Montoyas
Watershed Park Management Plan

April 2021

Southern Sandoval County Arroyo Flood Control Authority
(SSCAFCA)

This is a planning document. Nothing herein constitutes any commitment by SSCAFCA to construct any project, study any area, acquire any right of way or enter into any contract. This watershed park management plan does not obligate SSCAFCA in any way.

Drainage facility alignments, conveyance treatments, corridors, locations, rights-of-way and cost estimates are conceptual only, and may be altered or revised based upon future project analysis, changed circumstances or otherwise. Land uses included in this document were assumed for the basis of hydrologic modeling only. This document does not grant "free discharge" from any proposed development. Naturalistic channel treatments and piped storm drains are to be used for conveyance stabilization, unless otherwise authorized by SSCAFCA.

To ensure public health, safety and welfare, SSCAFCA develops and maintains the adopted "Master" regional hydrology for all watersheds within its jurisdiction. Updates and revisions are made and tracked by SSCAFCA, or their designee. A copy of the "Master" hydrology model is available for reference or use by others. Contact SSCAFCA to obtain copies of the model and see the SSCAFCA website for the Watershed Management Plan status. Use of electronic media provided by SSCAFCA is solely at the user's risk.

Contents

Appendices

1. Introduction

The Montoyas Watershed Park Management Plan was prepared by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA). The main goals presented in the plan are:

- To document current and future improvements necessary to provide flood protection up to the 100-year storm for the public health, safety and welfare of residents and properties within its boundaries.
- To recognize the value of the land purchased or controlled for floodways as areas with multi-use potential.
- To manage sediment and erosion within the boundaries of the Flood Control Authority.
- To assist other entities within SSCAFCA's jurisdiction in the construction of flood control for the good of the public.
- To provide discharge guidelines for future development.
- To preserve the natural character of the arroyos where possible and,
- To propose improvements to mitigate the effect of developed flows.

A regional hydrologic model and watershed management plan for the Montoyas watershed was first prepared in 2002 (SSCAFCA, 2002) and updated in 2010 (SSCAFCA, 2011). The present plan updates the hydrologic conditions to reflect urbanization as of 2019 and includes model calibration based on measured rainfall/runoff data. This data includes available discharge records for the watershed over a period of approximately twelve years (2007-2018). The hydrologic model and associated documentation were reviewed by the U.S. Army Corps of Engineers Albuquerque District. According to SSCAFCA policy, planning and design of flood control infrastructure is based on runoff from the 100-year (1% chance) storm. SSCAFCA understands that runoff resulting from a storm with a 1-percent chance of occurring in any given year cannot be inferred with confidence based on 12 years of data. Moreover, discharge measurements are only available near the outlet of the basin, while flow estimates are needed at various locations throughout the watershed (e.g. road crossings). Hydrologic modeling was therefore used in this study to provide runoff estimates for the 1% chance storm at all locations of interest throughout the watershed. The current hydrologic model and results used for this planning document are the most accurate and precise that can be reasonably expected. As new information becomes available and is verified, it will be incorporated into the model to continue improving our modeling efforts.

1.1. Location

The Montoyas Watershed Park consists of a 61 mi^2 drainage basin that discharges to the Rio Grande just north of the City of Albuquerque (Figure 1.1). The watershed encompasses portions of the City of Rio Rancho and the Village of Corrales and lies largely within the jurisdiction of SSCAFCA.

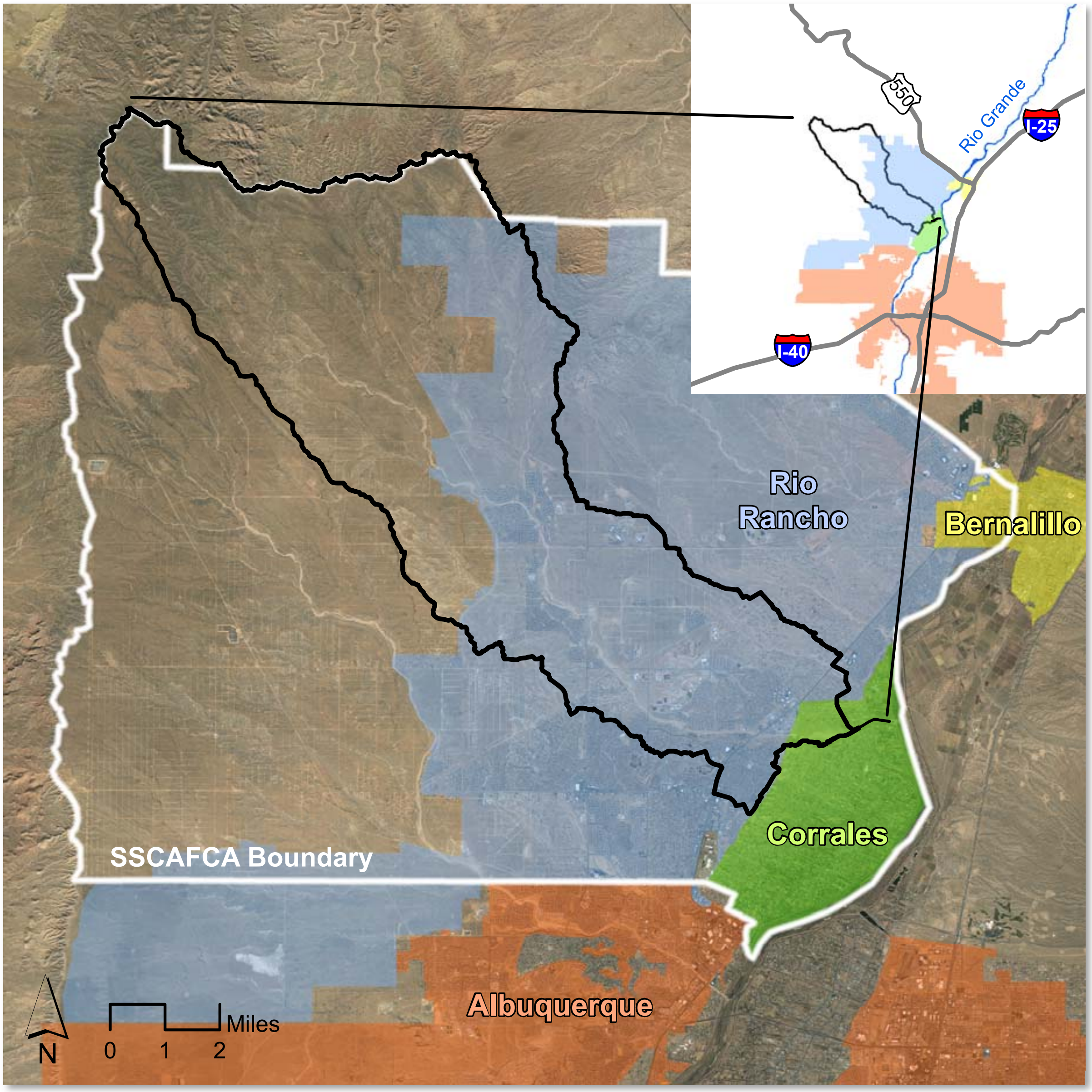

Figure 1.1: Overview map of the Montoyas watershed and local municipalities.

1.2. Climate

The Montoyas watershed is located west of the Rio Grande in the Middle Rio Grande valley, with elevations ranging from approximately 5000 to 6600 feet above sea level. The area has a mild, semiarid, continental climate characterized by low annual precipitation, low relative humidity, and large annual and diurnal temperature fluctuations (WRCC, 2019).

Based on 1981-2010 climate normals (Figure 1.2), average mean annual temperature for the area is 69 °F; average mean monthly temperatures range from 46 °F in December to 90 °F in July.

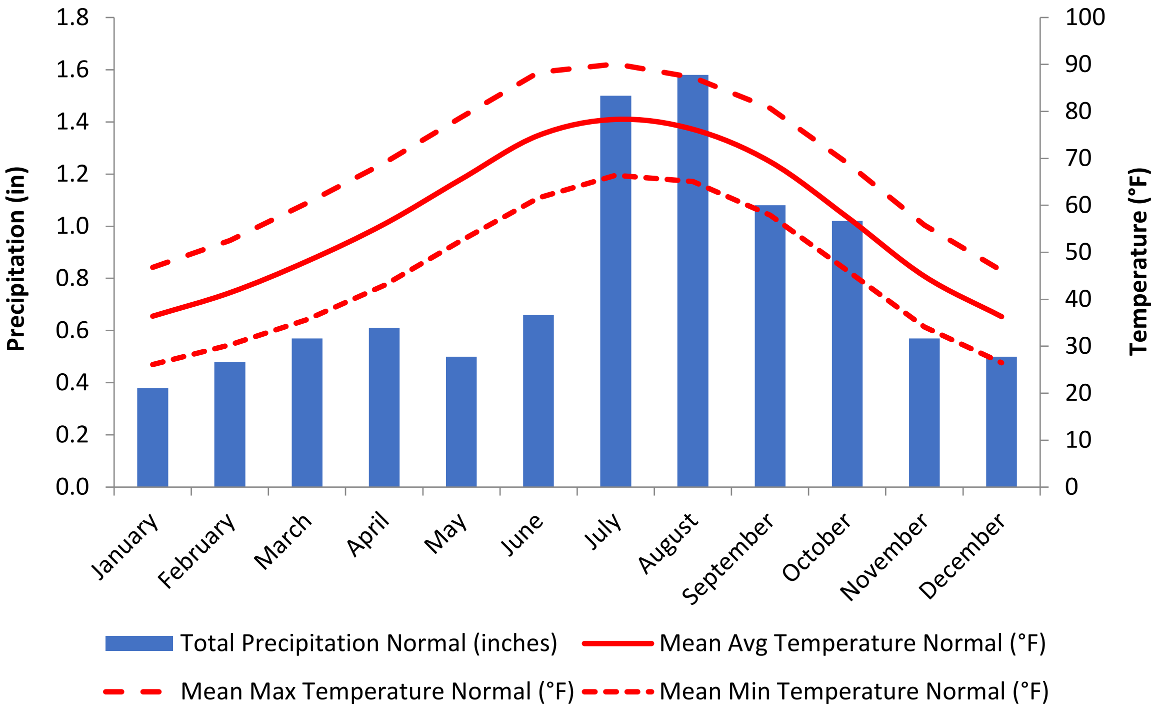

Figure 1.2: Monthly climate normal (1981-2010) for the Albuquerque, NM area (source: NOAA, 2019).

Average annual precipitation for the watershed is approximately 10 inches, with values ranging from 4 to 16 inches (NOAA, 2019). July and August are the months with highest rainfall totals (see Figure 1.2). Summer rain typically falls during brief, intense thundersotrms. Southeasterly circulation brings moisture for those storms from the Gulf of Mexico. Orographic lifting and surface heating causes air masses to rise and moisture to condensate (WRCC, 2019). Heavy rainfall associated with summer thunderstorms frequently leads to localized flash flooding (Adams and Comrie, 1997; Higgins et al., 1997). Winter precipitation is mainly related to frontal activity associated with storms from the Pacific Ocean. Much of the winter precipitation falls as snow in the mountains outside of the Montoyas watershed.

1.3. Soils

Soils in the Montoyas watershed are predominantly sandy loams and loamy fine sands (Figure 1.3) and can be characterized as highly erosive (Hacker and Banet, 2008). All soils fall into hydrologic soil groups A and B (see Figure 1.3, right).

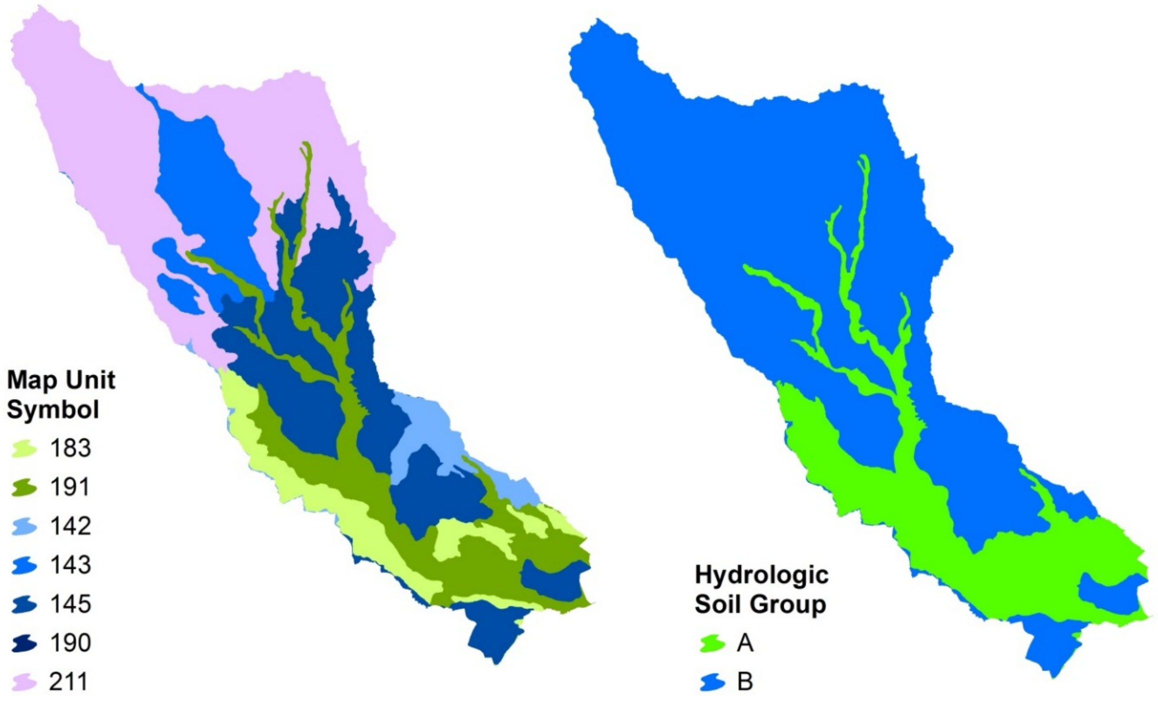

Figure 1.3: Soils found in the Montoyas watershed (left) and corresponding hydrologic soil group (right).

Table 1.1: Map unit symbols, descriptions and hydrologic soil groups for soils found in the Montoyas watershed.

Map Unit Symbol	Description	Hydrologic Soil Group
142	Grieta fine sandy loam, 1 to 4 percent slopes	B
143	Clovis fine sandy loam, 1 to 4 percent slopes	B
145	Grieta-Sheppard loamy fine sands, 2 to 9 percent slopes	B
183	Sheppard loamy fine sand, 8 to 15 percent slopes	A
190	Zia-Skyvillage-Rock outcrop complex, 5 to 40 percent slopes	B
191	Sheppard loamy fine sand, 3 to 8 percent slopes	A
211	Zia-Clovis association, 2 to 10 percent slopes	B

1.4. Vegetation and Wildlife

With elevations ranging from 5000 to 6600 feet, the study area features semi-desert shrub and grasslands. Clusters of juniper trees (Juniperus spp.) grow along ephemeral channels and in depressed areas and gullies that receive concentrated runoff. Typical shrubs include big sagebrush (Artemisia tridentata), and fourwing saltbush (Atriplex canescens). Apache Plume (Fallugia paradoxa) often lines ephemeral channel banks (Figure 1.4).

Figure 1.4: Apache plume growing along the banks of the upper Montoyas Arroyo.

Grama grasses (Bouteloua spp.) form important understory forage plants (Allison and Ashcroft, 2011). Cacti (Oppuntia spp. and Cylindropuntia spp.) are also commonly found in the area. Distribution of plant species has been affected by a combination of over-grazing and drought over the past century (Allison and Ashcroft, 2011).

The Montoyas watershed and its ephemeral channels provide habitat for a variety of animal species. Examples include the burrowing owl (Athene cunicularia, Figure 1.5) and bank swallow (Riparia riparia, Figure 1.6), both migratory species that nest in vertical arroyo banks.

Figure 1.5: Burrowing owls in the bank of the Montoyas Arroyo (photos by SSCAFCA).

Figure 1.6: Bank swallows nesting in the vertical bank of the lower Montoyas Arroyo. (photos by SSCAFCA).

1.5. References

Adams, D.K. and Comrie, A.C., 1997. The north American monsoon. Bulletin of the American Meteorological Society, 78(10), pp.2197-2214.

Allison C.D. and Ashcroft N. (2011). New Mexico Range Plants. New Mexico State University Circular 374. Las Cruces, NM.

Hacker, L., Banet, C., 2008. Soil Survey of Sandoval County Area, New Mexico, Parts of Los Alamos, Sandoval, and Rio Arriba Counties. Natural Resources Conservation Service, U.S. Department of Agriculture, U.S. Govt. Print Office, Washington, D.C.

Higgins, R.W., Yao, Y. and Wang, X.L., 1997. Influence of the North American monsoon system on the US summer precipitation regime. Journal of Climate, 10(10), pp.2600-2622.

NOAA (National Oceanic and Atmospheric Administration), (2019). “Monthly Climate Normals (1981-2010) – Albuquerque Area.” https://w2.weather.gov/climate/xmacis.php?wfo=abq (Accessed 2/20/2019).

SSCAFCA (Southern Sandoval County Arroyo Flood Control Authority) (2002). “Montoyas Arroyo Watershed Management Plan.” Rio Rancho, NM.

SSCAFCA (Southern Sandoval County Arroyo Flood Control Authority) (2011). “Montoyas Watershed Park Management Plan Version 2.0.” Rio Rancho, NM.

WRCC (Western Regional Climate Center) (2019). “Climate of New Mexico”. https://wrcc.dri.edu/narratives/NEWMEXICO.htm (Accessed 2/20/2019).

2. Watershed Hydrology

All hydrologic modeling was carried out using the U.S. Army Corps of Engineers HEC-HMS software version 4.2.1.

2.1. Basin Delineation

Orthophotography used for this project consists of tiled images which depict color digital aerial photographs acquired in the spring of 2018 during leaf-off conditions. LiDAR-derived elevation data (2-foot contour interval, 2010) was used to delineate watersheds and sub-basins as well as for calculating hydrologic parameters. Both orthophotography and elevation data are part of the Mid-Region Council of Governments (MRCOG) Digital Orthophotography and Elevation Data Project.

Initial watershed and subbasin boundary delineation was accomplished using HEC Geo-HMS software with a digital elevation model (DEM) created from 2010 MRCOG LiDAR data. Basins were modified to accommodate desired analysis points and achieve basins with relatively uniform land use characteristics. Analysis points were selected for tributary confluences, major existing culverts and road crossings, and existing and proposed pond locations. Questionable boundaries were verified in the field, especially at locations where graded roads influence flow paths, and where a dominant flow path was not immediately obvious from 2-ft contours. An overview map of basin boundaries can be seen in Figure 2.1; major tributaries are shaded in different colors.

2.2. Reach Routing

Routing reaches were delineated, and slopes estimated in Arc-GIS based on 2010, 2-ft contours. Channel reaches were modeled using idealized cross-sections that most closely resembled the natural geometry of the reach (trapezoidal and rectangular). Roughness coefficients (Manning’s n-values) were estimated based on orthoimagery and field investigations. In general, the following n-values were used in the model (Table 2.1):

Table 2.1: Roughness coefficients for routing reaches.

Surface Type	Manning's n-value
Concrete pipe	0.013
Road (asphalt)	0.017
Corrugated metal pipe	0.025
Major arroyo, sandy bed and vertical banks	0.020
Natural channel, moderate to heavy vegetation in channel bed and along banks	0.025 - 0.035

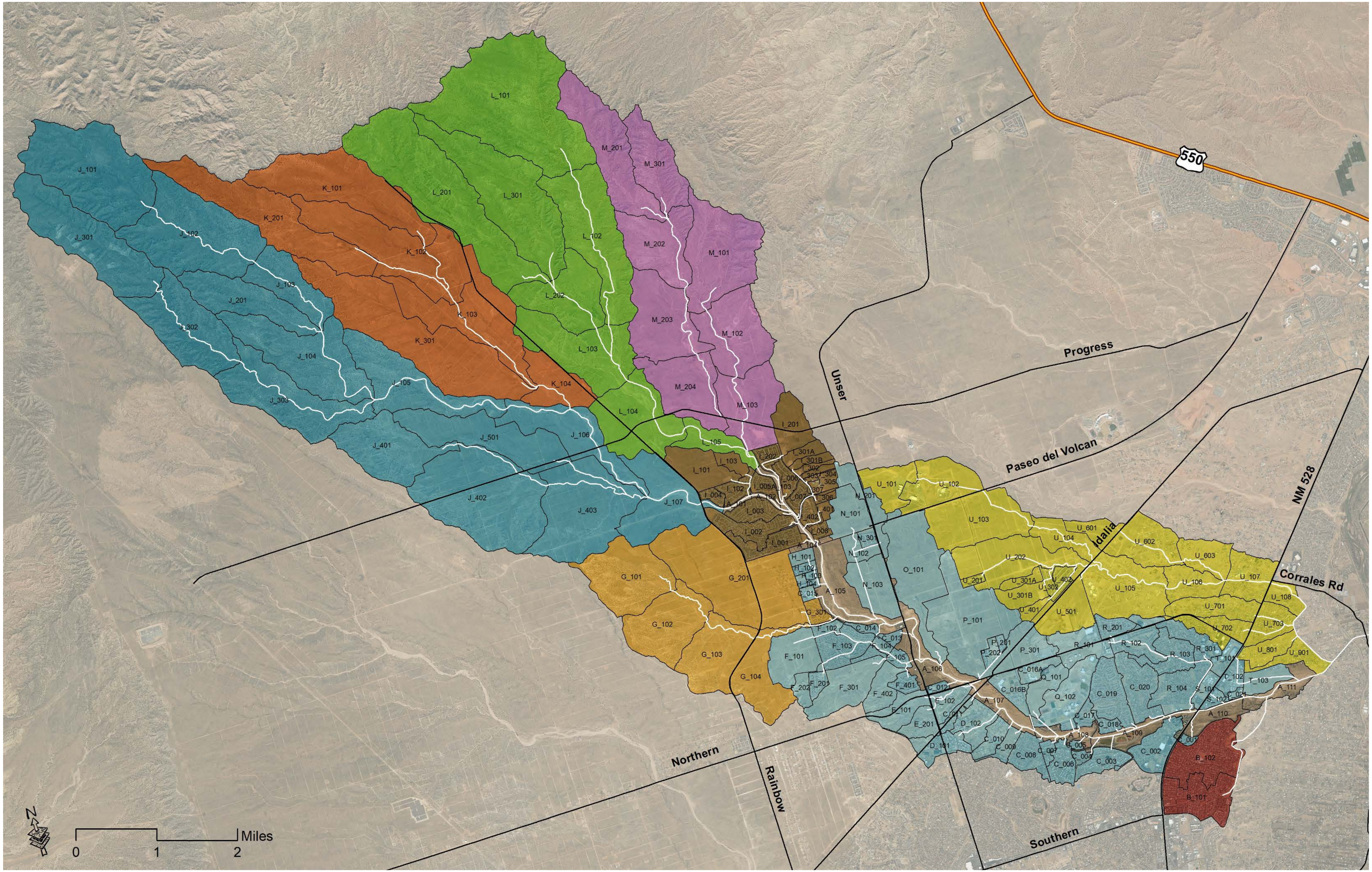

Figure 2.1: Subbasin overview map

2.3. Existing Land Use

The City of Rio Rancho, which covers a portion of the Montoyas watershed (see Figure 1.1), is one of the fastest growing cities in the southwestern U.S. The city was incorporated in 1981 with a population of approximately 10,000 residents. Figure 2.2 shows population growth since 1980. The growth rate slowed following the housing market crash of 2008 but is projected by the City of Rio Rancho to reach a population of approximately 106,000 by the year 2020. Other municipalities in the watershed include the Village of Corrales (see Figure 1.1) and unincorporated areas of Sandoval County.

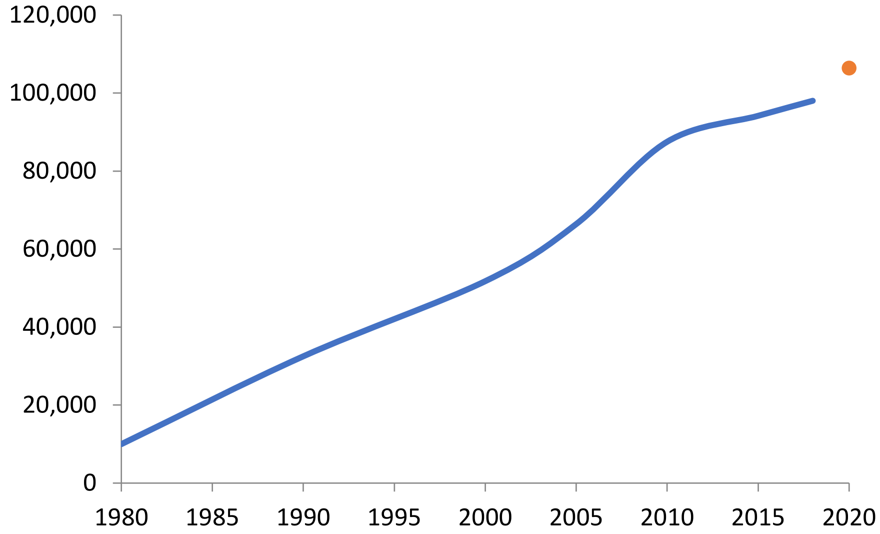

Figure 2.2: Population growth in the city of Rio Rancho (blue) and projected population for the year 2020 (orange). Data source: U.S. Census Bureau (https://www.census.gov/data.html) and City of Rio Rancho (https://rrnm.gov/4185/Community-Overview).

In 2019, a large portion of the Montoyas watershed was undeveloped. Figure 2.3 shows the extent of urbanization and major land use categories. Urbanization was focused in the lower and central portion of the watershed. Most of the urban development consisted of residential subdivisions (blue). Land use was quantified by manual digitization using orthoimagery and based on GIS data obtained from the City of Rio Rancho.

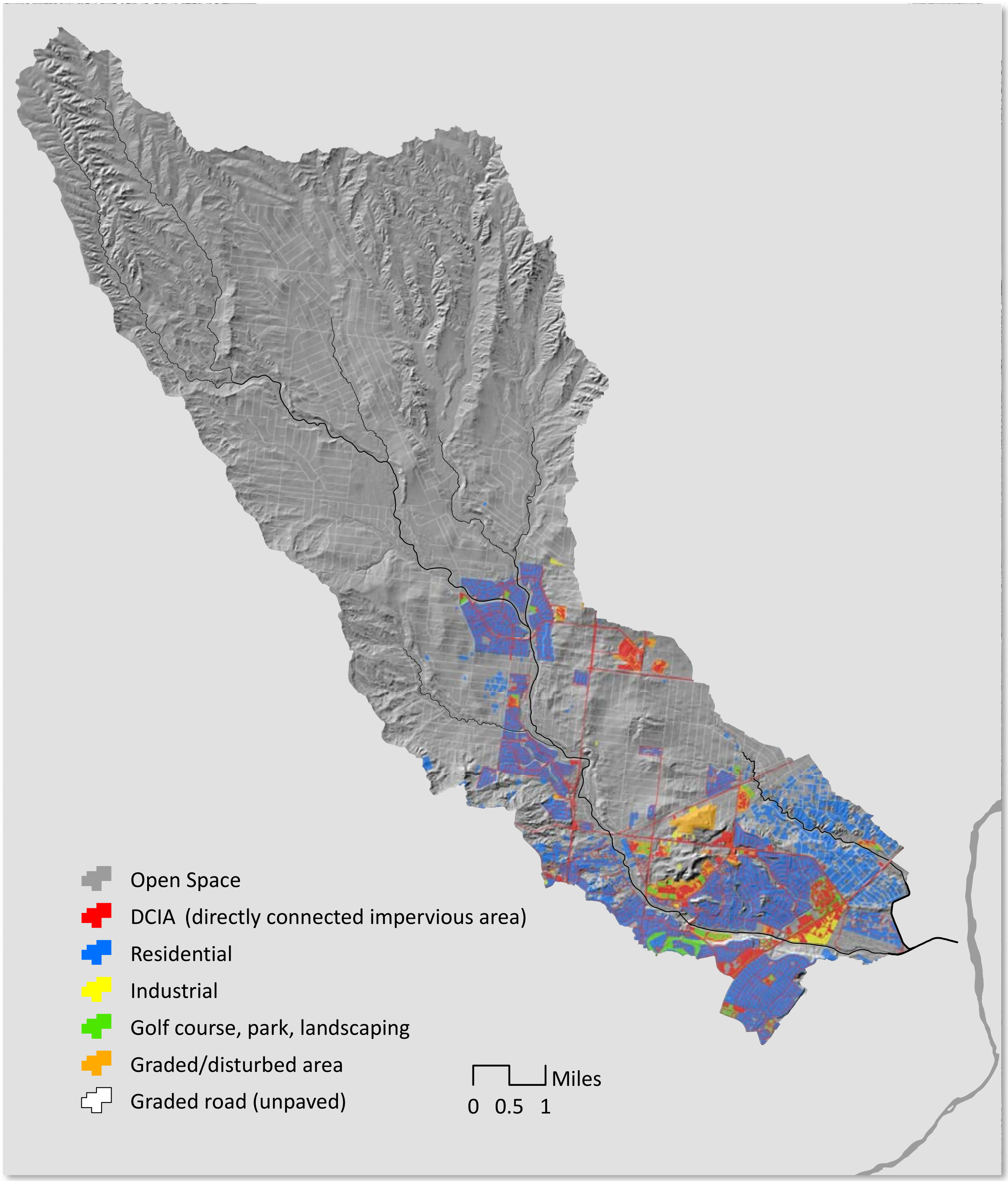

Figure 2.3: Overview map of the Montoyas watershed and major land use types in 2019.

2.4. Existing Conditions Loss Parameters

In accordance with SSCAFCA's hydrology guidance (SSCAFCA, 2020), the curve number method was used to compute precipitation loss and excess. Curve numbers for pervious areas were estimated based on 2019 land use conditions in the Montoyas watershed (see Figure 2.3). Special emphasis was placed on impervious coverage: directly connected impervious areas (DCIA) were specified explicitly for each subbasin rather than including them in a composite loss calculation. Major sources of DCIA such as commercial areas and paved roads (Figure 2.3, red) were digitized manually. A hybrid approach was adopted for residential areas (Figure 2.3, blue). Residential driveways and five percent of roof areas (the portion of the roof draining onto the driveway) were assumed to be directly connected. Residential roof areas were quantified based on GIS coverage of building footprints maintained by the City of Rio Rancho; an average driveway size of 700 ft^2 was assumed for each residential lot. Disconnected impervious areas (e.g. 95% of roof areas draining onto pervious landscaping) were included in the composite loss calculation for the corresponding subbasin. Table 2.2 lists land use types and associated loss parameters.

Table 2.2: Land use categories and associate loss parameters for existing conditions 2019

Land Use Type	Data Source	% DCIA	Pervious CN	% of Total Area
Paved roads with curb, residential driveways, other DCIA	CoRR curb coverage, parcels, manual digitization	100	-	3.5%
Disconnected impervious areas	CoRR building footprints, manual digitization	5	98	1.8%
Road ROW	Digitization, buffer around paved roads	0	92	1.1%
Unpaved road	CoRR road centerline, buffer applied in GIS	0	82	3.0%
Industrial	Manual digitization	0	88	0.2%
Graded areas	Manual digitization	0	86	0.8%
Sports fields, city parks, landscaping	Manual digitization	0	74	0.5%
Residential yard	CoRR parcels, manual digitization	0	74	6.3%
Open space	GIS	0	74	82.7%

Table 2.2 illustrates that under existing conditions, a large portion of the Montoyas watershed is undeveloped, with the exception of a network of graded dirt roads. Open space and residential yards account for nearly 90% of the basin area.

2.5. Projected Future Land Use

Given growth projections for the area, anticipated future land use for the basin was considered as part of this planning study. Based on these land use assumptions, expected impacts on watershed processes such as runoff and erosion were evaluated. Figure 2.4 shows a map of anticipated future land use in the basin; land use projections were based on the following assumptions:

- Residential lots in master planned developments and largely developed areas in the lower watershed will develop as platted;
- Areas covered by specific area plans (SAP) will develop as indicated in the planning document, specifically: Broadmoor Drive SAP (CoRR, 2007a), Dos Amigos SAP (CoRR, 2007b), Sierra Vista SAP (CoRR, 2008), Del Norte SAP (CoRR, 2009), Paseo Gateway West SAP (CoRR, 2010a), La Barranca SAP (CoRR, 2010b), Northern Unser SAP (CoRR, 2011);
- The state land tract and lots adjacent to the future Paseo-del-Volcan road alignment will develop as commercial;
- Approximately 650 acres in the upper watershed predominantly under one ownership will develop as a master planned subdivision and a commercial area;
- 60% of remaining residential lots south of the power line easement (see Figure 2.4, dark purple) will develop as platted, 40% will remain undeveloped;
- 15% of remaining residential lots north of the power line easement (see Figure 2.4, light purple) will develop as platted, 85% will remain undeveloped;
- Unplatted areas in the upper portion of the watershed will remain open space.

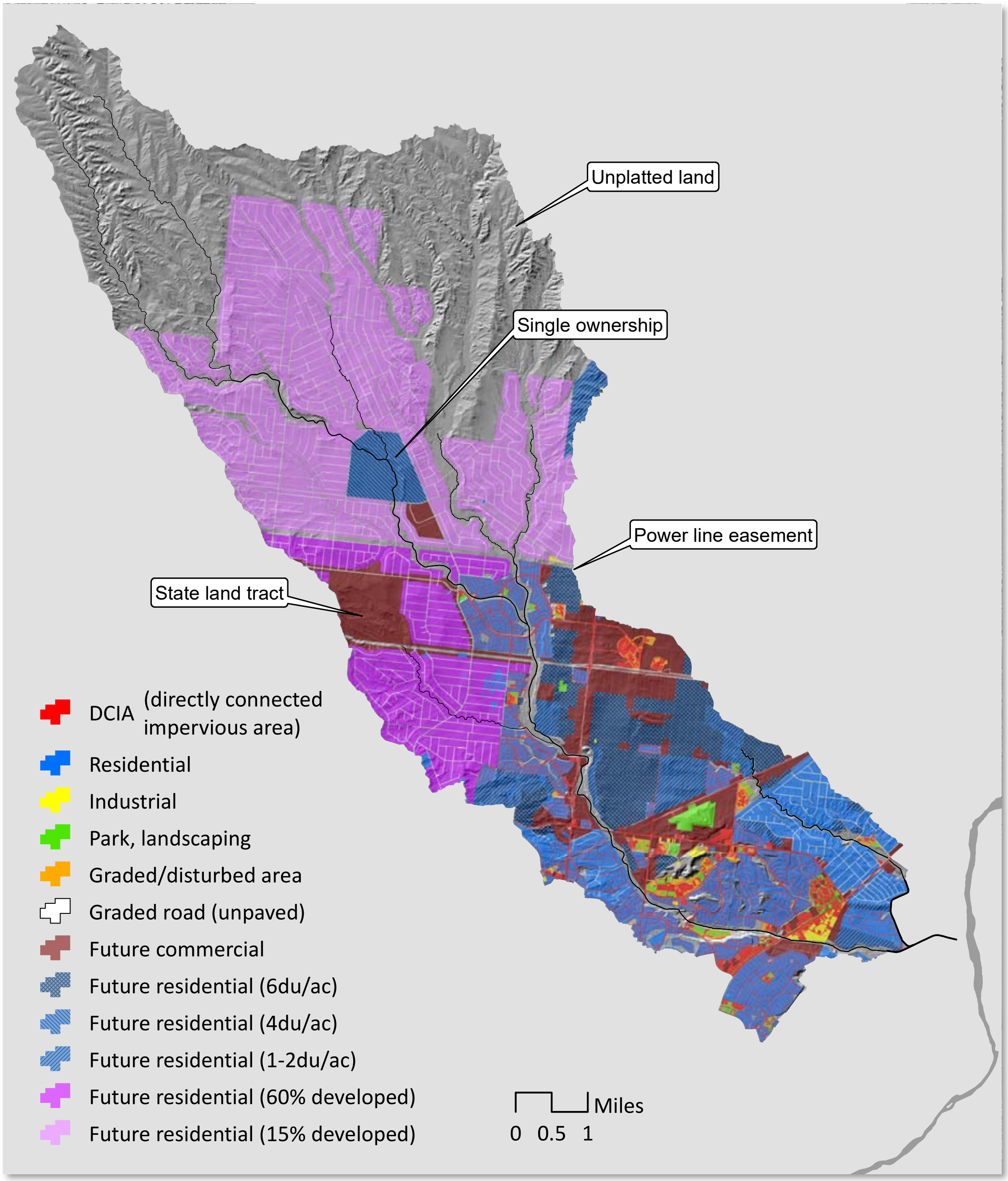

Figure 2.4: Anticipated future land use in the Montoyas watershed.

2.6. Developed Conditions Loss Parameters

The main purpose of the developed conditions model is to estimated runoff from the watershed under future urbanized conditions. The future conditions model helps to identify potential areas of flooding and plan for appropriate mitigation strategies such as land acquisition and drainage infrastructure.

Loss parameters for the developed conditions hydrologic model were estimated based on projected future land use (see Figure 2.4). Table 2.3 shows land use types and associated parameters along with a justification of how the parameters were estimated.

Table 2.3: Land use categories and associate loss parameters for anticipated future land use.

Land Use Type	Data Source	% DCIA	Pervious CN	Justification
Medium density residential (6du/ac)	Manual digitization	26	84	Non-DCIA is composed of: 32% disconnected impervious (CN=98), 14% road ROW (CN=92), 46% residential yard (CN=74), 8% open space (CN=74); statistics based in CoRR High Range subdivision
Medium density residential (4du/ac)	Manual digitization	21	81	Non-DCIA is composed of: 22% disconnected impervious (CN=98), 10% road ROW (CN=92), 43% residential yard (CN=74), 25% open space (CN=74); statistics based on CoRR Northern Meadows subdivision
Low Density Residential (2du/ac)	Manual digitization	3	77	Non-DCIA is composed of: 8% disconnected impervious (CN=98), 8% unpaved road (CN=82), 84% residential yard (CN=74); statistics based on CoRR Unit 17 typical development
Low Density Residential (1du/ac)	Manual digitization	2	76	Non-DCIA is composed of: 7% disconnected impervious (CN=98), 10% unpaved road (CN=82), 83% residential yard (CN=74); statistics based on Village of Corrales typical development
Residential 60% developed	Sandoval County parcels, manual digitization	1.8	76	Assumes 60% of this area is developed with an average density of 2du/ac; remaining area modeled as open space (CN=74)
Residential 15% developed	Sandoval County parcels, manual digitization	0.5	74	Assumes 15% of this area is developed with an average density of 2du/ac; remaining area modeled as open space (CN=74)
Future commercial	CoRR parcels, manual digitization	85	74	Assumes 85% DCIA, remainder is open space (CN=74)

2.7. Transform Method

In HEC-HMS, the Clark unit hydrograph method was selected to transform excess precipitation into a runoff hydrograph for each subbasin. This slight deviation from SSCAFCA's hydrology manual is justified because gridded precipitation data was used during model calibration; the ModClark method is the only transform currently available in HEC-HMS that can be used with gridded rainfall data. Times of concentration were estimated in Arc-GIS based on the watershed DEM using the methodology outlined in TR-55 (USDA, 1986). Subbasin storage coefficients were estimated as 50 percent of the time of concentration. Transform parameters were adjusted during model calibration. A list of model parameters for subbasins and routing reaches is contained in Appendix A.

2.8. Sediment Bulking

Sediment bulking factors of 18% for natural areas and 6% for urbanized areas were added as flow ratios to clearwater discharges in HEC-HMS to account for the increase in runoff volume due to suspended sediment in storm flows. Area averaged bulking factors were used for subbasins containing both urbanized and natural areas.

2.9. Existing Ponds

The Montoyas watershed model contains a total of 59 ponds and dams that attenuate runoff ranging from less than 1 ac-ft to more than 300 ac-ft in storage volume (see Appendix B). Pond parameters and dimensions were collected from corresponding engineering documents and verified in the field where necessary. A comprehensive list of all ponds included in the watershed model is contained in Appendix B. In HEC-HMS, pond routing was simulated using rating curves (elevation-storage and storage-discharge curves). Ponds were assumed to be dry at the start of each simulation.

2.10. Design Storm

The design storm is used as a planning tool. It is a hypothetical storm event based on point precipitation frequency estimates from the NOAA Atlas 14 (NOAA, 2019). Precipitation estimates for the Montoyas watershed and are displayed in Table 2.4.

Table 2.4: Point precipitation frequency estimates for the 100-year recurrence interval in the Montoyas watershed.

Duration	Point precipitation estimate (in)
5 minutes	0.589
15 minutes	1.110
1 hour	1.850
2 hours	2.130
3 hours	2.200
6 hours	2.390
12 hours	2.550
1 day	2.900

The design storm was modeled in HEC-HMS using the built-in frequency storm option with an intensity position of 25 percent (see Figure 2.5), intensity duration of five minutes, and the depth-area reduction for a watershed area of 61 square miles. Temporal and spatial patterns of real-world storm events will likely differ from the design storm and induce a different watershed response.

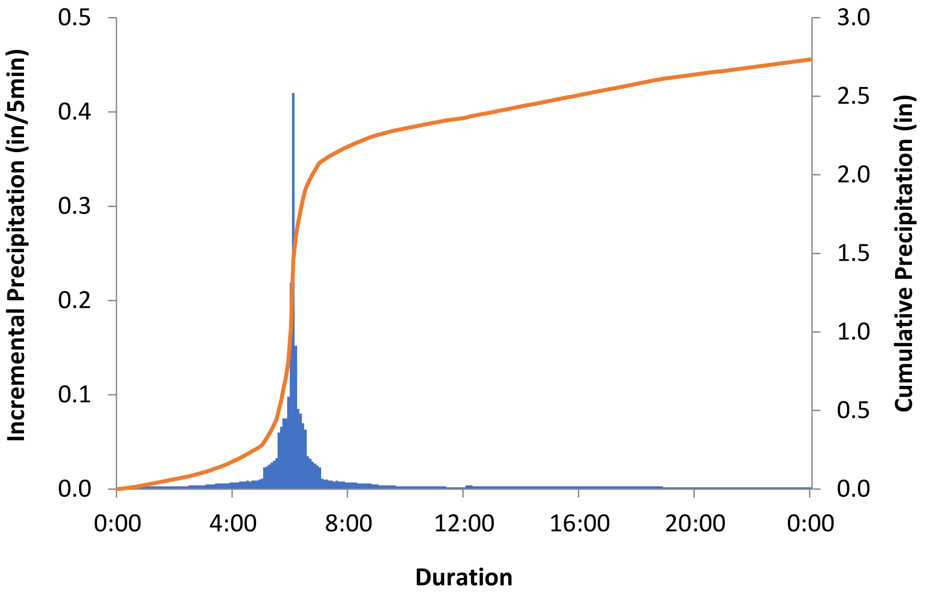

Figure 2.5: Design storm temporal distribution.

2.11. Existing and DEVEX Conditions Results

Figure 2.6 shows design storm hydrographs at the outlet of the watershed for existing land use conditions (left) and developed conditions with existing drainage infrastructure (DEVEX, right). Black lines in Figure 2.6 are results from model runs with a curve number of 74 assigned to all open space, landscaping, and residential yards. This represents the best estimate for a curve number representing intermediate moisture conditions. Grey areas represent model runs with a curve number range of 71-76 for open space, landscaping, and residential yards. This range was selected to provide an uncertainty envelope around the estimated 100-year runoff estimate associated with initial moisture conditions.

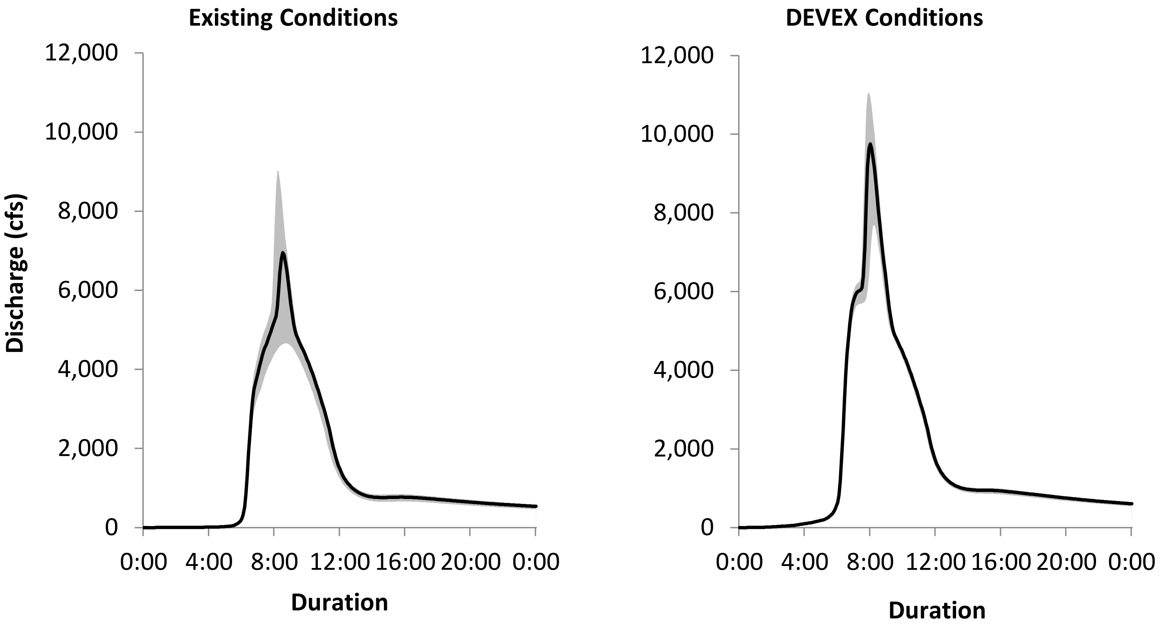

Figure 2.6: Simulated design storm discharge for existing conditions (left) and DEVEX conditions (right).

It is important to note that simulation results only provide a best estimate of the watershed runoff response from the design storm for current and projected future land use conditions. Model results are intended to be used for planning and design of flood control infrastructure but need to be interpreted with the underlying uncertainty in mind.

Based on this analysis, expected peak discharge at the watershed outlet is approximately 7,000 cfs (range: 4,700 – 9,000 cfs) for existing conditions and 9,800 cfs (range: 7,700 – 11,100 cfs) for developed conditions with existing drainage infrastructure. A detailed list of model results is contained in Appendix C.

2.12. Structure Capacities and Major Deficiencies

Crossing structure capacities for locations where 100-year peak flow rates exceed 500 cfs were analyzed based on Existing and DEVEX conditions model runs. Results are summarized in Table 2.5. Figure 2.7 shows crossing structure locations.

Table 2.5: Major crossing structures, capacities and peak discharges under existing and developed conditions with existing infrastructure (DEVEX).

Crossing	Location	HMS_ID	Drainage Area (mi^2)	Existing Q_p (cfs) [a]	DEVEX Q_p (cfs) [a]	Capacity (cfs)
1	Montoyas & King Blvd.	A_103_J4	38	6614	6987	4800
2	Tributary G & Cherry Rd.	G_104_J2	4	1234	2131	1100
3	Montoyas & Unser Blvd.	A_105_J4	44	7202	7992	5200
4	Montoyas & Northern Blvd.	A_106_J5	47	7388	8402	5800
5	Montoyas & Broadmoor Blvd.	A_107_J6	49	7484	8690	7300
6	Montoyas & NM 528	A_109_J5	53	6739	8877	7100
7	High Range Trib. & Loma Colorado Blvd.	U_202_J3	1	471	856	440
8	High Range Trib. & Idalia Rd	U_202_J3	1	471	856	510
9	Aloe Trib. & Idalia Rd.	U_104_J	2	505	1057	1100
10	Lomitas Negras & Saratoga Dr.	U_106_J2	5	1101	1537	1250
11	Lomitas Negras & NM 528	U_107_J	5	1164	1624	1400
12	Rockaway Channel & Turquoise Dr.	R_104_J1	1	673	818	430 [b]
13	Rockaway Channel & Rockaway Blvd.	R_103_R2	1	666	811	790
14	Rockaway Channel & Sundt Rd.	R_104_J	1	879	981	930
15	Harvey Jones Chan. & Corrales Rd.	HJC_J	61	6976	9762	5500
16	Montoyas & Serene Meadows	J_107_J	21	4225	4504	5200
17	Montoyas & Camino de los Montoyas	A_101_J	22	4207	4489	4800
18	Ponce de Leon & Camino de los Montoyas	L_105_J3	15	3128	3222	4100

[a] Flow rates from model runs with depth-area reduction factors corresponding to the drainage area contributing to each analysis point

[b] Estimated capacity if clean = 780 cfs

🟦	adequate capacity
🟩	< 10% exceedance
🟨	10-25% exceedance
🟧	25-50% exceedance
🟥	> 50% exceedance

Structure capacities were estimated for planning purposes only to establish approximate maximum allowable flow rates at each location. Capacity calculations are based on field investigations or existing planning documents (see Appendix E). Shading in Table 2.5 indicates if structure capacity is sufficient (blue), or the severity of capacity exceedances (green to red). Please note that the peak flow rates reported in Table 2.5 correspond to model runs with depth-area reduction factors appropriate for the contributing area of each analysis point (see drainage area, Table 2.5).

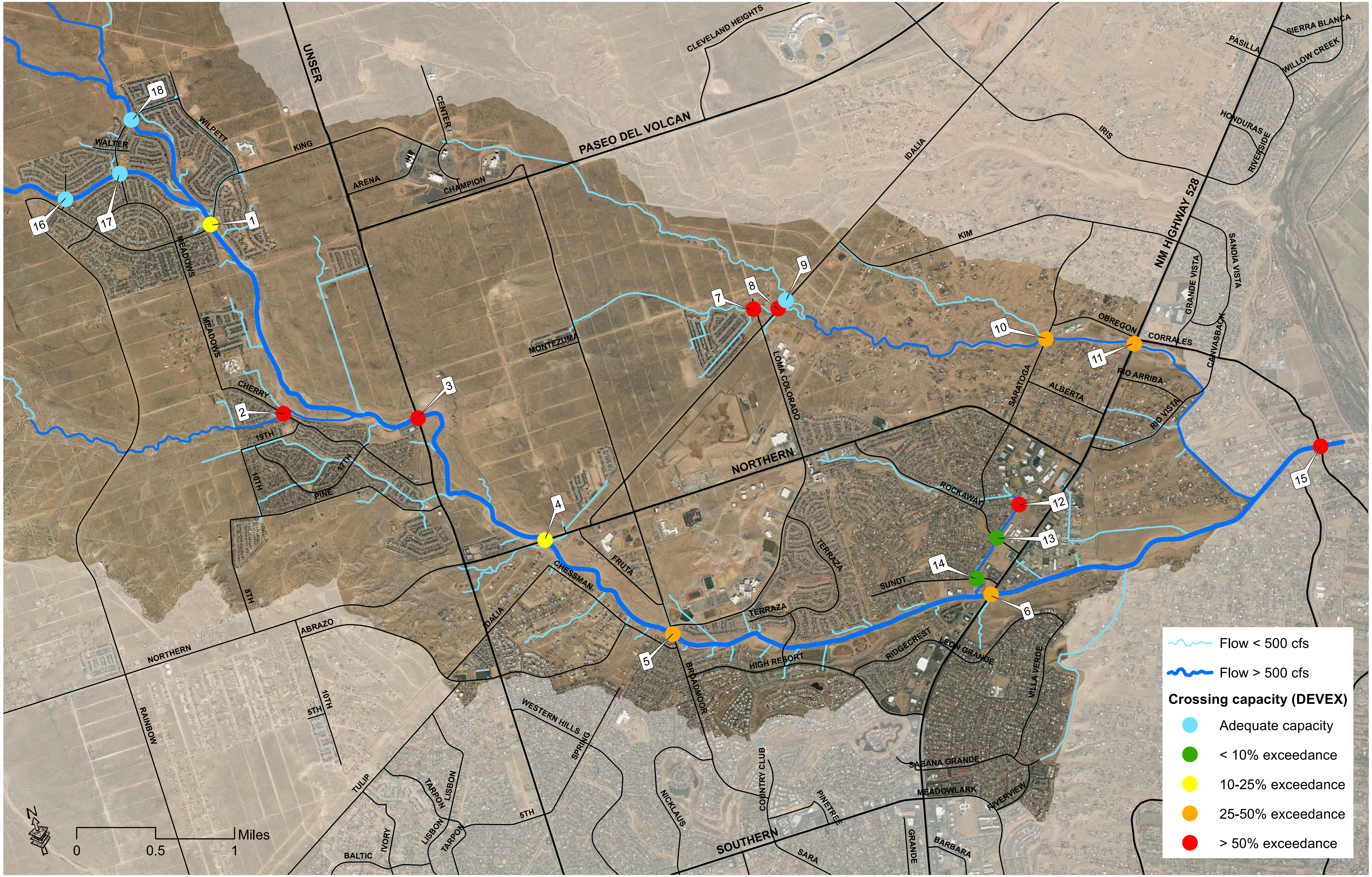

Figure 2.7: Major crossing structures and deficiencies in the Montoyas watershed (DEVEX conditions).

In 2019, a Base Level Engineering (BLE) analysis was completed for SSCAFCA's jurisdictional area by ESP Associates, Inc. in coordination with the University of New Mexico's Earth Data Analysis Center under FEMA's Cooperating Technical Partners program. BLE studies are meant to help communities better predict their flooding risk using estimated base flood elevations.

Hydrologic and hydraulic computations and analyses of the BLE study consisted of determining excess precipitation amounts and calculating Water Surface Elevations (WSELs) for the 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood events. Two-dimensional (2D) hydraulic models were developed for the project area using HEC-RAS version 5.0.7.

Although the 2D analysis can represent impacts from embankments and other features such as storage areas, no structures (i.e. dams, culverts, levees, etc.) were modeled in detail as part of the BLE analysis. SSCAFCA therefore contracted with ESP Associates to update the BLE model for the Montoyas watershed by including culverts with 10% capacity exceedance or more for Existing and/or DEVEX conditions.

Existing conditions inundation maps for culverts 1-11 resulting from the 100-year storm are included below (see Figure 2.8 through Figure 2.15). The full report including inundation maps for DEVEX conditions at each structure is included in Appendix H.

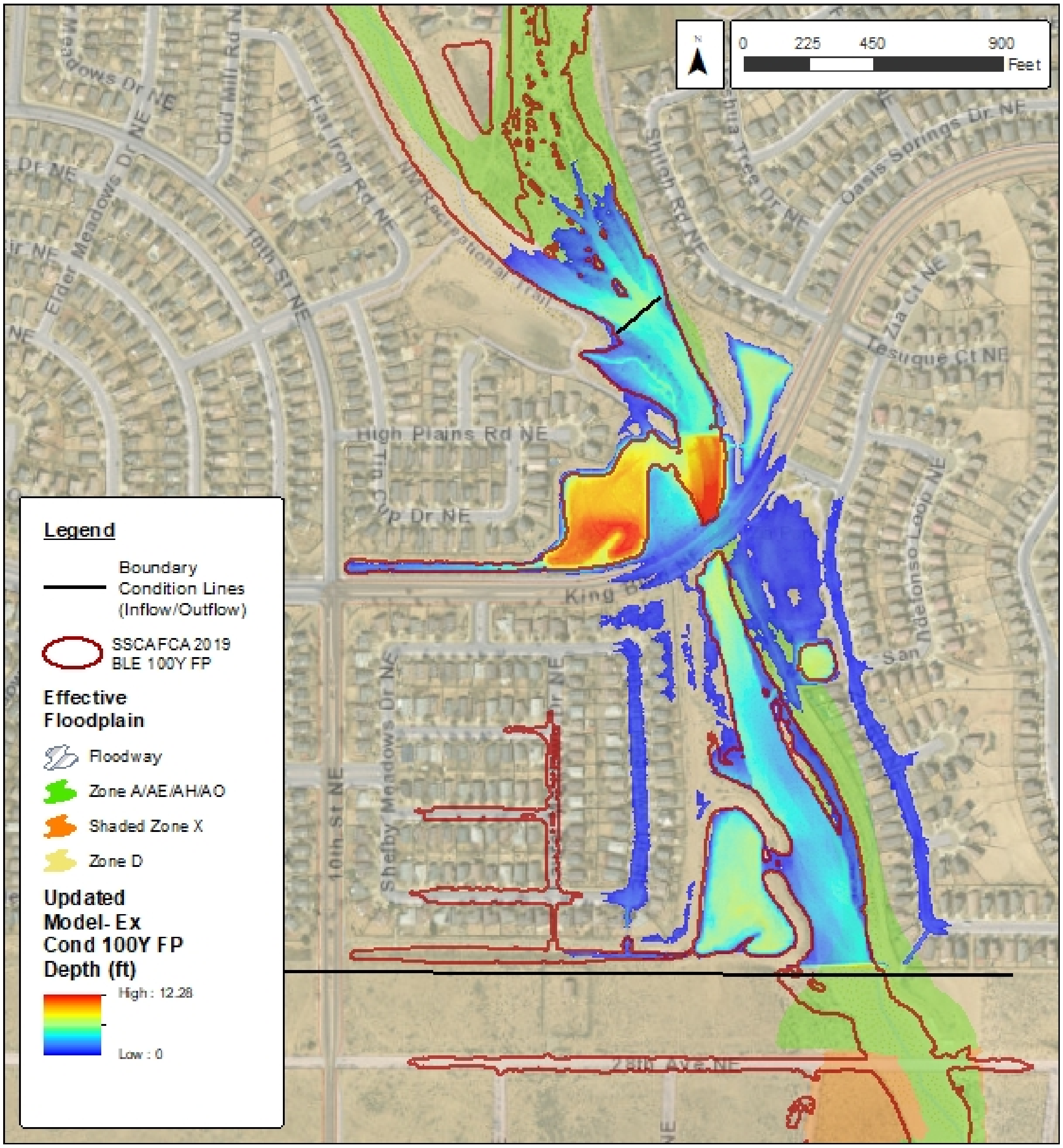

Figure 2.8: Flooding in the vicinity of structure 1 (Montoyas Arroyo and King Blvd.) under Existing conditions.

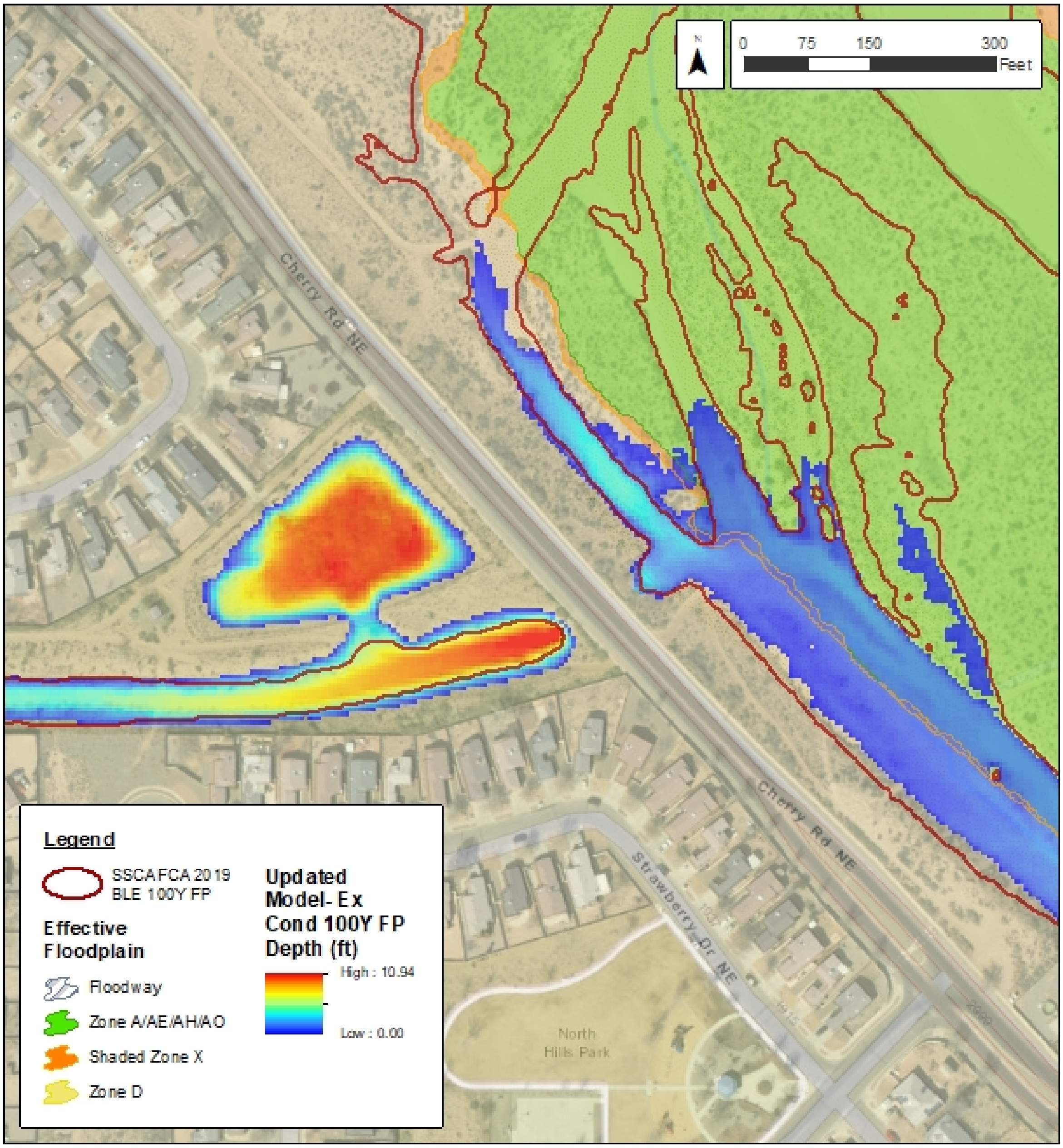

Figure 2.9: Flooding in the vicinity of structure 2 (Tributary G and Cherry Rd.) under Existing conditions.

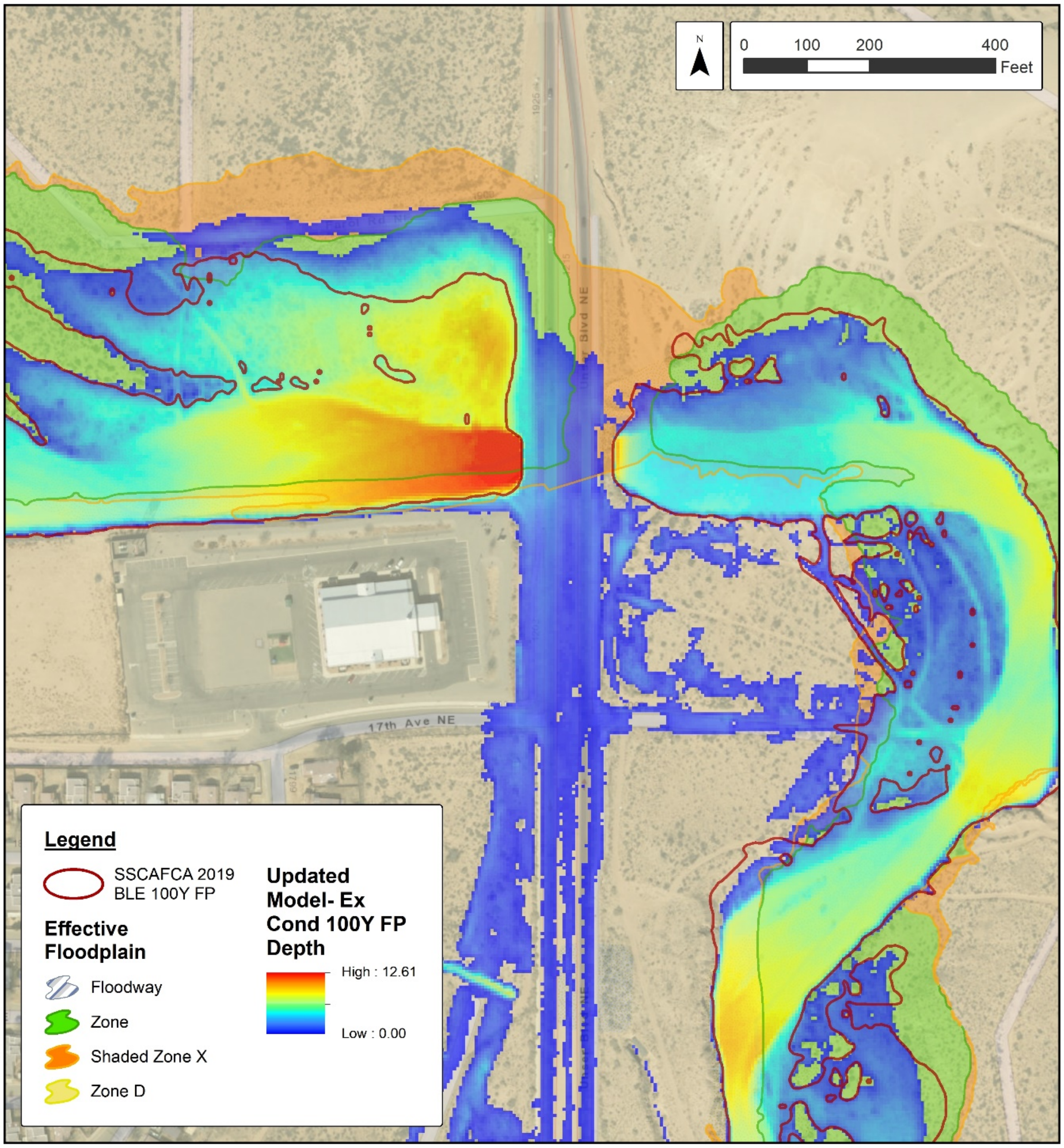

Figure 2.10: Flooding in the vicinity of structure 3 (Montoyas Arroyo and Unser Blvd.) under Existing conditions.

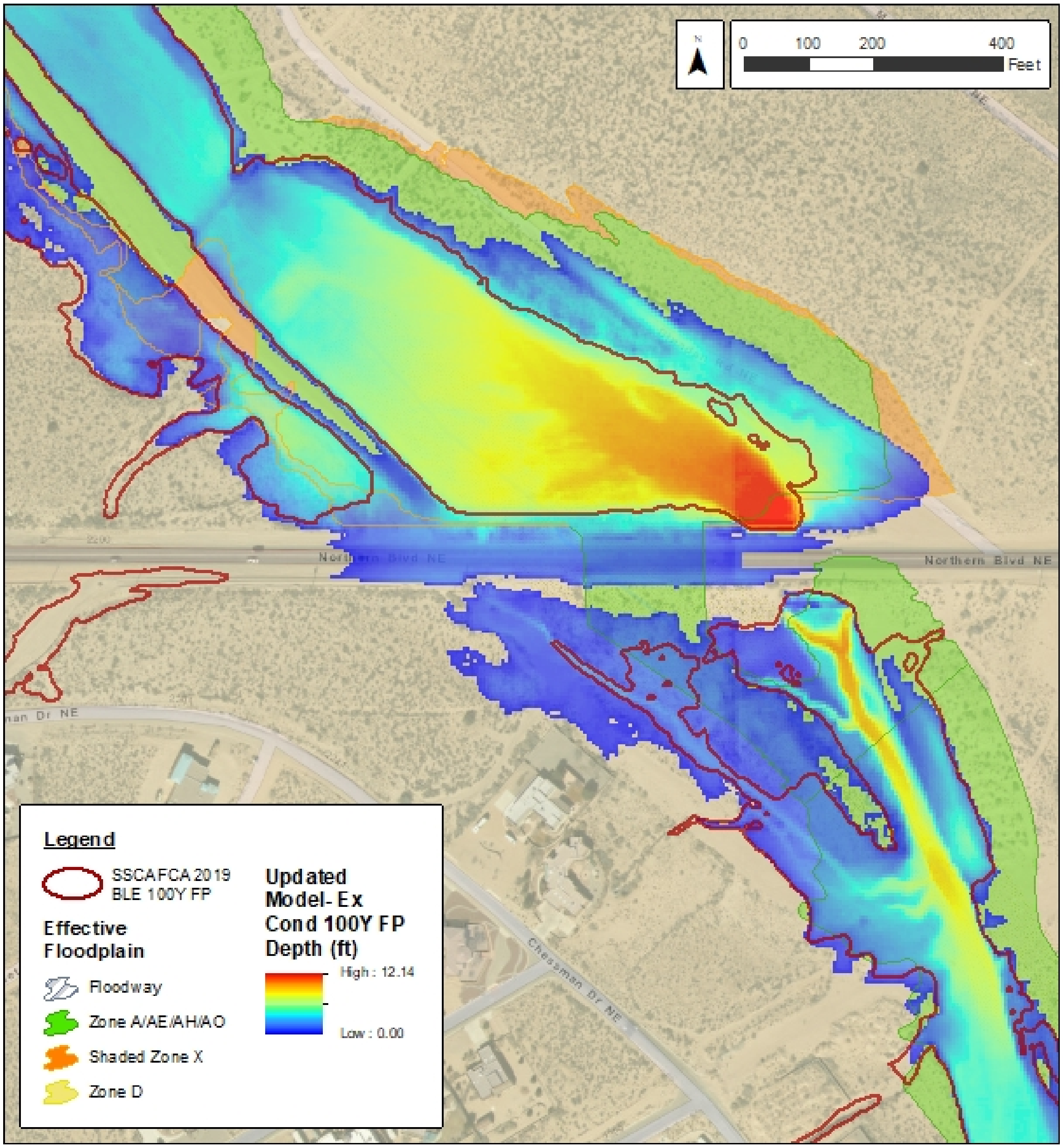

Figure 2.11: Flooding in the vicinity of structure 4 (Montoyas Arroyo and Northern Blvd.) under Existing conditions.

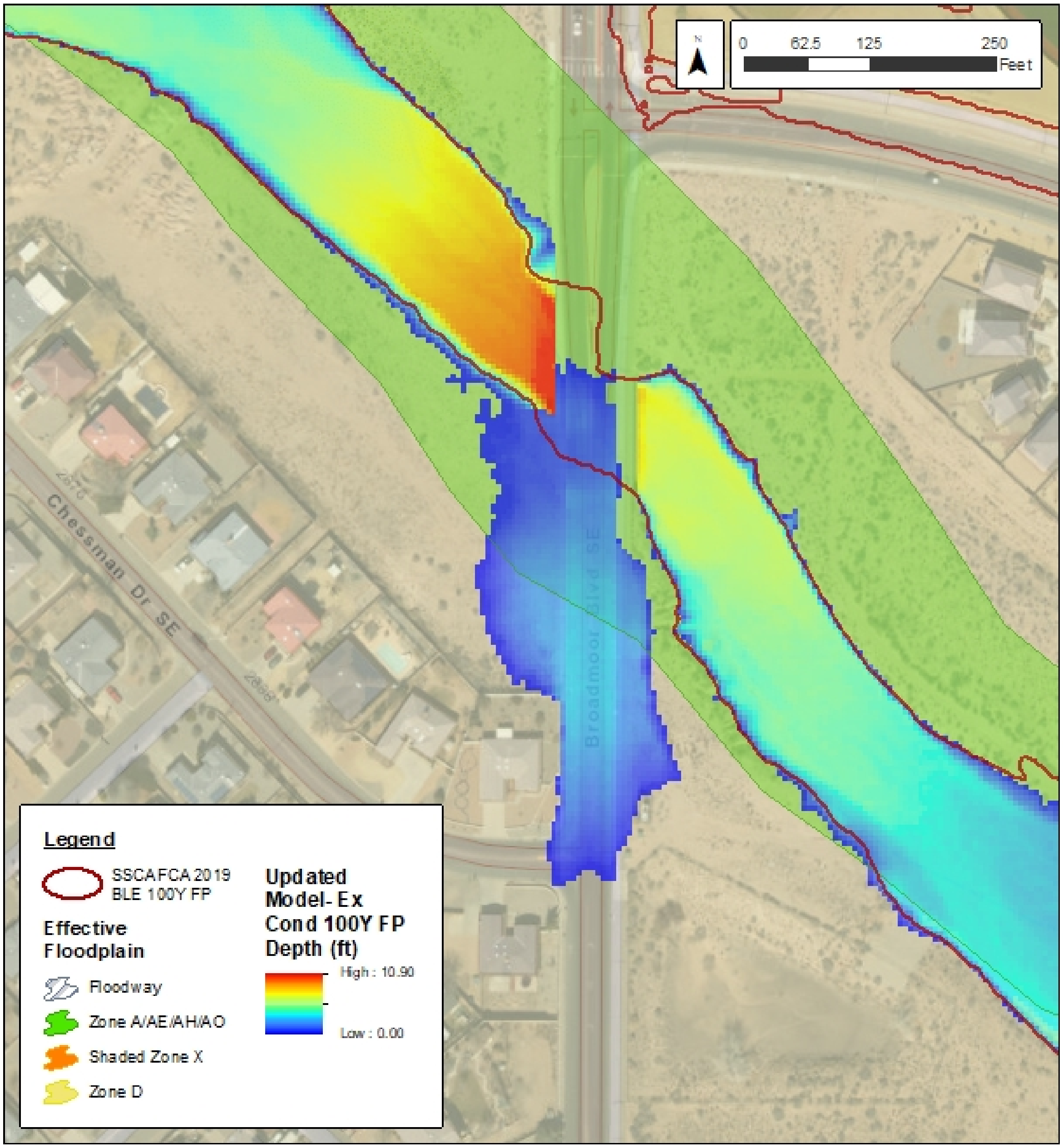

Figure 2.12: Flooding in the vicinity of structure 5 (Montoyas Arroyo and Broadmoor Blvd.) under Existing conditions.

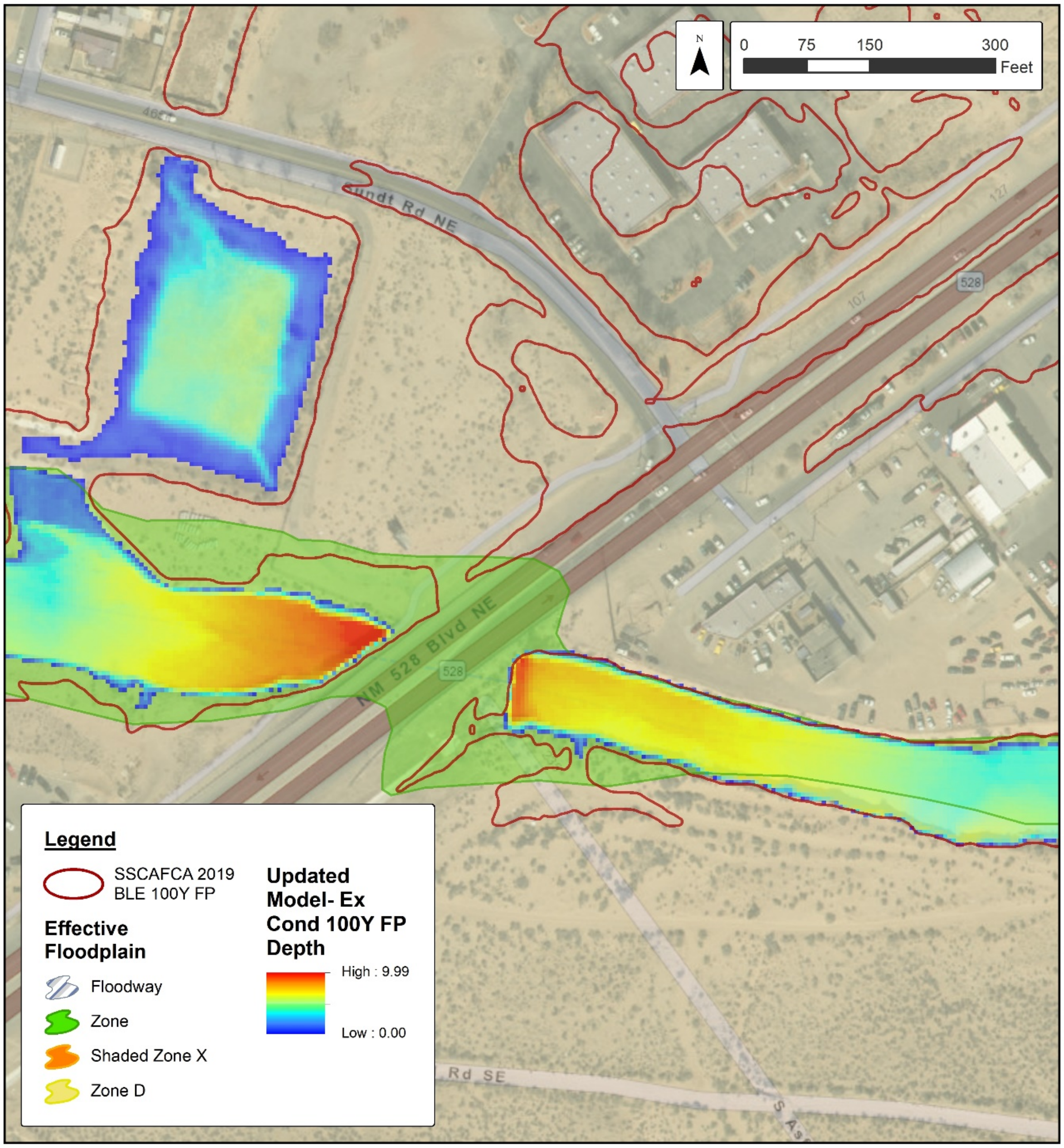

Figure 2.13: Flooding in the vicinity of structure 6 (Montoyas Arroyo and NM 528) under Existing conditions.

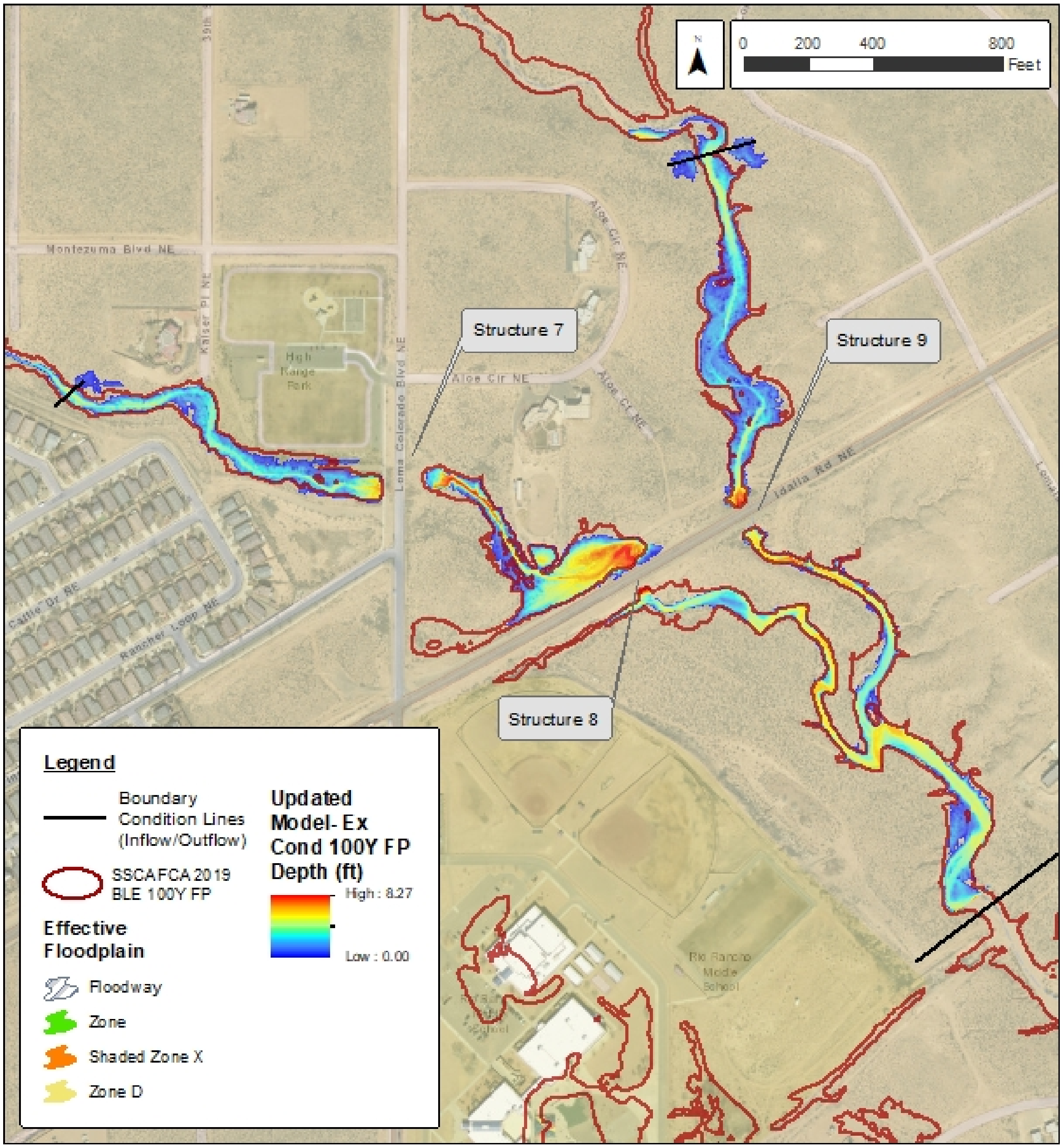

Figure 2.14: Flooding in the vicinity of structures 7-9 under Existing conditions.

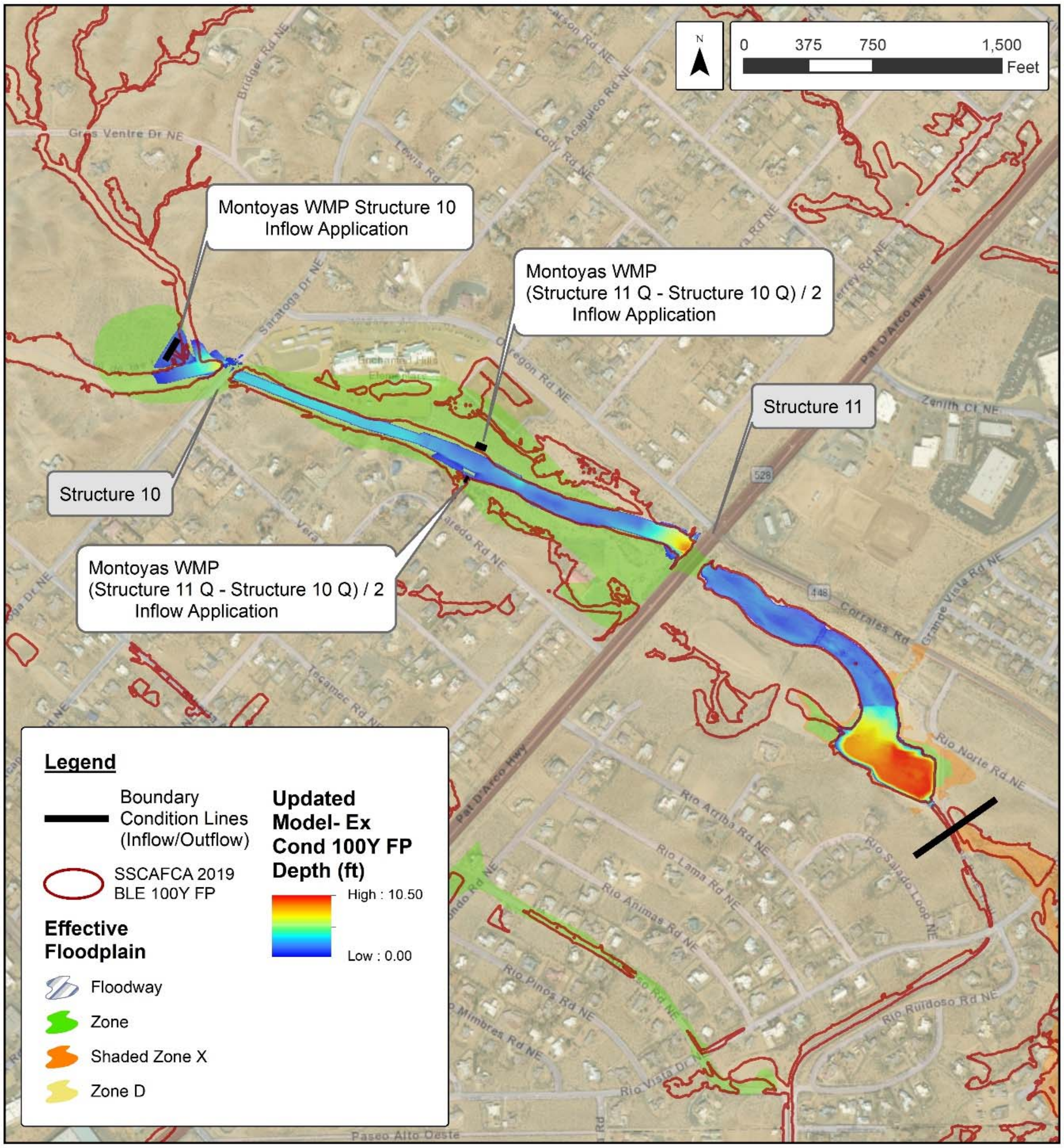

Figure 2.15: Flooding in the vicinity of structures 11 and 12 (Lomitas Negras Arroyo and Saratoga Dr./NM 528) under Existing conditions.

Existing ponds were evaluated for deficiencies based on Existing and DEVEX conditions model runs. Figure 2.8 shows pond locations in the watershed; a larger, more detailed map is included at the end of this document. The following color scheme was adopted to highlight pond deficiencies based on this analysis:

Green (no concern) – ponds have sufficient capacity under Existing and DEVEX conditions.

Yellow (low concern) – activation of the emergency spillway during the 100-year storm under Existing and/or DEVEX conditions, but no expected impact to downstream infrastructure because ponds discharge directly into a publicly owned portion the main stem of the Montoyas Arroyo. Also in this category are ponds with insufficient capacity during DEVEX conditions where plans for upstream improvements are already in place.

Red (high concern) – ponds have insufficient capacity under existing and/or DEVEX conditions and spill onto roadways or private property; also in this category are ponds with limited data where further analysis is recommended.

A detailed table with results for all 60 ponds included in the hydrologic models is contained in Appendix B; the table includes notes for each deficient pond.

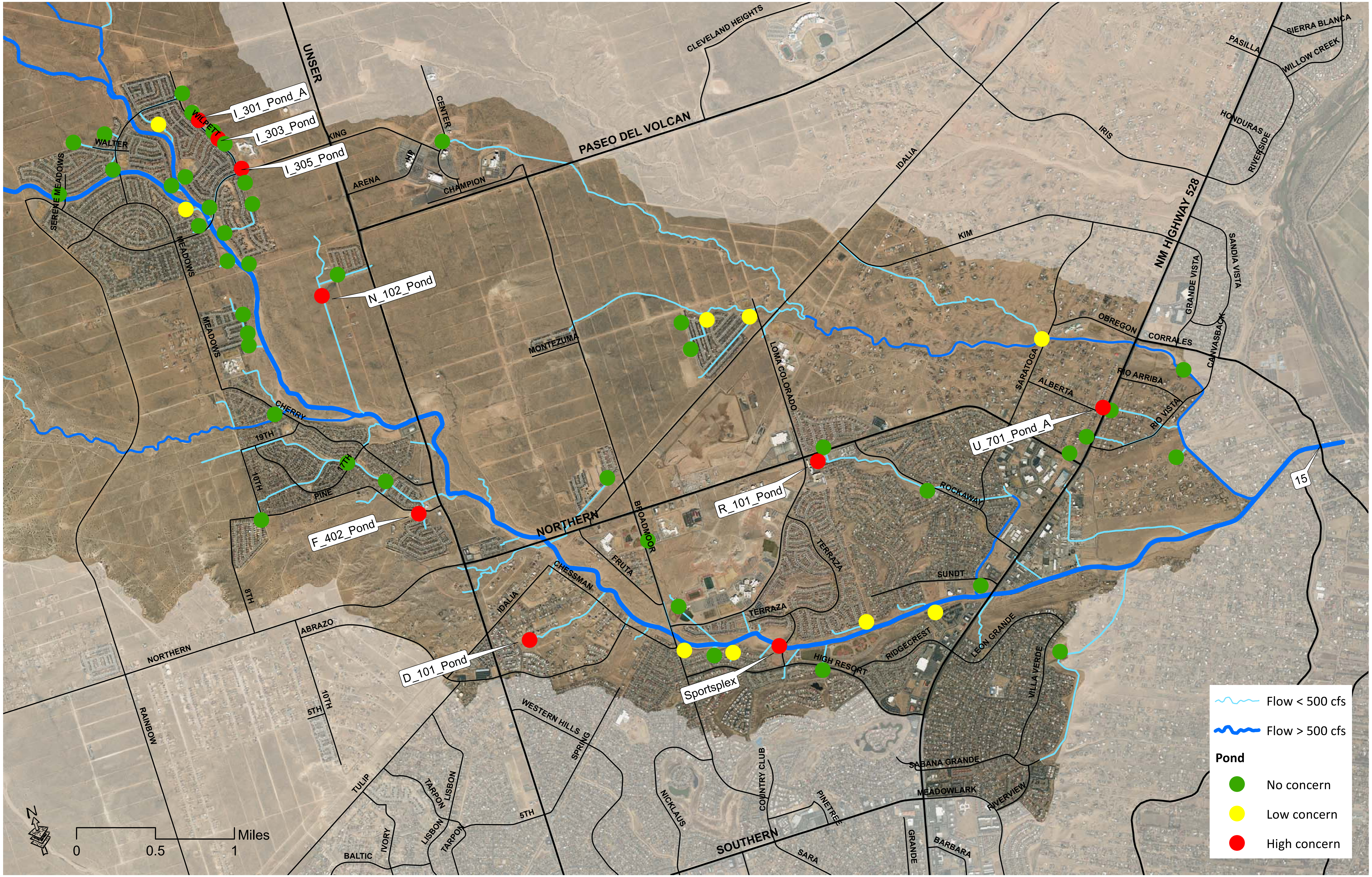

Figure 2.16: Existing stormwater detention ponds in the Montoyas watershed and associated deficiencies.

2.13. Lateral Erosion Envelope

Lateral migration is a natural arroyo process and occurs even in areas that are not impacted by urbanization. In 2008, SSCAFCA published the *Sediment and Erosion Design Guide* (Mussetter, 2008) to provide guidance for evaluating the lateral and vertical stability of arroyos, and for establishing the lateral erosion envelope (LEE). The LEE represents the maximum lateral migration distance of an arroyo that can be expected over the next 30-50 years; it identifies a corridor where properties and infrastructure are potentially at risk from erosion. Figure 2.17 shows mapped lateral erosion envelopes in the Montoyas watershed (see Appendix D for calculations).

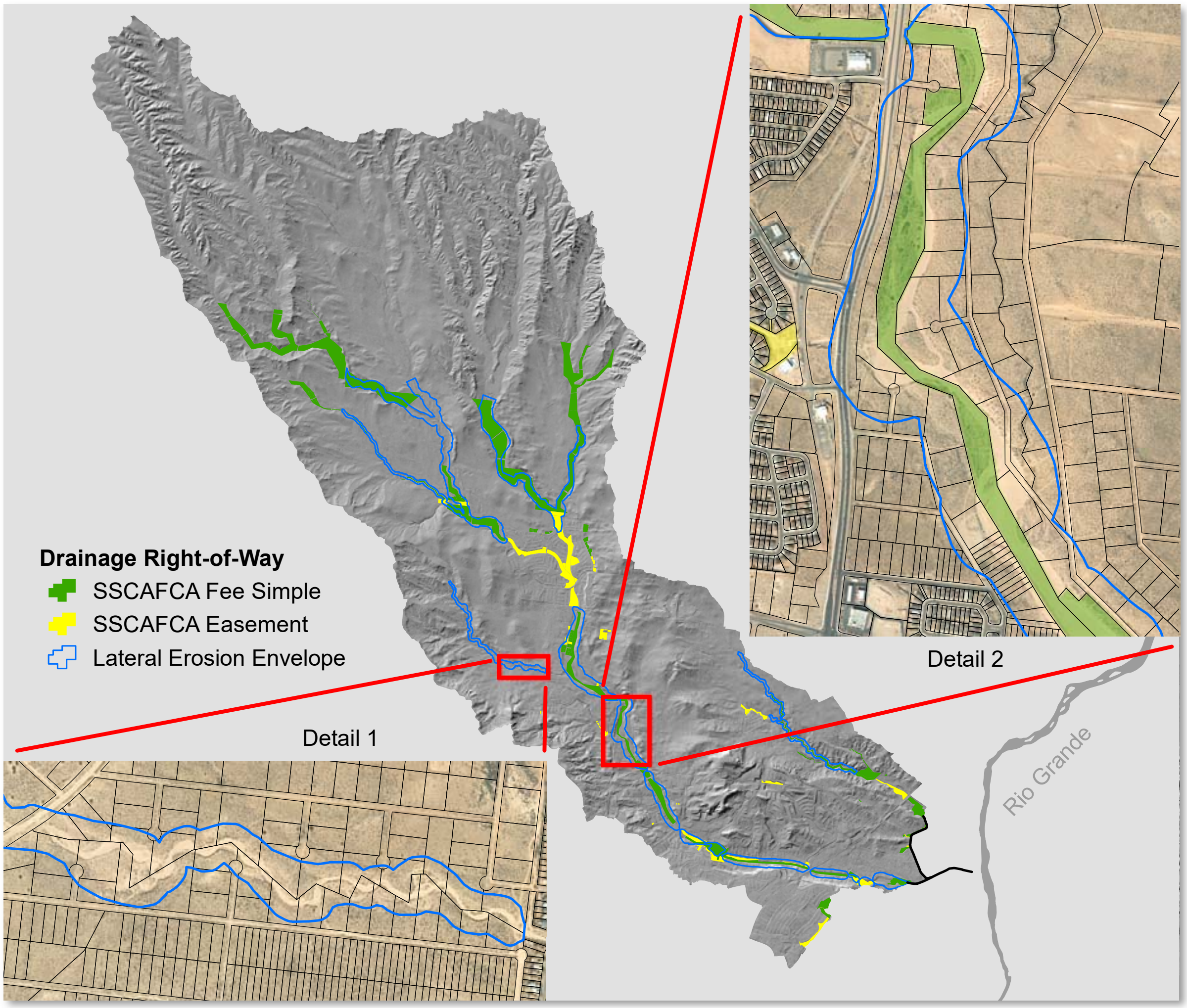

Figure 2.17: Lateral erosion envelopes (blue) in the Montoyas watershed.

2.14. References

CoRR (City of Rio Rancho) (2007a). “Broadmoor Drive Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

CoRR (City of Rio Rancho) (2007b). “Dos Amigos Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

CoRR (City of Rio Rancho) (2008). “Sierra Vista Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

CoRR (City of Rio Rancho) (2009). “Del Norte Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

CoRR (City of Rio Rancho) (2010a). “Paseo Gateway West Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

CoRR (City of Rio Rancho) (2010b). “La Barranca Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

CoRR (City of Rio Rancho) (2011). “Northern-Unser Specific Area Plan.” Rio Rancho, NM. https://www.rrnm.gov/index.aspx?NID=1543 (accessed Jan. 2019).

Mussetter, B. (2008). Sediment and Erosion Design Guide. Southern Sandoval County Arroyo Flood Control Authority, Rio Rancho, NM.

NOAA (National Oceanic and Atmospheric Administration), (2019). “NOAA atlas 14 point precipitation frequency estimates: NM.” (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=nm)

SSCAFCA (Southern Sandoval County Arroyo Flood Control Authority) (2020). “SSCAFCA Hydrology Manual.” Rio Rancho, NM.

3. Proposed Improvements

3.1. History of Regional Flooding

Flash flooding during the summer monsoon season is a natural phenomenon in the semi-arid southwestern U.S. and is an integral part of the dynamics of ephemeral channels. In urbanizing landscapes, flash flooding can cause considerable damage to property, public infrastructure, and endanger lives, especially if insufficient space is provided for the safe passage of floodwaters, or if drainage infrastructure is not designed and sized appropriately.

The disaster history published by the City of Rio Rancho lists 21 flash flood related disasters between the years 1973 and 2015, including eight state and three federal disaster declarations (CoRR, 2019). Figure 3.1 shows the aerial extent of flooding following heavy rains in August 1975.

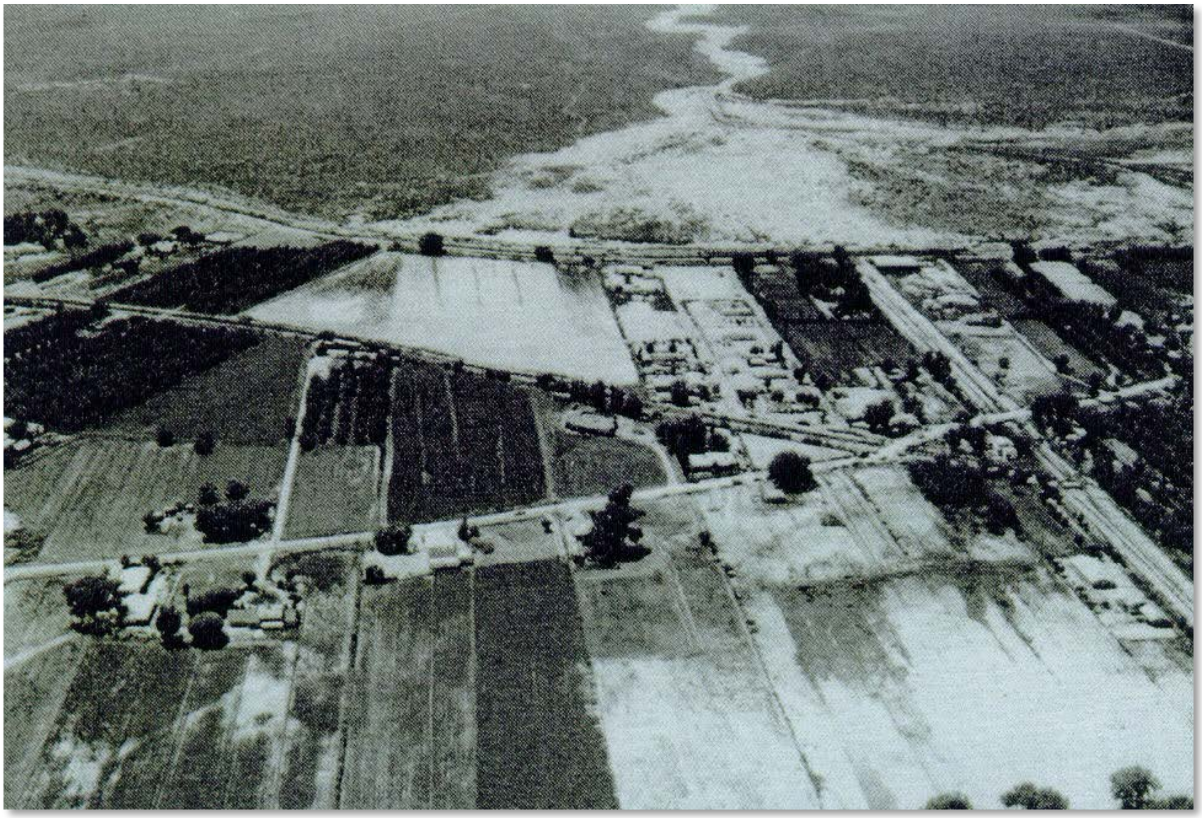

Figure 3.1: Aerial photograph of the Montoyas Arroyo looking upstream after a storm in 1975 (source: Mussetter, 2008; original image source unknown).

Figure 3.2 shows SSCAFCA's Dulcelina Curtis channel flowing full following storms in July of 2006. Erosion damage to an area road can be seen in Figure 3.3.

Figure 3.2: Dulcelina Curtis channel flowing full, July 2006 (image source: SSCAFCA archive).

Figure 3.3: Erosion damage in the Montoyas watershed following the July 2006 storm (image source: SSCAFCA archive).

Flow and sediment accumulation in the Harvey Jones channel following storms in September 2013 can be seen in Figure 3.4.

Figure 3.4: Flow (top) and sediment accumulation (bottom) in the Harvey Jones channel caused by storms in September 2013 (image source: SSCAFCA archive).

3.2. Regional Stormwater Detention Facilities

Several regional stormwater detention facilities will be required to prevent regional flooding as urbanization in the watershed advances (see Figure 3.5).

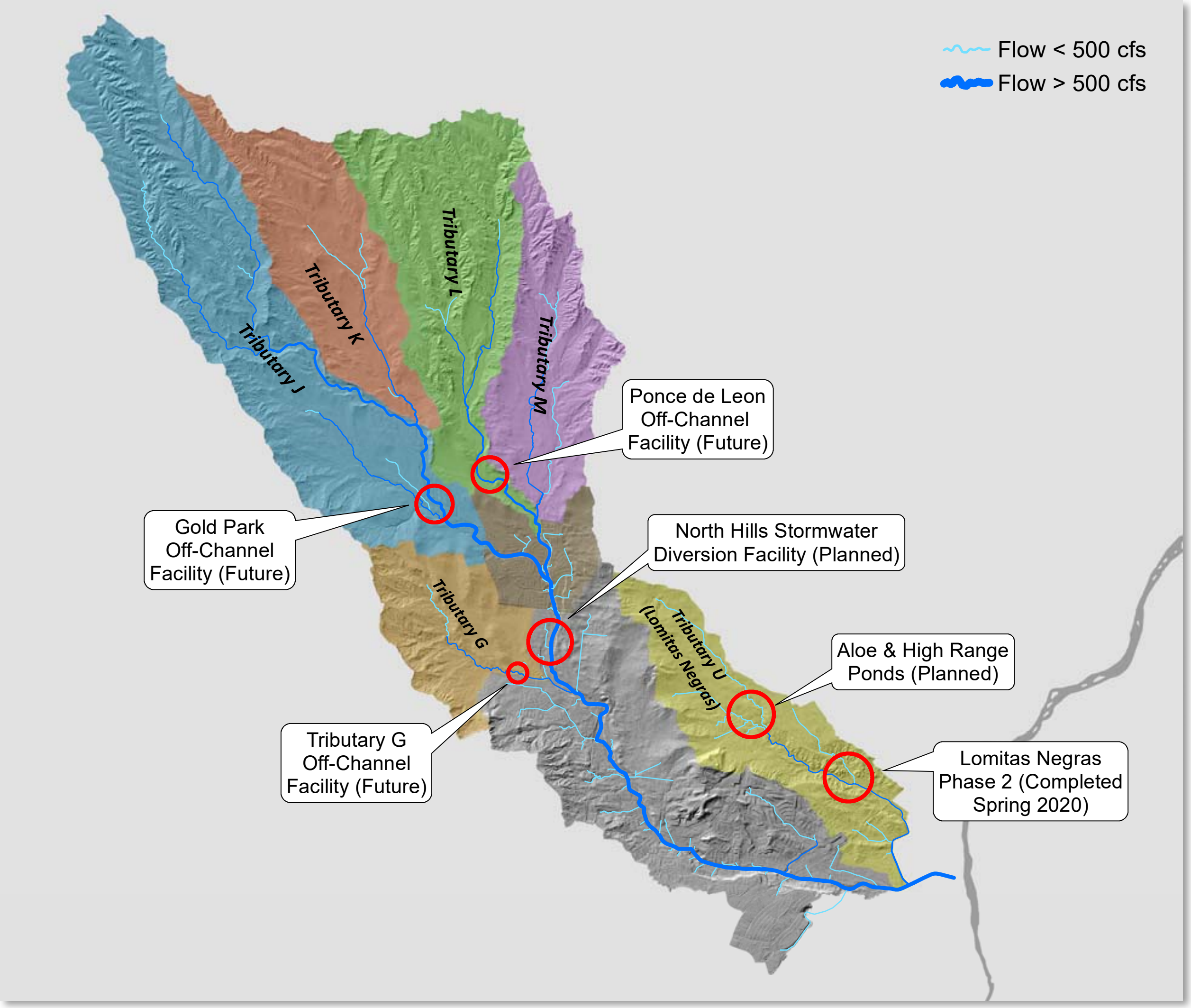

Figure 3.5: Locations of planned future regional stormwater detention facilities.

Wherever feasible, SSCAFCA will consider off-channel facilities to avoid some of the negative impacts of traditional dams. The concept behind off channel storage is illustrated in Figure 3.6. A pond is located adjacent to the channel separated by a lateral weir. During low flow conditions, stormwater continues flowing downstream in the channel, completely bypassing the pond (see Figure 3.6, left). Only during large storms and peak flow conditions will water spill over the lateral weir and enter the pond, where it is stored temporarily before returning to the channel through a return flow pipe.

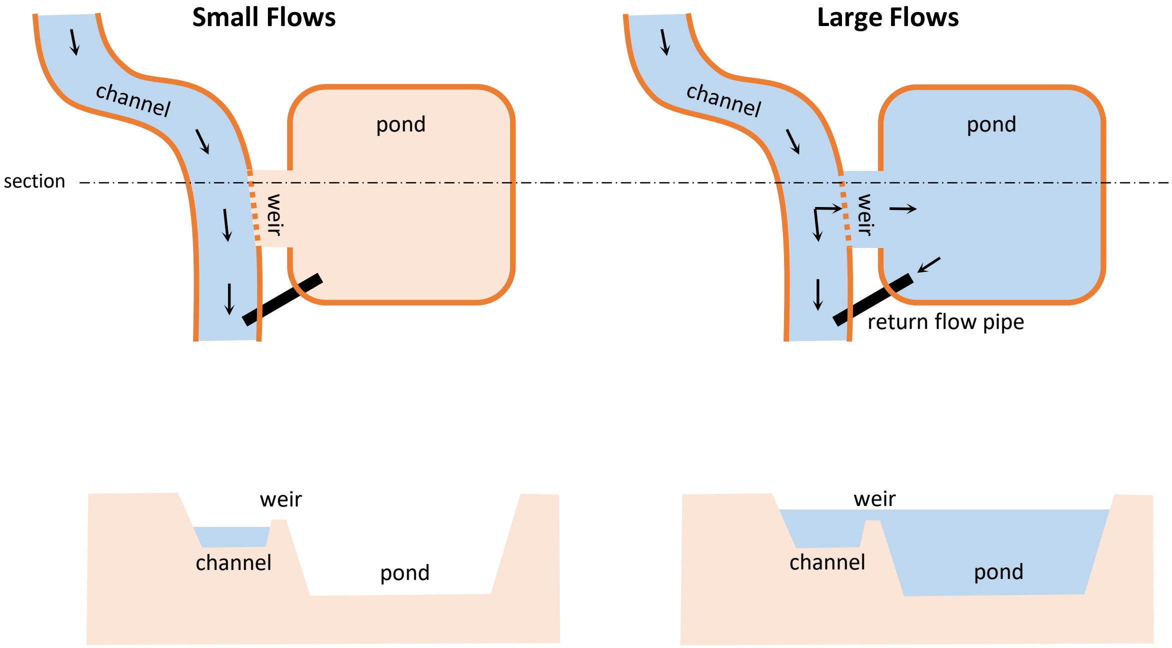

Figure 3.6: Conceptual plan view (top) and cross-section (bottom) of an off-channel pond under low flow (left) and high flow (right) conditions.

Off-channel facilities have several benefits compared to traditional, in-line stormwater detention dams:

- Since water only enters the pond during high flow conditions, regular maintenance such as sediment and debris removal is expected to be less.
- Less storage volume is required because only a portion of the flood hydrograph is stored in the pond during large floods.
- During more frequent floods, all flows bypass the pond; for all but the largest events, sediment connectivity is not interrupted.

Downsides associated with off-channel facilities include increased complexity of hydrologic and hydraulic modelling, and potentially more land required for construction.

Following below is a short description of each planned regional stormwater detention facility.

3.2.1. Lomitas Negras Phase 2

The Lomitas Negras Phase 2 facility (Stovall, 2014) was completed in Spring 2020. It was designed as an off-channel pond. Figure 3.7 shows an aerial view of the Lomitas Negras facility looking downstream. The lateral weir that diverts water into the off-channel pond can be seen in the foreground. Only if flow exceeds 500 cfs, runoff is diverted from the main channel. The pond has a maximum storage capacity of 103 ac-ft. Since the maximum embankment height above the downstream toe of slope is less than six feet, the pond does not fall under the jurisdiction of the Dam Safety Bureau (New Mexico Office of the State Engineer).

Figure 3.7: Aerial view of the newly constructed off-channel stormwater detention facility on Lomitas Negras tributary to the Montoyas Arroyo.

An overview map of the Lomitas Negras facility can be seen in Figure 3.8. The northern tributary bypasses the off-channel pond and flows directly to the crossing structure at Saratoga Dr. (see Figure 3.8, crossing 10; see Table 2.5 and Table 3.1 for more crossing structure information). Runoff temporarily stored in the off-channel pond is slowly released back to the Arroyo via the principal spillway, a 36 in diameter pipe.

The Lomitas Negras Phase 2 facility protects the road crossing structures at Saratoga Dr. and NM 528, as well as Enchanted Hills Elementary School (see Figure 3.8) from flooding. Two other ponds that will reduce peak discharge under urbanized conditions are planned further upstream in the Lomitas Negras Tributary: High Range and Aloe Ponds.

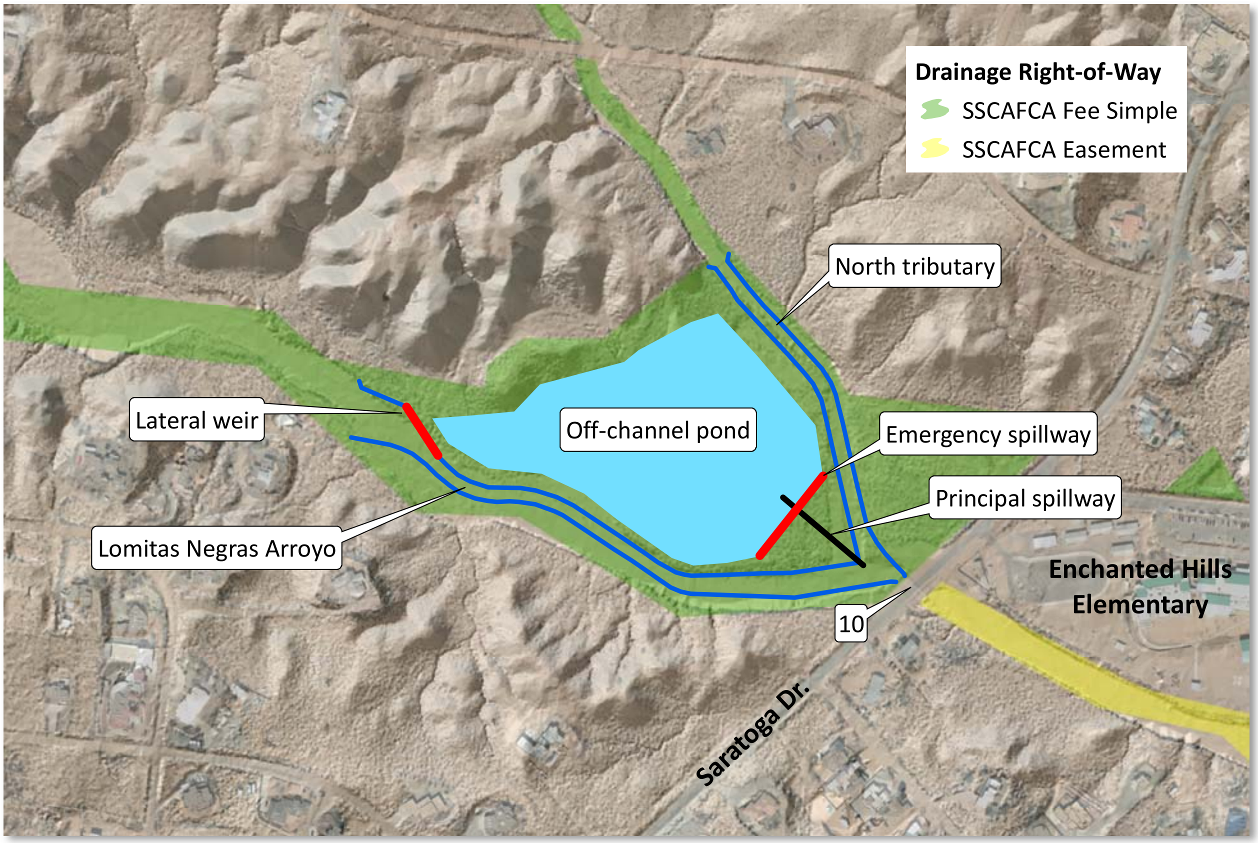

Figure 3.8: Overview map showing a conceptual layout of the Lomitas Negras facility.

3.2.2. High Range and Aloe Ponds

Figure 3.9 shows the location of the proposed High Range and Aloe Ponds. Road crossing numbers refer to Table 2.5 and Table 3.1. Conceptual designs for both facilities have been completed (Naidu, 2019), and final design for High Range pond is currently in progress. The drainage areas contributing to High Range and Aloe Ponds are 0.85 mi^2 and 0.63 mi^2, respectively. Both ponds have a design storage volume just under 50 ac-ft.

The ponds will protect road crossing structures at Loma Colorado Blvd. (see crossing 7, Figure 3.9) and Idalia Road (crossings 8 and 9). Peak flow attenuation provided by both facilities will also improve the operation of the Lomitas Negras off-channel facility downstream. The hydrology methods used in this watershed management plan follow the new SSCAFCA guidance adopted in 2020. Results show that given anticipated urbanization in the area, crossing structure capacities in the Lomitas Negras tributary will not be exceeded with all proposed facilities in place. The drainage analysis conducted as part of the conceptual design (Naidu, 2019) identified future constraints at Loma Colorado Blvd. (crossing 7) and Idalia Road (crossing 8) downstream of High Range Pond. This difference in results can in part be attributed to a difference in the underlying hydrology methods, since the 2019 report used SSCAFCA's old guidance. Nevertheless, it will be necessary to carefully monitor urbanization in the contributing area and restrict combined discharge to crossing and ponds capacities.

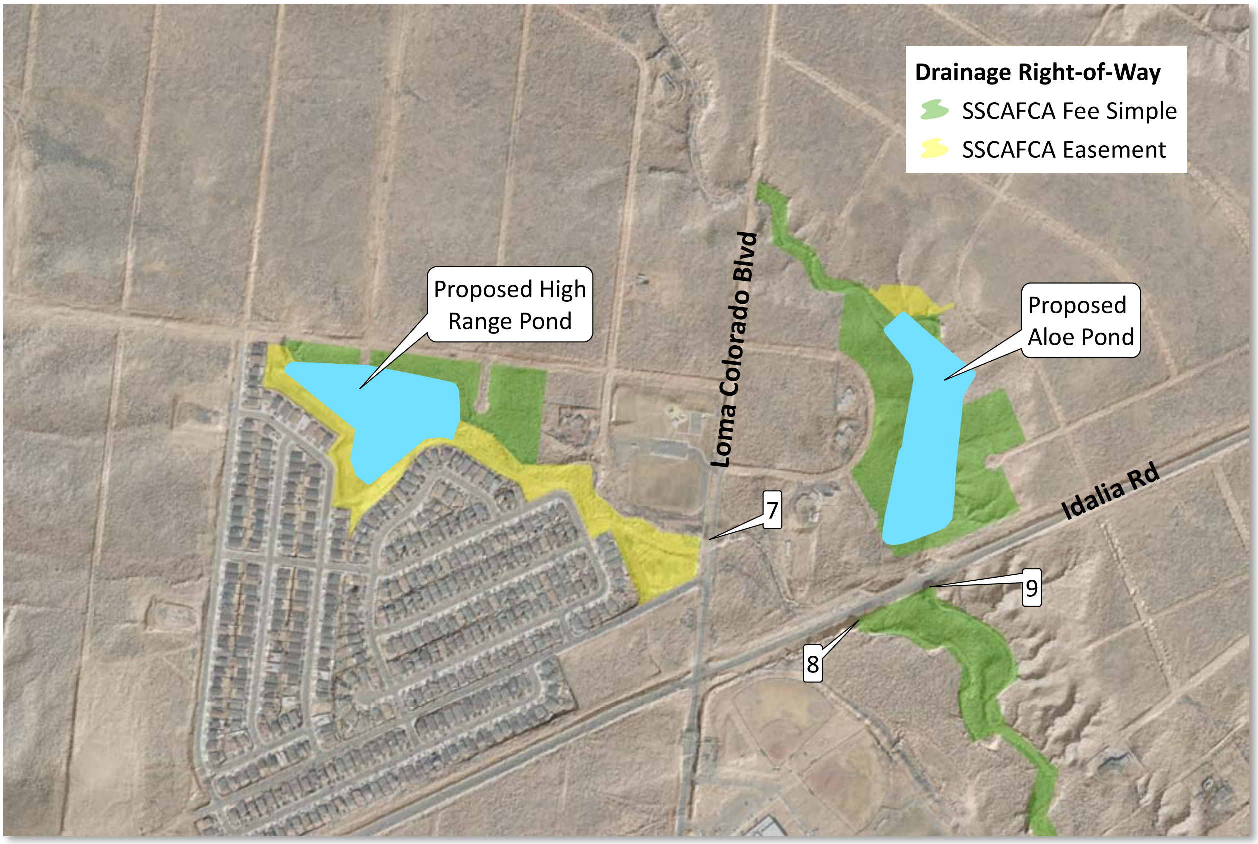

Figure 3.9: Map showing locations of proposed High Range and Aloe Ponds.

3.2.3. North Hills Stormwater Diversion Facility

A second large off-channel facility is planned along the main stem of the Montoyas arroyo. A location map of the proposed North Hills stormwater diversion facility can be seen in Figure 3.10. The facility will divert high flows from the Montoyas Arroyo into a 160 ac-ft off-channel pond and reduce peak discharges during large flash flood events. Runoff temporarily stored in the off-channel pond will slowly be released back into the Montoyas Arroyo via a principal spillway pipe. Conceptual-level design for the pond has been completed by SSCAFCA staff.

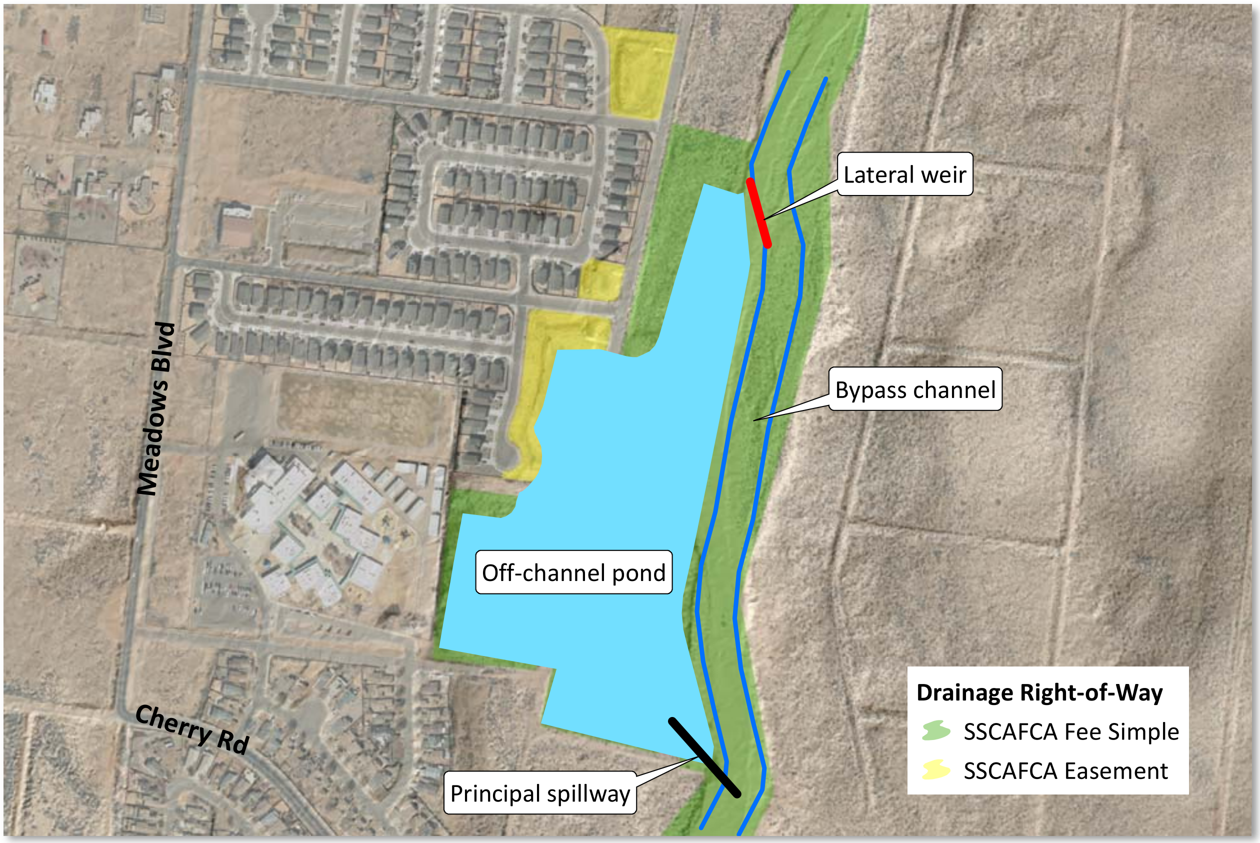

Figure 3.10: Overview map of the proposed North Hills facility.

The North Hills stormwater diversion facility is an integral component of the regional flood control plan for the Montoyas watershed. Once the Aloe, High Range and North Hills facilities are constructed, all but two of the deficiencies identified in Table 2.5 (see Section 2.12 above) under existing urban development will be resolved (see Section 3.3 below for model results including proposed facilities).

Additional flow attenuation will be required in the future as the watershed continues to urbanize. Three locations for future regional facilities have been identified. Each location is briefly described below.

3.2.4. Tributary G Off-Channel Pond

Tributary G joins the main stem of the Montoyas Arroyo adjacent to the North Hills subdivision, and just downstream of the proposed North Hills facility (see Section 3.2.3 above). Figure 3.11 shows the approximate location of a future facility. It is anticipated that 80 ac-ft will be necessary to attenuate peak flows from Tributary G if the facility is designed using the off-channel storage concept.

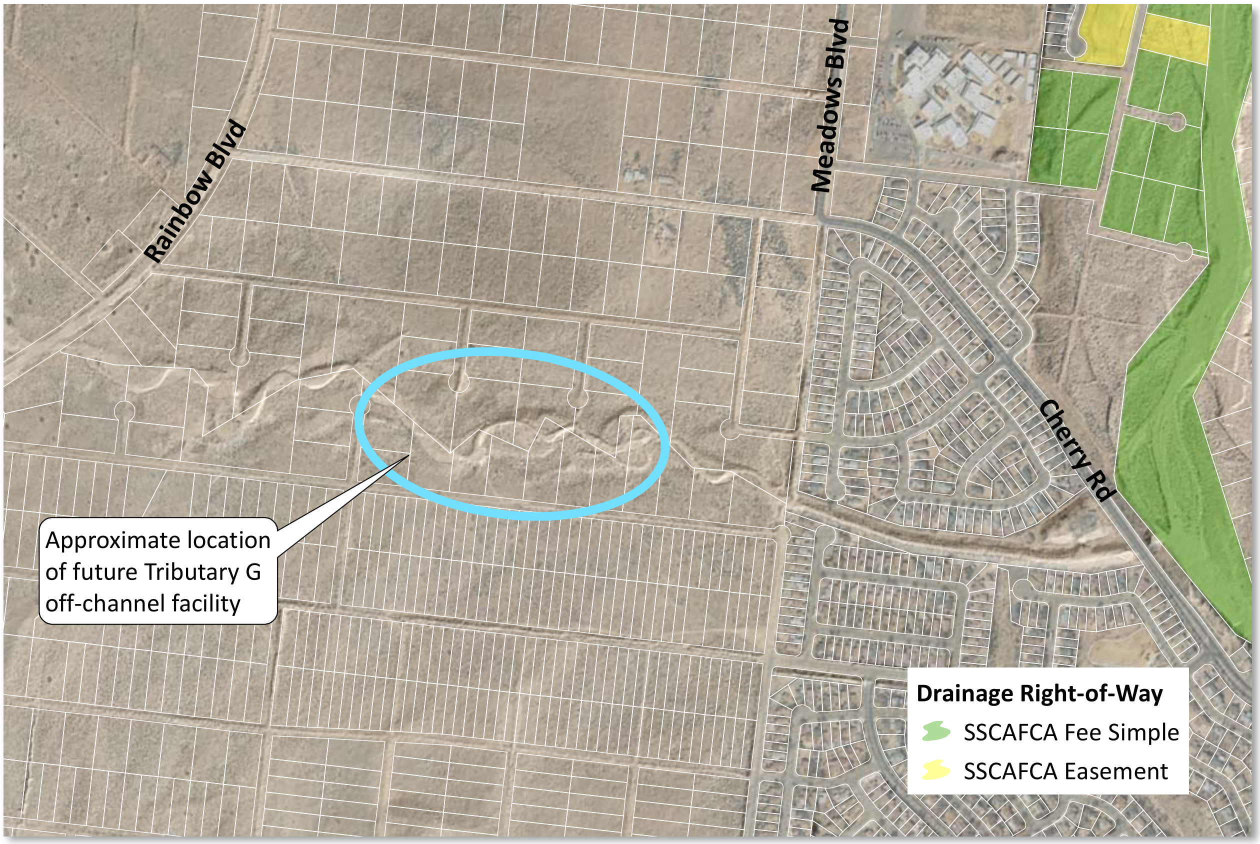

Figure 3.11: Approximate location of proposed Tributary G off-channel facility.

No public drainage right-of-way currently exists in the area; all parcels (indicated with white outlines in Figure 3.11) are under private ownership. Although this facility will not be needed until a larger portion of the watershed has been urbanized, conceptual design of the facility should be completed in the near future. All right-of-way necessary for construction should be identified and acquired by SSCAFCA.

3.2.5. Gold Park Off-Channel Facility

The Gold Park facility (Figure 3.12) will be located just upstream of the Northern Meadows subdivision where flows from tributaries J and K join. Initial analysis indicates that the greatest downstream flood protection will be achieved if flow from a small tributary originating in subbasins J_401, J_402, J_403 and J_501 completely bypass the pond (see Figure 3.12, left). A portion of high flows from the main stem (see Figure 3.12, top) will be diverted into the off-channel pond, effectively "shaving" the hydrograph and reducing peak discharges during infrequent flood events. It is anticipated that approximately 120 ac-ft of storage volume will be required under future developed conditions.

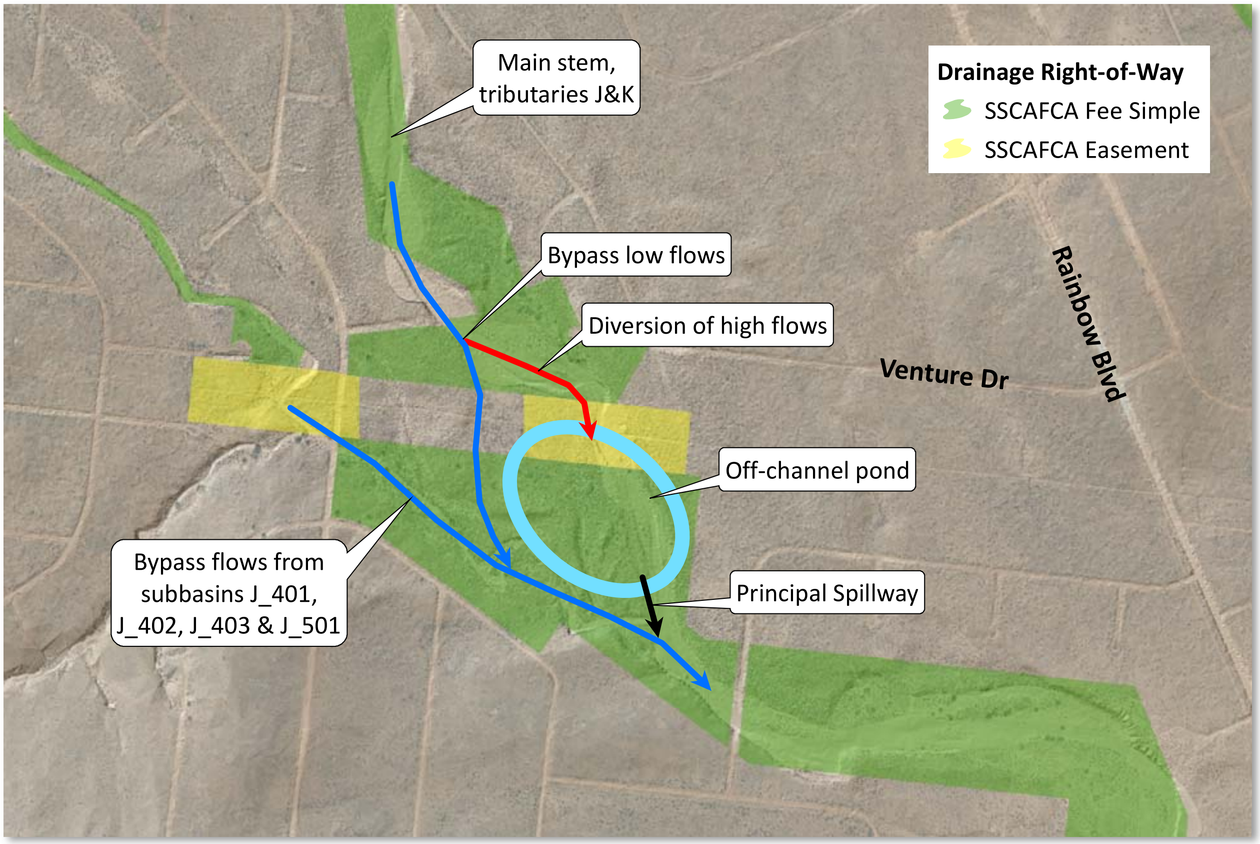

Figure 3.12: Overview map showing the approximate location of the future Gold Park off-channel facility.

3.2.6. Ponce de Leon Off-Channel Facility

The future Ponce de Leon off-channel facility (Figure 3.13) will be situated along tributary L just upstream of the Northern Meadows subdivision. Similar to the other off-channel facilities described above, low flows will bypass the off-channel pond. Only during high flow conditions, a portion of the hydrograph will be diverted. It is anticipated that approximately 100 ac-ft of storage volume will be required under future developed conditions.

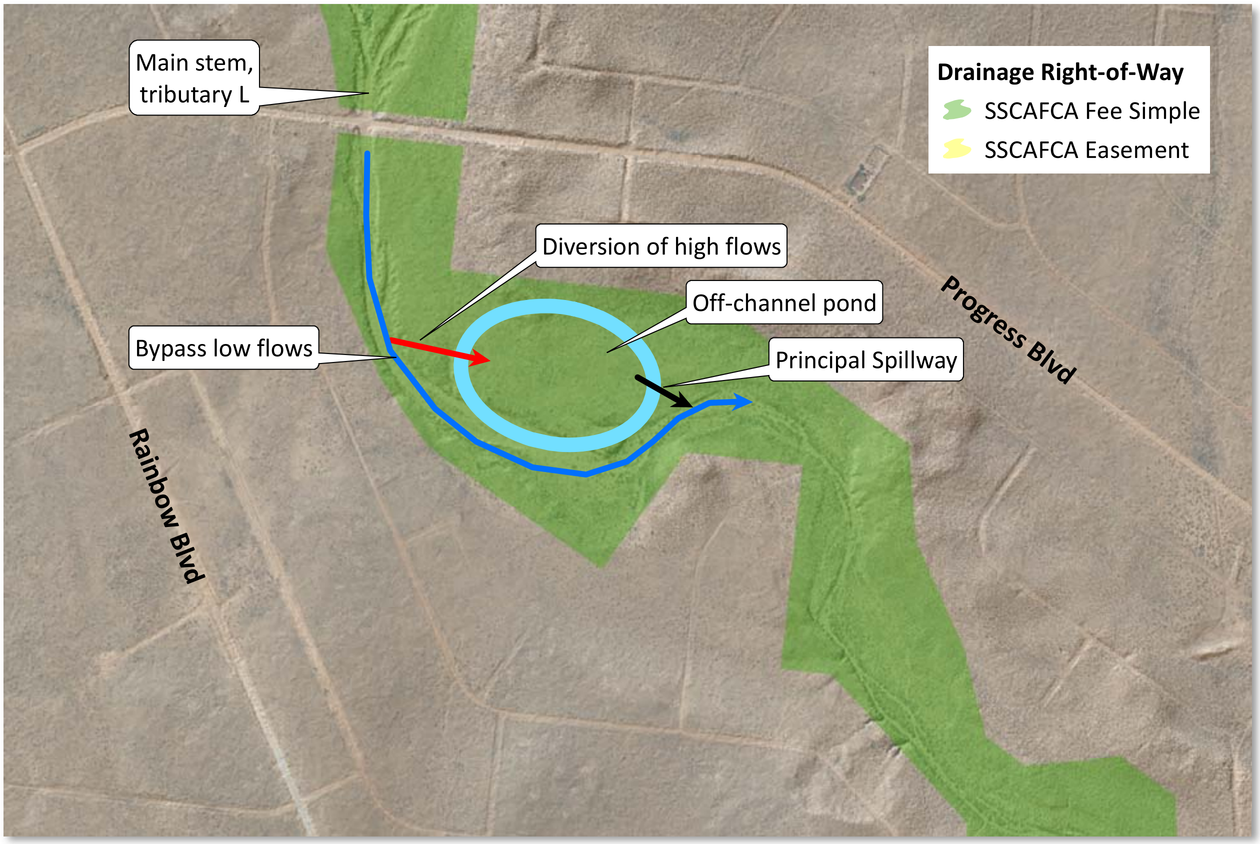

Figure 3.13: Overview map showing the approximate location of the future Ponce de Leon off-channel facility.

At both the Gold Park and Ponce de Leon sites, large tracts of public drainage right-of-way already exist. Nevertheless, conceptual designs for both facilities should be completed to identify additional land requirements.

3.3. Future Conditions Hydrology

Table 3.1 summarizes crossing structure capacities and estimated peak flows for two future scenarios:

- Scenario 1 assumes existing development with the North Hills Off-Channel facility as well as Aloe and High Range ponds in place (see Figure 3.14, blue circles). Results from this scenario show that all but two conveyance deficiencies that currently exist in the watershed will be resolved. One of the most important deficiencies is at the Corrales Road bridge of the Harvey Jones channel, since exceedance of the channel capacity at this location could result in substantial flooding of the surrounding low-lying area. The two deficiency not remediated are located at crossing 1 (King Blvd.) and crossing 2 (Cherry Rd.), whereby the updated 2D model (see Appendix H) suggests that crossing 2 has a slightly higher capacity that originally anticipated.

- Scenario 2 assumes a developed watershed with all proposed facilities in place (see Figure 3.14, blue and red circles). Flow rates reported in Table 3.1 show that all major deficiencies have been resolved (within 5% of estimated structure capacities). Periodic re-analysis of the watershed will be necessary to confirm development assumptions in the watershed.

Please note that the peak flow rates reported in Table 3.1 correspond to model runs with depth-area reduction factors appropriate for the contributing area of each analysis point (see drainage area, Table 3.1).

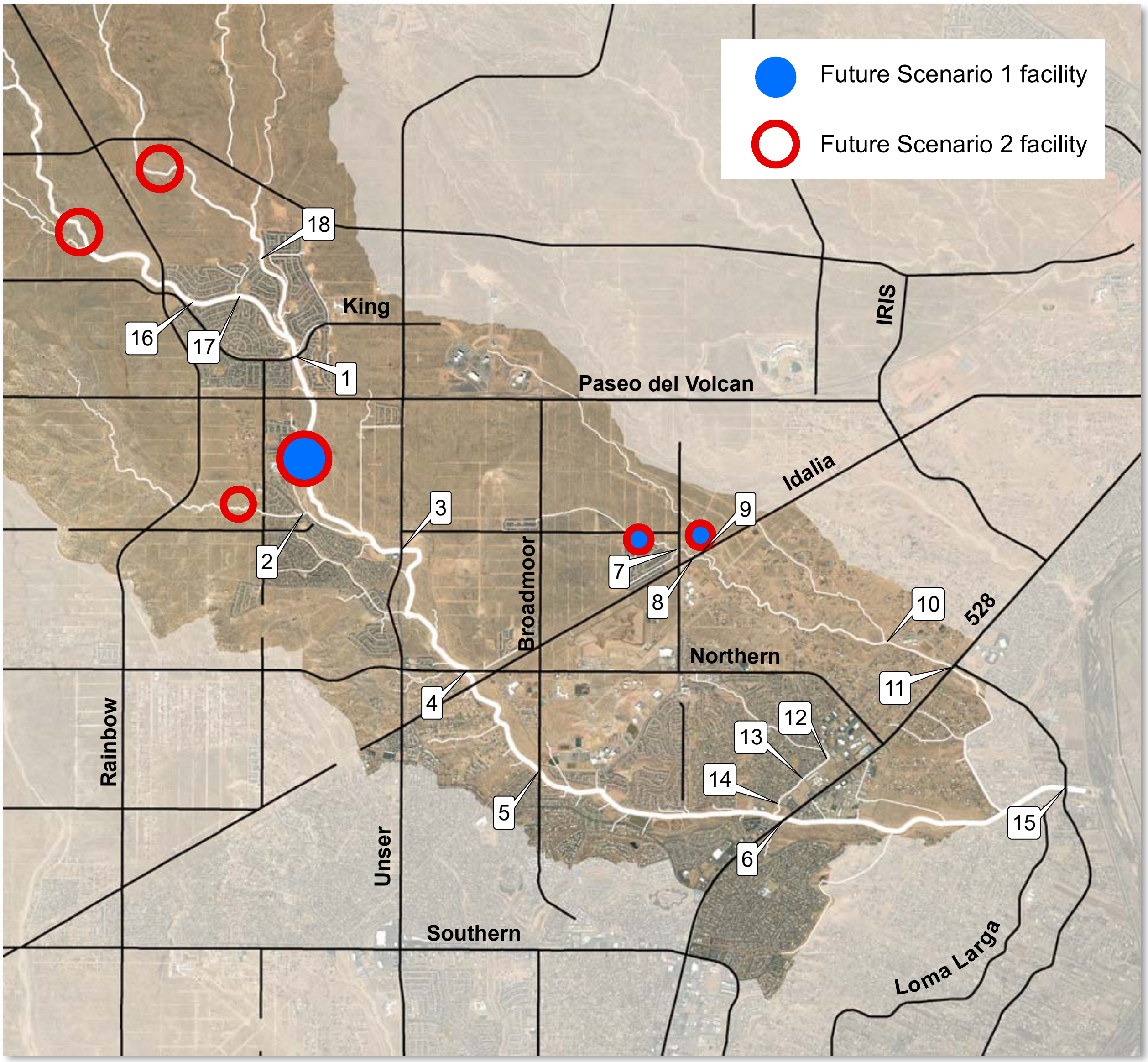

Figure 3.14: Major crossing structure locations and planned facilities in the Montoyas watershed for two future scenarios.

Table 3.1: Major crossing structures, capacities, and peak discharges for two future scenarios.

Crossing	Location	HMS_ID	Drainage Area (mi²)	Future Scenario 1 [a] (cfs)	Future Scenario 2 [b] (cfs)	Capacity (cfs)
1	Montoyas & King Blvd.	A_103_J4	38	6614	5030	4800
2	Tributary G & Cherry Rd.	G_104_J2	4	1234	1094	1100
3	Montoyas & Unser Blvd.	A_105_J4	44	5445	4667	5200
4	Montoyas & Northern Blvd.	A_106_J5	47	5678	5309	5800
5	Montoyas & Broadmoor Blvd.	A_107_J6	49	5806	5813	7300
6	Montoyas & NM 528	A_109_J5	53	4459	4560	7100
7	High Range Trib. & Loma Colorado Blvd.	U_202_J3	1	116	482	440
8	High Range Trib. & Idalia Rd	U_202_J3	1	116	482	510
9	Aloe Trib. & Idalia Rd.	U_104_J	2	505	744	1100
10	Lomitas Negras & Saratoga Dr.	U_106_J2	5	948	1229	1250
11	Lomitas Negras & NM 528	U_107_J	5	1038	1340	1400
12	Rockaway Channel & Turquoise Dr.	R_104_J1	1	673	818	780
13	Rockaway Channel & Rockaway Blvd.	R_103_R2	1	666	811	790
14	Rockaway Channel & Sundt Rd.	R_104_J	1	879	981	930
15	Harvey Jones Chan. & Corrales Rd.	HJC_J	61	4878	5468	5500
16	Montoyas & Serene Meadows	J_107_J	21	4225	3111	5200
17	Montoyas & Camino de los Montoyas	A_101_J	22	4207	3112	4800
18	Ponce de Leon & Camino de los Montoyas	L_105_J3	15	3128	2292	4100

[a] Existing development, North Hills Off-Channel Facility in place

[b] Future development, all proposed facilities (North Hills, Gold Park, Ponce de Leon) in place

[a&b] Flow rates from model runs with depth-area reduction factors corresponding to the drainage area contributing to each analysis point

🟦	adequate capacity
🟩	< 10% exceedance
🟨	10-25% exceedance
🟧	25-50% exceedance
🟥	> 50% exceedance

3.4. Channel Stabilization

Much of the Montoyas Arroyo main stem between Northern Meadows and the Harvey Jones Channel (Figure 3.15) will require bank protection and grade control as the arroyo moves closer to existing housing and roads. Reaches have been prioritized based on the most immediate danger to private property and public infrastructure. SSCAFCA is currently pursuing funding for the channel reach downstream of NM 528 (Figure 3.15, blue). The City of Rio Rancho is working on a stabilization project for a portion of the priority 3 reach (yellow), but stabilization measures for the entire reach to NM 528 will be required.

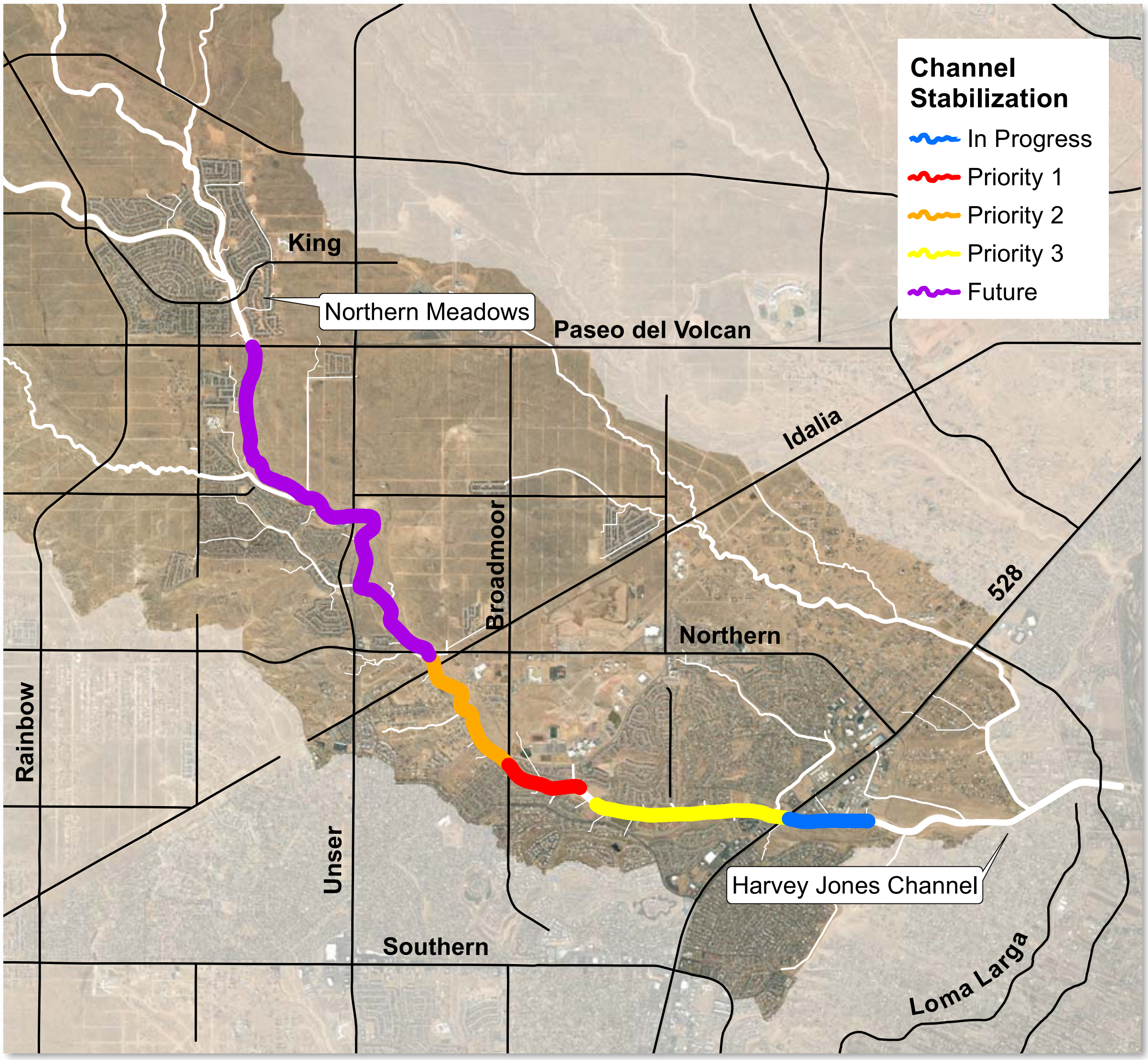

Figure 3.15: Channel stabilization priorities in the Montoyas watershed.

In addition to work in the main stem of the Montoyas Arroyo, erosion and channel degradation is threatening the integrity of several major road crossing structures:

- At the Idalia Road crossing of the Lomitas Negras tributary, degradation has occurred on the downstream side at one of two adjacent crossing structures (Figure 3.16);

Figure 3.16 Degradation downstream of a crossing structure at Idalia Rd. on the Lomitas Negras tributary.

- Upstream of Broadmoor Blvd., the Montoyas Arroyo is eroding the left bank near the crossing structure (Figure 3.17);

Figure 3.17: Erosion at the left bank wingwall of the crossing structure at Broadmoor Blvd.

- Upstream of New Mexico 528, the Montoyas Arroyo is eroding the right bank close to the wing wall of the concrete box culvert (Figure 3.18).

Figure 3.18: Erosion at the right bank wingwall of the crossing structure at New Mexico 528.

3.5. Detailed Studies

Figure 3.19 shows flood inundation areas for depths exceeding 0.5-ft resulting from the 1-percent (100-year) annual chance flood event in the Montoyas watershed (blue) based on the BLE analysis carried out for the Montoyas watershed. Although the 2D analysis can represent impacts from embankments and other features such as storage areas, no structures (i.e. dams, roadways, levees, etc.) were modeled in detail as a part of the BLE analysis. Results for urbanized areas therefore must be interpreted with caution and may need to be refined. Nevertheless, the BLE analysis is a powerful tool for identifying potential at-risk areas in rural regions with little or no drainage infrastructure. One example is shown in inset map in Figure 3.19: at the downstream end of subbasin G_201, residential housing has been constructed in a wide, shallow natural drainage channel. Several structures may be at risk from flooding. A detailed study of subbasin G_201 is therefore recommended.

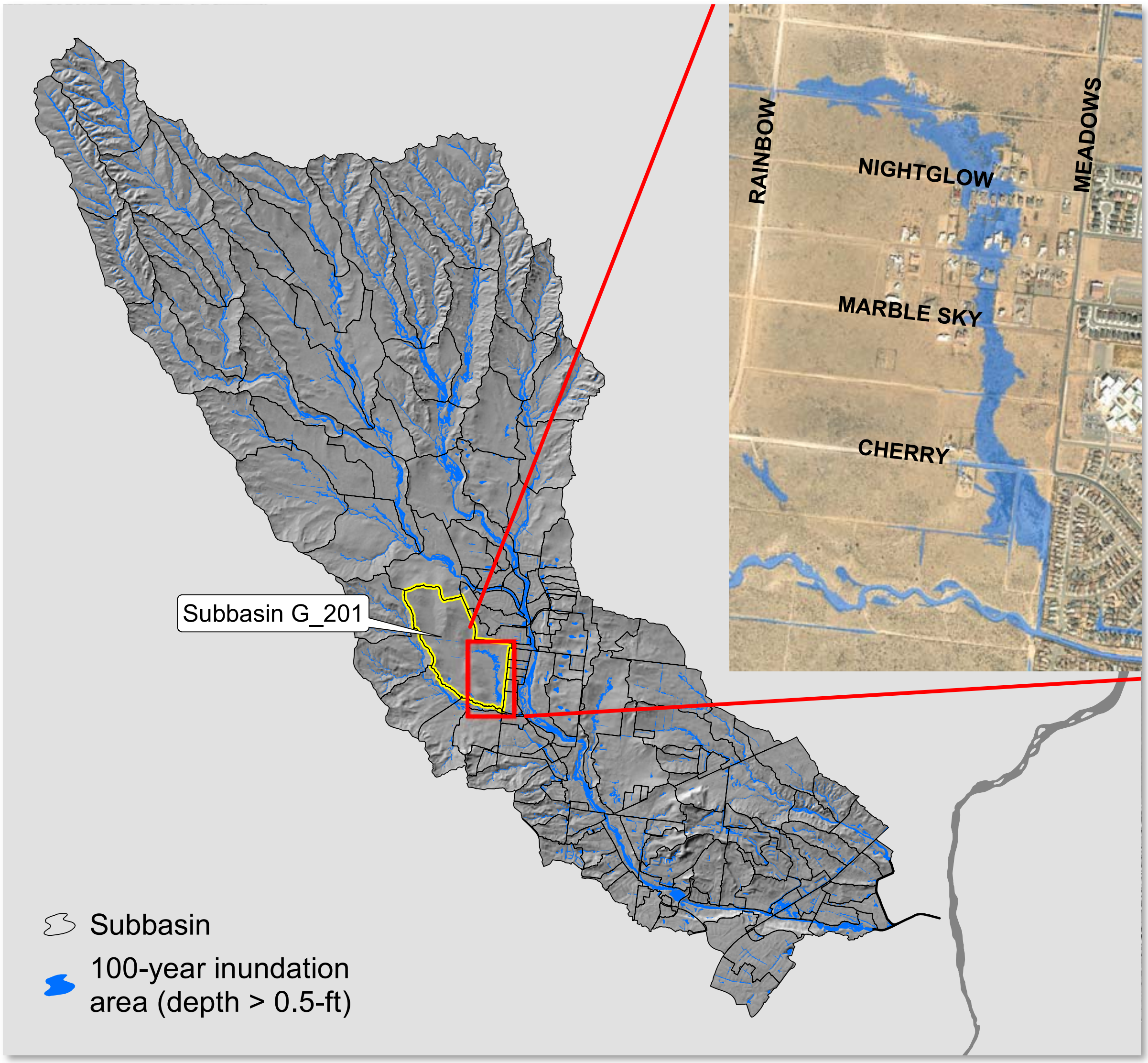

Figure 3.19: Inundation area (blue) resulting from the 1-percent (100-year) annual chance flood event.

3.6. References

CoRR (City of Rio Rancho) (2019). “Rio Rancho Disaster History.” https://rrnm.gov/710/City-Disaster-History-Chart (Accessed 2/15/2019).

Naidu, C.E. (2019). Lomitas Negras Phase 3 Design Memorandum. Smith Engineering Company, Albuquerque, NM.

Stovall, P. (2014). Design Memorandum for the Saratoga Pond, an off-channel storm water pond, Lomitas Negras Arroyo. Smith Engineering Company, Albuquerque, NM.