Final Analysis of Brownfields Cleanup Alternatives
Daniel's Mill
98 East Main Street
Vernon, Connecticut

I. Introduction & Background

This Analysis of Brownfields Cleanup Alternatives (ABCA) has been prepared to evaluate cleanup alternatives for 98 East Main Street, Vernon, Connecticut (Site). The ABCA is provided as part of the Town of Vernon's application for a Brownfields Cleanup Grant to the Connecticut Department of Economic and Community Development (CT DECD). The cleanup will be performed by the Town of Vernon (the Town), working with the developer Vernon Mill Owner II LLC, to remediate the property and abate hazardous building materials if the grant is received. The Site would be redeveloped for residential purposes as part of a larger redevelopment project following cleanup.

If the Brownfields Grant is received, the Site will be subject to the Connecticut Department of Energy and Environmental Protection (CT DEEP) Remediation Standard Regulation (RSRs) of the Regulations of Connecticut State Agencies (RCSA) Section 22a-133k-1 through -3, inclusive. The property is currently not in use and plans are to redevelop this former mill property and two abutting properties for a large-scale mixed-use redevelopment project including residential dwellings. Thus, remediation will need to achieve compliance with the Residential Direct Exposure Criteria (Res DEC). Groundwater at the Site is classified as GB and the GB pollutant mobility criteria (GB PMC) will apply to the leachability of chemicals from soil. In addition, groundwater will need to comply with the Surface Water Protection Criteria (SWPC).

1. Site Location

The Site, located at 98 East Main Street (parcel 40-0117-00005), is currently vacant and consists of an irregularly shaped parcel totaling approximately one acre of land. The Town will take ownership of the property on June 21, 2021 through a tax collectors deed. The Site is improved with a six-story (including basement and attic) structure with a footprint of approximately 9,050 square feet. The remaining portions of the Site exist as paved parking areas and driveways. The current zoning of the Site is Historic District – Industrial within the Town of Vernon.

The Site is in the Hockanum River Valley in northeastern Vernon and is part of the proposed redevelopment of the entire Amerbelle Mill Complex which includes adjacent properties at 40 Brooklyn Street and 1 Court Street to the west, and 5 Brooklyn Street, 104 East Main Street and 19 Grove Street to the southeast. The elevation of the ground surface for most of the Site is approximately 460 feet MSL dropping steeply toward the American Mill Pond that borders to the southwest.

Access to the Site is available from East Main Street. Industrial/Commercial properties are located on the adjacent properties to the west, east, and south. Residential properties are located to the north on the other side of East Main Street.

2. Forecasted Climate Conditions

EPA requires that an ABCA consider potential project-related impacts due to climate concerns. Specifically, this discussion addresses observed and forecasted climate change conditions for the area of the project and associated site-specific risk factors.

Vernon, Connecticut is located in the north-central portion of Connecticut. The northeastern United States, including the Town of Vernon, experiences 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 and/or hurricanes. Winter conditions can also be severe with ice storms and heavy snow common. Snowfalls of 2-3 feet in one event are not uncommon. The Site is located outside any designated 100-year flood plain and the location is not anticipated to be impacted by increased flooding due to the increased intensity and frequency of extreme weather events.

According to the US Global Change Research Program website (http://www.globalchange.gov/explore/northeast), as a result of climate change, the northeast region can expect increased temperatures and temperature variability and extreme precipitation events. The website states that "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." The State of Connecticut Climate Change Summary is attached as Attachment A.

According to FEMA Flood Insurance Rate Map for the Town of Vernon, # 0901310005C, the Site is located within "Zone X" indicating an area of minimal flooding (outside the 500-year floodplain). Therefore, the biggest threat to this Site is from localized stormwater impacts from extreme precipitation events. Ground thaw and freezing and wildfires are also not anticipated to affect the Site.

3. Previous Site Use(s) and Any Previous Cleanup / Remediation

The Site is the former Daniel's Mill, built in 1855 and is improved with a six-story (including basement and attic) historical mill building with a footprint measuring approximately 9,050 square-feet. A 2014 Phase I Environmental Site Assessment (ESA) reported the Site building as being occupied by Band Room & Studio Rentals, Sol Cantor Electric, AI Enterprises (sheet metal workshop), Daniel's Mill Self Storage and Charity Storage. The building is currently unoccupied.

The Site was reportedly developed as a textile mill which manufactured cotton, stockinet, and wool products between 1855 and 1951. After 1951 the Site was occupied by several different tenants as follows:

Year	Tenant Company	Description
1951-1978	Albi Manufacturing Company	Producer of fire-retardant paints and mastics
1952-1971	Double B Products	Producer of insecticides and paints
1960	Conversion Chemical Corporation	Not available
1960-1970	Outboard Shop & Sports Center	Not available
1985-2000	Hockanum Salvage, Inc.	Not available
1985	C&C Products, Inc.	Not available
1985	Furnace Brokers	Not available

II. Site Assessment Findings

1. A. Phase I ESA, Apex Companies, LLC (Apex), October 2011

The Phase I investigation completed by Apex identified the following environmental concerns for the Site:

- Historical and Current Site Operations. Historical uses of the Site raise the potential for on-Site contamination. Historical manufacturing operations may have included the handling and potential disposal, dumping, or releases of petroleum, metals, paints, solvents, and other potentially hazardous materials.
- Recognized Environmental Conditions (RECs)
  - REC #1 – Historic Site Usage as former fireproof paint, wax, and insecticide manufacturers
  - REC #2 – 1,000-gallon Above Ground Storage Tank (AST) located within the northeast corner of basement.
  - REC #3 – Twelve 425- gallon AST on exterior concrete platform.
  - REC #4 – Former 1,000-gallon Underground Storage Tank (UST) located beneath collapsed building.
  - REC #5 – Two former 2,000- gallon USTs located beneath loading dock.
  - REC #6 – Exterior 4,000-gallon UST located along northern portion of building.
  - REC #7 – Potential USTs located along northern portion of building.
  - REC #8 – Abutting Brownfield Site.
- Potential Off-Site Sources. A former gasoline station located to the southeast of the Site could be potentially hydraulically upgradient. A total of five USTs were removed from the site. Identified impacts include Dinitrophenol waste as noted in the MANIFEST database.

2. Phase I ESA, Fuss & O'Neill, December 2014

The Phase I investigation completed by Fuss & O'Neill identified the following environmental concerns for the Site:

- REC #1 - Historical and Current Site Operations. Historical uses of the Site raise the potential for on-Site contamination. Historical city directory listings identify multiple tenants previously, specifically an insecticide and paint manufacturing company. Other companies include sheet-metal and salvage. Historical manufacturing operations may have included the handling and potential disposal, dumping, or releases of petroleum, metals, and other potentially hazardous materials. Organic COCs include petroleum hydrocarbons, volatile organic compounds, and polynuclear aromatic hydrocarbons (PAHs).
- REC #2 - Former Furnace and Fuel-Oil AST Area (basement). Indication of an oil-fired furnace and 1,000 gallon fuel-oil AST were identified in the western portion of the building's basement.
- REC #3 - Former Floor Drain (basement). Indication of a floor drain was identified in the southwestern portion of the basement adjacent to exposed plumbing. The floor drain presumably discharged to the sewer, but is reportedly abandoned
- REC #4 - Historical AST Storage Area. Historic maps indicate an AST storage area. The ASTs were reportedly former acid storage tanks and were removed by the property owner at the time of the Phase I. The site contact reported that they were empty at the time of removal.
- REC #5 - Former/Current USTs. At least eight USTs were historically located at the Site. One UST is reported to have fallen into the adjacent pond, and visible vent and fill pipes indicate USTs are likely still present. The potential for subsurface release are likely due to leaks in the tanks or piping.

- REC #6 - Loading Dock. A loading dock is located off the Western side of the Site building. The potential for releases from materials being shipped/received exists.
- REC #7 - Former Pad-Mounted Transformer. Information from the Town of Vernon indicates a pad-mounted transformer formerly located on the Site. It is presumed around the area of the loading dock. The potential for the release of PCBs is likely.
- REC #8 - Urban Fill. Historical Sanborn maps indicate the parking lot area of the Site was filled between approximately 1892 and 1897.
- REC #9 - Potential Off-Site Sources. Soil and groundwater impacts have been documented at the adjacent, upgradient Amerbelle Corporation property. Identified impacts include VOCs, specifically PCE.

3. Phase II ESA, GZA, September 2015

GZA GeoEnvironmental, Inc completed a Phase II investigation in September 2015. The Phase II consisted of advancing twenty (20) soil borings and installation of two (2) groundwater monitoring wells and collecting three (3) soil vapor samples. Soil samples were analyzed for VOCs, PAHs, ETPH, Total and SPLP metals, Pesticides, Alcohols, and PCBs. Groundwater samples were analyzed for VOCs, PAHs, Pesticides, and selected metals. Soil vapor samples were analyzed for VOCs. A summary of the Phase II findings are as follows:

- REC #1 – Parking Lot - Two borings were completed to refusal. Trace concentrations of metals and PAHs were below the GB-PMC and Res DEC.
- REC #2 – Two Former USTs – Two borings were completed to refusal. No concentrations of VOCs, PAHs, or ETPH were detected.
- REC #3 – Loading Dock – Two borings were completed to refusal. No concentrations of pesticides, PAHs, or ETPH were detected. Concentrations of metals were detected in both borings below the GB-PMC and Res DEC. PCB concentrations (6.0 mg/kg) exceeded the Res DEC (1.0 mg/kg) and GB-PMC. Identified impacts appear to be related to a potential release from a transformer.
- REC #4 – Current/Former USTs – Three borings were completed to refusal. No concentrations of alcohols, PAHs, or ETPH were detected. VOC concentrations of 1,2,4 trimethylbenzene (19 mg/kg) and 1,3,5 trimethylbenzene (5.2 mg/kg) exceeded the GB-PMC.
- REC #5 – Former Boiler and AST – One boring was completed to refusal. No concentrations of VOCs, PAHs, and ETPH were detected.
- REC #6 – Historic Use of Building – Three soil vapor samples and one background air sample was collected. VOCs concentration were below the applicable standards. Ten borings were completed to refusal. Exceedances of the Res DEC and/or GB-PMC include VOCs, PCBs, PAHs, ETPH, and total metals were observed. Detected impacts may be related to poor quality fill, or releases from past or current factory operations. PCB concentrations (6 and 11 mg/kg) exceed the Res DEC and GB-PMC. Lead concentration (1,190 mg/kg) exceeds the Res DEC. Further PCB analyses resulted in concentrations ranging from 0.8 mg/kg to 91 mg/kg. Detection of PCBs may have been a result of historic fire-retardant paint and mastic manufacturing.
- REC #7 – Former Exterior Solvent ASTs – One boring was completed to 3 feet below ground surface. VOCs and PAHs were detected below the Res DEC and GB-PMC.

- REC #8 – Former Transformer Area – The boring from REC 3 was in the vicinity of REC 8. The soil sample had a PCB concentration (6.0 mg/kg) that exceeded the Res-DEC and GB-PMC.
- REC #9 - Upgradient Brownfield Property – Two bedrock groundwater monitoring wells were installed. Trace concentrations of VOCs were detected. Metals concentrations exceeding the SWPC included: arsenic (5 µg/L), copper (75 µg/L), and lead (78 µg/L). Concentrations reported may have resulted from releases from upgradient properties, which include former sites of the Amerbelle mill complex.

4. Phase III Data Gap Investigation Report, GZA, December 2019

The Phase III Data Gap Investigation was designed to evaluate certain data gaps identified based on the review of the available reports and the Phase II investigation program. The results of the investigations were used to: (1) determine the nature and extent of potential releases to the environment from former Site operations and (2) evaluate the distribution and extent of PCB impacts within interior building materials to determine the applicability of federal PCB regulations and CT DEEP guidance and potential abatement requirements for future Site development. The report determined that: (1) active remedial actions would be required to address impacts to soil to comply with the CT DEEP RSRs, (2) that source removal would likely address limited impacts to groundwater and (3) PCB-containing building materials would need to be abated to comply with federal PCB regulations and CT DEEP guidance.

5. Phase I ESA, GZA, March 2021

The Phase I investigation completed by GZA did not identify any new RECs for the Site and described the current condition of existing RECs as follows:

- REC #1/AOC #1 - Parking lot (urban fill): According to historical Sanborn maps, the parking lot area on the western side of the building was filled sometime between 1892 and 1897. Placement of urban fill is typically associated with potential VOC, PCB, PAH, ETPH and metals impacts. GZA conducted Phase II investigations in this area in 2015 and did not identify evidence of release related to urban fill.
- REC #2/AOC #2 - Two former fuel oil USTs below former loading dock: Two former fuel oil USTs were historically present in the western portion of the Site and UST piping reportedly remains beneath the ground in this area. GZA conducted Phase II investigations in this area in 2015 and did not identify evidence of release from these former USTs.
- Rec #3/AOC #3 - Loading dock: A loading dock is located on the western side of the building and chemicals and/or petroleum products historically used in the building were likely loaded and unloaded at this location. GZA's Phase II and III investigations within this area identified volatile organic compound (VOC) and polychlorinated biphenyl (PCB) impacts to soils. VOC impacts were determined to be less than the Connecticut Remediation Standards Regulations (RSR) remedial criteria and GZA proposed no further action for those impacts. PCB impacts to soils; however, were above the RSR Direct Exposure Criteria (DEC) and extended to depths of approximately two to four feet below grade. These PCB soil impacts have not yet been remediated.
- REC #4/AOC #4 - Six former/current USTs along northern side of the Site building: Six (6) USTs are present within a concrete vault immediately north of the Site building, adjacent to East Main Street. The USTs historically contained butyl acetate, isopropanol, butanol, No. 2 fuel oil, nitropropane and formoel. The USTs were investigated by GZA in 2015-2019 and no

alcohols, polycyclic aromatic hydrocarbons (PAHs), or extractable total petroleum hydrocarbons (ETPH) were detected in soils to the south (downgradient) of the UST vault. VOCs were detected in soils downgradient of the USTs at concentrations below the RSR criteria and leachable VOCs were not detected in soils. However, soils directly beneath the USTs could not be sampled and GZA concluded that additional investigation/sampling would be necessary to assess the extent of releases from the USTs and the need for remediation.

- REC #5/AOC #5 - Former boiler and AST in northwest corner of basement: A boiler and an associated 1,000-gallon AST were historically present in the northwestern corner of the building basement. GZA conducted Phase II investigations in this area in 2015 and did not identify evidence of release from the former boiler or basement AST.
- REC #6/AOC #6 - Historic use of the Site building: The Site was historically operated as a textile mill, then used for the manufacture of insecticides, fire-retardant paints and mastics. GZA conducted Phase II and III investigations, including soil and soil vapor sampling, in and around the Site building in 2015-2019. The results of those investigations indicated that VOCs, PCBs, PAHs, ETPH and metals (specifically arsenic and lead) were detected in soil samples collected from this REC. PCBs, ETPH, PAHs, arsenic and lead were detected in fill materials to the east of the Site building and/or beneath the building floor at concentrations above RSR criteria; VOC concentrations were below criteria. No pesticides or alcohols were detected in soils collected from this REC. VOC concentrations in soil vapor samples were below the RSR volatilization criteria. PCB, ETPH, PAH, arsenic and lead impacts at this REC have not yet been remediated.
- REC #7/ AOC #7 - Former exterior solvent ASTs (on platform adjacent to elevator): Twelve (12) former solvent aboveground storage tanks (ASTs) were historically located on an exterior concrete platform on the southern side of the building, adjacent to the building elevator shaft. The concrete platform is located above the Mill Pond and is not underlain by soils. GZA conducted Phase II investigations in this area in 2015 and identified evidence of VOC and PAH impacts to the soils beneath the floor adjacent to this area; however, the impacts appeared to be related to historical operations in the Site building basement, rather than to the former ASTs.
- REC #8/AOC #8 - Former transformer area: Concrete pad and/or pole-mounted electrical transformers were historically located outside the southwestern corner of the Site building. GZA conducted Phase II investigations in this area in 2015 and identified evidence of a PCB release; however, the source of the release appeared to have been related to PCB materials handling at the building loading dock.

III. Project Goal

As part of a proposed public private redevelopment plan, the property at 98 East Main Street will be remediated to comply with CT DEEP residential standards and federal PCB regulations. The cleanup and redevelopment of the Site will revive the neighborhood, invigorate the local economy, provide near-term and long-term employment opportunities, utilize sustainability in its cleanup and redevelopment, and remove human health and environmental impacts due to contamination of soil and building materials at the Site.

IV. Applicable Regulations and Cleanup Standards

1. Cleanup Oversight Responsibility

The Town of Vernon, who is in the process of acquiring the property, will undertake responsibility to remediate contaminated soil and abate building materials. Remedial activities will be overseen by a Licensed Environmental Professional (LEP) who will be responsible for collection of confirmatory samples for soil removal actions, reviewing analytical results, and evaluation of backfill analytical data to determine that it complies with the requirements of CT DEEP. The LEP will also collect post-abatement samples from the interior of the structure and observe building restoration following abatement so that it may be documented. Following the completion of remediation of the Site, the LEP will be responsible for completion and submission of the Verification Report and other reports and forms that will be required by CT DEEP if a grant is received.

2. Cleanup Standards

The CT DEEP is the state authority that regulates remediation of sites in the State of Connecticut. The Site is not currently regulated by CT DEEP because it is not entered into the Property Transfer Program (per Sections 22a-134 through -134e of the Connecticut General Statutes (CGS)) or the Voluntary Remediation Program (per Sections 22a-133x or 22a-133y of the CGS). However, remediation in compliance with the RSRs is required by CT DEEP if funding is provided by DECD. The remedial goal for Site soil is to comply with residential direct exposure criteria and GB-PMC criteria. Remediation will also be determined to comply with the SWPC by the performance of post-remediation groundwater monitoring.

PCBs identified in soil and building materials are also regulated under the federal PCB regulation found in the Code of Federal Regulations, Chapter 40, Part 761 (40 CFR Part 761). Remediation of soil will be performed to comply with the high-occupancy standards established in 40 CFR Part 761. The continued use of building materials manufactured with PCBs at concentrations greater than or equal to fifty milligrams per kilogram is not authorized in 40 CFR Part 761 and must be removed from the structure. CT DEEP guidance also requires removal of building materials with total PCB concentrations greater than one milligram per kilogram.

3. Laws and Regulations

The primary regulations for the remediation to comply with are the RSRs and 40 CFR Part 761. Additional applicable local, state and federal regulatory requirements will also be adhered to during the performance of the remediation. These include local regulations under the Town of Vernon Planning and Zoning Commission and Inland Wetlands and Watercourses Agency.

V. Evaluation of Cleanup Alternatives

1. Cleanup Up Alternatives Considered

EPA requires an ABCA to include the evaluation of three (3) remedial alternatives. To address the remediation of impacted soil and building materials at the Site, the following three alternatives were considered. Demolition of the structure was not included in the evaluation because redevelopment plans include the use of the existing structure.

- Alternative #1: No Action with redevelopment of the Site as it currently exists.
- Alternative #2: Capping of impacted soil and building materials in their current locations with redevelopment of the property following remediation.
- Alternative #3: Hazardous Building Materials(HBM) Abatement and Soil Remediation would include removal of PCB impacted building materials and soil with other targeted

soil removal actions to address impacts from other chemicals of concern. Targeted soil removal will remove source materials for identified groundwater impacts. Post-remediation groundwater monitoring to be performed to assess effectiveness of these remedial actions for groundwater.

2. Cost Estimate of Cleanup Up Alternatives

To satisfy EPA requirements, the effectiveness, implementability, and cost of each alternative must be considered prior to selecting a recommended cleanup alternative.

Effectiveness

- Alternative #1: "No Action" is not effective in controlling or preventing the exposure of potential receptors to contamination at the Site.
- Alternative #2: Capping would be effective in controlling the exposure of potential receptors to contamination at the Site but would require a long-term inspection, maintenance, and monitoring program to maintain the effectiveness of the caps. Without source removal, it is not anticipated that this remedial alternative would address identified impacts to groundwater.
- Alternative #3: HBM abatement, including PCB-containing building materials, followed by restoration of the structure in a manner that would isolate any remaining impacts would be effective in preventing exposure of potential receptors to contamination at the Site. Targeted soil excavations with restoration to current conditions would also be effective in preventing exposure and are anticipated to address impacts to groundwater as well.

Implementability

- Alternative #1: "No Action" is easy to implement, since no actions will be conducted. However, this alternative is not administratively implementable because it will not achieve compliance with the RSRs for soil and groundwater and would not comply with federal PCB regulations and CT DEEP guidance for PCBs in building materials.
- Alternative #2: Capping of impacted soil and building materials would be easy to implement and would require minimal remediation and construction activities. However, this alternative is not administratively implementable because it will not achieve compliance with the RSRs for soil and groundwater and would not comply with federal PCB regulations and CT DEEP guidance for PCBs in building materials.
- Alternative #3: HBM Abatement and Soil Remediation would be the most difficult to implement because it would require significant construction activities and targeted soil remediation. However, this alternative complies with the RSRs for soil and groundwater and the federal PCB regulations and CT DEEP guidance for PCBs in building materials.

Cost

- Alternative #1: Costs were not developed for this alternative because it is not considered to be implementable.
- Alternative #2: Costs were not developed for this alternative because it is not considered to be implementable.

- Alternative #3: The estimated costs to (1) abate building materials as required and restore the structure and (2) perform targeted soil excavations with restoration to current site conditions is $2,462,000.

3. Recommended Cleanup Up Alternatives

The recommended cleanup alternative for the Site is HBM Abatement and Soil Remediation. Alternative #1: No Action cannot be recommended since this alternative will not control exposure risks to Site receptors or comply with state and federal regulations . Alternative #2: Capping would be effective at controlling exposure risks to Site receptors but will not comply with state and federal regulations. Therefore, Alternative #3, HBM Abatement with Soil Remediation is the most cost effective alternative capable of (1) mitigating risks posed to site receptors and (2) complying with federal and state regulations and guidelines pertaining to the chemicals of concern at the Site.

Site remediation activities will utilize opportunities for achieving green remediation goals by using cleaner fuels, diesel emission controls, and/or other emission reduction practices for construction vehicles and other equipment in line with EPA's Clean and Green Cleanup guidelines.

Attachment A

"What Climate Change Means for Connecticut," USEPA, August 2016
EPA 430-F-16-009

EPA United States Environmental Protection Agency

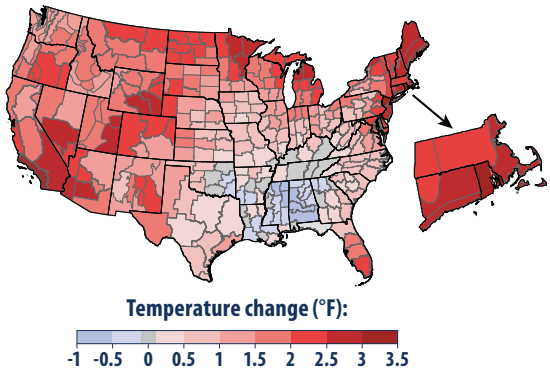
August 2016
EPA 430-F-16-009

What Climate Change *Means for* Connecticut

Connecticut's climate is changing. The state has warmed two to three degrees (F) in the last century. Throughout the northeastern United States, spring is arriving earlier and bringing more precipitation, heavy rainstorms are more frequent, and summers are hotter and drier. Sea level is rising, and severe storms increasingly cause floods that damage property and infrastructure. In the coming decades, changing the climate is likely to increase flooding, harm ecosystems, disrupt farming, and increase some risks to human health.

Our climate is changing because the earth is warming. Since the late 1700s, people have increased the amount of carbon dioxide in the air by 40 percent. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years. Warming is causing snow to melt earlier in spring, and mountain glaciers are retreating. Even the great ice sheets on Greenland and Antarctica are shrinking. Thus the sea is rising at an increasing rate.



Rising temperatures in the last century. Connecticut has warmed twice as much as the rest of the contiguous 48 states. Source: EPA, Climate Change Indicators in the United States.

Increasing Temperature and Changing Precipitation Patterns

Rising temperatures and shifting rainfall patterns are likely to increase the intensity of both floods and droughts. Average annual precipitation in the Northeast increased 10 percent from 1895 to 2011, and precipitation from extremely heavy storms has increased 70 percent since 1958. During the next century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. Average precipitation is likely to increase during winter and spring, but not change significantly during summer and fall. Rising temperatures will melt snow earlier in spring and increase evaporation, and thereby dry the soil during summer and fall. So flooding is likely to be worse during winter and spring, and droughts worse during summer and fall.

In 2011, Hurricane Irene filled the Connecticut River with muddy sediment as a result of erosion upstream. Heavy storms are becoming more common as a result of climate change. Credit: NASA.

Sea Level Rise, Wetland Loss, and Coastal Flooding

Rising sea level erodes wetlands and beaches and increases damage from coastal storms. Tidal wetlands are inherently vulnerable because of their low elevations, and shoreline development prevents them from migrating inland onto higher ground. Human activities such as filling wetlands have destroyed about one third of New England's coastal wetlands since the early 1800s. Wetlands provide habitat for many bird species, such as osprey and heron, as well as several fish species. Losing coastal wetlands would harm coastal ecosystems and remove an important line of defense against coastal flooding.

Coastal cities and towns will become more vulnerable to storms in the coming century as sea level rises, shorelines erode, and storm surges become higher. Storms can destroy coastal homes, wash out highways and rail lines, and damage essential communication, energy, and wastewater management infrastructure.

Coastal marshes in Old Saybrook and nearby properties are at risk from sea level rise. © James G. Titus; used by permission.

Ecosystems and Agriculture

Changing the climate threatens ecosystems by disrupting relationships between species. Wildflowers and woody perennials are blooming—and migratory birds are arriving—sooner in spring. Not all species adjust in the same way, however, so the food that one species needs may no longer be available when that species arrives on its migration. Warmer temperatures allow deer populations to increase, leading to a loss of forest underbrush, which makes some animals more vulnerable to predators. Rising temperatures also enable invasive species to move into areas that were previously too cold.

Climate change may also pose challenges for agriculture: Warmer temperatures cause cows to eat less and produce less milk. That could reduce the output of Connecticut's $70-million dairy industry, which provides 13 percent of the state's farm revenue. Some farms may be harmed if more hot days and droughts reduce crop yields, or if more flooding and wetter springs delay their planting dates. Other farms may benefit from a longer growing season and the fertilizing effect of carbon dioxide.

Human Health

Changes in temperature and precipitation could increase the incidence of acute and chronic respiratory conditions such as asthma. Higher temperatures can increase the formation of ground-level ozone (smog), a pollutant that can contribute to respiratory problems. Rising temperatures may also increase the length and severity of the pollen season for plants such as ragweed—which has already been observed in other regions. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor.

The risk of some diseases carried by insects may also increase. The ticks that transmit Lyme disease are active when temperatures are above 45°F, so warmer winters could lengthen the season during which ticks can become infected or people can be exposed to the ticks. Higher temperatures would also make more of New England warm enough for the Asian tiger mosquito, a common carrier of West Nile virus. The number of cases may or may not increase, depending on what people do to control insect populations and avoid insect bites.

The sources of information about climate and the impacts of climate change in this publication are: the national climate assessments by the U.S. Global Change Research Program, synthesis and assessment products by the U.S. Climate Change Science Program, assessment reports by the Intergovernmental Panel on Climate Change, and EPA's *Climate Change Indicators in the United States.* Mention of a particular season, location, species, or any other aspect of an impact does not imply anything about the likelihood or importance of aspects that are not mentioned. For more information about climate change science, impacts, responses, and what you can do, visit EPA's Climate Change website at www.epa.gov/climatechange.