8. Rio Verde Wildlife Corridor and Pedestrian Trail Report

McDowell Sonoran Preserve Commission | November 5, 2026

Rio Verde Wildlife Corridor Preliminary Study & Costing Plan

- Key City Code Chapter 21 Provisions:
  - Sec. 21-2 (a): Maintaining the Preserve as habitat for wildlife.
  - Sec. 21-2 (1): Preserving the local plants, wildlife and natural resources to maintain the biological diversity and long-term sustainability of the area's ecology.
  - Sec. 21-2 (9): Developing a non-paved public trail system for hiking, mountain biking, bicycling and horseback riding and link these trails, where appropriate, with other city and regional trails.
- The Rio Verde Wildlife Corridor and Pedestrian Trail Study supports these purposes.

CITY OF SCOTTSDALE

Project Overview

- Last fiscal year, the City contracted Kimley-Horn and Associates to prepare a feasibility study for a wildlife corridor and pedestrian trail across Rio Verde Drive.
- The project is funded through the Preservation Fund and is included in the City's capital budget.
- The feasibility study is supported by data analysis from the Arizona Game and Fish Department and the McDowell Sonoran Conservancy.

CITY OF SCOTTSDALE

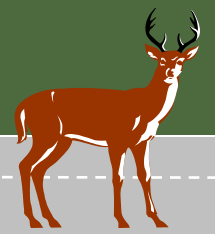
Wildlife Crossings and Connectivity

Jeff Gagnon

Arizona Game and Fish Department

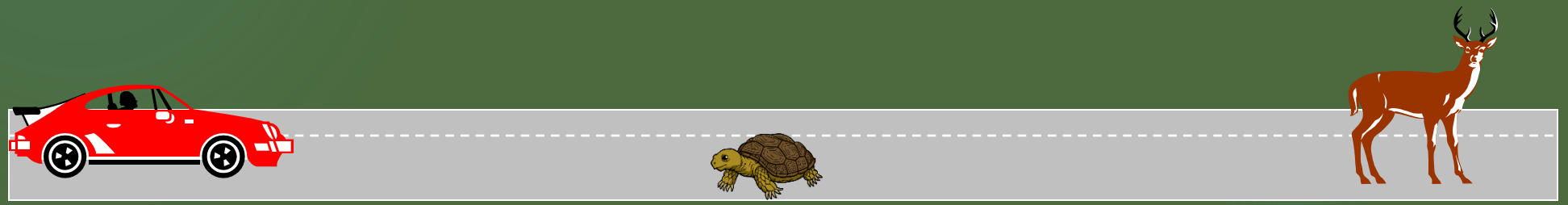




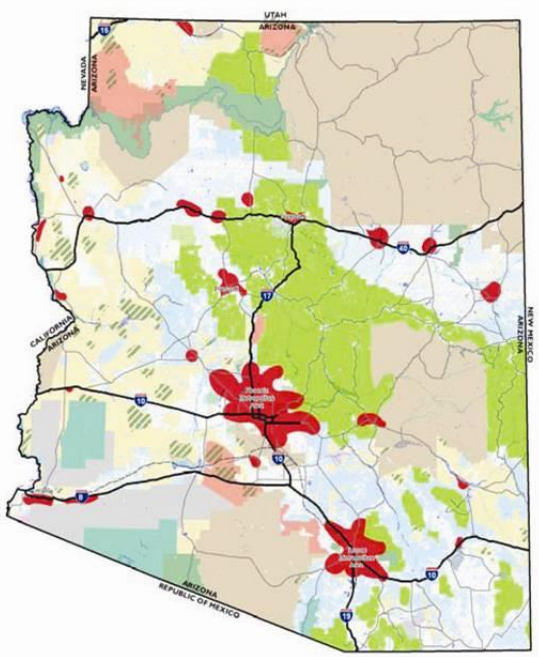


Presentation Objectives

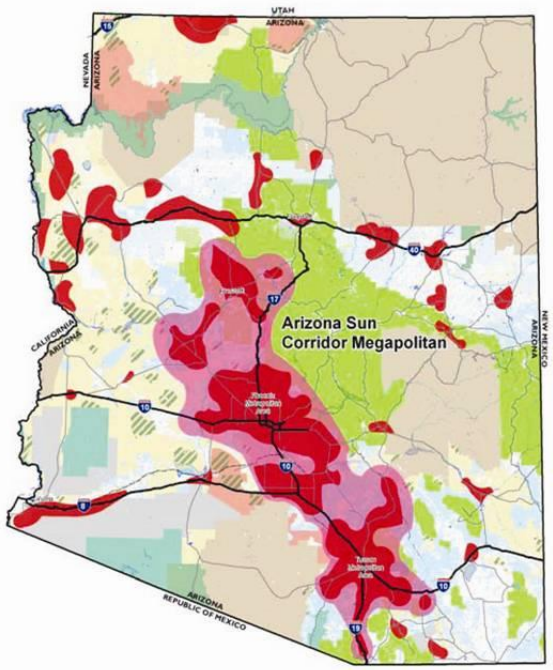
- Wildlife and Roads
- SR 77 Urban Desert Case Study
- Connectivity in the Scottsdale Area



Arizona's Potential for Growth



2005 Growth Areas
Population: 5.1 million



2050 Growth Areas
Population: 14.1 million

Direct Mortality



1-2 million large animals/year



>100% increase over 10 yrs

1 million vertebrates/day



Crime/Emergency Services

cvbugle.co

Man killed avoiding elk

A two-vehicle collision resulted in death at milepost 299.4 on Interstate-17 Wednesday night. A red 2001 Saturn four-door SUV was northbound on I-17 about just before 9 p.m. when it struck an elk in the roadway. The collision with the animal caused the passenger car to veer into the path of a tractor-trailer truck and roll over. The semi driver pulled into the emergency lane and the driver of the Saturn, Matthew Manegold, 28, of Flagstaff and another male passenger were able to get out of the car that had come to rest in the slow speed lane. Manegold was still standing in the traffic lane when he was struck by a second commercial vehicle that was also attempting to avoid the elk carcass. Manegold was pronounced dead at the scene.

A second rollover not far away on the interstate an hour later, but the driver who was wearing seatbelts refused medical care.

>200 human fatalities/year







30,000 vertebrates/yr SNP



HABITAT FRAGMENTATION

HIGHWAY IMPACTS TO WILDLIFE
Indirect Impacts



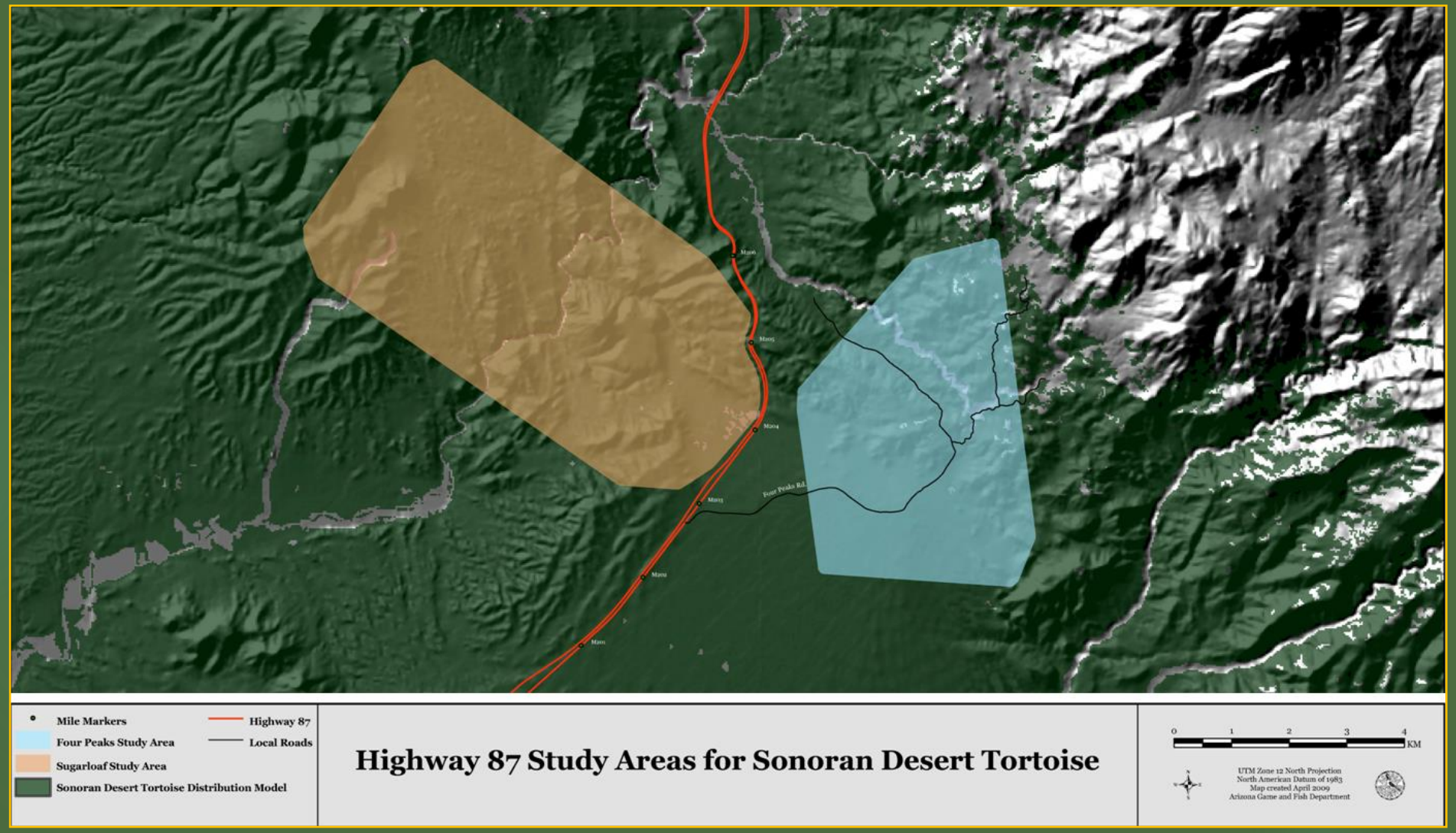
Habitat Fragmentation

Hwy 87 Desert Tortoise Study



Photo by: R. Babb

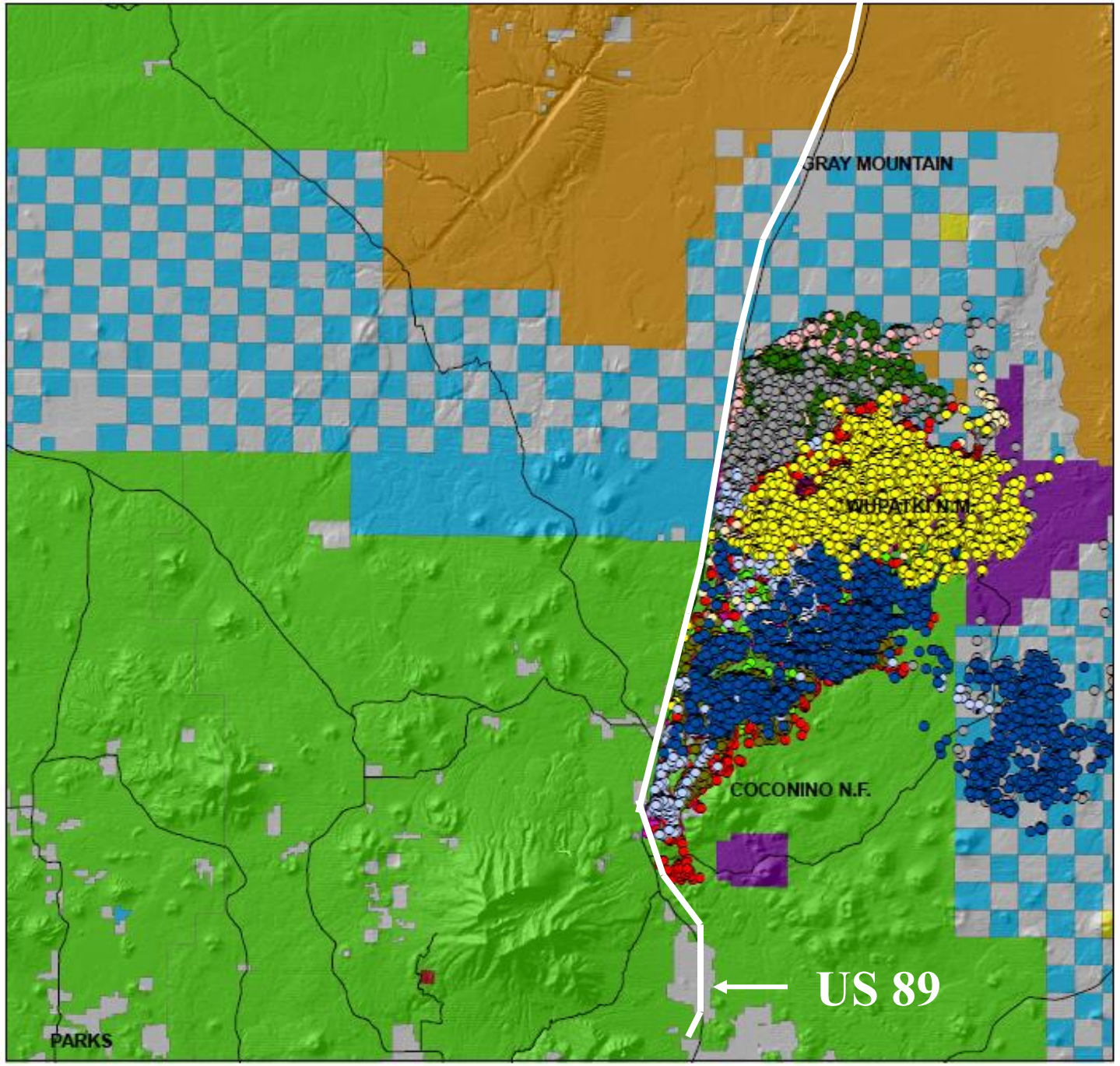
Hwy 87 Desert Tortoise Study



US Highway 89 Pronghorn



ARIZONA GAME & FISH



Hwy 89 Pronghorn Study Area

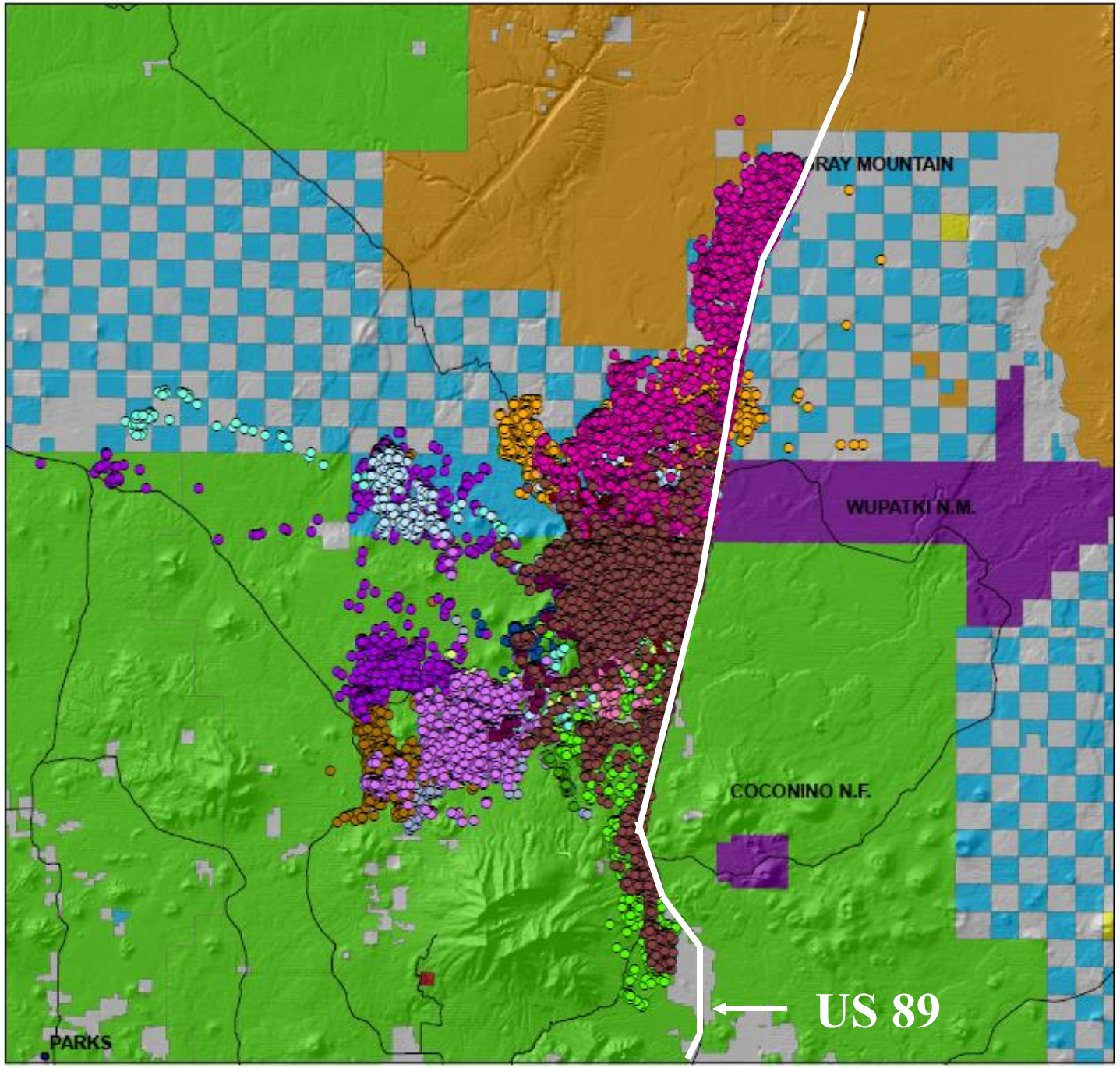
Pronghorn locations
from 1/2007 - 12/2008
37 Animals
121,000 Locations

- Private
- BLM
- State Trust
- Forest
- Indian Res.
- Natl. Parks
- Game and Fish

N

Kilometers

0 4 8



Hwy 89 Pronghorn
Study Area

Pronghorn locations
from 1/2007 - 12/2008
37 Animals
121,000 Locations

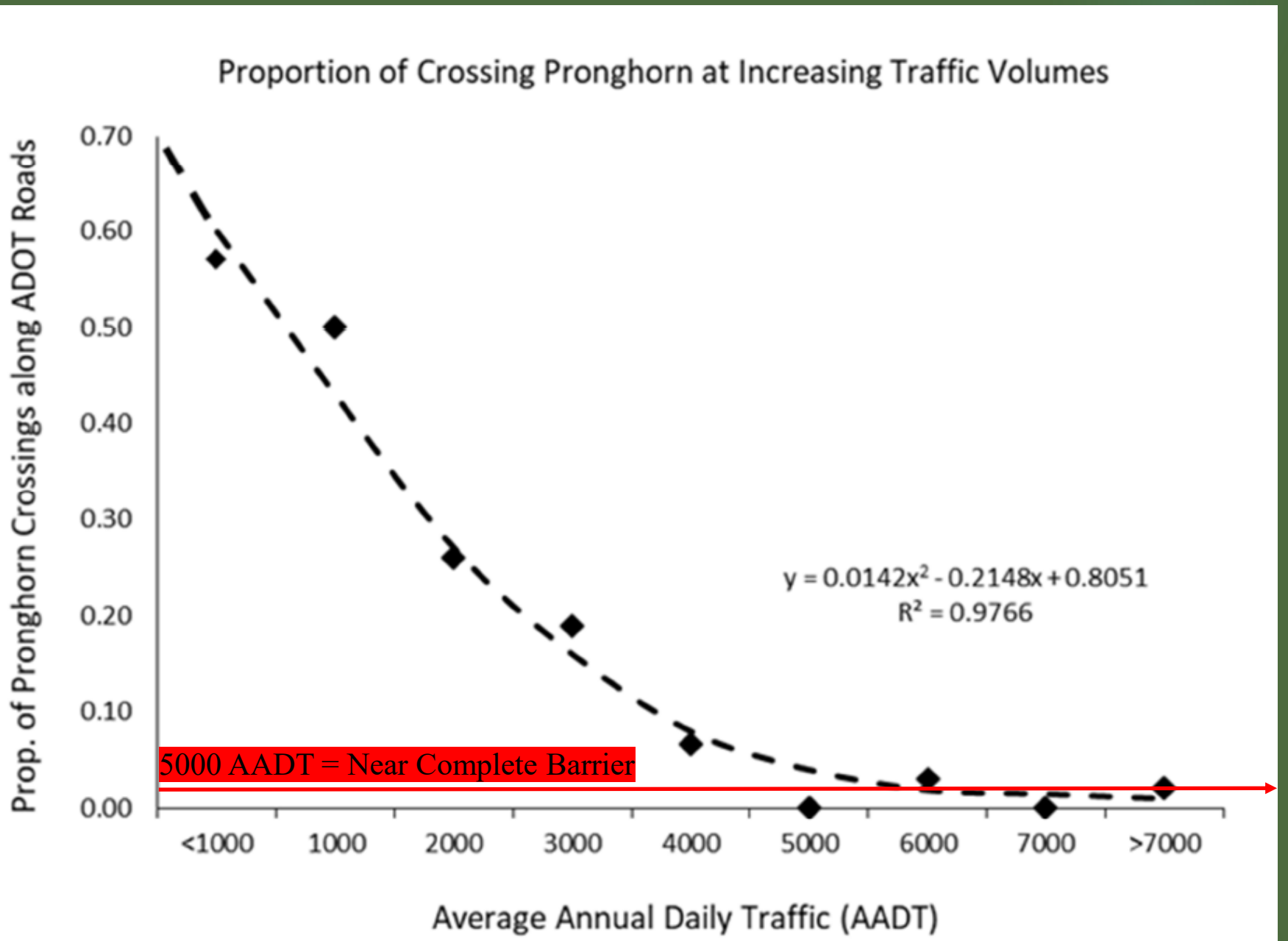
- Private
- BLM
- State Trust
- Forest
- Indian Res.
- Natl. Parks
- Game and Fish

N

Kilometers

0 4 8

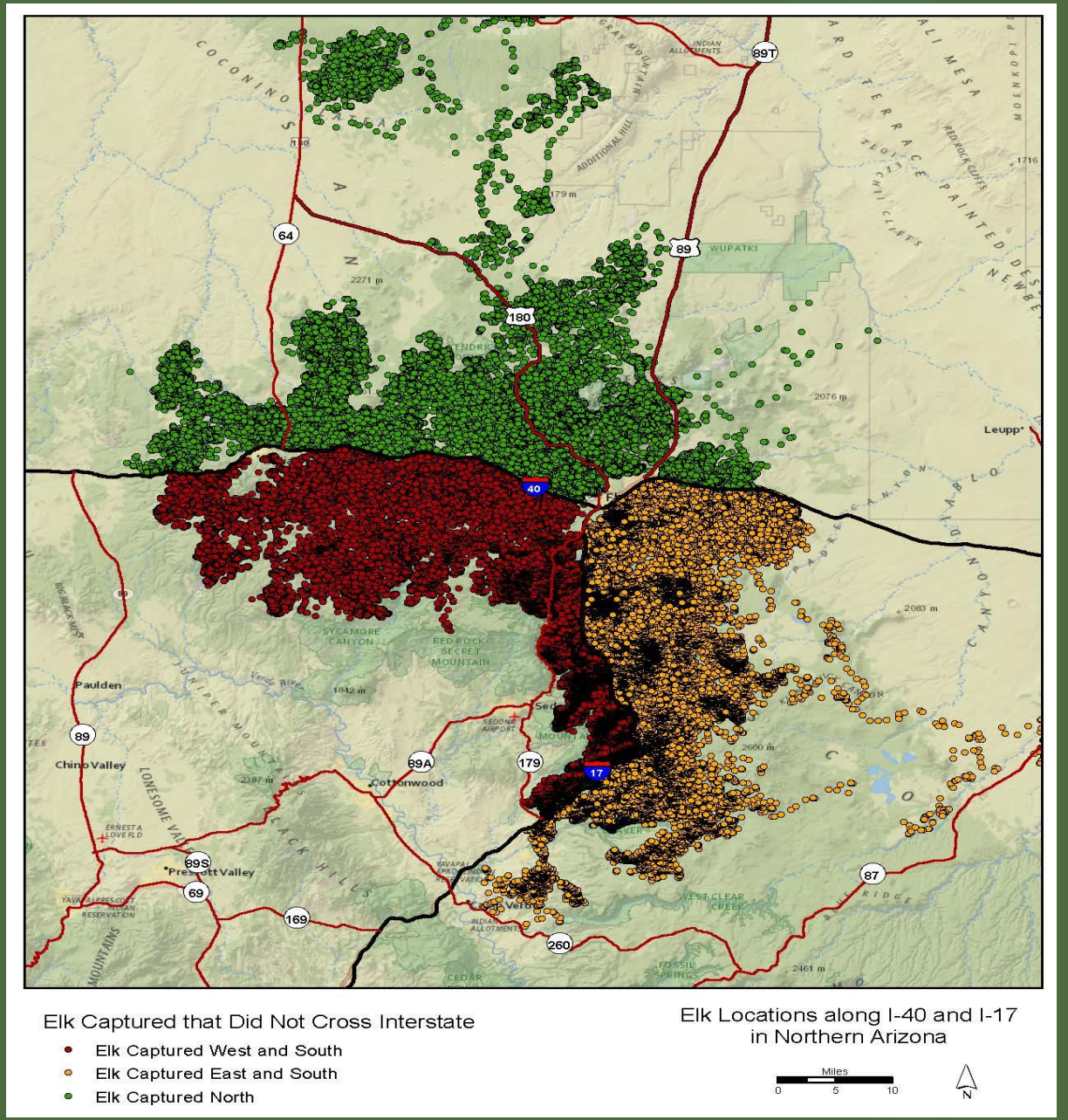
ARIZONA GAME & FISH


Proportion of Crossing Pronghorn at Increasing Traffic Volumes
Prop. of Pronghorn Crossings along ADOT Roads
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
y = 0.0142x² - 0.2148x + 0.8051
R² = 0.9766
5000 AADT = Near Complete Barrier
<1000
1000
2000
3000
4000
5000
6000
7000
>7000
Average Annual Daily Traffic (AADT)

GPS Data

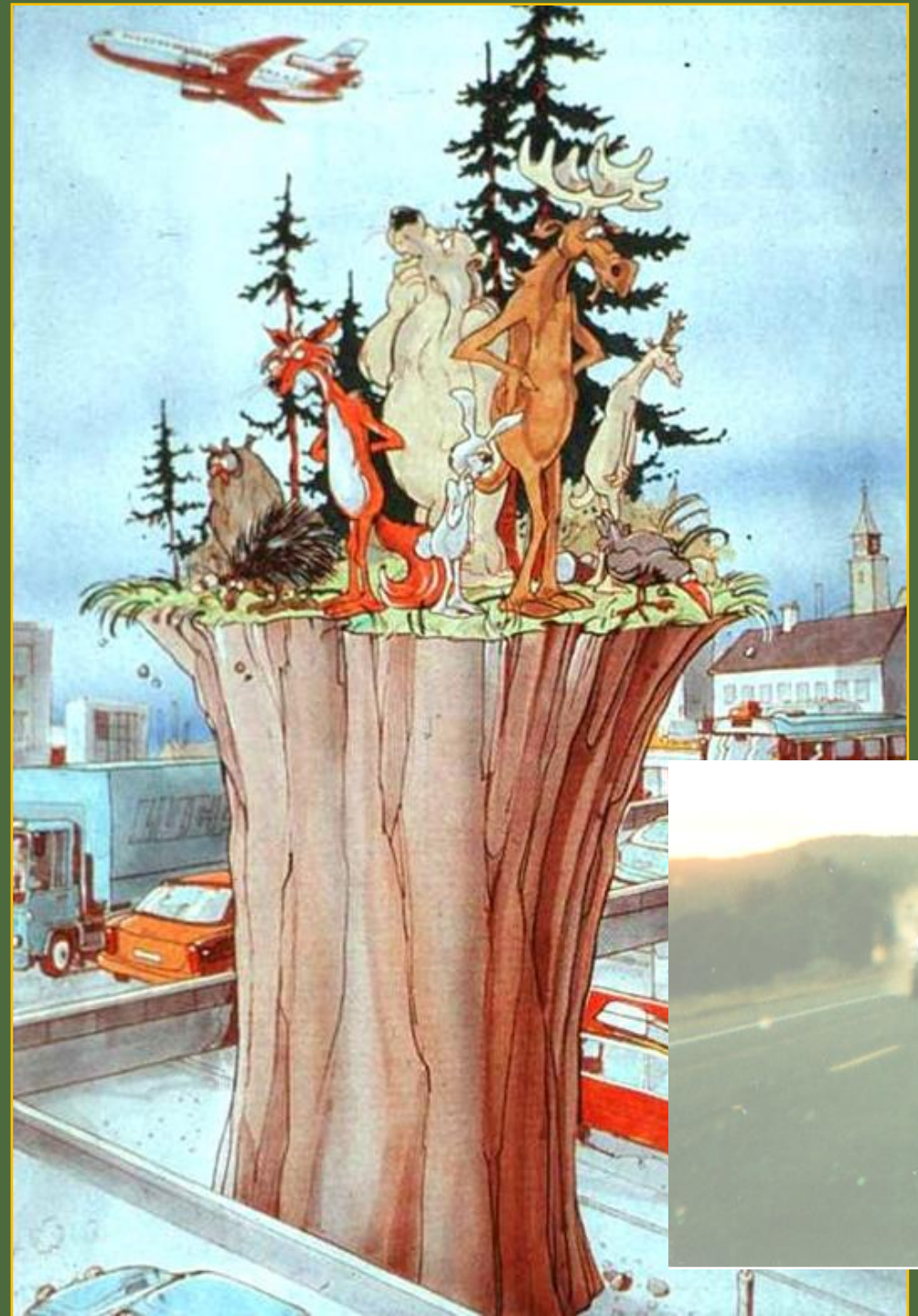
I-17 and I-40 Elk Movement





Now that we know some of the impacts of roadways on wildlife….

What can we do about it???





Roads: Wildlife Crossings and Fencing





Reduce Wildlife-Vehicle Collisions and Maintain Habitat Connectivity

State Route 77 Project



Similar to Rio Verde Project



35,000
Vehicles
Per Day



Similar Habitat
and Species as
Scottsdale



ARIZONA GAME & FISH



ARIZONA GAME & FISH


SR77 UP-4
RECONYX


SR77 UP2 LOW
RECONYX



Crossings by Structure Since Camera Install

Species	Overpass	Underpass	Total
Mule Deer	9659	2479	**12138**
Javelina	2877	5103	**7980**
Coyote	1165	4894	**6059**
Bobcat	148	524	**672**
Other	104	347	**451**
Total	**13953**	**13347**	**27300**

31 Species

SR 77 Take Home Message:

Conservation of Remaining Open Space and Corridors Can Maintain Wildlife Populations in Urban Areas for Future Generations





Habitat Blocks

+

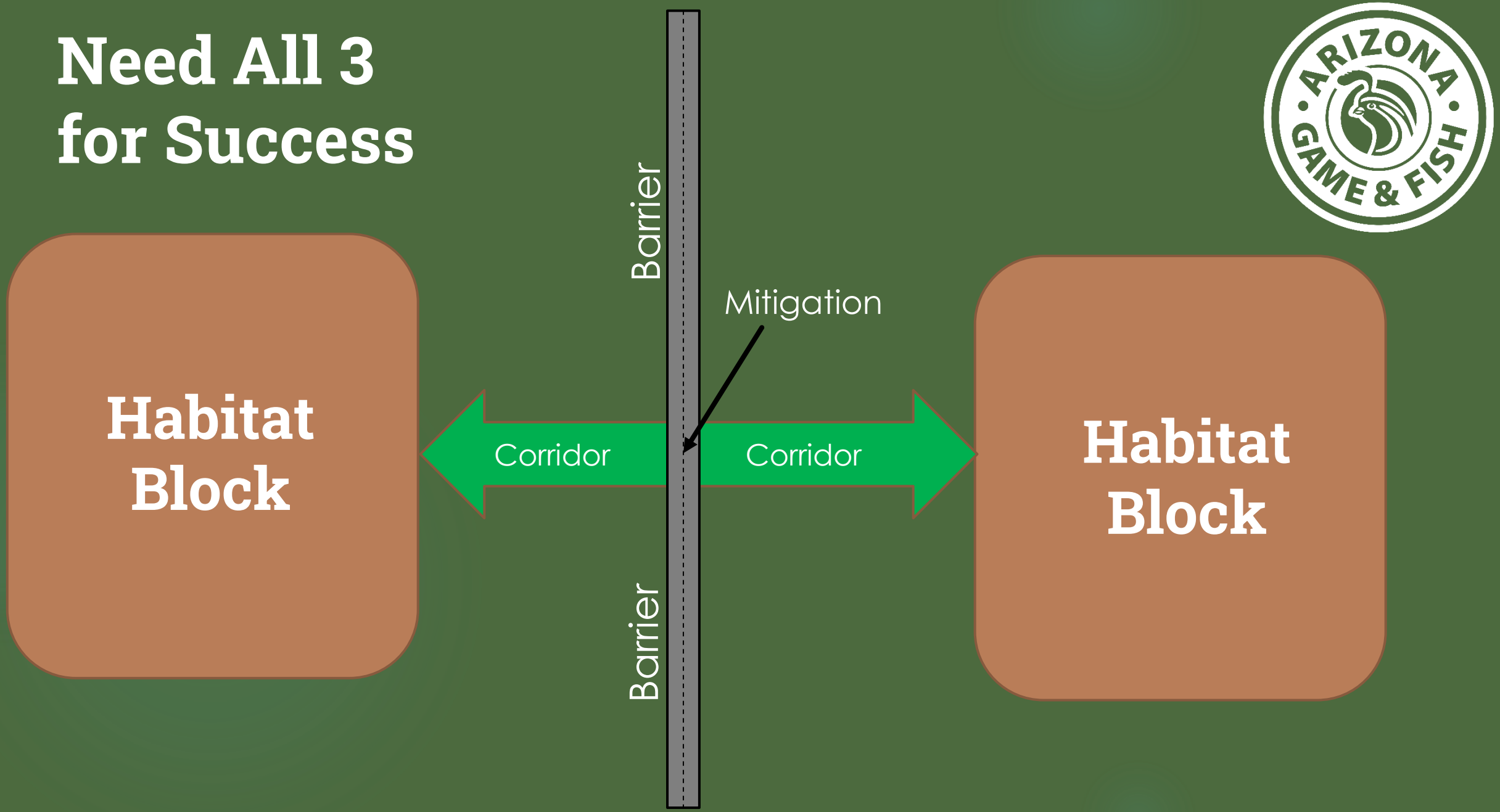
Corridors

+

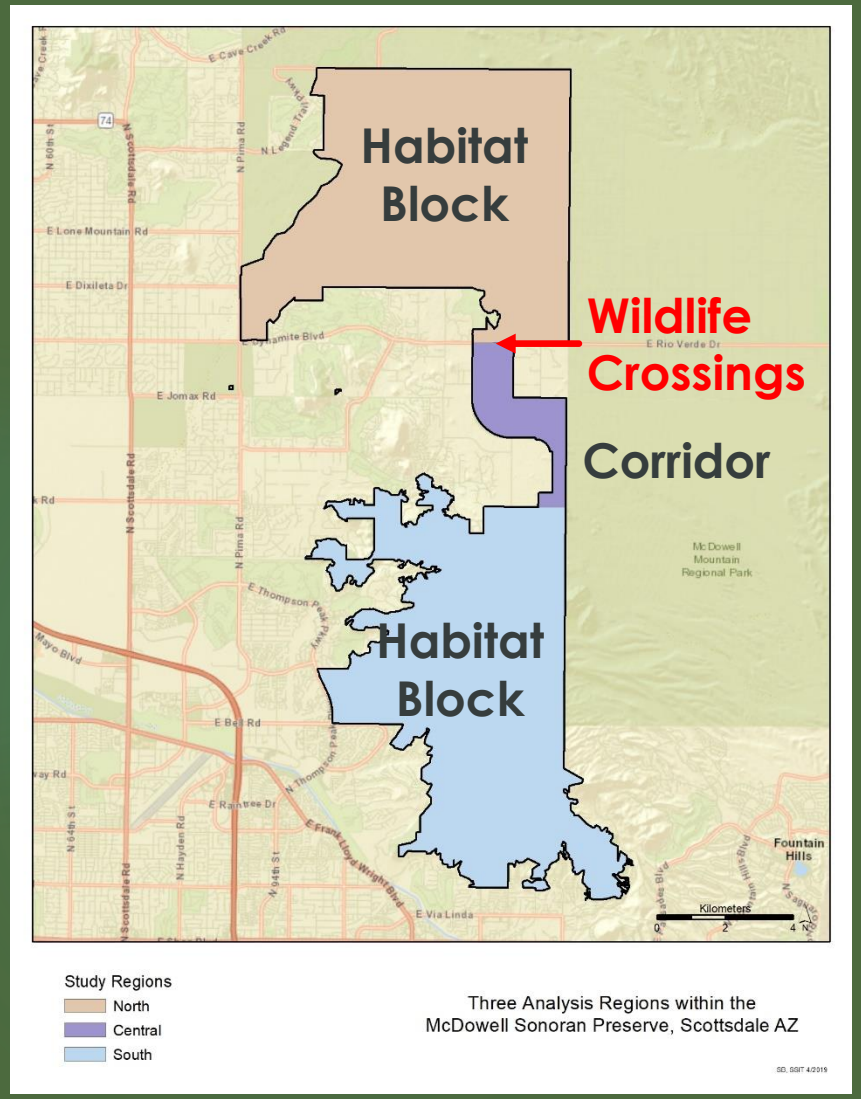
Mitigation (e.g. Wildlife Crossing)

Success!

Need All 3 for Success



McDowell Sonoran Preserve

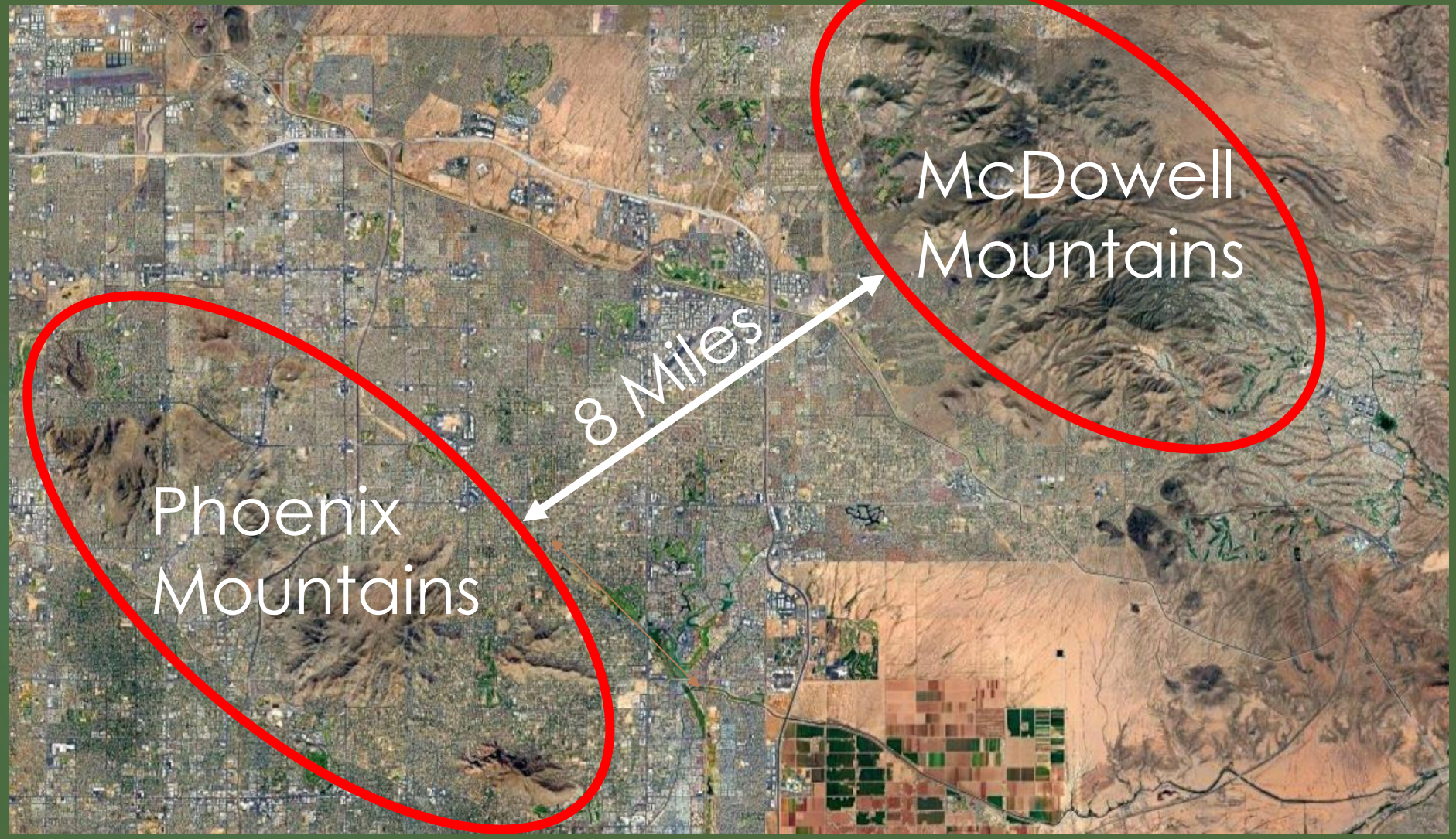


Habitat blocks and corridors secured

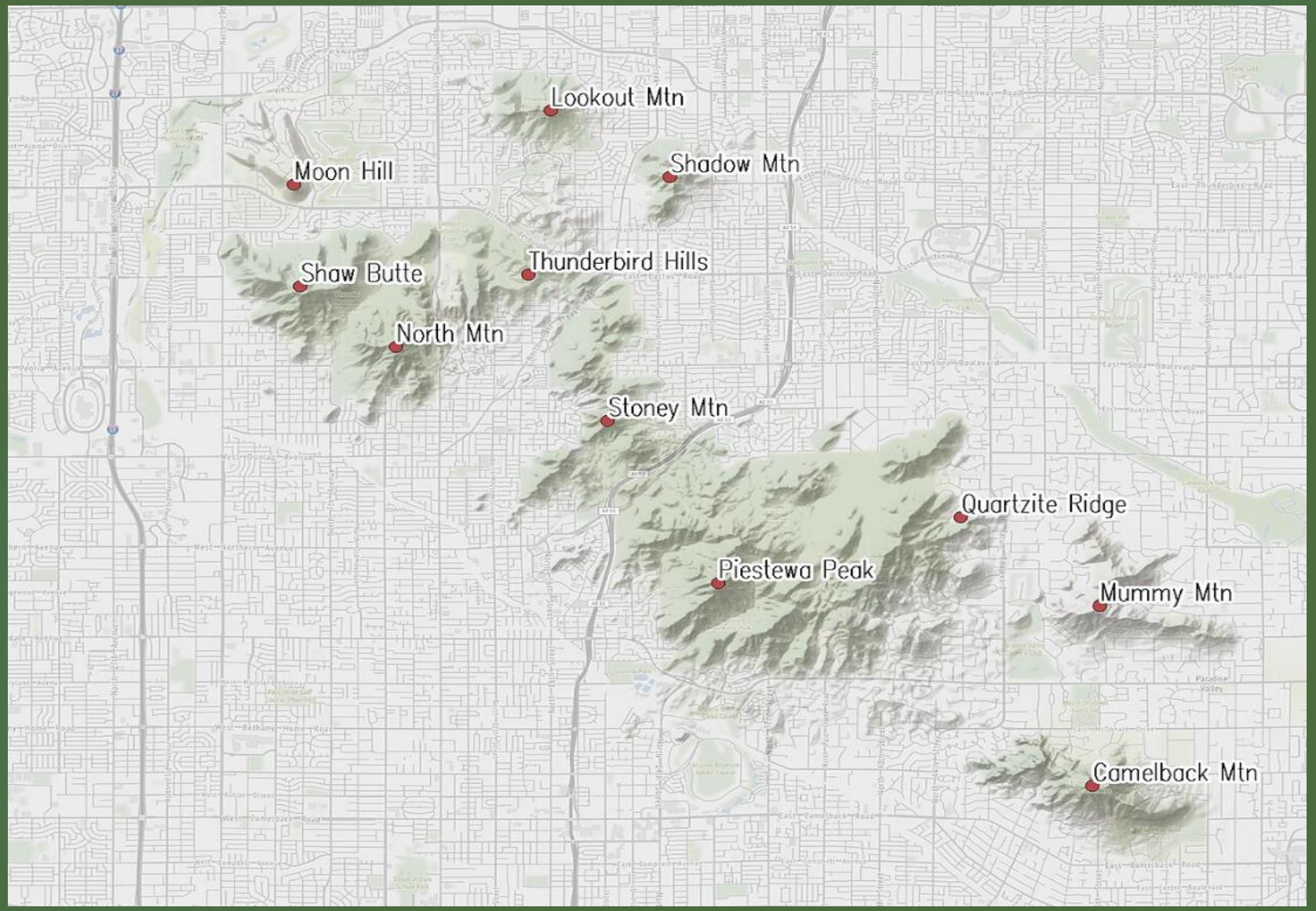
Wildlife Crossing(s) will help maintain wildlife habitat connectivity as traffic volumes on Rio Verde Drive increase (Feasibility Study)

Once complete all the boxes will have been checked

Isolation of Habitat >>>> Loss of Wildlife Diversity



Isolation of Habitat >>>> Loss of Wildlife Diversity



No Deer

Phoenix Mountains


2018-09-01 18:50:47 M 1/3 99°F
Questions?
SR77 OP3
RECONYX



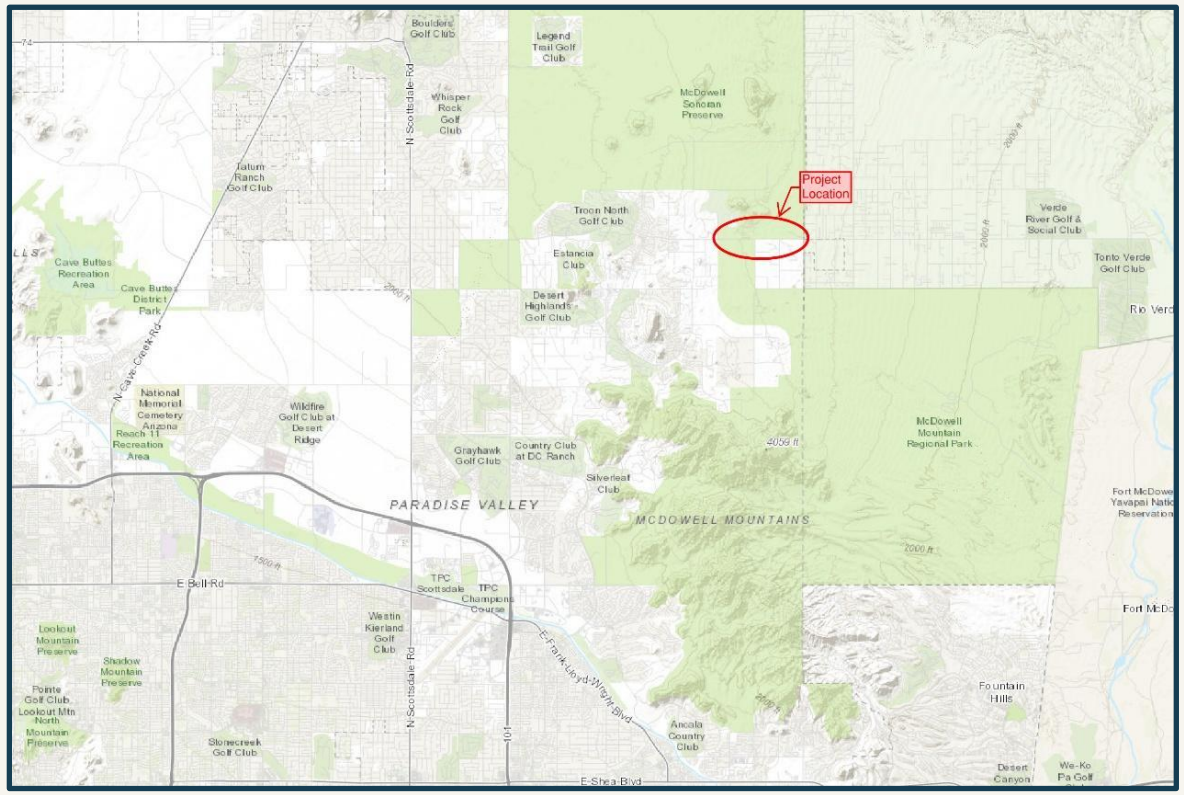
FEASIBILITY STUDY

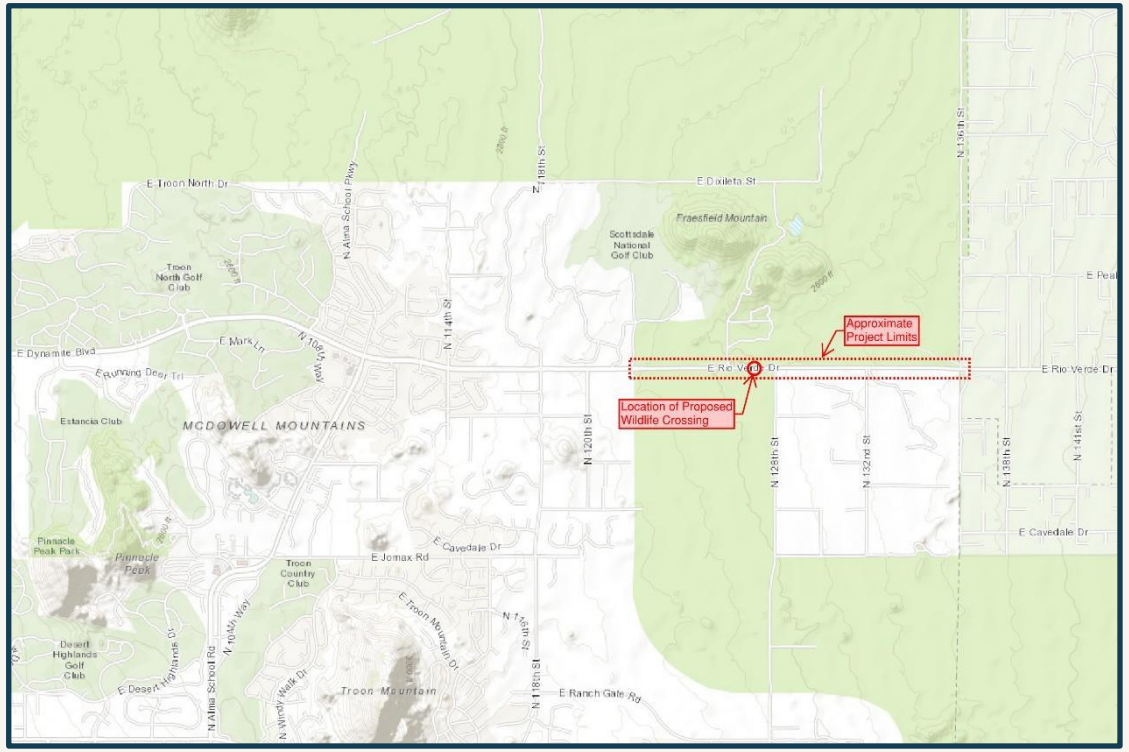
Rio Verde Wildlife Crossing

City of Scottsdale Project No. 2024-004-COS
Rio Verde Drive | August 2026

Purpose and project location

A strategic pinch point in the McDowell Sonoran Preserve's "gooseneck" corridor





Location

Rio Verde Drive between N. 126th Street and N. 128th Street, Scottsdale.

Study purpose

Document previous studies and evaluate a feasible crossing concept.

Regional role

Maintain north-south connectivity within the Preserve and toward Tonto National Forest.

More than a decade of evidence

Multiple independent methods consistently identify the corridor as important and Rio Verde Drive as a growing barrier

2011–12

Wildlife Linkage Study

453 mortality detections
326 track detections

STUDY METHODOLOGY

Weekly road-mortality surveys on Rio Verde Drive and N. 128th Street, plus track surveys in washes (Jul 2011–Oct 2012).

SOURCE

AZGFD (Grandmaison, 2012)

2016–18

Mule Deer Movement Study

38 collared mule deer
167,000+ locations

STUDY METHODOLOGY

GPS collars on mule deer, tracked over two years, using deer as an umbrella species for connectivity.

SOURCE

AZGFD with the City and MSC (AZGFD, 2019)

2019

Corridor Viability Project

11,310 detections
18 identified species

STUDY METHODOLOGY

Remote cameras documenting wildlife activity along Rio Verde Drive and within the Preserve corridor.

SOURCE

McDowell Sonoran Conservancy (MSC, 2019)

2024

Population monitoring

~205 mule deer
~87 javelina

STUDY METHODOLOGY

Annual aerial surveys estimate deer and javelina abundance and long-term trends in the Preserve.

SOURCE

AZGFD, City and MSC (MSC, 2024)

2025+

Effectiveness monitoring

Road mortality, GPS, cameras, mapping

STUDY METHODOLOGY

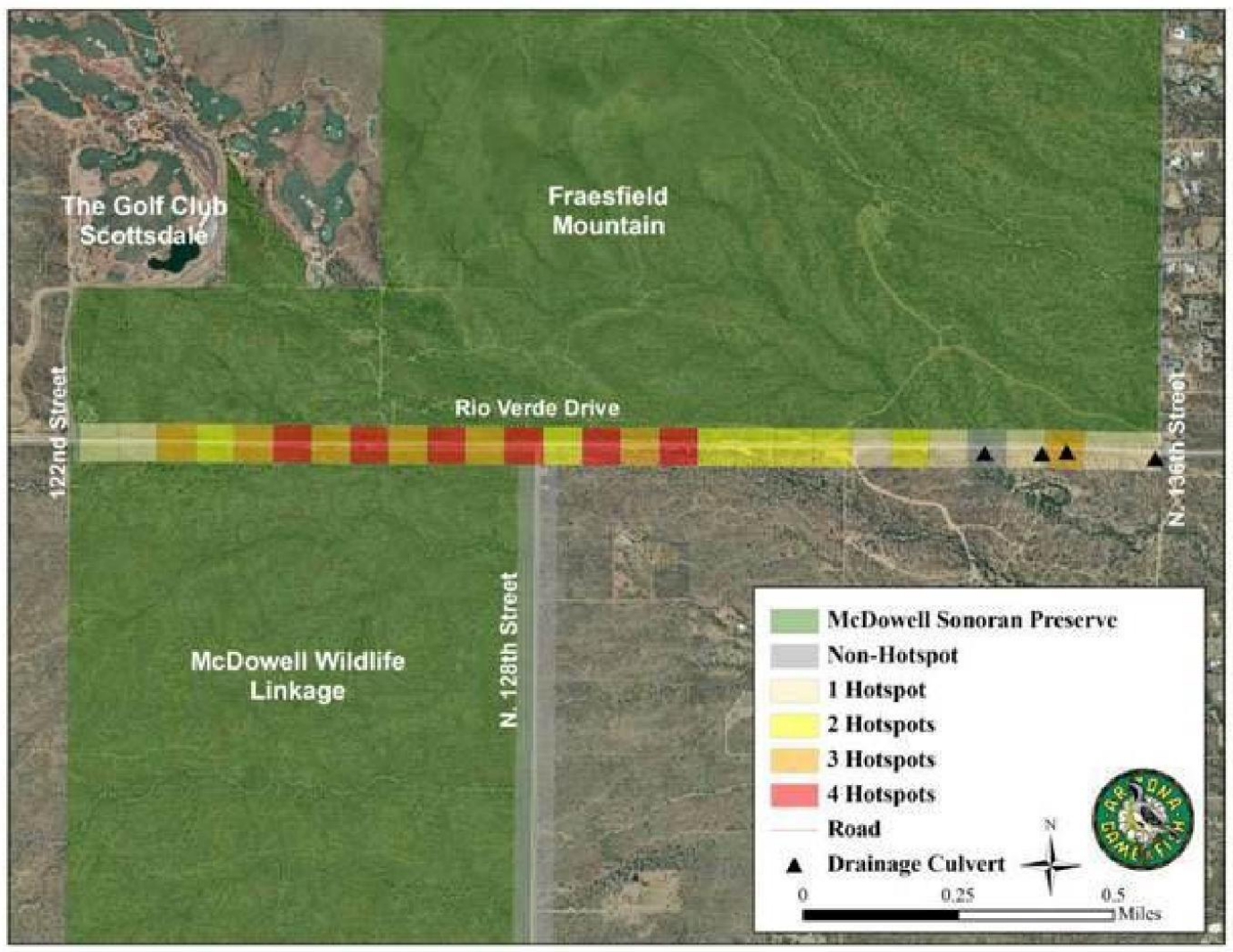
Repeats the 2011–12 mortality method, adds satellite GPS collars (up to 3 years) and trail cameras; continues for multiple years after construction.

SOURCE

AZGFD (2025)

What the data show

Road mortality hotspots overlap a corridor used by diverse wildlife



453

road-mortality detections
31 species

326

wildlife track detections
8 mammal species

203

documented roadway crossing instances

11,310

camera detections
18 species identified

Purpose of the recommended crossing

1. Reduce wildlife-vehicle collisions and associated property damage
2. Maintain multispecies movement, including mule deer and tortoise
3. Protect one of the region’s last intact desert wildlife linkages
4. Provide a grade-separated route for trail users

Recommended crossing concept



Crossing information

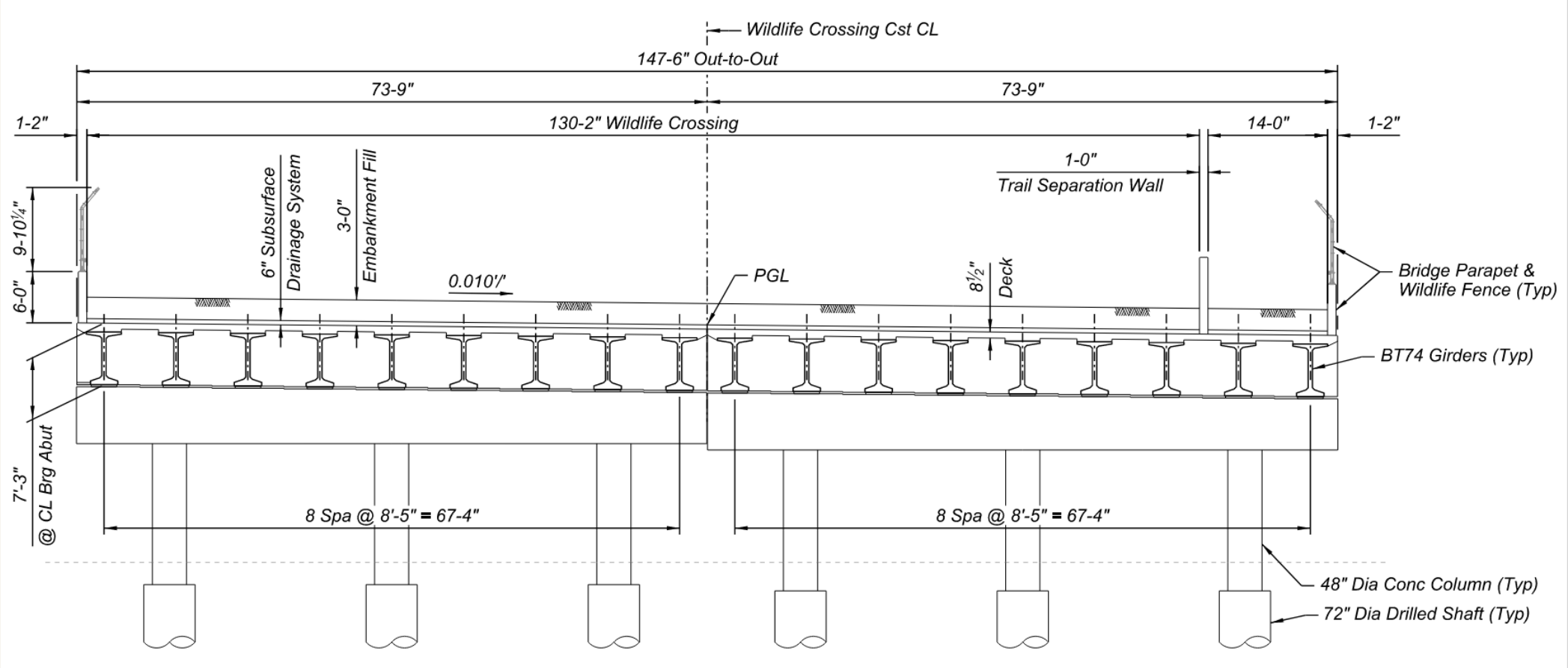
- **130 ft** clear wildlife crossing width
- **18 ft 6 in** minimum vertical clearance
- **Single span** precast prestressed girders
- **Integrated** pedestrian trail access
- **Full length** exclusion fencing, cattle guards, and escape ramps

Site considerations

- **Roadway:** minor arterial with two lanes and a bike lane each direction, plus median
- **Drainage:** box culvert, wingwalls, and riprap convey Rio Verde Wash 10 Tributary 4 beneath the south embankment
- **Utilities:** overhead APS lines, underground communications lines, and one buried gas line
- **Construction:** limited Rio Verde Drive closures; precast girders reduce falsework needs
- **Terrain:** existing north-side hillside reduces embankment fill
- **Lighting:** excluded beneath the crossing to avoid deterring wildlife

Design per AASHTO LRFD, ADOT Bridge Guidelines, the FHWA Wildlife Crossing Structure Handbook, and City of Scottsdale standards.

Bridge typical section



- **147'-6"** out-to-out bridge width
- **130'-2"** clear wildlife crossing
- **14'-0"** trail, separated by a trail separation wall
- **Parapet and fence:** parapet with wildlife fence at edges

Preliminary construction cost

Preliminary-engineering estimate with a 20% unidentified item allowance and 3-year escalation to 2029

RIO VERDE CROSSING CONSTRUCTION ESTIMATE

$24.4M

Construction total, 2029 dollars

Construction subtotal (2026 $)	$17,581,640
Unidentified item allowance (20%)	$3,516,000
Construction total (2026 $)	**$21,097,640**
3-year escalation (5% per year)	$3,325,520
Construction total (2029 $)	**$24,423,160**

Based on preliminary (15%) design quantities and current ADOT bid prices; escalated to 2029 construction.

For reference: ADOT's I-17 crossing (Munds Park)

$16.3M	$17.95M
ADOT estimate	Escalated to today's $

Bids ranged from just under $16M to $23M (avg ~$19M).

Note: ADOT carried 5% contingency vs. 20% here at this early design stage, which accounts for approximately $2.6M of the difference.

DRAFT FEASIBILITY STUDY

RIO VERDE WILDLIFE CROSSING

COS PROJECT NO: 2024-004-COS

LOCATION: RIO VERDE DR

PREPARED FOR:

CITY OF SCOTTSDALE

PREPARED BY:

Kimley»Horn



1661 East Camelback Road, Suite 400
Phoenix, Arizona 85016
October 2026

Kimley»Horn

TABLE OF CONTENTS

TABLE OF CONTENTS 2
EXECUTIVE SUMMARY 3
INTRODUCTION AND PROJECT LOCATION 5
BIOLOGICAL BASIS FOR EVALUATING A WILDLIFE CROSSING 7
TECHNICAL OVERVIEW 18
APPENDIX A – LITERATURE CITED 23
APPENDIX B – ESTIMATED QUANTITIES AND CONSTRUCTION COST 24
APPENDIX C – WILDLIFE CROSSING PRELIMINARY DESIGN PLANS 27
APPENDIX D – MSC WILDLIFE CONNECTIVITY ASSESSMENT 41

Kimley»Horn

EXECUTIVE SUMMARY

Rio Verde Drive bisects the McDowell Sonoran Preserve's Gooseneck Corridor, one of the last remaining functional wildlife linkages connecting the northern and southern Preserve and extending connectivity to Tonto National Forest. The City of Scottsdale acquired this land in 2011 specifically to preserve wildlife movement. The corridor also provides trail access across Rio Verde Drive for pedestrians, bicyclists, and equestrian riders. More than a decade of research, monitoring, and technical analysis by Arizona Game and Fish Department (AZGFD), the City, and the McDowell Sonoran Conservancy (MSC) shows regular wildlife movement attempts through this corridor and confirms that Rio Verde Drive increasingly acts as a barrier.

Key City Code Chapter 21 Provisions

- Sec. 21-2 (a): Maintaining the Preserve as habitat for wildlife.
- Sec. 21-2 (1): Preserving the local plants, wildlife and natural resources to maintain the biological diversity and long-term sustainability of the area's ecology.
- Sec. 21-2 (9): Developing a non-paved public trail system for hiking, mountain biking, bicycling and horseback riding and link these trails, where appropriate, with other city and regional trails.

Why a Wildlife Corridor Is Needed

Long-term studies (2011–2025) document consistent movement by mule deer, tortoise, and multiple species throughout the Gooseneck, along with high wildlife vehicle collision hotspots on Rio Verde Drive. Early surveys recorded 453 road-mortality detections (31 species) and 326 wildlife track detections (eight mammal species), including desert cottontail, jackrabbit, mule deer, javelina, coyote, bobcat, gray fox, and black bear. Camera surveys subsequently documented more than 11,000 wildlife detections, including mule deer, javelina, bobcats, coyotes, foxes, and mountain lions, demonstrating the corridor's ecological significance. GPS collar studies recorded 203 roadway crossing events by mule deer, reinforcing Rio Verde Drive as a critical pinch point for north–south connectivity within the Preserve and between the Preserve and Tonto National Forest. Wildlife activity drops near the roadway, showing behavioral avoidance as traffic increases.

What Happens Without a Corridor

Without mitigation, Rio Verde Drive will continue to fragment habitat, isolate wildlife populations, and remain a hazard for wildlife-vehicle collisions. Long term risks include reduced access to forage and water, diminished gene flow, and potential local population declines - effects especially pronounced for species such as mule deer and Sonoran Desert tortoise, which showed no documented roadway crossings during five years of monitoring. Loss of connectivity could become permanent as development and traffic grow.

Traffic Growth

Rio Verde Drive is a two-lane rural roadway with a posted speed of 50 mph and carries a daily traffic volume of 17,575 vehicles per day (vpd) based on counts from 2025 near 136th Street. Additional counts collected west of 118th Street show a daily traffic volume of 14,724 vpd in 2023. City of Scottsdale traffic data estimated an annual average daily traffic (AADT) on Rio Verde Road of 10,800 vpd in 2016 and 12,300 vpd in 2024, representing a 13% overall increase in traffic volume since 2016, and an average annual growth rate of 1.5%. Based on the average annual growth rate of 1.5% and the collected volumes from 2023 and 2025, the 2050 traffic volumes are estimated to be between 22,000 and 25,500 vehicles per day.

Benefits of a Wildlife Crossing

The feasibility study and biological assessments conclude that a wildlife crossing paired with exclusion fencing will:

- Reduce wildlife vehicle collisions, thus improving public safety and reducing property damage.
- Maintain ecological connectivity for mule deer, tortoise, and multispecies movement.
- Protect one of the region's last intact desert wildlife linkages.
- Integrate the Gooseneck Trail for safe pedestrian passage.

Crossings of similar design in Arizona have seen reduced collisions by up to 97% and are successfully used by large mammals and tortoises.

Benefits of Pedestrian Trail Access on the Crossing

- Provides safe crossing for Preserve users currently navigating an unsignalized section of Rio Verde Drive.
- Significantly improves public safety by removing pedestrians, bicyclists, and equestrians from active traffic.
- Minimal expected impact on wildlife, as pedestrian use aligns with Preserve hours while most wildlife activity occurs at night/early morning.
- Wildlife in the corridor is already acclimated to surrounding human activity.

Location of Crossing

The proposed wildlife crossing is situated in the gooseneck corridor which crosses Rio Verde Drive between 122nd and 128th Streets.

Design Summary

The recommended structure is a single span precast, prestressed concrete girder bridge with a 130'-0" clear wildlife crossing width, 18'-6" minimum vertical clearance, integrated pedestrian trail, and full-length wildlife exclusion fencing, cattle guards, and escape ramps. The site uses existing topography to minimize earthwork and includes necessary drainage, utility relocations, and aesthetic treatments.

Estimated Cost

The preliminary engineering estimate (15% design) identifies a construction cost of approximately $24.5 million (2029 dollars), including roadway reconstruction, fencing, drainage, utilities, and bridge structure, with a 20% contingency and a 3-year annual cost escalation (5%/year).

Agency Support

AZGFD and MSC strongly support the wildlife crossing, which will include a pedestrian trail. Their multiyear datasets provide the scientific basis for the project's necessity, and both agencies contributed to location selection, design standards, fencing requirements, and monitoring recommendations. The study concluded that Rio Verde Drive is already constraining wildlife movement and that future development and traffic will intensify connectivity loss and wildlife-vehicle collisions unless mitigated.

Kimley»Horn

INTRODUCTION AND PROJECT LOCATION

This project is located within the “gooseneck” corridor on Rio Verde Drive between N 122nd Street and N 128th Street in Scottsdale, Arizona. The purpose of the project is to prepare a feasibility study for a wildlife crossing of Rio Verde Drive. The study includes a research summary based on data analysis provided by the Arizona Game and Fish Department (AZGFD) and the McDowell Sonoran Conservancy (MSC) that will describe the purpose of the project and biological documentation supporting the need and benefits of the crossing, and risk of not implementing the crossing. The study also includes a technical overview of the physical crossing including supporting engineering documents and construction cost estimates for an eventual implementation of the final design and construction of the crossing.

See Figure 1 and Figure 2 below for maps showing the approximate location of the proposed wildlife crossing.

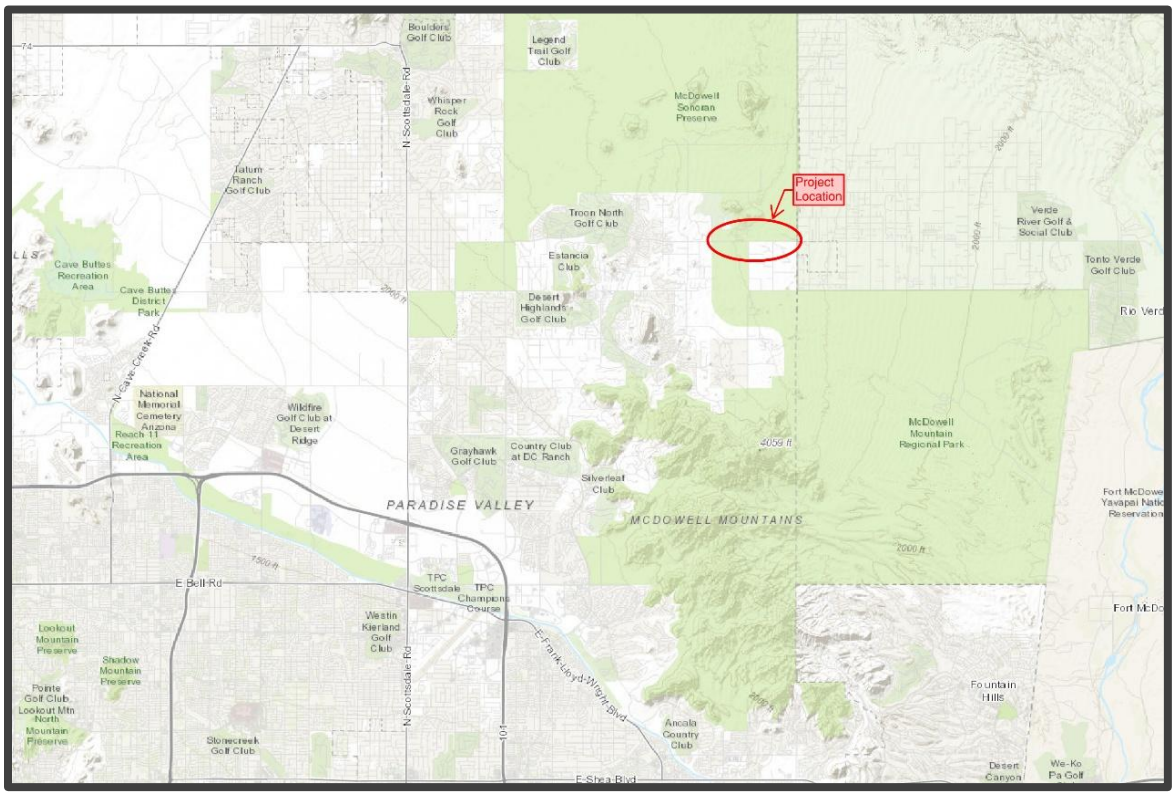


Figure 1: Area Vicinity Map

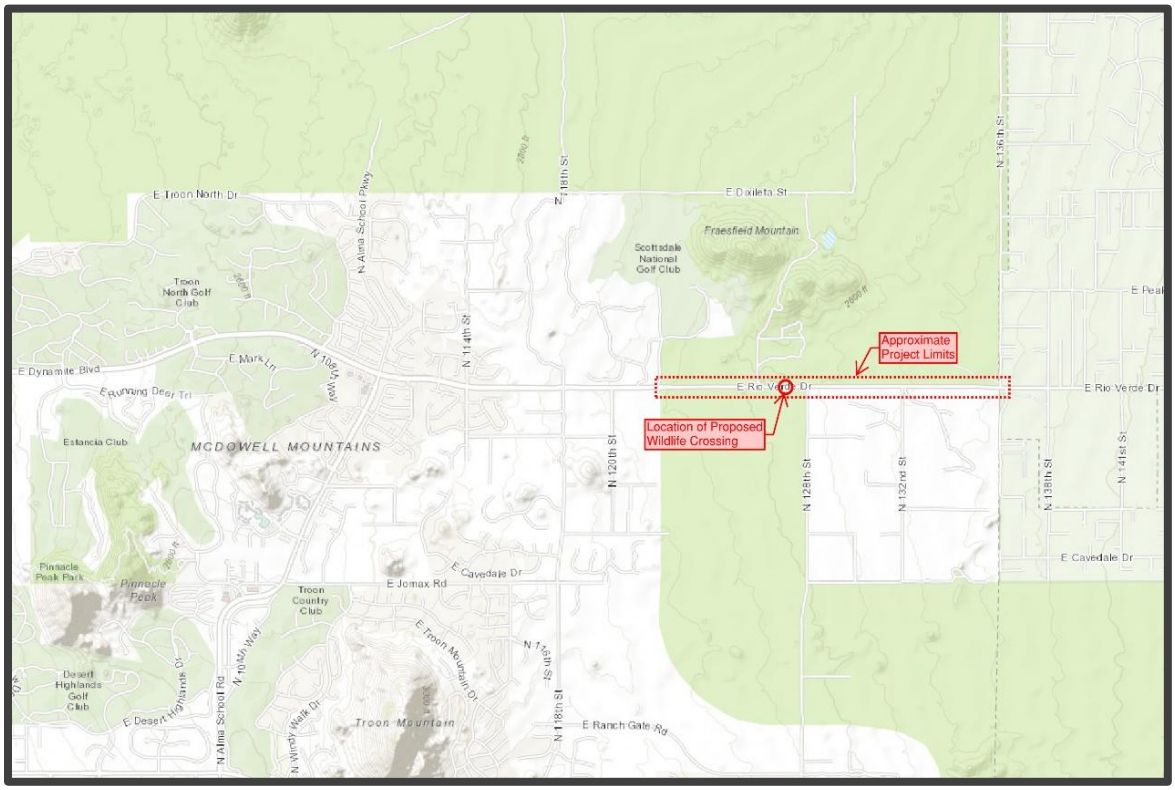


Figure 2: Local Vicinity Map

BIOLOGICAL BASIS FOR EVALUATING A WILDLIFE CROSSING

The Importance of Wildlife Overpasses for Connectivity

Arizona's rapid population growth and expanding infrastructure are fragmenting wildlife habitat. Roads, energy projects, resource extraction, and residential development can prevent animals from accessing food, water, seasonal ranges, and migration corridors. This fragmentation is especially dangerous for wide-ranging species such as mule deer and can increase the risk of local extinction (Gagnon & Knutson, n.d.).

Maintaining connectivity is also critical as drought and other climatic extremes become more common. Connected habitats allow wildlife to move in response to changing environmental conditions. **Avoiding habitat fragmentation is essential for the long-term persistence of wildlife populations and healthy ecosystems (Gagnon & Knutson, n.d.).**

Roads become a barrier to movement for wildlife and pedestrians when traffic volumes approach 8,000 to 10,000 vehicles per day. Higher-traffic roads create serious barriers. Animals may still try to cross when movement is necessary, increasing the likelihood of wildlife-vehicle collisions and threatening driver safety. An Arizona Department of Transportation study projects that wildlife-vehicle collisions could increase by more than 100% statewide by 2051 (Gagnon & Knutson, n.d.).

Wildlife overpasses and underpasses help reconnect fragmented habitats while reducing collisions. **At the State Route 77 crossing northeast of Tucson, nearly 10,000 mule deer used the overpass during nearly eight years of monitoring, approximately four times the number using the nearby underpass, and deer collisions were nearly eliminated (Gagnon & Knutson, n.d.). This example shows that overpasses can protect wildlife populations while improving public safety.**

Although overpasses can be expensive, wildlife–vehicle collisions impose substantial costs on society. **More than a decade ago, these costs were conservatively estimated to exceed $8 billion and are likely higher today given increasing wildlife–vehicle collision trends and associated costs (Huijser et al., 2008).** Incorporating overpasses into roadway projects can reduce costs by sharing expenses for design, construction, traffic control, utilities, and environmental review. Wildlife overpasses should therefore be viewed as essential infrastructure rather than optional conservation projects (Gagnon & Knutson, n.d.).

Overall, wildlife overpasses provide a practical way for Arizona to balance development with ecological responsibility. Protecting migration corridors, preserving open space, modifying fences, improving habitat, and maintaining water access will be essential to keeping wildlife populations connected and resilient (Gagnon & Knutson, n.d.).

Wildlife Connectivity in the McDowell Sonoran Preserve

The McDowell Sonoran Preserve (MSP) is one of the largest urban preserves in the United States, encompassing approximately 30,500 acres of protected Sonoran Desert habitat in northeastern Scottsdale (AZGFD, 2012). The MSP provides critical wildlife habitat and functions as an important regional movement corridor connecting the McDowell Mountains, McDowell Mountain Regional Park, and the Tonto National Forest (TNF). **A key component of this network is the "gooseneck" corridor, a narrow linkage connecting the northern and southern portions of the MSP, which the City of Scottsdale (City) acquired in 2011 to preserve wildlife movement and ecological function (AZGFD, 2012).**

Since 2011, the AZGFD, the City, and MSC have conducted a series of wildlife surveys within and adjacent to the "gooseneck" corridor (AZGFD, 2012). These investigations have documented regular wildlife use of the corridor, identified wildlife-vehicle collision hotspots along Rio Verde Drive, evaluated mule deer movement patterns using Global Positioning System (GPS) telemetry, and assessed factors affecting long-term habitat connectivity. Collectively, these studies demonstrate that the corridor supports movement of mule deer and numerous other wildlife species and provides the biological basis for consideration of wildlife crossing infrastructure along Rio Verde Drive. Without wildlife crossing infrastructure, continued increases in traffic volumes and surrounding development pressure could progressively reduce the effectiveness of the "gooseneck" corridor by increasing wildlife-vehicle collisions and discouraging animals from crossing Rio Verde Drive. If left unaddressed, this could accelerate habitat fragmentation, limit access to seasonal resources and breeding opportunities, and weaken regional connectivity not only between the northern and southern portions of the MSP, but also between the MSP, McDowell Mountain Regional Park, and the Tonto National Forest. Over time, this loss of connectivity could reduce biodiversity and increase the vulnerability of isolated wildlife populations to local decline or extirpation.

2011–2012 Wildlife Linkage Study

In 2011, the AZGFD initiated a study within the MSP Wildlife Linkage to evaluate wildlife use of the recently acquired "gooseneck" corridor and identify locations where wildlife mortality was occurring along Rio Verde Drive. The City acquired the "gooseneck" corridor to connect the northern and southern regions of MSP to maintain functional wildlife connectivity from the McDowell Mountains to the TNF (AZGFD, 2019).

The study included weekly wildlife road mortality surveys along Rio Verde Drive and North 128th Street, as well as wildlife track surveys within washes located throughout the linkage. **Surveys conducted between July 2011 and October 2012 documented 453 wildlife road mortality detections representing 31 species and 326 wildlife track detections representing eight mammal species, including desert cottontail, jackrabbit, mule deer, javelina, coyote, bobcat, gray fox, and black bear (AZGFD, 2012).**

Analysis of the road mortality data identified several wildlife mortality hotspots along Rio Verde Drive, with the highest concentration of mortality occurring within and immediately adjacent to the wildlife linkage (Figure 3). The location of these hotspots highlights areas where wildlife are most frequently interacting with the roadway and provides important biological context for the placement of future wildlife crossing infrastructure. These findings document concentrated wildlife-vehicle interactions along the roadway within and near the corridor. Wildlife track surveys further confirmed regular use of the linkage by a variety of species and documented movement patterns consistent with the corridor functioning as an important connection between habitat blocks.

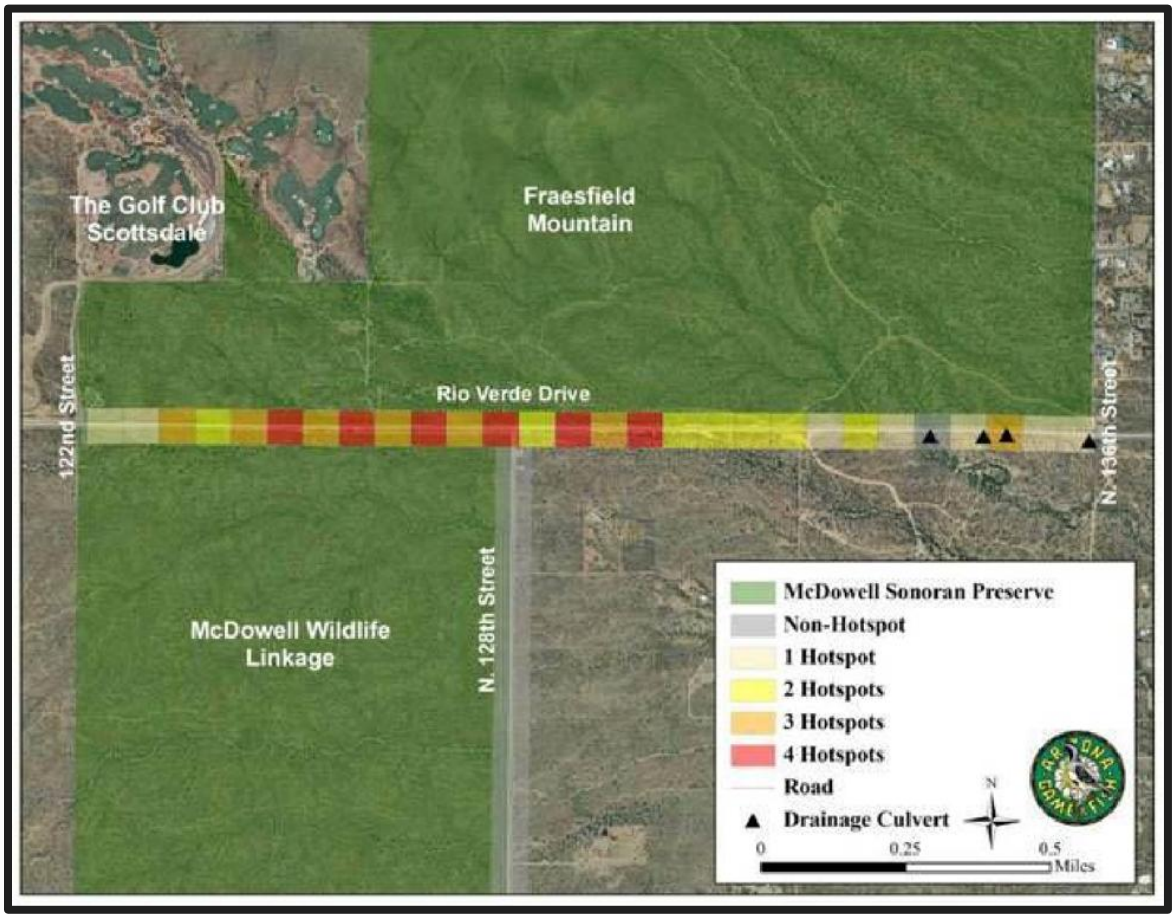


Figure 3: Wildlife Mortality Hotspots Identified along Rio Verde Drive within the MSP Wildlife Linkage (AZGFD, 2012)

The colors indicate the number of mortality hotspots identified along each roadway segment; they do not represent a continuous mortality rate or the number of individual animals killed at each location.

The study concluded that Rio Verde Drive represented a potential constraint to wildlife movement and that increasing future development and traffic volumes could further reduce habitat connectivity and increase wildlife-vehicle collisions. Based on these findings, AZGFD recommended considering wildlife crossing structures and associated exclusion fencing along Rio Verde Drive to maintain wildlife permeability, reduce wildlife mortality, and preserve long-term habitat connectivity through the MSP Wildlife Linkage.

This study established the first quantitative evidence supporting wildlife crossing improvements within the corridor and provided the foundation for subsequent wildlife movement and connectivity investigations conducted in the MSP.

2016–2018 Mule Deer Movement Study

Building on the findings of the 2011–2012 Wildlife Linkage Study, the AZGFD, in partnership with the City and the MSC, conducted a mule deer movement study from 2016 through 2018 to evaluate wildlife connectivity throughout the MSP and assess the functional importance of the “gooseneck” corridor. The study focused on mule deer as an umbrella species because of their ability to move throughout the MSP and serve as an indicator of habitat connectivity across the broader landscape (Figure 4).

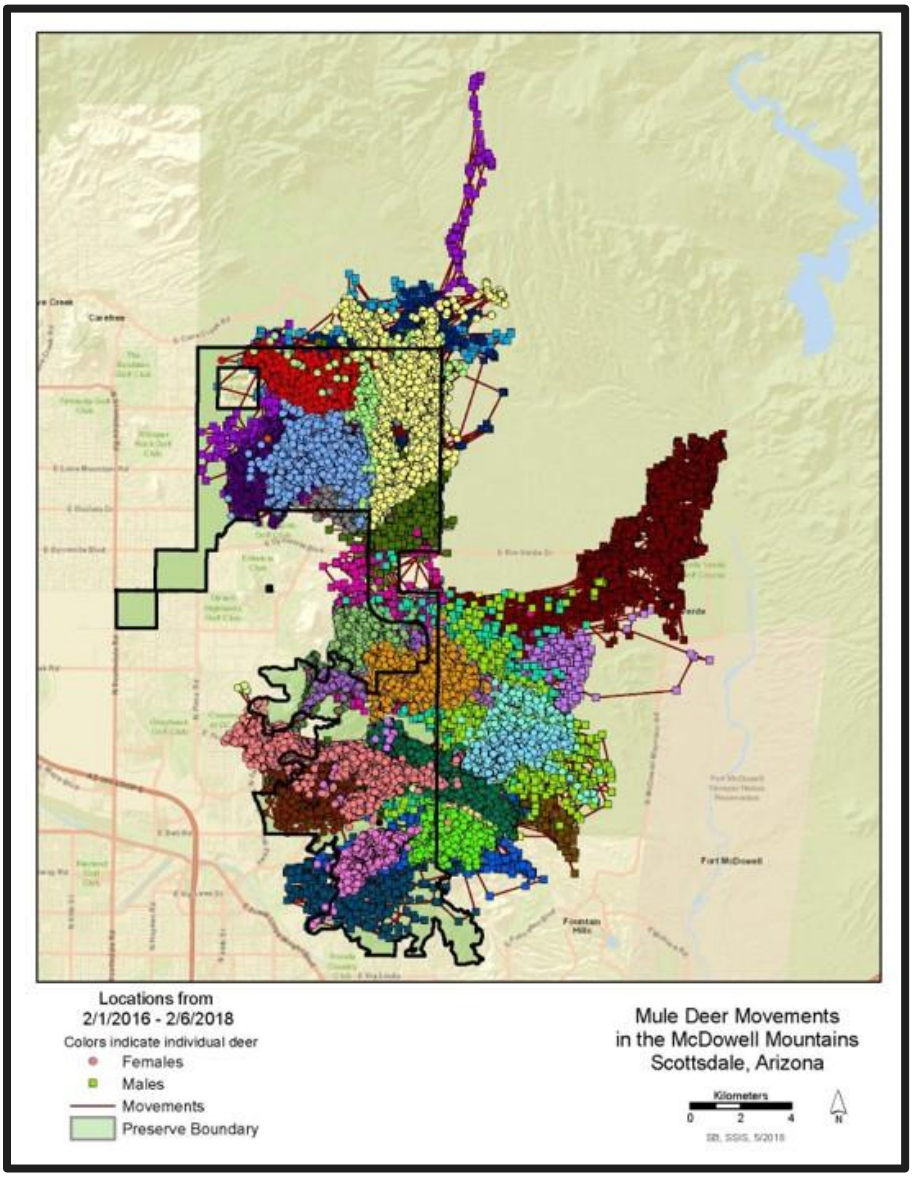


Figure 4: Mule Deer Movements in the McDowell Mountains, Scottsdale, Arizona (AZGFD, 2019)

Table 1: Rio Verde Road & Mule Deer Movement			
	Approaches (250m)	Xings	Passage Rate
8573	1	0	0.0%
8577	13	10	76.9%
8581	93	8	8.6%
8655	4	4	100.0%
8656	3	3	100.0%
Totals	114	25	21.9%

Table 1: Rio Verde Drive Mule Deer Movement Summary (AZGFD, 2019)

Table 1 presents a subset of five individual GPS-collared deer included in the Rio Verde Drive analysis; approaches represent monitored approaches within 250 meters of the roadway, and crossings represent documented roadway-crossing events.

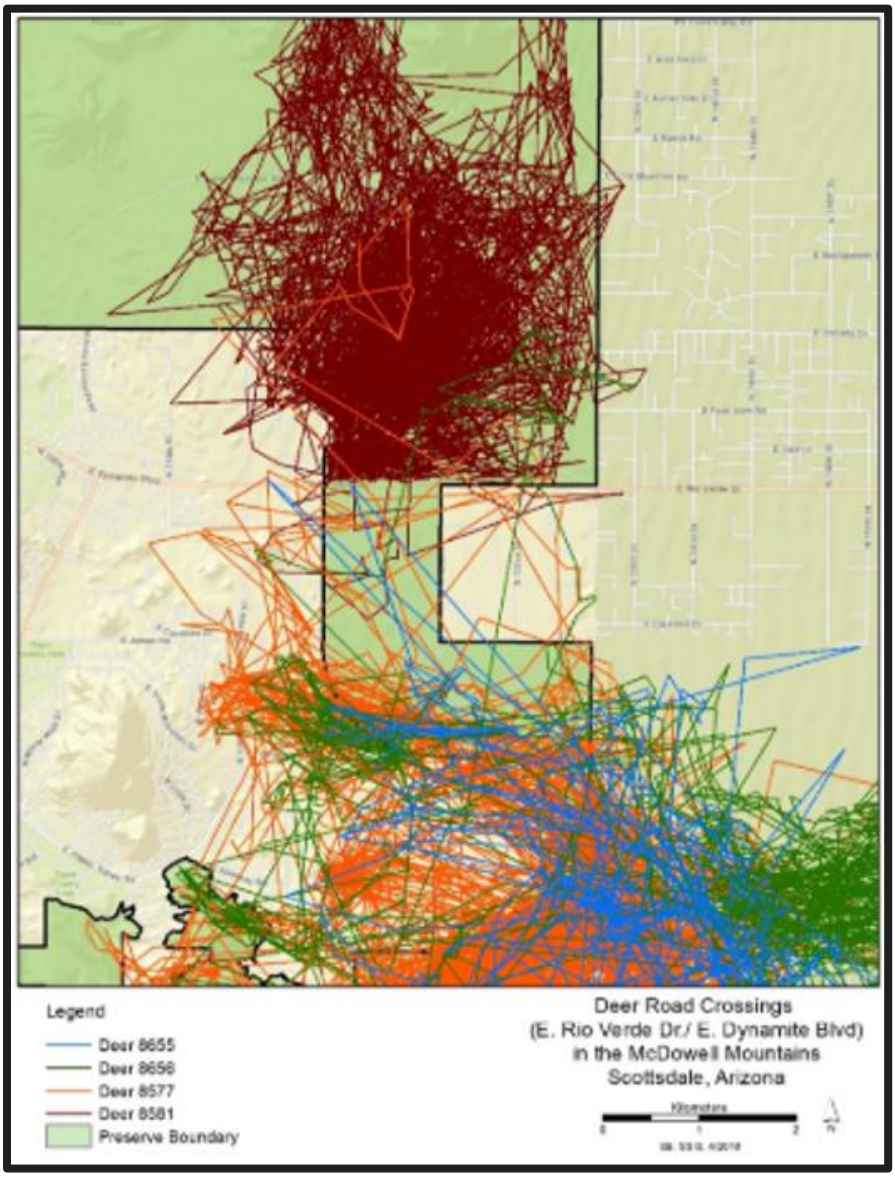


Figure 5: Mule Deer Movements and Roadway Crossings in the Vicinity of the "Gooseneck" Corridor (AZGFD, 2019)

Figure 5 depicts movement paths for four GPS-collared mule deer in the vicinity of Dynamite Boulevard and Rio Verde Drive, including documented roadway crossings on the evaluated roads. The GPS data documented 203 roadway-crossing events involving Dynamite Boulevard and Rio Verde Drive. Of these, 25 crossings were made by four individual mule deer within the "gooseneck" corridor area. The remaining 178 crossings were attributed to one male mule deer approximately seven kilometers east, near the Rio Verde community and the Golf Club (AZGFD, 2019). These data show extensive mule deer movement both north and south of the roadway network, but relatively few documented crossings within the "gooseneck" corridor compared with the number of roadway approaches.

To evaluate movement patterns, AZGFD deployed GPS collars on 38 mule deer and collected more than 167,000 location points over two years. Analysis of the telemetry data documented mule deer movements throughout the MSP and confirmed continued use of the "gooseneck" corridor as a connection between the northern and southern portions of the MSP.

While the roadway remained permeable during the study period, researchers identified Rio Verde Drive as a potential future constraint to wildlife movement as traffic volumes and development increase. The study concluded that connectivity across the corridor remained functional but recognized that this connection could become increasingly vulnerable if roadway expansion and surrounding development continue without mitigation measures.

In addition to evaluating roadway crossings, the study examined the influence of recreational use on mule deer habitat use. Results indicated that mule deer generally avoided areas immediately adjacent to trails, particularly during periods of high recreational activity, while utilizing those areas more frequently during nighttime hours when the MSP was closed. Researchers concluded that existing management measures, including restricting recreation to daylight hours, requiring visitors to remain on designated trails, prohibiting motorized vehicles, and requiring dogs to be leashed, help support wildlife use of the corridor and should be maintained.

The study ultimately concluded that the "gooseneck" corridor represents a critical wildlife linkage within the MSP and that maintaining permeability across Rio Verde Drive will be important for the long-term persistence of mule deer and other wildlife species. The report recommended that future transportation planning for Rio Verde Drive incorporate wildlife accommodations, including wildlife crossing structures and associated exclusion fencing, to maintain connectivity and reduce the potential for wildlife-vehicle collisions as development and traffic volumes increase.

This study provided direct evidence of wildlife movement through the "gooseneck" corridor and identified roadway interactions relevant to evaluating future wildlife accommodations along Rio Verde Drive.

Ongoing Population Monitoring

Since completion of the mule deer movement study, the AZGFD and its partners have continued monitoring wildlife populations within the MSP to evaluate long-term population trends and habitat connectivity. These efforts provide additional context for understanding the importance of maintaining wildlife movement through the "gooseneck" corridor and across Rio Verde Drive. Camera monitoring conducted as part of the MSC's 2019 McDowell Sonoran Preserve Corridor Viability Project Results and Summary documented extensive wildlife activity along Rio Verde Drive and within the MSP corridor. The study recorded 11,310 animal detections and identified 18 species, including 13 wild mammal species, two domestic mammal species, two bird species, and one amphibian species. Documented wildlife included mule deer, collared peccary, coyote, bobcat, gray fox, mountain lion, American badger, hooded skunk, striped skunk, northern raccoon, black-tailed jackrabbit, desert cottontail, American hog-nosed skunk, Gambel's quail, greater roadrunner, and Sonoran Desert toad, as well as domestic dog and domestic horse. These results further demonstrate that the Rio Verde Drive corridor supports frequent wildlife activity and a diverse wildlife community, including large mammals and carnivores that depend on landscape-scale movement opportunities (MSC, 2019).

These camera data are consistent with AZGFD population monitoring, which has documented that the MSP continues to support stable populations of large mammals, including mule deer and javelina. Annual aerial surveys conducted through a partnership between AZGFD, the City, and the MSC have been used to estimate deer and javelina abundance within the MSP and evaluate long-term population trends. The AZGFD estimated approximately 205 mule deer and 87 javelina within the MSP (MSC, 2024). Maintaining protected and connected habitat is an essential part of conserving ground-dwelling vertebrate populations (MSC, n.d.).

The AZGFD has noted that Rio Verde Drive represents a significant feature affecting wildlife movement within the MSP and has emphasized the importance of maintaining movement opportunities as traffic volumes increase. Ongoing monitoring efforts continue to identify the "gooseneck" corridor as a key linkage between major habitat blocks within the MSP and the surrounding regional open space network. As a result, wildlife crossings have been identified as an important future component of maintaining habitat connectivity and reducing the potential impacts of roadway fragmentation.

More than a decade of monitoring, wildlife surveys, movement studies, and population assessments collectively demonstrate that the MSP continues to function as an important wildlife habitat area and movement corridor. These ongoing efforts provide continued support for maintaining wildlife permeability across Rio Verde Drive to ensure long-term connectivity between the northern and southern portions of the MSP and adjacent protected lands.

Post-Construction Wildlife Monitoring and Data Collection

Recent development surrounding the MSP and increasing traffic volumes along Rio Verde Drive reinforce the need to maintain wildlife permeability through the "gooseneck" corridor. More than a decade of wildlife surveys, road mortality data, GPS telemetry, and population monitoring have already established the biological basis for wildlife crossing infrastructure along Rio Verde Drive. Future monitoring should therefore be understood as baseline and post-construction effectiveness monitoring rather than as additional data needed to justify the crossing.

The monitoring program is anticipated to include four primary components: (1) weekly road mortality surveys along Rio Verde Drive and North 128th Street; (2) deployment of additional GPS collars on mule deer within the "gooseneck" corridor and surrounding areas near Rio Verde Drive to compare habitat use and movement patterns with those documented by Sprague (2019); (3) review and assessment of trail camera data collected within the MSP; and (4) preparation of updated mapping and recommendations documenting movement paths and corridors, roadway approach and crossing locations, mortality hotspots, key habitat features; and wildlife crossing effectiveness (AZGFD, 2025).

Road mortality surveys should use the same methodology as the 2011–2012 wildlife linkage study, allowing future conditions to be compared against previously documented wildlife-vehicle collision patterns. GPS telemetry monitoring would expand previous mule deer movement research through deployment of additional satellite-linked collars capable of collecting movement data for up to three years. Trail camera data would provide additional information on wildlife use in portions of the "gooseneck" corridor where GPS collar deployment may be limited.

Post-construction monitoring should also recognize that wildlife use of the crossing structure may increase gradually over time. Although some animals may use a crossing shortly after construction, studies of wildlife crossing structures in Arizona have documented multi-year acclimation periods as animals learn crossing locations and adjust to associated exclusion fencing (Gagnon et al., 2011). Monitoring should therefore extend for multiple years after construction and should be used to evaluate crossing use, continued roadway mortality, fencing effectiveness, and any adaptive management measures needed to improve long-term performance.

Interpreting Future Wildlife-Crossing Data

In discussions regarding future monitoring, AZGFD representatives emphasized that repeating wildlife-use studies in the proposed crossing area may not provide a reliable measure of the area's underlying importance. As traffic volumes increase and development expands near Rio Verde Drive, wildlife may increasingly avoid approaching or crossing the roadway. A future study could therefore document fewer crossing attempts even while the roadway is becoming a more significant barrier to movement.

Reduced crossing activity should not necessarily be interpreted as reduced habitat value or reduced need for a wildlife crossing. Instead, it may reflect behavioral avoidance caused by traffic, noise, lighting, human activity, or other changes associated with roadway expansion and surrounding development. Some animals will likely continue attempting to cross, creating an ongoing risk of wildlife-vehicle collisions.

Providing a safe crossing in this location would help maintain and potentially restore the functional use of the corridor. By reconnecting habitat and providing a predictable, lower-risk crossing opportunity, the structure could encourage wildlife to continue using the established linkage rather than abandoning movement through the area. Monitoring should therefore evaluate not only the number of animals using the crossing, but also changes in roadway approaches, crossing attempts, mortality, fencing effectiveness, and broader movement patterns.

Wildlife Connectivity and Crossing Recommendations

More than a decade of wildlife research conducted within the MSP has consistently identified the “gooseneck” corridor as a critical wildlife linkage and Rio Verde Drive as a potential constraint to wildlife movement. Findings from road mortality surveys, wildlife track surveys, GPS telemetry studies, population monitoring, and connectivity assessments collectively demonstrate that wildlife continue to use the corridor and move between habitat blocks located north and south of Rio Verde Drive.

Without wildlife crossing infrastructure, increasing traffic volumes and continued development along Rio Verde Drive could further reduce wildlife movement through the “gooseneck” corridor and increase the risk of wildlife-vehicle collisions (Grandmaison, 2012). Roads can function as both direct sources of wildlife mortality and behavioral barriers that limit access to habitat, water, forage, and breeding opportunities (MSC, 2026). Over time, reduced movement across Rio Verde Drive could contribute to habitat fragmentation, population isolation, and loss of regional connectivity not only between the northern and southern portions of the MSP, but also between the MSP, McDowell Mountain Regional Park, and the Tonto National Forest (Gagnon et al., 2011). This could gradually diminish the corridor’s ecological value, reducing biodiversity and increasing the risk that isolated wildlife populations decline or disappear from portions of the landscape. These effects are particularly important in urban desert areas, where remaining habitat linkages are limited and isolated wildlife populations may become increasingly vulnerable to local extinction (AZGFD, n.d.). Incorporating wildlife crossing infrastructure and associated exclusion fencing would help reduce roadway mortality, improve motorist safety, and maintain the long-term ecological function of the MSP Wildlife Linkage (Gagnon et al., 2022).

The 2011–2012 Wildlife Linkage Study documented wildlife mortality hotspots along Rio Verde Drive that corresponded with areas of known wildlife activity within the corridor. Based on those findings, AZGFD concluded that maintaining permeability through the linkage would be important for sustaining wildlife movement and recommended wildlife crossing structures and associated fencing as an effective mitigation strategy. Recommended measures included crossings designed for a variety of wildlife species, exclusion fencing to guide animals toward crossing locations, and long-term monitoring to evaluate effectiveness (AZGFD, 2025).

Subsequent GPS telemetry research conducted between 2016 and 2018 confirmed that mule deer continued to move through the “gooseneck” corridor and successfully cross Rio Verde Drive. Although connectivity remained functional during the study period, researchers concluded that increasing traffic volumes and future development could reduce the effectiveness of the corridor if wildlife accommodations are not incorporated into future roadway improvements. The study emphasized the importance of maintaining wildlife permeability across Rio Verde Drive and recommended that wildlife crossings and associated funnel fencing be considered in future transportation planning efforts.

More recent monitoring efforts have continued to support these conclusions. The 2019 Corridor Viability Project further supports this conclusion, documenting more than 11,000 animal detections and 18 identified species along Rio Verde Drive and within the MSP corridor, including mule deer, javelina, bobcat, coyote, gray fox, mountain lion, and other medium- to large-bodied mammals (MSC, 2019). AZGFD presentations and population assessments have identified Rio Verde Drive as a feature that influences wildlife movement within the MSP and have highlighted wildlife crossings as an important tool for maintaining connectivity between protected habitat blocks as traffic volumes increase. Researchers have noted that the MSP already contains the key components necessary for long-term connectivity, including large habitat blocks and an established wildlife corridor, and that wildlife crossing infrastructure would help maintain movement across Rio Verde Drive and reduce the effects of habitat fragmentation.

Taken together, more than a decade of wildlife research, monitoring, and population assessments provide a strong biological foundation for wildlife crossing improvements within the "gooseneck" corridor. Multiple investigations have documented wildlife use of the corridor, identified roadway crossing activity and mortality hotspots, and recommended measures to maintain connectivity across Rio Verde Drive. These findings support the incorporation of wildlife crossing infrastructure and associated exclusion fencing into future transportation improvements to reduce wildlife-vehicle collisions, preserve regional habitat connectivity, and maintain the long-term ecological function of the MSP.

Case Study Evidence Supporting the Proposed Wildlife Overpass

Two Arizona case studies provide strong support for using a dedicated wildlife overpass to reduce wildlife–vehicle collisions while maintaining habitat connectivity. Together, the studies demonstrate that crossing structures can restore movement across highways, accommodate multiple species, and substantially improve roadway safety when they are properly sited, connected to exclusionary fencing, and monitored over time.

The strongest direct precedent is the US Highway 93 project in Arizona, where Gagnon et al. (2022) evaluated three wildlife overpasses, two bridges, three culverts, and associated ungulate-exclusion fencing. The project addressed both an immediate safety problem and a broader ecological concern: the highway had fragmented bighorn sheep habitat and previously averaged approximately 12 sheep–vehicle collisions per year. GPS data indicated that 82% of sheep highway crossings occurred at five major ridges, allowing managers to place crossing structures within established movement corridors. **This evidence-based siting strategy is directly applicable to the proposed overpass, which should likewise be located where wildlife movement data, topography, habitat continuity, and collision records indicate the greatest need.**

The results from US Highway 93 were substantial. During four years of post-construction monitoring, cameras recorded 6,936 wildlife crossings involving 12 species. Bighorn sheep accounted for approximately 95% of all recorded crossings, and 90% of sheep crossings occurred on the three overpasses rather than at the nearby bridges and culverts. Overpass use increased by 905% during the first year, demonstrating both strong structural preference and a period of behavioral adjustment following construction (Gagnon et al., 2022). **Most importantly, sheep–vehicle collisions declined from approximately 12 per year before construction to 0.8 per year after implementation, representing a 93.3% reduction. This finding provides compelling evidence that an overpass can function not merely as a conservation feature, but as a measurable transportation-safety investment.**

The study also identifies several design and management principles relevant to the proposed project. Wider overpasses initially received higher passage rates: sheep used the 30-meter-wide (approximately 100-foot-wide) structure at rates 83% and 175% higher than the two 15-meter-wide (approximately 50-foot-wide) structures. Although use among the structures became more similar by the fourth year, the early preference for greater openness suggests that width, visibility, and a natural appearance should be considered during design. The authors further emphasize that overpasses are most effective when paired with continuous exclusionary fencing. Fencing directs animals toward safe crossing points and prevents them from bypassing the structures to enter the roadway. At US Highway 93, continued monitoring identified fence breaches and other access points, allowing managers to make targeted corrections and further reduce collisions (Gagnon et al., 2022).

A second Arizona study reinforces the importance of design, placement, fencing, and long-term monitoring. Gagnon et al. (2011) evaluated six wildlife underpasses along State Route 260 using more than 9,000 hours of video surveillance. The researchers documented 15,134 visits by 21 species, with 72.4% of visits resulting in a successful crossing. Elk, white-tailed deer, mule deer, coyotes, foxes, raccoons, and other species all used the structures, demonstrating that properly designed wildlife crossings can improve landscape permeability for multiple species rather than serving only one target animal.

The State Route 260 findings are especially important for project expectations and evaluation. Elk crossing probabilities generally increased over time, reaching greater than 0.70 at four of five monitored underpasses by the fourth year. The researchers concluded that wildlife may require several years to habituate to a new crossing structure, and that early monitoring results should not be treated as a final measure of project success. At the same time, structure placement and design remained important throughout the monitoring period. Structures with better visibility through the crossing and less apparent predator risk were used more successfully, while a structure located near regular human activity had substantially lower elk use. These findings support designing the proposed overpass with clear sightlines, minimal visual obstruction, and naturalistic approaches.

Collectively, these case studies support the proposed overpass on three grounds. First, an overpass can substantially reduce wildlife–vehicle collisions when it is located along established movement routes and linked with exclusionary fencing. Second, an overpass can restore functional connectivity across a highway, allowing animals to access seasonal habitat, maintain movement between habitat blocks, and reduce the barrier effects of transportation infrastructure. Third, success should be evaluated through a long-term adaptive-monitoring program that tracks wildlife use, fence performance, collision rates, and species-specific responses. The evidence from US Highway 93 is particularly persuasive because it documents both a strong preference for overpasses and a 93.3% reduction in collisions.

Accordingly, the proposed overpass should be treated as an integrated mitigation system rather than as an isolated bridge. Its effectiveness will depend on four interconnected elements: placement within a documented wildlife movement corridor, an open and appropriately sized crossing design, continuous fencing that funnels animals toward the structure, and several years of post-construction monitoring with corrective management. The Arizona case studies show that this approach can produce measurable safety benefits while reconnecting fragmented wildlife habitat (Gagnon et al., 2011; Gagnon et al., 2022).

See Appendix A for a bibliography of all cited literature.

TECHNICAL OVERVIEW

Existing Roadway

Rio Verde Drive is an existing rural roadway with two 11'-0" travel lanes and two 8'-0" shoulders.

Existing Drainage

Rio Verde Wash 10 Tributary 4 is running parallel to Rio Verde Drive in the project limits. The wash is a tributary to Rio Verde Wash 10 which crosses Rio Verde Drive near the intersection with 128th Street. Rio Verde Wash 10 Tributary 4 is conveying 820 cubic feet per second (cfs) in the 100-year storm event. The wash is a Federal Emergency Management Agency (FEMA) Zone AE floodplain near the intersection with 128th Street. See Figure 6 below.

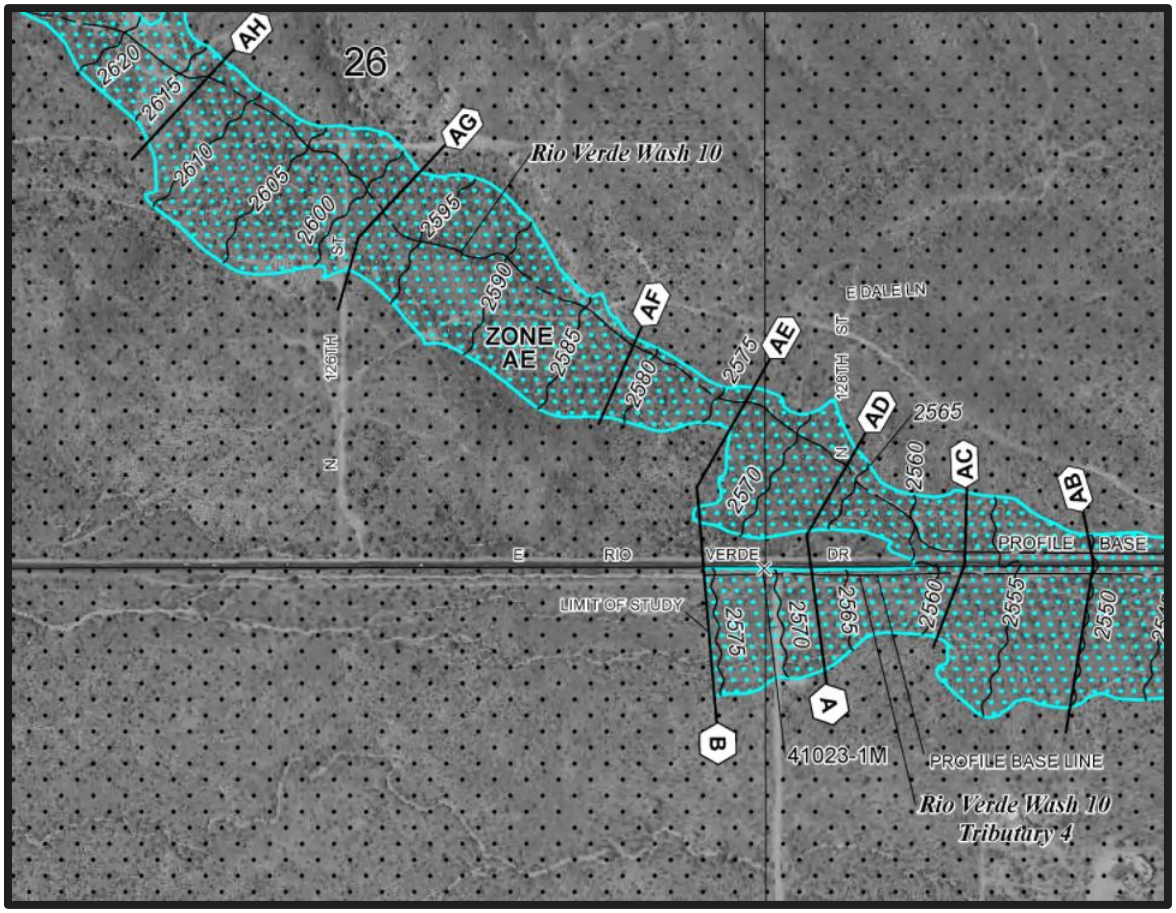


Figure 6: Rio Verde Wash 10

Onsite runoff from Rio Verde Drive is conveyed in roadside ditches which ultimately outfall into Rio Verde Wash 10 Tributary 4.

Existing Utilities

There are multiple utilities on the south side of Rio Verde Drive: two overhead APS power lines, three buried communication lines (Lumen, Cox, and Zayo), and one buried Southwest gas line.

Existing Right Of Way

The construction of this project will be within the current City of Scottsdale Right of Way.

Traffic Growth

Rio Verde Drive is a two-lane rural roadway with a posted speed of 50 mph and carries a daily traffic volume of 17,575 vehicles per day (vpd) based on counts from 2025 near 136th Street. Additional counts collected west of 118th Street show a daily traffic volume of 14,724 vpd in 2023. City of Scottsdale traffic data estimated an annual average daily traffic (AADT) on Rio Verde Road of 10,800 vpd in 2016 and 12,300 vpd in 2024, representing a 13% overall increase in traffic volume since 2016, and an average annual growth rate of 1.5%. Based on the average annual growth rate of 1.5% and the collected volumes from 2023 and 2025, the 2050 traffic volumes are estimated to be between 22,000 and 25,500 vehicles per day.

Crossing Location

Per coordination with the City and AZGFD, the proposed location for the wildlife crossing was identified based on previous research as well as the existing topography of the area. The proposed location utilizes the existing hillside on the north side of Rio Verde Drive to reduce the amount of embankment fill that will be required.

Design Specifications

The technical design specifications and guidelines followed in this wildlife crossing evaluation are:

- *AASHTO LRFD Bridge Design Specifications, 8th Edition, 2017,* except as modified by ADOT Bridge Group – *"Bridge Design Guidelines"*
- *Manual for Bridge Evaluation, 3rd Edition 2017,* with 2022 Interim Revisions, except as modified by the ADOT Bridge Group – "*Bridge Load Rating Guidelines*"
- *FHWA Wildlife Crossing Structure Handbook, March 2011*
- *AASHTO A Policy on Geometric Design of Highways and Streets, 7th Edition, 2018*
- *AASHTO Roadside Design Guide, 4th Edition, 2011*
- *City of Scottsdale Design Standards and Policies Manual, 2018*

Proposed Roadway

The ultimate Rio Verde Drive improvements will follow the City of Scottsdale Minor Arterials – Rural/ESL Character cross section with two travel lanes and a bike lane in each direction separated by a center median (see Figure 7 below).

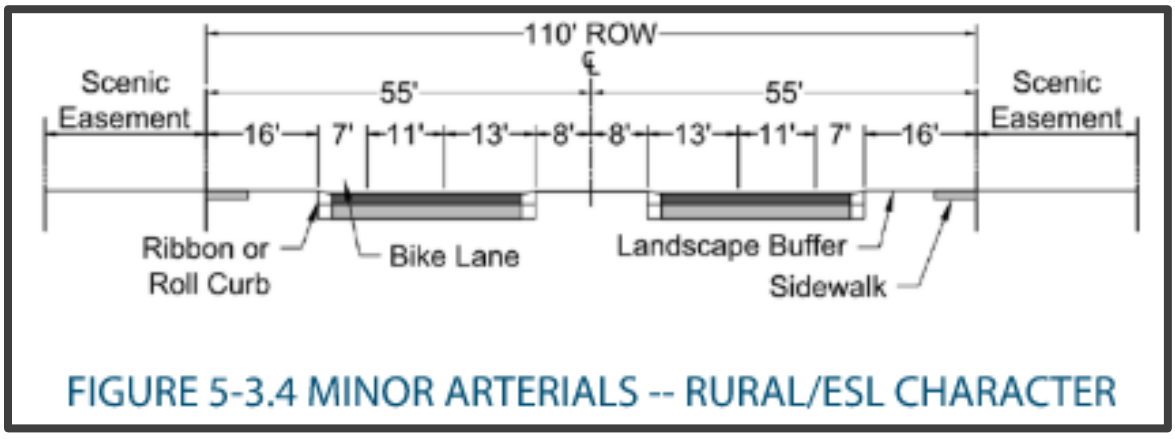


Figure 7: City of Scottsdale Minor Arterials - Rural/ESL Character

Rio Verde Drive is a tangent along the section line. The minimum vertical clearance under the structure is 18'-6". The horizontal clearance from the edge of travel lane to the structure is 22'-0", placing it outside the clear zone for Rio Verde Drive traffic.

Drainage

New drainage infrastructure will be required to convey runoff from Rio Verde Wash 10 Tributary 4 under the proposed embankment on the south side of Rio Verde Drive. Drainage infrastructure includes a box culvert with wingwalls and riprap outlet protection.

Utilities

There are two overhead APS power lines on the south side of Rio Verde Drive which will be relocated with this project. There are three buried communication lines (Lumen, Cox, and Zayo) on the south side of Rio Verde Drive which will be relocated with this project. There is one buried Southwest gas line on the south side of Rio Verde Drive which will be relocated with this project.

Aesthetics

A line item has been included in the preliminary cost estimate. Design and implementation of aesthetics will occur during final design of the crossing.

Lighting

In coordination with the City and AZGFD, it was decided to not include lighting under the wildlife crossing. Lighting during nighttime hours may deter wildlife from using the crossing. Adequate reflectors and delineators will be used to guide traffic as they pass under the wildlife crossing.

Bridge Hydraulics

Deck drains through the deck will not be required on this structure. The bridge deck will drain out towards the edge of the deck. The water will be conveyed along the barrier and off the structure at the end of the bridge.

Retaining Walls

Retaining walls are assumed to be mechanically stabilized earth (MSE) wall type with either concrete panels or open wired baskets with rock infill for this study. Cast-in-place reinforced concrete cantilever retaining walls would also be a viable option. Final wall type will be determined during final design.

Wildlife Crossing Grades and Width

Per the AZGFD, wildlife crossings should have a clear width of 100' to 175'. The proposed wildlife crossing has a clear width of 130'-2" with a cross slope of 1%. The approach embankment slope has a max slope of 3:1 except for the trail slope, which is 6:1 max.

Wildlife Fencing, Cattle Guards, and Escape Ramps

Kimley-Horn coordinated with the City and AZGFD regarding the recommendations of wildlife fencing, cattle guards, and ramps.

Fencing was kept parallel to Rio Verde Drive to reduce the length of the "pinch point" at the crossing. The intent is to increase the wildlife's feelings of openness on either side of the crossing. Fencing extends the length of the City's right-of-way on either side of the crossing and both sides of Rio Verde Drive. It is recommended that wildlife fencing include a fine steel mesh in the lower portion of the fence to deter small animals from crossing onto the road.

Cattle guards were placed in line with the fence at all vehicular access points onto Rio Verde Drive.

Escape ramps were placed at an equal spacing using recommendations from AZGFD.

Pedestrian Trail Access and Safety

Currently, pedestrian trail users are crossing at the unsignalized intersection of 128th Street and Rio Verde Drive. This unsignalized at-grade crossing is dangerous for both drivers and pedestrians, especially considering the anticipated future vehicular traffic on Rio Verde Drive.

Three different alternatives were discussed with the City and AZGFD for maintaining the Gooseneck Trail connectivity across Rio Verde Drive: an at-grade crossing including a HAWK signal; a pedestrian bridge structure separate from the wildlife crossing; and incorporating the pedestrian crossing on the same structure as the wildlife crossing. Ultimately, the City decided to incorporate the Gooseneck Trail crossing with the wildlife crossing. This will eliminate the cost of a second structure and the safety concerns with an at-grade crossing. Per AZGFD, incorporating the pedestrian crossing with the wildlife crossing should not hinder wildlife connectivity. AZGFD noted that wildlife in the area is accustomed to urban activity, and pedestrian and wildlife usage is typically during different times of day (daylight hours vs overnight).

Constructability

Construction of the wildlife crossing will require limited closures of Rio Verde Drive at critical points during construction.

Preliminary Structure Alternatives

Precast Arch

A precast concrete arch structure would include reinforced concrete headwalls/wingwalls supported on a reinforced concrete abutment wall. This alternative would include retaining walls supporting the embankment fill slopes leading to and from the crossing. To maintain vertical clearance, a precast arch would require a taller structure than a comparable concrete girder bridge. A single-span arch would need a clear span of at least 108ft to keep the structure out of the clear zone of Rio Verde Drive. The span limit of a precast arch is around 100ft. A two-span arch would place substructure elements within the median of Rio Verde Drive and would need to be protected since it is not outside of the clear zone. A precast arch structure would also introduce drainage concerns. Due to these concerns, the precast concrete arch structure alternative was ruled out early in the evaluation.

Precast Prestressed Concrete Girder Bridge

A precast, prestressed concrete girder bridge will require (18) BT74 girders spaced at 8’-5” on center supported on reinforced concrete abutments. The total out-to-out width of the superstructure will be 147’-6” with a superstructure depth of 7’-3”. The bridge superstructure will have an 8” thick composite cast-in-place concrete deck. This alternative includes retaining walls supporting the embankment fill slopes leading to and from the crossing.

The use of precast girders allows for a speedier construction timeline. The use of precast elements minimizes the need for falsework, and it has been shown that the BT girders are an efficient shape and allow shallower depths for longer span lengths. Additionally, superstructure construction is not dependent on the erection of falsework, allowing for simultaneous construction of bridge substructure and fabrication of precast elements.

Recommended Structure for Crossing

The recommended structure for this crossing is a single-span precast prestressed concrete girder superstructure with a cast-in-place reinforced concrete deck and barriers supported on reinforced concrete abutments. See Figure 8 below for a rendering of the proposed wildlife crossing.



Figure 8: Rendering of Proposed Wildlife Crossing

Construction Cost Estimates

Preliminary design (15%) level quantities and itemized construction cost estimates for the crossing can be found in Appendix B. Estimated construction costs are based on current bid prices found in the ADOT Historical Bid Lookup on the ADOT website and recently bid construction projects in the area. The cost estimate represents an estimated total construction cost of the crossing based on preliminary engineering and includes a 3-yr annual escalation of 5.0% for anticipated construction in 2029.

Construction Subtotal (2026 $) =	$17,581,640
Unidentified Item Allowance (20%) =	$3,516,000
Construction Total (2026 $) =	$21,097,640
3-yr Annual Cost Escalation (5%/yr) =	$3,325,520
Construction Total (2029 $) =	$24,423,160

ADOT recently designed a wildlife crossing over I-17 near Munds Park that has many similar features to the proposed Rio Verde wildlife crossing. The bids for this project were opened on Feb 28th, 2025, and is currently under construction. ADOT's construction estimate was $16,282,255. Adding a 2-yr, 5% cost escalation per year to ADOT's construction estimate results in a cost of $17,951,200 in current $'s.

Wildlife Crossing Preliminary Design Plans

Preliminary design plans for the wildlife crossing can be found in Appendix C.

APPENDIX A – LITERATURE CITED

Arizona Game and Fish Department. 2012. *Identification of Wildlife Road Mortality Hotspots and Wildlife Activity Patterns Within the Scottsdale MSP Wildlife Linkage.*

Arizona Game and Fish Department. 2019. *Mule Deer Corridor and Habitat Use in the MSP.*

Arizona Game and Fish Department. 2025. *Rio Verde Drive and the McDowell Sonoran Preserve Gooseneck Corridor Supplemental Wildlife Movement Data Collection.*

Gagnon, J. W., Dodd, N. L., Ogren, K. S., & Schweinsburg, R. E. (2011). "Factors Associated with Use of Wildlife Underpasses and Importance of Long-Term Monitoring." *The Journal of Wildlife Management* 75(6): 1477–1487.

Gagnon, J. W., Loberger, C. D., Ogren, K. S., Sprague, S. C., Boe, S. R., & Schweinsburg, R. E. (2022). "Mitigating Bighorn Sheep-Vehicle Collisions and Habitat Fragmentation with Overpasses and Adaptive Mitigation." *Human-Wildlife Interactions* 16(3), early online.

Gagnon, J. W., & Knutson, K. (n.d.). *Importance of Wildlife Overpasses for Connectivity.* Arizona Game and Fish Department.

Grandmaison, D. D. 2012. *Identification of Wildlife Road Mortality Hotspots and Wildlife Activity Within the McDowell Sonoran Preserve Wildlife Linkage.* Arizona Game and Fish Department.

Huijser, M. P., P. McGowen, J. Fuller, A. Hardy, A. Kociolek, A. P. Clevenger, D. Smith, and R. Ament. 2008. Wildlife–vehicle collision reduction study: best practices manual: report to Congress. U.S. Department of Transportation, Federal Highway Administration, Washington, D.C., USA.

MSC. 2019. *McDowell Sonoran Preserve Corridor Viability Project Results and Summary.*

MSC. 2024. *Mule Deer Corridor and Habitat Use in McDowell Sonoran Preserve.* https://www.mcdowellsonoran.org/wp-content/uploads/2024/01/Deer-telemetry_Sprague.pdf.

MSC. 2026. *Wildlife Connectivity Assessment Along Rio Verde Drive: Final Report.* August 10, 2026.

MSC. (n.d.). "Wildlife Camera Project." https://www.mcdowellsonoran.org/wildlife-camera/.

Pima Association of Governments. (2025, September 15). *RTA at 20: Regional Transportation Authority Plan delivered improvements across region.* https://pagregion.com/news/rta-at-20-regional-transportation-authority-plan-delivered-improvements-across-region/.

APPENDIX B – ESTIMATED QUANTITIES AND CONSTRUCTION COST

Kimley»Horn

City Project No. PP2610
Project Name: Rio Verde Wildlife Crossing
Bid Advertisement:

Project Location : Rio Verde Dr
Project Description : Wildlife Crossing
Project Manager :

ENGINEER'S OPINION OF PROBABLE COST - October 29, 2026

Item No.	Item Description	Unit	15% Quantity	DATE: 10/29/2026 Unit Price	Amount
105801	CONSTRUCTION SURVEYING[1]	LS	1	$ 75,000.00	$ 75,000.00
105820	AS-BUILTS[2]	LS	1	$ 25,000.00	$ 25,000.00
108001	SUPERVISION[3]	MO	14	$ 75,000.00	$ 1,050,000.00
108101	GENERAL REQUIREMENTS[4]	MO	14	$ 25,000.00	$ 350,000.00
108201	DUST CONTROL PERMIT	LS	1	$ 5,000.00	$ 5,000.00
108202	DUST CONTROL EQUIPMENT	MO	14	$ 15,000.00	$ 210,000.00
108203	DUST CONTROL WATER	MO	14	$ 1,500.00	$ 21,000.00
201005	CLEARING & GRUBBING	LS	1	$ 71,037.68	$ 71,038.00
211001	EMBANKMENT FILL	CY	42,364	$ 30.00	$ 1,270,920.00
301201	SUBGRADE PREPARATION	SY	3,000	$ 10.00	$ 30,000.00
310109	9" AGGREGATE BASE COURSE	SY	3,000	$ 25.00	$ 75,000.00
321114	2" ASPHALT CONCRETE (1/2" MIX) (EVAC)	SY	3,000	$ 20.00	$ 60,000.00
321126	3" ASPHALT CONCRETE (3/4" MIX) (EVAC)	SY	3,000	$ 40.00	$ 120,000.00
329101	TACK COAT	SY	3,000	$ 1.00	$ 3,000.00
340021	RIBBON CURB, MAG 220 TYPE "B"	LF	1,000	$ 65.20	$ 65,200.00
340041	ROLL CURB & GUTTER, MAG 220 TYPE "C"	LF	1,000	$ 76.05	$ 76,050.00
340204	CONCRETE SIDEWALK, MAG 230	SF	6,000	$ 11.71	$ 70,260.00
350001	REMOVE AC PAVEMENT	SY	2,301	$ 25.00	$ 57,525.00
350634	UNDERGROUND/RELOCATE FIBER	LF	1,500	$ 50.00	$ 75,000.00
350639	RELOCATE UNDERGROUND LUMEN	LF	1,500	$ 50.00	$ 75,000.00
350640	RELOCATE UNDERGROUND APS	LF	1,500	$ 300.00	$ 450,000.00
350641	RELOCATE UNDERGROUND COX	LF	1,500	$ 50.00	$ 75,000.00
350642	RELOCATE UNDERGROUND SWG	LF	1,500	$ 200.00	$ 300,000.00
401001	TRAFFIC CONTROL[5]	LS	1	$ 460,000.00	$ 460,000.00
401003	TRAFFIC SIGNAGE	LS	1	$ 20,000.00	$ 20,000.00
401004	PAVEMENT MARKING	LS	1	$ 20,000.00	$ 20,000.00
403710	MISCELLANEOUS WORK (DRAINAGE IMPROVEMENTS)	LS	1	$ 400,000.00	$ 400,000.00
420008	WILDLIFE FENCE	LF	13,361	$ 50.00	$ 668,050.00
420009	PAINT RAILINGS/FENCE	LF	262	$ 25.00	$ 6,550.00
420041	CATTLE GUARD (DOUBLE)	EA	2	$ 50,000.00	$ 100,000.00
420042	ESCAPE RAMP	EA	7	$ 45,000.00	$ 315,000.00
430001	DECOMPOSED GRANITE, COS 2620	SY	866	$ 25.00	$ 21,650.00
430008	HYDROSEEDING	SY	65,754	$ 4.50	$ 295,893.00
430835	LANDSCAPE RESTORATION	SF	20,000	$ 10.00	$ 200,000.00
505905	STORM WTR POLUTION PREVENTATION PLAN[6]	LS	1	$ 75,000.00	$ 75,000.00
800001	MOBILIZATION[7]	LS	1	$ 460,000.00	$ 460,000.00
	ROADWAY, TRAFFIC, LANDSCAPE & AESTHETICS CONSTRUCTION SUBTOTAL				**$ 7,652,136.00**
	Wildlife Crossing Bridge				
206001	STRUCTURAL EXCAVATION	CY	52	$ 200.00	$ 10,400.00
206101	STRUCTURAL BACKFILL	CY	1,972	$ 200.00	$ 394,400.00
403709	MISCELLANEOUS WORK (BRIDGE DECK WATERPROOFING)	LS	1	$ 75,000.00	$ 75,000.00
403712	MISCELLANEOUS WORK (DRAINAGE SYSTEM)	SF	20,917	$ 5.00	$ 104,585.00
430836	LANDSCAPE RESTORATION (BRIDGE)	LS	1	$ 100,000.00	$ 100,000.00
502054	DRILLED SHAFT FOUNDATION (72")[8]	LF	840	$ 1,250.00	$ 1,050,000.00
505200	108" CONCRETE BARRIER	LF	145	$ 500.00	$ 72,500.00
505202	COMB PED TRAFFIC BRIDGE RAILING W/FENCE	LF	263	$ 950.00	$ 249,850.00
505204	RESTRAINERS VERT EARTHQUAKE FIXED	EA	16	$ 325.00	$ 5,200.00
505205	RESTRAINERS VERT EARTHQUAKE EXP	EA	16	$ 850.00	$ 13,600.00
505208	DECK JT ASSY (FLANGELESS STRIP SEAL) ADOT SD 3.03	LF	289	$ 700.00	$ 202,300.00
505209	JOINT SEALANTS	LS	1	$ 25,000.00	$ 25,000.00
505501	REINFORCING STEEL	LB	313,900	$ 1.50	$ 470,850.00
505604	STRUCTURAL CONCRETE CLASS S 3,500 psi	CY	439	$ 1,200.00	$ 526,800.00
505605	STRUCTURAL CONCRETE CLASS S 4,500 psi	CY	843	$ 1,500.00	$ 1,264,500.00
505621	APPROACH SLAB (ADOT SD 2.01)	SF	4,428	$ 50.00	$ 221,400.00
505850	ARCHITECTURAL SURFACE TREATMENTS	LS	1	$ 200,000.00	$ 200,000.00
505902	MSE WALL	SF	19,463	$ 170.00	$ 3,308,710.00
506220	PRECAST, P/S MEMBER (BULB TEE GIRDER 74")	LF	2,043	$ 800.00	$ 1,634,400.00
	BRIDGE CONSTRUCTION SUBTOTAL				**$ 9,929,495.00**

Kimley»Horn

City Project No. PP2610
Project Name: Rio Verde Wildlife Crossing
Bid Advertisement:

Project Location : Rio Verde Dr
Project Description : Wildlife Crossing
Project Manager :

ENGINEER'S OPINION OF PROBABLE COST - October 29, 2026

Item No.	Item Description	Unit	15% Quantity	Unit Price	DATE: 10/29/2026 Amount
	CONSTRUCTION SUBTOTAL				**$ 17,581,631.00**
	UNIDENTIFIED ITEM ALLOWANCE (20%)				$ 3,516,000.00
	CONSTRUCTION TOTAL (2026)				**$ 21,097,631.00**
	3-YEAR ANNUAL COST ESCALATION (5.00%/YEAR)				$ 3,325,519.00
	CONSTRUCTION TOTAL (2029)				**$ 24,423,150.00**
	OVERHEAD (5.00%)				$ 879,081.55
	INSURANCES (2.50%)				$ 439,540.78
	PAYMENT & PERFORMANCE BOND				$ 307,658.00
	CONSTRUCTION FEE (5.00%)				$ 879,081.55
	SALES TAX (5.23%)				$ 919,519.30
	INSURANCE, TAXES, FEES				**$ 3,424,881.18**
	DESIGN				$ 1,250,000.00
	POST-DESIGN				$ 250,000.00
	UTILITY RELOCATION DESIGN FEES[9]				$ 1,000,000.00
	CITY FEES				$ 171,760.00
	PUBLIC ART				$ 313,790.51
	PROJECT TOTAL (2029)				**$ 30,833,581.69**

CHANGES PER COORDINATION WITH CITY

1. Construction Surveying: *Revised to match City Estimate.*
2. As-Builts*: Revised to align with City estimate.*
3. Supervision: *Adjusted to reflect an anticipated 14-month construction duration.*
4. General Requirements: *Adjusted to reflect an anticipated 14-month construction duration.*
5. Traffic Control: *Revised to match City estimate.*
6. SWPPP: *Revised to match City estimate.*
7. Mobilization: *Revised to match City estimate and rounded.*
8. Drilled Shafts*: Revised unit price to align with City estimate and rounded.*
9. *Utility Relocation Design Fees: Assumes utilities have prior rights.*

APPENDIX C – WILDLIFE CROSSING PRELIMINARY DESIGN PLANS

CITY OF SCOTTSDALE

PUBLIC IMPROVEMENTS

COUNCIL
LISA BOROWSKY, MAYOR
JAN DUBAUSKAS
BARRY GRAHAM
ADAM KWASMAN
KATHY LITTLEFIELD
MARYANN MCALLEN
SOLANGE WHITEHEAD

CITY MANAGER
GREG CATON

CITY ATTORNEY
LUIS E. SANTAELLA

CITY CLERK
BEN LANE

"AS-BUILT" CERTIFICATION

I HEREBY CERTIFY THAT THE "AS-BUILT" IMPROVEMENTS AS SHOWN HEREON ARE LOCATED AS NOTED, AND THE LOCATIONS ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

REGISTERED LAND SURVEYOR _____ DATE _____

CITY OF SCOTTSDALE

REVIEWED AND RECOMMENDED APPROVAL BY:

PAVING		STRUCTURES	
GRADING & DRAINAGE		BUILDING	
WATER & SEWER		PLUMBING	
TRAFFIC		MECHANICAL	
PLANNING IMPROVEMENTS		ELECTRICAL	
PLANNING FACILITIES		FIRE IMPROVEMENTS	
LANDSCAPE		FIRE FACILITIES	
NATIVE PLANT			

ENGINEERING COORDINATION MANAGER (OR DESIGNEE) _____ DATE _____

BUILDING OFFICIAL (OR DESIGNEE) _____ DATE _____

Contact Arizona 811 Two Working Days Before You Dig
ARIZONA811 BLUE STAKE, INC.
Call 811 or Click Arizona811.com

ENGINEER

Kimley»Horn

©2026 KIMLEY-HORN AND ASSOCIATES, INC.

RIO VERDE
WILDLIFE CROSSING FEASIBILITY STUDY
TRANSPORTATION & INFRASTRUCTURE
PROJECT NO. PP2610

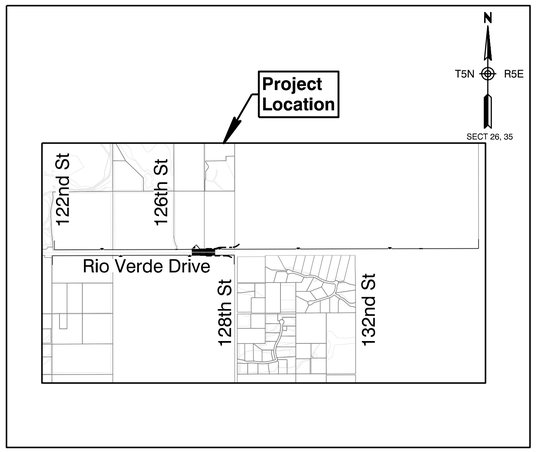
NO CONFLICT SIGNATURE BLOCK				
Utility	Utility Company	Name of Company Representative	Telephone Number	Date Signed
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-
XXX	XXX	XXX	XXX	-

Engineer's Certification

I _____, as the Engineer of Record for this development, hereby certify that all utility companies listed above have been provided final improvement plans for review, and that all conflicts identified by the utilities have been resolved. In addition, "No Conflict" forms have been obtained from each utility company and are included in this submittal.

Signature _____ Date _____

TOWNSHIP 5N, RANGE 5E, SEC 26, 35



Vicinity Map
N.T.S.

PRELIMINARY DESIGN
JULY 2026

SHEET INDEX

Sht. No.	Dwg. No.	Description
1	G10	COVER
2	G20	NOTES SHEET
3	G30	GEOMETRIC CONTROL SHEET
4	G40	TYPICAL SECTION
5	P01	ROADWAY PLAN & PROFILE
6-7	P02-P03	FENCE PLAN SHEETS
8-11	P04-P07	DETAIL SHEETS
12-13	S01-S02	STRUCTURE SHEETS

City of Scottsdale approved plans shall be kept on the job site at all times during the course of construction.

RIO VERDE - WILDLIFE CROSSING FEASIBILITY STUDY
PROJECT NO. PP2610 TRANSPORTATION & INFRASTRUCTURE

DR/STAFF APPROVAL NO.

PLAN REVIEW NO.

SHT. G10

GENERAL CONSTRUCTION NOTES FOR CAPITAL PROJECTS

1. All improvement construction shall comply with the 2020 Maricopa County Association of Governments Standard Specifications and Details for Public Works Construction as amended by the latest version of the City of Scottsdale Supplemental Standard Specifications and Details and City of Scottsdale's Design Standards & Policies Manual (DS&PM). If there is a conflict, the latter shall apply. All facilities construction shall comply with the latest building codes as amended and adopted by the City of Scottsdale.
2. The engineering designs on these plans are approved by the City in scope and not in detail. If construction quantities are shown on these plans, they are not verified by the City.
3. Based on the information submitted on the plans and associated documents, the City has reviewed and found them to be in accordance with the Scottsdale Revised Code and are acceptable for permit issuance. This acceptance by the City does not authorize violations of any applicable code, ordinance or standard as adopted by the Scottsdale Revised Code.
4. Approval of the plans by the City is valid for six months. If a permit for the construction has not been issued within six months of review, the plans shall be resubmitted to the City for reapproval.
5. Any deviation from the approved plans shall be reviewed and approved by the City prior to that change being incorporated into the project.
6. A City Capital Projects Inspector will inspect all work within the City rights-of-way, easements and facilities.
7. Any Special Inspection required shall be in addition to any routine inspection by the City.
8. City encroachment and building permits are required for work in public rights-of-way, easements granted for public purposes and facilities. Permits will be issued by the City through the City's One Stop Shop. Copies of all permits shall be retained on-site and shall be available for inspection at all times. Failure to produce the required permits will result in immediate work stoppage until the proper permit documentation is obtained.
9. The Contractor shall be responsible for obtaining all necessary permits for salvaging protected native plants prior to the start of construction.
10. Contractor shall contact AZ 811 two full working days prior to beginning excavation.
11. All excavation and grading which is not in public rights-of-way or in easements granted for public purposes must conform to Section 1803 and Appendix J of the latest International Code Council as adopted and amended by the City of Scottsdale. A permit for this grading must be secured from the City.
12. Thrust restraint, where required, on all City water lines shall be provided using Megalug mechanical joint restraints or City-approved equal.
13. Any asphalt mix design used on City projects shall have been approved for that use per Section 5-10 of the City's DS&PM and appear on the "Approved List of Asphalt Mixes" as distributed by the East Valley Asphalt Committee (EVAC).
14. The Contractor shall be responsible to remove and replace, at no additional cost to the City, any and all pavement, sidewalk, curb and gutter, drainage structures, etc. outside the pay limit that are damaged due to their activities on the project. This includes, but is not limited to, the removal and replacement of newly cracked roadway infrastructure, the removal and replacement of existing cracked roadway infrastructure where the cracks have been enlarged due to the Contractor's operations, the removal and replacement of deformed roadway infrastructure. All sawcuts used for the removal of these items shall be perpendicular and parallel to the centerline controlling that item, or at the direction of the City's Capital Projects Inspector.
15. All Capital Improvement Projects shall meet the procedures and standards for the use of temporary/security fencing around the perimeter of construction sites, as defined in the City's Zoning Ordinance, Article VII, Section 7.700.

GENERAL UTILITY NOTES

1. Contractor is advised that the location, number, and type of utilities shown on these plans and specifications are only as accurate as the best information available from public utilities, owners, and users at the time these plans and specifications were prepared. Underground utilities may be present on this project which were not disclosed to the engineer. No representation is made that the utility locations indicated on these plans are accurate, complete, or exclusive. Contractor is advised to undertake their own investigation of existing conditions before submitting a proposal on this project. The contractor is responsible for the cost of all test pits or other pre-construction investigation of underground utilities or structure. Pursuant to Ariz. Rev. Stat. 40-360.21, the contractor must contact "Blue Stake" at 602-263-1100 or the appropriate public utility for appurtenances prior to construction.

GENERAL NOTES FOR PUBLIC WORKS CONSTRUCTION

1. All construction in the public rights-of-way or in easements granted for public use must conform to the latest MAG Uniform Standard Specifications and Uniform Standard Details for Public Works Construction as amended by the latest version of the City of Scottsdale Supplemental Standard Specifications and Supplemental Standard Details. If there is a conflict, the City's Supplemental Standard Details will govern.
2. The City only approves the scope, not the detail, of engineering designs; therefore, if construction quantities are shown on these plans, they are not verified by the City.
3. The approval of plans is valid for six (6) months. If a right-of-way permit for the construction has not been issued within six months, the plans must be resubmitted to the City for reapproval.
4. A Public Works Inspector will inspect all works within the City rights-of-way and in easements. Notify inspection Services 24 hours prior to beginning construction by calling 480-312-5750.
5. Whenever excavation is necessary, call the Blue Stake Center, 811, two working days before excavation begins. The Center will see that the location of the underground utility lines is identified for the project.
6. Right-of-way permits are required for all work in public rights-of-way and easements granted for public purposes. A right-of-way permit will be issued by the City only after the registrant has paid a base fee plus a fee for inspection services. Copies of all permits must be retained on-site and be available for inspection at all times. Failure to produce the required permits will result in immediate suspension of all work until the proper permit documentation is obtained.
7. All excavation and grading that is not in the pubic rights-of-way or not in easements granted for public use must conform to Appendix J, Grading, of the latest edition of the International Building Code. A permit for this grading must be secured from the City for a fee established by the City.

ESL NOTES

1. Mirrored surfaces or any treatments which can change ordinary glass into a mirrored surface are prohibited.
2. Reflective building and roofing materials (other than windows) including materials with high gloss finishes and bright, untarnished copper, aluminum, galvanized steel or other metallic surfaces, shall be textured or have a matte or non-reflective surface treatment to reduce the reflection of sunlight onto other property.
3. Materials used for exterior surfaces of all structures shall blend in color, hue, and tone with the surrounding natural desert setting to avoid high contrast.
4. Surface materials of walls, retaining walls or fences shall be similar to and compatible with those of adjacent main buildings.
5. Development design and construction techniques should blend scale, form and visual character into the natural landform and minimize exposed scars.
6. Exterior lighting should be low scale and directed downward, recessed or shielded so that the light source is not visible from residential development in the area or from a public viewpoint.
7. No paint colors shall be used within any landform that have a LRV greater than thirty-five (35) percent.
8. Exterior paint and material colors shall not exceed a value of six (6) and a chroma of six (6) as indicated in the Munsell Book of Color.
9. Plant materials that are not indigenous to the ESL area shall be limited to enclosed yard areas and non-indigenous plants that have the potential of exceeding twenty (20) feet in height are prohibited. A list of indigenous plants is available from the City. Outdoor community recreation facilities, including parks and golf courses shall be allowed turf as specified in Section 6.1070.G.1.J.
10. Turf limited to enclosed areas not visible offsite from lower elevation. Outdoor recreation facilities, including parks and golf courses, shall be exempt from this standard.
11. All equipment appurtenant to underground facilities, such as surface mounted utility transformers, pull boxes, pedestal cabinets, service terminals or other similar on-the-ground facilities, shall have an exterior treatment that has a LRV of less than thirty-five (35) percent or otherwise screened from view from the adjoining properties.

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or click Arizona811.com

DATE	REVISION	BY
ENGINEER: 30% PLANS PRELIMINARY NOT FOR CONSTRUCTION	PUBLIC WORKS / TRANSPORTATION AND INFRASTRUCTURE / 7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251	

SHEET TITLE: GENERAL NOTES
PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	GPW	07/26		G20
VERT. N/A	DRAWN ME	AS-BUILT	PROJECT NO. PP2610	2 OF 13

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_GenNotes.dgn 7/16/2026 4:52:01 PM

Kimley»Horn

©2026 KIMLEY-HORN AND ASSOCIATES, INC.

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_GeomCntl.dgn 7/16/2026 4:52:07 PM

CITY OF SCOTTSDALE
216-75-016

CITY OF SCOTTSDALE
216-75-017B

CITY OF SCOTTSDALE
216-75-017A

CITY OF SCOTTSDALE
216-76-004

N 126TH ST

40 45 50 55 60 65

BEGIN RECONSTRUCTION LIMITS
STA 46+50.00
N: 997285.695
E: 733120.085

END RECONSTRUCTION LIMITS
STA 53+50.00
N: 997287.879
E: 733820.081

END RIO VERDE CST CL
STA 110+00.00
N: 997305.503
E: 739470.056

Exst R/W

RIO VERDE DR

N89°49'17"E
9349.98'

Rio Verde Dr Cst CL

Exst R/W

BEGIN RIO VERDE CST CL
STA 16+50.00
N: 997276.338
E: 730120.104

CITY OF SCOTTSDALE
216-78-023

N 128TH ST

C A TNT INVESTORS LLC
216-77-028

C A RIO VERDE
INVESTORS LLC
216-77-069

STRACHAN
ALEXANDRA/JON
217-77-050

MEHLHORN NEAL E
216-77-052

50 0 50 100
HORIZ SCALE IN FEET

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811 BLUE STAKE, INC.
Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

PUBLIC WORKS

TRANSPORTATION AND
INFRASTRUCTURE

7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE
GEOMETRIC CONTROL PLAN

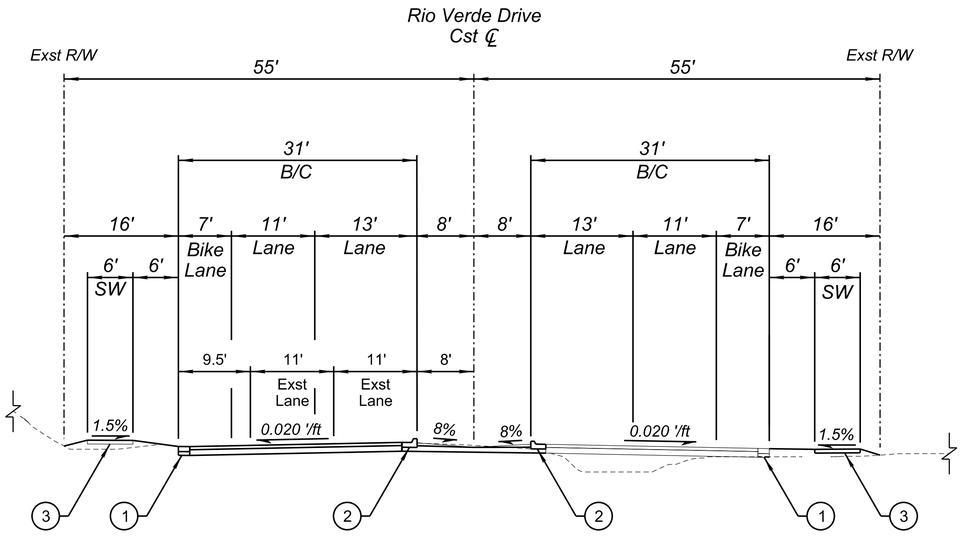
PROJECT TITLE
RIO VERDE WILDLIFE CROSSING
FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1" = 100'	GPW	07/26		G30
VERT. N/A	DRAWN DG	AS-BUILT	PROJECT NO. PP2610	3 OF 13

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_Typ01.dgn 4:52:16 PM 7/16/2026

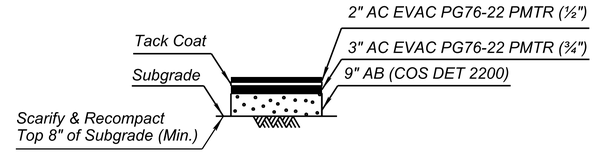
Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.

1. Ribbon Curb
   MAG Std Det 220-1, Type B
2. Roll Curb & Gutter
   MAG Std Det 220-1, Type C
3. Sidewalk
   MAG Std Det 230



TYPICAL SECTION

Rio Verde Drive
Eastbound Cst ℄
Sta 47+50.00 to 52+50.00



Total Thickness = 14"

SECTION NO. 1

N.T.S
(PENDING GEOTECHNICAL EVALUATION)

5 0 5 10
HORIZ SCALE IN FEET

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811 BLUE STAKE, INC.
Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER

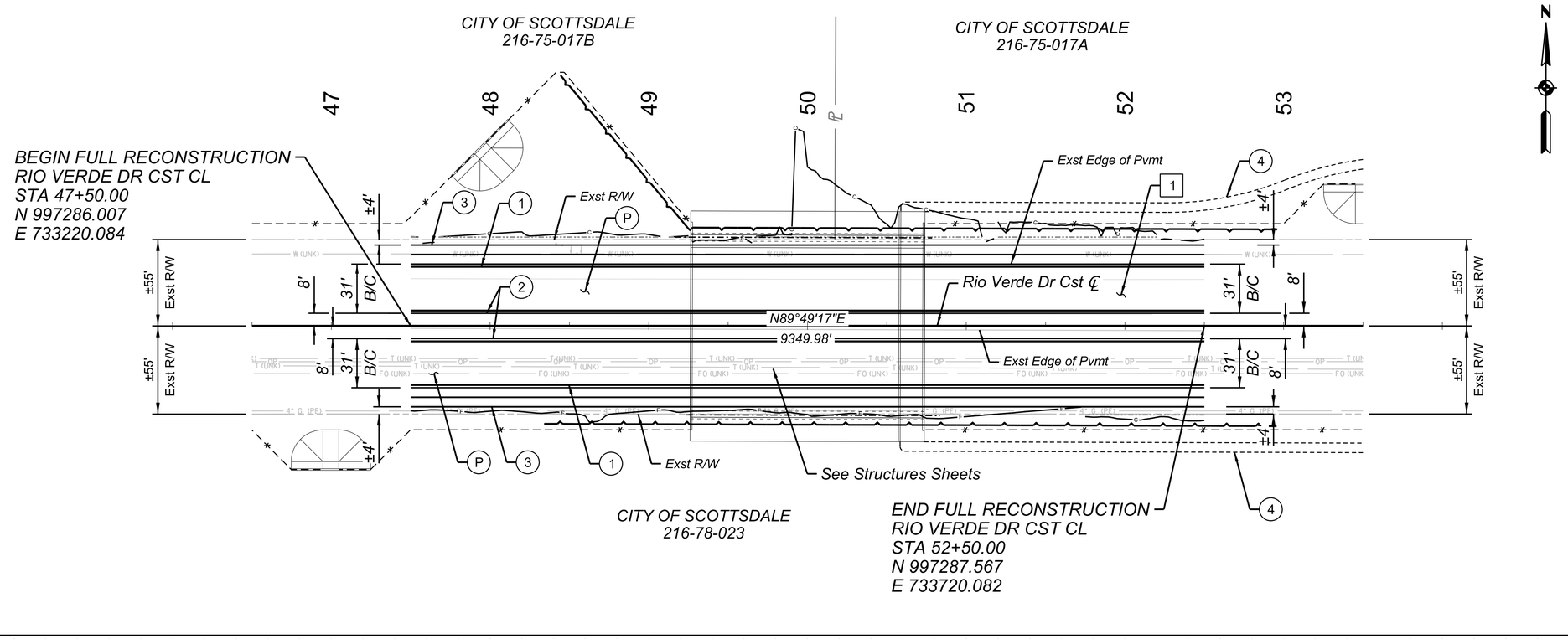
30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

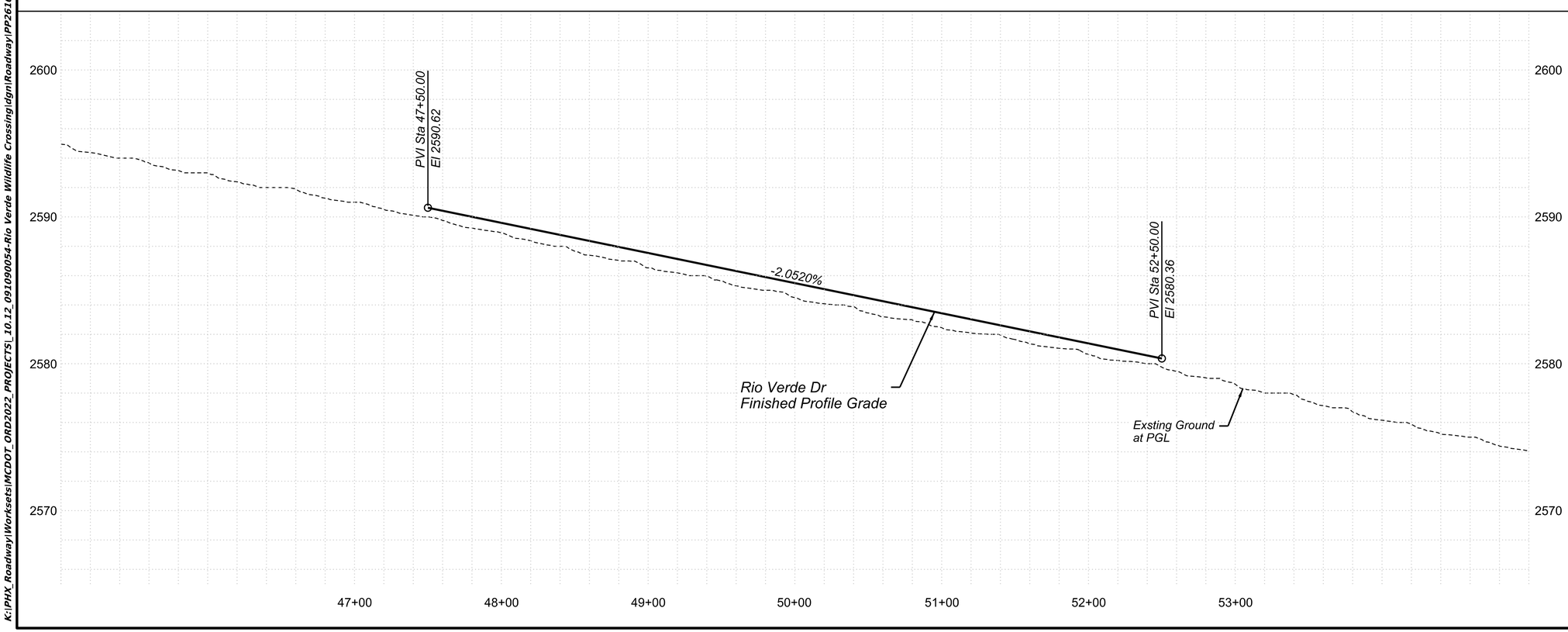
PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE
TYPICAL SECTION

PROJECT TITLE
RIO VERDE WILDLIFE CROSSING
FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1" = 10'	GPW	07/26		G40
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	4 OF 13
	DG		PP2610	





REMOVAL & RELOCATION NOTES

	Description	Unit	Quan
1	*Remove AC Pavement, Full Depth*	SY	2,301

CONSTRUCTION NOTES

	Description	Unit	Quan
P	*Pavement Section No. 1, See Sheet G40*	SY	3,000
1	*Ribbon Curb MAG Std Det 220-1, Type B*	LF	1,000
2	*Roll Curb & Gutter, MAG Std Det 220-1, Type C*	LF	1,000
3	*Sidewalk, MAG Std Det 230*	SF	6,000
4	*Trail*	SY	288

20 0 20 40
HORIZ SCALE IN FEET

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811 BLUE STAKE, INC.
Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER
30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE
RIO VERDE DR PLAN AND PROFILE

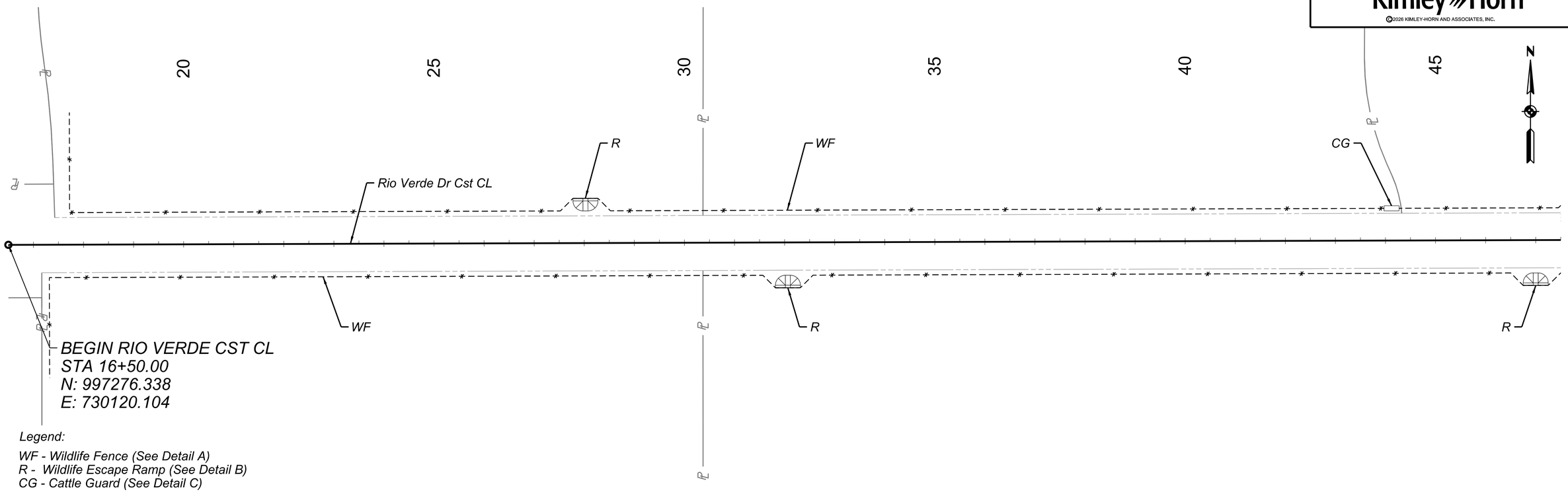
PROJECT TITLE
RIO VERDE WILDLIFE CROSSING
FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=40'	GPW	07/26		P01
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	
	DG		PP2610	5 OF 13

©2026 KIMLEY-HORN AND ASSOCIATES, INC.

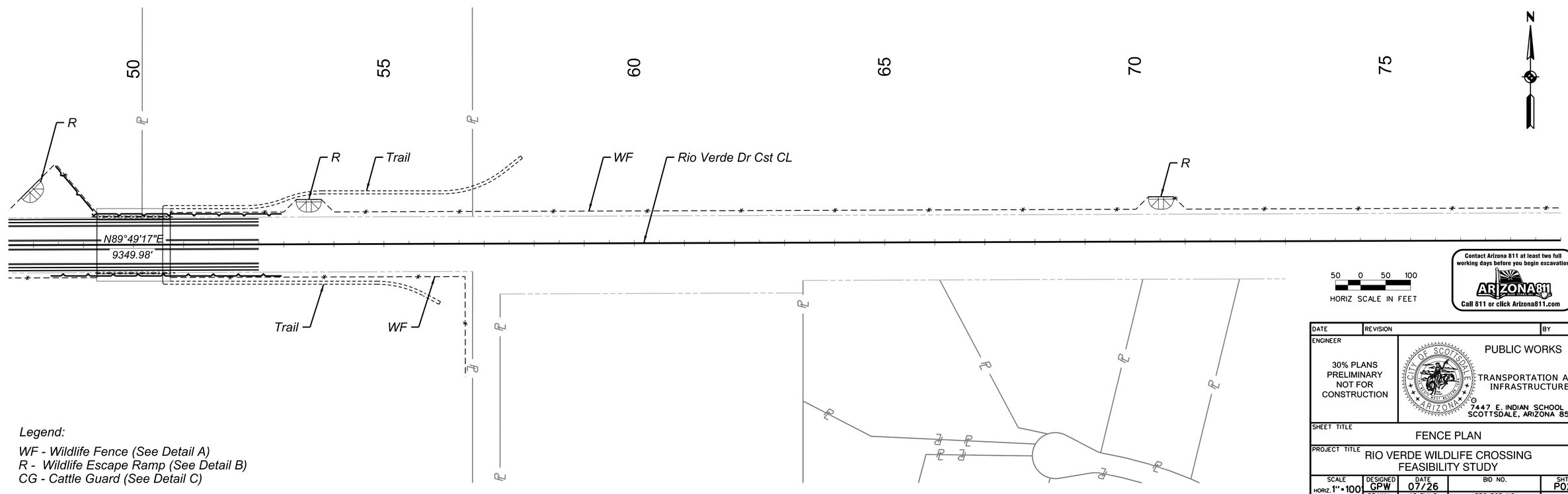
K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bb_pl01_40.dgn 7/16/2026 4:52:30 PM

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.



Legend:

WF - Wildlife Fence (See Detail A)
R - Wildlife Escape Ramp (See Detail B)
CG - Cattle Guard (See Detail C)



Legend:

WF - Wildlife Fence (See Detail A)
R - Wildlife Escape Ramp (See Detail B)
CG - Cattle Guard (See Detail C)

HORIZ SCALE IN FEET: 50 0 50 100

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811 BLUE STAKE, INC.
Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

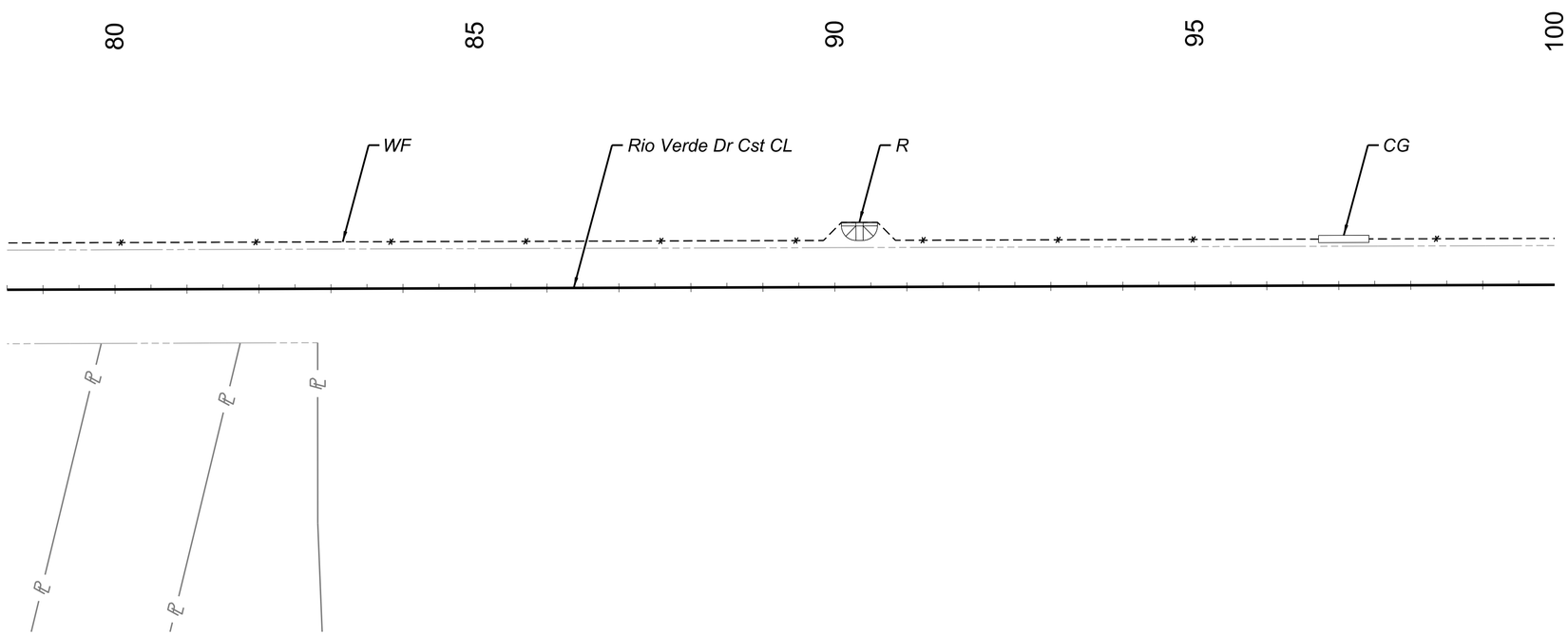
SHEET TITLE: FENCE PLAN

PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1" = 100'	GPW	07/26		P02
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	6 OF 13
	DG		PP2610	

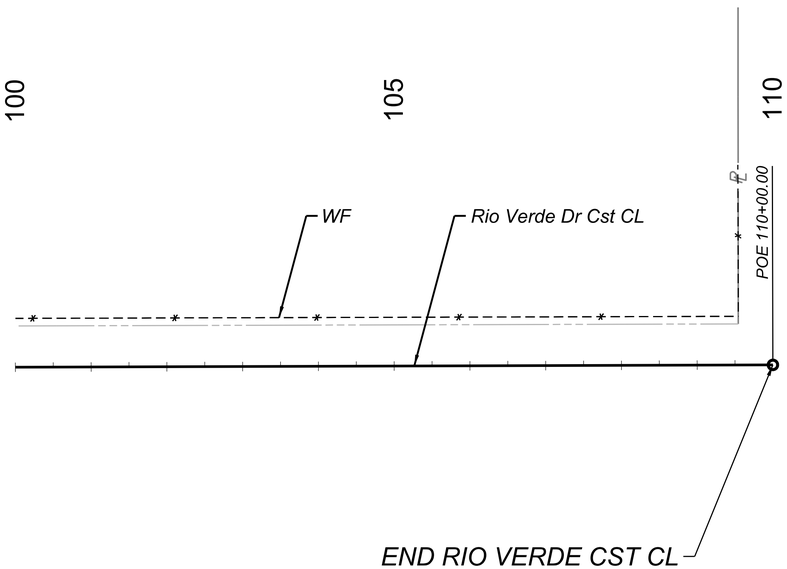
7/16/2026
4:52:43 PM
K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_fence01.dgn

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.



Legend:

WF - Wildlife Fence (See Detail A)
R - Wildlife Escape Ramp (See Detail B)
CG - Cattle Guard (See Detail C)



END RIO VERDE CST CL
STA 110+00.00
N: 997305.503
E: 739470.056

Legend:

WF - Wildlife Fence (See Detail A)
R - Wildlife Escape Ramp (See Detail B)
CG - Cattle Guard (See Detail C)

N

50 0 50 100
HORIZ SCALE IN FEET

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811 BLUE STAKE, INC.
Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

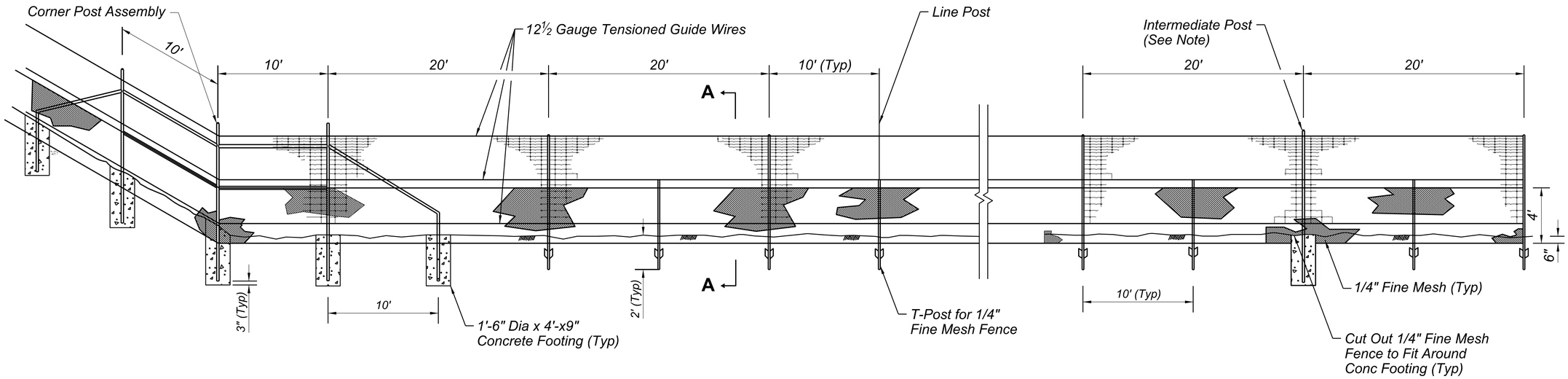
SHEET TITLE: FENCE PLAN

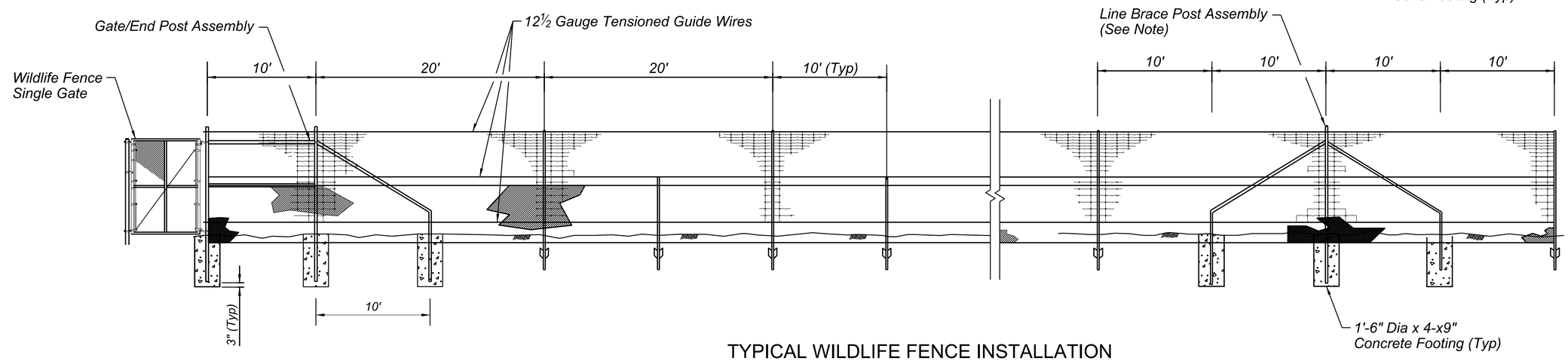
PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. 1"=100'	GPW	07/26		P03
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	7 OF 13
	DG		PP2610	

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_fence02.dgn
7/16/2026
4:52:50 PM

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.





TYPICAL WILDLIFE FENCE INSTALLATION

Notes:

1. *The fence fabric shall consist of 12½ gauge, twisted or tied (not welded). Line wires shall be high tensile and stay wires shall be medium tensile.*
2. *All fence fabric shall be metal stained.*
3. *The 1/4" fine mesh fence shall be buried 6" min.*
4. *Intermediate posts shall be placed at the low point of a dip and at the crown of a hump. The maximum spacing between intermediate posts shall not exceed 120 feet.*
5. *Line brace post assemblies shall be placed at dramatic changes (where grade changes exceed 15%) in the topography. The maximum spacing between line braces shall not exceed 1,320 feet.*
6. *Tensioned guide wires shall be tied off at both ends of the fence then tensioned in the middle of the pull.*
7. *General fence fabric attachment and splicing shall adhere to the guidelines written by the fence fabric manufacturer and at a minimum meet requirements of the specifications.*
8. *All concrete footings will meet the requirements of the specifications, and shall have tops crowned at ground level.*
9. *All concrete footings shall have 3" clear from bottom of post to bottom of footing.*
10. *See Fence Plans for locations.*
11. *Wildlife Fence shall be paid for under bid item #420008.*

DETAIL A

WILDLIFE FENCE
SHEET 1 OF 2

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE: DETAIL A

PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

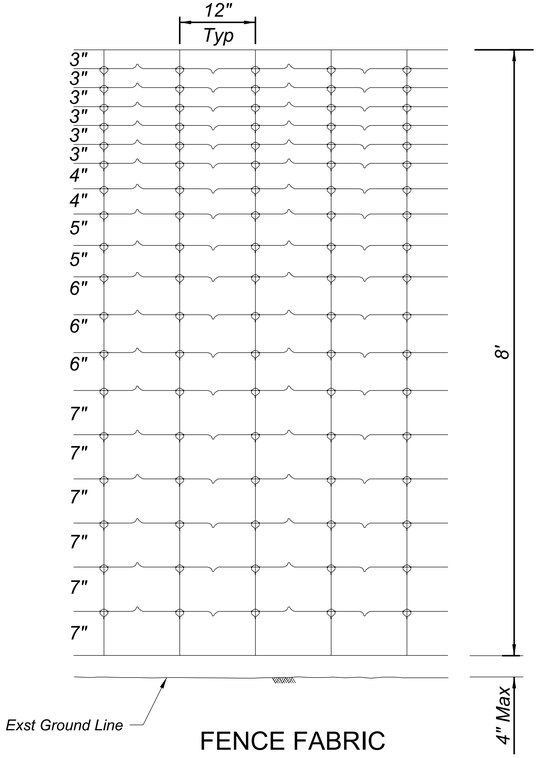
SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	GPW	07/26		P04
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	
	DG		PP2610	8 OF 13

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_dta1.dgn
7/16/2026
4:52:52 PM

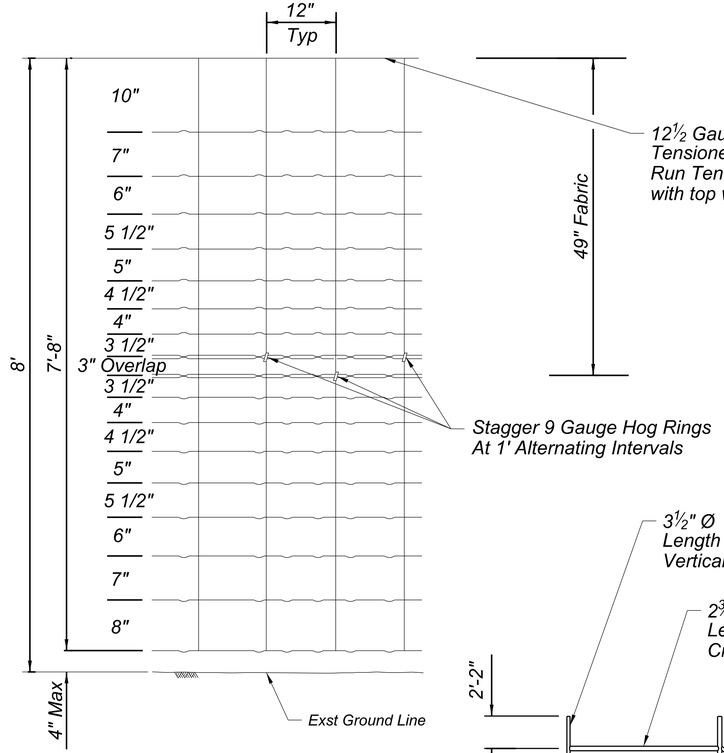
K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_dta2.dgn 4:52:54 PM 7/16/2026

Kimley»Horn

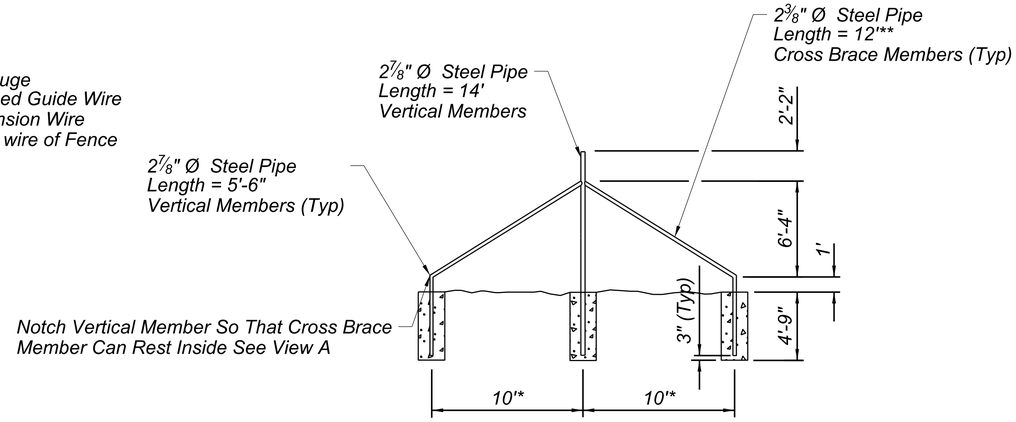
©2026 KIMLEY-HORN AND ASSOCIATES, INC.



FENCE FABRIC
(OPTIONAL)



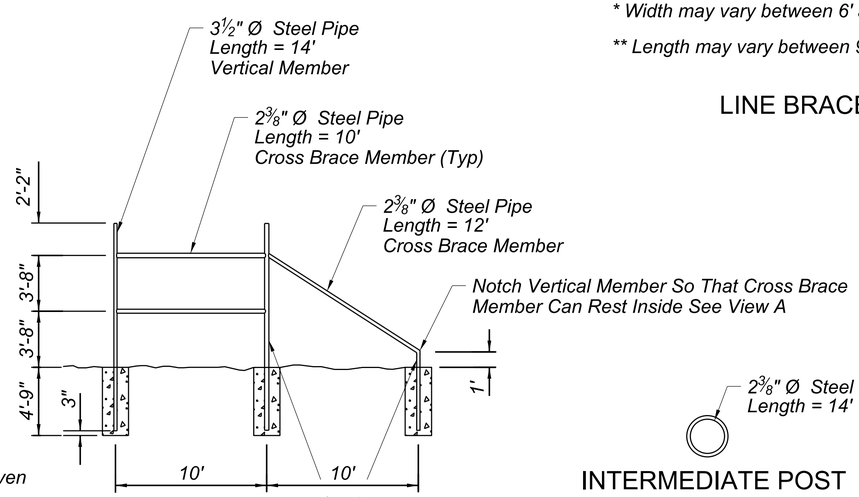
LAPPED FENCE FABRIC
(TYPE 4 WOVEN WIRE
ADOT C-12.10)



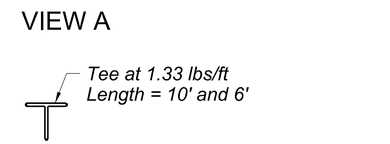
* Width may vary between 6' and 10' depending on terrain.

** Length may vary between 9' and 12' depending on terrain.

LINE BRACE ASSEMBLY



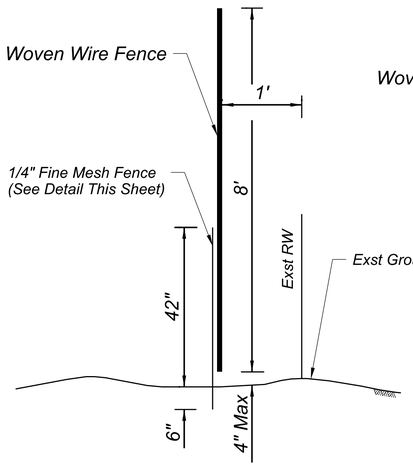
GATE/END POST ASSEMBLY &
CORNER POST ASSEMBLY



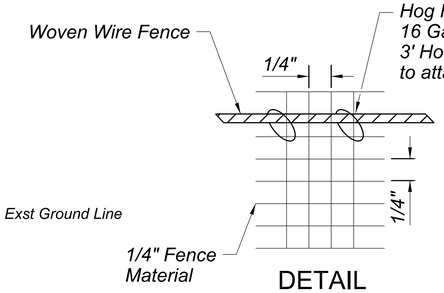
VIEW A

INTERMEDIATE POST
CROSS SECTION

LINE POST
CROSS SECTION



SECTION A-A
*(See Detail A, Sheet 1 of 2
for Wildlife Fence Elevation View)*



DETAIL
1/4" FINE MESH FENCE

Notes:

1. Ensure the fence post and materials conform to the standards approved by the U.S Fish and Wildlife Service.
2. Height above ground level is no less than 42 inches.
3. Ensure that the depth of fine mesh fence is no less than 6 inches below ground level.
4. Backfill and compact trench for buried fence.
5. Attach fence material to woven wire using hog rings at 12 inch intervals.
6. Fasten fence materials to posts with 3 tie wires with a wire near the top, bottom, and center of the fence material.
7. Attach fence material to all gates. Ensure that clearance at base of gate achieves zero ground clearance.
8. Weld solid all connections of vertical and cross brace members. The weld shall be ground flush inspected for voids and painted (stained) with primer or rust preventative. All freshly ground welds shall be painted or treated by the end of the work shift.
9. Cap all pipes with pressed steel caps.
10. All fencing materials will be Stained, T Posts to remain green, with no white tips.

DETAIL A

WILDLIFE FENCE
SHEET 2 OF 2

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

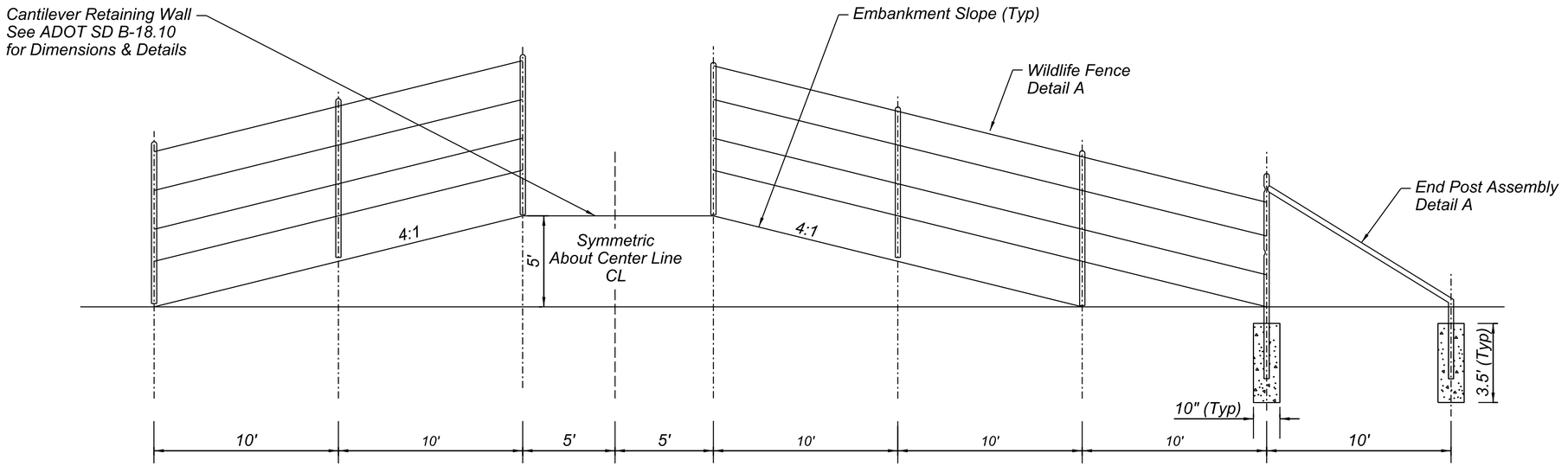
PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE: DETAIL A

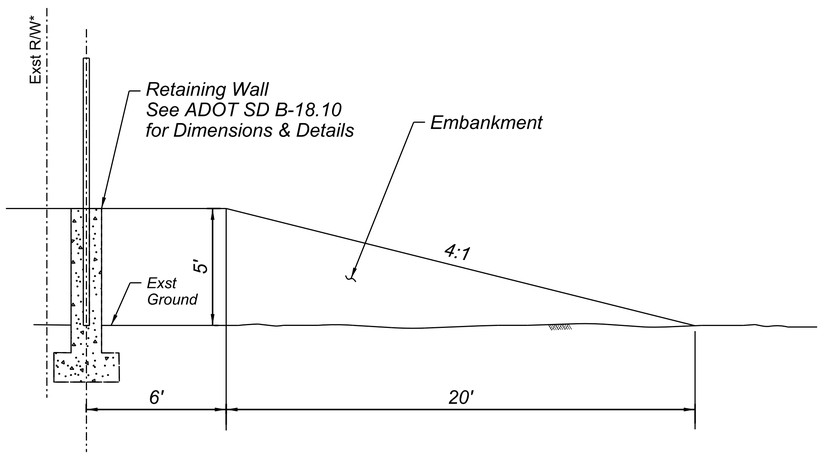
PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	GPW	07/26		P05
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	9 OF 13
	DG		PP2610	

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.

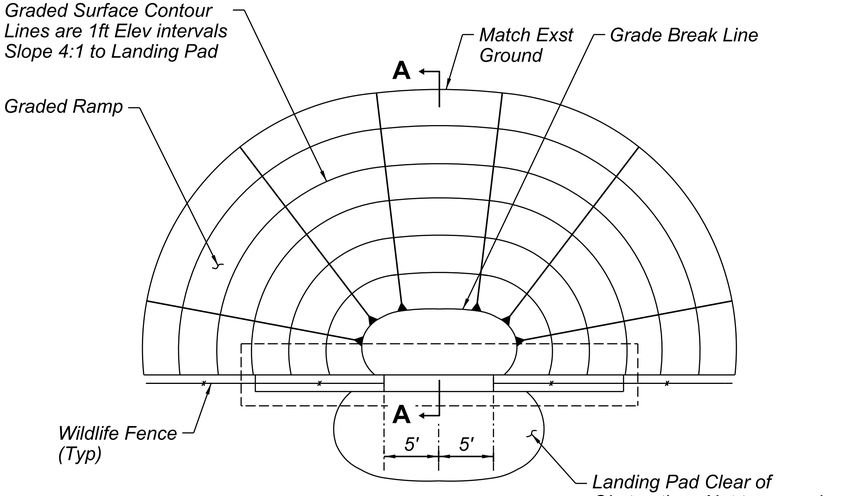


TYPE 1
ELEVATION
Not to Scale



TYPE 1
SECTION A-A
Not to Scale

*Note:
Retaining Wall & Footer
Shall Remain within COS
Right of Way



PLAN & GRADING
Not to Scale

Notes:

1. Do not pile embankment against wildlife fence.
2. Adjust the Size of Wildlife Ramps in the Field to Best Match Terrain to be Approved by Engineer and AZGFD biologist.
3. Access Routes to Fence and Structure Locations Will be Approved in the Field on a Case-by-Case basis by AZGFD biologist.
4. The contractor shall coordinate with the Engineer and the AZGFD for the installation & location of wildlife escape ramps.
5. Contractor shall measure final retaining wall height and confirm that the 6' height differential is maintained for the full width of the opening.
6. Landing Pad shall be free of rocks, bushes, and other obstructions.
7. Cost of Wildlife fences are included in the price of the escape ramp cost.
8. See plan for location.

DETAIL B

WILDLIFE RAMP

DATE	REVISION	BY
ENGINEER: 30% PLANS PRELIMINARY NOT FOR CONSTRUCTION	PUBLIC WORKS TRANSPORTATION AND INFRASTRUCTURE 7447 E. INDIAN SCHOOL RD. SCOTTSDALE, ARIZONA 85251	

SHEET TITLE: DETAIL B

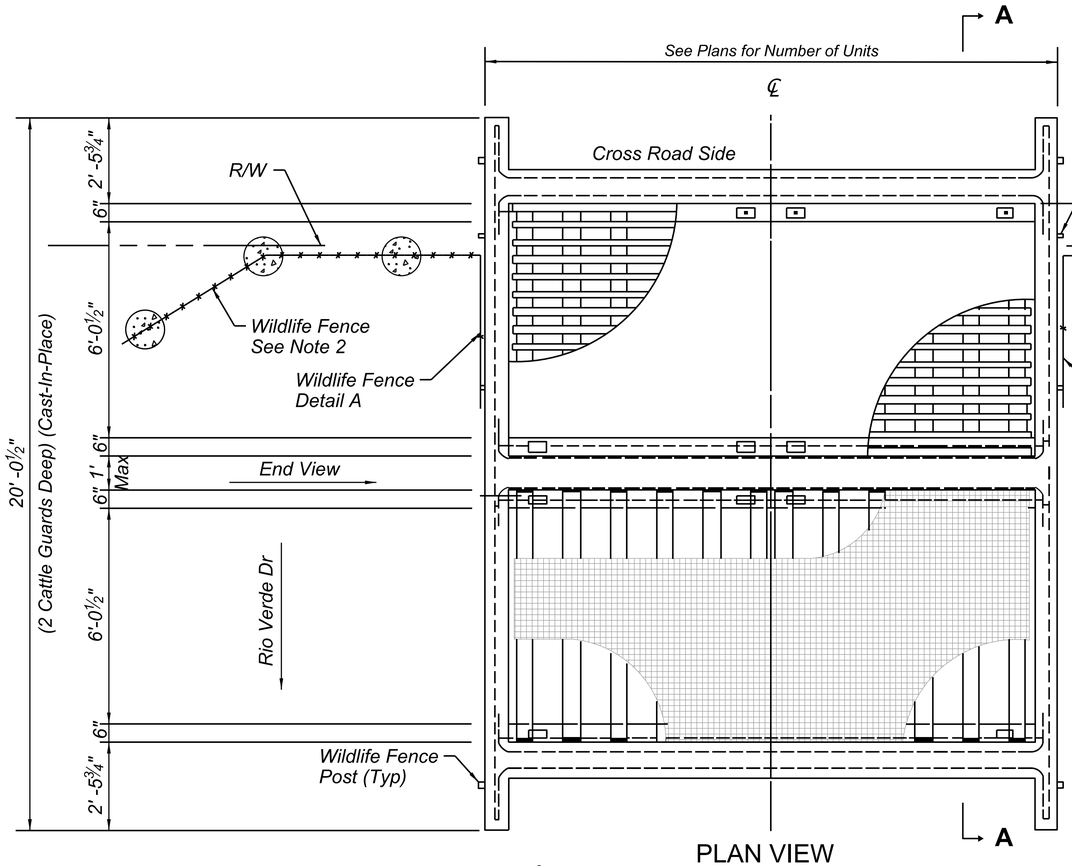
PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	GPW	07/26		P06
VERT. N/A	DRAWN DG	AS-BUILT	PROJECT NO. PP2610	10 OF 13

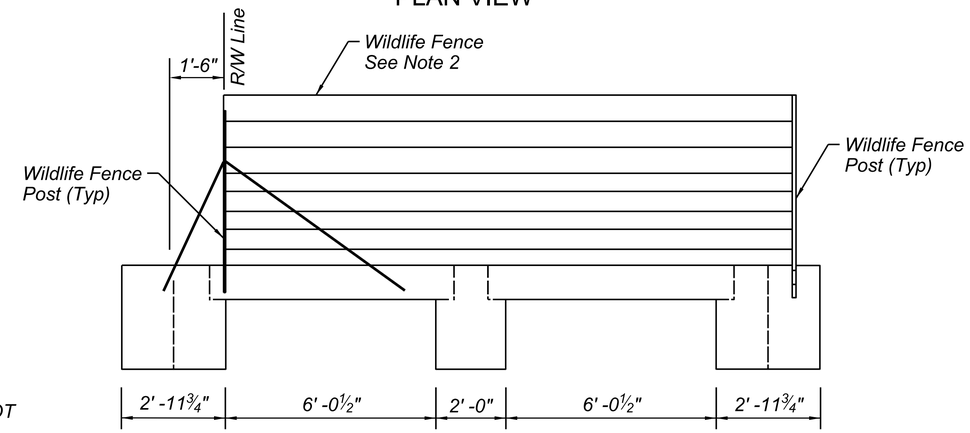
7/16/2026
4:52:56 PM
K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_dtb.dgn

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.

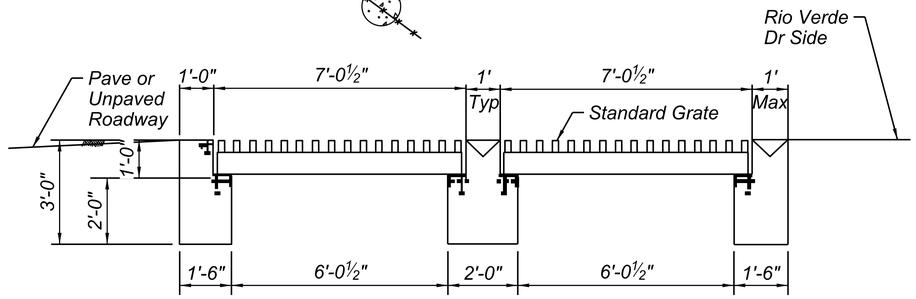
K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Roadway\PP2610_Bd_dtc.dgn 7/16/2026 4:52:58 PM



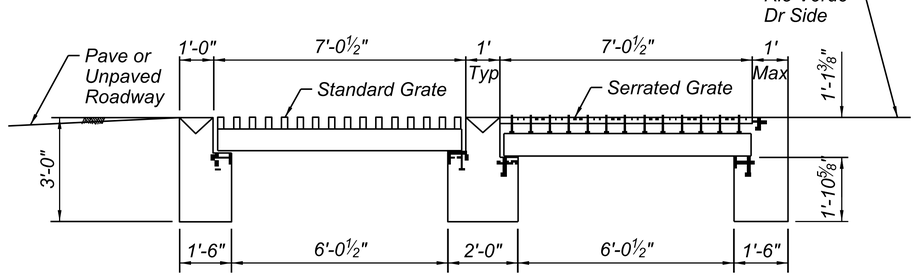
PLAN VIEW



END VIEW



SECTION A-A
DOUBLE CATTLE GUARD



SECTION A-A
DOUBLE CATTLE GUARD - SERRATED GRATE

DETAIL C

DOUBLE CATTLE GUARD

Notes:

1. *For Details not shown, See ADOT Std C-11.10*
2. *This work is paid for under item 420041, Cattle Guard (Double), the serrated grate is included in the pay item.*
3. *The grate for the cattle guard inside the right of way shall be replaced with a modified serrated grate for roadways that are open year round. See plans for locations. See specifications.*
4. *Double cattle guard to have standard double grate unless noted on the plans.*
5. *See plan sheets for cattle guard Locations.*

DATE	REVISION	BY
ENGINEER: 30% PLANS PRELIMINARY NOT FOR CONSTRUCTION		

PUBLIC WORKS
TRANSPORTATION AND INFRASTRUCTURE
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

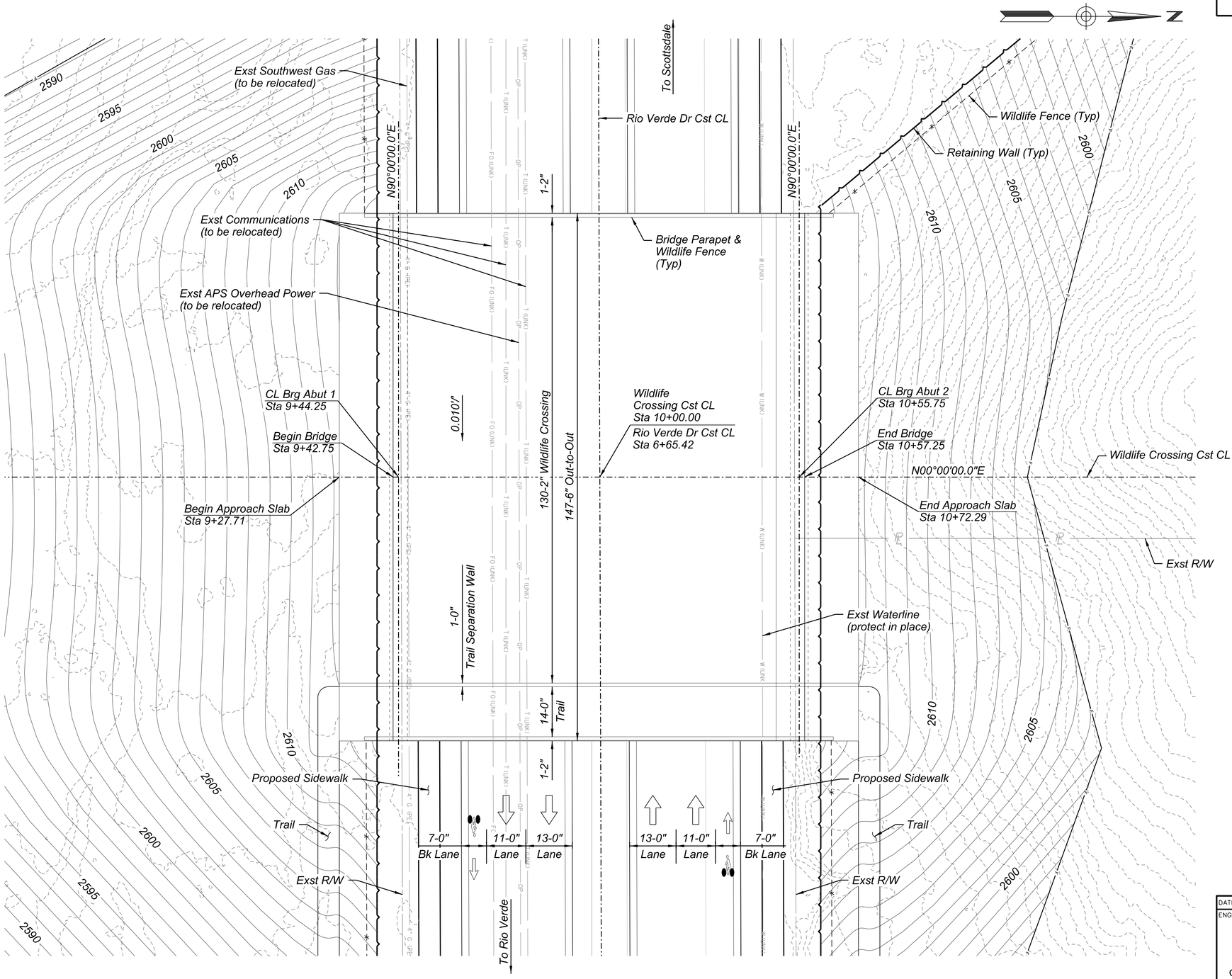
SHEET TITLE: DETAIL C

PROJECT TITLE: RIO VERDE WILDLIFE CROSSING FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	GPW	07/26		P07
VERT. N/A	DRAWN	AS-BUILT	PROJECT NO.	
	DG		PP2610	11 OF 13

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Bridge\Exhibits\PP2610_Bb_gp.dgn 7/16/2026 2:43:52 PM

Kimley»Horn
©2026 KIMLEY-HORN AND ASSOCIATES, INC.



PLAN

New Single Span Prestressed BT74 Girder Bridge
Skew = 00°00'00"
Contour Interval = 1'-0"
Scale: 1" = 15'-0"

Contact Arizona 811 at least two full working days before you begin excavation
ARIZONA811
Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

CITY OF SCOTTSDALE
ARIZONA

PUBLIC WORKS

TRANSPORTATION AND INFRASTRUCTURE

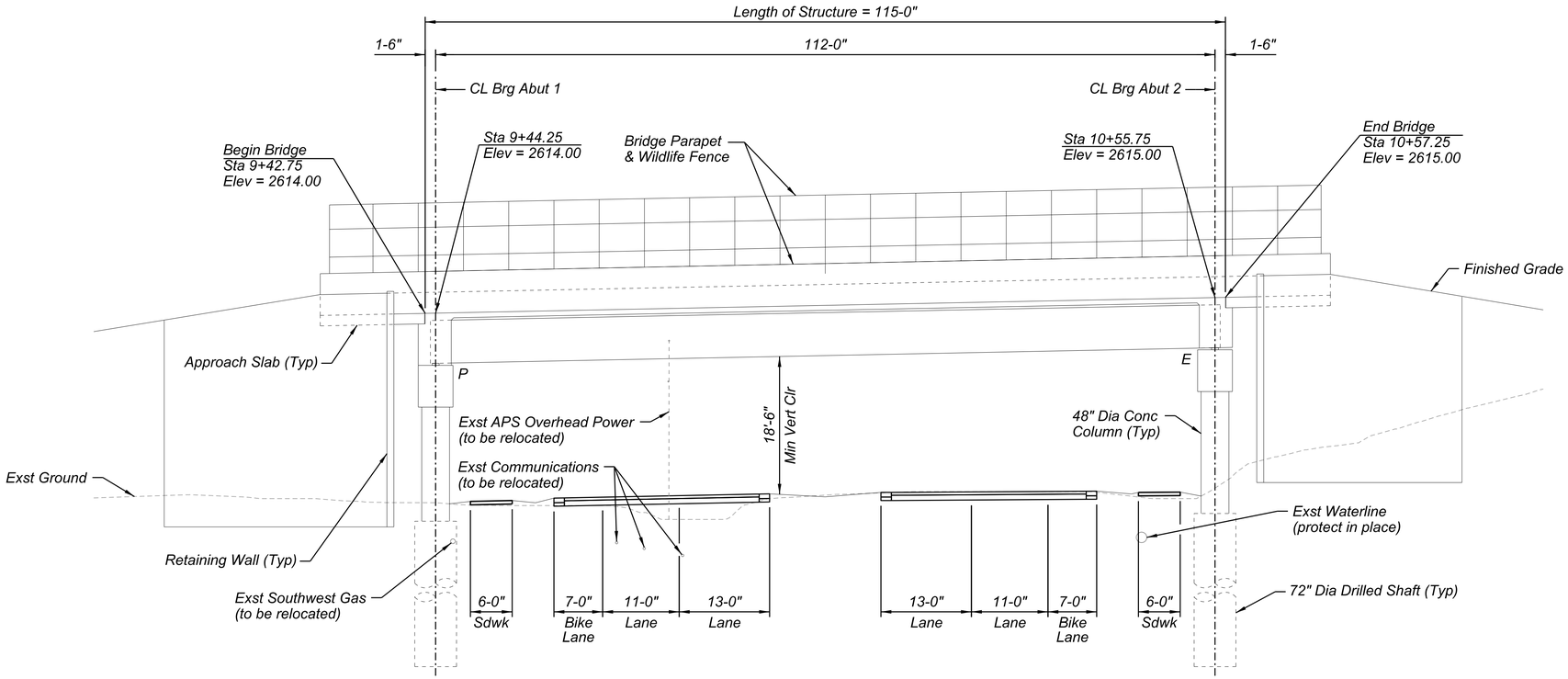
7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE
STRUCTURE PLAN

PROJECT TITLE
RIO VERDE WILDLIFE CROSSING
FEASIBILITY STUDY

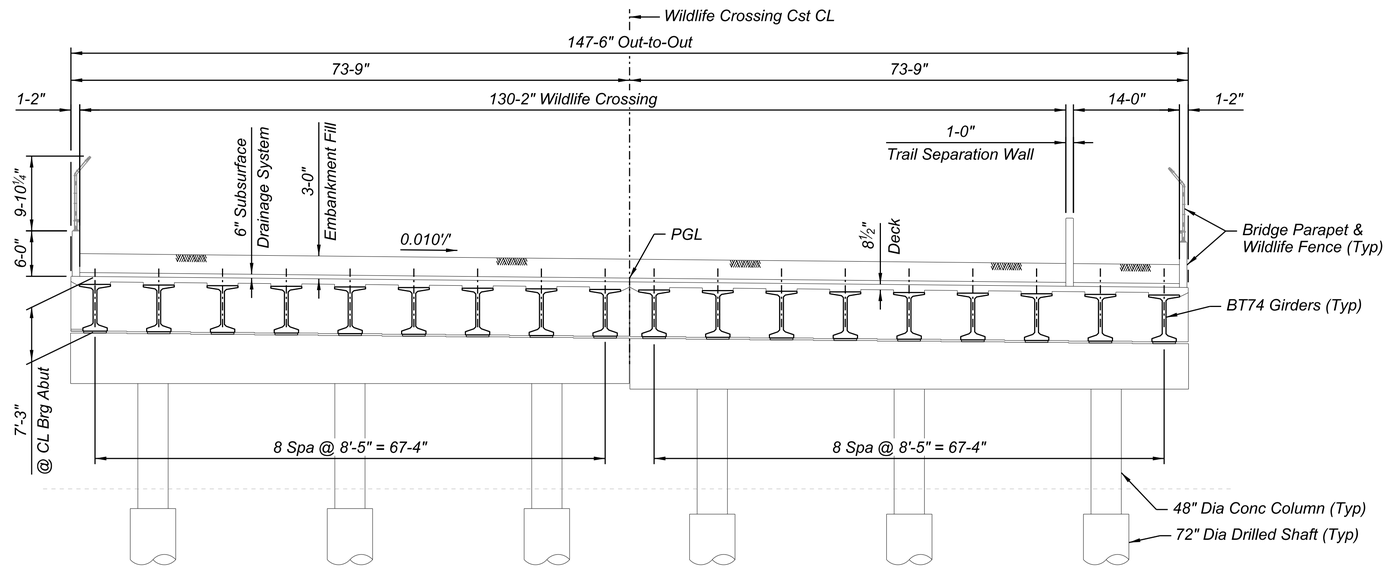
SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	DJL	07/26		S01
VERT. N/A	DRAWN CMF	AS-BUILT	PROJECT NO. PP2610	12 OF 13

K:\PHX_Roadway\Worksets\MCDOT_ORD2022_PROJECTS_10.12_091090054-Rio Verde Wildlife Crossing\dgn\Bridge\Exhibits\PP2610_Bb_xs.dgn 7/16/2026 2:43:55 PM



ELEVATION

Scale: 1" = 10'-0"



TYPICAL SECTION

Scale: 1" = 10'-0"

Kimley»Horn

©2026 KIMLEY-HORN AND ASSOCIATES, INC.

Contact Arizona 811 at least two full working days before you begin excavation

ARIZONA811 BLUE STAKE, INC.

Call 811 or click Arizona811.com

DATE	REVISION	BY

ENGINEER

30% PLANS
PRELIMINARY
NOT FOR
CONSTRUCTION

PUBLIC WORKS

TRANSPORTATION AND INFRASTRUCTURE

7447 E. INDIAN SCHOOL RD.
SCOTTSDALE, ARIZONA 85251

SHEET TITLE
STRUCTURE ELEVATION AND TYPICAL SECTION

PROJECT TITLE
RIO VERDE WILDLIFE CROSSING
FEASIBILITY STUDY

SCALE	DESIGNED	DATE	BID NO.	SHT.
HORIZ. N/A	DJL	07/26		S02
VERT. N/A	DRAWN CMF	AS-BUILT	PROJECT NO. PP2610	13 OF 13

APPENDIX D – MSC WILDLIFE CONNECTIVITY ASSESSMENT

MCDOWELL SONORAN CONSERVANCY

WILDLIFE CONNECTIVITY ASSESSMENT ALONG RIO VERDE DRIVE IN SCOTTSDALE'S MCDOWELL SONORAN PRESERVE

Prepared By: Jessie Dwyer, Senior Science Program Manager, McDowell Sonoran Conservancy

Date: August 10th, 2026



Sonoran Desert Tortoise (Gopherus morafkai) tracked with VHF radio telemetry [top] and mule deer (Odocoileus hemionus) captured with remote sensing cameras near vehicle driving on Rio Verde Drive [bottom].

EXECUTIVE SUMMARY

Rio Verde Drive is a major roadway that bisects the McDowell Sonoran Preserve, including the Gooseneck, an important wildlife movement corridor connecting the northern and southern parts of the Preserve. To evaluate whether the roadway influences wildlife connectivity within the Preserve, the McDowell Sonoran Conservancy analyzed data collected along Rio Verde Drive from 2021–2025, including remote camera surveys, radio telemetry of Sonoran Desert Tortoises, and wildlife–vehicle collision records.

Remote cameras documented a diverse assemblage of native wildlife using habitats adjacent to Rio Verde Drive. Across the 13 mammal taxa included in the mammal community analysis, overall mammal activity increased with distance from Rio Verde Drive, with activity approximately 14% higher for each standard-deviation increase in distance from the roadway. Mule deer exhibited a stronger species-specific response, with activity increasing approximately 43% for each standard-deviation increase in distance from Rio Verde Drive. Mammal species richness, however, was not significantly related to roadway distance after accounting for differences in camera sampling effort. Mountain lions were detected four times within the study area, confirming their use of adjacent habitat but providing insufficient data for analysis.

Radio telemetry of 27 Sonoran Desert Tortoises provided compelling evidence of reduced functional connectivity. Although several monitored tortoises occupied habitat adjacent to Rio Verde Drive and had telemetry locations immediately adjacent to the roadway, no locations were recorded across the roadway during the five-year monitoring period. In addition, wildlife–vehicle collision records documented 60 collision reports along Rio Verde Drive involving 11 taxa, including a Sonoran Desert Tortoise mortality, demonstrating that when wildlife does interact with the roadway it can result in vehicle-related injury and mortality.

Collectively, these independent datasets provide converging evidence that Rio Verde Drive functions as a substantial barrier to wildlife movement and may reduce functional connectivity within the Gooseneck. This assessment establishes a baseline for evaluating wildlife connectivity within the McDowell Sonoran Preserve and a scientific foundation for future monitoring, management, and conservation planning along Rio Verde Drive and the Gooseneck.

ACKNOWLEDGEMENTS

We thank the staff and volunteers of the McDowell Sonoran Conservancy, whose efforts make this assessment possible, for their dedication to long-term wildlife monitoring within the McDowell Sonoran Preserve. We appreciate the Arizona Game and Fish Department's guidance regarding Sonoran Desert Tortoise monitoring protocols and wildlife survey methods. We also thank the Southwest Wildlife Conservation Center for providing wildlife–vehicle collision records and the City of Scottsdale for continuing to support conservation within the Preserve. Lastly, we thank the animals living in and around the Preserve for the opportunity to observe them in the name of science.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
ACKNOWLEDGEMENTS 1
TABLE OF CONTENTS 2
LIST OF FIGURES 3
LIST OF TABLES 3
INTRODUCTION 4
STUDY AREA 5
METHODS 7
Wildlife Monitoring 7
Radio Telemetry Surveys 7
Remote Camera Surveys 7
Wildlife–Vehicle Collision Data 8
Statistical Analyses 9
RESULTS 10
Radio Telemetry Surveys 10
Sonoran Desert Tortoise (*Gopherus morafkai*) 10
Remote Camera Surveys 12
Mule Deer (*Odocoileus hemionus*) 12
Mammal Community 13
Mountain Lion (*Puma concolor*) 14
Wildlife–Vehicle Collisions 14
DISCUSSION 15
MANAGEMENT IMPLICATIONS 17
CONCLUSION AND RECOMMENDATIONS 18
LITERATURE CITED 19
Appendix A. Supplemental Photo Catalog 21

LIST OF FIGURES

Figure 1. Study area 6

Figure 2. Remote camera sites 8

Figure 3. Sonoran Desert Tortoise home ranges 11

Figure 4. Mule deer detection rate vs. distance to roadway 12

Figure 5. Mammal activity vs. distance to roadway 13

LIST OF TABLES

Table 1. Wildlife–vehicle collision records 14

INTRODUCTION

The McDowell Sonoran Preserve (Preserve) supports diverse native wildlife, including numerous species of conservation concern (Arizona Game and Fish Department, 2022; McDowell Sonoran Conservancy, 2014). Within the northern Preserve, the Gooseneck Corridor (Gooseneck) is a continuous area of protected open space that provides an important connection between the McDowell Mountains and surrounding undeveloped habitat. The corridor facilitates wildlife movement between habitat areas north and south of Rio Verde Drive and represents an important component of regional wildlife connectivity. Connectivity facilitates wildlife movement, dispersal, gene flow, and access to seasonal resources (Taylor et al., 1993). Therefore, maintaining habitat connectivity within the Preserve and across the surrounding landscape is fundamental to conserving biodiversity and sustaining ecological processes.

Roads and other transportation corridors are among the primary drivers of habitat fragmentation in terrestrial ecosystems. In addition to causing direct wildlife mortality, roads can reduce functional connectivity by creating behavioral barriers that alter movement patterns, decrease habitat use adjacent to roadways, and isolate wildlife populations (Forman & Alexander, 1998; Forman et al., 2002). These effects are particularly pronounced for wide-ranging mammals and long-lived reptiles that depend on movement among habitat patches to maintain demographic viability and genetic connectivity (Beier, 1995; Benson et al., 2016; Riley et al., 2014; U.S. Fish and Wildlife Service, 2021).

Rio Verde Drive bisects the Gooseneck, potentially interrupting movement between habitats on either side of the roadway. Given ongoing traffic and development pressures in the region, understanding whether the roadway influences wildlife movement is an important conservation and management priority. Although wildlife–vehicle collisions have been documented along Rio Verde Drive, its influence on wildlife movement and connectivity had not previously been evaluated using multiple independent lines of evidence.

To address this knowledge gap, the McDowell Sonoran Conservancy initiated long-term wildlife monitoring in 2021 and expanded its efforts in 2024 to include targeted surveys along Rio Verde Drive. This assessment integrates Sonoran Desert Tortoise radio telemetry, remote camera surveys, and wildlife–vehicle collision records to evaluate wildlife responses to Rio Verde Drive and assess its potential influence on connectivity across multiple taxa. Because these complementary monitoring techniques capture different aspects of wildlife movement, habitat use, and roadway interactions, their integration provides a more comprehensive assessment than any single method alone. Roadway effects were evaluated quantitatively for focal taxa where sample sizes permitted, while results for taxa with limited detections were presented descriptively.

The primary objective of this assessment was to evaluate whether Rio Verde Drive is associated with reduced wildlife movement and activity within the Gooseneck Corridor. Specifically, the

study sought to (1) characterize wildlife movement, activity, and roadway interactions in relation to Rio Verde Drive using complementary monitoring techniques, (2) evaluate species-specific responses to roadway proximity, (3) document evidence of restricted movement across the roadway and potential effects on functional connectivity, and (4) provide a scientific baseline to inform future transportation planning, wildlife crossing considerations, and long-term conservation management within the Gooseneck.

STUDY AREA

The study was conducted within the northern portion of Scottsdale's McDowell Sonoran Preserve in Maricopa County, Arizona (Figure 1). Spanning more than 30,500 acres of Sonoran Desert, the Preserve is one of the largest permanently protected urban desert preserves in the world (City of Scottsdale, 2026). The Gooseneck is a continuous stretch of protected open space within the Preserve that connects habitat associated with the McDowell Mountains to surrounding undeveloped lands and provides a potential pathway for wildlife movement across Rio Verde Drive (Figure 1).

Vegetation within the study area is characteristic of the Arizona Upland subdivision of the Sonoran Desert and is dominated by saguaro (*Carnegiea gigantea*), foothill palo verde (*Parkinsonia microphylla*), creosote bush (*Larrea tridentata*), brittlebush (*Encelia farinosa*), and mixed desert shrub communities typical of the northeastern Sonoran Desert.

The area supports a diverse assemblage of native wildlife, including mule deer (*Odocoileus hemionus*), mountain lion (*Puma concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), collared peccary (*Dicotyles tajacu*), grey fox (*Urocyon cinereoargenteus*), American badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), hooded skunk (*Mephitis macroura*), American hog-nosed skunk (*Conepatus leuconotus*), northern raccoon (*Procyon lotor*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and more than 190 bird species (McDowell Sonoran Conservancy, 2014). Several species occurring in the study area, including the Sonoran Desert Tortoise (*Gopherus morafkai*), are identified as Species of Greatest Conservation Need (Arizona Game and Fish Department, 2022).

Rio Verde Drive bisects the Gooseneck, creating a potential barrier to wildlife movement and connectivity between habitats on either side of the roadway. The roadway is a two-lane arterial with a posted speed limit of 50 mph and carries an annual average daily traffic (AADT) of approximately 12,300 vehicles per day, representing a 13% overall increase in traffic volume since 2016 (City of Scottsdale, 2016, 2024). These characteristics make Rio Verde Drive an ideal location for evaluating roadway effects on wildlife movement and habitat connectivity.

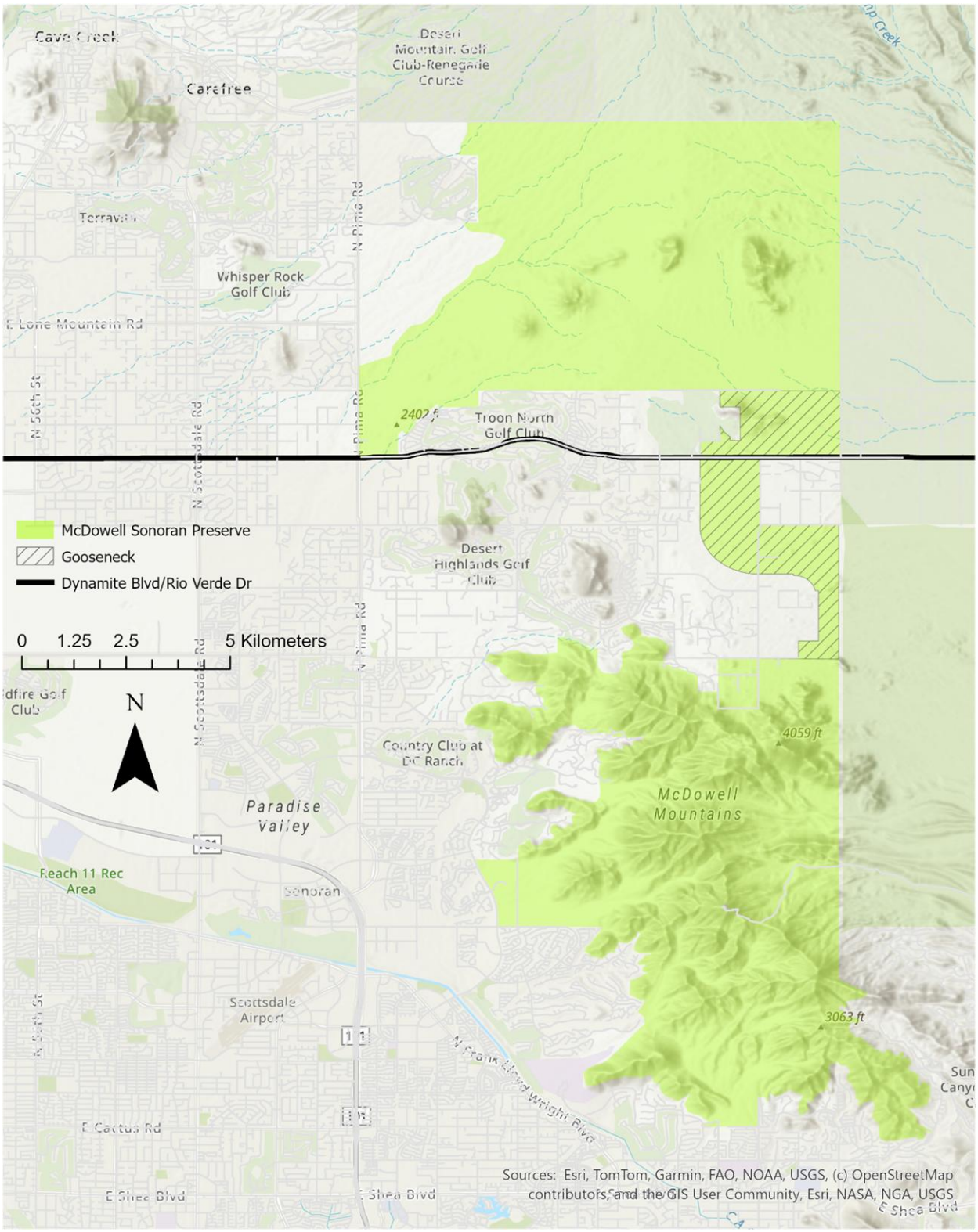


Figure 1. Study area within the northern portion of the McDowell Sonoran Preserve, Scottsdale, Arizona. Rio Verde Drive traverses the Preserve and bisects the Gooseneck, a primary habitat corridor for wildlife movement evaluated in this study.

METHODS

Wildlife Monitoring

The McDowell Sonoran Conservancy has conducted long-term wildlife monitoring within the McDowell Sonoran Preserve since 2021 to evaluate habitat use, wildlife movement, and functional connectivity within the Preserve and in relation to Rio Verde Drive. Monitoring focused on wildlife occupying habitats adjacent to the roadway within the northern Preserve and incorporated complementary survey methods, including radio telemetry, remote camera surveys, and wildlife–vehicle collision records. These datasets provide independent lines of evidence for evaluating whether Rio Verde Drive reduces functional connectivity for focal wildlife species. Sonoran Desert Tortoises, mule deer, and mountain lions served as focal taxa because they represent a range of body sizes, movement capabilities, trophic levels, and conservation priorities, allowing evaluation of roadway effects across multiple key taxa within the Preserve.

Radio Telemetry Surveys

Since 2021, 27 individual adult Sonoran Desert Tortoises have been monitored using very high frequency (VHF) radio telemetry to document seasonal movement patterns, home-range use, and potential roadway crossing events.

Each tortoise was relocated approximately once per month throughout the active season using standard VHF radio-telemetry techniques following Arizona Game and Fish Department protocols (Rubke & O'Donnell, 2018). At each relocation, geographic coordinates were recorded using a handheld Garmin Global Positioning System (GPS) unit and entered into an ArcGIS Survey123 field form to standardize data collection and facilitate quality assurance.

Minimum convex polygon (MCP) home ranges were generated in ArcGIS Pro to estimate individual space use and evaluate whether home ranges extended across Rio Verde Drive.

Remote Camera Surveys

Motion-triggered infrared trail cameras were deployed to document wildlife occurrence and evaluate species-specific responses to Rio Verde Drive. Bushnell Core DS No Glow trail cameras were strategically deployed at 23 sites on both sides of Rio Verde Drive to sample wildlife use throughout the primary habitat corridor (Figure 2). Camera sites were separated sufficiently to minimize overlap in detection areas while providing coverage of major movement corridors adjacent to Rio Verde Drive.

Cameras were deployed along washes, wildlife trails, and roadway culverts at varying distances from Rio Verde Drive to maximize detection probability while sampling a gradient of roadway influence. Cameras were deployed during multiple sampling periods between 2021 and 2025,

accumulating approximately 7,200 camera-trap nights. Each camera was programmed with a one-minute delay between trigger events to balance repeated image collection with continued sensitivity to wildlife movement.

Images were reviewed and classified to species by trained McDowell Sonoran Conservancy staff and volunteers using standardized image review protocols, with camera-trap data managed through Wildlife Insights (Ahumada et al., 2020). Detections for focal taxa were summarized by camera site for subsequent statistical analyses. Distance from each camera site to the centerline of Rio Verde Drive was calculated in ArcGIS Pro (Esri, 2024) and used as the primary explanatory variable.

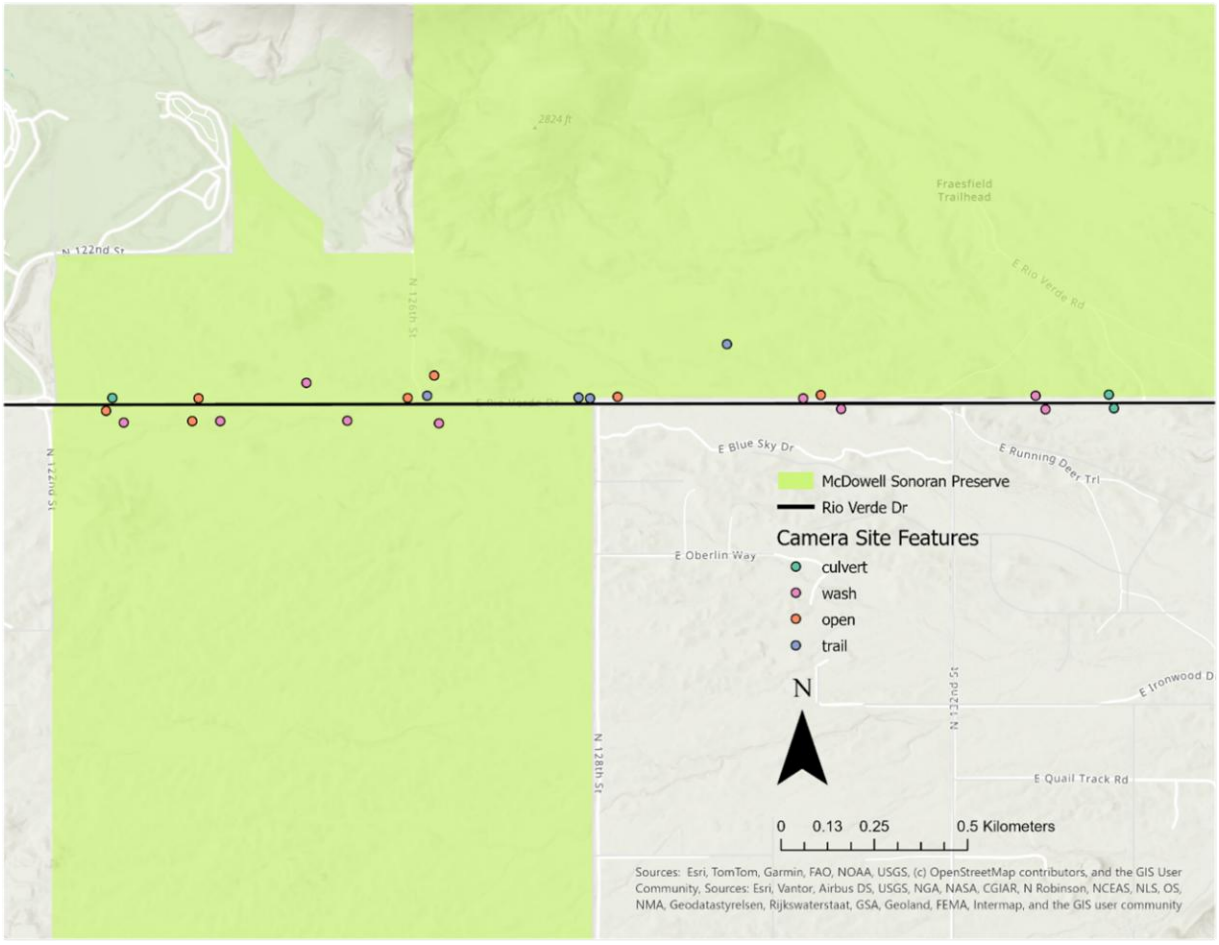


Figure 2. Locations of the 23 remote camera sites deployed along Rio Verde Drive within the northern McDowell Sonoran Preserve. Camera sites were positioned at varying distances from the roadway and across representative habitat features, including washes, culverts, trails, and open desert.

Wildlife–Vehicle Collision Data

Wildlife–vehicle collision (WVC) records were compiled from incident reports provided by the Southwest Wildlife Conservation Center (2026). The source dataset contained records collected

from 2022 through 2026. Records from 2024 were unusable because the source database was corrupted, and 2026 records were excluded because they represented only a partial year at the time of analysis. Therefore, analyses in this report were based on usable records from 2022, 2023, and 2025. The dataset consisted of opportunistic reports submitted by members of the public documenting wildlife that had been struck by vehicles or found injured or deceased.

Collision records were summarized by species to characterize the diversity of wildlife affected by vehicle traffic along the roadway. Because these reports represent opportunistic observations rather than systematic surveys, they were used to identify general patterns of wildlife mortality rather than estimate total collision frequency or spatial distribution. Wildlife–vehicle collisions are also known to be underreported, particularly for deer and smaller mammals (Huijser et al., 2008); therefore, reported incidents were interpreted as minimum estimates of documented roadway mortality.

Statistical Analyses

Overall mammal activity, mammal richness, and mule deer activity were analyzed using data from 23 remote camera sites. Mammal activity included detections of 13 mammal taxa: mule deer, collared peccary, coyote, bobcat, grey fox, mountain lion, American badger, hooded skunk, striped skunk, northern raccoon, black-tailed jackrabbit, desert cottontail, and American hog-nosed skunk.

Mammal activity and mule deer activity were quantified as total independent detections recorded at each camera site. Negative binomial regression models were used because count data exhibited greater variability than expected under a Poisson distribution. Trap-days were included as an offset to account for differences in sampling effort among camera sites. Distance from the centerline of Rio Verde Drive was standardized prior to analysis and included as the primary explanatory variable.

For mule deer, the final model included standardized roadway distance and a log(trap-days) offset. Model fit was evaluated using likelihood-ratio tests, AIC, coefficient estimates, profile-likelihood confidence intervals, and Pearson dispersion.

Mammal richness was calculated as the number of mammal taxa detected at each camera site. Because richness was strongly associated with sampling effort (Spearman's $\rho = 0.784$, $p < 0.001$), trap-days were included in the richness model before evaluating roadway distance. Poisson regression was used for the effort-adjusted richness analysis, which showed no evidence of overdispersion.

Mountain lion detection rates were standardized by camera effort and expressed as detections per 100 trap-days to facilitate comparisons among camera sites. Because only four mountain lion detections were recorded across the study area, sample size was insufficient to support reliable statistical modeling, and results were interpreted descriptively. The spatial and temporal distribution of detections was examined to characterize mountain lion use of the study corridor without inferring roadway crossing behavior.

Unless otherwise noted, all spatial analyses were conducted in ArcGIS Pro (Esri, 2024), and all statistical analyses were performed in R version 4.4.1 (R Core Team, 2024). Negative binomial models were fit using the MASS package.



Mountain lion (Puma concolor) captured with remote sensing camera near Rio Verde Drive.

RESULTS

Telemetry, remote camera monitoring, and wildlife–vehicle collision records documented wildlife responses to and interactions with Rio Verde Drive within the McDowell Sonoran Preserve. The strongest quantitative evidence of roadway-associated effects was observed for mule deer, with a similar but weaker pattern for overall mammal activity. Radio telemetry documented no roadway crossings by monitored Sonoran Desert Tortoises, while wildlife–vehicle collision records documented continued interactions between wildlife and the roadway.

Radio Telemetry Surveys

Sonoran Desert Tortoise (*Gopherus morafkai*)

None of the 27 monitored Sonoran Desert Tortoises crossed Rio Verde Drive during the study period (Figure 3). Minimum convex polygon home ranges ranged from 3.2 to 632.3 ha (median = 14.8 ha; mean = 50.8 ha), yet no individual home range extended across Rio Verde Drive. Several tortoises had telemetry locations immediately adjacent to the roadway, with subsequent locations remaining on the same side of the road, and no recorded locations on the other side of Rio Verde Drive.

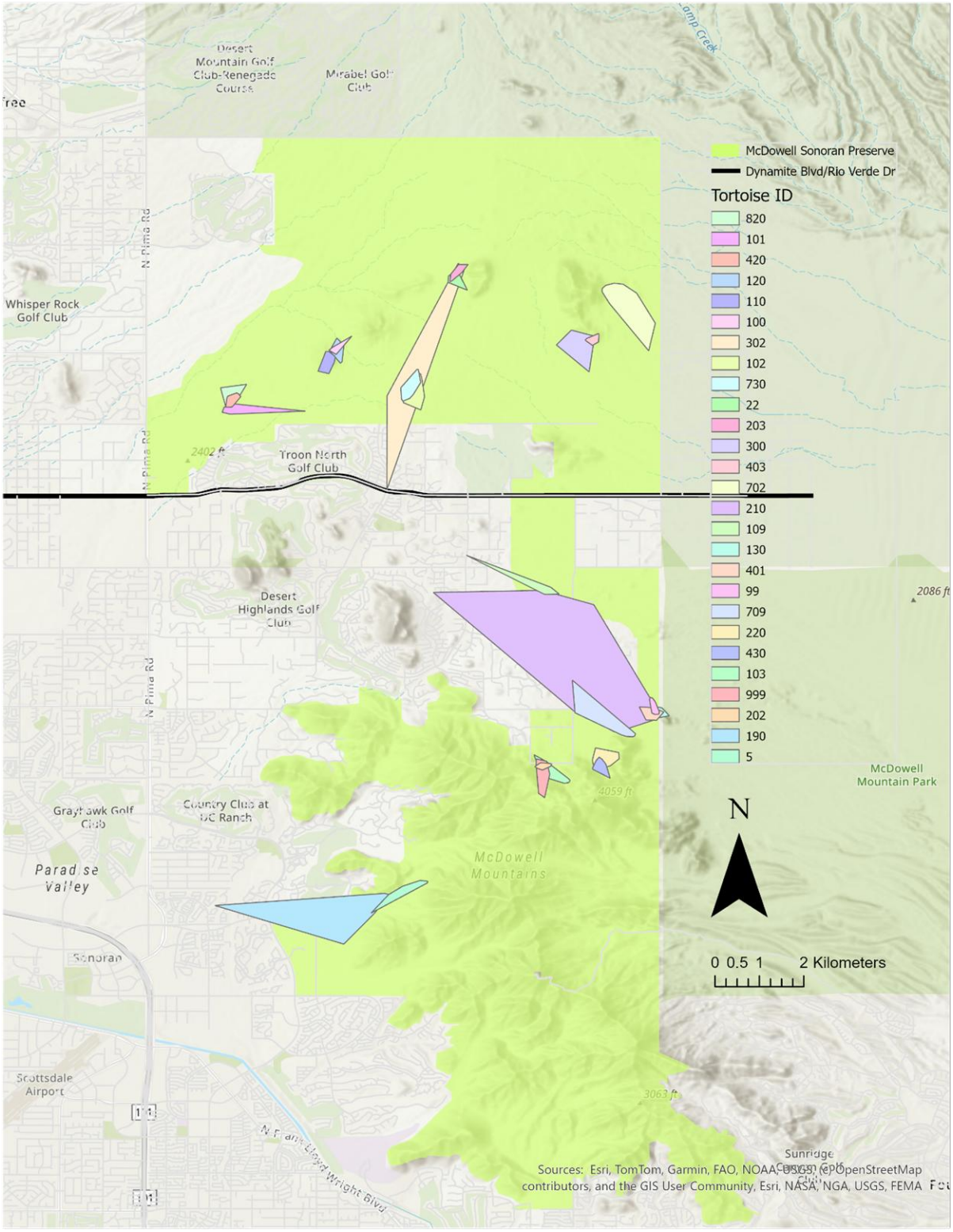


Figure 3. Minimum convex polygon (MCP) home ranges of 27 VHF-tagged Sonoran Desert Tortoises (*Gopherus morafkai*) monitored within the northern McDowell Sonoran Preserve, Scottsdale, Arizona, from 2021–2025. Home ranges remained confined to either side of Rio Verde Drive, and no monitored tortoise has been documented crossing the roadway during the study period.

Remote Camera Surveys

Mule Deer (*Odocoileus hemionus*)

Mule deer detection rates increased significantly with distance from Rio Verde Drive (negative binomial model: β = 0.359 ± 0.171 SE, z = 2.10, p = 0.036; Figure 4). After accounting for differences in sampling effort, mule deer detection rates were lowest at sites nearest the roadway and increased with distance from Rio Verde Drive. Roadway distance was the strongest-supported predictor of mule deer activity, while alternative models incorporating other variables, such as camera feature type and season, received less support. The distance model provided substantially greater support than the corresponding null model (AIC = 130.99 versus 136.49; likelihood-ratio test χ^2 = 7.50, df = 1, p = 0.0062). Model residual dispersion was 1.14, indicating no evidence of substantial residual overdispersion. These results demonstrate that mule deer activity was negatively associated with proximity to Rio Verde Drive, with an estimated 43% increase in detection rate for each standard-deviation increase in distance from the roadway.

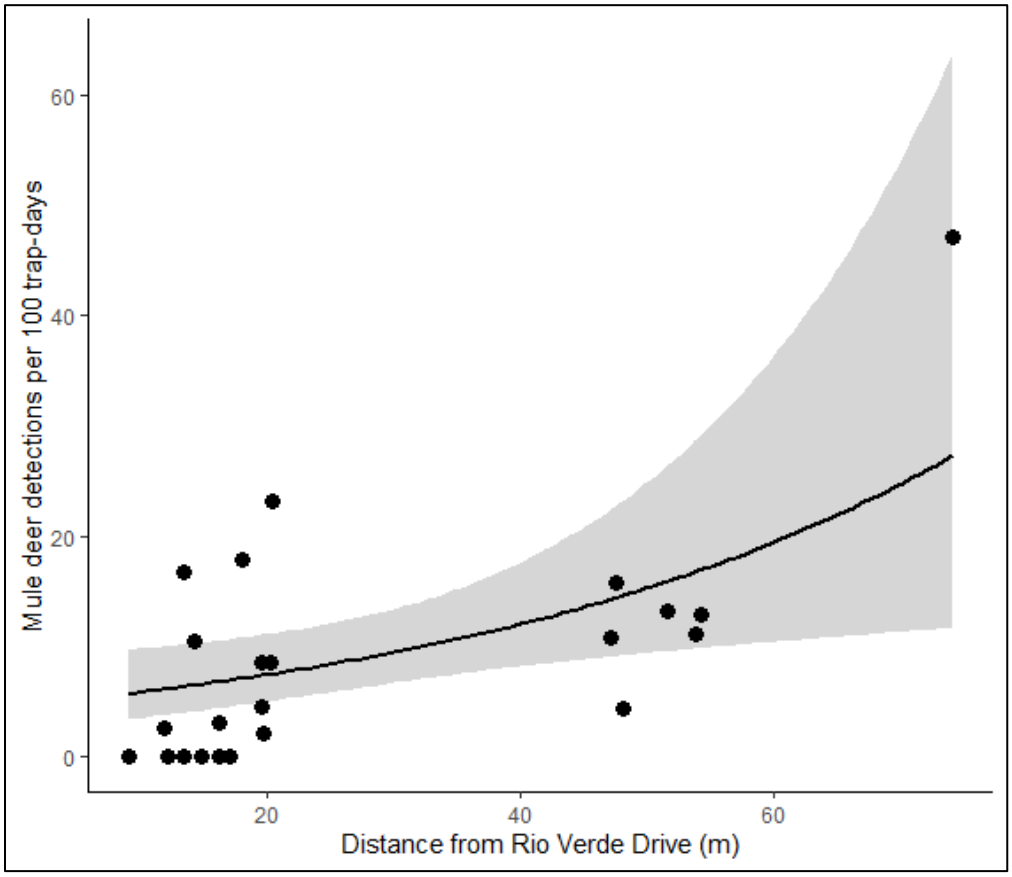


Figure 4. Relationship between mule deer detection rate (independent detections per 100 trap days) and distance from Rio Verde Drive. Points represent observed detection rates at camera sites, with the fitted relationship showing an increase in detection rate with increasing distance from the roadway.

Mammal Community

Across the 13-mammal species included in the analysis, overall mammal activity increased with distance from Rio Verde Drive. The final negative binomial model estimated a positive association between standardized roadway distance and mammal activity (β = 0.135 ± 0.064 SE, z = 2.09, p = 0.037). The corresponding rate ratio was 1.144 (95% CI = 1.010–1.302), indicating an approximately 14% increase in expected mammal detection rate for each one-standard-deviation increase in distance from the roadway. A likelihood-ratio test comparing the distance model with the effort-only null model also supported inclusion of roadway distance (χ^2 = 4.05, df = 1, p = 0.044). Final model dispersion was 1.06, indicating adequate model fit.

Mammal richness showed a different pattern. The number of mammal taxa detected at a site was strongly associated with sampling effort (Spearman's ρ = 0.784, p < 0.001), demonstrating that sites with more trap-days tended to record more mammal taxa. After accounting for sampling effort, roadway distance was not significantly associated with mammal richness (β = 0.0245, p = 0.692). The effort-only model had lower AIC than the model including roadway distance (AIC = 101.62 versus 103.13; ΔAIC = 1.51), providing no evidence that mammal richness varied systematically with distance from Rio Verde Drive.

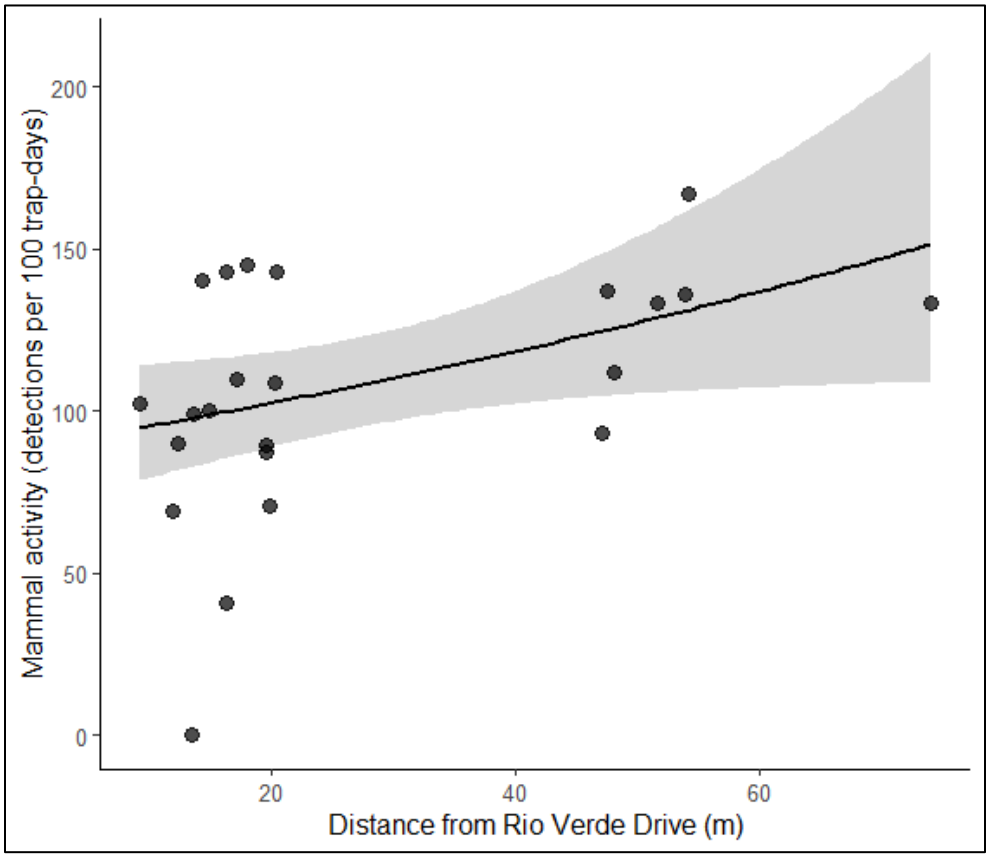


Figure 5. Relationship between relative mammal activity and distance from Rio Verde Drive across 13 mammal species. Points represent observed activity at camera sites, with the fitted relationship showing an increase in mammal activity with increasing distance from the roadway.

Mountain Lion (*Puma concolor*)

Four mountain lion detections were recorded during approximately 7,200 camera-trap nights, occurring at four of 23 camera sites. The detections occurred at distances of approximately 14.3, 17.0, 53.9, and 74.2 m from Rio Verde Drive. Because of the limited number of detections, no formal statistical analysis was conducted to evaluate the relationship between mountain lion activity and distance from the roadway.

Two of the four detections occurred within minutes of one another, with one detection recorded by a camera on the north side of Rio Verde Drive and another recorded shortly afterward by a camera directly south of the roadway. Although this temporal pattern is consistent with possible movement through the corridor, the available camera data cannot establish definitively that the detections represented the same individual.

Wildlife–Vehicle Collisions

Sixty wildlife–vehicle collision reports representing 11 wildlife taxa were documented along Rio Verde Drive in 2022, 2023, and 2025 (Table 2). Coyotes (17), bobcats (12), and collared peccaries (9) accounted for the majority of reported collisions, although incidents also included mule deer, Sonoran Desert Tortoises, raptors, and other native wildlife.

During 2025 alone, the Southwest Wildlife Conservation Center received 23 reports of wildlife–vehicle collisions or injured wildlife along Rio Verde Drive, including eight coyotes and six bobcats, further demonstrating the continued interactions between wildlife and the roadway.

Species	**2022**	**2023**	**2025**	**Total**
Coyote	3	6	8	17
Bobcat	4	2	6	12
Collared Peccary	5	1	3	9
Raccoon	4	2	0	6
Rabbit spp.	2	2	1	5
Deer spp.	0	2	2	4
Fox spp.	1	0	1	2
Owl	0	2	0	2
Hawk	0	0	1	1
Skunk spp.	0	0	1	1
Sonoran Desert Tortoise	1	0	0	1
Total	**20**	**17**	**23**	**60**

Table 1. Wildlife–vehicle collisions reported along Rio Verde Drive in 2022, 2023, and 2025. Records were compiled from incident reports provided by the Southwest Wildlife Conservation Center (2026).

DISCUSSION

Multiple independent lines of evidence indicate that Rio Verde Drive functions as a significant barrier to wildlife movement within the McDowell Sonoran Preserve. Telemetry monitoring, remote camera surveys, and wildlife–vehicle collision records demonstrate restricted wildlife movement, reduced wildlife activity near the roadway, and wildlife mortality across multiple taxa. Monitored Sonoran Desert Tortoises exhibited no documented roadway crossings during five years of telemetry monitoring, mule deer were detected significantly more frequently at camera sites farther from the roadway, and overall mammal activity showed a similar positive relationship with distance from the roadway. Together, these findings provide converging evidence that Rio Verde Drive influences wildlife movement and habitat use within the Gooseneck.

Although telemetry data cannot demonstrate that crossings never occur, the absence of documented roadway crossings by monitored Sonoran Desert Tortoises during five years of telemetry monitoring provides evidence that Rio Verde Drive may function as an effective movement barrier. Telemetry locations were recorded near the roadway, but no monitored locations were recorded on the opposite side, and subsequent locations occurred back in the direction from which tortoises had approached, suggesting that roadway crossings are uncommon. Furthermore, the documented Sonoran Desert Tortoise mortality in the wildlife–vehicle collision records demonstrates that when interactions with the roadway do occur, they can result in mortality. This finding is of particular conservation concern because the Sonoran Desert Tortoise is designated as a Tier 1A Species of Greatest Conservation Need in Arizona and is protected under Arizona Game and Fish Department regulations (Arizona Game and Fish Department, 2022; U.S. Fish and Wildlife Service, 2021). Sonoran Desert Tortoises exhibit relatively low mobility, delayed sexual maturity, and long generation times, making populations especially vulnerable to habitat fragmentation and roadway mortality (U.S. Fish and Wildlife Service, 2021). Even infrequent barriers to movement may reduce opportunities for dispersal, recolonization, and gene flow between habitat patches, increasing the risk of long-term population isolation.

Mule deer detections increased significantly with distance from Rio Verde Drive, consistent with previous GPS collar studies conducted within the Preserve and with broader research showing that roads alter movement patterns and increase physiological stress responses (Dwinnell et al., 2019; Parlin et al., 2026). The magnitude and statistical support of this relationship were stronger than those observed for the mammal community as a whole, suggesting that mule deer may be particularly responsive to roadway proximity. Unlike the larger habitat north and south of Rio Verde Drive, which may be where animals spend substantial portions of their time, the Gooseneck may be used primarily for movement between these areas. Wildlife may therefore be detected less frequently within the corridor because movements through it are relatively brief, while greater detections farther from the roadway may reflect greater use of adjacent core habitat. At the same time, reduced activity

near Rio Verde Drive suggests that roadway avoidance may further constrain use of the corridor. The observed pattern likely reflects both differences in habitat use between the Gooseneck and surrounding core habitat and reduced activity near the roadway.

The mammal community analysis provides additional evidence that the roadway may influence wildlife activity beyond the focal mule deer analysis. Across 13 mammal species, activity increased by approximately 14% per standard deviation of increasing distance from Rio Verde Drive. In contrast, mammal richness was not related to roadway distance after accounting for sampling effort. This distinction suggests that mammals may alter the intensity of habitat use near the roadway without a corresponding change in the number of species detected. Thus, the observed roadway-associated response appears to be more strongly reflected in activity than community richness.

Mountain lions were detected only four times during approximately 7,200 camera-trap nights, demonstrating use of the study corridor but providing insufficient data to evaluate roadway effects. Two detections occurred within minutes at cameras on opposite sides of Rio Verde Drive, providing an observation consistent with possible movement near the roadway; however, the data cannot determine whether the detections represented the same animal or whether a roadway crossing occurred. The limited detections precluded further inference about mountain lion responses to the roadway. To improve long-term monitoring, the McDowell Sonoran Conservancy recently replaced its camera network with 20 new cameras throughout the study corridor, enabling year-round monitoring. This expanded effort will improve future evaluation of movement patterns and roadway effects for infrequently detected species such as mountain lions.

Wildlife–vehicle collision records further indicate that roadway effects extend beyond the focal taxa, documenting interactions involving Sonoran Desert Tortoises, coyotes, bobcats, mule deer, and other native wildlife. Because wildlife–vehicle collisions are known to be underreported, particularly for deer and smaller mammals (Huijser et al., 2008), these records likely represent only a portion of roadway-related mortality.

These findings are consistent with broader regional connectivity assessments, which identify habitat fragmentation and isolation as important threats to wildlife movement and long-term biodiversity conservation in metropolitan Phoenix (Arizona Department of Transportation, 2014; Beach, 2024; White Tank Mountains Conservancy, 2024). As traffic volumes and surrounding development increase, continued loss of connectivity could progressively isolate habitat within the Preserve, reducing opportunities for dispersal, gene flow, and recolonization and potentially contributing to long-term declines in wildlife diversity. The increasingly isolated mountain preserves within the Phoenix metropolitan area, including the Phoenix Mountains, Piestewa Peak, and Camelback Mountain, illustrate the broader consequences of habitat isolation and urbanization, including declines in biodiversity and the abundance of previously common species such as mule deer (Beach, 2024). Maintaining connectivity through the Gooseneck before further fragmentation occurs therefore represents an opportunity to retain

ecological processes and wildlife diversity that become increasingly difficult to restore once habitat corridors are lost.

MANAGEMENT IMPLICATIONS

The findings of this study reinforce a fundamental principle of landscape conservation: maintaining existing wildlife connectivity is more effective than attempting to restore connectivity after habitat has become fragmented (Forman et al., 2002). Regional connectivity assessments emphasize the importance of maintaining remaining habitat linkages between protected areas as development and transportation infrastructure continue to expand. Because the Gooseneck represents an important remaining habitat corridor between larger protected habitats in the northeastern Phoenix metropolitan area, maintaining connectivity across Rio Verde Drive should remain a high conservation priority.

Construction of a wildlife crossing structure in conjunction with wildlife exclusion fencing represents an effective long-term strategy for maintaining landscape connectivity while reducing wildlife–vehicle collisions. Across North America, wildlife crossing systems paired with exclusion fencing have reduced large mammal–vehicle collisions by up to 97%, with several studies documenting mortality reductions approaching 98.5% (Ament et al., 2021; Bissonette & Rosa, 2012; Huijser et al., 2009).

Arizona projects demonstrate that these structures can also be effective in desert ecosystems. Long-term monitoring of wildlife crossings along U.S. Highway 93 documented substantial reductions in bighorn sheep collisions while maintaining landscape connectivity (Gagnon et al., 2017). Similarly, the Oracle Wildlife Crossing on State Route 77 was used by mule deer within weeks of construction, and subsequent monitoring documented successful use by Sonoran Desert Tortoises, demonstrating that wildlife crossing structures can facilitate movement for both large mammals and sensitive reptile species (Arizona Game and Fish Department, 2020; Coalition for Sonoran Desert Protection, 2025).

The multi-species responses documented in this assessment indicate that any future crossing structure along Rio Verde Drive should accommodate a diversity of wildlife taxa. Continued monitoring will be essential for evaluating the effectiveness of any future mitigation measures. The recent deployment of 20 Reconyx HyperFire 4K trail cameras provides year-round monitoring capacity that will strengthen future assessments of wildlife movement, habitat connectivity, and wildlife–vehicle collisions while supporting adaptive management.

CONCLUSION AND RECOMMENDATIONS

This assessment provides multiple lines of scientific evidence that Rio Verde Drive functions as a barrier to wildlife movement within the McDowell Sonoran Preserve, with reduced wildlife activity near the roadway, restricted documented movement by monitored tortoises, and documented wildlife mortality. As traffic volumes and surrounding development continue to increase, these effects may become more pronounced without measures to maintain connectivity. Because the Gooseneck remains one of the last functional wildlife corridors in the northeastern Phoenix metropolitan area, there is a unique opportunity to conserve connectivity before further fragmentation occurs. This assessment provides the scientific foundation for evaluating wildlife crossing infrastructure and implementing long-term solutions that improve public safety while sustaining ecological connectivity across the Preserve.

Recommendations

- Complete the ongoing feasibility study to determine the optimal location, design, implementation timeline, and estimated construction cost of a wildlife crossing.
- If the feasibility study demonstrates technical and economic feasibility, advance the project through design, funding, permitting, and construction of a wildlife crossing structure integrated with exclusion fencing.
- Continue the expanded long-term wildlife monitoring using multiple survey methods to establish baseline conditions, quantify long-term trends in wildlife movement, and evaluate the effectiveness of mitigation measures through adaptive management.



Vehicle on Rio Verde Drive exhibiting emergency braking indicators (brake lights, kicked-up roadside dirt) and an adjacent airborne mule deer (Odocoileus hemionus); immediate aftermath of suspected wildlife-vehicle collision.

LITERATURE CITED

Ament, R., Jacobson, S., Callahan, R., & Brocki, M. (Eds.). (2021). *Highway crossing structures for wildlife: Opportunities for improving driver and animal safety* (General Technical Report PSW-GTR-271). U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. **https://www.fs.usda.gov/psw/publications/documents/psw_gtr271/psw_gtr271.pdf**

Ahumada, J. A., Fegraus, E., Birch, T., Flores, N., Kays, R., O'Brien, T. G., Palmer, J., Schuttler, S., Zhao, J. Y., Jetz, W., Kinnaird, M., Kulkarni, S., Lyet, A., Thau, D., Duong, M., Oliver, R., & Dancer, A. (2020). Wildlife Insights: A platform to maximize the potential of camera trap and other passive sensor wildlife data for the planet. *Environmental Conservation*, 47(1), 1–6. **https://doi.org/10.1017/S0376892919000298**

Arizona Department of Transportation. (2014). *Biological evaluation: South Mountain Freeway (Loop 202), Interstate 10 (Papago Freeway) to Interstate 10 (Maricopa Freeway).* **https://apps.azdot.gov/files/projects/south-mtn/FEIS/11_smtc_biological_evaluation.pdf**

Arizona Game and Fish Department. (2020). *Evaluation of measures to reduce wildlife–vehicle collisions and promote connectivity in a Sonoran Desert environment: State Route 77.* **http://www.sonorandesert.org/wp-content/uploads/2020/04/2020-04-29-AGFD-SR-77-Progress-Report-.pdf**

Arizona Game and Fish Department. (2022). *Arizona wildlife conservation strategy: 2022–2032.* **https://azgfd-wdw.s3.amazonaws.com/awcs-2022/documents/AWCS_Final_Approved_11-22.pdf**

Beach, C. A. (2024). *Biological overview and connectivity report for the Sun Valley Linkage Complex.* White Tank Mountains Conservancy. **https://storymaps.arcgis.com/stories/8e4f645c7608455883827fad74dd9cac**

Beier, P. (1995). Dispersal of juvenile cougars in fragmented habitat. *The Journal of Wildlife Management*, 59(2), 228–237. **https://doi.org/10.2307/3808935**

Benson, J. F., Mahoney, P. J., Sikich, J. A., Serieys, L. E. K., Pollinger, J. P., Ernest, H. B., & Riley, S. P. D. (2016). Interactions between demography, genetics, and landscape connectivity increase extinction probability for a small population of large carnivores in a major metropolitan area. *Proceedings of the Royal Society B: Biological Sciences*, 283(1837). **https://doi.org/10.1098/rspb.2016.0957**

Bissonette, J. A., & Rosa, S. (2012). An evaluation of a mitigation strategy for deer–vehicle collisions. *Wildlife Biology*, 18(4), 414–423. **https://doi.org/10.2981/11-122**

Brooks, M. E., Kristensen, K., van Benthem, K. J., Magnusson, A., Berg, C. W., Nielsen, A., Skaug, H. J., Mächler, M., & Bolker, B. M. (2017). glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modeling. *The R Journal*, 9(2), 378–400. **https://doi.org/10.32614/RJ-2017-066**

City of Scottsdale. (2016). A*verage daily segment traffic volumes*. **https://www.scottsdaleaz.gov/docs/default-source/scottsdaleaz/transportation/traffic-volume-reports/2016-average-daily-segment-traffic-volumes.pdf**

City of Scottsdale. (2024). *Average daily segment traffic volumes.* **https://www.scottsdaleaz.gov/docs/default-source/scottsdaleaz/transportation/traffic-volume-reports/2024-average-daily-segment-traffic-volumes.pdf**

City of Scottsdale. (2026). *Fiscal year 2026/27 proposed budget.* **https://www.scottsdaleaz.gov/docs/default-source/scottsdaleaz/finance/budget-reports/fy2026-27/fy-2026-27-proposed-budget-book.pdf**

Coalition for Sonoran Desert Protection. (2025). *Santa Cruz Valley Natural Heritage Area grant: Further enhancement of a critical wildlife corridor in the Santa Cruz watershed wildlife camera monitoring progress report.* **https://www.sonorandesert.org/wp-content/uploads/2025/09/SCVNHA-Wildlife-Camera-Report-1-1.pdf**

Dwinnell, S. P. H., Sawyer, H., Randall, J. E., Beck, J. L., Forbey, J. S., Fralick, G. L., & Monteith, K. L. (2019). Where to forage when afraid: Does perceived risk impair use of the foodscape? *Ecological Applications*, 29(7). **https://doi.org/10.1002/eap.1972**

Esri. (2024). *ArcGIS Pro (Version 3.6.1) [Computer software]*. **https://www.esri.com**

Forman, R. T. T., & Alexander, L. E. (1998). Roads and their major ecological effects. *Annual Review of Ecology and Systematics*, 29, 207–231. **https://doi.org/10.1146/annurev.ecolsys.29.1.207**

Forman, R. T. T., Sperling, D., Bissonette, J. A., Clevenger, A. P., Cutshall, C. D., Dale, V. H., Fahrig, L., France, R., Goldman, C. R., Heanue, K., Jones, J. A., Swanson, F. J., Turrentine, T., & Winter, T. C. (2002). *Road ecology: Science and solutions.* Island Press. **https://arc-solutions.org/wp-content/uploads/2012/03/Forman-et-al.-2003-Road-Ecology-Sci-and-solutions.pdf**

Gagnon, J. W., Loberger, C. D., Ogren, K. S., Sprague, S. C., Boe, S. R., & Schweinsburg, R. E. (2017). *Evaluation of desert bighorn sheep overpass effectiveness: U.S. Route 93 long-term monitoring* (Report No. FHWA-AZ-17-710). Arizona Department of Transportation. **https://rosap.ntl.bts.gov/view/dot/37204/dot_37204_DS1.pdf**

Huijser, M. P., McGowen, P., Fuller, J., Hardy, A., Kociolek, A., Clevenger, A. P., Smith, D., & Ament, R. (2008). *Wildlife–vehicle collision reduction study: Report to Congress* (Report No. FHWA-HRT-08-034). Federal Highway Administration. **https://www.fhwa.dot.gov/publications/research/safety/08034/08034.pdf**

Huijser, M. P., Duffield, J. W., Clevenger, A. P., Ament, R. J., & McGowen, P. T. (2009). Cost–benefit analyses of mitigation measures aimed at reducing wildlife–vehicle collisions. *Biological Conservation*, 142(8), 1597–1607. **http://www.jstor.org/stable/26268301**

McDowell Sonoran Conservancy. (2014). *Flora and fauna of Scottsdale's McDowell Sonoran Preserve.* **https://www.mcdowellsonoran.org/wp-content/uploads/2023/11/Flora-and-Fauna-of-MSP.pdf**

Parlin, A. F., Ditmer, M. A., Laforge, M. P., Abernathy, H. N., Zeller, K. A., Stout, V., Stoner, D. C., Hersey, K. R., Larsen, R. T., McMillan, B. R., Wang, P., Sexton, J. O., Carter, N. H., Laske, T. G., & Wittemyer, G. (2026). Roads as dynamic stressors: Physiological response of mule deer to roads differs during range residency and migration. *Landscape Ecology*, 41, 30. **https://doi.org/10.1007/s10980-025-02272-0**

R Core Team. (2024). *R: A language and environment for statistical computing (Version 4.4.1) [Computer software]. R* Foundation for Statistical Computing. **https://www.R-project.org/**

Riley, S. P. D., Serieys, L. E. K., Pollinger, J. P., Sikich, J. A., Dalbeck, L. S., Wayne, R. K., & Morrison, S. A. (2014). Individual behaviors dominate the dynamics of an urban mountain lion population isolated by roads. *Current Biology*, 24(17), 1989–1994. **https://doi.org/10.1016/j.cub.2014.07.029**

Rubke, C. A., & O'Donnell, R. P. (2018). *Translocation and Radio-Telemetry Monitoring of Sonoran Desert Tortoises (Gopherus morafkai) along the Proposed Right-of-Way for State Route 202L South Mountain Freeway.* Final Report. Arizona Game and Fish Department.

Southwest Wildlife Conservation Center. (2026). *Wildlife–vehicle collision records along Rio Verde Drive, 2022–2026* [Unpublished dataset].

Taylor, P. D., Fahrig, L., Henein, K., & Merriam, G. (1993). Connectivity is a vital element of landscape structure. *Oikos*, 68, 571–573. **https://doi.org/10.2307/3544927**

U.S. Fish and Wildlife Service. (2021). *Species status assessment for the Sonoran Desert tortoise (Gopherus morafkai)* (Version 2.1). **https://downloads.regulations.gov/FWS-R2-ES-2021-0153-0004/content.pdf**

White Tank Mountains Conservancy. (2024). *Conceptual wildlife linkage report: White Tank Mountains Regional Connectivity Initiative—A regional plan for wildlife connectivity in the West Valley.* Prepared by Logan Simpson. **https://www.wtmconservancy.org/wp-content/uploads/2025/12/WTMC_Conceptual-Wildlife-Linkage-Report.pdf**

Appendix A. Supplemental Photo Catalog

Wildlife observations captured along Rio Verde Drive with remote sensing cameras. These photos are not referenced in the report but provide additional context, such as relevant wildlife behavior and observations of non-focal species.



Figure A1: Adult and juvenile collard peccary (*Dicotyles tajacu*) captured with remote cameras approaching Rio Verde Drive [top] and running away from the roadway seconds later [bottom].



Figure A2: Mule deer (*Odocoileus hemionus*) captured in motion with remote sensing cameras near Rio Verde Drive.



Figure A3: Coyote (*Canis latrans*) captured in motion with remote sensing cameras near Rio Verde Drive.



Figure A4: Bobcat (*Lynx rufus*) and vehicle captured along Rio Verde Drive with remote cameras.



Figure A5: Black-tailed jackrabbit (*Lepus californicus*) captured near Rio Verde Drive with remote cameras.



Figure A6: Grey fox (*Urocyon cinereoargenteus*) captured near Rio Verde Drive with remote cameras.



Figure A7: Striped skunk (*Mephitis mephitis*) captured near Rio Verde Drive with remote cameras.



Figure A8: American badger (*Taxidea taxus*) captured near Rio Verde Drive with remote cameras.



Figure A9: American hog-nosed skunk (*Conepatus leuconotus*) captured near Rio Verde Drive with remote cameras.



Figure A10: Great horned owl (*Bubo virginianus*) captured near Rio Verde Drive with remote cameras.



Figure A11: Greater roadrunner (*Geococcyx californianus*) and vehicle driving along Rio Verde Drive captured with remote cameras.

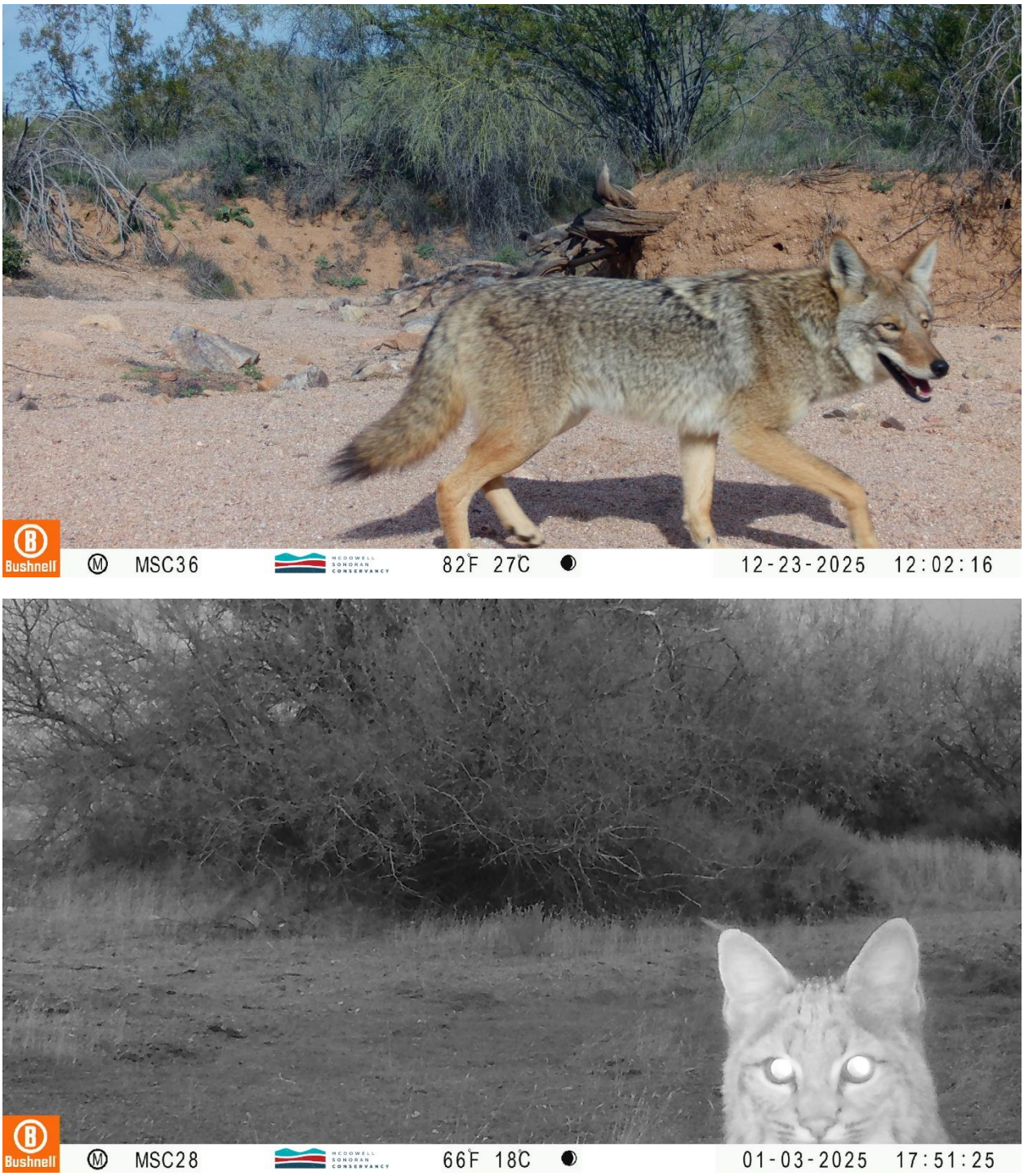


Figure A12: Coyote (*Canis latrans*) [top] and bobcat (*Lynx rufus*) [bottom] caught breaking the fourth wall, captured by remote cameras near Rio Verde Drive.