

# Bristol County Water Authority's Proposed Plan to Restore the Kickemuit River through the Removal of the Two Kickemuit Reservoir Dams

## Background

The two dams on the Kickemuit River (Figure 1) were constructed to create a public water supply for the Bristol County Water Authority (BCWA), the regional water supplier for the communities of Warren, Bristol and Barrington, Rhode Island. The Lower Kickemuit Dam (Figure 2) was constructed in 1883 to create the Kickemuit Reservoir, and the Upper Kickemuit Dam in 1961 to prevent saltwater intrusion into the upper section of the reservoir. The Shad Factory Pond Dam and the Swansea Reservoir in Massachusetts were also constructed in the late 1880's to provide additional supply.

The shallow Kickemuit Reservoir was never a good source for potable water, as water quality was poor and quantity was very limited. The reservoir's water treatment plant, built in 1908, struggled to meet federal water quality regulations, until it was designated for emergency backup use only in 2011 and decommissioned in 2019. The Upper and Lower Kickemuit Reservoirs became the BCWA's backup water supply in 1998 once the agency secured a new primary source of water from Providence Water's Scituate Reservoir via the East Bay Pipeline.

In 2012, the BCWA began studies to secure an alternative backup water supply. Continuing water quality deterioration due to water pollution and saltwater intrusion from sea level rise has led to this water supply being designated as unusable for potable water. The Rhode Island Department of Health (RIDOH) in their 2013 *SafeWater RI* report characterized the BCWA's system as critically vulnerable to three hazards related to climate change: sea level rise, coastal flooding and hurricanes. The Lower Kickemuit Reservoir impoundment is vulnerable today to tidal inundation during moon tides and storm events and will experience more tidal flooding with predicted sea level rise.

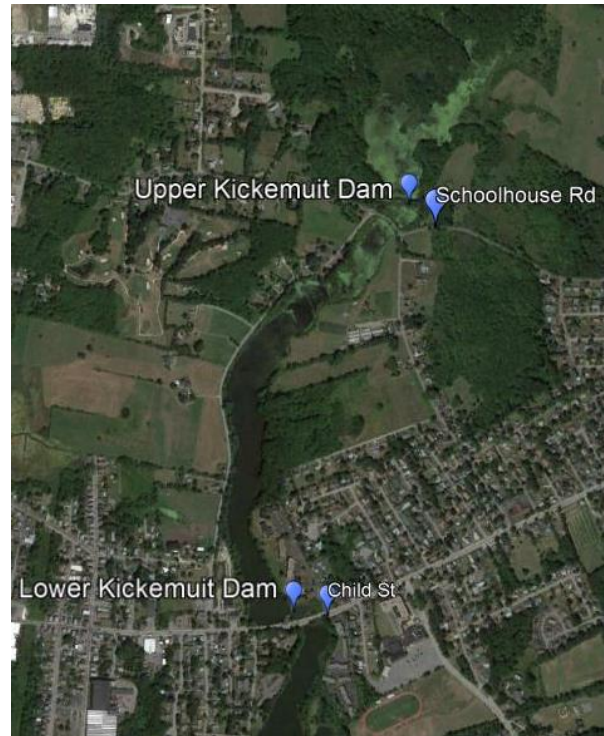


Figure 1: Upper and Lower Kickemuit Reservoir dams and impoundments



Figure 2: Lower Kickemuit Reservoir Dam: Tidal flooding of lower impoundment (in foreground) during a moon tide

Since 2012, BCWA has taken action on the RIDOH's recommended strategies to prevent losses to drinking water utilities by evaluating their at-risk infrastructure and developing and implementing a plan to abandon the former backup water supply and secure a new backup supply from an independent source. A 2012 BCWA study determined that the safest water quality and most economical alternate supply could be provided by Pawtucket Water, with a 30" pipeline to be run through the City of East Providence and terminating at the BCWA Providence connection in East Providence. As the City of East Providence, which also participated in the 2012 study, found that its connection to Providence Water is at risk, they are considering joining in the project.

The first phase of installing a temporary alternate supply began in 2016 when a new connection to East Providence was constructed. Construction is continuing in 2021 to connect BCWA's Providence Water connection with the East Providence source from Providence Water and to build redundancy into the system. Plans to secure a long term alternate supply is currently in the design phase and includes running a 30-inch water main from the East Providence connection to the Pawtucket border to connect to Pawtucket's water supply.

Since the Upper and Lower Kickemuit Reservoir Dams are no longer needed for the water supply, the BCWA is currently working with partners including the Town of Warren, Save The Bay, the National Oceanic and Atmospheric Administration's (NOAA) Restoration Center, RI Department of Environmental Management and the State of RI's Chief Resilience Officer to remove both the Upper and Lower Kickemuit Reservoir dams.

### **Benefits of Dam Removal**

Removing these dams will increase the ecological health of the Kickemuit River by restoring the tidal estuary, increasing both salt and brackish marsh habitat, improving habitat for fish and wildlife, and restoring the connectivity of this river with the estuary. The removal of these obstructions to natural tidal flow will restore provide sustainable and lasting ecological benefits and will restore natural ecosystem function to the Kickemuit River.

The dam removals, along with upgrading of the culverts under Schoolhouse Road, will:

- reduce stagnant conditions found in the impoundments and increase tidal flushing, significantly improving both water quality and habitat for a wide variety of fish and wildlife;
- enhance fish passage for river herring and eels
- create new habitat for estuarine fish such as mummichog, striped killifish, and menhaden that will benefit recreationally important species such as striped bass and bluefish;
- provide habitat for other species, such as blue crab, that have been observed in the lower impoundment due to its brackish conditions.
- increase access to potential nesting habitat for the state's threatened diamond-back terrapin population;
- restore salt marsh habitat along the tidal creek
- enhance public access to the river



Figure 3: Algae bloom in lower impoundment

The dam removals will also provide community resiliency benefits by increasing flood storage capacity of the wetlands and reducing flooding of Schoolhouse Road during precipitation events. As part of this project, BCWA and its partners have secured a commitment from the Rhode Island Department of Transportation (RIDOT) to elevate Schoolhouse Road and resize its culverts. This low-lying road just downstream of the upper dam has flooded in recent years; following dam removal it will not be as vulnerable to flooding during large precipitation events and will provide an important alternative access route for the eastern part of Warren.

The dam removals will enhance public access to the Kickemuit River for kayaking, fishing and recreation. Presently the area is restricted to public access since it was a designated watershed for BCWA's backup drinking water supply. Once an alternate supply is secured, the area is intended to be opened for low-impact public recreation such as walking, fishing and kayaking.

## The Dam Removal Project

The Upper Kickemuit River Dam (Warren Reservoir Upper Dam - State I.D. 480) is an earthen embankment (Figure 4); 965 feet in length and 14 feet in height. The Upper Kickemuit River Dam, built in 1961 to prevent saltwater intrusion into the upper impoundment, is approximately 0.8 miles upstream of the Lower Kickemuit River Dam. A large freshwater wetland exists adjacent to the Upper Kickemuit Reservoir and, upon removal of the dams, is predicted to convert to brackish and salt marsh. The Lower Kickemuit River Dam (Warren Reservoir Lower Dam - State I.D. 479), built in 1883, is 130 feet long. The dam when originally constructed prevented tides from flowing into the lower impoundment. With over 12 inches of sea level rise since the dam was constructed, salt water flows into the lower impoundment multiple times a month during higher tides, moon tides and coastal storm events.



Figure 4: Upper Kickemuit Reservoir Dam  
to the lower impoundment multiple times a month during

### *Environmental Monitoring*

In 2007, RIDEM, with funding and partnership from NOAA and other federal and state partners, constructed a fish ladder at the Lower Kickemuit River Dam to support fish passage. RIDEM's Division of Fish and Wildlife has stocked the lower impoundment with herring since 2010; and while herring have been observed below the fish ladder, they have not subsequently been recorded within the lower impoundment. An electrofishing survey in 2012 conducted by RIDEM confirmed that there were no juvenile herring in the lower impoundment. Since the installation of the fish ladder, the herring population has not rebounded as projected, likely due to brackish water conditions and poor water quality within the lower impoundment. In addition, blocked culverts under Schoolhouse Road and check valves on the outlets of the Upper Kickemuit River Dam prevent migratory fish from accessing the upper impoundment and three miles of upstream spawning habitat.

Water quality monitoring conducted of the two impoundments and in the estuary at the Child Street bridge in the summer of 2020 by the BCWA and Save The Bay through URI's Watershed Watch program confirmed that the lower impoundment has already converted to a brackish system, since moon tides flow into the lower impoundment over the spillway (Figure 5). The monitoring data also documented high nutrient and bacteria levels in both impoundments and downstream of the lower dam at Child Street. Nutrient pollution is indicated by the extensive algae blooms during the summer and early fall. Algae blooms result in low oxygen conditions that create degraded habitat conditions for fish and other aquatic life. These brackish waters and low oxygen levels have hampered the return of spawning river herring, despite the construction of the fish ladder at the Lower Kickemuit River

Dam.

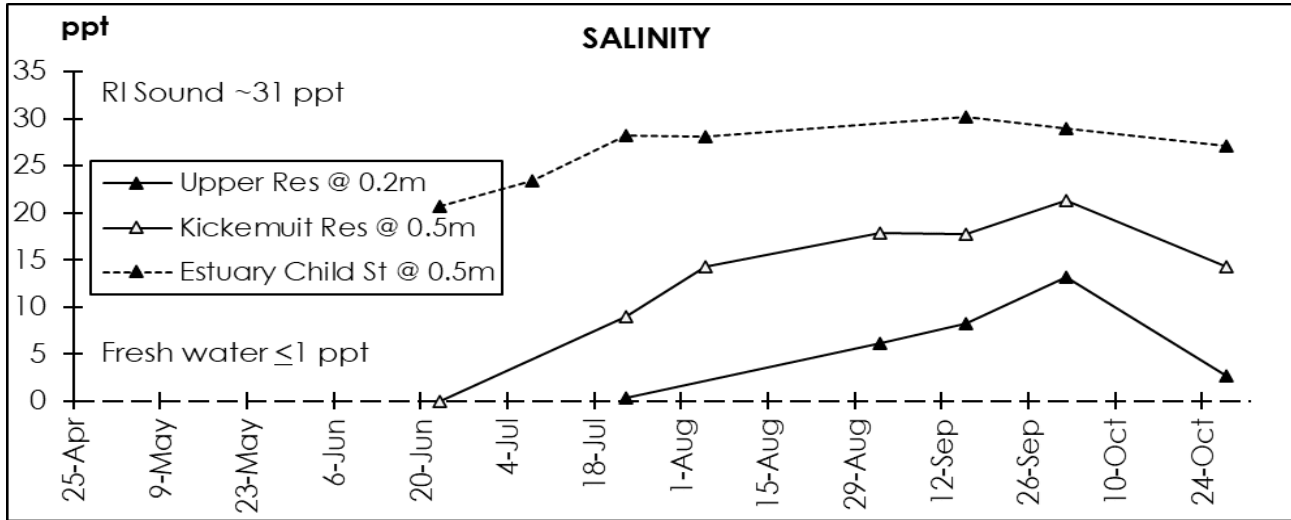


Figure 5: Salinity data of upper and lower impoundments and upper estuary at Child St. from 2020

### Project Planning

In 2014, the Upper Kickemuit River Dam safety report identified the dam as needing to address deficiencies highlighted by a statewide dam assessment, including the removal of vegetation to protect embankment stability. Based upon the fact that the dam no longer served its intended purpose, in 2015 the BCWA hired Pare Corporation, an engineering firm, to assess the projected impacts of dam removal. Since new dam regulations are being considered by RIDEM, the estimated cost to bring the Upper Kickemuit River dam up to these standards was estimated to be between \$500,000-\$600,000.

As part of the assessment, Pare conducted hydrologic modeling to assess future flooding scenarios with the removal of the Upper Kickemuit River Dam. The modeled conditions indicated that a breach would result in decreased depth and extent of flooding during precipitation events in residential neighborhoods in Rhode Island and Massachusetts, including Schoolhouse Road east of the dam.

However, the section of Schoolhouse Road that crosses the river directly downstream of the Upper Kickemuit River Dam (Figure 6) was identified as being more vulnerable to flooding if the dam were removed. Based upon this assessment, the state's Chief Resilience Officer coordinated meetings with RIDOT staff and project partners to discuss changing the Transportation Improvement Plan, reprioritizing this section of Schoolhouse Road from a repaving project to a road raising project. In 2019, RIDOT committed to elevating Schoolhouse Road and upgrading its culverts to prevent flooding of the roadway once the upper dam is removed. RIDOT hired an engineer to design and permit the Schoolhouse Road upgrades and culvert resizing, and construction is beginning in the late summer of 2021.



Figure 6: Schoolhouse Rd flooding during rain event (March 2018)

The modeling also predicted that downstream flooding of Serpentine Road, a town road running alongside the lower impoundment, would increase if the upper dam was removed but the lower dam remained in place. Based upon this analysis, in the fall of 2019 the BCWA and project partners decided to coordinate the removal of

both the Upper and Lower Kickemuit River dams in order to reduce flooding during precipitation events while restoring estuarine habitat, migratory fish passage, and river water quality.

Assessment of the Lower Kickemuit River Dam removal has included sediment analysis, a bathymetric and topographic survey, stream profile modeling and wetlands delineation, coastal surge modeling and identification and assessment of private wells adjacent to the lower impoundment. A storm surge analysis determined that the Lower Kickemuit River Dam provides no coastal flood mitigation benefits under existing and future scenarios. The lower dam removal will result in a slight flood increase when coastal storm surge is combined with a precipitation event under a worst-case scenario. The BCWA also conducted an assessment of the effects of the dam removal on private drinking water wells adjacent to the lower impoundment. The sediment assessment found exceedances of copper in some of the samples due to past treatment of the drinking water supply. Pare Engineering has developed a sediment management plan that includes removal of this contaminated sediment.

The engineering and design of the dam removal projects are being coordinated with the sizing of the culverts under Schoolhouse Road. To date, Pare has developed engineering plans for the removal of the Upper and Lower Kickemuit Reservoir dams. The design and engineering of the dam removals have been funded in part by two grants of \$75,000 each from Coastal Resources Management Council's (CRMC) Coastal and Estuarine Habitat Restoration Trust Fund. Additionally, \$1.2 million in funds for the dam removals was secured from the state's Climate Resilience Fund in 2020. Save The Bay has been collaborating with the BCWA on writing the grants for state and federal funds for design and construction.

#### *Partner and Public Engagement*

The BCWA formed a committee to study the removal of the Kickemuit Dams in 2016 including the Town of Warren, the Kickemuit River Council, the Warren Conservation Commission, the Town of Swansea, Save The Bay, and the State of Rhode Island's Chief Resilience Officer. The Chief Resilience Officer has highlighted this project as a model resiliency project that requires interagency coordination between RIDOT, RIDEM, RIDOH, BCWA and the Town of Warren.

The BCWA has convened a number of meetings with the Committee since 2016. The BCWA provided updates to the Warren Town Council on the dam removal planning and assessment in February 2021 and in May 2020. The BCWA has held two public meetings, that including abutters of the lower impoundment, to review the dam removal plans (in November 2019 and December 2020).

#### *Permitting*

The Upper Kickemuit River Dam removal project will require a RIDEM Freshwater Wetlands permit, RIDEM Water Quality Certification, and an Army Corps of Engineers 404 permit. The Lower Kickemuit River dam removal project will require a CRMC Assent, a RIDEM Water Quality Certification and an Army Corps of Engineers 404 permit. The BCWA and Pare Engineering have held a pre-permitting meeting with RIDEM and CRMC to discuss the permitting of both dam removals and the permits were submitted in August of 2021.

#### *Project Construction and Phasing*

Schoolhouse Road will be elevated and the culverts resized and replaced by RIDOT beginning in the late summer of 2021. Once permits are received, the Lower Kickemuit Reservoir Dam will be removed first and then the Upper Kickemuit Reservoir Dam. Both dam removals will occur in an incremental fashion, allowing sediment contained behind the dams to mobilize in stages. At the lower dam, sediment with elevated levels of copper will be removed and taken off site. As the lower dam is removed, clean sediment will collect downstream in the basin created by the Child Street bridge and will be mechanically removed from the estuary.

At the Upper Kickemuit Reservoir Dam, sediment will collect in the basin created by Schoolhouse Road, just downstream of the dam. Flow will be controlled at the Schoolhouse Road culverts. As the basin above Schoolhouse Road fills, sediment will be mechanically removed from the site – this process will be repeated until most of the sediment has been removed. It is anticipated that some sediment will flow into the lower reservoir, where it will provide a substrate for salt marsh plants. Once the dams are removed, the exposed areas of the riverbed will be restored with plant growth native to the former estuary. Soil samples taken in the reservoir have revealed plant roots that can reestablish in the brackish waters.

The removal of the dams will dramatically improve life along the Kickemuit. The reestablished tidal basin will fill at high tide and drain at low tide to form a tidal creek, supporting a healthier and ever-changing tidal estuary. As the river's water quality improves, the estuary will support a greater diversity of fish and with it opportunities for recreational fishing. Other wildlife will return to the salt marshes lining the estuary such as egrets and other wading birds. The river made newly accessible to kayakers, bird watchers, and other nature observers will enhance quality of life and bring economic benefits to nearby communities. Enjoying a safe alternative drinking water supply, a restored estuary with increased flood storage capacity, and a new emergency access route, the community of Warren will be better prepared and more resilient to climate change.

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