MASTER PLAN

BOROUGH OF PENNINGTON
NEW JERSEY

Climate Change-Related Hazard Vulnerability Assessment (CCRHVA)

The CCRHVA is part of the Land Use Plan element. Because it may need to be updated more frequently than the Land Use Plan element, it is kept as a separate document on the Master Plan page in the Planning and Zoning section of the Pennington Borough website.

The CCHRVA draft was posted on the Borough on December 22, 2025, and conditionally adopted by the Planning Board on January 14, 2026. The writing of Section E, the Build Out Analysis, was delayed until after the Amended 2025 Fourth Round Housing Plan was adopted by the Planning Board and Council adopted the HMU, MU and AH 1-5 ordinances in March, 2026. The CCRHVA will be available for comments until April 22, 2026, prior to final adoption at a public meeting of the Planning Board on May 13, 2026..

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Acknowledgements

Development of the CCHRVA was led by Andy Jackson. Thanks go to Yasmine Zein, who wrote the first draft and to Rick Smith and Doug Pinelli, who made significant additions. An extensive review by Kati Angerone and Nick Angerone greatly enhanced the final product, and thanks go to them.

A. CCRHVA Requirements

In 2021, the Municipal Land Use Law, N.J.S.A. 40:55D-28 was amended to include a provision requiring that a vulnerability assessment for hazards related to climate change be included in the land use plan element of any future Master Plan. The amendment requires that the climate change-related hazard vulnerability assessment meet the following criteria:

1. Municipalities are to analyze current and future threats to, and vulnerabilities of, the municipality associated with climate change-related natural hazards.
2. Include a build-out analysis of future residential, commercial, industrial, and other development in the municipality, and an assessment of the threats and vulnerabilities identified above related to that development.
3. Identify critical facilities, utilities, roadways, and other infrastructure that is necessary for evacuation purposes and sustaining quality of life during a natural disaster, to be maintained at all times in an operational state.
4. Analyze the potential impact of natural hazards on relevant components and elements of the master plan.
5. Provide strategies and design standards that may be implemented to reduce or avoid risks associated with natural hazards.
6. Include a specific policy statement on the consistency, coordination, and integration of the climate-change related hazard vulnerability assessment with certain other plans adopted by the municipality.
7. Rely on the most recent natural hazard projections and best available science provided by the New Jersey DEP.

The purpose of this vulnerability assessment is to assess Pennington Borough's vulnerability and resilience to the impacts of climate change using the best available data, to inform any future policy and development decisions for which climate-related hazards are relevant considerations, and to recommend actions the Borough can take to improve its resilience to climate change-related hazards.

B. Climate Change-Related Natural Hazards

This vulnerability assessment considers the extent to which Pennington Borough is at risk from various natural hazards, several of which are projected to increase in frequency or become more severe due to climate change. This section was developed using the best available science and natural hazard projections including the NJ DEP's 2020 Scientific Report on Climate Change and the 2021 Update to the Mercer County Hazard Mitigation Plan.

New Jersey Scientific Report on Climate Change

. Mercer County Hazard Mitigation Plan | Mercer County, NJ.

NJ DEP's 2020 Scientific Report on Climate Change describes multiple climate change-related natural hazards in New Jersey. Some effects, such as increases in ocean temperature and acidification, the rise in sea level and other impacts on marine and coastal ecosystems and communities do not directly impact Pennington Borough and its residents. The highlights below, taken from the 2020 report, are those of relevance to Pennington:

1. Rising temperatures

- New Jersey is warming faster than the rest of the Northeast region and the world.
- Since 1895, New Jersey's annual temperature has increased by 3.5°F.
- Historically unprecedented warming is projected for the 21st century with average annual temperatures in New Jersey increasing by 4.1°F to 5.7°F by 2050.
- Heatwaves are expected to impact larger areas, with more frequency and longer duration by 2050.
- Climate change could result in a 55% increase in summer heat-related mortalities.

More recent data on temperature rise can be found in "A 30-Year Heat Wave Analysis in New Jersey" published by the NJ DEP Division of Science and Research (2005): https://dep.nj.gov/wp-content/uploads/dsr/heat-wave-analysis.pdf

2. Precipitation

- Annual precipitation in New Jersey is expected to increase by 4% to 11% by 2050.
- The intensity and frequency of precipitation events is anticipated to increase due to climate change, resulting in flooding that can impact safety and the ability to access emergency services.
- Tropical storms have the potential to increase in intensity due to the warmer atmosphere and warmer oceans that will occur with climate change, resulting in power outages and damage from strong winds, hail and ice storms, in addition to flooding.
- Droughts may occur more frequently due to the expected changes in precipitation patterns.

3. Air Quality

- The effects of climate change are likely to contribute to an increase in air pollution, lead to increased respiratory and cardiovascular health problems, like asthma and hay fever, and a greater number of premature deaths.
- Environmental degradation from climate-induced increases in air pollution will reduce visibility and cause damage to crops and forests.
- Wildfire seasons could be lengthened, and the frequency of large fires increased due to the hot, dry periods that will result from increased temperatures. Wildfires not only threaten life and property but even at a great distance, e.g. Western Canada and Colorado, they can impact air quality, resulting in adverse health effects.
- Climate change is expected to lead to an increase in air pollution due to meteorological changes (known as the ozone-climate penalty).

4. Freshwater Resources

- Extreme temperatures and more frequent droughts will stress the water supply.
- Surface and groundwater quality will be impaired as contaminants, pathogens, and nutrients from fertilizers enter waters due to runoff from more intense rain events.

- While freshwater wetland ecosystems are generally resilient, environmental and human stressors may reduce the natural capacity of wetlands to rebound.
- Freshwater fish, like brook trout, that need cold-water habitats are expected to lose habitat as water temperatures increase due to climate change.
- Harmful algal blooms may increase as changes to precipitation patterns lead to increased nutrients and thus eutrophic conditions that favor the growth of blooms.

5. Terrestrial Systems

- The loss of forest habitats to climate change will result in carbon losses and increase New Jersey's net greenhouse gas emissions.
- Climate change will facilitate the range infilling and expansion of invasive plant species.
- Increasing temperatures will move the range of invasive pests to the north, and spread them into areas where they were not previously found.
- A third of New Jersey's bird species are vulnerable to climate change, including the State bird, the American Goldfinch.

The 2020 Scientific Report on Climate Change concludes with recommendations on research data gaps and needs. This is a rapidly changing field and continual adjustment to adaptation strategies will be needed as the impacts unfold.

C. Vulnerability Assessment

The 2021 Update to the Mercer County Hazard Mitigation Plan (HMP) assesses the vulnerability of the Borough to various natural hazards, and the Borough's adaptive capacity with respect to each hazard. The methodology of the assessment is described below, and results are summarized in this table.

Hazard	Risk/Vulnerability	Adaptive Capacity
Dam Failure	Low	Moderate
Disease Outbreak	High	Moderate
Drought	Medium	Moderate
Flood	Medium	Moderate
Hurricane/Tropical Storm	High	Moderate
Infestation and Invasive Species	High	Moderate
Nor'Easter	Medium	Moderate
Severe Weather	High	Moderate
Severe Winter Weather	High	Strong
Wildfire	Low	Moderate

Mercer County Hazard Mitigation Plan, 2021 Update. Volume II. Tables 9.10-8 and 9.10-12.

The hazard ranking, which evaluates risk or vulnerability, "involves an assessment of the likelihood of occurrence for each hazard, along with its potential impacts on people, property,

and the economy as well as community capability and changing future climate conditions" (Mercer County HMP, 9.10-20). Based on these considerations, the risk to the Borough from each natural hazard is ranked on a scale of Low to High.

The Mercer County HMP also considers adaptive capacity. Adaptive capacity is the ability of systems, institutions, humans and other organisms to adjust to potential damage, take advantage of opportunities, or respond to consequences. Using this definition, the Borough submitted to the County a ranking of its capacity to adapt to various natural hazards on a scale of Weak to Strong, where a rating of Strong indicates that the capacity exists and is in use, a rating of Moderate indicates that the capacity may exist, but is not used or could use some improvement, and a rating of Weak indicates that the capacity does not exist or could use substantial improvement.

D. Climate Change-Related Hazards in Pennington

1. Flooding

As with much of New Jersey, flooding is the most frequent and impactful climate hazard that occurs in Pennington Borough. With multiple waterways running through town, and significant amounts of impervious surface and aging infrastructure, the Borough is vulnerable to both fluvial (non-tidal) and pluvial (stormwater) flooding.

The Federal Emergency Management Agency (FEMA) designates Flood Zone AE as an area with a 1% annual chance of flooding (often called a 100-year-flood). AE is classified as a Special Flood Hazard Area (SFHA), and property owners in these areas are required to follow strict building codes and obtain flood insurance to mitigate the risks associated with flooding. In the Borough, FEMA has identified 2.1 acres of AE regulatory floodway and 1.3 acres of AE base floodplain along Stony Brook and its tributaries, adjacent to King George Road. The rest of the Borough is considered by FEMA to have minimal flood hazard. However, FEMA mapping is based on historical data and is not representative of potential increases in climate change-induced flooding. In fact, FEMA estimates that approximately 20% of flood impacts occur outside of mapped floodplains.

New Jersey rainfall studies released by the NJ DEP in 2021 show that data used to inform flood potential was out of date, and that the state was experiencing extreme precipitation 2.5-10% higher than data used by FEMA, depending on location in the state. These studies further projected a high likelihood that precipitation intensity will increase in the latter half of the century. For example, projections suggest that the amount of precipitation associated with the 100-year, 24-hour storm is likely to increase by up to 36% in Mercer County.

Recognizing that New Jersey is already experiencing regular flooding that is more extreme, and extends further than FEMA mapping, and based on the 2021 rainfall studies, in 2023 the NJ DEP adopted Inland Flood Protection rules that increase the extent of areas regulated by the NJ Flood Hazard Area Control Act. These new regulations increase the fluvial design flood elevation (height of the lowest floor level of a building) to 3 feet above the FEMA-mapped 1% annual floodplain and thus extends the area of the regulated floodplain. The geographic extent of this

new area is estimated by Rutgers University and provided at https://www.njfloodmapper.org/ This is shown in Figure 1 for Pennington. Areas in Pennington mapped as prone to fluvial flooding are limited and include the intersection of East Delaware and King George Road at the Stony Brook bridge, and within Kunkel Park at the confluence of Lewis Brook and Stony Brook.

Figure 1. NJ flood elevation (2023), 3 feet above FEMA 100-year flood.

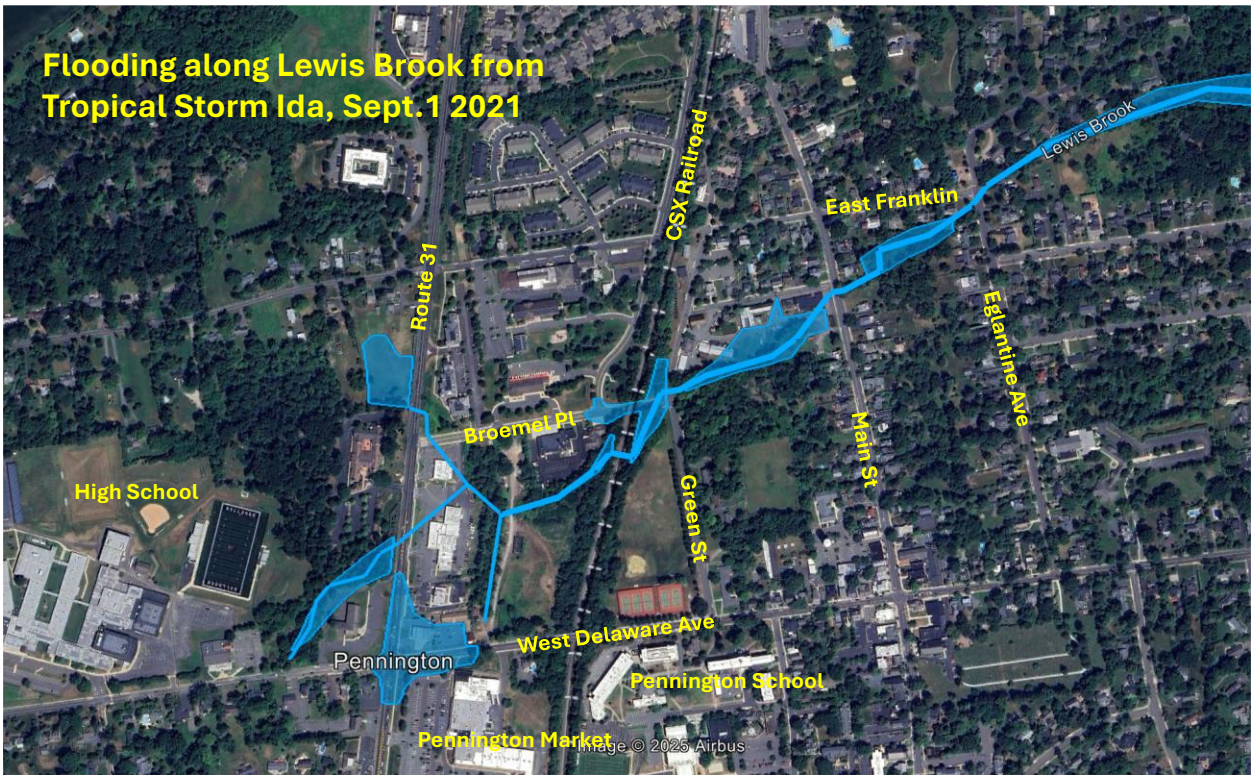
The Borough has also experienced flooding at several other locations during heavy rainfall events. Areas of concern include the intersection of Route 31 and West Delaware Avenue, the railroad underpass at Broemel Place, and the intersection of East Franklin Avenue and Eglantine Avenue, all of which have experienced flooding on multiple occasions. Flooding at the intersection of Route 31 and West Delaware Avenue results from outdated, inadequate stormwater management infrastructure controlled by the State and County, and by surrounding properties.

Multiple private properties also experience flooding, particularly along tributaries to Lewis Brook, due to culverts that pipe streams under roads and private homes and are unable to sufficiently drain at a rate commensurate with recent storm events. There is one repetitive loss property in the Borough that has repeatedly filed National Flood Insurance Program claims. Flooding can occur near Stony Brook, Lewis Brook and their tributaries because of overwhelmed stormwater systems.

Tropical Storm Ida impacted the region on September 1, 2021, causing one of the most severe flooding events in the Borough's recent history. During Ida, flooded roadways included the

intersection of Route 31 and West Delaware Avenue, Broemel Place at Green Street, King George Road at East Delaware Avenue, Eglantine at East Franklin, and North Main Street at Brookside. Three motorists were stranded in their vehicles at the intersection of Route 31 and West Delaware Avenue and were rescued by the police department. Several roadways became impassable, which could have severely hindered the ability of emergency vehicles to enter the Borough should an unrelated emergency have occurred. Figure 2 shows eight floods that occurred during Tropical Storm Ida on September 1, 2021. These areas are likely to flood again in the future unless steps are taken to update the stormwater management infrastructure that cause the flooding.

Figure 2. Flooding locations along Lewis Brook.



The Mercer County Hazard Mitigation Plan identifies 11 flood events and 5 severe weather events that impacted Pennington Borough in the years from 2008 to 2015. Note that multiple recent floods and severe weather events referenced here occurred after 2015.

Finally, the Stony Brook Regional Sewerage Authority (SBRSA) Pennington Treatment Plant experienced major flooding from Stony Brook during Tropical Storm Ida. A likely cause was the build-up of a large beaver dam on Stony Brook just east of the East Delaware Avenue bridge. The beaver dam was eventually washed away by Ida and the flood abated somewhat. The plant treats all of Pennington Borough's wastewater and sewage. While the plant is not located in Pennington Borough, the Borough is concerned about the risk of damage to the plant if another severe flooding event occurs. Figures 3-6 show floods at various locations in the Borough.

Figure 3. Flooding at the Route 31 and West Delaware Avenue intersection.

Figure 4. Flooding at North Main Street and Brookside Avenue

Figure 5. Flooding just north of the Stony Brook bridge on Pennington-Rocky Hill Road from an unnamed storm on August 22, 2021. Picture downloaded from https://mycoast.org/nj/.

Figure 6. Flooding of the Stony Brook onto King George Road, near the intersection with E. Delaware Avenue on August 22, 2021. Picture downloaded from https://mycoast.org/nj/.

2. Severe weather

Intense storms can result in a variety of hazardous conditions in addition to flooding. Strong winds can topple trees, damage buildings, and bring down overhead power lines. Tornados were rare in the past but are becoming more frequent in the area and are a threat to life. Snow and ice from winter storms can create life-threatening driving conditions and make roads impassable, hindering rescue services. Ice storms can bring down trees and power lines and immobilize traffic.

Helping the public respond to such emergencies is the role of the Hopewell Valley regional Office of Emergency Management (OEM), which covers Hopewell Township, Hopewell Borough and Pennington Borough and coordinates with County and State emergency services. The Hopewell Valley OEM uses several methods of alerting the public when there is an emergency event approaching or taking place. The Everbridge secure portal allows residents and businesses to add their contact information to receive emergency messages. The OEM has identified public and private facilities that can provide refuge in various kinds of emergencies and will coordinate public evacuation to the facilities as needed. Strong winds and ice storms can cause interruptions in electric power supply so refuge buildings, such as those designated as warming or cooling centers, should have backup power. Borough Hall is one such facility and it has backup power.

3. Drinking Water Availability

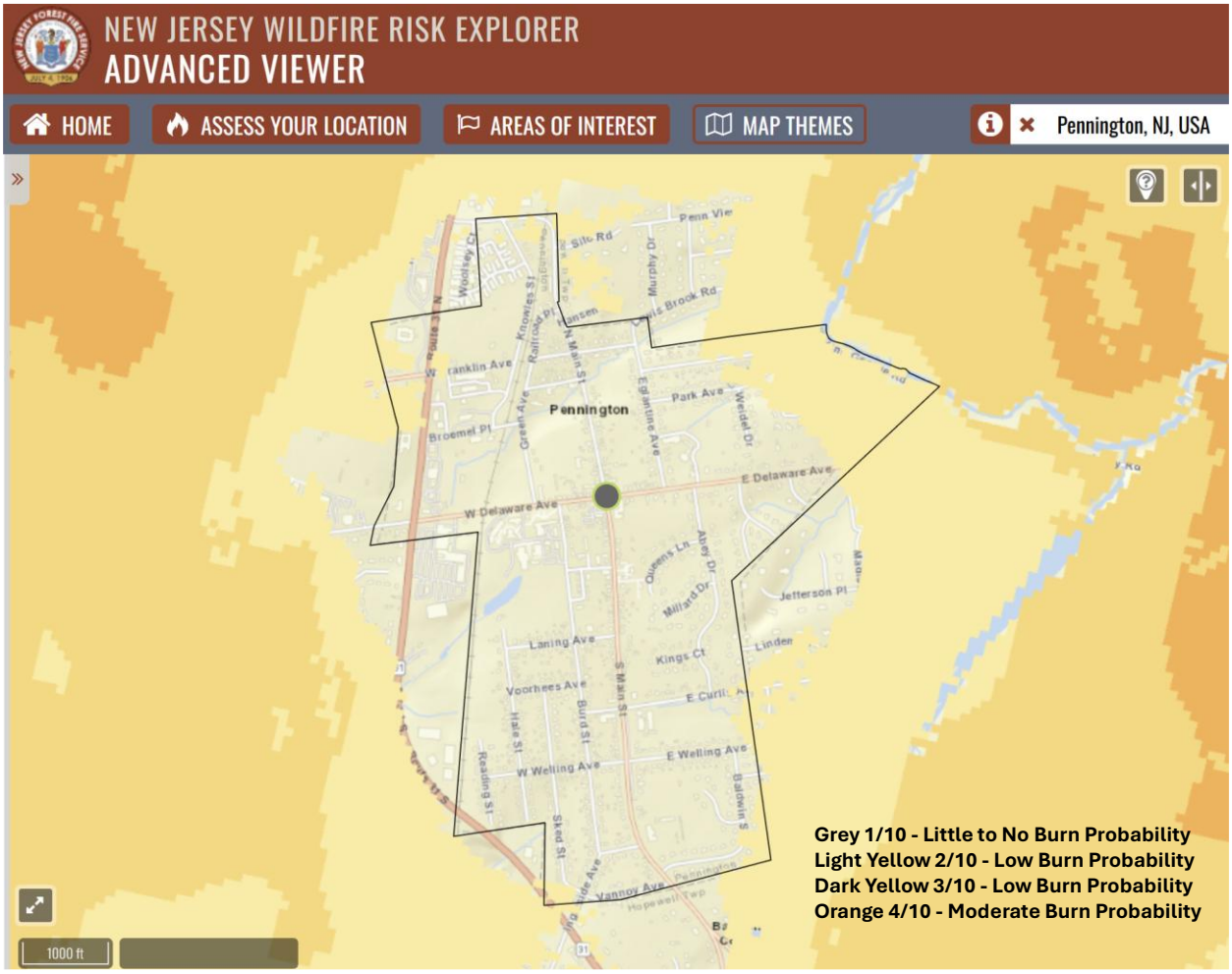
There currently are four active water supply wells in the Borough. Failure of the wells may reduce the amount of water available for consumption and firefighting. Backup power is needed in case of emergencies. Well 9, one of four wells supplying water for the Borough, is hooked up to a portable generator. With rationing, Well 9 should be able to meet the short-term needs of the customers of the Pennington Water Department. Average water demand in 2024 was 7.5 million gallons per month, or 175 gpm (gallons per minute), and Well 9 can produce 250 gpm. It may be prudent to add back-up power to Well 7 with a capacity of 190 gpm in case Well 9 develops a problem during an emergency. Battery back-up may be a better option for both in place of diesel generators. The Borough has a 600,000-gallon tank adjacent to Borough Hall as a back-up. At an emergency usage rate of 175 gpm, it could supply water for over two days. During heavy precipitation and flooding events, inflow and infiltration issues result in higher rates of wastewater, which has the potential to lead to sewage overflows and other related problems.

4. Wildfires

The New Jersey Forest Fire Service developed the Wildfire Risk Explorer tool which includes multiple datasets on local risk to wildfire hazards (https://wrap.newjerseywildfirerisk.com/). The majority of the Borough is classed as 1/10 Little or No Burn Probability, the outer edges are classed as 2/10 Low Burn Probability, see Figure 7. Risk to structures is also classed as low on this website. However, the Borough is not risk-free. In March 2025, a forest fire occurred in Hopewell Township between Woosamonsa and Poor Farm Roads It burned for two days and impacted 293 acres. Pennington experienced a severe 81-day drought from Sept. 1 to Nov. 20, 2024. There was no rain at all for 77 days. Less than 0.4 inches fell September 27-28 and 0.3

days on November 11-12 (data from the Rutgers NJ Weather Network for the weather station at The Watershed Institute in Hopewell Township, found on https://www.njweather.org/data). Foliage and grasses were very dry and could have presented a fire risk. We are proud of Pennington being a Tree City but the density of the canopy and spacing of trees should be controlled to prevent the spread of fire. Moving from lawns to meadows can increase fuel load and fire risk should be balanced against the benefits of rainwater capture.

Figure 7. Wildfire Risk in Pennington Borough



5. Infestations and invasive species

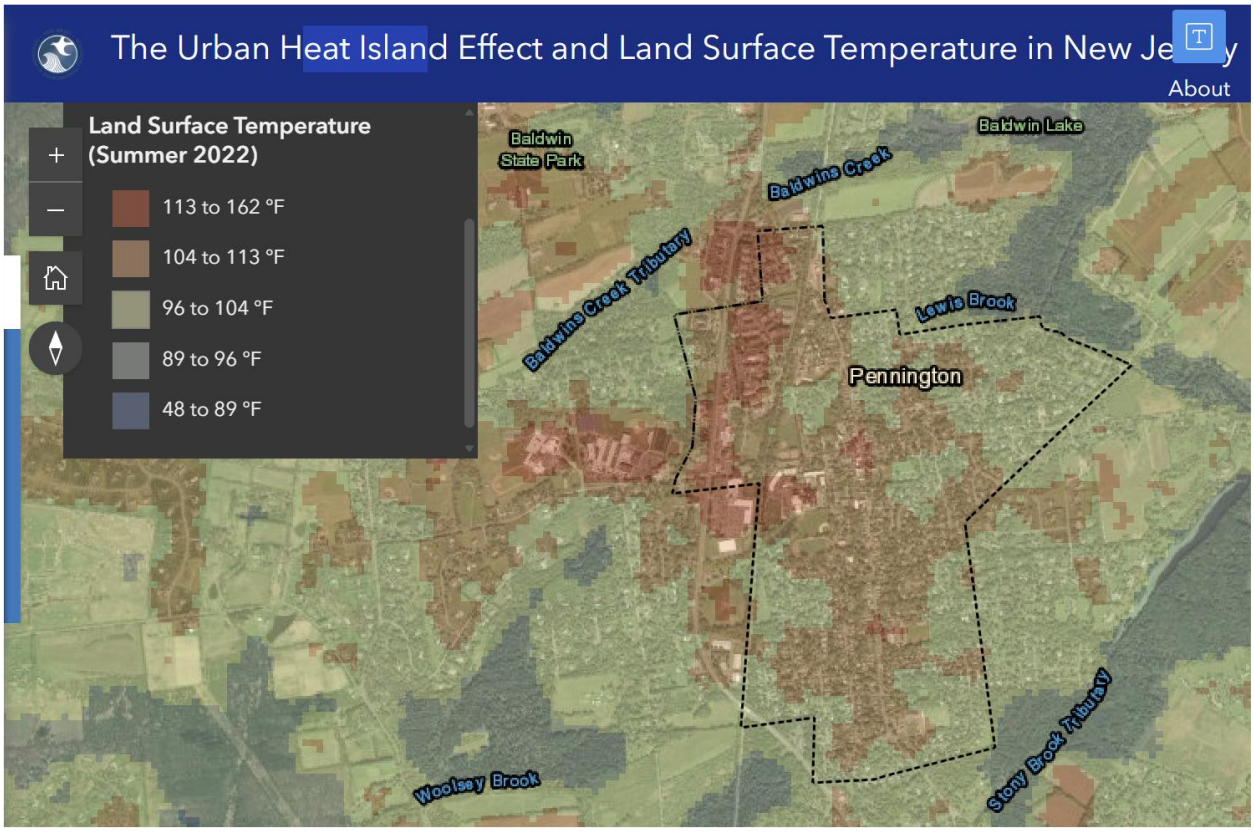
The Borough's Pin Oak trees have been impacted by Bacterial Leaf Scorch (BLS). Public Works has removed many dead and dying trees. However, there are 50-60 very large Pin Oaks within the Borough that exceed the Department's capabilities due to their size. Falling trees may result in damage to infrastructure and private property, as well as injuries or death in a worst-case scenario. The NJ DEP's 2020 Scientific Report on Climate Change projects that BLS may become more prevalent as temperatures increase while other pests and diseases may also spread more easily.

Emerald ash borer was first discovered in New Jersey in 2014 and has taken a toll on the Borough's ash trees. In addition to the loss of many of the Borough's mature shade trees, the weakened trees and dead limbs are dangerous. Fallen trees and branches also clog streams and culverts and can aggravate flooding. Regular removal of dead tree branches and trunks from streams near the entrance to culverts is a good practice to follow.

6. Extreme Heat

Extreme heat events significantly impact daily activities and public health, particularly for vulnerable populations such as the young, elderly, pregnant and those with chronic health issues. Federal statistics over a 30-year period show extreme heat is the leading cause of weather-related deaths in the United States. Communities in New Jersey are particularly at risk during extreme heat events due to the Urban Heat Island Effect, when urban areas are hotter than surrounding rural or forested areas. While Pennington's greenery and location in a rural area mitigates the most extreme impacts from heat, the Borough is not immune from this climate hazard.

Figure 8. Urban Heat Island effect in Pennington, Summer 2022



There are multiple tools that assess vulnerability to extreme heat, many of which are located on Heat Hub NJ (http://heathub.nj.gov/), New Jersey's one-stop hub for information regarding extreme heat. One such tool – The Urban Heat Island Effect and Land Surface Temperature in NJ – shows land surface temperature from satellite measurements during the summer of 2022 (see Figure 8). It shows the hottest areas in the northwest portion of the Borough, generally along

the Route 31 corridor, as well as on the Pennington School campus, Toll Gate, and in the town center. These areas show surface temperatures between 113 and 162-degrees F. Areas with less impervious surface (e.g. buildings, roads) and more green space have lower temperatures.

Similarly, the 2024 Heat Severity Map shows areas that are hotter than the average temperature for the area as a whole. In the Borough, the post office, Cambridge School, Straube Center and portions of Heritage townhouses and Pennington Point show as "extreme." Notably, other areas adjacent but important to Borough residents also show as extreme, including Timberlane Middle School, Hopewell Central High School, and the Pennington Quality Market parking lot.

Interestingly, a tool called "Where Will Tree Planting Improve Urban Heat Health?" seeks to identify areas that would benefit most from planting more trees to mitigate against extreme heat. Pennington Borough ranks 2.3 on a scale of 1-5, suggesting some improvement could be made through a tree planting campaign.

Finally, Heat Hub NJ includes a mapping application called "Chill Out NJ" that identifies places to visit to seek relief from the heat, but that are not necessarily official "cooling centers." In Pennington, both the Borough Library and Senior Center are identified, as are the Hopewell Branch of the Mercer County Library system and multiple county parks and in the surrounding area.

7. Air Quality

Along with extreme heat and wildfire in recent years air quality impacts come. New Jersey's air quality will be impacted by climate change, leading to increased exposure to pollutants (e.g., ground level ozone and particulate matter), which has been associated with symptoms ranging from eye irritation to severe respiratory distress, and exacerbates pre-existing conditions. Additionally, as experienced multiple times in recent year, most dramatically in 2023, smoke from wildfires also has a significant impact on air quality and has pushed the Air Quality Index to reach "unhealthy" and "very unhealthy" levels.

E. Build Out Analysis

Future construction in Pennington Borough will be almost entirely to meet state-mandated affordable housing obligations. Pennington's Fourth Round affordable housing obligation is 58 units and its unmet need from the Third Round is 125 units. In January 2026, the Pennington Borough Planning Board adopted an Amended 2025 Fourth Round Housing Plan designed to address the above obligation. Opportunities exist in the Route 31 corridor on the western side of the CSX railroad tracks, except that existing zoning did not allow residential development. In addition, several zones to the east of the railroad tracks limited residential use. The Housing Plan recommended two new ordinances, HMU (Housing Mixed Use) and MU (Mixed Use) to allow housing, including affordable in these areas. These two ordinances were adopted by Borough Council along with five affordable housing ordinances, AH 1-5, to address issues specific to certain sites. Council also adopted a revised Zoning Map which can be found on the Borough website.

A vacant land analysis in the 2026 Housing Plan concluded that only 5 lots are classified as vacant, totaling 0.85 acres. This is 0.14% of the 624 acres (0.97 square miles) area of the Borough. Publicly owned property takes up 30.7 acres and is either permanently restricted as open space, or for public uses such as Borough Hall, the library, parking or water supply. Two exceptions are the 7.8 acres of the former Borough landfill, and 2.7 acres north of the Senior Center close to the railroad on Reading Street. A Licensed Site Remediation Professional (LSRP) was contracted to conduct a preliminary environmental assessment and a floodplain analysis of the landfill site to inform future development. The assessment indicated that due to the landfill materials present on the property and environmental constraints associated with Lewis Brook, which runs through the property (wetlands, wetland transition areas, flood hazard areas and riparian buffers), development of the site will be significantly constrained unless the landfill materials are removed.

Since private and public vacant land is in limited supply, redevelopment and rehabilitation of existing facilities will be needed to meet the affordable housing obligation. The Borough will need to make it attractive to developers to pursue such opportunities. Since there has been little development in the Borough, the income to the Borough's Affordable Housing Trust fund has been small. The current balance will be spent on affordability assistance, rehabilitation and the extension of existing controls, leaving little to support new construction of affordable housing units. Such construction would therefore rely on requiring developers to set aside 15-20% of units in a development as affordable housing, which means that the total number of housing units to be built will be 4 to 5 times the number of affordable units.

The 2026 Housing Plan presents 11 such redevelopment opportunities. Details of each can be found in the Plan, but in summary the 58-unit obligation of the Fourth Round could be met along with 37 of the Third Round 125 unmet need. It is important to contemplate how these developments will impact the Borough's vulnerability to climate change-related hazards. These may come from the impact on stormwater management of an increase in impervious coverage, an impact on the heat island effect from reduced tree cover and increased roof areas or an increase in the need for emergency services during and after a major climate-related event.

The table below shows where the 11 areas proposed in the Housing Plan would be located and briefly what type of development it would be. Column 2 shows 82 affordable units are proposed, and the total number of units, based on developer set asides, is shown in column 3 as 360. The current average household size in the Borough is 2.31, so 360 units would add about 830 new residents to the Borough, increasing the population to over 3,600. While this would add tax income to the Borough, it will also add to the need for services and bring the Borough close to the limit of current drinking water and wastewater capacity. More places will be needed in the schools. It will increase the use of energy and add greenhouse gases to the Borough total. The impact of the increase in population on the hazards from climate change is small, however, but it could add to the need for services during a serious climate change-related event.

The area of the lots proposed for the developments is shown in column 4, with a total of 24 acres. This was gleaned from the Borough Tax Map, except for the development at the Straube Center, which was estimated using Google Earth Pro. Since most of the developments will be

replacements or conversions of existing buildings and would use existing parking lots with some additions, the added impervious area will be less than 24 acres. Column 5 is an estimate from observations in Google Earth Pro of the proportion of the unused land that may be needed for the development. The total is estimated at 5.7 acres.

	Affordable units	Total Units	Lot area acres	% new cover	New cover acres
Route 31 Shopping Centers (Block 202, Lot 1, Block 206, Lot 3) - add 2 stories for new apartments	22	106	6.44	0%	0.00
Howe Commons (Block 601, Lot 12.01) -Convert some commercial buildings, and add new buildings	8	40	3.72	20%	0.74
Levin Limousine (Block 502, Lot 2) - Replace existing building with an apartment building	3	12	0.34	0%	0.00
37, 41 and 43 South Main Street (Block 601, Lots 17 and 19) - New buildings in the rear of the lots	2	9	0.39	25%	0.10
245 and 250 South Main Street (Block 801, Lot 22, Block 703, Lot 30) - Add new stories or new buildings	4	16	1.52	10%	0.15
West Franklin 2 (Block 102, Lots 6, 7 and 8) - Replace two residences with an apartment building	6	30	1.12	70%	0.78
West Franklin 1 (Block 201, Lots 1, 2 and 9) - New townhouses	6	26	4.51	50%	2.26
Straube Center (Block 202, Lot 2) - New apartment building on the east side of the Center	15	75	0.70	40%	0.28
12 North Main (Block 205, Lot 22) - convert a commercial building to apartments	4	16	0.18	0%	0.00
Senior Center (Block 701, Lots 5, 6, 7 and 8) - Convert building to give 6 assisted living bedrooms	6	0	0.60	0%	0.00
Blackwell property (Block 205, Lots 2, 3, 4, 5 and 6) - Replace/add buildings to create mixed use area	6	30	4.53	30%	1.36
Totals	82	360	24.05		5.67

A reasonable estimate of the current impervious coverage of the total land area of the Borough is 30%, which is about 187 acres of the 624 total, so adding 5.7 is a 3% increase. This will reduce groundwater recharge during normal rain events but could be mitigated by the addition of new detention basins or improvements to existing basins. It will not have a significant impact on the rain flowing to the various town streams during heavy storms, since very little of that water is absorbed and the total amount of rain will be the same regardless of the developments.

Figure 8 shows the "heat island" effect in Pennington Borough. Three of the proposed developments fall in areas with the highest current heat island effect. Each will be impacted by being in the high heat area, but the contributions to the heat will be small. The additional land cover from the three, Straube Center apartment building, 0.28 acres, West Franklin 2 apartment building, 0.78 acres, and apartments over the Route 31 shopping centers, 0 acres, amounts to 1.06 acres. The area of high heat island effect in the Borough is about 55 acres, so the contribution from the three developments is about 2%. This could be mitigated by landscaping.

Finally, the Land Use Plan proposes changes to the R-80 and R-100 zones to allow in-fill development with accessory dwelling units (ADUs) and allowing conversion of existing residences to multi-family to promote housing affordability and offer a greater variety of housing types, and dwelling sizes to better fit a spectrum of household size and income levels. Demand for these is not known, but an estimate of 20 ADUs of 500 square feet in land cover area would be less than half an acre and should have a minimal effect on stormwater management.

The target year for achieving the affordable housing obligation is 2035, so development will happen slowly. This will give the Borough time to monitor the effect on climate change-related hazards and to make adjustments to the plans if needed.

F. Critical Facility Identification

Critical Facility	Facility Type
NJ State Highway Route 31	Roadway
East and West Delaware Avenues	Roadway
North Main Street	Roadway
NJ Transit Bus Line	Transit
West Delaware Avenue Bridge over CSX railroad	Bridge
Route 31 Bridge over CSX railroad	Bridge
North Main Street Bridge over CSX railroad	Bridge
Pennington Borough Hall	Government
Pennington Fire Department	Community Facility
Pennington Police Department	Community Facility
Hopewell Valley Senior Center	Community Facility
Pennington Water Department Active Wells (4)	Potable Water
Drinking Water Storage Tank	Potable Water
Curlis Avenue Pumping Station	Wastewater Utility
Sked Street Pumping Station	Wastewater Utility
Schools, Childcare, and other Education (5)	Educational Facilities

In the event of a disaster, certain facilities, utilities, roadways, and other infrastructure must remain functioning to ensure the safety and quality of life of residents or for evacuation purposes. The Borough identified 34 critical facilities in the action plan of the Mercer County

Hazard Mitigation (HMP) using FEMA's community lifelines approach. The locations of these facilities are shown in the Appendix Map 1. Note that the map was from an earlier report (2016) and some of the facilities no longer exist. The chart above from the Mercer County HMP lists critical facilities that may be vulnerable to natural hazards or that are especially important for safety, quality of life, and evacuation purposes. FEMA's community lifelines approach may assist the Borough in allocating adaptation investment among critical facilities.

1. Critical Facility Vulnerability.

There are no critical facilities located in the 1% annual risk floodplains identified by FEMA or the expanded flood prone areas identified by Rutgers University https://www.njfloodmapper.org (FEMA +3 ft). As discussed previously, several roads in the Borough are known to flood during periods of significant rainfall, including the busy intersection of Route 31 and West Delaware Avenue, and Broemel Place, which is an important means of access for the Fire Department to the rest of the town.

The EMS facility on Broemel Place has reverted to Borough ownership since the First Aid Squad went out of business. The parking apron of the facility floods during heavy rain events which prevented egress of the ambulances and limits the ability of the facility to provide critical services. The facility also lacks backup power.

G. Climate Change Resilience Strategies

The Borough should continue to reduce its vulnerability to the climate change-related natural hazards. Existing measures and potential strategies to reduce vulnerability are described below. The Borough Government is doing its part to reduce greenhouse gas emissions and is developing a community energy plan that will focus on residential and commercial energy efficiency and moving energy demand towards renewables. Pennington Borough should do all it can to limit government emissions and promote policies that incentivize and do not hinder individual action.

However, greenhouse gas emissions reduction policy in the United Staes is currently under threat and global targets for atmospheric CO_2 limits go unmet. It is therefore critical that Pennington pursue ways to adapt to climate change and to protect the community in extreme events. The following strategies are proposed.

1. Planning and General Strategies

1) Review the action plan in the Borough of Pennington annex in Section 9.9 of the 2021 Mercer County Hazard Mitigation Plan. It includes resources and information to assist public and private sectors with reducing losses from future hazard events. The annex is not intended as guidance for actions to take *during* an emergency. It provides actions that can be implemented *in advance* to protect people and reduce or eliminate damage to property. Following a general overview of Pennington, the annex presents an action plan that should be implemented to achieve a more resilient community.

a) Table 9.9-14. Status of Previous Mitigation Actions. As of 2021, 10 actions were listed, 3 were complete, 5 were in progress and 2 were not yet started.
b) Table 9.9-16. Proposed Hazard Mitigation Initiatives and Associated Priority. These are listed in the table in a Problem/Solution mode as summarized here and the 2025 status is shown in *italics*:
    i) Stormwater management upgrades. *In progress*.
    ii) Backup power for Well 7. *Not yet started*.
    iii) EMS flood protection and backup power. *Reviewing options for the building*.
    iv) Repetitive flood loss mitigation. *Completed.*
    v) All hazards - public education and outreach. *In progress*.
    vi) Disaster debris management plan. *Completed.*
    vii) Flood damage prevention ordinance update. *In progress*.
    viii) Increase staff hazard training and responsibilities. *In progress*.
    ix) Backup power for the Senior Center. *Obsolete*.
    x) Hazardous tree removal. *Not yet started.*
    xi) Backup water supply. *In progress*.
    xii) Reduce inflow and infiltration. . *In progress*.
c) Table 9.9-17. Summary Evaluation and Action Priority. This presented a scoring system to determine whether the items in Table 9-9-16 above were low, medium or high priority. All were ranked as high priority.

2) Increase public outreach and education about natural hazard risks, wildfire prevention, flood risk, extreme heat and other emergency preparedness topics.
    a) Document and provide public information on the locations and circumstances of flooding in the borough.
    b) Engage residents in taking pictures (safely) of flooding using mobile phones, which date and time stamp the images. Create a Borough repository for these images as they are invaluable data points for validating future models of flooding in Pennington.
    c) Include educational material in regular borough outreach strategies, such as the borough newsletter.
    d) Assess the needs of limited-income and socially vulnerable populations, such as the elderly, who may be at increased risk from natural hazards. In addition, work to build climate resilience within these communities through outreach and emergency planning at the municipal level. Target education and outreach to socially vulnerable populations and collaborate with appropriate messengers such as the Mercer County Office on Aging, Senior Advisory Board, and Board of Health to promulgate messaging.
    e) Create a "Welcome to Pennington" information package for new residents, including information on climate resilience and hazard mitigation, while providing other important government information (unrelated to resilience), and promoting local business.

3) Increase the awareness of Borough residents and businesses of the role of the Hopewell Valley regional Office of Emergency Management (OEM) in managing the response to a variety of emergencies.
    a) Send out occasional email reminders of the role of the OEM.
    b) Remind residents and businesses to sign up for the Everbridge secure portal in order to receive timely emergency messages.

c) Encourage residents to access the website of the New Jersey Office of Emergency Management (https://nj.gov/njoem/). The "Plan and Prepare" tab contains a wealth of information on weather and natural hazards; winter, hurricanes, earthquakes, droughts, floods, lightning/thunderstorms, pandemic influenza, tornados, and wildfires. It also covers man-made and technological hazards: nuclear power plants, power outages, chemical emergencies, hazardous materials, and terrorism

4) Identify and pursue funding opportunities to ensure investment in the adaptation measures needed to protect the Borough's residents and businesses from climate change-related natural hazards.
   a) Use the NJ Climate Resilience Funding Directory to identify grant and program opportunities for resilience projects.
   b) Assess the opportunities for financing of projects that include resilience from the NJ Infrastructure Bank, which includes opportunities for water infrastructure, transportation, and resilience projects.
   c) Partner with private landowners to implement mutually beneficial risk mitigation strategies, such as green infrastructure. One example of such an opportunity is to implement the Green Infrastructure Site Designs prepared by The Watershed Institute in 2021 for several properties in Pennington Borough.
   d) Maintain and monitor climate resilience and risk mitigation actions continuously to ensure goals are met and new challenges are addressed.

5) Pennington Borough is in two watersheds (HUC11) and is surrounded by another municipality, so it is significantly impacted by decisions outside its borders. Consider participating in regional planning programs (such as Resilient NJ) and continue working with regional partners, such as Mercer County, Hopewell Township, and The Watershed Institute, to address climate impacts.

6) Incorporate resilience and hazard mitigation into all capital projects and adopt a "dig-once" policy to consolidate construction projects.
   a) For example, when repaving streets, take the opportunity to install upgraded water/sewer lines; move electric wires and internet utilities underground; install stormwater green infrastructure that also acts of traffic calming; place sidewalks on the opposite side of the street from power lines allowing tree-planting to mitigate heat impacts on pedestrians.
   b) Incorporate and incentivize resilience and hazard mitigation into redevelopment projects, including green infrastructure, open space, tree planting, and shade structures.

7) Engage all borough boards, commissions, and committees in climate resilience; each has purview over resilience and risk mitigation activities, and/or represents communities/sectors that are impacted.

8) The Greater Mercer Public Health Partnership (GMPHP) has released a Community Health Improvement Plan (CHIP). It does not include climate change-related health issues, but it is described as a living document that will be amended as additional data and resources are identified. Our Board of Health representative on the GMPHP could suggest the addition of a climate change section in an expanded CHIP referencing the Health Addendum to the Science Report. https://dspace.njstatelib.org/items/8d5e35b0-bf75-40a0-9955-dff93eae3711.

Topics to cover are the effects of climate change on:

a) An increase in vector-borne diseases.
b) Stress from extreme heat or cold.
c) Declining air quality.
d) Mental health issues from coping with a disaster.

2. Flooding Strategies

The Borough has taken many steps to improve its resilience to flooding, one of the most urgent natural hazards it faces. The Stormwater Control and Flood Damage Prevention ordinances have continually been updated to remain in compliance with NJ DEP rules. In addition, in 2020, The Watershed Institute prepared an Impervious Surface Assessment and Reduction Plan for the Borough, designed to help assess and guide future policies. However, while the Borough continues to experience flooding during extreme rainfall events, new modeling tools and data are available, and a regional stormwater study is forthcoming. Pennington should consider updating climate-informed ordinances that will improve resilience and reduce flooding. Potential strategies to improve resilience to flooding include:

1) The Borough should consider infrastructure improvements, stormwater management improvements, reduction of impervious cover, and other strategies to mitigate flooding without exacerbating flooding downstream.

2) Work with the county and state to address flooding at the intersection of West Delaware Avenue and Route 31 and on North Main Street, while improving other state/county-owned infrastructure that reduces the efficient delivery of emergency services.

3) Increase the drainage or absorption capacity of the current stormwater management system, prioritizing stream sheds with flood-prone locations, Measures would include adding/enhancing detention or retention basins, relief drains, vegetated planters or swales, perform logjam and debris removal, and enhancing culverts.
    a) Most, if not all, stormwater management infrastructure in Pennington was built based on requirements that are out of date and do not consider increasing precipitation from climate change. Such infrastructure creates pinch points or fails to manage stormwater during extreme events and may flood adjacent areas, including transportation infrastructure. The borough should assess all stormwater management infrastructure and prioritize the replacement/appropriate sizing or increasing of drainage/absorption capacities of those structures deemed inadequately designed to withstand climate change-related disasters.

4) Update ordinances to restrict increases in and reduce impervious surfaces throughout the Borough.

5) Ensure that redevelopment and construction of new critical facilities, utilities, and community facilities meet or exceed statewide minimum stormwater standards and occurs away from floodplains.

6) Conduct a hydrology and hydraulic study of the watersheds feeding into the Borough's tributaries to identify the locations with the most severe flooding and to determine appropriate mitigation measures.

7) Address the following specific areas of deficient stormwater pipes and drainage
   a) the pipes to the landfill from the intersection of Route 31 and West Delaware Ave.
   b) the driveway bridge on the landfill property,
   c) the Lewis Brook tunnel from the landfill under the CSX tracks,
   d) the channel under the CSX railroad tracks at Knowles St. and Bixby's Way,
   e) the bridge tunnel and pipes at the Green Street and Broemel Place intersection,
   f) the tunnel under the garage on the Blackwell property,
   g) the pipes under the rear yards of 20 and 22 East Franklin Avenue.

8) The Lewis Brook bridges under Green Street, North Main Street and Eglantine Avenue are old and in poor condition. The County is looking to replace and upgrade the Green Street and Eglantine Avenue bridges.

9) Inflow and infiltration issues result in higher rates of wastewater during heavy precipitation and flooding events. Identify and address stormwater inflow and infiltration issues during heavy rainfall events.

10) Consider the use of open space funds to acquire properties both inside and outside of the borough to 1) attenuate existing flooding, and 2) that would result in additional flooding within the borough if developed.

11) Consider the acquisition/purchase or elevation/moving of the most flood-prone residential properties in the borough.
   a) Convert properties to open space designed to flood during extreme events and mitigate flooding in the area.
   b) Offset housing and ratable loss with increased density in the town center and appropriate redevelopment areas.

12) Consider daylighting streams in the borough that have been piped. Returning streams and buffers to natural function improves flood attenuation and slows stream flow, reducing flood impacts. Co-benefits of such action include heat island mitigation, additional open space, improved water quality, restored habitat, and neighborhood beautification.

13) Add green infrastructure throughout the borough, prioritizing public lands to lead by example.
   a) Work with Watershed Institute to utilize public green infrastructure for use as demonstration projects, education, and training opportunities.
   b) To promote stormwater infiltration, resurface impervious pavement such as borough-owned parking lots, with pervious surfaces.
   c) Incorporate stormwater green infrastructure in road designs that serve to mitigate stormwater flooding, while calming traffic and beautifying neighborhoods.
   d) Adopt and implement a Complete and Green Streets policy.

3. Severe Weather Strategies

The Borough has made concerted efforts to ensure that its critical facilities can remain functional in the event of a power interruption. So far, the municipal building, which serves as a cooling center, traffic signals at Main and Delaware and Route 31 and West Delaware, and Well 9 have been equipped with auxiliary power systems.

Potential strategies to improve resilience to severe weather include:

1) Work with PSE&G to ensure that the electrical grid is more resistant to severe weather, including high-speed winds. Measure would include replacing utility poles, reinforcing key infrastructure, burying power lines, managing vegetation, and pruning trees near power lines.

2) Ensure that remaining critical infrastructure facilities have auxiliary power systems installed and regularly tested.

3) Increase the Borough's long-term resilience through distributed renewable energy such as Community Solar or Wind projects.

4) Assess the vulnerability of the Borough's Historic District and other cultural resources to determine if adaptive measures are needed.

5) Assess the opportunity to enhance the Borough Hall/library into a resilience hub. Typically, resilience hubs are existing community-serving facilities that are upgraded to provide local communities with shelter and electricity during extreme heat events, poor air quality, and disasters. Resilience hubs should also act as education centers, where community members can go to learn about climate-related hazards and other effects, how to prepare and respond to them, and enhance community connections to increase adaptive capacity.

6) Ongoing natural weather hazards warrant the need for additional integration to allow for better emergency preparedness.

7) Public Works has removed many trees but estimates there are 50-60 very large pin oaks remaining that are outside of the Department's capabilities due to their size. A strategy is needed to remove these trees. Ash trees have also become a problem due to the emerald ash borer invasion and need to be managed.

4. Extreme Heat Strategies

Potential strategies to improve resilience to heat and air quality include:

1) Maintain or increase vegetated cover and shade tree plantings where possible to mitigate the urban heat island effect, especially adjacent to walkways and the shopping district.

2) Promote the use of heat-reflective building materials, shade structures, and other heat adaptations.

3) Plan for extreme temperature events to protect Borough residents that are uniquely vulnerable to extreme heat waves by promoting awareness of cooling centers and the signs and symptoms of heat related illness.

4) Coordinate with PSE&G to limit unnecessary tree loss, and to promote appropriate tree planting.

5) Prioritize tree planting in areas with hotter than average temperatures, including the post office, Cambridge School, Straube Center, and portions of Heritage townhouses and Pennington Pointe.

5. Air Quality Strategies

While the opportunities to address air quality impacts are limited, as these largely occur on a regional scale, there are some actions that Pennington can take:

1) Enforce anti-idling regulations, which negatively impact local air quality, particularly for vulnerable populations (e.g youth, elderly, those with pre-existing conditions).

2) Promote "green transportation" such as walking, biking, public transit, and electric vehicles, including the infrastructure to support and incentivize those uses. For example:
   a) Install EV charging stations
   b) Ensure that sidewalks and walkable areas are shaded
   c) Install bike lanes
   d) Work with NJ Transit to install shade-providing bus shelters at stops in the Borough, or if needed, install shade and seating at bus stops.

6. Wildfire Strategies

While Pennington has a low risk of wildfire, recent events demonstrate a need to remain vigilant. Additionally, while drought response is largely addressed by state resources, there are actions that the borough can take to ensure that we do our part to limit extensive impacts.

1) Ensure that public buildings are resistant to fire and manage risk from wildfire on an ongoing basis using forestry management strategies, wildfire fuel management, etc.

2) Consider participating in the Firewise Communities Program, a foundational action for community wildfire preparedness, and one included in the Sustainable Jersey program.

7. Drought Strategies

1) Prepare a drought emergency strategy, which may include:
   a) Criteria or triggers for drought-related actions
   b) A communication plan
   c) Agreements for secondary water sources

d) Mandatory water conservation measures for non-essential usage beyond state minimums (also a Sustainable Jersey action)
e) Increase public awareness of wildfire risk during periods of prolonged drought.

H. Impacts on the Other Elements of the Master Plan

Land Use Plan Element. The Land Use Plan Element informs and underpins the Borough's zoning and potential redevelopment areas. As discussed in this analysis, natural hazard vulnerability is a key consideration for the Borough as it plans for redevelopment. Climate change-related natural hazards are relevant to all land uses in the Borough.

Community Facilities and Services Plan Element. This element analyzes the existing and proposed locations of educational, cultural, health- and safety-related, and other community facilities in the Borough. The risk to community facilities from natural hazards and opportunities to improve their resilience are discussed in this vulnerability assessment.

Public Works Services Plan Element. Risk from natural hazards, especially flooding, is a key concern for the Utility Service Plan Element. The element considers the need for and location of water supply and distribution facilities, drainage and flood control facilities, sewage and wastewater treatment, stormwater management facilities and others. Heavy rainfall and flooding, damage from severe storms, and pollutant infiltration may impact the continued operation of the Borough's utilities.

Mobility Plan Element. Extreme rainfall and flooding events, most notably during tropical storm Ida in 2021, have historically impeded circulation in the Borough. The assessment of existing and future development should address mobility concerns due to these stressors.

Economic Development Plan Element. The Economic Plan Element considers all aspects of economic development in the Borough. Economic activity is impacted by disasters when businesses suffer damage or losses or business is interrupted by power loss or road closures. Resilience planning for businesses includes working with the county, state and landowners to ensure that stormwater is managed to reduce flood disruption and damage and that trees are planted to reduce daytime heat in business areas.

Historic Preservation Plan Element. Pennington's Crossroads Historic District consists of properties and landmarks whose historic character and architecture the Borough seeks to preserve. Severe storms, wind, flooding, and other natural hazards have the potential to cause damage to the historic district and its properties. The Borough and the Historic Preservation Commission should explore how to improve the resilience of these properties, and repair them if damaged, while maintaining their historic character.

Open Space and Recreation Plan Element. Flooding and damage from other hazards to the Borough's open spaces and recreation areas may negatively impact quality of life. The design of open spaces and recreation facilities can incorporate natural hazard adaptation measures as well as tree canopy and stormwater management measures that have the potential to enhance the

Borough's overall resilience. Open space acquisition that can prevent flooding, reduce local heat island effects, or protect water quality should be prioritized.

Conservation Plan Element. The Conservation Plan Element addresses the conservation, preservation, and utilization of the Borough's natural resources. Climate change and natural hazards are projected to impact wildlife habitats, water supplies, forests, and other natural resources. Conservation efforts can be strategically planned to increase the resilience of Pennington's environment and community.

Green Buildings and Environmental Sustainability Plan Element. The assessment of opportunities related to renewable energy systems, water conservation and reuse, the interactions between buildings and the environment, and the Borough's carbon footprint are fundamentally linked to future climate impacts and the costs associated with those impacts. Strategies discussed in the Green Buildings and Environmental Sustainability Plan Element have the potential to reduce the Borough's contributions to climate change, reduce future costs and improve its long-term resilience to natural hazards.

I. Consistency with Other Plans

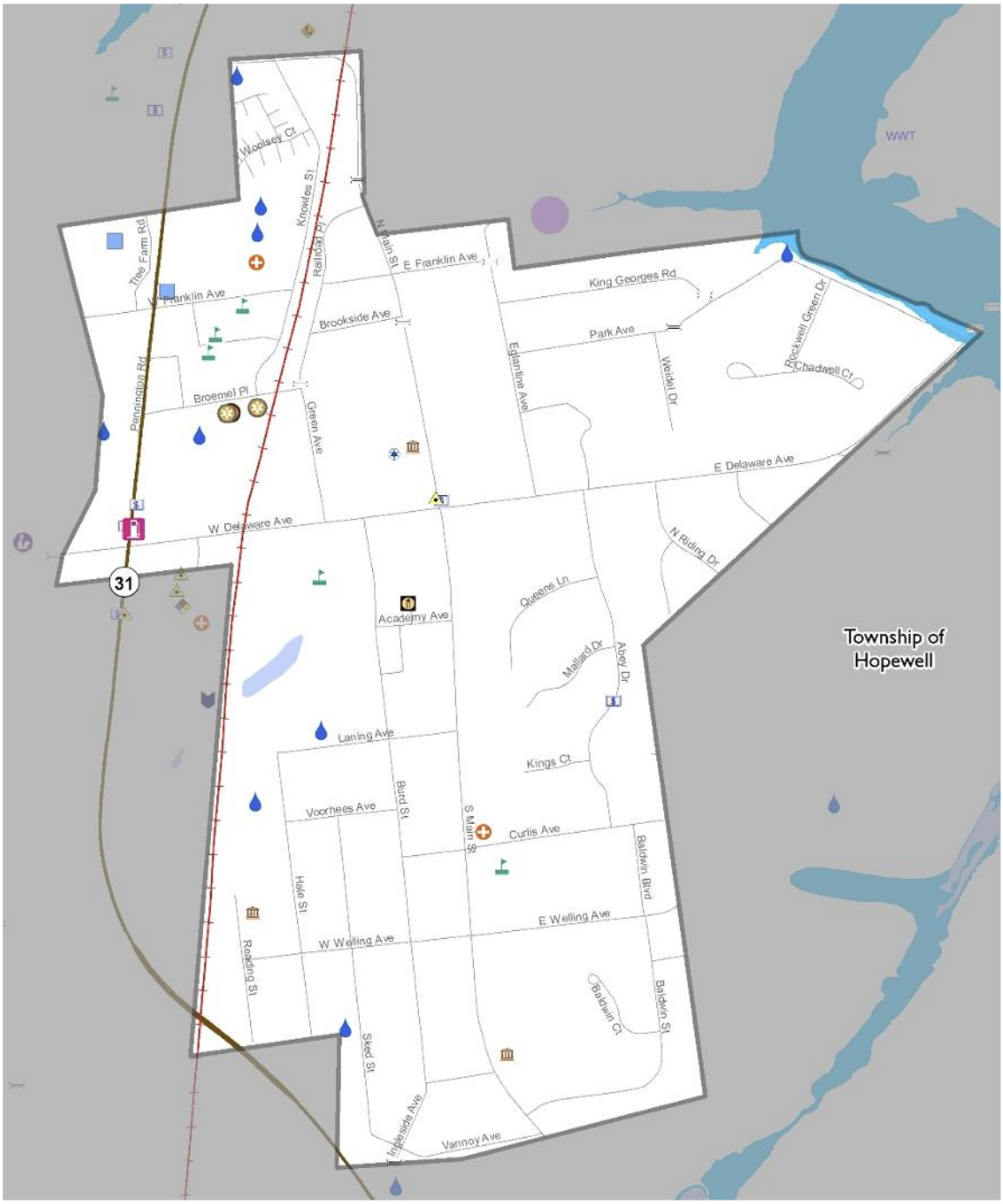
This assessment is intended to help Pennington Borough reduce its vulnerability to climate change-related natural hazards by identifying risks and suggesting strategies to improve resilience. This document builds upon and is consistent, coordinated, and integrated with the Mercer County Hazard Mitigation Plan as well as the Borough's Master Plan, Community Forestry Management Plan, and the Municipal Stormwater Management Plan.

In 2025, Pennington Borough joined Princeton, Hopewell Township, and Lawrence Township in a collaborative effort to address stormwater management requirements for the Stony Brook Watershed. The Borough Council approved a resolution authorizing participation in this regional initiative to develop a comprehensive Watershed Improvement Plan (WIP). The partnership will allow the four municipalities to share resources and expertise while working with a respected watershed management firm to collect essential technical data needed to meet state stormwater discharge requirements and plan for climate change. Work on the project is expected to be completed by Fall 2026, in advance of state deadlines for required reports. The resulting data and recommendations will help Pennington identify effective strategies to improve water quality, address pollutants, and mitigate flooding issues within the Stony Brook Watershed, benefiting residents, businesses, and the environment for years to come.

With an understanding that mitigating climate impacts is generally understood to be fiscally positive, the Borough will continue to implement and explore policies that improve resilience to climate change-related natural hazards and that align with and, where appropriate, exceed state and federal minimums. The findings and recommendations described here, in addition to the best available science, will be used to guide the Borough's resilience efforts and should be incorporated into future planning efforts and updates.

Appendix: Mercer County Hazard Mitigation Plan Critical Facilities Map

Note: Key to the symbols can be found on the next page.



A key to the symbols is on the next page.

Borough of Pennington