NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

AQUATIC ORGANISM PASSAGE

(Mi.)

CODE 396

CONDITIONS WHERE PRACTICE APPLIES

All aquatic habitats where barriers impede passage of aquatic organisms. Specifically, this practice applies to all watercourses and outlets of ponds, lakes and wetlands where barriers impede passage for fish and other aquatic organisms.

Passage barriers can be *natural* (e.g., waterfalls, beaver dams) or *artificial* (e.g., road culverts, surface water diversions).

- Natural barriers. Native fish have evolved around the presence of natural barriers; they should be left in place. Beaver dams, for example, may block weak-swimming fish at all flows or strong swimmers during only extreme flows, yet they create very diverse habitat for fish and numerous other species of aquatic and terrestrial wildlife.
- Artificial barriers. This practice addresses artificial barriers, to remove or alter the barrier to allow passage of aquatic organisms

Example

Before: passage is restricted by velocity and height.

RESOURCE MANAGEMENT SYSTEM

This practice is commonly applied concurrently with NRCS practice Stream Habitat Improvement and Management (395) as part of a resource management system.

DEFINING PASSAGE

There is no standard criterion for providing passage; it is based upon the needs of theorganisms within that aquatic habitat.

For example, passage for fisheries is based upon: the swimming and leaping performances of a fish species or a group of species; on the lifestages (juvenile, adult or both); on lifeform (resident or migratory); and on the range of flows necessary for the passage of that target species.

An understanding of the basic biology of those aquatic organisms is essential in order to provide adequate passage. Please Note: information about passage for amphibians, reptiles, invertebrates, and small mammals is limited. Where this is a concern, passage determinations should be based on inferences from information about the basic capabilities and needs of the species, and professional judgments of experienced technical experts.

The 396 Job Sheet will identify:

- species present that require passage,
- movement requirements of the species,
- any species that have established passage requirements or recommendations by state or federal agencies,
- list life stages that have the greatest movement limitations.

If it is determined that species passage needs cannot be identified then design passage structures to mimic channel geometry and morphology referenced from an adjacent reach that provides passage or from an analog (model) reach.

Conservation practice specifications are reviewed periodically and updated if needed. To obtain the current version, contact the New Mexico Natural Resources Conservation Service State Office *or visit the* NM Field Office Technical Guide *(FOTG).*

DIVERSITY OF NEW MEXICO FISHES AND AQUATIC HABITATS

Provided by Propst, 1999. Threatened and endangered fishes of New Mexico. NMDGF. Santa Fe, NM.

Among the states of the arid American Southwest, New Mexico historically had a comparatively rich and diverse native fish fauna comprised of at least 66 species, and perhaps four others, representing 15 families (Propst, 1999). Refer to Table 1-3.

The diversity of aquatic habitats, varying from isolated springs to large rivers with highly variable flows, also contributes to the richness of New Mexico. Aquatic habitats range in elevation from about 1,000 m in the Pecos River valley of southeast New Mexico to more than 4,000 m in the Sangre de Cristo Mountains of north-central New Mexico. Associated with elevational changes are differences in thermal conditions. Small, low elevation warm springs and high-elevation, coldwater mountain streams each may support only one or two species. Larger, eurythermal mid- and low-elevation rivers, such as the Pecos, support more than 20 species. Some native fish species can survive salinities greater than that of seawater while others are intolerant of the slightest amounts of salt in their environments.

THREATS

Provided by Propst, 1999. Threatened and endangered fishes of New Mexico. NMDGF. Santa Fe, NM.

Few native fish species of New Mexico currently occupy all or even major portions of their historic ranges in the state. While the reductions of range and abundance have occurred at least since the arrival of Europeans, the rate of decline of the native fish fauna has accelerated dramatically in the past 100 years. While the reasons for imperilment of each species are varied, all are the direct or indirect consequence of anthropogenic (human induced) activities.

- Dams/Reservoirs. Dams impound streams and alter the natural thermal and hydrologic regimes of many streams and all major rivers except the Gila-San Francisco. Reservoir management often results in diminished or eliminated natural seasonal overbank flows and attenuation of spring runoff; which serves as an environmental cue for initiation of spawning by many species. Dams cause seasonally desiccated reaches and block natural dispersal corridors that fragment populations.
- Aquatic Invasive Plants. Many streams are bordered by invasive plant species that reduce the floodplain and stream health, and aquatic invasive plants can negatively alter water quality and reduce or eliminate channel migration.
- Inappropriate Livestock Grazing. Livestock grazing in riparian areas has contributed to the decline in quality of many aquatic habitats, by causing damage to stream banks, accelerating erosion and elevating nutrient loading.
- Canalization/Levees. Substantial portions of some rivers have been canalized and levees restrict the naturally meandering character of low elevation and low gradient streams.
- Artificial Barriers. Culverts, fords, low-water crossings, diversion structures and weirs often fragment habitat, and block natural up- and downstream dispersal corridors.
- Wetland Alteration. Draining or otherwise altering wetlands, cienégas and springs has eliminated habitats for several species.
- Groundwater Mining has lowered the water table in several areas (e.g., lower Pecos River valley) with a consequent loss of springs and permanently flowing creeks.
- Contaminants. Contaminated wastewater and runoff from urban areas, industries (including mining), and agricultural lands enter aquatic environments to the detriment of aquatic biota.
- Watershed Alteration. Activities within the watershed also have major impacts on the welfare of native fish communities. For example, poor land management contributes to increased erosion (elevated sediment loads).
- Introduced Aquatic Species. The introduction of nonnative species has had a severe detriment to the native population by causing unnatural competition for food and habitat resources, by hybridization causing dilution and loss of valuable genetic information, and by some introduced species preying upon native species.

Aquatic organism passage (396) can directly address the threats of artificial, physical barriers; however, all threats should be evaluated as part of a resource management system. Refer to NRCS practice Stream Habitat Improvement and Management (395).

Example: Culvert Barriers

Perched Structure. If a culvert outlet is perched above the stream, various size classes of fish may not be able to make the jump into the culvert. The higher the jump to reach the culvert, the more difficult the passage is for fish.

Lack of an outlet pool prevents a "resting place" prior to the fish attempting to jump into the pipe. Inadequate outlet pool depth also limits the physical ability of the fish to leap.

Velocity of water moving through the culvert can impede fish passage by creating water velocities that exceed the swimming capabilities of the fish. Velocity barriers are created by 1) too steep a slope, 2) roughness reduced through the culvert, 3) reduction of channel cross-sectional area, and 4) a combination of culvert length and velocity. Swimming capabilities are determined by fish species and fish length. Juvenile fish are weaker swimmers than adults and culverts that allow adult passage may not provide it for juveniles.

Low water depth through culverts may also prevent passage of fish through the pipes. Shallow water may result in the fish not being fully submerged, preventing adequate swimming power to pass through the structure.

These passage 'limiting factors' also apply to other types of barriers.

PRELIMINARY ASSESSMENT

***Question 1:* Does the structure (the potential barrier) resemble the natural channel?**

It is reasonable to assume that the aquatic and semi-aquatic organisms that normally move through an area will be able to pass through artificial features (culverts, weirs etc.) that closely resemble the adjacent natural channel reaches.

Characteristics that indicate that the crossing resembles the natural, adjacent channel include:

• Streambed substrate is continuous throughout the structure and the streambed slope, particle size and arrangement are similar to the adjacent channel;

• The structure does not constrict the bankfull channel width. To meet this criterion, the inlet width must at least match the natural channel bankfull width, usually measured upstream of the structure and away from its zone of influence.

- The structure can pass a 100-year storm flow.
- The water surface within the crossing blends smoothly with upstream and downstream water surfaces without excessive drops.
- Stable streambanks upstream and downstream of the structure.

If yes, the structure is assumed to allow passage. Document this determination on the 396 Job Sheet; no further actions are warranted under this practice. *If no*, proceed to question 2.

***Question 2:* Is the structure already designed or modified to allow passage?**

For example, many culverts have been modified or retrofitted with baffles or weirs for fish passage. Baffles and weirs typically act to reduce velocities, provide resting pools, and consolidate low flows to provide more suitable depth. These structures are sometimes installed to retain streambed material inside the pipe. Where these are completely embedded the crossing can be considered to have continuous substrate. However, not all structure designed or modified to provide fish passage is adequate. Field verification is required.

If yes, the structure is adequate to allow passage. Document this determination on the 396 Job Sheet; no further actions are warranted under this practice. *If no*, proceed to conducting a quantitative assessment.

QUANTATATIVE ASSESSMENT

A quantitative assessment is a required to identify and evaluate passage barriers, if a passage barrier has been identified through the preliminary assessment. Several methods are listed below; it is not a complete list. Select the method which is most appropriate to the site needs.

Clarkin et. al. 2005. National Inventory and Assessment Procedure for Identifying Barriers to Aquatic Organism Passage at Road-Stream Crossings. USDA Forest Service. San Dimas, CA

FishXing, "FishXing Software: version 2.2." USDA Forest Service, Six Rivers National Forest. Eureka, CA. www.stream.fs.fed.us/fishxing/

Taylor, R.N. and M. Love. 2003. Fish passage evaluation at stream crossings. Part IX in: California Stream Habitat Restoration Manual, 3rd edition, 1998. Prepared by G. Flosi et.al.

Table 1
NATIVE FISHES OF MAJOR DRAINAGES, EAST OF THE CONTINENTAL DIVIDE, IN NEW MEXICO.

Species		South Canadian	Pecos	Rio Grande
ACIPENSERIDAE, STURGEONS				
Scaphirhynchus platorhynchus	shovelnose sturgeon			X
LEPISOSTEIDAE, GARS				
Lepisosteus osseus	longnose gar	?	X	X
ANGUILLIDAE, EELS				
Anguilla rostrata	American eel		X	X
CLUPEIDAE, SHAD				
Dorosoma cepedianum	gizzard shad	X	X	X
CYPRINIDAE, MINNOWS				
Campostoma anomalum	central stoneroller	X	X	
Cyprinella lutrensis	red shiner	X	X	X
Dionda episcopa	Roundnose minnow	?	X	
Machrybopsis aestivalis aestivalis	speckled chub		X	X
Machrybopsis aestivalis tetranemus	speckled chub	X		
Gila pandora	Rio Grande chub	X	X	X
Hybognathus amarus	Rio Grande silvery minnow		X	X
Hybognathus placitus	plains minnow	X		
Notropis amabilis	Texas shiner		X	
Notropis girardi	Arkansas River shiner	X		
Notropis jemezanus	Rio Grande shiner		X	X
Notropis orca	phantom shiner			X
Notropis simus simus	Rio Grande bluntnose shiner			X
Notropis simus pecosensis	Pecos bluntnose shiner		X	
Notropis stramineus	sand shiner	X	X	
Phenacobius mirabilis	suckermouth minnow	X		
Phoxinus erythrogaster	southern redbelly dace			
Pimephales promelas	fathead minnow	X	X	X
CATOSTOMIDAE, SUCKERS				
Carpiodes carpio	river carpsucker	X	X	X
Catostomus commersoni	white sucker	X	X	
Catostomus plebeius	Rio Grande sucker			X
Cycleptus elongatus	blue sucker		X	?
Ictiobus bubalus	smallmouth buffalo		X	X
Moxostoma congestum	gray redhorse		X	?
CHARACIDAE, TETRAS				
Astyanax mexicanus	Mexican tetra		X	
ICTALURIDAE, CATFISHES				
Ameiurus melas	black bullhead	X		
Ictalurus furcatus	blue catfish		X	X
Ictalurus lupus	headwater catfish		X	
Ictalurus punctatus	channel catfish	X		
Pylodictis olivaris	flathead catfish		X	
SALMONIDAE, TROUTS				
Oncorhynchus clarki virginalis	Rio Grande cutthroat trout	X	X	X
FUNDULIDAE, TOPMINNOWS				
Fundulus zebrinus	plains killifish	X	X	
Lucania parva	rainwater killifish		X	
POECILIIDAE, LIVEBEARERS				
Gambusia affinis	western mosquitofish	X	X	?
Gambusia nobilis	Pecos gambusia		X	
CYPRINODONTIDAE, PUPFISHES				
Cyprinodon pecosensis	Pecos pupfish		X	
CENTRARCHIDAE, SUNFISHES				
Lepomis cyanellus	green sunfish	X	X	
Lepomis macrochirus	bluegill		X	X
Lepomis megalotis	longear sunfish	X	X	
Micropterus salmoides	largemouth bass		X	
PERCIDAE, DARTERS				
Etheostoma lepidum	greenthroat darter		X	
Percina macrolepida	bigscale logperch		X	

Propst, D.L. 1999. Threatened and endangered fishes of New Mexico. Tech. Rpt. No. 1. NMDGF, Santa Fe, NM. 84 pp.

Table 2
NATIVE FISHES OF SMALL DRAINAGES AND ENDORHEIC BASINS, EAST OF THE CONTINENTAL DIVIDE, IN NEW MEXICO.

Species		Dry Cimarron	Tularosa	Mimbres
CYPRINIDAE, MINNOWS				
Campostoma anomalum	central stoneroller	X		
Cyprinella formosa	beautiful shiner			X
Cyprinella lutrensis	red shiner	X		
Gila nigrescens	Chihuahua chub			X
Hybognathus placitus	plains minnow	X		
Phenacobius mirabilis	suckermouth minnow	X		
Pimephales promelas	fathead minnow	X		
Platyogobio gracilis	flathead chub	X		
CATOSTOMIDAE, SUCKERS				
Catostomus plebeius	Rio Grande sucker			X
ICTALURIDAE, CATFISHES				
Ameiurus melas	black bullhead	X		
Ictalurus punctatus	channel catfish	?		
FUNDULIDAE, TOPMINNOWS				
Fundulus zebrinus	plains killifish	X		
CYPRINODONTIDAE, PUPFISHES				
Cyprinodon tularosa	White Sands pupfish		X	
Cyprinodon sp.	Palomas pupfish			X

Propst, D.L. 1999. Threatened and endangered fishes of New Mexico. Tech. Rpt. No. 1. NMDGF, Santa Fe, NM. 84 pp.

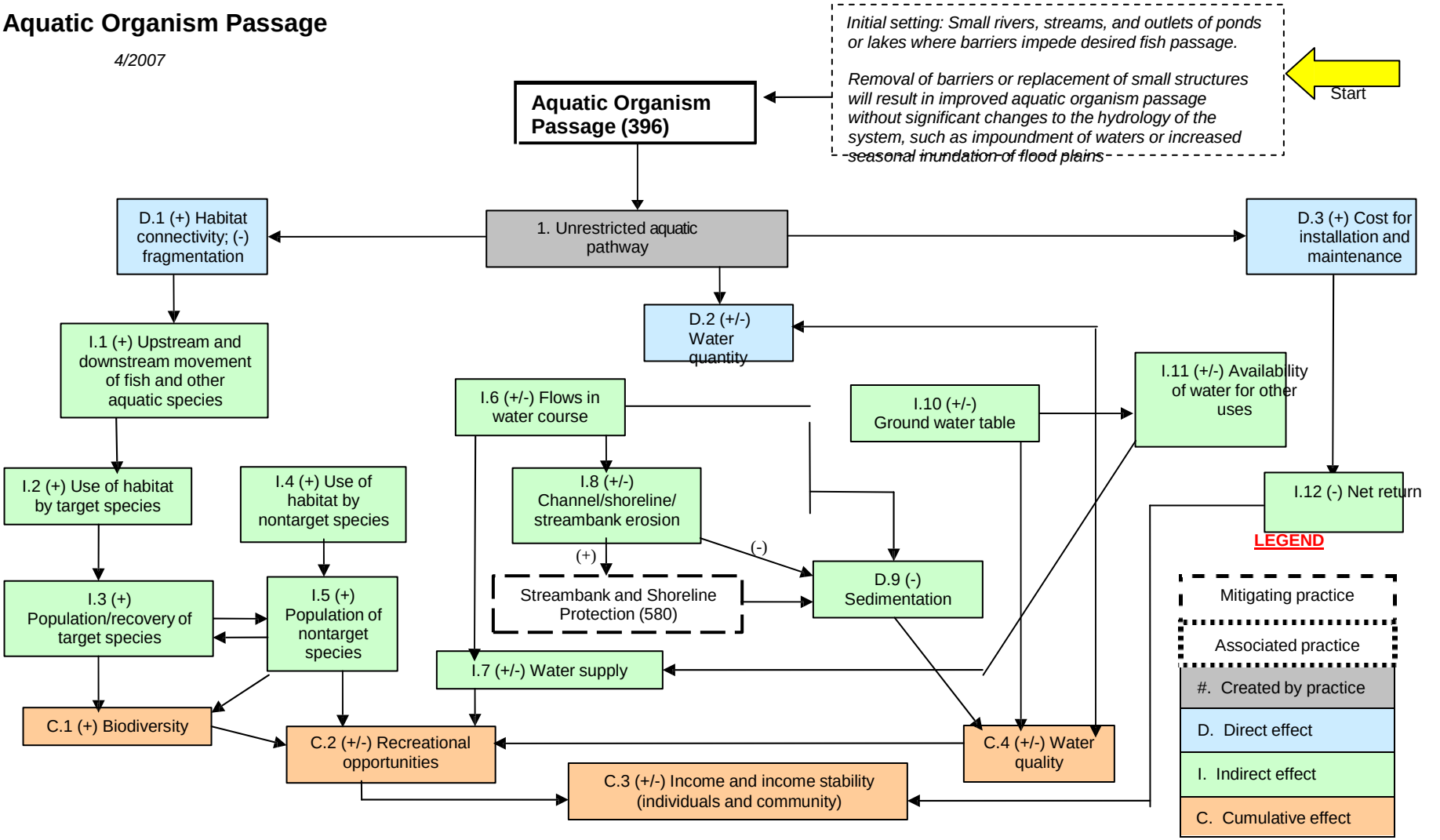
Table 3
NATIVE FISHES OF DRAINAGES, WEST OF THE CONTINENTAL DIVIDE, IN NEW MEXICO.

Species		San Juan	Gila	Zuni
CYPRINIDAE, MINNOWS				
Agosia chrysogaster	longfin dace		X	
Gila elegans	bonytail	?		
Gila intermedia	Gila chub		X	
Gila robusta	roundtail chub	X	X	X
Meda fulgida	spikedace		X	
Ptychocheilus lucius	Colorado pikeminnow	X	?	
Rhinichthys osculus	speckled dace	X	X	X
Tiaroga cobitis	loach minnow		X	
CATOSTOMIDAE, SUCKERS				
Catostomus clarki	desert sucker		X	
Catostomus discobolus	bluehead sucker	X		
Catostomus discobolus yarrowi	Zuni bluehead sucker			X
Catostomus insignis	Sonora sucker		X	
Catostomus latipinnis	flannelmouth sucker	X		
Xyrauchen texanus	razorback sucker	X	?	
SALMONIDAE, TROUTS				
Oncorhynchus clarki pleuriticus	Colorado River cutthroat trout	X		
Oncorhynchus gilae	Gila trout		X	
POECILIIDAE, LIVEBEARERS				
Poeciliopsis occidentalis occidentalis	Gila topminnow		X	
COTTIDAE, SCULPINS				
Cottus bairdi	mottled sculpin	X		

Propst, D.L. 1999. Threatened and endangered fishes of New Mexico. Tech. Rpt. No. 1. NMDGF, Santa Fe, NM. 84 pp.

Aquatic Organism Passage

4/2007



Note: Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

The scope of the practice implementation and resulting effects are limited to those described in the "initial setting." Projects involving larger river systems, impoundment of waters, increased seasonal inundation of flood plains, or any other changes to the hydrologic system may need to be evaluated in a site-specific EA.