3.7 Water Resources, Including Culinary and Municipal Water Systems, Surface Water, and Groundwater

3.7.1 Overview

Water Quality

Water quality in the UNF is influenced by several factors including geology, soils, vegetation, and human activities. Low dissolved oxygen, high phosphorous loads, and sedimentation are the prevailing water quality problems in the UNF. In general, water quality issues in the UNF are closely related to human activities that cause surface disturbance such as road use, grazing, and recreational use. Table 3.21 is a summary of water quality issues by RFOGD.

Table 3.21. Summary of water quality issues for RFOGDs with oil and gas potential.

RFOGD	Waterbody	Water Quality Issue
Currant Creek	West Fork Duchesne River	Historic high levels of phosphorous because of surface erosion
Deer Creek	Little Provo Deer Creek	Heavily impacted by road incursion and channel modifications
	Provo River	Watershed is designated as needing restoration
Diamond Fork	Diamond Fork Creek and tributaries	Flow alteration, riparian habitat alteration, stream habitat alteration, primarily because of CUP facilities
	Sixth Water Creek and tributaries	Soils in the watershed are easily eroded when disturbed, compounding water quality sedimentation issues
Payson	Big East Lake	Low dissolved oxygen. Elevated levels of nutrients which lead to overproduction of algae and a loss of dissolved oxygen due in part to the decomposition of organic matter
Spanish Fork	Soldier Creek	Phosphorus and sediment, perhaps due in part to natural geologic sources
Strawberry	Strawberry Reservoir and tributaries	Low dissolved oxygen and high total phosphorous loads in Strawberry Reservoir. Phosphorous loads may be due in part to sedimentation issues, UNF roads have been cited as a source impact
	Price River Basin	Disturbance of saline and easily eroded soils in the watershed results in stream instability and sediment problems
	White River	High sediment loads with UNF roads noted as source impacts
American Fork	American Fork and tributaries	Elevated metals concentrations due to historic mining
Upper Provo	Various; Mill Hollow and South Fork Provo	Fine sediments, often from roads and other disturbances; Elevated phosphorus in Mill Hollow and South Fork Provo
Vernon	Various	Perhaps elevated metals, due to past mining and natural mineralization

Central Utah Project

A major influence on water resources in the UNF is the Central Utah Project (CUP). The CUP is administered by Reclamation and diverts a portion (roughly 260,000 acre-feet of water annually) of Utah's share of Colorado River water from the Duchesne River Basin. This project consists of a network of dams, water diversions, and reservoirs to transfer water from the Duchesne River and its tributaries to the Wasatch Front. Figure 3.19: Forest-wide map of BOR Facilities shows the location of the CUP facilities on the UNF. CUP facilities are found in many RFOGDs with oil and gas potential, but are not located within the American Fork, Payson, Spanish Fork Canyon, and Vernon groups. However a Reclamation facility is located adjacent to the Payson Group to the north.

CUP facilities are known to affect water resources, especially stream habitat, through flow alteration and water quality impacts.

Drinking Water Sources

Surface water and groundwater in the UNF serve as sources of drinking water for nearby towns and cities. The State of Utah has designated protection zones for these sources of drinking water. Surface water protection zones in the UNF are located primarily in the northern and eastern portion of the UNF; groundwater protection zones are located primarily in the western part of the UNF (see Figure 3.20: Forest-wide map of Drinking Water Protection Zones). All RFOGDs have designated drinking water protection zones.

Groundwater

Groundwater resources have not been well-studied in the UNF. Typical of high elevation lands, these areas serve primarily as recharge zones. Unlike lower elevation valley bottoms, the UNF lands do not contain extensive unconsolidated deposits that support usable aquifers. However, there are consolidated bedrock aquifers at depth within the UNF that can provide usable groundwater. The majority of groundwater basins in the UNF are fully or almost fully appropriated, meaning that future development of groundwater is unlikely.

3.7.2 Introduction

The UNF contains approximately 800 miles of perennial streams, 2,030 miles of intermittent streams, and 17,770 acres of lakes and reservoirs (Figure 3.21: Forest-wide Map of Water Resources) (USFS 2003). An unknown number of springs occur on the UNF. Groundwater is also found at depth, though it has not been well studied in most of the UNF.

Water Resources Terms

The following is list of water resources terms that are used throughout the water resources section.

Hydrologic Unit Code (HUC): The United States is divided and sub-divided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units. The hydrologic units are arranged within each other, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique HUC consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.

The fourth level (or 4th order) of classification is the cataloging unit. A cataloging unit is a geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. The UNF is divided into 5th and 6th level HUCs, which represent watershed and sub-watersheds, respectively.

Utah Safe Drinking Water Act Terms

Public Water System (PWS): a system, either publicly or privately owned, providing water through constructed conveyances for human consumption and other domestic uses, which has at least 15 service connections or serves an average of at least 25 individuals daily at least 60 days out of the year and includes collection, treatment, storage, or distribution facilities under the control of the operator and used primarily in connection with the system, or collection, pretreatment or storage facilities used primarily in connection with the system but not under the operator's control.

Community Water System (CWS): a PWS which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Non-Transient Non-Community Water System (NTNCWS): a PWS that regularly serves at least 25 of the same nonresident persons per day for more than six months per year. Examples of such systems are those serving the same individuals (industrial workers, school children, church members) by means of a separate system.

Transient Non-Community Water System (TNCWS): a non-community PWS that does not serve 25 of the same nonresident persons per day for more than six months per year. Examples of such systems are RV parks, diners or convenience stores where permanent nonresident staff number less than 25, but the number of people served exceeds 25.

Drinking Water Protection Zones

Groundwater Source Zone 1: is the area within a 100-foot radius from the wellhead or margin of the collection area.

Groundwater Source Zone 2: is the area within a 250-day ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Groundwater Source Zone 3: is the area within a 3-year ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Groundwater Source Zone 4: is the area within a 15-year ground-water time of travel to the wellhead or margin of the collection area, the boundary of the aquifer(s) which supplies water to the ground-water source, or the ground-water divide, whichever is closer.

Surface Water Zone 1: (A) Streams, rivers and canals: Zone 1 encompasses the area on both sides of the source, 1/2 mile on each side measured laterally from the high water mark of the source (bank full), and from 100 feet downstream of the point of departure to 15 miles upstream, or to the limits of the watershed or to the State line, whichever comes first. If a natural stream or river is diverted into an uncovered canal or aqueduct for the purpose of delivering water to a system or a water treatment facility, that entire canal will be considered to be part of Zone 1, and the 15 mile measurement upstream will apply to the stream or river contributing water to the

system from the diversion. (B) Reservoirs or lakes: Zone 1 is considered to be the area 1/2 mile from the high water mark of the source.

Surface Water Zone 2: the area from the end of Zone 1, and an additional 50 miles upstream (or to the limits of the watershed or to the State line, whichever comes first), and 1000 feet on each side measured from the high water mark of the source.

Surface Water Zone 3: the area from the end of Zone 2 to the limits of the watershed or to the State line, whichever comes first, and 500 feet on each side measured from the high water mark of the source.

Surface Water Zone 4: the remainder of the area of the watershed (up to the State line, if applicable) contributing to the source that does not fall within the boundaries of Zones 1 through 3.

Clean Water Act Terms

303(d) list: is a list of waters in the State that are impaired. Impaired means that for one or more designated uses and/or pollutants, a waterbody or segment is not meeting water quality standards.

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

Five waterbodies on the UNF are on the 303(d) list and have established TMDLs for certain pollutants. They include American Fork River and some tributaries (from Diversion at mouth of Canyon to Tibble Fork Reservoir), Soldier Creek, Strawberry Reservoir, Mill Hollow Reservoir, and Big East Lake (see table 3.22).

3.7.3 Affected Environment

Surface Water

UNF water resources occur within one of two geographic regions: the Lower Green River watershed, which is part of the Colorado River basin; or one of several closed sub-basins that are part of the larger Bonneville Basin. The nine RFOGDs are within 10 separate fourth-order HUC sub-basins that are in one or the other of two basins named above (USFS 2003).

Precipitation supporting UNF water resources primarily occurs as snowfall between October and April (USFS 2003). Snow provides the primary source of recharge to groundwater resources and supports perennial stream flows. On occasion, high stream flows can be caused by rain on snow events or a thick snowpack that melts rapidly due to a rapid rise in temperature. Low flows generally occur between November and March (USFS 2003), reflecting winter temperatures that allow snow to remain on the ground. At lower elevations, high summer stream flows may also be caused by isolated thunderstorms (USFS 2003). Annual precipitation on the UNF is highly dependent on elevation and aspect, and ranges from approximately 13 to over 30 inches (USFS 2003).

Water Use

A major influence on water resources in the UNF is the CUP. Annually, the CUP diverts roughly 260,000 acre-feet of Utah's share of Colorado River water from the Duchesne River Basin. This project consists of a network of dams, water diversions, and reservoirs to transfer water from the Duchesne River and its tributaries to the Wasatch Front. The first diversion operations began in 1915 to transfer water from the West Fork Duchesne River to Strawberry Reservoir, then through the Sixth Water and Diamond Fork drainages to the Spanish Fork area. The completion of the Diamond Fork System was expected to bring an average of 86,100 acre-feet of CUP water and 61,500 acre-feet of Strawberry Valley Project water per year through the Diamond Fork drainage (USFS 2003a).

At present, 18 watersheds on the UNF provide water for domestic or municipal use. Though additional water sources outside of the UNF are supplying increasing proportions of municipal waters to nearby communities, UNF activities still have the potential to affect the quantity and quality of domestic water supplies (USFS 2003). The Utah Division of Drinking Water (DDW) identifies several types of protection zones that are associated with various permitted drinking water sources. Protection zones of varying types are defined for each of these kinds of sources, and affect all of the RFOGDs in the UNF (Figure 3.20: Forest-wide Map of Drinking Water Protection Zones), but some much more so than others.

Within the UNF, four stream segments have been determined to be eligible for adding to the National Wild and Scenic Rivers System. None have been designated to date. The eligibility determination was made based upon a 1997 inventory conducted by the Forest Service. Since that time, no management actions have been implemented or are being considered that would affect the free-flowing character or outstandingly remarkable value(s) of these four river segments. Currently, the USFS is preparing an EIS that addresses Wild and Scenic Rivers, and as a result of that document, recommendations for specific stream segments may change. Wild and Scenic Rivers are discussed in more detail under Section 3.11: Visual Resources.

Groundwater

Groundwater has not been well-studied on the UNF. Typical of high elevation lands, these areas serve primarily as recharge zones. Unlike lower elevation valley bottoms, the UNF lands do not contain extensive unconsolidated deposits that support usable aquifers, and which are often the focus of study. Regarding consolidated rock, the geologic formations found in the UNF that have been identified as potential targets for groundwater development include: the Browns Park Formation, Duchesne River Formation, Uinta Formation, Currant Creek Formation, Nugget/Navajo Sandstone, Morgan Formations, and Weber Quartzite. Due to their age, the first five of these would only be found in the southeastern half of the UNF. Although these geologic types may be aquifers, much of the area is considered as fully appropriated, so new groundwater rights are not obtainable. There are no EPA-designated Sole Source Aquifers in the UNF. Further, according to the State Water Plan (DWR 2001), there are no areas of significant groundwater development within UNF boundaries. Numerous springs on UNF lands represent discharge of typically smaller, more locally recharged areas; they are often used for livestock watering and for providing water to support perennial stream flow, wildlife, and wetland vegetation. Nearly all springs along the Wasatch Front have been developed for municipal use.

Water Quality

Water quality is assessed in terms of designated beneficial uses as defined by the State of Utah Division of Water Quality (UDWQ). The majority of streams and reservoirs on the UNF provide water for domestic and agricultural uses, cold-water fisheries, recreation, and wildlife. Maintaining the quality of these waters is becoming increasingly important as the demand for water increases with the rapidly growing urban population next to the UNF (USFS 2003). Streams and lakes that the State considers impaired, and thus not able to meet their designated beneficial uses, are reported on the State's 303(d) list, which is updated every other year. Listed water bodies are then scheduled for TMDL development. Table 3.22 lists the UNF's streams and reservoirs listed on the approved 2006 State's 303(d) list (UDEQ 2006).

Further, UDWQ's most recent 305(b) report (UDEQ 2006c) groups streams and reservoirs into other categories: Category 1 (fully assessed and fully supporting beneficial uses); Category 2 (some beneficial uses assessed and those that were assessed fully support the assessed uses); Category 3 (not assessed during the report cycle); Category 4A (units for which TMDLs have been completed and approved); Category 4C (impaired by non-water quality pollutants such as flow or habitat alterations and therefore no TMDLs are required); and Category 5B (a request has been made for removal from the 303(d) list). Table 3.23 lists UNF streams and reservoirs included in Categories 4A and 4C. Category 1, 2, and 3 reaches are too numerous to include here, but can be found in the report (UDEQ 2006c). There were no category 5B UNF streams or reservoirs in the report during this current cycle.

Table 3.22. UNF's streams and reservoirs on the approved 2006 303(d) list.

Unit ID and Name	RFOGD	Approved 2006 303(d) List
Rivers and Streams		
UT16020201-001 American Fork River and tributaries from Diversion at mouth of Canyon to Tibble Fork Reservoir	American Fork	Listed for pH impairment in 2004, Removed due to additional data showing standard being met.
UT16020202-012 Soldier Creek	Spanish Fork	Listed for sediment and total phosphorus
Lakes and Reservoirs		
UT-L-14060004-001 Strawberry Reservoir	Strawberry	Listed for dissolved oxygen and total phosphorus impairment
UT-L-16020203-004 Mill Hollow Reservoir	Upper Provo	Listed for total phosphorus and pH impairment
UT-L-16020202-002 Big East Lake	Payson	Listed for dissolved oxygen impairment

Table 3.23. UNF's streams and reservoirs in other 305(b) lists.

Unit ID and Name	RFOGD	305(b) List Category
Rivers and Streams		
UT16020202-006 Diamond Fork Creek and tributaries from confluence with Spanish Fork river to Sixth Water confluence.	Diamond Fork	4C for flow and habitat alterations
UT16020202-009 Sixth Water Creek and tributaries except Fifth Water and First Water creeks and tributaries from confluence with Diamond Fork.	Diamond Fork	4C for flow and habitat alterations
Lakes and Reservoirs		
UT-L-16020203-001 Deer Creek Reservoir.	Outside of UNF	4A

3.7.4 RFOGDs

The following is a detailed description of water resources for each RFOGD, whether or not they are considered to have oil and gas potential.

Currant Creek

Surface Water

The Currant Creek RFOGD is part of the Duchesne River watershed and thus is within the Green River basin; it includes lands within HUCs 1406003 (Duchesne) and 1406004 (Strawberry). It is bound by the Upper Provo RFOGD on the north, Strawberry RFOGD to the southwest, State land to the southeast, the Ashley National Forest to the northeast, and other non-Federal lands to the east and west (USFS 2003a).

Average annual precipitation in the area ranges between 13 inches in the lowest portion of the RFOGD to over 30 inches in the upper portions of the area. Most of the precipitation occurs as snow between October and April, with the remainder a result of summer thunderstorms (USFS 2003a).

There are approximately 250 miles of streams within this RFOGD: 156 are perennial and 94 are intermittent. As described in more detail in Section 3.6: Watershed Resources, all of these stream miles are in RHCAs. The main drainages include: the South, Left, and Right Forks of Currant Creek (USFS 2003a), which is a tributary to the Strawberry River, and in turn the Duchesne River; and the West Fork Duchesne River and its tributaries, which also flow to the Duchesne River. The Duchesne River then flows east into the Uinta Basin joining the Green River (USFS 2003a).

Drainages above the Currant Creek Reservoir are still natural, free-flowing systems. Currant Creek below the Currant Creek Reservoir is regulated and floods have been reduced from historic levels. Riparian communities are being impacted with the current below-dam flows (USFS 2003a).

Groundwater

Land in this RFOGD is part of the Duchesne-Strawberry subunit of the Uintah Basin, contributing to recharge in the valley fill aquifers associated with the Uintah Basin (DWR 1999).

According to the State Water Plan for the Uintah Basin (DWR 1999), groundwater circulation in the Basin's consolidated aquifers is affected (either enhancing or impairing movement) by folding and faulting, which can cause fracturing or aquifer offset. The State Water Plan indicates that the freshest water is found in the Precambrian rocks of the Uinta Mountains, but that development of the groundwater resources in the Uintah Basin has been minor, due in part to lack of need, less than ideal hydraulic properties, water quality issues, and/or economics. Only limited groundwater is available for appropriation in this RFOGD (water right area 43; DWR 2006).

Water Use

The CUP's Vat Creek tunnel brings water from the West Fork Duchesne River and Wolf Creek into the Currant Creek watershed. The Currant Creek Reservoir and the tunnel it feeds divert water from Currant Creek above the dam to Strawberry Reservoir for further distribution and use (USFS 2003a). This has depleted flows in several streams in the Duchesne River Basin (Wolf Creek, West Fork Duchesne River, Currant Creek, Layout Creek, Water Hollow, and Strawberry River (USFS 2003). Between 1984 and 1994, according to USGS gauging records, Currant Creek below the dam had average annual flows that ranged between 11.1 and 55.8 cubic feet per second (cfs).

Historic water uses in the RFOGD include water development for irrigation and developed recreation uses. Currently, water from the RFOGD is used for stock, irrigation, domestic, power, storage, and municipal purposes. The entire RFOGD is within a surface water protection zone defined by the DDW. There is one permitted transient water source and one permitted groundwater drinking source in the RFOGD, though protection zones for other transient sources overlap the RFOGD boundary. The Strawberry Water Users Association and the BOR hold the majority of municipal water rights in the RFOGD, though other small entities also own water rights (USFS 2003a). In addition to a limited availability of groundwater for appropriation, there are isolated springs that are also available; otherwise surface water is considered as fully appropriated (DWR 2006).

Water Quality

Water quality is generally good within this RFOGD (USFS 2003a). However, several samples in the 1990s showed high levels of phosphorus in the West Fork Duchesne River, which were attributed to surface erosion (USFS 1999). All streams within the Currant Creek drainage are currently meeting State water quality standards.

Deer Creek

Surface Water

The Deer Creek RFOGD is within the Utah Lake portion of the Great Basin and includes parts of HUCs 16020201 (Utah Lake), 16020202 (Spanish Fork), and 16020203 (Provo). It is bounded by the UNF boundary on the north and southwest, Pump Ridge to the southeast, and the natural boundaries of the Provo River watershed on the northwest (USFS 2003a). The RFOGD is immediately adjacent to rapidly growing urban areas in Utah and Salt Lake Valleys (USFS 2003a).

Precipitation in the RFOGD averages between 15 and 20 inches per year, while the mountainous portion of the area averages in excess of 30 inches annually, and in excess of 50 inches per year at the highest elevations. Most of this precipitation falls as snow during the winter. High

intensity, short duration summer thunderstorms are common from July through September (USFS 2003a).

There are approximately 542 miles of streams within the RFOGD: approximately 94 miles are classified as perennial and 448 miles are classified as intermittent. As described in more detail in Section 3.6: Watershed Resources, all of these stream miles are in RHCAs. The main streams in the RFOGD are the Provo River and tributaries, the Left and Right Forks of Hobble Creek, Wardsworth Creek, and Bartholomew and Whittemore Canyons. The Provo River is one of the largest rivers emerging from the Wasatch Front. Below Deer Creek Reservoir, which is just outside of the UNF and is a major CUP storage facility, the Provo River is managed as a blue ribbon sport fishery and is stocked with non-native species. Much of the river above the reservoir flows through private lands (USFS 2003a).

The Provo River below Deer Creek Dam was gauged between 1954 and 2003. During that time, average annual flows ranged from 148 to 641 cfs, and the average during that time was 341 cfs. Hobble Creek was gauged by the USGS for a number of years in the early 1900s and then again between 1946 and 1974. Average annual flows ranged from 9 to 135 cfs and averaged about 46 cfs during the gauged years.

Groundwater

Land in this RFOGD is within either the Round Valley or Utah-Goshen Valley groundwater basins. Generally, these UNF lands would contribute, via subsurface inflow from consolidated rocks, recharge to the valley fill aquifers (estimated total annual recharge of 7,950 acre-feet for Round Valley and 450,000 for Utah-Goshen Valley (DWR 1997). As with other groundwater basins in the Utah Lake Basin, these two groundwater basins are closed to new appropriation of groundwater.

Water Use

Many water resources in the RFOGD are currently used for livestock, domestic, power, irrigation or municipal and industrial purposes. Many entities, ranging from small communities to larger Wasatch Front cities, rely on surface water and/or springs from this RFOGD for municipal uses. In addition to the RFOGD area water, water is diverted from the North Fork of the Duchesne River via pipeline to the Provo River for use by cities along the Wasatch Front (USFS 2003a). The northern portion of the RFOGD is within designated DDW surface water protection zones; much of the western portion is within protection zones established for either transient or groundwater drinking sources. Along with groundwater, all surface water is fully appropriated in the area associated with this RFOGD (water right area 55; DWR 2006).

Water Quality

Portions of Little Provo Deer Creek are heavily impacted by road incursions and channel modifications. The Provo River is designated as a Class I (priority) watershed, in need of restoration (USFS 2003a).

Deer Creek Reservoir, which is upstream of the RFOGD, but receives stream flow generated from some small areas within the UNF, was the focus of a TMDL study because of temperature and dissolved oxygen impairments (Psomas 2002). The study determined that the impairments were not as serious as first thought, but recommended continuing reductions in nutrients (primarily phosphorus) in order to maintain a viable fishery. UNF lands were not perceived to be a major contributor of nutrient pollution.

Diamond Fork

Surface Water

Streams in the Diamond Fork RFOGD flow to Utah Lake, in the Great Basin, and are part of HUC 16020202. The RFOGD is bounded by the Deer Creek RFOGD to the north, the Strawberry RFOGD to the east, and the Spanish Fork RFOGD to the south. The RFOGD receives approximately 18 inches of precipitation at lower elevations and over 30 inches in its highest headwater areas. The majority of the precipitation comes as snow between the months of October and April (USFS 2003a).

The RFOGD contains approximately 98 miles of perennial streams and 225 miles of intermittent streams, and represents the largest headwater tributary of the Spanish Fork River. As described in more detail in Section 3.6: Watershed Resources, all 323 of these stream miles are in RHCAs. Primary streams are Sixth Water and Lower Diamond Fork Creeks (USFS 2003).

Groundwater

Land within this RFOGD overlies the Utah-Goshen Valley groundwater basin and supplies high-quality recharge water from consolidated rocks to the valley fill aquifer (DWR 1997). As with other groundwater basins in the Utah Lake Basin, this groundwater basin is closed to new appropriation of groundwater.

Water Use

Water from the RFOGD is used for stock water, irrigation, domestic, power, storage, and municipalities. There are no surface water resources available for appropriation in this water right area (area 51), according to the Utah Division of Water Rights (DWR) (2006). There are no permitted water sources (neither surface, groundwater, nor transient) within the RFOGD, though there are a few protection zones for sources outside the RFOGD that encroach within the boundaries.

The Diamond Fork System of the CUP is a major influence on water resources in this RFOGD, as it transfers water from the West Fork Duchesne River to Strawberry Reservoir, then to the Sixth Water and Diamond Fork drainages. It brings—or will bring—an average of 86,100 acre-feet of CUP water and 61,500 acre-feet of Strawberry Valley Project water per year to the Diamond Fork drainage through 2010. Historically, the transferred water flowed through the stream channels, which resulted in impacts to lower Diamond Fork and Sixth Water Creeks. These impacts included: loss of a multiple age cottonwood forest, stream channel down-cutting, excessive stream bank erosion, decreased aquatic habitat, and increased sedimentation. More recently, in order to deliver this amount of water and restore habitats adversely impacted by historically high CUP water flows, a series of pipelines, tunnels, and aqueducts have been or are being built to remove a majority of the transported water from the stream channels (USFS 2003a). Completion of the Diamond Fork system of the CUP is expected to allow restoration of 20 miles of stream in Diamond Fork and Sixth Water (USFS 2003). Monitoring programs have been initiated to track water quality and stream morphology trends as flow regimes are normalized and restoration activities take place.

Stream flows in lower Diamond Fork are highly altered due to CUP diversions; natural average bank full flows are thought be about 200 cfs at the canyon mouth, peaking in mid-May; with CUP flows, average annual flows averaged about 450 cfs, and peaked any time between May

and August (USFS 2000a). CUP flows have been fully contained in piping since July 2004, allowing a natural stream flow regime to occur.

Water Quality

An Area Assessment was completed for Diamond Fork (USFS 2000a) in order to describe the ecosystem of the Diamond Fork River system, the Properly Functioning Condition (PFC) of various resources, and the effect of the CUP, including mitigation, on the system. This report noted that hydrologic trend in most reaches and tributaries examined, particularly in the lower parts of the watershed, was downward, but that completion of the CUP would eliminate the main mechanisms of that downward trend. It also noted, however, that recovery rate and extent would be uncertain. Related indicators such as riparian condition, channel morphology, and water quality had similar trends and uncertainties related to recovery. The upper parts of the watershed were in generally better condition.

Portions of Diamond Fork Creek, Sixth Water Creek, and their tributaries were on the State's 2000 and Draft 2002 303(d) lists for flow alteration, riparian habitat alteration, and stream habitat alteration due to CUP flows from the Strawberry Reservoir (USFS 2003). These streams no longer appear on the approved 2006 303(d) list (UDEQ 2006). However, in addition to the long-term CUP-related effects on these streams, the geology in areas of the watershed can produce soils which are easily eroded when disturbed.

Payson

Surface Water

The Payson RFOGD encompasses all areas within an outlying part of the UNF located southwest of the main UNF area. These lands are within the Great Basin, and ultimately are tributaries to Utah Lake. HUCs in this RFOGD include 16020201 (Utah Lake) and 16020202 (Spanish Fork). Annual precipitation for this RFOGD ranges from 15 to over 30 inches at the higher elevations. The majority of the precipitation falls as snow during the months of October through April (USFS 2003a).

There are 109 miles of perennial and 275 miles of intermittent streams found on UNF land within this RFOGD. As described in more detail in Section 3.6: Watershed Resources, all 384 of these stream miles are in RHCAs. The RFOGD includes the Mona Reservoir watershed, Salt Creek, Summit Creek, Peteetneet Creek, Bennie Creek, Nebo Creek, and Thistle Creek. Several reservoirs (Payson Lakes, Big East Lake, Lake McClellan, Red Lake, Maple Lake, Dry Lake Reservoir, and Pete Winward Reservoir) were constructed in this RFOGD to aid in the transfer of water from the UNF to nearby cities (USFS 2003a).

Average annual flow in Nebo Creek near Thistle, according to USGS gauging records from 1964 to 1973, ranged from 9.5 to 28.6 cfs. Salt Creek below the UNF boundary was gauged between 1994 and 2004, and average annual flows ranged from 6.4 to 27.9 cfs.

Groundwater

Land within this RFOGD is primarily in the Northern Juab Valley groundwater basin, supplying a portion of the basin's annual 40,000 acre-foot recharge to the associated valley fill aquifer (DWR 1997). A portion of the northeastern part of the RFOGD supplies recharge to the Utah-Goshen Valley groundwater basin. As with other groundwater basins in the Utah Lake Basin, the basin is closed to new appropriation of groundwater.

Water Use

Water resources in the RFOGD provide municipal, stock water, well water, irrigation, power, and domestic water. Several irrigation ditches and pipelines were constructed to convey water to private land. The DDW has identified protection zones for several permitted groundwater and/or transient drinking water sources in this RFOGD. No water—surface or groundwater—is available for appropriation (DWR 2006).

Water Quality

One UNF lake in this RFOGD is listed on the current 2006 303(d) list: Big East Lake for dissolved oxygen (UDEQ 2006). A TMDL target date has not been set (UDEQ 2006).

Spanish Fork Canyon Group

Surface Water

The Upper Spanish Fork Canyon RFOGD is tributary to Utah Lake all lands within the RFOGD are in HUC 16020202. It is bounded on the north by the natural boundary of the Soldier Creek watershed and on the south by the UNF boundary. Precipitation and mean annual precipitation varies between 15 inches at the lower elevations and 25 inches on higher ridges. Most of the precipitation occurs as snow. The wettest months occur between December and May, depending upon the location and elevation. June and July are the driest months. High intensity summer thunderstorms are common during July and August (USFS 2003a).

There are approximately 25 miles of perennial and 130 miles of intermittent streams within this RFOGD. As described in more detail in the vegetation section of this EIS, all 155 of these stream miles are in Riparian Habitat Conservation Areas (RHCA). The RFOGD includes the northern part of the Soldier Creek watershed (though most of the stream is outside the UNF boundary), the Sheep Creek and Tie Fork drainages, all of which drain into the Spanish Fork River complex and eventually into Utah Lake. A USGS gauging station on Tie Fork near Soldier Summit was gauged from 1964 to 1996; average annual flows ranged from 1.7 to 14.1 cfs, with an average of 5.6 cfs.

Groundwater

Land within this RFOGD is in the Utah-Goshen Valley groundwater basin, supplying high-quality recharge water from consolidated rocks to recharge the valley fill aquifer associated with the basins (DWR 1997). As with other groundwater basins in the Utah Lake Basin, this groundwater basin is closed to new appropriation of groundwater. Surface water is also fully appropriated (DWR 2006).

Water Use

Water uses served by this RFOGD include domestic, stock, and irrigation water.

Water Quality

Soldier Creek is listed on the current (2004) and Draft (2006) 303(d) list for total phosphorus and sediment (UDEQ 2004; UDEQ 2006). A TMDL study has been submitted and is awaiting EPA approval. A large part of this MAG is located on geologic formations that produce saline and/or easily eroded soils, which can affect water quality.

Strawberry

Surface Water

All streams within the Strawberry RFOGD ultimately drain into the Green River, some as tributaries to the Strawberry River (HUC 14060004), and some via the Price River (HUC 14060004). This RFOGD is bounded by the natural boundaries of the Strawberry Reservoir watershed on the northeast and northwest, the UNF boundary on the east and south, and the Willow Creek and White River watershed boundaries on the southwest. Yearly precipitation in the RFOGD varies from approximately 15 inches at lower elevation to over 30 inches at higher elevations. Most precipitation comes as winter snow and summer thunderstorm events (USFS 2003a).

There are approximately 164 miles of perennial streams and 346 miles of intermittent streams found within this RFOGD. As described in more detail in Section 3.6: Watershed Resources, 511 of these stream miles are in RHCAs. The RFOGD includes part of the upper Strawberry River system; the Right, Left, and Middle Forks of White River; Tabbyune Creek; Willow Creek; Racetrack Hollow; Buffalo Canyon; Center Canyon; French Hollow; and Road Hollow. Strawberry Reservoir is a major storage facility in this RFOGD (USFS 2003a). Although not fully inventoried, there are a number of locally important seeps and springs in Strawberry Valley (USFS 2004).

Downstream of the reservoir, the Strawberry River was gauged for several years between 1986 and 1994; indicative of release schedules during that time, average annual flows ranged from 16.6 to 23.5 cfs, with an average of 19.8 cfs.

Downstream of the UNF, a USGS stream gauging station on White River records a wide variation in flows, both seasonally and in regard to annual yields. Average minimum flows are 2.2 cfs and average maximum flows are two orders of magnitude higher at 263 cfs. Between 1968 and 1995, annual yield ranged from 1,600 cfs to 22,643 cfs, and averaged 10,138 cfs. (USFS 1996a).

Groundwater

Land within this RFOGD is contained within one of two groundwater basins. The northern two-thirds are within the Duchesne-Strawberry subunit of the Uintah Basin, contributing recharge to the valley fill aquifers associated with the Uintah Basin (DWR 1999). The southern portion is within the Castle Valley groundwater basin and is generally thought to be unfavorable as a groundwater production area, from both quality and quantity aspects (DWR 2000).

Water Use

Water uses include livestock, irrigation, municipal, industrial, domestic, power, and storage. According to the DWR (2006), surface water in this RFOGD (water right areas 43 and 91) is fully appropriated, with the exception of isolated springs; groundwater is available to a limited extent. The entire RFOGD is within a designated surface water protection zone; in addition, there are several DDW-permitted transient drinking water sources.

Water Quality

Historical water diversions, overgrazing, elimination of riparian species through herbicide spraying, trapping of beaver, and removal of beaver dams have all caused detrimental impacts to the hydrology and fluvial geomorphology of the Strawberry Valley rivers and streams in the

past. The system is recovering slowly (USFS 2003a:5-121). In 1997, trends for proper functioning condition were determined for various streams in the Strawberry Valley area; most upper elevation channels were static, while mid- and lower-elevation streams varied but were generally improving (USFS 1997).

Some areas in this RFOGD, particularly those draining to the Price River basin, are located on geologic formations such as the Green River that tend to develop saline and easily eroded soils. The combination of this geology and the resultant soils can cause or exacerbate stream instability, upland erosion, and result in water quality problems. In the White River MA, there have been occasional problems with high sediment loads affecting water quality (USFS 2003a), and in 1996 the USFS rated water quality trends as stable to downward (USFS 1996a).

In April 2004, the UNF issued a report focusing on restoration of Strawberry Valley to a functioning ecosystem (USFS 2004). In addition to the above-noted impacts, UNF roads were also noted as source impacts. In some cases, previous attempts at stream channel rehabilitation have caused additional impacts. Restoration efforts in various reaches include structural, bioengineering, riparian fencing, beaver manipulation, etc. (USFS 2004). Additionally, in 2003 some reaches of the Strawberry River were fenced as part of a range exclosure project that would eventually protect water quality (USFS 2005). Other report recommendations are ongoing.

Within this RFOGD, Strawberry Reservoir is listed on the approved 2006 303(d) list due to dissolved oxygen and total phosphorus impairments (UDEQ 2006). In part, phosphorous loading may be a result of the northern Strawberry Valley tributary watersheds' placement in the Park City Formation. A TMDL study on the Strawberry Reservoir has been completed and is awaiting approval from the U.S. Environmental Protection Agency (EPA).

American Fork

Surface Water

The American Fork RFOGD consists of the American Fork River drainage, which flows to Utah Lake in the Great Basin; it is within HUC 16020201. The RFOGD is bounded by the UNF boundary on the west and the American Fork watershed boundary on the north, east, and south (USFS 2003a).

Rain makes up approximately 40 percent of the total precipitation at lower elevations of the RFOGD. Precipitation at the highest elevations exceeds 60 inches per year, while the precipitation at the lowest elevations ranges from 16 to 20 inches per year. The majority of the RFOGD's winter precipitation results from frontal storms. High intensity thunderstorms are common from July through September (USFS 2003a).

There are approximately 69 miles of perennial streams within the RFOGD, including the American Fork River, South Fork American Fork River, Grove Creek, Battle Creek, Deer Creek, Silver Creek, and Dry Creek. A one-mile segment of the South Fork of the American Fork River is eligible for the National Wild and Scenic Rivers System, 0.25 miles of which is outside the Mount Timpanogos Wilderness Area and eligible under the recreational river category. There are approximately 115 miles of intermittent streams in the area as well. As described in more detail in the vegetation section of this EIS, 184 of these stream miles are in Riparian Habitat Conservation Areas (RHCA). Five man-made reservoirs are located in the RFOGD: Silver and Pittsburg Lakes (both natural lakes that have been artificially enlarged), Silver Lake Flat

Reservoir, Tibble Fork Reservoir, and a PacifiCorp diversion dam downstream of Hanging Rock in the main stem of the American Fork River. A proposal to return Silver Lake to its natural level, or to stabilize the lake at its current or some intermediate level, is being considered. A proposal to remove the PacifiCorp diversion dam in the main stem of the American Fork River is being considered as well (USFS 2003a).

These streams, particularly the American Fork River, tend to be step-pool streams with steep gradients, whose profiles are influenced by the presence of boulders and woody debris. Based on long-term records, average minimum stream flow in the American Fork River at the USGS 4C gage station is about 15 cfs, while bankfull discharge is about 300 cfs. Dry Creek, another gauged station in this RFOGD, has a base flow of about 5 cfs and an average annual flow of about 21 cfs (USFS 2002c).

Groundwater

Land within this RFOGD is part of the Utah-Goshen Valley groundwater basin, supplying high-quality recharge water from consolidated rocks to recharge the valley fill aquifer associated with the basin (DWR 1997). As with others in the Utah Lake Basin, this groundwater basin is closed to new appropriation of groundwater.

Water Use

The RFOGD provides domestic, irrigation, municipal, and well water, as well as stock water and water for power and storage. There are numerous State-permitted transient water supply sources scattered throughout the RFOGD, and several groundwater wells along the western portion that provide drinking water. Municipal water is provided to several communities and other entities. The entire RFOGD is within a surface water protection zone as defined by the DDW. There is currently a demand for the area to supply more culinary water for local municipalities. The drainage contributes approximately 83,500 acre-feet of water to streamflow, and supplies an additional unmeasured quantity of groundwater. Most of the water yield is from the higher elevations (USFS 2003a). According to the Utah Division of Water Rights (2006), surface water in this RFOGD (water right area no. 55) is fully appropriated, as is groundwater.

Water Quality

Extensive mining activity occurred in the American Fork drainage in the late 19th and 20th Centuries. Evidence of this activity is especially apparent in the North Fork American Fork drainage. This past mining activity has had detrimental effects on water quality and aquatic populations. A comprehensive water quality monitoring program was established in the American Fork drainage in the summer of 2000, and indicated exceedances of lead, arsenic, zinc, and cadmium in various stream reaches, likely due to historic mining (USFS 2003a). This affected both the American Fork River and Mary Ellen Gulch, in part due to mine drainage flowing from closed tunnels in both drainages. Additionally, intensive local impacts by all-terrain vehicle (ATV) users keep the surfaces of tailings piles unstable and highly susceptible to erosion.

The Environmental Protection Agency (EPA) has listed American Fork Canyon as a Comprehensive Environmental Response, Compensation, and Liability Inventoried Site (CERCLIS). The Forest Service is working cooperatively with other Federal and State agencies, universities, private enterprises, past and present mine claimants, and other partners to implement reclamation measures. (USFS 2003b) Monitoring during some of this work in 2003

showed pH levels that did not meet State water quality standards, but all arsenic, cadmium, and lead levels were within standards. Zinc was analyzed, and results trended downward however, compliance with the water quality standard could not be determined because it is hardness-dependent. The reclamation work continued in 2004, and water monitoring in some locations continued to show low pH values in some mine adit areas, while downstream river pH levels were acceptable. (USFS 2005)

While the 2002 303(d) list included portions of the North Fork American Fork and main stem American Fork River (above Tibble Fork Reservoir) as impaired due to arsenic levels (USFS 2003a), these reaches were subsequently removed because a TMDL was deemed to be no longer necessary (UDEQ 2004). However, the reach of American Fork River downstream of the reservoir to the canyon mouth (below the UNF boundary) is listed on the current approved 2004 303(d) list for pH (UDEQ 2004). The draft 2006 list requests that the waterbody be removed during the current cycle because additional intensive surveys indicated that the pH standard was being met (UDEQ 2006).

Upper Provo Group

Surface Water

The Upper Provo RFOGD is in the Great Basin and is tributary to Utah Lake; it is within HUC 16020203. The RFOGD is bounded by the Wasatch-Cache National Forest on the north, the Ashley National Forest to the east, non-Federal land to the west, and by the Currant Creek RFOGD to the south (USFS 2003).

Average annual precipitation ranges from 20 to over 30 inches per year with the majority of the precipitation occurring as snow between the months of October and April. Most of the remainder of the precipitation occurs during summer thunderstorms. Runoff is dominated by spring snowmelt. Approximately two-thirds of the total annual runoff occurs during the period from April 15 to July 30. Average annual floods from streams in the area average about 14 cfs per square mile of watershed area, or slightly less than twice the average for most streams in northern Utah (USFS 2003a:5-145).

There are approximately 66 miles of perennial streams and 69 miles of intermittent streams within the RFOGD. As described in more detail in the vegetation section of this EIS, all 135 of these stream miles are in Riparian Habitat Conservation Areas (RHCA). The South Fork of the Provo River and Soapstone Creek are the major drainages, and runoff from this area flows south and west to Utah Lake.

Groundwater

Land within this RFOGD is part of the Heber Valley groundwater basin, supplying some portion of the total estimated 111,300 acre-feet/year recharge to the valley fill aquifer via subsurface inflow from consolidated rocks (DWR 1997). As with other groundwater basins in the Utah Lake Basin, the Heber Valley groundwater basin is closed to new appropriation of groundwater. Similarly, surface water is also fully appropriated in the water right area (55) associated with this MAG (DRW 2006).

Water Use

Water resources in the RFOGD are an important source of water for the State of Utah, providing water for domestic, irrigation, municipal, stock, well, and storage water. The municipal water

rights are owned by the BOR (USFS 2003a:5-145). The entire MAG is within a DDW-designated surface water protection zone, and there are several permitted transient water sources with related protection zones located here as well.

Water Quality

Water quality is generally good. The main impact on water quality is from fine sediment, which can result from the spring runoff described above, landslides, roads and other disturbed sites, local areas of streambank erosion, and areas with poor ground cover. Streams tend to be highly alkaline and productive in terms of aquatic life (USFS 2003). In the 1990s several samples in Mill Hollow and South Fork Provo River showed elevated phosphorus, likely a result of upland erosion (USFS 1999).

Mill Hollow Reservoir is listed on the current 2004 and the draft 2006 303(d) lists as being impaired for pH and total phosphorus. A TMDL study is underway.

Vernon Group

Surface Water

The Vernon RFOGD is an isolated parcel of UNF land surrounded by BLM-administered lands and private property (USFS 2003a). It drains to several closed Great Basin watersheds, and includes HUCs 160202034, 16020205, 16020306, and 16030005.

Precipitation throughout the Vernon Management Area is characteristic of high desert ranges, averaging around 14 inches annually in the lower elevations and over 25 inches at the upper elevation along the Sheeprock Mountain Range. The majority of this moisture falls as snow, with the remainder falling during the spring and summer months as thunderstorms. June is the driest month; March and April are commonly the wettest (USFS 2003a:5-168; USFS 2003a:5-191).

The RFOGD contains 29 miles of perennial streams and 321 intermittent streams. As described in more detail in the vegetation section of this EIS, 349 of these stream miles are in Riparian Habitat Conservation Areas (RHCA). These streams drain parts of the Rush Valley, and the Sevier River and Government Creek watersheds. Water resources in much of this part of the UNF are typical of desert regions in that they are smaller in volume and tend to dry up as the summer progresses.

Vernon Creek provides an average of about 2,070 acre-feet of water yearly, though the yearly amount fluctuates greatly (USFS 1996).

Groundwater

This RFOGD is within either the Great Salt Lake Desert or Tooele/Rush Valley sub-basins, in the West Desert Basin, where principal aquifers are associated with either the unconsolidated basin fill or with carbonate rock (DWR 2001a). Groundwater is not prevalent in this Great Basin semi-desert ecosystem; most groundwater in the area is thought to originate during the Pleistocene (USFS 1996). Appropriation is limited to small amounts of shallow groundwater (DRW 2006).

Water Use

The majority of the free-flowing water that originates in the Sheeprock Mountains was diverted for irrigation purposes when the area was first settled in the early to mid-1800s. Water from Vernon, Little Valley, and Bennion Creeks is diverted to the Vernon Reservoir for irrigation use,

leaving several miles of natural stream course dewatered through the year. Water from Harker Creek is diverted to the Harker Ditch and is also used for irrigation purposes. An intermittent unnamed tributary is also dewatered for the majority of its length after being diverted into Charlie's Ditch. In addition to irrigation, water uses within the MAG include water for domestic, well, and stock water (USFS 2003a; USFS 2003a). Surface water is unavailable for appropriation in this area (DRW 2006). A small area on the northern edge of the RFOGD has been designated as within the protection zone of a couple of DDW-permitted transient water sources.

Water Quality

Water quality in this RFOGD was sampled extensively during the summer of 2000. Results indicated that, as a result of past mining activity and naturally occurring mineralization of parent rock formations, isolated areas existed where metals exceed State of Utah clean water standards. A preliminary assessment report was prepared to determine whether a significant risk to the public, wildlife, or the environment existed (USFS 2003a; USFS 2003). As a result of that report, several adit closure and water quality improvement projects have been accomplished in concert with the Utah Division of Oil, Gas, and Mining's abandoned mine land reclamation program.

Figure 3.19. Forest-wide map of BOR facilities.

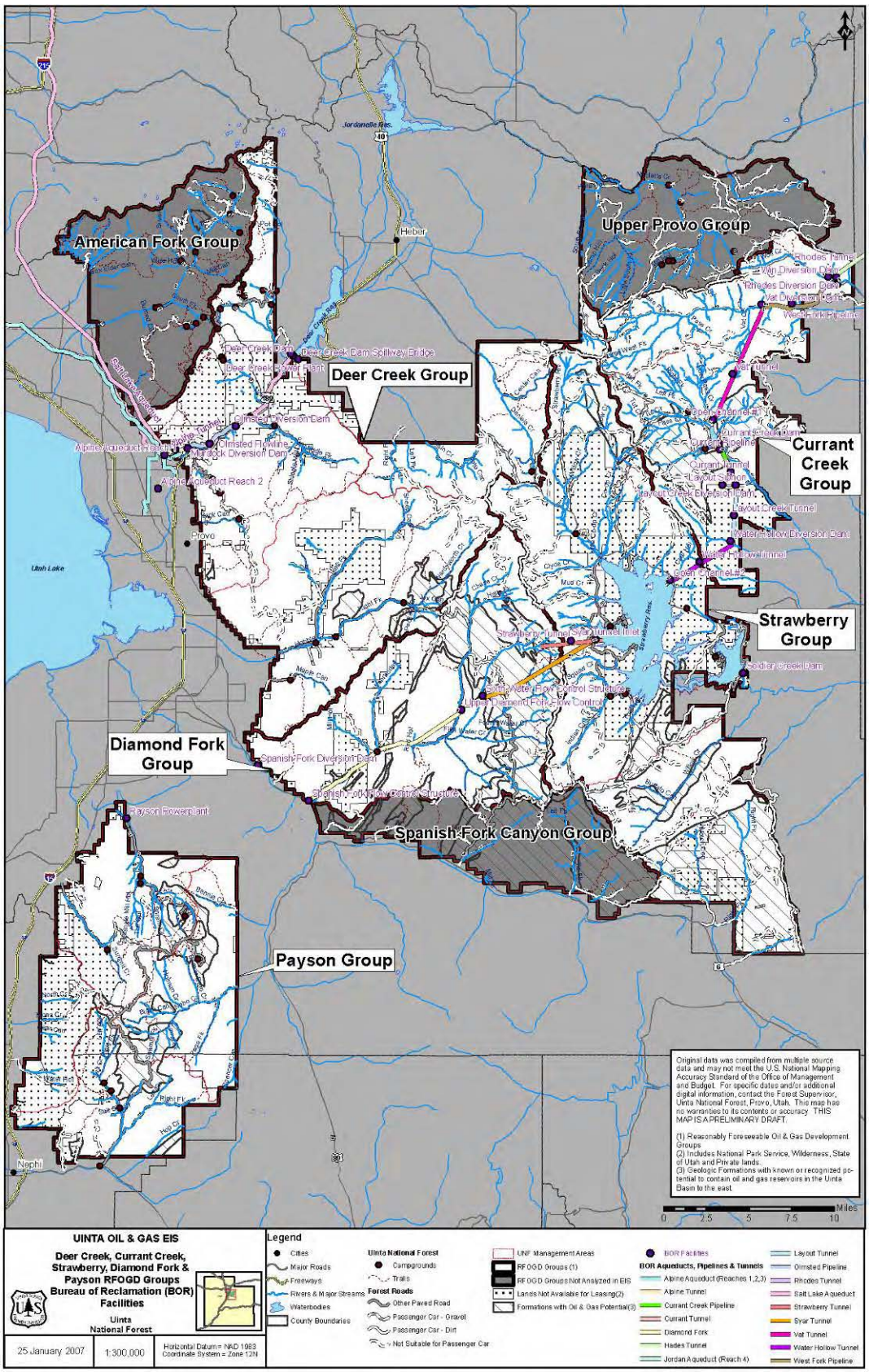

Figure 3.20. Forest-wide map of drinking water protection zones.

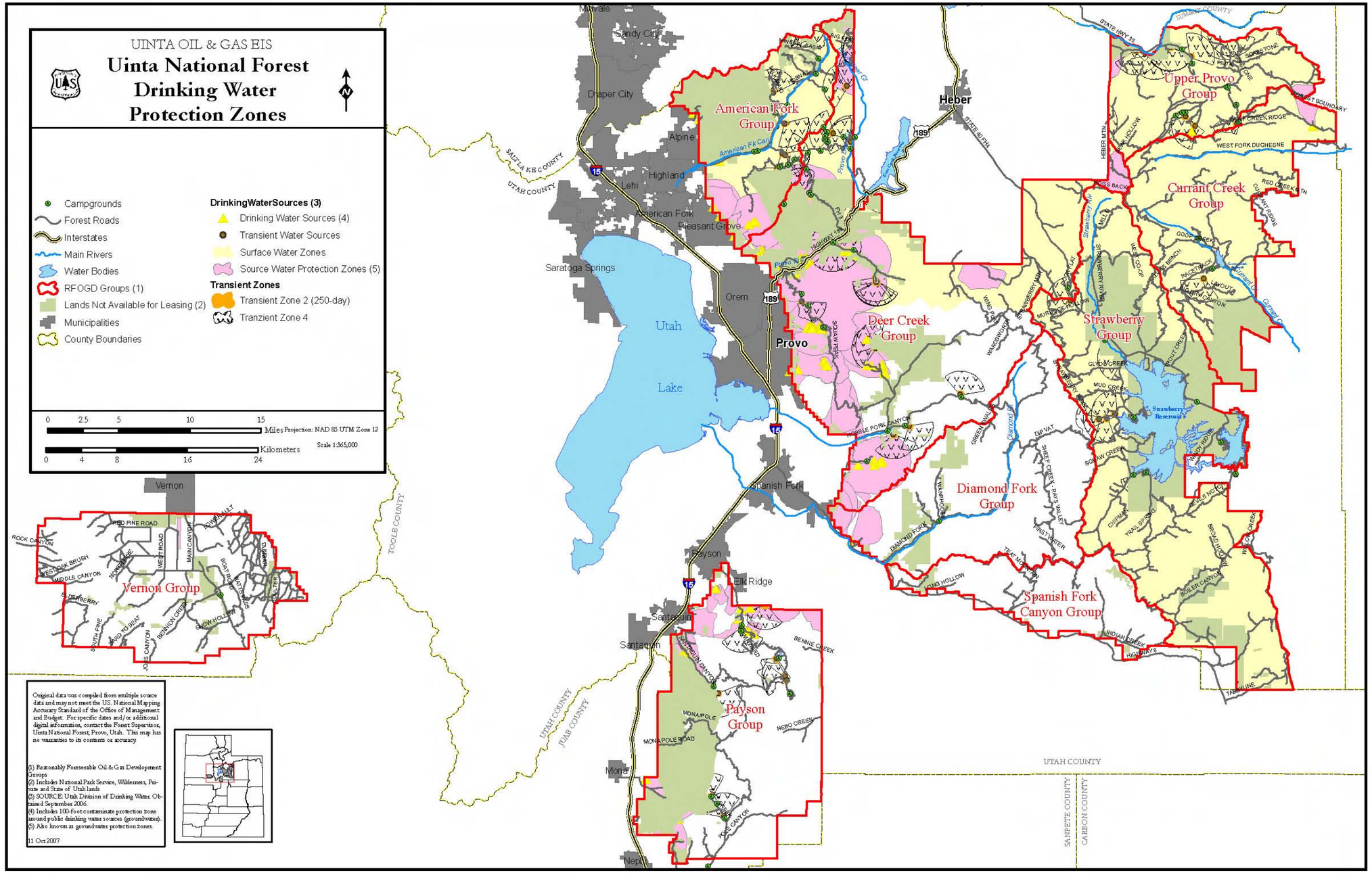
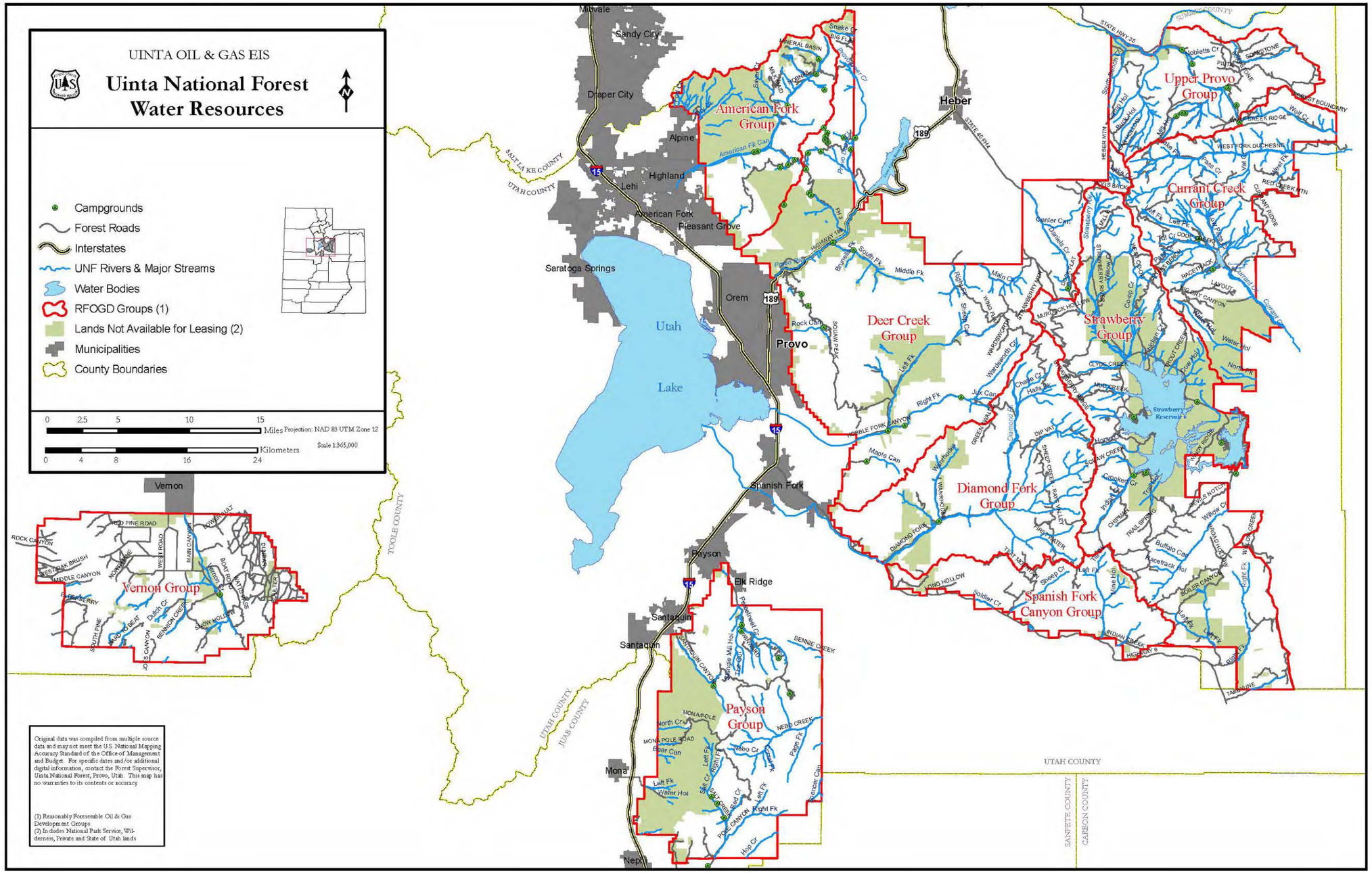
Figure 3.21. Forest-wide map of water resources.