Pacific Northwest
NATIONAL LABORATORY

Case Study: **Massachusetts Gap Energy Grant Program -**

An innovative state program to realize energy benefits in the water sector

July 25, 2023

Juliet S. Homer, P.E.
Senior Research Engineer

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

The U.S. Department of Energy's Water Power Technologies Office funded PNNL's research to study the MA Gap Funding Program to identify and share successful models for realizing the adoption of energy efficiency and renewable energy projects by water utilities.

Agenda

Agenda item	Presenter
Background and context	Juliet Homer, PNNL
Introduction to the U.S. Department of Energy (DOE) Office of State and Community Energy Programs (SCEP)	Shannon Zaret, SCEP
Massachusetts Department of Environmental Protection (DEP) – Program background and information	Danah Tench and Michael DiBara, MA DEP
Water utility experience – City of Brockton	Patrick Hill
Water utility experience – City of Fitchburg	Samuel Kenney
Q&A	Moderated by Juliet Homer
Wrap up	Juliet Homer

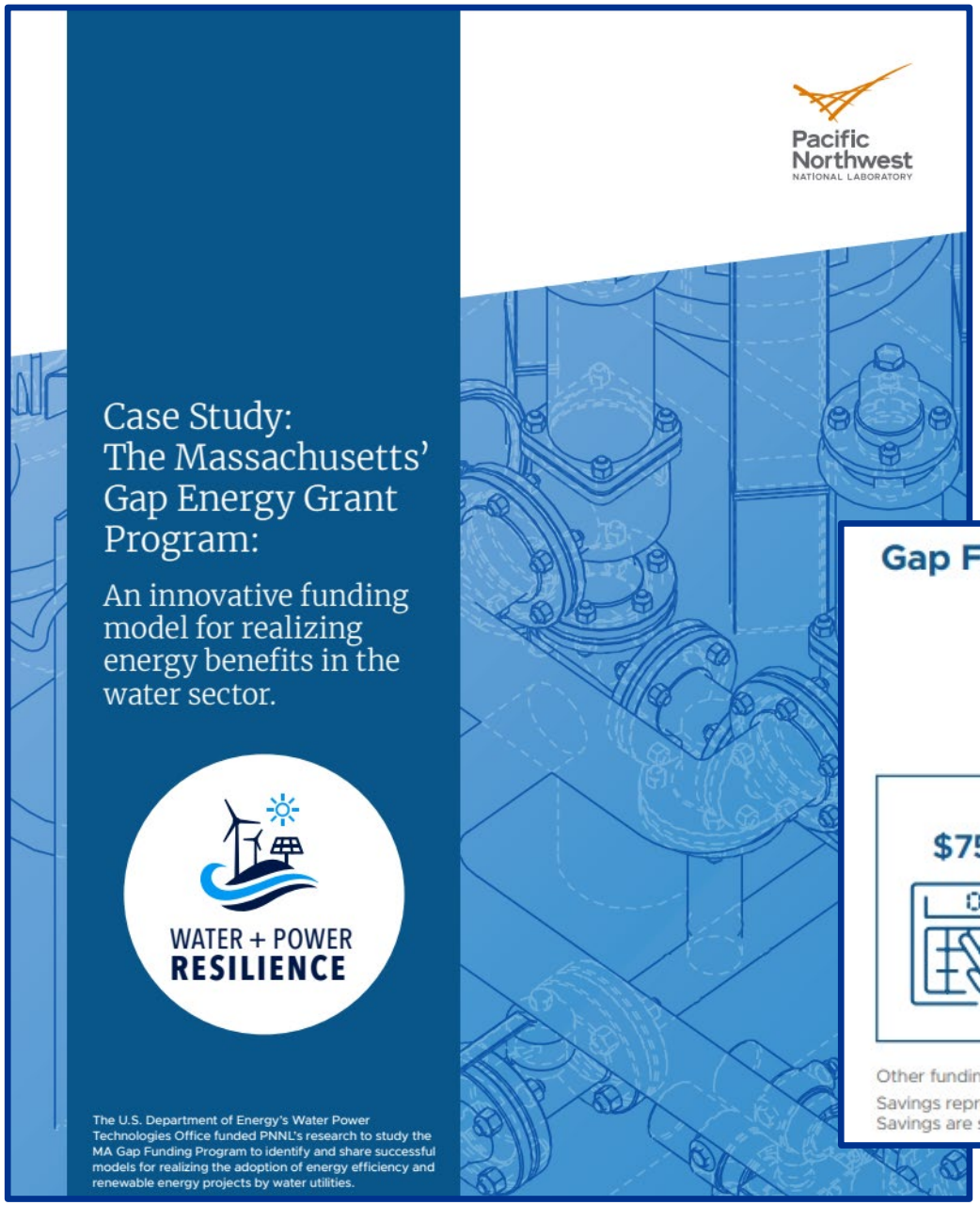
Integrated Water-Power Resilience Project - Objectives

Project objectives:

- Characterize interdependencies and vulnerabilities of water and power systems
- Develop analysis tools and share best practice methods
- Promote coordination and data development and sharing
- Support energy efficiency, flexibility, and renewable energy development in the water sector ✓
- Support equity and justice in interconnected energy and water systems

Massachusetts Gap Funding Model

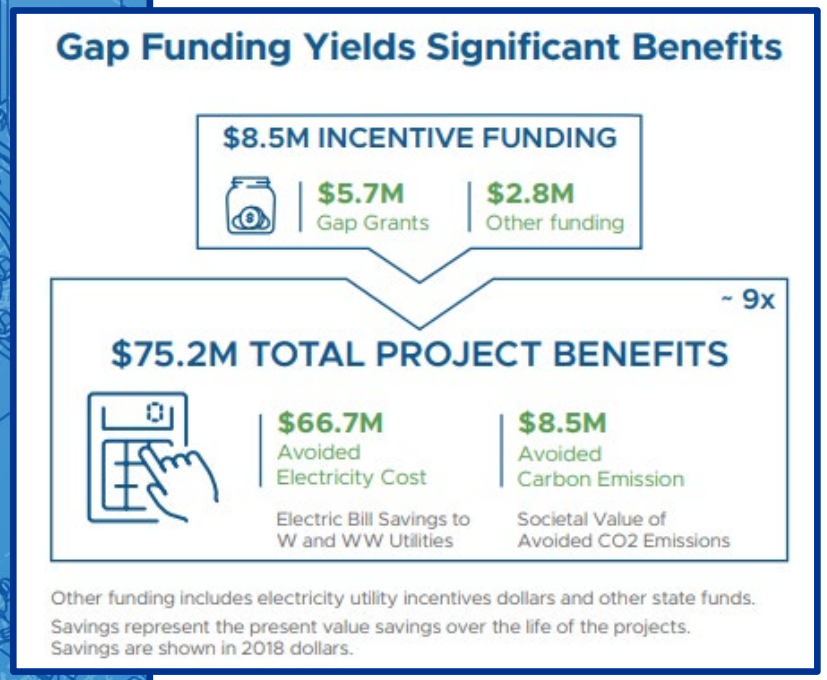
- An innovative and effective program for realizing energy benefits in the water sector
- PNNL conducted a cost-benefit analysis of the first two rounds of the Massachusetts Gap Funding and developed a fact sheet.
- The purpose of this webinar is to highlight this program and share it with other researchers, water and wastewater utilities, and state energy program managers.
- Factors of success include:
  1. **Information** - Utilities had clear information on energy savings & generation potential
  2. **Funding** - Gap funding helped supplement self-funding and other funding sources
  3. **Peer support** - Peer network and support were in place

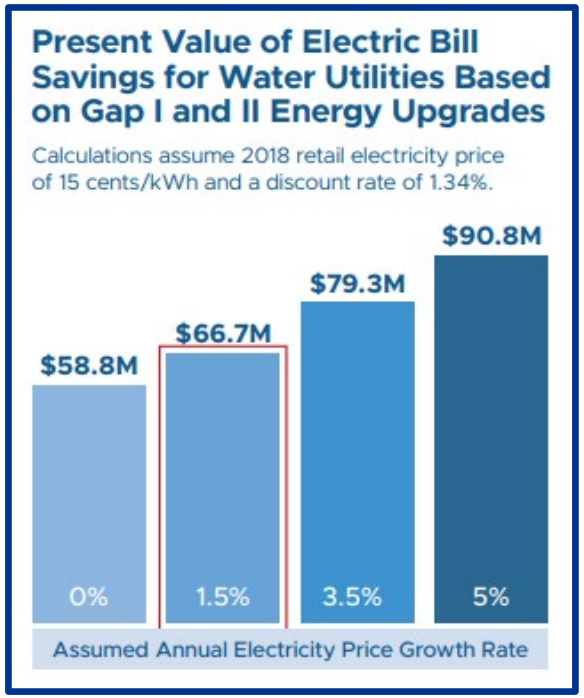


Wilfried Kabre

Kostas Oikonomou

Alisha Fernandez





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Thank you

Massachusetts' Gap Funding Model

Bringing Energy and Resiliency Results to the Water Sector and Beyond

July 25, 2023

Massachusetts Department of Environmental Protection

Danah Tench, Director
Clean Energy and Climate Resiliency Programs

Michael DiBara, Project Manager
Clean Energy Results Program

An Innovative Partnership:

- The Massachusetts Department of Environmental Protection
- The Massachusetts Department of Energy Resources
- The Massachusetts Clean Energy Center

Today's Discussion

- Clean Energy Results Program
- Genesis of the Gap Energy Grant Program
- Program Overview and Results
- Tips for Success

https://www.mass.gov/info-details/massachusetts-gap-energy-grant-program

MICHAEL DiBARA, JAMIE DOUCETT, ANN LOWERY, DANIEL KNAPIK, AND AIMEE POWELKA

Massachusetts' Return on Investment: A Gap Funding Model for Success

THANKS TO A GAP FUNDING PROGRAM OFFERED THROUGH A PARTNERSHIP OF MASSACHUSETTS GOVERNMENT AGENCIES, WATER AND WASTEWATER FACILITIES HAVE OVERCOME FINANCIAL AND OTHER RESOURCE BARRIERS AND ARE IMPLEMENTING CLEAN-ENERGY PROJECTS.

Maximizing returns on investments and reducing operating costs—every business and government agency should strive for these goals. This article describes a "gap funding" grant approach that promotes clean and efficient energy, benefits air quality, and effectively reduces energy and operating costs at public drinking water and wastewater facilities across the Commonwealth of Massachusetts. Without it, utilities would face barriers and miss opportunities to implement beneficial projects.

Serving as a model for collaboration and innovation, Massachusetts government agencies have successfully delivered both returns and efficiencies to municipal water ratepayers under the Clean Energy Results Program (CERP). CERP is a government-led, statewide partnership of the Massachusetts Department of Environmental Protection (MassDEP), the Massachusetts Department of Energy Resources (DOER), and the Massachusetts Clean Energy Center (MassCEC). This program helps meet joint environmental protection and energy goals by advancing the deployment of renewable e

CLEANENERGYRESULTS

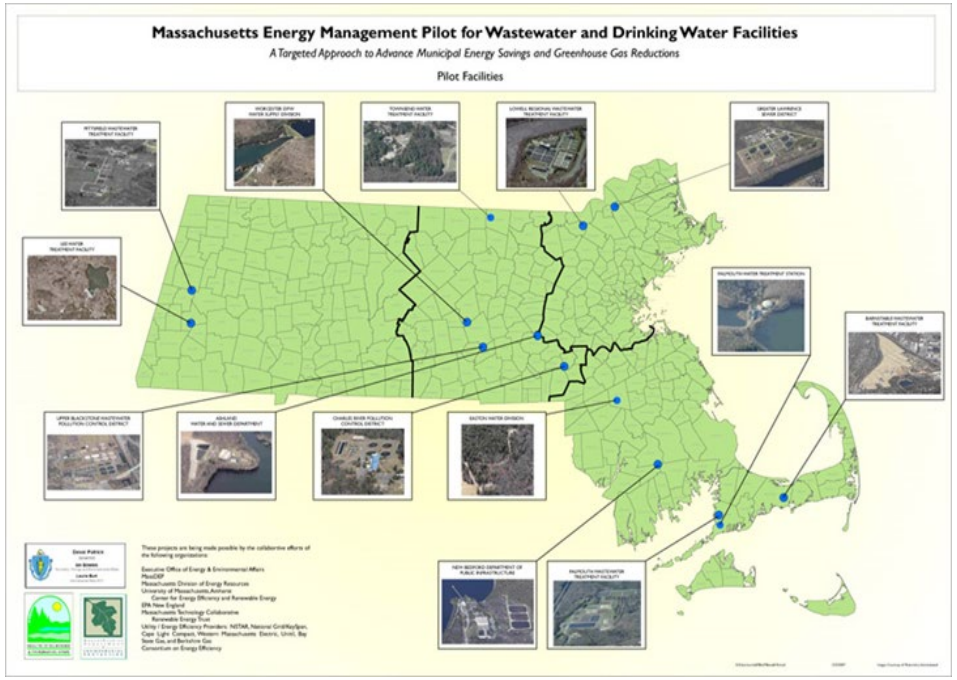
The Clean Energy Results Program strengthens the environment-energy connection by supporting MassDEP and DOER's efforts to reduce regulatory or other barriers to clean and energy-efficient development

CLEANENERGYRESULTS

- Utilizes MassDEP's unique expertise to overcome permitting & siting obstacles
  - e.g. Maximized solar development on landfills and brownfields
- Implements the Gap Energy Grant Program that provides cost-effective savings for communities and reduces harmful greenhouse gas emissions
- Creates and supports new forward-looking partnerships to produce results

Massachusetts' Gap Funding:

Building Partnerships through Energy Pilots (2007 – 2012)



- "No-cost" energy utility audits
- "No-cost" renewable energy assessments

Results: National
($1.2B ARRA for green infrastructure)

- Saving $5 million annually
- 10 megawatts of clean energy installed
- 23,000 tons of GHG emission reductions/year

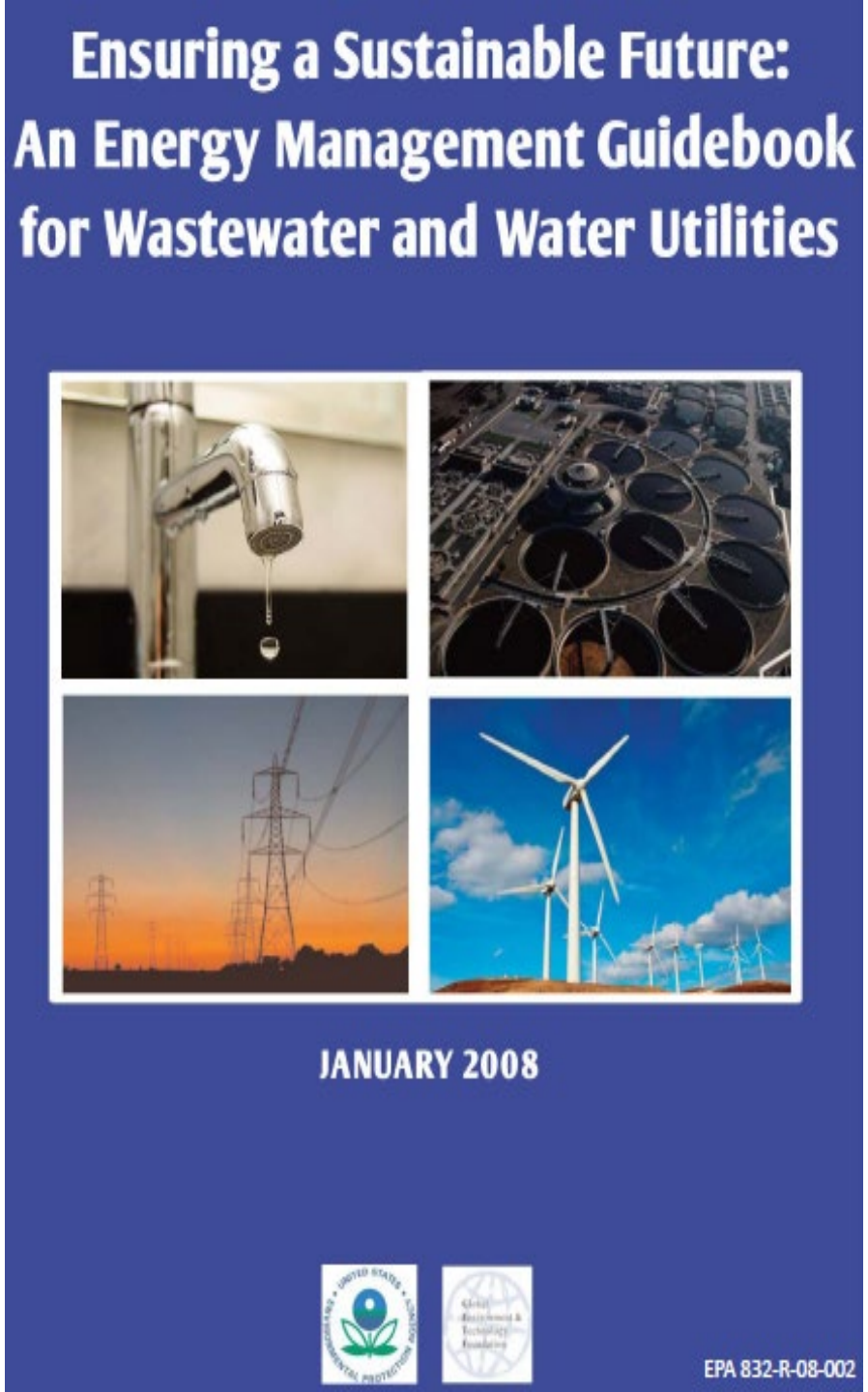
Energy Leader Roundtables (2008- 2014)

Coalition of state, federal, community, energy efficiency providers, consultants, and University of MA Lowell

17 Roundtable Meetings

Meeting Format:

- peer to peer learning
- a technical presentation
- discussion on energy management planning
- partner technical & financial assistance
- a facility site visit



Gap Energy Grant Program

- Provides grants (up to $200,000 / entity) for implementing energy efficiency and clean energy projects
- $5.7M in 2014 & 2018 (Gap I & Gap II)
  - awarded to drinking water & wastewater
- $8.1M in 2022 (Gap III)
  - awarded to 62 organizations
  - drinking water & wastewater and an expanded group that includes food pantries, affordable housing, and small farms

Gap Energy Grant Program

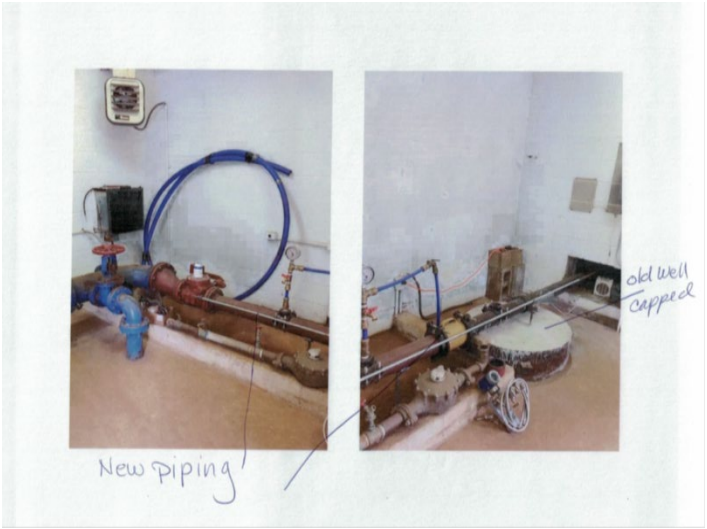
- Energy Efficiency
  - Variable speed drives, pump and motor replacements, HVAC, lighting
  - Process improvements (aeration, pumping optimization)
- Clean Energy
  - Solar, wind, in-line hydropower, battery storage, combined heat & power, geothermal
- Benefits
  - Save $ - reinvest energy savings back into your facility assets/infrastructure
  - Clean energy generation projects can improve a system's ability to withstand outages and resiliency

Utility Assessment Feeds into Gap Program

Town of Blackstone

Project: Decommission Well # 5 & install a new VFD-controlled submersible high-lift pump to well #5A

$0 Cost to Blackstone



Total Project Costs:		$56,000
Less: Gap II Grant Award:	$42,521	
National Grid Incentive:	$ 8,755	
Subtotal:		$51,276
Town of Blackstone (10% cost share amount):		**$ 4,724**

Annual Cost Savings: $6,259
- **6-month payback for Blackstone**

Annual Electricity Savings: 32,941 kWh
- **42% reduction in electricity usage**

Photos courtesy of James Sullivan, Superintendent – Town of Blackstone

Gap Energy Grant Program Projects

Ware Wastewater

6 new high-efficiency motors, VSD, and dissolved oxygen, pH, and temperature sensors – 5-month payback, reducing electricity usage by 41%.

Westfield Wastewater

Influent Pump Flows (GPM)			
Pump	Before	After	% Increase
1	3744	4006	7.0
2	3855	4000	3.8
3	3910	4042	3.4
4	2917	4048	38.8
Average	**3607**	**4024**	**13.2**

Pumping System Optimization rebuilt 4 influent pumps. A 5-month payback that produces a 24% reduction of electrical pumping usage, while increasing overall pumping efficiency by 13.2%.

Gap Energy Grant Program Projects

Bernardston Fire & Water District

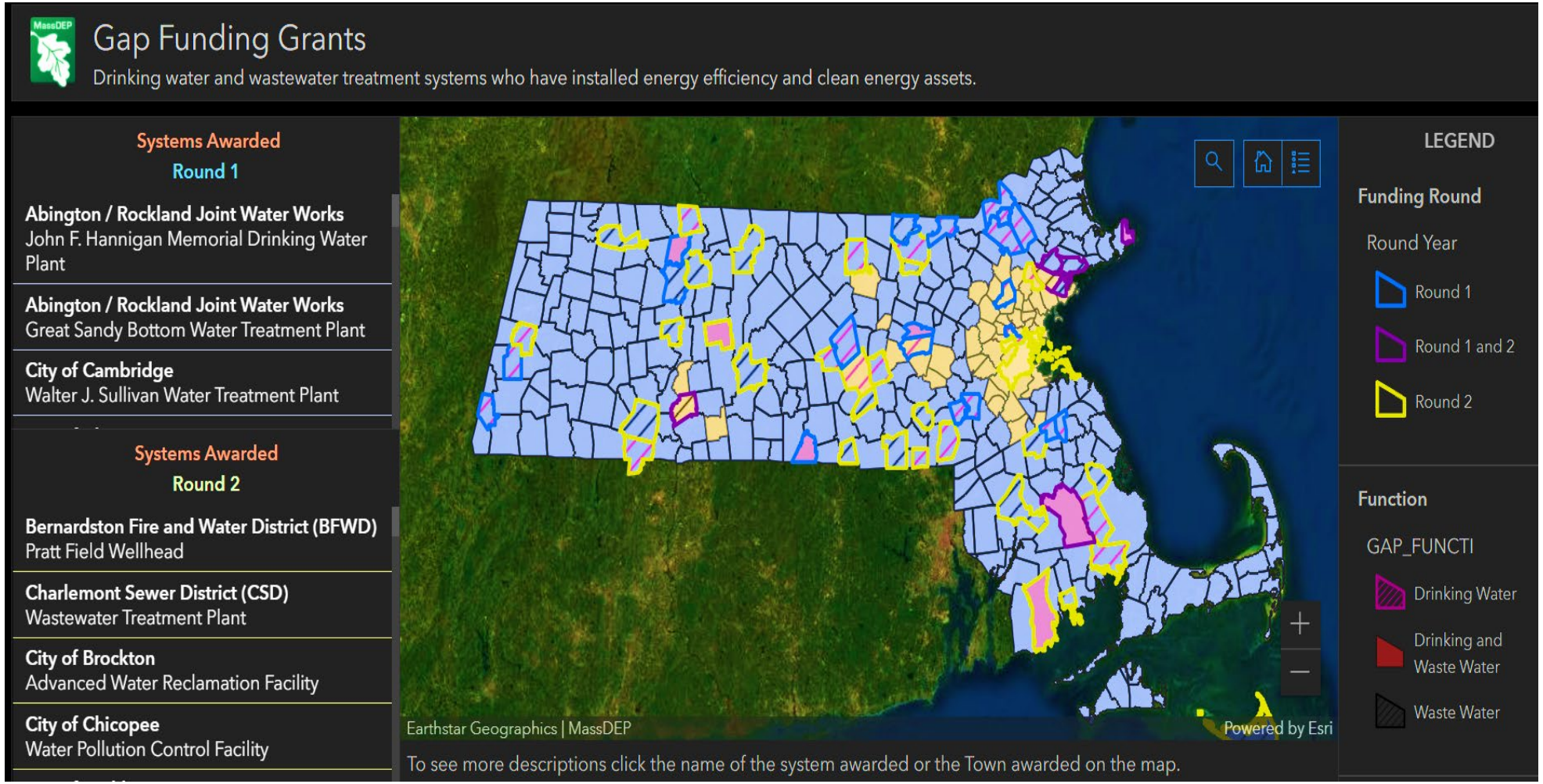
150 kW Solar Array – achieved Net-Zero Energy status and positive cash flow

Groton Drinking Water

Collaboration with DEP: Big Savings, Increased Capacity, Cleaner Water, *Groton Herald*

The town optimized and reconfigured how they pump water and postponed spending $2-$3 million for development of a new well for at least five years.

Story Map



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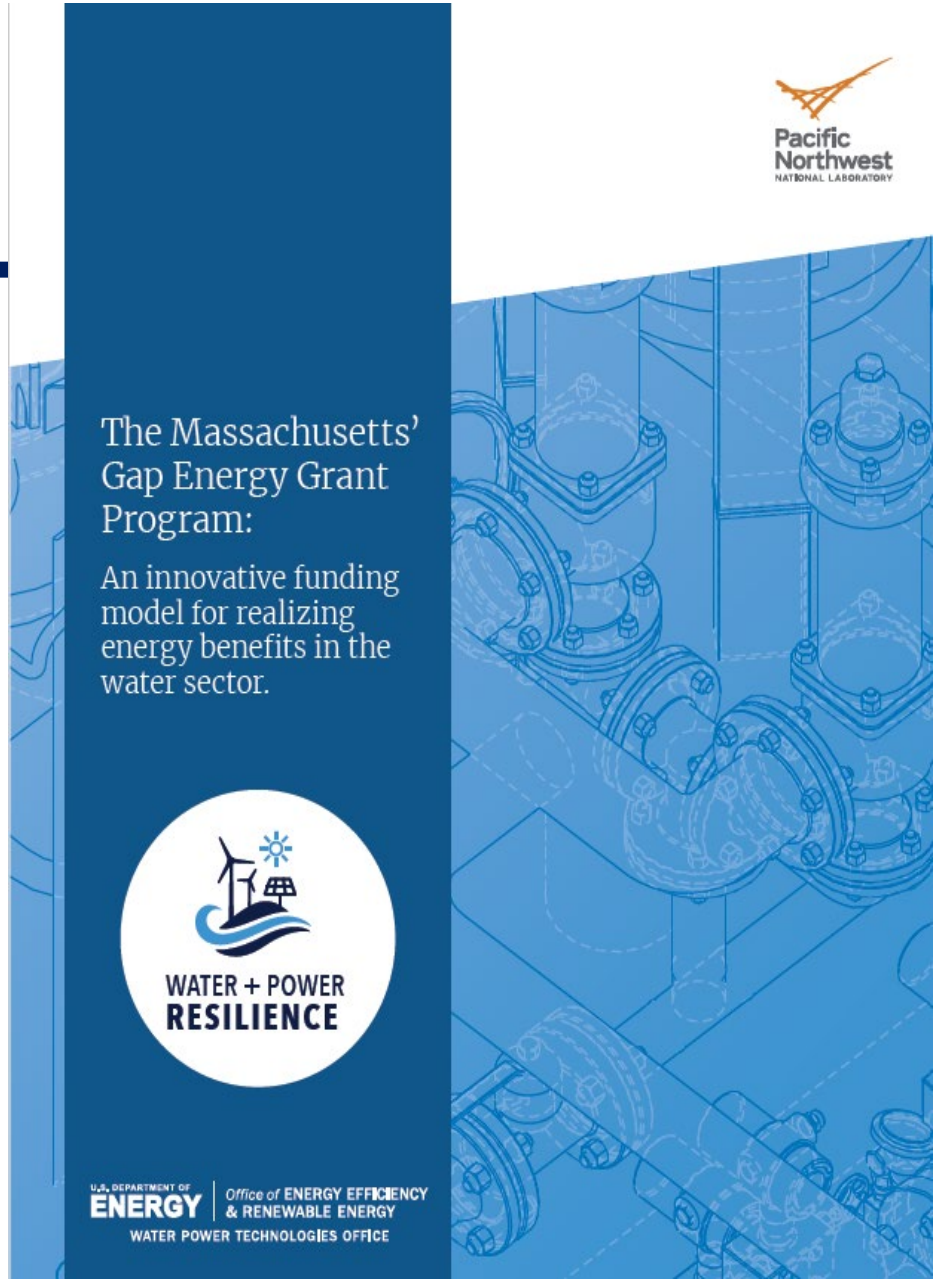
PNNL Analysis

Thank you!

Pacific Northwest National Laboratory

U.S. Department of Energy,
Water Power Technologies Office



PNNL Analysis
Economic Results

Gap Funding Yields Significant Benefits

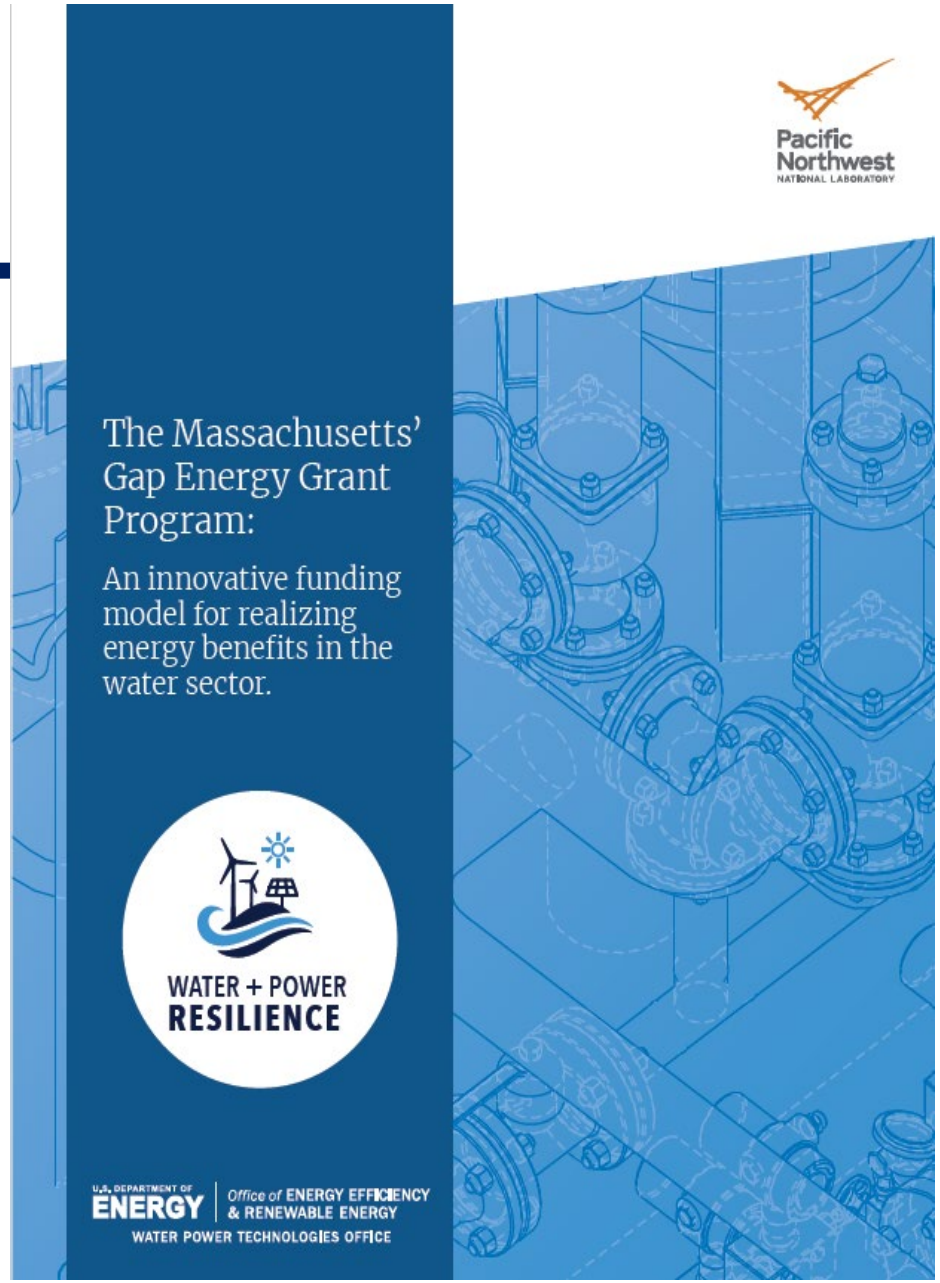
$8.5M INCENTIVE FUNDING

- **$5.7M** Gap Grants
- **$2.8M** Other funding

$75.2M TOTAL PROJECT BENEFITS

- **$66.7M** Avoided Electricity Cost — Electric Bill Savings to W and WW Utilities
- **$8.5M** Avoided Carbon Emission — Societal Value of Avoided CO2 Emissions

Other funding includes electricity utility incentives dollars and other state funds.
Savings represent the present value savings over the life of the projects.
Savings are shown in 2018 dollars.



PNNL Analysis

Energy / Environmental Results

Projected Benefits Over the Life of Projects (Gap I and II Only)

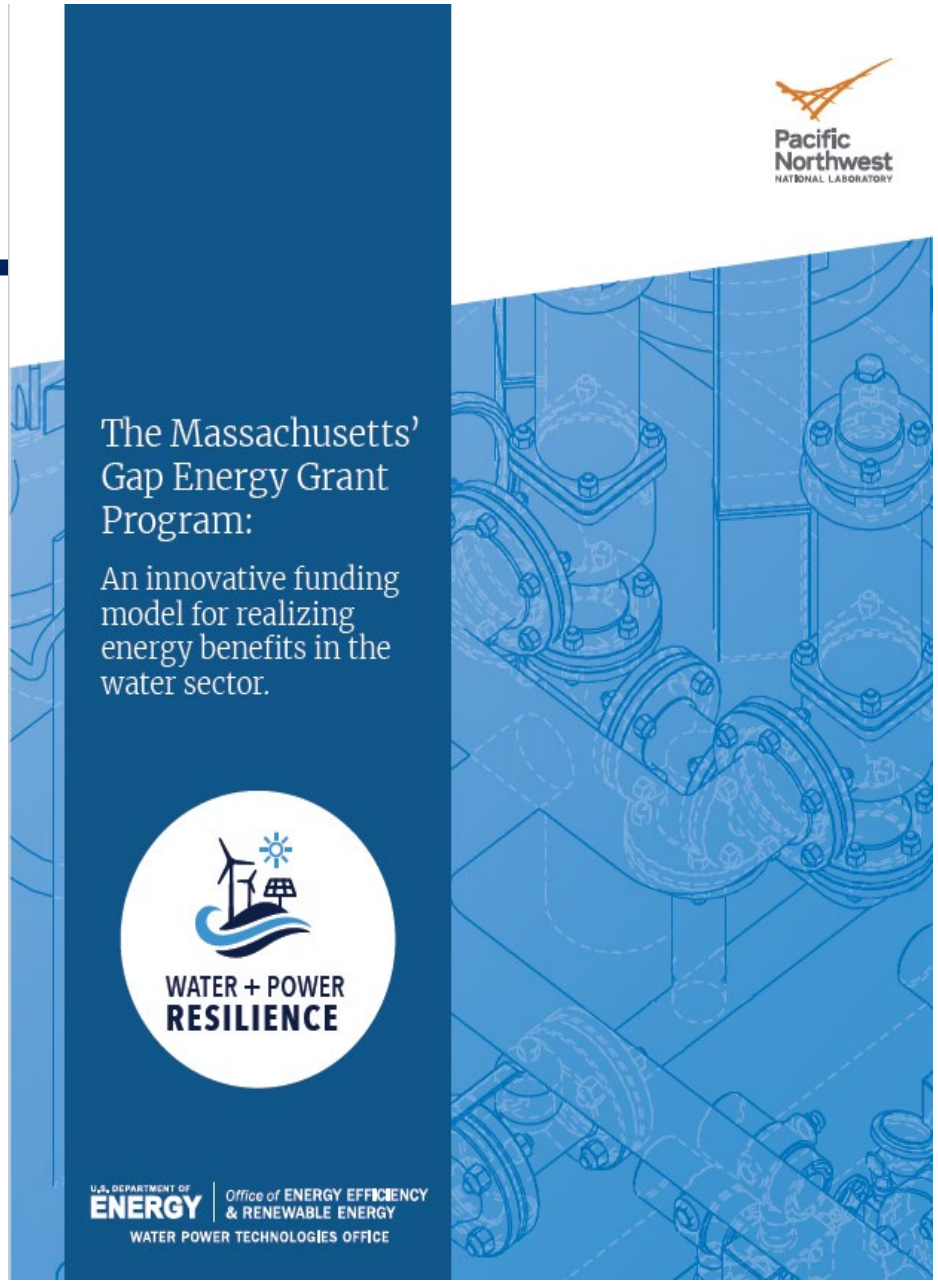
$66.7M
TOTAL ELECTRICITY COST SAVINGS

189,000 MWh
TOTAL ENERGY SAVED

252,000 MWh
TOTAL ENERGY GENERATED

441,000 MWh
TOTAL ENERGY SAVED/GENERATED

125,634 Metric Tons
TOTAL CO2 EMISSION REDUCTION



Tips For Success

- ✓ Building organizational trust between all partners is critical
- ✓ No-cost energy assessments for water utilities and other entities can jump-start good energy-saving projects
- ✓ Water and wastewater facilities are an outstanding investment for state energy efficiency Program Administrators
- ✓ Cost savings from energy projects will help mitigate utilities' rate increases to customers
- ✓ This approach resulted in a good 'Public Return-on-Investment'
- ✓ Continue to build off your small successes and experiences!

For Energy-Saving Assistance

Danah Tench, Director
Clean Energy and Climate Resiliency Programs
Danah.Tench@mass.gov 617.733.3398

Michael DiBara, Project Manager
Clean Energy Results Program
Michael.DiBara@mass.gov 508.767.2885

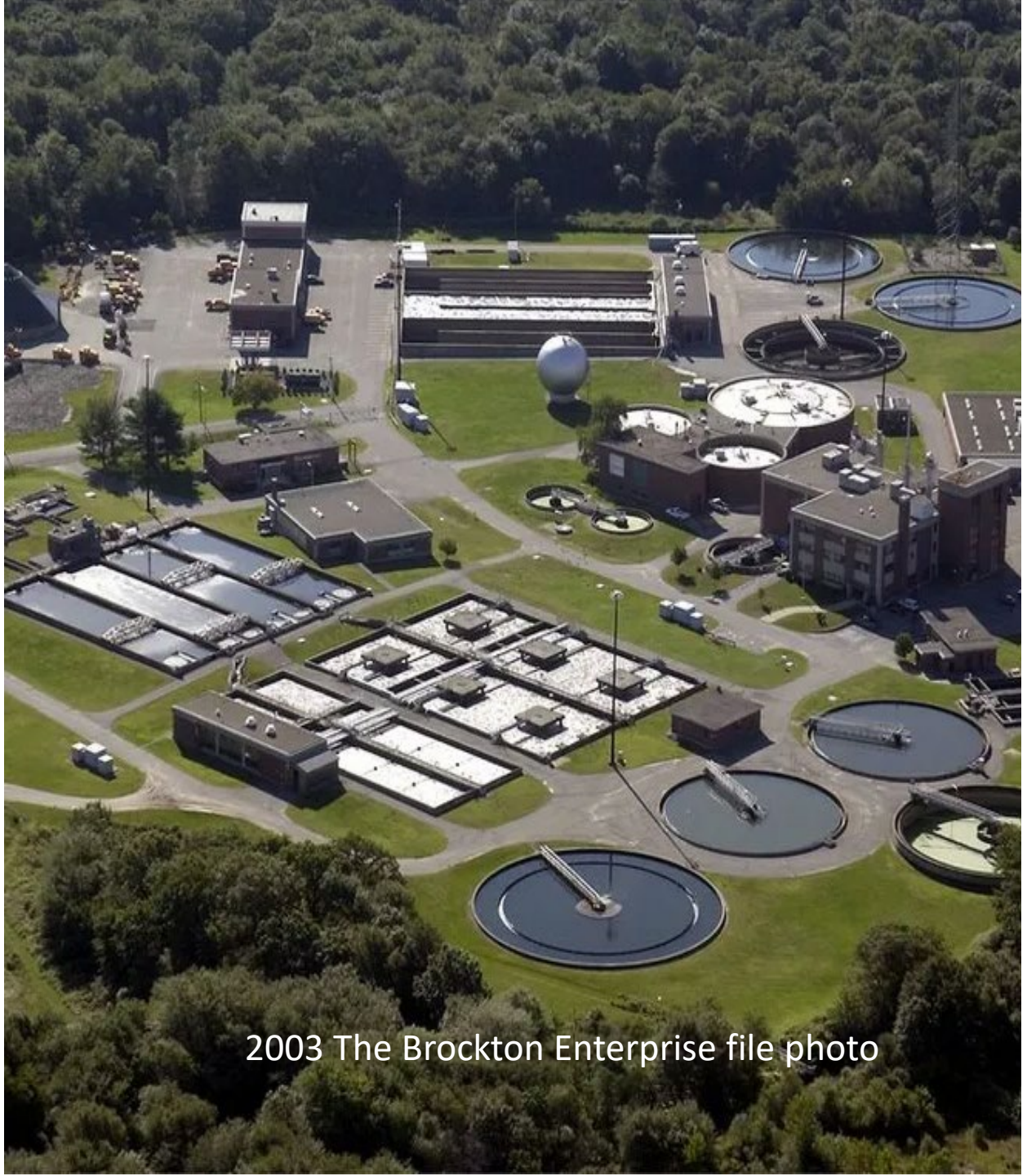
Clean Energy Results Program Website:
http://www.mass.gov/eea/agencies/massdep/climate-energy/energy/

Massachusetts' Gap Energy Grant Program:
https://www.mass.gov/info-details/massachusetts-gap-energy-grant-program

Advancing renewable energy & energy efficiency in the Commonwealth
CLEANENERGYRESULTS
www.mass.gov/dep/cerp

Advanced Water Reclamation Facility

- 20.5 MGD Design Capacity
- Serves City of Brockton and the towns of Abington and Whitman as well as Stonehill College in Easton
- Operated by Veolia, North America
- 320 miles of sewer mains
- 23,000 active sewer service accounts



Blower Upgrade Replacement Project

Brockton Massachusetts
Advanced Water Reclamation Facility

- Replace inefficient positive displacement blowers (#1-4) with turbo efficient blowers

<u>Phased Approach</u>

- 2018 - Blower #1
- 2019 - Blower #3 $200,000 Gap II Grant
- 2020 - Blowers #2, #4

Blower Upgrade Replacement Project

Brockton Massachusetts
Advanced Water Reclamation Facility

Blower #3

Total Project Costs:		$304,566
Less: Gap II Grant Award:	$200,000	
National Grid Incentive:	$ 35,137	
Subtotal:		$ 235,137
City of Brockton (cost share amount):		**$ 69,429**

Annual Savings **$ 40,994 (292,812 kWh)**

Results: 1.7 - year payback with increased oxygen transfer and treatment

Blower Upgrade Replacement Project

Brockton Massachusetts
Advanced Water Reclamation Facility

- The combination of MA Gap energy grant and National Grid incentive gave the city a great return-on-investment, making it an easier to justify blower #2,#4 upgrades.
- The grant was a great opportunity to build the Brockton's DPW visibility and credibility by showcasing this clean energy project.
- The grant is helping the City achieving their goal of reducing energy usage (and cost) for city-owned buildings.
- The grant program helped build /strength the relationship between City of Brockton and MassDEP.

Thank You

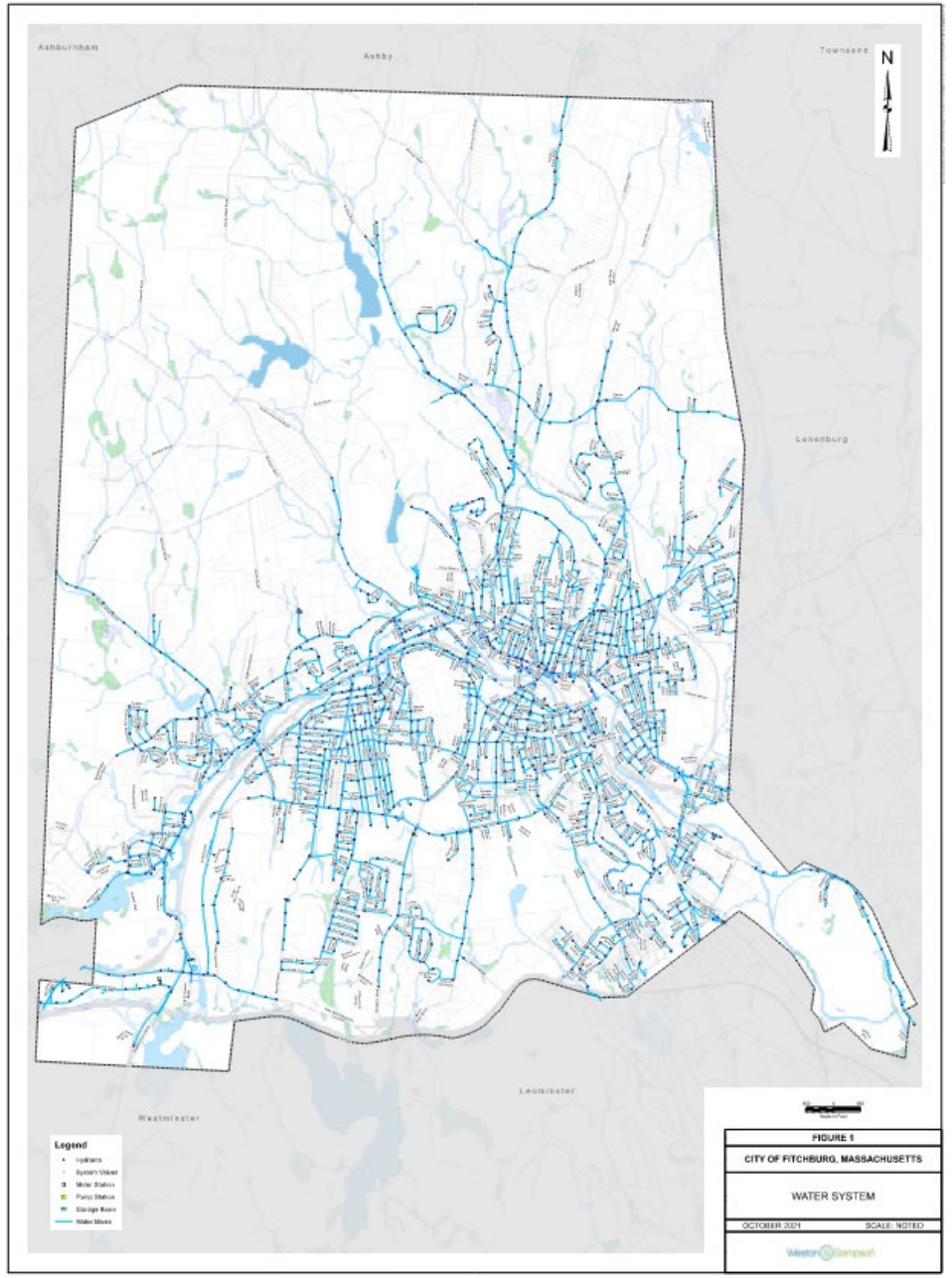
Patrick Hill, DPW Commissioner,
City of Brockton MA, phill@cobma.us, 508.580.7135

CITY OF FITCHBURG, MA
NARROWS ROAD FACILITY
HYDROGENERATOR

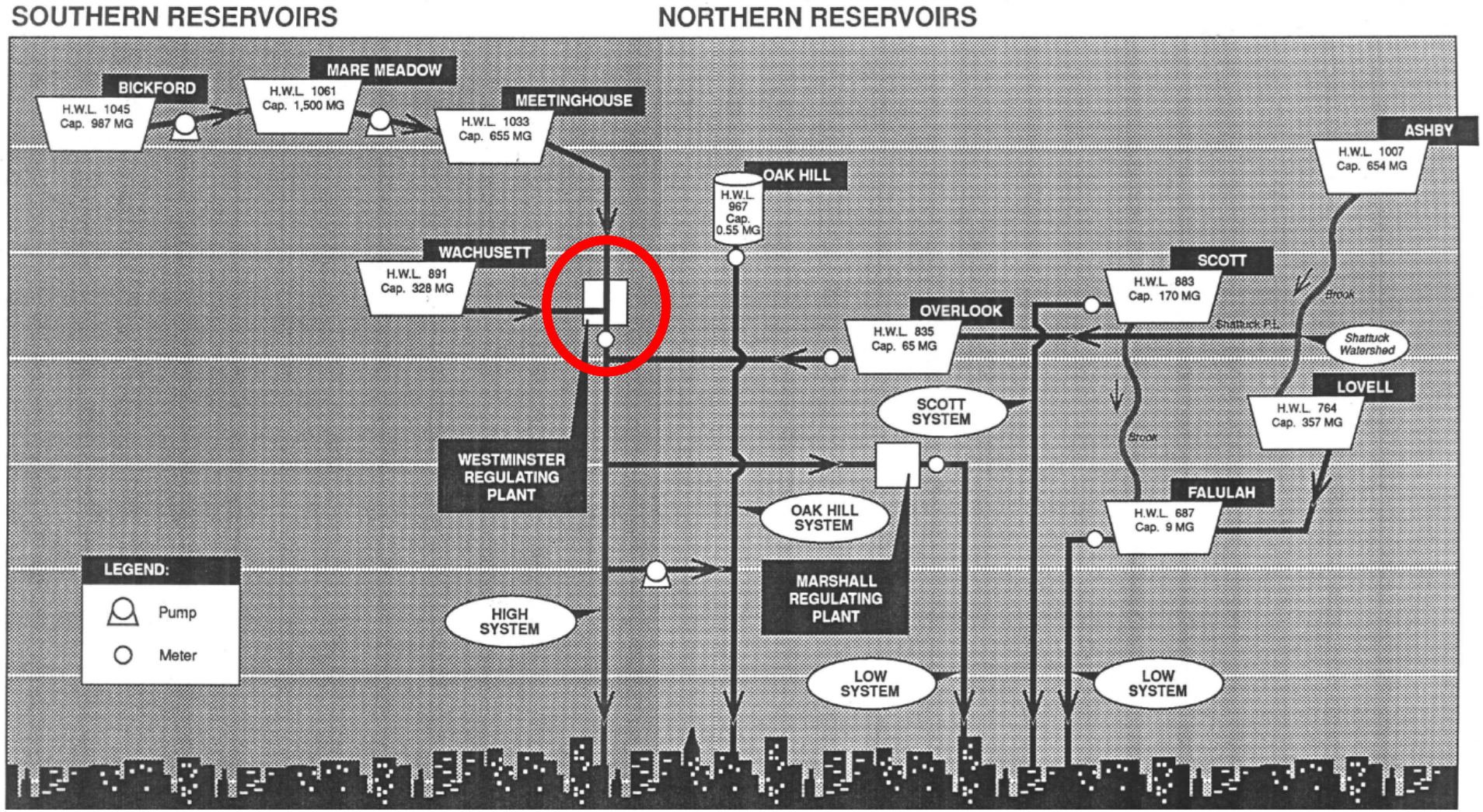
Presenter: Sam Kenney, P.E - Project Manager / Team Leader

Fitchburg Water System

- 7 Water supply reservoirs
- 7 Pump stations
- 2 Treatment plants
- 5 Storage tanks
- 190 miles of water main
- 4.7 MGD average day demand
- 40,600 customers



City of Fitchburg Water System (pre-SDWA)



Project Timeline

- 2011: Hey…what if?
- 2012: Initial report/hydropower investigation
- 2017: Second report/investigation
- 2019: Design & Public Bid
- 2020: Construction
- 2021: Unit Startup/Commissioning
- Late 2021 – Present: Beneficial Use

eral Project Info

Primary Objective: PAT Installation & Station Rehabilitation

Funding Partners: MassDEP,
Massachusetts Clean Energy Technology Center (MassCEC)

Total Construction Cost: $697,350

Grant Funding for the PAT:
MassDEP / Gap II - $200,000.00
MassCEC - $78,000.00

Outside Funding

MassDEP GAP II

Grant Award: $200,000

MassCEC

Grant Award: $78,357

Total: $278,357

Who's PAT?

- **P**ump **a**s **T**urbine or pump in reverse
- Converts kinetic energy (pressure) into mechanical energy

Why Here & Why Now?

Previous Process Piping

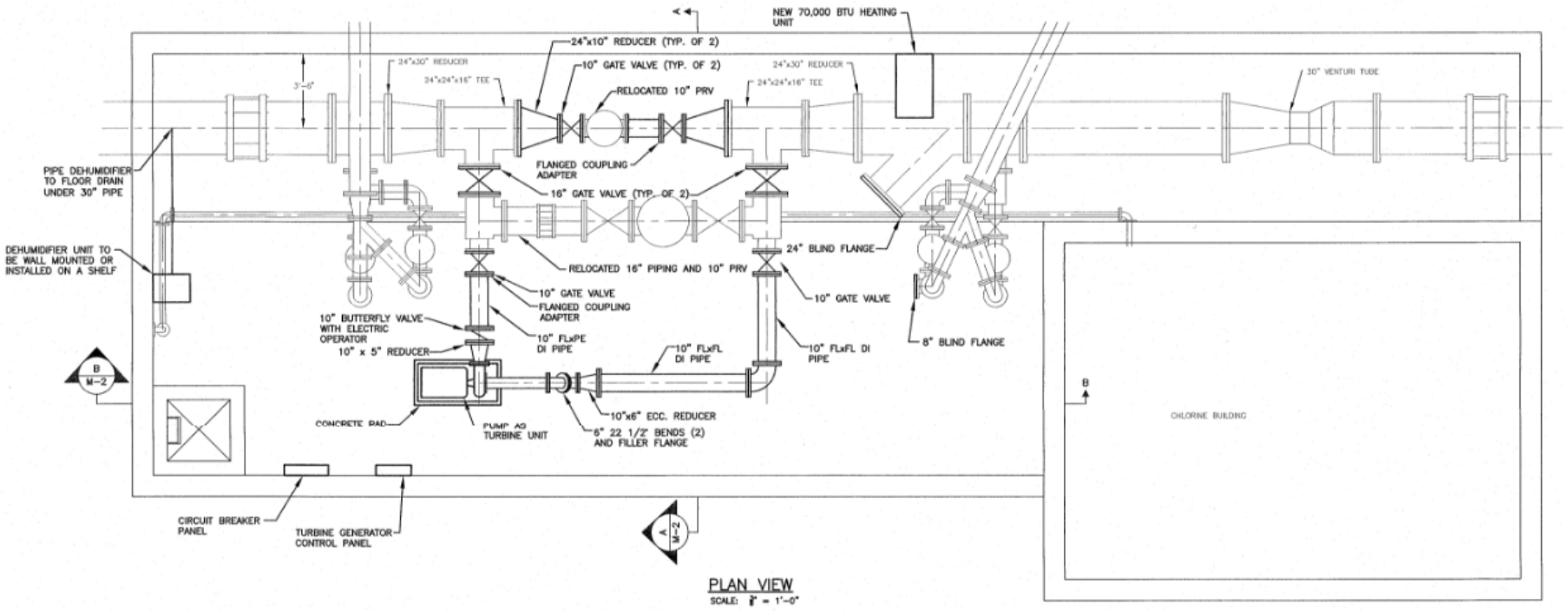
Facility reduces water pressure between the Regional WTP and the distribution system (gravity flow)

By 2020, the Facility was outdated and needed upgrades

Existing 24” pressure reducing valve (PRV) was no longer necessary due to decreased system demand

Opportunity to utilize pump as turbine (PAT) unit for energy creation

Narrows Station Layout & Concept



Financial Considerations

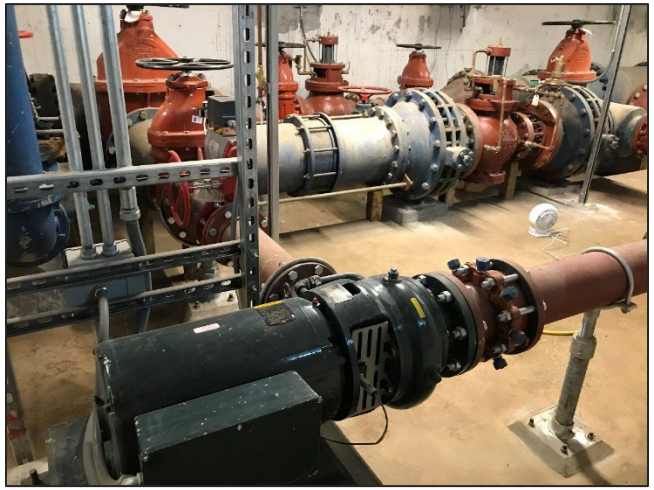
- Payback Period vs. Capital Expenditure
- Nameplate Capacity of Unit vs. Estimated Energy Generation
- (Bigger not always better!)

Table 1 – PAT Options Considered

Net Flow (CFS)	Design Head (FT.)	Nameplate Capacity (kW)	Turbine Cost	Estimated Annual Generation (kWh)
1.62	100	10	$61,685	65,297
3.00	100	18	$72,500	57,214
3.40	100	22	$78,000	54,436

Project Completion

New PAT Unit & Local Control Panel



Final Piping Layout Including PRVs & Hydroturbine Unit

March 2021 – Unit Online!

thank you

westonandsampson.com

Samuel Kenney, Project Manager, kenneys@wseinc.com

John Deline, Deputy Commissioner of Water Supply, jdeline@fitchburgma.gov

Questions/Comments?