City of Plano

EM

Emergency Management

Hazard Mitigation Action Plan (HMAP)

2023

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EXECUTIVE SUMMARY

June 26, 2023

Mitigation is typically defined as long-term efforts to lessen or eliminate risks to persons and property posed by hazards and the cascading consequences of hazards. Hazard mitigation focuses attention and resources on community policies and initiatives that will yield longstanding benefits. A mitigation plan outlines goals and strategies for action, to decrease vulnerability and exposure to future hazard situations. These plans are developed through a systematic process that includes input from residents, businesses, government officials, and other community stakeholders.

The incorporated area of the City of Plano serves as the planning area for this Hazard Mitigation Action Plan. The plan will cover a variety of hazards that potentially threaten the citizens, businesses, and environment within the community. Understanding that mitigation is an ongoing process, the City of Plano Hazard Mitigation Action Plan (HMAP) dated June 2023 is designed to affect mitigation actions and strategies over the next five years.

The plan fulfills the requirements of the Disaster Mitigation Act as administered by the Texas Department of Emergency Management (TDEM) and the Federal Emergency Management Agency (FEMA).

The City of Plano HMAP is more than just a planning document. Instead, the HMAP is a record of the community's commitment to mitigation initiatives. Looking ahead, the plan outlines a commitment to reducing the effects of hazards throughout the community.

The HMAP is divided into six (6) sections. Each section is designed to address the planning requirements set forth by the state and federal agencies tasked with mitigation oversight. The City of Plano Hazard Mitigation Action Plan sections are identified below:

- Section One: Introduction
- Section Two: Planning Process
- Section Three: Community Profile
- Section Four: Risk Overview
- Section Five: Mitigation Strategies
- Section Six: Plan Maintenance

The plan was prepared under the direction of the City of Plano Hazard Mitigation Steering Committee. For additional information, please contact the City of Plano Department of Emergency Management:

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SECTION 1. INTRODUCTION

1.1 Background

The City of Plano is the most populous municipality within Collin County, Texas. Plano has earned a national reputation as one of the best places in the United States for families to live and work. It has been ranked as one of the best places in the nation for jobs. The city is home to many leading global corporations, including Fortune 1,000 companies and over 10,000 businesses. Committed to providing its citizens with the highest level of service, the City of Plano supports its vision through comprehensive planning, like this Hazard Mitigation Action Plan (HMAP).

Mitigation helps the whole community keep hazards from turning into disasters. In a result, mitigation saves lives. Mitigation activities reduce risks to and impacts on lifelines, buildings, infrastructure, ecosystems, and cultural, historical, and natural resources. Mitigation activities also improve resilience. Mitigation includes the capabilities necessary to reduce loss of life and property by lessening the impact of disasters. The whole community will build a shared understanding of mitigation investment and its value.

The City of Plano is subject to natural and human-caused hazards that may cause injuries or death, destroy property, disrupt the economy and lower the overall quality of life for individuals. While it is impossible to prevent an event from occurring, the effect from many hazards to people and property can be lessened through mitigation planning.

This concept of hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Communities participate in hazard mitigation by developing hazard mitigation plans. The Texas Division of Emergency Management (TDEM) and FEMA have the authority to review and approve hazard mitigation plans through the Disaster Mitigation Act of 2000.

In 2006, the City of Plano originally developed a Hazard Mitigation Action Plan (HMAP) titled, “Maintaining a Safe and Secure Community…Reducing Risks from All-Hazards” in compliance with the Disaster Mitigation Act of 2000, as amended and was designed to be implemented through hazard mitigation measures intended to eliminate or reduce effects of disasters in 2006. Then in 2013, the plan was updated and the revisions were made in compliance with FEMA’s new plan guidance and requirements.

The Disaster Mitigation Act requires that hazard mitigation plans be reviewed and revised every five years to maintain eligibility for Hazard Mitigation Assistance (HMA) grant funding. FEMA originally approved the City of Plano HMAP in 2008, and then approved a plan update in 2013. In 2019, the City began the process of developing a HMAP update in order to maintain eligibility for grant funding. The COVID-19 pandemic response put planning efforts on hold as the city managed the impacts of a worldwide public health emergency. Beginning in 2021, the HMAP update planning process started anew, to once again provide an opportunity to evaluate successful mitigation actions and explore opportunities to avoid future disaster loss.

Hazard mitigation activities are an investment in a community’s safety and sustainability. It is widely accepted that the most effective hazard mitigation measures are implemented at the local level, where decisions on the regulation and control of development are most impactful. A comprehensive update to the hazard mitigation plan addresses existing hazard vulnerabilities and those in the foreseeable future. Therefore, it is essential that a plan identify projected patterns of future development, and the lasting impacts of development on overall hazard vulnerability. The Department of Emergency Management (DEM) is responsible for overseeing the development of the plan update for the City of Plano. .

1.2 Scope

The scope of the City of Plano HMAP encompasses all areas of Plano. The Plan identifies the natural and human-caused hazards that could threaten life and property across the City. The scope of this Plan includes both short-term and long-term mitigation strategies, the development of a mitigation framework, and a path for implementation, including possible sources of project funding.

1.3 Purpose

The City of Plano developed the Hazard Mitigation Plan (also referred to herein as the "Hazard Mitigation Action Plan," HMAP or the "Plan") as a single jurisdiction.

This HMAP includes a citywide analysis and assessment of hazards, risks, and capabilities, representing an update of the 2013 City of Plano Hazard Mitigation Action Plan. This Plan shall serve as a benchmark for future mitigation activities and identifies mitigation goals and objectives for the City of Plano.

Identifying the community's risks and working collectively toward preventing disasters is in everyone's best interest. The City of Plano Department of Emergency Management has led the development of the City of Plano HMAP.

The HMAP organizes the City of Plano's mitigation strategy. The implementation of this Plan supports a community that is resistant to the effects of a disaster. The development of this Plan aims to reduce post-disaster loss of loss of life and property while allowing the community to function with minimal disruption of vital services to its citizens.

This Plan establishes a risk assessment of the hazards within the City of Plano outlining puts several mitigation goals and objectives based on that risk assessment. The specific goals of the plan update are to:

- Provide a comprehensive update to the 2013 HMAP;
- Minimize disruption within the City of Plano following a disaster;
- Streamline disaster recovery by articulating mitigation actions to be taken before a disaster and establishing recovery goals post-disaster to reduce or eliminate further damage;
- Demonstrate a firm local commitment to hazard mitigation principles;
- Serve as a basis for future funding that may become available through grant and technical assistance programs offered by the State or Federal government. The plan update will enable the City of Plano to take advantage of rapidly developing mitigation grant opportunities as they arise; and
- Ensure that the City of Plano maintain eligibility for the full range of future Federal disaster relief..

1.4 Authority

The Plan is tailored specifically for the City of Plano and plan participants including Planning Team members, stakeholders, and the general public who participated in the plan update process. The plan update complies with all requirements promulgated by the Texas Division of Emergency Management (TDEM) and all applicable provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390), and the Bunning-Bereuter- Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al).

Additionally, the plan complies with the Interim Final Rules for the Hazard Mitigation Planning and HMGP (44 CFR, Part 201), which specify the criteria for approval of mitigation plans required in Section 322 of the DMA 2000 and standards found in FEMA's "Local Mitigation Planning Handbook" (March 2013). Additionally, the Plan is developed in accordance with FEMA's Community Rating System (CRS) Floodplain Management Plan standards and policies.

Table 1.1 provides and overview of the regulatory tools and plans identified by the Hazard Mitigation Steering Committee within the City of Plano.

Table 1-1 *Regulatory Tools and Plans*

REGULATORY TOOL/PLAN	REFERENCE	YEAR ADOPTED
Building Codes - International Codes	Plano Code of Ordinances, Chapter 6	2022
Building Codes - National Electric	Plano Code of Ordinances, Chapter 6	2022
Clean Air Strategy	City of Plano Cleaner Air and Reduced Emissions Strategy	2020
Community Investment Program	Plano Code of Ordinances, Chapters 16 and 19	2019, 2018
Comprehensive Emergency Management Plan	Plano Comprehensive Emergency Management Plan 2022	2022
Comprehensive Plan	City of Plano Comprehensive Plan 2021	2021
Economic Development	Summary of Economic Development Policies	2019
Erosion Hazard Setback Ordinance	Plano Code of Ordinances, Chapter 14	1998
Fire Prevention Code	Plano Code of Ordinances, Chapter 8	2022
Historic Preservation Overlay District		
Municipal Drainage Fee Ordinance	Plano Code of Ordinances, Chapter 21	1990
Park Master Plan	Park, Recreation, Trails, and Open Space Master Plan	2018
Site Plan Requirements	Plano Code of Ordinances, Chapter 23	2022
Stormwater Management Design Manual for Site Development	Plano Code of Ordinances, Chapter 21	2021
Stream Bank Stabilization Manual	Halff Associates AVO 15914	1998
Subdivision Regulations	Plano Code of Ordinances, Chapter 23	2017
Sustainability Implementation Plan	City of Plano Sustainability Implementation Plan	2016
Thoroughfare Standards Rules and Regulations	Street Design Standards Update 2022	2009
Zoning Ordinances	Plano Code of Ordinances, Chapter 23	2015

In the 88th Texas Legislature a pair of bills was advanced aimed to take control of a variety of local regulations in areas such as labor, business and commerce, local government, occupations, property, agriculture, insurance, natural resources, and finance. The bills referred to collectively as “super preemption” bar cities and counties from passing new regulations and overturn existing regulations which conflict with or are more restrictive than state and/or federal law.

The bills would nullify many of the local regulatory tools listed in Table 1.1, prohibiting local control or ability to expand or improve mitigation measures through regulatory authority. As a city, Plano would be tasked with enforcing state and federal laws, adopting municipal ordinances only in the absence of state or federal guidance.

1.5 Plan Organization

The HMAP is organized into six sections and three appendices. Figure 1-1 represents how the HMAP is organized.

Figure 1-1 *Outline of the City of Plano Hazard Mitigation Action Plan*

1.6 Plan Adoption

Adoption of the hazard mitigation plan by the City of Plano is essential to reducing the impact of disasters and protecting the community's safety, property, and resources. This hazard mitigation plan outlines the risks and identifies measures to reduce or eliminate the risks present across the community.

Adoption of the Hazard Mitigation Action Plan (HMAP) by the local governing body demonstrates the City of Plano's strong commitment to limiting losses during disaster. Formal adoption of the HMAP authorizes responsible agencies to take action when feasible.

The Plano City Council formally adopted the Hazard Mitigation Action Plan, including a final public comment period on June 26, 2023. A copy of the formal resolution is included in Appendix D of this plan.

SECTION 2. PLANNING PROCESS

2.1 Overview

The City of Plano approaches mitigation efforts proactively and comprehensively. A successful planning process builds partnerships and brings together members representing government agencies, the public, and community stakeholders to reach a consensus on how to collectively prepare for and respond to hazards most likely to occur. Applying a robust comprehensive and transparent process adds validity to the Plan. All involved stakeholders better understand the problem or identified issue and determine best solutions. The result is an updated set of common community values and widespread support for directing financial, technical, and human resources to an agreed-upon action. The planning process has been integral to updating the .

The HMAP update was prepared utilizing the most accurate information available from a variety of sources. Throughout the HMAP update process, a concerted effort was made to collect information from municipal and regional agencies, personnel, stakeholders, federal and state agencies, and residents.

2.2 Planning Team

Federal regulations require monitoring, evaluation, and updating of hazard mitigation plans. An update provides an opportunity to reevaluate recommendations, monitor the impacts of implemented actions, and evaluate whether there is a need to change the focus of mitigation strategies.

The City Plano's Hazard Mitigation Action Plan includes resources and information to assist residents, public and private sector organizations, and others interested in participating in planning for all hazards. In addition, the mitigation plan provides a list of activities that may assist the City of Plano in reducing risk and preventing loss from future hazard events.

2.2.1 HAZARD MITIGATION STEERING COMMITTEE

The City of Plano's Department of Emergency Management coordinated the formation of the Hazard Mitigation Steering Committee (HMSC). The committee (Table 2-1) comprised various stakeholders who work collaboratively with the Department of Emergency Management to identify, plan, and implement hazard mitigation policies and actions to reduce future risks and losses from hazards.

The benefits of why the HMSC was so vital to the planning process are:

- Stakeholder engagement
- Identification of hazards
- Identification of mitigation goals
- Prioritization of strategies
- Implementation and monitoring
- Access to funding

Table 2-1 *Hazard Mitigation Steering Committee Members*

NAME	TITLE	DEPARTMENT
Carrie Little	Director	Emergency Management
Nick Robison	Assistant Emergency Management Coordinator	Emergency Management
Lynn Hudson	Senior Emergency Management Specialist	Emergency Management
Nick Van Winkle	Emergency Management Specialist	Emergency Management
Al Carnley	Multimedia Specialist	Communications and Community Outreach
Jenny Zeilfelder	Economic Development Manager	Economic Development
Russell Erskine	Senior Engineer	Engineering
Rachel Patterson	Director	Environmental Health and Sustainability
Marc Pate	Deputy Fire Chief	Fire Department
Janet Cox	Library Technology Services Manager	Plano Public Libraries
Paul McNulty	Municipal Court Judge	Municipal Court
Ben Zajdel	Senior Property Standards Specialist	Neighborhood Services
Shelby Kervin	Police Lieutenant	Police Department
Stephen Tanner	Legislative Analyst	Policy and Government Relations
Derek Johns	Public Safety Communications Specialist	Public Safety Communications
Abby Owens	Strategic Planning/Compliance Manager	Public Works
Danny McDonald	Building Inspections Supervisor	Building Inspections
Brian Frantz	Police Sergeant	Police
Gus Duran	Chief Information Security Officer	Technology Services
Jason Aprill	Sr. Planner, Mobility	Planning

The Hazard Mitigation Steering Committee (HMSC) solicited information from local agencies and individuals with specific knowledge of certain hazards and past historical events. In addition, the committee took into consideration planning and zoning codes, ordinances, and recent land-use planning decisions.

As a result, the hazard mitigation strategies identified in this HMAP have been developed with support from local, county, and regional agencies, residents, and other community stakeholders.

2.2.2 HAZARD MITIGATION PLAN EXTERNAL STAKEHOLDERS

For the 2023 HMAP update, an External Stakeholder group was formed to represent key members of the community (Table 2-2). This group was invited to participate in the planning process via e-mail with copies of the draft plan provide for comment. The HMSC and Stakeholder Group coordinated to identify mitigation goals and develop mitigation strategies and action for the plan update. Their role as a representative of a diverse range of Plano organizations helped the larger HMSC with planning by providing input from various perspectives and information on specific topics.

Table 2-2 *External Stakeholders*

AGENCY NAME	AGENCY NAME
American Red Cross	Denton County Volunteer Organizations Active In Disasters
Baylor Scott and White Regional Medical Center	Frisco Independent School District
Children's Medical Center Legacy	Medical City Plano
Collin College	North Texas Tollway Authority
Collin County Emergency Management	Plano Chamber of Commerce
Collin County Public Health	Plano Independent School District
Collin County Voluntary Organizations Active In Disasters	Texas Health Presbyterian Plano
Dallas Area Rapid Transit	The Heart Hospital Baylor Plano
Denton County Emergency Management	The Salvation Army
Denton County Public Health	

2.3 Meetings and Documentation

Hazard Mitigation Steering Committee meetings were held during the plan update process. The list of meetings (Table 2-3) and meeting documentation is located in Appendix D.

Table 2-3 *Schedule of Steering Committee Meetings & Agenda Items*

HAZARD MITIGATION STEERING COMMITTEE MEETINGS		
Date	**Meeting**	**Task/Discussion Items**
8/10/2022	Final Stakeholders Meeting	Discussed future mitigation strategies. Identified priorities. Finalized the Plan
6/16/2022	Stakeholders Meeting	Discussed analytics of the public outreach survey. Review and update of 2013 mitigation actions. Identified the 2022 list of mitigation actions by hazard. Updated and prioritize mitigation actions
4/28/2022	HMSC Kickoff Meeting	Presented purpose and overview of HMSC and HMAP Plan and roles of the HMSC. Described mitigation planning process, HIRA, and review of 2013 Plan goals and actions. Discussed public outreach strategies and surveys and hazard identification and data collection process
11/8/2021	Pre-kickoff email to City departments	Discussed data needs. Identified members of the Hazard Mitigation Steering Committee (HMSC)

2.4 Review and Incorporation of Existing Plans

Background information utilized during the planning process included various studies, plans, reports, and technical information from sources such as FEMA, the U.S. Fire Administration, the National Oceanic and Atmospheric Administration (NOAA), the Texas Commission on Environmental Quality (TCEQ), the Texas Department Health and Human Services Department, Collin County Health Care Services, the Texas State Data Center, the Texas Division of Emergency Management (TDEM), and local hazard assessments and plans.

Specific background documents, including those from FEMA, provided information on hazard risk, hazard mitigation actions currently being implemented, and potential mitigation actions. Previous hazard events, occurrences, and descriptions were identified through NOAA's National Centers for Environmental Information (NCEI). Results of past hazard events were found through searching the NCEI. Materials from FEMA and TDEM were reviewed for guidance on plan update development requirements.

2.4.1 INCORPORATION EXISTING PLANS INTO THE HMAP PROCESS

A Capability Assessment was completed by the City of Plano and provided information pertaining to existing plans, policies, ordinances, and regulations to be integrated into the goals and objectives of the plan update.

Existing projects and studies were utilized as a starting point for discussing hazard mitigation actions among Planning Team members. The City of Plano's Comprehensive Plan is incorporated into the plan update as it pertains to mitigating risk from natural disasters and the resulting effects on transportation, and development in floodplain areas; and educating residents on how to protect themselves and their property. Additionally, mitigation actions from other plans were reviewed, such as Floodplain Management Plans and Storm-Water Management Plans. Finally, the 2013 State of Texas Mitigation plan update, developed by TDEM, was discussed in the initial planning meeting in order to develop a specific group of hazards to address in the planning effort. The 2013 State plan update was also used as a guidance document, along with FEMA materials, in the development of the City of Plano plan update.

The following State/Federal Data, Reports, and Plans were utilized and are currently in place:

- 2020 United States Census Data
- City of Plano Building Codes and Zoning Ordinances
- City of Plano Community Investment Program
- City of Plano Comprehensive Emergency Management Plan 2022
- City of Plano Comprehensive Plan 2021
- City of Plano Continuity of Operation Plan
- City of Plano Disaster Debris Management Plan
- City of Plano Disaster Recovery and Redevelopment Plan 2020
- City of Plano Hazard and Identification Risk Assessment
- City of Plano Hazard Mitigation Action Plan 2013
- County/Regional Plans, Ordinances
- FEMA regulations and guidance
- National Flood Insurance Program (NFIP)
- National Oceanic and Atmospheric Administration data
- NFIP Community Rating System

- State of Texas Hazard Mitigation Plan, October 2018[1]

2.4.2 INCORPORATION OF HMAP INTO OTHER PLANNING MECHANISMS

The City of Plano will integrate hazard mitigation actions contained in the plan with existing planning mechanisms such as the Community Investment Program, Comprehensive Plans, Stormwater and Design Plans, Emergency Management Plans, and other local planning efforts.

Upon formal adoption of the plan, the HMSC will review existing plans, along with local codes to guide development and ensure that hazard mitigation actions are implemented as allowable by state law. In addition, following disaster or emergency events where post-disaster funding is made available within the state, departmental representatives will evaluate the feasibility of submitting grant requests to complete identified mitigation actions.

Each hazard mitigation action has been assigned to a specific City department that is responsible for tracking and implementing the action. A funding source has been listed for each identified hazard mitigation action and may be utilized to implement the action. An implementation time period has also been assigned to each hazard mitigation action as an incentive and to determine whether actions are implemented on a timely basis.

The HMSC will conduct periodic reviews to evaluate the effectiveness of the Plan and remove or modify mitigation actions as necessary. DEM will ensure that future long-term planning objectives will contribute to the goals of the plan to reduce the long-term risk to life and property from moderate and high risk hazards. Periodic reviews will seek input from responsible city departments and community stakeholders. Reviews will occur annually and/or as part of the long-term recovery process post-disaster.

Further, the City of Plano will work with neighboring jurisdictions to advance the goals of the plan as it applies to ongoing, long-range planning goals and actions for mitigating risk to natural hazards, such as floodplains, with boundaries extending beyond the planning area. Future trends, technologies and mitigation actions will be employed in an ongoing effort to continuously refine and improve overall mitigation. Local jurisdictional resources are continuously being evaluated to ensure future needs are met.

2.4.3 CHANGES IN DEVELOPMENT OF PRIORITIES

The City of Plano's 2020 estimated population was 285,494, according to the most recent U.S. Census update available during plan preparation. This population represents an almost 10% increase from the 2010 U.S. Census population count. The City has adopted a Comprehensive Plan that governs land-use decisions and policy-making, as well as a building code and specialty ordinances based on state and federal mandates. This HMAP update assumes that some new development triggered by the increase in population occurred in hazard areas.

All such new development would have been regulated pursuant to local programs and codes. Therefore, it is assumed that hazard vulnerability did not measurably increase even if exposure did. Any new development would have accounted for potential hazard impacts under codes and standards such as the International Building Code and flood damage prevention requirements of the National Flood Insurance Program (NFIP).

[1]TDEM, Mitigation, [website], http://tdem.wpengine.com/wp-content/uploads/2019/08/txHazMitPlan.pdf, (accessed 11 November 2021)

The plan was revised to reflect changes in community priorities by adding and removing hazards to the risk assessment. The Infrastructure Failure and Earthquake hazards were removed from the plan. In the mid 2010's, the North Texas region saw an increase in Earthquake activity which some attributed to fracking. There has been minimal to little activity in the past five years; therefore, the risk profile was removed from the plan update. There was also a change to the following hazards, hail, high-winds, and lightning. Consensus among the HMSC members was to combine all the hazards into the severe thunderstorm hazard. This combination was applied to the HMAP because all three hazards are relative to conditions that severe thunderstorms produce.

2.5 Public and Stakeholder Involvement

An essential component of hazard mitigation planning is public participation and stakeholder involvement. Input from individual citizens and the community gives the HMSC a greater understanding of local concerns and increases the likelihood of successfully implementing hazard mitigation actions. In addition, if citizens and stakeholders, such as local businesses, nonprofits, hospitals, and schools, are involved, they are more likely to gain a greater appreciation of the risks that hazards may present in their community and take steps to reduce or mitigate their impact.

2.5.1 PUBLIC INPUT METHODS

- Open public meetings
- Online survey
- Draft plan for public comment

Throughout the planning process, members of community groups, local businesses, neighboring jurisdictions, schools, and hospitals were invited to participate in the development of the City of Plano HMAP.

Open public meetings

Information regarding public meetings was advertised on the City of Plano website and social media channels inviting residents, neighboring communities, local businesses, academia, agencies, and nonprofits to comment. Information was directly emailed to selected community partners and included in City of Plano citizen newsletters inviting participation in the planning process. This is depicted in Figure 2.1 on the lower right side of the image. A QR code was generated for residents to scan in order to acquire details about the meeting.

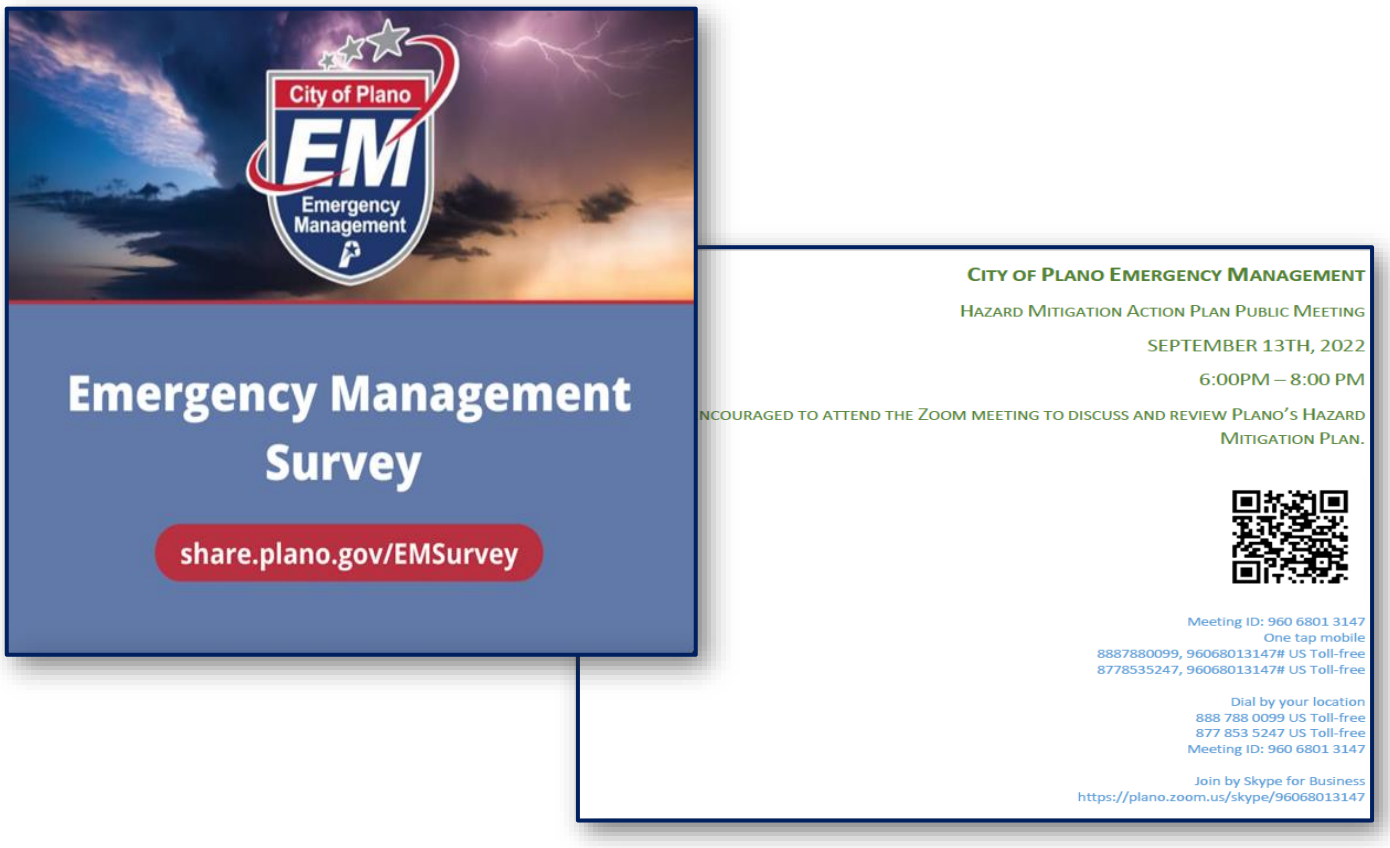
Public Input Survey

The City of Plano Department of Emergency Management conducted an online community survey to announce the update of the HMAP and to obtain public input into the planning process.

Plano Emergency Management posted information on the plan update and survey on its website and social media platforms (Facebook, Twitter, Nextdoor, and Reddit) and through the City managed newsletters at the beginning of the planning process. Many HMSC and external stakeholders also helped publicize the public input survey.

The purpose of the survey, which is shown in Figure 2-1, was to gather information, assess local household and business preparedness for disasters, identify actions which could reduce risk and loss from natural and other hazards, and give respondents the chance to comment to the HMSC.

Figure 2-1 *Screenshots of Outreach Survey and Public Meeting Information*



SECTION 3. COMMUNITY PROFILE

The City of Plano is located in North Central Texas and is the most populous city in Collin County. Initially settled in the 1840s, Plano was incorporated on June 2, 1873, six months after the Houston and Texas Central Railroad began service. Railroad service to the community established the city as the trading center of agriculturally rich southwest Collin County. Additional transportation improvements further secured the city's position. The Cotton Belt Railroad opened in 1887, connecting Plano to Fort Worth, and in 1908 the Texas Traction Company (interurban electric railway) began service between Plano and Dallas. The wagon road connecting Plano to Dallas, approximately 20 miles south, would evolve into a State highway (State Highway 5). Plano prospered, attaining a population of 1,304 people by 1900. Throughout the first half of the 20th century, downtown Plano consisted of a single block of one and two-story commercial buildings (approximately 110,000 sq. ft.) surrounded by a cotton gin and oil press mill and other scattered heavy commercial and service uses. Downtown businesses included grocery, drug, variety, furniture, appliance stores, banks, and other services. The small train and interurban depots were located downtown on the west and south sides. Churches and neighborhoods adjoined downtown, completing the small town. The development of the North Central Expressway from 1950 to 1956 greatly improved access to northern Dallas and Collin counties and stimulated suburban development.

Plano's population by 1950 was 2,126, at which time the expansion of the greater Dallas metropolitan area began to affect the city. Also, by 1950, eight area school districts completed a consolidation and established the 114 square mile jurisdiction of the Plano Independent School District. In 1951, Plano and nine other cities created the North Texas Municipal Water District to provide for their common water and wastewater treatment and solid waste disposal needs. The City of Plano was granted a home rule charter on June 10, 1961, increasing the city's governance authority and ability to annex. Plano grew steadily over the years, but its population "exploded" during the 1980s. Many large corporations, such as JC Penney and The Frito-Lay Company, moved their corporate headquarters to Plano during this time. The city was recognized as an All-American City in 1994. By 2000, the population grew to 222,030. Today, after decades of rapid expansion, the City of Plano occupies approximately 71.6 square miles and lies within Collin County and Denton County, Texas.

3.1 Population

The City of Plano's 2023 population is 292,066 according to the most recent population estimates maintained by the City of Plano Planning Department. This population represents an increase of over 10% from the 2010 U.S. Census population count. The City of Plano is the largest city in Collin County, the fourth largest city in the Dallas-Fort Worth region, the ninth-largest city in Texas, and the seventy-second largest city in the United States.

Table 3-1 *US Census QuickFacts*[2]

Population		
Population, Census, April 1, 2020		285,494
Population, Census, April 1, 2010		259,841
Age and sex		
Persons under 5 years, percent		5.6%
Persons under 18 years, percent		22.3%
Persons 65 years and over, percent		13.2%
Female persons, percent		50.7%
Race and Hispanic Origin		
White alone, percent		61.7%
Black or African American alone, percent	(a)	8.6%
American Indian and Alaska Native alone, percent	(a)	0.4%
Asian alone, percent	(a)	21.8%
Native Hawaiian and Other Pacific Islander alone, percent	(a)	0.1%
Two or More Races, percent		5.6%
Hispanic or Latino, percent	(b)	15.0%
White alone, not Hispanic or Latino, percent		51.3%
Population Characteristics		
Veterans, 2015-2019		11,181
Foreign born persons, percent, 2016-2020		27.4%
Housing		
Owner-occupied housing unit rate, 2016-2020		58.9%
Median value of owner-occupied housing units, 2016-2020		$341,800.00
Median selected monthly owner costs -with a mortgage, 2016-2020		$2,201.00
Median selected monthly owner costs -without a mortgage, 2016-2020		$877.00
Median gross rent, 2016-2020		$1,447.00
Households 2016-2020		
Persons per household, 2016-2020		2.68
Living in same house 1 year ago, percent of persons age 1 year+, 2016-2020		87.2%
Language other than English spoken at home, percent of persons age 5 years +, 2016-2020		35.3%
(a) Includes persons reporting only one race *(b) Hispanics may be of any race, so also are included in applicable race categories*		

Computers and Internet Use		
Households with a computer, percent, 2016-2020		98.4%
Households with a broadband Internet subscription, percent, 2016-2020		95.1%
Education		
High school graduate or higher, percent of persons age 25 years+, 2016-2020		93.7%
Bachelor's degree or higher, percent of persons age 25 years+, 2016-2020		95.1%
Health		
With a disability, under age 65 years, percent, 2016-2020		4%
Persons without health insurance, under age 65 years, percent		12.8%
Economy		
In civilian labor force, total, percent of population age 16 years+, 2016-2020		69.6%
In civilian labor force, female, percent of population age 16 years+, 2016-2020		61.6%
Total accommodation and food services sales, 2012 ($1,000)	(c)	846,883
Total health care and social assistance receipts/revenue, 2012 ($1,000)	(c)	2,962,762
Total manufacturers' shipments, 2012 ($1,000)	(c)	1,698,384
Total retail sales, 2012 ($1,000)	(c)	7,682,987
Total retail sales per capita, 2012	(c)	$28,239.00
Transportation		
Mean travel time to work (minutes), workers age 16 years+, 2016-2020		26.8
Income & Poverty		
Median household income (in 2019 dollars), 2016-2020		$96,348.00
Per capita income in past 12 months (in 2019 dollars), 2016-2020		$49,455.00
Persons in poverty, percent		6.3%
Businesses		
All firms, 2012		30,567
Men owned firms, 2012		15,742
Women owned firms,2012		10,475
Minority owned firms, 2012		10,098
Nonminority owned firms, 2012		19,011
Veteran owned firms, 2012		2,647
Nonveteran owned firms, 2012		26,154
Geography		
Population per square mile, 2010		3,630.0
Land area in square miles, 2010		71.58
FIPS code		4858016
(c) Economic Census - Puerto Rico data are not comparable to U.S. Economic Census data; X Not applicable		

3.2 Location, Geography, and Climate

The City of Plano is in North Central Texas on the northern edge of the Blackland Prairie. Approximately 15 miles north of Dallas, Plano is in Collin and Denton County. The five municipalities that border the City of Plano include the cities of Allen, Dallas, Frisco, Murphy, and Richardson. Plano's elevation is 695 feet above sea level, and the climate is classified as humid subtropical, with hot summers, mild winters, and comfortable spring and autumn. The region is considered continental, with a broad annual temperature range.

Winters are mild, but strong cold-weather systems drop winter temperatures on average three times a month during December, January, and February. The average winter temperatures range from a high of 64°F to a low of 33°F. Periods of extreme cold are typically short-lived.

Hot temperatures, fair skies, westerly winds, and low humidity characterize summer weather. Typically, hot weather in the summer is broken into three-to-five-day periods, separated by thunderstorm activity.

The average summer temperature ranges from a high of 98°F to a low of 75°F. Only a few nighttime lows exceed 80°F. It is common for daytime temperatures to register over 100°F in the later summer months. Typically, periods of extreme heat are short-lived.

The area receives an average number of 138 days per year of sunshine. Average rainfall per year ranges from 33 to 40 inches. Rainfall is abundant and evenly distributed throughout the year. A large part of the annual precipitations results from thunderstorm activity with brief periods of heavy downfall. Thunderstorms occur throughout the year but are most prevalent in the spring, March, April, and May.

High winds associated with thunderstorms have caused damage within the city. High winds have damaged large trees, power poles, and power lines. Thunderstorm winds have also caused electric transformers to malfunction.

3.3 Land Use

Current Land Use

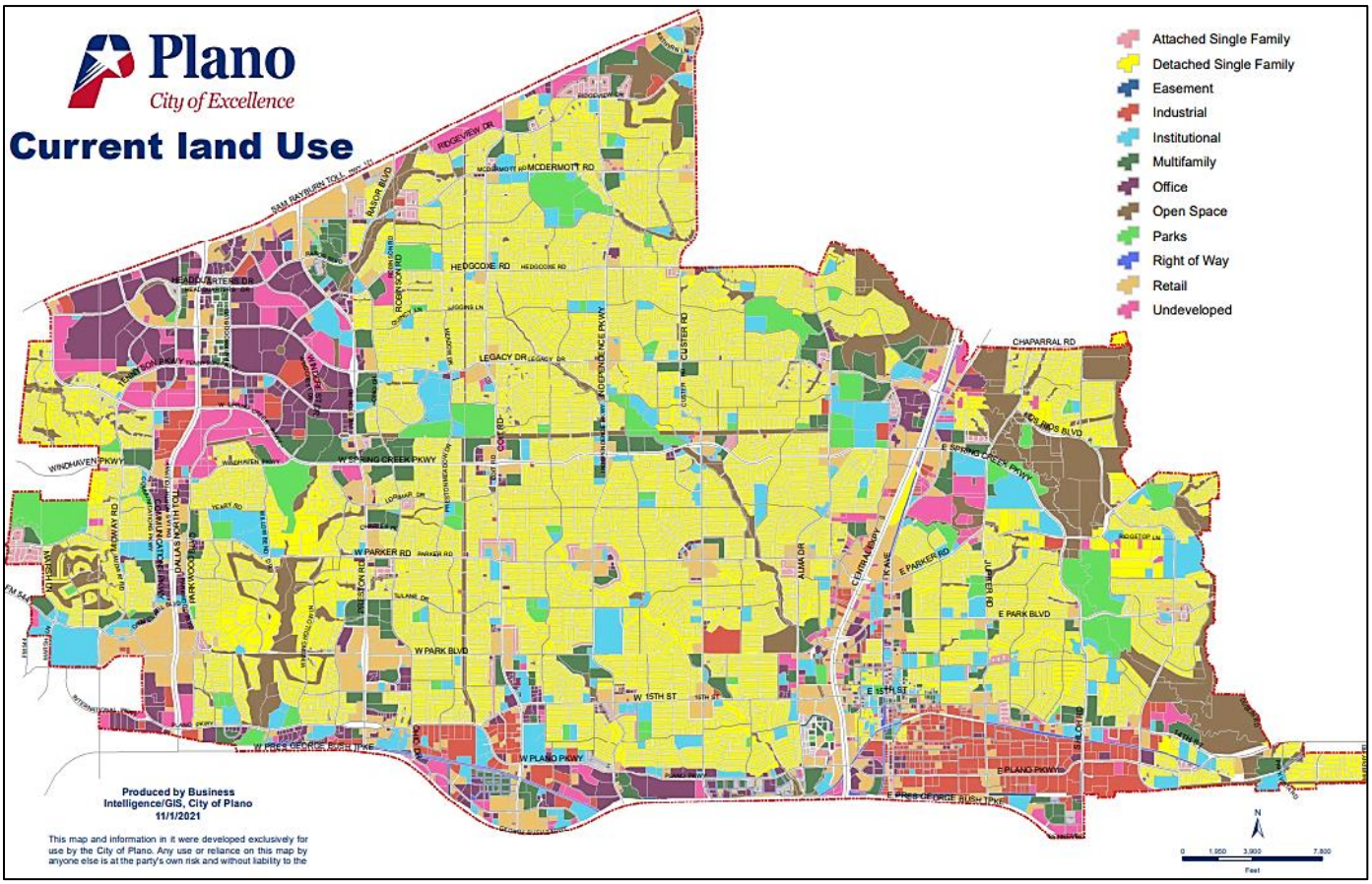
Plano developed its first Comprehensive Plan in 1963. This plan laid the foundation for the City of Plano today by establishing residential neighborhoods and locations for future roadway development. After the creation of Legacy Business Park in the early 1980s, the city developed its second Comprehensive Plan in 1986 to set the stage for Plano's transition from primarily a residential community to a regional employment center. In 2021, Plano adopted the most current Plano Comprehensive Plan, which the city currently utilizes for planning purposes. Current land use is shown in Figure 3-1.

Neighborhoods

The neighborhoods future land use category consists primarily of residential areas focused on sustaining a high quality of life through well-maintained infrastructure, housing, open space, schools, and limited service/institutional uses. Single-family residential should remain the primary use within neighborhoods. It is the intention to preserve and enhance these uses and to regulate the design of new residential infill products to be within the context of the surrounding environment. Existing multifamily developments transitioning from moderate to high-intensity commercial areas should be well maintained to preserve neighborhood character.

With few large tracts left for residential development, some infill and redevelopment opportunities may not fit the typical neighborhood design. Institutional, light office and service uses are considered secondary uses and may be located along the frontage of arterial streets and intersections.

Figure 3-1 *Current Land Use*



Neighborhood Corners

The Neighborhood Corners future land use category applies to the small-to-medium retail sites on the corners of major arterial roadways that have traditionally served the convenience retail, service, office, and institutional needs of surrounding neighborhoods. Continued maintenance, renovation, and revitalization are strongly encouraged to sustain neighborhood corner vitality and attractiveness. This may be achieved through parking lot landscaping enhancements, building renovations, and other site improvements to enhance community form and limit the visual impacts of parking. Adequate transitions in building setbacks and height should be provided when development is proposed near neighborhoods. An ongoing relationship between neighborhood residents and commercial property owners, and businesses in adjacent corners is encouraged to support the economic health and viability of the community.

Community Corners

The Community Corners future land use category applies to retail sites on the corners of major arterial roadways that traditionally serve surrounding neighborhoods' general retail, service, office, and institutional needs. These areas are often anchored by uses such as large grocery stores, hardware stores, department stores, fitness centers, or other big-box retailers.

Due to the abundance of retail zoning in Plano's development history and changes in retail consumer trends, these areas are increasingly susceptible to decline. Redevelopment is encouraged where appropriate to reduce excess retail square footage, increase green space, integrate new uses, improve walkability, limit visual impacts of parking, and enhance community form.

Furthermore, innovative solutions that introduce useable open space and repurpose existing structures are desired to create unique community gathering spaces in these corners. Adequate transitions in building setback and height must be considered when development is proposed near surrounding neighborhoods.

Suburban Activity Centers

The Suburban Activity Centers' future land use category applies to areas with large commercial and mixed-use developments that serve the specialty shopping, dining, service, and entertainment needs at the intersections of high-traffic corridors. These areas are typically 50-100 acres in size and anchored by major retailers, superstores, large grocers, or theaters. In addition, hotels, offices, and institutional uses are supportive uses in these centers. When provided, residential uses should be incorporated within cohesively planned, mixed-use developments of moderate density and intensity.

Urban Activity Centers

The Urban Activity Centers' future land use category applies to areas designated for significant development or redevelopment, with high-intensity mixed-use activity centers attracting large corporations, specialty shopping, dining, entertainment, and high-density residential development. These areas are typically at least 100 acres and include mid- to high-rise buildings with a compact block structure and human-scale street and building design, creating a highly walkable urban form.

Downtown Corridors

The Downtown Corridors' future land use category applies to historic Downtown Plano and the K Avenue and 14th Street corridors. Located along former State Highway 5, FM 544, and the Houston & Texas Central and Cotton Belt Railroads (now the DART Red/Orange and Silver Line), these areas have long served as major gateways to Downtown for both car and rail. The Downtown Corridors category is intended to create attractive gateways and support the continued transformation of historic Downtown Plano into the civic and cultural heart of the city.

Expressway Corridors

The Expressway Corridor future land use category applies to development along major expressways serving regional and interstate commerce. Development in these corridors is expected to include a mix of retail, service, office, restaurant, medical, hotel, and technology-based uses.

Employment Centers

The Employment Center's future land use category applies to business centers. The primary uses for employment centers are commercial uses which provide corporate office campuses, medical centers, educational facilities, technology centers, and research facilities. Limited manufacturing and warehouse use may be allowed to support the employment centers. Adequate building setbacks must be considered when development is proposed near neighborhoods. Residential development is inappropriate within these centers to ensure the city's ability to attract and maintain employment-generating uses.

Social Network

The Social Network future land use category includes a wide range of public and private uses such as colleges, universities, major public schools (high school/senior high schools), athletic complexes, recreational facilities, libraries, golf courses, country clubs, and large private open spaces. These areas are intended to retain their character to provide regional recreation and social opportunities.

Open Space Network

The Open Space Network future land use category includes major public open space preserves, community parks, neighborhood parks, linear parks, and trails. These areas are intended to retain their character to provide regional recreation and leisure opportunities.

3.4 Dams

The TCEQ manages the Dam Safety Program within the state. The Dam Safety Program monitors and regulates private and public dams in Texas. This program periodically inspects dams posing a high or significant hazard. In addition, TCEQ inspectors make recommendations and reports to dam owners to help them maintain safe facilities.

The TCEQ has identified five dams within the City of Plano, three posing high hazards and two posing significant hazards. Dams are considered a high hazard when loss of the dam may result in the following:

- Loss of life expected (3 or more habitable structures affected)
- Excessive economic loss expected and extensive damage to:
- Public facilities
- Agricultural, industrial, or commercial facilities
- Public utilities
- Main highways Texas Department of Transportation (TxDOT) classified arterial roads)
- Railroads used as a major transportation system

The dams classified as high hazards within the City of Plano are small as part of a water retention system within a neighborhood. The loss of the dam would affect neighborhood homes, public utilities, and arterial roadways. Dams are considered a significant hazard when loss of the dam *may* result in the following:

- Loss of life possible (1-2 habitable structures)
- Appreciable economic loss:
- Damage to isolated homes
- Damage to secondary highways (TxDOT classified collector roads)
- Damage to minor railroads
- Interruption of service or use of public utilities

The dams classified as significant hazards within the City of Plano are small as part of a water retention system within a commercial area. The loss of the dam would affect occupied businesses, public utilities, and collector roadways.

Dam breaches, although rare in occurrence, can have significant impacts on all areas downstream. In some cases, flood levels can rise to dangerous levels causing significant property damage and potentially death.

Detailed information including emergency action plans, flood inundation models and technical detailed on the five dams of significance or high hazard potential are kept with the City of Plano Department of Emergency Management. Table 3.2 depicts the City of Plano's dam inventory. More information is located in Appendix E., High Hazard Potential Dams.

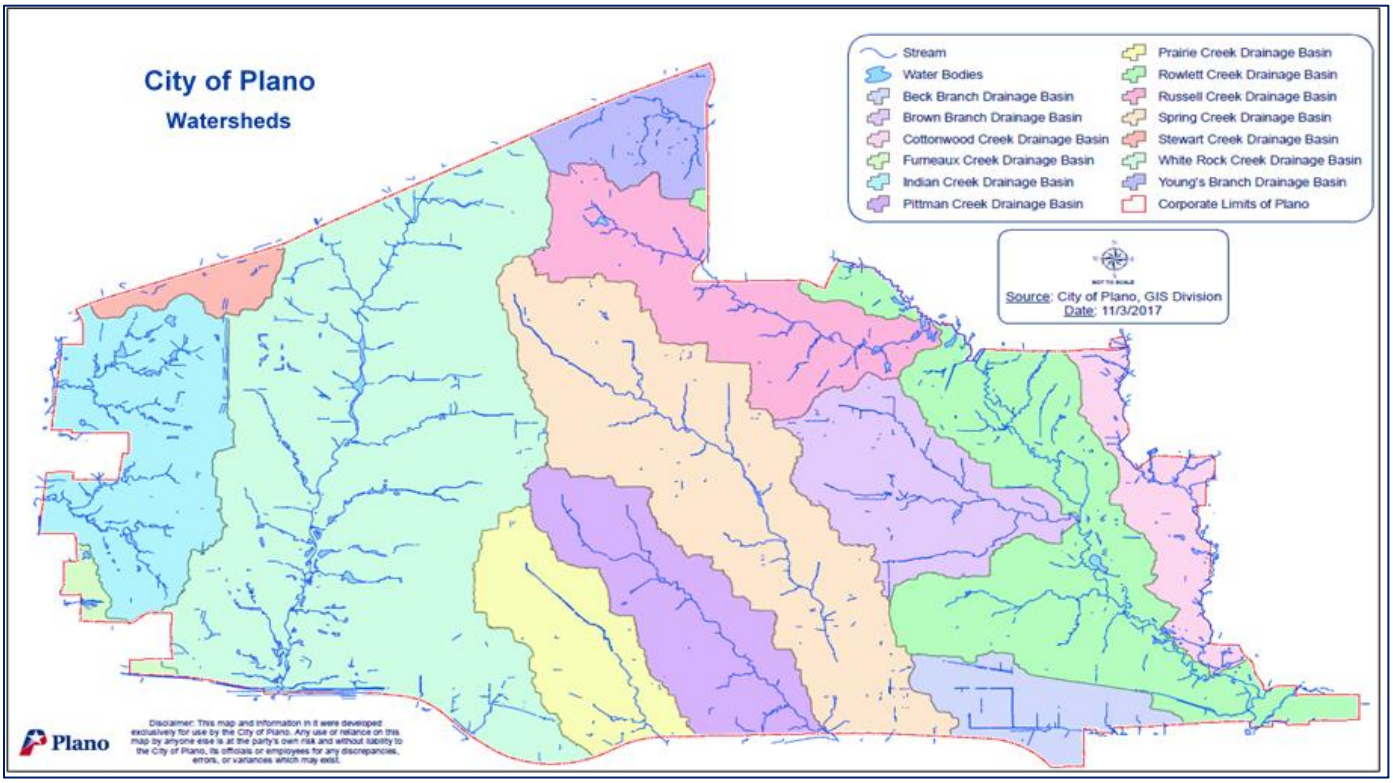
Table 3-2 *Dam Inventory for the City of Plano*

ID	NAME	COUNTY	LAT	LONG	HAZARD	OWNER	EAP
Tx00596	Lower Lake Dam	Denton	33.073894	-96.845112	**High**	Private	Yes
Tx01123	Willow Bend Lake No 1 Dam	Collin	33.033704	-96.80318	**High**	Private	Yes
Tx04860	Willow Bend Lake No 2 Dam	Collin	33.037906	-96.807602	**High**	Private	Yes
Tx06558	EDS Dam No 1	Collin	33.066531	-96.799358	**Significant**	Private	Yes
Tx06559	EDS Dam No 2	Collin	33.06001	-96.799923	**Significant**	Private	Yes

3.5 Watersheds

The City of Plano has thirteen major watersheds. (Figure 3.2). In addition, Plano is in the Upper Trinity River Basin, which covers an area of 17,696 square miles, contains 14 major reservoirs, and receives an average of 33 to 40 inches of rainfall per year.

Figure 3-2 *City of Plano Watersheds*



3.6 Government

The City of Plano was incorporated on June 2, 1873. Plano is a home-rule municipality meaning that it is self-governing under the Home Rule Charter. The city operates as a Council–City Manager form of government. Under this organization of government, all council members, including the mayor, have equal rights. The City Council appoints the City Manager. Most of the city government is under the leadership of the City Manager, organized into departments or divisions, and led by directors. While the city council is responsible for making laws and policy decisions, the city manager is responsible for City operations. As depicted in Figure 3.3, the city has 26 departments under the leadership of a departmental manager.

City Council

The mission of the Office of the Mayor and City Council is to work diligently to guide city staff to achieve Plano's mission as a regional and national municipal leader, providing outstanding services and facilities through cooperative efforts that engage the citizens and that contribute to the quality of life in the community. There are eight Council places in the City of Plano, including the place of the mayor. All City Council members run and serve at large, which means that all Council members represent the entire City, with an additional district-specific residency requirement for candidates who run for Places 1 through 4. Likewise, the entire City may vote for all eight places as they come due, regardless of where they reside in the city. Each Council Member serves a four-year term, and all members are limited to no more than two consecutive terms.

In addition to the appointment of the City Manager, the City Council also appoints the City Attorney, Municipal Court Judge, and all board and commission members.

As a body of elected officials, the eight-member City Council has numerous functions, including:

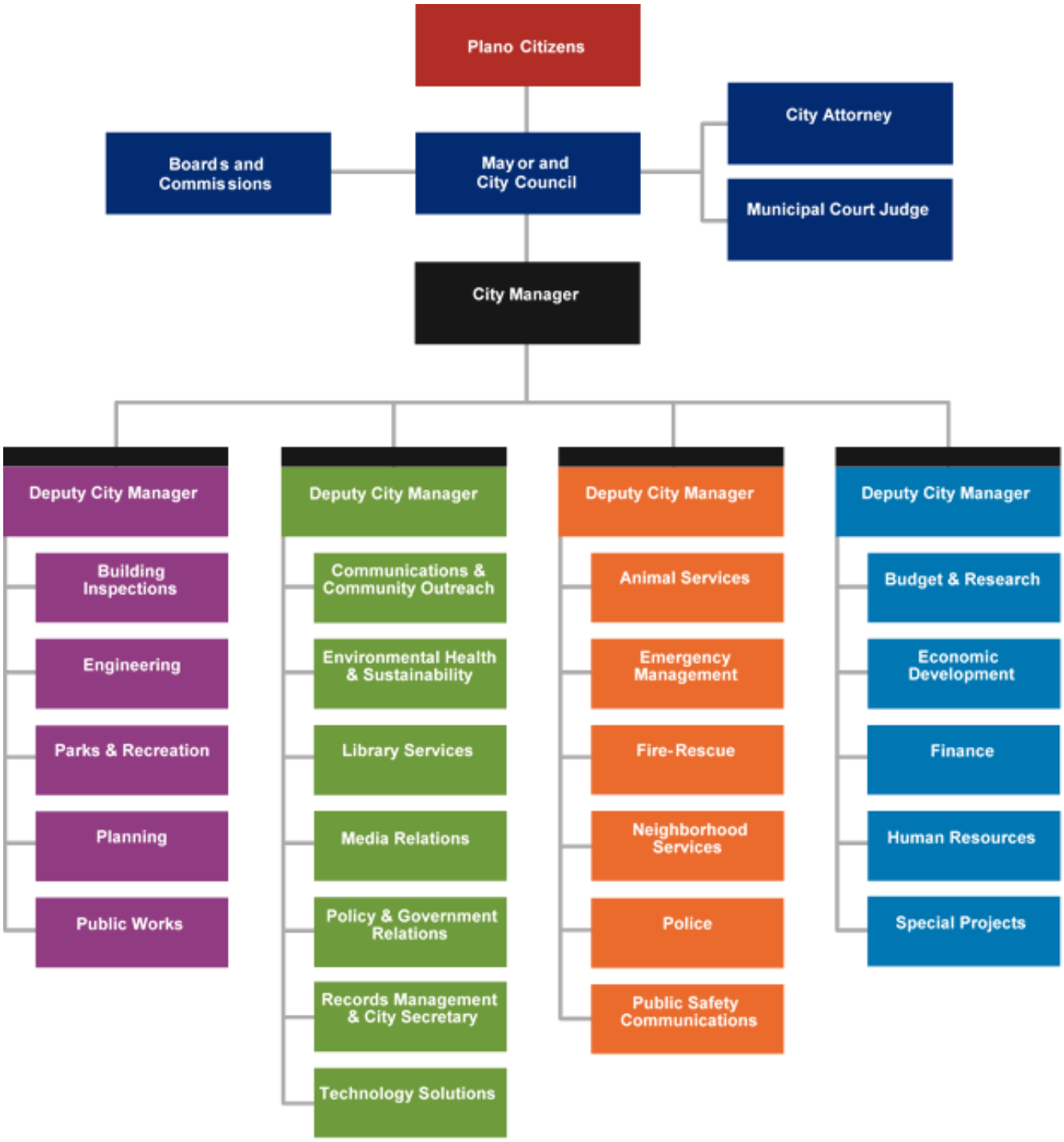
- Policymaking
- Passing ordinances and resolutions
- Oversee the direction of the city manager
- Approve of certain city-budgeted purchases
- Fill vacancies in appointed offices
- Approve city budget
- Adopt annual tax rate

City Manager

As the city's chief administrative officer, the City Manager is responsible for the city's daily operations. Duties of the City Manager include but are not limited to the following:

- Implement policy decisions made by Mayor and Council
- Manages city budget, prepares budget recommendations, and monitors city’s financial position.
- Appointment and removal of department heads and employees
- Oversee enforcement of non-criminal municipal laws and ordinances
- Supervision the operation of all City departments and other agencies providing service to the city on a contractual basis
- Preparing and submitting to the City Council reports that have been requested.
- Keeping the public informed through reports to the City Council regarding the operations of the city government.

Figure 3-3 *City of Plano Organizational Chart*



3.7 Community Lifelines

A community lifeline is an asset to enable the continuous operation of critical government and business functions. Community lifelines are essential to community health, safety, and economic security. Lifelines are the fundamental services within a community enabling other aspects of society to function. Lifelines include the network of assets, services, and capabilities used daily to support the function of the community.

Source: FEMA

Safety and Security

The City of Plano has a safety and security network consisting of police, fire, and government services. This lifeline aims to prevent, deter, and mitigate threats and hazards for residents and critical infrastructure.

Table 3-3 *City of Plano Public Safety Facilities*

POLICE	FIRE - RESCUE
Main Police Station 909 14th Street, 75074	**Station 1** 1901 Avenue K, 75074
Joint Use Facility Police Substation 7501-A Independence Parkway, 75025	**Station 2** 2630 West 15th Street, 75075
Northwest Police Substation 4640 McDermott Road, 75024	**Station 3** 3520 Sherrye Drive Plano, 75074
Legacy Town Center Police Substation 7200 Bishop Road, 75024	**Station 4** 6000 Roundrock Trail Plano, 75023
Legacy West Police Substation 7401 Windrose Avenue Building D, 75024	**Station 5** 5115 West Park Boulevard, 75093
	Station 6 900 Seabrook Drive, 75023
PUBLIC SAFETY COMMUNICATIONS	**Station 7** 5602 Democracy Drive, 75024
Municipal Center Complex 1520 Avenue K, 75074	**Station 8** 4555 Hedgecoxe Road, 75024
	Station 9 6625 West Parker Road, 75093
EMERGENCY MANAGEMENT	**Station 10** 3540 McDermott Road, 75025
Emergency Operations Center 4125 W Parker Road, 75093	**Station 11** 4800 Los Rios Boulevard, 75074
	Station 12 4101 W. Parker Road, 75093
	Station 13 6901 Corporate Drive, 75024

Food, Water, Shelter

Food, water, and shelter are the most basic of fundamental lifelines. The City of Plano provides essential food, water, and shelter during times of emergency and natural disaster. The city partners with community and faith-based organizations to provide these necessities year-round. A comprehensive list of these services is provided in Tables 3-4, 3-5, and 3-6.

Table 3-4 *Food Distribution Sites*

NAME	ADDRESS
Christian Food Pantry	1116 Dobie Drive
Holy Nativity Episcopal Church	2200 18th Street
God's Pantry	3420 14th St #101
North Texas Food Bank	3677 Mapleshade Lane
Minnie's Food Pantry - Distribution Center	3198 W. Parker Road
Christian Benevolent Outreach	1804 P Avenue
Seven Loaves Food Pantry	1401 Mira Vista Boulevard
Saint Vincent de Paul	1100 W 15th Street
Salvation Army-Plano Corps	3528 14th Street
Islamic Association of Collin County	6401 Independence Parkway
WillowCreek Fellowship	1804 P Avenue

Table 3-5 *Critical Water Infrastructure*

NAME	ADDRESS
Custer Pump Station	1901 W 15th Street
Ridgeview Pump Station	2501 Ridgeview Drive
Shiloh Pump Station	FM544/Shiloh Road
Stadium Pump Station	6601 Alma Drive
Legacy Lift Station	7803 Parkwood Boulevard
Legacy West Lift Station	8235 Dallas Parkway
Mapleshade Lift Station	4310 Mapleshade Lane

Table 3-6 *Shelter Locations (Subject to Change)*

NAME	ADDRESS
Carpenter Park Recreation Center	6701 Coit Road
Douglas Community Center	1111 H Avenue, Building B
Liberty Recreation Center	2601 Glencliff Drive
Oak Point Park Recreation Center	6000 Jupiter Road
Sam Johnson Senior Center	401 W. 16th Street
Tom Muehlenbeck Recreation Center	5801 W. Parker Road

Health and Medical

The City of Plano has numerous health and medical facilities, including hospitals, long-term care, assisted living, senior living, end-stage renal disease, and physician/clinic facilities. Table 3-7 lists the major hospitals within the City of Plano.

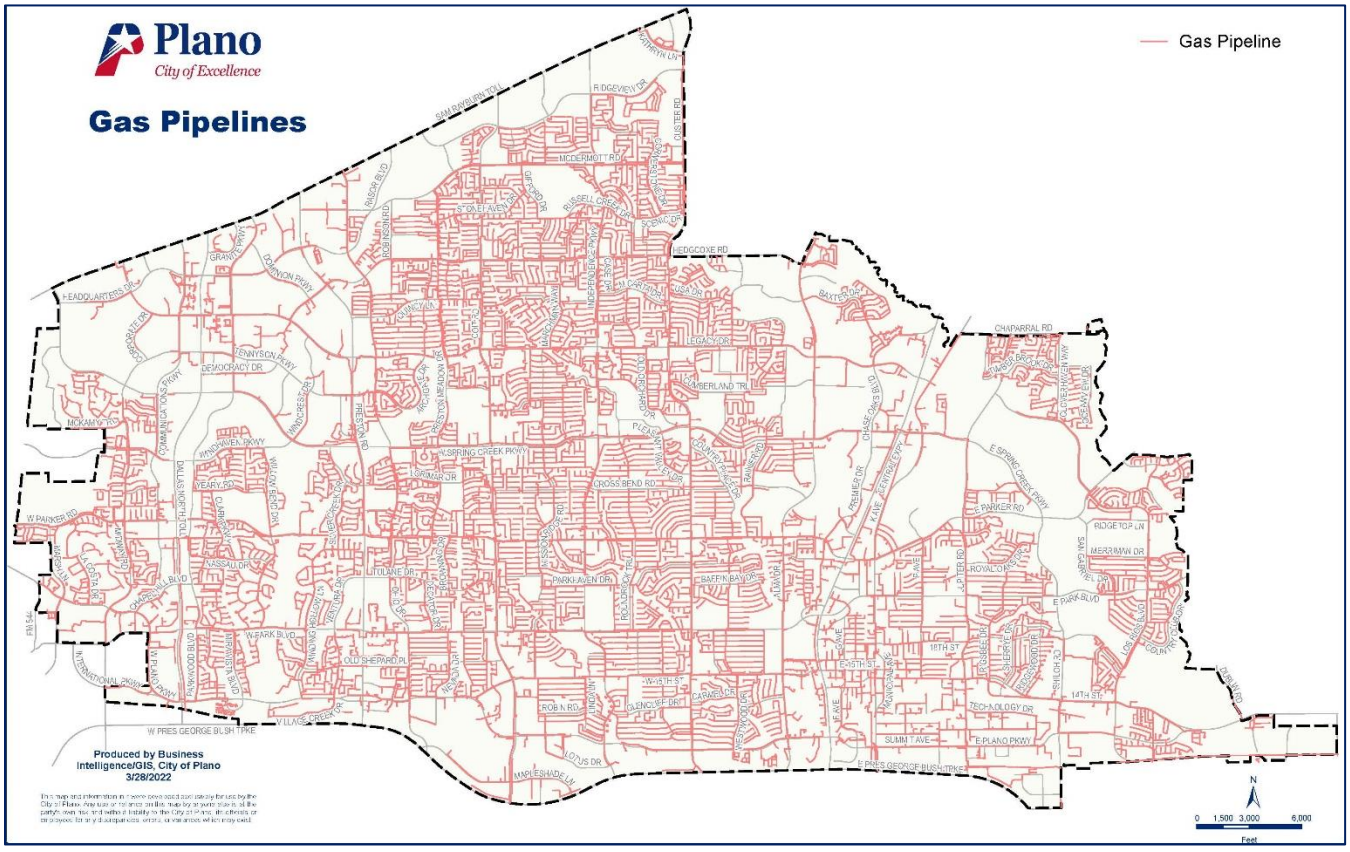
Table 3-7 *Plano Hospitals*

NAME	ADDRESS
Baylor Heart Hospital Plano	1100 Allied Drive
Baylor Scott & White Medical Center Plano	4700 Alliance Boulevard
Children's Medical Center Plano	7601 Preston Road
Medical City Plano	3901 W 15th Street
Texas Health Resources Plano	6200 W Parker Road

Energy

Energy is an important resource to any community. Providing electricity and fuel to residents is an essential part of the City of Plano's community lifelines. In addition, having a reliable electrical power grid and natural gas provides many other necessities to all residential and commercial areas. Figure 3-4 depicts the City of Plano's gas pipeline infrastructure.

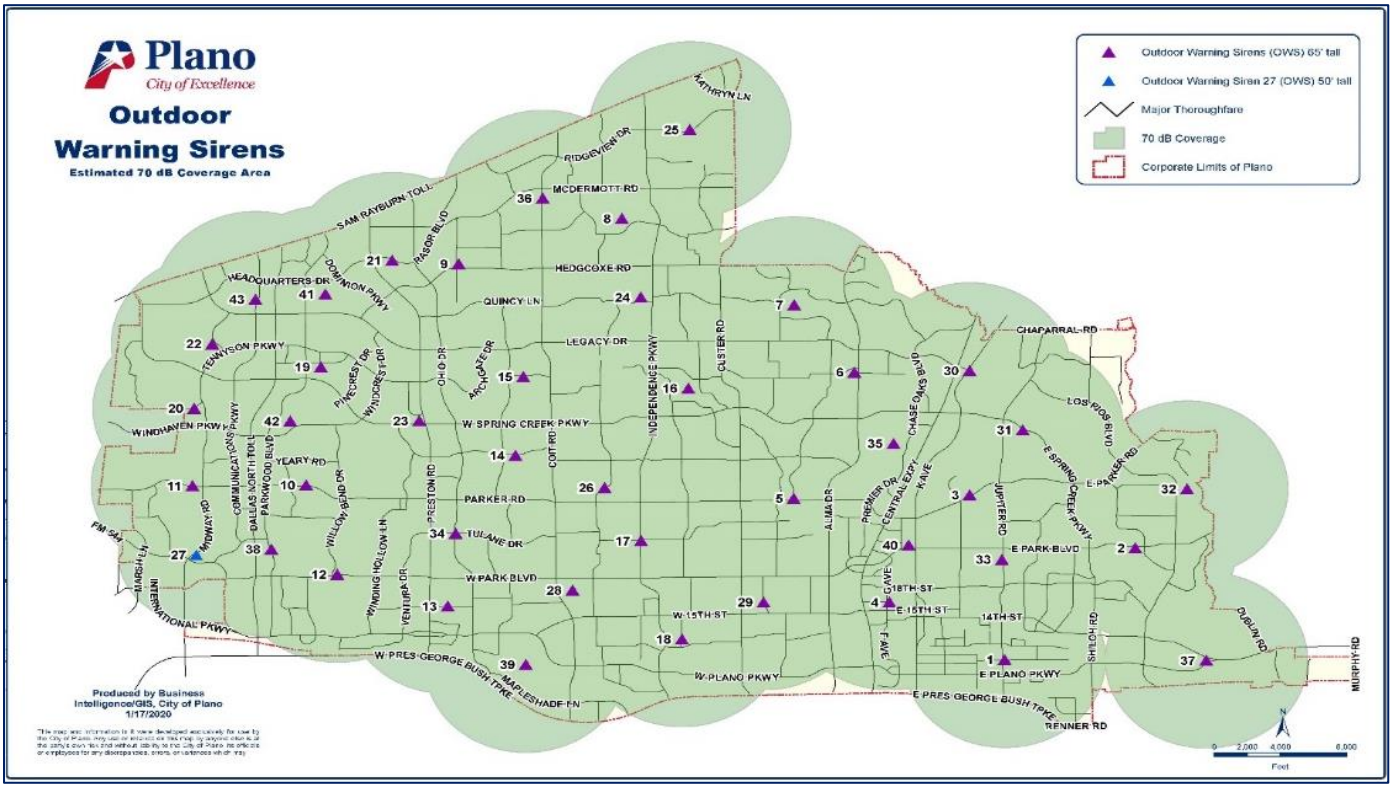
Figure 3-4 *Gas Pipeline Infastructure*



Communications

Communication between first responders and the community keeps information flowing and allows real-time information sharing. The City of Plano has identified critical locations for communication transmission and redundancies. The city can also broadcast warnings and alerts over its outdoor warning system comprising 43 individual sirens (Figure 3-5).

Figure 3-5 *Outdoor Warning System (OWS) Coverage Area*



Transportation

The City of Plano offers many transportation avenues for people and cargo, including major highways, railroads, and public transit, including buses and light rail. Figure 3-6 depicts the City of Plano's major transportation routes.

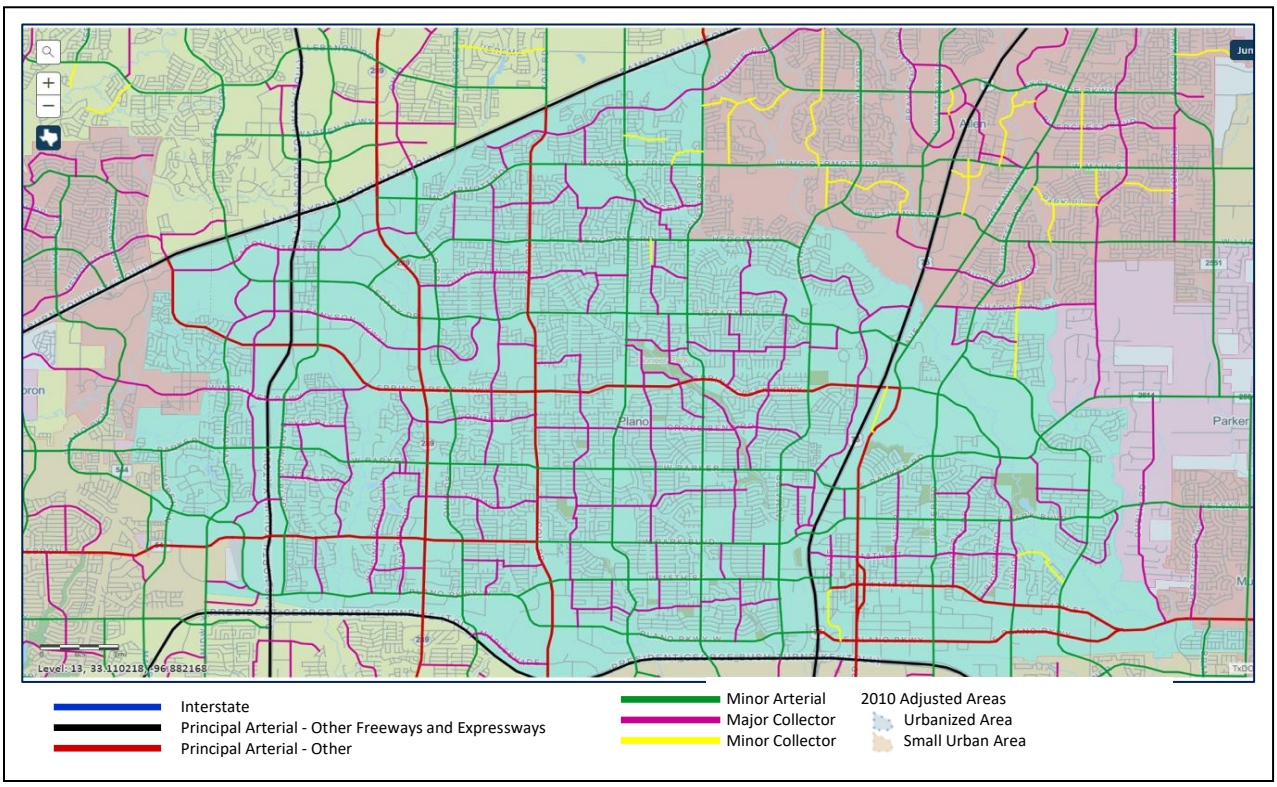
EAST - WEST HIGHWAYS

Access is provided by Sam Rayburn Tollway (State Highway 121) and George Bush Turnpike (State Highway 190). Both roads serve as the City's north and south boundaries and provide convenient access to Interstates 35 and 635 and Dallas/Fort Worth International Airport (DFW).

NORTH - SOUTH HIGHWAYS

Access is available by Dallas North Tollway (DNT) and US Highway 75 (Central Expressway). The Dallas North Tollway nicknamed "the Platinum Corridor," links Legacy, Granite, and International Business Parks to downtown Dallas and several regional shopping malls. US Highway 75 provides southbound access to downtown Dallas and northbound access to Oklahoma. In addition to the highway routes that pass through the city, several major transportation arteries and collector roads for highways across the City.

Figure 3-6 *City of Plano Major Transportation Routes*[2]



LIGHT RAIL

Dallas Area Rapid Transit (DART) operates a modern light rail system serving the greater Dallas community. The DART light rail system comprises 93 miles between its four lines; the Red Line, the Blue Line, the Orange Line, and the Green Line. Dart light rail has routes that connect Plano and other suburban cities such as Richardson, Garland, Carrollton, Irving, Rowlett, and Farmers Branch. DART also operates the Trinity Railway Express between Dallas and Fort Worth.

There are two DART light rail stations in Plano; the Downtown Plano Station, located on 15th Street, Plano, TX 75074, and the Parker Road Station, 2600 Archerwood Street, Plano, TX 75074

FREIGHT

Plano is accessible by three class-1 railroads: Union Pacific, Burlington Northern (BNSF), and Kansas City Southern. Short-haul rail is also available by Dallas, Garland, and Northeastern Railroad (DGNO).

PASSENGER RAIL

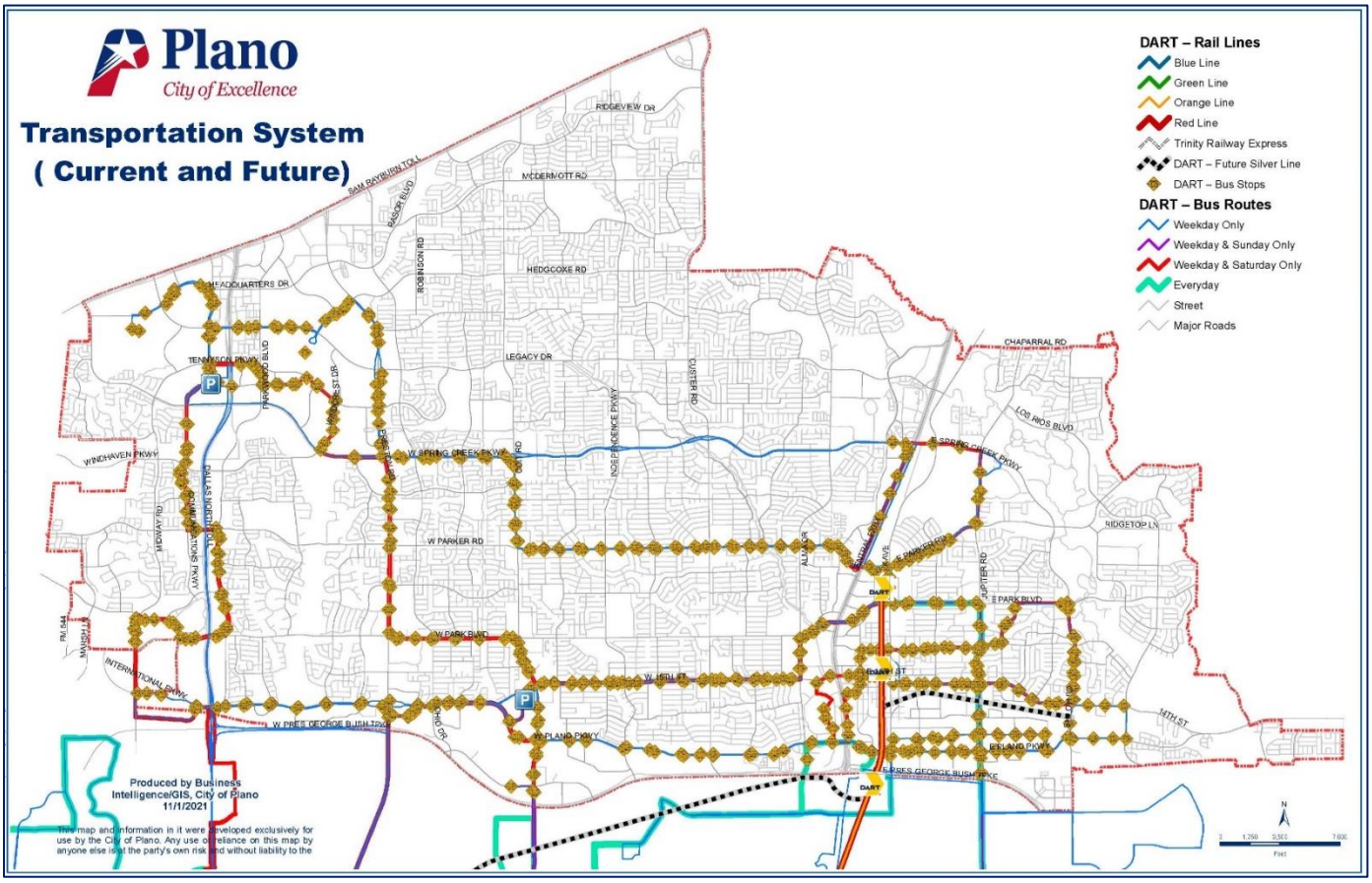
DART is in the process of constructing facilities along the existing Cotton Belt railway to improve mobility and accessibility within the northern portions of the DART service area. The renamed “Silver Line” will traverse through southern Collin County and northern Dallas County and terminate in Tarrant County at DFW Airport.

[2] Source: TxDOT Statewide Map portal: https://www.txdot.gov/apps/statewide_mapping/StatewidePlanningMap.html

TRANSIT CORRIDOR

The Transit Corridor future land use category applies to the Downtown Plano core and the adjoining rail corridor linking the Dallas Area Rapid Transit (DART) red/orange line and the future Cotton Belt line expected to be completed in 2023 (Figure 3-7). It intends to continue the transformation of the Downtown Plano core into a distinct and authentic urban center and expand the vision for transit-oriented development within the entire corridor. Major uses within Transit Corridor include housing, retail, cultural facilities, hotels, and government offices. Infill and redevelopment projects should be compatible with the area's historic character. Transit-oriented residential, employment, retail, and civic uses should be within one-quarter to one-half mile walking distance of a transit stop. Uses should be serviced by parking structures to reduce surface parking and encourage efficient use of land. Street, trail, and sidewalk improvements will be emphasized to create a more accessible, walkable, and unified corridor. Useable open spaces will be included to create active and interesting public spaces. Commercial and residential uses within the corridor shall be designed to acknowledge visibility from the rail, especially where elevated, as a gateway to the community.

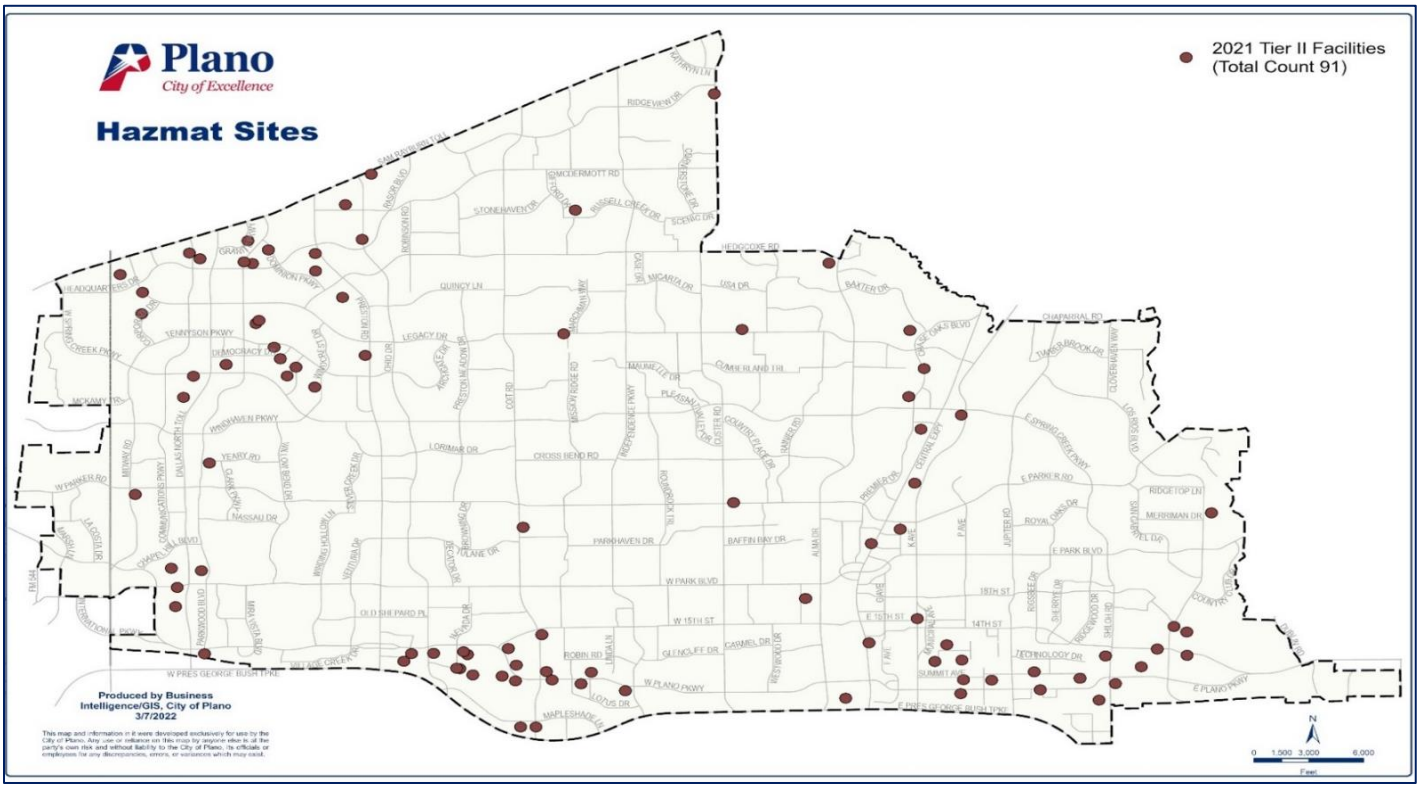
Figure 3-7 *City of Plano DART Transportation Lines*



HAZARDOUS MATERIALS

Chemical, biological, radiological, and nuclear hazards are dangerous and life-threatening to local communities and those working within the city. Often there is little or no warning to prepare and evacuate to safety. Therefore, identifying hazardous material stockpiles and hazard-producing sites is essential to mitigation and planning efforts. Figure 3-8 depicts current Tier II site locations within Plano (as of 2021).

Figure 3-8 *Hazardous Material Stockpile Locations, Including Hazard Producing Sites*



SECTION 4. RISK OVERVIEW

4.1 Hazard Identification

This section describes the risk assessment process, hazard identification, and hazard descriptions. It also includes a description, location, extent, historical occurrences, the likelihood of future events, vulnerability and impact and climate change of the identified hazards.

The Hazard Mitigation Action Plan for the City of Plano identified ten natural hazards, six human-caused hazards, and two "other" risks. The identification process relied on historical records, national data sources such as the *National Centers for Environmental Information (NCEI)*, existing plans such as the *Texas Hazard Mitigation Plan, October 2018*[3], and guidelines such as the *FEMA Local Mitigation Planning Tool, March 2013*[4], as well as consultations with the Hazard Mitigation Steering Committee and local and regional specialists.

The HMSC combined hail, high winds, and lightning under the "Severe Thunderstorm" hazard. Extreme heat and extreme cold were combined under the "Extreme Temperature" hazard. The City of Plano's 2013 Hazard Mitigation Plan identified thirteen hazards, eight of which were natural and three of which were human-caused. The risk assessment for this plan is focused solely on the specific hazards that have a high potential or have affected the City of Plano.

Atmospheric

Atmospheric risks are incidents or events linked to weather-related phenomena. The City has identified the following atmospheric hazards tornados, severe winter storms, severe thunderstorms (including hail, high winds & lightning), flooding, extreme temperatures (extreme heat & extreme cold), and drought.

Hydrologic Hazards

Hydrologic hazards, such as floods, droughts, and associated phenomena, contribute to considerable and rising loss of life and property in the United States and around the world.[5] Almost 75% of all federal disaster designations in the country are related to hydrologic hazards. Two hydrologic concerns that have been determined to be pertinent for the City of Plano planning area are drought and flooding. Floods and droughts may seriously harm agriculture, and they significantly influence local governments because of the increasing water needs in the City of Plano, which is seeing a substantial increase in population.

Other

The other category contains two hazards, expansive soil hazards and public health emergencies. They are classified as "other" risks for the risk assessment because they might be either natural or induced by humans, but they are not considered atmospheric or hydrologic risks.

Human-Caused

Human-caused disasters have an element of human intent, negligence, or error involving a failure of a man-made system, as opposed to natural disasters resulting from natural hazards. Human-caused disasters include public health emergencies (intentional biological/chemical threats), hazardous material and cyber-attacks, explosive incidents, terrorism, civil disorder, and active shooter/hostile event. Although a public health emergency is defined as any adverse event, natural or man-made, the City of Plano has grouped it under the other category.

[3] State of Texas Hazard Mitigation Plan (2018)
[4] FEMA Local Mitigation Planning Handbook, March 2013
[5] Geological Survey (U.S.), & National Research Council (U.S.). (1999). Hydrologic hazards science at the U.S. Geological Survey. Washington, D.C: National Academy Press.

Table 4-1 *Description of Natural Hazards*

HAZARD	DESCRIPTION
ATMOSPHERIC	
Tornado	A violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind speeds ranging from as low as 40 mph to as high as 300 mph. The destruction caused by tornadoes ranges from light to catastrophic, depending on the storm's location, intensity, size, and duration.
Severe Winter Storm	Snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads, and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property, and cause fatalities and injuries.
Severe Thunderstorms *(Includes hail, high winds & lightning)*	**Hail -** Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and subsequent cooling of the air mass. **High Winds -** Straight-line winds are thunderstorm winds with no rotation, i.e., not a tornado. Downbursts are a common cause of wind damage from a thunderstorm. They can reach over 100 mph and are caused by precipitation dragging air down. **Lightning -** A sudden electrostatic discharge that occurs during an electrical storm. This discharge occurs between electrically charged regions of a cloud, between two clouds, or between a cloud and ground.
Extreme Temperatures *(Includes extreme heat & extreme cold)*	**Extreme Heat -** The condition whereby temperatures hover 10 °F or more above the average high temperature in a region for an extended period of time.
	Extreme Cold – When temperatures are characterized by a drop in ambient air temperature to 32°F or below.
HYDROLOGIC	
Drought	A water shortage is caused by the natural reduction in the amount of precipitation expected over an extended period. It can be aggravated by other factors such as high temperatures, high winds, and low relative humidity. Extended periods of drought can enormously impact an area by affecting the abundance of water supply, the agricultural economy, and the foundations of structures.
Flooding	The accumulation of water within a body of water results in overflowing excess water onto adjacent lands, usually floodplains. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body susceptible to flooding.
OTHER	
Expansive Soils	Soils and soft rock that tend to swell or shrink due to changes in moisture content. Changes in soil volume present a hazard primarily to structures built on top of expansive soils.
Public Health Emergency	An occurrence or imminent threat of an illness or health condition caused by bioterrorism, epidemic or pandemic disease, or an infectious agent or biological toxin that poses a substantial risk to humans by causing significant human fatalities or permanent or long-term disability, including influenza.

HUMAN-CAUSED	
Hazardous Materials Incident	A hazardous material (solid, liquid, or gaseous contaminants) of flammable or poisonous material would be dangerous to life or the environment if released without precaution.
Cyber Incident	The offensive maneuver employed by individuals or whole organizations that targets computer information systems, infrastructures, computer networks, and/or personal computer devices by various means of malicious acts, usually originating from an anonymous source that either steals, alters, or destroys a specified target by hacking into a susceptible system.
Transportation Incident	A road traffic accident includes vehicle collisions, pedestrian–bicycle collisions, pedestrian–pedestrian collisions, etc., railroad accidents (including train wrecks), aviation accidents, and incidents.
Explosive Incident	Explosions can be from an accident or human negligence, or intentional. The immediate blast can cause casualties by injuring people nearby. In addition, the blast may result in additional environmental hazards from airborne dust/surface contamination.
Terrorism	Incidents involving one or more modes of harmful force to the built environment include contamination (chemical, biological, radiological, or nuclear), energy (arson, electromagnetic waves), or denial of service (sabotage, infrastructure breakdown, and transportation service disruption).
Civil Disorder	The US Code defines a civil disorder as any public disturbance involving acts of violence by three or more persons which cause an immediate danger or results in damage or injury to the property or person of any other individual.
Active Shooter/ Hostile Event	An individual actively engaged in killing/attempting to kill people in confined or populated areas. In most incidents, firearm(s) are used. Typically, a pattern or method for selecting victims creates unpredictable and quickly evolving situations that can result in loss of life and injury.

4.2 Overview of Hazard Analysis

The methodologies utilized to develop the Risk Assessment are a historical analysis and a statistical approach. Both methodologies provide an estimate of potential impact by using a common, systematic framework for evaluation.

Records retrieved from the National Centers for Environmental Information (NCEI) and National Oceanic and Atmospheric Administration (NOAA) were reported for the City of Plano. In addition, remaining records identifying the occurrence of hazard events in the planning area and the maximum recorded magnitude of each event were also evaluated.

Geographic information system (GIS) technology was utilized to identify and assess risks for the City of Plano planning area and evaluate community assets and their vulnerability to hazards.

4.2.1 RISK ASSESSMENT PARAMETERS

The four general parameters for each hazard in the risk assessment include frequency of return, approximate annualized losses, a description of the general vulnerability, and a statement of the hazard's impact.

The frequency of return was calculated by dividing the number of events in the recorded time period for each hazard by the overall time period in which the resource database was recording events. The frequency of return statements is defined in Table 4-2, and impact statements are defined in Table 4-3.

Table 4-2 *Frequency of Return*

PROBABILITY	DESCRIPTION
Highly Likely	Event is probable in the next year
Likely	Event is probable in the next three years
Occasional	Event is probable in the next five years
Unlikely	Event is probable in the next ten years

Table 4-3 *Impact Statements*

POTENTIAL	SEVERITY DESCRIPTION
Substantial	Multiple deaths. Complete shutdown of facilities for 30 days or more. More than 50 percent of the property is destroyed or with major damage.
Major	Injuries and illnesses resulting in permanent disability. Complete shutdown of critical facilities for at least two weeks. More than 25 percent of the property is destroyed or with major damage.
Minor	Injuries and illnesses do not result in permanent disability, a complete shutdown of critical facilities for more than one week. More than 10 percent of the property is destroyed or with major damage.
Limited	Injuries and illnesses are treatable with first aid. Shutdown of critical facilities and services for 24 hours or less. Less than 10 percent of the property is destroyed or with major damage.

4.3 Hazard Ranking

Table 4-4 portrays the results of the City's self-assessment for hazard ranking based on the preliminary results of the risk assessment presented at the Hazard Mitigation Steering Committee Kickoff Meeting. This table also takes into account local knowledge regarding the frequency of occurrence and the potential impact of each hazard.

Table 4-4 *Hazard Rankings*

HAZARD	FREQUENCY OF OCCURRENCE	POTENTIAL SEVERITY	RANKING
Tornado	Highly Likely	Substantial	**High**
Severe Winter Storm	Highly Likely	Major	**High**
Public Health Emergency	Likely	Minor	**High**
Severe Thunderstorms (Includes Hail, High Winds & Lightning)	Highly Likely	Substantial	**High**
Flooding	Likely	Major	**Moderate**
Hazardous Materials Incident	Likely	Minor	**Moderate**
Cyber Incident	Likely	Minor	**Moderate**

HAZARD	FREQUENCY OF OCCURRENCE	POTENTIAL SEVERITY	RANKING
Extreme Temperatures (Includes Extreme Heat & Extreme Cold)	Likely	Minor	**Moderate**
Drought	Likely	Minor	**Moderate**
Transportation Incident	Occasional	Minor	**Low**
Explosive Incident	Occasional	Major	**Low**
Terrorism	Occasional	Limited	**Low**
Civil Disorder	Occasional	Limited	**Low**
Active Shooter/ Hostile Event	Likely	Limited	**Low**
Expansive Soils	Likely	Minor	**Low**

4.4 Omission of Specific Hazards

Hurricanes

Hurricanes are not included in this plan. The absence is primarily due to Plano's geographic position to the Gulf of Mexico. Corpus Christi, located approximately 400 miles south-southwest of Plano, is the closest Gulf of Mexico coastal city.

Plano, Texas, is located inland and is not at risk for direct impacts from hurricanes. Hurricanes typically form over warm ocean waters and travel towards coastal areas, where they can produce storm surge, high winds, and heavy rainfall. While the City of Plano may experience indirect impacts from hurricanes, such as heavy rainfall and flash flooding, the likelihood of direct impacts is low.

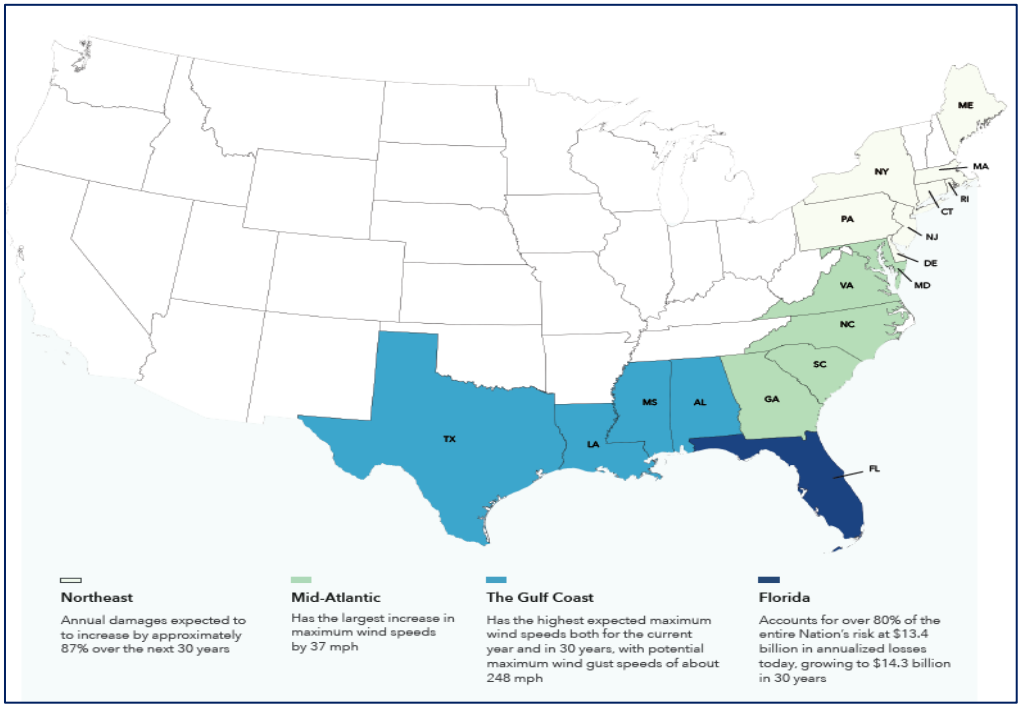
However, it is important to note that climate change is causing changes in the frequency and intensity of hurricanes, and some studies suggest that hurricanes may become more likely to impact inland areas in the future. According to a study published by First Street Foundation, *The 7th National Risk assessment- Worsening -Winds,* states;

> "Over the next 30 years, the tropical cyclones which develop are more likely to become major hurricanes, with greater intensities, and therefore their effects will reach further inland. While wind exposure and damages are most significant along the coast, they are likely to increase inland drastically in many places that have never before been exposed. Additionally, over the next 30 years, tropical cyclones will push further northward before making landfall."[6]

The estimated regional changes of tropical cyclone wind risk between 2023 and 2053 are shown in Figure 4-1. Climate change is causing tropical cyclones to intensify, move farther north, and affect more interior locations of the state. Future HMAP planning may eventually include this risk depending on increased occurrences.

[6] First Street Foundation. (2023, February 21). The 7th National Climate Risk Assessment: Worsening winds. National Report | Wind. Retrieved April 19, 2023, from https://report.firststreet.org/wind

Figure 4-1 *Regional Changes of Wind Risk - 2023-2053*



Wildfires

Wildfires are not typically a significant threat in the City of Plano and this hazard is not included in the plan. Plano is not densely forested and is not typically prone to drought conditions that can increase the risk of wildfires. However, wildfires can still occur in the surrounding areas and can potentially impact Plano and its residents.

Climate change can cause drier conditions in some regions, which can increase the risk of wildfires. Higher temperatures can lead to increased evaporation, and changing precipitation patterns can lead to longer periods of drought, which can dry out vegetation and make it more prone to ignition. Climate change can also cause changes in weather patterns that can increase the frequency of lightning strikes. Lightning is a common cause of wildfires, particularly in dry areas. Climate change can lead to changes in the distribution and abundance of plant species, including invasive species that can increase the fuel load and fire risk.

Earthquakes

Earthquakes were omitted from this plan as it is not typically a significant risk to the City of Plano. The area is in a region known as the North Texas Basin, which is not known for seismic activity. While the risk of earthquakes in Plano is generally low, it is not zero. There have been some small earthquakes recorded in the area in recent years, and there is some potential for earthquakes to occur in connection with oil and gas production activities.

Overall, the risk of earthquakes in Plano is relatively low compared to other parts of the world that are located near major fault lines or tectonic plate boundaries.

However, it is important to note that climate change can indirectly impact earthquakes in some regions. For example, melting of glaciers and ice sheets due to climate change can cause changes in the Earth's crust, which can lead to changes in the distribution of stresses and strains and potentially trigger earthquakes. However, the likelihood of this occurring in Plano or the surrounding regions is very low.

4.5 Tornado

4.5.1 HAZARD DESCRIPTION

A tornado is a rapidly rotating column of air extending between, and in contact with, a cloud and the earth's surface. Tornadoes are among the most violent storms on the planet; the most violent tornadoes are capable of tremendous destruction, with wind speeds of 250 miles per hour (mph) or more. In extreme cases, winds may approach 300 mph. Tornado damage paths can be more than one-mile-wide and 50 miles long.

Tornadoes often occur when two air masses with different characteristics collide. For example, when a warm, moist air mass collides with a cool, dry air mass, the sharp contrast in temperature and moisture content can trigger the development of severe thunderstorms and tornadoes. Several factors contribute to the formation of tornadoes:

- Instability in the atmosphere
- Convergence of air masses
- Vertical wind shear
- Thunderstorms

Wind shear refers to the change in wind speed and direction with height. Strong wind shear can create a rotating column of air known as a mesocyclone, which is a crucial ingredient for tornado formation. The rotating mesocyclone can be tilted vertically by updrafts within the storm, leading to the formation of a tornado. Straight-line winds can also cause tornados.

Table 4-5 *Tornado Variations*

WEAK TORNADOES	STRONG TORNADOES	VIOLENT TORNADOES
69% of all tornadoes	29% of all tornadoes	2% of all tornadoes
Less than 5% of tornado deaths	Nearly 30% of all tornado deaths	70% of all tornado deaths
Lifetime 1-10+ minutes	May last 20 minutes or longer	Lifetime can exceed 1 hour
Winds less than 110 mph	Winds 110 – 205 mph	Winds greater than 205 mph

A lift mechanism is needed to initiate the upward motion of air required for tornado formation. This can be provided by various factors, such as frontal boundaries, outflow boundaries from thunderstorms, or the interaction of winds with topographic features like hills or mountains.

Tornadoes are most commonly associated with severe thunderstorms. All thunderstorms have the potential to produce tornadoes, but the type of storm that is most commonly tornadic is the supercell. Supercells may produce strong, violent tornadoes or several tornadoes over several hours. Supercell thunderstorms are created when horizontal wind shears (winds moving in different directions at different altitudes) begin to rotate the storm. This horizontal rotation can be tilted vertically by violent updrafts, and the rotation radius can shrink, forming a vertical column of very quickly swirling air. This rotating air can eventually reach the ground, forming a tornado.

4.5.2 LOCATION

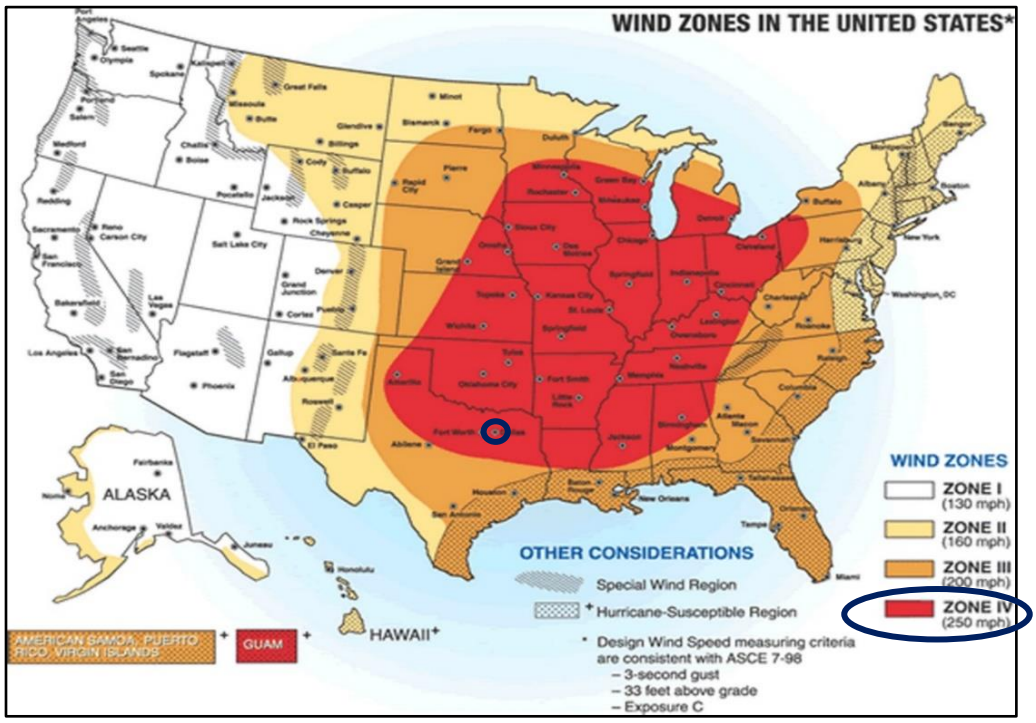
Tornadoes do not have any specific geographic boundary and can occur throughout the city uniformly. Therefore, it is assumed that the City of Plano is uniformly exposed to tornado activity.

4.5.3 EXTENT

The severity of a tornado's destruction can range from minimal to catastrophic, depending on the storm's size, duration, and intensity. Table 4-5 depicts the variations of tornado extent. Lightweight structures, such as residential dwellings, particularly mobile or manufactured homes, are typically the ones that sustain the most damage during tornadoes.

Figure 4-2 depicts how the frequency and strength of extreme windstorms vary across the United States. For example, wind speeds in Zone IV (red), where the risk of extreme windstorms is greatest, can be as high as 250 miles per hour. The City of Plano is in Zone IV (circled in blue).

Figure 4-2 *Wind Zone Map of the United States (Plano circled in blue)*



4.5.4 HISTORICAL OCCURRENCES

For all of Collin County, and the surrounding communities of Plano, there was a total of 61 tornadoes that have been documented between 1880 and 2023[7]. Table 4-7 displays historical data of tornadoes that was obtained from the National Centers for Environmental Information and the National Oceanic and Atmospheric Administration, not all events may be included. It is important to note that the Fujita Scale, rather than the Enhanced Fujita Scale (Table 4-6), was used to measure tornadic events before 2007[8].

[7] Source: https://www.weather.gov/fwd/collin-tor
[8] The EF Scale was revised from the original Fujita Scale to reflect better examinations of tornado damage surveys to align wind speeds more closely with associated storm damage. The new scale has to do with how most structures are designed.

Table 4-6 *Enhanced Fujita Scale*[9]

CATEGORY	WIND SPEED (MPH)	POTENTIAL DAMAGE
EF0	65 – 85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over
EF1	86 – 110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows/other glass broken
EF2	111 – 135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off the ground
EF3	136 – 165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance
EF4	166 – 200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown, and small missiles generated
EF5	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yards); high-rise buildings have significant structural deformation; incredible phenomena will occur

Table 4-7 *Historical Tornadic Events (1954-2022)*

DATE	TIME	MAG	FATALITIES	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
12/13/2022	947	EF2	0	2	0	0
4/4/2022	2032	EF1	0	0	$200,000	0
5/3/2021	1841	EF0	0	0	$500	0
10/20/2019	2322	EF0	0	0	$200,000	0
4/29/2016	1553	EF0	0	0	$30,000	0
12/26/2015	1909	EF2	2	119	$1,400,000	0
12/26/2015	1917	EF1	0	0	$1,500,000	0
12/26/2015	1933	EF1	1	2	$600,000	0
4/3/2014	1827	EF0	0	1	$200,000	0
4/10/2008	304	EF1	0	0	$12,000,000	0
3/30/2007	2020	EF0	0	0	$500,000	0
5/9/2006	2126	F0	0	0	0	0
5/9/2006	2133	F0	0	0	$30,000	0
5/9/2006	2137	F3	2	6	$1,000,000	0
3/4/2004	1535	F1	0	2	$150,000	0
7/1/2003	1350	F0	0	0	0	0

[9] Source: National Weather Service: https://www.weather.gov/hun/efscale_explanation

DATE	TIME	MAG	FATALITIES	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
9/5/2001	1405	F0	0	0	0	0
9/5/2001	1430	F1	0	0	$30,000	0
3/16/1998	1905	F1	0	0	$200,000	0
10/7/1994	1500	F1	0	2	$500,000	0
7/12/1994	2115	F0	0	0	$50,000	0
9/13/1993	1010	F0	0	0	0	0
3/17/1987	1940	F0	0	0	0	0
10/18/1985	930	F2	0	2	$250,000	0
3/27/1984	1630	F1	0	0	$2,500	0
7/27/1982	1300	F0	0	0	$2,500	0
3/29/1979	1415	F0	0	0	0	0
9/12/1977	1620	F2	0	0	$25,000	0
9/7/1977	1540	F1	0	0	$2,500	0
3/27/1977	454	F2	0	0	$250,000	0
6/9/1975	1840	F0	0	0	0	0
11/20/1973	110	F1	0	3	$25,000	0
8/10/1972	1600	F0	0	0	$2,500	0
12/14/1971	1815	F0	0	0	$25,000	0
7/19/1971	1715	F1	0	0	$25,000	0
9/1/1970	1615	F1	0	0	0	0
4/18/1970	2130	F1	0	2	$2,500	0
10/12/1969	744	F3	0	0	$2,500	0
4/27/1969	510	F2	0	45	$250,000	0
5/13/1968	300	F2	0	0	$25,000	0
4/22/1968	750	F1	0	0	$25,000	0
3/25/1967	2100	F0	0	0	0	0
3/25/1967	2100	F0	0	0	0	0
5/19/1963	1500	F0	0	0	0	0
4/28/1963	1230	F1	0	0	$2,500	0
4/22/1963	1730	F2	0	0	$250,000	0
10/4/1959	600	F3	0	5	$250,000	0
4/27/1958	1530	F2	0	0	$250,000	0
4/2/1957	1620	F3	0	2	$250,000	0
5/25/1954	1815	F0	0	0	0	0

DATE	TIME	MAG	FATALITIES	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
3/24/1954	2130	F1	0	4	$250,000	0

4.5.5 SIGNIFICANT PAST EVENTS

The City of Plano has had three direct tornadic incidents (Table 4-8). The National Weather Service rated these incidents as EF-0, EF-1, and EF-2. The most severe tornado to date was an EF-2 that occurred on 4/27/1969 and resulted in 14 injuries and $500,000 worth of property damage, making it the most significant event.

Table 4-8 *Significant Tornado Events in Plano*

DATE	TIME	CLASSIFICATION	DESCRIPTION OF EVENT
6/9/1975	1840	EF0	Tornado touched down briefly at Parker and Custer Road. No damage was reported.
4/18/1970	2130	EF1	Two Plano High School students were injured while riding in their automobile, which was picked up by a tornado and thrown into a fence.
4/27/1969	510	EF2	A tornado struck a mobile home park requiring the hospitalization of 45 persons, 14 of those hurt seriously. Total property damage was estimated at $500,000.

4.5.6 PROBABILITY OF FUTURE EVENTS

Tornadic storms can occur at any time of year and any time of day, but they are typically more common in the spring months during the late afternoon and evening hours. A smaller, high-frequency storm period can also emerge during the brief transition between the warm and cold seasons in the fall. According to FEMA's National Risk Index," Collin County, Texas has a relatively high risk of a tornadic event with a Risk Index Score rating of 34.13%[10]. Figure 4-3 depicts tornado tracks in Collin County over a 72-year span, Figure 4-4 is a heat map of tornado activity in the United States. Both maps are indicators that the City of Plano is vulnerable and a future event is highly likely.

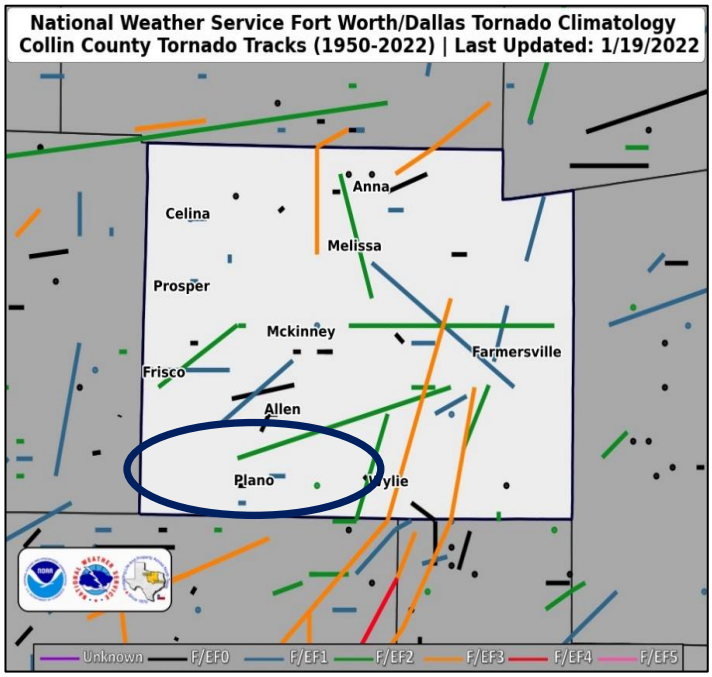
4.5.7 VULNERABILITY AND IMPACT

Tornadoes have been known to move in any direction at different strengths, in random locations, and typically create relatively narrow paths of destruction. Thus, it is difficult to evaluate the vulnerability of people and property to the impacts of a tornado. However, unless reinforced, trees, power lines and poles, signage, manufactured housing, radio towers, concrete block walls, windows, garbage receptacles, brick facades, and vehicles are vulnerable to severe winds associated with tornado events.

[10] Source: FEMA National Risk Index: Collin County Report
https://hazards.fema.gov/nri/report/viewer?dataLOD=Counties&dataIDs=C48085#SectionExpectedAnnualLoss

More severe damage involves windborne debris—in some instances, patio furniture and other lawn items have been reported to have been blown around by the wind, and, very commonly, debris from damaged structures, in turn, has caused damage to other buildings not directly impacted by the event. In numerous instances, roofs have been reported as torn-off buildings.

Figure 4-3 *Tracks of Tornadic Activity in Collin County, 1950-2022 (Plano circled in blue)*



Tornadoes have the potential to pose a significant risk to the population and can create dangerous situations.

Individuals exposed to the storm can be struck by flying debris, falling limbs, or downed trees. In addition, residential structures can be damaged or crushed by falling trees, which can physically harm the occupants.

In addition to the potential impacts faced by the general public, response personnel must enter the damaged area shortly after the tornado passes to begin rescue operations and to organize cleanup and assessment efforts. During these efforts, response personnel are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.

Tornadoes are a threat to operations and service delivery in the City of Plano and have the potential to impact the continuity of operations significantly. Roadway debris or other obstructions may prevent City staff from accessing facilities. Some departments and employees can perform their work with the resources accessible to them from their remote locations, such as working from home. Tornadoes frequently result in downed power lines and roadway blockages, disrupting the City's usual operations and service delivery.

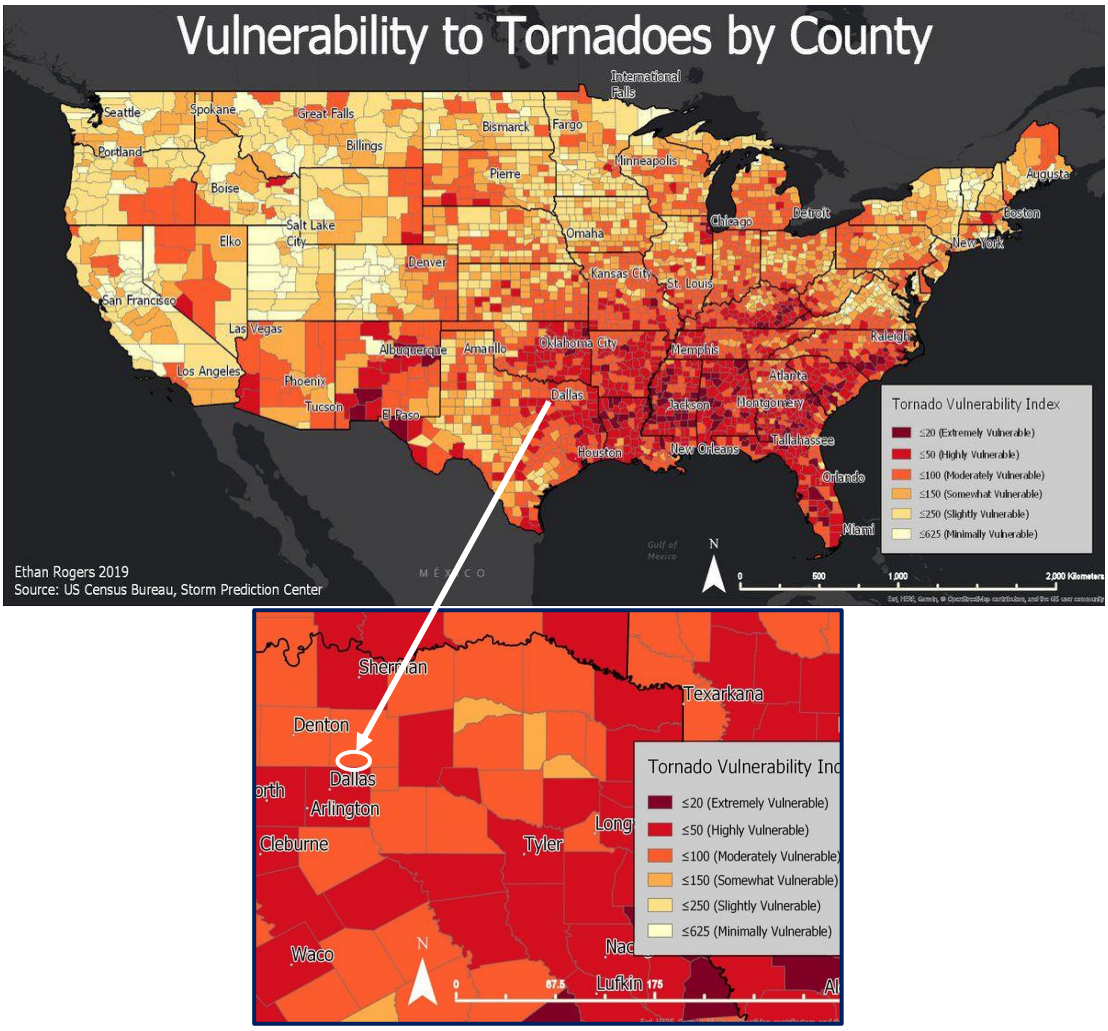
A large or severe tornado can have a significant economic impact by causing extensive property damage to City of Plano facilities, residential homes, and businesses. Tornadoes can also cause dramatic population shifts because people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area. As a result, they may require short-term relocation assistance, and some may decide not to return to the community. In addition,

uninsured or underinsured businesses may have difficulty reopening, resulting in a net loss of jobs for the community. Job losses impact the community's financial and economic health and stability and may increase unemployment.

The economic and financial consequences of a tornado in Plano will be determined by the magnitude of the event, what is damaged, and how quickly critical components of the economy can be repaired.

In addition, the level of preparedness and planning accomplished by the City, businesses, and residents will contribute to the overall economic and financial conditions following a tornado. A tornadic event in Plano is highly likely given the history, extent, impact, and vulnerability.

Figure 4-4 *Vulnerability to Tornadoes by County (Plano circled in white)* [11]



[11] Rogers, Ethan (6/25/19). *Vulnerability to Tornadoes by County*. [ca. 1:2000]. The Dallas Morning News: https://www.dallasnews.com/news/weather/2019/06/25/which-counties-in-north-texas-are-most-vulnerable-to-tornadoes-this-new-map-will-show-you/

4.5.8 CLIMATE CHANGE

"The Fourth National Climate Assessment report[12] summarizes the complicated relationship between tornados and climate change:

> "Some types of extreme weather (e.g., rainfall and extreme heat) can be directly attributed to climate change. Other types of extreme weather, such as tornados, are also exhibiting changes that may be linked to climate change, but scientific understanding isn't detailed enough to project direction and magnitude of future change." In other words, we still have a lot to learn about how climate change might affect tornados (U.S. Global Change Research Program 2018). There is increasing evidence linking global warming to changes in severe weather that gives rise to tornados. Observational data indicate detectable increases in tornado risk over the past few decades. There are several factors that contribute to tornados and tornado outbreaks in the last decade, which are influenced by climate change."

Tornadoes require certain atmospheric conditions, including high levels of instability, which can lead to the formation of thunderstorms and supercell storms. Climate change may cause changes in atmospheric instability, making it more or less likely that tornadoes will form.

Climate change is causing changes in temperature and moisture levels in the atmosphere, which can impact the formation and intensity of tornadoes. For example, higher temperatures and more moisture in the air can create conditions that are more conducive to tornado formation and intensification.

Tornadoes can have significant impacts on ecosystems, including damage to forests and other vegetation. Climate change is expected to exacerbate these impacts, which can have cascading effects on biodiversity and ecosystem function.

Overall, while the relationship between tornadoes and climate change is complex and not fully understood, it is possible that tornado frequency and intensity may be affected by climate change in Plano.

[12] https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf

4.6 Severe Winter Storm

4.6.1 HAZARD DESCRIPTION

Winter storms can cause significant problems for area residents. A severe winter storm event is identified as a storm with snow and ice or freezing rain. Winter storms are associated with freezing or frozen precipitation, such as freezing rain, sleet, snow, and the combined effects of winter precipitation and strong winds. Wind chill is a function of temperature and wind. Low wind chill is a product of high winds and freezing temperatures.

Winter storms that threaten the City of Plano usually begin as powerful cold fronts that push south from central Canada. Although the City of Plano is at risk to ice hazards, snow, and extremely cold temperatures, the effects and frequency of winter storm events are generally mild and short-lived. However, public safety response times can increase during ice and snow accumulation until major roads become passable.

4.6.2 LOCATION

Because winter storm events are not confined to specific geographic boundaries, all existing and future buildings, facilities, and populations within the City of Plano are considered exposed to this hazard and could be impacted.

Table 4-9 *Winter Storm Types*[13]

TYPE	DESCRIPTION
Winter Storm Watch	An advance statement that severe winter weather conditions are possible within the next day or two.
Winter Storm Warning	An urgent statement that severe winter weather conditions have begun or will begin within about 12 hours.
Winter Weather Advisory	A statement that winter weather conditions are imminent or occurring. These conditions will cause significant inconvenience and may become hazardous or life-threatening if safety tips are not followed.
Heavy Snow	Snowfall which accumulates to a depth of at least 4 inches in 12 hours or 6 inches in 24 hours.
Sleet	Pellets of ice composed of frozen or mostly frozen raindrops or snowflakes which have melted and refrozen
Freezing Rain/Freezing Drizzle	Rain or drizzle which falls as a liquid and then freezes when it strikes the ground or other surface.
Frost	The formation of thin ice crystals on the ground or other surfaces.
Wind Chill	A cooling effect is caused when the wind blows across exposed skin.

4.6.3 EXTENT

The extent or magnitude of severe winter storms is measured in intensity based on the temperature and level of accumulations. Table 4-9 depicts the National Weather Service's warning, watch, advisory, and description types. Table 4-10 describes winter storm magnitude by using storm intensity type and temperature range as the parameters. Also, the table includes the description of the extent such as, wind magnitude, sleet and snow accumulation.

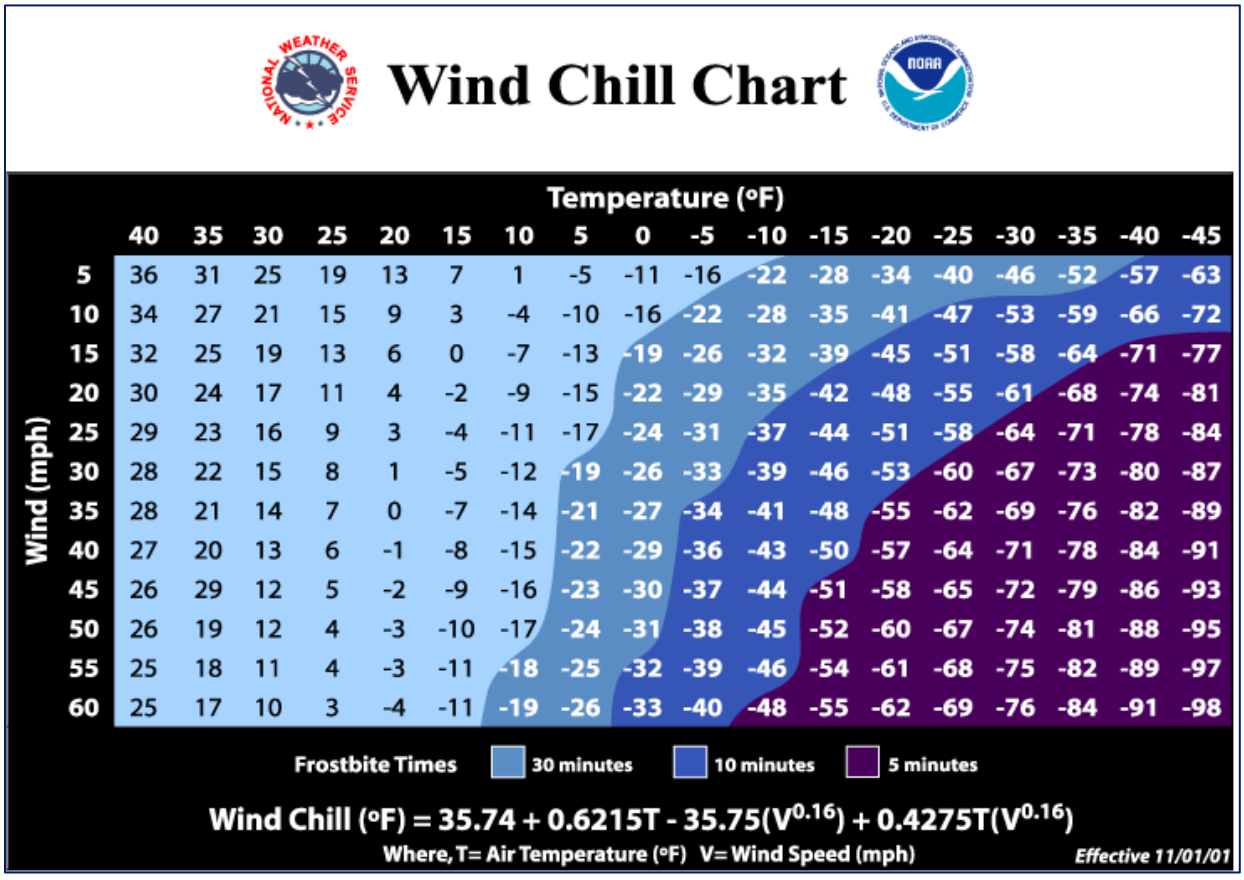
[13] Source: National Weather Service: National Weather Service, Ft. Worth/Dallas, "Texas Winter"

Table 4-10 *Severe Winter Storms Magnitude*

INTENSITY	TEMPERATURE RANGE	EXTENT DESCRIPTION
Mild	40° – 50°	Winds less than 10 mph and freezing rain or light snow falling for short durations with little or no accumulations.
Moderate	30° – 40°	Winds between 10 and 15 mph with sleet and snow up to 4 inches.
Significant	25° – 30°	Intense snow showers accompanied with strong gusty winds, between 15 and 20 mph, and significant snow accumulation.
Extreme	20° – 25°	Wind-driven snow that reduces visibility, heavy winds between 20 to 30 mph, and sleet or ice up to 5 millimeters in diameter.
Severe	Below 20°	Winds of 35 mph or more and snow and sleet accumulation greater than 4 inches.

Wind chill (depicted in Figure 4.5) temperature is a measure of how cold the wind makes real air temperature feel to the human body. For example, since wind can dramatically accelerate heat loss from the body, a blustery 30° day would feel just as cold as a calm day with 0° temperatures.

Figure 4-5 *Wind Chill Chart*[14]



[14] Source: National Weather Service https://www.weather.gov/safety/cold-wind-chill-chart

4.6.4 HISTORICAL OCCURRENCES

Table 4-12 contains the following winter-storm events: blizzard, heavy snow, ice storm, sleet, winter storm, and other winter weather events that have occurred in Collin County.

Table 4-11 *Historical Severe Winter Weather Events (1996-2021)*

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
2/11/2021	1830	Winter Weather	0	0	$200 Million	0
2/11/2018	1000	Winter Weather	0	0	0	0
12/7/2017	0900	Winter Weather	0	0	0	0
3/5/2015	0002	Heavy Snow	0	0	0	0
3/5/2015	0023	Heavy Snow	0	0	0	0
3/5/2015	0025	Winter Weather	0	0	0	0
3/5/2015	0050	Heavy Snow	0	0	0	0
3/5/2015	0100	Heavy Snow	0	0	0	0
3/5/2015	0102	Heavy Snow	0	0	0	0
3/5/2015	0115	Heavy Snow	0	0	0	0
3/5/2015	0134	Heavy Snow	0	0	0	0
3/5/2015	0134	Heavy Snow	0	0	0	0
3/5/2015	0146	Heavy Snow	0	0	0	0
3/5/2015	0250	Heavy Snow	0	0	0	0
3/5/2015	0359	Heavy Snow	0	0	0	0
3/5/2015	0815	Heavy Snow	0	0	0	0
3/5/2015	0911	Heavy Snow	0	0	0	0
3/5/2015	0911	Heavy Snow	0	0	0	0
3/5/2015	1020	Heavy Snow	0	0	0	0
3/5/2015	1129	Heavy Snow	0	0	0	0
2/27/2015	0900	Heavy Snow	0	0	$200,000	0
12/25/2012	1330	Heavy Snow	0	0	$550,000	0
2/3/2011	2330	Heavy Snow	0	0	$10,000	0
2/1/2011	0030	Ice Storm	0	0	$150,000	0
1/9/2011	0900	Heavy Snow	0	0	$150,000	0
3/20/2010	1900	Heavy Snow	0	0	0	0
2/11/2010	0500	Heavy Snow	0	0	$1,000,000	0
12/24/2009	1230	Winter Weather	0	0	$100,000	0
1/27/2009	0700	Ice Storm	0	0	$60,000	0
12/23/2008	0600	Winter Weather	0	0	0	0

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
12/15/2008	1800	Winter Weather	0	0	0	0
3/3/2008	2200	Winter Weather	0	0	0	0
2/2/2007	0100	Winter Weather	0	0	0	0
1/17/2007	0300	Winter Weather	0	0	$30,000	0
1/13/2007	1100	Ice Storm	0	0	$30,000	0
2/18/2006	0330	Winter Weather	0	0	0	0
12/22/2004	0001	Winter Weather	0	0	0	0
2/14/2004	0300	Heavy Snow	0	0	0	0
11/29/2001	0600	Ice Storm	0	0	0	0
1/1/2001	0	Heavy Snow	0	0	0	0
12/22/1998	0	Ice Storm	0	0	0	0
1/14/1997	2300	Winter Weather	0	0	0	0
1/12/1997	2000	Winter Weather	0	0	0	0
1/6/1997	1200	Winter Weather	0	0	0	0
12/17/1996	1200	Winter Weather	0	0	0	0

4.6.5 SIGNIFICANT EVENTS

In February 2021, a winter storm, Uri, hit Texas, including the City of Plano. The storm brought heavy snowfall, icy conditions, and power outages, leading to widespread disruption and damage. The storm caused an estimated $200 million in damages to the City of Plano alone. The damages included costs for repairing broken water pipes, road repairs, and damage to public and private property. The storm also led to a significant increase in energy consumption, resulting in skyrocketing electricity bills for many residents and businesses.

4.6.6 PROBABILITY OF FUTURE EVENTS

According to historical records, the City of Plano experiences one winter storm event every one to two years. Hence, the probability of a future winter storm affecting the city is highly likely.

4.6.7 VULNERABILITY AND IMPACT

While strong winter storms are often short-lived, their consequences can persist long after the storm has passed. Ice that falls and coating facilities, utilities, and roadways will not melt until the sun comes out and the temperature climbs above freezing, causing utility disruptions and hazardous road conditions for extended periods. Power outages caused by damaged lines will have an impact on properties and facilities, perhaps creating unsafe situations for individuals who use them. Water pipes may freeze and rupture if exposed to freezing conditions for an extended time. Roadways and other infrastructure damaged by ice and freezing temperatures will be unable to operate normally until temperatures increase and the ice evaporates.

The greatest threat posed by a winter storm is to public health and safety. Table 4-12 depicts the potential impact of winter storms and general safety guidance.

Table 4-12 *Winter Storm Impacts*[15]

POTENTIAL WINTER STORM IMPACTS	
Winter Weather Area	**Expect winter weather.** • Winter driving conditions. Drive Carefully.
Minor Impacts	**Expect a few inconveniences to daily life.** • Winter driving condition. Use caution while driving.
Moderate Impacts	**Expect disruptions to daily life.** • Hazardous driving conditions. Use extra caution while driving. • Closures or disruptions to infrastructure may occur.
Major Impacts	**Expect considerable disruptions to daily life.** • Extremely dangerous or impossible driving conditions. Avoid travel if possible.
Extreme Impacts	Expect substantial disruptions to daily life. • Extremely dangerous or impossible driving conditions. Travel is not advised. • Extensive and widespread closures and disruptions to infrastructure may occur. • Lifesaving actions may be needed.

Cold temperatures can create serious or life-threatening health concerns, especially in infants and the elderly, who have a lower ability to regulate their body temperature than healthy individuals. Anyone can be impacted, but those without shelter, living in a poorly insulated home, or lacking heat may confront perilous scenarios due to the intense cold.

As they may work in cold weather and winter precipitation conditions and be required to travel in potentially hazardous conditions, response personnel may be more exposed to the risks and effects of a winter storm event than the general public. Therefore, residents would be advised to stay indoors and off the roads. Responders might also come across downed electricity wires, which are extremely dangerous if they are still active. In addition, significant winter storm events may require the City of Plano to employ personnel and equipment from the following departments: Public Works, Parks and Recreation, Neighborhood Services, and other departments as deemed necessary.

Power outages in Plano may occur due to ice and snow bringing down trees and electrical lines. Winds can potentially cause additional breakage and downing of already weakened power lines. Repairing power transmission and distribution infrastructure damage might take days or weeks, depending on the severity and scale of the damage caused by ice and snow events. An excessive demand on the power grid might potentially result in system failures, preventing the typical customer base from obtaining electricity. There is also the possibility of rolling blackouts, which are often pre-planned periodic outages that are carried out to reduce the amount of strain placed on the electrical infrastructure. Increased health hazards from fire-related accidents or toxic gas inhalation may come from the loss of electric power, regular sources of heat, or both. Long-term power outages can raise the risk of structure fires and/or carbon monoxide poisoning as people try to cook or heat their homes with dangerous alternatives like barbecues. Operations or service delivery may be negatively impacted by electricity blackouts brought on by winter storms.

[15] Source: NOAA https://www.wpc.ncep.noaa.gov/wwd/wssi/wssi.php

The City of Plano Emergency Operations Center (EOC) has backup power through diesel generators. Other City departments may not be as well-equipped as the EOC and may suffer more interruptions as a result of loss of power. If files (hard copy or electronic) are damaged, destroyed, or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City.

The City of Plano Continuity of Operations Plan (COOP) may be activated as a result of a severe winter storm. Each department has its own continuity plan, which is an integral part of the city plan.

Private sector entities on which local government and its residents rely, such as utility providers, financial institutions, and medical care providers, should have specific plans that are routinely exercised. For example, if blackouts result in a loss of power to medical centers, there could be dire consequences to patients and patient care if no emergency power is available. Therefore, it is imperative that both public and private entities plan for these events and address how they will be able to function and provide services until normal operating conditions can be resumed. Limitations may also impact operations on access and mobility if roadways are closed, unsafe, or obstructed.

Given the history, extent, impact and vulnerability, a severe winter storm in Plano is highly likely.

4.6.8 CLIMATE CHANGE

Climate change can have various impacts on winter weather for the city of Plano. Generally, climate change can lead to warmer temperatures, which can result in milder winters with less snow and ice.

However, it is important to note that climate change can also lead to increased variability in weather patterns, including more frequent and intense extreme weather events such as winter storms. These storms can bring heavy snow and ice, which can cause power outages, transportation disruptions, and other significant impacts.

> "Extreme low temperatures during the winter months exhibit a stronger and more robust trend. Despite year to-year fluctuations that are much larger for extreme cold than extreme heat, there is a long-term warming trending monthly extreme cold temperatures across Texas, and the trend is larger in recent decades. Although they are much noisier, the absolute coldest temperature during winter shows similar long-term variations, with the extreme cold during 2021 easily identifiable." [16]

Additionally, warmer temperatures can lead to changes in precipitation patterns, including more rain and less snow, which can further complicate winter weather conditions.

Overall, the effects of climate change on winter weather in Plano will depend on a variety of factors, including changes in temperature, precipitation patterns, and extreme weather events. Climate change can alter the jet stream, a band of strong winds in the upper atmosphere that controls weather patterns. Some studies suggest that climate change is causing the jet stream to slow down and meander more, leading to more persistent weather patterns and an increase in extreme winter storms in some regions.

[16] Gammon*, J. N., Jorgensen*, S., & Holman*, S. (2021, October 7). Assessment of Historic and Future Trends of Extreme Weather In Texas, 1900-2036. Office of the Texas State Climatologist - Texas A&M University. Retrieved April 19, 2023, from https://climatexas.tamu.edu/files/ClimateReport-1900to2036-2021Update

4.7 Public Health Emergency

4.7.1 DESCRIPTION

A “public health emergency” may be defined as an event, either natural or manmade, that creates a health risk to the public. These emergencies significantly impact populations by inducing injuries, health complications, death, and an increased risk of communicable diseases.

A public health emergency is any adverse event (natural or human caused) that compromises the health of the population and has the potential to cause widespread illness, such as:

- Illness amongst the public that can occur naturally, (such as influenza), or is human-caused, (such as and intentional release of anthrax)
- Illness amongst the public that may cause a larger number of deaths and/or serious disabilities.
- Illness due to a hard to control infectious agent, (such as influenza)
- Illness due to a chemical attack on the public, (such as cyanide gas)
- Illness due to release of nuclear material, (such as radiology materials used in hospitals)
- Other illnesses of health hazards that can severely impact the health of the public, whether resulting from natural hazards (tornadoes, floods, etc.) or emerging infectious diseases.

Other factors that may cause a public health emergency includes loss or damage to healthcare facilities and infrastructure systems such as water treatment, electrical grid, communication, and transportation.

Common Infectious Diseases

An infectious disease is one that manifests clinically as a result of the presence of pathogenic microbial agents. Infectious diseases, according to FEMA, are major hazard all around the world, killing millions each year. An infectious disease can be transmitted through one or more routes, including physical contact with sick people. These pathogens can also be spread by drinks, food, bodily fluids, contaminated items, aerosol inhalation, or vector-borne dissemination. Population growth enhances vulnerability because densely populated places increase the likelihood of exposure to an infectious disease, allowing the sickness to spread rapidly.

Disease impacts are classified into three types: endemic, epidemic, and pandemic. An endemic, such as chicken pox in the United States, is prevalent at all times at a low frequency. An epidemic is a quick and severe outbreak of disease. A pandemic is an infection that spreads rapidly and impacts an entire region, continent, or the entire planet such as the bubonic plague during the Middle Ages.

Biological Agents

High consequence biological events, such as bioterrorism, have the potential to cause widespread casualties, epidemic illness, contamination of the environment, legal complications, and generate unease among both the medical community and the general public.

A biological agent is an infectious disease. They can be naturally occurring or be used in biological warfare. The Centers for Disease Control and Prevention (CDC) has divided the agents which can be used as biological weapons into three categories, Category A, B, and C (Table 4-13).

Table 4-13 *Bioterrorism Agents*[17]

CATEGORY A	AGENTS – DISEASES
• Easily disseminated or transmitted from person to person • High mortality rates and potential for major public health impact • Might cause public panic and social disruption • Require special action for public health preparedness.	• Anthrax (Bacillus anthracis) • Botulism (Clostridium botulinum toxin) • Plague (Yersinia pestis) • Smallpox (variola major) • Tularemia (Francisella tularensis) • Viral hemorrhagic fevers, including ▪ Filoviruses (Ebola, Marburg) ▪ Arenaviruses (Lassa, Machupo)
CATEGORY B	**AGENTS - DISEASES**
• Moderately easy to disseminate • Result in moderate morbidity rates and low mortality rates • Require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance.	• Brucellosis (Brucella species) • Epsilon toxin of Clostridium perfringens • Food safety threats (Salmonella species, Escherichia coli O157:H7, Shigella) • Glanders (Burkholderia mallei) • Melioidosis (Burkholderia pseudomallei) • Psittacosis (Chlamydia psittaci) • Q fever (Coxiella burnetii) • Ricin toxin from Ricinus communis (castor beans) • Staphylococcal enterotoxin B • Typhus fever (Rickettsia prowazekii)
CATEGORY C	**AGENTS - DISEASES**
• Availability • Ease of production and dissemination • Potential for high morbidity and mortality rates and major health impact.	• Nipah virus • Hantavirus

4.7.2 LOCATION

Public health emergencies can occur anywhere and at any time; therefore, all areas of the world are susceptible. Since air travel and global trade have risen, it has become increasingly difficult to prevent localized epidemics when sick or exposed individuals fly across the globe in a matter of hours. The United States public health system operates at the federal, state, and local levels to monitor diseases, plan and prepare for outbreaks, and, whenever possible, prevent epidemics.

4.7.3 EXTENT

The severity of a pandemic virus can be evaluated from the perspective of the individual who has been infected; or from the population level, how many complications and deaths might be expected.

[17] Source: CDC https://emergency.cdc.gov/agent/agentlist-category.asp

4.7.4 HISTORICAL OCCURRENCES

Table 4-14 depicts the public health emergencies that have affected City of Plano.

Table 4-14 *Historical Occurrences of Public Health Emergencies* [18]

DATE	PATHOGEN	IMPACT
2019- 2022	Covid-19	Monitoring/surveillance of contact addresses; expanded EMS capacity; expanded internal policies for employee population; return to work considerations.
2014	Ebola	Monitoring/Surveillance of contacts and/or travelers addresses; expanded EMS capacity
Annually	Chikungunya	Travel-related (none thus far are locally acquired); education/outreach; treatment of property depending on circumstances
2013, 2015 & 2022	West Nile	Surveillance, monitoring, treatment, education/outreach
2014-2022	Legionnaires	Surveillance assistance as requested by Collin County
2016-2017	Zika	Monitoring/Surveillance of contacts and/or travelers addresses

4.7.5 SIGNIFICANT EVENTS

Coronavirus (COVID-19)

COVID-19 is an infectious disease caused by the coronavirus 2, or SARS-CoV-2. The virus is highly contagious and primarily spreads through respiratory droplets when an infected person talks, coughs, or sneezes. Symptoms of COVID-19 include fever, cough, and difficulty breathing, but many infected individuals may also be asymptomatic.

The COVID-19 pandemic is a global health crisis that began in late 2019, when a new strain of coronavirus, SARS-CoV-2, was identified in the City of Wuhan, in the Hubei province of China. In January 2020, COVID-19 started slowly spreading worldwide and eventually to the United States and other countries. On March 11, 2020, the World Health Organization declared the outbreak a pandemic. By February 1, 2020, the City of Plano had its first monitored address. President Donald Trump declared COVID-19 a public health emergency on March 13, 2020. On March 16, 2020, the State of Texas, Collin County, and the City of Plano also declared public health emergencies.

In the absence of a vaccine or effective treatments, restrictions were put into place to reduce the number of infections, hospitalizations, and deaths caused by COVID-19 and to prevent healthcare systems from being overwhelmed by the surge of patients with severe illness. In addition, by slowing the spread of the virus, health authorities hoped to buy time to develop effective treatments, vaccines, and strategies for managing the pandemic.
The restrictions were also implemented to protect vulnerable populations, such as older adults, people with underlying health conditions, and healthcare workers, at a higher risk of severe illness and death from COVID-19. The following restrictions were put in place by the State of Texas to slow the spread of COVID-19.

- **Face Mask Mandate:** Texas implemented a statewide mask mandate in July 2020, requiring individuals to wear face masks in public spaces. However, the mandate was later lifted in March 2021.

[18] Source: Collin County Health Care Services

- **Business Closures:** In March 2020, Texas Governor Greg Abbott issued an executive order closing all bars, gyms, and other non-essential businesses. Some businesses were allowed to reopen with limited capacity in May 2020
- **Capacity Limits:** Texas implemented capacity limits for businesses, including restaurants, retail stores, and places of worship, in order to limit the number of people in enclosed spaces. These capacity limits varied over time and were relaxed in some areas as the pandemic situation improved.
- **Travel Restrictions:** In March 2020, Texas implemented a mandatory 14-day quarantine for individuals traveling from certain states and countries with high numbers of COVID-19 cases. The restrictions were later lifted.
- **School Closures:** Texas closed schools in March 2020 and moved to online learning. In-person learning resumed in the fall of 2020 with some restrictions and safety protocols in place.
- **Gatherings:** Texas limited the size of gatherings, including weddings and funerals, in order to limit the spread of COVID-19.

While the restrictions were effective in slowing the spread of the virus, they also had significant social, economic, and psychological impacts on individuals and communities. Therefore, governments and health organizations had to balance the need to contain the virus with the need to mitigate the negative effects of the pandemic on people's lives and livelihoods.

Governments and healthcare organizations worked to develop treatments and vaccines for COVID-19. The Pfizer-BioNTech and Moderna vaccines were authorized for emergency use in December 2020 in the United States, followed by others such as AstraZeneca, Johnson & Johnson, and Novavax in other countries.

Despite vaccination efforts, new variants of the virus have emerged, some of which may be more contagious and resistant to existing vaccines. COVID-19 continues to be a global health crisis, with millions of confirmed cases and deaths worldwide.

Efforts to contain and mitigate the spread of COVID-19 continue to be an ongoing challenge, but progress has been made in mitigating the effects of the pandemic and developing strategies to prevent future outbreak.

As of March 23, 2023, there have been 103,957,053 reported infections and 1,123,613 fatalities in the United States. Globally COVID-19 has killed more than 7.3 million people to date.

4.7.6 PROBABILITY OF FUTURE EVENTS

Several reasons play part for the growth in frequency and coverage of pandemics. A massive increase in globalization and connection has meant that disease pathogens can move from one side of the world to another within a few hours.

- Travel
- Urbanization
- Climate Change
- Increased Human-Animal Contact
- Shortage of Health Workers

4.7.7 VULNERABILITY AND IMPACT

Estimated potential losses to the built environment are difficult to evaluate because infectious disease does little harm to the built environment and most losses are incurred as a result of public

health response and medical costs, as well as patient lost earnings. As a result, it is considered that all structures and facilities are susceptible to illness but would suffer minimal harm in the event of an outbreak. However, due to staff absence or facility closures, upkeep and repair of buildings and facilities may fall behind.

An infectious illness incident can disrupt critical infrastructure services such as emergency services, utility services, water supplies, and telecommunications. Certain illness strains are very contagious and can be spread through coughing, touching, and even breathing.

Children under the age of five, seniors 65 and older, and women who are pregnant are the most likely to have complications from infectious infections. People with asthma, heart illness, chronic lung disease, problems of the blood, endocrine system, kidneys, liver, or metabolism, or a weakened immune system could have their conditions get worse.

The costs of responding to an outbreak in the public health sector and the effects on health, in general, could be "significant" for the City of Plano. There could be lasting injuries or illnesses, and the City of Plano could be closed for at least two weeks. Damage could occur if the personnel in charge of overseeing the property are not present frequently. Given the history, extent, impact and vulnerability, a public health emergency in Plano is likely.

4.7.8 CLIMATE CHANGE

Climate change can affect infectious disease patterns in several ways.

Changes in temperature and precipitation patterns can create new habitats for disease vectors, such as mosquitoes and ticks, and extend the length of the transmission season. This can increase the risk of vector-borne diseases like malaria, dengue fever, and Lyme disease.

Extreme weather events like floods and droughts can lead to the contamination of water sources and increase the risk of water-borne diseases like cholera and cryptosporidiosis.

Climate change can also impact the distribution and abundance of animal hosts for diseases that can infect humans, such as Ebola and hantavirus. It can also cause stress on ecosystems, making them more susceptible to disease outbreaks. This can lead to outbreaks of diseases in wildlife populations, which can then spread to humans.

Overall, the relationship between climate change and infectious disease outbreaks is complex and multifaceted. While climate change is not the only factor contributing to the emergence and spread of infectious diseases, it is an important factor that must be considered in efforts to prevent and control these diseases.

Other studies suggest that there is a high probability of observing a pandemic similar to COVID-19. Published in the *Proceedings of the National Academy of Sciences* (PNAS), the article "*Intensity and Frequency of Extreme Novel Epidemics"*, the author states "Together with recent estimates of increasing rates of disease emergence from animal reservoirs associated with environmental change, this finding suggests a high probability of observing pandemics similar to COVID-19[19]'

The author further asserts that probability of a pandemic with similar impact to COVID-19 is about 2% in any year, meaning that someone born in the year 2000 would have about a 38% chance of experiencing one by now.

[19] Marana, M. (2021, August 23). Intensity and frequency of extreme novel epidemics | PNAS. The Proceedings of the National Academy of Sciences (PNAS). Retrieved March 27, 2023, from https://www.pnas.org/doi/10.1073/pnas.2105482118

4.8 Severe Thunderstorm (High-Wind, Lightning, Hail)

The Hazard Mitigation Steering Committee combined high-wind, lightning and hail into one hazard as they are naturally occurring within thunderstorms. This representation can also be seen in the City of Plano's Hazard Identification Risk Assessment.

Thunderstorms are created when heat and moisture near the Earth's surface are transported to the upper levels of the atmosphere. By-products of this process are the clouds, precipitation, and winds that become a thunderstorm. According to the National Weather Service (NWS), a thunderstorm occurs when thunder accompanies rainfall. Radar observers use the intensity of radar echoes to distinguish between rain showers and thunderstorms.

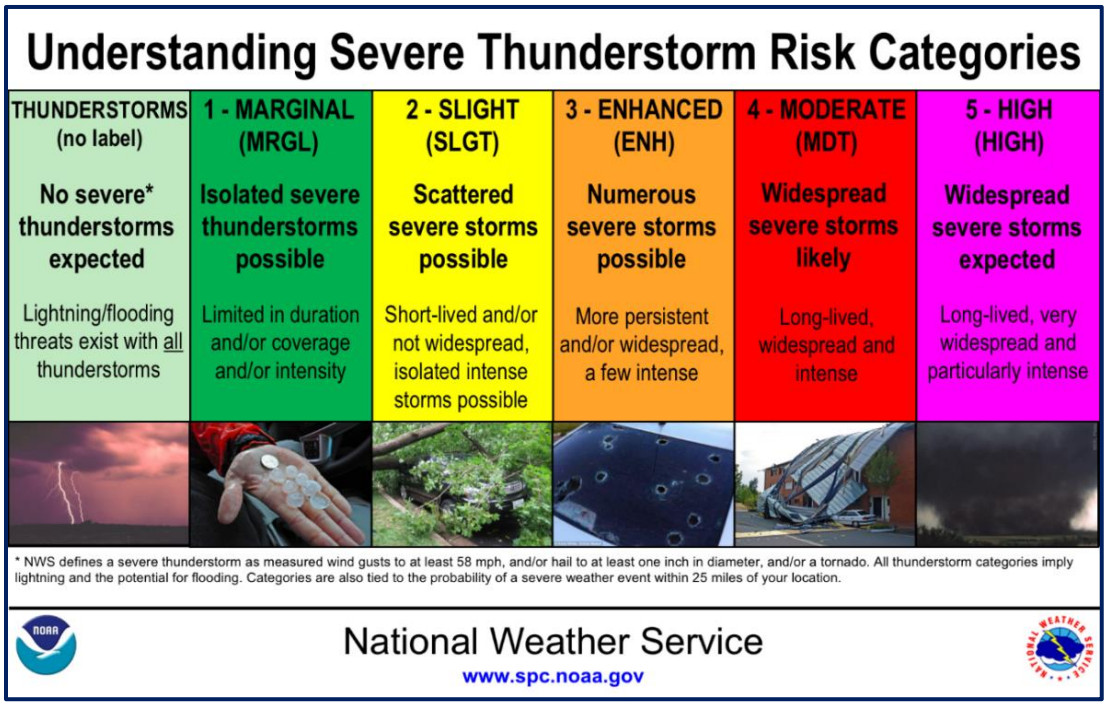
High-winds: Thunderstorms can produce strong gusts of wind that can cause damage to buildings, trees, and power lines. Straight-line winds are responsible for most thunderstorm wind damages. Severe thunderstorm winds are generally considered a common occurrence in the City of Plano. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. Despite the short time span, thunderstorms can be extremely dangerous as they are often strong and fast in their approach and can be accompanied by flash flooding, hail, tornadoes, and high winds

Lightning strikes: Lightning is one of the most dangerous aspects of a thunderstorm, and can cause injury or death to people or animals who are struck. Lightning can strike up to 10 miles from the main area of the thunderstorm.

Hail: Thunderstorms can also produce hail, which can range in size from small pellets to large chunks of ice. Large hailstones can cause significant damage to buildings, cars, and crops.

The National Weather Service uses the Storm Prediction Center (SPC) activity levels to represent severe weather outlooks (Figure 4-6).

Figure 4-6 *NWS Thunderstorm Risk Categories*[20]



[20] Source: https://www.spc.noaa.gov/misc/about.html

HIGH WIND

4.8.1 HAZARD DESCRIPTION

The wind is defined as the motion of air relative to the earth's surface. The horizontal component of the three-dimensional flow and the near-surface wind phenomenon are the most significant aspects of the high wind hazard. Extreme windstorm events are associated with extra-tropical and tropical cyclones, winter cyclones, severe thunderstorms, and accompanying mesoscale offspring such as tornadoes and straight-line winds.

STRAIGHT-LINE WINDS

Straight-line winds are strong, gusty winds that blow in a uniform direction and do not have rotation. They are caused by downdrafts within a thunderstorm, such as rear-flank downdrafts, outflow boundaries, or downbursts. Straight-line winds can occur during severe thunderstorms, including those that produce tornadoes, but they are separate from the tornado itself. Straight-line winds are often responsible for most of the wind damage associated with a thunderstorm. Significant damage, includes downed trees, structural damage to buildings, and the creation of dangerous projectiles.

MICROBURSTS

Microbursts are intense, localized downdrafts that can occur within a thunderstorm. They are characterized by a rapid descent of air from the cloud base to the ground. Microbursts can create powerful straight-line winds at the surface, causing damage similar to that of a small tornado. They are particularly hazardous to aviation due to the sudden and significant changes in wind speed and direction they create.

DOWNBURSTS

Downbursts are broader and more powerful versions of microbursts. They are strong downdrafts of air that descend from a thunderstorm cloud and spread out upon reaching the ground. Downbursts can generate widespread straight-line winds in multiple directions, resulting in extensive damage. They can be classified into two types: macrobursts, which have a diameter greater than 2.5 miles, and microbursts, which have a smaller diameter.

DERECHOS

Derechos are long-lived and widespread windstorms characterized by straight-line winds over a significant geographic area. They are often associated with a complex of severe thunderstorms and can travel hundreds of miles. Derechos typically form in environments with strong wind shear and can cause extensive damage to structures, forests, and power distribution systems.

TORNADIC WINDS

Tornadic winds refer specifically to the intense, rotating winds associated with tornadoes. Tornadoes are violent, destructive storms characterized by a rapidly rotating column of air. Tornadic winds can reach extreme speeds and cause severe damage, including the destruction of buildings and uprooting of trees.

Winds of 73 miles per hour or greater constitute a threat to the City of Plano. Such winds, equivalent to that of an EF0 tornado, would peel the surface off roofs, overturn mobile homes or push them off their foundations, push moving autos off the road, or destroy attached garages.

4.8.2 LOCATION

There is no defined geographic boundary to high winds. The spatial extent of high winds could cover a large area of the City of Plano, potentially affecting more than 50% of the property. The potential impact of high winds is “Minor,” involving few, if any, injuries.

4.8.3 EXTENT

The extent or magnitude of a thunderstorm wind event is measured by the Beaufort Wind Scale (Table 4-15). This scale describes the different intensities of wind in terms of speed and effects, from calm to violent and destructive. It was one of the earliest wind scales used to evaluate wind speeds.

Table 4-15 *Beaufort Wind Scale*[21]

FORCE	WIND MPH	WMO CLASSIFICATION	EFFECTS
0	Less than 1	Calm	Calm, smoke rises vertically
1	1 – 3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4 – 7	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	8 – 11	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	12 – 18	Moderate Breeze	Dust, leaves, and loose paper lifted; small tree branches move
5	19 – 24	Fresh Breeze	Small trees and leaves begin to sway
6	25 – 31	Strong Breeze	Larger tree branches moving, whistling in wires
7	32 – 38	Near Gale	Whole trees moving, resistance felt walking against wind
8	39 – 46	Gale	Whole trees in motion, resistance felt walking against wind
9	47 – 54	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	55 – 63	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	64 – 72	Violent Storm	If experienced on land, widespread damage
12	64+	Hurricane	Violence and destruction

4.8.4 HISTORICAL OCCURRENCES

Table 4-16 depicts historical occurrences of thunderstorm wind events for the City of Plano according to data from the National Centers for Environmental Information (NCEI).

Table 4-16 *Historical High Wind Events in Plano (1987-2022)*

DATE	TIME	EVENT	MAG	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
9/4/2022	1345	Thunderstorm Wind	55	0	0	$7,000	0
9/4/2022	1356	Thunderstorm Wind	50	0	0	0	0

[21] https://www.weather.gov/mfl/beaufort

DATE	TIME	EVENT	MAG	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
3/22/2021	2058	Thunderstorm Wind	50	0	0	0	0
8/16/2020	1740	Thunderstorm Wind	55	0	0	$5,000	0
8/16/2020	1820	Thunderstorm Wind	52	0	0	0	0
8/18/2018	1900	Thunderstorm Wind	50	0	0	$2,000	0
10/23/2011	0021	Thunderstorm Wind	61	0	0	0	0
5/24/2011	2125	Thunderstorm Wind	61	0	0	$8,000	0
7/19/2009	1313	Thunderstorm Wind	50	0	0	$8,000	0
6/10/2009	1819	Thunderstorm Wind	68	0	0	$5,000	0
6/10/2009	1820	Thunderstorm Wind	65	0	0	$3,000	0
6/17/2008	1038	Thunderstorm Wind	52	0	0	0	0
6/17/2008	1045	Thunderstorm Wind	50	0	0	0	0
8/29/2007	1454	Thunderstorm Wind	50	0	0	0	0
5/30/2007	847	Thunderstorm Wind	50	0	0	$15,000	0
5/2/2007	1820	Thunderstorm Wind	52	0	0	0	0
5/2/2007	1830	Thunderstorm Wind	65	0	0	0	0
8/27/2006	1530	Thunderstorm Wind	50	0	0	$5,000	0
8/22/2003	1610	Thunderstorm Wind	61	0	0	0	0
8/22/2003	1630	Thunderstorm Wind	61	0	0	$2,000	0
2/25/2000	2340	Thunderstorm Wind	61	0	0	0	0
2/25/2000	2345	Thunderstorm Wind		0	0	$2,000	0
5/9/1999	2345	Thunderstorm Wind		0	0	$100	0
4/26/1999	800	Thunderstorm Wind		0	0	$100	0
11/9/1998	2310	Thunderstorm Wind	50	0	0	0	0
5/27/1998	130	Thunderstorm Wind		0	0	0	0
6/22/1997	1541	Thunderstorm Wind		0	0	$4,000	0
6/16/1997	1903	Thunderstorm Wind		0	0	$40,000	0
6/16/1997	1904	Thunderstorm Wind		0	0	0	0
6/16/1997	1910	Thunderstorm Wind	58	0	0	0	0
6/9/1997	2019	Thunderstorm Wind		0	0	$2,000	0
5/19/1997	1758	Thunderstorm Wind	57	0	0	0	0
5/19/1997	1810	Thunderstorm Wind		0	0	$25,000	0
4/22/1997	0330	Thunderstorm Wind		0	0	$50,000	0
3/29/1997	2152	Thunderstorm Wind	52	0	0	0	0
10/21/1996	1050	Thunderstorm Wind		0	0	$3,000	0

DATE	TIME	EVENT	MAG	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/11/1996	1950	Thunderstorm Wind		0	0	$2,000	0
6/15/1996	1610	Thunderstorm Wind		0	0	$20,000	0
6/15/1996	1631	Thunderstorm Wind		0	0	0	0
6/12/1996	1710	Thunderstorm Wind		0	0	0	0
4/13/1996	2124	Thunderstorm Wind		0	0	$2,000	0
7/5/1995	0245	Thunderstorm Wind	0	0	0	$2,000	0
4/17/1995	2130	Thunderstorm Wind	0	0	0	$2,000	0

4.8.5 SIGNIFICANT EVENTS

Table 4-17 depicts high wind events that caused significant property damage and/or utility disruption.

Table 4-17 *Significant High Wind Events*

DATE	WIND SPEED	DESCRIPTION OF EVENT
6/10/2009	78 mph	Significant widespread damage including downed tree limbs
8/27/2006	58 mph	High winds blew down power lines on the west side of town
8/22/2006	46 mph	High winds blew down trees, a traffic control box and power lines which knocked out power to more than 5,000 people
8/22/2003	70 mph	High winds blew down trees and power lines
6/22/1997	Unknown	Strong winds blew down fences and power lines
6/16/1997	Unknown	Strong winds removed the roof of an apartment, destroyed a barn and blew down trees and large tree limbs
6/9/1997	Unknown	Strong winds blew down trees and power lines
4/22/1997	Unknown	Strong winds blew down trees and a church steeple
10/21/1996	Unknown	A billboard was blown down onto power lines
8/11/1996	Unknown	High winds blew down power lines
4/13/1996	Unknown	Power lines were blown down by high winds
7/5/1995	Unknown	Power lines were blown down by high winds
4/17/1995	Unknown	Power lines were blown down by high winds
8/23/1988	Unknown	Strong winds snapped 13 telephone poles, uprooted trees, damaged roofs and toppled 32 chimneys at an apartment complex within Plano
2/14/1987	Unknown	Strong winds downed at least 15 power lines within the city

4.8.6 PROBABILITY OF FUTURE EVENTS

The majority of thunderstorms occur in the spring, specifically in the months of March, April, and May, and in the fall, specifically in the month of September. Although the severity of thunderstorm winds is not always damaging to the City of Plano, the occurrence of a thunderstorm wind event is highly likely.

4.8.7 VULNERABILITY

Plano is in an area of the United States known as Tornado Alley, which is a region that is particularly prone to tornadoes and severe weather events. These weather patterns can produce high winds that can cause damage to buildings and property.

Plano and much of North Texas has a relatively flat topography, which means there are few natural barriers to high winds. This can allow wind to travel more easily across the area, increasing the potential for damage.

The hot and dry climate in North Texas can create unstable atmospheric conditions that contribute to the formation of thunderstorms and high winds.

The Gulf of Mexico affects the state's climate, which provides a major source of precipitation to most of the state and can contribute to the instability of the atmosphere and the formation of severe weather events.[22]

As Plano has developed and grown, the urbanization of the area has created more hard surfaces, such as buildings and pavement. This can create a "heat island" effect, which can lead to more intense thunderstorms and high winds.

4.8.8 IMPACT

High winds in the Plano, Texas area can be costly due to the damage they can cause to buildings, infrastructure, and property. There are several factors that contribute to the high cost of wind damage in Plano:

Plano is a densely populated area with many buildings and structures in a relatively small area. When high winds occur, there is a greater likelihood that buildings and other structures will be damaged, which can be costly to repair.

Many buildings in Plano, particularly older buildings, may not be built to withstand high winds. Building codes and construction standards have improved over time, but older buildings may be more susceptible to wind damage.

Trees in the City of Plano may be damaged by high winds causing them to fall or break and damage buildings, vehicles, and other property. Removing fallen trees and repairing the damage they cause can be costly.

High winds can cause power outages, which can be costly for both individuals and businesses. In addition to the inconvenience of not having power, businesses may lose revenue if they are unable to operate during an outage.

When high winds cause damage, individuals and businesses may file insurance claims to cover the cost of repairs. These claims can be costly for insurance companies, which can lead to higher premiums for policyholders.

4.8.9 CLIMATE CHANGE

Climate change may lead to changes in high wind events in Plano and other regions of the U.S. The specific impacts of climate change on high wind events may depend on a variety of factors.

High wind events, such as strong gusts and severe thunderstorms, are driven by a combination of atmospheric instability and changes in pressure and temperature. Changes in temperature, precipitation patterns, and atmospheric stability associated with climate change can all affect

[22] Larkin, T.J. and Bomar, G.W., 1983, Climatic Atlas of Texas: Texas Water Development Board Limited Publication 192, http://www.twdb.state.tx.us/publications/reports/limited_printing/doc/LP192.pdf.

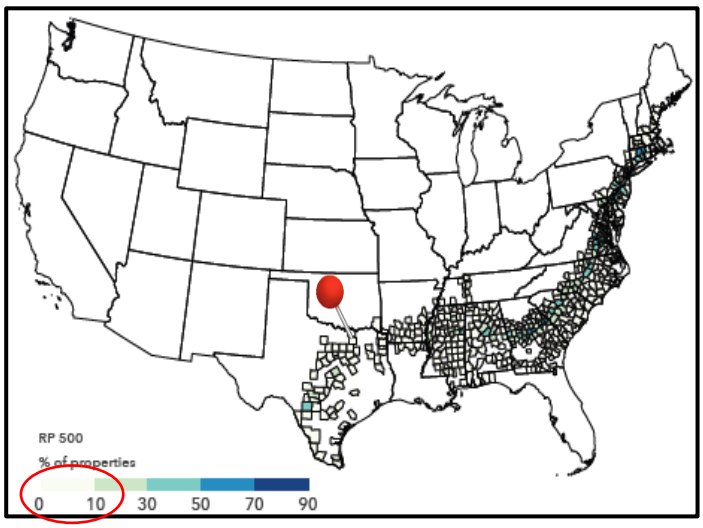
high wind events. Predictions about trends in severe storm likelihood and severity are typically made at broader spatial scales. Broad predictive efforts indicate that severe storms are likely to increase in severity globally and in the U.S. due to climate change. However, predictions also indicate that frequency of strong storms may decrease. Some predictions indicate a shift in storm loci, such that strong storms that affect the Central and South-Central U.S. may become less frequent as they become more frequent in Eastern and North-Eastern North America (Haberlie et al 2022[23]).

Other climate models consistently project environmental changes that would predict an increase in the frequency and intensity of severe thunderstorms (a category that combines Tornados, Hail, and Winds), especially over regions that are currently prone to these hazards such as the Southern and Eastern U.S (Trapp et al 2007[24]). However, the confidence intervals and predictive power of many of these models is relatively low (Wuebbles et al 2017[25]). Predictions specifically about wind are also varied.

Some research points to a "global stilling," meaning a reduction in mean winds globally. Other research suggest evidence for trends of increasing wind speeds globally (Zeng et al 2019[26]). While yet other work predicts declines in wind speed for many regions as the climate warms and a shift in high wind regions moving poleward increases in winds and wind speeds in specific locations, for example due to increases in hurricane severity in some regions (Abell et al 2021[27]).

Given the varied and uncertain predictions regarding storm frequency, severity, and resulting effects on severe wind event frequency and severity, planners should act with the expectation that severe storm and wind conditions are likely to be similar, if slightly lower or slightly higher, in frequency and severity in the future. For the planning area, a reasonable baseline for planning purposes would be approximately three to six significant thunderstorms per year, several of which may be accompanied by significant wind conditions."

Figure 4-7 *Areas with an Increase in Climate Change Damage (Plano is identified with the red pin)*



Climate change will affect the largest amount of properties over the next 30 years. Particularly "a band stretching from the Northeast through Texas where there are few properties exposed to tropical cyclone strength wind gusts today, but, in 30 years, many more properties in this band will be exposed and will be at risk."

For example, in the 500-year return period, in Figure 4-7, Collin County which the City of Plano resides in, can anticipate increases in the number of properties exposed to tropical storm strength winds or higher.

[23] https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2022GL098779
[24] https://www.pnas.org/doi/pdf/10.1073/pnas.0705494104
[25] https://journals.ametsoc.org/view/journals/bams/95/4/bams-d-12-00172.1.xml
[26] https://www.nature.com/articles/s41558-019-0622-6
[27] https://pubmed.ncbi.nlm.nih.gov/33408375/

LIGHTNING

4.8.10 HAZARD DESCRIPTION

Lightning results from the buildup and discharge of electrical energy between positively and negatively charged areas within thunderstorms. A bolt, or brilliant flash of light, is created when the buildup becomes strong enough. These bolts of lightning can be seen in cloud-to-cloud or cloud-to-ground strikes. Thunderstorm and lightning events are generated by atmospheric imbalance and turbulence due to the combination of the following conditions: unstable warm air rising rapidly into the atmosphere, sufficient moisture to form clouds and rain, and upward lift of air currents caused by colliding cold and warm weather fronts, sea breezes, or mountains.

The discharge of a lightning bolt interacts with the best-conducting object or surface on the ground. As a result, the air channel of a lightning strike reaches temperatures higher than 50,000 °F. The rapid heating and cooling of the air near the channel causes a shock wave, which produces thunder.

Lightning damage can result in the electrocution of humans and animals, vaporization of materials along the path of the strike, fire caused by the high temperature produced by the strike, and a sudden power surge that can damage electrical and electronic equipment. Millions of dollars of direct and indirect damages result from lightning strikes on electric utility substations and distribution lines. While property damage is the major hazard associated with lightning, it should be noted that in the United States, the average death toll from lightning is 93 fatalities per year, and an average of 300 people are injured. During the past nine years, lightning has killed 34 people in Texas alone. In addition, 184 injuries and an estimated 23 million dollars in damages can also be attributed to lightning since 1995. Lightning can also play a role in forest fires, structure fires, hazardous materials storage incidents, aircraft-related in-flight mishaps, airline delays, power outages, and electrical infrastructure malfunctions.

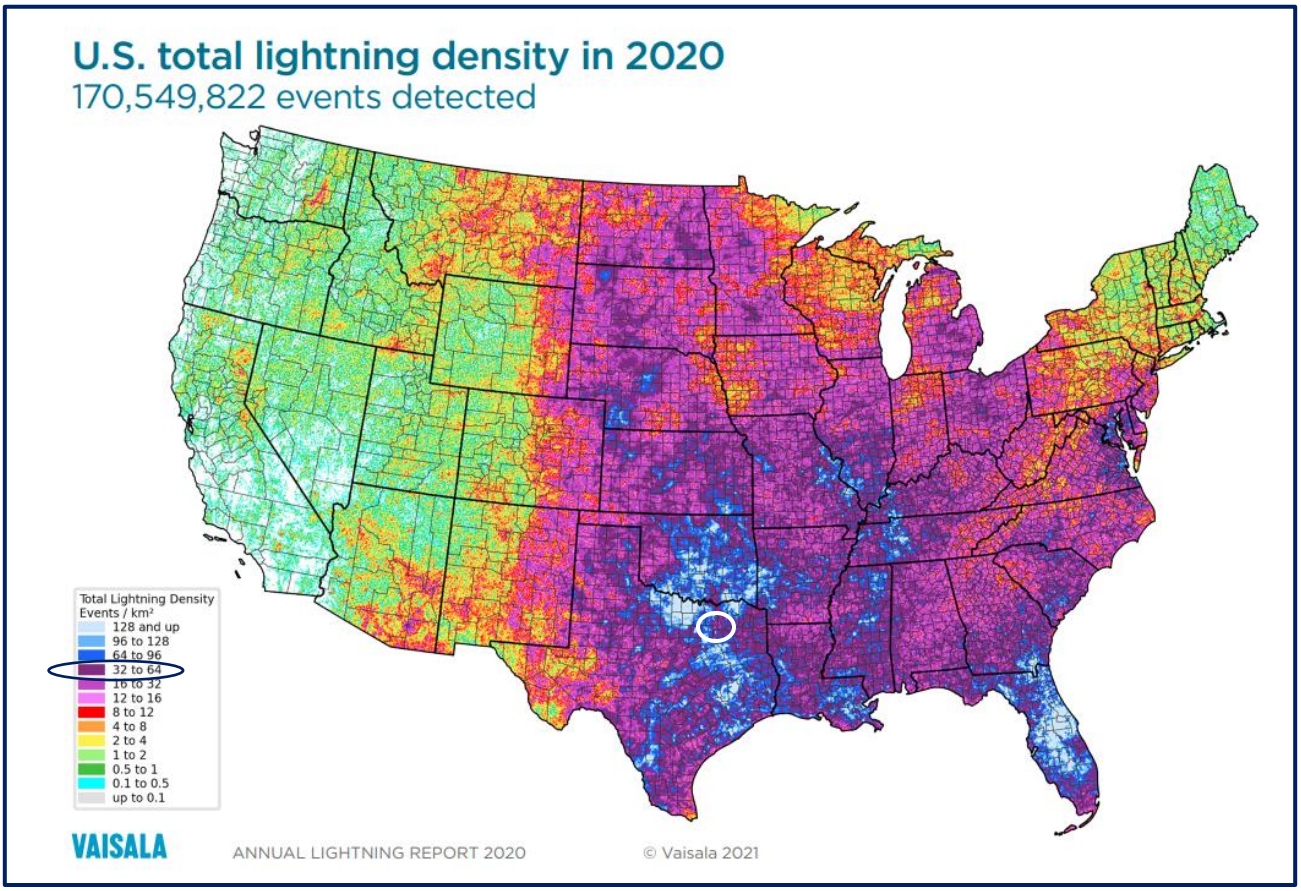
Table 4-18 *Lightning Count by State (2022)*

RANK	STATE	COUNT	RANK	STATE	COUNT
1	Texas	33,816,168	**6**	Louisiana	6,888,154
2	Florida	12,783,178	**7**	Arkansas	6,492,964
3	Oklahoma	12,620,899	**8**	Mississippi	6,310,507
4	Kansas	8,200,370	**9**	Nebraska	6,043,648
5	Missouri	6,940,725	**10**	Georgia	5,722,070

4.8.11 LOCATION

In 2022, Texas was ranked number one for the highest lightning count (depicted in Table 4–18), according to Vaisala, a weather analysis company. Spring is the peak for storms in Texas, especially in April and May. Moisture, lift, and unstable air are required for thunderstorms to form.

Figure 4-8 *Lightning Density Map of the US (Plano circled in white)*[28]



Moisture, lift, and unstable air are required for thunderstorms to form. These components combine to form massive water-saturated clouds. When they collide with each other in the right way, since electrons have been "stripped" from the ice and water, they make lightning and thunder.

The jet stream, a strong band of high-altitude wind that circles the planet, blows cold, dry air over the DFW Metroplex during the spring season. At the same time, warm moist air is blown up from the ocean as the Gulf of Mexico warms in the springtime sun. Warm moist air from the ocean begins to interact with the cooler, drier air from the jet stream, creating powerful thunderstorms.

4.8.12 EXTENT

Table 4-19 contains the Lightning Activity Level (LAL). It is a standard parameter that is part of fire weather forecasts nationwide. The City of Plano has a flash density of 12-20 flashes per square mile yearly.

[28] Source: *Vaisala*. https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf

Table 4-19 *Lightning Activity Level Scale*[29]

LAL	CLOUD & STORM DEVELOPMENT	LIGHTNING STRIKES/ 15 MIN
1	No thunderstorms	-
2	Cumulus clouds are common but only a few reach the towering cumulus stage. A single thunderstorm must be confirmed in the observation area. The clouds produce mainly virga, but light rain will occasionally reach the ground. Lightning is very infrequent.	1-8
3	Towering cumulus covers less than two-tenths of the sky. Thunderstorms are few, but two to three must occur within the observation area. Light to moderate rain will reach the ground and lightning is infrequent.	9-15
4	Towering cumulus covers two to three-tenths of the sky. Thunderstorms are scattered and more than three must occur within the observation area. Moderate rain is common, and lightning is frequent.	16-25
5	Towering cumulus and thunderstorms are numerous. They cover more than three-tenths and occasionally obscure the sky. Rain is moderate to heavy and lightning is frequent and intense.	>25
6	Similar to LAL 3 except thunderstorms are dry	

4.8.13 HISTORICAL OCCURRENCES

Table 4-20 *Historical Lightning Events (1996-2021)*

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
4/24/2021	0013	Lightning	0	0	$100,000	0
3/24/2021	2200	Lightning	0	0	$350,000	0
8/30/2020	0430	Lightning	0	0	$250,000	0
8/30/2020	0458	Lightning	0	0	$100,000	0
6/23/2020	0645	Lightning	0	0	$25,0000	0
5/23/2020	0011	Lightning	0	0	$200,000	0
4/28/2020	2200	Lightning	0	0	$3,000	0
4/28/2020	2200	Lightning	0	0	$30,000	0
4/28/2020	2200	Lightning	0	0	$83,000	0
4/28/2020	2200	Lightning	0	0	$8,000	0
4/28/2020	2200	Lightning	0	0	$500,000	0
3/18/2020	0415	Lightning	0	0	$800,000	0
10/20/2019	2321	Lightning	0	0	$150,000	0
6/16/2019	0200	Lightning	0	0	$5,000	0
6/16/2019	1551	Lightning	0	0	$1,000	0

[29] https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
6/9/2019	1240	Lightning	0	0	$1,000	0
4/23/2019	2130	Lightning	0	0	$150,000	0
4/23/2019	2145	Lightning	0	0	$500	0
4/23/2019	2200	Lightning	0	0	$100,000	0
12/26/2018	1615	Lightning	0	0	$100,000	0
8/18/2018	1900	Lightning	0	0	$2,000	0
8/9/2018	2008	Lightning	0	0	$400,000	0
10/22/2017	0000	Lightning	0	0	$225,000	0
8/7/2017	0050	Lightning	0	0	$100,000	0
7/5/2017	2000	Lightning	0	0	$1,000,000	0
1/2/2017	0555	Lightning	0	0	$500,000	0
6/12/2016	1651	Lightning	0	0	$4,000	0
5/29/2016	1830	Lightning	0	0	$200,000	0
5/23/2016	0725	Lightning	0	0	$300,000	0
4/29/2016	0111	Lightning	0	0	$200,000	0
6/26/2015	1920	Lightning	0	0	$25,000	0
6/21/2015	0700	Lightning	0	0	$50,000	0
10/2/2014	1500	Lightning	0	0	$100,000	0
5/30/2012	1015	Lightning	0	0	$275,000	0
5/30/2012	1022	Lightning	0	0	$450,000	0
5/30/2012	1030	Lightning	0	0	$275,000	0
5/30/2012	1059	Lightning	0	0	$250,000	0
6/21/2011	2318	Lightning	0	0	$30,000	0
9/1/2010	1330	Lightning	0	0	$25,000	0
9/11/2009	1700	Lightning	0	0	$150,000	0
9/11/2009	1700	Lightning	0	0	$5,000	0
8/21/2009	0421	Lightning	0	0	$750,000	0
7/19/2009	1315	Lightning	0	0	$405,000	0
7/19/2009	1320	Lightning	0	0	$200,000	0
5/27/2008	1030	Lightning	0	0	$70,000	0
2/15/2008	0145	Lightning	0	0	$500,000	0
7/31/2007	1445	Lightning	0	0	$7,300	0
5/30/2007	00920	Lightning	0	0	$50,000	0
5/3/2007	1810	Lightning	0	0	$250,000	0
4/24/2007	1530	Lightning	0	0	$20,000	0

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/26/2003	1530	Lightning	0	0	$300,000	0
4/29/2002	1500	Lightning	0	1	0	0
2/16/2001	0024	Lightning	0	0	$750,000	0
3/10/2000	1230	Lightning	0	0	$25,000	0
12/12/1999	0800	Lightning	0	0	$30,000	0
10/9/1999	0600	Lightning	0	0	$5,000	0
1/4/1998	2200	Lightning	0	0	$20,000	0
5/19/1997	1745	Lightning	0	0	$50,000	0
7/23/1996	1245	Lightning	0	0	$80,000	0
7/8/1996	1630	Lightning	0	0	$100,000	0

4.8.14 SIGNIFICANT EVENTS

In 2019, lightning struck a home in Plano, causing a fire that destroyed the roof and caused significant damage to the structure. In 2018, a man was struck by lightning while walking in a park in Plano and was hospitalized with serious injuries. In 2016, lightning struck a Plano home, causing a fire that destroyed the attic and caused significant damage to the rest of the house.

4.8.15 PROBABILITY OF FUTURE EVENTS

In 2022, the state of Texas was ranked number one for lightning count, according to Vaisala, a weather analysis company. Since lightning is common during severe weather events, the probability of experiencing a significant lightning occurrence increases throughout the spring and fall, when severe storm activity is at its highest; hence, the probability is quite high. It is important to note that the geographic occurrence of lightning events cannot be predicted; therefore, the entire city could be impacted by this hazard. Lightning strikes in the City of Plano are most prevalent in May, with August being the next month of highest occurrence.

4.8.16 VULNERABILITY

Plano is vulnerable to lightning due to its geography, climate, and weather patterns. Since the City of Plano is located in Tornado Alley, it is prone to frequent thunderstorms and severe weather events. These weather patterns can produce lightning. The State of Texas, particularly Plano, has a warm and humid climate, especially during summer. These conditions create a more unstable atmosphere, which is conducive to the formation of thunderstorms and lightning. Plano's relatively flat topography makes it more vulnerable to lightning strikes. Lightning tends to strike taller objects and areas with less overhead cover.

As Plano has developed and grown, urbanization has created more hard surfaces, such as buildings and pavement. This can increase the likelihood of lightning strikes because these surfaces can act as conductors. Lastly, the Gulf of Mexico can contribute to the instability of the atmosphere and the formation of thunderstorms and lightning.

4.8.17 IMPACT

The impact of lightning on the City of Plano, Texas, can vary depending on the severity of the storm and the location of the strikes. Lightning can have several impacts on the city, including:

- Lightning strikes can damage buildings, power lines, and other infrastructure. This can cause power outages, fires, and damage to electronics and appliances.
- Lightning strikes can create safety hazards for residents and visitors to the city. For example, lightning strikes can start fires that can spread quickly and create dangerous conditions.
- Lightning strikes can have economic impacts on the city, particularly if they cause damage to businesses or result in power outages that impact productivity.
- Lightning strikes can have environmental impacts, such as starting wildfires or damaging trees and other vegetation.
- Lightning strikes can be deadly or cause serious injuries to people who are struck or nearby when a strike occurs.

4.8.18 CLIMATE CHANGE

Climate change is expected to lead to changes in weather patterns, including an increase in extreme weather events such as thunderstorms. Thunderstorms are typically associated with lightning activity, so an overall increase in thunderstorm frequency could potentially lead to more lightning in the City of Plano.

Climate change is causing global temperatures to rise, and this warming trend can have various effects on thunderstorm development. Warmer air holds more moisture, which can contribute to the formation of thunderstorms and lightning. However, the relationship between temperature and lightning is complex, and other atmospheric conditions also play a role.

Climate change can lead to alterations in atmospheric conditions, such as humidity levels, wind patterns, and instability in the atmosphere. These changes can affect the likelihood of thunderstorm development and the intensity of lightning activity.

Lightning frequency can be influenced by local and regional factors. While climate change may have overarching effects, other factors specific to the City of Plano, such as local topography, proximity to bodies of water, and regional weather patterns, can also impact thunderstorm and lightning activity.

HAIL

4.8.19 HAZARD DESCRIPTION

Hail is a form of precipitation consisting of solid ice that forms inside thunderstorm updrafts. Hailstones are formed when raindrops are carried upward by thunderstorm updrafts into extremely cold areas of the atmosphere and freeze. Hailstones then grow by colliding with liquid water drops that freeze onto the hailstone's surface. If the water freezes instantaneously when colliding with the hailstone, cloudy ice will form as air bubbles will be trapped in the newly formed ice. However, if the water freezes slowly, the air bubbles can escape, and the new ice will be clear.

Hail falls when it becomes heavy enough to overcome the strength of the thunderstorm updraft and is pulled toward the earth by gravity. Smaller hailstones can be blown away from the updraft by horizontal winds, so larger hail typically falls closer to the updraft than smaller hail. However, if the winds near the surface are strong enough, hail can fall at an angle or sideways. Wind-driven hail can tear up siding on houses, break windows and blow into houses, break side windows on cars, and cause severe injury and/or death to people and animals.

Hail size is often estimated by comparing it to a known object. However, measuring using a ruler, calipers, or a tape measure is ideal.

4.8.20 LOCATION

Hailstorms are not confined to any specific geographic location and can vary greatly in terms of size, location, intensity, and duration. All areas of the City of Plano are exposed to this hazard.

4.8.21 EXTENT

Hail intensity is measured by using two parameters: hailstone size and hailstone density. The size of hailstones can be measured using a ruler or tape measure, while the density of hailstones is measured by weighing them.

The density of hailstones is an essential factor in determining the potential impact of hail on structures and crops. In addition, the size and density can be used to calculate the intensity of a hailstorm.

The National Weather Service's guidelines for hail size are shown in Table 4-21.

Table 4-21 *NWS Hail Size Reporting Guide*[30]

NATIONAL WEATHER SERVICE (DFW) HAIL SIZE GUIDE	
Reference Object	**Size in Inches**
Pea Size	0.25″
Marble Size (Plain M&M)	0.50″
Penny Size	0.75″
Nickel Size	0.88″
Quarter Size	1.00″
Half Dollar/Ping Pong Ball Size	1.50″
Golf Ball Size	1.75″

[30] Source: National Weather Service https://w2.weather.gov/fwd/hailsizeguide

NATIONAL WEATHER SERVICE (DFW) HAIL SIZE GUIDE	
Hen Egg Size	2.00″
Tennis Ball Size	2.50″
Baseball Size	2.75″
Grapefruit Size	4.00″
Softball Size	4.50″

4.8.22 HISTORICAL OCCURRENCES

Table 4-22 *Hail Historical Occurrences (1993-2020)*

DATE	TIME	EVENT	SIZE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/16/2020	1750	Hail	0.75″	0	0	0	0
3/24/2019	2139	Hail	1.75″	0	0	$10,000	0
6/6/2018	1800	Hail	1″	0	0	0	0
4/6/2018	1735	Hail	2″	0	0	$10,000	0
4/6/2018	1735	Hail	2″	0	0	10,000	0
4/6/2018	1748	Hail	2″	0	0	$10,000	0
4/21/2017	2206	Hail	1.75″	0	0	$120,000	0
4/11/2016	1645	Hail	1.75″	0	0	$100,000	0
4/11/2016	1650	Hail	2.5″	0	0	$1,000,000	0
4/11/2016	1657	Hail	2″	0	0	$1,000,000	0
4/11/2016	1707	Hail	1.5″	0	0	$100,000	0
3/23/2016	2115	Hail	1.75″	0	0	$150,000,000	0
3/23/2016	2125	Hail	0.75″	0	0	0	0
3/23/2016	2125	Hail	1.75″	0	0	$100,000,000	0
3/23/2016	2125	Hail	1.25″	0	0	$5,000	0
3/23/2016	2134	Hail	1.25″	0	0	0	0
8/17/2012	2115	Hail	0.88″	0	0	0	0
6/6/2012	1450	Hail	0.75″	0	0	0	0
5/30/2012	2230	Hail	0.75″	0	0	0	0
9/18/2011	1901	Hail	1″	0	0	0	0
5/20/2011	1419	Hail	1″	0	0	0	0
5/1/2011	2203	Hail	0.88″	0	0	0	0
5/1/2011	2205	Hail	0.75″	0	0	0	0
4/19/2011	1625	Hail	1.25″	0	0	0	0
4/14/2011	2139	Hail	1″	0	0	0	0
4/14/2011	2148	Hail	1″	0	0	0	0
4/4/2011	404	Hail	0.75″	0	0	0	0
4/8/2008	2220	Hail	1″	0	0	0	0

DATE	TIME	EVENT	SIZE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
4/4/2008	240	Hail	1″	0	0	0	0
4/3/2007	1805	Hail	1.25″	0	0	0	0
4/3/2007	1823	Hail	1″	0	0	0	0
5/25/2005	1230	Hail	0.75″	0	0	0	0
4/5/2005	1550	Hail	1″	0	0	0	0
1/12/2005	1715	Hail	1.25″	0	0	0	0
7/22/2003	1645	Hail	0.75″	0	0	0	0
6/14/2003	1640	Hail	1″	0	0	0	0
4/6/2003	1255	Hail	1″	0	0	0	0
4/6/2003	1300	Hail	1″	0	0	0	0
4/5/2003	2216	Hail	2″	0	0	0	0
4/5/2003	2232	Hail	3″	0	0	0	0
12/30/2002	1430	Hail	1″	0	0	0	0
5/6/2001	1822	Hail	1″	0	0	0	0
5/6/2001	1843	Hail	3″	0	0	0	0
3/11/2001	1440	Hail	0.88″	0	0	0	0
3/10/2000	1045	Hail	0.75″	0	0	0	0
3/2/2000	1815	Hail	1″	0	0	0	0
3/2/2000	1824	Hail	1.75″	0	0	0	0
6/16/1997	1903	Hail	0.75″	0	0	0	0
6/16/1997	1910	Hail	0.88″	0	0	0	0
6/9/1997	2014	Hail	1″	0	0	0	0
6/9/1997	2019	Hail	0.75″	0	0	0	0
6/9/1997	2045	Hail	1″	0	0	0	0
10/21/1996	1050	Hail	0.75″	0	0	0	0
10/21/1996	1435	Hail	2″	0	0	0	0
10/21/1996	1450	Hail	2″	0	0	0	0
6/12/1996	1710	Hail	1″	0	0	0	0
3/24/1996	1510	Hail	0.75″	0	0	0	0
3/24/1996	1520	Hail	1″	0	0	0	0
3/24/1996	1527	Hail	1.25″	0	0	0	0
5/24/1995	1637	Hail	1.75″	0	0	0	0
4/22/1995	1540	Hail	1.75″	0	0	0	0
10/21/1994	1245	Hail	0.75″	0	0	0	0
10/21/1994	1333	Hail	0.75″	0	0	0	0
8/7/1994	1325	Hail	0.75″	0	0	0	0
7/15/1994	1739	Hail	0.75″	0	0	0	0
9/20/1993	1750	Hail	1″	0	0	0	0

4.8.23 SIGNIFICANT EVENTS

April 11, 2016: A hailstorm produced large hailstones that measured up to 4.5 inches in diameter. The hailstorm caused extensive damage to homes, businesses, and vehicles in the Plano. The total cost of damages from the storm was estimated to be over $700 million, making it one of the most expensive hailstorms in Texas history.

June 6, 2018: A storm produced hailstones up to 2 inches in diameter and caused significant damage to vehicles and property in Plano and the surrounding areas. The storm caused an estimated $480 million in damages.

March 24, 2019: A storm produced hailstones up to 3 inches in diameter and caused significant damage to homes, vehicles, and other property in Plano and the surrounding areas. The total cost of damages from the storm was estimated to be around $300 million.

March 17, 2016: A storm produced hailstones up to 3 inches in diameter and caused significant damage to property in Plano and the surrounding areas. The total cost of damages from the storm was estimated to be around $300 million.

4.8.24 PROBABILITY OF FUTURE EVENTS

A hail event is highly likely for the City of Plano and is estimated to occur approximately one event annually. Most hailstorms occur during the spring (March, April, and May) and fall (September). Therefore, warning time for a hailstorm is generally minimal, or there is no warning.

4.8.25 CLIMATE CHANGE

Some studies suggest climate change may increase the risk of large hail events in other regions worldwide. As temperatures rise due to climate change, the atmosphere can hold more moisture, leading to more frequent and intense thunderstorms, including those that produce hail.

Predictions about the effects of climate changes on hail, including event frequency, spatial distribution, and intensity (e.g., hail size of kinetic energy), are limited and uncertain. Research suggests climate change is expected to result in conditions that broadly increase the potential for severe thunderstorms in the U.S. However, the resulting changes to specific storm-related events need to be better understood. Some predictive models predict fewer hail events broadly across the U.S., though may simultaneously predict an increase in the mean hail size, suggesting fewer small hail events but more frequent large hail events. However, regional conditions that may affect the likelihood of hail production vary, and regionally specific, precise predictions need to be better understood. However, most predictions suggest that the most likely future trend is an increase in the proportion of hail events consisting of large hail. In addition, large hail tends to produce greater and more significant economic damage, suggesting that planning for a future environment in which hail events and hail damage are likely to increase to some extent is reasonably well supported (Brimelow et al 2017[31]).

[31] https://www.nature.com/articles/nclimate3321

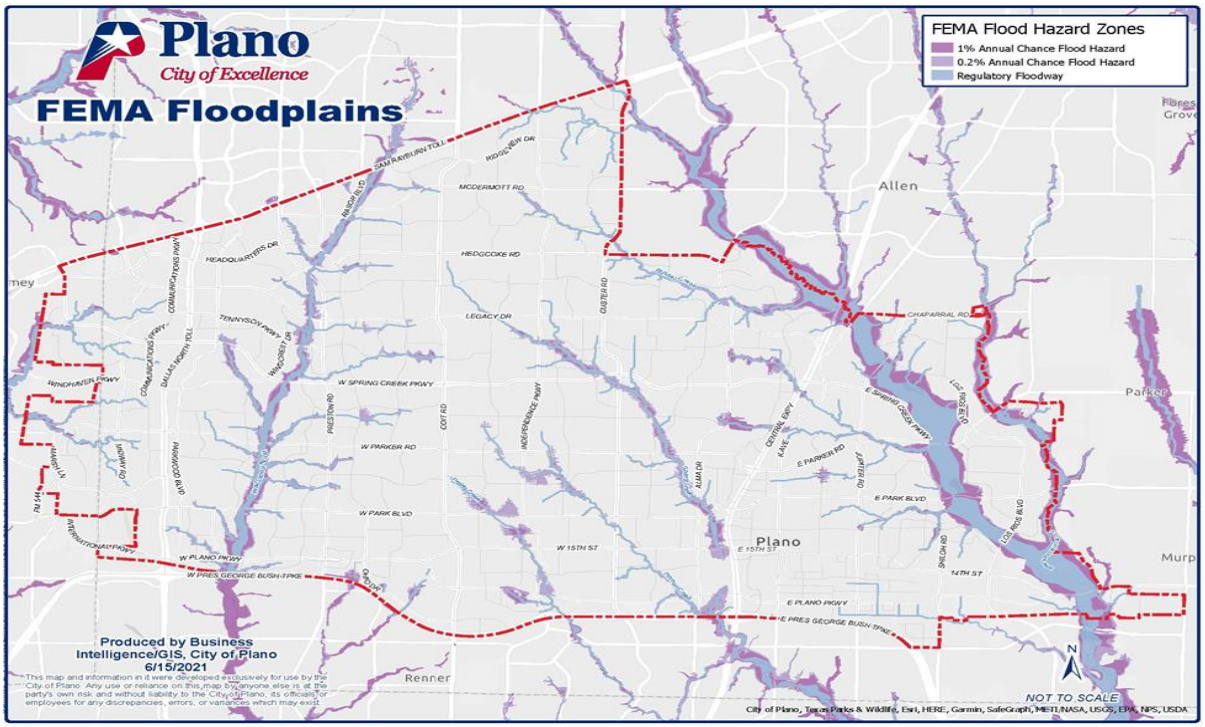
4.9 Flooding

4.9.1 HAZARD DESCRIPTION

Flooding is defined as the accumulation of water within a body of water and the overflow of excess water onto adjacent floodplain lands. The severity of a flood event is determined by a combination of several major factors, including stream and river basin topography and physiography, precipitation, weather patterns, recent soil moisture conditions, and the degree of vegetative clearing and impervious surface.

A flash flood is a rapid flood that inundates low-lying areas in less than six hours. Flooding is the most frequent and costly natural hazard in the United States. It is a major component in nearly 90 percent of all presidential disaster declarations involving natural hazards. The severity of a flooding event is determined by a combination of stream and river basin topography and physiography, precipitation and weather patterns, recent soil moisture conditions, and the degree of vegetative clearing.

Figure 4-9 *FEMA Floodplains within Plano*



4.9.2 LOCATION

Primary flooding locations are found in the East Fork Trinity River Basin on the east side of Plano.

4.9.3 EXTENT

The severity of a flood event is determined by a combination of several major factors, including stream and river basin topography and physiography, precipitation, and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surfaces. Typically, floods are long-term events that may last for several days.

Determining the intensity and magnitude of a flood event depends upon the flood zone and location of the flood hazard area in addition to the depths of flood waters. The extent of flood damages can be expected to be more damaging in the areas that will convey a base flood. FEMA categorizes areas on the terrain according to how the area will convey flood water. Table 4-23 describes FEMA flood zones and the flood impact in terms of severity or potential harm. Flood Zones A, AE, and X are the hazard areas mapped in the DFW region.

Table 4-23 *FEMA Flood Zones*

INTENSITY	ZONE	DESCRIPTION
HIGH	ZONE A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
	ZONE A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a Base Flood Elevation (BFE) (old format).
	ZONE AE	The base floodplain where base flood elevations are provided. AE Zones are now used on the new format FIRMs instead of A1-A30 Zones.
	ZONE AO	River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
	ZONE AO	River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
	ZONE A99	Areas with a 1% annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
	ZONE AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
MODERATE to LOW	ZONE X 500	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.

Table 4-24 *Extent Scale – Water Depth/Mean Sea Level (MSL)*

SEVERITY	MSL (in feet)	DESCRIPTION
BELOW FLOOD STAGE	0 to 15	Water begins to exceed low sections of banks and the lowest sections of the floodplain.
ACTION STAGE	16 to 23	Flow is well into the floodplain; minor lowland flooding reaches low areas of the floodplain. Livestock should be moved from low lying areas.
FLOOD STAGE	24 to 28	Homes are threatened and properties downstream of river flows or in low lying areas begin to flood.
MODERATE FLOOD STAGE	29 to 32	At this stage the lowest homes downstream flood. Roads and bridges in the floodplain flood severely and are dangerous to motorists
MAJOR FLOOD STAGE	33 and above	Major flooding approaches homes in the floodplain. Primary and secondary roads and bridges are severely flooded and very dangerous. Major flooding extends well into the floodplain, destroying property, equipment and livestock.

4.9.4 HISTORICAL OCCURRENCES

Table 4-25 depicts flood events that have occurred within Collin County between 1996 and 2022.

Table 4-25 *Historical Flood Events*

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
4/4/2022	2115	Flash Flood	0	0	$25,000	0
4/4/2022	2115	Flash Flood	0	0	$25,000	0
4/4/2022	2115	Flash Flood	0	0	$15,000	0
5/16/2021	1403	Flood	0	0	0	0
3/18/2020	415	Flash Flood	0	0	0	0
4/23/2019	2202	Flash Flood	0	0	$10,000	0
10/19/2018	1500	Flood	0	0	0	0
9/21/2018	1900	Flash Flood	0	0	$10,000	0
9/21/2018	1930	Flash Flood	0	0	0	0
8/17/2017	530	Flood	0	0	0	0
8/17/2017	727	Flood	0	0	0	0
7/5/2017	1950	Flash Flood	0	0	0	0
7/5/2017	1950	Flash Flood	0	0	0	0
7/5/2017	1956	Flash Flood	0	0	0	0
6/12/2016	1640	Flash Flood	0	0	0	0
12/26/2015	1953	Flash Flood	0	0	0	0
11/27/2015	645	Flood	0	0	0	0
6/21/2015	729	Flash Flood	0	0	$1,000	0

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
5/30/2015	605	Flash Flood	0	0	0	0
5/29/2015	514	Flash Flood	0	0	0	0
5/29/2015	515	Flash Flood	0	0	0	0
5/29/2015	830	Flash Flood	0	0	0	0
5/17/2015	745	Flood	0	0	0	0
5/9/2015	1019	Flash Flood	0	0	0	0
5/9/2015	1113	Flash Flood	0	0	0	0
5/9/2015	1530	Flood	0	0	0	0
7/31/2014	715	Flash Flood	0	0	0	0
3/20/2012	0	Flood	0	0	0	0
1/25/2012	500	Flood	0	0	$50,000	0
11/20/2009	1100	Flood	0	0	$20,000	0
10/25/2009	2121	Flash Flood	0	0	3,000	0
10/25/2009	2244	Flash Flood	0	0	$3,000	0
5/3/2009	405	Flash Flood	0	0	0	0
5/2/2009	1825	Flash Flood	0	0	$20,000	0
5/2/2009	2038	Flash Flood	0	0	$2,000	0
8/20/2008	600	Flash Flood	0	0	$20,000	0
8/20/2008	600	Flash Flood	0	0	0	0
8/20/2008	645	Flash Flood	0	0	$4,000	0
8/20/2008	1500	Flash Flood	0	0	0	0
4/23/2008	2255	Flash Flood	0	0	$2,000	0
3/18/2008	1154	Flash Flood	0	0	0	0
3/18/2008	1438	Flash Flood	0	0	0	0
3/18/2008	1654	Flash Flood	0	0	0	0
3/18/2008	1700	Flash Flood	0	0	$4,000	0
10/15/2007	742	Flash Flood	0	0	$80,000	0
7/11/2007	1642	Flash Flood	0	0	0	0
7/5/2007	1330	Flash Flood	0	0	0	0
6/27/2007	1743	Flash Flood	0	0	0	0
6/26/2007	1501	Flash Flood	0	0	$20,000	0
6/18/2007	200	Flash Flood	0	0	$10,000	0
6/18/2007	800	Flash Flood	0	0	0	0
5/30/2007	830	Flash Flood	0	0	$10,000	0

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
5/27/2007	906	Flash Flood	0	0	0	0
5/2/2007	1900	Flash Flood	0	0	$50,000	0
4/24/2007	2009	Flash Flood	0	0	0	0
4/3/2007	1852	Flash Flood	0	0	0	0
3/30/2007	2000	Flash Flood	0	0	0	0
1/12/2007	1715	Flash Flood	0	0	0	0
3/19/2006	1500	Flash Flood	0	0	0	0
8/15/2005	1945	Flash Flood	0	0	0	0
12/30/2002	1430	Flash Flood	0	0	0	0
10/19/2002	205	Flash Flood	0	0	$25,000	0
5/6/2001	128	Flash Flood	0	0	0	0
2/16/2001	134	Flash Flood	0	0	0	0
2/16/2001	351	Flash Flood	0	0	0	0
6/15/2000	200	Flash Flood	0	0	0	0
6/11/2000	1255	Flash Flood	0	0	0	0
6/4/2000	215	Flash Flood	0	0	0	0
6/8/1999	1900	Flash Flood	0	0	0	0
5/17/1999	1533	Flash Flood	0	0	0	0
12/4/1998	100	Flash Flood	0	0	0	0
12/4/1998	100	Flash Flood	0	0	0	0
1/4/1998	1640	Flash Flood	0	0	0	0
1/4/1998	1645	Flash Flood	0	0	0	0
1/4/1998	1650	Flash Flood	0	0	0	0
1/4/1998	1752	Flash Flood	0	0	0	0
1/4/1998	2109	Flash Flood	0	0	0	0
12/20/1997	2000	Flash Flood	0	0	0	0
6/9/1997	2048	Flash Flood	0	0	0	0
6/9/1997	2100	Flash Flood	0	0	0	0
5/19/1997	1815	Flash Flood	0	0	0	0
5/19/1997	1902	Flash Flood	0	0	$10,000	0
5/19/1997	1930	Flash Flood	0	0	0	0
4/4/1997	2225	Flash Flood	0	0	0	0
2/19/1997	1630	Flash Flood	0	0	0	0
2/19/1997	1651	Flash Flood	0	0	0	0

DATE	TIME	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
2/19/1997	1800	Flash Flood	0	0	0	0
2/19/1997	1825	Flash Flood	0	0	0	0
11/7/1996	30	Flash Flood	0	0	$10,000	0
10/27/1996	2120	Flash Flood	0	0	0	0

4.9.5 SIGNIFICANT EVENTS

Plano has experienced several significant flooding events, including floods in 1995, 2006, and 2015 that caused significant damage to homes, businesses, and infrastructure. In response to these events, the city has taken steps to improve its flood prevention and management systems, including constructing flood control structures and implementing storm water management programs. Table 4-26 depicts more significant flood events.

Table 4-26 *Significant Flood Events in Plano*

DATE	DESCRIPTION OF EVENT
5/16/2022	Heavy rain caused flooding of roads and low-lying areas including highway ramps at US 75 and President George Bush Turnpike exchange. There was a total of $10,000 in property damage.
9/21/2018	Highway 75 was shut down due to high water leaving several vehicles stranded
5/2/2009	Cars were flooded at Silverwood Lane and Regent Drive as they attempted to cross the bridge that was covered by high water. Approx. $20,000 of property damage reported
3/18/2008	Flash flooding was reported at Spring Creek and Highway 75. The creek was over both north and southbound service roads
10/15/2007	Numerous high-water rescues were conducted in Plano. There was a total of $80,000 in property damage.
7/11/2007	Creek rose above the bridge at the intersection of Park Haven and Round Rock Roads. Flooding was reported along Parker Road at 15th Street and Parker Road and Coit Road
12/30/2002	High water rescue was conducted by the Plano Fire Department in the 1000 block of Custer Rd
5/19/1997	Nearly 5 inches of rain fell in the city. Cars were stranded in floodwaters. Streets were flooded and a few homes received minor flooding from high water. Approx. $10,000 of property damage was reported

4.9.6 PROBABILITY OF FUTURE EVENTS

Flood probability means the likelihood of the hazard occurring and may be defined in terms of general descriptors (likely, highly likely, unlikely - with each category defined), historical frequencies, statistical probabilities, and /or on hazard probability maps. Texas suffers approximately 400 floods annually, more than double the average of the second-highest state. Because flooding events have been documented to occur even in times of widespread drought, the probability of flood is likely for the City of Plano.

Texas is particularly prone to floods, especially in two large parts of the state: the coast and a wideband called Flash Flood Alley that extends through Central and North Texas. Almost every major city in Texas is in an area at high risk of flooding.

4.9.7 VULNERABILITY AND IMPACT

Floods have the potential to impact the city, and all assets are considered vulnerable and can be impacted by this hazard.

The city is in a region prone to heavy rainfall events, particularly during the spring and summer months when thunderstorms are more common. Plano is also situated within the East Fork Trinity River Basin, a river system that has experienced flooding.

Additionally, as an urban area, Plano is susceptible to flooding because of urbanization. Paved and impervious surfaces in the city can increase runoff during heavy rain events, exacerbating flooding.

4.9.8 CLIMATE CHANGE

The following are some of the ways in which climate change can exacerbate flooding in the City of Plano:

Increased Precipitation: Climate change can cause more frequent and intense precipitation events, leading to more runoff and flooding. This can result in flash floods and increased river flooding, affecting areas such as Plano's creek systems.

Rising Sea Levels: Although Plano is an inland city, rising sea levels due to climate change can impact coastal areas, leading to increased storm surges and flooding along the coast.

Heatwaves and Droughts: Climate change can lead to more prolonged heatwaves and droughts, resulting in soil becoming dry and hardened. This, in turn, can lead to an increased risk of flash flooding, as the soil cannot absorb water as easily.

Urbanization: As cities like Plano grow and urbanize, natural areas such as wetlands and forests are often replaced with impervious surfaces like roads and buildings. This can lead to an increased risk of flooding, as water cannot be absorbed by the ground.

Overall, the effects of climate change on flooding in Plano are complex and multifaceted. However, there is no doubt that climate change will increase the frequency and severity of flooding events in the city.

4.9.9 NFIP PARTICIPATION

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against flood hazards. The City of Plano participates in the NFIP.

As an additional indicator of floodplain management responsibility, communities may choose to participate in FEMA’s Community Rating System (CRS). The incentive-based program allows communities to undertake flood mitigation activities beyond NFIP requirements.

The City of Plano participates in the CRS program to provide flood insurance incentives, expand the community’s current NFIP policy base, and reduce risk by adopting higher regulatory standards.

Mitigation by the City of Plano includes the reduction in flood losses created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazard areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, flood-proofed or otherwise protected from flood damage.

The City of Plano promotes public health, safety, and general welfare; and minimizes public and private losses due to flood conditions in specific areas by provisions designed to:

- Protect human life and health.
- Minimize expenditure of public money for costly flood control projects.
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public.
- Minimize prolonged business interruptions.
- Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains.
- Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas.
- Ensure that potential buyers are notified that property is in a flood area.

In order to accomplish these tasks, the City of Plano follows these guidelines:

- Restrict or prohibit uses that are dangerous to health, safety, or property in times of flood, or cause excessive increases in flood heights or velocities.
- Require that uses vulnerable to floods, including facilities, which serve such uses, be protected against flood damage at the time of initial construction.
- Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters.
- Control filling, grading, dredging and other development, which may increase flood damage.
- Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters, or which may increase flood hazards to other lands.

4.9.10 NFIP COMPLIANCE AND MAINTENANCE

As part of continual compliance with the NFIP, the City of Plano has developed a Floodplain Management Plan and has a current NFIP ordinance. The City of Plano also periodically conducts education programs for area homebuilders and through public outreach to increase awareness of the FEMA requirements for Flood Plain Management.

Flooding was identified as a moderate hazard during hazard ranking activities by the HSMC. Most flood mitigation actions address reducing flood risk through structural alterations and drainage projects and implementing flood awareness programs. The City of Plano recognizes the need for and is adopting higher NFIP regulatory standards to minimize flood risk in their community. An ordinance was last updated and adopted in 2021. The Director of Engineering for the City of Plano is designated as the Floodplain Administrator.

4.9.11 REPETITIVE LOSS

The Severe Repetitive Loss (RL) Grant Program under FEMA provides federal funding to assist states and communities in implementing mitigation measures to reduce or eliminate the long-term risk of flood damage to SRL residential structures insured under the NFIP. The Texas Water Development Board (TWDB) administers the SRL grant program for the State of Texas.

Severe Repetitive Loss properties are defined as residential properties that are:

- Covered under the NFIP and have at least four flood related damage claim payments (building and contents) over $5,000 each.
- The cumulative amount of such claims payments exceed $20,000.

- At least two separate claim payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

The City of Plano has the following repetitive loss structures:

- 8 Repetitive Loss structures in the City of Plano.
  - 7 Residential properties
  - 1 Apartment Complex

Every year, flood insurance letters are mailed to these properties and their neighbors. Article VIII of the City Municode's Chapter 16, Flood Damage Prevention, discusses what is required for new building or significant renovations.

4.10 Hazardous Materials Incident

4.10.1 HAZARD DESCRIPTION

Hazardous substances are categorized as toxic, corrosive, flammable, irritant, or explosive. The material may solid, liquid, and/or a gaseous contaminant that is released from fixed or mobile containers, by accident or purposely, an act of terrorism. A hazardous materials incident can span hours to days and depending upon the chemical, incidents may last months to years. An explosion and/or fire may be the result of a release. Chemicals or contaminants may reach beyond the initial area by persons, vehicles, water, wind, and possibly wildlife.

Hazardous materials incidents can also occur as a result of or in tandem with natural hazard events, such as floods, hurricanes, and tornadoes, which in addition to causing incidents can also hinder response efforts. A fixed hazardous materials incident is the accidental release of chemical substances or mixtures, which presents a danger to the public health or safety, during production or handling at the affected facility. When a hazardous material is discharged into the land, water, or air, it can harm people, property, or the environment. A transportation hazardous materials event occurs when a chemical substance or combination is accidentally released during transportation and poses a risk to public health or safety.

U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) can capture data related to these incidents. Table 4-27 contains Plano Fire Rescue's yearly response totals (2015-2021) to hazardous material type incidents.

A hazardous material transportation incident could occur in Plano. Especially now, with population growth and an increase in the number of motor vehicles sharing routes with vehicles that are transporting hazardous substances.

Table 4-27 *Plano Fire Rescue's Hazardous Material Report*[32]

CITY OF PLANO FIRE DEPARTMENT NFIRS REPORTING							
NFIRS CODE/TYPE	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
400 Hazardous Condition - other	12	23	16	20	0	0	35
410 Combustible spills/leaks - other	6	5	6	4	7	8	8
411 Gasoline/flammable liquid spill - Class 1	44	47	40	37	49	35	37
412 Gas leak	213	254	206	273	373	272	265
413 Oil/combustible liquid spill - Class II/III	20	14	15	20	21	10	8
420 Chemical release/reaction - other	0	1	1	1	2	2	2
421 Chemical hazard - no spill/leak	2	2	2	3	4	1	1
422 Chemical spill or leak	13	6	14	5	11	11	7
423 Refrigeration leak	0	0	3	1	1	1	1
424 Carbon monoxide leak	6	16	14	12	14	22	18
431 Radiation leak	0	0	1	0	0	0	78

[32] Source: The City of Plano Fire Department National Fire Incident Reporting System (NFIRS) data (2015-2021)

CITY OF PLANO FIRE DEPARTMENT NFIRS REPORTING							
440 Electrical wiring/equipment problem - other	113	101	79	103	90	88	10
441 Heat short circuit/worn insulation	9	10	12	14	8	3	10
442 Overheated motor/wiring	27	16	14	13	15	10	3
443 Breakdown of light ballast	2	6	7	1	0	2	36
444 Power line down	34	41	36	49	46	41	94
445 Arcing, shorted electrical equipment	116	98	83	86	93	74	2
451 Biological hazard	0	0	1	2	1	3	1
460 Accident/potential accident - other	4	1	1	1	1	4	6
461 Building/structure weakened/collapsed	6	3	3	5	9	8	4
463 Vehicle accident/general cleanup	7	10	5	3	8	7	1
480 Attempted burning/illegal action - other	1	1	0	0	1	0	1
481 Attempt to burn person	1	0	0	1	1	0	37
TOTALS	**636**	**655**	**559**	**654**	**755**	**602**	**665**

4.11 Cyber Event

4.11.1 HAZARD DESCRIPTION

A cyber event is defined as using one computer system against another to intimidate people or disrupt other systems. Cyber events may last minutes to days, depending on the intrusion, disruption, or infection type. Generally, there are no direct effects on the built environment, but secondary effects may be felt depending on the system being terrorized. Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks.

According to the National Strategy for Homeland Security, terrorists may seek to cause widespread disruption and damage, including casualties, by attacking electronic and computer networks linked to critical infrastructures such as energy, financial, and securities networks. In addition, terrorist groups exploit information technology and the internet to plan attacks, raise funds, circulate propaganda, gather information, and communicate. Therefore, regarding hazard mitigation, cyberterrorism is often explored in business continuity planning.

4.11.2 HISTORICAL OCCURRENCES

External threats that have impacted the City of Plano:

- **WannaCry Ransomware:** Triggered the city to review cybersecurity and assessment of implemented controls.
- **Log4j:** Global Impact Resources were utilized to mitigate the threat and manage new variants.
- **SolarWinds Hack:** The City has allocated resources to upgrade systems and investigate the incident because of its widespread impact on Technology Service teams.
- **Password Leaks**: MS-ISAC Reports on city account passwords that could be publicly available and Security track, block, and mitigate those accounts.
- **North Texas Ransomware attacks** between 2019 and 2020: Two targeted attacks in the North Texas area triggered cyber alerts in the city. The resources assigned to review the city defenses and backups took weeks to assess and test control mechanisms.

The City of Plano is frequently subject to web-, email-, and firewall-based attacks.

Internal threats that impacted the city of Plano:

- Vendors were sharing passwords/accounts with the city of Plano systems - Supply Chain impacted the city. Moreover, vendors' access to city resources was unrestricted and unmonitored, which led to password sharing.
- Password sharing puts the city's network at risk. As a result, accounts were locked.

Cyber incidents have been increasing exponentially in the U.S. and worldwide. Government entities are particularly targeted, and vital information can be lost or held hostage for monetary demands. Given the probability, impact, and vulnerability, a cyber-incident is likely to continually occur.

4.12 Extreme Temperature

HEAT

4.12.1 HAZARD DESCRIPTION

Extreme heat events can significantly impact human health, commercial and agriculture businesses and have primary and secondary effects on infrastructure. What constitutes extreme heat can vary across different areas of the country. Infants and the elderly are most susceptible to the effects of temperature changes. With increasing global temperatures, extreme heat trends may occur more frequently than seen in the past.

Extreme heat is characterized by very high temperatures and exceptionally humid conditions. When these conditions persist over a period, it is called a heatwave. Humid or muggy conditions occur when a dome of high atmospheric pressure traps hazy, damp air near the ground. Extreme heat has the potential to impact the entire city. Therefore, all of Plano is exposed to this hazard. Extreme heat generally affects the entire population, but the homeless, very young, elderly, and populations without air conditioning are most vulnerable.

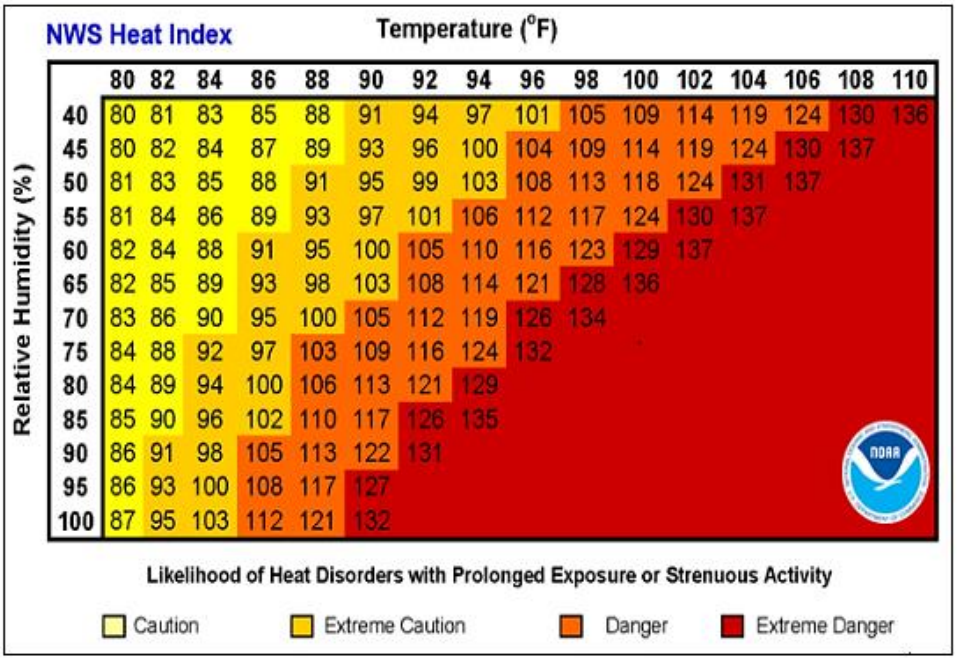
4.12.2 LOCATION

There is no specific geographic scope to the extreme heat hazard. Extreme heat could occur in any area of the City of Plano.

4.12.3 EXTENT

The heat index (depicted in Table 4-28), also known as the apparent temperature, is what the temperature feels like to the human body when relative humidity is combined with the air temperature.

Table 4-28 *NWS Heat Index Chart*[33]



[33] Source: National Weather Service, https://www.weather.gov/ama/heatindex

Table 4-29 depicts the levels of bodily risk from continued exposure to excessive heat. .

Table 4-29 *Bodily Risk From Continued Exposure to Excessive Heat*[34]

I	Extremely Hot	130°F or Higher	Heat/Sunstroke HIGHLY LIKELY with continued exposure
II	Very Hot	105°F - 130°F	Sunstroke, heat cramps, or heat exhaustion LIKELY, and heatstroke POSSIBLE with prolonged exposure and/or physical activity
III	Hot	90°F - 105°F	Sunstroke, heat cramps, or heat exhaustion POSSIBLE with prolonged exposure and/or physical activity
IV	Very Warm	80°F - 90°F	Fatigue POSSIBLE with prolonged exposure and/or physical activity

4.12.4 HISTORICAL OCCURRENCES

Table 4-30 depicts the historical frequency of extreme heat incidents that have occurred in Collin County.

Table 4-30 *Historical Heat Events (1997-2022)*

DATE	TIME	TYPE	MAG	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/3/22	1100	Heat	106°	0	0	0	0
7/17/22	1100	Excessive Heat	105°	0	0	0	0
7/7/22	1225	Excessive Heat	105°	0	0	0	0
7/6/22	1100	Heat	105°	0	0	0	0
6/23/22	1100	Heat	110°	0	0	0	0
6/11/22	1100	Heat	105°	0	0	0	0
9/1/21	1100	Heat	110°	0	0	0	0
8/9/21	1100	Heat	110°	0	0	0	0
8/1/21	1100	Heat	110°	0	0	0	0
7/29/21	1100	Heat	110°	0	0	0	0
7/25/21	1100	Heat	110°	0	0	0	0
9/1/20	0	Heat		0	0	0	0
8/30/20	1100	Heat	105°	0	0	0	0
8/28/20	1200	Excessive Heat	106°	0	0	0	0

[34] Source: National Weather Service https://www.weather.gov/fwd/heat2

DATE	TIME	TYPE	MAG	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/12/20	1200	Heat	112°	0	0	0	0
7/9/20	1200	Heat	115°	0	0	0	0
7/1/20	1100	Heat	105°	0	0	0	0
8/26/19	1300	Heat	112°	0	0	0	0
8/17/19	1100	Heat	112°	0	0	0	0
8/7/19	1100	Heat	110°	0	0	0	0
7/16/19	1200	Heat	108°	0	0	0	0
7/8/19	1200	Heat	108°	0	0	0	0
6/20/19	1500	Excessive Heat	110°	0	0	0	0
7/19/16	1600	Heat		1	0	0	0
6/14/16	1030	Heat	105°	0	0	0	0
7/19/15	1600	Excessive Heat		1	0	0	0
8/6/11	0221	Heat	100°	1	0	0	0
8/1/11	0600	Excessive Heat	109°	1	0	0	0
9/1/00	0	Heat		0	0	0	0
8/1/00	0	Heat	100°	0	0	0	0
7/1/00	0	Heat	106°	0	0	0	0
8/1/99	0	Heat	107°	0	0	0	0
7/1/98	0	Heat	110°	0	0	0	0
7/19/97	1800	Heat	115°	0	0	0	0

4.12.5 SIGNIFICANT EVENTS

July 2011: Plano experienced a heat wave with high temperatures exceeding 100° degrees for several days in a row. The incident caused heat-related illnesses and put a strain on the city's electrical grid due to increased energy demand for cooling.

August 2000: Plano experienced a heat wave with high temperatures exceeding 100° degrees for several days. There were heat-related illnesses and several deaths in the DFW region.

July 1998: Heat wave with high temperatures over 100° degrees for several days. There were heat-related illnesses and the city's water supply was strained due to increased irrigation.

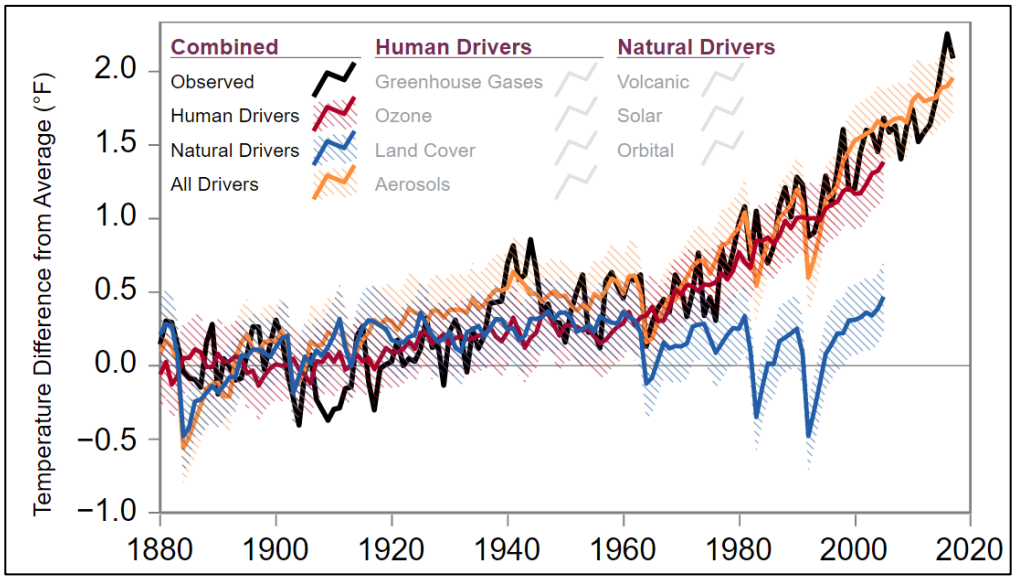
August 1980: Heat wave with high temperatures exceeding 100° degrees for several days There were heat-related illnesses and several deaths in the DFW region.

4.12.6 PROBABILITY OF FUTURE EVENTS

Human and natural causes impact the earth's climate, as seen in Figure 4-10. As a result, the combined effects will considerably raise global temperatures. The city of Plano, as well as the entire world, will witness a rise in the likelihood of future extreme heat occurrences. Climate models predict that temperatures in the DFW region will continue to rise and that heat waves will become more frequent and intense.

According to the *Fourth National Climate Assessment, Volume II*[35], North Texas is expected to experience an average increase in temperatures of between 4°F- and 8°F by the end of the century.

Figure 4-10 *Human and Natural Influences -Increaseing Global Temperatures*



Source: U.S. Global Change Research Program, Fourth National Climate Assessment, Chapter 2: Our Changing Climate, 2017[36].

4.12.7 VULNERABILITY

Summers in North Texas are notoriously hot and humid. The region is also renowned for heat waves, which are extended periods of extremely hot weather.

Plano has witnessed considerable expansion and urbanization in recent decades, resulting in a "urban heat island" effect. Because to the presence of buildings, pavement, and other heat-absorbing surfaces, urban regions become substantially hotter than adjacent rural areas. Furthermore, Plano's topography is rather flat, which might contribute to greater temperatures.

Additionally, flat terrain can lead to less shade and less natural ventilation, which can cause temperatures to rise. As an urban area, Plano has a lower percentage of tree cover than

[35] https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf
[36] Source: U.S. Global Change Research Program, Fourth National Climate Assessment, Chapter 2: Our Changing Climate, 2017. https://nca2018.globalchange.gov/chapter/2/

surrounding rural areas. Trees provide shade and can help cool the air through evapotranspiration, which can help mitigate the effects of heat.

The effects of climate change are expected to exacerbate the vulnerability of Plano and the surrounding areas to heat. Climate models predict that temperatures will continue to rise and that heat waves will become more frequent and intense. Given the likelihood, effect, and vulnerability, an intense heat occurrence will likely occur in Plano.

4.12.8 IMPACT

The following factors are impacted by extreme heat conditions:

- High temperatures can pose significant health risks, especially for vulnerable populations such as the elderly, children, and individuals with pre-existing medical conditions. Heat-related illnesses, including heat stroke and dehydration, can increase during extreme heat events.
- Extreme heat puts a strain on the electrical grid as the demand for cooling systems, such as air conditioners, escalates. Increased energy consumption for cooling purposes can lead to power shortages and potential blackouts if the supply cannot meet the demand.
- Extreme heat can negatively impact agriculture in Texas. Crops and livestock may suffer from heat stress, reduced productivity, and increased water demands for irrigation. Additionally, drought conditions associated with extreme heat can lead to water scarcity, affecting agricultural production and food prices.
- High temperatures contribute to increased evaporation rates, leading to water loss in reservoirs, lakes, and rivers. This can exacerbate existing water scarcity issues, particularly during drought conditions, impacting water availability for households, agriculture, and ecosystems.
- Extreme heat events can disrupt ecosystems, affecting plant and animal life. Native species may face challenges adapting to rapidly changing climatic conditions, and increased heat can lead to changes in habitat suitability, migration patterns, and alterations in species interactions.
- Prolonged extreme heat can strain infrastructure systems. Roads, bridges, and rail lines may experience thermal expansion and damage. Additionally, electrical infrastructure can face challenges from increased demand and potential equipment failures due to heat stress.

4.12.9 CLIMATE CHANGE

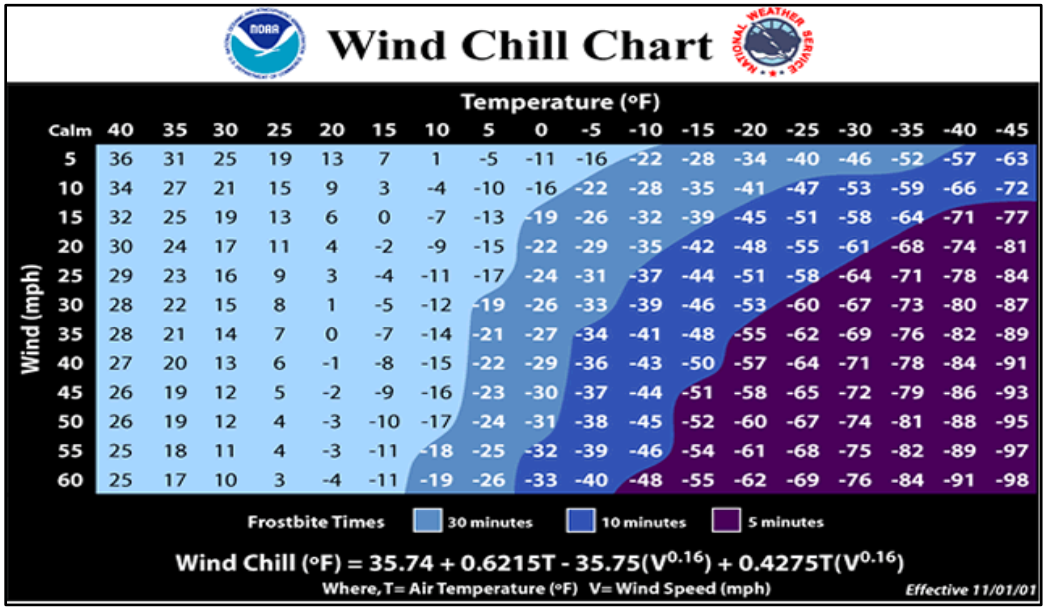
In Plano, which already experiences hot summers, climate change may increase the frequency and severity of extreme heat, leading to more cases of heat-related illnesses and deaths. In addition, vulnerable populations, such as older adults, young children, and those with pre-existing medical conditions, are at higher risk of heat-related illnesses. Additionally, high temperatures can increase the formation of ground-level ozone, which is a harmful air pollutant that can lead to respiratory problems.

EXTREME COLD

4.12.10 HAZARD DESCRIPTION

Extreme cold is when temperatures drop below normal; near-freezing temperatures are considered extremely cold. Extensive exposure to extremely cold temperatures can cause hypothermia and/or frostbite and become life-threatening. The extent of extreme cold temperatures is generally measured through the Wind Chill Temperature Index (WCT). Extreme cold can also cause emergencies in susceptible populations, such as those without shelter, motorists who may be stranded, or those who live in a poorly insulated home or without heat.

Figure 4-11 *NOAA/National Weather Service Wind Chill Chart*[37]



4.12.11 LOCATION

Climate variability, such as cold fronts or polar vortex events, can impact temperatures and contribute to extreme cold conditions. Topography, such as the city's elevation and proximity to bodies of water, can also influence temperatures. Infrastructure, such as homes and buildings that are not properly insulated or prepared for cold weather, can exacerbate the effects of extreme cold temperatures.

4.12.12 EXTENT

Figure 4-11 depicts the National Weather Service's Wind Chill chart which is utilized to measure the combined cooling effect of wind and temperature.

The extent of the impact of extreme cold events in Plano can depend on various factors, including the duration and intensity of the event, the preparedness of the community, and the availability of resources to respond to the effects of the cold weather.

[37] Source: National Weather Service https://www.weather.gov/safety/cold-wind-chill-chart

During an extreme cold event in Plano, temperatures can drop significantly below freezing for a period of time. This can result in icy conditions and potential disruptions to daily activities.

It's not uncommon for such events to be accompanied by a mix of freezing rain, sleet, or light snow, which can further contribute to hazardous conditions.

4.12.13 HISTORICAL OCCURRENCES

Table 4-31 *Historical Extreme Cold Events*

DATE	TIME	TYPE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
2/14/2021	1800	Extreme Cold/Wind Chill	0	0	$6,000,000	0
10/31/2019	0	Cold/Wind Chill	0	0	0	0
4/12/1997	400	Cold/Wind Chill	0	0	0	0

4.12.14 SIGNIFICANT EVENTS

2/14/2021 Winter Storm Uri: Winter Storm Uri was a major weather event that impacted the state of Texas, including the city of Plano, in February 2021. The storm brought extreme freezing temperatures, snow, and ice, causing substantial disruptions in electricity and water supplies, as well as threats to roadways and other essential infrastructure.

The storm began on February 9th, 2021, and continued to impair the DFW region through February 19th. One wave of winter precipitation moved across the region February 13-15th, with another round of snow and ice on February 16-17th. Icing totals were highest across Central Texas, where over a half inch of ice was reported in some areas. While the snow and ice impacted transportation, power, and water, the most significant impacts were from the record-breaking cold temperatures and wind chill.

The impact of Winter Storm Uri on Plano, Texas was significant, with many residents experiencing power outages and water disruptions for several days. The extreme cold temperatures led to an increased demand for electricity and natural gas, which caused widespread power outages and shortages of natural gas.

The city of Plano and its emergency responders worked to respond to the effects of the storm, including by opening warming centers for residents without power, distributing water and other supplies, and conducting wellness checks on vulnerable residents.

The impacts and damages to the region during this historic event were largely due to the cold temperatures and wind chill. The cold temperatures resulted in days-long power outages for some, and an immeasurable amount of pipe, infrastructure and building damage. Damage totals that have been reported so far are near 140 million for North and Central Texas, and most of that is likely contributed to the cold weather. In addition, 30 deaths were officially reported during this period/event. Many of the details of each case were unknown at the time of publication due to pending information from county officials, but many of the known causes were due to hypothermia or the cold weather.

10/31/2019: A strong cold front on October 30 brought a round of showers and thunderstorms, followed by cold and windy conditions across the DFW region. All counties across North and Central Texas

recorded their first freeze of the season Halloween morning. The official average first freeze for the DFW region is November 22.

4/12/1997: An unusually strong arctic cold front moved into North Texas on the 11th, setting the stage for a night of strong radiational cooling as high pressure built into the southern plains behind the front. Clear skies, light winds, and a dry atmosphere produce temperatures in the mid-20s to lower 30 across much of the area on the morning of the 12th.

Even colder readings were realized on the morning of the 13th. The last freeze of the season usually occurs in mid to late March in northern Texas, and this month's freeze was one of the latest on record.

4.12.15 PROBABILITY OF FUTURE EVENTS

Given the probability, impact, and vulnerability, an extreme cold weather event is likely to happen in Plano once every two to three years.

4.12.16 VULNERABILITY AND IMPACT

Plano is in a region that typically experiences mild winters; hence the community may be less prepared for a severe cold weather event. Buildings and homes may be less well-insulated for cold temperatures, and infrastructure such as power lines and water pipes may be vulnerable to damage from freezing.

Severe cold temperatures can significantly impact the community, including transportation, power, and water systems. The cold temperatures can also pose health risks, particularly to vulnerable populations such as older adults and those experiencing homelessness.

4.12.17 CLIMATE CHANGE

While climate change is primarily associated with increasing global temperatures, it can also impact extreme cold weather events in some regions, including Plano. However, the overall effect of climate change on extreme cold events in Plano is still subject to debate and research.

Some studies suggest that climate change may lead to more frequent and severe cold weather events in some regions due to changes in atmospheric circulation patterns. However, others argue that the warming of the planet may reduce the likelihood of extreme cold events in specific areas.

It's worth noting that the impacts of extreme cold weather events in Plano can still be significant, regardless of their causes. Cold snaps can cause a range of problems, including frozen pipes, increased energy demand for heating, and disruptions to transportation and other infrastructure.

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4.13 Drought

4.13.1 HAZARD DESCRIPTION

Drought is a water shortage caused by the natural reduction in precipitation expected over an extended period, usually a season or more in length. It can be aggravated by other factors such as high temperatures, high winds, and low relative humidity.

Drought is a slow-onset hazard that can last for months or years. As a hazard, it has the potential to impact many aspects of life, including two of our most essential needs: drinking water and food. Because of the long duration of droughts, the impacts last for years and can ripple through a community over time. Severe droughts may increase incidences of other events, like wildfires. Drought will affect the viability of communities and the economy across the nation.

Droughts can be classified as:

- **Meteorological Drought:** The degree of dryness, as measured as the departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
- **Hydrologic Drought:** The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- **Agricultural Drought:** Soil moisture deficiencies relative to water demands of plant life, usually crops.
- **Socioeconomic Drought:** The effect of demands for water exceeds the supply because of a weather-related supply shortfall.

4.13.2 LOCATION

Based on previous drought occurrences and Plano's location, the area could expect droughts ranging from extremely dry to exceptional, or D0 to D4, according to the Palmer Drought Category. Plano has seen extreme drought conditions and expects more in the future.

4.13.3 EXTENT

The Palmer Drought Severity Index (PDSI) (Table 4-32) is used to measure the extent of drought by measuring the duration and intensity of long-term drought-inducing circulation patterns.

Table 4-32 *Palmer Drought Index*

DROUGHT CONDITION CLASSIFICATIONS	PALMER DROUGHT SEVERITY INDEX						
	Extreme	Severe	Moderate	Normal	Moderately Moist	Very Moist	Extremely Moist
Z Index	-2.75 and below	-2.00 to -2.74	-1.25 to -1.99	-1.24 to +.99	+1.00 to + 2.49	+2.50 to + 3.49	N/A
Meteorological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above
Hydrological	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to + 2.99	+3.00 to +3.99	+4.00 and above

Long-term drought is cumulative, with the intensity of drought during the current month dependent upon the current weather patterns plus the cumulative patterns of previous months.

The PDSI uses readily available temperature and precipitation data to estimate relative dryness. It is a standardized index spanning -10 (dry) to +10 (wet). Maps of operational agencies like NOAA typically range from -4 to +4, but more extreme values are possible. The hydrological impacts of drought (e.g., reservoir levels, groundwater levels) take longer to develop.

4.13.4 HISTORICAL OCCURRENCES

Table 4-33 *Historical Drought Events*

DATE	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
9/1/22	Drought	0	0	0	0
8/1/22	Drought	0	0	0	0
7/19/22	Drought	0	0	0	0
4/1/22	Drought	0	0	0	0
3/1/22	Drought	0	0	0	0
2/1/22	Drought	0	0	0	0
1/1/22	Drought	0	0	0	0
8/1/18	Drought	0	0	0	$1,000
12/1/17	Drought	0	0	0	$1,000
11/21/17	Drought	0	0	0	0
10/1/15	Drought	0	0	$2,000	0
9/1/15	Drought	0	0	0	$1,000
4/1/15	Drought	0	0	0	$1,000
3/1/15	Drought	0	0	0	$1,000
2/1/15	Drought	0	0	0	$2,000
1/1/15	Drought	0	0	0	$2,000
12/1/14	Drought	0	0	0	$5,000
11/1/14	Drought	0	0	0	$2,000
10/1/14	Drought	0	0	0	$3,000
9/1/14	Drought	0	0	$5,000	0
8/1/14	Drought	0	0	0	$2,000
7/1/14	Drought	0	0	0	$3,000
6/1/14	Drought	0	0	0	$3,000
5/1/14	Drought	0	0	0	$3,000
4/1/14	Drought	0	0	0	$3,000
3/1/14	Drought	0	0	0	$4,000
9/1/13	Drought	0	0	0	$3,000

DATE	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
8/1/13	Drought	0	0	0	$3,000
7/9/13	Drought	0	0	0	$1,000
3/1/13	Drought	0	0	$2,000	0
2/1/13	Drought	0	0	0	$2,000
1/1/13	Drought	0	0	0	$3,000
12/1/12	Drought	0	0	0	$2,000
11/1/12	Drought	0	0	0	$3,000
9/25/12	Drought	0	0	0	$2,000
8/7/12	Drought	0	0	0	0
10/1/11	Drought	0	0	0	$5,000
9/1/11	Drought	0	0	0	$2,5000
8/1/11	Drought	0	0	0	$10,000
4/1/11	Drought	0	0	0	$10,000
3/21/11	Drought	0	0	0	$8,000
11/1/06	Drought	0	0	0	$800,000
10/1/06	Drought	0	0	$500,000	$500,000
9/1/06	Drought	0	0	0	0
8/1/06	Drought	0	0	0	0
7/1/06	Drought	0	0	0	0
6/6/06	Drought	0	0	0	0
5/1/06	Drought	0	0	0	0
4/1/06	Drought	0	0	0	0
3/1/06	Drought	0	0	0	0
2/1/06	Drought	0	0	0	0
1/1/06	Drought	0	0	0	0
12/1/05	Drought	0	0	0	0
11/1/05	Drought	0	0	0	0
10/1/05	Drought	0	0	0	0
9/1/05	Drought	0	0	0	0
8/1/05	Drought	0	0	0	0
7/1/05	Drought	0	0	0	0
6/1/05	Drought	0	0	0	0
5/1/05	Drought	0	0	0	0
9/1/00	Drought	0	0	0	0
8/1/00	Drought	0	0	0	0

DATE	EVENT	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
7/1/98	Drought	0	0	0	0
8/1/96	Drought	0	0	0	0

4.13.5 SIGNIFICANT EVENTS

The 2010-2015 drought was one of the most severe and prolonged droughts in Texas history. It resulted in significant agricultural losses, wildfires, and water supply challenges. Plano, being located in the North Texas region, was also affected by the drought's impacts. The lack of rainfall and high temperatures led to a decrease in water levels in lakes, rivers, and reservoirs, prompting water use restrictions and conservation measures.

Table 4-34 depicts more significant drought events. It details extreme and severe drought events that impacted the City of Plano.

Table 4-34 *Drought Historical Occurrences (2015-2021)*

DROUGHT HISTORICAL OCCURRENCES	
Date	**Description of Event**
8/1/2018	Severe (D2) drought conditions improved to Moderate (D1) drought by the middle of August following significant rainfall during the second week of the month.
12/1/2017	D2 / severe drought conditions across Collin County ended after 12/19 following beneficial rainfall during the middle part of the month.
11/21/2017	Severe drought conditions developed across the northern part of the county around November 21, then spread to the rest of the county through the end of the month.
10/1/2015	Collin County began the month in D2 severe drought conditions. By the middle of the month, the county was D3 extreme drought. However, several rounds of heavy rainfall towards the end of the month led to vast improvements and an end to drought conditions.
9/1/2015	Severe/D2 drought conditions covered Collin County for all of September 2015.
4/1/2015	The southern half of Collin County started the month of April in D2/Severe drought conditions. By April's end, the drought had been alleviated due to rounds of precipitation.
3/1/2015	Severe/D2 drought conditions county-wide at the beginning of March improved to Moderate/D1 across the northern third of the county in the middle of March. Conditions remained split between D2 in the south and D1 in the north through the end of the month.
2/1/2015	Nearly all of Collin County spent the month in D3/Extreme drought conditions, but, except for the southwestern portions of the county, the area saw improvement to D2/Severe drought conditions near the end of the month due to multiple rounds of winter precipitation.
1/1/2015	Severe/D2 drought conditions in place across all of Collin County at the beginning of January 2015 deteriorated to Extreme/D3 around the middle of the month across central and southern portions of Collin. Conditions remained as such through the end of January.

4.13.6 PROBABILITY OF FUTURE EVENTS

Plano, Texas, is in a region known for periodic drought conditions. The probability of a drought occurring in Plano can vary yearly. Several factors, including atmospheric conditions, precipitation patterns, and water usage, can influence it.

Plano has experienced several drought conditions in recent years, with the most significant drought occurring between 2011 and 2015. During this time, the city implemented water restrictions and other measures to conserve water and manage the impacts of the drought.

Several factors, including climate variability, land use changes, and population growth, can influence the probability of drought in Plano. Climate variability, such as El Niño or La Niña events, can impact precipitation patterns and contribute to drought conditions. Land use changes, such as urbanization, can also impact water availability by reducing the amount of vegetation and increasing runoff. Finally, population growth can also increase the water demand, putting additional stress on water resources.

4.13.7 VULNERABILITY AND IMPACT

Drought impacts large areas and crosses jurisdictional boundaries. Therefore, all existing and future buildings, facilities, and populations are exposed to this hazard and could potentially be impacted. However, drought impacts are mostly experienced as water shortages and crop and livestock losses on agricultural lands and typically have no impact on buildings.

The population, agriculture, property, and environment are vulnerable to drought. The average person will survive only a few days without water, and this timeframe can be drastically shortened for those people with more fragile health, including children, the elderly, and the ill. The population is also vulnerable to food shortages when drought conditions exist, and potable water is in short supply. Potable water is used for drinking, sanitation, patient care, sterilization, equipment, heating and cooling systems, and other essential medical functions.

The economic impact of drought events can be significant and produce complex impacts in various sectors of the economy beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. The direct and indirect economic impact can be significant if a drought event extends over several years. Based on the numerous previous occurrences and potential exposure to the hazard, a drought event is likely for the City of Plano.

4.13.8 CLIMATE CHANGE

Climate change is expected to have a significant impact on drought conditions in Plano, Texas, and the surrounding region. The effects of climate change are likely to exacerbate existing drought conditions, leading to more frequent and severe droughts.

Climate models predict that the average temperature in Texas will continue to rise in the coming years, leading to increased evaporation rates and a higher demand for water. This increased demand for water, coupled with a decrease in precipitation, will result in more frequent and severe droughts.

In addition to the direct effects of climate change, the region is also experiencing population growth and increasing water demand, which will put additional pressure on already limited water resources.

4.14 Transportation Incident

4.14.1 HAZARD DESCRIPTION

A highway transportation incident can involve single or multiple vehicles requiring responses exceeding normal day-to-day capabilities. An extensive transportation network exists in Plano; residents, travelers, businesses, and industries rely on the streets, roads, and highways that run through Plano; if the designed capacity of the roadway is exceeded, the potential for a significant transportation incident increase. Weather conditions also play a major factor in the ability of traffic to flow safely in and through Plano, as does the time of day and day of the week.

Figure 4-12 *Fatal Traffic Incidences in Plano from (2005-2019)*

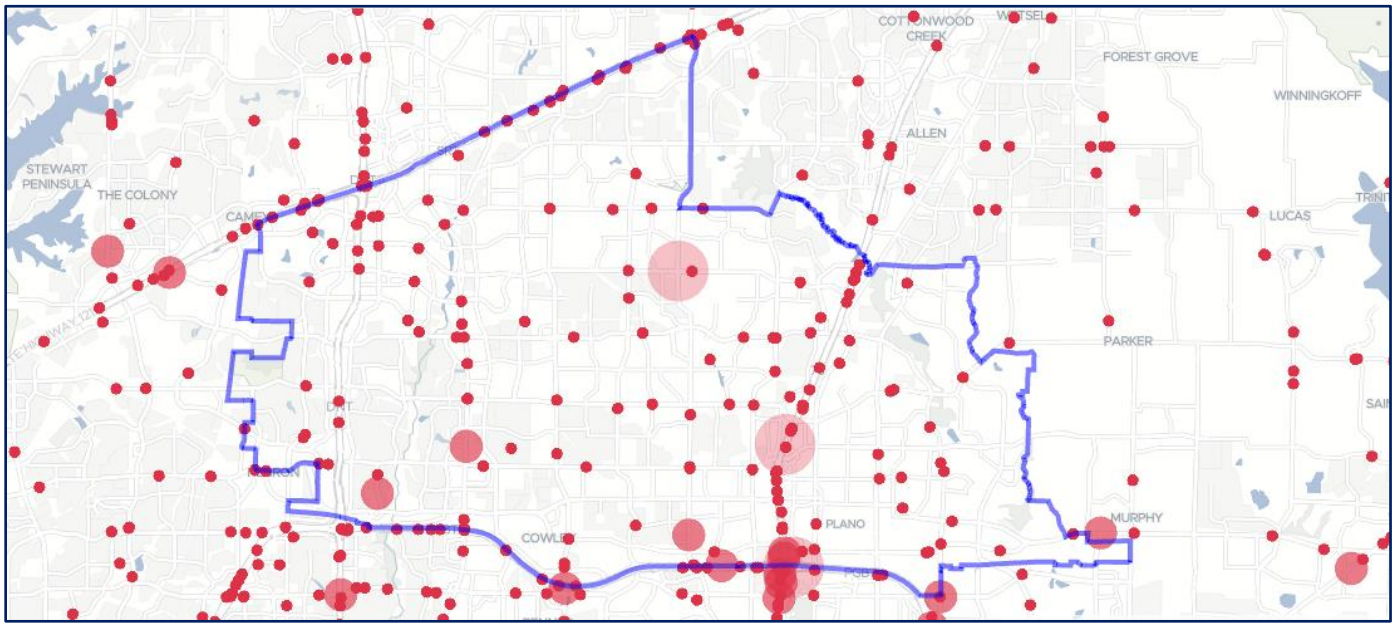
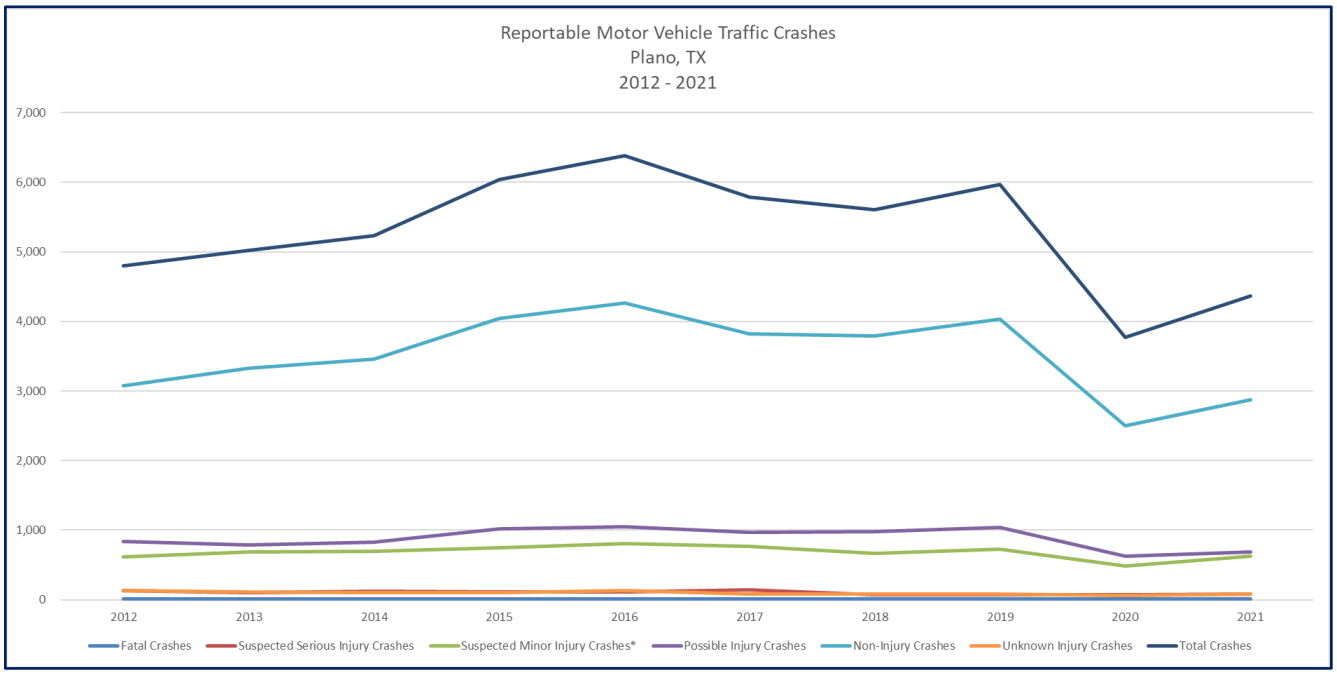


Table 4-35 *Reported Motor Vehicle Crashes (2013-2022)*

CRASH YEAR	FATAL CRASHES	SUSPECTED SERIOUS INJURY CRASHES	SUSPECTED MINOR INJURY CRASHES	POSSIBLE INJURY CRASHES	NON-INJURY CRASHES	UNKNOWN INJURY CRASHES	TOTAL CRASHES
2022	7	22	135	200	732	22	1,118
2021	9	78	631	684	2,874	87	4,363
2020	15	70	487	624	2,505	66	3,767
2018	10	75	724	1,044	4,034	85	5,972
2017	5	73	665	979	3,792	85	5,602
2016	8	116	809	1,047	4,261	137	6,378
2015	13	114	744	1,021	4,045	101	6,038
2014	8	128	697	831	3,462	105	5,231
2013	9	102	683	791	3,325	114	5,024
2012	9	132	616	840	3,072	132	4,801

Figures 4-13, 4-14 and Table 4-35, depict quantitative and geographic summaries of vehicle accidents that have occurred within the dates listed.

Figure 4-13 *Total Number of Motorvehicle Crashes by Year*



RAILWAY

A railway transportation incident is a train accident that directly threatens life and/or property or adversely impacts a community's capability to provide emergency services. Railway incidents may include derailments, collisions, and highway/rail crossing accidents. Train incidents can result from various causes, including human error, mechanical failure, faulty signals, and/or problems with the track. The results of an incident can range from minor "track hops" to catastrophic hazardous material incidents and even human/animal casualties.

AIRCRAFT

An aircraft accident is defined as an occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until it comes to rest at the end of the flight and the primary propulsion system is shut down.

Since 1930 a total of 30 aircraft accidents have been reported (Table 4-36) in the DFW area, resulting in 214 total fatalities. The deadliest of these accidents happened in 1985 when a Delta aircraft crashed, killing 135 of the 152 people on board.

Table 4-36 *Historical Aircraft Incidents in the DFW Surrounding Area (1930-2021)*

DATE	LOCATION	OPERATOR	FATALITIES
3/25/2020	McKinney, TX	Cessna 150	0
5/24/2019	McKinney, TX	Private	0

DATE	LOCATION	OPERATOR	FATALITIES
12/31/2016	McKinney, TX	2 Planes Collide	3
3/10/2006	Dallas-Love	C. Joekel	0
2/1/2003	Parts of Collin County Texas, Louisiana	NASA Space Shuttle Columbia	7
10/9/2001	Dallas-Love	J&D Aircraft Sales	0
5/23/2001	DFW	American Airlines	0
1/27/2000	Dallas-Love	Matix Aviation	0
4/14/1993	DFW	American Airlines	0
8/31/1988	DFW	Delta Airlines	14
5/21/1988	DFW	American Airlines	0
3/25/1988	DFW	American Eagle	0
12/7/1987	Dallas-Executive	Nicole Corporation	0
12/31/1985	Dallas-Love	Century Equipment	7
10/1/1985	Dallas	Rosewood Enterprises	4
8/2/1985	DFW	Delta Airlines	135
12/20/1978	Dallas-Love	Air Central	0
4/1/1975	Sinaloa, Mexico	Dallas Chapter (Cartel)	2
12/26/1973	Dallas-Love	Tircon Airlines	1
11/6/1972	Dallas-White Rock	Sportsman Air	2
9/27/1967	Dallas-Love	Ling-Temco-Vought	7
2/10/1967	Dallas-Love	Southwestern	3
11/7/1965	Lake Dallas	L. Watson	0
4/18/1962	Dallas-Love	Purdue	3
7/19/1953	Dallas-Love	Pan Am	0
11/29/1949	Dallas-Love	American Airlines	28
3/10/1948	Dallas-Love	American Airlines	0
9/15/1943	Dallas-Love	American Airlines	0
11/6/1941	Dallas	Private Prive	0
11/11/1941	Dallas	US AAF	0
12/23/1936	Dallas-Love	Braniff	6
2/16/1936	Dallas	Culver Oil Company	2
3/16/1933	Dallas	American Airways	0
11/22/1930	Dallas	Southern Transit Airways	0

4.15 Explosive Event

4.15.1 HAZARD DESCRIPTION

Human-caused disasters differ from natural disasters; the incident(s) result from hazards involving an element of human intent, negligence or error, or threats involving a failure of a man-made system and refers primarily to the use of explosive devices, such as conventional bombs, and incendiary operations such as arson attacks. The detonation of an explosive device, whether on or near a target, has an instantaneous effect, which can be compounded and/or prolonged using multiple devices. The extent of damage caused by an explosion is determined by the type and quantity of explosive used. It should be noted that explosive incidents can result in cascading effects, such as the incremental failure of a structure or system.

Arson and other incendiary attacks refer to the initiation of fire, which can be explosive on or near a target. This type of event can last for minutes or hours and possibly longer depending on the type and quantity of devices used and/or the type of accelerant used, and the materials present at the location of the attack. This type of attack can also result in cascading failures of structures or systems.

Table 4-37 *Historical Explosive Events in Plano*

DATE	DESCRIPTION
7/20/21	Six people were hurt as a result of a natural gas explosion that destroyed a single-story home in Plano. The blast was felt over a mile away and homes on both sides had significant structural damage.

4.16 Terrorism

4.16.1 HAZARD DESCRIPTION

The Federal Bureau of Investigation (FBI) categorizes terrorism in the United States as domestic terrorism or international terrorism. Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. International terrorism involves groups or individuals whose terrorist activities are foreign-based and directed by countries or groups outside the United States or whose activities transcend their national boundaries.

A terrorist attack can take several forms depending on the technological means available to the terrorist, the nature of the issue motivating the attack, and points of weakness of the terrorist's target. Bombing is the most frequently occurring terrorist event in the United States. A chemical or biological terrorist event is of particular concern to officials. Additionally, special training and equipment are necessary to safely manage a Weapons of Mass Destruction incident.

Biological agents are infectious microbes or toxins used to produce illness or death in people, animals, or plants. Biological agents can be dispersed as aerosols or airborne particles. Terrorists may use biological agents to contaminate food or water and may be extremely difficult to detect.

Chemical agents can kill and incapacitate people, destroy livestock, and ravage crops. Some chemical agents are odorless and tasteless and are, therefore, difficult to detect. Chemical agents can have an immediate effect, within a few seconds to a few minutes, or a delayed effect, within several hours to several days.

The U.S. Department of Defense estimates that 26 nations may possess chemical agents and weapons, and an additional 12 may be seeking to develop them. In addition, the Central Intelligence Agency reports that at least ten countries are believed to possess or conduct research on biological agents for weaponization.

Terrorist events involve the application of one or more modes of harmful force to the built environment. These modes include contamination, such as chemical, biological, radiological, and nuclear hazards; energy, such as explosives, arson, and electromagnetic waves; or denial of service, such as sabotage, infrastructure breakdown, and transportation service disruption.

4.16.2 HISTORICAL OCCURRENCES

Table 4-38 *Historical Terrorism Events in the DFW Region*[38]

DATE	EVENT
1/15/2022	A British citizen took four hostages in a Dallas-area synagogue and demanded the release of an Al-Qa'ida affiliate imprisoned nearby in what the FBI called "an act of terrorism targeting the Jewish community." The hostage-taker was killed by law enforcement.
8/2021	A man in Garland, Texas shot and killed a Lyft driver and subsequently shot inside of the Plano, Texas Police Department. Police officers shot back, killing the man. Later, a note from the man was found indicating potential inspiration by foreign terrorist organizations and is under investigation by the FBI.
4/2021	A Wichita Falls, Texas man was arrested in Fort Worth, Texas while attempting to procure explosives. He was charged with plotting to blow up an Amazon data center in Virginia and later pled guilty. The man also claimed to have attended the January 6th attack on the U.S. Capitol with an AR-15 receiver with a sawed-off barrel.

[38] Data compiled from the North Texas Fusion Center (NTFC), 4/27/2022

DATE	EVENT
12/2019	A Dallas, Texas man was sentenced to 30 years in prison for providing material support to a Foreign Terror Organization (ISIS).
8/2019	An Allen, Texas man opened fire inside a Walmart in El Paso, Texas, according to a national news program. The shooter killed 22 people and left 26 injured. The shooter drove 11 hours from North Texas to El Paso to conduct the attack and posted an anti-immigrant and anti-Hispanic manifesto online minutes before the shooting. The shooter has been charged with capital murder and hate crimes
6/2019	A North Texas resident opened fire inside of a federal courthouse in downtown Dallas, Texas. Before the attack, the individual expressed several antigovernment grievances and mentioned the Boogaloo Boys before the extremist movement was widely known, according to a local newspaper.
2/2019	A North Texas teen was arrested for making a terroristic threat online against an abortion clinic. According to local news outlets, the Waxahachie, Texas teen had tweeted "I'm going to commit jihad on an abortion." Other tweets from the same username featured photos and videos of guns and references to committing murder. The tweets were also filled with racist remarks.
7/2016	A Dallas, Texas man opened fire at police during a protest. Five officers were killed, and seven officers and two civilians were wounded in the shooting. According to local authorities, the individual had advocated violence against White and Jewish people. The shooter was killed by police during the incident, and police later found bomb-making materials, ballistic vests, rifles, ammunition, and a personal journal of combat tactics in his home.
5/4/2015	In May 2015, two armed individuals attacked a Muhammad-based cartoon art exhibit at the Curtis Culwell Center in Dallas, Texas. Both attackers were killed on site. A third individual was also tried and sentenced in 2017 for providing material support to the operation.
10/2010	A Phoenix, Arizona man was sentenced to 24 years in prison for plotting to blow up a Dallas skyscraper.

4.17 Civil Disorder

4.17.1 HAZARD DESCRIPTION

Mass demonstrations, or direct conflict by large groups of citizens, as in marches, protest rallies, riots, and non-peaceful strikes, are examples of civil disorder. These involve the assembling of people together in a manner to substantially interferes with public peace and constitute a threat. They may use unlawful force or violence against another person, cause property damage or attempt to interfere with, disrupt, or destroy the government, political subdivision, or group of people. Labor strikes and work stoppages are not considered in this hazard unless they escalate into a threat to the community. Vandalism is usually initiated by a small number of individuals and is limited to a small target group or institution. Most events are within the capacity of local law enforcement. Civil disorder is distinct from peaceful public celebrations, lawful protests, and acts of civil disobedience, such as peaceful but unpermitted protests, sit-ins, and comparable protest actions.

Civil unrest and disturbances affect the following factions of society:

The general population could serve as participants or targets in civil unrest actions. Widespread unrest could cause fear among the populace and cause them to be absent from school or work activities. During an event, bystanders may be harmed because of participants' activities.

Responses to civil unrest events are generally handled at the local level. In a significant event, the resources of a local jurisdiction may be exceeded. In this instance, state resources would be activated to fill the need. During an event, responders may become targets, which could hamper their effectiveness.

Widespread rioting or looting could impact the City's ability to provide services and conduct its normal operations. For example, protesters could occupy buildings and interrupt the normal functions of government, or targeted attacks on government facilities could interrupt operations entirely.

Private property often serves as a target in instances of civil unrest. Businesses can be targeted for looting or vandalism. If an event is particularly large, the damage could reach millions of dollars, and recovery could take years.

Often, in acts of civil unrest, government facilities become the focal point of protests or targets for vandalism. Damage suffered during an event or the inability of a worker to enter a facility may significantly affect the operations and capacity.

Infrastructure. Similar to government facilities, public and private infrastructure can become targets of civil unrest. Damage to transportation, communications, or utility infrastructure could further exacerbate the situation.

4.17.2 HISTORICAL OCCURENCES

Table 4-39 *Civil Disorder Incidents*

CIVIL DISORDER - HISTORICAL OCCURRENCES	
Date	**Event**
5/29/2022	March for Mental Health. This event was planned, and numerous attempts were made to coordinate a safe route for their demonstration. They started in Plano and marched on 121 Service Rd and went into Frisco and then returned to Plano. This event caused traffic delays.
5/3/2022	Women's Rights March. This event was sparked by Roe vs. Wade ruling. Due to last minute notification, police only had a couple hours to set up operations for the event. Approximately 100 people marched on Central Expressway during rush hour cause traffic delays.
10/17/2021	This rally took place at McCall Plaza in Downtown Plano. This event was for middle school student in Plano that was said to be bullied. Some attendees were armed, and they did an impromptu march around Downtown.
7/25/2021	Marvin Scott Protest. This event was started from the arrestee Marvin Scott's death in Collin County Jail's Custody. They marched from Shops of Legacy to Legacy West and back.
4/6/2021	PISD School Board Protests. Protest related to bullying incidents. Organized speakers to address the school board. No march was conducted.
3/14/2021	McCall Plaza Protest Next Generation Action Network. This event was ant-police protest and a march. People from apartments threw water bottles at the crowd as they marched past. No injuries reported. When the protest ended, they drove to multiple private residences and to protest outside the homes using loudspeakers.
3/8/2021	PISD Residential Protest. Protest related to bullying incident. Planned protests residences related to PISD. This was cancelled at the last minute.
3/2/2021	Police Headquarters Protest. Protest regarding a bullying incident. No march was supposed to occur however they did march through downtown Plano back to the Police Headquarters. The organizers then directed vehicles to several residences related to the school to protest.
6/7/2020	City Hall Protest. Protests surrounding the death of George Floyd. This was a large protest that began at city hall and marched the streets surrounding Haggard Park and retuned to city hall.
6/6/2020	Haggard Park Vigil. Protests surrounding the death of George Floyd. A prayer vigil was conducted within the park. No march was conducted.
6/4/2020	Haggard Park / City of Plano Municipal Court Protest. Protests surrounding the death of George Floyd. Two protests were held back-to-back at the same location. Both protests marched around the streets surrounding the courts and park.
6/3/2020	Haggard Park Protest. Protest surrounding the death of George Floyd. Protest was contained within the park and a march around the area was conducted.
6/2/2020	Protest surrounding the death of George Floyd. Protest began at Grace Church and a march was conducted along Preston Road and W. Parker Road.

4.18 Active Shooter

4.18.1 HAZARD DESCRIPTION

An Active Shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearms(s), and there is no pattern or method to the selection of victims.

Communities are facing an increasing number of tragedies involving active shooters and hostile events. As a result, the need for an integrated preparedness, response, and recovery program is more significant than ever.

Active shooter situations are unpredictable and evolve quickly. Because active shooting situations are often over within 10 to 15 minutes before law enforcement arrives, individuals must be mentally and physically prepared to deal with active shooters. In most cases, active shooters use firearms(s), and there is no pattern or method to their selection of victims.

4.18.2 LOCATION

Active shooter events can occur in a variety of locations, including schools, workplaces, public areas, and other locations where large groups of people gather. Some of the most common locations where active shooter events have occurred include:

- Schools and universities
- Workplace settings
- Public areas
- Houses of worship
- Government buildings

4.18.3 EXTENT

Texas or any other location, as such incidents are unpredictable and can vary greatly in their scope and impact.

4.18.4 HISTORICAL OCCURRENCES

Table 4-40 *Active Shooter Incidents in Plano*

DATE	FATALITIES	INJURED	DESCRIPTION
9/10/2017	9 (Including the gunman)	1	Shooter, Spencer Hight opened fire at a Dallas Cowboys football watch party killing his ex-wife and seven others. Seven people died at the scene, and one died at the hospital. The gunman was shot and killed by the Plano Police Department. The suspected motive was domestic dispute. Upon autopsy the gunman's blood alcohol content was .33, four times the legal limit.

4.18.5 SIGNIFICANT EVENTS

On September 10, 2017, a man opened fire at a Dallas Cowboys watch party at a private Plano residence. The shooting resulted in the deaths of eight people, including the shooter, and injured two others. The motive for the shooting is believed to have been related to a domestic dispute.

The Plano Police Department responded to the shooting and worked to secure the scene, evacuate the injured, and investigate the incident. The department also provided support and counseling to those affected by the shooting.

4.18.6 PROBABILITY OF FUTURE EVENTS

While it is impossible to predict the probability of an active shooter incident in any specific location, such incidents have occurred in various types of communities, including suburban areas like the City of Plano.

4.18.7 VULNERABILITY AND IMPACT

The City of Plano is a suburban city with a population of approximately 285,494 people. As with any community, there are various locations where people gather, including schools, workplaces, and public spaces. These locations can be vulnerable to an active shooter incident, particularly if there is insufficient security or if individuals are not trained to respond effectively in such situations.

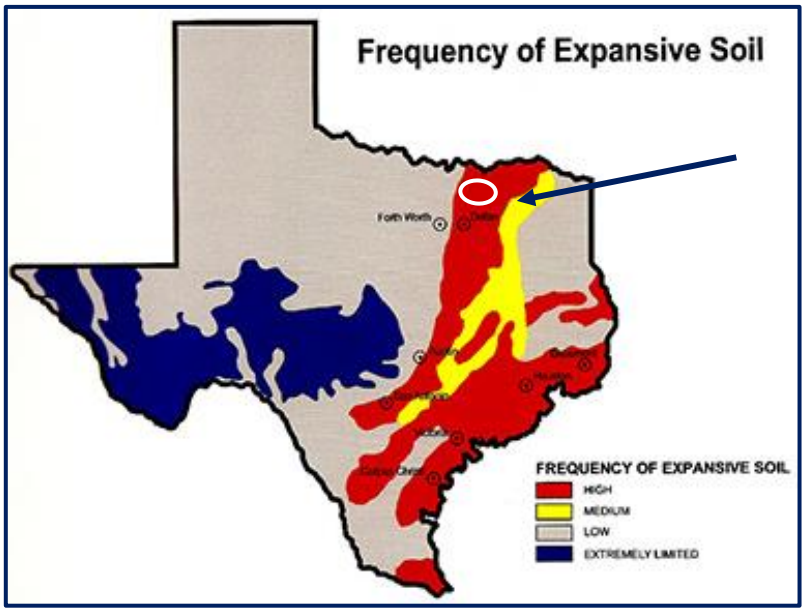
An active shooter incident in Plano could have a significant impact on the community, including loss of life, injuries, and psychological trauma for those involved. The incident could also have economic impacts, particularly if businesses are impacted or if there is damage to infrastructure.

4.19 Expansive Soils

4.19.1 HAZARD DESCRIPTION

Expansive soils are soils and soft rocks with a relatively high percentage of clay minerals that are subject to changes in volume as they swell and shrink with changing moisture conditions. Drought conditions can cause soils to contract in response to soil moisture loss.

Expansive soils will also lose volume and shrink when they dry. A reduction in soil volume can affect the support to buildings or other structures and result in damaging soil subsidence. Fissures in the soil can also develop and facilitate the deep penetration of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that place repetitive stress on structures.



Source: Tella Firma (Plano is circled in white)

While all infrastructures in the higher-risk areas are vulnerable, slab-on-grade structures are most likely to suffer damage from expansive soils. In addition, older structures built to less stringent building codes may be more susceptible to damage than new construction. Bridges, highways, streets and parking lots are especially vulnerable when they are constructed when clays are dry, such as during a drought, and then subsequent soaking rains swell the clay.

While some of the areas impacted by expansive soil are scarcely populated, others, especially those along the I-35 Corridor, contain the state's fastest-growing and most populated jurisdictions. According to a May 2016 US Census Bureau report, the cities of San Antonio, Austin, and Dallas were among the top 10 in the country with the largest population growth. The smaller cities of New Braunfels and Georgetown in the San Antonio-Austin area and Frisco near Dallas are listed among the top 10 fastest-growing in the same report. All are in the red/high-impact areas in the map above. The growing population and built environments of the growing metropolises increase the future risk potential of expansive soil events.

The Texas Department of Licensing and Regulation requires structures built after 2005 to include soil tests to be conducted for the likelihood of soil expansion, compression, or shifting. In such cases, top or subsoils are required to be removed and the remaining soils stabilized. Builders must ensure that water drains away from the structure on all sides and that building owners are notified of the potential for damage if changes in drainage flow occur.

The severity of widespread summer drought is projected to see a far above-average increase (the third greatest among the lower 48 states), and Texas is projected to remain the worst drought-affected state in the nation. Additionally, the probability of expanding atmospheric moisture leads to increasing rainfall during storm events. The increasing future drought and rainfall potential directly impact the risk potential of expansive soils across the state of Texas.

In the next five years, the City of Plano will likely experience some expansive soil impacts, such as problems with foundations, roadways, sidewalks, and other structures and infrastructure. However, a major expansive soil event is not likely.

The *State of Texas Hazard Mitigation Plan, 2018,* defines soil expansion measurements regarding its swelling potential or volumetric swell. The State uses the American Society for Testing and Materials (ASTM) soil expansion index adopted by ASTM in 1988. This expansion index has been determined to have a greater range and better sensitivity of expansion than other indices.

Due to expansive soils, there is no history of impact on critical structures, systems, populations, other community assets, or vital services.

4.19.2 LOCATION

Plano, Texas, is known for being vulnerable to expansive soils, which can cause significant damage to homes, buildings, and infrastructure. Several factors contribute to this vulnerability:

Soil Composition: The soil in the Plano area is primarily composed of clay, which is prone to swelling and shrinking in response to changes in moisture content. When the soil becomes saturated with water, it can expand and put pressure on foundations and other structures.

Climate: Plano experiences a hot and humid climate, which can contribute to soil expansion. In the summer, high temperatures can cause the soil to dry out and shrink, while heavy rainfall in the spring and fall can cause the soil to become saturated and expand.

Lack of Vegetation: The construction and development of the Plano have led to a significant decrease in vegetation, which can help to absorb excess moisture and stabilize the soil. Without vegetation, the soil is more vulnerable to expansion and contraction.

Construction Practices: Poor construction practices, such as inadequate foundation design or improper drainage systems, can exacerbate the effects of expansive soils and contribute to damage to homes and infrastructure.

4.19.3 EXTENT

The severity of widespread summer drought is projected to see a far above-average increase (the third greatest among the lower 48 states), and Texas is projected to remain the worst drought-affected state in the nation. Additionally, the probability of expanding atmospheric moisture leads to increasing rainfall during storm events. Therefore, the increasing future drought and rainfall potential directly impact the risk potential of expansive soils across Texas. Table 4-41 contains the soil extent classification.

Table 4-41 *Expansive Soils Index*[39]

PERCENT (%) OF EXPANSIVE SOILS PRESENT	EXTENT CLASSIFICATION
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

[39] https://link.springer.com/article/10.1007/s41403-016-0001-9/tables/9

4.19.4 HISTORICAL OCCURENCES

In the 1980s and 1990s, many homes in the Plano area experienced significant damage from expansive soils. The damage included cracked foundations, walls, and ceilings, as well as distorted floors and doors that would not close properly. The cost of repairs for homeowners was often significant.

In 2018, several homes in Plano were evacuated due to structural damage caused by expansive soils. The damage included cracked walls, windows, and ceilings, as well as distorted floors and doors.

4.19.5 SIGNIFICANT EVENTS

In 2004, a large sinkhole opened up in the middle of a street in Plano, which was attributed to soil expansion. The sinkhole caused significant damage to the road and required expensive repairs.

4.19.6 PROBABILITY OF FUTURE EVENTS

The probability is likely due to the historical events and soil composition, climate and lack of vegetation. Drought and aging structures will also add to the probability of future events. Therefore, a medium extent is predicted for future intensity of expansive soils within the City of Plano.

4.19.7 VULNERABILITY AND IMPACT

It is likely that the City of Plano will experience some level of expansive soil impacts such as problems with foundations, roadways, sidewalks, and other structures and infrastructure in the next five years. While a major expansive soil event is not likely, the Impact will be contingent upon the type and number of structures affected by expansive soils.

4.19.8 CLIMATE CHANGE

Expansive soils are soils that contain minerals that have the ability to swell and shrink in response to changes in moisture content. In Plano, Texas, which is located in a region with a subtropical climate, the amount of rainfall and temperature fluctuations can have a significant impact on expansive soils.

With climate change, there is expected to be an increase in average temperatures and changes in precipitation patterns, which could potentially worsen the effects of expansive soils in Plano. For example, higher temperatures could lead to increased evaporation rates, which could dry out the soil and cause it to shrink. Conversely, increased rainfall could lead to greater soil moisture content, which could cause the soil to swell.

In addition, changes in weather patterns may lead to more extreme weather events, such as heavy rainfalls or prolonged droughts, which can also impact the behavior of expansive soils. For example, heavy rainfall can cause the soil to swell rapidly, leading to soil movement and potential damage to buildings and infrastructure.

Overall, the effects of climate change on expansive soils in Plano are complex and depend on many factors.

SECTION 5. MITIGATION STRATEGIES

5.1 Summary

Based on the results of the risk and capability assessments, the Hazard Mitigation Steering Committee developed and prioritized the mitigation strategy. This involved utilizing the results of both assessments and reviewing the goals and objectives that were included in the previous 2013 Plan.

5.2 Mitigation Goals

1. **Increase public understanding, support, and demand for hazard mitigation.**

   Objective 1.1: Heighten public awareness of the full range of natural and human-caused hazards they face.

   Objective 1.2: Educate the public on actions they can take to prevent or reduce the loss of life or property damage from all hazards.

   Objective 1.3: Publicize and encourage the adoption of appropriate hazard mitigation measures.

2. **Protect public health and safety.**

   Objective 2.1: Advise the public about health and safety precautions to guard against injury and loss of life from hazards.

   Objective 2.2: Maximize the utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events.

   Objective 2.3: Reduce the danger to, and enhance protection of, dangerous areas during hazard events.

   Objective 2.4: Protect critical facilities and services.

3. **Protect existing and new properties.**

   Objective 3.1: Reduce repetitive losses to the National Flood Insurance Program.

   Objective 3.2: Use the most cost-effective approaches to protect existing buildings and public infrastructure from hazards.

   Objective 3.3: Enact and enforce regulatory measures to ensure that development will not put people in harm's way or increase threats to existing properties.

4. **Build and support local capacity and commitment to become continuously less vulnerable to hazards.**

   Objective 4.1: Build and support local partnerships to become continuously less vulnerable to hazards.

   Objective 4.2: Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster.

   Objective 4.3: Build hazard mitigation concerns into City planning and budgeting processes.

5. **Promote growth in a sustainable manner.**

   Objective 5.1: Incorporate hazard mitigation into the long-range planning and development activities.

   Objective 5.2: Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.

   Objective 5.3: Utilize regulatory approaches to prevent creation of future hazards to life and property.

6. **Maximize the resources for investment in hazard mitigation.**

   Objective 6.1: Maximize the use of outside sources of funding.

   Objective 6.2: Maximize participation of property owners in protecting their properties.

   Objective 6.3: Maximize insurance coverage to provide financial protection against hazard events.

   Objective 6.4: Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

5.2.1 PAST MITIGATION ACTIONS

PAST ACTION 1: TORNADO

Hazard(s): Tornado	**Proposed Action:**	Participate in the North Central Texas Council of Government's Metro Safe Room Rebate Program.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Provides residents of Plano an opportunity to receive reimbursement for the cost of constructing an individual safe room.
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time; grant funded
Potential Funding Sources:	Hazard Mitigation Grant Program Funds, through the North Central Texas Council of Governments
Lead Agency/Department Responsible:	Emergency Management, North Central Texas Council of Governments
Project Status:	Completed

2022 Analysis
Completed. Plano participated in the Safe Room Rebate program managed by the NCTCOG. Plano would like to participate in this program in the future if grant funds are released.

PAST ACTION 2: TORNADO

Hazard(s): Tornado	**Proposed Action:**	Distribute all-hazards emergency preparedness materials from the North Central Texas KnoWhat2Do preparedness campaign
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Educates and informs the public on what to do before, during and following a disaster.
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,700 (1,000 booklets) Staff and volunteer time
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Communications & Community Outreach, Emergency Management
Project Status:	On-going

2022 Analysis
On-going. Plano has participated in the North Central Texas KnoWhat2Do preparedness campaign since its inception. Emergency Management staff averages over 100 public outreach hours a year educating the public on emergency preparedness and disaster response.

PAST ACTION 3: TORNADO

Hazard(s): Tornado	**Proposed Action:**	Implement additional early warning systems such as IPAWS.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Tornado warnings would be targeted at those with mobile devices within the community to mitigate the impacts to lives.
Priority (High, Moderate, Low):	High
Estimated Cost:	$5000
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Communications & Community Outreach, Emergency Management
Project Status:	Deferred

2022 Analysis
Deferred- pending on software upgrade.

PAST ACTION 4: HIGH WINDS

Hazard(s):	**Proposed Action:**	Implement tree trimming initiative
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Periodic trimming of trees will significantly reduce wind damage to people and property. Trimming along power lines will reduce the frequency and duration of electric power outages. It will also significantly enhance electric power system operations and reliability.
Priority (High, Moderate, Low):	High
Estimated Cost:	To be determined
Potential Funding Sources:	TXU, Oncor and General Revenues
Lead Agency/Department Responsible:	Public Works with TXU Energy/Oncor Energy
Project Status:	On-going

2022 Analysis
On-going. Collaboration with electric providers has been successful in tree trimming initiatives along major thoroughfares throughout the city.

PAST ACTION 5: HIGH WINDS

Hazard(s): **High winds**	**Proposed Action:**	Develop and initiate a wind resistant landscaping campaign
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Periodic trimming of trees will significantly reduce wind damage to people and property. Trimming along power lines will reduce the frequency and duration of electric power outages. It will also significantly enhance electric power system operations and reliability.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	$2000
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Emergency Management, Public Works
Project Status:	Deferred

2022 Analysis
Delete Action- Action was not completed. There was no campaign.

PAST ACTION 6: HIGH WINDS

City of Plano – Past Mitigation Action		
Hazard(s): **High winds**	**Proposed Action:**	Distribute all-hazards emergency preparedness materials from the North Central Texas KnoWhat2Do preparedness campaign
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Educates and informs the public on what to do before, during and following a disaster.
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,700 (1,000 booklets), Staff and volunteers time
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Emergency Management
Project Status:	On-going

2022 Analysis
On-going. Plano has participated in the North Central Texas KnoWhat2Do preparedness campaign since its inception. Emergency Management staff averages over 100 public outreach hours a year educating the public on emergency preparedness and disaster response.

PAST ACTION 7: HAIL

Hazard(s): Hail	**Proposed Action:**	Distribute all-hazards emergency preparedness materials from the North Central Texas KnoWhat2Do preparedness campaign
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Educates and informs the public on what to do before, during and following a disaster.
Priority (High, Moderate, Low):	High
Estimated Cost:	$5,700 (1,000 booklets), Staff and volunteers
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Emergency Management
Project Status:	On-going

2022 Analysis
On-going. Plano has participated in the North Central Texas KnoWhat2Do preparedness campaign since its inception. Emergency Management staff averages over 100 public outreach hours a year educating the public on emergency preparedness and disaster response.

PAST ACTION 8: HAIL

Hazard(s):	**Proposed Action:**	Implement the Collaborative Adaptive Sensing of the Atmosphere (CASA) radar system
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Current National Weather Service (NWS) radar technology, most notably Next-Generation Radar (NEXRAD– currently in North Central Texas), does not provide coverage at the lower levels of the atmosphere where the majority of severe weather takes place. CASA WX technology addresses this gap with a network of smaller, faster Doppler Dual Polar radars. This innovative network provides real-time, detailed mapping of events in the lower atmosphere that fall below conventional radar coverage – storms, winds, rain, hail, and the flow of airborne hazards. The comprehensive weather data and resulting enhanced prediction capabilities will allow leaders and decision makers in both the public and private sectors to make more informed weather-related decision relating to daily activities. Impacts could affect school closing, emergency response staging, damage reporting, citizen warnings, air traffic control, transportation asset protection, and numerous other weather-based actions
Priority (High, Moderate, Low):	High
Estimated Cost:	$25,000
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Emergency Management
Project Status:	On-going

2022 Analysis
On-going. Plano pays yearly subscription dues to the NCTCOG to be a member of the CASA radar system.

PAST ACTION 9: HAIL

Hazard(s): Hail	**Proposed Action:**	Develop and implement a campaign for new and remodeling construction to promote the use of hail-resistant materials.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Campaign will mitigate the impacts of hail and increase the resiliency of structures within the community.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	$2000
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Emergency Management, Building Inspections
Project Status:	Deferred

2022 Analysis
Delete Action- Action was not completed. There was no campaign.

PAST ACTION 10: HAIL

Hazard(s): Hail	**Proposed Action:**	Develop revised standards to require hail resistant practices when constructing new public buildings.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	Buildings are minimally damaged from hail. Stronger windows are needed to resist damage from hail.

Mitigation Action Details	
Benefit:	Standards will mitigate the impacts of hail and ensure those within public buildings are more protection when severe hail impacts a public facility.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds
Lead Agency/Department Responsible:	Emergency Management, Engineering
Project Status:	Deferred

2022 Analysis
Delete Action- Action was not completed. There was no revision of building codes or standards.

PAST ACTION 11: SEVERE WINTER/ICE STORMS, HIGH WINDS

Hazard(s): Severe winter/ice storms; high winds	**Proposed Action:**	Develop and implement a Debris Management Plan and associated training program
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	In a severe winter/ice storm, there will likely be many fallen tree limbs that will need to be removed. A debris management plan will provide an estimate of the amount of debris that may result from a variety of disaster events, identify alternative disposal sites, and pre-screen debris management contractors and put procedures in place to more quickly and effectively remove the debris. Removal of debris may help save lives by allowing for emergency personnel to enter affected areas, reduce disease and aid the recovery process. Sending additional personnel to obtain their certification in Debris Management will provide better trained personnel. With such training, staff will be able to more quickly, effectively and efficiently move debris. There will be a succession of command and knowledge that will enable those involved in this effort to better function as a team with maximum efficiency. Because of the complex Public Assistance rules related to debris removal, it will also facilitate reimbursement in a Presidentially declared disaster.
Priority (High, Moderate, Low):	High
Estimated Cost:	$50,000
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Emergency Management, Public Works
Project Status:	Completed

2022 Analysis
Completed. The City of Plano Debris Management Plan was completed in November 2013 and adopted by Council in January 2014

PAST ACTION 12: SEVERE WINTER/ICE STORMS

Hazard(s): Severe winter/ice storms	**Proposed Action:**	Install sensors to detect freezing potential on overpasses and bridges. Currently Plano has rain sensors installed. This would provide for additional advance warning and more accurate warning capabilities for winter storms.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Sensors on overpasses and bridges can better predict freezing potential and thus provide advance warning and more accurate warning of severe winter/ice storms. The Department can prioritize its responses and more efficiently make the roads available for safe passage through such measures as applying sand or salt.
Priority (High, Moderate, Low):	High
Estimated Cost:	Prices vary based on the brand, wireless vs. wire, etc. and Plano is looking into viable options.
Potential Funding Sources:	General Funds, Grant funds
Lead Agency/Department Responsible:	Public Works
Project Status:	Deferred

2022 Analysis
Delete Action- Action was not completed.

PAST ACTION 13: SEVERE WINTER/ICE STORMS

Hazard(s): Severe winter/ice storms	**Proposed Action:**	Develop a public awareness campaign to encourage citizens to purchase NOAA weather radios.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	NOAA weather radios keep citizens informed in the event of a natural disaster. These radios are available for purchase at many local locations throughout the City and online.

Mitigation Action Details	
Benefit:	Warning and notification of hazardous conditions will mitigate the impacts of severe winter/ice storms throughout the community.
Priority (High, Moderate, Low):	High
Estimated Cost:	Minimal
Potential Funding Sources:	General funds
Lead Agency/Department Responsible:	Emergency Management
Project Status:	On-going

2022 Analysis
On-going. Information and disbursement of NOAA weather radios is included in public awareness campaigns.

PAST ACTION 14: SEVERE WINTER/ICE STORMS

Hazard(s): Severe winter/ice storms	**Proposed Action:**	Implement awareness campaign to inform the community of severe winter/ice hazards
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	An informed community that knows the hazards associated with severe winter/ice will mitigate citywide impacts.
Priority (High, Moderate, Low):	High
Estimated Cost:	Staff time
Potential Funding Sources:	General Funds, Grant funds
Lead Agency/Department Responsible:	Emergency Management. Communications & Community Outreach
Project Status:	On-going

2022 Analysis
On-going. Plano has participated in the North Central Texas KnoWhat2Do preparedness campaign since its inception. Emergency Management staff averages over 100 public outreach hours a year educating the public on emergency preparedness and disaster response.

PAST ACTION 15: LIGHTNING

Hazard(s): Lightning	**Proposed Action:**	Distribute NOAA "All Hazards" radios for warning of lightning and severe weather to community stakeholders.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	NOAA weather radios keep citizens informed in the event of a natural disaster. These radios are available for purchase at many local locations throughout the City and online.

Mitigation Action Details	
Benefit:	NOAA "All Hazards" radios are a direct conduit to the National Weather Service and serve as a great warning point during emergency and disaster events. Having one of these devices in business or homes will provide persons with ample warning time to seek shelter or take evasive action from an impending threat.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	Minimal
Potential Funding Sources:	General funds
Lead Agency/Department Responsible:	Emergency Management
Project Status:	On-going

2022 Analysis
On-going. NOAA Weather radios have been handed at public outreach events to citizens and community stakeholders.

PAST ACTION 16: LIGHTNING

Hazard(s): Lightning	**Proposed Action:**	Provide surge protection at critical facilities and promote surge protection as part of public education.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	All Municipal Workstations and building have been retrofitted with surge protection devices. Surge protection is an effective way to reduce the damage due to lightning. Plano will continue surge protection at critical facilities and include lightning mitigation as part of a comprehensive public information program. New buildings and offices will be outfitted with the same devices.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	To be determined
Potential Funding Sources:	Community Investment, Grant funds, General Funds
Lead Agency/Department Responsible:	Engineering; Emergency Management; Risk Management
Project Status:	On-going

2022 Analysis
On-going. Plano is in the process of retrofitting and updating generators and other forms of surge protection at critical facilities.

PAST ACTION 17: FLOODING

Hazard(s): Flooding	**Proposed Action:**	Purchase portable generators to reduce the likelihood of failure that may occur to the city's drainage systems**.**
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Access to back up generators will allow the city to have more control over drainage channels during a storm that could potentially flood areas of concern throughout the city. Also, portable generators will allow the City of Plano more flexibility and versatility in case of large power outages- helping the city to maintain tools and equipment that require electricity
Priority (High, Moderate, Low):	Medium
Estimated Cost:	$40,000.00 each
Potential Funding Sources:	Hazard Mitigation Grant Program Funds
Lead Agency/Department Responsible:	Public Works
Project Status:	Completed

2022 Analysis
Completed. Plano utilized 2012 UASI grant funds to purchase portable generators that can be utilized throughout the City to continue essential functions that may fail during utility disruptions.

PAST ACTION 18: FLOODING

Hazard(s): Flooding	**Proposed Action:**	Implement damage reduction measures of drainage ways and retention basins through stream bank erosion reduction program.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Significant flooding reductions
Priority (High, Moderate, Low):	Medium
Estimated Cost:	$500,000
Potential Funding Sources:	Community Investment, Hazard Mitigation Grant Program Funds
Lead Agency/Department Responsible:	Engineering
Project Status:	On-going

2022 Analysis
On-going. Engineering regularly partners with contractor/vendors to conduct surveys and studies on the current drainage and retention basins in the city.

PAST ACTION 19: FLOODING

Hazard(s): Flooding	**Proposed Action:**	Remove repetitive loss structures out of the floodplain
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Removing structures threatened by flooding will mitigate the risk to lives and property while also reducing response costs.
Priority (High, Moderate, Low):	$500,000
Estimated Cost:	Plano Engineering Department
Potential Funding Sources:	Community Investment, Hazard Mitigation Grant Program Funds
Lead Agency/Department Responsible:	Emergency Management, Public Works
Project Status:	Deferred

2022 Analysis
Delete Action- Action was not completed.

PAST ACTION 20: DROUGHT

Hazard(s): Drought	**Proposed Action:**	Implement public outreach campaign to educate and inform the public about drought and water conservation.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Outreach to Plano's citizens is essential in educating them about the importance of water conservation and specific steps they can take to reduce water consumption, such as curtailing non-essential uses during times of water shortage or other emergency water supply conditions.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	Staff time
Potential Funding Sources:	Use of media, website and local television station
Lead Agency/Department Responsible:	Public Works, Environmental Health
Project Status:	On-going

2022 Analysis
On-going. Plano partners with the North Texas Water Municipal District (NTWMD) on public outreach campaigns on educating the public on water conservation.

PAST ACTION 21: DROUGHT

Hazard(s):	**Proposed Action:**	Develop revised standards that require the use of low water landscaping practices throughout the community.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	Campaign will mitigate the impacts to lives and property by ensuring an adequate water supply remains available through conservation efforts.
Priority (High, Moderate, Low):	Low
Estimated Cost:	Undetermined
Potential Funding Sources:	Water & sewer fund, if needed
Lead Agency/Department Responsible:	Public Works
Project Status:	On-going

2022 Analysis
On-going. Plano partners with the North Texas Water Municipal District (NTWMD) on public outreach campaigns on educating the public on water conservation. Plano department Environmental Health & Sustainability conducts partners with TEEX on xeriscaping classes.

PAST ACTION 22: EXCESSIVE HEAT

Hazard(s): Excessive heat	**Proposed Action:**	Initiate an excessive heat public awareness and educational campaign
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	

Mitigation Action Details	
Benefit:	This program will provide for a public awareness campaign as well as certain mitigation steps to (1) make the general public aware of the dangers of high temperature, (2) make targeted populations aware of the specific hazards for their age groups, and (3) provide mitigation opportunities for targeted groups such as the distribution of household electric fans.
Priority (High, Moderate, Low):	Medium
Estimated Cost:	Staff time
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Emergency Management, Fire Department
Project Status:	On-going

2022 Analysis
On-going. Plano has participated in the North Central Texas KnoWhat2Do preparedness campaign since its inception. Emergency Management staff averages over 100 public outreach hours a year educating the public on emergency preparedness and disaster response.

PAST ACTION 23: EXCESSIVE HEAT

Hazard(s): Excessive heat	**Proposed Action:**	Increase tree plantings along public rights of way to reduce the urban heat island effect.
	Background Information	
	Site and Location:	City of Plano
	History of Damages:	The City experiences extreme temperatures. Planting trees with help reduce temperatures.

Mitigation Action Details	
Benefit:	This program is designed to reduce the heat in urban areas caused by concrete, buildings and loss of tree cover. The tree plantings along rights of way are aimed at shading streets and reducing the heat absorbed by dark pavement. It is estimated that the "urban heat island effect" causes urbanized areas to be 3 to 9 degrees hotter than surrounding rural areas, leading to increased energy bills and more dependence on fossil fuels to create electricity. This action will help reduce the urban heat island effect.
Priority (High, Moderate, Low):	Low
Estimated Cost:	Since 2006, an additional 1,025 trees have been planted in the City's medians at a cost of approximately $199,875.00. That brings the total to over 6,600 trees and approximately $1,370,000 spent on tree plantings in the past 12 years. For the FY 2012-13 budget year, City Council approved an additional $200,000.00 in funding for tree care to keep up with the increased service base. The contract includes pruning of dead wood and hazardous limbs, removal of dead trees and inspection for disease. This brings the annual tree maintenance program expenditures to $602,000 annually.
Potential Funding Sources:	Bond funds, Community Investment, General funds
Lead Agency/Department Responsible:	Parks and Recreation, Public Works
Project Status:	On-going

2022 Analysis
On-going. Plano adopted the Cleaner Air and Reduced Emissions (CARE) Strategy in May 2020 and the Sustainability Implementation Plan in 2016 which outlines future tree planting goals.

5.2.2 NEW MITIGATION ACTIONS

NEW ACTION 1: TORNADO

Action	
Proposed Action	Promote the construction and use of safe rooms.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of life and bodily injury.
Type of Action:	Prevention, Property Protection

Mitigation Action Details	
Effect on new/existing buildings:	This action would strengthen existing buildings and residences by making them more resistant to damage from tornadoes.
Priority (High, Moderate, Low):	High
Estimated Cost:	$6,000 per safe room
Potential Funding Sources:	Grant funds, Community Investment
Lead Agency/Department Responsible:	Emergency Management, Building Inspections
Implementation Schedule:	2-3 years - implemented after receipt of funds

Comments
Program will be implemented after receipt of funds. Program existed in region and was managed by NCTCOG.

NEW ACTION 2: ALL HAZARDS

Action	
Proposed Action	Conduct a community outreach and awareness program including: community event activations, social media campaigns, e-mail communications, website, and other methods as deemed appropriate to educate citizens of natural and human-caused disasters that may threaten the community and provide mitigation measures to reduce potential damages and injuries.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of life, property destruction and recovery efforts.
Type of Action:	Public Education and Awareness

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	High
Estimated Cost:	$1,000
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Emergency Management
Implementation Schedule:	3-5 years

Comments

NEW ACTION 3: NATURAL HAZARDS

Action	
Proposed Action	Research the feasibility to remove dead trees that pose threat to power lines, road right of ways and property. Remove trees prone to storm damage should be replaced with more appropriate species, if possible.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce potential for property damage, injury and loss of life.
Type of Action:	Natural Resource Protection, Prevention

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Neighborhood Services, Public Works, Parks and Recreation
Implementation Schedule:	2-5 years

Comments

NEW ACTION 4: ALL HAZARDS

Action	
Proposed Action	Conduct risk analysis and resiliency assessments for Plano's affordable housing properties that will result in property-specific mitigation actions.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce hardship, injury and loss of life to vulnerable populations.
Type of Action:	Property Protection

Mitigation Action Details	
Effect on new/existing buildings:	Extensive
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	General funds, Grant Funds
Lead Agency/Department Responsible:	Neighborhood Services
Implementation Schedule:	3-5 years

Comments

NEW ACTION 5: PUBLIC HEALTH EMERGENCY

Action	
Proposed Action	Combine risk awareness and emergency preparedness campaigns with existing public health campaigns as well as engaging with health officials as part of their planning process.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce overload on hospitals and clinics. Reduce potential loss of life.
Type of Action:	Public Education & Awareness, Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Emergency Management, Environmental Health, Collin County Health Services, Fire Department Community Paramedicine Program
Implementation Schedule:	1-3years

Comments

NEW ACTION 6: PUBLIC HEALTH EMERGENCY

Action	
Proposed Action	Collaborate with public health to educate vulnerable groups about detrimental health impacts related to extreme weather and climate hazards.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce injury and loss of life.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Environmental Health, Collin County Health Services, Neighborhood Services, Fire Department Community Paramedicine Program
Implementation Schedule:	2-3 years

Comments
Partner with County and State Health Departments on conducting exercises to ensure ongoing vigilance regarding public health emergency prevention activities for vulnerable populations.

NEW ACTION 7: TORNADOES, SEVERE WINTER STORMS, SEVERE THUNDERSTORMS

Action	
Proposed Action	Meeting with providers of electric power, land developers, and contractors to examine the cost of and potential sources of funding for burying power lines.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of power and recovery timeline.
Type of Action:	Prevention

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	High
Potential Funding Sources:	Developers, General funds, Grant funds
Lead Agency/Department Responsible:	Planning, Economic Development, Government Relations, Engineering
Implementation Schedule:	3-5 years

Comments

NEW ACTION 8: TORNADO, SEVERE WINTER STORMS, SEVERE THUNDERSTORMS

Action	
Proposed Action	Retrofit existing facilities government critical facilities with wind resistant/shatter proof windows, mitigation includes replacing seals, installing A/C covers and tie-downs for example.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of continuity of government and first responder capabilities.
Type of Action:	Property Protection, Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Strengthen current buildings by making them more resistant to severe thunderstorms and high winds.
Priority (High, Moderate, Low):	High
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, Community Investment
Lead Agency/Department Responsible:	Engineering
Implementation Schedule:	3-5 years

Comments

NEW ACTION 9: FLOODING

Action	
Proposed Action	Design and construction of erosion control projects for streams within Plano
Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Implementation of erosion control projects limit the threat of erosion during a storm even to the surrounding structures.
Type of Action:	Natural Resource Protection, Structural Projects

Mitigation Action Details	
Effect on new/existing buildings:	Implementation of erosion control projects reduce the risk of structural failure of existing structures.
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	High
Potential Funding Sources:	Grant funds, General funds, Community Investment
Lead Agency/Department Responsible:	Engineering, Public Works
Implementation Schedule:	3-5 years

Comments

NEW ACTION 10: FLOODING, SEVERE THUNDERSTORMS

Action	
Proposed Action	Conduct public awareness campaign for realtors, insurance agents, and property owners on benefits of flood insurance and the National Flood Insurance Program (NFIP).

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce property damage, loss of life and recovery time.
Type of Action:	Public Education & Awareness, Property Protection

Mitigation Action Details	
Effect on new/existing buildings:	This action would reduce the impact of flooding for existing and new structures.
Priority (High, Moderate, Low):	Low
Estimated Cost:	Staff time
Potential Funding Sources:	General funds
Lead Agency/Department Responsible:	Engineering, Emergency Management, Realtor Associations, Insurance Associations
Implementation Schedule:	2-3 years

Comments

NEW ACTION 11: HAZARDOUS MATERIAL INCIDENT

Action	
Proposed Action	Provide training to First Responders to ensure proper response to all HAZMAT incidents.

Background Information:	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Quick detection and mitigation will save many lives in the event of a Hazardous Material incident. Training is the only way to prepare the team to respond and quickly mitigate.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$100,000
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Fire-Rescue
Implementation Schedule:	3-5 years

Comments
Training is provided at no cost to Hazardous Material personnel. The only cost incurred by the city if the overtime and backfill for the members to be absent from duty to attend.

NEW ACTION 12: HAZARDOUS MATERIAL INCIDENT

Action	
Proposed Action	Provide analytical lab equipment for first responders responding to a WMD/CBRNE incident.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce response time for first responders and effectiveness of response overall.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$50,000
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Fire-Rescue
Implementation Schedule:	3-5 years

Comments

NEW ACTION 13: CYBER INCIDENT

Action	
Proposed Action	Conduct a cyber-risk assessment to determine vulnerabilities in identifying internal and external threats.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Continuity of Government
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Unknown
Priority (High, Moderate, Low):	High
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Technology Services
Implementation Schedule:	3-5 years

Comments

NEW ACTION 14: CYBER INCIDENT

Action	
Proposed Action	Create, review, and exercise a system recovery plan to ensure the restoration of data as part of a comprehensive disaster recovery strategy.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Continuity of Government
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Unknown
Priority (High, Moderate, Low):	High
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Technology Services
Implementation Schedule:	3-5 years

Comments

NEW ACTION 15: ALL-HAZARDS

Action	
Proposed Action	Continue to upgrade and/or replacement of fixed site generators in preparation for potential critical facilities utility interruptions.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Ensure continuation of essential services to the public.
Type of Action:	Prevention, Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Extensive impact on existing and new structures.
Priority (High, Moderate, Low):	High
Estimated Cost:	Moderate
Potential Funding Sources:	Grant funds, Community Investment
Lead Agency/Department Responsible:	Engineering, Public Works
Implementation Schedule:	3-5 years

Comments
City has started the first year of a four-year process of identifying critical facilities that need upgraded or replaced fixed site generators.

NEW ACTION 16: NATURAL HAZARDS

Action	
Proposed Action	Develop an incentive program to encourage builders and developers to construct new buildings above 2018 IECC requirements, specifically when it comes to natural hazards.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Saving lives
Type of Action:	Property protection

Mitigation Action Details	
Effect on new/existing buildings:	Storage of additional mass sheltering supplies at City warehouse, EOC and potentially additional buildings.
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Community Investment, Grant Funds
Lead Agency/Department Responsible:	Emergency Management, Neighborhood Services, Parks and Recreation
Implementation Schedule:	3-5 years

Comments

NEW ACTION 17: SEVERE THUNDERSTORMS

Action	
Proposed Action	Use a consultant to analyze the current outdoor warning system coverage.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Early warning saves lives and property.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$60,000 per siren
Potential Funding Sources:	Hazard Mitigation Grant Program, General fund
Lead Agency/Department Responsible:	Radio Shop, Emergency Management
Implementation Schedule:	3-5 years

Comments

NEW ACTION 18: DROUGHT

Action	
Proposed Action	Replace water fixtures in public buildings with low flow fixtures.
Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce risk of drought impacts through water reduction measures.
Type of Action:	Prevention, Property Protection

Mitigation Action Details	
Effect on new/existing buildings:	Reduces the water footprint of existing structures
Priority (High, Moderate, Low):	Low
Estimated Cost:	Minimal
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Public Works, Environmental Health, North Texas Water Municipal District
Implementation Schedule:	2-4 years

Comments
On-going. The City would work with the North Texas Water Municipal District on detecting leaks and replacing water fixtures in public buildings with low flow fixtures.

NEW ACTION 19: DROUGHT

Proposed Action	Develop incentives and strengthen standards and requirements to amplify the deployment of green infrastructure technologies and strategies on residential and commercial sites and buildings.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce risk of drought impacts through water reduction measures.
Type of Action:	Natural Resource Protection, Property Protection

Mitigation Action Details	
Effect on new/existing buildings:	Extensive impact on existing and new structures
Priority (High, Moderate, Low):	Low
Estimated Cost:	Minimal
Potential Funding Sources:	General funds, Grant funds
Lead Agency/Department Responsible:	Building Inspections, Environmental Health
Implementation Schedule:	3-5 years

Comments
Update and revise the Sustainability Implementation Plan and Code of Ordinances.

NEW ACTION 20: TRANSPORTATION ACCIDENT

Action	
Proposed Action	Mitigate against possible incidents along transportation corridors (signal communications upgrade, citywide signal retiming, etc.)

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Increased information sharing between engineering and public safety agencies, as well as increased traffic flow reducing crashes and saving drivers time, money, and wasted fuel.
Type of Action:	Emergency Services, Prevention

Mitigation Action Details	
Effect on new/existing buildings:	N/A
Priority (High, Moderate, Low):	Low
Estimated Cost:	Unknown
Potential Funding Sources:	General fund, Grant funds, Community Investment
Lead Agency/Department Responsible:	Engineering- Traffic/Transportation
Implementation Schedule:	3-5 years

Comments

NEW ACTION 21: TRANSPORTATION ACCIDENT

Action	
Proposed Action	Expand functionality of city traffic management center.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Proactively identify weak areas, suggest solutions, and communicate solutions/information to drivers and transit riders in real time.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Little impact on existing building to expand traffic management center
Priority (High, Moderate, Low):	Low
Estimated Cost:	Unknown
Potential Funding Sources:	General funds
Lead Agency/Department Responsible:	Engineering- Traffic/Transportation
Implementation Schedule:	2-4 years

Comments

NEW ACTION 22: TERRORISM / CIVIL DISORDER

Proposed Action	Purchase and install new cameras in high risk/heavily populated areas.
Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of life, bodily injury and property damage.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Minimal effect on buildings
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Police Department
Implementation Schedule:	3-5 years

Comments
This project would purchase and install new cameras that would increase the observability of critical infrastructure and key resources across the city.

NEW ACTION 23: TERRORISM / CIVIL DISORDER

Action	
Proposed Action	Identify and implement hardening measures of critical infrastructure and critical facilities.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of life, bodily injury and property damage.
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Minimal to moderate impact
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$25,000
Potential Funding Sources:	Grant funds, General funds, Public/Private Partnership
Lead Agency/Department Responsible:	Police
Implementation Schedule:	3-5 years

Comments

NEW ACTION 24: CIVIL DISORDER

Action	
Proposed Action	Work with local businesses to have evacuation and shelter in place plans to be used during civil disorders.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Increase businesses continuity and reduce property damage and bodily injury.
Type of Action:	Emergency Services, Public Education & Awareness

Mitigation Action Details	
Effect on new/existing buildings:	Minimal impact
Priority (High, Moderate, Low):	Low
Estimated Cost:	$5,000
Potential Funding Sources:	Staff time
Lead Agency/Department Responsible:	Police
Implementation Schedule:	3-5 years

Comments

NEW ACTION 25: ACTIVE SHOOTER / HOSTILE EVENT, CIVIL DISORDER

Action	
Proposed Action	Develop and implement more advanced access controls and badging for all city facilities.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of life or serious bodily injury.
Type of Action	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Unknown
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	Engineering/Facilities, Technology Services
Implementation Schedule:	2-4 years

Comments

NEW ACTION 26: ACTIVE SHOOTER / HOSTILE EVENT

Action	
Proposed Action	Implement safety specialist and facility safety program.
Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Reduce loss of life or serious bodily injury
Type of Action:	Emergency Services

Mitigation Action Details	
Effect on new/existing buildings:	Unknown
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	Unknown
Potential Funding Sources:	Grant funds, General funds
Lead Agency/Department Responsible:	HR/Risk Management, Police, Fire, Emergency Management, Engineering/Facilities
Implementation Schedule:	2-3 years

Comments

NEW ACTION 27: EXPANSIVE SOILS

Action	
Proposed Action	Harden City-owned infrastructure and assets against the impacts of extreme weather and climate hazards by separating drip irrigation from overall irrigation systems to maintain soil moisture around building foundations and prevent foundation damages from expansion of soils.

Background Information	
Site and Location:	City of Plano
Risk Reduction Benefit (Current Cost/Losses Avoided)	Maintain and preserve the structural integrity of City owned facilities.
Type of Action:	Prevention, Structural Projects

Mitigation Action Details	
Effect on new/existing buildings:	Cracking, distortion, roughness, structural damage
Priority (High, Moderate, Low):	Moderate
Estimated Cost:	$300,000
Potential Funding Sources:	General funds, Grant funds, Community Investment
Lead Agency/Department Responsible:	Public Works, Engineering, Parks and recreation
Implementation Schedule:	3-5 years

Comments

SECTION 6. PLAN MAINTENANCE

The following is an explanation of how the City of Plano and the general public will be involved in implementing, evaluating, and enhancing the Plan over time. When the plan is discussed in all maintenance procedures it includes mitigation actions and hazard assessments. The sustained hazard mitigation planning process consists of four main parts:

- Incorporation
- Monitoring and Evaluation
- Updating
- Continued Public Involvement

6.1 Incorporation

Once the Plan is adopted, departments within Plano will implement actions based on priority and the availability of funding. The mitigation actions developed for this Plan will enhance this ongoing effort and will be implemented through other program mechanisms where possible.

The potential funding sources listed for each identified action may be used when the jurisdiction seeks funds to implement actions. An implementation time period or a specific implementation date has been assigned to each action as an incentive for completing each task and gauging whether actions are implemented in a timely manner.

City departments will integrate implementation of the mitigation actions with other plans and policies such as construction standards and emergency management plans, and ensure that these actions, or proposed projects, are reflected in other planning efforts. Coordinating and integrating components of other plans and policies into goals and objectives of the HMAP will further maximize funding and provide possible cost-sharing of key projects, thereby reducing loss of lives and property and mitigating hazards affecting the area.

Upon formal adoption of the Plan, HMSC members will work to integrate the hazard mitigation strategies into other plans and codes as they are developed. HMSC members will conduct periodic reviews of plans and policies and analyze the need for changes if necessary.

6.2 Monitoring and Evaluation

Periodic revisions of the Plan are required to ensure that goals, objectives, and mitigation actions are kept current. When the plan is discussed in these sections it includes the risk assessment and mitigation actions as a part of the monitoring, evaluating, updating and review process. Revisions may be required to ensure the Plan is in compliance with federal and state statutes and regulations. This section outlines the procedures for completing Plan revisions, updates, and review. The department of Emergency Management is the party responsible for Plan monitoring, evaluating, updating, and review of the Plan.

Overall mitigation strategy monitoring will be conducted on an ongoing basis via the department of emergency management or applicable city department dependent on mitigation action and parties involved. See Section 5 *new mitigation actions* for a detailed list of ongoing and potential mitigation actions. It is under guidance of city management, emergency management and elected officials that priority of mitigation actions is decided and under what funding source.

As part of the evaluation process, the Planning Team will assess changes in risk; determine whether the implementation of mitigation actions is on schedule; determine whether there are any implementation problems, such as technical, political, legal, or coordination issues; and identify

changes in land development or programs that affect mitigation priorities for each respective department or organization. Overall incorporation of this plan into other city wide planning considerations such as community investment or future development is imperative and will be considered by the planning team and local leaders when reviewing effectiveness of the plan.

The Planning Team will meet on an annual basis to evaluate the Plan and identify any needed changes. The annual evaluation process will help to determine if any changes are necessary.

6.3 Updating

At any time, minor technical changes may be made to update the City of Plano Hazard Mitigation

Action Plan. Material changes to mitigation actions or major changes in the overall direction of the Plan or the policies contained within it, must be subject to formal adoption by the City.

The City will review proposed amendments and vote to accept, reject, or amend the proposed change. Upon ratification, the amendment will be transmitted to TDEM.

In determining whether to recommend approval or denial of a Plan amendment request, the City will consider the following factors:

- Errors or omissions made in the identification of issues or needs during the preparation of the Plan;
- New issues or needs that were not adequately addressed in the Plan; and
- Changes in information, data, or assumptions from those on which the Plan was based.

At a minimum a 5-year review cycle will be in place to facilitate regular review and update periods to comply with state and federal laws and standards.

6.4 Continued Public Involvement

Planning review will be conducted on an annual basis via a public survey which will be posted on all applicable social media outlets and city of Plano news sources. This survey will allow for direct engagement from all citizens and stakeholders on current and future hazards and/or trends for mitigation consideration.

The public can review the Plan on the City of Plano EM website and copies of the Plan will be kept in the offices of the City. Officials and the public are invited to provide ongoing feedback by sending comments to the Emergency Management email. The City of Plano will also provide an opportunity for feedback during the annual Emergency Operations Plan review.

6.5 Conclusion

Through the development of this plan, the City of Plano has developed a thorough hazard history, an inventory of critical facilities, and an updated contact list for emergency contacts at critical facilities. This data, when used in conjunction with the updated information about hazard threats and vulnerabilities, will prove to be invaluable to the City of Plano and its citizens. Natural and human-caused hazards have been identified citywide. Possible mitigation projects that would reduce the risk to lives and property due to the identified threats have been compiled and prioritized.

The creation of the City of Plano Hazard Mitigation Steering Committee brought together stakeholders from the government and community organizations into one planning team. This group has been able to work together effectively and efficiently to produce this document and establish a greater awareness of our risks and our mitigation strategies.

This plan will continue to evolve as necessary to properly represent the threats and vulnerabilities affecting the City of Plano.

Continued public participation is encouraged and will be continued through the ongoing hazard mitigation process.

APPENDICES

APPENDIX A. ACRONYMS / ABBREVIATIONS

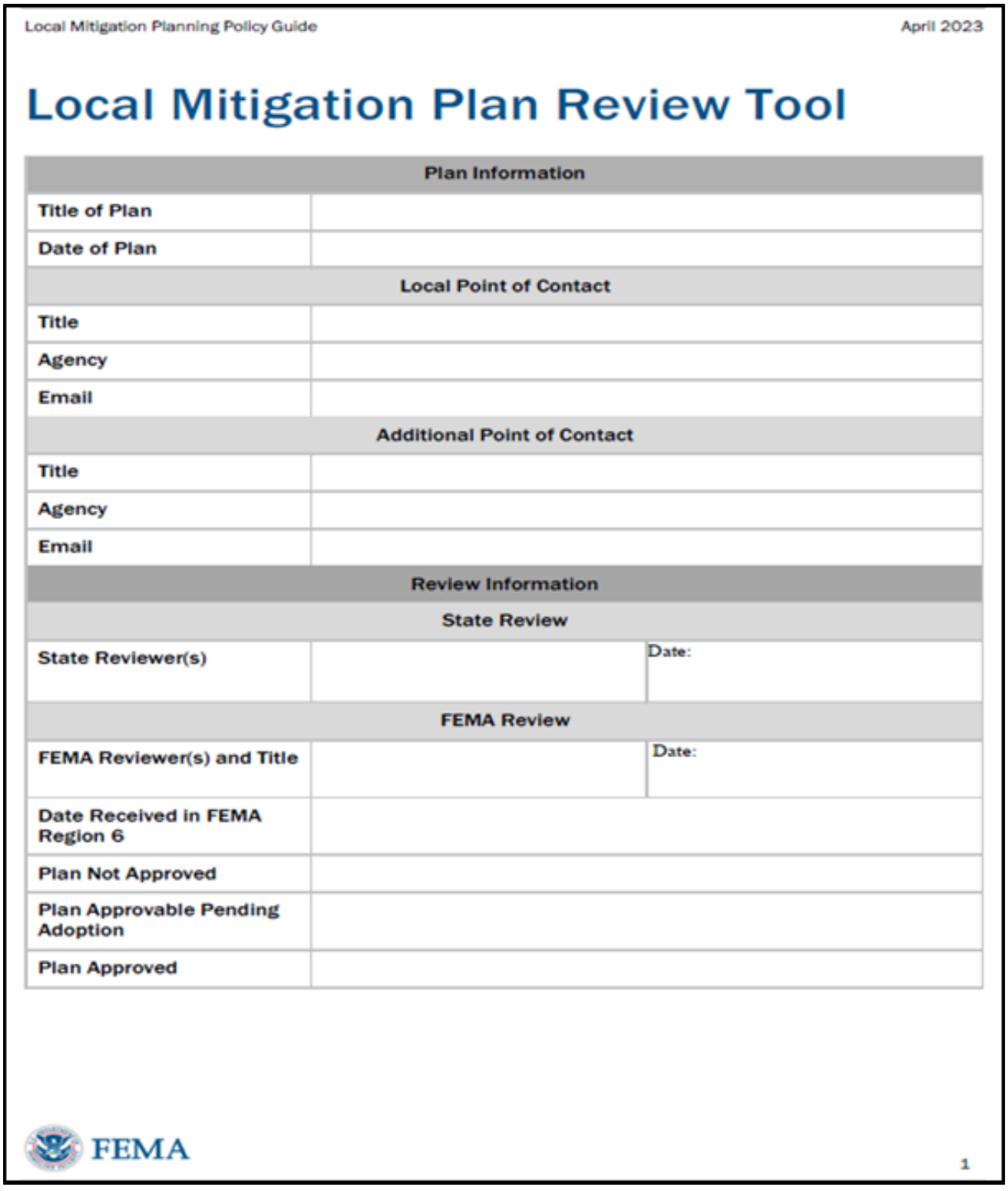
Table A-1 *Acronyms and Abbreviations*

2D	Two-Dimensional
AMC	Antecedent Moisture Condition
ASTM	American Society for Testing and Materials
BNSF	Burlington Northern Santa Fe Railroad
CFS	Cubic Feet per Second
CRS	Community Rating System
DART	Dallas Area Rapid Transit
DFIRM	Digital Flood Insurance Rate Map
DFW	Dallas/Fort Worth
DGNO	Dallas Garland and Northeastern Railroad
DMA	Disaster Mitigation Act of 2000
DNT	Dallas North Tollway
DR	Disaster Declarations
EAP	Emergency Action Plan
EFS	Enhanced Fujita Scale
EM	Emergency Management
EOC	Emergency Operations Center
°F	Fahrenheit
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HEC-HMS	Hydrologic Engineering Center - Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center's (HEC) River Analysis System
H&H	Hydrologic and Hydraulic
HHPD	High Hazard Potential Dams
HMA	Hazard Mitigation Assistance
HMAP	Hazard Mitigation Action Plan
HMSC	Hazard Mitigation Steering Committee
ICC	Increased Cost of Compliance

MSL	Mean Sea Level
Mph	Miles per Hour
NCEI	National Centers for Environmental Information
NFIP	National Flood Insurance Program
NFIRS	National Fire Incident Reporting System
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PISD	Plano Independent School District
PDSI	Palmer Drought Severity Index
PMF	Probable Maximum Flood
RL	Repetitive Loss
SRL	Severe Repetitive Loss
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDEM	Texas Division of Emergency Management
TNRIS	Texas Natural Resources Information System
TWDB	Texas Water Development Board (
TXDOT	Texas Department of Transportation
USFA	United States Fire Administration
WCT	Wind Chill Temperature
WSE	Water Surface Elevation

APPENDIX B. FEMA MITIGATION PLAN REVIEW TOOL

Figure B-1 *FEMA Plan Review Tool*



Local Mitigation Planning Policy Guide April 2023

Local Mitigation Plan Review Tool

Plan Information		
Title of Plan		
Date of Plan		
Local Point of Contact		
Title		
Agency		
Email		
Additional Point of Contact		
Title		
Agency		
Email		
Review Information		
State Review		
State Reviewer(s)		Date:
FEMA Review		
FEMA Reviewer(s) and Title		Date:
Date Received in FEMA Region 6		
Plan Not Approved		
Plan Approvable Pending Adoption		
Plan Approved		

FEMA

1

Multi-Jurisdictional Summary Sheet

#	Jurisdiction Name	Requirements Met (Y/N)							
		A. Planning Process	B. Risk Assessment	C. Mitigation Strategy	D. Plan Maintenance	E. Plan Update	F. Plan Adoption	G. HHPD Requirements	H. State Requirements
1									
2									
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2

Plan Review Checklist

The Plan Review Checklist is completed by FEMA. States and local governments are encouraged, but not required, to use the PRT as a checklist to ensure all requirements have been met prior to submitting the plan for review and approval. The purpose of the checklist is to identify the location of relevant or applicable content in the plan by element/sub-element and to determine if each requirement has been "met" or "not met." FEMA completes the "required revisions" summary at the bottom of each element to clearly explain the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is "not met." Sub-elements in each summary should be referenced using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each element and sub-element are described in detail in Section 4: Local Plan Requirements of this guide.

Plan updates must include information from the current planning process.

If some elements of the plan do not require an update, due to minimal or no changes between updates, the plan must document the reasons for that.

Multi-jurisdictional elements must cover information unique to all participating jurisdictions.

Element A: Planning Process

Element A Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))		
A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved?		
A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process?		
A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))		
A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity?		
A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))		

3

Element A Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan?		
A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))		
A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document?		
Element A Required Revisions		
Required Revision:		

Element B: Risk Assessment

Element B Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
B1. Does the plan include a description of the type, location, and extent of all natural hazards thatcan affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))		
B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area?		
B1-b. Does the plan include information on the location of each identified hazard?		
B1-c. Does the plan describe the extent for each identified hazard?		
B1-d. Does the plan include the history of previous hazard events for each identified hazard?		

4

Element B Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
B1-e. Does the plan include the probability of future events for each identified hazard? Does the plan describe the effects of future conditions, including climate change (e.g., long-term weather patterns, average temperature and sea levels), on the type, location and range of anticipated intensities of identified hazards?		
B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area?		
B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIP-insured structuresthat have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))		
B2-a. Does the plan provide an overall summary of each jurisdiction's vulnerability to the identified hazards?		
B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction?		
B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods?		
Element B Required Revisions		
Required Revision:		

Element C: Mitigation Strategy

Element C Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))		
C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?		

5

Element C Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?		
C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C2-a. Does the plan contain a narrative description or a table/list of their participation activities?		
C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))		
C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan?		
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment?		
C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment?		
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a cost-benefit review), implemented, and administered by each jurisdiction?(Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))		
C5-a. Does the plan describe the criteria used for prioritizing actions?		
C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame?		
Element C Required Revisions		
Required Revision:		

Element D: Plan Maintenance

6

Element D Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))		
D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved?		
D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))		
D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process?		
D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible.		
D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process?		
D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))		
D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?		
D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated?		
D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms?		
Element D Required Revisions		

7

Element D Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
Required Revision:		

Element E: Plan Update

Element E Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?		
E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))		
E2-a. Does the plan describe how it was revised due to changes in community priorities?		
E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan?		
E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms?		
Element E Required Revisions		
Required Revision:		

Element F: Plan Adoption

Element F Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted theplan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F1-a. Does the participant include documentation of adoption?		
F2. For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted The plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F2-a. Did each participant adopt the plan and provide documentation of that adoption?		
Element F Required Revisions		
Required Revision:		

Element G: High Hazard Potential Dams (Optional)

HHPD Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
HHPD1. Did the plan describe the incorporation of existing plans, studies, reports and Technical information for HHPDs?		
HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency?		
HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners?		
HHPD2. Did the plan address HHPDs in the risk assessment?		
HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs?		
HHPD2-b. Does the plan document the limitations and describe how to address deficiencies?		
HHPD3. Did the plan include mitigation goals to reduce long-term vulnerabilities from HHPDs?		
HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other long-term strategies?		
HHPD3-b. Does the plan link proposed actions to reducing long-term vulnerabilities that are consistent with its goals?		
HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?		
HHPD4-a. Does the plan describe specific actions to address HHPDs?		
HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs?		
HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs?		
HHPD Required Revisions		
Required Revision:		

Element H: Additional State Requirements (Optional)

Element H Requirements	Location in Plan (section and/or pagenumber)	Met Y/N
This space is for the State to include additional requirements		

APPENDIX C. HMAP MEETING DOCUMENTATION

PreparedinPlano.com

The City of Plano Emergency Management HMAP Stakeholders Meeting 1 Agenda

Location: 4125 W. Parker Rd, Plano TX, EOC Media Room
Date: 4/28/22
Attendees: Sign in sheet attached
Time: 0900

I. Introductions

II. Presentation

A) HMAP Overview

B) HIRA Overview

C) What is mitigation and how do we mitigate?

D) Mitigation Planning Process

E) Mitigation Strategies

F) Whole Community Mitigation

G) Survey Overview

III. Open Discussion

IV. Closing Remarks/Next Meeting Time

HMAP KICKOFF MEETING

Project:	HMAP	**Meeting Date:**	4/28/2022
Facilitator:	Plano Emergency Management	**Place/Room:**	EOC- Media Room

Name	Title	Department	E-Mail
Carrie Little	Director	EM	carriel@plano.gov
Nick Robison	Asst. EMC	EM	Nickre plano.gov
Nick VanWinkle	EM Specialist	EM	NVanWinkle@Plano.gov
Ben Zajdel	Sr. Prpty Stds Spclst	NS	benz@plano.gov
DEREK JOHNS	PSC SPECIALIST	PSC	DEREKJ@PLANO.GOV
JASON APKILL	SR MOBILITY PLANNER	Planning	japkill@plano.gov
Nina Martin	Lib. Manager	Libraries	ninaz@plano.gov
Jenny Zeilfelder	E.D. Manager	Econ Dev	jennyz@plano.gov
Stephen Tanner	Legislative Anal	BGR	stephent@plano.gov
Gus Duran	CISO	TS	gduran@plano.gov

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HMAP KICKOFF MEETING

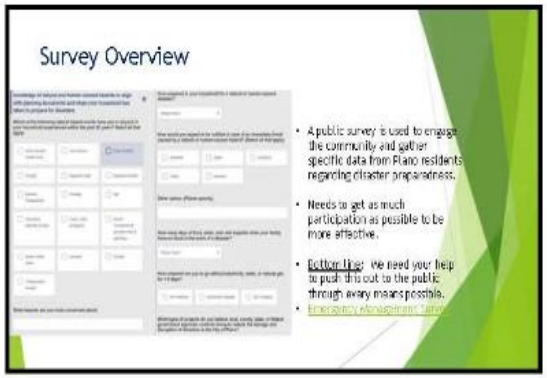
Project:	HMAP	**Meeting Date:**	4/28/2022
Facilitator:	Plano Emergency Management	**Place/Room:**	EOC- Media Room

Name	Title	Department	E-Mail
ALEX SIMMONS	BATTALION CHIEF	PLANO FIRE RESCUE	ALEXS@PLANO.GOV
DENNY MCDONALD	BLD INSP COOR.	BLDG INSPECTIONS	DENNYM@PLANO.GOV
Shelby Kervin	Homeland Sec. Lt	PD	ShelbyK@plano.gov
Abby Owens	AD of PW	PW	abbyo@plano.com
LYNN HUDSON	SR EM Spec	EM	LHudson@plano.gov

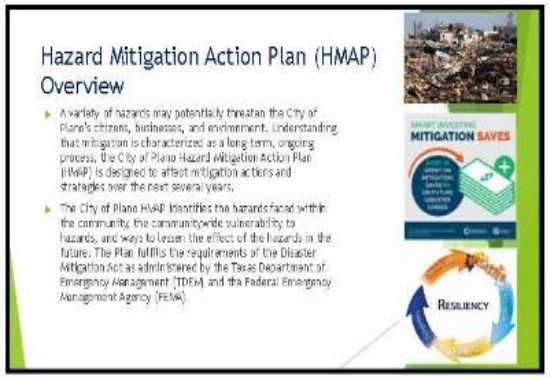

City of Plano Hazard Mitigation Steering Committee


WHAT IS MITIGATION?
HOW DO WE MITIGATE?
WHY DO WE MITIGATE?
MITIGATION ACTIONS


Whole Community Mitigation
The city of Plano's government is just one piece of the overall mitigation effort
For an effective mitigation strategy all resources, partners and jurisdictions are needed.
Looking outside the city as well as NGOs and private sector entities further adds to our cities resiliency.
Whole Community


Survey Overview
A public survey is used to engage the community and gather specific data from Plano residents regarding disaster preparedness.
Needs to get as much participation as possible to be more effective.
Bottom line: We need your help to push this out to the public through every means possible.


THE MITIGATION PLANNING PROCESS
TAKING ACTION
MITIGATION AT WORK
RiskMAP
FEMA


Hazard Mitigation Action Plan (HMAP) Overview
A variety of hazards may potentially threaten the City of Plano's citizens, businesses, and environment. Understanding that mitigation is characterized as a long term, ongoing process, the City of Plano Hazard Mitigation Action Plan (HMAP) is designed to affect mitigation actions and strategies over the next several years.
The City of Plano HMAP identifies the hazards faced within the community, the community-wide vulnerability to hazards, and ways to lessen the effect of the hazards in the future. The Plan fulfills the requirements of the Disaster Mitigation Act as administered by the Texas Department of Emergency Management (TDEM) and the Federal Emergency Management Agency (FEMA).
MITIGATION SAVES
RESILIENCY


Hazard Identification and Risk Assessment (HIRA) Overview
City Of Plano HIRA Ranking
NATURAL HAZARDS
Location
Extent
(Magnitude/Strength)
Previous Occurrences
Future Probability
RISK
COMMUNITY ASSETS
Population
Built Environment
Natural Environment
Economy


Mitigation Strategies
RISK
MITIGATION


Open for discussion
WHEN YOU ADD THE PERFECT COMMENT TO THE GROUP DISCUSSION

HMAP STAKEHOLDERS MEETING #2

Project:	HMAP	**Meeting Date:**	6/16/2022
Facilitator:	Plano Emergency Management	**Place/Room:**	EOC- Policy Room

Name	Title	Department	E-Mail
Nick Van Winkle	EM Specialist	Emergency Manager	NVANWINKLE@plano.gov
DANNY MCDONALD	Building inspect supervisor	Bldg inspections	dannym@plano.gov
DEREK JOHNS	PSC SPECIALIST	PSC	DEREKJ@PLANO.GOV
Ben Zajdel	SPSS Specialist	Neighborhood Svcs	benz@plano.gov
PAUL MCCOLLUM	Chief Municipal Judge	Municipal Court	PAULMC@plano.gov
Gus Duran	CISO	TS	gduran@plano.gov.
JASON APRILL	Senior Mobility Planner	Planning	japrill@plano.gov

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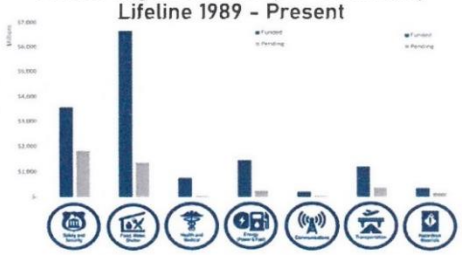
MITIGATION STRATEGIES

HMAP Stakeholders Meeting 2

Mitigation Planning Framework

FEMA Mitigation Funds per Community Lifeline 1989 - Present



Resilient Infrastructure: Example

6-acre underground resiliency park in NJ offers outdoor public recreation amenities such as a natural oasis, athletic fields, play areas, fitness stations, and event space:

- ✓ Lowered basketball court provides green stormwater storage
- ✓ Rain gardens for capture and filtration
- ✓ Provides significant mitigation of fluvial and flash flooding for multi-story residential, commercial, and industrial properties
- ✓ Reduces economic, environmental, and social impacts

8 Drainage areas

7 Landscape types

1.75M Gallons of stormwater storage

$10M FED SHARE + $47M MATCH

MITIGATION STRATEGIES

Past and Future

Tornado

Previous mitigation efforts

1) Distribute all-hazards emergency preparedness materials from the North Central Texas KnoWhat2Do preparedness campaign. Ongoing
2) Implement additional early warning systems such as IPAWS. Ongoing

Future mitigation efforts

1) Promote the construction and use of safe rooms.
2) Conduct outreach activities to increase awareness of tornado risk.

Severe Winter Storm

Previous mitigation efforts

1) Develop and implement a Debris Management Plan and associated training program. Complete
2) Install Sensors to detect freezing potential on overpasses and bridges. Deleted
3) Implement awareness campaign to inform the community of severe winter/ice hazards. Ongoing

Future mitigation efforts

1) Public awareness of severe winter storm preparedness and mitigation strategies.
2) Protect vulnerable populations from the impacts of severe winter storms.

Public Health Emergency

Previous mitigation efforts – None

Future mitigation efforts

1) Combine risk awareness and emergency preparedness campaigns with existing public health campaigns and engaging with health officials as part of their planning process.
2) Collaborate with public health on bio-surveillance, pre-scripted public health emergency messaging, public education, and outreach.

Severe Thunderstorm (Includes Wind & Lightning)

Previous mitigation efforts

1) Provide surge protection at critical facilities and promote surge protection as part of public education. Deleted
2) Implement tree trimming initiative. Complete

Future mitigation efforts

1) Consider using underground utilities.
2) Protection of critical facilities and infrastructure from severe thunderstorm damage.

Flooding

Previous mitigation efforts

1) Purchase portable generators to reduce the likelihood of failure that may occur to the city's drainage systems. Complete
2) Implement damage reduction measures of drainage ways and retention basins through stream bank erosion reduction program. Ongoing
3) Remove repetitive loss structures out of the floodplain. Deleted

Future mitigation efforts

1) Protect critical facilities from flood events.
2) Property owner outreach and education.

Hazardous Materials Incident

Previous mitigation efforts - None

Future mitigation efforts

1) Environmental and hazard monitoring systems to proactively detect potential for hazardous material events.
2) Cross department training and exercises for Hazmat response.
3) Continue to increase hazmat team's capabilities.

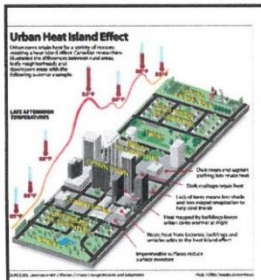
Cyber Incident

Previous mitigation efforts - None

Future mitigation efforts

1) Continue cyber security training for city employees.
2) Coordinate with TS to develop a more resilient cyber security infrastructure.

Extreme Temperatures



Previous mitigation efforts

1) Initiate an excessive heat public awareness and educational campaign. Ongoing
2) Increase tree plantings along public rights of way to reduce the urban heat island effect. Deleted

Future mitigation efforts

1) Continue upgrade and / or replacement of fixed site generators in critical facilities.
2) Protect vulnerable populations from extreme temperatures.

Hail

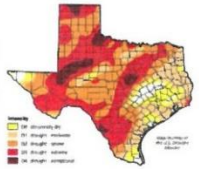
Previous mitigation efforts

1) Develop revised standards to require hail resistant practices when constructing new public buildings. Deleted

Future mitigation efforts

1) Retrofitting existing critical infrastructure to minimize hail damage.
2) Use a consultant to analyze outdoor warning systems.

Drought



Previous mitigation efforts

1) Implement public outreach campaign to educate and inform the public about drought and water conservation. Ongoing
2) Develop revised standards that require the use of low water landscaping practices throughout the community. Deleted

Future mitigation efforts

1) Monitoring and checking for leaks in water supplies to reduce water loss.
2) Revise existing drought communication strategies.

Transportation Incident

Previous mitigation efforts - None

Future mitigation efforts

1) Mitigate against possible incidents along transportation corridors.
2) Expand functionality of traffic management center.
3) Coordinate with transportation carriers regarding traffic flow.

Explosive Incident

Previous mitigation efforts
None

Future mitigation efforts

1) Public outreach and awareness campaign.
2) Provide training for first responders to pipeline failures.
3) Continue to increase capabilities of EOD team.

Terrorism

Previous mitigation efforts - None

Future mitigation efforts

1) Harden critical infrastructure against terrorism threats.
2) Increase intelligence gathering capabilities.

Civil Disorder

Previous mitigation efforts - None

Future mitigation efforts

1) Develop layered security measures around critical facilities.
2) Work with local businesses to have evacuation and shelter in place plans to be used during civil disorders.
3) Train all first responders on riot control tactics and techniques.

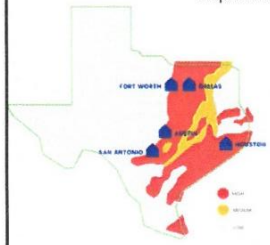
Active Shooter/Hostile Event

Previous mitigation efforts - None

Future mitigation efforts

1) Continue collaboration between schools, businesses and first responders against active shooters.
2) Develop and implement more advanced access controls and badging for all city facilities.
3) Implement safety specialist and facilities safety program.
4) Train supervisors on early detection of possible active shooters.

Expansive Soils



Previous mitigation efforts – None

Future mitigation efforts

1) Educate the public about expansive soils and potential mitigation actions.
2) Continue code enforcement.

COMMENTS....

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Plano HMAP Stakeholders Meeting

Location: Skype (Virtual)
Date: 8/10/22
Time: 1100

I. **Introduction**

II. **Overview of previous meetings**

III. **Go over future mitigation strategies**

- Briefly discuss strategies by hazard/threat

IV. **Final approval of mitigation strategies**

- Decide on which departments will be involved with which strategies
- Final confirmation of all strategies

V. **Discuss Actions Prior to adoption by council**

- Public input
- Private sector input
- Approval via TDEM and FEMA

VI. **Open Discussion**

VII. **Closing Remarks**

Thank you for joining!

We will Begin at 6 PM

City of Plano EM Emergency Management

PreparedInPlano.com

City of Plano Hazard Mitigation Action Plan (HMAP)

Public Meeting

Hosted via Zoom by The City of Plano Emergency Management

Today's Agenda

- Welcome/Introductions
- Ground rules
- PowerPoint Overview
- Open Discussion/Citizen Comments
- Next Steps
- Closing

Ground Rules

- Please leave yourself Muted during the PPT Slides, I will ask for questions at the end of each slide
  - You can put questions in Chat
  - You can also ask questions Via your device's Microphone
- After the PowerPoint, it will be an open discussion and Comment Time
- I have the ability to Display portions of the Plan
- This Meeting is being recorded

Background

- What is it
- Why do we have it
- Who does it serve
- What is the benefit to us
- When was it written and updated
- What is the purpose of our meeting

City Planning Team

- City's Emergency Management
- City's Department Heads (stakeholders)

So what has happened since 2013?

- Increase in population
- Increase in development
- More data on possible hazards
- Updated maps
- Updated and revised action items
- New and emerging threats/hazards

Previous action items and status summary

- Will continue some Action Items across the City
- Funding for these projects - through FEMA
- Public Education and providing information to the public is an easy and very beneficial action item

New action items

- Priority based on HIRA (Hazard Incident risk assessment)
- Tornado Shelters
- Training and equipment upgrades for first responders
- Infrastructure upgrades

Next steps

- Update Plan with everyone's comments (Including survey results)
- Present to City Council (October 10th)
- Send to TDEM and FEMA for Approval

Thank you

City of Plano EM Emergency Management

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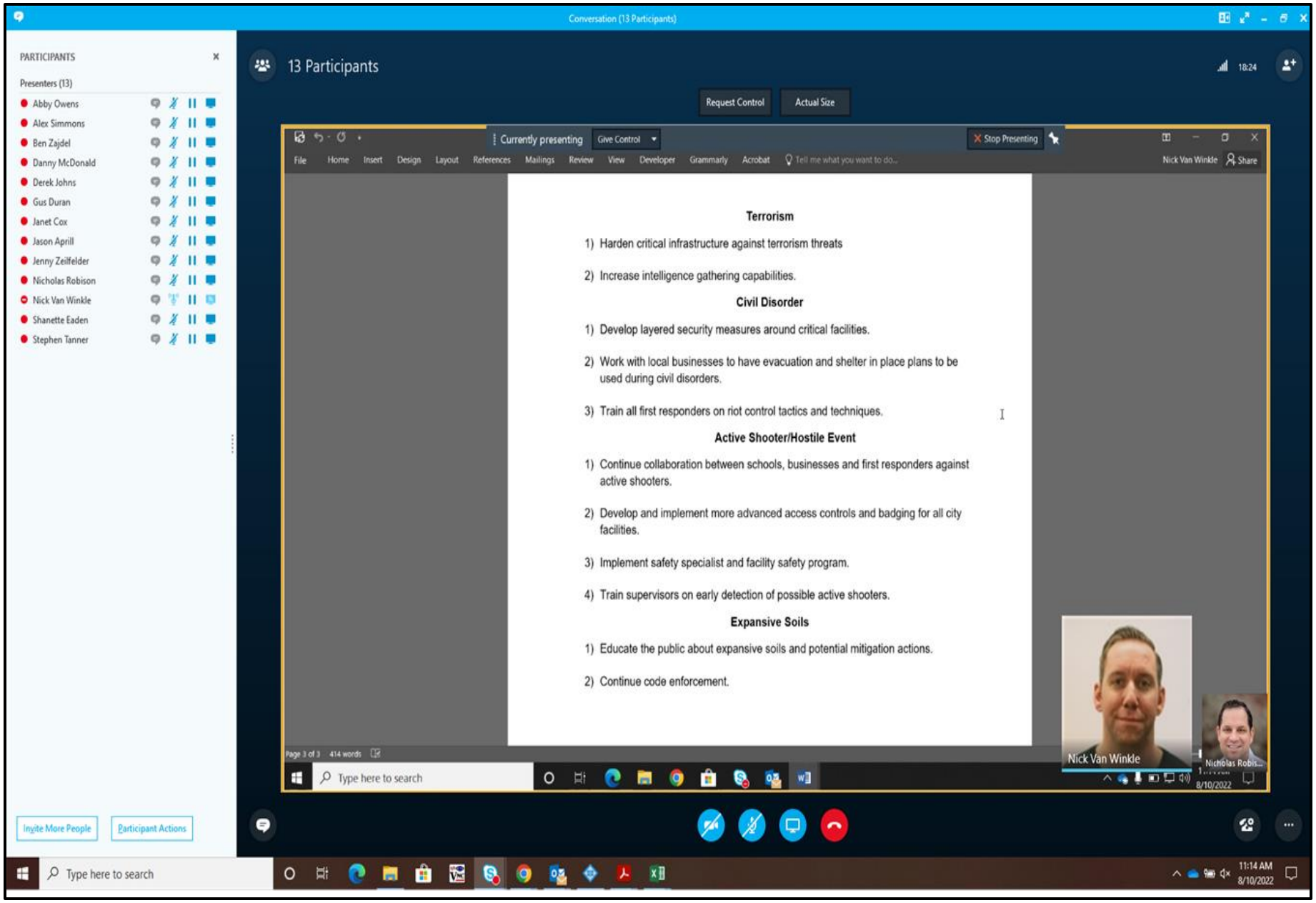
Conversation (13 Participants)
PARTICIPANTS
Presenters (13)
Abby Owens
Alex Simmons
Ben Zajdel
Danny McDonald
Derek Johns
Gus Duran
Janet Cox
Jason Aprill
Jenny Zeilfelder
Nicholas Robison
Nick Van Winkle
Shanette Eaden
Stephen Tanner
13 Participants
Request Control
Actual Size
Currently presenting
Give Control
Stop Presenting
Terrorism
1) Harden critical infrastructure against terrorism threats
2) Increase intelligence gathering capabilities.
Civil Disorder
1) Develop layered security measures around critical facilities.
2) Work with local businesses to have evacuation and shelter in place plans to be used during civil disorders.
3) Train all first responders on riot control tactics and techniques.
Active Shooter/Hostile Event
1) Continue collaboration between schools, businesses and first responders against active shooters.
2) Develop and implement more advanced access controls and badging for all city facilities.
3) Implement safety specialist and facility safety program.
4) Train supervisors on early detection of possible active shooters.
Expansive Soils
1) Educate the public about expansive soils and potential mitigation actions.
2) Continue code enforcement.
Nick Van Winkle
Invite More People
Participant Actions
Type here to search
11:14 AM
8/10/2022

APPENDIX D. PLAN ADOPTION

APPENDIX E. HIGH HAZARD POTENTIAL DAMS

The City of Plano has three high hazard potential dams (HHPD) and two significant hazard dams, as identified by the State of Texas. The *Federal Guidelines for Dam Safety; Hazard Potential Classification System for Dams*[40], states that dams assigned a high hazard potential classification are those where failure has the potential to cause the loss of human life.

Data from private dam owners, the City of Plano Engineering Department, the National Inventory of Dams, and the Texas Commission on Environmental Quality were utilized to understand better the risk associated with the three HHPDs. In addition, a detailed assessment of each dam's emergency response plans, FEMA 100-year flood plain maps and flood inundation models, soil information, urban expansion, and projected development were all part of a complete analysis of these HHPDs.

Dam breaches, although rare in occurrence, can have significant impacts on all areas downstream. In some cases, flood levels can rise to dangerous levels, causing significant property damage and potentially death. Further information regarding the three high hazard potential dams is provided in Table E-1, which depicts the City of Plano's dam inventory.

Table E-1 *Total Dam Inventory for the City of Plano*

ID	NAME	COUNTY	LAT	LONG	HAZARD	OWNER	EAP
Tx00596	Lower Lake Dam	Denton	33.073894	-96.845112	**High**	Private	Yes
Tx01123	Willow Bend Lake No 1 Dam	Collin	33.033704	-96.80318	**High**	Private	Yes
Tx04860	Willow Bend Lake No 2 Dam	Collin	33.037906	-96.807602	**High**	Private	Yes
Tx06558	EDS Dam No 1	Collin	33.066531	-96.799358	**Significant**	Private	Yes
Tx06559	EDS Dam No 2	Collin	33.06001	-96.799923	**Significant**	Private	Yes

[40] https://www.ferc.gov/sites/default/files/2020-04/fema-333.pdf

TX00596 - LOWER LAKE DAM (QUISENBERRY LAKE DAM)

Breach Analysis

According to Texas Administrative Code (TAC) Title 30 Chapter 299, §299.15(a)(1)(A), the minimum design flood hydrograph for a small, high hazard structure is the 75% Probable Maximum Flood (PMF) hydrograph. Kimley-Horn performed the Breach Analysis in accordance with *Hydrologic and Hydraulic Guidelines for Dams in Texas*[41] According to the Guidelines, the following breach scenarios should be considered when performing a complete breach analysis:

- Sunny Day breach:
  - Reservoir at its maximum normal operating pool level.
- Design Flood breach:
  - Inflow hydrograph equal to the full design flood. In this case, the 75% PMF event.

Hydrology

Per the H&H Analysis, the critical storm for Quisenberry Lake was found to be the 1-Hour 75% PMF and is the thus the design storm for the Dam. The inflow hydrograph for the 1-Hour 75% PMF was utilized for the breach analysis.

Inflow hydrographs for the Indian Creek watershed downstream of Quisenberry Lake were calculated using HEC-HMS. Kimley-Horn utilized drainage areas delineations, Curve Numbers, and Time. Concentration values from the City of Carrollton Floodplain Update Study for Indian Creek. Kimley-Horn converted the Curve Numbers to Antecedent Moisture Condition (AMC) III and added the rainfall values for 1-Hour PMP storm event. The hydrographs for the downstream watershed were reduced to 75% of the PMF to be consistent with design hydrograph for Quisenberry Lake. A drainage area map referencing the downstream areas has been included in the owner's emergency action plan (EAP).

Hydraulics

Kimley-Horn performed the beach analysis using an unsteady 2D hydraulic model using HEC-RAS v.5.0.7 modeling software. Two breach events were modeled: the 75% PMF breach event (design storm) and the Sunny Day breach event. It was determined at the conclusion of this modeling effort that the 75% PMF breach event resulted in the largest inundation area and will be the inundation area displayed on the inundation maps included within the EAP amd on file with the City of Plano.

Model Geometry

Kimley-Horn created a 2D mesh of Indian Creek and its tributaries extending from the downstream face of Quisenberry Lake Dam down to point just upstream of Indian Creek's crossing with N Josey Ln. The cell size for the 2D mesh consists of 40'x40' cells supplemented with 20'x20' cells along the flow line, ridgelines, and other areas were additional detail is needed. The mesh geometry was determined using TNRIS aerial topography dated 2009. Manning's "n" values were selected using aerial photography, engineering judgement, and HEC-RAS 2D modeling guidelines.

Quisenberry Lake was modeled as storage area and Quisenberry Dam was modeled as an inline structure. Geometry of the embankments is based on the TNRIS aerial topography dated 2009. The outfall structure was modeled as an outfall rating curve obtained from the H&H Analysis for the proposed spillway layout.

[41] https://www.tceq.texas.gov/downloads/compliance/publications/gi/gi-364.pdf

The inflow hydrograph for 75% PMF event for the 1-hour duration storm for Quisenberry lake was routed through the storage area, and the inflow hydrographs for the downstream watershed was applied along the flow line of Indian Creek as inflow hydrographs.

For the Sunny Day breach event, Quisenberry Lake was assumed to be at its normal pool depth (628.0') and the downstream channel was considered to be empty.

The Guidelines indicate the breach width should be at least three times the depth of water impounded in each of the breach events. The breach is initiated once the peak WSE is reached and forms at a rate of three feet of depth of water impounded per minute per the Guidelines. For Quisenberry Lake Dam the breach width was assumed to be 72' and formed in 0.13 hours.

Inundation Mapping

As previously mentioned, the 75% hydrograph resulted in the maximum inundation area. The 75% PMF and Sunny Day breach elevations determined from the HEC-RAS modeling were mapped using 1-foot aerial contours (TNRIS, 2009). A breach inundation map was conducted for the 75% PMF breach event and the Sunny Day breach which is on file with dam owner and the City of Plano. The limits of the Sunny Day breach are not shown on the inundation maps included with the EAP.

When comparing the 75% breach event to a non-breach event, the difference in water surface elevation is less than 1.0' once flow reaches Indian Creeks crossing with Windhaven Parkway. Thus, per Section 8.5 of the Guidelines, the inundation length terminates at the downstream face of Windhaven Parkway, which is approximately 10,000 linear feet downstream of the Quisenberry Lake dam.

TX01123 - WILLOW BEND LAKE NO. 1 DAM

Rainfall & Distribution

While this study was only focused on an overtopping failure of the structure, two scenarios were developed; a 9.2 inch 24-hr storm to verify the hydrologic model and 19.1 inch 1-hr storm (from HMR-52) for the 75% PMF event. Because the drainage area is small and fully developed, storms longer than 1 hour would have had minimal impact on the downstream breach hydrograph and were not used.

Study Area

The study area for this project was the drainage area of Willow Bend Lake #1 and the area downstream on White Rock Creek to the BNSF Rail Line approximately 2 miles downstream. The basin boundary was determined using a GIS program. The data used for the digital elevation model (DEM) was the USGS quad sheet grid. This data was checked using the 2-ft LIDAR contours provided by the City. The measured area upstream of the dam was approximately 440 acres. Based on topology and land use, the watershed was not further subdivided for analyses. The hydraulic effects of the 2 bridges downstream of the structure were estimated to get a better estimate of the breach wave water surface.

Soils

Soils information was obtained from the NRCS SSURGO database. The data included tabular soils information as well as a spatial data set used to determine areas. In this study area there were 6 different soils types which included 2 hydrologic soils groups (C & D). The nontechnical soils descriptions, as well as the hydrologic soils groups are located in the Dam plan.

Land Use

This entire drainage area for the Dam is 100% developed, with 78% (345 acres) being light residential, with remaining area in commercial and high density residential (95 acres). This data was verified with the Multi-Resolution Land Characteristics Consortium's (MRLC) National Land Cover Database (NLCD 2001) information that was created for the entire United States with 30m resolution.

Soil Cover Complex

The soils were combined with the land use data to create a soil cover complex for determining a composite Curve Number (CN) for the basin. The methods used to determine these values are located in the NRCS's Urban Hydrology for Small Watersheds (TR-55).

The CN used for this study was 77 using AMC II conditions for urban open space with 60% imperviousness from the NLCD dataset. For the PMP event, an AMC III CN of 89 was used (with the same imperviousness).

Time of Concentration

The time of concentration was calculated by combining two methods using sheet flow and open channel flow in the watershed. Because the entire watershed has an installed storm drain network that would be overwhelmed in any overtopping event, it is assumed that the majority of the runoff would travel down the streets. Starting with the sheet flow, it was estimated that from the time the rain began until the runoff reached a street (back to front of a residential lot) is 15 minutes.

A flow path was measured via the centerline of streets from the most hydraulically remote point in the watershed to the mouth of the lake. Assuming normal depth using Manning's equation, an average street flow velocity was found using the average street slope and a conservative roughness factor. These time values were used to determine the Tc for the channel portion and then added to the sheet flow values.

Dam Breach Analysis

A dam breach hydrograph was developed to determine the hazard posed from an overtopping failure of the dam. (It is assumed that the dam will breach if overtopped.) The breach routine built into the HEC-HMS model and breach parameters discussed below were used to develop a breach hydrograph. The depth of the breach was determined by the elevation of the principal spillway invert (permanent pool) and the elevation of the water surface at the time of the breach (0.1 ft. below the top of the dam). It was assumed that the sediment in the bottom of the lake would not impact the breach event (adding volume), staying within the reservoir during a failure. The size, shape, and development time of the breach was developed using the methods described in a paper by Froehlich & Tufail "Evaluation and Use of Embankment Dam Breach Parameters and Their Uncertainties". Since this study was only focusing on a breaching event, the analysis assumed that the dam would fail at the when the water level was at its highest elevation in the lake to ensure that the breach was conservative enough.

Flood Routing

Using the rainfall data, as well the soil cover-complex, a hydrologic model was created in HEC-HMS 3.1 to route the 100-year storm events through the structure as well as downstream to the BNSF rail line on White Rock Creek. The reason the 100-year storm was used was to calibrate the model to ensure that the Curve Number and Time of Concentration were within a reasonable range. The routed storm was within 1 ft. of the spillway crest in the model 759.0 ft. vs. 759.7 ft., respectively, in the 100-year storm and the model was therefore determined to reasonable approximate the analyses performed for the original design. The breach routine was routed using this model as well.

Breach

The breach event required 19.1 inches of rain in a 1-hr period over the watershed to trigger a breach (an elevation 0.1 ft. below the top of the dam). It was also assumed that this rainfall event would only occur over the drainage area. Even though the breach was routed to the BNSF rail line, no additional rainfall was added beyond the dam due to the reduced probability of this event occurring on the larger watershed (White Rock Creek). This event created a total outflow from the structure of 6,520 cfs (breach + auxiliary spillway flow). This breach was routed to the BNSF rail line where the discharge was 6,190 cfs.

TX04860 - WILLOW BEND LAKE NO 2 DAM

Willow Bend Lake No 2 Dam TX04860 is owned and/or operated by Gleneagles Country Club, a subsidiary of GCC Asset Management, Inc. The dam is located approximately 6.9 miles west of downtown Plano in Collin County, Texas. The latitude and longitude of the dam is 33.037935N, -96.807618E respectively.

The dam was completed in 1957 and was originally intended for use as a livestock and recreational reservoir. Talmadge Tinsley Company acquired the dam in 1979 for residential development purposes. The dam embankment was modified and a concrete spillway was added in 1979-1980, according to the Texas Commission on Environmental Quality (TCEQ) Dam Safety Report dated December 10, 2008.

Dam TX04860 is located at the downstream end of Tributary 5B25 and discharges into White Rock Creek, as denoted in the most recent Digital Flood Insurance Rate Map (DFIRM) data. This dam has a primary spillway consisting of a concrete overflow weir approximately 96 feet long. There is a pilot channel, vertical walls and a stilling basin at the bottom. The dam does not have an outlet pipe through the embankment. The dam embankment rises approximately 18 feet and the crest width varies from 14-25 feet. Additionally, Dam TX04860 has an emergency spillway which is simply a grass covered, earthen low area on the far left of the dam (looking downstream).

Inundation

The Inundation Map shows generalized inundation areas for two situations:

- When the dam breaches due to an extreme storm event and
- When the dam fails on a sunny day due to an earthquake, vandalism, structural failure, or other cause not related to a storm event.

According to the hydraulic model that is the basis of the Hydrologic and Hydraulic Report for this dam, the breaching of Dam TX04860 during an extreme storm event would not significantly impact the depth of flooding that would already occur along White Rock Creek. Accordingly, a design storm breach inundation area has not been mapped

Please note that because of the methods, procedures, and assumptions used to determine the flooded areas, the inundation areas are approximate and should only be used as a guideline for establishing evacuation zones. Areas inundated in an actual event will depend on the actual failure conditions and may differ from the areas mapped.[42]

Responsibilities for Notification

The Golf Course Superintendent is responsible for inspecting the dam in a potential emergency such as the threat of high waters or a tornado. The Superintendent will contact the appropriate emergency personnel (the owner's representative and the City of Plano Police Department). The City of Plano Department of Emergency Management will implement the notification flowchart for regional and state emergency management contacts.

If warranted, the Owner's Representative will notify the TCEQ Dam Safety Program. Downstream resident notification will occur as soon as the City of Plano is made aware of necessity by the dam owner.

- Golf Course Superintendent for Gleneagles Country Club (972) 867-6666
- Owner's Representative for GCC Asset Management, Inc. (972) 888-7580.

Possible Emergency Conditions

[42] Maps are file with the dam owners and the City of Plano Department of Emergency Management

Daily surveillance at the site and during an event will be the normal method of detecting potential emergency situations. The Golf Course Superintendent and/or Owner's Representative are responsible for making decisions about the classification of a hazard condition. Should there be any question about how to classify a condition at the dam, the Superintendent or Owner's Representative should contact the TCEQ Dam Safety Office. Each event or situation will be placed in one of the following classifications:

- **Slowly Developing (Watch).** A problem is developing; however, the dam is not in danger of failing, but flooding is expected downstream. Contact the City of Plano Department of Emergency Management. A "Watch" message will be issued by the Department of Emergency Management for the City of Plano to downstream contacts, with information provided by the Superintendent and/or Owner's representative.
- **Possible failure.** A situation is developing that could cause the dam to fail. The Golf Course Superintendent should contact the City of Plano Police Department. A "Possible Failure" message will be issued by the Department of Emergency Management for the City of Plano to downstream contacts. The owner's representative will also contact the TCEQ's Dam Safety Program.
- **Imminent or Actual failure.** A dam failure is occurring that may result in flooding that threatens life and property. When the Golf Course Superintendent and/or Owner's Representative determines that there remains no time to implement measures to prevent failure, the City of Plano Police Department and Department of Emergency Management will be notified for implementation of emergency procedures.