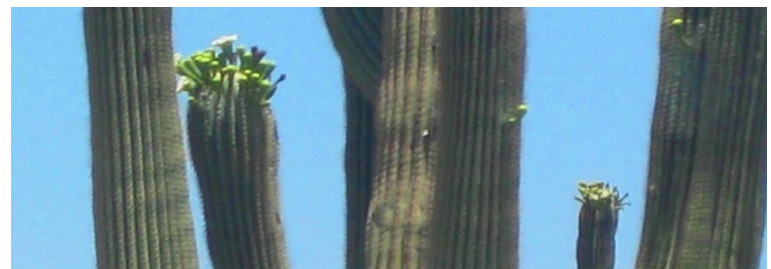




FLOODPLAIN MANAGEMENT PLAN

TSMS Phase V(b)

November 18, 2025



Acknowledgements

Mayor and Council Adoption

The City of Tucson Mayor and Council formally adopted the Floodplain Management Plan (FMP) Phase V on August 9, 2016. The first 5-year update was in 2020 for the FMP Phase V(a), adopted on December 8, 2020. The City of Tucson updated the FMP for the second 5-year update TSMS Phase V(b) with a first draft in June 2025 and a final draft October 2025.

2025 Mayor and Council
Mayor Regina Romero
Lane Santa Cruz - Ward One
Paul Cunningham - Ward Two
Kevin Dahl – Ward Three
Nikki Lee – Ward Four
Rocque Perez – Ward Five
Karin Uhlich – Ward Six

2025 City Manager
Timothy M Thomure, P.E.

Project Team

The Tucson Floodplain Management Project team would like to thank the Floodplain Management Plan (FMP) committee members for their support and participation in the 2025 update of the plan. During the annual FMP committee meeting in November 2019, the committee determined that the formal 2020 update for the plan should concentrate on the action item list. Over a four-month period (March through June 2020), the committee members met monthly to discuss the action item list and identify the current flooding FMP Risks and erosion FMP Hazards that Tucson faces. The FMP committee worked diligently keeping in mind the goal of protecting Tucson's citizens by using their expertise in planning, engineering, real estate, environmental sciences, and policy formation to update the FMP. For the 2025 5-year update, City of Tucson had working groups for 7 main topics identified by key stakeholders from previous FMP meetings and had a total of 16 meetings to discuss potential updates between April and July 2025.

Elizabeth Eberbach, P.E., CPM, CFM, Civil Engineer, in Tucson's Department of Transportation & Mobility (DTM), was the lead advocate for completing the Tucson FMP Update, and was assisted by Kirshana Guy, DTM Grant Writer, Stephen Blood, Engineering Manager in the Planning and Development Services Department (PDSD), as well as Alfred Zuniga, P.E., Tucson City Engineer Administrator, who serves as the City of Tucson Floodplain Administrator and champions the FMP update with the general goal of reducing flood hazards and reducing flood-related costs to

the Tucson citizens. City of Tucson also utilized WSP for this 2025 update. Koren Manning is the Interim Director of PDSD during this update. For the original 2016 FMP, guidance and support was provided to the City by FEMA Region IX, Arizona Department of Water Resources (ADWR), and FEMA Region IX's Production and Technical Services (PTS) Contractor. For this year's update, City staff along with their consultant Gabi Davis from WSP took the lead.

acknowledgments cont'd

Committee Member List

A diverse group was convened to form the committee, including key participants listed below. A complete listing of committee members is provided in the Appendix (p.59) of this report.

Table 1. Key committee participants for 2025 FMP Update

Name	Organization	Title	FMP Committee Function/Role
Eric Shepp, P.E., CFM	Pima County Regional Flood Control District	Deputy Director	Public/Structural Flood Control Projects
Fred Narcaroti	Ninyo & Moore	Principal, Geotechnical & Environmental Sciences Consultant	Public/Property Protection
Marek Kasztalski, P.E.	Ninyo & Moore	Principal Engineer, Geotechnical & Environmental Sciences Consultant	Public/Property Protection
Oscar Ponce	Tucson Clean & Beautiful	Grow Tucson Designer & Project Manager	Tucson/Natural Resource/Tree Canopy Protection
Savannah Martinez	City Manager's Office	Emergency Manager	Flood Hazard Emergency Response
Claire Jean Prager	Coldwell Banker Realty / Tucson Association of Realtors	Associate Broker	Public/Preventive Measures/Resident
Elizabeth Eberbach, P.E., CPM, CFM	City of Tucson, Dept of Transportation & Mobility,	Civil Engineer	Tucson/Preventive Measures
David Marhefka, L.A.	City of Tucson, Dept of Transportation & Mobility	Landscape Architect	Natural Floodplain Function
Luke Cole, PhD	Santa Cruz River Program, Sonoran Institute	Director	Regional Watercourse Conservation/Floodplain Champion
Irene Ogata	City of Tucson, Tucson Water	Project Coordinator	Tucson/Preventive Measures/Natural Resource
Jim Robinson	City of Tucson, Dept of Transportation & Mobility ITS Division	GIS Technician	Public/Property Protection
John Wise, P.E, CFM	WLB Group Engineering	Sr Drainage Engineer	Public/Property Protection, TSMS
Jim "JJ" Janecek, P.E., CFM	Pima County Regional Flood Control District	Development Review Civil Engineer	Public/Structural Flood Control Projects
Beryl Baker	Resident, Westside	Resident, Westside	Riparian Floodplain Preservation / West Branch Santa Cruz River
Mo El-Ali, P.E.	City of Tucson, Dept. of Transportation & Mobility	City Engineer (retired)	Public/Structural Flood Control Projects
Catlow Shipek	Watershed Management Group	Policy and Technical Director	Public/Natural Resource Protection
Larry Roberts, P.E., MS	Arroyo Engineering	Principal Engineer	Public/Preventive Measures, TSMS (lead contributor)
Sabrina Ortiz-Encinas	Resident	Resident	Resident/Floodplain Champion

Victor Palma	Tucson Airport Authority (TAA)	Airport Authority	Critical Infrastructure Protection
Stephen Blood	City of Tucson, Planning & Development Services Dept	Engineering Manager	Flood Regulation and Development
Melanie Alvarez	Pima Association of Government	Planning Coordinator	Regional/Planning & Public Information
Frank Souza	Resident, Geologist	Retiree	Natural Flood and Erosion Function
Preston Hould	Tucson Police Dept	Officer	Tucson/Emergency Services
Alfred Zuniga, P.E.	City of Tucson, Transportation & Mobility, Engineering	Floodplain Administrator	Tucson/Structural Flood Control Projects
Gregory Bambauer, P.E.	WSP Drainage Consultant	Senior Vice President, Water Resources Group Lead	Flood/Erosion Regulatory Planning
Blue Baldwin	City of Tucson, Green Street Infrastructure	GSI Storm to Shade Manager	Green Infrastructure Management
Adam Call, AICP	Development / Homebuilders	Forward Planner Landscape Architecture	Public/Planning
Brendan Lyons, MPA	Southern Arizona Homebuilder Association	SAHBA Government Affairs Director	Building Regulations and Development

There also have been City of Tucson FMP Riparian Floodplain Champions since 2023 that have been involved with updates for the City of Tucson.

Tucson FMP Riparian Floodplain Champion 2023



Bob Lindrud

Bob Lindrud since 2013 has spent hundreds of hours picking up trash in the Alamo Wash, from Grant to the Rillito, and the streets of the Old Fort Lowell neighborhood. Tucson Clean and Beautiful has provided heavy duty bags, TMC has made available a dumpster to make his work easier. Bob's neighbors appreciate his making the wash parklike. A place safe to walk and walk your dog. Bob, 80+, considers his hours in the wash exercise and shuns recognition. His neighbors think of him as inspirational, leading by example.

Tucson Annual FMP Floodplain Champion 2024



Luke Cole, PhD

Director of the Santa Cruz River program at the Sonoran Institute and a part of the Santa Cruz Watershed Collaborative, has lead clean-up activities within the Santa Cruz River and has studied the type of trash found in the wash (garbology). Almost half of all of the Santa Cruz River trash is food packaging and cups. An additional 10 percent of the Santa Cruz River garbage is single-use clothing and plastic bags. His efforts and drive have prioritized the City of Tucson's main regional watercourse as the lifeline for the old growth desert and surrounding riparian areas.

Tucson 5-Year FMP Floodplain Champion 2025



Sabrina Ortiz -Encinas

The 2025 Five-Year Floodplain Management Plan Floodplain Champion is Sabrina Ortiz -Encinas. In honor of her husband, William Ortiz-Encinas, age 44 who passed away August 9th, 2024, in the Airport Wash. His death is under investigation. He was born and lived in Tucson. William attended CE Rose, Wakefield, Pueblo High Schools and the University of Arizona. He worked in the construction field and pursued the Art of Tattooing. His main passion was his wife, Sabrina, and his five children. He always made himself available to family, friends, and even strangers to extend a hand. William has been dearly missed by all who knew and loved him. Since his passing, his wife Sabrina has engaged the local community to help clean the surrounding area within the Airport Wash where William had passed. The watercourse has seen less deaths and illegal activity since her community's efforts to keep the wash clean. William, Sabrina's inspiration, has inspired others in the community to work together to keep the local wash clean.

Table of Contents

Acknowledgments	i
Council Adoption	i
Project Team	i
Committee Member List	ii
Executive Summary.....	1
Chapter 1: Purpose & Intent of the FMP	4
Introduction to Tucson	4
Tucson's Unique Floodplains, Erosion Areas, and Watersheds	6
Outreach	15
Decision Making Considerations for Tucson Floodplain Managers.....	23
Tucson Hydrologic Modeling	23
Introduction to the FMP Update Process	27
Quick Risk MAP Product Discussion	39
Chapter 2: Planning Phase	41
Tucson Staff Involvement.....	42
Other Agency Coordination.....	43
Report Review	43
In-Progress Floodplain Mapping Studies of Most Concern for Tucson	46
City of Tucson Participation.....	51
Project Website and Education Tools	53
Public Involvement	53
Planning Process Conducted through a Planning Committee.....	54
Public Meetings Held on Draft Plan/Other Public Information to Encourage Input.....	54
Community Rating System FMP Steps.....	56
Chapter 3: Assessing the Hazard	57
Flood Areas with Utility/Municipal Structures	60
Geomorphologic Flood Hazards.....	61
Natural Floodplains.....	61
Private Drainage Infrastructure.....	62

Public Infrastructure Conveyance.....	63
Vegetation Associated Flood Hazards.....	64
Urban High-Density Flood Areas	65
Seven Most Vulnerable Hazards for Tucson.....	66
Other Hazards in Tucson	68
Less Frequent Flood Hazards	70
Future Condition Considerations and Their Potential Impact to Floodplains.....	73
Climate Change	74
 Chapter 4: Assessing the Problem.....	 75
Review of all Damaged Buildings/Flood Insurance Claims (HAZUS)	78
Repetitive Loss Property	78
 Chapter 5: Setting Goals and Defining Actions	 79
City of Tucson FMP Goals.....	79
Reviewing Possible Activities	81
 Chapter 6: Action Plan	 82
Mitigation Activity Summary Prioritization.....	83
Post-Disaster Mitigation Policies and Procedures	90
Actions Items for Mitigation of Other Hazards	91
Action Plan.....	92
 Chapter 7: Plan Adoption and FMP Updates	 97
Adoption by Tucson City Council	97
FMP Updates	97
 References	 98
 Appendices	 99

Figures & Tables

List of Figures

Figure 1	Downtown Tucson 1988	1
Figure 2	West Branch Santa Cruz River Native Fauna.....	2
Figure 3	Rillito River	3
Figure 4	Tucson Regional Watercourses.....	4
Figure 5	Old Growth Desert.....	5
Figure 6	Tucson Region Watershed Map	7
Figure 7	Chubasco	8
Figure 8	Post Storm Utility Damage	8
Figure 9	Swift Water Rescues	9
Figure 10	Soil Cement Protection	9
Figure 11	Santa Cruz River	9
Figure 12	Dual Use of Floodplain	10
Figure 13	Sediment Transport	11
Figure 14	TCB Available Adopt-a-Washes	12
Figure 15	Rillito After Storm.....	13
Figure 16	Storm Detected by Radar	13
Figure 17	Tucson View	14
Figure 18	Sample Water Harvesting	15
Figure 19	“Retention is Restrictive, Do Detention”	15
Figure 20	FIM Outreach Events Provides Various Information.....	16
Figure 21	FIM Outreach Events Promote Flood Insurance	17
Figure 22	Monsoon Awareness Proclamation	17
Figure 23	Kid’s Coloring Book.....	18
Figure 24	Drainage Facility Maintenance handout	21
Figure 25	Tucson Flood Risk MAP	23
Figure 26	Rillito near Flood Stage	25
Figure 27	Tucson Sunset	27
Figure 28	Before – Exposed Sanitary Sewer	32
Figure 29	After – Colored concrete protected sewer line.....	32
Figure 30	PCRFGD ALERT Map	34
Figure 31	Agua Caliente Levee Failure	36
Figure 32	Sediment in Right-of-way	40
Figure 33	Pavement Damage.....	40



Figure 34 FMP Committee (2016)	41
Figure 35 Monsoon Clouds.....	42
Figure 36 Desert Flora.....	43
Figure 37 The Bridges Regional Detention Basin	45
Figure 38 Outreach – Flood Maps	47
Figure 39 FEMA Remapping	47-48
Figure 40 Flowing Wells Wash	49
Figure 41 High School Wash Box Culvert	50
Figure 42 Broadway Stormdrain	51
Figure 43 Arroyo Chico/Tucson Arroyo Floodplain.....	52
Figure 44 Tucson FMP Website (2016).....	53
Figure 45 FEMA FMP Website (2016).....	53
Figure 46 Tucson FMP Website (2020).....	53
Figure 47 Tucson Virtual Public Meeting Ad (2020).....	55
Figure 48 Watercourse Maintenance	63
Figure 49 Urban Storm System.....	64
Figure 50 Flooded Bike Path.....	66
Figure 51 Fires in Stormdrain System.....	68
Figure 52 Homeless Activities in Floodplain.....	69
Figure 53 Stormdrain pollutants	70
Figure 54 Floodwall Levees.....	71
Figure 55 Map of Major Flood Control Structures	71
Figure 56 Crooked Brick	73
Figure 57 Tanque Verde Creek side slope.....	73
Figure 58 Sustainable practices	74
Figure 59 Before: Ineffective Floodplain Area	74
Figure 60 After: Solar Project	74
Figure 61 Christmas W.A.S.H.....	76
Figure 62 Sediment Transport and Erosion	77
Figure 63 City infrastructure damage	78
Figure 64 Sediment Transport	80
Figure 65 Tucson landscape in bloom.....	81
Figure 66 Sandbagging (Tucson’s Programs – Operation Splash / Operation Freeze)	82
Figure 67 Houghton Road Con Arches.....	92
Figure 68 Thunderhead Over Tucson	99





List of Tables

Table 1. Key Committee Participants	ii
Table 2. Tucson’s FEMA Major Disaster Declarations.....	2
Table 3. NFIP CRS 600 Series Warning and Response Activities.....	35
Table 4. Actions for FMP Hazards Listed in the HMP	83
Table 5. HMP Action for other Hazards	91
Table 6. Action Plan.....	93

Executive Summary

The City of Tucson has actively managed its floodplain resources since the mid-1970's and continues to undertake programs that will improve its resilience to flooding. The City has experienced sixteen (16) flooding and three (3) major storm events since 1983. Economic and environmental impacts of flood are severe, and may increase in the future. This report will go over the findings from the various stakeholders including one workshop series that focused on developing an Emergency Response Action Plan scenario. The City of Tucson, with support from FEMA Region IX, had created the City's first "Floodplain Management Plan" (FMP) in 2016 to address community-wide flooding hazards and mitigation measures based on Community Rating System (CRS) guidelines. Subsequent 5-year updates have occurred in 2020 and in 2025.

As a participating National Flood Insurance Program (NFIP) community, City of Tucson performs various floodplain and erosion hazard management activities and gets credits based on performance. Tucson has a CRS rating of 6 which provides Tucson property owners a 20% discount on either their low-risk or high-risk flood insurance policies.

During the last two FEMA Discovery Processes, several at-risk areas in the Upper Santa Cruz Watershed were identified, and community members and local agency representatives participated in discussions to address floodplain mitigation. By creating and continuing to update this FMP as one of the CRS activities, City of Tucson can better address floodplain management decisions, consider all mitigation alternatives or consequences, and improve its class as a participant in FEMA's CRS program.

The FMP is considered Phase V of the Tucson Stormwater Management Study (TSMS). Phase V does not override the previous phases but enhances and re-instates TSMS by becoming current in the city's assessment of floodplain management needs and direction. The 2016 adopted FMP is considered the beginning of Phase V. The 2020 FMP (Phase V Task a) included an updated action plan to best address the highest priority action items identified by FMP Committee Members, and prioritized actionable mitigation measures. This 2025 formal update will be Phase V Task b with Subtasks i through vi of the TSMS. The 2025 FMP update includes updated action plans with working groups formed to address Subtasks i through vi that will reduce the risk to life and property and lessen costs associated with flooding.



Like other NFIP communities, FEMA performs annual recertifications, which are like audits to review Tucson's CRS activities which include FMP Updates, flood use permitting, mapping, stormdrain system maintenance, flood & erosion hazard information outreach, drainage infrastructure installation, and other CRS activities.

Figure 1: Downtown Tucson 1988

The City receives assistance from the Pima County Flood Control District. In addition, small portions of capital project budgets are allocated for only some of the needed drainage improvements. Since funding for flood and erosion hazard mitigation has limited resources, the City of Tucson has been actively pursuing FEMA grants since 2017 through DEMA, the State's emergency management program. Many factors are considered by FEMA when awarding FEMA grants. By adopting updates to the FMP, and performing other CRS activities, the City's opportunities for FEMA grants improve.

A FEMA 5-year Cycle verification performed approximately every 5 years and is expected in the spring of 2026, so adoption of the updated FMP report helps the City show compliance, increases chances for more grants, and improves our flood resiliency.

Pima County has experienced 14 Major Disaster Declarations and 2 Emergency Declarations.

Table 2. Tucson's FEMA major disaster declarations and historical storm data.
Pima County Presidentially Declared Flood Disaster Events

Significant Rain Events	
Date	Description
July 28, 2023	Hail damage from microburst storms
July 1, 2022	May Swiftwater incidents
August 17, 2021	Flooded houses in Alamo watershed
August 10, 2021	Flooded houses in Alamo watershed
July 23, 2021	Flooded houses
July 31, 2019	Critical facilities damaged and houses flooded
July 29, 2017	Swiftwater Incidents
July 22, 2017	Swiftwater Incidents
July 17, 2017	Mesoscale Convective Vortex storm. COOP met, preparing for EOC Activation
September 7-8, 2016	Widespread rain
August 9, 2016	Swiftwater incidents and houses flooded in Silvercroft and other watersheds
August 3, 2016	Pantano wash crossing inundated
July 27, 2016	Houses flooded in Christmas Watershed
July 1, 2016	Swiftwater incidents and many houses flooded in Christmas Watershed
June 26, 2016	Swiftwater incidents
September 14, 2014	Flooded houses in Alamo Watershed

Major Disaster Declarations		
FEMA Disaster #	Date	Description
4620	9/13/2021	Arizona Severe Storms and Flooding
4203	11/5/2014	Severe Storms and Flooding*
1940	10/4/2010	Severe Storms and Flooding*
1888	3/18/2010	Severe Winter Storms and Flooding
1660	9/7/2006	Severe Storms and Flooding
1477	7/14/2003	Wildfire*
977	1/19/1993	Severe Storms, Tornadoes, Flooding
884	12/6/1990	Flooding, Severe Storm
691	10/5/1983	Severe Storms, Flooding
570	12/21/1978	Severe Storms, Flooding
551	3/4/1978	Severe Storms, Flooding
540	11/4/1977	Severe Storms, Flooding
343	7/3/1972	Severe Storms, Flooding
217	4/30/1966	Flooding
Emergency Declarations		
3307	1/24/2010	Severe Winter Storms and Flooding
3241	9/12/2005	Hurricane Katrina Evacuation

* Pima County included under statewide Hazard Mitigation Grant Program assistance.



Figure 2: Sinaloan Narrow-Mouthed Toad
- native to the West Branch Santa Cruz River

Executive Summary Cont'd

Given that Tucson is currently rated at a CRS Class 6, this FMP process was built on the community's existing floodplain management practices and programs and focused on expanding available resources and utilizing them efficiently. In 2016, FMP committee had agreed that Tucson's multiple FMP Hazard vulnerabilities could be grouped into seven (7) main FMP Hazard categories and Public Infrastructure Conveyance has remained the top FMP Hazard in the City of Tucson. Since 2020, these FMP Hazards were determined to continue to be ranked in order of vulnerability to City of Tucson as shown above for the 2025 FMP Update.

1. Public Infrastructure Conveyance
2. Flood Areas with Utility/Municipal Structures
3. Urban High-Density Flood Areas
4. Private Drainage Infrastructure
5. Natural Floodplains
6. Vegetated Associated Flood Hazards
7. Geomorphological Flood Hazards

Categories from the 2016 adopted FMP were revisited during the 2020 and 2025 updates; see Chapter 3. It was determined during the 2025 Update to differentiate the terminology for risk, hazard and problem. For the 2025 FMP report, the 7 main categories of hazards will be henceforth referred to as FMP Hazard. Likewise, the problems associated with each FMP Hazard will use the nomenclature: FMP Problem. This clarification provides a framework for the FMP report so that the terms risk, problem, and hazard can be used as general terminology.

In 2025, the FMP committee updated the Tucson's Floodplain Management Plan goals; see Chapter 5.



Figure 3: Panorama of the Rillito downstream/west of Campbell Avenue

Purpose and Intent of the FMP

INTRODUCTION TO TUCSON

Tucson experiences a desert climate with a rainy summer thunderstorm season called “monsoon” and gets an average of 12 inches of rain annually. While a majority of Pima County is considered rural or moderately developed, Tucson is decidedly an urban area and the challenges it encounters differ and are more pronounced than those endured by the other Pima County communities. Precipitation in Tucson is higher than most desert climates, and the soils in the city have slower infiltration than other areas in southern Arizona, which is cause for more flash flooding than in other parts of the state. Because many areas of the city do not have stormdrain systems, Tucson often experiences flooding in the streets. The most common risks identified within the City of Tucson are flooding, erosion, sediment transport, and flash flood events.



Figure 4: Map of Tucson Arizona with Regional Watercourses labeled

Tucson is in the top 10 metro areas that are in the best position to quickly recover from the coronavirus-caused economic disaster, according to Moody's Analytics¹. Tucson's population rate has increased slowly over the last ten years from a rate of just below 1 percent to 1.13%. With the City's ongoing need for flood and erosion hazard mitigation, the lack of funding and slowed economic growth due to the pandemic, it is essential to update the FMP to mitigate floodplain hazards, while taking into account the potential for public infrastructure deterioration and needed maintenance. Also, with the potential for climate change conditions, communities are at risk for a higher potential for damage caused by natural disasters. Ultimately the City of Tucson Floodplain Management Plan concentrates efforts on life and safety, flood control function, environmental conservation, and resiliency.



Figure 5: Tucson's Arid Old Growth Desert

1. May 20, 2020 Information from Michael Coretz: <https://www.commercial-real-estate-tucson.com/tucson-economy-likely-will-recover-quickly-from-covid-19/>

TUCSON'S UNIQUE FLOODPLAINS, EROSION AREAS, AND WATERSHEDS

Located in the upper Santa Cruz River watershed basin, Tucson is bounded by several mountain ranges: Sierrita Mountains and Black Mountain to the southwest, Tucson Mountains to the west, Santa Catalinas to the north, Rincons to the east, and Santa Ritas to the south. There are several regional watercourses that convey the majority of flows primarily southeast to northwest, within the City of Tucson.

- Santa Cruz River
- Rillito Creek
- Pantano Wash
- Tanque Verde Wash
- Agua Caliente
- Lee Moore Washes

Pantano Wash conveys runoff from the eastern portion of the Tucson area, northerly to the confluence with the Tanque Verde Wash where the flow turns westerly. The Agua Caliente is a tributary upstream of the Tanque Verde Wash conveying rain and debris flow from the Santa Catalina foothills. Within the Rillito Creek, the flow combines with Santa Catalina foothill runoff, and then continues to the Santa Cruz River at the northwestern side of the City. The Santa Cruz River, flowing from Mexico, conveys flows northerly along the western side of the City. Located at the south portion of the City of Tucson limits, the Lee Moore Wash area (a 50 square mile watershed management area), has east-to-west uncertain flow distribution of transitional or braided sheet flooding and channelized flows.

Regional watercourses have watersheds greater than 30 square miles whereas major watercourses are less than 30 square miles but have flow rates greater than 2,500 cubic feet per second (cfs) during the regulated storm event. There are several major watercourses in Tucson which feed into the regional watercourses that include:

- Alamo Wash
- Cholla Wash
- Pima Wash
- Rodeo Wash
- Silvercroft Wash
- Tucson Arroyo
- West Branch of the Santa Cruz River Washes

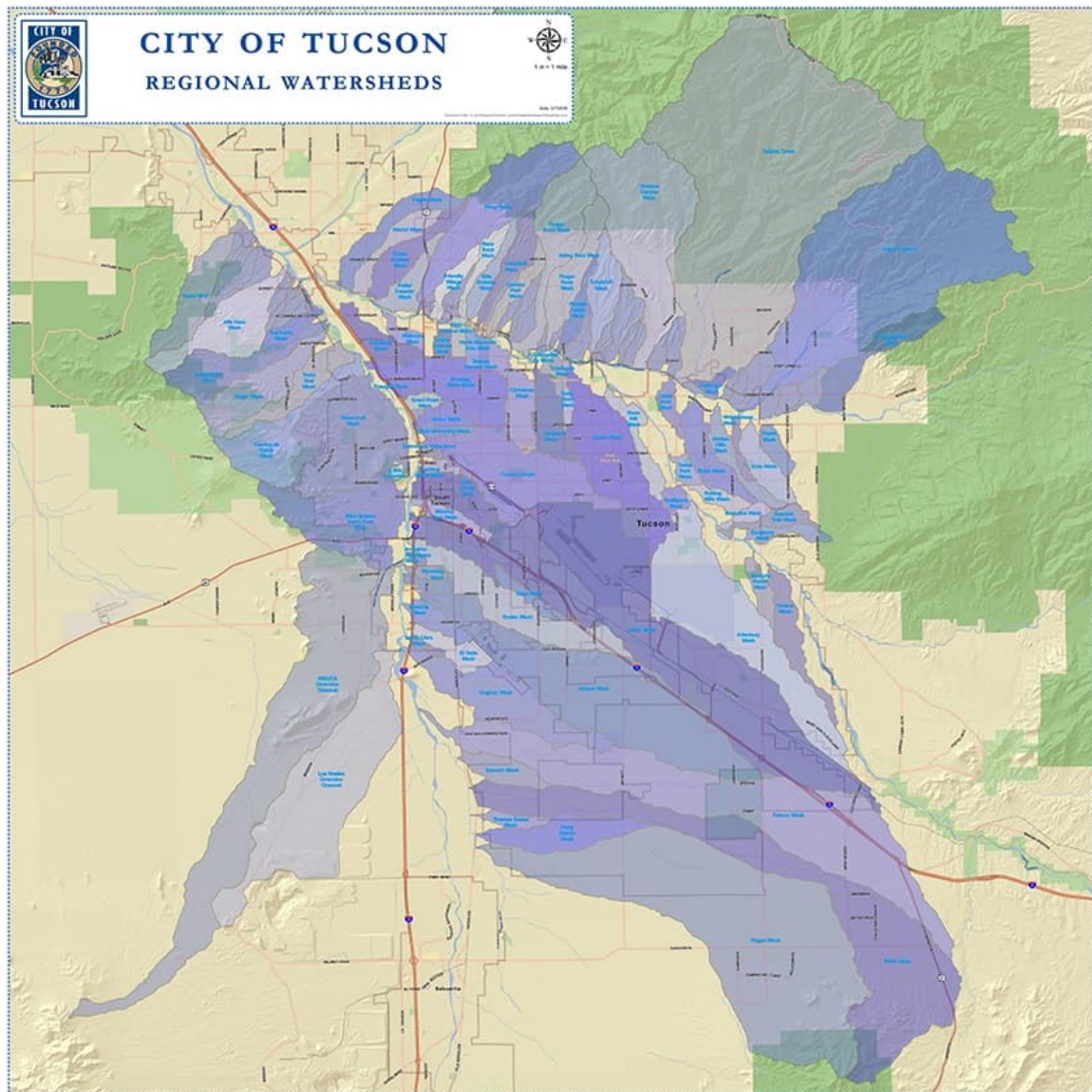


Figure 6: Tucson Region Watershed Map - existing watershed boundaries overlap county-city jurisdictional line, with general flow direction for southern watersheds from southeast to northwest, northern watersheds entering the Rillito Creek from north to south-southwest, western watersheds flowing southwest to northeast to the Santa Cruz River. All of these watersheds contribute to the Upper Santa Cruz Watershed.

As mentioned, the City of Tucson receives about a foot of rain every year, with approximately eight inches in the summer and early fall, and the remaining approximate four inches during winter rains. Tucson experiences a series of summer thunderstorms for several months of the year called “monsoon”. Since 2008 the National Weather Service (NWS) has identified Tucson's official monsoon season as starting June 15 and ending September 30. Although thunderstorms can occur at anytime, however the majority of storms typically occur during this time. A smaller thunderstorm that suddenly occurs in a localized manner and produces very strong winds is called a “chubasco”.



Figure 7: Chubasco

For monsoon and chubasco events, rain is typically heavy and downpours can last for several minutes to a few hours. When atmospheric vapor from tropical storms (also known in Spanish as “tormentas”) travels continually from the Baja California or the Gulf of Mexico regions, these storm systems can sometimes last several days. (See Appendix for anecdotal story by a hydrometeorologist specializing in “atmospheric vapor trains”).

Tucson hazards include not only flooding within the streets, overtopping of washes and channels, flash flooding, erosion along channel embankments, channel migration, but also subsidence or sinkholes, excessive heat, and other hazards. Tucson experiences excessive heat exceeding 100 degrees during June and July, although not as excessive as Phoenix area due to our slightly higher elevation (average elevation of Tucson is approximately 2500 feet above sea level NGVD 88).



Figure 8: Downed power lines along Oracle Road following a storm event

Monsoon hazards include risks of adverse impacts from flooding, erosion, damaging winds, hail, microbursts, dust, and lightning. Tucson experiences high incidents of lightning strikes as well as short, concentrated heavy downpours called microbursts with violent and strong winds during Monsoon. These thunderstorm events can cause power outages during the hot summer months taking out air conditioning and creating life-threatening conditions if not restored quickly. Among other flood related issues, Tucson residents are concerned about power outages and access issues across the City of Tucson's bridge and street system during flooding.

Swift water rescues by Fire and Police are common occurrence during the monsoon. Erosion and flooding along regional watercourses have resulted in injuries, deaths, and private and public property damage with high repair costs, during catastrophic flood events. Tragically, a large number of flood-related deaths have occurred in cars stranded in deep, fast-moving floodwaters.



Figure 9: Emergency responders often conduct swift water rescues. Vehicles or people are sometimes swept away in the fast-moving water, and many City resources are required.
A.E. Araiza / Arizona Daily Star

Tucson has a semiarid climate where post-storm evaporation rates are high, and soils are more permeable in the regional watercourses where the fastest rate of infiltration to the underground aquifers occurs. Regarding soil characteristics, Tucson is different than Phoenix and other jurisdictions to the north. Tucson has variable terrain with grade changes throughout the city and experiences infiltration challenges including harder, slower percolating soils such as caliche and hydrologic soil groups “C” & “D” as determined by the United States Department of Agriculture Natural Resources Conservation Service. These soils are harder for rainwater to infiltrate and thus ponding issues typically arise.

Soil cement embankments are commonly used for the regional watercourse containment and erosion protection, with a few segments having levee protection. Soil cement has been successfully used along most of the regional watercourses. Soil cement bank protection constructed by U.S. Army Corps of Engineers (USACE) and maintained by PCRFC D has decreased the potential damages from flooding and in particular lateral migration along regional watercourses. It is that lateral migration that has resulted in the most significant private property and infrastructure damage in the past. Historically, many manufactured housing structures in the Tucson area were located near or within medium to high-risk flood zones, posing risks to manufactured home property owners. Apartment complexes and other rental properties pose different challenges for the City as it addresses flood hazard mitigation. For this 2025 FMP Update, there has been an increase in flood issues and stormwater quality problems for Apartment complexes.



Figure 10: Rillito regional watercourse soil cement embankment with railing and naturally sandy bottom.



Figure 11: Santa Cruz River bank protection



Figure 12: Solar infrastructure in HOA common area is elevated above the overbank waters of the Santa Cruz River for the reduction of electrical costs to this manufactured home subdivision community.

Solar infrastructure has been introduced successfully in shallow floodplain areas and within existing basins, providing safe opportunities to double the use in a floodplain area.

Subsidence can occur when there is seepage or other underground issues within the bedding soil in utility line trenches. Floodwater that seeps into the soil can undermine utility trenches causing an underground path for floodwaters to follow which can cross into other utility trenches or lead to pipes breaking.

The Tucson Water utility has invested approximately five million dollars in a 20-mile Acoustic Fiber Optics (AFO) monitoring and advance warning system that signals Tucson Water staff prior to a large water main failure, which could cause flooding to nearby buildings and potential loss of hundreds of thousands of gallons of water. A failure of this type occurred in 1999 resulting in millions of dollars in property damage from the 38 million gallons of water that flooded the neighboring properties as a result of the pipe break. An example of the effectiveness of the warning system involved an 84-inch diameter water main along San Marcos Boulevard between Greasewood and Mission Roads. Tucson Water was alerted by electronic signal that the main was in danger of breaking. The monitoring system allowed the utility to shut down the water main, drain the water from the area, and make the needed repairs.

The AFO monitoring system with other programs in Tucson Water, led to a 2014 Association of Metropolitan Water Agencies (AMWA) Platinum Award recognizing Tucson Water for their Attributes of Effective Utility Management. Tucson Water was the first American utility to install an AFO system in all of its prestressed concrete cylinder pipeline. Not only does this Tucson program save valuable resources, it provides reduced flooding potential for those areas near large water pipelines. The City of Tucson water utility's specialized monitoring system (AFO and other water utility sensor systems) acts as a flood threat recognition and early warning dissemination application and the Tucson Floodplain Administration is seeking credits for this award-winning warning system.



Development within the floodplain increases as less developable area exists in central urban Tucson. Developable areas are still available especially in Tucson's western, eastern, and southern periphery; however these locations tend to have floodplain and erosion hazard development design challenges including riparian floodplain and increased elevation changes. Guidelines and requirements are set forth in the City's Environmental Resource Zone, Hillside Development Zone, Lee Moore Wash watershed master plan, Watercourse Amenities, Safety and Habitat Ordinance, and other regulations. These riparian floodplain regulations were developed from the vegetative density analyses performed by earlier phases of TSMS. Opportunities exist for aesthetic development designs that incorporate floodplain and human activity zones, setbacks for erosion hazard that also provide for natural floodplain function, recreational areas, trails, and conservation of riparian floodplain habitat.

Figure 13: Sediment transport in a natural riparian floodplain

Many communities look to the City of Tucson for its innovations, regulations, and applications of water harvesting, Green Stormwater Infrastructure (GSI), stormwater quality, and Low Impact Design (LID). In the 1990, Tucson floodplain ordinance prohibited unnecessary alteration of riparian habitats of watercourses and adjacent bank areas. In 1998, the City of Tucson Land Use Code (LUC), now called the Unified Development Code (UDC), went further to dictate the necessary alteration for proposed development as exclusively: necessary access to a property, necessary utility installation, and/or trail improvements.

The City of Tucson is a leader in drainage maintenance, stormwater management, and drainage system protections. Since 1953 the City of Tucson has had a code that includes:

- No dumping in watercourses
- No illegal discharges to the stormdrain system
- No adverse impacts to adjacent properties
- No obstructing / no impedance of floodwaters in drainage systems
- Requirements to clean for property owners of drainage systems

City of Tucson DTM Streets Division, with assistance by DTM Stormwater Management Staff and Tucson Fire Department, are able to inspect the City's public stormdrain systems annually. City of Tucson also has regulations which require subdivisions, commercial business and other new development to generate a private drainage facility maintenance report annually prepared by a Civil Engineer (paid by owner) to be provided to the City Engineer upon request. As a supplemental activity, over 1,345 basins are inspected annually by the City of Tucson PDSG grading/ drainage Inspectors for a general inspection of the private detention/retention basins. Both of these activities (the private engineering inspection and City inspection) are instrumental to assuring detention and retention basins are properly maintained and help to reduce potential flooding.

Tucson Clean and Beautiful (TCB) is a non-profit environmental advocacy and action organization and has been a key stakeholder for the FMP Updates since inception. TCB offers an Adopt-a-Wash Program which has been successful in keeping washes clean and aesthetically pleasing. TCB Staff works closely with City of Tucson Floodplain Administration, Storm-to-Shade and Street Maintenance Staff.

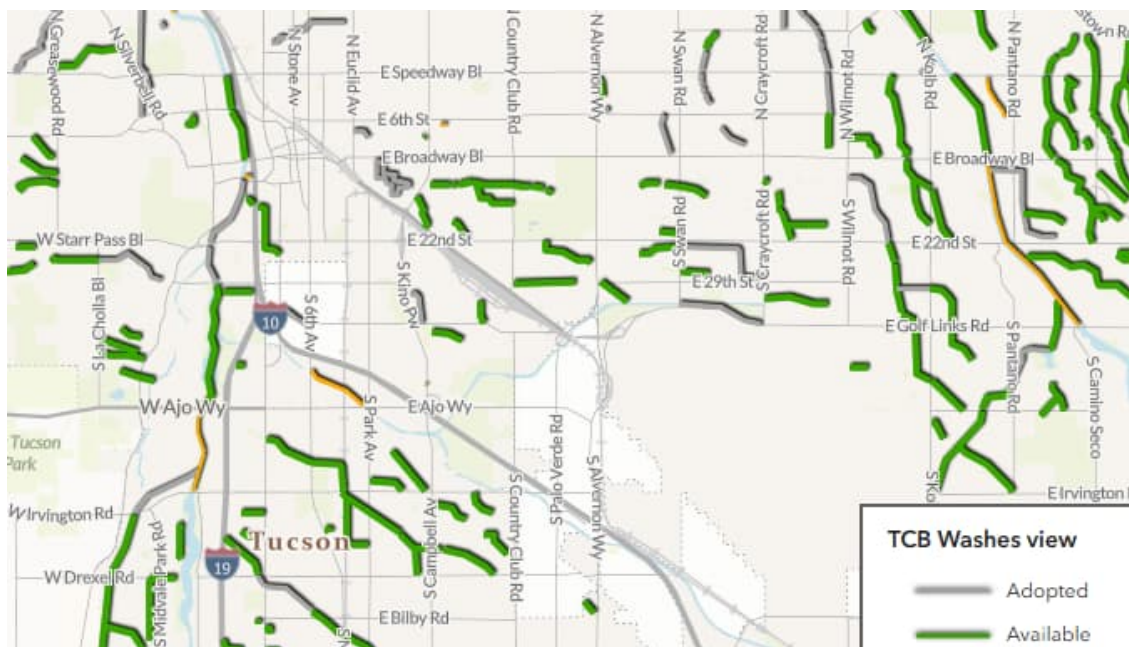


Figure 14: TCB Available Adopt-a-Washes

In 1998, City of Tucson Mayor and Council required new development to utilize stormwater harvesting to the maximum extent possible. In October 2005, the Water Harvesting Guidance Manual became ordinance and in October 2008, the City adopted the Commercial Rainwater Harvesting Ordinance. A water bill fee for stormwater generates funds for stormwater quality management, and a rebate program was developed to promote water harvesting. City's Green Infrastructure Program for public right-of-way is used for all road projects. Beginning in May 2020 a Green Infrastructure Fee was added to water bills to:

- Provide a funding source for maintaining hundreds of existing GSI features in city neighborhoods
- Support growing more trees and plants on streets, and in parks and public areas using stormwater as a primary water source
- Address and reduce flooding issues on neighborhood streets

Administrator to convene the STAC committee when needed. Currently, the STAC members include Greg Bambauer P.E., Adam Call AICP, John Wallace P.E., Dr. Kevin Lansey, and Theresa Knoblock.



Figure 15: Rillito – a regional watercourse

Rainfall runoff generally flows from the southeast to the northwest across the Tucson area. Flows are not allowed to be obstructed per code. Runoff flows within streets, rights-of-way, and in other drainage systems, from property to property, matching pre-developed flow conditions. Stormwater conveyance in the City of Tucson includes stormdrains, side yard swales, wall openings, improved structural channels, natural channels, semi-natural channels, sheet flow, and other systems to continue its path to feed vegetation and eventually, with remaining flow, recharge in the regional watercourses.

The following large detention systems were funded and constructed by various entities:

- Rita Ranch Regional Basin – City of Tucson
- Bridges Regional Detention Basin - PCRFC
- Ajo Detention Basin – USACE, PCRFC, Pima County
- Arroyo Chico / Cherry Field Regional Detention Basins – USACE, PCRFC, City of Tucson, Tucson Unified School District

Larger detention or reservoir systems work to lessen flooding conditions within the City of Tucson with their capacity to handle large storm runoff. These systems also help to lower heat island effect with increased tree canopy, as summer storms travel north and divert around the City of Tucson. In the 2020 FMP Committee meetings, enhancement of tree canopy was prioritized, and continues to be prioritized for the 2025 FMP, with efforts to further build awareness of the important role that tree canopy plays in the community, and to increase the planting of trees throughout the City.

The City of Tucson regional basin facilities are usually multi-purpose and collect runoff from a relatively large area and have been designed to use storage as a means of reducing downstream flood peaks, reducing possible flood damage, or reducing downstream channel construction costs.



Figure 16: Radar - storm approaching from the southeast

Pima County Regional Flood Control District (PCRFCDD)'s ALERT system provides an excellent resource for accessing City of Tucson rainfall data, watercourse stage (depth) gauge data, and recent post-fire inundation mapping, which assists floodplain management by providing information about recent or historic storm events, and potential areas of flooding. In June 2020, the Bighorn Fire increased burn runoff potential in the Santa Catalina Mountains, and overtime, an increase in sediment transport will occur and impact capacity of the Rillito regional watercourse. PCRFCDD has been performing sediment removal from the regional watercourses to help maintain flow capacities. To reduce flood risk along the Santa Cruz River, PCRFCDD removed approximately 85,000 cubic yards of sediment that was accumulating between Silverlake Road and Cushing Street. Utilizing the ALERT system's data, warning systems help prevent flooding damage. See page 31 for additional information on PCRFCDD ALERT Map.

PCRFCDD also provides flood hazard mapping which has been directly requested by the City of Tucson Floodplain Administration per the adopted TSMS/FMP priority list. Different types of flood studies are performed to achieve various results: those studies that are used for flood insurance updates, maps for risk areas used for permitting purposes, studies for drainage improvement projects, and other studies. TSMS has prioritized the studies and Floodplain Administration follows these priorities. FIRM maps and maps used for design and permitting are updated on MapTucson. The City of Tucson Floodplain Administrator decides which maps are added to MapTucson. Additional tasks by the PCRFCDD include open space management, and drainage system capital improvements (El Rio Golf Course, USACE Arroyo Chico Basins Project). Tucson's Basin (watershed) Management plan includes non-designated basin management areas, Balanced Basin Management Areas (where less severe flooding issues exist), and Critical Basin Management Areas. Development in Balanced Basin Management Areas requires post developed runoff to not exceed pre-developed conditions. In Critical Basin Management Areas, detention requirement includes a reduction of the post-construction flowrate by a minimum of 15% as compared to pre-developed conditions.

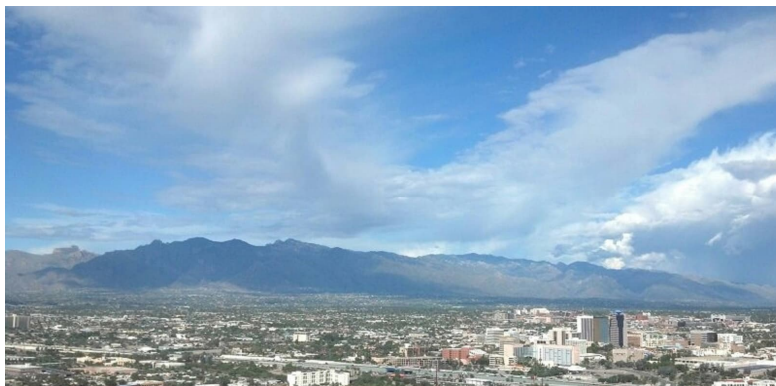


Figure 17: View of Tucson watershed basin from A Mountain

The most successful basin designs (where there are less post-construction maintenance issues) include a detention concept, incorporating low-flow outlets and positive gradients. When detention is used, there are reduced potential for termites, mold, ponding/stagnant water, structural issues to nearby foundations, and contamination of the groundwater aquifer from fertilizers, herbicides, and other chemicals. Mosquito-borne illnesses are being reduced by the use of detention systems since standing water is minimized. Heidi E. Brown, PhD, MPH, of the Epidemiology and Biostatistics Department at The University of Arizona, concurred that Tucson's drain-down time requirements of 12-hours and 24-hours help to reduce mosquito populations.



Figure 18: Water Harvesting in Side Yard Swale



Figure 19: R2D2 – “Retention is Restrictive, Do Detention”

OUTREACH

The City of Tucson performs some of the following various flood and erosion hazard outreach activities annually including:

- A. Floodplain Management Plan Annual Meeting
- B. Flood Insurance Meetings
- C. Monsoon Awareness Week
- D. Operation Splash
- E. Operation Freeze
- F. Tucson Juneteenth Festival at Kino Sports Complex – Children's table
- G. EHSS Vendor Fair – Raytheon
- H. Davis Monthan Airforce Base (DMAFB) Outreach
- I. Ward IV Back to School Bash
- J. Tucson Association of Realtors EXPO
- K. Tucson Association of Realtors - Floodplain Information for Realtors
- L. Southern Arizona Homebuilders Association (SAHBA) Technical Committee Meeting
- M. Engineers Week Event
- N. Earth Day
- O. Neighborhood Association Outreach Meetings
- P. Flyers in the Mail
- Q. Other Outreach

The City of Tucson Engineering Staff provides the following outreach besides flood and erosion hazard status. Free field investigations/meetings with property owners to look at and discuss floodplain conditions at their Site. General flood mitigation advice is provided, however, no professional design is given.

A. Floodplain Management Plan Annual Meeting

The City of Tucson advertises the FMP annual meetings on the City of Tucson Floodplain Administration website as well as on social media and email. These events include flood and stormwater outreach materials besides the meeting agenda and presentations. See Introduction to the FMP Process on page 25 for additional information.

B. Flood Insurance Meetings

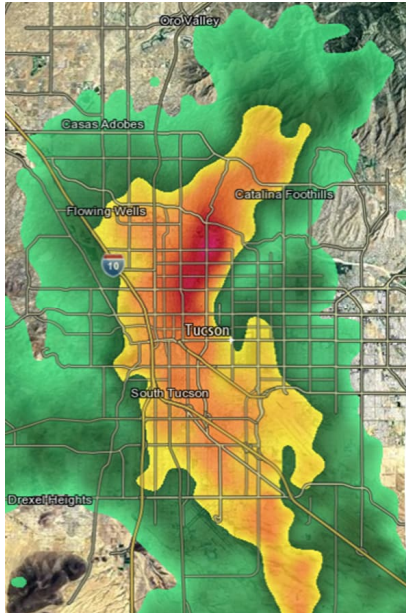
The City of Tucson currently organizes two Flood Insurance Meetings (FIM) to promote flood insurance. In 2025, this was the fifth year that these virtual meetings were held. The City of Tucson invited other local jurisdictions to participate in this outreach event including PCRCD, Town of Oro Valley, Town of Marana, and Town of Sahuarita. Arizona Department of Insurance and Financial Institutions were also invited and provided a State overview of information on flood insurance. Every year the FIM was presented by each jurisdiction and provided constituents floodplain safety information, shared ongoing floodplain management efforts by the local jurisdictions and explained the importance of flood insurance and how to check flood status at the local engineering offices.



Figure 20: FIM Outreach Events Provides Various Information

Some of the topics that were presented at the FIM outreach events included:

- ✓ Flooding & Erosion Hazard Risk
- ✓ How to Reduce Risk
- ✓ Special Flood Hazard Areas and Municipal flood areas
- ✓ Post-Wildfire Flooding
- ✓ Flood Zone Determinations
- ✓ Debris and Mud Flow
- ✓ Flood Insurance Information – Risk Rating 2.0
- ✓ Insurable Property
- ✓ FloodSmart.Gov
- ✓ Resources & Contact Information



Municipal / Local Floodplain Considerations

- Sudden storms, flash flooding, and erosion can occur anywhere in the Tucson area.
- Municipal / local floodplain areas do not require flood insurance.
- For those property owners who choose to obtain a policy, flood insurance would be based on X-zone rates, which are less expensive than SFHA zone or "A" zone rates (A/AE/AO/AH)
- Over one third of all flood insurance policies in the City of Tucson are in X zone areas that are not required to have flood insurance, but they choose to get it.

Figure 21: FIM Outreach Events Promote Flood Insurance

C. Monsoon Awareness Week

For Monsoon awareness week every year (second week of June), the City of Tucson prepares a Mayor's proclamation to encourage residents to be safe during the summer monsoon season.

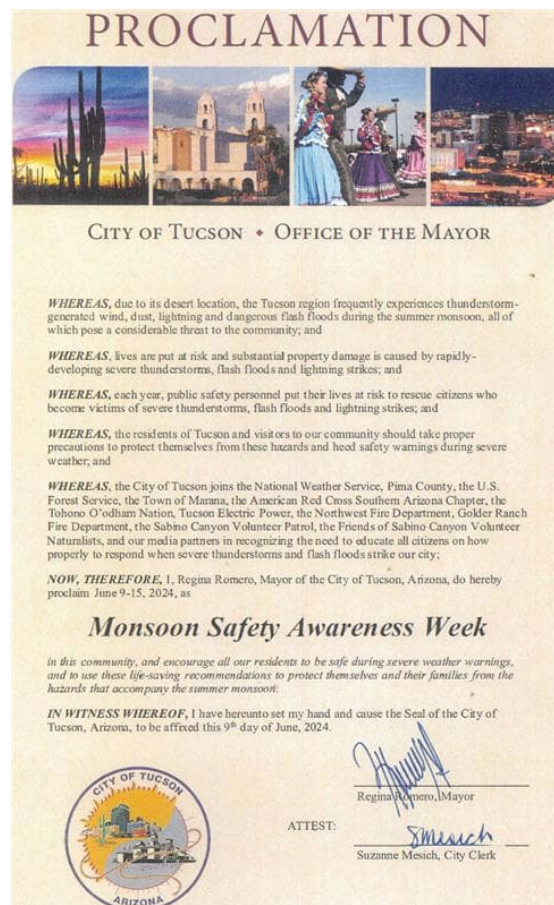


Figure 22: Monsoon Awareness Proclamation

D. Operation Splash

The City of Tucson also sends out social media advertising for Operation Splash to inform residents of locations where materials will be available for free sandbags. Focused advertising for Operation Splash provides notifications in anticipation of pending large storm events.

Approximately 80% percent of the buildings in the high-risk flood zones may be "non-conforming structures" which means they were built before the first FEMA flood maps were generated in the early 1980's, and may not have been elevated above the current regulatory flood depth requirements. When a building is too low it is subject to flooding inside the structure. The use of temporary measures can help. The City of Tucson offers free sandbag program where locations are set up within the City of Tucson for picking up sand and bags, that can be used at front doors or other temporary locations. The locations are set up early Monsoon and advertised before forecasted large storm events.

Although Operations Splash provides outreach, the program also consists of additional flood and erosion hazard response activities including engineering assigned bridges and additional inspections for washes and other portions of the drainage system using NWS flood warning system and PCRFCF ALERT Flood Threat Recognition and Early Warning Dissemination (see action plan).

E. Operation Freeze

A counterpart to Operation Splash is Operation Freeze which focuses on bridge deck safety during colder winter months. Operation Freeze consists of spraying bridge decks with magnesium chloride to reduce the potential for freezing. This aims to reduce traffic accidents.

F. Tucson Juneteenth Festival

The City of Tucson has been attending the Juneteenth festival for the last several years. City Staff provided the Desert Wash Safety book and other outreach materials in the children's section of the festival. In this activity/coloring book, Zack Rabbit and Lenny Lizard explore Tucson's Washes and teaches elementary school aged children about wash safety.

Various flood safety messages in this activity/coloring book include:

- Washes are dangerous when it rains
- Do not enter flowing washes
- Washes are home to desert creatures that shouldn't be disturbed
- Don't dump trash in the wash
- Don't dig forts in the banks of the wash
- Don't dump pollutants into stormdrains, stormdrains lead to washes
- Water harvesting is a wonderful way to use stormwater



Figure 23: Kid's Coloring Book

G. EHSS Vendor Fair Raytheon

The City of Tucson Floodplain and Stormwater Staff have periodically attended this event to share various flyers, pamphlets, and swag as well as coloring/activity books.

H. Davis Monthan Outreach

The City of Tucson Floodplain and Stormwater Staff have periodically attended this event to share various flyers, pamphlets, and swag as well as coloring/activity books.

I. Ward IV Back to School Bash

The City of Tucson Floodplain and Stormwater Staff have periodically attended this event to share various flyers, pamphlets, and swag as well as coloring/activity books.

J. Tucson Association of Realtors EXPO

The City of Tucson has periodically attended this event and shared a table with Tucson Water, handing out various flood and erosion hazard safety and flood information specifically for real estate purposes. Information shared at this EXPO informs the public on the multiple listing service (MLS) sheets which have been updated with the collaboration between MLS/Realtors and City of Tucson Floodplain Administration to include:

- “FEMA ins?” – Yes or No is shown on the MLS to reflect whether flood insurance may be required
- “Municipal FP?” – Yes or No is shown on the MLS to reflect whether local floodplain impacts the parcel

K. Tucson Association of Realtors – Floodplain Information for Realtors

The City of Tucson floodplain management staff presents almost annually on the topic of “What Every Real Estate Professional Should Know About Flood & Erosion Hazards”.

1. City of Tucson Regulatory Updates
2. Special Flood Hazard Areas and Lender Requirements
3. Zone Determinations
4. Insurable Property
5. Post-Fire Risk
6. Resources & Contact Information

L. Southern Arizona Homebuilders Association (SAHBA) Technical Committee Meetings

The City of Tucson has been invited to speak at several meetings for SAHBA. A Topic for one of the meetings was *Dealing with Drainage on your Development Site*. Some of the development considerations include:

- Importance of checking floodplain and erosion hazard status
- Understanding why stormwater quality regulations are needed
- Essentials about riparian floodplain development within the City of Tucson
- Floodplain use permitting
- Upcoming regulatory changes

M. Engineers Week Event

The City of Tucson participates in various events as part of the Engineers Week (E-Week), usually held in February of each year either at one of the Malls in the Tucson area or at the University of Arizona. Floodplain and stormwater outreach is geared towards high school and college aged students.

N. Earth Day

The City of Tucson participates in various events for Earth Day, usually held in April of each year. Floodplain and Stormwater outreach materials are handed out at the table.

O. Neighborhood Association Outreach Meetings

The City of Tucson provides homeowner associations (HOA) and neighborhood associations (NA) upon request with on-site field meetings as well as office meetings to discuss flood and erosion hazard management actions that are being performed by City of Tucson staff.

P. Flyers in the Mail

The City of Tucson has annually sent out various flood and erosion hazard information in the water bills in late spring. For a few years, PCRFCDD sent out a mailer that included some of the City's flood information.

Q. Other Outreach

As a participating community of the National Flood Insurance Program / Community Rating System (NFIP CRS), the City of Tucson Floodplain Administration assists constituents with property drainage concerns related to both flood and erosion hazards. In some cases when a phone call to go over drainage concerns or city flood maps are not enough to answer the questions, engineering staff schedules a field meeting to provide general guidance on identified flood or erosion issues at the property. The property owner for instance may ask specific questions about flood status, erosion hazard setbacks that may be impacting the property; this data is available.

Besides staff counter service and drainage field visits, there is flood permitting, public drainage maintenance, flood mapping, and other activities which are reviewed by FEMA, and then the City is given points that equate to a discount on flood insurance policies. The insurance discount for the City of Tucson is currently 20% and applies to high and low risk areas. Anyone can obtain a flood insurance policy for the building they own or rent.

City of Tucson Engineering staff in the PDSD and DTM responds to constituent's flood, erosion and stormwater concerns via phone, email, and walk-ins. Field visits and meetings may be setup as deemed necessary by City of Tucson staff. There are various other outreach that the City of Tucson Floodplain Management Staff performs.

Individual Constituent Field Drainage Inspections / Meetings

If a constituent asks, and staff deems it would be helpful to have a field meeting, the City of Tucson Floodplain Administration occasionally sends out engineers that have drainage background. This type of activity falls under the NFIP CRS program Activity 360 - 'property protection advice' and 'advice after a site visit'.

Engineering staff does not provide specific design for a property as City staff cannot provide professional design services to individual constituents. Beyond general guidance, City of Tucson Engineering staff might also recommend contacting local drainage engineers or Environmental Engineers that specialize in floodproofing and retrofitting who can provide specific design, alternative retrofitting options to reduce flood/erosion hazard risks. The City of Tucson Floodplain Administration also has some handouts and flyers and provides general outreach. One of the City of Tucson's more popular handouts is the *Drainage Facility Maintenance handout* that is helpful for commercial developments or HOA's. Floodproofing manuals from FEMA are available and can be checked out by property owners at the main library.

For drainage inquiries or request for a field visit by a City of Tucson Civil Engineer or Engineering Manager, typically the process starts with a phone call to the Department and ask for Engineering / Drainage (phone 311, or 791-5550), or an inquiry to the email: TDOTConcerns@tucsonaz.gov or TucsonFloodErosionInfo@tucsonaz.gov



Drainage Facility Annual Maintenance

Drainage basins and other drainage facilities in both commercial, residential subdivisions, or other developments are **required to be inspected annually** at minimum, by a Civil Engineer hired by the HOA, or other appointed oversight group, to assure that the drainage basins and drainage facilities function to City standards and codes. (City of Tucson Technical Manual Section 4-04.1.5, 14.3.)

Some HOA's have their annual inspection and report performed in late summer or in the fall and then use the recommendations to clean and repair damage after monsoon season, or perform the annual inspection report and repairs in early spring in preparation for next monsoon.

List of maintenance requirements or guidelines specific to your subdivision are typically found in the subdivision's drainage report, on the Final Plat, and/or in the subdivision's Covenants, Conditions, and Restrictions (CC&R's).

If the HOA has not been maintaining their drainage facilities, the HOA can begin by hiring a Civil Engineer to perform an inspection of the subdivision and watershed areas. They typically will research the approved grading plan and drainage report to see if there are changes from the originally approved plans and determine which areas may need maintenance/ attention. As a suggestion, the City of Tucson recommends asking your engineer to provide the HOA with clearly described options, if more than one is available, to address each correction. That way the HOA can discuss the costs and/or recommendations and vote on or discuss the options if needed. Addressing the maintenance items quickly is important as problems can compound and created increased potential for flood, erosion, or other hazards, as well as liability issues. Violation letters or other penalties may also be sent if maintenance is not being performed. (Reference: Tucson Code Chapters 11 and 26 Article I.)

List of commonly found drainage problems for basins and other subdivision drainage facilities:

- | | |
|--|---|
| ☐ Broken / damaged scuppers | ☐ Sediment reducing capacity or flow |
| ☐ Clogged / damaged inlet or outlet | ☐ Shopping carts |
| ☐ Damaged / failing embankment | ☐ Side bank or spillway erosion |
| ☐ Debris, contaminants, or trash | ☐ Sinkholes, tunneling, or piping |
| ☐ Erosion at outlet or inlet areas | ☐ Stagnant or ponding water |
| ☐ Erosion undercutting or scour | ☐ Watershed change or breach |
| ☐ Overgrown vegetation | ☐ Weeds (ie illegal buffelgrass, etc.) |

In some cases, the Final Plat may indicate that a certain watercourse or drainage improvement is maintained by the City of Tucson (publicly maintained drainage infrastructure), in which case the City should be contacted if there are any issues found or if there are any breaches in the watershed area of the subdivision. In other cases, Final Plats may also indicate for some subdivisions that the drainage facilities are privately maintained, which generally require maintenance by HOA management.

Figure 24: Drainage Facility Maintenance handout

Social Media

The City of Tucson uses social media as a form of floodplain outreach with posts on Instagram, Facebook and X. The floodplain management websites are being updated per one of the FMP Action Items working groups and City of Tucson GIS staff is assisting in this task which is expected to start Fall of 2025 and expects to update the Floodplain Administration Website by May of 2027. The Floodplain administrative website in PDSD will also require an update.

The City of Tucson GIS staff are working on a Floodplain Management Hub Site which will contain questionnaires, applications, stories, narratives, and more. The City of Tucson is also looking at how drainage inquiries and reporting of flooding incidents can be received in both Spanish and English. Flood status information can be more easily obtainable.

A Floodplain Report Dashboard is being considered for viewing regions in each watershed with levels of urgency assigned based on a variety of factors including:

- High number of swift water incidents
- High number of certain types of drainage complaints
- Soil type
- Equity (incorporating the Equity Priority Index)
- Watershed updates – explain drainage improvement project underway in that watershed

The City of Tucson's new Floodplain Management Hub Site will also have a Story Map explaining floodplains and Tucson floodplain regulations. The City of Tucson's Floodplain Administration is considering another tool on this Hub Site that will act as a Content library. This library would contain a PDF repository for TSMS reports and other smaller drainage master plans, drainage reports, floodplain maps, elevation certificates, and other documents for the public to be able to search through documents.

DECISION MAKING CONSIDERATIONS FOR TUCSON FLOODPLAIN MANAGERS

Optimal results for flood, erosion, or other hazard management decisions can be realized by utilizing the various documents including the Floodplain Management Plan and reports and data from other phases/reports of TSMS, Flood Risk MAP (FRM), MapTucson, and other local GIS data, as well as master drainage plans, City of Tucson Drainage Manual, current detention / retention manual, and specific City of Tucson plans such as Plan Tucson.

HAZUS is a nationally applicable standardized methodology that contains models for estimating potential losses from floods. HAZUS FRM map was one of the tools created in the FMP project and was generated with collaboration between the FEMA consulting firm and the FMP Committee members' data with effort and special assistance by the City of Tucson's Transportation GIS Technician. A pared down version of the map was provided to the City by the FEMA consultant in April 2016. This Risk MAP document is kept for floodplain management purposes and provided to floodplain administrative staff only since some of the data, such as locations of critical facilities, is restricted due to security concerns.

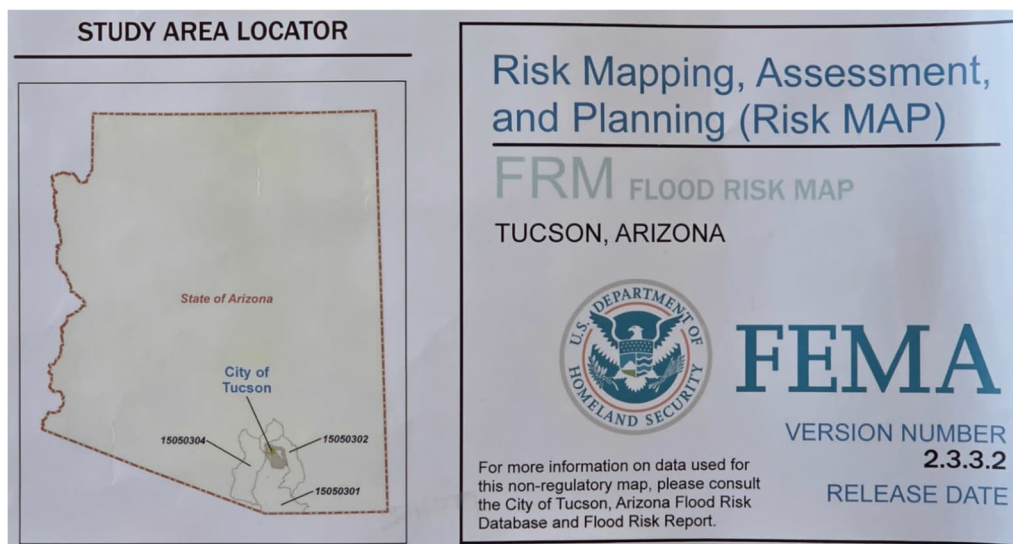


Figure 25: Title Block of City of Tucson Flood Risk MAP

Plan Tucson is the City of Tucson's General & Sustainability Plan, which was ratified by voters in 2013 and recently updated to include community approval with mayor and council adoption on June 3, 2025. Plan Tucson acts as a master planning document providing broad planning focus for Tucson, including reducing hazards. Plan Tucson goals and policies are intended to develop and enhance transportation and other infrastructure to increase our community's resilience to flooding and other emergencies. All Ward offices encourage the use of Plan Tucson, and other Tucson planning documents, when making decisions regarding the management of floodplain and other hazards.

TUCSON HYDROLOGIC MODELING

Tucson Stormwater Management Study (TSMS)

Tucson Stormwater Management and Tucson Watershed Modeling Systems are the City's adopted methodologies. This modeling is ideal for the Tucson urban valley area since it models the type of short storms with high intensity rainfall that hit the Tucson valley located between the surrounding mountains, which most often is experienced during Tucson's Monsoon. Hydrologic modeling of watersheds located within the City of Tucson was previously completed in 1993 as part of the TSMS Phase II, Stormwater Master Plan (Existing-Conditions Hydrologic Modeling, Simons, Li and Associates, November 1995). The development of the TSMS hydrologic modeling resulted in a uniform, conservative, and consistent technique for predicting stormwater

discharges within the City of Tucson. TSMS included future conditions for modeling the watersheds within the city limits. Within Balanced Basin Management Plan Areas, future development is able to offset increased runoff with detention and retention requirements to show no increase to existing conditions for the 2-, 10-, 100-year flow events. In Critical Basin Management Plan Areas, a 15% reduction in the 2-, 10-, and 100-year flow events is required. In Non-Designated Basin Management Plan Areas, TSMS studies indicated that due to existing pre-FIRM urban development, flooding would likely still occur with any level of flood mitigation. The Non-Designated Basin Management Plan Areas were adopted as Balanced Basin Management Plan Areas and required to show at minimum no increase to existing conditions for the 2-, 10-, and 100-year flow events. In all cases, the City of Tucson requires no adverse impact to adjacent properties. This is especially important for urban communities where 82.7% of the building within the existing local and FEMA SFHA floodplains were built prior to the City of Tucson first flood maps.

The TSMS hydrologic methodology replicates physical processes of rainfall, runoff, and flood routing. In addition, the physically-based modeling was calibrated to recorded flow events and statistical flood-peak estimates. The results of the TSMS hydrologic modeling were subsequently approved by the Federal Emergency Management Agency on May 21, 1996. On January 22, 1996, the results of the TSMS, Phase II Stormwater Master Plan were adopted, by Resolution, by Mayor and Council.

The TSMS hydrologic modeling was comprised of two main components – (1) the Stormwater System Planner (SSP), a proprietary software program used to compile HEC-1 input files and generate watershed reports from an extensive City-wide data base, and (2) HEC-1 software used to perform the hydrologic modeling for 59 major watersheds within the geographical boundaries of the City. Numerous additional software components were utilized in calibration, SSP access, and data-base retrievals. The SSP software package was meant to be used by the City and water-resource consultants for stormwater management purposes and the consistent and reliable calculation of stormwater discharges. Although the flow rates (TSMS nodes) have been adopted, the data related to the use of HEC-1 modeling aspects of TSMS will no longer be available since FEMA currently does not accept HEC-1. Many of the TSMS nodes have been verified and provide conservative flood data for the Tucson valley. The precipitation rate of 3.0 in/hr is one of the conservative parameters used in the City of Tucson's Flood Peak Estimator.

Tucson Watershed Modeling System (TWMS)

A newer version of the TSMS Watershed Modeling System (TWMS) was being updated, however, it has been shelved due to staffing. TWMS is a more modern map-based system using GIS, ArcView and HEC-HSMS. The TWMS hydrologic modeling software developed for the TSMS had consisted of DOS-based programs that had become outdated over time. In order to utilize more current software, as well as utilize more advanced GIS-based data management tools, the City of Tucson initiated development of the TWMS (User's Manual, June 2008) as a replacement for TSMS software package. TWMS incorporates automated watershed management tools in a GIS environment. The TWMS provides the City with the ability to calculate stormwater flow values for use in planning, floodplain management, and hydraulic design.



Figure 26: Regional watercourse near flood stage

City of Tucson Hydrologic Modeling Challenges

There has been an attempt to restudy some of the watersheds using newer 2-D hydrologic software. The City of Tucson is learning that the new software has challenges to mesh with the TSMS flow rates. The modeling for Ruthrauff Watershed and Christmas Watershed were able to mesh with TSMS flowrates and maintain the conservative flowrates that are needed. With the concern for climate change, the need to maintain TSMS conservative flowrates is crucial.

Another challenge that has been occurring on updated maps is “fingerling floodplain” where high-risk floodplain (FSHA) is being mapped with flowrates under the City of Tucson’s regulatory threshold. City of Tucson has been in discussion with FEMA mapping staff to explain contradictory mapping data (ie. regulatory floodplain that is mapped within the City of Tucson that does not meet Floodplain Ordinance requirement). These small thin floodplain areas are showing up typically within basin inlet/outlet areas and areas in the street between the curbs. Fingerling floodplain on FIRM panels trigger flood insurance even though the flowrates are under the regulatory flood hazard threshold. The City of Tucson will continue to ask FEMA to correct this inconsistent and contradictory data.

As a response to requests from the City for flood mitigation, PCRFCF has been working with the City of Tucson Floodplain Administration for many years providing drainage studies. New hydrologic mapping software provides an opportunity to address urban flooding by providing grid cell depth and flow modeling. However, the software has to be carefully used to assume that the proposed mapping can mesh with TSMS flow rates. These studies have largely been watershed re-studies to provide floodplain limits where only TSMS nodes or when no data was available. The watershed studies should typically start with a meeting between the PCRFCF project manager and City of Tucson Floodplain Management staff to explain the mapping and drainage issues within a particular watershed. The City Floodplain Management staff provides either a request for City of Tucson Flood Hazard Areas (COTFHA) and/or FEMA SFHA mapping. Parameters for the mapping are also requested such as a minimum flood depth for areas to be mapped. PCRFCF reports provide suggested alternatives to mitigate flooding within each watershed.

Funding is the biggest challenge for the City of Tucson for flood mitigation. The City of Tucson submits funding requests for drainage infrastructure improvements to PCRFCF, DEMA, and FEMA (Region IX and headquarters). Notices of intent and flood mitigation grant applications have been applied for annually for many years. The City of Tucson (1) in 2015 received funding from FEMA Region IX for the City of Tucson FMP and (2) in 2020, FEMA Region IX provided funding for the Christmas Wash Watershed feasibility study which is the latest report for the Christmas Wash Watershed. A Federal grant application (BRIC) was initiated for the design and construction plans for the Christmas Wash Watershed improvements that were deemed feasible by the FEMA study. PCRFCF has supported the share-cost funding for the design and construction plans. In 2025, the BRIC funding has been halted by the Federal Administration. The City of Tucson Floodplain Administration was asked by DEMA to complete the grant application so that if another flood mitigation grant opportunity opened up, DEMA would already have the application. The City of Tucson Floodplain Administration recommends the following:

1. Continue to work with ADWR and FEMA Region IX for special funding opportunities
2. Tucson Floodplain Board (Mayor and Council) should work with lobbyists and congressmen to obtain more funding
3. Tucson Floodplain Board should consider general fund allocation towards floodplain mitigation projects that will be augmented by PCRFCF funding

PCRFCF has committed to provide watershed studies for Navajo/Wilson Wash, Bronx Wash, and Silvercroft Wash. For the Navajo/Wilson Watersheds, the City of Tucson Floodplain Administration has a need to reduce the 1,000-foot wide SFHA and had previously done studies to assess whether stormdrains can be installed, however due to shallow grades it was not feasible. A road corridor project for First Avenue may show promise for feasibility for diverting some of this flow to Rillito within a new stormdrain system in First Avenue by crossing watersheds to drain interior watersheds that are not adjacent to the regional watercourses. This diverted flow is similar to the solution provided along Mountain Avenue that helps drain urban floodprone areas into the regional watercourse. The Bronx Wash Watershed has incorrect mapping where University Boulevard has unmapped regulatory floodplain that needs COTFHA mapping.

The Silvercroft Wash Watershed has multiple challenges. There is a need to determine to correct water surface elevations as there are multiple base flood elevations from various reports near the confluence of Painted Hills Wash and the Santa Cruz River. There appears to be aggradation within the Painted Hills Wash, a tributary to the Silvercroft Wash, which may trigger a need for a levee next to an existing landfill and high-pressure gas line. The SFHA on DFIRM for the Silvercroft Wash needs to be checked and revised as there are areas where the SFHA is drawn at the top of bank and not situated within the existing channel.

INTRODUCTION TO THE FMP PROCESS

2016 FMP

The FMP is an outgrowth of the Upper Santa Cruz Discovery initiated by FEMA in the fall of 2011. After the Discovery process ended, FEMA had recognized that there was potential to expand on best management practices and encourage a more resilient community within Tucson and had granted the City funding in the form of FMP consulting services. Discussions between FEMA and city officials had resulted in the 2016 plan being created to facilitate floodplain management activities in Tucson.

FEMA's Risk Mapping, Assessment, and Planning, or Risk MAP program, helps communities identify, assess, and reduce natural hazard risks. Through Risk MAP, FEMA had provided information to enhance local mitigation plans, improve community outreach, and increase local resilience to hazards. Flood risk products are created to provide concrete evidence and reference materials to those who manage floodplain material data. With the development of the 2016 FMP, participants had been able to create an action plan for floodplain management, which could ultimately reduce region-wide flood insurance rates.

2020 FMP

Another Discovery engagement occurred in May 2019 and included the City of Tucson and nearby municipalities. After further discussions with FEMA, FEMA Region IX hosted a Risk MAP Post-Discovery webinar with the City of Tucson on August 23, 2019. The City was granted re-allocated FEMA Region IX funds for consulting services to provide feasibility studies and preliminary designs for the Cushing Street Levee Extension project and the Christmas Wash Watershed storm drain and regional detention basins. The 2016 FMP expected the update to the FEMA product to be completed by October 2020, and FEMA NFIP requires the update at the latest by August 2021. The 2019 FMP committee decided to schedule three or more FMP Committee meetings in the Spring 2020 to perform the 2020 FMP update. The 2019 annual meeting determined that the focus of the update should concentrate on the Action Plan lists. Five meetings and two public virtual meetings were provided and Action Plan (Table 6 in Chapter 6) and comments for the prioritized categories were discussed by the FMP Committee in the meetings. Additional comments were received and reviewed by the FMP Working Group and incorporated in the report.

Upper Santa Cruz Discovery Report and more information regarding the Discovery process is available on FEMA's website, www.fema.gov.



Figure 27: Sunset after a Tucson storm

2025 FMP

For the 5-year update of the FMP, City of Tucson staff continued to meet annually and had additional meetings with key stakeholders to discuss and reprioritize the 5-year action items. The Tucson Stormwater Management Study (TSMS) indicated that in 2025, an update would be warranted to the City of Tucson's drainage master plan. Therefore, there was extra focus to modernize TSMS.

Outside of the annual FMP meetings, Stakeholder Meetings and series of workshops have also been occurring since 2023 to discuss the 2025 5-year update. The dates of the meetings are listed below:

- May 11, 2022 (annual FMP meeting)
- July 28, 2023 (annual FMP meeting)
- November 28, 2023 (5-year FMP key stakeholder meeting)
- June 11, 2024 (annual FMP meeting) and
- December 10, 2024 (5-year FMP meeting)
- April 11, 2025 (Human Access Control Working Group – Meeting 1)
- April 15, 2025 (Retrofitting Existing Sanitary Sewer Lines Working Group– Meeting 1)
- April 22, 2025 (Creating Online Application Working Group – Meeting 1)
- April 24, 2025 (Riparian Floodplain Corridors Working Group – Meeting 1)
- April 28, 2025 (FPO Updates and Demystifying Drainage Regulations Working Group – Meeting 1)
- May 1, 2025 (Human Access Control Working Group – Meeting 2)
- May 13, 2025 (Retrofitting Existing Sanitary Sewer Lines Working Group – Meeting 2)
- May 27, 2025 (Creating Online Application Working Group – Meeting 2)
- May 29, 2025 (Requirements for Software Submittals Working Group – Meeting 1)
- June 2, 2025 (FPO Updates and Demystifying Drainage Regulations Working Group – Meeting 2)
- June 3, 2025 (Flood & Erosion Emergency Response Exercise Working Group – Meeting 1)
- June 5, 2025 (Riparian Floodplain Corridors Working Group – Meeting 2)
- July 1, 2025 (Flood & Erosion Emergency Response Exercise Working Group – Meeting 1)
- July 8, 2025 (FPO Updates and Demystifying Drainage Regulations Working Group – Meeting 3)
- July 11, 2025 (Human Access Control Working Group – Meeting 3)
- July 14, 2025 (Requirements for Software Submittals Working Group – Meeting 2)
- July 17, 2025 (Floodplain Management Plan Open House)

Stakeholders identified a need to modernize TSMS. Although rainwater still runs downhill and the TSMS model had always had a conservative approach, there is still a need to modernize the Drainage Manual and improve ease of submittals by defining modeling parameters.

2025 Workshops

For the workshops held in 2025, key stakeholder types included the following:

Name of Stakeholder	Stakeholder Type
Destiny Colorado	DEMA representative
Roy Jobe	DEMA representative
Dr. Jennifer Duan, PhD	University of Arizona Professor, Software Modeling
John Wise, P.E., CFM	Engineering Consultant – natural floodplain function, Key Stakeholder
Irene Ogata	Riparian Floodplain Planner, Key Stakeholder
Claire Prager	Real Estate Agency, Key Stakeholder
Blue Baldwin	Green Infrastructure Program Manager
Greg Bambauer, P.E.	Engineering Consultant – Software Modeling
Adam Call, AICP	Planner, Development Representative, Landscape Architecture
Jiankang Wang	Engineering Consultant
Jim “JJ” Janecek, P.E., CFM	PCRFC, Development Review Civil Engineer
Victor Palma	Tucson Airport Authority (TAA), Key Stakeholder
Sabrina Ortiz-Encinas	Resident
Richard Lozano, P.E.	Engineering Consultant
John Oliver	Engineering Consultant
Daniel Lawlor	City of Tucson, GIS Staff
Cy Miller	Engineering Consultant
Jacob Prietto	PCRFC, Mapping
Peng Zhang	Engineering Consultant
Joe Kingston	Engineering Consultant
Ron Coupland	Engineering Consultant
Stephen Blood	PCRFC, Engineering Manager
Chris Rod	Engineering Consultant
Jacob Lomeli	Engineering Consultant
Bryan Yurs	Engineering Consultant
Stan Timler	RWRD Engineering
Steve Richey	Pima County Wastewater
Joe Siva	Pima County Wastewater
Chelsi Remme	Engineering Consultant
Jamie Rivera	Engineering / RWRD
Cindy Mechter	Tucson Police Department
Mari Vasquez	Senior Advisor, Pima County
Sabrina Trejo	Resident
Chad Keller	PDSD
David Marhefka	DTM, Landscape Architect
Baylee Barker	Tucson Association of Realtors
Teresa DeKoker	Tucson Clean and Beautiful
Oscar A. Rodriguez Ponce	Tucson Clean and Beautiful
Clayton Trevillyan	Building Official, PDSD
Chuck Martin	Resident
Vladimir Berg	Tucson GIS

Laura Sharp	Tucson GIS
Rolanda Mazeika	Tucson, HCD
Issac Tineo	Engineering staff, PDSD
Marco Contreras	Engineering staff, PDSD

Due to prioritization and overlapping of FMP Action items identified in the 2020 FMP, the Stakeholders came up with the 7-workshop series during the initial meetings for the 5-year FMP Update. Over the last 5-year period, the key stakeholders determined 7 FMP Action items overlapped many Actions of the main action item chart, so these 7 workshops reflect addressing some of those FMP Action items.

Prioritized Action Items (workshops)	Description
TSMS Subtask V(b)i	Creating online app / GUI for the Tucson drainage manual (modernization, easier to use)
TSMS Subtask V(b)ii	Software Parameter Requirements for Drainage Submittals to the City of Tucson (modernization to address software submittals, accuracy, consistency)
TSMS Subtask V(b)iii	Retrofitting Existing Sanitary Line (reduce risk for exposed lines in stormdrain areas)
TSMS Subtask V(b)iv	Human Access Controls for Stormdrain Systems (to reduce potential obstructions & other hazards from encampments impacting watercourses)
TSMS Subtask V(b)v	Maintain, Enhance, Outreach for Watercourses - outreach to promote understanding of value of natural floodplain function
TSMS Subtask V(b)vi	Flood & Erosion Emergency Response Exercise (describing scenarios for Emergency Management to use as future exercises)
TSMS Subtask V(b)vii	Outreach to demystifying Tucson drainage regulations

Stakeholders were also asked to reprioritize the action items as well as assess the FMP Hazards. See Page 57 for more information on the reprioritization.

Subtask V(b)i Working Group - Creating Online Application / GUI for the Tucson drainage manual

The purpose of this working group is to modernize the existing *City of Tucson Standards Manual for Drainage Design and Floodplain Management* and make it more user friendly. There were two sessions of this workshop held on April 22, 2025 and May 27, 2025. These working group meetings discussed how the manual will be updated and discussed how to develop an easy-to-use graphical user interface (GUI). Currently, the City of Tucson drainage manual is a searchable PDF document.

The City of Tucson Floodplain Management Staff are working on a guideline document for detention/retention basin requirements to clarify overlaps and discrepancies in the new *Design Standards for Stormwater Detention and Retention for Pima County*. Additionally, the City of Tucson is looking at updating the old Stormwater in the Desert Middle School educational booklet as well as the Water Harvesting Manual.

Subtask V(b)ii Working Group - Requirements for Drainage Software Submittals – Defining Parameters

The purpose of this working group is to modernize and address City of Tucson software submittals, accuracy, efficiency and consistency. There were two sessions of this workshop held on May 29, 2025 and July 14, 2025. An additional pre-meeting with key stakeholders (Elizabeth Eberbach, Cy Miller, Greg Bambauer and Dr. Duan) was held on May 13, 2025 to help establish focus for defining parameters.

Stakeholders chose to add a section in Chapter 2 Technical Standard section 4-04.2.5 to the drainage manual pertaining to software submittals on a higher-level without specific software mentioned since software is updated frequently. Stakeholders also determined that it would be beneficial to have an annual letter issued by the City of Tucson Floodplain Administrator to clarify approved software or other specific software parameters, that way the manual would not have to be continually updated. The City of Tucson Floodplain Administration is considering a letter for these guidelines to be issued every year or every other year. Other changes to the City of Tucson drainage manual will be performed, likely by a Consultant, to add interactive online applications for computing erosion hazard setbacks for non-regional watercourses, the City of Tucson Flood Peak Estimator and the Scour Calculations.

The Stakeholders suggested that one or two consultants will be hired to work on the new proposed Technical Standards. However, City staff may develop the draft of the Technical Standards and present it at a future FMP meeting.

The City of Tucson FMP Stakeholders came up with the following tasks for the Drainage Software Parameters Workshop series:

- City of Tucson Floodplain Administration will hire one or two consultants to work on adding a section to the City of Tucson's Drainage Manual that will provide a high-level of guidance to what the City of Tucson expects for drainage computation submittals using various types of software other than City methods.
- The City of Tucson will also be tasked with developing periodic letters, *Tucson Software Update Letter*, from the City Floodplain Administrator to act as an annual or bi-annual update for drainage software submittals to further clarify software parameters.
- The technical standard section update in the manual will further clarify submittal requirements for encroachment analysis and other drainage computations, where TSMS is prioritized. Tucson methods are required unless acceptable engineering justification to use an alternative method is provided and accepted by the City of Tucson Floodplain Administration.
- The City of Tucson's drainage software list will include a compilation of software considering those software applications acceptable per the FEMA list, Maricopa County RFCD list, and/or other jurisdiction or a combination or in addition to other software that may need to be assessed for compatibility.
- There may be additional consultant services needed periodically for assessment of new or specific software not on the FEMA and/or other jurisdictional lists to verify level of accuracy.
- The drainage manual task is proposed to be completed by December 2026.
- The first annual *Tucson Software Update Letter* with the first software list will be issued by March 2027.

Subtask V(b)iii Working Group - Retrofitting Existing Sanitary Sewer Lines

The purpose of this working group is to reduce flood and erosion hazard risks for exposed lines in stormdrain areas. There were two sessions of this workshop held on April 15, 2025 and May 13, 2025. This working group discussed the impacts to the City of Tucson from sanitary sewer overflows (SSO) and criteria for retrofitting old sewer infrastructure. SSOs have increased in the City of Tucson due to the age of the infrastructure and updates to floodplain regulations since they were constructed. Any retrofitting of sanitary systems must ensure that there are no adverse impacts to neighboring property, consider the designation of the watercourse and provide a long-term solution.

These workshops were successful, and protocol is being developed to include when the City is notified of at-risk sewer infrastructure in the City watercourses. Stakeholders for this workshop series discussed the vulnerable flood and erosion hazard prone sewer lines within the City limits. Pima County Region Wastewater Reclamation Department (PCRWRD) has already setup several assessments for sanitary lines that need attention and has prioritized them and prepared lists and maps which are being shared with the City Floodplain Administration and

stormwater management engineering staff. During the workshop, there was discussion regarding changing and/or adding GIS data to differentiate sanitary sewer data and adding search information. City of Tucson Floodplain Administration is working to provide a set a guidelines for retrofitting existing exposed sewer lines within W.A.S.H. ordinance or ERZ watercourses. When concrete is proposed to be incorporated as part of the solution for a retrofitted sewer system within a W.A.S.H. Ordinance watercourse, Mayor and Council approval as well as colored concrete will be required. This workshop provided a discussion on best approaches for retrofitting different types of at risk sanitary structures to protect the public and environment from potential sanitary sewage breaches in a flood prone or erosion hazard area.



Figure 28: Before - Exposed Sanitary Sewer



Figure 29: After – Colored concrete protected sewer line

Subtask V(b)iv Working Group - Human Access Controls

The purpose of this working group is to reduce fatalities and reduce potential obstructions, stormwater diversion, scour, as well as other flood and erosion hazards due to encampments. There were three sessions of this workshop held on April 11, 2025, May 1, 2025 and July 11, 2025.

The working group discussed strategies identified for a human access control assessment in June 2023 which was performed for 9 locations. The stakeholders reviewed FMP Problems associated with identified FMP Hazards. The City of Tucson also proposed adding ember fire FMP Problems as a new addition to the identified FMP Hazards for human access controls. The findings for each of these specific locations were re-assessed for potential human access control measures. The strategies used for human access controls can either be hardscape/physical controls or policy. Each of the strategies consider the following characteristics:

City of Tucson Human Access Control Measure Alternatives	Example / description	How it lowers death risk	Conditions needed for use	Type of Stormdrain where this option can be used	Impact to Emergency Responders	Maintenance considerations	Benefits	Challenges	Cost considerations	Riparian habitat impact
--	-----------------------	--------------------------	---------------------------	--	--------------------------------	----------------------------	----------	------------	---------------------	-------------------------

- An example and description of the access control measure
- How this access control measure lowers the potential for death
- Conditions needed for use of the access control measure
- Type of stormdrain where this human access control measure can be used
- Impact to Emergency Responders

- Maintenance considerations
- The benefits of human access control
- The challenges of human access control
- Cost considerations
- Impact to riparian floodplain habitat

Human Access Control measures to keep persons from entering stormdrain systems, include a variety of engineering solutions that need to be weighed for safety. A popular solution to areas of concern in stormdrains is to add grates at the inlet and outlet for the box culvert. However, more than other communities, Tucson has more flash flood conditions with higher flow rates and higher velocities. Therefore, where the inlet of the box culvert is a vertical opening and not a surface grate or horizontal inlet, there is a potential to be pinned against the inlet grate during a flood event. Recreational users, pets, children playing in a wash, or first responders could be pinned against the grate and not be able to get out of the floodwaters and drown.

In summary, adding a grate to a box culvert can be used only when the upstream stormdrain system consists of only surface grates, catch basins and surface/horizontal inlets. See page 67 for more information on access control measures.

In cases where vertical box culvert inlets with high velocities exist and human access control measures are needed, alternative human access controls must be considered and assessed for engineering feasibility, adverse impacts, and safety. Some alternative measures include: top of bank fencing, cacti, angular rock, heavy-duty metal fencing, elevated drop inlet catch basins, boulders, electronic flow sensor transducer triggered grate or magnetic grate, enforcement, policy changes or a combination of solutions. For each stormdrain system, flow rate, velocity and other on-site characteristics must be evaluated in order to find the best and safest human access control measure solution.

Subtask V(b)v Working Group - Riparian Floodplain Corridors – Maintain, Enhance, Outreach for Watercourses

The purpose of this working group is to create outreach to promote understanding of the value of natural floodplain function and broadcast important flood and erosion hazard safety messages for natural watercourses. There were two sessions of this workshop held on April 24, 2025 and June 5, 2025.

A few members of the working group, led by John Wise, came up with the following definition for Natural Floodplain Function:

Natural Floodplain Function reserves the regulatory d area to the natural floodplain and thereby lessens flood damage risk to the adjacent community naturally by lessening severity of runoff and providing a location to store floodwater. Other benefits include old growth dessert conservation, maintaining the natural beauty of the riparian washes, while providing recreational opportunities such as bike paths and walking trails. When watercourses remain in the same location, maximum recharge replenishment is maintained. Natural Floodplain Function benefits floodplain management goals as well as the economy by improving quality of life and enhancing property values.

The City of Tucson has been regulating riparian floodplain for decades with the following regulatory watercourses designations: Protected Riparian Floodplain, Watercourse Amenities, Safety and Habitat Ordinance (W.A.S.H.), and Environmental Resource Zone Overlay designated watercourses.

The working group identified the target audience for this outreach as well as outreach tools. City of Tucson also met with the Public Information Officer (PIO) for recommendations and ideas. That messaging for the City of Tucson is to ensure the outreach covers the general flow patterns and soil types for the City of Tucson. Also to ensure the public understands the importance of natural floodplain function, the value of riparian floodplains, and that floodplain encroachment that may be allowed is limited to utilities, roadway improvements, walkways or bike paths.

During this working group, Irene Ogata suggested ember fire as a new FMP Hazard as it poses a risk to riparian floodplain areas. However, it was determined that ember fire would not generate an eighth FMP Hazard but rather overlap the seven existing FMP Hazards identified as one of the five FMP Problem considerations for one or more of the FMP Hazards. Ember fires can start with lightning, unhoused encampments, cigarette butts, vehicular sparks, and improperly controlled campfires. Fires can reduce the vegetative protection of riparian floodplains which in turn can cause destabilization and increase erosion potential and thereby reducing watercourse capacity due to the increase in sediment transport. Prioritizing natural floodplain function can be an important part of floodplain management.

PCRFC D has online floodplain management tools, as mentioned on page 12. Besides precipitation data, PCRFC D ALERT Map (<https://alertmap.rfcd.pima.gov/gmap/gmap.html>) also provides various wildfire data. Impact from the 2020 Big Horn fire caused changes to the floodplain runoff along the Santa Catalina mountains which have impacted the City of Tucson at several locations along the north boundary. See Figure 30.

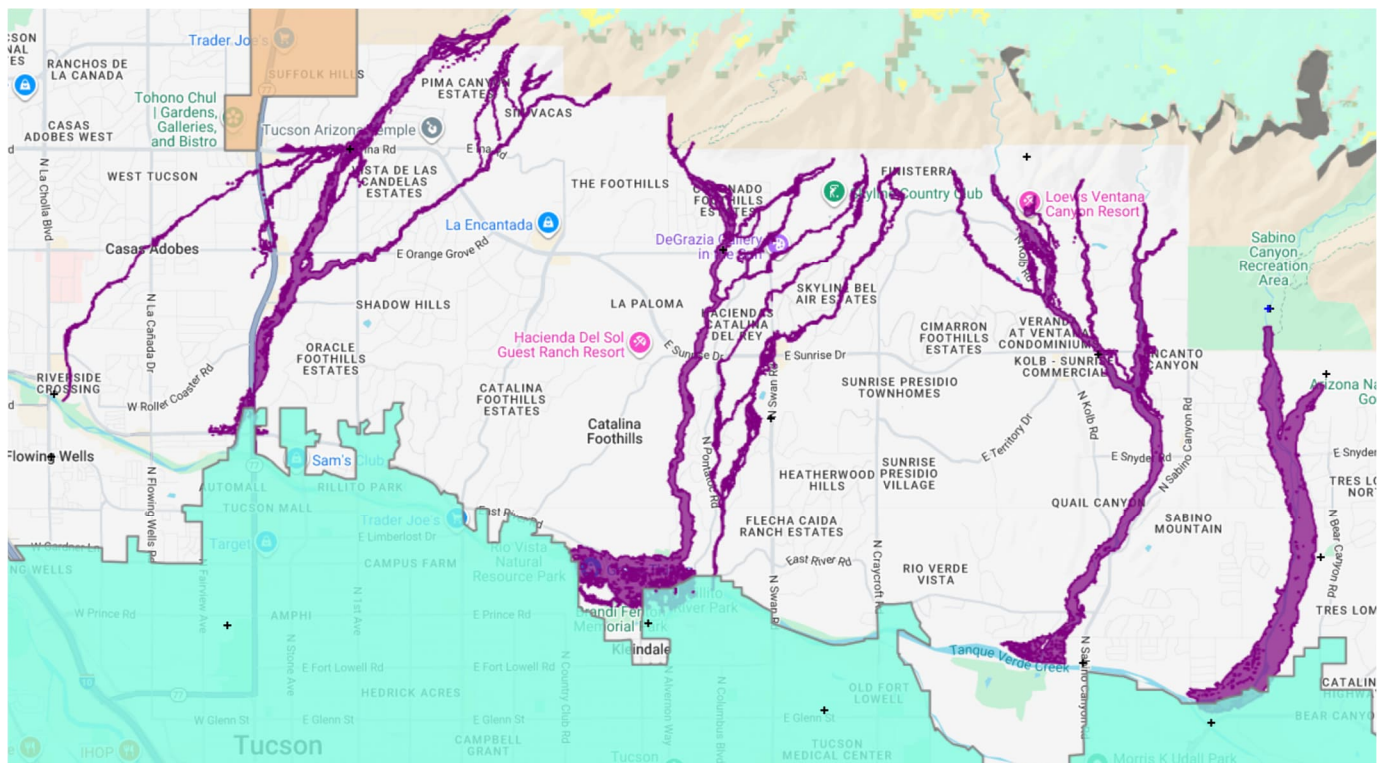


Figure 30: PCRFC D ALERT Map showing Provisional Big Horn Fire Inundation Map

Subtask V(b)vi Working Group - Flood & Erosion Emergency Response Exercise

The purpose of this working group was to describe one or more hazard scenarios for City of Tucson Emergency Management to use as future exercises. There were two sessions of this workshop held on June 3, 2025 and July 1, 2025.

The City of Tucson has been working annually with emergency management staff and including them in all the annual FMP meetings and in the 5-year FMP update. This workshop series is concentrating on scenarios that emergency management might consider for a pre-disaster preparedness exercise. The NFIP CRS program provides suggested action items for developing an exercise. See table below.

600 Series: Warning and Response		
610 (Flood Warning and Response)		
a	FTR	Flood threat recognition system
b	EWD	Emergency warning dissemination
c	FRO	Flood response operations plan
d	CFP	Critical facilities planning
e	SRC	StormReady community
f	TRC	TsunamiReady community
620 (Levees)		
a	LM	Levee maintenance
b	LFR	Levee failure threat recognition
c	LFW	Levee failure warning
d	LFO	Levee failure response operations
e	LCF	Levee failure critical facilities
630 (Dams)		
a	SDS	State dam safety program
b	DFR	Dam failure threat recognition
c	DFW	Dam failure warning
d	DFO	Dam failure response operations
e	DCF	Dam failure critical facilities

Table 3. NFIP CRS 600 Series Warning and Response Activities

The City of Tucson Floodplain Administration is working on the below topics for the CRS prerequisites with emergency management staff and looking at one or more sites for a Flood / Erosion Response Operations Plan. Prerequisites are required in order to obtain any NIFP points for the 600 Series. The City of Tucson has many CRS activities that could be credited in the 600 Series (some of the credits are part of the regional flood control emergency activities); and with the completion of this flood response operation plan, the other points will then be awarded by FEMA.

1. Information regarding activation of Emergency Operations Center
2. Buildings impacted by Potential Emergency Hazard
3. Critical Facilities Inventory
4. Flood Inundation Maps
5. Flood Warning Response System
6. Annual Exercises
7. FEMA evaluation and approval of the City's proposed emergency response scenario exercise

During the working group meeting, various scenario locations were considered including potential Agua Caliente Levee east bank failure that could cause \$62 million dollars in structural damage (see photo below).

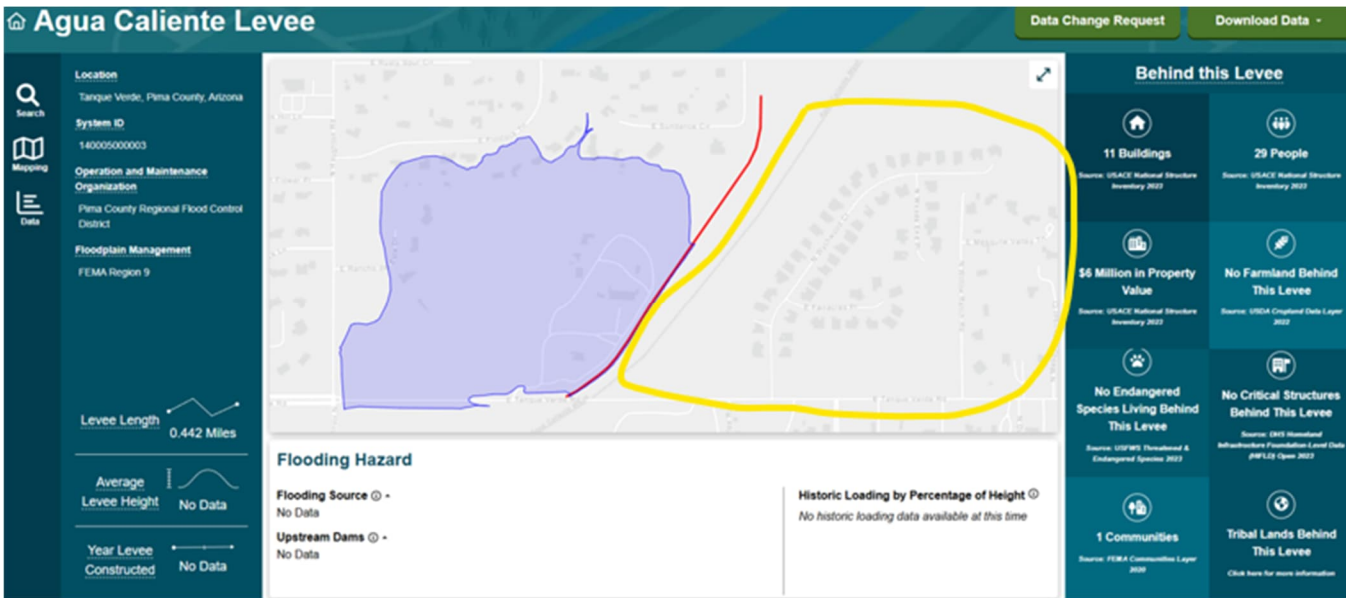


Figure 31: Agua Caliente Levee Failure (structures east of the eastern levee embankment)

All scenarios that were considered by the working group included:

Location	Hazard Type
1. Tucson Unified School District - Cherry Field Detention Basin	Dam/Levee Failure
2. Agua Caliente Levee	Levee Failure
3. Camino Real Levee	Levee Failure
4. Craycroft and Confluence of Tanque Verde Creek and Pantano Wash	Erosion Hazard
5. Saint Mary's Levee	Levee Failure
6. Santa Cruz River	Erosion and Flood Overtopping

City of Tucson's City Engineer / Floodplain Administrator worked with engineering staff and determined that each of these scenarios should be considered for an emergency response plan and exercise. The prioritization is shown on the table above. Each of the six scenarios will be further assessed for number of people impacted and value of structures at risk. These scenarios will be forwarded to the City Manager and Mayor and Council who will decide on the proposed prioritization of the emergency response exercise scenarios.

City of Tucson Floodplain Administrator will also share these emergency response scenarios with PCRFC, who operates the flood recognition and warning system. This allows the City of Tucson and PCRFC to partner together to prepare for and participate in the exercise which will focus on the City of Tucson's risk areas, which are the highest density vulnerable populations in the county.

Some pre-disaster planning considerations that were brought up during the workshop include:

- How and when to engage community about the exercise
- Whether simulated evacuation would be part of the exercise
- Community impact (number of people)
- Participation and buy-in by National Weather Service, Tucson Fire Department (TFD), PCRFC, City Emergency

Management and property owners

- Damage to potential buildings (number of buildings/cost)
- Whether Unhoused are impacted in the location
- Whether rain gauges are available in the area of the proposed pre-disaster preparedness scenario

Subtask V(b)vii Working Group - Outreach for FPO Updates and Demystifying Tucson Drainage Regulations

The purpose of this working group is to promote clarification of City of Tucson drainage regulations & any upcoming Floodplain Ordinance (FPO) updates, increase resiliency, and better broadcast important flood and erosion FMP Hazard safety messages. There were three sessions of this workshop held on April 28, 2025, June 2, 2025 and July 8, 2025. The City of Tucson performs various flood and erosion FMP Hazard outreach activities throughout the year and annually. Current outreach is explained on page 14.

Some of the City of Tucson's key outreach messages regarding floodplain regulations include:

- The majority of the buildings in local and FEMA high-risk floodplains were constructed prior to the first flood maps; therefore flood status is an important part of development planning.
- Since soils have slower infiltration rates, for the City of Tucson the most sustainable approach is the use of Detention Design for reducing flow rates from developed sites.
- For development considerations, besides the FEMA floodplain status, there are also local floodplain and erosion hazards to consider.
- Flow pattern in the City of Tucson is generally southeast to northwest.
- City of Tucson is in charge of flood mapping, updating the city's Floodplain Ordinance and other responsibilities.
- Any development within the City of Tucson, regardless of property ownership, must use City drainage methodology and regulations and obtain floodplain use permitting by the City of Tucson.
- City of Tucson Mayor and Council is the City of Tucson Floodplain Board.
- Soil types in Tucson are different than other areas in Southern Arizona. Tucson has mostly hydrologic soil groups C & D and caliche are harder soils so percolation of stormwater runoff infiltrating into the soil can be slower.
- City of Tucson has a hierarchy of city drainage requirements with the Floodplain Ordinance being at the top.
- To assess adverse impact for proposed projects, encroachment analysis must include evaluation of potential increases in water surface elevation, increases in velocities, and changes to flow direction.
- City of Tucson Floodplain Administration has updates to policies and Floodplain Ordinance.
- City of Tucson requires drainage maintenance responsibilities for development. See page 19 for Drainage Facility Maintenance handout.
- City of Tucson has a W.A.S.H. Ordinance that ensures existing vegetation is protected/restored as well requires no concrete is proposed without City Engineer and Mayor and Council approval. This Ordinance also has a 50-foot buffer area where Protected Riparian Areas must be delineated.
- City of Tucson's most restricted floodplain is Environmental Resource Zone (ERZ) overlay in ERZ designated watercourses where the 100-year floodplain is to remain natural, with some exceptions.
- Where box culverts are needed, the minimum height of 6 feet is needed to allow riparian fauna activity within ERZ designated watercourses.
- City of Tucson only allows encroachment to the riparian floodplain for utilities, roads, and trails.
- Scenic Route Buffer Areas code regulations require that natural drainage is preserved.
- The maximum depth for public right-of-way water harvesting features is 6-inches.
- There are waivers to detention and retention where no adverse impacts will occur, however engineering justification needs to be provided.
- Grading permits are required for ground disturbance when drainage may be altered and when a building pad is placed in a floodplain.

- Floodplain use permits are required for utility improvements, work within an erosion hazard setback, as well as other activities within mapped or unmapped local or FEMA floodplain areas.

Evaluation of Outreach Methods

The City of Tucson is evaluating existing ways of disseminating these messages. The City of Tucson currently has the annual water bill flyer which reaches most property owners and messages are updated annually. The water bill flyers are sent strategically in early summer to coincide with monsoon to help remind property owners about flood safety tips and other information. This water bill flyer is small and monochrome and needs to be reevaluated for messaging impact. Starting in 2026, the City of Tucson will be producing a flood and erosion hazard outreach flyer to be mailed before monsoon.

The City of Tucson will perform outreach for the adopted 2005 Water Harvesting Manual which is currently being updated to provide new calculations.

The Middle School Book is an interactive tool where the book and a computer are being used simultaneously. Teachers throughout the Southern Arizona area have successfully used this tool and found it to be a well-received educational aid, however the City will need a consultant to update the computer aspect to ensure it works as intended.

The City of Tucson's Floodplain Administration (DTM) and Floodplain Information (PDSD) websites both need updating. The main GIS group in City of Tucson received authorization from their supervisor to create the City of Tucson Floodplain Management Hub Site. The Floodplain Management Hub Site would contain drainage inquiry reporting form, Floodplain Use Permit applications, historical storm events, Floodplain Management Plan updates, floodplain ordinance updates, watershed action item updates, links to drainage master plans, and more.

Since 2023, other action items were identified in prior 5-year Update FMP Stakeholder meetings including sewerline hazards, flow diversion and obstructions due to unhoused encampments, emergency flood/erosion response, and the need for more outreach.

The main take aways from these meetings were to focus on establishing annual software submittal requirements in order to modernize TSMS. Additionally, in order to improve on outreach, it was determined that there was a need to update the floodplain administration website using GIS staff as well as focus on social media outreach. Another important outcome of these meetings was improved relationships between floodplain administration, Pima County Wastewater, and City of Tucson Emergency Management staff.

In 2016, the FMP process had been unique in that FEMA assisted primarily with the project management, oversight, and production of final products, while the City of Tucson had led the planning efforts and discussions. This process proved beneficial in obtaining the community's first-hand perspectives and objectives. In creating Tucson's FMP, the best assessment had been provided by the committee for potential floodplain and erosion hazards, along with the most efficient mitigation actions for alleviating disaster potential.

With the city's current CRS Rating, it's apparent that Tucson has already achieved major goals with regard to Floodplain Management. By going a step further in the Risk MAP process by creating and updating the FMP, community representatives (and the public) will be able to access tools for floodplain management in the years to come.

As floodplain management increases overall, the flood risk potential for a community will decrease. This FMP update not only considers the well-being of the people, but also takes into consideration the natural and built environment. The intent of this updated comprehensive report is to further discuss existing flood and erosion risks, areas of potential hazard, and ways to address these concerns. Updating the FMP will continue to allow for the utilization of concrete and realistic flood risk products, and at the same time, it increases the public's awareness of flood risk potential. Updating this report also increases the ability of state and local officials and their constituency to adapt to current hazards and risks that may arise. It allows committee participants to take part in a discussion of ongoing efforts and can be used for a more coordinated effort in case of emergencies. It also helps to increase federal funding for hazardous events and decreases insurance premiums for local property owners. Currently, property owners in Class 6 communities are eligible for premium reductions of 20%. Improving Tucson's CRS rating will result in increased savings for its residents and other property owners.

The intention of this FMP update is to continue to emphasize the unique flood and erosion characteristics of Tucson, and outline every issue faced by the urban community. This FMP update intends to:

- Facilitate an update to the TSMS by putting the drainage manual online and setting drainage submittal software parameters
- Identify current, existing and future flood-related hazards and their causes
- Ensure a comprehensive review of all possible activities and mitigation measures is conducted so that the most appropriate solutions will be implemented to address the hazard
- Ensure the recommended activities meet the goals and objectives of the community, are in coordination with land use and comprehensive planning, do not create conflicts with other activities, and are coordinated so that the costs of implementing individual activities are reduced
- Ensure the criteria used in community land use and development programs account for the hazards faced by existing and new development
- Look for ways to improve education for residents and property owners about the hazards, loss reduction measures, and the natural and beneficial functions of the floodplain
- Continue to build public and political support for activities and projects that prevent new problems, reduce losses, and protect the natural and beneficial functions of floodplains
- Expand a constituency that wants to see the plan's recommendations implemented



FEMA

RiskMAP

Increasing Resilience Together

QUICK RISK MAP PRODUCT DISCUSSION

Because flood hazards change over time, the Discovery process provides an opportunity to engage in a comprehensive review of activities that contribute to flood risk. Engaging local officials in this process increases their understanding of flood risk and gives them an active role in identifying proactive steps that can be implemented to protect the lives and property of community residents. Through Risk MAP, FEMA provides communities with information that can improve risk communication and enhance local mitigation plans, resulting in decreased flood risk. FEMA has developed a suite of multi-hazard risk assessment products, referred to as Flood Risk Products (FRPs), to assist with this endeavor. FRPs can help community officials assess, visualize, and communicate local flood risk. The FRPs developed as part of the overall project are included in the Appendix of the 2016 report. As part of the 2016 project, the following FRPs had been developed for Tucson:

- Flood Risk Report - The Flood Risk Report (FRR) provides community and watershed-specific flood risk information extracted from the Flood Risk Database (FRD), explains the concept of flood risk, and identifies useful tools and reference materials. The FRR, used in combination with the Flood Risk MAP (FRM), is a good tool for communities to use for raising local flood risk awareness.
- Flood risk database (including Hazus-MH) - The FRD stores all of the flood risk assessment data, which provides an evaluation of potential financial consequences and other impacts associated with structures located in the Special Flood Hazard Area (SFHA). This data also enables communities to make informed decisions regarding future land development and community infrastructure.
- Flood Risk MAP - The FRM depicts flood risk data (not necessarily flood limits) for a flood risk project area and is typically used to illustrate an overall picture of flood risk for the area.

For 2025, the City of Tucson produced the following products for this 5-year update:

- Flood Risk Report - The FRR provides updated floodplain management information regarding the prioritized Hazards, the accessed Problems, and the current Activities that the City of Tucson has been working on during the last 5 years. The report also includes a thorough explanation of the types of outreach activities.
- Flood Risk MAP - The City of Tucson GIS Staff produced a map illustrating the substantial number of buildings within the SFHA and local regulatory floodplain. The percentage of pre-FIRM buildings in the flood risk area is 82.7%. Therefore, buildings built before 1982 may not have flood elevations high enough to meet current flood standards and may be at risk of flooding. See Appendix F. This GIS map provides additional data for the City of Tucson's Flood Risk MAP.



Figure 32: Erosion in right-of-way.



Figure 33: Increased pavement damage without curb.

Chapter 2

Planning Phase

The FMP Working Group (WG) which were core members of the project team, met in November 2019 and a portion of the 2019 annual update agenda included determining how the planning process should go in order to meet the CRS requirements and maximize the resulting points that Tucson will receive toward increasing the City's CRS rating. In 2019, core FMP members determined that the 2020 formal update should focus on the Action Plan and updating the priority list. The WG met about once a week beginning in February 2020 to identify availability of 2016 committee participants for 2020 FMP Committee, also planned the meeting dates, agendas, and invitations, discussed meeting activities and format, committee tasks, and potential outcomes. The WG continues to meet throughout the entire FMP process. Annual FMP meetings for 2017 – 2025 were held in June through December of each year. For the 2025 FMP update, 7 working group topics were set and 16 working group meetings were scheduled between April and July of 2025.



Figure 34: John Wise P.E. addressing 2016 FMP Committee – emphasizing the importance of natural functions of floodplains

TUCSON STAFF INVOLVEMENT

Per CRS requirements, the WG cited that it was very important to try to include stakeholders from as many departments within Tucson as possible to provide action item recommendations that could actually be supported and adopted by those departments. Having a wide range of participants would also provide the committee with a fresh perspective on Tucson as a whole. Without the appropriate community backing, the recommendations and the FMP will not succeed. The different groups within Tucson's governmental structure include the Tucson Department of Transportation and Mobility (DTM) which includes engineering, stormwater management, and floodplain administration), Planning and Development Services Department (PDSD) which includes engineering and planning), Trees for Tucson, Tucson Clean & Beautiful, Tucson Airport Authority, Tucson Water, Tucson City Council Ward Offices, Tucson Police Department, and Environmental and General Services Departments.

Per the CRS Manual, the FMP committee included stakeholders that covered six categories that reflect the possible FMP Activities that can prevent or eliminate the FMP Problems caused by the FMP Hazards:

1. Preventive measures (e.g., codes and standards) (PDSD, DTM, Tucson Water)
2. Property protection (e.g., elevation) (PDSD, DTM)
3. Natural resource protection (Tucson Clean & Beautiful)
4. Emergency services (Tucson Fire and Police Departments)
5. Structural flood control projects (DTM with assistance from PCRFCD and PCRWRD)
6. Public information (PDSD, Tucson City Council Ward Offices, DTM)

The list of committee members that attended each committee meeting is listed below for the 2025 FMP meetings. The working group PowerPoints and sign in sheets are in the appendix.



Figure 35: Desert monsoon sky

OTHER AGENCY COORDINATION

In addition to local Tucson staff, the WG also reached out to other agencies to participate in the process. Those agencies included FEMA, ADWR, USACE, Pima County Regional Flood Control District (PCRFCD), Arizona Floodplain Management Association, Southern Arizona Home Builders Association, Tucson International Airport Authority, and the Tucson Association of Realtors (TAR). PCRFCD, TIA, and TAR were active in the 2020 and 2025 FMP Update meetings. TAR has been active in collaborating with the City of Tucson for floodplain management, including educational trainings at TAR meetings, and assistance with City's request to assure Multiple Listing Service (MLS) forms include both FEMA and local floodplain information. Tucson Association of Realtors (TAR) provided the public meeting space at their main office for the 2025, 5-year FMP Update. See page 50 for additional information.

City of Tucson has 3 representatives in the monthly multi-jurisdictional PCRFCD flood advisory committee. Each of the three representatives are assigned by Floodplain Administrator / City Engineer, City Manager and the Mayor. The City Manager had assigned James MacAdam and the City Engineer has assigned himself (City Floodplain Administrator) for the second representative. Currently, the Mayor has not yet assigned the third representative. There are several Pima County unincorporated representatives and there is one representative each for the Towns of Oro Valley, Marana and Sahuarita. The City of Tucson, having three representatives, provides additional voting power. At this monthly Advisory Committee, decisions are made on how flood levy money is spent. The City of Tucson property owners contribute approximately 50% of the total levy money received by PCRFCD per ARS48.

Communications with TIA occur regularly to assure understanding of floodplain use permitting requirements for the airport's critical facilities and this year, included discussion of proposed updates to code for critical facilities to meet current CRS minimum standards. With assistance from FEMA, the City performed a presentation for TAR for floodplain updates. Tucson Botanical Gardens had interest in attending future FMP meetings. Sonoran Institute has also been an active participant working with the City of Tucson Floodplain / Stormwater Management on stormwater quality aspects of the Santa Cruz River.

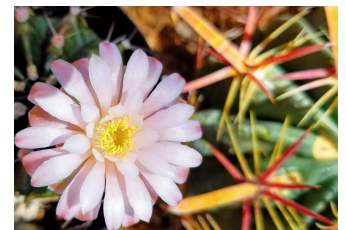


Figure 36: Desert flora

REPORT OVERVIEW

The City of Tucson initiated TSMS in 1988 in order to develop a comprehensive stormwater management program. Fortunately for the FMP committee, Larry Roberts P.E. was a member of the team that created the TSMS and Mr. Roberts provided the following TSMS description. The TSMS was planned as a multi-year project with the following four phases:

- Phase I: Establish Framework, Goals, and Objectives
- Phase II: Develop Stormwater / Floodplain Master Plan
- Phase III: Prepare Implementation Program and Maintenance Management Program,
Assess Institutional and Financial Elements
- Phase IV: Implementation

Phase I of the TSMS was adopted by Mayor and Council in March 1990. The Phase I study utilized an extensive public participation program for soliciting citizen involvement. The Phase I study also redirected future stormwater management efforts toward an emphasis upon nonstructural approaches which maintain or enhance naturally vegetated watercourses.

Phase II of the TSMS was initiated in 1992 in order to develop a Stormwater Master Plan for controlling both stormwater quantity and quality. One of the primary purposes of Phase II of the TSMS was to expand on the

results of the Phase I study and develop a Stormwater Master Plan that adequately and economically addresses City-wide stormwater management. The Stormwater Master Plan was prepared under the direction of the City of Tucson by a multi-disciplined consultant team with areas of expertise in water resources, stormwater quality, environmental aspects, public participation, and legal issues. The Stormwater Master Plan was approved by Mayor and Council in 1996.

The Final Report presented the recommended Stormwater Master Plan (Simons, Li & Associates, 1992). Seventeen additional key documents were also prepared as the foundation for the Stormwater Master Plan.

The Tucson Floodplain Management Plan is TSMS Phase V and follows the Implementation Phase IV. Although implementation includes actions like floodplain management planning, the City chose to start TSMS Phase V.

The Final Report of the TSMS, Phase II, Stormwater Master Plan provided a 30-year framework for managing the surface water resources by integrating those technical, economic, social, and environmental factors which are essential for sound stormwater management. The comprehensive, watershed-based plan consisted of six major elements, described as follows:

1. Preservation of Naturally Vegetated Watercourses

Riparian habitat was identified and classified along the naturally vegetated watercourses within the City of Tucson. Approximately 77 miles of these watercourses, representing 570 acres of riparian habitat, were recommended for preservation. This represented 98% of the riparian habitat that was identified. Since then the City has created / adopted code for Environmental Resource Zone and Wash Amenities Safety and Habitat (W.A.S.H.) Ordinance, as well as water harvesting requirements.

2. Flood hazard studies

Flood Hazard Studies were proposed for approximately 41 miles of watercourses where nonstructural stormwater management measures were recommended. These studies were designed to better define the extent of flooding risks and identify possible nonstructural measures such as the purchase of flood insurance or floodproofing. Public education regarding results of the Flood Hazard Studies was also recommended.

The Flood Hazard Studies were proposed to be prepared by the City of Tucson for local floodplain management, and not create any new regulatory floodplains under the jurisdiction of the Federal Emergency Management Agency (FEMA). However, some Flood Hazard Studies may result in the remapping of existing FEMA floodplains in order to provide more accurate information which may reduce the size of the regulatory FEMA floodplain. The new data were to also be used by the City to determine whether additional studies were warranted.

3. Stormwater Quality Investigations

Although no significant problems with the quality of stormwater runoff were documented. The stormwater sampling equipment however was outdated, and it was recommended to be updated for the 5 sampling sites in order to obtain more reliable data. New stormwater management equipment and new SAMS software for stormwater surface water quality was purchased in 2018-2019. Today, seasonal sampling of rainwater runoff are indicating increases in E.coli. Stormwater quality continues to be an important topic to many constituents and is a priority to the City of Tucson who will continue to develop an historical scientific database of testing results to support monitoring efforts and protecting City's water quality.

4. Stormwater Capital Improvement Programs

The major structural component of the TSMS was 47 capital improvement projects which generally involved channelization, bank protection, stormdrains, or detention/retention facilities. The 47 projects, which were prioritized into a series of 5-year programs, would result in over 2,000 homes and 3 million square feet of commercial and industrial buildings protected from flooding. Some of these projects have been completed and others are being designed or awaiting funding source.

5. Miscellaneous Capital Projects

The need for various small, less costly projects was identified to address localized flooding problems throughout the City. These smaller projects generally consisted of roadway culverts, stormdrains, channel improvements, and grade control structures. Due to funding issues, these types of projects have been limited.

6. Recommendations for Implementation

Recommendations were prepared for new or revised City policies, regulations, standards, and practices which were necessary to fully implement the Phase II Stormwater Master Plan. The actual development of new or revised policies was completed as part of the TSMS, Phase III, Implementation Program.

The Phase III Implementation Program was initiated in 1996 to develop new or revised City policies, regulations, standards, and practices in order to fully implement the Phase II Stormwater Master Plan. The key new or revised items are listed as follows:

1. Revised Drainage Standards Manual,
2. Draft Stormwater Quality Ordinance,
3. Implementation Plan for Preservation of Naturally Vegetated Watercourses,
4. Detailed Scope of Work for Flood Hazard Studies,
5. Detailed Scope of Work for Design Analyses of Capital Improvement Projects,
6. Identification of remapping needs for existing FEMA Flood Insurance Study,
7. Implementation Plan for Miscellaneous Capital Projects, and
8. Plan for Addressing Stormwater Quality and NPDES Requirements.

TSMS serves as the foundation for the FMP, and many reports listed below share the same goals as TSMS. The reports included:

- 2012 Upper Santa Cruz Discovery Report (FEMA)
- 2012 Pima County Flood Insurance Study (June 16, 2011) (FEMA)
- 2008 Tucson Watercourse Maintenance Guidelines (Tucson)
- 2006 Water Harvesting Guidance Manual (Tucson)
- 2017 Pima County Multi-Jurisdictional Hazard Mitigation Plan (HMP) (PCRFCFCD)
- 2003 City of Tucson Habitat Conservation Plan (PCRFCFCD)
- 2013 Pima County Community Wildfire Plan (Pima County)
- 2011-2015 Action Plan for Water Sustainability (Tucson)
- 2016 Tucson Parks & Recreation 10-year Strategic Plan (Tucson)
- Tucson Police Department Strategic Plan (2013-2018) (Tucson)
- Solving Flooding Challenges with Green Stormwater Infrastructure in the Airport Wash Area (2015) (Tucson Ward 1)
- Plan Tucson: City of Tucson General & Sustainability Plan (2013) (Tucson)
- 2013 City of Tucson Unified Development Code (Tucson)
- 2014 Tucson Emergency Operations Plan
- Multiple PCRFCFCD Studies on behalf of the City of Tucson

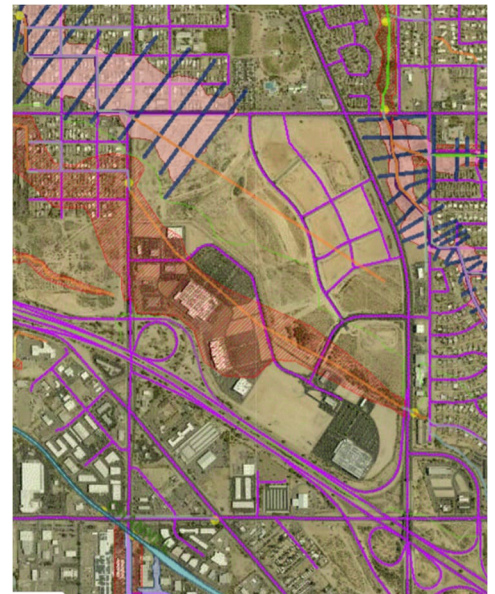


Figure 37: New mapping is needed to reflect new regional detention basin

IN-PROGRESS / RECENTLY COMPLETED FLOODPLAIN PROJECTS AND MAPPING STUDIES OF MOST CONCERN FOR TUCSON

1. The FEMA SFHA floodplain mapping information is periodically updated approximately every 10 years by FEMA. The City of Tucson is due for a DFIRM update (previous update was in 2011). FEMA mapping staff performed a partial DFIRM update for unincorporated county areas which overlapped three city boundary areas. These revised maps were provided in November 2024, however, they did not significantly change flood data within the city limits. While the City of Tucson Floodplain Administration has requested mapping corrections, FEMA staff indicated that the city will not receive any mapping updates in the 2024-2025 DFIRM revision.
2. Downtown Links project remapping includes Pima County Regional Flood Control District and the City of Tucson in cooperation with the USACE which have jointly undertaken a multi-phase flood control, environmental restoration and recreation project called the Tucson Drainage Area/Arroyo Chico Multi-Use Project. Downtown Links project is anticipated to be completed in 2025 for the construction of drainage system and road improvements. Then, PCRFCFCD will use City as-built data to complete and submit the LOMR or PMR which will lower flood risk to the many areas downtown.
3. Of the several Santa Cruz River studies that have been completed over the last few years that incorporate mapping, the Paseo de Las Iglesias project provided additional benefits to the City. The Paseo de Las Iglesias Phase I: Santa Cruz River Bank Protection, Ecosystem Restoration, and Linear Parkway Project changes flow pattern to allow for PCRFCFCD riparian habitat enhancement.
4. Santa Cruz River Management Plan (Trico Road) – multi-jurisdictional comprehensive management plan for flood risk management, drainage infrastructure protection, water resources, trash reduction, recreation, education opportunities and riparian habitat preservation for the Santa Cruz River. The City of Tucson is working with the Luke Cole from the Sonoran Institute to install trial trash sock features to address pollutants and the need for increased maintenance.
5. An aggregation - degradation study was performed by PCRFCFCD of the regional water courses. Sediment removal and relocation was performed by PCRFCFCD based on the study in order to improve conveyance for much of the Santa Cruz River reaches and the Rillito. The reach along the Santa Cruz River from Cushing Street to Grant Road was completed July 2020. The City of Tucson expects periodic assessment of aggregation within the regional watercourses in order to ensure the capacity is not reduced due to post-storm deposition.
6. Pantano Wash Linear Park-Craycroft to Tanque Verde - Phase 3 bank protection, Rose Hill Wash bridge, and green infrastructure river park construction completed February, 2018.
7. Alamo Watershed Study - Alamo Wash Letter of Map Revision was completed and became effective at the beginning of 2021. The Alamo Study was the next prioritized TSMS watershed identified by the City Floodplain Administration. The Pima County Regional Flood Control District performed this study on behalf of the City of Tucson Wards 3 and 6. After the study, 42 properties were added into the SFHA and 151 properties were removed from the floodplain. A total of 298 parcels were impacted by this re-mapping. Outreach in the form of Notification Letters went out to properties where buildings were impacted (summer 2020). The City of Tucson requests that when a map revision occurs, that the notification letters to impacted properties includes a pre- and post- map as shown in Figure 36 below. The FEMA approval letter had an effective date of March 15, 2021 (Case Number 20-09-2061P). This

outreach provided guidance for property owners to plan for obtaining a flood insurance policy, or researching other options such as elevation certificate surveys, which may help lessen the cost of flood insurance for those properties having to purchase flood insurance by the Effective Date. In Figure 37, the pre and post flood conditions were provided to every property owner impacted by the Alamo Watershed Study as part of the City's notification procedures.

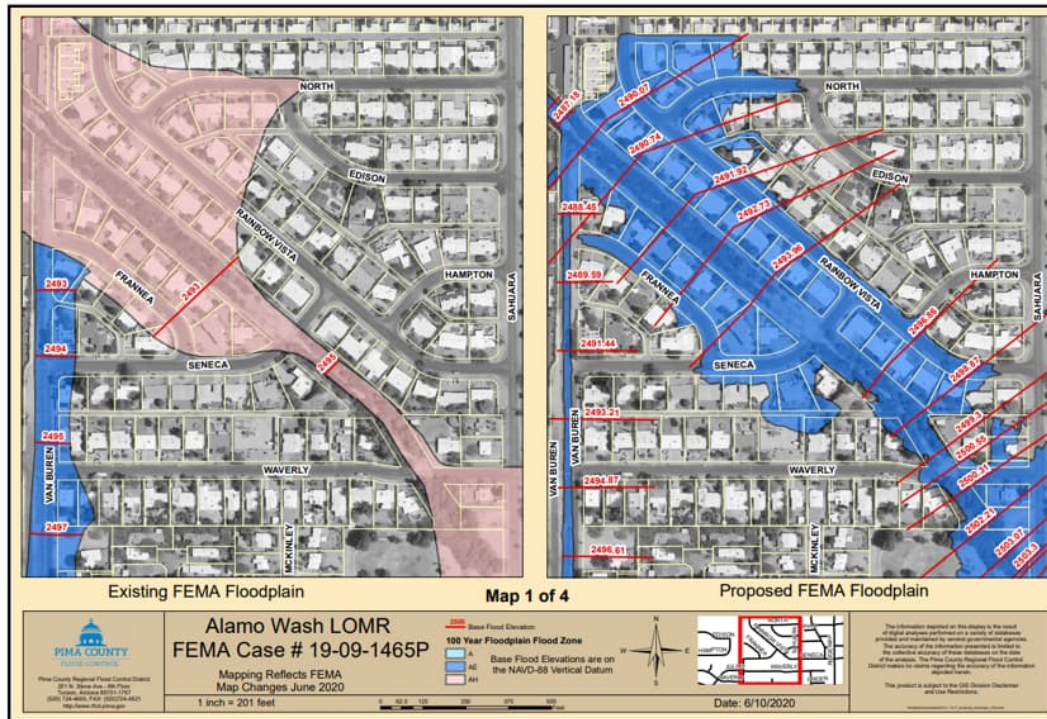
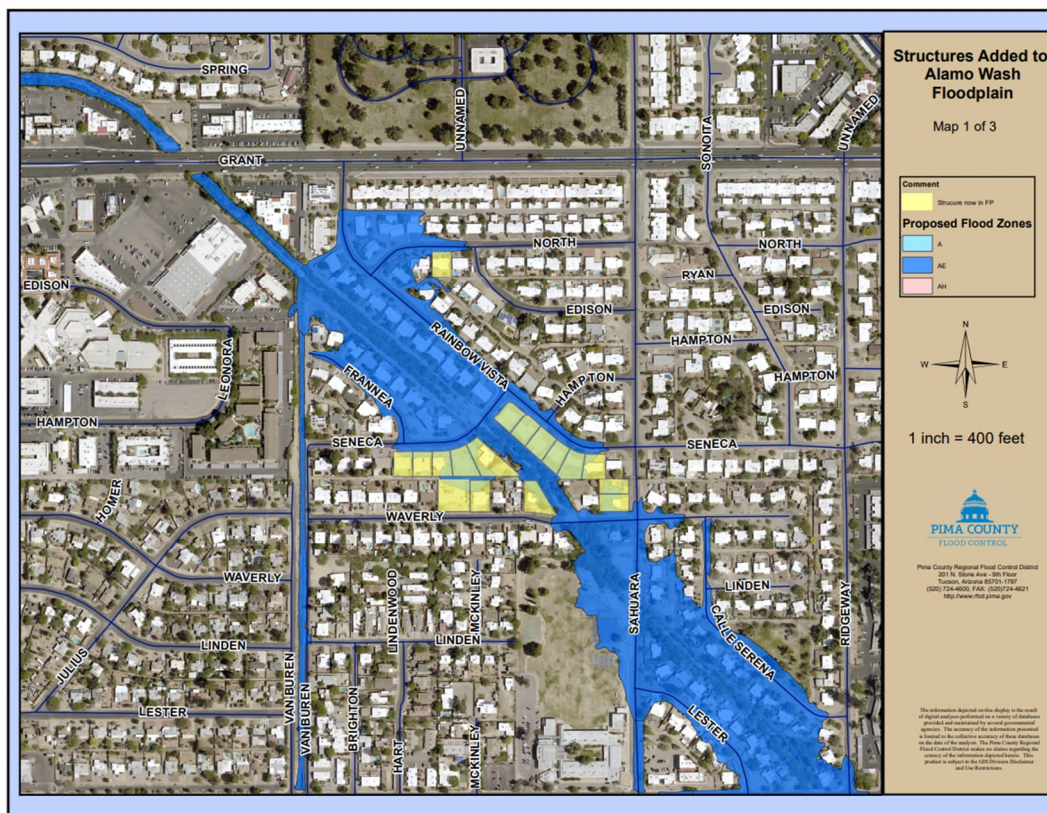


Figure 38: Notification Letter shows existing and proposed floodplain maps



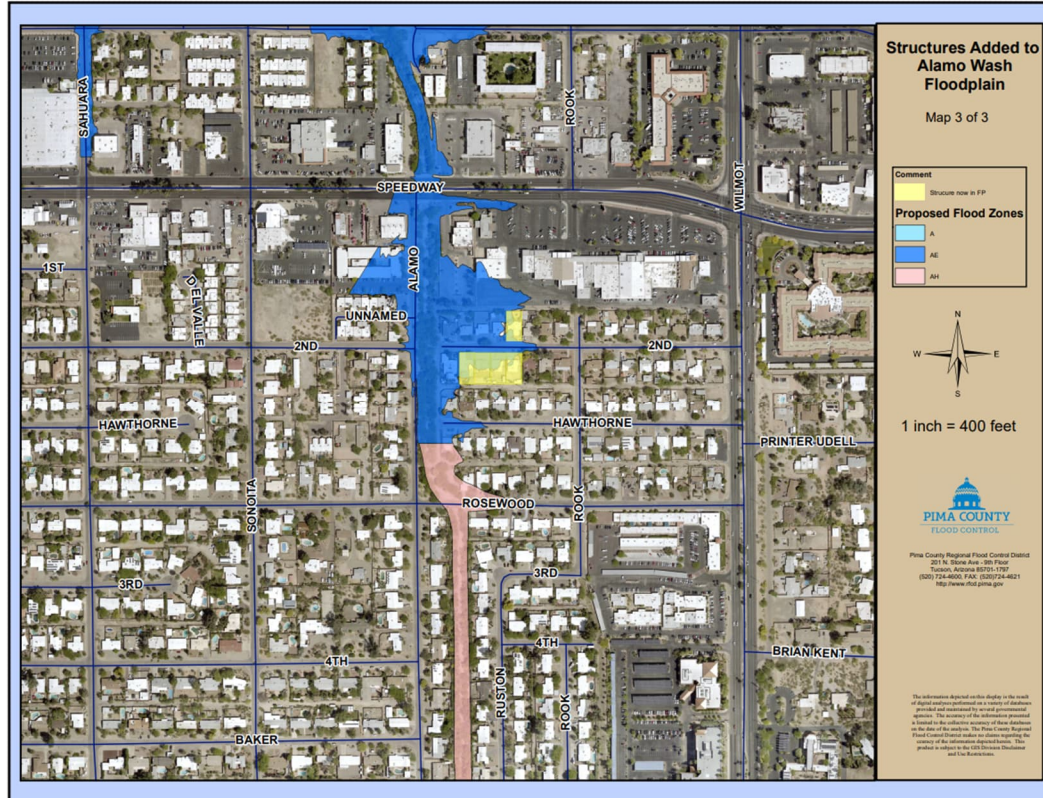
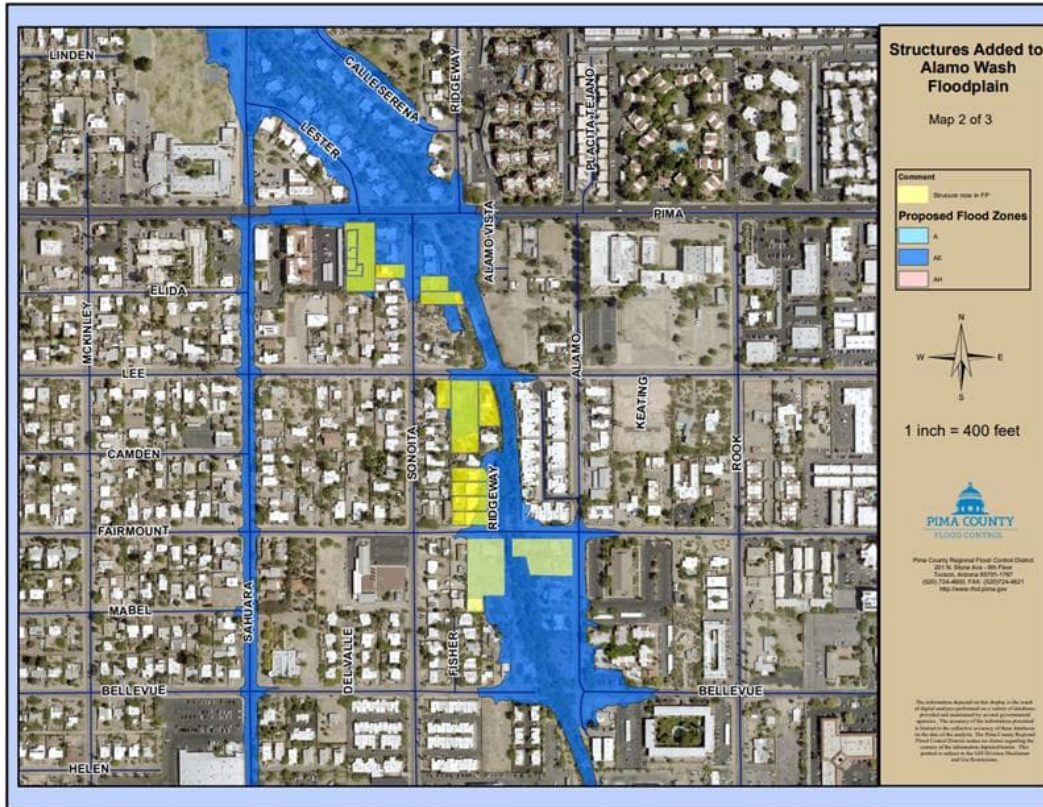


Figure 39: The above maps show proposed changes to SFHA Floodplains which are carefully considered by Floodplain Administrator prior to deciding whether to submit to FEMA for a Letter of Map Revision (LOMR).

8. Updated Erosion Hazard Setback requirements were adopted by Mayor and Council to address increases in development along regional watercourses of the Santa Cruz River, Rillito, and Pantano Wash. Erosion Hazard setback mapping for regional watercourses will be started.



Figure 40: Reduced areas of floodprone property north of Flowing wells Wash

9. Gardner Lane area remapping (see Figure 39). The City of Tucson Mayor and Council adopted the Ruthrauff Basin Management Study on October 24, 2017. Per this multi-jurisdictional basin management plan, the Ruthrauff South/Highway Drive will collect flows along Highway Drive and Wetmore Road and direct the flows to a drainage channel to be constructed parallel to the Union Pacific Railroad (UPRR) tracks. With coordination with Arizona Department of transportation (ADOT) and UPRR a conveyance structure (pipe culverts under the railroad) is intended to provide relief for stormwater runoff towards the Santa Cruz River on the west side of I-10. PCRFC is still working on utility relocations for this project. Kinder Morgan/SFPP is currently relocating their active hydrocarbon pipeline at the westside of the UPRR tracks. Lumen (fiberoptic utility) will be relocating several fiber lines on the east side. There are condemnation of easements and relocations on the property to make room for the culverts. The County anticipates bidding the construction at the end of the fiscal year to begin construction in 2026. Additional map changes may occur after the construction of the relief pipes, however it is not anticipated for some years. The area, both in the City and the unincorporated county, should be seeing the economic benefit for the commercial/ industrial properties that may see additional lessening in flood insurance as well as less flooding conditions near Prince Rd and freeway in Ward 3.
10. Silvercroft Watershed study with remapping. Various segments of the Silvercroft Watershed have inconsistent base flood data and flood limit delineations so a full watershed study with remapping is

being scheduled. The City of Tucson is considering obtaining additional survey data for the Painted Hills Wash to verify adjacent homes have proper freeboard.

11. City's TSMS Watershed Management Area Map was updated and the current watersheds are now designated as either Balanced Basin Management Areas or Critical Basin Management Areas. City Floodplain Administration understands that the non-designated basin management areas have a higher risk of flooding, however engineering review staff continues to review for no adverse impacts including checking changes to flood depth, flow rate and velocity.

Chapter 2 Cont.



Figure 41: Construction of High School Wash stormdrain

CITY OF TUCSON PARTICIPATION: FLOOD & EROSION HAZARD MANAGEMENT PROJECTS

Santa Cruz River Management Plan is a multi-jurisdictional, comprehensive plan for flood risk management, drainage infrastructure protection, water resources, recreation, education opportunities and riparian habitat preservation for the Santa Cruz River. Tucson is participating in the action items (reviewing trash sock proposal) for this adopted plan which was a planning project led by Pima County Regional Flood Control District Manager, Evan Canfield, P.E., PhD., CFM. As part of the project, regional watercourse conveyance was studied and sediment removal was performed by the PCRFCF to improve conveyance, completing the work in July 2020 through much of the Santa Cruz River reach from Cushing Street to Grant Road. Periodic regional watercourse aggradation and degradation studies as well as associated sediment removal will continue to be performed by PCRFCF. Conveyance of flood waters is a crucial aspect of the function of the regional watercourses especially during large storm events. City of Tucson Floodplain Administration recognizes the increasing need for consideration of sediment transport aspects within the City of Tucson watercourses.

The City of Tucson has played a major role in the overall Tucson Arroyo and Arroyo Chico phased improvements. Tucson Drainage Area / Arroyo Chico Multi-Use Project. This is a USACE project, in partnership with the PCRFCF and the City of Tucson.

Phase 1 (Randolph South Detention Basin): Completed April 1996

Phase 2A (Cherry Field Detention Basin): Completed December 2008

Phase 2B (Park Avenue Detention Basins): Completed December 2012

Increment 4 (High School Wash Stormdrain): Complete April 2015

Increment 3 (Upstream Channel Improvements): USACE canceled this phase as the cost-benefit ratio was less than expected

The new LOMR maps reflects the reduced flood hazards as a result of these projects. This is a multi-phase flood control project, and each phase of the project has provided additional benefits to the community and users beyond the direct flood control benefits. The watershed is almost fully developed and contains a mix of residential, commercial and industrial areas.

The downtown drainage infrastructure was originally constructed in the 1920s, 30's and 40's, which includes 1.7 miles of underground culverts. Because of the increased runoff due to urbanization the capacities of the existing drainage infrastructure were inadequate to convey the peak flows caused by intense thunderstorm events, resulting in frequent and severe flooding of residential, commercial and industrial areas along the entire length of the arroyo. Potential flood damages to both private properties and public infrastructure were estimated by the USACE at \$2.7 million (1998 prices) annually.



Figure 42: Broadway Boulevard Project includes installation of sixteen 90-inch diameter underground stormdrains as part of the Broadway Improvement Project from Euclid Ave to Country Club Road including approximately 192 tons of stormdrain pipe installed in one day.

The City provided the land for Phase 1 Randolph South Detention Basin, participated in the design and were the contracting agency for the construction of the Randolph South Basins. The City also donated a significant portion of the land needed for development of the Phase 2B Park Avenue Basins. The City also donated other lands to TUSD, provided improvements Tucson High School, and allowed temporary use of their parks to offset impact to TUSD during construction of Phase 2A Cherry Field basins as part of the IGA. Increment 3 (Upstream Channel Improvements) located east of Kino Boulevard and west of Tucson Boulevard was to be redesigned to provide channel capacity and green infrastructure. This section of the watercourse is W.A.S.H. Ordinance watercourse, so vegetation enhancements at top of banks was to be looked at for green infrastructure. The PCRFCFCD worked with the Army Corps of Engineers and determined this phase of the project to not be required due to clarification of the existing available capacity.

The City Transportation Department & Mobility also installed stormdrain system in the area of Main Avenue at the downstream portion of the Tucson Arroyo. The City has also replaced the Arroyo Chico stormdrain along 8th Street for the “Downtown Links” (DTL) transportation improvements which included higher capacity than design infrastructure improvements. The City constructed (two) ten-foot by 12-foot concrete box culverts and many other upgrades to the stormdrain system on the upstream portion of Tucson Arroyo as part of the DTL road improvements started August 31 2020. After final construction of DTL, PCRFCFCD will perform a LOMR for the area to revise the FEMA floodplain data.

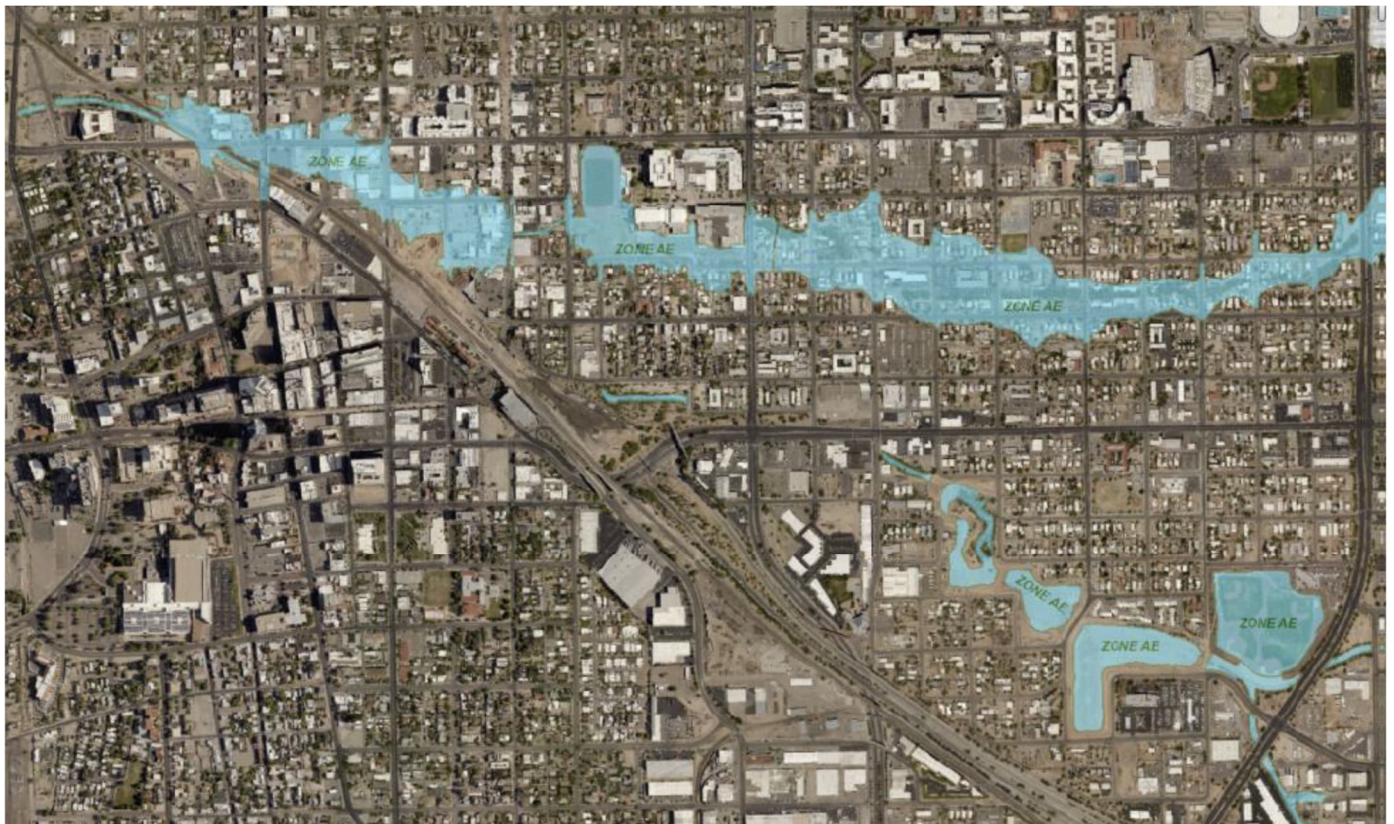


Figure 43: Downstream of the Arroyo Chico drainage improvements is the “Downtown Links” road improvement project (in the upper left of the image above) which was not formally a part of the Tucson Arroyo Chico Letter of Map Revision (LOMR) for the regional basins (lower right in the image above).

PROJECT WEBSITE AND EDUCATION TOOLS

An important component of the FMP process is encouraging community participation in the FMP's development. A project-specific FEMA Web page had been created on Risk MAP Region IX's Website prior to the first 2016 FMP committee meeting. The FMP meeting logistical information was posted at the FEMA Region 9 website for the duration of the 2016 FMP project (see Figure 33). In addition, meeting minutes and other pertinent information were posted to this location. Information regarding all FMP Updates has been also posted to Tucson's project Web page (see Figure 32) <https://www.tucsonaz.gov/Departments/Transportation-Mobility/DTM-Projects-Programs/Floodplain-Administration>

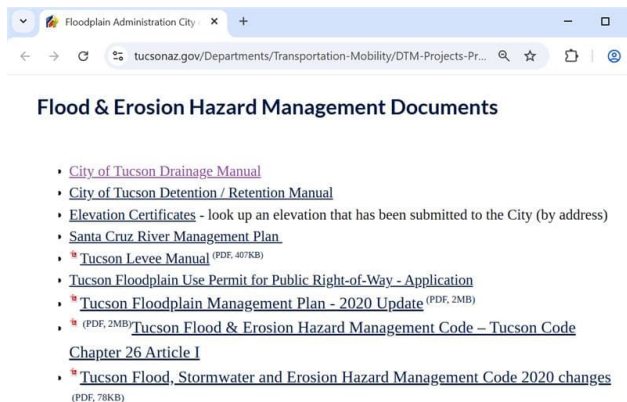


Figure 44: The City of Tucson's FMP information website

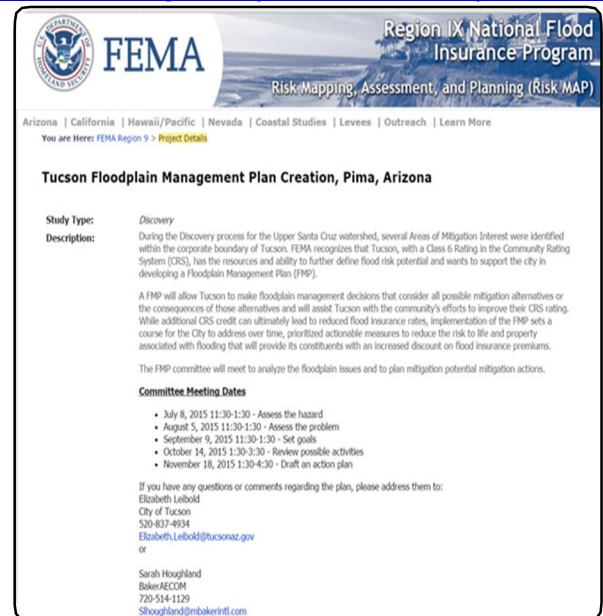


Figure 45: FEMA's 2016 Tucson FMP website

Since the FMP process has only been around for about 10-years, City floodplain administration provided important components of the FMP process in the last section of the FMP reports (see page 62).

As discussed in the 2025 FMP committee meetings, outreach is a top priority for all aspects of Floodplain Management. Website links and Flood and Erosion Hazard Protection information has been made available on the Floodplain Administration websites. In 2025, the FMP Update was advertised in the Territorial Newspaper, emails, City Floodplain Administration webpage, and on social media (Facebook, Instagram, X). The 2025 FMP Update also provided updates on the City websites including posted recordings of some of the public meetings.



Figure 46: Tucson Floodplain Management Open House July 17, 2025

PUBLIC INVOLVEMENT

Planning Process Conducted Through A Planning Committee

In addition to representatives from Tucson's local government, the WG solicited participation in the FMP process from the public and other stakeholders outside of Tucson's local government. As part of the planning process, Tucson residents, as well as individuals from local engineering and planning consulting firms, the PCRFC, the University of Arizona, and the Tucson Association of Realtors lent their time and expertise to the 2025 FMP Update that will guide future flood and erosion hazard mitigation project planning in the city. The 2025 FMP Update committee lists and meeting attendance lists are located in the Appendix of this report.

Public Meetings Held on Draft Plan/Other Public Information to Encourage Input for 2025 FMP Update

On July 17, 2025 City of Tucson hosted an open house / public meeting to discuss the 5-year update to the FMP. Tucson Association of Realtors (TAR) hosted the public meeting at their main office at 2445 North Tucson Blvd. Members of the WG presented the draft FMP to the community with the intent of soliciting review comments to improve the report's content. The open house was setup with Staff stationed at 7 tables with displays and other materials on computers, display boards, flyers/handouts, maps, exhibits, comment cards, for the following:

1. Sign-in sheet and raffle prize sign-up.
2. 2025 FMP Draft, Goal, Tucson Hazards information and prioritization, and Action Items.
3. Summary of the 7 workshops. Comment card box in which to collect completed comment cards.
4. Flood maps and flood status, drainage issues, repetitive loss areas, and floodproofing for constituents.
5. Operation Splash locations/information, Streets staff showed photos of completed drainage system maintenance, and logging drainage system concerns from constituents.
6. Floodplain Ordinance, timeline (when Ordinance began, process – stakeholder meetings, next steps). Comment card box in which to collect completed comment cards.
7. Public Input on creative ideas for flood or erosion safety slogans.

In addition to the FMP plan, the City took the opportunity to explain the NFIP CRS system benefits at tables 2 and 6 to Tucson's constituents. Tucson advertised the Open House in Newsnet and in other social media including Instagram, X and Facebook during the weeks prior to the event and on the Tucson Web site at <https://www.tucsonaz.gov/Departments/Transportation-Mobility/DTM-Projects-Programs/Floodplain-Administration> beginning May 2025. The public meeting notices, agendas, attendee list are included in the Appendix of this report. The public comments and responses were prepared for the public hearing where the 2025 FMP update was considered for approval by Mayor and Council.



NOTICE OF VIRTUAL PUBLIC MEETINGS

NOTICE IS HEREBY GIVEN that City of Tucson will hold two virtual public meetings on **Monday August 17, 2020** from 5:30 PM to 6:30 PM, <https://bit.ly/30aaBi2> +1 213-293-2303 / Conference ID: 222 658 537# There will be a second virtual meeting on **Tuesday August 18, 2020** from Noon to 1:00 PM, <https://bit.ly/39LBWuo> +1 213-293-2303 / Conference ID: 697 255 60#. These virtual public meetings will be held so all interested persons will have opportunity to learn about & comment on the following:

*Draft City of Tucson Floodplain Ordinance Update and
Draft City of Tucson Floodplain Management Plan Update and
Draft City of Tucson Levee Manual*

City of Tucson, a participating community in the National Flood Insurance Program, is proposing revisions to Floodplain & Erosion Hazard Area regulations of Tucson Code, Chapter 26, Article I, to reflect updates as guided by the Federal Emergency Management Agency for community rating system requirements. City of Tucson is also performing periodic update to the 2016 Mayor & Council adopted Floodplain Management Plan, as Phase V.b to the Tucson Stormwater Management Study. A City of Tucson Levee Manual is also being proposed to meet maintenance requirements per Code of Federal Regulations Section 44CFR65.10(d). For more information on these drafts proposed for adoption, see: <https://www.tucsonaz.gov/tdot/floodplain-administration>

For other information or if you have questions about the meetings, please email TucsonFloodErosionInfo@tucsonaz.gov or you may contact Elizabeth Leibold, Civil Engineer, Transportation & Mobility Department, at (520) 429-4905, or Peter McLaughlin, Lead Planner, Planning & Development Services Department, at (520) 837-4898. Spanish captioning will be available during both meetings. Los subtítulos en español estarán disponibles durante la reunión.

Figure 47: Advertising for Public Meeting

Community Rating System FMP Steps

The 2025 FMP planning process was based on hazard mitigation planning steps and is summarized below:

- | | |
|----------|--|
| Phase 1 | Organize to prepare the plan. <ul style="list-style-type: none">a) Involvement of Office Responsible for Community Planning.b) Planning committee of department staffc) Process formally created by the community's governing board. |
| Phase 2 | Involve the public <ul style="list-style-type: none">a) Planning process conducted through a planning committee.b) Public meetings held at the beginning of the planning process.c) Public meeting held on draft plan.d) Other public information activities to encourage input. |
| Phase 3 | Coordinate with other agencies. <ul style="list-style-type: none">a) Review of existing studies and plans (REQUIRED).b) Coordinating with communities and other agencies. |
| Phase 4 | Assess the FMP Hazard. <ul style="list-style-type: none">a) Plan includes an assessment of the FMP Hazard (REQUIRED).b) Plan includes assessment of less frequent floods.c) Plan includes assessment of areas likely to flood.d) The plan describes other natural hazards (REQUIRED). |
| Phase 5 | Assess the FMP Problem. <ul style="list-style-type: none">a) Summary of each FMP Hazard and their impact on the community (REQUIRED).b) Description of the impact of the FMP Hazards.c) Review of all damaged buildings/flood insurance claims.d) Areas that provide natural floodplain functions.e) Development/redevelopment/population trends.f) Impact of future flooding conditions outlined in Step 4, item C. |
| Phase 6 | Set goals. |
| Phase 7 | Review possible FMP Activities. <ul style="list-style-type: none">a) Preventive FMP Activities.b) Floodplain Management Regulatory/current & future conditions.c) Property protection FMP Activities.d) Natural resource protection FMP Activities.e) Emergency services FMP Activities.f) Structural projects.g) Public information FMP Activities. |
| Phase 8 | Draft an action plan. <ul style="list-style-type: none">a) FMP Actions must be prioritized (REQUIRED).b) Post-disaster mitigation policies and procedures.c) FMP Action items for mitigation of other hazards. |
| Phase 9 | Adopt the plan. |
| Phase 10 | Implement, evaluate, and revise. <ul style="list-style-type: none">a) Procedures to monitor and recommend revisions shall be determined the prior year and the annual FMP meeting Formal Updates shall occur at minimum every 5 years.b) Same planning committee/successor committee that qualifies under Section 511.a.2 (a) does the evaluation. |

Assessing the Hazard

Past Assessment of the City of Tucson's Erosion and Flood Hazards

To the credit of the diverse participants of the 2016 FMP process, the FMP Hazard brainstorming sessions had included a wide array of hazards Tucson faces. FMP Hazards were identified by participants based on experiences and known issues caused by the hazard and via technical data gathered as part of the FEMA Discovery Process, Existing Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS), Tucson data studies, PCRFCF data studies. Also, public complaints had been considered to help identify and prioritize the FMP Hazards. The SFHA shown on the FIRMs generally had formed the basis of the assessment, but Tucson and the PCRFCF flood studies, not yet included on the FIRM's and FIS, had also been considered. In addition, the repetitive loss properties in the city had also been evaluated. As the 2016 committee progressed through the brainstorming sessions, they also had considered areas not mapped on the FIRM that experience flooding, either due to riverine or localized flooding issues.

It is important to note that while TSMS had been generally organized on a watershed basis, the FMP considers Tucson as a whole. The FMP committee decided that the FMP should be more broadly based than TSMS. Since the 2016 FMP was the first Risk MAP floodplain management plan for Tucson, the FMP document acts not only as the Phase V of TSMS, but is also intended to currently perform as a higher-level planning document.

The 2016 FMP committee's brainstorming session revealed multiple FMP Hazards, so the FMP WG decided that it would be beneficial to group the FMP Hazards into seven main categories. Not all FMP Hazards listed in the groupings carry the same weight, but for the sake of this report they will all be discussed in terms of the main category subject. In addition, some FMP Hazards are listed in multiple categories.

During the 5-year review of the plan, the 2020 FMP committee was informed that floodplain administration was performing watershed-based floodplain management while continuing to look at Tucson as a whole. This type of floodplain management identifies issues within a watershed and looks at impact to the watershed, and when needed, also looks at watershed boundaries and beyond / upstream or downstream of the watershed to include a wholistic view to the City and the watershed's surrounding areas. Risk MAP looks at the whole City and provides a planning tool for flood and erosion hazard management to help identify risk areas for flood and erosion hazard mitigation projects and assist PCRFCF with flood studies generated on behalf of the City of Tucson.

Other uses for Risk MAP, since the base product was provided in 2016, includes assisting other flood assessment tools including PAG's Watershed Toolkit and the Tucson Water's Green Stormwater Infrastructure tool.

Pima Association of Governments (PAG) created a comprehensive GIS map to help municipalities, non-profits, and neighborhood groups to determine best locations that would benefit from increased access to shade trees, higher property values, enhanced recreation, improved air quality, reduced urban heat island effect, traffic calming, pavement preservation, energy conservation, enhanced stormwater quality, better mobility and livability. The City is continuing to work with Mead Mier at PAG to assist with the toolkit development to add

soil data that assists with determining potential for infiltration, which can help determine areas with detention (low infiltration potential) or retention basins (high infiltration potential) would best be utilized.

Tucson Water's Green Stormwater Infrastructure (GSI) GIS tool is similar to the PAG tool and uses GIS data to help identify areas where GSI can be best located within the City. Since May 1, 2020, a new Green Stormwater Infrastructure fee was included water bills within the City of Tucson generating approximately \$3 million annually to build and maintain GSI projects to capture rain runoff from public streets and parking lots and divert it into vegetated water harvesting areas. This program, championed by Tucson Water Department, provides a funding source for maintaining hundreds of existing GSI features in city neighborhoods, enhancing vegetation and tree canopy on streets, parks and other public areas, providing a rainwater source for irrigation, assist with stormwater quality, provide shade to cool streets, sidewalks, bikeways, and parking areas, and for beautifying the community. Aside from conducting training for maintenance staff and contractors and requiring qualifications to provide appropriate care of GSI features (building on Cooperative Extension/Tucson Water collaboration), the key to successful GSI projects will be in designing sustainable projects with low maintenance needs.

Risk MAP data along with the type of hazard category, associated flood and erosion risk, drainage complaint areas, hydrologic soil type, and infiltration potential all play a part in potential success for sustainable GSI designs as well as conventional flood mitigation projects.

Assessing the City of Tucson's Erosion and Flood Hazards in 2025

The City of Tucson regulates erosion and flood hazards with various Tucson regulations including the Tucson Floodplain Ordinance. Higher standards include:

- Erosion hazard equations for all watercourses other than regional watercourses, are computed at specific locations depending on bend conditions and other parameters. Regional watercourses have an updated table in the Floodplain Ordinance which establishes the mandated setback for straight and curved sections.
- Restricted development in riparian floodplain by only allowing necessary access, utilities and trails within the protected riparian floodplain as determined by Tucson's floodplain, W.A.S.H., ERZ, and ERR requirements.
- Utility development restriction in the flood and erosion hazard areas
- Designated watercourses for extra riparian protection (W.A.S.H. ordinance watercourses are prohibited from using concrete without Mayor and Council approval)
- Higher regulatory flood elevation requirements for critical facilities
- Since 1958, the City Ordinance has required no dumping in city watercourses
- Other higher standards

During the 5-year review of the plan, the 2025 FMP committee, during one of the seven workshops, determined that an additional FMP Problem would be incorporated into the existing FMP Problem lists for some of the FMP Hazard categories. This new FMP Problem, Ember Fire Risk, refers to the danger posed by embers, which are tiny burning particles that can be carried by the wind during wildfires. After wildfires, Constituents are concerned about burned vegetation & charred soil form a water-repellent layer, blocking water absorption for years. During rain events, water bounces off this soil, so even light rain can potentially turn into a flood or mudflow. This new FMP Problem overlaps almost all of the existing FMP Hazard categories. Ember Fire Risk is an urban problem that can create post-fire flood concerns and impact flood related activity topics.

These seven main FMP Hazard categories are listed below along with the risk that were identified. Not all FMP Hazards listed in the groupings carry the same weight, but for the sake of this report they will all be discussed in terms of the main category subject. In addition, some FMP Hazards are listed in multiple categories. The seven main FMP Hazard categories were reviewed by the 2025 FMP Stakeholders for prioritization. Geomorphologic Hazard and Private Drainage Infrastructure Hazard were proposed to be prioritized higher by a small portion of the FMP Stakeholders that were re-prioritizing the hazard ranking. However, the number of proposed changes were not significant enough to change the ranking of the Hazards for this 5-year FMP cycle.

FLOOD AREAS WITH UTILITY/MUNICIPAL STRUCTURES

This hazard statement describes the types of structures that are at risk during the 1-percent-annual-chance flood event, and possibly lower frequency flood events. These structures include the different types of utility and municipal structures that are at risk from flood.

- Buildings with sensitive storage
- Critical facilities
- Dams/reservoirs
- Electrical substation
- Emergency Management buildings
- Existing underground contamination plume areas
- Groundwater contamination
- Land subsidence/sinkholes
- Landfills
- Municipal low-income housing
- Overhead utility lines
- Police/Fire Stations
- Railroads
- Root intrusion
- Sand & Gravel operations
- Sanitary sewer crossing washes
- Underground utility lines
- Undersized drainage structures
- Wastewater/Effluent Discharge
- Wells

GEOMORPHOLOGIC FLOOD HAZARDS

This group of hazards designate the multitude of different geomorphological hazards that result from flooding. Debris flow as defined in this grouping consists of debris on steep terrain, like what is seen in canyon areas.

- Aggradation
- Channel headcutting
- Contamination plumes
- Dam / Levee failure
- Debris flows
- Degradation
- Displacement of conveyance
- Embankment failure
- Erosion zone setbacks
- Groundwater contamination
- Land subsidence
- Lateral erosion
- Mud flows
- Natural earth fissures
- Post-fire soil infiltration
- Sand and gravel operations
- Sediment transport
- Septic tanks
- Uncertain flow paths
- Wells

NATURAL FLOODPLAINS

This hazard grouping involved all potential hazards associated with floodplains.

- Alluvial fans
- Bajadas – not as steep as alluvial fans
- Braided flows
- Buffel grass
- City of Tucson Flood Hazard Areas (COTFHA)
– jurisdictional floodplains
- Critter holes
- Erosion hazard areas
- Environmental Resource Zone (ERZ)
floodplain
- FEMA SFHAs
- Hail
- Homeless encampments
- Invasive species
- Lightning
- Microbursts
- Monsoons
- Post-wildfire areas
- Regional Watercourses
- Riparian habitat issues
- Sedimentation
- Sheet Flows
- Uncertain flow paths
- Vados
- W.A.S.H. Ordinance
watercourses
- Watershed boundaries
- Watersheds
- Wind

PRIVATE DRAINAGE INFRASTRUCTURE

This hazard subset is the most difficult to regulate because the hazards occur on private property.

- Channel headcutting
- Detention
- Diverted flows
- Drywells
- Fencing
- Flood proofing
- Green infrastructure
- Homeless encampments
- Low Impact Development (LID)
- Low flow crossing
- Non-conforming Pre-FIRM buildings
- Ponding
- Retention
- Riparian habitat issues
- Sedimentation
- Speed humps / tables
- Standing water
- Wall openings
- Water harvest areas – techniques should not cause adverse impacts

PUBLIC INFRASTRUCTURE CONVEYANCE

The hazards in this grouping encompass all potential hazards that arise in the public infrastructure domain.

- Access of maintenance
- All weather access
- Bridges
- Channel headcutting
- Culverts
- Dams
- Detention
- Dip crossings
- Drop catch basin
- Grated inlets
- Green infrastructure
- Homeless Encampments
- Junctions
- Levees
- LID
- Lowflow crossing
- Maintenance of Drainage Facilities
- Non-levee embankments
- Ponding
- Railroads
- Regional detention basins
- Regional water courses
- Retention
- Riparian habitat issues
- Sedimentation
- Spillways
- Standing water
- Street drainage
- Undersized drainage systems
- Water harvest areas - techniques should not cause adverse impacts



Figure 48: Maintenance is needed to re-establish flowline.

VEGETATION ASSOCIATED FLOOD HAZARDS

This category highlights potential flood hazards that are a result of vegetation in the floodplain.

- Braided flow
- Buffelgrass
- Debris flows
- Diverted flow
- Ember fire hazards
- ERZ floodplain
- Flow velocities
- Habitat issues
- Illegal dumping
- Invasive species
- Lightning
- Natural washes
- Ponding
- Riparian habitat issues
- Root intrusion
- Standing water
- W.A.S.H Ordinance floodplain



Figure 49: Streets are part of the urban stormdrain system (J. Hayt)

URBAN HIGH-DENSITY FLOOD AREAS

Tucson is primarily an urban setting and differs from the PCRFC urban watercourse. Due to the City's higher population density, encroachment in the floodplain is an issue. As land becomes scarcer, more development begins occurring in the floodplain. Concerns of floodplain preservation, natural floodplain function, and safety result from this encroachment.

- Airport drainage
- Buffel grass
- Channel headcutting
- City of Tucson Flood Hazard Areas- jurisdictional floodplains
- Critical facilities
- Development
- Drug Paraphernalia
- Drywells
- Ember fire hazard
- Encroachment
- Erosion zone setbacks
- FEMA SFHA's
- Flood depth changes
- Floodproofing
- Flow velocity changes
- Green infrastructure
- Homeless encampments
- Illegal dumping
- Invasive species
- Levee walls
- Low Impact Design
- Low-flow crossing
- Manufactured housing
- Non-conforming Pre-FIRM buildings
- Nursing homes
- Pedestrian bridges
- Ponding
- Railroads
- Riparian habitat issues
- Sand bags
- Sediment transport
- Septic tanks
- Standing water
- Street waves
- Urban agricultural areas in the floodplain
- Water harvest areas – techniques should not cause adverse impacts.

Ranking of Hazards

The 2016 committee then had prioritized the FMP Hazards according to group consensus regarding Tucson's overall vulnerability to each FMP Hazard. Results were as follows, where 1 was the FMP Hazard Tucson was most vulnerable to, and 7 was the FMP Hazard to which Tucson was least vulnerable.

2016 Tucson's FMP Hazard Vulnerability assessment:

- 1 Public Infrastructure Conveyance**
- 2 Utility/Municipal Structures**
- 3 Urban High-Density Flood Areas**
- 4 Private Drainage Infrastructure**
- 5 Natural Floodplains**
- 6 Vegetated Associated Flood Hazards**
- 7 Geomorphological Flood Hazards**

In 2020 the categories for FMP Hazard vulnerabilities were reviewed to determine if the prioritization of these vulnerabilities had changed since 2016. From the 2020 FMP Committee exercise, the Public Infrastructure Conveyance category continues to rank as the highest vulnerability.

2020 Tucson's FMP Hazard Vulnerability assessment:

- 1 Public Infrastructure Conveyance**
- 2 Urban High-Density Flood Areas**
- 3 Natural Floodplains**
- 4 Vegetated Associated Flood Hazards**
- 5 Utility/Municipal Structures**
- 6 Private Drainage Infrastructure**
- 7 Geomorphological Flood Hazards**



Figure 50: Santa Cruz River Bike Lane Underpass – flooded

In 2025 the categories for hazard vulnerabilities were reviewed by stakeholders to determine if the prioritization of these vulnerabilities had changed since 2020. From the 2025 FMP Committee exercises, the Public Infrastructure Conveyance category continues to rank as the highest vulnerability. See page 58 for how the Hazard ranking was determined by the 2025 FMP Stakeholders.

2025 Tucson's FMP Hazard Vulnerability assessment

- 1 Public Infrastructure Conveyance**
- 2 Urban High-Density Flood Areas**
- 3 Natural Floodplains**
- 4 Vegetated Associated Flood Hazards**
- 5 Utility/Municipal Structures**
- 6 Private Drainage Infrastructure**
- 7 Geomorphological Flood Hazards**

OTHER HAZARDS IN TUCSON

In addition to flood hazards, as previously stated, Tucson is also vulnerable to a variety of other natural and man-made hazards. A review of the 2022 Pima County Multi-Jurisdiction HMP showed that while Tucson is generally affected by all risk hazard profiles, 2025 FMP 5-year Update Committee determined that the City's FMP addresses more than the high-risk hazards as identified in the Multi-Jurisdictional HMP. The HMP weather related hazards include (in addition to flood):

- Drought
- Extreme Cold
- Extreme Heat
- Landslide
- Severe Wind (Straight Winds)
- Post-Fire Flood

Another risk found in the City stormdrain system is the impact from homeless encampments. Homeless encampments and drug paraphernalia in Tucson's watercourses have increased substantially since 2015 and have posed a safety concern for the homeless persons in the floodprone areas as the persons are vulnerable to flash flooding related drowning, cave-ins where encampments are set near soils subject to floodwaters that have an increase potential to slumping (collapse of slope). Fire Department frequently responds to fires set by



Figure 51: Blackened concrete at location where encampment was removed from box culvert after a fire.

persons within encampments inside box culverts or stormdrain pipes. City Floodplain Administration is assisting the Fire Department responders with training on how to find and use the drainage plans to speed up time to access the stormdrain system to save persons that may be trapped by the fire. Trash, blankets, and furniture from encampments increase potential for blockage, flow diversion, clogging and obstructions during storm events in the watercourses, reducing capacity for floodwaters to remaining in the drainageway, thereby increasing flooding risks to homeless persons and neighboring residents and properties. Ember fires are occurring due to embers from homeless warming fires dropping onto dry vegetation. As human feces increase in the watercourses, potential for spreading of communicable diseases increase, and stormwater quality is impacted as increases in E. Coli are found in more and more City stormwater sampling. Public safety is also an

issue for other recreational users and maintenance staff when drugs or drug paraphernalia is present at or near an encampment. Homeless persons have used children's park area water fountains for washing under garments, and electrical outlets are used to recharge batteries that are used in the camps.

There is an increased financial burden to the City in the form of police assistance to help homeless in the watercourses, assisting the neighboring property owners, and implementing Homeless Protocol which requires notification time for the persons within the homeless encampment. Neighboring commercial properties have seen an increase in revenue with police presence in areas prone to homeless activities. Department of Transportation and Mobility Streets Maintenance and Stormwater Inspection staff as well as and Parks and Recreation staff have experienced increase staff time and costs to perform homeless clean-up, vactoring (vacuuming), and other environmental hazard remediation services.

Staff from many departments are working together to look for ways to help the homeless community as well as reduce the associated floodplain risks to the stormdrain system, the environment, and neighboring properties. Police presence, as mentioned, has had a positive result for Tucson's public drainageways, however repeated time and effort is needed for visits to sites to monitor. Tucson Police Department identified a solution to assist with encampment issues; adding a "No Loitering" sign to the drainageway or culvert can aid officers when asking persons to leave the drainageway. Tucson Police Department also works with maintenance staff to coordinate clean-up efforts, by posting the homeless protocol notices prior to maintenance crew performing clean-up activities. The City of Tucson Housing and Community Development Department staff has assisted with making services available to the homeless. CODAC services appear to be a successful partner and have been assisting in the efforts. Human Access Control (HAC) structures to keep persons from entering box culverts, have pros and cons for implementation due to potential to be pinned against the inlet grate during a flood event. Serious concern for drowning can occur with or without a HAC in place. Recreational users, pets, or children playing in a wash could be pinned against the grate and not be able to get out of the floodwaters and drown. Various types of fencing or constructed barriers around drainageways have been found to provide limited success as persons have been seen to use crow bars to open fencing or dig under the barrier. Fencing also can be constrained by floodplain limits; placement of fencing is not permitted to obstruct the floodwaters. If channel contains the jurisdictional floodplain, then fencing may be an alternative. Special drop-inlet catch basin designs can also be used as HAC structures with elevated grates so velocity is reduced and potential for pinning is lessened. These features have been found to be successful in detention types of drainage systems. One experimental Human Access Control structure with a slanted grate, to facility better access out of the channel, was designed and constructed for the City in Ward 3. The City continues to develop proactive coordination tools between departments and with other agencies to address homeless camp trash, excrement (E.coli water quality issue), and debris in the floodplain. See findings from the workshop series on human access controls on page 30.

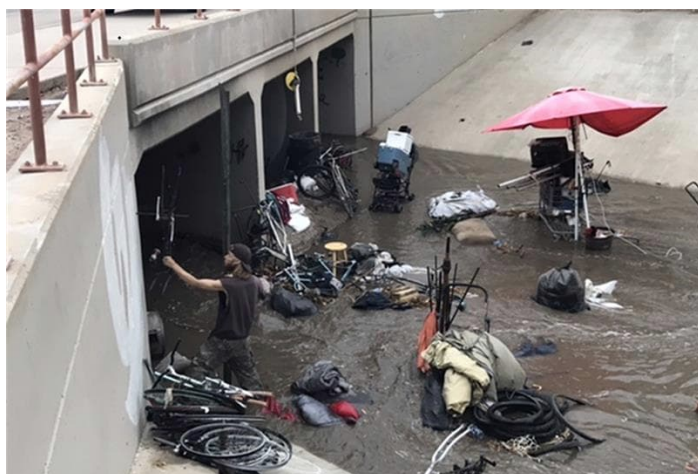


Figure 52: Debris from homeless activities in a mapped regulatory urban floodplain

LESS FREQUENT FLOOD HAZARDS

An investigation of the numerous hazards that were identified showed that, somewhat surprisingly, Tucson is not seriously vulnerable to the hazards listed below:

Alluvial Fans: Despite being located in the desert, where conditions are favorable, there are no known alluvial fans in Tucson. Most of Tucson is located in the valley and not in the foothills or mountains, where alluvial fans most commonly occur. Although there are no formal alluvial fans, there are areas throughout the City that exhibit similar characteristics. Watersheds on the north side of the City of Tucson flow toward the Rillito Creek regional watercourse conveying alluvial sediments from the Catalina foothills. Sediment transport increases as changes to riverbed slope lessens with increasing grade control improvements such as riparian habitat enhancements within the riverbeds of the regional watercourses. Regional Flood Control dredging to remove excess sediment occurred in 2019-2020 for Rillito and Santa Cruz River after capacity analyses identified high risk zones for overtopping.

Dams: In Tucson, there are four locations of dams in the city, with one being located Lakeside, in Kennedy Park, another located in Randolph South, and the Cherry Field / Park Avenue Detention Basins. These dams do not pose a significant danger to the community and are considered reservoirs. In 2025, USACE, PCRFC, City of Tucson Floodplain Management staff, and TUSD facility maintenance staff performed an inspection of the Cherry Field / Park Avenue Detention Basins. During this inspection, TUSD facility maintenance staff stated their interest to city staff in participating in an Emergency Response Exercise for this site (see workshop starting on page 34).

Ember fire: This FMP Hazard is a newly identified FMP Problem and is related to fires generated by embers from other fires. Burned vegetation and charred soil form a water-repellent layer that can block storm runoff absorption for years. During rain events, water bounces off this soil, so even light rain can potentially turn into a flood or mudflow. Vegetation that is damaged from fires increases risk of embankment failure where roots of burnt trees die and thereby reduce embankment stability. In one location, within one of the major City watercourses, slumping has occurred due to homeless encampment ember fire issues, which will cost the City of Tucson almost \$2 million dollars to repair. Fires in box culverts are also causing structural damage to the existing infrastructure due to spalling. When fires heat the reinforced concrete, structural damage sometimes occurs.



Figure 53: Fires in stormdrains cause potential pollutants and damage to infrastructure



Figure 54: Floodwall Levee on the Silvercroft (ERZ) watercourse at termination point (see page 39)

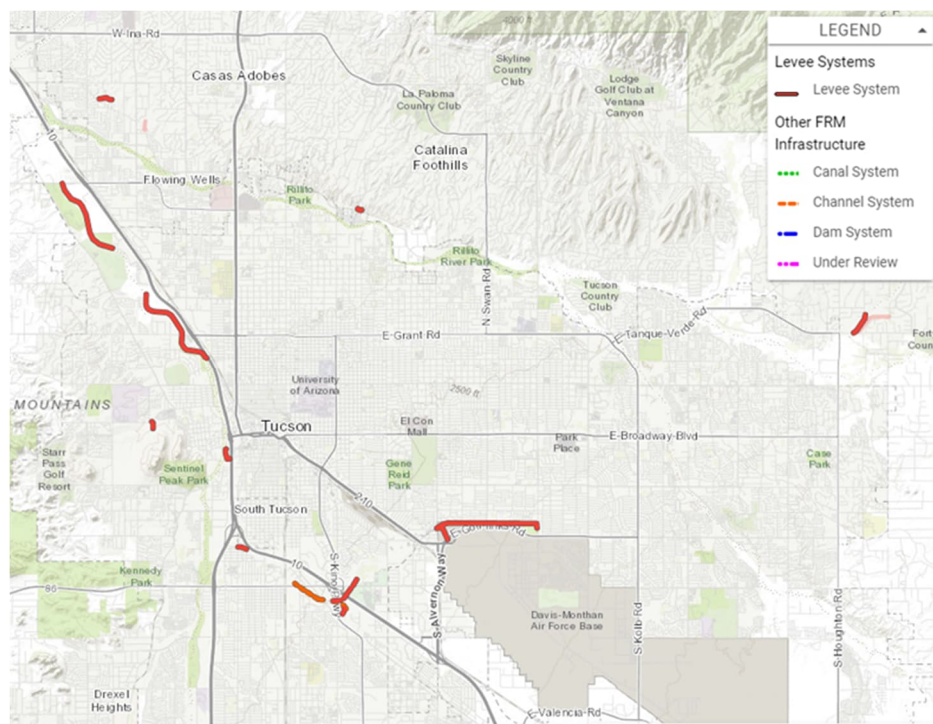


Figure 55: Locations of flood control structures and levees per national database

Levees: Levees also do not present a significant hazard to Tucson due to the small number of levees in the jurisdiction. FEMA accredited levee segments occur along the Santa Cruz River on FIRM panels 04019C1666L, 04019C1667L, 04019C1669L, 04019C1688L, and 04019C2276L for two separate levee segments in northwestern Tucson. An accredited levee also is located in an annexed area on panel at the northeast side of the city along the Agua Caliente watercourse that provides soil cement berm protection for lowering flood risk to a residential community. Levee-like structures are part of the Tucson Diversion Channel system which were designed to intercept flows from the Arroyo Chico, Tucson Arroyo, Julian Wash, and Railroad Wash and divert those flows to the Santa Cruz River. Floodwalls are rarely utilized although exist along the Silvercroft Wash to protect a non-profit hospital, medical offices, and residences for nuns, as well as along the Santa Cruz River southeast of the Cushing Street Bridge. A third floodwall on the north side of River Road in unincorporated Pima County lessens flood risk for downstream commercial and residential structures within the City limits on FIRM Panel 1695 L.

A Tucson levee manual was adopted in December 2020 to provide City of Tucson information on emergency response planning, levee requirements and maintenance checklists. For one of the seven workshops for the 2025 FMP Update, an emergency management exercise scenario was described and that scenario may be used by City of Tucson Emergency Management Staff for an annual exercise to simulate an emergency response to a levee failure. During this 2025 FMP update, it was determined that maintenance records from PCRFCFCD are needed for dams / levees upstream of the City of Tucson limits, to assure that residents and business owners are protected by infrastructure that is regularly maintained. Additional information such as HEC-RAS 2D modeling from PCRFCFCD or a consultant, would benefit the simulation of emergency response scenarios for levee failures.

FUTURE CONDITION CONSIDERATIONS AND THEIR POTENTIAL IMPACT TO FLOODPLAINS

Population: Since the last Census in 2010, the Pima Association of Government (PAG) estimates Tucson's population has grown at a steady, but slow, pace from below 1 percent to 1.13 percent. According to the PAG's 2013-2050 Incorporated Places Population Projects for Pima County and Incorporated Areas, Tucson's population is expected to grow by approximately 1 percent per year through 2050. Since the population growth isn't expected to increase rapidly and is expected to be on a steady projection, Tucson can take this opportunity to get out ahead of future development in areas where the floodplain mapping is outdated or non-existent.

Development/Redevelopment: Since Tucson is largely developed, new development will occur mostly on the outskirts of the City which also correlates to the more rural areas in the city where the SFHAs are likely old or non-existent. Also, redevelopment in Tucson is likely to occur to replace aging infrastructure. Tucson's floodplain ordinance addresses development issues by defining setbacks along watercourses, outlining other subdivision and development project requirements, and outlining detention and retention system constraints.



Figure 56: Erosion Hazards can cause structural issues



Figure 57: Tanque Verde Creek side slope

Like many floodprone properties built prior to flood mapping, roads have also been constructed in floodprone areas. The main issue is funding to build or reconstruct all weather access public routes. Development for properties that do not have all weather access have subdivision restrictions in City codes, so no new subdividing can be approved if access is not already physically provided at the development site.

Erosion hazard setbacks and changing flowline slopes are a serious concern for City floodplain management. Setbacks are becoming a frequent constraint for development, especially along the City's major and regional watercourses. More accurate flowrates have been determined based on the City of Tucson Flood Insurance Study (FIS, effective 2012) and so updated flood and erosion hazard management code is being considered to address increase in setbacks between the top of embankment and the proposed needed development improvements (necessary all weather access, emergency access, utility and building setbacks).

Technological updates also impact future considerations. Survey datums will be changing for both vertical and horizontal datums with the upcoming National Geodetic Survey updates. This will impact upcoming FIRM mapping as current benchmarks are based on NAVD 88 datum. Also, the use of LiDAR and other new technology increases accuracy for floodplain studies and mapping.

As Green Infrastructure is used more, successful design aspects need to be considered. There are concerns regarding removal of the first $\frac{1}{2}$ inch of rain runoff from the watercourses. The first discharge is the primary watering feature for vegetation along all watercourses. Starvation of vegetation impacts critical erosion stabilization as vegetation dies. Stopping flow in retention features also increases potential for sediment impoundment and thus more erosion of the watercourse as "clean water" conditions occur.

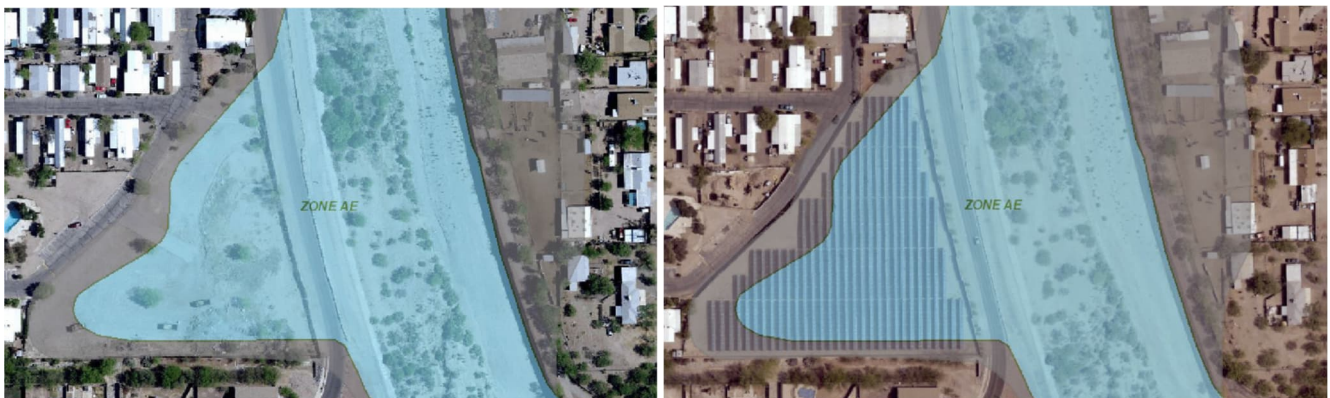
Sustainable approaches include the use of sediment traps for collection of parking lot runoff or locations where trash or debris may occur. In most other locations, new low-flow bypass systems will need to be designed to allow for the smaller storm events to continue through the watershed. Using detention features also helps to provide continuation of some of the rainwater runoff to help feed downstream riparian floodplain and neighbor's citrus trees.

Climate Change: Currently, Plan Tucson is being updated with similar policies from the last Plan Tucson. In 2024, the City adopted the Heat Action Roadmap which coincides with the City's efforts to address heat island effect. Climate change assessment considers if there are noticeable changes to weather patterns and if there are side effects caused by these changes. Plan Tucson policies (Energy & Climate Change Element) may have an impact on Tucson's floodplain management practices by influencing regulations, maintenance practices, and hydrologic and hydraulic analysis methodologies.

Desert-adapted trees help trap pollutants to improve water quality, prevent soil erosion, reduce electricity usage, reduce atmospheric CO₂, reduce heat island effect, and add to community aesthetics and livability. In 2020, Mayor Regina Romero launched Tucson's Million Tree program by 2030 for the City of Tucson as part of our Emergency Declaration for Climate Action with TCB partnership to help meet this initiative.



Figure 58: Sustainable practices create vibrant communities



Figures 59 & 60: Before & after: dual purpose: ineffective flow area floodplain & solar project – reduces community's electrical costs

Assessing the Problem

There are FMP Problems associated with each FMP Hazard. For clarification within this report, FMP Problem will be the terminology used. Seven main FMP Hazards were identified and sub-groups formed based on these FMP Hazards which include:

1. Public Infrastructure Conveyance
2. Utility/Municipal Structures
3. Urban High-Density Flood Areas
4. Private Drainage Infrastructure
5. Natural Floodplains
6. Vegetated Associated Flood Hazards
7. Geomorphological Flood Hazards

For each of the seven main FMP Hazard groupings, the FMP Problems were assessed according to these five criteria, which represent the impact of the FMP Hazards on:

- i. Life, safety, health, procedures for warning and evacuation
- ii. Public health including health hazards due to floodwaters/mold
- iii. Critical facilities and infrastructure
- iv. The community's economy and tax base
- v. Number and type of affected buildings

The 2016 Stakeholders identified the top five FMP Problems caused by each of the seven identified FMP Hazards. In 2020, these FMP Problems were not changed, however in 2025 an additional FMP Problem was identified as ember fire. Ember fire was added as multiple action items within the FMP Hazard categories. Several of the FMP Problem statements were updated to include ember fire for the following 3 FMP Hazard categories: Flood Areas with Utility/Municipal Structures, Urban High-Density Flood Areas, and Vegetated Associated Flood Hazards.

1. Public Infrastructure Conveyance
 - I. Ingress/egress for access and evacuation
 - II. Inundation, etc., from embankment breach
 - III. Swept away hazard at low water, etc.
 - IV. Drowning hazard for ponding
 - V. Loss of utility service
2. Flood Areas with Utility/Municipal Structures
 - I. Emergency response plans are current and active
 - II. Inadequate access to hospitals and emergency resources during a flood event
 - III. Impacts to the cost of developing and attracting new businesses
 - IV. Hazards from contamination, debris, and ember fire
 - V. Loss of tax base due to disruptions

3. Urban High-Density Flood Areas

- I. Erosion
- II. Contamination of stormwater
- III. Standing water/ponding – mobility (car, bike, pedestrian, etc.) and West Nile Virus
- IV. Watercourse maintenance – clogging, debris, vegetation, and ember fire
- V. Unplanned historic growth

4. Private Drainage Infrastructure

- I. Access – ensuring community flow during all issues that may arise with varying problems
- II. Contamination of groundwater and natural facilities near or adjacent to properties. Be able to make proper notification of hazards whether private or public contaminants
- III. Erosion and sediment from basins
- IV. Ponding water in all areas and the hazards that may be produced.
- V. Public/private notifications.
- VI. West Nile Virus/mosquito transference of unhealthy viruses throughout the neighborhoods and surrounding communities.



Figure 61: Christmas W.A.S.H. (Watercourse Amenities Safety and Habitat) watercourse. Flood stage for this watercourse extends over the wash embankments.

5. Natural Floodplains

- I. Access
- II. Utilities
- III. Flood warning program and process
- IV. Pre-1980 structures not compliant
- V. Regulations and enforcement – keep development out of natural floodplains which poses both a challenge and an opportunity for the community

6. Vegetated Associated Flood Hazards

- I. Debris flows – naturally generated vegetation debris that blocks flows, water conveyance, etc.
- II. Invasive species – Buffel Grass and Salt Cedar fire effects and intensity, power poles, utility structures
- III. Riparian habitat – human occupancy and illegal grading within the riparian corridor, ember fire, notification and evacuation of occupants when events occur
- IV. Ponding – mosquito breeding, public use, potential health issues
- V. Riparian habitat – lack of mapping of what vegetation is actually in the floodplain, where are concentrations of invasive species/good native habitats, etc.



Figure 62: As floodwater erode side banks, natural lateral migration of washes occur

7. Geomorphological Flood Hazards

- I. Groundwater contamination – runoff from the auto service industry and airport-related facilities (surface contamination leading to groundwater contamination); landfills and sand and gravel operations
- II. Channel headcutting and erosion – loss of taxable land; economic hardships on the community, property owners; the general public
- III. Subsidence – leads to property damage and economic hardship-condemned facilities and structure collapse; leads to fissures/roads and structure damage; alters flow paths
- IV. Mud flows – road and structure/property damage; infrastructure/facility damage
- V. Wells – impacted groundwater; monitoring wells; flumes

REVIEW OF ALL DAMAGED BUILDINGS/FLOOD INSURANCE CLAIMS (HAZUS)

Hazus, FEMA's loss estimation and hazard modeling software, was used to conduct a flood risk analysis based on the 1-percent-annual chance flood event for structures within Tucson. This enhanced analysis leveraged locally managed inventory, hazard, and terrain data.

Parcel boundaries were used in conjunction with assessor data tables to create building centroids representing structure types and values. A comprehensive 1-percent-annual-chance flood event floodplain was developed by combining FEMA and local data sources, and a flood depth grid was developed using a citywide elevation surface derived from Tucson's LiDAR data. These enhanced data inputs were modeled in two Hazus scenarios in order to estimate damages to structures and aggregated census block data within the city. With the new Risk Rating 2.0, other parameters are used for actuarial data.



Figure 63: Flooding can easily damage city infrastructure

The December 9, 2024 Community Overview Report lists 692 policies in force. The current amount of coverage that the City of Tucson constituents have purchased is \$187 million dollars. There were also 205 paid losses with a cost of \$2,647,975.80. Since 1978, there were 11 substantial damage claims. This information was taken from FEMA's Community Information System (CIS) database. This data indicates that there were lesser policies since the last 2 CAVs. The reduction could be attributed to weakened economy during COVID-19 and the lack of major flooding since 2017 when property owners tend to purchase flood insurance. The City of Tucson Floodplain Administration is researching data regarding the number of non-SFHA policies. In the past, a third of the City of Tucson Flood Insurance Policies were in non-SFHA areas. Another factor to lower policies numbers is the increased cost of flood insurance.

REPETITIVE LOSS PROPERTY

There are only seven properties in Tucson that are considered Repetitive Loss Properties (RLP). RLP properties receive letters from the city to inform the owners of ways to protect against future flood damage. At this time, Tucson has been looking into mitigation actions for the property owners. One property owner had taken steps to hire a civil engineer to prepare a drainage report to look at floodproofing and to physically help protect the home from flooding from Christmas Wash. Two of the properties are located along Bronx Wash, and the other property is located along Navajo Wash. Another RLP address is near the Rillito and the other is on the Alamo Wash overbank floodplain. The City is also researching possible funding for mitigation projects for one or more of these RLP areas from our City contributions to PCRFCF, federal mitigation funding such as a Flood Mitigation Assistance (FMA) Grant, HMGP (Post-Fire) or possible future Stormwater Utility funds. Repetitive Loss Maps have been generated by the city floodplain engineering staff, and due to federal privacy protection laws, are located with the Floodplain Administrator and floodplain management staff. Information for constituents impacted by flood risk in repetitive loss areas was provided at the 2025 public open house.

Setting Goals and Defining Actions

In 2016, working on the Action Plan as an FMP Committee had included prioritizing action items and making recommendations as to which actions were to be included in the report. Time had also been utilized by the group to discuss post-disaster mitigation policies and procedures and action items of mitigation of other hazards. The goals the 2016 FMP committee had identified align with Tucson's overall goals, and they support the FMP committee's vision for how Tucson can address flood hazards in the future.

In the 2020 FMP Update, the FMP Committee kept the 2016 goals with some minor changes – to emphasize the importance of promoting tree canopy and green infrastructure. The goals can be directly correlated to the community's hazard mitigation activity strategies, and a brief discussion of how each goal furthers Tucson's objectives has been included below the goal statement.

In the 2025 FMP Update, the FMP Planning Committee kept the general concept of the 2020 goals to reduce hazards and associated costs and had some minor updates to the overall goal. During the 5-year FMP meetings and 17 FMP workshops, goal statements were handed out to all stakeholders for input. The new 2025 goal wording was updated based on stakeholder input which enhanced and maintained the goal's effectiveness. This goal reflects the City of Tucson's constituents' needs and hydrologic environment.

THE CITY OF TUCSON 2025 FLOODPLAIN MANAGEMENT PLAN GOAL IS TO:

Reduce flood and erosion hazards, damage, and associated costs by continuing to:

- Identify high-risk areas and corresponding agency/department contacts.
- Provide safe, efficient, and balanced conveyance for stormwater runoff.
- Promote tree canopy, maintaining, enhancing and restoring riparian ecosystems and wildlife corridors.
- Increase community awareness of green infrastructure, water harvesting and low impact design methodologies, stormwater quality protection, floodplain preservation measures, and general flood and erosion information.
- Expand incentives for private property owners and developers to implement sustainable flood and erosion hazard mitigation strategies.

1. Identify high-risk areas and corresponding agency / department contacts. While many flooding sources in Tucson have been mapped and officially recognized by FEMA, the city acknowledges that some flooding sources are in need of restudy due to development and other pressures. In addition, determining the locations of the high-risk areas will help inform capital improvement plans, outreach strategies, and emergency management plans in addition to having many other purposes. During the 2025 FMP Update, stakeholders choose to include the need for identifying corresponding agency and department contacts who would respond to these hazards.



Figure 64: Sediment transport is common in the desert

2. Provide safe, efficient, and balanced conveyance for stormwater runoff. Whether this goal is referring to capital improvement projects or to restoring natural watercourses, the intent is for Tucson to address areas where stormwater runoff causes an issue for its residents in the manner described by the goal statement. For Tucson, safety is the ultimate objective.
3. Promote tree canopy, maintaining, enhancing and restoring riparian ecosystems and wildlife corridors. This goal is important to Tucson because the community is proud of and protective of its natural resources. Tucson is a unique desert community, and its natural features make it a desirable place to explore. Promoting tree canopy and enhancing vegetation can reduce heat island effect and other benefits which are sought by floodplain administration and the community. Protecting the natural habitat while balancing the pressures an urban community faces is of the highest importance.
4. Increase community awareness of green infrastructure, water harvesting and low impact design methodologies, stormwater quality protection, floodplain preservation measures, and general flood and erosion information. Enhancing and diversifying community outreach and educational activities will be a primary focus for Tucson. It is important to understand your community prior to formulating an outreach plan. For Tucson, a systematic and targeted approach to disseminate information is likely the best way to deliver the messages regarding the topics listed in the goal statement.
5. Expand incentives for private property owners and developers to implement sustainable flood and erosion hazard mitigation strategies. The intent of this goal is to foster community support for resiliency and awareness of flood hazards. By providing incentives to property owners, Tucson will likely be more successful in achieving its floodplain management objectives.

REVIEWING POSSIBLE FMP ACTIVITIES

All major FMP Problems caused by the FMP Hazards were assessed by reviewing them in consideration to the possible FMP Activities that can be implemented to address the FMP Hazards and further Tucson's FMP goals. The possible FMP Activity topics included:

- i. Preventive activities
- ii. Floodplain management regulatory/current and future conditions
- iii. Property protection activities
- iv. Natural resource protection activities
- v. Emergency services activities
- vi. Structural projects
- vii. Public information activities

The 2016 FMP committee considered all possible FMP Activities as potential mitigation measures, noting which ones were valid and which ones should not be considered. The FMP Problem statements were arranged in matrices according to hazard, and the top five problems were listed so that they could be assessed against their potential mitigation activities in a systematic way. Blanks in the matrices mean that the FMP Activities were considered, but the FMP committee did not deem them applicable. The full spreadsheets are located in the Appendix of this report. As the FMP committees for each 5-year update filled out the matrices, they were asked to highlight the activities the committee recommended most for those problem statements. Although not all activities were selected for inclusion in the 2025 action plan, the city will catalogue all responses for consideration in future updates to the FMP, including this 2025 FMP Update.



Figure 65: Tucson's landscape in bloom

Action Plan

Building on the work completed by reviewing the potential mitigation activities, the 2025 committee then reviewed the activities that were adopted in 2016 and reviewed in 2020. In the 2016 FMP committee meetings, of the activities determined and considered as valid, three to five activities were then recommended that could be implemented for each of the seven major FMP Hazard groups. In the 2025 FMP committee meetings, the top three activities per FMP Hazard were requested to be identified by the stakeholders. Projects in the 2022 Pima County Hazard Mitigation Plan and identified by City Floodplain Administration are also identified in this 2025 FMP Update report.

The following four questions were evaluated for each recommendation and these items must be identified in the Action Plan:

- 1 Who is responsible for implementing the action?
- 2 When it will be completed?
- 3 How it will be funded?
- 4 What goal does the action support?



Figure 66: Sandbagging is an easy and cost-effective technique to battle flooding. DTM provides sandbag pickup stations for the community for each monsoon.

MITIGATION ACTIVITY SUMMARY PRIORITIZATION

In order to meet NFIP CRS requirements for credits, Action Items are identified using Table 6 and the prioritized larger Action Item projects are removed from Table 6 and HMP report to be listed in Table 4. The following flood hazard mitigation projects are either beginning, completed, or ongoing and some were included in the 2022 Pima County HMP:

Table 4. Actions for Flood Hazards to be Mitigated (List to be updated in the PCHMP if not already in the PCHMP)

Mitigation Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Acoustic Fiber Optics (AFO) monitoring and advance warning system – City of Tucson's water utility has developed a nationally recognized disaster-resistant water delivery system. Utility and community will be less susceptible to flooding from broken water mains and loss of water delivery due to natural or manmade disasters. Pipeline management program includes electromagnetic (EM) assessment and AFO monitoring to provide warning so pipeline can be fixed before pipe breaks and causes sinkholes, flooding and erosion.	Flood / Erosion / Subsidence / Sinkholes	\$7.9 million / Operations Budget	Began in 2005 - Completed, Continuous Monitoring	Tucson Water Department / Water Administrator Maintenance & Operations
Ajo Regional Basin – This regional basin is in line with the Tucson Diversion Channel, maintained by PCRFCF. Originally built in 1966, basin was reconstructed during construction of the Tucson Diversion Channel (TDC).	Flood	\$11 million	Completed 2002	USACE, PCRFCF
Alamo Gabion Project – design and construction of gabion infrastructure for erosion protection in W.A.S.H. Ordinance watercourse (riparian floodplain protected watercourse). Includes repetitive loss property protection.	Flood / Erosion / RLP mitigation	DEMA Grant (75% Federally funded, 25% City/PCRFCF funded)	2030	Department of Transportation & Mobility / Director
Alamo Watershed Study - Watershed Study to include proposed solutions to drainage issues. The report was completed in July 2020. The effective date of LOMR was March 15, 2021. Case number: 20-09-2061P	Flood / Erosion / Sediment Transport	\$1 million PCRFCF	Completed 2021	Department of Transportation & Mobility / Director
Arroyo Chico / Cherry Field Regional Basins – This system that includes four basin with interconnecting channel and dam attenuates flow conditions entering residential and downtown areas.	Flood	Total estimated project costs \$74 million	Completed December 2008	USACE, PCRFCF, City of Tucson, TUSD
Backwater Flooding – Significant flooding occurs upstream of the UPRR and ADOT elevated improvements blocking conveyance, ultimately to the Santa Cruz River. City to work with ADOT and UPRR to perform engineering assessment and determine design alternatives to reduce flooding of homes and other structures. Projects to include 18 th Street and Euclid Avenue east of UPRR and other projects.	Flood	Varies / PCRFCF	Ongoing	ADOT / UPRR / City of Tucson
Barrio Viejo - Re-direct the drainage canal at Barrio Viejo.	Flood	\$425,000 Grant Funds, General Fund, PCRFCF	Completed 2016	Department of Transportation & Mobility / Project Administrator

Mitigation on Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Bridge Funding - Identify funding source and construct three bridges (Harrison Bridge at Pantano, First Avenue at Rillito - First Avenue Master Plan, and Sunset Road Bridge system over UPRR and the Rillito) and 50 box culverts with 380 back-up power units for signalized intersections at high flood hazard crossings - in the City of Tucson limits in accordance with the City's Department of Transportation & Mobility 5-year plan. If a bridge or box culvert cannot be constructed, an automated warning device, consisting of a barricade, signs, transducers and flashing lights will be installed or upgraded.	Flood, Severe Wind	\$100 million, Staff Time / Grant Funds, RTA, FWHA and/or ADOT	Ongoing effort with long-term horizon. Schedule dependent upon funding.	Department of Transportation & Mobility City Engineer, Streets Administrator, RTA, ADOT and/or USACE
Broadway Boulevard Corridor (Camino Seco to Houghton) – Also known as SR10 / Broadway East, multi-lane road improvements with drainage infrastructure.	Flood	\$13.5 million, Drainage: \$3 million Funding: Hurf & RTA	Completed in 2020	Department of Transportation & Mobility / Director
Broadway Boulevard Corridor (Euclid to Country Club) – Also known as SR3A / Broadway West, this phase includes six travel lanes and large diameter underground stormdrain system will be installed throughout the project limits.	Flood	Cost just under \$26.5 million, Drainage just over \$8 million Funding: Hurf & RTA	Began January 2020, Completed August 9, 2023	Department of Transportation & Mobility / Director
Christmas Watershed Flood Mitigation Project - feasibility study and subsequent potential construction project with GSI for stormdrain system to reduce SFHA and regional basins to help mitigate flood.	Flood / Erosion	FEMA funded 100% for feasibility study. FEMA/PCRCD (75% / 25%) for final reports, plans and construction	2029	Department of Transportation & Mobility / Director
Christmas Watershed Study – Existing conditions Watershed Study included proposed solutions to drainage issues. This included multiple constituent outreach events and stakeholder meetings. RHENA has been requesting this flood mitigation for over a decade.	Flood / Erosion / Sediment Transport	\$1 million PCRCD City of Tucson Staff Time	Completed July 2022	Department of Transportation & Mobility / Director
CLOMR - In compliance with 44CFR and National Flood Insurance Plan (NFIP), City of Tucson will continue to require the preparation and submittal of a Conditional Letter of Map Revision (CLOMR) or Conditional Letter of Map Revision based on Fill (CLOMR-F) for all proposed development within FEMA-delineated SFHA's. City will also review for approval all updates to SFHA and City Flood hazard Areas. City of Tucson to work with PCRCD to assure the continuance of providing GIS data based federal map repository for the City.	Flood	Staff Time	Annual - Ongoing	Department of Transportation & Mobility and Planning and Development Services Department / Directors
Compliance - City of Tucson will maintain compliance with NFIP regulations by enforcement of current floodplain management ordinance (which already exceeds minimum standards) through review of new development located in the local and FEMA floodplain and erosion hazards, and issuance of floodplain use permits. City to work with PCRCD to set up a policy for newly annexed/future annexed areas within the City of Tucson to extend ERZ and W.A.S.H. Ordinance designations.	Flood / Erosion	Staff Time	Annual - Ongoing	Planning and Development Services Department and Department of Transportation & Mobility / Directors / PCRCD

Mitigation on Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Critical Facility Assessment - Assess the vulnerability of critical facilities to flooding and erosion from stormwater runoff and encourage reducing runoff and means for mitigating critical facilities when runoff cannot be reduced. Outreach to encourage emergency response planning. Look at how to keep information secure.	Flood / Erosion	Staff Time	Annual - Ongoing	Department of Transportation & Mobility and Planning and Development Services Department / Directors
Cushing Street Bridge Levee Extension – Feasibility study and subsequent potential construction project for floodwall levee extension along Santa Cruz River, to include protection to hotel and electric substation (Critical Facility) servicing downtown area.	Flood / Erosion	FEMA Region IX Reallocated Budget, Partnerships with hotel and utility	Grant awarded May 2020, Completed 2024	Department of Transportation & Mobility / Director
Drainage Facility Maintenance - Enhancing enforcement of the City of Tucson's drainage facility maintenance program by using outreach to inform property management / owners of City's requirements to have a Civil Engineer annually inspect their on-site drainage facilities.	Flood / Erosion / Sediment Transport/ Ponding/ Surface Water Quality	\$8,000 / City of Tucson Staff Time and Printing Costs	Annual Ongoing	Department of Transportation Floodplain Administration
Drainage Studies - Bronx, West University, Flowing Wells Watershed Studies and other TSMS drainage studies - watershed studies to include proposed solutions to drainage issues.	Flood / Erosion / Sediment Transport	(underway / in-review / continuing) / PCRFCF, FEMA Region IX funding	Annual - Ongoing	Department of Transportation & Mobility / Director
Drainage Improvements - Tucson to provide PCRFCF with TSMS / FMP priority list of projects where PCRFCF will be utilizing property tax revenues to fund drainage improvements. This includes: Santa Cruz River (Drexel to Valencia East Bank Riverpark), Santa Cruz River (Sunset Road Bank Protection and Riverpark), SCRMP Project (El Corazon within city limits), Pantano Wash (fix head cut extending upstream from a historic sand and gravel pit repair design), Columbus Boulevard downstream from Seneca Street (stormdrain), Silverbell Road (drainage improvements), Pantano Wash and tributary stabilization, and Ruthrauff/Gardner Lane area (drainage improvements).	Flood / Erosion / Sediment Transport	Varies PCRFCF	Varies for each project	Department of Transportation & Mobility Floodplain Administration, PCRFCF
Dip Crossing Flood Mitigation Projects – safety improvements for residential access, including automated lights, signage and gates placed at regulatory floodplain limits, erosion bank protection and/or guard rail. Projects include Camino De La Tierra and other locations.	Erosion	\$750,000 per site / DEMA grant City and/or PCRFCF	2030	Department of Transportation & Mobility Floodplain Administrator
Downtown Links - Roadway and drainage improvements for last phase of the Tucson Arroyo - Arroyo Chico master drainage project. (St Mary's Road stormdrain phase completed already by City of Tucson, and Cherry Field & Park Avenue detention systems completed in 2016.) After as-builts, LOMC will be submitted by PCRFCF.	Flood	\$75 million / RTA, PCRFCF (LOMC)	Began August 2020, Anticipated Completion: Feb 2026	Department of Transportation & Mobility / Director
El Rio Detention Basin – Flood mitigation project along Silvercroft Wash at El Rio City Golf Course, lessening residential flood conditions downstream.	Flood	\$1 million PCRFCF / City of Tucson	Completed 2020	Department of Transportation & Mobility / Director

Mitigation on Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Emergency Erosion Protection - Tucson Arroyo emergency erosion protection / repair. Gabion and retaining wall improvement to repair encampment damage.	Erosion	Estimated \$2 million	Anticipated 2026	Department of Transportation & Mobility / Director
Emergency Response Exercises for Flood / Erosion Hazards - Obtain HEC-RAS 2D modeling for simulating emergency response scenarios for levee / dam failures, and work with City of Tucson Emergency Management Staff and other agencies. Provide Annual Outreach to city property owners located behind levees and dams.	Flood / Erosion	City Staff Time / PCRFC	Estimated Completion 2026 Outreach to commence in 2026	Department of Transportation Floodplain Administration, City Manager's Office / Emergency Management
Erosion Hazard Mitigation Projects – Design and construct improvements to reduce excessive sediment transport, scour and other erosion hazards. Projects include: Audrey Road at Millmar Road, 6 th Avenue and Illinois wingwall installation and sidewalk repair, Bonanza/5 th /Tonner subsidence fill and embankment repair, Rodeo Wash near 16 th Ave and District Street Embankment repair, Osborne ditch south of 22 nd wingwall and erosion protection, Rodeo Wash scour protection at Lundy and Pennsylvania, and Cactus erosion repair at outlet. City to work with DMAFB for Kinnison and Appletree Washes sediment transport reduction project to include temporary and long-term solutions including potential DMAFB detention basin.	Erosion	Cost Varies by Project (~\$10,000-\$2 million per project) / City Staff Time, Tucson Water, and/or HURF Cactus Erosion - \$10,000 / DTM Landscaping	Cactus erosion repair at outlet completed 2025 Others are On-going	Department of Transportation Floodplain Administration and Streets Division
Fire Breaks – City to request that PCRFC updates their open space management plans and manuals to consider location specific vegetation maintenance practices including fire breaks, which will reduce potential for post-fire debris flow into the City limits along the Rillito, Santa Cruz River, Pantano, and Tanque Verde watersheds.	Flood / Erosion	PCRFC	Commencement Date TBD	PCRFC
Flood Insurance Meetings (FIM) – City of Tucson's Annual Flood Insurance Meetings have occurred since 2021 where the City invites the public to hear from the local jurisdictions (Tucson, Oro Valley, Marana, Sahuarita & PCRFC) to promote flood insurance and other general flood and erosion hazard reduction messaging specific to each jurisdiction. City will continue to invite PCRFC.	Flood / Erosion	City Staff Time	Annual - Ongoing	Department of Transportation Floodplain Administration
Floodplain Encroachment Reduction – City to request PCRFC to assist with park construction in lieu of building construction in urban floodplain areas ie. Amphi Neighborhood Stormwater Park.	Flood	Estimated \$80,000 PCRFC	Amphi construction began Spring 2025 Estimated completion in Spring 2028	PCRFC
Gardner Lane Improvements Drainage infrastructure improvements to provide relief for floodprone area east of UPRR railroad/I-10.	Flood	\$18,600 / RTA / HURF	Ongoing-utilities, begin construction in 2026	PCRFC / Department of Transportation & Mobility

Mitigation on Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Gauges – Request PCRCD to install 15 additional ALERT rainfall and stream gauges within the City of Tucson limits. There are currently 24 rain gauges and 23 stream gauges however, there is limited number of gauges in the high-density urban areas of the City of Tucson.	Flood / Erosion	\$375,000 PCRCD	Ongoing – request into PCFCD	PCRCD
1st / Grant Road Detention Basin - Part of Grant Road master project green infrastructure improvements.	Flood	\$650,000 / PCRCD	Completed 2018	Department of Transportation & Mobility / Director
Grant Road Phase 1 and 2 Project - Road improvements with drainage features – box culvert/siphon structures, catch basins, and green infrastructure.	Flood	\$1 million / PAG, HURF	Completed in 2023	Department of Transportation & Mobility / Director
Grant Road Phase 3 and 4 Project - Road project with drainage improvements and green infrastructure features.	Flood	\$56,183,000 RTA	Ongoing – under construction Expected Completion Oct. 2026	Department of Transportation & Mobility / Director
Grant Road Phase 5 and 6 Project - Road project with drainage improvements and green infrastructure features.	Flood	Estimated Construction Cost \$60,100,000 RTA	Ongoing – NTP Construction July 2029	Department of Transportation & Mobility / Director
Houghton Road, Valencia Road to Mary Ann Cleveland Way - Roadway Widening - Drainage improvements with all-weather six lane divided roadway, multi-use lanes, median, multi-use paths, and improving drainage, cross town mobility, reducing congestion and improving safety.	Flood	Drainage Project Total Costs: \$1,717,164 / PC Impact Fees, PC Bonds, PAG HURF, SE District Prior to 2012, & RTA	Completed January 2022	Department of Transportation & Mobility / Director
Human Access Controls – City to continue to access various locations for potential control measures to deter encampment activities in stormdrain system. Grates and other alternative solutions have been identified, and implementation is based on case-by-case conditions within the stormdrain. Projects to include alternative human access controls for Valencia Wash at 12 th Avenue. See also stormdrain grates below.	Swiftwater Drowning / Flood	Varies by Project / City of Tucson	On-going	Department of Transportation & Mobility
Interagency reviews – The City of Tucson regulations already require courtesy reviews to be performed for development and studies/projects where the project is within 1 mile of the City limits for project in unincorporated Pima County.	Flood / Erosion	Staff time	On-going Ordinance dated 1990 (updated 2016)	City of Tucson DTM / PDSD / PCRCD
Manufactured Housing – Due to higher costs and risk for this type of development, City of Tucson is working on an outreach project to assist manufactured housing communities understand their risk and options to floodproof.	Flood	Staff time	On-going	City of Tucson Floodplain Administration and PDSD
Plan Tucson - City of Tucson General & Sustainability Plan (and associated updates) includes broad, sustainability planning focus for Tucson, including goals and policies to reduce hazards.	All	Staff Time	Completed 2025	All departments

Mitigation on Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Ponding Mitigation Projects – including Euclid Avenue and 35 th Street, “Lake Brott”, Country Club Park, Church Avenue between Council and Franklin Streets stormdrain improvements, and other right-of-way projects to improve runoff.	Flood	Proposition 411 Church Ave funding source not identified, \$250,000	Ongoing (Euclid / 35 th : November 2025)	Department of Transportation & Mobility / Deputy Director
Prop 407 - PCRFCF to assist City / provide funding for drainage enhancements for the Proposition 407 projects.	Flood	\$225 million bond package	2028	City of Tucson Parks and Rec, DTM, PCRFCF
Randolph South Regional Detention Basins - As part of Reid Park, the regional basin is comprised of many smaller basins within the golf course and is maintained by the City.	Flood	\$12 million	Completed April 1996	City of Tucson, PCRFCF
Regional Detention Basins - Identify and prioritize other locations for design and construction or transfer of maintenance of large regional detention basin systems for reducing flooding prioritizing vulnerable, disadvantaged and underserved areas to be maintained by PCRFCF. Identify limited areas within the City of Tucson hydrologic soil groups A and B where there might be a potential to construct regional stormwater recharge facilities upgradient of water well fields, and shallow groundwater areas that provide flood control benefits as well as green spaces that can reduce the heat island effect while also providing habitat restoration and enhancement in coordination with partners and owners on stormwater and treated effluent use. Rita Ranch Master Plan Detention System - City to work with PCRFCF on retrofit to enhance recharge in the Pantano watershed.	Flood	City Staff Time PCRFCF	Transfer Completed 2025 (Rita Ranch Detention Basin)	City of Tucson Parks and Rec, DTM, PCRFCF
Regional Watercourse Dredging – Provide outreach to changes in flood levels and erosion hazards for PCRFCF periodic dredging activities that were based on aggradation and degradation analyses and instability for the Santa Cruz River, Pantano, and other regional watercourses. Identify land within half a mile of the Santa Cruz River for potential inclusion in the Urban National Wildlife Refuge, where periodic PCRFCF dredging may occur to maintain flood safety.	Flood	\$1,500 – Outreach (City of Tucson) plus Dredging Costs (PCRFCF)	First Dredging project 2019 Periodic – Ongoing	City of Tucson, PCRFCF
Sewell School Detention System - PCRFCF to continue to assist the City and work with TUSD to design a flood reduction detention system at Sewell School within the Alamo watershed to help reduce flooding issues in the area.	Flood	No estimated cost determined yet PCRFCF	Interagency discussions began 2021	City of Tucson, PCRFCF, TUSD
Silvercroft Watershed – DFIRM mapping correction needed. Also watershed study to determine base flood elevations and flowrates. Subsequent channel improvements to assure all weather access to vulnerable residential properties.	Flood / Erosion	DEMA grant, PCRFCF, plus potential partnership with gas company FEMA DFIRM update	2030	Department of Transportation & Mobility / Director
Stormdrain Grates – Grates can be placed where there is no risk for swiftwater death. No box culvert entrance was identified upstream from Alvernon Wash confluence with Columbus Wash, therefore a grate can be installed at box culvert outlet to deter encampment activity in stormdrain.	Swiftwater drownings	Varies by size (Average ~\$15,000 each) / City of Tucson DTM, ADOT, Pascua Yaqui Tribe, UPRR, USACE and PCRFCF	Ongoing	City of Tucson Floodplain Administration

Mitigation on Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Storm Inspections – improve on the existing programs. Operation Freeze preventing ice on bridges and Operation Splash which already provides signage at dip crossings right before the storm based on NWS warnings, sandbag pickup stations are provided, engineering project managers are assigned to bridges during storm events to watch for various adverse conditions. PCFCD ALERT Flood Threat Recognition and Early Warning Dissemination system provides greater detail than NWS on local rainfall amounts and streamflow stage at specific locations within the City. Additional inspection staff are assigned to the field for NWS flood warnings and ALERT data to assess washes, smaller bridges, and other critical infrastructures within City of Tucson.	Flood / Erosion /Sediment Transport	Staff Time Operation Splash and Operation Freeze – DTM ALERT - PCRFCD	Annual - Ongoing enhancement to existing programs	Department of Transportation & Mobility and Planning and Development Services Department / Directors
Stormwater Quality – Although the City has a separate stormwater management program, TSMS includes both floodplain and stormwater quality management. Replace missing <i>Only Rain in the Drain</i> diskettes on existing scuppers / catch basins and continue to place diskettes on new scuppers / catch basins. City of Tucson is responsible for providing diskettes and other stormwater management activities. Retrofit feasibility study to lower pollutants in the City's stormdrain system was completed in 2025. City is looking at a new feasibility for trash socks in the Tucson Arroyo based on the latest adopted Santa Cruz River Master Plan. The City of Tucson is partnering with the Sonoran Institute, COX Enterprises and PCRFCD. COX Enterprises donated money for the Bandalong Bandit trash traps with shipping and installation support. City of Tucson will provide the land and sampling for feasibility, and the Sonoran Institute is coordinating the project.	Floodplain surface water quality	Estimated \$7,000 / City of Tucson diskettes \$5,000 / City of Tucson feasibility sampling \$120,000 donation / Cox Enterprises TBD Trash Socks Maintenance	Retrofit report completed 2025 Trash Sock feasibility trial to be installed in 2025	City of Tucson: diskettes, land, feasibility sampling and other SW management activities. PCRFCD: Santa Cruz River Master Plan - Trash Sock feasibility project
TSMS Drainage Maintenance Manuals - Update maintenance procedures, administrative directives, and TSMS manuals which already includes vegetation, sediment, and debris for City maintained drainage systems. Original manual was performed in 1998 and periodic updates have been performed, most recently in 2025.	Flood / Erosion	Staff Time	Completed 2025	Department of Transportation & Mobility – Streets and Engineering
Tucson Diversion Channel (TDC) – Intercepts flows from large watercourses and diverts flow to the Santa Cruz River. This concrete channel was authorized by Congress in 1948.	Flood	Varies by phase	Completed 1966 with subsequent additional work	USACE, PCRFCD
Tucson Green Streets Active Practice Guidelines – City shall update the Green Streets Active Practice Guidelines.	Erosion / Ponding	Staff time	Expected Completion 2026	Department of Transportation & Mobility / Director
Valencia Road, Kolb Road to Houghton Road - nearly four-mile project includes widening Valencia Road to a six-lane roadway, drainage improvements, bicycle and pedestrian facilities, traffic signal upgrades and more.	Flood	Drainage Project Total Costs: \$30 million RTA	Construction began November 11, 2024 Expected completion mid-2026	Department of Transportation & Mobility / Director

POST-DISASTER MITIGATION POLICIES AND PROCEDURES

The 2024 City of Tucson Emergency Operation Plan states that the emergency manager is responsible for directing the coordination of recovery activities. Certain recovery activities may commerce concurrently with response operations. Response operations should set the conditions for the transition to recovery once stabilization is reached. Recovery activities are outlined in the ESF-14 Recovery Annex and shall follow guidance from the National Disaster Recovery Framework and the Arizona Disaster Recovery Framework.

The emergency manager will engage the proper departments and staff for recovery operations as well as conduct an After-Action Report (AAR) that summarizes emergency response successes along with recommendations for future improvements. The City of Tucson Floodplain Administration has requested training for post-disaster inspection procedures from the State. City of Tucson Floodplain Administration is working with City of Tucson Building Officials to review current directives for post-disaster response and approach to assessing damage.

The City of Tucson identified 7 NFIP prerequisites for maximizing CRS points:

1. Information regarding Activation of Emergency Operations Center
2. Buildings impacted by Potential Emergency Hazard
3. Critical Facilities Inventory
4. Flood Inundation Maps
5. Flood Warning Response System
6. Annual Exercises
7. FEMA evaluation and approval

The City of Tucson Floodplain Administration is working with City of Tucson Emergency Management Staff to encourage annual emergency response scenario exercises. For 2025 FMP Update workshop TSMS Phase V(b)vi, flood / erosion hazard scenarios were developed and described by stakeholders as potential scenario exercises. See workshop summary for the scenarios on page 36.

ACTION ITEMS FOR MITIGATION OF OTHER HAZARDS

The following mitigation actions and projects summaries were taken from the 2022 Pima County HMP. This project list only contains action items for non-flood hazards. All flood hazard projects have been included in the recommendation matrices listed in a previous section.

Table 5. HMP Action for other Hazards

Mitigation Action/Project	Hazard(s) Mitigated	Estimated Cost/Funding Source	Completion Date	Responsible Agency
Heat Action Road Map for the City of Tucson. Strategies, actions, and code updates are available for community review as of May 2024.	Heat	Estimate not available at this time Partial funding through Grow Tucson Grant (i.e. workforce in green infrastructure) Additional Funding Pending	Ongoing effort with long-term horizon	City Manager's Office
Plan Tucson, the Master Plan for the City of Tucson, outlines goals, policies and development guidelines that address floodplain, stormwater, resilience, natural systems, and hazard mitigation. The current effective Plan Tucson was adopted in 2013, and a draft update is being considered for adoption in November 2025.	Cold, Drought, Fire, Flood, Heat	Estimated \$400,000 ARPA / Framework / City of Tucson General Fund	2013 Draft 2025	City of Tucson PDSD
Pima County Multi-Jurisdiction Hazard Mitigation Plan includes hazards identified from each community within the Pima County area. The City of Tucson participates during each update.	Cold, Drought, Erosion, Fire, Flood, Heat, Terrorism, Tornado, Wind	Staff Time	2022	PCRFC
Tucson Water, a division of the Utility Services Department, will secure its assets and facilities by implementing actions as identified in the Federally mandated Water System Vulnerability Assessment completed in October 2002.	Terrorism, Vandalism	\$20 million Operations Budget	On-going with full completion by 2020	Water Department/Water Engineer & Operations
Work with the Arizona Geological Society and USGS on projects that mitigate geo-hazards (e.g., continue the feasibility study with the AZGS and USGS Water Plan 2000-2050. Construct second recharge facility to be known as the Southern Avra Valley Recharge and Recovery Project (SAVSARP). The utility could then use its entire allotment of Central Arizona Project water and provide capacity for recharging additional water supplies. Construction will take 5 years.	Drought, Subsidence, and other geo-hazards	\$252 million (SAVSARP and CAVSARP combined) Operations Budget	Completed 2008	Water Department/Staff

The Tucson FMP committee came up with one defining Action Plan Goal that aligns with Tucson's overall goals. This goal can be directly correlated to the community's hazard mitigation activity strategies, and a brief discussion of how each goal furthers Tucson's objectives has been included below the goal statement. The City of Tucson goal has already been explained in Chapter 5 but is reiterated in this chapter to help show how the action plan aligns with the goals.

THE CITY OF TUCSON FLOODPLAIN MANAGEMENT PLAN GOAL IS TO;

Reduce flood and erosion hazards, damage, and associated costs by continuing to:

- 1) Identify high-risk areas and corresponding agency / department contacts.
- 2) Provide safe, efficient, and balanced conveyance for stormwater runoff.
- 3) Promote tree canopy, maintaining, enhancing and restoring riparian ecosystems and wildlife corridors.
- 4) Increase community awareness of green infrastructure, water harvesting and low impact design methodologies, stormwater quality protection, floodplain preservation measures, and general flood and erosion information.
- 5) Expand incentives for private property owners, HOAs, NAs, and developers to implement sustainable flood and erosion hazard mitigation strategies.



Figure 67: Houghton Road Improvements on Atterbury Wash Watershed

The following chart (Table 6) looks at these 5 Goals and the Activities identified by the 2025 FMP Committee and provides updated information about the responsible entity for the Activity and schedule and a prioritized list of larger Action Item projects are in tables 4 and 5.

Table 6. Action Plan

Problem Statement	Recommended Activity	Responsible Party	Target Completion Date	Goal Activity Supports				
				1	2	3	4	5
Public Conveyance Infrastructure	Research high-risk dip crossing locations and look into replacing dip crossings with 100-year drainage structures. Areas of interest: 12th Ave at Rodeo Watercourse, Betelgeux at Alamo Wash, Neosha dip crossing, and others. Increase public awareness of dip crossings hazards. Working with Tucson Fire Department, map all-weather access routes. Continue to update infrastructure map to track age and condition.	City Engineer, DTM, Floodplain Managers, Permits Manager. DTM Planning & GIS, mapping in progress.	On-going effort with long- term horizon. Schedule dependent upon funding.	X	X		X	
	Map areas where barricades are used for low water crossing. Assess / expand Operation Splash & Operation Freeze. (DTM Engineer)		2017	X	X		X	
	Provide 100 yr conveyance structures where feasible in urban settings. Prioritize watercourses based on City defined parameters of importance, w/ safe conveyance of floodwaters as top priority. Educate & implement projects that include sediment transport as a natural function. (Consider inlet structure designs that allows flows from frequent storm events to bypass stormdrain so as to continue to feed downstream riparian areas).		On-going effort with long- term horizon. Schedule dependent upon funding.	X	X		X	
	Provide template designs & a case study / demonstration to ease implementation of first flush / sediment traps in an update to the Green Streets Active Practice Guidelines.	DTM Engineering	December 2026		X	X	X	
	Annual Plan and Implement: Educate by learning from each other - crews and engineering staff. City Floodplain Administration Certified Floodplain Management meets with DTM Streets Superintendent every 2 months to update list of drainage infrastructure improvements needed. Encourage consistency between agencies/jurisdiction. Continue to improve procedures for Operations & Maintenance Forces to steward watercourses by removing trash, debris, landscaping clippings from public ROW. Develop Routine Maintenance with a plan for crew / educate crews including in the field during monsoon. Crews receive 3 annual trainings that includes vegetative pruning, riparian floodplain protection, and other stormwater issues. DTM Streets Maintenance tracks costs and records data. Develop city-wide maintenance and operation procedures regarding debris removal; including vegetation clearance protocols; include annual (minimum) workshops to inform staff, contractors and NGOs of protocols to explain and show how to preserve and protect habitat and tree canopy while maintaining conveyance capacity. Develop outreach for TSMS manuals that provide a strategic public conveyance master plan.	DTM, Tucson Water, (TW), Environmental Services, Parks & Rec Operations & Maintenance	Annual - On-going	X			X	
	City of Tucson to update the 2016 geo-database Tucson Risk MAP for all critical facility infrastructure within floodplain and flood prone areas.	PDSO, DTM Engineering, GIS	2030 and update every 5 years	X	X			
Utility Municipal Structures	Meetings on an "Annual" Basis, Educate & Outreach, Open Houses/PSA's/HOA's, Newsletters, Annual Outreach to the Public and share the Emergency Response Plan(s). FIM provides public awareness program that provides regular and routine education outreach; timed seasonally when most needed.	Floodplain Managers, Public Information Office	Annual - On-going			X	X	X
	Assure Utilities are obtaining required permits in floodplain and erosion hazard areas.	DTM Staff	Annual - On-going		X		X	
	Work with USACE, ADOT, UPRR and T'Ohono Odham on projects that reduce human access to drainage systems.	Floodplain Administration	On-going	X	X	X		
	Work with UPRR & ADOT to reduce backwater conditions at existing embankments that are causing urban flooding.	USACE, TW, DTM, Floodplain	2025	X	X			

Action Plan Cont'd

Table 6. Action Plan

Problem Statement	Recommended Activity	Responsible Party	Target Completion Date	Goal Activity Supports				
				1	2	3	4	5
Urban High Density	Using solutions found from 2025 FMP workshop, City will identify locations and apply human access control solutions to lessen clogging or conveyance issues for unhoused blankets and other encampment materials.	DTM Stormwater Management	Annual - On-going	X	X	X	X	X
	- Enhancing analysis of drainage complaint GIS data to improve stormdrain systems by identifying locations along conveyance systems that need retrofits or replacement; routinely monitor at least annually, especially after major flow events. - Assess & address barriers to GI/LID implementation. - Conduct an assessment to review distribution of flood infrastructure efforts for equity of efforts for more vulnerable or low-income communities using the City's new Neighborhood Vulnerability Index or Title Six assessment.	DTM Engineering, TW, PCRFC, TCB, WMG, Sonoran Institute	2025 and monitor on an annual basis	X	X			
	The need to identify and inventory high value riparian areas for protection, stewardship and enhancement, including those that provide quality habitat, tree canopy, intact ecosystems, functional natural drainage systems, and/or recreational opportunities was accomplished by early TSMS studies and culminated in the adoption of City of Tucson's code Chapter 29 Article VIII and Unified Development Code (UDC) Section 5.7 Environmental Resource Zone (ERZ) overlay code.	City Floodplain Management and Consultants	Completed (various dates)		X	X	X	
	Improve procedures for routine maintenance to prevent and remove accumulation of debris; and provide public information on how to prevent clogging and obstruction of stormwater conveyance systems. Provide more outreach for flood status and insurance information to public. Incorporate outreach in various outlets (for example: radio in English, Spanish, T'Ohono Odham; billboards, transit stops/benches; wraps on buses; info/ads in buses/streetcar; K-12 school outreach programs). Continue to implement First Flush Retention, or in-lieu detention, requirement to keep first 0.3 – 0.6 inch of rainfall onsite of new development.	DTM, Tucson Water, Environmental Services (ES)	Annual - On-going	X			X	X
	- Faded signage for ERZ and W.A.S.H. Ordinance watercourses at some crossings will be redesigned and replaced once funding has been determined. - For flood prone streets, DTM is providing flood warning signs when there is a road improvement project.	DTM Engineering, DTM Sign Shop	On-going	X			X	
	Include population migration and annexations in TSMS 5-year updates.	DTM Stormwater	On-going	X	X		X	X
	Continue to update outreach material to owners of flood prone property & send annually. Continue to have outreach recommending flood insurance, how to protect contents, and promote flood response plan including critical facilities.	DTM	Annual - On-going	X	X	X	X	X
Private Drainage Infrastructure	Derive an annual short list from the TSMS prioritization lists including watershed studies which the City's Floodplain Administration will request from PCRFC.	DTM/PDSD	Annual - On-going	X	X	X	X	X
	Derive a map of high incident of access issues for emergency response activities from the OMS map that began in 2022.	DTM/TFD	2022 and monitor on an annual basis	X	X			
	City Floodplain Management staff to continue to work on a guideline to clarify discrepancies in the Pima County Detention / Retention Manual and other City drainage regulations.	DTM/PDSD	December 2025	X	X	X	X	X
	City Floodplain Management staff to continue to work on guidance to help clarify the 17 criteria required for drywell installation. The guidelines shall also clarify requirements regarding limiting use of pumps to truck well enclosures, 4-hour maximum draindown for temporary drain down scenarios.	DTM / PDSD	December 2025	X	X			
	City of Tucson Floodplain Administration will continue to provide Flood Insurance Meetings (FIM) and continue to invite other jurisdictions (State DIFI, PCRFC, and others) to participate in flood safety outreach topics, which educates property owners, HOA's, realtors, insurance agents, landlords, and general public. Utilize case studies to share with other HOA's. Continue to provide training to all staff levels involved in LID/GI related permits. Since codes, ordinances, and standards already exist, discussion with reviewers is valuable to be on same page. Need support & to address concerns at all levels. City to continue to have NHA outreach & property management conference / meetings as opportunities for outreach. Continue to track private basin condition, age and perform inspections regularly. Continue to ask for annual drainage facility maintenance inspection reports from private developments.	PDSD, DTM, ES, & TW	Annual - On-going (FIM since May 2021)		X	X	X	X
	Continue to require proper sediment trap (first flush) basins/utilize water harvesting to minimize sediment from unstable soil. Establish positive drainage during design, construction & maintain through life of facility. Develop guidelines with template designs & case studies / demonstrations to ease implementation of first flush / sediment traps for private development.	PDSD, DTM Project Managers	On-going		X	X	X	
	Continue to map privately maintained drainage infrastructure throughout the City, including age, adequacy and need for maintenance. Continue to compel maintenance of private infrastructure. Continue to prioritize and implement an inspection program for 100% of private basins.	DTM / PDSD	On-going	X	X			
	Continue to request as-builts / record drawings to update stormdrain data on Map Tucson.	DTM Records, PDSD Records	Annual - On-going	X			X	

Table 6. Action Plan

		Goal Activity Supports							
Problem Statement	Recommended Activity	Responsible Party	Target Completion Date	1	2	3	4	5	
Natural Floodplains	City of Tucson will develop and implement habitat management plans along with maintenance guidelines and best practices that include and are complimentary to WASH ordinance requirements, ERZ code (restricting development within the floodplain), the ERR reporting requirements for proposed floodplain disturbance and all other applicable local, state, and federal codes, ordinances or regulations (High Impact). Assess how to ensure field personnel are aware of and adhere to management plans. Setup presentation for groups to go over status.	PDSD, DTM Floodplain Management, Sonoran Institute, TCB, WMG	December 2025		X	X	X	X	
	City of Tucson to work with Tucson Clean and Beautiful, Ward offices, Community Housing and Development Dept. and neighborhood groups to delineate target areas for intense public outreach on managing flood waters and family safety tips during floods and other hazards such as lightning, hail, dust, & erosion, in addition to public education and awareness about community clean-ups, canopy preservation, and homeless protocols. (Maintenance Practices, flood prevention, opportunities, involvement). Update FIM to include these topics.	TCB, Ward Offices, HCD, NA's, DTM, PDSD, TFD, TPD, and Parks and Rec.	Annual - On-going	X	X	X	X	X	
	City of Tucson will develop recommendation for acquisition, relocations or additional flood protective measures for at-risk properties (PCRFCF Flood prone Land Acquisition Program (FLAP), Ward offices, Community Housing and Development Dept. and neighborhood groups Involvement)	DTM Engineering, PCRFCF, Ward offices, HCD, and neighborhood groups	Monitoring on an annual basis	X	X			X	
	City of Tucson Floodplain Administration would work with Tucson Clean and Beautiful, Tucson Water, Arizona Sonora Desert Museum\ Sonoran Desert Weedwackers, and the Sonoran Desert Cooperative Weed Management Area (SD-CWMA) in producing information brochures designed for city elected officials, administrator and additional information for the general public informing of the value of healthy riparian floodplain corridors within the City of Tucson and planned management activities to maintain and enhance riparian corridors for the City resident's quality of life (TCB Involvement). City of Tucson will follow up with TSMS subtask Vbv (M.E.O.W. Workshops 2025) with TCB to further promote outreach on the importance of natural floodplain function.	TCB, Tucson Water, Arizona Sonora Desert Museum, Sonoran Desert Cooperative Weed Management Area (SD-CWMA)	Annual - On-going		X	X	X	X	
	Continue to implement Green Infrastructure (Storm to Shade) Fund to identify & maintain existing LID, & construct new ones.	Tucson Water, DTM Engineering and Landscaping & Stormwater Management	On-going effort since 2021 (pilot program) with adoption in June 2023 Annual - On-going			X	X	X	
	Continue to request for PCRFCF to participate in Multi-jurisdictional Flood Panel for Realtors for flood/erosion info outreach activity.	Realtors, DTM Streets, Golder Ranch Fire District, Stormwater Management	Annual - On-going	X	X	X	X	X	
	Besides through stormwater inspectors, TFD, and TPD, City of Tucson to develop a communication format that doesn't generate trash to be delivered to unhoused encampment warning of dangers of occupancy in the floodplain due to potential flood, erosion, cooking fires, warming fires, and ember fire.	DTM Streets, DTM Engineering TFD, TPD, Stormwater Management	2027 and monitor on an annual basis	X	X	X	X		
	Coordinate with ecologist/biologists ramification of standing water in natural resource areas and implement acceptable sustainable mitigation practices. Mitigation practices developed with ecologists/biologists should be transparent with information available and accessible on-line; providing teaching/outreach opportunity to inform public of practices. Continue to implement Green Infrastructure Fund to identify & maintain existing LID, & construct new ones.	PDSD, DTM Landscaping & Stormwater Management	On-going effort with long- term horizon. Schedule dependent upon funding.	X		X	X	X	

Problem Statement	Recommended Activity	Responsible Party	Target Completion Date	Goal Activity Supports				
				1	2	3	4	5
Vegetated Hazards	City of Tucson, collaborating across city departments will identify and coordinate Integrative Weed Management practices to control invasive vegetation in the washes; and also practice industry-accepted tree pruning protocols; while being cognizant of the Migratory Bird Species Treaty.	DTM Engineering, GIS, ESD, GSD, HCD, TW, Parks and Rec.	In-house Staff December 2025	X	X	X	X	
	City of Tucson will work with the Southern Arizona Buffelgrass Coordination Center (SABCC), Tucson Clean and Beautiful, Arizona Sonora Desert Museum (ASDM) \ Sonoran Desert Weedwhackers (SDW), and the Sonoran Desert Cooperative Weed Management Area (SD-CWMA) to develop (or expand) and recommend incentives for private land owners and developers to implement programs to reduce invasive species within flood prone areas while protecting toboso swale areas - and assist in riparian habitat restoration.	PDSO, DTM Engineering, SABCC, TCB, ASDM, SDW, SD-CWMA	Spring 2026 and monitor on an annual basis		X	X	X	X
	Using the City of Tucson ERZ code, WASH ordinance, ERR standards to develop vegetation management guidelines such as requirements for trimming woody vegetation to 6 feet above ground (for SVT and emergency responders' safety purposes), describe seed mix for herbaceous understory of perennial grasses for soil stabilization and establishing fencing around riparian areas to protect from grading disturbance. Continue staff training regarding pruning / trimming riparian floodplain.	DTM Engineering, DTM Streets	On-going			X		
Geomorphological	Map top of regional watercourse bank areas for locations where erosion hazard review is required. Request PCRFCO continue to provide periodic aggregation degradation assessment of the regional watercourses to identify areas where sediment buildup will be removed by PCRFCO. Enhance outreach for constituents to call 311 or email at TucsonFloodErosionInfo@tucsonaz.gov to report erosion risk or damage to infrastructure like roads and utilities.	DTM Streets, DTM Engineering, PCRFCO	On-going Estimated completion 2026	X	X		X	
	City of Tucson to request PCRFCO to analyze areas of sediment transport issues within the City of Tucson's major watercourses.	Floodplain Administration, PCRFCO	2025	X	X			
	Multi-agency post-fire collaboration to help verify conveyance capacity in watercourses at City and County limits.	DTM Engineering, PCRFCO, PDSO	On-going	X	X		X	
	Update erosion hazard setback regulations for regional watercourses.	PDSO, DTM Engineering, University of Arizona, Floodplain Managers	Completed Adoption on December 8, 2020	X	X		X	
	Provide staff training and create PSAs, public information outreach through utility bills and flood use permits that explain the importance of an erosion hazard setback, subsidence area safety, debris flow, and sediment transport issues.	DTM Engineering, Floodplain Administration	On-going				X	

Plan Adoption and FMP Updates

ADOPTION BY TUCSON CITY COUNCIL

The Action Plan for the Floodplain Management Plan as adopted by City of Tucson Floodplain Board by formal resolution can serve as a floodplain and erosion hazard management reference tool for all City of Tucson departments and divisions.

FMP UPDATES

The FMP committee will continue to convene on a yearly basis to monitor and assess the action plan implementation process. The committee will continue to prepare an evaluation report to submit with Tucson's annual CRS recertification documentation. Per CRS guidelines, the report "must be submitted to the governing body, released to the media, and made available to the public."

In 2030, the Tucson FMP committee will convene for a formal FMP Update to review the 2025 FMP and to recommend updates by December 8, 2030, or five years after the plan was updated in 2025. CRS Cycle Visit by FEMA is scheduled for spring 2026 and spring of 2031. Following this 2025 update, the FMP evaluation and updates are to be scheduled to occur concurrently or before the community's normal 5-year CRS Cycle Visits for the review of the other CRS activities. Although the Pima County Regional HMP was updated in 2022 and is expected to be updated in 2027, this cycle is every five years. The City of Tucson has the next 5-year FEMA CRS Cycle Visit in Spring of 2026, which is strategic since the 5-year FMP Update will occur in fall of 2025. It is beneficial that the FMP and CRS Cycle Visits are synced up so that the project lists in the FMP are adopted prior to the CRS cycle verification. The formal 5-year FMP review cycle tasks should include at a minimum:

1. Convene the same committee that prepared the 2025 plan or one that meets the criteria identified in the CRS manual.
2. Hold a public meeting to review the updated report.
3. Review new studies and information that was completed after the FMP was created.
4. Review the FMP Hazard and FMP Problem assessments and update if necessary.
5. Review goals and update if necessary.
6. Review the action plan and update to account for actions that were completed, ones that are no longer necessary, and to add in new actions.
7. Prepare formal update for adoption by Tucson Mayor and Council.

References

- Tucson Stormwater Management Study Phases I-V (Tucson)
- 1990 Tucson Flood & Erosion Hazard Management Ordinance (Tucson)
- 1991 Watercourse Amenities, Safety and Habitat - W.A.S.H. Ordinance (Tucson)
- 2001 Unified Development Code Environmental Resource Overlay code (Tucson)
- 2003 City of Tucson Habitat Conservation Plan (PCRFCF)
- 2005 Water Harvesting Guidance Manual (Tucson)
- 2008 Tucson Watercourse Maintenance Guidelines (Tucson)
- 2011 Pima County Flood Insurance Study (June 16) (FEMA)
- 2011-2015 Action Plan for Water Sustainability (Tucson)
- 2013 Pima County Community Wildfire Plan (Pima County)
- 2013 Plan Tucson: City of Tucson General and Sustainability Plan (Tucson)
- 2013-2018 Tucson Police Department Strategic Plan (Tucson)
- 2014 Tucson Emergency Operations Plan (Tucson)
- 2016 Tucson Green Streets Active Practice Guidelines (Tucson)
- 2016 Tucson Parks and Recreation 10-year Strategic Plan (Tucson)
- 2017 Community Rating System Manual (FEMA)
- 2017 Pima County Multi-Jurisdictional HMP (PCRFCF)
- 2017 Stormwater Summit (multi-jurisdictional)
- 2017 Stormwater in Pima County: A Blessing & A Curse (PCRFCF)
- 2019 (March 13) Engaging Homeowners Associations on Water Harvesting in Common Areas (Hans Huth)
- 2019 (August 23) Risk MAP Post-Discovery webinar with the City Tucson
- 2019 FEMA Discovery multi-jurisdictional meeting (May) (FEMA)
- 2019 Upper Santa Cruz Watershed Discovery (FEMA)
- ALERT System Map & Rain Gauge Data (PCRFCF)
- Arroyo Chico Phase 3 Channelization Project (Army Corps of Engineers, PCRFCF)
- Census www.factfinder.census.gov
- Center for Western Weather and Water Extremes Scripps Institution of Oceanography cw3e.ucsd.edu
- El Rio Golf Course Detention System Improvements (PCRFCF)
- ERZ and WASH Ordinances Watercourse Analysis: Southeast Region and TSMS Recommendations (Tucson DTM)
- FEMA's Community Information System (CIS)
- FMP Committee Meeting Minutes & CRS 510 FMP Checklist
- Grant Road Phase 2 Green Infrastructure / Detention System Improvements
- Lee Moore Wash Basin Management Study (PCRFCF/Tucson)
- Mission View Wash Drainage Improvements (PCRFCF)
- National Levee Database <https://levees.sec.usace.army.mil/>
- PAG's 2013-2050 Incorporated Places Population Projects for Pima County and Incorporated Areas
- PAG Green Infrastructure Prioritization Tool (PAG)
- Paseo de las Iglesias Phase I: Santa Cruz Bank Protection, Ecosystem Restoration & Linear Parkway, Ajo Wy to Silverlake Rd (PCRFCF)
- Tucson FMP Update Public Meeting Attendee List & Public Comment Summary
- Ruthruaff 2017, Airport Wash South 2014, Alamo 2017, Christmas 2019 Basin Management Plans (PCRFCF)
- Santa Cruz River and Rillito Sediment Removal Projects (PCRFCF)
- Solving Flooding Challenges with Green Stormwater Infrastructure in the Airport Wash Area (PCRFCF, Tucson Ward 1)
- Sustainability Tools for Assessing and Rating Communities/STAR (Tucson Office of Integrated Planning)
- The University of Arizona Epidemiology and Biostatistics Department

Appendices

Appendices

The 2016, 2020 and 2025 City of Tucson Floodplain Management Plan reports can be downloaded at <https://www.tucsonaz.gov/Departments/Transportation-Mobility/DTM-Projects-Programs/Floodplain-Administration>

The appendices to this report include the following:

- a. Flood Risk MAP (see FMP Report 2016, 2020 and 2025, upon request to Floodplain Administration)
- b. Pre-FIRM Buildings Map (This data is part of the Flood Risk MAP)
- c. Step 7 Spreadsheets
- d. Public Meeting Notices
- e. Flood Insurance Meeting (FIM) PowerPoint (see Floodplain Administration website)
- f. 2025 FMP Update Committee Comments and Meeting Agendas/PowerPoints (see Floodplain Administration website)

