Phelps Dodge Corporation

Loach Minnow and Spikedace Management Plan

Upper Gila River, New Mexico

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I. GENERAL BACKGROUND

The loach minnow (*Tiaroga cobitis*) was listed as "threatened" by the United States Fish and Wildlife Service ("FWS") in 1986, following proposed listing in 1985 (FWS, 1986a). The spikedace (*Meda fulgida*) was listed as "threatened" by FWS in 1986, following proposed listing in 1985 (FWS, 1986b). Recovery plans for the species were finalized in 1991 (FWS, 1991a, 1991b). Critical habitat was designated for both species in 1994 and again in 2000. Both designations were invalidated by federal courts. FWS recently proposed critical habitat for these species on the Gila River in New Mexico.

A. CHARACTERISTICS OF THE UPPER GILA RIVER

The segment of the Upper Gila River proposed for critical habitat designation for spikedace and loach minnow extends from Moore Canyon, near the Arizona/New Mexico state line, 102.1 miles (164.3 km) upstream to the confluence of the East and West Forks of the Gila River, plus 26.1 miles (42.0 km) of the East Fork, 7.7 miles (12.3 km) of the West Fork, and 7.7 miles (12.3 km) of the Middle Fork, for a total of 143.6 miles (230.9 km). The East, West, and Middle Forks of the Gila River exit the rugged Mogollon Mountains near Mogollon Creek northeast of Cliff and Gila, flowing across a broad valley for approximately 15 miles before re-entering mountainous terrain near Ira Canyon. The stream is perennial, unencumbered by major dam/reservoir systems, and exhibits a riffle/run/pool morphology along an average gradient of 0.4% (Rinne et al., 1999). Land ownership is principally federal (BLM, US Forest Service [Gila National Forest], National Park Service), with private lands irregularly situated along the river, concentrated in the Cliff/Gila area, and a lesser component of State lands in the Gila River main stem segment.

This management plan covers riparian lands owned by Phelps Dodge along the reach of the Gila River as depicted in Figure 1 ("Phelps Dodge Reach"). The area generally includes the middle reach of the main stem Gila River south of Mogollon Creek. Land use within the Phelps Dodge Reach consists of irrigated pasture for livestock grazing, with some recreational use. The Phelps Dodge Reach is currently occupied by both species, and experiences periodic, significant flood events. The Phelps

Dodge Reach also has the highest overall fish abundance of five segments of the Upper Gila River identified by Rinne (et al., 1999). The upper portion of Rinne's segment IV of the Gila River roughly coincides with the Phelps Dodge Reach. Spikedace and loach minnow combined comprised approximately 49% of the fish community in this reach during a survey conducted in 1999. Only two non-natives, one smallmouth bass and one yellow bullhead, were detected in this reach (Rinne et al., 1999).

The Phelps Dodge Reach contains a high proportion of favorable habitat types for the spikedace and loach minnow. Four major aquatic macrohabitat types have been demonstrated to be occupied by all native species. This habitat includes high gradient riffles (HGR), low gradient riffles (LGR), glide-runs (GRUN), and pools (POOL). LGRs and GRUNs are the habitats in which these species are typically found. The combined percentage of LGR and GRUNs for Rinne's segment IV is 67%, the highest recorded for the Upper Gila River (Rinne et al., 1999).

Phelps Dodge's water rights in the Gila River Basin are used for many purposes, including mining, agricultural, and other uses. Phelps Dodge's Gila River Basin water rights and delivery system have been developed and maintained to provide a dependable and adequate water supply for the operation of the Tyrone Mine. The water system includes the Gila Diversion Structure, the Bill Evans Lake, and several wells. The Gila Diversion Structure is located on the Gila River in the Southeast Quarter of Section 21, Township 16 South, Range 17 West, within the Bill Evans Ranch owned by Phelps Dodge, approximately 26 miles northwest of the Tyrone Mine. The Gila Diversion Structure minimizes the migration of non-native fish from the lower reach of the Gila River into the middle and upper reach of the Gila River. Notably, the area just upstream of the Gila Diversion Structure contains very few non-native fish (Rinne et al., 1999).

Surface water is diverted from the Gila River at the Gila Diversion Structure for storage in Bill Evans Lake and then transported via pipeline to the Tyrone Mine facility for subsequent use. The Bill Evans Lake is also operated as a recreational facility by the New Mexico Game and Fish Department. Phelps Dodge primarily operates the Gila Diversion Structure to supply water to the Tyrone Mine and maintain storage of 1,600 acre-feet in Bill Evans Lake.

B. PRIMARY CONSTITUENT ELEMENTS

FWS identified several primary constituent elements ("PCE") essential to the conservation of the loach minnow and spikedace (FWS, 2005). The PCE identified by

FWS in the proposed critical habitat rule include: (1) permanent, flowing water; (2) sand, gravel, and cobble substrates; (3) pool, riffle, run, and backwater stream components; (4) a natural, unregulated hydrograph that allows for periodic flooding or, if flows are modified or regulated, a hydrograph that allows for adequate river functions, such as flows capable of transporting sediments; and (5) habitat devoid of non-native fish species detrimental to loach minnow and spikedace, or habitat in which detrimental non-native fish are at levels which allow persistence of spikedace (FWS, 2005). Phelps Dodge reviewed these PCE in the context of the proposed critical habitat designation and submitted comments to FWS (Fennemore Craig, 2006). Phelps Dodge's comments are incorporated herein by reference.

II. MANAGEMENT PLAN

Although Phelps Dodge believes the Phelps Dodge Reach not require special management and the benefits of excluding outweigh the benefits of including the Phelps Dodge Reach, Phelps Dodge will implement the following management plan in the Phelps Dodge Reach for the benefit of the loach minnow and spikedace. The Phelps Dodge lands subject to this management plan are depicted in Figure 1, and the legal descriptions are provided in Figure 2. The goals of this management plan include:

- monitoring the distribution and abundance of the loach minnow and spikedace in the Gila River passing through the Phelps Dodge Reach;
- obtaining an understanding of the population dynamics of the loach minnow and spikedace as they relate to existing habitat conditions and land use practices in the Gila River passing through the Phelps Dodge Reach;
- continuing historic land use practices and water supply practices which enhance water flows in the Phelps Dodge Reach, and consideration of loach minnow and spikedace habitat when deviating from such historic management practices.

Phelps Dodge believes the implementation of the management activities and future coordination with FWS discussed below negates the need, if any, for special management considerations or protection within the Phelps Dodge Reach. In addition, Phelps Dodge believes this management plan results in the following benefits that might not otherwise occur: (1) the formation of working relationships to promote the conservation of the loach minnow and spikedace and their habitat; (2) the opportunity for collaboration and cooperation on loach minnow and spikedace management and other resources of interest to the Federal government; and (3) conservation benefits to riparian

ecosystems, including habitat that may be or may potentially become suitable to loach minnow and spikedace.

A. MANAGEMENT OF THE GILA DIVERSION STRUCTURE

Ensuring perennial flows for the loach minnow and spikedace has been identified as a critical component to their recovery (FWS, 1991a, 1991b). As stated by FWS, the loach minnow and spikedace "cannot exist in dewatered places, and populations can be expected to decline or disappear from stream reaches which are intermittent or ephemeral" (FWS, 1991a, 1991b). Moreover, "[p]ermanence of flows of sufficient quantity and quality must be assured to maintain integrity of spikedace [and loach minnow] populations and their habitats" (FWS, 1991a, 1991b).

Phelps Dodge's historic operation of the Gila Diversion Structure has enhanced water flows in the Gila River immediately upstream and downstream of the diversion while allowing for periodic flooding and adequate river functions such as sediment transport and sand, gravel, and cobble substrates. Under this management plan, Phelps Dodge will continue operating its Gila Diversion Structure in this manner to the extent legally, economically, and hydrologically reasonable under the circumstances.

It is important to note that while maintaining flows is beneficial to Phelps Dodge and the Gila River, it is possible that Phelps Dodge operational requirements will require short terms (weeks to months in duration) reduction or elimination of pumping and/or diversion activities. Further, at some unknown date in the future, active mining will cease at Tyrone and the use and diversion of water may need to be modified or moved to an alternate location. Nothing in this management plan will impair Phelps Dodge's ability to hold, exercise or modify its water rights and associated uses of water as it deems necessary under the circumstances.

Phelps Dodge also intends to maintain the Gila Diversion Structure, which is known to prevent the immigration of non-native fish from downstream into the middle reach of the Gila River. Such management practices are expected to promote and maintain the integrity of native fish populations and their habitats within the Phelps Dodge Reach of the Gila River.

B. U-BAR RANCH MANAGEMENT

For over ten years, Phelps Dodge and its wholly owned subsidiary, Pacific Western Land Co., have supported surveys and studies of known populations of the

Southwester Willow Flycatcher (*Empidonax traillii extimus*) in the Cliff/Gila Valley of New Mexico. The focus of the studies has been on the U-Bar Ranch in Grant County, New Mexico, which is owned by Pacific Western Land Co.

Management of the U-Bar Ranch consists of a multifaceted and highly flexible rest-rotation system utilizing both native range and irrigated fields. The Ranch's numerous pastures allow for a relatively dynamic rotation system that is modified based on current conditions. Grazing use of river bottom pastures is monitored by daily visual inspections. Use of these pastures is limited to ensure that forage utilization levels are moderate and over-use does not occur. In addition, all riparian areas are monitored regularly, and riparian vegetation is allowed to propagate along the river as well as irrigation ditches.

Management and irrigation practices of the fields described below may be modified over time as Phelps Dodge practices sound management of its water resources:

Lower River Pasture: This pasture is located on both the east and west sides of the Gila River from State Highway 211 downstream to State Highway 180 West. This pasture contains native vegetation along with several old stands of improved pasture. Although no irrigation occurs in this pasture at present, two irrigation ditches transect the property and flow when irrigation is occurring upstream. Grazing in this pasture is limited to the November through April period to protect riparian vegetation. The number of animal units varies as the stocking rate is dependant upon forage conditions, but typically is 50-75. Occasionally dry land farming occurs in this pasture during the fall, winter and spring. The approximate acreage of this pasture is 1,000 acres.

River Pasture: This pasture is located upstream of State Highway 211 and extends to the Hooker property. It lies along both the west and east side of the Gila River. This pasture is narrow and contains only the Gila River and riparian vegetation along the Gila River. Grazing is limited to November through April to protect riparian vegetation. The animal units vary, but are typically less than 40. No farming currently occurs in this pasture at present. The approximate acreage of this pasture is 400 acres.

Out Pasture: This pasture is located on the west side of the Gila River and is adjacent to the River Pasture. This pasture is not irrigated at present, but significant dry land farming does occur when moisture is available. The Upper Gila Irrigation Ditch crosses this pasture and flows when upstream irrigation is occurring. Grazing in this pasture is rotational, and may occur anytime during the year. Normally, however, this

pasture is used during the summer months and in the fall and spring when dry land crops are successful. The number of animal units in this pasture varies, but may be as high as 125 during the fall and spring. The approximate acreage is 800 acres.

Black Barn Pasture: This pasture is located west of and adjacent to the Out Pasture. The management system and season of use is the same as the Out Pasture and serves as part of the overall rotation of the Out Pasture. This pasture has some dry land farming, but no current irrigation. The Upper Gila Irrigation Ditch crosses this pasture. The approximate acreage is 250 acres, and the number of animal units is usually less than 40.

Jackson Pasture: This pasture is located on the east side of the Gila River and adjacent to the Lower River Pasture. The season of use varies and depends on successful dry land farming and the condition of native grasses and improved forage. The pasture may be used any month or months of the year, but is always rested a portion of the year. The number of animal units also varies, but normally is less than 50. The approximate acreage of this pasture is 200 acres.

Shelby Clark Pasture: This pasture is located on the east side of the Gila River and north of State Highway 211. This pasture has some irrigated pasture as well as native forage. The use of this pasture is the same as the Jackson Pasture. The approximate acreage is 40 acres, and the number of animal units may be as high as 50 during favorable forage conditions.

Garcia Pasture: The Garcia Pasture is the upper-most pasture on the east side of the Gila River and is adjacent to the River Pasture. Very little riparian vegetation is found in this pasture. This pasture is currently irrigated, and contains winter annuals as well as about 40 acres of permanent pasture. The use of this pasture is the same as the Jackson and Shelby Clark Pastures, but may be as high as 150 animal units during the fall and spring when annual crops are available to graze. The approximate acreage of this pasture is 400 acres.

Bennett Pasture: The Bennett Pasture is located on the west side of the Gila River and is adjacent to the River Pasture. It is the northern-most pasture in the Gila Valley. This pasture is currently irrigated, and primarily contains permanent pasture with some hay. The use of this pasture is year-round because of its high forage production. The approximate acreage of the Bennett Pasture is 300 acres, and as many as 200 animal units may graze this area when forage is available.

Spring Canyon Pasture: The Spring Canyon Pasture is located along the Bill Evans Road downstream of the Highway 180 West Bridge. Although healthy riparian forests occur in the pasture, the river valley here is very narrow and may be as little as 175 yards wide in places. Grazing occurs in this pasture from March to October. No irrigation occurs in this pasture at present, and the approximate acreage is 8,500 acres. The number of animal units is typically 200.

Bird Area Pasture: The Bird Area Pasture is located just north of the Gila Bird Area on the west side of the Gila River. This pasture is primarily utilized as a corridor for driving cattle from pasture to pasture. The approximate acreage of the Bird Area Pasture is 300 acres. The number of animal units varies, but is typically less than 200.

As the foregoing indicates, all grazing land is carefully managed by Pacific Western Land Co. and its grazing lessee, U-Bar Ranch, using a flexible system that incorporates adaptive management principles. These parties determine the use and magnitude of grazing on all Pacific Western Land Co. properties on an annual basis, taking into account available forage, moisture and other local factors and conditions. This rest-rotation system has been in place since 1992, and has been very successful in the management of both forage for livestock and the development of riparian habitat for wildlife.

C. MONITORING AND RESEARCH SUPPORTED BY PHELPS DODGE

Due to the lack of adequate information and scientific understanding, monitoring the status of existing populations in conjunction with recovery-management actions is important to the successful recovery of the loach minnow and spikedace (FWS, 1991a, 1991b; RMRS, 2006). In furtherance of this objective, Phelps Dodge has co-sponsored numerous studies on the Gila River in the past ten years. More recently, the Rocky Mountain Research Station ("RMRS"), a division of the United States Forest Service, commenced a study in cooperation with Phelps Dodge to analyze the ecology of the loach minnow and spikedace and their habitat in Mangas Creek and the Gila River in New Mexico and other selected streams and rivers in Arizona (RMRS, 2006). This project is expected to yield new information regarding native fish habitat selection and the influence of land uses and management practices to native fish and their habitat. A copy of the study plan is attached as Exhibit 1.

Phelps Dodge will continue to monitor loach minnow and spikedace populations in the Gila River Basin on a yearly basis. In conjunction with RMRS, Phelps Dodge will continue monitoring and defining the relationships between native fish preferences for selected habitats and various associated environmental factors (*e.g.*, substrates, channel conditions, vegetation, and morphology).

D. COORDINATION WITH FWS

Phelps Dodge will coordinate with FWS regarding management activities in the Phelps Dodge Reach. Such coordination will include:

(1) Phelps Dodge will provide an annual summary to FWS regarding its implementation of this plan. This summary will provide a brief narrative statement affirming implementation of the plan elements over the previous year and noting any deviations. This summary will also provide a brief narrative statement affirming anticipated implementation of the plan for the upcoming year and noting any anticipated deviations. The summary for each calendar year will be provided to FWS during the first quarter of the next calendar year.

(2) Phelps Dodge will make reasonable efforts to provide FWS with notice of any significant changes that are outside the range of historic operating parameters discussed in this plan. When making such changes, Phelps Dodge will consider loach minnow and spikedace habitat and any comments received from FWS, and will make reasonable efforts to minimize adverse impacts to loach minnow and spikedace habitat to the extent legally, economically, and practically reasonable under the circumstances. However, nothing in this management plan will impair Phelps Dodge's ability to hold, exercise or modify its water rights in its sole discretion.

(3) Phelps Dodge (or its designated representative) will make reasonable efforts to coordinate its water management activities by attending regularly scheduled fisheries management working group meetings to stay abreast of ongoing management issues and concerns that may affect Phelps Dodge management activities contemplated by this management plan.

III. CONCLUSION

Phelps Dodge's historic management of its resources in the Phelps Dodge Reach of the Gila River has promoted loach minnow and spikedace habitat. In fact, the Phelps

Dodge Reach currently provides habitat for one of the largest known loach minnow and spikedace populations. The goal of this management plan is to continue management of Phelps Dodge's resources utilizing the proven management regime set forth above. Phelps Dodge will continue to manage its resources consistent with these historic operations to the extent legally, economically, and practically reasonable under the circumstances. In addition, Phelps Dodge will make reasonable efforts to coordinate with FWS and other stakeholders in the watershed. Phelps Dodge will also continue its cooperative efforts with RMRS, FWS, and others to monitor and analyze the habitat of the loach minnow and spikedace in the Gila River.

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EXHIBIT 1

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Study Plan #4302-06-02

Ecology of Native Minnows and Associated Habitat of Mangas Creek, Sections of the Gila River, Southwestern New Mexico and Selected Streams and Rivers of Arizona

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[1]**Rocky Mountain Research Station, RWU-4302, Watersheds and Riparian Ecosystems of Forests and Woodlands in the Semi-Arid West**
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1 Study Description

Alvin Medina and John Rinne from the Rocky Mountain Research Station Research Work Unit 4302, Flagstaff, Arizona, and Dennis Miller from Western New Mexico University propose to study the ecology of native minnows and their habitats in Mangas Creek in Southwestern New Mexico and selected streams in Arizona. The principal focus is on understanding the population dynamics of loach minnow (*Tiaroga cobitis*) and spikedace (*Meda fulgida*) as they relate to existing habitat conditions and land use practices of the selected stream reaches. This study will be initiated and completed within a period of a year. The streams of interest are Mangas Creek located on private land belonging to Pacific Western Land Company and Aravaipa Creek located on Bureau of Land Management land in south central Arizona. We would propose to: (1) establish permanent sampling stations where both fish and aquatic and terrestrial components can be measured within the same (40 m) sample unit; (2) survey fish assemblages of the proposed study areas for the purpose of estimating respective population sizes and age/size attributes, (2) inventory vegetation attributes on streamsides associated with the fish sample unit to include but not limited to vegetation cover of herbaceous plants and density of woody plants by species, canopy cover; (3) inventory various channel attributes, including channel substrates, channel geomorphology (profiles); (4) inventory in-channel attributes to characterize aquatic habitat; (5) determine flow attributes of various habitats; (6) characterize geological attributes.

This project is expected to yield ‘State of the Art’ knowledge for management of these sensitive fish throughout their range of distribution in Arizona, New Mexico and Mexico, including criteria for describing ‘critical habitat’ and ‘Best Management Practices’ that conserve the species and their habitat. This project seeks answers to key ecological questions about management of Southwestern native fish and their habitats, which is critical for developing management criteria that can be used in species recovery plans, public land management plans, and private land enterprises. Various attempts to define the relationships of native fish to such land use activities as livestock grazing have fallen short of their goal because of the difficulty in designing cause and effect studies with sensitive species, and the cost and complexity of accounting for many environmental factors. This study will attempt to define relationships between native fish preferences for selected habitats and various associated environmental factors (e.g. substrates, channel conditions, vegetation, and morphology). In this fashion, we hope to describe the positive and negative associations of fish and their environments. This information can subsequently be used by resource managers to prescribe land use practices for areas where native fish are of concern throughout the Southwest.

2 LITERATURE REVIEW

A complete understanding of the ecology of minnow populations in low, desert rivers and streams of varying size is non-existent. Several long-term studies in smaller streams are ongoing: 1) Scientists have a 12-year record of fish assemblages changes in the Verde River (Rinne 2005, Rinne in press); 2) A parallel study in the upper Gila River spans 7 years (Rinne et al. 2005); and 3) There is a 25-year record of fish assemblages in Aravaipa Creek (Fish Data Base, Arizona State University. Whereas these existing data sets may be useful for comparing effects of floods and droughts on native species, and perhaps for defining both micro and macro-habitat associations and factors legislating them, not all study areas have been studied (Mangas Creek), all have not been studied with the same objectives or in the same manner (Aravaipa Creek), and none have been designed to address land use impacts on habitats and, in turn, fish assemblages and abundance relative to habitats.

Two major, controlling factors appear to interact to affect stability and integrity of native fish populations in southwestern North America: 1) alteration of the natural hydrograph through dams, diversions, pumping, and land use and 2) introduction of nonnative species of fish (Rinne 2003). In all but a few streams, these factors have eliminated native fish species and modified fish assemblage structure and dynamics, often within a few years after the action. Streams where the native fauna remains predominant are a rarity in the Southwest. The exact mechanism that sustains native is not totally understood, but is thought related, in part, to the extreme droughts and floods that characterize streams in this region, and, in part, land uses. How these two major legislators of fish habitat and abundance interact is not entirely understood. Clarification of these relationships is important at this time because of the ever-increasing demand by an ever-increasing populace for riparian areas and their water resources and the generally imperiled status of Arizona's native fish fauna. These imperial and mostly listed fish species can have marked changes on existing and proposed utilization of the riparian resource.

3 OBJECTIVES

The specific objectives of this study are:

1. Survey the fish from Mangas Creek and Aravaipa Creek.

2. Survey the aquatic and terrestrial habitat of these creeks within discrete (homogeneous) habitat conditions for aquatic, terrestrial, geomorphology, hydrology, and geology components.

3. Examine the relationships between fish species/fish abundance and their aquatic and terrestrial habitat attributes.

In addition, this research has the potential to provide much needed answers to several other questions of interest to private and public land managers, although not a specific intents of this study. These sets of questions include:

1. Why are observed populations of loach minnow and spikedace robust in the Gila River and associated tributaries? Previous fish surveys by RMRS (Rinne et al. 2005) of fish in the Gila River have shown unusually robust populations of native fish which is in stark contrast to other areas (e.g. Verde River). It is unclear what environmental factors are at play to result in these contrasts.

2. What are possible linkages between native fish and livestock grazing? Similarly, many riparian areas in New Mexico and Arizona have been excluded from livestock grazing based on the premise that this activity causes adverse effects to native fish and their habitats. To date, there is no substantiated scientific evidence to validate this premise (Rinne 2000). To the contrary, clear evidence abounds that major threats to native fish populations are from introduced fish into their native habitats. The clarification of these interactions is critical knowledge for resource managers to redirect management efforts at the conservation of native fish and their habitats. Livestock producers have borne the impact of various conservation efforts that may not be well founded. Hence, it remains for research to seek more definitive answers to these questions, dispelled the myths and paradigms of grazing effects (Rinne 1999), and develop better management practices for grazing riparian areas.

3. What are the linkages between native minnows and their habitats? The preponderance of scientific literature suggests that fish are directly linked to

various terrestrial components, and as such affect population densities. These linkages have been pursued in other streams/rivers (e.g. Verde River), but the answers have eluded researchers because populations of these fish are nonexistent to rare. Hence, robust fish populations are needed to identify other environmental factors that may be operative and associated with positive changes in fish numbers. Land management agencies are at a loss for specifying management criteria aimed at enhancing native fish populations. Most management efforts are aimed at protecting native fish populations through conservative land management practices, many of which have failed to protect native fish from extinction such as on the Verde River.

4. How do populations of spikedace and loach minnow on Mangas Creek and Gila River (selected reaches) compare with known populations such as Aravaipa, Eagle Creek, Blue River, and the Verde River? It is uncertain what common factors are responsible for robust populations across the Southwest. The populations on the Verde River are absent despite conservative measures (e.g. livestock exclusion, limited recreation, predator removal) to protect the fish (Rinne 2001). Fish were apparently abundant in times (pre-1990) when recreation and livestock grazing were common impacts to the riverine environment.

5. What are the relationships between water diversions and fish populations or their habitats? Water diversions are a common in-channel disturbance in most streams and rivers where the minnows are found. Considerable speculation exists on the negative effects of these structures and their maintenance. However, same minnows are commonly observed to occupy areas about these sites despite their limited expanse (probably less than <0.001%) and the availability (>99+ %) of other habitats. Are there microhabitat qualities of these sites that attract minnows and or aid in their reproduction? It is commonly assumed that any man-made structure or man-induced activity is apt to have negative consequences. This question needs to be examined by close examination of the relationships between minnows and channel structures.

6. Assuming that land use activities have negative effects on minnows, how can these effects be mitigated to provide secure conservation measures for fish and ensure sustained production from the land? This is often a critically ignored facet of research, but remains an integral component of this proposed study. It would be short sighted to evaluate the negative effects of a given factor, without a complete examination of all potential actions that could mitigate those effects. Land managers require clear prescription criteria of how to manage sensitive habitats as part of their obligation to meet multiple resource management goals. This is a key social connection between the land user and land manager.

7. What are the relationships between native fish preferences for selected habitats and associated aquatic and terrestrial components (e.g. vegetation,

channel morphology; Medina et al. 2005)? How are these same relationships linked to existing land uses such as livestock grazing (grazed and ungrazed)? Much of current knowledge is based on assumptions that livestock grazing and native fish are incompatible, and is reflected in land use and recovery plans. However, ample evidence exists that these assumptions may be unfounded, especially where robust populations prevail (Rinne and Miller in press). This information is critical for livestock producers and land managers, because current land management policies advocate the exclusion of livestock from areas of native fish habitat

8. Why are observed populations of loach minnow and spikedace robust in the Gila River and associated tributaries? Previous fish surveys by RMRS (Rinne et al. 2005) of fish in the Gila River have shown unusually robust populations of native fish which is in stark contrast to other areas (e.g. Verde River; Rinne 2005). It is unclear what environmental factors are at play to result in these contrasts.

9. What are possible linkages between native fish and livestock grazing? Similarly, many riparian areas in New Mexico and Arizona have been excluded from livestock grazing based on the premise that this activity causes adverse effects to native fish and their habitats. To date, there is no substantiated scientific evidence to validate this premise (Rinne 1999, Rinne 2000, Rinne in press). To the contrary, clear evidence abounds that major threats to native fish populations are from introduced fish into their native habitats. The clarification of these interactions is critical knowledge for resource managers to redirect management efforts at the conservation of native fish and their habitats. Livestock producers have borne the impact of various conservation efforts that may not be well founded. Hence, it remains for research to seek more definitive answers to these questions, dispelled the myths and paradigms of grazing effects (Rinne 1999; Rinne and Miller in press b), and develop better management practices for grazing riparian areas.

10. What are the linkages between native minnows and their habitats? The preponderance of scientific literature suggests that fish are directly linked to various terrestrial components (Rinne 1996, Rinne and Miller 2006), and as such affect population densities. These linkages have been pursued in other streams/rivers (e.g. Verde River), but the answers have eluded researchers because populations of these fish are nonexistent to rare. Hence, robust fish populations are needed to identify other environmental factors that may be operative and associated with positive changes in fish numbers. Land management agencies are at a loss for specifying management criteria aimed at enhancing native fish populations. Most management efforts are aimed at protecting native fish populations through conservative land management practices, many of which have failed to protect native fish from extinction such as on the Verde River.

11. How do populations of spikedace and loach minnow on Mangas Creek and Gila River (selected reaches) compare with known populations such as Aravaipa, Eagle Creek, Blue River, and the Verde River? It is uncertain what common factors are responsible for robust populations across the Southwest. The populations on the Verde River are absent despite conservative measures (e.g. livestock exclusion, limited recreation, predator removal) to protect the fish (Rinne 2001, 2005). Fish were apparently abundant in times (pre-1990) when recreation and livestock grazing were common impacts to the riverine environment.

12. What are the relationships between water diversions and fish populations or their habitats? Water diversions are a common in-channel disturbance in most streams and rivers where the minnows are found. Considerable speculation exists on the negative effects of these structures and their maintenance. However, same minnows are commonly observed to occupy areas about these sites despite their limited expanse (probably less than <0.001%) and the availability (>99+ %) of other habitats. Are there microhabitat qualities of these sites that attract minnows and or aid in their reproduction? It is commonly assumed that any man-made structure or man-induced activity is apt to have negative consequences. This myth needs to be examined by close examination of the relationships between minnows and channel structures (Rinne and Miller 2006).

13. Assuming that land use activities have negative effects on minnows, how can these effects be mitigated to provide secure conservation measures for fish and ensure sustained production from the land? This is often a critically ignored facet of research, but remains an integral component of this proposed study. It would be short sighted to evaluate the negative effects of a given factor, without a complete examination of all potential actions that could mitigate those effects. Land managers require clear prescription criteria of how to manage sensitive habitats as part of their obligation to meet multiple resource management goals. This is a key social connection between the land user and land manager.

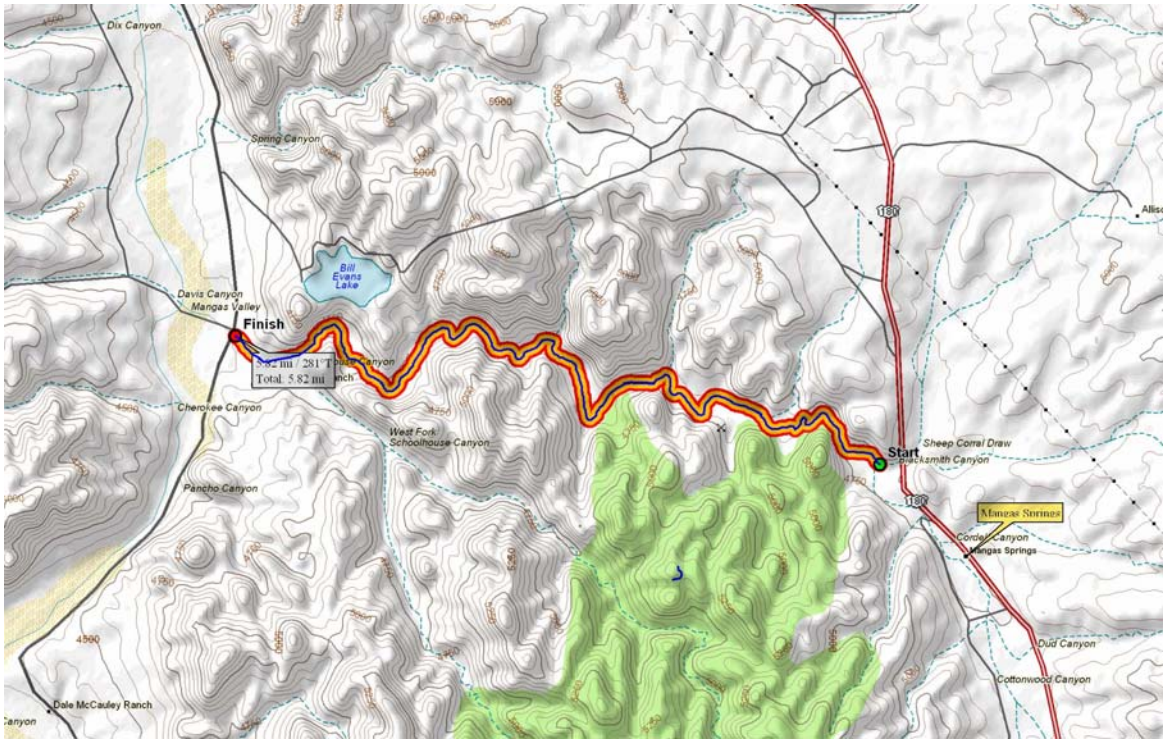
This information could be used to conduct various analyses, including but not limited to association analyses to ascertain what factors are associated with robust vs. non-robust populations, principal component analyses to ascertain what factors are most influential with respect to population attributes.

4 METHODS

A. STUDY AREAS

The principal study areas for this 2006 study are Mangas Creek in southwestern New Mexico and Aravaipa Creek in south central Arizona. These two streams have not been extensively studied, yet harbor abundant populations of native minnows. Other key streams of potential interest for future studies where either loach minnow or spikedace (or both) are found include Eagle Creek and the Blue River on the Apache Sitgreaves NF, the Gila River, and the Verde River. The Gila and Verde rivers have been studied extensively and much environmental data (i.e. vegetation, channel conditions, geomorphology, water quality, macroinvertebrates, watershed condition, historical analyses) are available for comparisons with other sites.

Figure 1. Location of Mangas Creek in southwestern New Mexico.



Mangas Creek is located largely on private lands belonging to Pacific Western Land Company, a subsidiary of Phelps Dodge Corporation, Silver City, New Mexico. Gila National Forest and Bureau of Land Management properties adjoin the creek's floodplain on the south sides (Figure 1). Mangas Creek is a small six code watershed stream located in Southwestern New

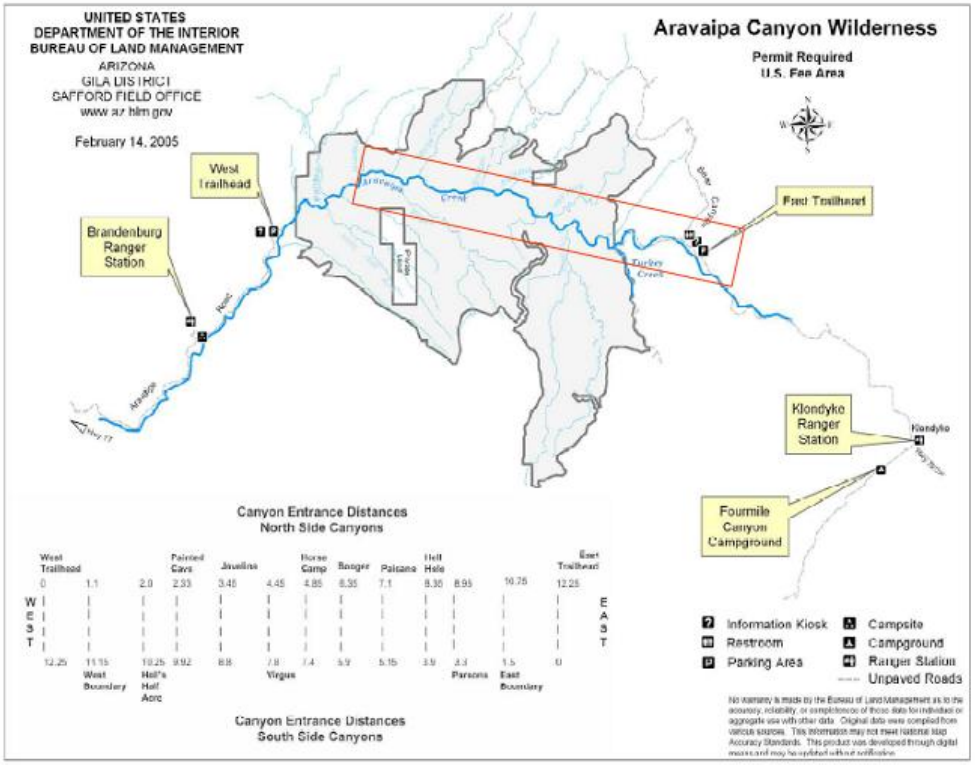
Mexico that emanates from the Mangas Springs in the Mangas Valley and flows westerly as a tributary to the Gila River south of Cliff, New Mexico. It is a 5.8 mile long perennial stream with a sub-watershed size of 204 square miles, large variables in flows at different times of the year. Most of the length of the stream is located between Highway 180 West along Blacksmith Canyon and the confluence of the Gila River just below the location of Bill Evans Lake and just north of Schoolhouse Canyon where it connects with the Gila Valley. Access is limited to hiking and horseback. The area is occupied with various historical remnants of occupation by settlers. The land use is limited to livestock grazing. Bill Evans Lake, a popular fishing spot, lies near the lower reaches but access to the creek is prohibited. Mangas Creek, with its location and inaccessibility is believed by some biologists to play an important role in maintaining the populations of spikedace and loach Minnow in the Gila River ecosystem. Reported fish species include loach minnow (*Tiaroga cobitis*), spikedace (*Meda fulgida*), longfin dace (*Agosia chrysogaster*), and desert sucker (*Catostomus clarkii*) (New Mexico Environment Department 2001). Base flow estimations range about 5-10cfs, but the channel shows signs of probable higher (>500 cfs) flood flows. Geologic information is available from Griffin (2001). Potential study site locations were identified in October 2005. These sites are distributed along Mangas Creek as depicted in Appendix A.

Aravaipa Creek is a tributary to the San Pedro River and flows through Aravaipa Valley from the southeast to the northwest. The creek, ephemeral in its upper reaches, becomes perennial in Aravaipa Canyon where impermeable bedrock forces groundwater into the creek bed. Aravaipa Creek maintains its perennial flow through the canyon before becoming ephemeral again west of the canyon. Major tributaries to Aravaipa Creek are Stowe Gulch, Deer Creek, Laurel Canyon, Squaw Creek, and Turkey Creek. Mean annual flow of Aravaipa Creek, measured at the western end of Aravaipa Canyon, is 26,059 acre-feet (EarthInfo1991). The drainage area approximates 537 square miles at the USGS gage. Base flows average about 17.6 cfs, with a minimum of 6.5cfs and a maximum of 70,800cfs. Several springs support perennial flow in streams tributary to Aravaipa Creek; flows of 100 to 150 gallons per minute have been reported for some springs. Summer (May-September) flows typically range from 14.1cfs to 23.8, and are conducive for fish sampling, with the possible exception of monsoon events. Water pH is reported (USGS Station #09473000) as 7.8 to 8.0. Specific conductance ranges from 240 uS/cm to 490 uS/cm. Water temperatures also fluctuate considerably and reported between 3.2 C to 25 C. The chemical quality of water in Aravaipa Canyon basin is suitable for most uses. Detailed analysis of water from over 90 wells and springs in the basin was done in 1981-1982 by Neuman and Adar (1983). Total dissolved solids concentrations ranged from 64 to 496 milligrams per liter (mg/l) and averaged 232 mg/l. The recommended secondary maximum contaminant level for total dissolved solids is 500 mg/l (U.S. Environmental Protection Agency, 1988). Irrigated agriculture, grazing, and mining are the main water uses in the watershed.

The hydrology of Aravaipa creek has been studied by Gould and Wilson (1976) and Ellingson (1980). Geologic information is available from Robinson (1976) and Simons (1964).

The following seven native species can be found: *Agosia chrysogaster* - longfin dace, *Gila robusta* - roundtail chub, *Meda fulgida* – spikedace, *Rhinichthys osculus* - speckled dace, *Tiaroga cobitis* - loach minnow, *Catostomus insignis* - Sonora sucker, and C*atostomus clarkii* - desert sucker. In addition, there are other extant and introduced species common to the lower reaches, including: *Cyprinella lutrensis* - red shiner, *Pimephales promelas* - fathead minnow, *Ameiurus natalis* - yellow bullhead, *Gambusia affinis* - central mosquitofish, *Lepomis cyanellus* - green sunfish.

Aravaipa Creek is a stream of interest because it also harbors robust populations of native minnows, has some long-term fishery data (ASU Fish Data Base), and is under the jurisdiction of the Bureau of Land Management. It would be important to compare Mangas Creek to Aravaipa Creek because both systems are quite similar in geomorphology and hydrology, have the same fish species, and the latter has a robust fish data base.



B. FIELD METHODS

Field studies are planned for initiation in May 2006 and continue throughout the summer season until all field data is collected. Unforeseen factors e.g. illness, injuries, and weather factors such monsoons may delay data collection for short periods, but none of these are expected to influence the surveys.

Sampling Criteria

All fish, aquatic and terrestrial habitat surveys are nested within a 40m stream segment. This segment size is based on the following stratification criteria that requires a high degree of uniformity (homogeneity) in the aquatic habitat, the terrestrial vegetation, the geomorphology of the channel, the hydrology (e.g. channel type, flow), and the geologic/lithologic unit. The size of 40m was determined from reconnaissance surveys where the minimum and maximum length of stream segments that possessed all these criteria was discerned. This size is consistent with other habitat surveys from other study areas in desert rivers and montane streams (Medina 1993, 1996). Units much larger than 40m trend towards higher heterogeneity in habitat character. While heterogeneous habitats may harbor unique populations of fish, it is not the principal focus of this study and could be examined at a later time. Furthermore, heterogeneity is not conducive for establishing basic fish-habitat relationships, as sampling costs increase exponentially.

Based on field reconnaissance, six principal channel-terrestrial habitat types were identified. Four samples of each habitat type across the entire selected stream reach for selected Creeks will be sampled for a total of 24 per creek (e.g. Mangas, Aravaipa). All fish and habitat sampling will be conducted in summer-fall of 2006. The aquatic habitats are limited to uniform 40m reaches of riffles, pool-riffle complexes and glide runs. Pool segments do not occur in 40m lengths. These aquatic habitats are seen repeatable throughout the stream length and in association with distinct vegetation and streambank geomorphology. Potential sample locations are plotted and provided in Appendix A. Final selections will be made during field sampling to insure field conditions have not changed since reconnaissance. Sample sites selection for Aravaipa Creek will be based on sites of similar character and criteria as used on Mangas Creek. Initial reconnaissance of Aravaipa Creek revealed that nearly identical habitat types were present in ample numbers.

Preliminary list of habitat types include, low gradient riffle/shrub, low gradient riffle/tree-shrub, low gradient riffle-pool/ shrub, high gradient riffle/ shrub, high gradient riffle/ tree-shrub, and high gradient riffle-pool/ shrub.

Sampling Stations

Each selected 40m sampling site will be identified as a permanent station where subsequent repeated measurements can be taken within a nested framework for habitat measurements (see Appendix B). All measurements of vegetation, fish, channel and geomorphology are taken within the 40m reach. Additional channel estimations are taken outside the 40m as per Rosgen (1996). A geomorphology transect is established at or near the 20m (midpoint), perpendicular to the channel, and extends across the floodplain to the next terrace. Small rock monuments (1'x1'x1') are established away from the channel, on adjacent terraces and perpendiculars to the start (0 mark) of transect to provide a visual landmark and distance measurements taken to transect-rebar location. GPS location data for each location is also recorded and plotted on topographic reference maps (see appendix A). In addition, each vegetation transect of 40m in length is identified with rebar at each end. These rebar locations also serve as reference markers for all other sampling, e.g. fish, geomorphology. Geomorphology transect endpoints are also identified with rebar (Appendix D). For all sampling work the convention of denoting right and left streambanks facing upstream was used.

Fish Sampling

Fish sampling is designed to expeditiously gather data with minimal impact to fish. Sample locations are selected based on a site stratification criteria listed above with consideration for linear disposition of available sample sites over the entire reaches of respective streams.

Selected habitats will be sampled for fish using a 3-pass depletion method to obtain best estimates of fish abundance and composition (Figure 2). Study sections will be blocked on upper and lower ends with block nets (mesh size 1/8") to prevent fish escapement. Fish sampling will be in sequence, progressing from a downstream to upstream direction. Fish will be collected using backpack DC electrofishing units, seines, dipnets, and trammel nets as appropriate to habitats conditions. Seining from upstream to downstream is an alternative effective method of sampling spikedace. Units of effort expressed as time and arte of electric current expended is recorded to establish a comparative basis for fish abundance across sample sites.

All fish captured will be held in 5 gallon buckets for rapid processing and returned to the stream. Air bubblers can be used to reduce stress of captive fish. Every fish will be identified to species and measured for length. Approximately 10-20 fish, depending on availability, will be

weighed to obtain a size-weight estimation equation for respective creeks. In the event that many fish are captured in the first samples, or it is estimated that many fish could be collected in the first samples, smaller segments of the 40m reach may be sampled to expedite fish measurements and return fish quicker to the stream. All data will be recorded on standardized forms (Appendix E).

VEGETATION SAMPLING

Established vegetation stations are sample using a standardized methodology (Medina 1986) for plant estimations and widely used in monitoring changes in vegetation and channel conditions of riparian areas. Both sides of the channel are sampled for herbaceous and woody vegetation.

Herbaceous

Plant and ground cover estimates are determined using a technique designed to place emphasis on vegetation about the water's edge and on the streambanks immediately adjacent to the channel. Detection of aquatic and semi-aquatic plants is considered important because many are pioneer types inhabit the water-land interface zone and they may serve as hiding cover for fish. These plants are also extensively utilized by herbivores, may form the microhabitat conditions necessary for other perennial sedge-like plants to colonize, and may express the relative condition of the streambanks in general. Herbaceous plant cover is estimated using a modified Daubenmire approach (Medina 1986). Within each sampling station, herbaceous vegetation is sampled within quadrats (16.0 x 62.5 cm) located along two 40-meter transects (one on each streambank) (Appendix B, Figure 1). These curvi-linear transects follow the edge of the stream channel. Transects contain 40 quadrats positioned in pairs at 2 m intervals. Quadrats are oriented with their long axis perpendicular to the stream channel. One quadrat of each pair extends 25 cm into the stream channel to sample aquatic plants, while the other quadrat is placed adjacent to the first and opposite the channel (rotated about the transect axis). Aerial cover within quadrats is separated by species and assigned to the categories developed by Bailey and Poulton (1968). Cover of soil (< 2 mm diameter), gravel (2 mm to 7.5 cm), rock (> 7.5 cm), litter, and cryptogams was also recorded. Station averages for total vegetative cover, cover by plant groups, and cover by ground cover categories are calculated by averaging all 80 quadrats sampled along the two transects (right and left bank).

Woody

Woody vegetation is sampled in 8 x 8 m plots (10 total) along the same 40-meter sampling reaches (i.e. stations) used for herbaceous vegetation sampling. Plots 1-5 are located on the right streambank, while plots 6-10 are located on the left streambank (Appendix B, Figure 1). All tree and shrub species were counted and assigned to height and diameter class (see Appendix B, Tables 1 and 2).

GEOMORPHOLOGY SAMPLING

Geomorphology data is used to characterize the local landscape morphology of the channel and its associated floodplain. The information collected here coupled with other channel and flow data provides a fundamental characterization of the hydrologic regime and is useful in contrasting habitat changes across time and space.

A cross channel transect is established across the floodplain from terrace to terrace (Appendix D). The transect line bisects the station at mid point. Using a laser level, the cross channel profile is determined by measuring the vertical displacement across the horizontal transect line. Measurements are taken starting at 0 and at 1m intervals or at intervals that reflect the local topography. The methodology used is per Rosgen (1996). Various additional profile measurements are taken to determine channel type and all associated estimators of channel attributes, e.g. bankfull.

CHANNEL SAMPLING

Channel measurements will be taken as per Rosgen (1996) to characterize the channel type. Typical measurements include bankfull locations, maximum depth, channel width, and sinuosity. Pebble counts are collected as per (Bevenger and King (1998). Sample size estimates will be determined using Bevenger and King (2001). Generally, a sample size of 330 measurements is taken per site. Flow measurements will be taken at each site using a digital flow meter.

Additional channel measurements will be taken of the stream-water column (wetted zone) to characterize the volume of aquatic habitat within the station. This is done by taking profile measurements across the stream and recording water depths coincident with horizontal measurements. These profiles are taken at the 0, 10, 20, 30, and 40m marks coincident

with the vegetation transect. Under complex habitat conditions, additional measurements may be taken.

GEOLOGIC CHARACTERIZATION

Prior to field sampling, geological data from geological maps is examined and the lithology determined. This determination is validated in the field. Rock samples are collected when doubt remains about the lithology. Samples are validated by consulting with professional geologists or other reference materials available at Northern Arizona University. This information is recorded on the data sheets.

PHOTOGRAPHIC CHARACTERIZATION

Photographs are taken to characterize the study site. Views of the channel and morphology profile, vegetation transects, are taken over the rebar locations. Other views of the local landscape that aid in characterization are also collected. These photos are subsequently referenced and archived to match site files.

LANDUSE CHARACTERIZATION

Data about the land use that are directly associated with the study sites is collected as part of the reconnaissance and laboratory analyses. This data is corroborated in the field.

C. LAB METHODS

Data Analyses

All data will be transferred from field forms to Excel spreadsheets for archival and processing. All data files will be referenced within a master dataset for respective streams. All data is checked for errors manually and summaries are checked against error checking programs. Only descriptive analyses will be presented in the final report. Other statistical analyses are limited to the production of manuscripts and beyond the scope of the inventory and survey procedures and requirements of the study.

FISH: Fish data is summarized using descriptive statistics, archived and in combination with graphic outputs is used to characterize site and stream differences and similarities. Fish-weight equations will be derived from field data and used in combination with aquatic habitat data to obtain estimates of habitat and stream productivity.

VEGETATION: Vegetation data is summarized using descriptive statistics to check for errors, then archived. Summary outputs using graphs are used in the final report.

GEOMORPHOLOGY: Geomorphology transect data is analyzed and plotted using WINXSPRO (USDA Forest Service 1998). Output data files are archived and referenced to study sites.

PEBBLE COUNTS: Pebble count data is analyzed using the zig-zag pebble count analyzer of Bevenger and King (2001).

CHANNEL: Channel data is summarized to produce estimators needed to classify the channel. Additional data from other measurements are also incorporated to produce a characterization. Various graphic and tabular outputs are used in the final report.

CONTRASTS: The experimental design permits various inter- and intra-stream contrasts to be examined. In addition, association analyses can be performed to examine relationships between fish parameters (composition, abundance) and aquatic and terrestrial components (substrates, vegetation cover, etc). These contrasts can be used to compare to other study sites with different land uses and hydrogeomorphologic conditions.

One of the emerging tools in statistics is meta-analysis, which is an approach to combine multiple experimental results into a statistical statement of cumulative knowledge (Hedges and Olkin 1985, Hunt 1997, Gurevitch et al. 2001). Meta-analysis is the combined analysis and quantitative synthesis of a collection of multiple studies generally using a set of summary statistics for each study (Hedges and Olkin 1985). In recent applications in ecology, meta-analysis has been extended to include the combined analysis of complete data sets from the individual studies, not only their summary statistics. The fish habitat data collected here and elsewhere, e.g. Verde River, Gila River, lend themselves to these possible forms of analyses to make collective sense of the individual scientific findings, to sort through everything that has been done, and come up with a summary of "what does this all mean" (Hobbs and Hilborn 2006).

In the absence of formal meta-analysis, scientists must either say they know nothing other than what the data they have in hand tell them, or they must find a way to summarize their professional opinion. Formal methods for meta-analysis are easily learned by anyone familiar with likelihood (Gelman et al. 1995), and have recently been extensively used in fisheries (Hilborn and Liermann 1998, Myers 2001, Myers et al. 2001, 2002, Dorn 2002) and ecology (Bender et al. 1998, Connor et al. 2000, Schmitz et al. 2000, Chalfoun et al. 2002, Fahrig 2002, Hillebrand and Cardinale 2004).

Additional data can be collected from USGS flow stations, e.g. Aravaipa, to relate discharge and annual streamflow to the dynamics of the fish community. The web site for Aravaipa Creek near Mammoth, Arizona is: http://waterdata.usgs.gov/az/nwis/uv/?site_no=09473000&PARAmeter_cd

5 QUALITY ASSURANCE & QUALITY CONTROL

Data methodologies are standardized and validated procedures that permit comparative analyses using standard statistical procedures. The same mesh size seine and dip nets and electrofishing units are used on both rivers. Units of effort expressed as time of electric current induced during sampling and expressed in seconds are mandatory.

All personnel are trained prior to making field observations. Observer bias is controlled by permitting only one observer to record specific data e.g. plant species cover.

The experimental approach controls for environmental bias by nesting all habitat measurement within a 40m experimental unit. Laser technology is invoked to minimize observer error and increase precision. All data is manually checked for observer error and using statistical programs prior to archival and analyses. All statistical analyses are reviewed by RMRS biometricians. All data is secured at the Rocky Mountain Research Station with identical copies held at Pacific Western Land Company in Silver City, New Mexico.

INFORMATION ARCHIVAL AND DOCUMENTATION

An annual report consisting of all raw data and associated summaries will be produced to track the progress of the project. In addition, data will be formatted to conform to standard ASCII formats, or spreadsheet. The entire set of documents (e.g. study plan, transmittals, data, analyses, manuscripts, publications, posters) that pertain to this study will be archived and maintained under a master file so as to retain complete tracking of all essential materials are per USDA Forest Service accountability procedures. This master file is maintained by the principal investigator and transferred to the project leader, with an identical copy provided to the Pacific Western Land Company, upon termination of the study or reassignment.

6 APPLICATION OF RESEARCH RESULTS

This research is considered vital for several reasons. First, land management decisions are currently being made based on limited information about the interactions of native fish, their environments and land uses (e.g. grazing). The recovery plan for these minnows are outdated (USDI 1991), yet nonetheless cited as best scientific knowledge available. In 1998, livestock grazing of riparian areas in Region 3 was removed owing to several factors, including lack of information about how cattle affect native fish and their habitats. These restrictions are apt to remain in place until better information is provided to the Forest Service. Critical habitat designations for these minnows were imposed in April 2000 (Federal Register 2000) that had a regional effect over 822 miles of river for the spikedace and 894 miles for the loach minnow but was recently vacated for lack of information and proper analyses. Information collected herein can used to provide alternative management perspectives for native minnows as it relates to livestock grazing and other activities. In addition, this research is expected to provide multiple benefits to land managers and producers, including answers to the following issues:

-This research will help us make informed decisions, and avert future litigation. Without the science, land management decisions are exposed to a higher risk of litigation.

- It will help resolve controversy about the science surrounding the spikedace and native desert fishes.

- On the Verde River (Prescott NF) we are faced with the reintroduction of spikedace without knowing what the requirements are to be successful.

- Not knowing the effects of our management actions (the relationships of spikedace habitat needs and management) affects what land managers can and cannot do on the ground. The lack of knowledge minimizes management options.

- Lack of information directs land management in uncertain directions.

- Irrespective of the outcomes of this proposed research, land managers need to know what the relationships and needs of the spikedace are to land management practices. By not knowing, the decision is taken out of our hands and into a stance of 'perceived caution' which may be wrong for conservation of the fish and economically adverse to producers.

- If we had this knowledge years ago, it could have saved the Forest Service and Bureau of Land Management, taxpayers and users large sums of money by minimizing litigation costs and preventing outcomes that cause hardships on users and the Forest Service and BLM.

7 SAFETY AND HEALTH

All personnel are required to attend various safety training to include defensive driving, first aid, CPR, and blood borne pathogens. Additionally, safety session are held at the start of every field tour to familiarize workers with unique circumstances and rules of conduct. A detailed hazard analysis has been made part of this study plan and found in Appendix D. Some additional safety considerations include: 1) exposure to high ambient summer temperatures, 2) electroshock from electrofishing units, 3) possible muscle strain or injury resulting from carry and deploying equipment on highly variable, often rough and slick stream bottoms, 4) dehydration from exposure to high summer temperatures, 5) insect and snake bites, 6) injury from spines of certain catfish, sunfish and bass species and common carp. Field equipment is provided to workers to provide a optimum level of safety. First aid kits and other first care products are provide to each employee and available in kits in all field vehicles.

8 ENVIRONMENTAL CONSIDERATIONS

None of the actions of this study constitute harm or irreversible conditions to any and all resources. The Mangas study is being conducted entirely on private lands and the Aravaipa study on Bureau of Land Management lands. These studies are observational in nature and as such excludes various considerations for environmental analyses. All employees in the conduct of their work will minimize their impact upon the land and abide by all rules of conduct as per the guidelines set forth by Pacific Western Land Company. Similarly, all employees will abide by the rules of access set forth by the BLM for wilderness areas and other lands associated with the areas under study. The following brief environmental analysis addresses additional issues.

ENVIRONMENTAL ANALYSIS

Systematic interdisciplinary approach in planning and decision making:

This study plan conforms to USDA Forest Service, Rocky Mountain Research Station guidelines as per FSM 4072.3. The methods detailed in this plan are not expected to incur significant negative impacts to the environment or fauna. Some potential impacts to vegetation may be attributed to overgrazing in the rare event that monitoring is insufficient to thwart overuse, but precautionary measures have been prescribed to minimize this risk. There are no adverse environmental effects as a result of implementing this study which have not been addressed herein.

Environmental impact of proposed actions

Riparian vegetation: The observational nature of this study will have no or minimal effect upon the vegetation resource.

Landscape: The observational nature of this study will have no or minimal effect upon the landscape resource. Small rock monuments and rebar are used to mark transect locations. This activity is non-invasive.

Fish: The observational nature of this study will have little or minimal effect upon the fish and aquatic resource. Standards methods for fish observational studies are employed. All fish will be process expeditiously and returned to the stream to minimize stress. Air bubblers can be used to reduce stress of captive fish. TES species in the study area of consideration include spikedace and loach minnow. All fish work will be

conducted under the strict direction of Dr. John Rinne, an authority on native fish.

Alternatives to the proposed action

There are no other reasonable alternatives to discovering unique resource facts about native fish and their habitats from these study areas. The methods specified are intended to be non-invasive. The use of surrogate streams is not an option as those streams have limiting populations of native fish.

Relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity

The future of native fishes of the Southwest may rest upon separation of facts, myths, and perceptions about the cumulative effects of land uses upon fisheries. The short term (day) influence of sampling fish and other habitat resources is neglible compared to the long term potential benefits from understanding environmental effects on these TES fish. Besides the ecological benefits, there are considerable economic benefits from the elimination or reduction in litigation over effects issues, and the concomitant effects on local communities.

Irreversible and irretrievable commitments of resources

This study, if implemented, would not entail any irreversible and irretrievable commitments of resources. The study could be terminated at any time, with the only commitment to date being the current year's cost for the study.

9 PERSONNEL ASSIGNMENT, TIMELINES, AND COSTS

COLLABORATORS:

Project Coordinator/Ecologist: Alvin L. Medina

Research Fishery Biologist : John N. Rinne

Rocky Mountain Research Station, RWU 4302, Flagstaff, AZ.

Dennis Miller Biologist/Professor

Western New Mexico University

Tom Shelley Environmental Manager

Pacific Western Land Company, a subsidiary of Phelps Dodge Corp.

DURATION:

This project is expected to last one year to accomplish the objectives set forth in the study plan. It is not possible to predict the need for additional study until the data from the first year has been analyzed. Such options are reserved for discussion with Pacific Western Land Company at the term of this study.

COSTS:

RMRS CONTRIBUTIONS: RMRS-RWU-4302 in-kind contributions to this study approximate $80k/year for 2 scientists' salary and administrative costs.

RMRS-RWU-4302 IN-KIND CONTRIBUTION	
Research Scientist Salaries (30%)	$60,000
Administrative Costs	$6,000
Data Management	$6,000
Indirect costs	$8,000
TOTAL	**$80,000**

PACIFIC WESTERN LAND COMPANY CONTRIBUTIONS: This funding will cover salaries for labor and contracts to include Mr. Dennis Miller (Biologist at Western New Mexico University), temporary technicians (5-6 students) and travel.

OPERATIONAL COSTS CONTRIBUTED BY PACIFIC WESTERN LAND COMPANY

Field Technician PT Salaries (30%)	$37,500
Travel and Per Diem	$19,000
Indirect costs (overhead 18%)	$9,900
TOTAL	**$ 66,400**

These costs include the 5% estimates for reconnaissance work to determine the complexity of study sites.

TIME LINES

The suggested timeline below is not intended to reflect a continuous or accurate timeline, rather to indicate the relative amount of time spent on a given function. Accurate timelines are not practical owing to weather and other unpredictable events. Differences between streams are apt to increase or decrease field work.

Week 1-2: Field reconnaissance of Mangas Creek and Aravaipa Creek by RMRS.

Products: Site sampling requirements, revised cost estimates.

Week 3-5: Develop study plan and MOU; obtain sampling permits.

Products: Draft study plan, MOU between Phelps dodge and RMRS.

Week 6-8: Study plan peer reviews; RMRS biometrician review;

Week 9: Study plan revisions; Process temporary student appointments.

Products: Study plan finalized; student appointments.

Week 10-12: Field inventories and fish surveys of Mangas Creek

Products: Field survey data for Mangas Creek.

Week 13-15: Field inventories and fish surveys of Aravaipa Creek

Products: Field survey data for Aravaipa Creek.

Week 16-17: Field inventories and fish surveys of Gila River (PD and USFS lands)

Products: Field survey data for Gila River.

Week 18-20: Data management/analyses for Mangas, Aravaipa, Gila.

Products: Preliminary results (Presentation) for Phelps Dodge.

Week 21: Discussion of results, planning other surveys with Phelps Dodge.

Products: Draft manuscripts, revised field surveys itineraries for other streams in Arizona (e.g. Eagle Creek, Verde River, Blue River).

Week 22-36: Finalize manuscripts; submit to journals; develop presentations to professional and layman groups; pending final reviews of manuscripts and presentations from Phelps Dodge. Note submission of manuscripts is not a condition set forth in this study. The submission of a final report to Pacific Western Land Co. satisfies the contractual requirements.

10 DATA MANAGEMENT

All data will be electronically stored and management will follow RMRS Quality Assurance Standards.

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12 APPENDICES

APPENDIX A. **LOCATION OF POTENTIAL STUDY SITES ON MANGAS CREEK, OCTOBER 2005.**

APPENDIX B. **PLOT LAYOUT AND PLANT CLASSES**

APPENDIX C. **ESTIMATION CLASSES FOR VEGETATION MEASUREMENTS ON PERMANENT STATIONS.**

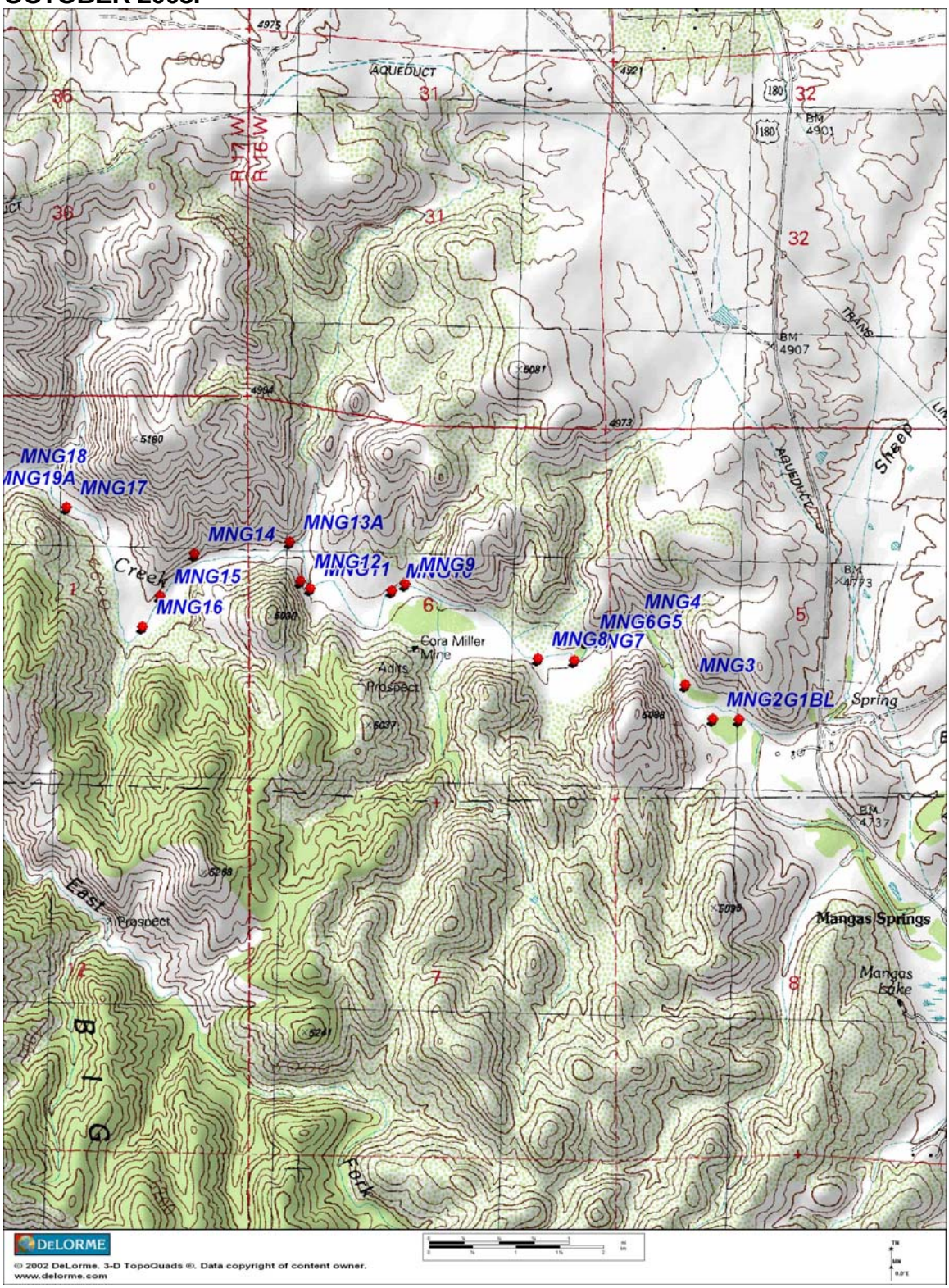
APPENDIX D. **GEOMORPHOLOGY PLOT LAYOUT & FORMS**

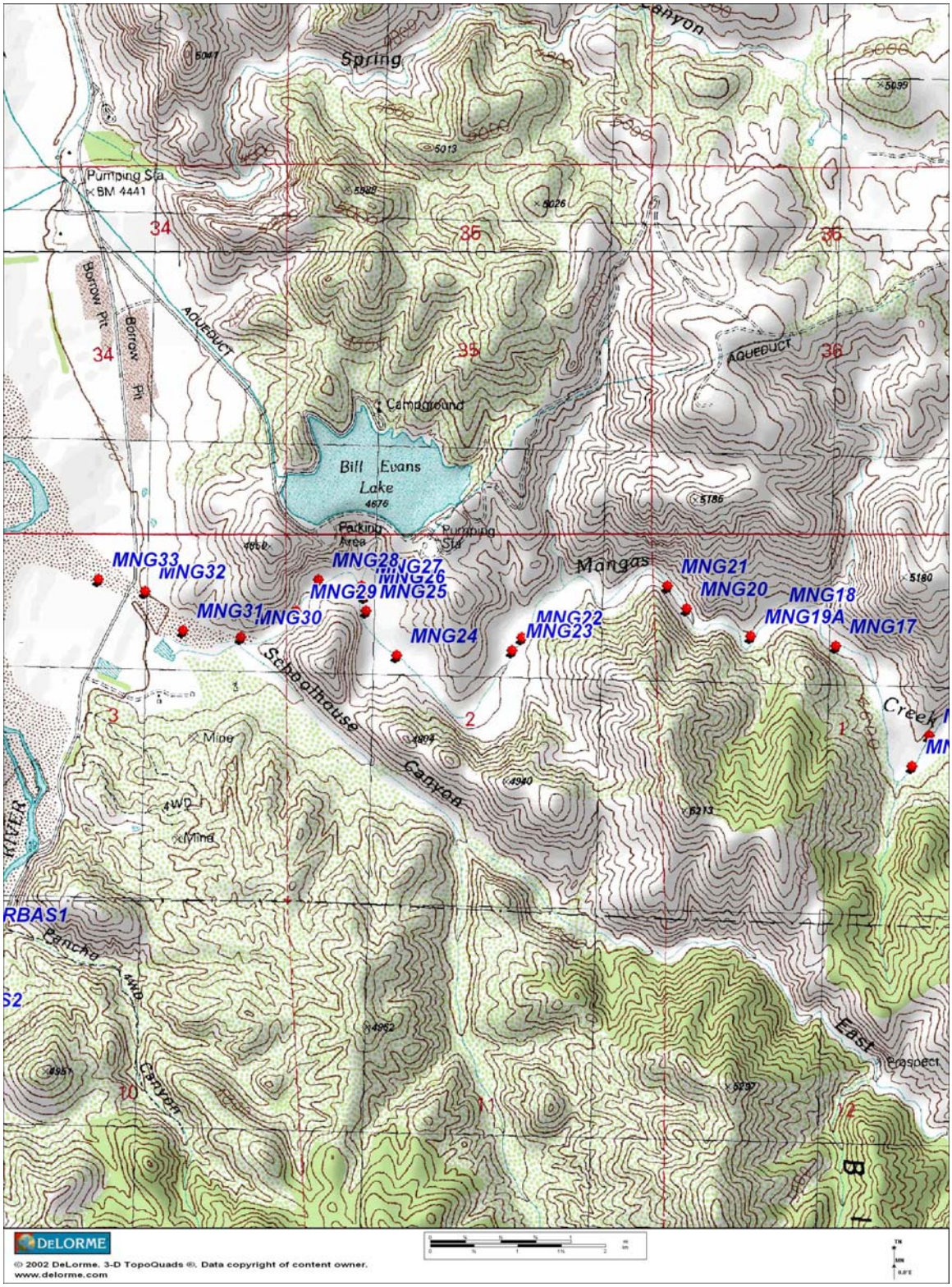
APPENDIX E. **FISH SAMPLING LAYOUT, CONCEPTS, FORMS**

APPENDIX F. **USGS FLOW DATA FOR ARAVAIPA CREEK.**

APPENDIX G. **JOB HAZARD ANALYSIS**

APPENDIX A. LOCATION OF POTENTIAL STUDY SITES ON MANGAS CREEK, OCTOBER 2005.




Spring
Pumping Sta
BM 4441
34
35
36
Borrow Pit
AQUEDUCT
Campground
Bill Evans
Lake
4676
Parking Area
Pumping Sta
MNG33
MNG32
MNG31
MNG30
MNG29
MNG28
MNG27
MNG26
MNG25
MNG24
MNG23
MNG22
MNG21
MNG20
MNG19A
MNG18
MNG17
Mangas
Schoolhouse
Canyon
Mine
4WD
Mine
RBAS1
Rancho
4WD
Canyon
East
Prospect
Creek
DELORME
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APPENDIX B. PLOT LAYOUT AND PLANT CLASSES

Table 1. Diameter classes for woody species.

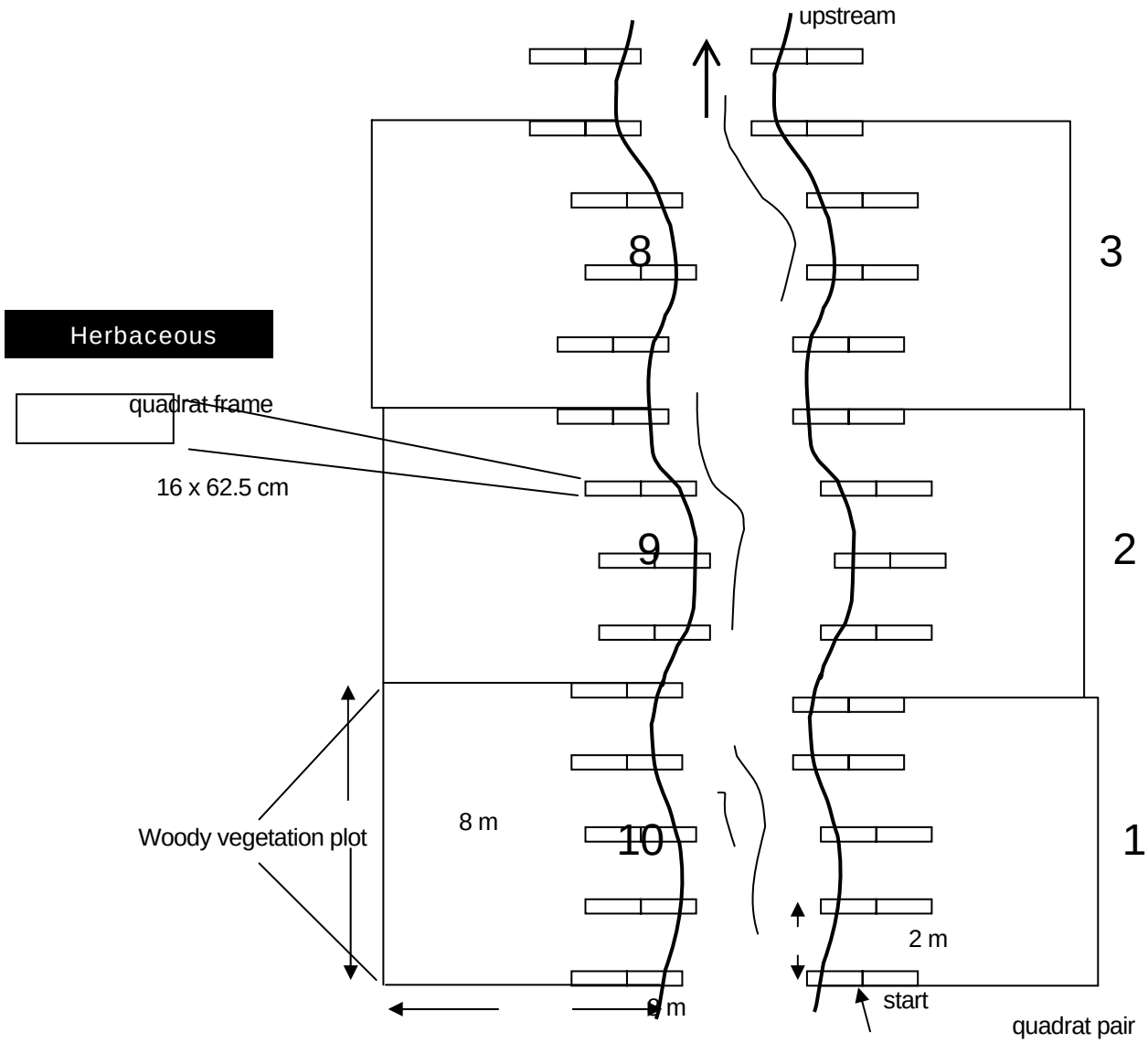
Class	Size (dm)
0	0 – 0.5
0.5	0.5 – 0.9
1	1 – 1.9
2	2 – 2.9
3	3 – 3.9
4	4 – 4.9
5	5 – 5.9
6	6 – 6.9
7	7 – 7.9
8	8 – 8.9
9	9 – 9.9
10	> 10

.

Table 2. Height classes for woody species.

Class	Size (trees)	Size (shrubs)
0	< 1 m	< 1 dm
0.5	1 – 1.9 m	1 – 1.9 dm
1	2 – 4.9 m	2 – 4.9 dm
2	5 – 9.9 m	5 – 9.9 dm
3	10 – 19.9 m	1 – 1.9 m
4	20 – 20.9 m	> 2 m

Figure 1. Layout of vegetation sampling transects.



APPENDIX C. ESTIMATION CLASSES FOR VEGETATION MEASUREMENTS ON PERMANENT STATIONS.

ESTIMATION CATEGORIES, CLASSES, AND SYMBOLS

(Revised 10/1/05 - ALM)

Stand structure and plant life form and size class (F):

Overstory stratum life form (woody plants):

TB → broadleaf, nondesciduous tree.
TD → broadleaf, deciduous tree.
TE → needleleaf, nondesciduous tree.
TN → needleleaf, deciduous tree.

Overstory (trees & shrubs) stratum DBH class (D):

0 → 0.0 ↔ 0.5dm	5 → 5.0 ↔ 5.99 dm
0.5 → 0.5 ↔ .99 dm	6 → 6.0 ↔ 6.99 dm
1 → 1.0 ↔ 1.99 dm	7 → 7.0 ↔ 7.99 dm
2 → 2.0 ↔ 2.99 dm	8 → 8.0 ↔ 8.99 dm
3 → 3.0 ↔ 3.99 dm	9 → 9.0 ↔ 9.99 dm
4 → 4.0 ↔ 4.99 dm	10 → 10.0 ↔10.99 dm , etc

Overstory (trees) stratum height classes (H):

0 → 0 ↔ 1 m tall
0.5 → 1 ↔ 2 m tall
1 → 2 ↔ 5 m tall
2 → 5 ↔ 10 m tall
3 → 10 ↔ 20 m tall
4 → 20 ↔ 30 m tall
5 → 30 ↔ 40 m tall
6 → > 40 m tall

Shrub stratum life form (F): (woody plants):

SB - broadleaf, nondesciduous shrub.
SD - broadleaf, deciduous shrub.
SE - needleleaf, nondesciduous shrub

Shrub & herb stratum height classes (H): (may include small trees):

1 - < 1 dm	4 - 5-10 dm	7 - > 3m
2 - 1-2 dm	5 - 1-2 m	
3 - 2-5 dm	6 - 2-3 m	

Herb stratum. All vascular herbaceous plants, plus tree and shrub seedlings (F):

GP - perennial graminoids GA - annual graminoid

FP - perennial forb FA - annual forb

Surface stratum (cryptogam) (F):

CI - crustose lichen
CF - foliose lichen
CR - fruitcose lichen
CO - other cryptogams

Special life form classes (F) (May occur in any strata:

LI - liana
SU - succulents
AP - aphyllous

List of Taxa (TAXA):

1. Use 4-letter symbols made up of the first two-letters of the genus and the species (e.g. CALA = Carex lanuginosa).
2. If Subspecies known, add the first two letters of the subspecies to the end of the symbol e.g. Carex lanuginosa spp vaseyana = CALAVA).
3. If two taxa have the same first two letters for genus and species (e.g. Poa ampla = POAM and Potentilla ambigens - POAM), and the subspecies is not known, add the numeral 2 (or 3, , ... etc.) at the end of the 4-letter symbol. (E.g. POAM ~ Poa ampla; POAM2 - Potentilla ambigens).
4. If identification is to general only, use an X before the first 3 letters of the generic name (e.g. XCAR= Carex spp).

Canopy coverage classes for shrub, herb, and surface strata taxa (CV):

1. Classes are modified from those used by Daubenmire (1959). Enter values of midpoint (rounded to nearest full number):

Value entered	Range in Coverage
T (use 0.5 for	< 1%
3 calculations)	1 → 5%
15	5 → 25%
38	25 → 50%
62	50 → 75%
85	75 → 95%
98	95 → 100%
0	PRESENT ON SITE

2. Taxa which occur on the vegetation macroplot, but which are not sampled on the microplots should be recorded as P. A value of 0.1% will be used for these taxa in any computations.

3. The categories of exposed soil (SOIL); rocky material < 2 cm in diameter (GRAVEL); rocky material > 2 cm in diameter (ROCK); dead and shed organic material (LITTER); and the total cryptogamic ground cover (CRYPGAM) are estimated with the same canopy coverage classes.

4. A zero (0) denotes the absence of the taxon from the microplot. Zeros are used in place of blank space to facilitate vertical alignment.

5. Average canopy coverage (COV) is calculated by summing all entries for each individual taxon and dividing by the total number of microplots (40). Values are rounded to the nearest 0.1% (e.g. 25.4). Average canopy coverage values < 0.1% are designated by T in the COV column.

6. Frequency (FRQ) is calculated by counting the number of entries and multiplying this count by 2.5% for taxa recorded on the microplots. Frequency values are entered to the nearest 0.5% (e.g. 27.5).

7. Total canopy coverage is obtained by summing the average value calculated for each taxon. Summations may be made by strata and for all strata. Total canopy coverage may exceed l00%.

Density determinations for tree and shrub strata (D)

1. Density is determined on a taxon-size class basis. Count only those taxa which appear to be more than 75% rooted in the microplot.

2. Average density for shrubs is calculated by dividing the total count for each taxon-size class by the appropriate number of plots (5 for shrubs and trees). Shrub density is reported as x/m . Tree density as x/ha.

3. Shrub frequency is calculated by counting the number of entries and multiplying this value by 20%. Frequency values are entered in 5% intervals (e.g. 5, 10, 15,... 100). Tree frequency is similarly calculated.

APPENDIX D. GEOMORPHOLOGY PLOT LAYOUT & FORMS

Morphology Profile Data

Notes:

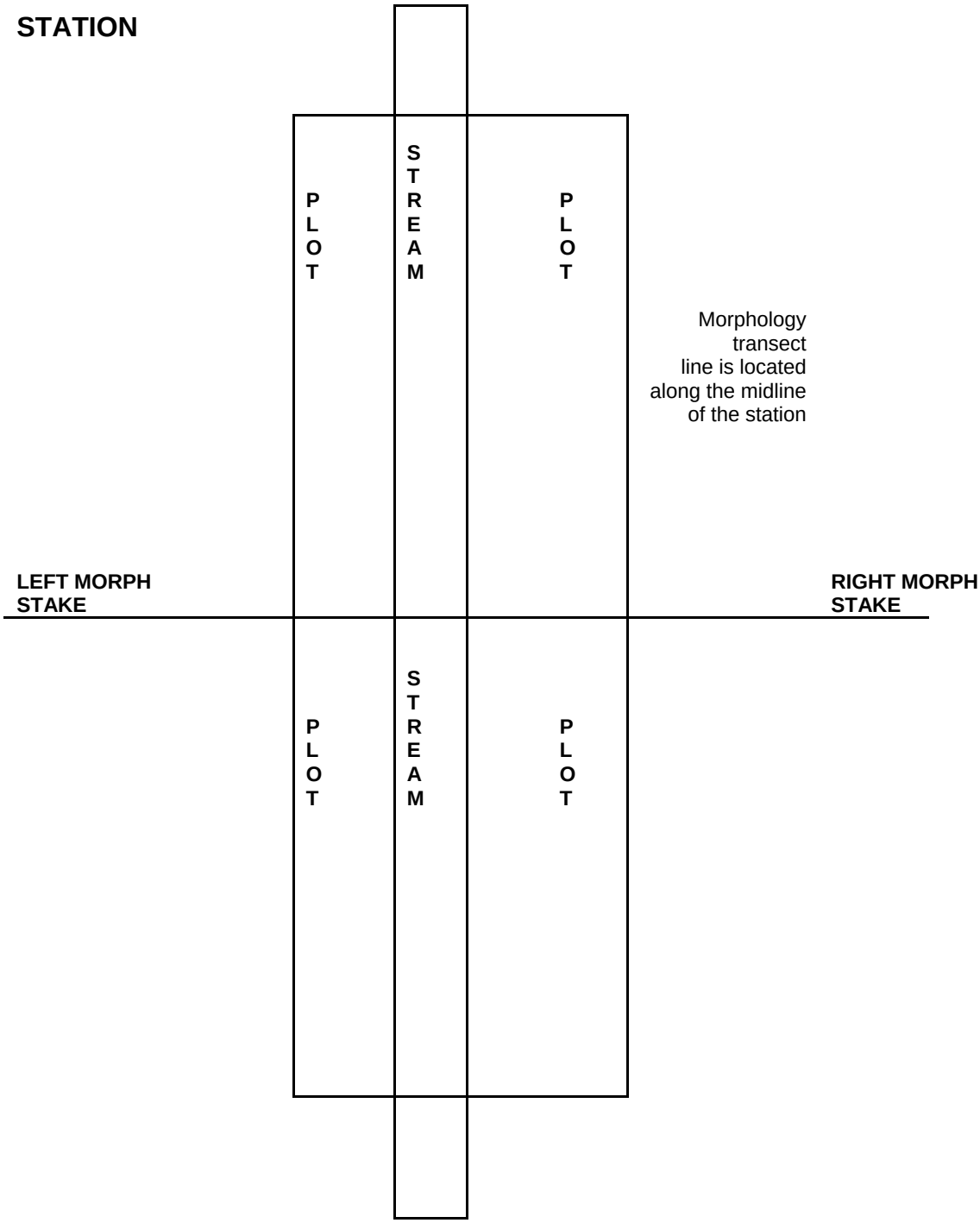
RS/LS=right/left morph stake -(Stake Ht in cm)/(Notch Ht in cm)
RFP/LFP=right/left flood prone
ROCK=rock or bolder; SB=sandbar; BKWR=backwater;

RWE/LWE=right/left water's edge
RBF/LBF=right/left bank full
NR=no reading
LOG=fallen brach/tree

HOR(m)	VERT(m)	NOTES	HOR(m)	VERT(m)	NOTES	HOR(m)	VERT(m)	NOTES

MORPHOLOGY TRANSECT LOCATION

STATION



LOCATION
TRANSECT
DATE

NOTE: FOR PURPOSES OF SORTING ALL PARTICLES THAT ARE < 1 ARE CONSIDERED .9
FOR PURPOSES OF SORTING ALL PARTICLES THAT ARE < .062 ARE CONSIDERED .06

	DATA	SORTED		PARTICLE	mm	TYPE	FORMULA	COUNT
1			**AVG.**	SILT/CLAY	< .062	SILT/CLAY	0	**0**
2			#####	VERY FINE	.062 - .124	SANDS	0	**0**
3			**MED.**	FINE	.125 - .24	SANDS	0	**0**
4			#NUM!	MEDIUM	.25 - .4	SANDS	0	**0**
5			**Q1**	COARSE	.5 - .9	SANDS	0	**0**
6			#NUM!	VERY COARSE	1	SANDS	0	**0**
7			**Q3**	VERY FINE	2 - 3	GRAVELS	0	**0**
8			#NUM!	FINE	4 - 5	GRAVELS	0	**0**
9				FINE	6 - 7	GRAVELS	0	**0**
10				MEDIUM	8 - 11	GRAVELS	0	**0**
11				MEDIUM	12 - 15	GRAVELS	0	**0**
12				COARSE	16 - 23	GRAVELS	0	**0**
13				COARSE	24 - 31	GRAVELS	0	**0**
14				VERY COARSE	32 - 47	GRAVELS	0	**0**
15				VERY COARSE	48 - 63	GRAVELS	0	**0**
16				SMALL	64 - 95	COBBLE	0	**0**
17				SMALL	96 - 127	COBBLE	0	**0**
18				LARGE	128 - 191	COBBLE	0	**0**
19				LARGE	192 - 255	COBBLE	0	**0**
20				SMALL	256 - 383	BOULDER	0	**0**
21				SMALL	384 - 511	BOULDER	0	**0**
22				MEDIUM	512 - 1023	BOULDER	0	**0**
23				VERY-LARGE	1024 - 2047	BOULDER	0	**0**
24				VERY-VERY LARGE	2048-4096	BOULDER	0	**0**
25				BEDROCK	10,000	BEDROCK	0	**0**
26						**TOTAL**	0	0
27						**D50**	0	
28						**D84**	0	
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								

CHANNEL CLASSIFICATION DATA FOR CHARACTERIZATION STUDY

MEASUREMENTS IN METERS (M)

Characterization Site:	Thalwag:
Valley Distance:	Bankfull Width:
Stream Distance:	Bankfull Max. Depth:
Elevation Change:	Bankfull Mean Depth:
Channel Slope:	Flood Prone Area Width:
Valley Slope:	Width/Depth Ratio:
Sinousity:	Entrenchment:

APPENDIX E. FISH SAMPLING LAYOUT, CONCEPTS, FORMS

FISH SURVEY **DATE:** **SITE:** **CREW:** **OTHER;**

SPECIES RECORDS

	SPIKE DACE		LOACH MINNOW		LONGFIN DACE		SONORAN SUCKER		DESERT SUCKER		ROUNDTAIL CHUB		SPECKLED DACE	
ct	**MEFU**	**wt**	**TICO**	**wt**	**AGCH**	**wt**	**CAIN**	**wt**	**CACL**	**wt**	**GIRO**	**wt**	**RHOS**	**wt**
1														
2														
3														
4														
5														
6														
7														
8														
9														
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			RED SHINER		FATHEAD MINNOW		YELLOW BULLHEAD		MOSQUITO FISH		GREEN SUNFISH			
ct		**wt**	**CYLU**	**wt**	**PIPR**	**wt**	**AMNA**	**wt**	**GAAF**	**wt**	**LECY**	**wt**		**wt**
1														
2														
3														
4														
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6														
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FIG. 1. 40-M FISH PROCESSING

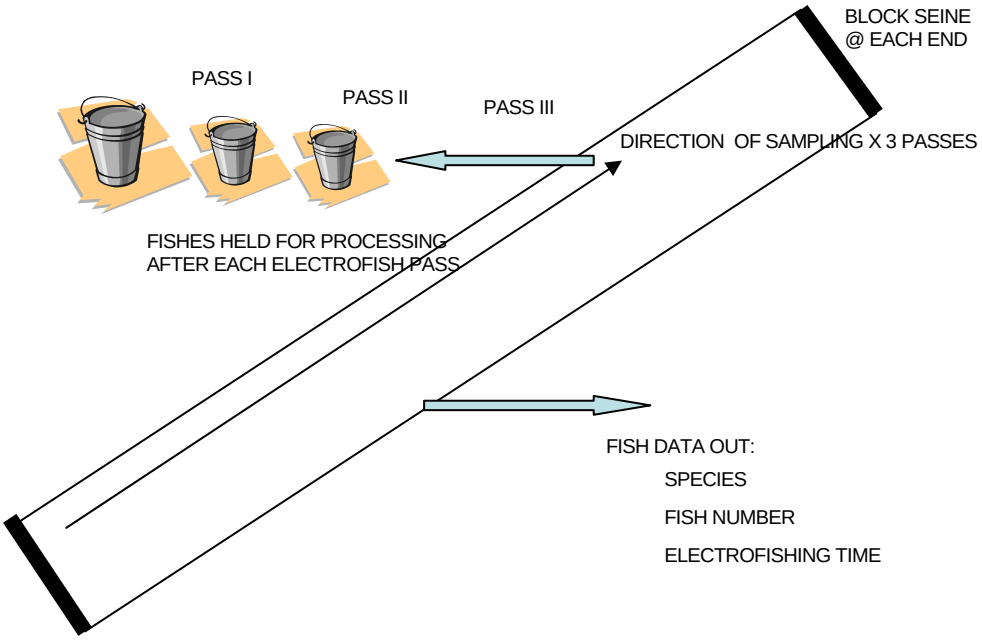
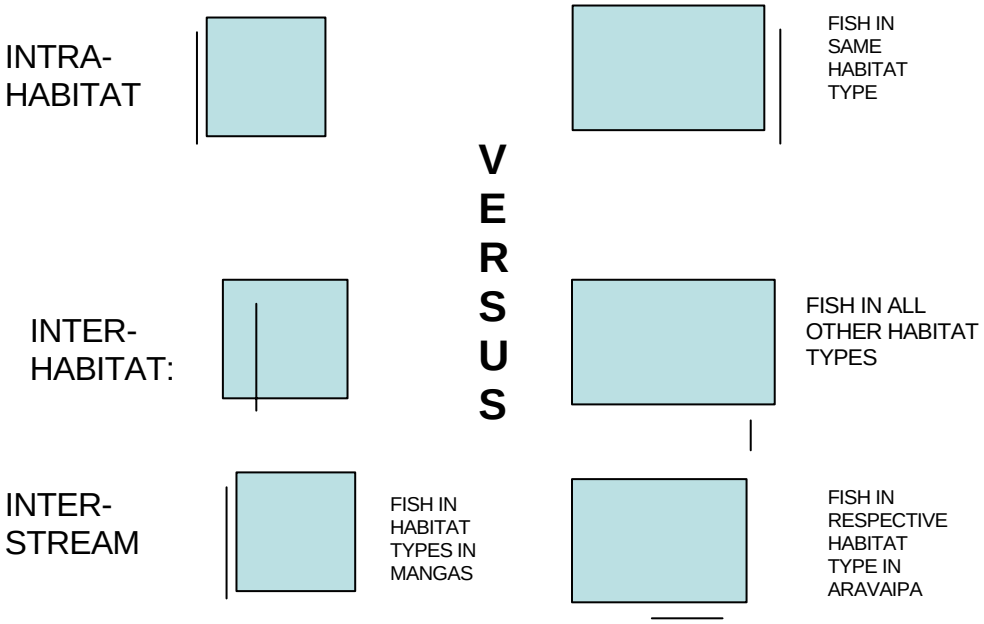


FIG. 2. POTENTIAL COMPARISONS AMONG HABITAT TYPES



APPENDIX F. USGS FLOW DATA FOR ARAVAIPA CREEK.

```
#
# U.S. Geological Survey
# National Water Information System
# Retrieved: 2006-04-25 18:45:07 EDT
#
# ---------------------WARNING---------------------
# The data you have obtained from this automated U.S. Geological Survey
database have not received Director's approval and as such are
provisional and subject to revision.  The data are released on the
condition that neither the USGS nor the United States Government may be
held liable for any damages resulting from its use.
#
# More data may be available offline.
# #For more information on these data,  contact  Arizona NWISWeb Data
Inquiries.
# This file contains the annual peak streamflow data.
#
# This information includes the following fields:
#
#  agency_cd     Agency Code
#  site_no       USGS station number
#  peak_dt       format YYYY-MM-DD
#  peak_va       Annual peak streamflow value in cfs
#  peak_cd       Peak Discharge-Qualification codes (see explanation
below)
#  gage_ht       Gage height for the associated peak streamflow in feet
#  gage_ht_cd    Gage height qualification codes
#  year_last_pk  Peak streamflow reported is the highest since this
year
#  ag_dt         Date of maximum gage-height for water year (if not
concurrent with peak)
#  ag_tm         Time of maximum gage-height for water year (if not
concurrent with peak
#  ag_gage_ht    maximum Gage height for water year in feet (if not
concurrent with peak
#  ag_gage_ht_cd maximum Gage height code
#
# Sites in this file include:
#  USGS 09473000 ARAVAIPA CREEK NEAR MAMMOTH, AZ.
#
# Peak Streamflow-Qualification Codes(peak_cd):
#   1 ... Discharge is a Maximum Daily Average
#   2 ... Discharge is an Estimate
#   3 ... Discharge affected by Dam Failure
#   4 ... Discharge less than indicated value,
#           which is Minimum Recordable Discharge at this site
#   5 ... Discharge affected to unknown degree by
#           Regulation or Diversion
#   6 ... Discharge affected by Regulation or Diversion
#   7 ... Discharge is an Historic Peak
#   8 ... Discharge actually greater than indicated value
#   9 ... Discharge due to Snowmelt, Hurricane,
#           Ice-Jam or Debris Dam breakup
#   A ... Year of occurrence is unknown or not exact
```

```
#   B ... Month or Day of occurrence is unknown or not exact
#   C ... All or part of the record affected by Urbanization,
#            Mining, Agricultural changes, Channelization, or other
#   D ... Base Discharge changed during this year
#   E ... Only Annual Maximum Peak available for this year
#
# Gage height qualification codes(gage_ht_cd,ag_gage_ht_cd):
#   1 ... Gage height affected by backwater
#   2 ... Gage height not the maximum for the year
#   3 ... Gage height at different site and(or) datum
#   4 ... Gage height below minimum recordable elevation
#   5 ... Gage height is an estimate
#   6 ... Gage datum changed during this year
#
#
```

agency_cd	site_no	peak_dt	peak_tm	peak_va	peak_cd	gage_ht	gage_ht_cd
5s	15s	10d	6s	8s	27s	8s	13s	4s	10d
USGS	09473000		1919-08-02			20000	E	6.30	3
USGS	09473000		1920-01-05			7400	E	4.30	3
USGS	09473000		1921-07-31			12600	E	5.00	3
USGS	09473000		1931-08-20			4700		8.11	3,6
USGS	09473000		1931-10-01			6300		9.00	3
USGS	09473000		1933-07-23			9340		10.50	3
USGS	09473000		1934-07-20			3100		7.12	3
USGS	09473000		1935-08-15			10200		10.90	3
USGS	09473000		1936-07-25			6500		9.10	3
USGS	09473000		1937-02-07			3380		7.30	3
USGS	09473000		1938-03-04			3600		7.56	3
USGS	09473000		1939-08-05			6450		9.10	3
USGS	09473000		1940-09-21			5480		8.60	3
USGS	09473000		1940-12-31			9600		10.88	3
USGS	09473000		1965-09-03			4480	E		
USGS	09473000		1965-12-22			6340	E		
USGS	09473000		1967-09-25			2340		5.66	
USGS	09473000		1967-12-17			15300		11.86	
USGS	09473000		1969-08-29			1800		5.36	
USGS	09473000		1970-03-03			5560		6.51	
USGS	09473000		1971-08-21			1780		5.05	
USGS	09473000		1972-09-10			1830		4.93	
USGS	09473000		1972-10-19			8200		6.74	
USGS	09473000		1974-08-02			2100		4.80	
USGS	09473000		1974-10-22			836		4.02	
USGS	09473000		1976-08-23			1120		4.32	
USGS	09473000		1977-07-12			2560		5.33	
USGS	09473000		1978-08-01			5100		6.40	
USGS	09473000		1978-12-18			16200		13.30	
USGS	09473000		1980-02-15			2460		5.26	
USGS	09473000		1981-08-10			2460		5.25	
USGS	09473000		1982-08-12			1620		5.38	
USGS	09473000		1983-03-19			3920		7.50	
USGS	09473000		1983-10-01			**70800**	7	16.76	
USGS	09473000		1984-12-12			1330		4.77	
USGS	09473000		1986-03-14			1060		4.34	
USGS	09473000		1986-10-12			1320		4.46	
USGS	09473000		1988-07-31			1040		4.28	
USGS	09473000		1989-09-03			3610		6.06	
USGS	09473000		1990-07-20			5090		6.68	

USGS	09473000	1991-03-02		6760	7.31
USGS	09473000	1992-08-24		4710	6.52
USGS	09473000	1993-01-11		13000	9.09
USGS	09473000	1994-02-08		2750	5.42
USGS	09473000	1995-01-05		8930	8.33
USGS	09473000	1996-09-11		932	4.28
USGS	09473000	1997-08-30		3500	6.02
USGS	09473000	1998-07-22		3840	6.18
USGS	09473000	1999-07-28		4150	6.32
USGS	09473000	2000-08-30	0430	1440	4.74
USGS	09473000	2000-10-23	1014	1100	4.41
USGS	09473000	2002-09-10	2015	8270	7.81
USGS	09473000	2003-07-30	2045	6990	7.41
USGS	09473000	2004-03-05	1215	1860	5.07

APPENDIX G. JOB HAZARD ANALYSIS

U.S. Department of Agriculture Forest Service	1. WORK PROJECT/ACTIVITY Ecology of Native fish & Habitat	2. LOCATION Mangas Creek, NM, Aravaipa Creek, Arizona
JOB HAZARD ANALYSIS (JHA) Reference-FSH 6709.11 and 12 (Instructions on Reverse)	4. NAME OF ANALYST Alvin L. Medina	5. JOB TITLE Rangeland Management Specialist
7. TASKS / PROCEDURES	8. HAZARDS	9. ABATEMENT
Walking and Hiking		Fitness sufficient to carry 40 pound p
	Walking Surfaces Weather Falling Objects Sharp or Pointed Objects Poisonous Plants Insects and Animals	If rattlesnakes are observed at the w should wear high boots or waders ar Drive rebar stakes so that less than above the ground surface and cover Be able to contact emergency servic phone, or other means. Be alert. Be careful walking or climbing over c Look above you. Do not walk or wor branches - "widow- and widower-ma Look where feet and hands are place in areas where rebar stakes may hav
Motorized Vehicle		Motorized Vehicle 12.1 - Qualifications. All Forest Serv Government vehicles (or private veh hold a valid State driver's license wit the size and class being driven and a identification card indicating the type operator is authorized and qualified t Motorized Vehicle 12.11 - Training. Defensive driving t Service employees who drive Govern official duty. Drivers must attend a Council or equivalent defensive drivi
	Fatigue Weather	12.04b - Drivers/Operators. Drivers responsibility to: 1. Inform their supervisors of a emotional condition that might impai motorized vehicle or operate machin 2. Know and observe all State a 3. Drive safely while operating limits. 4. Consider the needs of passen traveling, such as accessibility and a vehicle fires or accidents. Motorized Vehicle 12.2 - Required Vehicle Equipment. and equipment shall not be nullified, that Government vehicles are equipp

		1. Safety belts for all passenge exception of bus passengers. 2. Warning markers or reflecto 3. First aid kit. The standard fir vehicles must contain two packets o equipment (rubber gloves, face mas clear-mouth barrier) (refer to the Gl 4. Chock blocks. 5. Tire chains. 6. Window scraper. Motorized Vehicle 12.3 - Safety Practices. Vehicle ope laws, regulations, or ordinances, eve situations (sec. 12.32).Motorized Ve
Water Surveys		
	Sharp or Pointed Objects Walking Surfaces Falling Objects Weather Insects and Animals Poisonous Plants	Drive rebar stakes so that less than above the ground surface and cover Be able to contact emergency servic phone, or other means. Be alert. Be careful walking or climbing over c Look above you. Do not walk or wo branches - "widow- and widower-ma Look where feet and hands are place in areas where rebar stakes may ha Wear sunglasses to protect eyes and Exercise caution when in the presen ivy. Wear long pants in areas with poiso
Poison Ivy/Oak/Sumac and Noxious Weeds		
	Poisonous Plants	Exercise caution in areas with poison launder any clothes that may have c
Ticks		
	Insects and Animals	Inspect skin and hair to detect prese according to first aid guidelines; be a diseases.
Poisonous Snakes		
	Insects and Animals	Wear protective chaps if operating in Be alert when walking or placing ha with limited visibility.
Bears		

U.S. Department of Agriculture Forest Service	1. WORK PROJECT/ACTIVITY Ecology of Native fish & Habitat	2. LOCATION Mangas Creek, NM, Aravaipa Creek, Arizona
	Insects and Animals	Be alert for dangerous wildlife, do no back away from animals, announce and be prepared to take cover behin
Spiders		
	Insects and Animals	Wear gloves and be observant when ground.
Scorpions		
	Insects and Animals	Shake out and carefully inspect footw where scorpions could enter. Wear gloves when picking up rocks.
Mosquitoes		
	Insects and Animals	Apply insect repellent frequently to a sleeved clothes where mosquitoes ar symptoms of West Nile virus and oth
Hot Conditions		
	Temperature	Take sufficient quantities of clean wa fluids regularly to avoid dehydration; dehydration among self and coworke
Flash Floods		
	Weather	Exercise extreme caution when ente flooding may be possible.
Lightning and Thunderstorms		
	Weather	When lightning and thunderstorms a worksite, prepare to evacuate to the necessary. When lightning strikes are occurring fiberglass equipment (including eleva objects (including fence posts and wi running water, do not stand in open at the vehicle if possible or under lar trees where limbs or trunks are capa
Solar Radiation		
	Weather	Wear protective clothing and sunscre regularly to avoid sunstroke.
Cold Conditions		
	Temperature	Wear appropriate clothing for cold w layers are readily available in the eve temperature. Be observant for signs other crew members. Quickly warm from hypothermia through ingestion warming.

Evacuation Plan (see attached Evacuation Plan)

10. LINE OFFICER SIGNATURE

11. TITLE

FIELD SITE
EMERGENCY EVACUATION PROCEDURES AND TRAVEL ROUTES

Project Name: **Ecology of Native Minnows and Associated Habitat of Mangas Creek, Sections of the Gila River, Southwestern New Mexico and Selected Streams and Rivers of Arizona**

Work Site Location: Mangas Creek, Aravaipa Creek, Gila River, Verde River, and other streams of White Mountains, Arizona
Include legal description:

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To prepare for an emergency which requires first aid, and/or immediate evacuation of personnel due to serious illness or injury, the following information should be predetermined, and available to all crew members:

DESIGNATED FIRST AID PROVIDER(S):
(At least one person on each crew should be designated to provide first aid)

Alvin Medina, Jackson Leonard, Wesley Sprinkle, Tyler Johnson

COMMUNICATION PROCEDURES TO FOLLOW IN THE EVENT OF AN EMERGENCY:

MEANS OF COMMUNICATION:
Duty Hours: Cell phone 928-853-1391 (Medina)
Off Duty Hours: Cell phone 928-853-7078 (Medina)
(Radio, cell phone, EPIRB, etc.)

RADIO CHANNEL:
PHONE NUMBER:
Jackson Leonard, Cell Phone (928) 533-6747, (928) 853-1860
Tyler Johnson, Cell Phone (928) 308-0750
Wesley Sprinkle, Cell Phone (928) 853-1860

HOME BASE: 928-556-2180

HOME BASE EMERGENCY COORDINATOR: Alvin Medina

EMERGENCY SERVICES:

AMBULANCE: **Marcus J Lawrence Medical Center AND Heliport**
PHONE NUMBER: 520-634-2251

HOSPITALS:
VERDE VALLEY MED. CTR., 269 SOUTH CANDY LANE, COTTONWOOD, AZ 520-639-6000
GILA REG. MED. CTR., 1313 E. 32ST, SILVER CITY, NM (505)-538-4009

PHONE NUMBER:
HOSPITAL: **YAVAPAI REGIONAL MEDICAL CENTER, PRESCOTT, AZ**
PHONE NUMBER:

HOSPITAL: **FLAGSTAFF MEDICAL CENTER**
(Air evacuation should be obtained through the SO dispatcher, if needed.)

EMERGENCY EVACUATION TRAVEL ROUTES: Attach map with roads for evacuation to main highway to above hospital (and helispots, if appropriate) highlighted.

Evacuate via nearest Forest Service roads to Highway 89, proceed to Yavapai Medical Center or Verde valley Medical center, which ever is closest. Emergency evac is available from Prescott NF fire center.

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CREW MEMBERS SHOULD PROVIDE THE FOLLOWING WHEN CALLING FOR ASSISTANCE:

- **nature of injury or accident (do not broadcast victim(s) name(s);**
- **type of assistance needed;**
- **number, and (for air transport) estimated weight, of persons to be transported;**
- **location of injured, using landmarks identifiable on ground and/or map;**
- **current information about weather and travel hazards/obstacles.**
- **(Crew should remain in contact with home unit until evacuation team arrives, if possible.)**

Copies of this plan should be provided to crew leader(s) and Home Base Coordinator(s), prior to beginning work.