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, 2013).

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 Chenango County, has large tracts of diverse forest lands. Although destructive fires do not occur on an annual basis, New York's fire history shows a cycle of fire occurrence that result in human death, property loss, forest destruction, and air pollution (NYS DHSES, 2013).

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:

- <u>Wildland fires</u> – fueled almost exclusively by natural vegetation. They typically occur in national forests and parks, where Federal agencies are responsible for fire management and suppression.
- <u>Interface or intermix fires</u> – urban/wildland fires in which vegetation and the built-environment provide fuel
- <u>Firestorms</u> – 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.
- <u>Prescribed fires and prescribed natural burns</u> – fires that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes (FEMA, 1997).

The potential for wildfire, and its subsequent development (growth) and severity, is determined by three principal factors including the area's topography, the presence of 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).

Impacts from Other Natural Disasters

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 and Flood Vulnerability

Wildfires can also increase the probability of other natural disasters, specifically flash floods and mudflows. Wildfires, particular large-scale, can dramatically alter the terrain and ground conditions, making land already devastated by fire susceptible to floods. Lands impacted by wildfire increase the risk of flooding and mudflow in those areas impacted by wildfire. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water; thus, creating conditions perfect for flash flooding and mudflows. Flood risk in these impacted areas remain significantly higher until vegetation is restore, which can take up to five years after a wildfire (FEMA, 2013).

Flooding after a wildfire is often more severe, as debris and ash left from the fire can form mudflows. During and after a rain event, as water moves across charred and denuded ground, it can also pick up soil and sediment and carry it in a stream of floodwaters. These mudflows have the potential to cause significant damage to impacted areas. Areas directly affected by fires and those located below or downstream of burn areas are most at risk for flooding (FEMA, 2013). For detailed information regarding flooding, see Section 5.4.3 (Flood).

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 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).

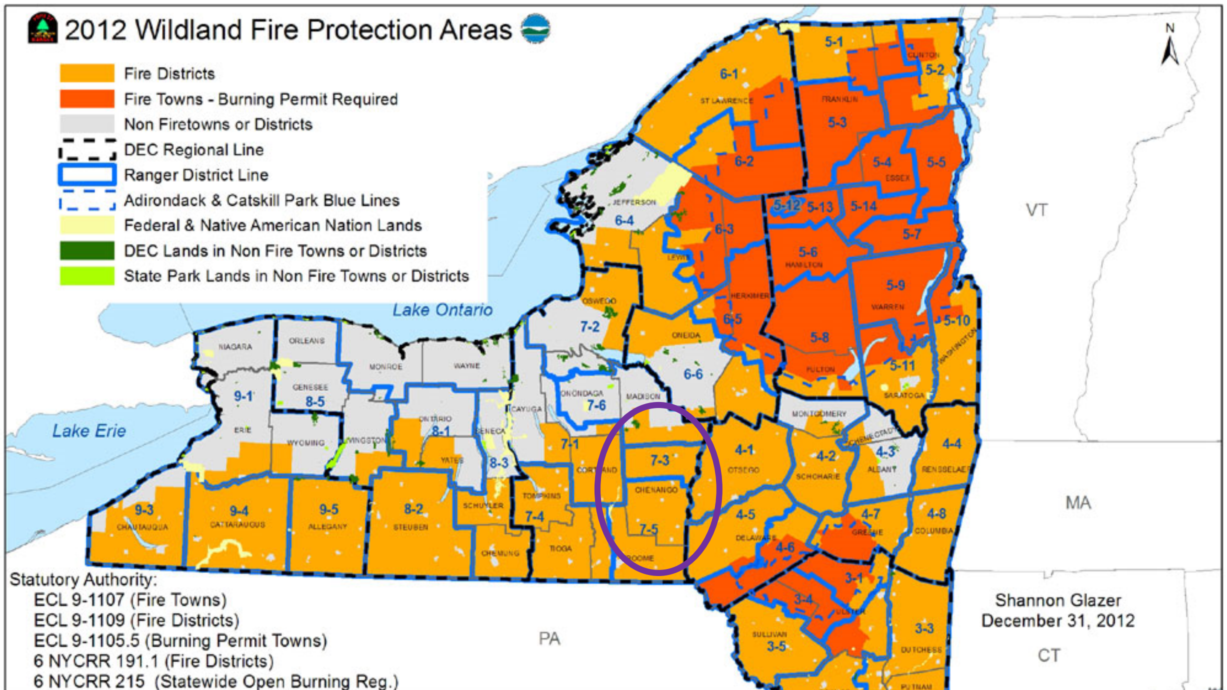
Location

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, 2012). Wildfires occur in virtually all of the U.S. The western portion of the U.S. is subject to more frequent wildfires, due to their more arid climate and prevalent conifer and brush fuel types. Wildfires have proven to be the most destructive in California, but have become an increasingly frequent and damaging phenomenon nationwide (FEMA, 1997). States with a large amount of wooded, brush, and grassy areas, such as California, Colorado, New Mexico, Montana, Kansas, Mississippi, Louisiana, Georgia, Florida, North and South Carolina, Tennessee, Massachusetts, and the national forests of the western U.S. are at highest risk for wildfires (University of Florida, 1998).

New York State is 30.9 million acres in size, with 18.9 million acres of non-federal forested land. Many areas in the State, especially those that are heavily forested or contain large tracts of brush and shrubs, are prone to wildfires. The Adirondacks, Catskills, Hudson Highlands, Shawangunk Ridge, and Long Island Pine Barrens are examples of fire-prone areas. The State also contains open space, non-forested lands that have significant wildfire potential. The wetlands of western and lower New York State are examples of these lands and can burn as weather conditions allow (NYS DHSES, 2013).

The New York State Forest Ranger Division provides forest fire protection for 657 municipalities in the State. Figure 5.4.7-1 displays the fire protection areas in New York State. This figure indicates that Chenango County is part of the wildfire protection area.

Figure 5.4.7-1. 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 highlight added

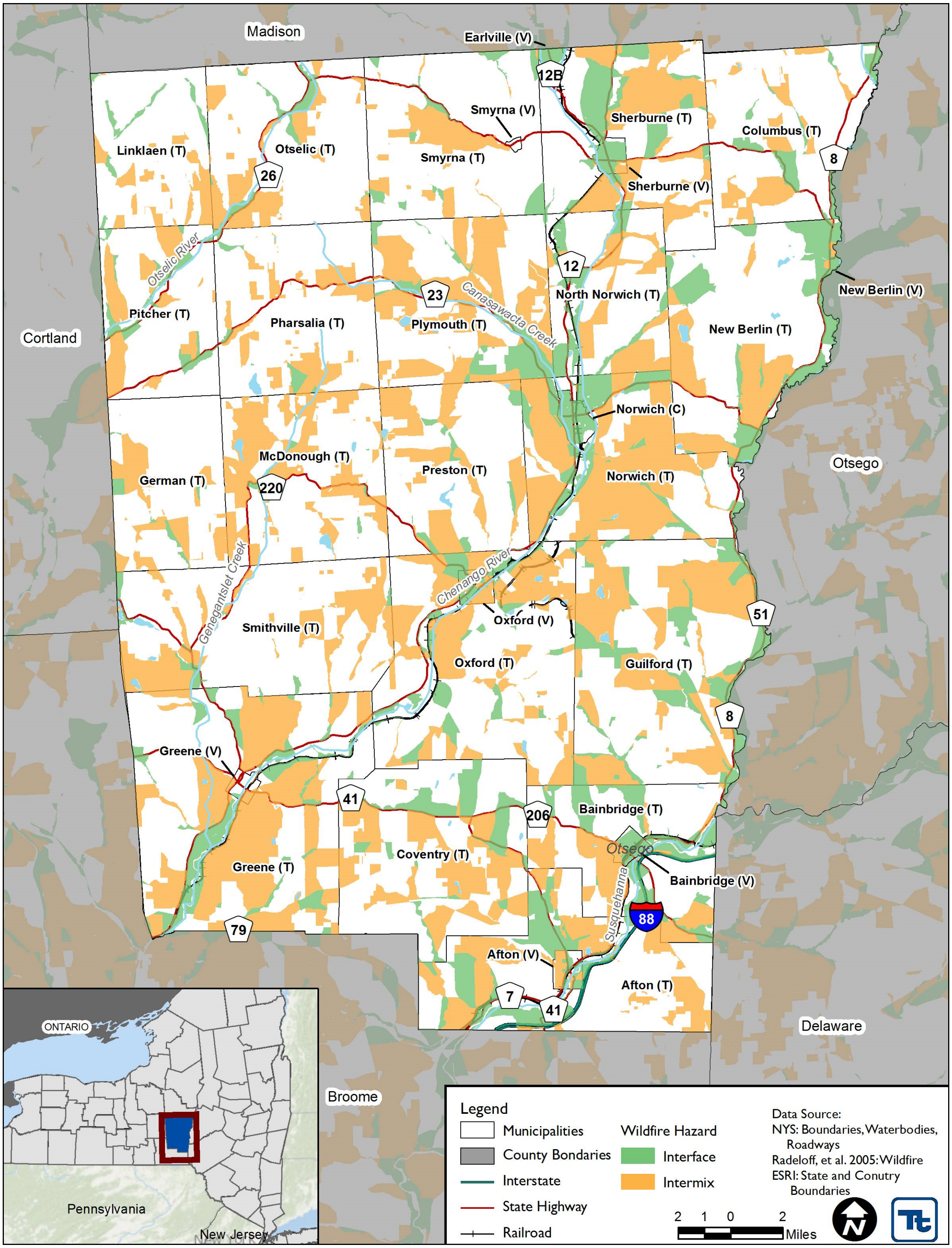
Wildfire/Urban Interface (WUI) in New York State/ Chenango County

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 Chenango County, an official list that details the location, type of interface and surrounding fuel make-up does not exist (NYS DHSES, 2011).

A detailed WUI (interface and intermix) spatial dataset was obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison which 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 (interface and intermix) illustrated in Figure 5.4.7-2 below (Radeloff, et al, 2005).

Figure 5.4.7-2. SILVIS Wildland Urban Interface in Chenango County



Source: *Radeloff et al, 2005*

Previous Occurrences and Losses

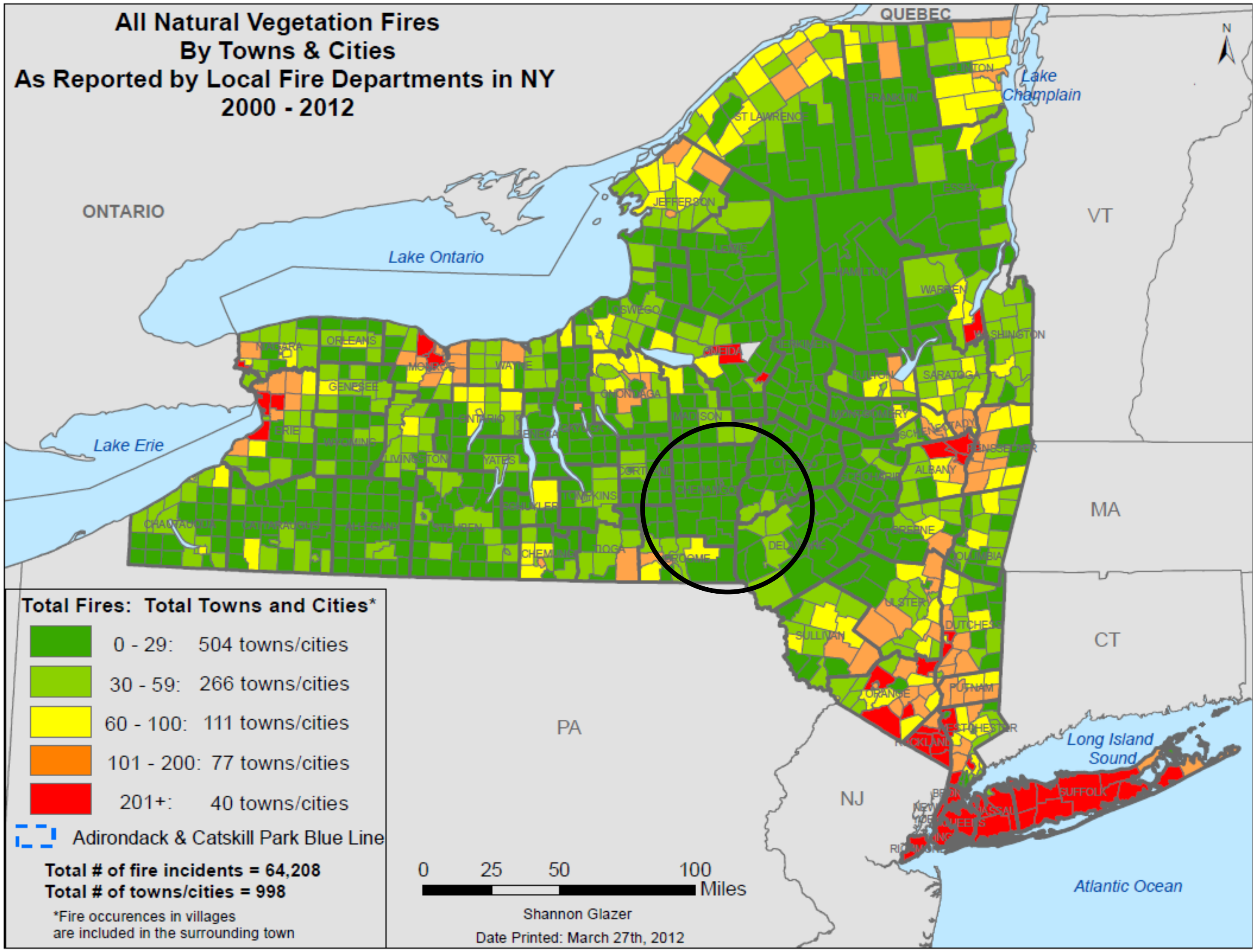
The short-term effects of wildfires can include destruction of timber, forest, wildlife habitats, scenic vistas, and watersheds. Business and transportation disruption can also occur in the short-term. Long-term effects can include reduced access to recreational areas, destruction of community infrastructure 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 1988 and 2012, the Division has suppressed over 6,900 wildfires that burned over 67,000 acres. The New York State Office of Fire Prevention and Control indicated that between 2002 and 2012, fire departments throughout the State responded to over 64,000 wildfires, brush fires, grass fires and 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-percent; children accounted for 5-percent; and smoking, equipment, railroads, and other causes accounted for 30-percent (NYSDEC, 2013). Figure 5.4.7-4 illustrates the occurrences of wildfires in New York State, between 2000 and 2012. According to this figure, each city or town in Chenango County had 0-29 wildfires between 2000 and 2012. No additional information was found regarding these wildfire events in the County.

The NOAA NCDC Storm Events Database for 1950-2013 does not include any records of wildfires in Chenango County. The SHELDUS database shows one severe storm/thunderstorm-wildfire event occurred on April 20, 1962 and caused approximately $8,000 in property damages.

Figure 5.4.7-3. Wildfire Occurrences in New York State, 2000-2012



Source: *NYSDEC, 2013*
Note: *The black circle indicates the location of Chenango County.*

Probability of Future Events

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, 2013).

Modern scientific thought has led to the emergence of "controlled burns" in wildfire vulnerable areas (such as those found in the Adirondack Region and Central Pine Barrens of Long Island). These controlled burns have reduced the risk for extreme wildfires, but the risk still exists. 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, 2013). Chenango County will continue to experience direct and indirect impacts of wildfires.

In Section 5.3, the identified hazards of concern for Chenango 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 'Occasional' (likely to occur more than once every 100 years, as presented in Table 5.3-3).

Wildfires and Climate Change

According to the U.S. Forest 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 conducive to large, severe fires (USFS, 2011).

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; therefore, affecting fire-weather conducive to extreme fire behavior (USFS, 2011).

5.4.7.2 VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following text evaluates and estimates the potential impact of the wildfire hazard on Chenango 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 and infrastructure, (4) economy and (5) future growth and development
- 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.

As previously discussed, wildfires change the landscape and ground conditions which can lead to an increased risk of flooding due to heavy rains, flash flooding and mudflows (or rivers of liquid and flowing mud). Please refer to Section 5.4.3 (Flood) for additional discussion on the flood hazard and its impact on population, the built environment and the economy.

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. In Figure 5.4.7-2 presented earlier in the profile display the 2010 Wildfire Urban Interface for the U.S. and Chenango 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 2010 Census population data (U.S. Census, 2010) was overlaid with the WUI (interface and intermix). The Census blocks with their center within the hazard area were used to calculate the estimated population exposed to the wildfire hazard. Table 5.4.7-2 summarizes the estimated population exposed by municipality.

Table 5.4.7-2. Estimated Population Located within the WUI in Chenango County

Municipality	U.S. Census 2010 Population	Estimated Population Exposed			% of Total Exposed
		Intermix	Interface	Total	
Afton (T)	2,029	770	858	1,628	80.2
Afton (V)	822	329	493	822	100.0
Bainbridge (T)	1,953	658	965	1,623	83.1
Bainbridge (V)	1,355	202	1,153	1,355	100.0
Columbus (T)	975	180	236	416	42.7
Coventry (T)	1,655	692	493	1,185	71.6
Earlville (V)	327	0	219	219	67.0
German (T)	370	193	36	229	61.9
Greene (T)	4,024	2,131	866	2,997	74.5
Greene (V)	1,580	157	0	157	9.9
Guilford (T)	2,922	1,014	1,249	2,263	77.4
Linklaen (T)	396	93	103	196	49.5
McDonough (T)	886	575	114	689	77.8
New Berlin (T)	1,654	480	708	1,188	71.8
New Berlin (V)	1,028	141	887	1,028	100.0
North Norwich (T)	1,783	550	904	1,454	81.5
Norwich (C)	7,183	0	7,183	7,183	100.0
Norwich (T)	4,005	1,969	1,699	3,668	91.6
Otselic (T)	1,054	359	396	755	71.6
Oxford (T)	2,451	953	615	1,568	64.0
Oxford (V)	1,450	567	883	1,450	100.0
Pharsalia (T)	593	343	64	407	68.6
Pitcher (T)	803	256	319	575	71.6
Plymouth (T)	1,804	986	532	1,518	84.1
Preston (T)	1,044	488	136	624	59.8
Sherburne (T)	3,721	1,065	1,812	2,877	77.3
Smithville (T)	1,330	616	277	893	67.1
Smyrna (T)	1,067	240	146	386	36.2
Smyrna (V)	213	0	0	0	0.0
Chenango County	50,477	16,007	23,346	39,353	78.0

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 default building inventory in HAZUS-MH. The replacement cost value of the Census block with their center in the WUI were totaled. Table 5.4.7-3 summarizes the estimated building stock inventory exposed by municipality.

Table 5.4.7-3. Building Stock Replacement Value Located within the WUI in Chenango County

Municipality	Total RV (Structure and Contents)	Building RV Exposed			% of Total Exposed
		Intermix	Interface	Total	
Afton (T)	$185,853,000	$68,023,000	$61,105,000	$129,128,000	69.5
Afton (V)	$111,535,000	$49,763,000	$60,258,000	$110,021,000	98.6
Bainbridge (T)	$262,226,000	$47,837,000	$161,879,000	$209,716,000	80.0
Bainbridge (V)	$230,761,000	$78,738,000	$152,023,000	$230,761,000	100.0
Columbus (T)	$103,146,000	$13,332,000	$15,416,000	$28,748,000	27.9
Coventry (T)	$133,560,000	$45,724,000	$33,685,000	$79,409,000	59.5
Earlville (V)	$25,282,000		$18,822,000	$18,822,000	74.4
German (T)	$39,095,000	$14,137,000	$8,274,000	$22,411,000	57.3
Greene (T)	$357,673,000	$172,810,000	$78,861,000	$251,671,000	70.4
Greene (V)	$318,370,000	$21,300,000	$0	$21,300,000	6.7
Guilford (T)	$260,236,000	$94,512,000	$80,010,000	$174,522,000	67.1
Linklaen (T)	$32,805,000	$8,570,000	$5,734,000	$14,304,000	43.6
McDonough (T)	$84,992,000	$58,045,000	$9,081,000	$67,126,000	79.0
New Berlin (T)	$155,791,000	$41,284,000	$54,449,000	$95,733,000	61.4
New Berlin (V)	$142,288,000	$9,132,000	$133,156,000	$142,288,000	100
North Norwich (T)	$173,219,000	$45,734,000	$67,700,000	$113,434,000	65.5
Norwich (C)	$1,078,469,000	$0	$1,021,656,000	$1,021,656,000	94.7
Norwich (T)	$436,723,000	$166,281,000	$156,209,000	$322,490,000	73.8
Otselic (T)	$103,092,000	$27,261,000	$54,391,000	$81,652,000	79.2
Oxford (T)	$245,148,000	$91,403,000	$73,618,000	$165,021,000	67.3
Oxford (V)	$173,075,000	$61,383,000	$110,782,000	$172,165,000	99.5
Pharsalia (T)	$50,234,000	$23,369,000	$3,416,000	$26,785,000	53.3
Pitcher (T)	$49,359,000	$16,425,000	$12,964,000	$29,389,000	59.5
Plymouth (T)	$185,178,000	$65,131,000	$75,429,000	$140,560,000	75.9
Preston (T)	$81,871,000	$28,672,000	$5,915,000	$34,587,000	42.2
Sherburne (T)	$220,011,000	$41,624,000	$37,106,000	$78,730,000	35.8
Sherburne (V)	$289,072,000	$29,681,000	$259,391,000	$289,072,000	100.0
Smithville (T)	$114,370,000	$45,213,000	$20,920,000	$66,133,000	57.8
Smyrna (T)	$92,261,000	$19,134,000	$15,828,000	$34,962,000	37.9
Smyrna (V)	$20,409,000	$0	$0	$0	0.0
Chenango County	$5,756,104,000	$1,384,518,000	$2,788,078,000	$4,172,596,000	72.5

Source: Hazus-MH v2.1; Radeloff et al, 2005
Notes: 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 5.4.7-4 summarizes critical facilities located within the wildfire hazard area by jurisdiction.

Table 5.4.7-4. Facilities in the WUI (Intermix or Interface) in Chenango County

Municipality	Facility Types													
	Airport	Bus	Communication	Fire	Hazmat	Medical	Police	Potable Pump Wells	Potable Tank	School	Senior	Shelter	WW Pump	WWTF
Afton (T)	1				1									
Afton (V)				1	4	1	1	1		1	1	2		
Bainbridge (T)														
Bainbridge (V)				1			1	1		2	2	1	1	1
Columbus (T)	1			1			1					1		
Coventry (T)														
Earlville (V)												1		
German (T)														
Greene (T)	1				1									
Greene (V)											1			1
Guilford (T)				2					1	1		1		
Linklaen (T)														
McDonough (T)				1								1		
New Berlin (T)				2				1		1		1		
New Berlin (V)							1			1	3	2		
North Norwich (T)	1			1						1		1		
Norwich (C)					2	3	1			5	11	3		
Norwich (T)		1	2	1	4		2	2					2	
Otselic (T)				1			1							

Municipality	Facility Types													
	Airport	Bus	Communication	Fire	Hazmat	Medical	Police	Potable Pump Wells	Potable Tank	School	Senior	Shelter	WW Pump	WWTF
Oxford (T)														
Oxford (V)				1		1	1	2		2		3		1
Pharsalia (T)				1										
Pitcher (T)														
Plymouth (T)				1								1		
Preston (T)														
Sherburne (T)														
Sherburne (V)					3	2	1	2			4		6	1
Smithville (T)														
Smyrna (T)														
Smyrna (V)												1		
Chenango County	4	1	2	14	15	7	10	9	1	14	22	19	9	4

Source: Radeloff et al, 2005

Impact on the Economy

Fires 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. Due to insufficient data, an economic loss estimate was not completed for the wildfire hazard

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. In Chenango County during the July 1999 drought, the NYSDEC closed NYSDEC lands in Chenango County for recreational users and were closed until the fire danger risk was lowered (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).

Change of Vulnerability

The WUI (interface and intermix) obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison was not used for the 2008 HMP vulnerability assessment. Differences in exposure and potential losses estimated from the 2008 HMP and this update is mainly due to the difference in these wildfire hazard areas, as well the release of the 2010 U.S. Census statistics.

Future Growth and Development

Areas targeted for potential future growth and development in the next five (5) years have been identified across Chenango 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.

Several entities with ongoing wildfire management responsibilities in Chenango County should be involved with any future data collection and analysis. These include the Central Pine Barrens Wildfire Task Force, The Nature Conservancy, Brookhaven National Laboratory, the 17 local fire jurisdictions through the Chenango County Fire Chief's Council and Fire District Managers' Association, Chenango County Office of Emergency Management and Fire Rescue and Emergency Services, New York State Department of Environmental Conservation Wildfire and Incident Management Academy, and New York State Emergency Management Office. Development and availability of such data would permit a more detailed estimate of potential vulnerabilities, including loss of life and economic damages, based on the population and resources exposed to the hazard.

WUI planning should include ongoing efforts to:

- Identify and map structures, resources, and property that require protection
- Use satellite imagery to create land cover and vegetation community maps outside of the legal boundary of the Central Pine Barrens
- Create land use regulations that encourage construction of defensible space and shaded fuel breaks
- Create land use regulations that require firewise construction in the WUI
- Reduce fuel and create shaded fuel-breaks (including a combination of mechanical thinning and prescribed fire)
- Include public education campaigns to spread information to citizens at risk