



Fiscal Year
2019-2020
A Year in Review



ON THE COVER



Rainbow seen in the New River Dam area

For 60 years, the mission of the District has been simple: we identify flooding hazards, inform the public about those hazards and develop solutions to reduce those hazards. In 1959, only three individuals were tasked with this mission. Today the District employs nearly 200 people with a variety of skills and backgrounds. Still, we are united by the same mission. This mission connects us to those that came before us laying the foundation and those that will follow us and continue the legacy we leave today.

During Fiscal Year 2019 - 2020, the District spent its resources refining the things we do best – protecting people and property from the impacts of flooding. 60 years of structures placed around Maricopa County have offered residents this protection, but the development and urbanization of the County has ushered in a new era at the District. Typical large-scale projects have given way to small-scale solutions to reduce neighborhood flooding. Major maintenance

and rehabilitation projects were worked on this year to ensure these flood control giants continue to provide this protection for the next 60 years.

Technology is not just our future but our present. Our use of smart technology like drones and tall-pot trees not only lead to more efficient projects but has also attracted national attention for our innovative approach to government.

As we look at the past and toward the future, I am honored to have been able to play a small part in that work and look forward to what the District will accomplish in the next 60 years.

Michael Fulton, Director

GAGE VS. GAUGE?

The District uses a number of different kinds of **gages**, but it is understandable to think that it is misspelled. Turns out, there is a debate between scientists and spell check. This difference comes from the work of a man named Fredrick Newell.

In 1888, Newell was appointed to the US Geological Survey (USGS) Irrigation Survey created to evaluate the potential for dams and canals in the western US. At that time, there was no practical way to collect daily streamflow records. Newell developed water measurement methods that are widely used by the USGS today.

Newell is reported to be the person responsible for the use of the spelling *gage* instead of *gauge*. He reasoned that *gage* was the proper Saxon spelling before the influence of other cultures added the **u**. Historians have also attributed influence to Newell for the adoption of *gage* in *The Standard Dictionary of the English Language*, the first dictionary produced by Funk and Wagnalls.

The District uses the spelling *gage* to be consistent with the USGS and other federal agencies.



IDENTIFY HAZARDS

9



ADMS/ADMP IN PROGRESS

462



SQ. MILES MODELED

PERMIT DEVELOPMENT

287



FLOOD USE PERMITS ISSUED

63



RIGHT OF WAY PERMITS ISSUED

7



SMALL PROJECTS

3



CITIES

50



HOMES WITH TARGETED FLOOD PROTECTION

MITIGATE IMPACTS

PROJECTS IN PROCESS

- Arizona Canal Diversion Channel Fence Repairs
- East Maricopa Floodway Low Flow Channel
- El Rio Pilot Project #2
- McMicken Dam Outlet Channel
- White Tanks Flood Retarding Structure No. 4 Outlet Channel
- 27th Avenue and Olney Storm Drain
- Durango Regional Conveyance Channel
- Rawhide Wash Flood Hazard Mitigation
- Sun City and Sun City West Drains
- Mandan Street Drainage Improvements

DAM REHABILITATIONS/IMPROVEMENTS

- McMicken Dam
- Vineyard Flood Retarding Structure
- Buckeye Flood Retarding Structure No. 1
- Powerline Flood Retarding Structure Channel
- Cave Buttes Dam Outlet

FLOODPLAIN DELINEATION STUDIES

- Lower Gila River Overflow
- Fountain Channel
- Hassayampa River
- Mesa Zone D
- Sunland Avenue Tributary

AREA DRAINAGE MASTER STUDIES (ADMS) AND PLANS (ADMP)

- Metro (Phoenix Area)75 sq miles
- San Tan West31 sq miles
- North Mesa20 sq miles
- Middle Indian Bend Wash34 sq miles
- Cudia City Wash14 sq miles
- Desert Mountain27 sq miles
- Downtown Mesa20 sq miles
- East Shea Road Corridor51 sq miles
- Sun Valley190 sq miles

COMMUNITY RATING SYSTEM/AFFORDABLE FLOOD INSURANCE

The Flood Control District of Maricopa County maintained its Class 4 Rating. This offers unincorporated county residents up to a 30% discount on their flood insurance.

RISK REDUCTION



ON THE ALERT

Every second counts when a flash flood is heading towards people and property, as they are quick, unpredictable natural disasters that pose grave danger to anything in their path. District personnel have made flash flood early detection and warning a top priority to protect Maricopa County from this hazard.

The District was recognized for its advancement in flash flood early warning and detection this year. Predicting how quickly water collects behind dams during a flood event is critical to flood warning for residents downstream of dams. New software was developed to collect data and estimate dam fill time and outflow, significantly improving early prediction capabilities and potentially saving lives and property.

This new software interfaces with the 356 precipitation gages throughout Maricopa and surrounding counties

and the 217 water-level gages on streams, channels and dams that make up the District's comprehensive ALERT network. The gage data is then transmitted back to the District in real time, using the data as the input to predict dam fill time and dam outflow. The software can self-correct the prediction results based on real-time measurements of water level values in the reservoir. With this tool, the Flood Warning Branch is alerted to the flood risk up to several hours in advance.

In addition to the dangers posed to Maricopa County's dams, river and wash crossings become increasingly dangerous when flash floods strike. This is especially true in the undeveloped and remote outer areas of the County where it can take hours for County crews to arrive and barricade the roads. The District's ALERT network stream gages collect data that activates flashing signs

found at these types of crossing. Drivers have the information needed to safely avoid the threat of flooded crossings. The District's continued commitment to using technology to provide maximum protection includes two sets of flashings signs installed this year on Skunk Creek in the New River area, one set at 19th Avenue and one set at Honda Bow Road.

In June 2019, the Woodbury Fire destroyed thousands of acres in eastern Maricopa County. Burn-scarred ground does not absorb rain effectively, and runoff creates an increased risk for flash flooding. By July, the District had already installed three new rain gages in the area, adding to the lead time needed to warn drivers of potentially dangerous road crossings. This quick reaction delivered immediate benefits to residents in the area before the end of the 2019 Monsoon.



EYES IN THE SKY

Proactively monitoring and maintaining the County's network of flood control structures is a top priority for the District – and a serious logistical challenge given the County's rough terrain and vast acreage. A drone program has been instituted to overcome these challenges, giving staff a bird's-eye view of all of District structures.

Drone photography creates significantly less expensive aerial mapping and delivers more accurate and actionable data faster than ever before. Drones reach remote facilities, often inaccessible to staff, providing that critical set of eyes to inspect the existing conditions of a structure. The drone program also assists the District in monitoring active construction projects across the geographically diverse County. Progress can be monitored and evaluated for adherence to design plan.

Most importantly, the District drones stand ready to safely view levee, dam, channel and basin performance in a flood event. Proactive and forward-looking, the drone program is merging the District's mission with 21st century smart technology solutions.



TIME SAVINGS

FY 2020 TOTALS

6.1

HOURS OF
CONSTRUCTION
MONITORING

12.9

HOURS OF
INSPECTIONS

12.8

HOURS OF
MAPPING

WORKING SMARTER

Precision is key when it comes to maintaining the complex network of flood control structures throughout the fourth largest county in the US. District staff frequently conducts field visits for projects, taking photos and noting the exact photo location, camera orientation and date the photo was taken. This data is collected and compiled into reports that are used by every workgroup within the District. Compiling this data from the field is a very time-consuming task that used to take from several hours to several days. District software engineers recognized the opportunity to return valuable time back to District engineers, hydrologists, planners and maintenance crews to do more of their work that keeps people and property safe from flooding.

The District needed to automate this process and reduce data collecting and compiling time down to minutes or even seconds. To that end, staff created a tool that automatically generates a photo location map, a PDF and PowerPoint that contains the index map and all field photos with detailed information, an organized digital folder system that stores photos by stops and a GIS file with live links to the photos. After a field visit in August 2014, one engineer spent six hours to manually process and organize these field notes and photos. This new software was recognized by the National Association of Counties for its ability to create a similar report in only 14 seconds.





STEM EDUCATION PROGRAM

The District has prioritized reaching the County's youngest residents to help them understand how urbanization can affect the way the water flows in the desert. The Science, Technology, Engineering and Math (STEM) program has lessons specifically designed for County school children. It is important to reach youth because they are receptive to new information and likely to carry flood safety messages home to their parents and other family members.

STEM programming also serves as an opportunity to show how the professionals at the District study, design, engineer, construct, monitor and maintain the complex network of flood control structures throughout Maricopa County. These lessons are

intended to supplement current curriculum and can be added to instruction about the earth's water and weather. Developed by a former educator, lessons have been updated this year to remain in alignment with Arizona Science Standards.

Curriculum is available for third through fifth grade, with a sixth through eighth grade unit under development. In these lessons, students participate in research projects, read background information about monsoons and look at real rain gage data. Hands-on lessons assist in introducing meteorology, emergency planning and engineering concepts. At the end of the unit, students create emergency preparedness plans, work in teams to solve flooding problems and

create public service announcements to warn the public of the dangers of flooding.

Each grade level unit includes lesson plans, PowerPoint slides, vocabulary cards and links to websites, videos and interactive tools. Schools can check out free resource kits with materials necessary for the hands-on components of the lessons.

District staff from all divisions and disciplines have attended STEM nights around the County, and new events are scheduled throughout the school year. A flood simulation model that demonstrates runoff in both a natural and urban environment is the main event. Staff is on hand to describe how designing, building and maintaining structures reduces flooding risk.

TALL-POT NURSERY

District structures add to the flood protection for County residents; however, these construction projects can have an impact on adjacent communities and the sensitive desert landscape. Projects continue to include a focus on limited disturbance, effective landscape restoration strategies and water conservation to minimize adverse environmental impacts. The climate in Maricopa County is arid desert, making it critical to choose appropriate vegetation suitable to survive the desert's harsh conditions.

The District adopted a growing method known as tall-pot planting in 2002. The District grows its own trees in an innovative nursery because commercially available trees are not suited for flood control projects. This growing method develops trees with deep root systems that mimic the natural growth habit of many native Sonoran Desert trees, allowing them to survive without supplemental irrigation after establishment. Tall-pot trees do not require supplemental water, allowing the District to reduce the use of potable water irrigation systems on many projects. This reduces operation and maintenance efforts as well as reliance on potable water for outdoor landscaping, all while allowing the District to



mitigate construction impacts in a cost effective way. Tall-pots mimic the natural growing process increasing the survivability. Most desert species have long tap roots that reach to find moisture. The length of these roots are several times the height of the above ground stems.

When it is time to install, a hole is drilled and the tall-pot tree container (a PVC pipe) is placed into the hole. The container is removed, leaving the plant in the pit. This allows the tall-pot container to be reused keeping operation costs low. Dirt is filled in around the roots, and the tree is watered thoroughly. Rain and stormwater runoff will continue to provide water for the tree throughout its lifetime.

To date, more than 12,000 tall-pot trees have been planted and an additional 4,000+ trees are planned for several upcoming projects. The nursery grows several tree species and has the capacity to produce up to 8,500 trees concurrently, at a unit cost much lower than a traditional landscape nursery tree and irrigation system.

LANDSCAPE ARCHITECTURE AND GREEN INFRASTRUCTURE



The District has a long history of using desert landscaping and effective landscape restoration techniques in flood control projects. The first aesthetics policy was adopted in 1979 and has evolved over time. Residents have come to expect the District to plan, design and construct flood control facilities that preserve natural desert open space, enhance the local community image and provide opportunities for multiple uses including both passive and active recreation (like desert greenbelts and urban parks). The focus from that initial policy has shifted from merely creating more aesthetically pleasing structures to using trees, shrubs and natural vegetation to aide in flood control. Using the original, undisturbed characteristics of the desert allows the District to mimic the flood control measures found in nature.

Green infrastructure, a component of Landscape Architecture, allows the District to incorporate more cost effective, longer lasting and easier to maintain alternatives to the concrete channels that dominated early flood control measures. District design features include water harvesting basins that accept stormwater runoff for use as a native revegetation water source. This nature-based approach treats stormwater like the valuable resource it is and nearly eliminates the need for expensive, ongoing irrigation.



27TH AVENUE AND OLNEY

Monsoon 2014 brought significant flooding to Maricopa County, and cities and towns looked to the Flood Control District to help those neighborhoods that were flooded. The flooding was particularly heavy, even disastrous, for those in Laveen. Homes in the Southern Hills and Citrus Mountain Neighborhoods found themselves in deep waters when streets quickly turned to rushing rivers. Several neighbors had to rebuild multiple times over the next few years.

In response, District planners and engineers focused efforts on the critically affected area, completing an updated area drainage study. The update evaluated flooding hazards and developed alternatives

that could help reduce flooding for Laveen area residents. One of these proposed alternatives was the 27th Avenue and Olney Avenue project.

This large project consists of several flood control components. A combination of basins and storm drains, the completed project will reduce the flooding risk by capturing and safely conveying the stormwater away from roads and homes to a final regional retention basin. The regional basin was built in 2016 near 27th Avenue and South Mountain Avenue. The basin has collected monsoon rains, providing some relief for neighbors in the area. The District partnered with the City of Phoenix to build three more basins near 23rd

Avenue and Olney Avenue. District engineers determined these interim measures, including the basins that came into service this year, would provide additional relief.

The District's work is not complete - a storm drain along 27th Avenue is being designed to transport the water from the three new basins to the large basin at 27th Avenue and South Mountain Avenue. The design should be complete in the summer of 2020. The total project is anticipated to be complete and in place in time for Monsoon 2021. This small-scale solution is a prime example of the District advancing its mission while adapting to the changes brought on by urban development.



RAWHIDE WASH FLOOD HAZARD MITIGATION PROJECT

Rawhide Wash is the third largest wash in Scottsdale. It starts north of the McDowell Mountains and runs through Scottsdale southwesterly into Phoenix towards the Central Arizona Project Canal. During a 100-year flood, the high flood flows and rapid water velocities would create a serious flood hazard. Flood flows often create new channels and cause flooding in areas that are not next to the existing wash. This area is identified by FEMA as a special flood hazard area.

The project was a proposed alternative of the Pinnacle Peak West Area Drainage Master Study. Engineers are currently focused on designing a floodwall and levee system to contain the 100-year flood. Existing floodwalls have been evaluated. Improvements will need to be made to those walls, and new walls must be constructed to provide continued protection.

Once design is complete, the plans will be submitted to FEMA for their review. This will be the start of the process towards remapping the floodplain, reducing the amount of buildings in the high hazard area. Construction of the project is anticipated to start in 2021.

More than 1,000 Phoenix and Scottsdale homes, businesses and other structures are within this 100-year floodplain and are at potential risk – the District and its regional partners are working together to provide additional flood protection to these residents and property owners.



EL RIO PILOT PROJECT #2

Salt cedar, introduced in the 1800s for erosion control, grows significantly denser than native riparian plant species. This dense growth can increase the risk for flooding along rivers like the Gila River in western Maricopa County. In the Southwest, native ecosystems provide high-quality wildlife habitat as well groundwater recharge and improved water quality. While revegetating areas dominated by salt cedar can take 20 to 25 years to reach its maximum environmental benefits, the District considers this an excellent opportunity to continue its investment in the protection of life and property while respecting the natural environment.

District staff have started work to remove 15 acres of salt cedar from the Gila River west of State Route 85 as part of the El Rio Pilot Project #2. Duplicating the successful activities of the first

pilot project, salt cedar will be removed and native, desert-appropriate vegetation will be planted in its place.

El Rio Pilot Project #1, partially funded by a Gila River Indian Community gaming grant, removed 27 acres of salt cedar trees and revegetated with native species using pole-planting and tall pots. Tree removal was completed in three weeks, ahead of schedule due to the innovative use of a masticator attachment. Tree mulch was used on-site to save hauling and landfill costs and was spread over the site to retain moisture for future plants.

The revegetation area has been divided into three areas. 500 cottonwood and willow poles were planted in the first zone where the groundwater is the shallowest. This section proved to be

challenging to tree survival, so the District planted nearly 300 tall-pot trees in the second phase of the project. The deep-planting technique requires no additional irrigation and has high survival rates. Nearly two years later, 60 percent of the tall pot trees are alive in the project area. More importantly, significant native vegetation has begun growing back on its own.

The project team is cautiously optimistic about the results thus far – no irrigation was brought into the site allowing for the natural river and rainfall to feed the new vegetation. However, a drop in groundwater levels and low rainfall caused the team to closely monitor the survivability of the new vegetation. Maintenance of the area is also key. To achieve the desired density, 1,600 new plants will be planted over the next few years.



DESERT MOUNTAIN ADMS

The District is currently conducting an Area Drainage Master Study (ADMS) in the Desert Mountain area. The Desert Mountain area is a small, 15 square mile area that includes residential homes, commercial areas and undeveloped land.

In an area drainage master study, the project team identifies the flood hazards in a specific

area based on the conditions that exist. Data is collected from engineering modeling, physical surveys and meetings with property owners and others.

The results of the Desert Mountain Study will be used to determine if additional actions are needed to help protect property owners and development from flooding hazards. Results

can also be used to guide future development as well as help plan drainage infrastructure.

The project team is in process of mapping the 100-year floodplains along the major washes. This will make flood insurance more affordable for the homeowners that wish to buy it. Concept solutions are also being developed by the team to provide options for residents to reduce their flood risk.



DURANGO REGIONAL CONVEYANCE CHANNEL

The construction of the Durango Regional Conveyance Channel (DRCC) Phase 2 is complete. The channel was originally proposed as a part of a regional drainage plan in 2001. At that time, the land was mostly agricultural, but 13 housing developments have since been planned for the area along the project. The District resolved to get out in front of the development to provide flood control for this growing area of the County.

Twenty years later, more than 7,000 homes are found in this area.

The DRCC was, in concept, a combination of a channel, box culverts at the road crossings and basins. Designed to move a 100-year flow, it would ultimately empty into the Agua Fria River. Like many complex,

regional projects, the DRCC was broken down into three separate phases.

The first portion of this multi-phased project was completed in 2010. The District then partnered with the City of Phoenix to build a channel, basin and storm drain. This laid the foundation for the entire project. Two years later, the District and City of Phoenix partnered again to start design on phase two. Phase two was designed to add three basins and four miles of channel continuing on from phase one at 75th Avenue and traveling out to 107th Avenue.

Construction of the three basins in the next portion started in May 2018. Two of the basins are located at 87th and 89th Avenues where rainfall runoff will gather from the surrounding homes. A final basin caps the end

of the conveyance at 107th Avenue. Flows from the channel will gather in this basin until phase three can be constructed. All three basins can be transformed at a future date into recreational spaces, adding value to the neighborhoods surrounding them.

These initial improvements provided relief to more than 2,000 homes and even more developable lots. Now with the addition of future phases, 4,500 more homes, three elementary schools, several areas of agricultural land and thousands of developable lots benefit from increased flood protection.

In the future, phase three will continue the channel down to the Agua Fria River. Committed to continue its work in this area, this part of the project is currently in the planning stage at the District.



ACDC FENCE REPAIRS

The Arizona Canal Diversion Channel (ACDC) was originally completed in 1994. The 20-mile channel winds through portions of Phoenix, Glendale and Peoria.

Where the channel transitions from an earthen channel to a concrete one, a fence was installed to provide protection to the

residents surrounding the channel as well as District staff.

During regular inspections, Operations and Maintenance staff identified that several sections of the fence along the channel were deteriorating. This posed a significant safety risk to the community and the integrity of

the structure. Maintenance crews made temporary improvements to these sections as engineers designed a replacement fence.

The project is scheduled in three phases. During the replacement and repair of the fence, the multi-use path has remained open for use.



maricopa.gov/floodcontrol



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Construction of 115th and Union Hills Project