5.4.10 WILDFIRE

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

5.4.10.1 Profile

This section provides information regarding the description, extent, location, previous occurrences and losses, and the probability of future occurrences for the wildfire hazard.

Hazard Description

Wildfire is defined as an uncontrolled fire spreading through natural or unnatural vegetation that can threaten lives and property if not contained. Wildfires are commonly termed forest fires, brush fires, grass fires, wildland-urban interface fires, range fires, or ground fires. Wildfires do not include fires naturally or purposely ignited to manage vegetation for one or more benefits (NYS DHSES 2019). Although destructive fires do not occur annually, the State's fire history shows a cycle of outbreaks that have caused human death, property loss, forest destruction, and air pollution (NYS DHSES 2019).

Extent

Wildfire events can range in size and intensity. A wildfire's intensity depends significantly on both meteorological conditions and human activity.

Wildfire Behavior and Fire Ecology

Fire behavior is defined as the way fuel ignites, flame develops, and fire spreads, which depend on interactions among fuel, weather, and topography. Fire behavior is one of the most important aspects of wildfires because almost all actions in response to a fire depend on how it behaves. The extent to which fire manages can understand and predict fire behavior relies on success in pre-suppression planning and actual suppression of wildfires.

Potential for wildfire and its subsequent development (growth) and severity are controlled by the three principal factors of topography, fuel, and weather, described as follows:

Topography – Topography can powerfully influence wildfire behavior. Movement of air over the terrain tends to direct a fire's course. A gulch or canyon can funnel air and act as a chimney, intensifying fire behavior and inducing faster spread. Saddles on ridgetops tend to offer lower resistance to passage of air and 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 the wildfire spreads will most likely double as well. Terrain can inhibit wildfires: fire travels downslope much more slowly than it does upslope, and ridgetops often mark the end of a wildfire's rapid spread (FEMA 1997.).

Fuel – Fuels are classified by weight or volume (fuel loading) and by type. Fuel loading is used to describe the amount of vegetative material available. If this amount doubles, energy released can also double. Each fuel type is given a burn index—an estimate of amount of potential energy that may be released, effort required to ignite a fire in a given fuel and expected flame length. Different fuels have different burn qualities, and some burn more easily than others. Grass fires release relatively little energy but can sustain very high rates of spread (FEMA 1997). According to the U.S. Forest Service (USFS), 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):

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 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 between the top of surface fuels and bottom of overstory tree crowns.
- Crown fuels are suspended above the ground in treetops or other vegetation and consist 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 constitute the primary fuel layer in a forest crown fire (USFS 2003).

Fire behavior is strongly influenced by these fuels.

Weather / Air Mass – Weather is the most important factor influencing fire behavior, but it is always changing. Air mass, defined by the National Weather Service (NWS) as a body of air covering a relatively wide area and exhibiting horizontally uniform properties, can affect wildfire through climatic factors that include temperature and relative humidity, local wind speed and direction, cloud cover, precipitation amount and duration, and stability of the atmosphere at the time of the fire (NWS 2009). Extreme weather leads to extreme events, and often a subsidence of severe weather 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 radically and suddenly change 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).

Several tools are available to estimate fire potential, extent, danger, and growth, including, but not limited to, the following:

The ***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 (USFS n.d.).

The ***Fire Potential Index (FPI)*** is derived by combining information on daily weather and vegetation condition and can identify areas most susceptible to fire ignition (Burgan et al. 2000).

Fuel Moisture (FM) content is quantity of water in a fuel particle expressed as a percent of oven-dry weight of the fuel particle and is an expression of cumulative effects of past and present weather events, to help evaluate the effects of current or future weather on fire potential (Burgan et al. 2000).

The ***Keetch-Byram Drought Index (KBDI)*** is designed for fire potential assessment and is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers (USFS n.d.).

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 potential for existing fires to become large fires (USFS n.d.).

The ***Buildup Index (BUI)*** is a number that reflects combined cumulative effects of daily drying and precipitation in fuels with a 10-day time lag constant (North Carolina Forest Service 2007).

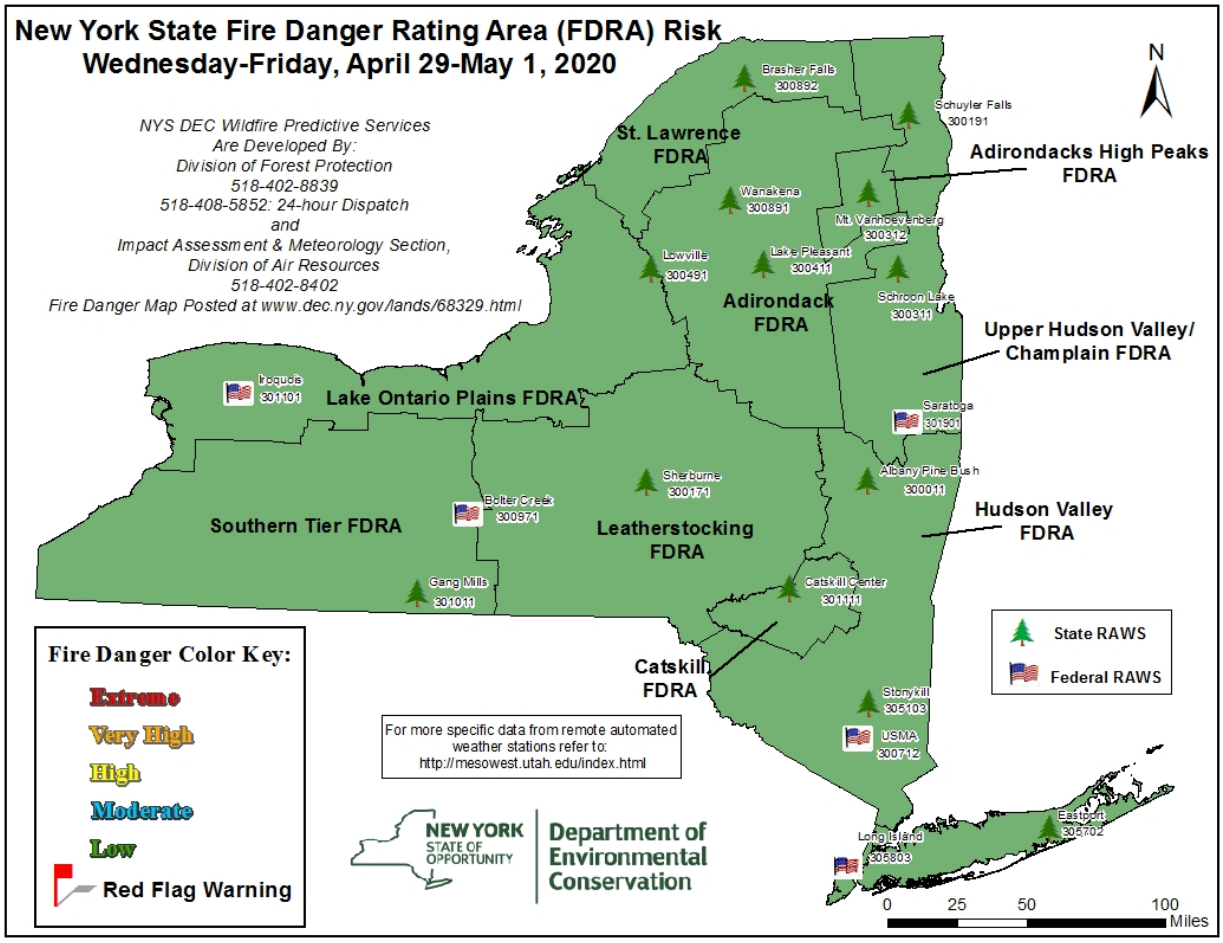
The ***Fire Danger Rating*** in New York is established using information from the National Fire Danger Rating System (NFDRS) and takes into account current and antecedent weather, fuel types, and both live and dead fuel moisture. This information is provided by local station managers (USFS, n.d.) in each of the ten regions of New York State. Figure 5.4.10-1 shows an example of a Fire Danger Rating Areas (FDRA) in NYS and the fire danger risk within each area on a specific date. Putnam County is part of the Hudson Valley FDRA. On this particular day, the entire state's fire danger was low. Table 5.4.10-1 lists fire danger ratings and color codes, also used by NYSDEC to update its fire danger rating maps, identified later in this section.

Table 5.4.10-1. Description of Fire Danger Ratings in New York State

Adjective Rating Class and Color Code	Class Description
Red Flag	A short-term, temporary warning, indicating presence of a dangerous combination of temperature, wind, relative humidity, fuel, or drought conditions that can contribute to new fires or rapid spread of existing fires. A Red Flag Warning can be issued at any Fire Danger level.
Extreme (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 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.
Very High (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.
High (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.
Moderate (blue)	Fires can start from most accidental causes, but except for 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.
Low (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.

Source: NYS DEC 2020

Figure 5.4.10-1. New York State Fire Danger Rating Areas



Source: NYSDEC 2020

Location

In Putnam County, areas that are heavily forested or contain large tracts of brush and shrubs, are prone to fires (NYSDEC 2020). In NYS, NYSDEC's Division of Forest Protection (Forest Ranger Division) is designated as the State's lead agency for wildfire mitigation. It has fought fires and retained records for more than 125 years. Over the past 25 years (1993-2017), Division records indicate that rangers suppressed 5,423 wildfires that burned a total of 52,580 acres (NYSDEC 2020). Currently, more than 1,700 fire departments respond to an average of 4,500 wildfires each year. Forest Rangers respond to approximately 3% of all wildfires. However, they help contain 33% of all wildfire acres (NYSDEC 2020). The Forest Ranger Division (different than the Fire Danger Rating Area) for Putnam County is Region 3. The boundaries of the Fire Danger Rating Areas do not match the Forest Ranger Division boundaries displayed in Figure 5.4.10-1.

Putnam County has significant areas of forest cover. Some of these forest covered areas are in the form of State-owned lands, including California Hill State Forest, Cranberry Mountain Wildlife Management Area, Great Swamp Wildlife Management Area, Bog Brook Unique Area, Big Buck State Forest, Ninham Mountain Multiple Use Area, White Pond Multiple Use Area, Castle Rock Unique Area, Donald Trump State Park, and Fahnestock State Park.

According to the National Land Cover Database, as of 2011 there are 105,295 acres (164 square miles) of forest in Putnam County and 9,623 acres of wetlands. Altogether, 73 percent of the County's land area is wetlands or forest. Of the County's total acreage (157,632 acres), 36,400 are preserved open space or parks and recreation lands – accounting for 23% of land area in the County. Table 5.4.10-2 displays the acres of public park land by owner in Putnam County.

Table 5.4.10-2. Parks & Recreation Land by Owner

Owner	Acres
County	2,972.9
Federal	1,338.1
Municipal	2,242.9
State	25,322.6
Non-Profit	2,086.8
Private	2,434.5
Other	2.4
Total	**36,400.2 acres**

Source: Putnam County Online 2020

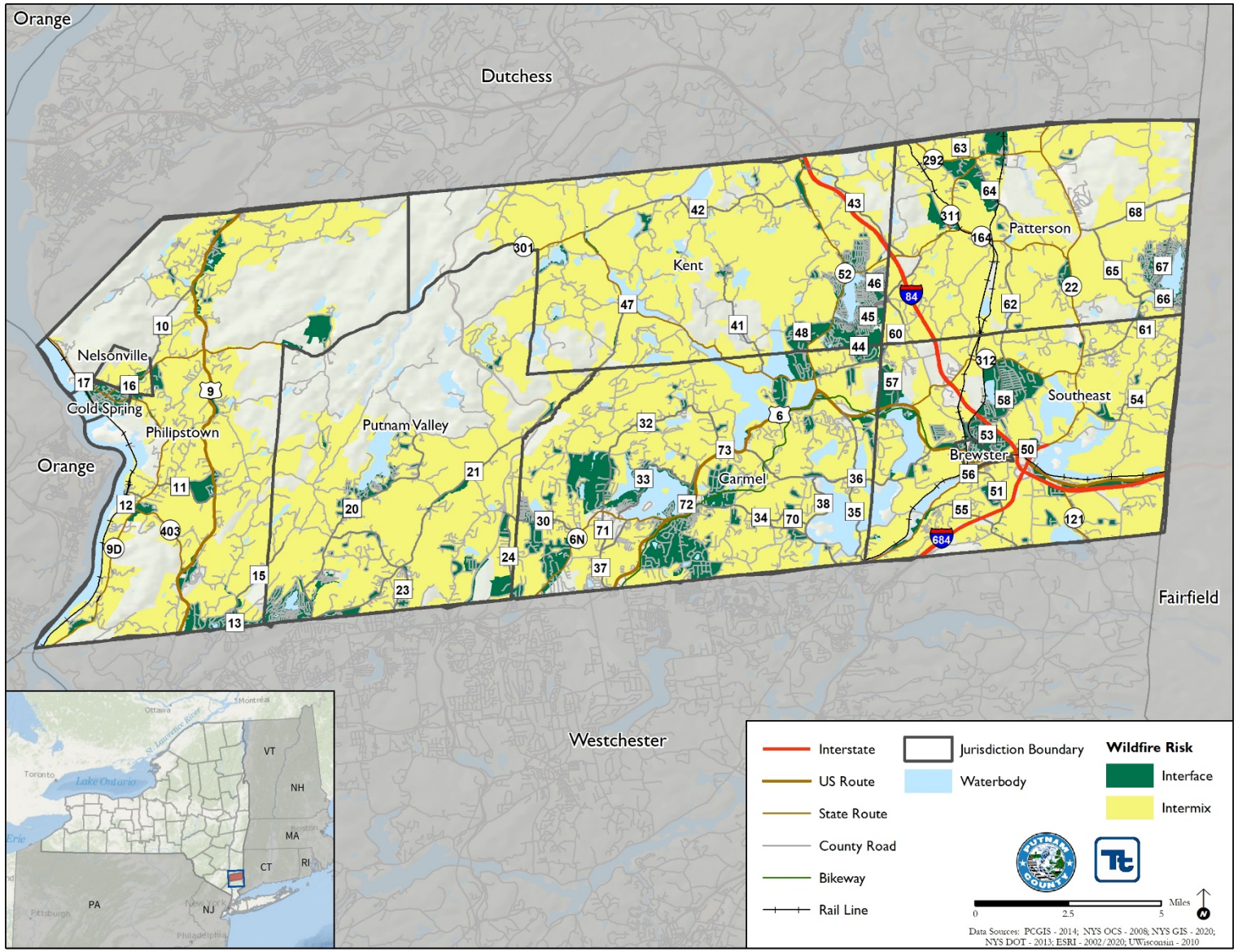
The wildland-urban interface (WUI) is the area where houses and wildland vegetation meet or intermingle, and where wildfire problems are most pronounced (Radeloff et al 2018). A detailed WUI, divided into Interface and Intermix areas, defines the wildfire hazard area for Putnam County. Intermix WUI are areas where housing and vegetation intermingle; interface WUI are areas with housing in the vicinity of contiguous wildland vegetation. This data was obtained through the SILVIS Laboratory, Department of Forest Ecology and Management, University of Wisconsin – Madison. Approximately 9.3 percent of the county's land area is within the WUI interface and 59.5 percent of the county's land is within the WUI intermix.

Figure 5.4.10-2. Wildland-Urban Interface Area and Changes, 1990-2010

	2010 Total (Sq. Mi)	% of County Land Area	# Change Since 1990 (Sq. Mi)	% of Change
Intermix WUI	146.6	59.53%	5.842351	4.20%
Interface WUI	23.1	9.37%	1.53	7.10%
WUI Total	**169.7**	68.90%	**7.37**	**4.50%**
Non-WUI	**76.6**	31.10%	**-7.37**	**-8.80%**

Source: University of Wisconsin-Madison 2020

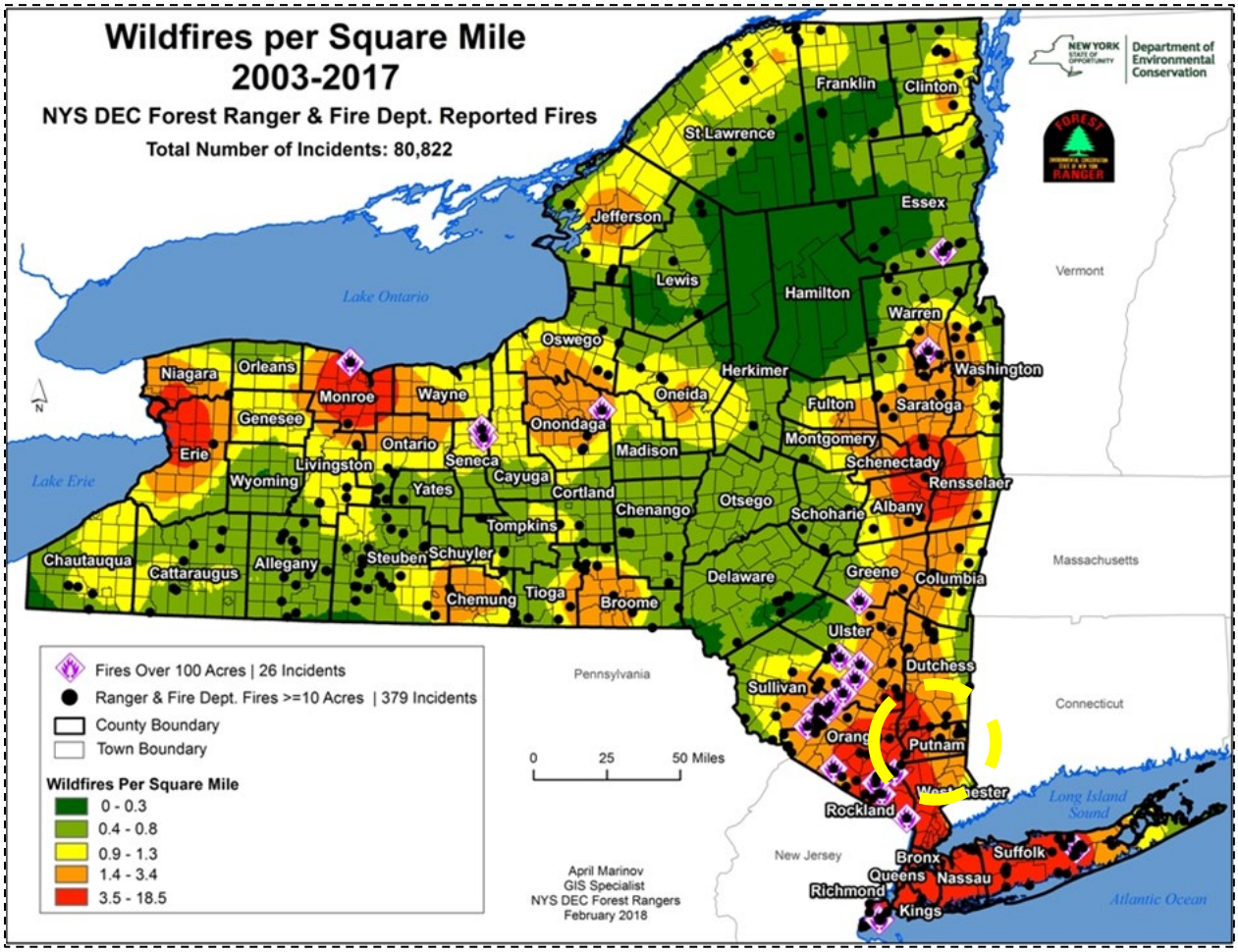
Figure 5.4.10-3. Wildland-urban Interface and Intermix in Putnam County, 2010



Previous Occurrences and Losses

Determinations of wildfire occurrences in NYS are based on two data sources: the New York State Forest Ranger force, and the New York State Office of Fire Prevention and Control (NYS OFP&C). Figure 5.4.10-4 illustrates occurrences of wildfires in NYS between 2003 and 2017. This figure reveals occurrences of between 1.4 and 18.5 wildfires per square mile from 2003 to 2017 within Putnam County municipalities with the lowest rate of occurrence in the eastern portion of the county and the highest rate of occurrence in the western portion of the county. The majority of these fires are small brush fires. The plurality of fires in the Hudson Valley region is caused by burning debris (35%) followed by arson and campfires (NYSDEC 2018).

Figure 5.4.10-4. Wildfire Occurrences in New York State, 2003-2017



Source: *NYSDEC 2018*
Note: *The yellow oval indicates the location of Putnam County.*

FEMA Disaster Declarations

Between 1954 and 2020, NYS was not included in any wildfire-related major disaster (DR) or emergency (EM) declarations (FEMA 2020).

Previous Events

In March 2020, Putnam County and Dutchess County fire companies in addition to New York State Park Rangers responded to a major brushfire that broke out between Cold Spring and Beacon. The brush fire started from a

maintenance vehicle on the Metro-North Railroad line, damaged several park vehicles at a hiking trailhead, then jumped Route 9D and burned approximately 300 acres in Hudson Highlands State Park (Welber 2020, Sucato n.d.). No structures were reported damaged.

Figure 5.4.10-5. Breakneck Ridge Wildfire

Source: Sucato n.d.

Climate Change Projections

Climate change directly and indirectly affects growth and productivity of forests: directly as a result of changes in atmospheric carbon dioxide and climate, and indirectly through complex interactions within forest ecosystems. Climate also affects frequency and severity of many forest disturbances, such as infestations, invasive species, wildfires, and storm events. Extreme heat events and heat waves are also projected to increase, as listed in Table 5.4.10-3 below. As temperatures increase, suitability of a habitat for specific types of trees changes. Prolonged heat waves are likely to generate a greater number of wildfires. Stronger winds from larger storms may lead to more fallen branches for wildfires to consume. Increases in rain and snow events prime forests for fire by supporting growth of more fuel. Drought and warmer temperatures lead to drier forest fuels (NYS DHSES 2020).

Table 5.4.10-3. Extreme Event Projections for Region 5

Event Type (2020s)	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
Days over 90 degrees Fahrenheit (°F) (10 days)	14	17-22	23
# of Heat Waves (1 heat waves)	2	2 to 3	4
Duration of Heat Waves (4 days)	4	5 to 5	5
Days below 32°F (155 days)	123	127 to 136	139

Source: NYSERDA 2014

Fire potential depends on climate variability, local topography, and human intervention. Climate change can affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot, dry spells create highest fire risk. With temperatures increasing in NYS, wildfire danger may intensify with warming and drying of vegetation. When climate alters fuel loads and fuel moisture, susceptibility of forest 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.

Probability of Future Occurrences

Nationally, wildfire risk is increasing. Wildfire experts point to four reasons why wildfire risks are increasing:

- The way forests were handled in the past allowed fuel in the form of fallen leaves, branches and plant growth, to accumulate. Now this fuel is lying around the forest with potential to "feed" a wildfire.
- Increasingly hot, dry weather has occurred and will occur within the United States.
- Weather patterns across the country are changing.
- More homes are built within areas of WUI, meaning that homes are built closer to wildland areas where wildfires can occur (NYS DHSES 2014).

According to the NYS Forest Ranger Division, between 1993 and 2017 more than half of all fire department-response to wildfires occurred between March and May (NYS DEC n.d.). Beginning in 2010, NYS enacted revised open burning regulations that ban brush burning statewide during this time period. Forest ranger data indicate that this new statewide ban resulted in 46 percent fewer wildfires caused by debris burning in upstate New York from 2010 to 2017 (NYS DEC 2020).

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

In Putnam County, brush fire events will continue to occur. The likelihood of one of those fires attaining significant size and intensity cannot be predicted and is highly dependent on environmental conditions and firefighting response. However, advanced methods of wildfire management and control and better understanding of fire ecosystems should reduce the number of devastating fires in the future (NYSDEC 2020). Invasive forest insects can increase the likelihood of wildfires occurring; insects that attack and kill trees, such as Emerald Ash Borer, increase the total wildfire fuel available in wooded areas. Climate change is also likely to increase the probability of future wildfires. Prolonged periods of drought caused by climate change can potentially increase the length of the wildfire season and provide a more favorable climate for ignition.

In Section 5.3, the ranking of identified hazards of concern for Putnam County is provided. 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 'occasional' (event has between a 10% and 100% annual probability of a hazard event occurring).

5.4.10.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. A spatial analysis was conducted using the University of Wisconsin 2010 wildland-urban interface/intermix spatial layer. For the purposes of the assessment, an asset (population, structures, critical facilities, and lifelines) is considered exposed and potentially vulnerable to the wildfire hazard if it is located in the wildland-urban interface or wildland-urban intermix hazard areas.

Impact on Life, Health, and Safety

Wildfires have the potential to impact human health and life of residents and responders, structures, infrastructure, and natural resources. The most vulnerable populations include emergency responders and those within a short distance of the interface between the built environment and the wildland environment. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. Table 5.4.10-4 summarizes the estimated population exposed to the wildfire hazard by jurisdiction.

Based on the analysis, an estimated 96,096 residents, or approximately 97-percent of the County's population, are located in the wildland-urban interface/intermix hazard areas. Overall, the Town of Carmel has the greatest number of individuals located in the wildfire hazard areas (i.e., 31,959 persons).

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65. In Putnam County, there are 5,191 persons in poverty and 16,053 persons over 65 years old (U.S. Census Bureau 2018). Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families. The population over age 65 is also more vulnerable because they are more likely to seek or need medical attention that may not be available due to isolation during a wildfire event, and they may have more difficulty evacuating. Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Table 5.4.10-4. Estimated Population Located in the Wildland-urban Interface/Intermix Hazard Areas in Putnam County

Jurisdiction	American Community Survey (2014-2018) Population	Estimated Population Exposed				
		Wildland-Urban Interface	Percent of Total	Wildland-Urban Intermix	Percent of Total	Total Wildland-Urban Interface/Intermix (WUI)
Brewster (V)	2,087	1,919	91.9%	150	7.2%	2,069
Carmel (T)	34,227	14,522	42.4%	17,437	50.9%	31,959
Cold Spring (V)	1,862	1,859	99.8%	3	0.2%	1,862
Kent (T)	13,325	7,481	56.1%	5,729	43%	13,211
Nelsonville (V)	699	344	49.2%	341	48.8%	685
Patterson (T)	11,922	5,110	42.9%	6,693	56.1%	11,804
Philipstown (T)	7,163	1,764	24.6%	5,235	73.1%	6,999
Putnam Valley (T)	11,654	4,393	37.7%	7,068	60.7%	11,461
Southeast (T)	16,131	7,381	45.8%	8,666	53.7%	16,047
Putnam County (TOTAL)	**99,070**	**44,773**	**45.2%**	**51,323**	**51.8%**	**96,096**

Source: American Community Survey 2018 (ACS 2014-2018); University of Wisconsin, 2010
Notes: T = Town, V = Village, ACS = American Community Survey; % = Percent

Impact on General Building Stock

The most vulnerable structures to wildfire events are those within the wildland-urban interface/intermix hazard area. 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

wildland-urban interface/intermix hazard areas were overlaid upon the updated building inventory at the structure level. The replacement cost value of the structures with their center in the wildland-urban interface and intermix hazard areas were totaled (refer to Table 5.4.10-5 and to Table 5.4.10-6, respectively). Overall, 30,241 buildings with a replacement cost value of $25.7 billion is exposed to the wildfire hazard areas in Putnam County.

Table 5.4.10-5. Building Stock Replacement Cost Value and Building Count within the Wildland-Urban Interface Hazard Area in Putnam County

Jurisdiction	Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Exposed to the Wildland-Urban Interface Hazard Area			
			Number of Buildings Exposed	Percent of Total	Replacement Cost Value of Exposed Buildings	Percent of Total
Brewster (V)	406	$665,633,363	360	88.7%	$587,711,744	88.3%
Carmel (T)	10,170	$9,304,370,987	4,306	42.3%	$3,631,631,441	39%
Cold Spring (V)	679	$790,405,963	676	99.6%	$785,655,591	99.4%
Kent (T)	5,021	$2,983,284,562	2,800	55.8%	$1,357,635,538	45.5%
Nelsonville (V)	261	$209,404,256	128	49.0%	$95,480,431	45.6%
Patterson (T)	3,393	$2,927,865,178	1,425	42.0%	$872,052,649	29.8%
Philipstown (T)	2,767	$2,629,391,554	693	25.0%	$466,609,721	17.7%
Putnam Valley (T)	4,521	$3,314,750,529	1,711	37.8%	$981,824,798	29.6%
Southeast (T)	4,128	$4,717,511,487	1,819	44.1%	$1,383,967,990	29.3%
Putnam County (TOTAL)	**31,346**	**$27,542,617,878**	**13,918**	**44.4%**	**$10,162,569,903**	**36.9%**

Source: Putnam County GIS, 2020; University of Wisconsin, 2010
Notes: T = Town, V = Village

Table 5.4.10-6. Building Stock Replacement Cost Value and Building Count within the Wildland-urban Intermix Hazard Area in Putnam County

Jurisdiction	Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Exposed to the Wildland-Urban Intermix Hazard Area			
			Number of Buildings Exposed	Percent of Total	Replacement Cost Value of Exposed Buildings	Percent of Total
Brewster (V)	406	$665,633,363	30	7.4%	$38,136,815	5.7%
Carmel (T)	10,170	$9,304,370,987	5,139	50.5%	$4,836,366,550	52.0%
Cold Spring (V)	679	$790,405,963	1	0.1%	$264,678	<0.1%
Kent (T)	5,021	$2,983,284,562	2,165	43.1%	$1,562,670,117	52.4%
Nelsonville (V)	261	$209,404,256	127	48.7%	$110,947,559	53.0%
Patterson (T)	3,393	$2,927,865,178	1,898	55.9%	$1,886,325,804	64.4%
Philipstown (T)	2,767	$2,629,391,554	2,001	72.3%	$1,946,362,018	74.0%
Putnam Valley (T)	4,521	$3,314,750,529	2,723	60.2%	$2,236,701,244	67.5%
Southeast (T)	4,128	$4,717,511,487	2,239	54.2%	$2,937,880,367	62.3%
Putnam County (TOTAL)	**31,346**	**$27,542,617,878**	**16,323**	**52.1%**	**$15,555,655,151**	**56.5%**

Source: Putnam County GIS, 2020; University of Wisconsin, 2010
Notes: T = Town, V = Village

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. Majority of the critical facilities exposed to the wildland-urban interface/intermix hazard areas are government facilities, potable water and wastewater facilities. Table 5.4.10-7 through Table 5.4.10-9 summarize the number of critical facilities and lifelines within the wildfire hazard areas by jurisdiction. Overall, 313 critical facilities are exposed to the wildland-urban interface/intermix hazard areas; of which, 277 of the critical facilities are considered lifelines for Putnam County. The Town of Carmel has the greatest number of critical facilities built in the wildland-urban interface/intermix hazard areas (i.e., 86). The exposed lifelines are categorized into FEMA lifeline groupings and are summarized in Table 5.4.10-9. Additionally, the distribution of critical facilities exposed to the wildfire hazard areas by critical facility type are shown in Table 5.4.10-10 and Table 5.4.10-11.

Table 5.4.10-7. Critical Facilities and Lifelines in the Wildland-Urban Interface Hazard Areas in Putnam County

Jurisdiction	Total CFs Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to the Wildland-Urban Interface Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Brewster (V)	36	29	18	50.0%	13	44.8%
Carmel (T)	127	111	27	21.3%	26	23.4%
Cold Spring (V)	13	11	13	100.0%	11	100.0%
Kent (T)	41	31	9	22.0%	6	19.4%
Nelsonville (V)	4	4	3	75.0%	3	75.0%
Patterson (T)	72	66	14	19.4%	13	19.7%
Philipstown (T)	23	22	3	13.0%	3	13.6%
Putnam Valley (T)	27	15	10	37.0%	6	40.0%
Southeast (T)	76	74	7	9.2%	7	9.5%
Putnam County (TOTAL)	**419**	**363**	**104**	**24.8%**	**88**	**24.2%**

Source: Putnam County GIS 2020; University of Wisconsin, 2010

Table 5.4.10-8. Critical Facilities and Lifelines in the Wildland-urban Intermix Hazard Areas in Putnam County

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to the Wildland-Urban Intermix Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Brewster (V)	36	29	3	8.3%	3	10.3%
Carmel (T)	127	111	59	46.5%	52	46.8%
Cold Spring (V)	13	11	0	0.0%	0	0.0%
Kent (T)	41	31	19	46.3%	18	58.1%
Nelsonville (V)	4	4	1	25.0%	1	25.0%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to the Wildland-Urban Intermix Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Patterson (T)	72	66	43	59.7%	39	59.1%
Philipstown (T)	23	22	14	60.9%	13	59.1%
Putnam Valley (T)	27	15	14	51.9%	9	60.0%
Southeast (T)	76	74	56	73.7%	54	73.0%
Putnam County (TOTAL)	**419**	**363**	**209**	**49.9%**	**189**	**52.1%**

Source: Putnam County GIS 2020; University of Wisconsin, 2010

Table 5.4.10-9. Lifelines Exposed to the Wildland-Urban Interface/Intermix Hazard Areas

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Exposed to Wildland-Urban Interface/Intermix Hazard Areas
Communications	21	13
Energy	23	20
Food, Water, Shelter	150	113
Health and Medical	18	15
Safety and Security	114	90
Shelter	1	1
Transportation	35	25
Putnam County (TOTAL)	**362**	**227**

Source: Putnam County GIS 2020; University of Wisconsin, 2010

Table 5.4.10-10. Distribution of Critical Facilities in the Wildland-Urban Interface Hazard Area by Type and Jurisdiction

Jurisdiction	Facility Types																					
	Commercial	Communication	Dam	Electric	EMS	Fire Station	Government	Highway Bridge	Housing	Institutional	Marina	Medical	Oil Facility	Police Station	Potable Water	Propane Gas	Rail Facility	Recreation	Residential	School Facility	Senior Facility	Wastewater Facility
Brewster (V)	1	2	0	0	0	0	4	0	0	0	0	1	1	1	0	0	0	0	3	1	1	3
Carmel (T)	0	0	0	1	0	4	3	0	0	0	0	0	0	1	10	0	0	1	0	3	0	4
Cold Spring (V)	0	0	1	0	1	1	2	0	0	0	1	0	0	1	0	0	1	0	0	1	0	4
Kent (T)	0	0	1	0	0	0	2	3	0	0	0	0	0	0	1	0	0	0	1	0	0	1
Nelsonville (V)	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Patterson (T)	1	1	1	1	0	0	5	0	0	2	1	0	0	0	0	0	1	1	0	0	0	0
Philipstown (T)	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Putnam Valley (T)	0	0	1	0	1	0	3	0	0	0	0	0	0	0	1	0	0	0	0	4	0	0
Southeast (T)	0	1	0	0	0	1	1	0	1	0	0	0	0	0	2	1	0	0	0	0	0	0
Putnam County (TOTAL)	**2**	**4**	**4**	**3**	**2**	**7**	**22**	**3**	**1**	**2**	**2**	**1**	**1**	**4**	**15**	**1**	**2**	**2**	**4**	**9**	**1**	**12**

Source: Putnam County GIS 2020; University of Wisconsin, 2010

Table 5.4.10-11. Distribution of Critical Facilities in the Wildland-Urban Intermix Hazard Area by Type and Jurisdiction

Jurisdiction	Facility Types																							
	Agriculture	Communication	Cultural	Dam	Electric	EMS	Entertainment	EOC	Fire Station	Government	Highway Barn	Highway Bridge	Housing	Institutional	Medical	Natural Gas Facility	Police Station	Potable Water	Rail Bridge	Rail Facility	Recreation	Religion	Residential	School Facility	Wastewater Facility
Brewster (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Carmel (T)	0	0	1	1	1	1	1	1	2	5	0	0	0	0	3	1	2	24	0	0	4	1	0	3	8
Cold Spring (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Jurisdiction	Facility Types																								
	Agriculture	Communication	Cultural	Dam	Electric	EMS	Entertainment	EOC	Fire Station	Government	Highway Barn	Highway Bridge	Housing	Institutional	Medical	Natural Gas Facility	Police Station	Potable Water	Rail Bridge	Rail Facility	Recreation	Religion	Residential	School Facility	Wastewater Facility
Kent (T)	0	1	0	0	1	0	0	0	3	4	0	7	0	0	0	0	1	1	0	0	0	0	0	1	0
Nelsonville (V)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patterson (T)	0	3	0	0	2	0	0	0	3	4	0	3	0	3	0	4	0	4	3	0	1	1	1	4	7
Philipstown (T)	0	3	0	2	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Putnam Valley (T)	0	3	0	0	1	0	0	0	2	6	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Southeast (T)	1	1	0	1	2	0	0	0	0	4	0	0	2	0	2	2	1	19	0	2	3	0	0	6	10
Putnam County (TOTAL)	**1**	**11**	**1**	**4**	**7**	**1**	**1**	**1**	**13**	**25**	**1**	**10**	**2**	**3**	**5**	**7**	**4**	**49**	**3**	**2**	**8**	**2**	**1**	**19**	**28**

Source: Putnam County GIS 2020; University of Wisconsin, 2010

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 can 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.

Impact on the Environment

According to the USGS, post-fire runoff polluted with debris and contaminates can be extremely harmful to ecosystem and aquatic life (USFS 2020). Studies show that urban fires in particular are more harmful to the environment compared to forest fires (USFS 2020). The age and density of infrastructure within Putnam County can exacerbate consequences of fires on the environment because of the increased amount of chemicals and contaminates that would be released from burning infrastructure. These chemicals, such as iron lead, and zinc, may leach into the storm water, contaminate nearby streams, and impair aquatic life.

Cascading Impacts on Other Hazards

Wildfires result in the uncontrolled destruction of forests, brush, field crops, grasslands, real estate, and personal property, and have secondary impacts on other hazards such as flooding, by removing vegetation and destroying watersheds.

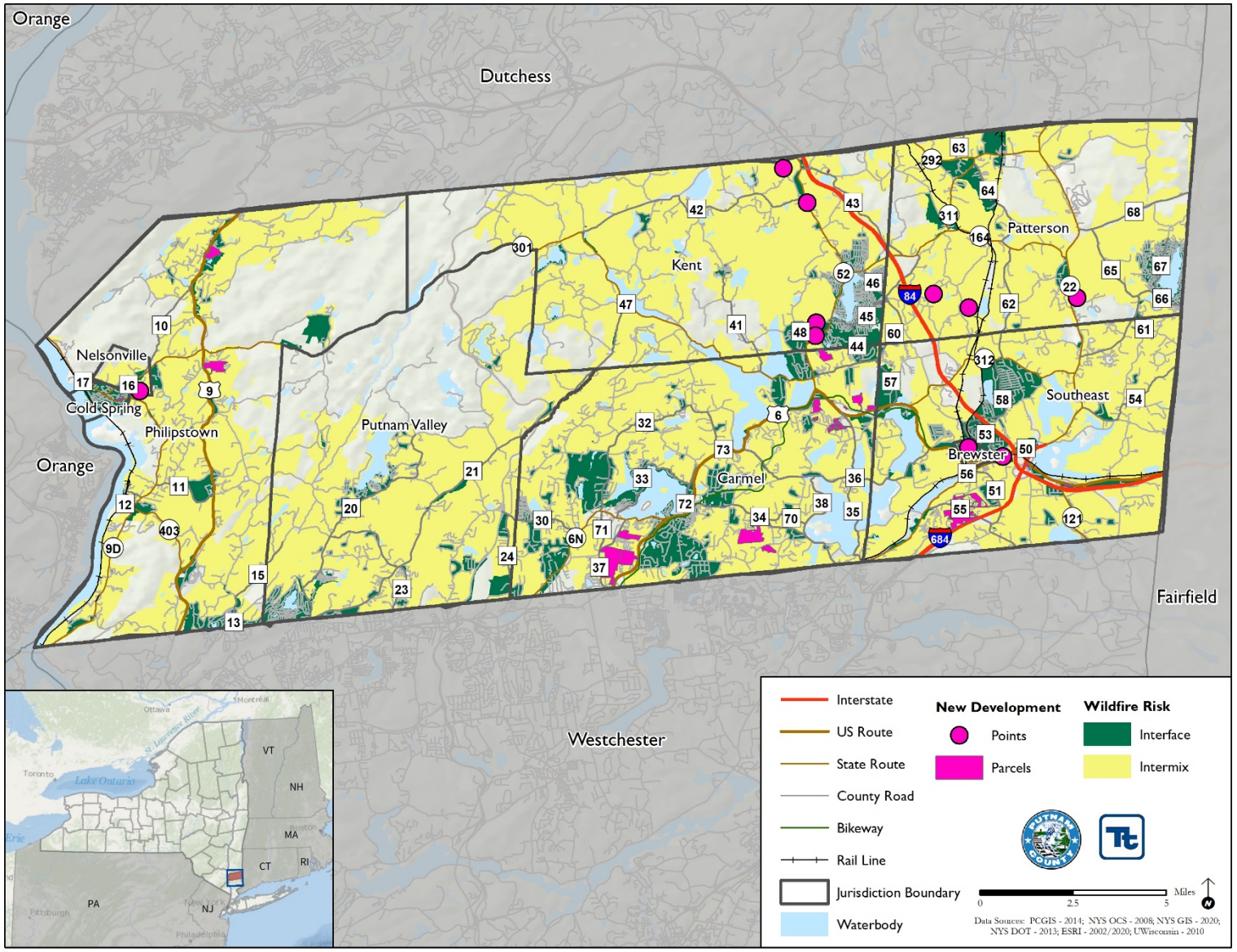
Future Changes That May Impact Vulnerability

Understanding future changes that effect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the wildland-urban interface/intermix hazard areas could be at risk. Refer to the maps in each jurisdictional annex (Section 9 of this HMP) to view the new development project areas and their proximity to the wildland-urban interface/intermix hazard areas. There are 177 new development sites located within the Wildland Urban Interface (WUI). Refer to Figure 5.4.10-7 for potential new development in the County and their proximity to the WUI Hazard Area.

Figure 5.4.10-6. New Development and Wildland Urban Interface (WUI) in Putnam County



Projected Changes in Population

According to the U.S. Census Bureau, the population in Putnam County has decreased by approximately 0.7-percent between 2010 and 2018 (US Census Bureau 2018). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will increase slowly into 2040, increasing total population to approximately 100,435 persons (Cornell Program on Applied Demographics 2017). As more people reside in the County, the number of persons at risk to wildfires will increase. Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Changes in temperature can have an effect on how fire interacts with the surrounding natural habitat and built environment. 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 2020).

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 2020).

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 2020).

Change of Vulnerability Since the 2014 HMP

For this hazard mitigation plan update, the 2010 Wildland-Urban Interface/Intermix data from the University of Wisconsin was referenced to determine areas within Putnam County that are vulnerable to wildfires. Population statistics have also been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The 2014 general building stock was updated using RS Means 2019 replacement cost values. Additionally, the critical facility inventory was updated by Putnam County.

Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Putnam County.

Identified Issues

Putnam County's people, property, and economy have a significant wildfire exposure due to the County's wildland urban interface and its extent of forest cover. Despite the low frequency of fire events, the potential for additional fires in the future is anticipated to increase.

The road network of Putnam County is vulnerable to a severe wildfire event due to the lack of east-west routes across the County. In the case of a forest fire in the central/western portion of the County, evacuation and

emergency access to and from the Villages of Nelsonville and Cold Spring and the Town of Philipstown from the western portions of the County will be hindered.