



**FLOOD WARNING  
PROGRAM SPECIALIST**

**FLOOD CONTROL  
DISTRICT OF MARICOPA  
COUNTY**

**CHANDRA MILLER, CFM**



# Background

## Post-College

- 2001-2005 Western Oregon University
  - Bachelors of Science in Earth Sciences and a Minor in Chemistry
- 2006-2008 **Environmental Specialist**
- 2008-Present **Hydrologist/Flood Warning Program Specialist**
  - Hydrology
  - Meteorology
  - Flood Warning
  - Programming and Software Development
  - Geographic Information Systems (GIS)

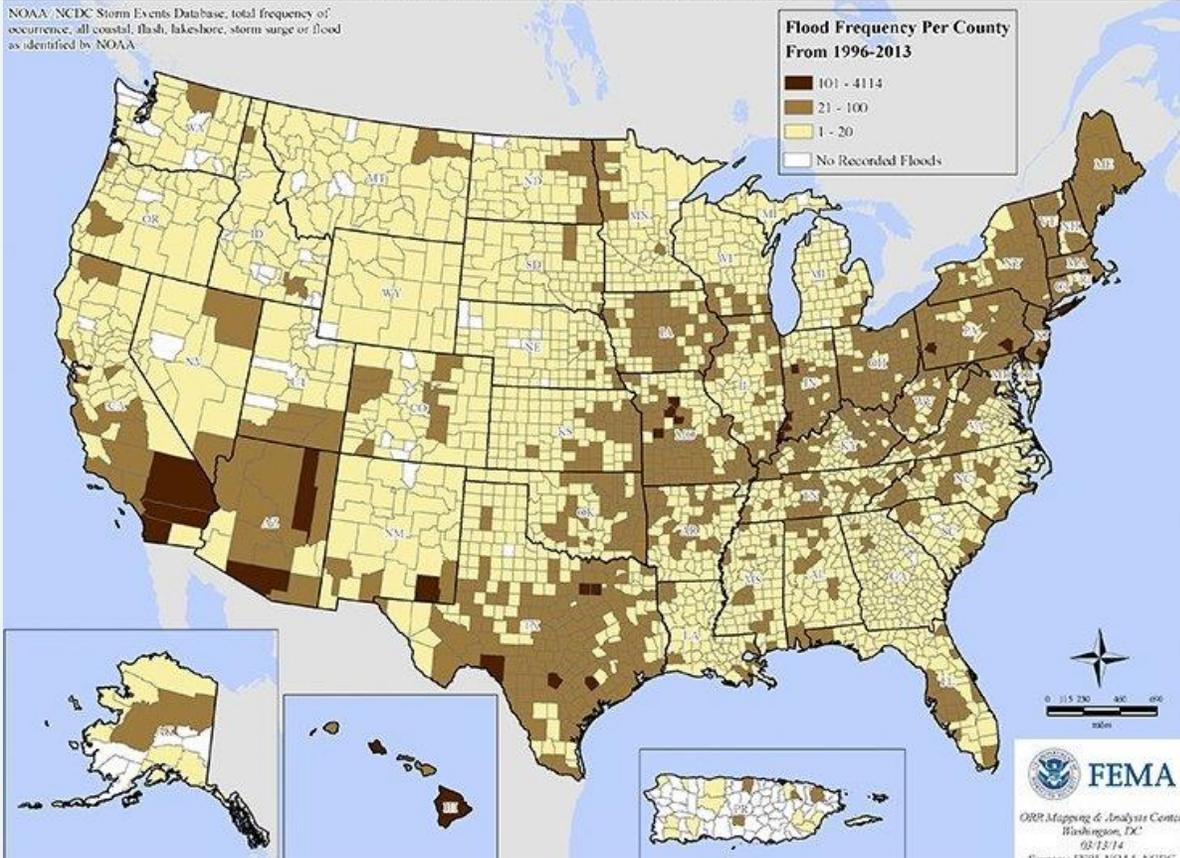
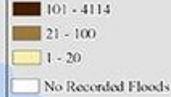
# Flood Warning & Response in an Arid Environment



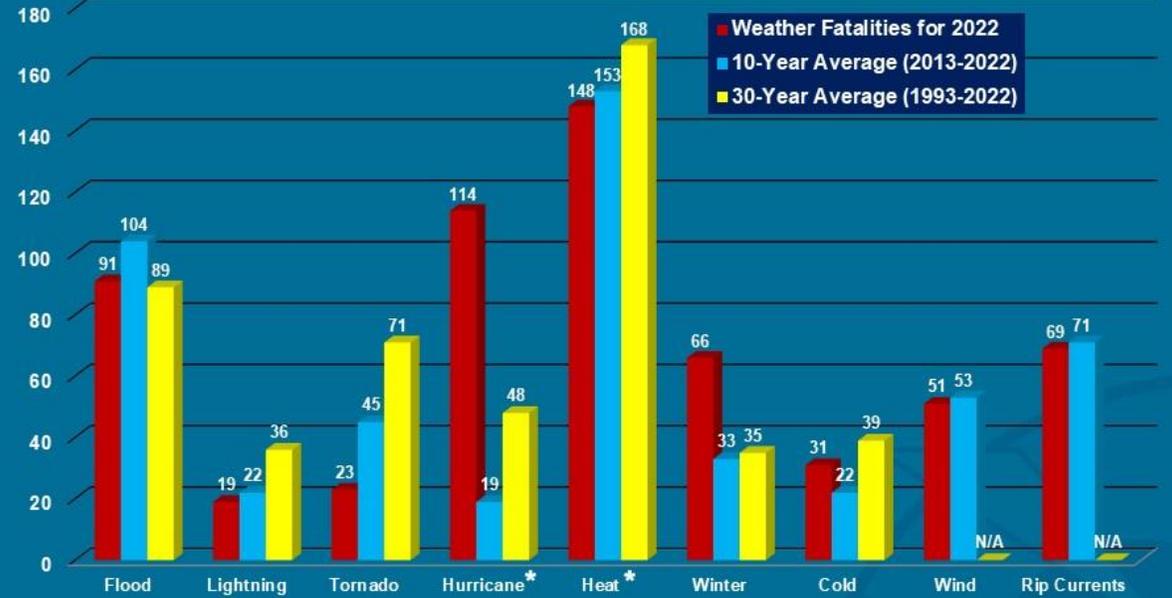
### Frequency of Flood Events by County: 1996-2013

NOAA/NCEP Storm Events Database, total frequency of occurrence, all coastal, flash, lakeshore, storm surge or flood as identified by NOAA.

#### Flood Frequency Per County From 1996-2013



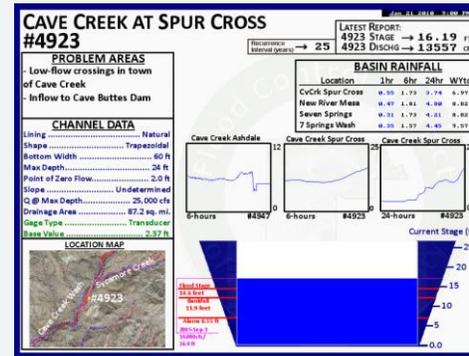
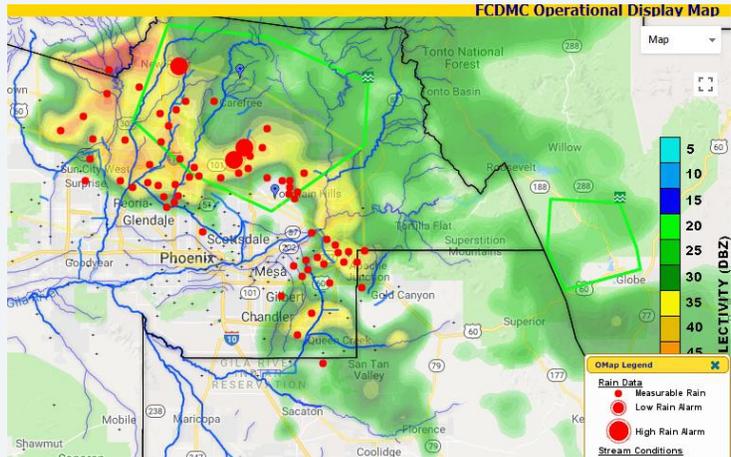
### Weather Fatalities 2022



\*Due to an inherent delay in the reporting of official heat fatalities in some jurisdictions, this number will likely rise in subsequent updates.  
 \*The fatalities, injuries, and damage estimates found under Hurricane/Tropical Cyclone events are attributed only to the wind.

# The Team

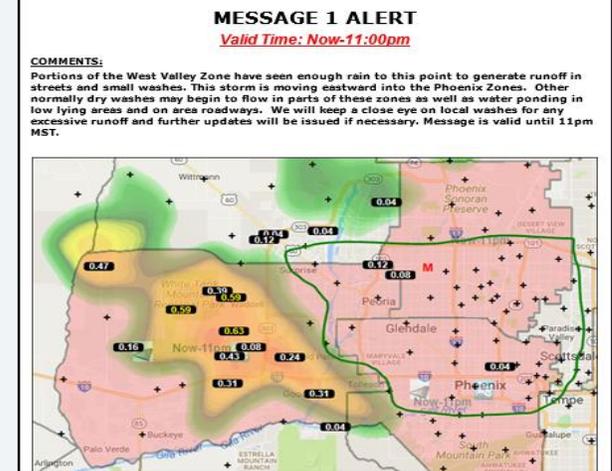
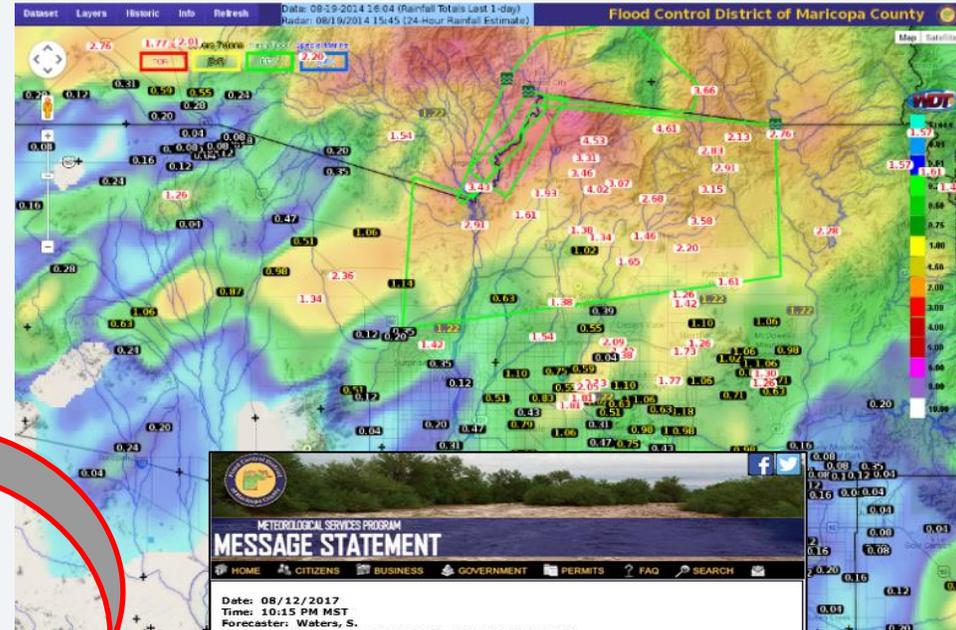
## A day in the Flood Warning Branch



**FCDMC Internal Significant Events**

Record #	Source	Position	Name	Phone	Submitted	Last Update	Attachments
1934	FCDMC Winter 2018 Training	FCD Alert Room Operator	Michael Jones	602508820	11/27/2018 09:04:55	11/27/2018 09:19:43	
Team 2 verified Dreamy Draw Dam gauge at 10.57 ft - 09:06:54 on 11/27/2018		FCD Operations and Maintenance - FCD OM at 09:08:09 on 11/27/2018					
Dreamy Draw Dam retaining water		FCD Alert Room Operator - FCD Alert at 09:04:55 on 11/27/2018					
1931	Test new flooding location	FCD Hydrology and Hydraulics	Kathryn		11/27/2018 08:58:51	11/27/2018 09:08:03	
Test new flooding location		FCD Hydrology and Hydraulics - FCD HHI at 08:58:51 on 11/27/2018					

# Operation Flood Warning Program



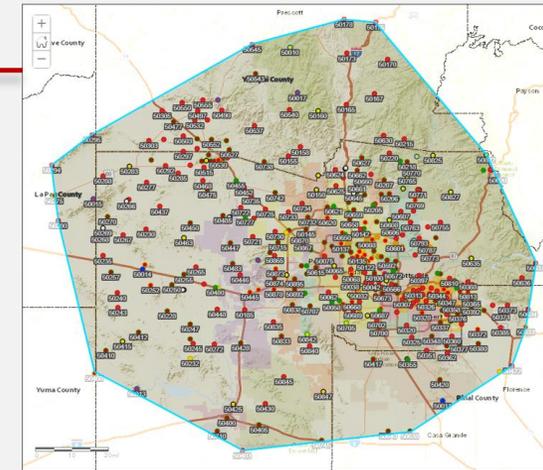
# FCDMC ALERT System Inventory

Area: 11,505 mi<sup>2</sup>  
Perimeter: 395 mi.

Updated 11/14/2023

## ALERT Stations – 412

- Rain Sensors – 362
  - *Density: 1 gage per 31.8 mi<sup>2</sup>*
- Water-level Sensors – 215
  - *On Rivers, Washes & Channels – 142*
  - *On Dams & Basins – 68*
  - *Status Sensors (dry/wet) – 5*
- Weather Stations – 40
  - *Temperature/Humidity Sensors – 40*
  - *Wind Speed/Direction Sensors – 35*
  - *Barometric Pressure Sensors – 24*
  - *Solar Radiation Sensors – 23*
- Flashing Roadway Signs – 7 pairs



# Flood Warning Program

## Meteorological Service Program (MSP)

- FCDMC has an in-house meteorologist
- Provide real-time flood-related information to agencies and the public to protect lives, property, and flood control structures.
- Our Responsibilities
  - Flood Structures (Dams and Levees)
  - MCDEM
  - County Departments & Agencies (Local & State)
    - FRPs, EAPs, Weather Messages, Lake Alerts, Maricopa Flooded Roadway Response Program, etc.

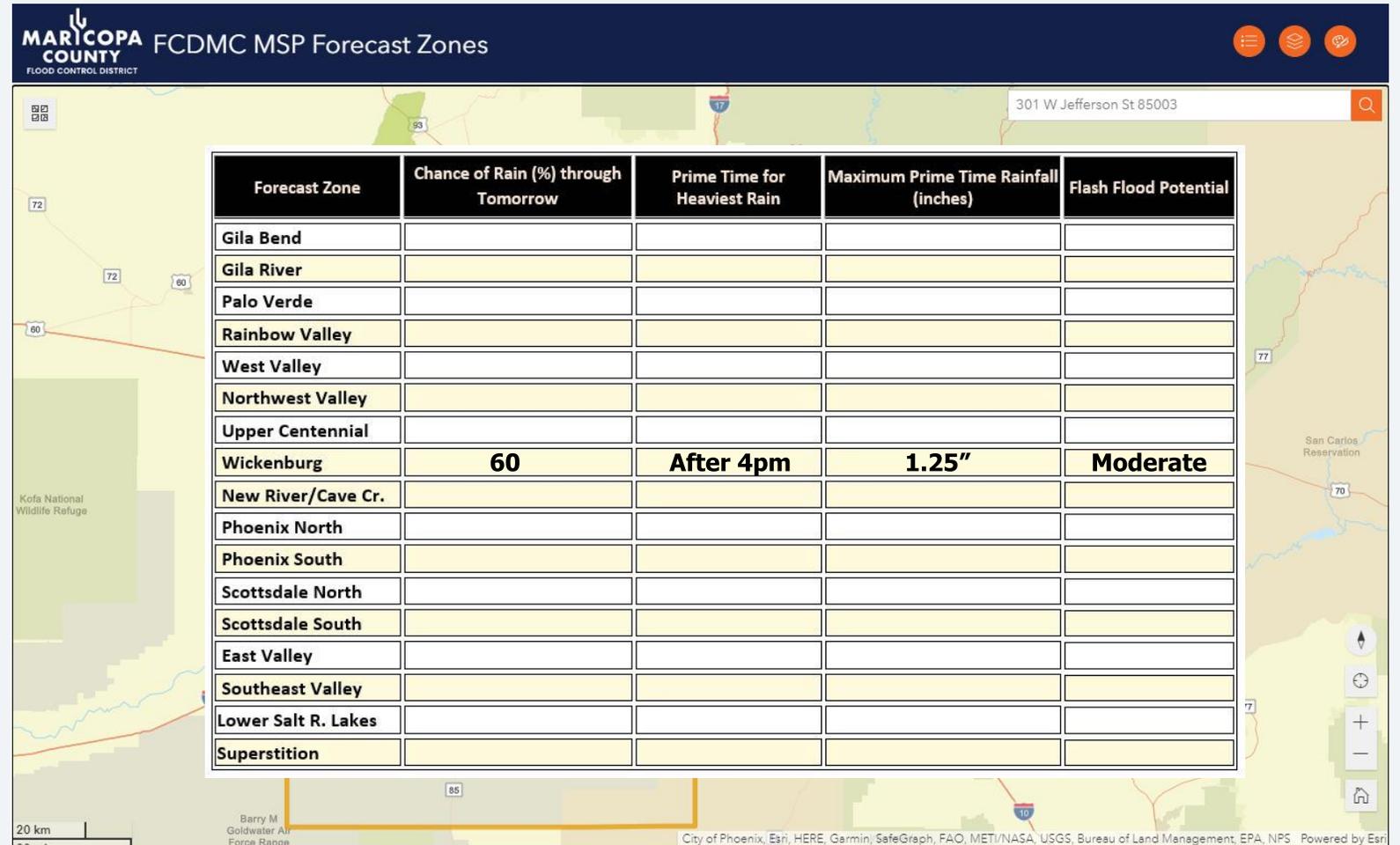
## *Some Things We Don't Do...*

- *Warn the Public Directly*
- *Close Roads or Bridges*
- *Initiate or Oversee Evacuations*
- *Deliver or Place Sandbags*

# MSP Forecast Zones

## Maricopa County

- 17 forecast zones
- 6 lake zones





Wednesday March 15, 2023

## Wet and Unsettled

We've got lots to talk about as our rain system today bringing increased breezy cooler conditions. We'll see two distinct systems quickly exit the state of showers and light/moderate rain is expected to continue to push east across the county this afternoon, a second wave possible this evening lasting into the night and possible minor flooding impacts (see this below). Moving ahead, the system general clearing and drying conditions showers. Daily highs will also step up Thursday and into Friday

[Read the full story](#)

## Precipitation

Forecast Zone	Chance of Rain (%) through 12pm Tomorrow
Gila Bend	^
Gila River	
Palo Verde	
Rainbow Valley	
West Valley	
Northwest Valley	
Upper Centennial	
Wickenburg	Lower Deserts: 80%
New River/Cave Cr.	Higher Terrain: 80-100%
Phoenix North	
Phoenix South	
Scottsdale North	
Scottsdale South	
East Valley	
Southeast Valley	
Lower Salt R. Lakes	
Superstition	v

# METEOROLOGICAL SERVICES PROGRAM MESSAGE STATEMENT

03/15/2023 @ 9:30 PM MST by Waters, S.  
Phone: 602-390-7804 (Work Cell)

## MESSAGE 3 ALERT

**Valid Time: Now-11:00pm**

### COMMENTS:

- A cluster of strong t-storms are moving east at 20 mph across portions of the Wickenburg forecast zone.
- Rainfall potential: 0.10"-0.25" with localized greater totals around 0.50" possible if storms stall out. Stronger cells in the cluster will also be capable of infrequent lightning, small hail and strong wind gusts.
- This zone has already received a round of rainfall earlier this evening and additional heavy rain may lead to flooding issues.

### FLOOD THREAT:

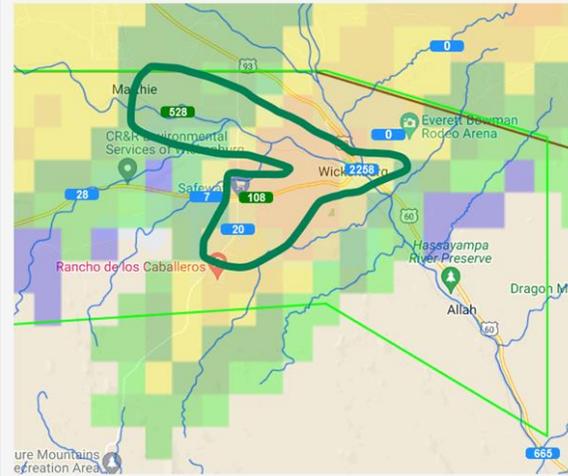
Moderate/Elevated

### AFFECTED WASHES/ROADS/STRUCTURES:

Normally dry washes are flowing in parts of the zone as well as water ponding in low lying areas and on area roadways. Cansandro and Powder House Washes are already flowing. Sols Wash should be given **immediate** attention. We will keep a close eye on local washes for any excessive runoff and further updates will be issued if necessary.

### AREAS OF GREATEST CONCERN (highlighted in green below):

Areas south of US 60.



AREAS OF GREATEST CONCERN WITHIN THE ZONE(S) ARE HIGHLIGHTED IN GREEN

This weather statement is not intended for public dissemination. Please expedite this information to affected emergency response organizations (police, fire, transportation, etc.) within your area. Also, please take appropriate actions to prepare for possible flooding. Further information will be provided as it becomes available.

Get real-time rainfall, streamflow, and weather information



Click to view the ALERT Interactive Data Display (AIDD) Map

### Flood Threat Categories



Click for explanation of Flood Threat categories

### Looking for custom products, maps, plans?



Click to view our custom products

### Forecast Zone Locator



Click to view the interactive map

### Experience Flooding?



Click to use the Report a Flood Tool

CONTACT US

PREFERENCES/UNSUBSCRIBE

SUBSCRIBER HELP

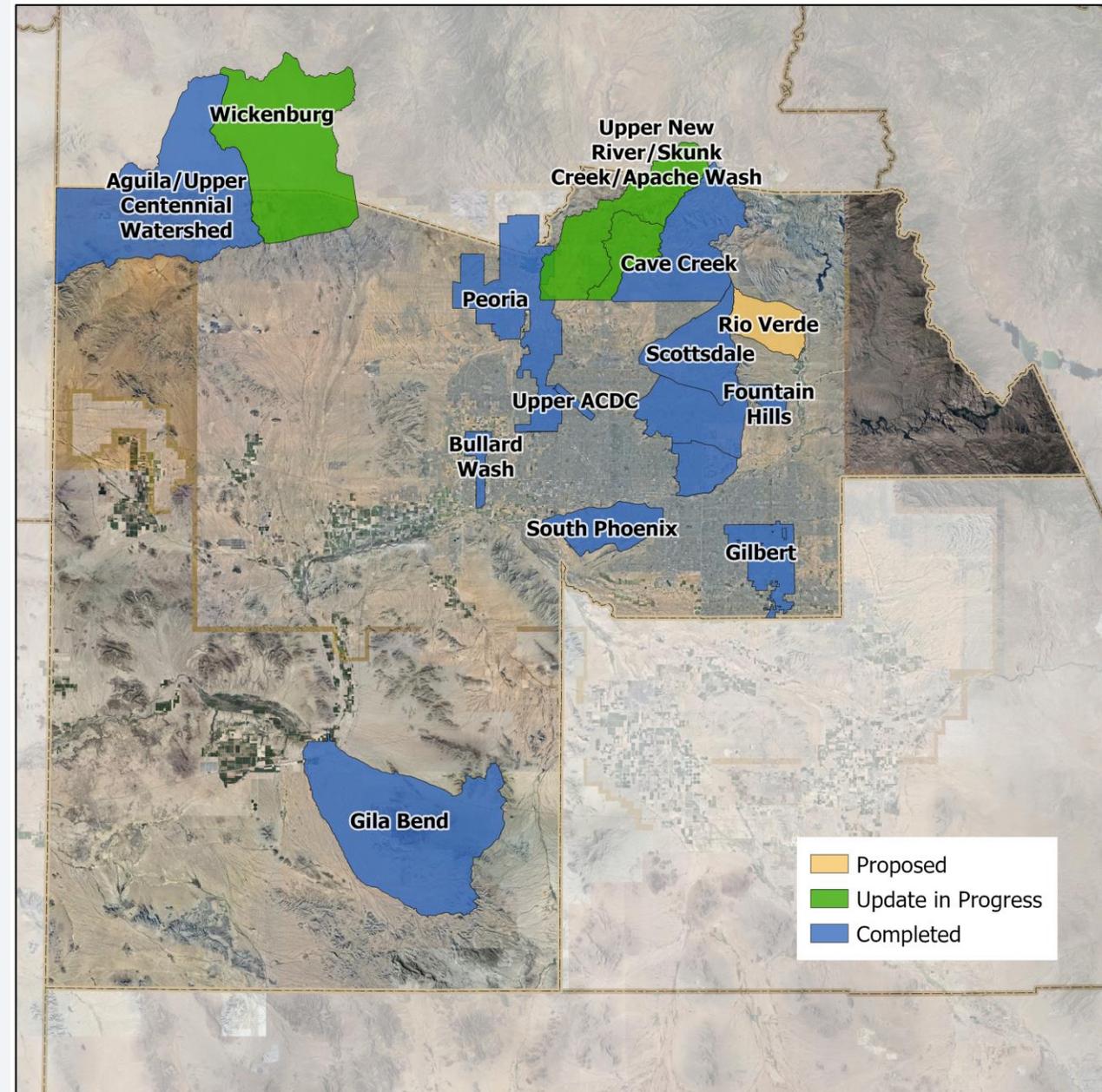
Departments

Search

# Purpose of a FRP

## Wickenburg Flood Response Plan

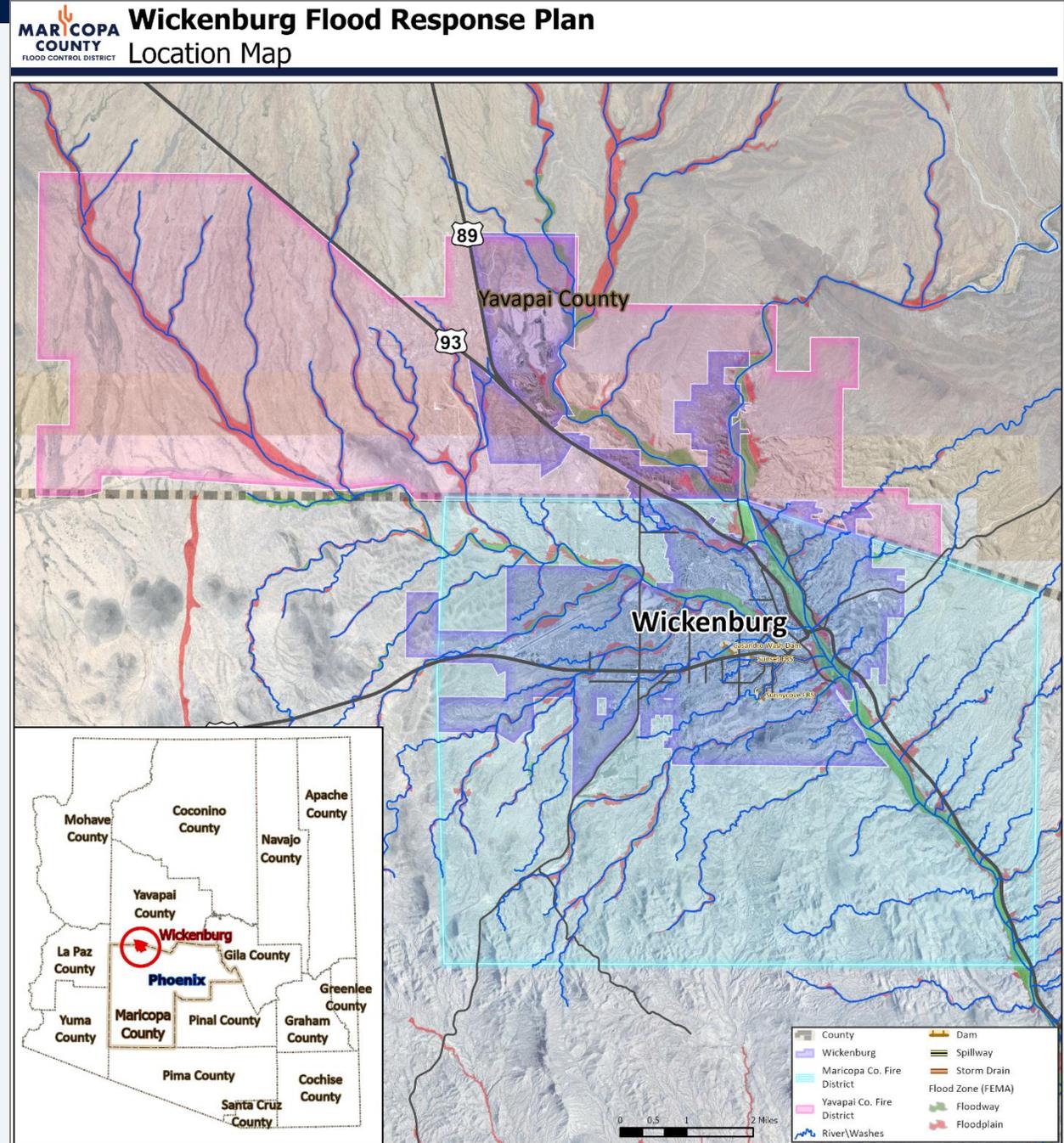
- Formalized communications and warnings
- Different departments know what to do
- Plan of action and potential leave time
- Varying levels ready-set-go



# Location

## Wickenburg Flood Response Plan

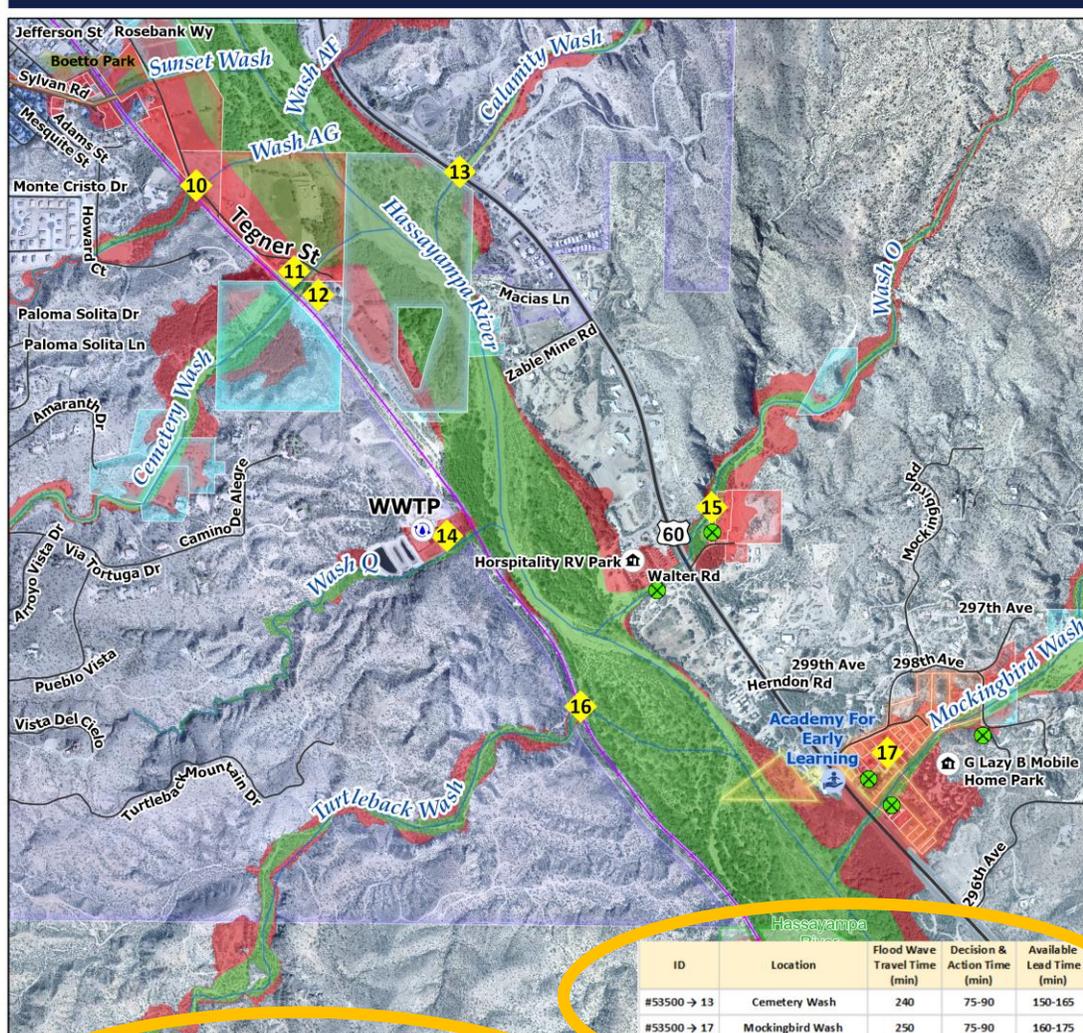
- FRP is town and wash/river based
- NW of Phoenix in Maricopa County
- Includes
  - 26 sq mi of incorporated town
  - Total of 166 sq mi that Wickenburg Fire serves



# What are the key part to a Flood Warning Program?

1. Alert Protocol
2. Actions Required
3. Potential Trouble Areas
4. Critical Times





**Alert Level**

**RED**

**Locations of Concern** - See East Flowchart

- 10. Tegner Street Structures at Risk of Inundation on Wash AQ.
- 11. Local Flooding at Cemetery Wash at Confluence.
- 12. Monitor BNSF Railroad Embankment at Cemetery Wash.
- 13. US60 at Calamity Wash may be Overtopped.
- 14. Wickenburg Wastewater Treatment Plant at Risk of Inundation on Wash Q.
- 15. Structures at Risk on Wash O East and West of US60 - Evacuate Hospitality RV Park.
- 16. Monitor BNSF Railroad Embankment at Turtleback Wash.
- 17. 298<sup>th</sup> Ave Structures at Risk East of US60 at Mockingbird Wash - Evacuate G Lazy B Mobile Home Park.

- Denotes Private/County Road Not Barricaded by the Town of Wickenburg  
Note: Jurisdiction of the Wickenburg Police & Public Works Departments is within the Town limits only.

**Legend:**

- Wickenburg
- Crossings
- River/Washes
- Recreation
- Mobile Home Park
- Wastewater Treatment
- Child Care Facility
- Flood Zone (FEMA)
- Floodway
- Structures in Floodplain
- SFR (32)
- Mobile (17)
- Multi-Family (1)
- Commercial (3)
- Other (21)
- Dam PMF Zone

Scale: 0, 0.1, 0.2 Miles

# Flood Vulnerability and Alert Levels

- Each alert describes an intensity or likelihood of flooding in Wickenburg.
- Weather Outlooks, Message 1, 2 and 3

# Flood Response Plan Components

- ALERT protocol
- Actions required
- Potential trouble areas
- Critical times

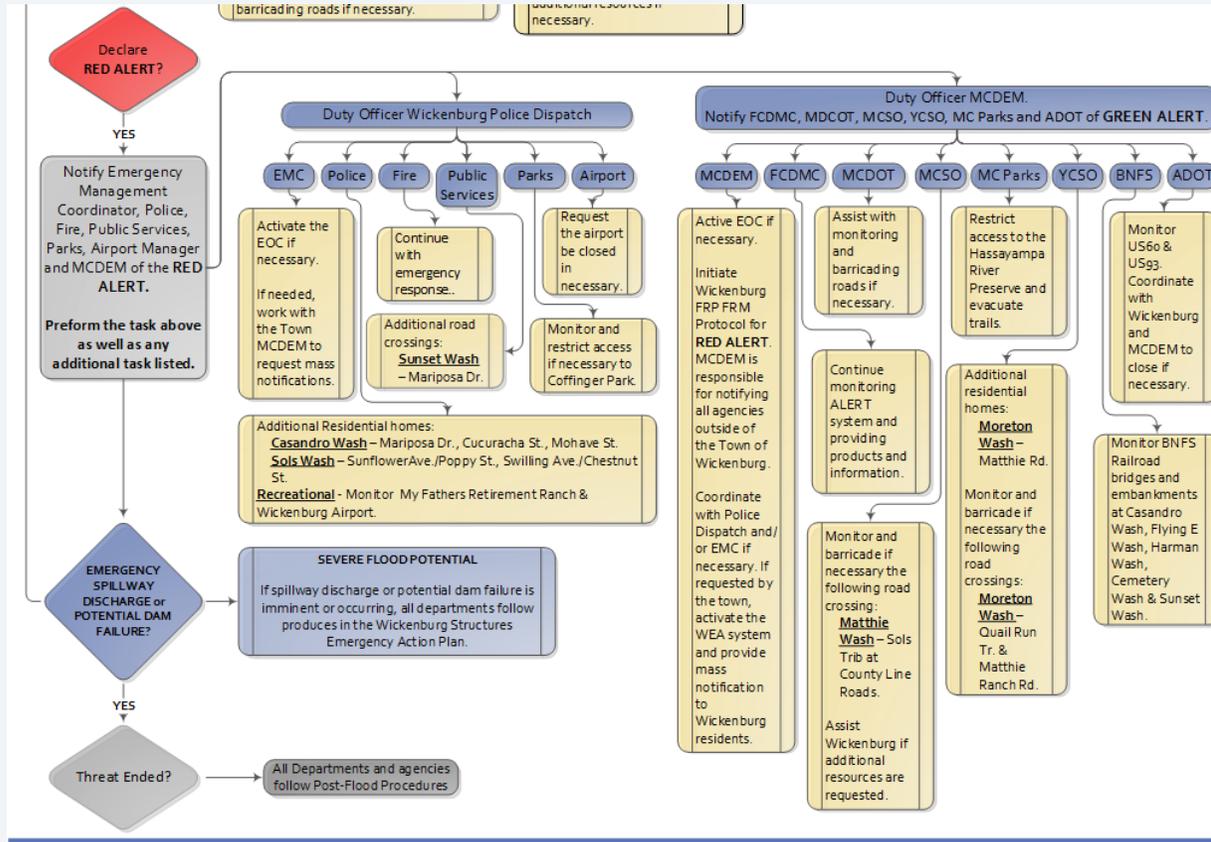
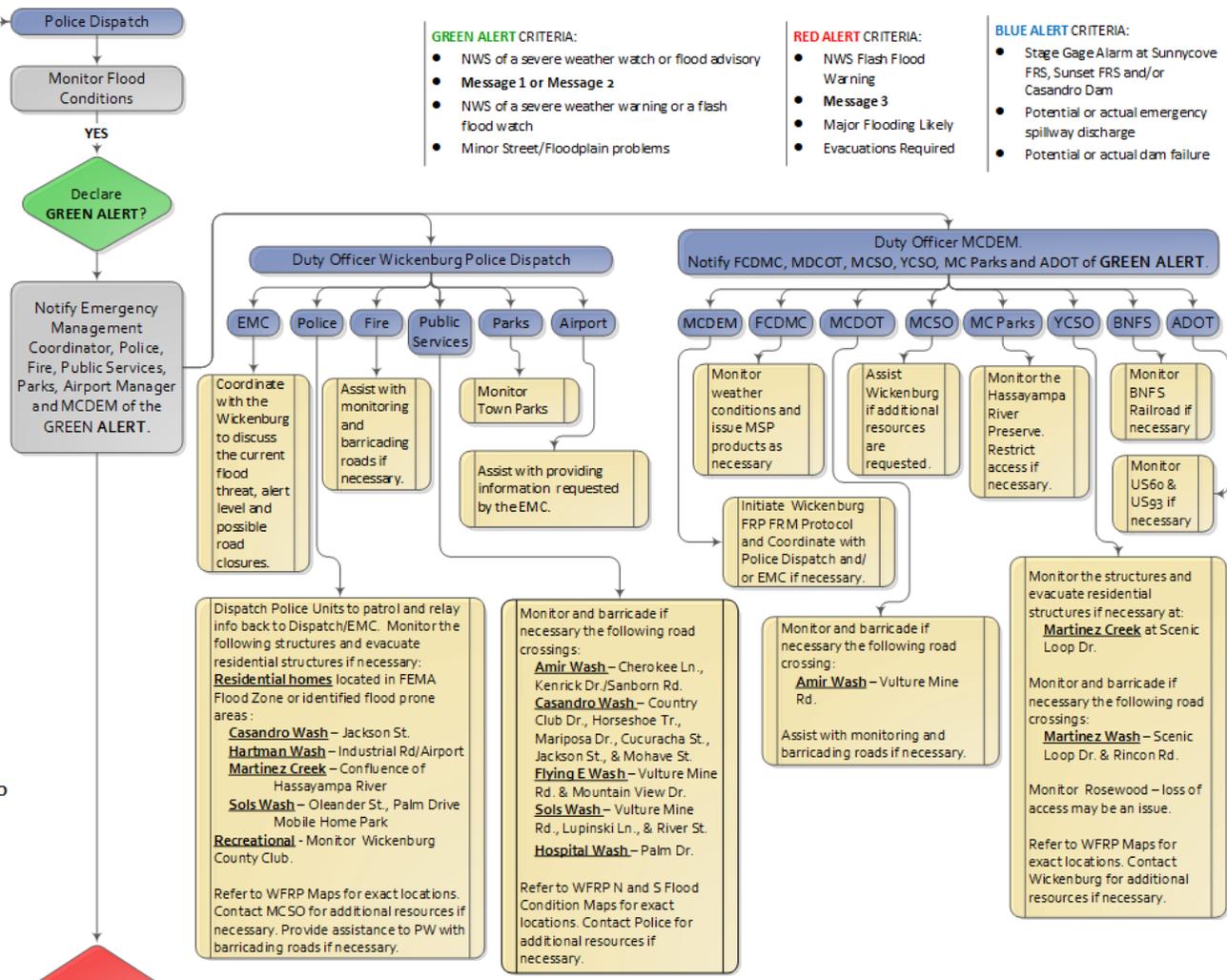
# Dissemination of Information

## Wickenburg Flood Response Plan

- Town of Wickenburg Police Dispatch is tasked with declaring **Green Alert**, **Red Alert** or **Blue Alert**
- Town of Wickenburg is tasked with notifying FCDMC and MCDEM at a **Red Alert**
- MCDEM is tasked with notifying all other agencies that are not within the Town

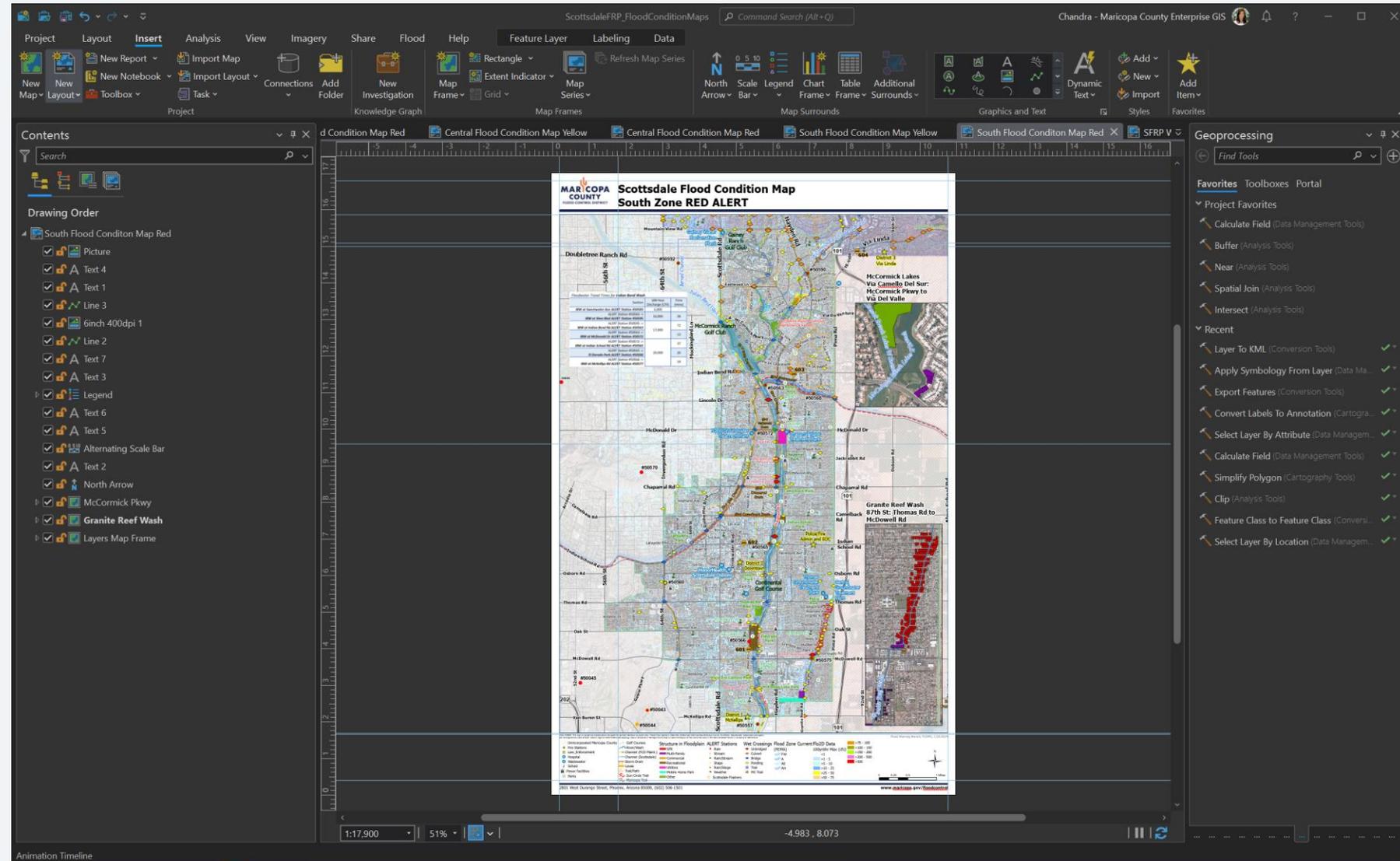
# Wickenburg Flood Response Plan – North Flowchart

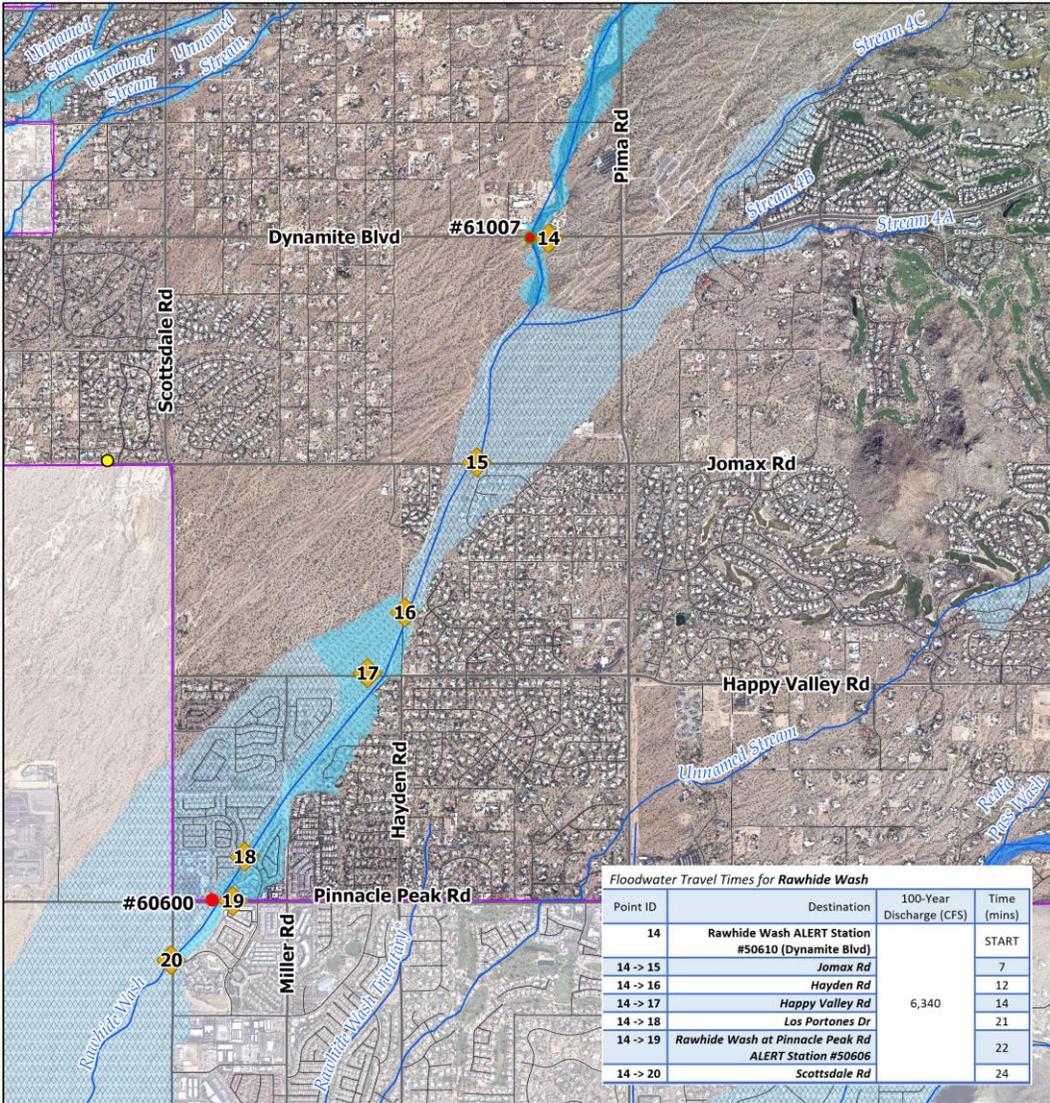
## GREEN and RED ALERT Operational Procedures Flowchart



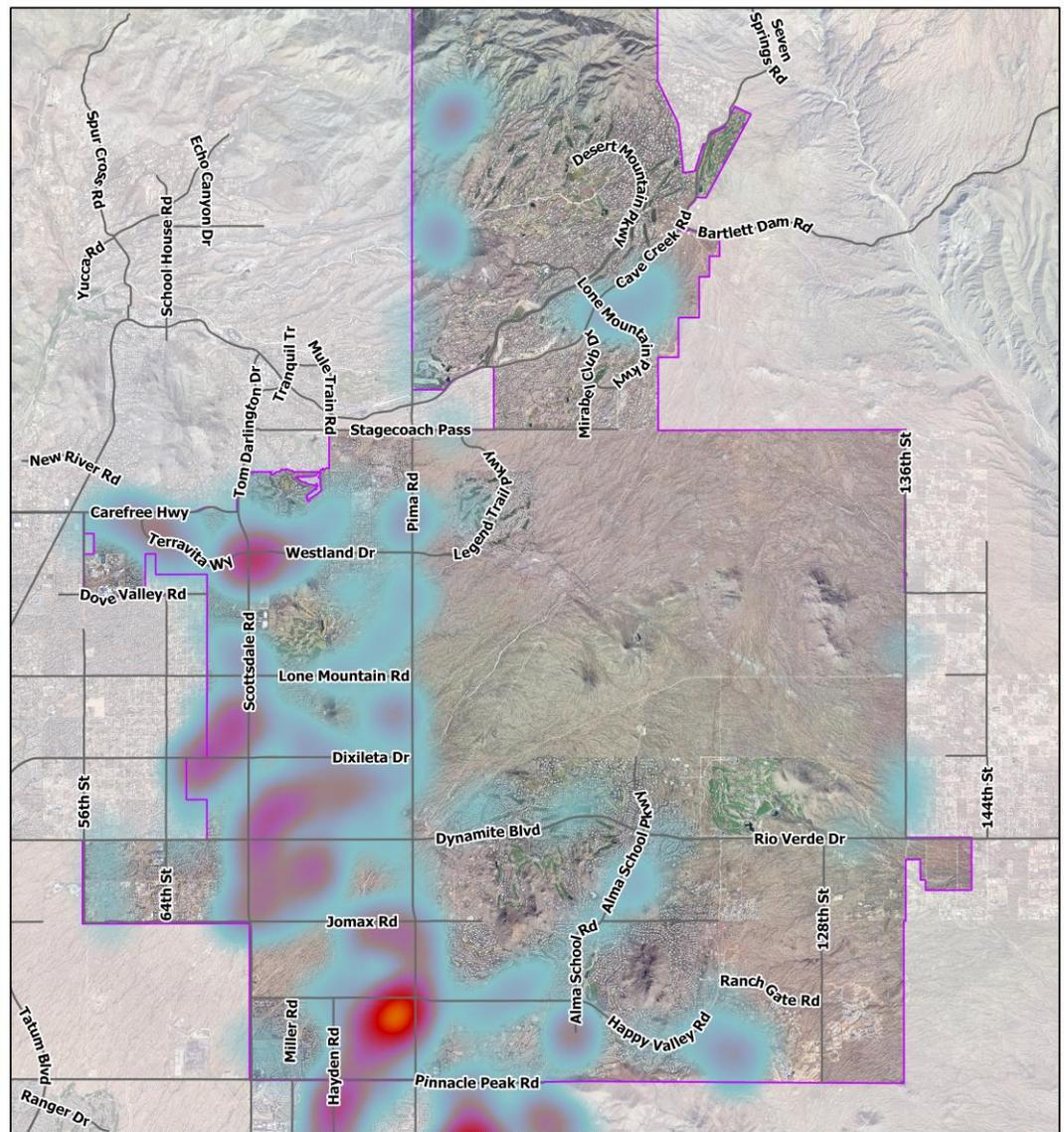
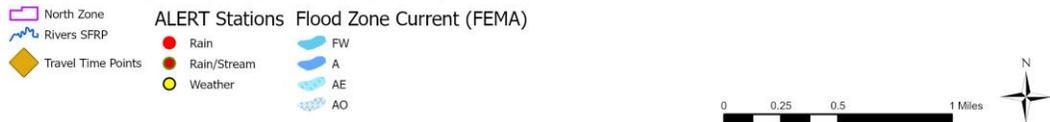
# ArcPro >>> ArcMap

- 2019 started using ArcPro exclusively
- Organization – one project and one geodatabase with multiple layouts/maps
- Cartography and legends way easier





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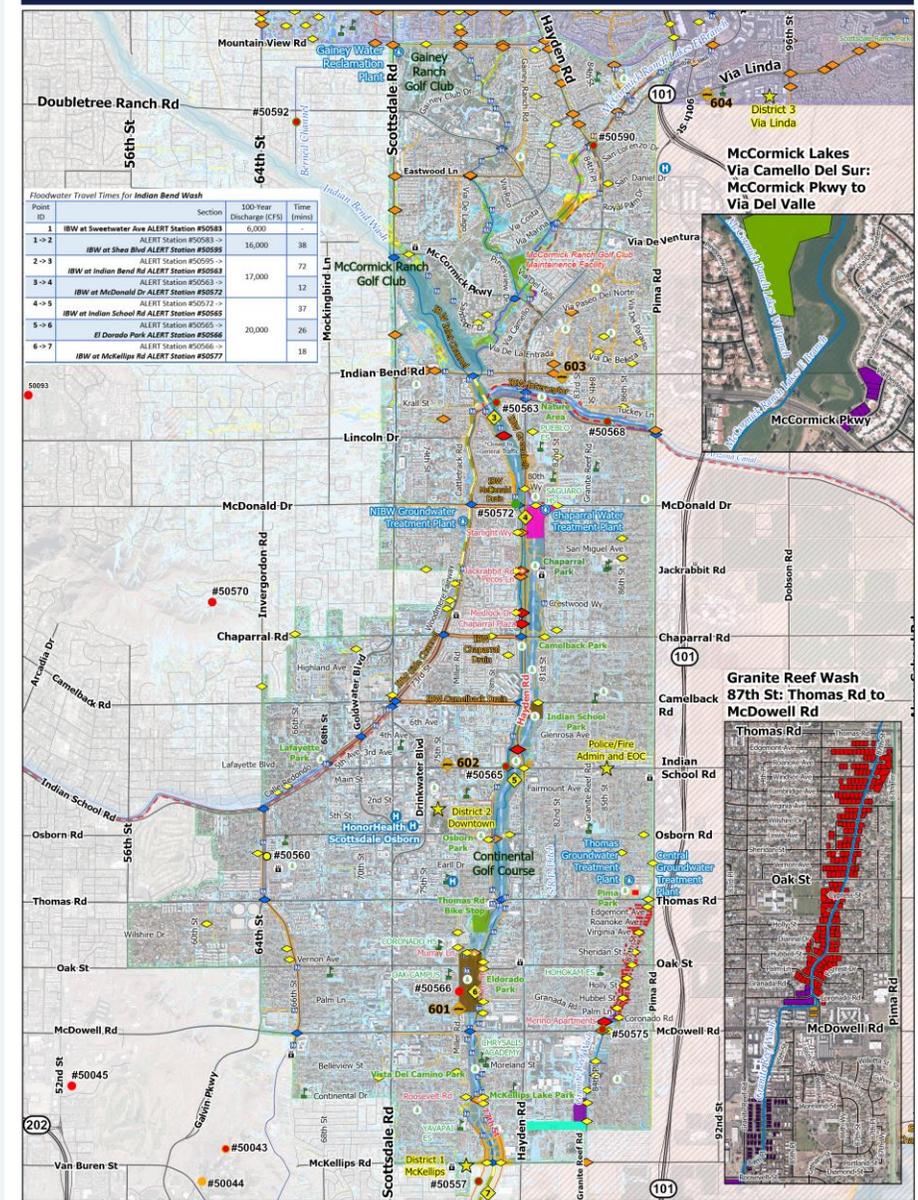
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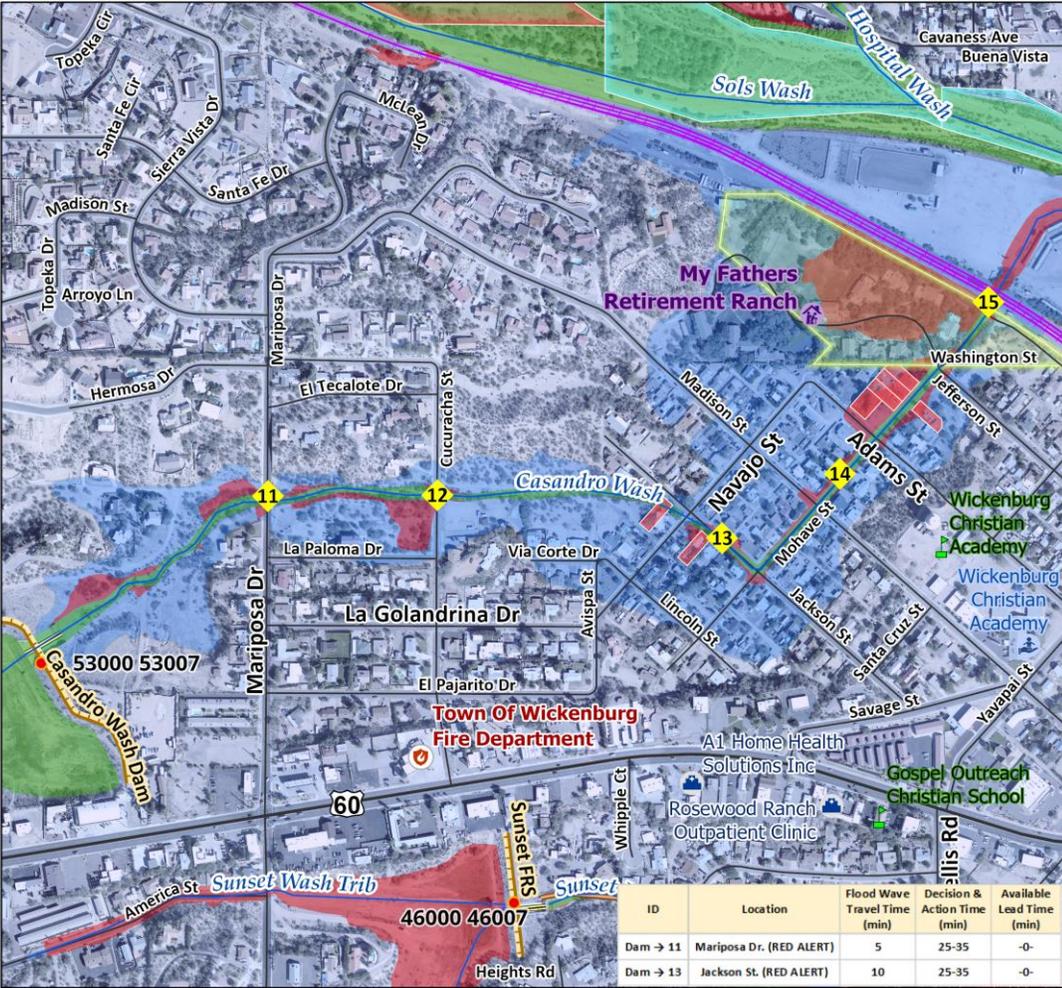


**MARICOPA COUNTY**  
FLOOD CONTROL DISTRICT

# Scottsdale Flood Condition Map

## South Zone RED ALERT





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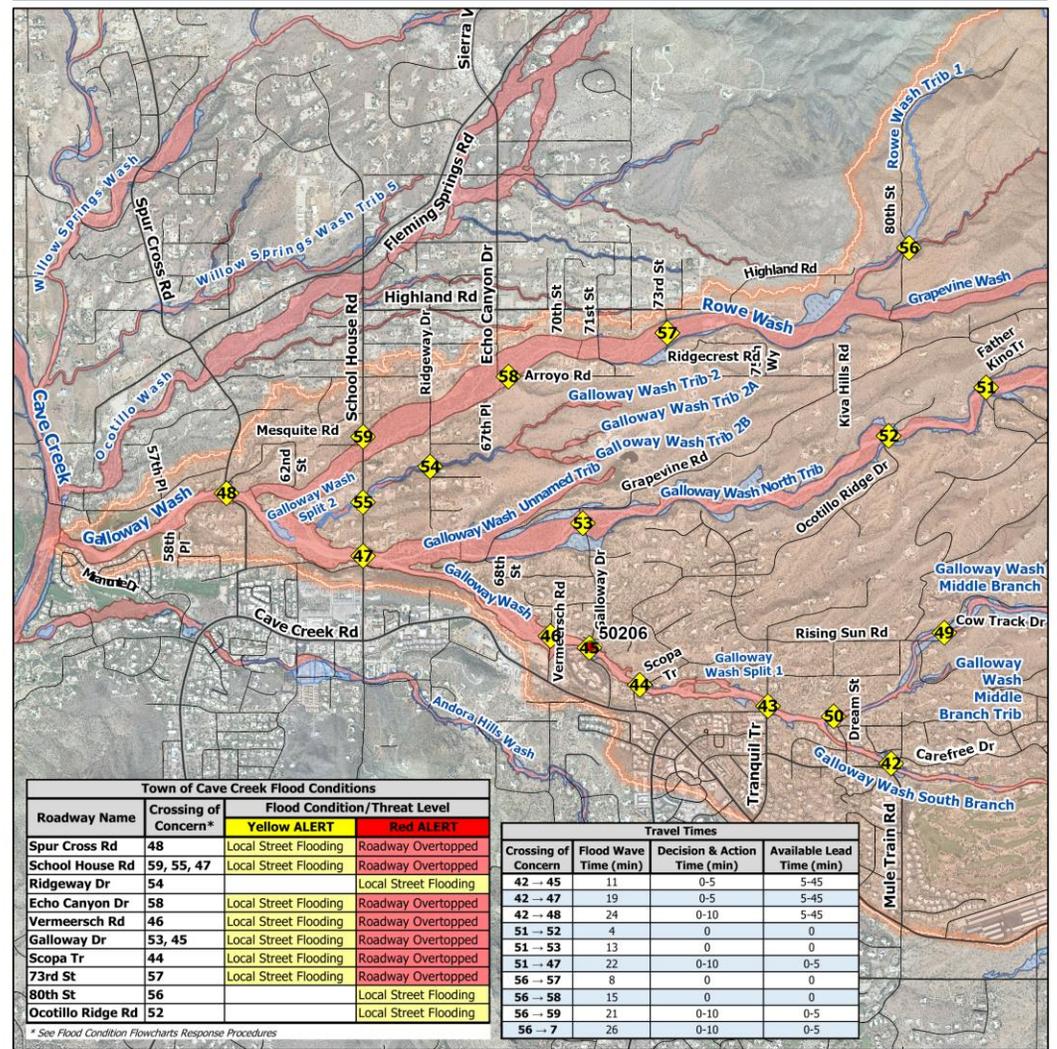
**Alert Level**

**RED**

**BLUE**

- Locations of Concern – See North Flowchart**
- 11. N. Mariposa Dr. Overtopped**
  - 12. Cucuracha Steet Overtopped**
  - 13. Jackson Street Overtopped**
  - 14. Monitor My Fathers Retirement Ranch. Mohave St. Inundated between Jackson St. & the BNSF Railroad, Including Jackson, Madison, Adams, & Jefferson Streets.**
  - 15. Monitor the BNSF Railroad Bridge & Embankment**
- SEVERE FLOOD POTENTIAL: Follow Procedures in the Emergency Action Plan for Wickenburg Structures**

- Wickenburg
- Crossings
- River/Washes
- School
- Medical Facility
- Fire Station
- Child Care Facility
- Assisted Living Facility
- Dam
- Spillway
- Railroad
- ALERT Stations
- Rain/Stage
- Structures in Floodplain
- SFR (16)
- Multi-Family (1)
- Other (2)
- Flood Zone (FEMA)
- Floodway
- Floodplain
- PMF Hazard Zone



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**Galloway Wash Watershed FEMA Flood Zones ALERT Stations**

- Crossing of Concern
- FW
- AE
- A
- Rain/Stream



# 3 D Rainfall Animations

The screenshot shows the ArcGIS Pro software interface. The main window displays a 3D terrain map with a color-coded elevation surface. Labels on the map include Payson, Cave Creek, Surprise, Phoenix, Mesa, Buckeye, and Gila Bend. The interface includes a top menu bar with options like Project, Map, Insert, Analysis, View, Edit, Imagery, Share, and Help. A left-hand Contents pane shows a list of layers, including 3D Layers and 2D Layers. The bottom of the interface features an Animation Timeline with a play button and a keyframe gallery.

The screenshot shows the Geoprocessing tool 'Auto Rainfall Map 1.0'. The Parameters tab is active, showing the following fields:

- Input CSV: [Empty text box]
- Input View Grid: [Dropdown menu]
- Output Geodatabase: [Empty text box]
- Raster Name for Output: [Empty text box]

The screenshot shows the Layer Properties dialog for 'Sept03\_05z\_Cumu'. The Elevation tab is selected, showing the following settings:

- Features are: On custom elevation surface
- Custom Surface: Sept03\_05z\_Cumu\_Ex
- Cartographic offset: 0.00
- Vertical units: Meters

The screenshot shows the Export Movie dialog. The Movie Export Presets section includes options for Draft, YouTube, Vimeo, Twitter, Instagram, HD720, HD1080, and GIF. The File Name field is set to 'C:\Users\Chandra.Miller\Desktop\Scene.mpd'. The File Export Settings section is expanded, showing Advanced Movie Export Settings. A Save Preset button is visible at the bottom right.

The screenshot shows the Animation Timeline for the animation. The timeline is labeled 'Animation Timeline: Animation' and shows a sequence of keyframes from 1 to 22. The timeline is currently at 0:00. The interface includes a play button, a stop button, and a refresh button. The Keyframe Gallery shows a sequence of keyframes from 1 to 22.



# Historic Rainfall Layer

Problem – Data Request  
Solution – Map Overlay

- To get rainfall markers
  - Uses HTML/JavaScript
  - Need Month, Day, Year, Time Ending and Time Stamp.
- To get rainfall layer
  - Uses php/hist\_rain\_GET.php and Python
  - arcpy.GetParameterAsText
  - Arcpy.SpatialReference
  - arcpy.MakeXYEventLayer\_management
  - arcpy.FeatureClassToFeatureClass\_conversion
  - arcpy.AddField\_management
  - arcpy.CalculateField\_management
  - arcpy.NaturalNeighbor\_3d
  - arcpy.mapping.MapDocument
  - arcpy.mapping.ExportToPNG

```
<!-- Historic Rainfall -->
<div id="rainPane" title="Historic Rainfall">
  Select historic ALERT data ending date, time and timestep<br>
  <select name="ME" id="ME" size="1">
    <option VALUE="01" SELECTED> January </option><option VALUE="02"> February </option><option VALUE="03"> March </option><option VALUE="04"> April </option><option VALUE="05"> May </option><option VALUE="06"> June </option>
    <option VALUE="07"> July </option><option VALUE="08"> August </option><option VALUE="09"> September </option><option VALUE="10"> October </option><option VALUE="11"> November </option><option VALUE="12"> December </option>
  </select>
  <select name="DE" id="DE" size="1">
    <option VALUE="01" SELECTED> 1 </option>
    <option VALUE="02"> 2 </option>
    <option VALUE="03"> 3 </option>
    <option VALUE="04"> 4 </option>
    <option VALUE="05"> 5 </option>
    <option VALUE="06"> 6 </option>
    <option VALUE="07"> 7 </option>
    <option VALUE="08"> 8 </option>
    <option VALUE="09"> 9 </option>
  </select>
  <input type="text" value="" id="Day" />
  <input type="text" value="" id="Year" />
  <input type="text" value="" id="TimeEnd" />
  <input type="text" value="" id="TimeStart" />
  <input type="button" value="Get Data" />
  <div id="map" style="width: 100%; height: 100%; border: 1px solid black; position: relative; margin-top: 10px;">
    <div style="position: absolute; top: 5px; left: 5px; font-size: 8px; color: gray;">
      <input type="checkbox" /> Show Markers
    </div>
  </div>
</div>

import sys, string, os, arcpy, urllib2, datetime

try:
    arcpy.env.overwriteOutput = True
    arcpy.CheckOutExtension("3D")

    Month = arcpy.GetParameterAsText(0)
    Day = arcpy.GetParameterAsText(1)
    Year = arcpy.GetParameterAsText(2)
    TimeEnd = arcpy.GetParameterAsText(3)
    TimeStart = arcpy.GetParameterAsText(4)

    RainRaw = open("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\RainRaw.txt", "w")

    for line in urllib2.urlopen("http://alert.fod.mariocopa.gov/php/hist_rain_GETText.php?ME=" + Month + "&DE=" + Day + "&YE=" + Year + "&TE=" + TimeEnd + "&TS=" + TimeStart):
        if not "# " in line and not "*" in line and not "----" in line:
            RainRaw.write(line)

    RainRaw.close
    del RainRaw

    sr = arcpy.SpatialReference(2868)
    result = arcpy.MakeXYEventLayer_management("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\RainRaw.txt", "Xcoord", "Ycoord", "RainPoints", sr)

    del result

    Exists = arcpy.Exists("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\Gauges")
    if Exists == True:
        arcpy.Delete_management("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\Gauges")
    del Exists
    Exists = arcpy.Exists("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\RainRaster")
    if Exists == True:
        arcpy.Delete_management("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\RainRaster")
    del Exists

    result = arcpy.FeatureClassToFeatureClass_conversion("RainPoints", "\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb", "Gauges", "", "GageID", "GageID", true true false 4 Long 0 0 ,First#,RainRaw_Layer)
    del result

    result = arcpy.AddField_management("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\Gauges", "RainTotal", "DOUBLE", "", "", "", "NULLABLE", "NON_REQUIRED", "")
    del result

    result = arcpy.CalculateField_management("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\Gauges", "RainTotal", "!Rainfall!", "PYTHON", "")
    del result

    result = arcpy.NaturalNeighbor_3d("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.gdb\\Gauges", "RainTotal", "\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\Interpolat
    del result

    mxd = arcpy.mapping.MapDocument("\\\\giscahed.mariocopa.gov\\GISCache\\WebSourceData\\GeoDatabase\\InterpolateRain\\InterpolateRain.mxd")
    result = arcpy.mapping.ExportToPNG(map_document = mxd, out_png = "\\\\giscahed.mariocopa.gov\\GISCache\\stores\\dacsrgp3\\directories\\arogisjobs\\flood\\interpolate_rain_gserver\\InterpolateRain.png", transparent_color = "255, 255, 255")
    del mxd
    del result

    16     var aname = markers[i].getAttribute("name");
    17     var id = markers[i].getAttribute("id");
    18     var latDMS = markers[i].getAttribute("lat");
    19     var pLat = dmsCon(latDMS);
    20     var longDMS = markers[i].getAttribute("long");
    21     var pLong = (dmsCon(longDMS) * -1);
    22     var lstRpt = markers[i].getAttribute("last_rpt");
    23     var rain = markers[i].getAttribute("rainamt");
    24     var point = new google.maps.LatLng(pLat, pLong);
    25     var Historic = createHistoric(point, aname, id, rain, lstRpt, ME, DE, YE, TE, TS);
    26     Historic.setMap(map);
    27     overlayMarkers.push(Historic)
    28     }
    29     item = $('#date')[0];
    30     item.style.background = "#FFF000";
    31     item.style.color = "black";
    32     $('#date')[0].innerHTML = "Data: Archived Rainfall Data " + ME + "/" + DE + "/" + YE + "-" + TE + " " + TS + "";
    33 }
```



# Questions

