Rhode Island’s congressional delegation endured in pushing the Fox Point Barrier through Congress. (Source: The Providence Journal-Bulletin, 5/24/1957, © Providence Journal – USA TODAY NETWORK.)



**Figure S5.** A hydraulic model of the East Passage of Narragansett Bay in Vicksburg, Mississippi. A wave generator is visible in the foreground. A wind generator is on a track on the right. The hurricane barrier extends from Castle Hill (right) to Southwest Point (left). (Source: Courtesy of US Army Engineer Division, New England, US Army Corps of Engineers, Waltham, MA.)



It Can't Happen Here

**Figure S6.** A political cartoon depicting the how Rhode Islanders felt after the U.S. Army Corps of Engineers was attempting to continue to advance the Bay barriers following strong and consistent public opposition. (Source: The Providence Journal-Bulletin, 11/18/1965, © Providence Journal – USA TODAY NETWORK.)



R.I.P.

**Figure S7.** A political cartoon depicting the Army Corps grieving the loss of the Narragansett Bay Barrier project after more than a decade of planning and deliberation. (Source: The Providence Journal-Bulletin, 1/6/1966, © Providence Journal – USA TODAY NETWORK.)

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