Step7.0: REVIEW OF ACTIVITIES

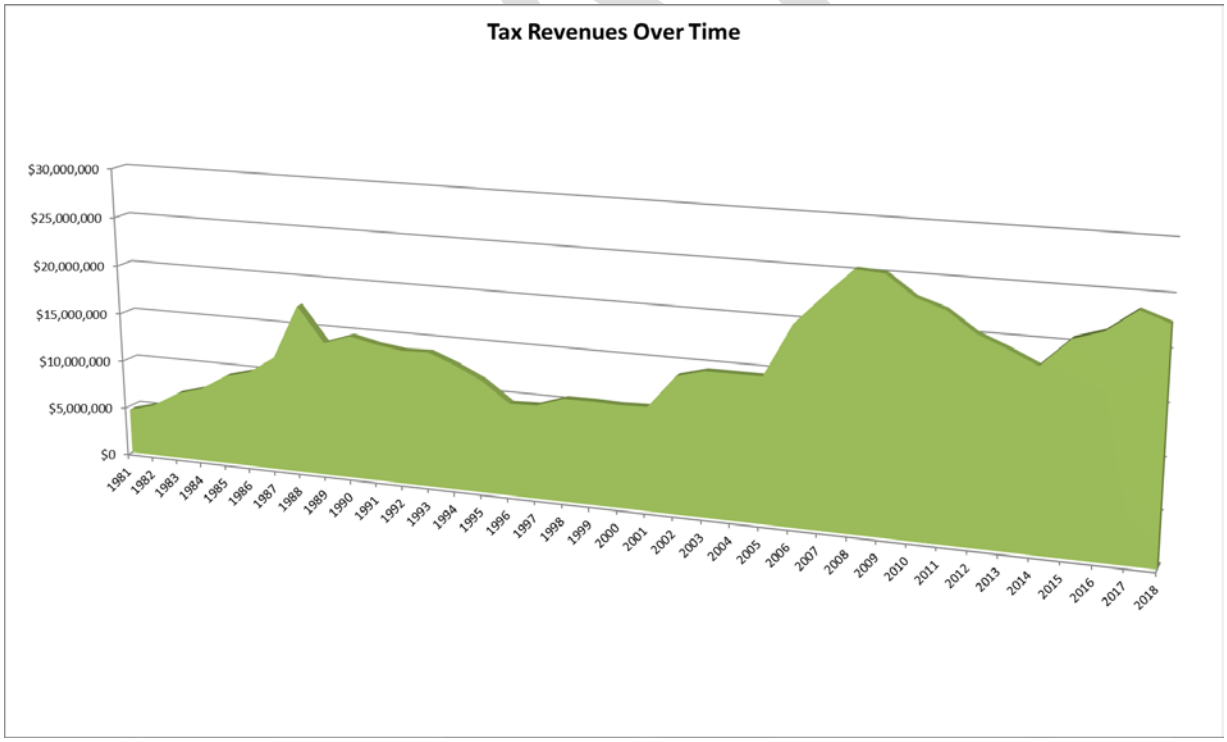
The District utilizes a state authorized property tax levy to fund hazard mitigation activities that include the full range of those recognized by the CRS. The following sections summarize the effectiveness of current District activities and highlights accomplishments during the previous 5-year planning period. While the Manual identifies six "categories" of "activities" to consider for local implementation, the CRS awards points based upon four classes of activities as follows:

- Public Information (300)
- Mapping and Regulation (400)
- Flood Damage Reduction (500)
- Flood Warning and Response (600)

A section devoted to each, describing current District activities and identifying future needs follows. The following financial information shows the scale and distribution of these activities.

The chart below shows District tax levy revenues over time. Additional sources of revenue including bonds and federal funds have been decreasing in significance over the last five years. Typically, the property tax makes up over 95% of revenues.

Figure 259 - Revenues



The table below excerpted from the last Comprehensive Program Report show a parallel shift in expenditures from CIP much of which had been bond funded to operating expenses including maintenance of conveyance channel capacity:

Table 70 - Expenditures

Expenditures	FY 11/12	FY 12/13	FY 13/14	FY 14/15	FY 15/16
Capital Improvements	11,121,058	12,097,821	14,225,843	11,413,161	8,188,139
Operating Budget	10,550,092	11,093,517	11,399,089	14,011,582	14,595,991
Pima Association of Governments	30,266	-	-	73,230	-
PimaCore/Debt Services	-	49,536	42,460	50,068	63,591
Total	**21,701,416**	**23,240,874**	**25,667,392**	**25,548,041**	**22,847,721**

The overview above demonstrates of the level of financial commitment shown by the County. The following section assesses effectiveness.

Urban Drainageways

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7.1 Overview of Current Activities and Survey Results

The District's Capital Improvement Plan continues to be successful in completing projects that benefit public safety, natural floodplain functions and recreation. While the frequency and severity of floods and related weather hazards have increased with climate change, property exposure and damages have not. Increased compliance enforcement and inspection capability have resulted in better maintenance of both public and private drainage improvements and preservation of natural flow corridors where appropriate.

The combination of significant acquisition programs and active watershed restoration via Green Infrastructure/Low Impact Development methods and water harvesting, along with robust regulatory frameworks, has made the County a regional and national leader under the National Flood Insurance Program. During the program period, District staff facilitated development of a Program for Public Information in consultation with stakeholders. Because of these programs, FEMA has recognized the success of this program and as a result, significantly lower flood insurance rates are available in unincorporated Pima County. Continual improvements undertaken with community and Board support have positioned the District to achieve even greater success and discounts within the next 5 years.

Preserving open space for the safe conveyance of floods has long been a high priority for the District. The District continues to find new ways to maximize the available land acquisition funding to achieve the greatest results. One aspect of this is the protection of riparian habitat, which is an essential part of managing watersheds and watercourses. Vegetation along stream banks and in the overbank serves to slow the flow of floodwaters, encourages the infiltration of floodwaters, indirectly remediates contaminants and stabilizes soil against erosion. The District continues to provide protection of the natural riparian habitat through land use regulations in the Ordinance, acquisition of floodprone land to preserve riparian habitat, and the management of water resources to maintain the environment necessary for healthy riparian vegetation.

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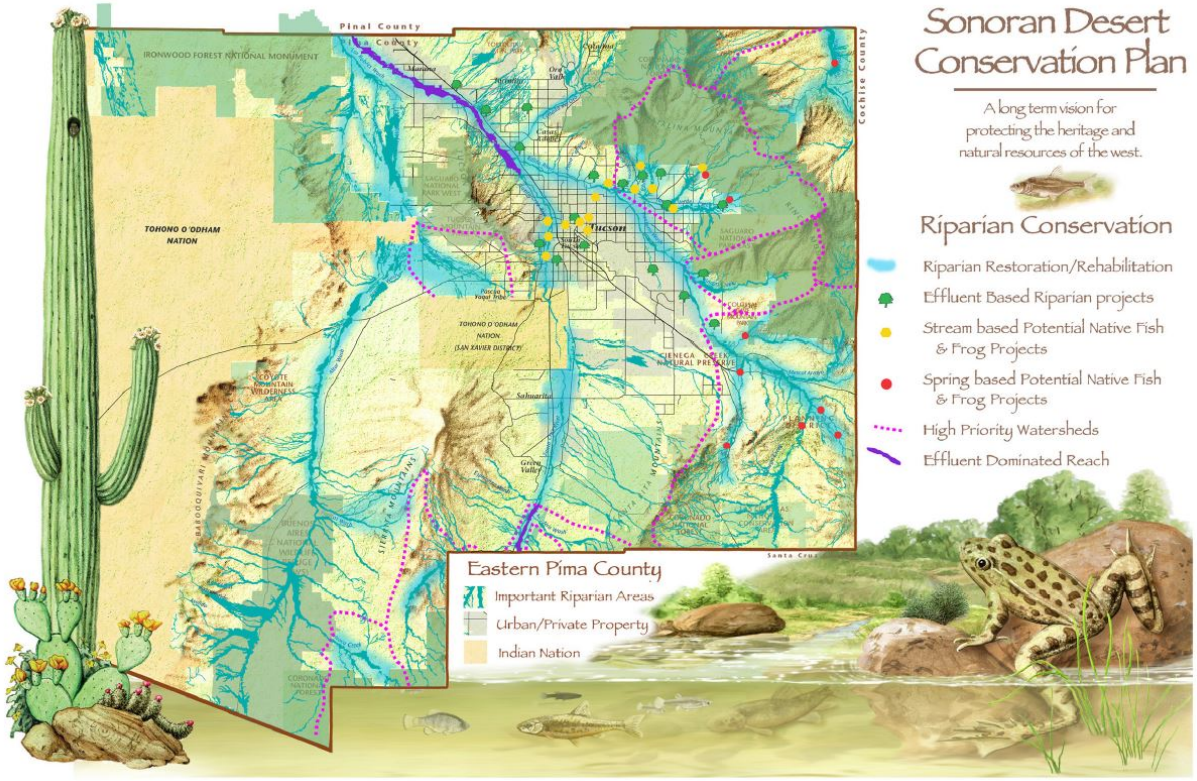
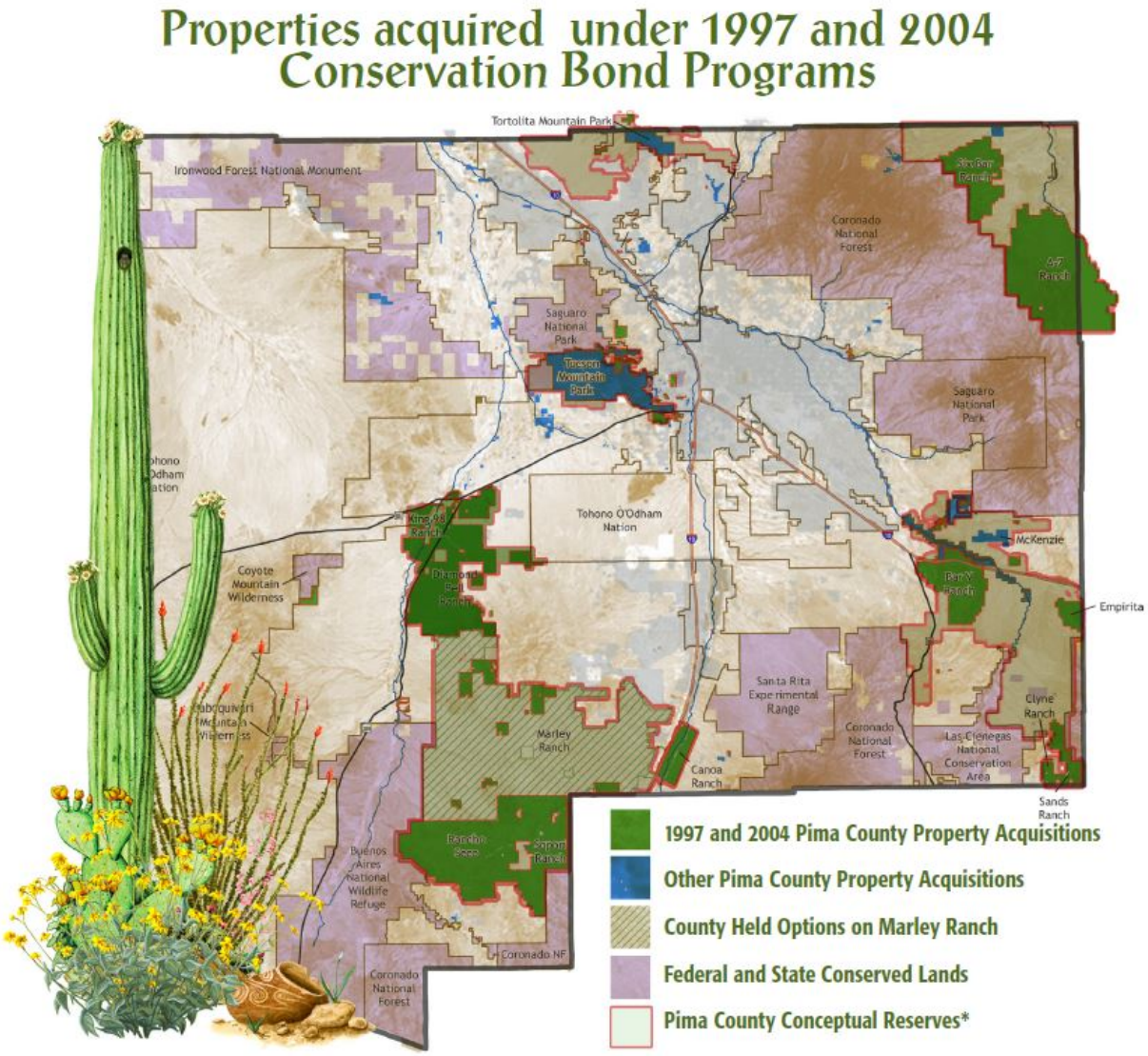
Figure 260 - Sonoran Desert Conservation Plan Riparian Conservation Map



Since the adoption of the SDCP and the Conservation Land System, the District has participated in mapping important riparian areas along the major watercourses and other streams for protection. The District has assisted in the development of updated riparian mapping of Pima County's resources and has revised the Ordinance to align it with the land use plan of the SDCP and the updated and more detailed mapping of riparian habitat in Pima County. In concert with the SDCP, the District will continue technical studies and evaluations of habitat and water resources for the preservation and protection of riparian habitat in Pima County.

As part of the Sonoran Desert Conservation Plan, the District acquires and manages land to preserve the natural and beneficial functions of floodplains and to reduce exposure to flood risk. Since 1984, the District has been active in acquiring floodprone land in upper watershed areas such as Cienega Creek and the Santa Cruz River at Canoa Ranch as a means of preserving the natural floodplain functions. This program also provides a cost effective means of removing residents from floodprone areas where structural flood control options are not practical. The program also protect riparian areas. Chapter 5 describes lands acquired and enhanced during the last 5 years. District Annual Reports include expenditures for these activities. This program is partly responsible for our success in protecting floodplain open spaces and our high score under the Community Rating System. The SDCP map in Figure 28 provides a general depiction of acquisition strategy along with FLAP parcels in blue.

Figure 261 - Open Space Acquisition



** These are conceptual reserves and in no way affect any Federally, State or privately owned land within each reserve. Lands within reserves have been identified within the Conservation Lands System since 2001.*

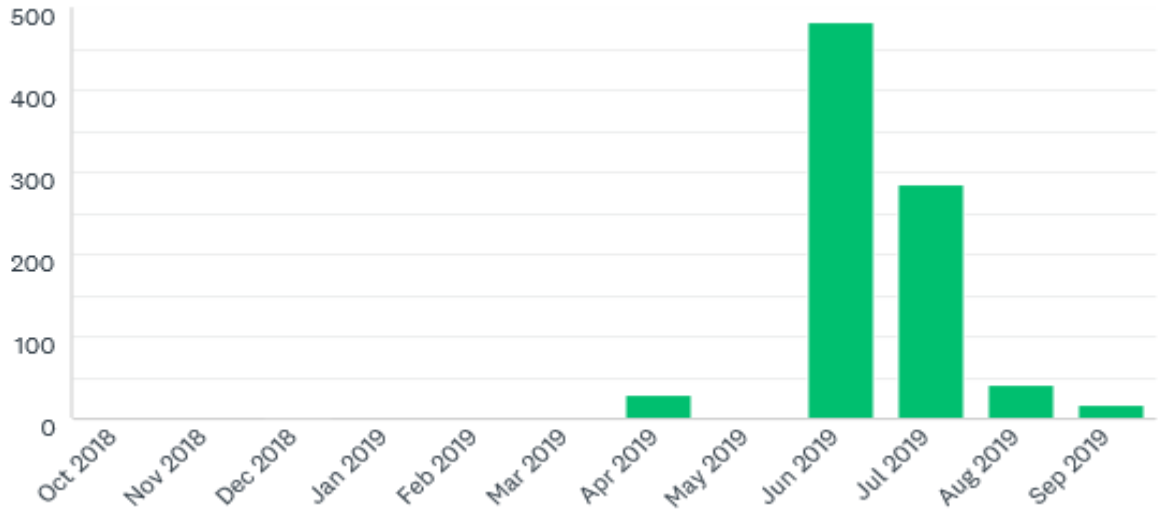
Preventative activities such as mapping and regulation are those, most residents are familiar along with per the survey results. In addition, acquisition and management for recreation and habitat amenity were the most popular amongst respondents. Never the less the greatest expense has been flood erosion control improvements including channelization, bank protection, grade control, and regional detention basins. While bond funds have decreased, the need for major additional improvements has also since the flood of 1983 demonstrated the need. The floods of 2006 demonstrated the effectiveness of this strategy as damages to critical infrastructure and residences were relatively minor, if non-existent. Still this period of acquisition and CIP has left the District with a significant of land management responsibility. So much so, that staffing and budgeting has shifted to

open space and infrastructure management. An emphasis has been on maintaining channel conveyance capacity, including management of sediment and vegetation.

In order to evaluate the public's familiarity with flood control activities and services, the District mailed a promotional brochure with link to the survey to all regulatory floodplain residents in Pima County just prior to Monsoon season. The project webpage and other outreach used in informational meetings throughout the project also contained this link. District staff also distributed paper copies at each meeting and event reported in section 2.2.

The chart below shows the number and distribution of responses over time. The number in April is the test period. The mailing occurred in May.

Figure 262 - Survey Responses



A blank sample of the paper version of the survey is below. Responses received on paper, largely during the test phase although also at events throughout the project timeframe are separate from those completed in the Survey Monkey on-line version for tracking purposes, and because the test audience was more familiar with flood control activities than the public at large. The complete set of results as of October 3, 2019, with the exception of comments, are shown on the below charts below following the sample.

PIMA COUNTY
FLOOD CONTROL

Community Survey

Also available on the Floodplain Management Plan webpage noted below or at:
https://www.surveymonkey.com/r/PCFC_survey

The purpose of this survey is that the Regional Flood Control District (District) wants to understand your level of flood awareness, your concerns and preferred solutions. This information will be used to develop a Floodplain Management Plan for Pima County. Please select all that apply to you from the answers below. If you have a concern regarding a specific location please describe it in the comment box below.

1. What floodplain issues are important to you?

a) Knowing where flood risk exists.
b) Reducing flood risk.
c) Preserving and enhancing riparian habitat.
d) Opportunities for recreation.
e) Protecting water supply and groundwater recharge.

2. What flood risk information sources do you use?

a) County GIS and Websites
b) County Department of Transportation Hotline
c) County Road Closure Email Service
d) County Department of Transportation Road Closure Webpage and Map
e) District Information Counter
f) District GIS or Flood Hazard Map
g) FEMA Webpages
h) Friends & Neighbors
i) Realtors & Insurance Agents

3. What sources of flood warning information have you used?

a) District ALERT Webpage and/or Mobile App
b) National Weather Service (radio and television)
c) MyAlerts.pima.gov
d) Weather Websites
e) Cell Phone Alert

4. What flooding situations have you experienced?

a) I have experienced flooding while driving.
b) I have altered my route due to street flooding.
c) I have driven through flooded washes to get to my destination.
d) My home has flooded.
e) One or more buildings on my property have flooded.
f) My property has flooded (but no buildings).
g) A wash on my property has flowed.
h) My property has experienced erosion due to flooding.

5. Do you have flood insurance?

a) Yes, my mortgage requires building coverage.
b) Yes, I like to be safe.
c) Yes, I have contents coverage.
d) No, I don't have a mortgage that requires it.
e) No, it never floods here.
f) No, I rent and didn't know that contents coverage was available.
g) I don't know.

For More Information
www.pima.gov/fmp/ * greg.saxe@pima.gov * 520-724-4633
201 N. Stone Avenue, 9th Floor, Tucson Arizona 85701

6. Have you taken steps to reduce the impacts of flooding on your property and/or prepared for flooding?

a) Yes, I have taken steps to reduce damages to my property.
b) Yes, I know what to do during a flood.
c) No, it doesn't concern me.
d) No, I rent.
e) No, I don't have the money.
f) No, I didn't know what to do.

7. What steps have been taken in your area or neighborhood to reduce flood risk?

a) Constructed Improvements (channels, culverts, crossings, and erosion control)
b) Education (HOA meetings, handouts, public events)
c) Habitat and Open Space Preservation
d) Installation of Water Harvesting or Other Green Infrastructure.
e) Preventative Maintenance (brush and debris removal)

8. Please check all of the following District activities in which you have participated:

a) Resolving Complaints
b) Getting Technical Assistance
c) Education & Outreach (Including attending project meetings and workshops.)
d) Using Flood Maps & Studies, or Obtaining Elevation Certificates
e) Using Flood Warning Systems
f) Implementing Habitat Management, Water Harvesting and Green Infrastructure
g) Implementing Infrastructure Improvements
h) Visiting Multi-Use Recreation Sites
i) Obtaining Permit

9. Do you support public funding of flood control improvements?

a) Yes
b) No

10. Maintaining floodprone areas in their natural state is a beneficial and cost effective way of managing flood risks. Do you support preserving floodplains in their natural condition?

a) Yes
b) No

11. Would you be interested in participating further in the Floodplain Management Plan process? <u>If yes, please provide contact Email below!</u>

a) Yes, to receive meeting announcements and project update emails.
b) Yes, to complete a more detailed survey about flood hazard awareness and management preferences.
c) Yes, to provide information or management preferences regarding a specific location, or locations.
d) No

Comments:

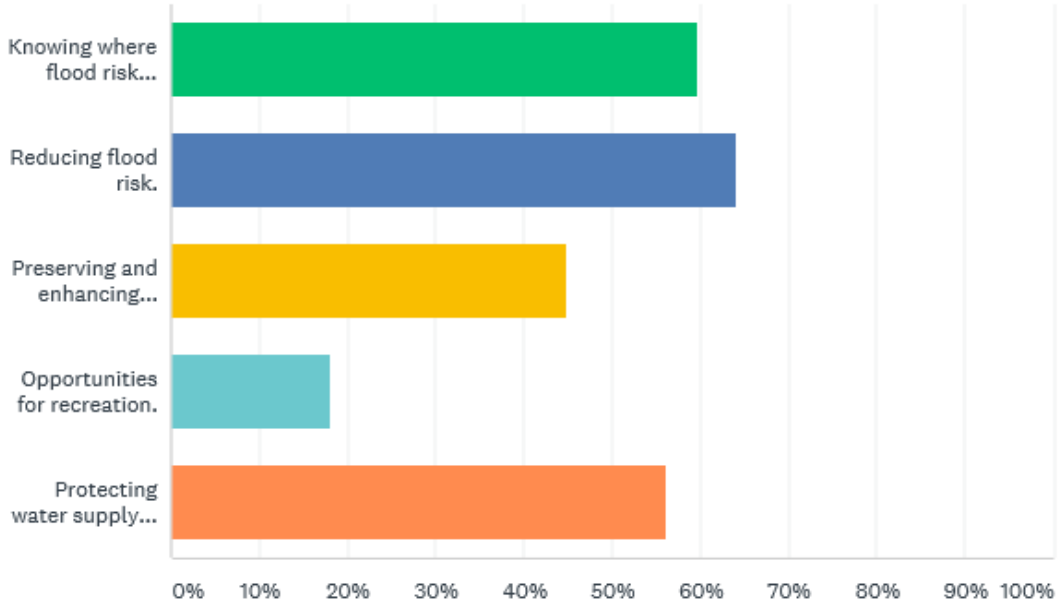
Contact Email:

For More Information
www.pima.gov/fmp/ • greg.saxe@pima.gov • 520-724-4633
201 N. Stone Avenue, 9th Floor, Tucson Arizona 85701

Figure 263 - Sample Survey (Paper Version)

What floodplain issues are important to you?

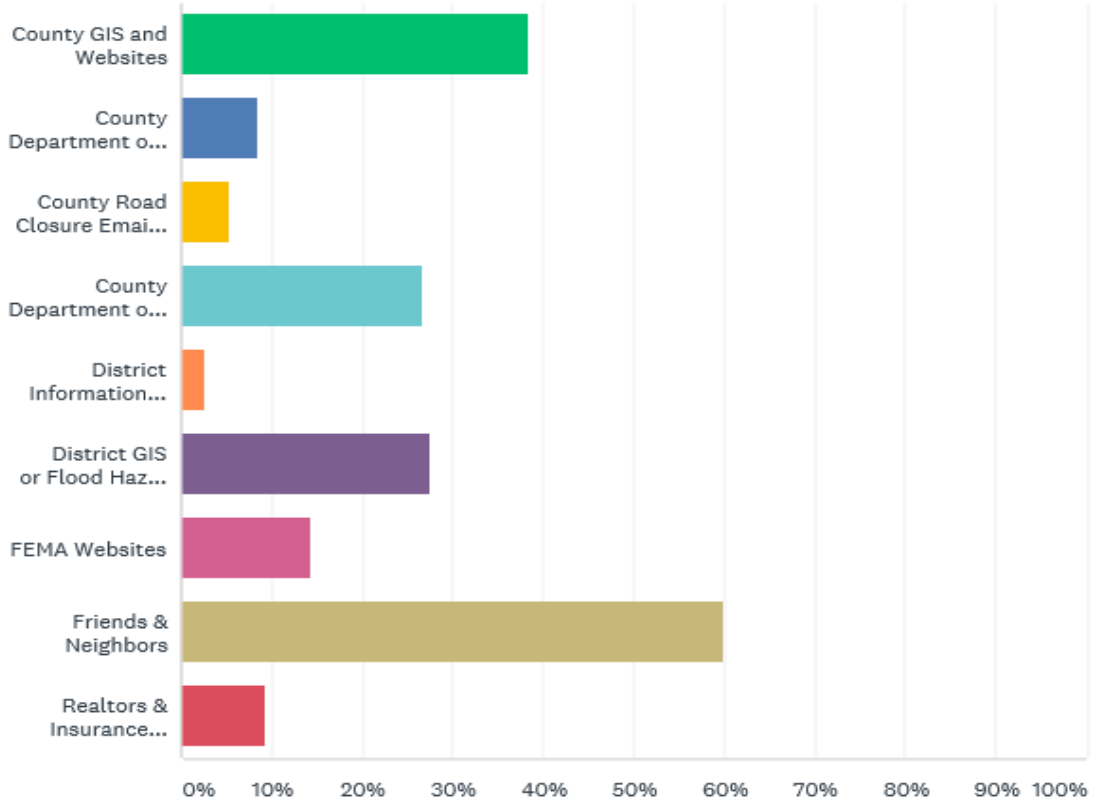
Answered: 855 Skipped: 4



ANSWER CHOICES	RESPONSES	
Knowing where flood risk exists.	59.53%	509
Reducing flood risk.	64.09%	548
Preserving and enhancing riparian habitat.	44.80%	383
Opportunities for recreation.	18.01%	154
Protecting water supply and groundwater recharge.	56.02%	479
Total Respondents: 855		

What flood risk information sources do you use?

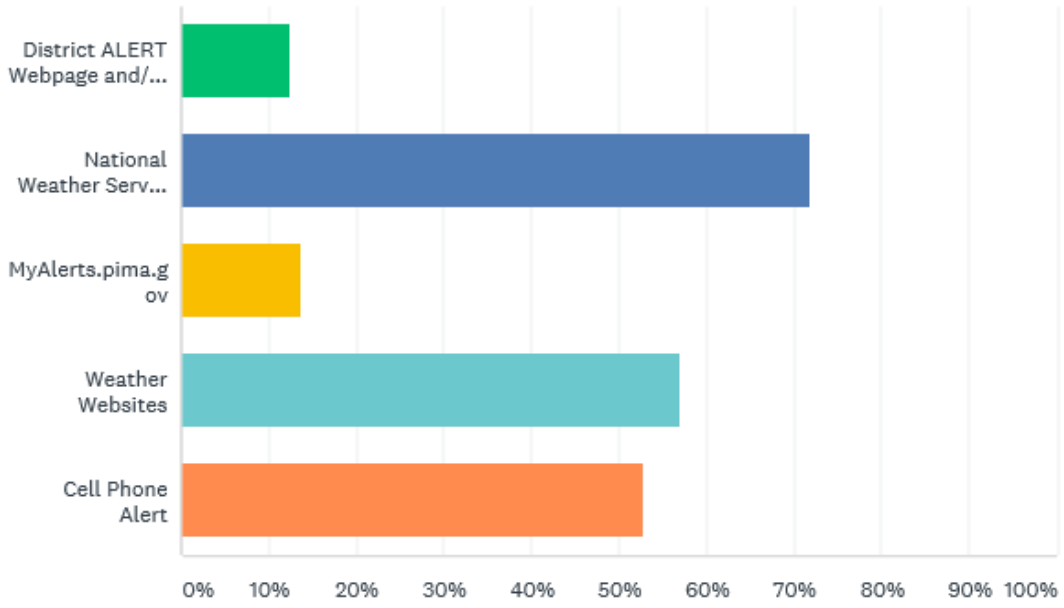
Answered: 810 Skipped: 49



ANSWER CHOICES	RESPONSES	
County GIS and Websites	38.27%	310
County Department of Transportation Hotline	8.40%	68
County Road Closure Email Service	5.19%	42
County Department of Transportation Road Closure Webpage & Map	26.67%	216
District Information Counter	2.47%	20
District GIS or Flood Hazard Map	27.41%	222
FEMA Websites	14.32%	116
Friends & Neighbors	59.75%	484
Realtors & Insurance Agents	9.26%	75
Total Respondents: 810		

What sources of flood warning information have you used?

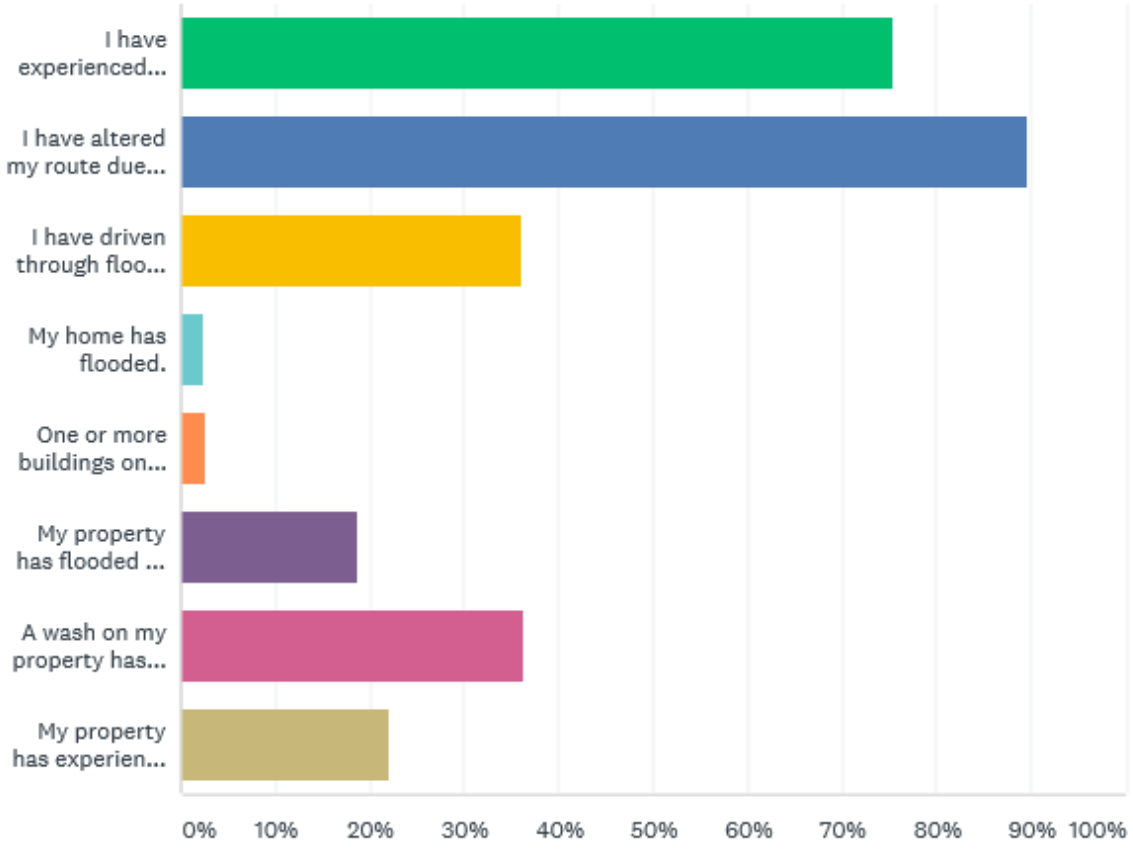
Answered: 822 Skipped: 37



ANSWER CHOICES	RESPONSES	
District ALERT Webpage and/or Mobile App	12.29%	101
National Weather Service (radio and television)	71.78%	590
MyAlerts.pima.gov	13.50%	111
Weather Websites	56.93%	468
Cell Phone Alert	52.80%	434
Total Respondents: 822		

What flooding situations have you experienced?

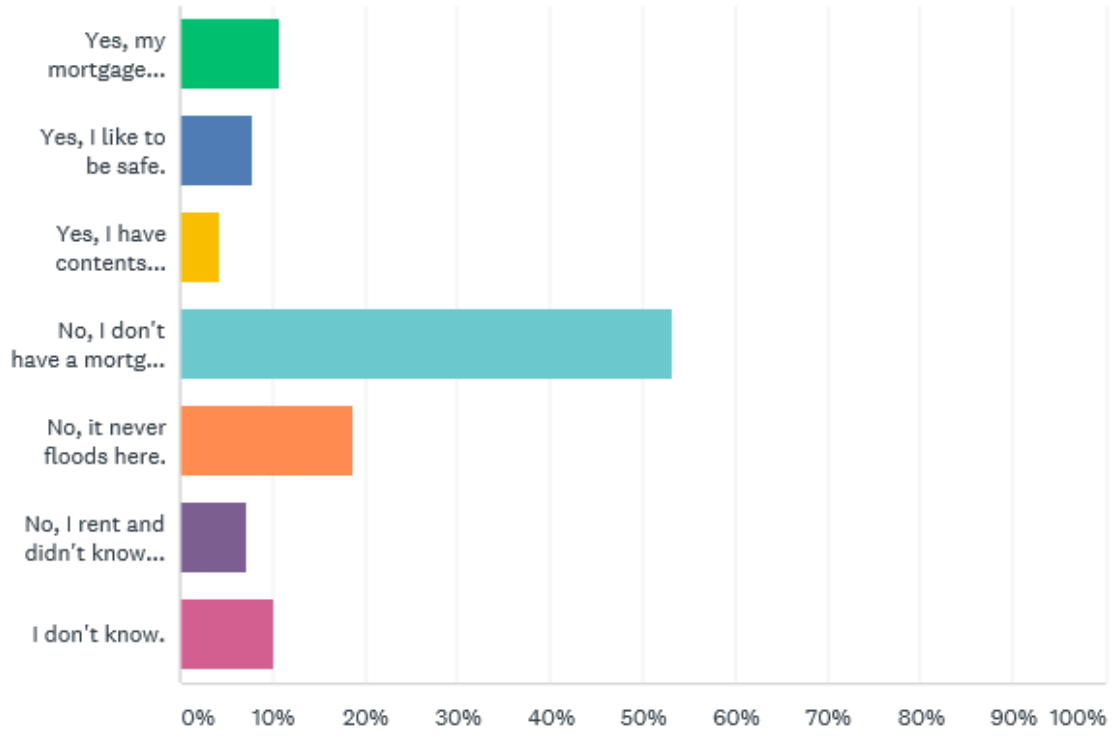
Answered: 836 Skipped: 23



ANSWER CHOICES	RESPONSES	
I have experienced flooding while driving.	75.24%	629
I have altered my route due to street flooding.	89.47%	748
I have driven through flooded washes to get to my destination.	36.00%	301
My home has flooded.	2.39%	20
One or more buildings on my property have flooded.	2.51%	21
My property has flooded but not buildings.	18.66%	156
A wash on my property has flowed.	36.12%	302
My property has experienced erosion due to flooding.	22.01%	184
Total Respondents: 836		

Do you have flood insurance?

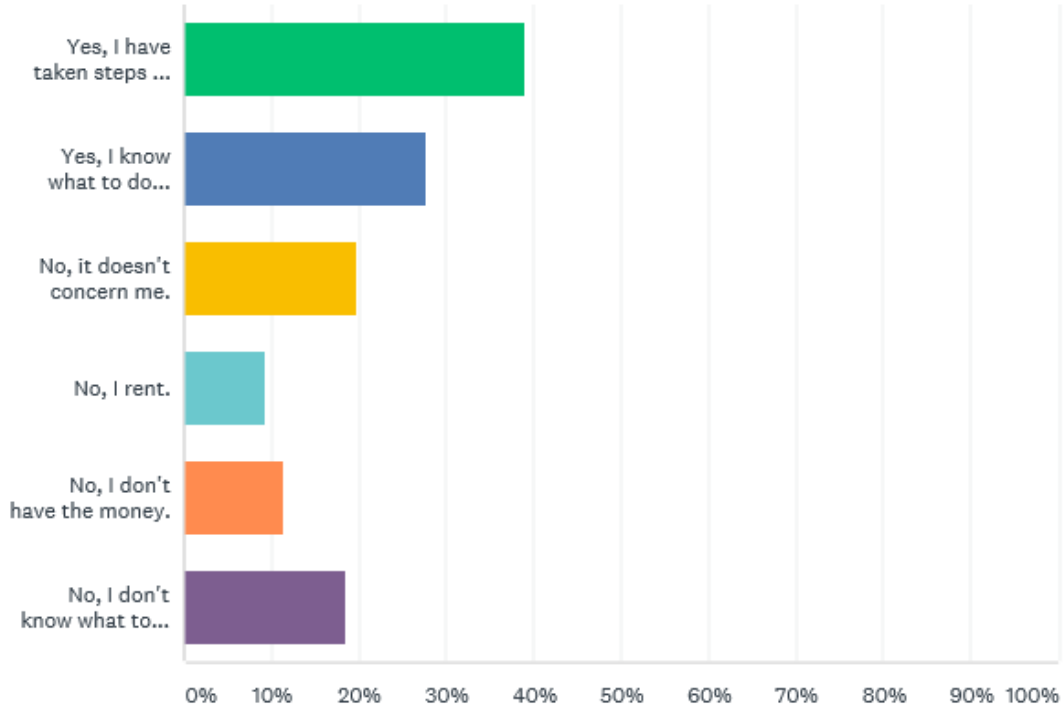
Answered: 849 Skipped: 10



ANSWER CHOICES	RESPONSES	
Yes, my mortgage requires the building to be covered.	10.72%	91
Yes, I like to be safe.	7.77%	66
Yes, I have contents coverage.	4.24%	36
No, I don't have a mortgage that requires it.	53.24%	452
No, it never floods here.	18.61%	158
No, I rent and didn't know that contents coverage was available.	7.18%	61
I don't know.	10.01%	85
Total Respondents: 849		

Have you taken steps to reduce the impacts of flooding on your property and/or prepared for flooding?

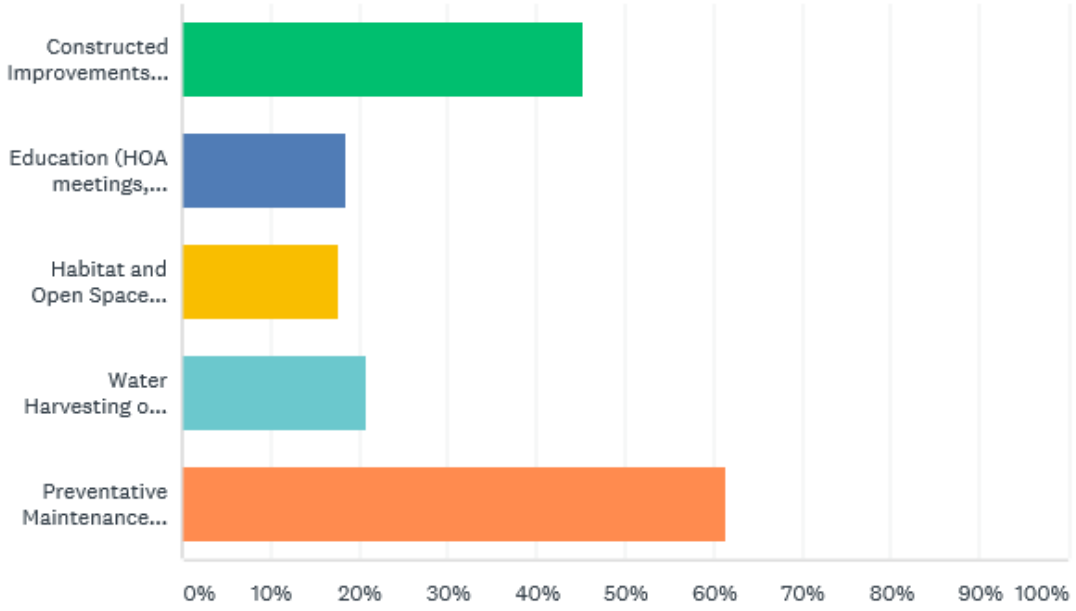
Answered: 846 Skipped: 13



ANSWER CHOICES	RESPONSES	
Yes, I have taken steps to reduce damages to my property.	38.89%	329
Yes, I know what to do during a flood.	27.54%	233
No, it doesn't concern me.	19.74%	167
No, I rent.	9.10%	77
No, I don't have the money.	11.23%	95
No, I don't know what to do.	18.44%	156
Total Respondents: 846		

What steps have been taken in your area or neighborhood to reduce flood risk?

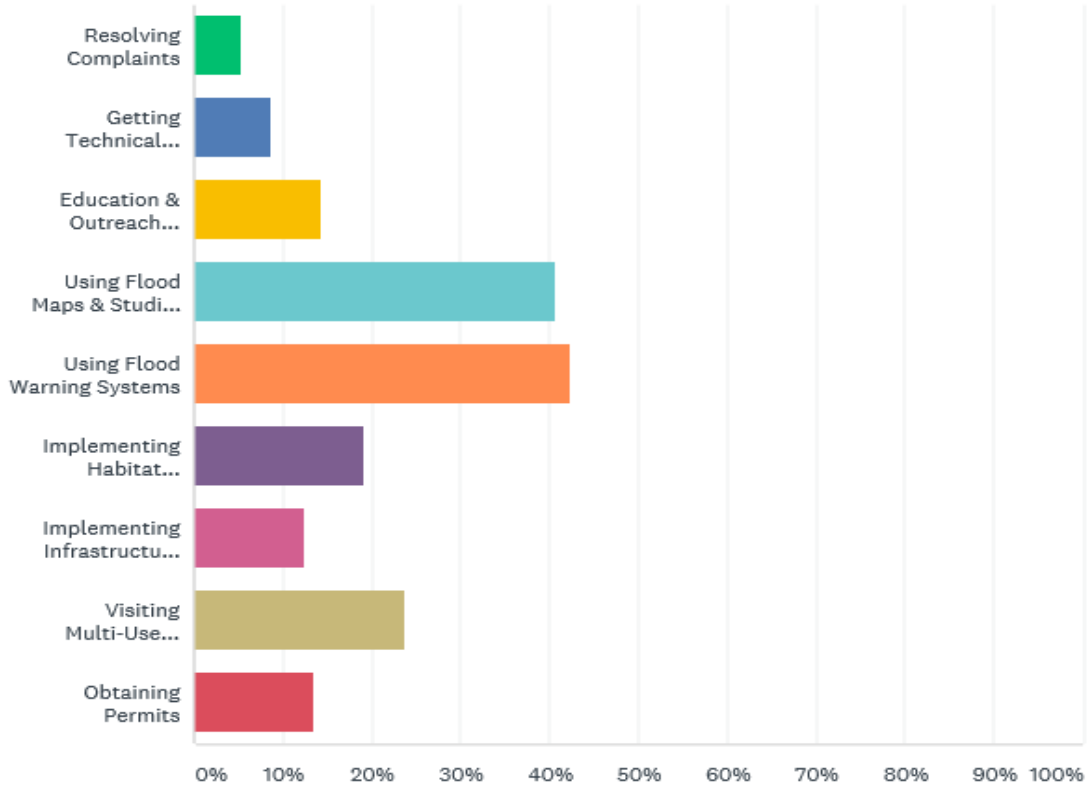
Answered: 696 Skipped: 163



ANSWER CHOICES	RESPONSES	
Constructed Improvements (channels, culverts, crossings, and erosion control)	45.11%	314
Education (HOA meetings, handouts, public events)	18.39%	128
Habitat and Open Space Preservation	17.67%	123
Water Harvesting or Other Green Infrastructure Installation	20.69%	144
Preventative Maintenance (brush and debris removal)	61.21%	426
Total Respondents: 696		

Please check all of the following District activities in which you have you participated:

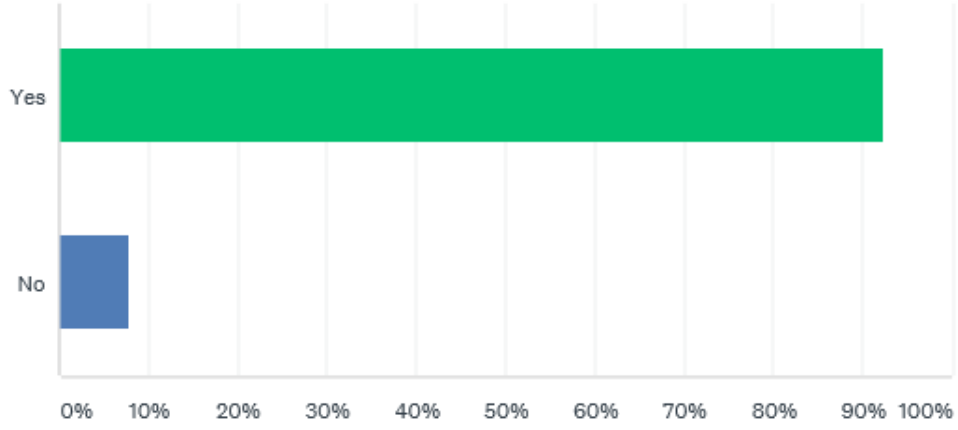
Answered: 671 Skipped: 188



ANSWER CHOICES	RESPONSES	
Resolving Complaints	5.22%	35
Getting Technical Assistance	8.49%	57
Education & Outreach (Including attending project meetings and workshops.)	14.31%	96
Using Flood Maps & Studies, or Obtaining Elevation Certificates	40.54%	272
Using Flood Warning Systems	42.18%	283
Implementing Habitat Management, Water Harvesting and Green Infrastructure	19.08%	128
Implementing Infrastructure Improvements	12.37%	83
Visiting Multi-Use Recreation Sites	23.70%	159
Obtaining Permits	13.41%	90
Total Respondents: 671		

Do you support public funding of flood control improvements?

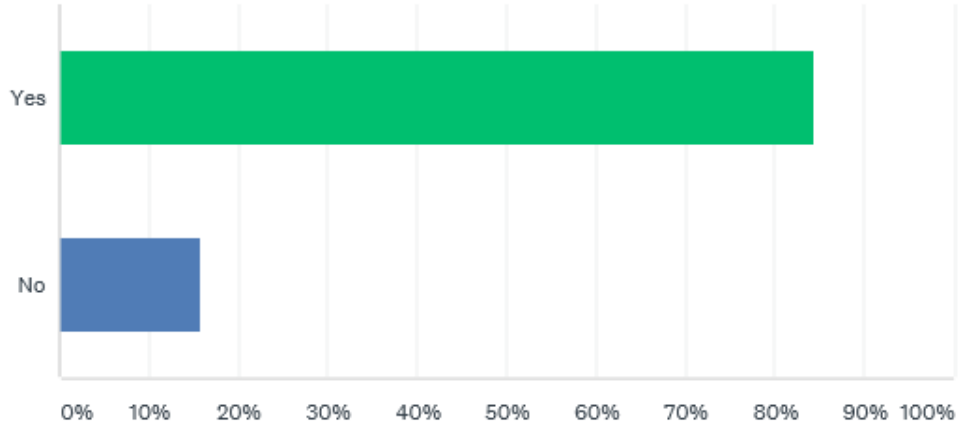
Answered: 846 Skipped: 13



ANSWER CHOICES	RESPONSES	
Yes	92.32%	781
No	7.68%	65
TOTAL		**846**

Maintaining floodprone areas in their natural state is a beneficial and cost effective way of managing flood risks: Do you support preserving floodplains in their natural condition?

Answered: 845 Skipped: 14



ANSWER CHOICES	RESPONSES	
Yes	84.38%	713
No	15.62%	132
TOTAL		**845**

These results clearly show areas requiring greater emphasis including outreach, promotion of flood insurance and natural floodplain function including infiltration, as well as support for and widespread participation in these activities.

7.2 Recent Accomplishments

The recent accomplishments listed below reflect all 6 categories described in the Manual.

Preventative:

- 2014 Adoption of revised "Design Standards for Stormwater Detention and Retention in Pima County"
- 2014 Adoption of a new ordinance with procedures governing fines for non-compliance, appeal and hearing procedures.

Property Protection:

- Acquired over 400 acres of floodprone land and removed 16 structures from the SFHA in federal fiscal year 2018/19 alone.

Natural Resource Protection:

- 2015 Publication of the "Low Impact Development and Green Infrastructure Guidance Manual";
- 2011 Adoption of the Regulated Riparian Habitat Mitigation Standards and Implementation Guidelines.
- 2017 Updated shallow groundwater dependent ecosystem protections in the Comprehensive Plan, and added Pima County Regulated Riparian Habitat to regulatory floodplains as areas to be avoided during the entitlement process.

Emergency Services:

- 2019 Updated Flood Response Field Manual
- Initiated multi-agency annual flood exercises
- 2017 Approval of the Multi-Jurisdictional Hazard Mitigation Plan
- Established inundation area early warning systems in cooperation with Pima County Office of Emergency Management and first responders.

Structural Projects:

- Completed the Paseo de las Iglesias project along the Santa Cruz River. This project used a design featuring a low flow channel and a restored overbank habitat and multi-use recreation area considered a model for future projects.
- Removed X amount of sediment for the Rillito River channel.

Public Information:

- Established "Program for Public Information" Committee and annually updated the program
- Published the Living River Report

- Hired an outreach project manager

I addition to these highlights, throughout the five-year period covered by this plan, the District continued its program of conducting local flood hazard studies, including:

- Sabino Vista
- Tucson Mountains Unnamed Wash #10
- Caliente Hills
- Airport Wash
- Pima Wash
- Catalina Mountains Unnamed Wash #4
- Indian Hills Wash
- Red Butte/ Saginaw Hill
- Upper Santa Cruz River RiskMAP
- North Ranch

Each of these include element of all six activities as many identify hazards, structural needs or even higher regulatory standards.

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7.3 Ongoing Program Improvements

Again, these are by the categories of activities identified in the Manual.

Preventative

Drainage System Maintenance: During the last five years, the District expanded staff to provide improved drainage infrastructure inspection and monitoring capabilities. This has resulted in increased preventative drainage maintenance including removal of aggraded sediments from channels. Studies of aggradation and channel capacity remains a priority for the next five years to better direct this work.

Planning, Zoning and Open Space Preservation: The District implements and continues to improve upon numerous nonstructural programs to address flood hazards, such as; regulation of land use in floodplains, developing watershed plans, river and basin management studies to delineate flood hazards and avoid future risks, and floodprone land acquisitions.

Floodplain Regulations: The Ordinance provides goals and objectives to guide nonstructural activities, regulate land use and reduce the potential for future flood damages. District staff and the Flood Control District Advisory Committee review the Ordinance and associated standards annually for consistency with land development patterns and the NFIP.

Stormwater Management: The District develops Watershed and Basin Management Plans as strategic floodplain management tools to address the unique physical and hydrological characteristics of each watershed and major watercourse. The goal of watershed planning is to control the impact of urbanization within each watershed to minimize the potential for increased flood peaks and erosion that may occur with urbanization. Watershed plans provide guidance for acquisition of floodprone land, protection of natural conditions, urban stormwater controls and detention, riparian habitat protection, and control of soil erosion. Watershed studies include topographic and aerial mapping to allow for improved identification of flood and erosion risks and to prepare improved floodplain mapping. Within an urbanizing watershed, basin management plans address the need for stormwater detention to minimize the potential for increased flood peaks with development.

Property Protection

Acquisition and Relocation: The Floodplain Land Acquisition Program continues and this year alone the Infrastructure Management Division removed 16 structures from AO Zones. This effort to mitigate affected property in the lowlands complements significant donations in headwater riparian areas.

Natural Resource Protection

Land Stewardship Program: With extensive ownership and maintenance, responsibility for major rivers and tributaries the District employs inspectors and managers. While maintaining conveyance and capital improvements requires a large budget the Manual and local expertise identify preservation and restoration of natural floodplain function as key to protecting public safety while controlling cost. In addition to an Infrastructure Management Division, the District has established a Land Stewardship

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Program to address this need. Program staff is including naturalists and restoration experts are conducting detailed inventory and management plans for these areas. These plans establish best practices including fencing, erosion control, and water harvesting and habitat restoration.

Emergency Services

Hazard Warning: In part due to public concern over several major flood events and the recognition that transportation infrastructure is at risk, the District has embarked on an expansion of the ALERT network. Furthermore, the District is greatly improving the manner in which we convey flood threat information to the public and other agencies.

Hazard Response Operations: Revised the Flood Response Field Manual in 2019. It includes pre and post crest procedures for staff conducting investigations, communication protocols and specific items of concern by watershed including:

- Data Gathering Needs
- Frequently Flooded Structures and Properties Subject to Damage
- Infrastructure; and
- Safety Concerns

Hazard Threat Recognition: Natural hazard mitigation planning is the process of identifying and implementing programs to reduce or eliminate the loss of life and property damage that may result from natural hazards such as floods. Through the Disaster Mitigation Act of 2000, the federal government has established criteria for state and local governments to develop a community-based hazard mitigation plan for natural and manmade disasters. Pima County, with assistance from the Arizona Department of Emergency Management, has developed an Inter-jurisdictional Multi-Hazard Mitigation Plan for Pima County and incorporated communities therein. The basic steps for mitigation planning include:

- *Organization of Resources*. For state and local communities the initial focus is gathering resources, including identifying the necessary technical expertise and community agencies in hazard mitigation.

- *Assess Risks*. Identify the characteristics and potential consequences of natural hazards and the potential risks and damages.

- *Develop a Mitigation Plan.* Prioritize structural and nonstructural approaches to avoid or minimize damages by development of a formalized hazard mitigation plan.

- *Implementation of the Plan and Monitoring of Progress.* Implementing specific mitigation projects, adopt land use regulations to avoid future hazards, periodic evaluation of the effectiveness of the plan, and project improvements and regulations in reducing or avoiding damages and loss from natural hazards.

Through annual reports and 5-year comprehensive reports, the District has been formally reporting and evaluating flood hazard mitigation strategies. These hazard mitigation strategies include floodplain management, riparian habitat protection, and capital improvements.

The Department of Emergency Services and Homeland Security is the agency responsible for coordination with local, state and federal agencies for hazard mitigation and emergency response, including Early Warning Dissemination. The District provides the local technical expertise for flood and erosion hazards, including providing Flood Threat Recognition and mitigation project implementation.

During 2016, the County Office of Emergency Management began to update this plan, which FEMA has credited as the CRS Floodplain Management Plan for Pima County, as it receives formal approval by the Board of Supervisors and other participating jurisdictions. This report incorporates the HMP by reference and hazard exposure and mitigation activity materials are cross-referenced.

Structural Projects

Descriptions of completed and ongoing Capital Improvements Projects are included in Section 7.6.3 of this report.

Public Information

Public education and awareness of potential severe storm and flood hazards is a vital component of the floodplain management strategy. Education includes addressing issues on the NFIP for homeowners and businesses. The District plans to continue and expand educating professionals in real estate, building and manufactured housing regarding disclosure and compliance issues; and educating citizens on flood preparedness, including flood insurance, family safety planning and safety tips about entering flooded washes. While existing programs are extensive and have been highly rated, during the last five years the District began development of a formal Program for Public Information to improve our outreach by engaging stakeholders in analysis of target audiences and message delivery. Chapter 5 contains information about the PPI. During the next five years, the District shall implement and update this program. Specific new outreach activities include developing courses for realtors and newcomer packages for major employers, along with modernizing the look of older materials and reevaluating the use of printed notices.

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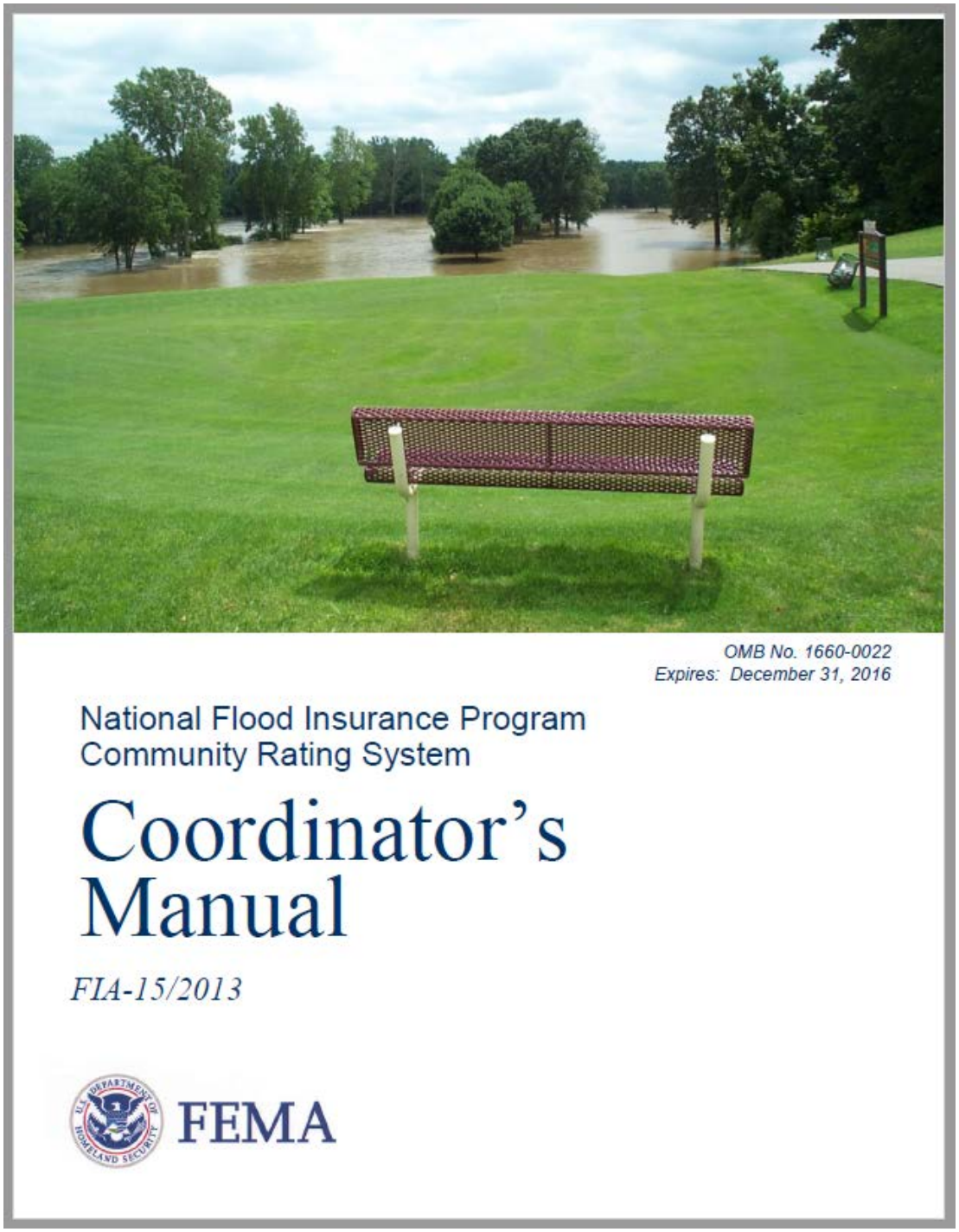
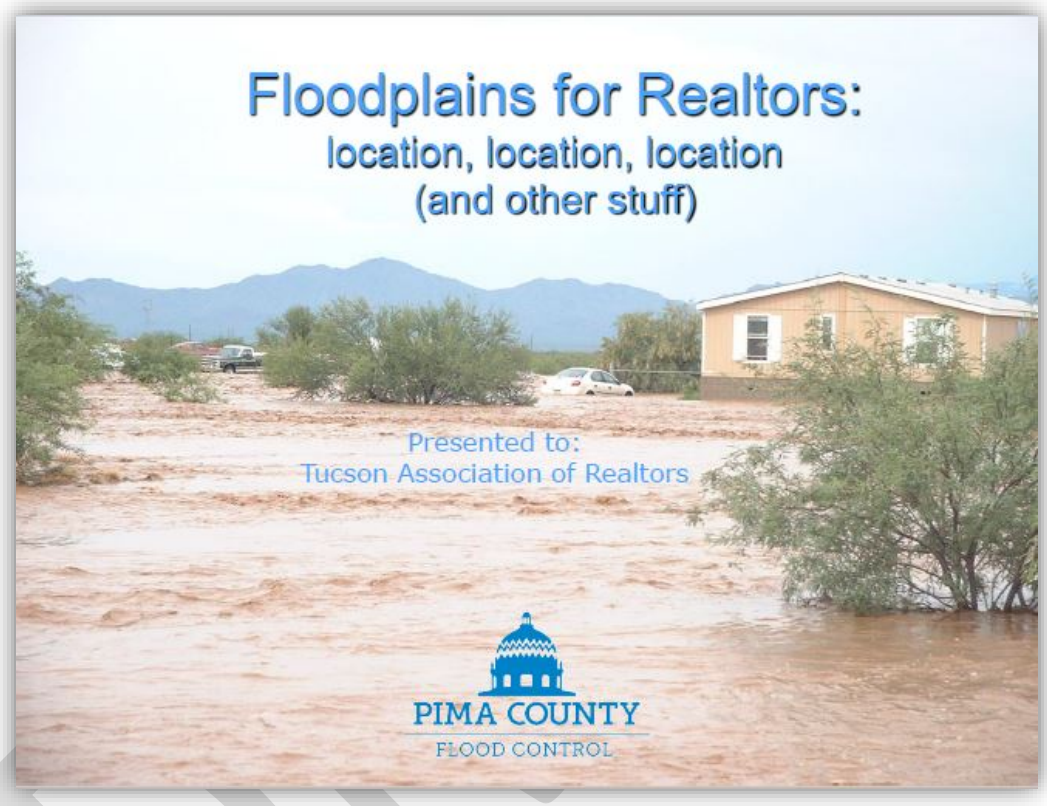
For CRS purposes, the 6 categories of activities identified in the Manual and described above are scored in four categories due to overlap. A detailed review of District activities as scored during the previous audit follows.



7.4 Public Information Activities (CRS Activity 300)

In order to inform the public about risk exposure and reduction the District provides floodplain mapping, protection assistance, and education. The 2017 score for this activity is 692 up 117 from the prior audit.

Figure 264 - Sample of Outreach Efforts



7.4.1 Elevation Certificates (CRS Activity 310)

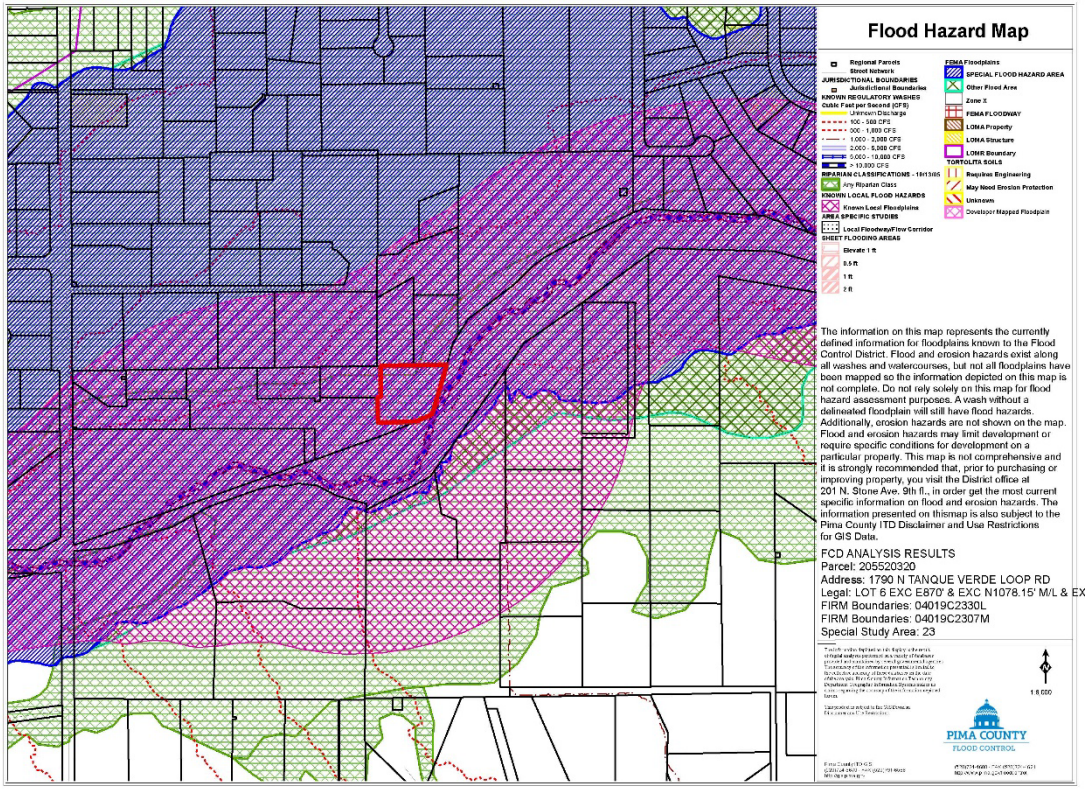
An Elevation Certificate is a form created by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program (NFIP) as a compliance and insurance tool within federally mapped floodplains. The certificates verify that structures are safely elevated above the expected 100-year flood level and that they meet other floodplain requirements. Insurance companies utilize the certificates to determine flood insurance premiums for homeowners within flood hazard zones.

The NFIP requires FEMA Elevation Certificates for structures within federally mapped floodplains. The District also requires their use in locally mapped floodplains. The Ordinance requires Elevation Certificates required for compliance purposes to be completed by an Arizona registered land surveyor or Arizona registered civil engineer.

7.4.2 Map Information Service (CRS Activity 320)

As the official repository for FEMA Flood Insurance Rate Maps (FIRMs), the District provides the map information service required for participation in the NFIP. The District provides an additional service of providing maps showing all known flood hazards for individual parcels, obtained by the public on-line at: http://pcmaps1.pima.gov/mapps/rfcd/parcelsearch/. Certified Floodplain Managers, Hydrologists, Engineers and Planners are available to assist the public on a walk-in or scheduled basis to provide comprehensive flood hazard information and related design guidelines. The public information counter is open from 8:00 a.m. to 4:30 p.m. weekdays. Property owners, buyers, lenders, architects, engineers, builders and their representatives may obtain detailed flood elevation information including Elevation Certificates, local and federal flood maps, guidance and assistance.

Figure 265 - Sample Flood Hazard Map



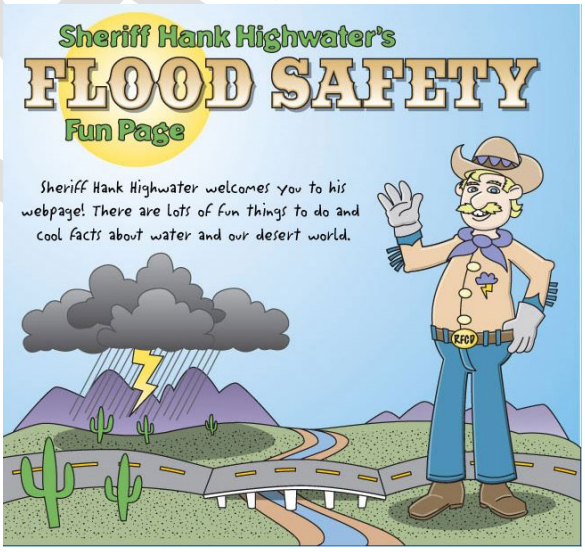
7.4.3 Program for Public Information (CRS Activity 330)

In order to promote risk reduction and the purchase of flood insurance the District engages in extensive outreach and educational activities. These range from signage to advanced technical workshops, including activities targeted to specific audiences such as property owners and floodplain residents, realtors, drivers, surveyors, engineers and children to name a few.

Prior to 2015, as promoted by the NFIP CRS 2007 Manual, the District conducted three major types of outreach in addition to the Map Information Service. This included direct mailings to floodplain and Repetitive Loss Property owners and residents, including annual informational brochures and floodplain status information. This activity fell under the CRS heading of Outreach to Floodplain Residents and included over 12,000 properties annually. Additionally, the District provides a monsoon themed insert in water bills. It reaches over 250,000 customers of Tucson's major water provider and provides flood safety, road closure and other flood preparedness information. The main message of the insert is do not drive through flooded roadways. Other outreach efforts include posters on buses and other general information placed in public places, as well as radio and TV ads. This activity falls under the CRS heading of Outreach to the Community. The District reaches additional targeted audiences by cooperating with various stakeholders such as schools, the Sheriff's Department, Pima County Office of Emergency Management, libraries, Tucson Association of Realtors and other professional groups to conduct special events, including Earth Day, various street and school fairs, and professional development seminars.

Typical Event Booth

These programs have been in place since the prior five-year planning period, in which time technological, social and environmental changes have occurred. In order to reevaluate the effectiveness of these programs and to comply with the FEMA CRS 2017 Manual, the District created a Program for Public Information. A stakeholder committee participated in creating the plan by identifying service gaps. They also recommended specific messages for identified audiences.



Sample Hank Highwater School Outreach

7.4.4 Hazard Disclosure (CRS Activity 340)

In Arizona, realtors and sellers are required to disclose when flood insurance is required for a federally backed mortgage prior to closing. The flood hazard information shown on a property information form completed by real estate agents and provided to buyers through a widely used Multiple Listing Service is not always accurate. As part of the Program for Public Information described above and included in Appendix A for reference (excluding appendices) the District has targeted real estate

agents for further outreach regarding disclosures and the availability of local hazard information including locally mapped floodplains, erosion hazard areas, and Regulated Riparian Habitat. As previously noted, the District mails annual notices to all property owners within unincorporated Pima County impacted by known flood hazards.

Figure 266 - Annual Disclosure and Brochure Cover Page

THE PARCEL SHOWN ON THE ADDRESS LABEL IS IN A MAPPED FLOOD ZONE

As shown on the Flood Insurance Rate Map produced by the Federal Emergency Management Agency (FEMA) or on locally developed floodplain maps (excluding local sheet flood areas).

THINGS YOU SHOULD KNOW BEFORE IT FLOODS

The Pima County Regional Flood Control District (District) is sending this information to property owners whose properties lie within FEMA and locally mapped flood zones. The District provides flood protection information and services for the general health, safety and welfare of the residents of Pima County. You may obtain a detailed flood map and an Elevation Certificate, if available, for your property by visiting our office, or by going to the District's website at: http://www.pima.gov/floodcontrol. In addition to showing the floodplains, the map in this brochure shows streets that Pima County considers passable and questionable during times of flooding. The District recommends identifying a reliable route to your property. If a reliable route does not exist, the District recommends identifying a location where you can wait out the flood.

The brochure contains a map of roads impacted by floods and other useful information for floodprone property owners. The District, with its partners, conducts additional outreach relating to travel hazards that are not specific to individual property.

7.4.5 Flood Protection Information (CRS Activity 350)

The Pima County public library system consists of multiple branches throughout incorporated and unincorporated areas. The card catalogue is web based to make it easier to find a full suite of materials required by FEMA and many locally pertinent publications, including historical accounts of flooding and flood farming practices, land use and environmental change, desert and riverine ecology, modern water harvesting, low impact development, green infrastructure, flood protection practices and much more.

The District also maintains an extensive website with advanced mapping and flood threat recognition information. This includes a link where a visitor may download or print a Flood Hazard Map. This map depicts hazards identified by FEMA and locally, along with Regulated Riparian Habitat. The map includes a section with information on regulations, permitting, dumping, and the availability of insurance and the beneficial functions of floodplains.

The website also includes an interactive map to find historic, real-time rainfall, and stream flow data for more than 100 gage sites maintained by the District and other agencies. Known as the Automated Local Evaluation in Real Time (ALERT) system the District has recently upgraded its ALERT system software and improved the public interface for displaying real, or near real-time hydro-meteorological data for Southeastern Arizona. Precipitation, stream flow and other weather related information produced by gages maintained by the District and other agencies is now just a few clicks away. More information on ALERT is in Section 5.4.

7.4.6 Flood Protection Assistance (CRS Activity 360)

When addressing a flood concern, the District has used various combinations of regulatory, CIP, and open space options to protect properties. When the public submits a complaint or permit, District staff provides technical assistance. This includes determining design adequacy and identifying alternatives. The District has also adopted a series of Technical Policies and Procedures designed to assist the public. These provide guidance on items such as minimum foundation requirements for structures built in floodprone areas, locally appropriate scour calculation methodologies for underground utilities, wet flood proofing, fence and wall design and much more. District staff meets with clients at the customer service counter and conducts site visits as needed. Should the assistance require either maintenance of a public drainage facility, enforcement of a regulation, construction of flood or erosion control improvements, or environmental restoration the District will engage its infrastructure and resources management staff and partners as needed. Whether the result is a public or private flood control project District staff remain involved throughout design and maintenance to ensure functionality.

Samples of Damaged Homes Where the District Provided Assistance

7.4.7 Flood Insurance Promotion (CRS Activity 370)

The District promotes the purchase of flood insurance as part of annual outreach projects to floodplain residents, at special events, and as part of post flood investigations. The District maps local floodplains and erosion hazard areas and encourages property owners to obtain flood insurance in these areas. The outreach notifies floodplain property owners of the insurance requirement for federally backed mortgages and the availability of low cost polices outside of FEMA Special Flood Hazard Areas. During 2016, our Program for Public Information Committee identified the need to further target residents of locally mapped floodprone areas, particularly renters, regarding the availability of insurance.

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7.5 Mapping and Regulations (CRS Activity 400)

This Section describes our mapping program, ordinance and supporting policies and procedures. The 2017 score for this activity is 2,021 up 414 from the prior audit.

7.5.1 Floodplain Mapping (CRS Activity 410)

The District conducts river and basin management plans and other flood and erosion studies to identify present and future flood control needs and to implement related land use planning activities on major watercourses and tributary watersheds. The basin management plans and studies allow the District to move away from reactive spot improvements toward larger-scale long-range improvements. When the District first joined the CRS, the Floodplain Management Plan Synopsis described updating the plan one watershed at a time via basin management studies. This effort continues and this Watershed Management Plan compiles these studies into one document for the first time.

Below is a list of local studies conducted during the previous five years. These used the latest hydraulic and hydrologic modeling techniques, weather records, and topographic conditions to provide updated floodplains, depths and discharges.

- Sabino Vista
- Tucson Mountains Unnamed Wash #10
- Caliente Hills
- Airport Wash
- Pima Wash
- Catalina Mountains Unnamed Wash #4
- Indian Hills Wash
- Red Butte/ Saginaw Hill
- Upper Santa Cruz River RiskMAP
- North Ranch

The map below is the most recent CRS Cycle verification submittal. The watershed maps in Chapter 5 include all studies.

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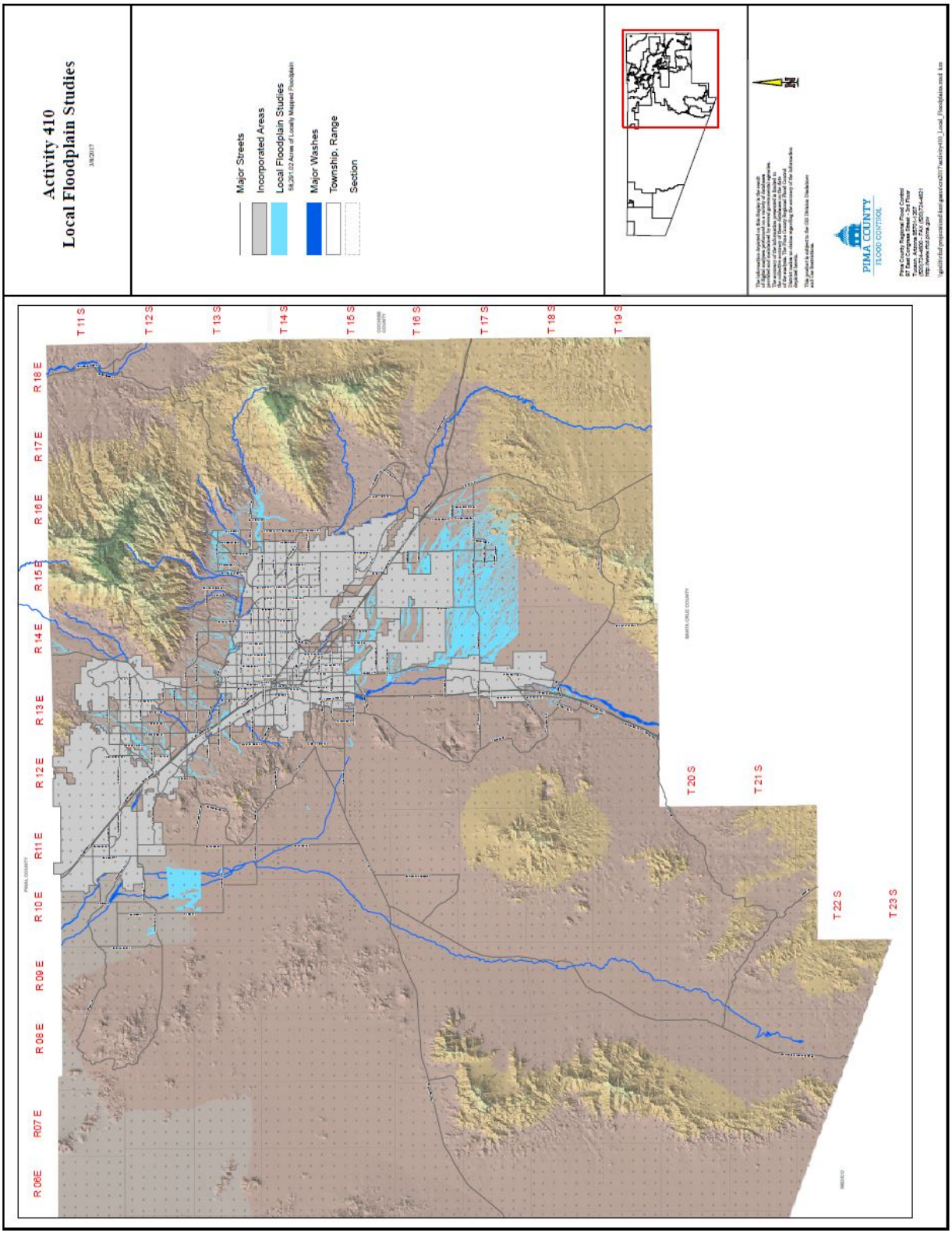
Figure 267 – CRS Cycle Verification Map of Local Floodplain Studies



7.5.2 Open Space (CRS Activity 420)

Pima County has been proactive in recognizing the role of open space in flood risk reduction and the other beneficial functions of floodplains, such as groundwater recharge, riparian habitat preservation and as a recreational amenity. Open space is protected via regulatory processes and by land acquisition. The Sonoran Desert Conservation Plan (SDCP) is Pima County's plan for balancing the conservation and protection of our cultural and natural resource heritage with our efforts to maintain an economically vigorous and fiscally responsible community. The Pima County Board of Supervisors approved the SDCP in 1999.

Broadly, the SDCP considered the following elements: critical habitats and biological corridors, riparian areas, mountain parks, historical and cultural preservation, and ranch conservation. All five elements, along with fiscal analysis, were critical in forming a viable land management plan for Pima County.

The SDCP identified the types of development that improved the tax base, and the relationship of these with the sewer service area. Excesses of land needed for urban development exist within the County as shown by build-out analyses. Furthermore, certain types of development are costly to the tax base and are contrary community values identified through over 600 public meetings. Over 200 technical reports documented these values, using the combined talents of over 150 contributing scientists.

In 2001, the Pima County Board of Supervisors updated the Pima County Comprehensive Land Use Plan, integrating the land-use policies and principles of conservation developed in the SDCP, including the Conservation Lands System (CLS). The CLS identifies lands necessary to achieve SDCP biological goals, while delineating areas suitable for development. The CLS covers approximately 2 million acres in eastern Pima County. The CLS was renamed the Maeveen Marie Behan Conservation Lands System in 2009 in memory of Dr. Behan's work on the SDCP and development of the CLS.

Since 2001, the SDCP has guided where public money is spent to conserve important natural areas, providing the basis for how cultural and historic resources are protected, and serving to help insure that our western lifestyle, heritage, and traditions continues. The SDCP set the stage for later efforts

such as the City-County Water Study and re-investment in the County's sewage treatment facilities. It also created a new standard for public transparency and involvement. The Multi Species Conservation Plan (MSCP) is the part of the SDCP that deals with compliance with the Endangered Species Act. Significant property acquisitions have greatly contributed to the success of this plan along with complementary regulatory and voluntary components. Although out of date, Figure 19 depicts how this works as a regional approach.

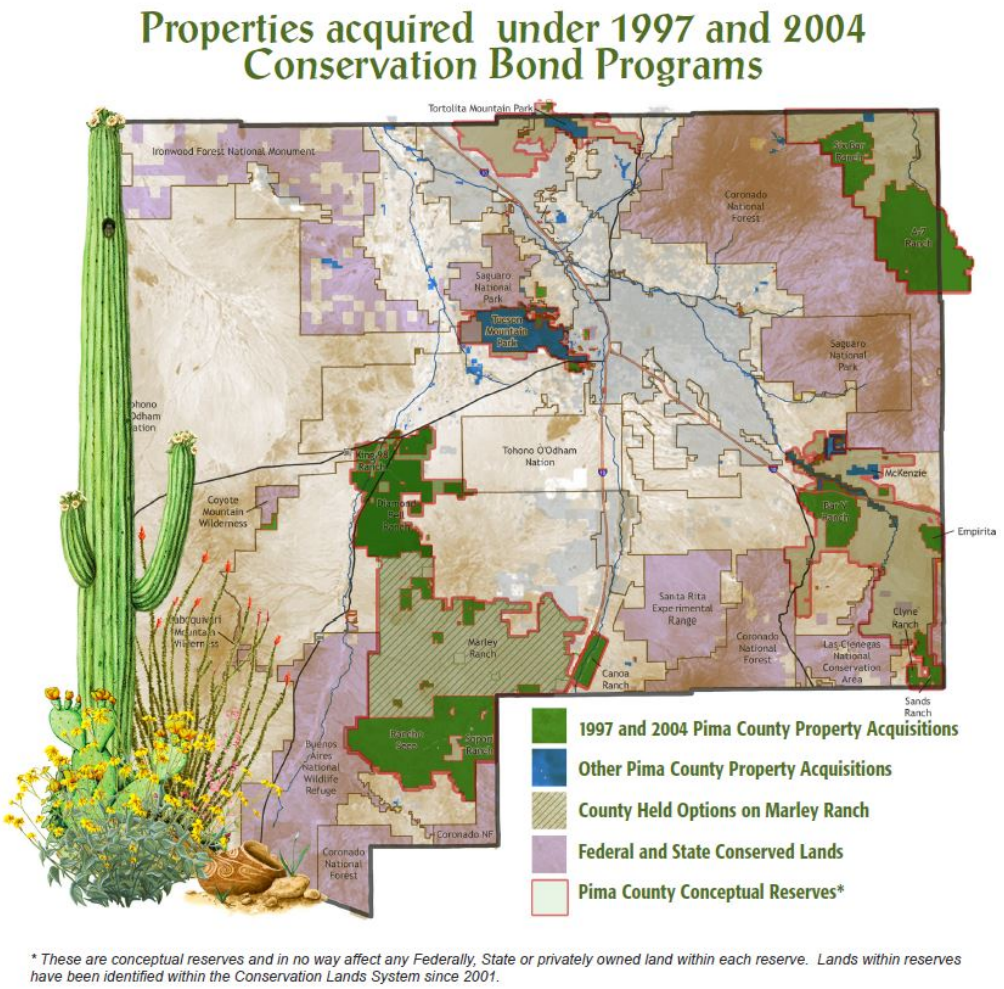


Figure 268 - Open Space Acquisition Map

In 2013, FEMA approved the SDCP as our NFIP CRS compliant Natural Floodplain Functions Plan. Components of the plan include Pima County Regulated Riparian Habitat and Important Riparian Areas designated under the SDCP and Pima County Conservation Lands System. These resources guide and inform staff recommendations for entitlements such as rezoning requests to the Board of Supervisors. The County has adopted avoidance regulations for Pima County Regulated Riparian Habitat throughout the Ordinance and Zoning Code as well as through the adoption of mitigation guidelines. Mitigation standards require replacement of habitat in like kind and the standards apply to both public and private projects. The descriptions and illustrations below describe the classifications of regulated habitat.

Hydroriparian habitat is generally associated with perennial watercourses, and may contain plant species such as cottonwood and willow. This is the rarest type of riparian habitat in Pima County and is vital to the many wildlife species that require this habitat for at least some portion of their life cycle.

Mesoriparian habitat is associated with areas of shallow groundwater and/or intermittent stream flow. Mesquite bosques are characteristic of this habitat type.

Xeroriparian habitat is typically associated with ephemeral streams (those that flow only in response to rainfall). The plant species present are similar to those found in upland areas but plant densities tend to be greater due to the relative abundance of water. There are four classes of Xeroriparian habitat based upon species, density and size, they are:

Xeroriparian Class A

Xeroriparian Class B

Xeroriparian Class C

Xeroriparian Class D

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7.5.3 Higher Regulatory Standards (CRS Activity 430)

The Ordinance regulates activities and developments in the regulatory floodplain in unincorporated Pima County. The Ordinance contains the following chapters:

Chapter 16.04 - General Provisions
Chapter 16.08 - Definitions
Chapter 16.12 - Exemptions and Nonconforming Uses
Chapter 16.16 - Floodplain Maps and Boundaries
Chapter 16.20 - Use Permits—General Provisions
Chapter 16.24 - Floodway Requirements
Chapter 16.26 - Floodway Fringe Area Requirements
Chapter 16.28 - Erosion Hazard Areas and Building Setbacks
Chapter 16.30 - Watercourse and Riparian Habitat Protection and Mitigation Requirements
Chapter 16.34 - Manufactured Homes and Manufactured Home Parks and Subdivisions
Chapter 16.36 - Subdivisions and Development
Chapter 16.38 - Maintenance of Private Drainage Improvements
Chapter 16.42 - Sediment and Erosion Control
Chapter 16.44 - Vehicular Access
Chapter 16.48 - Runoff Detention Systems
Chapter 16.52 - Sand, Gravel and Other Excavation Operations
Chapter 16.54 - Administration, Compliance
Chapter 16.56 - Appeals and Variances
Chapter 16.60 - Amendments
Chapter 16.64 - Violation—Penalty

Administering the Ordinance accomplishes two goals:

1. Meeting FEMA Flood Insurance Study (FIS) and NFIP requirements, governing activities in federally mapped flood hazard area.
2. Addresses local flood hazard issues by regulating activities in locally designated regulatory flood and erosion hazard areas. Provisions of the Ordinance are more restrictive than the minimum required by the NFIP.

Floodplain Use Permit Program

A Floodplain Use Permit (FPUP) is required prior to development in a regulatory flood or erosion hazard area. As defined by the Ordinance, "Development" is "any manmade change to improved or unimproved real estate, including, but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, fencing, excavating or drilling or storage of equipment or materials." The Ordinance further states that, "…[no person shall be exempt] from obtaining a floodplain use permit …for any use which diverts, retards or obstructs the flow of water and creates a danger or hazard to life or property in the affected area."

The most restricted area is the floodway, an area necessary to allow for the passage of the base flood. In these areas, there are prohibitions on structures and most other developments. Allowable floodway uses include agricultural, recreational, and accessory residential uses, as well as sand and gravel excavations subject to the conditions stated in the Ordinance. Annual renewal of FPUPs for sand and gravel excavation is required.

The Ordinance allow most uses in the floodway fringe (the portion of the regulatory floodplain outside of the floodway), including the placement of buildings, provided they adhere to minimum design and construction standards. The Ordinance prohibits structures designed for human habitation where the product of the flow depth times the square of the flow velocity (dv^2) exceeds the value of 18 for more than 30 minutes or the depth of the surrounding base flood exceeds three feet. In addition, the lowest floor of habitable structures must be at least one foot above the water surface elevation of the base flood. Other regulations govern the design of the foundation, the amount and type of any fill used, measures for protecting the fill, anchoring structures to prevent flotation, elevating service facilities such as electrical and heating equipment, and aligning structures relative to the direction of flow.

Unless approved bank stabilization is constructed, the Ordinance also requires buildings to be set back from watercourses in order to allow for lateral channel migration. The setback marks the edge of the erosion hazard measured from the top edge of the highest channel bank or the edge of the floodplain, whichever is closer to the channel centerline. The setback distance of varies with the discharge of the watercourse as dictated by the Ordinance unless an alternative erosion hazard area is established through a site-specific engineering analysis. Revisions adopted during the last decade include requirements for riparian habitats and critical facilities.

Appeals, Variances and Enforcement

In 2014, the Board adopted FPMO revisions including procedures governing fines for non-compliance, appeal and hearing procedures. The Ordinance specifies activity and development types allowed in flood and erosion hazard areas and provides a mechanism for appealing any interpretation of the Ordinance, and a process for obtaining a variance from the Ordinance. During this reporting period, the hearing process for enforcement was in development and no variances requested nor fines leveed. In 2014, the Board adopted Ordinance 2014-FC1, which proscribes enforcement procedures related to non-compliance, including fines, appeals and hearing procedures related to violations of the Ordinance.

Please refer to the above-references ordinances for more detailed information, copies of which are available on the District website.

Other Regulatory Activities

In addition to issuing FPUPs, District staff provides information to the public about permissible activities in flood hazard areas, provides information about the flood hazard status of specific properties, and provides flood protection assistance as needed. Requests for information can be made via letter, fax or on a walk-in basis. The public information counter is open weekdays from 8:00 a.m. to 4:30 p.m.

Staff also investigates drainage complaints filed by the public. The District notifies the property owner and requests corrective action when it is determined that a violation of the Ordinance exists. When not corrected to the District's satisfaction, staff issues a violation notice, and may refer the case to the

Pima County Attorney's Office. Staff often provides technical support to the attorney working on the case and may testify on behalf of the District.

The table below provides data on floodplain management services provided by the District over the past five years.

Table 71 – Floodplain Management Services

	2015	2016	2017	2018	2019 through August
FPUPs (Received/Issued)	538/352	686/498	758/554	805/865	534/461
Complaints Received	397	488	510	641	186
Counter Service	1,913	2,319	2,312	2,400	1,673

7.5.4 Flood Data Maintenance (CRS Activity 440)

In addition to identifying locally regulated floodplains, FEMA FIRMs need periodic revision due to the availability of better data, improved modeling techniques, new development, construction of structural flood control projects, or natural changes in floodplain conditions. Changes to the effective FIRMs include Physical Map Revisions, whereby FEMA republishes the entire FIRM panels and Letters of Map Revision (LOMRs), whereby FEMA modifies a portion of a FIRM panel.

Changes can also be requested on a parcel basis if a parcel or structure is incorrectly included in an SFHA (i.e., if a small topographic high point did not show up), and the structure or parcel is actually elevated above the 100-year water surface elevation. In this case, FEMA issues a Letter of Map Amendment (LOMA), which eliminates the flood insurance requirements but does not modify the floodplain boundary shown on the FIRM.

The District typically funds the cost of LOMRs associated with public projects. The private sector is responsible for completing the necessary paperwork to obtain LOMRs and LOMAs for private improvement projects. The District performs complementary reviews of LOMR and LOMA applications prior to submittal. See Appendix B for a listing of LOMR and LOMA activity within unincorporated Pima County over the past five fiscal years.

The question of who should file for lands held in Trust by the Department of the Interior for Native American governments has arisen in recent years but is unresolved.

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7.5.5 Stormwater Management (CRS Activity 450)

The District has developed this Comprehensive Program Report in part to satisfy watershed-planning requirements of the CRS. It incorporates by reference the critical and balanced basin designation contained in our Retention/Detention Manual. This designation identifies basins in which drainage infrastructure is inadequate and therefore flow reduction is required on a project-by-project basis. The City of Tucson adopted these standards, promoting a holistic approach to watershed management.

7.6 Flood Damage Reduction (CRS Activity 500)

This section describes our damage reduction activities including Floodplain Management Planning, Acquisition and Relocation, Flood Protection, and Drainage System Maintenance. The 2017 score for this activity is 689 up 247 from the prior audit.

Constructed channels require maintenance including sediment removal

7.6.1 Floodplain Management Planning (CRS Activity 510)

The first Floodplain Management Plan approved when Pima County joined the CRS indicated that the district would update the plan as basin studies are completed. The District has since completed numerous basin studies but did not update the plan. The County has received FMP credit under the CRS for the Multi-Jurisdictional Hazard Mitigation Plan in recent cycles. The District is also participating in updating the HMP and is incorporating it herein by reference.

7.6.2 Acquisition and Relocation (CRS Activity 520)

Bond monies authorized by Pima County voters and annual allocations from the District's tax levy are used to fund the Floodprone Land Acquisition Program (FLAP) that began in 1984. FLAP is an effective nonstructural floodplain management tool that provides a number of community benefits. Some of these include removing residences and structures from vulnerable areas, preserving natural floodplain characteristics and attenuation of downstream flood peaks, providing recreational opportunities, maintaining open space, and protecting groundwater quality and riparian habitat resources. The District purchases property through FLAP solely on a voluntary basis without utilizing its land condemnation authority. The District has acquired Floodprone parcels along the Cañada Del Oro Wash, in Avra Valley, along the Black and Brawley Washes, and along the Santa Cruz River. The table below provides an overview of FLAP acquisition acreage and costs by fiscal year.

Table 72 - Floodprone Land Acquisition Program Summary

Fiscal Year	Land Purchased in Acres	Total Cost
FY 2014/15	246.92	$271,000
FY 2015/16	101.69	$172,180
FY 2016/17	313.06	$625,500
FY2017/18	411.36	$765,448
FY2018/19	525.01	$850,750
5 Year Total	1,598.01	$2,684,878

The District anticipates that funding for this program will continue.

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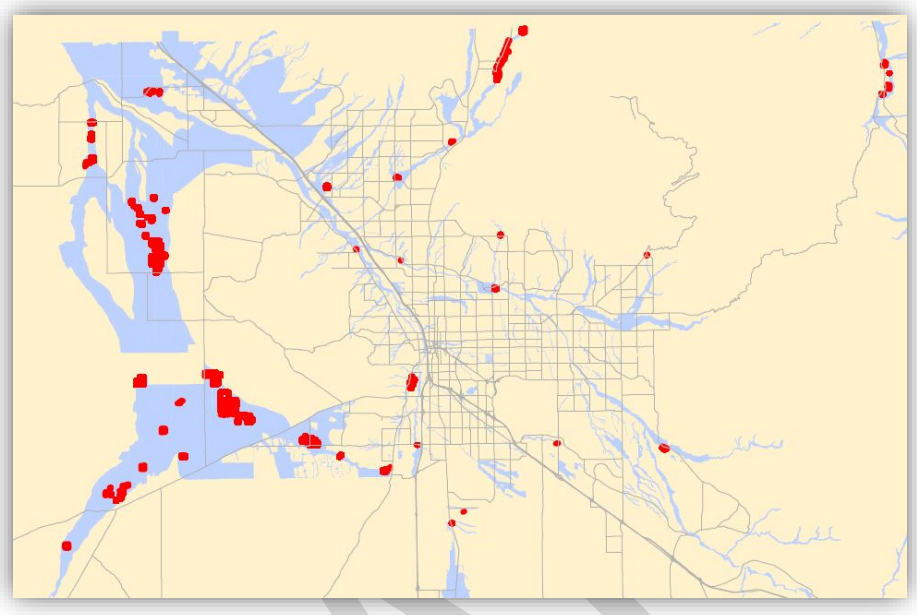
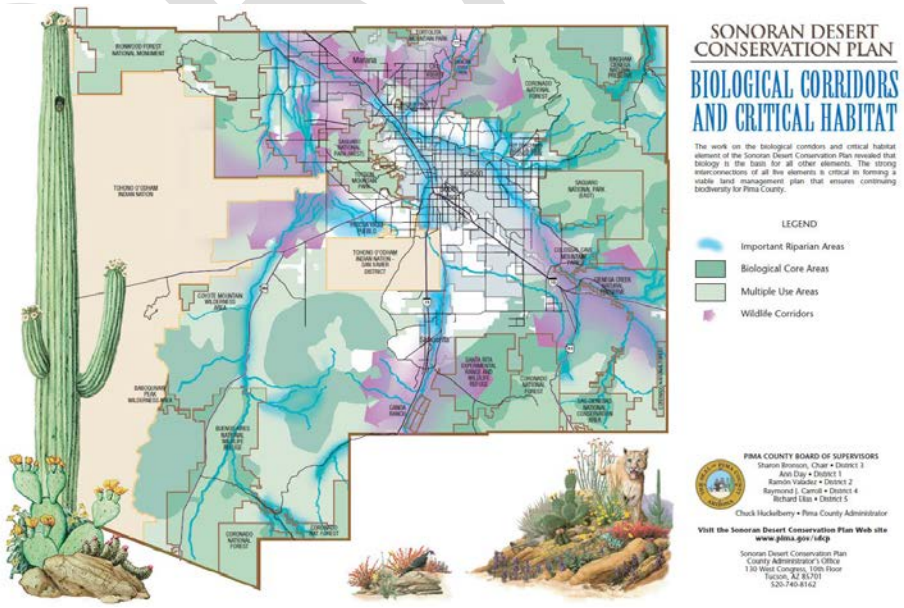
The map below shows the distribution of acquired land as of 2017 in red and floodplains in blue.

Figure 269 - FLAP Acquisitions



Seen below in context of preserves and regulatory context of the Sonoran desert Conservation Plan including Pima County Regulated Riparian Habitat and Maeveen Behan Conservation Lands System the true regional benefit becomes apparent.

Figure 270 - Maeveen Marie Behan Conservation Lands System



7.6.3 Flood Protection (CRS Activity 530)

The District's Capital Improvement Plan seeks to reduce future flood damage by utilizing bank stabilization, regional detention, engineered channels and floodprone land acquisition to address regional flood and erosion issues throughout incorporated and unincorporated Pima County. Due to the erosive nature of many regional watercourses, the District historically expended the bulk of CIP funds on bank protection. However, both structural and non-structural components of the plan contribute to the overall success.

The District constructs bank stabilization along major watercourses within Pima County where flood and erosion hazards threaten public and private development or infrastructure. Bank stabilization projects along major watercourses typically employ soil cement, which is a mixture of cement and local soil materials. Soil cement is a cost-effective flood and erosion control solution that has many of the strength characteristics of concrete. It also retains much of the appearance and textural quality of a natural riverbank that occurs in an arid landscape. Bank protection projects often include linear parks that provide a safe and attractive place for recreation. CIP expenditures during this program period reflect the high degree of public support for these projects.

Another structural flood control strategy used by the District is the construction of detention basins. Detention basins are facilities that allow for the temporary storage and measured release or metering out of floodwaters. Control of flows exiting a detention basin during a storm event significantly

decrease downstream flood peaks, and thereby minimize the potential for inundation in downstream areas. In most cases, basins serve multiple purposes including buffering, recreation and habitat.

The District's CIP for FY 2011 to FY 2016 included projects addressing flood and erosion control along the Santa Cruz River and Rillito Creek. The program also included urban infrastructure improvements to control drainage and repetitive flooding, channel improvements, linear parks, habitat restoration and substantial floodprone land acquisition.

While countywide flood control property tax projects, the citizenry is so supportive of flood control efforts that Pima County voters have approved bonds to provide for additional improvements. Below are descriptions of the projects completed within the last five years. Chapter 9.4 contains a list of CIP planned for the next five years.

Funding

The revenue from the District's tax levy provides the largest share funding for CIP projects. At the start of the reporting period, revenues from the District's property tax levy accounted for 91.8% of CIP funding. By the end, almost 98% of CIP funding came from the tax. Other sources of revenue include voter approved General Obligation Bonds and state grants. Federal matching funds of about $2 million from the Army Corps remained for completion of the Arroyo Chico project; however, the district received no new federal funds.

In 2004, voters for approved significant funds for five urban drainage projects and FLAP funds for open space acquisition. The District completed forty-six projects during the reporting period using revenue derived primarily from the property tax.

From the beginning of the reporting period in FY 2011/12 to the end in FY 2015/16, property tax revenue decreased for two years and then increased for two, ending at $21,462,804 annually. This is lower than the previous five-year period average.

Typical bank protection

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Figure 21 on the following page shows the locations of projects in the list below, which the District completed during the current reporting period.

1. Arroyo Chico Final Phase – High School Wash Box Culvert Storm Drain;
2. Catalina Estate Drainage Way Improvements;
3. CDO River Park Thornydale to Magee;
4. City of South Tucson Urban Drainage;
5. City of South Tucson Urban Drainage;
6. Dakota Wash Erosion Control;
7. Green Valley Drainageway #6;
8. Green Valley Erosion Control;
9. Julian Wash Kolb Rd Pathway Underpass;
10. Los Reales Wash at SCR Channel Extension;
11. Lower Santa Cruz Levee Bank Repair;
12. Lower SCR Levee at Tangerine Rd;
13. Mission View Wash;
14. Pantano Wash Speedway to Tanque Verde;
15. Pantano Wash Watershed Study;
16. Paseo de Las Iglesias;
17. Pasqua Yaqui Tribe Black Wash Urban Drainage Improvements;
18. Rillito Riverpark Repaving between La Cholla Boulevard and Campbell Avenue;
19. Santa Cruz to Julian Connection;
20. SCR Continental Ranch Remediation;
21. SCR Grant Camino del Cerro River Park Drainage Improvements;
22. SCR Paseo de Las Iglesias Restoration;
23. SCR Watershed Study; and
24. Tucson Mall Linear Park.

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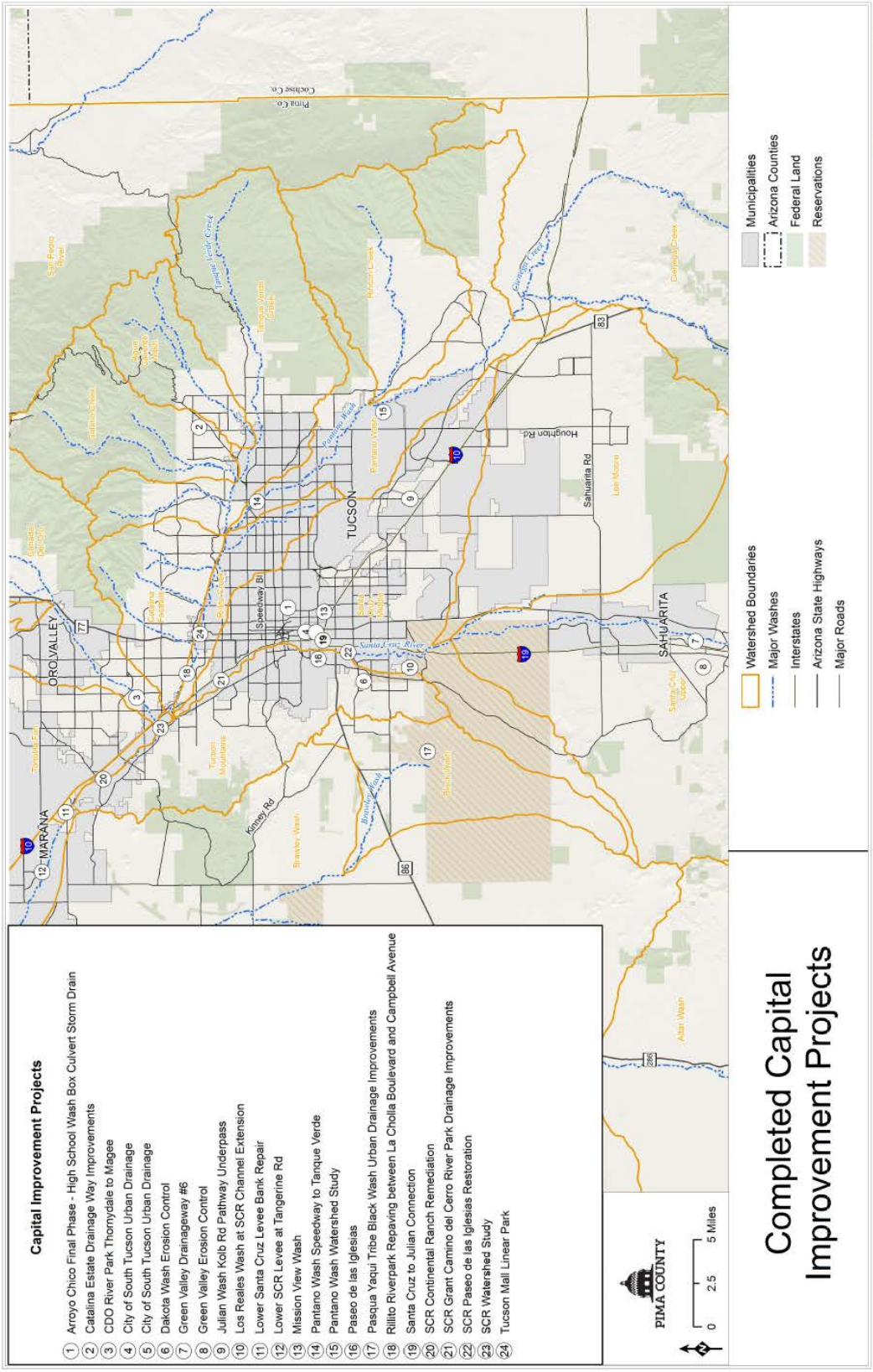
Figure 271 - Completed Capital Improvements Projects



The following table shows project expenses by year.

Table 73 - Capital Improvement Project Expenditures

Number	Name	2012	2013	2014	2015	2016	Total by Project
CFC.4FPDLI	FC - SCR Paseo de Las Iglesias Restoration USACOE	$ 1,263,649	$ 1,279,879	$ 490,058	$ (3)	$ (15,124)	**$ 3,018,459**
CFC.4FTVCS	FC - TV Creek Sabino Canyon to Craycroft USACOE		$ 172,787	$ 113,693	$ 4,487	$ -	**$ 290,967**
CFC.5AIRPO	FC - Airport Wash - Economic Development Zone		$ 46	$ 425,560	$ 306,025	$ 229,406	**$ 961,037**
CFC.5CDOLL	FC - CDO Pathway La Cholla to La Canada		$ 498,354	$ 936,504	$ 162,097	$ 825,568	**$ 2,422,523**
CFC.5CDOPK	FC - CDO River Park Thornydale to Magee	$ 162,485	$ 501,398				**$ 663,883**
CFC.5CDOTY	FC - CDO Linear Park - Thornydale Rd to I-10		$ 180,948	$ 418,974	$ 917,932	$ 520,734	**$ 2,038,588**
CFC.5CRLFR	FC - SCR Continental Ranch Remediation	$ 1	$ 356,513				**$ 356,514**
CFC.5FLPRA	FC - Floodprone & Riparian Land Acq	$ 92,268	$ 420,403	$ 301,959	$ -	$ (2)	**$ 814,628**
CFC.5JUCON	FC - Santa Cruz to Julian Connection		$ 150,597	$ 25,000			**$ 175,597**
CFC.5JWKRP	FC - Julian Wash Kolb Rd Pathway Underpass	$ 39,565	$ 560,431				**$ 599,996**
CFC.5LOSRW	FC - Los Reales Wash at SCR Channel Extension		$ 52,600				**$ 52,600**
CFC.5PWSTV	FC - Pantano Wash Speedway to Tanque Verde	$ 2,785,724	$ 691,798	$ 93,484			**$ 3,571,006**
CFC.5PWWSS	FC - Pantano Wash Watershed Study	$ 105,192	$ 27,081				**$ 132,273**
CFC.5RILPV	FC - Rillito Riverpark Repaving La Cholla Blvd-Campbell Ave			$ 710,324			**$ 710,324**
CFC.5SCRBR	FC - Lower Santa Cruz Levee Bank Repair				$ 335,000		**$ 335,000**
CFC.5SCRGF	FC - SCR Grant Cmno del Cerro River Park Drainage Imprvmt	$ 602,861	$ 1,223,348	$ 317,123	$ -	$ (2)	**$ 2,143,330**
CFC.5SCRLT	FC - Lower SCR Levee at Tangerine Rd	$ 61,820					**$ 61,820**
CFC.5SCWSS	FC - SCR Watershed Study	$ 133,448	$ 110,982	$ 38,292			**$ 282,722**
CFC.5SERAJ	FC - SCR Flood Control Erosion Control & Linear Pk Ajo to 29	$ 17,759	$ 163,501	$ 6,406,829	$ 6,032,759	$ 1,638,968	**$ 14,259,816**
CFC.5TMALL	FC - Tucson Mall Linear Park		$ 17,461				**$ 17,461**
CFC.5UDPYT	FC - Pasqua Yaqui Tribe Black Wash Urban Drainage Imprvmt		$ 1,363	$ (484)	$ 445,411		**$ 446,290**
CFC.5UDSTU	FC - City of South Tucson Urban Drainage	$ 3,267					**$ 3,267**
Total by Year		$ 5,268,039	$ 6,409,490	$ 10,277,316	$ 8,203,708	$ 3,199,548	**$ 33,358,101**

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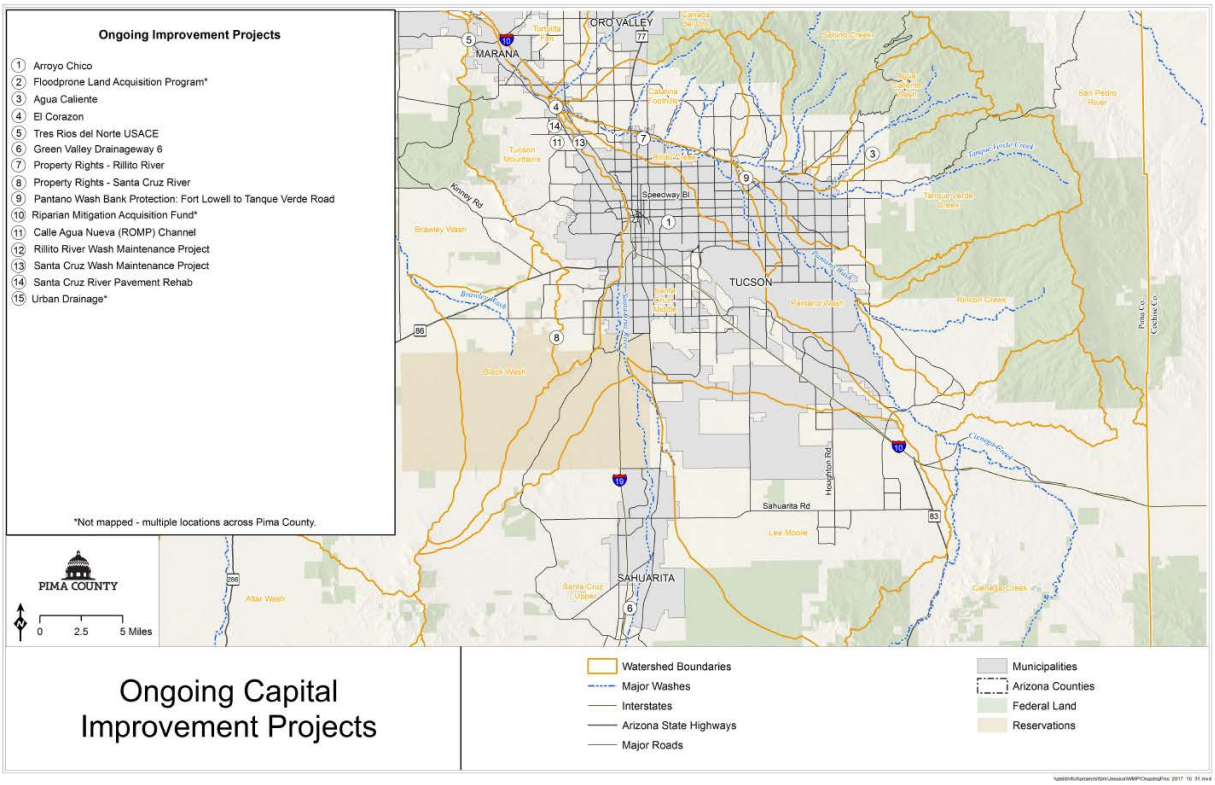
The District typically constricts projects in phases due to the complexity, cost and the mix of funding sources. For example, the Arroyo Chico Flood Control Project was a $31.6 million project with the USACOE, to relieve flooding along Arroyo Chico and tributary washes in central and downtown areas within the City of Tucson. The project was two phase: Phase I included the construction of the Randolph South Detention Basin, which was completed in 1997 at a construction cost of $7 million; and Phase II includes construction of four detention basins along the Arroyo Chico upstream of Park Avenue and a new storm drain system for High School Wash. The District completed construction during the reporting period, in spring 2015.

CIP Project Highlights

The following sections describe the projects completed during the reporting period. Large, on-going projects not completed prior to June 30, 2016 are also included. Figure 23 shows the location of each project.

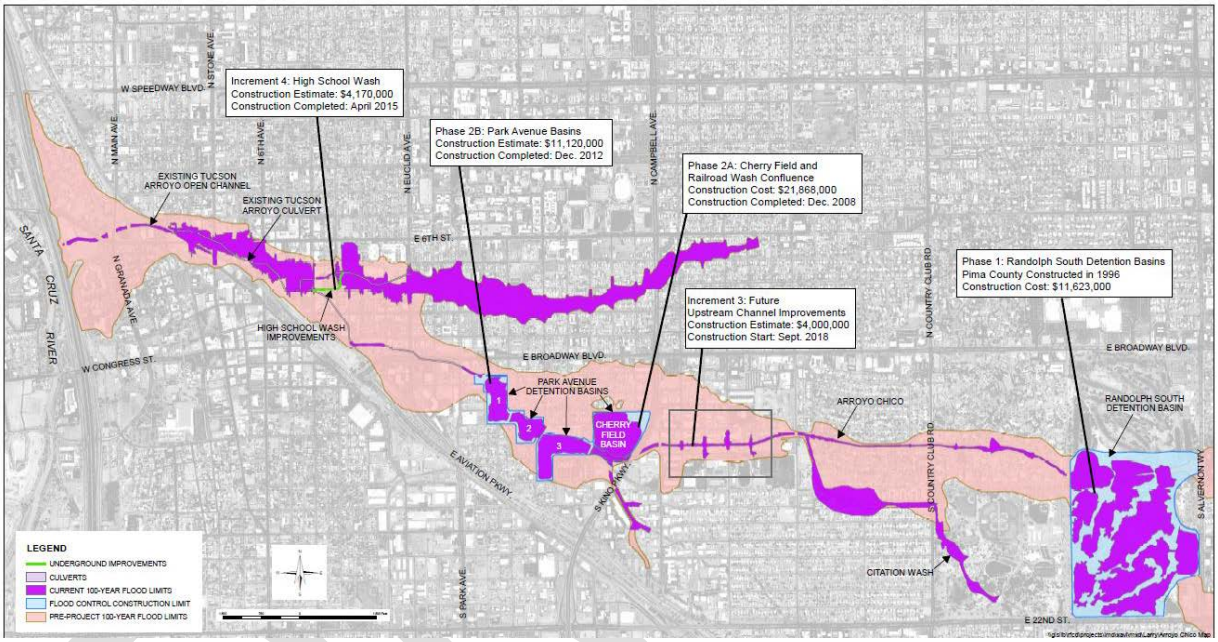
Figure 272 - Ongoing and Planned Capital Improvements Projects



Arroyo Chico Final Phase – High School Wash Box Culvert Storm Drain

The District and the City of Tucson, in cooperation with the USACE, have jointly undertaken a multi-phase flood control, environmental restoration and recreation project called the Tucson Drainage Area/Arroyo Chico Multi-Use Project. The phases of the project are Phase 1, Randolph South Detention Basins, completed in April 1996 by the District and the City of Tucson. Phase 2A, Cherry Field Detention Basin, completed in December 2008 by the USACE. Phase 2B, Park Avenue Detention Basin Complex, completed by the USACE in December 2012. Increment 4, High School Wash Storm Drain) started construction on June 2, 2014 and was completed in 2015.

Figure 273 - Arroyo Chico Phasing Plan



The High School Wash large box culvert is part of the contracted Phase 2B improvements. Using federal funds authorized on June 24, 2013, construction began on June 2, 2014 and completed in March 2015. At the request of the City of Tucson, the Board authorized an additional $1,500,000 for the District to construct drainage improvements in the form of enlarging a section of the main storm drain to handle additional flood flows and the addition of catch basins to remove street runoff, thereby reducing downstream flooding. The total cost of this additional work was $1,921,165.

The High School Wash box culvert storm drain consists of a 776 linear foot box culvert (12 ft. x 8 ft. and 10 ft. x 8 ft.) that connects with the existing 1930s vintage (10 ft. x 7.5 ft.) concrete box culvert located under Tucson High School. With the recently completed City of Tucson/Regional Transportation Authority (RTA) 8th Street Drainage Improvements that ended at 4th Avenue, the new storm drain efficiently moves storm flow from the inlet at Euclid east of Tucson High School into the new 8th Street storm drain system and ultimately into the Santa Cruz River. The project will significantly reduce flooding around Tucson High School and the 4th Avenue business district. The

estimated cost for construction of this increment was $4.2 million. The District completed this project in spring 2015.

Canada Del Oro River Park – Thornydale to Magee

Cañada Del Oro Wash is now bank protected from the Union Pacific Railroad on the south bank and from just west of Thornydale on the north bank to the Omni Tucson National Golf Resort. The project provided a river linear park between Thornydale Road and Magee Road plus a paved bike path connection to the Rillito River Park via Thornydale Road. It includes a paved pathway on both sides of the river, landscaping, irrigation, and six pedestrian bridges. There are also underpass ramps at Thornydale and Ina Road, a parking node at Magee Road with ramadas and a restroom, a parking easement at Thornydale, as well as a reclaimed water irrigation system.

Bank protection under construction

Lower Santa Cruz River Levee at Tangerine Road

The District completed improvements to the Lower Santa Cruz River Levee at Tangerine Road for $61,820. Constant low flows had degraded the flowline along a section of the Santa Cruz River to within a couple of feet of the existing toe of the bank protection. This project included relocation of the thalweg by replacing material against the existing bank that had been lost during previous large storm events. The design included placing riprap groynes to direct low flows away from the bank and create a thalweg that does not run adjacent to the toe of bank and to help re-establish protective vegetation along the bank. The District awarded the contract for project on March 5, 2012. Construction started immediately and completed by April 10, 2012. The District completed this project within schedule and for roughly 15% of the estimated cost. This is because the estimate was for extending the toe down depth. Switching to groynes saves cost and had the added benefit that a Section 404 permit would not be required.

Groynes placed to shift the low flow channel and allow vegetation to grow

Pantano Wash Phase 2 – Speedway to Tanque Verde Road

Construction of bank protection along Pantano Wash started November 2011 and completed in February 2013. The project included the construction of 4,300 linear feet of new soil cement bank

protection and paved river park pathways, landscaping, irrigation, and new underpasses at Tanque Verde Road and on the west bank at Speedway Boulevard. The project is located on the Pantano Wash between Speedway Boulevard and Tanque Verde Road.

Paseo de Las Iglesias

Phase 1 of the Paseo de las Iglesias project, located along the Santa Cruz River from Ajo Way to Silverlake Road, and funded by the 2004 Bond Election. Construction began in November 2013 and included extensive removal of buried and exposed debris and clearing of invasive species prior to the beginning of bank protection construction, completed in 2017. Work was also performed to clean and bank protect Julian Wash, expand Mission View Wash and begin construction of gabion terraces and culverts on a minor tributary south of Mission View Wash. Grading was performed on the top of banks to begin construction of the parking areas and restroom as well as staking for pathway and landscape irrigation lines. The artists selected to create public art for the project made site visits and began construction of their pieces for the site. The District coordinated multiple onsite tours for groups such as Pima County, the U.S. Army Corps of Engineers (USACE), Arizona Department of Transportation, Tucson Electric Power, University of Arizona, and the Arizona Riparian Council Conference.

Santa Cruz River – Grant to Camino Del Cerro

With the bank protection completed primarily before this reporting period, the Board authorized additional work, including installation of pedestrian bridges pictured here and paved pathway on the east bank.

This is another example of the District's flood safety projects providing multiple benefits including flood control, recreation, open space, riparian habitat corridors and neighborhood stabilization.

Pantano Wash Fort Lowell Road to Tanque Verde Road Flood Control Improvements (CIP)

In February 2018, the District along with its design consultant Psomas and contractor Borderlands completed the Pantano Wash Bank Protection and River Park project. The contractor completed the project under budget, saving the District $400,000. The Pantano Wash Bank Protection and River Park Project, located along the Pantano Wash between Ft. Lowell Park and Tanque Verde Road provided:

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- Construted bank protection along the banks of the Pantano Wash to protect from flooding and erosion hazards,
- Stabilized the channel bed,
- Provided River Park and passive recreational improvements that completed the Loop (a 131-mile urban paved pathway alternative transportation and recreational system along the major watercourses at connect and encompasses the Tucson metropolitan area).
- Protected riparian habitat within the existing flood prone lands,
- Developed a new restoration area which utilized storm water harvesting in a formerly degraded depression,
- Utilized storm water harvesting basins throughout the project,
- Reused onsite inert debris to create lizard habitat,
- Reused onsite inert debris and rejected cobble material for slope erosion protection,
- Provided public art, sitting areas and interpretive signage.

Sunrise at the new pedestrian bridge over Rose Hill Wash, showcasing its river inspired public art.

The project that closed the final gap in the Chuck Huckelberry Loop received a "Project of the Year" honor from the Southern Arizona Branch of the American Public Works Association. Funding for the $8.2 million project came from the Pima County Regional Flood Control District tax levy, a secondary property tax.

The completed and current CIP is shown on each watershed map in Chapter 5 and on the project webpage.

7.6.4 Drainage System Maintenance (CRS Activity 540)

Maintenance of improvements and open space is a significant component of the District budget and activity. FEMA defines the Drainage System as improved or natural drainages that require maintenance in order to prevent property damages. County wide there is 25,562 acres in this drainage system. This includes portions of the system located within incorporated areas that the District maintains. These are largely located along the major river corridors.

Infrastructure Division staff routinely conducts field inspections of the District's drainage structures for all major watercourses and regional detention/retention basins. As part of this program, District staff compiled a resource base of all construction plans for bank protection, levees, grade control structures and detention/retention basins. In order to monitor potential structural failure inspection staff created a cross-referenced filing system for inspection documentation including digital photographs.

The Chief Engineer approved a series of technical policies during the program period that establish infrastructure inspection and maintenance procedures. Infrastructure Management staff inspects, maintains and repairs watercourses and associated improvements that are owned or operated by Pima County or the District per these procedures. Tasks include repairing constructed improvements, removing sediment buildup, clearing vegetation and other debris, maintaining drainageway access roads, and grading channels to provide positive drainage. District Water Resources Division staff complements these drainageway inspections by monitoring natural areas. District Floodplain Management Division staff is also involved when investigating drainage complaints.

When internal resources are not available, contractors may be used. Additionally, through Inter-Governmental Agreements, the District maintains major watercourses, bank stabilization and other improvements within the City of Tucson, and the towns of Oro Valley and Marana. When conducting maintenance work, the District obtains appropriate permits from the USACE and notifies the U.S. Fish and Wildlife Service.

With sediment management becoming an ever-larger portion of District activity in major and minor watercourses, the following excerpt from the 2017/2018 District Annual Report emphasized this role.

Alamo Wash Sediment Removal

In April 2018, the District began removal of approximately 5,000 cubic yards of sediment in the Alamo Wash where it meets Rillito Creek just east of Swan Road. The project seeks to prepare the confluence ahead of the Monsoon, which brings more than half of the Tucson area's annual rainfall. A buildup of sand at that spot has lowered the capacity of the wash to handle storm runoff.

Contractors preserve stands of desirable vegetation while removing invasive species and other plant life that could contribute to flooding or hamper Flood Control's response. County-contracted herpetologists scoured the area and relocated dozens of lizards and other reptiles prior to commencement of work.

7.7 Flood Warning and Response (CRS Activity 600)

The 2017 score for this activity is 3,492 up 45 from the prior audit.

7.7.1 Flood Threat Recognition and Early Warning Dissemination

The District has advanced an Automated Local Evaluation in Real Time (ALERT) system that is the linchpin in the District's Flood Threat Recognition (CRS Activity 611) and Early Warning Dissemination (CRS Activity 611). The District's Flood Response Field Manual describes response procedures and needs in detail. Staff substantially updated it in November 2016, with interjurisdictional coordination described in the Pima County Hazard Mitigation Plan and Emergency Response and Recovery Plans, Dam O&M Plans.

Road Closure Due to Flooding

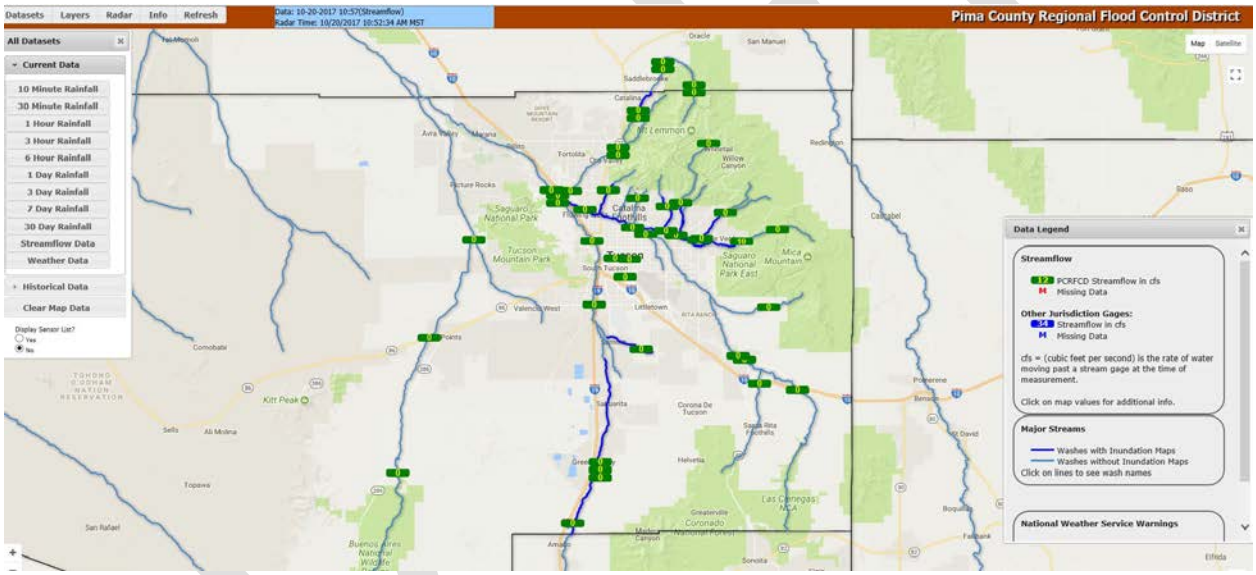
As one of our most used services, the District's ALERT Flood Threat Recognition System has been providing precipitation and stream flow data from a series of gages located throughout Pima County since 1981. The ALERT system is part of a three-way agreement with the National Weather Service (NWS), the Arizona Department of Water Resources (ADWR) and the District. The ALERT system initially provided advanced warning of potential flood flows on the Upper Cañada Del Oro watershed

from a breach of the Golder Dam. Federal and state financial assistance combined with funding from the District has allowed us to expand the ALERT system.

The system of gages now covers most of the large watersheds in eastern Pima County and currently includes 94 precipitation gages, 36 stream gages, and 5 weather sites. The precipitation gages relay rainfall amounts and intensities, stream gages measure the depth of flow in streams, and weather stations provide precipitation information plus wind speed, temperature, relative humidity and barometric pressure. This network of automated gages transmits data in real time to the District, NWS, and the ADWR office in Phoenix. The NWS uses this data to produce flash flood watches and warnings and ground-truth radar estimates of precipitation. District personnel utilize the information to assist emergency response agencies including the Pima County Department of Transportation's Maintenance Operations staff and the Office of Emergency Management during storm events. The public and responders may view data generated by these sites at:

https://alertmap.rfcd.pima.gov/gmap/gmap.html

Figure 274 - Screen Capture of ALERT Webpage



The rapid development of floods in many watersheds poses a significant challenge to adequate flood warning and as such, calibration of travel times as become a priority for the District in recent years. The table on the next page provides a summary of critical discharges and early warning criteria for known locations**.** The Flood Response Field Manual provides full operational details.

Table 74 - Early Warning Discharges

Flood Threshold Known to be Less Than 100 Year Flood			
Watercourse	Flood Level Threshold	100 Year	Critical Areas
Tanque Verde Creek	7,000 cfs (6.6 ft at 2093)	16,000 cfs 13.0 ft at 2093	South Bank – Tanque Verde Loop Rd to Houghton Rd
Tanque Verde Creek	8,000 cfs (7.0 ft at 2093)	16,000 cfs 13.0 ft at 2093	49ers Subdivision (North bank, west of Wentworth)
Tanque Verde Creek	11,000 cfs (4.2 ft at 2093)	16,000 cfs 13.0 ft at 2093	Woodland Rd Area (North bank near Tanque Verde Rd Bridge)
Tanque Verde Creek			
Canada Del Oro Wash	2,000-2,500 cfs (7.1-7.6 ft at 1079/1083)	17,500 cfs (7.25 at 1103*)	West Bank – just south of Meadowcrest alignment
Canada Del Oro Wash	2,000 cfs (7.1 ft at 1079/1083)	17,500 cfs (7.25 at 1103*)	West Bank – just north of Hauser Street alignment
Canada Del Oro Wash	875-1,500 cfs (5.2-6.4 ft at 1079/1083)	17,500 cfs (7.25 at 1103*)	West Bank – just south of Golder Ranch Rd Bridge
Canada Del Oro Wash	1,500-2,000 cfs (6.4-7.1 ft at 1079/1083)	17,500 cfs (7.25 at 1103*)	West Bank – just north of Rollins Rd
Rincon Creek	1,000 cfs (5.5 ft at 4113)	16,000 cfs (12.5 ft at 4113)	Ranchos Pequenos Subdivision

The improved website is more user friendly, presents our ALERT data more reliably and offers much more information to assist local communities, public safety agencies, researchers and the public about current weather conditions. The website provides real-time data from the streamflow and weather-monitoring stations run by the District and partner agencies, including National Weather Service, U.S.

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Geological Survey, Arizona Game and Fish, and Pinal, Cochise and Santa Cruz Counties. The list of available cooperator sites continues to expand and will be added as they become available.

The map display is built on a Google Maps structure which provides an easy to navigate, up-to-date map that can be viewed in either street- or terrain-view, and can display satellite imagery. Additionally, current radar images, both static and animations, can be displayed on the map along with National Weather Service storm warnings which appear on the map as a box outlining the affected area(s). At this time, flow depths and inundation areas including flood prediction are not available on a countywide basis.

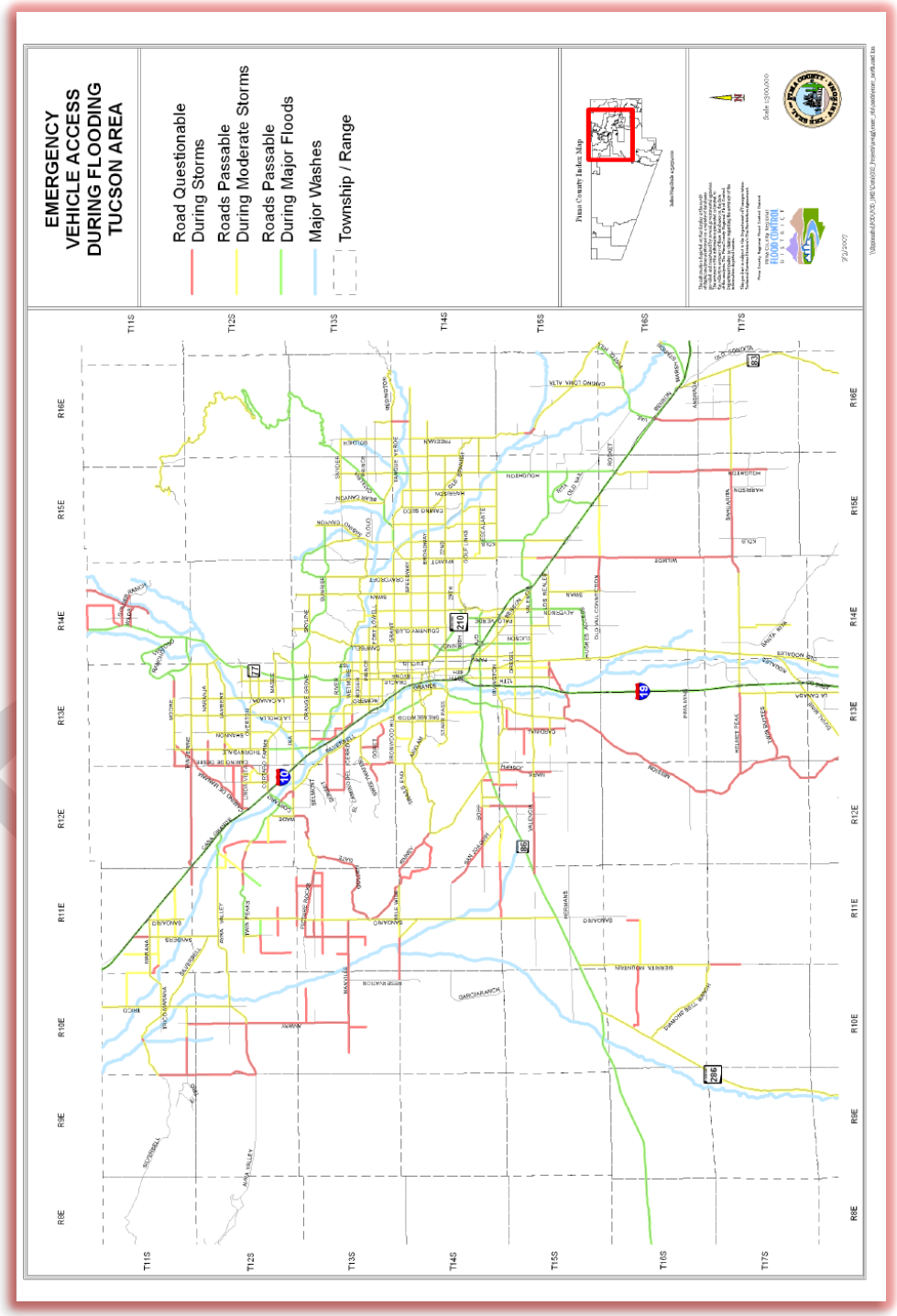
During the previous five years, numerous rainfall events resulted in road closures and roadway damage. This required close communication with the Pima County Office of Emergency Management, the Pima County Department of Transportation, and the NWS.

The ALERT system also guides emergency response by identifying where people, infrastructure and critical facilities may be in danger from the rising floodwaters. In addition to triggering warning and notifying responders, the District responds directly by dispersing staff to flooded locations to inspect infrastructure and respond to complaints or other calls for assistance.

The District Flood Response Field Manual (Administrative Procedure 202) guides staff conducting Flood Response Operations and includes forms for gathering information, handouts relating to flood recovery, cameras and checklists of places and criteria for record keeping. A levee and dam specific plan (CRS Activity 620/630) is contained in the "O & M Report". The Pima County Recorder's office has the O & M plan recorded in Docket 13162 at Page 701. A list of levees and dams maintained by the District is also included in the Flood Response Plan for reference by staff conducting flood investigations.

Since residents may not be familiar with which roads are impassible during flooding, the Program for Pubic Information committee has emphasized the need to increase outreach relating to road closures. The maps attached to our annual floodprone property owner mailing now include frequently flooded roads for route planning purposes. Figure 26 below shows this information.

Figure 275 - Map of Frequently Flooded Roads



The County maintains a road closure website and hotline, issues press releases and includes maps for frequently flooded roads in direct mailers to the community. The ALERT page allows residents; drivers and responders to determine when they should avoid certain wash crossings.

7.7.1.1 Rain Gage Volunteer Program

Since 1977, the District has operated a system of volunteer weather watchers, known as rain gage volunteers. The District provides participants in the program with a standardized rain gage and data sheets to record daily rainfall information. Participants may also provide information about the duration and amount of each storm. Volunteers submit the data to the District every two months, at which time they are compiled and recorded. Since July 2006, the network has averaged approximately 60 volunteers distributed across the entire metropolitan and outlying areas.

7.7.1.2 Flood Preparedness

The District, in cooperation with the USACOE, Arizona Department of Water Resources, and other state and local agencies continues working to develop the communication aspect of a statewide flood warning system. District staff participates in the Multi-Agency Task Force committee, which provides communication activities between jurisdictions and coordinate development and updating of the HMP and Emergency Response and Recovery Plan.

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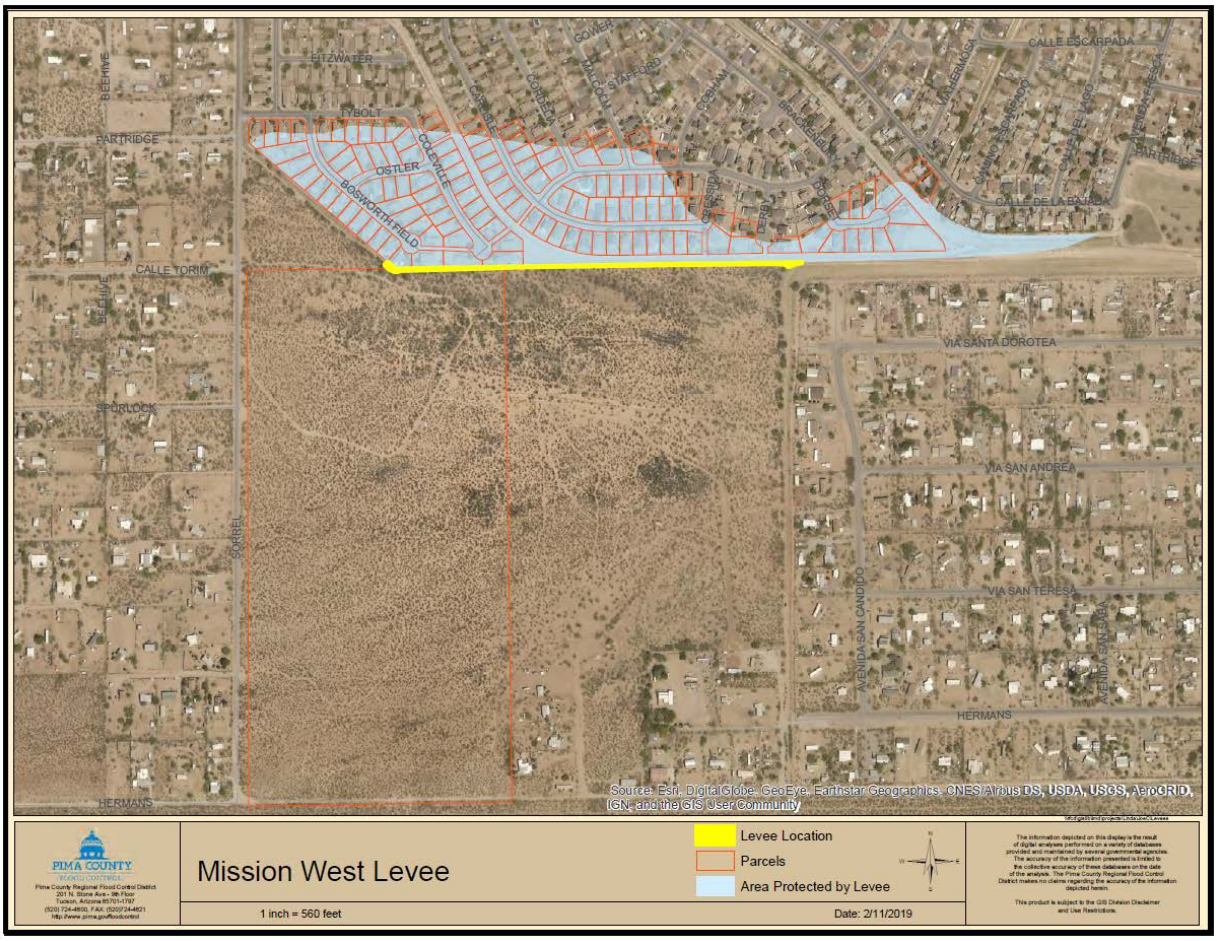
7.7.4 Levees (Activity 620)

Section 5.3 reports the estimated population, number and value of buildings and critical facilities located behind levees on Table 2. In 2019 for the first time the District expanded direct mailing outreach to these residents. This outreach included information on risks, availability of insurance, flood preparation and warning dissemination. This was a target audience identified in the 2019 PPI and appropriate because of the implementation of MyAlerts.com for direct warning notification. The District provided this notification to 2,192 properties, including to those in incorporated areas of Marana and Tucson, as well as unincorporated areas.

Figure 276 - Sample Levee Outreach Map



7.7.5 Dams (Activity 630)

The table below shows dams licensed by the Arizona Department of Water Resources.

Table 75 - Licensed Dams

National ID	State ID	Dam Name	Hazard Level	Owner
AZ00217	10.14	Murphy Reservoir	high hazard	Tucson Water
AZ00026	10.13	Kennedy Park	high hazard	PC
AZ00080	10.07	Leach Flood #1	high hazard	Phelps Dodge
AZ00210	10.16	Clearwell Reservoir	high hazard	Tucson Water
AZ00307	10.2	Park Avenue (aka Arroyo Chico)	high hazard	COT
AZ00265	10.18	The Lake	low	State
AZ00264	10.17	Twin Tanks	low	State
AZ00209	10.15	Green Valley WWTP	low	PC
AZ00132	10.08	Lower Rose Canyon	low	NPS
AZ00131	10.12	Arivaca	significant	AZGFD
AZ00273	10.19	Avra Valley WWTP	very low	PC

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