ANALYSIS OF BROWNFIELDS CLEANUP ALTERNATIVES (ABCA)

Former Remington Arms – Site E
Buildings 82, 83, 84, 85 & 86
14 Hoefler Avenue
Ilion, New York

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1.0 INTRODUCTION

This Analysis of Brownfield Cleanup Alternatives (ABCA) was conducted to evaluate cleanup alternatives and establish the costs to support the cleanup necessary for the buildings 82, 83, 84, 85 and 86 located on Site E of the former Remington site located at 14 Hoefler Avenue, Ilion, NY (Site). The Site owner, Turin Hoefler Avenue LLC. (Turin), intends to remove the hazardous building materials from the Site buildings to prepare the buildings for demolition, as site preparation for a forthcoming development project. A topographic map with the general Site location is attached as Figure 1.

This ABCA is intended to briefly summarize the Site building asbestos contamination issues including cleanup standards, applicable laws, cleanup alternatives considered, and the proposed cleanup. Each of the cleanup alternatives was reviewed for effectiveness, ability to implement the alternative, cost, how commonly accepted climate change conditions might impact the alternatives, reasonableness of the cleanup alternatives and a recommendation of a cleanup alternative.

Cleanup alternatives were evaluated in accordance with USEPA Region 2, NYS Department of Environmental Conservation (NYSDEC) and NYS Department of Labor (NYSDOL) regulations and guidance.

1.1 Background

Buildings 82, 83, 84, 85 and 86 are located on Project Site E in the southeast corner of the former Remington site at 14 Hoefler Avenue, Ilion, NY. The Site consists of approximately 3 acres and is occupied by approximately 211,600 ft^2 of buildings that were constructed in 1915 of concrete foundations, steel frames, brick walls and concrete or wood floors. The structures were operated for the manufacturing of firearms throughout their history.

1.2 Site Assessment History

In December of 2014 through January of 2025, HRP Associates, Inc. (HRP) with our DOL- licensed subcontractor, Rome Environmental Solutions & Testing, LLC. (REST) of Rome, NY, completed a hazardous materials (hazmat) survey at the referenced Site. The survey was requested to identify Asbestos Containing Materials (ACM) to assist HRP and Turin with managing the Site for planned redevelopment.

The survey was completed for Buildings 82, 83, 84, 85 and 86, located on Project Site E.
The inspection included limited destructive testing to determine if any materials were buried behind walls or above fixed ceilings. The inspection included materials that were accessible during the time of the inspection. Samples were analyzed per New York State Environmental Laboratory Protocol (NYSELAP). Friable bulk samples were analyzed using the Polarized Light Microscopy (PLM) NYS ELAP Method 198.1. Non-friable organically bound samples were analyzed utilizing gravimetric reduction with PLM analysis (NYS ELAP Method 198.6) and Transmission Electron Microscopy (TEM) confirmation of PLM negatives (NYS ELAP Method 198.4). In accordance with the New York State Department of Health as of April of 2011 all ceiling tiles that contain cellulose must be analyzed by TEM method 198.6/198.4

"Asbestos-containing materials" (ACMs) as defined by the EPA are any materials that contain more than 1% asbestos by weight. ACMs were detected in the following building materials and selected for abatement for this project:

1. Thermal System Insulation (TSI)

Thermal system insulation includes all insulation material applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat gain or loss. The following TSI was identified in these buildings:

- Pipe Insulation, ~ 2,141 linear feet
- Tank and Mechanical Equipment Insulation, ~310 ft^2

2. Surfacing Materials

Materials that are sprayed-on, troweled-on, or otherwise applied to surfaces such as acoustical or finished plaster on ceilings and walls, and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

- No Surfacing Materials were identified in the project area.

3. Miscellaneous Materials

Materials not identified as either TSI or Surfacing are considered miscellaneous.
The following miscellaneous materials were identified in these buildings:

- Floor Tiles; ~1200 ft^2
- Equipment Mounted to Cementitious Panels, ~768 ft^2
- Tank/Pipe Gaskets, ~ 60 linear feet
- Duct Tape, ~90 ft^2

1.3 Summary of Hazardous Substances for Remedy

<u>Asbestos</u>

Asbestos is the hazardous substance identified for this ABCA. Asbestos is a naturally occurring mineral fiber that occurs in rock and soil. Because of its fiber strength and heat resistance asbestos has been used in a variety of building construction materials for insulation and as a fire retardant. Asbestos has also been used in a wide range of manufactured goods, mostly in building materials (roofing shingles, ceiling and floor tiles, paper products, and asbestos cement products), friction products (automobile clutch, brake, and transmission parts), heat-resistant fabrics, packaging, gaskets, and coatings.

Asbestos may be found in attic and wall insulation produced containing vermiculite, vinyl floor tiles and the backing on vinyl sheet flooring and adhesives, roofing and siding shingles, textured paint and patching compounds used on walls and ceilings, walls and floors around wood-burning stoves protected with asbestos paper, millboard, or cement sheets, hot water and steam pipes coated with asbestos material or covered with an asbestos blanket or tape, oil and coal furnaces and door gaskets with asbestos insulation and heat-resistant fabrics.

Asbestos fibers may be released into the air by the disturbance of asbestos-containing material during product use, damaged or dilapidated structures, demolition work, building or home maintenance, repair, and remodeling. In general, exposure may occur only when the asbestos-containing material is disturbed or damaged in some way to release particles and fibers into the air.

Exposure to asbestos increases your risk of developing lung disease. That risk is made worse by smoking. In general, the greater the exposure to asbestos, the greater the chance of developing harmful health effects. Disease symptoms may take many years to develop following exposure. Asbestos-related conditions can be difficult to identify. Three of the major health effects associated with asbestos exposure are: lung cancer; mesothelioma, a rare form of cancer that is found in the thin lining of the lung, chest and the abdomen and heart; asbestosis, a serious progressive, long-term, non-cancer disease of the lungs.

2.0 PROJECT GOAL AND RE-USE PLAN

As part of Turin's ongoing redevelopment efforts, the removal of asbestos containing materials from the Site E buildings will serve to prepare these buildings for a planned site redevelopment project, and to prevent deterioration and release of ACM now that the buildings are vacant.

3.0 APPLICABLE REGULATIONS AND CLEANUP STANDARDS

Turin is the Site owner and will be responsible for hiring qualified contractors. Turin will use a qualified Environmental Professional to assist with contracting documents, cleaning up contractor oversight and final documentation. The cleanup will be conducted by an asbestos abatement contractor licensed in the State of New York. If necessary, all Petitions for Site-Specific Variances and Project Notifications will be obtained/submitted from NYSDOL.

Clean up Standards

The asbestos NESHAP (40 CFR Part 61, Subpart M) regulates asbestos fiber emissions and asbestos waste disposal practices. It also requires the identification and classification of existing building materials prior to demolition or renovation activities. Under NESHAP, asbestos-containing building materials are classified as either friable, Category I non-friable, or Category II non-friable ACM. Friable materials are those that, when dry, may crumble, pulverized, or reduced to powder by hand pressure. Category I non-friable ACM includes packing materials, gaskets, resilient floor coverings and asphalt roofing products containing more than 1 percent asbestos. Category II nonfriable ACM are nonfriable materials other than Category I nonfriable materials that contain more than 1% asbestos.

Regulated ACM (RACM) must be removed before renovation or demolition activities that will disturb the materials. RACM includes:

- Friable ACM;
- Category I nonfriable ACM that has become friable or will be subjected to drilling, sanding, grinding, cutting, or abrading; and
- Category II nonfriable ACM that could be crumbled, pulverized, or reduced to powder during renovation or demolition activities.

NYS further regulates asbestos. Asbestos abatement and worker protection activities are regulated by the NYSDOL under Industrial Code Rule 56, and asbestos waste transport and disposal under NYSDEC under Part 360. Abatement contractors, abatement methods, independent air monitors, project monitors, and project designers are regulated under DOL ICR 56. Project notification to building occupants and nearby businesses is required at least 10 working days prior to the start of any asbestos abatement activities.

Removal of RACM must be conducted by a NYSDOL-licensed asbestos abatement contractor. A NYSDOL Licensed Project Designer will prepare a Petition for a Site- Specific Variance that details work practices that reflect Site conditions.

The asbestos standard for construction (29 CFR 1926.1101) established by the Occupational Safety and Health Administration (OSHA) requires that employee exposure to airborne asbestos fibers be maintained below the permissible exposure limits (PEL).

The occupational exposure limits are as follows:

- Asbestos Excursion Limit (excursion limit of 30 minutes): 1.0 f/cc fibers per cubic centimeter as detected using phase contrast microscopy)
- Asbestos PEL (8-hour time-weighted average permissible exposure level): 0.1 f/cc.

Transportation of asbestos waste is regulated under U.S. Department of Transportation 49 CFR 171-180 and by NYS under 6 NYCRR Part 364, Waste Transporters.

4.0 EVALUATION OF CLEANUP ALTERNATIVES

Cleanup Oversight Responsibility

Turin will undertake responsibility to properly abate asbestos containing building materials in accordance with NYS Department of Labor regulatory requirements. NYS licensed/permitted personnel will conduct abatement and monitoring of hazardous building materials.

4.1 Cleanup Alternatives Considered

EPA requires that ABCAs includes the evaluation of at least two cleanup alternatives in addition to a no action alternative. Due to the physical and chemical properties of asbestos, (i.e., not readily broken down or degraded), there are two options available, removal of asbestos or leave the asbestos in place under an Operations and Management Plan (O&M Plan).

Alternatives were also evaluated with regards to the sustainability of the cleanup alternatives regarding current and future climate change concerns. Climate conditions are discussed below.

4.2 Forecasted Climate Conditions

Ilion is located approximately 70 miles southeast of Lake Ontario. The Site is located topographically higher than the Mohawk River (nearest surface water body to the Site), which is located 0.5 miles northeast of the Site.

The northeastern United States, including Ilion, includes warm and often humid summers and cold winters. Rainfall can be severe with summer thunderstorms common and severe weather resulting from regional nor'easter anticyclone storms. Winter conditions can also be severe with ice storms and heavy snow. Snowfalls of 2-3 feet in one event are common. Portions of the Town of Frankfort are prone to flooding during storm surge events; however, due to its location and elevation, the Site is located outside of the Federal Emergency Management Agency (FEMA) identified regulatory floodways. In fact, 17 tornadoes affected the surrounding area of the project in June 2024 (https://www.thedailynewsonline.com/news/deep-dive-upstate-ny-gets-slammed-by-17-tornadoes-in-just-seven-days/article_f5b1dd3e-4646-11ef-b4c8-f30e2fd67a29.html).

According to the US Global Change Research Program, because of climate change, the northeast region can expect increased temperatures and temperature variability and extreme precipitation events. The website states: "Heat waves, coastal flooding, and river flooding will pose a growing challenge to the region's environmental, social, and economic systems. This will increase the vulnerability of the region's residents, especially its most disadvantaged populations. Infrastructure will be increasingly compromised by climate-related hazards, including sea level rise, coastal flooding, and intense precipitation events." According to the National Oceanic and Atmospheric Administration (NOAA) State Climate Summaries New York State Climate Summary from 2022 (Appendix A), winter and spring precipitation is projected to increase in New York. In addition, the frequency and intensity of extreme precipitation events are projected to increase, potentially increasing the frequency and intensity of floods.

According to FEMA Flood Insurance Rate Map # 3603030020D (Appendix B), the Site is not located in any flood hazard zones; therefore, currently, the greatest threat to this Site is from localized stormwater impacts from extreme precipitation events. Other forecasted climate change factors such as sea level rise and storm surge effects have the potential to affect the Site in the future given its geographic location, which is currently situated less than 25 miles from the identified 100-year special flood hazard area near the Mohawk River. Earthquakes, hurricanes, tornados, and wildfires are also not anticipated to affect the Site.

4.3 Clean Up Alternatives Considered

To satisfy EPA requirements, the effectiveness, ability to be implemented, and cost of each alternative must be considered prior to selecting a recommended cleanup alternative. The following alternatives were reviewed.

- Alternative #1: No Action
- Alternative #2: Leave Regulated Asbestos Containing Materials (RACM) In-Place and Manage
- Alternative #3: RACM Abatement

4.4 Alternative #1: No Action

The "no action" scenario is required by the EPA ABCA process. This scenario assumes that exposure to asbestos is not occurring and will not worsen as the building continues to degrade.

Effectiveness
This alternative is deemed ineffective and unacceptable for continued Brownfield redevelopment for this Site because:

- It is likely to be considered unacceptable to the community because residents, visitors, nearby workers and construction workers could unknowingly be placed at risk in the future. No action provides neither remedy nor elimination of the exposure for projection of public health.
- This approach does not provide any mitigation of known human carcinogens to potential human receptors (adult and child). Additionally, asbestos exposure does not have an indicator of exposures like petroleum or solvents that have distinctive odors that can be perceived by human receptors alerting them of exposure so they can move away from the exposure.
- The continued presence of ACM in the building would continue to pose a long-term health risk to the public and to workers entering or working around the building.
- This alternative would not meet the project goal and re-use plan.

Implementibility

The alternative is implementable as it requires no action. However, the ACM would still pose a hazard to those entering the building and asbestos fibers would continue to be released to ambient air and the Site structures would be expected to degrade further providing ongoing physical and chemical exposure concerns to nearby residents, workers, and visitors.

Cost

There is no direct cost for this alternative, however, it is likely that Site security will be needed to keep unauthorized personnel from accessing the Site and Site buildings. Additionally, it is possible storms due to climate change (tornados, see 4.1.1) could further degrade the abandoned buildings and increase the spread of asbestos contamination to nearby properties and reduce property value and increase cleanup costs.

4.5 Alternative #2: Leave RACM in Place and Manage

Alternative 2 consists of leaving regulated asbestos-containing materials (RACM) in place within the existing buildings and implementing engineering and institutional controls to prevent exposure to asbestos fibers. Under this alternative, ACM would not be physically removed; instead, exposure would be managed through a combination of encapsulation, enclosure, and long-term management measures.

Encapsulation would involve applying approved sealants or coatings to exposed ACM to bind asbestos fibers and reduce the potential for fiber release. Where appropriate, enclosure would be implemented by constructing physical barriers (such as gypsum board or metal panel systems) to isolate ACM from occupied or accessible areas. No disturbance of regulated asbestos-containing material (RACM) would occur beyond minor surface preparation required for encapsulation or enclosure.

An Asbestos Operations and Management Plan (O&M Plan) would be developed in accordance with OSHA and NYS requirements and guidelines and implemented as part of this alternative. The plan would include documentation of ACM locations, warning labels and signage, access restrictions, worker notification procedures, and periodic inspections to ensure the continued integrity of encapsulated or enclosed materials. Ongoing operations and maintenance (O&M) activities would be required to monitor the condition of ACM and to repair damaged encapsulation or enclosures as needed.

This alternative relies on continued building stability and long-term ownership or control to ensure that ACM is not disturbed during future use. No demolition or major renovation activities that would impact ACM would be permitted under this alternative.

Effectiveness
This alternative is generally implementable where buildings are intended to remain standing and in use and where long-term monitoring and maintenance can be assured. Implementation is less complex than full abatement but requires ongoing administrative and financial

commitments. Alternative 2 is not suitable where demolition, redevelopment, or substantial renovation is planned, as it does not meet regulatory requirements for disturbing or removing RACM.

Implementibility

This alternative is technically achievable although it adds extensive additional engineering controls, operations and measures that substantially increase the cost of maintaining the building.

Cost

Based on estimates from similar area project costs and building sizes, the cost to complete Alternative #2 is:

- Professional Fees and Services $500,000
  - Permitting, notification, Asbestos Management Plan, Building Security and maintenance plans, annual inspections and reporting for an estimated 20 years.

Building O&M

- Periodic inspections
- Recordkeeping
- Repairs to encapsulation/enclosure
- Training and access controls
- Building maintenance, heating and repairs
  - For an assumed 20 years the cost to leave asbestos in place and manage it in a building of this size and type would be estimated at a cost of $21,000 - $63,000/year. As such, the cost to leave asbestos in place for 20 years, the total cost would range between $420,000 and $1,260,000. This cost does not include the cost for normal building heating and maintenance as the buildings age.

4.6 Alternative #3: RACM Abatement

Alternative 3 consists of the removal of asbestos-containing materials (ACM) from the on-site buildings in accordance with applicable federal, state, and local regulations. Under this alternative, regulated asbestos-containing material (RACM) would be identified, abated, and properly disposed of prior to or in coordination with demolition activities.

Regulated areas would be established prior to the removal of ACBMs, utilizing a variety of controls such as polyethylene sheeting to establish primary and secondary barriers, negative pressure systems/containments, and/or other applicable measures to prevent asbestos fiber migration beyond the regulated area(s). Abatement procedures require that ACBMs be adequately wetted to control potential spreading of damaged or friable asbestos and airborne particulates. The work would also require decontamination facilities for both abatement workers and for equipment/materials. To aid in the remedial efforts, debris, particulates, and other residual materials would be vacuumed with high efficiency particulate air (HEPA) units.

Waste would be containerized in air and leak tight containers to contain ACM in manageable quantities and would be kept adequately wet until final disposal. Waste would be labeled with appropriate OSHA warning labels, Class 9 labels and generator information and disposed in a landfill permitted to accept RACM waste. Landfill disposal authorizations would be confirmed before starting the project.

Site-specific variances would be developed and submitted to NYSDOL for review and approval. Any disturbance of asbestos would include air monitoring and project monitoring by a NYSDOL licensed air monitor to ensure appropriate work methods are being adhered to. Final clearance would be provided following a visual inspection of the work area followed by receipt of acceptable phase contrast microscopy (PCM) air sampling in accordance with National Institute for Occupational Safety and Health (NIOSH) 7400 methodology.

The ACM is permanently removed. This approach is technically effective as a definitive and direct physical elimination of contaminants that provide a public risk. Follow-up inspections and maintenance will not be required. With removal and off-site disposal of contaminants, the approach requires no special post-remedy institutional or land use controls for the property. Removal of all ACM reduces the potential for environmental contamination due to climate change conditions (damaged from storms).

Effectiveness

Alternative 3 is highly effective because it permanently removes the source of asbestos contamination from the site. By eliminating ACM rather than managing it in place, this alternative fully addresses current and future exposure pathways and provides the highest level of long-term protectiveness for human health and the environment.

Implementability

This alternative is readily implementable using well-established asbestos abatement techniques and licensed contractors. While implementation requires careful coordination, regulatory notifications, and short-term site controls, asbestos abatement is a common and proven remediation approach. Alternative 3 is fully compatible with planned demolition and redevelopment and complies with EPA Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements.

Cost

- Professional Fees and Services $50,000
  - Permitting, notification, variance, document preparation, bidding, and reporting
- Abatement $338,000
  - Removal and disposal of asbestos by a licensed abatement contractor and monitoring and final clearance of the site during and after abatement by a licensed project monitor.

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4.7 Cost Comparison of Alternatives for RACM

The table below summarizes the costs for the alternatives considered in this ABCA.

Alternative	Capital Cost	Annual Cost
#1 No Action	$0	$0
#2 Leave RACM In Place	$500,000	$21,000 - $63,000
#3 RACM Abatement	$338,000	N/A

5.0 RECOMMENDED CLEANUP ALTERNATIVE

Alternative #3 is recommended due to following considerations:

- It eliminates toxic exposure to workers, visitors, and residents
- Supports and is consistent with the project goals and reuse plans, and consistent with the owners plans for site redevelopment.
- Eliminate long term obligations (inspection, repair, safety concerns, security)
- Promotes sustainability strategies

6.0 GREEN REMEDIATION TECHNIQUES

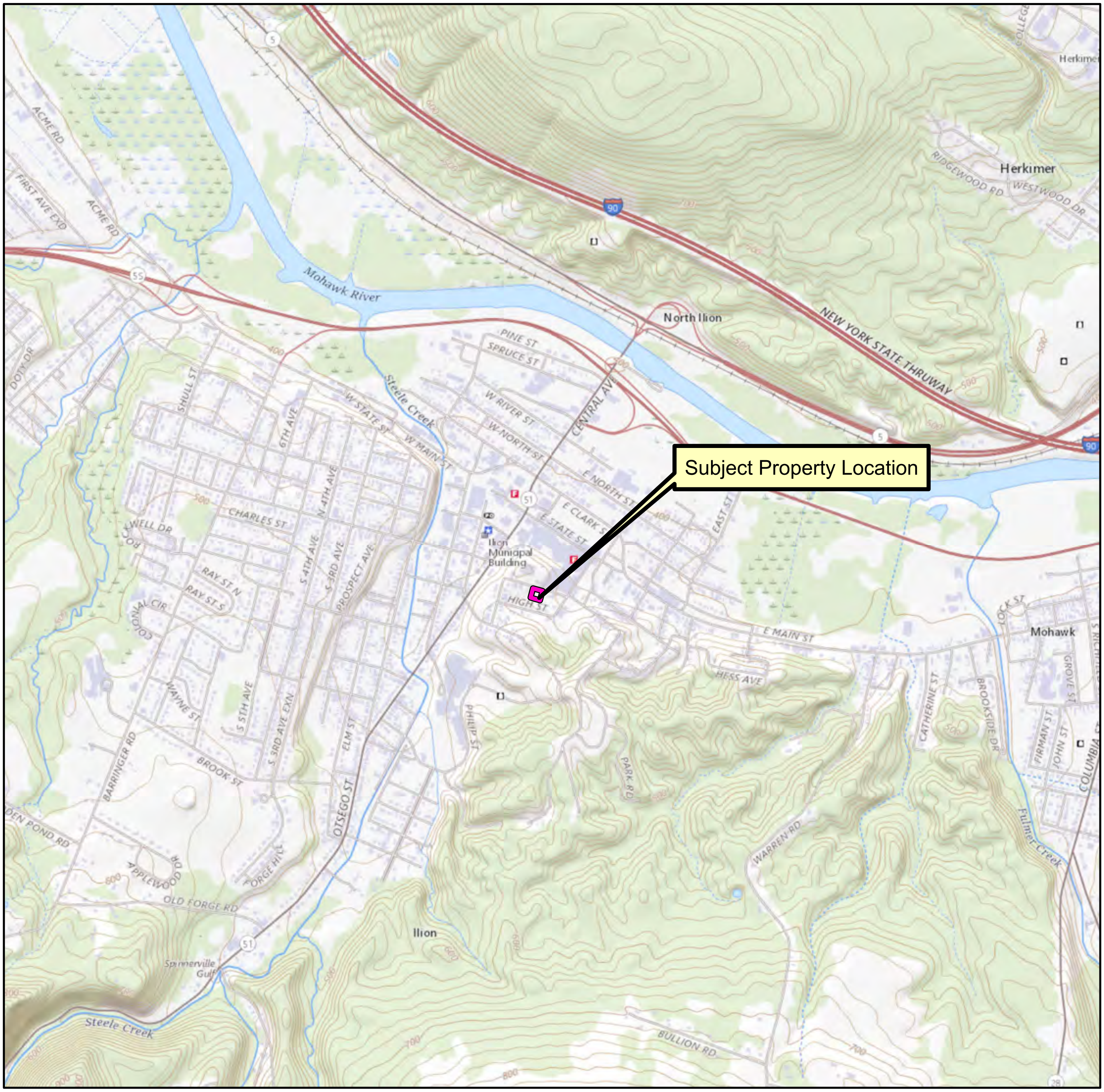
Turin will implement green remediation strategies to complete this project in accordance with EPA's strategic plan for improving environmental performance of business sectors. Green remediation builds on environmentally conscious practices already used across business and public sectors, as fostered by the EPA's Sectors Program, and promotes incorporation of state-of-the-art methods. The following represent BMPs and how they will be applied for the project:

- Conserving water by applying minimal amounts of water, as practical, for dust/particulate control.
- Erosion Control measures will be used to control sediment/pollutant runoff during remedial activities.
- Managing and minimizing toxics as presented in the ACM RACM Cleanup Plan.
- Managing and minimizing waste as presented in the ACM RACM Cleanup Plan.
- Reducing emission of criteria air pollutants and greenhouse gases (GHGs) (U.S. EPA National Center for Environmental Innovation, 2006) as presented in the ACM RACM Cleanup Plan.
- Reducing landfill waste by recycling brick, concrete and metal that can be salvaged, decontaminated and reused.

7.0 PUBLIC MEETING

Public comments regarding this ABCA will be obtained via the Community Involvement Plan for the Site. An advertisement will be published notifying the public of a public to be held May 18th, 2026 at 6PM at Ilion Village Hall, 49 Morgan Street, Ilion, NY. Details of the public meeting including public comments and responses, will be included in Appendix D.

FIGURES



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USGS Quadrangle Information
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Name: Attica, New York
Date Rev: 1976
Date Pub: 1979

Figure 1
Subject Property Location
Remington Avenue
Ilion, New York
HRP # HER1510.P2

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APPENDIX A
NOAA State Climate Summaries – New York State Climate Summary (2022)

NEW YORK

Key Messages

Temperatures in New York have risen almost 2.5°F since the beginning of the 20th century. Under a higher emissions pathway, historically unprecedented warming is projected during this century. Extreme heat is a particular concern for densely populated urban areas such as New York City, where high temperatures and high humidity can cause dangerous conditions.

Since 1880, sea level has risen by about 13 inches along the coast of New York, more than the global average rise of 7–8 inches. Global average sea level is projected to rise another 1–4 feet by 2100, but levels along the coast of New York will likely be higher due to local and regional factors. Sea level rise will increase the frequency, extent, and severity of coastal flooding, which is a grave risk to dense, high-value development along New York's coastline.

New York has experienced a large increase in the frequency and intensity of extreme precipitation events, and further increases are projected. Increases in winter and spring precipitation are projected, raising the risk of springtime flooding, which could cause delayed planting and reduced yields.

New York is regionally diverse, encompassing the Nation's most populous metropolitan area, as well as large expanses of sparsely populated but ecologically and agriculturally important areas. The state's climate is heavily influenced by several geographic features. The Atlantic Ocean has a moderating effect on coastal areas, while the Great Lakes and Lake Champlain moderate the northwestern and northeastern parts of the state, respectively. During much of the year, the prevailing westerly flow brings air masses from the North American interior across the entire region, with occasional episodes of bitter cold during winter. The jet stream, which is often located near or over the region during winter, brings frequent storm systems that cause cloudy skies, windy conditions, and precipitation. New York is often affected by extreme events, such as floods, droughts, heat waves, hurricanes, nor'easters, and snow and ice storms.

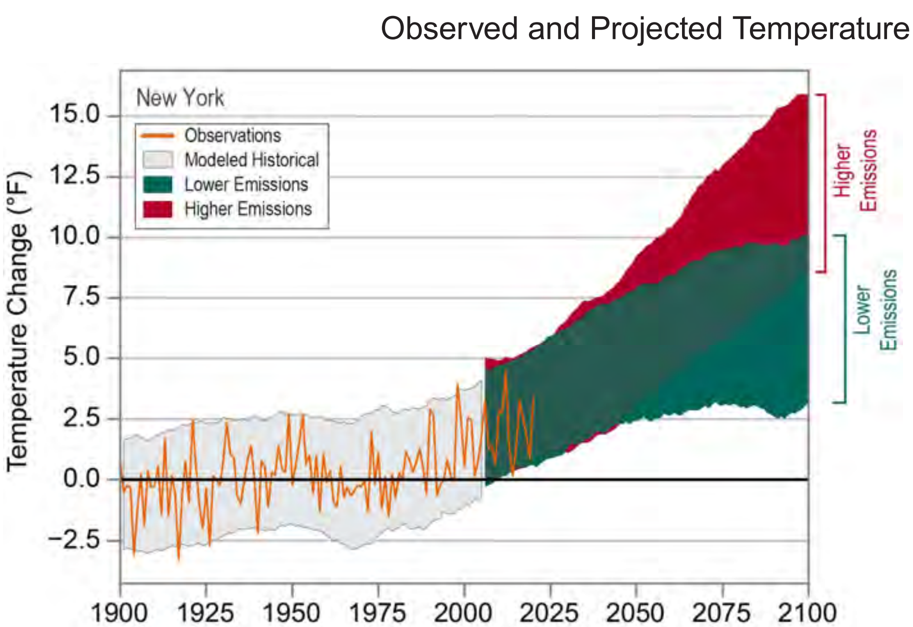
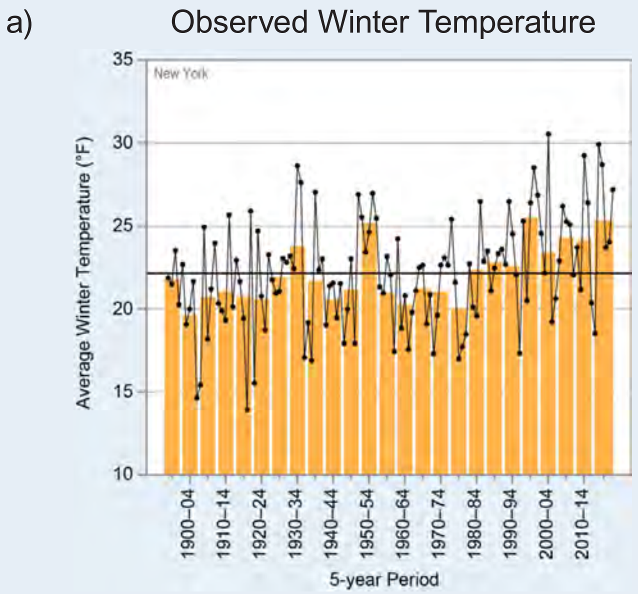
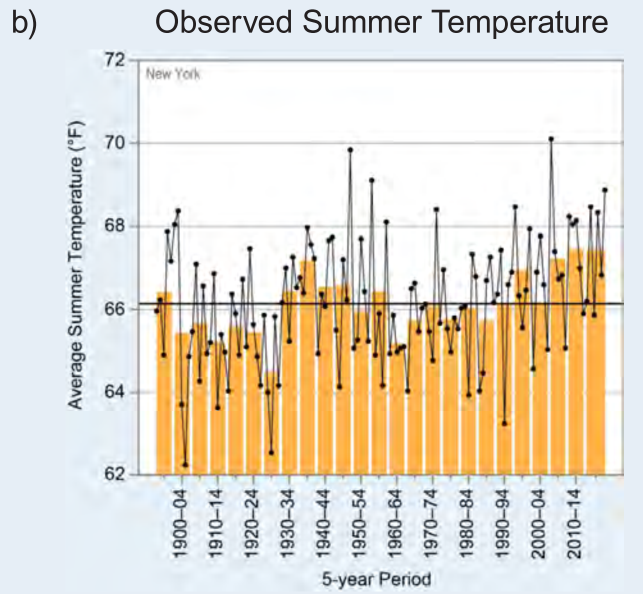
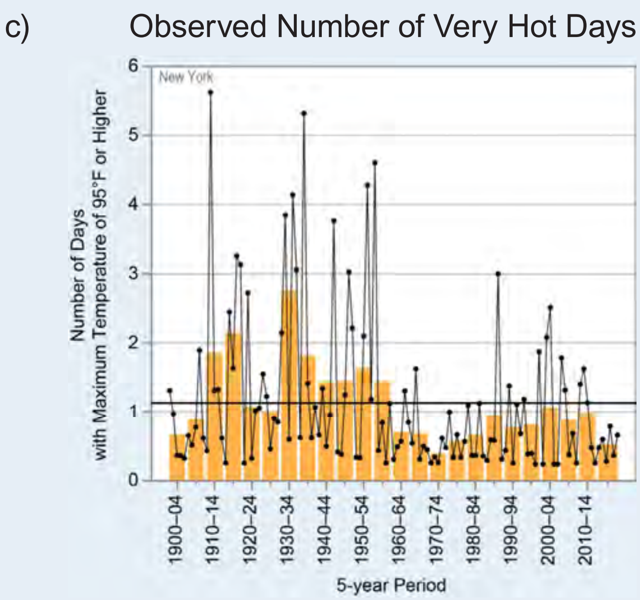
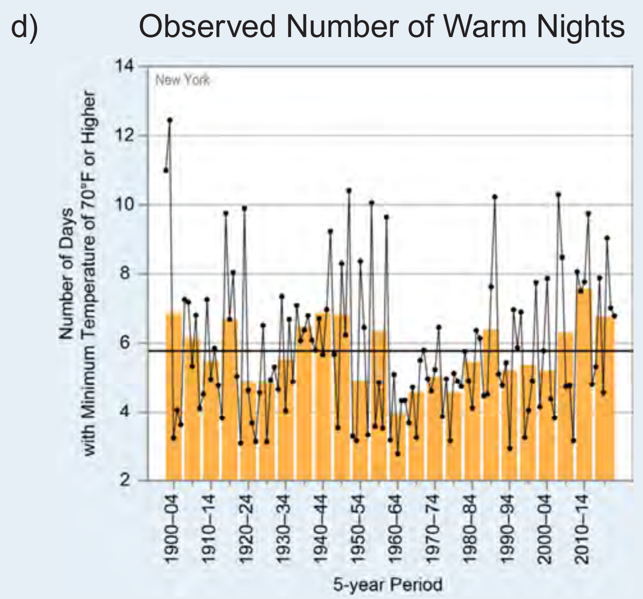


Figure 1: Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for New York. Observed data are for 1900–2020. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Temperatures in New York (orange line) have risen almost 2.5°F since the beginning of the 20th century. Shading indicates the range of annual temperatures from the set of models. Observed temperatures are generally within the envelope of model simulations of the historical period (gray shading). Historically unprecedented warming is projected during this century. Less warming is expected under a lower emissions future (the coldest end-of-century projections being about 3°F warmer than the historical average; green shading) and more warming under a higher emissions future (the hottest end-of-century projections being about 11°F warmer than the hottest year in the historical record; red shading). Sources: CISESS and NOAA NCEI.









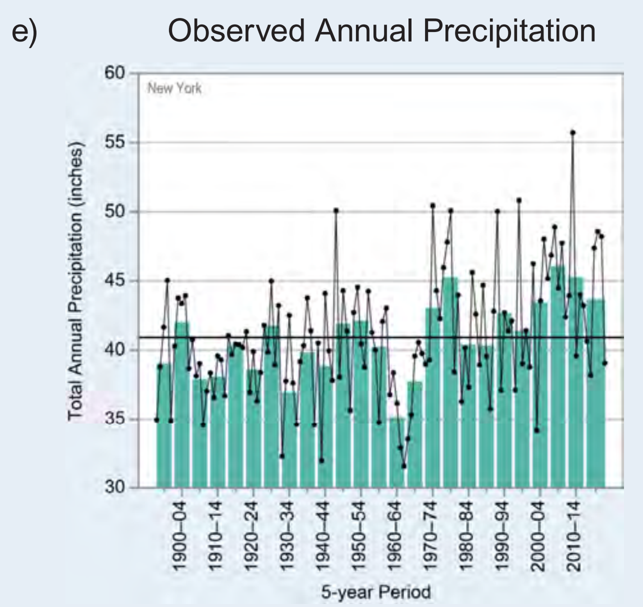


Figure 2: Observed (a) winter (December–February) average temperature, (b) summer (June–August) average temperature, (c) annual number of very hot days (maximum temperature of 95°F or higher), (d) annual number of warm nights (minimum temperature of 70°F or higher), and (e) total annual precipitation for New York from (a, b, e) 1895 to 2020 and (c, d) 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages: (a) 22.2°F, (b) 66.1°F, (c) 1.1 days, (d) 5.8 nights, (e) 40.9 inches. Recent years have seen some of the warmest winter and summer temperatures in the historical record. The number of very hot days peaked during the 1930–1934 period, while the number of warm nights was highest during the 2010–2014 period. Total annual precipitation has been significantly above average since 2000. Sources: CISESS and NOAA NCEI. Data: (a, b, e) nClimDiv, (c, d) GHCN-Daily from 12 long-term stations.

Since the beginning of the 20th century, temperatures in New York have risen almost 2.5°F, and temperatures in the 2000s have been higher than in any other historical period (Figure 1). As of 2020, the hottest year on record for New York was 2012, with a statewide average temperature of 48.8°F, more than 4°F above the long-term average (44.5°F). This warming has been concentrated in the winter and spring, while summers have not warmed as much (Figures 2a and 2b). Summer warming is more influenced by the number of warm nights than by the occurrence of very hot days (Figures 2c and 2d). The state has experienced an increase in the number of warm nights and a decrease in the number of very cold nights (Figure 3). The increase in winter temperatures has had an identifiable effect on Great Lakes ice cover. Since 1998, there have been several years when Lakes Erie and Ontario were mostly ice-free (Figure 4).

Annual average precipitation is slightly more than 40 inches statewide but varies regionally, with mountainous areas receiving near 50 inches per year. Statewide annual precipitation has ranged from a low of 31.6 inches in 1964 to a high of 55.7 inches in 2011. The driest multiyear periods were in the early 1930s and early 1960s and the wettest in the late 1970s and since 2000 (Figure 2e). The driest consecutive 5-year interval was 1962–1966, with an annual average of 33.9 inches, and the wettest was 2007–2011, with an annual average of 46.8 inches. **New York has recently experienced a large increase in the number of 2-inch extreme precipitation events** (Figure 5), which peaked during the 2010–2014 period. The annual precipitation record, set in 2011, was partially due to extreme precipitation events caused by Hurricane Irene and Tropical Storm Lee in late August and early September, respectively. Many areas of eastern New York received more than 7 inches of rain from Hurricane Irene, with more than 18 inches in some locations in the Catskill Mountains. Less than two weeks later, Tropical Storm Lee brought additional heavy rainfall, with more than 12 inches falling in the Susquehanna River basin. The extreme rainfall from these two events caused devastating flooding and damage. Nontropical systems can also bring extreme rainfall, such as during August 12–13, 2014, when the state 24-hour precipitation record was broken (13.57 inches) at Islip. New York experienced extreme drought during 2016 and severe drought during 2020, which had major impacts on agriculture in some parts of the state.

In addition to causing heavy flooding inland, hurricanes and tropical storms can cause coastal damage from storm surge and flooding. In late October 2012, Superstorm Sandy (a post-tropical storm) caused massive storm surge in New York City. The extensive

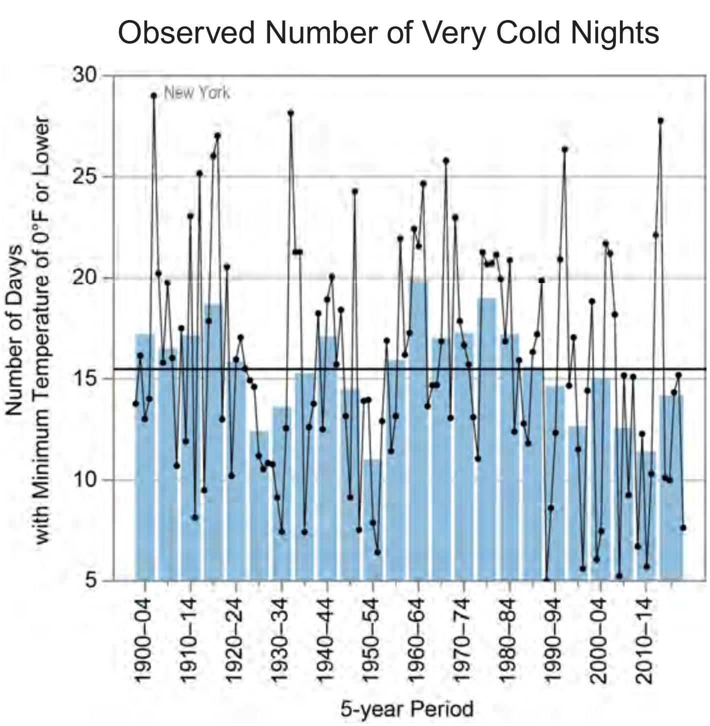


Figure 3: Observed annual number of very cold nights (minimum temperature of 0°F or lower) for New York from 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 16 nights. The number of very cold nights has been below average since 1990, reflecting a long-term winter warming trend. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 12 long-term stations.

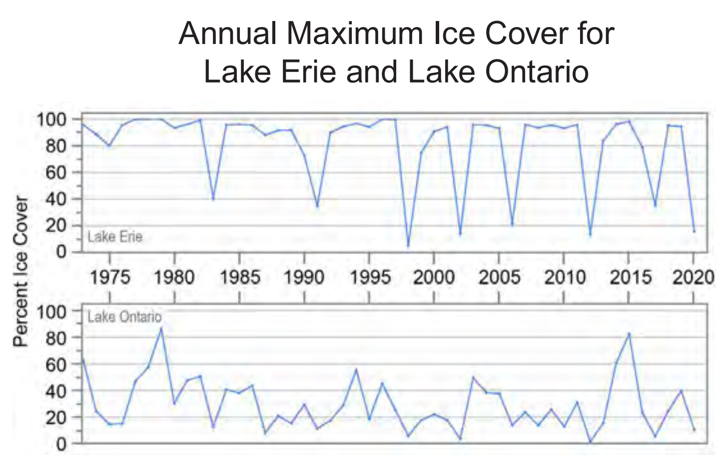


Figure 4: Annual maximum ice cover extent (%) for Lake Erie (top) and Lake Ontario (bottom) from 1973 to 2020. During most years, Lake Erie was nearly frozen over, while Lake Ontario was mostly ice-free. There were 6 years when Lake Erie was mostly ice-free, and all of those occurred since 1998. Since 2006, Lake Ontario's ice cover extent has remained below 40%, except for higher values during the cold 2013–14 and 2014–15 winters. Source: NOAA GLERL.

flooding from the storm surge inundated subway tunnels, damaged the electrical grid, overwhelmed sewage treatment plants, and destroyed thousands of homes. Superstorm Sandy caused tens of billions of dollars in damages in the state, with an estimated $19 billion in damages to New York City.

Winter storms occur frequently across the state due to the large temperature contrast between the cold interior of the North American continent and the warm moist air of the western Atlantic. **These storms, popularly known as nor'easters, can produce crippling snowfall, flood-producing rainfall, hurricane-force winds, and dangerous cold**. The Blizzard of 1996, January 6–8, was a classic nor'easter, dropping more than 20 inches of snow in New York City and causing an estimated $70 million in damages across the state. During the Blizzard of 2016, January 22–24, more than 30 inches of snow fell in some areas, such as Kennedy Airport, where near-blizzard conditions persisted for 9 hours; travel bans were also enacted in New York City. The northern part of the state frequently experiences heavy lake-effect snows due to the warming and moistening of arctic air masses as they pass over the Great Lakes. This results in intense bands of heavy snowfall over areas downwind of Lakes Ontario and Erie. During November 17–19, 2014, a lake-effect snowstorm delivered more than 5 feet of snow just east of Buffalo. A second lake-effect event immediately followed during November 19–20, dropping as much as an additional 4 feet of snow; snowfall rates as high as 6 inches per hour were reported, with some areas receiving more than 3 feet of snow in less than 12 hours. These two storms were considered unprecedented events but were characteristic of lake-effect snows that affect the state. The Great Lakes can also experience flooding and erosion due to high water levels. Wet spring conditions contributed to record-high water levels and flooding in 2017 and 2019. Cleanup costs, infrastructure damages, and agricultural losses were in the millions of dollars.

Under a higher emissions pathway, historically unprecedented warming is projected during this century (Figure 1). Even under a lower emissions pathway, annual average temperatures are projected to most likely exceed historical record levels by the middle of this century. However, a large range of temperature increases is projected under both pathways, and under the lower pathway, a few projections are only slightly warmer than

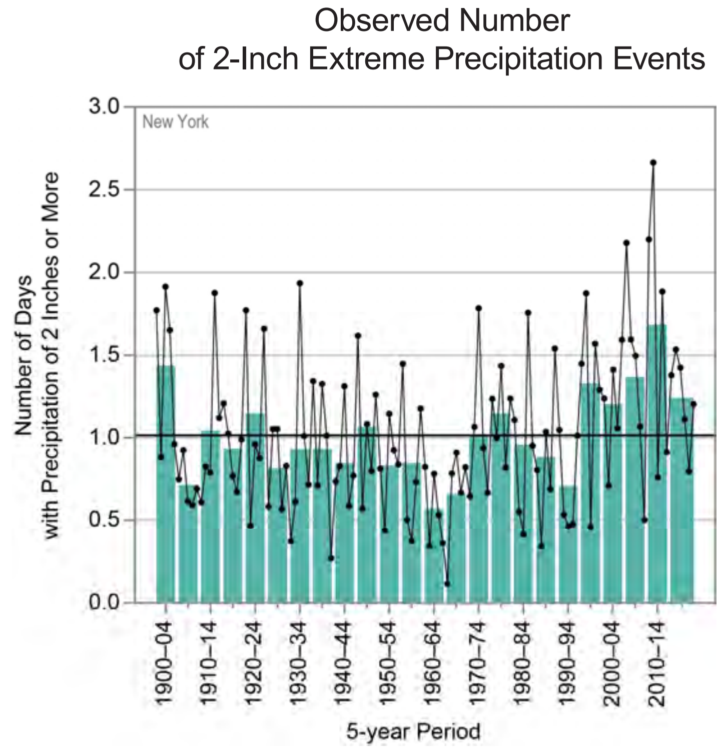


Figure 5: Observed annual number of 2-inch extreme precipitation events (days with precipitation of 2 inches or more) for New York from 1900 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 1.0 days. A typical station experiences 1 event each year. Since 1995, New York has experienced an above average number of 2-inch extreme precipitation events, with the highest frequency occurring during the 2010–2014 period. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 16 long-term stations.

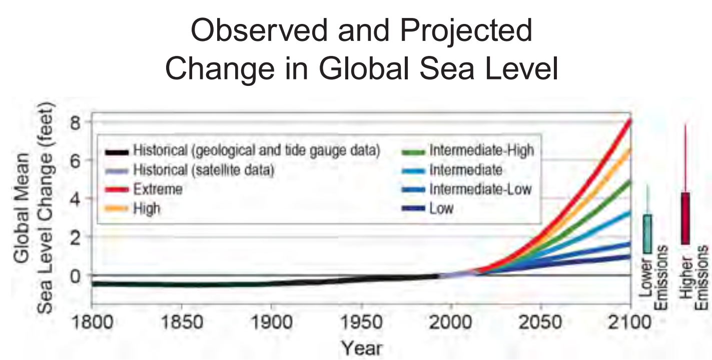


Figure 6: Global mean sea level (GMSL) change from 1800 to 2100. Projections include the six U.S. Interagency Sea Level Rise Task Force GMSL scenarios (Low, navy blue; Intermediate-Low, royal blue; Intermediate, cyan; Intermediate-High, green; High, orange; and Extreme, red curves) relative to historical geological, tide gauge, and satellite altimeter GMSL reconstructions from 1800–2015 (black and magenta lines) and the very likely ranges in 2100 under both lower and higher emissions futures (teal and dark red boxes). Global sea level rise projections range from 1 to 8 feet by 2100, with a likely range of 1 to 4 feet. Source: adapted from Sweet et al. 2017.

historical records. Heat waves are projected to be more intense. Extreme heat is a particular concern for New York City and other urban areas, where the urban heat island effect raises summer temperatures. High temperatures combined with high humidity can create dangerous heat index values. By contrast, cold waves are projected to become less intense.

Increasing temperatures raise concerns for sea level rise in coastal areas. Since 1880, sea level has risen by about 13 inches along the coast of New York, more than the global average rise of about 7–8 inches since 1900. Global sea level is projected to rise another 1–4 feet by 2100 as a result of both past and future emissions from human activities (Figure 6), but local and regional factors are expected to cause New York's sea level to rise more than the global projection. Even if storm patterns remain the same, sea level rise will increase the frequency, extent, and severity of coastal flooding. Sea level rise has caused an increase in tidal floods associated with nuisance-level impacts. Nuisance floods are events in which water levels exceed the local threshold (set by NOAA's National Weather Service) for minor impacts. These events can damage infrastructure, cause road closures, and overwhelm storm drains. As sea level has risen along the New York coastline, the number of tidal flood days (all days exceeding the nuisance-level threshold) has also increased, with the greatest number occurring in 2009 and 2017 (Figure 7). This is a particular concern for New York because of dense, high-value development along the coastline.

Winter and spring precipitation is projected to increase in New York (Figure 8). This could result in enhanced snowpack at higher elevations, but with warmer temperatures, more of the precipitation will fall as rain, particularly at lower elevations. In addition, the frequency and intensity of extreme precipitation events are projected to increase, potentially increasing the frequency and intensity of floods. Heavier precipitation increases the risk of springtime flooding, which could pose a particular threat to New York's agricultural industry by delaying planting and resulting in yield losses.

Observed and Projected Annual Number of Tidal Floods for The Battery, NY

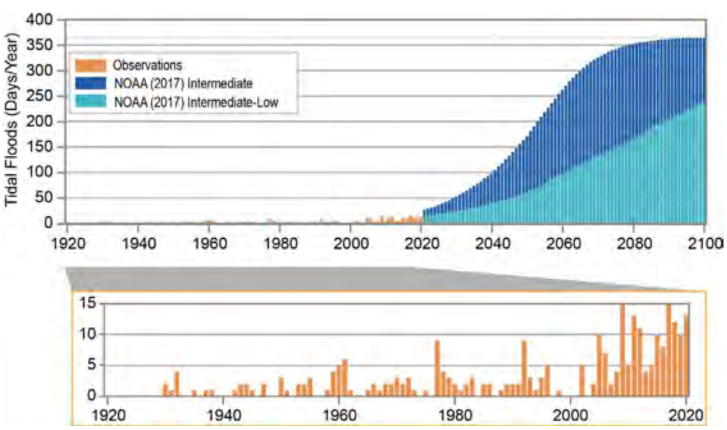


Figure 7: Number of tidal flood days per year at The Battery, NY, for the observed record (1920–2020; orange bars) and projections for two NOAA (2017) sea level rise scenarios (2021–2100): Intermediate (dark blue bars) and Intermediate-Low (light blue bars). The NOAA (2017) scenarios are based on local projections of the GMSL scenarios shown in Figure 6. Sea level rise has caused a gradual increase in tidal floods associated with nuisance-level impacts. The greatest number of tidal flood days (all days exceeding the nuisance-level threshold) occurred in 2009 and 2017 at The Battery. Projected increases are large even under the Intermediate-Low scenario. Under the Intermediate scenario, tidal flooding is projected to occur nearly every day of the year by the end of the century. Additional information on tidal flooding observations and scenarios is available at https://statesummaries.ncics.org/technicaldetails. Sources: CISESS and NOAA NOS.

Projected Change in Winter Precipitation

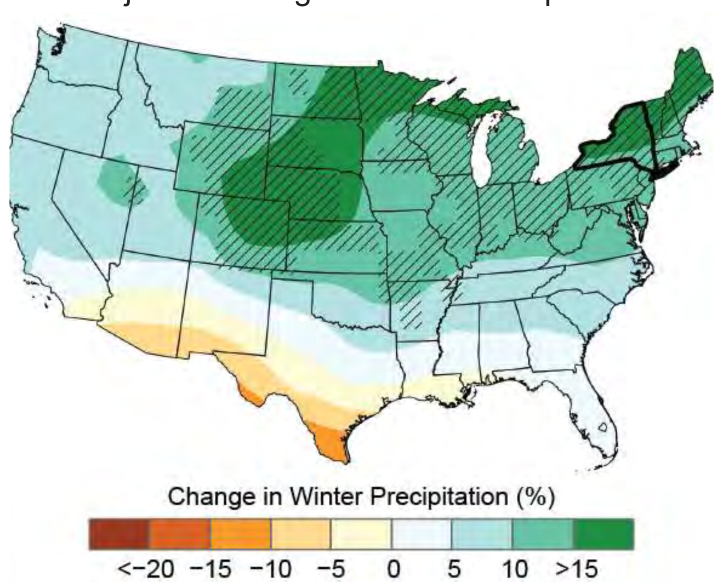


Figure 8: Projected change in winter (December–February) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. Hatching represents areas where the majority of climate models indicate a statistically significant change. By the middle of this century, if greenhouse gas emissions continue to rise rapidly, winter precipitation is projected to increase by 10%–15% in southern New York and 15%–20% in northern New York. Sources: CISESS and NEMAC. Data: CMIP5.

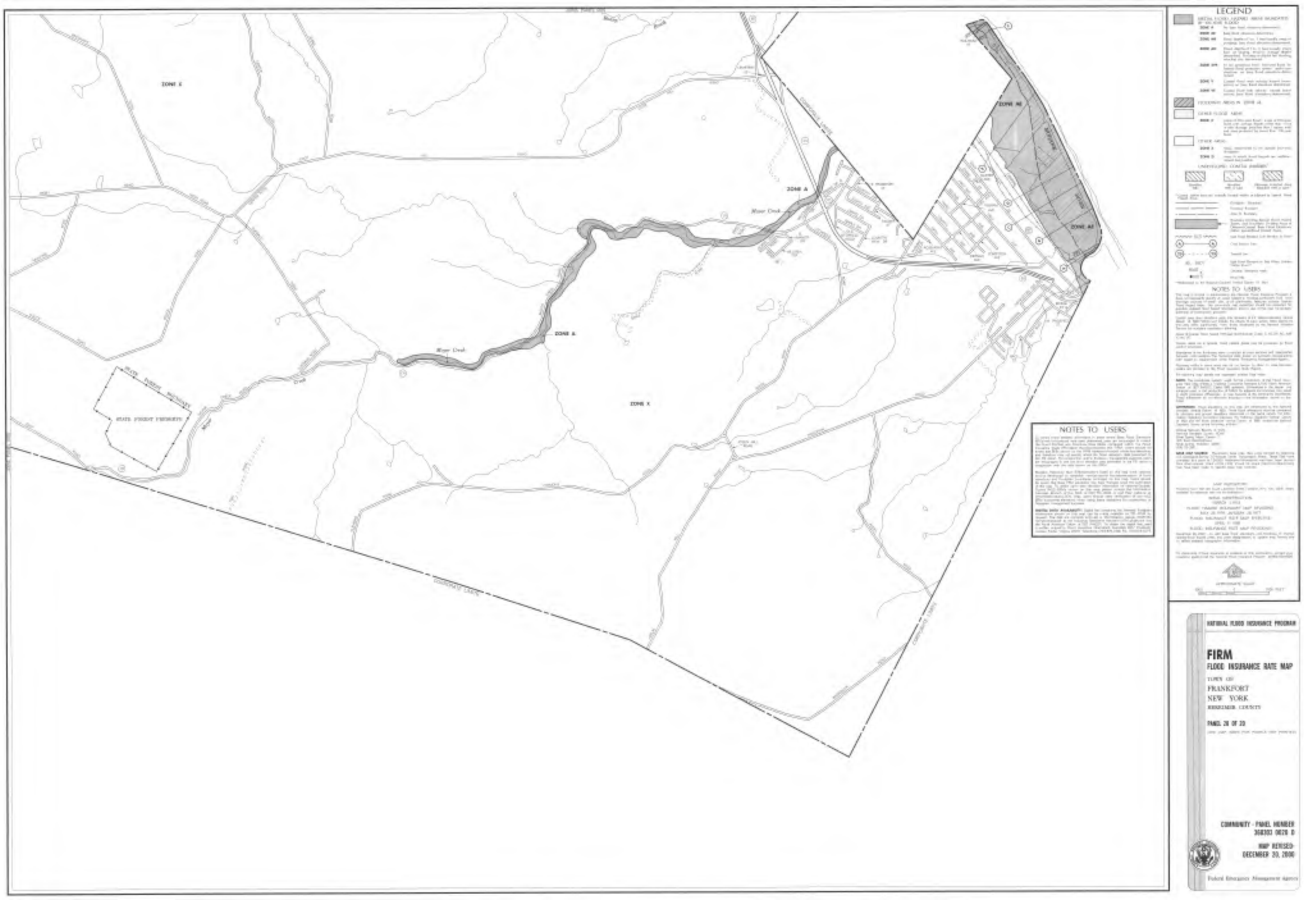
Technical details on observations and projections are available online at https://statesummaries.ncics.org/technicaldetails.

APPENDIX B
FEMA Flood Zone Map

FEMA Flood Map Service Center: FIRMette Web

Help

CREATE A FIRMETTE



MAX ZOOM

APPENDIX C
ABCA Public Meeting Details and Comments