

## FY19 MVP Action Grant – Case Study Report

### Enhancing Water Supply Reliability: Resilient Water Storage and Water Conservation Planning

Town of Belchertown

June 29, 2020

#### 1 Introduction

Extreme weather and natural and climate-related hazards are an increasing concern for the communities of Western Massachusetts. Participants at the MVP Community Resilience Building (CRB) workshop in Belchertown identified water supply reliability as one of the top hazards and vulnerabilities facing the Town. Specifically, the Town's Park Street water storage tank is approximately 100 years old and in need of replacement, as the tank is both vulnerable to storm and wind damage and is undersized. In addition, the Town's public groundwater supplies are susceptible to drought, emphasizing the need to further reduce public water demand through water conservation and reuse. The CRB Workshop Summary of Findings identified several high-priority recommendations associated with the Town's public water supply system: 1) replace the Town's Park Street water storage tank, and 2) implement a rainwater harvesting system at Belchertown High School.

In 2016, the Belchertown Water District commissioned an evaluation of the rehabilitation needs of the District's water storage tanks, including the Part Street water storage tank, which is a 100,000 gallon capacity elevated steel tank located in the Town center. Based on a 2011 structural evaluation of the tank (KM Consulting Engineers, 2011), and as described in the 2016 study report, the nearly 100-year old tank structure is not adequate to withstand a wind speed of 95 mph, with a 1-inch ice load. The District has been exploring the possibility of replacing its Park Street tank since modifications or further repairs (corrosion removal and applying coatings to joint areas) to the tank are not thought to be practical or cost-effective. In addition, the water system's existing total storage (650,000 gallons) is less than the recommended usable storage and a larger tank is needed. Based on the 2016 evaluation, construction of a new 250,000-gallon water storage tank is recommended to replace the existing Park Street water storage tank (Tighe & Bond, 2016). Replacing the Town's Park Street water storage tank with a new and larger tank would increase the storage capacity and address structural deficiencies with the existing tank, making the Town's public water supply system more resilient to drought as well as storm and wind damage.

The Belchertown Water District supplies water to residential, commercial, and municipal customers, including the Belchertown School District. The existing irrigation system that serves the athletic fields at the High School, which opened in 2000, accounts for a large percentage of the municipal water demand particularly during periods of peak demand. In 2018, water usage at the High School (3.4 million gallons) was approximately 80% of the overall municipal usage (4.2 million gallons), and irrigation of the athletic fields (1.1 million gallons) accounted for approximately one-third of the water used at the school. As part of its ongoing water conservation initiatives, the Town of Belchertown and the Belchertown Water District are proposing to implement a rainwater harvesting system for irrigation of the athletic fields at the High School. The rainwater harvesting system would reduce the demand on the Town's public water system during times of peak demand and conserve potable water for essential uses, enhancing the reliability of the water system under existing and future climatic conditions. The system would also

reduce stormwater runoff volumes and pollutant loads and increase infiltration through the use green stormwater infrastructure.

## 2 Project Outcomes

### 2.1 Park Street Water Storage Tank

The Town of Belchertown contracted with Fuss & O'Neill to lead the design and permitting of the replacement water storage tank. Fuss & O'Neill completed sizing of the proposed tank, local and state permitting, and preparation of final design drawings and specifications that will be used to bid the project and construct the replacement storage tank. Local approvals were received from the Belchertown Planning Board, Zoning Board of Appeals, and Historic District Bylaw Commission. The Massachusetts Department of Environmental Protection also reviewed the proposed project and granted approval with conditions that need to be met prior to and during construction.

The design evaluation confirmed the need for additional water storage in order to meet maximum daily demands within the system, provide equalization during peak pumping events, and include provisions for fire flows and emergency storage. The recommended volume of the replacement tank is 250,000 gallons. The overflow elevation was also increased to match the overflow elevation of the existing Allen Street water storage tank. Construction of a new 250,000-gallon water storage tank to replace the existing Park Street water storage tank will increase the storage capacity and address structural deficiencies with the existing tank, making the Town's public water supply system more resilient to drought as well as storm and wind damage.

The water storage tank replacement project includes improvements to the municipal parking lot adjacent to the tank site. These improvements will include construction of green infrastructure stormwater control measures, specifically permeable pavement and bioretention, to better manage stormwater runoff from the site. Stormwater management using green infrastructure aims to increase retention and infiltration of stormwater and decrease peak flows, working with natural processes to reduce runoff volumes, pollutant loads, and promote groundwater recharge.

### 2.2 Stormwater Harvesting and Reuse at Belchertown High School

The feasibility of a stormwater/rainwater harvesting and reuse system for Belchertown High School was evaluated to reduce the amount of potable water required to irrigate the athletic fields, reducing the overall demand for municipal water during periods of peak demand, conserving potable water for essential uses, and increasing the reliability of the irrigation system.

A water budget tool was developed for the site to evaluate how much of the High School's irrigation demand could be met by a harvesting and reuse system and to help select a cost-effective water storage tank (i.e., cistern) size. Three underground cistern locations and contributing drainage areas were identified. A range of tank sizes were evaluated for each option, including a rainwater-only (roof runoff) system located at the western end of the main parking lot (Option 1), a rainwater-only system located behind the gymnasium (Option 2), and a combined stormwater/rainwater system located beneath the main parking lot (Option 3). The optimal size for an underground cistern for the site is generally between 20,000 and 50,000 gallons. A 50,000-gallon tank was chosen for further evaluation for its ability to meet a greater percentage of the average annual irrigation demand and to provide a measure of resilience against potential future increases in irrigation water demand due to climate change.

The estimated capital cost for the rainwater-only systems (Options 1 and 2) is \$426,000 to \$444,000 or approximately \$8.50 - \$8.88 per gallon of water storage capacity. The estimated capital cost for the Option 3 stormwater harvesting and reuse system is higher at \$532,000 (\$10.64 per gallon of storage) due to more extensive drainage system modifications required to divert and treat larger volumes of combined stormwater and rainwater. The anticipated payback period for each option was calculated based upon the estimated capital cost, annual irrigation savings, and annual operation and maintenance cost. Assuming the Town and/or Water District pay for the full up-front cost to construct a harvesting and reuse system, the payback period is between 46 and 50 years. If the Town obtains a 75% grant for construction of the system, the payback period is reduced to between 19 and 21 years. From a strictly financial perspective, implementing an active harvesting and reuse system at the High School is only practical and cost-effective if grant funding can be secured for a significant portion of the capital cost of the system. Without a grant, the estimated 50-year payback period exceeds the design life of the system and the remaining useful life of the school itself. With a 75% grant, the 20-year payback period is within the design life of the system and potentially within the remaining useful life of the school.

Furthermore, implementing a stormwater harvesting and reuse system at Belchertown High School would provide other benefits that are difficult to quantify such as education and public awareness, reduced stress on the municipal water system during peak usage, reduction in overall energy footprint and reduced carbon emissions, and reduced stormwater discharge and MS4 Permit compliance benefits. For a stormwater harvesting and reuse system to be cost-effective, it should be implemented in combination with other water conservation/demand management measures to further reduce irrigation demand. At a minimum, the Town should consider:

- Replacing the non-functional rain sensor with a new sensor or a weather-based irrigation controller technology such as EPA WaterSense labeled irrigation controllers
- Incorporating soil moisture sensors to measure moisture and regulate irrigation so that it only occurs when soil moisture falls below a set threshold
- Adding soil amendments (e.g., zeolite) and overseeding with more drought resistant turfgrass.

If the Town proceeds with the design and implementation of a water harvesting and reuse system, the design should also:

- Address the current operational issues related to the existing irrigation system (i.e., the need to operate the system above its design flow and pressure to provide full coverage of the athletic fields).
- Include provisions for future expansion of the harvesting and reuse system to increase storage capacity (and further reduce municipal water demand) and/or to provide irrigation water for the landscaped area in front of the school building.

### 3 Related Reports

Belchertown High School Stormwater Harvesting and Reuse Feasibility Evaluation and Concept Design. Fuss & O'Neill, 2020.

Park Street Water Storage Tank Replacement: Background Information & Pre-Design Evaluation Results. Fuss & O'Neill, 2019.

Water Storage Tank Study: Belchertown, MA. Tighe & Bond, 2016.