3.0 INDIVIDUAL WATERSHED DESCRIPTIONS

TMDLs were developed for each assessment unit for which constituent (or pollutant) concentrations measured during the 2000 water quality survey indicated impairment. Because characteristics of each watershed, such as geology, land use, and land ownership provide insight into probable sources of impairment, they are presented in this section for the individual watersheds within the Upper Rio Grande (Part 1) basin. In addition, the sampling stations established for the 2000 intensive water quality survey are presented in detail, and the 2002-2004 §303(d) listings within the Upper Rio Grande (Part 1) river/stream reaches are discussed.

3.1 Rio Costilla

Rio Costilla (Costilla Creek) originates in CO in the Sangre de Christo range and flows into NM and then back into CO. Costilla Creek then flows back into NM where it joins the Rio Grande just south of the state line. Approximately 33 miles of the Rio Costilla are within the NM border. Water only flows to the Rio Grande occasionally because of diversions in the two states and the high loss rate in the stream channel (Vandiver 1999). The Valle Vidal Wildlife Management Unit is a 100,000 acre parcel of wilderness below the Costilla reservoir dam. Costilla Creek watershed is approximately 230 mi^2 and includes Cordova Creek, Casias Creek, Latir Creek, Ute Creek, Sanchez Creek, and Comanche Creek tributaries. As presented in Figure 3.1, land ownership is 72% private and 28% U.S. Forest Service (USFS). Land use includes 80% forest, 14% rangeland, 4% barren tundra, 2% agriculture, and less than 1% built-up land (Figure 3.2).

The geology of the Costilla Creek watershed consists of a complex distribution of Precambrian metamorphic rocks, and Tertiary volcanics. Smaller deposits of intrusives, ash flows, and unaltered igneous rocks are also present. Costilla Creek bisects two distinct geologic areas. The area south of the CO-NM State line mainly consists of Precambrian igneous and metamorphic rocks of the Sangre de Cristo Range. Metamorphic rocks in this area mainly consist of amphibolites, granite gneiss, and mica schist. The less abundant igneous rocks consist of granitic stocks. The upper portions of the watershed are also highly faulted as a result of Rio Grande Rift tectonics. Tertiary volcanics are the predominant rock type in the lower portions of the watershed, north of the state line. These volcanics consist of basalt flows that are interbedded with sands and gravels, which were deposited during periods of erosion between volcanic events. Varying thicknesses of alluvial material cover much of these basalt flows, especially near the base of the Sangre de Cristos.

Thirteen sampling stations were established in the Costilla Creek watershed during the 2000 survey (Table 2.1, Figure 3.1). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (SWQB/NMED 2000a). Data results from grab sampling have been uploaded to USEPA's STORET database. Costilla Creek (Diversion above Costilla to Comanche Creek) was included on the 2002-2004 CWA §303(d) list for temperature and requires a TMDL. Violations of the temperature criterion in Comanche Creek (Costilla Creek to Little Costilla Creek) were also observed based on 2002 monitoring

data. No TMDLs have previously been completed for Costilla Creek or Comanche Creek. Cordova Creek (Costilla Creek to headwaters) was included on the 2002-2004 §303(d) list for SBD (NMED/SWQB 2002); however, a TMDL for SBD was previously completed for this assessment unit (SWQB/NMED 1999a). Therefore, TMDLs were developed for the following assessment units in the Rio Costilla watershed:

- ***Temperature***: Costilla Creek (Diversion above Costilla to Comanche Creek)
- ***Temperature***: Comanche Creek (Costilla Creek to Little Costilla Creek)

Photo 3.1 Rio Costilla at Colorado Border (downstream) – May 2000

Photo 3.2 Comanche Creek above Rio Costilla - July 2003

Photo 3.3 Comanche Creek below Upper Exclosure – May 2000

Figure 3.1 Rio Costilla Land Ownership and Sampling Stations

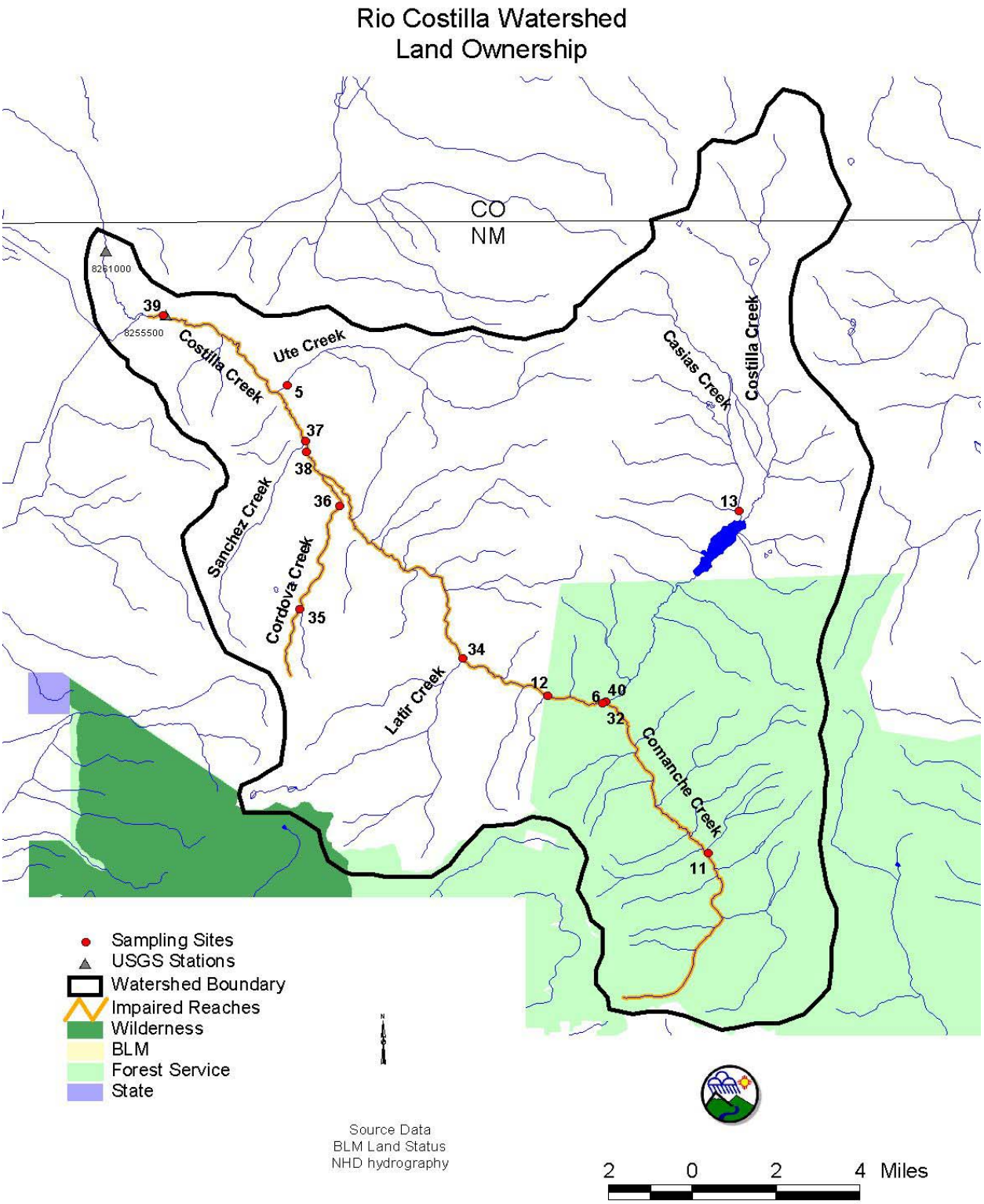
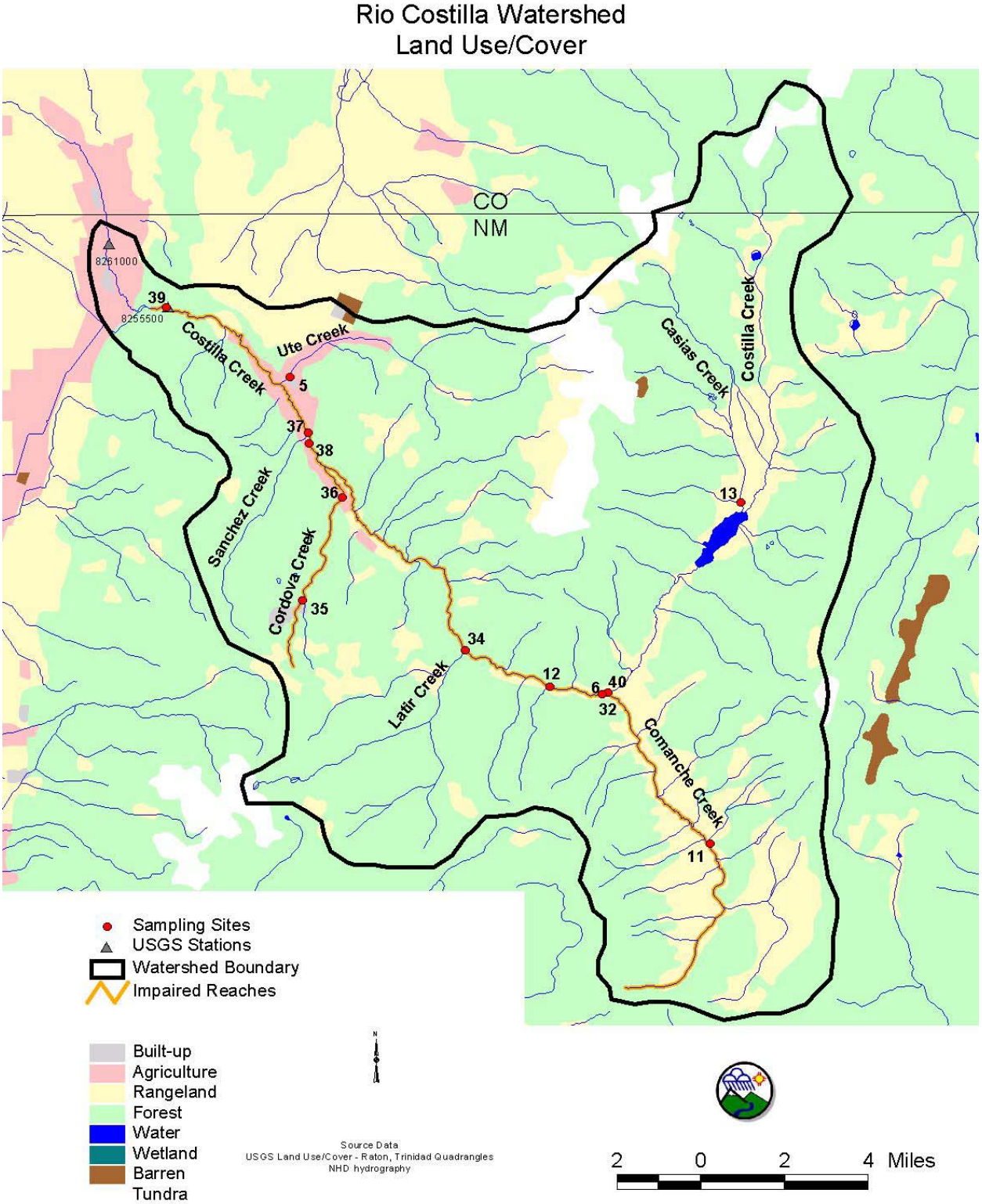


Figure 3.2 Rio Costilla Watershed Land Use and Sampling Stations



3.2 Rio de los Pinos and Rio San Antionio

The Rio de los Pinos originates in the San Juan Mountains in southern CO. The stream flows south and then east through NM for about 20 miles then crosses the CO border again near Ortiz, CO. The Rio de los Pinos watershed is approximately 160 mi^2. Approximately 28% of the Rio de los Pinos watershed lies within CO. As presented in Figure 3.3, land ownership in the Rio de los Pinos watershed is USFS (91%), Bureau of Land Management (BLM) (7%), and private (2%). As shown in Figure 3.4, land use in the Rio de los Pinos watershed is predominately forest (61%), rangeland (39%), agriculture (less than 1%), and built-up lands (less than 1%).

The geology of the Rio de los Pinos and Rio San Antonio watersheds consists primarily of Precambrian igneous and metamorphic rocks and Tertiary volcanics related to the Rio Grande Rift tectonic events. The Precambrian rocks, which are not abundant in the area, occur mainly near the headwaters of the watershed. These Precambrian rocks consist of gneiss, schist and amphibolite which are intruded by granite and aplite. Tertiatary-aged volcanic units are the next oldest rocks present. The oldest of the tertiary units consists of breccias, mudflows, tuffs and basaltic andesites. These units were derived, in part, from the erosion of older volcanic rocks. Small amounts of sandstone and conglomerate were deposited between volcanic events, and are interbedded throughout these units. Conglomerate clasts consist various volcanic rocks. These older Tertairy units are overlaid by three primary basalt flows. These flows create the cap-rock for many of the mesas in the area. The two youngest basalt flows are of varying thicknesses and lithologies and together make up the Hinsdale Volcanic Series. Quaternary deposits present in the watershed include stream, fan and talus deposits.

The Rio de los Pinos (NM reaches) is approximately 20.9 miles in length. Two sampling stations were established in the Rio de los Pinos watershed during the 2000 survey (Table 2.1, Figure 3.3). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (SWQB/NMED 2000a). Data results from grab sampling have been uploaded to USEPA's STORET database. 2002 monitoring data for temperature at these locations indicate non-support for the temperature criterion of 20^oC. Rio de los Pinos was not listed for temperature in the 2002-2004 §303(d) list (NMED/SWQB 2002) because some temperature data from the 2000 monitoring were lost. Follow-up temperature monitoring was conducted in 2002 and 2003 for the purpose of developing TMDLs. The following TMDLs have been developed for the Rio de Los Pinos assessment unit:

- ***Temperature***: Rio de los Pinos (CO border to headwaters)

The Rio San Antonio headwaters are located in the Carson National Forest northwest of Tres Piedras and northeast of Tierra Amarilla, NM. Approximately 4% of the Rio San Antonio watershed lies within CO. Land ownership in the Rio San Antonio watershed is USFS (86%), BLM (12%), state land (1%), and private (1%). Land use in the Rio San Antonio watershed is rangeland (63%), forest (37%), agriculture (less than 1%), and built-up lands (less than 1%).

The Rio San Antonio (NM reaches) is approximately 19.1 miles in length. Two sampling stations were established in the Rio San Antonio watershed during the 2000 survey (Table 2.1,

Figure 3.3). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (SWQB/NMED 2000a). Data results from grab sampling have been uploaded to USEPA's STORET database. 2002 monitoring data for temperature at these locations indicate non-support for the temperature criterion of 20°C. Rio San Antonio was not listed for temperature in the 2002-2004 §303(d) list (NMED/SWQB 2002) because some of the 2000 results for temperature were lost. Follow-up temperature monitoring was conducted in 2002 and 2003 for the purpose of developing TMDLs. The following TMDLs have been developed for the Rio San Antonio assessment unit:

- ***Temperature***: Rio San Antonio (Montoya Canyon to headwaters)

Photo 3.4 Rio de los Pinos at USFS Bridge – May 2000

Photo 3.5 Rio San Antonio near USGS Gage near Ortiz, CO – May 2000

Rio San Antonio/Rio de los Pinos
Watersheds
Land Ownership

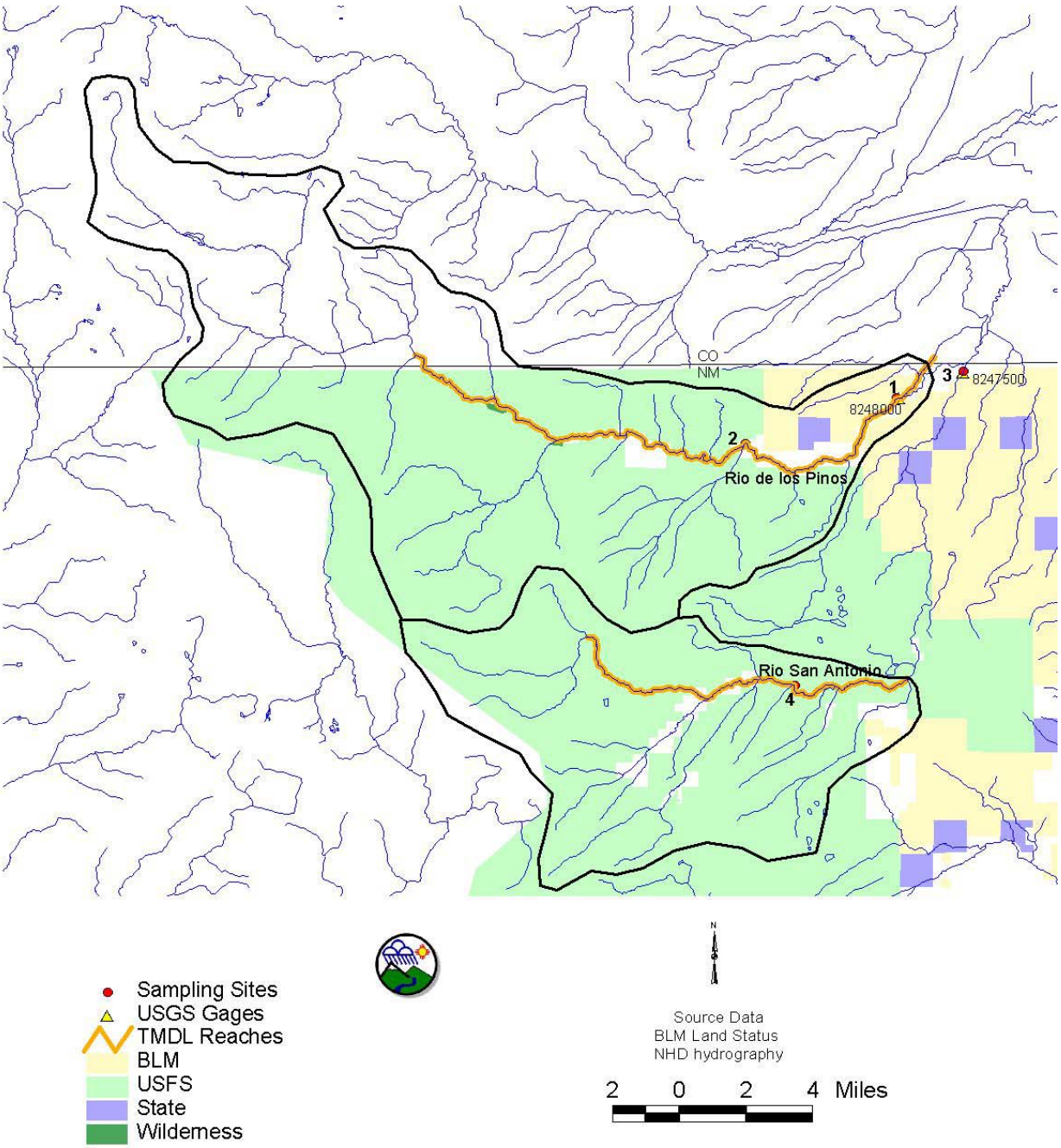
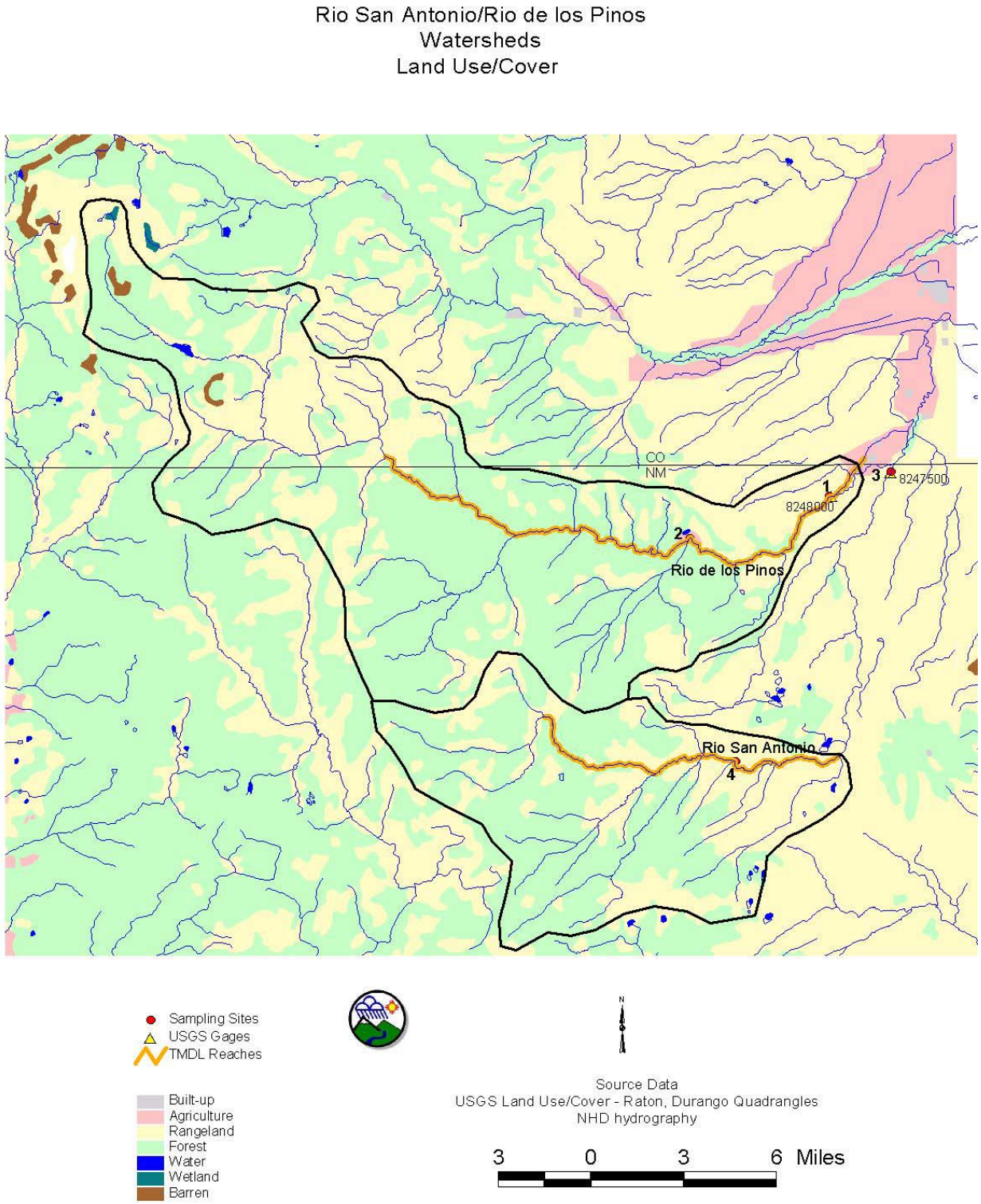


Figure 3.4 Rio de los Pinos and Rio San Antonio Watersheds Land Use and Sampling Stations



3.3 Upper Rio Grande

The Rio Grande originates at 12,000 feet above sea level in the San Juan Mountains west of Creede, CO. The Rio Grande and Red River of northern NM were among the original eight rivers designated by Congress as Wild and Scenic in 1968 (National Park Service [NPS] 2002). The Upper Rio Grande watershed is roughly 5,660 mi^2. As shown in Figure 3.5, land ownership is 32% private, 30% BLM, , 28% USFS, and 10% state land. Figure 3.6 presents the land use in this watershed, which is predominately forest (46%), rangeland (42%), agriculture (11%), barren tundra (1%), and built-up lands (less than 1%).

The geology of the Upper Rio Grande watershed consists of a complex distribution of Precambrian metamorphic rocks, Paleozoic sedimentary rocks and Tertiary volcanics (Table 2.2, Figure 2.2). Smaller deposits of intrusives, ash flows and unaltered igneous rocks are also present. The Upper Rio Grande river bisects the two distinct geologic areas. The area west of the Rio Grande mainly consists of late Quaternary to Tertiary basalts formed as a result of the Rio Grande Rift tectonic events. The Tertiary volcanics (mainly basalt flows) are interbedded with sands and gravels, which were deposited during periods of erosion between volcanic events. The Rio Grande River has incised a deep canyon through these basalt flows, which extends from the CO border to Velarde. Immediately east of the Rio Grande recent alluvial deposits cover these basalt deposits. The source of this alluvial material is the Sangre de Cristo Mountains, which parallel the river in a north-south direction. The Sangre de Cristo mountains mainly consist of Precambrian metamorphic rocks (amphibolites, granite, gneiss, and mica schist) and granitic stocks. Dikes of rhyolite, monzonite porphyry, latite and andesite are also common. Not as common, but still notable, are the scattered deposits of Pennsylvanian sediments including conglomerates, sandstones, shales and limestones. This portion of the Sangre de Cristo range is highly mineralized and heavily mined, as a result.

The Rio Grande from the Red River to the NM-CO border is approximately 27.75 miles in length and from the Rio Pueblo de Taos to Red River is approximately 23.35 miles in length. Four sampling stations were established in the Upper Rio Grande watershed during the 2000 survey (Table 2.1, Figure 3.5). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (SWQB/NMED 2000a). Data results from grab sampling have been uploaded to USEPA's STORET database. The Red River subwatershed was excluded from the 2000 investigation, as that portion of the Upper Rio Grande was surveyed in a separate intensive study during 1999. Follow-up temperature monitoring was conducted in 2003 for the purpose of developing TMDLs. The following TMDLs were developed for this watershed:

Temperature: Rio Grande (CO border to headwaters);

Photo 3.6 Rio Grande above Red River – July 2003

Figure 3.5 Upper Rio Grande Watershed Land Ownership and Sampling Stations

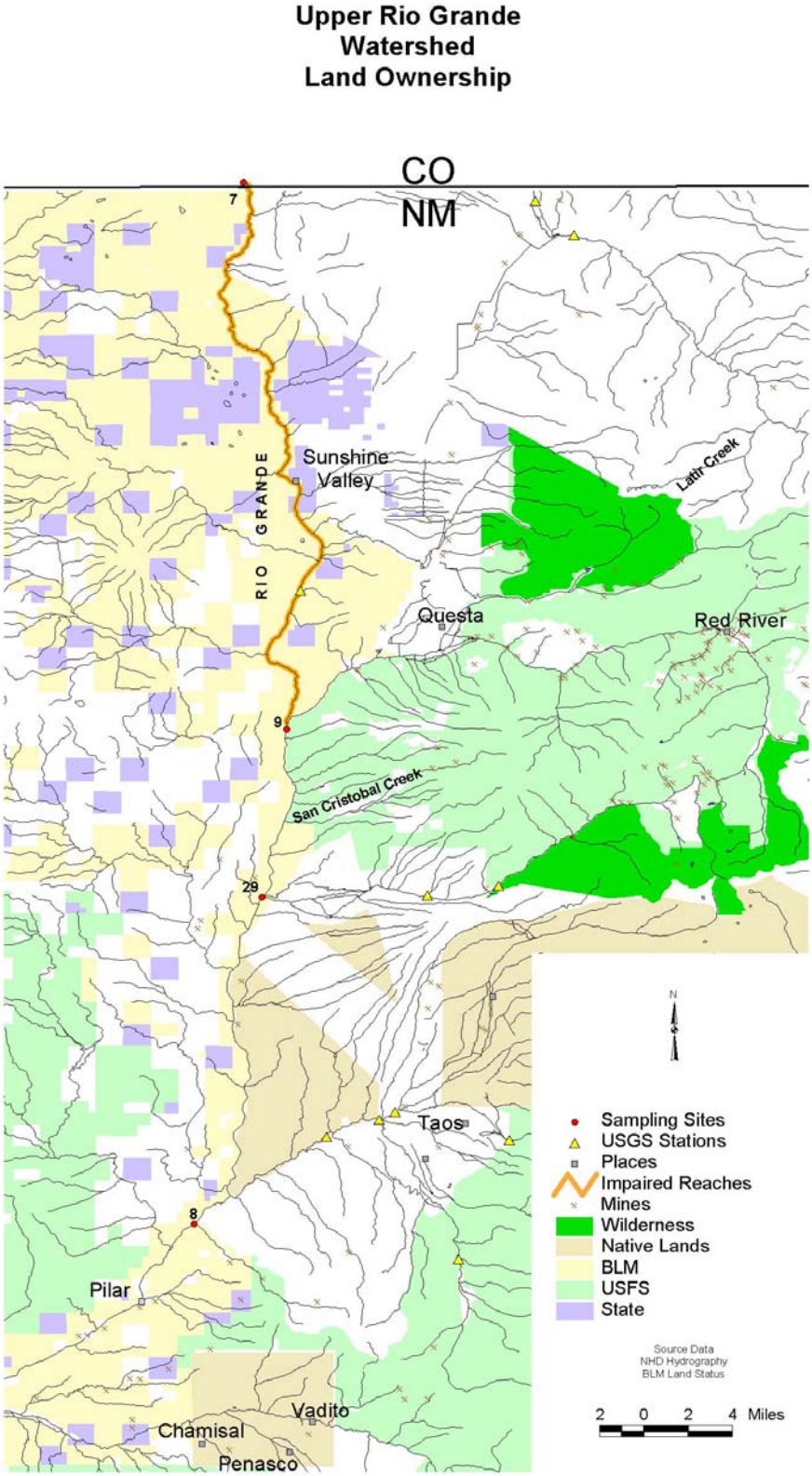
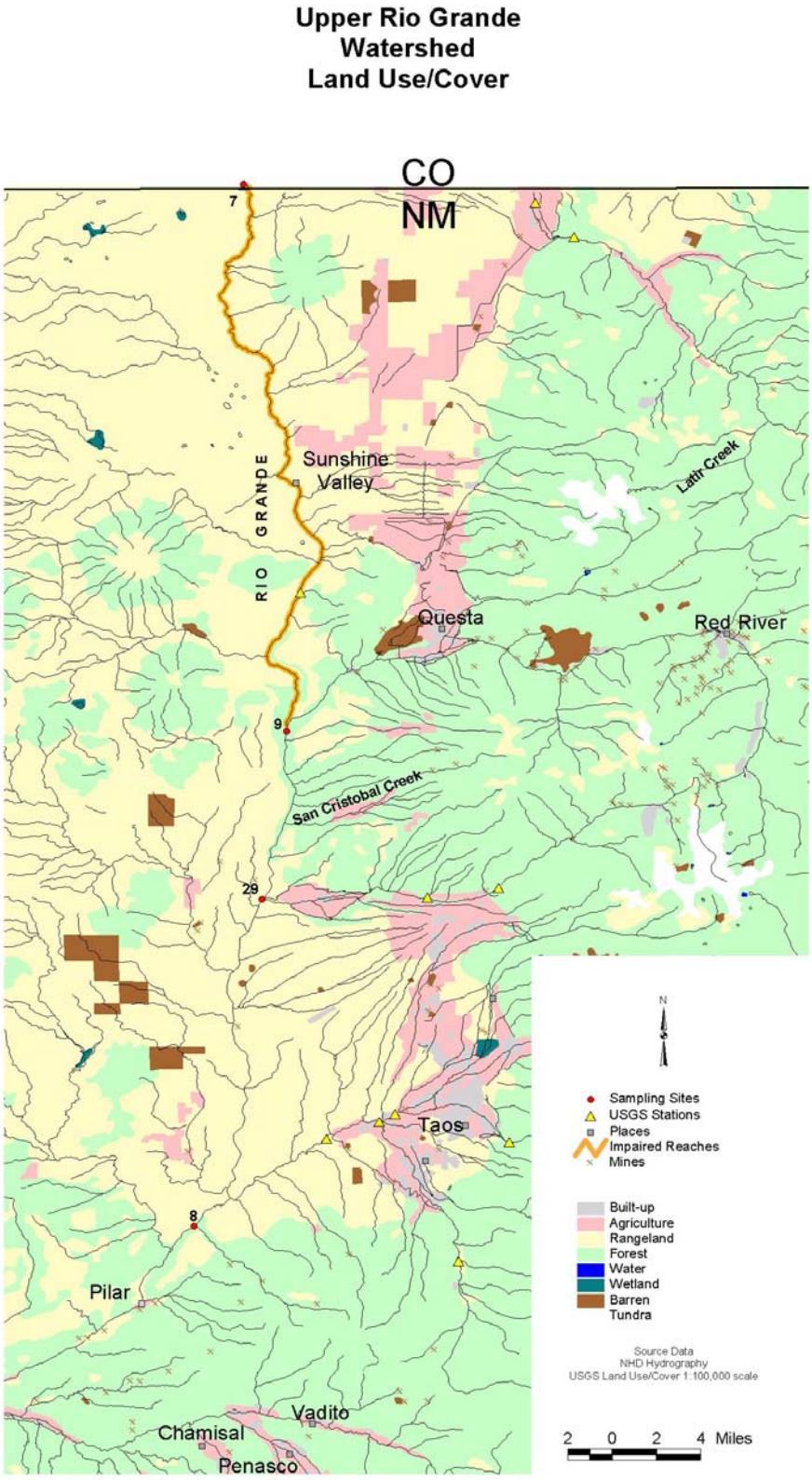


Figure 3.6 Upper Rio Grande Watershed Land Use and Sampling Stations



3.4 Rio Hondo

The Village of Taos Ski Valley is situated near the headwaters of the Rio Hondo in the Sangre de Cristo mountains of northern NM. The Rio Hondo watershed is roughly 72 mi^2. As shown in Figure 3.7, land ownership is 61% USFS, 38% private, and 1% tribal land. Figure 3.8 presents the land use in this watershed, which is predominately forest (78%), agriculture (10%), rangeland (7%), built-up lands (3%), and barren tundra (2%).

The geology of the Rio Hondo watershed consists of a complex distribution of Precambrian igneous and metamorphic rocks, Pennsylvanian sedimentary rocks, Tertiary intrusives. The lower portions of the watershed also contain Quaternary deposits including volcanics and various alluvial materials. The Rio Hondo bisects two distinct geologic areas. The area east of Valdez consists mainly of Precambrian metamorphic (schist, gneiss and quartzite) and igneous rocks (granite, andesite, porphyry). This area may also contain small deposits of Pennsylvanian sedimentary rocks including arkosic shales, sandstones and conglomerates. The area west of Valdez consists mainly of Quaternary alluvial materials (including stream, fan and glacial deposits) and basalt flows interbedded with sands and gravels, which were deposited during periods of erosion between volcanic events.

Rio Hondo from the Rio Grande to USFS boundary is approximately 8.5 miles in length. Four sampling stations were established in the Rio Hondo watershed during the 2000 survey (Table 2.1, Figure 3.7). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (SWQB/NMED 2000a). Data results from grab sampling have been uploaded to USEPA's STORET database. Rio Hondo (Rio Grande to USFS boundary) was included on the 2002-2004 CWA §303(d) list for temperature. Field measurements for temperature from the 2000 survey indicate non-support for the temperature criterion of 20^oC. The following TMDLs were developed for this watershed:

Temperature: Rio Hondo (Rio Grande to US Forest Service boundary).

A TMDL for nutrients was previously completed for Rio Hondo (New Mexico Environmental Improvement Division [EID] 1981). SWQB is implemented a special study in 2004 to prepare for a revision of this nutrient TMDL because the Twinings WWTP is proposing to increase the amount of effluent discharged into the stream.

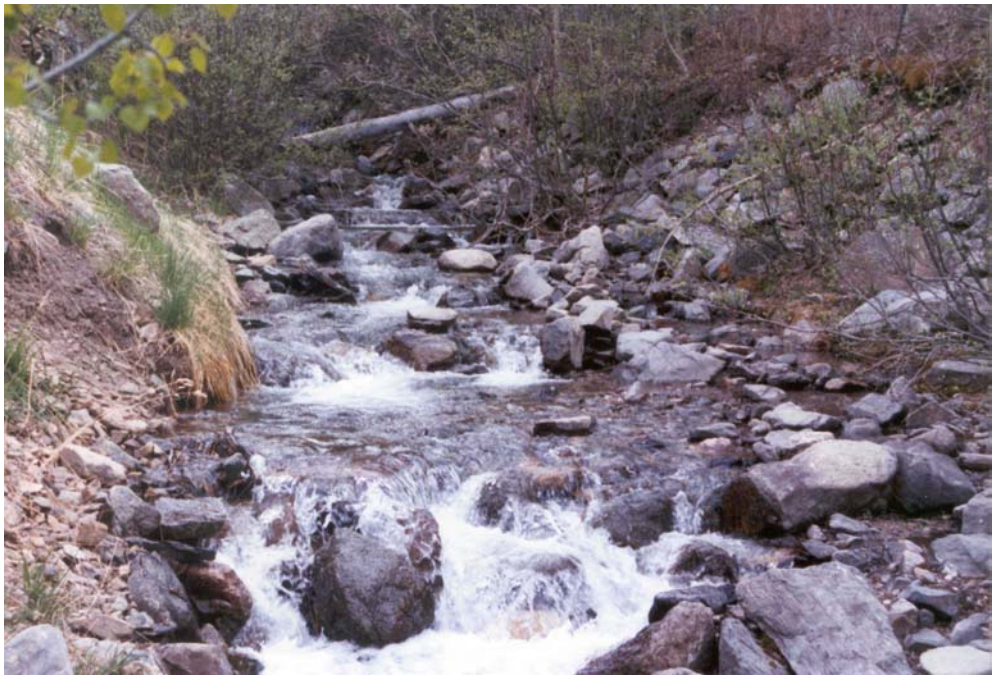


Photo 3.7 Rio Hondo at Taos Ski Valley – May 2000

Figure 3.7 Rio Hondo Watershed Land Ownership and Sampling Stations

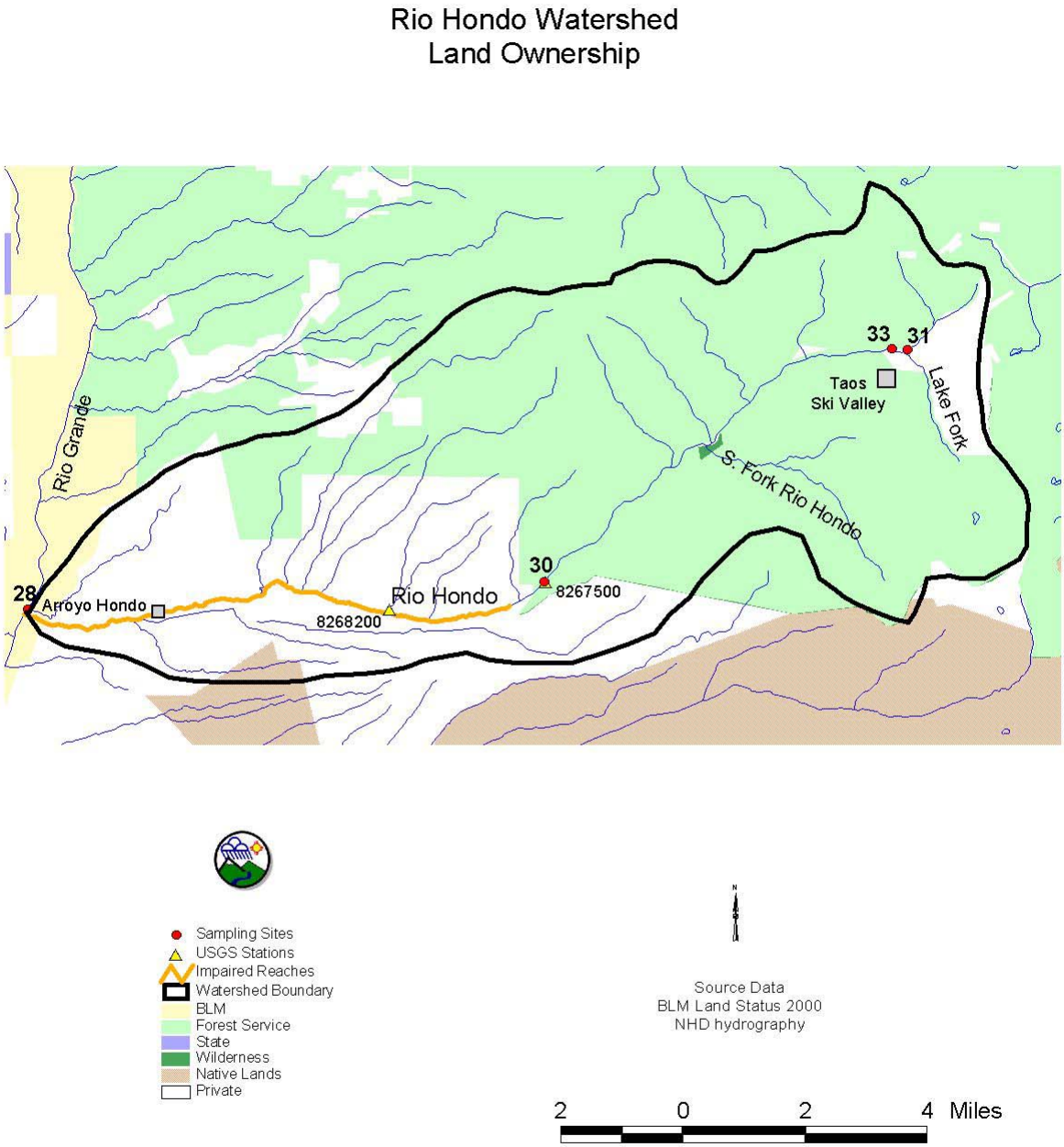
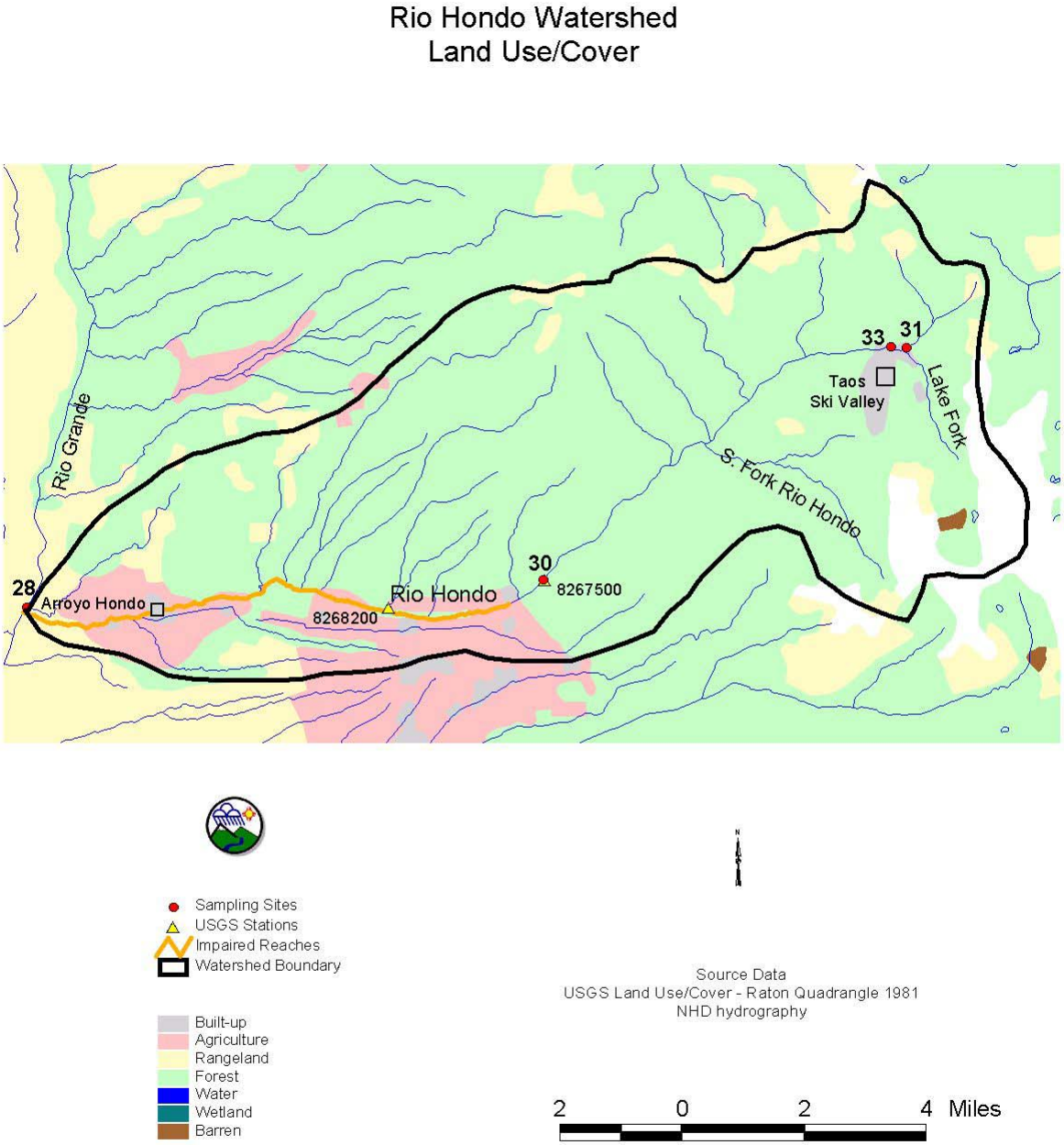


Figure 3.8 Rio Hondo Watershed Land Use and Sampling Stations



3.5 Rio Pueblo de Taos

The Rio Pueblo de Taos, which originates in the Sangre de Cristo mountains at Blue Lake, is used by the Taos Pueblo for irrigation and domestic purposes. There is currently one active National Pollution Discharge Elimination System (NPDES) permit on the Rio Pueblo de Taos issued to the Town of Taos (NM0024066).

The Rio Pueblo de Taos watershed is roughly 400 mi^2 and includes Rio Chiquito, Rito de la Olla, Rio Fernando de Taos, and Rio Grande del Rancho tributaries. As shown in Figure 3.9, land ownership is 56% tribal lands, 30% USFS, and 14% private land. Figure 3.10 presents the land use in this watershed, which is predominately forest (78%), agriculture (9%), rangeland (7%), built-up lands (5%), and barren tundra (1%). Fifteen sampling stations were established in the Rio Pueblo de Taos watershed during the 2000 survey (Table 2.1, Figure 3.9). Surface water grab samples from all of the above stations were analyzed for a variety of chemical/physical parameters. The chemical data were collected, assessed, and summarized in a water quality survey report (SWQB/NMED 2000a). Data results from grab sampling have been uploaded to USEPA's STORET database. Rio Pueblo de Taos (Arroyo del Alamo to Rio Grande del Rancho) was included on the 2002-2004 CWA §303(d) list for temperature and SBD. Rio Pueblo de Taos (Rio Grande del Rancho to headwaters) was included on the 2002-2004 CWA §303(d) list for temperature and specific conductance (SC). Rio Pueblo de Taos (Rio Grande to Arroyo del Alamo) was included on the 2002-2004 CWA §303(d) list for temperature. Rio Fernando de Taos (Rio Pueblo de Taos to headwaters) was included on the 2002-2004 CWA §303(d) list for temperature and conductivity. Rio Grande del Rancho (Rio Pueblo de Taos to Hwy 518) was included on the 2002-2004 CWA §303(d) list for conductivity. The following TMDLs were developed for the Rio Pueblo de Taos watershed:

Temperature:	Rio Pueblo de Taos (Rio Grande to Arroyo del Alamo)
	Rio Pueblo de Taos (Arroyo del Alamo to Rio Grande del Rancho)
	Rio Pueblo de Taos (Rio Grande del Rancho to headwaters)
	Rio Fernando de Taos (Rio Pueblo de Taos to headwaters)
SBD:	Rio Pueblo de Taos (Arroyo del Alamo to Rio Grande del Rancho)
Specific Conductance:	Rio Fernando de Taos (Rio Pueblo de Taos to headwaters)
	Rio Grande del Rancho (Rio Pueblo de Taos to Hwy 518)

Photo 3.8 Rio Pueblo de Taos below Taos WWTF – May 2000

Photo 3.9 Rio Pueblo de Taos near Los Cordovas, NM – May 2000

Photo 3.10 Rio Fernando de Taos at USGS Gage – May 2000

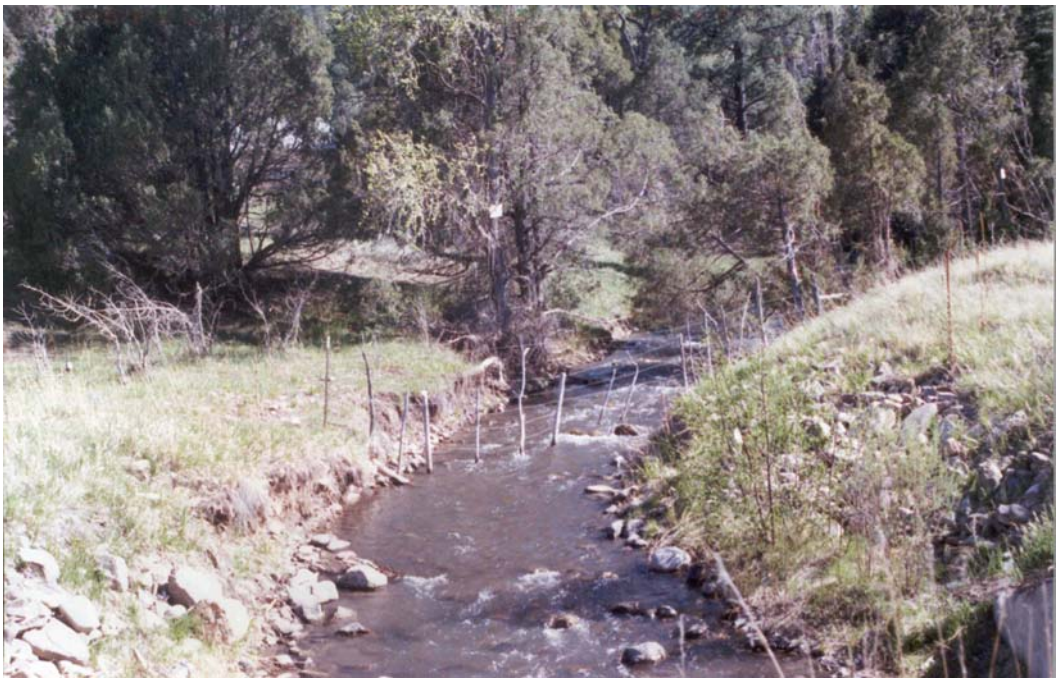


Photo 3.11 Rio Grande del Rancho at Highway 518 Bridge – May 2000

Figure 3.9 Rio Pueblo de Taos Land Ownership and Sampling Stations

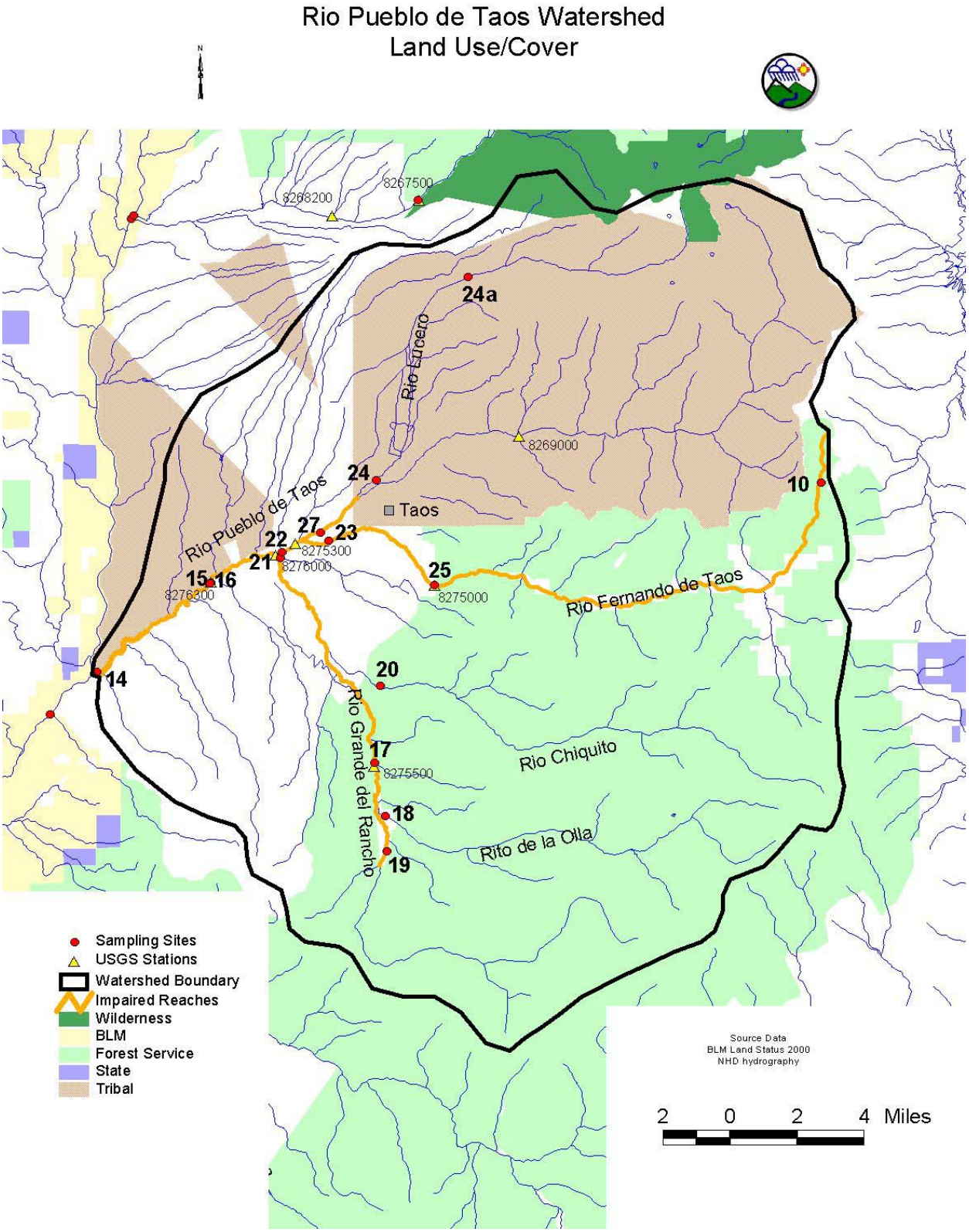
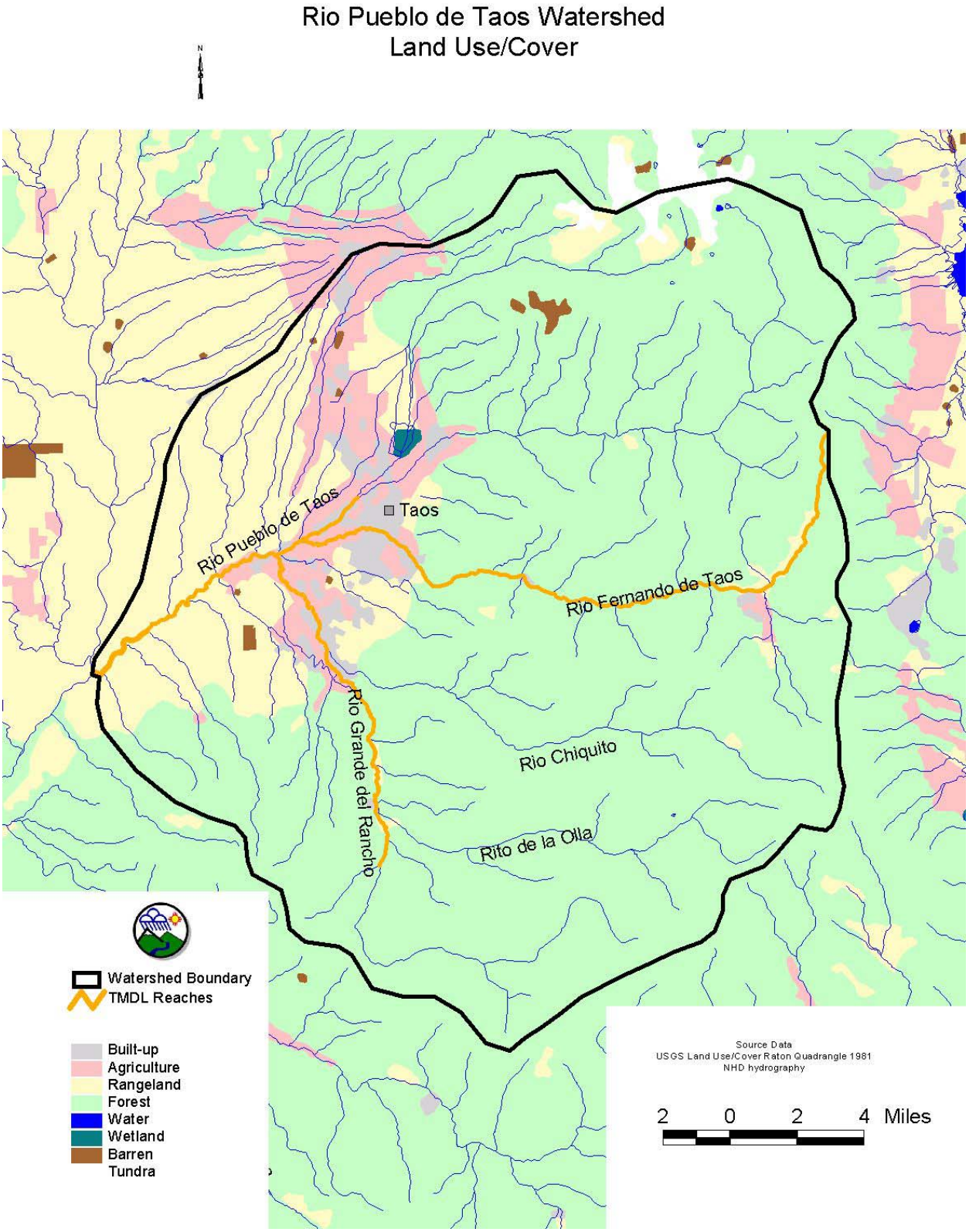



Figure 3.10 Rio Pueblo de Taos Land Use and Sampling Stations