FINAL - ANALYSIS OF BROWNFIELDS CLEANUP ALTERNATIVES (ABCA)

1000 Block of South 4th Street
Asbestos Contaminated Site
1000, 1002, 1004, 1006 – 1008, and 1010 – 1012 South 4th Street
Clinton, Clinton County, Iowa
State Tracking Number: Not Applicable

Prepared for:
City of Clinton
611 South 3rd Street
Clinton, Iowa 52733

Prepared by:
Blackstone Environmental
1465 41st Street, Suite 13
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Project Number: 3563

December 11, 2023

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Prepared for:

City of Clinton
611 South 3rd Street
Clinton, Iowa 52733-2958

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I. Introduction & Background

a. Site Location

The site is located at 1000, 1002, 1004, 1006 - 1008, and 1010 - 1012 South 4th Street in Clinton, Iowa, USA (herein referred to as "the Site").

a.1. Forecasted Climate Conditions

According to the National Oceanic and Atmospheric Administrative (NOAA) National Centers for Environmental Information State Climate Summaries from 2022 website (https://statesummaries.ncics.org/chapter/ia/), temperatures in Iowa have risen more than one degree Fahrenheit since the beginning of the 20th century with warming concentrated in the winter and fall. Rising temperatures will increase evaporation rates and droughts are likely to be more intense in the future. Future increases in the frequency and intensity of extreme precipitation may increase the frequency and intensity of floods (see attached summary included in Attachment A). As the Site is approximately 2,300 feet west of the Mississippi River, the increase of flood waters due to increased precipitation would be most applicable to the Site cleanup. The presence of stormwater and sanitary sewer lines in South 4th Street, located adjacent on the eastern side of the Site, presents potential flooding pathways. After demolition, the sewer and other utility lines will be capped at their entrance of the Site. The Site will be backfilled with soil, rock, or other compactable material and capped with soil and seeded to establish vegetation. The capped utilities and the planned vegetated area will help slow infiltration rates at the Site from flooding and rain events. Additionally, according to FEMA Flood Zone Map 19045C0504F, the Site is not located within a flood zone (see Attachment B). It is also approximately 465 east of and 10 feet higher in elevation than Zone X, which is determined to be outside of the 500-year floodplain and protected by levee from the 100-year floodplain.

Based on the nature of the Site and its proposed reuse, increase in flood waters events, changing temperature, increased precipitation, wildfires, changing dates of ground thaw/freezing, changing ecological zone, and changing groundwater table are not likely to significantly affect the Site.

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

The Site consists of five 2- and 3-story brick buildings constructed between 1868 and 1912 that were used for retail purposes on the first floor and residential apartments on the second and third floors. Retail occupants have included a grocery, laundromat, hardware store, resale shop, upholstery store, furniture and antique store, used clothing store, offices, barber shop, drug store, restaurants, taverns, and a meeting hall. The buildings are currently vacant and have been for up to a decade. They are in disrepair, having been occupied by squatters for years, and are structurally unsafe with sagging roofs and unstable floors. The City has secured the buildings by boarding windows and doors.

Based on the age of the buildings, it is assumed asbestos containing materials (ACM) are present. An ACM inspection was conducted on the building located at 1010 – 1012 South 4th Street in 2022 that identified roofing materials, floor tile, and linoleum as ACM. The south and southwest portions of the second and third floors were not able to be inspected due to severe deterioration of the structure. Due to the state of the remaining buildings (severe disrepair and unsafe to enter), testing for ACM has not been conducted.

North Building Block
The buildings addressed as 1000, 1002, 1004, and 1006 - 1008 South 4th Street comprise the North Building Block. The buildings are connected and share common walls between each.

The property located at 1000 South 4th Street was quit claimed to the City of Clinton ("City") in 2023 under proper due diligence practices. The property located at 1002 South 4th Street was acquired by the City in 2019 through tax sale. The City purchased the building located at 1004 South 4th Street in 2020 due to the dilapidated condition. Due diligence was not conducted prior to purchase. The 1006 - 1008 South 4th Street building was acquired in 2021 by the City under Iowa Code 657A – Abandoned or Unsafe Buildings. The property located at 1010 - 1012 South 4th Street was acquired by the City in 2019 through tax sale.

The 1002, 1006 – 1008, and 1010 – 1012 South 4th Street buildings were included in the City's Brownfields Cleanup Grant application. Cleanup Grant funds will be used for the demolition of these buildings. As the buildings addressed as 1000 and 1004 South 4th Street were not included in the application for the Cleanup Grant, the City plans to pay for the demolition of these buildings using City funds, a loan from East Central Intergovernmental Agency's Revolving Loan Fund, and/or IDNR Brownfields funds. All of the buildings are eligible for Brownfields funding.

North Building Block - Underground Storage Tank (UST)
Evidence of a suspected UST was observed in the basement of 1000 South 4th Street building in the form of a vent pipe. Based on the suspected location in the floor of the basement, the suspected UST is presumed to be a former heating oil UST. A Phase II Environmental Site Assessment (ESA) was conducted in 2018 that included the collection of soil samples in the vicinity of the building. Groundwater samples were not collected due to lack of water volume. The soil samples did not have concentrations of the contaminants of concern above the Iowa Statewide Standards (SWS) and/or above the laboratory detection limit. However, the soil samples were over 40 feet from the suspect UST. Based on the location of the UST, it was not possible to assess the UST further as there was limited access in the basement, there are sidewalks around the building that are raised with very thick concrete around the building, and any accessible boring locations would be too far from the UST to assess it properly. It was proposed that the UST be assessed once the building has been demolished.

North Building Block - Building Collapse
On August 11, 2023, the building located at 1006 – 1008 South 4th Street collapsed. Building materials (bricks) from the collapse were strewn into South 4th Street (Lincoln Highway). The same evening, Crandal Excavating, a contractor hired by the City of Clinton, removed the debris on South 4th Street and placed it in the collapsed area. The contractor also pushed in three of the remaining walls of the building to prevent further collapse. The wall connected to the 1004 South 4th Street building was left standing. In a letter dated August 15, 2023, a structural engineer from Willett Hofman & Associates Inc. indicated the collapsed building posed a significant threat to the

structural integrity of the connected buildings located at 1000, 1002, and 1004 South 4th Street and recommended they be demolished to a level where a collapse would not allow debris to land on the roadway.

Based on the engineer's recommendation, the structures located at 1000, 1002, and 1004 South 4th Street were demolished to a level where a collapse would not allow debris to land on the roadway and possibly do harm to the public. The demolition was conducted from August 28 through 30, 2023 and was conducted by Lawson Rigging and Excavating, a contractor hired by the City of Clinton that was overseen by a certified asbestos abatement contractor. The building materials from the four buildings were stockpiled on Site and covered with plastic. Air monitoring for asbestos was conducted during the demolition and periodic air monitoring has been conducted since the demolition. Periodic air monitoring will be conducted until the debris pile can be removed. It is planned that the 1010 – 1012 South 4th Street building be demolished when the debris pile is removed.

South Building Block

The building addressed as 1010 - 1012 South 4th Street comprises the South Building Block and was acquired in 2019 due to unpaid taxes.

c. Site Assessment Findings

A Phase I ESA was conducted for the property located at 1006 South 4th Street by Impact 7G dated February 3, 2017. The report indicated that the building was constructed in approximately 1900 and was formerly used as commercial on the first floor and residences on the second and third floors. Recognized environmental conditions (RECs) were not identified. Non-ASTM considerations were also noted and included the possible presence of ACM and lead-based paint (LBP) based on the age of the buildings.

A Phase I ESA was conducted for the properties located at 1000 – 1004 South 4th Street by Impact 7G dated February 28, 2018. The report indicated that the buildings were constructed between 1864 and 1900 and were formerly used as commercial on the first floor and residences on the second and third floors. RECs were identified and included the following: a vent pipe, typically seen in conjunction with USTs, was observed in the basement of 1000 South 4th Street and was presumed to be a former heating oil UST; a brick lined cistern was identified in the basement of the 1000 South 4th Street building; and the adjacent property to the west was occupied by an auto repair shop from 1987-1992. Non-ASTM considerations were also noted and included the possible presence of ACM and LBP based on the age of the buildings.

Impact 7G completed a Phase II ESA for the properties located at 1000 – 1006 South 4th Street dated December 12, 2018. Five soil borings were advanced and soil samples were collected for analysis of Resource Conservation and Recovery Act (RCRA) metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and total extractable hydrocarbons (TEH). Groundwater samples were not collected due to lack of water volume. The soil samples did not have contaminants of concern above the Iowa SWS and/or above the laboratory detection limit. Based on the analytical results, further action was not recommended.

An Asbestos Inspection Report was prepared by Environmental Management Services of Iowa, Inc. (EMSI) for the buildings located at 1010 – 1012 South 4th Street detailing an ACM inspection that was conducted on April 29, 2022. The report identified roofing materials, floor tile, and linoleum in the Site building as ACM. The south and southwest portions of the second and third floors were not able to be inspected due to severe deterioration of the structure. The report concluded the Site building would need to be demolished as a Regulated ACM (RACM) project by a demolition contractor with an Iowa Asbestos Contractor Permit.

A Phase I ESA was conducted for the properties located at 413 10th Avenue South and 1000 South 4th Street by Blackstone dated June 20, 2022. The 413 10th Avenue South building is not included in the cleanup and is therefore not included in this discussion. The report concluded that although a Phase II ESA had been conducted, the soil samples were over 40 feet from the suspect UST and cistern and the Phase II ESA had not adequately assessed the concerns. Further assessment of the suspect UST and cistern were recommended. However, based on the location of the UST and cistern, it was not possible to assess the UST further as there was limited access in the basement, there are sidewalks around the building that are raised with thick concrete around the building, and accessible boring locations would be too far from the UST to assess it properly. It was proposed that the UST and cistern be assessed once the building has been demolished.

A Phase I ESA was conducted for the properties located at 1010 - 1012 South 4th Street by Blackstone dated August 12, 2022. The report indicated the property was developed with a three-story building constructed in 1912. RECs were not identified. Non-ASTM considerations were noted and included the presence of ACM and possible LBP. Removal of ACM prior to demolition or disposal of building materials as regulated RACM was recommended.

On September 23, 2002, Willett Hofmann & Associates, Inc. prepared letter reports for the buildings located at 1002 - 1012 South 4th Street, indicating that an Iowa licensed engineer had inspected the buildings to provide recommendations to whether the property is safe to enter for asbestos mitigation. The engineer indicated that the buildings were in severe disrepair, were beyond the point of repair, and unsafe to enter.

A Phase I ESA was conducted for the property located at 1000 South 4th Street by Blackstone dated August 24, 2023. The report identified RECs that include the presence of a suspected UST, the former use of the adjacent building located at 413 10th Avenue South as auto repair, and the possible presence of a vapor encroachment condition.

Permitting to remove ACM and/or disposal of building materials as RACM is required by Iowa Department of Natural Resources (IDNR). However, ACM removal and/or disposal of building materials as RACM is not regulated under the Iowa Land Recycling program (LRP; Iowa's voluntary cleanup program) and has therefore not been entered into the LRP.

Records were not identified indicating the possible UST was registered with the IDNR Tank Section. If the UST is identified and determined to contain or formerly contained regulated petroleum products, the UST will be registered. The UST will be removed under IDNR protocols whether or not it is required to be registered.

d. Project Goal

The planned reuse for the Site is as a commercial area.

II. Applicable Regulations and Cleanup Standards

a. Cleanup Oversight Responsibility

The asbestos cleanup will be conducted under the oversight of the IDNR and Iowa Occupational Safety and Health Administration (IOSHA). A licensed Asbestos Contractor/Supervisor and/or an Asbestos Inspector will be onsite to oversee the demolition.

If an UST is identified on the Site, the UST removal will be conducted by an Iowa Certified UST Remover under the oversight of an Iowa Certified Groundwater Professional (CGP) and the IDNR UST Section. Based on the location in the basement of the 1000 South 4th Street building, the suspected UST is assumed to have contained heating oil. Heating oil USTs are exempt from regulation under IDNR. However, if the UST is determined to have contained heating oil, the removal will generally follow the IDNR UST Section guidelines for removal.

b. Cleanup Standards for Major Contaminants

The standards to be used for the ACM are Iowa Administrative Codes 88B and 155 and the EPA National Emission Standards for Hazardous Air Pollutants (NESHAP).

Cleanup standards for the UST removal, if present, would be the IDNR Tier 1 levels as presented in the Iowa Administrative Code 567, chapter 135.

c. Laws & Regulations Applicable to the Cleanup

Laws and regulations that are applicable to this cleanup include:

- The Federal Small Business Liability Relief and Brownfields Revitalization Act
- Federal Davis-Bacon Act
- Title 29, Code of Federal Regulations, Sections 1910.120, 1910.1001, 1910.134, 1910.2, 1910.1200 and 1926.58. Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.
- Title 40, Code of Federal Regulations, Part 61, Subparts A and M, National Emission Standards for Hazardous Air Pollutants, EPA.
- Title 40, Code of Federal Regulations, Part 763, Subparts E and G, Asbestos Abatement Project.
- Chapter 88B of the Code of Iowa, Removal or Encapsulation of Asbestos.
- Chapter 81 of the Iowa Administrative Code, Asbestos Control Procedures, Iowa Bureau of Labor.

- Iowa Bureau of Labor Guidelines for removal of non-friable ACM, e.g., floor tile, roofing, etc.
- IAC 567, 455B, Jurisdiction of Department of Natural Resources.
- IAC 567, 455B, Chapter 133, Rules for Determining Cleanup Actions and Responsible Parties.
- IAC 567, 455B, Chapter 134, UST Licensing and Certification Programs.
- IAC 567, 455B, Chapter 135, Technical Standards and Corrective Action Requirements for Owners and Operators of USTs.

Federal, state, and local laws regarding procurement of contractors to conduct the cleanup will be followed. In addition, appropriate permits (e.g., notify state before demolition, fees to state and/or local agencies, transport/disposal manifests) will be obtained prior to the work commencing.

III. Evaluation of Cleanup Alternatives

a. Cleanup Alternatives Considered

To address ACM contamination at the Site, three different alternatives were considered, including Alternative #1: No Action; Alternative #2: Asbestos Abatement and Demolition; Alternative #3: Demolition without Abatement and Disposal.

To address possible contamination at the Site from the suspected UST, three different alternatives were considered, including Alternative #1: No Action; Alternative #2: Fill In Place; Alternative #3: UST Removal.

b. Cost Estimate of Cleanup Alternatives

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

ACM Contamination

<u>Effectiveness</u>

- **Alternative #1: No Action** is not effective in controlling or preventing the exposure of receptors to contamination from the known and suspected asbestos at the Site or surrounding areas. The buildings located at 1000, 1002, 1004, and 1006 - 1008 South 4th Street have been demolished and the building materials are stockpiled on the Site. The stockpile has been covered but the debris must be disposed to remove the ACM, to protect against exposure to asbestos, and to satisfy IDNR regulations. Cover maintenance and continued air monitoring would be required to protect the public. This maintenance would need to be conducted continuously until the stockpile was removed as required by the IDNR.

The building located at 1010 - 1012 South 4th Street is severely deteriorated and has been deemed unsafe to enter and structurally unsound. Asbestos has been identified in the portion of the building that could be accessed. The No Action alternative would not be effective in preventing exposure to asbestos from this building.

- **Alternative #2: Asbestos Abatement and Demolition** is an effective way to remove ACM and prevent exposure to receptors. However, the building located at 1010 – 1012 South 4th Street is severely deteriorated and has been deemed structurally unsound by a structural engineer. Because of this designation, abatement is not possible without risking the safety of workers. Abatement of the debris from the demolition of the 1000, 1002, 1004, and 1006 - 1008 South 4th Street buildings is not possible as all materials in the debris pile are assumed to contain asbestos. The covered stockpile must be disposed to remove the ACM, to protect against exposure to asbestos, and to satisfy IDNR regulations. Cover maintenance and continued air monitoring would be required to protect the public. This maintenance would need to be conducted continuously until the stockpile was removed as required by the IDNR. Therefore, as asbestos abatement is not safe or possible, it would not be effective in removing the asbestos exposure risk.

- **Alternative #3: Demolition without Discrete Abatement** is a safer and more effective way to eliminate risk at the Site from ACM. The building debris from the buildings located at 1000, 1002, 1004, and 1006 - 1008 South 4th Street have been stockpiled and will be removed by heavy equipment, loaded into trucks, and hauled away for disposal as Regulated Asbestos Containing Materials (RACM). The building located at 1010 – 1012 South 4th Street will be demolished, and the materials will be disposed of as RACM. Once the removal is complete, the excavations will be backfilled with soil, pea rock, or other compactable materials. The removal of the debris stockpile and the demolition of the 1010 – 1012 South 4th Street building without abatement is the safest and most effective option to remove the exposure risk.

Feasibility

- **Alternative #1: No Action** is easy to implement since no actions will be conducted.

- **Alternative #2: Asbestos Abatement and Demolition** would be very difficult to impossible to implement. The building located at 1010 – 1012 South 4th Street has been deemed unsafe to enter and the remaining buildings have been demolished with the debris stockpiled. ACM abatement could not be conducted in the building without risking the safety of the abatement contractors. Abatement of the debris from the demolition of the 1000, 1002, 1004, and 1006 - 1008 South 4th Street buildings is not possible as all materials have been combined and are assumed to contain asbestos. This alternative is considered the most difficult to implement.

- **Alternative #3: Demolition without Discrete Abatement** is moderately difficult to implement. Coordination (e.g., dust suppression and monitoring) during cleanup activities and short-term disturbance to the community (e.g., trucks transporting contaminated building materials) are anticipated. However, the removal and disposal of the building materials will remove the risk of asbestos exposure and is the most feasible alternative.

Cost

- There would be no costs associated under **Alternative #1: No Action** with the exception of the maintenance of the stockpile cover and continued air monitoring. This cost is estimated at $31,800 for six months. Costs would continue to accrue until the stockpile material is removed. This estimate includes the following:
  - Weekly sampling - $1,250 (six-month total - $30,000)
  - Daily cover check (price per week) - $75 (six-month total $1,800)

- Because it is not possible to implement safely, there are no costs associated with **Alternative #2: Asbestos Abatement and Demolition**. However, maintenance of the stockpile cover and continued air monitoring would cost approximately $31,800 for six months. Costs would continue to accrue until the stockpile material is removed. This estimate includes the following:
  - Weekly sampling - $1,250 (six-month total - $30,000)
  - Daily cover check (price per week) - $75 (six-month total $1,800)

- **Alternative #3:** Based on initial costs estimates obtained (not publicly bid but obtained for purposes of budgeting) and estimated emergency response costs, **Demolition without Discrete Abatement** is estimated to cost approximately $900,000. This estimate includes costs incurred as well as the proposed cleanup going forward. The following is included in the estimate:
  - Initial Demolition overseen by Iowa Licensed Asbestos Abatement Contractor (tear down of remains of collapsed building and attached buildings located at 1000, 1002, and 1004 South 4th Street and stockpile materials) - $140,000
  - Asbestos air sampling - $18,200
  - Weekly sampling - $1,250 (six-month total - $30,000)
  - Daily cover check (price per week) - $75 (six-month total $1,800)
  - ABCA, Cleanup Plan/Demolition Plan, QAPP, and Initial Demolition Report - $30,000
  - Building demolition and debris stockpile removal with QEP oversight - $680,000

UST Removal

Effectiveness

- **Alternative #1: No Action** is not effective in controlling or preventing the exposure of receptors to contamination from the suspected UST at the Site or surrounding areas.

- **Alternative #2: Fill-In-Place** is an effective way to address the hazard of the UST. The As part of closure, the UST would be cleaned and filled with mortar. This would remove the source of impacts, if any. However, fill in place is only allowed in Iowa when removal of the UST is hazardous due to utilities or other barriers or when it compromises the structure. Since the 1000 South 4th Street building has been demolished, the removal of the UST will not affect the integrity of the structure and would be required to be removed.

- **Alternative #3: UST Removal** is a safer and more effective way to eliminate risk at the Site from the suspected UST. The removal will remove the source of contamination, if any.

Feasibility

- **Alternative #1: No Action** is easy to implement since no actions will be conducted. However, if the UST is determined to contain petroleum products other than heating oil, the IDNR UST Section requires out-of-service UST systems to be properly closed which means no action would not be legally permitted.

- **Alternative #2: Fill-In-Place** would be moderately difficult to implement once the building is demolished. Based on the location in the basement of the building, accessing the suspected UST would pose some challenges. The collection of samples of native soils from around the UST would be difficult as a drill rig would be needed to collect the samples and there may not be a way to get the drill rig into the basement. Coordination during cleanup activities and short-term disturbance to the community (e.g., trucks transporting the fill for the UST) are anticipated. Additionally, fill-in-place of USTs is only allowed in Iowa when removal of the UST is hazardous due to utilities or other barriers or when it compromises the structure. Since the 1000 South 4th Street building has been demolished, the removal of the UST will not affect the integrity of the structure and would be required to be removed. Additionally, new development is planned for the area and the filled in place UST may be a hinderance to the foundation of the new construction. This alternative is considered the most difficult to implement.

- **Alternative #3: UST Removal** would be slightly difficult to implement once the building is demolished. Based on the location in the basement of the building and that the suspected tank is beneath concrete, accessing this area may be difficult. However, excavators can generally reach between 20 to 30 feet and long-reach excavators can reach 30 to 60 feet, which should be sufficient to reach the UST and surrounding soils. Coordination during cleanup activities and short-term disturbance to the community (e.g., trucks transporting the UST) are anticipated. However, removing the UST would remove the risk of contamination from the UST.

Cost

- There would be no costs under **Alternative #1: No Action**.

- **Alternative #2: Fill-In-Place** is estimated to cost approximately $25,000. This estimate includes the following:
    - Iowa Licensed UST Removal Contractor - $10,000
    - Oversight of a Certified Groundwater Professional (CGP) - $2,000
    - IDNR required soil and groundwater sampling - $8,000
    - UST Fill-In-Place report - $5,000

- **Alternative #3: UST Removal** is estimated to cost approximately $30,000. This estimate includes the following:

- Iowa Licensed UST Removal Contractor - $15,000
- Oversight of a Certified Groundwater Professional (CGP) - $2,000
- IDNR required soil and groundwater sampling - $8,000
- UST Closure report - $5,000

c. Recommended Cleanup Alternative

ACM Contamination

The recommended cleanup alternative is Alternative #3: Demolition without Discrete Abatement. Alternative #1: No Action cannot be recommended since it does not address Site risks and does not comply with IDNR regulations. Alternative #2: Asbestos Abatement and Demolition cannot be recommended due to safety issues and does not comply with IDNR regulations. Alternative #3 is the safest and most cost-effective alternative to remove the ACM and is the recommended alternative.

UST Removal

The recommended cleanup alternative is Alternative #3: UST Removal. Alternative #1: No Action cannot be recommended since it does not address Site risks. Alternative #2: Fill in Place cannot be recommended due to access issues and possible requirements for removal by the IDNR. Alternative #3 is the recommended alternative to remove the potential hazard and comply with IDNR requirements.

Green and Sustainable Remediation Measures for Selected Alternatives:

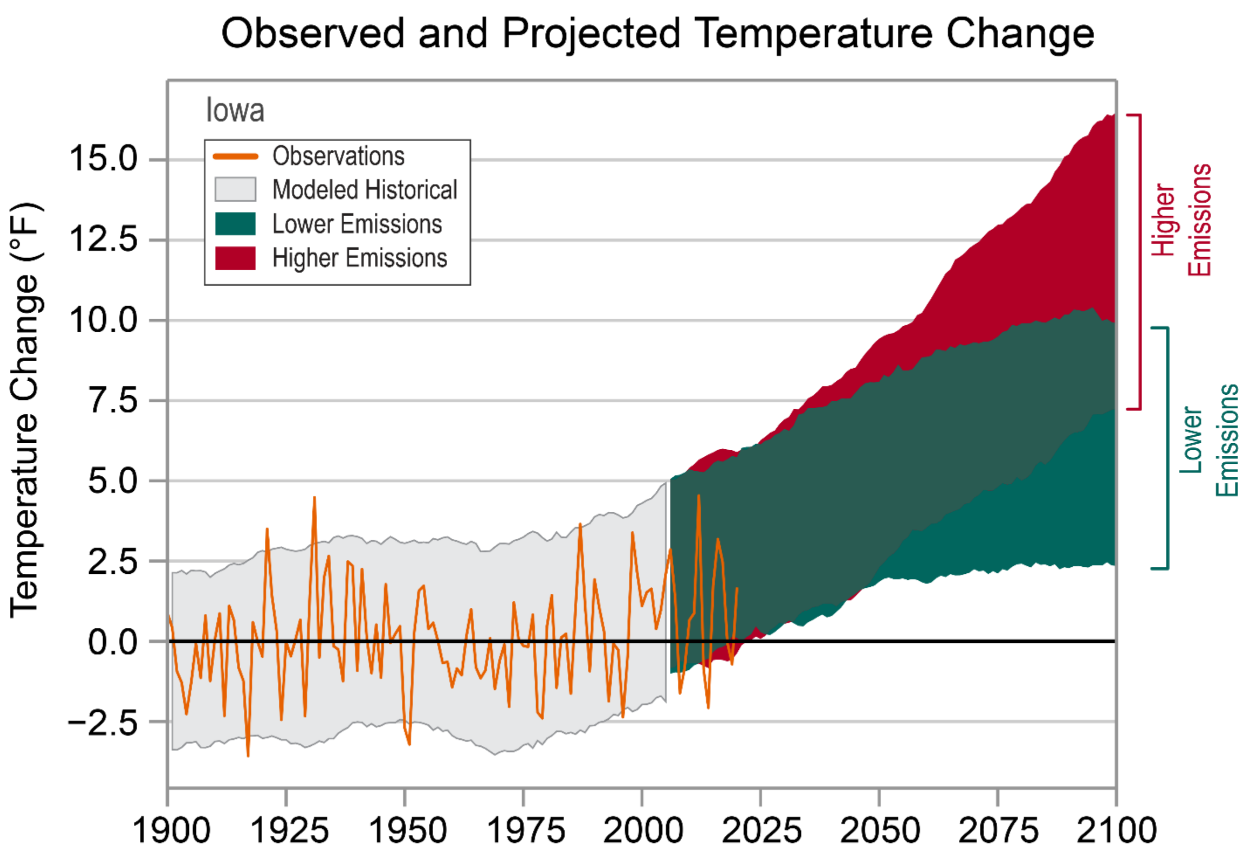
To make the selected alternatives greener, or more sustainable, several techniques are planned. The most recent Best Management Practices (BMPs) issued under ASTM Standard E-2893: Standard Guide for Greener Cleanups will be used as a reference in this effort. The City of Clinton will require the cleanup contractor to follow an idle-reduction policy and recommend the use of heavy equipment with advanced emissions controls operated on ultra-low sulfur diesel. The number of mobilizations to the Site would be minimized. In addition, the City plans to ask bidding contractors to propose additional green remediation techniques in their response to the Request for Proposals.

Attachment A – NOAA Summary

NOAA National Centers for Environmental Information

IOWA

Figure 1



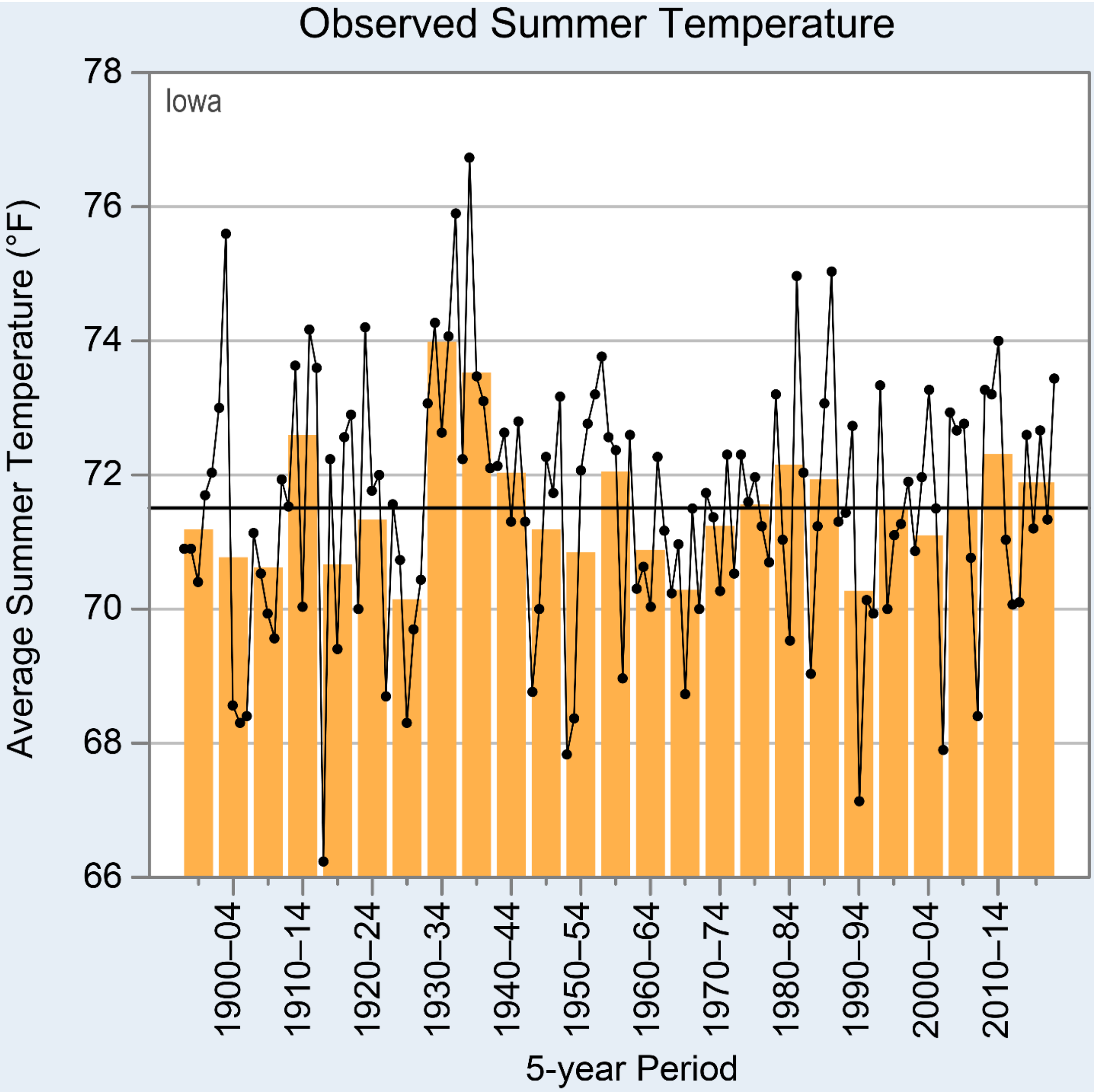
Time series of observed and projected temperature change (in degrees Fahrenheit) for Iowa from 1900 to 2100 as described in the caption. Y-axis values range from minus 4.6 to positive 17.5 degrees. Observed annual temperature change from 1900 to 2020 shows variability and ranges from minus 3.6 to 4.5 degrees. By the end of the century, projected increases in temperature range from 2.4 to 9.9 degrees under the lower emissions pathway and from 7.2 to 16.5 degrees under the higher pathway.

Iowa’s location in the interior of North America and the lack of mountains to the north and south expose the state to incursions of bitterly cold air masses from the Arctic in the winter and warm, humid air masses from the Gulf of Mexico in the summer. As a result, its climate is characterized by wide-ranging temperatures.

Temperatures in Iowa have risen more than 1°F since the beginning of the 20th century (Figure 1). Temperatures in the 2000s have been higher than in any other historical period, with the exception of the early 1930s Dust Bowl era. The warming is due to increases in nighttime minimum temperatures; daytime maximum temperatures, however, show no trend. Increases in humidity may be one cause of this asymmetric warming between night and day. The hottest year on record was 2012, with an annual average temperature of 52.1°, which is 4.5°F above the long-term (1895–2020) average. Warming has been concentrated in winter and fall, while summers have not warmed substantially (Figure 2a), a feature characteristic of much of the Midwest. This lack of summer warming is reflected in a below average number of very hot days (Figure 2b) and no overall trend in warm nights (Figure 2c). The winter warming trend is reflected in a below average number of very cold nights since 1990, with the exception of the 2010–2014 period (Figure 2d).

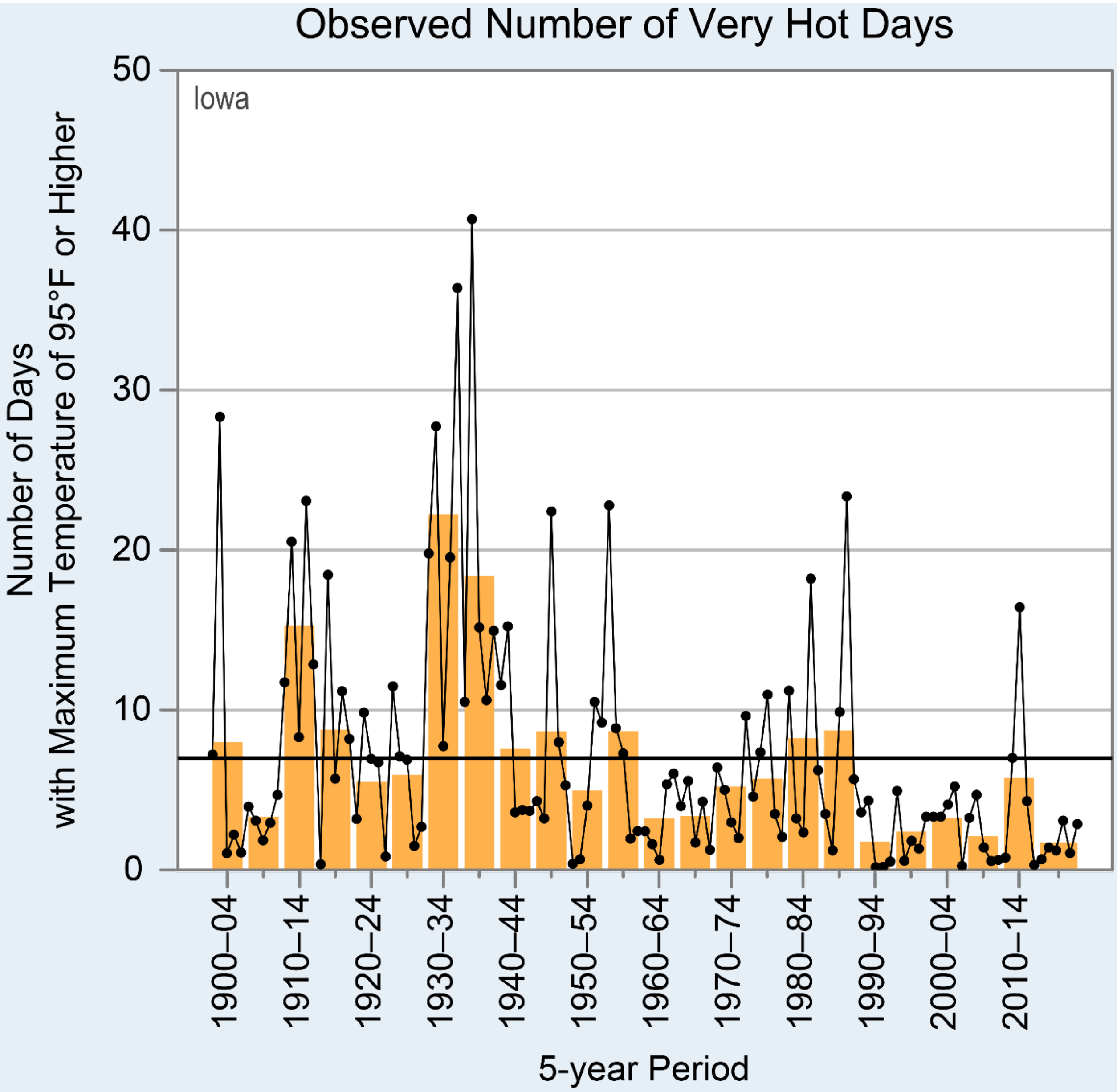
Figure 2

a)



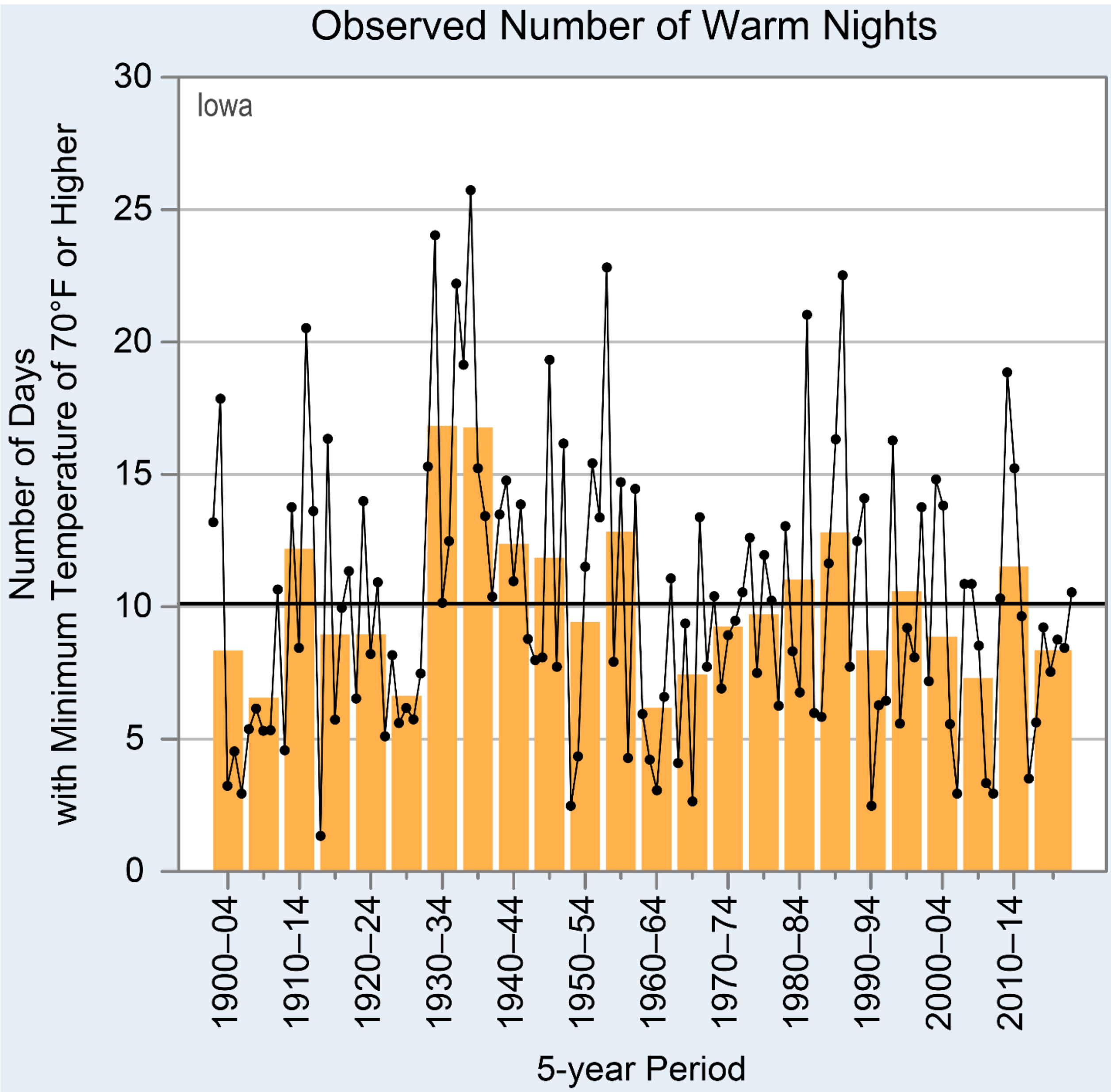
Graph of the observed summer average temperature for Iowa from 1895 to 2020 as described in the caption. Y-axis values range from 66 to 78 degrees Fahrenheit. Annual values show year-to-year variability and range from about 66 to 77 degrees. Multiyear values also show variability and are mostly near or below the long-term average of 71.5 degrees across the entire period. Exceptions include the 1930 to 1934 and 1935 to 1939 periods, which are well above average and have the two highest multiyear values, and the 2010 to 2014 and 2015 to 2020 periods, which are above average. The 1925 to 1929 period has the lowest multiyear value.

b)



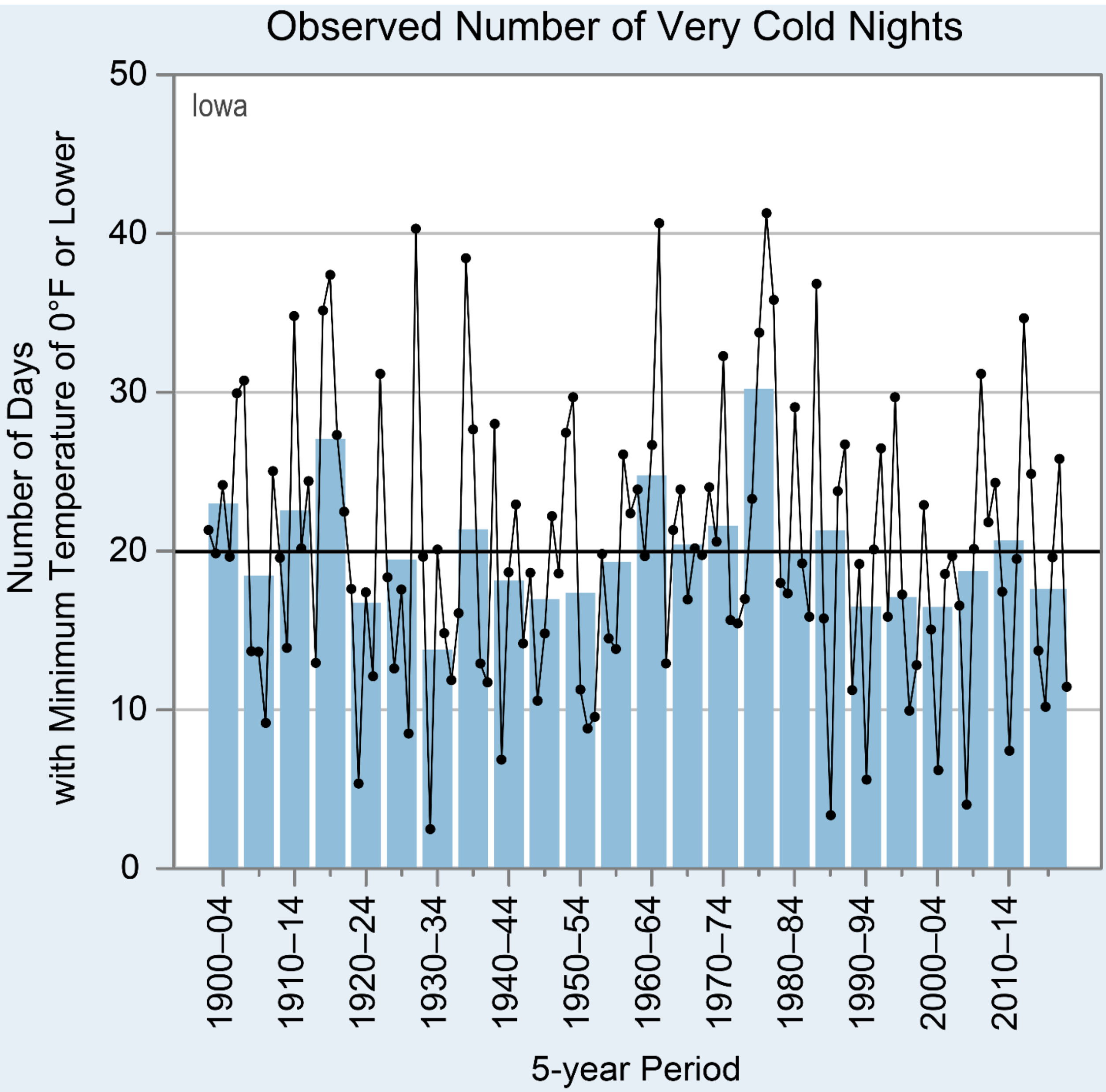
Graph of the observed annual number of very hot days for Iowa from 1900 to 2020 as described in the caption. Y-axis values range from 0 to 50 days. Annual values show year-to-year variability and range from 0 to about 41 days. Multiyear values also show variability and are mostly near or above the long-term average of 7 days between 1900 and 1959. The 1930 to 1934 and 1935 to 1939 periods are well above average and have the highest multiyear values, more than double the long-term average. With the exception of multiyear periods of the 1980s, multiyear values are all below average since 1960. The 1990 to 1994 and 2015 to 2020 periods have the lowest multiyear values.

c)



Graph of the observed annual number of warm nights for Iowa from 1900 to 2020 as described in the caption. Y-axis values range from 0 to 30 nights. Annual values show year-to-year variability and range from about 1 to 26 nights. Multiyear values also show variability and are mostly below the long-term average of 10 nights between 1900 and 1929 but are mostly above average between 1930 and 1959. Since 1960, multiyear values show no clear trend but are mostly near or below average. The 1960 to 1964 period has the lowest multiyear value, and the 1930 to 1934 and 1935 to 1939 periods, which are well above average, have the highest.

d)



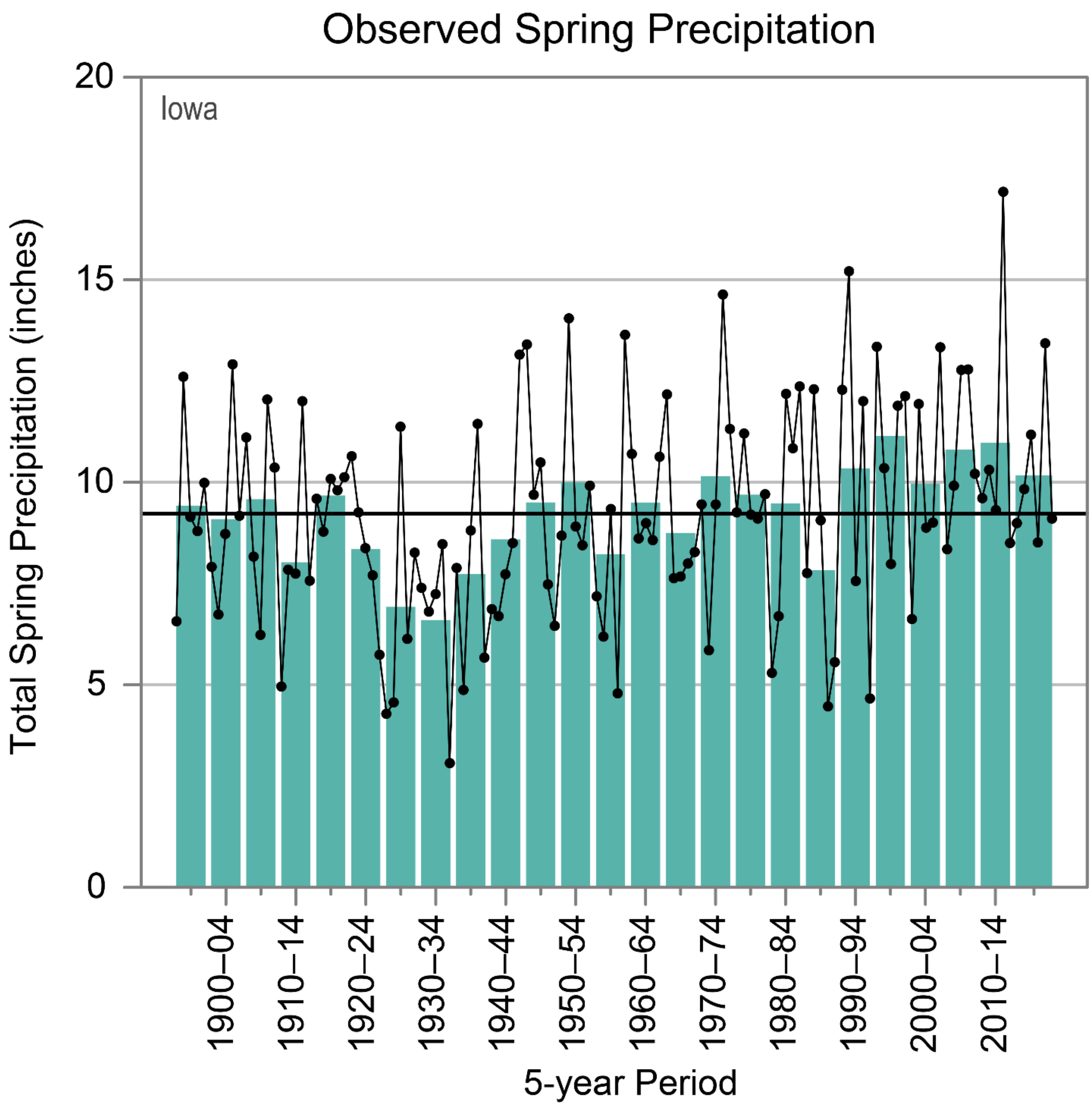
Graph of the observed annual number of very cold nights for Iowa from 1900 to 2020 as described in the caption. Y-axis values range from 0 to 50 nights. Annual values show year-to-year variability and range from about 2 to 41 nights. Multiyear values also show variability and are mostly near or below the long-term average of 20 nights across the entire period. Exceptions include the 1915 to 1919 and 1975 to 1979 periods, which are above and well above average, respectively, and have the highest multiyear values. The 1930 to 1934 period has the lowest multiyear value.

Figure 2: Observed (a) summer (June–August) average temperature, (b) annual number of very hot days (maximum temperature of 95°F or higher), (c) annual number of warm nights (minimum temperature of 70°F or higher), and (d) annual number of very cold nights (minimum temperature of 0°F or lower) for Iowa from (a) 1895 to 2020 and (b, 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) 71.5°F, (b) 7 days, (c) 10 nights, (d) 20 nights. Summer temperatures have generally been near average since 1995. The number of very hot days has been below average since 1990, while the number of warm nights shows no clear trend. Due to extreme drought and poor land management practices, the summers of the 1930s remain the warmest on record. The number of very cold nights has been below average since 1990, except for the 2010–2014 period. Sources: CISESS and NOAA NCEI. Data: (a) nClimDiv, (b, c, d) GHCN-Daily from 49 long-term stations.

Precipitation varies widely across Iowa, with the southeastern portion of the state receiving around 38 inches annually compared to only 26 inches in the northwest. Much of Iowa’s precipitation falls in summer, averaging about 14 inches in the central part of the state. Spring precipitation has been above average since 1990 (Figure 3a), which can make it difficult for farmers to plant crops. Summer and annual precipitation has also been above average since 2005 (Figures 3b and 4), which has benefited crop production but also increased flooding. Iowa’s planting season, which runs from April into June, has been particularly wet in recent years, averaging about 2.8 inches above the long-term average of 12 inches since 2008. Statewide annual precipitation has ranged from a low of 20.2 inches in 1910 to a high of 47.9 inches in 1993. Snowfall also varies across the state, ranging from more than 40 inches in the north to about 20 inches in the south. For most of the state, more than 40% of the annual precipitation occurs on the 10 wettest days of the year, a percentage that rises to more than 48% in the western portion. **The**

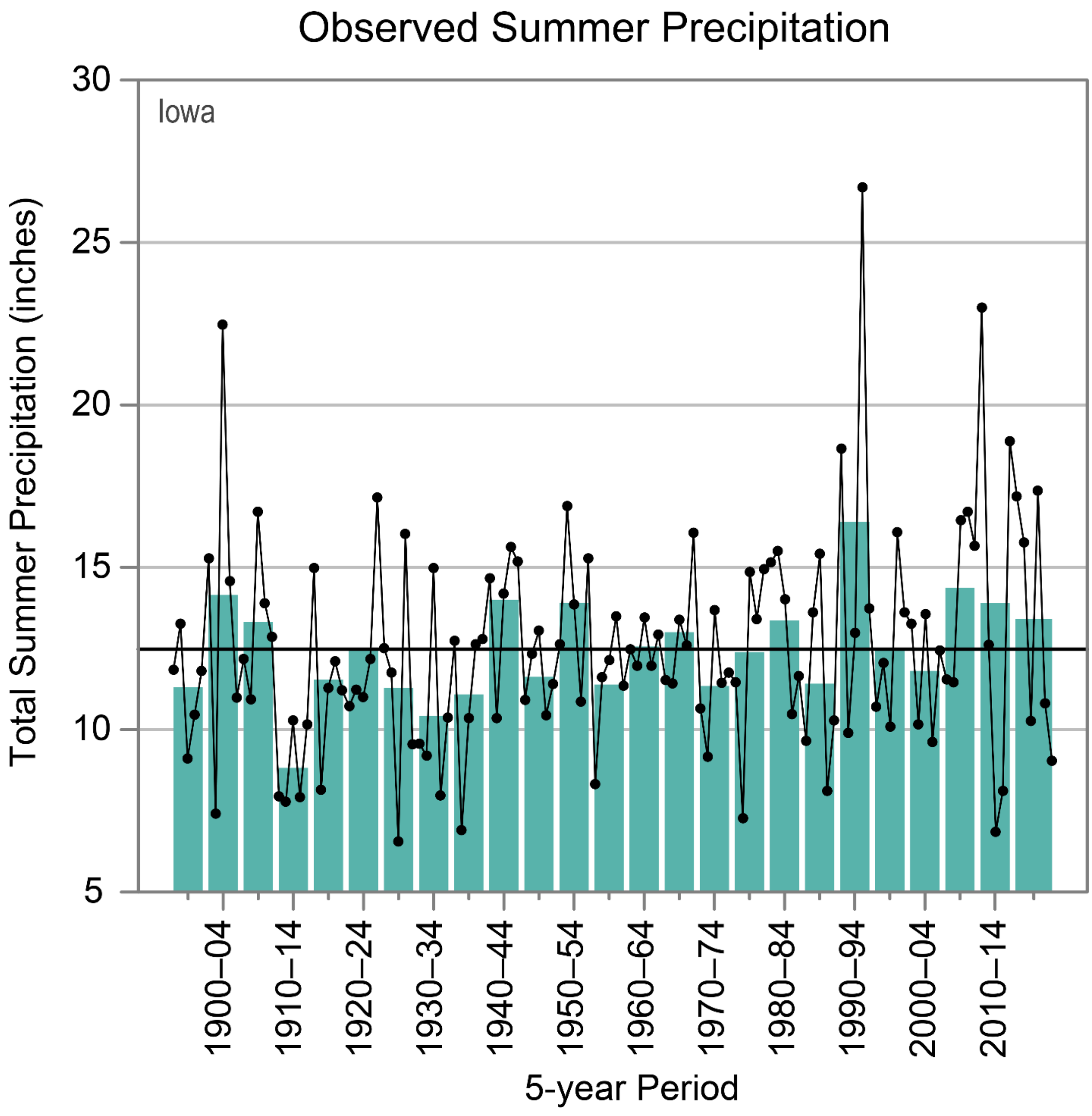
frequency of 2-inch extreme precipitation events has increased, with the highest number occurring during the past 16 years (Figure 5).

a)



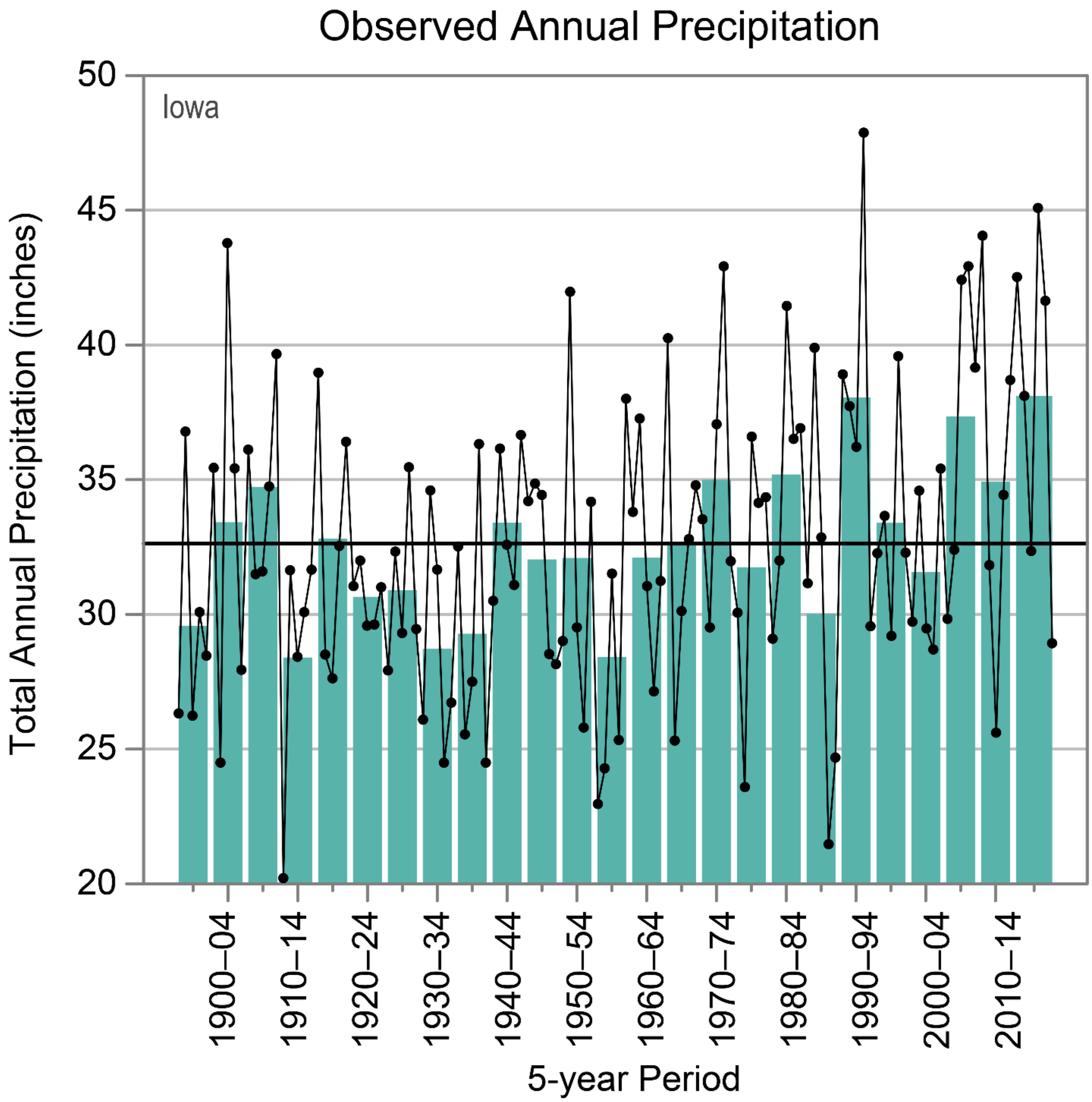
Graph of the observed total spring precipitation for Iowa from 1895 to 2020 as described in the caption. Y-axis values range from 0 to 20 inches. Annual values show year-to-year variability and range from about 3 to 17 inches. Multiyear values also show variability and are mostly near or below the long-term average of 9.2 inches between 1895 and 1989 but are all above average since 1990. The 1930 to 1934 period has the lowest multiyear value and the 1995 to 1999 period the highest.

b)



Graph of the observed total summer precipitation for Iowa from 1895 to 2020 as described in the caption. Y-axis values range from 5 to 30 inches. Annual values show year-to-year variability and range from about 7 to 27 inches. Multiyear values also show variability and are mostly near or below the long-term average of 12.5 inches between 1895 and 1989, but, with the exception of the 2000 to 2004 period, they are all near or above average since 1990. The 1910 to 1914 period, which is well below average, has the lowest multiyear value, and the 1990 to 1994 period, which is well above average, has the highest.

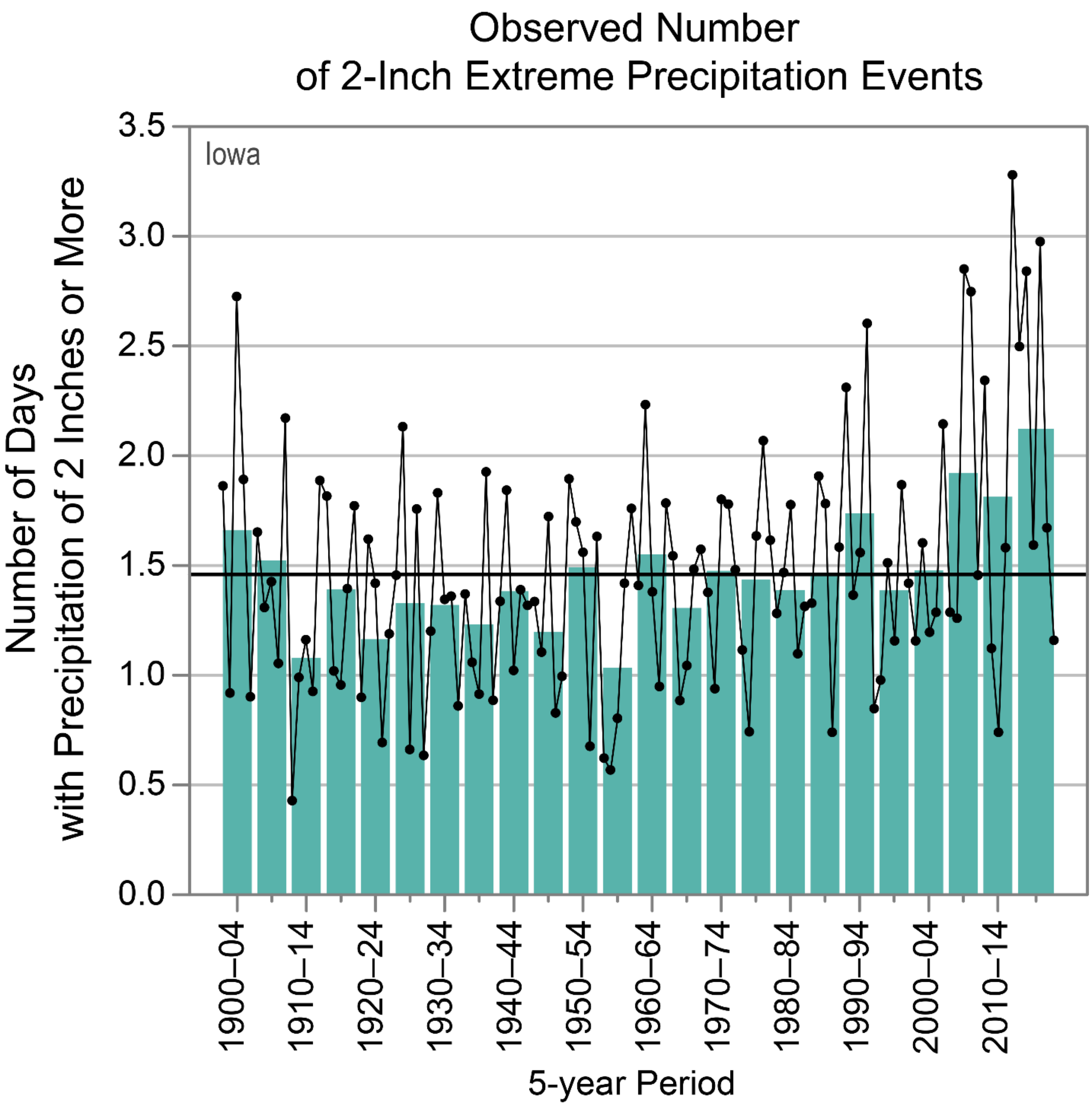
Figure 3: Observed (a) total spring (March–May) and (b) total summer (June–August) precipitation for Iowa from 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages: (a) 9.2 inches and (b) 12.5 inches. Spring and summer precipitation has been above average since 1990 and 2005, respectively. Sources: CISESS and NOAA NCEI. Data: nClimDiv.



Graph of the observed total annual precipitation for Iowa from 1895 to 2020 as described in the caption. Y-axis values range from 20 to 50 inches. Annual values show year-to-year variability and range from about 20 to 48 inches. Multiyear values also show variability and are mostly near or below the long-term average of 32.6 inches between 1895 and 1969. Since 1970, multiyear values show no clear trend but are mostly above average. The 1910 to 1914 and 1955 to 1959 periods have the lowest multiyear values, and the 1990 to 1994 and 2015 to 2020 periods, which are well above average, have the highest.

Figure 4: Observed total annual precipitation for Iowa from 1895 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 32.6 inches. Annual precipitation over the past 16 years has generally been several inches above average. The wettest consecutive 5-

year interval was 2006–2010, while the driest was 1952–1956. Sources: CISESS and NOAA NCEI. Data: nClimDiv.



Graph of the observed annual number of 2-inch extreme precipitation events for Iowa from 1900 to 2020 as described in the caption. Y-axis values range from 0 to 3.5 days. Annual values show year-to-year variability and range from 0.4 to 3.3 days. Multiyear values also show variability and are mostly near or below the long-term average of 1.5 days between 1900 and 1989. Since 1990, multiyear values are all near or above average. The 1955 to 1959 period has the lowest multiyear value, and the 2015 to 2020 period, which is well above average, has the highest.

Figure 5: Observed annual number of 2-inch extreme precipitation events (days with precipitation of 2 inches or more) for Iowa 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 1.5 days. A typical station experiences 1 to 2 events per year. Multiyear averages since 2005 are the highest in the historical record. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 45 long-term stations.

Agriculture is an important sector of Iowa's economy and is particularly vulnerable to extreme weather conditions. Both flooding and droughts have resulted in billions of dollars in losses in recent years. Following abnormally dry conditions in 2011, Iowa experienced severe drought conditions in 2012 and then very dry conditions again in 2013. Below average rainfall totals for the critical growth months of July and August were 6.4, 4.1, and 3.2 inches in 2011, 2012, and 2013, respectively (the long-term average for July–August rainfall is 7.8 inches). This 3-year period was unlike any other 3-year period dating back to 1895 and superseded the dry years of the Dust Bowl era. By the end of September 2012, much of the state was in extreme drought, with portions in the northwest experiencing exceptional drought conditions extending into 2013.

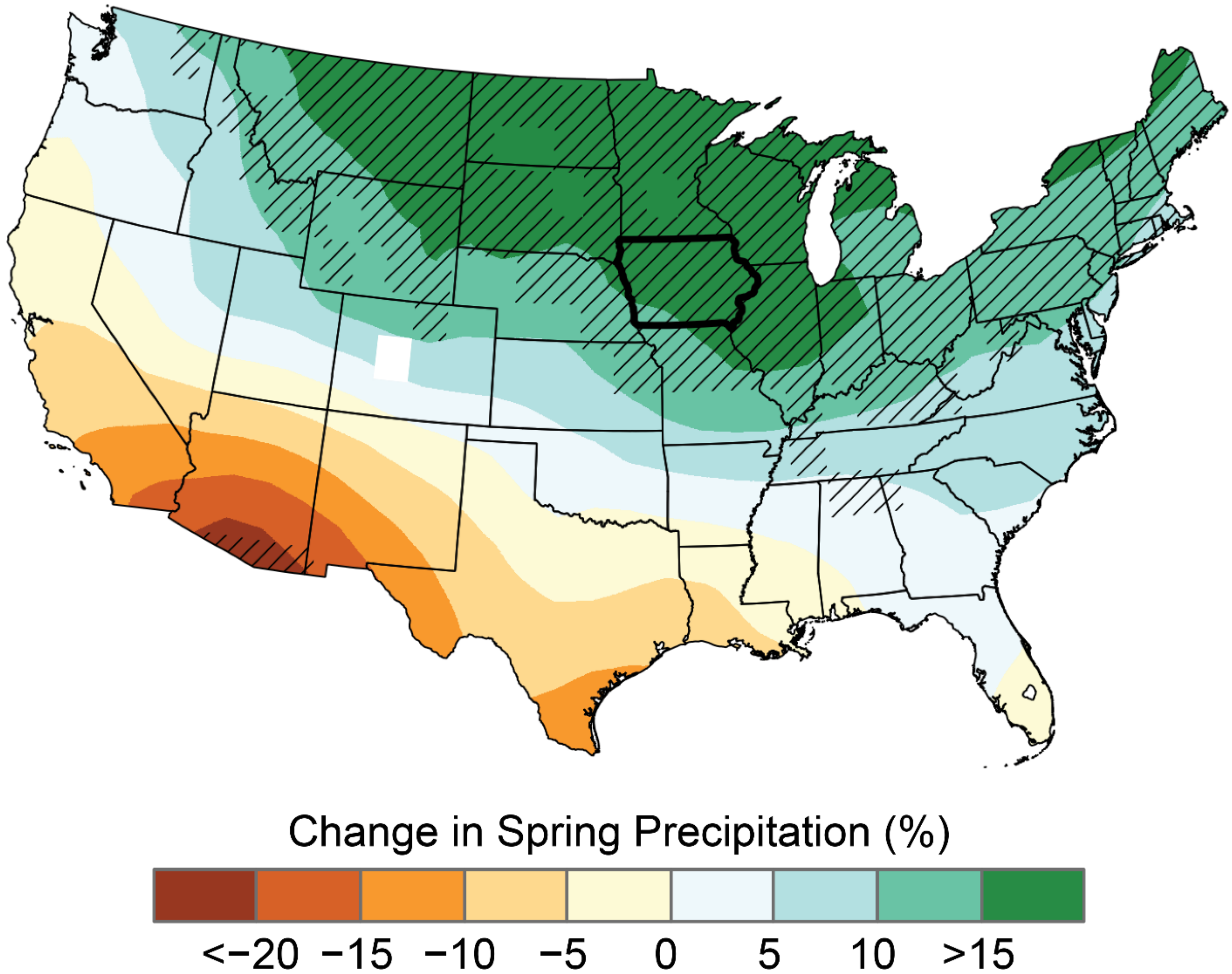
Thousands of miles of rivers flow through Iowa, which is bordered by the Mississippi River to the east and the Big Sioux and Missouri Rivers to the west. **With many of these waterways located alongside cities and farmland, flooding is a severe hazard**. From 1955 to 1997, Iowa was ranked first in state losses due to flooding. During the first two weeks of June 2008, heavy rainfall on soil already saturated from unusually wet conditions caused record flooding along multiple rivers. Numerous long-term stations reported more than 10 inches during the 2-week period, and levels on the Cedar River exceeded the previous record by more than 11 feet. Of the state's 99 counties, 83 were declared disaster areas, and damages were estimated at almost $10 billion. Snowmelt, as well as ice jams, can also cause flooding. In June 2011, runoff from a record winter snowpack in the Rocky Mountains accompanied by heavy rains caused major flooding along the entire length of the Missouri River. The region around Hamburg was particularly hard hit, where levee failures forced evacuation of the town and farmland flooding caused extensive agricultural losses.

Iowa experiences damaging storms during all seasons. During winter months, snowstorms and ice storms are a frequent hazard. During December 8–9, 2009, a strong storm produced heavy snowfall across the state, with multiple long-term stations reporting more than 15 inches. Wind gusts of more than 50 mph produced large snow drifts and caused widespread whiteout conditions. The blizzard conditions were compounded by bitter cold on December 9, with temperatures below 10°F and wind chills below 0°F across large portions of the state. Thunderstorms capable of producing floods, hail, and tornadoes are common in the warmer months. On May 25, 2008, an EF-5 tornado killed 8 people and destroyed nearly 200 homes in Parkersburg. This was the strongest tornado to hit the state since June 13, 1976. One of the most destructive thunderstorms to ever affect the state occurred on August 10, 2020. A powerful derecho produced widespread winds greater than 100 mph, causing extensive damage to millions of acres of corn and soybean crops across central Iowa and severe damage to homes, businesses and vehicles, particularly in Cedar Rapids.

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 historical records. Intense heat waves can occur in Iowa, often accompanied by high humidity. Heat waves are projected to become more intense, and impacts on human health could be significant. However, cold waves are projected to be less intense.

Increases in precipitation are projected for Iowa, most likely during the winter and spring (Figure 6). Increases in the frequency and intensity of extreme precipitation are also projected, potentially increasing the frequency and intensity of floods. Springtime flooding in particular could pose a threat to Iowa’s important agricultural economy by delaying planting and reducing yields.

Projected Change in Spring Precipitation

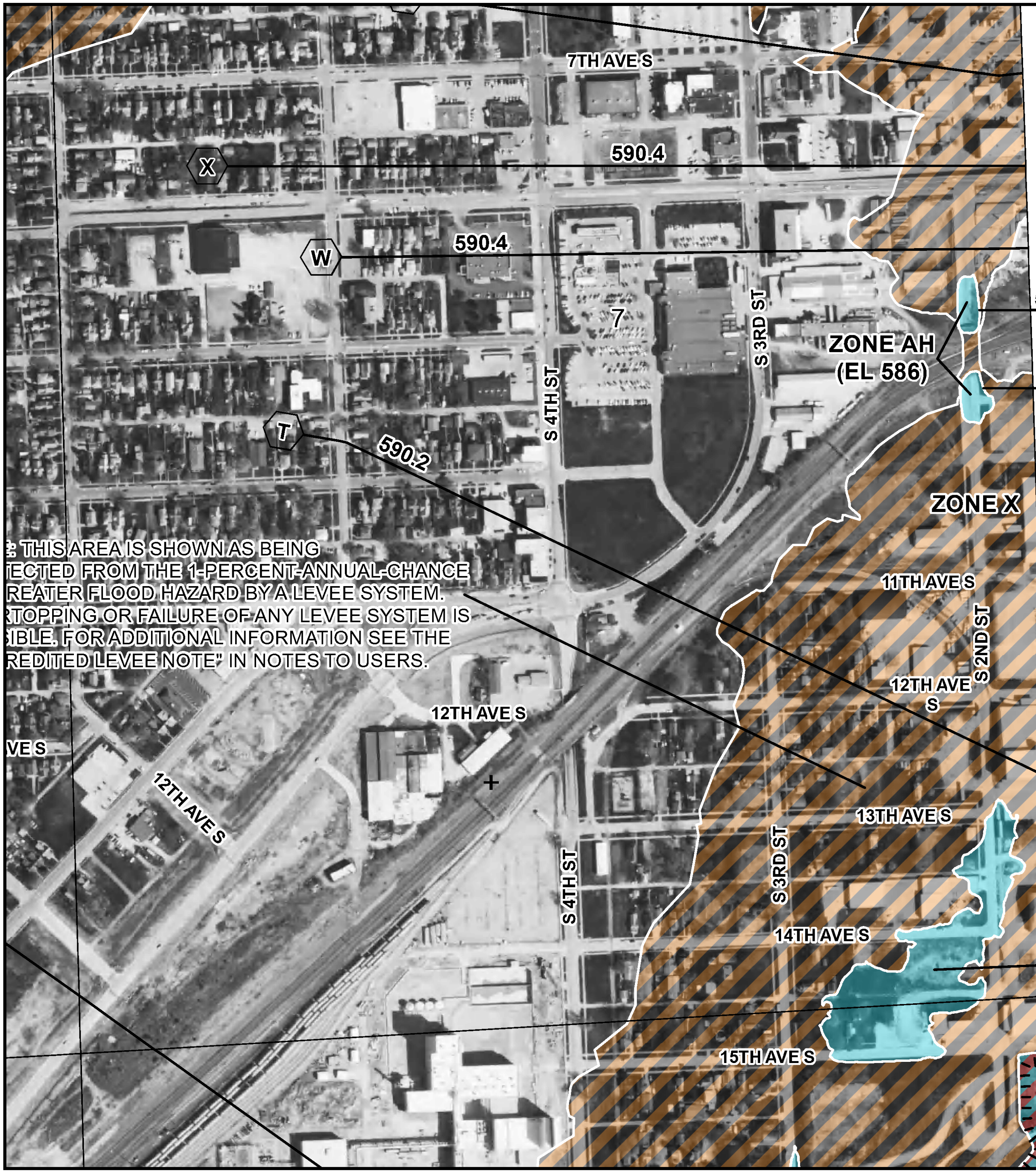


Map of the contiguous United States showing the projected changes in total spring precipitation by the middle of this century as described in the caption. Values range from less than minus 20 to greater than positive 15 percent. Spring precipitation is projected to increase across most of the northern half of the United States, particularly in the Northern Great Plains, Midwest, and Northeast. Most of these projected increases are statistically significant across these areas. The projected change in spring precipitation is uncertain in central Colorado. The greatest decreases are projected for the Southwest United States. The majority of Iowa is projected to see a statistically significant increase of greater than 15 percent, with the exception of the southwestern corner, with a projected statistically significant increase of 10 to 15 percent.

Figure 6: Projected changes in spring (March–May) precipitation (%) for the middle of the 21st century compared to the late 20th century under a higher emissions pathway. The whited-out area indicates that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Iowa is part of a large area of projected increases in the Northeast and Midwest. Sources: CISESS and NEMAC. Data: CMIP5.

The intensity of future droughts is projected to increase even if precipitation increases. Rising temperatures will increase evaporation rates and the rate of soil moisture loss. Thus, periodic summer droughts, a natural part of Iowa's climate, are likely to be more intense in the future.

Attachment B – FEMA Flood Zone Map



SCALE

Map Projection:
Universal Transverse Mercator Zone 15N;
North American Datum 1983;
Western Hemisphere; Vertical Datum: NAVD 8

1 inch = 500 feet

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

CLINTON COUNTY, IOWA
and Incorporated Areas

PANEL 504 OF 625

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLINTON, CITY OF	190088	0504	F
CLINTON COUNTY	190859	0504	F

VERSION NUMBER
2.6.4.6

MAP NUMBER
19045C0504F

MAP REVISED
July 19, 2023