

# Solar Resource and Infrastructure Assessment

for  
the Town of Montague



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## EXECUTIVE SUMMARY

**Please note that this report was first compiled in fall 2022 and updated in summer 2023. Some information contained within the report may therefore be out of date.** One component that has changed since the report's completion is the ability of the local grid infrastructure within Montague to interconnect additional large solar arrays. In fall 2022, there were several circuits serving Turners Falls and surrounding areas that could accommodate the addition of a 2-3 MW solar PV facility. Currently, circuits in Montague can only accommodate additional projects under 1 MW in size. This status could change quickly – if a substation or other infrastructure is upgraded by Eversource, new hosting capacity may quickly become available. Local grid capacity is therefore important for short-term planning, but hard to incorporate into long-term planning, because it can change so quickly. For more information about solar hosting capacity, see the report itself, or UMass Clean Energy Extension's fact sheet on grid infrastructure. The current hosting capacity of the electricity grid within Montague can be viewed at: <https://eversource.maps.arcgis.com/apps/webappviewer/index.html?id=eea778f65e5d4bac87a7ad83bde9f999>)

This report is a Solar Resource and Infrastructure Assessment for the town of Montague Massachusetts. The assessment was conducted through a joint collaboration among the town, UMass undergraduate students, UMass Clean Energy Extension (CEE), and the UMass iCons program, using CEE's *Community Planning for Solar* toolkit ([ag.umass.edu/solarplanning](http://ag.umass.edu/solarplanning)). As Step 2 in the UMass *Community Planning for Solar* process, this assessment details existing infrastructure, resources, and potential solar development opportunities in Montague. This assessment is designed to describe relevant bylaws and infrastructure within the town, identify the types of solar facilities that could be developed, and quantify the total space available for each type of facility.

In this report, we review [existing](#) electricity grid infrastructure and the potential to interconnect additional solar facilities.

The ability of the local electricity grid to interconnect additional solar capacity is related to the type of circuit (three-phase vs. single-phase) and the extent to which large-scale electricity generation systems have already been connected to that circuit. A number of circuits that provide electricity to Montague already have battery, solar or hydro projects connected to them, some of which are located in Montague, and some of which are in neighboring towns. Several of these circuits (as of August 2023) could connect additional large (2.3-3 MW) solar projects; other circuits are currently saturated and could not host additional large projects. Most three-phase lines could nevertheless accommodate additional small-to-medium scale projects (under 200 kW). This description represents the local grid infrastructure as it is – planning for future scenarios of development could include recommendations for areas of grid infrastructure improvement to increase hosting capacity and allow siting of additional solar projects in preferred locations. Future scenarios may also include the addition of energy storage and other “non-wires alternatives.”

The single-phase distribution lines in Montague are mostly located in the southern portion of the town, where there are fewer businesses and less infrastructure. Most of the single-phase lines could currently accommodate solar projects under 50 kW in size.

Rooftops represent a large proportion of the potential for solar in Montague. There is an estimate of 32 acres of roof space across over one hundred medium and large rooftops that are suitable for solar.

There are large parcels in Montague that could be used for commercial solar development. These include parking lots, disturbed sites (landfills and brownfields), and agricultural land. Certain agricultural lands

may be more difficult to develop due to protections that restrict uses to agricultural purposes. However, there is some potential for agrivoltaics (dual-use solar and agriculture), as well as the installation of solar on barn roofs. There is limited space available on disturbed lands, totaling 4.9 acres. There is also significant potential for additional solar arrays on residential rooftops and properties, businesses, small parking lots, and farms. A summary of solar technical potential for different types of sites is provided in Section 5.0 of this document.

Future patterns of solar development are likely to be affected by Montague's solar bylaw. The current solar bylaw in Montague generally encourages solar installations on buildings and over parking lots. Certain types of ground-mounted solar require additional permitting or are prohibited in some zoning districts. Future updates to the bylaw should consider community preferences regarding land use, as well as conservation goals and state law. Montague is currently 77% natural land, 11% open land, and 10% developed land (10%). Much of the town (39%) is permanently conserved.

## TERMINOLOGY

The following terms, abbreviations, and acronyms are used in this report.

### Terms

**Photovoltaic**, or "PV," systems are solar arrays composed of panels that generate electricity from sunlight. These panels are a different type of technology than the types of panels used in "solar hot water" or "solar thermal" systems.

**Voltage** of an electric power line can be thought of as the equivalent of pressure in a water line. The voltage of transmission and distribution power lines is typically measured in kilo-volts (kV). One kilo-volt is equivalent to 1000 volts (V). In residential use in the United States, electrical wires within a household carry electricity at 120 V.

**Capacity** of a solar array is a description of the instantaneous power output of the panels at top production (i.e, in full sun). It is typically measured in kilowatts (kW) or megawatts (MW). A residential-size solar system is typically 5-10 kW in capacity. Commercial-scale solar arrays are typically 1 MW or greater in size. An average 1 MW array would cover approximately 4-5 acres of land.

**Annual generation** of a solar array is a measure of the yearly energy output produced by the panels. It is typically measured in kilowatt-hours (kWh) or megawatt-hours (MWh). In New England, annual generation is approximately equal to the array's capacity (in DC) \*14% \* 8760 hours per year.

**DC** is the abbreviation for direct current, the type of electricity produced by solar panels. The DC capacity of a solar array is a good indication of its size, and footprint on the landscape.

**AC** is the abbreviation for alternating current, the type of electricity flowing into the grid from a solar array, after it has gone through a transformer. In the absence of energy storage, a typical DC to AC ratio for solar array capacity is about 1.25:1. However, with energy storage, that ratio can be significantly higher (close to 2:1), since excess electricity can be stored in batteries during the day, and released into the grid during the night, when the panels are not generating electricity.

**Solar facility size** terms used in this report are in line with current state solar incentive program categories (not with municipal bylaws). That is:

- **Small** systems are 25 kW or less in size

- **Medium** systems are 25-500 kW in size
- **Large** systems are over 500 kW (0.5 MW) in size

**SMART** is the abbreviation for the current state solar energy incentive program (the Solar Massachusetts Renewable Target program). This program replaced earlier solar incentive programs, commonly known as “SREC” programs, in November of 2018, and was further updated through an emergency regulation in April 2020. The SMART regulation includes incentives for projects up to 5 MW AC in size. Additional incentives are available for projects located on buildings, parking lot canopies, landfills, brownfields, and “dual-use” solar and agriculture projects, as well as certain types of projects that benefit public entities, like municipalities. The updated regulation places restrictions on what types of large, ground-mounted projects can receive incentives, if they are sited on undeveloped land designated as BioMap2 Critical Natural Landscapes or Core Habitat, by the state MassWildlife Natural Heritage and Endangered Species Program.

**Three phase lines:** These are designed to serve large commercial or industrial buildings that use large amounts of electricity or have sensitive equipment that requires high power quality and consistency. Three phase lines, have three wires which are all carrying power out of phase with each other, exactly 120 degrees apart.

**Single-Phase lines:** These lines are suitable for residential-scale lighting and heating loads. They typically have one line that carries power and one neutral line.

### Abbreviations & Acronyms

**CEE** - UMass Clean Energy Extension

**DOER** - Massachusetts Department of Energy Resources

**FRCOG** - Franklin County Regional Council of Governments, the regional planning authority for Franklin County, MA

**kV** - kilo-volt

**kW** - kilowatt

**kWh** - kilowatt-hour

**MDAR** - Massachusetts Department of Agricultural Resources

**MVP** - Municipal Vulnerability Preparedness plan, a municipal planning document

**MW** - megawatt

**MWh** - megawatt-hour

**OSRP** - Open Space and Recreation Plan, a municipal planning document

**PV** – photovoltaic, the type of solar panels that generate electricity from sunlight

**PVPC** - Pioneer Valley Planning Commission, the regional planning authority for Hampden and Hampshire Counties, MA

**sf** - square feet

## 1. INTRODUCTION

This report is a Solar Resource and Infrastructure Assessment for the Town of Montague. Montague is a large town located in Franklin County in the Connecticut River Valley region of Massachusetts. The town has a total land area of 31.5 square miles (20,160 acres). According to the 2020 census, the town's population is estimated to be 8,600 residents who live in Montague's five villages: Montague City, a residential neighborhood near the General Pierce Bridge to Greenfield; Lake Pleasant, a residential neighborhood surrounding the Lake Pleasant reservoir; Millers Falls, which contains both a residential neighborhood and a small business center along Route 63; Turners Falls, which contains a mixture of single family and multi-family residences, and businesses; and Montague Center, which primarily includes single family residences, with some businesses.<sup>1</sup> Montague achieved Green Communities status in 2010 as one of the inaugural communities in the program.<sup>2</sup> The town has several large-scale solar projects and some residential solar, as well as one of the state's largest hydropower facilities, the 62MW Cabot Station, located on the Connecticut River.

This assessment was conducted through a collaboration among the town, UMass undergraduate students, UMass Clean Energy Extension (CEE), and the UMass iCons program, using CEE's *Community Planning for Solar* toolkit ([ag.umass.edu/solarplanning](http://ag.umass.edu/solarplanning)).

To support Montague in the second step of the *Community Planning for Solar* process, UMass team members prepared this assessment of existing infrastructure, resources, and potential solar development opportunities. This assessment is designed to describe relevant bylaws and infrastructure within the town, identify the types of solar facilities that could be developed, and quantify the total space available for each type of facility.

In this report, we review and describe:

- Existing electricity grid infrastructure, and the potential to interconnect additional solar facilities
- Current municipal solar zoning bylaws
- Town conservation priorities and conservation land
- Existing renewable energy facilities
- Priority energy storage sites
- Businesses and institutions with potentially moderate to heavy electricity use
- Areas available for development on:
  - Residential rooftops and properties
  - Medium to large-scale rooftops
  - Parking lots
  - Landfills, brownfields, and other previously disturbed sites
  - Farms
  - Undeveloped land where large-scale commercial development could be viable

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<sup>1</sup> <https://data.census.gov/all?q=Montague+town,+Franklin+County,+Massachusetts>

<sup>2</sup> <https://www.montague-ma.gov/p/325/Green-Communities-Program>

## 2. GRID INFRASTRUCTURE ASSESSMENT

### 2.1 Introduction

In this section, we provide a description of the existing electricity grid infrastructure serving the town, and the potential for new solar arrays to connect to existing circuits. Through this description, we hope to provide a general understanding of how the electricity grid functions, as well as to provide a snapshot of current conditions. Existing grid infrastructure plays a major role in where large solar arrays are built. The cost of connecting large solar facilities to the grid varies widely in different locations, and hence is a primary decision-making factor in where solar developers propose to site projects.

**While existing grid infrastructure may currently financially constrain the types of solar projects that can be developed in some locations, the electricity grid, utility regulations, and related state laws are in a constant state of change, and grid components are regularly being upgraded.** This description of the current state of the grid may be most relevant to situations in which the town or community members have an interest in the development of a particular site for medium- to large-scale solar soon. **The current state of grid infrastructure within the town may be less relevant to long-term planning. In fact, we suggest that significant town-level planning around solar energy could potentially drive the location of electric grid upgrades to allow development in places where community members would prefer to see solar facilities sited.**

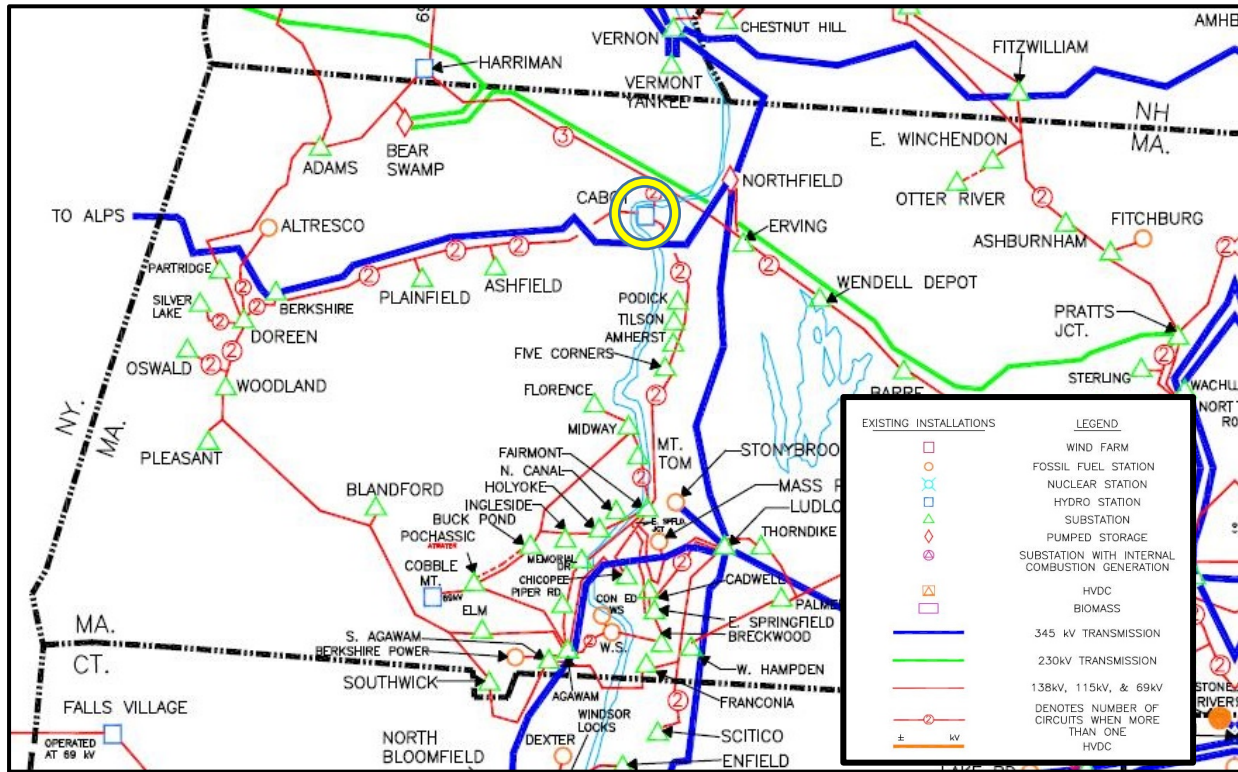
### 2.2 Grid Infrastructure Basics

The New England electricity grid is overseen by ISO New England, the regional transmission organization that serves the states of Massachusetts, Maine, New Hampshire, Vermont, Connecticut, and Rhode Island. This non-profit organization is charged with ensuring grid reliability – that is, to continuously balance electricity supply and demand, in Massachusetts and throughout the region. The electricity grid consists of transmission lines, high-voltage lines which carry electricity over long distances, and distribution lines, lower voltage lines which distribute power to individual communities and households. Most transmission lines in Massachusetts are owned by the two major electricity utilities which operate in the state - Eversource (formerly NSTAR and WMECO) and National Grid. Distribution lines are owned by Eversource, Montague’s local electricity provider. Transmission lines range in voltage from 69-345 kV. When these lines reach a substation, electricity is “stepped down” to a lower voltage and distributed along 13-34 kV distribution lines.

The “interstate highways” of the electrical grid are 345 kV transmission lines. In western Massachusetts, one 345 kV line runs north-south, east of, but approximately paralleling, the Connecticut River (see dark blue lines **Figure 1** below). This line connects the pumped storage facility in Northfield with the Stonybrook Power Plant, an oil and natural gas facility, in Ludlow. A second 345 kV line runs west from the Northfield pumped storage facility, through Ashfield, Plainfield, and Pittsfield, and ultimately across the state line into New York.

For a more complete introduction to the electricity grid, please see CEE’s [Fact Sheet: The Electric Grid, Distributed Generation, and Grid Interconnection](#).





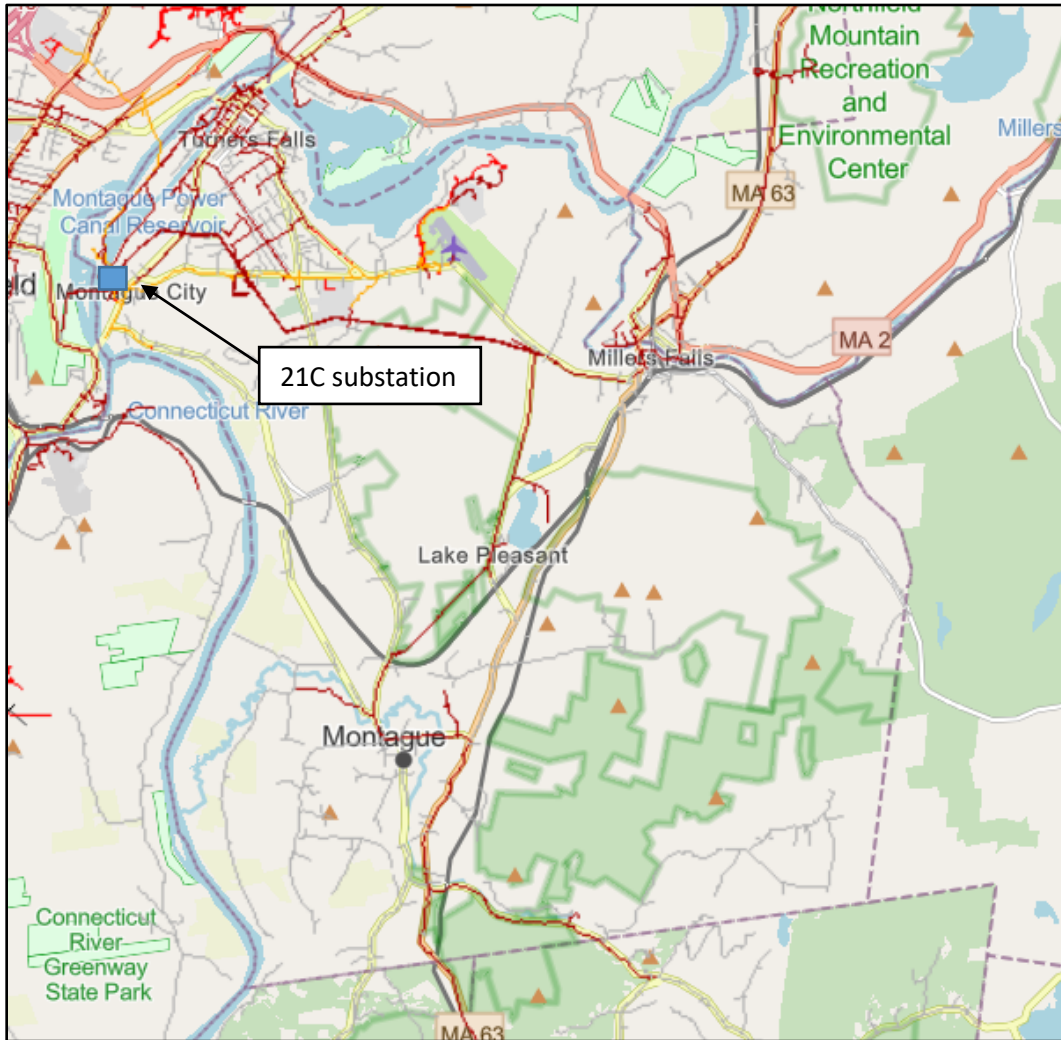
**Figure 1** Major electricity transmission lines and substations in western Massachusetts. The location of Montague is shown as a yellow circle. Source: ISO New England 2019.

### 2.3 Existing Grid Infrastructure

Montague is part of the Eversource WCMA (western/central Massachusetts) load zone. The distribution circuits that serve Montague are named 21C1, 21C2, 21C5, 21C6, 21C7, 21C8 and 18G7. The first six circuits are connected to the 21C “Montague” substation, located in Montague City adjacent to the canal. The 18G7 circuit is connected to the 18G “Podick” substation located along Route 116 in North Amherst.

As shown below in **Figures 2-5**, Montague’s three-phase distribution infrastructure is primarily clustered in the northern portion of the community, where there is a complex network of three-phase lines, especially in the vicinity of Turners Falls. The southern part of town is more rural, and is connected primarily by single-phase lines, with one three-phase line extending southwards into this area and connecting to the 18G7 line coming north from Leverett. The majority of energy generation facilities connected to the grid in Montague are solar arrays. There is also a hydroelectric power plant on the Connecticut River in northern Montague, located right next to the 21C Montague substation.

**Figure 2** below illustrates the entirety of Montague, including three-phase distribution lines and the 21C Montague substation.



**Figure 2** The Town of Montague, including local three-phase distribution lines (red and orange) and the 21C Montague substation (blue box). Single-phase lines are shown in gray. Source: eversource.maps.arcgis.com.

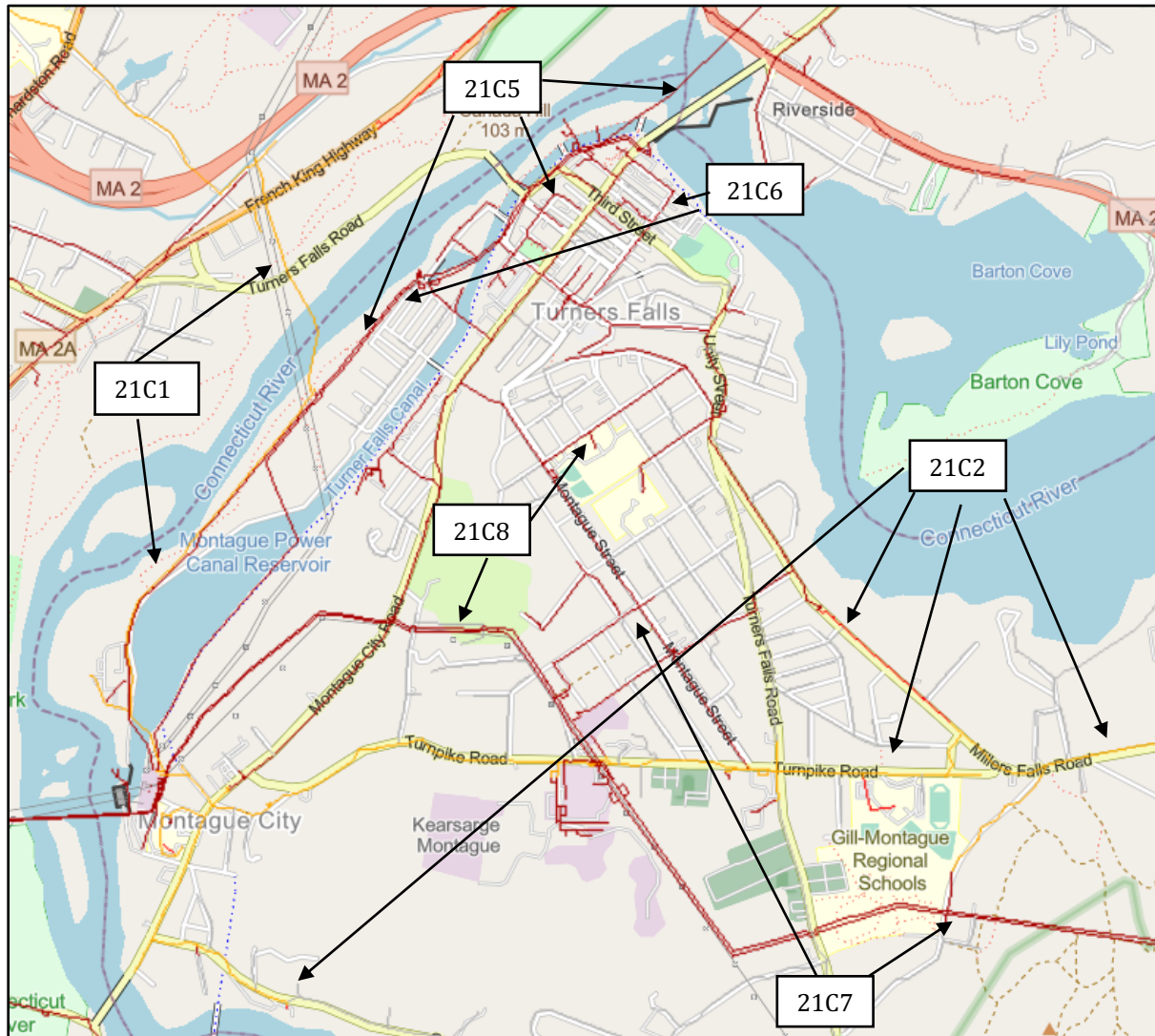
**Figure 3** below illustrates the distribution network in the Turners Falls area, specifically circuits 21C1, 21C2, 21C5, 21C6, 21C7, and 21C8. This area is densely populated, with some industrial areas, and therefore requires multiple three-phase power lines.

Circuit 21C1 provides three-phase power to the Conte Anadromous Fish Research Laboratory, before continuing north and crossing the river into Greenfield.

Circuit 21C2 connects to the Montague Substation and extends along most of the northern edge of Montague, as far as the Turners Falls Airport. This circuit serves portions of the northern part of Turners Falls, which features a high density of commercial and residential buildings. It then runs south down Turners Falls Road until just past the intersection with Hillside Road, extends through the center of Turners Falls on Turnpike Road, and continues south along Montague City Road.

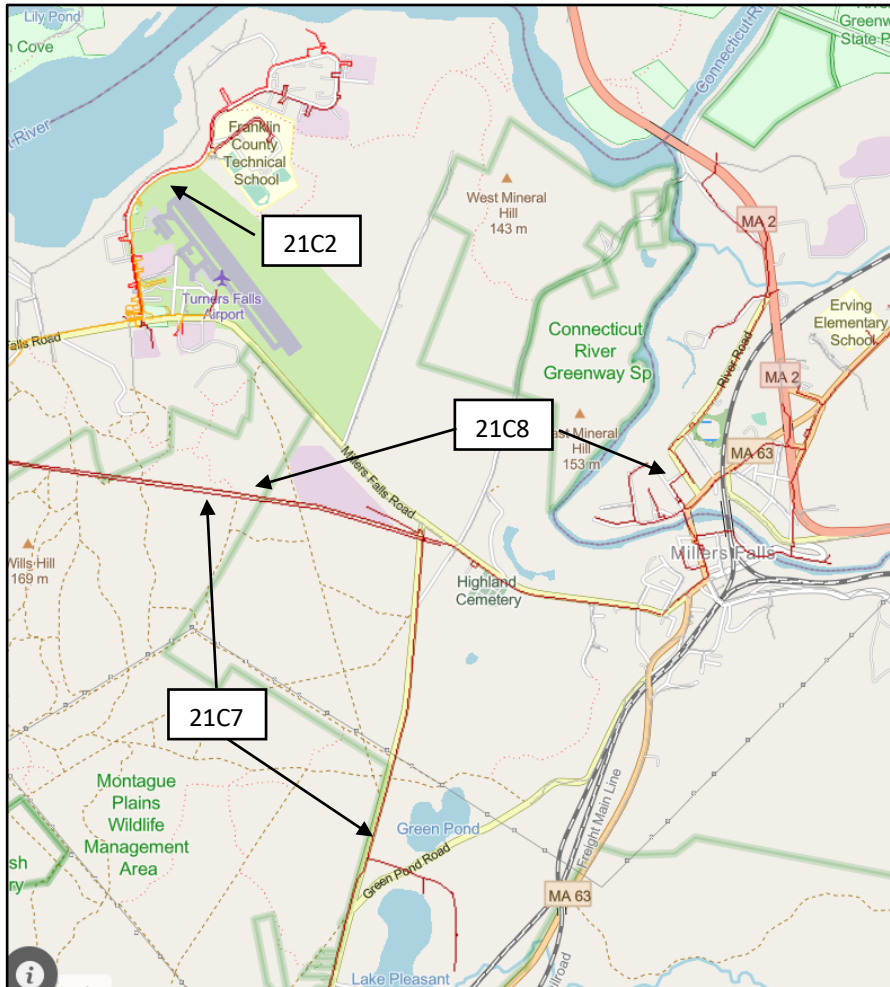
Circuits 21C5 and 21C6 proceed north from the Montague substation, serving much of the northern section of Turners Falls, north of High Street. 21C5 subsequently crosses the Connecticut River into Gill.

Circuits 21C7 and 21C8 proceed northeast from the Montague substation, serving southern portions of Turners Falls before cutting east to the intersection of Millers Falls Road and Lake Pleasant Road. 21C7 then turns south along Lake Pleasant Road, providing three-phase power to the village of Lake Pleasant, and then proceeding to Montague Station. From Montague Station, 21C7 continues along Turners Falls Road into Montague Center, providing three-phase power to portions of Meadow Road, Turners Falls Road, and Center Street. The circuit continues south down Federal Street/Route 63, crossing the southern town border into Sunderland. From the intersection with Lake Pleasant Road, 21C8 continues east along Millers Falls Road, providing three-phase power to downtown Millers Falls, before crossing the Millers River into Erving.



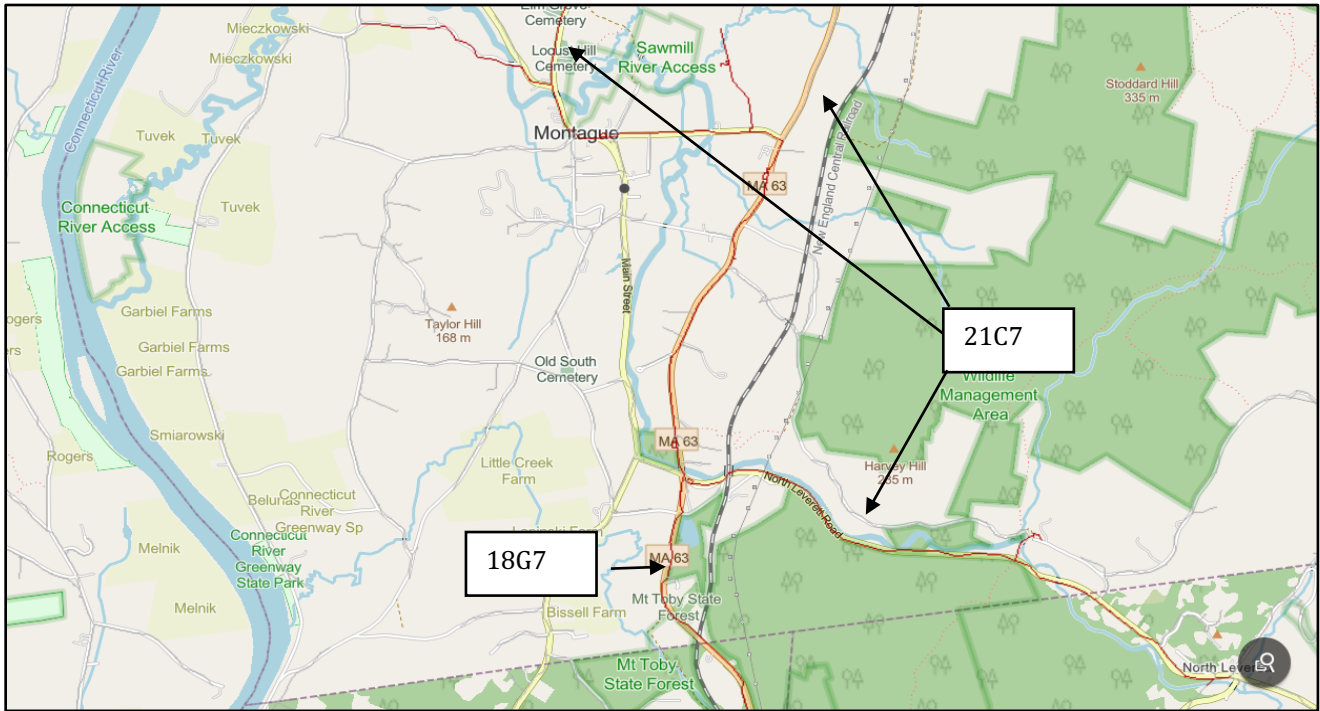
**Figure 3** Detail of the Turners Falls area and Montague City, showing the complex network of electrical distribution lines. Three-phase distribution lines are shown in red and orange; single-phase lines are shown in gray. Source: [eversource.maps.arcgis.com](http://eversource.maps.arcgis.com).

**Figure 4** below shows three-phase distribution lines in the vicinity of Millers Falls, Lake Pleasant, and the Turners Falls Airport.



**Figure 4** Detail of the electricity grid in the northeastern section of town, including Millers Falls. Three-phase lines are shown in orange and red; single-phase lines are shown in gray. Source: eversource.maps.arcgis.com.

**Figure 5** below illustrates the southern region of Montague, which is served by the 21C7 three-phase distribution line. Circuit 18G7 is a three-phase distribution line that runs north from Leverett along Route 63 from the 18G “Podick” substation (not shown) to the intersection with North Leverett Road in Montague, where it intersects with circuit 21C7.



**Figure 5** The southern region of Montague, served primarily by one three-phase distribution line. Single-phase lines are shown in gray. Source: eversource.maps.arcgis.com.

## 2.4 Existing Hosting Capacity

Historically, distribution lines in the electricity grid were designed as somewhat akin to one-way streets, supplying power to homes and businesses from large power plants connected to high-voltage transmission lines. With the addition of solar and wind resources, there are now many energy-generating facilities that seek to interconnect to the grid via distribution lines. These “distributed generation” electricity sources require that distribution lines act as two-way streets instead, allowing for energy to flow into the grid via distribution lines, while still allowing energy to continue to flow outward into individual homes and businesses. Balancing this two-way flow can represent a challenge for ensuring reliability and safety of the grid. This is especially true where distributed generation electricity sources are renewable sources, such as wind and solar energy, which supply electricity to the grid in an intermittent and variable manner. In order to ensure that generation facilities can be connected safely, developers are required to obtain written permission from the local utility company before interconnecting these systems to the electricity grid.

The “hosting capacity” of an electric power line identifies its ability to incorporate distributed generation electricity sources, such as wind and solar. In most places, including those served by single-phase distribution lines, small solar systems of up to 50 kW can be incorporated without adverse impacts on the grid’s reliability. In areas served by three-phase power lines, solar systems of up to 200 kW can typically be interconnected without significant challenges. However, for larger systems, it is necessary to ensure there is sufficient capacity available on the distribution line before these facilities can be built and interconnected. Otherwise, power lines or substations may require upgrades before additional distributed generation sources can be interconnected without compromising reliability. While not true across the board, an industry ‘rule-of-thumb’ is that 6 MW can be connected safely for every 13.8 kV distribution line. In western Massachusetts, where many towns are served by one or a few low-voltage feeder circuits, the

local grid can quickly become “saturated,” such that there is not sufficient hosting capacity to incorporate additional medium to large solar arrays.

The state of Massachusetts now requires that utilities provide publicly available maps and data regarding the available hosting capacity of distribution lines, and the level of saturation of individual feeder circuits. This public information lists all projects greater than 25 kW in capacity connected to three-phase lines, and all projects greater than 10 kW connected to single-phase lines. If circuits are currently saturated, it does not mean that no more distributed generation systems can be added to the circuit but does suggest that upgrades are needed before additional large projects can be interconnected. Upgrades may involve significant costs, which the energy facility developer is typically expected to pay for, as a condition of interconnection. Previously, interconnection applications were considered on a project-by-project basis, but recently, ISO New England has determined that multiple projects may be considered together as one group for the purposes of interconnection, in what are known as “Affected System Operator,” or Group, studies. This change is anticipated to streamline the review of interconnection requests for projects “queued” up to connect to each circuit. Even if areas currently appear saturated on the map, they may not remain so. Companies developing large, more lucrative solar projects may be able and willing to support significant upgrades to these circuits (either individually or in groups with cost sharing). New upgrades may then open new hosting capacity.

Within Montague, saturation levels of the three-phase lines vary both within and across circuits. For example, circuit 21C2 at Industrial Boulevard has a maximum hosting capacity of 2.2 MW but only 0.2 MW of hosting capacity at Sandy Lane. In general, circuits have the following hosting capacities:

- **21C1** – 3.0 MW along its entire length within Montague
- **21C2** – Mostly 2.30 or 2.40 MW (although small stretches have a hosting capacity of 0.20 MW or less, mostly along shorter offshoots, including the section serving Franklin County Tech and points north)
- **21C5** – Mostly 0.20 MW, but slightly higher (e.g., 0.40 MW along some sections), always under 1.0 MW.
- **21C6** – Mostly 0.20 MW, but slightly higher in some sections (e.g., 0.40 MW), always under 1.0 MW.
- **21C7** – Mostly 0.20 MW, but in some small sections even lower (e.g., 0.05 MW)
- **21C8** – 0.20 MW, but slightly higher in some sections (e.g., 0.60 MW)
- **18G7** – 0.20 MW along its entire length in Montague

This information suggests that most of the circuits in Montague (18G7, 21C5, 21C6, 21C7, and 21C8) are saturated with existing or pending distributed generation projects and could currently only accommodate small to medium-sized solar projects (under 200 kW in capacity), although a few sections could accommodate projects up to 400-600 kW in capacity. Additional (and potentially costly) upgrades to the electricity grid would likely be required before larger projects could be connected to these lines. Circuit 21C1 only travels a short distance through Montague but could currently accommodate a larger facility (up to 3.0 MW), and 21C2 could also host a larger project (up to 2.30 -2.40 MW). Meanwhile, most single-phase lines could likely accommodate additional projects under 50 kW in size.

**Table 1** below provides a listing of proposed distributed generation projects in Montague and those in adjacent towns utilizing the same circuits. This table provides an explanation for the high level of saturation on many of the circuits serving Montague – one or more large projects have already been proposed or authorized to connect to the 18G7, 21C5, and 21C8 circuits, which collectively take up much of the available hosting capacity on these circuits (which is, as noted earlier, roughly 6 MW per three-phase line prior to the connection of any distributed generation projects). From this table, it is not clear why the 21C6 or 21C7 circuits currently have little hosting capacity, because no particularly large projects are listed, although it could be that they are actually not independent from the 21C5 and/or 21C8 circuits.

Readers should note that the description above represents the local grid infrastructure as it is. It is not known how many of the projects currently “in process” or with unknown status in **Table 1** will ultimately be built and connected to the grid. If these projects are cancelled, or grid infrastructure is upgraded, it would open additional hosting capacity. Planning for future scenarios of development could also include recommendations for areas of grid infrastructure improvement to allow siting of distributed generation in preferred locations. Future scenarios may also include the addition of what are known as “non-wires alternatives,” which can reduce the needs for grid upgrades. These are technologies like energy storage, energy efficiency, demand-response, and grid software, which reduce the need for additional power lines to be added to the grid.

Circuit Name	City/Town	Design Capacity (kW)	Fuel Type	Date Application Received	Authorization to Interconnect	Project Status
18G7	Amherst	4,980	Battery	4/12/2017	7/30/2019	Authorized
	Amherst	3,182	Solar	12/19/2018		Status unknown
	Leverett	3,120	Solar	2/9/2018		Status unknown
	Amherst	2,000	Battery	6/22/2018		Status unknown
	Leverett	366	Solar	9/14/2017	2/14/2019	Authorized
	Amherst	25	Solar	2/1/2021	5/26/2022	Authorized
21C1	Greenfield	4,990	Battery	10/27/2020		Status unknown
	Bernardston	4,990	Battery	12/29/2020		Status unknown
	Greenfield	4,500	Solar	12/14/2017		Status unknown
	Bernardston	4,500	Solar	6/24/2020		Status unknown
	Bernardston	4,160	Solar	2/23/2018		In Process
	Greenfield	2,000	Solar	9/8/2015	1/25/2019	Authorized
	Bernardston	2,000	Solar	4/23/2020		Status unknown
	Bernardston	2,000	Solar	4/23/2020		Status unknown
	Bernardston	2,000	Solar	4/23/2020		Status unknown
	Bernardston	1,570	Solar	4/23/2020		Status unknown
	Bernardston	1,410	Solar	2/12/2018		In Process
	Greenfield	1,300	Solar	6/24/2020		Status unknown
	Greenfield	1,200	Solar	10/18/2016	12/23/2021	Authorized
	Greenfield	220	Solar	11/6/2019	9/30/2020	Authorized
	Greenfield	220	Solar	11/6/2019	9/30/2020	Authorized
	Bernardston	180	Solar	7/5/2018	4/22/2020	Authorized
	Greenfield	135	Solar	8/17/2012	12/12/2012	Online
	Greenfield	101	Solar	7/21/2021		In Process
	Greenfield	56	Solar	3/5/2015	4/20/2017	Authorized
	Greenfield	48	Solar	12/12/2014	6/8/2015	Online
Bernardston	36	Solar	7/27/2015	12/18/2015	Authorized	
21C2	Montague	4,500	Battery	12/17/2020		Status unknown
	Montague	4,500	Battery	12/17/2020		Status unknown
	Montague	4,176	Solar	10/30/2015	9/24/2018	Authorized
	Montague	3,770	Solar	11/29/2017	11/23/2021	Authorized
	Turners Falls	996	Solar	10/30/2017	12/24/2019	Authorized
	Montague	800	Solar	10/11/2017	12/31/2020	Authorized
	Turners Falls	460	Solar	6/25/2019		Status unknown
21C5	Gill	4,950	Solar	7/17/2018		In Process
21C6	Turners Falls	370	Hydro	1/10/2012		In Process
21C7	Montague	56	Solar	4/12/2016	1/26/2017	Authorized
	Montague	36	Solar	5/10/2016	11/10/2017	Authorized
21C8	Erving	4,980	Solar	1/18/2018		In Process
	Montague	4,080	Solar	11/15/2016	10/12/2018	Authorized
	Erving	2,600	Solar	2/4/2022		In Process
	Montague	450	Solar	11/22/2016		Status unknown

**Table 1** Distributed generation projects online, authorized, or in process in Montague and adjacent towns that utilize the same circuits. It is unknown how many of the projects currently “in process” will ultimately be built and connected to the grid. Source: MA DOER October 2022.



## 3. MUNICIPAL PLANNING DOCUMENTS

### 3.1 Planning Documents & Bylaw Review

A brief review of Montague's relevant planning documents and municipal bylaws identified the following:

- Montague's Master Plan was completed in 2016 by the Montague Parks and Recreation Commission. This plan addresses parks, facilities, and other resources in Montague. The Master Plan does not address solar development directly but is further described in Section 3.2 *Master Plan*.
- Montague's town bylaws address solar development within the community. The content of these bylaws is addressed in Section 3.3 *Solar Zoning*.
- Montague does not have a specific wetland bylaw. However, the protection and conservation of wetlands is addressed in other town bylaws. This is discussed further below in Section 3.4 *Wetlands Bylaws*.
- Montague approved its Open Space and Recreation Plan (OSRP) in 2011. A summary of town conservation priorities from the OSRP is briefly outlined in Section 3.5 *Open Space and Recreation Planning*.
- Montague's Municipality Vulnerability Preparedness (MVP) plan is described in Section 4.3 *Potential Energy Storage Sites*.

### 3.2 Master Plan

Montague's Master Plan was approved in 2016 and serves as a policy guide based on the town's goals for future development. Though it does not include direct references to solar development, land-use in general is covered extensively in the plan. The Master Plan states, for example, that park property cannot be sold without an affirmative vote by the town's residents.

Land-use categories listed in Montague's Master Plan include agricultural, residential, commercial, industrial and undeveloped acreage. Agricultural lands are noted as largely in the southwest corners of the town. Residential development is the predominant land use, with most homes being single-family detached. There is more multi-unit housing on the west-central side of the town. Commercial includes retail outlets, specialty shops, restaurants, and grocery/drug stores. Retail operations are mostly located in the Downtown Business District in the village of Turners Falls. This district also hosts the Turners Falls Post Office, and Montague City Hall, Library, and Senior Center. The industrial sector is located in the western part of town, primarily in the Turnpike Road Industrial Park. Finally, there is undeveloped land, which makes up less than a quarter of the town area. Undeveloped land includes vacant parcels and smaller lots, as well as undeveloped land that will likely not be developed, such as wetlands.

Montague's Master Plan describes the following goals for the community:

- Maintain strong community ties with residents
- Build a strong business community where residents want to linger
- Maintain a strong and diverse housing stock
- Protect natural resources within the town and enhance its natural setting
- Develop an accessible and diverse park, trails and recreation system

- Maintain Montague’s unique small-town character
- Promote an efficient transportation system in the town that prioritizes complete streets and mobility
- Develop a cost effective, consolidated infrastructure system
- Promote teambuilding within town leadership and philosophy of intergovernmental cooperation in the area to maximize public resources
- Monitor community changes to keep abreast of issues and opportunities

It will be important to keep these community goals in mind when planning for the development of solar.

### 3.3 Solar Zoning

Montague’s zoning bylaw was updated in February 2019 and is summarized here.

#### Purpose

Montague’s solar bylaw exists to encourage solar energy installations and facilities with minimal environmental impact which are located on roofs, over parking lots, and on degraded sites.

#### Definitions

Montague’s solar bylaw categorizes installations by how they are mounted and by their size and location:

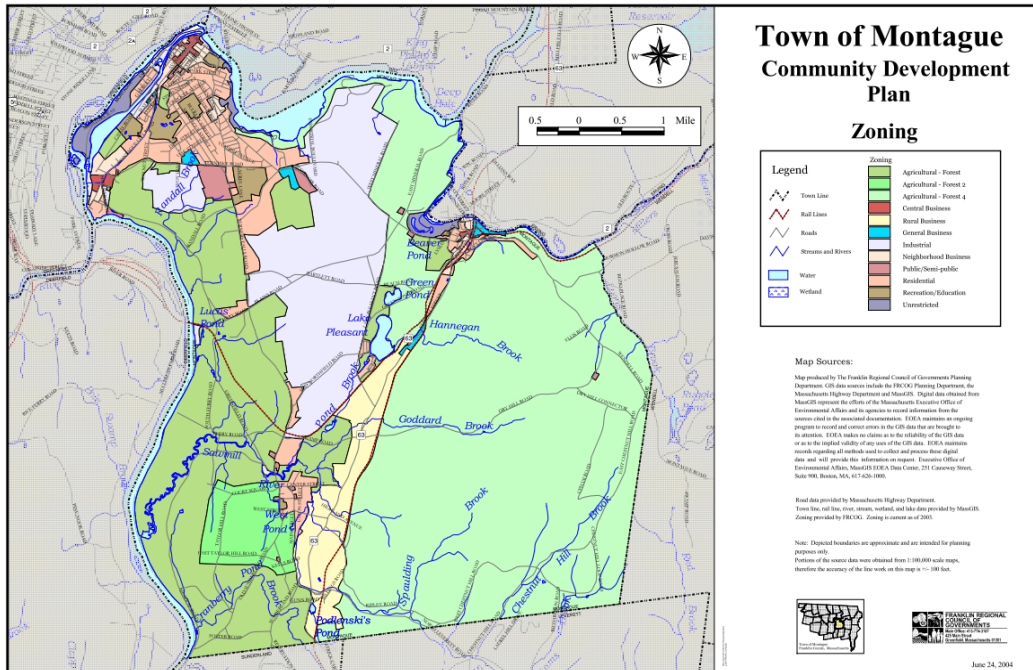
- Building-mounted solar energy installations are permanently affixed to a building, including canopy structures.
- Accessory ground-mounted solar energy installations are mounted on the ground or on a non-building structure and the energy collected is primarily used on-site.
- A solar energy facility is a ground-mounted array which occupies more than 2,000 sf (about 0.05 acres).

#### Districts & Applicability

Montague has twelve zoning districts:

- Agricultural – Forest 1, 2, and 3
- Business – Central, Rural, Neighborhood, and General
- Industrial
- Public/Semi-public
- Residential
- Recreation/Education
- Unrestricted

Montague’s zoning bylaws feature three overlay districts: the Flood Plain Overlay District, Water Supply Protection District, and Agricultural Business Overlay District. The zoning districts are illustrated in **Figure 6** below. The southern part of Montague is primarily Agricultural-Forest and Rural Business. The middle of town contains a large Industrial zone. In Turners Falls in the northern part of Montague, there are Residential, Recreation/Education, and Central Business districts. However, the largest swaths of land in Montague are Agricultural-Forest and Industrial.



**Figure 6** Zoning districts in Montague.

In general, the solar bylaws encourage solar installations on buildings; building-mounted and parking canopy solar energy installations are permitted in all zoning districts. However, ground-mounted solar energy installations are subject to additional requirements.

Accessory ground-mounted installations (primarily serving on-site load) are considered an accessory structure and must meet setback requirements of the Zoning District in which they are located. Depending on size, they may require a special permit, as detailed in **Table 2** below.

Zoning District	Requirement
Neighborhood Business, Central Business, and Recreation-Education	Special Permit Required
RS-1	Special Permit Required if exceeding 150 square feet of panel surface area
All other districts	Special Permit Required if exceeding 500 square feet of panel surface area

**Table 2** Requirements for ground-mounted solar energy installations by Zoning District.

According to Montague’s zoning bylaws, Solar Energy Facilities are defined as ground-mounted solar energy installations that exceed 2,000 square feet of panel surface area. Solar Energy Facilities are allowed in Industrial and Historical Districts by special permit, with site plan review from the Planning Board and are subject to submittal requirements. The Planning Board may require additional conditions based upon the land/site importance.

Required submittals for Solar Energy Facilities include:

- General procedures for operation and maintenance. This includes installing security measures and shutting down the facility in case of emergency.

- Inclusive estimate of costs associated with removal and site restoration.
- Owners and successors need to provide money (bond, escrow account, etc.) to cover the cost of removal and restoration of landscape. This amount is determined by the Planning Board but cannot exceed 125% of the cost of removal. This may be waived for municipal or state-owned facilities.
- A stormwater management report.

The standards for a Special Permit include:

- Access to parking for service and emergency vehicles; there can be no exterior long-term storage of equipment or vehicles on site.
- For every mature tree cleared for construction, at least one living mature tree shall be retained on site.
- An 8-foot security fence needs to be installed no closer to the property line than the setback required for principal building. Site and fencing need to be buffered by vegetation unless determined otherwise by the Planning Board.
- If feasible, all network interconnections and power lines should be underground.
- Drainage and impervious surfaces need to be accommodated onsite.
- No array should be floodlit.
- Herbicides cannot be used to control vegetation onsite.
- The owner must provide a 24-hour emergency contact phone number.

### 3.4 Wetlands Bylaws

Montague does not have a specific wetland bylaw, although wetlands are addressed in other town bylaws. This includes zoning for the water supply protection district, development in the agricultural business overlay district, and in the open space residential district.

There are some specific restrictions on development surrounding wetlands, namely:

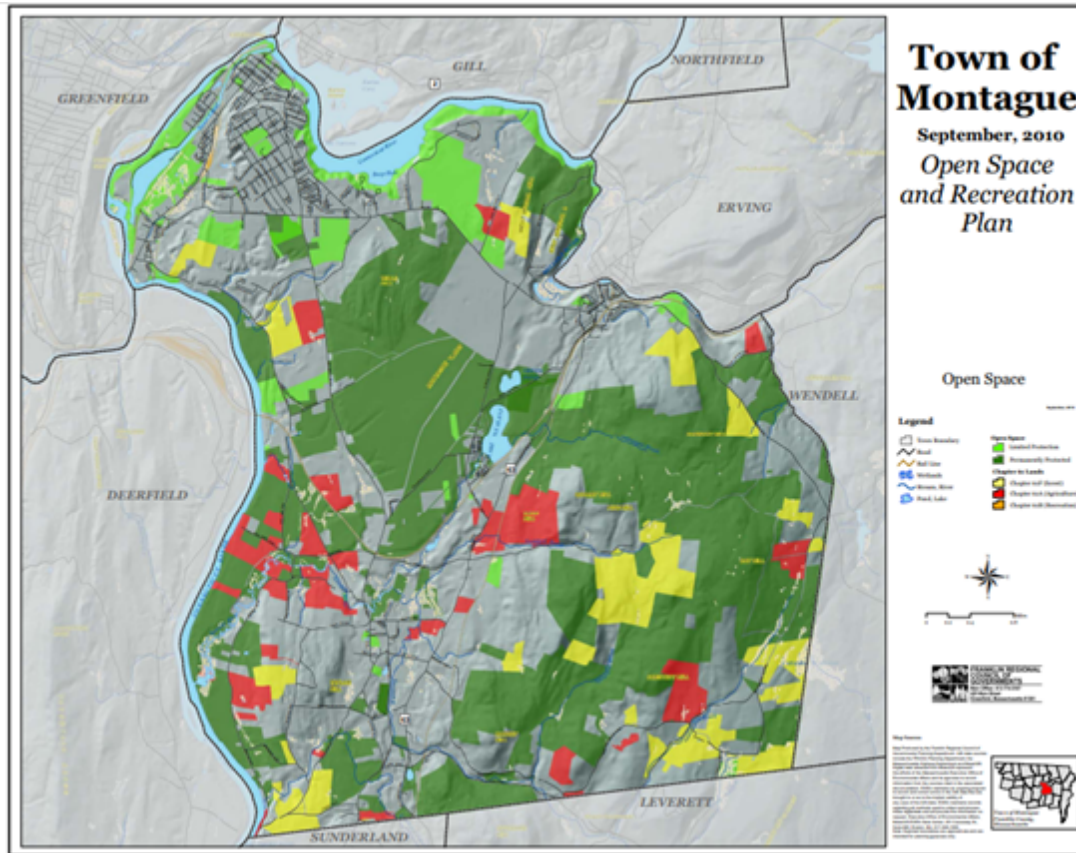
- Significant site features like wetlands need to be preserved from development.
- Development in the vicinity of wetlands must be carried out in consultation with the Conservation Commission and in accordance with the state Wetlands Protection Act.

### 3.5 Open Space and Recreation Planning

Montague has an OSRP, which was developed in December of 2010 by the Montague Open Space Planning Committee and the Franklin Regional Council of Governments Planning Department. The OSRP protects Montague's natural, agricultural, and recreational resources for future generations. The goal of the OSRP is to identify land valuable for agriculture, forestry, conservation, and recreation in order to protect it, and to allow for residential, commercial, and industrial development on other land.

The OSRP emphasizes that Montague residents value farms and forests, surface and groundwater resources, wildlife habitat, native plant communities, the Connecticut, Millers, and Sawmill Rivers, scenic views, and especially publicly owned conservation lands. The Plan also explains that, to meet the needs of current and future residents in Montague, it is also necessary to provide for further development of some lands within the town.

An Open Space map from the OSRP is provided in **Figure 7** below, which shows protections that are placed on various land parcels at the time of the plan’s composition (2010). Large areas of Montague are permanently protected (dark green), and some land is under limited protection (light green). In addition, some land is afforded limited protection through the Chapter 61 programs. These lands are labeled as Chapter 61F (Forest), shown in yellow; Chapter 61A (Agricultural), shown in red; and Chapter 61B (Recreation), shown in orange.



**Figure 7** Open Space and Chapter 61 lands in Montague, as included in the Open Space and Recreation Plan (2010).

## 4. COMMUNITY INFRASTRUCTURE

### 4.1 Introduction

In this section, we briefly review community infrastructure of relevance to solar energy development and energy storage. Information included in this section was drawn from a variety of sources, including:

- Municipal representatives participating in this planning process
- Municipal planning documents
- Department of Energy Resources (DOER) databases of renewable energy generation facilities
- Community Involved in Sustaining Agriculture Farm Finder
- Mass GIS geospatial data layers

Associated maps are provided in **Appendix A** of this document.

### 4.2 Existing Renewable Energy Infrastructure

According to public information available from the MA DOER, there are currently 290 small-scale (less than or equal to 25 kW) solar facilities in Montague.<sup>3</sup> Cumulatively, these projects represent 2,034 kW (2.0 MW) of capacity and the vast majority are residential installations. There are five medium-scale (greater than 25 kW to 500 kW) solar facilities in Montague totaling 498 kW and four large-scale facilities (greater than 500 kW) totaling roughly 11.6 MW. The large-scale four projects are as follows:

- One 5,998 kW DC project located at 10 Sandy Lane which came online in 2018. This project has a PPA with Town of Montague.
- One 1,422 kW DC project located at 131 Turnpike Road, which came online in 2019.
- One 1,188 kW DC project located at 248 Millers Falls Road, which came online in 2020.
- One 3,024 kW DC project located on municipal property at 12 Sandy Lane came online in 2021. This project included a small parking canopy and a ground-mounted solar array located over the footprint of a former landfill.

In addition to the projects already built in Montague, additional facilities have been proposed. As shown in **Table 1** above, a number of medium-scale solar and hydro projects are in process, and two large battery storage projects have also been proposed. It is unknown how many of these proposed projects will ultimately move forward to construction.

### 4.3 Potential Energy Storage Sites

Energy storage systems help to balance differences between electricity demand and generation and are especially valuable components for intermittent energy sources like wind and solar, which do not produce energy 24 hours a day, and may not be producing during times of peak demand.

Energy storage systems have the potential to allow larger solar facilities to be built in areas where interconnecting a medium or large solar array could otherwise exceed the ability of the local distribution lines to accommodate additional renewable energy capacity. Prices of battery storage are dropping quickly, but energy storage is still a relatively expensive technology. At present, these types of systems

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<sup>3</sup> <https://www.mass.gov/service-details/lists-of-qualified-generation-units>

typically require loads larger than residential scale to be cost-effective where cost is the sole consideration, but these systems can provide energy reliability during outages, which means that they also provide additional value in terms of public health and safety.

Montague has several large commercial and industrial developments that could have the potential for energy storage. In this section, we briefly review sites where energy storage may be of value.

#### 4.3.1 Town Hall and Municipal Buildings

There are multiple municipally owned buildings in Montague that could benefit from energy storage systems. The Montague Town Hall, Police Station, and Fire Station are all vital to the town. The Police and Fire Station together represent the Public Safety Complex. Montague's 2018 MVP Plan mentions that the complex currently has back-up power generators, and that the town is studying the feasibility of establishing a micro-grid powered by solar PV between the High School and Public Safety Complex to provide emergency back-up power. The approximately 5,700 sf of new roof on the Town Hall Annex, on the east section of the Town Hall, offers an opportunity for a smaller solar array.

#### 4.3.2 Public Schools

The Turners Falls High School (222 Turnpike Road) serves as an emergency shelter, making it a prime location for energy storage, as this would allow it to have some resilience in case of grid outages. Montague's 2018 MVP Plan mentions that the complex currently has back-up power generators, and that the town is studying the feasibility of establishing a micro-grid powered by solar PV between the High School and Public Safety Complex to provide emergency back-up power. The roof space on the High School is a total area of 93,048 sf and could host an estimated 913 kW of solar capacity. In addition, the school has a large parking lot measuring approximately 4 acres, which has the capacity to host roughly 1.0 MW of solar capacity. It is worth noting that schools and libraries often constitute large energy loads, and the use of energy storage may provide a cost-effective strategy for meeting these loads and managing energy costs.

Other schools in Montague also have potential for roof-mounted solar and parking canopies. The Hillcrest Elementary School (30 Griswold Street) has a 34,544 sf roof (estimated solar capacity of 339 kW) and a 1-acre parking lot (263 kW). Sheffield Elementary School (43 Crocker Avenue) has a 45,506 sf roof (estimated solar capacity of 446 kW) and a 47,379 sf parking lot (estimated solar capacity of 286 kW).

Finally, the Franklin County Technical School (82 Industrial Boulevard) has a large 154,104 sf roof (estimated solar capacity of 1,511 kW) and a 3-acre parking lot (estimated solar capacity of 789 kW). Overall, the schools have a high potential for solar capacity on the roofs and as parking lot canopies, and have a combined estimated solar capacity of 5,576 kW (estimated solar capacity of 5.6 MW) if all roofs and parking lots were developed.

#### 4.3.3 Turners Falls Airport

The Turners Falls Airport is municipally owned and was mentioned by the Solar Planning Committee as a potential site for energy storage. It should be noted that a previous plan to add solar energy storage at the airport was not implemented. However, a new solar plan is being explored, and as this location has three-phase circuit 21C2 running along some of the property, it might be a viable site for a larger project.

#### 4.3.4 Electric Vehicle Charging

There are four Level 2 electrical vehicle (EV) charging sites in Turners Falls and 124 total chargers within a 30-mile radius of Montague. **Figure 8** below illustrates the location of selected Montague EV charging stations located near Unity Park.



**Figure 8** Selected Montague EV charging stations.

As EVs become more prevalent, the town may wish to consider adding EV charging infrastructure, potentially paired with solar PV installations. Potentially appropriate areas include those where people may gather to shop/eat out, which could allow for charging for multiple hours or residential housing complexes, where vehicles could charge overnight. This spring, the town is considering adding two more chargers.

DC Fast Chargers (DCFCs) in Turners Falls might attract EV drivers travelling on Route 2. They may be more feasible if the MA Department of Public Utilities passes regulations that would lower demand charges for DCFCs that draw large amounts of electricity when in use. Coupling them with solar PV and battery storage could reduce demand charges, fees on the highest electric use incurred each month.

#### 4.3.5 Businesses

Commercial establishments often have higher electricity use than single-family homes, and as such may be good locations for solar installations and energy storage. There are at least 86 businesses in Montague. Some of the largest businesses and institutions are listed below:

- Judd Wire (124 Turnpike Rd)
- Heat Fab (130 Industrial Blvd)
- New England Extrusion, Inc. (Industrial Blvd)
- Hillside Plastics (262 Millers Falls Rd)
- Mayhew Steel Products (199 Industrial Blvd)
- Great Falls Aquaculture (1 Australia Wy)
- Walgreens (250 Avenue A)
- Light Life Foods (Rear LightLife Way)
- Montague Machine Co. (15 Rastallis St)



- Atlantic Golf & Turf (27 Industrial Blvd)
- Former Paperlogic building (36 Canal Rd)
- 253 Farmacy Recreational Weed Dispensary (253 Millers Falls Rd)
- Shea Theater/Crocker Cutlery Apartments (61 Third St)
- JaDuke Center - Performing Arts (110 Industrial Blvd)
- FirstLight Hydro Facility (15 Cabot St)
- Turbosteam Manufacturing (161 Industrial Blvd)
- Business Complex (320 Avenue A)
- Pioneer Aviation Building (Airport) (40 Industrial Blvd)
- Rubin's Auto Service (194 Millers Falls Rd)
- Turners Falls Airport (36 Industrial Blvd) [Limited town authority because governed by Fed Aviation Administration]
- The two largest commercial establishments are Judd Wire and Heat Fab. Judd Wire has a total of 3.8 acres available on the roof, and around 1 acre of parking lot. This is a total of 2,746 kW of solar production. Heat Fab has a total of 2.14 acres available on the roof, for 1,385 kW of potential solar production.

## 5. SOLAR RESOURCE ASSESSMENT

### 5.1 Introduction

In this section, we identify, summarize, and attempt to quantify the available solar resources in the Town of Montague. We identify a number of different types of potential resources in this assessment, including:

- Residential-scale solar resources (roof-mounted and small ground-mounted systems)
- Medium to large-scale roofs (greater than 5,000 sf)
- Parking lots
- Landfills and brownfields
- Other previously developed/disturbed land
- Undeveloped land with the potential for large, commercial-scale solar development

This analysis was a desktop analysis, incorporating publicly available geospatial data layers downloaded from MassGIS, the state's Bureau of Geographic Information. It is important to recognize that information contained within these data layers may be out-of-date, inaccurate, or include irregularities that reduce the accuracy of this analysis. For example, tax parcel data included in this analysis was last updated in 2020. Boundaries of conserved land outlined in the MassGIS Protected and Recreational Open Space data layer do not appear to line up perfectly with tax parcel boundaries. This should be considered as a preliminary analysis, providing direction regarding where more in-depth site assessments can be conducted.

### 5.2 Residential-Scale Resources

In this analysis, we will provide several rough estimates of solar potential, based on MassGIS structures data, and National Renewable Energy Laboratory (NREL) solar potential estimates for small buildings. For this analysis, we follow NREL's definition of a "small building" as one with a roof area of 5,000 sf or less.

Based on MassGIS Structures data, the Town of Montague has a total of 4,696 small buildings, totaling 6,199,400 sf in roof area. Most of these buildings are residential structures, including houses, garages, and sheds, although some small businesses and farm outbuildings are included in this total. NREL estimates that nation-wide, an average of 26% of the roof area of small buildings is suitable for solar.<sup>4</sup> Therefore, we could project a total technical solar resource of 1,611,850 sf available, equivalent to 23,952 kW (24.0 MW) of solar. Of course, this is the *technical* resource available, and not necessarily feasible.

NREL provides additional data and estimates regarding small building roof space in western Massachusetts. A second, and perhaps more practical, estimate of residential-scale solar potential can be derived by considering the potential for roof-mounted OR small-scale ground-mounted arrays to support residential use. Montague has a total of about 3,757 households. In Montague, approximately 67.9% of small buildings have some roof space suitable for solar, with the most common impediment to development being tree shading on the property. If we assume 68% of households could install solar at their residences, either on a rooftop, or as a ground-mounted system, the town could ultimately have 2,555 residential systems. The average size of a residential solar system in Montague is currently 7.26 kW. By this method, we can estimate a potential residential solar capacity of 18,549 kW (18.5 MW).

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<sup>4</sup> Gagnon, P., Margolis, R., Melius, J., Phillips, C. and Elmore, R., 2016. *Rooftop solar photovoltaic technical potential in the United States. A detailed assessment* (No. NREL/TP-6A20-65298). National Renewable Energy Lab.(NREL), Golden, CO (United States).

### 5.3 Medium to Large-Scale Rooftops

Montague has 121 buildings with roofs over 5,000 sf, totaling 2.37 million sf of roof space. NREL’s analysis suggests that virtually all medium and large-scale buildings have a roof plane suitable for solar; on average, approximately 49% of area on medium-scale roofs is available for solar and 66% of area on large-scale roofs<sup>2</sup>. Our technical estimates are based on these statistics. We estimate 1.41 million sf of medium and large roofs in Montague are suitable for solar. Our estimate of total technical potential on medium to large-scale roofs is 20,951 kW (21.0 MW). Again, this is the *technical* resource available, and does not reflect structural or financial considerations.

**Table 3** below provides the estimated solar potential of the 26 largest roofs identified in Montague. These roofs are all over 15,000 sf in area. This list includes schools, industrial facilities, municipal buildings, and several large business/residential complexes. The numbers provided in the table reflect a rough estimate of technical potential, based on nationwide data from NREL. As described above, this technical potential is not reflective of roof structural integrity or economic viability, and on-the-ground assessments would need to be conducted. Additional rooftops are listed in **Appendix B**.

Structure/Ownership Status	Street Address	Total Roof Area (sf)	Estimated Technical Solar Potential (kW)
Judd Wire	124 Turnpike Rd	253,121	2,483
Franklin County Technical School / Public	82 Industrial Blvd	154,104	1,511
Heat Fab	130 Industrial Blvd	141,198	1,385
New England Extrusion, Inc.	Industrial Blvd	101,873	999
Turners Falls High School / Public	222 Turnpike Rd	93,048	913
Hillside Plastics	262 Millers Falls Rd	71,516	701
Mayhew Steel Products	199 Industrial Blvd	70,105	688
Great Falls Aquaculture	1 Australia Way	69,300	680
Walgreens	250 Avenue A	65,877	646
LightLife Foods	Rear LightLife Way	59,366	582
Montague Machine Co.	15 Rastallis St	55,830	548
Atlantic Golf & Turf	27 Industrial Blvd	52,367	514
Paperlogic	36 Canal Rd	49,771	488
Foreclosed Property (owned by Town of Montague) / Public	20 Canal Rd	49,589	486
Franklin County Home Care	330 Montague City Rd	46,654	458
Sheffield Elementary School / Public	40 Crocker Avenue	45,506	446
Hillcrest School/Public	30 Griswold St	34,544	339
253 Farmacy Recreational Weed Dispensary	253 Millers Falls Rd	29,947	294
Department of Public Works (solar-ready roof) / Public	128 Turners Falls Rd	28,804	282
Shea Theater/Crocker Cutlery Apartments	61 Third St	27,254	267
Turners Falls Water Department / Public	226 Millers Falls Rd	26,310	258
Public Safety Complex / Public	178 Turnpike Rd	22,971	167
JaDuke Center - Performing Arts	110 Industrial Blvd	21,087	154
FirstLight Hydro Facility	15 Cabot St	19,725	144
Turbosteam Manufacturing	161 Industrial Blvd	17,908	130
Business Complex	320 Avenue A	16,883	123

**Table 3** Estimated solar potential of the 26 largest roofs (all over 15,000 sf in area) identified in Montague.

## 5.4 Parking Lots

Several sites with at least 0.5 acres of parking lot or paved area in town were identified. Potential sites for parking canopies are summarized in **Table 4** below. Estimates of solar technical potential in these areas are based on a packing density of 263 kW per acre<sup>5</sup>. Our estimate of total technical potential on the listed parking lots is 8,127 kW (8.1 MW).

Location/Ownership Status	Approximate Area (acres)	Estimated Solar Technical Potential (kW) acres x 263
Turners Falls High School/Public	4	1,052

<sup>5</sup> Krishnan, Ram. 2016. *Technical solar photovoltaic potential of large-scale parking lot canopies*. Dissertation, Michigan Technological University.

<b>Location/Ownership Status</b>	<b>Approximate Area (acres)</b>	<b>Estimated Solar Technical Potential (kW) acres x 263</b>
Franklin County Technical School/Public	3	789
Gill Montague Special Education/Public	2.75	723
Turners Falls Airport	2.3	605
Montague Machine Co.	2.03	534
Food City, Salvation Army, Walgreens, Aubuchon	1.8	473
Unity Park Community Garden	1.73	455
Kelter Ronald A Nursing Home	1.63	429
Montague Elks Lodge	1.6	421
Montague Town Hall/Public	1.32	347
Montague Community Television/Public	1.19	313
Fire Department, Police Department, and International Worldwide Travel/Public	1	263
Hillcrest School/Public	1	263
Sheffield Elementary School/Public	1	263
Unity Park Parking Lot/Public	0.91	224
Shady Glen	0.85	158
Our Lady of Peace Church	0.63	166
Montague Housing Authority Maintenance/Public	0.6	158
Basketball Court/Public	0.53	139
Highland School Apartments	0.53	139
Montague Recycling Center/Transfer Station/Public	0.5	132
<b>Total</b>	<b>30.9 acres</b>	<b>8,127 kW (8.1 MW)</b>

**Table 4** Parking lots and paved surfaces identified in Montague.

## 5.5 Landfills, Brownfields, and other Disturbed Sites

There are a number of previously developed and disturbed sites in Montague.

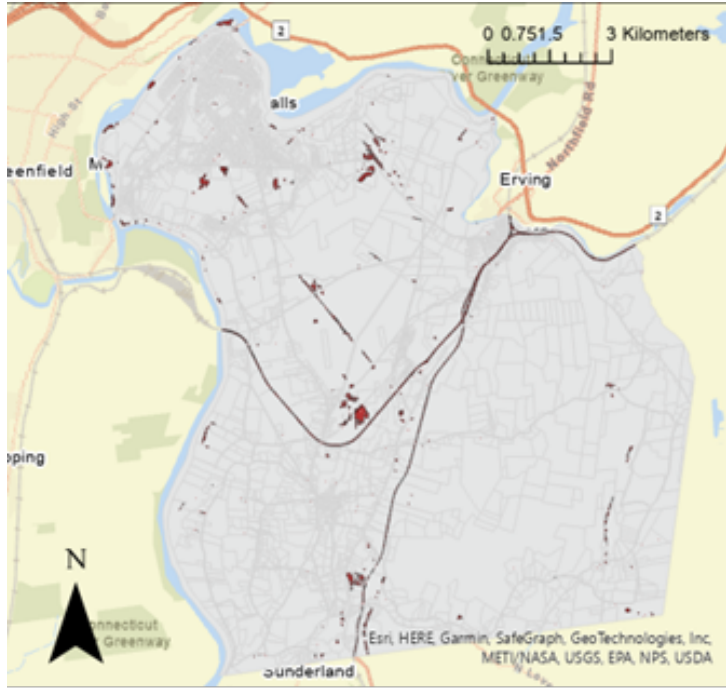
The Massachusetts Department of Environmental Protection (MassDEP) identifies brownfields located in the state. A brownfield is defined as a real property whose redevelopment may be complicated by actual or perceived contamination by oil or hazardous materials. These properties are typically abandoned or for sale or lease and have been used for commercial or industrial purposes. Montague’s brownfields are listed in **Table 5** below. In total there are 4.9 acres of identified brownfields located in Montague. Additional previously developed areas contaminated by hazardous materials could qualify as brownfields. In total, these areas could represent roughly 900 kW (0.90 MW) of potential solar development.

Former use	Current use	Address	Approximate Area (acres)
Paper mill	Town-owned, seeking re-development	20 Canal Street	1.90
Residence	Residence	34 East Main Street	1.73
Vacant lot	Vacant lot	2 Third Street	0.45
Franklin County Home Care	Soon to be town-owned, disturbed site	330 Montague City Rd	0.4
Unknown	Commercial, open space	Second 3 <sup>rd</sup> Street	0.42
<b>Total</b>			<b>4.90 acres</b>

**Table 5** Brownfields located in Montague, as identified by MassDEP.

In addition, tax parcel data identifies two properties with sand-and-gravel operations along Federal Street, and one other mining/quarrying operation, located at 9 Woodland Drive. Little disturbance is evident at 9 Woodland Drive, although it could be associated with the larger operation on an adjacent property along Federal Street. That property currently has roughly 4-5 acres of land disturbed as part of the sand and gravel operation, out of a total of 17.5 acres. If that site becomes inactive, developing the current 4-5 acres could yield 1 MW of solar capacity. Developing the full property for solar would support roughly 3.5 MW of solar capacity. The other sand-and-gravel site is on the western side of Federal Street near the southern border of town. This site has roughly 1.6 acres of disturbed land. The full lot is roughly 15 acres. This site, if it became inactive, could support 0.3 MW of development on the disturbed area, or 3.0 MW on the full lot.

We also looked at land identified as “bare land” using MassGIS land cover data in order to identify any additional disturbed sites. **Figure 9** below shows areas of bare land (shown in red) in Montague.



**Figure 9** Map showing areas of bare land in Montague (indicated in red). Source: MassGIS.

**Table 6** below lists large areas of bare land in Montague. In addition, there appears to be bare land by the airport, though this area might not be well-suited for solar installations. The Department of Conservation Land listed is part of the Montague Sand Plains, a protected area that is not suitable for solar development.

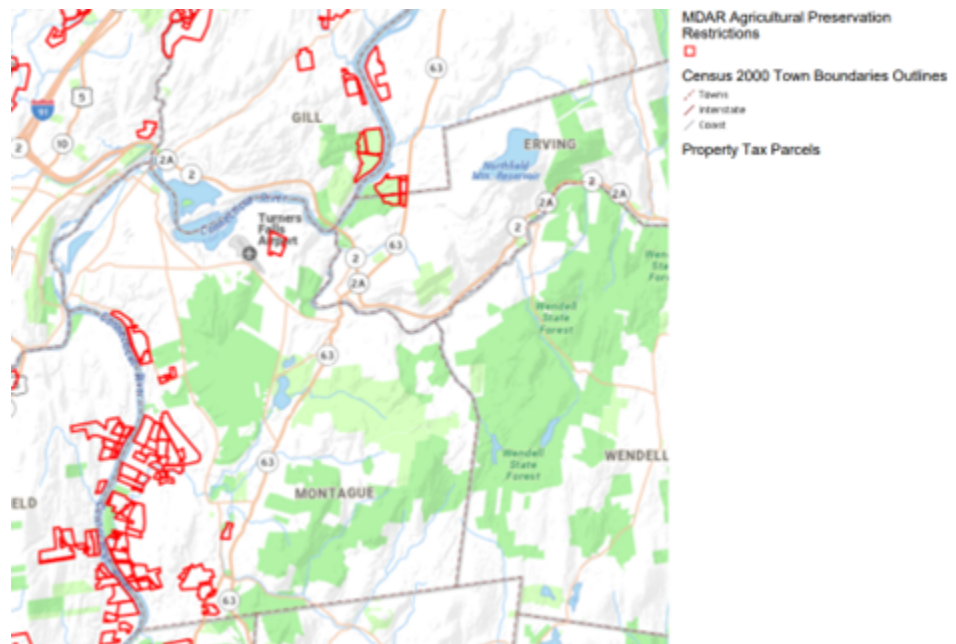
Address	Site use	Acres
262 Millers Falls Road	Building and manufacturing operations	14.61
Turnpike Road	Improved land	9.81
<i>Plains Road</i>	<i>Department of Conservation</i>	<i>30.75</i>
Turners Falls Road	Vacant, Education (municipal or county)	5.12
		<b>Total 60.29 acres</b>

**Table 6** Areas of bare land in Montague.

## 5.6 Agricultural Resources

There is a significant level of active agriculture in Montague, and large areas of prime farmland. According to MassGIS Land Cover data, 631 acres are currently cultivated in Montague and 553 acres are kept in pasture/hay.

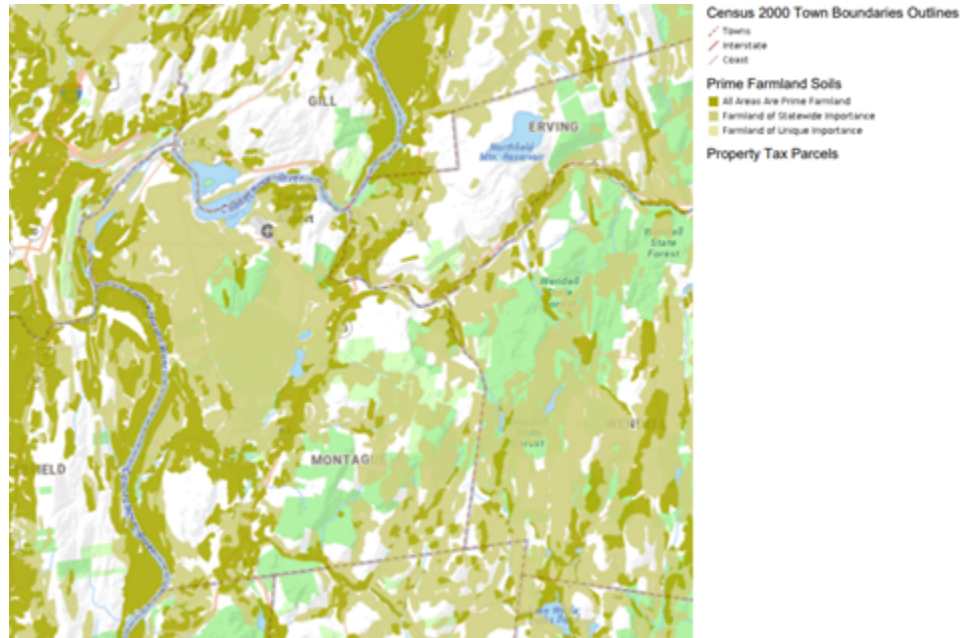
A total of 57 properties are currently (2020) enrolled in the Chapter 61A program for the purposes of agricultural production, totaling 722 acres. In addition, there are some mixed-use properties which include land enrolled in Chapter 61A. Forty-nine properties totaling 965 acres are permanently protected through Agricultural Preservation Restrictions (APR). **Figure 10** below shows the land that has agricultural protection restrictions. These areas are mainly located along the Connecticut River.



**Figure 10** A map of Montague showing areas with agricultural protection restrictions. Source: <https://maps.massgis.digital.mass.gov/MassMapper/MassMapper.html>.

**Figure 11** below shows areas of prime farmland soils in Montague. A majority of the farmland is also considered of statewide importance or unique importance. These areas are mostly in the center and the southwest corner of Montague. In total, the town hosts approximately 5,000 acres of statewide/unique importance soil. Prime farmland is largely located along the Connecticut river and through the middle of Montague. In total there are around 3,000 acres of prime farmland in Montague.





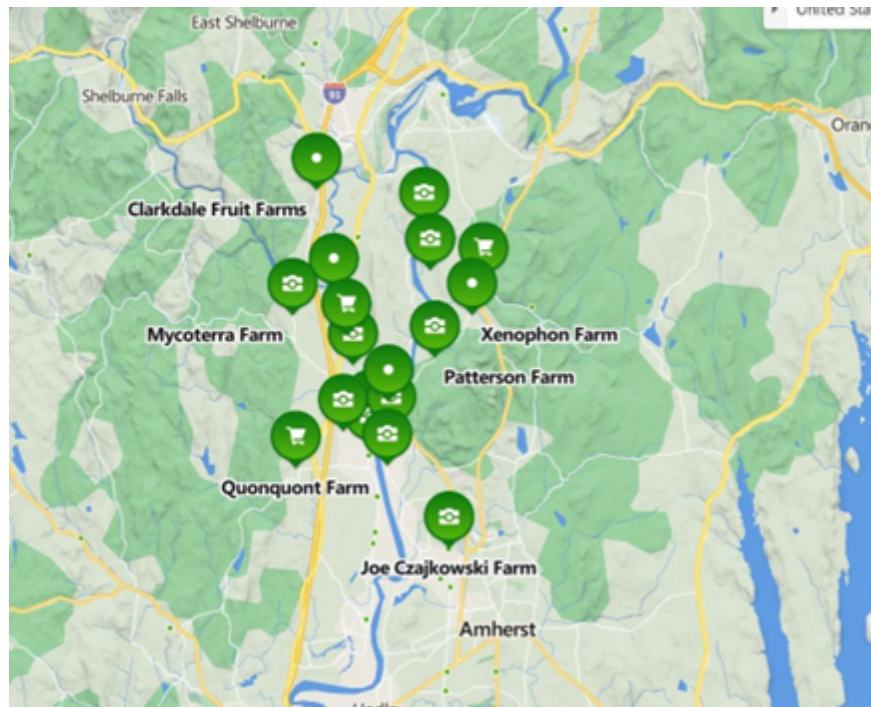
**Figure 11** Map of Montague showing areas of prime farmland, farmland of statewide importance, and farmland of unique importance. Source: <https://maps.massgis.digital.mass.gov/MassMapper/MassMapper.html>.

Note that at least 15 large barn roofs were identified in Section 5.3, as well as large greenhouses.

The following farms were identified in Montague which could be approached regarding their interest in agriculturally related energy projects. Most are clustered along the Connecticut River as shown in **Figure 12** below.

- Big Foot Food Forest: 16 Hatchery Road
- Boulder Top Farm: 8 Richardson Road
- Brook’s Bend Farm: 119 Old Sunderland Road
- Falls Farm CSA: 202 Old Sunderland Rd
- Great Falls Aquaculture: 1 Australia Way
- Great Falls Harvest: 50 3<sup>rd</sup> Street
- Little Song Farm: 119 Old Sunderland Road
- Our Family Legacy Farm: 442 Turners Falls Road
- Ox and Robin: 131 Chestnut Hill Loop
- Red Fire Farm: 184 Meadow Road (already has solar on at least some structures)
- Ripley Farm: 11 W Chestnut Hill Road
- Sugarbush Farm: 47 Davis Road
- They Keep Bees: 258 Greenfield Road
- Waidlich Farm: East Mineral Road

- Xenophon Farm: 80 Sunderland Road (has some solar on barn roof)



**Figure 12** Map showing the locations of farms in Montague.

Roof-mounted systems designed to support on-farm electricity use, solar parking canopies to protect farm equipment, dual-use systems developed to allow continued use of the land underneath the panels for agriculture, or other types of solar facilities may be appropriate for some of the sites. On-farm solar potential can be further explored in conjunction with the Massachusetts Department of Agricultural Resources, which provides agricultural energy grants to farms across the state.

### 5.7 Commercial-Scale Development Sites

As a final step in the assessment, we explored the potential for large-scale commercial solar development on currently undeveloped land within Montague. When looking for a location to install a solar facility, solar developers typically look for a location near (within 2,000 ft of) a three-phase distribution line because the expense of upgrading single-phase lines to allow interconnection of a solar facility can be cost-prohibitive. In addition, commercial developers typically look for a site where it is possible to install a large facility. For this analysis, we considered a minimum lot size of 5 acres, which could accommodate a solar facility of at least 1 MW.

Based on Mass Audubon’s analysis<sup>6</sup>, Montague’s 20,150 acres (31.5 square miles) include:

- 15,585 acres (77%) of natural land
- 2,126 acres (11%) of open land

<sup>6</sup> Ricci, E.H., J. Collins, J. Clarke, P. Dolci, and L. de la Parra. 2020. Losing Ground: Nature’s Value in a Changing Climate. Massachusetts Audubon Society, Inc., Lincoln, Massachusetts, 33 pp.; <https://www.massaudubon.org/our-conservation-work/policy-advocacy/local-climate-resilient-communities/losing-ground/statistics/town/montague>

- 2,081 acres (10%) of developed land
- 55 acres of land in Montague were “newly developed” from 2012-2017, which ranks the town at 171st (out of 351 cities and towns) in the state for the rate of development.
- Montague has 7,915 acres (39%) of permanently conserved land, ranking it 40th in the state for amount of conserved land.
- 1,128 acres of land were “newly conserved” from 2012 to 2019. 598 of these acres were BioMap2 Core Habitat, 659 acres were BioMap2 Critical Natural Landscape, and 69 acres were classified by The Nature Conservancy as “resilient.”

Because the majority of Montague is undeveloped, properties of a size appropriate for commercial-scale solar development sites are most likely to consist largely of undeveloped land. When evaluating the potential for commercial-scale solar development, it is important to consider what undeveloped areas which may be unsuitable for solar, either because they are legally protected from solar development or because they may be important areas for recreation or wildlife habitat protection.

In Montague, there are a number of large, permanently protected properties which are not available for development. These include the Montague Plains WMA and Montague State Forest, properties of the Commonwealth of Massachusetts, and the Water Supply Zone for Turners Falls. Smaller protected areas include Tolland Farms and the Sawmill River Access area.

Montague also has a number of properties which are currently enrolled in the Chapter 61 and Chapter 61B programs, providing timber products, recreation, wildlife habitat, or open space value. Chapter 61 and 61B programs act as a financial disincentive for solar development but do not preclude development of these parcels. A total of 66 properties are currently (2020) enrolled in one of these programs, comprising 1,399 acres. In addition, there are some mixed-use properties which include land enrolled in these programs.

Several large water bodies and rivers are located in Montague. These include the Connecticut River, the Sawmill River, the Millers River, Lake Pleasant, and Green Pond. Under the Massachusetts Wetland Protection Act, development in wetlands, lakes, rivers, and perennial streams is prohibited. The Conservation Commission must be consulted regarding any projects proposed within 200 ft of a river or stream or 100 ft of a wetland.

The town also has large areas of BioMap2 habitat, which represent valuable habitat for wildlife and plant species. Solar development is not prohibited in these areas but may require review by the state Natural Heritage and Endangered Species Program. In addition, these areas are not currently eligible for state incentives for solar development, due to the values they offer as open land maintained in its natural condition. Much of Montague is mapped as BioMap2 habitat, although there are portions of the southwest portion of town, and a large area around Turners Falls, which are not mapped as priority wildlife habitat.

As noted above, for this analysis of potential sites for commercial-scale development, we considered properties with a minimum lot size of 5 acres – equivalent to approximately 1 MW of solar development – located within 2,000 feet of an existing three-phase distribution line. Within Montague, 342 properties meet these criteria, but 75 properties are largely comprised of permanently protected land. This leaves 267 properties with the potential for commercial-scale solar development, totaling some 4,161 acres. However, wetlands comprise a considerable portion of these properties, and are not available for development. Removing wetland areas leaves approximately 3,838 acres available for development across these 249 properties.

The current state solar incentive program does not provide incentives for solar development on land identified in state databases as important habitat conservation land – designated either as BioMap2 Core Habitat or Critical Natural Landscapes – or for development on parcels on which more than half of property receives this designation. Further excluding these parcels, as well as the BioMap2 habitat on developable parcels, 101 properties remain with the potential for large-scale solar development, totaling roughly 1,562 acres of land that is not comprised of permanently protected land, wetlands, or BioMap2 habitat. Note that this estimate does not take into consideration the current land use at the property. Some of these properties may include single-family homes and residential yards. Montague’s OSRP makes clear that maintaining the town’s natural resources is a priority for residents, and consideration must be given to the appearance of the land.

See **Map A.4** in **Appendix A** for a map of properties with the potential for large-scale solar development overlaid with constraints on development (i.e., permanently protected lands, wetlands, BioMap2 habitat). Much of Montague is mapped as BioMap2 habitat, but there are some large parcels in western portions of town which are not permanently protected, do not have large wetlands, and do not consist largely of BioMap2 habitat. Some of these parcels have buildings located on them and others do not.

## 5.8 Summary

**Table 8** below provides a summary of solar resources identified in this assessment.

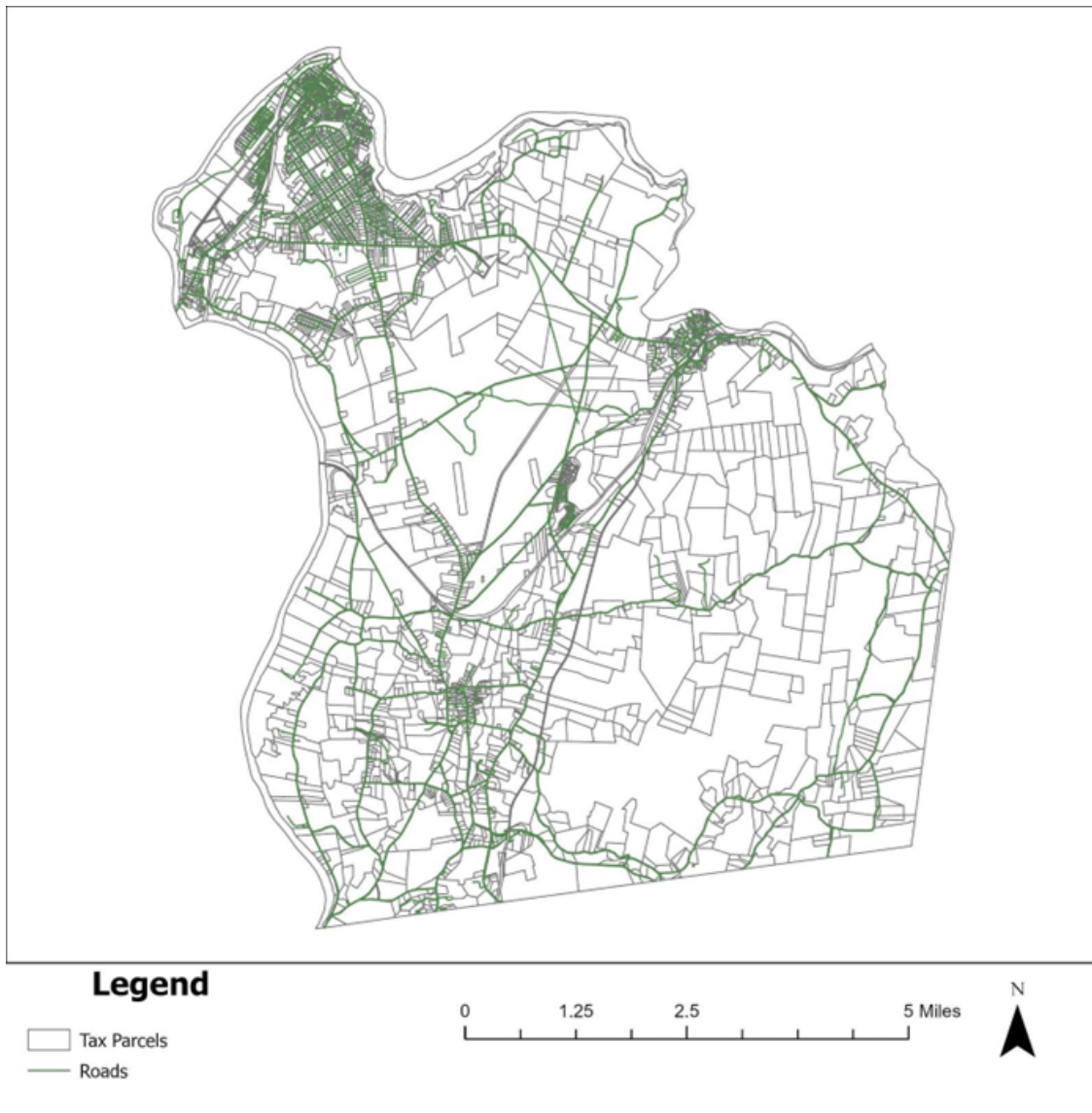
Resource Type	Resources Available	Estimated Technical Potential
Residential-Scale Solar	<ul style="list-style-type: none"> <li>- Total of 4,696 small building roofs with estimated 1,611,844 sf of small building roof space suitable for solar</li> <li>- Total number of residential households: 3,757</li> <li>- Estimated 2,555 residential households (68%) could support some solar</li> <li>- Average size of a residential solar array: 7.26 kW</li> </ul>	<ul style="list-style-type: none"> <li>-At least 18.5 MW assuming 68% of households can install a roof or ground-mounted system</li> <li>-24.0 MW if all small building roofs were developed</li> </ul>
Medium to Large Scale Roofs	<ul style="list-style-type: none"> <li>- Estimated 1.41 million sf across 121 medium and large rooftops suitable for solar</li> </ul>	Estimated at 21.0 MW
Parking Lots	<ul style="list-style-type: none"> <li>- Estimated 30.9 acres of parking lot space suitable for solar canopies at 21 properties</li> </ul>	8.1 MW, if all sites listed were to be developed
Landfills, Brownfields, and other Previously Disturbed Sites	<ul style="list-style-type: none"> <li>- Four brownfield sites totaling 4.5 acres</li> <li>-Additional previously developed sites in Montague could potentially qualify as brownfields</li> <li>- Two properties with sand-and-gravel operations totaling 32.5 acres, out of which about 6 acres are currently disturbed</li> <li>-Additional roughly 30 acres of bare soil to be evaluated across three sites</li> </ul>	<ul style="list-style-type: none"> <li>-Maximum of 0.9 MW on identified brownfield sites</li> <li>-Up to 6.5 MW on gravel pits if those sites become inactive</li> <li>-Additional sites to be evaluated for suitability for solar (30 acres of bare soil would equate to roughly 6 MW of solar)</li> </ul>
Agricultural Resources	<ul style="list-style-type: none"> <li>- Multiple active farms, at least 15 large barn roofs</li> <li>- Estimated 1,184 acres in agricultural production</li> <li>- At least 722 acres in Chapter 61A program for agriculture</li> </ul>	<ul style="list-style-type: none"> <li>-656 kW on barn roofs</li> <li>-Other projects dependent on project type (e.g., solar greenhouses, parking canopies for farm equipment, agrivoltaic arrays, solar arrays at field margins)</li> </ul>

Resource Type	Resources Available	Estimated Technical Potential
Undeveloped Land	<p>-249 large land parcels located near three-phase power have at least 5 acres that are not permanently protected, not wetlands, and are near three-phase power = 3,838 acres of non-wetland land</p> <p>-101 large land parcels have at least 5 acres located near three-phase power that are not permanently protected, not wetlands, and not located on properties that are more than 50% BioMap2 habitat, eligible land on these properties = 1,562 acres</p>	<p>Approximately 1 MW per 5 acres:  3,838 acres = 768 MW  1,562 acres = 312 MW</p> <p><i>It is not expected that all undeveloped land available would be built out for solar development.</i></p>

## Appendix A – Maps of Solar Resources and Infrastructure

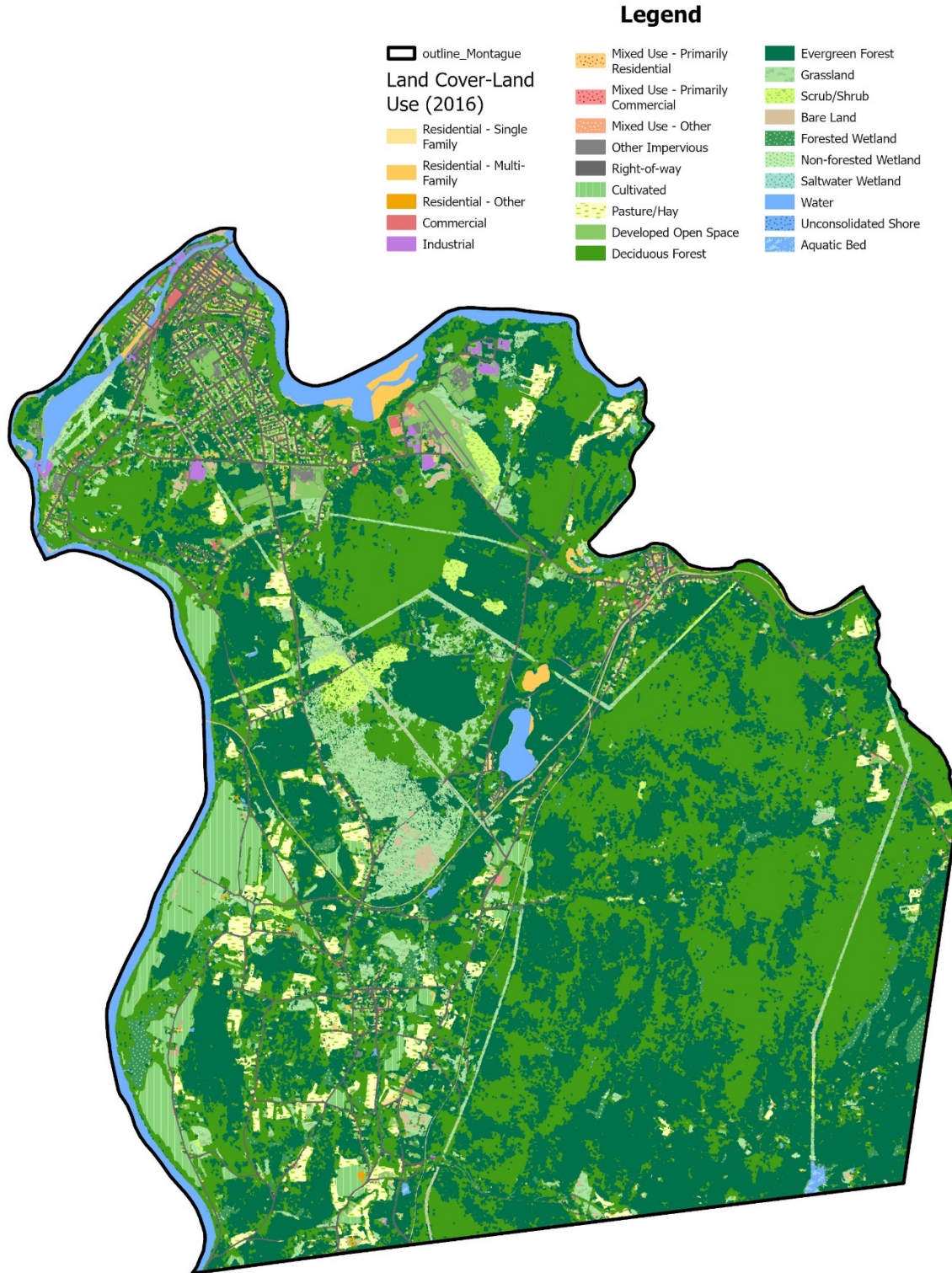
### A.1 Roads and Property Lines

Data from MassGIS Tax Parcel data (<https://docs.digital.mass.gov/dataset/massgis-data-standardized-assessors-parcels>) and MassDOT roads.



## A.2 Land Cover

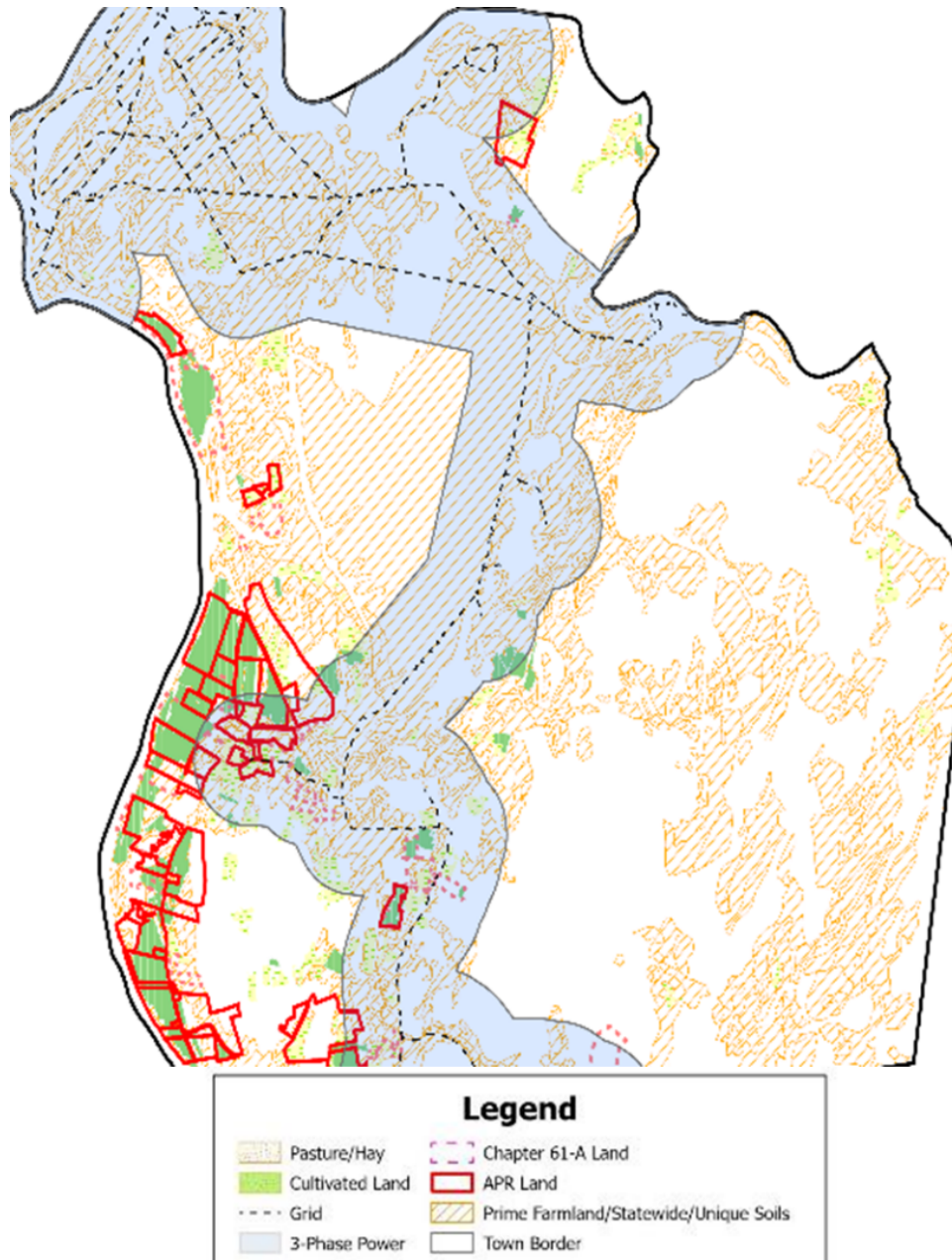
Land cover data from the MassGIS Land Cover/Land Use data layer, updated in 2016 (<https://www.mass.gov/info-details/massgis-data-2016-land-coverland-use>).





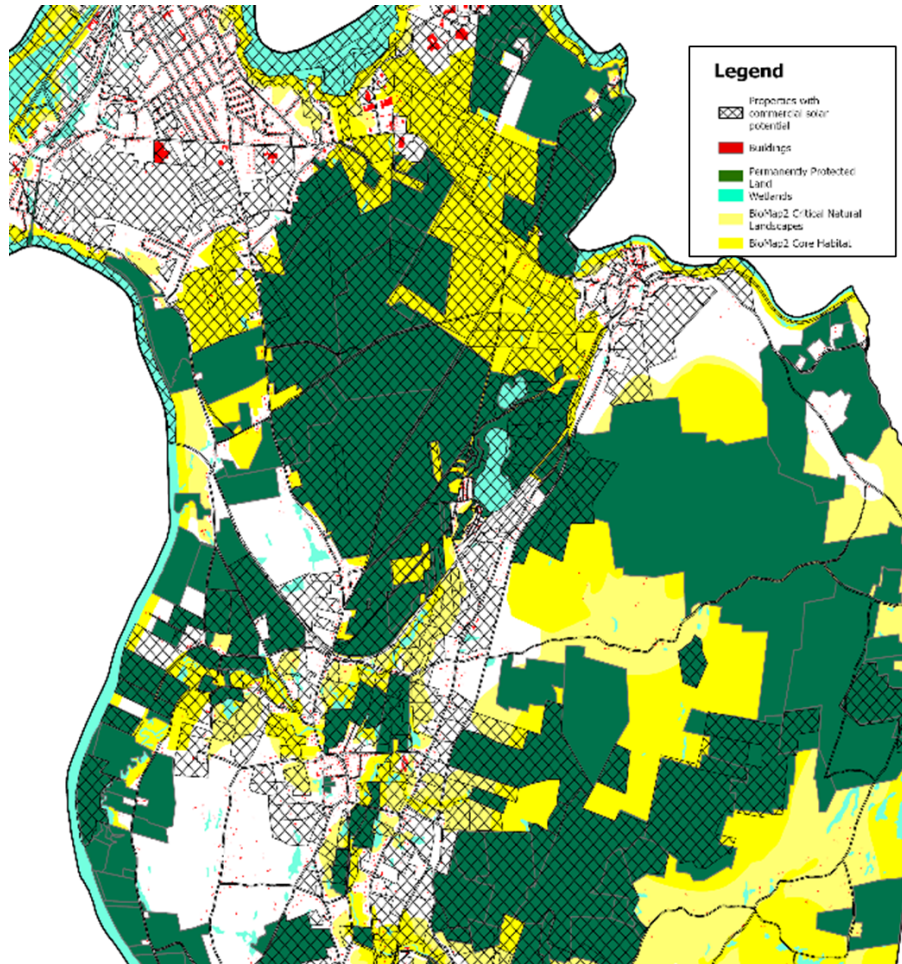
### A.3 Agricultural Resources

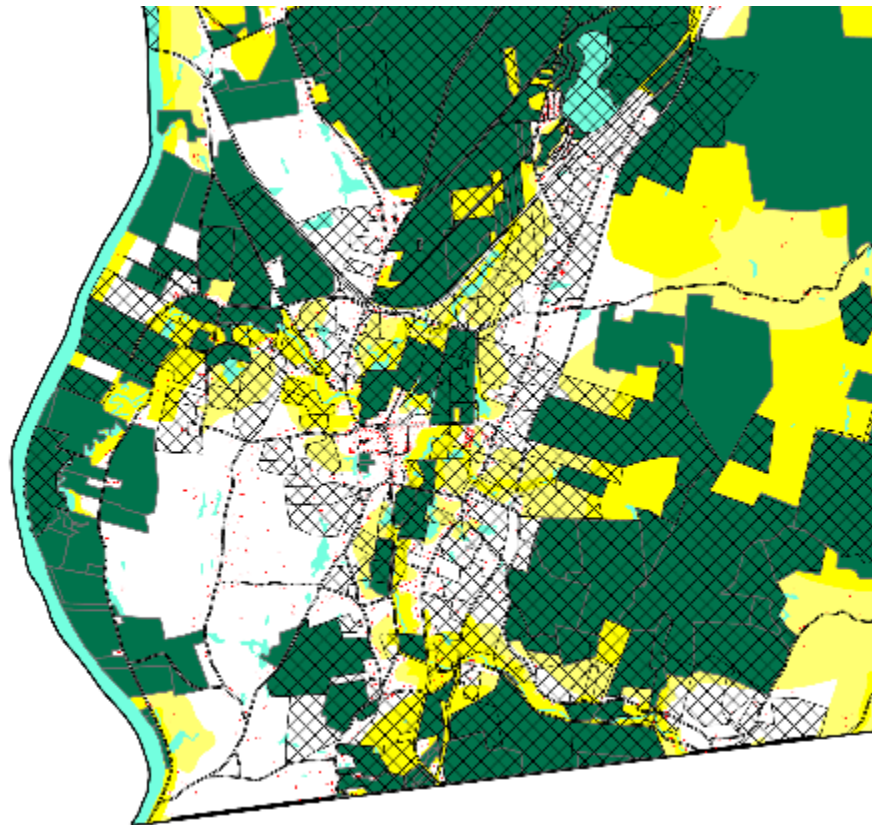
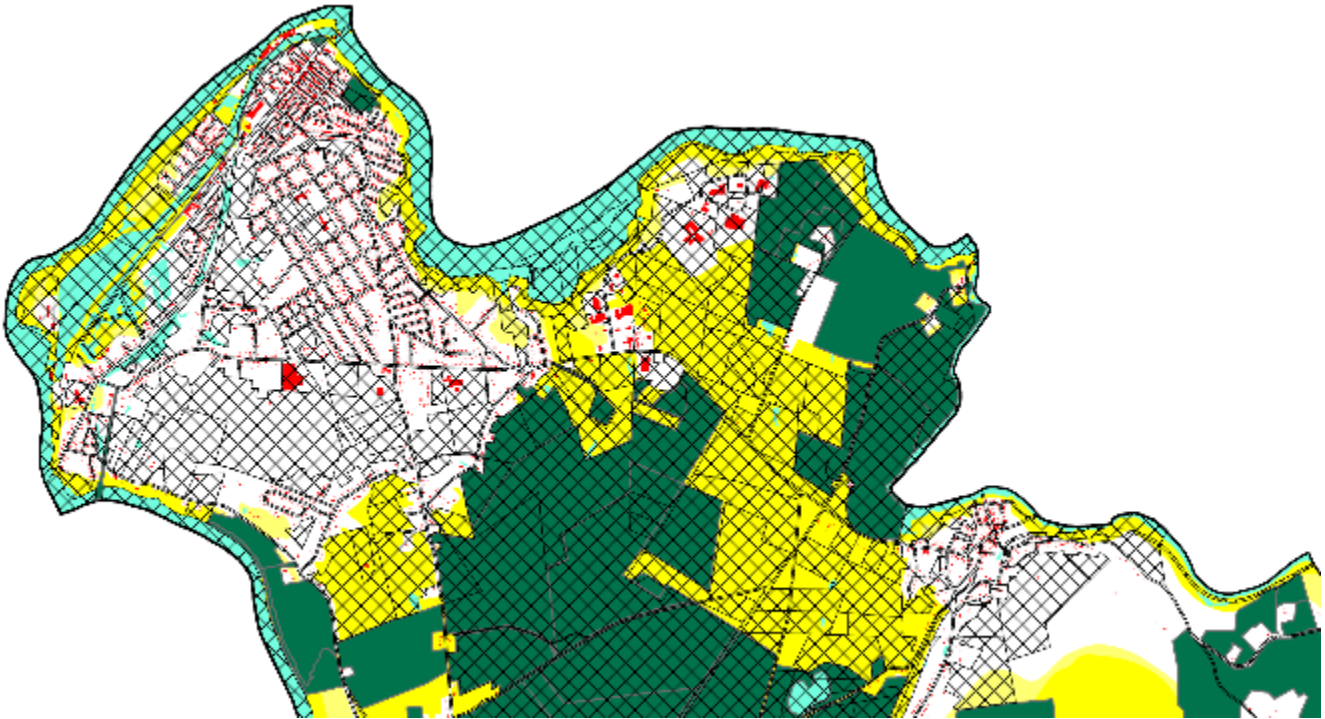
Data from MassGIS Tax Parcel data (<https://docs.digital.mass.gov/dataset/massgis-data-standardized-assessors-parcels>), MassGIS Land Cover/Land Use data layer (<https://docs.digital.mass.gov/dataset/massgis-data-2016-land-coverland-use>), and NRCS SSURGO-Certified Soils (<https://docs.digital.mass.gov/dataset/massgis-data-nrcs-ssurgo-certified-soils>).<sup>4</sup>



#### A.4 Parcels available for Commercial-Scale Development

This map depicts parcels suitable for solar development due to large size (5 acres or more) and proximity to three-phase distribution lines (within 2,000 ft), as well as several constraints on development, including permanent conservation protections, presence of wetlands, and extent of BioMap2 wildlife habitat. Buildings present on the property could also indicate a competing land use. Data from MassGIS BioMap2 repository (<https://docs.digital.mass.gov/dataset/massgis-data-biomap2>), MassGIS Protected Land and Recreational Open Space (<https://docs.digital.mass.gov/dataset/massgis-data-protected-and-recreational-openspace>), and MassGIS OLIVER DEP wetlands data layer ([http://maps.massgis.state.ma.us/map\\_ol/oliver.php](http://maps.massgis.state.ma.us/map_ol/oliver.php)).





Note that some large parcels near Turners Falls and Millers Falls (above) and in the southwest portion of town (left) are near three-phase power and include large areas not mapped as priority wildlife habitat or wetlands, and not permanently protected, which means they could be suitable for solar development. However, competing land uses (such as residential or agricultural use) are already occurring on some of these properties, which would preclude development for solar.

## Appendix B – Medium and Large Roofs

Structure/Ownership Status	Street Address	Total Roof Area (sf)	Estimated Technical Solar Potential (kW)
Judd Wire	124 Turnpike Rd	253,121	2,483
Franklin County Technical School	82 Industrial Blvd	154,104	1,511
Heat Fab	130 Industrial Blvd	141,198	1,385
New England Extrusion, Inc.	Industrial Blvd	101,873	999
Turners Falls High School	222 Turnpike Rd	93,048	913
Hillside Plastics	262 Millers Falls Rd	71,516	701
Mayhew Steel Products	199 Industrial Blvd	70,105	688
Great Falls Aquaculture	1 Australia Wy	69,300	680
Shopping complex: Walgreens, Food City and Aubuchon Hardware	250 Avenue A	65,877	646
Light Life Foods	Rear Light Life Way	59,366	582
Montague Machine Co.	15 Rastallis St	55,830	548
Atlantic Golf & Turf	27 Industrial Blvd	52,367	514
Paper logic (closed)	36 Canal Rd	49,771	488
Foreclosed Property (owned by Town of Montague)	20 Canal Rd	49,589	486
Sheffield Elementary School	40 Crocker Avenue	45,506	446
Hillcrest School	30 Griswold St	34,544	339
253 Pharmacy Recreational Weed Dispensary	253 Millers Falls Rd	29,947	294
Department of Public Works	128 Turners Falls Rd	28,804	282
Shea Theater/Crocker Cutlery Apartments	61 Third St	27,254	267
Turners Falls Water Department	226 Millers Falls Rd	26,310	258
Public Safety Complex (Town of Montague)	178 Turnpike Rd	22,971	167
JaDuke Center - Performing Arts	110 Industrial Blvd	21,087	154
FirstLight Hydro Facility	15 Cabot St	19,725	144
Turbosteam Manufacturing	161 Industrial Blvd	17,908	130
Business Complex	320 Avenue A	16,883	123
Pioneer Aviation Building (Airport)	40 Industrial Blvd	14,696	107
Rubin's Auto Service	194 Millers Falls Rd	14,612	106
Turners Falls Airport	36 Industrial Blvd	14,592	106
Apartment	15 School St	14,525	106
US Geological Survey (Government Building)	1 Migratory Wy	14,251	104
US Geological Survey (Government Building)	1 Migratory Wy	13,522	98
Municipal	500 Avenue A	12,722	93
Office	282 Avenue A	12,397	90
Business Complex	123 Avenue A	12,224	89
Montague Housing Authority Maintenance	41 Sunrise Terrace	12,068	88
Montague Town Treasurer	1 Avenue A	11,881	87
Office	241 Millers Fall Rd.	11,696	85
Baystate Health Office	8 Burnham St	11,147	81
Office	42A Canal Rd.	10,421	76
Millers Falls Rod & Gun Club	210 Turners Falls Rd.	10,351	75
Residential - Apartments	15 Canal St	9,886	72

Business - Manufacturing	26 North Leverett Rd	9,590	70
Firstlight Electricity Generation Facility	26 Power St	9,522	69
Greenhouse - Red Fire Farm (already has solar PV)	184 Meadow Rd	9,461	66
Turners Falls Airport	Millers Falls Rd	9,369	68
Greenhouse - Red Fire Farm	184 Meadow Rd	9,105	66
Franklin Survival Center	96 4th St	9,079	66
Business - Manufacturing	15 Rod Shop Rd	8,958	65
Barn - Agricultural	South Ferry Rd	8,846	64
Clean Water Facility	34 Greenfield Rd	8,714	63
Business - Manufacturing	10 Industrial Blvd	8,645	63
Business Complex - Restaurants	33 East Main St	8,612	63
Residential - Apartments	152 Avenue A	8,489	62
JaDuke Theater	110 Industrial Blvd	8,485	62
United Arc	294 Avenue A	8,353	61
Business Complex	107 Avenue A	8,192	60
Kustom AutoBody Garage	48 Randall Rd	8,082	59
Elementary School (Town of Montague)	35 Crocker Ave	8,081	59
Montague Center Fire Department (Town of Montague)	28 Old Sunderland Rd	8,065	59
Greenhouse - Red Fire Farm	184 Meadow Rd	7,986	56
Business Complex	76 Avenue A	7,727	56
Business	400 Avenue A	7,720	56
Catholic Church	80 Seventh St	7,555	55
FastLights Lighting	47 J St	7,529	55
Marks Rentals Garage	484 Federal St	7,522	55
Barn - Agricultural	Old Greenfield Rd	7,324	53
Business - Manufacturing	10 Industrial Blvd	7,168	52
Industrial - Firstlight Electricity Generation	0 Avenue A	7,154	52
Church	148 L St	7,134	52
Warehouse - Commercial	7 Rod Shop Rd	7,031	51
Turners Falls Airport	36 Industrial Blvd	6,939	51
Great Falls Discovery Center	2 Avenue A	6,926	50
Medical Offices	Rear Burnham St	6,788	49
Warehouse (Town of Montague)	20 Canal Rd	6,742	49
Residential - Multifamily	60 J St	6,728	49
Business Complex	104 Avenue A	6,656	48
Office Complex	176 Ripley Rd	6,636	48
Business Complex	161 Avenue A	6,616	48
Shanahan Construction	298 Avenue A	6,575	48
Business Complex	82 Third St	6,486	47
Element Brewing Company	16 Bridge St	6,473	47
House with barn complex	442 Federal St	6,471	47
Residential - Multifamily	801 Fairway Ave	6,443	47
Residential - Multifamily	801 Fairway Ave	6,425	47
Business Complex	Unity St	6,353	46
Barn - Residential	N/A	6,238	45
Church	19 Bridge St	6,107	44

Residential - Multifamily	801 Fairway Ave	6,103	44
Water Treatment Facility (Town of Montague)	92 Green Pond Rd	6,025	44
Barn - State DFG	W Chestnut Hill Rd	6,002	44
Barn - Commercial	Rear Montague City Rd	5,991	44
Barn - Agricultural	Meadow Rd	5,982	44
Barn - Agricultural	Meadow Rd	5,973	43
Offices of Dolan & Dolan	170 Avenue A	5,852	43
Barn - Agricultural	Wills Ferry Rd	5,838	43
Barn - Agricultural	Meadow Rd	5,791	42
Barn - Residential	N/A	5,735	42
Social Hall	197 Avenue A	5,713	42
Barn - Agricultural	Meadow Rd	5,704	42
Barn - Agricultural	N/A	5,532	40
Offices	15 Power St	5,488	40
Business (closed)	310 Federal St	5,477	40
Business Complex	52 Avenue A	5,442	40
Residential - Apartments	11 Fourth St	5,432	40
Barn - Red Fire Farm	172 Meadow Rd	5,415	39
Residential	N/A	5,352	39
Jarvis Pools & Spas	72 Unity St	5,329	39
Business - Funeral Home	1 Kostanski Sq	5,308	39
Warehouse - Commercial	314 Montague City Rd	5,272	38
Residential - Multifamily	27 West St	5,263	38
Social Hall	1 Elks Ave	5,224	38
Brick & Feather Brewery	320 Avenue A	5,158	38
Church	4 North St	5,148	37
Barn - Residential	N/A	5,143	37
Business - Closed	5 Millers Falls Rd	5,140	37
Country Club/Golf Course	29 Country Club Ln	5,121	37
Residential - Apartments	152 Avenue A	5,107	37
Residential	N/A	5,046	37