USE ATTAINABILITY ANALYSIS

AQUATIC LIFE USES FOR THE MIMBRES RIVER IN NEW MEXICO

NEW MEXICO ENVIRONMENT DEPARTMENT

SURFACE WATER QUALITY BUREAU

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SUMMARY

This Use Attainability Analysis (UAA) is conducted to determine factors affecting the attainment of aquatic life use (ALUs), to identify the most protective aquatic life use(s) for the Mimbres watershed, and to perform a data-driven evaluation of current or existing uses. From the analysis, the Surface Water Quality Bureau (SWQB) proposes to refine the currently designated uses within a weight of evidence approach. Reaches of the Mimbres River exceed criteria for its designated ALU as high quality coldwater and coldwater; surveys of the chemical, physical, and biotic indicators in the middle to lower Mimbres River watershed suggest natural temperatures of cold to cool, with warm water temperature transitions. It is recognized in the current water quality standards that in some instances, adopted numeric criteria for a body of water reflect current uses and not necessarily the existing or attainable conditions (Subsection B, 20.6.4.10 NMAC):

> **20.6.4.10 REVIEW OF STANDARDS; NEED FOR ADDITIONAL STUDIES:**
> **B.** It is recognized that, in some cases, numeric criteria have been adopted that reflect use designations rather than existing conditions of surface waters of the state. Narrative criteria are required for many constituents because accurate data on background levels are lacking. More intensive water quality monitoring may identify surface waters of the state where existing quality is considerably better than the established criteria. When justified by sufficient data and information, the water quality criteria will be modified to protect the attainable uses.
>
> This UAA follows the EPA Water Quality Standards Handbook (EPA 1994) and addresses the following questions:

(1) What are the current aquatic life uses for the Mimbres and its significant tributaries?
(2) What are the causes of any impairment of the aquatic life uses?
(3) What are the aquatic life uses that can be attained based on the physical, chemical, and biological characteristics of the water body?

Water Quality Survey data (NMED/SWQB 2011) show temperature criteria were exceeded in the lower Mimbres River (perennial reaches downstream of Willow Springs) and in the middle Mimbres (perennial reaches of Willow Springs Canyon to Cooney Canyon). Based on this UAA, it is recommended to:

> (1) Retain the headwater segment, Cooney Canyon to headwaters of the Mimbres River, and East Fork Mimbres (McKnight canyon) from the fish barrier to the headwaters as a High Quality Coldwater (HQCW) Aquatic Life Use (ALU), including all perennial tributaries from New Mexico ecoregion 23d (Subalpine forests);
>
> (2) Re-designate the perennial reaches of the middle Mimbres River as a Coldwater (CW) ALU, from below Cooney Canyon to just below the upper boundary of the Nature Conservancy property (Upper TNC), at a point where Allie Canyon joins the Mimbres River; and,
>
> (3) Assign a Coolwater ALU to the perennial reaches of the main stem of the Mimbres River downstream of Allie Canyon.

A weight of evidence approach was used to determine the attainable ALU including recent thermograph (water temperature) data (2009, 2003), river physiognomy, fish communities, and New Mexico's Ecoregional setting (Omernik,1987). Each will be discussed in support of the UAA recommendations.

INTRODUCTION

Study Area

The Mimbres is listed as an endorheic "closed basin" watershed in southwestern New Mexico (USGS HUC 13030202). The watershed spans several ecological zones or "ecoregions" (Figure 1 and Table 1). As described in New Mexico's Standards for Interstate and Intrastate Surface Waters (NMAC 20.6.4, 2011), the Mimbres has designated uses of irrigation, domestic water supply, livestock watering, wildlife habitat, and primary contact. Aquatic life uses include high-quality cold water for the perennial reaches *upstream of the confluence with Willow Springs canyon and all perennial tributaries therein* and coldwater downstream of the confluence (20.6.4.803 and 20.6.4.804 NMAC).

The watershed drains an area of approximately 5,140 square miles (13,313 square km), and consists of approximately five perennial confluences or tributaries; the mainstem is approximately 91 miles in length (146 km). Snowmelt and rain-fed headwaters arise from the southwestern slopes of the Black Range (igneous mountain range running north-south in Sierra and Grant counties in west-central

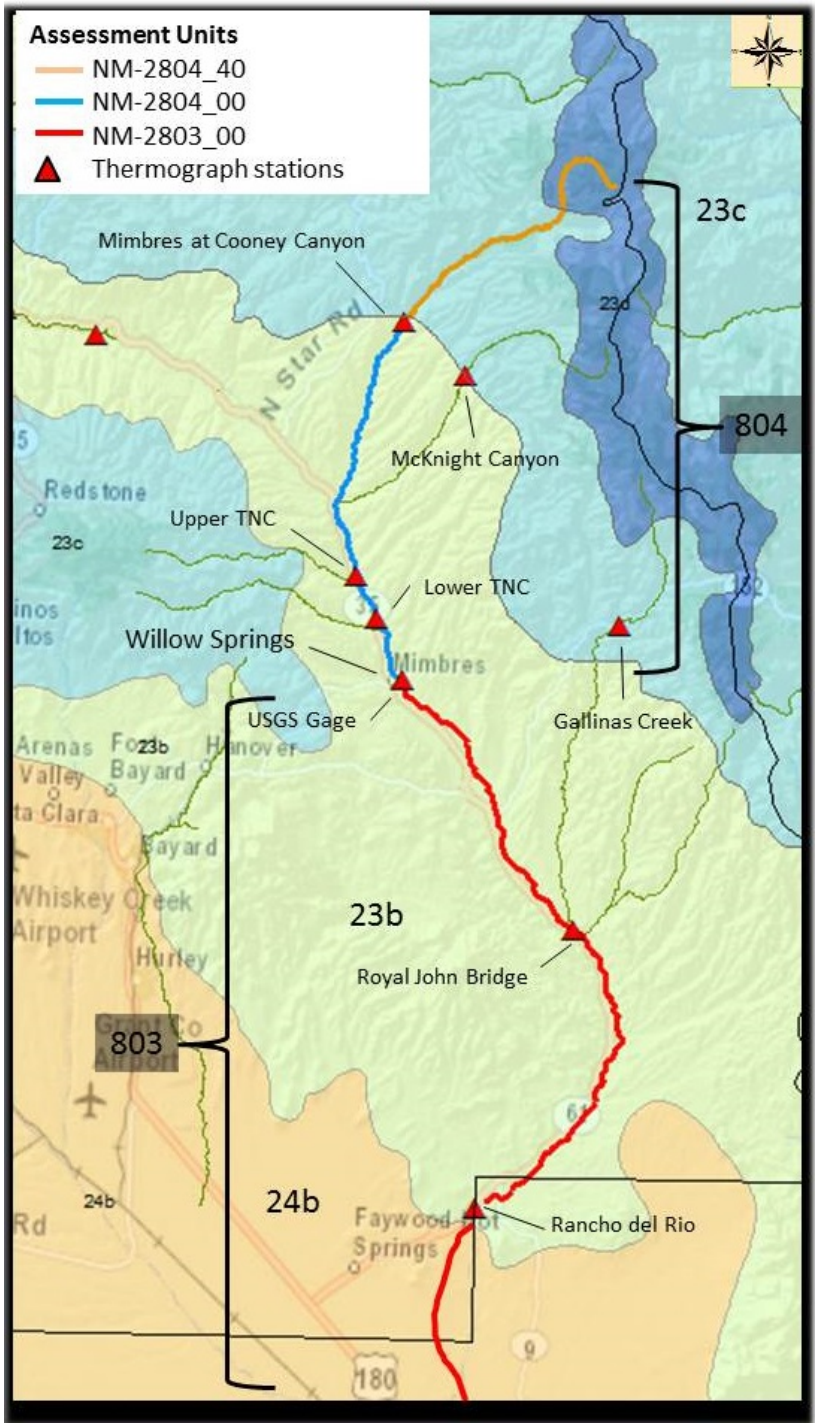


Figure 1. Map of the Mimbres River, current segments, and its Ecoregional setting. (See Table 1 for alphanumeric Ecoregional code assignments)

New Mexico); the river continues through the Mimbres valley into the Chihuahuan Desert grasslands south of Silver City. The Mimbres headwaters are in U.S. Forest Service lands and the reach flowing through the Mimbres valley is mostly privately held, including five linear miles in conservation easement by The Nature Conservancy (TNC) organization for the protection of riparian zones as habitat for the Chiricahua leopard frog (*Lithobates chiricahuensis*), to restore natural flow regime, and promote recovery of aquatic habitat loss (TNC; accessed 01/2014).

Water use in the Mimbres basin includes both surface water diversions for agriculture and groundwater pumping for agriculture, mining, and municipal uses. Irrigation began in the Mimbres basin in the early 1900's, expanding significantly during the 1930's and peaking in the mid to late 1970's (White, 1934; Theis, 1939; Cuddy & Keyes., 2011). Consumption of groundwater for irrigation, for instance, peaked in 1979 at 72,725 Acre-Feet, whereas more recent data shows a continual decline in use, and less than half of the peak drawdown (28,170 Acre-Feet in 2005) (Cuddy *et al*., 2011). Basinwide analysis, however, has shown significant drawdown as evidenced by an average of 0.3 ft. well water level loss per year (Effati, 2014).

Mimbres River surface flow ceases north of Deming, NM, however the dry river bed periodically channels storm flow beyond the area where cessation of surface flow typically occurs. The Mimbres River system traverses four Level IV Ecoregions; the Arizona/New Mexico Subalpine Forests (23d), the Montane Conifer Forests (23c), the Madrean Lower Montane Woodlands (23b), and the Chihuahuan Desert Grasslands (24b) (Figure 1 and Table 1).

Table 1: Ecoregions of the Mimbres basin*

Ecoregion Code	Relevant Segment	Name	Elevation (ft)	Hydrology	Physiography
23		**Arizona/New Mexico Mountains**			
23b	20.6.4.804	Madrean Lower Montaine Woodlands	5,500-7,200	Moderate to high gradient streams	High hills, low mountains and some canyons
23c	20.6.4.804	Montane Conifer Forests	7,000-9,500	High to moderate gradient streams	Open low mountains, numerous canyons
23d	20.6.4.804	Arizona/New Mexico Subalpine Forests	9,500+	High gradient perennial streams	High mountains, steep slopes
24		**Chihuahuan Deserts**			
24a	20.6.4.803	Chihuahuah Basins and Playas	<4,500	Closed basin ephemeral streams	Rolling hill basins, sediment filled grabens
24b	20.6.4.803	Chihuahuan Desert Grasslands	<4,500	Perreneal, intermittant	Plateaus, intermountain basins, alluvial fans

*Griffiths et al., 2006

Attainability of Current Aquatic Uses and Temperature Criteria in the Mimbres River and its Tributaries

The New Mexico Water Quality Control Commission (NMWQCC) promulgates water quality standards for inter- and intrastate waters and has defined the Mimbres as a closed river basin within segments 20.6.4.803 and 20.6.4.804 NMAC of the water quality standards, including:

1) Mimbres River perennial reaches below the town of Mimbres, NM (Willow Springs Canyon; Latitude: 32.8561861 Longitude: -107.9797612).
2) Mimbres River perennial reaches above the town of Mimbres, NM (Willow Springs Canyon),
3) Mimbres River at Bear Canyon Reservoir (Latitude: 32.8828523 Longitude: -107.9922618), and

4) Ephemeral and Intermittent tributaries

State Water Quality Standards (WQS) are codified in the New Mexico Administrative Code (NMAC) as *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC), (WQCC, 2012). Segments are defined in 20.6.4.7.S (2) NMAC:

> **"Segment"** means a classified water of the state described in 20.6.4.101 through 20.6.4.899 NMAC. The water within a segment should have the same uses, similar hydrologic characteristics or flow regimes, and natural physical, chemical and biological characteristics and exhibit similar reactions to external stresses, such as the discharge of pollutants.

Segments of the Mimbres are currently designated as a high-quality coldwater (HQCW) and coldwater (CW) ALUs in **20.6.4.804** NMAC and **20.6.4.803** NMAC, respectively. However, exceedences of temperature have historically occurred along these two segments (SWQB thermograph surveys of 1998, 2000 and 2003) including during the most recent water quality survey for the Mimbres River watershed in 2009 (NMED/SWQB, 2011a). The temperature criteria for ALUs in the New Mexico Water Quality Standards are listed in Table 2.

Table 2: Temperature Criteria (°C) for ALUs in New Mexico. Chronic temperature criteria (4T3, 6T3) are the temperatures not to exceed for a period of 4 or 6 hours on more than 3 consecutive days, respectively.

Criterion	High Quality Coldwater	Coldwater	Marginal Coldwater	Coolwater	Warmwater	Marginal Warmwater
4T3	20	-	-	-	-	-
6T3	-	20	25	-	-	-
T_{MAX}	23	24	29	29	32.2	32.2

A summary of thermograph statistics for the most-recent survey (2009) is shown below (Table 3a). Both acute (T_{MAX}) and chronic (4T3, 6T3, as appropriate) temperature criteria were exceeded in the two segments of the Mimbres river. In the lower Mimbres segment **20.6.4.803 NMAC**, the coldwater ALU temperature criteria were exceeded at Rancho del Rio (**45Mimbre062.7**) and at Royal John Bridge (**45Mimbre085.7**). Specifically, the data records from Rancho del Rio, the most downstream thermograph site, exceed the 6T3. The 6T3 criteria applicable to the CW ALU requires temperatures not exceed 20°C for more than six hours, for more than three consecutive days (20.6.4.7.A(2) NMAC). At the Rancho del Rio site, the 6T3 criteria was exceeded eight times during the 2009 thermograph campaign; this was consistent with findings at the same site during previous thermograph deployment in 2003 (Table 3b). At Royal John Bridge both the T_{MAX} and 6T3 coldwater ALU criteria were exceeded; the T_{MAX} exceeded 30 °C, and there were 28 exceedences of the 6T3.

The USGS Gage station (**45Mimbre104.3**) located at the lower end of segment 20.6.4.804 NMAC (and below the TNC property) was not measured in 2009; however this station exceeded the T_{MAX} during the 2003 thermograph survey (Table 3b). Four thermograph stations were deployed in 2009 from the lower TNC property north of the town of Mimbres, NM to the headwaters at Cooney Campground (**45Mimbre127.4**). The data were used to assess the high quality coldwater ALU for segment **20.6.4.804**

NMAC. In 2009, the station at Lower TNC preserve (**45Mimbre109.0**) was in exceedence of both the T_{MAX} and the 4T3 criteria indicating that the Mimbres was unable to meet the high quality coldwater ALU criteria for both acute and chronic temperatures. The upper TNC preserve, McKnight canyon (sometimes referred to as the East Fork of the Mimbres) and Cooney Campground thermograph records were fully supportive of the HQCW designation.

Table 3a. Summary Statistics of Water Temperatures for the Mimbres River (2009)

Station ID	Location/Current Aquatic Life Designation (ALU)	Elevation	Reference date*	T_{MAX}	4T3	6T3
20.6.4.803	**Coldwater ALU**	**(ft)**		**°C**	**°C**	**°C**
45Mimbre062.7	Rancho del Rio	5,052	7/21/2009	23.3	NA	20.9
45Mimbre085.7	Royal John Bridge	5,453	7/27/2009	30.1	NA	24.1
45Gallin021.5	Gallinas Creek-Tributary of Mimbres	6,667		20.6	NA	17.4
20.6.4.804	**High Quality Coldwater ALU**					
45Mimbre109.0	Lower TNC Preserve on Mimbres	6,024	7/27/2009	24.6	24.6	NA
45McKnig011.9	McKnight Canyon-East Fork Mimbres	7,152		22.0	18.0	NA
45Mimbre127.4	Cooney Campground on Mimbres River	6,857		20.9	16.4	NA

Temperature readings in red indicate exceedence of the criterion, NA=Not Applicable, ND=No Data.

Table 3b. Summary Statistics of Water Temperatures for the Mimbres River (2003)

Station No.	Location/Current Aquatic Life Designation (ALU)	Elevation	Reference date	T_{MAX}	4T3	6T3
20.6.4.803	**Coldwater ALU**	**(ft)**		**°C**	**°C**	**°C**
45Mimbre062.7	Rancho del Rio	5,052	8/3/2003	29.1	NA	19.9
45Mimbre085.7	Royal John Bridge	5,453		ND	NA	ND
45Gallin021.5	Gallinas Creek-Tributary of Mimbres	6,667		ND	NA	ND
20.6.4.804	**High Quality Coldwater ALU**					
45Mimbre104.3	USGS Gage	5,920	8/1/2003	28.9	24.9	NA
45Mimbre109.0	Lower TNC Preserve on Mimbres	6,024	6/26/2003	29.7	22.5	NA
45Mimbre112.2	Upper TNC Preserve on Mimbres	6,155		18.6	16.7	NA
45McKnig011.9	McKnight Canyon-East Fork Mimbres	7,152		21.2	18.1	NA
45Mimbre127.4	Cooney Campground on Mimbres River	6,857		ND	ND	NA

Temperature readings in red indicate exceedence of the standard, NA=Not Applicable, ND=No Data.

An additional gauge of attainable conditions for the Mimbres River is the Maximum Weekly Average Temperature (MWAT) index. The MWAT is a measure of chronic temperature trends calculated from the average of daily temperature measurements, which are again averaged over the seven contiguous days of highest daily averages from the record. A chronic temperature index is commonly used to set standards for thermal regimes of streams (Oregon Department of Environmental Quality, 2004; Colorado Department of Public Health and Environment, 2011), and a great deal of comparative literature also exists relating MWAT in particular to thermal requirements of freshwater fish (Brungs and Jones, 1977). The MWAT can be applied in a flexible way, such as Colorado's criteria that address stream order, species present, and even seasonal limits on temperature based on spawning (Todd et al., 2008). Colorado's MWAT criterion for an equivalent stream (*i.e.,* CWAL) to the Mimbres is 18.2 °C, which itself is similar to the EPA guidance for salmonids (18°C). The MWAT calculated from 2009 thermograph data show that only three sites would achieve either thermal limit; Gallinas Creek, McKnight Canyon and Cooney Campground, which are all low-order tributaries of the Mimbres. New Mexico's water quality standards do not require the use of the MWAT for chronic temperature

assessments; however because of its utility in identifying attainable uses as related to fish communities, the SWQB has developed an Air-Water Temperature Correlation for New Mexico streams. This correlation, when compared with MWAT calculated from SWQB-deployed thermographs, allows for the calculation of chronic and acute temperature indices when and where data may not be available (NMED/SWQB, 2011). The advantage of the Air-Water Temperature Correlation is that other than in streams which receive significant groundwater inputs, air temperature has the greatest influence on stream temperature. Air temperatures, either modeled or measured, are more readily available and spatially representative than periodic and spatially limited stream temperature datasets. The Air-Water Temperature Correlation uses recorded thermograph data from 293 New Mexico stream locations and the Parameter-elevation Regression on Independent Slopes elevation Model (PRISM) that predicts air temperatures which can then be used to predict water temperatures (PRISM Climate Group, 2004). The New Mexico regression correlation results relate July average air temperatures to estimate attainable temperature statistics such as MWAT, but can also be used to estimate TMAX and chronic temperature indices (4T3, 6T3). Mimbres air temperature data for 2009 as well as the PRISM modeled air temperature are shown in Table 6 in appendix B for comparison of modeled and actual air temperatures. Briefly, PRISM-modeled air temperatures are within ± 1.6 degrees of the July average air temperature, and in no particular trend direction. This suggests microclimate differences and model errors may account for small error being included in the projection. The net recommendations of the Air-Water Temperature Correlation analyses for New Mexico streams are:

- High quality and coldwater uses may be attainable if July average air temperature is ≤18°C;
- Marginal coldwater and coolwater uses may be attainable if July average air temperature is >18°C and ≤23 °C; and
- Uses more restrictive than warmwater are generally not attainable if July average air temperature is >23°C.

The modeled MWAT, 4T3, 6T3 and T_{MAX} for Mimbres thermograph stations as well as the actual MWAT for the thermograph survey (2009) are shown in Table 3c.

Table 3c. Air-Water Temperature Correlation-modeled criteria for the Mimbres River.

Station ID	Location	Current Aquatic Life Use	July Average Air Temp, °C (PRISM)	MWAT 2009 Thermograph data	MWAT Modeled	4T3 modeled	6T3 modeled	TMAX modeled
	20.6.4.803							
45Mimbre062.7	Rancho del Rio	Coldwater	24.6	19.65	24.6	**NA**	**26.6**	31.3
45Mimbre085.7	Royal John Bridge	Coldwater	23.5	21.47	23.5	**NA**	**25.5**	30.1
45Gallin021.5	Gallinas Creek-Tributary of Mimbres	Coldwater	21.0	16.89	21.0	**NA**	**22.9**	27.4
	20.6.4.804							
45Mimbre109.0	Lower TNC Preserve on Mimbres	High Quality CW	22.2	19.62	22.2	**25.4**	**NA**	28.7
45McKnig011.9	McKnight Canyon-East Fork Mimbres	High Quality CW	20.5	16.09	20.5	**23.6**	**NA**	26.9
45Mimbre127.4	Cooney Campground on Mimbres River	High Quality CW	20.5	15.63	20.5	**23.6**	**NA**	26.9

The Air-Water Temperature Correlation-modeled MWAT values are similar to (Royal John Bridge, Lower TNC) or exceed the 2009 thermograph data-calculated MWAT. This trend of higher modeled MWAT values (in all cases) may have occurred for several reasons; (1) The PRISM record of July

temperatures used in the model are averaged for the period 1981-2010. Averaging may smooth extremes and trends in the modeled temperature record. This, in combination with interannual variation in the water temperature record (in this case, lower 2009 thermograph-generated MWAT) could lead to poor agreement with the modeled MWAT. (2) Bias in placement of the thermographs may also lead to lower values as compared to those modeled by the air-water temperature correlation. Namely, thermographs are placed in the sections of a stream to avoid being buried in silt, emergence during low flow, and believed to have consistent flow. Despite these provisos, both measured and modeled chronic (MWAT, 4T3, 6T3) and acute (T_{MAX}) temperature criteria suggest that the reach from Cooney canyon downstream to Upper TNC are not expected to attain HQCW ALUs and are sometimes challenged to attain the CW ALU (Tables 3a,c). For the reach downstream of the Upper TNC (excluding the Gallinas Creek tributary), the 2009 thermograph and modeled temperature criteria suggest that the CW ALU is not attainable and the T_{MAX} suggests Cool to Warmwater ALU transitions are likely to be more appropriate and attainable.

Geomorphology of the Mimbres River Basin

In general, the ecoregional setting, highly drained soils and sediments, natural sinuosity, and frequent departure from sparse riparian vegetation in the Mimbres River basin promote high water temperatures. As streams progress from headwater seeps, to low order streams, and then to rivers, physical changes occur that define the biota. Small streams are in intimate contact with the parent lithology and exhibit physical properties under strong influences of their ground water origins. In low order streams, emergent ground water temperature and the nature of the riparian flora strongly moderate temperatures. As streams move through the landscape, they generally increase in size and flow, widen, and the riparian shading becomes less of an influence on insolation (*i.e.*, solar radiation). Stream physico-chemical characteristics are a result of multiple water sources (springs and tributaries), the changing geology, and the influence of allochthonous and autochthonous productivity.

The Mimbres River headwaters arise from north of the town of Mimbres, and flow through deep incised canyons with narrow, forested riparian zones, which keep waters relatively cool (Fig 2a). However, as the river progresses from AZ/NM Subalpine Forests (23d) through Montane Conifer Forests (23c) to the Madrean Lower Montane Woodlands (23b); the stream physiognomy adopts a typical meandering river valley and has an active channel that is often underfitting the total channel width which it can occupy during times of flood (Figures 2b, 2c, and 2d; elevations in Table 3a). Snowmelt, high flow events, and sedimentation can significantly change the flow path of the middle to lower sections of the Mimbres River and present challenges to development of a persisting, shading riparian community. The SWQB uses these geomorphic, stream channel, and riparian community features to establish Assessment Units (AU) within segments to capture the changing topography and thus influences to water quality (20.6.4.7.S (2) NMAC).

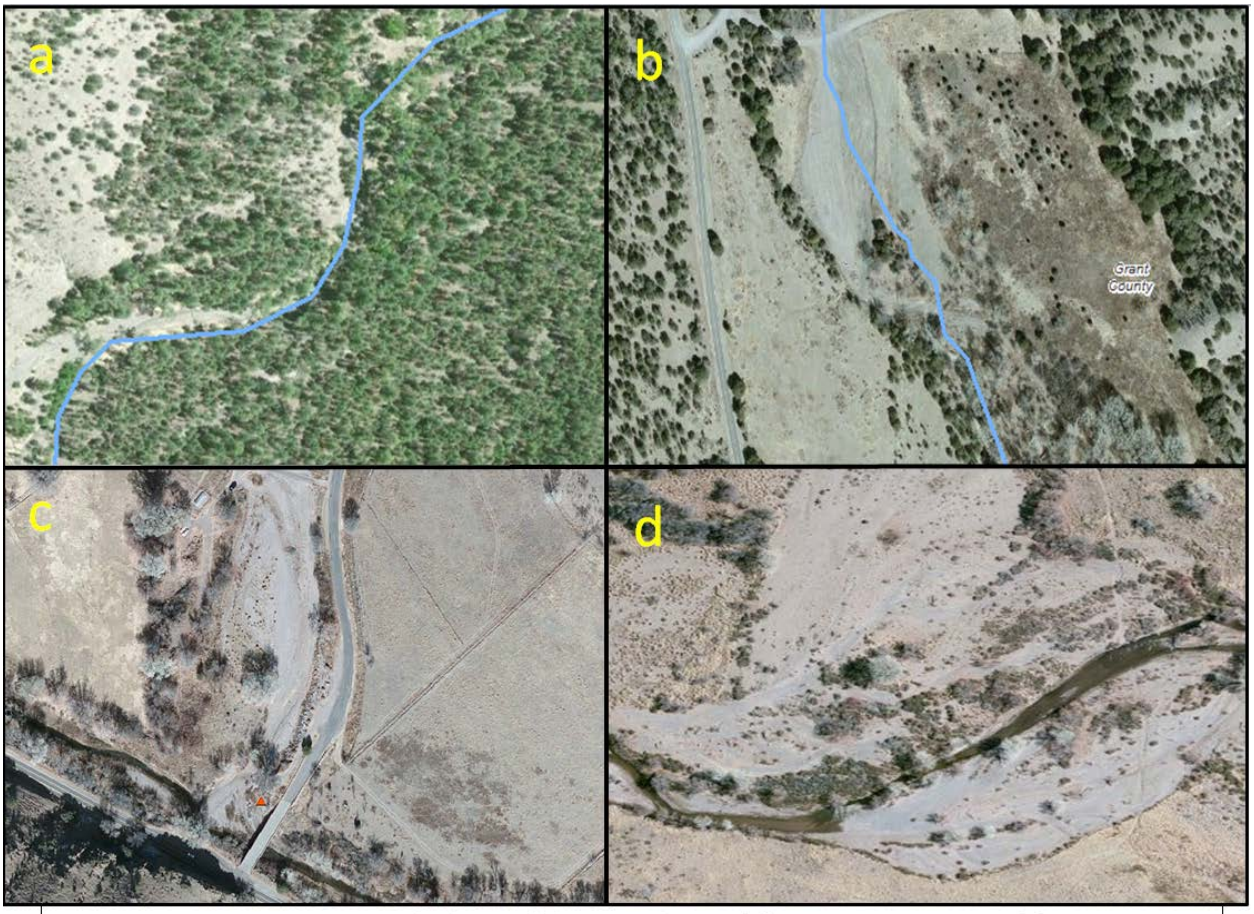


Fig 2. Stream course morphology of the Mimbres. (a) Cooney Canyon, (b) Lower TNC (c) Royal John bridge and (d) Rancho del Rio

AUs are designed to represent surface waters with homogenous water quality (WERF 2007), however, natural changes to landscape features within an AU occur along a continuum and thus changes to water quality can occur within an AU. Once the Mimbres River reaches the valley floor (below Cooney Canyon), and flows into the Madrean Lower Montane Woodlands ecoregion (23b), it adopts a meandering character. The riparian flora shades only small fractions of the active channel, and even when present, these riparian areas are often abandoned when the river migrates (meanders) to a new flowpath or channel. Development of shading riparian flora is also challenged by the nature of soil and sediment present in the watershed that may limit water storage available to support plant growth. The sediments in the middle to lower Mimbres are a loose, porous, unconsolidated Quaternary alluvium and contain gravels and sand that are many hundreds of feet thick in places (Heywood 2002). Major soil units of the upland, valley floor, and basin Mimbres valley beginning two miles downstream of the McKnight canyon confluence with the Mimbres are shown in Table 4. Drainage classes listed for soil within the basin are all *well* to *excessively well drained* and thus water may be lost rapidly from the rooting zone. Available Water Storage (AWS) is a measure of water storage capacity to support plant growth and is defined as the magnitude of the difference between field capacity (the maximum amount of water a soil can hold against gravity) and the wilting point (the amount of soil moisture below which plants wilt and die) (USDA NRCS, 2005). According to the AWS drainage classifications, most Mimbres valley soils have a limited

capacity to store water in support of plant growth; however porous soils may be advantageous in areas where the water table is proximal to the rooting zone (Table 4).

Table 4. Major soil units of the Mimbres valley, their geomorphic positions, drainage classes, and water storage availability (AWS) to support plant growth. AWS <25 cm indicates soils prone to drought and challenging to plant growth.

Major Upland Soil Units	Geomorphic Position	Drainage Class	Available Water Storage (cm, 1-100)
Lonti-Ustorthents	Summits and Shoulders	Well drained	11.84
Sanloren-Majada Var.	Terraces, Ridges, Backslopes	Well drained	11.70
Guy	Hillslope/Footslopes	Well drained	9.97
Muzzler	Hills/Toeslope	Well drained	3.41
Major Valley Floor Units			
Carnero-Santa Fe	Hillslopes/Footslopes	Well drained	10.05
Paymaster-Ellicott-Monzano	Alluvial fans	Well drained	12.20
Manzano	Valley floors	Well drained	18.84
Major Basin and Range Units			
Riverwash	Valley floors	Well drained	3.00
Stellar	Basin floors/footslopes	Well drained	15.52
Mimbres	Stream terraces	Well drained	19.96
Arizo-Vinton	Terraces/Alluvial fans	Excessively well drained	5.94

Historical and Current Observations of Aquatic Life in the Mimbres River

Another approach to determining the proper attainable aquatic life use is to understand the thermal preferences of the biological assemblages therein (Lyons 1996, Wehrly et al., 2003). To avoid the circular argument that current biological assemblages define the stream, and the possibility that changes in the thermal regime may have selected for the current assemblage, it is important, whenever possible, to determine the historical assemblages present in the water body under consideration. The earliest records for Mimbres fish communities date to 1944 and there have been periodic samplings along much of the perennial reaches in the decades since. Historical data compiled by the University of New Mexico, Museum of Southwestern Biology (MSB/UNM, 2013) indicate that three to five species of fish can be considered native to the watershed. These include beautiful shiner (*Cyprinella formosa*), the federally-listed Chihuahua chub (*Gila nigrescens*), Rio Grande sucker (*Pantosteus plebeius*) and fathead minnow (*Pimephales promelas*). Of these, beautiful shiner has been recorded as extirpated (last encountered in a 1950 collection, Sublette et al., 1990) and fathead minnow was recorded only once in recent surveys, in 1989 (MSB, 2013). Rio Grande sucker and Chihuahua chub have been recorded often from 1947 to the present and their historical presence and thermal preferences, along with several successful introduced

species (rainbow trout and longfin dace) are shown in Tables 5a and 5b (Sublette et al., 1990). Of the native fish species currently or historically found in the Mimbres basin, all are either coolwater (sometimes termed "intermediate") or warmwater species (Sublette and Hatch, 1990; Zaroban et al., 1999; Minckley, 1973; Schiffmiller, pers comm).

Table 5a. Historical Native Fish Fauna of the Mimbres Drainage

Genus/species	Common name	Extant	Thermal Preference
Cyprinella formosa	Beautiful shiner	extirpated[b]	Warmwater
Gila nigrescens	Chihuahua chub	yes	Coolwater
Pimephales promelas	Fathead minnow	unlikely	Warmwater
Catostomus plebeius	Rio Grande sucker[a]	yes	Coolwater
Cyprinodon sp.	Pupfish sp	unlikely	Warmwater

[a]Stable in Mimbres River [b]Jelks et al., 2008, Pittenger 1997.

Table 5b. Historical non-native fish fauna of the Mimbres Drainage

Genus/species	Common name	Extant	Thermal Preference
Oncorhynchus gilae	Gila trout[a]	East Mimbres	Coldwater
Oncorhynchus mykiss	Rainbow trout[b]	yes	Coldwater
Salmo trutta	Brown trout	maybe	Coldwater
Agosia chrysogaster	Longfin dace[c]	yes	Warmwater
Rhinichythys osculus	Speckled dace[d]	yes	Coolwater
Ictalurus punctatus	Channel catfish	unlikely	Warmwater
Lepomis cyanellus	Green sunfish[e]	unlikely	Warmwater
Lepomis macrochirus	Bluegill	unlikely	Warmwater
Lepomis megalotis	Longear sunfish	unlikely	Warmwater
Micropterus salmoides	Largemouth bass	unlikely	Warmwater
Pomoxis annularis	White crappie	unlikely	Warmwater

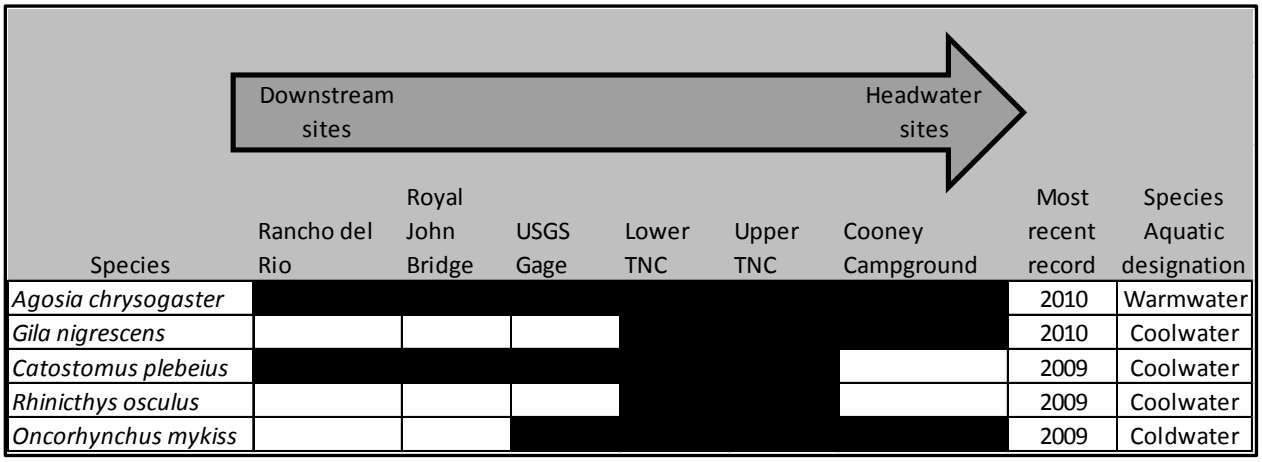
[a]Transplants to East Mimbres, a tributary of the Mimbres, as a replicated population from the nearby Gila basin for conservation management
[b]Introduced to all major drainages in New Mexico; in Mimbres by 1949 (Koster) [c]Introduced to the Mimbres in the 1960s; established.
[d]Introduced to the Mimbres in the 1970s
[e]Introduced into the Mimbres prior to 1950

Of the sixteen native, introduced, and transplanted species encountered in the historical record, only five appear with regularity in recent surveys (2009, 2010; Figure 3). Extant native species include Chihuahua chub and Rio Grande sucker. Non-native species that appear to be successfully established in the Mimbres River include longfin dace (*Agosia chrysogaster*), speckled dace (*Rhinichthys osculus*) and rainbow trout (*Oncorhynchus mykiss*). Other fish in the historical record (sunfish, bass, and catfish) occur occasionally and should be considered unlikely as reproducing populations due to unsuccessful introductions, or as escapes from Bear Canyon Reservoir. The most abundant species in SWQB's 2002 and 2009 survey data are listed in Table 5c by sampling station, however, a longer term record showing species distributions across additional sites compiled by SWQB and the MSB/UNM is shown in Figure 3.

Table 5c. Species richness (no. of species observed), abundance (no. of individuals observed), dominant species and species aquatic designation for Mimbres basin fish as compiled by SWQB.

Station Name	Year	Species Richness	Abundance	Dominant Sp*.	Sp Aq Des**
Rancho del Rio	2002	2	1,949	*A. chrysogaster*	Warmwater
Rancho del Rio	2009	2	533	*C. plebeius*	Coolwater
USGS Gage	2002	3	322	*A. chrysogaster*	Warmwater
Lower TNC	2002	5	271	*C. plebeius*	Coolwater
Upper TNC	2009	5	89	*O. mykiss*	Coldwater
McKnight canyon Trib	2002	1	2	*O. mykiss*	Coldwater

*Sp. =Species **Sp Aq Des=Species Aquatic Designation/Thermal Preference



Species	Rancho del Rio	Royal John Bridge	USGS Gage	Lower TNC	Upper TNC	Cooney Campground	Most recent record	Species Aquatic designation
Agosia chrysogaster	■	■	■	■	■	■	2010	Warmwater
Gila nigrescens				■	■	■	2010	Coolwater
Catostomus plebeius	■	■	■	■	■		2009	Coolwater
Rhinicthys osculus				■	■		2009	Coolwater
Oncorhynchus mykiss			■	■	■	■	2009	Coldwater

Solid bar indicates presence of species in the assessment unit

Figure 3. Fish species distribution in the Mimbres River.

The most current assessments of fish present in the Mimbres River show that the introduced rainbow trout is able to persist in the upper reaches, but also can be found in segments of the stream that exceed both acute and chronic temperature criteria for coldwater use. This suggests that refugia from high temperatures may exist in the river, that allow trout to escape or tolerate these temperatures, or that rainbow trout may move in and out of less optimal habitat as a result of numerous pressures including competition, opportunity, or are washed into these areas during high flow events. Other fish species documented in the Mimbres River basin, whether native or introduced, are either coolwater or warmwater species (Sublette and Hatch, 1990; Zaroban et al., 1999; Minckley, 1973; Schiffmiller, pers comm). With the exception of speckled dace and Chihuahua chub, these other species are found in more of the AUs than trout. This indicates that a significant thermal gradient exists supporting both native cool- and warmwater communities, while the streams provide refugia for the introduced coldwater rainbow trout.

Records indicate that rainbow, Gila, and brown trout have been reported for the Mimbres River, with rainbows being the most consistently reported throughout the historical record and in both segments. Brown trout are rarely reported and they, along with Gila trout, have only been reported in the upper reaches of the Mimbres (Cooney and McKnight Canyons, respectively; segment 20.6.4.804 NMAC). Data indicate segment 20.6.4.804 can support a coldwater fishery in its upper reaches; however, the suitability of waters rapidly changes in the lower part of the segment. In order to better understand the potential for success of coldwater fish, size classes of fish in the upper and lower segments of the Mimbres River were evaluated. A variety of size classes within a species (*e.g.*, young-of-the-year and/or juvenile fish in addition to adults present) would likely indicate a successfully reproducing population. The analysis showed that there are at least two distinct habitat zones broadly consistent with the current segment assignments. However, these zones are not consistent with their currently assigned aquatic life uses. The warmwater longfin dace was present in both segments in high numbers, and in size classes indicating a reproducing population tolerant of a wide range of stream temperatures. Coolwater species, Chihuahua chub and Rio Grande sucker, were also found in multiple size classes, however mostly relegated to the upper and lower Mimbres segments, respectively. Conversely, the coldwater rainbow trout was only found in significant numbers and size classes in the upper reaches of the Mimbres. The size class range, thermal preferences, and abundance of fish in the lower segment of the Mimbres River are shown in Figure 4. Only adult rainbow trout (and very few of them) were found in the survey just south of the town of Mimbres.

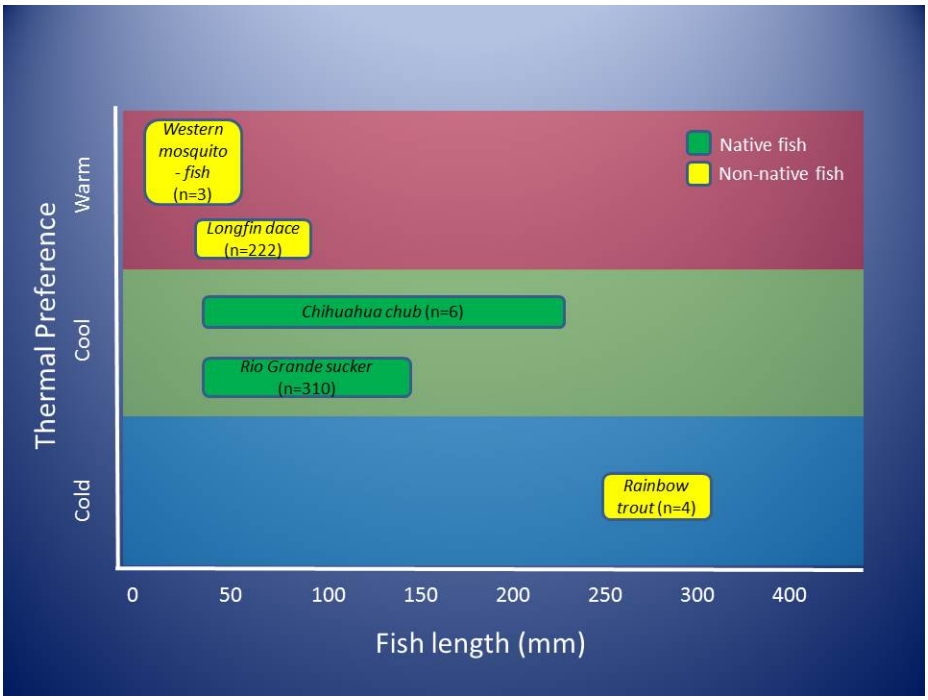


Figure 4. Fish size classes and thermal preferences in the upper part of segment 20.6.4.803. New Mexico Game and Fish 2013 survey. Conclusion: very few Rainbow trout, all adults, were found in this reach. ["n" is the number of fish captured in the survey].

Discussion

From its headwaters to its mouth, the Mimbres River moves from moderately high elevation, deeply incised canyons to the Guzman basin; a drop in elevation spanning approximately 2,000 feet (610 m) and traverses five ecoregions. The variations in the geomorphology along this gradient produce significant changes in the water quality. Once the Mimbres River reaches the valley floor, crossing from the Montane Conifer Forests ecoregion (23c) into the Madrean Lower Mountain Forest ecoregion (23b), its latitude, elevation, meandering course, widening river valley, and well-drained soil and sediments become limiting influences on riparian vegetation and shading, resulting in naturally occurring higher temperatures downstream of the upper Nature Conservancy property.

There are significant natural and geomorphic influences affecting attainable ALUs in the Mimbres River. The natural migration of the river on the valley floor and seasonal flooding has led to the development and subsequent abandonment of associated riparian flora. The fluvial geomorphology can be examined by way of aerial imagery (*e.g.*, Google Earth) and the numerous abandoned meanders suggest that the Mimbres River has an active channel that changes frequently. Although riparian woody species may be well adapted to flood regimes, channel morphological changes because of flooding create riparian abandonment, affecting the Mimbres River and attainable temperature regimes. Soils along the Mimbres are highly porous, drain quickly, and may limit the development of a persistent riparian zone due to a poor water storage potential to support plant growth. Generally, the ecological setting of the mid to lower Mimbres (moderate elevations and latitude) presents challenges in an environment where air temperatures and insolation (solar irradiation) are the most important influences upon water temperature.

Air-water temperature modeling (*e.g.*, SWQB's Air-Water Temperature Correlation for New Mexico streams) suggests that the coldwater aquatic life use is not attainable throughout large sections of the

Mimbres River, even in the highest elevation ecological zone, the Subalpine Forests (23d), where trout populations are currently known to reproduce. It appears that spring-fed cold water, and/or refugia exist in the headwaters/upper portion of the Mimbres River, and pending further fish population studies and thermograph data collections, the current ALU designation is attainable despite occurrences of high air temperatures. It is recommended that a new headwater segment, 20.6.4.807 NMAC, from Cooney Canyon to the headwaters of the Mimbres and all perennial reaches thereto, which would remain HQCW, be established. In addition, the tributary East Fork Mimbres (also known as McKnight creek) should be placed as HQCW in the segment 20.6.4.807 for perennial reaches above the fish barrier. However, as the Mimbres transitions from ecoregion 23c to 23b, the naturally intermittent nature of the upper-to-mid portion of the Mimbres River is prone to flash floods, exacerbated by occurrence of historic disturbances such as fires, indicate that HQCW is not attainable, and that perennial reaches below the Cooney Canyon confluence with the East Fork Mimbres River should be designated as CW ALU is more appropriate. Below the fish barrier, the East Fork Mimbres should also be considered CW aquatic life use to its confluence with the similarly designated segment of the mainstem Mimbres River.

Historically, as now, the Mimbres River has supported a small diversity of fish species, one that has been changed significantly by extirpations and introductions. The Mimbres River downstream of the confluence with McKnight Canyon has supported three warmwater and two coolwater fish species whereas currently, it supports one warmwater, three coolwater and one coldwater species. Modeling of the air-water temperature relationship and the natural conditions of air temperature and the fluvial geomorphology of the Mimbres River demonstrate that the attainable aquatic life use for this section is coolwater below the Upper TNC property (Allie canyon) with a segment-specific 30°C temperature, which is consistent with both historical and current fish communities (Figure 5).

Aquatic Life Use (ALU) Recommendations

Cooney Canyon to the headwaters of the Mimbres River, including all perennial tributaries from the 23d ecoregion (Subalpine Forests), should remain designated as High Quality Coldwater ALU. A new segment extending from Allie Canyon to Cooney canyon (the "Middle Mimbres") should be re-designated as Coldwater ALU, and a segment from Allie Canyon to the mouth re-designated as Coolwater ALU with a segment-specific temperature criterion of 30°C (Figure 5). While survey year 2009 exhibited a lower flow as compared to the 30 year mean (USGS 08477110 MIMBRES RIVER AT MIMBRES, NM), interannual variation in flows, and both the 2003 and 2009 temperature dataset suggest that the 29°C criteria associated with coolwater ALU will not be attainable and a segment-specific criteria of 30°C is more appropriate. Therefore, the following changes to the water quality standards are recommended:

20.6.4.803 CLOSED BASINS - Perennial reaches of the Mimbres River downstream of the confluence with ~~Willow Springs~~ Allie canyon and all perennial reaches of tributaries thereto.

A. Designated Uses: coolwater aquatic life with a segment-specific temperature of 30°C, irrigation, livestock watering, wildlife habitat and primary contact.

20.6.4.804 CLOSED BASINS - Perennial reaches of the Mimbres River upstream of the confluence with ~~Willow Springs~~ Allie canyon upstream to Cooney canyon, and all perennial reaches of East Fork Mimbres (McKnight Canyon) below the fish barrier, and perennial reaches thereto.

A. Designated Uses: irrigation, domestic water supply, coldwater aquatic life, livestock watering, wildlife habitat and primary contact.

20.6.4.807 CLOSED BASINS - Perennial reaches of the Mimbres river upstream of Cooney Canyon and all perennial reaches thereto, including perennial reaches of East Fork Mimbres river (McKnight Canyon) above the fish barrier.

A. Designated Uses: irrigation, domestic water supply, high quality coldwater aquatic life, livestock watering, wildlife habitat and primary contact.

Figure 5. Map of recommended segments and attainable uses for the Mimbres watershed. Ecoregion assignments and attributes are listed in Table 1.

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Appendix A

Representative photos of the Mimbres River and tributaries showing stream course and riparian character.

Figure legends:

Figure A. Royal John Bridge, Segment 20.6.4.803. (upstream view). Note sparse riparian flora, wide meandering channel.

Figure B. USGS Gage site, Segment 20.6.4.803 (upstream view).

Figure C. McKnight (L) confluence with the Mimbres (R), Segment 20.6.4.804, (downstream view). Note wide, open meandering channels and sparse riparian cover.

Figure D. Middle TNC Property, Segment 20.6.4.804, downstream view. Note improved riparian cover, ample channel shading from primary canopy, but poor secondary canopy and riparian flora.

Figure E. Cooney Campground, Segment 20.6.4.804 Note significant channel shading from primary canopy, but poor secondary canopy and riparian flora.

Fig A Royal John Bridge, Segment 20.6.4.803 (upstream view)

Fig B. USGS Gage site, Segment 20.6.4.803 (upstream view)

Fig C. McKnight (L) confluence with the Mimbres (R), Segment 20.6.4.804, downstream view

Fig D. Middle TNC Property, Segment 20.6.4.804, downstream view

Fig E. Cooney Campground, Segment 20.6.4.804

Appendix B

Table 6: A comparison of PRISM predicted air temperatures and SWQB's air temperature from thermographs deployed in 2009 and National Climate Data Center's (NCDC) long term normal temperatures for July.

Station ID	Location	Elevation	July Average Air Temp
20.6.4.803	**Coldwater ALU**	**(ft)**	**°C**
45Mimbre062.7	Rancho del Rio (PRISM)	5,052	24.6
45Mimbre062.8	Rancho del Rio (2009 AIR)	5,052	25.5
Faywood, NM	NCDC 1981-2010 Normals (AIR)	5,190	24.3
45Mimbre085.7	Royal John Bridge (PRISM)	5,453	23.5
20.6.4.804	**High Quality Coldwater ALU**		
45Gallin021.5	Gallinas Creek-Trib (PRISM)	6,667	21.0
Mimbres Ranger Stn	NCDC 1981-2010 Normals	6,240	21.1
45Mimbre109.0	Lower TNC on Mimbres (PRISM)	6,024	22.2
45McKnig011.9	McKnight Canyon (PRISM)	7,152	20.5
45Mimbre127.4	Cooney Campground (PRISM)	6,857	20.5
45Mimbre127.4	Cooney Campground (2009 AIR)	6,857	18.9