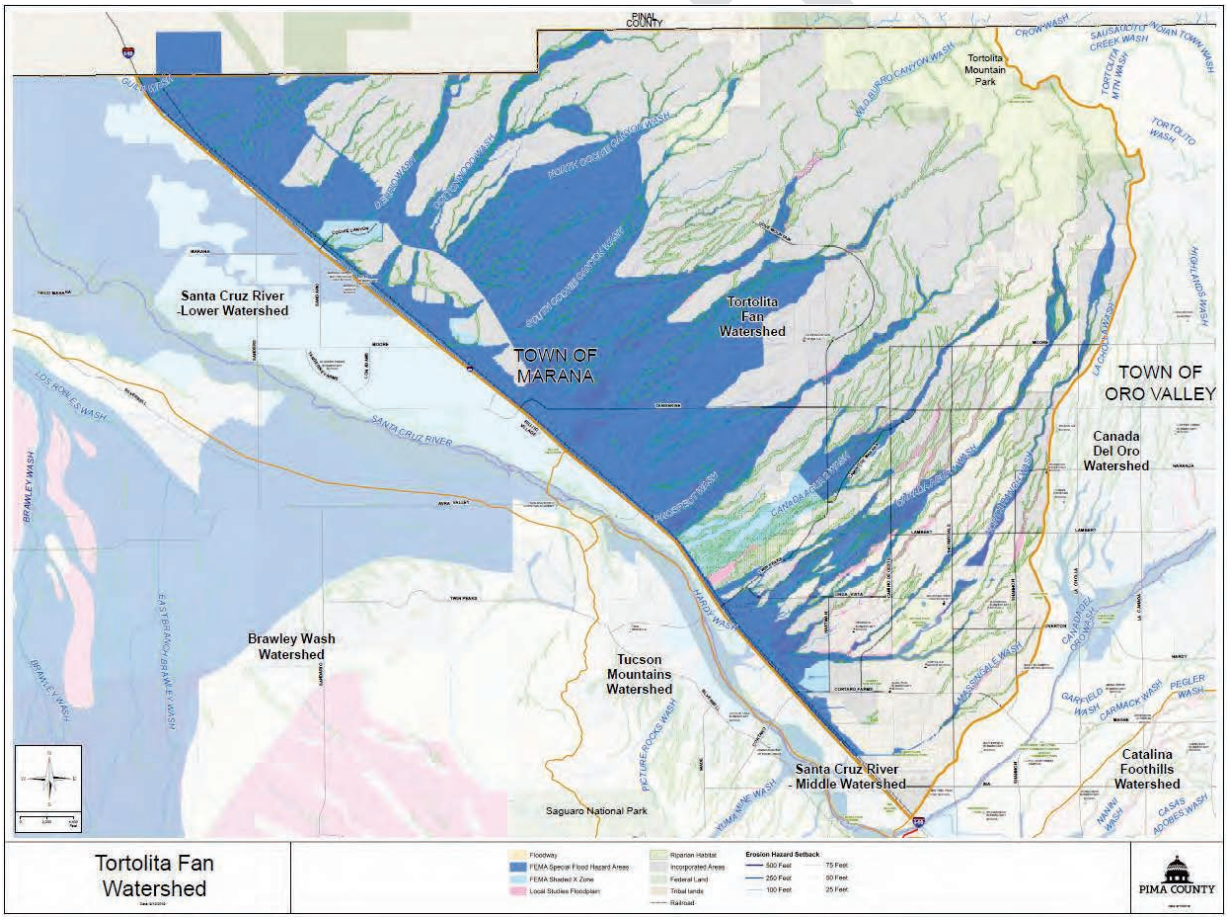
5.4.16 Tortolita Fan

This watershed includes numerous washes draining the southwestern slopes of the Tortolita Mountains. These include Cottonwood, Prospect, Canada Agua and Hardy Washes. Originating on the relatively gentle slopes of alluvial fans, these terminate in the geologic floodplains of the Santa Cruz River. The railway and Interstate as well as the natural geomorphology have reduced direct connection. Within Pima County, it is comprised of 64,682 acres (101 square miles), of which 44,630 are in the Town of Marana and 1,913 in the Town of Oro Valley. Soils are sandy and deep and often require special engineering. This geographic feature helps define the northwestern terminus of the Tucson basin itself and along with the northern arm of the Tucson Mountains creates what known locally as the Santa Cruz River narrows.

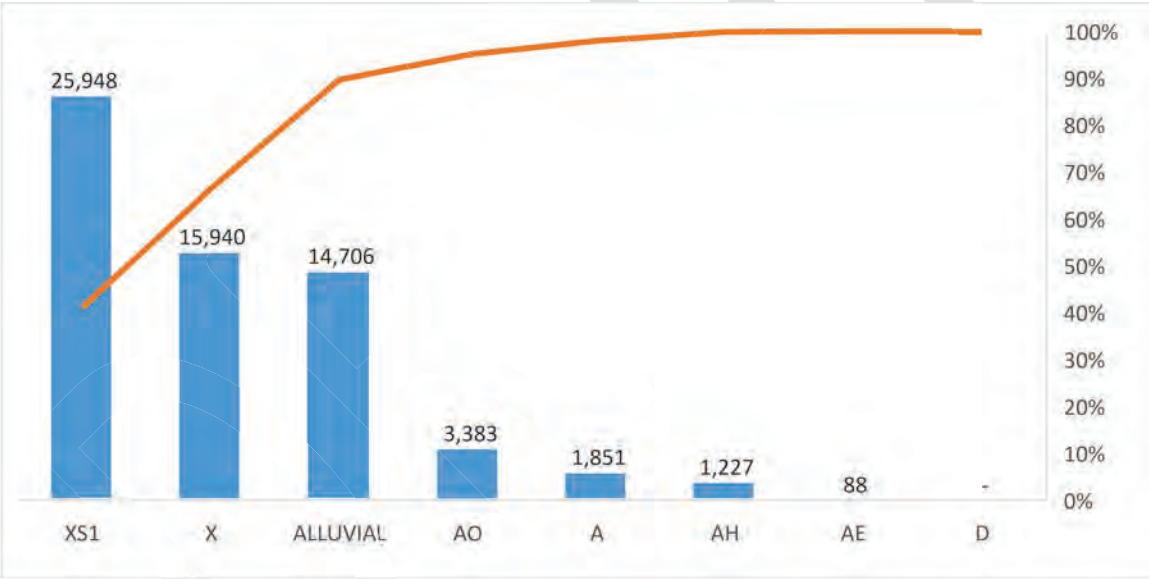
Figure 165 - Tortolita Fan Watershed Map



5.4.16.1 Flood Characteristics

The geomorphology of the Tortolita Fan to the east was evaluated in Special Study #19 (Arizona Geological Survey, 1992) and determined to be an active alluvial fan with possibility for channel migration and avulsion. For the Tortolita Fan to the east was evaluated using a 24-hour Type I storm to identify the flood risk on the active alluvial fan (CMG Drainage, 2008) which drains about 165 square miles. Since most of the fan is active, small tributary watersheds, which might have critical storms shorter than 24 hours were not included in this study. This study updated two previous studies that looked at flooding from the Fan. Special Study #24, Tortolita Area Basin Management Plan, Phase 1, Phase IIB (Cella Barr Associates, 8\3\1993) identifies 1%-annual-chance discharge values for the Tortolita fan area near the watershed's southeastern boundary. Special Study #44, Central Arizona Project (CAP) Tucson Aqueduct (Bureau of Reclamation, U.S. Dept. of the Interior, Reach 3 May 1982, Reach 4 April 1984, Reach 5 June 1983) identified 1%-annual-chance discharge values at select locations along the Central Arizona Project (CAP) canal within the alluvial fan area east of Interstate 10 and west of the Santa Cruz River.

Figure 166 - Tortolita Fan SFHA in Acres



In addition to the 21,255 acres of SFHA zones included on the chart above, there are also 935 acres of District Special Studies Floodplains and 2,955 acres of sheet flood area in this watershed. Distributory alluvial flows on unstable soils impacts much of the watershed, 39% of the watershed is within mapped floodplains. In addition to these floodplains, the District has also mapped alluvial soils requiring special engineering prior to development.

Tortolita Fan Soils

Flow across the upper Tortolita Alluvial Fan originates in the Tortolita Mountains, which lie primarily in Pinal County. Upper elevations are at about 4,000 feet typically populated by Saguaro and rocky slope faces rather than traditional forests. Canyon formations transition to fan formations at about 2,500 feet and slope at about 3% to Interstate-10 at the base of the fan at approximately 2,000 feet. Soils in the mountains tend to infiltrate less rainfall, and canyon flows are relatively contained. Resulting mountain-front flows at the fan apexes diverge along parallel contours and may avulse and re-distribute over a period of time or during a significant storm event.

The Town of Marana Tortolita Alluvial Fan Study dated April 25, 2008, includes hydrologic analyses for the watersheds above the fan apexes. According to this study, a series of four canyon watersheds each can deliver between 3,000 to 7,000 cfs in a 24-hour storm to the piedmont. Two-dimensional modeling in the study assessed flows delivered to the piedmont combined with flows resulting from rainfall on the fan formations. The study determined that the critical storm, the storm predicted to have the highest peak discharge, should be considered the 24-hour storm. Short duration storms should not produce fan-wide flooding; however, short duration storms would be associated with establishment of flow paths on the piedmont. These flow paths would be subject to change and complete inundation during a large storm event. Most of the fan is undeveloped, and future development would be subject to somewhat unpredictable flood and erosion risk. Development should be restricted to uses compatible with significant unconfined flows. Fan areas and flat areas without defined conveyances may be at risk for both flood, sediment deposition and erosion hazards during shorter duration storms.

There are no USGS gaging stations on the Tortolita Fan.

Table 54 - Tortolita Fan ALERT Rainfall Gages

USGS Gaging Station	Canada Del Oro near Tucson, AZ 09486300
USGS Gaging Station	**Canada Del Oro Near Tucson, AZ 09486300**
Period of Record	1959-07-21 to 1983-10-01
Watershed Area (sq. m)	250
Flood-Peak of Record (cfs)	17000
Date	07-21-1959
Table of Regulatory Discharge (cfs)	22100

Table 55 - Tortolita fan ALERT Precipitation Gages

Pima County Alert Gage	Moore Rd at La Cholla Blvd- Canada Del Oro Basin ID: 1240	Arthur Pack Park- Santa Cruz Basin ID: 1000
Location (Latitude, Longitude)	(32.4381, -111.0119)	(32.376,-111.0476)
Period of Record	2001-10-18 to Present	2015-08-22 to Present

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Avulsion and distributary flows are prevalent within this watershed. The table below contains excerpts from the District's Regulatory Discharge Table for discharges that have been determined by studies within this watershed.

Table 56 - Tortolita Fan Regulatory Discharges

Watercourse	Regulatory Discharge, cfs 1% Return Frequency	Drainage Area, sq. miles	Source of Discharge Information
Tortolita Fan (discharge values are at the fan apex of each sub-basin)			
@ Canada Agua Canyon East	3,623 (x-sec 2, T11,R13, Sec 21)		Pima County Regional Flood Control District Special Study (#22)
@Canada Agua Canyon West	1,030 (x-sec 2, T11, R13, sec 29)		" "
@North Ranch	1,123 (x-sec 1, T11, R13, Sec 27		" "
@Prospect Wash	5,912 prospect (x-sec 2, T11, R13, Sec 30)		" "

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Flooding in this watershed area can occur along the main stem of the lower Santa Cruz River, within fan formations to the east and along major infrastructure that stands between the fan flows and the river. The significant man-made features east of the river include from west to east, Interstate-10 (I-10), Union Pacific Railroad and the Central Arizona Project (CAP) canal, with the CAP canal lying about 1 mile to the east of the transportation features. I-10 and UPRR embankments are adjacent to one another and extend into Pinal County, with the CAP canal continuing to diverge east of I-10 toward the north. At the Tangerine Road/I-10 intersection, which is approximately the southern limit of this watershed, the CAP canal turns west and extends underground beyond the river.

The majority of the watershed is within the flood control jurisdiction of the Town of Marana. The District cooperated with technical assistance during the 2008 study to support the Town in developing inundation maps for the Tortolita Fan; however, the Town is responsible for flood control regulations within its incorporated limits. The Town's 2008 study assessed flooding potential related to CAP embankments, and certain segments of the canal embankment were modeled in a breach condition. For reaches where the embankment is assumed stable, sheet flows are temporarily impounded, then diverted to overchutes and conveyed downstream of the embankment. Within about one mile, flows encounter the UPRR and I-10 where major flows are not conveyed without significant ponding through UPRR and I-10 drainage structures. Flows downstream of I-10 flow northwesterly in relatively shallow unconfined paths across agricultural lands. North of Trico Marana Road, the entire watershed is mapped as a FEMA Zone AE with depths of 2 feet or more, creating a broad floodplain unsuitable for most types of development.

While flow on this watershed below canyon slopes is largely unconfined, fan flows may be pernicious because of unpredictable flow paths. Damage from both erosion and flooding is highly likely on fans from both short and long duration storms. An additional risk can be posed for the watershed where fan flows combine across shifting boundaries and where flows arrive mostly perpendicular to constructed features and then combine and travel laterally along the features.

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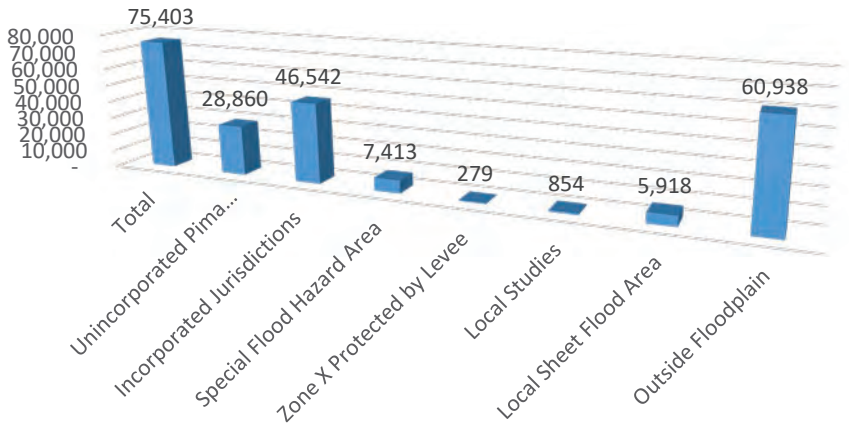
5.4.16.2 Existing Development & Infrastructure Trends

The chart below shows the population distribution between incorporated and unincorporated areas. This chart also shows the distribution of residents within known floodplains. Almost 20% of residents live within floodplains and another 279 behind a levee.

Figure 167 - Tortolita Fan Watershed Population Distribution



Although urbanized due to proximity to the interstate and railway corridors, this watershed is one of the few urban watershed with large amounts of private land that is vacant.

Figure 168 - Tortolita Fan Watershed Ownership in Acres

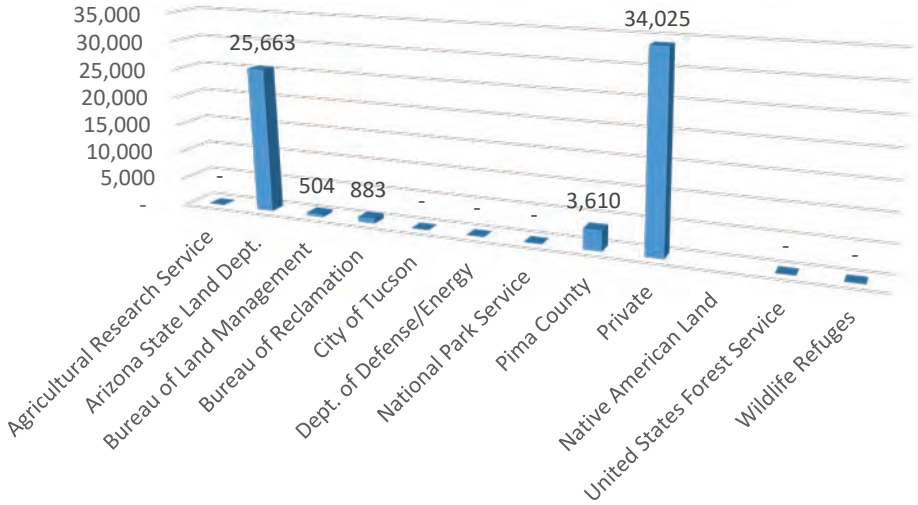
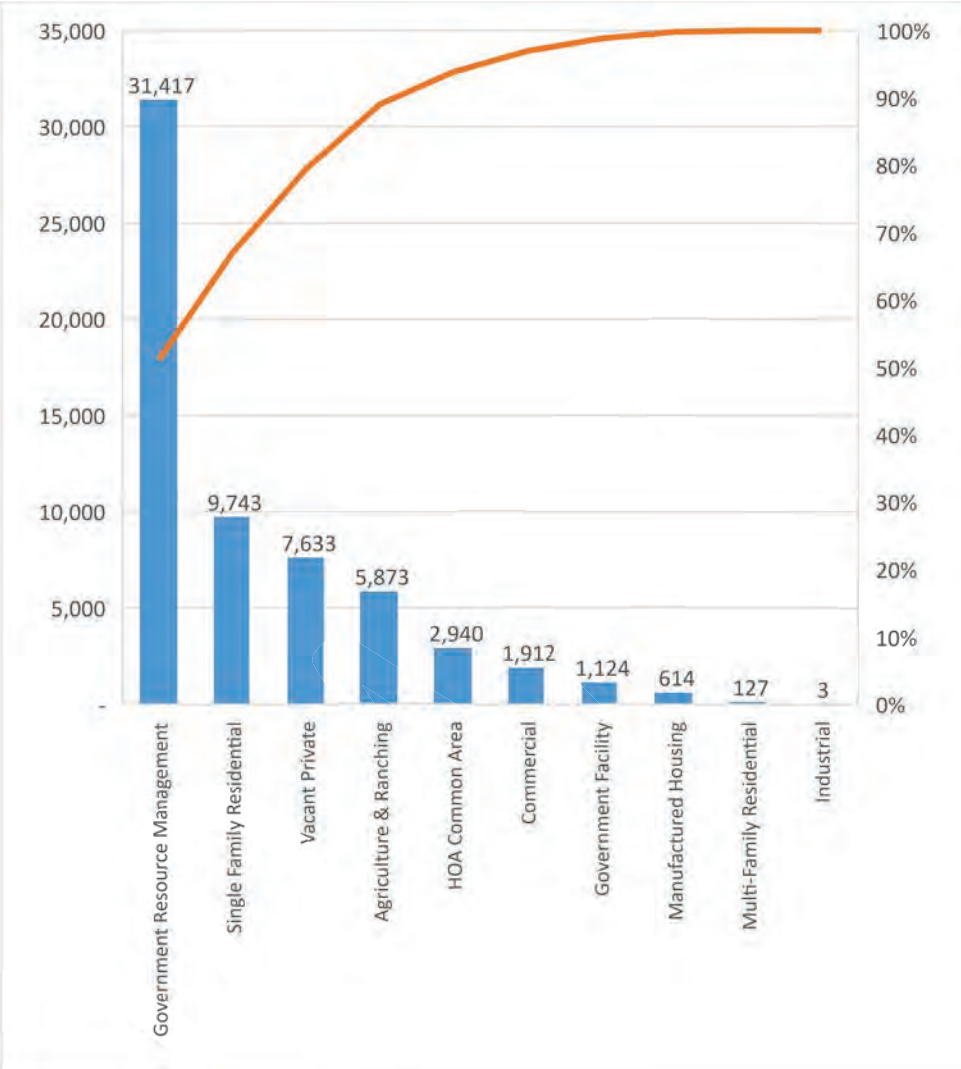


Figure 169 - Tortolita Fan Watershed Land Use



Although grazing was a traditional use of this area until recently and remains outside Oro valley, the increased intensity of commercial and residential uses on unstable soils and distributory flows paths has required large channels, basins, and road crossing infrastructure, as indicated by the large amount of HOA common area.

Figure 170 - Twin Peaks Road Culverts Photo

Figure 171 - Tortolita Fan Floodplain Land Use

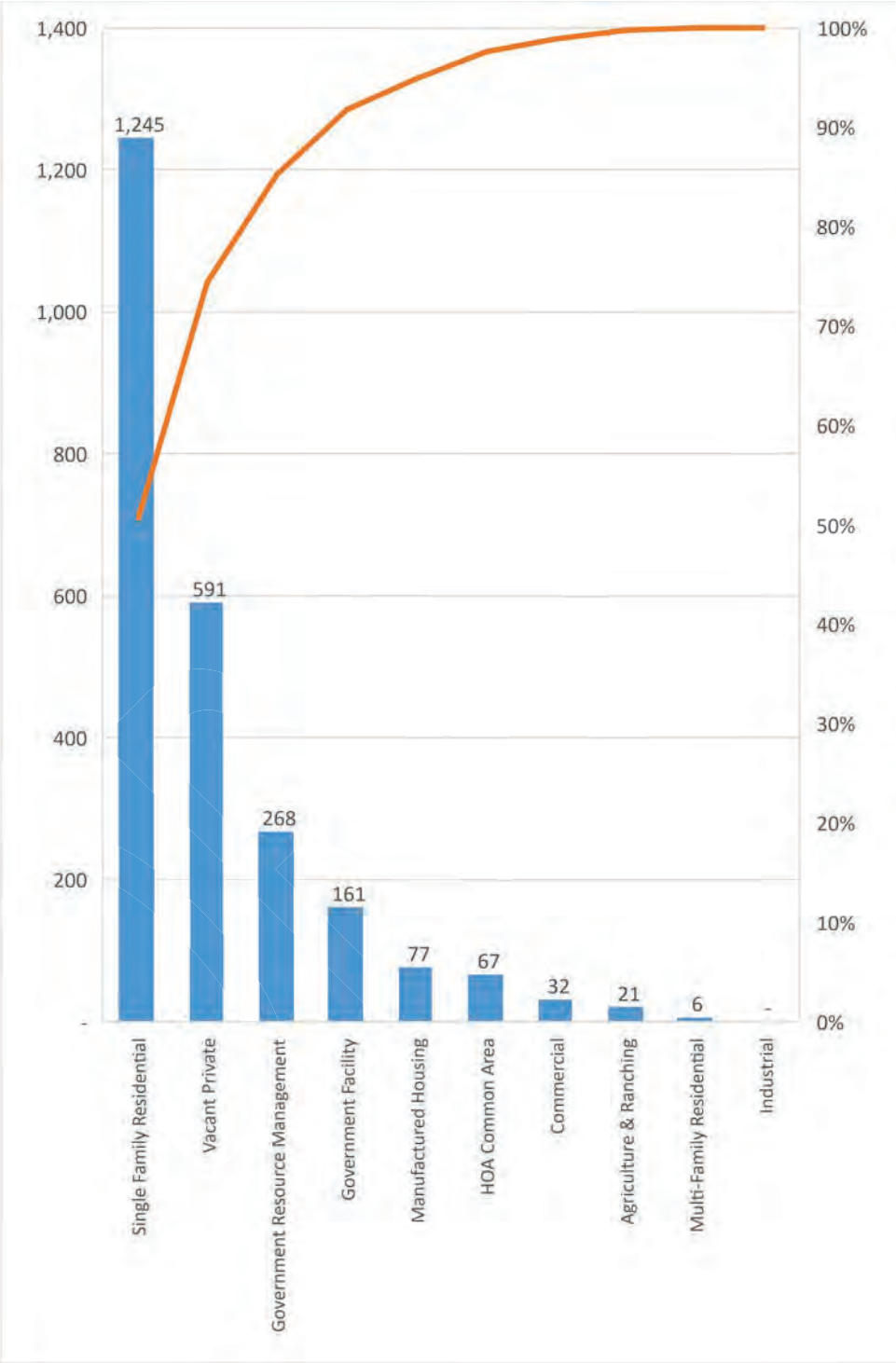
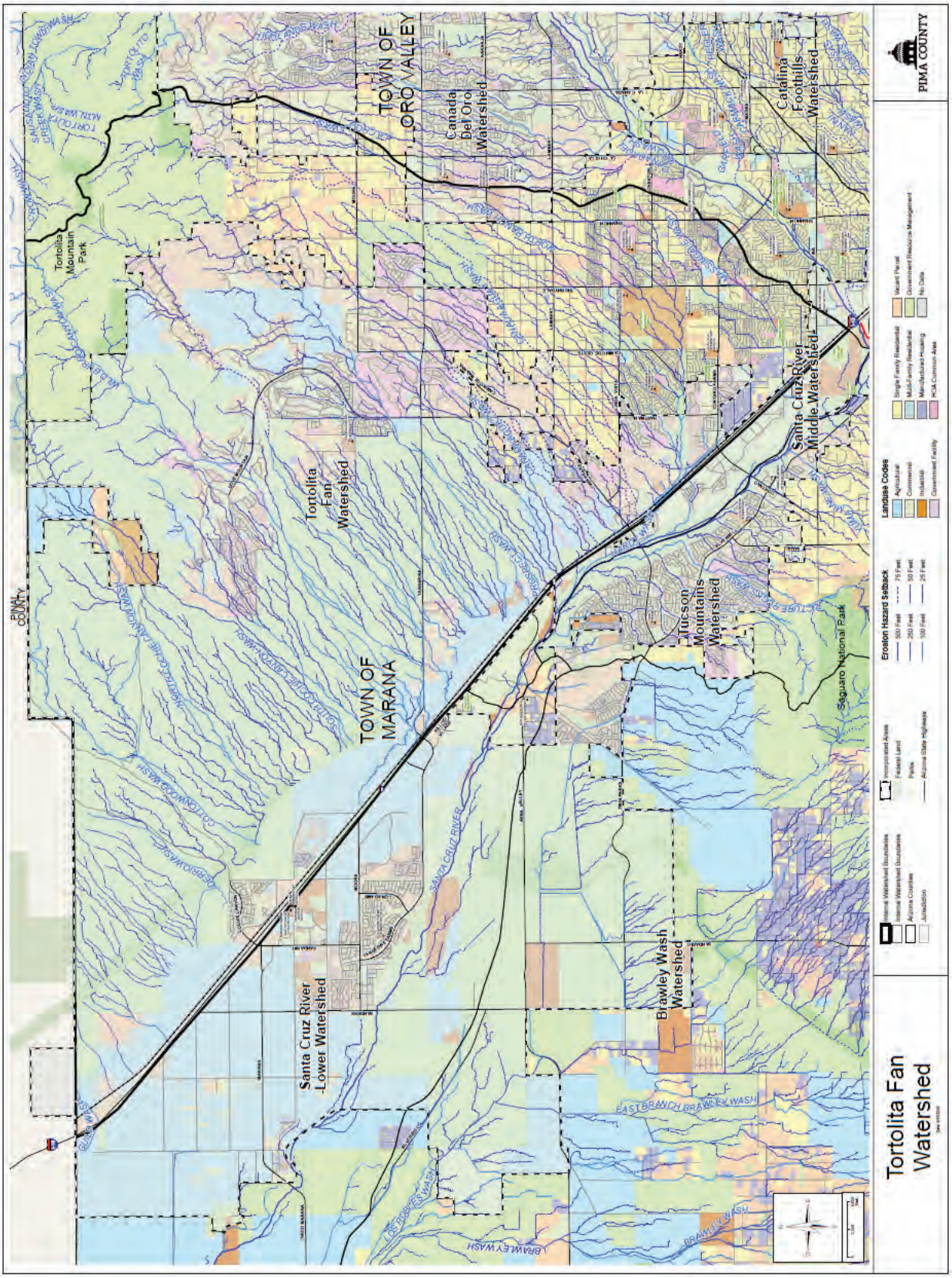


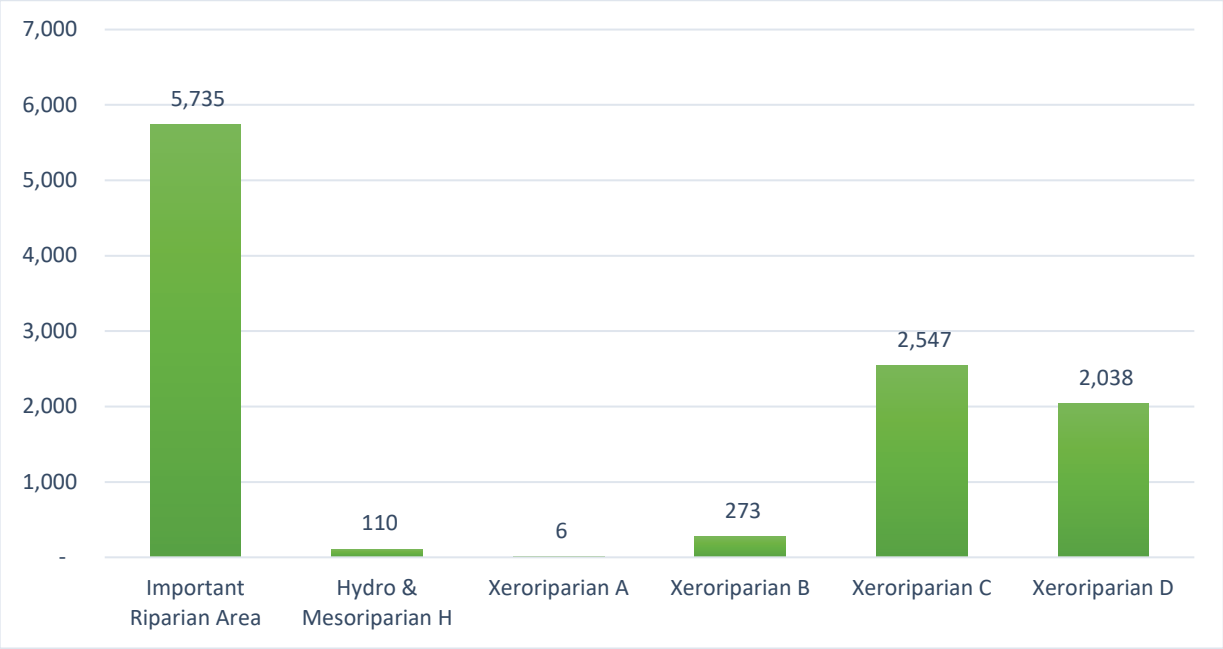
Figure 172 - Tortolita Fan Land Use Map



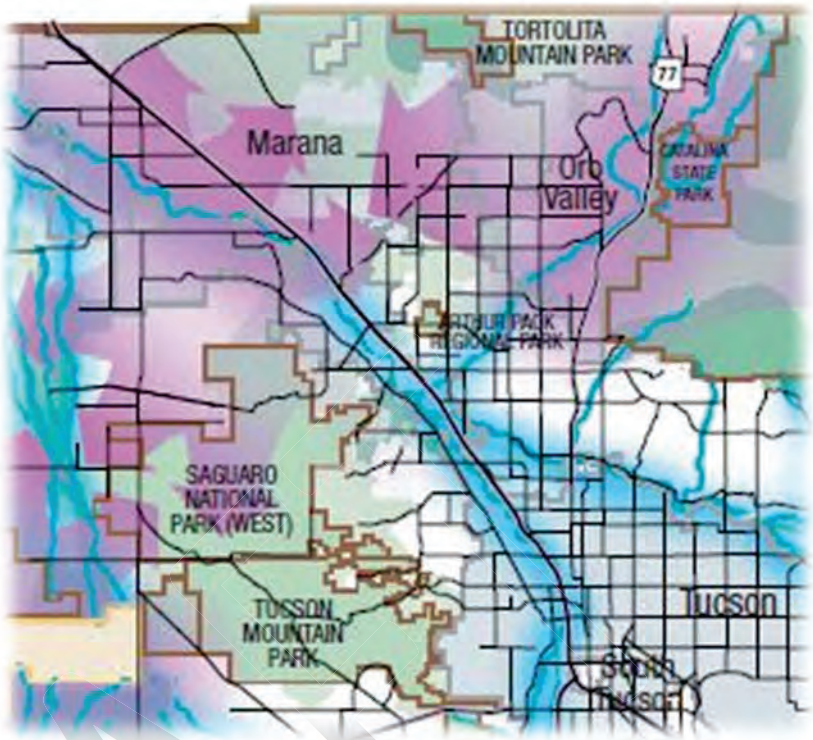
5.4.16.3 Riparian Habitat and Natural Areas

As shown on the figure below, there are 4,974 acres of Pima County Regulated Riparian Habitat in this watershed, as well as 5,735 acres of IRA. The low quality of the habitat reflects the sandy nature of these major river corridors. There are also 8,887 preserved acres in this watershed, including 2,628 in regulatory floodplain.

Figure 173 - Tortolita Fan Watershed Riparian Habitat in Acres



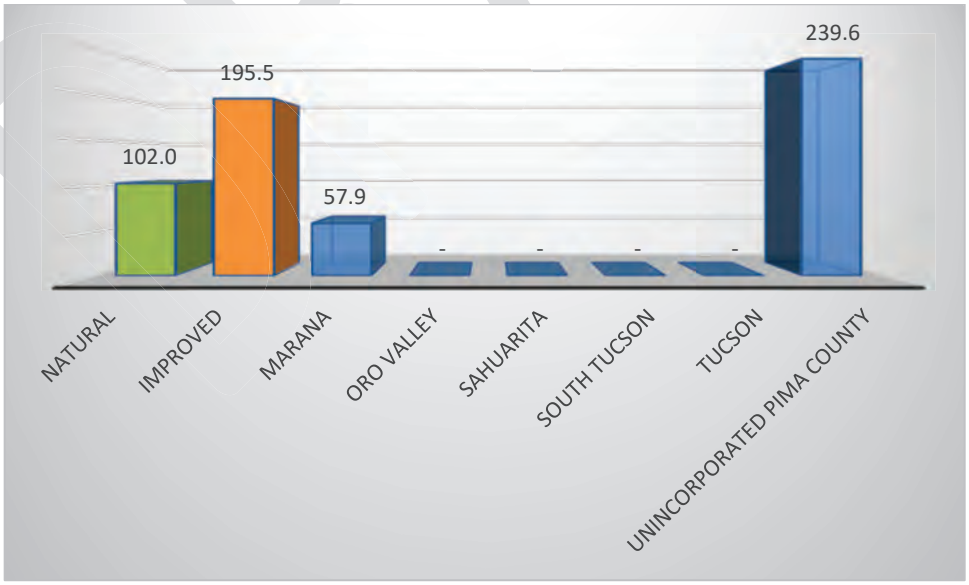
The large amount and percentage of IRA is due to significance as connectivity between the Tortolita mountains and Tucson Mountains and therefore ultimately between the Catalina and Tucson Mountains as a well.



5.4.16.4 Historic Floodplain Management Approach

The figure below shows the split between natural and improved drainageways, and how many acres the District is responsible for in each jurisdiction.

Figure 174 - Tortolita Fan Drainageway Acreage



The District has designated the Tortolita Fan as Critical Basin. New development located with a Critical Basin must provide a sufficient combination of retention and detention to reduce the post-developed 2-, 10-, and 100-year peak discharge rates to 90% of the pre-developed peak discharge rates. The Floodplain Administrator may specify other reductions. The District considers a watershed Balanced, unless it has been determined to be a Critical Basin. New development located within a Balanced Basin must provide a sufficient combination of retention and detention to reduce the post-developed 2-, 10- and 100-year peak discharge rates to the pre-developed rates. As noted above the intensity of land use in this sensitive area has relied upon large channelization and detention projects such as the Massingale Basin.

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5.4.16.5 Needs – Capital Improvement

For each watershed; monitoring, frequently flooded structures and properties subject to damage, exposed infrastructure, and safety concerns have been described in full detail in the District's Flood Response Field Manual (April 2019). Each of the areas so identified have addresses and geodetic coordinates associated with them and District personnel have them mapped in the Geographic Information System used. For planning purposes, specific items of concern follow; the complete report is in Appendix D.

Data Gathering Needs

- No site-specific issues identified.

Frequently Flooded Structures and Properties Subject to Damage

- No site-specific issues identified.

Infrastructure

- Drainageway # 1841 (poly ID 3532) in Countryside subdivision experienced bank erosion in heavy 2018 monsoon season, requiring repairs. (T12S R12E Sec. 24) <GIS POINT ID TRT- INF-001>
- Drainageway # 3236 (poly ID 3666) in Orangewood North subdivision experienced bank erosion in heavy 2018 monsoon season, requiring repairs. (T12S R13E Sec. 30) <GIS POINT ID TRT- INF-002>
- Drop structures, grates and other infrastructure on Drainageway #s 2718 (poly ID 3806), 666 (poly IDs 3804 and 3805) in Sunset Point Number 2A subdivision requires inspection after every intense storm event in the area, as the grate often gets clogged with debris, causing ponding. In 2018, water nearly entered a garage due to the ponding. (T12S R12E Sec. 25) <GIS POINT ID TRT-INF-003>

Safety Concerns

- Hartman Lane as it enters Marana (near Countryside Vista and Countryside Terrace) is subject to flooding and can become impassable, especially at the crossing near Wood Owl Drive. Also, the wash south of Condor Dr. is prone to filling up with sediment. (T12S R12E Sec. 24) <GIS Point ID: TRT-SAF-001>

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5.4.16.6 Floodplain Management

Future needs identified by District staff include:

- Soils/fans
- Geologic floodplain canyon development
- Corridors
- Lot splits cumulative impacts
- Riparian disturbances rural uses
- PCDOT sediment placement/drainage complaints
- Interjurisdictional Coordination
- Potential for retrofits with green infrastructure to reduce detention storage volume
- Sand and gravel mining in the Santa Cruz River floodplain

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