Feasibility Study:
Potential for Restoration of River Otters
in New Mexico

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Summary

The North American river otter (*Lontra canadensis*) is a moderately large, semi-aquatic carnivore that historically occurred throughout much of North America in freshwater rivers, stream, and lakes and coastal areas. The species is highly adapted to living in aquatic situations and feeds primarily on fishes, but also will eat crayfishes, frogs, and other small animals found in or near water bodies. River otters formerly occurred in several river systems in New Mexico, although verified specimen records from the state are limited to one animal taken in the Gila River in 1953 and physical evidence of a likely introduced otter from Navajo Reservoir in 2004. Populations that formerly occurred in New Mexico have been referred to the subspecies *L. c. sonora* which, based on available evidence, is now extinct in its former range in the Southwestern United States. Many states in which river otter was extirpated in the 19th or early 20th centuries have conducted reintroduction programs from the 1970s through 1990s to restore otter, often using animals collected from locations outside of those states. These programs have been largely successful and, at present, New Mexico is the only state within the historic range of river otters that does not have an established population of native or introduced otters.

This Feasibility Study assessed six river reaches which met initial criteria for evaluation as possible restoration sites: the Upper Rio Grande, White Rock Canyon, and the Middle Rio Chama in the Rio Grande Basin; and the Upper and Lower Gila River and Lower San Francisco River in the Gila Basin. The reaches were evaluated for ten parameters (A-J) relevant to the success of river otter restoration: A. Potential for Natural Recolonization; B. River Miles of Suitable Contiguous Habitat; C. Human Activity and Land Management; D. Water Quantity; E. Prey Availability; F. Water Quality; G. Riparian (Streamside) Habitat; H. Stream Structure; I. Potential for Connectivity (between Populations); and J. Potential for Threatened, Endangered, or Sensitive (TES) Species Conflicts.

The analysis provided in the Feasibility Study indicated that restoration of river otters is feasible in New Mexico. Although all six reaches are potentially suitable for otter restoration, the Upper Rio Grande shows the most promise for an initial restoration project should the State Game Commission approve implementation. Features of the Upper Rio Grande that made it score higher than other reaches include: 1) Reliable perennial flows even during periods of severe drought; 2) An established fishery, including many "rough fish" species such as carp and white sucker that are suitable as prey and whose control by otters could benefit native fishes; 3) Suitable in-stream and riparian habitat that is relatively undisturbed; 4) Long stretches of river that are not readily accessible to the public; 5) Relatively little human use and therefore little potential conflict; 6) Adjacent public lands administered by BLM, an agency which has already indicated its desire to participate in otter restoration in this reach as part of its Rio Grande Corridor Plan; 7) Historical presence of otters in or adjacent to this reach; 8) Low potential for conflict with management of threatened, endangered, or sensitive species; 9) Low potential for otters to naturally colonize this reach; and 10) Fairly good potential for otters to move into other suitable reaches of the Upper Rio Grande near the restoration area.

If implementation is approved, an analysis of fish tissue samples from the proposed release site would be conducted to address unknowns concerning presence of bioaccumulating toxicants in the river reach. Information from this analysis would be used to determine if the selected reach is

appropriate for otter releases. Other components of a restoration effort (e.g., coordinating with stakeholders, identification of funding, selection of a source population, contracting support services) would also be addressed should approval for restoration be granted.

Acknowledgments

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1.0 Introduction

The North American river otter (*Lontra canadensis*) is a semi-aquatic carnivore that historically inhabited most of the United States and Canada, and extreme northwestern Mexico along the Colorado River. By the mid 1900s, the river otter had experienced significant declines and was extirpated from many parts of the United States as a result of overharvesting, destruction of riparian and aquatic habitats, alteration of river hydrology, and water pollution (Melquist and Dronkert 1987). Great efforts have been made to restore the river otter to native habitats in 21 states, including the adjacent states of Arizona, Colorado, and Utah. Viable populations of river otter are now known to exist in every state within its historic range except New Mexico (Raesly 2001).

In the last several years there has been growing interest among the public in restoring this component of New Mexico's natural ecological heritage (e.g., Salmon 2005). To address this interest, the New Mexico Department of Game and Fish (NMDGF) developed a working relationship with the New Mexico River Otter Working Group (NMROWG), a broad-based coalition whose mission is to promote the restoration of the river otter to New Mexico. Participants in the NMROWG include Amigos Bravos, Four Corners Institute, Upper Gila Watershed Alliance, U.S. Bureau of Land Management (BLM), Center for Biological Diversity, New Mexico Environment Department, Defenders of Wildlife, New Mexico Wildlife Federation, and New Mexico Natural History Institute. The NMROWG has conducted a number of activities relating to river otters including habitat surveys, development of educational brochures, and discussing potential reintroduction with the public and stakeholder groups. As a result of this significant public interest, a Feasibility Study was initiated by the NMDGF to evaluate the potential for river otter restoration in one or more river systems in New Mexico.

The purpose of this document is to summarize information on the river otter and its habitat in New Mexico and evaluate the feasibility of establishing a population in one or more river reaches, based on suitability of habitat and availability of resources. Information from previous otter restoration projects in the Southwest is incorporated. The document does not address in detail the costs or logistics of accomplishing an otter restoration project; these items would be addressed during the implementation phase of restoration efforts, should restoration be approved by the State Game Commission.

2.0 Evidence of River Otter in New Mexico: Historical and Present

Bailey (1931) summarized the earliest reports of river otter in New Mexico available to him, but noted the absence of any specimen from the state. He noted a 1906 report of a "few Arizona otters along the headwaters of the Gila River in southwestern New Mexico" and an 1825 report from the Gila near the modern-day Arizona-New Mexico border. In the Canadian River, an otter was reportedly killed near the mouth of the Mora River in 1845. In the upper Rio Grande drainage, a few were reported "near Espanola, Rinconada, and Cienequilla" and the Taos Pueblo Indians were "familiar with them." Bailey (1931) considered river otter to be "so rare to be of little economic importance" in New Mexico.

The first, and to date only, verifiable specimen of river otter to be taken in New Mexico was obtained in 1953 in a beaver trap set on the Gila River near the town of Cliff, Grant County (McClellan 1954). The mounted pelt of this animal is preserved at the University of New Mexico Museum of Southwestern Biology.

Findley et al. (1975), in their review of New Mexico mammals, provided no additional information on river otter in New Mexico and suggested "the species may well be extinct in the state."

Various reports of river otter in New Mexico are available subsequent to the review by Findley et al. (1975). Stahlecker (1986) summarized three reports from northern New Mexico. In 1978 or 1979, an otter was reportedly seen near the Vermejo Ranch headquarters in Colfax County. In 1986, an otter was reported by two Bureau of Land Management employees as they were rafting the Rio Grande about 7 miles south of the Colorado border. In the same year, an otter was reported in a stock tank at San Cristobal, Taos County, approximately one mile from the nearest perennial stream (San Cristobal Creek). In each case, the observer reported some characteristics that were consistent with river otter but apparently no physical evidence was obtained that could substantiate the sightings (Stahlecker 1986).

Possible river otter observations are also available from the lower Pecos River drainage in southeastern New Mexico. William R. Radke (U.S. Fish and Wildlife Service, personal communication, 2005) provided the following four records he compiled while manager at Bitter Lake National Wildlife Refuge (BLNWR), Chaves County:
1) Several tracks were found and photographed along the Pecos River east of BLNWR Unit-3 on October 9, 1993. The tracks exited the east bank of the river, traveled along the muddy riverbank immediately adjacent to the Pecos River for about 3 meters, and then re-entered the river. Subsequent examination of the track photographs suggested they may not have been otter (J.K. Frey, personal communication, 2005).
2) Refuge visitors reported a river otter on BLNWR Unit-6 in "early May 1994."
3) Three members of a Spokane, Washington Fire Crew (Fish and Wildlife Service) reported watching a river otter feeding on dead carp in BLNWR Unit-15 in "summer of 1996." The observers, who were familiar with otters, watched the animal for nearly 30 minutes as it "inch-wormed" its way from carcass to carcass inspecting and chewing on the fish. The crew reported the sighting not because they were aware that it was noteworthy for New Mexico, but because they simply found it of interest.
4) During a field trip to the refuge, unidentified staff from the New Mexico Museum of Natural History reportedly observed an otter at the north end of BLNWR Unit-6 on April 25, 1999.

Most recently, Polechla et al. (2004) collected three scats of river otter in the Los Pinos River arm of Navajo Reservoir in San Juan County, New Mexico in November 2004. The scats, which were confirmed by DNA analysis to be from otter, provided the first verified evidence of this species in the state since McClellan's (1954) record. River otters had been reported from Navajo Reservoir in Colorado and New Mexico during the late 1980s; these observations were attributed to the downstream dispersal and establishment of otters introduced in the Piedra River (a tributary that drains into Navajo Reservoir) in southwestern Colorado during 1979-1983 (CDOW 2003). There had been some previous reports of otter observations on Navajo Reservoir but no

detailed information; the alleged killing of two otters below Navajo Dam in recent years has not been confirmed (C.M. Wethington, NMDGF, personal communication, 2005).

A report, with photograph, of two river otters allegedly observed near San Marcial, Socorro County in early 2005 has since been discredited (NMDGF files).

In summary, although a number of reports of river otter are available from New Mexico from the mid-1800s through the early 2000s, including some intriguing observations from the last 20 years, the only ones verified by physical evidence are the 1953 specimen from the Gila River and the 2004 scat sample obtained at Navajo Reservoir. The Navajo Reservoir record provides compelling evidence that river otter may be migrating into San Juan County near the Colorado state line.

3.0 Taxonomy and Legal Status

Seven subspecies of the species *Lontra canadensis* (formerly placed in the genus *Lutra*) that are native to North America have been proposed (Toweill and Tabor 1982) but the validity of these subspecies delineations is currently a subject of debate (Serfass et. al. 1998). The Southwestern river otter (*Lontra canadensis sonora)* historically occupied the major river systems in New Mexico, Arizona, and Nevada as well as southern portions of Colorado, Utah, and California (Hoffmeister 1986, Findley et al. 1975, Fitzgerald et al. 1994). However, it occurred in low densities and was restricted to a few major rivers throughout its range (Buskirk 2000).

This subspecies was named in 1886, by E.A. Mearns based on three specimens collected from the Verde River area in central Arizona (Spicer, 1987). Mearns' (1891) description of these three specimens was later used by Rhoads (1898) to designate the subspecies *L. c. sonora* (Spicer, 1987). Van Zyll de Jong (1972) revised the taxonomy of river otters and retained the subspecies *L. c. sonora*, because its "peripheral and relatively isolated geographical range as well as its different proportions suggest that it may represent a relatively well-differentiated form that could be recognized." However, he questioned the validity of the subspecies since the original description was based on only a few specimens. He noted that only a larger sample size could confirm its distinctiveness (Van Zyll de Jong, 1972). To date, only six specimens referable to *L. c. sonora* have been collected (Compton 2000, Klingel and MacDonald, 2002). If the taxon is valid, there is a distinct probability that it is extinct.

The legal status of *Lontra canadensis sonora* has changed at both the Federal and State levels over the years. The U.S. Fish and Wildlife Service listed the subspecies as "Candidate- Category 2" in 1991, but revised the status to "Species of Concern" in 1996. The U.S. Bureau of Land Management and U.S. Forest Service have both listed the subspecies as "sensitive."

The State of New Mexico listed the subspecies as Endangered in January 1975, but subsequently removed it from the list in March 1985 because it was considered to be extirpated throughout its historic range (Frey and Yates 1996, Jones and Schmitt 1997, Compton 2000). River otter is classified as a protected furbearer by state law (Chapter 17, NMSA 1978) with a closed season; it is also a Species of Greatest Conservation Need as designated in the New Mexico Comprehensive Wildlife Conservation Strategy that was approved in 2006. Natural Heritage

New Mexico, which tracks the status of many wildlife species in New Mexico, classifies the subspecies as "SX, apparently extirpated from NM".

At present, the validity of the subspecies *L. c. sonora* remains unresolved. Even if the *sonora* subspecies is still recognized as a valid taxon, it may be moot in terms of conservation and management decisions given the lack of evidence that any native populations within the historic range of the subspecies still persist. Other states within the historic range of the subspecies (as delineated by Hall 1981), such as Arizona, Colorado, and Utah, have already conducted otter restoration projects that used animals from outside the range of *L. c. sonora*, thus making it less likely that any remnant populations of native river otter remain in the southwestern United States.

4.0 River Otter Ecology

4.1 Description and Life History

The river otter is highly adapted for aquatic life (Melquist and Dronkert 1987). Physical adaptations include a relatively small, flattened head with a short muzzle and small ears, short legs with large webbed feet, and short dense underfur that provides insulation. Physiological adaptations include oxygen conservation measures such as bradycardia (slowing of heartbeat), which allows otters to remain underwater for 4 minutes. The weight of an adult otters ranges from 5 to 15 kg (11-33 pounds) and body length from 90 to 140 cm (35-55 inches). Adult males are approximately 20% larger than females (Toweill and Tabor 1982).

Otters are relatively social, with the basic family group comprised of a female and her most recent offspring (Melquist and Dronkert 1987). The family group remains intact until immediately prior to parturition in late spring. Adult males do not associate with families, but may congregate to form bachelor groups. River otters reach sexual maturity at 2 years of age. Breeding activity peaks in March and April, and otters undergo delayed implantation which lengthens the total gestation period to approximately 320 days (Toweill and Tabor 1982). Mean litter size is three pups, which develop rapidly and are weaned at 3-4 months, self-sufficient at 5-6 months, and disperse from the family group at 8-12 months (Toweill and Tabor 1982, Melquist and Hornocker 1983). The lifespan of otters is 10-15 years.

Given their agility and speed, river otters have few natural enemies when in the water. On land, otters are vulnerable to a number of predators including cougars, wolves, bobcats, and coyotes, but predation represents an insignificant source of mortality in most otter populations (Toweill and Tabor 1982). While trapping has historically represented a primary cause of otter mortality, other causes have become more significant following the implementation of harvest regulations in the mid-1900s. For example, vehicle collisions and domestic dogs are the primary mortality sources for reintroduced otters in Colorado (Tom Beck, Colorado Division of Wildlife, personal communication). While otters are susceptible to a variety of diseases, including canine distemper, feline panleukemia, hepatitis, and jaundice, disease has not been identified as a significant cause of mortality among wild populations (Harris 1968). However, disease is a consideration for restoration programs that reintroduce otters into habitats that are in close proximity to humans (and their pets and domestic livestock).

4.2 Habitat Requirements

River otters occupy a variety of marine and freshwater habitats in North America (Yeager 1938, Sheldon and Toll 1964, Mowbray et al. 1979, Humphrey and Zinn 1982, Melquist and Hornocker 1983, Erickson et al. 1984, Serfass 1984, Schreckengrast 1988). Otter abundance and population performance are correlated with ecosystem productivity via the proximate factors of prey availability and water quality. Relatively high otter densities occur in highly productive estuarine habitats and large, pristine waterways while lower densities are found in relatively unproductive mountain streams and polluted water systems (Melquist and Dronkert 1987). River otters prefer habitats with minimal human activity and encroachment, although they do tolerate the presence of humans if not disturbed (Bottorf et al. 1976, Mowbray et al. 1979, Edwards 1983, Melquist and Hornocker 1983, Serfass 1984).

Efforts to model habitat selection by river otters have not been entirely successful, primarily because of the species adaptability to a variety of aquatic environments (Mack 1985). Despite this, high quality habitat possesses 3 essential components: an adequate prey base, diverse aquatic and riparian structure and a sufficient supply of unpolluted water (Melquist and Dronkert 1987).

In terms of microhabitat, otters need diverse structure in both the aquatic system and adjacent riparian zone (Liers 1951, Jalkotzy 1982, Tumlinson et al. 1982, Melquist and Hornocker 1983, Reid et al. 1994b, Serfass 1984, Mason and MacDonald 1986). Prey abundance alone does not ensure a sufficient food supply for otters, since fish may be present but not available (Polechla and Sealander 1985). Diverse in-stream structure, including beaver dams, log jams, exposed tree roots, and boulders, promotes a diverse, and therefore stable, prey base and increases prey availability throughout the various seasonal hydrological conditions (Toweill and Tabor 1982, Schreckengrast 1988). As a result, in-stream structure provides core habitat for forage, dens and rest sites (Bottorff et al. 1976, Melquist et al. 1981, Melquist and Hornocker 1983, Serfass 1984). River otters utilize existing animal dens, man-made structures, and natural formations (i.e., downed logs, tree root systems, rocks and talus, and beaver lodges) for den and rest sites (Lauhachinda 1978, Toweill and Tabor 1982, Melquist and Hornocker 1983, Mason and MacDonald 1986, Bradley 1994). Selection of these sites is opportunistic, with security and proximity to foraging habitat more important than specific structure type (Larsen 1983, Melquist and Hornocker 1983, Tango 1988).

River otters reintroduced into rivers have been found to move into reservoirs. However, fluctuating water levels discourage long-term occupancy of reservoirs because of increased distance between water and bankside cover when levels drop. In Utah, a small number resides in Lake Powell, possibly denning at the ends of isolated coves (Bill Bates, Utah Division of Wildlife Resources, personal communication). In Colorado, otters are year-round residents in Williams Creek Reservoir which experiences minimal fluctuations. Conversely, they will bear and raise young but not winter in Vallecito Reservoir which experiences much greater fluctuations (Scott Wait, Colorado Division of Wildlife, personal communication). The species is also detected occasionally in Navajo Reservoir on the Colorado-New Mexico state line (CDOW 2003), but it is unknown how consistently they use this water body.

4.3 Food Habits

Food availability and the distribution of foraging sites exert the strongest influence on river otter habitat selection (Melquist and Hornocker 1983). Diets are almost exclusively comprised of aquatic foods, with fish representing >90% of the diet. However, where abundant, crayfish may constitute up to 100% of the diet on a seasonal basis (Grenfell 1974). A variety of alternative prey species supplement their diet including frogs, insects, and an occasional bird, snake, or small mammal (Lagler and Ostenson 1942, Wilson 1954, Ryder 1955, Hamilton 1961, Knudsen and Hale 1968, Toweill 1974, Toweill and Tabor 1982, Melquist and Hornocker 1983, Serfass 1984, Reid et al. 1994). The diversity of prey used by river otter was reviewed by Hansen (2003).

Otters are highly opportunistic predators, and the particular species of fish preyed upon is largely determined by the distribution, abundance, swimming ability, detectability, and habitats used by potential fish prey and the quality of in-stream structure. Slower fish are more susceptible to otter predation. Diets will change in relation to spatial and seasonal variability in the availability of different fish species (Hansen 2003).

It has been theorized that 1) otters do not prey upon trout and other salmonids because of their superior swimming ability and ability to utilize escape cover and 2) otters are beneficial to game fish by preying upon "less desirable" species (Ryder 1955, Toweill and Tabor 1982). However, otters do prey upon trout and salmon where these species are available (Melquist and Hornocker 1983), although they are usually not the main species targeted by otter (Melquist and Dronkert 1987 in Hansen 2003). Complexity of aquatic systems makes it extremely difficult to determine the relative effects on trout and other game species, although the availability of slower, less desirable (to anglers) species such as suckers and carp is a good predictor that trout will be less often taken by otters.

Adult otter energy requirements are estimated to be 1,394 kcal /day (Fitzgerald et al. 1994) equating to daily consumption between 0.9 kg (1.98 lb.) and 1.5 kg. (3.3 lb) (Serfass et al. 1990) of fresh fish per day; data for crayfish consumption were not included. Given these requirements, river otter populations require relatively productive habitats that ensure an available food supply throughout the spectrum of seasonal flow rates and environmental conditions (Bottorf et al. 1976, Tango 1988, Britt 1980, Serfass 1984).

4.4 Water Quantity, Quality and Toxicological Concerns

Maintaining adequate water flows throughout the year is important as this is a primary determinant of fish abundance and diversity (Toweill and Tabor 1982). Given the diversity of aquatic systems inhabited by river otters, it is difficult to quantify minimum flows required by otters. The species can probably tolerate fairly low flows as long as healthy fish populations are maintained and other ecological needs are met (i.e., den sites). For the purposes of delineating suitable habitat for reintroductions in New Mexico, we defined adequate mean monthly flows as $\geq$10 cubic feet per second (CFS) following Fitzgerald et al. (1994).

Water pollution adversely affects river otter food supplies and foraging habitats. Otter habitat use has been positively correlated with neutral pH levels, low levels of turbidity, and low nitrite concentrations (Shackleford 1995). Conversely, heavy metals, pesticides, and other pollutants can reduce fish abundance and diversity and the availability of invertebrates and other alternative food sources (Bottorff et al. 1976, Britt 1980, Serfass 1984), so otters generally are not found in heavily polluted waters (Serfass 1984, Cardoza 1986, Tango 1988, Shackleford 1995). Sedimentation may negatively affect otter foraging efficiency (Lehman 1979); otters likely avoid waters with low clarity (Melquist and Dronkert 1987). However, otters do inhabit rivers that experience temporary/seasonally high levels of turbidity (Lehman 1979),

Studies have shown that otters are sensitive to environmental pollutants. Residues of mercury (Wren 1985, Ben-David et al. 2001) and other heavy metals, polychlorinated biphenyls (PCBs) and pesticides (Mason and O'Sullivan 1992), and petroleum products (Bowyer et al. 1995, Ben-David et al. 2002) have been shown to have adverse effects in otters. However, most studies of toxic levels of these substances are based on laboratory experiments, and not on wild otter populations. In laboratory experiments, dietary levels of 2 parts per million (PPM) mercury were lethal to otters, and that prolonged exposure to < 2 PPM negatively affected otter behavior (O'Conner and Nielsen 1981).

The accumulation of mercury in otter tissues is a concern where studies have been done in the northeast U.S. (e.g.,Yates et al. 2004). Methylmercury has been found to exceed EPA criterion for fish in New England (Kammen et al. 2005), where the primary source of mercury is industrial emissions and acid deposition. In the Southeastern U.S., mean mercury concentrations found in otter tissues in Georgia suggested that adverse effects of contaminants on wildlife species may be associated with population declines in parts of their range (Halbrook et al. 1994). Spatial variation in mercury concentration is pronounced, and is influenced by differences in type of soil deposits, and local and long-range aerial transport from regional or extra-regional industrial centers (Fortin et al. 2001). Thus far, mercury intoxication has only been previously reported in one wild river otter in North America (Wren 1985), and otter populations persist in waters containing mercury in the eastern U.S.

Likewise, otter populations persist in areas with organochlorine pesticide residues. Although residues of PCBs can affect otter reproductive success in laboratory experiments (Mason and O'Sullivan 1992), comparable tissue concentrations in wild animals were rarely found in a study of otter populations in Norway, Scotland, Ireland and Portugal, where otter populations are thriving (Mason and O'Sullivan 1992).

Otters represent the top trophic level in riverine systems, and therefore are susceptible to adverse effects of bioaccumulation which include reproductive failure and physiological impairment (Melquist and Dronkert 1987). The decline of river otters on the lower Columbia River was attributed to DDT and PCBs, pollutants which adversely affected otter reproduction (Halbrook et al. 1981). Runoff from mines have contributed to population declines and avoidance of drainages with otherwise suitable habitat (Mowbray et al. 1979, Mack 1985). The near extirpation of river otters (*Lutra lutra*) in the United Kingdom was atributed to the effects of Aldrin and Dieldrin on reproduction, and otter populations have rebounded following the ban of these pesticides (Strachan and Jefferies 1996).

4.5 Home Range and Population Density

Otters inhabiting riverine systems have linear home ranges. Within a home range, otter activity is concentrated around core activity centers which are sites that possess abundant prey, in-stream structure, and secure denning and rest sites (Melquist and Hornocker 1983). Activity centers often change in response to seasonal variability in prey abundance and availability.

Otter densities in the mountains of Idaho were estimated to be 1 adult per 2.4 river miles and 1 breeding female per 12 river miles (Melquist and Hornocker 1983). Densities have not been measured in the Southwest, but rough estimates are available. In Arizona, 50-75 otters inhabit approximately 50 miles of the Verde River; the population is slowly expanding (Pat Barber, Arizona Game and Fish Department, personal communication). In Colorado, up to 100 otters inhabit 30-35 miles of the Piedra River and approximately 40 otters inhabit 25-30 miles of the Pine River; these populations have stabilized (Scott Wait, Colorado Division of Wildlife, personal communication). In Utah, a population of 250-300 otters is in the expanding stage and currently inhabits possibly 200 or more miles of the Green River and its tributaries (Bill Bates, Utah Division of Wildlife Resources, personal communication). These equate to densities of 1 otter per river mile in Arizona, 2 otters per river mile in Colorado, and possibly 1 to 1.5 otter per river mile in Utah.

Based on data from adjacent states, and for the purposes of this Feasibility Study, we conservatively estimate that 1 otter per river mile is a reasonable population density in the larger river systems of New Mexico, provided that habitat and prey availability are adequate and human impacts are minimal.

5.0 River Otter Restoration

5.1 Overview

Since 1976, viable river otter populations have been established in 21 states and feasibility studies for otter restoration in Grand Canyon National Park in Arizona and the Escalante River in Utah are currently in progress. Nineteen reintroduced populations are stable or growing. Numbers of river otter released at each site have ranged from 11 to 845, totaling 4,286 individuals. A private company in Louisiana, which supplied >2,400 otters to 14 programs, represented the primary source population for reintroduction. Criteria for selecting source populations for river otter included the availability and ease of obtaining otters, success with other reintroductions, and geographic proximity to release sites.

5.2 Restoration in Southwestern States

Colorado, Arizona, and Utah, have reintroduced otters to several rivers. Colorado released 114-122 otters into five watersheds between 1976 and 1991 (J.E. DePue and P. Schnurr, personal communication, 2003). Utah released 58 otters into the Green River near the Colorado/Utah border between 1989 and 1992 (Bill Bates, Utah Division of Wildlife Resources, personal communication, 2003). Arizona released 46 otters into the Verde River in central Arizona

between 1981 and 1983 (Britt et. al., 1984); the species is now established from Horseshoe Reservoir upstream to above Perkinsville, Yavapai County. Reintroduced river otter populations in all three states have persisted and are considered to be stable to growing. Agency personnel believe these projects were successful and the restoration programs generated a public relations benefit for their wildlife departments.

All three states conducted a qualitative assessment of waterways in their states, and developed rankings through information provided by literature review. In addition, Colorado compared potential sites with sites supporting viable otter populations in other states. Waterways identified as potential release sites were then surveyed on the ground. Waterways that received high rankings had historic records of otters, significant amounts of public land bordering the river, sufficient perennial water flow throughout the year, abundant and diverse prey, healthy and diverse riparian habitat, good water quality, remoteness and inaccessibility, little human disturbance, potential for population expansion, and low potential for impact on endangered and threatened species. These criteria were adapted for use in the current Feasibility Study (see Appendices A and B).

Otters released in Colorado were obtained from Newfoundland, Washington, Oregon, Michigan, Wisconsin, Minnesota, Alaska and California; the majority of otters came from Wisconsin, Minnesota and Oregon (Pam Schnurr, Colorado Division of Wildlife, personal communication 2005; J. Kike, personal communication). Otters restored to Utah were primarily from Alaska, although they obtained a small number from Nevada (Bill Bates, Utah Division of Wildlife Resources, personal communication, 2003; Bates 1988). Otter released in Arizona were all obtained from Louisiana (Britt et. al., 1982; Britt and Phelps 1980).

The primary consideration in selecting source stock was the availability and ease with which otter could be obtained. However, all three states also attempted to obtain otter from sources with climate and habitat similar to that present at their proposed release sites. Utah and Colorado investigated the subspecies delineation of their historic otter populations.

River otter reintroduction generated a high level of public interest and support. Students in classes throughout Utah raised $10,000 for the capture and transport of otter as part of an Adopt an Otter program initiated by the Utah Division of Wildlife Resources. Colorado used the river otter recovery to promote their non-game income tax check-off program, which has generated 11 million dollars since its inception in 1977. The Colorado Division of Wildlife still has a significant number of volunteers involved in monitoring Colorado's river otter populations (Pam Schnurr, Colorado Division of Wildlife, personal communication 2005).

Predation at fish hatcheries and private ponds following restoration in some states has occurred but has been uncommon (Bill Bates, Utah Division of Wildlife Resources, personal communication, 2003; Pam Schnurr, Colorado Division of Wildlife, personal communication, 2003; Bill Burger, Arizona Game and Fish Department, personal communication, 2003). Some hatcheries had to be fenced to prevent depredation (Bill Bates, Utah Division of Wildlife Resources, personal communication), and otter removal has been done in Arizona on occasion when conflict with hatchery operations occurred (Bill Van Pelt, Arizona Game and Fish Department, personal communication, 2006).

No declines in fish populations have been clearly documented as a result of reintroduction projects in the Southwest and complaints from fishermen have been infrequent (Bill Bates, Utah Division of Wildlife Resources, personal communication, 2003; Pam Schnurr, Colorado Division of Wildlife, personal communication, 2003; Bill Burger, Arizona Game and Fish Department, personal communication, 2003). One exception to this is the montane portion of the Piedra River and one of its tributaries, Williams Creek. Five thousand fingerling trout are planted in these streams annually, but 7,000 adult trout are estimated to be consumed by otters (Scott G, Colorado Division of Wildlife, personal communication). One reason for the heavy toll on trout may be that few other fish species are available as prey in this river system.

Four species of endangered fish inhabit Utah's Green River and all are currently increasing in the presence of otters (Bill Bates, Utah Division of Wildlife Resources, personal communication). However, the imperiled bluehead sucker has dwindled in areas of Colorado where otters reside (Scott Wait, Colorado Division of Wildlife, personal communication) although the cause of the declines has not been determined.

Beaver trapping is one area of conflict with otter restoration. Colorado worked closely with the Colorado Trappers Association to develop beaver trapping regulations that were acceptable to trappers. These included a temporary prohibition on beaver trapping in a zone surrounding each release site, and a request that beaver trappers voluntarily use trapping techniques and technologies that minimized incidental take of otters. Utah closed the Green River to beaver trapping. Arizona had beaver trapping restrictions around their release site, but these sites did not receive significant beaver trapping pressure prior to otter reintroduction (Britt and Phelps 1980).

Periodic surveys have been used to document persistence and overall distribution of reintroduced river otter populations. Arizona conducted yearly surveys at the release site for four years post-release and resumed them in 1998 (Christensen 1984; Bill Burger, Arizona Game and Fish Department, personal communication 2003); at present, Arizona does not have a good estimate of numbers (Bill Van Pelt, Arizona Game and Fish Department, personal communication, 2006). Colorado conducted follow up surveys at each release site at least once within five years post-release and recently conducted an extensive survey of 11 rivers in western Colorado (J.E. DePue and P. Schnurr, personal communication, 2003). Utah conducted post-release surveys, but no recent surveys have been conducted. These surveys have provided information on relative abundance and distribution but have yielded only estimates of population size or density.

5.3 Natural Colonization as an Alternative to Restoration Projects

One potential alternative to conducting otter restoration in New Mexico through release of translocated animals is to wait for otters in adjacent states to colonize one or more river systems in the state. Otters from Rocky Mountain National Park have emigrated to Grand Junction, a distance of 70 miles by river (Scott Wait, Colorado Division of Wildlife, personal communication) and have traveled over 200 miles down the Gunnison River in Colorado to the Colorado River in Utah (Bill Bates, Utah Division of Wildlife Resources, personal

communication). These reports demonstrate that otters can colonize habitats separated by considerable distances if areas are in the same river system.

Natural recolonization of otters to New Mexico from Texas via the Rio Grande is unlikely. Otters are restricted to the eastern one-quarter of Texas with a small number of records near the mouth of the Rio Grande (John Young, Texas Parks and Wildlife Department, personal communication, 2004) The mouth of the Rio Grande is a distance of over 900 river miles from New Mexico.

In Colorado, there are no known otter populations in the Rio Grande or any of its tributaries, although there has been one recent unconfirmed sighting of an otter by a fisherman in the Rio Grande near Creede, Colorado (Pam Schnurr, Colorado Division of Wildlife, personal communication, 2005). Otters reside in the Gunnison, Dolores and San Juan river systems in Colorado. River otter from these systems could possibly recolonize the Rio Grande drainage in Colorado at some point in the future. However, these river systems are separated from the Rio Grande by high mountain ranges. Thus, it is unlikely that river otters from existing populations in Colorado will naturally recolonize the Rio Grande in New Mexico in the near future.

Otter released into the Verde River in Arizona could conceivably disperse into the Gila River system in New Mexico. However, the lack of suitable riverine habitat for many miles in the Phoenix metropolitan area provides a significant barrier to downstream dispersal. Otters could potentially move upstream on the Salt River (Bill Burger, Arizona Game and Fish Department, personal communication, 2003). The population on the Verde River is still relatively small, so dispersal appears unlikely in the near future (Bill Burger, personal communication, Arizona Game and Fish Department, 2003).

A computer model to evaluate the potential for natural recolonization of the Grand Canyon by river otters from the Upper Colorado River Basin indicated it would take between 45 and 134 years for otters to naturally recolonize the Grand Canyon in the lower Colorado River basin (Ben-David 2002). Thus, natural recolonization of most of New Mexico's rivers will be a slow process even under the best of circumstances. The one exception is the San Juan River, where established river otter in the Piedra River of Colorado may currently be moving into the Navajo Reservoir area.

River otters in adjacent states possibly could recolonize New Mexico's rivers, as may be occurring in the San Juan River system, but in all cases (other than the San Juan) would have to travel significant distances across dry land and through many miles of poor habitat, thus making successful establishment highly unlikely. Even if otters were to establish in the San Juan of New Mexico, they would be unable to reach any other river systems in the state.

6.0 Potential for River Otters in New Mexico

6.1 Field Surveys for Possible Extant Otters

Despite the limited evidence for river otter in New Mexico, the potential remains for the existence of a small, remote population. As a result, systematic surveys of major rivers were

completed by volunteers, contractors, and NMDGF personnel. The purpose of these surveys was to 1) ascertain whether any remnant otter populations exist and 2) qualitatively assess the riparian ecosystems along these waterways. The reaches of major rivers surveyed to date include the upper Rio Grande, middle Chama, middle Gila, lower Gila, and lower San Francisco (e.g., Conn and Klingel 2004; Crowl and Klingel 2005a-b; Klingel and Conn 2003; Klingel and MacDonald 2002; Polechla et al. 1994; Stahlecker 1986). These reaches were selected because they represent the best potential habitat in New Mexico, and the apparent absence of river otters in these areas would suggest that no remnant population of the Southwestern river otter exists in the state. No otters or otter sign were observed during these surveys and descriptions of these reaches are provided in Appendix B. In addition, the NMDGF has not received any credible (i.e., substantiated) reports of river otter in New Mexico for at least 20 years.

6.2 Habitat Evaluation

Six rivers (Rio Grande, Canadian, Cimarron, Pecos, Gila and San Juan rivers) and their major tributaries were evaluated as potential river otter habitat. A review of the literature on river otter habitat requirements provided information that was used to develop a set of evaluation criteria. Initial assessment focused primarily on the mainstem in each river system. The mainstem is likely to support a higher biomass of river otter prey than its tributaries. If the mainstem of the major river in the river system could not support river otters, then it was unlikely that its tributaries could. In addition, reintroduced populations established in tributaries in other states have often moved downstream and colonized the mainstem of the major river in the river system over time. Thus, it might not be advisable to reintroduce otter in tributaries if the mainstem does not have reaches that provide high quality river otter habitat.

To be considered as a possible otter reintroduction site, a river reach had to have minimum requirements that included historic records of river otter occurrence within the river system; segments $\geq$20 miles long that were surrounded by >50% public land that is remote and largely inaccessible; and a minimum mean monthly and lowest recorded monthly flows each $\geq$10 cubic feet per second (CFS). The minimum stream length and minimum for adjacent public land are based on successful reintroduction efforts in adjacent states, particularly Colorado; minimum flow requirement follows Fitzgerald et al. (1994).

If the above-mentioned minimum criteria were met, sites were evaluated with numerical scores for 10 parameters (identified A through J):

A. Potential for Natural Recolonization
B. River Miles of Suitable Contiguous Habitat
C. Human Activity and Land Management
D. Water Quantity
E. Prey Availability
F. Water Quality
G. Riparian (Streamside) Habitat
H. Stream Structure
I. Potential for Connectivity (between Populations)
J. Potential for Threatened, Endangered, or Sensitive (TES) Species Conflicts

Numerical scores for each criterion ranged from 1 to 3, representing low to high quality conditions, respectively. Scores for each of the reaches within a given river system were added together to rate the entire riverine complex (Appendices A and B).

6.3 River Reaches Eliminated from Consideration in Potential Restoration

The Canadian, Pecos, and San Juan River systems did not meet the initial minimum criteria, and thus were excluded from detailed consideration as potential restoration sites. One reach that was considered initially as a possible release site (upper San Francisco River) was subsequently eliminated.

Canadian River: The Canadian River is surrounded primarily by private land, does not contain a reach of at least 20 miles of adjacent public land, and monthly flows of 0 CFS have been recorded.

Cimarron River: this tributary to the Canadian, is similarly affected by low flow and lack of adjacent public lands.

Pecos River: Two reaches of the Pecos River are surrounded primarily by public land, separated by a large middle section which is surrounded primarily by private land. The upper section consists of an approximately 30 mile reach from the source of the Pecos River to the town of Pecos, NM and is surrounded by > 50% public land. However, only the upper 14 mile segment is remote and inaccessible. The lower 16 mile segment closely parallels a major road, State Route 63, and receives high levels of recreational use. The middle section of the Pecos River, from Pecos to Hagerman New Mexico, is surrounded primarily by private land. Throughout this entire middle section of the Pecos, the river often parallels or crosses major roads and flows through numerous communities. There is no reach of greater than 20 miles within this segment that is remote and inaccessible. Finally, a monthly flow of 0 CFS was recorded within this reach for four months in 1956 (September-December), which indicates that it may not always have adequate water to support sufficient prey. The lower section of the Pecos River consists of an approximately 54 mile reach, from the confluence with Rio Felix, near Roswell, downstream to the New Mexico-Texas state line. Within this reach, approximately 52% of the land within five miles of the river is publicly owned. Monthly flow dropped to 1 CFS in the past (August 1964) indicating that flow in this reach may drop to levels that may not support an adequate amount of river otter prey. In addition, no historic records of otters in the Pecos are available and a number of threatened, endangered or sensitive fish species occur in the Pecos River and its tributaries.

San Juan River: The San Juan River was separated into two major sections for analysis. The first section consists of a 62 mile reach from the end of Navajo Reservoir to the Navajo Reservation, just past Waterflow, New Mexico. Approximately 50% of the land within five miles of this reach is publicly owned. However, parts of this reach also receive heavy recreational and agricultural use. No major portion is remote and inaccessible. The second major section consists of the approximately 43 mile reach from a point just before the river enters the Navajo Reservation, near Waterflow to the Colorado state line near the Four Corners. This reach is almost completely surrounded by tribal land. Although this reach does not meet the

requirement of being surrounded primarily by public land, it does meet the remaining minimum requirements. It is relatively remote and inaccessible. There are no major roads that parallel or intersect this segment, and it receives a relatively low level of human use. There is an adjacent reach in Utah that is also relatively remote, inaccessible, and receives a low level of human use. The San Juan River also has high water flows; the lowest recorded monthly flow was 259 CFS (August 1978). Thus, this reach may have the potential to provide high quality river otter habitat. However, no segment of the San Juan greater than 20 river miles met all of the minimum criteria.

In addition, river otters from populations that were established by reintroductions in Colorado and Utah are present in the San Juan River on either end of the reach that flows through New Mexico. Therefore, this reach has relatively high potential for natural recolonization; evidence of otter presence at Navajo Reservoir suggests such recolonization may be occurring. Given these factors, no portion of the San Juan was considered a priority reach.

Rio Grande. Two reaches of the Rio Grande were eliminated from primary consideration: the reach from Cochiti Reservoir downstream to the Texas border, and a smaller reach from the Taos Junction Bridge downstream to the Otowi Bridge in northern New Mexico. The former reach was considered sub-optimal due to intensive development of the river valley for urban, suburban, and agricultural uses, and highly reduced surface flows in the river during much of the year due to water withdrawals. The reach below Taos Junction Bridge, near the Rio Pueblo de Taos, is far less impacted by human use, but has been developed for human residences, agriculture, and recreation. In addition, much of this reach is paralleled by highways which allow ready access by humans. Although this reach has historic records of otter occurrence, and would likely serve as a suitable corridor for otter movement and possibly even support a small number of river otters, it would not be suitable as an area for an initial restoration project given the proximity of humans and human development.

Upper San Francisco River. Although originally given consideration as a priority reach, the recorded low flows, issues associated with adjacent private-land ownership, and lack of detailed habitat data suggested this reach should not be considered a priority reach.

6.4 River Reaches of Primary Consideration in Potential Restoration

The Rio Grande and the Gila River drainage systems have reaches that meet all initial criteria. For the Rio Grande, this includes two reaches in the mainstem of the Rio Grande, and one reach in the Rio Chama, which is a major tributary of the Rio Grande. There are historic records of river otter from both the Rio Grande and Gila River drainage systems, although not from all reaches being considered within these systems.

The Rio Grande system has three reaches that meet all three of the initial criteria:

1. Rio Grande from the Colorado state line downstream to the Taos Junction Bridge near the Rio Pueblo de Taos confluence;

2. Rio Grande in White Rock Canyon from Otowi Bridge to Cochiti Lake;

3. Rio Chama from El Vado Reservoir to Abiquiu Lake.

The Gila River system has three major reaches that meet all three of the initial criteria: two reaches in the mainstem of the Gila River, and one in the San Francisco River, a major tributary of the Gila River. In the Gila the two reaches that were given more detailed consideration are adjacent to one another; they are being considered separately because of major differences in land ownership. The reaches to be given more detailed consideration in the Gila watershed are:

1. Upper Gila River: from the confluence of the Gila and the East Fork of the Gila to the confluence with Mogollon Creek;

2. Lower Gila River: from the confluence with Mogollon Creek to the Arizona state line;

3. Lower San Francisco River: from the San Francisco Hot Springs (below Pleasanton) to the Arizona state line.

These reaches are discussed in more detail in Appendix B.

7.0 Toxicology Concerns in New Mexico

The geology and history of mining in New Mexico has resulted in a number of rivers in the state being impaired to various degrees due to metal contaminants. In most cases, these contaminants are of concern due to their effects on strictly aquatic life, including fishes. In terms of potential otter restoration, two separate concerns have been identified: contamination that impacts the prey base for otters in a river system; and contamination that has the potential to bioaccumulate in prey species and, ultimately, in otters, thus directly compromising the survivorship of these animals. As discussed in section 4.4, otters may be susceptible (as top predators in an aquatic ecosystem) to certain contaminants such as methylmercury, organochlorines, and PCBs that could accumulate in their body tissues and ultimately impair their survivorship.

At present, there is insufficient data on concentrations of pollutants in waters or bioaccumulation in fish or otters, and therefore an inadequate body of knowledge to create a general model of otter susceptibility to pollutants in New Mexico. Although some reservoirs in New Mexico have been studied in terms of bioaccumulation of toxicants in fish tissues, available data are lacking from many reaches and all free-flowing rivers in the state (G. Schiffmiller, New Mexico Environment Department, personal communication, 2006). Studies of pollutant impacts on otters in North America have focused primarily in the northeast and southeast parts of the continent, regions with higher human population densities and more intense river pollution. New Mexico does not have as many industrial point sources or toxic surface runoff as parts of eastern North America. Adverse impacts of acid deposition, for example, has largely occurred in eastern coniferous forests with acidic and tannic waters and aerial industrial inputs, mostly absent in New Mexico. In addition, there are currently no warnings against human consumption of fish in riverine habitats in New Mexico, only in warm-water reservoirs. In general, the effects of chronic and/or synergistic exposure of pollutants on river otters are unknown at this time (Melquist et al. 2003).

Should this Feasibility Study for otter restoration in New Mexico be approved, the NMDGF will collect fish samples from the river reach where initial restoration has been proposed and contract an analysis of these samples for constituents of concern (methylmercury, organochlorines, and PCBs). Results will be provided to the New Mexico Environment Department and other specialists in ecotoxicology and an evaluation will be made if the detected levels of these constituents pose a potential hazard to otters that may be released in this reach. Should the samples indicate that toxicant levels are a significant risk to otter restoration, the NMDGF will consider one or more of the alternative reaches for restoration and will conduct additional toxicology analyses as needed to determine if the alternative reach or reaches are suitable for restoration.

8.0 Socioeconomic Considerations

Public input received during early phases in development of this Feasibility Study (see Appendix C) indicated a range of opinions about the socioeconomic effects of restoration on New Mexicans. Although a majority of participants in the public meetings and those who provided written comments on proposed otter restoration were supportive, concern was expressed by some members of the public that restoration could result in negative effects on New Mexicans and

their livelihood. The primary concerns centered on the effect of river otters on native fisheries and non-native gamefish populations and the possibility that other water and land uses in any area of restoration could be curtailed by restoration.

Restoration of river otters in one or more river systems in New Mexico is not expected to have significant social or economic impacts to residents of the state. A major consideration in the selection of a potential restoration site is the remoteness from human activities such as agricultural and residential uses and from private lands. Intensively-used reaches of rivers, where conflicts between humans and otters are most likely, are not considered suitable sites for otter restoration. The best locations for potential restoration are remote reaches, bordered by public lands, where human activity is limited.

Adverse effects of restored otters on important fisheries, either native or non-native, remains a small possibility. However, reaches where a diversity of fish species are absent are considered poor areas for possible restoration. A diverse prey base, including non-native and undesirable species such as carp, suckers, and crayfish provides the best potential for successful restoration. Introduction of otters in such situations may also lead to an improved fishery by reducing the number of undesirable fishes. In addition, non-native species such as crayfish and bullfrogs, which also would provide food for otters, could be similarly reduced in reaches where otters have been restored.

Many anglers and recreationists (such as hikers and rafters) who use the more remote river reaches in the state where otter restoration would likely be most feasible have expressed positive opinions for restoration (see Appendix C). According to many fishing guides, having otters in fishing waters provides an “added value” to the fishing experience while also providing a practical benefit in the culling of non-native and undesirable species of fishes (T. Streit, personal communication, 2006; Salmon 2005). Such added value to outdoor experiences can provide economic benefits if the presence of otters serves as an additional draw for recreationists.

One likely impact to river use that could occur in association with otter restoration is limitation (or, more likely, change in technique of) beaver trapping in the immediate area where otters are released. Given that any release site would be in a remote area, the number of beaver trappers affected would be small. A successful restoration of otters in one or more reaches could lead to eventual reclassification of the river otter as a harvestable furbearer in the state.

An economic analysis prepared by Kroeger (2005) suggests significant economic benefits could accrue for the state of New Mexico from river otter restoration. However, it is difficult to assign monetary value to restoration and much would depend on the success of such a program, the accessibility of the restoration site to the interested public, and the desire of State and local interests to promote otters as a tourism draw.

9.0 Conclusions and Recommendations

Information presented in the reach analysis in Appendix B and summarized in Table 1 indicates that suitable habitat and conditions for river otter does still exist in New Mexico and therefore restoration of otters in or more of the priority reaches under evaluation is feasible. Our evaluation

of the six reaches under consideration did not demonstrate that one particular reach was significantly superior to the others. This is mainly because the methodology we used had relatively low power to separate out these reaches from each other, and the data available in many cases was incomplete or somewhat subjective. In addition, the six priority reaches under evaluation were already considered to be potentially highly suitable for otters prior to our evaluation and therefore were likely to score similarly in most respects.

The six priority reaches in descending order based on cumulative scores are:

1. Upper Rio Grande
2. White Rock Canyon (Rio Grande)
3. Upper Gila River
4. Lower San Francisco River
5. Lower Gila River
6. Rio Chama (middle reach)

Both of the Rio Grande mainstem reaches scored high primarily because of highly reliable river flows (which contribute to a fishery with larger species), good habitat that is largely unaltered, and relative isolation from human activities. In the case of the upper reach of the mainstem Rio Grande, long contiguous habitat was also an important factor. Although the reaches in the Gila basin scored lower, we believe these could also be suitable should an approved initial effort in the Upper Rio Grande prove successful. Smaller and less reliable river flows, a possibly less reliable fish prey base, and conflicts with management of other aquatic wildlife in these reaches are the main challenges to otter restoration in the Gila basin.

In summary, we conclude the Upper Rio Grande has the greatest potential for a successful pilot restoration effort for the following reasons:

1. Reliable perennial flows even during periods of severe drought.
2. An established fishery, including many “rough fish” species such as carp and white sucker that are suitable as prey and whose control by otters could benefit native fishes.
3. Suitable in-stream and riparian habitat that is relatively undisturbed.
4. Long stretches of river that are not readily accessible to the public other than recreationists (e.g., rafters).
5. Relatively little human use and therefore little conflict with human activities.
6. Adjacent public lands administered by BLM, an agency which has already indicated its desire to participate in otter restoration in this reach as part of its Rio Grande Corridor Plan.
7. Historical presence of otters in or adjacent to this reach.
8. Low potential for conflict with management of threatened, endangered, or sensitive species.
9. Low potential for otters to naturally colonize this reach.
10. Fairly good potential for otters to move into other suitable reaches of the Upper Rio Grande near the restoration area (e.g., White Rock Canyon).

If this Feasibility Study is approved and the NMDGF is authorized to proceed with implementation of otter restoration in the Upper Rio Grande, the agency would begin on the following tasks:

1. Collection and analysis of fish samples from the Upper Rio Grande to determine of toxicological threats to otters are present in this reach.
2. Identification of a source or sources outside of New Mexico for purchasing and/or trapping otters. Other states in the past have used commercial sources of otters, such as one that formerly operated in Louisiana, to supply otters. At present no commercial source for otters has been identified.
3. Identification of number of otters to release in initial restoration effort. The Upper Rio Grande has been reported to have adequate resources to support 14-18 river otters (Polechla 2000) although, based on extrapolation from restoration programs in adjacent states, an estimated 50 otters could potentially survive in this reach. Based on restoration efforts in Colorado, a release of 50-75 otters has been recommended in any restoration site to ensure success due to mortality and emigration (Tom Beck, personal communication). Based on available information, we propose an initial release would likely involve approximately 20 adults (all equipped with radiotelemetry transmitters), with augmentation of additional animals in subsequent years if deemed necessary.
4. Consultation and coordination with land management agencies and other stakeholders in the Upper Rio Grande Basin to ensure that all known or potential issues associated with restoration are addressed. The BLM, Taos Pueblo, and State of Colorado (i.e., CO Division of Wildlife) would be among the entities that NMDGF would contact.
5. Develop cost estimate and secure funds through within-agency sources and possibly exterior sources for funding the purchase/trapping of otters, support services (including veterinary), radiotelemetry equipment, etc. Post release monitoring of otters would also have to be factored into budgets for the next several fiscal years at least.
6. Contracting or acquiring in-kind support for work. Due to manpower shortage, the NMDGF would likely have to contract much of the support work.

Table 1. Scoring of six New Mexico priority river reaches as potential River Otter restoration sites based on ten parameters (A-J) for evaluating suitability. See Appendix A for explanation of the numerical scoring system and Appendix B for information and discussion of scoring.

River Reach	A. Natural Recolon-ization	B. Contig. Habitat	C. Human Activity/ Land Mgt.	D. Water Quantity (Mean)	E. Prey Avail.	F. Water Quality	G. Riparian Habitat	H. Stream Structure	I. Connect-ivity	J. TES Species Conflicts	Total Score
Upper Rio Grande	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**28**
White Rock Canyon	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**26**
Rio Chama	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**23**
Upper Gila	**3**	**2**	**3**	**1.7**	**2**	**3**	**3**	**3**	**3**	**1**	**24.7**
Lower Gila	**3**	**3**	**2**	**2.3**	**2**	**3**	**1**	**2**	**3**	**2**	**23.3**
Lower San Fran.	**3**	**1**	**3**	**1.3**	**2**	**3**	**3**	**3**	**3**	**2**	**24.3**

10.0 LITERATURE CITED

Bailey, V. 1931 (= 1932). Mammals of New Mexico. North American Fauna 53:1-412.

Bates, B. 1988. Reintroduction of the river otter in Utah. Utah Division of Wildlife Resources. Unpublished Report.

Beck, T.D.I. 1993. River otter reintroduction procedures. Colorado Division of Wildlife Research Review. Colorado Department of Natural Resources, Denver. 2:14-16.

Ben-David, M. 2002. Can river otters naturally recolonize the Grand Canyon? River Otter Journal 11(1):4-5.

Ben-David, M., G.M. Blundell, and J.E. Blake. 2002. Post-release survival of river otters: Effects of exposure to crude oil and captivity. J. of Wildlife Management 66: 1208-1223.

Ben-David, M., L.K. Duffy, G.M. Blundell, and R.T. Bower. 2001. Exposure of coastal river otters to mercury: relation to age, diet, and survival. Environmental Toxicology and Chemistry 20: 1986-1922.

Bluett, R.D., E.A. Anderson, G.F. Hubert, Jr., G.W. Kruse and S.E. Lauzon. 1999. Reintroduction and status of the river otter (*Lutra canadensis*) in Illinois. Transactions of the Illinois State Academy of Science. 92(1,2):69-78.

Bluett, R., G. Hubert Jr., E. Anderson, S. Lauzon, and D. Glosser. 1995. Illinois river otter recovery plan. Illinois Department of Natural Resources, Division of Wildlife Resources: Technical Bulletin 7.

Bottorff, J.A., R.A. Wigal, D.Pursley, and J.I. Cromer. 1976. The feasibility of river otter reintroduction in West Virginia. Special Report, West Virginia Department of Natural Resources, Division of Wildlife. 14 pp.

Bowyer, R.T., J. W Testa, and J. B Faro. 1995. Habitat selection and home ranges of river otters in a marine environment: effects of the Exxon Valdez oil spill. J. of Mammalogy 76: 1-11.

Bradley, P.V. 1994. Otter Limits. Natural History. 103: 36-45.

Britt, T.L. 1980. River otter information and a reintroduction proposal for the Verde River. Unpublished Performance Report W-53-R, 6:4, Arizona Game and Fish Department, Flagstaff, AZ.

Britt, T.L., R. Gerhart, and J.S. Phelps. 1984. River Otter Stocking. Unpublished report. Arizona Federal Aid Project. W-53-R-30, WP6-J4 10pp.

Britt, T.L., R.L. Glinki, and J.S. Phelps. 1982. River otter stocking. Unpublished Report, Arizona Federal Aid Project, W-53-R-30, WP6, J4. 13 pp.

Britt, T.L. and J.S. Phelps. 1980. River otter information and a reintroduction proposal for the Verde River. Performance Report W-53-R Work Plan 6, Job 4. Arizona Game and Fish Department, Phoenix, AZ. 21 pp.

Buskirk, S.W. 2000. The conservation status of New World mustelids. In H.I. Griffiths (ed.) Mustelids in a modern world: management and conservation aspects of small carnivore – human interactions. Backhuys Publishers, Leiden. pp 40-51.

Cardoza, J.E. 1986. A preliminary assessment of the status of fisher and river otter in Massachusetts. Massachusetts Division of Fisheries and Wildlife. 31 pp.

Christensen, K.M. 1984. Habitat selection, food habits, movements and activity patterns of reintroduced river otters (*Lutra canadensis*) in central Arizona. Masters Thesis, Northern Arizona University, Flagstaff, AZ.

Colorado Division of Wildlife (CDOW). 2003. State of Colorado river otter recovery plan: revision of 1980, 1984, and 1988 draft plans. Colorado Division of Wildlife, Denver, CO.

Compton, L.A. 2000. Status of southwest river otters, *Lontra canadensis sonora*, in the Colorado River through Grand Canyon National Park. River Otter Journal 9(2):10-11.

Conn, R. and J. Klingel. 2004. River otter (*Lontra canadensis*) surveys of White Rock Canyon, Rio Grande, New Mexico by New Mexico River Otter Working Group (NMROWG). 6 pp. + appendices.

Crowl, J. and J. Klingel. 2005a. General assessment of potential river otter habitat in the Ute Mountain segment of the upper Rio Grande, New Mexico. (Colorado border to Lee Trail): mid August 2005. Report to New Mexico River Otter Working Group.

Crowl, J. and J. Klingel. 2005b. General assessment of potential river otter habitat in the Gila Wilderness segment of the Gila River, New Mexico. (East Fork to Turkey Creek): June 26 – July 1, 2005. Report to New Mexico River Otter Working Group.

Edwards, C. 1979. A report on the distribution, abundance, population trends and habitat requirements for the river otter on the lower Colorado River. Arizona Game and Fish Department. Phoenix, Arizona. 16 pp.

Edwards, T.L. 1983. River otter abundance, distribution, and habitat use in Louisiana. M.S. Thesis, Louisiana State University. Baton Rouge. 43 pp.

Erickson, D.E., C.R., McCullough, and W.R. Porath. 1984. River otter investigations in Missouri, final report. Missouri Federal Aid Project, W-13-R-38, S63, J2. 46 pp.

Findley, J.S., A.H. Harris, D.E. Wilson, and C. Jones. 1975. Mammals of New Mexico. Univ. New Mexico Press, Albuquerque. xxii + 360 pp.

Fitzgerald, J.P., C.A.Meaney, D.M. Armstrong. 1994.Mammals of Colorado. Denver Museum of Natural History and University of Colorado Press.

Fortin, C, G Beauchamp, M Dansereau, & D Bélanger. 2001. Spatial Variation in Mercury Concentrations in Wild Mink and River Otter Carcasses from James Bay Territory, Québec, Canada. Arch. Environ. Contam. Toxicol. 40, 121-127

Halbrook, R.S., J.H. Jenkins, P.B. Bush, and N.D. Seabolt. 1981. Selected environmental contaminants in river otters (*Lutra canadensis*) of Georgia and their relationship to the possible decline of otters in North America. Proceedings of the Worldwide Furbearer Conference 3:1752-1762.

Halbrook, R.S., J.H. Jenkins, P.B Bush, and N.D. Seabolt. 1994. Sublethal Concentrations of Mercury in River Otters: Monitoring Environmental Contamination. Archives of Environmental Contamination and Toxicology 27: 306-310.

Hall, E.R. 1981. The mammals of North America. John Wiley and Sons, New York. 2: 1029-1032.

Hamilton, W.J. Jr. 1961. Late fall, winter and early spring foods of 141 otters from New York. New York Fish and Game Journal. 8:106-109.

Hansen, H. 2003. Food habits of the North American river otter (*Lontra canadensis*). Unpublished manuscript, University of Wyoming. 7 pp.

Harris, C.J.A. 1968. Otters,A Study of the Recent Lutrinae. London: Weidenfeld and Nicholson.

Humphrey, S.R. and T.L. Zinn. 1982. Seasonal habitat use by river otters (*Lutra canadensis*) and everglades mink (*Mustela vison evergladensis*) in Florida. Journal of Wildlife Management 46:375-381.

IUCN. 1998. Guidelines for reintroductions. Cambridge. United Kingdom.

Janlkotzky, M.G. 1982. Reintroduction of river otter in Kananaskis Country Alberta, Canada. M.E.D. Thesis, University of Calgary, Calgary, Alberta. 175pp.

Kammen, N.C. et al. 2005. Mercury in Freshwater Fish of Northeastern North America – A Geographic Perspective Based on Fish Tissue Monitoring Databases. Ecotoxicology 14: 163-180.

Klingel, J. and R. Conn. 2003. River otter (*Lontra canadensis*) surveys of Rio Chama, San Francisco and lower Gila Rivers, New Mexico. Report from New Mexico River Otter Working Group. 8 pp. + appendices.

Klingel, J. and S. MacDonald. 2002. Southwestern river otter, *Lontra canadensis sonora*; summary of taxonomy, legal status, and distribution in New Mexico. Unpublished report to New Mexico River Otter Working Group. 4 pp.

Knudsen, G.J. and J.B. Hale. 1968. Food habits of otters in the Great Lakes region. Journal of Wildlife Management 32:89-93.

Kroeger, T. 2005. Economic benefits of reintroducing river otter (*Lontra canadensis*) into rivers in New Mexico. Report from Defenders of Wildlife, prepared for Amigos Bravos.

Lagler, K.F., and B.T. Ostenson. 1942. Early spring food of the otter in Michigan. Journal of Wildlife Management 6:244-254.

Larsen, D.N. 1983. Habits, movements and foods of river otters in coastal southeastern Alaska. M.S. thesis, University of Alaska, Fairbanks. 149 pp.

Lauhachinda, V. 1978. Life history of the river otter in Alabama with emphasis on food habits. Ph.D. dissertation, University of Auburn, Alabama. 185 pp.

Laviere, S. and L.R. Walton. 1998. *Lontra canadensis*. Mammalian Species 587:1-8

Lehman, L.E. 1979. The Feasibility of River Otter Reintroduction in Indiana. Special Report Department of Natural Resources, Division of Fish and Wildlife. 19 pp.

Liers, E.E. 1951. Notes on the river otter (*Lutra canadensis*). Journal of Mammology. 32:1-9.

Mack, C.M. 1985. River otter restoration in Grand County, Colorado. M.S. Thesis. Colorado State University, Ft. Collins, CO. 134 pp.

Mason, C.F. and S.M. MacDonald. 1986. Otters: Ecology and conservation. Cambridge University Press, Cambridge, MA. 148 pp.

Mason, C.F., and W.M. O'Sullivan. 1992. Organochlorine Pesticide Residues and PCBs in Otters from Ireland . Bulletin of Environmental Contaminants and Toxicology 48: 387-393.

McClellan, J. 1954. An otter catch on the Gila River in southwestern New Mexico. Journal of Mammalogy 35:443-444.

McDonald, K.P. 1989. Survival, home range, movements, habitat use, and feeding habits of reintroduced river otters in Ohio. M.S. Thesis, Ohio State University, Colombus. 142pp.

Mearns, E.A. 1891. Notes on the otter (*Lutra canadensis*) and skunks (genera *Spilogale* and *Mephitis*) of Arizona. Bull. Amer. Mus. Nat. Hist 3:252-256.

Melquist, W.E. and A.E. Dronkert. 1987. River otter. Pp. 626-641 in M. Novak, J.A. Baker, M.E. Obbard, and B. Malloch, (eds.) Wild Furbearer Management and conservation in North America. Ontario Ministry of Natural Resources, Toronto Canada. 1150 pp.

Melquist, W.E. and M.G. Hornocker. 1983. Ecology of river otters in west central Idaho. Wildlife Monographs 83:1-60.

Melquist, W.E., P.J. Polechla, and D. Toweill. 2003. River otter (*Lontra canadensis*). Pp. 708-734, in G.A. Feldhamer, B.C. Thompson, and J.A. Chapman, Wild Mammals of North America: Biology, Management, and Conservation, 2nd ed. Johns Hopkins University Press.

Melquist, W.E., J.S. Whitman, and M.G. Hornocker. 1981. Resource partitioning and coexistence of sympatric mink and river otter populations. Proceedings of the Worldwide Furbearer Conference 1:187-220.

Mowbray, E.E., D. Pursley and J.A.Chapman. 1979. The status, population characteristics, and harvest of the river otter in Maryland. Wildlife Ecology 2:1-16.

O'Conner, D.J., and S.W. Nielson. 1981. Environmental survey of methylmercury levels in wild mink and otter from the northeastern United States and experimental pathology of methylmercurialism in the otter. Proceedings of the Worldwide Furbearer Conference. 3:1728-1745.

Polechla, P.J. 1994. Field reconnaissance for river otters of the upper Rio Grande, Cow Paddy to Lee's Trail, Taos County, New Mexico. Report to BLM and U.S. Forest Service, Taos, NM.

Polechla, P.J. 2000. Ecology of the river otter and other wetland furbearers in the upper Rio Grande. Report to Bureau of Land Management.

Polechla, P.J. 2004. A southwestern river otter (*Lontra canadensis sonora*) and riparian survey of the Lower Gila River., Grant and Hidalgo counties. Report to New Mexico Department of Game and Fish.

Polechla, P.J., A.G. Burns, S. Rist, K.A. Moore, J.W. Dragoo. 2004. First physical evidence of the Nearctic river otter (*Lontra canadensis*) collected in New Mexico, USA, since 1953. IUCN Otter Specialist Group Bulletin 21(2):70-74.

Polechla, P.J., S. DesGeorges, R. Gardiner, B. Hayes, G. Long, and D. Storch. 1994. Field reconnaissance for river otters of the upper Rio Grande, Cow Paddy to Lee's Trail, Taos. County, New Mexico. Report to U.S. Bureau of Land Management, Taos, NM. 19 pp.

Polechla, P.J., Jr., and J.A. Sealander. 1985. An evaluation of the status of the river otter (*Lutra canadensis*) in Arkansas. Final Report, Arkansas Game and Fish Committee, Federal Aid Project Number W-56-23. 157 pp.

Propst, D.L. 1999. Threatened and Endangered Fishes of New Mexico. New Mexico Department of Game and Fish, Tech. Report No. 1.

Raesly, E.J. 2001. Progress and status of river otter reintroduction projects in the United States. Wildlife Society Bulletin 29:856-862.

Reid, D.G., T.E. Code, A.C.H. Reid, and S.M. Herrero. 1994a. Food habits of the river otter in a boreal ecosystem. Canadian Journal of Zoology 72:1306-1313.

Reid, D.G., T.E. Code, A.C.H. Reid, and S.M. Herrero. 1994b. Spacing, movements and habitat selection of the river otter in boreal Alberta. Canadian Journal of Zoology 72:1314-1324.

Rhoads 1898. Trans. Amer. Philosoph. Soc. n.s. 19:431.

Ryder, R.A. 1955. Fish predation by the otter in Michigan. Journal of Wildlife Management 19:497-498.

Salmon, M.H. 2005. The river otter: return of a native? New Mexico Wildlife 50(2):6-7.

Savage, M. 2003. The Case for River Otter Restoration in New Mexico. A Report to the River Otter Working Group. 9 pp.

Schreckengast, G.E. 1988. River otter reintroductions in West Virginia. M.S. Thesis. College of Agriculture and Forestry, West Virginia University. Morgantown, West Virginia. 113 p.

Serfass, T.L. 1984. Ecology and feeding relationships of river otter in northeastern Pennsylvania. M.S. Thesis, East Stroudsburg University. 110 pp.

Serfass, T.L., R.P. Brooks, J.M. Novak, P.E. Johns, and O.E. Rhodes. 1998. Genetic variation among populations of river otters in North America: considerations for reintroduction projects. Journal of Mammalogy. 79(3):736-746.

Serfass, T. L., L. M. Rymon, R. P. Brooks. 1990. Feeding relationships of river otters in northeastern Pennsylvania. Trans. Northeast Sect. Wild. Soc. 47:43-53.

Shackleford, J.T. 1995. Habitat and relative abundance of river otter, (*Lutra canadensis*), in three drainage basins of Southeastern Oklahoma. M.S. Thesis, University of Central Oklahoma, Edmond, Oklahoma. 67 pp.

Sheldon, W.G., and W.G. Toll. 1964. Feeding habits of the river otter in a reservoir in central Massachusetts. Journal of Mammalogy 45:499-455.

Spicer, R.B. 1987. Status of the Arizona River Otter (*Lutra canadensis sonora*) along the Colorado River in Arizona. Arizona Department of Game and Fish, prepared for Office of Endangered Species, USFWS Contract No. 14-16-0002-82 216. Albuquerque, NM.

Stahlecker, D.W. 1986. A survey for the river otter (*Lutra canadensis*) in Taos and Colfax counties, New Mexico. Final report to New Mexico Dept. Game and Fish, Santa Fe, contract 519-75-01. 10 pp.

Strachan, R and D.J. Jefferies. 1996. Otter Survey of England, 1991-1994. Vincent Wildlife Trust, London.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The Fishes of New Mexico. University of New Mexico Press.

Tango, P.J. 1988**.** Home range of reintroduced river otter in West Virginia. M.S. Thesis. Division of Forestry, West Virginia University, Morgantown, West Virginia.

Toweill, D.E. 1974. Winter food habits of river otters in western Oregon. Journal of Wildlife Management 38:107-111.

Toweill, D.E., and J.E. Tabor. 1982. River Otter (*Lutra canadensis)*. Pp. 688-703 *in* Chapman, J.A., and G.A. Feldhamer (eds.). Wild mammals of North America: biology, management and ecology. Johns Hopkins University Press, Baltimore.

Tumlinson, R., M. Karnes, and A.W. King. 1982. The river otter in Arkansas: II. Indications of a beaver-facilitated commensul relationship. Proceedings of the Arkansas Academy of Science 36:73-75.

Van Zyll de Jong, C.G. 1972. A systematic review of the Nearctic and Neotropical river otters. Life Science Contributions, Royal Ontario Museum, No. 80.

Wilson, K.A. 1954. The role of mink and otter as mukrat predators in northeastern North Carolina. Journal of Wildlife Management 18:199-2000.

Wren, C.D. 1985. Probable case of mercury poisoning in a wild otter, *Lutra canadensis*, in Northwestern Ontario. Canadian Field-Naturalist 99: 112-114.

Yates, D., D. C. Evers, and L. Savoy. 2004. Developing a mercury exposure profile for mink and river otter on Maine. BioDiversity Research Institute, Gorhan, Maine, (BRI 2003-05), 24 pp.

Yeager, L.E. 1938. Otters of the delta hardwood region of Mississippi. Journal of Mammology 19:195-201.

Appendix A

Scoring System for Evaluating River Otter Habitat in New Mexico

The following parameters (A through J) were considered in the scoring of each identified priority river reach in regard to its suitability as a potential site for river otter reintroduction. For each parameter, a score of 3 indicates conditions that would be most conducive for otter restoration; a score of 2 indicates conditions that are average for otter restoration; and a score of 1 indicates conditions that are poor for otter restoration. Scores for each variable and each priority reach are provided in Appendix B and summarized in Table 1.

A. Potential for Natural Recolonization

This parameter considers the likelihood that river otters could recolonize a particular reach on their own, thus making restoration efforts unnecessary.

3 = No known river otter occurrence in the river system or in any nearby river system not separated by a large expanse of unsuitable habitat.
2 = Medium potential for natural recolonization. Known river otter occurrence in the river system outside of New Mexico, but a combination of factors make natural recolonization into New Mexico unlikely. Factors could include low population density, large distance to travel, and existence of barriers to dispersal.
1 = High potential for natural recolonization. Known river otter occurrence in the river system in question outside of New Mexico, from which river otter could reasonably be expected to disperse into New Mexico in the near future.

B. River Miles of Suitable Contiguous Habitat

This parameter considers the linear miles of river in which an otter population could exist, based on available reaches in New Mexico and occupied habitat data from adjacent states from text section 4.5.

3 = >50 river miles
2 = 25-50 river miles
1 = < 25 river miles

C. Human Activity and Land Management

This parameter considers adjacent land ownership and percentage of public land surrounding the reach in question within a five mile buffer zone on either side of the river.

3 = Combination of the following:

- Relatively low percentage of private land ownership compared to other considered reaches.
- Little human activity. The majority of the reach is undeveloped, and has a low level of grazing and little degradation of riparian areas.
- No major roads parallel significant portions of the reach.
- A relatively small number of roads intersect the river.
- Large portions of the reach are managed under designations that provide a high level of habitat protection, including any of the following designations: USFS Wilderness Area, USFS Roadless Area, BLM Area of Critical Environmental Concern, BLM Wilderness Study Area, Wild and Scenic River, National Park etc.
- Natural features such as deep canyons or gorges make significant portions of the reach inaccessible.

2 = Combination of the following:

- A moderate amount of private land ownership compared to other considered reaches.
- Medium human activity within five miles of the reach, and particularly activity or land use that could be detrimental to riparian habitat or water quality. A relatively low percentage of the reach is associated with development or degradation of riparian areas from overgrazing or off road vehicle use
- Large portions of the reach are managed by the BLM/USFS/State and receive protection from some types of development .
- Major roads parallel the reach in some places, but large segments of the reach have no major road within five miles.
- A medium number of major and minor access roads intersect and provide access to the reach.
- Natural features make some parts of the reach more inaccessible than reaches given a score of 3, but less inaccessible than reaches given a score of 1.

1 = Combination of the following:

- A relatively high percentage of private land ownership compared to other considered reaches.
- High human activity within five miles of the reach, and particularly activity or land use that could be detrimental to riparian habitat or water quality. A large percentage of the reach is associated with development or a high level of degradation of riparian areas due to overgrazing or off road vehicle use
- Major roads parallel the river within five miles of significant portions of the reach.
- A large number of major and minor roads intersect and provide access to the river.
- No portions of the reach are offered formal protection from uses that may negatively impact river otter habitat.

D. Water Quantity

Information on surface flows in cubic feet per second (CFS) is taken from the nearest U.S. Geological Survey river gauge station on the reach and is based on multi-year data available as

of 2006. The final rank is derived from an average of the three variables (minimum annual mean flow, minimum mean monthly flow, and lowest recorded monthly flow).

We consider a minimum of 10 CFS to be the minimum flow tolerable by otter if pools are available (Fitzgerald et al. 1994).

Mean Annual Flow

3 = > 500 CFS
2 = 200-500 CFS
1 = < 200 CFS

Minimum Mean Monthly Flow

3 = > 50 CFS
2 = 10-50 CFS
1 = < 10 CFS

Lowest Recorded Monthly Flow (ever recorded)

3 = > 30 CFS
2 = 10-30 CFS
1 = < 10 CFS

E. Prey Availability

Relative diversity and abundance of otter prey species (medium-sized to large fishes, crayfish, and to a lesser extent frogs) in each reach, based on available survey and biomass data.

3 = Relatively large abundance and diversity of prey species.

2 = Relatively moderate abundance and diversity of prey species.

1 = Prey species uncommon.

F. Water Quality

The term 'parameters of primary concern' refers to parameters which may affect otters directly, such as chronic aluminum, total recoverable selenium, gross alpha, and mercury in fish tissues. Parameters of primary concern are listed in table J of the New Mexico Water Quality Standards - section 20.6.4.900.J. The New Mexico Environment Department tests for these parameters to see if designated uses are being met in New Mexico's waters. These are considered to be parameters that have the potential to directly impact an otter's health.

The term 'parameters of secondary concern' refers to parameters that are unlikely to affect otter directly, but may affect either their ability to capture prey (e.g., water turbidity), or the abundance of their prey (e.g., temperature, stream bottom deposits, specific conductance, plant nutrients, and conductivity). Parameters of secondary concern are the other parameters that the New Mexico Environment Department tests for in New Mexico waters such as temperature, stream bottom deposits, dissolved oxygen and pH. These parameters are not thought to directly impact the health of otters but could impact the health of fish populations. The health of river otters potential prey base (i.e. fish and other aquatic animals) is assessed in other sections of this feasibility study such as the prey biomass and the fish tissue toxicity analysis.

3 = No water quality impairment for parameters of primary concern. No water quality impairment of primary concern in major tributary.

2 = No water quality impairment for parameters of primary concern in main stem. Water quality impairment of primary concern in major tributary.

1 = Main stem impaired for parameters of primary concern.

G. <u>Riparian (Streamside) Habitat</u>

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This parameter characterizes streamside and bank features that would be important in providing denning habitat for otters.

3 = High amount of riparian vegetation and rock cover, a relatively large number of potential den sites.

2 = Medium amount of riparian vegetation and rock cover, some potential den sites

1 = Low amount of riparian vegetation and rock cover, few potential den sites

H. <u>Stream Structure</u>

This parameter characterizes in-stream features that would be important in providing aquatic habitat for otters.

3 = Combination of the following:

- Reach not channelized, larger number of meanders present
- Much of reach in form of pools and riffles
- Large variation in depth across stream
- Large amount of structure in the stream in the form of woody debris, large boulders, etc.
- Evidence of high numbers of beaver in the reach

2 = Combination of the following:
- Reach not channelized, some meanders present.
- Pools and riffles present
- Medium variation in depth across the stream
- Some structure in the stream in the form of woody debris, large boulders, etc.
- Evidence of the presence of low numbers of beaver in the reach

1 = Combination of the following:
- Reach channelized or relatively straight
- Few pools present
- Little variation in depth across the stream
- Relatively low amount of structure in the stream in the form of woody debris, large boulders, etc.
- Little or no evidence of the presence of beaver in the reach

I. Potential for Connectivity

This parameter addresses the potential for restored otters to access and colonize one or more other reaches with suitable habitat in the same river drainage.

3 = The reach in question is contiguous or nearly so with another potential restoration site identified by this Feasibility Study or a reach outside New Mexico that supports river otters.

2 = The reach in question is contiguous with a reach that contains some potential for restoration; otters can reasonably be expected to move through this marginal reach into another reach identified as a potential restoration site by this Feasibility Study.

1 = Because of large stretches of unsuitable habitat, or other barriers to movement, otters cannot reasonably be expected to move from or to any other reach identified for potential river otter restoration or ones where river otters reside.

J. Potential for Threatened, Endangered or Sensitive (TES) Species Conflicts

Primary species that potentially could be affected by otter restoration are TES fishes (especially larger species) or frogs which could be impacted by otter predation.

3 = No potential for TES species conflicts; no TES species present or they would not be prey.

2 = Low to Medium potential for TES species conflicts; TES species present are not expected to be important otter prey.

1 = High potential for TES species conflicts; TES species are expected to be otter prey (at least in part) or the reach includes existing management programs for aquatic TES species which may conflict with otter introduction.

Appendix B

Description and Scoring of Priority River Reaches in New Mexico.

References cited in this appendix are listed in the Literature Cited section.

Rio Grande System

Upper Rio Grande: Rio Grande from Colorado/New Mexico border downstream to Rio Pueblo de Taos, just above the Taos Junction Bridge.

A. Potential for Natural Recolonization **Score: 3**

No known population occurs anywhere in the Rio Grande drainage from which river otters could reasonably be expected to naturally recolonize New Mexico. In Colorado, there are no known otter populations in the Rio Grande or any of its tributaries (Pam Schnurr, Colorado Division of Wildlife, personal communication, 2003, 2005). River otter from the Gunnison, Dolores and San Juan river could possibly naturally recolonize the Rio Grande drainage in Colorado at some point in the future. However, these river systems are separated from the Rio Grande by mountain ranges, heavily populated areas, or large expanses of relatively poor habitat.

B. River Miles of Suitable Contiguous Habitat **Score: 3**

Estimated 59 miles

C. Human Activity and Land Management **Score: 3**

Public = 56%

Tribal = 29 mi^2, 7%
Private = 158 mi^2, 37%
National Forest = 33 mi^2, 8%
Bureau of Land Management = 160 mi^2, 38%
State = 45 mi^2, 11%

Nearly all of this reach is designated as Wild and Scenic. A number of regulations put in place by the Bureau of Land Management to protect the 50 mile long wild scenic river corridor will be beneficial to river otter habitat including no livestock grazing, no sales of mineral materials, vehicle use limited to designated roads, no motorized watercraft, and management aimed at conserving and enhancing riparian vegetation.

Significant portions of this reach are relatively remote and inaccessible. NM State Highway 522, and U.S. Highway 64 both parallel this reach but are mostly >5 miles away and is relatively remote from major highways.

Rafting occurs throughout the most of this entire reach ranging from 16 to 456 people per day. Generally speaking, with the exception of the Taos Box, the reach receives relatively low levels of use by rafters. The BLM divides the Upper Gorge into five sections, for the purpose of regulating rafting.

Beaver trapping is allowed throughout the Upper Gorge, with the exception of the Wild Rivers Recreation Area. Harvest was only 10 beavers in Taos County in 2003-04, indicating low trapping pressure in this general area.

The Taos Pueblo also manages land adjacent to the river under a designation that provides protection as a religious and ceremonial zone.

D. Water Quantity **Averaged Score: 3**

	Near Cerro, NM	Near Taos Junction Bridge
Annual Mean Flow	511 CFS	778 CFS
Minimum Monthly Mean Flow	187 CFS	380 CFS (Sept.)
Lowest Recorded Monthly Mean Flow	49 CFS	161 CFS (Sept. 1956)

E. Prey Availability **Score: 3**

Main river species, Colorado border to SR 567 bridge above Pilar:
(list assembled by J. Klingel, J. Pittenger, C. Painter, B. Lang)
Fish
White Sucker, *Catostomus commersoni*: Preferred forage species: large, slow, abundant.
Longnose Dace, *Rhinichthys cataractae*: Preferred forage species: small, fast, abundant.
Rio Grande Chub, *Gila pandora*: Preferred forage species: small, common; State sensitive.
Flathead Chub, *Platygobio gracilis*: Preferred forage species, uncommon; FWS & BLM sensitive.
Fathead Minnow, *Pimephales promelas*: Preferred forage species: small, common.
Green Sunfish, *Lepomis cyanellus*: Preferred forage species: medium size, uncommon; game fish.
Red Shiner, *Cyprinella lutrensis*: Preferred forage species: rare in this reach.
Brown Trout, *Salmo trutta*: Secondary forage species: fast, abundant; non-native game species.
Rainbow Trout, *Oncorhynchus mykiss*: Secondary forage species: fast, common; non-native game species.
Rio Grande Sucker, *Catostomus plebeius*: Minor forage species: uncommon; USFS sensitive, mostly hybridized or displaced by white sucker.

Invertebrates
Crayfish, *Orconectes sp.*: Preferred forage species: Probably non-native to NM, crayfish are non-native to Rio Grande.

Amphibians
Northern Leopard Frog, *Rana pipiens*: Secondary forage species: small, shy, rare; USFS sensitive.

Reptiles
Blackneck Garter Snake, *Thamnophis cyrtopsis*: Minor forage species.
Western Terrestrial Garter Snake, *Thamnophis elegans*: Minor forage species.

Fish species present in upper Rio Grande (from Sublette et al 1990):
Black bullhead, Common carp, River carpsucker, Rainbow trout, Cutthroat and Rainbow trout hybrids, Brown trout, Fathead minnow, Flathead chub, Longnose dace, Mosquitofish, Northern pike, Red shiner, Rio Grande chub, White sucker. Rio Grande sucker, Green sunfish, Largemouth bass.

In 2003-2004, 11 sites on the Rio Grande from Embudo upstream to the Colorado border were surveyed with backpack electroshockers (NMDGF files). Upper sites were dominated by White sucker, Common carp, and Brown trout. Lower sites were dominated by these three species plus Smallmouth bass. Majority of fish biomass consisted of White sucker, Common carp, and Brown trout. White sucker comprised more than 73% of the individual fishes captured. A rough estimate of biomass in the surveyed segment was 4600 kilograms of fish, which was considered an underestimate of available fish.

F. Water Quality **Score: 3**

The main stem of the Rio Grande from Rio Pueblo de Taos confluence upstream to the Colorado border is not impaired for parameters of primary concern. A portion of this segment is impaired for pH and temperature, both parameters of secondary concern. Increased temperature (which is the nature of the temperature impairment) in this stretch could potentially be beneficial to otters as warmwater fish are typically preferable to otters as they are bigger and slower thus provide more nutrients for less effort. The Red River, a tributary of this stretch, is impaired for chronic aluminum. Although aluminum is a parameter of primary concern the only use that is impaired for aluminum in the Red River is the aquatic life use, and that is impaired for chronic aluminum rather than a more problematic acute aluminum exceedance. The livestock watering and wildlife habitat uses in the Red River are fully supported and not impaired by the high aluminum levels. The main stem – which is the section that is being assessed for otter habitat (tributary miles were not included in the mileage or biomass estimates) – is not impaired for aluminum. If these levels of aluminum were drastically impacting the prey base in the Rio Grande we would expect to see these impacts in the fish tissue samples or biomass studies downstream from the Red River. It is unlikely that this exceedance of chronic aluminum in a tributary to the main segment being analyzed would have a direct impact on river otter and thus is considered a parameter of secondary concern.

Mainstem Impairments

Rio Grande (from Red River to the Colorado border) - temperature and pH.
Rio Grande (from San Juan Pueblo Bend to Rio Pueblo de Taos) - turbidity

G. Riparian (Streamside) Habitat **Score: 3**

Much of the reach is confined to a steep narrow canyon with a fairly narrow riparian vegetation zone. A combination of large boulders, vegetative cover, and beaver bank dens provides adequate den and rest sites at bankside. Talus slopes and rock slides are common throughout the gorge, and cobble and large boulders are scattered along the banks of the river (Polechla, 2000). Talus slopes and piles of boulders provide crevices may serve as den and rest sites (Crowl and Klingel 2005a)

H. Stream Structure **Score: 3**

This portion of the Rio Grande is more or less unregulated, and generally free of artificial channel and flow modifications. The channel has not been modified by dredging, use of jetty jacks or rip rap to stabilize banks, or channelized by levees (Durkin et al. 1995).

Durkin et al. (1995) classified this reach as a B1 stream. This stream type has a moderate gradient, and is moderately sinuous. Width to depth ratio is 5 to 15. The channel is moderately entrenched, and valley walls are confining. The bed of the channel consists of small boulders and very large cobbles. Floodplain depositional landforms, such as sidebars and terraces are uncommon. The channel is well armored by large rocks and boulders. Riffles with infrequently spaced pools dominate the flow

Polechla (2000) observed that large boulders are common along the bank. Large boulders jut out into the stream and are also present in the channel. These boulders and rocks provide stream structure. Beaver contribute significantly to stream structure through constructing pools and adding woody debris.

I. Potential for Connectivity **Score: 2**

Within the Rio Grande drainage, three major reaches meet minimum criteria for detailed consideration as potential river otter restoration sites. This reach is contiguous with an 8 mile segment in Colorado that contains habitat very similar to this reach. The BLM is currently managing this segment under interim management restrictions to protect their wild and scenic values. (Bureau of Land Management, 2002) It is likely that river otter reintroduced into the Upper Gorge in New Mexico, will use or inhabit the contiguous 8 mile stretch of suitable habitat in the Upper Gorge in Colorado. The presence of this contiguous suitable habitat provides potential for a population reintroduced into the Rio Grande in New Mexico, to expand into Colorado.

The three potential restoration sites in the Rio Grande drainage (including Rio Chama) are separated from one another by reaches that did not meet all the criteria for detailed consideration as potential river otter restoration sites due primarily to human uses. Over time, some river otters can reasonably be expected to move through, and possibly use, this intervening habitat. Thus, there is medium potential for connectivity between all of the potential restoration sites in the Rio Grande system.

No detailed assessment of habitat present in tributaries has been done. These tributaries include the Rio Costilla, Red River, Rio Hondo, Rio Pueblo de Taos, and Rio Embudo. Polechla (2000)

noted that the Rio Pueblo de Taos and the Rio Hondo were the most likely to provide habitat suitable for use by river otters. The Rio Costilla is periodically dry because of irrigation, and runs dry before it reaches the Rio Grande at some times of year (Polechla 2000). The Red River contains aluminum. The Rio Embudo contains aluminum and is periodically turbid.

J. Potential for Threatened, Endangered and Sensitive (TSE) Species Conflicts

Score: 2

The Rio Grande Cutthroat trout (*Oncorhynchus clarki virginalis*) is listed as sensitive by the USFS and is a species of concern by the NMDGF. The NMDGF is currently involved with cooperators in the restoration of cutthroat in the upper Rio Grande drainage, with primary focus in the Rio Costilla drainage, a Rio Grande tributary which becomes intermittent near the Rio Grande. A relict population of cutthroats also occurs in San Cristobal Creek, but this tributary is also not perennial to the Rio Grande due to diversion. No impact of otter restoration on cutthroat restoration is anticipated in this reach (Kirk Patten, NMDGF, personal communication, 2006), although some potential could exist for dispersing otter to reach cutthroat restoration sites.

The Rio Grande from Taos Junction Bridge upstream to the Colorado state line is considered a "special trout water" and angler harvest is limited to three trout. No pure population of cutthroat occurs in the mainstem Rio Grande, although "cutbow" hybrids are present. The reach of the Rio Grande between Rio Pueblo de Taos and the Red River confluences is classified a "high quality trout fishery" for brown trout, rainbow trout, and some "cutbows." (Kirk Patten, NMDGF, personal communication, 2006). Introduced otters in this reach of the Rio Grande would be expected to take some trout, although undesirable species such as common carp and white sucker would likely be the most frequently taken fishes by otter.

Northern leopard frogs are present in the mainstem of the Rio Grande (Polechla, 2000). The Northern leopard frog is listed by the USFS (Region 3) as a sensitive species. River otters consume amphibians infrequently.

White Rock Canyon Reach – Rio Grande, from Otowi Bridge on State Highway 502, downstream to Cochiti Reservoir through White Rock Canyon.

A. Potential for Natural Recolonization **Score: 3**

No known population occurs anywhere in the Rio Grande drainage from which river otters could reasonably be expected to naturally recolonize New Mexico. In Colorado, no known otter populations in the Rio Grande or any of its tributaries (Pam Schnurr, Colorado Division of Wildlife, personal communications, 2003, 2005). River otter from the Gunnison, Dolores and San Juan rivers could possibly naturally recolonize the Rio Grande drainage in Colorado at some point in the future. However, these river systems are separated from the Rio Grande by mountain ranges, heavily populated areas, or other large expanses of relatively poor habitat.

B. River Miles of Suitable Contiguous Habitat **Score: 1**

Estimated 21 miles, above head of Cochiti Reservoir.

C. Human Activity and Land Management **Score: 3**

Publicly owned = **61%**

Tribal = 84 mi^2, 33%
Private = 15 mi^2, 6%
National Forest = 70 mi^2, 28%
Bureau of Land Management = 21 mi^2, 8%
State = 1.1 mi^2, 0.4%
Department of Energy = 27 mi^2, 11%
National Park Service = 33 mi^2, 13%

Protected Areas
Bandelier National Monument
Remoteness/Inaccessibility
Access to White Rock Canyon is extremely limited and no roads parallel this reach.

D. Water Quantity **Averaged Score: 3**

	Otowi Bridge
Annual Mean Flow	1524 CFS
Minimum Monthly Mean Flow	638 CFS (January)
Lowest Recorded Monthly Mean Flow	191 CFS (Sept. 1953)

E. Prey Availability **Score: 3**

Fish species known or likely to occur in the White Rock Canyon reach, including species that may range upstream at least occasionally from Cochiti Reservoir (based on Sublette et al. 1990)

include: Brown trout, Red shiner, Common carp, Rio Grande chub, Fathead minnow, Flathead chub, Longnose dace, River carpsucker, White sucker, Rio Grande sucker, Black bullhead, Channel catfish, Mosquitofish, Green sunfish, Bluegill, Largemouth bass, Yellow perch, Walleye, White crappie.

No detailed fish surveys have been done in White Rock Canyon. Cochiti Reservoir, at the bottom of this reach, has been surveyed extensively and some game fishes such as Largemouth bass and Walleye present in the reservoir likely would occur in the lower end of the reach.

F. Water Quality **Score: 2**

The main stem of the Rio Grande is not impaired for parameters of primary concern. There are several tributaries that are impaired for two parameters of primary concern- gross alpha and selenium - which is why this section is scored a 2. The impaired tributaries that feed into the Rio Grande in this section flow at very low levels and have not, to date, resulted in impairments in the main stem for these parameters. In addition, because these tributaries are so small, often just a trickle, it is unlikely that otters will spend much time in these drainages. The main stem is impaired for a parameter of secondary concern, turbidity.

Mainstem
No water quality impairments

Major Tributaries
No major tributaries enter the Rio Grande in White Rock Canyon.

Minor Tributaries
Pueblo Canyon (very little water) – total recoverable selenium, gross alpha
Water Canyon – total recoverable selenium, gross alpha
Mortandad Canyon (little to no water) - gross alpha
Pajarito Canyon (little to no water) - gross alpha
Rito Canyon de los Frijoles (very little water) – pesticides DDT
Los Alamos Canyon (very little water, sometimes dry) – total recoverable selenium, gross alpha

G. Riparian (Streamside) Habitat **Score: 3**

The riparian vegetation varies in different stretches of the survey area, with a range of vegetative cover conditions from poor to excellent, but generally in good condition, Willows, Russian olive, and salt cedar are abundant. Excellent boulder structure on banks. The understory of grasses, forbes and rushes is thick. In addition, there is good cover in the form of large boulders and rocks. There is no livestock use. (Conn and Klingel 2004).

H. Stream Structure **Score: 3**

The reach contains numerous deep pools between riffles and runs and the width is up to 80 ft. The channel has mostly a sand substrate but large boulders and cobbles are present and there are

numerous meanders. Beaver are present in at least moderate numbers, including at the downstream end in Cochiti Reservoir (Conn and Klingel 2003).

I. Potential for Connectivity **Score: 2**

The White Rock Canyon reach is separated by approximately 15 miles from the Rio Chama confluence and approximately 40 miles from the Rio Pueblo de Taos confluence (the lower end of the Upper Rio Grande reach). There is therefore some potential for connectivity between the White Rock Canyon reach and the Upper Rio Grande reach. The potential for connectivity between the White Rock reach and the Rio Chama reach is limited by the presence of Abiquiu Dam and Reservoir and a long river reach below Abiquiu Dam.

J. Potential for Threatened, Endangered and Sensitive (TES) Species Conflicts

Score: 3

None in the White Rock Canyon reach. Rio Grande silvery minnow no longer occurs above Cochiti Dam.

Rio Chama -- from El Vado Reservoir downstream to Abiquiu Reservoir. The Rio Chama is a major tributary to the Rio Grande.

A. Potential for Natural Recolonization **Score: 3**

No known population occurs anywhere in the Rio Grande or Rio Chama drainage from which river otters could reasonably be expected to naturally recolonize New Mexico. In Colorado, there are no known otter populations in the Rio Grande or any of its tributaries (Pam Schnurr, Colorado Division of Wildlife, personal communication, 2003, 2005). River otter from the San Juan drainage could possibly naturally recolonize the nearby Chama drainage in northern New Mexico at some point in the future. However, these river systems are separated by mountain ranges or large expanses of relatively poor habitat.

B. River Miles of Suitable Contiguous Habitat **Score: 2**

Estimated 30 miles

C. Human Activity and Land Management **Score: 3**

Public = **74%**

Breakdown of Adjacent Land Ownership (within a five mile buffer zone on either side of the river):

Tribal = 24 mi^2, 8.6%
Private = 49 mi^2, 18%
National Forest = 154 mi^2, 55%
Bureau of Land Management = 27 mi^2, 10%
State = 26 mi^2, 9%

Approximately 24.6 miles is designated as a Wild and Scenic River. Significant portions of this reach are relatively remote and inaccessible.

D. Water Quantity **Averaged Score: 2**

Gauge below El Vado Dam (USGS 08285500)

Annual Mean Flow	487 CFS
Minimum Monthly Mean Flow	83 CFS (Jan.)
Lowest Recorded Monthly Mean Flow	0.5 CFS (Jan. 1958)

Flows from El Vado Dam have been cutoff for periods of several days or more on occasion, resulting in virtually no flow in the Rio Chama above Abiquiu Reservoir.

E. Prey Availability Score: 2

Fish in the Rio Chama drainage (USGS Hydrological Unit):
(list assembled by J. Klingel, J. Pittenger)
"Hatchery" Cutthroat Trout, *Oncorhynchus clarki*: non-native game
Rio Grande Cutthroat Trout, *Oncorhynchus clarki virginalis*: State & USFS sensitive
Rainbow Trout, *Oncorhynchus mykiss*: non-native game
Kokanee Salmon, *Oncorhynchus nerka*: non-native game; lakes
Brown Trout, *Salmo trutta*: non-native game
Brook Trout, *Salvelinus fontinalis*: non-native game
Lake Trout, *Salvelinus namaycush*: non-native game; lakes
Red Shiner, *Cyprinella lutrensis*:
Common Carp, *Cyprinus carpio*: non-native
Rio Grande, Chub *Gila pandora*: State sensitive
Fathead Minnow, *Pimephales promelas:*
Flathead Chub, *Platygobio gracilis*: FWS & BLM sensitive
Longnose Dace, *Rhinichthys cataractae*:
River Carpsucker, *Carpiodes carpio carpio*:
White Sucker, *Catostomus commersoni*
Rio Grande Sucker, *Catostomus plebeius*: USFS sensitive
Channel Catfish, *Ictalurus punctatus*:
Green Sunfish, *Lepomis cyanellus*:
Bluegill, *Lepomis macrochirus*:
Smallmouth Bass, *Micropterus dolomieui*: non-native game
Largemouth Bass, *Micropterus salmoides salmoides*:
White Crappie, *Pomoxis annularis*: non-native game
Yellow Perch, *Perca flavescens*: non-native game
Walleye, *Stizostedion vitreum*: non-native game

Fishes known or likely to occur in this reach of the Rio Chama (based on Sublette et al. 1990) include: Brown trout, Common carp, Rio Grande chub, Fathead minnow, Longnose dace, River carpsucker, White sucker, Rio Grande sucker, Channel catfish, Green sunfish, Largemouth bass.

Recent fish surveys have not been done in this reach. The NMDGF surveyed the Rio Chama below Abiquiu Dam, downstream of this study reach, in 2004 (NMDGF files) and found Brown trout and White sucker to be the most common species. The fish density in this reach derived from catch per unit effort ranged from 6 to 51 kilograms per hectare.

Due to minimum flows from El Vado Dam, some impact to large prey fish species might be expected.

F. Water Quality Score: 2

The main stem in this section is not impaired for parameters of primary concern or secondary concern. El Vado Reservoir, which is directly upstream from this segment and thus considered a major tributary is impaired for mercury in fish tissue thus giving this section a score of 2. The main stem of the river is not impaired for mercury or any other parameter and is fully supporting all of its uses including livestock watering, irrigation, wildlife habitat, coldwater aquatic life, warmwater aquatic life, and secondary contact. None of the other tributaries in this section are impaired for parameters of primary concern or secondary concern.

Rio Chama mainstem - chronic aluminum (San Juan Pueblo to Abiquiu Dam)
Heron Reservoir – mercury in fish tissue
El Vado Reservoir – mercury in fish tissue
Rio Chamita - temperature, chronic aluminum, fecal coliform, total ammonia
Rito de Tierra Amarilla - temperature, stream bottom deposits, turbidity
Rio Nutrias – turbidity
Rio Puerco de Chama - temperature, fecal coliform
Canones Creek - chronic aluminum, turbidity, fecal coliform
Abiqui Creek - stream bottom deposits, plant nutrients
Abiquiu Reservoir – mercury in fish tissue

G. Riparian (Streamside) Habitat **Score: 2**

Grazing impacts in the riparian zone are evident in many segments of this reach. The riparian vegetation is highly variable ranging from very good to poor. The 13-mile middle section has good riparian habitat. The upper and lower sections (17 miles total) are fair. (Klingel and Conn 2003).

H. Stream Structure **Score: 2**

The sinuosity in this reach is moderate. Pools and riffles are common, and large rocks are present in some reaches. Beavers are present but not abundant. A moderate number of deep pools are available and the range of depth across the river was moderate and variable. Reach is not channelized (Klingel and Conn 2003).

I. Potential for Connectivity **Score: 2**

Potential connectivity to either of the two Rio Grande reaches under consideration (upper Rio Grande and White Rock Canyon), although this would require movement of otters into Abiquiu Reservoir and then downstream on the Chama through developed agricultural lands to the Rio Grande confluence.

J. Potential for Threatened, Endangered or Sensitive (TES) Species Conflict
Score: 3

No TES species occur in the Rio Chama that would be affected by river otter.

Gila River Drainage System

Upper Gila Reach -- from the confluence of the Gila and the East Fork of the Gila River, downstream to the confluence with Mogollon Creek (above town of Gila, ends at edge of Wilderness). Nearly entirely contained within Wilderness Section

A. Potential for Natural Recolonization **Score: 3**

The potential for river otters established in the Gila drainage system (Verde River) in Arizona to move into the Gila drainage of New Mexico is highly unlikely. The Verde River population in central Arizona is separated from the mainstem Gila River in that state by more than 50 river miles, including a reach of the Salt River. Much of this intervening area is highly unsuitable as otter habitat and there is no evidence that otters have migrated or are capable of migrating downstream in the Verde. The distance from the Gila/Verde confluence to the New Mexico border is approximately 220 river miles. Therefore, no recolonization of the Gila drainage in New Mexico from other inhabited river reaches is likely.

B. River Miles of Suitable Contiguous Habitat **Score: 2**

Estimated 33 miles

C. Human Activity and Land Management **Score: 3**

This reach lies almost entirely within the Gila Wilderness of the Gila National Forest.

Public = **88%**

Breakdown of Adjacent Land Ownership (within a five mile buffer zone on either side of the river):

Private = 40 mi^2, 12.1%
National Forest = 286 mi^2, 87%
Bureau of Land Management = 0.5 mi^2, 0.2%
State = 4 mi^2, 1%

D. Water Quantity **Averaged Score: 1.7**

USGS 09430500 Gauge: Gila River near Gila, just above Mogollon Creek confluence

Annual Mean Flow	158 CFS (1928-2000)
Minimum Monthly Mean Flow	58 CFS (June)
Lowest Recorded Mean Flow	19 CFS (June 2002)

E. Prey Availability **Score: 2**

Upper Gila: main river species, confluence of East Fork to Gila valley near Cliff:
(list assembled by J. Klingel, D. Propst, C. Painter, B. Lang)
This segment is characterized as almost entirely introduced species having replaced native fish and Ranid frogs.
Species are native unless listed as introduced.
Rainbow Trout, *Oncorhynchus mykiss*: maybe present; introduced; game
Brown Trout, *Salmo trutta*: maybe present; introduced; game
Common Carp, *Cyprinus carpio*: some present; introduced
Roundtail Chub, *Gila robusta*: some present; state endangered; FWS, BLM & USFS sensitive
Fathead Minnow, *Pimephales promelas*: maybe present; introduced into Gila
Desert Sucker, *Catostomus clarki*: present; FWS, BlM & state sensitive;
Sonora Sucker, *Catostomus insignis*: present; FWS, BLM & state sensitive;
Black Bullhead, *Ameiurus melas*: present; introduced into Gila; game
Yellow Bullhead, *Ameiurus natalis*: present; introduced; game
Channel Catfish, *Ictalurus punctatus*: present; introduced; game
Flathead Catfish, *Pylodictis olivaris*: present; introduced into Gila; game
Mosquitofish, *Gambusia affinis*: maybe present;
Green Sunfish, *Lepomis cyanellus*: present; introduced into Gila; game
Smallmouth Bass, *Micropterus dolomieui*: present; introduced; game
Largemouth Bass, *Micropterus salmoides salmoides*: present; introduced; game
Bullfrog, *Rana catesbeiana*: abundant; introduced

Potential forage species not in main river or not occurring in preferred otter habitat:
Gila Trout, *Oncorhynchus gilae*: fed. endangered & state threatened; headwater streams only
Longfin Dace, *Agosia chrysogaster*: BLM sensitive
Gila Chub, *Gila intermedia*: FWS, USFS & BLM sensitive & state endangered;
Spikedace, *Meda fulgida*: fed. threatened, state threatened & USFS sensitive; not in preferred otter habitat
Speckled Dace, *Rhinichthys osculus*: BLM sensitive
Loach Minnow, *Rhinichthys cobitis*: fed. threatened & state threatened; not in preferred otter habitat
Rio Grande Sucker, *Catostomus plebeius*:
Chihuahua Catfish, *Ictalurus sp.*: FWS & state sensitive
Chiricahuan Leopard Frog, *Rana chiricahuensis*: fed. threatened, USFS & state sensitive; extirpated from main river, replaced by bullfrogs.

The following fish species have been reported or are likely to occur in the Upper Gila River drainage based on Sublette et al. (1990): Gila trout, Rainbow trout, Brown trout, Longfin dace, Roundtail chub, Spikedace, Fathead minnow, Speckled dace, Loach minnow, Sonora sucker, Desert sucker, Black bullhead, Yellow bullhead, Channel catfish, Flathead catfish, Mosquitofish, Green sunfish, Smallmouth bass, Largemouth bass. Bullfrogs are abundant in this reach. Detailed information on fish density are not available. Crowl and Klingel (2005) reported schools of carp.

F. Water Quality Score: 3

The main stem of the Upper Gila is not impaired for parameters of primary concern or secondary concern. There is some impairment of temperature, a parameter of secondary concern, in the middle and west fork of the Gila. The headwaters of the East Fork are impaired for chronic aluminum. The forks and other tributaries of the Gila are low flow systems, often flowing below 10 CFS, making it unlikely that the river otter would spend much time in these drainages. Thus

impairment in the east fork for chronic aluminum, which is characteristic of an impairment of a parameter of secondary concern, is unlikely to directly impact otters. As in the Upper Rio Grande, chronic aluminum impairment affects the aquatic life use in the East Fork but does not impact the livestock watering, domestic water supply, irrigation and wildlife habitat uses in this stretch. All of these uses are fully supported in all of the tributaries and forks of the Upper Gila as well as in the main stem.

G. Riparian (Streamside) Habitat **Score: 3**

This reach is in a wilderness and human disturbance is minimal. Beaver are present. Livestock have been removed and riparian vegetation is in excellent condition. Boulders are common along banks, and there is abundant woody debris (Crowl and Klingel 2005).

H. Stream Structure **Score: 3**

Much of reach is in a deep and narrow canyon. There are deep pools (> 6 ft) and large boulders are common. River sinuosity is very good and channel shifts/flooding have produced debris piles due to high flows. There are no manmade alterations to the channel. Beaver are present throughout reach, and abundant below Sapello (Crowl and Klingel 2005).

I. Potential for Connectivity **Score: 3**

This reach is contiguous with the Lower Gila reach and thus otters from either reach would be expected to eventually occupy the other reach. The Lower San Francisco reach could be colonized by otters from this reach if individuals moved downriver into Arizona and ascended the San Francisco River in that state.

J. Potential for Threatened, Endangered and Sensitive (TES) Species Conflicts
Score: 1

The Upper Gila River reach has the following TES fish species (Propst 1999): Roundtail chub, Spikedace, Loach minnow, Gila trout. The Gila trout, which occurs in headwater streams, is possibly of concern should otters be released in the Upper Gila. The Chiricahua leopard frog historically occurred in much of this reach and is now extirpated in most places on the mainstem Gila. Potential for conflicts with TES management.

Lower Gila Reach -- from the confluence of the Gila River with Mogollon Creek, downstream to the Arizona state line.

A. Potential for Natural Recolonization **Score: 3**

The potential for river otters established in the Gila drainage system (Verde River) in Arizona to move into the Gila drainage of New Mexico is highly unlikely. The Verde River population in central Arizona is separated from the mainstem Gila River in that state by more than 50 river miles, including a reach of the Salt River. Much of this intervening area is highly unsuitable as otter habitat and there is no evidence that otters have migrated or are capable of migrating downstream in the Verde. The distance from the Gila/Verde confluence to the New Mexico border is approximately 220 river miles. Therefore, no recolonization of the Gila drainage in New Mexico from other inhabited river reaches is likely.

B. River Miles of Suitable Contiguous Habitat **Score: 3**

Estimated 58 miles.

C. Human Activity and Land Management **Score: 2**

Public = **66%**

Private = 170 mi^2, 34%
National Forest = 81 mi^2, 16%
Bureau of Land Management = 185 mi^2, 37%
State = 60 mi^2, 12%

Some development and agriculture.

D. Water Quantity **Averaged Score: 2.3**

USGS Gauge: 09431500: Redrock

Minimum Annual Mean Flow	248 CFS
Minimum Monthly Mean Flow	56 CFS (June)
Lowest Recorded Monthly Mean Flow	11 CFS (July 1951)

E. Prey Availability **Score: 2**

Despite a diverse fish fauna, the limitations imposed by lack of deepwater habitat in parts of the reach suggest that availability of suitably-sized fish prey may be moderate at best.

Lower Gila: main river species, Arizona border to edge of mountains near Cliff, NM:
(list assembled by J. Klingel, D. Propst, C. Painter, B. Lang)
This segment is characterized as almost entirely introduced species having replaced native fish and Ranid frogs. Species are native unless listed as introduced.

Rainbow Trout, *Oncorhynchus mykiss*: maybe present, introduced; game
Brown Trout, *Salmo trutta*: maybe present; introduced; game
Longfin Dace, *Agosia chrysogaster*: maybe present; BLM sensitive
Red Shiner, *Cyprinella lutrensis*: present; introduced into Gila
Common Carp, *Cyprinus carpio*: present; introduced;
Fathead Minnow, *Pimephales promelas*: maybe present; introduced into Gila;
Desert Sucker, *Catostomus clarki*; present; FWS, BlM & state sensitive;
Sonora Sucker, *Catostomus insignis*: present; FWS, BLM & state sensitive;
Yellow Bullhead, *Ameiurus natalis*: present; introduced; game
Channel Catfish, *Ictalurus punctatus*: present; introduced; game
Flathead Catfish, *Pylodictis olivaris*: present; introduced into Gila; game
Mosquitofish, *Gambusia affinis*: maybe present;
Green Sunfish, *Lepomis cyanellus*: present; introduced into Gila; game
Smallmouth Bass, *Micropterus dolomieui*: present; introduced; game
Largemouth Bass, *Micropterus salmoides salmoides*: present; introduced; game
White Crappie, *Pomoxis annularis*: present; introduced; game
Bullfrog, *Rana catesbeiana*: abundant; introduced
Crayfish, *Orconectes sp.*: abundant; introduced; preferred otter food

Potential forage species not in main river or not occurring in preferred otter habitat:
Roundtail Chub, *Gila robusta*: state endangered; FWS, BLM & USFS sensitive
Spikedace, *Meda fulgida*: fed. threatened, state threatened & USFS sensitive; not in preferred otter habitat
Speckled Dace, *Rhinichthys osculus*: BLM sensitive
Loach Minnow, *Rhinichthys cobitis*: fed. threatened & state threatened; not in preferred otter habitat

The Lower Gila River reach is known or likely to have the following fish species based on Sublette et al. (1990) and Polechla (2004): Longfin dace, Red shiner, Common carp, Roundtail chub, Spikedace, Fathead minnow, Loach minnow, Sonora sucker, Desert sucker, Black bullhead, Yellow bullhead, Channel catfish, Flathead catfish, Mosquitofish, Green sunfish, Smallmouth bass, Largemouth bass. Desert sucker comprised 46% of one sample (Polechla 2004). Bullfrogs are abundant in this reach. Detailed density data are lacking for fish prey species. Non-native crayfish are present.

F. Water Quality **Score: 3**

The main stem of the Gila in this stretch is not impaired for parameters of primary concern or parameters of secondary concern. Mogollon Creek, a tributary to the Gila in this stretch, is impaired for chronic aluminum for aquatic life. Mangas Creek, also a tributary to the Gila in this stretch, is impaired for nutrients for the coldwater aquatic life use. The warmwater aquatic life use in Mangas Creek is not impaired. Both of these (see above) are considered parameters of secondary concern and are not thought to directly impact otters. All other uses including industrial water supply, irrigation, livestock watering, warmwater aquatic life, and wildlife habitat are fully supported both in the main stem and all the tributaries of this segment.

G. Riparian (Streamside) Habitat **Score: 1**

Riparian vegetation has been impacted by agriculture, although there are occasional good stands of vegetation including patches of cottonwood and willow. This is a very variable reach, with both good and degraded segments. Cattle are present. There is much more bare streambank and less bank structure than Upper Gila. Bank cover and deep pools are infrequent. In the Lower Box, habitat improves (B. Long, unpublished data; Polechla 2004).

H. Stream Structure **Score: 2**

The reach has deep pools in upper portion (which is better part of reach). Woody debris, meanders, riffles, and boulders are present in this reach. The lower section is below town of Gila and is affected by bridges, overgrazing; this reach is sinuous, with few deep pools and boulders, and bank cover is poor with some snags and overhanging willows, but mostly bare gravel or sand bars. This is a highly variable reach. The Gila Box section has pools. Overall, is highly variable, with some good segments. Beaver are present. (Polechla 2004; Klingel and Conn 2003).

I. Potential for Connectivity **Score: 3**

This reach is contiguous with the Upper Gila reach and thus otters from either reach would be expected to eventually occupy the other reach. The Lower San Francisco reach could be colonized by otters from this reach if individuals moved downriver into Arizona and ascended the San Francisco River in that state.

J. Potential for Threatened, Endangered and Sensitive (TES) Species Conflicts
Score: 2

Roundtail chub, Spikedace, and Loach minnow are extant in this reach; Gila chub occurred here historically (Propst 1999). These species are in general smaller than typical fish prey of otters. Chiricahua leopard frog occurred historically in much of this reach but is now extirpated from most localities. Moderate potential impact to TES species.

Lower San Francisco Reach -- the confluence of San Francisco River with Whitewater Creek downstream to the Arizona border.

A. Potential for Natural Recolonization **Score: 3**

The potential for river otters established the Gila drainage system (Verde River) in Arizona to move into the Gila drainage of New Mexico (including the San Francisco River) is highly unlikely. The Verde River population in central Arizona is separated from the mainstem Gila River in that state by more than 50 river miles, including a reach of the Salt River. Much of this intervening area is highly unsuitable as otter habitat and there is no evidence that otters have migrated or are capable of migrating downstream in the Verde. The distance from the Gila/Verde confluence to the New Mexico border is approximately 220 river miles. Therefore, no recolonization of the San Francisco in New Mexico from other inhabited river reaches is likely.

B. River Miles of Suitable Contiguous Habitat **Score: 1**

Estimated 20 miles. Contiguous with suitable habitat in San Francisco River of Arizona.

C. Human Activity and Land Management **Score: 3**

Public = 85%

Private = 30 mi^2, 15%
National Forest = 166 mi^2, 83%
State = 3.0 mi^2

Remote and inaccessible with little access by public. Some ATV use. Livestock have been removed from most of riparian area.

D. Water Quantity **Averaged Score: 1.3**

USGS Gauge 09444000: San Francisco near Glenwood

Minimum Annual Mean Flow	113 CFS
Minimum Monthly Mean Flow	28 CFS (June)
Lowest Recorded Monthly Mean Flow	6 CFS (June 1956)

E. Prey Availability **Score: 2**

As with the Lower Gila, habitat limitations in this reach are expected to result in relatively low density of suitably-sized prey fish (see below).

Lower San Francisco: main river species, Arizona border to diversion at Pleasanton, NM:

This segment is characterized as mostly introduced species having replaced native fish and Ranid frogs. Species are native unless listed as introduced.

Rainbow Trout, *Oncorhynchus mykiss*: maybe present; introduced; game
Brown Trout, *Salmo trutta*: maybe present; introduced; game
Longfin Dace, *Agosia chrysogaster*: maybe present; BLM sensitive
Red Shiner, *Cyprinella lutrensis*: present;
Common Carp, *Cyprinus carpio*: present;
Fathead Minnow, *Pimephales promelas*: maybe present; introduced into Gila;
Desert Sucker, *Catostomus clarki*: present; FWS, BLM & state sensitive;
Sonora Sucker, *Catostomus insignis*: present; FWS, BLM & state sensitive;
Black Bullhead, *Ameiurus melas*: present; game;
Channel Catfish, *Ictalurus punctatus*: present; introduced; game
Flathead Catfish, *Pylodictis olivaris*: present; introduced into Gila; game
Mosquitofish, *Gambusia affinis*: maybe present;
Green Sunfish, *Lepomis cyanellus*: present; introduced into Gila; game
Largemouth Bass, *Micropterus salmoides salmoides*: present; introduced; game
Bullfrog, *Rana catesbeiana*: abundant; introduced
Crayfish, *Orconectes sp.*: abundant; introduced; preferred otter food

Potential forage species not in main river or not occurring in preferred otter habitat:
Gila Trout, *Oncorhynchus gilae*: fed. endangered & state threatened; headwater streams only
Brook Trout, *Salvelinus fontinalis*: introduced; game
Grass Carp, *Ctenopharyngodon idella*: introduced;
Gila Chub, *Gila intermedia*: FWS, USFS & BLM sensitive & state endangered;
Speckled Dace, *Rhinichthys osculus*: BLM sensitive
Loach Minnow, *Rhinichthys cobitis*: fed. threatened & state threatened; not in preferred otter habitat
Rio Grande Sucker, *Catostomus plebeius*:

Fishes reported by Sublette et al (1990) from this reach include: Rainbow trout, Brown trout, Longfin dace, red shiner, Common carp, Fathead minnow, Speckled dace, Loach minnow, Sonora sucker, Desert sucker, Black bullhead, Yellow bullhead, Channel catfish, Flathead catfish, Mosquitofish, Green sunfish, Largemouth bass. Non-native crayfish are established in this reach.

A 2004 backpack shocking/depletion fish survey was conducted in the San Francisco below Glenwood at two sampling sites between Big Dry Creek and Mule Creek (NMDGF files). Larger fishes (> 6 inches) were rare. Red shiner and Fathead minnow were the primary species. Total fish biomass was estimated at 4.7 kilograms per hectare and 18.4 kilograms per hectare at upper and lower sites, respectively. The reach from the Big Dry Creek confluence to the Arizona line is about 15 miles; the estimate of biomass in this segment is 208 kilograms in approximately 18 hectares of water. Larger fish found in this reach were Channel catfish, Flathead catfish, and Smallmouth bass. No native fish were present. Bullfrogs are abundant in this reach.

Low flows in much of this river reach would likely reduce the larger species to deep holes in various places along the river.

F. Water Quality **Score: 3**

There are no impairments of parameters of primary concern or secondary concern in either the main stem or any of the tributaries in this segment.

G. Riparian (Streamside) Habitat **Score: 3**

Riparian habitat was described by Klingel and Conn (2003) as very good to excellent, with dense streamside stands of trees and shrubs and very little evidence of degraded conditions.

H. Stream Structure **Score: 3**

Stream structure was described by Klingel and Conn (2003). The reach includes sections of riffles and some deep pools and undercut banks; some sandbars; some wide sections; human impacts minimal (some ORV impacts); variable cross-channel depth with occasional deep pools against cliffs; lots of woody debris; cut-off channels across oxbows; mostly sandy bottom with some rocks cobbles. There are fewer boulders than other reaches but good pools. Beaver sign was abundant.

I. Potential for Connectivity **Score: 3**

Potential for otters introduced in this reach to access the Gila River (via the confluence in Arizona) and move upstream to the Lower Gila reach in New Mexico, and subsequently to the Upper Gila reach. The distance is 40-50 river miles from the San Francisco at the Arizona border to the Gila at the Arizona border.

J. Potential for Threatened, Endangered and Sensitive (TES) Species Conflicts
Score: 2

Spikedace and Loach minnow are still extant in this reach; Gila chub, Roundtail chub, and Gila topminnow historically were present. These fish species are smaller than typical river otter prey species. Gila trout are managed in headwater streams of the San Francisco. Chiricahua leopard frog and Lowland leopard frog historically occurred in this reach. See additional information provided above under E. Moderate potential for TES conflicts.

Appendix C

Summary of Public Comment on Possible River Otter Restoration in New Mexico

To gather public input about the desirability and feasibility of river otter restoration in New Mexico, four public meetings were hosted by the New Mexico River Otter Working Group (NMROWG) and the New Mexico Department of Game and Fish (NMDGF) during the fall and winter of 2004-2005. Meetings were held at Silver City, Taos, Santa Fe, and Albuquerque.

Written responses were gathered at the four meetings to the question "Do you support river otter restoration in New Mexico?" Forty-seven respondents answered "Yes," 4 answered "No," and 2 were undecided. Most of those expressing a "yes" opinion cited the ethical importance of restoring a species extirpated in the state, the importance of otter as a predator in riverine ecosystems (including as a means to control non-native fishes and crayfishes), the desirability to see otters in the state, and/or the socioeconomic benefits that could accrue from having a population that is available for public viewing. Written comments received by both the NMDGF and the NMROWG outside of these public meetings have been overwhelmingly in favor of otter restoration.

A number of concerns were raised by those who had varying opinions about the desirability of otter restoration. Some of the individual concerns raised were similar in nature and therefore were combined in the following list. Brief responses to these concerns are provided below and where possible addressed in the Feasibility Study. Identified concerns included:

1. Otter restoration and management could impose financial and regulatory burden on the state. *Response*: Potential otter restoration is consistent with the NMDGF's mandate to manage sustainably the wildlife of New Mexico for the citizens of the state and therefore would not conflict with the agency's mission.
2. Otters could impact sport fishing, rafting, off-road vehicle use, and other land and water uses, and on the rural economies dependent on these activities. *Response*: The evaluation process included in the Feasibility Study considered the potential for conflict with human activities and the selection of a location, if any, for restoration will be made based in part on the avoidance or minimization of such conflicts.
3. Otters could impact threatened, endangered, and sensitive species and important game fishes. *Response*: The evaluation process included in the Feasibility Study considered the potential for conflict with management of other species and the selection of a location, if any, for restoration will be made based in part on the avoidance or minimization of such conflicts.
4. There is insufficient detailed information on resources needed by otters in the state. *Response*: It is true that very little information is available on historic river otter populations in New Mexico, however extensive information is available from other states, including states where restoration work has been successfully accomplished, and these data have been used in the development of this Feasibility Study.

5. There is insufficient information from otter restoration in adjacent states. *Response*: Information available from restoration work in adjacent states varies in detail depending upon how intensively wildlife managers followed up on restoration work with monitoring of survivorship and reproduction of released animals. However, in all such restoration projects, otters have persisted for a decade or more and all projects have been considered successful.
6. Otter restoration could be jeopardized by poaching. *Response*: Poaching of otters does pose a risk to the success of any restoration effort, but the selection of potential release sites does factor in the accessibility of such sites to the public and thus is intended, at least indirectly, to minimize the opportunity for poaching.
7. Sufficient prey may not be available. *Response*: Prey base was considered in the evaluation process for possible restoration sites and would be among the deciding factors in the selection of any such site.
8. Otters will damage river banks. *Response*: Otters do use bankside holes and structures as denning sites but do not excavate extensive burrow systems as do many rodents.
9. Otters will damage native fisheries. *Response*: Otters will feed on native fishes of suitable size but will also focus on species that are most easily obtainable such as many non-native species (e.g., carp, white sucker). Thus, there is a high potential for otters to actually improve native fisheries by culling undesirable non-native fishes.
10. No otters should be introduced until we are sure native otters are indeed absent. *Response*: All available evidence indicates that native otters are no longer present in New Mexico, nor in any river system in adjacent states where restoration work using introduced otters from outside of the Southwest has already been done.
11. The source of otters for restoration has not been identified. *Response*: This is true, and would be a task for investigation should the NMDGF be directed to proceed with otter restoration work.
12. Introducing non-native otters where natives may still persist could affect the persistence of the native (*sonora* subspecies) form. *Response*: As discussed in comment 10 above, there is no evidence that the river otter that was native to New Mexico and the Southwest is still extant.
13. Otter restoration fails to consider entire ecosystem health. *Response*: Restoration of a single species such as otter to one or more river systems in New Mexico is indeed a fairly small part of any effort to restore an entire aquatic ecosystem, but can be viewed as an important step in that direction. River otters, as top carnivores in a riverine system, have the potential to provide important benefits to aquatic ecosystems through the control of non-native species such as introduced fishes and crayfish.
14. Otter restoration detracts from NMDGF activities focused on game species of wildlife. *Response*: NMDGF is tasked with management of all wildlife in the state, including non-game species. In addition, river otter is a protected furbearer species and potentially could be restored to harvestable levels via restoration efforts.
15. Otters may prey on household pets. *Response*: There is no evidence that river otters target household pets as prey.
16. Restored otters may be subject to same threats that led to their earlier extirpation. *Response*: Although it is impossible to reconstruct exactly what factors were involved in the extirpation of otters in New Mexico, it is likely that unregulated harvest was the most important. At present, river otter is designated a protected furbearer with no season in

New Mexico and any restored otters would be subject to this legal protection until such a time that sustainable harvest might be feasible.

To the extent possible, the Feasibility Study was written to address these concerns beyond the brief responses provided above. Some concerns focused on aspects of possible otter restoration that cannot be addressed unless and until the Feasibility Study is approved by the State Game Commission and authorization is given to proceed with otter restoration.
