Town Of Truro – Transfer Station

Climate Leader Communities

Decarbonization Roadmap Report

5 Town Dump Rd, Truro MA

Prepared on November 4th, 2024

Hossam Mahmoud & Julian Joffe
HMahmoud@theRISEgroupinc.com; JJoffe@theRISEgroupinc.com

Contents

Contacts

Facility / Project Location			
Truro Transfer Station 5 Town Dump Rd Truro, Massachusetts 02666			
Program Administrator Representative(s)			
Laura Selmer	Energy Efficiency Analyst	Cape Light Compact	(508) 375-6644 Laura.Selmer@Capelightcompact.org
RISE Engineering			
Hossam Mahmoud	Senior Energy Engineer	RISE	(774) 994-7269 HMahmoud@theRISEgroupinc.com
Julian Joffe	Senior Energy Engineer	RISE	(401) 230-7464 JJoffe@theRISEgroupinc.com
Site Contact(s)			
Jarrod Cabral	Director – Dept. Of Public Works	Town of Truro	(508) 214-0400 jcabral@truro-ma.gov

Executive Summary

Overview

Cape Light Compact has retained RISE to evaluate the energy consumption and a potential decarbonization pathway that includes standard efficiency, load reduction, and electrification measures for multiple buildings owned and operated by the Town of Truro, MA. The intent of this review is to summarize and benchmark the site's existing energy consumption with respect to the policies set forth by the Massachusetts Department of Energy Resources (DOER) and to create a Municipal Decarbonization Roadmap to meet 2030 and 2050 net-zero goals. These measures will help offset the site's reliance on fossil fuels, improve efficiency levels, and move toward the town's overall decarbonization goals. All costs, savings, and incentives[1] are representative of findings observed on site.

The efficiency measures listed within this report as energy conservation measures (ECMs) will decrease the site's energy consumption and support the decarbonization pathway. Further measures such as load reduction, renewables, and electrification, will also support the reduction of on-site fossil fuels and grid-based energy consumption. Incentives and tax credits may be available to help defer the cost of implementation. These tax credits and incentives are subject to change based on programs sponsored by the government, the utilities, or other parties involved in determining eligibility. The energy savings and project costs presented below are based on preliminary data and are subject to change pending confirmation of existing conditions and formal proposals being developed for the identified energy efficiency measures. The building management team is interested in pursuing electrification measures to reduce emissions and operating costs while maintaining or increasing occupant comfort within the space(s).

This report details potential decarbonization measures found at the Transfer Station in Truro, Massachusetts.

Summary of Findings

Year	EUI (kBtu/sf/yr)	CEI (MTCO2e/sf/yr)
2022	241.1	0.0001
Current (2023 Usage)	210.4	-
2030 Target	180.8	0.00034
2030 Projected	141.4	0.00000

Table 1: EUI & CEI Summary (Target Values Based on a 25% EUI and 35% CEI Reduction from 2022 Consumption Values)

[1] Further site review may be necessary to develop final incentive approval.

Measure Type	Estimated Electric Savings (kWh)	Estimate Propane Savings (Gallons)	Savings ($)	Incentive ($)	Net Cost ($)
LED Lighting	1,780	-	$392	-	$730
Air Sealing	61	-	$13	-	$100
Solar	11,079	-	$2,437	$7,902	$18,438
TOTAL:	**12,920**	**-**	**$2,842**	**$7,902**	**$19,268**

Table 2: Measures, Savings, and Cost Summary

Cost Savings are based on the estimated cost $0.22/kWh for electricity and $3.50/Gallon for propane.

Efficiency Measures	Load Reduction Measures	Electrification Measures	Renewables

Facility Overview

General Facility Information

Building Use

The Truro Transfer Station building was constructed in 2006. Based on the site assessment performed, there have not been any significant upgrades made to the facility. The core use of this building is used as a small office and control space to manage and operate the transfer station activities. The space is comprised of one main space with a single restroom. There are usually only two or three people working within the space. The occupancy profile of this facility changes seasonally such that the typical hours of use of this facility are as follows:

In Season Hours: May 1st – October 31st, M-F, 7:30AM-3:30PM

Off Season Hours: November 1st – April 30th, Mondays/Tuesdays/Fridays, 7:30AM-3:30PM

Gross Floor Area

Below is a summary of the building areas which notes the size of each floor and size of the space occupied:

Area Description	Floor Area
Full Building	446 Square Feet
1st Floor	446 Square Feet

Table 3: Floor Area & Square Footage

Building Overview

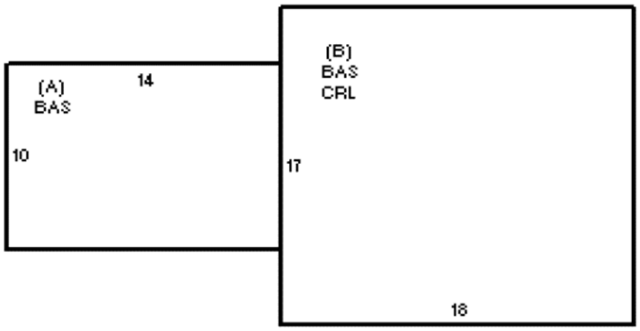
Year of Construction: 2006

Number of Stories: 1

Structure Material: Wood Frame

Building Type: Residential Style Office

Conditioned Floor Area: 446 sq. ft.



General Conditions of Facility

This facility is in good condition and operates sufficiently for the type of occupancy. There have not been any significant upgrades to the structure although some upgrades have been implemented which include a mini-split heat pump, a few LEDs, and new doors. There is a mix of LEDs and fluorescent lighting that should be completely converted to LED. The roof is shingled and in good condition. The foundation is concrete and there is a crawlspace between the main space and the foundation. The crawlspace has blown spray foam insulation on the walls and some fiberglass insulation below the 1st floor which is not continuous and does not create a sufficient thermal barrier. The flooring is hardwood and tile. Based on the age of construction and the insulation seen on-site, there is a sufficient thermal barrier from the walls to the ceiling and the floor. Exterior door weatherstripping is in good condition but can is starting the wear in some places. There are no renewables on-site. There is a propane tank that was identified on site but there are no propane fired systems operating. There are large pieces of equipment used for trash compacting and although this consumption is not quantified it is expected that this equipment is responsible for the majority of the site's electrical consumption.

System	Condition	Approximate Age	Useful Life (years)	Remaining Life (years)
HVAC	Okay	4	18	14
DHW	Good	2	13	11
Windows	Okay	<10	20	10+
Envelope	Good	18	-	-
Lighting Systems	Okay	18	10	0
Renewable Energy Systems	N/A	-	-	-

Table 4: Facility and System Conditions

Site Summary

The Truro Transfer Station building was built in 2006 and serves the Truro community with waste management services. The site relies on electricity operate. Although the site does not consume propane making further displacement of on-site carbon-based fuels an impossibility, the site still has opportunity to reduce its overall electric usage to work toward Climate Leaders energy reduction goals.

System	Description
Building Enclosure	Insulated walls (expected to be R-13 fiberglass batt) and known to have new spray foam ceiling insulation in the ceiling and walls of the crawlspace. There is no continuous insulation between the crawlspace and the 1st floor. Double-paned, Low-E windows are in good condition and have plenty of useful life remaining. One of the two exterior doors are new, and the weather stripping is generally in good condition. Shingles on the roof appear to be in good condition.

Electrical Infrastructure	There is one 150A main breaker in the main electrical panel provided with 480V service. There is a step-down transformer serving a 120V panel within the building for lighting, plug loads, electric baseboard heat, and the water heater. This panel is served directly from the meter which is located on a post just a short distance away from the building.
Carbon-Based Fuel Sources	There is one propane tank on-site next to the building but there is no propane fired equipment for either hot water, HVAC, or processes.
Lighting Systems	All but one of the lighting fixtures inside the building utilize fluorescent and incandescent lamps. Although the fixture bodies are in good condition, the 2-lamp fluorescent surface wrap fixtures and screw in incandescent lamps should be converted to LED. The crawl space has A19 incandescent lamps. There is just (1) metal halide wall pack and (2) 2-lamp screw in flood lights that should also be converted to LED.
HVAC	This building does not have any forced air systems and relies on a mix of electric baseboard heating and a mini-split heat pump capable of providing 12,000 Btu/h of heating and cooling. There is an in-wall window AC unit that is no longer used but still exists. This should be removed from the wall and the wall should be sealed to avoid air infiltration and heating/cooling losses.
Domestic Hot Water	The domestic hot water load is provided by (1) 19-gallon, 2-year-old electric water heater located in the restroom. Based on the occupancy and DHW load which is for hand washing only, this heater may be over-sized and can be replaced with a point of use instant hot water heater.
Building Controls	There are no advanced controls at this building. The ductless mini-split has its own remote controller and the electric baseboard operates off of a standard dial thermostat.
Process Loads	Large trash compactors are operated at this facility and are expected to be a significant portion of the site's energy use.
Renewable Energy Systems	This site does not have any existing renewable energy systems. An initial review of the site yielded that although there is no ideal roof space free of shading, there may be opportunities to add a carport solar system or add solar to the adjacent building known as the "swap shack".

Table 5: Description of Systems

Energy Use Overview

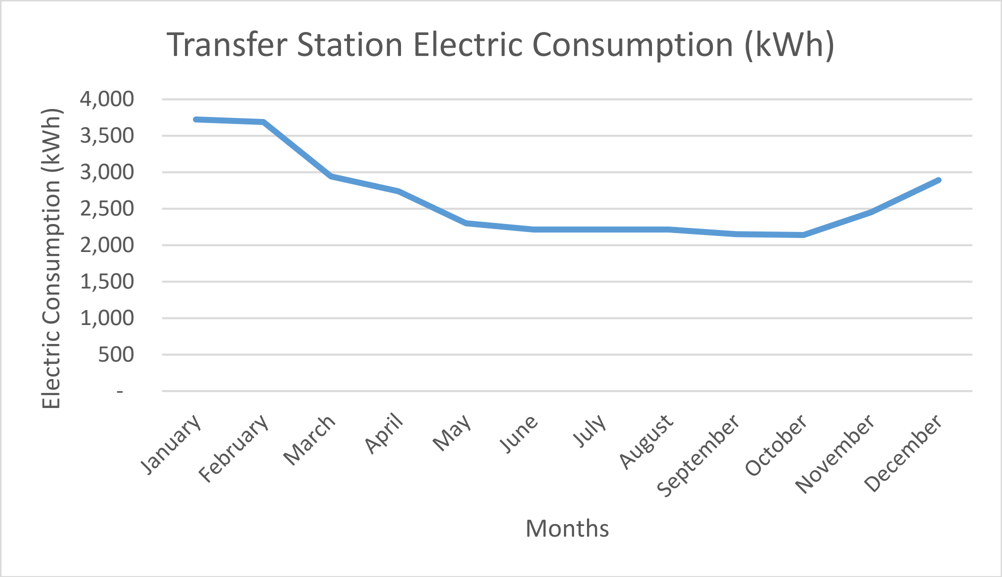
Electricity Consumption

The site has one electric account, Acct# 13834900014, that serves the building. There is one electric meter (Meter# 5089774) feeding the 150A, 480/277V main electrical panel. There are other meters next to the property which meter cell phone tower consumption and the Swap Shack. The usage listed and normalized for 2022 in the below table only accounts for meter# 5089774.

Normalized Electric Usage

Month	2022 Electricity Consumption (kWh)	2023 Electricity Consumption (kWh)	Normalized Electricity Consumption (kWh)
January	3,780	2,916	3,724
February	3,595	3,020	3,689
March	2,837	2,509	2,943
April	2,633	2,238	2,738
May	2,290	1,971	2,299
June	2,235	2,040	2,215
July	2,261	2,140	2,215
August	2,304	2,274	2,215
September	2,152	2,064	2,152
October	2,140	1,867	2,140
November	2,394	2,134	2,451
December	2,783	2,323	2,893
Totals:	**31,404**	**27,496**	**31,675**

Table 6: Electricity Usage (2022 Usage, 2023 Usage, & Weather Normalized to Represent an Average Year)



Deliverable Fuel Consumption (Propane)

Based on provided MEI data for the reported propane usage of this facility, there were only (4) gallons of propane recorded in 2022. There is no reported usage for 2023. Although benchmarking the delivered propane for the Climate Leaders program will compare 2022 usage to 2030 and 2050 target reduction values, it is assumed that this site no longer utilizes any propane. There is no propane consuming equipment noted on site.

Energy Usage & Carbon Emissions Benchmarking

Energy Usage Intensity (EUI)

Energy Usage Intensity measures how much energy a facility uses with respect to its size. Based on the noted square footage and the available utility consumption data, the Truro Transfer stations had an EUI of approximately 241.1 kBtu/Sqft/yr in 2022 which is not typical for buildings of this size. This is above the national median reference value of 40.1 kBtu/Sqft/yr reported for “Other – Public Services” by Energy Star Portfolio Manager Data. Due to the heavy machinery on-site used for waste management, which is the core purpose of this facility, the EUI is expected to be significantly beyond the reference value.

Based on the recorded usage data for electricity and the size of the structure, it is not likely that any kind of efficiency measures will provide enough savings and consumption reduction to meet the required EUI reduction requirements in the upcoming benchmark years. It is estimated that the site must reduce its usage by 8,000kWh of grid provided energy to reach the goal. It is recommended that the site develops a plan to implement solar PV or some form of a renewable energy generation system.

https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf

Carbon Emissions Index (CEI)

Benchmarking the carbon emissions of any facility begins with identifying the quantity and types of the fuels used to operate a facility. Organizations such as local, state, and federal governments continue to implement regulatory compliance policies requiring carbon emissions of buildings to be calculated and benchmarked against ordinance defined emission limits.

For Climate Leader Communities in the state of Massachusetts, the carbon emissions index is a measure of Metric Tons (MT) of CO2e/sf/yr which accounts for the different carbon emissions values of each unit of fuel type considered. Based on the noted square footage of the facility and the quantities used of each fuel type, this facility has a CEI of 0.0001 MTCO2e/sf/yr. The only on-site fossil fuel use reported at this site was (4) gallons of propane which explains the low CEI value. As of 2023, no usage was reported and so it is expected that the current CEI is now 0.0 MTCO2e/sf/yr which is compliant with the required reduction by the 2030 benchmark year.

EUI & CEI Benchmarking

The Climate Leader Communities program in Massachusetts requires the use of a greenhouse gas emission baseline in Metric Tons of CO2. This report utilizes DOER's MassEnergyInsight (MEI) data provided by Cape Light Compact. As noted in the table below, the decarbonization road map required by Climate Leaders lists that both emissions from onsite fossil fuels in buildings and the energy usage intensity must be reduced by the noted percentages in the noted years.

Suggested Emission Reduction Timeline

Targets	2027	2030	2040	2050
Reduce emissions from onsite fossil fuels in buildings	-20%	-35%	-60%	-100%
Zero emission vehicles (ZEVs) in light-duty fleet adoption	5%	20%	75%	100%
Zero emission vehicles (ZEVs) in medium-/heavy-duty fleet adoption	0%	20%	50%	100%
Energy Use Intensity reduction *(deep energy retrofits/retro commissioning)*	-20%	-25%	-25%	-30%
Total Emissions Reduction Goals (% of 2022 emissions)	**>15%**	**>35%**	**>65%**	**>95%**

https://www.mass.gov/doc/climate-leader-communities-municipal-decarbonization-roadmap/download#:~:text=The%202021%20Climate%20Law%2C%20statewide,reduction%20by%20calendar%20year%202030.

Transfer Station - EUI				
Year	**Electricity Usage (kWh)**	**Propane Usage (Gal)**	**EUI (kBtu/sf/yr)**	**2030 EUI Compliance**
2022	31,404	4	241.1	-
2023	27,496	-	210.4	-
2030 (Projected)	18,484	-	141.4	Compliant

Table 7: EUI Benchmarking

Transfer Station - CEI					
	Propane CO2e (MT/yr)	**Total CO2e (MT/yr)**	**CEI (MT/sf/yr)**	**2030 CEI Target - 35% Reduction (MT/sf/yr)**	**Compliance**
2022	0.02	0.02	0.0001	0.000034	-
2023	-	-	-		-
2030 (Projected)	-	-	-		Compliant

Table 8: CEI Benchmarking (2030 Projected Emissions are Based on the Implementation of the Proposed Measures)

Decarbonization Overview

The process of decarbonizing a building involves implementing measures to reduce or eliminate carbon dioxide (CO2) emissions associated with its operation. The goal is to make buildings more energy-efficient, use cleaner energy sources, and overall contribute to a lower carbon footprint. Here are key strategies for decarbonizing a building which includes Energy Efficiency (Foundational), Load Reduction, and Electrification measures.

The start to the decarbonization process takes a whole building approach similar to the energy efficiency process; the site is subject to an energy audit. Opportunities to upgrade the building envelope are identified and implemented. Here, envelope insulation and fenestration deficiencies are rectified to reduce heating and cooling loads. At this point, the site considers installing energy efficient equipment including but not limited to lighting, HVAC systems, appliances and any equipment specific to building use. The transition from fossil fuel-based heating systems to electric heat pumps for space heating and cooling needs to be considered at this part of the process. In concert, smart building technologies like controls based on occupancy or other parameters can be implemented to further reduce energy load.

Installing on-site renewable energy systems such as solar panels or wind turbines to generate clean, renewable electricity needs to be a part of the plan with the goals of electrification and decarbonization in mind. When the site’s electric loads are reduced through energy efficiency and optimization, renewable energy systems like solar panels can be properly sized. Energy storage solutions to store excess energy generated by renewable sources, such as batteries, are part and parcel and will improve overall energy resilience.

Decarbonizing a building requires a holistic approach that considers both operational and embodied carbon, as well as the entire lifecycle of the structure. It often involves a combination of technological innovations, design considerations, and policy support to achieve meaningful reductions in carbon emissions.

Proposed Measures

Type	Measure Description	Implementation Difficulty	Cost Implication ($/$$/$$$)
Efficiency Measure 1	LED Lighting	Low	$
Load Reduction Measure 1	Air Sealing – Window AC	Low	$
Renewable Energy Generation	Solar PV	High	$$$

Table 9: Proposed Emissions Reduction Measures

Efficiency Measures	Load Reduction Measures	Electrification Measures	Renewables

Efficiency & Load Reduction Measures:

The noted efficiency and load reduction strategies shown in the table above provide an overview of measures that can be explored to immediately reduce the facility's consumption. Both measures are typically easy measures to implement. Implementing the load reduction strategy will reduce the consumption required to operate the HVAC system by reducing envelope losses. The only identified efficiency measure from the on-site assessment is to upgrade all light fixtures (interior and exterior) to LED. The only load reduction measure is to remove the un-used in-wall window AC unit to reduce air infiltration.

LED Lighting:

It is recommended to convert the remaining fluorescent lighting equipment to LED. This conversion will allow the facility to provide the same lighting layout and reach the desired illumination levels while consuming about a third less energy than typical fluorescent system. Although not quantified in this report, due to the lifespan of LEDs and versus other lighting technologies, an additional benefit included reduced maintenance and operational costs related to changing lamps and ballasts. There are a few fluorescents, incandescent and metal halide (HID) fixtures that should be upgraded.

Incentives: No available incentives (at this time) as Mass Save lighting program to undergo significant changes in 2025).

Electrification Measures:

This site already utilizes a ductless mini-split heat pump for heating and cooling. Based on the site visit and assessment performed, there are no opportunities to further electrify the site.

Renewables

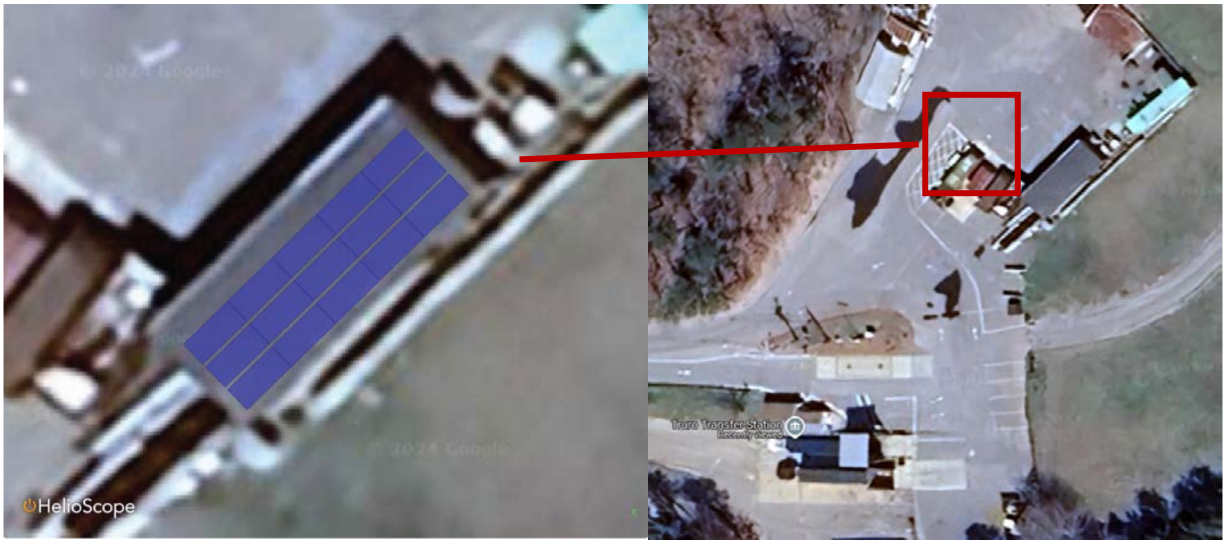
Solar Photovoltaic (PV) Array

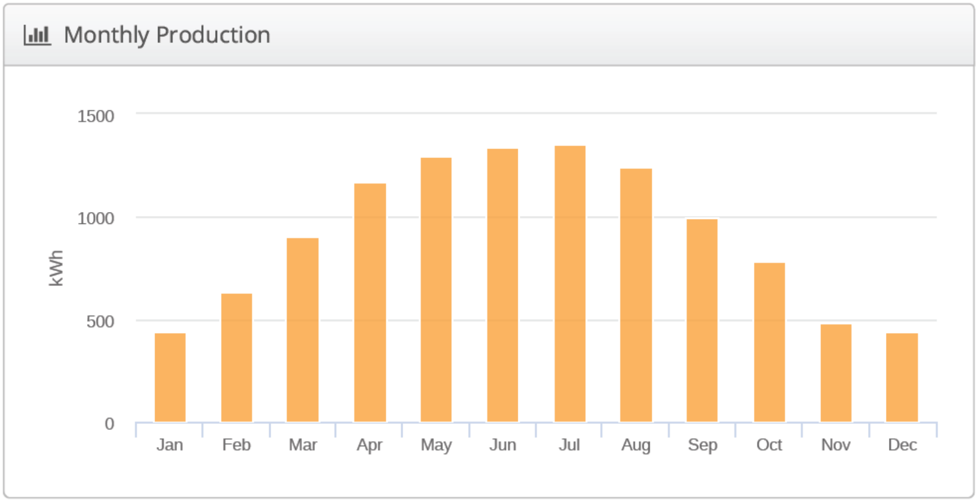
Solar Photovoltaic (PV) systems harness sunlight to generate electricity, where semiconductor materials convert sunlight into direct current (DC) electricity. These systems consist of solar panels made up of interconnected solar cells, inverters to convert DC electricity into usable alternating current (AC), mounting structures, and often include energy storage solutions such as batteries for storing excess energy. Ideally in the northern hemisphere, solar panels are south facing to receive the most direct sunlight.

The main structure's roof has a south-facing sloped roof but will be shaded by trees in the afternoon hours. Solar PV modules in the north-east United States are most effective and receive the most solar irradiance when facing south-west leading to a high performance ratio seen in the solar simulation performed for this site. In this case, a solar PV array would not have sufficient irradiance to be effective on this structure. However, a carport solar PV structure could be implemented if the proper space is identified on the property. Furthermore, the site has noted that they have plans to implement solar in the field behind the paved area. Additional solar modeling was performed on the roof of the storage structure adjacent to the main Transfer Station building. This storage building does not have any electric service but is expected to have the structural integrity needed to support a solar PV system, per conversations with facility staff. Before solar is added to this building, a structural analysis should be performed. The modeling and the solar design details provided below describe a system that would provide enough energy production to reduce the site's EUI to the target values.

PV System Summary	
Module DC Nameplate	8.78 kW
Total Estimated Annual Production	11,079 kWh
Performance Ratio	84.2%
Total Estimated Cost (Est. $3/Watt Installed)	$26,340
Total Tax Credits (Est. 30% Credit, 179d)	$7,902
Total Cost Savings (Est. $0.22/kWh)	$2,437
Payback (After Tax Credits)	7.6 years

Table 10: Proposed PV System Summary





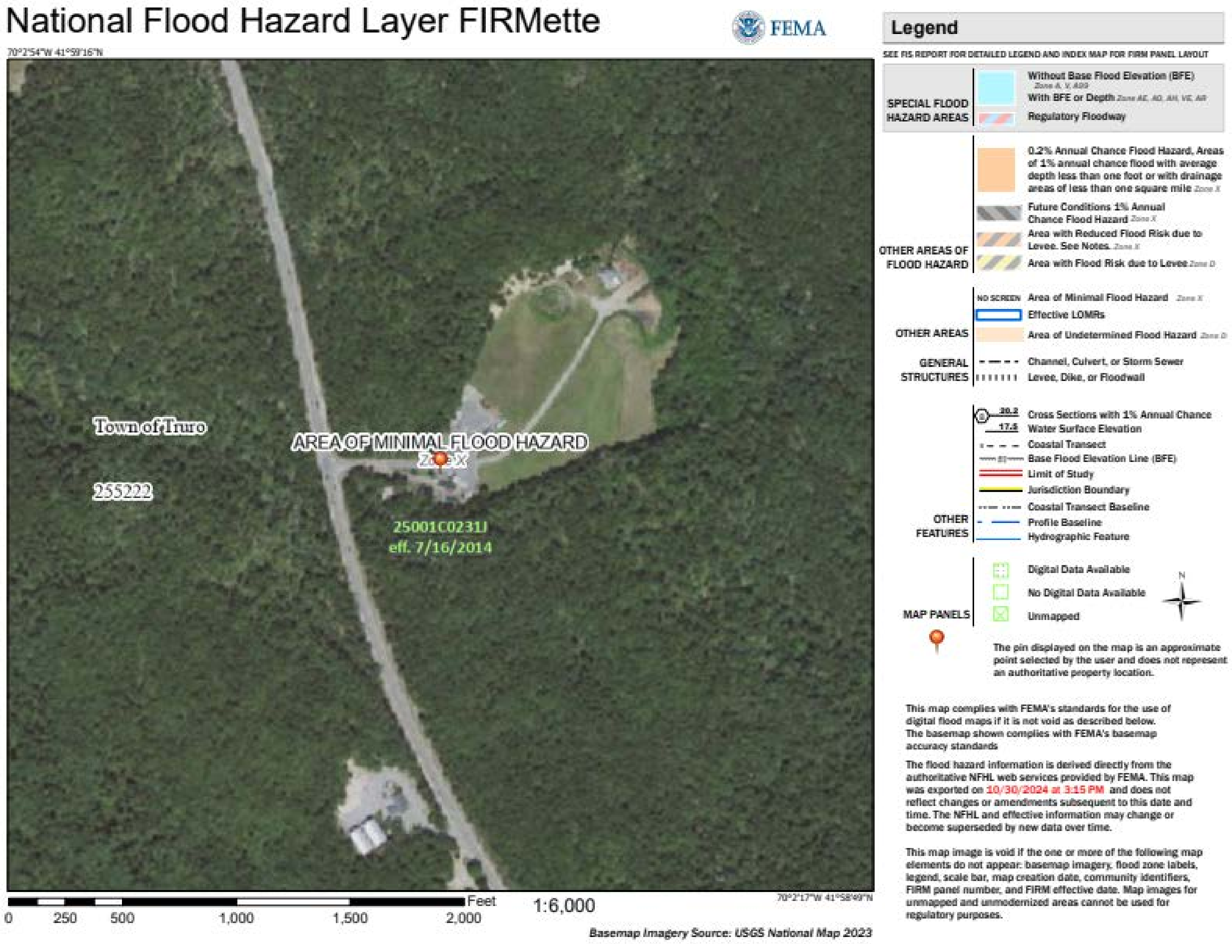
Resiliency

Backup Power Sources

In the event of a power outage or service disruption, there is no on-site backup generator to operate in brief outage periods. Further studies and development of a Solar PV system in conjunction with a battery storage system would support the facility with phasing out of fossil fuel use.

Coastal Flooding

The following depicts the National Flood Hazard FIRMette for the site location. Figure 9 shows localized flood hazard data derived from the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs), which can help stakeholders identify flood risk and facilitate informed decision-making to mitigate potential risks. Based on this data, the building is in an area of minimal flood hazard. This indicates a low risk of flooding, with less than 0.2*% annual chance of flood events (500-year flood zone). Properties within this zone generally have a low probability of flood damage, and flood insurance is not typically required but may still be recommended for added protection. Incorporating flood-resistant designs and infrastructure ultimately safeguards lives and property and can reduce design costs when done in conjunction with designing for emission reduction measures.



Next Steps

It is recommended that you consider moving forward with the sustainable measures identified in this report. These measures represent a valuable opportunity to decarbonize the building while reducing energy usage and costs while leveraging available efficiency and sustainability incentives to decrease the overall implementation costs.

THREE EASY STEPS TO PARTICIPATE

- **Step #1:** Review your report with your Engineer and elect which measures to move forward with.
- **Step #2:** Sign proposal and schedule the installation of energy efficiency and microgrid improvements to ensure immediate meaningful energy savings and resiliency.
- **Step #3:** Recognize sustainable energy savings on a monthly basis!

Please be sure to contact Hossam Mahmoud, Sr. Energy Engineer at RISE engineering to take advantage of these opportunities today. I can be reached at hmahmoud@therisegroupinc.com or (774)-994-7269.