Drainage Regulation, Floodplain Management, and Master Planning

A Nexus to Ecosystem and Riparian Area Preservation

Pinal Partnership Open Space & Trails Committee

February 13th, 2024

PINAL COUNTY

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Introduction/Agenda

- Regulations, Guidance Documents, and Planning Studies
- Using Data to Enhance Decision Making
- Ongoing Studies
- Examples
- Drainage Manual Update
- Questions/Comments

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Ordinances: Purpose & Intent

- **Drainage Ordinance**

  Preventing unnecessary loss from erosion, flooding and landslides through reasonable regulation of development by minimizing soil erosion, mitigating natural waterways and help ensure that all new development is free from adverse drainage conditions.

- **Floodplain Management Ordinance**

  It is the purpose of this title to comply with Arizona State Law (pertaining to the National Flood Insurance Program), to promote and protect the health, peace, safety, comfort, convenience, and general welfare of the residents within the jurisdictional area of Pinal County, Arizona; to minimize public and private losses due to flooding; and to enable Pinal County and its residents to participate in the National Flood Insurance Program (NFIP), receive federal disaster assistance, obtain flood insurance and reduce the cost of flood insurance.

Pinal County Guidance Documents

- Pinal County Drainage Design Manual
- Pinal County Subdivision and Infrastructure Design Manual
- Pinal County Comprehensive Plan
- Pinal County Open Space and Recreation Area Design Manual

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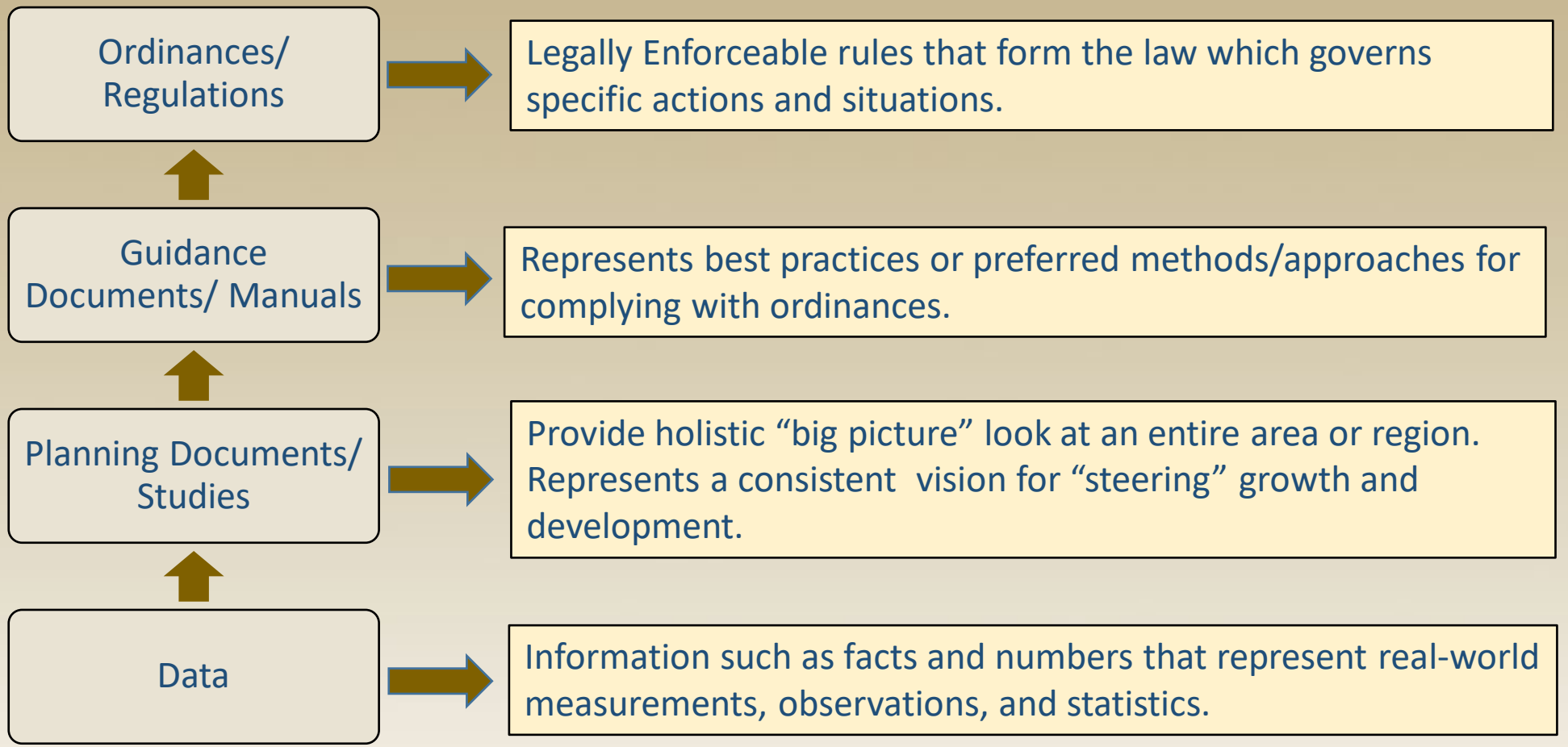
PINAL COUNTY COMPREHENSIVE PLAN
We Create Our Future

Planning Documents

- Ordinances provide framework for regulating development.
- Design Manuals are guidance documents that provide preferred methods and approaches to complying with ordinance.
- Master Plans are documents that can serve to “steer” development towards desirable outcomes.
  - Area Drainage Master Plan/Study (ADMP/ADMS)
  - Watercourse Master Plan (WCMP)
  - Watershed Plan (WP)
  - Master Hydrology Model

Hierarchy of Authority & Regulation



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Master Hydrology Model

- A hydrologic model for a region or watershed that provides a consistent framework for developing further-refined models and to guide future development, drainage master plans, and watercourse master plans.
- Improves adherence to regulations by providing regional analysis that can be used at the local scale to ensures all development uses a common and consistent plan for drainage management.
- Ensures regional watercourse connectivity
- Data and study will be publicly available; eventually a dedicated web viewer and data library will be created.

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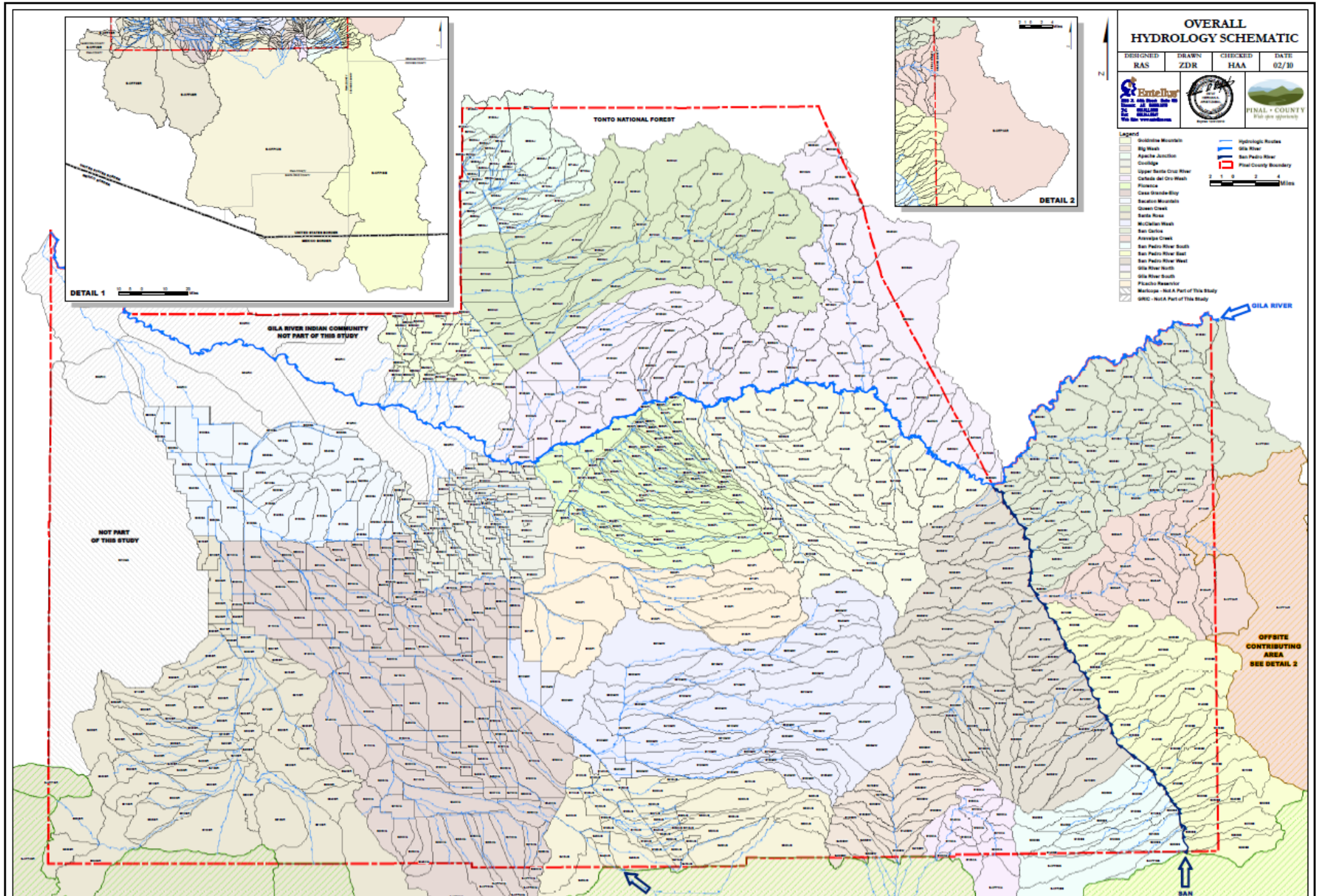
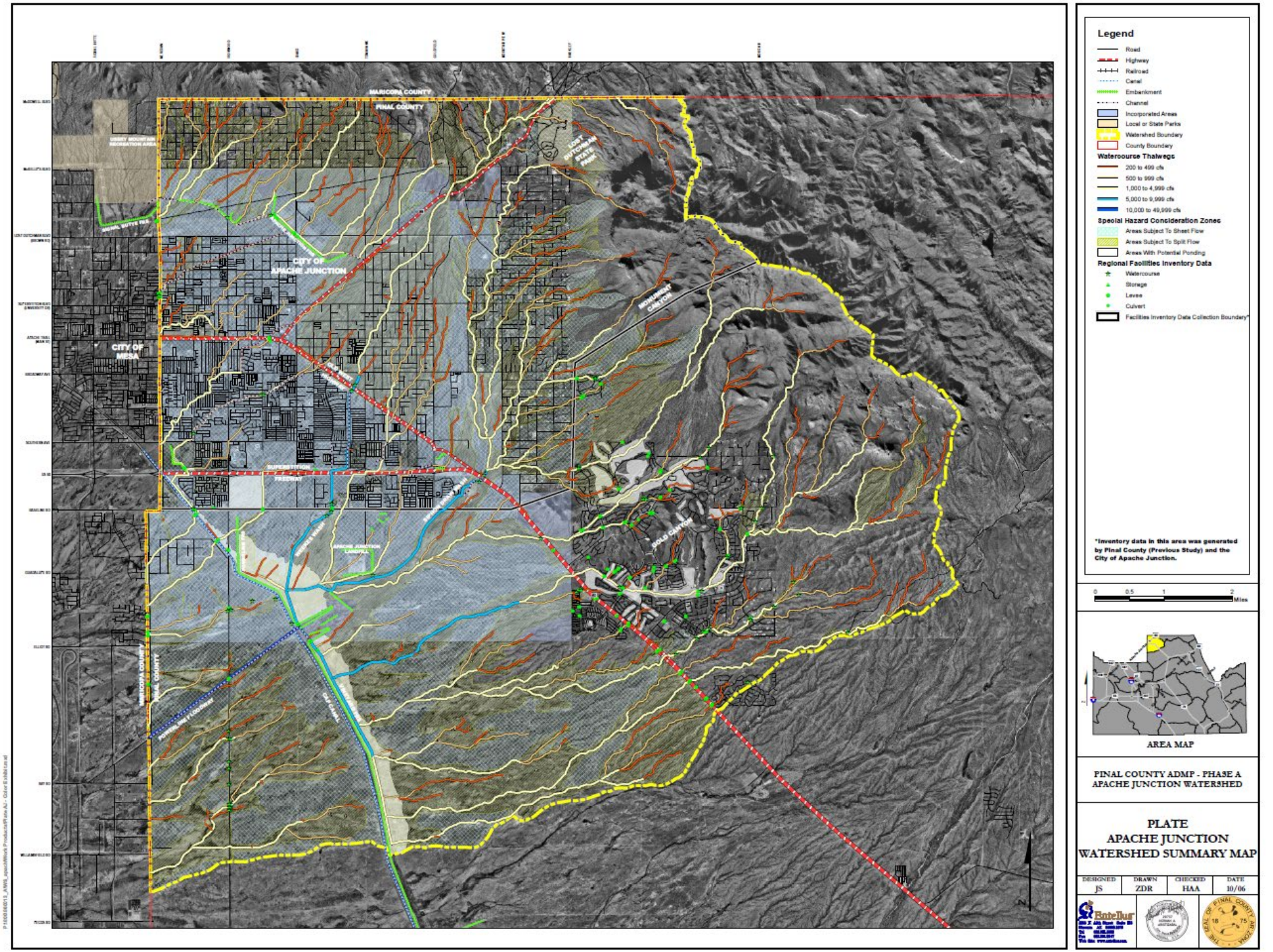

OVERALL
HYDROLOGY SCHEMATIC
DESIGNED
RAS
DRAWN
ZDR
CHECKED
HAA
DATE
02/10
PINAL • COUNTY
Legend
Hydrologic Routes
Gila River
San Pedro River
Pinal County Boundary
Miles
DETAIL 1
DETAIL 2
TONTO NATIONAL FOREST
GILA RIVER INDIAN COMMUNITY
NOT PART OF THIS STUDY
NOT PART
OF THIS STUDY
GILA RIVER
OFFSITE
CONTRIBUTING
AREA
SEE DETAIL 2
SAN



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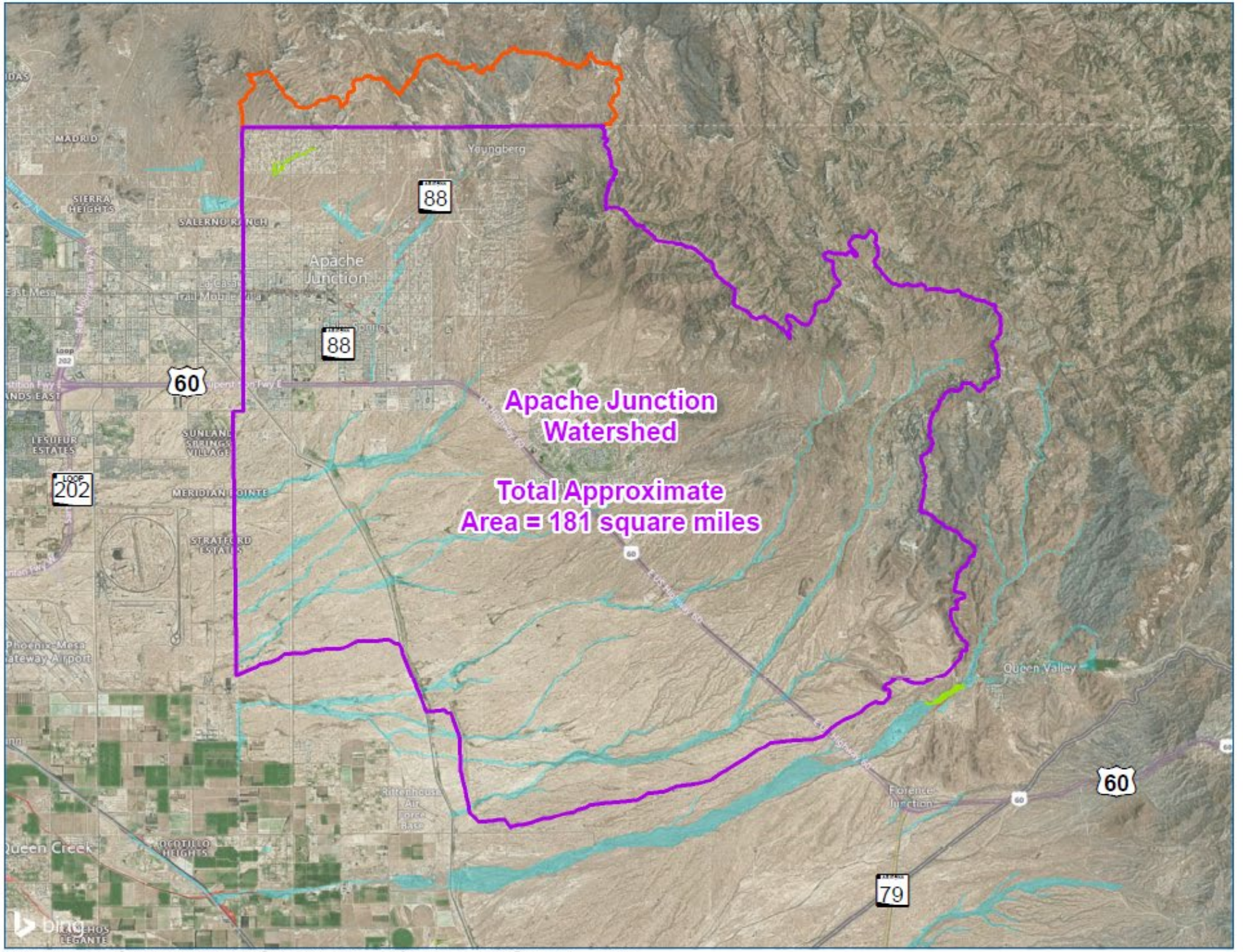

PINAL COUNTY FLOOD CONTROL DISTRICT

MASTER HYDROLOGY

Apache Junction Floodplains

Black & Veatch Project Number: 406885

- Apache Junction Watershed (172.2 square miles)
- Out of County Contributing Area (8.8 square miles)
- Local Administrative Floodplain (0.1 square miles)

FEMA FLOOD ZONE

- AH (0.1 square miles)
- AE (0.5 square miles)
- A (7.3 square miles)

N

0 1 2

Miles

1 inch = 2 miles

Data Source: FEMA; PCFCD

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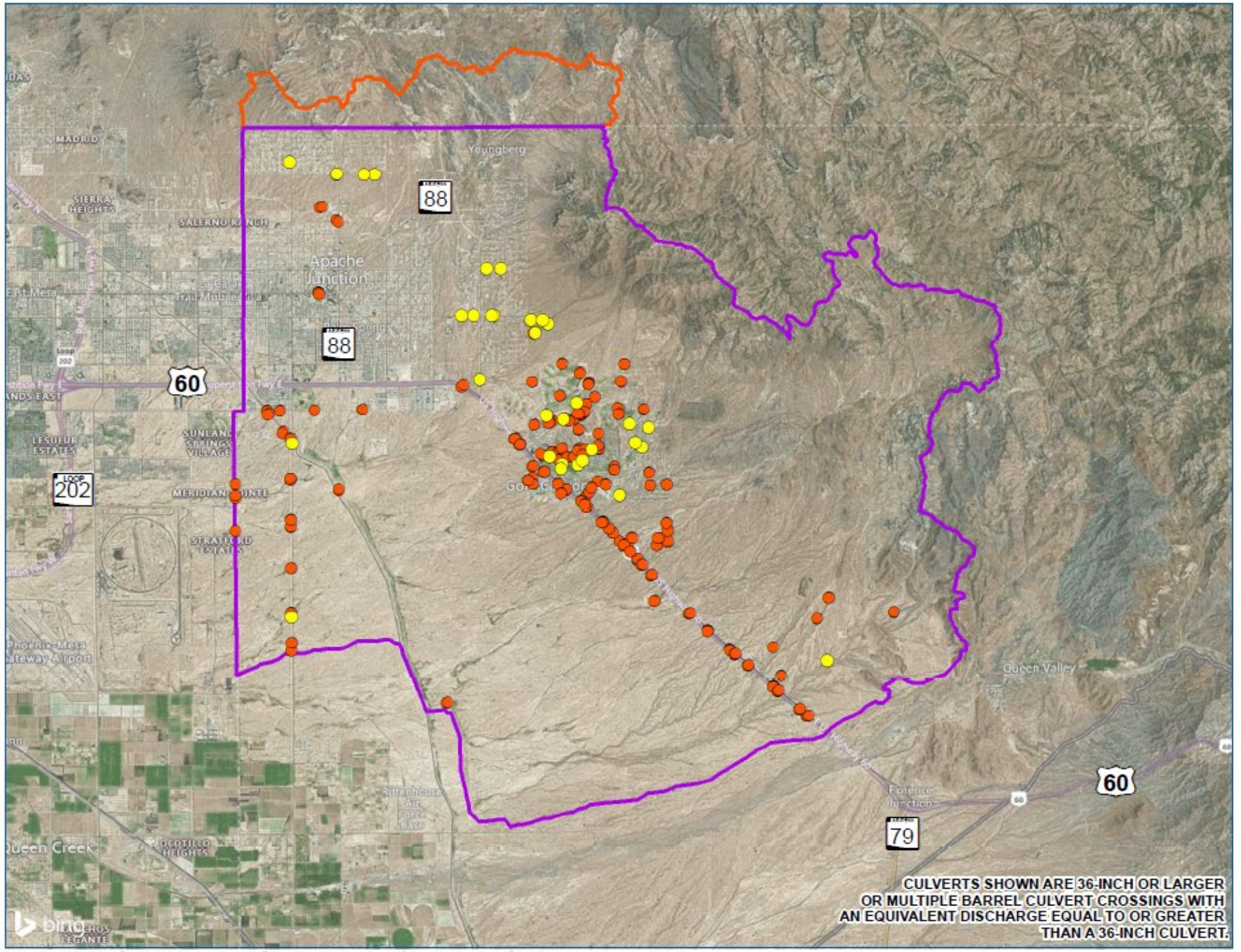

PINAL COUNTY FLOOD CONTROL DISTRICT

MASTER HYDROLOGY

Apache Junction Bridges and Culverts

Black & Veatch Project Number: 406885

- Bridges (Approx. 33 bridges)
- Culverts (Approx. 157 culverts)
- Apache Junction Watershed (172.2 square miles)
- Out of County Contributing Area (8.8 square miles)

NOTE: Culvert points include circular elliptical, arch, and box culverts.

N

0 1 2

Miles

1 inch = 2 miles

Data Source: PCFCD

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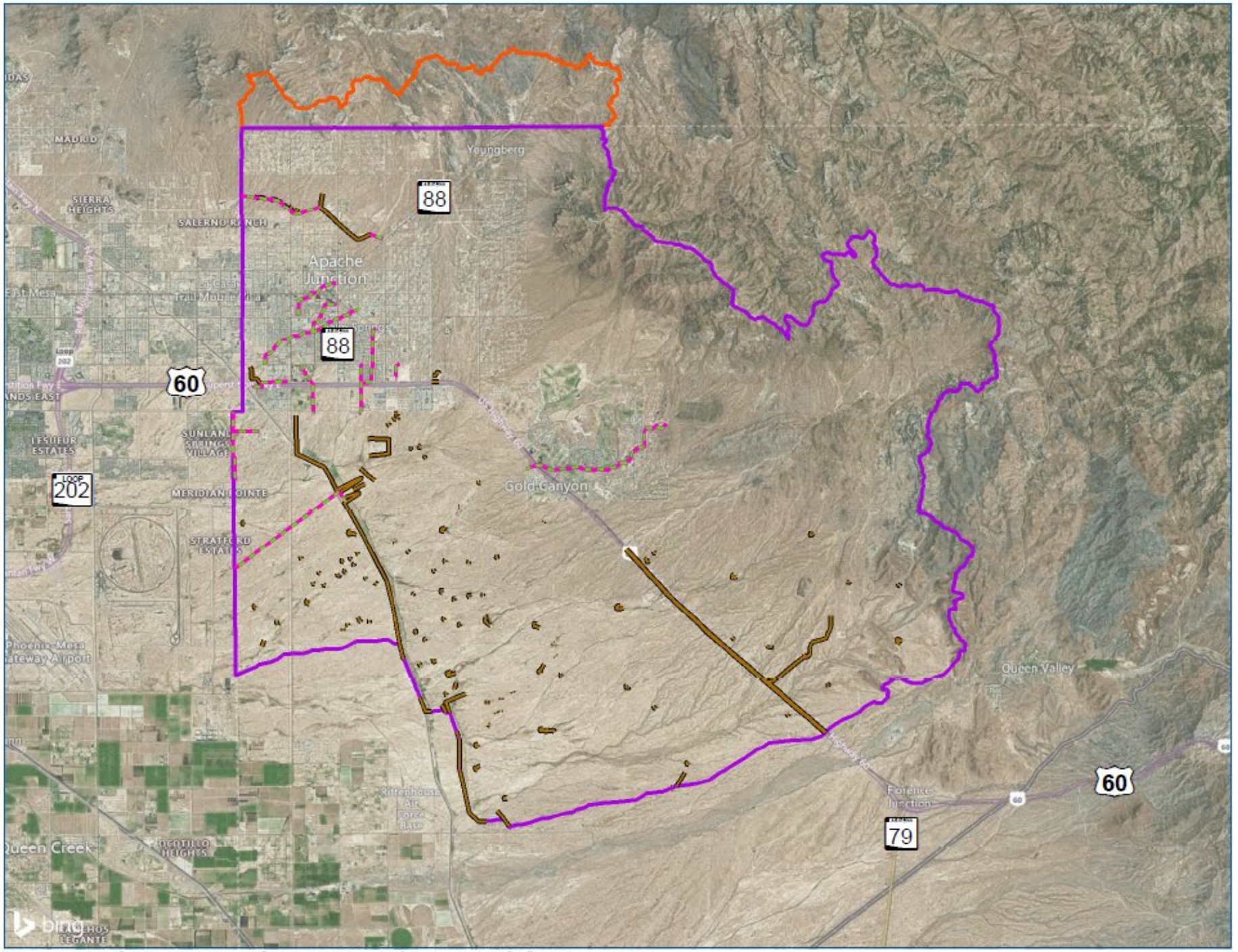

PINAL COUNTY FLOOD CONTROL DISTRICT

MASTER HYDROLOGY

Apache Junction Basins, Channels, and Embankments

Black & Veatch Project Number: 406885

- Channels (20.5 miles)
- Embankments (39.2 miles)
- Basins (0 Basins)
- Apache Junction Watershed (172.2 square miles)
- Out of County Contributing Area (8.8 square miles)

NOTE: Embankments include stock ponds, roadways, canal berms, flood control structures, and other raised features. County basins only.

N

0 1 2

Miles

1 inch = 2 miles

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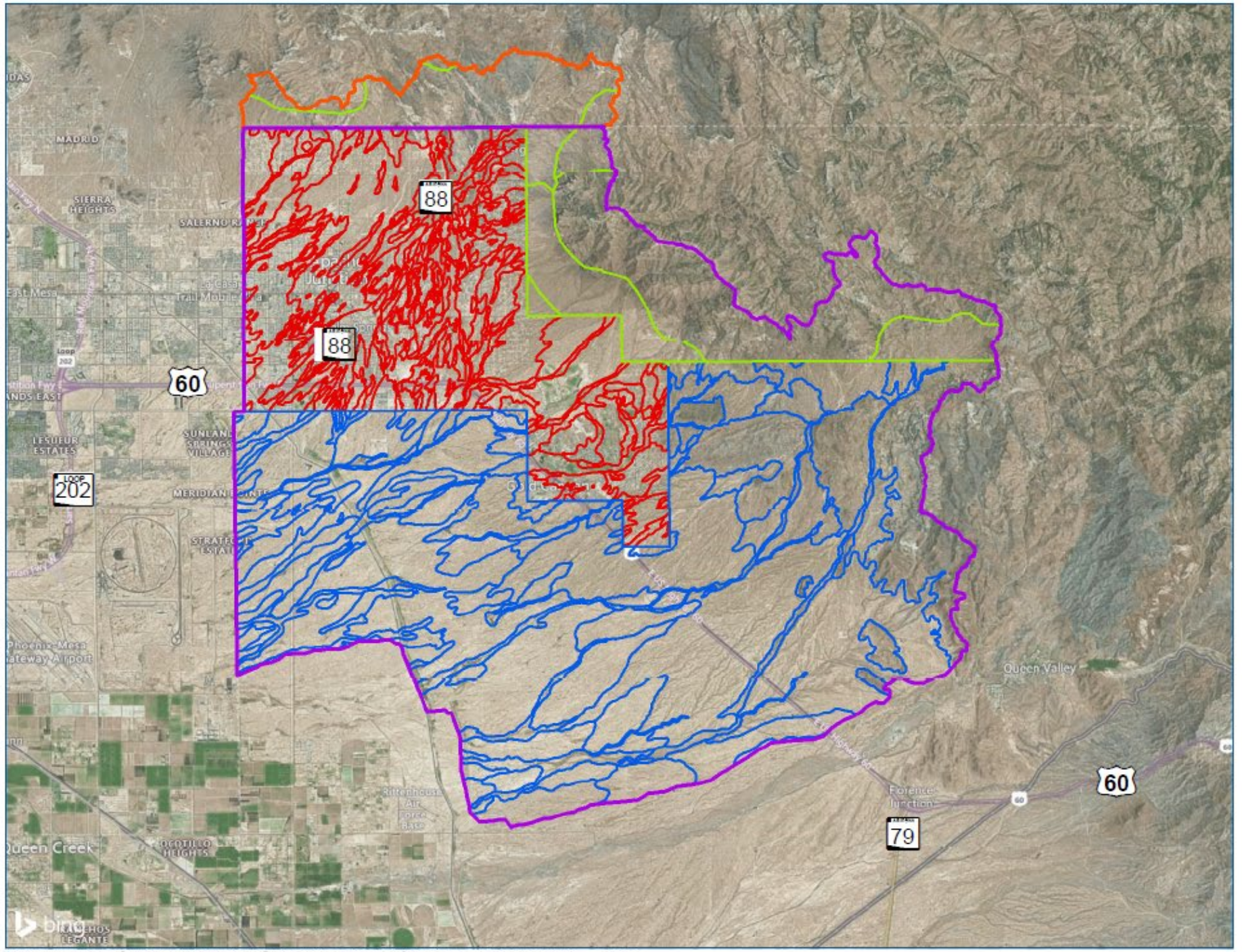

PINAL COUNTY FLOOD CONTROL DISTRICT

MASTER HYDROLOGY

Apache Junction Soils

Black & Veatch Project Number: 406885

Apache Junction Watershed (172.2 square miles)

Out of County Contributing Area (8.8 square miles)

Soil Survey

AZ645

AZ661

ADOT General Soils

N

0 1 2

Miles

1 inch = 2 miles

Data Source: NRCS SSURGO and STASGO. Obtained from ADOT Webpage

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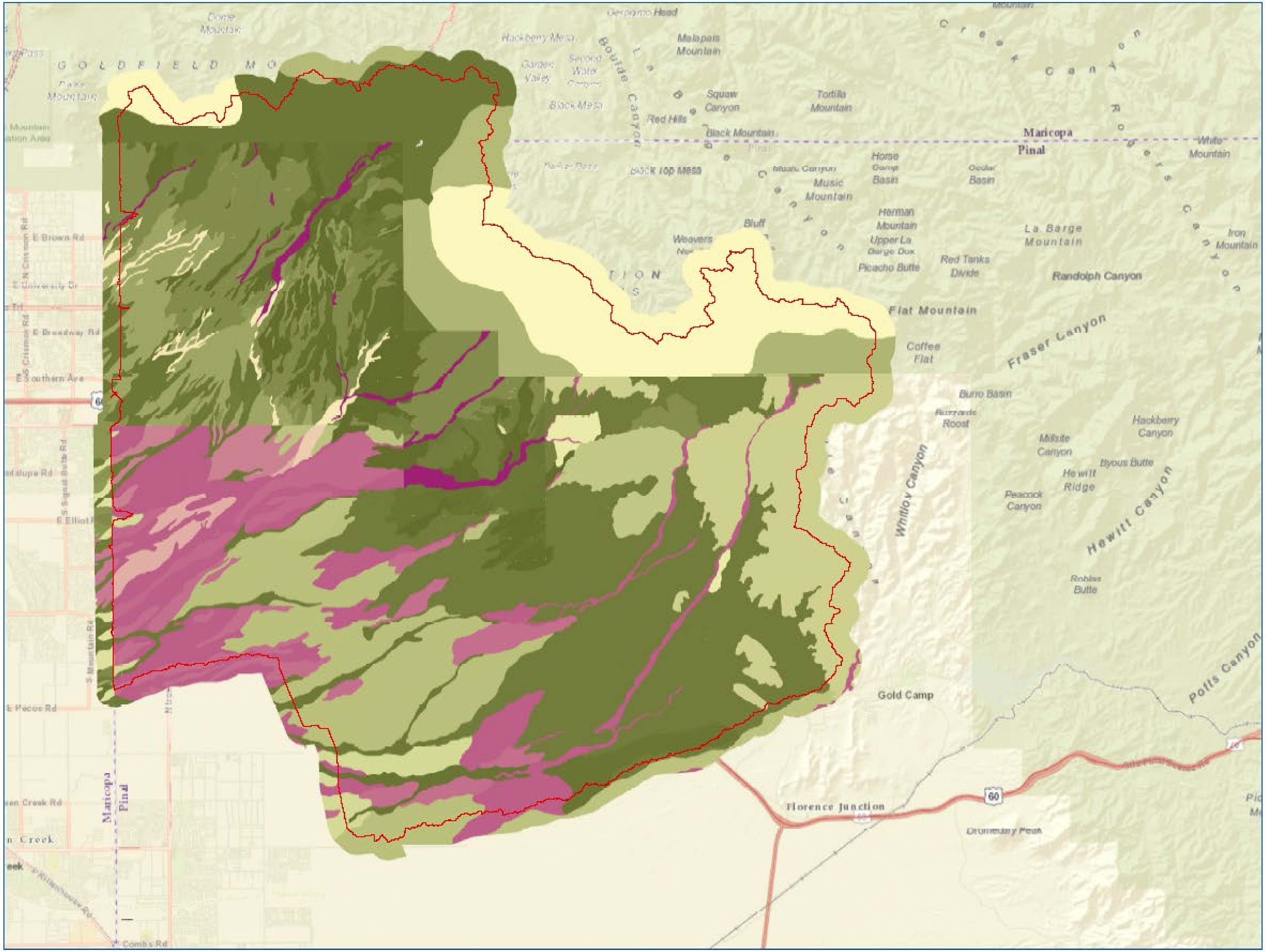

GOLDFIELD MO
Black Mesa
Squaw Canyon
Tortilla Mountain
Red Hills
Black Mountain
Maricopa
Pinal
Horse Camp Basin
Cedar Basin
Music Mountain
Herman Mountain
Upper La Barge Box
Picacho Butte
Red Tanks Divide
La Barge Mountain
Randolph Canyon
Flat Mountain
Coffee Flat
Fraser Canyon
Burro Basin
Buzzards Roost
Millsite Canyon
Hackberry Canyon
Byous Butte
Hewitt Ridge
Peacock Canyon
Whitlow Canyon
Hewitt Canyon
Roblas Butte
Gold Camp
Potts Canyon
Florence Junction
Dromedary Peak
E Brown Rd
E University Dr
E Broadway Rd
E Southern Ave
E Elliot Rd
Pecos Rd
Combs Rd

Pinal County Master Hydrology

Apache Junction Green and Ampt Parameters

Black & Veatch Project Number: 406885

Pinal County Contract Number: 172721

LEGEND

Apache Junction Watershed

Hydraulic Conductivity (in/hr)

1.19

0.49

0.01

N

0 1 2

Miles

1 inch = 2 miles

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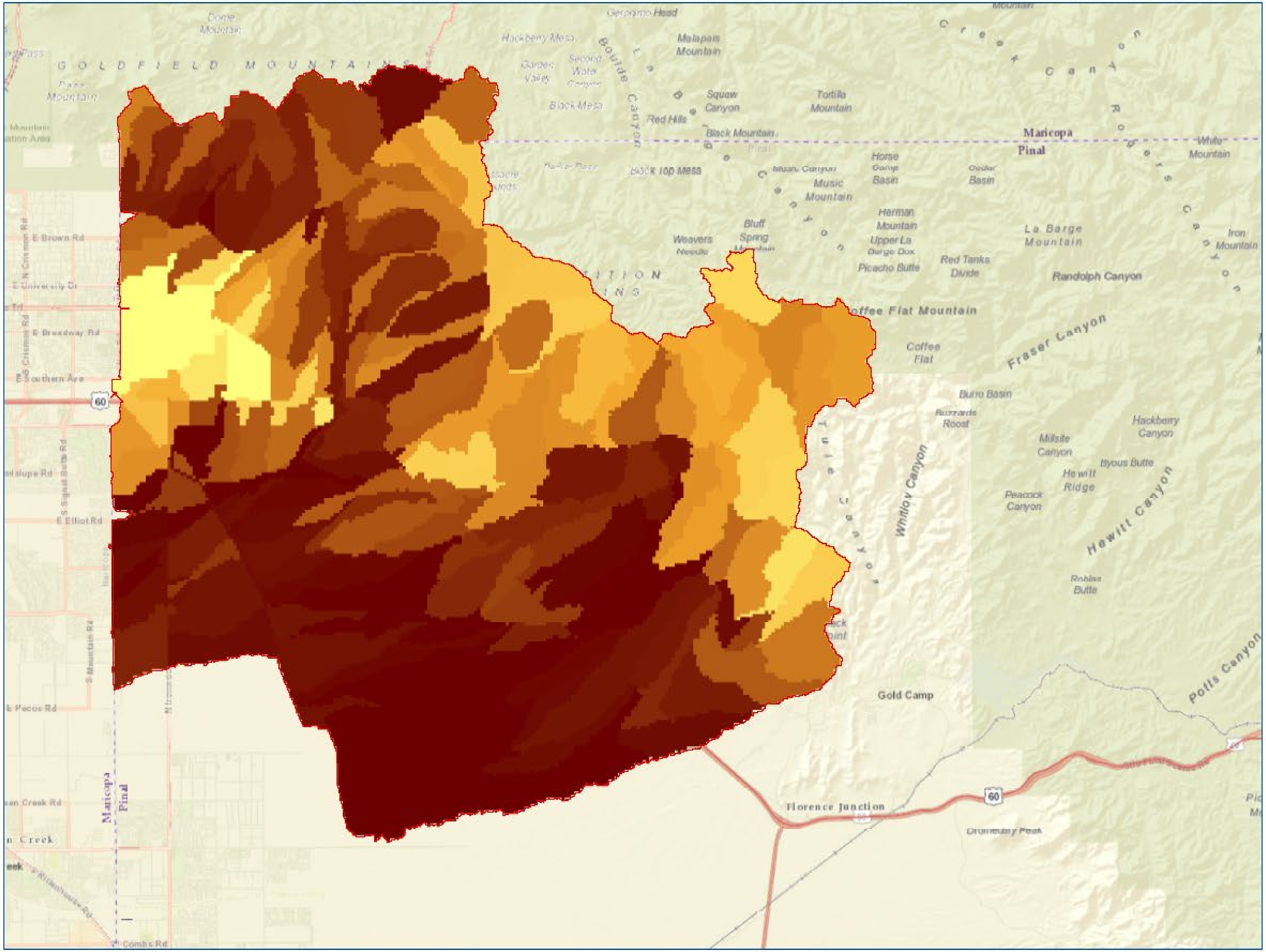
GOLDFIELD MOUNTAINS
Geronimo Head
Hackberry Mesa
Malapais Mountain
Squaw Canyon
Tortilla Mountain
Black Mesa
Red Hills
Black Mountain
Maricopa
Pinal
Black Top Mesa
Music Canyon
Music Mountain
Horse Camp Basin
Cedar Basin
White Mountain
Herman Mountain
Bluff Spring
Weavers Needle
Upper La Barge Box
Picacho Butte
Red Tanks Divide
La Barge Mountain
Randolph Canyon
Iron Mountain
Coffee Flat Mountain
Coffee Flat
Fraser Canyon
Burro Basin
Buzzards Roost
Whitlow Canyon
Millsite Canyon
Hackberry Canyon
Byous Butte
Hewitt Ridge
Peacock Canyon
Hewitt Canyon
Roblas Butte
Gold Camp
Potts Canyon
Florence Junction
60
E Brown Rd
E University Dr
E Broadway Rd
E Southern Ave
E Elliot Rd
E Pecos Rd
Maricopa
Pinal

Pinal County Master Hydrology

Apache Junction Green and Ampt Parameters

Black & Veatch Project Number: 406885

Pinal County Contract Number: 172721

LEGEND

Apache Junction Watershed

Impervious Area (%)

52.47

18.94

0.00

0 1 2 Miles

1 inch = 2 miles

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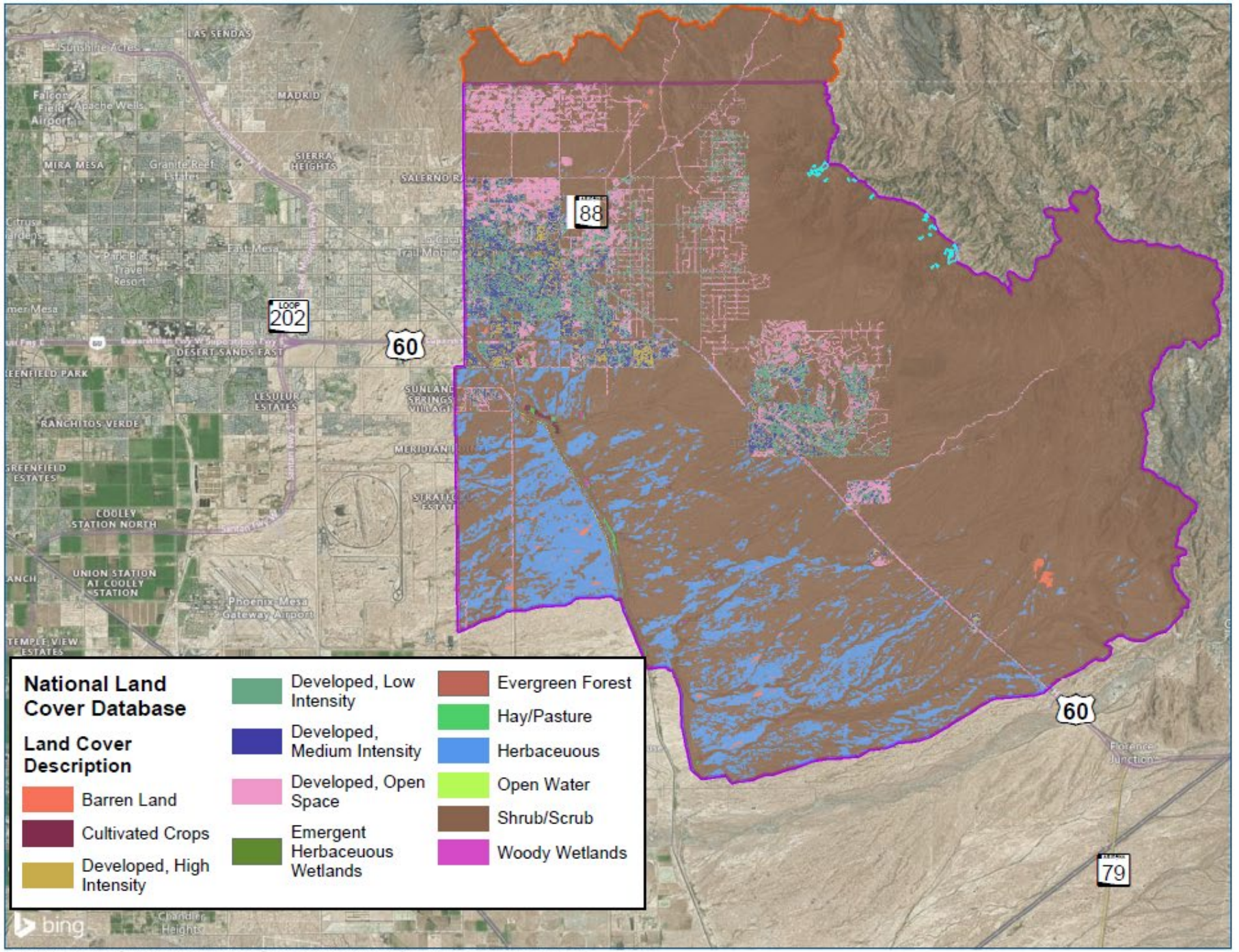

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PINAL COUNTY FLOOD CONTROL DISTRICT

MASTER HYDROLOGY

Apache Junction Land Cover

Black & Veatch Project Number: 406885

Apache Junction Watershed (172.2 square miles)

Out of County Contributing Area (8.8 square miles)

N

0 1 2

Miles

1 inch = 2 miles

Data Source: National Land Cover Database (2016)

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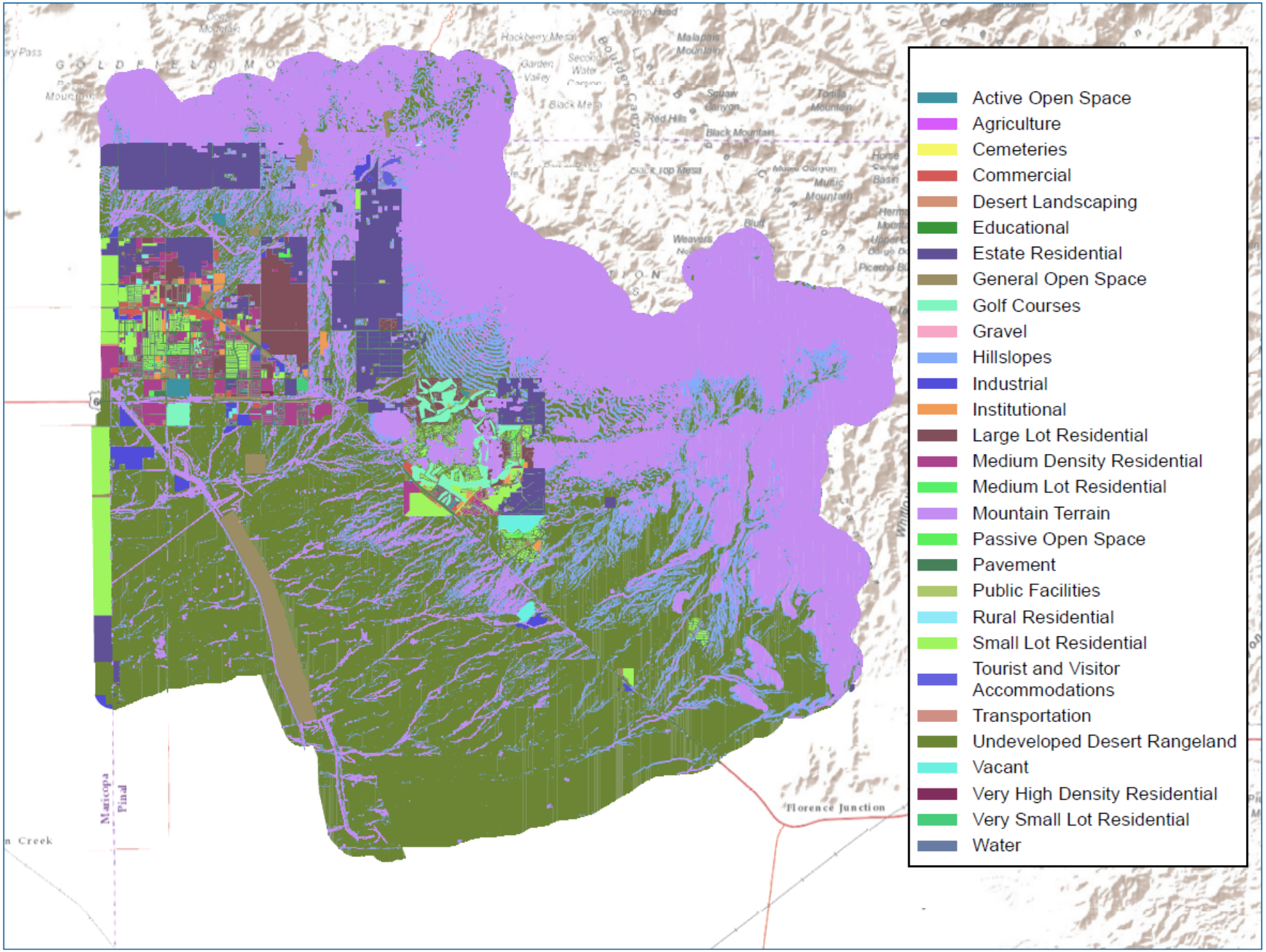

Pinal County Master Hydrology

Apache Junction Land Use

Black & Veatch Project Number: 406885

Pinal County Contract Number: 172721

N

0 1 2 Miles

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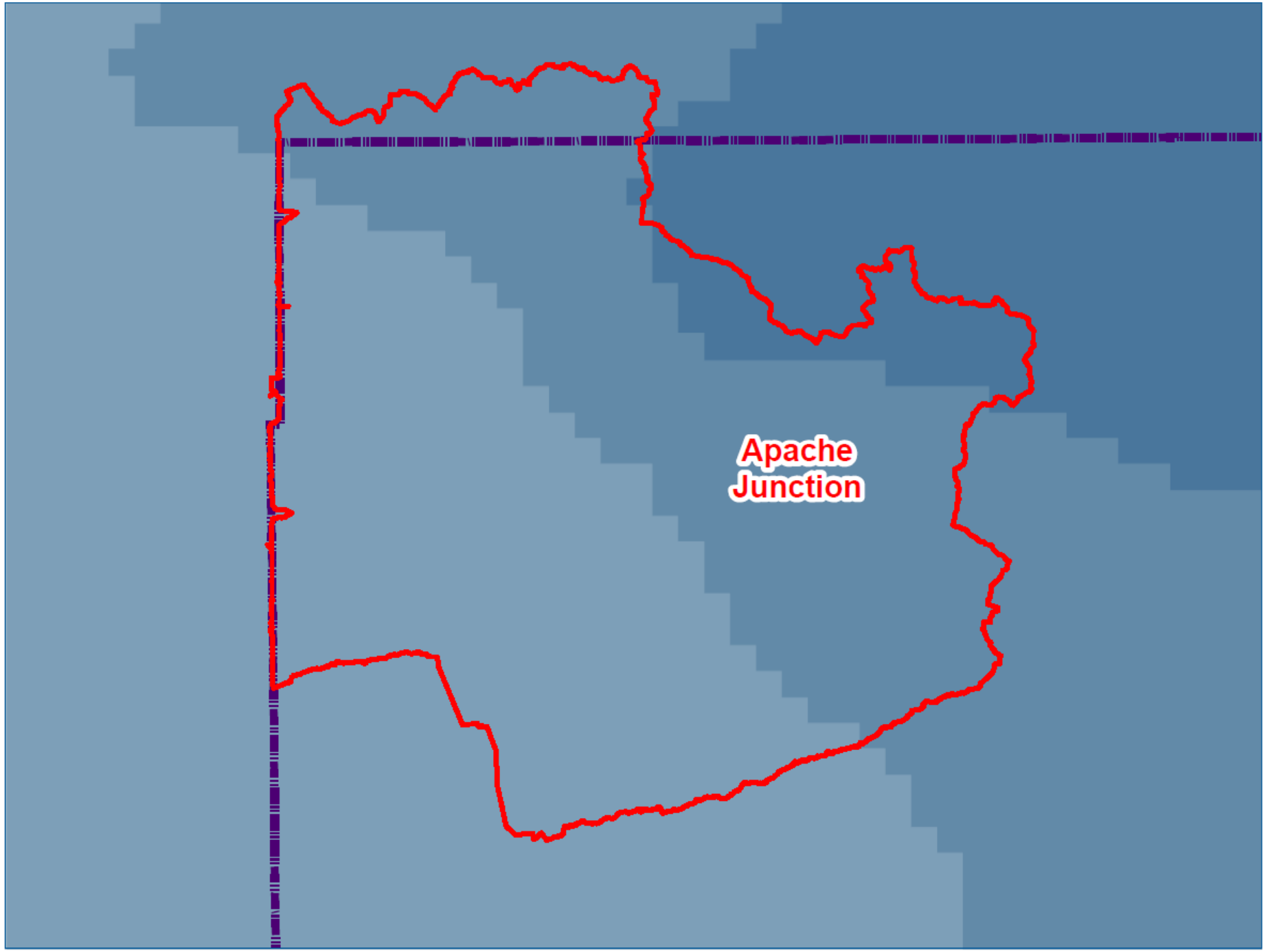

Pinal County Master Hydrology

Apache Junction Precipitation Map

Black & Veatch Project Number: 406885
Pinal County Contract Number: 172721

Apache Junction Watershed

Pinal County Boundary

100yr 24hr

Precipitation

- 3.0-4.0 in
- 4.0-5.0 in
- 5.0-6.0 in

N

0 1 2
Miles

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August 2022

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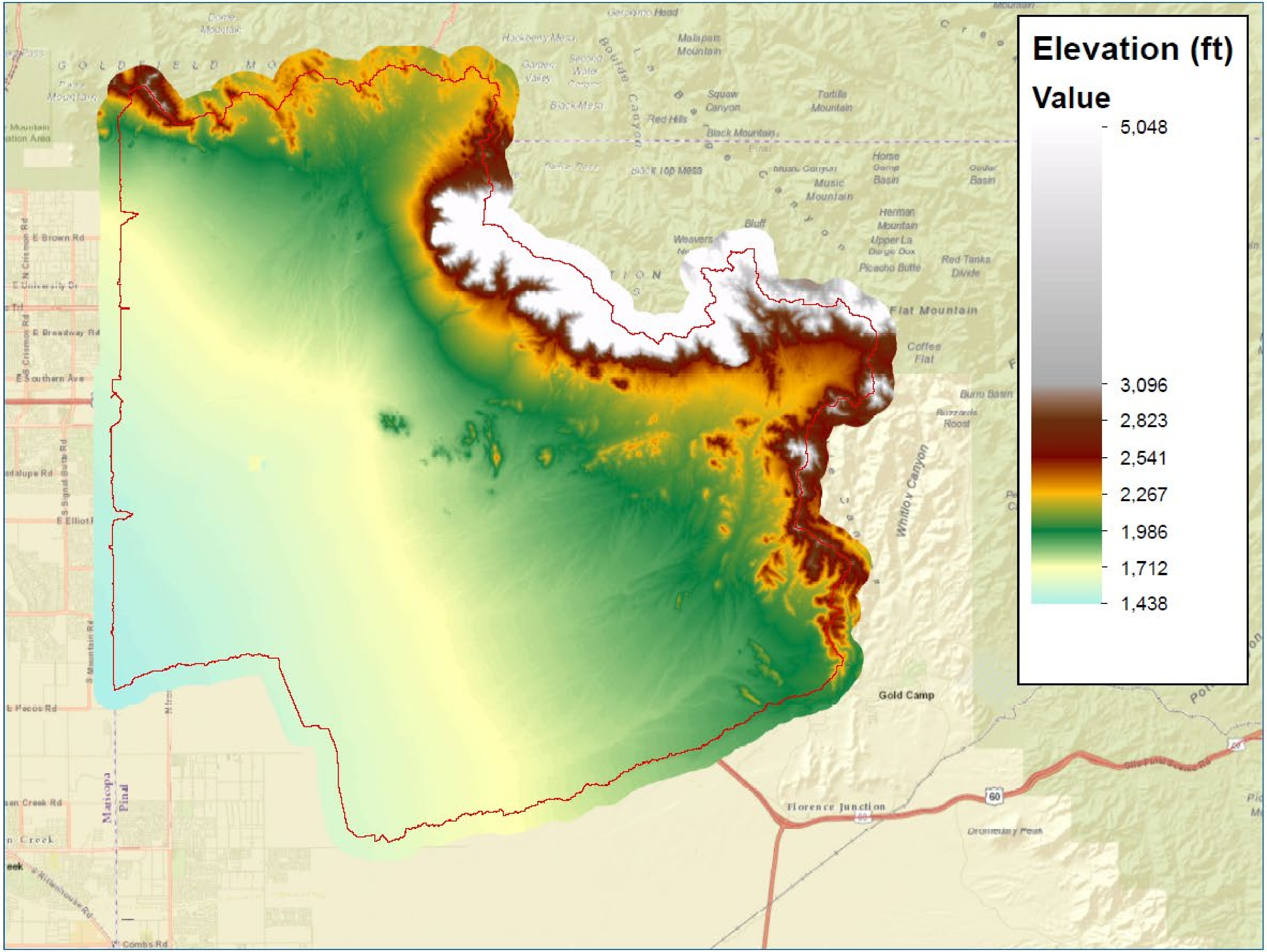

Pinal County
Master Hydrology
Apache Junction
Terrain Exhibit

Black & Veatch Project Number: 406885

Pinal County Contract Number: 172721

LEGEND

Apache Junction Watershed (~180 square miles)

N

0 1 2
Miles

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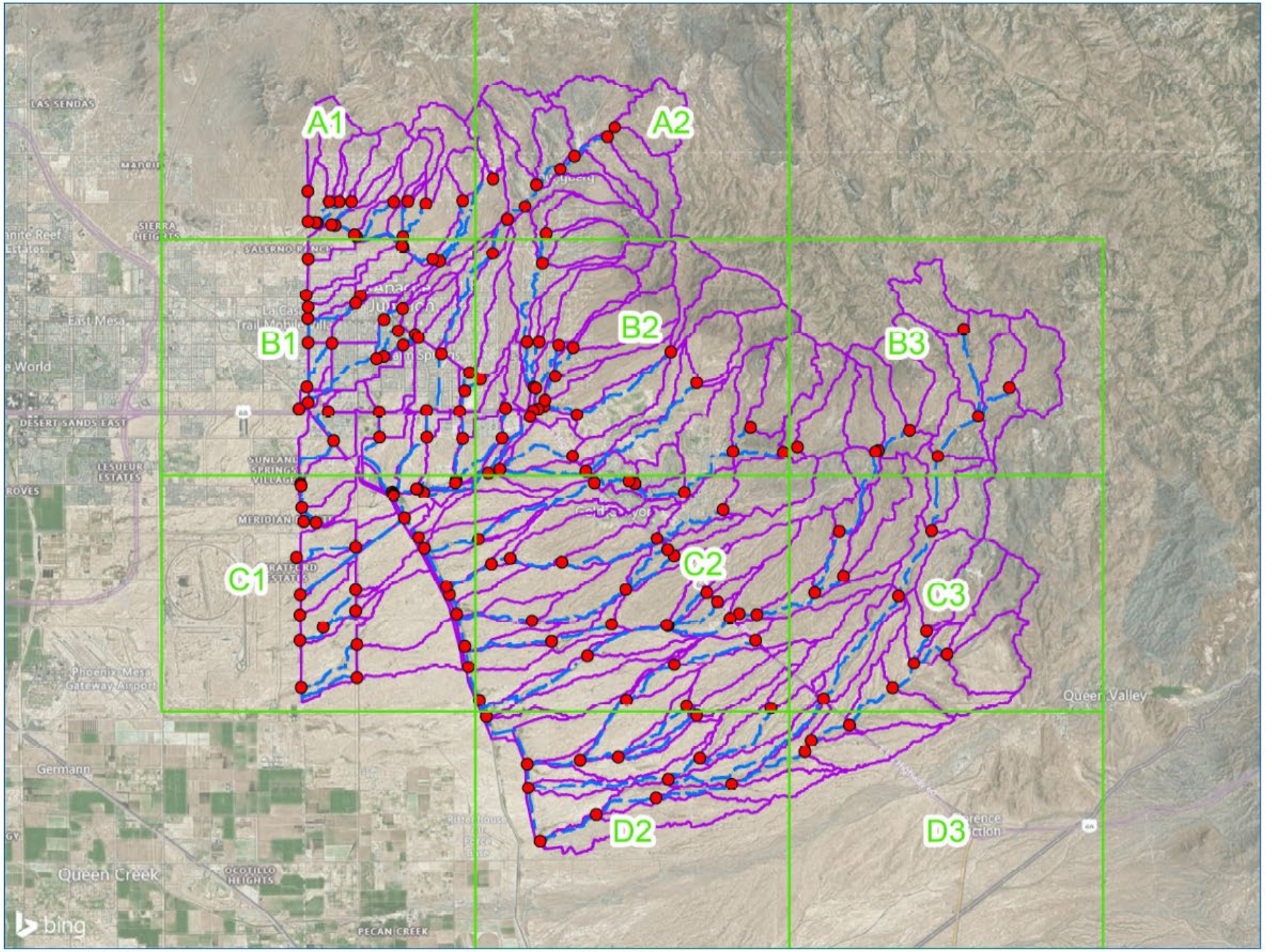

Pinal County Master Hydrology

Apache Junction HEC-HMS Basin Overview Map

Black & Veatch Project Number: 406885
Pinal County Contract Number: 172721

LEGEND

- Apache Junction HEC-HMS Junctions
- Apache Junction HEC-HMS Reaches
- Apache Junction HEC-HMS Subbasins
- Apache Junction HEC-HMS Grid Index

N

0 1 2 Miles

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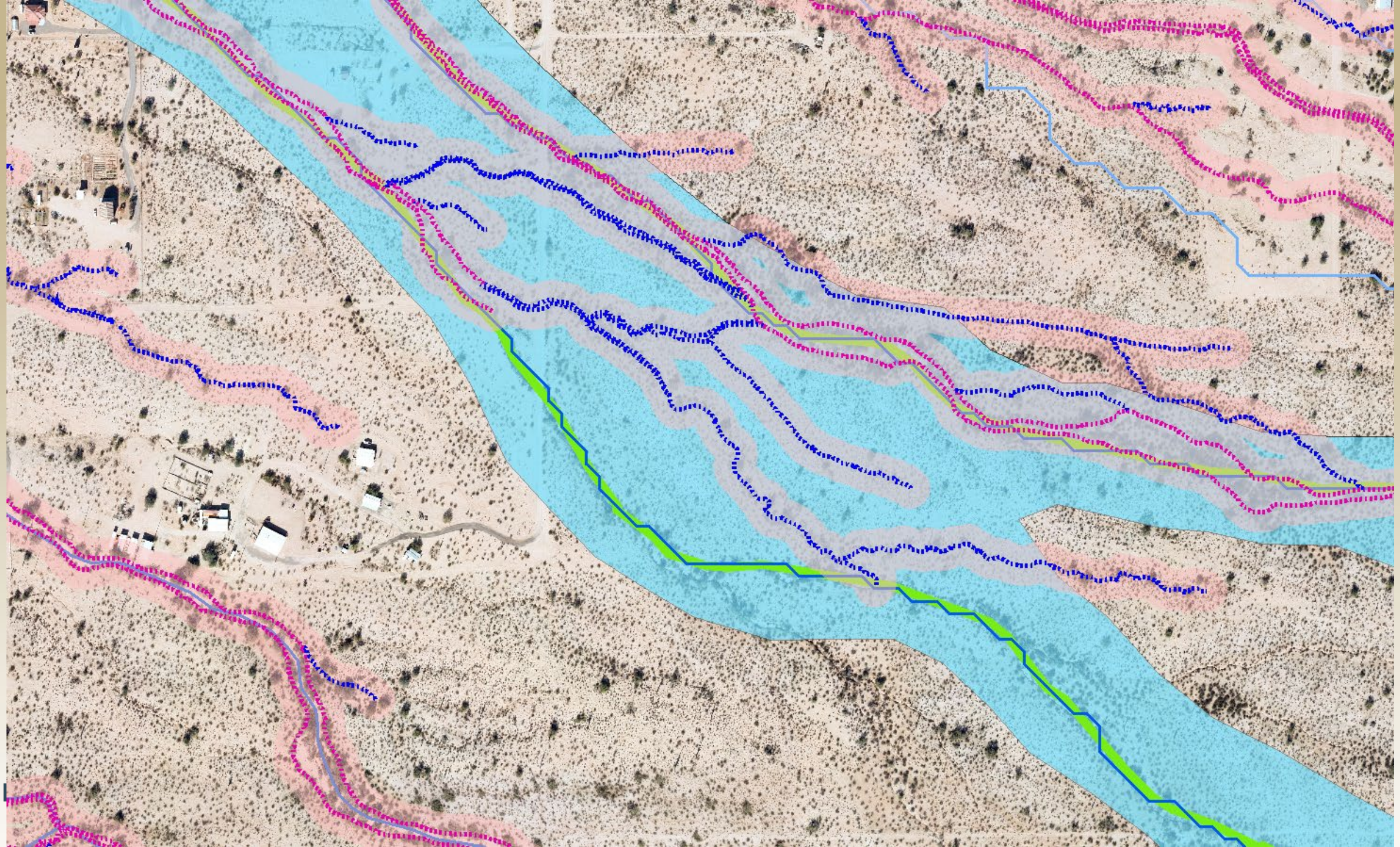
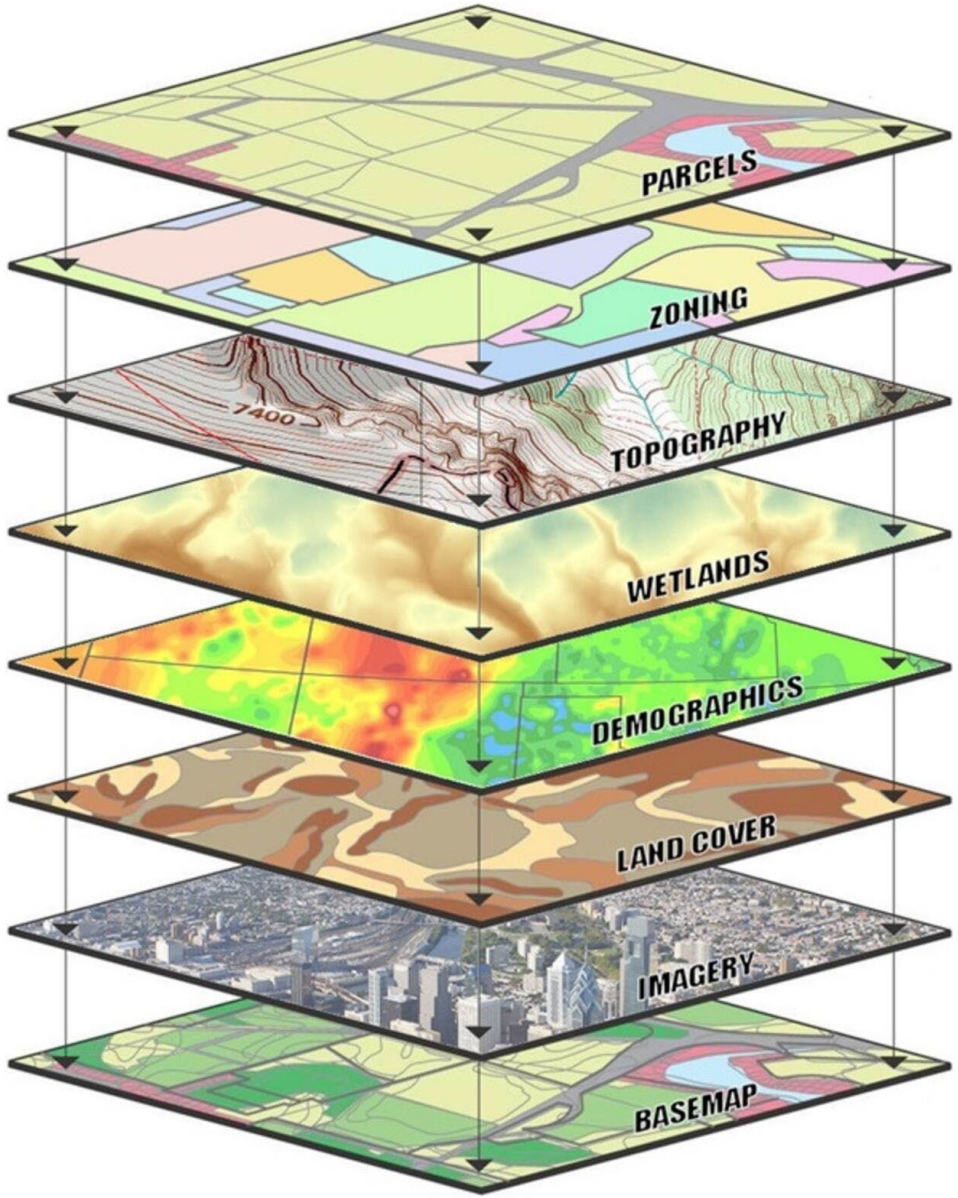
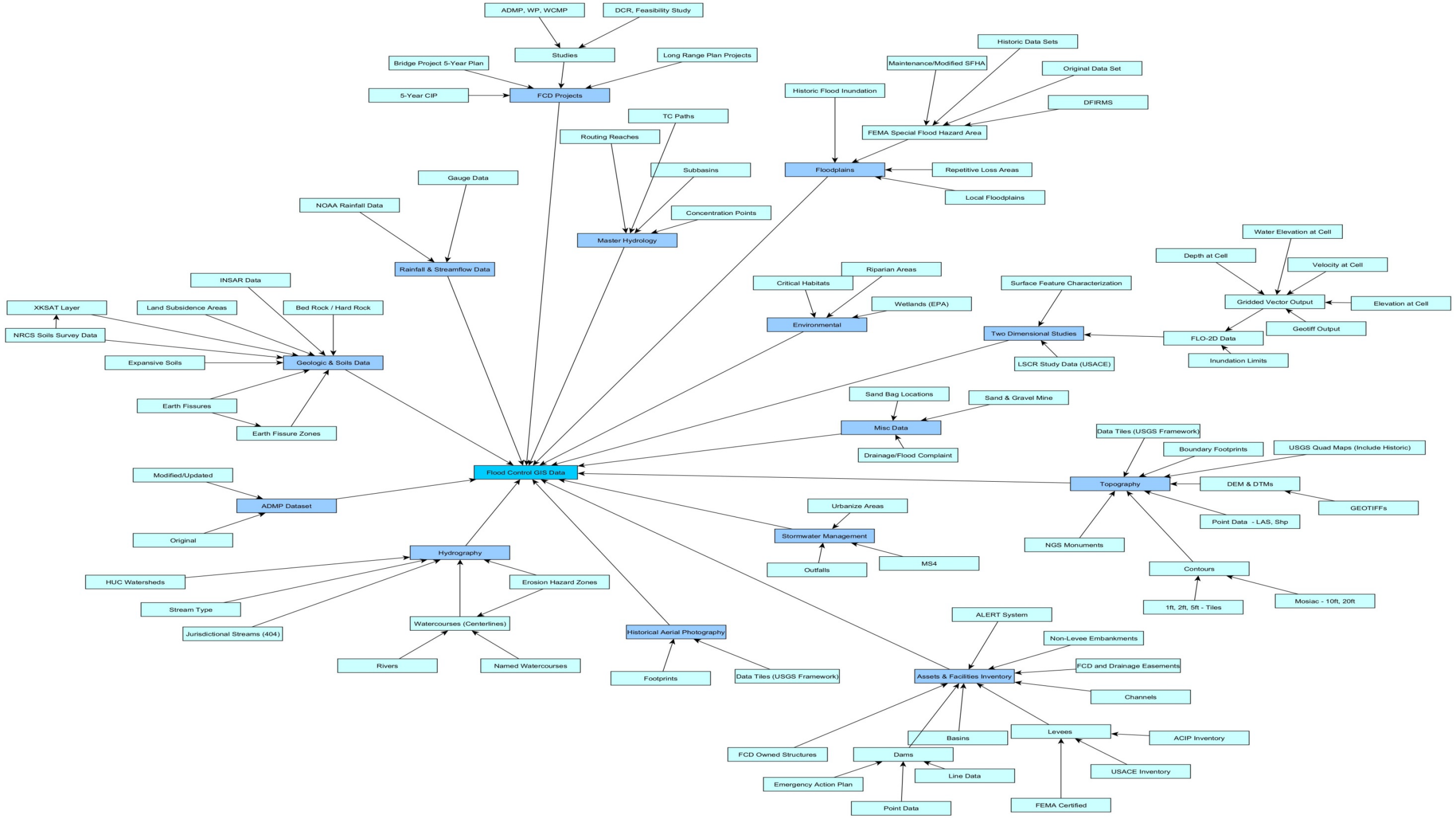


Data Driven Decision Making

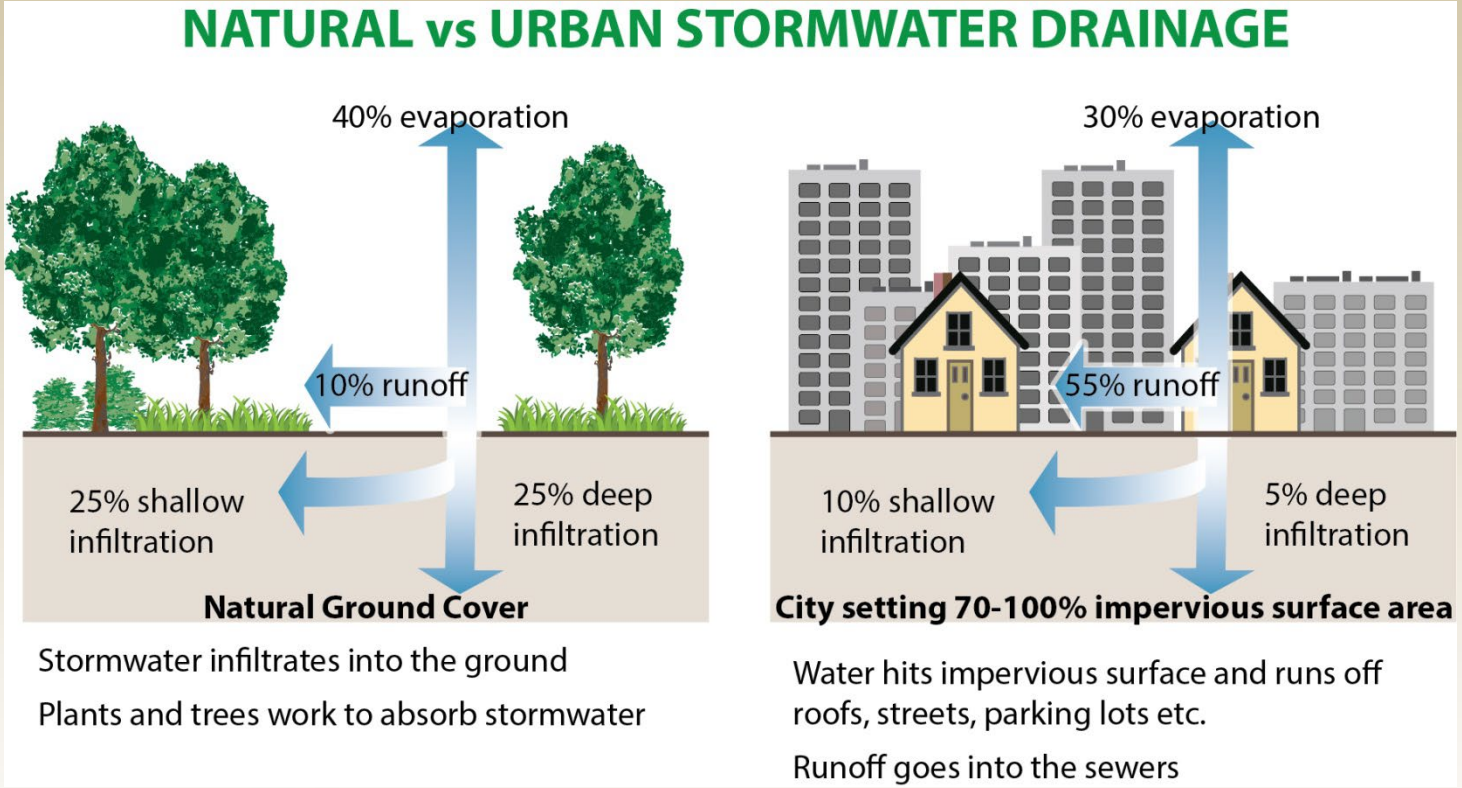


- Development Risk Analysis
- Regional/Local Land Use Planning
- Regional Planning for Infrastructure
- Risk/Hazard Assessment
- Natural and Beneficial Floodplain Functions
- Maintain regional drainage patterns and natural character


ADMP, WP, WCMP
DCR, Feasibility Study
Studies
Bridge Project 5-Year Plan
Long Range Plan Projects
5-Year CIP
FCD Projects
Historic Data Sets
Maintenance/Modified SFHA
Original Data Set
Historic Flood Inundation
DFIRMS
FEMA Special Flood Hazard Area
TC Paths
Routing Reaches
Subbasins
Floodplains
Repetitive Loss Areas
Local Floodplains
Gauge Data
NOAA Rainfall Data
Concentration Points
Master Hydrology
Rainfall & Streamflow Data
Water Elevation at Cell
Depth at Cell
Velocity at Cell
Gridded Vector Output
Elevation at Cell
Geotiff Output
FLO-2D Data
Inundation Limits
Riparian Areas
Critical Habitats
Wetlands (EPA)
Environmental
Surface Feature Characterization
Two Dimensional Studies
LSCR Study Data (USACE)
INSAR Data
XKSAT Layer
Land Subsidence Areas
Bed Rock / Hard Rock
NRCS Soils Survey Data
Expansive Soils
Geologic & Soils Data
Earth Fissures
Earth Fissure Zones
Sand Bag Locations
Sand & Gravel Mine
Misc Data
Drainage/Flood Complaint
Data Tiles (USGS Framework)
Boundary Footprints
USGS Quad Maps (Include Historic)
Topography
DEM & DTMs
GEOTIFFs
Point Data - LAS, Shp
NGS Monuments
Contours
1ft, 2ft, 5ft - Tiles
Mosiac - 10ft, 20ft
Flood Control GIS Data
Modified/Updated
ADMP Dataset
Original
Urbanize Areas
Stormwater Management
Outfalls
MS4
Hydrography
HUC Watersheds
Stream Type
Jurisdictional Streams (404)
Erosion Hazard Zones
Watercourses (Centerlines)
Rivers
Named Watercourses
Historical Aerial Photography
Footprints
Data Tiles (USGS Framework)
ALERT System
Non-Levee Embankments
FCD and Drainage Easements
Assets & Facilities Inventory
Channels
Basins
Levees
ACIP Inventory
FCD Owned Structures
Dams
Line Data
USACE Inventory
Emergency Action Plan
Point Data
FEMA Certified

Drainage Design Manual Update

- Currently working on a new drainage design manual
  - Complete rewrite – modern methods and design philosophy
  - Tiered approach to drainage analysis and design
  - New chapter on **Low Impact Development** methodology



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Low Impact Development (LID)

- LID practices for stormwater can be used to improve water quality, lower urban temperatures and reduce potable water consumption.
- These practices reduce stress on traditional stormwater infrastructure and restore natural drainage with a variety of stacked benefits for the environment.
- On a large scale, LID practices emphasize the preservation and restoration of natural landscape features.
- On a small scale, LID practices may include porous pavements, infiltration planters, onsite rainwater harvesting or stormwater harvesting/capture in public rights-of-way, open spaces or common areas.

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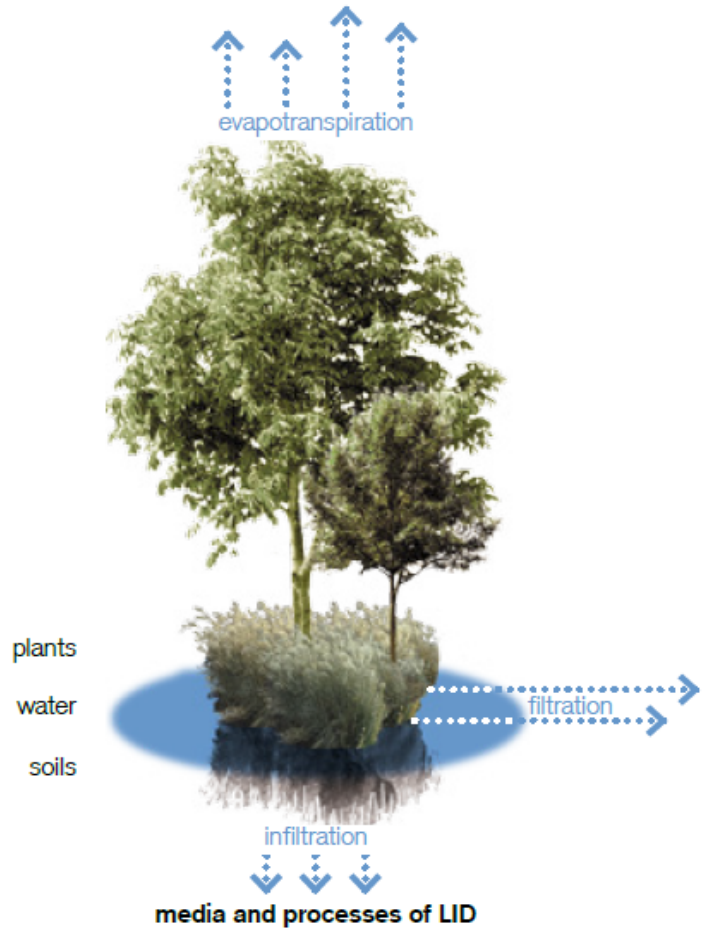
What is LID?

Low Impact Development (LID) is an ecologically-based stormwater management approach favoring soft engineering to manage rainfall on site through a vegetated treatment network. The goal of LID is to sustain a site's pre-development hydrologic regime by using techniques that infiltrate, filter, store, and evaporate stormwater runoff close to its source. Contrary to conventional "pipe-and-pond" conveyance infrastructure that channels runoff elsewhere through pipes, catchment basins, and curbs and gutters, LID remediates polluted runoff through a network of distributed treatment landscapes.

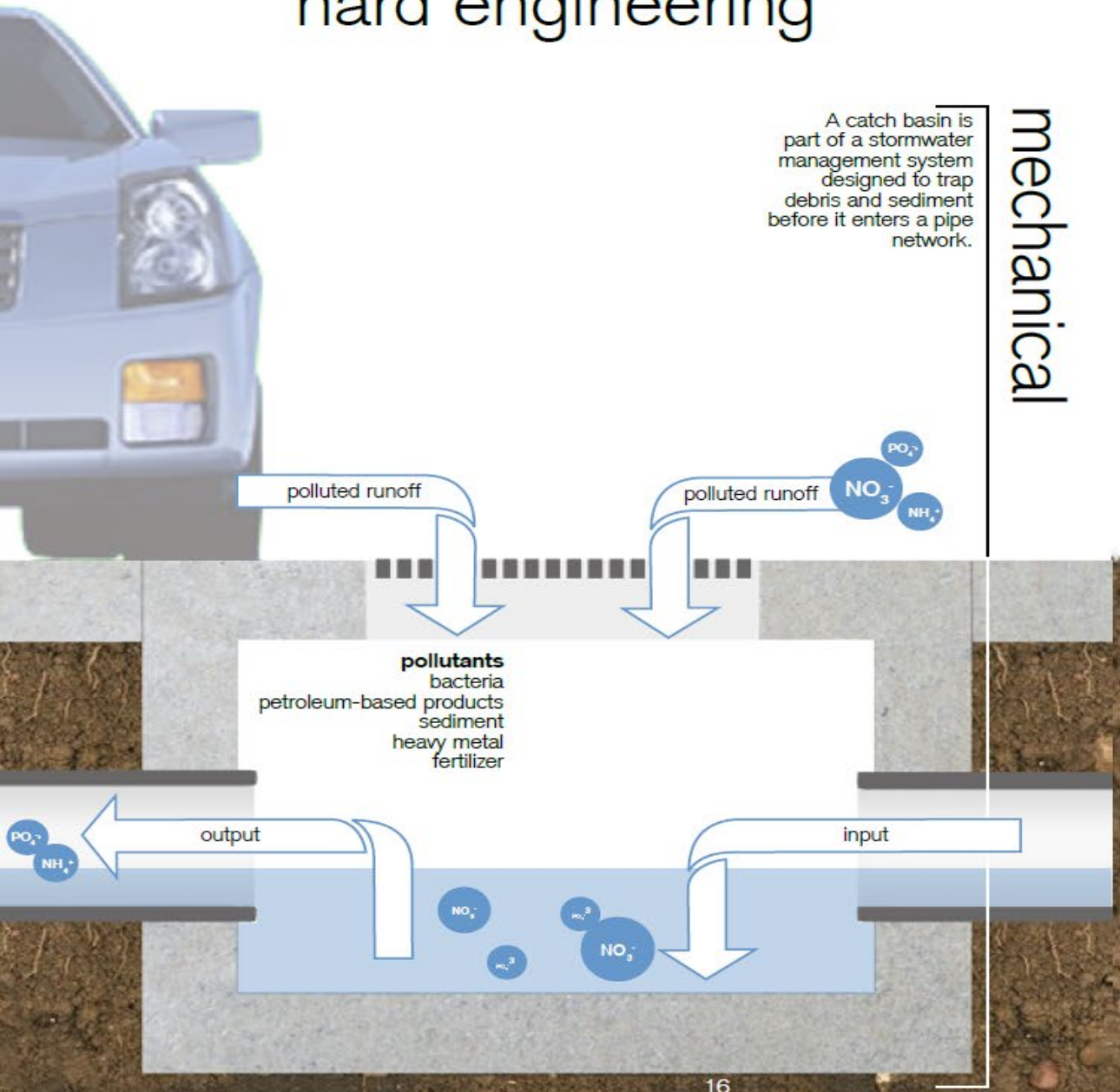


Stormwater infrastructure can be planned to deliver valuable ecological benefits

hard engineering

mechanical

A catch basin is part of a stormwater management system designed to trap debris and sediment before it enters a pipe network.



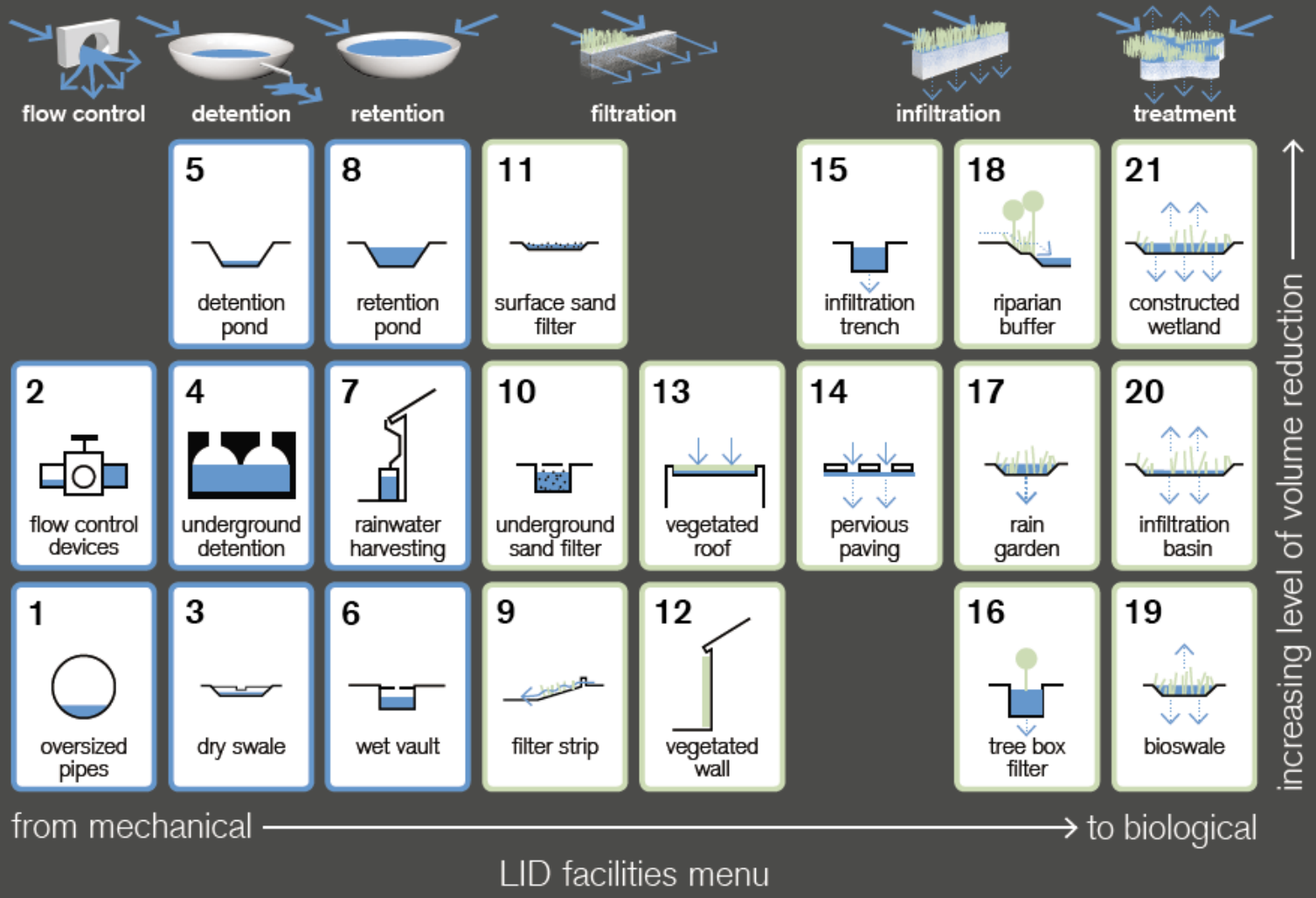
soft engineering

biological

Phytoremediation is the mitigation of contaminated soil, water, or air using plants to contain, degrade, or eliminate pollutants.

What are the LID facilities?

The Facilities Menu organizes the LID facilities based on increasing level of treatment service (quality) as well as increasing level of volume reduction (quantity). Therefore, number one (1), flow control devices offer the least amount of treatment services while number twenty-one (21), constructed wetland offers the most. Most municipalities require drainage infrastructure to manage 100-year storm events. Though one facility alone will likely not satisfy performance requirements, facilities with varying levels of service in a treatment network will provide superior levels of treatment and volume reduction.



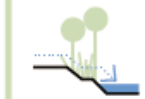
optimal level of service
filtration/infiltration/treatment

location in LID network
downstream of all LID facilities, before waterbodies

scale
from 100' to 300' wide is most effective, however smaller widths may also be used

management regime
trash and sediment removal as necessary, and occasional mowing in zone 3

18



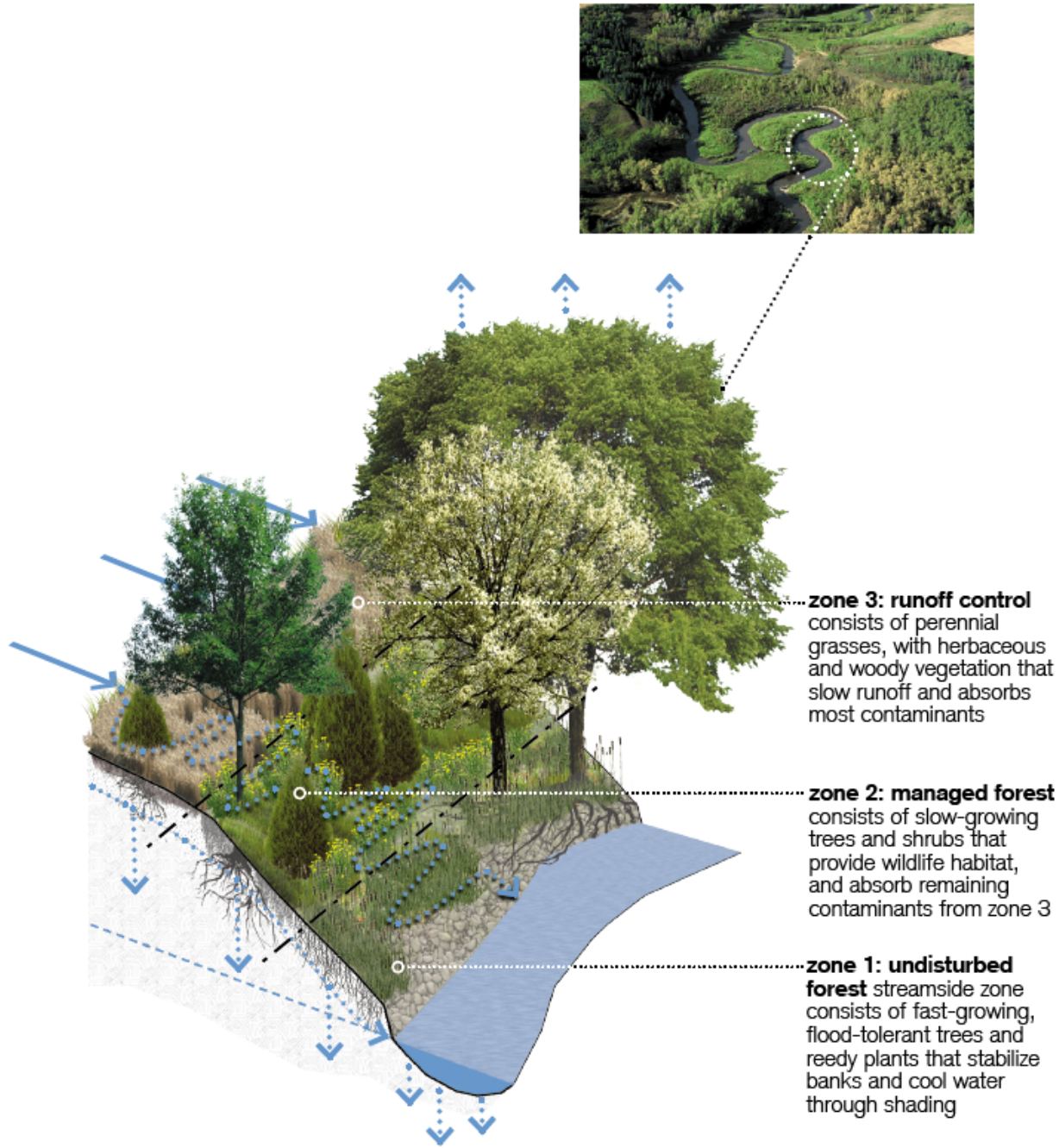
riparian buffer

Riparian Buffer

A riparian buffer is a vegetated strip along the banks of moving bodies of water.

Riparian buffers are a simple, inexpensive way to protect and improve water quality through local plant communities. Between 50 percent and 85 percent of stormwater pollutant loads can be filtered within 100 to 300 foot vegetation buffers. Buffer strips structurally stabilize banks and shorelines to prevent erosion and slumping. Trees and shrubs provide shade to maintain consistent water temperature necessary for the survival of some aquatic life. Width of the buffer is based on surrounding context, soil type, size and slope of catchment area, and vegetative cover.

Riparian buffers are most effective when combined with flow attenuation devices throughout a watershed in order to avoid high velocity flows into riparian buffer areas. Some management is required when riparian buffers are near urban development. Avoid disturbing Zone 1 as tree litter aids in flow control and filtration.



zone 3: runoff control consists of perennial grasses, with herbaceous and woody vegetation that slow runoff and absorbs most contaminants

zone 2: managed forest consists of slow-growing trees and shrubs that provide wildlife habitat, and absorb remaining contaminants from zone 3

zone 1: undisturbed forest streamside zone consists of fast-growing, flood-tolerant trees and reedy plants that stabilize banks and cool water through shading

References:
Low Impact Development Manual for Michigan
Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways

Next Steps

- Drainage Manual Update
- Master Hydrology Model
- Develop Guidance documents and/or policy statements for specific situations

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Questions or Comments?

Thank You!

Christopher Wanamaker, PE, CFM, CPM
Pinal County Engineer/Floodplain Administrator
Christopher.Wanamaker@pinal.gov

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