

Innovative Approach to the Recovery of the San Joaquin Kit Fox



Mary Gray, Parsons, Sacramento, California, United States

ABSTRACT

San Joaquin kit fox in Bakersfield, California have adapted to the urban environment where industrial and residential development have expanded and replaced native plant communities. Unlike elsewhere within their range, the kit fox in Bakersfield rely primarily on anthropogenic habitats in which natural ecological processes are nonexistent or substantially altered. Most kit fox dens in Bakersfield are earthen, but kit fox can also exploit a variety of anthropogenic structures for denning. Proposed roadway improvement projects in the city will result in temporary and permanent loss of habitats known to support the San Joaquin kit fox. To mitigate this loss, an artificial den strategy for kit fox was developed collaboratively by local, state, and federal agencies to provide long-term protection of artificial dens within the city limits in City-owned storm water ponds (i.e. storm-water drainage basins).

A. THE URBAN KIT FOX POPULATION

San Joaquin kit fox in Bakersfield have adapted to the urban environment where industrial and residential development have expanded and replaced native plant communities. Unlike elsewhere within their range, kit fox in Bakersfield rely primarily on anthropogenic habitats in which natural ecological processes are nonexistent or substantially altered. Most San Joaquin kit fox dens in Bakersfield are earthen, but kit fox can also exploit a variety of anthropogenic structures for denning. The kit fox diet in urban Bakersfield is also supplemented by anthropogenic foods such as refuse, pet food, and handouts. Behaviorally, San Joaquin kit fox in Bakersfield are also adept at avoiding vehicles and crossing roads, including busy six-lane highways. By all accounts, despite continued urbanization of remaining undeveloped land in Bakersfield, it appears that the kit fox population is stable and may even be increasing.

B. THOMAS ROAD IMPROVEMENT PROGRAM (TRIP) IMPACTS ON KIT FOX

Although San Joaquin kit fox in Bakersfield have successfully adapted thus far to an increasingly urbanized environment, proposed roadway improvement projects have the potential to adversely affect the kit fox population. Potential effects include an incremental loss and fragmentation of habitat, den loss, increased vehicular mortality, and disruption to kit fox movement.

Widening roads and developing new roads is expected to result in the incremental loss and fragmentation of kit fox habitat, which is already highly fragmented in Bakersfield. Implementing the TRIP projects will result in temporary and permanent loss of habitats known to support San Joaquin kit fox. Habitats that could be affected, which provide high value for kit foxes, include valley sink scrub, valley saltbush scrub, nonnative grasslands, and disturbed/ruderal habitat. In addition to directly removing habitat, the roadway improvements could increase barriers to kit fox movement. By reducing the connectivity of kit fox habitat and increasing habitat fragmentation, roadway expansion could reduce the probability that kit foxes could safely move from one area of suitable habitat to another in search of suitable denning and foraging habitat.

Proposed roadway improvements could result in the loss of potential and active kit fox dens. Surveys conducted in support of this analysis in 2008 documented potential and/or presumed active kit fox dens within the preliminary limits of construction for proposed TRIP projects.

Vehicle strike is the leading cause of mortality to San Joaquin kit fox in Bakersfield. Building new roads, widening existing roads, and creating new interchanges increase the potential for vehicular mortality of San Joaquin kit foxes. New road features that include exclusionary fencing or other barriers could increase the difficulty for kit foxes attempting to cross major roadways and result in increased vehicular mortality and/or disruption of kit fox movement patterns.

The cumulative loss of kit fox habitat resulting from implementation of the TRIP projects will be relatively small. The kit fox may be adversely affected by “footprint” impacts, and also by habitat fragmentation. The potential for reduced habitat connectivity associated with the build out of the TRIP roadways and infrastructure could force kit foxes to use different areas for

movement that could result in greater exposure to potential predators and risk of collisions with vehicles. Implementing the TRIP projects in combination with other future development could substantially impair north-south movement by kit foxes because most of the TRIP project alignments cross the study area in an east-west direction. For this reason, there is a proposed package of avoidance, minimization and mitigation measures

C. MITIGATION IMPLEMENTATION PLAN

The mitigation implementation plan will fully mitigate the impacts of the TRIP on kit fox. The mitigation approach involves minimizing impacts to the maximum extent practicable by:

- Participating in the Metropolitan Bakersfield Habitat Conservation Plan (MBHCP)
- Implementing an innovative *Kit Fox Urban Benefit Program* which has been developed in coordination with the *City of Bakersfield Water Resources Department*. Storm water pond locations were selected as proposed locations for creation of kit fox dens and
- Incorporating project designs with features that will minimize disruption of kit fox movement, reduce vehicular mortality, and minimize impacts on kit fox habitat.

D. CREATION OF ARTIFICIAL DENS

The creation of artificial dens offers an opportunity to provide important long-term benefits to the urban kit fox population by developing safe denning sites in Bakersfield. Kit fox are known to occupy earthen dens in storm water pond banks and artificial dens previously installed in the tops of storm water ponds.

Providing kit fox access is an essential component of the storm water pond artificial den program as well as limiting accessibility to kit fox predators. Kit foxes are able to negotiate many fence designs and fence gates by either passing directly through spaces in the fence/gate or passing under it (Cypher and Van Horn Job 2009).

Artificial dens have been successfully occupied by kit fox in at least four City-owned storm water ponds. A kit fox family group normally uses approximately two artificial dens during the pupping season. A female and pups may use one den when the pups are born but the female will usually move to a nearby den when the pups are 10–12 weeks old (Cypher, pers. comm. 2009c).

Certain activities carried out during routine storm water pond maintenance operations (including, but not limited to, operation of heavy equipment, vegetation removal, and pesticide, herbicide and rodenticide application) may pose a risk of injury or death to kit foxes using existing storm water pond sites. Therefore, this effort provides for protection assurances with respect to that risk by establishing management and maintenance procedures that are protective of kit fox use.

The artificial den component of the TRIP mitigation strategy for kit fox was developed collaboratively by TRIP, the City of Bakersfield Water Resources Department, and Dr. Cypher, USFWS and CDFG. The strategy is designed to provide long-term protection of artificial dens within the city limits in City-owned storm water ponds (i.e. storm-water drainage basins)

The enhancement measures proposed for the storm water ponds include:

- Improving accessibility,
- Installing artificial dens, and
- Minimizing impacts associated with routine maintenance.

SURVEYS AND BASELINE DATA COLLECTION

This section describes methods used to conduct field surveys and collect historic and current information on San Joaquin kit fox for this analysis. Methods were designed to gather information for the overall TRIP kit fox study area, which includes the project-specific kit fox study areas of the TRIP projects in the city of Bakersfield, described above.

1. Review of Existing Kit Fox Information

Existing data on the status and distribution of San Joaquin kit fox in metropolitan Bakersfield were used to supplement field survey data in project-specific kit fox study areas and evaluate distribution of kit foxes in the TRIP kit fox study area. Data on den locations, sightings, activity areas, vehicular mortality locations, and movement patterns were evaluated to characterize habitat types and land uses associated with kit fox locations, movement and vehicular mortality in the study area. Habitat types and land use were derived from 2006 aerial photographs of the TRIP kit fox study area.

Existing kit fox data in metropolitan Bakersfield were compiled from records in the California Natural Diversity Database (CNDDDB) (2008), Bjurlin et al. (2005), and the San Joaquin kit fox database of the MBHCP maintained by the City of Bakersfield Planning Department. These are the most recent publicly available data for kit fox locations in metropolitan Bakersfield. Vehicular mortality locations and activity areas for San Joaquin kit fox were approximated from maps and radio telemetry locations, respectively, of collared foxes, as described in Bjurlin et al. (2005).

Background research on the ecology of the San Joaquin kit fox in Bakersfield was gathered by an extensive review of the peer-reviewed literature and federal and state reports, including *Recovery Plan of Upland Species of the San Joaquin Valley, California* (USFWS 1998) and the MBHCP (City of Bakersfield and Kern County 1994), and reports developed by the Endangered Species Recovery Program (ESRP) at California State University, Stanislaus.

2. Collaboration with Resource Agencies and Kit Fox Biologists

During preparation of this report, the City frequently consulted with the USFWS and DFG, Caltrans, Dr. Brian Cypher with ESRP, and other environmental consultants with knowledge of the status and distribution of the San Joaquin kit fox in Bakersfield.

The City and Caltrans coordinated with USFWS and DFG on the approach to kit fox field surveys, potential project-specific and program-level effects of TRIP, and mitigation options for project-specific impacts. (See “Consultation History” below for information on specific consultations.)

Dr. Cypher, a kit fox specialist with ESRP, provided supplemental information about kit fox distribution, abundance, and ecology in metropolitan Bakersfield. Information was gathered regarding known kit fox locations, known and suspected areas of high kit fox concentrations, reported observations, habitat associations of kit fox in Bakersfield, suitable kit fox habitat areas, diet, den preferences, and known movement corridors. Dr. Cypher provided guidance throughout the development of field surveys, synthesis and interpretation of kit fox data for project-specific surveys, and appropriate program-level mitigation measures. Dr. Cypher also reviewed and provided comments on earlier drafts of this report.

Consultant biologists sought input from environmental consultants in Bakersfield and other individuals with knowledge of the local San Joaquin kit fox population. Marcia Wolfe of MH Wolfe and Associates provided a general assessment of the kit fox distribution in central and northeastern Bakersfield. Steven Pruett of Paul Pruett and Associates conducted field surveys with biologists and provided information on the suitability of project-specific habitat, a kit fox den evaluation, and historical accounts of kit fox movement in project-specific study areas and throughout metropolitan Bakersfield. Biologists also interviewed residents, business owners, environmental consultants under contract with the City for TRIP projects, and staff members of the City Department of Recreation and Parks for information on kit fox sightings and den locations.

3. San Joaquin Kit Fox Den Surveys

San Joaquin kit fox surveys were conducted to determine the distribution of kit fox at the project-specific level for the TRIP projects. Diurnal surveys were conducted for kit fox dens and signs (e.g., scat or tracks), an evaluation of suitable habitat, and potential locations for kit fox mitigation elements (e.g., culverts).

Project-Specific Study Areas

Project-specific kit fox study areas for each of the TRIP road improvement projects were developed. A project-specific kit fox study area is defined as the proposed road alignment and any accessible habitat within 500–1,000 feet of that alignment. Field surveys did not include residential property.

Project-Specific Survey Methods

Surveys for San Joaquin kit fox dens and signs were conducted in project-specific kit fox study areas. The road alignments were surveyed twice during two discrete survey periods to maximize the potential for biologists to detect kit fox during both denning (survey period 1—early and midsummer) and dispersal (survey period 2—late summer and early fall) seasons).

STORM WATER POND LOCATIONS

The City of Bakersfield will be responsible for implementing this program. Project funds will be set aside in an endowment managed by an Environmental Non-governmental Organization (NGO) to be selected with the help of USF&W within one year of the approval of the Final Environmental Document (FED) for the last of the TRIP projects, anticipated in 2018. The City will be responsible for installing the artificial dens and access points in the fence as well as maintenance in perpetuity of the artificial dens.

USFWS and DFG have approved the Draft Thomas Roads Improvement Program San Joaquin Kit Fox Effects Analysis, Mitigation Strategy, and Implementation Plan. USFWS and DFG also approved the Storm water pond Habitat Program and request that the City, in coordination with Caltrans, establish long term conservation assurances for the storm water ponds through covenants, a trust fund, and long-term management plan.

Accessibility to Artificial Dens

Providing kit fox access to storm water pond habitat is an essential component. Limiting accessibility to kit fox predators will provide a further benefit to the species. Kit foxes are able to negotiate many fence designs and fence gates by either passing directly through spaces in the fence/gate or passing under it (Cypher and Van Horn Job 2009). Kit foxes have been able to navigate small fence openings and some existing City-owned storm water ponds are currently occupied by kit fox.

The enhance storm water pond accessibility for kit fox by installing fence gaps at the base of storm water pond fencing. The fence gap will be a 6-square-inch design cut into the base of a chain-link fence where the fence attaches to the fence post. Gaps will be framed to cover sharp fence wires and to prevent vandalism. This fence design will permit passage by kit fox and prevent access by kit fox predators. Fence gaps will be prioritized where a storm water pond is adjacent to suitable kit fox habitat (e.g., open space or a movement corridor). A minimum of two gaps is recommended for each fence side that is adjacent to suitable kit fox habitat; for sides greater than 200 feet long, one gap every 100 feet will be created. For storm water ponds surrounded by concrete walls, the City will maintain or create gaps in storm water pond gates to allow kit fox access. A 6-square inch hole in the base of the gate itself (which is usually chain link) is one design possibility.

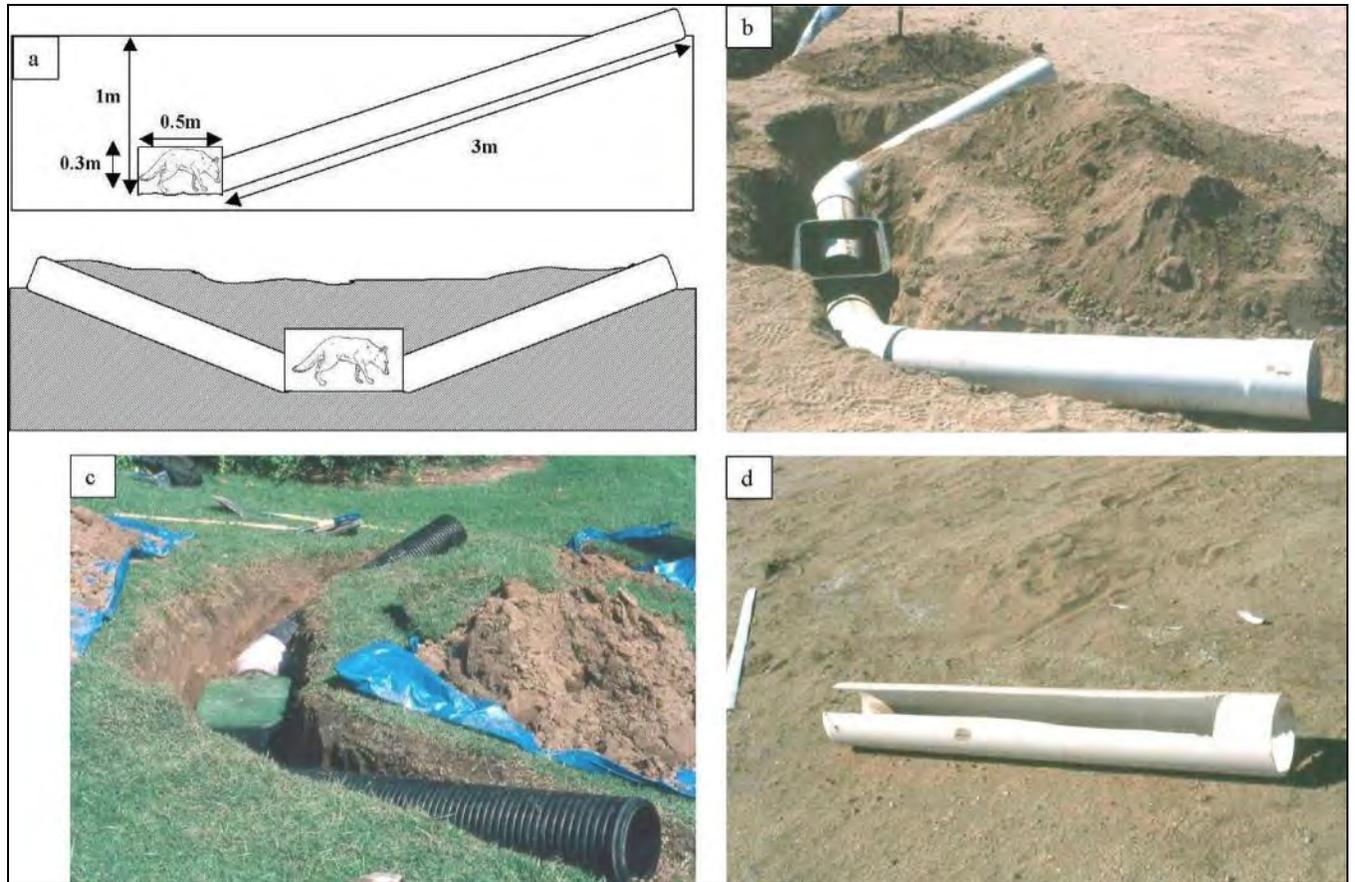
Construction of Artificial Dens

A kit fox family group will normally use approximately two dens during the pupping season, therefore two artificial dens will be installed at each of the selected storm water ponds. A female and pups may use one den when the pups are born but the female usually move to a nearby den when the pups are 10–12 weeks old (Cypher, pers. comm., 2009c).

The artificial dens consist of two pipe entrances and a chamber. Den entrances will be constructed of high-density polyethylene that is 8 inches in diameter with single-walled pipe approximately 5 feet long (Appendix D, Exhibit D-3 [c]). The two entrances will be angled in a V-shape and slope to approximately 3 feet below ground before connecting to a chamber. A piece of curved rebar could be installed in front of den entrances to discourage entry by a larger animal if storm water pond accessibility is compromised. Holes or other openings will be cut along the bottom of the entrance pipes to facilitate drainage (Appendix D, Exhibit D-3[a] and [d]). The chamber will be made from a plastic irrigation valve box (approximately 20–30 inches long, 15–20 inches wide, and 15–20 inches tall) and holes will be cut into the sides of the chambers where entrance pipes connect. The chamber will have a top cover to prevent soil from entering the den but have a bottomless design so kit fox may expand the den below.

An area around each artificial den will be designated as a kit fox conservation zone, and mechanical equipment, including vegetation removal equipment and vehicles, will be prohibited from entering the zone. The purpose of the conservation zone is to provide a buffer from disturbance for kit foxes using artificial dens, and to ensure artificial dens are not accidentally destroyed. Signs indicating the presence of a kit fox artificial den will be erected on permanent posts (e.g., T-posts) and surround an artificial den to alert maintenance crews. Artificial dens will be installed in areas that are suitable for kit fox use and also outside of access roads that are used for storm water pond maintenance (e.g., corners and terraces).

Because each storm water pond is unique, the locations and specifications for all kit fox artificial dens and boundaries of conservation zones will be developed by the City, a qualified biologist, and project engineers at the beginning of project design and before environmental review. The goal is to locate artificial dens and designate conservation zones in a manner that provides the most protection for the San Joaquin kit fox artificial dens while minimizing impacts on the City of Bakersfield Water Resources Department's ability to maintain and operate these storm water ponds. Dens will be located in suitable but unobtrusive areas, and that conservation zones will not include access roads or other areas that will require routine maintenance.



Source: Bjurlin et al. 2005

Example Designs of Artificial Subterranean Dens for San Joaquin Kit Fox in Bakersfield

- (a) Artificial Den Schematic
- (b) PVC Two-Entrance Chamber Den under Construction
- (c) High-Density Polyethylene Two-Entrance Den
- (d) PVC Tunnel with Floor Removed Longitudinally

Minimizing Impacts Associated with Routine Storm water pond Maintenance

Pre-activity surveys and standardized maintenance will be carried out in a manner to minimize disturbance to kit fox occupying storm water pond habitat.

The City of Bakersfield Water Resources Department performs routine maintenance at storm water ponds to control vegetation and maintain capacity and percolation capabilities (Richardson, pers. comm., 2009). Maintenance activities can include vegetation removal, erosion repair, pumping, and fence repairs. Depending on the needs of the storm water pond, the City

may use heavy equipment like bulldozers and excavators to remove vegetation from the sides and bottom of storm water ponds.

Recommendations have been developed for storm water pond pre-maintenance surveys and monitoring needs intended to alert storm water pond operators to kit fox resources and presence before storm water pond maintenance begins. As with maintenance recommendations, storm water pond monitoring recommendations will apply. The long term maintenance plan can be found in chapter 2 and it provides more specific details on actions that will be taken to protect the artificial dens.

MONITORING, INSPECTIONS, AND REPORTING

1. Monitoring

Description of monitoring responsibilities (and frequency):

- Pre-maintenance monitoring: The Program Manager will conduct one kit fox survey approximately two weeks prior to routine storm water pond maintenance. The Program Manager will coordinate with WRD to determine if the den should be avoided during maintenance activities.
- Maintenance monitoring: The Program Manager or trained WRD staff will be on site for up to four hours during storm water pond maintenance activities to alert crews to sensitive kit fox resources, and insure that the terms of the Management Plan are being properly implemented.

2. Inspections

The Program Manager will conduct an annual visual inspection of kit fox artificial dens and access points in the fence as well as storm water pond conditions and make recommendations to WRD staff for needed repairs to enhancements, storm water pond fencing, vegetation management, or other site maintenance activities that will enhance kit fox habitat values. It is recommended that the Manager conduct the inspection during pre-maintenance surveys. Specifically, the manager will be inspecting:

Fencing

Objective: Maintain fences and gates to provide necessary access for storm water pond maintenance and kit fox access, prevent unauthorized trespass, and exclude predators

Task: During annual inspection:

- Record condition of fences and gates, and
- Recommendations for fence and/or gate repair or replacement

Artificial Den

Objective: Maintain artificial dens – openings free of debris and vegetation

Task: During annual inspection:

- Record condition of dens, and

- Make recommendations on needed artificial den repair or replacement.

Conservation Zone and Signage

Objective: To make sure that the posts and signs are still in place

Task: during the annual inspection:

- Record the condition of the signs and the posts, and
- Make recommendations for post and sign repair or replacement, if applicable.

3. Reporting

Pre-maintenance reports:

The Program Manager will prepare an electronic letter report describing the results of pre-maintenance kit fox surveys that will be submitted to WRD supervisor and the resource agencies as required. The letter report will describe survey methods, timing of surveys, potential and known kit fox dens identified during surveys, and recommendations for vegetation management, enhancement repairs, and other site maintenance activities needed to enhance kit fox habitat values.

Maintenance reports:

The Program Manager will prepare an electronic letter report that will be submitted to WRD supervisor that describes the results of the environmental awareness training of WRD staff, maintenance activities within and outside kit fox conservation zones, and any repairs made to site conditions and kit fox enhancements.

Database maintenance:

The Program Manager will maintain a storm water pond-specific database that includes data on kit fox use of storm water ponds, results of pre-maintenance surveys and den monitoring, excavation/buffering, routine maintenance and vegetation management activities in storm water ponds, repairs or replacements of kit fox enhancements and site conditions, and dates of surveys and report submittals.

FUNDING MECHANISMS AND OTHER ASSURANCES

An endowment is being established and funded with \$1 million dollars. The annual interest earned will be used for training, maintenance, monitoring and repairs. Artificial dens were installed in Bakersfield City Storm water ponds several years ago. They are protected by existing fencing and in the past have not required extensive maintenance.

A priority for maintenance activities and repairs will be established by the program manager if, in any year, the needed work exceeds the amount of money available.

LIST OF STUDY PARTICIPANTS***City of Bakersfield***

Theodore Wright.....City Program Manager
 Luis Topete City Engineer
 Kris Budak City Engineer
 Florn CoreCity Water Director
 Mark LambertCity Water Superintendent

Parsons

Mary Gray.....Environmental Manager
 Heather Ellison.....Senior Environmental Analyst

AECOM

Stephanie Coppeto Wildlife Biologist, Project Manager
 Leo Edson Senior Wildlife Biologist
 Thomas Leeman.....Senior Wildlife Biologist

Paul Pruett and Associates

Steven PruettWildlife Biologist

Endangered Species Recovery Program, California State University, Stanislaus

Brian Cypher, Ph.D.....Research Ecologist

California Department of Transportation

Zachary Parker Biology Branch Chief
 Kirsten Helton..... Senior Environmental Planner
 Heather Baker Associate Environmental Planner/Biologist

U.S. Fish and Wildlife Service

Susan Jones San Joaquin Valley Branch Chief, Endangered Species Division
 Jennifer SchofieldWildlife Biologist

California Department of Fish and Game

Julie Vance.....Senior Environmental Scientist
 Laura Peterson-Diaz..... Environmental Scientist

BIOGRAPHICAL SKETCH

Mary Gray is a graduate of Stanford University with a Masters in Civil Engineering. For 20 years Mary worked delivering transportation projects for the U.S. DOT Federal Highway Administration (FHWA). With her unsurpassed knowledge and experience with FHWA regulations, Mary was able to deliver projects by creating innovative engineering and environmental solutions. She is now an Environmental Manager with Parsons Consulting and is responsible for completing the Endangered Species consultations, air quality conformity and QA/QC on the environmental documents for a billion road program in Bakersfield, California.

REFERENCES

Amling, Michael. Project Manager. LSA Associates Inc., Irvine, CA. May 20, 2008—telephone conversation with Stephanie Coppeto of AECOM about kit fox presence reported by residents in the 24th Street Improvement Project area.

Berry, W. H., J. H. Scrivner, T. P. O'Farrell, C. E. Harris, T. T. Kato, and P. M. McCue. 1987. *Sources and Rates of Mortality of the San Joaquin Kit Fox, Naval Petroleum Reserves #1, Kern County, CA, 1980–1986*. U.S. Department of Energy report EGG 10282–2154.

Bjurlin, C. D., B. L. Cypher, C. M. Wingert, and C. L. Van Horn Job. 2005 (July 10). *Urban Roads and the Endangered San Joaquin Kit Fox*. Final report submitted to the California Department of Transportation.

California Natural Diversity Database. 2008 (October). Results of electronic records search. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch. Sacramento, CA.

City of Bakersfield and Caltrans. 2009 (July). *Thomas Roads Improvement Program San Joaquin Kit Fox Life History, Effects Analysis, and Conceptual Mitigation Strategy*. Bakersfield and Fresno (Caltrans), CA. Prepared by AECOM (formerly EDAW), Sacramento, CA.

City of Bakersfield and Kern County. 1994 (April). *Metropolitan Bakersfield Habitat Conservation Plan*. SCH #89020264. Prepared by Metropolitan Bakersfield Habitat Conservation Plan Steering Committee. Bakersfield, CA.

CNDDDB. *See* California Natural Diversity Database.

Cypher, B. L. 2000 (December). *Effects of Roads on San Joaquin Kit Fox: A Review and Synthesis of Existing Data*. Final report submitted to the California Department of Transportation.

Cypher, Brian. Research ecologist. Endangered Species Recovery Program, California State University, Stanislaus, Bakersfield, CA. November 14, 2008—written comments provided to Stephanie Coppeto of AECOM on a working draft of the San Joaquin Kit Fox Conceptual Strategy setting section.

Cypher, B. L. Research ecologist. Endangered Species Recovery Program, California State University, Stanislaus, Bakersfield, CA. June 2, 2009a—meeting with Stephanie Coppeto of AECOM to discuss kit fox concentration areas, movement corridors, and potential mitigation for the conceptual strategy.

- Cypher, B. L. Research ecologist. Endangered Species Recovery Program, California State University, Stanislaus, Bakersfield, CA. June 3, 2009b—e-mail correspondence with Stephanie Coppeto of AECOM that included Bakersfield kit fox den and food preferences as well as reproductive and survival rates of Bakersfield kit fox as compared to nonurban kit fox.
- Cypher, B. L. Research ecologist. Endangered Species Recovery Program, California State University, Stanislaus, Bakersfield, CA. November 12, 2009c—meeting with Stephanie Coppeto, Kim Duncan, and Leo Edson of AECOM to discuss sump enhancements and maintenance recommendations.
- Cypher, B.L. Research ecologist. Endangered Species Recovery Program, California State University, Stanislaus, Bakersfield, CA. October 29, 2009d—*Kit fox use of road crossing structures*.
- Cypher, B. L. 2010. Kit foxes. Chapter in S. D. Gehrt, S. P. D. Riley, and B. L. Cypher, *Urban Carnivores: Ecology, Conflict, and Conservation*. Johns Hopkins University Press, Baltimore, MD. In press.
- Cypher, B. L., and N. Frost. 1999. Condition of San Joaquin Kit Foxes in Urban and Exurban Habitats. *Journal of Wildlife Management* 63(3):930–938.
- Cypher, B. L., and K. A. Spencer. 1998. Competitive Interactions between Coyotes and San Joaquin Kit Foxes. *Journal of Mammalogy* 79:204–214.
- Cypher, B. L., and C. L. Van Horn Job. 2009 (March). *Permeable Fence and Wall Designs That Facilitate Passage by Endangered San Joaquin Kit Foxes*. California State University, Stanislaus, and Endangered Species Recovery Program.
- Cypher, B. L., and G. D. Warrick. 1993. Use of Human-Derived Food Items by Urban Kit Foxes. *Transactions of the Western Section of the Wildlife Society* 29:34–37.
- Cypher, B. L., G. D. Warrick, M. R. M. Otten, T. P. O’Farrell, T. P. Berry, W. H. Harris, C. E. Kato, T. T. Kato, P. M. McCue, J. H. Scrivner, and B. W. Zoelick. 2000. Population Dynamics of San Joaquin Kit Foxes at the Naval Petroleum Reserves in California. *Wildlife Monographs* 145:1–43.
- Dragoo, J. W., J. R. Choate, and T. P. O’Farrell. 1987. Intrapopulation Variation in Two Samples of Arid-Land Foxes. *The Texas Journal of Science* 39:223–232.
- Federal Highways Administration. 2003. Chapter 2C, Warning Signs, including Revisions 1 and 2 in *Manual on Uniform Traffic Control Devices for Streets and Highways*. Available: <<http://mutcd.fhwa.dot.gov/>>. Accessed October 29, 2009.
- FHWA. *See* Federal Highways Administration.
- Frost, N. 2005. San Joaquin Kit Fox Home Range, Habitat Use, and Movements in Urban Bakersfield. Master of Science thesis. Humboldt State University, Arcata, CA.
- Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. *Fur-Bearing Mammals of California*. Vol. 2. University of California Press. Berkeley, CA.
- Hall, E. R. 1981. *The Mammals of North America*. Second edition. John Wiley and Sons, New York, NY.

Kern County. 2007. The Metropolitan Bakersfield Habitat Conservation Plan. Available: <<http://www.co.kern.ca.us/planning/form218.asp>>. Last updated November 16, 2007. Accessed January 31, 2009.

Koopman, M. E., J. H. Scrivner, and T. T. Kato. 1998. Patterns of Den Use by San Joaquin Kit Foxes. *Journal of Wildlife Management* 62(1):373–379.

Krebs, J. W., S. M. Iams, J. S. Smith, C. E. Rupprecht, and J. E. Childs. 2003. Rabies among Infrequently Reported Mammalian Carnivores in the United States, 1960–2000. *Journal of Wildlife Disease* 39:253–261.

MBHCP. See City of Bakersfield and Kern County.

McGrew, J. C. 1979. *Vulpes macrotis*. *Mammalian Species* 123.

Mercure, A., K. Ralls, K. P. Koepeli, and R. K. Wayne. 1993. Genetic Subdivisions among Small Canids: Mitochondrial DNA Differentiation of Swift, Kit, and Arctic Foxes. *Evolution* 47:1313–1328.

Merriam, C. H. 1902. Three New Foxes of the Kit Fox Desert Fox Groups. *Proceedings of the Biological Society of Washington* 15:73–74.

Montgomery, Rocky. Wildlife Biologist. U. S. Fish and Wildlife Service, Sacramento, CA. August 26, 2008—coordination meeting among David Clark (Parsons), Luis Topete (City of Bakersfield), Zachary Parker (Caltrans), Kirsten Helton (California Department of Transportation), Rachel Kleinfelter (California Department of Transportation), Heather Baker (California Department of Transportation), Laura Peterson-Diaz (California Department of Fish and Game), Susan Jones (U.S. Fish and Wildlife Service), Ellen McBride (U.S. Fish and Wildlife Service), Leo Edson (AECOM), and Stephanie Coppeto (AECOM) to develop initial results of San Joaquin kit fox den surveys and develop a mitigation strategy approach for the San Joaquin kit fox conceptual strategy.

Morrell, S. 1972. Life History of the San Joaquin Kit Fox. *California Fish and Game* 58:162–174.

Pruett, Steven. Wildlife biologist. Paul Pruet and Associates, Bakersfield, CA. September 30, 2008—letter report to Stephanie Coppeto and Leo Edson of AECOM, describing results of San Joaquin kit fox den surveys for Centennial Corridor.

Ralls, K., and P. J. White. 1995. Predation of San Joaquin Kit Foxes by Larger Canids. *Journal of Mammalogy* 76:723–729.

Richardson, Don. Supervisor II, Water Resources Department, City of Bakersfield, CA. December 1, 2009—email to Kim Duncan with AECOM describing sump maintenance criteria, procedures, and sump schedule for sumps included in on-site evaluation.

Spiegel, L. K., and M. Disney. 1996. Mortality Sources and Survival Rates of San Joaquin Kit Foxes in Oil-Developed and Undeveloped Lands of Southwestern Kern County, California. Pages 15–36 in L. K. Spigel (ed.), *Studies of the San Joaquin Kit Fox in Undeveloped and Oil-Developed Areas*. California Energy Commission. Sacramento, CA.

- Standley, W. G., W. H. Berry, T. P. O'Farrell, and T. T. Kato. 1992. *Mortality of San Joaquin Kit Fox (Vulpes vulpes macrotis) at Camp Roberts Army National Guard Training Site, California*. U.S. Department of Energy Report EGG 10617–2157.
- U. S. Fish and Wildlife Service. 1998. Recovery Plan for Upland Species of the San Joaquin Valley, California. Region 1. Portland, OR.
- . 1999 (June). Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or During Ground Disturbance. Sacramento Fish and Wildlife Office. Sacramento, CA.
- . 2004 (December 21). Programmatic Biological Opinion on the Effects of Minor Transportation Projects on the San Joaquin Kit Fox, Giant Kangaroo Rat, Tipton Kangaroo Rat, Blunt-nosed Leopard Lizard, California Jewelflower, San Joaquin Woolly-threads, Bakersfield Cactus, and Recommendations for the San Joaquin Antelope Squirrel. Sacramento Fish and Wildlife Office. Sacramento, CA.
- . 2008 (November 24). Table of mitigation ratios for Mohawk Street Extension Project, Bakersfield, CA. transmitted as an email attachment from Ellen McBride (Wildlife Biologist), Sacramento Fish and Wildlife Office. Sacramento, CA, to Zachary Parker (Biology Branch Chief), California Department of Transportation, California Central Region, Fresno, CA.
- . 2009 (September 24). Amended Biological Opinion for the State Route 99 Goshen to Kingsburg 6-Lane Project, Tulare and Fresno Counties (FRE/TUL-99-PM FRE R0.0/R1.0; TUL 41.3/R53.9) Sacramento Fish and Wildlife Office. Sacramento, CA.
- USFWS. *See* U.S. Fish and Wildlife Service.
- Van Horn Job, C. L., B. L. Cypher, and J. S. Storlie. 2000. *Den Site Selection by San Joaquin Kit Fox in an Urban Environment and Den Competitors*. The Western Section of the Wildlife Society. Annual Meeting 2000. Abstract.
- Warrick, G. D., and B. L. Cypher. 1999. Variation in Body Mass of San Joaquin Kit Foxes. *Journal of Mammalogy* 80:972–979.
- White, P. J., W. H. Berry, J. J. Eliason, and M. T. Hanson. 2000. Catastrophic Decrease in an Isolated Population of Kit Foxes. *Southwestern Naturalist* 45:204–211.
- White, P. J., K. Ralls, and C. A. Vanderbilt White. 1995. Overlap in Habitat and Food Use between Coyotes and San Joaquin Kit Foxes. *Southwestern Naturalist* 40:342–349.
- Wolfe, Marcia. President. MH Wolfe and Associates, Bakersfield, CA. May 28, 2008—telephone conversation with Stephanie Coppeto of AECOM about general kit fox occurrence on East Rosedale Highway in the area of the Big West Property.