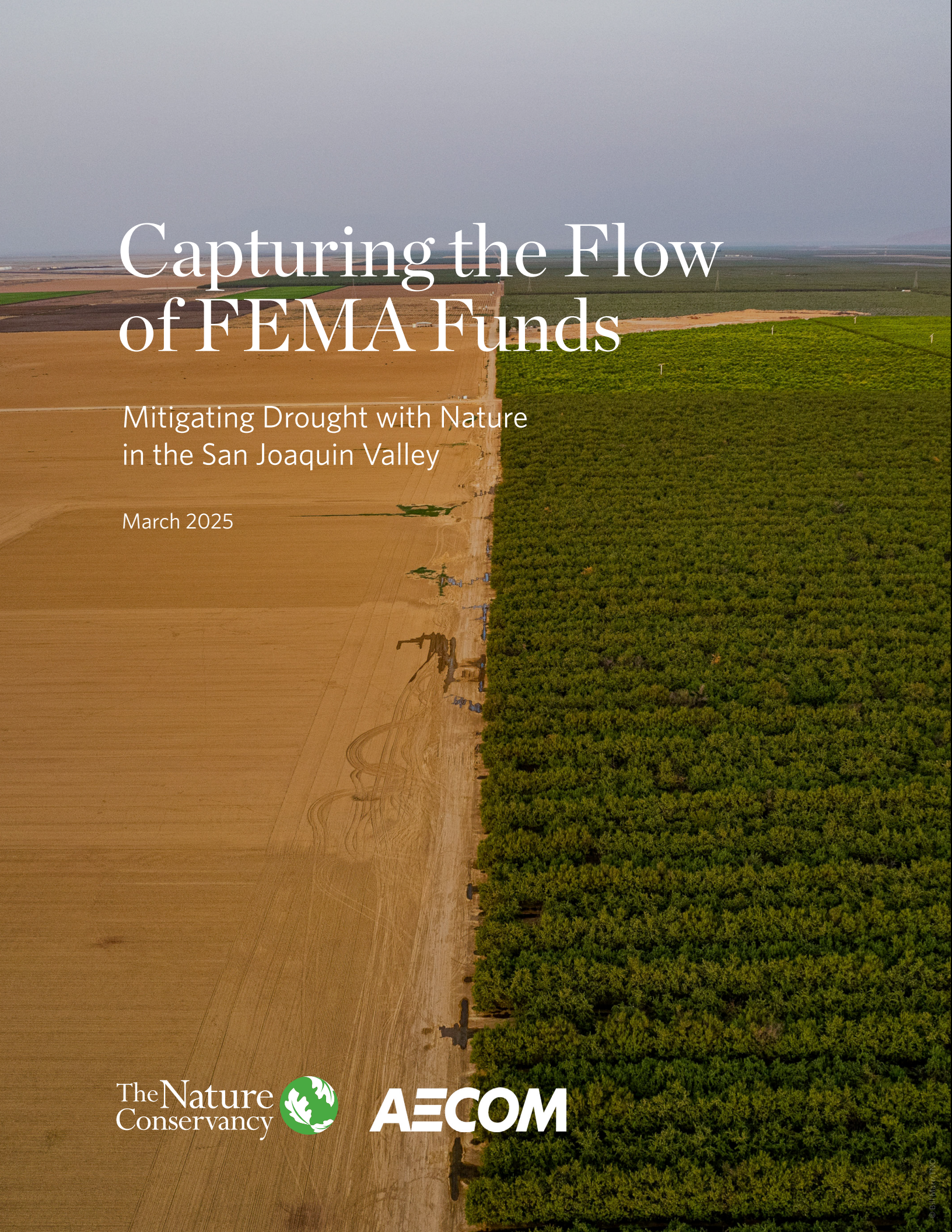

Capturing the Flow of FEMA Funds

Mitigating Drought with Nature in the San Joaquin Valley

March 2025

The Nature Conservancy

AECOM

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Cover photo: Aerial image of a farm crop next to fallowed land in the San Joaquin Valley, near the town of Taft, California, in Kern County. © Stuart Palley

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Acronyms and Iconography

BCA	Benefit-Cost Analysis
BCR	Benefit Cost Ratio
BRIC	Building Resilient Infrastructure and Communities
Cal OES	California Governor's Office of Emergency Services
CEJST	Climate and Economic Justice Screening Tool
DWR	Department of Water Resources
EHP	Environmental Planning and Historic Preservation
FEMA	Federal Emergency Management Agency
GSA	Groundwater Sustainability Agencies
GSP	Groundwater Sustainability Plans
HMA	Hazard Mitigation Assistance Program
MJLHMP	Multi-Jurisdictional Local Hazard Mitigation Plan
MLRP	Multibenefit Land Repurposing Program
NEPA	National Environmental Policy Act
NBS	Nature-based Solutions
NOFO	Notice of Funding Opportunity
NRI	National Risk Index
PPIC	Public Policy Institute of California
SGMA	Sustainable Groundwater Management Act of 2014
SJV	San Joaquin Valley
TNC	The Nature Conservancy

Throughout this document, several icons are used to highlight information that may be important for applicant and subapplicant consideration throughout the FEMA HMA process. This may include information that relates to frontline communities, key FEMA HMA eligibility criteria, drought project types, and additional resources that may be useful when developing an application.

FRONTLINE COMMUNITIES

FLOOD MITIGATION ASSISTANCE

TECHNICALLY FEASIBLE

RESOURCES

SAFEGUARDING TOMORROW REVOLVING LOAN FUND

EFFECTIVE AT MITIGATING RISK

HAZARD MITIGATION GRANT PROGRAM (HMGP)

SUPPLY ENHANCEMENT

COMPLIANT WITH FEDERAL, STATE, AND LOCAL LAWS

HMGP POST FIRE

DEMAND REDUCTION

ELIGIBILITY CRITERIA FOR FEMA PROJECTS

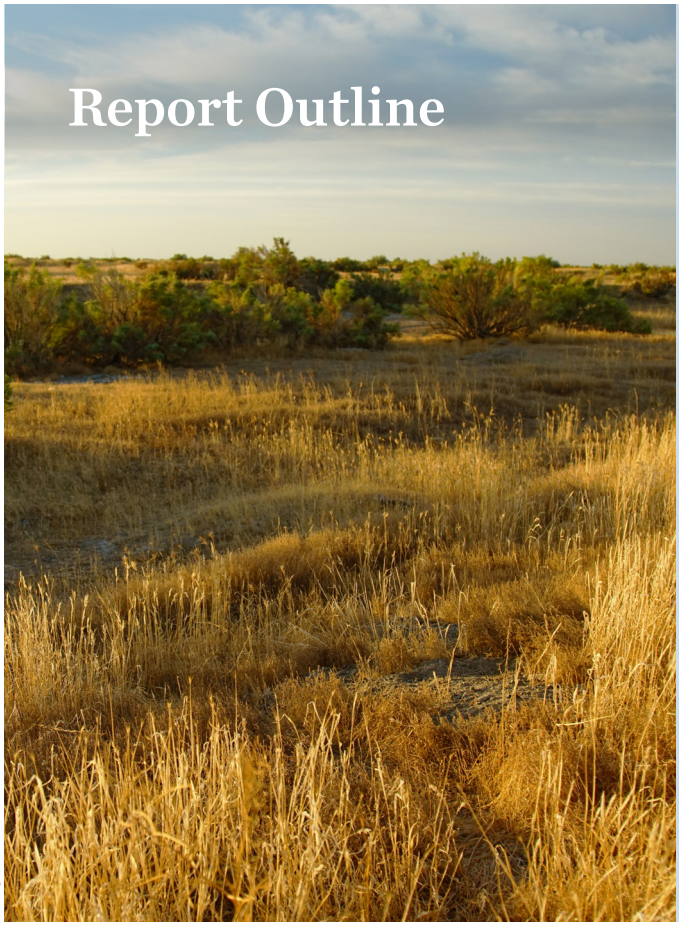
BUILDING RESILIENT INFRASTRUCTURE AND COMMUNITIES

COST EFFECTIVE

Executive Summary

Climate hazards such as drought, flooding, and wildfire have year-round impacts on California's communities, with increasingly catastrophic consequences. Climate change is increasing the frequency and severity of existing hazards, and in some cases introducing new hazards to communities. Withstanding current and future impacts of climate hazards will require new, or updated, approaches to reduce risk for communities. Working with nature can be an effective approach to mitigate hazards while promoting sustainable futures for socially vulnerable, or frontline, communities by providing important environmental, economic, and social co-benefits.

The following document explores the intersection of the Federal Emergency Management Agency (FEMA) funding programs and the use of nature-based solutions (NBS) to address drought hazards in California—creating additional funding opportunities and programmatic support for projects of this type. This report includes a hypothetical case study in California's San Joaquin Valley (SJV), centered at the Tule Subbasin, where there is an intersection of drought impacts, water supply issues, and over pumping of groundwater. This case study highlights two project types – habitat restoration and wildlife-friendly recharge basins – and how these projects can meet FEMA requirements, more specifically the Building Resilient Infrastructure and Communities (BRIC) funding program, to enhance climate adaptation and resilience. The case study provides insight and guidance for parties interested in applying for FEMA hazard mitigation funding for nature-based drought mitigation projects, including key co-benefits and other elements to consider for selecting FEMA project sites and completing the required Benefit-Cost Analysis (BCA). This document also identifies potential barriers to funding that may be encountered throughout the FEMA application process. Ultimately, this document is intended to increase partner capacity to fund and implement NBS for drought mitigation using FEMA hazard mitigation funding, like the BRIC program.



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Section 1 provides background and context.

Section 2 describes California's SJV and within that region, the Tule Subbasin, which has been historically impacted by drought.

Section 3 highlights a case study for one community located in the Tule Subbasin, evaluating two nature-based approaches to drought mitigation—groundwater sustainability and habitat restoration—and potential compatibility for FEMA hazard mitigation funding programs.

Section 4 provides a path forward to advance resiliency by identifying outstanding barriers that project proponents may face when implementing nature-based drought mitigation projects through FEMA funding mechanisms and potential recommendations to overcome such hurdles.

Section 5 connects this work with necessary next steps for completing FEMA BRIC funding applications – a Benefit-Cost Analysis (BCA) that emphasizes and quantifies nature-based drought solutions and associated project types.

Key Findings from the Tule Subbasin Case Study

- To be eligible to receive funding through a FEMA grant program, projects must align with a FEMA-approved Hazard Mitigation Plan, be technically feasible and effective at reducing risk, be cost effective, and meet other federal or local regulations, such as the National Environmental Policy Act (NEPA).
- Understanding the relative importance of site selection criteria is useful to selecting a location that not only fits the needs of the project and provides an opportunity to effectively implement NBS, but first and foremost meets FEMA's hazard mitigation goal to reduce the climate hazard risk to people and property. The primary site selection factors included drought risk, overall water shortage, habitat suitability for restoration of target species, proximity to a protected area, areas suitable for the creation of wildlife-friendly recharge basins, and proximity to frontline communities. In addition, the location of land parcels that have been selected for retirement was used to determine potential locations to move land out of agricultural production.
- When proposing an innovative solution to mitigate drought hazards, subapplicants should coordinate with FEMA, their State Hazard Mitigation Officer, and any other relevant agencies or organizations early in the project development process to understand whether that solution would qualify for funding or should be a separate component to be completed prior to applying for FEMA funds.

Major Takeaways: Opportunities and Barriers

- Currently, FEMA only includes Aquifer Storage and Recovery projects for drought mitigation within their BCA process and does not account for the benefits provided by NBS as part of the Benefit Cost Ratio (BCR). Subapplicants must provide these calculations separately in the project narrative included with the BCA.
- Habitat restoration and the creation of wildlife-friendly recharge basins encompass several of the FEMA-recognized drought mitigation strategies (i.e., improving soil stabilization; flood storage; and aquifer recharge, storage, and recovery). These projects can meet the requirement to accomplish mitigation goals by reducing the risk to life and property from drought hazards within the communities surrounding the project location.
- Innovative ideas and methods are encouraged by FEMA if shown to be cost effective, but some approaches contemplated for rural agricultural regions like SJV, such as transitioning to lower water use crops or fallowing lands to reduce reliance on groundwater, have not yet been established in FEMA programs and guidance, but may be eligible if other program requirements are met.
- Acquiring agricultural lands to move into retirement could be an effective drought mitigation tool to reduce groundwater withdrawal. However, FEMA has traditionally used acquisition to mitigate flood hazards and has not historically recognized it as a drought mitigation strategy. Project proponents should discuss with FEMA and California Office of Emergency Services (Cal OES) whether acquisition can be included in a project early in the application process. In addition, FEMA should consider broadening the eligible use of acquisitions beyond flood mitigation and provide technical guidance and job aids to guide applicants and subapplicants through utilizing this strategy to capture the vast range of benefits that could be leveraged.
- Many of the NBS for drought mitigation recognized by FEMA – including xeriscaping, water-smart landscaping, and water harvesting – are more appropriate for small-scale urban settings and do not address strategies that could benefit agricultural and other rural communities.
- Despite relatively few examples of projects in California, NBS for drought mitigation can be competitive for FEMA funding by aligning with program priorities, such as promoting community resilience and maximizing FEMA dollars to address multiple hazards.
- A critical barrier that may arise for drought mitigation projects includes consideration and issues with obtaining or understanding water rights for the parcel(s) where the project will take place.

1. Background

Over the last 100 years, the landscape of California's San Joaquin Valley (SJV) has transformed from a region with meandering rivers and creeks, healthy riparian corridors, and vast wetlands to a critically important agricultural region. This transformation has caused the region to experience depleted and fragmented habitat, overdrafted aquifers, subsidence, and severe impairments to air and water quality. California's SJV is also a region where climate-driven drought has led to severe impacts on local communities, the agricultural economy, and water supplies. Prolonged periods of drought are anticipated to become more frequent, severe, and longer in duration as climatic conditions continue to shift.

Climate change and the conversion of natural landscapes pose serious threats to California communities, ecosystems, and economies. As a result, the communities and remaining habitat areas in the region are especially susceptible to drought impacts, and they are looking for nature-based solutions (NBS) for drought mitigation. In the SJV, there is particular interest in repurposing irrigated agricultural land to other uses that can support groundwater sustainability and provide additional co-benefits to local communities.[1,2]

Mitigating drought hazards is important for reducing additional strain on regional water supplies. The Federal Emergency Management Agency (FEMA) defines hazard mitigation as "any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazard events and their effects."[3] Current FEMA guidance emphasizes that communities consider whole-community solutions that provide additional environmental, social, and economic benefits, including protecting natural assets that help with mitigation.[4] FEMA provides funding through their Hazard Mitigation Assistance (HMA) programs to address risks associated with current and future climate hazards while tackling problems associated with climate change and habitat degradation. Pre-disaster funding streams, such as the Building Resilient Infrastructure and Communities (BRIC) program, can be especially useful as it aims to reduce risk and enhance community resilience before a hazard occurs.

Traditionally, hazard mitigation has been accomplished through engineering and hardened infrastructure projects, designed to reduce climate impacts such as flooding and wildfire. There is growing interest, and scientific evidence,[5] that nature-based approaches provide additional benefits, help mitigate climate change, and increase resilience to changing climatic conditions. Because this approach to hazard mitigation is relatively new, FEMA is still working towards incorporating these elements into their funding streams and programs.

1.1 Purpose of Report

This report addresses how nature-based approaches can help reduce drought risk for frontline communities by focusing on a case study from the southern SJV. The case study identifies and evaluates two potential nature-based drought mitigation projects that involve repurposing and restoring irrigated agricultural lands and implementing wildlife-friendly recharge basins in the Tule Subbasin, a critically overdrafted groundwater subbasin within the SJV. The case study evaluates a hypothetical project, including its co-benefits to communities and ecosystems, with the goal of informing readers how such benefits can be included in FEMA BRIC funding applications. The report uses the case study to highlight where and how

Frontline communities are those that experience disproportionate effects from climate hazards and have been directly burdened by harmful impacts. These communities can collectively name the ways they have been burdened and are actively organizing to complete actions to reduce impact. These communities should be engaged and considered during hazard mitigation project development.

1 Identification of potentially suitable habitat for strategic land retirement and restoration in the San Joaquin Desert – The Nature Conservancy (tnc.org)
2 Managing Water and Farmland Transitions in the San Joaquin Valley – Public Policy institute of California (ppic.org)
3 Hazard Mitigation Assistance Program and Policy Guide Part 1 – Federal Emergency Management Agency (fema.gov)
4 Hazard Mitigation Assistance Program and Policy Guide – Federal Emergency Management Agency (fema.gov)
5 Nature-based Solutions for climate – International Union for Conservation of Nature (iucn.org)

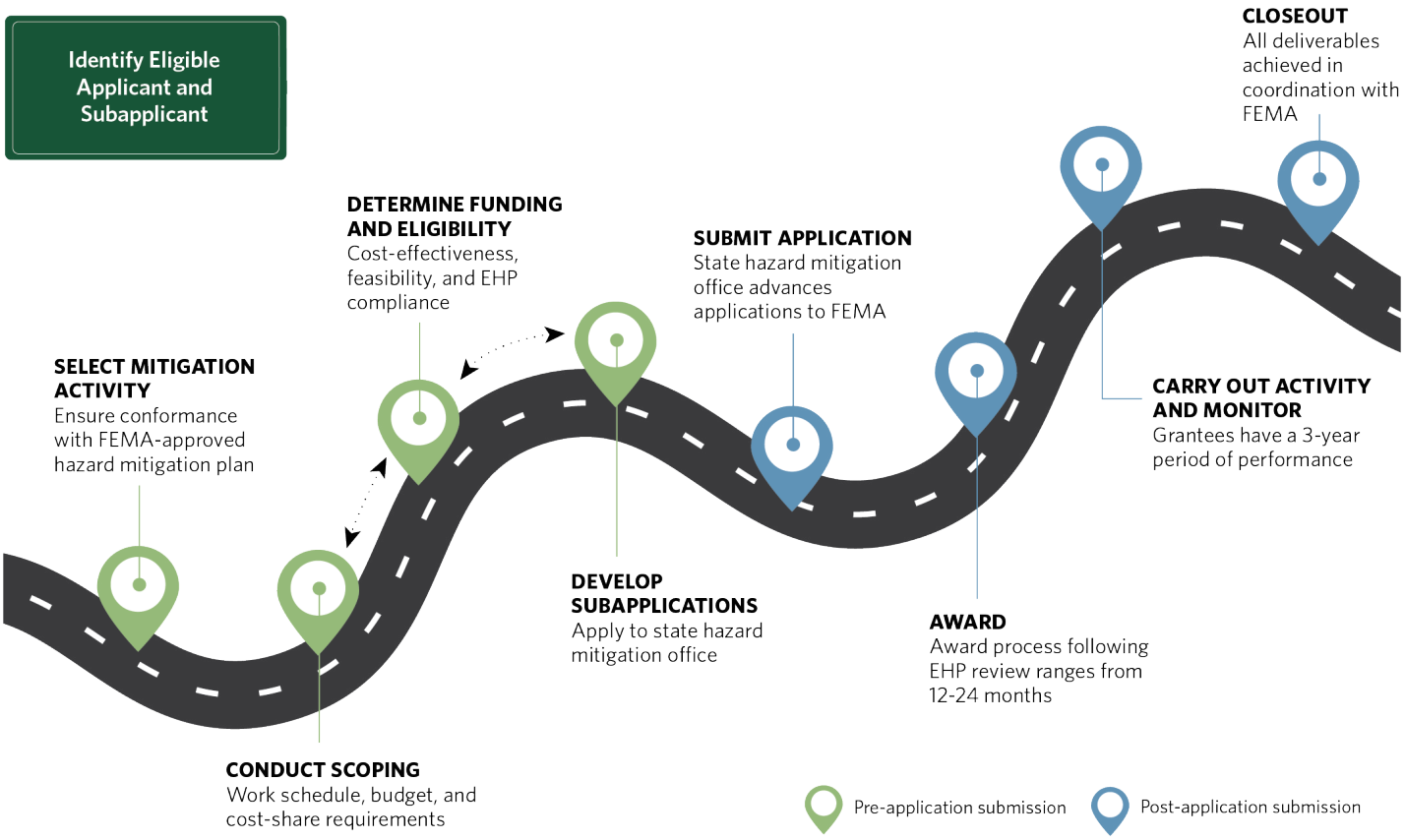

Figure 1. This pathway describes the process of submitting a FEMA HMA application and identifies when eligibility criteria come into play during the project development process.

FEMA project requirements align with land repurposing projects and what factors (eligibility requirements, costs, and benefits) interested communities should consider when applying for FEMA BRIC funding assistance. The case study is intended to act as a guide for project proponents undertaking the FEMA application process and demonstrate how nature-based designs can offer a broader suite of benefits (social, ecological, and economic) when compared with traditional hazard mitigation projects alone.

The purpose of this document is to 1) provide an example of a nature-based drought mitigation project that could be eligible for FEMA BRIC funding, 2) evaluate considerations for project site selection, necessary partners, and BCA guidance, and 3) highlight current limitations to harness FEMA BRIC funding for nature-based drought mitigation projects in the SJV and potential recommendations.

The two intended audiences for this report include: NBS practitioners (i.e., conservation and/or restoration practitioners), who may be less familiar with using FEMA hazard mitigation programs to fund NBS projects, and potential project proponents or hazard mitigation practitioners who are interested in considering nature-based approaches to drought mitigation that increase social, ecological, and economic co-benefits.

For the purposes of this case study, the primary focus will be the FEMA BRIC Program for drought mitigation as this funding stream is most appropriate for nature-based projects, mitigating drought as a single hazard, and has been the program that has funded the most drought projects to-date. Most concepts presented herein are transferable to other FEMA funding streams, though each program has its own set of guidance and complexities that should be consulted. There are numerous resources available for all aspects of the FEMA funding process. Many are linked throughout this document. Readers should familiarize themselves with the variety of FEMA HMA funding programs available.

Additional Resources
This document includes links to several additional resources that readers may find useful when understanding or developing a FEMA HMA application. These resources range from FEMA developed documents to guidance documents developed by other entities, such as The Nature Conservancy.

Useful Links to Additional Resources

FEMA's HMA Program and Policy Guide

FEMA's nature-based solutions guide

FEMA's Drought Policy Aid

FEMA's Community Disaster Resilience Zones Viewer

TNC/AECOM Guidebook on utilizing nature-based solutions as hazard mitigation solutions

FEMA HMA Funding Programs

Hazard Mitigation Grant Program (HMGP)
This program provides post-disaster recovery funds to rebuild in a way that reduces future disaster losses in the community. Funding is typically available after a presidentially declared disaster.

HMGP Post Fire
This program provides funding for communities to implement hazard mitigation measures after wildfire disasters. Funding is typically available after an event that results in a Fire Management Assistance Grant declaration.

Building Resilient Infrastructure and Communities
This annual grant program provides funding to implement hazard mitigation projects to reduce risk from disasters and natural hazards. The aim of this program is to shift focus from post-disaster recovery to proactive investment in resilient solutions to combat hazard risks.

Flood Mitigation Assistance
This annual grant program provides funding to reduce or eliminate risk associated with repetitive flood damage to buildings that participate in the National Flood Insurance Program.

Safeguarding Tomorrow Revolving Loan Fund
This program provides funds through a revolving loan for local governments to reduce risk from natural hazards and disasters.

More information on these FEMA funding programs can be found in FEMA's Hazard Mitigation Policy and Program Guide.

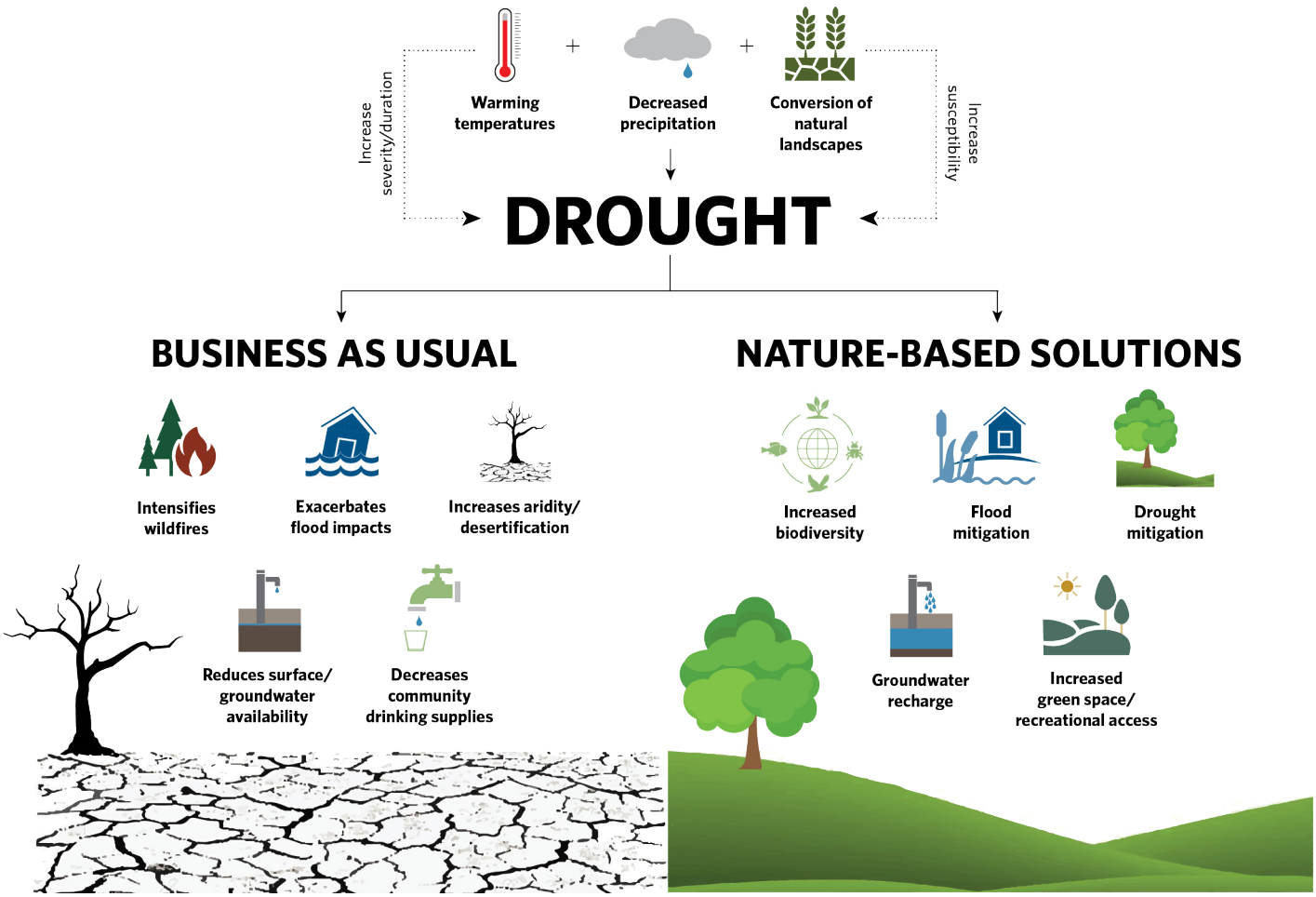

Figure 2. Drought is primarily driven by interactions between natural climate patterns and the environment. However, these interactions are exacerbated by the water and land management policies and practices being enacted within the human interface that exists within these drought-tolerant landscapes. This, along with other factors such as climate change, leads to increased demand and reduced supply of water, causing more severe drought conditions. NBS can mitigate some of these challenges.

1.2 Managing and Mitigating Drought in California

While drought is a normal climatic pattern for California, climate change is increasing the severity and duration of droughts and other extreme weather events, like atmospheric rivers and flooding, with significant impacts to California's frontline communities,[6] as described in Figure 2.

California leads the nation in agricultural production, with the SJV producing more than half of California's agricultural output.[7] However, drought emergencies have been declared by a Presidential Major Disaster Declaration for three of the past seven years throughout most of the SJV.[8] FEMA's National Risk Index identifies drought risk as moderate to high across the SJV, as depicted in Figure 3a. In normal and wet years, local water supplies are heavily subsidized by water imported from elsewhere in the state to support this important region. However, during drought years, availability of imported water is diminished, and groundwater is the primary source for irrigating crops and accounts for roughly two-thirds of California's water supply, compared to one-third in non-drought conditions.[9,10] As a result, the region's aquifers have become significantly overdrafted.

6 Climate, Drought, and Sea Level Rise Scenarios for the Fourth California Climate Assessment. California's Fourth Climate Change Assessment – California Energy Commission
7 Water and the Future of the San Joaquin Valley - Public Policy Institute of California (ppic.org)
8 Disaster Designation Information – U.S. Department of Agriculture (usda.gov)
9 Satellites measure recent rates of groundwater depletion in California's Central Valley – University of California Irvine (uci.edu)
10 Groundwater Issue: Supply – State Water Resources Control Board (waterboards.ca.gov)

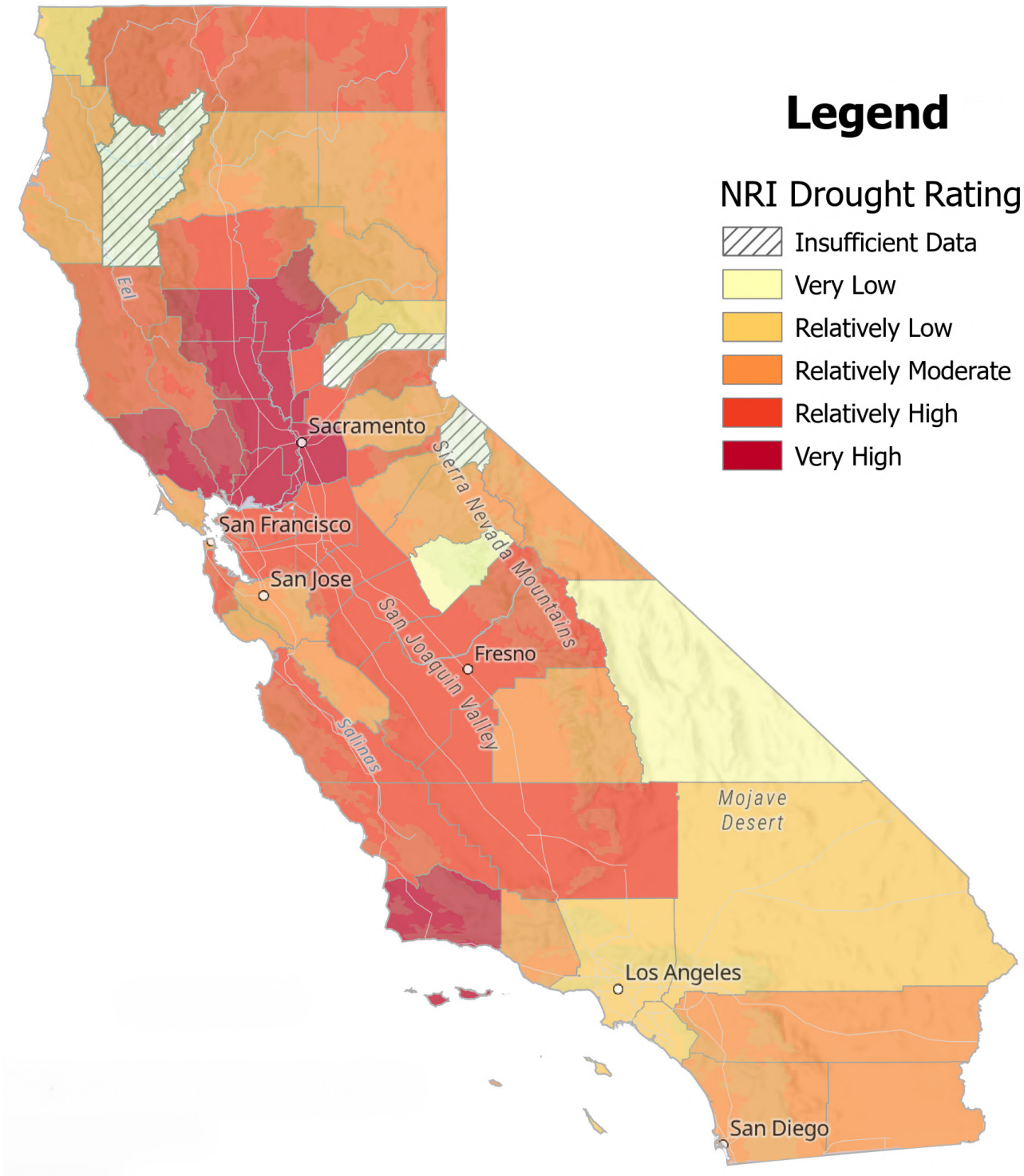

Figure 3a. This map depicts FEMA's National Risk Index Drought Risk. Figures 3a and 3b highlight the need to implement measures to reduce drought risk in California's San Joaquin Valley.

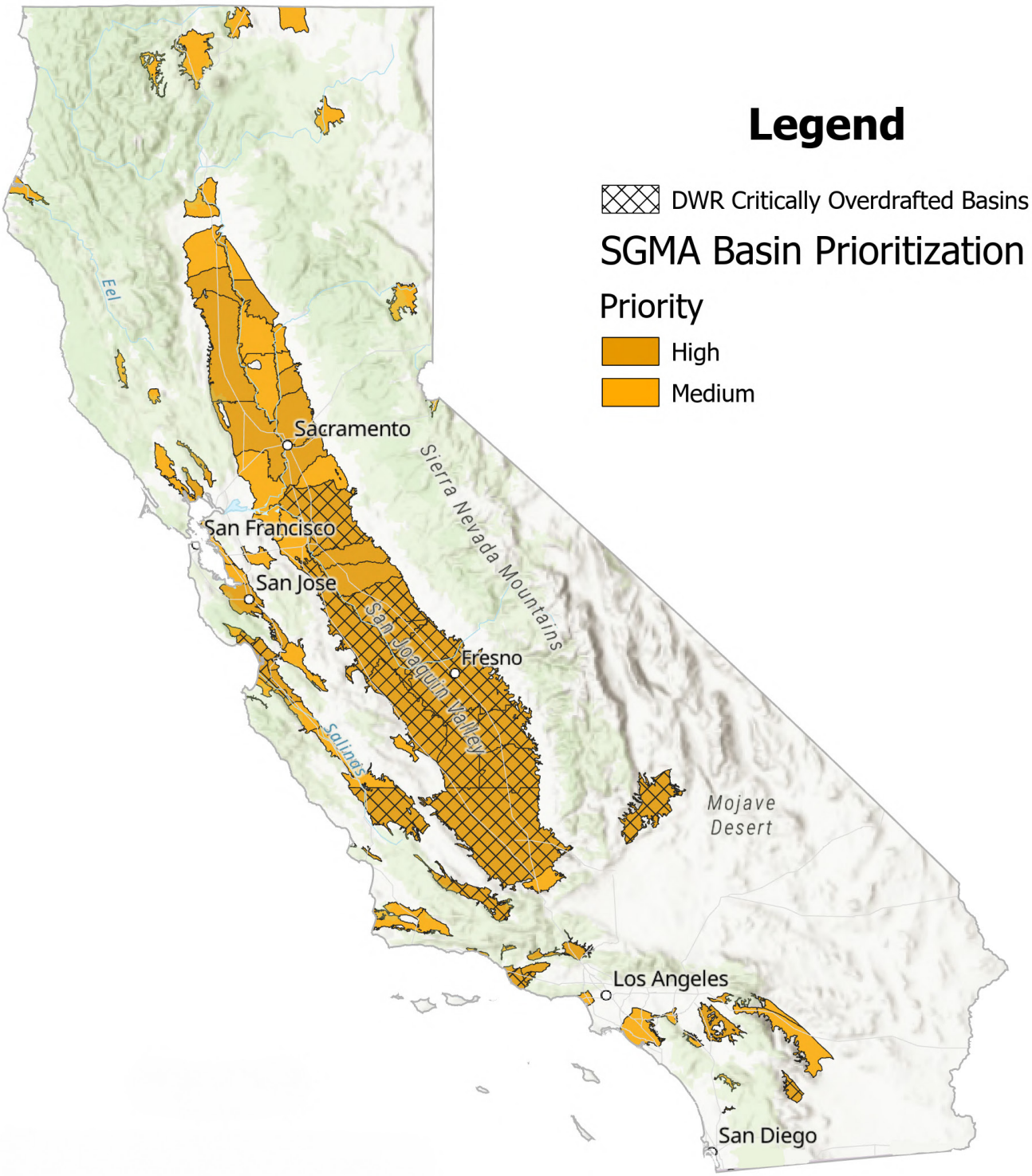

Figure 3b. This map depicts the California Department of Water Resources' Critically Overdrafted Basins overlaid with the SGMA Priority Basins. Figures 3a and 3b highlight the need to implement measures to reduce drought risk in California's San Joaquin Valley.

To protect California's groundwater basins from further overdraft, California Legislature enacted the Sustainable Groundwater Management Act of 2014 (SGMA), requiring overdrafted basins to achieve sustainable groundwater use by 2040. California has additional policies and management strategies geared towards managing groundwater for multiple benefits in the face of climate change including Flood-Managed Aquifer Recharge (Flood-MAR),[11] the Central Valley Flood Protection Plan,[12] the California Comeback Plan (Water and Drought Resilience Package),[13] and the California Water Plan 2023 Update,[14] among others. Further, California legislature recently set 81 NBS climate targets to strategically harness more than half its land to help achieve carbon neutrality by 2045 and combat the climate crisis (April 22, 2024).[15]

Implementing groundwater sustainability actions is critical for California communities and ecosystems to adapt and achieve drought resilience through time. This can be accomplished through several different avenues, including mitigation projects that are eligible for FEMA HMA program funding.[16] FEMA supports nature-based drought mitigation projects that aid communities in preventing and adapting to drought by improving soil stabilization, restoring floodplains and streams, capturing and storing excess flood waters, and amplifying aquifer recharge, storage, and recovery. These projects target landscape-scale NBS to mitigate drought, however, FEMA also recognizes several other activities that can be implemented on a smaller scale within both urban and rural settings. More information on these can be found in FEMA's Drought Policy Aid.[17]

In addition, innovative ideas (e.g., solutions that are not specifically outlined in the HMA Program and Policy guide for each funding mechanism) and methods are encouraged whenever benefits outweigh the cost of implementation. This report focuses on restoration of upland habitat and the creation of wildlife-friendly recharge basins as two nature-based drought mitigation projects that may be possible to fund with FEMA HMA program funding.

The goals of SGMA aim to:

- Address challenges facing the SGMA Priority Basins depicted in Figure 3b;
- Provide sustainable management of groundwater basins;
- Enhance local management of groundwater consistent with right to use or store groundwater;
- Establish minimum standards for effective, continuous management of groundwater;
- Provide local groundwater agencies with the authority, technical, and financial assistance needed to maintain groundwater supplies;
- Avoid or minimize impacts for land subsidence;
- Improve data collection and understanding of groundwater resources and management;
- Increase groundwater storage and removes impediments to recharge; and
- Empower local agencies to manage groundwater basins, while minimizing state intervention.

Drought Mitigation Project Types

Supply enhancement: This drought management strategy involves restorative and nature-based measures to capture and recharge groundwater and aquifer sources.

Demand reduction: This drought management strategy aims to restore working lands to upland habitat thereby reducing agricultural water demand.

11 Flood-Managed Aquifer Recharge (Flood-MAR) – California Department of Water Resources (ca.gov)
12 Central Valley Flood Protection Plan – California Department of Water Resources (ca.gov)
13 Governor Newsom Signs Climate Action Bills, Outlines Historic $15 Billion Package to Tackle the Climate Crisis and Protect Vulnerable Communities – Governor Gavin Newsom (gov.ca.gov)
14 California Water Plan 2023: Navigating Climate Challenges with Equity and Resilience – California Department of Water Resources (water.ca.gov)
15 California's Nature-Based Solutions Climate Targets – Administration of Governor Gavin Newsom (resources.ca.gov)
16 Additional eligible activities include capability and capacity building activities, non-financial direct technical assistance, mitigation projects, and management costs. More information can be found in FEMA's Hazard Mitigation Assistance Program and Policy Guide.
17 Drought Mitigation Policy Aid – Federal Emergency Management Agency (fema.gov)

1.3 Requirements for FEMA Funding and Additional Funding Programs

One of the challenges to access FEMA HMA funding can be meeting eligibility requirements for the various programs. At a high level, mitigation projects submitted for FEMA funding must be cost-effective, technically feasible, effective at mitigating risk, and comply with the National Environmental Policy Act and any other applicable federal, state, and local laws. All applicants and subapplicants must also have a FEMA-approved Hazard Mitigation Plan in place. Furthermore, cost share is typically required for hazard mitigation projects funded through FEMA grants. More information on the minimum requirements for FEMA hazard mitigation grants and any cost share requirements can be found in Tables 2-1 and 2-2 of The Nature Conservancy's (TNC) and AECOM's Guidebook, *Promoting Nature-Based Hazard Mitigation Through FEMA Mitigation Grants*.[18]

Table 1 includes a list of potential and additional funding sources for drought mitigation projects that could be useful for helping applicants meet cost share requirements for FEMA HMA funding programs and/or the project is not selected for FEMA funding. This is not an exhaustive list and should be used solely as a guide.

Key Eligibility Requirements

Table 1. Additional Funding Resources for drought mitigation and community resilience projects

Resource	Details
Multibenefit Land Repurposing Program (MLRP)	MLRP is a block grant awarded through the California Department of Conservation aimed at funding groundwater sustainability projects. Funding is especially directed at projects which reduce groundwater use, repurpose irrigated agricultural land, and provide additional wildlife habitat.
WaterSMART Drought Resiliency Project Grants	The Bureau of Reclamation works with states, tribes, and local entities in funding initiatives which aid in increasing water supply. Several aquifer recharge, water supply resiliency, water storage, and water reuse projects in California were funded through the 2023 cycle. However, it is important to note that as this is a federal program, any funding received cannot be used as a match for FEMA funding.
Sustainable Groundwater Management Grant Program	Working in consultation with California's Department of Water Resources (DWR) Sustainable Groundwater Management Office, this program provides funding to GSAs to promote sustainable groundwater basins. Additionally, the program seeks to promote projects that provide multiple benefits as well as improving groundwater supply and quality. Basins identified as 'critically overdrafted' by DWR are especially appropriate for the grant program.
California Governor's Office of Emergency Services (Cal OES) Prepare California Program	This funding, set forth by Cal OES, focuses on building community resilience and reducing long-term risk amongst vulnerable communities in areas of the state most susceptible to natural disasters such as flooding, earthquakes, wildfires, landslides, extreme heat, and drought. This program was designed to provide access to federal match funds for community mitigation projects.

18 Promoting Nature-Based Hazard Mitigation Through FEMA Mitigation Grants – The Nature Conservancy (tnc.org)

1.4 Mitigating Drought with NBS and Eligibility for FEMA Hazard Mitigation Assistance

Reducing demand and increasing water storage are two main elements to mitigate drought risk. Solutions such as tanks and artificial reservoirs may increase storage capabilities but fall short in restoring the natural system. NBS that promote restoration provides additional co-benefits and mitigates future scenarios of worsening drought conditions and curtailed water supplies while providing flood capture and water storage options during extreme precipitation and storm events. Working with nature to mitigate drought risk promotes land uses that improve storage and provide ecosystem services such as groundwater recharge, air and water quality improvement, additional flood protection, improved habitat and soil health, and mental and physical health benefits to the community through increased access to nature and open space. NBS create more climate resilient communities by enhancing the capacity of natural systems to protect communities from the impacts of drought and additional hazards such as flooding and wildfire.

FEMA funding increased for nature-based hazard risk mitigation projects across the United States in fiscal year 2023. But even with this increase and focus, projects featuring NBS are still uncommon or in the development stage, especially for lower resourced and/or frontline communities. While valuation of nature-based project benefits is gaining traction with a greater repository of scientific evidence, there is still additional information needed for support. Communities that would benefit most from such projects may be hindered by a variety of challenges and obstacles, such as a lack of clarity in the funding application process or limited community resources and/or experience to prepare the required components of an application. Furthermore, there may be a poor understanding of which project types are eligible for funding and how NBS fit into traditional funding programs.

FEMA funding could play an integral role in mitigating drought risk for California, more specifically for SJV communities, by increasing climate resilience and sustainable groundwater sources in an agricultural region of statewide, national, and international importance. Despite relatively few examples of projects in California, NBS for drought mitigation can be competitive for FEMA funding due to alignment with program priorities and calculation of benefits. Drought mitigation through nature-based and hybrid approaches has evolved over time, with a few California communities recently selected for BRIC funding for projects that reduce risk, increase resilience, amplify water storage, and improve water systems. Further, statewide management strategies and funding streams have been put into place to help cope with drought risk and create a more resilient future. Past FEMA BRIC selections have begun to demonstrate the need to mitigate drought risk as the main climate hazard, as opposed to a multi-hazard project, but there is more headway to be made to further the eligibility of drought mitigation projects through the FEMA HMA funding programs.

San Joaquin Valley. (top) Aerial view of agricultural fields in the valley. © Lara Weatherly; (bottom) A dry, grassy landscape in the valley. © Abigail Hart/TNC

2. Setting the Stage: Overview of the San Joaquin Valley

The SJV, in addition to the Sacramento Valley and the Sacramento-San Joaquin Delta, makes up California's agriculturally intensive region and serves as a key contributor to the nation's food supply. Groundwater extraction has led the SJV to be one of the most productive agricultural regions in the world, while simultaneously resulting in near complete alteration and conversion of the natural landscape for agricultural use.[19]

Drought has impacted SJV communities and systems in a variety of ways, including, but not limited to: water scarcity, food insecurity, consequences for agricultural livelihoods, reduction in recreational opportunities, and impacts to the health of residents. The severe drought from 2012-2016 was particularly impactful. During that period, reduced precipitation led to decreased surface water imports and a greater reliance on, and overdrafting of, groundwater resources. Subsequently, community water supplies and groundwater-dependent ecosystems were temporarily or permanently dried. Water scarcity also impacted water availability for irrigation and reduced agricultural output in many parts of the SJV.

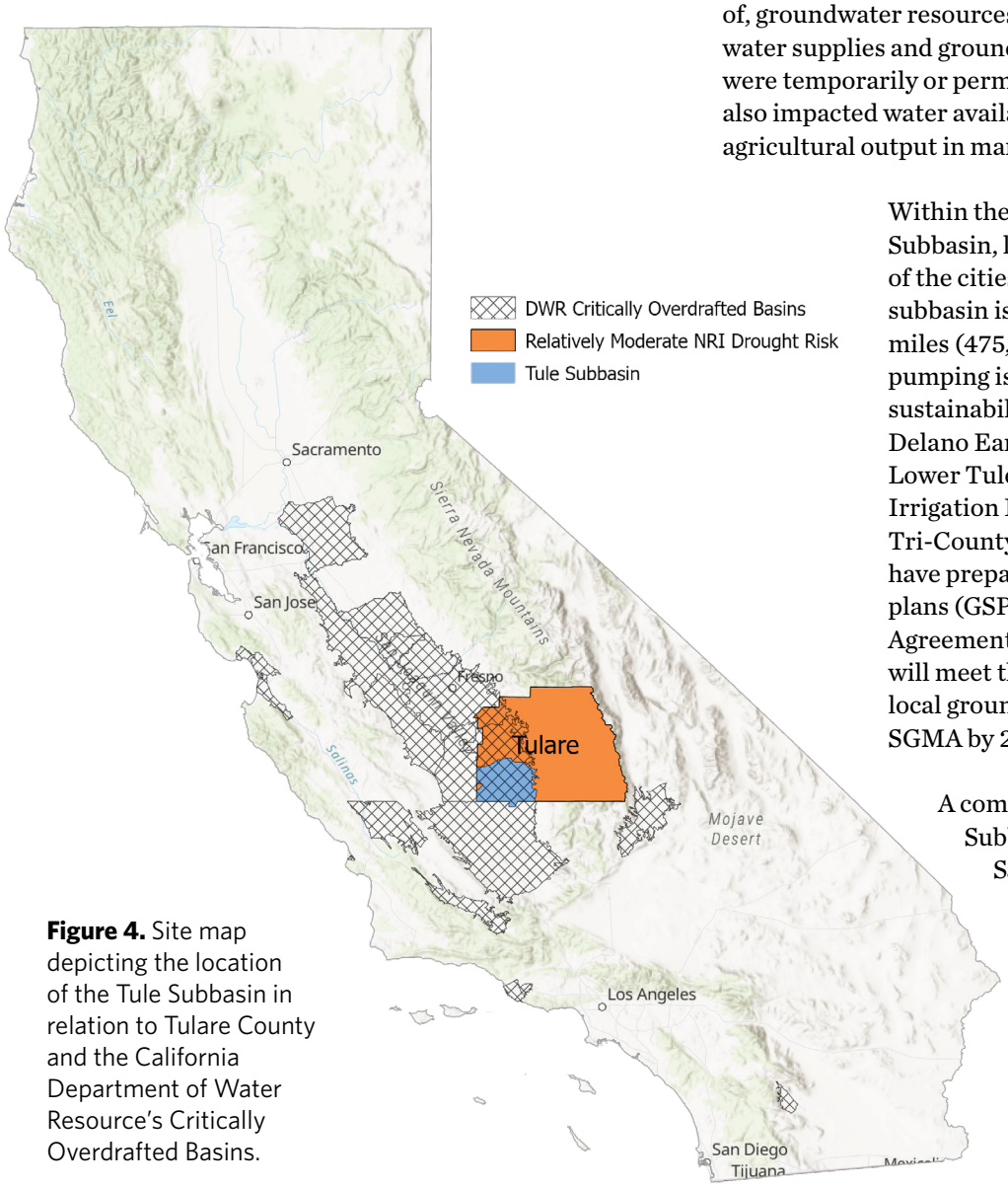

Figure 4. Site map depicting the location of the Tule Subbasin in relation to Tulare County and the California Department of Water Resource's Critically Overdrafted Basins.

Within the southern SJV lies the Tule Subbasin, located in Tulare County, south of the cities of Visalia and Tulare. The subbasin is approximately 744 square miles (475,895 acres) and groundwater pumping is governed by six groundwater sustainability agencies (GSAs): Alpaugh, Delano Earlimart Irrigation District, Lower Tule River Irrigation District, Pixley Irrigation District, Eastern Tule, and the Tri-County Water Authority. The agencies have prepared groundwater sustainability plans (GSPs) and a Coordination Agreement that describes how the subbasin will meet the state's goals for sustainable, local groundwater management under SGMA by 2040.

A community profile for the Tule Subbasin (within the southern SJV) can be found in **Appendix A**. This profile provides a more detailed background of the natural systems, communities, and economic factors that comprise the Tule Subbasin and the rationale behind why this region is an ideal location for nature-based drought mitigation projects.

19 Water and the Future of the San Joaquin Valley – Public Policy Institute of California (ppic.org)

3. A Case Study for the Tule Subbasin

To provide real-world context to these concepts, a hypothetical project is outlined below. Based on the overall need to reduce drought risk within the Tule Subbasin, this project identifies and describes multiple NBS approaches that could be implemented to accomplish this goal. In addition, this project highlights factors considered during the project development phase that ultimately sets the project up to meet FEMA eligibility requirements for their funding programs (i.e., FEMA's BRIC program). The project points to resources available to subapplicants but does not necessarily include all aspects of FEMA eligibility criteria. In addition, criteria discussed below is based on the 2023 BRIC Notice of Funding Opportunity (NOFO) announcement.[20] Changes to eligibility may vary in subsequent years and subapplicants should continue to review updated FEMA guidelines and program NOFOs, as applicable. This document should be used as an informational guide on considerations for utilizing one or more NBS approaches to mitigate drought and connecting those to the FEMA BRIC program. Ultimately, building these connections early in the project development process provides the tools necessary to design more robust risk mitigation projects that are more fully aligned with FEMA funding opportunities and realize greater benefits.

3.1 Project Overview

The Tule Subbasin was designated a critically overdrafted subbasin by the California DWR in 2020[21] and is identified as having high drought risk from FEMA's National Risk Index (NRI). Furthermore, Tulare County released an update to their FEMA-approved Multi-Jurisdictional Local Hazard Mitigation Plan (MJLHMP) in 2023, which identified drought and water shortage as a critical hazard with extensive geographical impacts expected. Specific drought mitigation actions with the most potential to incorporate a nature-based approach identified in the MJLHMP include:[22]

- Identification and implementation of strategies that result in promoting stormwater management through groundwater recharge projects and
- Development of groundwater recharge projects that promote groundwater sustainability and mitigate and recover from the effects of prolonged drought.

Maintaining an adequate supply of groundwater is important to provide drinking water to residents and sustain the agricultural industry, a major economic driver in the area that provides food for the state, nationally, and internationally and jobs for the frontline communities in this region. As part of this effort, the broader SJV is undergoing land use transition as agricultural land is being moved out of production and retired to reduce overdraft and achieve sustainable water use through SGMA. Moving some of this land out of production not only enhances water sustainability, but may help to preserve adjacent and high-functioning agricultural lands that are critical for the local economy and national food security.[23] It's estimated that in order to meet SGMA goals, an average of half a million acres or more of cropland per year will need to be retired.[24] The diversification of land use in the region is beneficial for both climate and drought resilience by allowing different responses to a given stress and increases the adaptive capacity of the landscape as a whole. Considering this, the hypothetical project includes the cessation of groundwater pumping and conversion of some agricultural lands to upland habitat. Furthermore, a nature-based approach is utilized to recharge groundwater supplies, restore important critical habitat, enhance local biodiversity, and provide habitat connectivity to currently protected areas.

20 Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Grant Program fact sheet – Federal Emergency Management Agency (fema.gov)
21 Critically Overdrafted Basins – California Department of Water Resources (water.ca.gov)
22 Tulare County Local Hazard Mitigation Plan – County of Tulare California (tularecounty.ca.gov)
23 Water, environment, and socioeconomic justice in California: A multi-benefit cropland repurposing framework – University of California Merced (ucmerced.edu)
24 Managing Water and Farmland Transitions in the San Joaquin Valley – Public Policy institute of California (ppic.org)

3.2 NBS Approaches to Drought Risk Reduction in the Tule Subbasin

For this project, two NBS approaches were identified and explored for compatibility in FEMA HMA programs: the creation of wildlife-friendly recharge basins and habitat restoration. These approaches encompass several FEMA-recognized drought mitigation strategies discussed in Section 1.2, such as aquifer recharge, storage, and recovery, and improving soil stabilization and flood storage. Furthermore, these approaches, particularly the creation of wildlife-friendly recharge basins, meet the requirement to accomplish mitigation goals by reducing risk to life from drought hazards through the storage of excess waters solely for the purpose of sustaining the surrounding communities during drought events. Stored groundwater would aid surrounding communities by providing an additional source of potable water and/or meeting other municipal or industrial water demands. In addition, restoring habitats that have the capacity to store excess floodwaters, such as floodplains and wetlands, not only enhances groundwater capacity, but also provides flood mitigation benefits such as reducing the rate of flow towards downstream communities.

HABITAT RESTORATION

The growth of the agriculture industry in the SJV has not only contributed to groundwater concerns and increased drought conditions but has also led to the loss of valuable native upland and alkali scrub habitat. Furthermore, loss of this habitat drives the decrease in endemic, desert-adapted species observed within the area.[25] Restoring this habitat, namely upland and alkali scrub habitat, is vital for maintaining local biodiversity and providing critical habitat for special-status species. Habitat restoration also helps bolster ecosystem services that can benefit humans, such as promoting pollination to sustain ongoing agricultural practices in the region.

Identifying native desert-adapted alkali scrub plant species, either through historical records or through observations within the nearby protected areas, will be a vital component to restoring agricultural land back to its natural function. For example, plant communities found within the Pixley National Wildlife Refuge include native species commonly found in the Central Valley, such as saltgrass (*Distichlis spicata*), Menzies' fiddleneck (*Amsinckia menziesii*), California goldfields (*Lasthenia californica*), Great Valley phacelia (*Phacelia ciliata*), allscale (*Atriplex polycarpa*), and bush seepweed (*Suaeda moquinii*). Designing restoration to utilize plant species from adjacent protected areas promotes and increases connectivity to surrounding habitat communities, providing additional habitat for special-status wildlife and allowing the return of ecosystem health and function. In addition, identifying special status plants that may have previously existed on, or near, the site to include in the restoration effort provides an additional opportunity to increase biodiversity, promote pollination, and support declining populations. Restoring the habitat to its natural function can also aid in aquifer recharge, as native plants are often more drought tolerant than invasives.

Carrizo Plain. Desert plants grow in the arid climate of the Carrizo Plain. © Lara Weatherly

25 Capinero Creek Vegetation Restoration, Monitoring, and Management Plan – The Nature Conservancy (tnc.org)

WILDLIFE-FRIENDLY RECHARGE BASINS

The Environmental Defense Fund and Audubon have developed a guide to display the multiple benefits provided by WFRB. This guide also provides technical advice on designing and implementing WFRB.

In addition to restoring desert habitat, designing, and implementing a wildlife-friendly recharge basin enhances benefits provided by habitat restoration alone. This drought mitigation strategy directly addresses depleted groundwater supplies by capturing surface water from precipitation, snowmelt, or excess flood waters to replenish and recharge aquifer levels, while providing wildlife habitat. Precautions may need to be taken by applicants to ensure that implementation of this approach would not impact downstream flow for communities within the project design phase. More specifically, wildlife-friendly recharge basins target shorebirds, waterfowl, and pollinators that utilize the surface water resources and/or associated plant communities. Groundwater recharge through the creation of wildlife-friendly recharge basins can be a multi-benefit approach to replenish depleted aquifers, store water for future use, promote beneficial habitat for wildlife, stabilize soil, and reduce erosion. The water stored in the connected aquifer provides additional resources for communities to rely on during extended periods of drought, allowing them to be more resilient to this hazard.

There are many additional considerations that subapplicants should review when designing a wildlife-friendly recharge basin. Point Blue Conservation Science, with their partners at the Environmental Defense Fund, Audubon California, and Sustainable Conservation, have developed a guide[26] for designing and implementing effective wildlife-friendly recharge basins that provide multiple benefits to drought risk reduction, habitats, and the surrounding communities.

3.2.1 Agricultural Land Retirement and Acquisition

The acquisition of agricultural lands for retirement is proposed as a potential and innovative solution for drought mitigation through the cessation of groundwater and surface water extraction for crop production by retiring all transitional water pumping associated with the property. Land acquisition is traditionally used to reduce flood risk and has historically not been recognized by FEMA as a drought mitigation strategy. However, as exemplified by the ongoing land use transition in the SJV to meet SGMA goals, this approach would be effective at reducing groundwater pumping to accomplish drought mitigation in addition to providing numerous other benefits to the community, natural systems, and local economy.[27] See Section 4.1 for further discussion and recommendations on taking this approach.

Should this approach be acceptable for FEMA funding, target parcels for acquisition should be located near communities to benefits from reducing groundwater withdrawal and create positive impacts into perpetuity. In addition, conservation and restoration of working lands can support increased biodiversity by preserving connectivity, especially when in proximity to established habitat corridors. Among the many benefits to drought risk reduction, this ecologically strategic approach also supports the goals of SGMA. Overall, retirement of agricultural lands contributes to drought mitigation through the reduction of groundwater demand and aquifer replenishment, while enhancing water and air quality.

3.3 Project Location / Site Selection

For this project, primary site selection factors included drought risk, overall water shortage, habitat suitability for restoration of target species, proximity to a protected area, and proximity to frontline communities. The table below (Table 2) includes an overview of the site selection analysis performed to determine locations which met suitability criteria and could potentially derive a broad range of benefits from the project. After appropriate project locations were selected, the GSA boundaries were layered on top to determine the appropriate entity to include in project coordination activities.

As the primary focus of this project is to reduce drought risk, the NRI dataset was used to identify areas with the highest risk within the Tule Subbasin, by census tracts for each GSA. In conjunction, the water shortage

26 Attractive and Beneficial: Groundwater Recharge Basins Can Be Both for People and Wildlife – Point Blue Conservation Science (pointblue.org)
27 Water, environment, and socioeconomic justice in California: A multi-benefit cropland repurposing framework – University of California Merced (ucmerced.edu)

vulnerability score was included to understand which areas within the subbasin may be most at risk. The data used to define water shortage vulnerability was developed by DWR.[28] The average water shortage vulnerability score within the Tule Subbasin is approximately 40 with the highest possible score being 101. DWR classifies anything above 40 as highly vulnerable.

As a requirement of the FEMA BRIC program, this analysis considered how projects will ultimately benefit communities that face a disproportionate burden as a result of climate hazards. Projects that provide benefits to frontline communities are more competitive and receive more points during project evaluation, according to the BRIC scoring criteria.[29] The Climate and Economic Justice Screening Tool (CEJST) was used to locate and identify priority areas at the census tract level, which the tool defines as communities that meet the threshold (90th percentile) for one or more indicator in a burden category and the associated socioeconomic indicator (65th percentile). This tool was used in place of state-level tools, such as the Cal OES CalEnviroScreen or DWR's Disadvantaged Communities data, as the FEMA BRIC Program is a Justice40 Initiative Program, which requires the use of CEJST for federal funding programs. It should be noted here that CEJST and the state-level tools and datasets use different indicators and threshold levels to make the frontline community determinations and subapplicants should be cognizant of those differences when developing projects. Of the 30 census tracts that are included in the Tule Subbasin, 29 are identified as prioritized. For this case study, the project location was selected based on proximity to or being within a prioritized community, as defined by CEJST. Including socio-economic considerations when selecting a parcel to acquire provides an opportunity to not only meet FEMA eligibility requirements, but also ensures that projects are providing benefits equitably across all communities. This creates an avenue for frontline communities to provide input, be involved in the project development process, and potentially join as a project partner.

San Joaquin Valley. The dry, sandy environment of the valley supports desert plant life. © Not sure of photo credit

28 Water Shortage Vulnerability Web Viewer – California Department of Water Resources (dwr.maps.arcgis.com)
29 BRIC Technical Evaluation Criteria – Federal Emergency Management Agency (fema.gov)

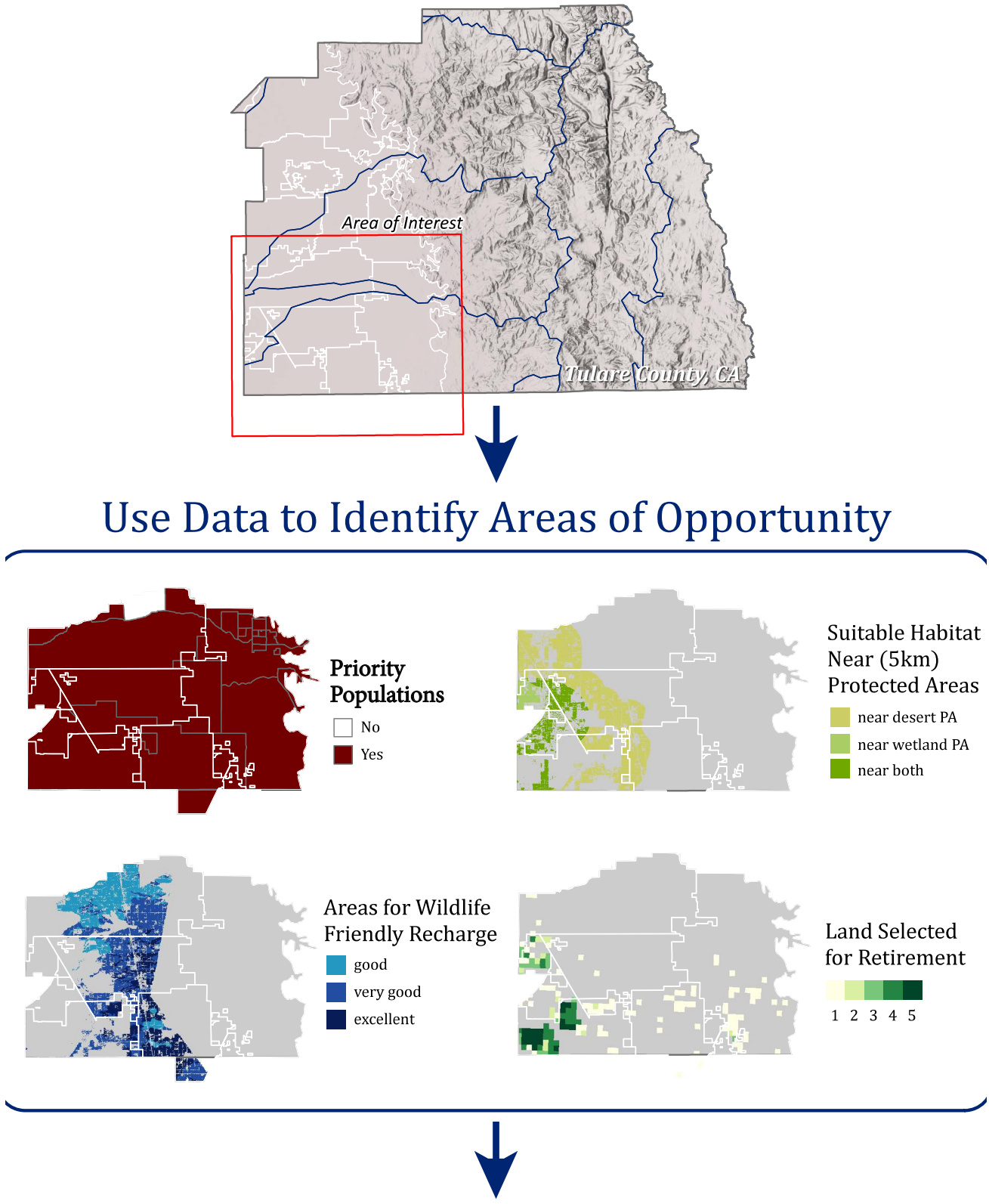

Figure 5a. Site selection data considerations for the Tule Subbasin. These included identifying areas of opportunity to implement NBS and the relative hazard and vulnerability of these areas.

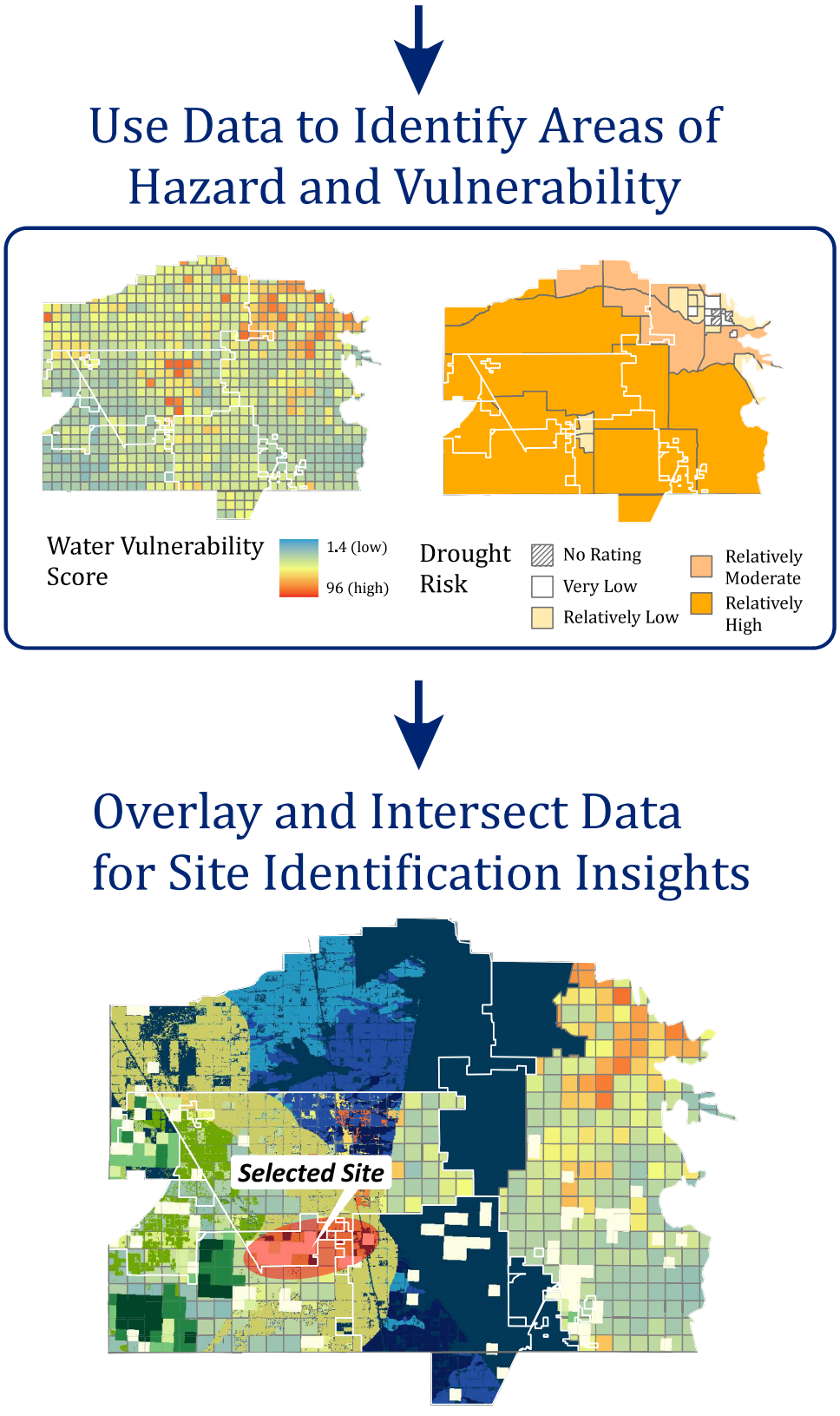

Figure 5b. Site selection data considerations for the Tule Subbasin. These included identifying areas of opportunity to implement NBS and the relative hazard and vulnerability of these areas.

3.3.1 Site Selection Summary

Based on the results of the site selection analysis, detailed in Section 3.3.2 below, an aquifer recharge drought mitigation project that includes habitat restoration and leverages agricultural land retirement would benefit the areas west of the City of Earlimart, within the Delano Earlimart Irrigation District. Agricultural lands approximately 5 miles west of Earlimart, surrounding the unincorporated City of Allensworth, are noted as having desert habitat suitable for two or more target species present as well as being identified as having 'Very Good' to 'Excellent' potential for creation of a wildlife-friendly recharge basin.[30] This, along with the proximity of the area to the Pixley National Wildlife Refuge, proximity to the Allensworth Ecological Reserve, and having agricultural parcels that have been identified up to three times as suitable for retirement, provides an opportunity to implement an NBS approach to mitigate drought risk and provide additional benefits for the City of Earlimart, the City of Allensworth, and surrounding areas.

3.3.2 Site Selection Considerations for Nature-Based Solutions

This analysis also considered locations in which surrounding features may be leveraged to provide additional nature-based benefits. For this project, agricultural lands with potential to be moved out of production were identified to not only meet FEMA requirements to reduce the drought risk to surrounding communities through cessation of associated groundwater pumping, but to also capitalize on lands that are likely to be repurposed and meet habitat suitability criteria. The presence of upland habitat adjacent to a protected area may be utilized for increased connectivity, protection of critical habitat for special-status species, and increased biodiversity, among other things. In addition, as aquifer recharge has been identified by FEMA as a drought mitigation strategy, identifying areas suitable for wildlife-friendly recharge basins was included as part of the site selection process for this project.

When selecting a location for this project, the primary considerations for agricultural land retirement included habitat restoration potential, proximity to a protected area, potentially suitable habitat for key wildlife species, and suitability for the creation of a wildlife-friendly recharge basin. In a 2017 study, TNC identified agricultural land potentially suitable for retirement and restoration and with potential for creation of a successful wildlife-friendly recharge basin.[35] This dataset was used to understand the general location of agricultural land with better chances of implementing successful restoration, building habitat connectivity, and protecting important habitat for targeted species. Additional data that identifies agricultural land suitable for retirement based on future landscape scenarios and SGMA conditions provided a secondary layer for project site selection.[36] Locations with parcels that were selected up to three or more times as suitable for retirement and met the habitat suitability criteria were prioritized for acquisition.

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30 Identification of potentially suitable habitat for strategic land retirement and restoration in the San Joaquin Desert – The Nature Conservancy (tnc.org)

31 The dataset used for Drought Risk (FEMA's NRI data) utilizes the 2010 census tract boundaries, while the CEJST data utilizes the 2020 census tract boundaries with legal boundary modifications submitted to the TIGER system in the year 2021. As such, a direct comparison of census tracts with drought risk and which were prioritized by CEJST was not possible at this time.

32 Metrics used to calculate the water shortage vulnerability score include projected climate change (temperature shift, projected saltwater intrusion, and wildfire risk), current conditions and episodic events (precipitation, consecutive dry years, wildfire risk, geology, water quality aquifer risk, subsidence, basin salt, overdrafted basin, chronic declining water levels, and surrounding land use), infrastructure (dry domestic well susceptibility in basins and domestic well density in fractured rock areas), and observed shortage (reported household outages on domestic well). Data is aggregated and scored using a calculation that weights each variable. More information can be found here: https://water.ca.gov/Programs/Water-Use-And-Efficiency/SB-552/SB-552-Tool. 33 Identification of potentially suitable habitat for strategic land retirement and restoration in the San Joaquin Desert – The Nature Conservancy (tnc.org)

34 Shaping Land Use Change and Ecosystem Restoration in a Water-Stressed Agricultural Landscape to Achieve Multiple Benefits – Stanford University (standard.edu)

35 Tulare County Local Hazard Mitigation Plan – County of Tulare California (tularecounty.ca.gov)

36 Nature-based Solutions – European Commission (research-and-innovation.ec.europa.eu)

Table 2. Summary of Project Site Selection Analysis for each GSA

GSA	Percentage of Census Tracts with High Drought Risk within GSA Boundaries[33]	Percentage of Prioritized Census Tracts within GSA Boundaries	Water Shortage Vulnerability Score (Avg.)[34]	Upland Habitat within 5 kilometers of Protected Area	Agricultural Land Identified for Retirement (Avg.)	Suitable Area for Wildlife-Friendly Recharge
Alpaugh GSA	100%	100%	29	Wetland and Desert	Relatively High	No
Delano-Earlimart Irrigation District	60%	100%	40	Desert	Moderate	Yes
Eastern Tule GSA	15%	100%	41	No	Moderate	No
Lower Tule River Irrigation District	43%	83%	46	Desert	Very Low	Yes
Pixley Irrigation District	75%	100%	41	Wetland and Desert	Relatively Low	Yes
Tri-County Water Authority	100%	100%	30	Wetland and Desert	Very High	Yes

3.4 Project Partners and Interested Parties

Eligible applicants and subapplicants and their roles are defined within the HMA Program and Policy Guide. Eligible applicants include States, territories, and federally recognized tribes. The applicants are responsible for overseeing the grant requirements. Eligible subapplicants include state agencies, local governments, and tribal governments and must apply to the applicant to be considered for inclusion in an HMA application. Subapplicants are responsible for administration and management of the grant. Individuals, businesses, and non-profits are not eligible to apply for HMA grants, but a subapplicant may submit an application on their behalf. Based on the site selection for this hypothetical project scenario, Tulare County is identified as a potential subapplicant due to their role in leading the development of the Tulare County MJLHMP and their commitment to reducing risk and taking action to lessen the impacts of climate hazards on the people and property within the County.[37] Coordination would likely need to occur with the Delano Earlimart Irrigation District as a potential primary project partner as the project falls within their program area and would support the GSAs goal to implement sustainable groundwater management activities, as required by SGMA. Additional interested parties may include the City of Earlimart, representatives from the City of Allensworth, the Central Valley Regional Water Control Board, and TNC, among others.

Carrizo Plain Landscape. Grasslands extend across the Carrizo Plain. © Lara Weatherly

37 Nature-based Solutions: a Cost-effective Approach for Disaster Risk and Water Resource Management – World Bank Group (worldbank.org)

4. Conclusions

As drought hazards continue to be a growing concern, particularly in California, it is important to consider actions that can be implemented to mitigate both current and future risk. Projects that aim to restore natural systems ultimately increase societal well-being, and environmental and infrastructure resilience to natural hazards; are frequently known to be cost-effective;[38,39] and provide multiple co-benefits in addition to the identified risk reduction.

Implementing NBS provides an opportunity to mitigate increasing drought hazard and support social, natural, and economic systems throughout the Tule Subbasin. The hypothetical project outlined in Section 3 describes a drought mitigation project aimed to increase drought resilience, create habitat for wildlife, encourage recreational opportunities for surrounding communities, and enhance the sustainability of groundwater in the Tule Subbasin. The project does so through:

- Strategic acquisition of agricultural land to provide mitigative actions that reduce current groundwater pumping for crop irrigation;
- Restoration of natural vegetation and ecosystem functionality to increase ecosystem services such as soil retention, thereby increasing soil health, retaining moisture, and improving percolation and infiltration rates for groundwater supplies;
- Restoration of habitat to increase biodiversity by providing suitable habitat for native and special-status species and enhancing connectivity between wetland and desert habitat and surrounding protected areas within the Tule Subbasin;
- Creation of a recharge basin that replenishes depleted groundwater supplies to reduce drought risk for surrounding communities by capturing and storing surface water within aquifers and provides enhanced habitat for waterfowl and pollinators; and
- Inclusion of design elements for wildlife-friendly recharge basins to attract target species and create space for waterfowl to forage, nest, and/or breed, and provide increased connectivity and suitable habitat for a wide variety of species that may not otherwise utilize the native desert habitat.

Additional community benefits include improved water quality and air quality through the reduction of agricultural practices and use of fertilizers and pesticides, increased water quantity via more effective and natural groundwater recharge methods, and access to open space for recreational and educational opportunities, among others. Further, through the NBS presented herein, flood mitigation benefits would also help reduce risk to infrastructure in downstream communities by reducing the flow rate of surface waters during extreme flood events and better capture and store flood waters through restored native wetland habitat.

In addition to societal, environmental, and economic benefits, NBS can also provide mitigation benefits across multiple hazards. As mentioned previously, land acquisition is traditionally recognized by FEMA as a flood mitigation strategy. Typically, acquiring land within a floodplain mitigates risk by reducing development within a river's natural floodway. In this scenario, retiring land from agricultural production reduces strain on groundwater resources by removing the need to pump water for crop irrigation. By acquiring a parcel within a floodplain, the subapplicant can mitigate risk to both drought and flood hazards, while enhancing benefits associated with the project. As an additional benefit, subapplicants may consider restoring riparian areas to increase flood storage within the floodplain, thereby reducing flood risk within the surrounding communities and enhancing aquifer recharge during flood conditions. Furthermore, wildlife-friendly recharge basins not only provide additional flood storage through the basins themselves but create wetland habitat which helps modulate flood risk and increase water filtration before entering the groundwater supply.

38 Innovative Drought and Flood Mitigation Projects – Federal Emergency Management Agency (fema.gov)
39 Hazard Mitigation Assistance Guidance – Federal Emergency Management Agency (fema.gov)

4.1 Project Barriers and Recommendations

Funding opportunities for drought mitigation activities have only recently become more available. FEMA HMA funding programs expanded the inclusion of drought mitigation projects within the last five years.[40] Previously, these activities were only identified as "Miscellaneous/ Other."[41] As such, there are many unanswered questions and complexities when it comes to being awarded FEMA funds for drought mitigation, specifically when considering nature-based approaches. Subapplicants should be cognizant of potential barriers that may prevent funding during the project development process. Review of the specific program's NOFO for the year of application submission, as well as any subsequent years, is encouraged as criteria and eligible activities may vary. The NOFO's also include a list of eligible applicants and subapplicants, which may limit entities that are eligible to submit applications in a given application period. In addition, most FEMA funding programs require that the project location be included in an area that received a Presidential Disaster Declaration within a specified timeframe. For projects submitted for BRIC funding, Presidential Disaster Declarations must have occurred within the last seven years before the application period start date.

In the hypothetical scenario presented above, potential barriers may include intricacies with FEMA-specific requirements for land acquisition projects. In many cases, FEMA requires specific restrictions to be included in the deed of the property that may limit the activities that occur on the property after acquisition, limits who may be an eligible subapplicant, and requires that a government agency has ownership of the property, among other limitations. However, as property acquisition in this case study is intended for drought mitigation and not flood mitigation, these requirements may be less restrictive. In particular, this case study points to the use of acquisition to cease groundwater pumping in perpetuity, thereby reducing drought hazard to surrounding communities. Subapplicants should contact their State Hazard Mitigation Officer[42] for more information. Overcoming this barrier may include working closely with FEMA, Cal OES, and the U.S. Department of Agriculture to highlight the importance of moving agricultural land out of production as an important step towards reducing the shortage of groundwater supplies, particularly in critically overdrawn basins, understand any restrictions, or whether the acquisition should be completed as a separate project prior to the FEMA-funded portions of the project. At a federal level, FEMA should consider broadening the eligible use of acquisitions beyond flood mitigation and provide technical guidance and job aids to guide applicants and subapplicants through utilizing this strategy to capture the vast range of benefits that could be leveraged.

An additional project barrier may include issues with obtaining or understanding water rights for the parcel(s) where the project will take place. Water rights encompass the legal use of water for beneficial purposes, beyond what is already allocated for municipal use. This includes taking water from a waterbody or underground resource for uses such as swimming, fishing, farming, or other industrial use. Each state varies in their laws regarding who is eligible to obtain water rights and how these are allocated to those individuals. In California, an eligible entity must obtain a permit, which can be a confusing and difficult legal process. When developing a drought mitigation project, particularly one that involves underground storage for water management activities, it will be vital to understand how to obtain water rights, who is eligible to hold those water rights, and how to handle using that water during drought events. Subapplicants should consult the agency that governs water rights in their state early in the project development process to obtain any necessary permits before submitting an application for FEMA funding. It will be beneficial to include in the application that there is a legal right to use the water being stored, or to highlight how this process is being managed long-term.

Carrizo Plain. The landscape of the Carrizo Plain is strongly affected by drought. © Lara Weatherly

40 State Hazard Mitigation Officers – Federal Emergency Management Agency (fema.gov)
41 https://www.fema.gov/sites/default/files/2020-04/HMA_Guidance_FY15.pdf
42 https://www.fema.gov/grants/mitigation/state-contacts

5. Looking Forward: Next Steps for Communities

5.1 FEMA Benefit-Cost Analyses

As a next step in the FEMA application process, a BCA will need to be completed to be eligible for hazard mitigation funding. The BCA is used to verify the cost-effectiveness of the project, meaning that the holistic benefits outweigh the costs to implement the project. BCAs generally tend to be more challenging for NBS projects when calculating benefits, as most of the emphasis is placed on traditional, hardened and pre-calculated approaches to mitigate hazard risk. The BCA Toolkit is a tool that helps calculate the Benefit Cost Ratio (BCR) based on specific project metrics and hazard, risk, economic, and project benefit data. Benefits fall under either quantitative or qualitative categories. Quantifiable benefits are generally what is used to calculate the BCR, and those benefits that cannot be quantified (i.e., those that are qualitative and cannot be assigned a monetary value/would be too difficult to determine) can be described in the narrative for additional benefit consideration. To input and quantify nature-based benefits, the ecosystem services provided by the project's land cover types that could be created and/or enhanced with the implementation of the project would be used. For drought mitigation projects, the BCA Toolkit does not currently account for the ecosystem services provided by the project within the BCR. All calculations should be performed outside of the BCA Toolkit and included with the project narrative. Although these benefits will not be included in the BCR, they may still provide additional points through the BRIC scoring criteria.

In the hypothetical case study presented above, the nature-based benefits provided by the project beyond the mitigation of risk to people and property may include increased social equity, providing additional native habitat, increased biodiversity, reduced erosion, increased aesthetic value within the project area, increased nutrient cycling, increased climate regulation, increased carbon capture, increased water filtration and water supply, and increased water storage capacity. Not all benefits may be assigned an economic value. For those that are not included in the quantitative calculation, they can be described in the project narrative associated with the BCA. Nature-based benefits with economic values associated are detailed in FEMA's 2022 Ecosystem Service Value Updates.

In order to understand cost-effectiveness of the quantifiable benefits, the first step is to calculate the number of acres of each land cover category that will be restored, created, enhanced, or protected as a result of the project, as defined by FEMA in their "Ecosystem Service Value Updates" document. This project includes both inland wetland and rural green open space. Subapplicants should then determine whether these land cover categories meet feasibility and eligibility criteria and then select an appropriate amount of time that the project is expected to be effective or useful. FEMA provides eligibility criteria and a standard list of useful life values based on project type in the "Ecosystem Service Value Updates" document. The annual economic value associated with each land cover category is then multiplied by the number of acres identified for that land cover category and converted to present day value using a standard financial equation that accounts for the assumed discount rate (used to account for the reduced value of future benefits) across the useful life of the project. If multiple land cover categories are included, the annual values are summed for all categories.

Future benefits (in today's dollars) – **Costs (in today's dollars)** = **Net Present Value (NPV)**

Figure 6. FEMA's standard financial equation used to calculate the present-day value of benefits associated with each project.

For additional information, visit *Demystifying Nature's Benefits for Hazard Mitigation*, a parallel effort that helps project proponents gain a deeper understanding of FEMA BCAs for drought, flood, and pre-disaster wildfire mitigation projects. More specifically, this supplemental document aims to 1) provide justification to value NBS as a cost-effective means to hazard mitigation; 2) outline hazard risk reduction actions that are eligible to include in BCAs; 3) act as a guide to complete required mitigation cost analyses specific to NBS projects; 4) identify areas where NBS fall short in FEMA BCAs; and lastly 5) highlight resources to help value NBS for hazard risk reduction in BCAs.

Appendix A

San Joaquin Valley Community Profile

The Tule Subbasin, located in the southern San Joaquin Valley (SJV), is governed by six groundwater sustainability agencies (GSAs) that aim to meet the state's 2040 goals for sustainable, local groundwater management under the 2014 Sustainable Groundwater Management Act (SGMA). Since the SJV is largely dominated by agriculture, sustainable and resilient groundwater supply for sustained agricultural operations and community water supply is at the forefront of needs in this region. As climatic conditions shift through time, droughts are projected to increase in duration, frequency, and intensity over time causing major implications for both surface and groundwater supplies in the SJV. Both human and natural systems will be impacted by the ever present and ongoing dynamics between wet and dry periods, making water supply difficult to manage and predict into the future. Opportunities to help protect water supplies include the use of nature-based solutions, reservoir optimization, and municipal management systems to help with water conservation and beneficial reuse of water.[1]

The purpose of this detailed community profile is to provide a deeper background for SJV natural systems, communities, and the economy as they relate to drought. More specifically, focus on the Tule Subbasin and highlighting the rationale behind why this community would be an ideal candidate for nature-based drought mitigation project types and how FEMA funding may be able to support.

Addressing Drought in the Tule Subbasin: A Community in the Heart of California's Agricultural Lands

In Tulare County, approximately 10% of the population is designated as "water insecure" meaning that drinking water is either unavailable or unreliable.[2] Furthermore, there are entire communities without connection to water systems due to old or failing wells due to groundwater depletion and/or water sources that are contaminated by pesticides and fertilizers—most of which are for residential, not agricultural use.[10]

The Tule Subbasin is part of the greater Tulare Lake Hydrologic Region and encompasses three main drainages – the Tule River, Deer Creek, and the White River, all of which flow west and empty into the historic Tulare lakebed. Historically, this region was characterized by a vast network of inland wetlands, riparian corridors, and upland/grassland complexes that have since been almost entirely converted to agriculture. There are two primary aquifers in the Tule Subbasin – an upper unconfined to semi-confined aquifer and a lower semi-confined aquifer.[3] Groundwater generally flows from the eastern boundary that gathers natural recharge from stream networks flowing off the Sierra Nevada Mountain Range towards the western-central depression of the subbasin. Groundwater levels have shown sharp declines in both the upper and lower aquifers between 1987 and 2017, and groundwater storage has also dramatically declined. Groundwater quality is generally fair in the subbasin, however, certain areas of the subbasin experience highly localized, point source contamination issues from agricultural practices. Subsidence of the land surface has also been well-documented in the subbasin, with the highest rates occurring along the Friant-Kern Canal which transports surface water supplies to the southern SJV.

There are several open space and protected areas within the Tule Subbasin, some of which include the Pixley National Wildlife Refuge, Natural Resource Conservation Service Wetland Reserve Program easements, California Department of Fish and Wildlife lands, and Allensworth State Park, among others. Habitat loss and degradation over time has significantly impacted plants and wildlife in the region, resulting in more than thirty species being threatened, endangered, or otherwise in need of protection, including special-status species such as the San Joaquin kit fox (*Vulpes macrotis mutica*), blunt-nosed leopard lizard (*Gambilia sila*), and the Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*).

1 Fifth National Climate Assessment: Report-in-Brief – U.S. Global Change Research Program, 2023 (https://nca2023.globalchange.gov/)
2 Tulare County's never-ending drought brings dried up wells and plenty of misery – CalMatters, 2021 (calmatters.org)
3 Tule Subbasin Coordination Agreement – Groundwater Exchange, 2020 (groundwaterexchange.org)

COMMUNITIES

Tulare County has a population estimate of 477,544 according to the 2022 US Census Bureau. A majority (67%) of the population is Hispanic or Latino, 26% is white, and the remainder of the county is almost evenly split between African American, American Indian, and Asian. The median value of owner-occupied housing units is approximately $240,000 (all metrics reported in 2021 dollars), whereas the median value for California is $573,000. The median household income is $57,394 in Tulare County, whereas the statewide median household income is $84,097. Approximately 19% of the County is in poverty.[4]

According to the Climate and Economic Justice Screening Tool (CJEST), the majority of Tulare County is considered prioritized, with the exception of the northeastern region which encompasses portions of Sequoia National Park and the Sequoia-Kings Canyon Wilderness, and a few parcels surrounding the cities of Visalia and Tulare. Priority rankings consider both environmental burden and socioeconomic thresholds (i.e., climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development).[5]

The Tule River Indian Reservation is the only Tribal Nation that falls within Tulare County. Original inhabitants of the SJV included the Yokut-speaking tribes which encompassed over 50 dialect groups and spanned territory from Sierra Nevada Range rivers and creeks to Tulare Lake. The Tachi Yokut tribe considers much of Tulare County as part of their ancestral homelands containing important tribal resources, especially in the Deer Creek vicinity.[6] The Tule River Indian Reservation includes descendants from the Yokut tribes and have the overarching goal of self-government and self-sufficiency on the land.[7]

ECONOMY

Agriculture is the largest industry within the County and is heavily reliant upon both surface water and pumped groundwater supplies to meet water demands in the subbasin.[8] According to the Tulare County Agricultural Commissioner's Annual Crop Report, the County's gross agriculture production value in 2021 was $8,089,621,300, a 13.3% increase from 2020. The leading commodity throughout the County is milk ($1,943,043,000), which represents 23% of the total crop and livestock value for 2021. Additional commodities in the region include livestock and poultry ($732,406,000), field crops ($571,436,000), fruit and nuts ($4,607,905,000), nursery products ($118,779,000), and vegetables ($20,544,000). Tulare County produced over 150 different commodities based on the 2021 crop report for more than 90 countries throughout the world.[9]

In addition to the impacts of drought previously mentioned, climate change may impact agriculture in the region by reducing productivity, agricultural yield, and nutritional value of produce. It could disrupt pollination ecosystem services, necessitate increased fertilization, and ultimately result in crop failure.[1] Increased storm frequency and intensity also have the capability of damaging crops and property and contaminating water supplies.[1]

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31 The dataset used for Drought Risk (FEMA's NRI data) utilizes the 2010 census tract boundaries, while the CEJST data utilizes the 2020 census tract boundaries with legal boundary modifications submitted to the TIGER system in the year 2021. As such, a direct comparison of census tracts with drought risk and which were prioritized by CEJST was not possible at this time.

32 Metrics used to calculate the water shortage vulnerability score include projected climate change (temperature shift, projected saltwater intrusion, and wildfire risk), current conditions and episodic events (precipitation, consecutive dry years, wildfire risk, geology, water quality aquifer risk, subsidence, basin salt, overdrafted basin, chronic declining water levels, and surrounding land use), infrastructure (dry domestic well susceptibility in basins and domestic well density in fractured rock areas), and observed shortage (reported household outages on domestic well). Data is aggregated and scored using a calculation that weights each variable. More information can be found here: https://water.ca.gov/Programs/Water-Use-And-Efficiency/SB-552/SB-552-Tool.

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