5.4.7 Wildfire

This section provides a profile and vulnerability assessment for the wildfire hazard.

5.4.7.1 Hazard Profile

This section provides profile information including description, location, extent, previous occurrences and losses and the probability of future occurrences.

Description

According to the New York State Hazard Mitigation Plan (NYS HMP), wildfire is defined as an uncontrolled fire spreading through natural or unnatural vegetation that often has the potential to threaten lives and property if not contained. Wildfires that burn in or threaten to burn buildings and other structures are referred to as wildland urban interface fires. Wildfires include common terms such as forest fires, brush fires, grass fires, wildland urban interface fires, range fires or ground fires. Wildfires do not include those fires, either naturally or purposely ignited, that are controlled for a defined purpose of managing vegetation for one or more benefits (NYS DHSES, 2014).

Wildfire in New York State is based on the same science and environmental factors as any wildfire in the world. Fuels, weather, and topography are the primary factors that determine the natural spread and destruction of every wildfire. New York State, including Putnam County, has large tracts of diverse forest lands, many of which are the result of historic destructive wildfires. Although destructive fires do not occur on an annual basis, the State's fire history shows a cycle of fire occurrence that result in human death, property loss, forest destruction, and air pollution (NYS DHSES, 2014).

There are three different classes of wildfires: surface fires, ground fires, and crown fires. Surface fires are the most common type and burns along the forest floor, moving slowly and killing or damaging trees. Ground fires are usually started by lightning and burns on or below the forest floor. Crown fires spread rapidly by wind and move quickly by jumping along the tops of trees.

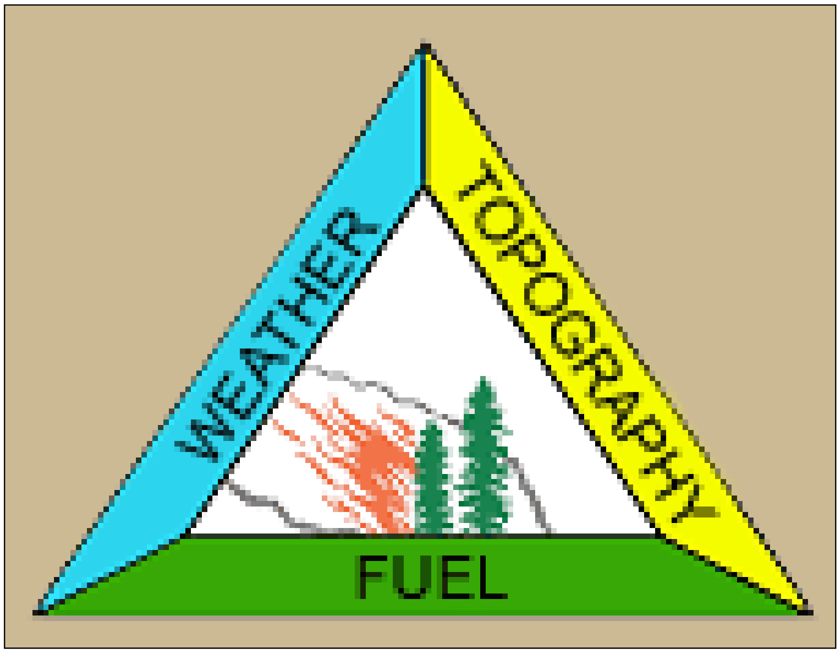
FEMA indicates that there are four categories of wildfires that are experienced throughout the U.S. These categories are defined as follows:

- Wildland fires – fueled almost exclusively by natural vegetation. They typically occur in national forests and parks, where Federal agencies are responsible for fire management and suppression.
- Interface or intermix fires – urban/wildland fires in which vegetation and the built-environment provide fuel
- Firestorms – events of such extreme intensity that effective suppression is virtually impossible. Firestorms occur during extreme weather and generally burn until conditions change or the available fuel is exhausted.
- Prescribed fires and prescribed natural burns – fires that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes (FEMA, 1997).

Fire Ecology and Wildfire Behavior

Fire behavior is one of the most important aspects of wildfires because almost all actions taken on a fire depend on how it behaves. Success in pre-suppression planning and actual suppression of wildfires is directly related to how well fire managers understand and are able to predict fire behavior. Fire behavior is defined as the manner in which fuel ignites, flame develops, and fire spreads as determined by the interaction of fuel, weather and topography. The wildfire behavior triangle (Figure 5.4.7-1) illustrates how each these factors influence wildfire.

Figure 5.4.7-1. Wildfire Behavior Triangle



Source: USDA Forest Service, Date Unknown

The potential for wildfire, and its subsequent development (growth) and severity, is determined by the three principal factors (topography, fuel and weather). These factors are described below:

Topography - Topography can have a powerful influence on wildfire behavior. The movement of air over the terrain tends to direct a fire's course. Gulches and canyons can funnel air and act as a chimney, intensifying fire behavior and inducing faster spread rates. Saddles on ridgetops tend to offer lower resistance to the passage of air and will draw fires. Solar heating of drier, south-facing slopes produces upslope thermal winds that can complicate behavior.

Slope is an important factor. If the percentage of uphill slope doubles, the rate at which the wildfire spreads will most likely double. On steep slopes, fuels on the uphill side of the fire are closer physically to the source of heat. Radiation preheats and dries the fuel, thus intensifying fire behavior. Terrain can inhibit wildfires: fire travels downslope much more slowly than it does upslope, and ridgetops often mark the end of wildfire's rapid spread (FEMA, 1997).

Fuel - Fuels are classified by weight or volume (fuel loading) and by type. Fuel loading can be used to describe the amount of vegetative material available. If this doubles, the energy released can also be expected to double. Each fuel type is given a burn index, which is an estimate of the amount of potential energy that may be released, the effort required to obtain a fire in a given fuel, and the expected flame length. Different fuels have different burn qualities and some burn more easily than others. Grass releases relatively little energy but can sustain very high rates of spread (FEMA, 1997). According to the U.S. Forest Service, a forest stand may consist of several layers of live and dead vegetation in the understory (surface fuels), midstory (ladder fuels), and overstory (crown fuels). Fire behavior is strongly influenced by these fuels. Each of these layers provides a different type of fuel source for wildfires.

- Surface fuels consist of grasses, shrubs, litter, and woody material lying on the ground. Surface fires burn low vegetation, woody debris, and litter. Under the right conditions, surface fires reduce the likelihood that future wildfires will grow into crown fires.
- Ladder fuels consist of live and dead small trees and shrubs; live and dead lower branches from larger trees, needles, vines, lichens, mosses, and any other combustible biomass located between the top of the surface fuels and the bottom of the overstory tree crowns.
- Crown fuels are suspended above the ground in treetops or other vegetation and consists mostly of live and dead fine material. When historically low-density forests become overcrowded, tree crowns may merge and form a closed canopy. Tree canopies are the primary fuel layer in a forest crown fire (U.S. Forest Service, 2003).

Weather / Air Mass - Weather is the most important factor in the make-up of a fire's environment, yet it is always changing. Air mass, which is defined by the National Weather Service (NWS) as a body of air covering a relatively wide area and exhibiting horizontally uniform properties, can impact wildfire through climate, including temperature and relative humidity, local wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere at the time of the fire (NWS, 2009). Extreme weather leads to extreme events and it is often a moderation of the weather that marks the end of a wildfire's growth and the beginning of successful containment. High temperatures and low humidity can produce vigorous fire activity. Fronts and thunderstorms can produce winds that are capable of radical and sudden changes in speed and direction, causing similar changes in fire activity. The rate of spread of a fire varies directly with wind velocity. Winds may play a dominant role in directing the course of a fire. The most damaging firestorms are typically marked by high winds (FEMA, 1997).

Extent

The extent (that is, magnitude or severity) of wildfires depends on weather and human activity. There are several tools available to estimate fire potential, extent, danger and growth including, but not limited to the following:

Wildland/Urban Interface (WUI) is the area where houses and wildland vegetation coincide. Interface neighborhoods are found all across the U.S., and include many of the sprawling areas that grew during the 1990s. Housing developments alter the structure and function of forests and other wildland areas. The outcomes of the fire in the WUI are negative for residents; some may only experience smoke or evacuation, while others may lose their homes to a wildfire. All states have at least a small amount of land classified as WUI. To determine the WUI, structures per acre and population per square mile are used. Across the U.S., 9.3-percent of all land is classified as WUI. The WUI in the area is divided into two categories: intermix and interface. Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface areas have more than one house per 40 acres, have less than 50-percent vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75-percent vegetated (Stewart et al., 2006).

Concentrations of WUI can be seen along the east coast of the U.S., where housing density rarely falls below the threshold of one housing unit per 40 acres and forest cover is abundant. In the mid-Atlantic and north central regions of the U.S., the areas not dominated by agriculture have interspersed WUI and low density vegetated areas. Areas where recreation and tourism dominate are also places where WUI is common, especially in the northern Great Lakes and Missouri Ozarks (Stewart et al., 2006).

Wildland Fire Assessment System (WFAS) is an internet-based information system that provides a national view of weather and fire potential, including national fires danger, weather maps and satellite-derived "greenness" maps. It was developed by the Fire Behavior unit at the Fire Sciences Laboratory in Missoula, Montana and is currently supported and maintained at the National Interagency Fire Center (NIFC) in Boise, Idaho (USFS, Date Unknown).

Each day during the fire season, national maps of selected fire weather and fire danger components of the National Fire Danger Rating System (NFDRS) are produced by the WFAS (USFS, Date Unknown). Fire Danger Rating level takes into account current and antecedent weather, fuel types, and both live and dead fuel moisture. This information is provided by local station managers (USFS, Date Unknown). Table 5.4.7-1 shows the fire danger rating and color code.

Table 5.4.7-1. Fire Danger Rating and Color Code

Fire Danger Rating and Color Code	Description
Low (L) (Dark Green)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate (M) (Light Green or Blue)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H) (Yellow)	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH) (Orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E) (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and tree tops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

Source: USFS, Date Unknown

The ***Fire Potential Index (FPI)*** is derived by combining daily weather and vegetation condition information and can identify the areas most susceptible to fire ignition. The combination of relative greenness and weather information identifies the moisture condition of the live and dead vegetation. The weather information also identifies areas of low humidity, high temperature, and no precipitation to identify areas most susceptible to fire ignition. The FPI enables local and regional fire planners to quantitatively measure fire ignition risk (USGS, 2005). FPI maps are provided on a daily basis by the U.S. Forest Service. The scale ranges from 0 (low) to 100 (high). The calculations used in the NFDRS are not part of the FPI, except for a 10-hour moisture content (Burgan et al, 2000).

Fuel Moisture (FM) content is the quantity of water in a fuel particle expressed as a percent of the oven-dry weight of the fuel particle. FM content is an expression of the cumulative effects of past and present weather events and must be considered in evaluating the effects of current or future weather on fire potential. FM is computed by dividing the weight of the "water" in the fuel by the oven-dry weight of the fuel and then multiplying by 100 to get the percent of moisture in a fuel (Burgan et al, 2000).

There are two kinds of FM: live and dead. Live fuel moistures are much slower to respond to environmental changes and are most influenced by things such as a long drought period, natural disease and insect infestation, annuals curing out early in the season, timber harvesting, and changes in the fuel models due to blow down from windstorms and ice storms (Burgan et al, 2000). Dead fuel moisture is the moisture in any cured or dead plant part, whether attached to a still-living plant or not. Dead fuels absorb moisture through physical contact with water (such as rain and dew) and absorb water vapor from the atmosphere. The drying of dead fuels is accomplished by evaporation. These drying and wetting processes of dead fuels are such that the moisture content of these fuels is strongly affected by fuel sizes, weather, topography, decay classes, fuel composition, surface coatings, fuel compactness and arrangement (Schroeder and Buck, 1970).

Fuels are classified into four categories which respond to changes in moisture. This response time is referred to as a time lag. A fuel's time lag is proportional to its diameter and is loosely defined as the time it takes a fuel particle to reach two-thirds of its way to equilibrium with its local environment. The four categories include:

- 1-hour fuels: up to ¼-inch diameter – fine, flashy fuels that respond quickly to weather changes. Computed from observation time, temperature, humidity, and cloudiness.
- 10-hour fuels: ¼-inch to one-inch in diameter - computed from observation time, temperature, humidity, and cloudiness or can be an observed value.
- 100-hour fuels: one-inch to three-inch in diameter - computed from 24-hour average boundary condition composed of day length (daylight hours), hours of rain, and daily temperature/humidity ranges.
- 1000-hour fuels: three-inch to eight-inch in diameter - computed from a seven-day average boundary condition composed of day length, hours of rain, and daily temperature/humidity ranges (National Park Service, Date Unknown).

The ***Keetch-Byram Drought Index (KBDI)*** is a drought index designed for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers (USFS, Date Unknown). The index increases each day without rain and decreases when it rains. The scale ranges from 0 (no moisture deficit) to 800 (maximum drought possible). The range of the index is determined by assuming that there is eight inches of moisture in a saturated soil that is readily available to the vegetation. For different soil types, the depth of soil required to hold eight inches of moisture varies. A prolonged drought influences fire intensity, largely because more fuel is available for combustion. The drying of organic material in the soil can lead to increased difficulty in fire suppression (Florida Forest Service, Date Unknown).

The ***Haines Index***, also known as the Lower Atmosphere Stability Index, is a fire weather index based on stability and moisture content of the lower atmosphere that measures the potential for existing fires to become large fires. It is named after its developer, Donald Haines, a Forest Service research meteorologist, who did the initial work and published the scale in 1988 (Storm Prediction Center [SPC], Date Unknown).

The Haines Index can range between 2 and 6. The drier and more unstable the lower atmosphere is, the higher the index. It is calculated by combining the stability and moisture content to the lower atmosphere into a number that correlates well with large fire growth. The stability term is determined by the temperature difference between two atmospheric layers; the moisture term is determined by the temperature and dew point different. The index, as listed below, has shown to correlate with large fire growth on initiating and existing fires where surface winds do not dominate fire behavior (USFS, Date Unknown).

- Very Low Potential (2) – moist, stable lower atmosphere
- Very Low Potential (3)
- Low Potential (4)
- Moderate Potential (5)
- High Potential (6) – dry, unstable lower atmosphere (USFS, Date Unknown)

The Haines Index is intended to be used all over the U.S. It is adaptable for three elevation regimes: low elevation, middle elevation, and high elevation. Low elevation is for fires at or very near sea level. Middle elevation is for fires burning in the 1,000 to 3,000 feet in elevation range. High elevation is intended for fires burning above 3,000 feet in elevation (SPC, Date Unknown).

The ***Landscape Fire and Resource Management Planning Tools Project (LANDFIRE)*** is a five-year, multi-partner project. The project is producing comprehensive and consistent maps and data describing vegetation, fire and fuel characteristics for the entire U.S. LANDFIRE is a shared project between the U.S. Department of Agriculture Forest Service and the U.S. Department of the Interior. The project has several principal partners, which include the USFS Missoula Fire Sciences Laboratory, the USGS Center for Earth Resources Observation and Science, and the Nature Conservancy (LANDFIRE, Date Unknown).

Additionally, the U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station developed a historical natural fire regimes dataset. The fire regimes are described in terms of frequency and severity and represent pre-settlement, historical fire processes. Fire regimes I and II represent frequent fire return intervals. The 0-35+ years/low severity fire regime (I) occurs mostly on forested land. The 0-35+years/stand-replacement regime (II) occurs mostly on grasslands and shrublands. Fire regimes III, IV, and V have longer fire return intervals and occur on forest lands, shrublands, and grasslands. These coarse-scale data were developed for national-level planning and were not intended to be used at finer spatial scales (Schmidt et al., 2002).

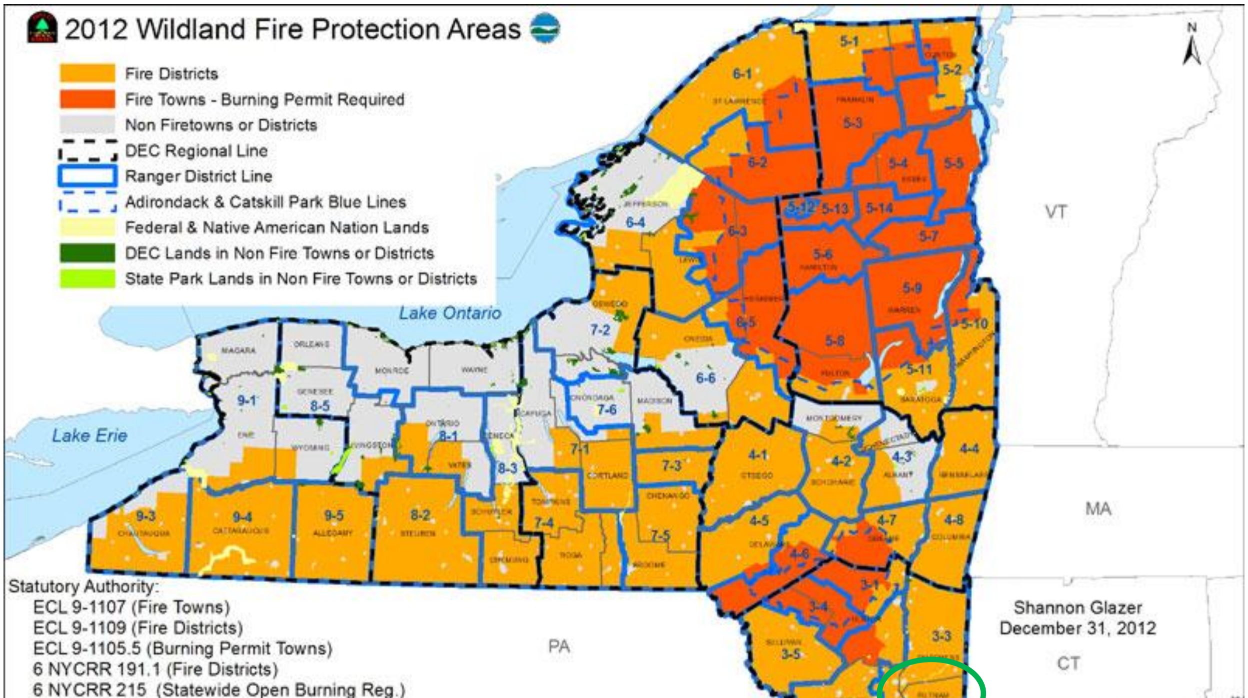
The ***Buildup Index (BUI)*** is a number that reflects the combined cumulative effects of daily drying and precipitation in fuels with a 10 day time lag constant. The BUI can represent three to four inches of compacted litter or can represent up to six inches or more of loose litter (North Carolina Forest Service, 2007).

Location

According to the U.S. Fire Administration (USFA), the fire problem in the U.S. varies from region to region. This often is a result of climate, poverty, education, demographics, and other causal factors (USFA, 2013). Wildfires do occur in New York State. Many areas in the State, particularly those that are heavily forested or contain large tracts of brush and shrubs, are prone to fires. New York State has over 18 million acres of non-Federal forested land, along with an undetermined amount of open space and wetlands. The Adirondacks, Catskills, Hudson Highlands, Shawangunk Ridge, and Long Island Pine Barrens are examples of fire-prone areas (NYSDEC, 2013).

In New York State, the NYSDEC's Division of Forest Protection (Forest Ranger Division) is designated as the State's lead agency for wildfire mitigation. The Forest Ranger Division has a statutory requirement to provide a forest fire protection system for 657 of the 932 jurisdictions throughout New York State. It includes cities and villages and cover 23.1 million acres of land, including all state-owned land outside of the jurisdictions. The Lake Ontario Plains and New York City-Long Island areas are the general areas not included in the statutory requirement. Figure 5.4.7-2 displays the fire protection areas in New York State. This figure indicates that, as of 2012, Putnam County is almost entirely included as part of the wildfire protection area.

Figure 5.4.7-2. Forest Ranger Division Wildfire Protection Areas

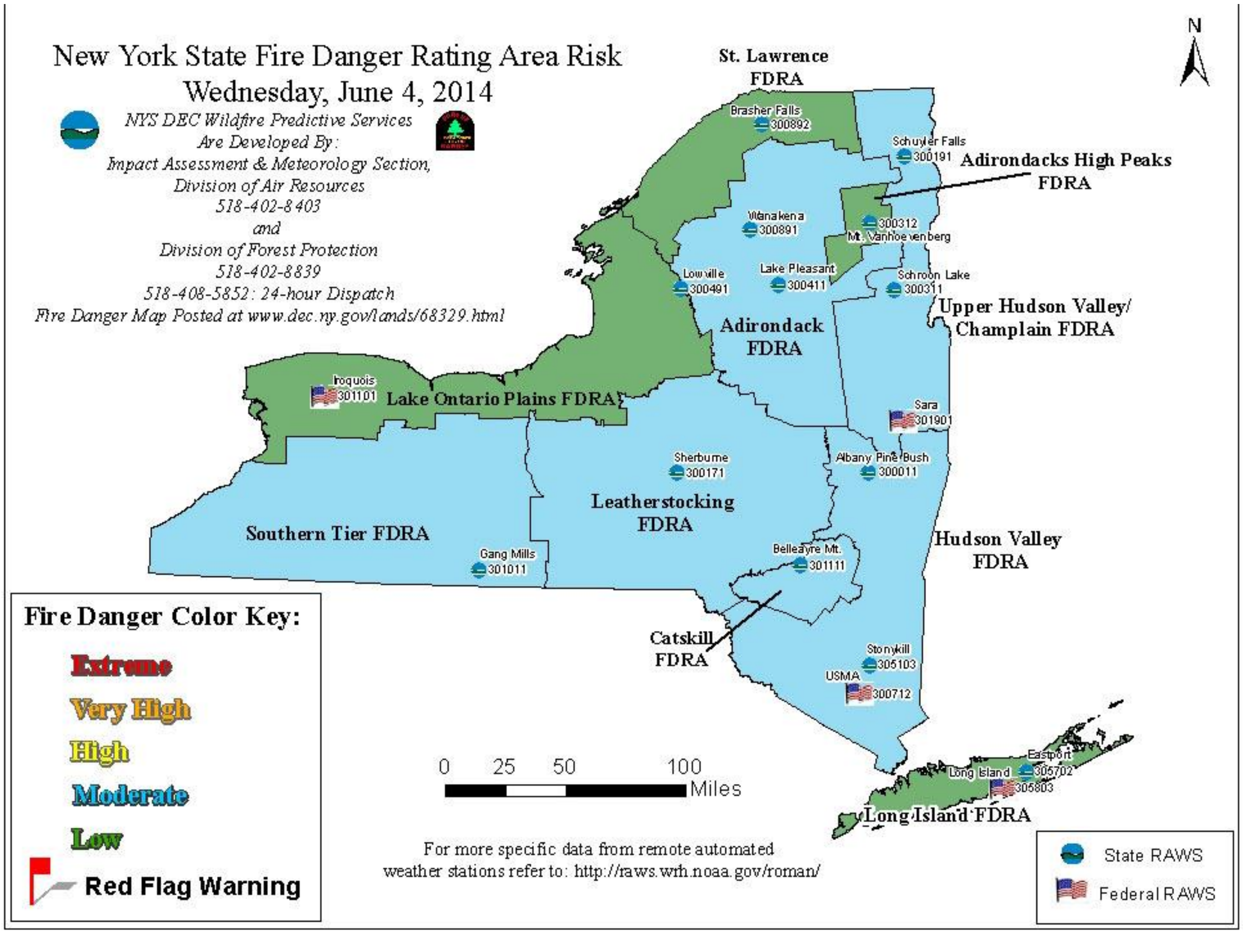


Category	Acreage	# of Towns/Cities
Fire Towns [excl. Fed/Native American Lands]	7,428,240	102
Fire Districts [excl. Fed/Native American Lands]	15,544,893	555
DEC Lands and State Parks outside Protection Areas	217,542	-
Total Fire Management Protection Areas	**23,190,676**	-
Non Fire Towns/Cities [excl. Fed/Nat. American Lands]	7,432,744	341
Federal/Native American Lands	321,588	-
Total State of New York	**30,945,008**	998

Source: NYSDEC, 2012
Note: Putnam County is indicated by the green oval.

New York State is divided into 10 fire danger rating areas (FDRAs). FDRAs are defined by areas of similar vegetation, climate, and topography in conjunction with agency regional boundaries, National Weather Service (NWS) fire weather zones, political boundaries, fire occurrence history, and other influences. The Forest Ranger Division issues daily fire danger warnings when the fire danger rating is at high or above in one or more FDRAs. A current fire danger rating map is updated daily on the NYSDEC website. Figure 5.4.7-3 shows the FDRAs in New York State and the current fire danger risk for each of the areas.

Figure 5.4.7-3. New York State Fire Danger Rating Areas



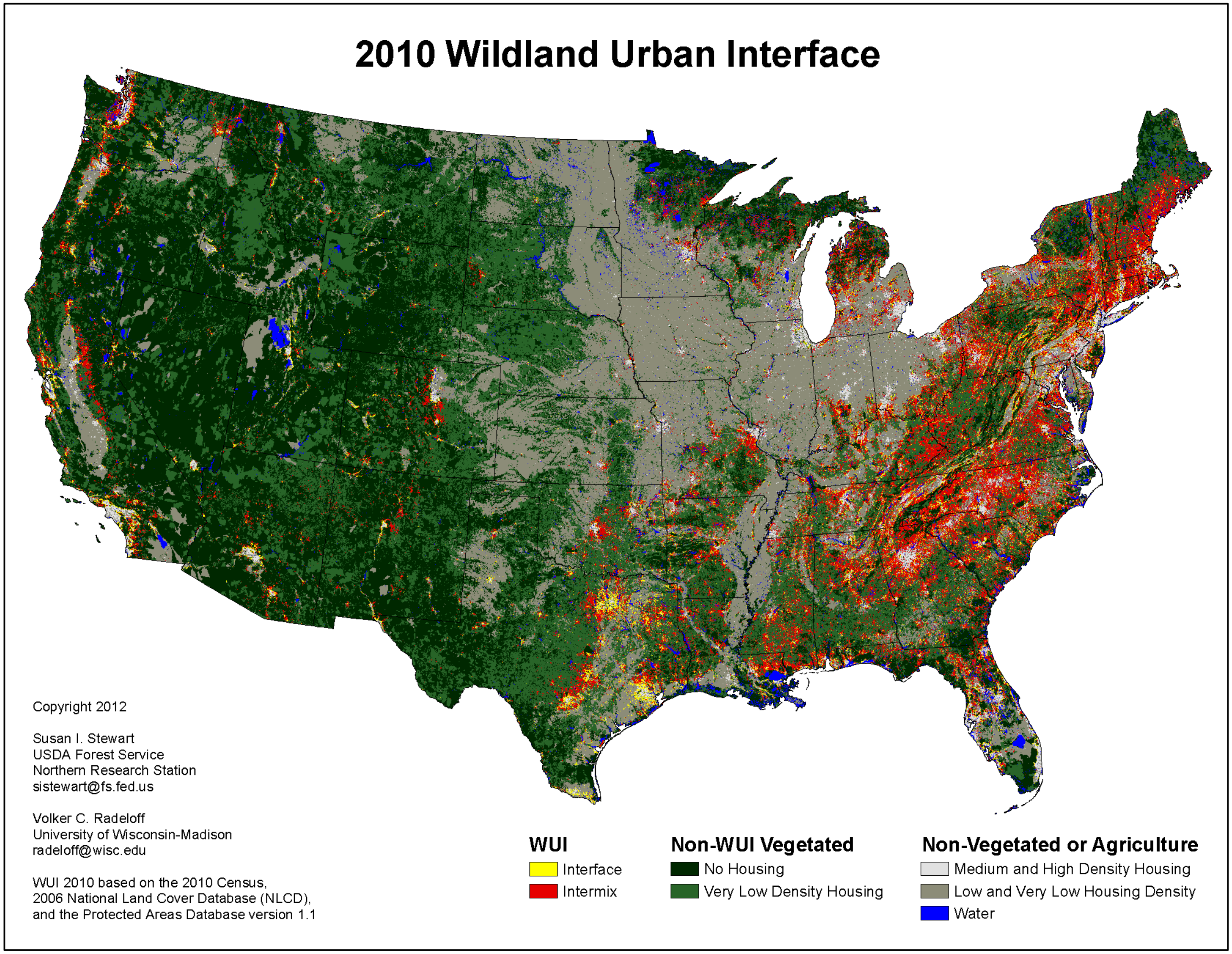
Source: NYSDEC, 2014

Wildfire/Urban Interface (WUI) in New York State/Putnam County

As previously defined, the NYS HMP indicates that New York State has all three types of WUI interfaces. The Adirondack and Catskill Mountains contain large tracts of forests with the mixed, and to a lesser extent, the classic interface occurring throughout. The remainder of the State contains classic and mixed interfaces with some major cities containing an occluded interface. The population migration from an urban to suburban and rural living will continue, increasing the possibility of loss and/or damage to structures in the WUI. Many property owners are unaware that a threat from a wildfire exists or that their homes are not defensible from it. Water supplies at the scene in the WUI are often inadequate. Access by firefighting equipment is often blocked or hindered by driveways that are either narrow, winding, dead-ended, have tight turning radii or have weight restrictions. Most wildland fire suppression personnel are inadequately prepared for fighting structural fires and local fire departments are not usually fully-trained or equipped for wildfire suppression. Further, the mix of structures, ornamental vegetation and wildland fuels may cause erratic fire behavior. These factors and others substantially increase the risk to life, property and economic welfare in the WUI. While there are many interface communities throughout New York and Putnam County, an official list that details the location, type of interface and surrounding fuel make-up does not exist (NYS DHSES, 2014).

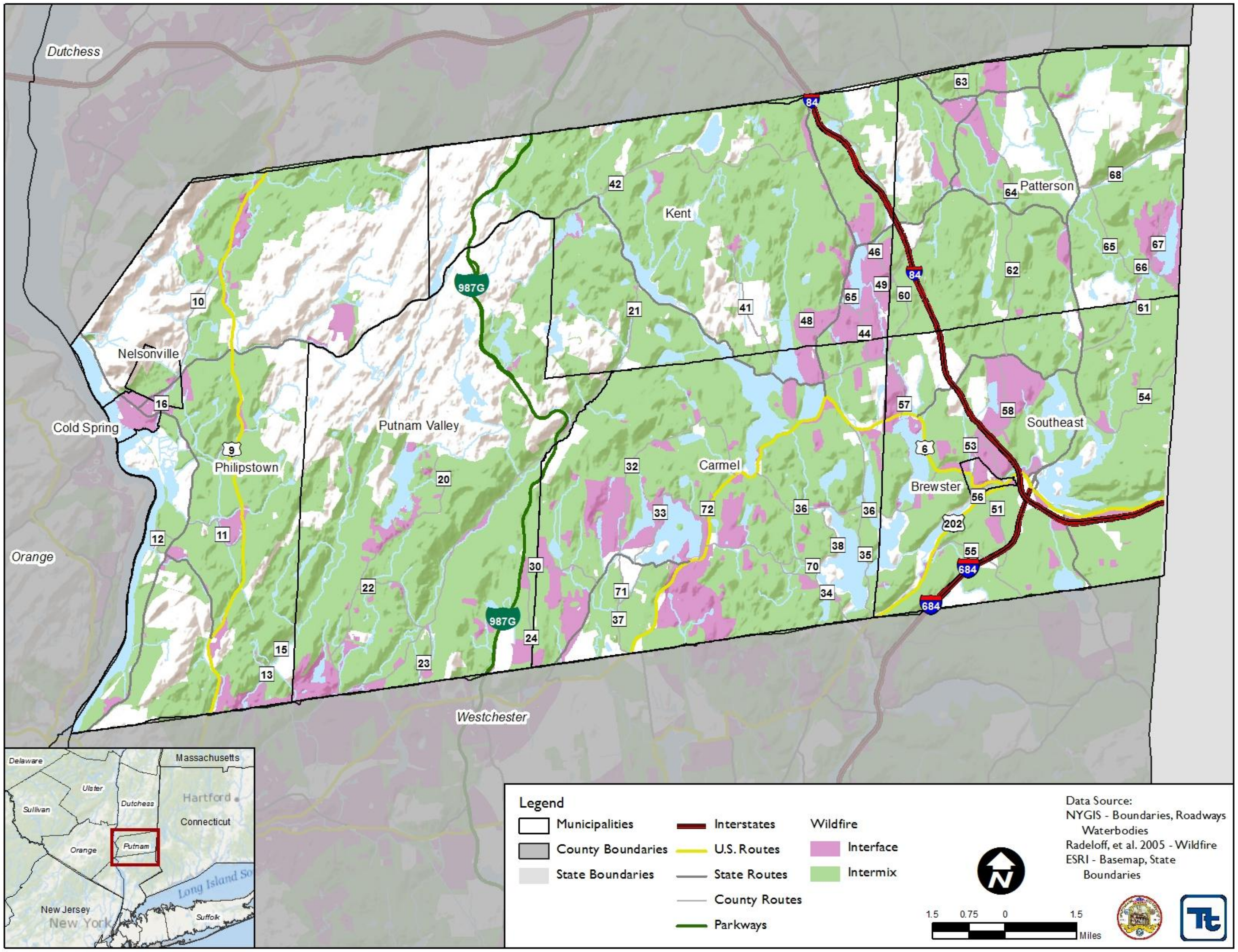
A detailed WUI (interface and intermix) was obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison which also defines the wildfire hazard area. The California Fire Alliance determined that areas within 1.5 miles of wildland vegetation are the approximate distance that firebrands can be carried from a wildland fire to the roof of a house. Therefore, even structures not located within the forest are at risk to wildfire. This buffer distance, along with housing density and vegetation type were used to define the WUI illustrated in Figure 5.4.7-4 through 5.4.7-5, below (Radeloff, et al, 2005). Using this WUI, approximately 170 square miles, or approximately 69% of the County's land area is located in the WUI (interface and intermix).

Figure 5.4.7-4. SILVIS Wildland Urban Interface across the United States



Source: Radeloff et al, 2005

Figure 5.4.7-5. SILVIS Wildland Urban Interface and Intermix in Putnam County



Source: Radeloff et al, 2005

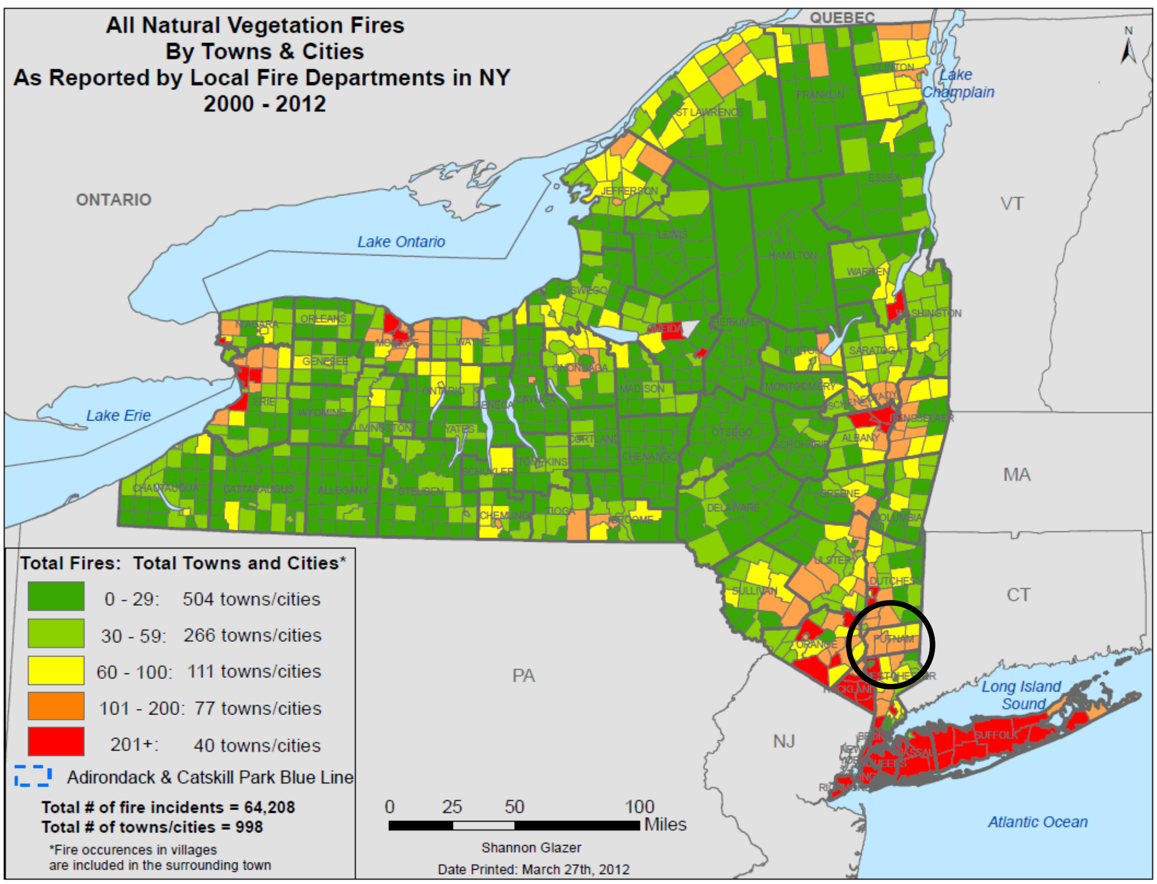
Previous Occurrences and Losses

The short-term effects of wildfires can include destruction of timber, forest, wildlife habitats, scenic vistas, and watersheds. Business and transportation disruption can also occur in the short-term. Long-term effects can include reduced access to recreational areas, destruction of community infrastructure and cultural and economic resources (USGS, 2006).

Wildfire occurrence in New York State is based on two data sources – the New York State Forest Ranger force and the New York State Office of Fire Prevention and Control. The New York State Forest Ranger is a division of the NYSDEC. It has fought fires and retained records for over 125 years. Between 1989 and 2012, Ranger Division records indicate that rangers suppressed 6,971 wildfires that burned a total of 67,273 acres (NYSDEC, 2013). NYS Office of Fire Prevention and Control (OFP&C) indicates that from 2002 through 2012, fire departments throughout New York responded to 64,208 wildfires, brush fires, grass fires or other outdoor fires (NYSDEC, 2013).

According to the Ranger Division wildfire occurrence data from 1988 through 2012, 95-percent of wildfires in the State were human-caused. Debris burning accounted for 35-percent; arson accounted for 17-percent; campfires accounted for 13-persent; children accounted for 5-percent; smoking, equipment, and railroads accounted for 30-percent; and lightning accounted for 5-percent of all wildfires (NYSDEC, 2013). Figure 5.4.7-6 illustrates the occurrences of wildfires in New York State, between 2000 and 2012.

Figure 5.4.7-6. Wildfire Occurrences in New York State, 2000-2012



Source: NYSDEC, 2013
Note: The black oval indicates the location of Putnam County.

In 2013, the NYSDEC reported that 1,059 acres burned due to 126 wildfire events. There were 19 prescribed burns that burned a total of 453 acres (NYSDEC, 2014).

Table 5.4.7-2 shows the wildfire statistics for the NYSDEC's Division of Forest Protection's Region 3, Zone B area (which includes Putnam County) for 2007 through 2013 (NYSDEC, 2014). Details for events specific to Putnam County were not available.

Table 5.4.7-2. Region 3, Zone B Wildfire Statistics

Cause	Year						
	2007	2008	2009	2010	2011	2012	2013
Debris		3	3	2			
Campfire			1	2		3	5
Lightning							
Arson			4	6	1	1	1
Other	3	6	2	4		3	5
Total # of Fires	3	9	10	14	1	7	11
0.1 to 0.9 acres		1					
< 0.25 acres	1			1			
0.25 to 9.9 acres			6	12	1	5	5
1 to 9.9 acres		4					
10 to 99.9 acres	2	3	4	1		1	4
> 100 acres		1				1	2
Total Acres of Fires	153	2945	228	53	2	507.6	672.6
Total Cost of Fires	$99	$222,961	$-	$871	$-	$439	$2,338

Source: NYSDEC 2014

For this 2014 Plan Update, known wildfire events that have impacted Putnam County between 1950 and May 2014 are identified in Table 5.4.7-3. The National Climatic Data Center's Storm Events Database includes no records of wildfires in Putnam County from 1950 through February 2014. The University of South Carolina's SHELDUS database includes only one record of a wildfire in Putnam County between 1960 and the present. It is shown in Table 5.4.7-3. Figure 5.4.7-8 shows that each town in the County experienced between 60 and 200 wildfires between 2000 and 2012, however no details were available. Table 5.4.7-3 may not include a complete record of all wildfire events that have occurred in the County.

Table 5.4.7-3. Wildfire Events between 1950 and May 2014

Dates of Event	Event Type	FEMA Declaration Number	Location / County Designated?	Losses / Impacts
April 20, 1962	Wildfire	N/A	N/A	$8,000 in property damages
April 22, 2014	Brush Fire	N/A	N/A	A wind-swept brush fire burned over 12 acres of a mountain overlooking Morefar Golf Club in the Town of Southeast. The fire most likely started when high tension wires rubbed against tree branches. About 75 firefighters from five departments were called.
April 25, 2014	Brush Fire	N/A	N/A	A brush fire burned an area behind the Milltown Cemetery in the Town of Brewster.

Sources: SHELDUS; NCEHTF; FEMA; NYS DHSES; NYSDEC

Note: Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of inflation.

EM — *Emergency Declaration*
FEMA — *Federal Emergency Management Agency*
FM — *Fire Management Assistance Declaration*
HMP — *Hazard Mitigation Plan*
K — *Thousand ($)*
M — *Million ($)*
N/A — *Not Applicable*
NCEHTF — *The Nature Conservancy Eastern Heritage Task Force*
NCDC — *National Climatic Data Center*
NOAA — *National Oceanic and Atmospheric Administration*
NWS — *National Weather Service*
PA — *Public Assistance*

Probability of Future Events

According to the New York State Forest Ranger Division, wildfire occurrence data from 1988 to 2012 have shown that New York State, including Putnam County, will always be susceptible to wildfires. Ninety-five percent of wildfires in New York State are caused by humans, while lightning is responsible for only five percent. Beginning in 2010, New York State enacted revised open burning regulations that ban brush burning statewide from March 15th through May 15th. This time period is when 47% of all fire department-response wildfires occur. Forest ranger data indicates that this new statewide ban resulted in 74% fewer wildfires caused by debris burning in upstate New York from 2010 to 2012. Debris burning has been prohibited in New York City and Long Island for more than 40 years. Since compliance with this regulation, forest ranger and fire department historical fire occurrence data will serve as a benchmark for analysis of wildfire occurrence (NYS DHSES, 2014).

The State's large size, diverse topography, and variety of climates require the State be divided into distinct units for describing wildfire potential and risk. See the Location section of this profile for information regarding the risk areas.

Fire probability depends on local weather conditions, outdoor activities (e.g. camping, debris burning, and construction), and the degree of public cooperation with fire prevention measures. Dry weather, such as drought, can increase the likelihood of wildfire events. Lightning can also trigger wildfire and urban fire events. Other natural disasters can increase the probability of wildfires by producing fuel in both urban and rural areas. Forest damage from hurricanes and tornadoes may block interior access roads and fire breaks; pull down overhead power lines; or damage pavement and underground utilities (NVRC, 2006).

Wildfire experts say there are four reasons why wildfire risks are increasing:

- Fuel, in the form of fallen leaves, branches and plant growth, have accumulated over time on the forest floor. Now this fuel has the potential to "feed" a wildfire.
- Increasingly hot, dry weather in the U.S.
- Changing weather patterns across the country.
- More homes built in the areas called the Wildland/Urban Interface, meaning homes are built closer to wildland areas where wildfires can occur (NYS DHSES, 2014).

It is likely that New York State will experience small wildfires throughout the state on a yearly basis (as the State has regularly experienced in the past). However, advanced methods of wildfire management and control and a better understanding of the fire ecosystems should reduce the number of devastating fires in the future (NYS DHSES, 2014).

In Section 5.3, the identified hazards of concern for Putnam County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for wildfire in the County is considered 'frequent' (event likely to occur within 25 years, as presented in Section 5.3)

Climate Change Impacts

Climate change directly and indirectly affects the growth and productivity of forests: directly due to changes in atmospheric carbon dioxide and climate, and indirectly through complex interactions in forest ecosystems. Climate also affects the frequency and severity of many forest disturbances, such as infestations, invasive species, wildfires, and storm events. As temperatures increase, the suitability of a habitat for specific types of trees changes. There is also evidence that prolonged heat waves are likely to lead to a greater number of wildfire incidents. Stronger winds from larger storms may lead to more fallen branches for wildfires to consume. An increase in rain and snow events primes forests for fire by growing more fuel. Drought and warmer temperatures lead to drier forest fuels (NYS DHSES, 2014).

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA], 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Putnam County is part of Region 5, East Hudson and Mohawk River Valleys. Some of the issues in this region, affected by climate change, include: more frequent heat waves and above 90°F days, more heat-related deaths, increased frequency of heavy precipitation and flooding, decline in air quality, etc. (NYSERDA, 2011).

Temperatures in New York State are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA, 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA, 2014).

In Region 5, it is estimated that temperatures will increase by 3.5ºF to 7.1ºF by the 2050s and 4.1ºF to 11.4ºF by the 2080s (baseline of 47.6ºF). Precipitation totals will increase between 2 and 15% by the 2050s and 3 to 17% by the 2080s (baseline of 38.6 inches). Table 5.4.7-4 displays the projected seasonal precipitation change for the East Hudson and Mohawk River Valleys ClimAID Region (NYSERDA, 2011).

Table 5.4.7-4. Projected Seasonal Precipitation Change in Region 5, 2050s (% change)

Winter	Spring	Summer	Fall
+5 to +15	-5 to +10	-5 to +5	-5 to +10

Source: NYSERDA, 2011

With the increase in temperatures, heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality and agriculture. Summer droughts are projected to increase, affecting water supply, agriculture, ecosystems, and energy projects (NYSERDA, 2011).

Fire is determined by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. With the increasing temperatures occurring in New York State, wildfire danger may intensify by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

5.4.7.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. The following text evaluates and estimates the potential impact of the wildfire hazard on Putnam County including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety and health, (2) general building stock, (3) critical facilities, (4) economy; (5) change of vulnerability and (5) future growth and development
- Effect on Climate Change on Vulnerability
- Further data collections that will assist understanding of this hazard over time

Overview of Vulnerability

Wildfire hazards can impact significant areas of land, as evidenced by wildfires throughout the U.S. over the past several years. Fire in urban areas has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas. Wildfire, however can spread quickly, become a huge fire complex consisting of thousands of acres, and present greater challenges for allocating resources, defending isolated structures, and coordinating multi-jurisdictional response. If a wildfire occurs at a WUI, it can also cause an urban fire and in this case has the potential for great damage to infrastructure, loss of life, and strain on lifelines and emergency responders because of the high density of population and structures that can be impacted in these areas.

Data and Methodology

The WUI (interface and intermix) obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison was used to define the wildfire hazard areas. The University of Wisconsin-Madison wildland fire hazard areas are based on the 2010 Census and 2006 National Land Cover Dataset and the Protected Areas Database. For the purposes of this risk assessment, the high-, medium- and low-density interface areas were combined and used as the ‘interface’ hazard area and the high-, medium- and low-density intermix areas were combined and used as the ‘intermix’ hazard areas. Figure 5.4.7-5 presented earlier in the profile displays the 2010 Wildfire Urban Interface for the U.S. and Putnam County by 2010 U.S. Census block, respectively.

The asset data (population, building stock and critical facilities) presented in the County Profile (Section 4) was used to support an evaluation of assets exposed and the potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data was overlaid upon the hazard area. The limitations of this analysis are recognized, and as such the analysis is only used to provide a general estimate.

Impact on Life, Health and Safety

As demonstrated by historic wildfire events in New York and other parts of the country, potential losses include human health and life of residents and responders, structures, infrastructure and natural resources. In addition, wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment.

Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

As a way to estimate the County's population vulnerable to the wildfire hazard, the population located within the WUI were overlaid upon the 2010 Census population data (U.S. Census, 2010). The Census blocks with their center within the hazard area were used to calculate the estimated population exposed to the wildfire hazard. Table 5.4.7-5 summarizes the estimated population exposed by municipality.

Table 5.4.7-5. Estimated Population Located within the WUI in Putnam County

Municipality	U.S. Census 2010 Population	Estimated Population Exposed			% of Total Exposed
		Intermix	Interface	Total	
Village of Brewster	2390	134	2,256	2,390	100%
Town of Carmel	34,305	17,151	14,307	31,458	91.7%
Village of Cold Spring	2,013	0	2,000	2,000	99.4%
Town of Kent	13,507	4,231	7,904	12,135	89.8%
Village of Nelsonville	628	263	352	615	97.9%
Town of Patterson	12,023	6,179	4,092	10,271	85.4%
Town of Philipstown	7,021	4,220	2,104	6,324	90.1%
Town of Putnam Valley	11,809	6,777	4,300	11,077	93.8%
Town of Southeast	16,014	9,218	5,780	14,998	93.7%
Putnam County	**99,710**	**48,173**	**43,095**	**91,268**	**91.5%**

Source: U.S. Census 2010; Radeloff et al, 2005

Impact on General Building Stock

The most vulnerable structures to wildfire events are those within the WUI. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. To estimate the buildings exposed to the wildfire hazard, the WUI was overlaid upon the updated building inventory at the structure level. The replacement cost value of the structures with their center in the WUI were totaled. Table 5.4.7-6 summarizes the estimated building stock inventory exposed by municipality.

Table 5.4.7-6. Building Stock Replacement Value Located within the WUI in Putnam County

Municipality	Total RV (Structure and Contents)	Building RV Exposed			% of Total Exposed
		Intermix	Interface	Total	
Village of Brewster	$333,167,631	$22,340,319	$276,963,854	$299,304,173	89.8%
Town of Carmel	$6,097,638,257	$3,173,324,886	$2,305,932,557	$5,479,257,444	89.9%
Village of Cold Spring	$442,869,640	$308,405	$438,113,456	$438,421,860	99.0%
Town of Kent	$2,066,530,876	$1,051,943,953	$975,629,645	$2,027,573,597	98.1%
Village of Nelsonville	$121,130,957	$66,402,100	$52,847,840	$119,249,939	98.4%
Town of Patterson	$1,897,944,173	$1,161,782,804	$589,625,409	$1,751,408,212	92.3%
Town of Philipstown	$1,669,292,142	$1,162,406,181	$321,355,532	$1,483,761,713	88.9%
Town of Putnam Valley	$2,091,379,851	$1,369,193,319	$660,151,783	$2,029,345,102	97.0%
Town of Southeast	$3,155,126,947	$1,949,057,246	$905,550,255	$2,854,607,502	90.5%
Putnam County	**$17,875,080,474**	**$9,956,759,212**	**$6,526,170,331**	**$16,482,929,543**	**92.2%**

Source: Putnam County; Radeloff et al, 2005

Notes: GBS = General Building Stock; RV = Replacement Value; WUI = Wildland Urban Interface

Impact on Critical Facilities

It is recognized that a number of critical facilities are located in the wildfire hazard area, and are also vulnerable to the threat of wildfire. Many of these facilities are the locations for vulnerable populations (i.e., schools, senior facilities) and responding agencies to wildfire events (i.e., fire, police). Table 5.4.7-7 summarizes critical facilities located within the wildfire hazard area by jurisdiction.

Table 5.4.7-7. Number of Critical Facilities in the WUI (Intermix or Interface) in Putnam County

Municipality	Facility Types																						
	Agriculture	Commercial	Communication	Dam	Electric	Entertainment	Fire Station	Government	Highway Bridge	Institutional	Medical	Natural Gas	Police Station	Potable Water	Rail Bridge	Rail Facility	Recreation	Religion	Residential	School	UDF	Vacant	Wastewater
Village of Brewster	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Town of Carmel	0	0	0	6	2	1	3	5	0	0	4	1	1	6	0	0	4	1	0	3	2	0	26
Village of Cold Spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Town of Kent	0	0	1	14	1	0	3	4	7	0	0	0	1	1	0	0	0	0	0	1	0	1	0
Village of Nelsonville	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Town of Patterson	0	1	3	11	2	0	3	5	3	3	0	4	0	3	4	0	1	1	1	3	0	0	9
Town of Philipstown	0	0	3	3	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
Town of Putnam Valley	0	0	2	7	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Town of Southeast	1	0	1	5	2	0	0	1	0	0	1	2	1	7	0	1	0	0	0	7	0	1	8
Putnam County	**1**	**1**	**10**	**46**	**8**	**1**	**14**	**19**	**10**	**3**	**5**	**7**	**3**	**17**	**4**	**1**	**5**	**2**	**1**	**18**	**2**	**2**	**45**

Source: Radeloff et al, 2005
Note: UDF – User Defined Facility

Table 5.4.7-8. Critical Facilities Located in the Wildfire Hazard Areas

Municipality	Facility Name	Facility Type	Wildfire
Brewster	Not provided	UDF	Interface
Brewster	Not provided	Wastewater	Interface
Brewster	Not provided	Wastewater	Interface
Brewster	Apartments	Residential	Interface
Brewster	Apartments	Residential	Interface
Brewster	Apartments	Residential	Interface
Brewster	Brewster Police	Police Station	Interface
Brewster	CAP/ County Office Building	Government	Interface
Brewster	Carmel Avenue Pump Station	Wastewater	Interface
Brewster	County Record Facility	Medical	Interface
Brewster	DEP Laboratory	Wastewater	Intermix
Brewster	GARDEN ST SCHOOL	School	Interface
Brewster	GOVERNMENT	Government	Interface
Brewster	Highway Department	Government	Interface
Brewster	Senior Housing	Senior	Interface
Brewster	St. Andrews	School	Interface
Brewster	St. Larence School	School	Interface
Brewster	Telephone Commutations, Except Radiote	Communication	Interface
Brewster	Verizon	Commercial	Interface
Brewster	Verizon COMM	Communication	Interface
Brewster	Waste Water Head Works	Wastewater	Intermix
Brewster	WWTP	Wastewater	Interface
Carmel	Not provided	UDF	Intermix
Carmel	Not provided	UDF	Intermix
Carmel	Not provided	Wastewater	Interface
Carmel	Aerobic Digester	Wastewater	Intermix
Carmel	AUSTIN RD ELEMENTARY SCHOOL	School	Interface
Carmel	Basketball Courts	Recreation	Intermix
Carmel	Bureau of Emergency Services	Emergency Center	Interface
Carmel	CAMARDA CARE CENTER	Medical	Intermix
Carmel	CARMEL AMBULANCE	Medical	Intermix
Carmel	CARMEL CENTRAL SCHOOL DISTRICT	School	Intermix
Carmel	CARMEL FIRE DEPARTMENT	Fire Station	Intermix
Carmel	CARMEL HIGH SCHOOL	School	Intermix
Carmel	CARMEL POLICE DEPT SUBSTATION	Police Station	Interface
Carmel	Carmel Post Office	Government	Interface
Carmel	Carmel waste water	Wastewater	Intermix
Carmel	Cen Hud - Stillwater Road	Natural Gas	Intermix
Carmel	County Court House	Government	Intermix
Carmel	County Office Building	Government	Intermix
Carmel	Crane Park Restrooms	Recreation	Intermix

Municipality	Facility Name	Facility Type	Wildfire
Carmel	DONALD B. SMITH GOVT CAMPUS	Government	Interface
Carmel	FULMAR RD ELEMENTARY SCHOOL	School	Interface
Carmel	HEFFERMAN DAM	Dam	Intermix
Carmel	Historic Court House	Government	Intermix
Carmel	Lake Casse Club House	Entertainment	Intermix
Carmel	LAKE CASSE DAM	Dam	Intermix
Carmel	LAKE GILEAD DAM	Dam	Intermix
Carmel	Lake Gleneida pump station	Potable Water	Intermix
Carmel	LONG POND DAM	Dam	Intermix
Carmel	MAHOPAC CENTRAL SCHOOL DISTRICT	School	Interface
Carmel	MAHOPAC FALL FD - STATION 1	Fire Station	Intermix
Carmel	MAHOPAC FALLS FD STATION 2	Fire Station	Interface
Carmel	MAHOPAC FD STATION 1	Fire Station	Interface
Carmel	MAHOPAC FD STATION 2	Fire Station	Intermix
Carmel	MAHOPAC FD STATION 3	Fire Station	Interface
Carmel	Microfilter Bldg- Sewer #4	Wastewater	Intermix
Carmel	NYSEG - Carmel	Electric	Intermix
Carmel	NYSEG - Wood Street	Electric	Intermix
Carmel	PALMER LAKE DAM	Dam	Intermix
Carmel	personnel	UDF	Interface
Carmel	PHC AMBULATORY CARE OFFICES	Medical	Intermix
Carmel	PHC- EMERGENCY ROOM	Medical	Intermix
Carmel	Primary Clarifier	Wastewater	Intermix
Carmel	Pump Station	Wastewater	Intermix
Carmel	Putnam County Law Offices	Government	Intermix
Carmel	PUTNAM COUNTY SHERIFF	Police Station	Intermix
Carmel	RAINBOW WATER CO., INC	Potable Water	Interface
Carmel	RBC Bldg	Wastewater	Interface
Carmel	RBD Tanks	Wastewater	Intermix
Carmel	Recreation Bldg	Recreation	Intermix
Carmel	Salt Shed & Town Garage	Government	Interface
Carmel	SD 1 Lift Station (White Sail)	Wastewater	Interface
Carmel	SD 2 Belden N Pump	Wastewater	Interface
Carmel	SD 2 Belden S Pump	Wastewater	Intermix
Carmel	SD 2 Hughson N Pump	Wastewater	Intermix
Carmel	SD 2 Mechanic Street Pump	Wastewater	Intermix
Carmel	SD2 301 Pump	Wastewater	Intermix
Carmel	SD2 Centenial Ridge Pump	Wastewater	Interface
Carmel	SD2 Laurel Frams Pump Station	Wastewater	Interface
Carmel	SD2 Little Pond Manor	Wastewater	Intermix
Carmel	SD2 Willowridge Pump	Wastewater	Intermix
Carmel	SD4 Pumphouse	Wastewater	Intermix

Municipality	Facility Name	Facility Type	Wildfire
Carmel	SD4 Pumphouse	Wastewater	Intermix
Carmel	SD4 Pumpstation	Wastewater	Intermix
Carmel	SD4 Sewer Treatment Plant #4	Wastewater	Intermix
Carmel	SD6 Lift Station	Wastewater	Intermix
Carmel	SD7 Sewer Tx #1 Control Bldg	Wastewater	Interface
Carmel	SD8 Pumpstation	Wastewater	Intermix
Carmel	Secondary Settle	Wastewater	Intermix
Carmel	SEWER PLANT - LONG DRIVEWAY	Wastewater	Intermix
Carmel	Sewer Plant #6	Wastewater	Intermix
Carmel	SEWER PLANT-LONG DRIVEWAY	Wastewater	Intermix
Carmel	Sewer Tx #1 Tank/ Sew 7 Sand Fltr	Wastewater	Interface
Carmel	Skate Park	Recreation	Intermix
Carmel	St James Church	Religion	Intermix
Carmel	ST. JAMES THE APOSTLE SCHOOL	School	Intermix
Carmel	ST. JOHN SCHOOL	School	Interface
Carmel	Storage Building	Wastewater	Intermix
Carmel	TENNIS COURT/SWING SET/2 PUMPHOUSES	Potable Water	Intermix
Carmel	TOWN OF CARMEL PUMP STATION	Potable Water	Intermix
Carmel	UPPER LAKE ROAD DAM	Dam	Intermix
Carmel	Vacant Dwelling	Vacant	Interface
Carmel	Vacant Dwelling	Vacant	Interface
Carmel	VFW Hall	Government	Intermix
Carmel	Wastewater Treatment Plant	Wastewater	Intermix
Carmel	WATER PUMP HSE VER	Potable Water	Intermix
Carmel	WD 14 Pump House #2	Wastewater	Interface
Carmel	WD 14 Pump House #2	Wastewater	Interface
Carmel	WD 2 Lake Shore Pump Station	Wastewater	Intermix
Carmel	WD 2 Shoprite Water Tank	Potable Water	Intermix
Carmel	WD 2 Water Tank	Potable Water	Intermix
Carmel	WD 8 Tank	Wastewater	Interface
Carmel	WD2 Water Tank	Potable Water	Interface
Carmel	WD3 Water Tank	Potable Water	Interface
Carmel	WD3 Well Building 1	Wastewater	Interface
Carmel	WD3 Well Building 2	Wastewater	Interface
Carmel	WD6 Water Plant & Tanks	Wastewater	Intermix
Cold Spring	Boathouse	Boat	Interface
Cold Spring	COLD SPRING FIRE DEPT	Fire Station	Interface
Cold Spring	COLD SPRING POLICE DEPT	Police Station	Interface
Cold Spring	Cold Spring WWTP	Wastewater	Interface
Cold Spring	HALDANE JR/SR HS	School	Interface
Cold Spring	Market Street Pump Station	Wastewater	Interface
Cold Spring	Metro North - Cold Spring Station	Rail Facility	Interface

Municipality	Facility Name	Facility Type	Wildfire
Cold Spring	PHILIPSTOWN AMBULANCE	Medical	Interface
Cold Spring	PHILIPSTOWN TOWN HALL	Government	Interface
Cold Spring	SEWAGE PUMP 3	Wastewater	Interface
Cold Spring	Village Hall	Government	Interface
Cold Spring	WEST POINT FOUNDRY DAM	Dam	Interface
Cold Spring	West Street Pump Station	Wastewater	Interface
Kent	<Null>	Communication	Intermix
Kent	<Null>	Residential	Interface
Kent	BARRETT POND DAM	Dam	Intermix
Kent	BLUE SPRUCE DAM	Dam	Intermix
Kent	BROWNS POND DAM	Dam	Intermix
Kent	CHINA POND DAM	Dam	Intermix
Kent	CLEAR POOL DAM	Dam	Intermix
Kent	Deans Road	Highway Bridge	Intermix
Kent	East Boyds Road 1	Highway Bridge	Intermix
Kent	FRIED POND DAM	Dam	Intermix
Kent	GOVERNMENT	Government	Intermix
Kent	GOVERNMENT	Government	Intermix
Kent	IVAN BENNETT DAM	Dam	Intermix
Kent	KENT FD	Fire Station	Intermix
Kent	KENT POLICE DEPT	Police Station	Intermix
Kent	Kent Public Library	Government	Intermix
Kent	KENT SCHOOLS & TRANS	School	Intermix
Kent	Kent Sewer District	Wastewater	Interface
Kent	KENT TOWN HALL	Government	Intermix
Kent	Kern Building	UDF	Interface
Kent	Lake Carmel Community Center	Government	Interface
Kent	LAKE CARMEL DAM	Dam	Interface
Kent	Lake Carmel FD	Fire Station	Intermix
Kent	LAKE CARMEL FD STATION 2	Fire Station	Intermix
Kent	LEVINE LAKE DAM A	Dam	Intermix
Kent	LITTLE BUCK MOUNTAIN POND DAM	Dam	Intermix
Kent	LOUIS ENTEN POND DAM #2	Dam	Intermix
Kent	LOWER LAKE NIMHAM DAM	Dam	Interface
Kent	LOWER SWIMMING POND DAM	Dam	Intermix
Kent	Ludington Court 1	Highway Bridge	Interface
Kent	Ludington Court 2	Highway Bridge	Interface
Kent	Mooney Hill	Highway Bridge	Intermix
Kent	Nihmam Road	Highway Bridge	Intermix
Kent	Nihmam Road	Highway Bridge	Intermix
Kent	NYSEG - Kent Cliffs	Electric	Intermix
Kent	PUMP HOUSE	Potable Water	Interface

Municipality	Facility Name	Facility Type	Wildfire
Kent	PUMP HOUSE	Potable Water	Intermix
Kent	RYDER LAKE DAM	Dam	Intermix
Kent	Sagamore Road	Highway Bridge	Interface
Kent	Schrade Road	Highway Bridge	Intermix
Kent	TWIN BROOKS DAM	Dam	Intermix
Kent	UPPER LAKE NIMHAM DAM	Dam	Intermix
Kent	Vacant Dwelling	Vacant	Intermix
Kent	Whangtown Road	Highway Bridge	Intermix
Nelsonville	NELSONVILLE VILLAGE HALL	Government	Interface
Nelsonville	Putnam County Sheriff Substation	Police Station	Interface
Patterson	Alpine Acres Water Treatment Plant	Potable Water	Intermix
Patterson	AMOS NOACH DAM	Dam	Intermix
Patterson	Bath House	Recreation	Intermix
Patterson	Boat House	Boat	Interface
Patterson	Brimstone Road	Highway Bridge	Intermix
Patterson	BURMAN POND DAM	Dam	Intermix
Patterson	Camp Brady Dam	Dam	Intermix
Patterson	CAMP HERRLICH DAM	Dam	Intermix
Patterson	Camp Wilbur Herrlich	Religion	Intermix
Patterson	CELL TOWER IN SILO	Communication	Intermix
Patterson	Clover Lake Estates Dam	Dam	Intermix
Patterson	CORNWALL HILL ESTATES DAM	Dam	Intermix
Patterson	CORNWALL MEADOWS PUMP STATION	Wastewater	Intermix
Patterson	Countyline Getty	Government	Intermix
Patterson	Countyline Getty	Natural Gas	Intermix
Patterson	Courthouse	Government	Interface
Patterson	COVINGTON GREENS PUMP STATION	Wastewater	Intermix
Patterson	Dorsett Hollow Water Treatment Plant	Potable Water	Intermix
Patterson	Dwelling	Residential	Intermix
Patterson	Echo Road Telecommunications Tower	Communication	Intermix
Patterson	Fair St. Garage	Government	Intermix
Patterson	Fox Run Condominiums	Wastewater	Intermix
Patterson	FOX RUN WATER TREATMENT	Potable Water	Intermix
Patterson	GEORGE FISHER MIDDLE SCHOOL	School	Intermix
Patterson	George Fisher Middle School	Wastewater	Intermix
Patterson	Green Chimneys School For Little People	School	Intermix
Patterson	Griffin's Pond	Dam	Intermix
Patterson	Group Home	Institutional	Intermix
Patterson	Group Home	Institutional	Interface
Patterson	Group Home	Institutional	Intermix
Patterson	Group Home	Institutional	Intermix
Patterson	Highway Department	Government	Intermix

Municipality	Facility Name	Facility Type	Wildfire
Patterson	LOST LAKE DAM & DIKE	Dam	Intermix
Patterson	MATTHEW PATTERSON ELEMENTARY SCHOOL	School	Intermix
Patterson	Maybrook E1 Route 164	UDF	Interface
Patterson	MENDEL POND DAM	Dam	Intermix
Patterson	Metro North - Patterson	Rail Facility	Interface
Patterson	Mooney Hill Bridge	Rail Bridge	Intermix
Patterson	NYS Route 164	Rail Bridge	Intermix
Patterson	NYS Route 164	Rail Bridge	Intermix
Patterson	NYS Route 164	Rail Bridge	Intermix
Patterson	NYSARC Group Home	Institutional	Interface
Patterson	NYSEG - Haviland Hollow Substation	Electric	Intermix
Patterson	NYSEG - Kent Substation	Electric	Interface
Patterson	NYSEG - West Patterson Substation	Electric	Intermix
Patterson	Patterson Automotive	Commercial	Intermix
Patterson	Patterson Automotive	Natural Gas	Intermix
Patterson	PATTERSON COMMONS PUMP STATION	Wastewater	Intermix
Patterson	PATTERSON FD & AMB.	Fire Station	Intermix
Patterson	PATTERSON FIRE DEPT. STATION 2	Fire Station	Intermix
Patterson	PATTERSON HAMLET WWTP	Wastewater	Intermix
Patterson	Patterson Highway Salt Shed	Government	Interface
Patterson	Patterson Mobil	Natural Gas	Intermix
Patterson	PATTERSON TOWN HALL	Government	Interface
Patterson	PATTERSON VILLAGE PUMP STATION	Wastewater	Intermix
Patterson	Pump House	Wastewater	Intermix
Patterson	PUTNAM LAKE DAM	Dam	Interface
Patterson	PUTNAM LAKE FIRE DEPT	Fire Station	Intermix
Patterson	PVMP Pavilion	Government	Intermix
Patterson	Rec Building	Recreation	Interface
Patterson	Recycling Center	Government	Interface
Patterson	Recycling Center	Government	Interface
Patterson	RIHM & KITTEL DAM	Dam	Intermix
Patterson	Route 22 Bridge	Highway Bridge	Intermix
Patterson	Route 311 Bridge	Highway Bridge	Intermix
Patterson	SOUTH STREET PUMP STATION	Wastewater	Intermix
Patterson	Stateline Food & Beverage	Natural Gas	Intermix
Patterson	Stateline Food & Beverage (Citgo)	Commercial	Interface
Patterson	Storage	Government	Interface
Patterson	Verizon	Communication	Interface
Patterson	Veterans of Foreign Wars	Government	Intermix
Patterson	Waterfield Farms Dam	Dam	Intermix
Patterson	Wireless Edge Telecommunications Tower	Communication	Intermix
Philipstown	CARGILL RESERVOIR DAM	Dam	Intermix

Municipality	Facility Name	Facility Type	Wildfire
Philipstown	CELL TOWER	Communication	Intermix
Philipstown	CENHUD - Indian Brook Road	Electric	Interface
Philipstown	COMMUNICATIONS TOWER	Communication	Intermix
Philipstown	CONTINENTAL VILLAGE FD	Fire Station	Interface
Philipstown	CROWN ATLANTIC TOWER	Communication	Intermix
Philipstown	GARRISON ELEMENTARY/MIDDLE SCHOOL	School	Intermix
Philipstown	GARRISON SCHOOL DIST	School	Intermix
Philipstown	GARRISON SCHOOL DIST.	School	Intermix
Philipstown	Garrison Union Free School District	School	Intermix
Philipstown	Garrison VFD - Station #1	Fire Station	Intermix
Philipstown	GARRISON VFD - STATION 2	Fire Station	Intermix
Philipstown	GOVERNMENT	Government	Intermix
Philipstown	GOVERNMENT	Government	Intermix
Philipstown	North Highlands FD	Fire Station	Intermix
Philipstown	PERKINS ESTATE POND DAM	Dam	Intermix
Philipstown	WEISE POND DAM	Dam	Intermix
Putnam Valley	(213-0477)	Dam	Intermix
Putnam Valley	CELL TOWER/POWER LINES	Communication	Intermix
Putnam Valley	FLORADAN ESTATES DAM	Dam	Intermix
Putnam Valley	G L LLOYD POND DAM	Dam	Intermix
Putnam Valley	GOVERNMENT	Government	Interface
Putnam Valley	GOVERNMENT	Government	Intermix
Putnam Valley	GOVERNMENT	Government	Interface
Putnam Valley	GOVERNMENT	Government	Interface
Putnam Valley	HOLLOW BROOK DAM	Dam	Intermix
Putnam Valley	INDIAN LAKE DAM	Dam	Intermix
Putnam Valley	L BERMAN POND DAM	Dam	Intermix
Putnam Valley	LOUIS ENTEN POND DAM #1	Dam	Intermix
Putnam Valley	NYSEG - Adams Corners	Electric	Intermix
Putnam Valley	PUTNAM VALLEY FD - STATION 2	Fire Station	Intermix
Putnam Valley	PUTNAM VALLEY HS	School	Interface
Putnam Valley	PUTNAM VALLEY MS	School	Interface
Putnam Valley	PUTNAM VALLEY TOWN HALL	Government	Intermix
Putnam Valley	PUTNAM VALLEY VFD	Fire Station	Intermix
Putnam Valley	VERIZON CELL TOWER	Communication	Intermix
Southeast	Algonquin - Tulip Road	Natural Gas	Intermix
Southeast	BOG BROOK DAM #1	Dam	Intermix
Southeast	BREWSTER FD - STATION 2	Fire Station	Interface
Southeast	BREWSTER HIGH SCHOOL	School	Intermix
Southeast	BREWSTER SCHOOL ADMIN BLDG	School	Intermix
Southeast	BREWSTER SCHOOL BUS GARAGE	School	Intermix
Southeast	CELL TOWER	Communication	Interface

Municipality	Facility Name	Facility Type	Wildfire
Southeast	CELL TOWER WAY BACK IN DRIVEWAY	Communication	Intermix
Southeast	CV STARR SCHOOL	School	Intermix
Southeast	GOVERNMENT- Post Office	Government	Intermix
Southeast	HH WELLS MIDDLE SCHOOL	School	Intermix
Southeast	Hudson Valley United Cerebral Palsey	Medical	Intermix
Southeast	JFK ELEMENTARY SCHOOL	School	Intermix
Southeast	Local and Suburban Transit	Transportation	Interface
Southeast	LOUNSBURY WILDLIFE POND #1 DAM	Dam	Intermix
Southeast	LOUNSBURY WILDLIFE POND #2 DAM	Dam	Intermix
Southeast	MIDDLE BRANCH DAM	Dam	Interface
Southeast	MILLTOWN ESTATES DAM	Dam	Intermix
Southeast	MT EBO CORPORATE CENTER DAM	Dam	Intermix
Southeast	MTA Brewster Yard	Rail Facility	Intermix
Southeast	NY STATE POLICE	Police Station	Intermix
Southeast	NYSEG - Brewster City Gate	Natural Gas	Intermix
Southeast	NYSEG - Putnam Lake	Electric	Intermix
Southeast	NYSEG - Tilly Foster	Electric	Intermix
Southeast	SE SCHOOLHOUSE	School	Intermix
Southeast	Sewage Lift Station	Wastewater	Intermix
Southeast	Sewage Lift Station	Wastewater	Intermix
Southeast	Sewage Lift Station	Wastewater	Intermix
Southeast	Sewage Lift Station	Wastewater	Intermix
Southeast	Sewage Lift Station	Wastewater	Intermix
Southeast	Sewage Lift Station	Wastewater	Intermix
Southeast	Sewerage Systems	Wastewater	Intermix
Southeast	Tilly Foster Farm	Agriculture	Intermix
Southeast	Vacant Dwelling	Vacant	Intermix
Southeast	WASTWATER TREATMENT PLAN	Wastewater	Intermix
Southeast	Water Supply- Pump House	Potable Water	Intermix
Southeast	Water Supply- Well Field	Potable Water	Intermix
Southeast	Water Tank	Potable Water	Intermix
Southeast	WATER TANK, PUMPHOUSE	Potable Water	Intermix
Southeast	WATER TREATMENT	Potable Water	Intermix
Southeast	WELL AND CLUBHOUSE	Potable Water	Intermix
Southeast	WELL SITE	Potable Water	Intermix

Impact on the Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from working to fight these fires.

Effect of Climate Change on Vulnerability

According to the U.S. Fire Service (USFS), climate change will likely alter the atmospheric patterns that affect fire weather. Changes in fire patterns will, in turn, impact carbon cycling, forest structure, and species composition. Climate change associated with elevated greenhouse gas concentrations may create an atmospheric and fuel environment that is more conductive to large, severe fires (USFS, 2011). Under a changing climate, wildfires are expected to increase by 50% across the U.S. (USFS, 2013).

According to the New York State 2014 HMP Update, climate change can impact drought and extreme heat, causing drier conditions, which can lead to an increased number of wildfire events. During several drought events in New York State, the NYSDEC were forced to close public lands for recreational uses and ban open-burning at State campgrounds (NYS HMP, 2014).

Fire interacts with climate and vegetation (fuel) in predictable ways. Understanding the climate/fire/vegetation interactions is essential for addressing issues associated with climate change that include:

- Effects on regional circulation and other atmospheric patterns that affect fire weather
- Effects of changing fire regimes on the carbon cycle, forest structure, and species composition, and
- Complications from land use change, invasive species and an increasing wildland-urban interface (USFS, 2011).

It is projected that higher summer temperatures will likely increase the high fire risk by 10 to 30-percent. Fire occurrence and/or area burned could increase across the U.S. due to the increase of lightning activity, the frequency of surface pressure and associated circulation patterns conductive to surface drying, and fire-weather conditions, in general, which is conductive to severe wildfires. Warmer temperatures will also increase the effects of drought and increase the number of days each year with flammable fuels and extending fire seasons and areas burned (USFS, 2011).

Future changes in fire frequency and severity are difficult to predict. Global and regional climate changes associated with elevated greenhouse gas concentrations could alter large weather patterns, thereby affecting fire-weather conducive to extreme fire behavior (USFS, 2011).

Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) years have been identified across Putnam County at the jurisdiction level. Refer to the jurisdictional annexes in Volume II of this HMP. It is anticipated that any new development and new residents in the WUI will be exposed to the wildfire hazard.

Additional Data and Next Steps

The custom building inventory developed for this Plan should be updated as data regarding the construction of structures, such as roofing material, fire detection equipment, structure age, etc. are available. As stated earlier, buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. The proximity of these building types to the WUI should be identified for further evaluation. Development and availability of such data would permit a more detailed estimate of potential vulnerabilities, including loss of life and potential structural damages.