Southern Sandoval County Arroyo Flood Control Authority

August 2024

Calabacillas Watershed Park Management Plan

Management Plan Revision History

Version	*Date*	*Title*	*Prepared by*	*Notes*
v.1	2015	Interim Calabacillas Watershed Park Management Plan	SSCAFCA	Initial release
v.2	2024	Calabacillas Watershed Park Management Plan	SSCAFCA	Followed updated SSCAFCA *Hydrology Manual*

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 a regional hydrologic model for all watersheds within its jurisdiction. Updates and revisions are made and tracked by SSCAFCA, or their designee. A copy of the regional 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.

Southern Sandoval County
Arroyo Flood Control Authority

1041 Commercial Drive SE • Rio Rancho, NM 87124
Ph (505) 892-RAIN (7246) • Fax (505) 892-7241

The Calabacillas Watershed Park Management Plan was accepted by the SSCAFCA Board of Directors on 8/15/2024.

Dave Gatterman, P.E. (Executive Engineer) — Date: 8/15/24

Ron Abramshe for.
Cassandra D'Antonio (Chair) — Date: Aug 15, 2024

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Appendices

1. Introduction

The Calabacillas Watershed Park Management Plan (CAWMP) 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 stormwater conveyance as areas with multi-use potential.
- To manage sediment and erosion within the boundaries of SSCAFCA.
- 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.

A regional hydrologic model and watershed management plan for the Calabacillas watershed was first prepared in 2015 (SSCAFCA, 2015). The present plan updates the hydrologic conditions to reflect urbanization as of 2024. The hydrologic model and associated documentation were reviewed by CobbFendley & Associates, Inc., as well as AMAFCA and SSCAFCA staff. Individual review comments and corresponding responses are included in Appendix G. The draft document was also shared with the City of Rio Rancho and Sandoval County, but no comments were received.

According to SSCAFCA policy, planning and design of flood control infrastructure is based on runoff from the 100-year (1% chance) storm. Hydrologic modeling was used in this study to provide runoff estimates for the 1% chance storm at all locations of interest throughout the watershed.

1.1. Location

The Calabacillas watershed consists of an 80 square mile drainage basin that discharges to the Rio Grande within the City of Albuquerque (Figure 1.1). The upper portion of the watershed lies within Sandoval County and/or the City of Rio Rancho as well as SSCAFCA jurisdiction. The lower portion of the basin lies within the City of Rio Rancho (in Bernalillo County) and the City of Albuquerque, and is within the jurisdiction of the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA).

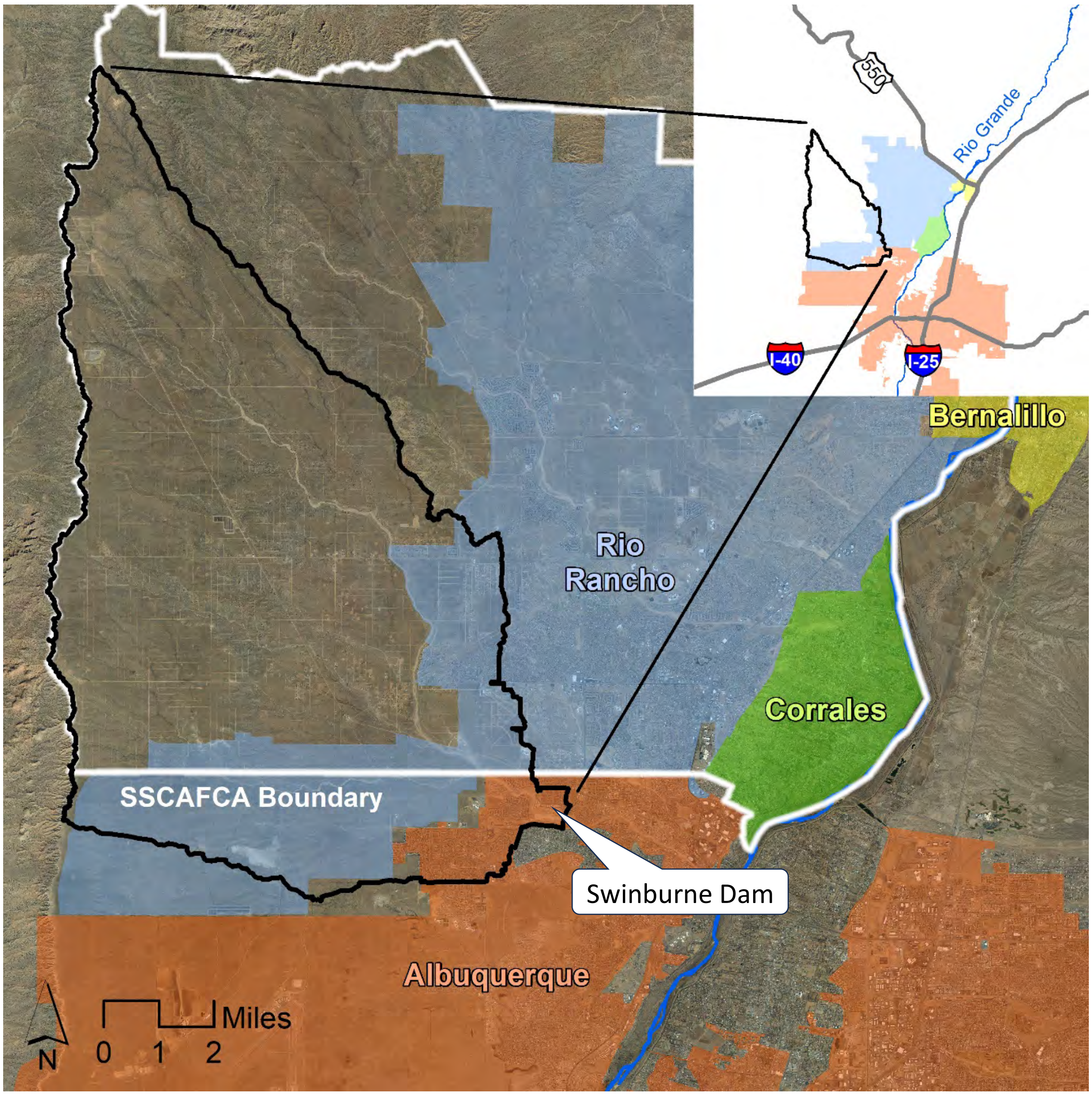

Figure 1.1: Overview map of the Calabacillas watershed and local municipalities.

In this study, the Calabacillas watershed upstream of AMAFCA's Swinburne Dam was analyzed. The boundary of the basin draining to the dam is outlined in black in Figure 1.1.

1.2. Climate

The Calabacillas watershed is located west of the Rio Grande in the Middle Rio Grande valley, with elevations ranging from approximately 5,300 to 6,700 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, 2023).

Based on 1991-2020 climate normals (Figure 1.2), average mean annual temperature for the area is 58 °F; average mean monthly temperatures range from 37 °F in January to 80 °F in July.

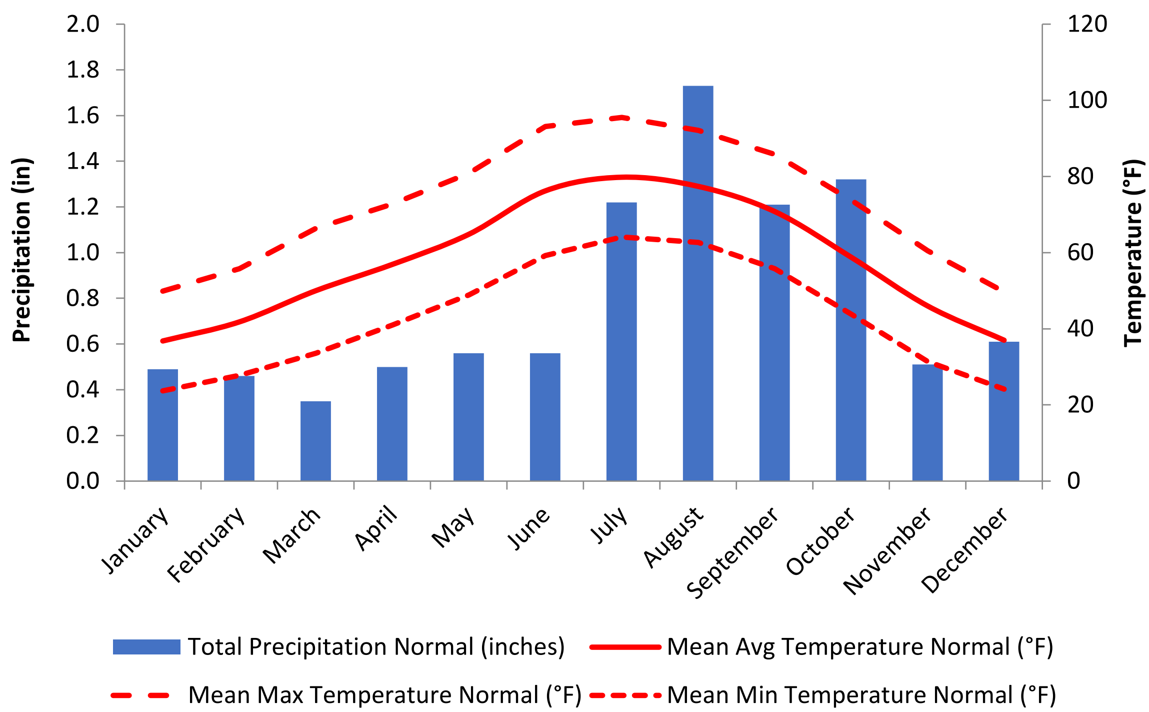

Figure 1.2: Monthly climate normal (1991-2020) for the Rio Rancho, NM area (source: NOAA, 2021).

Average annual precipitation in the Rio Rancho area is 9.5 inches, with values ranging from 4 to 16 inches. July through October are the months with highest rainfall totals (see Figure 1.2). Summer rain typically falls during brief, intense thunderstorms. 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, 2023). 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.

1.3. Soils

Figure 1.3 shows NRCS soil map units for the Calabacillas watershed obtained from the NRCS web soil survey (https://websoilsurvey.nrcs.usda.gov/app/). Descriptions of typical profiles for all map units are included in Table 1.1.

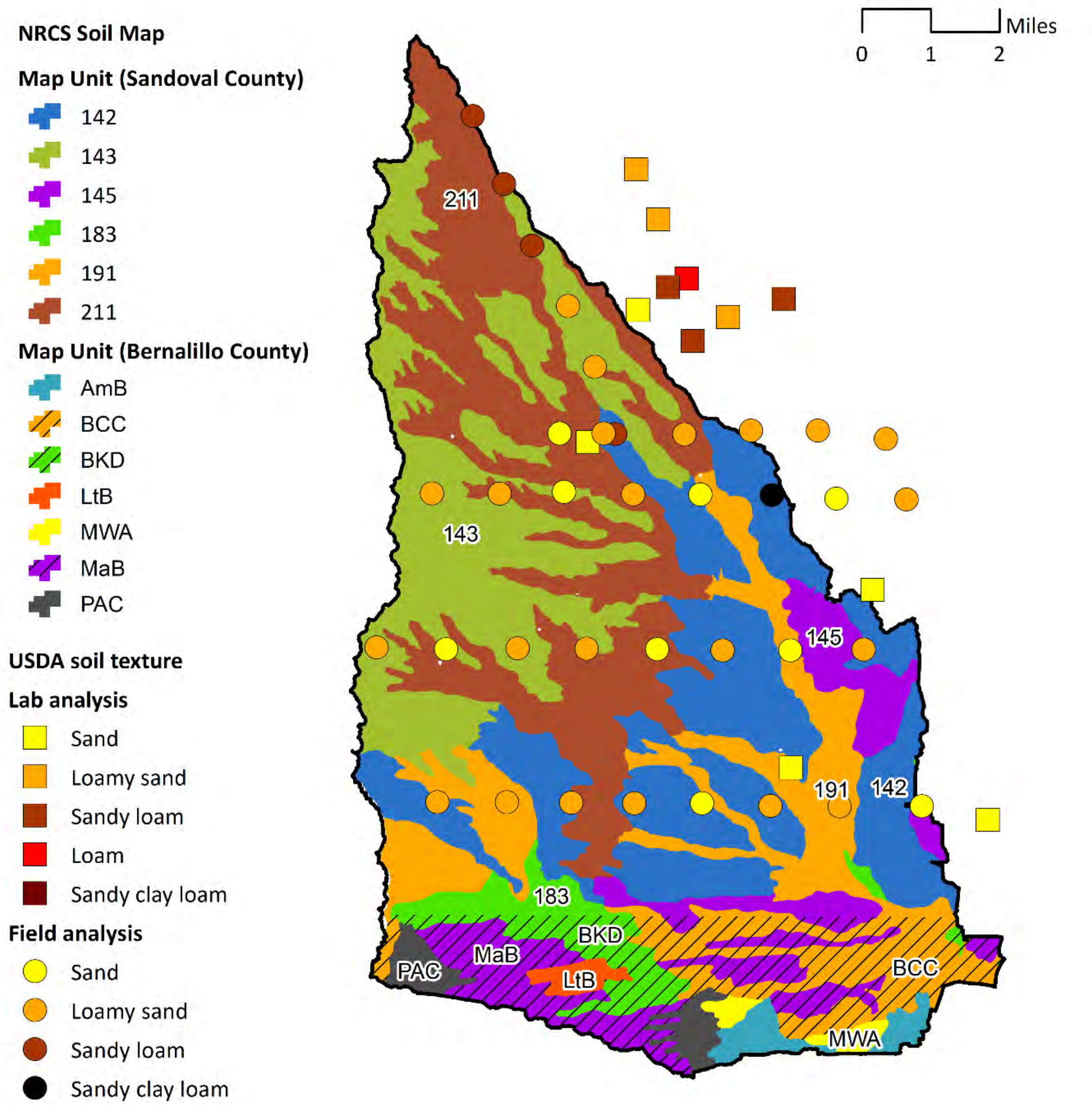

Figure 1.3: Map showing NRCS soil map units (shaded) as well as laboratory testing (squares) and field assessment (circles) of soil samples for the Calabacillas watershed.

According to the soil survey (Hacker and Banet, 2008), near-surface soils in the Calabacillas watershed are predominantly sandy loams and loamy sands. In some locations, sandy clay loams can be found starting at depths of 4-33 inches.

Table 1.1: Map unit symbols, descriptions, and typical soil texture profile for soils found in the Calabacillas watershed.

Map Unit	Description	Typical Profile	
142	Grieta fine sandy loam, 1 to 4 percent slopes	0 to 11 in	fine sandy loam
		11 to 48 in	sandy clay loam
		48 to 60 in	loamy sand
143	Clovis fine sandy loam, 1 to 4 percent slopes	0 to 11 in	fine sandy loam
		11 to 48 in	sandy clay loam
		48 to 60 in	loamy sand
145	Grieta-Sheppard loamy fine sands, 2 to 9 percent slopes	0 to 3 in	fine sandy loam
		3 to 60 in	sandy clay loam
183	Sheppard loamy fine sand, 8 to 15 percent slopes	0 to 60 in	loamy fine sand
191	Sheppard loamy fine sand, 3 to 8 percent slopes	0 to 60 in	loamy fine sand
211	Zia-Clovis association, 2 to 10 percent slopes	0 to 33 in	sandy loam
		33 to 46 in	sandy clay loam
		46 to 60 in	sandy loam
AmB	Alemeda sandy loam, 0 to 5 percent slopes	0 to 4 in	sandy loam
		4 to 13 in	gravelly sandy loam
		13 to 26 in	very cobbly loam
		26 to 30 in	bedrock
BCC	Bluepoint loamy fine sand, 1 to 9 percent slopes	0 to 53 in	loamy fine sand
		53 to 60 in	loamy sand
BKD	Bluepoint-Kokan association, hilly	0 to 8 in	loamy fine sand
		8 to 60 in	fine sand to gravelly loamy fine sand
LtB	Latene sandy loam, 1 to 5 percent slopes	0 to 15 in	sandy loam
		15 to 60 in	gravelly sandy loam
MaB	Madurez loamy fine sand, 1 to 5 percent slopes	0 to 4 in	loamy fine sand
		4 to 21 in	sandy clay loam
		21 to 60 in	sandy loam
MWA	Madurez-Wink associatin, gently sloping	0 to 21 in	fine sandy loam
		21 to 60 in	sandy loam
PAC	Pajarito loamy fine sand, 1 to 9 percent slopes	0 to 3 in	loamy fine sand
		3 to 60 in	fine sandy loam

In addition to NRCS soil maps, Figure 1.3 contains results from field and laboratory analysis of soil samples (circles and square, respectively). Through a partnership with the Ciudad Soil and Water Conservation District, soils at 36 sites in and around the Calabacillas watershed were characterized and soil texture estimated using the NRCS “Guide to Texture by Feel” method (NRCS, 2021). Detailed results are included in Appendix E. Circles in Figure 1.3 are color-coded in accordance with soil textures representative of the upper four inches of the soil profile, which is expected to influence runoff dynamics during short-duration rainfall events characteristic of the study area. Squares in Figure 1.3 represent locations where soil texture was determined by laboratory analysis (see Appendix E).

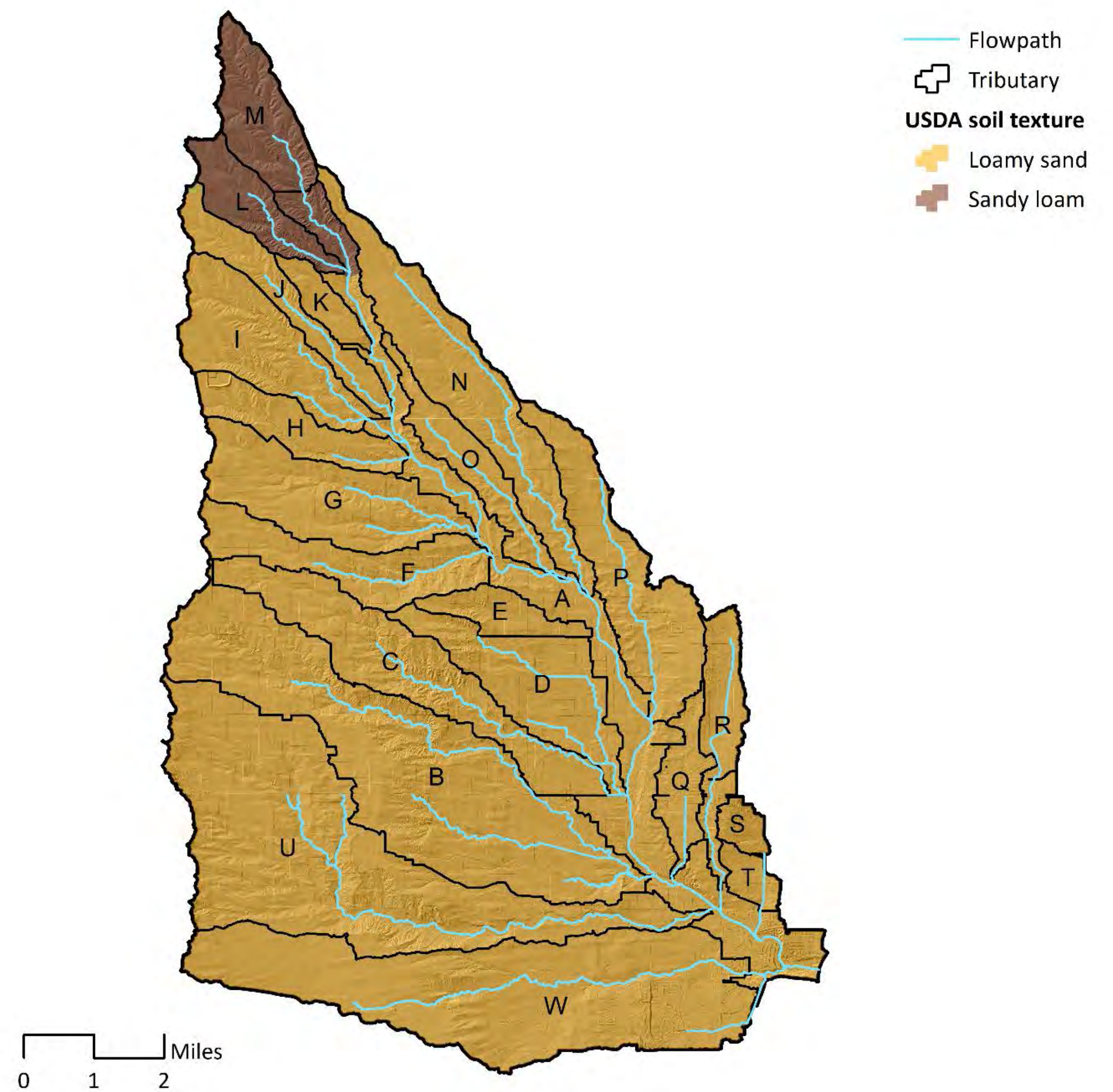

Figure 1.4: Map showing soil texture assumptions for the Calabacillas watershed used in developing the hydrologic model.

While NRCS data suggests that textures for most near-surface soils fall into the sandy loam category, field and laboratory analysis generally indicate loamy sands for the majority of the watershed. The only exception appears to be the area near the headwaters of the basin, where multiple samples indicate finer textures.

Figure 1.4 shows an overview map of the Calabacillas watershed with major tributaries (labeled with capital letters). The term “tributary” is used to identify an area draining to the main stem of the Calabacillas Arroyo via a distinct channel or storm drain pipe. Based on soil analysis results, only tributaries L and M, along with a portion of tributary A, were assumed to comprise sandy loams; the remainder of the watershed was assumed to feature loamy sands (see Figure 1.4).

1.4. Vegetation and Wildlife

With elevations ranging from 5,300 to 6,700 feet, the study area features semi-desert shrub and grasslands. Few juniper trees (Juniperus spp.) can be found at higher elevations along ephemeral channels and at the toe of hillslopes where they receive increased runoff. Typical shrubs include winter fat (Krascheninnikovia lanata) and fourwing saltbush (Atriplex canescens). 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 Calabacillas watershed and its ephemeral channels provide habitat for a variety of animal species. Examples include the burrowing owl (Athene cunicularia) and bank swallow (Riparia riparia), both migratory species that nest in vertical arroyo banks.

2. Watershed Hydrology

All hydrologic modeling was carried out using the U.S. Army Corps of Engineers HEC-HMS software version 4.11.

2.1. Basin Delineation

Orthophotography used for this project consists of tiled images which depict color digital aerial photographs acquired in the spring of 2022 during leaf-off conditions. Lidar-derived elevation data (2018) was used to delineate drainage boundaries and estimate model parameters. Both orthophotography and elevation data are part of the Mid-Region Council of Governments (MRCOG) digital orthophotography and elevation data project. Initial watershed, tributary and subbasin boundary delineation was accomplished using the GIS tools available in the HEC-HMS software based on a digital elevation model (DEM) created from 2018 MRCOG lidar data. Boundaries 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 the DEM. An overview map can be seen in Figure 2.1; major tributaries are shaded in different colors. Subbasins are labeled staring with the tributary letter followed by a three-digit numerical subbasin ID.

2.2. Reach Routing

The Muskingum-Cunge method was used in HEC-HMS to route flows through open channels and storm drain pipes (assuming open channel flow conditions). Routing reaches were delineated, and slopes estimated in ArcGIS based on the 2018 DEM. Roughness coefficients (Manning’s n-values) were estimated based on orthoimagery and field investigations. 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 – 0.025
Natural channel, moderate to heavy vegetation in channel bed and along banks	0.025 – 0.035

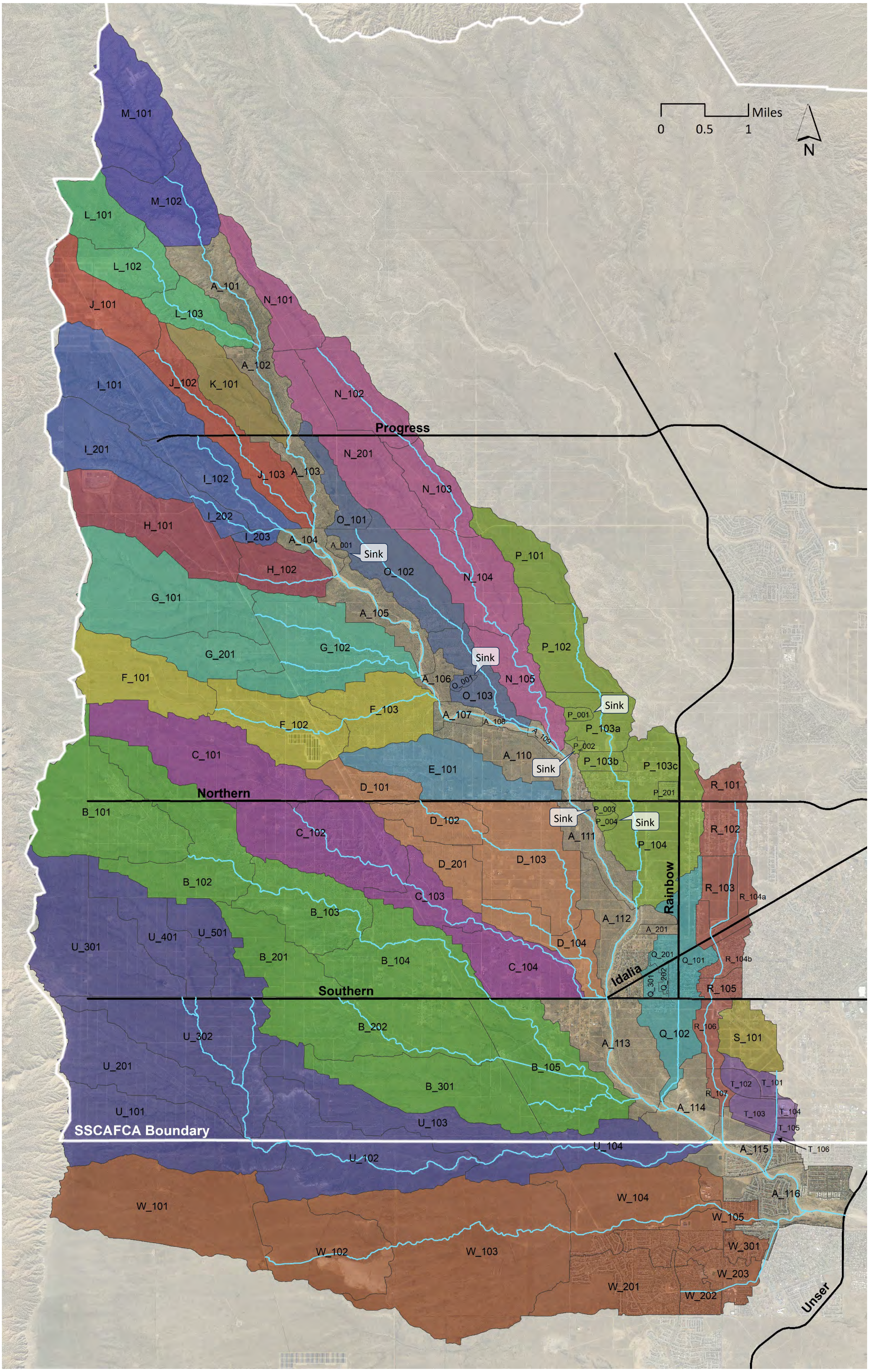

Figure 2.1: Subbasin overview map. Major tributaries are indicated with different color shading. Playa basins are identified with a "sink" callout.

Channel reaches were modeled using an idealized trapezoidal shape, with typical bottom widths and side slopes estimated from elevation data and orthoimagery in ArcGIS. Transmission losses in major arroyos were modeled using a percolation loss rate of 1.5 in/h based on a study for the neighboring Montoyas Arroyo (Schoener 2017). Minor conveyances were assumed to have negligible transmission losses and were assigned a loss rate of 0 in/h.

2.3. Existing Land Use

As of 2024, a large portion of the Calabacillas watershed was undeveloped. Figure 2.2 shows the extent of urbanization and major land use categories. Land use was quantified by manual digitization using orthoimagery and based on GIS data obtained from the City of Rio Rancho (https://rrnm.gov/2334/GIS-Data-Download) and the City of Albuquerque (https://www.cabq.gov/gis/geographic-information-systems-data). Urbanization is focused along the eastern edge of the watershed. Most of the urban development consists of residential subdivisions (blue) and scattered residential development (purple). Two solar farms, one in the center and the other near the headwaters of the Calabacillas Arroyo feature areas of disturbed land (orange) and unconnected imperviousness (dark red).

2.4. Existing Conditions Loss Parameters

In accordance with SSCAFCA's Hydrology Manual (SSCAFCA, 2021a), the curve number method was used to compute precipitation loss and excess. Curve numbers for pervious areas were estimated based on 2024 land use conditions in the Calabacillas watershed (see Figure 2.2). Table 2.2 lists land use types and associated curve numbers.

Table 2.2: Land use categories and associate curve numbers used in the Calabacillas model.

Land Use	Curve Number (CN)
Directly Connected Impervious Area (e.g. paved roads, driveways, paved parking)	% Impervious (not included in CN calculation)
Unconnected impervious area	98
Graded/disturbed	86
Unpaved road	82
Park/lawn	68
Residential yard, subdivision	80
Residential yard, estates lot	78
Open space, loamy sand	74
Open space, sandy loam	78

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 (Figure 2.2, red) were digitized manually.

Table 2.3 contains land use categories and corresponding loss model parameters for single family residential lots of varying sizes in the Calabacillas watershed. Lots within subdivisions were distinguished from estate lots; the main difference is that subdivisions are mass-graded at the time of development. Due to the resulting soil compaction, the portion of each lot characterized as residential yard was therefore modeled with curve number 80. Estate lots, on the other hand, usually develop individually. We therefore determined the typical extent of disturbed area (compacted by driving, vegetation removed) and assigned it a curve number of 86. The remainder of residential yards was treated equivalent to open space (curve number 74).

Land use percentages for different lot sizes reported in Table 2.3 were adopted from the Barranca Watershed Management Plan (SSCAFCA, 2022a). Values in Table 2.3 were developed from a representative sample of each land use category within SSCAFCA's jurisdiction. Building footprints, driveways, disturbed areas, and unconnected impervious areas were measured manually in ArcGIS. The driveway and 50% of the building footprint were assumed to be DCIA; the remaining 50% of the building footprint was modeled as unconnected impervious area (UIA, CN=98).

Table 2.3: Land use categories for single family residential lots in the Calabacillas watershed.

	Building Footprint [a]	Driveway [b]	Disturbed [c]	Unconnected Impervious Area [d]	Residential Yard [e]	% DCIA	Composite CN
Subdivision 6du/ac	35%	7%	0%	4%	54%	25%	85
Subdivision 4du/ac	28%	5%	0%	4%	63%	19%	84
Subdivision 2du/ac	17%	3%	0%	4%	76%	12%	83
Estates 2du/ac	13%	3%	30%	3%	51%	10%	83
Estates 1du/ac	9%	1%	25%	2%	63%	6%	81

[a] 50% DCIA, 50% UIA; [b] 100% DCIA; [c] CN=86 [d] CN=98

[e] subdivision: CN=80; estate lots: CN=78

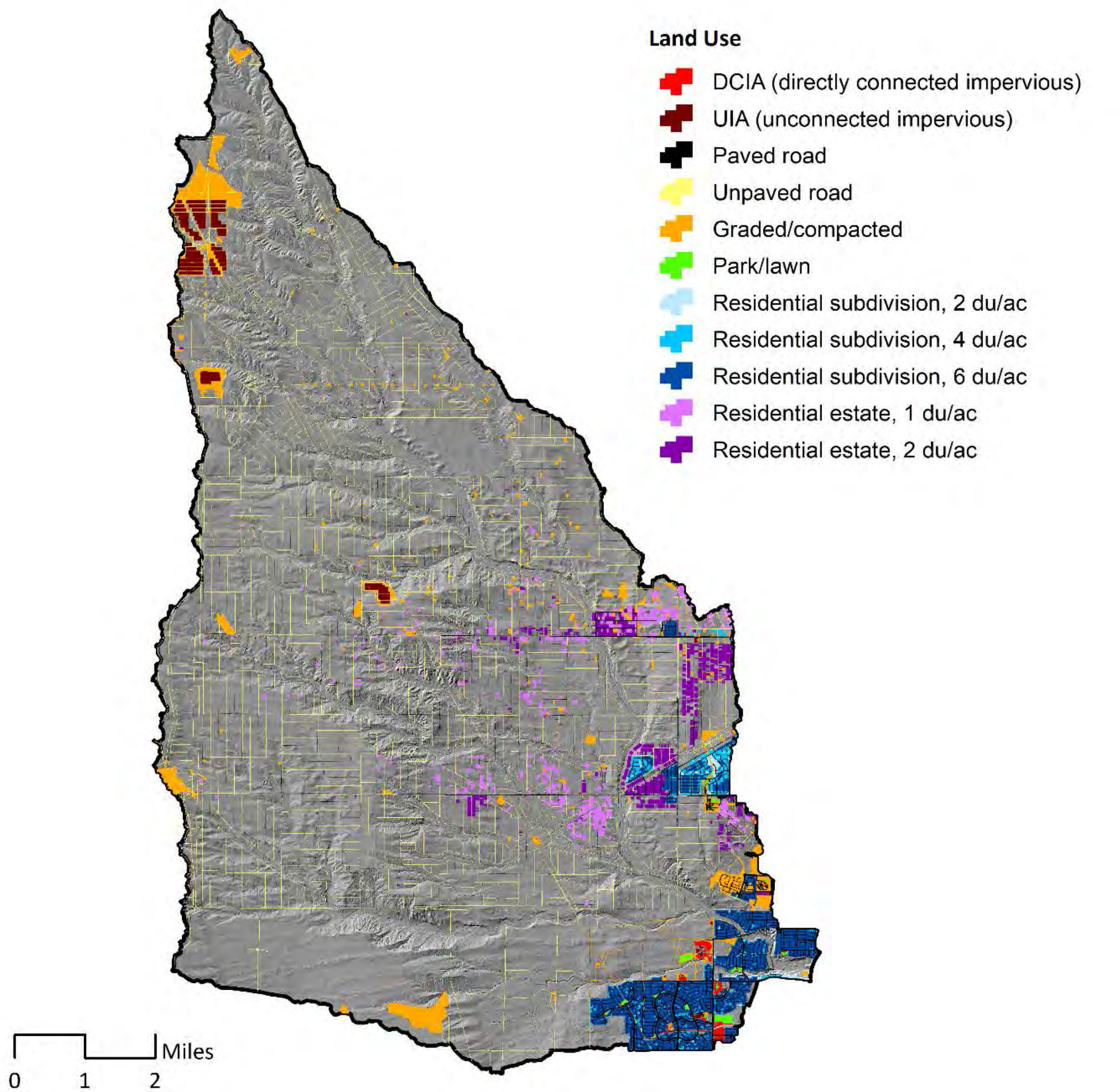

Figure 2.2: Overview map of the Calabacillas watershed and major land use types in 2024. Areas without shading (gray background) are open space.

2.5. Transform Method

In HEC-HMS, the SCS unit hydrograph method was selected to transform excess precipitation into a runoff hydrograph for each subbasin. Lag times were estimated based on the velocity method (USDA 2010) using flow path measurements performed in ArcGIS. Flow paths for each basin were split into distinct segments: a sheet flow portion not exceeding 100 feet in length, a shallow concentrated flow section not exceeding 2,000 ft, and up to two channel flow segments. Travel times for each segment were calculated based on the equations outlined in chapter 15 of the National Engineering Handbook (USDA 2010). Channel geometry was approximated using trapezoidal cross sections. The hydraulic radius for each channel segment was estimated based on channel geometry (cross-section, slope) and peak discharge resulting from a design storm with a 100-year recurrence interval. A list of model parameters for subbasins and routing reaches is contained in Appendix A.

2.6. Sediment Bulking

Based on SSCAFCA's Hydrology Manual (SSCAFCA 2021) and Sediment and Erosion Design Guide (Mussetter 2008), 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.

2.7. Existing Ponds and Diversions

The Calabacillas watershed model contains ten ponds that attenuate runoff ranging from less than 10 ac-ft to nearly 1,000 ac-ft in storage volume. Seven ponds are within SSCAFCA jurisdiction, the remaining three are within AMAFCA's boundary (see Figure 2.3). Pond parameters and dimensions were collected from corresponding engineering documents and field investigation. A list of all ponds included in the model is contained in Appendix B. In HEC-HMS, pond routing was simulated using rating curves (elevation-storage and storage-discharge curves) as well as outlet structures in some cases. Ponds were assumed to be dry at the start of each simulation.

In addition to ponds, six playas were identified and included in the model (see Figure 2.1, "sink"). Playas are natural depressions in the landscape. The basin draining to each playa was delineated as a separate subbasin (see basins A_001, O_001, and P_001–P_004). Any runoff generated within a playa basin was treated as an internal sink in the model and did not contribute flow to the Calabacillas Arroyo.

The model also contains one location with a diversion: Harely's Pond (S_101_Pond), completed in 2022, diverts flow from basin S_101 to the Calabacillas arroyo. Historically, the basin drained to the Black Arroyo. The pond's principal spillway is designed for the 100-year storm; flow is routed to the south through a storm drain in 10th St and Saltillo St. and discharges into the Calabacillas Arroyo downstream of the McMahon Blvd bridge. In the event of a storm exceeding the 100-year design storm, excess runoff would spill over the pond's emergency spillway and continue down the historic flow path. The historic conveyance is a natural arroyo flowing east between Vargas Rd and Westside Blvd until meeting the Black Arroyo upstream of the Unser Blvd crossing.

2.8. Design Storm

In accordance with SSCAFCA policy, the 100-year 24-hour design storm was used to evaluate flood risk and identify any drainage deficiencies in the Calabacillas watershed. It is a hypothetical storm event based on point precipitation frequency estimates from NOAA Atlas 14 (NOAA, 2023). Precipitation estimates representative of the centroid of the Calabacillas watershed are displayed in Table 2.4.

Table 2.4: Point precipitation frequency estimates for different recurrence intervals and durations in the Calabacillas watershed.

	Point precipitation estimate (in)				
Duration	2-yr	10-yr	50-yr	100-year	500-year
5-min	0.229	0.368	0.515	0.582	0.750
10-min	0.349	0.560	0.784	0.887	1.140
15-min	0.432	0.694	0.972	1.100	1.420
30-min	0.582	0.935	1.310	1.480	1.910
1-h	0.721	1.160	1.620	1.830	2.360
2-h	0.835	1.320	1.860	2.110	2.750
3-h	0.889	1.380	1.930	2.190	2.850
6-h	1.020	1.540	2.110	2.370	3.010
12-h	1.140	1.690	2.270	2.540	3.170
24-h	1.330	1.940	2.590	2.880	3.590

The design storm was modeled in HEC-HMS using the built-in frequency storm option with an intensity position of 25 percent and an intensity duration of five minutes. Temporal and spatial patterns of real-world storm events will likely differ from the design storm and induce a different watershed response.

NOAA point precipitation estimates (Table 2.4) are statistics for one point in space. For instance, the 100-year 1-hour point precipitation estimate for the centroid of Calabacillas watershed is 1.83 inches. As the area of analysis increases, the likelihood of experiencing that amount of precipitation decreases. One would not expect 1.83 inches of rainfall uniformly covering the entire 80 square mile Calabacillas watershed during the 100-year 1-hour storm. The current state of practice to account for this spatial effect is to use depth-area reduction curves. As the name implies, these curves reduce point estimates with increasing basins size. In HEC-HMS, the TP40/TP49 area reduction option was selected for this study, where curves are based on NOAA Technical Paper Number 40 (Hershfield 1961) and NOAA Technical Paper Number 49 (Miller, 1964).

Depth-area reduction was used to estimate runoff for analysis points of interest within the Calabacillas watershed. To do this, a storm area must be specified under frequency storm in the meteorological model within HEC-HMS. The storm area must equal the area of the drainage basin upstream of the point of interest. All runoff values reported in this document stem from model runs with depth-area reduction factors appropriate for the corresponding drainage area. Appendix C contains detailed tables with model results for all model elements; these results are from a model run without depth area reduction. If users of this document require results for analysis points with large contributing areas not reported in this plan, please re-run the model with an appropriate storm area or consult SSCAFCA.

2.9. Results

Figure 2.3 shows model results at selected locations for existing land use conditions. It is important to note that simulation results only provide a best estimate of the watershed runoff response from the design storm for current land use conditions. All hydrologic models are simplified representations of complex physical processes. Numerous factors contribute to model uncertainty, including choices related to model structure and methods used to simulate infiltration and overland flow, parameter estimation, as well as precipitation input. 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.

2.10. Structure Capacities and Major Deficiencies

There are currently three road crossing structures in the Calabacillas watershed within SSCAFCA's jurisdictional area where 100-year peak flows are expected to exceed 500 cfs: the box culvert at Southern Blvd on the main stem of the Calabacillas Arroyo, along with the crossings of two tributaries along Southern Blvd (see Figure 2.3, triangles). Structure capacities were analyzed using HY-8 software version 8; results are reported in Table 2.5. All other major road crossings within SSCAFCA's jurisdiction are at-grade crossings.

Table 2.5: Major crossing structures, capacities, and peak discharges.

Crossing	Location	HMS_ID	Drainage Area (mi²)	Q_p (cfs) [a]	Capacity (cfs)
CA_01	Calabacillas Arroyo at Southern Blvd	A_112_J2	40	8,068	2,558
CA_02	Tributary D at Southern Blvd	D_104_J1	3	1,175	26
CA_03	Tributary B at Southern Blvd	B_104_J1	6	1,681	182

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

No concern

High concern

Structure capacities were estimated for planning purposes only to establish approximate maximum allowable flow rates. Culvert dimensions were measured during field visits in the winter of 2023/2024 and estimated in GIS using 2018 Lidar-derived elevation data. Capacity analysis was based on the following assumptions:

- Culverts are free of sediment and debris unless otherwise noted in the data tables (see Appendix D); actual capacities may be less than those reported due to sediment accumulation, vegetation, and debris caught at culvert entrances.
- For simplicity, downstream channels were assumed to be trapezoidal with a bottom width and slope equal to that of the culvert crossing and a Manning's n-value of 0.025.
- Overtopping of roadways was not modeled in HY-8. Maximum capacities correspond to maximum upstream water levels before flow starts overtopping the road or break out of the channel upstream of the crossing.

Shading in Table 2.5 and Figure 2.3 indicates if structure capacity is sufficient (green) or insufficient (red). Depth-area reduction was applied by setting the storm area in the meteorological model equal to the corresponding drainage area (see drainage area, Table 2.5).

Existing ponds were evaluated for deficiencies based on existing conditions model runs. Figure 2.3 (circles) shows pond locations in the watershed. The following color scheme was adopted to highlight pond deficiencies based on this analysis:

Green (no concern) – ponds have sufficient capacity.

Red (high concern) – ponds have insufficient capacity and spill onto roadways or private property.

A detailed table with results for all ponds included in the hydrologic models is contained in Appendix B.

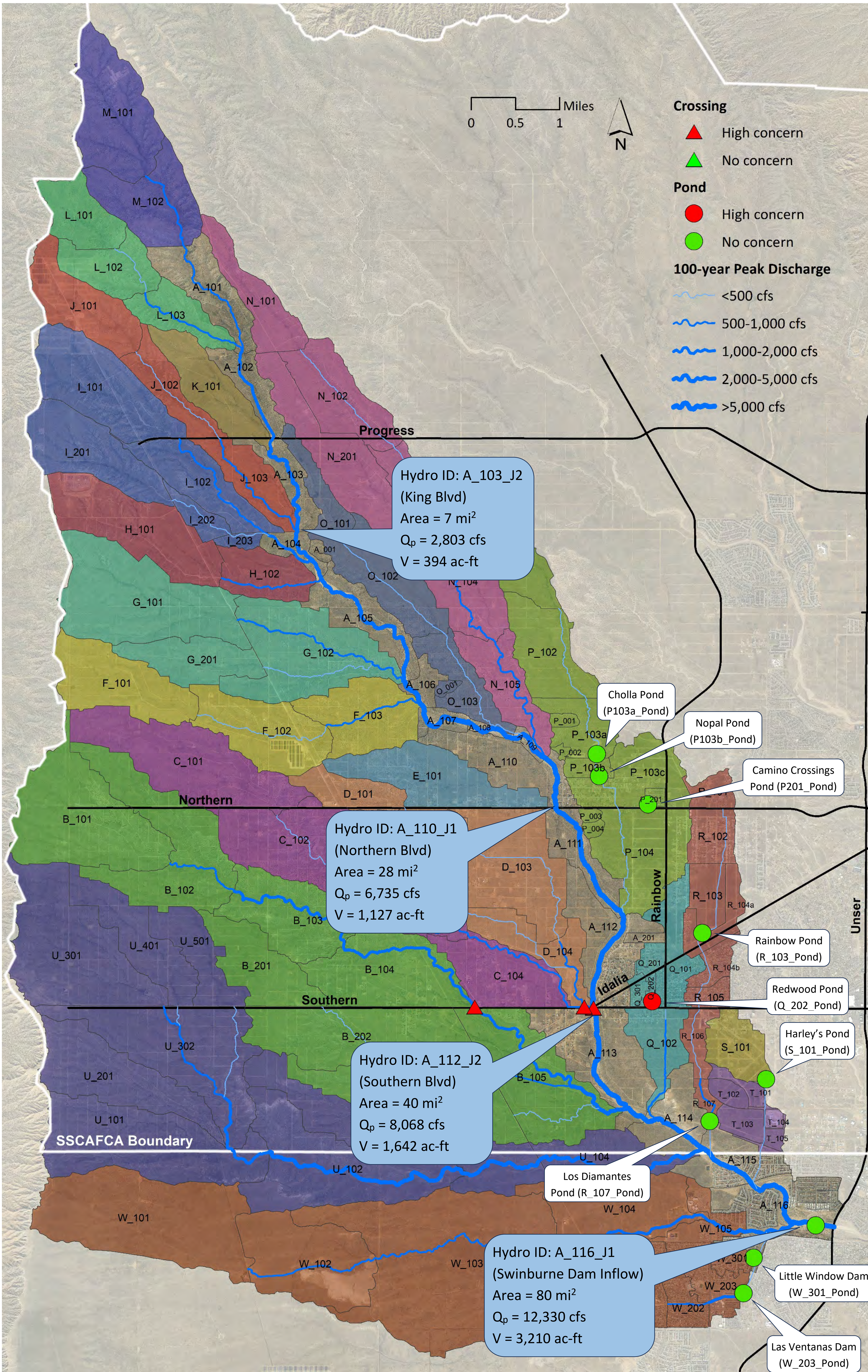

Figure 2.3: Peak discharge and runoff volumes resulting from the 100-yr design storm at selected analysis points.

2.11. Lateral Erosion Envelopes and FEMA Floodplains

Lateral migration is a natural arroyo process and occurs in both urbanized and natural watersheds. 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 and identifies a corridor where properties and infrastructure are potentially at risk from erosion. Figure 2.4 shows mapped lateral erosion envelopes in the Calabacillas watershed (see Appendix F for calculations). In this document, the LEE is delineated for any reach where peak discharge during the 100-year storm is expected to exceed 500 cfs under existing conditions. However, please note that erosion can cause problems and threaten structures and infrastructure in smaller arroyo systems where the LEE has not been calculated. SSCAFCA recommends performing LEE analysis prior to development of any land adjacent to a natural arroyo, regardless of size. Local municipalities may include LEE considerations in their development ordinances (see for example City of Rio Rancho Chapter 152.33 ordinance, flood-related erosion-prone areas). Figure 2.5 shows mapped FEMA floodplains in the Calabacillas watershed. Lateral Erosion envelopes were not delineated for the West Branch (tributary W), as this area falls within AMAFCA jurisdiction.

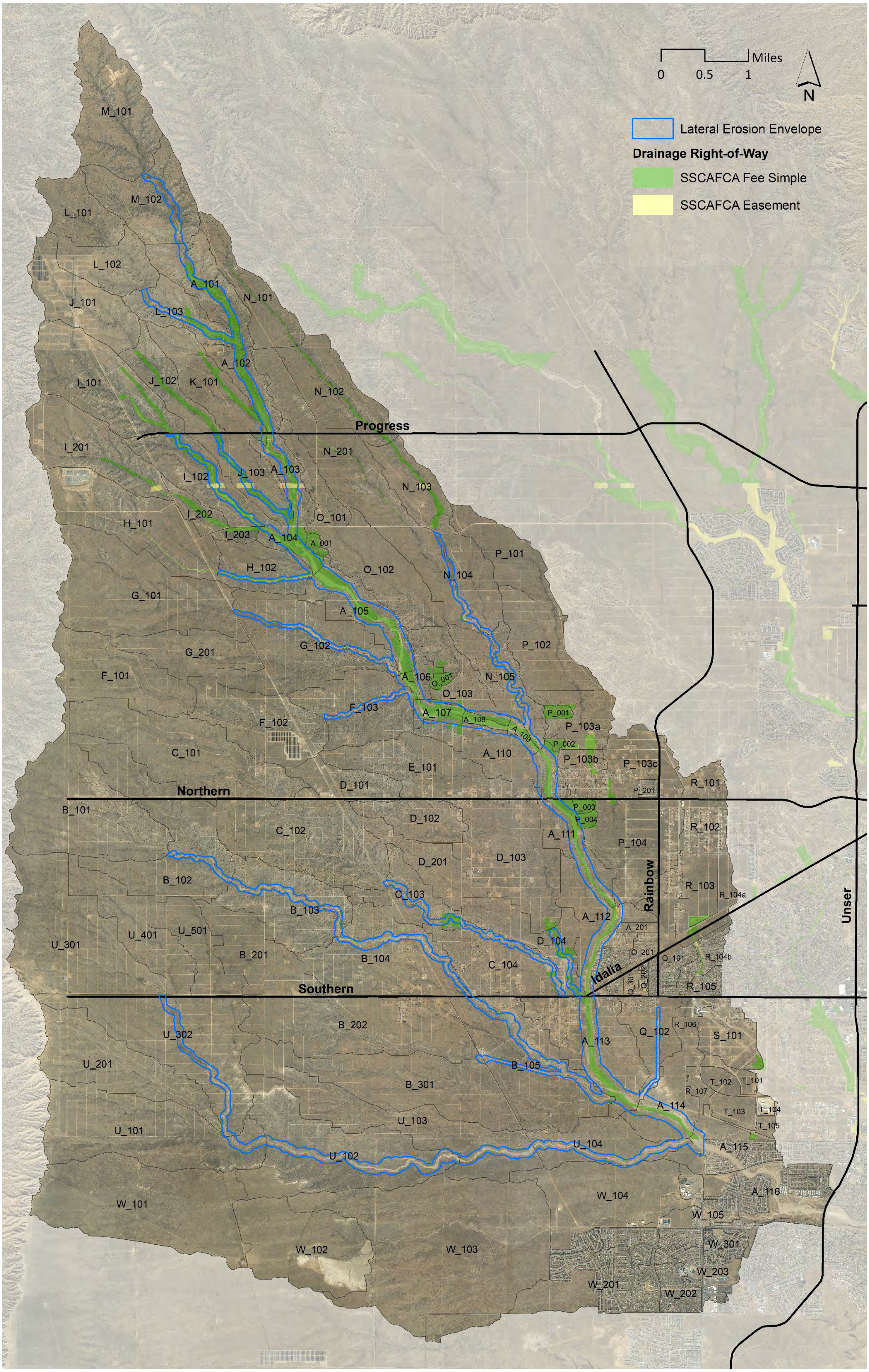

Figure 2.4: Map showing lateral erosion envelopes (blue) and SSCAFCA drainage right-of-way in the Calabacillas watershed.

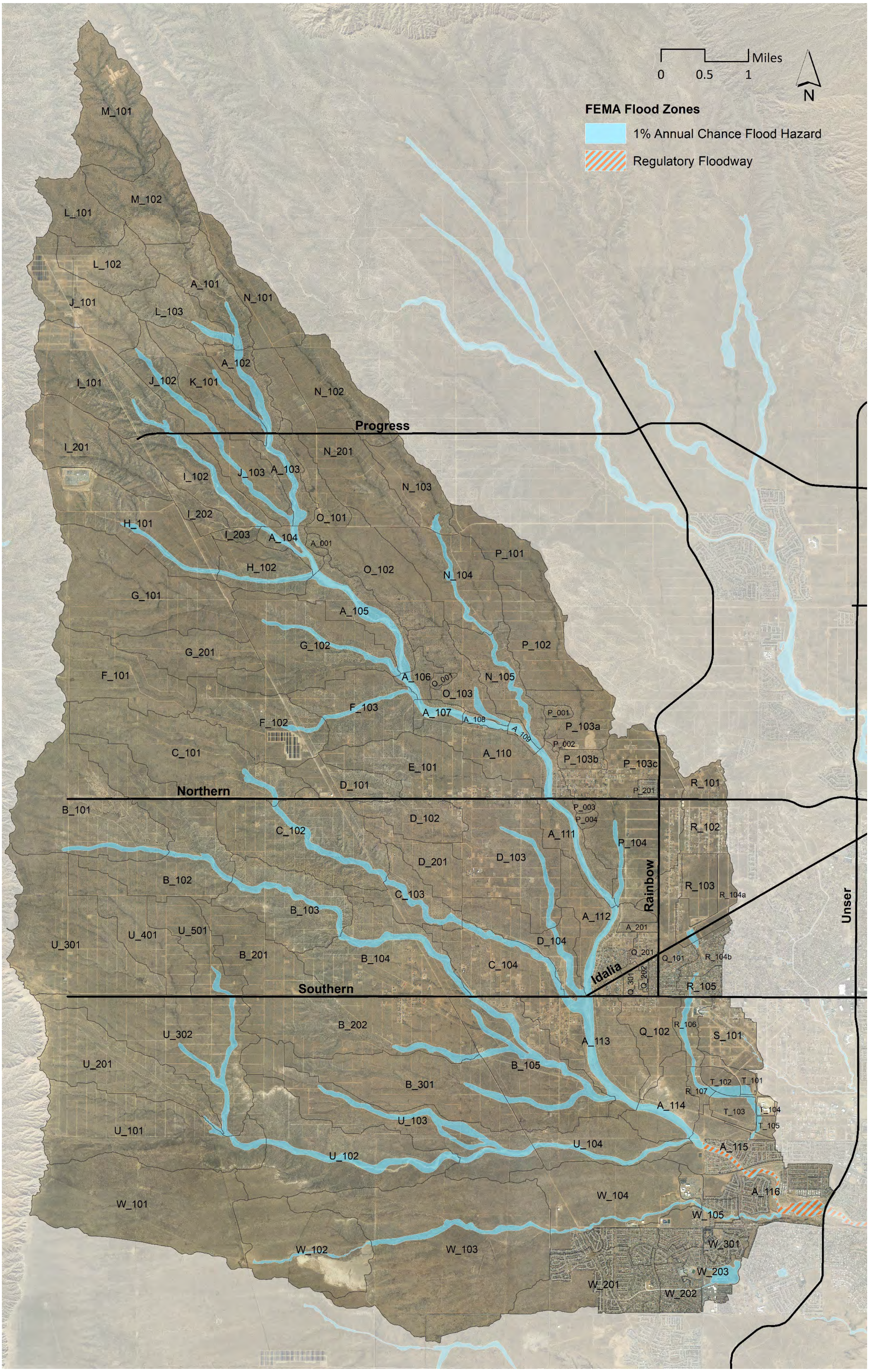

Figure 2.5: FEMA flood hazard zones (red) in the Calabacillas watershed.

3. Proposed Improvements and Recommendations

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 water courses. 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 maintained appropriately. This section discusses proposed solutions to drainage deficiencies described in this study and identifies needs for additional analysis.

3.1. Projects Completed since the last WMP Update

Three regional projects identified in previous watershed management plans have been completed: Rainbow Pond, the Cactus Pond system, and Harley's Pond. The projects are briefly described below.

3.1.1. Rainbow Pond

The Rainbow Pond project was designed by SSCAFCA and constructed in 2018. The project accomplishes two goals:

(1) The pond attenuates runoff resulting from the 1% annual chance storm and discharges at a rate not exceeding downstream capacity constraints.
(2) Pond outflow is safely conveyed through a newly constructed channel to the existing Rainbow channel located south of Vancouver Rd.

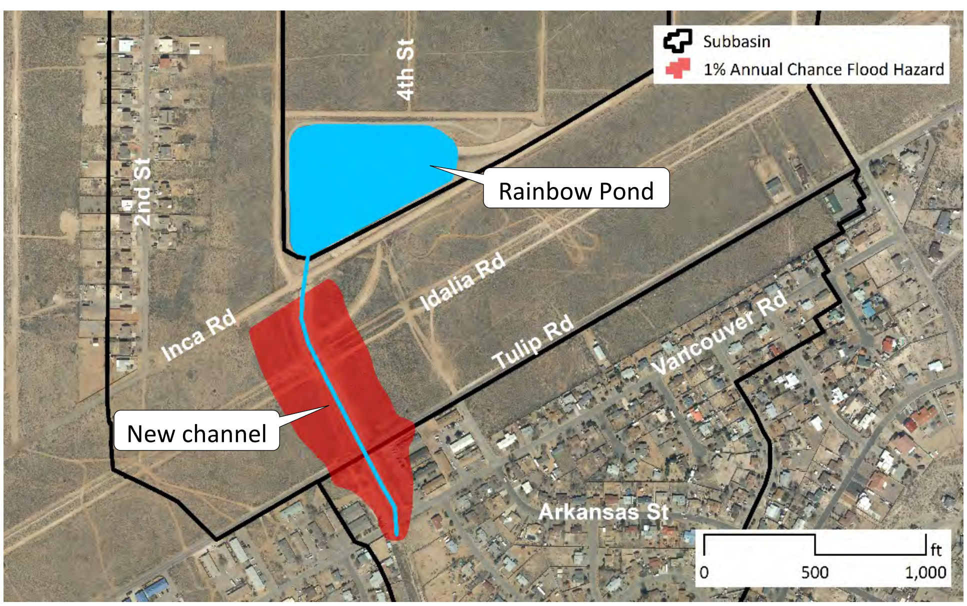

Figure 3.1: Map of Rainbow Pond and channel in tributary R of the Calabacillas watershed.

Figure 3.1 shows an overview map of the Rainbow Pond project. Included on the map is the FEMA 1% annual flood hazard zone (red). Construction of the Rainbow Pond project now safely conveys runoff through the newly constructed channel, eliminating flooding concerns in this area. An aerial view of the completed project is included in Figure 3.2.

Figure 3.2: Aerial view of the completed Rainbow Pond project looking downstream.

3.1.2. Cactus Pond System

The Cactus Pond system was built in response to deficiencies identified in the previous version of the Calabacillas WMP. The project was designed by Stantec (Easterling, 2019) and constructed in 2020. An overview map of the project area is included in Figure 3.3. The project consists of two ponds: the larger Cholla Pond intercepts runoff from the contributing upstream basin and attenuates peak flow from storms up to the 100-year 24-hour event. Runoff then flows through an open channel to the smaller Nopal Pond, where it enters a newly constructed storm drain system that conveys floodwaters to the natural channel downstream of Northern Blvd. Construction of the project alleviates flooding concerns for the residential area north of Northern Blvd Figure 3.4 shows an aerial view of the Cactus Ponds system.

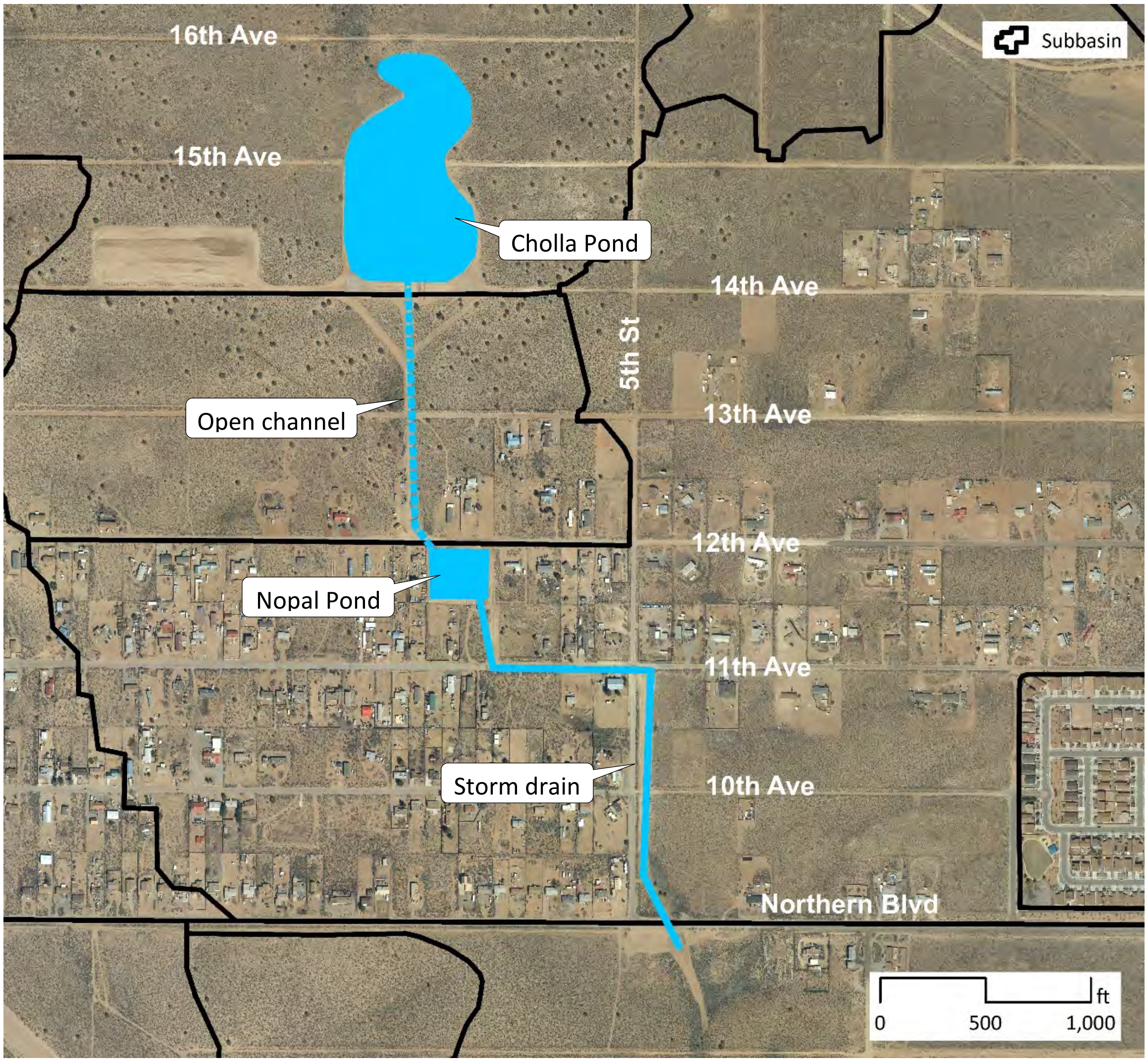

Figure 3.3: Overview map of the Cactus Pond project.

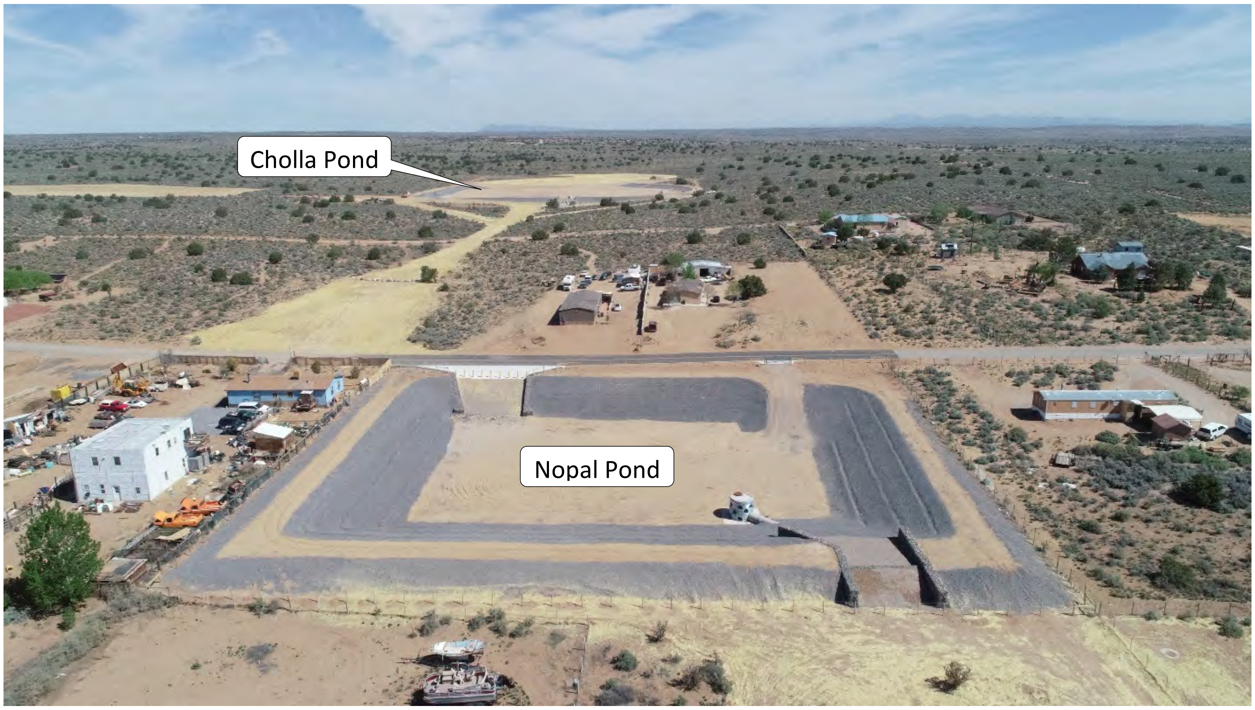

Figure 3.4: Aerial view of the Cactus Pond system looking north.

3.1.3. Harley's Pond

Harley's Pond (previous Tributary A Dam) is located in the Black Arroyo watershed, immediately adjacent and just to the east of the Calabacillas watershed. The location was first identified as a recommended flood control facility in the original Black Arroyo Watershed Management Plan (SSCAFCA, 2002) to decrease the risk of flooding in the downstream drainage system. Historically, runoff from the basin draining to Harley's Pond flowed east in a natural arroyo paralleling Vargas Rd until joining the Black Arroyo just upstream of Unser Blvd (see Figure 3.5). The pond was designed by RESPEC Inc. and constructed in 2021. An outfall storm drain sized to convey discharge up to the 1% annual chance storm was constructed south along 10th St (Figure 3.5) and connects to the existing storm drain under the Saltillo subdivision, ultimately discharging to the Calabacillas Arroyo just downstream of McMahon Blvd. Runoff from to the 100-year storm is therefore diverted from the Black Arroyo to the Calabacillas Arroyo. Discharge resulting from storms exceeding the 100-year design storm will flow over the pond's emergency spillway (Figure 3.6) and continue down the historic flow path.

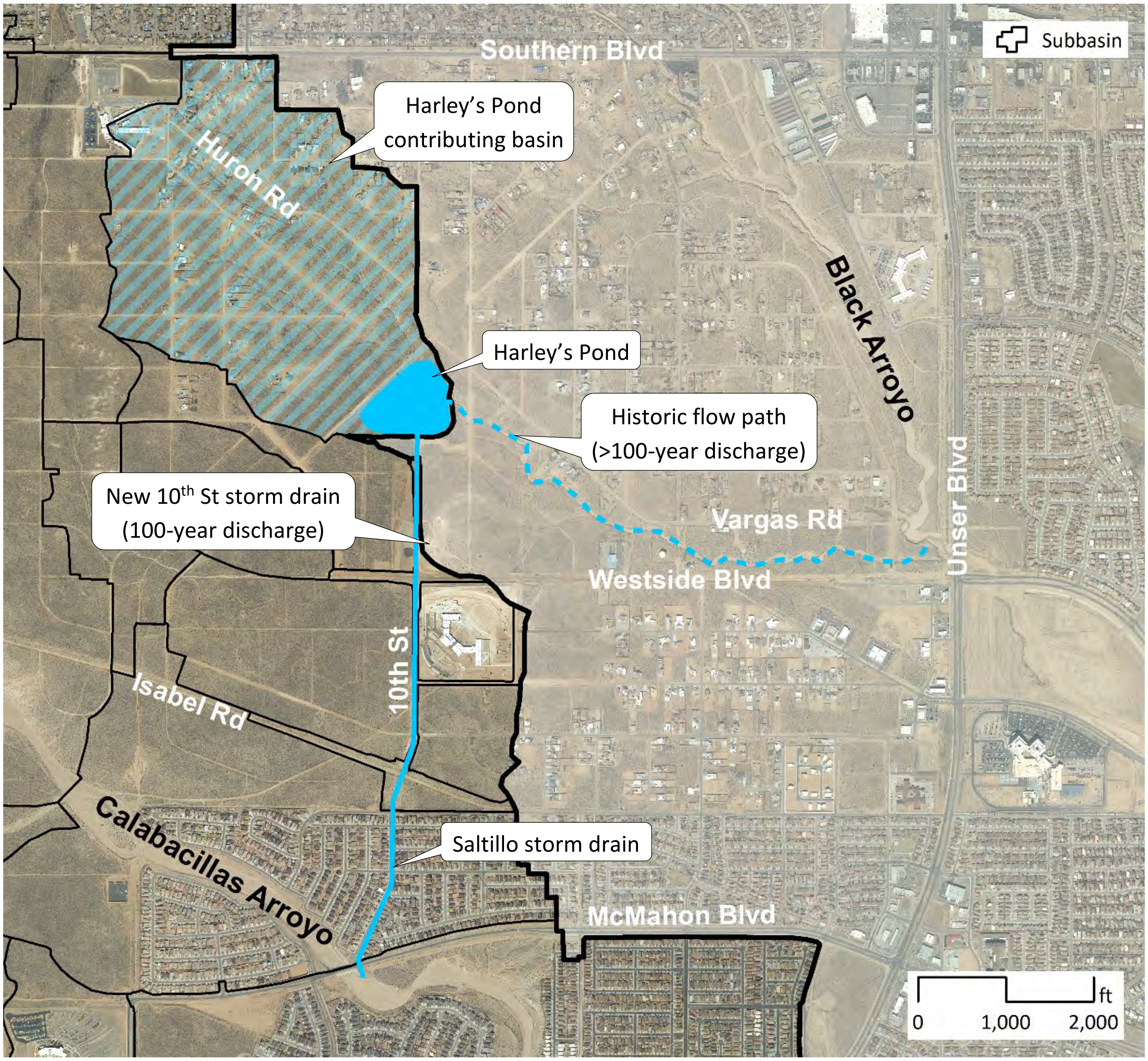

Figure 3.5: Overview map of Harley's Pond.

Figure 3.6: Aerial view of Harley's Pond looking south.

3.2. Required Drainage Improvements

Despite substantial progress since the last watershed management plan update, several drainage concerns remain; they are addressed in detail below.

3.2.1. Northern Blvd Crossing of the Calabacillas Arroyo

Northern Blvd crosses the Calabacillas Arroyo at grade. Any storm flows in the arroyo have to cross the roadway, and no signage currently exists to warn motorists of the potential dangers of crossing flowing water. Storm flows also frequently cause damage to the road surface as can be seen in Figure 3.7.

The 100-year peak discharge at this location is estimated at 6,735 cfs under existing conditions. Please note that this flow rate is based on a model run with a depth-area reduction factor appropriate for the 28 square mile contributing area upstream of the road crossing.

Recommendations for improvement include construction of a road crossing structure sized to safely pass the predicted 100-year peak discharge. In the interim, signage warning drivers not to cross the arroyo when water is present should be installed on both east- and westbound lanes.

Figure 3.7: Damage to Northern Blvd caused by a storm event that occurred on September 13, 2013.

3.2.2. Southern Blvd Crossing of the Calabacillas Arroyo

The road crossing of the Calabacillas Arroyo at Southern Blvd consists of five 8-ft wide by 6-ft high concrete box culverts with an estimated total capacity of 2,558 cfs. The effective capacity may be lower due to sediment accumulation and debris obstructing flow at the culvert entrance. The estimated 100-year peak discharge at this location is 8,068 cfs. Please note that this flow rate is based on a model run with a depth-area reduction factor appropriate for the 40 square mile contributing area upstream of the road crossing.

There is at least one recorded incident of stormwater overtopping Southern Blvd – during the storm of September 13, 2013 (Figure 3.8). A flow gauging station further downstream at Swinburne Dam indicated peak flows of approximately 1,300 cfs during the storm event. The crossing at Southern Blvd likely overtopped due to a combination of sediment accumulation in the culvert and debris caught on the upstream side.

Recommendations for improvement at the Southern Blvd crossing include replacement of the structure with a crossing sized to safely pass the predicted 100-year peak discharge. In the interim, signage warning drivers not to cross the arroyo when water is present should be installed on both east- and westbound lanes.

Figure 3.8: Storm flows overtopping Southern Blvd during the event of September 13, 2013. (Source: KOAT News).

3.2.3. Southern Blvd Crossing of Tributary B

The upper portion of tributary B (approximately 5.5 mi^2) crosses Southern Blvd through a set of four corrugated metal pipe culverts between 18th Street and 20th Street. The crossing structure has an estimated capacity of 182 cfs. Results from the hydrologic model indicate that 100-year peak discharge at this location is 1,681 cfs. Please note that this flow rate is based on a model run with a depth-area reduction factor appropriate for the 6 mi^2 contributing area upstream of the road crossing. The crossing is severely undersized; flows in excess of the culvert capacity are expected to overtop the roadway. Given the topography of the location, a portion of the runoff will likely flow eastward along Southern Blvd (Figure 3.9), causing erosion along the roadway and exacerbating deficiencies that exist downstream (see section 3.2.4 below).

Recommendations for improvement at the Southern Blvd and tributary B include replacement of the structure with a crossing sized to safely pass the predicted 100-year peak discharge. In the interim, signage warning drivers not to cross the arroyo when water is present should be installed on both east- and westbound lanes.

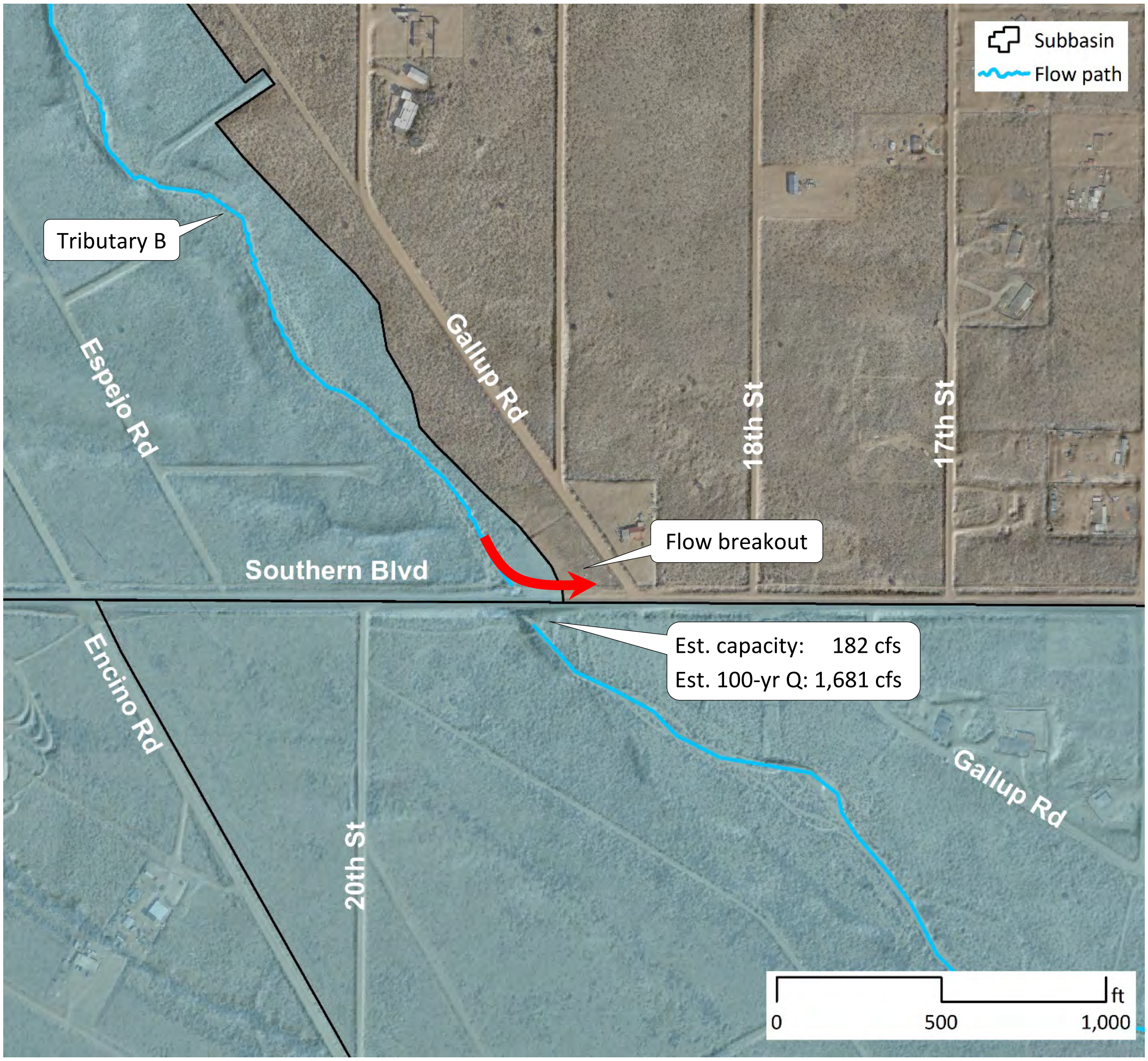

Figure 3.9: Overview map showing the location where tributary B crosses Southern Blvd.

3.2.4. Southern Blvd Crossing of Tributaries C and D

The historic flow path of tributary C has been obstructed by Southern Blvd. Culverts that used to convey some of the runoff under the roadway are completely filled with sediment. Moreover, residential housing has been constructed in the former flow path south of Southern Blvd. Under current conditions, runoff from tributary C will flow eastward along the north side of Southern Blvd towards the Calabacillas Arroyo. During large events, a portion of storm flows may cross the roadway and cause flooding and erosion downstream.

Tributary D intersects Southern Blvd just west of the Calabacillas Arroyo. The crossing structure consists of two 24-inch diameter corrugated metal pipes with an estimated capacity of 26 cfs. The estimated peak flow rate from tributary D during the 100-year storm is 1,175 cfs (Please note that this flow rate is based on a model run with a depth-area reduction factor appropriate for the 3 mi^2 contributing area upstream of the road crossing). Flows at this location may be even larger due to runoff from tributaries C and B.

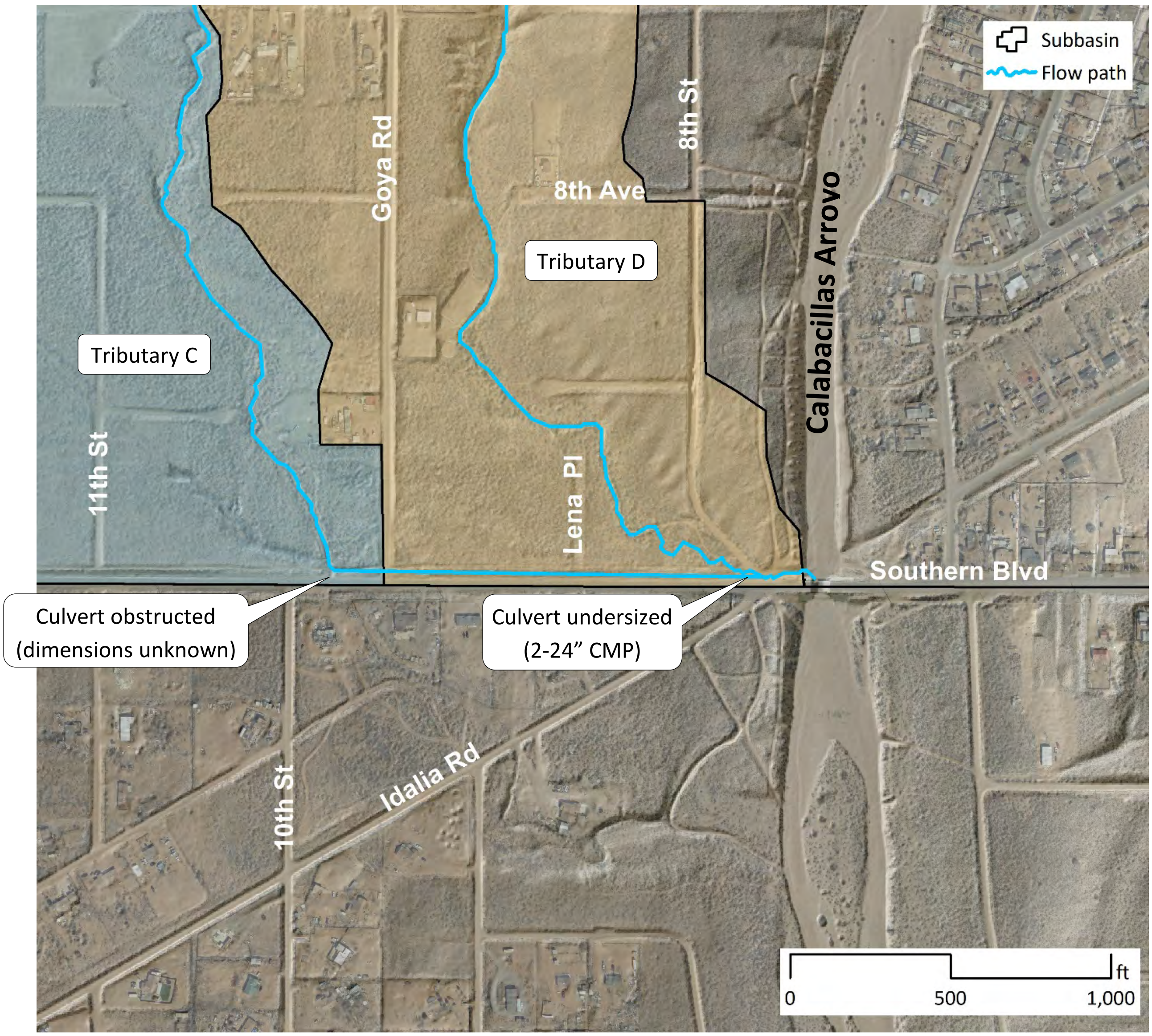

Figure 3.10: Overview map show the location where tributaries C and D intersect Southern Blvd.

In a design analysis report completed by Smith Engineering for SSCAFCA (Lopez, 2022), two alternative solutions to the drainage problems at Southern Blvd were analyzed, including a detention pond and storm drain along 8th Ave., and a roadside diversion channel along Southern Blvd. The latter was recommended as the more cost-effective solution. Smith

Engineering is currently working on the design of the pond and channel, which is expected to be completed in the summer of 2024.

3.2.5. Santa Fe Junction

The Santa Fe Junction, operated by New Mexico Gas Company, is a major distribution point for natural gas infrastructure. The facility has been constructed in the former flow path of an arroyo with an upstream drainage area of approximately 2 mi^2. The facility is also partially within FEMA Flood Zone A. Estimated peak discharge at this location is 648 cfs. Please note that this flow rate is based on a model run with a depth-area reduction factor appropriate for the 2 mi^2 contributing area. With the exception of a non-engineered berm, no structures currently exist to protect the facility from flooding and erosion during a large storm event.

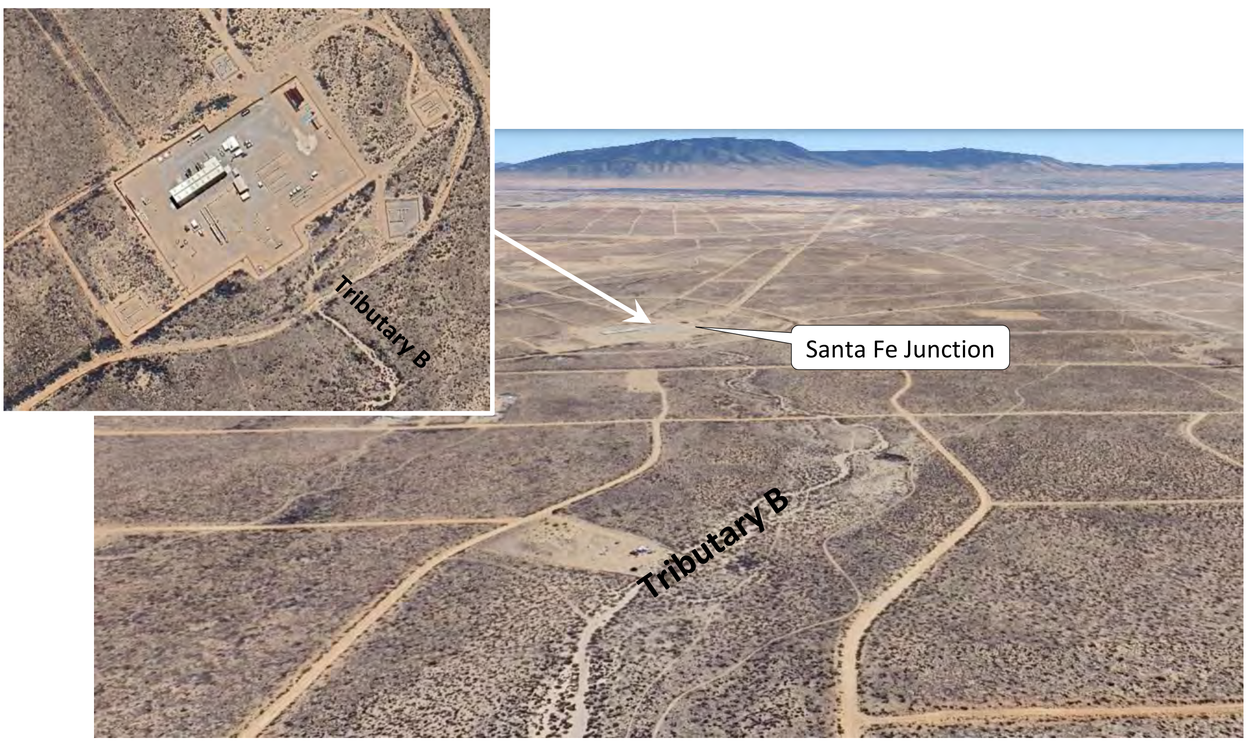

Figure 3.11: Aerial view of tributary B intersecting the Santa Fe Junction, a major distribution point for natural gas infrastructure in New Mexico (Source: Google Earth).

Given the importance of the Santa Fe Junction for natural gas supply to the State of New Mexico, it is strongly recommended to design and construct improvements to safely convey stormwater runoff around the facility without causing flooding and erosion damage. Improvements should be sized to accommodate at least the 100-year peak flow rate, or possibly a higher standard of protection, given the critical nature of this facility.

3.2.6. Bank Erosion and Flooding, Northern Blvd

Several residential properties have been developed along the left (east) bank of Calabacillas Arroyo upstream of Northern Blvd. Due to their proximity to a major arroyo with projected peak flows of 6,735 cfs, these properties are at risk from flooding and erosion. Hydraulic analysis conducted as part of the previous watershed management plan (SSCAFCA, 2015) showed that during the 100-year storm, a portion of the runoff will flow east along Northern Blvd to approximately Hondo Rd before turning south and rejoining the main stem of the arroyo further downstream. This can cause flooding to existing homes along Northern Blvd between 10th St and Hondo Rd.

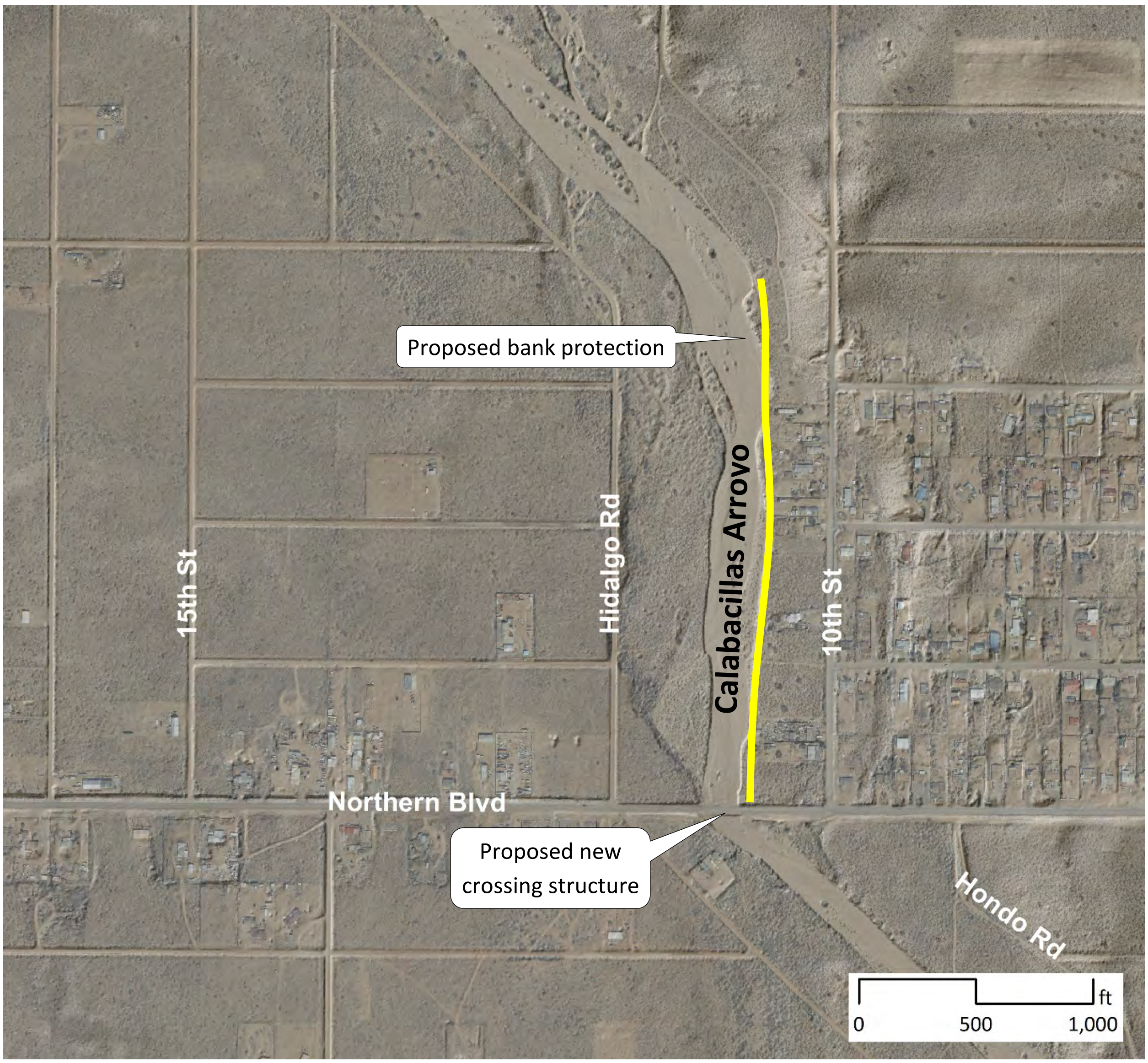

Figure 3.12: Overview map of the Calabacillas Arroyo north of Northern Blvd where residential properties have been developed immediately adjacent to the arroyo.

The proposed solution is design and construction of channel improvements upstream of Northern Blvd that would prevent bank erosion and provide flood protection for adjacent properties, in conjunction with design and construction of a crossing structure at Northern Blvd (see section 3.2.1 above).

3.2.7. Bank Erosion and Flooding, Southern Blvd

Similar to conditions at Northern Blvd, several residential properties have been developed along the left (east) bank of Calabacillas Arroyo upstream of Southern Blvd.

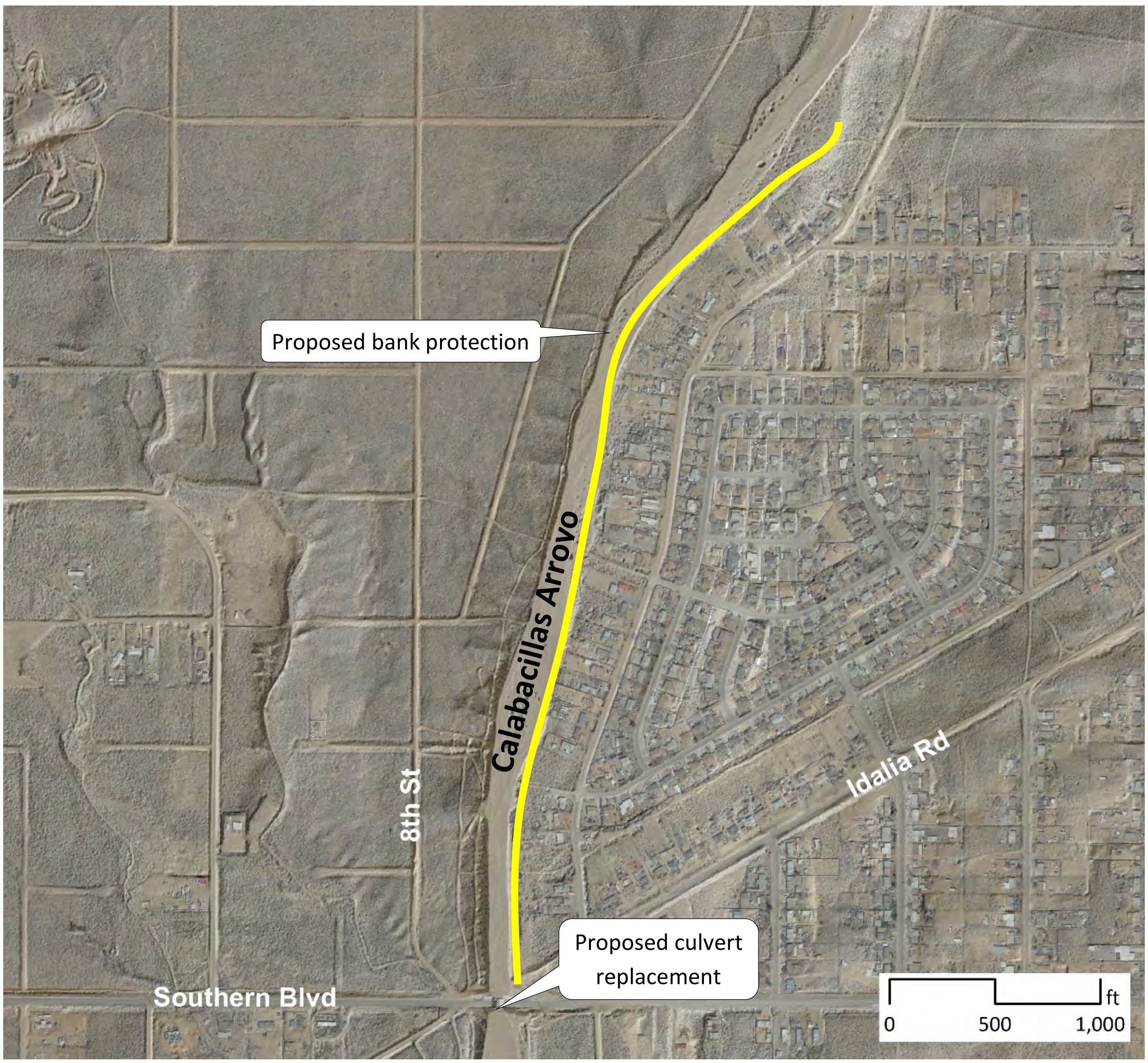

Figure 3.13: Overview map of the Calabacillas Arroyo north of Southern Blvd where residential properties have been developed immediately adjacent to the arroyo.

Due to their proximity to a major arroyo with projected peak flows of 8,068 cfs, these properties are at risk from flooding and erosion. Insufficient capacity of the crossing structure at Southern Blvd causes ponding upstream of the road embankment and exacerbates the flooding concerns upstream of Southern Blvd. Proposed improvements include re-design and replacement of the crossing structure at Southern Blvd (see section 3.2.2 above) in conjunction with bank armoring along the left (east) bank of the arroyo to prevent lateral migration and provide flood protection for adjacent properties.

3.2.8. Future Regional Stormwater Detention Facilities

The previous watershed management plan (SSCAFCA, 2015) identified several sites along the future alignment of Paseo del Volcan as suitable locations for future regional stormwater detention facilities. Two such locations are included below: Figure 3.14 shows the location of a potential future dam on the main stem of the Calabacillas Arroyo at 20th St. A conceptual design for this facility was completed by Bohannan Huston Inc. (Wine and Hoover, 2014). Figure 3.15 displays the footprint of a potential future facility along tributary C (conceptual layout completed by SSCAFCA).

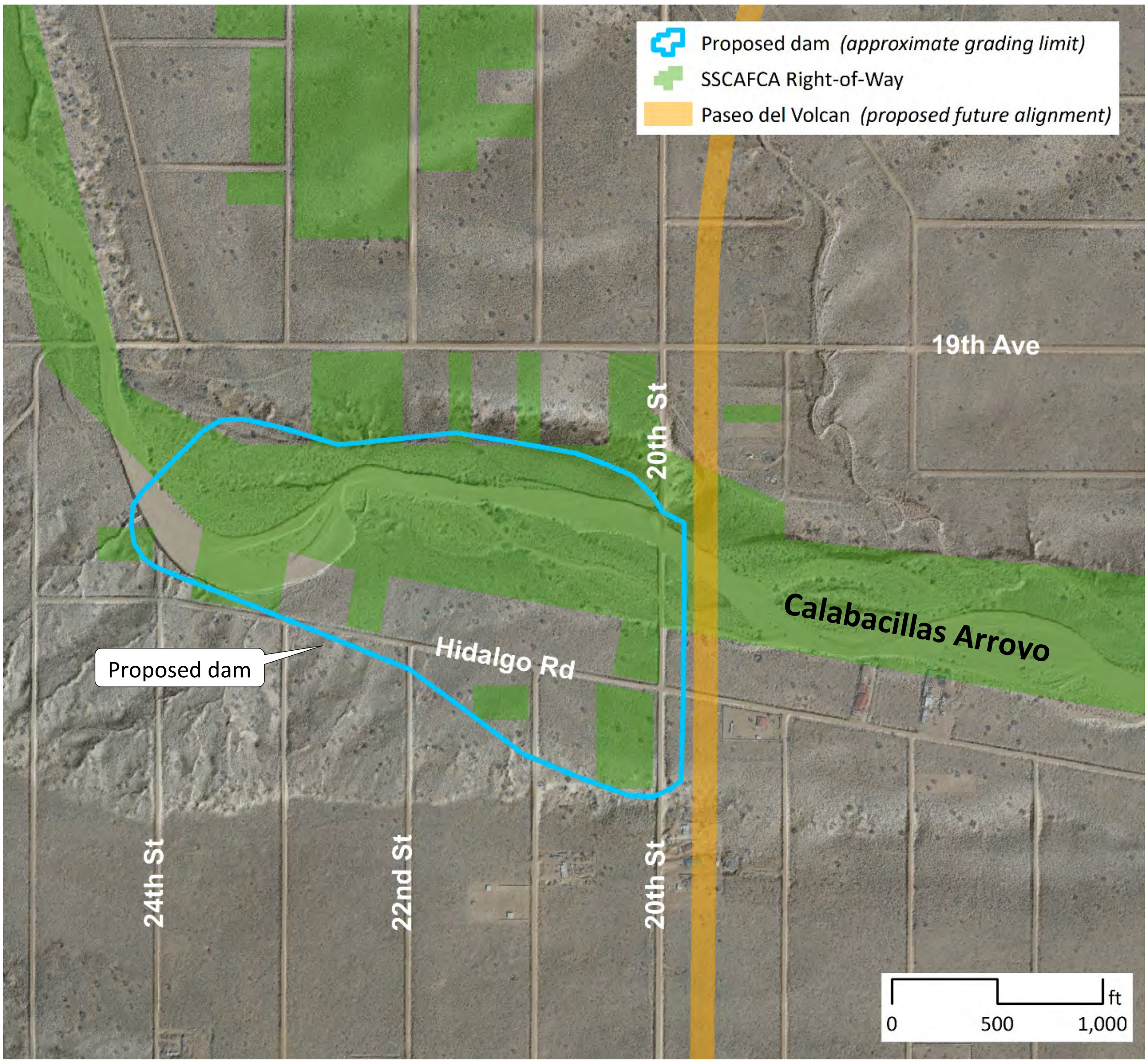

Figure 3.14: Overview map showing the approximate footprint of the proposed Calabacillas Dam on the main stem of the Calabacillas Arroyo.

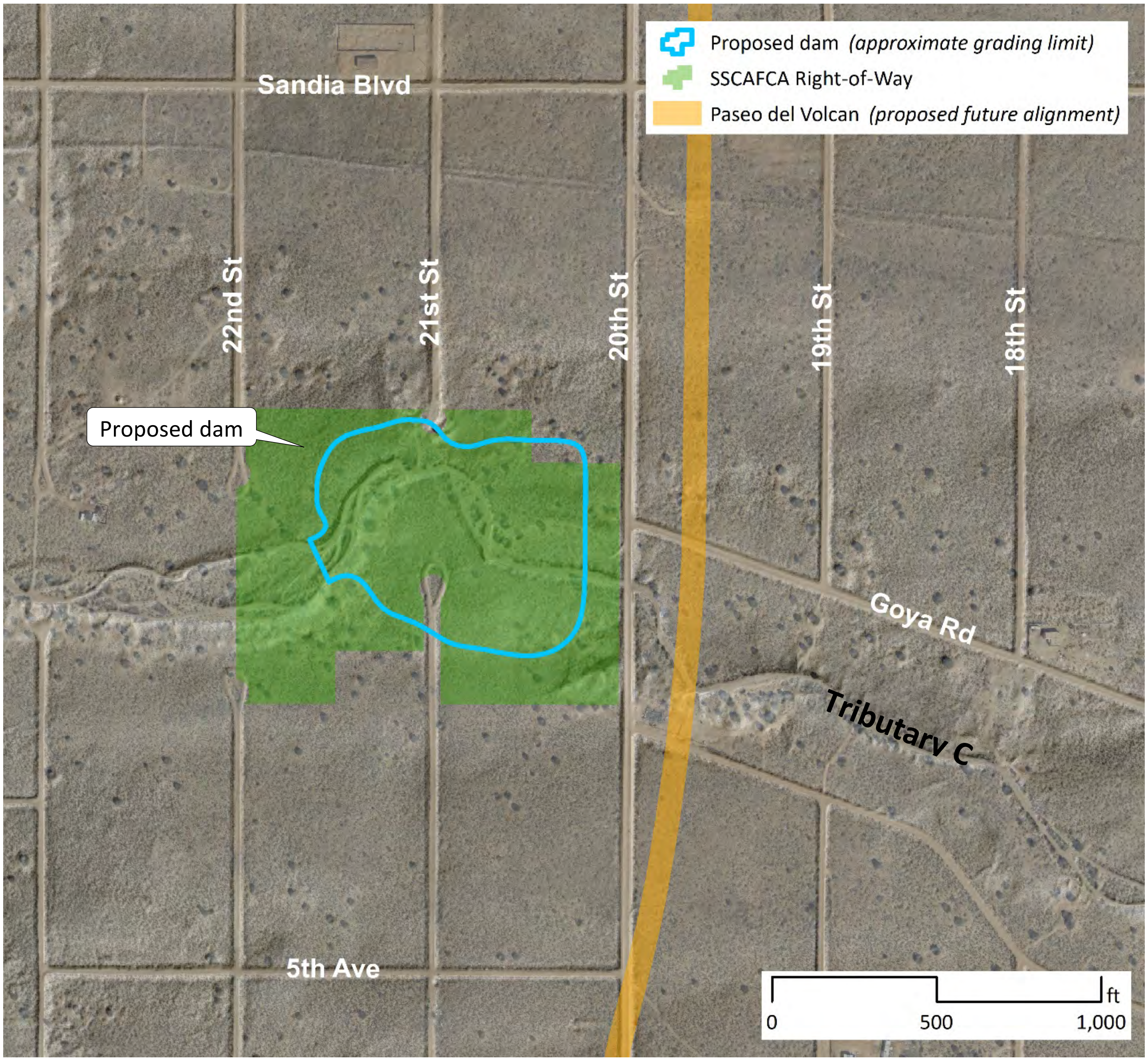

Figure 3.15: Overview map showing the approximate footprint of a potential future regional stormwater detention facility along tributary C.

Current analysis indicates that at present, no additional regional stormwater detention facilities are required in the watershed. Current infrastructure deficiencies are best addressed through replacement of individual crossing structures and localized bank protection. Future urbanization in the watershed should minimize downstream effects by complying with local drainage ordinances and constructing drainage infrastructure sized to reduce discharge to historic conditions. Nevertheless, any planning document is associated with different sources of uncertainty. Hydrologic models are constructed based on the best available data, but simulations are subject to uncertainty due to model structure and parameter estimation.

Climate change may impact future storm intensities and magnitudes, with the potential to exacerbate flooding concerns. Unplanned urban development (i.e. residential lots developed individually rather than as part of a master planned subdivision) is not subject to the same drainage requirements and can therefore increase flooding concerns. Given these sources of uncertainty, it is prudent for SSCAFCA to plan for potential future regional facilities and acquire necessary rights-of-way. This will give the agency the flexibility to construct a facility in the future, should the need arise. The only recommended action with regard to regional stormwater detention facilities is therefore to complete land acquisition for the proposed Calabacillas Dam (Figure 3.14).

3.3. Arroyo Preservation

In December 2021, the SSCAFCA Board of Directors adopted a resolution to include conservation of natural arroyo beds as corridors of infiltration and groundwater recharge as an integral component of flood control systems owned and operated by the agency (SSCAFCA, 2021b). The resolution is based on research showing that focused infiltration in ephemeral channels is a crucial source of groundwater recharge in many dryland watersheds (Goodrich et al., 2018; Shanafield and Cook, 2014; Constantz et al., 2002; Coes and Pool, 2005). Major arroyos within SSCAFCA's jurisdiction likely provide this important ecosystem service (Schoener, 2022) and should therefore be protected wherever feasible. Preservation of ephemeral channels requires foresight and planning. In urbanizing areas, land is a finite and valuable resource. If seen as mere conduits for runoff, ephemeral streams will likely be transformed into concrete channels or pipes, the hydraulically most "efficient" means for moving water downstream while occupying the smallest possible footprint. Strategies for preserving focused infiltration in ephemeral channels include designation of a buffer zone to allow space for lateral migration. In cases where existing infrastructure is already encroaching, strategic use of bank armoring and grade control structures to limit lateral and vertical movement is preferrable to channel lining. In the Calabacillas watershed, strategic purchase of drainage right-of-way will be critical to achieve the important goal of preserving permeable channel beds from lining. Insufficient public drainage right-of-way exists along many major arroyo reaches. Lateral erosion envelopes may be used as a guide for identifying priorities for land acquisition.

3.4. Water Quality

As land use changes due to urbanization, stormwater runoff quality is adversely impacted. Nearly all of the associated water quality issues result from one underlying cause: loss of the water-retaining and evapotranspiration functions of the soil and vegetation in the urban landscape. Increases in impervious cover result in increased runoff volume and frequency, transporting ever greater quantities of pollutants and sediment to the arroyos and the Rio Grande in short, concentrated bursts of high discharge. When combined with the introduction of pollutant sources from urbanization (such as trash, motor vehicle fluids, domesticated animal waste, and household hazardous waste), these changes in hydrology have led to water quality and habitat degradation in many urban streams.

The Federal Clean Water Act contains provisions to address control of pollution in stormwater through promulgation of the National Pollutant Discharge Elimination System (NPDES). Under this program, entities responsible for the discharge of municipal stormwater runoff to waters of the United States are regulated through an NPDES permit issued by the Environmental Protection Agency. Under the conditions of the NPDES permit, each entity must conduct stormwater quality management activities that seek to reduce pollutant levels in stormwater runoff to the maximum extent practicable. The pollutants of concern are established by the New Mexico Environment Department and are indicated as impairments to the Rio Grande when the state-established water quality standard is exceeded.

Stormwater quality management has not historically been a formal part of the mission of SSCAFCA. The importance of SSCAFCA's facilities in the management and conveyance of water resources in the region and SSCAFCA's dedication to watershed stewardship have expanded the role of SSCAFCA to include water quality. This reinforces elements of SSCAFCA's overall mission to preserve the natural character of the arroyos, provide multi-use and quality-of-life opportunities for lands controlled by SSCAFCA, and to control sediment transport and erosion. The Rio Grande is also viewed as a valuable resource for residents of the jurisdiction including the flora and fauna of riparian and arroyo corridors.

SSCAFCA, along with the City of Rio Rancho (CoRR) and Sandoval County, were identified as regulated entities under the NPDES in 2006. SSCAFCA submitted the latest Stormwater Management Plan (SWMP) on November 27, 2019. Under the permit, SSCAFCA is required to:

- Reduce the discharge of pollutants to the "maximum extent practicable" (MEP)
- Protect water quality
- Satisfy the appropriate water quality requirements of the Clean Water Act

These requirements are accomplished through six minimum control measures:

- Public education and outreach
- Public participation/involvement
- Illicit discharge detection and elimination
- Construction site runoff control
- Post-construction runoff control

- Pollution prevention/good housekeeping

Details of the requirements and activities completed by SSCAFCA under the permit can be found on our website, www.sscafca.org. Regional best management practices planned in the Calabacillas watershed to help reduce potential sediment and pollutants in stormwater runoff include:

- SSCAFCA, in cooperation with the CoRR, has implemented a policy that requires subdivision-scale residential as well as commercial and industrial developments to provide operation and maintenance of on-site stormwater quality facilities to treat the runoff from a 0.6 in, 6-hour storm event prior to discharge to a public facility (see CoRR Development Process Manual and CoRR Chapter 153 Ordinance for details)
- Naturalistic channel treatments (unlined channels, stabilized with bank protection and drop structures where necessary) will be utilized wherever feasible to slow down the velocity of stormwater runoff and promote infiltration into channel bed sediments
- Water quality treatment mechanisms will be incorporated in the design of all regional stormwater detention facilities.

All three regional stormwater detention facilities constructed in the watershed since publication of the last WMP incorporate water quality features designed to remove floatables using inverted ported riser outlet structures.

3.5. Quality of Life

SSCAFCA has long recognized that land owned and operated by the authority has multi-use potential when not in use to actively convey stormwater. The original quality-of-life master plan (SSCAFCA, 2006) laid the foundation for a comprehensive, connected system of multi-use areas along arroyos within SSCAFCA's jurisdiction. The plan was updated in 2022 and includes a series of focused actions in the short term, as well as long-range projects, organized by watershed (SSCAFCA, 2022b). The Calabacillas watershed contains a large segment of the planned Outer Loop Trail, a long-distance trail loop using arroyo corridors for both trail alignment and maintenance access. For additional details, the reader is referred to the quality-of-life plan, which can be found on SSCAFCA's website (www.sscafca.org).

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