



# **City of Dixon Natural Environment Element Background Report**

Final Draft  
September 2022

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# NATURAL ENVIRONMENT ELEMENT

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## 1 INTRODUCTION

### 1.1 PURPOSE AND CONTENT

The Safety Element, which is a section of the Dixon Natural Environment Element, is a state-mandated General Plan element that must identify potential natural and human-created hazards that could affect the City of Dixon's (City's) residents, businesses, and services. The purpose of a Safety Element is to establish a framework that anticipates these hazards and prepares the community to minimize exposure to these risks.

The Safety Element section of the Natural Environment Element conveys the City's goals, policies, and actions to minimize the risks to safety in and around Dixon. It identifies the natural and human-caused hazards that affect existing and future development, describes present and expected future conditions, and sets policies and standards for improved public safety. This includes efforts to minimize physical harm to the buildings and infrastructure in and around Dixon to reduce damage to local economic systems, community services, and ecosystems. Some degree of risk is inevitable because the potential for many disasters cannot be eliminated completely, and the ability to predict such disasters is limited.

The Safety Element section of the Natural Environment Element serves the following functions:

- Develops a framework by which safety considerations are introduced into the land use planning process.
- Facilitates the identification and mitigation of hazards for new development, and thus strengthens existing codes, project review, and permitting processes.
- Presents policies directed at identifying and reducing hazards in existing development.
- Strengthens earthquake, flood, dam inundation, and wildland fire preparedness planning, and post-disaster reconstruction policies.
- Identifies how natural and climate change hazards are likely to increase in frequency and intensity in the future and provides policies to increase community resilience through preparedness and adaptation.

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The Safety Element section addresses the topic of public health and safety following state requirements, as presented in Section 65302(g) of the California Government Code. State law requires that a Safety Element contain background information and policies to address multiple natural hazards, analyze the vulnerabilities from climate change and contain policies to improve climate change resilience, and assess residential areas with evacuation constraints. The public safety issues in Dixon include emergency preparedness and response, flood and inundation hazards, seismic and geologic hazards, fire hazards, hazardous waste and materials, as well as other climate change hazards, such as drought, extreme heat, and severe weather.

## **1.2 REGULATORY FRAMEWORK**

In 2015, the state adopted Senate Bill (SB) 379, amending Section 65302(g) of the California Government Code to require the Safety Element of the General Plan to include more information about wildfire hazards, flooding risks, and short-term and long-term threats posed by climate change. SB 379 requires local governments to conduct vulnerability assessments as part of their long-range planning efforts and to prepare resilience and adaptation policies that will protect against harm caused by climate change. A vulnerability assessment evaluates the impacts that climate change hazards will have on people and community assets, as well as the current resources and programs available to help people and community assets prepare and respond to those impacts. This analysis creates a prioritized list of vulnerable populations and assets that will be used to develop policies and actions in the Natural Environment Element to increase resilience citywide.

Other important updates to the California Government Code related to Safety Elements, climate change, and resiliency include SB 1241, SB 1035, SB 99, Assembly Bill (AB) 2140, and AB 747/1409.

- **SB 1241** added Section 65302(g)(3) to the California Government Code, requiring jurisdictions in a state responsibility area or very high fire hazard severity zone to provide background; historical context; and goals, policies, and implementation measures to address wildfire risks in a community. The City of Dixon does not have lands within the state responsibility area or very high fire hazard severity zones; therefore, this requirement does not apply. However, historical context and other wildfire content will be included in the Natural Environment Element update.

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- **SB 1035**, which established Section 65302(g)(6) of the California Government Code, builds on previous legislation and requires local governments to review and update their Safety Element during an update to their Housing Element or Local Hazard Mitigation Plan (LHMP), or no less than every eight years. Any revisions should include updated information related to flood hazards, fire hazards, and climate adaptation and resilience.
- **SB 99** established Section 65302(g)(5) of the California Government Code and requires jurisdictions to review and update their Safety Elements to include information identifying residential developments in hazard areas that do not have at least two emergency evacuation routes.
- **AB 2140** added Sections 8685.9 and 65302.6 of the California Government Code, enabling cities and counties to adopt an LHMP into the Safety Element.
- **AB 747, amended by AB 1409**, added Section 65302.15 to the California Government Code, requiring local governments to identify the capacity, safety, and viability of evacuation routes and locations in the Safety Element or LHMP. This requirement is triggered by future updates to the LHMP.

## 1.3 **COMMUNITY PROFILE**

Dixon is a community of approximately 20,197 residents with a rich agricultural heritage and a distinct small-town feel. The city is home to the Dixon May Fair, the oldest district fair in California, and the central portion of Dixon boasts numerous historic structures dating back to the origin of the town as a nineteenth-century railroad town. Dixon consists of a roughly triangular-shaped piece of flat land covering 7.2 square miles, as well as the land associated with the City’s wastewater treatment facility to the southeast. The city is surrounded by agricultural land and open space, including over 1,000 acres protected in the Vacaville-Dixon Greenbelt. Dixon is 20 miles southwest of Sacramento and 65 miles northeast of San Francisco, within Solano County. Dixon experiences a Mediterranean climate, with hot, dry summers and short, cold, wet winters. Historically, Dixon has received 18.5 inches of rain per year. The annual average high is 74.9 degrees Fahrenheit (°F), and the annual average low is 47.3°F.<sup>1</sup> Key environmental and ecosystem features include annual grassland, wetland and riparian habitats, and groundwater.

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Regional access is provided by Interstate 80 (I-80), which runs along the western perimeter of the city, as well as State Route 113 (SR-113), a north-south state highway that runs through the center of Dixon and serves as the “Main Street” of the community. The Union Pacific Railroad mainline bisects the city in a southwest-northeast directions, carrying freight and passengers, although trains do not currently stop in Dixon. The city is flown over by large military jet aircraft from Travis Air Force Base on a regular basis.

All land within the city limits is south of I-80, except for a small area known as the Milk Farm. Agricultural uses make up nearly 30 percent of the city. Residential uses compose nearly one-fifth of the city, and the predominant housing type is single-family homes. Many of the residential neighborhoods are found west of SR-113, although some neighborhoods are east of the highway on the southern side of the Union Pacific Railroad tracks. The community has experienced a high rate of residential growth since 2000, and today it features an existing core of established neighborhoods, surrounded by newer residential subdivisions and clusters of highway-oriented commercial businesses at the freeway interchanges. Commercial activity is generally clustered in the northwestern part of the city. The city’s commercial and mixed uses are along the SR-113 corridor and near freeway off-ramp along the I-80 corridor. Most of the city’s industrial uses are clustered north of the Union Pacific Railroad tracks, between SR-113 and Pedrick Road.

Approximately 20,197 people live in Dixon, an increase of approximately 12 percent since 2010 and 20 percent since 2000. The racial makeup of Dixon is primarily Non-Hispanic White (45 percent). Approximately 42 percent of the population identifies as Hispanic or Latino, 5 percent as Asian, and 2 percent as Black or African American. Mixed-race persons make up approximately 5 percent of the population. Native Americans constitute less than 1 percent of the population.

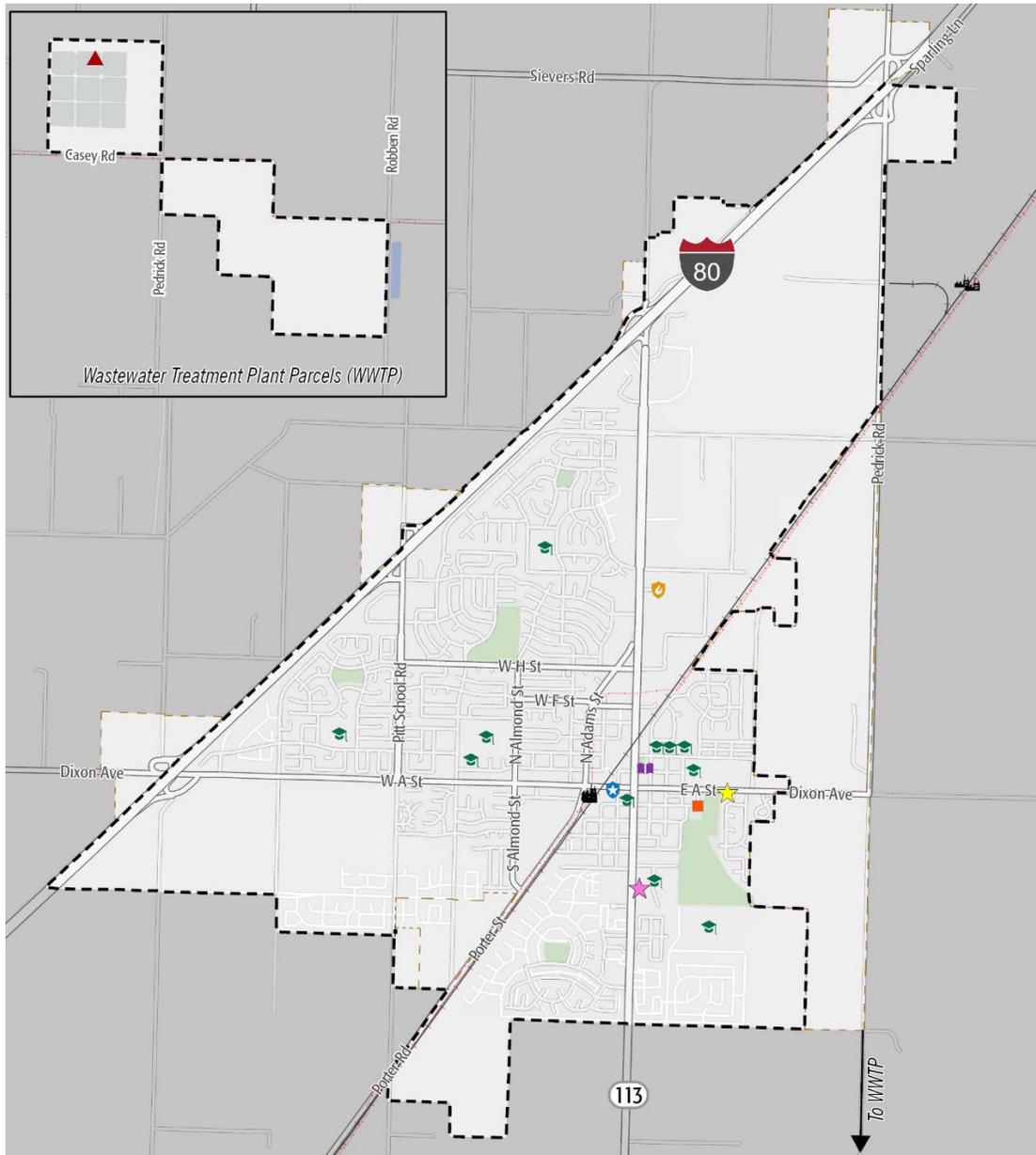
As of the 2020 American Community Survey, approximately 10,663 Dixon residents are active in the labor force and the citywide median income is \$79,465. The largest industries are education and healthcare (18 percent of labor force), manufacturing (13 percent), retail trade (11 percent), and construction (10 percent). Approximately 1 percent of the labor force is employed in sectors related to agriculture and forestry. Approximately 4 percent of the labor force is unemployed. Major economic drivers include agriculture, livestock, and food processing; construction services and industrial manufacturing; education; and retail. Major employers include Dixon Unified School District, Wal-Mart, Dixon Canning, Altec Industries, Basalite, Superior Packing, Cardinal Health, and City of Dixon.

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**Figure 1** shows key community features, including medical facilities, schools, police and sheriff stations, fire stations, electrical transmission infrastructure, community centers, libraries, railways, airports, and water and wastewater facilities in Dixon.

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**Figure 1: Community Facilities**



Source: CalOES 2021, Solano County 2021, PlaceWorks 2022, ESRI

- |                      |                  |                                     |
|----------------------|------------------|-------------------------------------|
| City Boundary        | City Hall        | Police Station                      |
| Sphere of Influence  | Community Center | Water/Wastewater Treatment Facility |
| Railroad             | Library          | Electrical Substation               |
| Transmission Lines   | School           | Dixon May Fair Grounds              |
| Parks and Open Space | Fire Station     |                                     |



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## **1.4 RELATIONSHIP TO OTHER PLANS**

California Government Code Section 65302(g) requires all local jurisdictions to update their Safety Element upon each revision of the Housing Element or LHMP, or at least once every eight years. The State of California specifies types of information that must be updated, notably, climate change resiliency and adaptation mitigation. Other topics relating to natural hazards, which are already addressed in the Safety Element section of the Natural Environment Element but may be updated as necessary to reflect new information, include fire risk, seismic risk, flood risk, site contamination, and the City's ability to respond to natural and human-made disasters.

The Natural Environment Element is one of several elements of the Dixon General Plan. Other social, economic, political, and aesthetic factors must be considered and balanced with safety needs. Rather than compete with the policies of related elements, the Natural Environment Element provides policy direction that complement the intent and policies of other General Plan elements. Crucial relationships exist between the Natural Environment Element and the other General Plan elements. How land uses are determined in areas prone to natural hazards, what regulations limit development in these areas, and how hazards are mitigated for existing development, are all issues that all elements must address. For instance, the Land Use and Community Character Element policies must consider the potential for various hazards identified in the Natural Environment Element and must be consistent with the policies to address those hazards. Natural Environment Element policies, especially those concerning evacuation routes and critical facilities, must also be consistent with those of the Mobility Element. Policies and information in the updated Natural Environment Element should not conflict with those in other elements.

The 2022 update to the Safety Element section of the Natural Environment Element will draw from information in the Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) for Solano County. The MJHMP for Solano County was developed in accordance with the Disaster Mitigation Act of 2000 and followed the Federal Emergency Management Agency's (FEMA's) LHMP guidance. Solano County's MJHMP is a plan to identify and profile hazard conditions, analyze risks to people and facilities, and develop mitigation actions to reduce or eliminate hazard risks in the incorporated and unincorporated areas of Solano County. Volume 2 of Solano County's MJHMP contains an annex discussing hazards specific to Dixon. FEMA approved the MJHMP in December 2021 and the City adopted it in 2022.

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The MJHMP and the Natural Environment Element address similar issues, but the Natural Environment Element provides a higher-level framework and set of policies, and the MJHMP focuses on more specific mitigation actions. The implementation of these mitigation actions, which include both short- and long-term strategies, involve planning, policy changes, programs, projects, and other activities.

## 1.5 CLIMATE CHANGE VULNERABILITY

Changes to the global climate system are expected to affect future occurrences of natural hazards in and around Dixon. Many hazards are projected to become more frequent and intense in coming years and decades, and in some cases, these trends have already begun. Key climate change considerations that affect Dixon include increasing temperatures and changes in precipitation patterns. Overall, precipitation levels are expected to increase slightly, with more years of extreme precipitation events and droughts that last longer and are more intense.

### 1.5.1 VULNERABILITY ASSESSMENT METHODS

The Vulnerability Assessment primarily follows the recommended process in the *California Adaptation Planning Guide* (APG), published in 2020 by the California Governor’s Office of Emergency Services. This includes a four-step process: (1) characterizing the city’s exposure to current and projected climate hazards; (2) identifying potential sensitivities and potential impacts to city populations and assets; (3) evaluating the current ability of the populations and assets to cope with climate impacts, also referred to as its adaptive capacity; and (4) identifying vulnerabilities based on systematic scoring. **Figure 2** presents these steps.

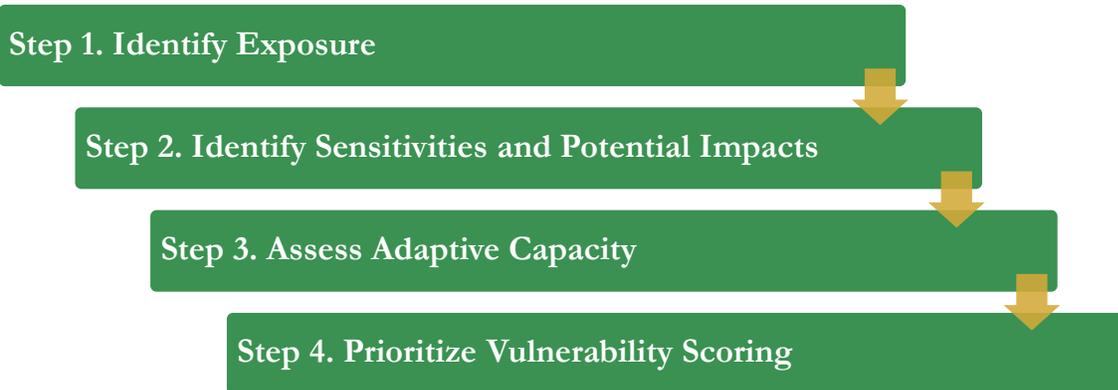
#### What is vulnerability?

Vulnerability is the degree to which natural, built, and human systems are susceptible to harm from exposure to stresses associated with environmental and social change and from the absence of a capacity to adapt.

Source: California Governor’s Office of Emergency Services. 2020. California Adaptation Planning Guide. <https://www.caloes.ca.gov/climate>.

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**Figure 2: California Adaptation Planning Guide Recommended Model**



**Step 1. Identify Exposure.** The goal of this step is to characterize the community’s exposure to current and projected climate change hazards. The climate change hazards included in the Vulnerability Assessment are **agricultural and ecosystem pests, drought, extreme heat and warm nights, human health hazards, flooding, landslides, severe weather, and wildfire and wildfire smoke.**

Projections of climate change hazards rely on multiple scenarios that reflect different levels of greenhouse gas (GHG) emissions and concentrations over time. The Cal-Adapt database, which provides California-specific climate change hazard projections, uses Representative Concentration Pathway (RCP) 4.5 for a low-emissions scenario and RCP 8.5 for a high-emissions scenario. RCPs are scenarios that include time series of emissions and concentrations of the full suite of GHGs, aerosols, chemically active gases, and land use/land cover. RCP 4.5 is considered an intermediate stabilizing pathway; RCP 8.5 is considered a high-emissions pathway. The Governor’s Office of Planning and Research *Planning and Investing for a Resilient California* document and the *California Adaptation Planning Guide* recommend using RCP 8.5 for analyses considering impacts through 2050 and 2100, as there are minimal differences between emission scenarios for the first half of the century and for late-century projections, this is a more conservative and risk-averse approach. The RCP 8.5 scenario was used as input for global climate models on the Cal-Adapt database, and other resources.

**Step 2. Identify Sensitivities and Potential Impacts.** This step involved evaluating potential future climate change impacts to community populations<sup>2</sup> and assets. City staff first identified a comprehensive list of populations and assets to understand how susceptible the people, places, ecosystem services, and services within the community are to climate change hazards, as shown in Table 1.

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**Table 1: Populations and Assets**

<b>Populations</b>			
Children under 10	Cost-burdened households	Households in poverty	Immigrant communities
Linguistically isolated persons	Low-income households	Low-resourced people of color	Outdoor workers
Overcrowded households	Persons experiencing homelessness	Persons living in mobile homes	Persons living on single-access roads
Persons with chronic illnesses and/or disabilities	Persons without a high school degree	Persons without access to lifelines	Pollution-burdened populations
Renters	Seniors (65+)	Seniors living alone	Unemployed persons
<b>Infrastructure</b>			
Bicycling and pedestrian trails	Bridges	Communication facilities	Electrical transmission/distribution lines and infrastructure
Electric vehicle charging stations	Hazardous materials sites	Major roads and highways	Natural gas pipelines
Parks and recreation facilities	Railway	Solid waste facilities	Transit facilities
Water and wastewater infrastructure	Stormwater and flood-control infrastructure		
<b>Buildings</b>			
Community centers and libraries	Commercial businesses	Dixon May Fairground	Government buildings
Historic buildings and museums	Homes and residential structures	Medical and care facilities	Public safety buildings
Schools			
<b>Economic Drivers</b>			
Agriculture	Construction services and industrial facilities	Education services	Food and wholesale services
Livestock	Major employers	Retail centers	
<b>Ecosystems and Natural Resources</b>			
Annual grassland	Fresh emergent wetland	Riparian and riverine habitats	Groundwater

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Key Services			
Communication services	Emergency medical response	Energy delivery	Government administration and community services
Public safety response	Public transit access	Solid waste removal	Water delivery
Stormwater management and flood control			

After confirming this list, City staff looked at which hazards are likely to affect which populations and assets. For example, human health hazards are likely to impact most populations, but would not physically affect buildings. City staff then evaluated potential impacts to the applicable populations and community assets. Based on the results of the impact assessment, each population and asset was identified as experiencing low, medium, or high impacts for each relevant hazard. Impact is considered a negative quality, and therefore, a higher impact score means that there is a higher potential for harm to a population or asset. A lower impact score means that there is a lower potential for harm to a population or asset.

**Step 3. Assess Adaptive Capacity.** Adaptive capacity is the ability of populations and community assets to prepare for, respond to, and recover from the impacts of climate change using existing resources and programs. Dixon, Solano County, and community-based organizations already provide some of these tools and resources to both populations and community asset owners or managers.

## Non-Climate Stressors

Non-climate stressors are trends unrelated to climate hazards that can exacerbate impacts or impede adaptive capacity, making populations or assets more vulnerable. They are also known as pre-existing conditions that make populations or assets more susceptible to harm from hazards because the stressors may impair their ability to prepare for, respond to, or recover from hazards.

Addressing non-climate stressors can improve the adaptive capacity of populations and community assets.

*Source: United State Global Change Research Program. 2016. "U.S. Climate Resilience Toolkit." <https://toolkit.climate.gov/>.*

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Based on the results of the adaptive capacity assessment, the City ranked the adaptive capacity of each population or asset as low, medium, or high for each relevant hazard. Adaptive capacity is considered a positive attribute, so a higher adaptive capacity score means that a population or asset may be more adaptable to the hazard. A lower adaptive capacity score means that a population or asset may have a harder time adjusting to the changing conditions given available resources.

Dixon, Solano County, and community-based organizations already provide some of these tools and resources to both populations and community asset owners or managers. The following list describes the plans, projects, programs, and initiatives that increase adaptive capacity throughout the city.

- **Plans**

- Emergency Operations Plan methods for responding to hazardous events
- 2021 Solano County Multi-Jurisdictional Hazard Mitigation Plan, Dixon Annex Mitigation Action Plan
- 2020 Solano County Active Transportation Plan
- Update to Sewer & Storm Drain Master Plan
- 2020 Urban Water Management Plan and Water Shortage Contingency Plan, including water shortage contingency planning and demand management measures

- **Municipal Code Requirements**

- Flood Damage Prevention (Municipal Code Chapter 9.04)
- Stormwater Control (Municipal Code Chapter 16.06)
- Water-Efficient Landscaping (Municipal Code Chapter 14.02.275)
- Water Conservation (Municipal Code Chapter 14.02.900)
- Conservation Regulations (Municipal Code Chapter 18.36)
- Street Trees (Municipal Code Chapter 13.05)
- Conservation Regulations (Municipal Code Chapter 18.36) contains provisions to encourage the conservation of energy and water resources and reduce the urban heat island effect
- Fire Code (Municipal Code Chapter 16.02)
- Weed Abatement (Municipal Code Chapter 9.01.500)

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- **Capital Improvement Projects**

- Wastewater Rehab Projects (including sewer trunk line rehabilitation and lift station improvements)
- Storm Drainage Projects (including outfall improvements, detention pond construction and maintenance, storm drain system repair and replacement, South Almond Area Drainage improvements, and Eastside Drainage Project)
- Core Area Drainage Rehabilitation Project
- Fire Department Capital Improvement Projects

- **Programs and Initiatives**

- Sandbags available from Dixon Fire Department
- Dixon Regional Watershed Joint Powers Authority, made up of the Dixon Resource Conservation District, Reclamation District 2068, Maine Prairie Water District, and the City of Dixon, the Dixon Regional Watershed Joint Powers Authority works to implement the projects outlined in the Dixon Regional Watershed Management Plan, including the construction of detention ponds
- Dixon Resource Conservation District, in collaboration with Reclamation District 2068, Maine Prairie Water District, and the City of District, operates and maintains drainage facilities in Dixon
- Solano Resource Conservation District operates urban greening, flood protection and prevention, and conservation planning programs
- Update to Wastewater Treatment Facility design for additional capacity
- Solano Resource Conservation District operates water conservation and watershed and conservation planning programs
- California Home Energy Renovation Opportunity (HERO) provides financing for water-efficient products and irrigation improvements
- Solano County Water Agency programs: rebates for water conserving products, Solano High-Efficiency Washer Rebate, Smart Irrigation Controller Rebates, Water-Efficient Landscape Rebate for both residential and commercial properties, Commercial Water Savings Incentive Program
- Solano County Green Business program initiatives
- BayREN energy-efficiency rebate programs for homes and businesses
- Dixon Street Repair Program

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- Dixon Community Connect allows residents to share information about their household that will aid first responders and emergency response personnel
- Solano County Mosquito Abatement District
- DART Paratransit, Read-Ride, SolTrans, Solano County Mobility Program, Pace Solano, and Solano County In-Home Support Services to help individuals travel to cooling centers and medical facilities, as well as evacuate during emergencies
- Alert Solano through Solano County to inform residents of hazardous events or evacuation notices
- Independent Living Resources of Solano County provides those with access and functional needs support with emergency preparedness, response, and recovery
- Solano Community College and Solano Workforce Development Board assist with career development services
- Solano Napa Small Business Development Center (SBDC) and Downtown Dixon Business Association support the stability of Dixon's small and local businesses.

**Step 4. Conduct Vulnerability Scoring.** The City used the impact and adaptive capacity scores for each population and asset for each relevant hazard to determine the vulnerability score. The vulnerability score reflects how susceptible a population or asset is to harm from a particular hazard. Vulnerability is assessed on a scale from V1 to V5, with V1 meaning minimal vulnerability and V5 meaning severe vulnerability. The following list describes the level of vulnerability:

- V1: Minimal vulnerability
- V2: Low vulnerability
- V3: Moderate vulnerability
- V4: High vulnerability
- V5: Severe vulnerability

Having a low vulnerability score does not mean that the population or asset will be unaffected by climate change, but that the effects are likely to be less substantial. The matrix in **Figure 3** shows how impact and adaptive capacity scores combine and translate into a vulnerability score. For example, extreme heat would create a high impact on energy delivery services as mechanical failures, heat damage, and high demand for electricity from cooling equipment can disrupt this service. Adaptive capacity is low because many community members need to use more electricity on extreme heat days

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to keep cool and retrofitting electrical equipment can be expensive. Therefore, energy delivery services have a high vulnerability to extreme heat.

**Figure 3: Vulnerability Scoring Matrix**

	Low Impact	Medium Impact	High Impact
Low Adaptive Capacity	V3	V4	V5
Medium Adaptive Capacity	V2	V3	V4
High Adaptive Capacity	V1	V2	V3

## 1.5.2 CLIMATE CHANGE HAZARDS

Changes to the global climate system are expected to affect future occurrences of natural hazards in and around Dixon. Many hazards are projected to become more frequent and intense in coming years and decades, and in some cases, these trends have already begun. Key climate change considerations that affect Dixon include increasing temperatures and changes in precipitation patterns. Overall, precipitation levels are expected to increase slightly, with more years of extreme precipitation events and droughts that last longer and are more intense. According to California’s *Fourth Climate Change Assessment*,<sup>3</sup> Dixon can expect to experience various changes to climate change hazard events.

- According to the Solano County Crop and Livestock Report, agriculture and livestock production had a value of \$357 million in 2020.<sup>4</sup> In 2020, top agricultural commodities were almonds, tomatoes, nursery products, cattle and calves, and walnuts. Agricultural pests and diseases can affect crop plants, orchards, and nurseries throughout and surrounding the City of Dixon. The severity of this hazard is measured in terms of pests and disease incidents, which are likely to increase as higher temperatures allow insects to reproduce more rapidly and increase the activity window for pests and diseases. Pests and diseases can slow the growth of plants, inflict damage, or lead to fatalities.
- Warmer temperatures are projected to cause an increase in extreme heat events. The number of extreme heat days, defined in Dixon as a day when the high temperature is at least 103.7°F, is expected to rise from a historical annual average of 5 days per year to an annual average of 29 days per year by the middle of the century (2035 to 2064), and to an annual average of 53 days per year by the end of the century (2070 to 2099). In addition to the increases in extreme

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heat events, Dixon is expected to see an increase in the average daily high temperatures. The number of warm nights, defined in Dixon as a day in April through October when the minimum temperature is above 65.2°F, is expected to rise from a historical annual average of 5 nights per year to an annual average of 30 nights per year by the middle of the century (2035 to 2064), and to an annual average of 75 nights per year by the end of the century (2070 to 2099).<sup>5</sup>

- Climate change can increase the rates of infection for various diseases because many of the animals that carry diseases are more active during warmer weather. There are several diseases that are linked to climate change and can be harmful to the health of Dixon community members, such as hantavirus pulmonary syndrome, Lyme disease, and West Nile fever. Many of these diseases are carried by animals, such as mice and rats, ticks, and mosquitoes, which are usually seen as pests even if they do not cause infections. Warmer temperatures earlier in the spring and later in the winter can cause these animals to be active for longer periods, increasing the time that these diseases can be transmitted.
- Both droughts and floods are expected to become more frequent as rainfall is expected to occur in fewer, more intense storms due to climate change. Although Dixon is likely to experience a slight increase in average annual precipitation, the region is also expected to see an increase in the number of extreme precipitation events. As a result, floods are expected to become more frequent, and climate change may expand the parts of the city that are considered prone to flood. Climate change is expected to also increase the frequency and severity of droughts that cause soil to dry out and condense. When precipitation does return, dry ground means that more water runs off the surface rather than being absorbed into the ground, which can lead to floods.
- Landslides occur when a hillside becomes unstable, causing soil and rocks to slide downslope. Landslides are most common on steep slopes made up of loose soil or other material where excavation and grading drainage alterations, or changes in vegetation have occurred. Small portions of central Dixon are vulnerable to landslide.
- Severe weather events, such as strong storms and high winds, may become more frequent and intense due to climate change. Climate change is expected to cause an increase in intense rainfall, which is usually associated with strong storm systems. In Dixon, most severe weather consists of high winds and heavy rains. The types of dangers posed by severe weather vary widely and include injuries or deaths, damage to buildings and structures, fallen trees, roads blocked by debris, and landslides.

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- While wildfire risk in Dixon is generally low, climate change-induced hotter and drier weather is expected to lead to an increase in wildfires in surrounding Solano County and an extended wildfire season. Dry conditions are anticipated earlier in the year, leaving most of the region in moderate to extreme dry conditions prior to summer. These continued dry conditions with above-normal temperatures through spring will leave fuel moisture levels lower than normal, increasing the potential for wildfire activity. Increased winds may result in more erratic fire behavior, making fires harder to control. This increase in wildfire activity across the region will increase Dixon’s exposure to wildfire smoke and associated poor air quality and respiratory health impacts. Increased air emissions from urban growth and development may also add to these air quality problems.

## 1.5.3 VULNERABILITY ASSESSMENT RESULTS

Under California law, the Safety Element is required to include a vulnerability assessment that looks at how people, buildings, infrastructure, and other key community assets may be affected by climate change. The City conducted a Climate Change Vulnerability Assessment in the winter of 2022 to analyze Dixon’s susceptibility to climate change hazards. Dixon’s vulnerability assessment, prepared in accordance with the most recent available guidance in the *California Adaptation Planning Guide*, assesses how eight different climate change hazards (agricultural and ecosystem pests, drought, extreme heat, flooding, human health hazards, landslides, severe storms, and wildfire and smoke) may affect 63 different population groups and community assets. Each population or asset received a score of V1 (minimal vulnerability) to V5 (severe vulnerability) for each climate change hazard. The Climate Change Vulnerability Assessment indicates that Dixon’s populations and assets are most vulnerable to severe weather, extreme heat, flooding, and wildfire and smoke. The most vulnerable communities include households in poverty, seniors living alone, persons experiencing homelessness, outdoor workers, immigrant communities, pollution-burdened populations, persons with chronic illness and/or disabilities, and low-resourced people of color.

Citywide, energy delivery is vulnerable to multiple hazards, including severe storms, such as high winds that can damage electrical infrastructure and trigger power outages, extreme heat that reduces the capacity and strains the system, and wildfires that damage the system, ultimately disrupting energy service. Furthermore, energy delivery services, specifically electricity delivery, is subject to harm during extreme heat events. Extreme heat can lead to power outages by causing mechanical failure of grid equipment, heat damage to power lines, and by creating a high demand for electricity to power air conditioners, all of which place stress on the network. This is likely to lead to greater service

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disruptions. These conditions can damage communication infrastructure, decreasing network capacity. There may be a higher demand for communication services during severe storms, potentially putting stress on the network and increasing the risk of service interruptions.

Interruptions in energy service can create vulnerabilities for Dixon community members. A loss of electricity can cause a loss of refrigeration for food and medical supplies, limit cooking, cause loss of cooling (particularly dangerous during extreme heat events), lighting, and limited or no access to the Internet or other information systems. Many businesses are forced to close during a power outage, causing economic hardships and depriving community members of important services, such as grocery stores, gas stations, and banks/ATMs. Power outages may also be harmful to people who depend on electrically powered medical devices.

Climate change is also expected to exacerbate flood risk. As a result, structures within and adjacent to the 100-year floodplain (including homes in southeastern Dixon) will likely experience an increase in the frequency and magnitude of flood events in future years. Increases in damaging flood events in the city are expected to cause greater property damage, public health and safety concerns, displacement, and loss of life. The City's wastewater treatment services may be impacted by flood events, which may damage water infrastructure and interrupt service.

Climate change could affect the transportation network and associated economic activity within Dixon by creating strain on transportation infrastructure, resulting in impacts to travel behavior, goods movement, and supply chain business continuity. Major routes, including I-80 and 1st Street (SR-113) are in the 100- or 500-year floodplain. Flooding can damage major roads and highways, causing them to become impassable. The city could become isolated and may not be able to get vital goods and services if I-80 is closed. Major bridges along I-80 and other major roadways may be damaged or close due to severe weather such as severe wind. Smaller bridges and overpasses could be washed out or damaged by high rainfall or debris from severe wind, reducing their capacity or closing them until repairs can be completed. This could isolate communities that rely on these bridges and disrupt regional commuting patterns.

The Union Pacific railway may be damaged or become unusable during heavy rainfall or severe winds. Extreme heat can lead to thermal expansion of railroad tracks and cause warping or buckling of the tracks. This can subsequently cause train accidents, slowing of rail and freight services, or suspension of all rail traffic. If a train accident were to occur in Dixon, the eastern portion of the city would be cut off from the other areas of the city, making evacuation more difficult during emergencies. Damage to rail lines could mean disruptions to the multi-state and intra-state Amtrak lines and freight lines.

# NATURAL ENVIRONMENT ELEMENT

Dixon's agriculture and livestock industries could be significantly impacted by the effects of climate change. Agricultural and ecosystem pests, drought, high heat, flooding, and severe weather could significantly interrupt agricultural activities, requiring expensive preparation and recovery efforts and lowering the value of agricultural products. Food and wholesale services predominantly rely on successful agricultural production and could therefore also be impacted. Major interruptions to the agricultural and livestock industries would have detrimental effects on individuals employed in these industries, many of whom may already be subject to elevated levels of social vulnerability.

The Natural Environment Element includes goals, policies, and implementation actions to increase community resilience and help lower vulnerability scores, particularly for the populations and assets that received a score of V4 or V5 in the Vulnerability Assessment. A full list of the Vulnerability Assessment results can be found in **Appendix A**.

# NATURAL ENVIRONMENT ELEMENT

## 2 PUBLIC SAFETY ISSUES

This section outlines the existing and likely future hazardous conditions and other public safety issues in Dixon and policy responses to these issues. The public safety issues in Dixon include:

- Hazards (including geologic and seismic, flooding, and fire hazards)
- Emergency preparedness and response
- Hazardous waste and materials
- Additional climate change hazards (agricultural and ecosystem pests, drought, extreme heat, severe weather, and human health hazards)

This section provides details pertaining to probable locations each hazard or issue is likely to occur (per availability of data), past notable events in and around Dixon, agencies responsible for providing protection from these public safety issues, and other background information required by the State of California Government Code Section 65302(g)(4). The results and implications of the Vulnerability Assessment are integrated into each of the hazard and public safety topics.

### 2.1 HAZARDS

#### 2.1.1 SEISMIC AND GEOLOGIC HAZARDS

Seismic and geologic hazards are risks caused by the movement of different parts of the Earth's crust, or surface. Seismic hazards include earthquakes and hazardous events caused by them. Geologic hazards are other hazards involving land movements that are not linked to seismic activity and are capable of inflicting harm to people or property.

##### 2.1.1.1 Seismic Hazards

Seismic activity occurs along boundaries in the Earth's crust, called faults. Pressure along the faults builds over time and is ultimately released, resulting in ground shaking that we refer to as an earthquake. Earthquakes can also trigger other hazards, including surface rupture (cracks in the ground surface), liquefaction (causing loose soil to lose its strength), landslides, and subsidence (sinking of the ground surface). Earthquakes and other seismic hazards often damage or destroy property and public infrastructure, including utility lines, and falling objects or structures pose a risk of injury or death.

# NATURAL ENVIRONMENT ELEMENT

## Earthquakes

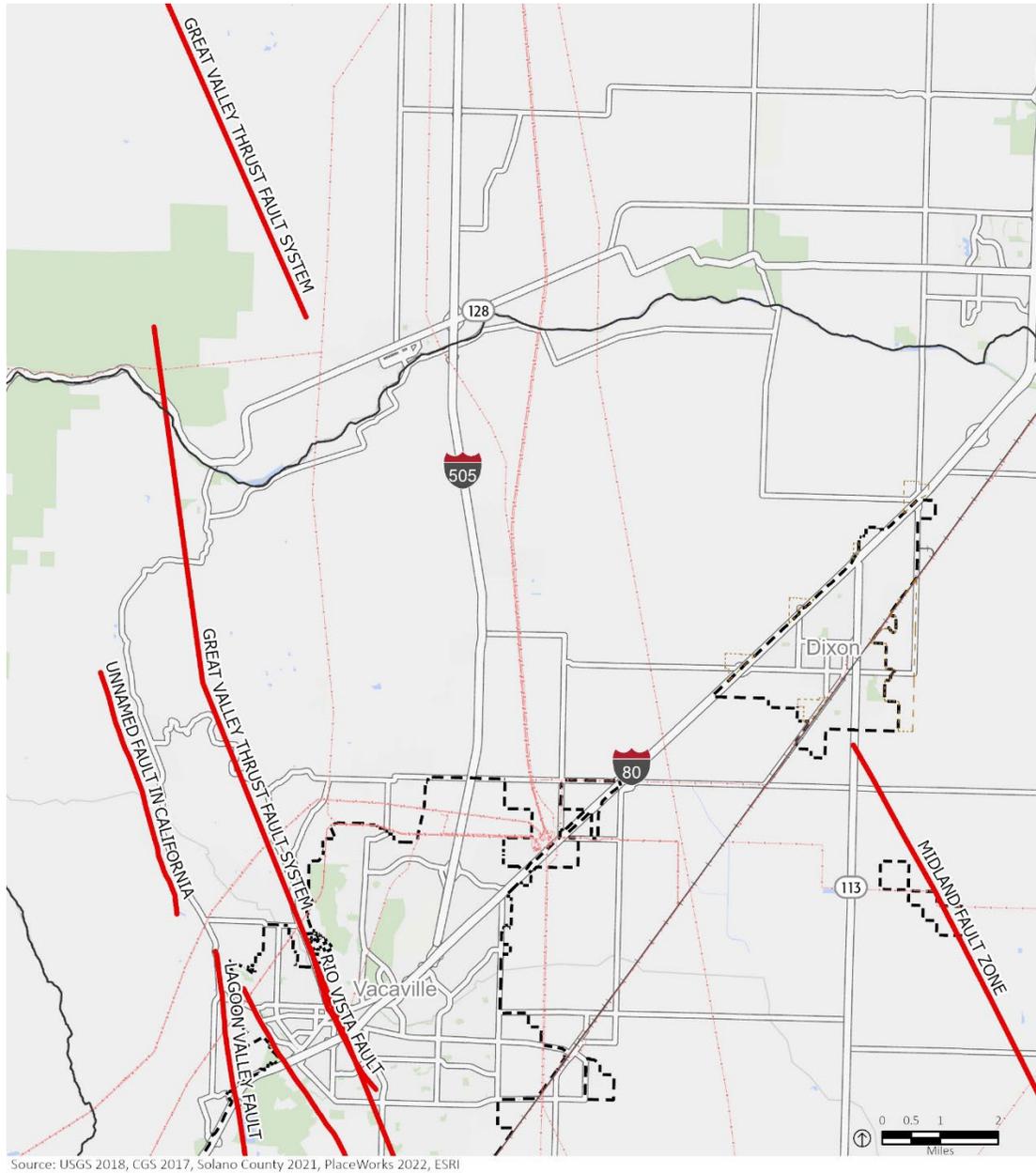
Like much of California, Dixon is in a seismically active region. While there are no known active faults within Dixon, there are faults nearby that could subject the community to ground shaking and seismic hazards, which has periodically occurred in the past. The nearest fault lines active in the last 200 years are the Cordelia Fault and the Green Valley Fault, both part of the greater Concord/Green Valley Fault system, about 20 miles southwest of Dixon. **Figure 4** shows the regional fault lines surrounding the city.

The Concord/Green Valley Fault system, including the Concord and Green Valley Faults and some active secondary traces, such as the Cordelia Fault, consists of a highly complex zone with potential for either major or smaller events to the northwest and southeast of Suisun Bay. The Green Valley Fault trends northwest along the eastern front of the Benicia Hills and appears to have right lateral offset, which means that the western side has moved northward relative to the eastern side, or vice versa. The fault shows many features associated with recent activity, including offset fences and power lines, location of micro-earthquake epicenters along the fault trace, and disrupted drainage patterns. In 2002, the U.S. Geological Survey Working Group on California Earthquake Probabilities (WGCEP) determined that the Concord/Green Valley Fault has a 4 percent chance of experiencing an earthquake of magnitude 6.7 or greater.<sup>6</sup> In the event of a moderate to severe earthquake, Dixon could be subject to extensive property damage, particularly to pre-1930s non-reinforced masonry structures. Earthquakes can also cause significant numbers of fatalities and injuries, damage to water and sewer systems, disruption of communication systems, broken gas mains and petroleum pipelines, disruption of transportation arteries, and competing requests for scarce mutual-aid response resources.

Earthquakes could also increase the risk of dam failure at nearby Monticello Dam, which could result in the entire Dixon area, as well as the surrounding communities, being inundated with water.

# NATURAL ENVIRONMENT ELEMENT

**Figure 4: Regional Fault Lines**



- |                     |                        |
|---------------------|------------------------|
| County Boundary     | Transmission Lines     |
| City Boundary       | Parks and Open Space   |
| Sphere of Influence | USGS Quaternary Faults |
| Railroad            |                        |

# NATURAL ENVIRONMENT ELEMENT

## Liquefaction

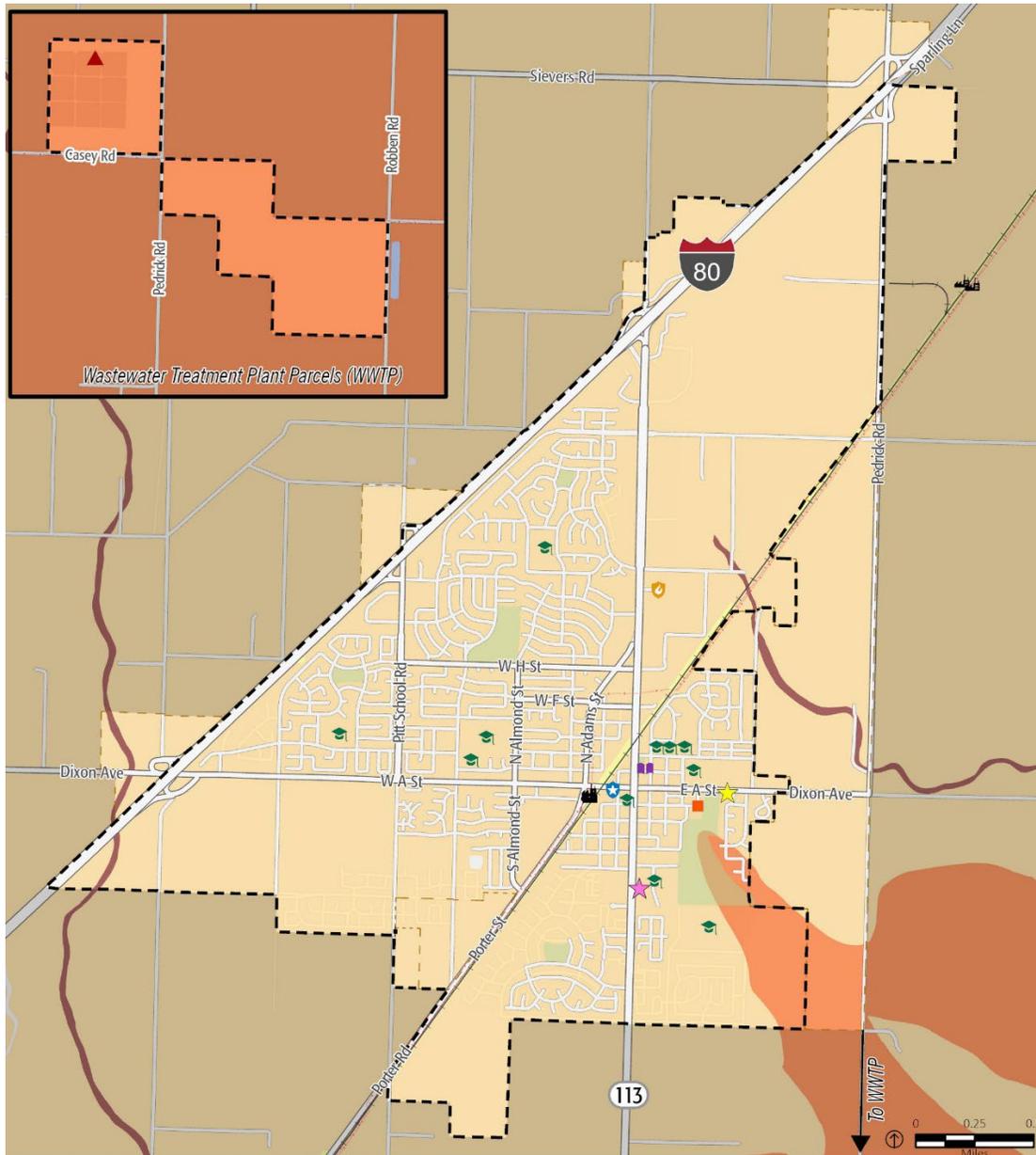
In addition to the direct physical damage that can result from the motion of the earthquake, damage can result from liquefaction. Liquefaction occurs where water-logged soils near the ground surface lose compaction during strong ground motion. This can cause building foundations to shift and can result in significant structural damage.

Liquefaction occurs primarily in saturated, loose, fine- to medium-grained soils in areas where the groundwater table is within approximately 50 feet of the surface. Groundwater that is less than 10 feet to the surface can cause the highest liquefaction susceptibility, with lower groundwater levels causing lower liquefaction risks. Soils susceptible to liquefaction are typically found in areas of low-lying, current, or former floodplains. Site-specific geotechnical studies are the only practical and reliable way of determining the specific liquefaction potential of a site; however, a determination of general risk potential can be provided based on soil type and depth of groundwater.

As shown in **Figure 5**, the Dixon area has some risk of seismic activity leading to liquefaction, which could cause severe damage to buildings and infrastructure. Most of Dixon is classified as having a moderate risk of liquefaction; however, a portion of the city is within a high-risk area and a few narrow channels of very high susceptibility run through the city, likely reflecting historic filled creek beds. These areas fall along the eastern border of the city and are primarily overlain by relatively low-density industrial land. However, some residential areas south of West A Street are underlain by soils with moderate liquefaction potential.

# NATURAL ENVIRONMENT ELEMENT

Figure 5: Liquefaction



Source: USGS 2006, Solano County 2021, PlaceWorks 2022, ESRI

- |                        |                             |                    |                                       |
|------------------------|-----------------------------|--------------------|---------------------------------------|
| — City Boundary        | Liquefaction Susceptibility | ★ City Hall        | ★ Police Station                      |
| ⬜ Sphere of Influence  | Very high                   | ■ Community Center | ▲ Water/Wastewater Treatment Facility |
| — Railroad             | High                        | ■ Library          | ⚡ Electrical Substation               |
| — Transmission Lines   | Moderate                    | 🎓 School           | ★ Dixon May Fair Grounds              |
| 🌳 Parks and Open Space | Low                         | 🚒 Fire Station     |                                       |

# NATURAL ENVIRONMENT ELEMENT

## 2.1.1.2 Geologic Hazards

Geologic hazards, such as landslides, erosion, and soil expansion depend on the geologic composition of the area.

### Landslides

Landslides may occur in sloped areas, especially areas with steep slopes, and usually in areas of loose and fragmented soil. Landslides, rockfalls, and debris flows occur continuously on all slopes; some processes act very slowly, while others occur very suddenly, often with disastrous results. There are predictable relationships between local geology and landslides, rockfalls, and debris flows. Slope stability is dependent on many factors and interrelationships, including rock type, pore water pressure, slope steepness, and natural or human-made undercutting. Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods, or wildfires, so landslide frequency is often related to the frequency of these other hazards.

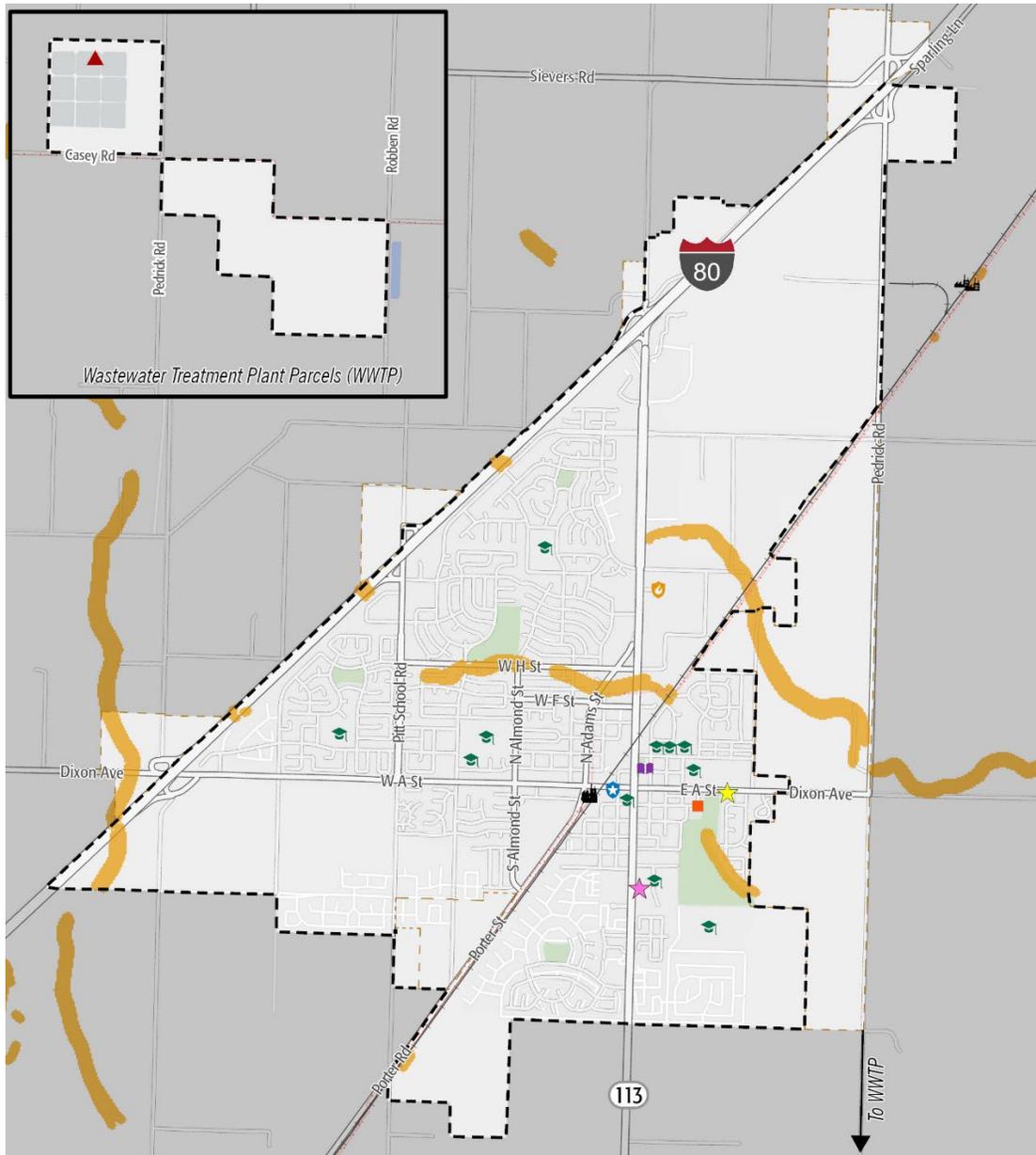
As the Dixon area has a relatively flat topography, it has limited potential for landslides. However, as seen in **Figure 6**, areas of moderate landslide risk occur primarily near the center of the city, which have both industrial and residential development. Dixon has minimal to moderate vulnerability to landslides associated with climate change hazards.

### Erosion

Soil erosion is the process by which soil materials are worn away and transported to another area, either by wind or water. Not accounting for slope and groundwater factors, soils high in clay have low susceptibility to erosion because they are resistant to detachment. Coarse-textured soils, such as sandy soils, also have low erosion potential despite their easy detachment, because of low runoff. Medium-textured soils, such as silt and loam soils, are moderately susceptible to erosion, while soils with a high silt content are the most susceptible. Approximately 95 percent of the Dixon area is underlain by soils that are moderately to highly susceptible to erosion. Since Dixon is primarily flat and has no natural waterways, the risk of soil erosion due to water runoff is relatively low. However, stormwater drainage and wind can cause soil erosion.

# NATURAL ENVIRONMENT ELEMENT

**Figure 6: Landslides**



Source: Solano County 2021, PlaceWorks 2022, ESRI

- |                        |   |                                       |
|------------------------|---|---------------------------------------|
| — City Boundary        | Landslide Hazards (Solano County MJHMP) | 🚒 Fire Station                        |
| ⬜ Sphere of Influence  | 🟠 Medium                                | 👮 Police Station                      |
| 🚊 Railroad             | ★ City Hall                             | 🏭 Water/Wastewater Treatment Facility |
| — Transmission Lines   | 🏠 Community Center                      | ⚡ Electrical Substation               |
| 🌳 Parks and Open Space | 📖 Library                               | ★ Dixon May Fair Grounds              |
| 🎓 School               |   |                                       |
- 0 0.25 0.5  
Miles

# NATURAL ENVIRONMENT ELEMENT

## **Expansive Soils**

Expansive soils have shrink-swell potential, meaning that they may swell when wetted and shrink when dried. Expansive soils can be hazardous to structures, and may cause cracks in building foundations, distortion of structural elements, and warping of doors and windows. Though not all types of clay are expansive, soils with a clay component are more prone to expansion. The soils underlying Dixon range from low to high shrink-swell potential. Areas of high expansiveness are scattered across the city, with the highest concentration occurring in the northern tip of the city.

## **Subsidence**

Land subsidence is the sinking of a large area of ground surface with little or no horizontal movement. Subsidence areas are associated with land over areas where groundwater or natural gas is extracted and can also occur as a result of seismic activity. There are two general types of subsidence: elastic (reversible) and inelastic (permanent). Subsidence appears to have occurred historically in an area stretching from central Colusa County to Dixon in Solano County, primarily due to groundwater withdrawal. In 2018, Dixon joined Solano County's Joint Groundwater Sustainability Agency, which monitors groundwater conditions, including potential for subsidence. There is currently no documented inelastic subsidence due to groundwater pumping within the Solano Subbasin. Small amounts of subsidence recorded within the subbasin have not resulted in reported adverse impacts to infrastructure or conditions at the land surface.<sup>7</sup>

### **2.1.1.3 Seismic and Geologic Hazard Reduction**

The City of Dixon's Municipal Code contains several provisions for mitigating risk pertaining to seismic and geologic hazards.

Chapter 16 of the Dixon Municipal Code adopts the California Building Code (CBC) in its entirety excepting additions, revisions, and omissions as listed in Section 16.03.030. The CBC regulates seismic design, the excavation of foundations and retaining walls, analysis of slope instability, requirements for drainage and grading, and other aspects of building design and construction that relate to geology, soils, and seismicity. Chapters 16.04 through 16.06 establish administrative procedures, minimum standards of review, and implementation and enforcement procedures for controlling erosion, sedimentation, and other pollutant runoff.

# NATURAL ENVIRONMENT ELEMENT

Chapter 17 of the Municipal Code requires that soils reports, seismic analysis, bank stabilization, and other factors pertinent to the project site be provided as part of the application for a tentative subdivision map, unless the city engineer determines that no preliminary analysis is necessary.

## **2.1.1.4 Past Occurrences**

In April 1892, a Magnitude 6.0 earthquake struck to the northwest of the city, followed by a Magnitude 5.6 quake to the southeast several days later.

## **2.1.1.5 Potential Changes to Geologic and Seismic Risk in Future Years**

### **Likelihood of Future Occurrence**

#### *Seismic Risk*

Earthquakes are likely to continue to occur on an occasional basis and are likely to be small. Most are expected to cause no substantive damage and may not even be felt by most people in Dixon. Major earthquakes are rare, but a possibility in the region.

#### *Geologic Risk*

Dixon is vulnerable to geologic hazards such as landslides, erosion, and expansive soils. However, hazard areas are confined to relatively small areas of the city. Heavy rainfall may exacerbate risks pertaining to erosion and landslide.

### **Climate Change and Geologic and Seismic Hazards**

While climate change is unlikely to increase earthquake frequency or strength, the threats from seismic and geologic hazards are expected to continue. Climate change may result in precipitation extremes (i.e., wetter rainfall periods and drier dry periods). While total average annual rainfall may not change significantly, rainfall may be concentrated in more intense precipitation events. Heavy rainfall could cause an increase in the number of landslides or make landslides in drainage areas larger than normal. The combination of a generally drier climate in the future, which will increase the chance of drought, and the occasional extreme downpour, is likely to cause more landslides. Impacts from these conditions would compound landslide potential for the most susceptible locations.

# NATURAL ENVIRONMENT ELEMENT

## 2.1.1.6 Implications For the Natural Environment Element Update

The Natural Environment Element Update can address Dixon’s ability to prepare for and respond to seismic and geologic hazards by:

- Increasing public awareness regarding seismic and geologic risks,
- Ensuring that critical facilities will remain operational in the event of an earthquake or landslide, and
- Engaging in soil erosion and slope stabilization activities in areas that have been subject to erosion or landslides.

## 2.1.2 FLOOD HAZARDS

Flooding is the rising and overflowing of a body of water onto normally dry land. Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide, causing substantial damage to structures, landscapes, and utilities, as well as life-safety issues. Flooding can be extremely dangerous, and even six inches of moving water can knock a person over given a strong current. Floodwaters can transport large objects downstream, which can damage or remove stationary structures, such as dam spillways. Ground saturation can result in instability, collapse, or other damage. Objects can be buried or destroyed through sediment deposition and floodwaters can break utility lines and interrupt services. Standing water can cause damage to roads, foundations, and electrical circuits. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, loss of environmental resources, and certain health hazards.

Areas at an elevated risk of flooding are generally divided into 100- and 500-year flood zones. A 100-year flood zone has a 1-percent chance of experiencing a major flood in any given year and a 500-year flood zone has a 0.2-percent chance of flooding in any given year. A few areas of Dixon and within the sphere of influence are within the Federal Emergency Management Agency (FEMA) 100-year or 500-year flood hazard zones (see **Figure 7**). These areas occur predominately along the eastern boundary of the city, in areas with predominately industrial or government/institutional land uses and coincides closely with the locations of the City’s detention basins B and C (both along the eastern border of the city). However, some residential areas, primarily those at the south end of the city near SR-113 and near Northwest Park, are also subject to flood hazards. These areas are classified as 100-year and 500-year floodplains, respectively. Most of Dixon, however, is not within a flood hazard zone.

# NATURAL ENVIRONMENT ELEMENT

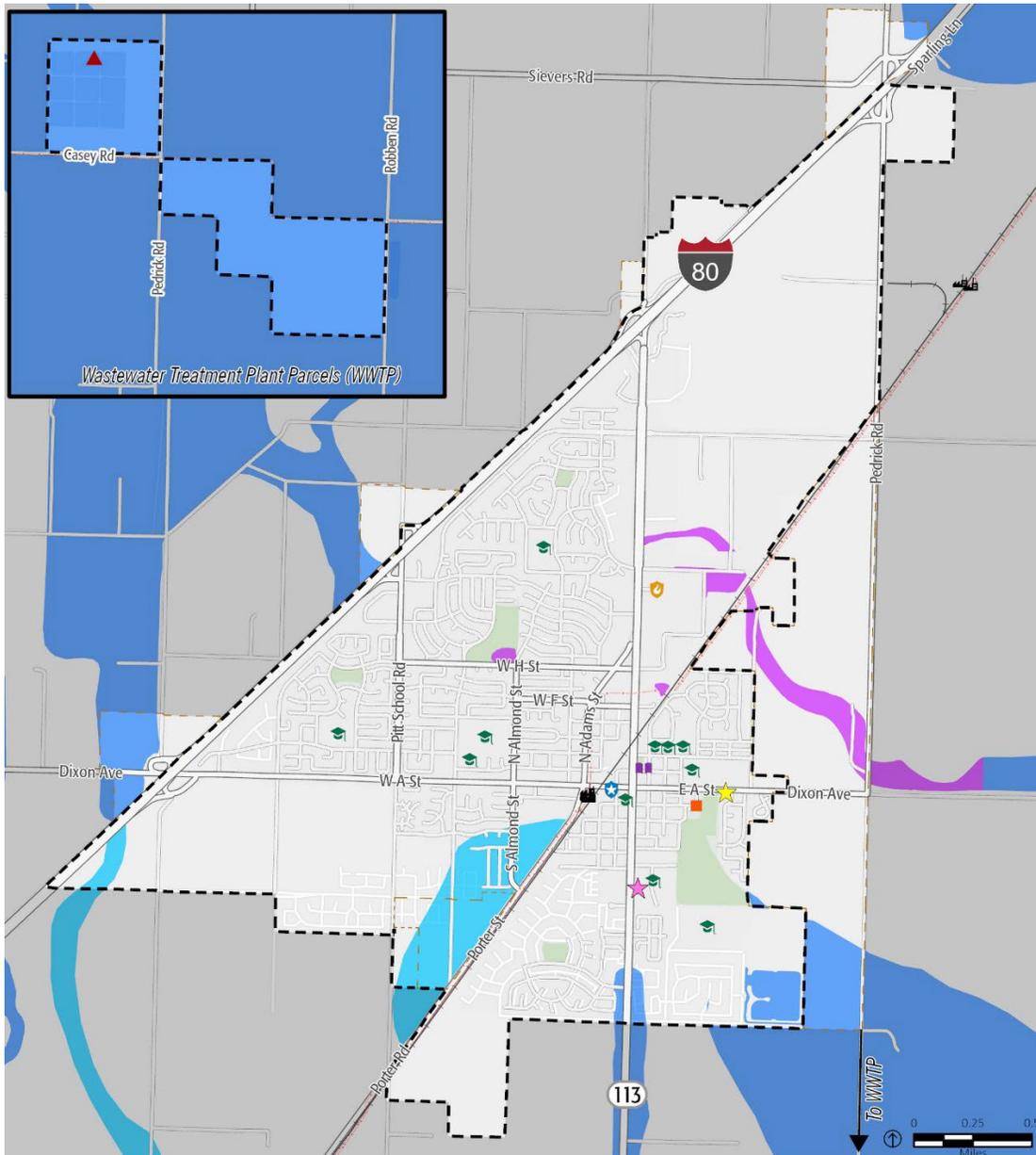
Households in poverty, persons experiencing homelessness, those without access to lifelines such as private vehicles, and pollution-burdened populations are especially vulnerable to flooding. Households in poverty in southeastern Dixon or along the historic Dickson and Dudley Creeks are within the 100-year or 500-year floodplain.<sup>8</sup> Households in poverty are more likely to live in homes that are in low-lying areas, less well maintained, or more structurally deficient, and these households may struggle to obtain the financial resources necessary to relocate during a flood or repair flood damage.<sup>9</sup> Homeless encampments are more likely to be within or near floodable areas in Dixon and persons experiencing homelessness can have their temporary shelters and property damaged or destroyed by floodwaters. Homeless services can also be interrupted, decreasing the number of essential services for persons experiencing homelessness. Persons experiencing homelessness may be able to move away from floodable areas during flood events. However, they may be disconnected from the community and unaware of upcoming storms that can cause floods.

Persons without access to lifelines, such as those without vehicles that may rely on public transportation or those without access to telecommunications, may face significant challenges during flooding events. These individuals may not be aware of flood warnings or road closures, hindering their ability to escape flood events even if transportation is available. Individuals without access to transportation or telecommunications may rely on friends and neighbors for assistance and information. These informal support networks provide essential connections for preparing for floods and evacuating safely. However, these support networks may be less effective in advance of flooding events.

Neighborhoods with pollution from pesticides, fertilizers, and industrial facilities are also within a flood hazard zone in northeastern Dixon.<sup>10</sup> Flooding can inundate these areas, causing toxic chemicals and contaminants to spread into the water and soil, causing harmful health affects for pollution-burdened populations.<sup>11</sup> Communities who are already exposed to water pollution and contaminated lands are less able to prepare for or respond to flooding events due to existing health concerns and disruption of daily life.<sup>12</sup>

# NATURAL ENVIRONMENT ELEMENT

**Figure 7: Flood Hazard Zones**



Source: DWR 2021, Solano County 2021, PlaceWorks 2022, ESRI

- |                                   |   |                                     |
|-----------------------------------|---|-------------------------------------|
| City Boundary                     | Inland Flooding (Solano County MJHMP) 100 year floodplain | School                              |
| Sphere of Influence               | 500 year floodplain                                       | Fire Station                        |
| Railroad                          | City Hall   | Police Station                      |
| Transmission Lines                | Community Center  | Water/Wastewater Treatment Facility |
| Parks and Open Space              | Library   | Electrical Substation               |
| DWR Awareness 100 Year Flood Zone |   | Dixon May Fair Grounds              |

# NATURAL ENVIRONMENT ELEMENT

Dixon's stormwater, flood control, water, and wastewater infrastructure are also vulnerable to flood hazards. Flooding can cause stormdrains and detention basins to overflow and become damaged. If damaged, flood control infrastructure may be unable to provide the essential service of protecting the community against floodwaters. The City of Dixon has taken measures to identify and address potential harm to flood control infrastructure and plans to develop an annual drainage maintenance plan to ensure that stormdrains function adequately during flood events and to upgrade culverts to convey 100-year stormwater. The Dixon Wastewater Treatment Plant is within the 100-year floodplain.<sup>13</sup> The wastewater treatment plant could be damaged from floodwaters, preventing the plant from functioning as needed and causing untreated effluent to flow into the surrounding water and soil. Wastewater treatment plants can be expensive to retrofit, and the City may be unable to pay for additional retrofits to protect the plant from flooding.

Agricultural land uses surrounding the city fall within the 100- and/or 500-year floodplain. Flooding can cause significant damage to crop production because floodwaters can damage plants, wash away topsoil nutrients, and degrade essential microbial activity. Levees and berms can help prevent floodwaters from affecting agricultural land, although these features may not be economically feasible, may take land out of active agricultural production, or may not be capable of preventing floodwaters. Cover crops can be planted to replenish the soil microbiome, although this may postpone economic hardship if the land is normally used for more valuable crops.

## **2.1.2.1 Flood Hazard Reduction and Response**

The City has adopted a Floodplain Management Ordinance that describes methods for reducing flood losses, including restricting or prohibiting uses which are dangerous to health and safety due to water or erosion hazards, or which result in increases in erosion or flooding. Other requirements of this ordinance include requiring that uses vulnerable to floods be protected against flood damage at the time of initial construction; controlling the alteration of natural floodplains, stream channels, and natural protective barriers; controlling filling, grading, dredging, and other development that may increase flood damage; and preventing or regulating the construction of flood barriers that will unnaturally divert floodwaters. The Floodplain Management Ordinance contains several provisions for flood hazard reduction, including anchoring standards, specifications for construction materials and methods, and elevation and floodproofing requirements.

# NATURAL ENVIRONMENT ELEMENT

Several agencies participate in flood prevention and management in and around Dixon. The Dixon Regional Watershed Joint Powers Authority (DRWJPA), made up of the City of Dixon, Dixon Resource Conservation District (DRCD), Maine Prairie Water District, and Reclamation District 2068, works to construct and operate new or upgraded drainage facilities that provide drainage to two or more of the participating entities. The Solano County Water Agency (SCWA) provides flood control and operates the SCWA Flood Warning System to provide up-to-date information to the community and public agencies on potential flooding in Solano County. The DRCD operates and maintains the Dixon Drain, a 70-mile-long system of ditches designed to provide water drainage, reduce duration of flooding, and diminish ponding of water on agricultural lands.

Additional flood warning is provided through a variety of means, such as National Weather Service (NWS) announcements, National Oceanic and Atmospheric Administration (NOAA) radio, standard radio, and television Emergency Alert System (EAS) bulletins. These actions help inform citizens about flood threats or actual flooding conditions.

FEMA manages the National Flood Insurance Program (NFIP), providing insurance to the public in communities that participate in the program. FEMA is the main federal government agency contact during natural disasters and publishes the Flood Insurance Rate Maps (FIRMs), which identify the extent of flood potential in flood-prone communities based on a 100-year flood (or base flood) event.

## 2.1.2.2 Dam Failure

A dam failure is an uncontrolled release of water from a reservoir through a dam because of structural failures or deficiencies in the dam, usually associated with intense rainfall or prolonged flooding. Dam failures can range from minor to catastrophic and can potentially harm human life and property downstream from the failure. In addition, ecosystems and habitats are destroyed because of waters flooding them. Although dam failures are very rare, these events are not unprecedented. There are four major causes of dam failures:

- **Overtopping:** These failures occur when a reservoir fills too high with water, especially in times of heavy rainfall, leaving water to rush over the top of the dam. Other causes of this type of failure include settling of the crest of the dam or spillway blockage.
- **Foundation defects:** These failures occur as a result of settling in the foundation of the dam, instability of slopes surrounding the dam, uplift pressures, and seepage around the foundation. All these failures result in structural instability and potential dam failure.

# NATURAL ENVIRONMENT ELEMENT

- **Piping and seepage failures:** These failures occur as a result of internal erosion caused by seepage and erosion along hydraulic structures such as spillways. Erosion may also be caused by animal burrows and cracks in the dam structure.
- **Conduit and valve failure:** These failures occur as a result of problems with valves and conduits.

Many dam failures are also the secondary result of other natural disasters, such as earthquakes, landslides, extreme storms, or heavy snow-melt. Other causes include equipment malfunction, structural damage, and sabotage.

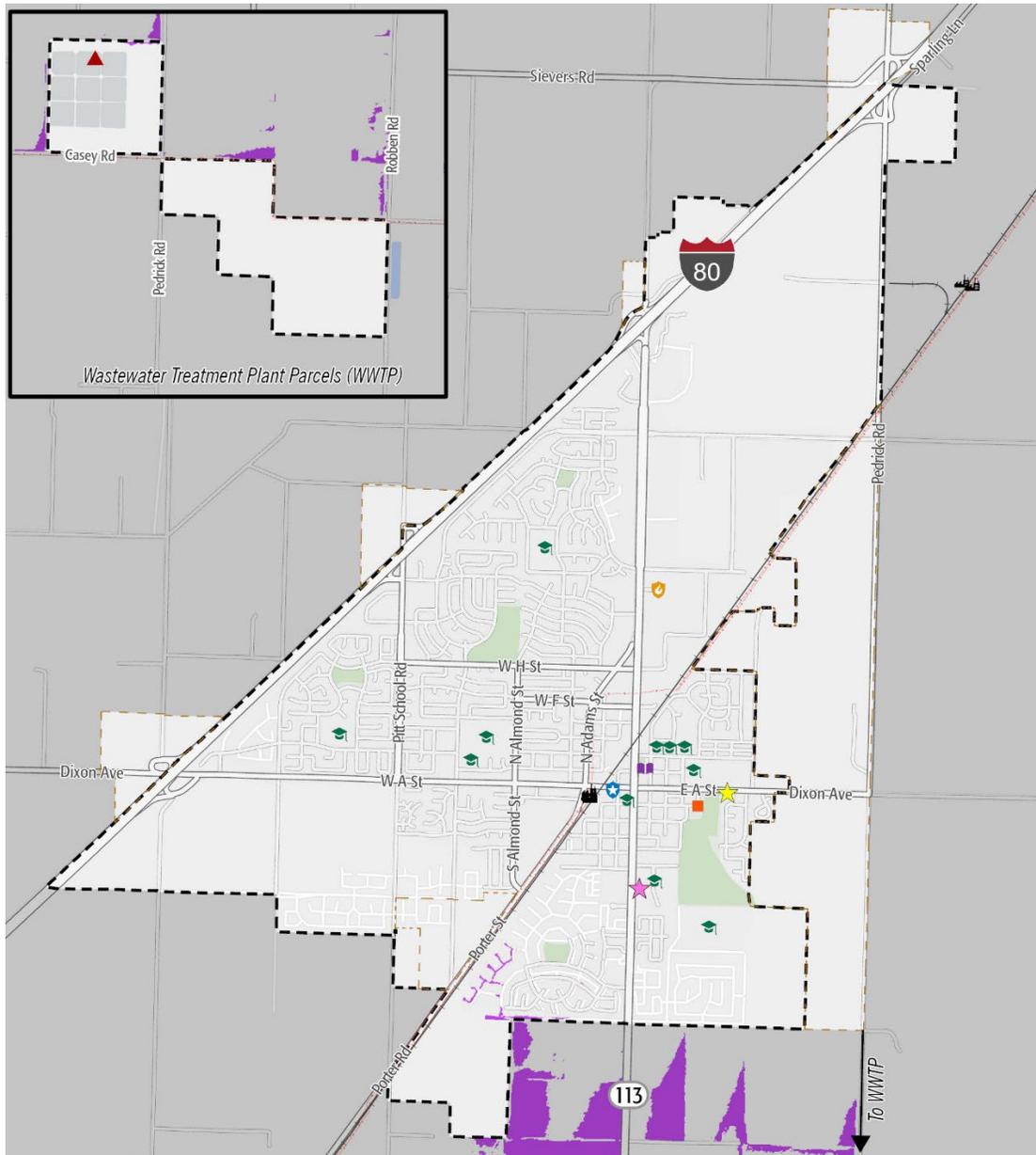
There are several dams in Solano County. The Monticello Dam (Lake Berryessa) is most likely to trigger inundation and damage within Dixon if it were breached at full capacity. **Figure 8** shows areas in the city that would be affected by inundation if Monticello Dam were to fail.

The Federal Energy Regulatory Commission (FERC), as required by federal law, has reviewed and approved comprehensive emergency action plans (EAPs) for each of these dams. The EAP minimizes the threat to public safety and the response time to an impending or actual sudden release of water from project dams. The EAP is also designed to provide emergency notification when floodwater releases may present the potential for major flooding.

As mandated by the National Dam Inspection Act, the United States Army Corps of Engineers (USACE) has the authority and responsibility for conducting inspections of all dams. The purpose of these inspections is to check the structural integrity of the dam and associated appurtenant structures, ensuring protection of human life and property. Periodic inspections disclose conditions that might disrupt operation or dam safety.

# NATURAL ENVIRONMENT ELEMENT

**Figure 7: Dam Inundation**



Source: DWR DSOD 2021, Solano County 2021, PlaceWorks 2022, ESRI

- |                      |                      |                                     |                        |
|----------------------|----------------------|-------------------------------------|------------------------|
| City Boundary        | Dam Inundation Areas | School                              | Dixon May Fair Grounds |
| Sphere of Influence  | Detention Pond A     | Fire Station                        |                        |
| Railroad             | City Hall            | Police Station                      |                        |
| Transmission Lines   | Community Center     | Water/Wastewater Treatment Facility |                        |
| Parks and Open Space | Library              | Electrical Substation               |                        |



# NATURAL ENVIRONMENT ELEMENT

## 2.1.2.3 Past Occurrences

Dixon does not have an extensive history of past flood events. However, several noteworthy flood events have occurred in and around Dixon:

- **1986 Northern California and western Nevada floods.** A strong storm known as a Pineapple Express (a large flow of moisture-laden air from the waters near Hawaii) caused unprecedented amounts of rain and extensive flooding of the Napa and Russian Rivers. The nine-day storm brought half of the average annual rainfall for the year. Sacramento, Yuba, and Feather River levee breaks in Olivehurst and Linda forced thousands of residents to evacuate. On the San Joaquin River and in the Delta, levee breaks along the Mokelumne River caused flooding in Thornton and flooded four Delta islands. The event resulted in 13 deaths, 50,000 people evacuated, and over \$400 million in property damage.
- **1996–1997 New Year’s Day Northern California flood.** A Pineapple Express storm hit northern California, making December one of the wettest on record. The Klamath River experienced its worst flood since 1974 and permanently changed course in some areas. Dozens of levees failed and produced widespread flooding throughout the San Joaquin River Basin, including along the Cosumnes River and near Olivehurst, Arboga, Wilton, Manteca, and Modesto. Massive landslides occurred in El Dorado National Forest east of Sacramento, closing Highway 50. Forty-eight counties in California were declared disaster areas. Over 23,000 homes and businesses, agricultural lands, bridges, roads, and flood management infrastructures—valued at about \$2 billion—were damaged. Nine people were killed and 120,000 people were evacuated from their homes. Overall, the storms led to flooding across 300 square miles.
- In December 2016, heavy rains caused flooding and road closures on SR-113 between Fry and Hay Roads.

# NATURAL ENVIRONMENT ELEMENT

## 2.1.2.4 Potential Changes to Flood Risk in Future Years

### Likelihood of Future Occurrence

While Dixon does not have an extensive history of past flooding and the City has taken steps to mitigate flood risk, management of flood risk should continue to be incorporated into future planning efforts. The potential for a dam failure event in Dixon is likely to remain a risk in future years, although the odds of such events are expected to remain very low.

### Climate Change and Flooding

Climate change and associated changes to the local and regional hydrological cycle may exacerbate flood risk. Historically, Dixon has experienced annual precipitation levels of 18.5 inches per year. As climate change progresses, annual average rainfall levels are projected to increase to an annual average of 21.3 inches per year by mid-century (2035-2064) and to an annual average of 23.9 inches by the end of this century (2070-2099). This increase in average rainfall is likely to occur in fewer, high-intensity storms throughout the century. These high-intensity storms will likely increase flood risk within Dixon, meaning that flood events currently considered 100- and 500-year floods will likely occur with greater frequency than they have historically.

## 2.1.2.5 Implications For the Natural Environment Element Update

The Natural Environment Element Update can further address flood risk by adding policies to avoid or minimize the risks of flooding to new development, minimize the danger to new development in flood hazard zones, maintaining the structural and operational integrity of essential public facilities during flooding, and establishing cooperative working relationships among public agencies with responsibility for flood protection. Additional policies can promote public awareness of flood hazards and preparation and ensure that adequate funding is available for the maintenance of Dixon's flood prevention infrastructure, providing flood protection and recovery resources to residents whose housing and/or access to freshwater may be compromised by flooding, and ensuring the continued maintenance of Dixon's flood control infrastructure.

# NATURAL ENVIRONMENT ELEMENT

## 2.1.3 FIRE HAZARDS

Dixon is subject to fire hazards from urban and structural fires, wildfire, and wildfire smoke from neighboring regions.

### 2.1.3.1 Structural Fires

Structural fires pose the largest fire risk within Dixon. Structural fires occur in built-up environments, destroying buildings and other human-made structures. These types of fires are often due to faulty wiring or mechanical equipment, combustible construction materials, the absence of fire alarms and fire sprinkler systems, or human accidents, though deliberate fires (arson) may be a cause of some events. Older buildings that lack modern fire safety features may face greater risk of damage from fires.

To minimize fire damage and loss, the City's Fire Department implements and enforces the Fire Code and Building Code, based on the California Building Standards Code, which sets standards for building and construction. It requires the provision of adequate water supply for firefighting, fire-retardant construction, and minimum street widths, among other things. The City's Fire Department also conducts fire prevention awareness programs and fire drills to train residents to respond quickly and correctly to reduce injury and losses during fires.

### 2.1.3.2 Wildfires

Highly flammable vegetation and warm, dry summers contribute to wildfire risk. Dixon's risk of wildland fires is relatively low; however, wildfire's dependence on the complex relationship between environmental factors such as winds, temperatures, humidity levels, level of exposure to human activity, and fuel moisture content means that the city is not completely immune.

Most of Dixon is classified as having little or no or moderate wildfire threat, with the more developed portions of the city generally having a moderate risk and surrounding areas having low risk.<sup>14</sup> The land surrounding the city is primarily cultivated agriculture land, which can provide protection from wildfire.

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## 2.1.3.3 Fire Hazard Zones

The California Department of Forestry and Fire Protection (CAL FIRE) establishes Fire Hazard Severity Zones (FHSZs), designating each as moderate, high, or very high severity. Incorporated areas, such as Dixon, are considered local responsibility areas (LRAs). CAL FIRE only designates very high FHSZs within LRAs, and Dixon does not have land designated as a very high FHSZ. As shown in **Figure 9**, high and very high fire FHSZs occur west and southwest of Dixon along the western boundary of Solano County.

## 2.1.3.4 Wildland-Urban Interface

The wildland-urban interface (WUI) is an area where buildings and infrastructure (e.g., cell towers, schools, water supply facilities) mix with areas of flammable wildland vegetation. The WUI is made up of three distinct zones. The intermix zone contains housing development or improved parcels interspersed in an area dominated by wildland vegetation subject to wildfire. The interface zone contains dense housing next to vegetation, but not dominated by wildland vegetation, which can burn in a wildfire. The influence zone contains wildfire-susceptible vegetation within 1.5 miles from the WUI or wildland-urban intermix zones. Hundreds of homes now border major forests and brush areas in California. With thousands of people living near and visiting wildland areas, the probability of human-caused fires is growing. As shown in **Figure 10**, there are few WUI zones within the city. Intermix and interface zones are concentrated to the eastern border of the city. Influence zones are primarily in southern Dixon, with other areas off SR-113 north of H Street and along I-80, west of Pitt School Road.

In the WUI, efforts to prevent ignitions and limit wildfire loss hinge on hardening structures and creating defensible space through a multi-faceted approach, which includes engineering, enforcement, education, emergency response, and economic incentive.

## 2.1.3.5 Wildfire Smoke

Increasing local and regional fire frequency has created recurring air quality degradation events. These poor air quality events represent a significant health concern for the Dixon community. Wildfire smoke consists of a mix of gases and fine particulate matter from burning vegetation and materials. The pollutant of most concern from wildfire smoke is fine particulate matter (PM<sub>2.5</sub>). PM<sub>2.5</sub> from wildfire smoke is damaging to human health due to its ability to deeply penetrate lung tissue and affect

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the heart and circulatory system. Although wildfire smoke presents a health risk to everyone, sensitive groups may experience more severe acute and chronic symptoms from exposure to wildfire smoke, such as children, older adults, people with chronic respiratory or cardiovascular diseases, or people experiencing low socioeconomic status. Households in poverty, immigrant communities, low-resourced people of color, outdoor worker, persons experiencing homelessness, persons with chronic illnesses and/or disabilities, pollution-burdened communities, and seniors living alone are especially vulnerable to the effects of fire, wildfire, and wildfire smoke.

Households in poverty, immigrant communities, persons experiencing homelessness, and low-resourced people of color are all more likely to encounter structural barriers that compromise their ability to limit their exposure to wildfire smoke. These populations may live in structures that are not well insulated or sealed, enabling smoke from wildfires in the region to lower indoor air quality, and may be more likely to work in outdoor environments that increase smoke exposure. Existing significant financial burdens may create significant challenges in taking protective steps, such as sealing windows and obtaining air filtration systems. Financially stressed and low-resourced populations are also less likely to have access to transportation, which can make evacuations more challenging if a fire burns near the city limits. The Alert Solano warning system may help residents prepare and evacuate from wildfire. Smoke from wildfires can exacerbate health issues and persons in these communities may have existing health issues from poor air quality or other environmental hazards or may lack the financial resources to seek timely medical care. Due to their immigration status, immigrant communities may be afraid to seek help during or after a wildfire or may be unable to connect to disaster-relief services due to immigration status.<sup>15, 16</sup> Immigrants may also not qualify for federal assistance programs such as FEMA.<sup>17</sup>

Persons with chronic illnesses and/or disabilities, seniors, and pollution-burdened populations may be especially sensitive to the health effects of smoke exposure. Smoke from wildfires can exacerbate illness that persons with chronic illnesses and pollution-burdened populations may have, such as asthma, acute bronchitis, chronic obstructive disease, and pneumonia.<sup>18</sup> Seniors and persons with disabilities face challenges during wildfire conditions as evacuation may not always be possible and may be unable to maintain defensible space around their homes or prepare for wildfire and smoke conditions. The Independent Living Resources of Solano and Contra Costa Counties can also provide personalized emergency planning and preparation to ensure these communities are prepared for wildfire events.<sup>19</sup> Evacuation assistance may also be available through DART Paratransit, Read-Ride, SolTrans, Solano County Mobility Program, Pace Solano, and Solano County In-Home Support Services. Those with chronic illnesses may still have difficulty evacuating due to the medicine or equipment needed if they are unable to return to their homes.

# NATURAL ENVIRONMENT ELEMENT

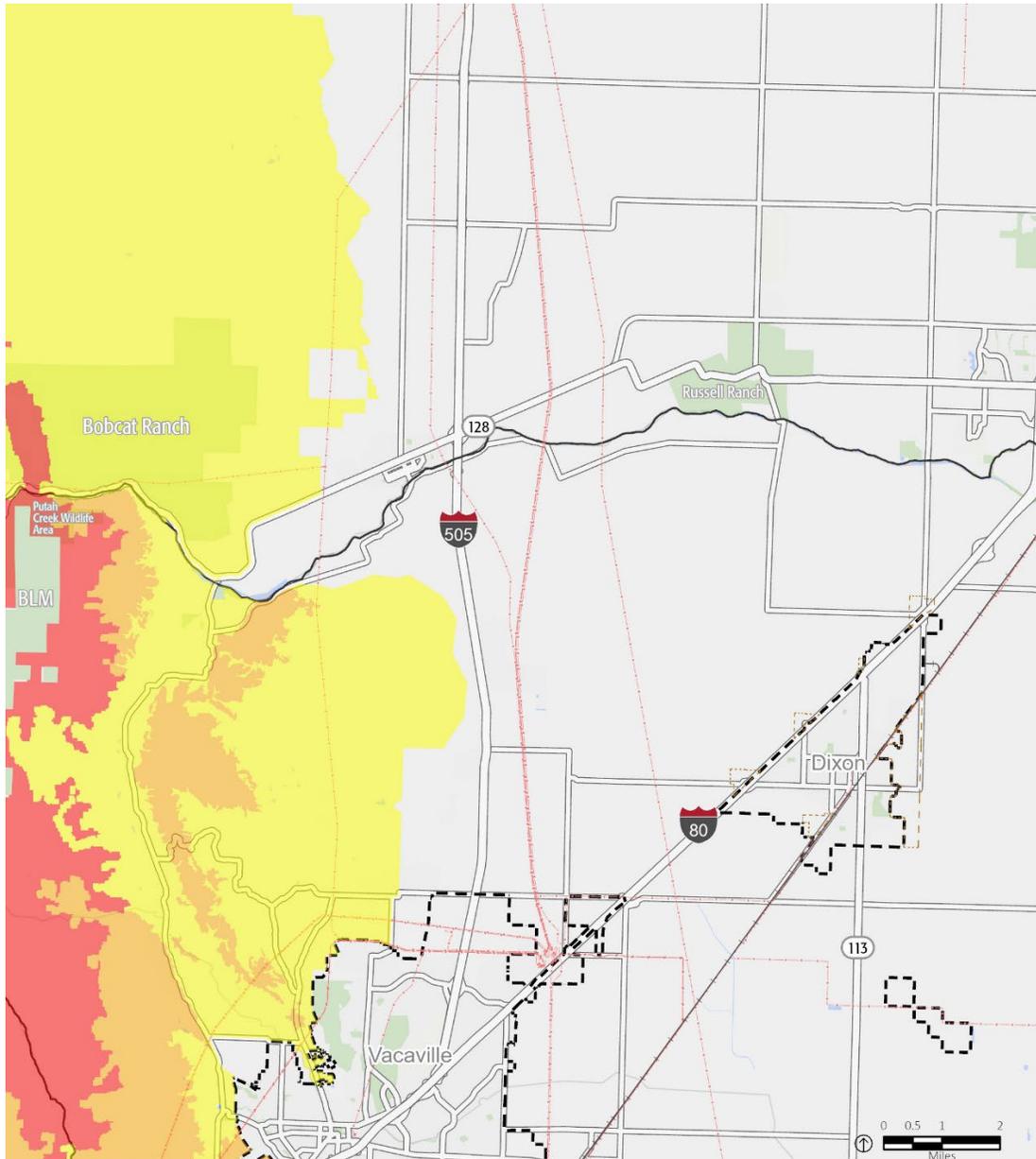
Dixon’s energy delivery system is vulnerable to wildfire hazards. Wildfires can damage or destroy energy delivery infrastructure (even if not located in Dixon), which can cause power outages that can last for days or weeks depending on the severity of the event. This can directly harm the economy, government operations, and public safety. Pacific Gas and Electric Company (PG&E), who manages the electricity lines, can clear vegetation around powerlines to ensure that energy delivery is not disrupted. In many areas, it would be extremely difficult and expensive to underground powerlines, especially high-voltage lines that go through the hillsides. Substations can be cleared of vegetation and retrofitted with fire-retardant materials, but this may not be effective at maintaining the capacity of all substations during a wildfire.

## **2.1.3.6 Fire Protection**

Fire protection in Dixon is provided by the Dixon Fire Department. Fire Department services include fire containment, fire prevention, education, emergency medical and rescue services, and response to incidents involving hazardous materials. In 2021, the Fire Department responded to 2,953 incidents, approximately 60 percent of which were related to rescue and emergency services. The Fire Department also responded to calls pertaining to fire, hazardous conditions, and explosions, although the Fire Department has not set a goal for minimum response times.<sup>20</sup> In 2019, response times varied by subdistrict but were lowest in the city center with an average response time of 4.7 minutes for one subdistrict and 5.4-minute average response time for another.

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**Figure 8: Fire Hazard Severity Zones**

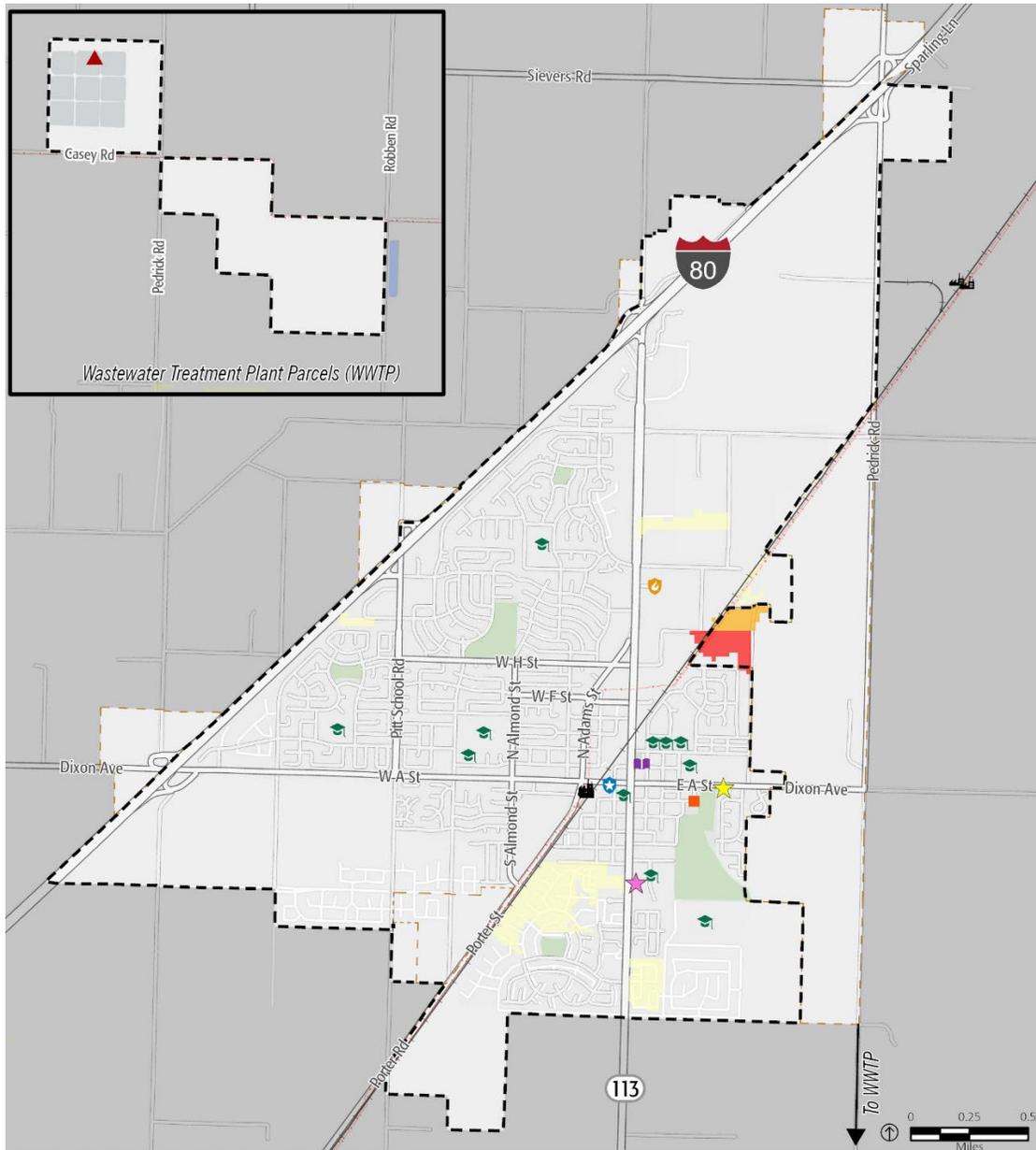


Source: CalFire 2007, Solano County 2021, PlaceWorks 2022, ESRI

- |                     |                      |  |
|---------------------|----------------------|--|
| County Boundary     | Railroad             | Fire Hazard Severity Zones in State Responsibility Areas |
| City Boundary       | Parks and Open Space |  |
| Sphere of Influence |                      |  |
| Transmission Lines  |                      | Very High  |
|                     |                      | High   |
|                     |                      | Moderate   |

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**Figure 9: Wildland-Urban Interface Areas**



Source: CalFire 2015, Solano County 2021, PlaceWorks 2022, ESRI

- |                      |   |                  |                                     |
|----------------------|---|------------------|-------------------------------------|
| City Boundary        | CalFire Wildland/Urban Interface Influence Zone | City Hall        | Police Station                      |
| Sphere of Influence  | Intermix Zone                                   | Community Center | Water/Wastewater Treatment Facility |
| Railroad             | Interface Zone                                  | Library          | Electrical Substation               |
| Transmission Lines   |   | School           | Dixon May Fair Grounds              |
| Parks and Open Space |   | Fire Station     |                                     |

# NATURAL ENVIRONMENT ELEMENT

## 2.1.3.7 Past Occurrences

According to the CAL FIRE historic wildfire perimeter database, a wildfire has not occurred in Dixon or the land adjacent to the city. However, small structural, vegetation, vehicle, and trash fires do occur within and around the city on a semiregular basis.

The closest fires to Dixon in recent years include the following:

- One of the largest and most destructive wildfires in California history, the Camp Fire originated in Butte County in November 2018. The fire was ignited by a faulty electric transmission line and its spread was exacerbated by strong winds and regional drought conditions. The fire forced the evacuation of several Butte County communities. While Dixon was not directly impacted by the blaze itself, smoke from the air caused significant reductions in air quality across the Bay Area and Central Valley. Due to the large number of structures burned in the Camp Fire, the smoke contained elevated levels of lead, zinc, calcium, iron, and manganese.<sup>21</sup>
- The LNU Lightning Complex was a large complex of wildfires that burned during the 2020 California wildfire season across much of the wine country area of Northern California—Lake, Napa, Sonoma, Solano, and Yolo Counties—from August 17 to October 2, 2020. The complex consisted of numerous lightning-sparked fires, most of which were small. The Hennessey Fire eventually grew to merge with the Gamble, Green, Markley, Spanish, and Morgan fires, scorching 192,000 acres by itself, for a total burn area of 363,220 acres in the complex. The fire, which burned in the hills surrounding Vacaville, Fairfield, and Napa, destroyed 1,491 structures and damaged an additional 232. Six people were killed and another five injured. As of spring 2022, the LNU Lightning Complex was the sixth-largest, eleventh-most destructive, and sixteenth-deadliest fire in California’s recorded history.
- In June 2020, the Quail Fire erupted in Solano County between Vacaville and Winters. Low humidity and high winds helped the fire spread quickly, reaching up to 600 acres and threatening 100 structures. Evacuations were ordered for people living or working on Quail Canyon Road from Pleasants Valley Road to SR-128, and in the Olive School Lane areas.<sup>22</sup>
- In May 2021, a vegetation fire occurred on Tremont Road.<sup>23, 24</sup> In July 2021, a fourplex was destroyed by fire.<sup>25</sup>

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## 2.1.3.8 Potential Changes to Fire Risk in Future Years

### Likelihood of Future Occurrence

Structural, vehicle, trash, and other types of urban and structural fire and originate within built-up areas will likely continue to occur periodically within Dixon. The spread of these fires can be exacerbated by high temperatures, high winds, and low humidity.

Dixon's topography, climate, and patterns of land use and vegetation mean that it is not at a high risk for wildfire. As such, while it is important to continue to plan for wildfire prevention and mitigation, a large wildfire occurring within Dixon is unlikely. Historically, an annual average of 57 acres per year within Dixon have been burned by wildfire. This value is projected to increase to an annual average of 80 acres per year by the middle of this century (2035 to 2064) and to an annual average of 81 acres by the end of the century (2070 to 2099). Even while it remains unlikely that a significant wildfire will break out within Dixon, the city will likely continue to experience poor air quality events due to wildfires occurring across the region.

### Climate Change and Wildfire

Changing climate conditions are expected to increase the fire risk and wildfire smoke exposure in and around Dixon. Warmer temperatures brought on by climate change can exacerbate drought conditions. Droughts can kill or dry out plants, creating more fuel for wildfires. Warmer temperatures are also expected to increase the number of pest outbreaks, such as sudden oak death, creating more dead trees and increasing the fuel load. Increased winds may result in more erratic fire behavior, making fires harder to contain and increasing the possibility that a fire could move into Dixon. Warmer temperatures are also expected to occur later in the year, extending the wildfire season, which is likely to begin earlier in the year and extend later than it has historically. Even if a significant wildfire does not break out within Dixon itself, the city will likely experience a heightened probability of poor air quality events due to wildfires occurring across the region.

## 2.1.3.9 Implications for the Natural Environment Element Update

The Natural Environment Element Update can help the Dixon community prepare for and respond to fire hazards by introduce policies to:

# NATURAL ENVIRONMENT ELEMENT

- Avoid or minimize fire hazards associated with new uses of land.
- Work cooperatively with public agencies with responsibility for fire protection; ensure that firefighting services and infrastructure are aligned with the needs of the Dixon community and will remain operational in the event of an emergency.
- Consider exposure to fire hazards when approving new development.
- Educate the public about fire prevention and response.
- Offer educational materials, rebates, and incentives for property owners looking to retrofit their buildings to improve fire safety.
- Provide resources to assist elderly and physically disabled residents in maintaining defensible space around their homes.
- Expand programming for individuals experiencing homelessness within the city.
- Provide resources to help residents respond to poor air quality events.

## **2.2 EMERGENCY PREPAREDNESS AND RESPONSE**

### **2.2.1 LOCAL EMERGENCY RESPONSE**

Resilient communities adequately plan for hazards and emergencies so that when emergency situations occur, they can respond quickly and work together towards recovery. A resilient community understands that planning to ensure the safety of its most vulnerable members means that everyone will be safer when an emergency occurs. The City of Dixon has an annex in the Solano County MJHMP Update, which provides a blueprint for hazard mitigation planning to better protect people and property throughout the county from the effects of future natural hazard events. The City also has an Emergency Operations Plan that addresses multiple parts of disaster response, including animal care, earthquake, flood and tsunami, mass care and mass shelter, mass fatality, mental health, people with access and functional needs, public information, recovery, and terrorism. The plan is managed by the Dixon Fire Department. The City's Emergency Operations Plan is based on the State of California's Standardized Emergency Management System (SEMS) and is designed to work with the rest of Solano County. If a major disaster occurs, the County will coordinate mutual aid and response.

The Dixon Fire and Police Departments respond to emergency incidents. An overview of the Dixon Fire Department is provided in Section 2.1.3.6, Fire Protection. The Dixon Police Department includes the Field Operations Division; the division of the Police Department, which is responsible

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for the Department's community policing initiative; Patrol Services Unit; and response to traffic accidents. The Patrol Services Unit investigates thousands of cases per year, including assault, burglaries, and theft. To support the operations of the Field Operations Division, the Police Department operates the Support Services Division. This division includes all ancillary but critical components of the Police Department, including investigations and terrorism liaison officers. The Police Department strives to have a response time of less than five minutes to Priority 1 calls, which typically relate to incidents in which there is an immediate threat to life, danger of serious physical injury, or danger of major property damage. In 2019, the Police Department averaged 5.08 minutes in their response times to citizen-initiated calls for service.

Other emergency resources in and surrounding Dixon include the Sutter Medical Plaza, several urgent care centers, and providers of emergency shelter and food assistance.

## **2.2.2 COMMUNITY WARNING SYSTEMS**

The Office of Emergency Services is responsible for public warning efforts during the preparedness phases of a disaster, as well as the alert and notification needs during a disaster response. The County Public Information Officer (PIO) within the Command Staff of the County Emergency Operations Center (EOC) is the representative within the OES staff who is responsible for public information efforts. With the approval of the EOC Director, the PIO will disseminate emergency messages to the public regarding preparedness measures to take, evacuation areas and routes (if applicable), emergency resources, measures that the County OES is taking during the event and recovery assistance information.

Dixon uses Alert Solano to notify residents and businesses within Dixon that are impacted by, or are in danger of being impacted by, an emergency. Alert Solano provides basic information about incidents and what specific protective actions (shelter in place, lockdown, evacuation, avoidance of the area, etc.) are necessary to protect life and health. Alert Solano enables agencies within Solano County to provide residents with critical information quickly in a variety of situations, such as severe weather, unexpected road closures, missing persons, and evacuations of buildings or neighborhoods. In the event of an emergency, public safety officials, including local police and fire, send out a message directly to those who have registered for Alert Solano. The Alert Solano emergency notification system allows users to provide customized information and facilitate delivery of emergency information via phone call, text, and email.

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## 2.2.3 EMERGENCY EVACUATION

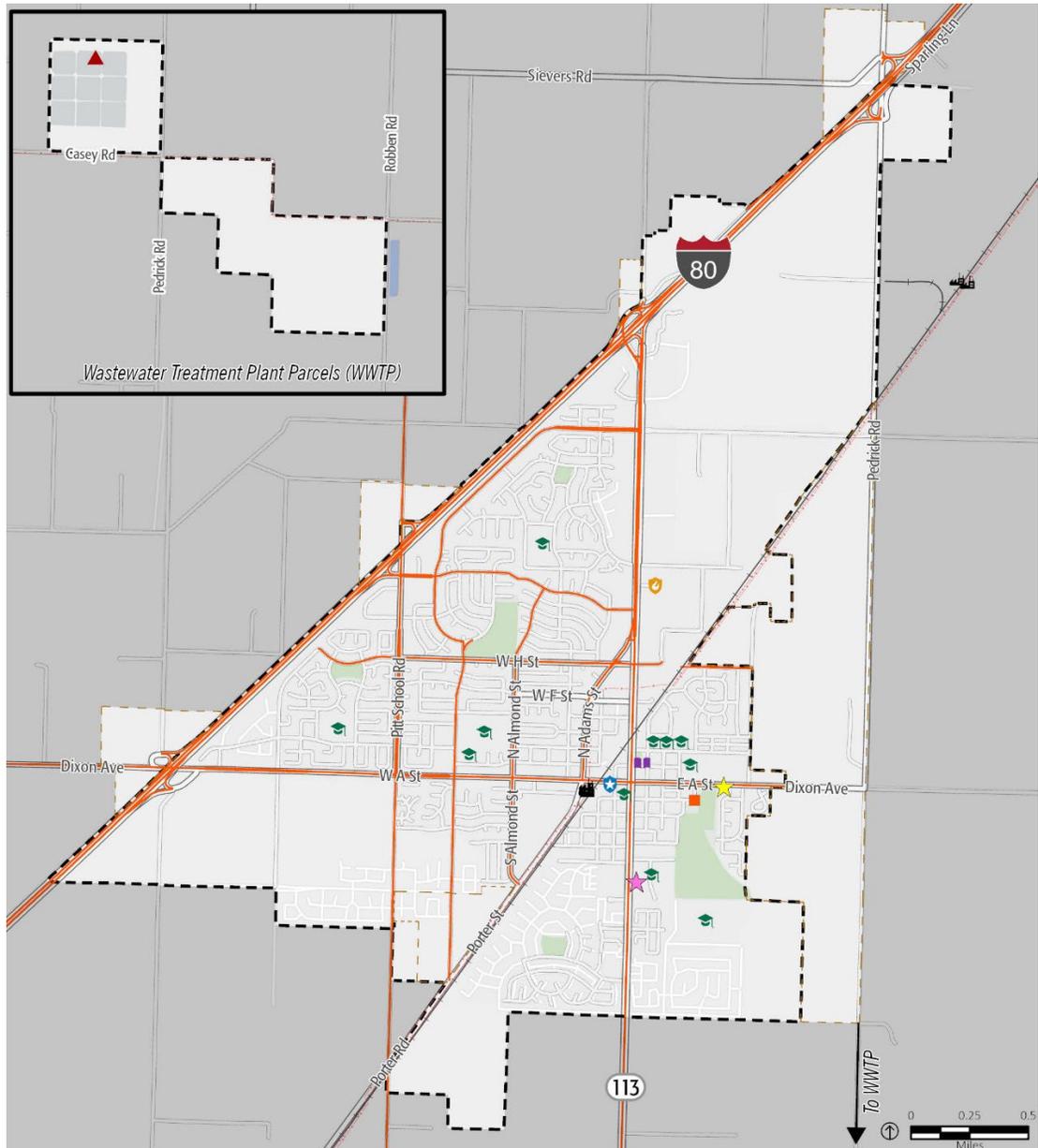
During an emergency, the Police Department is responsible for the evacuation and movement of citizens throughout the operational area. During significant evacuation emergencies, the Police Department's key functions include coordination and emergency management, public alert and warning, and traffic control. The Solano County Department of Health and Social Services (DHSS) is responsible for coordination support of the movement of People with Access and Functional Needs (PAFN) during an evacuation emergency. If evacuation operations seem likely, the EOC Operations and Planning Unit coordinates public safety, security, and evacuation resources.

With advanced warning, evacuation can be effective in reducing injury and loss of life during a catastrophic event. **Figure 11** shows the major roadways serving Dixon, including I-80, SR-113, Dixon Avenue, West A Street, H Street, Stratford Avenue, Pitt School Road, Lincoln Street, Almond Street, Adams Street, and First Street.

**Figure 12** shows residential parcels within Dixon with evacuation constraints. All parcels with an evacuation constraint may have only one emergency evacuation route. The lack of multiple emergency access points limits roadway access for these properties, which may create difficulties if there is a need to evacuate. Multiple evacuation-constrained neighborhoods are throughout the city, most notably along the northern border of the city between Pitt School Road, W H Street, and SR-113. Other major evacuation-constrained neighborhoods are along the southern border of the city near Porter Street and Parkway Boulevard.

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**Figure 10: Evacuation Routes**

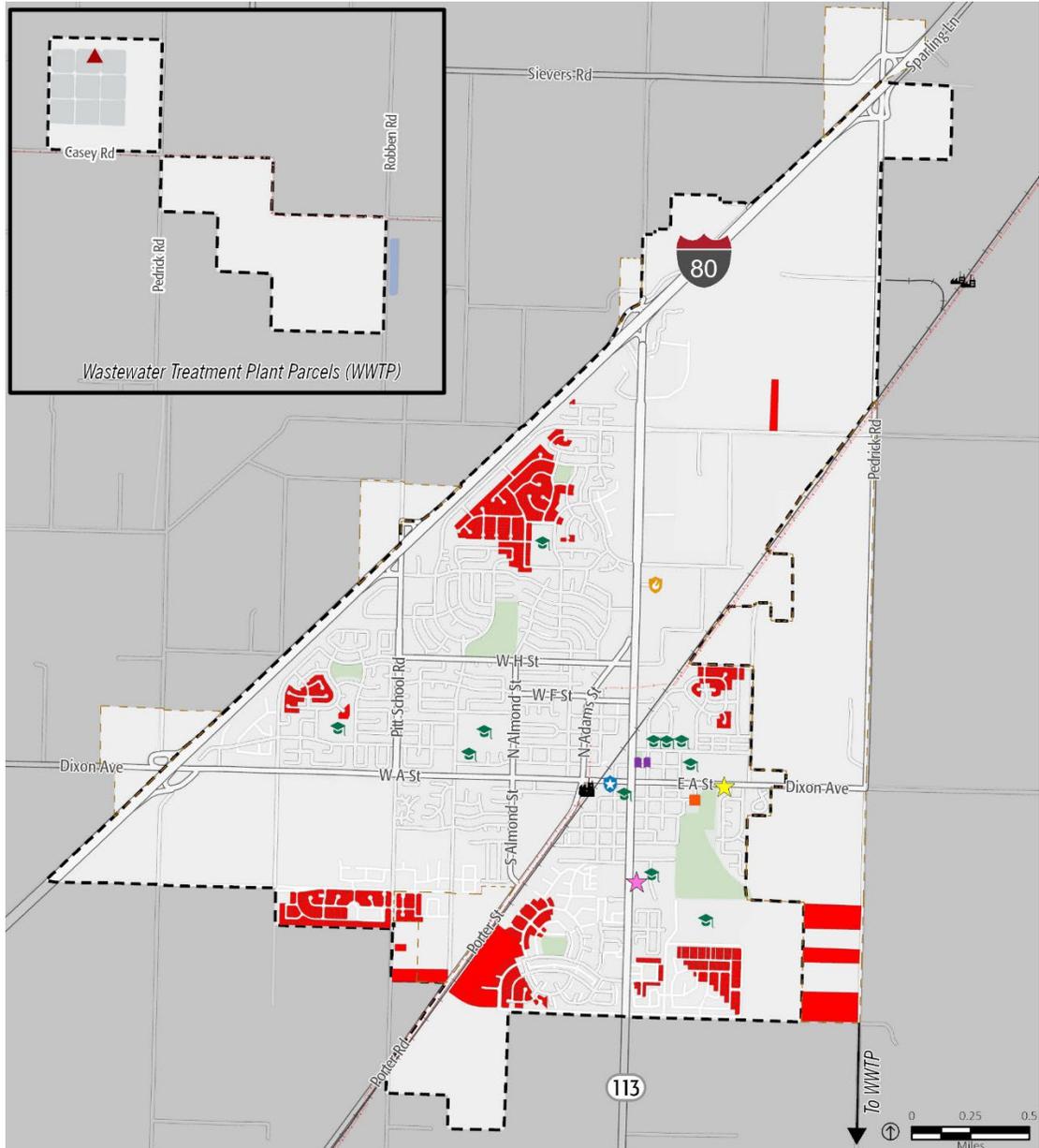


Source: Solano County 2021, PlaceWorks 2022, ESRI

- |                      |                           |                                     |
|----------------------|---------------------------|-------------------------------------|
| City Boundary        | Possible Evacuation Route | Police Station                      |
| Sphere of Influence  | City Hall                 | Fire Station                        |
| Railroad             | Community Center          | Water/Wastewater Treatment Facility |
| Transmission Lines   | Library                   | Electrical Substation               |
| Parks and Open Space | School                    | Dixon May Fair Grounds              |

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**Figure 11: Residential Parcels with Evacuation Constraints**



Source: Solano County 2021, PlaceWorks 2022, ESRI

- |                      |  |                                     |
|----------------------|--|-------------------------------------|
| City Boundary        | Residential Parcels with Possible Evacuation Constraints | Fire Station                        |
| Sphere of Influence  | City Hall  | Police Station                      |
| Railroad             | Community Center   | Water/Wastewater Treatment Facility |
| Transmission Lines   | Library  | Electrical Substation               |
| Parks and Open Space | School   | Dixon May Fair Grounds              |

# NATURAL ENVIRONMENT ELEMENT

## **2.2.4 POTENTIAL CHANGES TO EMERGENCY PREPAREDNESS AND RESPONSE IN FUTURE YEARS**

### **Climate Change and Emergency Preparedness and Response**

Climate change-related changes in flooding, extreme heat, and severe weather patterns will likely make natural hazards-related emergencies both more frequent and more intense. Given the ability of floods, extreme heat, and severe weather to damage structures and infrastructure, as well as harm human health, increased frequency of these natural hazards will likely increase demand disaster preparation and recovery services. More frequent disasters will increase the need for adequate evacuation routes.

## **2.2.5 IMPLICATIONS FOR THE NATURAL ENVIRONMENT ELEMENT UPDATE**

Policies within this section should address adequacy of city-wide evacuation facilities and emergency response services. Examples of specific policies could include addressing the needs of evacuation-constrained parcels via road construction, operating evacuation assistance programs in conjunction with local transit providers to help those with limited mobility or who lack access to a vehicle to safely evacuate and ensure that evacuation routes remain operational in the event of an emergency. Emergency warning policies could include working with the Fire and Police Departments to increase enrollment in AlertSolano and Dixon Community Connect, as well as identifying additional emergency warning mechanisms that can increase access to emergency warnings among isolated or socially vulnerable members of the community. Creation of centrally located resilience hubs designed to serve the emergency response needs of Dixon's most vulnerable populations, including the elderly, disabled, financially stressed, and those who face high levels of exposure to climate change hazards due to unstable or unsound housing or outdoor work conditions would help residents prepare for emergencies and evacuations.

## **2.3 HAZARDOUS WASTE AND MATERIALS**

Hazardous materials are materials that pose a significant risk to public safety, human welfare, or environmental health. These include toxic chemicals, flammable or corrosive materials, petroleum products, and unstable or dangerously reactive materials. They can be released through human error, malfunctioning or broken equipment, or as an indirect consequence of other emergencies (e.g., if a flood damages a hazardous material storage tank). Hazardous materials can also be released accidentally during transportation, as a consequence of vehicle accidents.

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A release or spill of bulk hazardous materials could result in fire, explosion, toxic cloud, or direct contamination of water, people, and property. The effects may involve a local site or many square miles. Health problems may be immediate, such as corrosive effects on skin and lungs, or gradual, such as the development of cancer from a carcinogen. Damage to property could range from immediate destruction by explosion to permanent contamination by a persistent hazardous material.

Pesticides used on nearby agricultural lands or in local landscaping run off into water and can impact the soils and groundwater. CalEnviroScreen ranks all four of Dixon's census tracts in the highest quarter of the state for risk of exposure to pesticides.<sup>26</sup>

Point sources<sup>27</sup> of pollution in Dixon includes contaminated sites within the city, such as gas stations with leaking underground storage tanks, fertilizer shops, and former trucking sites, all of which can release chemicals. According to the State Department of Toxic Substance Control's (DTSC) EnviroStor database, Dixon contains six sites with known hazardous substance contamination. One of these sites is classified as active, two are non-operating, one is operating under an operating permit, and two are schools that require no further action.

CalEnviroScreen ranks the census tract that contains downtown Dixon in the ninety-first percentile for risk of groundwater contamination due to the number of underground cleanup sites, including gas station fuel tanks, solvents, heavy metals, and pesticides. According to the State Water Boards' GeoTracker database, Dixon contains 48 underground storage tank sites that have the potential to impact water and groundwater quality. The status of 40 of these sites is classified as complete – case closed. The remaining eight open sites are undergoing remediation, site assessment, verification monitoring, or assessment and interim remedial action. Of the total 48 sites, 36 are leaking underground storage tank sites, the remaining sites are cleanup program sites. The Dixon area also has 33 plugged and abandoned oil wells, which could also impact groundwater and soils.<sup>28</sup> Sites with any contamination are required to undergo remediation before any development occurs on them to protect future occupants.

Hazardous materials could be transported by vehicle, railways, or through transmission lines such as pipelines. Major transportation routes include I-80, SR-113, and surface streets, particularly arterials and expressways that accommodate truck traffic. The Union Pacific Railroad, which bisects the city in a southwest-northeast direction, could be used to transport hazardous materials.

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## 2.3.1 HAZARDOUS MATERIALS MANAGEMENT AND RESPONSE

State laws regulate underground storage tanks (USTs) containing hazardous substances. These laws are primarily found in California's Health and Safety Code. The laws contain requirements for UST permitting, construction, installation, leak detection monitoring, repairs, and correct actions and closures.

The California DTSC has primary regulatory responsibility, with the delegation of enforcement to local jurisdictions that enter into agreements with the state agency, for the management of hazardous materials and the generation, transport, and disposal of hazardous waste under the authority of the Hazardous Waste Control Law. The DTSC is responsible for compiling a list of hazardous materials sites pursuant to Government Code Section 65962.5, which includes five categories:

1. Hazardous waste facilities subject to corrective action pursuant to Section 25187.5 of the health and safety code.
2. Land designated as "hazardous waste property" or "border zone property."
3. Properties with hazardous waste disposals on public lands.
4. Hazardous substance release sites selected for (and subject to) a response action.
5. Sites included in the Abandoned Site Assessment Program.

The California Environmental Protection Agency (Cal EPA) plays a major role in overseeing the management of hazardous materials and waste within California. In 1993, SB 1082 gave Cal EPA the authority and responsibility to establish a unified hazardous waste and hazardous materials management and regulatory program, commonly referred to as the Unified Program. The purpose of this program is to consolidate and coordinate six different hazardous materials and hazardous waste programs, and to ensure that they are consistently implemented throughout the state. State law requires county and local agencies to implement the Unified Program. The agency in charge of implementing the program is called the Certified Unified Program Agency (CUPA). The Solano County Department of Resource Management is the designated CUPA for the county. As the CUPA, the Department of Resource Management administers the following Unified Programs:

- Hazardous Materials Release Response Plans and Inventory (Business Plan) Program
- California Accidental Release Prevention Program
- Underground Storage Tank Program

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- Hazardous Waste Generator and Hazardous Waste On-Site Treatment Program
- Aboveground Storage Tank Program (Spill Prevention, Control, and Countermeasure Plans)

The Dixon Fire Department may also respond to hazardous materials incidents. Dixon City Council Resolution No. 18-057 authorizes the Mayor to enter in a Mutual Aid Agreement by and between Solano County Fire Agencies for all Hazard Emergency Response. The California Department of Transportation (Caltrans) is the first responder for hazardous materials spills and releases that occur on highway and freeway lanes and inter-city rail services.

The Solano County Department of Resource Management is also the designated administering agency for Solano County's Area Hazardous Material Monitoring Program. In the event of a spill or release, this agency should be notified immediately to obtain the most up-to-date hazmat storage locations information. Major incidents are coordinated through the County Office of Emergency Services.

## **2.3.2 PAST OCCURRENCES**

Dixon is subject to periodic hazardous materials spills. The Governor's Office of Emergency Services has recorded 45 hazardous materials spills in Dixon between 2006 and 2022. Twenty-eight of these spills were petroleum spills, seven were classified as chemical spills, six as vapor spills, and four as either railroad or another type of spill.

## **2.3.3 POTENTIAL CHANGES TO HAZARDOUS MATERIALS IN FUTURE YEARS**

### **Likelihood of Future Occurrence**

The presence of I-80 and the Union Pacific railway mean that Dixon will likely continue to be subject to minor hazardous materials in the future. The use of agricultural chemicals in and around Dixon will likely continue to influence local air, soil, and water quality.

### **Climate Change and Hazardous Materials**

Climate change is unlikely to substantially affect hazardous materials transportation incidents. However, increases in the frequency and intensity of hazards, such as floods and severe weather may create a greater risk of hazardous materials releases during these events.

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## 2.3.4 IMPLICATIONS FOR THE NATURAL ENVIRONMENT ELEMENT UPDATE

The Natural Environment Element Update can improve Dixon’s response to and management of hazardous materials by introducing policies to:

- Encourage business owners and residents to reduce their own use of hazardous materials.
- Promote agricultural practices that limit pesticide use.
- Providing health resources to residents who may be at elevated risk of chemical exposure at work or at home.

## 2.4 ADDITIONAL CLIMATE CHANGE HAZARDS

### 2.4.1 AGRICULTURAL AND ECOSYSTEM PESTS

According to the Solano County Crop and Livestock Report, agriculture and livestock production had a value of \$357 million in 2020.<sup>29</sup> In 2020, top agricultural commodities were almonds, tomatoes, nursery products, cattle and calves, and walnuts. Agricultural pests and diseases can affect crop plants, orchards, and nurseries throughout and surrounding the City of Dixon. Pests and diseases can slow the growth of plants, inflict damage, or lead to fatalities.

Major pests of concern in Solano County include Asian Citrus Psyllid, European Grapevine Moth, Glassy-Winged Sharpshooter, Gypsy Moth, Japanese Beetle, Light Brown Apple, Mediterranean Fruit Fly, Melon Fly, Oriental Fruit Fly, Asian Gypsy Moth, Rosy Moth, Nun Moth, and Siberian Silk Moth.<sup>30</sup> Pesticides and herbicides can help crops resist pests and diseases and new crop varieties may be pest-resistant; however, quickly evolving pests may make it difficult for some plant species to survive; changing crop varieties can also be expensive for farm owners.

Due to the severe vulnerability of the agricultural economic driver to pests and diseases, outdoor workers and immigrant communities are also highly vulnerable, as many people from these populations work in agriculture. Persons working in these industries may be indirectly affected by agricultural and ecosystem pests and diseases that damage crops. Damage to agricultural assets can reduce work opportunities, create economic hardships for some workers, and cause employees to be let go from their jobs when farms experience economic hardships.

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Livestock operations can be harmed by an increase in persistence and dispersal of animal pathogens due to warmer temperatures.<sup>31</sup> These pests and diseases could lead to declines in overall production of meat, eggs, and dairy products, as well as decreased reproductive capabilities of livestock. Impacts could become chronic as conditions continue to change and warmer temperatures persist. Livestock operators can use medicine and other methods to prevent or slow the spread of animal pathogens. However, this may become more difficult to do as pests and diseases worsen and combined with drought and extreme heat.

## 2.4.1.1 Agricultural and Ecosystem Pest Reduction and Response

Pest exclusion is the first line of defense to prevent detrimental, non-native pests from entering the county. In 2020, a total of 457 premise visits occurred at shipping terminals, nurseries, and residences in the county. During these visits, 2,002 shipments of plant material, seed, and household goods were inspected. A total of 17 shipments were rejected for live pests, material not properly certified, or improper container markings. County staff inspected 11 production nurseries, encompassing 1,572 acres, for pests and diseases.

Pest detection is Solano County's second line of defense against the introduction and spread of insect pests of concern. Insect traps are placed throughout the county and monitored for early detection of pests. In 2020, 22,320 inspections were conducted on a total of 2,712 traps.

The County also implements the following programs to address agricultural and ecosystem pests and diseases:

- The Pierce's Disease Control Program works to prevent the spread of the glassy-winged sharpshooter into Solano County, which is the main insect vector of Pierce's Disease. In 2020, Department personnel inspected 533 shipments of nursery stock arriving from infested counties in California.
- The Sudden Oak Death program prevents the spread of the disease caused by the pathogen *Phytophthora ramorum*. Department personnel conducted 46 inspections at 9 production shipping nurseries.
- The Phytosanitary Certification Program ensures that plants and plant communities shipped to other states or foreign countries are free from injurious pests. Solano County personnel performed 812 phytosanitary field inspections on 7,137 acres of seed crops.<sup>32</sup>

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## 2.4.1.2 Past Occurrences

False yellowhead (*Dittrichia viscosa*) is a State-listed noxious weed originating from the south Mediterranean, first found in western Solano County in 2014. This was the first documented sighting in California. *D. viscosa* is a world-wide weed of concern that proliferates in disturbed landscapes such as roadsides and burn sites. It is a threat to Solano County's unique biodiversity and is toxic to livestock. The Solano County Agricultural Department, in cooperation with Caltrans, has established an eradication project area between Vallejo and Fairfield.<sup>33</sup>

In 2017, a quarantine was initiated in response to the Mediterranean fruit fly (*Ceratitidis capitata*). This quarantine encompassed 108 square miles of Solano County and was declared eradicated in August 2018 by the California Department of Food and Agriculture and the Solano County Agricultural Commissioner's Office. Eradication efforts included fruit removal from trees in hot spot areas, organic insecticidal bait treatments, and the release of over 100 million sterile Mediterranean fruit flies to disrupt the reproduction cycle of the pest.<sup>34</sup>

## 2.4.1.3 Potential Changes to Agricultural and Ecosystem Pests in Future Years

### *Likelihood of Future Occurrence*

Agricultural and ecosystem pests will likely maintain an ongoing presence in Solano County and Dixon, though their activity can be at least partially managed via the County's pest-control initiatives.

### *Climate Change and Agricultural and Ecosystem Pests*

Pest activity is likely to increase as higher temperatures caused by global warming allow insects to reproduce more rapidly and increase the activity window for pests and diseases. Row crops can be affected by fungal pathogens and invasive disease vectors as temperatures continue to rise, affecting the quality and viability of crops.

## 2.4.1.4 Implications for the Natural Environment Element Update

Dixon's Natural Environment Element Update can help the community prepare for and respond to agricultural and ecosystem pests by including policies to:

- Support local and regional collaboratives addressing pest management and monitoring;

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- Help members of the agricultural community identify and implement best management practices for pest management; and
- Support members of the Dixon community who may find their employment jeopardized by agricultural pests.

## 2.4.2 DROUGHT

A drought is an extended period when precipitation levels are well below normal. Drought is a normal part of the climate cycle. Drought may cause losses to agriculture; affect domestic water supply, energy production, public health, and wildlife; and contribute to wildfire. Like most of California and the western United States, Dixon chronically experiences drought cycles.

The U.S. Drought Monitor recognizes a five-point scale for drought events: D0 (abnormally dry), D1 (moderate drought), D2 (severe drought), D3 (extreme drought), and D4 (exceptional drought). As of May 2022, the eastern portion of Solano County was classified as being in “extreme” drought and the western half was classified as being in “severe” drought.

Groundwater from the Solano Subbasin is the sole source of water for Dixon, which is provided through City-owned and operated wells. The City is one of two water purveyors within the City limits, providing potable water to the residences and businesses within Core, North, and South Zones of the city.<sup>35</sup> California Water Service, or Cal Water, provides water services to the remaining residences and businesses in the center of the city.<sup>36</sup> The Solano Subbasin includes the southernmost portion of the Sacramento Valley Groundwater Basin and extends into the northern portion of the Sacramento-San Joaquin Delta. The Solano Subbasin is hydrologically complex, with influences from a variety of surface water features and tidal influences and encompasses both shallow and deeper groundwater resources. The primary sources of surface water for the subbasin are watersheds in the lower-elevation Coast Range Mountains, which lack significant snowpack. Overall long-term trends in groundwater levels are stable in the subbasin with some declining levels evident in localized areas, most notably in the northwestern part of the subbasin.<sup>37</sup>

Climate change is projected to result in increases in net seepage, indicating greater stream seepage to groundwater, as well as decreases in deep percolation, decreasing inflows to the groundwater basin. Climate change is also expected to result in pumping increases. However, analysis conducted by the Solano Subbasin Groundwater Sustainability Agency (GSA) suggests that the overall annual change in storage will remain positive.<sup>38</sup>

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Households in poverty, immigrant communities, low-resourced people of color, outdoor workers, and pollution-burdened populations are especially vulnerable to the effects of drought. During drought conditions, additional water may be pumped from the Solano Subbasin, potentially causing overdraft or reduced water quality. This may cause water prices to increase beyond what households in poverty and low-resourced people of color are able to pay.<sup>39, 40</sup> Water quality may also decrease as nutrients such as nitrate build up due to lack of water flows. Households in poverty and low-resourced people of color may be able to reduce water costs by reducing overall water use. The Solano County Water Agency (SCWA) also provides several water rebate and retrofit programs to incentivize reducing water use.

Drought can reduce water availability for agricultural operations and livestock, which can indirectly harm outdoor workers by making less work available to them. Major crops, such as almonds, tomatoes, and nursery products, are highly dependent on irrigation from groundwater wells. Drought conditions can decrease the availability of groundwater for irrigation, reducing the yield from farms and vineyards. In severe instances, farmers may choose to replace water-intensive plants with less thirsty crops. These operations can be reduced or halted, which may cause outdoor workers to lose jobs and suffer from financial-related hardships, such as food insecurity, substandard housing, displacement, and homelessness.<sup>41</sup> Outdoor workers and immigrant communities may be highly dependent on this industry and face economic hardship if work is halted to delayed. The Solano Subbasin has a Groundwater Sustainability Plan (GSP) to ensure long-term sustainable management of the groundwater basin that supports most the county's agricultural operations. However, some measures require significant reduction in water use, which may be difficult for farmland. Water quality may also decrease with lower water levels. Populations already facing high levels of pollution exposure from pesticides, fertilizers, and other contamination sources who rely on groundwater would likely see a decrease in water quality during drought events due to an existing high nitrate problem in groundwater near Dixon.<sup>42</sup> Decreased water quality could cause illnesses for pollution-burdened populations. Additional water treatment could help reduce nutrient concentrations during drought conditions, but these treatment options may be expensive for the City of Dixon and Cal Water to implement.

The City's wetland ecosystems are also especially vulnerable to drought impacts. Wetland ecosystems are largely dependent on rainfall and natural springs for their water sources throughout the year. Droughts can reduce spring and summer soil moisture in wetlands, which can cause tree and shrub encroachment on this ecosystem.<sup>43</sup> Due to their low connectivity and fragmented distribution, it can be difficult for wetlands to adapt to drought conditions.<sup>44</sup> Ecosystem managers can restore floodplain

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function and reduce negative effects of roads and trails on these systems.<sup>45</sup> However, this could be difficult and expensive to do, and would require extensive coordination with multiple agencies.

## 2.4.2.1 Drought Hazard Reduction and Response

Cal Water has developed a Water Shortage Contingency Plan in its Urban Water Management Plan to address potential water shortage conditions. The Water Shortage Contingency Plan includes a variety of actions that Cal Water can implement to reduce demands and further ensure supply reliability at various levels of water shortage. Measures include limiting irrigation, expanding rebates for water efficiency, increasing water waste enforcement, and implementing a drought rate structure and customer water budgets. Section 14.02.275 of the Dixon Municipal Code adopts the State's Model Water-Efficient Landscape Ordinance and requires all vegetation and landscaping required by the zoning regulations to employ low water use and drought-resistant species.

The 2022 Solano Subbasin GSP was developed by the Solano Subbasin GSA Collaborative to ensure the sustainable management of the region's groundwater. The Solano Subbasin GSA Collaborative includes the Solano GSA, City of Vacaville GSA, Sacramento County GSA, Solano Irrigation District GSA, and the Northern Delta GSA. The Solano Subbasin GSA Collaborative developed a single GSP for the Solano Subbasin to fulfill the requirements of the Sustainable Groundwater Management Act. Projects and management actions set forth in the GSP include developing outreach materials and incentives for municipal and industrial water users to increase water-use efficiency, evaluating the use of specific managed aquifer recharge activities on local farms, developing a program to incentivize voluntary participants to reduce water consumption, monitoring Solano Subbasin conditions, providing groundwater education to the community, and expanding the use of recycled water.

## 2.4.2.2 Past Occurrences

Major droughts have occurred periodically throughout California in the Solano County region. Recent major droughts include:

- **1896 to 1900:** A four-year drought occurred in the Vaca Valley area of Solano County. Within two years, fruit production in this area dropped by more than 50 percent.
- **1975 to 1977:** The two driest years (1976 and 1977) in the State of California's history resulted in severe drought conditions in Solano County. The drought was declared an Emergency (FEMA-EM-3023) on January 20, 1977, and a State disaster in Solano County in February

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1976. Crop damages statewide totaled \$2.67 billion dollars for both years (\$888.5 million in 1976 and \$1.8 billion in 1977).

- **1991:** A drought emergency was declared for Solano County. The US Department of Agriculture (USDA) provided \$995 million for crop losses in 1990-1991 nationwide, and an additional \$775 million in emergency funds for 1990-1992 crop losses.
- **2004:** The Small Business Administration (SBA) declared an Economic Injury Disaster in Solano County (Declaration #10073) for drought conditions, which occurred March 1 through September 23, 2004. Small, non-farm businesses in Solano County were able to apply for Economic Injury Disaster Loans to cover working capital needs. The declaration covered the impact of reduced revenue caused by the drought. These loans were available to offset the economic losses caused by reduced revenue from farmers and ranchers whose crop production suffered.
- **2006 to 2009:** A California State-declared three-year drought of below-average rainfall, low snowmelt runoff, and the largest court-ordered water restriction in state's history. The dry conditions damaged crops, deteriorated water quality, and caused extreme wildfire danger. Approximately \$300 million in agricultural revenue loss, and a potential \$3 billion in economic losses over time.
- **2012 to 2016:** The years of 2012 to 2016 were particularly dry for much of the state. The USDA included all of California's counties in its drought disaster designations at various times over the course of the drought. An emergency proclamation was issued in January 2014 that ordered state agencies to take specified actions and called on Californians to voluntarily reduce their water usage by 20 percent. In April 2014, the Governor issued an Executive Order to redouble state drought actions that ordered the State Water Resources Control Board to adopt emergency regulations as necessary to direct urban water suppliers to limit wasteful outdoor water use practices and ordered the Department of Water Resources to conduct intensive outreach to local agencies to increase their groundwater monitoring in areas of significant impacts.<sup>46</sup> In September 2014, Urgency Ordinance 14-012 limited or prohibited the use of potable water for outdoor landscaping, car washing, cleaning driveways and sidewalks, and in fountains in the absence of a recirculation system.<sup>47</sup>

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## 2.4.2.3 Potential Changes to Drought in Future Years

### *Likelihood of Future Occurrence*

Drought is different than many of the other natural hazards in that it is not a distinct event and usually has a slow onset. Drought can severely impact a region both physically and economically, affecting different sectors in different ways and with varying intensities.

Based on historical information, the occurrence of drought in California, including Solano County, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on comparing observed precipitation with what is normal (climatologic), comparing soil moisture and crop conditions with what is normal (agricultural), or by looking at groundwater levels (hydrologic). However, how individuals recognize drought depends on the ways in which it affects them. The impacts from drought include reduction in water supply and an increase in dry fuels. Dixon's groundwater supply is expected to be sufficient to meet demands during an extended five-year drought period.

### *Climate Change and Drought*

Although droughts are a regular feature of California's climate, scientists expect that climate change will lead to more frequent and intense droughts statewide. Overall, precipitation levels within Dixon are expected to increase slightly, from a historical average of 18.5 to 21.3 inches per year by the middle of the century (2035 to 2064) and to 23.9 inches per year by the end of the century (2070 to 2099).<sup>48</sup> However, the state's current data say that there will be more years with extreme levels of precipitation, both high and low, as a result of climate change. This is expected to cause more frequent and intense droughts compared to historical norms that cause soil to dry out and become hard.

When precipitation does return, more water runs off the surface than is absorbed into the ground, which can lead to floods. Higher air temperatures are expected to increase evaporation, causing more water loss from lakes and reservoirs, exacerbating drought conditions. Climate strongly influences the level and seasonal pattern of local water demands. Cal Water has estimated that climate change may, on average, increase future water demands by 2 to 3 percent compared to current climate conditions, though there may be significant year-to-year variation.

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## 2.4.2.4 Implications for the Natural Environment Element Update

The Natural Environment Element already contains a number of provisions for conserving water and managing drought conditions. Additional policies could address:

- The promotion of water-efficient landscaping on existing private property;
- Collaborating with the Solano County Water Agency and Dixon Resource Conservation District to share best practices regarding drought management and distribute resources to the community;
- Working with the agricultural community to experiment with water-wise agricultural techniques;
- Providing public education and outreach about water-use efficiency; and
- Providing support to Dixon residents whose employment may be adversely affected by drought.

## 2.4.3 EXTREME HEAT

While there is no universal definition of extreme heat, California guidance documents define extreme heat as temperatures that are hotter than 98 percent of the historical high temperatures for the area, as measured between April and October of 1961 to 1990. Days that reach this level are called extreme heat days. In Dixon, the extreme heat day threshold is 103.7°F. An event with five extreme heat days in a row or more is called a heat wave.

Health impacts are the primary concern with high heat days, though economic impacts are also an issue. The Center for Disease Control and Prevention (CDC) recognizes extreme heat as a substantial public health concern. Historically, NOAA data indicates that about 175 Americans succumb to summer heat, although this number has increased in recent years. From 2004 to 2018, studies by the U.S. Department of Health and Human Services indicate that there is an average of 702 deaths annually that are directly or indirectly linked to extreme heat.<sup>49</sup>

Extreme heat events are dangerous because people exposed to extreme heat can suffer heat-related illnesses, including heat cramps, heat exhaustion, and (most severely) heat stroke. As reflected in **Appendix A**, elderly persons, small children, persons with chronic illnesses and/or disabilities, persons experiencing homelessness, outdoor workers, and households in poverty are particularly vulnerable to extreme heat.

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Households in poverty, low-resourced people of color, immigrant communities, individuals experiencing homelessness, and outdoor workers all encounter barriers that increase their exposure to extreme heat. These populations may be less likely to have access to adequate shelter from heat, including stable housing in good condition and air conditioners.<sup>50</sup> Reduced access to medical services due to financial challenges or immigration status can mean that these populations are more likely to have medical conditions that may be exacerbated by extreme heat events. Lack of access to a vehicle makes it harder to seek temporary shelter in a cooling center, such as the Dixon Senior Center or Library. These populations may also not feel comfortable traveling to designated cooling centers or may not be aware that such services exist. Individuals who own their own homes can participate in weatherization assistance programs through energy-efficiency financing programs. However, these populations may be unaware of these services.

Individuals working outdoors in the agriculture, construction, or landscaping industries face a much greater exposure to extreme heat events than many other persons, as they do not work in sheltered locations. Outdoor work is often physically intense, increasing the risk of individuals overheating, suffering heat-related medical complications, or making dangerous mistakes due to fatigue that can cause additional harm.<sup>51, 52</sup> Outdoor work may be curtailed during significant extreme heat events, which can cause significant economic hardships. Outdoor worksites can make water, shelter, and protective gear available during extreme heat events in compliance with Occupational Safety and Health Administration (OSHA) standards, although these requirements are difficult to enforce.<sup>53</sup> The California Extreme Heat Action Plan aims to improve these enforcement actions.<sup>54</sup>

Children and the elderly are especially physiologically sensitive to the effects of high heat. Children may have a lower level of awareness about the need to stay hydrated or may be unable to articulate their needs regarding the early symptoms of heat-related illnesses, preventing them from taking action to avoid heat-related illnesses. This can be particularly concerning for children who do not always have adequate adult supervision. Seniors are physically more susceptible to heat-related illnesses, which can exacerbate existing medical conditions and create heat-related complications. In general, seniors are more likely to suffer medical complications or death during extreme heat events than other members of the population.<sup>55</sup> Seniors living alone can seek relief from extreme heat through air conditioning, wearing cool clothes, and staying hydrated. If air conditioning is not available, seniors living alone can go to one of the two cooling centers in Dixon. Many seniors have limited mobility, and some have decreased awareness, preventing them from traveling to cooling centers or adequately responding to extreme heat conditions. Seniors living alone may not be able to seek help if they become ill. DART Paratransit, Readi-Ride, SolTrans, Solano County Mobility Program, Pace Solano, and Solano County In-Home Support Services can also help seniors travel to cooling centers or

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heating centers. Extreme heat conditions will most likely affect electricity transmission and distribution lines in and surrounding Dixon, as temperatures are projected to increase substantially on extreme heat days. Extreme heat can cause an increase in air conditioning use, which can stress and overload the grid, subsequently causing rolling power outages and damage to the lines. In buildings where there is currently no air conditioning, new air conditioning units could be installed, stressing the transmission and distribution lines further. Electricity transmission lines can be turned off through rolling power outages during extreme heat events to reduce damage to lines and substations from overworking due to increased energy demand. However, this could disrupt local services and economic activity.

The City of Dixon experiences the urban heat island effect,<sup>56</sup> meaning that temperatures within the city are often significantly higher than those within outlying less developed areas. Urban heat islands often occur in areas that lack open space and shade and are built up with heat-absorbing materials such as asphalt. During high heat events, demand for air conditioning and other types of cooling services will likely be elevated with urban heat islands, and the health effects of high heat may be especially severe. While areas affected by the urban heat island effect occur throughout the city, the center of the city is especially vulnerable.<sup>57</sup> Residents of older homes, which are more likely to lack air conditioning and effective insulation, are also vulnerable to high heat. Approximately 44 percent of Dixon's housing stock was constructed prior to 1980.<sup>58</sup>

Extreme heat can lead to thermal expansion of railroad tracks and cause warping or buckling of the tracks.<sup>59</sup> This can subsequently cause train accidents, slowing of rail and freight services, or suspension of all rail traffic. If a train accident were to occur in Dixon, the eastern portion of the city would be cut off from the other areas of the city, making evacuation more difficult during emergencies.

Dixon's agricultural and livestock industries will likely be affected by rising temperatures. Climate change is expected to alter the variety of crops that can be grown in the region and diminish productivity of some crops, while increasing the productivity of others. Yields of wine grapes are expected to decrease.<sup>60</sup> Warmer temperatures may also increase water demands for agriculture and reduce plant growth.<sup>61, 62</sup> Very few options are available for farmers to protect their crops from extreme heat. Heat-resistant varieties of some crops exist, but the cost to replace existing crops with heat-resistant strains can be very expensive and may not be economically viable.

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Extreme heat is also highly harmful to livestock animals, especially cattle. Temperatures above 100°F can create heat stress, increasing the risk of infection, reducing milk production and fertility, and may lead to death, particularly among animals that are already stressed by illness. Providing shade structures, misters, and making water available can help reduce heat stress. However, for animals in pasture environments, this may not be an option. Recent extreme heat events in other parts of California have caused significant cattle mortality despite ranchers' best efforts, becoming severe enough to prompt some communities to declare local emergencies as a result.

Very high temperatures can harm plants and animals that are not well adapted to them, including natural ecosystems. Extreme heat can increase the temperature of water in streams, creeks, and other water bodies, especially during drought events when water levels are lower. In some cases, water temperatures may exceed comfortable levels for several plants and animals, causing ecological harm. Outdoor workers in construction or agriculture are also much more exposed to the elements than most people, so they are more susceptible to extreme heat conditions and the potential illnesses associated with very high temperatures.

Indirectly, extreme heat puts more stress on power lines, causing them to run less efficiently. The heat also causes more demand for electricity (usually to run air conditioning units), and in combination with the stress on the power lines, may lead to rolling blackouts.

## **2.4.3.1 Past Occurrences**

In June 2000, very hot weather persisted across interior Northern California for three days. Sixteen people were treated for heat stroke in Sacramento and Solano Counties and one individual, a 16-year-old male in West Sacramento, died. A heavily used portion of I-80 between Sacramento and San Francisco was closed for several hours to repair three lanes in which the asphalt had buckled due to the sustained heat. Power outages were suffered by more than 100,000 customers during the event.

In June 2013, strong high pressure built across the Solano County region, which resulted in very hot temperatures on June 7 and 8, accompanied by warm overnight temperatures. The heat sickened at least 15 people, 2 critically. Many of those stricken suffered heat exhaustion and heat stroke and ranged from 15 to 80 years of age and older.

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## 2.4.3.2 Potential Changes to Extreme Heat in Future Years

### *Likelihood of Future Occurrence*

Extreme heat tends to occur on an annual basis and is likely to continue occurring annually. Due to Dixon's inland location and relatively low elevation, high temperatures will continue to be a more common occurrence than cold temperatures.

### *Climate Change and Extreme Heat*

The warmer temperatures brought on by climate change are likely to cause an increase in extreme heat events. Depending on the location and emissions levels, the state Cal-Adapt database indicates the number of extreme heat days is expected to rise from a historical annual average of 4 days per year to 29 days per year by the middle of the century (2035 to 2064), and to 53 days per year by the end of the century (2070 to 2099).

Overall, Dixon is expected to see an increase in the average daily high temperatures. The Cal-Adapt database indicates the annual average maximum temperature is expected to increase from a historical annual average of 74.9°F to an average of up to 80.3°F by the middle of the century (2035 to 2064), and an average of 83.6°F by the end of the century (2070 to 2099). These increases make it more likely that an above-average daily high temperature will cross the extreme heat threshold. As temperatures increase, Dixon will face increased risk of death from dehydration, heat stroke, heat exhaustion, heart attack, stroke, and respiratory distress caused by extreme heat.

## 2.4.3.3 Implications for the Natural Environment Element Update

The Natural Environment Element Update can help protect the community from the effects of heat by:

- Providing for the continued support and maintenance of cooling centers;
- Providing public education about the health impacts of high heat;
- Providing support for residents looking to make weatherization improvements to their homes;
- Ensuring that public facilities such as schools and bus stops are adequately protected from heat; and
- Providing house calls to residents such as single seniors who are particularly vulnerable to heat.

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## 2.4.4 SEVERE WEATHER

Severe weather is generally any destructive weather event and can occur in the form of heavy rain, hail, thunderstorms, and strong winds. Severe weather is usually caused by intense storm systems, although types of strong winds can occur without a storm. The types of dangers posed by severe weather vary widely and may include injuries or deaths, damage to buildings and structures, fallen trees, roads and railways blocked by debris, and fires sparked by lightning. Severe weather often produces high winds and lightning that can damage structures and cause power outages. Lightning from these storms can ignite wildfires and structure fires that can cause damage to buildings and endanger people. Objects such as vehicles, unprotected structures (e.g., bus stops, car ports), fences, telephone poles, or trees can also be struck directly by lightning, which may result in an explosion or fire.

A relatively common weather pattern that brings southwest winds and heavy rain to California is often referred to as an atmospheric river. Atmospheric rivers are long, narrow regions in the atmosphere that transport water vapor carried away from the tropics. These columns of vapor move with the weather, carrying large amounts of water vapor and strong winds. When the atmospheric rivers make landfall, they release this water vapor in the form of rain or snow, often causing heavy rains that can lead to flooding and mudslide events.

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as “severe” when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 57.5 miles per hour (mph), or tornado. However, tornadoes are uncommon in Solano County; only four have been recorded in the county since 1950.

High winds, often accompanying severe storms, can cause significant property damage, threaten public safety, and have adverse economic impacts from business closures and power loss. High winds, as defined by the National Weather Service, are sustained wind speeds of 40 mph or greater lasting one hour or longer, or wind gusts of 58 mph or greater for any duration. These winds may occur as part of a seasonal climate pattern or in relation to other severe weather events, such as thunderstorms.

All wind events pose several different types of threats. By themselves, the winds pose a threat to the health of people and structures in the city. Dust and plant pollen blown by the wind can create respiratory illnesses. The winds can blow roofs off buildings and cause tree limbs to fall on structures. High winds also increase the threat of wildfires. Winds may dry out brush and forest areas, increasing the fuel load in fire-prone areas. Winds may spark wildfires and interrupt power service by knocking

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down power lines or causing them to arc. If wildfires do start, high winds can push flames quickly into new areas, contributing to rapid spread of wildfires and making them harder to control. This can affect the air quality in Dixon and may disrupt regional infrastructure networks.

Households in poverty, outdoor workers, persons experiencing homelessness, and persons living in mobile homes are especially vulnerable to the effects of severe weather. These populations may lack access to sound and stable housing, may lack the financial resources necessary to prepare for and recover from severe weather, and may face elevated levels of exposure to severe weather. In addition to facing heightened exposure, outdoor workers may be jeopardized by severe weather. Weatherization programs for low/fixed-income households can help harden homes against severe weather. However, households in poverty may not have the financial means or transportation options to evacuate in emergencies or medical insurance to help pay for injuries caused by severe weather.<sup>63</sup> There are several services for persons experiencing homelessness across Solano County. However, none of these programs are in Dixon. Persons experiencing homelessness may also not be aware of homeless services, have the transportation to get there, and may not have the medical services available to them if they are sick or injured. Persons experiencing homelessness may have an extremely difficult time recovering if possessions are lost due to severe weather.

Electricity transmission and distribution lines can be damaged or destroyed by high-velocity winds. This can cause secondary impacts, such as power outages, which would impact Dixon residents and businesses. Electricity transmission lines can be shut off to reduce the chance of sparking; however, critical facilities may not have backup power generation, which could impede community services and key economic drivers. Electricity lines can also be undergrounded; however, this is expensive and would require extensive construction to complete.

## **2.4.4.1 Past Occurrences**

The greater Solano County area is subject to periodic extreme weather events, most frequently in the form of heavy rain, high wind, thunderstorms, and fog. In December 1997, dense fog contributed to a chain reaction collision on I-5 near Lambert, 17 miles south of downtown Sacramento, where 5 were killed and 26 were injured. In December 1998, 1 person was killed and 10 injured during a dense fog event that resulted in a vehicle pileup 10 miles northwest of downtown Sacramento on I-5.

In June 2000, one person was killed during a high wind event. Sustained winds of 30 to 40 mph blew through Carquinez Strait, pushing a motorcyclist on I-680 off the highway near Marshview Road.

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In January 2021, an atmospheric river event caused heavy rain and high winds across Northern California. Thousands of Solano County residents lost power, and rockslides, flooding, road closures, and downed trees occurred across the region.<sup>64</sup> Heavy rains also occurred in October 2021, triggering road closures, downed trees, and flooding across Solano County.<sup>65</sup>

## *Public Safety Power Shutoff Events*

Electricity utilities throughout California, including PG&E, have begun to occasionally “de-energize,” or turn off the electricity for power lines that run through areas where there is an elevated fire risk. This is intended to reduce the risk of power lines sparking or being damaged and starting a wildfire. As previously described, these activities, called public safety power shutoff (PSPS) events, result in a loss of power for customers served by the affected power lines. A PSPS event may occur at any time of the year, usually during high wind events and dry conditions. PSPS events may be limited to specific communities or they may affect broad swaths of the state. Four PSPS events affected Solano County in 2019, affecting more than 25,000 customers. Three PSPS events affected Solano County in 2021, the largest of which resulted in approximately 4,700 Solano County customers losing power.<sup>66</sup>

PSPS events can impact emergency management activities. A loss of power can make it more difficult for homes or businesses to receive emergency notifications if needed. PSPS events can also create vulnerabilities for community members that lack backup power supplies and depend on electricity for heating or cooling homes and buildings, lighting, and internet. PSPS events may also be harmful to people who depend on electrically powered medical devices. Additionally, community members may be faced with economic hardships and be deprived of important services, such as grocery stores, gas stations, and banks/ATMs. Traffic lights and other traffic-control systems may not work, which can complicate any evacuation needs and may hinder emergency response. Although critical public health and safety facilities often have backup generators, the loss of power may also disable other key infrastructure systems.

## **2.4.4.2 Potential Changes to Severe Weather in Future Years**

### *Likelihood of Future Occurrence*

According to historical hazard data, severe weather is an annual occurrence in Solano County. Damage related to severe weather has occurred and will continue to occur in the future. Strong winds are the most frequent type of severe weather occurrences in the county. Wind and lightning often accompany these storms and have caused damage in the past. However, actual damage associated with the primary effects of severe weather have been limited. The secondary hazards caused by severe weather, such as

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floods and fire, have had the greatest impact on the county. In general, any severe storm that affects Solano County has local effects in Dixon as well. Thunderstorms, high winds, and lightning can each have localized impacts on infrastructure, properties, and public safety. Transportation, including freight shipping, faces increased congestion when severe storms occur.

## *Climate Change and Severe Weather*

Climate change is expected to cause an increase in intense rainfall and strong storm systems, which is usually associated with strong storm systems. This means that Dixon could see more intense weather resulting from these storms in the coming years and decades, although such an increase may not affect all forms of severe weather. While average annual rainfall may increase only slightly, climate change is expected to cause an increase in the number of years with intense levels of precipitation. Heavy rainfall can increase the frequency and severity of other hazards, including flooding.

### **2.4.4.3 Implications for the Natural Environment Element Update**

The Natural Environment Element Update can help the City of Dixon prepare for the impacts of severe weather by:

- Supporting resiliency of the local power grid;
- Supporting weatherization retrofits for older homes;
- Regularly trimming trees;
- Providing support to workers whose employment may be jeopardized by severe weather;
- Expanding services for homeless individuals within Dixon; and
- Providing public education about how to prepare for and respond to severe weather.

### **2.4.5 HUMAN HEALTH HAZARDS**

Human health hazards are bacteria, viruses, parasites, and other organisms that can cause diseases and illness in people. Some of these diseases may cause only mild inconvenience, but others are potentially life threatening. These diseases can be and often are carried by animals, such as mice and rats, ticks, and mosquitos. Warmer temperatures and high levels of precipitation can lead to increased populations of disease-carrying animals, creating a greater risk of disease and increased rates of infection.

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Populations most vulnerable to human health hazards are those who spend a disproportionate amount of time outdoors (such as outdoor workers or persons experiencing homelessness), those with fragile immune systems or existing illnesses (which may include persons with chronic illnesses, seniors and seniors living alone, and pollution-burdened populations), and those who may live in sub-standard housing or not have access to health insurance and medical care (households in poverty, low-resourced people of color, immigrant communities, and overcrowded households). These persons may be living in conditions that increase their chances of catching vector-borne illnesses, lack the ability to fight off infections that may occur, or lack the financial resources to seek timely medical care.

## **2.4.5.1 Past Occurrences**

Isolated incidents of West Nile Virus and Lyme Disease have been a perennial concern within Solano County. However, there are no records of recent widespread disease incidents.

## **2.4.5.2 Potential Changes to Human Health Hazards in Future Years**

### *Likelihood of Future Occurrence*

Human health hazards of various scales and levels of severity are likely to occur in the future.

### *Climate Change and Human Health Hazards*

Increases in average temperature and changes in precipitation patterns favoring larger precipitation events may facilitate the growth and activity of disease-carrying vectors. Overall risk of human health hazards is thus expected to increase.

## **2.4.5.3 Implications for the Natural Environment Element Update**

The Natural Environment Element Update can help the Dixon community prepare for and respond to human health hazards by introducing policies to work with local public health agencies to monitor and report on emerging disease conditions and connecting low-income residents and residents who may lack access to health insurance with local healthcare organizations.

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## APPENDIX A – VULNERABILITY ASSESSMENT RESULTS MATRIX

### 3 APPENDIX A: VULNERABILITY ASSESSMENT RESULTS MATRIX

The Vulnerability Assessment evaluates the impact and adaptive capacity of 63 populations and assets for each of the relevant 8 hazards. Vulnerability scores of V1 to V5 were assigned to reflect how susceptible the population or asset is to the harm posed by the hazard. The following list describes what each score means:

- V1: Minimal Vulnerability
- V2: Low Vulnerability
- V3: Moderate Vulnerability
- V4: High Vulnerability
- V5: Severe Vulnerability

The City assessed 313 different pairings for vulnerability, 108 of which scored as highly or severely vulnerable. The following matrix provides the scores for each population and assets to each relevant hazard. Gray cells with a dash (-) indicate that a specific hazard is not applicable to a specific population or asset, and therefore was not scored.

POPULATIONS AND ASSETS	AGRICULTURE & ECOSYSTEM PESTS	DROUGHT	EXTREME HEAT & WARM NIGHTS	HUMAN HEALTH HAZARDS	FLOODING	LANDSLIDES	SEVERE WEATHER	WILDFIRE & SMOKE
<b>Populations</b>								
Children under 10	-	-	V5	V3	V3	-	V3	V4
Cost-burdened households	-	V1	V3	V3	V3	-	V3	V3
Households in poverty	-	V4	V5	V5	V5	-	V5	V5
Immigrant communities	V5	V4	V5	V4	V4	V3	V4	V5
Linguistically isolated persons	-	V2	V3	V3	V3	-	V3	V3
Low-income households	-	V2	V4	V3	V3	-	V3	V4

# NATURAL ENVIRONMENT ELEMENT

## APPENDIX A – VULNERABILITY ASSESSMENT RESULTS MATRIX

POPULATIONS AND ASSETS	AGRICULTURE & ECOSYSTEM PESTS	DROUGHT	EXTREME HEAT & WARM NIGHTS	HUMAN HEALTH HAZARDS	FLOODING	LANDSLIDES	SEVERE WEATHER	WILDFIRE & SMOKE
Low-resourced people of color	-	V4	V5	V5	V4	-	V4	V5
Outdoor workers	V4	V4	V5	V5	V3	V3	V5	V5
Overcrowded households	-	V2	V3	V4	V3	-	V2	V3
Persons experiencing homelessness	-	V3	V5	V5	V5	-	V5	V5
Persons living in mobile homes	-	V2	V4	V3	-	-	V5	V3
Persons living on single-access roads	-	V1	V2	V2	V4	-	V4	V2
Persons with chronic illness and/or disabilities	-	V2	V4	V5	V4	-	V4	V5
Persons without a high school degree	-	V2	V2	V2	V3	-	V2	V2
Persons without access to lifelines	-	V2	V4	V4	V5	-	V4	V3
Pollution-burdened populations	-	V5	V4	V5	V5	-	V3	V5
Renters	-	V1	V3	V3	V3	-	V3	V3
Seniors (65+)	-	V1	V4	V4	V3	-	V3	V4
Seniors living alone	-	V2	V5	V5	V4	-	V4	V5
Unemployed persons	-	V2	V3	V3	V3	-	V3	V3
<b>Infrastructure</b>								
Bicycling and pedestrian trails	V2	V2	V2	-	V3	V1	V3	-
Bridges	-	-	V2	-	-	-	V4	-

# NATURAL ENVIRONMENT ELEMENT

## APPENDIX A – VULNERABILITY ASSESSMENT RESULTS MATRIX

POPULATIONS AND ASSETS	AGRICULTURE & ECOSYSTEM PESTS	DROUGHT	EXTREME HEAT & WARM NIGHTS	HUMAN HEALTH HAZARDS	FLOODING	LANDSLIDES	SEVERE WEATHER	WILDFIRE & SMOKE
Communication facilities	-	-	V3	-	-	V2	V4	-
Electrical transmission infrastructure	V3	-	V5	-	V2	V2	V5	-
Electric vehicle charging stations	-	-	V3	-	-	-	V2	-
Hazardous materials sites	-	-	V3	-	V3	V2	V4	-
Major roads and highways	-	-	V4	-	V4	V2	V3	-
Natural gas pipelines	-	-	-	-	V1	-	-	-
Parks and recreation facilities	V3	V2	V3	-	V1	V3	V3	-
Railway	-	-	V5	-	V3	V3	V4	-
Solid waste facilities	-	-	V2	-	-	-	V3	-
Stormwater and flood control infrastructure	-	-	-	-	V5	V1	V3	-
Transit facilities	-	-	V2	-	-	-	V3	-
Water and wastewater infrastructure	-	V3	V2	-	V5	V3	V2	-
<b>Buildings</b>								
Community centers and libraries	-	-	V2	-	-	-	V3	-
Commercial businesses	-	-	V3	-	-	-	V2	-
Dixon May Fairground	-	-	V1	-	-	-	V4	-
Government buildings	-	-	V1	-	-	-	V2	-

# NATURAL ENVIRONMENT ELEMENT

## APPENDIX A – VULNERABILITY ASSESSMENT RESULTS MATRIX

POPULATIONS AND ASSETS	AGRICULTURE & ECOSYSTEM PESTS	DROUGHT	EXTREME HEAT & WARM NIGHTS	HUMAN HEALTH HAZARDS	FLOODING	LANDSLIDES	SEVERE WEATHER	WILDFIRE & SMOKE
Historic buildings and museums	-	-	V2	-	-	-	V4	-
Homes and residential structures	-	-	V3	-	V4	V3	V5	-
Medical and care facilities	-	-	V2	-	-	-	V3	-
Public safety buildings	-	-	V1	-	-	-	V1	-
Schools	-	-	V3	-	-	-	V3	-
<b>Economic Drivers</b>								
Agriculture	V4	V5	V5	V4	V5	V2	V4	V4
Construction services and industrial facilities	-	V2	V3	V4	V2	V2	V2	V3
Education services	-	V1	V3	V3	V3	-	V2	V3
Food and wholesale services	V3	V4	V4	V3	V4	V1	V3	V3
Livestock	V5	V4	V5	V2	V4	V2	V3	V3
Major employers	V3	V3	V3	V3	V3	V2	V3	V3
Retail centers	-	V2	V2	V3	V3	V1	V2	V2
<b>Ecosystems and Natural Resources</b>								
Annual grassland	V2	V3	V2	-	V3	-	V1	V3
Fresh emergent wetland	V3	V5	V5	-	V3	-	V1	V3
Riparian and riverine habitats	V3	V4	V3	-	V3	-	V4	V3

# NATURAL ENVIRONMENT ELEMENT

## APPENDIX A – VULNERABILITY ASSESSMENT RESULTS MATRIX

POPULATIONS AND ASSETS	AGRICULTURE & ECOSYSTEM PESTS	DROUGHT	EXTREME HEAT & WARM NIGHTS	HUMAN HEALTH HAZARDS	FLOODING	LANDSLIDES	SEVERE WEATHER	WILDFIRE & SMOKE
Groundwater	-	V3	V3	-	-	-	-	-
<b>Key Services</b>								
Communications services	V2	-	V3	-	V2	-	V4	V3
Emergency medical response	-	-	V2	V4	V2	-	V3	V2
Energy delivery	V2	V3	V5	-	V3	V3	V4	V5
Government administration & community services	-	-	V1	V1	V2	-	V2	V2
Public safety response	-	-	V1	V3	V1	-	V3	V2
Public transit access	-	-	V4	V2	V3	V2	V4	V4
Solid waste removal	-	-	V3	V3	V3	V3	V3	V3
Stormwater management and flood control	-	-	V1	-	V4	V1	V4	V1
Water and wastewater delivery	-	V4	V3	-	V5	V3	V3	V4

# NATURAL ENVIRONMENT ELEMENT ENDNOTES

## ENDNOTES

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