

TULAROSA WATERSHED

The Tularosa Watershed covers approximately 3.2 million ac (0.1 million ha) in south central New Mexico in the northern Chihuahuan Desert and includes parts of Santa Fe, Torrance, Socorro, Lincoln, Otero, and Dona Ana counties and the municipalities of Alamogordo, Carrizozo, and Mountainair. It is a closed basin with no inlet or outlet. All of the water in the watershed remains within the basin. Much of the Tularosa Watershed is federal government property (White Sands Missile Range (WSMR), Holloman Air Force Base, White Sands National Monument, and the Lincoln National Forest). Further, the Mescalero Apache Indian also has ownership and jurisdiction of significant portions of the Tularosa Watershed. As such, there has been limited development and currently there are no man-made barriers (dams or reservoirs) or other alterations to the natural flow regime. Between 1990 and 2000, population growth within the watershed varied from a 65% increase in Torrance County to a 20% increase in Otero County. According to the *2003 State Water Plan* (Office of the State Engineer/Interstate Stream Commission 2003), both water levels and water quality are declining in the Tularosa Watershed.

Key aquatic habitats in the Tularosa Basin include perennial marsh/cienega/spring/seep, and perennial 1st and 2nd order stream (Fig. 5-15). These habitats are primarily restricted to the Salt River drainage on White Sands Missile Range. Perennial 1st and 2nd order streams, such as Indian Creek, are found in the higher elevation mountains.

Non-native species occur sporadically throughout the watershed. They include largemouth bass (*Micropterus salmoides*), goldfish (*Carassius auratus*), western mosquitofish (*Gambusia affinis*), and crayfish (*Procambarus clarkia*). Prior to 1994 a large population of feral horses on WSMR caused a severe reduction in vegetative cover and subsequent channelization and cutting of waterways. Since 1995 nearly all of the horses have been removed and rapid re-vegetation has been observed. Oryx (*Oryx beisa*), a non-native African antelope introduced onto WSMR in the 1960s to provide hunting opportunities, are currently abundant.

Species of Greatest Conservation Need

Within the Tularosa Watershed low-elevation perennial springs provide habitat for several endemic Species of Greatest Conservation Need (SGCN), such as the White Sands pupfish (*Cyprinodon Tularosa*), Tularosa springsnail (*Juternia tularosae*), an un-described gammarid amphipod and hyalellid amphipods (Table 5-17). Higher elevation marsh habitat associated with the Tularosa River supports an isolated population of blunt ambersnails (*Oxyloma retusum*), land snails of restricted occurrence in New Mexico. Fossil specimens of blade vertigo snails (*Vertigo milium*) and ovate vertigo snails (*Vertigo ovata*) are also known from Pleistocene and Holocene deposits within the basin (Metcalf and Smartt 1997). Only two SGCN are found in 1st and 2nd order stream habitats in the Tularosa Watershed, Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), in mountain streams, and White Sands pupfish, in low desert streams.

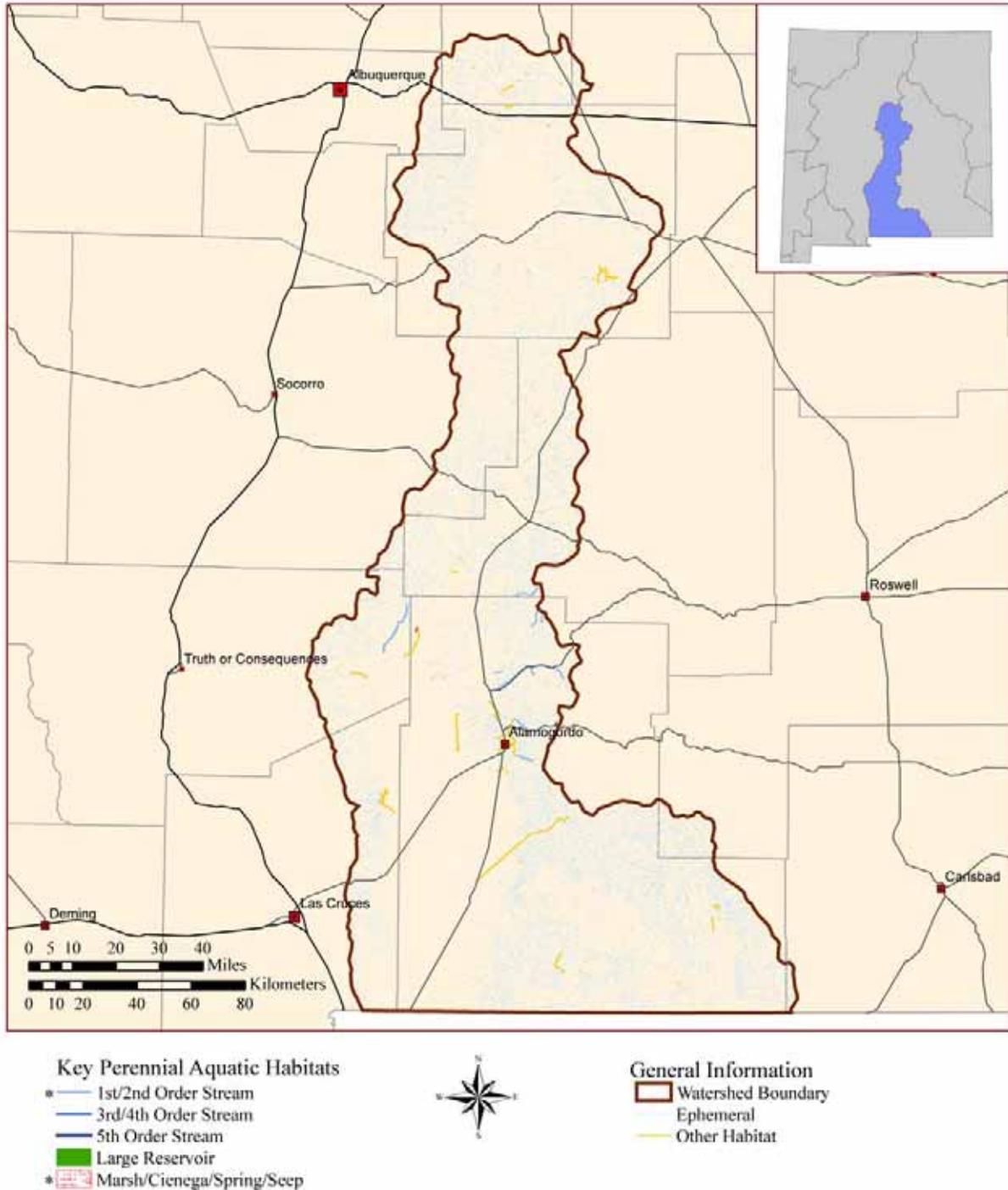


Figure 5-15. Key perennial aquatic habitats in the Tularosa Watershed in New Mexico. Key habitats are designated with an asterisk (*).

Table 5-17. Species of Greatest Conservation Need in the Tularosa Watershed in New Mexico.

Common Name or Scientific Name ¹	Perennial	
	Marsh/ Cienega/ Spring/ Seep	1 st and 2 nd Order Stream
<i>Fish</i>		
White Sands Pupfish	X	X
Rio Grande Cutthroat Trout		X
<i>Birds</i>²		
Eared Grebe	X	
American Bittern	X	
White-Faced Ibis	X	
Northern Pintail	X	
Bald Eagle	X	
Northern Harrier	X	
Peregrine Falcon	X	
Sandhill Crane	X	
Southwestern Willow Flycatcher	X	
Yellow Warbler	X	X
<i>Mammals</i>²		
Western Red Bat	X	
Spotted Bat	X	
New Mexico Meadow Jumping Mouse	X	
Desert Bighorn Sheep	X	
<i>Amphibian</i>²		
Tiger Salamander	X	
Plains Leopard Frog	X	
Northern Leopard Frog	X	X
<i>Molluscs</i>²		
Tularosa Springsnail	X	
Blunt Ambersnail	X	
Ovate Vertigo Snail	X	
Blade Vertigo Snail	X	
<i>Crustaceans</i>²		
<i>Hyalella</i> spp.	X	X
<i>Gammarus</i> spp.	X	

¹ Scientific names are provided where common names for the species does not exist.

² Additional conservation concerns for these taxa are addressed in the Statewide Distributed Riparian Habitats, Statewide Distributed Ephemeral Habitats and Perennial Tanks and/or Ecoregion and terrestrial habitat sections.

Twenty-five SGCN, excluding arthropods other than crustaceans, occur in the Tularosa Watershed (Table 5-17). Ten species (40%) were classified as vulnerable, imperiled, or critically imperiled both statewide and nationally. Thirteen species (52%) were considered nationally secure, but vulnerable, imperiled, or critically imperiled in New Mexico. Conservation status codes (abundance estimates) for each SGCN are provided in Appendix H. Conservation concerns for birds, mammals, amphibians, and reptiles are primarily addressed in the Riparian Habitat and/or Terrestrial Habitat section.

Perennial Marsh/Cienega/Spring/Seep

Habitat Condition

Perennial spring-fed habitats (marshes, cienegas, springs, seeps) occur sporadically throughout the Tularosa Watershed as isolated wetlands that discharge surface water to localized aquatic systems that eventually recharge shallow aquifers. Other springs may contribute surface flows to perennial streams found throughout the basin. Thompson *et al.* (2002) developed a rapid assessment procedure for springs and seeps in the Tularosa Basin. Springs and seeps were rated on the basis of riparian vegetation, surface water, and evidence of recent human activity. Of the 276 springs and seeps evaluated, 84 springs retained typical riparian vegetation and perennial surface water. Of these, 73 springs had evidence of human activity that may alter these habitats. Overall, 6% of the historic springs were dry and had no typical riparian vegetation. Much of the vegetation (grasses and sedges) in and around marsh/cienega/spring/seep habitats in the Tularosa Basin has been rejuvenated following the removal of feral horses from WSMR.

Problems Affecting Habitats or Species

Water Withdrawal

Several proposals and plans exist for desalination plants for research and development and to provide drinking water to Alamogordo. The surface water loss resulting from the water withdrawal and dewatering necessary to support these projects, exacerbated by recent drought conditions, will have significant adverse effects upon marsh/cienega/spring/seep habitats and associated SGCN of the Tularosa Basin.

Military Activities

Habitat loss or contamination and species extermination from military activities are serious factors that adversely influence aquatic perennial spring-fed habitats in the Tularosa Basin. The *Integrated Natural Resources Management Plans* for White Sands Missile Range and Holloman Air Force Base, to which both the New Mexico Department of Game and Fish (NMDGF) and US Fish and Wildlife Service (USFWS) are signatories, consider and propose to mitigate adverse military mission effects on natural resources (Holloman Air Force Base 2000, WSMR 2001). Additional efforts have been made on WSMR to protect SGCN and associated habitats, particularly the White Sands pupfish. A *Cooperative Agreement for the Protection and Maintenance of White Sands Pupfish* was signed in 1994 (NMDGF 1994b), but the potential to update and continue implementation of the agreement on WSMR is tenuous. Military activities may increase the risk of fire in areas with sufficient fine fuels. White Sands Missile Range has recently completed a fire management plan outlining specific responses.

Invasive Species

Currently, perennial marsh/cienega/spring/seep habitats in the Tularosa Basin have only native aquatic animal species. However, non-native crayfish and western mosquitofish occupy waters in nearby areas, and may impose a future factor of concern. The possibility of introductions into these key habitats exists and would be a significant detriment to native species including the White Sands pupfish. Saltcedar (*Tamarix* spp.) occurs around many of the springs in the Tularosa Basin. This invasive plant has long taproots that allow it to intercept deep water tables and interfere with natural aquatic systems. Saltcedar disrupts the structure and stability of native plant communities and degrades native wildlife habitat by successfully competing with and replacing native plant species and consuming limited sources of moisture. The State Forest and Watershed Health Plan devotes significant planning to the management of non-native invasive phreatophytes (New Mexico Energy, Minerals, and Natural Resources Department 2004).

Legal Protection

Current interpretation of state and federal regulatory authority (Clean Water Act) over non-navigable waters of the United States and the state poses concern for protection of perennial wetlands (such as, marsh/cienega/spring/seep, 1st and 2nd order streams, ponds, lakes) and ephemeral wetlands (natural catchments, marsh/cienega/spring/seep, 1st and 2nd order streams) within the Tularosa Watershed. See Statewide Distributed Ephemeral Habitats and Perennial Tanks section for details.

Information Gaps

There are several major information gaps regarding perennial marsh/cienega/spring/seep habitats in the Tularosa Basin and associated SGCN that impair our ability to make informed conservation decisions. These are outlined below.

- Little is known about the natural history and ecological needs of invertebrate SGCN, such as the Tularosa springsnail, in perennial marsh/cienega/spring/seep habitats.
- Our capacity to implement actions to conserve the White Sands pupfish, despite an existing cooperative agreement, is currently unknown because of funding cuts for natural resource protection in the Department of Defense.
- Uncertainty exists regarding the potential effects of recent changes in the Clean Water Act apparently removing protections for closed basins such as the Tularosa.
- Current condition, trend, and status of perennial marsh/cienega/spring/seep habitats in the Tularosa Basin are largely unknown. Thompson *et al.* (2002) provides a baseline to obtain this information.

Research, Survey, and Monitoring Needs

Research and surveys needed to make informed conservation decisions for the perennial marsh/cienega/spring/seep habitats of the Tularosa Watershed and associated SGCN are outlined below.

- Research, surveys, and monitoring projects are needed regarding the distribution, biology, and stability of invertebrate SGCN and their microhabitats.
- Detailed surveys and monitoring of perennial marsh/cienega/spring/seep habitats are needed to adequately protect these habitats and SGCN. Surveys, following guidelines of Thompson *et al.* (2002), would provide trend data to evaluate the longevity and potential amount of net loss that has occurred in springs and seeps over the last 10 years.
- GIS-based biotic surveys basin wide would serve to map the distribution and extent of perennial marsh/cienega/spring/seep habitats in the Tularosa Watershed, including their associated SGCN. These data will also serve to assess at-risk wetlands and will facilitate monitoring of wetland loss or gain.

Desired Future Outcomes

The following broad future outcomes are consistent with the *Cooperative Agreement for the Protection and Maintenance of White Sands Pupfish* and the *Integrated Natural Resources Management Plans for White Sands Missile Range and Holloman Air Force Bases*.

- Perennial marsh/cienega/spring/seep habitats in the Tularosa Basin persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN, facilitate uninterrupted movement patterns of native aquatic and terrestrial SGCN, and host a variety of land management uses with reduced resource use conflicts.
- Perennial marsh/cienega/spring/seep habitats are free of non-native species that that may adversely affect SGCN or their habitats.
- There is a no net-loss of perennial spring-fed habitats throughout the Tularosa Watershed.
- Collaborative relations are established among state and federal agencies, NGO's, universities, and private landowners to secure adequate funding to conserve, enhance, and restore perennial marsh/cienega/spring/seep habitats of the Tularosa Watershed.
- Citizen-based “watershed watch groups” or “wetland alliances” are established to facilitate the conservation of perennial marsh/cienega/spring/seep habitats of the Tularosa Watershed.
- Management practices are developed and adopted by land managers to protect the ecological integrity of perennial spring-fed habitats.

- Viable populations of the White Sands pupfish are distributed throughout their historic range in the perennial marsh/cienega/spring/seep habitats of the Tularosa Watershed.
- The *Cooperative Agreement for Protection and Maintenance of White Sands Pupfish* and the *Integrated Natural Resources Management Plans* for White Sands Missile Range and Holloman Air Force Bases are fully implemented.

Prioritized Conservation Actions

Conservation actions necessary to conserve the perennial marsh/cienega/spring/seep habitats of the Tularosa Basin are also outlined in the *Cooperative Agreement for Protection and Maintenance of White Sands Pupfish* and the *Integrated Natural Resources Management Plans* for White Sands Missile Range and Holloman Air Force Base (NMDGF 1994b, Holloman Air Force Base 2000, WSMR 2001). Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Collaborate with involved government agencies to attain implementation of the Integrated Natural Resources Management Plans for White Sands Missile Range and Holloman Air Force Bases.
2. Work with the USFWS and the Department of Defense to re-authorize the *Cooperative Agreement for Protection and Maintenance of White Sands Pupfish*.
3. Work with state and federal land managers, and research institutions to investigate the current status of SGCN associated with perennial marsh/cienega/spring/seep habitats of the Tularosa Basin and factors limiting their populations.
4. Work with appropriate state and federal government entities and potentially affected interests to identify and pursue alternatives to the Clean Water Act for restoring protection to perennial marsh/cienega/spring/seep habitats in the Tularosa Watershed.
5. Work with federal, state, and tribal governments, NGOs, and universities to improve and increase the use of existing data management systems for tracking information pertinent to perennial marsh/cienega/spring/seep habitats in the Tularosa Watershed.
6. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN and perennial marsh/cienega/spring/seep habitats specified in the Problems or Research, Survey, and Monitoring Needs sections, with emphasis on the White Sands pupfish and Tularosa springsnail.
7. Work with public and private land managers to remove non-native aquatic and riparian species from the Tularosa Basin and to prevent further introductions.

8. Encourage partnerships between federal and state land managers and private landowners to protect and rehabilitate perennial marsh/cienega/spring/seep habitat.
9. Collaborate with federal, state, local, and tribal governments and affected publics to adopt and implement standardized monitoring and survey methods by which to track gains and losses of perennial marsh/cienega/spring/seep habitats in the Tularosa Watershed.
10. Work with local, state, federal, and tribal governments, NGOs, and private landowners to establish “watershed alliances” or “wetland working groups” that monitor, protect, and restore perennial marsh/cienega/spring/seep habitats in the Tularosa Watershed.
11. Encourage public participation in state and federal incentive-based programs, such as Swampbuster, Wetlands Reserve Program, and the Landowner Incentive Program, to protect, enhance, and restore perennial marsh/cienega/spring/seep habitats.
12. Collaborate with WSMR and Holloman Air Force base to provide information concerning perennial marsh/cienega/spring/seep habitats to the USFWS for updating the New Mexico National Wetland Inventory.
13. Collaborate with the New Mexico Environment Department’s Wetland Program to more efficiently protect, restore, conserve, and create perennial marsh/cienega/spring/seep habitats and to monitor and evaluate progress.
14. Teach local resource users about measures that conserve perennial marsh/cienega/spring/seep habitats and associated SGCN in the Tularosa Basin.
15. Collaborate with federal and state agencies, tribal governments, NGOs, and affected publics to create an awareness and understanding of ecosystem functions, services, and values afforded by perennial marsh/cienega/spring/seep habitats in the Tularosa Watershed.

Perennial 1st and 2nd Order Streams

Habitat Condition

There are several perennial 1st and 2nd order streams in the closed Tularosa Basin including Salt Creek, Lost River, Three Rivers, and Indian Creek. The watershed as a whole has experienced few adverse effects from urban or rural development and there are currently few impediments to natural flows of 1st and 2nd order streams in the Tularosa Basin. Although 1st and 2nd order streams are for the most part uncorrupted, they have been subject to drying associated with the recent drought and often are wetted only near spring heads.

Problems Affecting Habitats or Species

Water Withdrawal

Several proposals and plans exist for desalination plants to provide drinking water to the city of Alamogordo. The surface water loss resulting from water withdrawal and dewatering necessary to support these projects, exacerbated by recent drought conditions, will have significant adverse effects upon perennial 1st and 2nd order stream habitat and associated SGCN.

Military Activities

Habitat loss or contamination and species extirpation from military activities are potentially serious factors that may adversely influence perennial 1st and 2nd order streams in the Tularosa Basin. The *Integrated Natural Resources Management Plans* for WSMR and Holloman Air Force Base, to which both NMDGF) and USFWS are signatories, propose to mitigate adverse military mission effects on natural resources (Holloman Air Force Base 2000, WSMR 2001). Additional efforts have been made on WSMR to protect SGCN and associated habitats, particularly the White Sands pupfish. A *Cooperative Agreement for the Protection and Maintenance of White Sands Pupfish* was signed in 1994 (NMDGF 1994b), but the potential to update and continue implementation of the agreement on WSMR is tenuous.

Habitat Conversion

Land uses, such as urban development, improper grazing, logging, road building, and fire management, alter perennial 1st and 2nd order streams in the Tularosa Watershed. Wildfires and increased urban development have the potential to adversely affect streams such as Indian Creek where Rio Grande cutthroat trout and other SGCN are present.

Invasive Species

Invasive and non-native plants and animals are a concern in the perennial 1st and 2nd order streams in the Tularosa Basin. The introduction of crayfish and western mosquitofish from nearby waters into these key habitats would significantly impact native species including the White Sands pupfish. Non-native trout are present and adversely affect Rio Grande cutthroat trout. Saltcedar occurs around many perennial 1st and 2nd order streams in the Tularosa Basin. This invasive plant has long taproots that allow it to intercept deep water tables and interfere with natural aquatic systems. Saltcedar disrupts the structure and stability of native plant communities and degrades native wildlife habitat by successfully competing with and replacing native plant species and consuming limited sources of moisture. The State Forest and Watershed Health Plan devotes significant planning to the management of non-native invasive phreatophytes (New Mexico Energy, Minerals, and Natural Resources Department 2004).

Legal Protection

Current interpretation of state and federal regulatory authority (Clean Water Act) over non-navigable waters of the United States and the state poses concern for protection of perennial wetlands. These include marsh/cienega/spring/seep, 1st and 2nd order, ponds, lakes and ephemeral wetlands such as natural catchments, marsh/cienega/spring/seep, 1st and 2nd order streams within the Tularosa Watershed. See Statewide Distributed Ephemeral Habitats and Perennial Tanks section for details.

Information Gaps

- There are several major information gaps regarding perennial 1st and 2nd order streams and associated SGCN that impair our ability to make informed conservation decisions.
- The extent is unknown to which the timing, intensity, and duration of livestock grazing, anthropogenic development, road-building, off-road vehicle use, and non-native species invasions fragment and alter habitats in relation to patch size, edge effect, and use by wildlife. This information is important in understanding how different land use intensities and frequencies of disturbances affect SGCN in perennial 1st and 2nd order streams.
- Little is known about the invertebrate SGCN in perennial 1st and 2nd order streams in the Tularosa Watershed.
- Our capacity to implement actions to conserve the White Sands pupfish, despite an existing cooperative agreement, is currently unknown because of undetermined effects of natural resource funding reductions by the US Department of Defense.
- The effects of chemical treatment for saltcedar on pupfish are unknown.

Research, Survey, and Monitoring Needs

Much of the land upon which perennial 1st and 2nd order streams occur in the Tularosa Basin is under the ownership and jurisdiction of the US Department of Defense, the Lincoln National Forest, and the Mescalero Apache Tribe. The conduct of meaningful and productive research, survey, and monitoring work will require that NMDGF collaborate closely with these entities. Research and surveys needed to make informed conservation decisions for perennial 1st and 2nd order streams in the Tularosa Watershed include:

- Research, surveys, and monitoring projects are needed regarding the distribution, biology, and stability of invertebrate SGCN and their microhabitats.
- Research is needed to characterize population dynamics and species interactions in perennial 1st and 2nd order streams.
- More detailed habitat surveys are needed of perennial 1st and 2nd order streams and associated SGCN.
- Research is needed to investigate the effects of chemical treatment for saltcedar around perennial 1st and 2nd order streams on pupfish.

Desired Future Outcomes

Desired future outcomes for perennial 1st and 2nd order streams in the Tularosa Watershed include:

- Perennial 1st and 2nd order streams in the Tularosa Watershed persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN, facilitate uninterrupted movement patterns of native aquatic and terrestrial SGCN, and host a variety of land management uses with reduced resource use conflicts.
- The NMDGF, the Lincoln National Forest, The US Department of Defense, and the Mescalero Apache Tribe are engaged in collaborative and complementary research, survey, monitoring, and resource management activities in the Tularosa Basin.
- Native riparian plant communities associated with perennial 1st and 2nd order streams in the Tularosa Watershed are restored and maintained.
- The perennial 1st and 2nd order streams in the Tularosa Watershed are free of non-native species that may adversely affect SGCN or their habitats.

Prioritized Conservation Actions

Conservation actions necessary to secure the perennial 1st and 2nd order streams of the Tularosa Basin are also outlined in the Cooperative Agreement for Protection and Maintenance of White Sands Pupfish and the Integrated Natural Resources Management Plans for White Sands Missile Range and Holloman Air Force Base (NMDGF 1994b, Holloman Air Force Base 2000, WSMR 2001). Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Work with the USFWS and the US Department of Defense to re-authorize the *Cooperative Agreement for Protection and Maintenance of White Sands Pupfish*.
2. Work with federal and state agencies, the Mescalero Apache Tribe, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN and perennial 1st and 2nd order streams outlined in the Problems or Research, Survey, and Monitoring Needs section. Studies on the White Sands pupfish and invertebrates are especially desirable.
3. Collaborate with involved government agencies to implement the *Integrated Natural Resources Management Plans* for White Sands Missile Range and Holloman Air Force Bases
4. Work with the US Forest Service to implement the watershed goals of the Lincoln National Forest Plan.

5. Promote cooperation and partnerships among federal, state, and tribal governments, NGOs, and private landowners to conserve perennial 1st and 2nd order streams in the Tularosa Watershed.
6. Work with public, tribal, and private land managers to remove non-native aquatic and riparian species from the Tularosa Basin and prevent further introductions.
7. Work with state, federal, and tribal governments and potentially affected interests to identify and pursue alternatives to the Clean Water Act for restoring protection to perennial 1st and 2nd order streams in the Tularosa Watershed.
8. Teach local resource users about measures that conserve perennial 1st and 2nd order streams and associated SGCN in the Tularosa Watershed.