SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.®

Avian Surveys and Nest Monitoring on MSHCP Properties 2021 Final Project Report

Prepared for

Desert Conservation Program
Clark County Department of Environment and Sustainability

Prepared by

SWCA Environmental Consultants

September 2021

AVIAN SURVEYS AND NEST MONITORING ON MSHCP PROPERTIES
FINAL PROJECT REPORT

Prepared for

Desert Conservation Program
Clark County Department of Environment and Sustainability
4701 W. Russell Road, Suite 200
Las Vegas, Nevada 89118

Prepared by

SWCA Environmental Consultants
7210 Placid Street
Las Vegas, Nevada 89119
702-248-3880
www.swca.com

SWCA Project No. 52768 & 66114

DCP Project Nos. 2017-SWCA-1730P & 2017-SWCA-1750F

September 2021

CONTENTS

Appendices

Figures

Tables

EXECUTIVE SUMMARY

In 2021, SWCA Environmental Consultants (SWCA) conducted avian surveys across all properties managed by the Clark County Desert Conservation Program (County); these properties include the Riparian Reserve Units and the Boulder City Conservation Easement (BCCE). Surveys were conducted to build on the baseline dataset of avian species presence and distribution at the County's properties. These baseline data can be compared with future data to quantify the success of management and restoration efforts at the County's properties. Surveys consisted of three rounds of breeding bird point-count surveys at the Riparian Reserve Units and at the BCCE and species-specific surveys for southwestern willow flycatcher (*Empidonax traillii extimus*) and yellow-billed cuckoo (*Coccyzus americanus*) at the Riparian Reserve Units. In addition, an intensive southwestern willow flycatcher monitoring program was instituted at Mesquite West (a historic southwestern willow flycatcher breeding site that includes County Parcel 1-A) and at Mormon Mesa Parcel 5-A, and a brown-headed cowbird (*Molothrus ater*) control program was implemented at Mesquite West in 2021.

Surveys conducted in 2021 were completed between May 1 and August 5. During point-count surveys, surveyors detected six of the eight bird species covered by the Clark County Multiple Species Habitat Conservation Plan (MSHCP): American peregrine falcon (*Falco peregrinus anatum*), Arizona Bell's vireo (*Vireo bellii arizonae*), blue grosbeak (*Passerina caerulea*), phainopepla (*Phainopepla nitens*), southwestern willow flycatcher, and summer tanager (*Piranga rubra*). In addition, the two other bird species covered by the MSHCP, vermilion flycatcher (*Pyrocephalus obscurus*) and yellow-billed cuckoo, were detected incidentally during southwestern willow flycatcher surveys. The surveys also yielded three evaluation species: loggerhead shrike (*Lanius ludovicianus*), crissal thrasher (*Toxostoma crissale*), and LeConte's thrasher (*Toxostoma lecontei*). In total, 77 avian species were recorded across all the County's properties in 2021, and MSHCP-covered and evaluation species were observed at each property.

Southwestern willow flycatcher monitoring was conducted between May 15 and August 19, 2021, to determine residency of willow flycatchers (*E. traillii*), find and monitor southwestern willow flycatcher nests, and band adults and nestling southwestern willow flycatchers. The monitoring program was also important to assessing the effects of brown-headed cowbird control on southwestern willow flycatcher nest success at Mesquite West. A total of 18 adult willow flycatchers were detected at Mesquite West, Bunkerville West Parcel 2-M, Riverside Parcel 3-A, and Mormon Mesa Parcel 5-A. The three willow flycatchers detected at Parcels 2-M and 3-A were detected only during the first round of surveys and were believed to be spring migrants passing through the Riparian Reserve Units. The remaining 15 individuals at Mesquite West and Mormon Mesa 5-A comprised three pairs, four unpaired males, and five individuals for which residency and/or breeding status could not be determined. Eight confirmed nesting attempts were documented; two of these attempts were successful. Seven adult and three nestling southwestern willow flycatchers were newly banded in 2021; one adult banded in a previous year was recaptured. Of the three nestlings banded at Mesquite West, all were confirmed to have fledged.

SWCA conducted targeted brown-headed cowbird control at Mesquite West from May 15, 2021, to July 25, 2021. SWCA biologists performed targeted mist-netting of adult brown-headed cowbirds over 13 mornings, totaling 18.6 net-hours. Male brown-headed cowbirds were released, and females were euthanized. In total, 20 adult brown-headed cowbirds (1.1 adults/net-hour) were captured, of which six were male. Fourteen female brown-headed cowbirds were euthanized, and three brown-head cowbird eggs were addled in 2021.

1.0 INTRODUCTION

The Clark County Desert Conservation Program (County) manages compliance with the Endangered Species Act (ESA) through the Clark County Multiple Species Habitat Conservation Plan (MSHCP) (Clark County 2000). This is accomplished, in part, through the management of a reserve system, which includes Riparian Reserve Units and the Boulder City Conservation Easement (BCCE). The MSHCP covers eight bird species, six of which are known to occur primarily in desert riparian habitats: Arizona Bell's vireo (*Vireo bellii arizonae*), blue grosbeak (*Passerina caerulea*), southwestern willow flycatcher (*Empidonax traillii extimus*), summer tanager (*Piranga rubra*), vermilion flycatcher (*Pyrocephalus rubinus*), and yellow-billed cuckoo (*Coccyzus americanus*). The other two MSHCP-covered bird species can occur either in or away from desert riparian habitats: phainopepla (*Phainopepla nitens*) is typically found in desert washes with mesquite (*Prosopis* spp.) or catclaw acacia (*Senegalia greggii*), and American peregrine falcon (*Falco peregrinus*) can be found in almost any type of habitat but prefers to nest on cliff faces (Clark County 2000). Two of the eight covered bird species are also protected under the ESA—southwestern willow flycatcher, listed as endangered (U.S. Fish and Wildlife Service [USFWS] 1995), and yellow-billed cuckoo, listed as threatened (USFWS 2014a). In addition to the eight covered species, several evaluation species can be found in a variety of desert habitats, including upland habitats, which compose most of the BCCE.

The extent and quality of desert habitat across the Southwest, particularly desert riparian habitat, have been steadily diminishing for decades, threatened by urban and agricultural development, invasion of non-native species such as tamarisk (*Tamarix* spp.), fire, and the reduction of water tables through unsustainable water use (Clark County 2015). Because quality avian habitats, particularly riparian habitat, are scarce within arid environments, management of these areas, and conservation of the MSHCP-covered avian species that inhabit them, are essential to these species' survival.

1.1 Description of the Project

In 2019, the County solicited proposals to conduct continued avian surveys on its Riparian Reserve Units (Figure 1) and on the BCCE (Figure 2). The County contracted SWCA Environmental Consultants (SWCA) to conduct presence/absence surveys for both southwestern willow flycatcher and yellow-billed cuckoo across the Riparian Reserve Units (Muddy River, Virgin River Subunit 1 [Mesquite West], Virgin River Subunit 2 [Bunkerville], Virgin River Subunit 3 [Riverside], and Virgin River Subunit 5 [Mormon Mesa]) (see Figure 1), as well as to conduct avian point-counts at 47 locations across the Riparian Reserve Units and the BCCE. In 2020, SWCA continued these surveys at all the properties surveyed in 2019 and at an additional property that the County purchased in early 2020 (Bunkerville Parcels 2-K, 2-L, and 2-M). SWCA continued these surveys in 2021, and the resulting data build on baseline presence/absence and relative abundance data for all bird species on these properties, including any MSHCP-covered and evaluation avian species. Data collected during these surveys can be used to inform and evaluate the success of restoration efforts and land management decisions for these properties. Additionally, in 2021, SWCA was contracted by the County to perform southwestern willow flycatcher territory and nest monitoring at Mesquite West and at Mormon Mesa Parcel 5-A. Furthermore, in 2021, SWCA implemented a target-netting program for brown-headed cowbirds (*Molothrus ater*) at Mesquite West to evaluate the potential of target netting in reducing the negative effects of brood parasitism on southwestern willow flycatcher nest success.

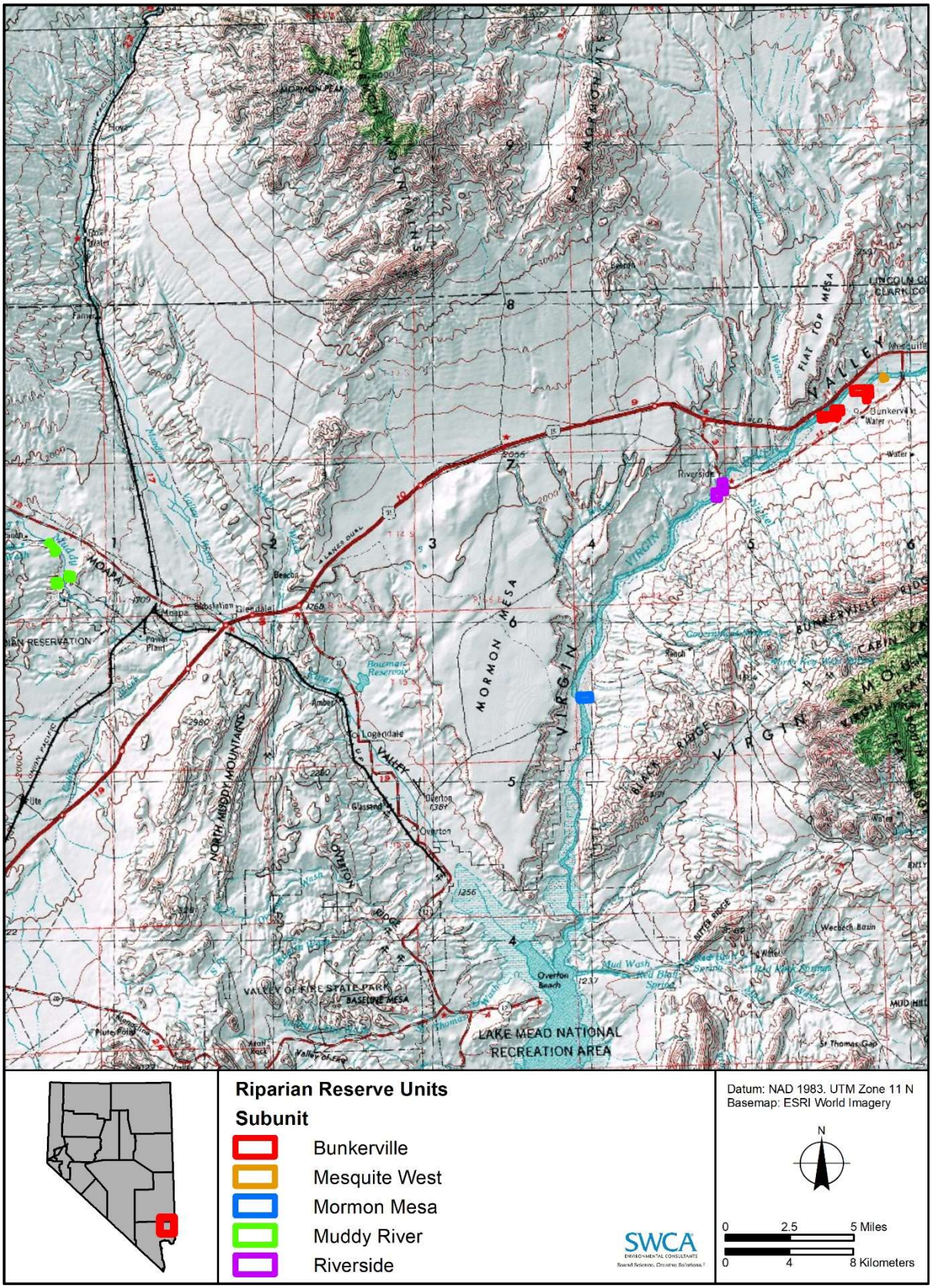

Figure 1. Riparian Reserve Unit locations.

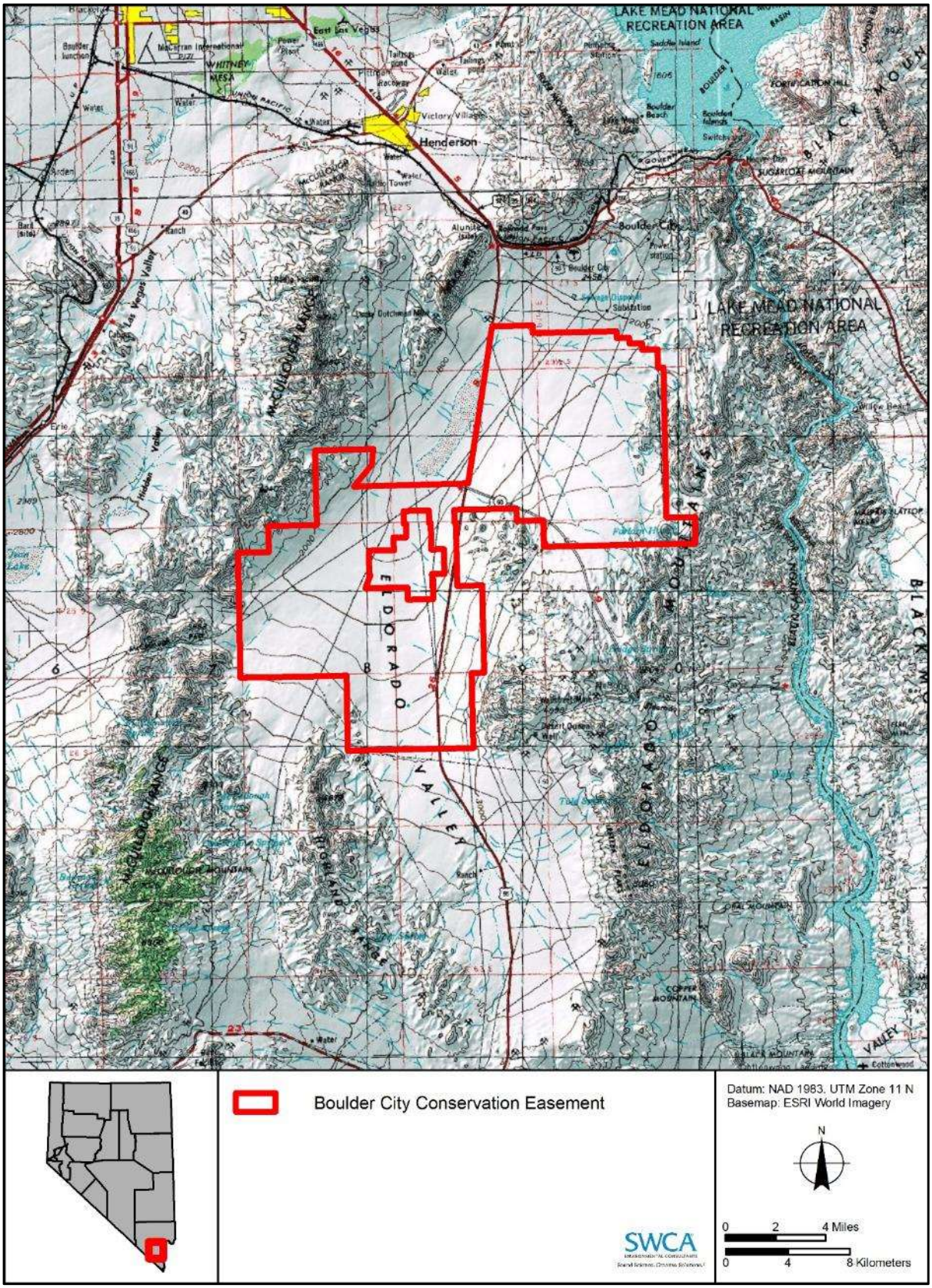

Figure 2. BCCE location.

1.2 Background and Need

On November 19, 2000, the USFWS issued the Intra-Service Biological and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada, for an MSHCP (Biological and Conference Opinion) (USFWS 2000). Then, on March 28, 2001, the USFWS issued an amended incidental take permit for the Clark County MSHCP (USFWS 2001).

1.2.1 Riparian Reserve Units

According to both the Biological and Conference Opinion and Condition K.1 of the associated incidental take permit, the County must acquire private property that contains desert riparian habitat along the Virgin River, Muddy River, and Meadow Valley Wash in Clark County. It was recognized that proper management of desert riparian habitats would be crucial in conserving the six bird species covered by the MSHCP (including the two federally listed species) that are known to use this habitat. To date, the County has acquired approximately 267 hectares (ha) (660 acres) of land along the Muddy and Virgin Rivers in northeastern Clark County, Nevada.

Prior to 2017, the County acquired 115 ha (285 acres) along the Muddy and Virgin Rivers. SWCA began conducting avian surveys at these parcels in 2017 to establish a baseline dataset of avian species presence and distribution under two separate projects: 1) Federally Listed Bird Surveys on Riparian Properties (SWCA 2017a) and 2) Point-count Surveys on Riparian Properties (SWCA 2017b). In late 2017, the County acquired an additional 128 ha (316 acres) along the Virgin River. Point-count surveys and species-specific surveys for federally listed species were conducted at these newly acquired properties under one project in 2018 (SWCA 2018a). In 2019, avian surveys at all the County's properties were combined into one project (SWCA 2019a). Point-count surveys and species-specific surveys for federally listed species were conducted at all the County's riparian properties through 2020, including at the newly acquired Parcels 2-L and 2-M (SWCA 2020). Surveys at all the County's properties were continued in 2021, and those surveys are described herein.

FEDERALLY LISTED BIRD SURVEYS

Species Background

Southwestern Willow Flycatcher

Southwestern willow flycatcher is one of four subspecies of willow flycatcher (*E. traillii*) (Unitt 1987). Throughout this report, the term "willow flycatcher" is used for individuals for which the subspecies could not be confirmed. Southwestern willow flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987). Factors contributing to the decline of southwestern willow flycatchers on their breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by non-native plants; and brood parasitism by brown-headed cowbirds. One of the last long-distance neotropical migrants to arrive in North America in spring, southwestern willow flycatchers typically arrive in May or June and depart in August (Sogge et al. 2010).

Southwestern willow flycatchers nest in a variety of habitats, but common characteristics of southwestern willow flycatcher breeding habitat include dense tree or shrub cover ≥ 3 m (9.8 feet) in height, vegetation with dense twig structure and high canopy closure, and proximity to surface water or saturated soil (McLeod and Pellegrini 2013; Sogge et al. 2010). Southwestern willow flycatchers nest in habitat patches ranging in size from 0.8 ha (2.0 acres) to several hundred hectares but are rarely found in narrow strips of habitat < 10 m (32.8 feet) wide (Sogge et al. 2010). During the nesting season, southwestern willow

flycatchers occupy home ranges averaging less than 0.5 ha (1.2 acres) in size (Cardinal 2005). Willow flycatchers are generally monogamous, but polygyny has been documented (Ehrlich et al. 1988), particularly in the southwestern subspecies (SWCA 2019a, 2019b, 2020). Migrant willow flycatchers are found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, though not necessarily used for breeding, are likely important for both reproduction and survival. Designated critical habitat for the southwestern willow flycatcher includes riparian habitats along the Virgin River from Berry Springs, Utah, downstream to the full pool level of Lake Mead (USFWS 2013a) and includes all three subunits of the Virgin River Riparian Reserve Unit.

Western Yellow-billed Cuckoo

The yellow-billed cuckoo was historically widespread and locally common along rivers throughout the western United States (USFWS 2013b). However, populations have declined across the West in recent years, largely as a result of loss, degradation, and fragmentation of riparian habitat. Consequently, the western distinct population segment was listed as threatened under the ESA in October 2014 (USFWS 2014a). Critical habitat for the western yellow-billed cuckoo was designated in 2021, but no critical habitat units were designated within the state of Nevada (USFWS 2021).

Yellow-billed cuckoos are late neotropical migrants, arriving on their breeding grounds around mid-June and departing by mid-September. Yellow-billed cuckoo home ranges are generally at least 40 ha (100 acres) in size and often exceed 80 ha (200 acres), though home ranges as small as 1 ha (2.5 acres) have been documented (USFWS 2020). These patches are typically at least 100 m (328 feet) wide (USFWS 2020). Yellow-billed cuckoos have not been found nesting in isolated patches less than 1 ha (2.5 acres) in size or in linear habitats less than 10 to 20 m (33 to 66 feet) wide, but they may use these habitats during migration and early in the breeding season (Halterman et al. 2015). Breeding habitat typically includes multi-storied riparian woodlands dominated by willow (*Salix* spp.) or cottonwood (*Populus* spp.) (USFWS 2020). Breeding habitat is typically adjacent to watercourses with less than 3 percent slopes. Yellow-billed cuckoos are known to nest in dense early to mid-successional riparian habitats (USFWS 2014b). A study of nest placement in Arizona and California found that nests were placed between 1 and 22 m (0.3 to 72 feet) above ground, with an average height of 7 m (23 feet) (Hughes 2015). Yellow-billed cuckoos tend to be serially monogamous, but serial polyandry has been regularly documented in western populations.

Survey Background

By 2019, the County had outlined 53.5 ha (132.2 acres) within the Riparian Reserve Units that were targeted for southwestern willow flycatcher and yellow-billed cuckoo surveys. Habitat suitability and the need for species-specific surveys were assessed during a site reconnaissance. Any portions of the 53.5 ha (132.2 acres) identified in the County's solicitation that were devoid of woody vegetation ≥ 3 m (9.8 feet) in height (as a result of scouring, restoration activities, etc.) were not surveyed. These areas were described (e.g., species, height, and percent cover of the dominant vegetation), photographed, delineated in the field, and then delineated in ArcGIS. Of the 53.5 ha (132.2 acres) originally estimated for survey by the County, SWCA delineated 47.9 ha (118.4 acres) in 2019 as potential habitat to be surveyed for both species across all subunits; these areas were resurveyed in 2020, although some minor changes were made to the survey area.

During 2019 yellow-billed cuckoo surveys, a cuckoo was detected in a screwbean mesquite (*Prosopis pubescens*)–dominated bosque outside the delineated survey area within Mormon Mesa Parcel 5-A. In an effort to better document cuckoo habitat use within this portion of the parcel, SWCA added this 5.1 ha (12.7 acres) of mesquite bosque to the Mormon Mesa yellow-billed cuckoo survey area in 2020.

In early 2020, the County acquired three new parcels (2-K, 2-L, and 2-M) within the Bunkerville Subunit, totaling an additional 23.9 ha (59.0 acres). SWCA delineated 2.6 ha (6.4 acres) of riparian habitat within Parcels 2-L and 2-M (no habitat was identified in Parcel 2-K) to be surveyed for southwestern willow flycatchers and yellow-billed cuckoos, and this area was surveyed in 2020. Then in late 2020, the County masticated 14.6 ha (36 acres) of dead and dying tamarisk at Mormon Mesa Parcel 5-A. These areas of masticated tamarisk were not surveyed for southwestern willow flycatcher or yellow-billed cuckoo in 2021.

Southwestern willow flycatcher monitoring data collected at Mesquite West from 2003 through 2013 show that southwestern willow flycatcher nest and territory locations varied from year to year, according to the distribution of suitable habitat within the greater Mesquite West study site, and sometimes were outside the County's Parcel 1-A. Furthermore, monitoring at Parcel 1-A in 2020 resulted in detections of singing male willow flycatchers well west of the County's Parcel 1-A boundary. Therefore, it was determined that southwestern willow flycatcher surveys across the entire Mesquite West site were important for detecting between-year habitat changes and southwestern willow flycatcher movements, as well as for assessing the effects of brown-headed cowbird control on the breeding success of southwestern willow flycatchers across all occupied habitat at Mesquite West. To accomplish these goals, 10.1 ha (24.9 acres) of additional habitat within Mesquite West, west of the County's Parcel 1-A, was added to the southwestern willow flycatcher survey area in 2021.

SOUTHWESTERN WILLOW FLYCATCHER MONITORING

SWCA has been conducting surveys and monitoring for southwestern willow flycatcher in southern Nevada since 2003, and SWCA has documented southwestern willow flycatcher nesting in Mesquite West (which includes the County's Parcel 1-A) for decades. Surveys conducted for the County from 2017 through 2020 documented occupancy of Mesquite West by southwestern willow flycatcher throughout those years. Over the course of this work, SWCA has also documented consistently high rates of parasitism of southwestern willow flycatcher nests by brown-headed cowbirds.

Since 2013, the Mesquite study area (which encompasses several sites, including Mesquite West) has consistently yielded one of the lowest average productivity rates (0.45 fledglings/nest) of all the southwestern willow flycatcher study areas in southern Nevada. More recently, of the 13 nests at the County's Parcel 1-A in 2019 and 2020 with at least one southwestern willow flycatcher egg and a known outcome, six (46.2%) were parasitized by brown-headed cowbirds (SWCA 2019b, 2020). Mean productivity for all Parcel 1-A nests was 0.38 fledglings/nest for 2019 and 2020 combined. Productivity at all southern Nevada sites monitored in 2019 ranged from 0 to 2.5 fledglings/nest, with an overall average of 1.43 fledglings/nest (SWCA 2019b)—over three times greater than at Parcel 1-A.

Continued monitoring of southwestern willow flycatcher territories and nests would be an essential component in determining whether brown-headed cowbird control has an impact on the nesting success of the southwestern willow flycatchers at Mesquite West (Bureau of Reclamation 2004). SWCA contracted with the County to conduct territory and nest monitoring of southwestern willow flycatchers at Mesquite West in 2021. Additionally, SWCA monitored southwestern willow flycatchers at Mormon Mesa Parcel 5-A in 2021, following successful breeding within that parcel in 2020.

BROWN-HEADED COWBIRD CONTROL

It is believed that parasitism has significantly contributed to the nest failures and low productivity at Mesquite West (SWCA 2019b). As part of a previous project with the Bureau of Reclamation, SWCA trapped brown-headed cowbirds across the Mesquite study area from 2003 through 2007 (McLeod and Pellegrini 2013). Despite substantial trapping efforts, the percentage of successful nests did not

significantly improve during or following trapping (pre-trapping: 48%; trapping: 49%; post-trapping: 36%).

Starting in 2010, SWCA began addling brown-headed cowbird eggs on southwestern willow flycatcher projects for the Bureau of Reclamation and the Nevada Department of Wildlife (NDOW). After addling began, the proportion of brown-headed cowbird eggs that hatched dropped from 74% (2003–2009) to 11% (2010–2012) (McLeod and Pellegrini 2013). Nest productivity did not increase significantly as a result of cowbird egg addling, possibly because high depredation rates obscured any benefits of egg addling. However, data collected in earlier years showed that nests with unhatched brown-headed cowbird eggs produced more southwestern willow flycatcher fledglings, on average, than nests with brown-headed cowbird nestlings; therefore, McLeod and Pellegrini (2013) recommended that addling continue to be used as a brown-headed cowbird control method in the Lower Colorado River watershed.

Southwestern willow flycatcher nests in the Mesquite study area had high (53%) nest parasitism rates from 2015 through 2019 (SWCA 2019b). Rothstein et al. (2003) recommended implementing a brown-headed cowbird control program when parasitism rates reach 20%–30% for a threatened or endangered host or 50% for non-protected host species. While trapping or addling alone did not prove beneficial to southwestern willow flycatcher nest success or productivity across Mesquite West, several avian studies have shown an increase in nest success when different means of cowbird control were combined, such as shooting adult brown-headed cowbirds, addling cowbird eggs, and removing nestling cowbirds (Whitfield et al. 1999; Kostecke et al. 2005).

To reduce high levels of nest parasitism by brown-headed cowbirds on southwestern willow flycatchers, SWCA proposed a combined-method brown-headed cowbird control program at Mesquite West for 2021. In addition to southwestern willow flycatcher territory and nest monitoring, SWCA contracted with the County to conduct brown-headed cowbird egg addling, nestling euthanasia, and target netting.

POINT-COUNT SURVEYS

In 2017, SWCA began conducting breeding bird point-count surveys for the County at 51 locations across the Riparian Reserve Units (SWCA 2017b). In 2018 and 2019, SWCA continued breeding bird point-count surveys at all or a subset of these locations as part of the comprehensive bird survey effort across all the County's properties (SWCA 2018a, 2019b). Four additional point-count locations were added with the acquisition of Parcels 2-L and 2-M in 2020 (SWCA 2020).

1.2.2 Boulder City Conservation Easement

In addition to the acquisition of riparian properties, implementation of the MSHCP also required the establishment of a conservation easement in the Eldorado Valley. This easement, known as the BCCE, was established in July 1995 through an agreement between Clark County and Boulder City. Then, in early 2020, the County completed a land exchange for certain portions of the BCCE, resulting in a net increase of 325 ha (803 acres) within the BCCE.

According to both the Biological and Conference Opinion (USFWS 2000) and Condition P of the associated incidental take permit (USFWS 2001), the County is required to take measures necessary to ensure maintenance of connectivity for Mojave desert tortoise (*Gopherus agassizii*) and other covered species within the BCCE. While the BCCE is primarily managed for protection of the desert tortoise, it was recognized that proper management of desert tortoise habitat could also be beneficial for protecting habitat for other species covered by the MSHCP, including avian species (Clark County 2019).

POINT-COUNT SURVEYS

In 2018, SWCA began conducting breeding bird point-count surveys for the County at 40 locations across the BCCE (SWCA 2018b). From 2019 to 2020, SWCA continued breeding bird point-count surveys at a subset of these locations as part of the comprehensive bird survey effort across all the County's properties (SWCA 2019a, 2020).

1.3 Management Actions, Goals, and Objectives

The County's Riparian Reserve Unit Management Plan (Clark County 2015) identifies goals and objectives that help guide management directives on the Riparian Reserve Units. The first goal listed in this plan is to "manage reserve units to provide habitat for the six MSHCP covered bird species" (Clark County 2015:35) that use desert riparian habitat. The objective identified to reach this goal is to "restore, create, and enhance habitat for riparian bird species" (Clark County 2015:35). In addition, the BCCE Management Plan (Clark County 2019) identifies goals and objectives that help guide management directives within the BCCE. The second goal listed in the BCCE Management Plan is to "protect and manage the BCCE for other MSHCP covered species" (Clark County 2019:78).

Managing species covered under the MSHCP and their habitats requires an in-depth understanding of baseline conditions within a given management unit. Collecting species' abundance and distribution data is a critical first step in monitoring of and conservation management efforts for the MSHCP-covered bird species found in Clark County. The short-term objectives for this project are 1) to establish a baseline record of all breeding bird species recorded on the County's reserve system properties and 2) to assess the effect of brown-headed cowbird control on nesting southwestern willow flycatchers. The long-term goal is to track changes in presence and relative abundance of all the MSHCP-covered bird species that use these properties in an effort to measure the success of management and restoration efforts conducted therein.

2.0 METHODS

2.1 Federally Listed Bird Surveys

Multiple broadcast surveys for southwestern willow flycatcher conducted throughout the breeding season were used to assess the presence of the southwestern subspecies of willow flycatcher. Southwestern willow flycatcher surveys followed the standard five-survey protocol described in Sogge et al. (2010), which calls for one survey between May 15 and 31, two surveys between June 1 and 24, and two additional surveys between June 25 and July 17. The surveys were separated by a minimum of 5 days. To elicit responses from nearby southwestern willow flycatchers, surveyors stopped approximately every 30 m (98 feet) and broadcast 10–15 seconds of the willow flycatcher's primary song (*fitz-bew*) and call (*breet*). Surveyors watched for flycatchers and listened for vocal responses for 1 minute before proceeding to the next survey station. If an unidentified *Empidonax* flycatcher was observed but did not respond with song to the initial broadcast, other conspecific vocalizations were broadcast, including *creets/breets*, *wee-oos*, *whitts*, *churr/kitters*, and a set of interaction calls given by a mated pair of flycatchers (in accordance with Lynn et al. 2003). These calls are frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify willow flycatchers.

Cuckoos vocalize infrequently, have a short breeding cycle, and typically occupy home ranges varying from 40 to 80 ha (100 to 200 acres) in size (USFWS 2020). These factors make it difficult to use survey results to determine the number of cuckoo territories at a site. However, repeated broadcast surveys allow

an assessment of the presence or absence of cuckoos, and survey results can be used to estimate the number of possible and probable breeding territories (Halterman et al. 2015).

Yellow-billed cuckoo surveys followed the standard four-survey protocol described by Halterman et al. (2015). One survey was completed between June 15 and 30, two surveys were completed between July 1 and 31, and one survey was completed between August 1 and 15. Surveys were separated by 12–15 days. Surveyors stopped every 100 m (328 feet) and listened for 1 minute for spontaneously calling yellow-billed cuckoos, then broadcast five series of cuckoo contact calls (*kuk/kowlp*) at 1-minute intervals. Surveyors listened and watched for cuckoo responses between each set of broadcast calls; the total time spent at each survey point was approximately 6 minutes.

If willow flycatchers or yellow-billed cuckoos were detected, the observer recorded the location of the bird, the type of detection, and any other pertinent notes. The surveyor then proceeded at least 40 m (131 feet) beyond any detected willow flycatcher and 300 m (984 feet) beyond a cuckoo before resuming the survey to avoid double-counting individuals. All surveys commenced before sunrise when it was light enough for observers to walk safely. Surveys were concluded by 10:45 a.m. Pacific Daylight Time (PDT) for southwestern willow flycatcher and by 11:15 a.m. PDT or when the temperature reached 40° Celsius for yellow-billed cuckoo. No surveys were conducted if winds exceeded 3 on the Beaufort scale (19.3–30.6 km [12–19 miles] per hour).

Starting points for southwestern willow flycatcher and yellow-billed cuckoo surveys varied between surveys. Standard southwestern willow flycatcher and yellow-billed cuckoo survey summary forms were completed. All surveys were completed by biologists authorized under a USFWS 10(a)1(A) permit (#ESPER0009523) and an NDOW permit (#495754). In addition to completing yellow-billed cuckoo and southwestern willow flycatcher surveys, SWCA recorded qualitative site descriptions for each parcel. Surveyors recorded the dominant vegetation species, visual estimates of vegetation height (to the nearest meter), canopy closure (to the nearest 5%), and qualitative assessments of surface hydrology.

The 2021 southwestern willow flycatcher survey area totaled 43.9 ha (108.4 acres), and the 2021 yellow-billed cuckoo survey area totaled 38.5 ha (95.2 acres) (Figures 3–7). Within these polygons, surveys were completed in all areas that were dominated by trees or shrubs ≥ 3 m (9.8 feet) in height.

2.2 Southwestern Willow Flycatcher Monitoring

Southwestern willow flycatcher territory and nest monitoring involves more frequent visits to southwestern willow flycatcher territories than broadcast surveys alone and results in locating nests, determining nest fates, and calculating productivity. Nest searching and monitoring commenced at Mesquite West and Mormon Mesa Parcel 5-A once a territorial flycatcher was detected. The methods described herein followed those described by Rourke et al. (1999), Martin et al. (1997), Martin and Geupel (1993), and Ralph et al. (1993), which recommend territory monitoring every 2–4 days, depending on territory stage and activity.

Southwestern willow flycatcher territory and nest monitoring occurred at each territory once approximately every 4 days to determine territory status, locate nests, and monitor known nests. When possible, nests were monitored using a mirror on a telescoping pole to determine nest contents, including the presence of any brown-headed cowbird eggs or nestlings. When appropriate, biologists addled brown-headed cowbird eggs. No nest was mirror poled after nestlings reached 8 days of age to avoid forced fledging.

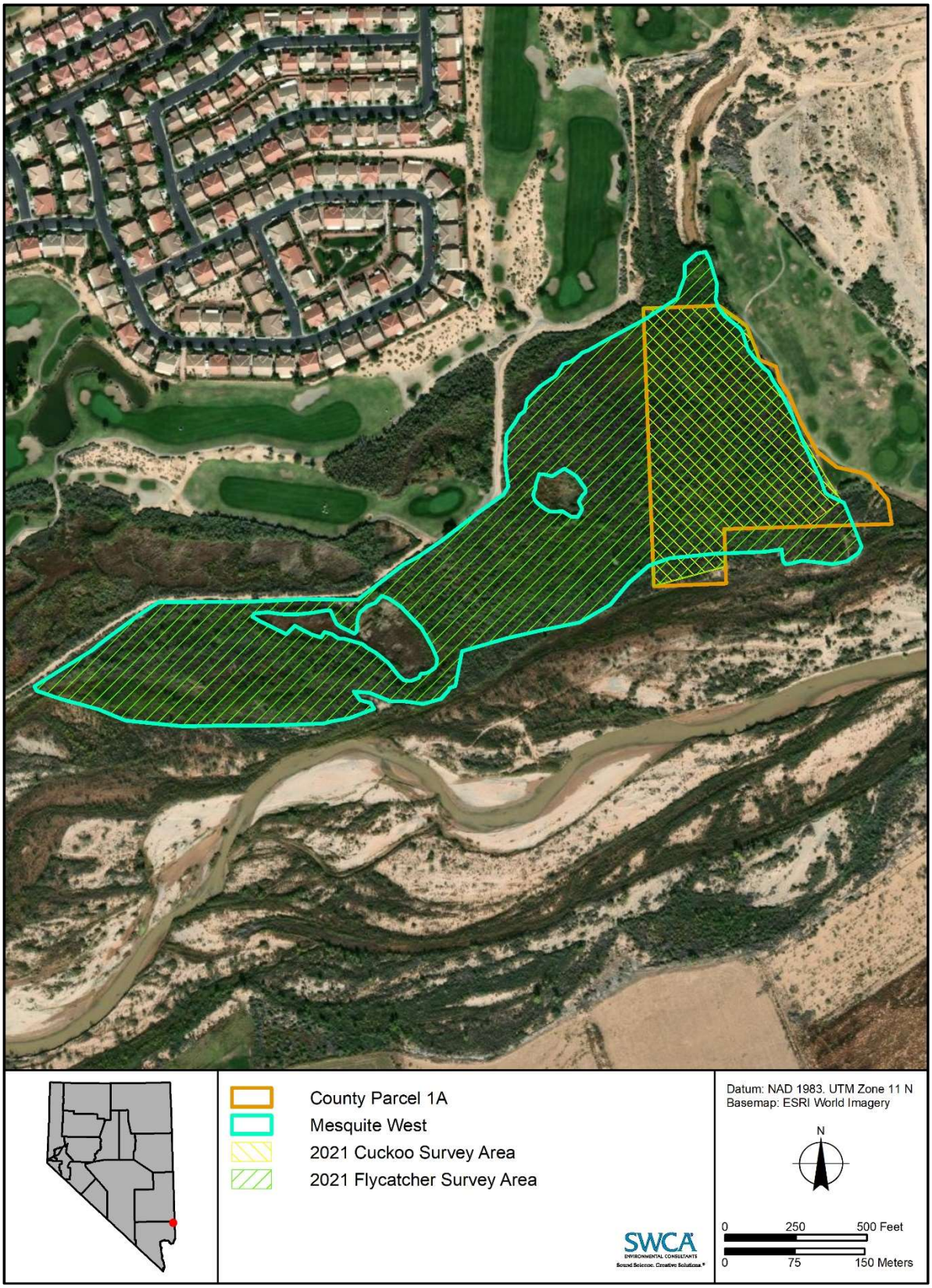

Figure 3. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at Mesquite West.

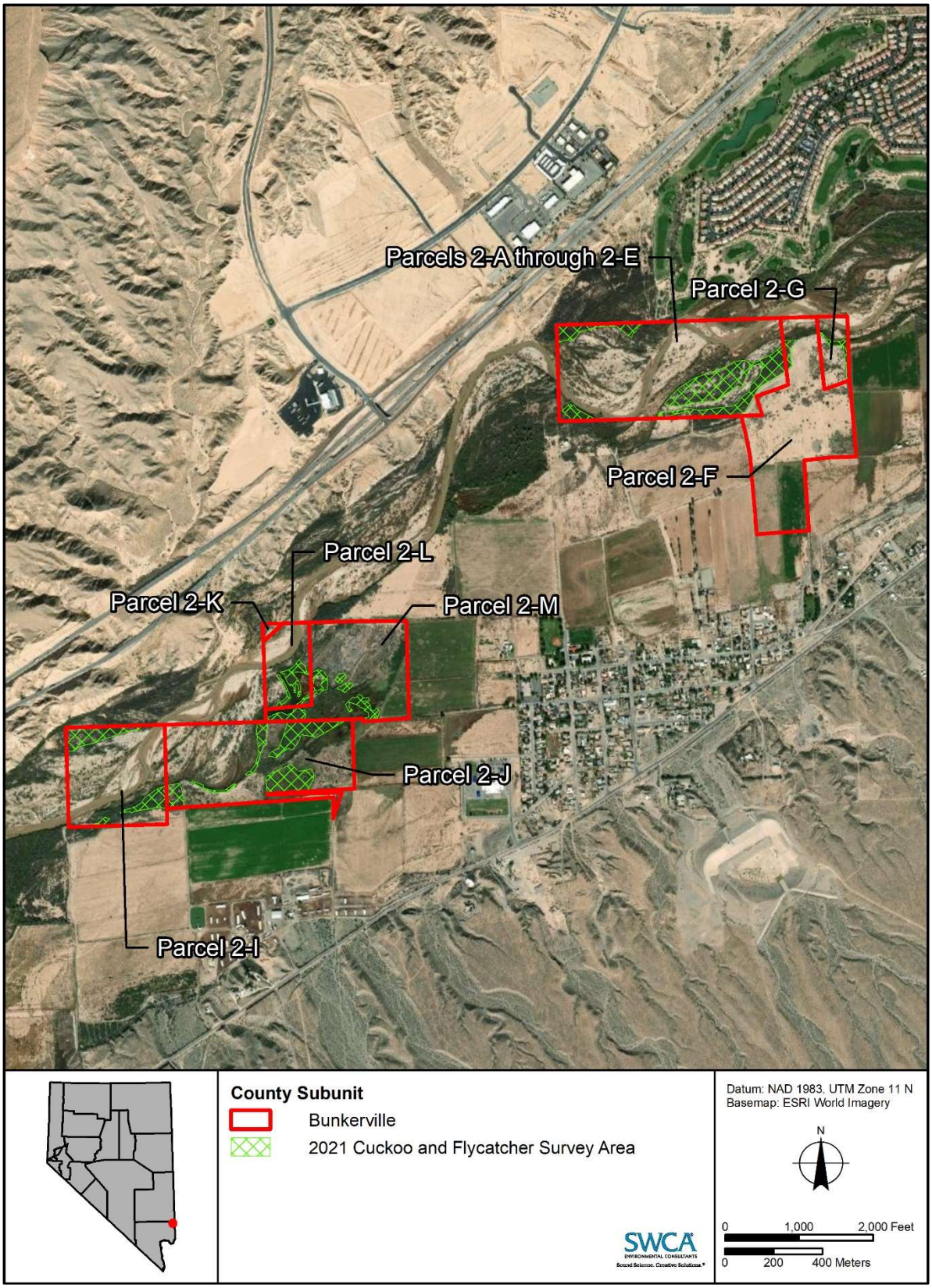

Figure 4. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Bunkerville Riparian Reserve Subunit.

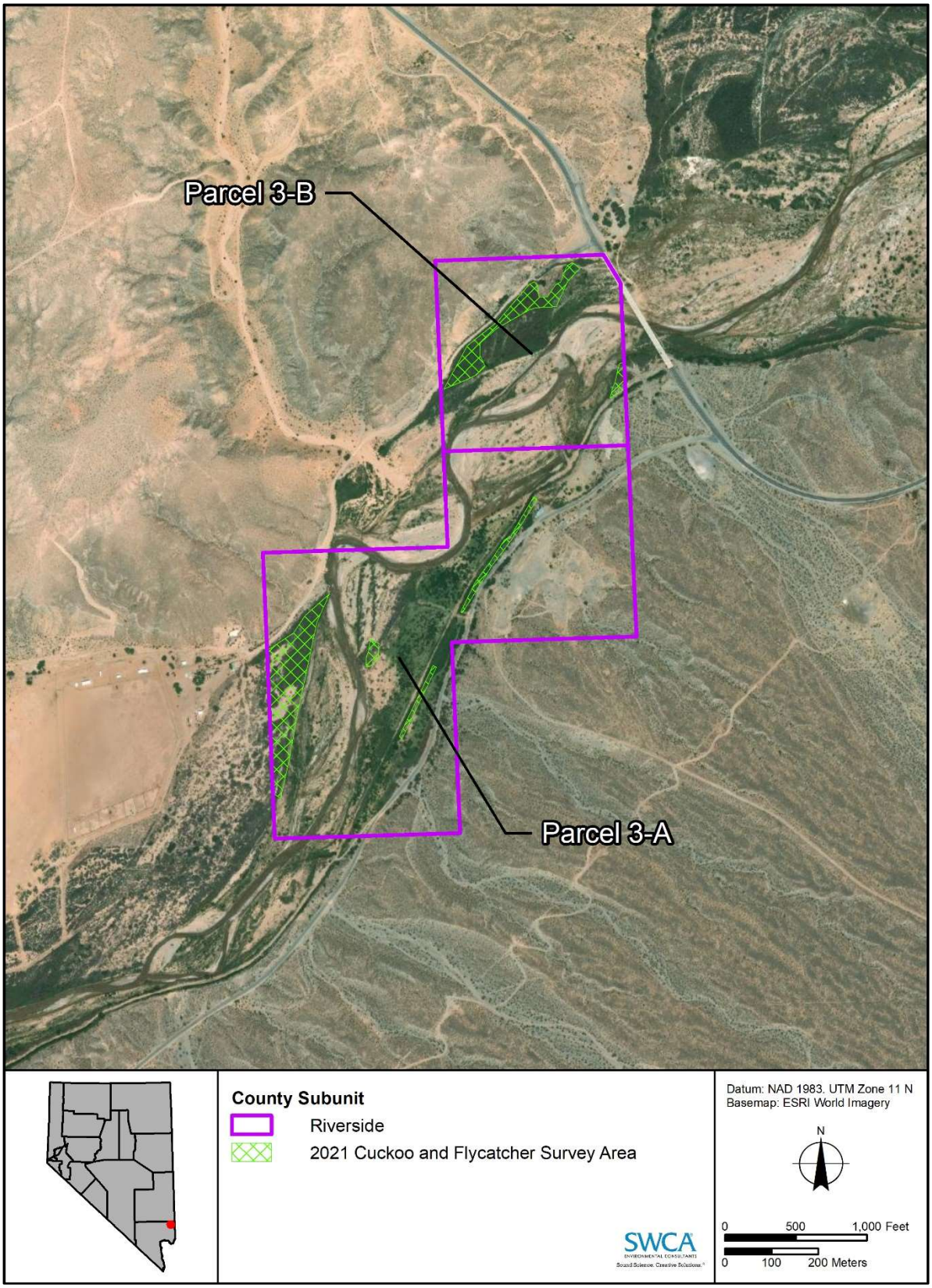

Figure 5. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Riverside Riparian Reserve Subunit.

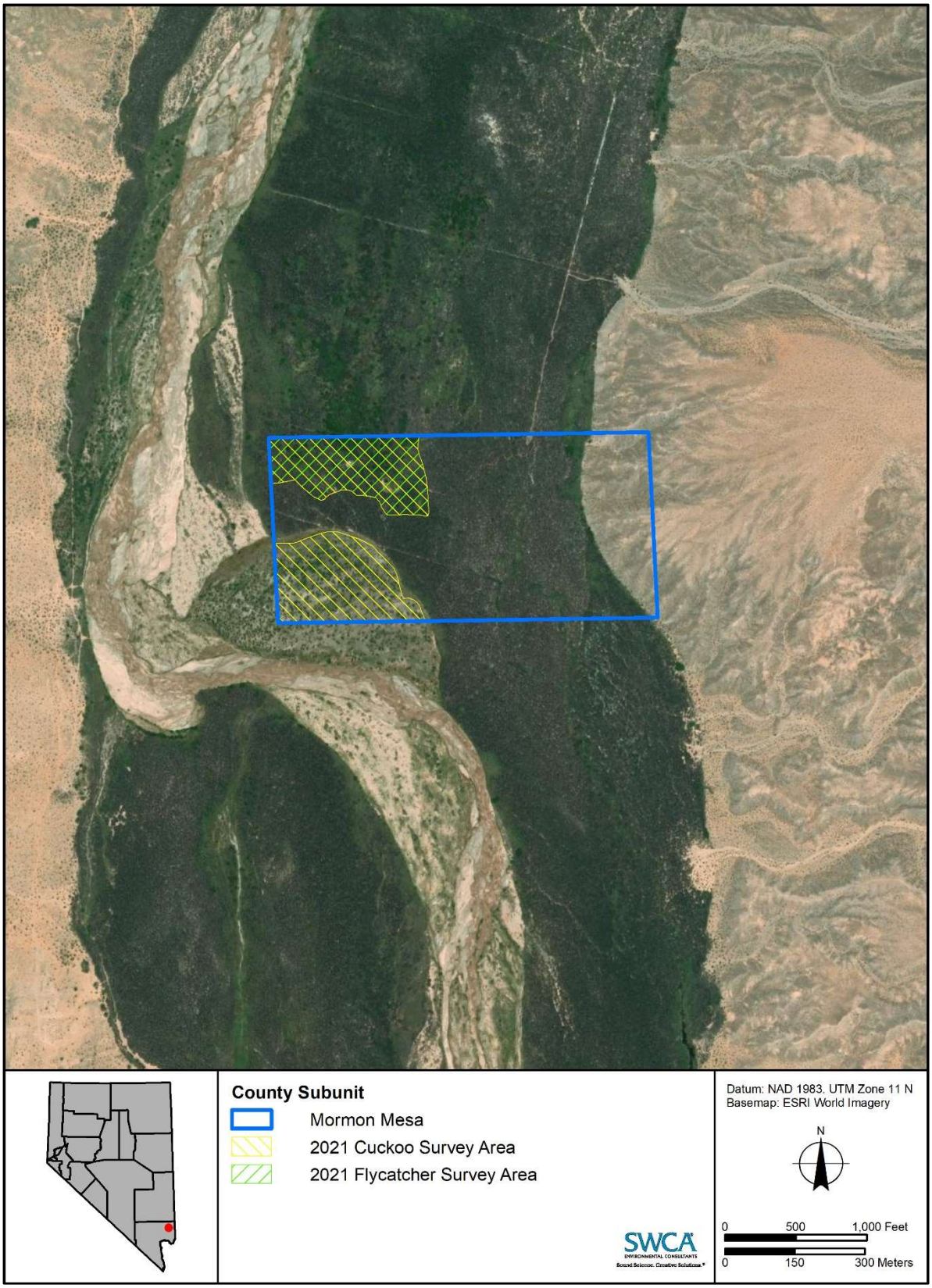

Figure 6. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Mormon Mesa Riparian Reserve Subunit.

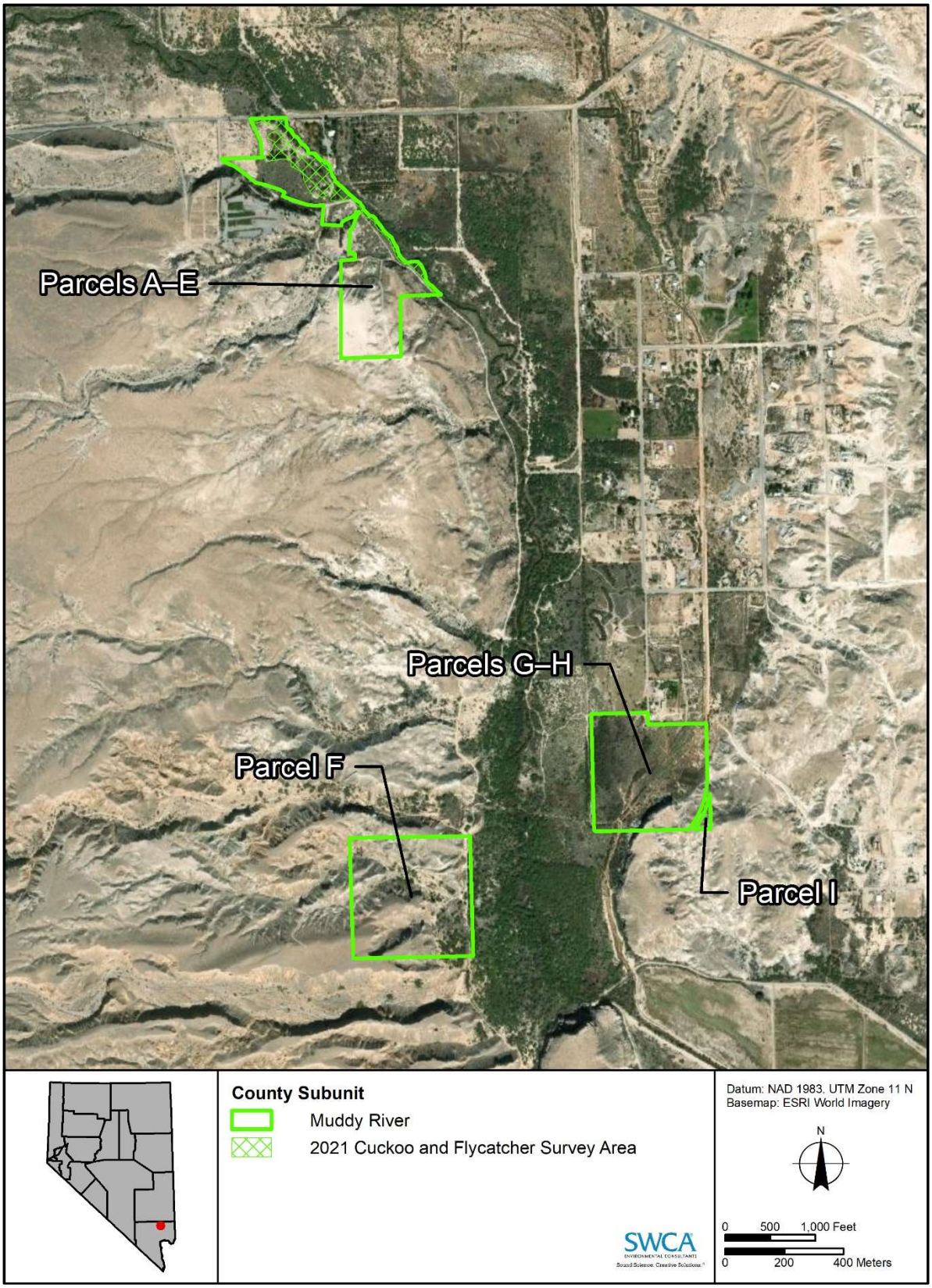

Figure 7. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Muddy River Riparian Reserve Unit.

Nesting attempts were determined to be successful if fledged young were observed in the vicinity of the nest or were identified by their color bands. The number of nestlings produced from each nest was determined by the number of fledglings visually confirmed, resulting in a conservative number of nestlings produced per nest. Failed nests were inspected to determine the condition of the nest and record the presence of eggs, eggshells, or dead nestlings in or around the nest. These data were used to determine the stage and cause of nest failure.

Color banding and subsequent resighting can greatly improve the certainty with which individual southwestern willow flycatchers can be associated with a specific territory or nest. Furthermore, color banding nestling southwestern willow flycatchers helps with confirming the number of fledglings produced from each nest and allows for a more accurate determination of nest success and productivity. Color banding involves fitting each flycatcher with an aluminum federal band (either standard silver or anodized in one of several colors) on one leg and a colored, metal, pin-striped band on the opposite leg, resulting in a unique color combination of bands. Resighting involves subsequently observing these color bands via binoculars to confirm a bird's identity. Resighting color-banded birds at different times of the season or in subsequent years can also help with understanding movements of southwestern willow flycatchers within and between study areas and sites.

Biologists captured, uniquely color banded, and subsequently monitored adult and nestling southwestern willow flycatchers whenever possible. Adult willow flycatchers were captured with mist nets, which provide the most effective technique for live capture of adult songbirds (Ralph et al. 1993). A targeted capture technique was used (in accordance with Sogge et al. 2001) whereby a variety of conspecific vocalizations were broadcast via an MP3 player and remote speakers to lure territorial southwestern willow flycatchers into the nets. Nestlings were banded at 7 to 10 days of age, when they were large enough to retain leg bands, yet young enough that they would not prematurely fledge from the nest (Paxton et al. 1997; Whitfield 1990).

2.3 Data Management for Federally Listed Bird Surveys and Monitoring

For southwestern willow flycatcher and yellow-billed cuckoo surveys and southwestern willow flycatcher monitoring, biologists collected data on Samsung or Panasonic tablets equipped with Field Maps for ArcGIS and paired with an external GPS receiver. The GPS receiver was capable of submeter accuracy and provided real-time data corrections; data post-processing was not required. Several feature services were published to ArcGIS Online for use in Field Maps. These included site boundaries, trails, a feature service to record real-time locations of the surveyor at regular intervals (i.e., surveyor "tracks"), a 30 × 30–m (98 × 98–foot) grid, and feature services for field data. High-resolution aerial imagery of all survey sites was also loaded directly onto the tablets for use in Field Maps.

Data collected included point locations of survey points, willow flycatcher and yellow-billed cuckoo detections (e.g., territorial male, territory center, pair, nest, nest flag, or family group), and line features to show the relationship between any two willow flycatcher detection locations (e.g., same bird, different bird, countersinging males, or possible pair). All data collected in the field were recorded into an offline copy of the feature services.

Summary information for each resight and for each territory or nest visit (time in and out of the territory, breeding stage [e.g., single male, pair, nest stage, or no activity], nest contents [if applicable], and behavioral comments) was entered in a form in Survey123 for ArcGIS. Each form was a child feature linked to its respective territory center or nest flag parent point.

All data recorded in Field Maps were synced to and managed in a feature service that resided on the ESRI server. All data on the ESRI server were backed up to an SWCA server periodically and will be stored indefinitely. Quality control features that facilitate identifying common errors were built into Field Maps. All data was reviewed and proofed at least twice: once immediately after the data were downloaded or imported into the database, and again by the project manager before data were delivered.

All spatial data collected in the field, as well as any spatial data provided by the County and edited by SWCA, were exported to a geodatabase and will be included as part of the 2021 Final Data Deliverable. A full list of the spatial layers and a description of the data that each layer contains is included in the metadata for the geodatabase that will be provided as part of the 2021 Final Data Deliverable. The geodatabase also includes general project information, such as the County project number, the name of SWCA's project manager, the dates for the project, a brief project description, the title of the associated final report, the model of GPS receiver used for the project, and an average positional accuracy of data collected.

2.4 Brown-headed Cowbird Control

2.4.1 Target Netting

Brown-headed cowbird target netting was conducted at Mesquite West at the beginning of the southwestern willow flycatcher breeding season (i.e., mid-May) in anticipation of the site being occupied by southwestern willow flycatchers. Target netting employed broadcasts of conspecific vocalizations to lure brown-headed cowbirds into a mist net. Each target-netting attempt consisted of erecting a single mist net 2.6 m (8.5 feet) in height with 38-mm (1.5-inch) mesh size and placing a female brown-headed cowbird decoy near the midpoint of the net. A small, portable speaker was placed near the decoy, and a second speaker was placed on the opposite side of the net. These speakers were coupled to an MP3 player that had multiple tracks of brown-headed cowbird vocalizations.

Once the net was erected and the decoy and speakers were set in place, the observer hid approximately 10 m from the net in a place with a full view of the net. The observer began broadcasting a female brown-headed cowbird chatter vocalization, with periodic pauses to mimic a natural vocalization rate, until a female cowbird came near the net. Once a female brown-headed cowbird was in sight, different tracks were played to agitate the female and draw her into the net. Any male cowbirds or non-target species that were caught in the net were removed immediately and released. The observer clipped the tail of each male brown-headed cowbird in a "swallow pattern" prior to release to signify that the bird had been previously captured, should the bird be caught again later in the season. All female brown-headed cowbirds were euthanized via decapitation, a method approved under the current American Veterinary Medical Association guidelines for euthanizing small birds (American Veterinary Medical Association 2020).

NET LOCATIONS

Mist nets were placed in semi-open areas at least 70 m (230 feet) from all known southwestern willow flycatcher nests or territory centers, which resulted in net locations being approximately 50 m (164 feet) (or more) from the edge of those breeding territories. Because SWCA also conducted territory and nest monitoring for southwestern willow flycatchers at Mesquite West in 2021, biologists attempting to net brown-headed cowbirds had access to current information on all willow flycatcher detection and territory locations. All net locations were approached from a direction that did not cause the observer to pass through or near a southwestern willow flycatcher territory.

Female brown-headed cowbird territories can occupy areas of 5.0 ha (12.4 acres) or greater and are typically much larger than those of southwestern willow flycatchers (less than 0.5 ha [1.2 acres]); thus,

placing netting attempts between 50 and 100 m (164 and 328 feet) from the edge of southwestern willow flycatcher territories targeted female brown-headed cowbirds whose ranges likely overlapped with southwestern willow flycatcher territories. Placing all netting attempts outside southwestern willow flycatcher territories minimized the chance of inadvertently capturing a southwestern willow flycatcher or drawing a brown-headed cowbird into a southwestern willow flycatcher territory. Although it was unlikely that a southwestern willow flycatcher would be captured as part of this activity, all biologists who attempted to target net brown-headed cowbirds were also authorized through SWCA's existing 10(a)1(A) permit (ESPER0009523) and Master Banding permit (23258) to handle southwestern willow flycatchers.

TIMING OF NETTING ATTEMPTS

No netting attempt lasted more than 1.1 hours, and any netting attempt that failed to attract female brown-headed cowbirds to the vicinity was terminated after 1 hour. The first netting attempt of the day began at first light, allowing for multiple netting attempts in a day. Female brown-headed cowbirds are typically on their laying territories in the early morning; thus, morning netting attempts targeted those cowbirds likely to parasitize hosts in the vicinity. Netting attempts were terminated by 10:00 a.m. PDT, and no netting attempts were conducted during inclement weather or with direct sunlight on the net. The net was removed at the conclusion of each netting attempt. Netting attempts began in mid-May and were conducted at least once per week until the end of July. Starting brown-headed cowbird control in mid-May allowed for two netting visits prior to the initiation of the earliest southwestern willow flycatcher nests.

2.4.2 Egg Addling

When an accessible southwestern willow flycatcher nest was parasitized on or before the fifth day of incubation, the brown-headed cowbird egg(s) was addled via vigorous shaking. Brown-headed cowbird eggs were not removed from the nest so as not to mimic a partial depredation event, which could cause nest desertion. Shaking brown-headed cowbird eggs greatly reduces the chance of the egg hatching, and there is no evidence that this activity results in nest desertion (McLeod and Pellegrini 2013; McLeod et al. 2018).

2.5 Point-Count Surveys

Surveys conducted for this study in 2021 followed methods used during the 2017–2020 point-count surveys (SWCA 2017b, 2018a, 2018b, 2019a, 2020), which applied established point-count protocols and drew from methods described in *A Habitat-based Monitoring Program for Breeding Birds of Nevada* (Great Basin Bird Observatory [GBBO] 2003) and in the *Handbook of Field Methods for Monitoring Landbirds* (Ralph et al. 1993).

In 2019, SWCA randomly selected 25 of the 51 previously established point-count locations across the Riparian Reserve Units to be surveyed in odd-numbered years (i.e., 2019, 2021, 2023); the remaining 26 points were selected to be surveyed in even-numbered years (i.e., 2020, 2022) (Figures 8–12). In 2020, the County added four additional survey points in Parcels 2-L and 2-M, two to be surveyed in odd years and two to be surveyed in even years.

In 2021, SWCA conducted avian point-count surveys at the 27 odd-year point-count locations. Prior to the commencement of surveys, SWCA avian biologist Mike Swink conducted a site reconnaissance to re-familiarize himself with the project parcels and identify any impediments to access. During the reconnaissance, Mr. Swink navigated to each survey point and marked each with flagging so that it could be easily located on subsequent visits.

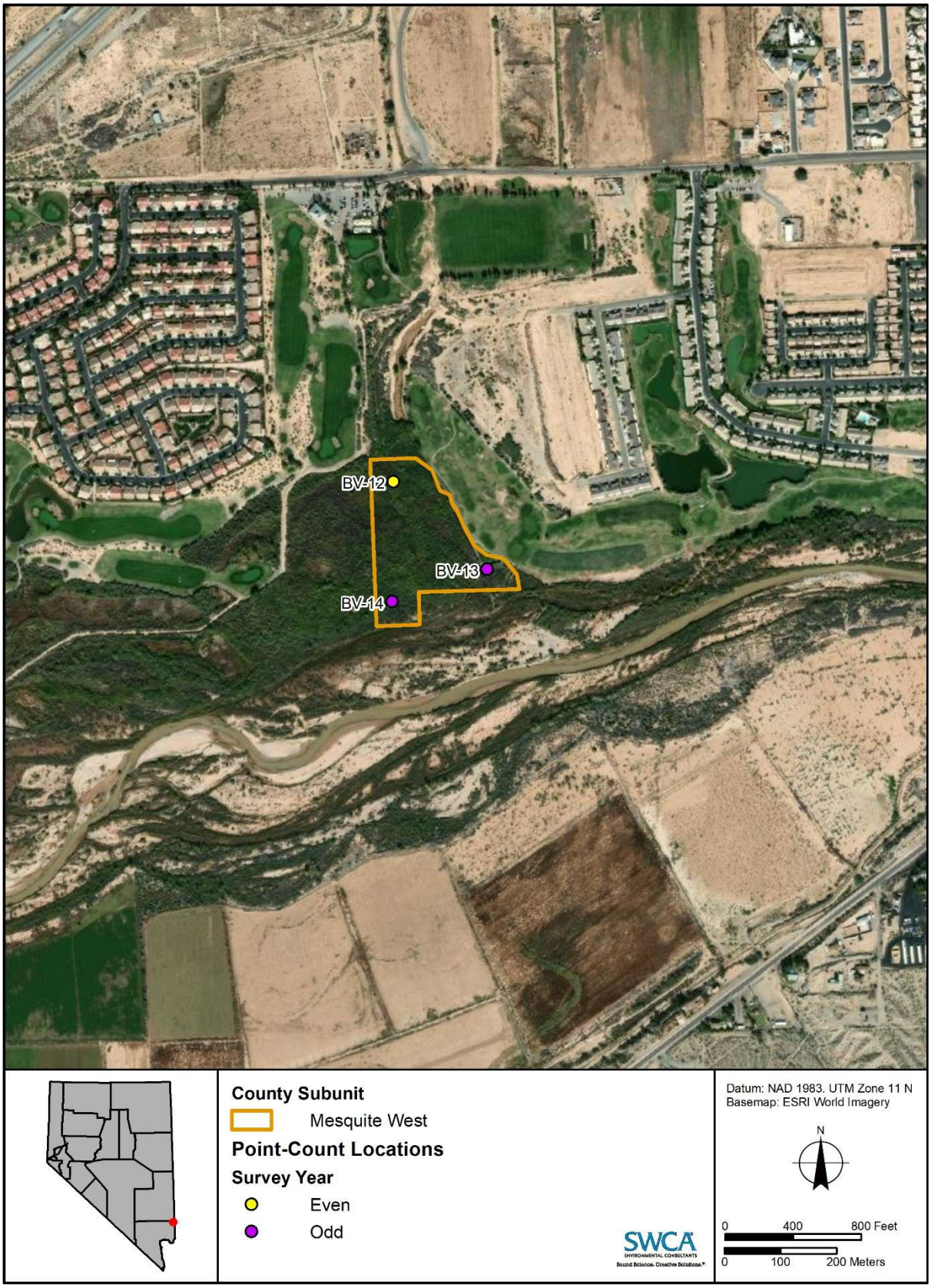

Figure 8. Point-count locations within the Mesquite West Riparian Reserve Subunit.

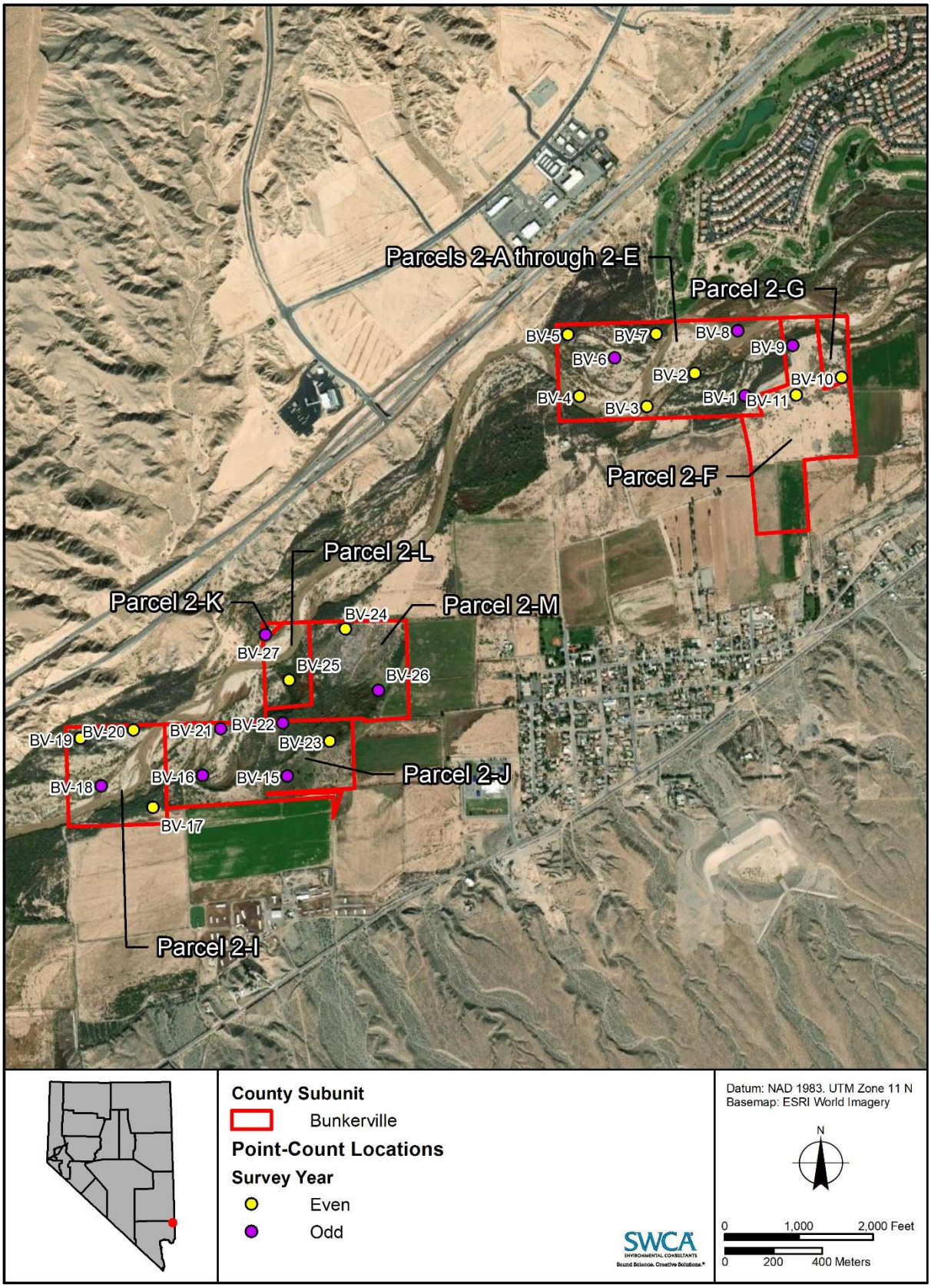

Figure 9. Point-count locations within the Bunkerville Riparian Reserve Subunit.

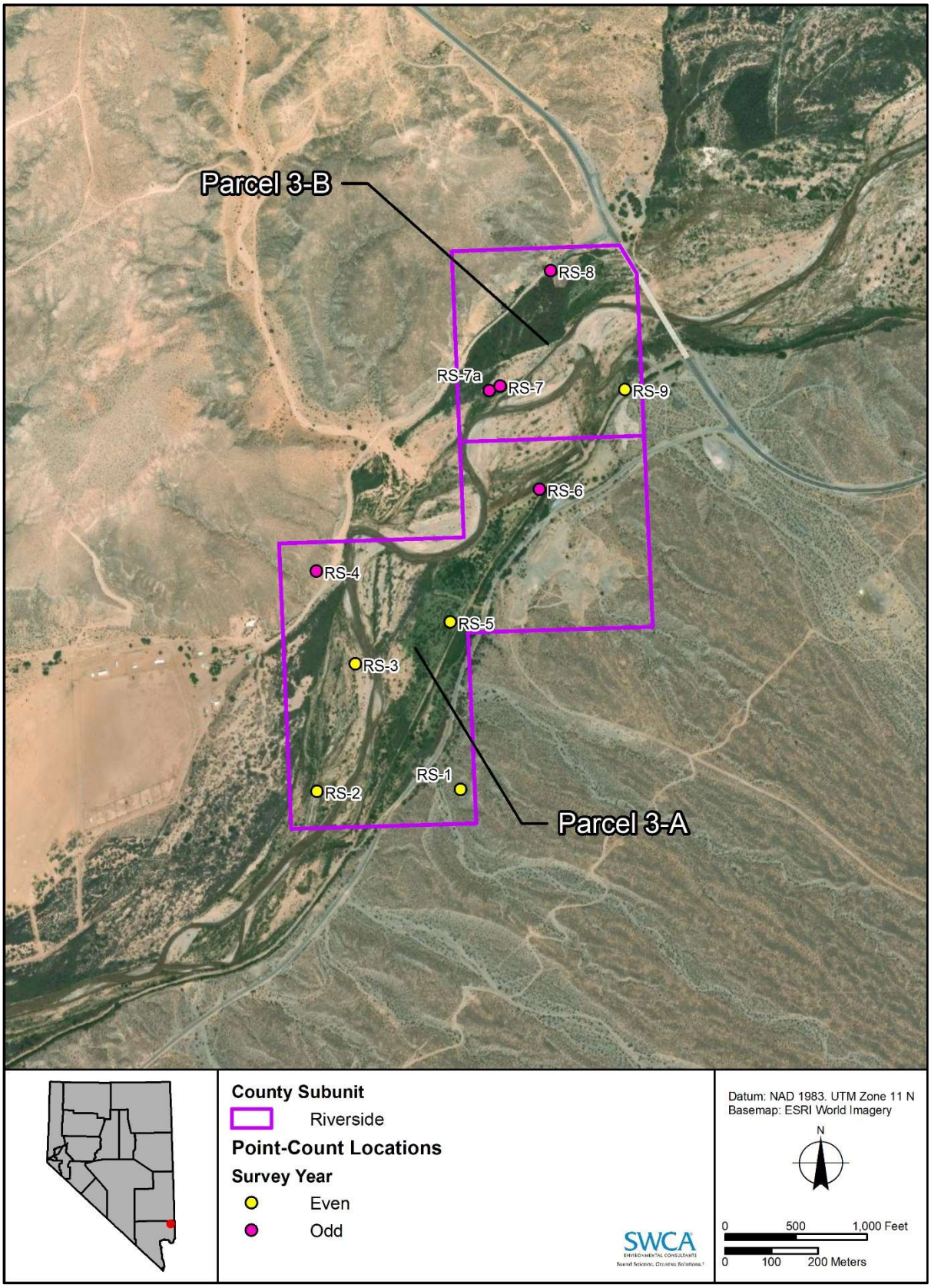

Figure 10. Point-count locations within the Riverside Riparian Reserve Subunit.

Figure 11. Point-count locations within the Mormon Mesa Riparian Reserve Subunit.

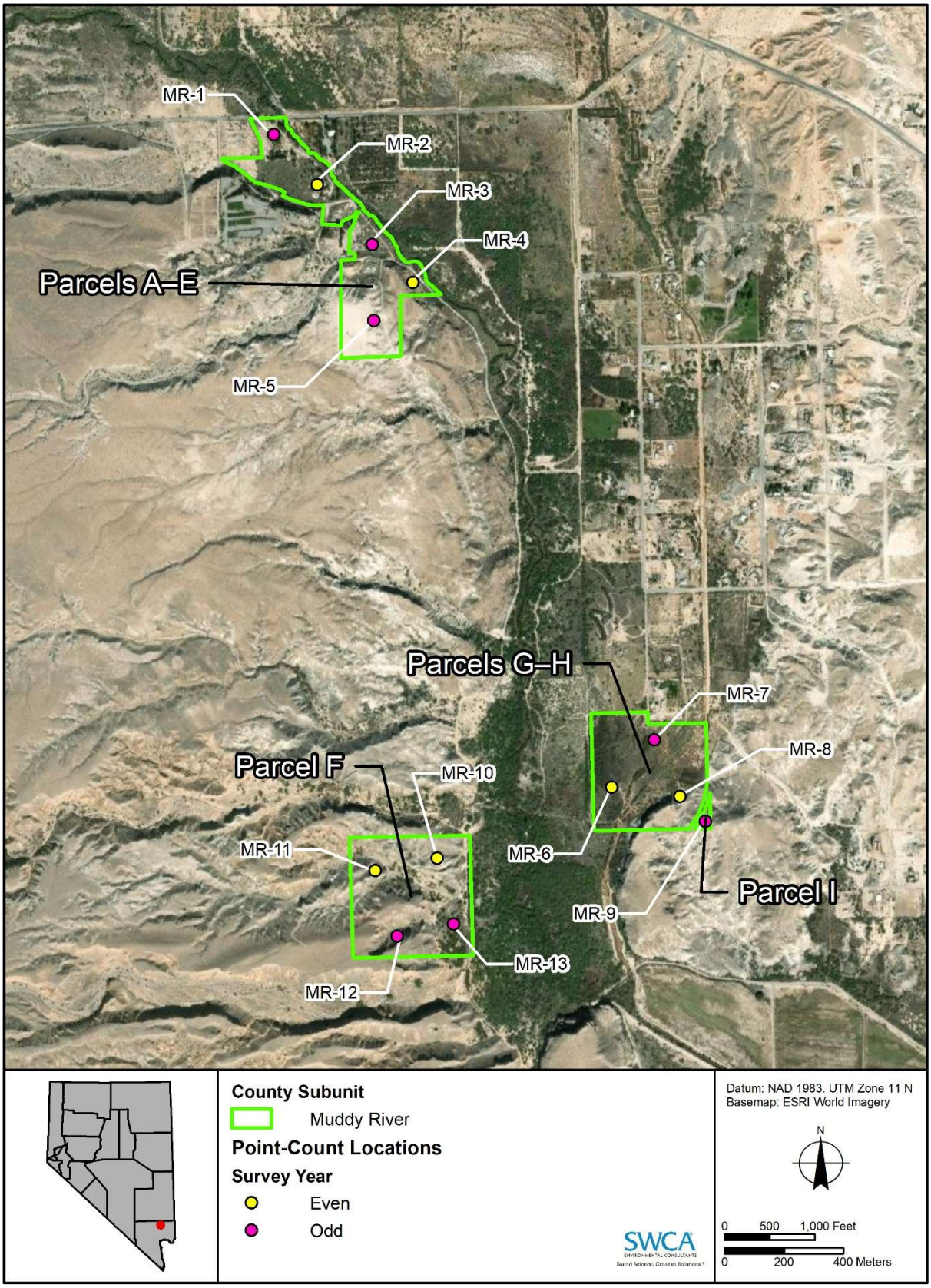

Figure 12. Point-count locations within the Muddy River Riparian Reserve Unit.

In 2019, above-average winter precipitation yielded abnormally high water levels along the Virgin River. As a result, two of the riparian point-count locations scheduled for surveys in 2019 were inundated by the active river channel, and these point-count locations were repositioned. In 2021, one of the previously inundated point-count locations (RS-7) was still in the active river channel. Therefore, the alternate point-count location for that point (RS-7a) was used again in 2021 (see Figure 10); all other originally established point-count locations for odd-numbered years were used in 2021.

In 2019, SWCA randomly selected 20 of the 40 previously surveyed point-count locations at the BCCE to be surveyed in odd-numbered years (i.e., 2019, 2021, 2023); the remaining 20 locations were selected to be surveyed in even-numbered years (i.e., 2020, 2022) and were surveyed by SWCA in 2020 (Figure 13). As it was anticipated that conditions at the BCCE had not changed dramatically since 2019, no field reconnaissance was completed prior to field surveys at that property in 2021. Surveyors were able to access all 20 of the previously surveyed point-count locations without impediment, and all the original locations assigned to odd-numbered years were used in 2021.

Each surveyor followed standard unlimited-radius point-count procedures, with surveys starting at sunrise and concluding by 10:00 a.m. PDT (GBBO 2003; Ralph et al. 1993). Consecutive surveys at a given point were separated by a minimum of 7 days. The order in which a group of point-counts was completed was alternated between each round of surveys so that a given point was not always surveyed at the same time of day.

For each survey, the surveyor approached each point quietly to avoid overly disturbing any birds present. Prior to the commencement of each point-count, the surveyor recorded weather data, including cloud cover, wind speed and direction, temperature, and precipitation, on a standardized form. No surveys were conducted when wind speeds exceeded 40 km (25 miles) per hour or during periods of heavy rain, as both conditions could have inhibited the comprehensive inventory of a survey area (GBBO 2003).

The 10-minute observation period was broken into four intervals (0–3, 3–5, 5–8, and 8–10 minutes), and surveyors noted the time interval in which the first detection of a given bird was made. Surveyors recorded species code, interval of detection, sex, age, estimated distance from the observer, bearing to the bird, and behavior of the bird as it pertained to its breeding status. Any bird that flushed as the surveyor approached the point-count location but that was not detected during the survey was recorded as observed during the 0- to 3-minute interval and in the location from where it flushed. All detections were recorded on hardcopy datasheets, and bird locations were plotted on a standard point-count map (with their associated behavior codes) to help avoid double-counting individuals within a survey location. Any bird that gave an unknown vocalization was tracked following the survey to determine its identity (Ralph et al. 1993).

3.0 RESULTS AND EVIDENCE OF THE RESULTS

3.1 Objectives Completed

The objectives for this project were 1) to continue building on a baseline record of federally listed and non-listed bird species present at both the Riparian Reserve Units and at the BCCE and 2) to assess the effect of brown-headed cowbird control on nesting southwestern willow flycatchers. Completion of both objectives will allow for comparison with future datasets to measure the success of management and restoration efforts at the County's properties. Both objectives were completed in 2021, and results of the 2021 field efforts are presented here.

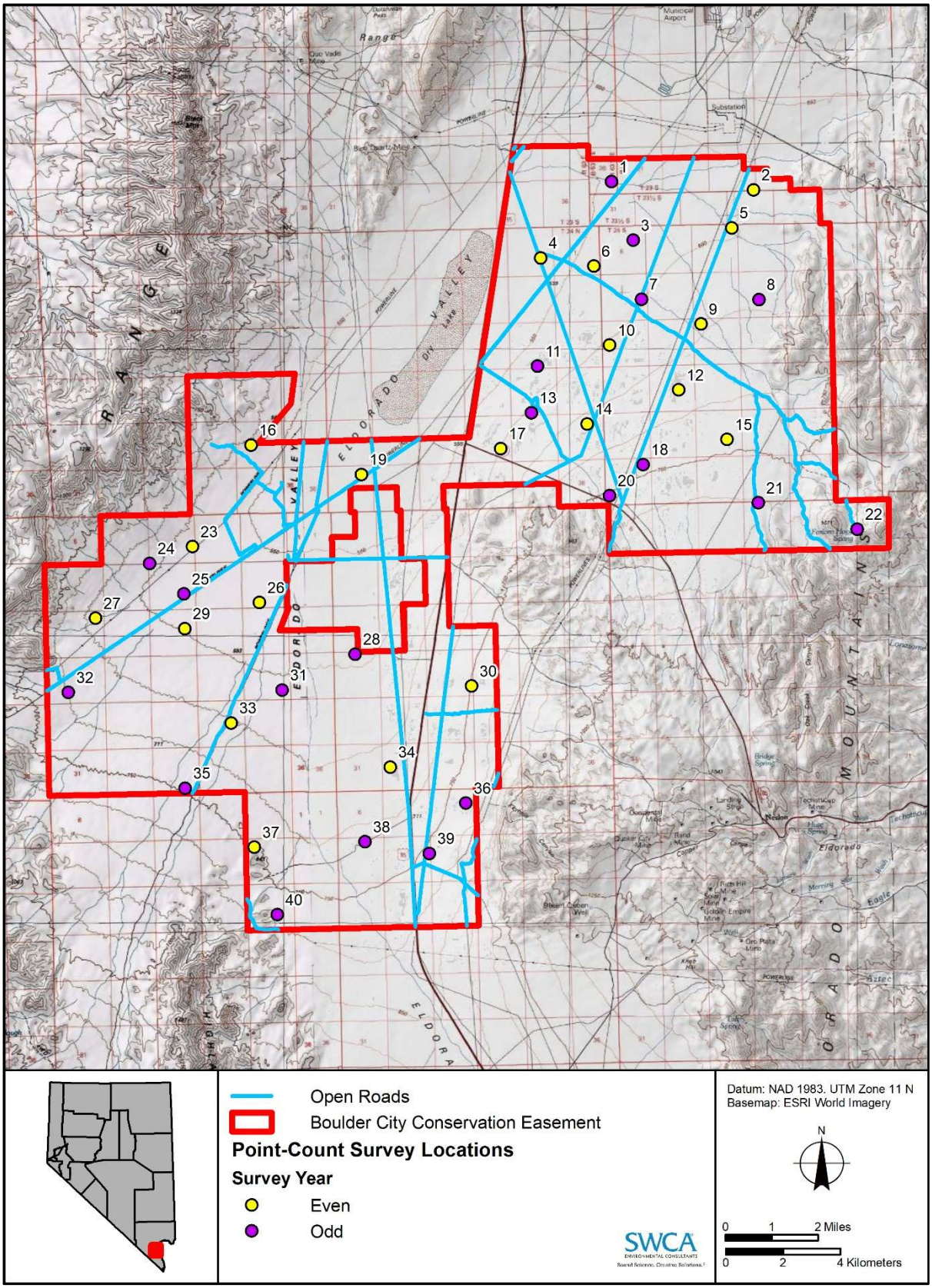

Figure 13. Point-count locations within the BCCE.

3.2 Survey Effort

3.2.1 Federally Listed Bird Surveys

The five rounds of southwestern willow flycatcher surveys were completed by Mr. Swink and SWCA biologists Steve Dougill, Sarah Nichols, Justin Streit, Lauren Strong, and Trevor Hinckley between May 17 and July 16, 2021 (Table 1). Each round of southwestern willow flycatcher surveys required from five to nine observer-mornings, sometimes requiring shorter survey mornings combined with other activities.

Table 1. Dates for Southwestern Willow Flycatcher Surveys, 2021

Subunit	Mesquite West	Bunkerville			Riverside	Mormon Mesa	Muddy River
Parcel(s)	**1-A***	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**A through H**
First survey	May 19, 30	May 27	May 19	May 19	May 25	May 17	May 17
Second survey	June 4, 8, 15	June 7, 9	June 7, 9	June 9	June 1, 4	June 6, 10	June 2
Third survey	June 20, 21	June 15	June 16, 17	June 17	June 14	June 14	June 18
Fourth survey	July 2, 9	June 27	June 29	July 6	July 7	June 30	June 30
Fifth survey	July 15	July 14	July 13	July 15	July 16	July 12	July 12

* Includes occupied southwestern willow flycatcher habitat west of County Parcel 1-A

The four rounds of yellow-billed cuckoo surveys were completed by Mr. Swink, Mr. Streit, and Ms. Nichols between June 22 and August 5, 2021 (Table 2). Each yellow-billed cuckoo survey round required four or five observer-mornings. In 2021, SWCA surveyed a total of 43.9 ha (108.4 acres) for southwestern willow flycatcher and 38.5 ha (95.2 acres) for yellow-billed cuckoo across all subunits (Table 3). These surveys required 126.6 survey-hours for southwestern willow flycatcher and 61.9 survey-hours for yellow-billed cuckoo (see Table 3). Descriptions of and rationale for areas excluded from surveys in 2021 are included in Section 4.0.

Table 2. Dates for Yellow-Billed Cuckoo Surveys, 2021

Subunit	Mesquite West	Bunkerville			Riverside	Mormon Mesa	Muddy River
Parcel(s)	**1-A**	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**A through H**
First Survey	June 24	June 24	June 23	June 23	June 25	June 22	June 22
Second Survey	July 6	July 6	July 8	July 8	July 9	July 7	July 7
Third Survey	July 19	July 19	July 21	July 23	July 22	July 22	July 20
Fourth Survey	August 2	August 2	August 4	August 4	August 5	August 3	August 3

Table 3. Area and Total Hours of Survey for Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Surveys

Subunit	Mesquite West	Bunkerville			Riverside	Mormon Mesa	Muddy River
Parcel(s)	**1-A***	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**A through H**
Area surveyed (acres)	34.8†; 9.9‡	20.5	17.9	6.3	9.6	10.8†; 22.5‡	8.5
Total survey hours, southwestern willow flycatcher	25.7	25.5	24.4	11.6	19.8	10.4	9.2
Total survey hours, yellow-billed cuckoo	4.4	13.4	12.5	6.3	12.1	7.4	5.8

* Includes occupied southwestern willow flycatcher habitat west of County Parcel 1-A for southwestern willow flycatcher surveys only

† Acres surveyed for southwestern willow flycatcher.

‡ Acres surveyed for yellow-billed cuckoo.

3.2.2 Point-Count Surveys

The three rounds of point-count surveys were completed at the Riparian Reserve Units by Mr. Swink between May 10 and June 18, 2021 (Table 4). Each round of point-counts required four mornings to cover all the Riparian Reserve Units. Weather conditions were favorable during all three survey rounds, with no precipitation and wind speeds ranging from 0 to 19.8 km (0 to 12.3 miles) per hour.

Table 4. Survey Dates for Point-Count Surveys at the Riparian Reserve Units, 2021

Subunit	Mesquite West	Bunkerville			Riverside	Mormon Mesa	Muddy River
Parcel(s)	**1-A**	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**A through H**
First survey	May 13	May 13	May 12	May 12	May 11	May 11	May 10
Second survey	June 3	June 3	June 4	June 4	June 2	June 2	June 1
Third survey	June 18	June 18	June 17	June 17	June 16	June 16	June 15

Mr. Streit, Mr. Swink, and Mr. Hinckley completed three rounds of point-count surveys within the BCCE between May 4 and June 23, 2021 (Table 5). Each round of point-counts at the BCCE required three to five observer-mornings. Weather conditions were favorable during all three survey rounds, with no precipitation and wind speeds ranging from 0 to 13.4 km (0 to 8.3 miles) per hour.

Table 5. Survey Dates for Point-Count Surveys at the BCCE, 2021

Survey Round	Dates
First	May 4, 5, 6
Second	May 24, 25, 26
Third	June 8, 9, 12, 13, 23

3.3 Findings

3.3.1 Federally Listed Bird Surveys and Monitoring

SOUTHWESTERN WILLOW FLYCATCHER

Adult willow flycatchers detected for more than 7 days at a particular study area were considered to be residents at that study area. Additionally, adults detected between June 24 and July 20 were also considered residents of that study area, independent of duration of detections.

A total of 18 adult willow flycatchers were detected during survey and monitoring activities at the Riparian Reserve Units in 2021. Of the 18 adults, three were detected during the first round of surveys at Bunkerville Parcel 2-M (one individual) and Riverside Parcel 3-A (two individuals). Band status could not be confirmed for these three individuals, but behavior observed during the initial detections and the lack of subsequent survey detections suggest these individuals were likely spring migrants.

Of the remaining 15 adults, 14 were detected at Mesquite West, and one was detected at Mormon Mesa Parcel 5-A (Table 6). Of these 15 adults, 10 were residents that were present for more than 7 days, and three individuals were considered to be residents based on their dates of detection: one was detected on June 28, one was detected on July 13, and one was detected on July 19 and 20. Of these 13 residents, 11 (85%) were known to be banded. The band status for the remaining two residents could not be confirmed. Seven of the 11 banded adults were banded in 2021, while three were returning adults that had been banded in previous years. One individual was known to be banded, but the band combination could not be confirmed. Of the three adults that had been banded in previous years, two returned to the study area where they had been most recently detected. Female GG(M):EY was originally banded at the Muddy River study area at the Overton Wildlife Management Area in 2017 but has been detected at Mesquite West for several years since, and male MG(M):VI was originally banded at Mesquite West in 2020. Male MY(M):VI was observed at Mesquite West in July 2021 after holding a territory at Bunkerville study site Electric Avenue Pond in May and June (personal communication, C. Klinger, NDOW, with Sarah Nichols, SWCA, July 10, 2021).

Of the two individuals for which residency status could not be confirmed, the band status could not be determined for one, while the other was known to be banded. Because one of these adults was known to be banded, this individual was determined to be a resident floater of the southwestern subspecies.

Mesquite West

Biologists spent 78.9 observer-hours territory and nest monitoring at Mesquite West in 2021; activities included determining residency status, observing resident southwestern willow flycatchers, monitoring nests, and banding adults and nestlings. Fourteen adult southwestern willow flycatchers and willow flycatchers were documented at Mesquite West in 2021. The 14 adults comprised three pairs, three territorial males, and five individuals for which residency and/or breeding status could not be confirmed.

Nests were confirmed for all three pairs documented in 2021 (pairs 01, 04, and 06) (see Table 6). Eight confirmed nesting attempts were documented (Appendix A: Figures A-1 and A-2); two of these were successful. Ms. Nichols color banded six new adults (see Table 6). Three additional adults were identified to individual via resighting. Two adults were determined to be banded, but their color combinations could not be confirmed; band status could not be determined for the remaining three adults. One male (MG(M):VI) was polygynous with two females (GG(M):EY and EY:VWV(M)) (see Table 6).

Table 6. Details of Southwestern Willow Flycatchers and Willow Flycatchers Detected at Monitored Parcels During the 2021 Breeding Season

Subunit[1]	Parcel	Date Banded[2]	Federal Band #[2]	Color Combination[3]	Age[4]	Sex[5]	Territory or Location[6]	Observation Status[7]
		July 13, 2021	2660-23395	WGW(M):EY	SY	F	01	N
		July 13, 2021	2660-23393	EY:RVR(M)	AHY	M	01	N
		July 13, 2021	2660-23396	RYR(M):EY	L	U	01	N
		June 24, 2017	2590-53216	GG(M):EY	6Y	F	04	RS
		May 27, 2020	2660-23165	MG(M):VI	A3Y	M	04, 06[8]	R July 13
		Aug 14, 2021	2590-59203	VI:MDM(M)	L	U	04	N
		Aug 14, 2021	2590-53196	WRW(M):XX	L	U	04	N
		July 19, 2021	2660-23398	EY:VWV(M)	SY	F	06	N
MW	1-A[9]	N/A	N/A	banded	AHY	M	06	RS; detected June 4–12
		May 31, 2021	2660-23363	YV(M):EY	AHY	M	T03	N
		INA	INA	undetermined	AHY	M	T07	detected June 8–20
		July 20, 2021	2660-23399	KBK(M):EY	AHY	M	T09	N; detected July 9–30
		INA	INA	undetermined	AHY	M	F05	detected May 19
		INA	INA	undetermined	AHY	M	F08	detected June 28
		June 27, 2019	2660-23228	MY(M):VI	3Y	M	F10	RS; detected July 19–20
		INA	INA	banded	AHY	U	F11	RS; detected July 30
		July 13, 2021	2660-23394	EY:WYW(M)	SY	M	F12	N; detected July 13
MM	5-A	May 29, 2021	2660-23311	WG(M):EY	AHY	M	T01	N; detected May 20 – June 30

[1] MW = Mesquite West and MM = Mormon Mesa.

[2] INA = information not available.

[3] Color-band codes: B = light blue, D = dark blue, EY = electric yellow federal band, G = green, K = black, M = mulberry, (M) = metal pinstriped band, R = red, V = violet, VI = violet federal band, W = white, XX = standard silver federal band, and Y = yellow. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for left and right legs are separated with a colon.

[4] Age in 2021: L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, and 6Y = 6 years.

[5] Sex codes: F = female, M = male, and U = unknown.

[6] Territory or location code: Numbers indicate unique individual, pair, or nest locations, a number without an alpha prefix indicates a flycatcher pair, F = individual detected for less than 7 days, and T = territorial individual detected for at least 7 days.

[7] Observation status codes: N = new capture, R = recapture followed by date captured, and RS = resight.

[8] This male paired with EY:VWV(M) after banded 06 male was no longer detected.

[9] Includes occupied southwestern willow flycatcher habitat west of County Parcel 1-A

Of the eight nesting attempts that were documented at Mesquite West in 2021, six were known to contain at least one southwestern willow flycatcher egg and were used in calculating nest success and productivity. Two of these six (33%) nests were successful and fledged young, and four (67%) failed (Figure 14; Table 7).

Nesting attempts were located for three female southwestern willow flycatchers, all of which were known to have produced at least one egg. Of the three females, two had two nesting attempts, and one had four nesting attempts. In total, three fledglings were produced from the six nests that contained southwestern willow flycatcher eggs (Table 8). Productivity at Mesquite West was 0.5 young per nest (see Table 8).

Figure 14. Left: Parasitized southwestern willow flycatcher nest 06B at Mesquite West Parcel 1-A. Right: Southwestern willow flycatcher fledgling from nest 04C at Mesquite West Parcel 1-A.

Table 7. Summary of Southwestern Willow Flycatcher Nest Monitoring Results at All Study Areas, 2019 to 2021

Subunit[1]	Year	Pairs	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate	Nests with 1+ WE[2] and Known Parasitism Status	Parasitized Nests[4]	Young Fledged
MW	2019[5]	6	9	4 (44)	4 (44)	1 (11)	8	4 (50)	5
	2020	4	5	0	5 (100)	0	5	2 (40)	0
	2021[5]	3	6	2 (33)	4 (67)	0	6	3 (50)	3
	Total	**13**	**20**	**6 (30)**	**13 (65)**	**1 (5)**	**19**	**9 (47)**	**8**
MM	2019	0	0	0	0	0	0	0	0
	2020	2	1	1 (100)	0	0	1	0	1
	2021	0	0	0	0	0	0	0	0
	Total	**2**	**1**	**1 (100)**	**0**	**0**	**1**	**0**	**1**
All	2019	6	9	4 (44)	4 (44)	1 (11)	8	4 (50)	5
	2020	6	6	1 (17)	5 (83)	0	6	2 (33)	1
	2021	3	6	2 (33)	4 (67)	0	6	3 (50)	3
Overall Total		**15**	**21**	**7 (33)**	**13 (62)**	**1 (5)**	**20**	**9 (45)**	**9**

[1] MW = Mesquite West, and MM = Mormon Mesa.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in tallies and percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg regardless of nest fate. Percentages in parentheses include only nests with at least one flycatcher egg and for which parasitism status could be determined.

[5] Data presented are combined from Parcel 1-A and occupied southwestern willow flycatcher habitat west of County Parcel 1-A.

Table 8. Southwestern Willow Flycatcher Nest Productivity and Fecundity at Mesquite West, 2019–2021

Year	# Young Fledged	# Nests with Known Outcome	Productivity Mean (SE)[1]	# Females with Known Outcome	Fecundity Mean (SE)[2]
2019	5	8	0.63 (0.26)	5[3]	1.00 (0.58)
2020	0	5	0	4	0
2021	3	6	0.50 (0.34)	3	1.00 (0.58)
Total	**8**	**19**	**0.42 (0.16)**	**12**[3]	**0.67 (0.29)**

[1] Productivity calculations (number of young produced per nest) include nests that contained flycatcher eggs and had a known outcome. SE = standard error.

[2] Fecundity calculations (number of young produced per female) include all females for which nest outcomes were known. SE = standard error.

[3] One female that had one successful nest and one nest of unknown outcome is not included.

Depredation was the main cause of nest failure at Mesquite West in 2021, accounting for 33% of failed nests (Table 9). One nest (17%) was abandoned, one (17%) was deserted, and parasitism caused failure at one nest (17%). The cause of failure for one nest (17%) was unknown.

Table 9. Summary of Causes of Southwestern Willow Flycatcher Nest Failure at Mesquite West, 2021

Total # of nests	All failed nests	Abandoned	Depredated	Deserted	Parasitized	Unknown
8	6	1 (17%)	2 (33%)	1 (17%)	1 (17%)	1 (17%)

Note: All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure. Abandoned = no flycatcher eggs were laid; deserted = deserted with eggs or young remaining in the nest; depredated = nest empty or destroyed 2 days or more before anticipated fledge date; and parasitized = cowbird young outlived any flycatcher young or appearance of cowbird egg(s) coincided with disappearance of all flycatcher eggs.

Three of six nests (50%) with flycatcher eggs and known parasitism status were brood parasitized by brown-headed cowbirds (04A, 04B, and 06B) (Table 10). Three brown-headed cowbird eggs were addled via vigorous shaking at nests 04A and 06B in Mesquite West Parcel 1-A. Nest 04A contained one southwestern willow flycatcher egg and two brown-headed cowbird eggs; both cowbird eggs were addled. This nest was no longer in the tree on the next visit, and eggshell fragments were found on the ground beneath the nest location; thus, this nest failed due to depredation. Nest 06B initially contained only southwestern willow flycatcher eggs before one egg was replaced by a brown-headed cowbird egg (see Figure 14); the 06B brown-headed cowbird egg was addled and did not hatch. The female flycatcher subsequently deserted nest 06B after incubating for 19 days without either egg hatching. Nest 04B was also parasitized. This nest was checked after the female had completed building the nest, and two brown-headed cowbird eggs were present in the nest with southwestern willow flycatcher eggshell fragments present on the ground below the nest; therefore, this nest failed due to parasitism when all southwestern willow flycatcher eggs were replaced with brown-headed cowbird eggs. Two nesting attempts were documented at a single nest in territory 01. At this nest, it was discovered that a brown-headed cowbird egg had been built over in nest 01A. The brown-headed cowbird egg was found buried in the nest lining while the nestling at nest 01A2 was being removed from the nest for banding. It is unknown whether any southwestern willow flycatcher eggs were laid in nest 01A prior to the brown-headed cowbird egg being buried.

Table 10. Fates of Southwestern Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds at Mesquite West, 2021

Subunit	Nest ID	Outcome*
MW	04A	1WE, 2CE in nest; both CE addled. Nest gone from tree on next visit; nest depredated.
	04B	2CE in nest with WE fragments on ground; parasitism caused failure.
	06B	2WE on one visit. 1WE, 1CE on next visit; CE addled. Neither egg hatched after 19 days of incubation; nest deserted.

* WE = flycatcher egg(s) and CE = cowbird egg(s).

Mormon Mesa

Biologists spent 11.9 observer-hours territory monitoring at Mormon Mesa in 2021; monitoring activities included determining residency status, observing the resident southwestern willow flycatcher, and banding one adult. Just one southwestern willow flycatcher was recorded in the northwestern portion of Mormon Mesa Parcel 5-A (Appendix A: Figure A-3). This lone male was never successful in attracting a mate, so no breeding attempts were documented at Mormon Mesa in 2021 (see Table 6). Ms. Nichols color banded the lone adult.

YELLOW-BILLED CUCKOO

Yellow-billed cuckoo surveys across the Riparian Reserve Units in 2021 resulted in zero yellow-billed cuckoo detections. One incidental yellow-billed cuckoo detection was recorded on July 14, 2021, during southwestern willow flycatcher surveys: at Bunkerville Parcel 2-A through 2-E, a yellow-billed cuckoo was observed foraging in a stand of narrowleaf willow (*Salix exigua*) just south of the parcel boundary before flying farther south–the bird never vocalized (Appendix A: Figure A-4). This bird was not detected during the two subsequent rounds of yellow-billed cuckoo surveys; therefore, it does not meet the criteria for a possible breeder (Halterman et al. 2015).

No yellow-billed cuckoos were detected at the Mesquite West, Mormon Mesa, Riverside, or Muddy River Subunits or at any of the other Bunkerville Subunit Parcels in 2021.

3.3.2 Brown-headed Cowbird Control

Brown-headed cowbird netting was conducted over a period of 11 weeks, beginning May 15 and ending July 25 (Table 11). Netting occurred on 13 mornings, with a total of 30 separate net set-ups totaling 18.6 net-hours. Depending on weather conditions, one to four nets were set up each morning, beginning at first light and ending by 10:00 am PDT. In total, 20 adult brown-headed cowbirds were captured: six males and 14 females. None of the six males were recaptures. Biologists used a small mammal guillotine to decapitate the 14 female brown-headed cowbirds immediately following extraction from the net. As detailed in Section 3.3.1, three brown-headed cowbird eggs from two nests were addled in 2021 (see Table 10).

Table 11. Number of Brown-headed Cowbirds Netted by Date at Mesquite West, 2021

Sex	May 15	May 23	Jun 1	Jun 8	Jun 15	Jun 16	Jun 26	Jun 28	Jun 29	Jul 9	Jul 15	Jul 20	Jul 25	Total
Male	1	1	1	0	1	0	0	1	0	0	0	1	0	6
Female	1	3	2	1	1	1	2	0	0	0	2	1	0	14
Total	**2**	**4**	**3**	**1**	**2**	**1**	**2**	**1**	**0**	**0**	**2**	**2**	**0**	**20**

3.3.2 Point-Count Surveys

In total, 75 avian species were recorded across all the County's properties during 2021 point-count surveys, and MSHCP-covered and evaluation species were observed at each property.

RIPARIAN RESERVE UNITS

MSHCP Species

Of the eight avian species covered by the MSHCP, six were recorded during the 2021 point-count surveys: American peregrine falcon, Arizona Bell's vireo, blue grosbeak, phainopepla, southwestern willow flycatcher, and summer tanager. In addition, two other MSHCP-covered species, vermilion flycatcher and yellow-billed cuckoo, were recorded incidentally during southwestern willow flycatcher surveys at the Riparian Reserve Units. A female-type (i.e., a female or first-year bird for which the sex could not be determined) vermilion flycatcher was detected at Bunkerville Parcels 2-J and 2-M, and the previously discussed yellow-billed cuckoo was detected from Bunkerville Parcels 2-A through 2-E.

In addition to the eight covered bird species, the MSHCP also identifies seven evaluation bird species for which future viability is a concern and that may be considered for inclusion in subsequent phases or amendments to the MSHCP. Crissal thrasher (*Toxostoma crissale*) was recorded at several Bunkerville parcels and throughout the Muddy River Subunit, and loggerhead shrike (*Lanius ludovicianus*) was recorded at the Muddy River Subunit. Loggerhead shrike was also incidentally detected at the Mormon Mesa and Bunkerville Subunits.

Eight MSHCP-covered and evaluation species were recorded during point-count surveys at the Riparian Reserve Units in 2021 (Table 12). For each species, the number of recorded individuals is listed for each set of connected parcels. In an effort to standardize the data and account for species (e.g., crissal thrasher, American peregrine falcon) that may be detected at greater distances than others, numbers reported in Table 12 only include birds detected within 100 m (328 feet) of a point-count location.

Table 12. Number of Detections of MSHCP Species Recorded at the Riparian Reserve Units During Point-Count Surveys, 2021

Subunit	Mesquite West	Bunkerville		Riverside	Mormon Mesa	Muddy River
Parcel(s)	1-A	2-A through 2-G	2-I through 2-M	3-A and 3-B	5-A	A–H
American peregrine falcon	–	–	2	X	–	–
Arizona Bell's vireo	2 (PO)	X	5 (PO)	6 (PO)[1]	1 (PO)	–
Blue grosbeak	–	3 (PO)	1 (PO)	X	–	–
Crissal thrasher	–	X	1	–	–	X
Loggerhead shrike	–	–	–	–	–	X
Phainopepla	–	–	2	2	–	9 (PO)
Summer tanager	–	–	1 (PO)	–	–	–
Southwestern willow flycatcher	1 (PO)[2]	–	–	–	X	–

Note: X = species recorded at that unit but never within 100 m (328 feet) of a point-count location; PO = breeding possible—individual(s) singing in appropriate habitat at that unit during the breeding season.

[1] A presumed Arizona Bell's vireo nest was found in Riverside Parcel 3-A, but breeding could not be confirmed.

[2] Breeding was confirmed for this species during surveys for federally listed birds but not during point-count surveys.

SWCA documented multiple nesting attempts of southwestern willow flycatcher at Mesquite West in 2021. Breeding could not be confirmed, however, for any of the other MSHCP species in 2021, though a presumed Arizona Bell's vireo nest was found within a patch of narrowleaf willow along an irrigation ditch in Riverside Parcel 3-A (Figure 15). Therefore, Arizona Bell's vireo, along with blue grosbeak, phainopepla and summer tanager, were suspected of breeding at various Riparian Reserve Units (refer to breeding codes in Table 12; note that a species without a breeding code does not indicate that the species was not breeding in a particular subunit or set of parcels, but only that no evidence of such was recorded).

Figure 15. Presumed Arizona Bell's vireo nest and irrigation ditch habitat at Riverside Parcel 3-A.

Non-MSHCP-listed Species

During the three rounds of point-count surveys in 2021, biologists recorded 58 non-MSHCP avian species across all the Riparian Reserve Units (Table 13). Of these 58 species, nine were recorded at each of the five subunits: Abert's towhee (*Pipilo aberti*), ash-throated flycatcher (*Myiarchus cinerascens*), brown-headed cowbird, Gambel's quail (*Callipepla gambelii*), common raven (*Corvus corax*), Lucy's warbler (*Leiothlypis luciae*), mourning dove (*Zenaida macroura*), northern rough-winged swallow (*Stelgidopteryx serripennis*), and yellow-breasted chat (*Icteria virens*). While some species (e.g., black-throated gray warbler [*Setophaga nigrescens*], green-tailed towhee [*Pipilo chlorurus*], long-billed curlew [*Numenius americanus*], western tanager [*Piranga ludoviciana*],Wilson's warbler [*Cardellina pusilla*], and yellow-rumped warbler [*Setophaga coronata*]) were likely just migrating through the area on their way to breeding grounds farther north or at higher elevations, most of the species recorded during point-count surveys are known to breed in the Mojave Desert. While breeding could not be confirmed for most of the species recorded at the Riparian Reserve Units, it is assumed that many may have bred or attempted to breed in the Riparian Reserve Units in 2021.

Breeding was confirmed for common raven, house sparrow (*Passer domesticus*), Lucy's warbler, and mourning dove, for which biologists recorded the observation of a fledgling, an adult carrying food, or an adult at a nest. Additionally, 22 other species were recorded singing or performing territorial displays, indicating that breeding for those species was possible within the Riparian Reserve Units (though some species may also exhibit either of these behaviors during migration).

Species richness varied between the five Riparian Reserve Subunits. The Bunkerville Subunit showed the highest avian species richness, with 39 species recorded, while the Mormon Mesa Subunit yielded the lowest species richness, with 18 species recorded. The five most commonly detected species across all the

Riparian Reserve Units were mourning dove, brown-headed cowbird, Abert's towhee, Gambel's quail, and red-winged blackbird (*Agelaius phoeniceus*).

Table 13. All Other Bird Species Present at the Riparian Reserve Subunits during Point-Count Surveys, 2021

Common Name	Scientific Name	Clark County Riparian Reserve Subunits – Presence and Breeding Codes*				
		Mesquite West	Bunkerville	Riverside	Mormon Mesa	Muddy River
Cooper's hawk	*Accipiter cooperii*	–	X	1	–	–
Red-winged blackbird	*Agelaius phoeniceus*	1 (PO)	53 (PO)	2	–	1
Mallard	*Anas platyrhynchos*	–	1	–	–	–
Black-chinned hummingbird	*Archilochus alexandri*	–	1	–	–	–
Verdin	*Auriparus flaviceps*	2 (PO)	23 (PO)	8 (PO)	–	5 (PO)
Red-tailed hawk	*Buteo jamaicensis*	–	1	–	–	X
Green heron	*Butorides virescens*	–	3	–	–	–
Gambel's quail	*Callipepla gambelii*	2	13 (PO)	1	13 (PO)	35 (PO)
Anna's hummingbird	*Calypte anna*	1	–	–	–	–
Wilson's warbler	*Cardellina pusilla*	1	1	–	–	–
Turkey vulture	*Cathartes aura*	–	1	X	–	1
Killdeer	*Charadrius vociferus*	1	8	1	1	–
Lark sparrow	*Chondestes grammacus*	–	–	–	–	1
Common raven	*Corvus corax*	X	3 (CO)	X	X	3
Ladder-backed woodpecker	*Dryobates scalaris*	3 (PO)	1 (PO)	–	3 (PO)	3 (PO)
Gray flycatcher	*Empidonax wrightii*	–	–	–	1	–
American coot	*Fulica americana*	–	2	–	–	–
Greater roadrunner	*Geococcyx californianus*	–	2 (PO)	–	–	–
Common yellowthroat	*Geothlypis trichas*	3 (PO)	11 (PO)	X	3 (PO)	–
House finch	*Haemorhous mexicanus*	–	4	2 (PO)	1	19 (PO)
Barn swallow	*Hirundo rustica*	1	2	–	–	–
Yellow-breasted chat	*Icteria virens*	11 (PO)	8 (PO)	X	8 (PO)	2 (PO)
Bullock's oriole	*Icterus bullockii*	1	–	1	–	–
Hooded oriole	*Icterus cucullatus*	–	–	–	–	1 (PO)
Lucy's warbler	*Leiothlypis luciae*	3 (CO)	19 (PO)	2 (PO)	1	7 (PO)
Song sparrow	*Melospiza melodia*	7 (PO)	X	–	4 (PO)	–
Northern mockingbird	*Mimus polyglottos*	–	–	–	–	2 (PO)
Brown-headed cowbird	*Molothrus ater*	13 (PO)	26 (PO)	29 (PO)	2 (PO)	7 (PO)
Ash-throated flycatcher	*Myiarchus cinerascens*	3 (PO)	1	4	1	4
Long-billed curlew	*Numenius americanus*	–	–	1	–	–
Black-crowned night-heron	*Nycticorax nycticorax*	–	1	–	–	–
House sparrow	*Passer domesticus*	–	–	–	–	14 (CO)
Lazuli bunting	*Passerina amoena*	–	1	–	–	–

Common Name	Scientific Name	Clark County Riparian Reserve Subunits – Presence and Breeding Codes*				
		Mesquite West	Bunkerville	Riverside	Mormon Mesa	Muddy River
Cliff swallow	*Petrochelidon pyrrhonota*	–	16	21	–	–
Double-crested cormorant	*Phalacrocorax auratus*	–	X	–	–	–
Black-headed grosbeak	*Pheucticus melanocephalus*	–	1 (PO)	1	–	1
Abert's towhee	*Pipilo aberti*	10 (PO)	22 (PO)	4	2	26 (PO)
Green-tailed towhee	*Pipilo chlorurus*	2	–	–	–	–
Western tanager	*Piranga ludoviciana*	–	–	–	–	2
White-faced ibis	*Plegadis chihi*	–	X	–	–	–
Black-tailed gnatcatcher	*Polioptila melanura*	–	4 (PO)	1	–	1
Great-tailed grackle	*Quiscalus mexicanus*	–	4 (PO)	–	–	–
Rock wren	*Salpinctes obsoletus*	–	–	–	–	1
Black phoebe	*Sayornis nigricans*	–	–	–	–	1
Say's phoebe	*Sayornis saya*	–	4	–	–	2
Yellow-rumped warbler	*Setophaga coronata*	–	3	4	–	2
Black-throated gray warbler	*Setophaga nigrescens*	–	–	–	–	1
Yellow warbler	*Setophaga petechia*	6 (PO)	5 (PO)	19	1	–
Lesser goldfinch	*Spinus psaltria*	–	5	–	1	–
Northern rough-winged swallow	*Stelgidopteryx serripennis*	X	26	3	1	3
Eurasian collared-dove	*Streptopelia decaocto*	–	X	–	–	7 (PO)
Western meadowlark	*Sturnella neglecta*	–	X	–	–	X
Bewick’s wren	*Thryomanes bewickii*	–	–	–	2 (PO)	3 (PO)
Western kingbird	*Tyrannus verticalis*	–	4	–	–	5 (PO)
White-winged dove	*Zenaida asiatica*	–	–	–	X	7 (PO)
Mourning dove	*Zenaida macroura*	18 (PO)	51 (PO)	16 (PO)	13 (PO)	12 (CO)
White-crowned sparrow	*Zonotrichia leucophrys*	–	–	–	–	1

***** X = species recorded at that unit but never within 100 m (328 feet) of a point-count location; CO = Breeding confirmed—adult observed carrying nesting material, adult at a nest, or a fledgling observed; PO = breeding possible—individual(s) singing or performing a territorial display in appropriate habitat at that unit during the breeding season.

BCCE

MSHCP-listed Species

None of the eight MSHCP-covered bird species were recorded during 2021 point-count surveys in the BCCE. However, biologists recorded two evaluation bird species; loggerhead shrike and LeConte’s thrasher (*Toxostoma lecontei*) were recorded from one point-count location each in 2021 (Table 14). While breeding could not be confirmed for either species during 2021 point-count surveys, LeConte’s thrasher nests have been documented in the BCCE during previous survey years (SWCA 2020).

Table 14. Number of Detections and Breeding Codes for MSHCP Evaluation Species Recorded at the BCCE during 2021 Point-Count Surveys

Common Name	Scientific Name	Total Detections	Detections Within 100 m	Breeding Codes
Loggerhead shrike	*Lanius ludovicianus*	2	0	–
LeConte's thrasher	*Toxostoma lecontei*	2	1	–

Non-MSHCP-listed Species

SWCA biologists recorded 17 avian species not listed under the MSHCP across the BCCE point-count locations over all three rounds of 2021 point-count surveys (Table 15). These data are presented as total detections and detections within 100 m (328 feet) of the observer to account for species with different detection probabilities and reduce bias towards species that are more conspicuous at greater distances (e.g., common raven) (GBBO 2003; Ralph et al. 1995). Of these 17 species recorded during point-count surveys, 13 were recorded within 100 m (328 feet) of a point-count location. The four most commonly detected species at the BCCE, independent of distance from surveyor, were black-throated sparrow (*Amphispiza bilineata*), horned lark (*Eremophila alpestris*), common raven, and ash-throated flycatcher (see Table 15). The four most common species recorded within 100 m (328 feet) of a point-count location were horned lark, black-throated sparrow, house finch (*Haemorhous mexicanus*), and ash-throated flycatcher.

Table 15. Number of Detections and Breeding Codes for Non-MSHCP-listed Species Recorded at the BCCE during Point-Count Surveys, 2021

Common Name	Scientific Name	Total Detections	Detections Within 100 m	Breeding Codes*
Golden eagle	*Aquila chrysaetos*	1	0	–
Black-throated sparrow	*Amphispiza bilineata*	21	9	PO
Verdin	*Auriparus flaviceps*	1	1	–
Red-tailed hawk	*Buteo jamaicensis*	1	0	–
Gambel's quail	*Callipepla gambelii*	1	0	–
Cactus wren	*Campylorhynchus brunneicapillus*	1	1	CO
Costa's hummingbird	*Calypte costae*	1	1	–
Common raven	*Corvus corax*	16	2	–
Horned lark	*Eremophila alpestris*	21	19	PO
Prairie falcon	*Falco mexicanus*	1	0	–
House finch	*Haemorhous mexicanus*	6	6	–
Ash-throated flycatcher	*Myiarchus cinerascens*	11	6	PO
Cliff swallow	*Petrochelidon pyrrhonota*	1	1	–
Rock Wren	*Salpinctes obsoletus*	1	1	–
Say's phoebe	*Sayornis saya*	2	2	–
Tree swallow	*Tachycineta bicolor*	3	2	–
Violet-green swallow	*Tachycineta thalassina*	2	2	–

* CO = Breeding confirmed—adult observed carrying nesting material; PO = breeding possible—individual(s) singing in appropriate habitat during the breeding season.

While some of the species detected at the BCCE in 2021 were likely migrating through the area on their way to breeding grounds farther north or at higher elevations (e.g., tree swallow [*Tachycineta bicolor*]), most of these species are known to breed in the Mojave Desert and may have bred or attempted to breed within the BCCE boundary in 2021. For example, horned lark and black-throated sparrow, the two most abundant species at the BCCE in 2021, were never confirmed to be breeding within the BCCE during the 2021 point-count surveys; however, these species are two of the most common breeders in the Mojave Desert scrub habitats, and they undoubtedly breed within the BCCE boundary.

Confirmation of breeding was recorded for one species not covered under the MSHCP: cactus wren (*Campylorhynchus brunneicapillus*) (carrying nesting material). Additionally, three other species were recorded singing at the BCCE, which indicates that breeding for those species was possible (though some species sing during migration). Species lacking a breeding code in Table 15 may have bred within the BCCE; however, no evidence of breeding was recorded.

4.0 EVALUATION/DISCUSSION OF RESULTS

This project builds on a baseline avian dataset for the County's MSHCP properties. Point-count surveys across the Riparian Reserve Units resulted in a total of 66 avian species detected, including eight MSHCP-covered and evaluation species; two additional MSHCP-covered species were detected incidentally in 2021. Point-counts across the BCCE yielded 19 total avian species, including two MSHCP-evaluation species. Goals identified in both the Riparian Reserve Unit Management Plan (Clark County 2015) and the BCCE Management Plan (Clark County 2019) include managing these properties to protect MSHCP-covered species. Baseline vegetation community and structure data for the MSHCP properties are necessary to inform habitat management interventions for managing avian species at these properties. This section includes a closer analysis of avian species presence and distribution for each set of connected parcels within the Riparian Reserve Units and at the BCCE, as well as a qualitative assessment of existing vegetation conditions therein.

4.1 Mesquite West

4.1.1 Parcel 1-A

More than 90% of the vegetation at Bunkerville Parcel 1-A consists of narrowleaf willows, most of which are 4–6 m (13.1–19.7 feet) in height (Figure 16); the remainder of the vegetation consists of tamarisk 4–6 m (13.1–19.7 feet) in height and some patches of narrowleaf willow approximately 3–4 m (9.8–13.1 feet) in height. Parcel 1-A generally has canopy closure > 90%. Intermittently throughout the breeding season, irrigation return water runs generally from north to south throughout all but the southeast corner of Parcel 1-A. On days when there are no return flows, the site still contains saturated soils. This parcel contains the best habitat for southwestern willow flycatchers within the County's Riparian Reserve Units. All 4.0 ha (9.9 acres) originally delineated for surveys by the County were considered habitat suitable for federally listed bird surveys in 2019 through 2021 (see Figure 3).

Figure 16. Typical narrowleaf willow habitat at Mesquite West Parcel 1-A.

Habitat quality within Parcel 1-A is evidenced by the presence of multiple southwestern willow flycatcher territories (see Section 3.3.1 and Appendix A: Figure A-1). Parcel 1-A occupies most of the eastern portion of a larger study site known as Mesquite West, which has been monitored annually by SWCA (under various contracts) and NDOW biologists since 2003 (McLeod and Pellegrini 2013, 2014; NDOW, unpublished data). From 2003 through 2012, Mesquite West had anywhere from 6 to 30 resident adult southwestern willow flycatchers each year (McLeod and Pellegrini 2013). Hydrologic conditions within Parcel 1-A are highly variable from year to year, and soil moisture levels were noted to be decreasing in July 2020. All documented southwestern willow flycatcher nesting attempts failed in 2020, and the increasingly arid conditions observed toward the end of the nesting season may have been a contributing factor in southwestern willow flycatcher nests being abandoned or deserted (see Table 7). It appeared that more water was present in Mesquite West in 2021 than in 2020, and successful southwestern willow flycatcher breeding attempts were again documented.

There were four cuckoo detections within Parcel 1-A in 2020, and breeding in this parcel was confirmed in 2019. However, no yellow-billed cuckoos were detected in Parcel 1-A in 2021 during species-specific surveys or incidentally while conducting other work.

In addition to southwestern willow flycatcher, one other MSHCP-covered avian species, Arizona Bell's vireo, was recorded at one of the two survey points within Mesquite West Parcel 1-A in 2021. This habitat is ideal for Arizona Bell's vireo, as this species is known to nest in thickets of dense willow (Clark County 2000; Floyd et al. 2007), and Arizona Bell's vireos likely breed within this parcel.

Though not an MSHCP-covered species, yellow warbler (*Setophaga petechia*), a Mojave riparian indicator species (GBBO 2010), was also recorded singing within Mesquite West Parcel 1-A in 2021, further indicating that Parcel 1-A has some of the best quality habitat of any of the parcels within the Riparian Reserve Units.

4.2 Bunkerville

The habitat at the Bunkerville Subunit is extremely varied, ranging from highly disturbed areas to mostly intact, native habitat. In vegetated areas, dominant species range from young, sparsely distributed arrowweed (*Pluchea sericea*) in sandy soil, to mature monotypic tamarisk, to dense stands of narrowleaf willow. The following section describes the habitat and avian detections within each unique set of

connected parcels in the Bunkerville subunit: 1) Parcels 2-A through 2-G, 2) Parcels 2-I and 2-J, and 3) Parcels 2-K through 2-M.

4.2.1 Parcels 2-A through 2-G

Bunkerville Parcels 2-A through 2-G contain mostly shrubby habitat with frequent openings that have been scoured by flooding or cleared by anthropogenic activities. Parcels 2-A through 2-E are mostly within the active floodplain of the Virgin River, which experiences frequent high-flow events. These parcels therefore consist largely of sandy bare ground dotted with sapling arrowweed and tamarisk (Figure 17). In 2019, higher than normal winter precipitation yielded significant spring run-off that scoured portions of these parcels, creating more open, unvegetated habitat (Figure 18), and affected the habitat at point-count location BV-7 (Figure 19). Of the 9.8 ha (24.3 acres) originally delineated for surveys by the County, 1.3 ha (3.2 acres) was scoured by the 2019 flooding, and 0.3 ha (0.7 acre) was burned in a wildfire late in 2017 (SWCA 2017a). This 1.6 ha (3.9 acres) of previously tamarisk-dominated woodland was excluded from surveys starting in 2019.

Figure 17. Examples of flood-disturbed habitat at Bunkerville Parcels 2-A through 2-E.

Figure 18. Evidence of the 2019 flooding at Bunkerville Parcels 2-A through 2-E.

Figure 19. BV-7, facing north, in 2017 (left) and in 2020 (right).

Parcels 2-A through 2-G do not currently contain vegetation that resembles typical southwestern willow flycatcher or yellow-billed cuckoo breeding habitat, and, through 2020, neither species had been recorded within these parcels. In 2021, however, a yellow-billed cuckoo was recorded just outside of the southwest corner of these parcels in a patch of young narrowleaf willow (see Appendix A: Figure A-4). The vegetation south of Parcels 2-A through 2-E where the cuckoo was incidentally observed contains fairly dense narrowleaf willow and may provide potential southwestern willow flycatcher or yellow-billed cuckoo nesting habitat.

In contrast, the County parcels lack the multistoried canopy that is generally used by yellow-billed cuckoos, and although the minimum canopy height for breeding southwestern willow flycatchers is considered to be 3 m, occupied southwestern willow flycatcher sites along the Virgin River in 2003–2011 had median canopy heights of 5–6 m (16.4–19.7 feet) (McLeod and Pellegrini 2013). There is generally very little continuous canopy at this height within Parcels 2-A through 2-G. Median canopy closure of occupied southwestern willow flycatcher sites along the Virgin River from 2003 to 2011 was > 90% (McLeod and Pellegrini 2013). Portions of the site exhibit canopy closure that reaches 80%, but most of the site is much more open.

Bunkerville Parcels 2-F and 2-G are dominated by anthropogenically disturbed lands and include large areas that have been completely bladed and cleared of native vegetation (Figure 20). Any regrowth in this area is generally patchy tamarisk and arrowweed, 2–4 m (6.6–13.1 feet) in height, with little continuous canopy. Much of the southern portion of Bunkerville Parcel 2-F is currently being used for growing alfalfa (*Medicago sativa*) and grazing cattle (see Figure 4). The areas of Parcels 2-F and 2-G that have not been disturbed by anthropogenic activities are dominated by 1- to 3-m- (3.3- to 9.8-foot-) tall seep willow (*Baccharis salicifolia*), tamarisk, and intermittent arrowweed (Figure 21).

There is a small patch of monotypic tamarisk in Parcel 2-F and a small patch of narrowleaf willow in Parcel 2-G (Figure 22). The tamarisk patch is largely on a dry terrace and consists of 3- to 4-m- (9.8- to 13.1-foot-) tall trees with < 50% canopy closure. The patch of willow consists largely of narrowleaf willow, with intermittent tamarisk and seep willow, all of which ranges mostly between 3 and 4 m (9.8 and 13.1 feet) in height. This area of willow has intermittent surface water and relatively dense canopy cover (~75%) but is less than 0.4 ha (1 acre) in size, which is likely too small to support most of the MSHCP-covered bird species, including southwestern willow flycatcher (Sogge et al. 2010). A few mature Goodding's willows (*Salix gooddingii*) and screwbean mesquite are also present within the Virgin River floodplain throughout Parcels 2-A through 2-G.

Figure 20. Anthropogenically disturbed habitat at Bunkerville Parcels 2-F and 2-G.

Figure 21. Examples of young seep willow and arrowweed at Bunkerville Parcels 2-F and 2-G.

Figure 22. Monotypic tamarisk at Bunkerville Parcel 2-F (left) and the narrowleaf willow patch at Bunkerville Parcel 2-G (right).

Three MSHCP-covered and evaluation avian species were recorded at Bunkerville Parcels 2-A through 2-G: Arizona Bell's vireo, blue grosbeak, and crissal thrasher. Arizona Bell's vireo is typically found in desert riparian habitat (Clark County 2000), and this species was recorded from two of the four points surveyed within this set of parcels in 2021. Blue grosbeaks were detected from all four point-count locations surveyed within this set of parcels in 2021. While both species are considered to be desert riparian obligates, it appears that they both can tolerate more open, scrubby habitat than can some of the other MSHCP riparian species. In addition to the covered species, crissal thrasher was also recorded from one of the four point-locations within these parcels in 2021. This species prefers dense, scrubby vegetation often near water, but is not a riparian obligate species.

4.2.2 Parcels 2-I and 2-J

Much of Bunkerville Parcels 2-I and 2-J appears to be subject to regular flooding, and some of the most abundant plants within these two parcels are sapling arrowweed and tamarisk < 3 m (9.8 feet) tall (Figure 23). Additionally, much of the area is relatively unvegetated in comparison to other riparian habitat in the desert Southwest. This is likely due, at least in part, to regular flood events, including flooding in the spring of 2019. Of the 8.1 ha (20.1 acres) delineated for surveys by the County prior to 2019 surveys, 0.9 ha (2.2 acres) were scoured by spring flooding, leaving unvegetated bare ground (Figure 24). These areas were excluded from southwestern willow flycatcher and yellow-billed cuckoo surveys starting in 2019.

Bunkerville Parcels 2-I and 2-J host very few large native riparian trees, such as those used by southwestern willow flycatcher and yellow-billed cuckoo. Most of the mature riparian vegetation within these parcels consists of tamarisk and screwbean mesquite 2–5 m (6.6–16.4 feet) tall (Figure 25), and these stands have virtually no continuous canopy cover or nearby surface water. Additionally, much of the tamarisk is dead or dying, due to defoliation by tamarisk leaf beetles (*Diorhabda* spp.) or herbicidal treatment by the National Park Service (personal communication, C. Deuser, National Park Service, with Justin Streit, Project Manager, SWCA, August 28, 2019) (Figure 26). While tamarisk can provide habitat for desert riparian bird species, much of the tamarisk at Bunkerville Parcels 2-I and 2-J does not, due largely to its poor health at these two parcels.

Figure 23. Typical open, scrubby habitat at Bunkerville Parcels 2-I and 2-J.

Figure 24. Evidence of the 2019 flooding at Bunkerville Parcel 2-I.

Figure 25. Open tamarisk (left) and screwbean mesquite (right) habitat at Bunkerville Parcels 2-I and 2-J.

Figure 26. Tamarisk stand treated with herbicide at Bunkerville Parcel 2-J, before (left) and after (right) treatment.

No southwestern willow flycatchers or yellow-billed cuckoos were detected during 2021 surveys at these parcels, and Bunkerville Parcels 2-I and 2-J do not currently contain any potential breeding habitat for southwestern willow flycatcher or yellow-billed cuckoo. Despite a lack of native trees, Parcels 2-I and 2-J do have flowing channels, a pond, and a wet meadow/wetland with emergent vegetation (Figure 27), all of which could support native riparian habitat in the future. The wet meadow is in the east half of Parcel 2-J and is composed largely of sedges (*Carex spp.*) and other wetland grasses, with scattered Goodding's willow and tamarisk. The wet meadow is unique to Parcel 2-J within the County's reserve system and could be an area to target for riparian restoration. In contrast with previous years, no cattle or recent sign thereof were observed within the wet meadow habitat at Parcel 2-J in 2021, and, subsequently, there appeared to be more vegetative cover than had been observed in previous years. (Figure 28).

Figure 27. Open water (left) and wet meadow (right) habitats at Bunkerville Parcel 2-J.

Figure 28. Increased vegetative cover, relative to prior years, was noted in the wet meadow areas of Parcel 2-J in 2021.

In total, five MSHCP-covered bird species (American peregrine falcon, Arizona Bell's vireo, blue grosbeak, phainopepla, and summer tanager) and one MSHCP evaluation bird species (crissal thrasher) were recorded within Bunkerville Parcels 2-I and 2-J during 2021 point-count surveys. Additionally, vermilion flycatcher and loggerhead shrike were recorded incidentally during federally listed bird surveys at Parcels 2-I and 2-J in 2021. This relatively long list of MSHCP species hints at the diversity of habitat represented by this pair of parcels.

4.2.3 Parcels 2-K through 2-M

Bunkerville Parcels 2-K, 2-L, and 2-M comprise a total of 59 acres and are immediately north of Bunkerville West Parcel 2-J (see Figure 4). In total, SWCA mapped 6.3 acres as potential yellow-billed cuckoo or southwestern willow flycatcher breeding habitat in Parcels 2-L and 2-M, which are characterized by isolated and/or narrow patches of riparian vegetation containing tamarisk, narrowleaf willow, and Goodding's willow adjacent to wet meadows, marshes, and open water features (Figures 29 and 30). There were no areas mapped as potential yellow-billed cuckoo or southwestern willow flycatcher habitat within Parcel 2-K.

Figure 29. Tall, dense tamarisk along a backwater feature in Parcel 2-M provides potential southwestern willow flycatcher breeding habitat.

Figure 30. Goodding's and narrowleaf willow habitat in Bunkerville Parcel 2-M.

Outside the areas mapped as potential yellow-billed cuckoo and southwestern willow flycatcher habitat, vegetation within these parcels consists primarily of riparian scrub dominated by arrowweed, and soils in these areas were generally dry in 2021 (Figure 31). Bunkerville Parcels 2-L and 2-M do not currently provide habitat for southwestern willow flycatcher or yellow-billed cuckoo; however, future restoration actions, including changes in vegetation and water management, could improve the habitat potential for these species within these areas.

Figure 31. Typical open, scrubby habitat at Bunkerville Parcels 2-L and 2-M.

A total of three MSHCP-covered bird species and one evaluation species were recorded during surveys in Parcels 2-L and 2-M in 2021. A single willow flycatcher was detected during targeted playback surveys for southwestern willow flycatcher. This individual was detected only during the first round of surveys and was believed to be a migrant willow flycatcher. Biologists recorded one phainopepla, an MSHCP-covered species, and one crissal thrasher, an MSHCP evaluation species, during point-count surveys. In addition, Arizona Bell's vireo and vermilion flycatcher, both MSHCP-covered species, were detected incidentally during federally listed bird surveys.

4.3 Riverside

Much like Bunkerville Parcels 2-I and 2-J, Riverside Parcels 3-A and 3-B are composed mostly of the open, scrubby habitat typically found in riparian areas that experience frequent flooding (Figure 32). Also like Parcels 2-I and 2-J, the Riverside Subunit was subjected to substantial seasonal run-off associated with above-average winter precipitation in the Virgin River watershed in 2019. The 2019 flooding removed portions of a large, contiguous patch of tamarisk at the northern end of the Riverside Subunit. Subsequently, of the 5.3 ha (13.1 acres) that the County identified for federally listed bird surveys, 3.9 ha (9.6 acres) were deemed suitable for surveys by SWCA. The survey areas consisted of two general vegetation types: 1) relatively contiguous tamarisk 3–4 m (9.8–13.1 feet) in height, with canopy closure < 50%, and 2) a generally < 5-m- (16.4-foot-) wide strip of 3- to 4-m- (9.8- to 13.1-feet-) tall narrowleaf willow along an irrigation ditch (Figure 33).

As of 2018, there were also large areas of dense 2-m- (6.6-foot-) tall arrowweed and fairly dense 2- to 4-m- (6.6- to 13.1-foot-) tall screwbean and honey mesquite (*Prosopis glandulosa*) (Figure 34). However, between the 2018 and 2019 surveys, most of this largest patch of mesquite was cut down by an unknown party (see Figure 34). Regrowth of these mesquite trees in Parcel 3-A was observed in 2020 and 2021 (Figure 35).

Figure 32. Scrubby, open habitat within the floodplain at Riverside Parcels 3-A and 3-B.

Figure 33. Narrowleaf willow along the irrigation ditch at Riverside Parcels 3-A and 3-B.

Figure 34. Mesquite patch at Riverside Parcels 3-A and 3-B before (showing the location from where the right photo was taken; facing north) (left) and after cutting in 2019 (facing northwest) (right).

Figure 35. Mesquite patch at RS-5, facing west, in 2018 - showing dense growth (left), and in 2020 – following thinning but exhibiting regrowth (right).

Four MSHCP avian species were recorded at the Riverside Subunit: American peregrine falcon, Arizona Bell's vireo, blue grosbeak, and phainopepla. The MSHCP identifies all of these species except Arizona Bell's vireo as capable of occupying habitat other than desert riparian, and blue grosbeak can occupy open riparian habitat (Clark County 2000). Phainopepla prefer shrub- or mesquite-dominated habitats and are not desert riparian obligates, so their presence at the Riverside Subunit is not surprising. Peregrine falcons nest on cliff walls but can forage in a variety of habitats, particularly near water.

Arizona Bell's vireo is a desert riparian obligate, and a presumed Arizona Bell's vireo nest was found in 2021 in a narrowleaf willow in the irrigation ditch that runs along the eastern side of Parcels 3-A and 3-B (see Figure 15). This species can also occupy dense mesquite habitat, and Arizona Bell's vireos were regularly heard singing and seen foraging in screwbean and honey mesquites at the Riverside Subunit. The Arizona Bell's vireo was the sixth-most detected species at the Riverside Subunit (down from the third-most detected species in 2020).

The Riverside Subunit does not currently contain vegetation that resembles typical southwestern willow flycatcher or yellow-billed cuckoo breeding habitat. The patch of narrowleaf willows along the irrigation ditch is generally not wide enough to provide suitable breeding habitat, and the patches of tamarisk are dry and open and do not have the saturated soils typical of southwestern willow flycatcher breeding habitat. Surface water at the Riverside Subunit is restricted to the active river channel and the irrigation ditch along the east side of the Subunit. Furthermore, the Riverside Subunit completely lacks the mature vegetation and multistoried canopy that are generally required by yellow-billed cuckoo. Two willow flycatchers were detected in mesquite trees during the first round of southwestern willow flycatcher surveys in Parcel 3-A, but these birds were not detected during subsequent survey rounds and were believed to be northbound migrants.

4.4 Mormon Mesa

Since its acquisition by the County, the Mormon Mesa Subunit has been largely dominated by a monotypic stand of tamarisk. However, much of this vegetation has died or is dying as the result of defoliation by tamarisk leaf beetles. In 2018, the County masticated 1.7 ha (4.3 acres) of dead tamarisk (Figure 36) and in 2020 masticated an additional 14.6 ha (36.0 acres) (Figure 37). These areas of masticated tamarisk were not surveyed for southwestern willow flycatcher or yellow-billed cuckoo in 2021 (see Figure 6). There are a few narrow patches of mostly dead and dying tamarisk that remain

outside the masticated area within the Mormon Mesa Parcel 5-A (see Figure 37, right), but these areas do not provide the vegetative or hydrologic conditions used by nesting southwestern willow flycatchers or yellow-billed cuckoos.

Figure 36. Dead and dying tamarisk at the Mormon Mesa Subunit.

Figure 37. Masticated tamarisk at the Mormon Mesa Subunit in 2021 (left); Narrow, mostly dead and dying tamarisk patches remain outside the masticated area within the Mormon Mesa Subunit (right).

An approximately 5-ha (13-acre) patch of screwbean mesquite and arrowweed shrubland is present in the southwestern corner of this Subunit, and some large Goodding's willows are present in the northwestern corner. Eight restoration plots are also scattered throughout the northwestern corner of the Mormon Mesa Subunit; in 2014, the County cleared non-native tamarisk and planted native vegetation within these plots (see Appendix A: Figure A-3). Examples of these plots are shown in Figure 38. For the first time in 2021, SWCA biologists observed cattle within multiple restoration plots at Mormon Mesa.

Figure 38. Sample habitat within restoration plots at the Mormon Mesa Subunit.

While southwestern willow flycatchers successfully nested in one of the County's restoration plots in 2020 (SWCA 2020) (Figure 39), the lone male detected and subsequently monitored at Parcel 5-A in 2021 was unsuccessful in attracting a mate; therefore, no nesting attempts were documented in Parcel 5-A in 2021. Despite the lack of nesting attempts in 2021, this habitat still appears suitable for southwestern willow flycatcher (see Figure 39).

Figure 39. Narrowleaf willow habitat in the occupied restoration plot in Mormon Mesa Parcel 5-A.

While tamarisk can provide habitat for desert riparian species, the dead or dying tamarisk at the Mormon Mesa Subunit has less benefit to wildlife than does native vegetation or live tamarisk. This is corroborated by the fact that Mormon Mesa yielded the lowest species richness of any of the subunits during the 2017, 2019, and 2021 point-count surveys (surveys were not conducted at Mormon Mesa in 2018) and the second lowest species richness in 2020. These dying monotypic tamarisk stands provide less concealment from predators and are relatively hot and dry compared to living vegetation, thereby causing a reduction in canopy cover and decreased thermal protection for eggs and nestlings (McLeod 2019). McLeod and Pellegrini (2013) showed that occupied breeding habitat for southwestern willow flycatcher exhibited > 90% median canopy closure along the Virgin River between 2003 and 2011. However, despite much of the unit appearing to be in poor health, there are still patches of mature native vegetation that should be protected.

Three MSHCP-covered and evaluation bird species were recorded at the Mormon Mesa Riparian Reserve Unit. A lone male southwestern willow flycatcher was detected in Parcel 5-A in late May and stayed through June 30, 2021. In addition, biologists recorded one detection of Arizona Bell's vireo and incidental sightings of loggerhead shrike.

4.5 Muddy River

Vegetation at the Muddy River Riparian Reserve Unit is highly diverse. Parcels A–E are dominated by horticultural plantings (e.g., pine [*Pinus* spp.] and California fan palm [*Washingtonia filifera*]) (Figure 40), creosote bush (*Larrea tridentata*) scrubland, and big saltbush (*Atriplex lentiformis*). Parcel F is dominated almost completely by creosote bush scrub, with smaller patches of honey mesquite, particularly in the central and southeastern portions of the parcel (Figure 41). Parcels G–I are composed largely of very dense thickets of big saltbush and Mojave seablite (*Suaeda moquinii*), mixed with scattered honey mesquite and tamarisk (Figure 42). While the Muddy River runs near the Muddy River Riparian Reserve Unit, it does not run through any of the southern parcels and only forms the eastern boundary of Parcels A–E. This portion of the Muddy River is also deeply incised, and desert riparian vegetation, consisting of widely scattered tamarisk and velvet ash (*Fraxinus velutina*), is generally limited to within a couple of meters (approximately 6 feet) of the riverbank.

Figure 40. Horticultural trees planted at Muddy River Parcels A–E.

Figure 41. Creosote bush habitat with scattered honey mesquite at Muddy River Parcel F.

Figure 42. Varied scrub habitat at Muddy River Parcels G-I.

One MSHCP-covered bird species (phainopepla) and two MSHCP evaluation bird species (crissal thrasher and loggerhead shrike) were recorded during point-count surveys at the Muddy River Riparian Reserve Unit in 2021. Additionally, Arizona Bell's vireo was detected incidentally during species-specific surveys for yellow-billed cuckoo. Crissal thrasher and phainopepla were recorded from multiple point-count locations at the Muddy River Riparian Reserve Unit. Most of the desert riparian obligates (e.g., southwestern willow flycatcher and yellow warbler) were not detected in the Muddy River Riparian Reserve Unit in 2021, which is not surprising given the lack of desert riparian habitat at this property. Although multiple yellow-billed cuckoo detections were recorded at the Muddy River Riparian Reserve Unit in both 2019 and 2020, 2021 surveys at this Unit yielded zero cuckoo detections.

Crissal thrashers were recorded from three of the seven point-count locations at the Muddy River Riparian Reserve Unit in 2021, and this species is typically found in dense cover within mesquite and riparian woodlands (Floyd et al. 2007). Phainopepla was recorded from four of the seven Muddy River point-count locations in 2021. This species depends heavily on mistletoe (*Phoradendron* spp.) berries that grow on mesquite, and Muddy River has a relatively abundant population of honey mesquite compared to the other Riparian Reserve Units. Given the abundance of their preferred habitats therein, it is suspected that both crissal thrasher and phainopepla are breeding within the Muddy River Riparian Reserve Unit.

4.6 BCCE

Mojave Desert scrub, which is co-dominated by creosote bush and burrobush (*Ambrosia dumosa*), is the dominant vegetation community across the Mojave Desert, and this community covers over 97% of the BCCE (Clark County 2019). Most point-count survey locations at the BCCE are within this habitat type (Figure 43). The remainder of the BCCE is composed of salt desert scrub (1.5%), mesquite/acacia habitat (less than 1%), and previously disturbed habitat (Clark County 2019). A few survey points were in areas of dense cholla (*Cylindropuntia* spp.) or desert wash habitat (Figure 44).

Figure 43. Mojave Desert scrub habitat at point-count locations 12 (left) and 17 (right).

Figure 44. Dense cholla at point-count location 33 (left) and desert wash habitat at point-count location 37 (right).

The BCCE Management Plan identified that no MSHCP-covered avian species are known to occur within the BCCE (Clark County 2019). During the initial site reconnaissance and point-count surveys of the BCCE in 2018, biologists did not observe any habitat, including desert riparian habitat, that could be considered suitable breeding habitat for the MSHCP-covered avian species. It is therefore not surprising that no MSHCP-covered species were observed within the BCCE in 2021. Two evaluation species, LeConte's thrasher and loggerhead shrike, are known to occur within the BCCE (Clark County 2019) and were each recorded twice within the BCCE during 2021 point-count surveys (see Table 14).

4.7 Brown-headed Cowbird Control

Following limited brown-headed cowbird control and continued high brood parasitism rates of southwestern willow flycatcher nests at Mesquite West in 2020, SWCA implemented a target-netting program for brown-headed cowbirds at Mesquite West in 2021. The goal of this program was to reduce the incidence of brood parasitism on southwestern willow flycatcher nest. SWCA was successful in target netting brown-headed cowbirds in 2021 and removed 14 female brown-headed cowbirds. In addition, three brown-headed cowbird eggs were addled at two southwestern willow flycatcher nests at Mesquite West in 2021. Both nests later failed, one due to depredation and the second due to nest desertion following 19 days of incubation.

Despite increased brown-headed cowbird control in 2021, 50% of southwestern willow flycatcher nests at Mesquite West were parasitized. This parasitism rate matches that of 2019 and is higher than the parasitism rate in 2020 (40%), indicating that brown-headed cowbird control efforts were initially unsuccessful in reducing parasitism rates. However, two successful nests produced a total of three southwestern willow flycatcher fledglings in 2021. No fledglings were produced in 2020.

5.0 CONCLUSION

Eight MSHCP-covered and three MSHCP evaluation bird species were recorded at the County's reserve system properties in 2021. Some notable conclusions about MSHCP avian species and their habitats at the County's properties are listed below.

- Despite multiple detections of yellow-billed cuckoos from multiple properties in 2019 and 2020, no yellow-billed cuckoos were detected during targeted surveys for that species within the Riparian Reserve Units in 2021. One yellow-billed cuckoo was incidentally detected south of Bunkerville Parcels 2-A through 2-E during southwestern willow flycatcher surveys.
- Southwestern willow flycatcher monitoring resulted in documentation of three pairs at Mesquite West in 2021, all of which were confirmed to be nesting. These three pairs had eight nesting attempts, two of which were successful and produced three fledglings.
- SWCA successfully target netted 20 adult brown-headed cowbirds (14 female, six male) at Mesquite West in 2021; the 14 female brown-headed cowbirds were subsequently euthanized.
- Three brown-headed cowbird eggs from two nests at Mesquite West were addled. Of these two nests, one later failed due to depredation and the second was deserted after 19 days of incubation.
- Despite the increased implementation of brown-headed cowbird control in 2021, 50% of southwestern willow flycatcher nests at Mesquite West were parasitized. This parasitism rate matches that of 2019 and is higher than the parasitism rate in 2020 (40%).
- Mature native desert riparian habitat within the County's Riparian Reserve Units is limited to small patches throughout the parcels and one large patch of narrowleaf willow that constitutes almost all of Mesquite West Parcel 1-A. Due to a number of factors, native riparian habitats throughout the southwestern United States have largely died off or been replaced by non-native species such as tamarisk. While tamarisk can provide valuable habitat for some species, such as the southwestern willow flycatcher, habitat quality diminishes after infestation and defoliation by the tamarisk leaf beetle.
- It appears that cattle have been successfully excluded from portions of Bunkerville Parcel 2-J, and early stages of a positive vegetative response were observed in 2021.

- Breeding habitat for the MSHCP-covered bird species is currently limited or non-existent within the BCCE. Habitat for phainopepla could be created or enhanced with the establishment of more mesquite/acacia habitat, as long as that habitat also includes mistletoe, a required food source for phainopepla. Phainopepla was not recorded at the BCCE during the 2021 point-counts.
- Biologists recorded two MSHCP evaluation species at the BCCE in 2021: LeConte's thrasher and loggerhead shrike. Although breeding of LeConte's thrasher could not be confirmed within the BCCE during 2021 point-count surveys, this species is known to breed at the BCCE as several active nests were incidentally recorded in 2019 and 2020.

Aggressive efforts are likely required to restore, create, and enhance additional habitat for most of the MSHCP avian species at the County's Riparian Reserve Units. Continued monitoring of avian populations before, during, and after the restoration process is needed to document restoration success within the County's properties. Recommendations to achieve these objectives are detailed in the following section.

6.0 RECOMMENDATIONS

On the basis of observations from the 2021 avian surveys and factors discussed in this report, there are several recommendations that would support the County's long-term goals for the Riparian Reserve Units and the BCCE in Clark County:

- As directed by the *Clark County Desert Conservation Program Riparian Reserve Units Management Plan* (Clark County 2015), the County should continue to purchase parcels along the Virgin and Muddy Rivers, particularly available parcels adjacent to the existing Riparian Reserve Units (if possible), and attempt to purchase parcels along the Meadow Valley Wash.
- Tamarisk that has been killed or has suffered substantial dieback from tamarisk leaf beetles provides little benefit to avian species that require at least some degree of canopy closure for nesting. The County should begin or continue the removal of tamarisk from all its Riparian Reserve Units, particularly these dead or dying stands, provided that tamarisk removal is immediately followed by planting of native vegetation, such as willow and Fremont cottonwood (*Populus fremontii*), in suitable areas (SWCA 2017c).
- The County could plant honey and screwbean mesquite in areas of enhanced runoff that do not have the hydrological potential to support wetland facultative species like willow or cottonwood. Portions of the Riparian Reserve Units are susceptible to scouring floods, as evidenced by conditions recorded in 2019. Any restoration plan should take this into account by limiting plantings in flood-prone areas or taking steps to protect planted areas from floods. The potential to create mature habitats at these sites may be limited by the flood risk.
- Areas of native vegetation that currently provide nesting habitat for MSHCP-covered and evaluation bird species should not be disturbed during restoration and should be allowed appropriate buffers, particularly the existing willow stands in the Mesquite West, Bunkerville, and Mormon Mesa Subunits and the patches of honey and screwbean mesquite scattered throughout the County's properties.
- Because the Virgin River Riparian Reserve Unit is within designated critical habitat for the southwestern willow flycatcher, restoration plans should be designed in coordination with the USFWS.
- Cattle have been observed at all the Riparian Reserve Subunits except for Muddy River; they should be inhibited from foraging on native plantings, wherever practicable. Cattle exclusion

fencing should be erected in any area where native trees are newly planted. At parcels where fencing already exists, such as portions of Mormon Mesa and Bunkerville Parcel 2-J, the County should remove cattle from within fenced areas and make sure that all fences and gates are maintained and in proper working order. At Mormon Mesa, cattle have bypassed incomplete or ineffective fencing; maintenance of existing fencing and erection of additional perimeter fencing could prevent future breaches into the parcel.

- Avian point-counts and species-specific surveys should be continued to help build on baseline data and to track changes in avian populations throughout the land management, restoration, and post-implementation processes. These surveys should use the protocols established for this project to ensure datasets are standardized and comparable.
- Additional target-netting, along with added brown-headed cowbird trapping, concentrated during the early part of the southwestern willow flycatcher breeding season may increase the number of female brown-headed cowbirds removed from the site prior to the onset of the southwestern willow flycatcher nesting period and may result in higher southwestern willow flycatcher productivity and fecundity.

7.0 LITERATURE CITED

American Veterinary Medical Association. 2020. *Guidelines for the Euthanasia of Animals*. Rev. ed. Schaumburg, Illinois. Available at: https://www.avma.org/sites/default/files/2020-01/2020-Euthanasia-Final-1-17-20.pdf. Accessed September 2021.

Cardinal, S.N. 2005. Conservation of southwestern willow flycatchers: Home range and habitat use by an endangered passerine. Unpublished M.S. thesis, Northern Arizona University, Flagstaff.

Clark County. 2015. *Clark County Desert Conservation Program Riparian Reserve Units Management Plan*. February 2015.

———. 2019. *Clark County Desert Conservation Program Boulder City Conservation Easement Management Plan*. Version 3.4, February 2019. Available at: https://files.clarkcountynv.gov/clarknv/Environmental%20Sustainability/Desert%20Conservation/Forms%20and%20Attachments/BCCE%20Management%20Plan%20%20Version%203.4%20Final.pdf?t=1625231652552&t=1625231652552. Accessed September 2021.

———. 2000. *Final Clark County Multiple Species Habitat Conservation Plan and Environmental Impact Statement for Issuance of a Permit to Allow Incidental Take of 79 Species in Clark County, Nevada*. Prepared by RECON, San Diego, California. Las Vegas, Nevada: Clark County Department of Comprehensive Planning, and Reno, Nevada: U.S. Fish and Wildlife Service.

Bureau of Reclamation. 2004. *Brown-headed Cowbird Management Techniques Manual*. Denver, Colorado: U.S. Department of the Interior Bureau of Reclamation, Technical Service Center, Ecological Planning and Assessment.

Ehrlich, P.R., D.S. Dobkin, & D. Wheye. 1988. *The Birder's Handbook*. New York: Simon & Schuster Inc.

Floyd, T., C.S. Elphick, G. Chisholm, K. Mack, R.G. Elston, E.M. Ammon, and J.D. Boone. 2007. *Atlas of the Breeding Birds of Nevada*. Las Vegas: University of Nevada Press.

Great Basin Bird Observatory (GBBO). 2003. *Nevada Bird Count. A Habitat-Based Monitoring Program for the Breeding Birds of Nevada. Instruction Package and Protocol for Point-count Surveys*. April 2003. Available at: https://www.gbbo.org/s/Instructions2003.doc. Accessed September 2021.

———. 2010. *Nevada Comprehensive Bird Conservation Plan*, ver. 1.0. Reno, Nevada: Great Basin Bird Observatory. Available at: http://www.gbboinfo.org/secure/Whole%20Document%20PDF/NV_Bird_Conservation_Plan_ver1.0_Dec2010.pdf. Accessed September 2021.

Halterman, M.D., M.J. Johnson, J.A. Holmes, and S.A. Laymon. 2015. *A Natural History Summary and Survey Protocol for the Western Distinct Population Segment of the Yellow-billed Cuckoo*. U.S. Fish and Wildlife Techniques and Methods. Available at: https://www.fws.gov/southwest/es/Documents/R2ES/YBCU_SurveyProtocol_FINAL_DRAFT_22Apr2015.pdf. Accessed September 2021.

Hughes, J.M. 2015. Yellow-billed cuckoo (*Coccyzus americanus*). In *The Birds of North America*, edited by P.G. Rodewald. Ithaca, New York: Cornell Lab of Ornithology.

Kostecke, R.M., S.G. Summers, G.H. Eckrich, and D.A. Cimprich. 2005. Effects of brown-headed cowbird (*Molothrus ater*) removal on black-capped vireo (*Vireo atricapilla*) nest success and population growth at Fort Hood, Texas. *Ornithological Monographs* 57:28–37.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: Characteristics and threats. In *Ecology and Conservation of the Willow Flycatcher*, edited by M.K. Sogge, B.E. Kus, S.J. Sferra, and M.J. Whitfield, pp. 41–51. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Martin, T.E., and G.R. Geupel. 1993. Nest-monitoring plots: Methods for locating nests and monitoring success. *The Journal of Field Ornithology* 64:507–519.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. *Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol*. Missoula: Montana Cooperative Wildlife Research Unit, University of Montana.

McLeod, M.A. 2019. Responses of southwestern willow flycatchers to tamarisk defoliation. Paper presented at 15th Biennial Conference of Science and Management on the Colorado Plateau and Southwest Region, Flagstaff, Arizona.

McLeod, M.A., and A.R. Pellegrini. 2013. *Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2008–2012*. Submitted to Bureau of Reclamation, Boulder City, Nevada. Flagstaff, Arizona: SWCA Environmental Consultants.

———. 2014. *Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2013*. Submitted to Bureau of Reclamation, Boulder City, Nevada. Flagstaff, Arizona: SWCA Environmental Consultants.

McLeod, M.A., A.R. Pellegrini, and G. Cummins. 2018. *Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries: 2013–2017 Summary Report.* Submitted to the Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada. Flagstaff, Arizona: SWCA Environmental Consultants.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. *Banding and Population Genetics of Southwestern Willow Flycatchers in Arizona – 1997 Summary Report*. Flagstaff: U.S. Geological Survey Colorado Plateau Research Station and Northern Arizona University.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. *Handbook of Field Methods for Monitoring Landbirds*. Gen Tech. Rep. PSW-GTR-144. Albany, California: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Ralph, C.J., J.R. Sauer, and S. Droege. 1995. *Monitoring Bird Populations by Point Counts*. General Technical Report PSW-GTR-149. Albany, California: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Rothstein, S.I., B.E. Kus, M.J. Whitfield, and S.J. Sferra. 2003. Recommendations for cowbird management in recovery efforts for the southwestern willow flycatcher. In *Ecology and Conservation of the Willow Flycatcher*, edited by M.K. Sogge, B.E. Kus, S.J. Sferra, and M.J. Whitfield, pp 157–167. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. *Southwestern Willow Flycatcher Nest Monitoring Protocol*. Nongame and Endangered Wildlife Program Technical Report No. 144. Phoenix: Arizona Game and Fish Department.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. *Western Birds* 32:167–172.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. *A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher*. U.S. Geological Survey Techniques and Methods 2A-10. Available at: https://pubs.usgs.gov/tm/tm2a10/pdf/tm2a10.pdf. Accessed September 2021.

SWCA Environmental Consultants (SWCA). 2017a. *Federally Listed Bird Surveys on Three Riparian Reserve Units in Clark County, Nevada – Final Project Report.* September. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2017b. *Point-Count Surveys on Riparian Properties – Final Project Report*. September. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2017c. *Mormon Mesa Parcel Restoration – Virgin River Riparian Reserve Unit 1*. October. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2018a. *Avian Surveys on Riparian Properties – Final Project Report*. September. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2018b. *Desert Upland Baseline Bird Surveys – Final Project Report*. September. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2019a. *Avian Surveys on MSHCP Properties – Final Project Report*. September. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2019b. *Southwestern Willow Flycatcher Surveys and Monitoring in Southern Nevada – 2019*. Prepared for Animal and Plant Health Inspection Service, Riverdale, Maryland. Las Vegas, Nevada: SWCA Environmental Consultants.

———. 2020. *Avian Surveys and Nest Monitoring on MSHCP Properties – 2020 Final Project Report*. September. Prepared for Desert Conservation Program, Clark County Department of Air Quality. Las Vegas, Nevada: SWCA Environmental Consultants.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. *Western Birds* 18:137–162.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the southwestern willow flycatcher. *Federal Register* 60:10694–10715.

———. 2000. *Intra-Service Biological and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada for a Multiple Species Habitat Conservation Plan*. Available at: http://www.clarkcountynv.gov/airquality/dcp/Documents/Library/Guiding%20Docs/current/MSHCP_BioOpin.pdf. Accessed September 2019.

———. 2001. Clark County Desert Conservation Plan Permit TE-034927-0.

———. 2013a. Designation of critical habitat for southwestern willow flycatcher. *Federal Register* 78:344–534.

———. 2013b. Proposed threatened status for the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). *Federal Register* 78:61622–61666.

———. 2014a. Determination of threatened status for the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). *Federal Register* 79:59992–60038.

———. 2014b. *Species Fact Sheet. Western Yellow-billed Cuckoo*. Available at: https://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/YellowBilledCuckoo/WYBC-factsheet-southwestlearning.pdf. Accessed September 2021.

———. 2020. Endangered and threatened wildlife and plants; revised designation of critical habitat for the western distinct population segment of the yellow-billed cuckoo; proposed rule. *Federal Register* 85:11458–11594.

———. 2021. Endangered and threatened wildlife and plants; designation of critical habitat for the western distinct population segment of the yellow-billed cuckoo; final rule. *Federal Register* 86:20798–21005.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to brown-headed cowbird parasitism. M.S. thesis. California State University, Chico. 25 p.

Whitfield, M.J., K.M. Enos, and S.P. Rowe. 1999. Is brown-headed cowbird trapping effective for managing populations of the endangered southwestern willow flycatcher? *Studies in Avian Biology* 18:260–266.

APPENDIX A – CONFIDENTAL

Location Maps for Federally Listed Birds

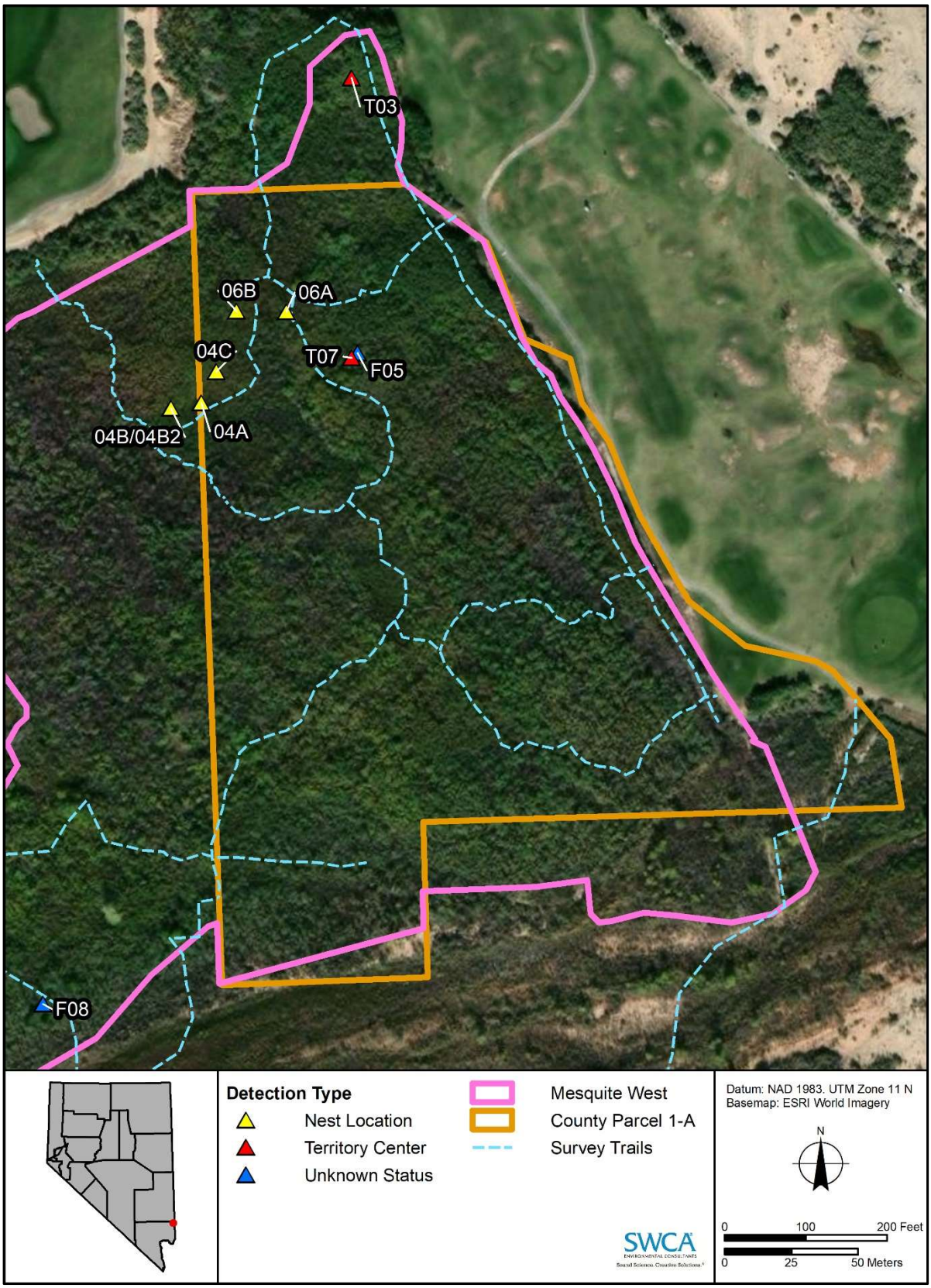

Figure A-1. Southwestern willow flycatcher territories and nests, Mesquite West Parcel 1-A, 2021.

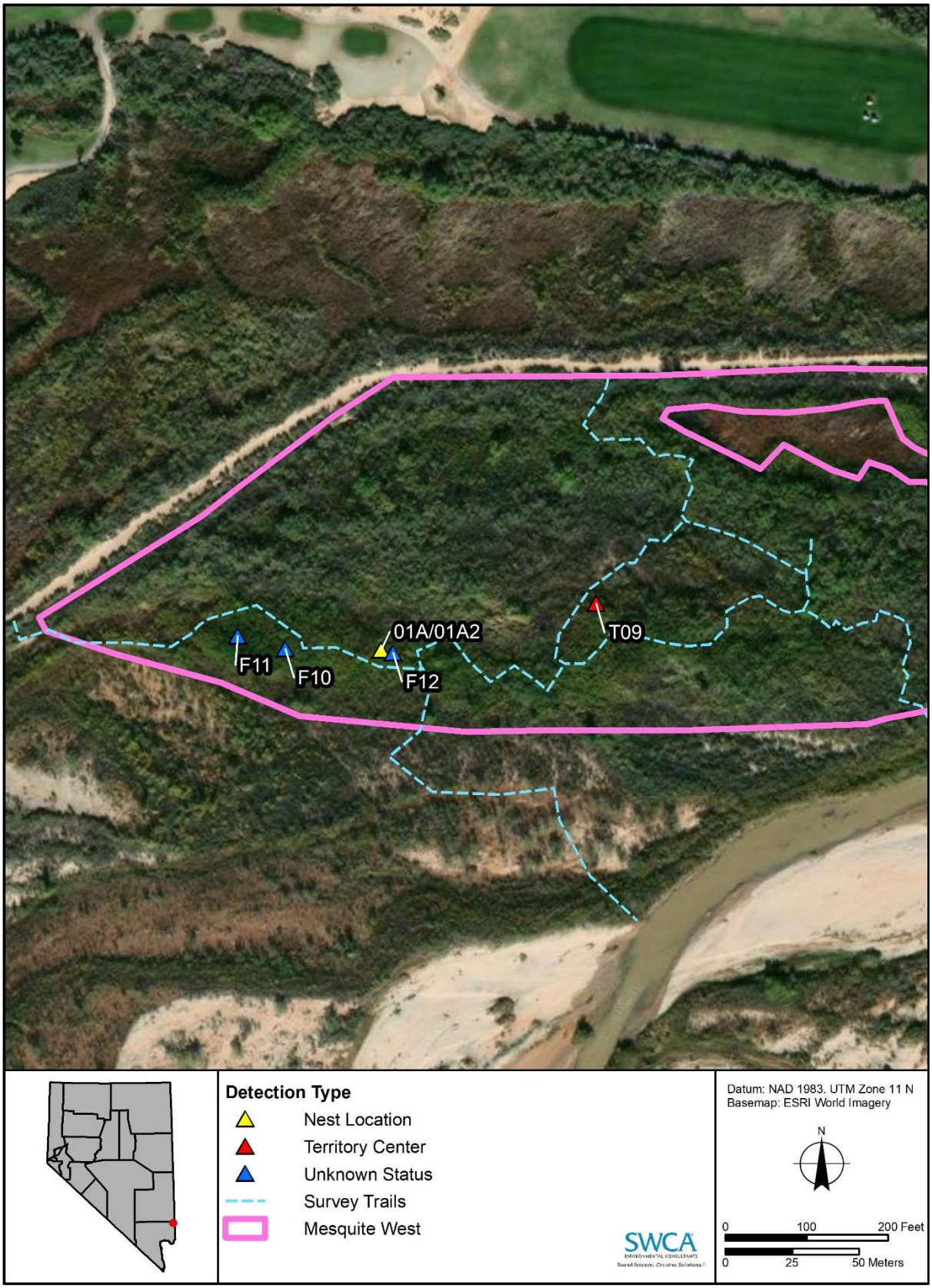

Figure A-2. Southwestern willow flycatcher territories and nests, west of Parcel 1-A, 2021.

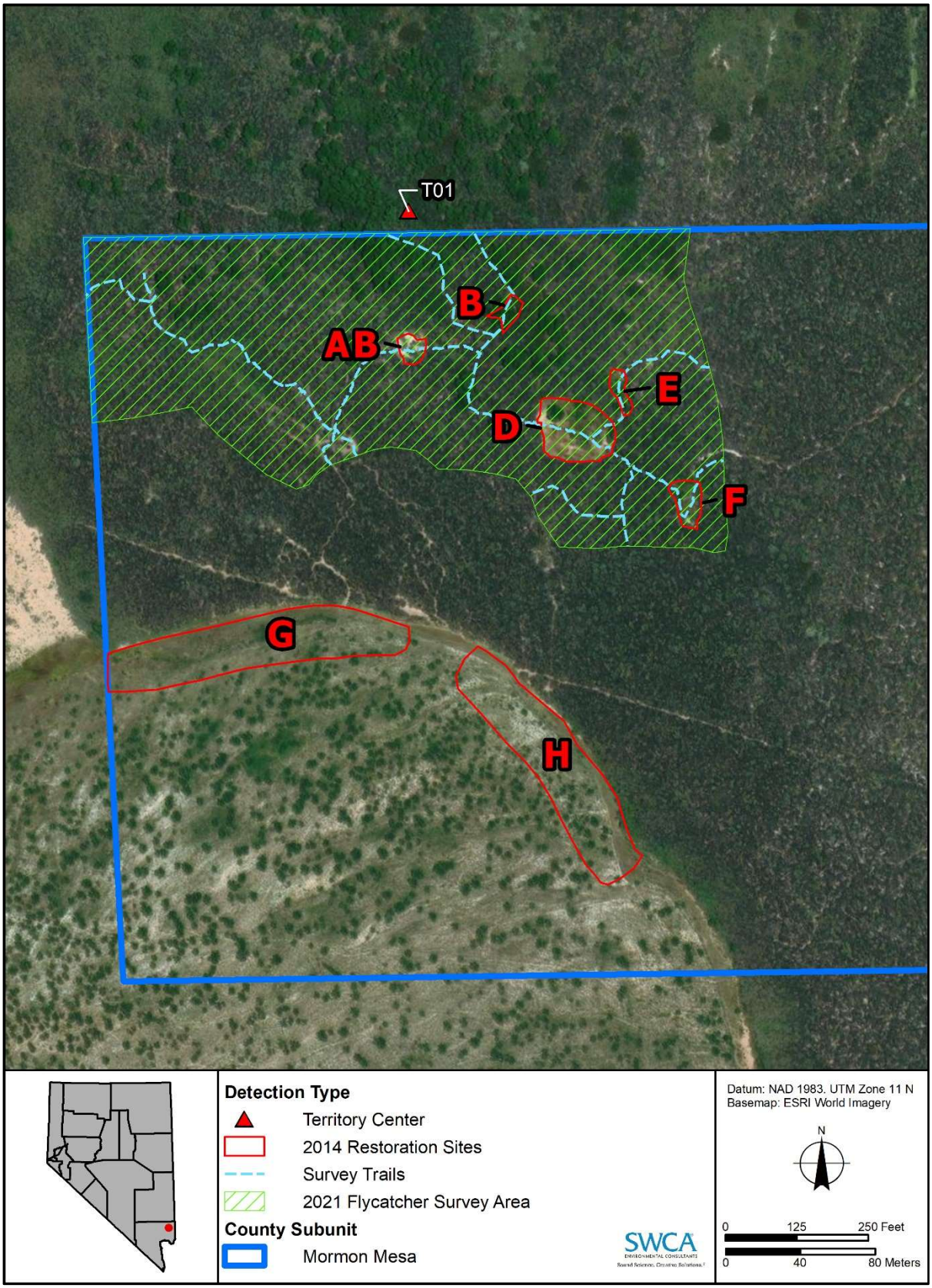

Figure A-3. Southwestern willow flycatcher territory location, Mormon Mesa Parcel 5-A, 2021.

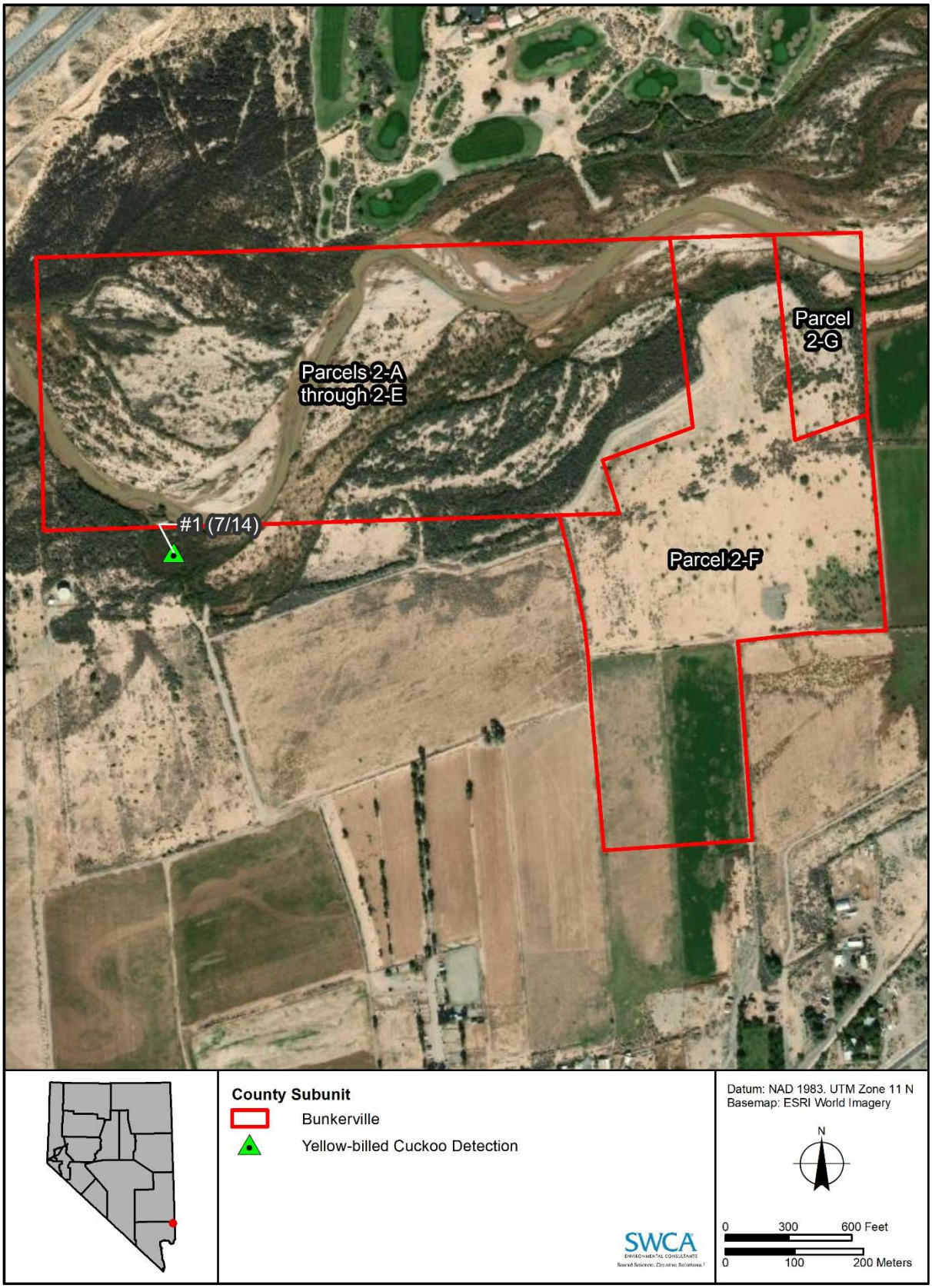

Figure A-4. Incidental yellow-billed cuckoo detection, Bunkerville Parcel 2-A through 2-E, 2021.