Chiricahua Leopard Frog Conservation Framework

Conservation Framework

Species: Chiricahua leopard frog (*Rana chiricahuensis*)

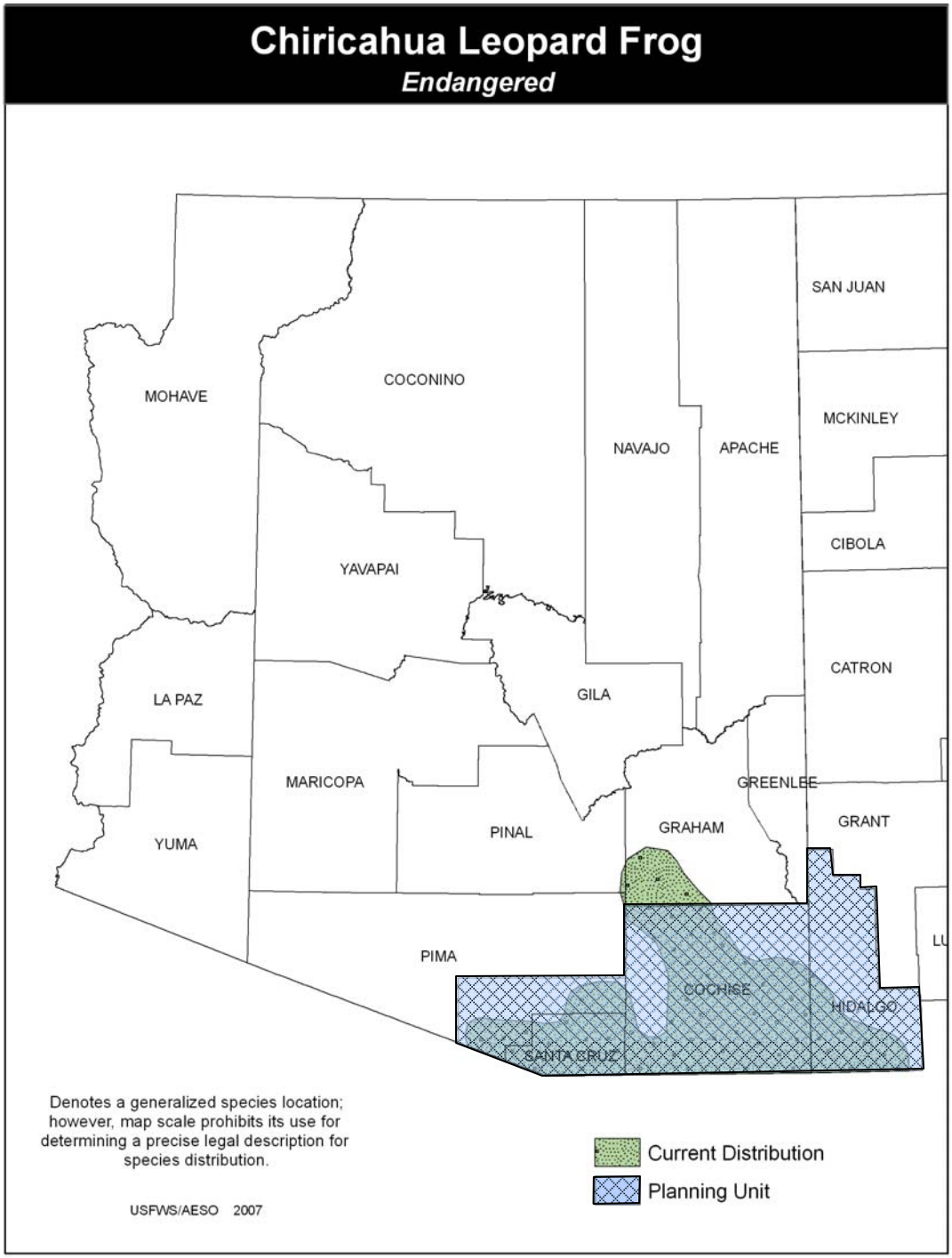
Planning Unit

The Chiricahua leopard frog (frog) was listed as a threatened species without critical habitat in 2002 (USFWS 2002a). The range of the frog includes central and southeastern Arizona, west-central and southwestern New Mexico, and northeastern Sonora and western Chihuahua, Mexico. The planning unit encompasses the natural and potentially reintroduced populations in southern Arizona in Cochise, Santa Cruz, and southern Pima counties and southern Hidalgo County in New Mexico (Map 1). The following factors were used in defining the unit.

Southern Arizona-New Mexico Planning Unit.

- *Resources available***:** This unit contains almost all of the southern populations of the frog in the U.S. (the range of the southern population extends north of Cochise County into Graham County which is not included in this planning unit), including all of three recovery units (RU 1-3) and a portion of the fourth unit in the United States. Recent genetics work indicates that these southern frogs are different from those in the populations found along the Mogollon Rim in central Arizona and west-central New Mexico. The Mogollon rim frogs may be a distinct, but closely related, undescribed species or subspecies of *Rana*. We did not include the southern frog populations in the vicinity of the Dragoon and Galiuro Mountains in Cochise and Graham counties due to the distance between those frogs and the ones in the planning unit. Some of the threats from Customs and Border Protection (CBP) actions do not likely extend that far north. Land ownership for these sites is varied and includes Federal, state, and private lands. Leopard frogs on the eastern slope of the Huachuca Mountains (e.g. Miller, Ramsey, and Brown canyons) were described as "Ramsey Canyon leopard frogs (*R. subaquavocalis*)", but have recently been found to be genetically identical to *R. chiricahuensis* in southeastern Arizona. Nonetheless, the Fish and Wildlife Service will consider these frogs not to be listed until *R. subaquavocalis* is sunk in the scientific literature and we publish a correction notice in the Federal Register recognizing those populations as *R. chiricahuensis.* The Ramsey Canyon leopard frog is protected by a conservation agreement and is subject to the same threats discussed herein for the Chiricahua leopard frog and for the purposes of this planning unit, is included with the Chiricahua leopard frog.
- *Threat sources*: A threats analysis was conducted for each recovery unit during the preparation of the recovery plan (USFWS 2007). Threats fell into the following categories: 1) extraordinary predation, 2) infectious disease, 3) aquatic habitat degradation, 4) aquatic patch loss, 5) contaminants, and 6) reduced connectivity. Across all four recovery units, extraordinary predation, due to non-

Map 1


Chiricahua Leopard Frog
Endangered
SAN JUAN
MOHAVE
COCONINO
MCKINLEY
NAVAJO
APACHE
CIBOLA
YAVAPAI
CATRON
LA PAZ
GILA
MARICOPA
GREENLEE
GRANT
YUMA
PINAL
GRAHAM
PIMA
COCHISE
HIDALGO
SANTA CRUZ
Denotes a generalized species location; however, map scale prohibits its use for determining a precise legal description for species distribution.
USFWS/AESO 2007
Current Distribution
Planning Unit

native predators such as bullfrogs, crayfish, barred tiger salamanders, and various fishes, was consistently a very important threat. The effects of a virulent, probably introduced fungal skin disease (chytridomycosis caused by the pathogen *Batrachytrium dendrobatidis* or "Bd"), as well as catastrophic fire, drought, and hydrological alterations were also important. Contaminants from copper smelters, smuggling and illegal immigration combined with law enforcement response, stock tank mismanagement, development, and groundwater pumping were additional threats. Historically, heavy livestock grazing likely caused much loss of wetlands and frog populations. Although much better managed now, grazing still contributes to habitat degradation, but the species can coexist under a variety of current grazing regimes. Catastrophic fire causes erosion and sedimentation of canyon and stream habitats of the frog, and can convey toxic ash and other substances into the aquatic habitat.

- *Threat levels*: Presence and spread of non-native predators are widespread and preclude management for frogs in many areas. Continued spread of some species, particularly crayfish, which is not yet widely distributed, could further complicate recovery. Chytridomycosis occurs in RUs 1-3 (it has not been documented in RU 4 frogs) and appears to eliminate populations in some areas, but not others. Ground disturbing activities continue to occur across the planning unit. There is considerable management of these activities on some Federal and private lands. At potential reintroduction sites, pre-introduction management plans provide for the protection of the sites. Threats are at high levels.
- *Management options*: Options to protect and manage the frog rely primarily on conservation on Coronado National Forest (CNF) lands, which contain the greatest number of populations and recovery potential. Additional opportunities exist on Bureau of Land Management (BLM), Fish and Wildlife Service (San Bernardino National Wildlife Refuge, Buenos Aires NWR), Fort Huachuca, State lands, and private lands. Section 7 consultations under the Endangered Species Act, Habitat Conservation Planning, and Safe Harbor Agreements for non-Federal landowners are all tools that can be used to recover this species. There is a range-wide Safe Harbor Agreement with Arizona Game and Fish Department (AGFD) (AGFD and USFWS 2006) and one with the Malpai Borderlands Group (MBG and USFWS 2004) that provide opportunities for reintroduction and management of the frog on non-Federal lands in the planning unit. Because of the opportunities for reintroduction, the specific locations occupied by the frog may change over the short and long-term.

Threats Analysis

Stressor Profile

The frog is a resident of cienegas, pools, livestock tanks, and streams at elevations of 3,281 to 8,890 feet (USFWS 2002a, 2007). Within the planning unit, most populations are in small streams, cienega complexes, and livestock tanks. The species has been eliminated, presumably by non-native predators, from larger streams, most valley bottom cienegas, reservoirs, and rivers. Remaining habitats are small and subject to drying

during drought, or loss from project activities or disease. Loss of aquatic habitats has considerably reduced numbers of frog populations, and caused extensive fragmentation and isolation of habitats that disrupts metapopulation dynamics. In addition, the fungal disease chytridiomycosis that has been linked to declines in amphibian populations around the world has been found in RUs 1-3 and is involved in several local frog population die-offs (USFWS 2007). Populations in RU 1 appear to persist with the disease better than in the other recovery units. Active management is needed to address these issues.

More complete information on the threats to the species is found in the listing package (USFWS 2002a), final recovery plan (USFWS 2007), the Safe Harbor Agreements (AGFD and USFWS 2006, MBG and USFWS 2004) and recent biological opinions for land management activities (USFWS 2002b, 2005). Information from these documents is herein incorporated by reference.

The following categories of common stressors are used in the Threats Analysis Table for the Southern Arizona/New Mexico planning unit. The stressors are not exhaustive and many also occur throughout the range of the frog.

Habitat loss

Stressors under this category focus on the aquatic patch loss threat identified in the recovery plan. The frog was well adapted to harsh physical conditions that were common in the aquatic habitats of the planning unit, including high temperatures and changing water availability due to droughts. Historically, the larger habitats that were available were of higher quality for the frog due to greater stability of conditions. The smaller areas available now are less stable (for example, more likely to dry up) and are less suitable.

Sources of habitat loss include drought, water development projects, and changes in land use.

Direct (physical) loss

Direct loss of aquatic habitats has affected the distribution of the frog, and the ability of metapopulations to function. Aquatic habitats are physically lost due to surface water diversion, groundwater pumping, or filling of wetlands. Artificial aquatic habitats such as stock tanks can replace natural ones lost at the site but doing so may interfere with normal runoff reaching downstream habitat areas. Stock tanks are now important habitats for the frog, but the maintenance of these structures depends on continuing livestock management actions. Once a habitat area is physically lost, regaining it is unlikely.

Drought

Drought has become an especially important factor in habitat loss. The small habitats remaining for the frog are susceptible to drying during drought events and unless there is a nearby aquatic area that the frogs can reach, the population will be lost with the habitat. Re-colonization of habitats post-drought is hampered by fragmentation of the remaining habitats and subsequent loss of metapopulation structure. The drought-resistant habitats (e.g. rivers, perennial streams, valley bottom cienegas, and lakes), which historically supported the largest and most robust frog populations, and were source populations for smaller, nearby aquatic sites, are all overrun by non-native predators and are no longer suitable habitats for the frog.

Physical habitat degradation

Stressors under this category focus on the aquatic habitat degradation and contaminants threats identified in the recovery plan. For any particular habitat site, degradation may involve one or more of the following stressors. The amount of degradation at any particular site will also vary, and it is unclear at what point the level of degradation becomes significant enough that the frog can no longer live in the habitat. Degradation in the habitat may also affect the ability of the individual frogs to respond to other stressors such as disease. Because the smaller habitats may already be of reduced quality, frogs there are already under habitat-related stress that can exacerbate the effects of additional degradation.

Sources of habitat degradation include poor land management practices on the watershed, invasive plants on the watershed that contribute to increased fire risk, and human activities in and around the habitats. The latter includes actions taken by the U.S. Border Patrol to secure the Southerly International Boundary.

Sedimentation

The quality of the small aquatic habitats occupied by the frog is governed in part by the conditions of the watershed. Sediment inflows increase as watershed conditions decline due to poor range management which removes significant amounts of plant cover, poorly designed roads that are subject to erosion during precipitation events, and the results of wildfire. Appropriate levels of high water flows are also important to maintaining sediment movement out of the system in streams. High flows may not provide the same benefit to cienegas and stock tanks unless there is an outflow. Where water ponds and is not moved through, sediment is deposited and can fill in a shallow habitat. While some sediments in the habitat are necessary for plant growth, excessive sediment inflows can bury frog eggs as well as the invertebrates on which the adults feed. The balance between watershed conditions, runoff flows and sediment transport is complex, especially when excess sediment is being introduced to the system through runoff on degraded watershed conditions.

Water quality

Maintenance of suitable water quality in the habitat is a factor of both the size and configuration of the habitat, and land management practices. In very small habitats with limited water recharge and lack of complex structure to provide refuges, high summer temperatures may exceed frog tolerance. After a wildfire, ash flows that alter pH may be introduced into the habitats. Livestock use of the streams also introduces fecal material that contaminates the water. Water quality may directly affect various life stages differently, and may also affect the prey base of the adult frogs. Water quality may also be adversely affected by people using the habitat for off-road vehicle travel, water-based recreation, and trash disposal. These can be recreationists or undocumented aliens (UDAs) crossing the border from Mexico.

Contaminants

Contaminants include potentially toxic substances introduced into the aquatic habitats. This introduction can come directly, as from vehicles running through or adjacent to the habitat or persons deliberately depositing oils or other substances into the water, or indirectly as from airborne sources (including fire retardants dropped from aircraft) or deposition of toxic wastes and pesticides (including herbicides) on the watershed that are then carried into the habitat by runoff. Historically, airborne contaminants from copper smelters were likely a factor in population loss; however, all smelters in the unit and nearby have been closed since 1999 and contaminants associated with those smelters are probably less of a threat now. Direct introduction and watershed introduction remain potentially significant. The extent of the adverse effect of the contamination will vary with the toxicity, amount of material introduced, and the frequency of the introductions. Disposal of trash by humans using the area at and around the habitat is also a source of contaminants as well as an issue for water quality. These can be recreationists or undocumented aliens (UDAs) crossing the border from Mexico.

Biological habitat degradation

Stressors under this category focus on the extraordinary predation and infectious disease threats identified in the recovery plan. The suite of competitors and predators historically present has been significantly altered. Disease sources may have come with the introduction of non-native species, or via other transmission routes. The presence of these stressors can render otherwise suitable habitats unavailable for the frog.

Sources of biological habitat degradation include fish and wildlife management actions (purposeful and accidental introductions), and inadvertent transfer by other human activities including bucketing of water for fire suppression, transmission via vehicles or water transfers between aquatic sites. The latter may include actions taken by the U.S. Border Patrol to secure the Southerly International Boundary.

Predation

Non-native animal species including crayfish, bullfrogs, and predatory fish (e.g. bass, sunfishes, and catfish) introduced into the planning unit have had significant adverse effects on the frog. Predation occurs on all life stages and can be significant enough to eliminate frogs from the habitat. In the larger remaining suitable habitats, conditions are such that these non-natives flourish and occupancy by frogs is precluded. In the smaller, shallower habitats, conditions are less suitable for non-native bullfrogs and fish due to the higher probability of habitat drying and marginal breeding habitat. Such conditions do not affect crayfish to the same extent, and they can often persist where bullfrogs and fishes cannot. If there are suitable non-native habitats within the immediate watershed of the particular frog site, reinvasion after seasonal high flows or floods that reconnect the habitats can occur. During wet springs and the summer monsoon period, bullfrogs and crayfish are capable of moving overland or through ephemeral drainages for several miles to colonize aquatic habitats.

Disease

The spread of the pathogenic chytridiomycete fungus has had significant adverse effects to the remaining frog populations. Chytridomycosis may have been introduced to Arizona via African clawed frogs imported for human pregnancy testing. Once on the landscape, the disease was probably spread by bullfrogs, leopard frogs, tiger salamanders, and potentially other animals. People can also spread the disease by moving infected animals, water, or mud across the landscape. Numerous frog populations in RUs 1-3 are known to be infected with this disease. Population declines associated with the disease have been noted in the Pajarito, Santa Rita, and Huachuca Mountains, Las Cienegas, and San Bernardino National Wildlife Refuge. Infection does not automatically lead to the death of the entire population, as some populations have persisted successfully with the fungus for more than 30 years. However, infection is an additional stressor that affects the ability of the individual or population to cope with degradation of habitat, predation, competition, or environmental contamination. Native or introduced frogs and salamanders traveling between breeding sites can spread this disease, which has the potential to wipe out the local frog populations. The effects of the disease on individuals and populations are probably exacerbated by a variety of stressors, such as cold weather, pesticides and other contaminants, and UV-B radiation.

Disruption of movement and dispersal

Stressors under this category focus on the reduced connectivity threat identified in the recovery plan. Clearly, habitat loss and degradation are the operative stressors that govern the resultant reduction in connectivity between habitats. This reduction in connectivity has disrupted metapopulation dynamics that may have functioned in local (with a five mile radius of a site) habitat clusters. Because the small habitats currently occupied by frogs can be very dynamic (in terms of stability and longevity), the increased isolation of these habitats limits the opportunity for frogs to find alternative sites or recolonize the affected site after an extirpation event. Additionally, adult frogs move

outside the aquatic portion of their habitats seasonally and can be affected by land use activities within the zone they occupy.

Sources of disruption of movement and dispersal include drought, water development projects, and changes in land use. The latter may include actions taken by the U.S. Border Patrol to secure the Southerly International Boundary, such as pedestrian barriers.

Fragmentation

The end result of habitat loss and degradation is the fragmentation of once connected habitats within a local area. With fewer available sites, and likely greater distances between sites, it is likely more difficult for frogs to move among remaining habitats and maintain any metapopulation structure. Frogs in habitats that are becoming unsuitable may not be able to move to a more secure habitat. Fragmentation cannot be undone without restoration of habitats that were lost or degraded.

Barriers

Human activities may have placed barriers between the remaining habitats that impede frog movements. Placement of roads between sites may increase mortality of frogs moving between sites. Buildings and structures, particularly "solid" fences, may have a similar barrier effect and reduce movements. There may be increases in mortality of adult frogs due to barriers.

Responses to Stressors

Frogs respond to stressors at both the individual and population level. The response to a particular stressor may range from no reaction to physical injury, to death. Stressors may act in concert in their effects on individual frogs such that the addition of a new stressor may intensify the level of effects from existing stressors to the extent that a more severe response occurs.

Debilitation

Debilitation is the condition where the physical condition of the individual frog declines due to increased water temperature, reduced forage base, competition for resources with non-native fish or amphibian species, contamination of the habitats, and similar resource challenges. A decrease in growth rate, reproductive potential and susceptibility to disease or parasites are also components of debilitation. Eggs laid by frogs in debilitated condition may be less viable, or the larvae have reduced nutritional resources that affect their survival. Disturbances that can cause injury, such as vehicles driving through a stream or human entry into the water also lead to debilitation. The presence of contaminants may also affect the overall health of the individual frogs as well as their ability to remain in the habitat during high flows. A weakened frog may not be able to hold in place during floods and be removed from the habitat. Displacement itself may not

be fatal; however, the isolated nature of the remaining frog habitat does present the risk of displacement to areas normally dry.

Recruitment

Beyond the production of viable eggs by healthy adult frogs, the physical and biological habitat conditions must be suitable for hatching and survival of tadpoles and metamorphosis to the adult stage. This requires suitable vegetation stands for attachment of egg masses, and shallow, marshy pools with abundant algae for tadpoles. Excessive sedimentation can bury egg masses and fill in the shallow pools. A lack of vegetation cover can also result in high water temperatures not suitable for egg hatching. Non-native fish and amphibians in the habitat also prey on eggs and tadpoles. Populations of frogs do not persist in habitats with significant populations of non-native species.

Mortality

Destruction or elimination of habitats is likely to result in mortality of frogs in the habitat that are killed and those that escape but are unable to find another habitat before dying. Frogs may also be adversely affected by actions that take place in or adjacent to their aquatic habitat. Use of the area by recreationists or UDAs, vehicle use, illegal border crossers, and livestock not only degrades the habitat conditions, but can result in death or injury to individuals. Use of vehicles in the water or trampling by humans or cattle in the shallow stream margins can kill eggs and tadpoles. Livestock drinking from isolated pools may directly ingest eggs and tadpoles and reduce the amount of water to support the frog through the dry periods. Human use of pools also reduces the amount of water available, and contamination of the water by improper trash disposal, leaks of petroleum products and other toxic materials into the water contributes to potential mortality.

Threats Analysis Table

These stressors, sources, and responses are summarized and rated in the threats analysis table on the following pages. Information on how these factors affect the available resources, conservation needs, and species demographics are derived.

Threats Analysis Table

Species: Chiricahua Leopard Frog				**Planning Unit: Southern Arizona-New Mexico**			**page 1**
Action	**Sub-action**	**Stressor**	**Response**	**Resource Affected**	**Demographic Consequence**	**Conservation Need**	**Management Options**
Water development	Surface depletions	Direct loss Fragmentation	Mortality	Habitat Metapopulation Individuals	Numbers Distribution	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Impoundments that dry up streams and cienegas[1]	Direct loss Water quality Fragmentation Predation Disease	Debilitation Recruitment Mortality	Habitat Metapopulation Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Groundwater depletions	Direct loss Fragmentation	Mortality	Habitat Metapopulation Individuals	Numbers Distribution	Breeding Feeding Sheltering	Avoid, minimize, mitigate
Livestock management	Vegetation removal	Sedimentation	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Increased fire risk due to non-native plants	Sedimentation Water quality	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate

[1] The creation of stock tanks for livestock use has replaced natural habitats available for the frog and is thus beneficial. Maintenance of the stock tanks is essential to the continued habitat value for the frog.

Species: Chiricahua Leopard Frog				**Planning Unit: Southern Arizona-New Mexico**			**page 2**
Action	**Sub-action**	**Stressor**	**Response**	**Resource Affected**	**Demographic Consequence**	**Conservation Need**	**Management Options**
Livestock management con't	Roads and fences	Sedimentation Water quality Barriers	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Use of stock tanks	Water quality Disease	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
Facilities development and maintenance	Roads and trails	Sedimentation Water quality Contaminants Barriers	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Structures	Contaminants Barriers	Debilitation Mortality	Habitat Individuals	Numbers Distribution	Feeding Sheltering	Avoid, minimize, mitigate
	Drain and fill wetlands	Direct loss Fragmentation	Mortality	Habitat Metapopulation Individuals	Numbers Distribution	Sheltering	Avoid, minimize, mitigate
Human activities	Non-native species introduction	Predation Disease	Debilitation Mortality	Habitat Individuals	Numbers Distribution	Feeding Sheltering	Avoid, minimize, mitigate
	Off-road vehicle use	Sedimentation Water quality Contaminants Disease	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate

Species: Chiricahua Leopard Frog				**Planning Unit: Southern Arizona-New Mexico**			**page 3**
Action	**Sub-action**	**Stressor**	**Response**	**Resource Affected**	**Demographic Consequence**	**Conservation Need**	**Management Options**
Human activities con't	Use of aquatic habitats	Water quality Contaminants Disease	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Trash and contaminant dumping	Water quality Contaminants	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
CBP activities	Road construction	Sedimentation Water quality Contaminants Barriers	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Road use	Sedimentation	Debilitation Mortality	Habitat Individuals	Numbers Distribution	Feeding Sheltering	Avoid, minimize, mitigate
	Patrol (off-road)	Sedimentation Water Quality	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate
	Facilities construction (fences, staging areas etc.)	Direct loss Sedimentation Water quality Barriers	Debilitation Recruitment Mortality	Habitat Metapopulation Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate

Species: Chiricahua Leopard Frog				**Planning Unit: Southern Arizona-New Mexico**			**page 4**
Action	**Sub-action**	**Stressor**	**Response**	**Resource Affected**	**Demographic Consequence**	**Conservation Need**	**Management Options**
Catastrophic events	Drought	Direct loss	Mortality	Habitat Metapopulation Individuals	Numbers Distribution	Sheltering	Avoid, minimize, mitigate
	Wildfire	Sedimentation Contaminants	Debilitation Recruitment Mortality	Habitat Individuals	Numbers Distribution Reproduction	Breeding Feeding Sheltering	Avoid, minimize, mitigate

Conservation Objectives for the Chiricahua Leopard Frog: Southern Arizona/New Mexico Planning Unit

Conservation need: Breeding

Conservation goal: To maintain or improve suitable physical and biological habitat conditions and individuals necessary to provide for successful breeding and recruitment of young frogs to the populations.

Conservation objectives:

- To prevent loss of breeding habitat, avoid, minimize, or mitigate for loss or degradation of physical and biological conditions in natural or constructed aquatic habitats that would reduce or eliminate the ability of frogs to successfully produce viable young.
- To prevent loss of breeding individuals, avoid, minimize, or mitigate for activities in or around aquatic habitats supporting the frogs that result in mortality of adult frogs.
- To prevent loss of eggs, tadpoles, or young adult individuals, avoid, minimize, or mitigate for activities in or around aquatic habitats supporting the frogs that result in mortality of these life stages.

Conservation need: Feeding

Conservation goal: To maintain or improve suitable physical habitat conditions in the aquatic habitats that support the maintenance of adult and tadpole forage bases.

Conservation objectives:

- To prevent the loss of feeding habitat, avoid, minimize, and mitigate for land use activities that adversely affect the physical conditions in the aquatic habitat that support the invertebrate and algal forage bases for the frog and its tadpoles.

Conservation need: Sheltering

Conservation goal: To maintain or improve the physical biological conditions in the aquatic habitat of the frog.

Conservation objectives:

- To prevent the loss of sheltering habitat, avoid, minimize, and mitigate for direct loss of aquatic habitats.
- To prevent the reduction in the number of habitats available to the frogs for sheltering, avoid, minimize, and mitigate for the introduction of non-native animals that are predators or competitors of the frog.

- To prevent degradation of aquatic habitat, avoid, minimize, and mitigate for land use activities in and around the habitat that have adverse effects to physical conditions that support populations of the frog.
- To prevent loss of access to sheltering habitat, avoid, minimize, or mitigate for the effects of land use that fragment habitats or create barriers to movements among habitats.

Best Management Practices

Best Management Practices (BMPs) are recommended measures that if implemented as part of the proposed action, would, to the extent practicable, avoid, minimize, and mitigate for adverse effects of that proposed action on the frog. However, even with these BMPs in place, there may be adverse effects related to incidental take that may remain and require initiation of formal consultation. The inclusion of BMPs into the project proposal would streamline any formal consultation that might still be required.

Construction and Maintenance Actions

Project Planning/Documentation

- During early development of a proposed action, contacts with the landowning agencies (Coronado National Forest, Bureau of Land Management, Ft. Huachuca, Fish and Wildlife Service, state, and private lands) should be made to identify particular resource issues for this species at occupied or potentially occupied sites on those lands.
- Coordination with Federal and state agencies having regulatory authority over on-the-ground activities, such as the U.S. Army Corps of Engineers-Regulatory Division, and Arizona Department of Environmental Quality should be initiated as appropriate.
- Arizona Game and Fish Department (AGFD) and New Mexico Department of Game and Fish (NMDGF) have responsibilities to address effects to native fish and wildlife, including T&E species, and should be a partner in planning activities consistent with the MOA between Arizona Ecological Services Office (AESO) of the FWS and AGFD or the MOA between New Mexico Ecological Service Field Office (NMESFO) and NMDGF.
- For linear projects such as fences, roads, surveillance sites, and related patrol operations where occupied frog habitat is within five miles of the project boundaries, the project area should extend as far as those sites to provide for analysis of change in UDA traffic patterns. Potential UDA travel ways within that extended area that could result in increased UDA travel through the Complex should be identified. Measures, including increased CBP protection or patrols in that area to deter UDA use should be developed and implemented.
- Pre-construction surveys for the Chiricahua leopard frog may be required for aquatic habitats within the area potentially disturbed by construction or off-site effects of construction. Protective measures may need to be in place before construction begins.
- All personnel involved with the on-the-ground construction or maintenance for the proposed action will receive training in the species, the agreed upon BMPs, and the role of the construction monitor.
- During construction or maintenance activities in or within the connected watershed of the frog habitat, a construction monitor with authority to halt construction at any time the appropriate BMPs are not being properly implemented as agreed to will be present on site.

- Roads should be designed to appropriate standards based on the site conditions, landowner/manager requirements, and type of use.
- If new routes, or maintenance or improvement of existing routes would facilitate public or UDA movement towards or access to suitable breeding sites and such facilitation cannot be avoided, such routes should be closed to the public and signs should be posted at nearby suitable breeding sites with pertinent regulations that protect the frog. Route closures and signs would need to be negotiated with land owners/managers.
- In planning for roads, fences, and other facilities that would require land clearing in any watershed containing frog habitats, the minimum amount of vegetation should be cleared, and measures to control erosion off the construction site put into place. Roads, fences, and other facilities that would require land clearing, should be designed to avoid areas within 0.3 mile of frog habitats.
- If facilities must be located within 0.3 mile of frog habitat, the facility should be placed as near the outer edge of the area with as little ground disturbance as possible, vegetation clearing should be limited, and erosion control measures put in place to reduce sediment runoff. It may be prudent to construct frog fencing along new roads, use biological monitors, and implement construction worker education programs (see Appendix I of the recovery plan) (USFWS 2007). Monitoring of effects to the frog's terrestrial and aquatic habitat may be required. Disease prevention protocols should be employed if the project is in areas known or likely to harbor chytridiomycosis (consult with FWS to identify these areas). In such cases, if vehicles/equipment use will occur in more than one frog habitat, ensure that all equipment is clean and dry or disinfected before it moves to another habitat (see Appendix G of the recovery plan for protocols) (USFWS 2007).
- Removal of riparian vegetation within 100 feet of aquatic habitats should be avoided to provide a buffer area to protect the habitat from sedimentation.
- All new roads should be designed to minimize the risk of erosion or adverse effects to aquatic habitats of the frog. Routes that cross seasonally or perennially flowing streams should be avoided. If not avoidable, crossings should be designed to minimize effects to streams through use of culverts or other design features that protect natural substrates and flows. New routes or improvement of routes leading to or near stock tanks that provide suitable breeding habitat for frogs should be avoided, or they should be closed for administrative use only.
- In planning for site access, use of existing roads and trails should be maximized, and stream crossings should be avoided. New trails should avoid the area around stock tanks that provide suitable breeding habitat for frogs and cienegas to reduce damage to areas surrounding the habitat. Educational briefing materials on the presence of the species should be provided as part of training. Maps may be helpful for this purpose.

During Construction/Maintenance

- The perimeter of all areas to be disturbed during construction or maintenance activities should be clearly demarcated using flagging or temporary construction fence, and no disturbance outside that perimeter should be authorized.
- The area to be disturbed should be minimized through scheduling materials deliveries and equipment on site to only those needed for effective project implementation.
- Materials such as gravel should be obtained from existing developed or previously used sources, not from undisturbed areas adjacent to the project area.
- All access routes into and out of the project disturbance area should be flagged, and no travel outside of those boundaries should be authorized.
- If new access is needed or existing access requires improvement to be usable for the project, roads should be constructed to accepted standards.
- To the extent possible, areas already disturbed by past activities or those that will be used later in the construction period should be used for staging, parking, and equipment storage.
- Within the designated disturbance area, grading or topsoil removal should be limited to areas where this activity is needed to provide the ground conditions needed for construction or maintenance activities. Minimizing disturbance to soils will enhance the ability to restore the disturbed area after the project is complete.
- Any vegetation removal outside the project area should be minimized, and vegetation should only be removed using hand tools or controlled by mowing. If root systems remain intact, many plants will resprout from the base. In accordance with Arizona Native Plant laws, native trees, cacti, and significant shrubs in the construction area should be salvaged for replanting.
- For placement of in-ground monitoring or sensor arrays, ground disturbance should be limited as much as practicable to existing disturbed areas. Use of hand tools or small trenchers to dig placement sites is preferred. Vegetation removal should be minimized.
- If construction or maintenance projects cannot avoid working in aquatic sites that provide suitable breeding habitat for the frog, then to prevent spread of disease, equipment and vehicles should be disinfected or allowed to dry thoroughly before such equipment is moved to another wetland site.
- Any use or storage of chemicals or fuels at construction sites or staging areas should be kept well away from suitable frog sites. No storage of such chemicals or fuels should occur within 0.3 mile of frog sites.
- No pumping of water from suitable breeding sites should occur for road maintenance, dust control, mixing concrete or other purposes. No transfer of water or mud among aquatic sites should occur.
- Water for construction use should be from existing wells or new wells at the discretion of the landowner. If local groundwater pumping is an adverse effect to aquatic, marsh, or riparian dwelling T&E species, it may be more appropriate to bring in treated water from outside the immediate area.

- Surface water from nearby aquatic or marsh habitats should not be used if that site supports the frog or if it contains non-native invasive species or disease vectors and there is any opportunity to contaminate another frog habitat through use of the water at the project site.
- Surface water from untreated sources should not be used for construction or maintenance projects located within one mile of aquatic habitat that may be occupied by frogs. Groundwater or surface water from a treated municipal source should be used when close to such habitats. This is to prevent the transfer of invasive animals or disease pathogens among habitats if water on the construction site was to reach the frog.
- Water tankers that convey untreated surface water should not discard unused water into a defined drainage way within two miles of any aquatic or marsh habitat.
- Open storage tanks containing untreated water should be of a size that if a rainfall event were to occur, the tank would not be overtopped and cause a release of water into the adjacent drainages. Water storage on the project area should be in open, on-ground containers located on upland areas not in washes.
- Pumps, hoses, tanks and other water storage devices should be cleaned and disinfected with a 10% bleach or 1% quaternary ammonia solution at an appropriate facility (this water is not to enter any surface water areas) or allowed to dry completely, before use at another site, if untreated surface water was used. If a new water source is used that is not from a treated or groundwater source, the equipment will require additional cleaning. This is important to kill any residual disease organisms or early life stages of invasive species that may affect local populations of the frog.
- CBP will develop and implement stormwater management plans for every project.
- All construction shall follow DHS management directive 5100 for waste management.
- A CBP-approved spill protection plan should be developed and implemented at construction and maintenance sites to ensure that any toxic substances are properly handled and do not escape into the environment. Agency standard protocols should be used. Drip pans underneath equipment, containment zones used when refueling vehicles or equipment, and other measures should be included as appropriate.
- Waste materials and other discarded materials should be removed from the site as quickly as possible. This should assist in keeping the project area and surroundings free of litter and reduce the amount of disturbed area needed for waste storage.
- Waste water (water used for project purposes that is contaminated with construction materials, was used for cleaning equipment and thus carries oils or other toxic materials or other contaminants in accordance with state regulations) should also be stored in closed containers on site until removed for disposal. Concrete wash water should not be dumped on the ground, but should be collected and moved offsite for disposal. This wash water is toxic to aquatic life.

Post Construction

- The need for and extent of site restoration should be determined in coordination with the landowner/manager and the extent of impacts to frog habitat.
- If site restoration is included, a restoration plan should be developed during project planning and provide an achievement goal to be met by the restoration activity. Roads or access developed for construction projects should be obliterated and restored, if not needed for other purposes.
- During follow-up monitoring, invasive plants that appear on the site should be removed. Removal should be done in ways that eliminate the entire plant and remove all plant parts to a disposal area. Use of herbicides to control unwanted invasive plants at facilities or roadsides is an acceptable management technique when used at label directions and such that introduction of the herbicides to the frog's aquatic habitats does not occur. Other FWS recommendations regarding application buffers and other conservation measures for pesticides in and near Chiricahua leopard frog habitats (see White 2004) should be implemented.
- Training to identify non-native invasives will be provided for CBP personnel or contractors as necessary.
- The project management plan will provide for a report describing the implementation of the BMPs and their effectiveness. This report will be completed at the completion of the project and posted to the IPaC system. Documentation of completion of any mitigation actions will be included in the report.

Mitigation:

- Appendix I of the Recovery Plan (USFWS 2007) contains extensive mitigation recommendations for a variety of project types and is broadly applicable to CBP activities in the planning unit. The measures recommended therein should be consulted during the planning stages of any actions in the planning unit that may affect the frog or its habitat. The FWS will provide the complete list of these measures for use by CBP.
- Compensation levels for loss of habitat should be determined based on the formula contained in Appendix I of the recovery plan. The FWS will provide this information for use by CBP.

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