3.0 INDIVIDUAL WATERSHED DESCRIPTIONS

TMDLs were developed for assessment units for which constituent (or pollutant) concentrations measured during the 2003 water quality survey, as combined with quality outside data, indicated impairment. Because characteristics of each subwatershed, such as geology, land use, and land ownership provide insight into probable sources of impairment, they are presented in this section for the individual subwatersheds within the Rio Hondo basin. In addition, the 2004-2006 Integrated §303(d)/§305(b) listings within the Rio Hondo basin are discussed (NMED/SWQB 2004a). Assessment units that will have delist letters prepared are discussed in their respective individual subwatershed sections.

3.1 Carrizo Creek Subwatershed

The headwaters of the 24.6 mi^2 Carrizo Creek subwatershed originate on the Mescalero Apache Indian Reservation. According to available Geographic Information System (GIS) coverages, the Carrizo Creek watershed has an average elevation of 7615 feet above sea level and receives approximately 22.7 inches of precipitation a year. As presented in Figure 2.1, land uses include 97% forest, 2% grassland, and less than 1% of the land use in this watershed is commercial, residential, or shrubland. Land ownership is 9% private, 79% Tribal Lands, and 12% Forest Service (Figure 2.2). The geology of the Carrizo Creek watershed is predominantly comprised of the Mesaverde Group and Mancos Shale with limited areas of Dakota Sandstone, San Andres Formation, Yeso Formation, and Quaternary Alluvium (Figure 2.3).

Carrizo Creek (Rio Ruidoso to Mescalero Apache Boundary) is approximately 3 miles in length. SWQB established two stations along this assessment unit and deployed one thermograph during the 2003 intensive survey. Carrizo Creek (Rio Ruidoso to Mescalero Apache Boundary) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for bacteria. No TMDLs have previously been established for Carrizo Creek. Therefore, TMDLs were developed for inclusion in this document for the following assessment unit in the Carrizo Creek subwatershed:

- ***Bacteria*:** Carrizo Creek (Rio Ruidoso to Mescalero Apache Boundary)

Photo 3.1 Carrizo Creek at Two Rivers Park (June 10, 2003)

3.2 Rio Bonito Subwatershed

Rio Bonito originates in the Sacramento Mountains. The Rio Bonito watershed is approximately 296 mi^2 and is a tributary to Rio Hondo, which then joins the Pecos River. As presented in Figure 2.1, land use is 47% forest, 29% grassland, 22% shrubland, 1.4% agriculture, and less than 1% residential. Land ownership is 44% private, 39% U.S. Forest Service, 12% BLM, and 5% State (Figure 2.2). The Rio Bonito is usually perennial in the mountainous areas, but is dry much of the year in the reach beginning 10 miles upstream of the confluence with Rio Hondo (Mourant 1963).

The geology of the Rio Bonito watershed consists of Cretaceous intrusive rocks, Tertiary sediments, alluvium, and various Permian sedimentary rock formations. The Yeso Formation underlies most of this watershed (Mourant 1963). This subwatershed may mark the fault boundary with the Cub Mountain Formation to the north and Mesaverde Formation to the south (Ash and Davis 1964). The San Andres Limestone lies flat, but the Yeso Formation is folded into the Lincoln Folds, which are exposed for seven miles in bluffs north of Rio Bonito (Chronic 1987).

Rio Bonito (Rio Ruidoso to Angus Canyon) is approximately 34 miles in length. Two stations were established (Table 2.2, Figure 2.2) and one thermograph was deployed (Figure 7.1) in this assessment unit during the 2003 intensive survey. Rio Bonito (Rio Ruidoso to Angus Canyon) was listed on the 2004-2006 Integrated §303(d)/305(b) List of Impaired Waters (NMED/SWQB 2004a) for low flow alteration and sedimentation/siltation (stream bottom deposits) impairments. However, Rio Bonito at BLM Apple Orchard site was used as a sedimentation/siltation (stream bottom deposits) reference site during the assessment process and requires a de-list letter. No TMDLs have previously been prepared for this assessment unit.

Photo 3.2 Rio Bonito at Apple Orchard site (February 18, 2003)

Rio Bonito (Angus Canyon to headwaters) is approximately 10 miles in length. Three stations were established (Table 2.2, Figure 2.2) and two thermographs were deployed (Figure 7.1) in this

assessment unit during the 2003 intensive survey. Rio Bonito (Angus Canyon to headwaters) was listed on the 2004-2006 Integrated CWA §303(d)/305(b) List of Impaired Waters (NMED/SWQB 2004a) for low flow alteration impairment. After assessing the 2003 water quality data, this reach was also found to be impaired by bacteria requires a TMDL. No TMDLs have previously been prepared for this assessment unit. The following TMDL was developed for this watershed:

- ***Bacteria*** **-** Rio Bonito (Angus Canyon to headwaters)

Photo 3.3 Rio Bonito above Bonito Lake at Forest Road 107 (March 4, 2003)

3.3 Rio Hondo Watershed

Rio Hondo orginates in the Sacramento Mountains. The Rio Hondo watershed is approximately 586 mi^2 and includes Rio Bonito and Rio Ruidoso before it joins the Pecos River near Roswell, New Mexico. As presented in Figure 2.1, land use is 45% forest, 33% grassland, 20% shrubland, 1% agriculture, and less than 1% residential and commercial. Land ownership is 45% private, 28% U.S. Forest Service, 19% Mescalero Apache Reservation, 5% BLM, and 3% State (Figure 2.2). The Rio Hondo is perennial in its upper reaches, gains in flow from Hondo to Picacho, then loses flow from Picacho to Roswell, but is again perennial from Roswell to the Pecos River (Mourant 1963). The Rio Hondo is dry most of the year from Riverside to Roswell (*Ibid*), so the SWQB 2003 intensive survey included a site near Riverside (site 12) as the most downstream site of the survey.

The geology of the Rio Hondo watershed consists of Cretaceous intrusive rocks, Tertiary sediments, alluvium, and various Permian sedimentary rock formations. The Rio Hondo Valley displays the San Andres Limestone and Permian Yeso Formation (Chronic 1987). The Yeso Formation is mostly pink sandstone and siltstone, but also contains limestone and gypsum (*Ibid*). Passages honeycomb the San Andres Limestone, sinks have formed as cavern roofs have collapsed, and fossil shellfish is abundant (*Ibid*).

Rio Hondo (Perennial reaches Pecos River to Rio Ruidoso) is approximately 8 miles in length. Two stations were established (Table 2.2, Figure 2.2) and two thermographs were deployed (Figure 7.1) in this assessment unit during the 2003 intensive survey. Rio Hondo (Perennial reaches Pecos River to Rio Ruidoso) was listed on the 2004-2006 Integrated §303(d)/305(b) List of Impaired Waters (NMED/SWQB 2004a) for unknown impairment. After assessing the water quality data, this reach was found to be impaired by bacteria and requires a TMDL. No TMDLs have previously been prepared for this assessment unit. The following TMDL was developed for this watershed:

- ***Bacteria*** **-** Rio Hondo (Perennial reaches Pecos River to Rio Ruidoso)

Photo 3.4 Rio Hondo at Rio Hondo Land and Cattle property (March 18, 2003)

3.4 Rio Ruidoso Subwatershed

The headwaters of the 290 mi^2 Rio Ruidoso watershed originate in the Sacramento Mountains. According to available GIS coverages, the Rio Ruidoso watershed has an average elevation of 7152 feet above sea level and receives approximately 20.2 inches of precipitation a year. As presented in Figure 2.1, land uses include 77% forest, 13% grassland, 8% shrubland, 1% agriculture, and less than 1% of the land use in this watershed is commercial or residential. Land ownership is 26% private, 33% Tribal Lands, 38% U.S. Forest Service, 2% State Lands, and 1% Bureau of Land Management (Figure 2.2). Rio Ruidoso is a perennial stream; the river is cut below the water table and will have some flow even during periods of low precipitation (Mourant 1963). The geology of the Rio Ruidoso watershed is predominantly comprised of Tertiary Igneous Rocks in the headwaters and the San Andres Formation, Yeso Formation, and Quaternary Alluvium in the lower regions with limited areas of Dakota Sandstone, Mancos Shale, Mesaverde Group, Triassic Rocks (general), Artesia Group, and Tertiary Sediments (Figure 2.3).

The Rio Ruidoso is divided into three assessment units (AUs). Rio Ruidoso (North Fork above Mescalero Apache Boundary) is approximately 2 miles in length. One station was established (Table 2.2, Figure 2.1) in this assessment unit during the 2003 intensive survey. Data from this station was combined with readily available data from other sources that met quality control objectives, and were assessed using established assessment protocols to determine whether or not designated uses were being met. As a result, the Rio Ruidoso (North Fork above Mescalero Apache Boundary) was found to be fully supporting of its designated uses and was NOT listed on the 2004-2006 Integrated §303(d)/305(b) List of Impaired Waters (NMED/SWQB 2004a). No TMDLs will be written for this assessment unit.

The Rio Ruidoso (US Highway 70 Bridge to Mescalero Apache Boundary) is approximately 12 miles in length. Four stations were established (Table 2.2, Figure 2.1) and three thermographs were deployed (Figure 7.1) in this assessment unit during the 2003 intensive survey. Rio Ruidoso (US Highway 70 Bridge to Mescalero Apache Boundary) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for nutrient/eutrophication biological indicators, sedimentation/siltation, temperature, and turbidity. Nutrient/eutrophication biological data from these stations were combined with readily available data from other sources that met quality control objectives and were reassessed using a weight-of-evidence approach developed by SWQB and submitted to the USEPA in 2004. The weight-of-evidence approach includes analysis of a number of indicators of nutrient enrichment, such as total nitrogen (TN) concentration, total phosphorus (TP) concentration, dissolved oxygen concentration, dissolved oxygen saturation, pH, algal productivity (from algal bioassays), and benthic macroinvertebrate Index of Biotic Integrity (IBI) scores. As a result, the Rio Ruidoso (US Highway 70 Bridge to Mescalero Apache Boundary) will be de-listed for plant nutrients. The Rio Ruidoso at Mescalero Apache boundry site was used as a sedimentation/siltation (stream bottom deposits) reference site during the assessment process and requires a de-list letter. No TMDLs have previously been established for the Rio Ruidoso. Therefore, TMDLs were developed for inclusion in this document for the following assessment units in the Rio Ruidoso subwatershed:

- ***Temperature, Turbidity***- Rio Ruidoso (US Hwy 70 Bridge to Mescalero Apache Bndy)

Photo 3.5 Rio Ruidoso at Mescalero Apache Boundary (June 10, 2003)

The Rio Ruidoso (Rio Bonito to US Highway 70 Bridge) is approximately 20 miles in length. Four stations were established (Table 2.2, Figure 2.1) and two thermographs were deployed (Figure 7.1) in this assessment unit during the 2003 intensive survey. Data from these stations were combined with readily available data from other sources that met quality control objectives, and were assessed using established assessment protocols to determine whether or not designated uses were being met. As a result, Rio Ruidoso (Rio Bonito to US Highway 70 Bridge) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for nutrient/eutrophication biological indicators and sedimentation/siltation. However, as a result of the application of the data to the assessment protocol, this assessment unit will be de-listed for sedimentation/siltation. No TMDLs have previously been established for the Rio Ruidoso. Therefore, TMDLs were developed for inclusion in this document for the following assessment units in the Rio Ruidoso subwatershed:

- ***Nutrients*** - Rio Ruidoso (Rio Bonito to US Hwy 70 Bridge)

Photo 3.6 Rio Ruidoso at U.S. Highway 70 (September 24, 2003)

Photo 3.7 Rio Ruidoso at U.S. Highway 70 (June 11, 2003)