United States
Department of
Agriculture

Forest
Service

**Southwestern
Region**

# Water
# Specialist Report

## Forest Plan Revision
## DEIS

**Submitted by:** __/s/ _____

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# Contents

## Introduction

This report evaluates and discloses the potential environmental consequences on the water resource that may result with the adoption of a revised land management plan. It examines, in detail, four different alternatives for revising the 1987 Apache-Sitgreaves NFs land management plan (1987 forest plan).

## Relevant Laws, Regulations, and Policy that Apply

## Federal Statutes

The following is a partial listing of relevant laws which have been enacted by Congress. A Federal statute, or law, is an act or bill which has become part of the legal code through passage by Congress and approval by the President (or via congressional override). Although not specified below, many of these laws have been amended.

**Bankhead-Jones Farm Tenant Act of July 22, 1937 -** Directed the Secretary of Agriculture to develop a program of land conservation and utilization in order to correct maladjustments in land use and thus assist in such things as control of soil erosion, reforestation, preservation of natural resources, and protection of fish and wildlife.

**Clean Water Act (see Federal Water Pollution Control Act)**

**Emergency Flood Prevention (Agricultural Credit Act) Act of August 4, 1978** - Authorizes the Secretary of Agriculture to undertake emergency measures for runoff retardation and soil-erosion prevention, in cooperation with land owners and users, as the Secretary deems necessary to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or other natural occurrence is causing or has caused a sudden impairment of that watershed.

**Endangered Species Act of 1973, as amended** - Authorizes the determination and listing of species as endangered and threatened; prohibits unauthorized taking, possession, sale, and transport of endangered species; authorizes the assessment of civil and criminal penalties for violating the Act or regulations; and, authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction for any violation of the Act or any regulation issued there under. Section 7 of the Act requires Federal agencies to use their authorities to carry out programs for the conservation of endangered and threatened species and to insure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

Section 4 of the Act directs the development and implementation of recovery plans for threatened and endangered species and the designation of critical habitat. Several species listed under the Act are found on the Apache-Sitgreaves NFs, some with recovery plans and some with designated critical habitat. Those with a recovery plan and/or a critical habitat designation as of 2010 are listed below:

- Southwest Willow Flycatcher, Recovery Plan and Critical Habitat
- Mexican Spotted Owl, Recovery Plan and Critical Habitat
- Chiricahua Leopard Frog, Recovery Plan and pending Critical Habitat
- Little Colorado River Spinedace, Recovery Plan and Critical Habitat
- Arizona Trout (Apache Trout), Recovery Plan
- Spikedace, Recovery Plan and Critical Habitat

- Gila Trout, Recovery Plan
- Gila Chub, Critical Habitat
- Loach Minnow, Recovery Plan and Critical Habitat
- Mexican Wolf, Recovery Plan

**Federal Land Policy and Management Act of October 21, 1976** - Requires that public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use. Also states that the United States shall receive fair market value of the use of the public lands and their resources unless otherwise provided for by law.

**Federal-State Cooperation for Soil Conservation Act of December 22, 1944 -** Authorized the adoption of eleven watershed improvement programs in various states for the improvement of water runoff, water flow retardation, and soil erosion prevention.

**Federal Water Pollution Control Act and Amendments of 1972 (Clean Water Act) -** Enacted to restore and maintain the chemical, physical, and ecological integrity of the Nation's waters. Provides for measures to prevent, reduce, and eliminate water pollution; recognizes, preserves, and protects the responsibilities and rights of States to prevent, reduce, and eliminate pollution, and to plan the development and use (including restoration, preservation, and enhancement) of land and water resources; and provides for Federal support and aid of research relating to the prevention, reduction, and elimination of pollution, and Federal technical services and financial aid to state and interstate agencies and municipalities for the prevention, reduction, and elimination of pollution.

Established goals for the elimination of water pollution; required all municipal and industrial wastewater to be treated before being discharged into waterways; increased Federal assistance for municipal treatment plant construction; strengthened and streamlined enforcement policies; and expanded the Federal role while retaining the responsibility of States for day-to-day implementation of the law.

**Federal Water Project Recreation Act of July 9, 1965 -** Requires that recreation and fish and wildlife enhancement opportunities be considered in the planning and development of Federal water development.

**Forest and Rangeland Renewable Resources Planning Act of August 17, 1974** - Directs the Secretary of Agriculture to prepare a Renewable Resource Assessment every ten years; to transmit a recommended Renewable Resources Program to the President every five years; to develop, maintain, and, as appropriate, revise land and resource management plans for units of the National Forest System; and to ensure that the development and administration of the resources of the National Forest System are in full accord with the concepts of multiple use and sustained yield.

**Healthy Forests Restoration Act of 2003 (H.R. 1904) -** Purposes are to reduce wildfire risk to communities and municipal water supplies through collaborative hazardous fuels reduction projects; to assess and reduce the risk of catastrophic fire or insect or disease infestation; to enhance efforts to protect watersheds and address threats to forest and rangeland health (including wildfire) across the landscape; to protect, restore, and enhance forest ecosystem components such as biological diversity, threatened/endangered species habitats, enhanced productivity.

**Joint Surveys of Watershed Areas Act of September 5, 1962 -** Authorizes and directs the Secretaries of the Army and Agriculture to make joint investigations and surveys of watershed areas in the United

States, Puerto Rico, and the Virgin Islands, and to prepare joint reports setting forth their recommendations for improvements needed for flood prevention, for the conservation, development, utilization, and disposal of water, and for flood control.

**Knutson-Vandenberg Act of June 9, 1930** -Authorizes the Secretary of Agriculture to establish forest tree nurseries; to deposit monies from timber sale purchasers to cover the costs of planting young trees, sowing seed, removing undesirable trees or other growth, and protecting and improving the future productivity of the land; and to furnish seedlings and/or young trees for the replanting of burned-over areas in any National Park.

**Land and Water Conservation Fund Act of September 3, 1964 -** Authorizes the appropriation of funds for Federal assistance to States in planning, acquisition, and development of needed land and water areas and facilities and for the Federal acquisition and development of certain lands and other areas for the purposes of preserving, developing, and assuring accessibility to outdoor recreation resources.

**National Forest Management Act of October 22, 1976 -** The National Forest Management Act reorganized, expanded, and otherwise amended the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on National Forest System lands. The National Forest Management Act requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. It is the primary statute governing the administration of National Forests.

**National Forest Roads and Trails Act of October 13, 1964 -** Authorizes the Secretary of Agriculture to provide for the acquisition, construction, and maintenance of forest development roads within and near the National Forests through the use of appropriated funds, deposits from timber sale purchasers, cooperative financing with other public agencies, or a combination of these methods. The Act also authorizes the Secretary to grant rights-of-way and easements over National Forest System lands.

**Organic Administration Act of June 4, 1897** - Authorizes the President to modify or revoke any instrument creating a national forest; states that no national forest may be established except to improve and protect the forest within its boundaries, for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States. Authorizes the Secretary of Agriculture to promulgate rules and regulations to regulate the use and occupancy of the national forests.

**Multiple-Use Sustained-Yield Act of June 12, 1960 -** States that it is the policy of Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes, and authorizes and directs the Secretary of Agriculture to develop and administer the renewable surface resources of the national forests for the multiple use and sustained yield of products and services.

**Mining and Minerals Policy Act of December 31, 1970 -** States that it is the policy of the Federal government to foster and encourage the development of economically sound and stable domestic mining, minerals, metal, and mineral reclamation industries; the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs; mining, mineral, and metallurgical research to promote the wise and efficient use of our natural and reclaimable mineral resources; and the study and development of methods for the disposal, control, and reclamation of mineral waste products and the reclamation of mined land.

**National Environmental Policy Act of January 1, 1970 -** Directs all Federal agencies to consider and report the potential environmental impacts of proposed Federal actions, and established the Council on Environmental Quality.

**Safe Drinking Water Amendments of November 18, 1977 -** Amended the Safe Drinking Water Act to authorize appropriations for research conducted by the Environmental Protection Agency relating to safe drinking water; Federal grants to states for public water system supervision programs and underground water source protection programs; and grants to assist special studies relating to the provision of a safe supply of drinking water.

**Sikes Act of October 18, 1974, as amended -** This Act authorizes the Forest Service to cooperate with state wildlife agencies in conservation and rehabilitation programs for fish, wildlife, and plants considered threatened or endangered.

**Soil and Water Resources Conservation Act of November 18, 1977 -** Provides for a continuing appraisal of the United States' soil, water and related resources, including fish and wildlife habitats, and a soil and water conservation program to assist landowners and land users in furthering soil and water conservation.

**Surface Mining Control and Reclamation Act of August 3, 1977 -** Authorizes the Secretary of Agriculture to enter into agreements with landowners, providing for land stabilization, erosion, and sediment control, and reclamation through conservation treatment, including measures for the conservation and development of soil, water, woodland, wildlife, and recreation resources, and agricultural productivity of such lands.

**U.S. Mining Laws (Public Domain Lands) Act of May 10, 1872 -** Provides that all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are free and open to exploration and purchase, and the lands in which they are found to occupation and purchase by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners, so far as the same are applicable and not inconsistent with the laws of the United States. There are a number of Acts which modify the mining laws as applied to local areas by prohibiting entry altogether or by limiting or restricting the use which may be made of the surface and the right, title, or interest which may pass through patent.

**Water Quality Improvement Act of April 3, 1970 -** Amends the prohibitions of oil discharges, authorizes the President to determine quantities of oil which would be harmful to the public health or welfare of the United States; to publish a National Contingency Plan to provide for coordinated action to minimize damage from oil discharges. Requires performance standards for marine sanitation device and authorizes demonstration projects to control acid or other mine pollution, and to control water pollution within the watersheds of the Great Lakes. Requires that applicants for Federal permits for activities involving discharges into navigable waters provide state certification that they will not violate applicable water quality standards

**Water Resources Planning Act of July 22, 1965 -** Encourages the conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal government, states, localities, and private enterprises.

**Watershed Protection and Flood Prevention Act of August 4, 1954 -** Establishes policy that the Federal government should cooperate with states and their political subdivisions, soil or water conservation districts, flood prevention or control districts, and other local public agencies for the purposes of preventing erosion, floodwater, and sediment damages in the watersheds of the rivers and

streams of the United States; furthering the conservation, development, utilization, and disposal of water, and the conservation and utilization of land; and thereby preserving, protecting, and improving the Nation's land and water resources and the quality of the environment.

## Regulations

Below is a partial listing of relevant regulations. Federal executive departments and administrative agencies write regulations to implement laws. Regulations are secondary to law. However, both laws and regulations are enforceable.

**33 CFR 323 Permits for Discharges of Dredged or Fill Material into Waters of the United States** - This regulation prescribes those special policies, practices and procedures to be followed by the Corps of Engineers in connection with the review of applications for permits to authorize the discharge of dredged or fill material into waters of the United States.

**36 CFR 212.5 (b) Roads -** ...the responsible official must identify the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of National Forest System lands. ... The minimum system is the road system determined to be needed to meet resource and other management objectives adopted in the relevant land and resource management plan (36 CFR 219), to meet applicable statutory and regulatory requirements, to reflect long-term funding expectations, to ensure that the identified system minimizes adverse environmental impacts associated with road construction, reconstruction, decommissioning, and maintenance.

Identification of unneeded roads. Responsible officials must review the road system on each National Forest and Grassland and identify the roads on lands under Forest Service jurisdiction that are no longer needed to meet forest resource management objectives and that, therefore, should be decommissioned or considered for other uses, such as for motorized routes.

Regional Forester’s direction: Roads analysis process (RAP) for all other existing roads should be completed in conjunction with implementation of the off-highway vehicle (OHV) Record of Decision, watershed analyses, other project level activities or Forest Plan revisions.

**Travel Management Rule** - On December 9, 2005, the Forest Service published the TMR. The agency rewrote direction for motor vehicle use on National Forest Service (NFS) lands under 36 CFR, Parts 212, 251, and 261, and eliminated 36 CFR 295. The rule was written to address at least in part the issue of unmanaged recreation. The rule provides guidance to the Forest Service on how to designate and manage motorized recreation on the Forests. The rule requires each National Forest and Grassland to designate those roads, motorized trails, and Areas that are open to motor vehicle use.

**36 CFR 219 Planning -** Sets forth a process for developing, adopting, and revising land and resource management plans for the National Forest System.

**36 CFR 241 Fish and Wildlife -** Sets forth the rules and procedures relating to the management, conservation, and protection of fish and wildlife resources on National Forest System lands.

**40 CFR 121-135 Water Programs** - Sets forth the provisions for the administration of water programs including: state certification of activities requiring a Federal license or permit; EPA administered permit programs; state program requirements; procedures for decision making; criteria and standards for the National Pollutant Discharge Elimination System; toxic pollutant effluent standards; water quality planning and management; water quality standards; water quality guidance for the Great Lakes System;

secondary treatment regulation; and, prior notice of citizen suits. See Title 40 (Protection of Environment), Chapter 1 (Environmental Protection Agency), subchapter D (Water Programs).

**40 CFR 1500 Council on Environmental Quality -** Council on Environmental Quality regulations implementing the National Environmental Policy Act.

## Executive Orders

Below is a partial listing of relevant executive orders. Executive orders are official documents by which the President provides instructions to executive departments and agencies. An executive order may be used to reassign functions among executive branch agencies. It may adopt guidelines, rules of conduct, or rules of procedure for government employees or units of government. It can also establish an advisory body or task force.

**EO 11988 Floodplain Management, 1977 -** Requires each Federal agency to provide leadership and to take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for acquiring, managing, and disposing of Federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

**EO 11990 Protection of Wetlands, 1977 -** Requires each Federal agency to provide leadership and to take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for acquiring, managing, and disposing of Federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

## Policy

The Forest Service Manual (FSM) contains legal authorities, goals, objectives, policies, responsibilities, instructions, and the necessary guidance to plan and execute assigned programs and activities.

Forest Service Handbooks (FSH) are directives that provide instructions and guidance on how to proceed with a specialized phase of a program or activity. Handbooks either are based on a part of the FSM or they incorporate external directives.

**FSM 2500** Watershed and Air Management

- **FSM 2520** Watershed Protection and Management
    - FSH 2509.25 Watershed Conservation Practices Handbook, Southwestern Region
- **FSM 2540** Water Uses and Development, Southwestern Region supplement

**FSM 7700** Transportation System

- **FSM 7710** Travel Planning
    - FSH 7709.55 Travel Analysis

- FSH 7709.56 Chapter 2 – Road Location

## Methodology and Analysis Process

This section describes the methodology and analysis processes used to determine the environmental consequences on water resources from implementing the alternatives. Environmental consequences are not site-specific at the broad forest planning level and will be described with qualitative descriptions supported by past studies and observations. Much of the background information is found in the Ecological Sustainability Report (Forest Service 2008) and it's supporting specialists' reports.

Effects to water quality will be assessed qualitatively by alternative, by comparing projected changes to current areas of water quality impairment, and by comparing predicted indirect effects by major land disturbing activities (e.g. forest thinning, animal grazing, roads, mining, and burning).

Water quality has been assessed in major perennial stream reaches and lakes on the forests. The general classification used for surface water quality by ADEQ is attaining, attaining some uses, inconclusive/not assessed, not-attaining, and impaired for the identified uses. The classification designates each waterbody in one of five categories:

**Category 1:** Attaining all designated uses.

**Category 2:** Attaining some designated uses, and no use is threatened or impaired

**Category 3:** Insufficient or no data and information to determine if any designated use is attained.

**Category 4:** Impaired or threatened for one or more designated used but a TMDL is not necessary because:

- 4a – a TMDL has already been completed
- 4b – other pollution control requirements are reasonably expected to result in the attainment of the water quality standard;
- 4c – The impairment is caused by pollution but not a pollutant
- 4n – The impairment is solely by natural conditions

**Category 5:** Impaired or threatened for one or more designated uses by a pollutant, and a TMDL needs to be developed or revised.

The State of Arizona sets narrative and numeric surface water standards for water quality based on the uses people and wildlife make of the water. These "designated uses" are specified in the standards for individual surface waters, or if the surface water is not named in the rule, the designated uses are determined by the tributary rule. "Attaining" means that the water quality has met state and federal standards to fully support the assigned designated use for a water body and data used in the determination meets the credible data requirements of the Arizona's Impaired Water Identification Rule (A.A.C. R18-11-602).

Water quality is assessed by comparing existing conditions (category 1 to 5) with desired conditions (standards) that are set by Arizona as promulgated by Environmental Protection Agency (EPA) under authority of the Clean Water Act. Waters that are not impaired (those not on 303d[1] list or in category 4 or 5) are providing for beneficial uses identified for that stream and can be considered in a desired condition until further sampling indicates impairment. Those in category 2 or higher require special attention during site specific project analysis.

The ADEQ also interprets its surface water quality standards to apply to "intermittent, non-navigable tributaries." The ADEQ interprets the definition of "surface water" to include tributaries ("the tributary rule") and assigns water quality standards to intermittent surface waters that are not specifically listed by name in Arizona's surface water quality standards rules. ADEQ feels it is necessary to regulate and protect these types of waters as "waters of the United States" because it is estimated that approximately 95 percent of the surface waters in Arizona are either intermittent or ephemeral.

Effects to water yield will be discussed qualitatively, based on comparison of current activities to projected effects of implementing alternatives. Generally, reducing canopy cover in vegetation types within higher precipitation zones will generate more runoff. Vegetation treatment types were entered into the Vegetation Digital Dynamics Tool (VDDT) model which provided changes in vegetation states (i.e., from groups of trees with closed canopy to open canopy). This change implies changes in water yield.

Effects to groundwater availability will be discussed qualitatively using regional studies and FS policies to generally predict effects to the forests. There is little difference between alternatives from a groundwater use or quality standpoint, and slight differences predicted in groundwater recharge potential from the forests.

## Assumptions

- For estimating the effects of alternatives at the programmatic forest plan level, the assumption has been made that the kinds of resource management activities allowed under the prescriptions will occur to the extent necessary to achieve the goals and objectives of each alternative. The actual location, design and extent is not known at this time and will be a site specific (project by project) decision. Therefore this analysis refers to potential of the effect to occur, realizing that in many cases, these are only estimates. The effects analysis is useful in comparing and evaluating alternatives on a forestwide basis but is not to be applied to specific locations on the forests. Some resources are not within the Agency's ability to control; these will be noted.
- Data used in this analysis represents forest-wide conditions and may not represent water quality or flow conditions at any given point across the landscape. On site inspection should be conducted for site specific project assessments. A more detailed description of existing water conditions can be found in the Water Resources Specialist's Report for the Ecological Sustainability Report for the Apache-Sitgreaves NFs (Forest Service 2008).
- There are a few important considerations to note to put describing the environmental effects of implementing the alternatives into context with regard to ecological restoration. Each alternative

[1] Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. (http://yosemite.epa.gov/R10/WATER.NSF/TMDLs/CWA+303d+List )

is described as having a range of treatment objectives, from low to high[2]. Each alternative has a different treatment emphasis by vegetation type as well. The benefits and effects to forest resources at a low objective level may be quite similar to each other in some alternatives on a forest scale, and quite different at a high objective level. The benefits and effects to forest resources within each particular vegetation type may be similar or different as well. As an example, Alternative C proposes high emphasis the ponderosa pine vegetation type for treatment, where alternatives B and D treatment emphasis are geared more towards restoration of all vegetation types that are currently departed from desired condition. At the low level treatment objectives, the resulting improvement in vegetative condition for Alternative B and D are very similar, and somewhat lower than C as modeled by the VDDT. At the high level of treatment objectives there are greater differences noted between the alternatives. In all cases with regard to Alternative A, which does not emphasize restoration treatments but fuel treatment around communities, there is little improvement towards desired conditions for vegetation condition, even with similar treatment levels. Table xx summarizes differences in emphasis and effects to watershed condition and soil, water and riparian resources.

## Revision Topics Addressed in this Analysis

Water Resources

Water Quality

- Attainment of water quality standards
    - Indicator – Qualitative discussion of projected changes to current areas of water quality impairment: 4 lakes and 4 streams are listed by the Arizona Department of Environmental Quality (ADEQ) and the Environmental Protection Agency (EPA) as impaired or non-attaining.
    - Indicator - Qualitative assessment of effects of major land disturbing activities in relation to protecting water quality in streams and lakes.

Water Yield

- Restoration treatment objectives may contribute additional water yield
    - Indicator – Qualitative description of the effects of vegetation treatments to water yield and timing of flow.
- Effects of groundwater pumping may result in loss of fish/riparian habitat and needs for administrative uses.
    - Indicator - Qualitative assessment of potential effects of off forest groundwater pumping to forest resources.

[2] The low objective level is based on a minimum program of work to treat only areas of highest priority, such as treatment or maintenance of vegetation near communities where fire risk is high, or treatments in critical wildlife habitats. The high objective level is an estimate of the forest's highest capability to accomplish treatments using the current workforce and assuming funding is not limiting.

## Summary of Alternatives

A summary of alternatives, including the key differences among alternatives, is outlined in the Draft Environmental Impact Statement.

## Description of Affected Environment (Existing Condition)

### Water Quality

Improvements to the Nation's waters over the past three decades are largely due to the control of traditional point sources of water pollution. However, a large number of waterbodies remain impaired and the goal of eliminating pollutant discharge and attaining fishable and swimmable waters is still unrealized. Non-point sources of pollution such as agriculture, construction, forestry, and mining are responsible for much of the nation's remaining water quality impairment. The desired condition is that water quality meets or exceeds Arizona State standards[3] or Environmental Protection Agency (EPA) water quality standards for designated uses, and water quality meets critical needs of aquatic species.

Currently on Apache-Sitgreaves NFs land, the most prevalent non-point source of pollution is from sediment generated from roads in close proximity to drainages, from residual effects of past, and in some cases, current livestock grazing and from short term impacts of ground disturbing activities such as timber harvest and higher severity prescribed fire. Before the initiation of Best Management Practices (BMPs) in the1980's, timber harvesting was widespread and was also a non-point source of pollution in the form of sediment delivery off-site and into adjoining stream courses. Currently the forests implement and monitor site-specific BMPs for all activities with the potential to pollute surface waters. Forest Service policy directs compliance with required CWA permits, State rules and regulations, and the use of approved BMPs in an adaptive management strategy to control nonpoint source pollution to meet applicable water quality standards and other CWA requirements.

Knowing which waters are "Impaired" or "Not Attaining" is important. The following lakes and stream reaches have been identified by ADEQ as those with the most severe water quality problems. Permit requirements for discharge into these waters is very strict and ADEQ and the forests must make sure that any new discharges or modifications will not further degrade water quality.

- **Category 5 "Impaired"** waters currently on the 303 d list include the following: Bear Canyon Lake, Lower Blue River, and the San Francisco River below the confluence with Blue River. These waters were not listed prior to 2006. About 27 miles of stream are included in Category 5
- **Category 4 "Not Attaining"** waters include the following: Nutrioso Creek, Little Colorado River below the Greer Lakes, Luna Lake, Rainbow Lake, Crescent Lake. These waters have approved TMDL's with recommendations that when implemented are believed to improve the water quality, at which time ADEQ will move them into lower categories. About 26 miles of stream are included in Category 4.
- **Category 1 – 3** waters round out the rest of the waters on the forests. Category 3 "Inconclusive" waters are placed on the planning list for additional monitoring. The remaining waters (about 422 miles) fall into categories 1, 2, and 3. Overall, forestwide water quality, based on data from 1987 to 2008, is improving.

[3] Arizona Administrative Code Title 18. Chapter 11 Arizona Water Quality Standards.

The following table summarizes water quality and trend by 5th level HUC and reach where data is available. Water quality data is from 1994, 2000, 2004, 2006/2008 and 2010 305b reports (ADEQ 1994, 2000, 2004, 2009, 2012).

The State of Arizona has also identified stream segments that are particularly pristine and where no degradation of water quality is allowed. These are called "Outstanding Arizona Waters" (OAW), formerly known as "Arizona Unique Waters", nine of which are located in the high-elevation regions northeast, east, and southeast of Mount Baldy Wilderness (ADEQ 2009 and 2012). The nine OAWs are:

- Bear Wallow Creek, from its headwaters to the boundary of the San Carlos Indian Reservation
- South Fork Bear Wallow Creek, from its headwaters to Bear Wallow Creek
- North Fork Bear Wallow Creek, from its headwaters to Bear Wallow Creek
- Hay Creek, from its headwaters to its confluence with the West Fork of the Black River
- KP Creek, from its headwaters to its confluence with the Blue River
- Lee Valley Creek, from its headwaters to Lee Valley Reservoir
- West Fork Little Colorado River, above Government Springs
- Snake Creek, from its headwaters to its confluence with the Black River
- Stinky Creek, from the Fort Apache Indian Reservation boundary to its confluence with the West Fork of the Black River

Figure 1 displays the general location of Arizona Outstanding Waters, the Class 5 Impaired Streams and Lakes found on the Apache-Sitgreaves NFs.

The Wallow fire burned significant portions of the watersheds contributing to all of these streams except Lee Valley Creek. Potential effects to these streams include; additions of sediment and nutrients found primarily from erosion of severely burned uplands, increased flood flow intensity and frequency which may alter stream bank and stream bed stability, input of large amounts of debris from mass wasting due to slope instability, increases in water temperature from loss of shading vegetation. The outstanding character of these streams was based on the need to protect water quality to support the cold water fisheries designated use, primarily for protection of Apache trout habitat. To date, the Forest and ADEQ have yet to determine the status of these streams or determine what actions may be required to mitigate the effects of the fire. Wildfire is a natural event, and natural recovery can be allowed based on the State's anti-degradation policies

**Table 1. Current water quality and apparent trend for monitored streams by watershed (HUC 5) associated with the Apache-Sitgreaves NFs (ASNF).**

| HUC 5 Watershed Name | Category 1, 2, 3 | | Category 4 | | Category 5 | | [4]Trend from 1987 – Present Including 2008 Assessment |
|---|---|---|---|---|---|---|---|
| | [5]Miles of Streams/in Watershed | Miles of Streams on ASNF | Miles of Streams/Lakes in Watershed | Miles of Streams/Lakes on ASNF | Miles of "Impaired" Streams/Lakes in Watershed | Miles of "Impaired" Streams/Lakes on ASNF | |
| Nutrioso Creek | 8.6 | 6.8 | 30.3 | 15.1 | 0.0 | 0.0 | Upward -TMDL completed and implemented |
| South Fork Little Colorado River-Little Colorado River Headwaters | 57.7 | 55.2 | 24.8 | 10.5 | 0.0 | 0.0 | Upward – TMDL completed and implemented |
| Coyote Creek | | | | | | | No Data Available |
| Carnero Creek-Little Colorado River Headwaters | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 | 0.0 | Upward - TMDL completed and implemented |
| Big Hollow Wash | | | | | | | No Data Available |
| Oso Draw | 25.8 | 10.7 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Show Low Creek | 61.0 | 42.5 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Upper Silver Creek | 48.1 | 19.1 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Cottonwood Creek | | | | | | | No Data Available |
| Phoenix Park Wash-Dry Lake | | | | | | | No Data Available |
| Upper Clear Creek | 86.8 | 30.9 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Lower Clear Creek | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Upper Chevelon Canyon | 53.6 | 53.6 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Black Canyon | | | | | | | No Data Available |
| Lower Chevelon Canyon | 18.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Apache Creek-Upper Gila River | 6.6 | 0.0 | 0.0 | 0.0 | 15.2 | 0.0 | By tributary Rule |
| Centerfire Creek-San Francisco River | 49.7 | 9.9 | 14.7 | 0.0 | 16.1 | 0.0 | Upward – Luna Lake TMDL completed and implemented |
| Upper Blue River | 60.3 | 51.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Pueblo Creek-San Francisco River | 50.8 | 0.0 | 19.4 | 0.0 | 0.0 | 0.0 | |
| Lower Blue River | 0 | 0 | 0.0 | 0.0 | 27.3 | 27.3 | Down – E. coli. Exceeded 2008 Assessment |

[4] Trend is an evaluation of ADEQ water quality data (not shown in this document) from 1989 – present (2008).

[5] The water quality of streams/lakes dataset was provided by the AZ State DEQ to Region 3 (2004 version).

| HUC 5 Watershed Name | Category 1, 2, 3 | | Category 4 | | Category 5 | | |
|---|---|---|---|---|---|---|---|
| | [5]Miles of Streams/in Watershed | Miles of Streams on ASNF | Miles of Streams/Lakes in Watershed | Miles of Streams/Lakes on ASNF | Miles of "Impaired" Streams/Lakes in Watershed | Miles of "Impaired" Streams/Lakes on ASNF | [4]Trend from 1987 – Present Including 2008 Assessment |
| Mule Creek-San Francisco River | 49.7 | 20.3 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Chase Creek-San Francisco River | 53.4 | 19.3 | 0.0 | 0.0 | 0.0 | 0.0 | Down – E. coli. Exceeded 2006 Draft Assessment |
| Willow Creek | | | | | | | No Data Available |
| Upper Eagle Creek | 11.8 | 5.7 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Lower Eagle Creek | 28.5 | 7.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Upper Black River | 72.7 | 67.2 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Middle Black River | 21.8 | 21.8 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Upper North Fork White River | | | | | | | No Data Available |
| East Fork White River | | | | | | | No Data Available |
| Canyon Creek | 8.6 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | |
| Corduroy Creek | | | | | | | No Data Available |
| Carrizo Creek (Local Drainage) | | | | | | | No Data Available |
| Haigler Creek-Tonto Creek | 32.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| **Total** | **805.9** | **422.1** | **104.7** | **25.6** | **58.6** | **27.3** | |

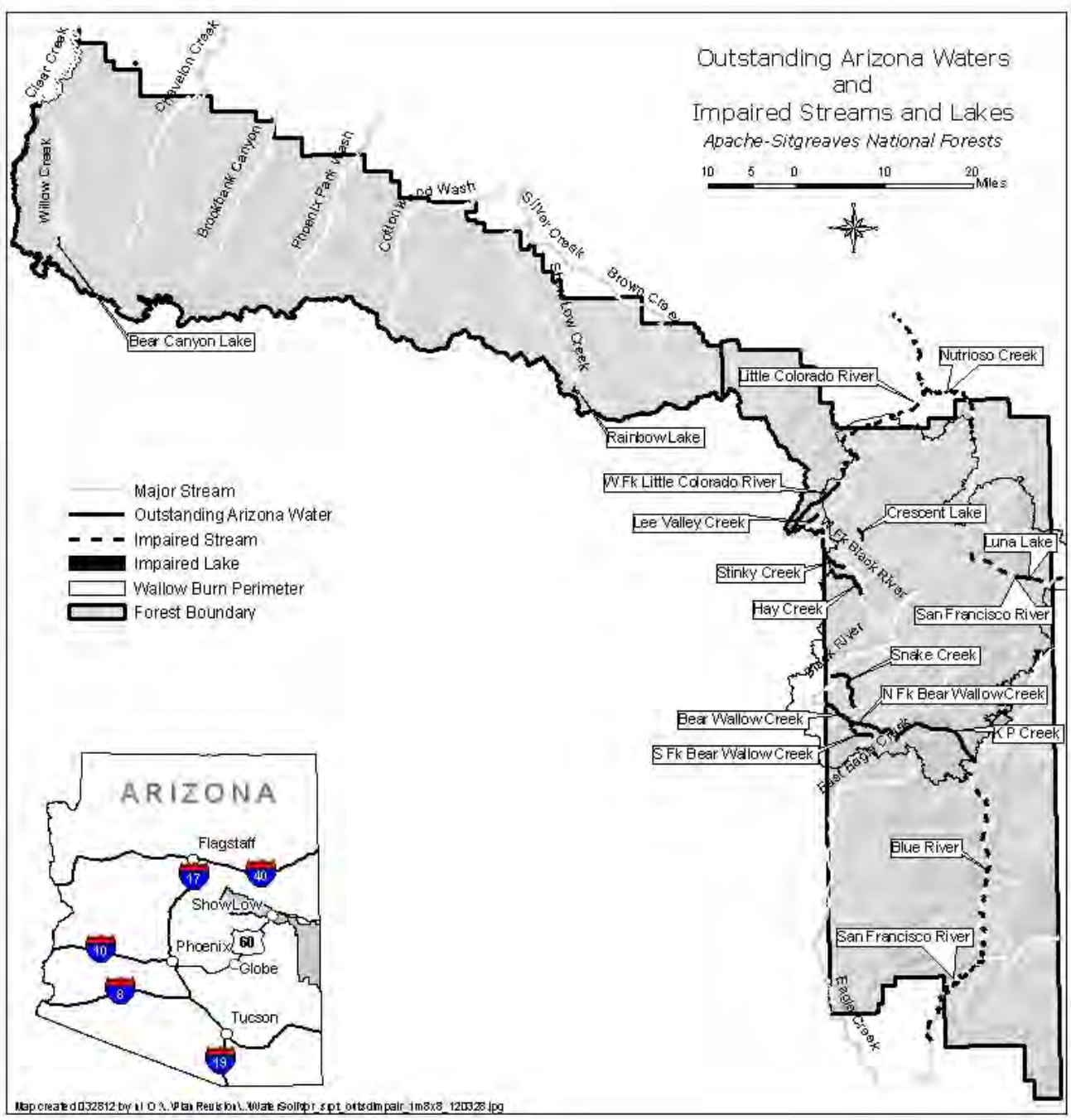



**Figure 1. Map of Arizona Outstanding Waters and Impaired streams and lakes within the Apache-Sitgreaves NFs.**

## Water Yield and Water Rights

To provide a baseline for discussion of water produced from the forests, an analysis was performed to estimate the amount of water yield that reaches surface streams which leave the national forest. It does not

attempt to account for waters on the forests infiltrating to deep aquifers. Estimates are made for water yield from NFS land by individual 5th level HUC watersheds. These estimates are then aggregated to individual 4th level HUC watersheds. Similar estimates are made for the water yield from entire 5th and 4th level HUC watersheds containing Apache-Sitgreaves NFs lands. Water yield from other national forests adjacent to the Apache-Sitgreaves NFs were not estimated. Current water yield from the forests is estimated to be 384,650 acre feet per year (Probst 2007a).

Streamflow is directly dependent on annual precipitation, including snowpack. Overall, the current trend in water yield appears to be static or slightly reduced over time as tree density increases. Additionally, climate change predictions for the Southwest favor higher temperatures and increased drought occurrence. More evapotranspiration and earlier snowpack melt are predicted, which may affect available water for forests use.

Periodic flooding is a natural disturbance that is necessary for maintenance of stream channels and many riparian plant species. Occasionally, high flows cause damage to road infrastructure and other manmade structures. Flooding is more common after large wildfires, where protective vegetation is removed and soil structure is altered. In severely burned watersheds, studies show peak flows (the highest flow rate measured after a storm event) can be slightly to thousands of times higher than the pre-fire flow rate (Neary et.al. 2005) as was observed during the summer rainstorms after the Rodeo-Chediski Fire near Heber Arizona (Ffolliott and Neary 2003). Other damaging flow events have occurred during very high intensity summer rainstorms, or when a warm rainstorm falls over a melting snowpack, such as occurred in 1992 in the Willow Creek watershed east of Heber which destroyed the concrete bridge at Wiggins Crossing. Flooding and debris flows have occurred as a result of the 2011 Wallow Fire. This fire has generated within numerous small watersheds some extreme runoff events from summer thunderstorms. The fire caused flood events may continue for many years, and even though damage is expected to be somewhat localized under normal rainfall conditions, the communities of Eagar, Nutrioso, Tal WiWi, Alpine, Blue and Greer are at risk for flooding.

### Water Rights

The current trend of use of surface water by the forests is static. The forests' consumptive use is expected to remain static into the future, as surface water in Arizona is considered to be fully appropriated. Water rights adjudications are proceeding slowly, and will dictate the amount and ownership of surface waters within the forests. According to Arizona Department of Water Rights (ADWR) Statement of Claim (SOC) filings for water rights, there are 2,240 stock tank claims located on the forests. The forests have a total of 3,547 forest-owned claims and certificates. These claims include several watershed-level reserved water right claims allowing use of water for firefighting and road watering for maintenance.

### Instream Flow

Instream flow water rights are unique rights created by Arizona to protect the State's fisheries and associated riparian resources in selected stream segments. They are fundamentally different from appropriated water rights since they are non-consumptive. Under Arizona law, the instream flow water rights the Forest Service is applying for do not allow use from the stream; the Forest Service cannot divert or interfere with surface water flow, and cannot affect any existing (senior) water rights. The Forest Service is applying for these rights to ensure minimum flows that are needed for fish, wildlife and water based recreation are protected from future claims on these waters. There is no other mechanism available to maintain sufficient flows in the streams, which are critical to protect wildlife habitats and tourism-based economies in rural Arizona. With instream flows provided for, the water may still be available for future appropriation; however, it must be taken after the water leaves the national forest boundary, or only

at a time when streamflows are not below the minimum baseflow levels set within the permitted right. Table 2 summarizes the forests' program to acquire instream flow rights.

### Groundwater

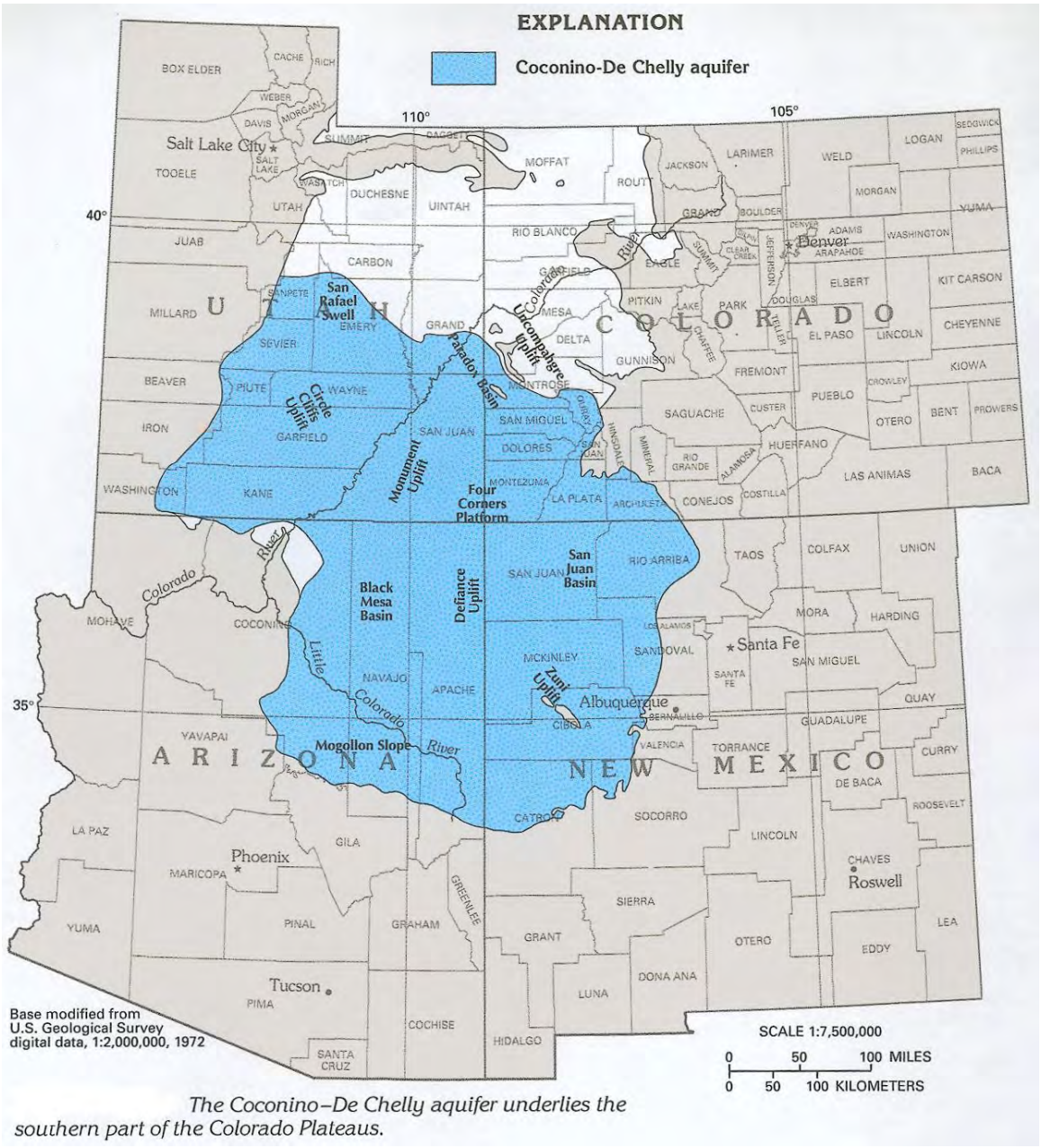
Water resources are obtained from surface water runoff, shallow perched water-bearing zones (which generally do not provide useful water source) and very deep regional aquifers. Although not well understood, groundwater is connected to surface water and where groundwater is pumped at a rate greater than recharge, connected surface water flow is reduced. Groundwater recharge occurs throughout all watersheds but is greatest at higher elevations where precipitation is greater and in areas with heavily fractured rock units.

Groundwater pumping outside of designated Active Management Areas[6] is not limited by current Arizona groundwater codes. Projected growth will put higher demands on surface and groundwater resources, and therefore, more pressure to provide water could be placed on federal managers. One of the three basins (Little Colorado) associated with the forests have documented groundwater pumping to some level greater than inflow (ADWR, 2009) (Feth, J.H.et.al., 1963) (Freethey, G.W., et.al., 1986) (Brown, 1989), (Hart, R.J., et.al., 2002). Historic conditions were described as being in steady state, or where inflow equaled outflow. Continued or increased pumping may negatively affect base flow of streams that are directly connected to major aquifers, such as Chevelon Creek and Tonto Creek, which are tied to the Coconino-De Chelly Aquifer (C Aquifer) (Hart, R.J., et.al., 2002.). Groundwater pumping within the C Aquifer may negatively affect aquatic habitat and the amount of water forest wells can access used for stock watering and domestic use as groundwater levels are drawn down. See figure 1 for a location map of the C Aquifer.

[6] The 1980 Arizona Groundwater Code recognized the need to aggressively manage the state's finite groundwater resources to support the growing economy. Areas with heavy reliance on mined groundwater were identified and designated as Active Management Areas (AMAs). There are five AMAs; Prescott, Phoenix, Pinal, Tucson, and Santa Cruz.

**Table 2. Instream flow program projected through 2014.**

| Stream Name | ADWR Claim Number | 5th Level HUC Watersheds Name | HUC 5 | Miles of Stream Claimed | Total Miles of Stream | Expected Year of Permitting |
|---|---|---|---|---|---|---|
| Blue River | *33-96974* | Upper Blue River<br>Lower Blue River | 1504000405<br>1504000407 | 45.7 | 53.5 | 2012-13 |
| Eagle Creek | *33-96969* | Lower Eagle Creek<br>Upper Eagle Creek | 1504000503<br>1504000502 | 12.1 | 56.0 | 2013 |
| Beaver Creek | *33-96970* | Upper Black River | 1506010101 | 11.7 | 13.8 | 2013 |
| West Fork Black River | *33-96968* | Upper Black River | 1506010101 | 14.1 | 20.2 | 2013 |
| North Fork of the East Fork Black River | *33-96971* | Upper Black River | 1506010101 | 20.3 | 21.0 | 2013 |
| San Francisco River (Lower) | *33-96972* | Mule Creek-San Francisco River<br>Chase Creek-San Francisco River | 1504000408<br>1504000409 | 23.7 | 157.5 | 2013 |
| East Fork Black River | *33-96967* | Upper Black River | 1506010101 | 8.4 | 8.4 | 2013 |
| Black River | *33-96966* | Upper Black River<br>Middle Black River | 1506010101<br>1506010103 | 18.8 | 131.9 | 2013 |
| Dix Creek | *33-96965* | Mule Creek-San Francisco River | 1504000408 | 1.6 | 1.6 | 2014 |
| San Francisco River (Upper) | *33-96973* | Centerfire Creek-San Francisco River | 1504000403 | 7.8 | 157.5 | 2014 |
| Mineral Creek | *33-96983* | Oso Draw | 1502000204 | 5.6 | 21.6 | 2014 |
| Brown Creek | *33-96977* | Upper Silver Creek | 1502000502 | 8.6 | 25.2 | 2014 |
| Billy Creek | *33-96979* | Show Low Creek | 1502000501 | 3.4 | 7.8 | 2014 |
| Walnut Creek | *33-96980* | Show Low Creek | 1502000501 | 2.4 | 6.3 | 2014 |
| Porter Creek | *33-96981* | Show Low Creek | 1502000501 | 1.9 | 1.9 | 2014 |
| Show Low Creek | *33-96982* | Show Low Creek | 1502000501 | 2.6 | 32.0 | 2014 |
| Chevelon Ck. (Upper) | *33-96978* | Upper Chevelon Canyon | 1502001001 | 22.6 | 56.6 | 2014 |
| Chevelon Ck. (Lower) | *33-96707* | Upper Chevelon Canyon | 1502001001 | 10.9 | 56.6 | 2014 |
| Coyote Creek | N/A | Coyote Creek | 1502000103 | 5.6 | >33 | Beyond 2014-Norviel Decree Area (NDA) - |
| South Fork Little Colorado River | N/A | South Fork Little Colorado River-Little Colorado River Headwaters | 1502000102 | 9.9 | 10.5 | Beyond 2014-NDA |
| Little Colorado River | N/A | South Fork Little Colorado River-Little Colorado River Headwaters | 1502000102 | 7.7 | >33 | Beyond 2014 - NDA |
| East Fork Little Colorado River | N/A | South Fork Little Colorado River-Little Colorado River Headwaters | 1502000102 | 10.8 | 10.9 | Beyond 2014 - NDA |
| West Fork Little Colorado River | N/A | South Fork Little Colorado River-Little Colorado River Headwaters | 1502000102 | 9.5 | 9.7 | Beyond 2014 - NDA |
| | | | **Total** | **246.0** | | |




*The Coconino–De Chelly aquifer underlies the southern part of the Colorado Plateaus.*

Figure 1. Extent of the Coconino-De Chelly (C) Aquifer. (Robson and Banta 1995)

## Environmental Consequences of Alternatives

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carryout any project or activity. Because the land management plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions) there can be no direct effects. However, there may be implications, or longer term environmental consequences, of managing the forests under this programmatic framework.

### Water Quality

#### Trend

Trend is estimated to be towards desired conditions. Water quality monitoring provided by ADEQ resulted in a reduction of category 5 (impaired) reaches and lakes through completion of Total Maximum Daily Load (TMDL) plans. Water quality was improving throughout the forest until the Wallow Fire occurred. Water quality monitoring is needed to determine new baseline levels and establish recovery rates for Arizona Outstanding Waters, as all but one was affected to some extent by the Wallow Fire.

#### Forest Restoration Activities

##### *Mechanical Treatments*

Timber harvest and restoration treatment activities have the potential to adversely affect soil, water resources, and aquatic habitats. Typical ground disturbances used in product removal include use and maintenance of roads, skid trails, log landings, and stream crossings (Litzchert and MacDonald 2009). In addition to erosion and sedimentation, impacts may include potential vegetation loss in riparian areas, effective extension of the channel network through roads and skid trails connecting upstream disturbances to streams, and channel damage from higher flows generated from canopy reduction within the watershed contributing to the channel.

Additional impacts from timber harvest and forest restoration operations and prescribed fire include the contamination of water or wetlands from chemical substances such as gasoline, oil, or hydraulic fluid that is leaked from forestry equipment. There are also potential effects from chemicals (herbicides) used for site preparation, timber stand improvement, and treatment of non-native invasive plants associated with timber harvest activities.

Erosion that results from timber harvest activity is generally temporary, and usually returns to pre- harvest erosion rates within 2 years. Effectiveness monitoring and research have shown that proper implementation of Best Management Practices (BMPs) and Soil and Water Conservation Practices (FSH 2209.23) greatly reduce erosion, compaction, sedimentation and other water quality impacts (US Forest Service, 2007 and 2008a; and US EPA 2005). In addition, streamside management zones or vegetative filters would be prescribed for all streams which minimize impacts from all ground disturbing activities. The width of these filter strips vary based on stream order, type, slope, erosion hazard of adjacent uplands, and protection status (e.g., federally listed critical habitat, Outstanding Arizona Water) (FS, 2008b)

*Alternative Comparison*

Although much of the effects to water quality from mechanical treatments are mitigated through BMPs and SWCPs, there may be short term sediment pulses from activity roads, skid trails, and landings. Alternative C prescribes the most mechanical treatment acres and therefore the highest risk to water quality, followed by B, D, then A. At the project level, site specific mitigation would reduce impacts to water quality below significant levels under all alternatives.

### *Burning Treatments*

The effects of prescribed fire on water quality vary depending on fire severity, type and amount of vegetation burned, soil moisture, proximity to streams, weather conditions and burning techniques. The magnitude of the effects of fire on water quality is primarily driven by fire severity. Fire severity is a qualitative term describing the immediate effects of fire on vegetation, litter or soils. Moderate or high severity fires consume more fuel and release more nutrients, and are more susceptible to erosion of soil and those nutrients into a stream where water quality can be degraded than low severity broadcast burns (Neary, et.al. 2005). BMPs are prescribed for all fires, and have shown to be effective in reducing sediment to streams through the use of filter strips and implementation strategies.

Research of watershed effects from prescribed burning implemented under managed or controlled conditions have negligible effect on the physical, chemical, and biological properties of soil and soil productivity (Neary et.al. 2005). In addition, there is little evidence that sedimentation or water yield increases significantly in streams from forested lands burned according to a prescribed burning plan that is designed to meet resource objectives (e.g., wildlife, recreation, watershed, vegetation, ecological). Understory burning would consume only a small portion of the duff layer and would expose very little mineral soil. Most of the organic layer and fine root layer would be left in place.

Burning under higher severity conditions can result in water quality degradation. Physical change of soil cover and structure will lead to additional runoff and sediment loss. Decreases in the time of water concentration of flows typically occur in watersheds with extensive high burn severity which can increase channel erosion and loss of floodplains from flooding (Neary, 2005)(Ffolliett and Neary, 2003). High severity burning in riparian areas can remove protective vegetation and large wood needed to retain vertical and horizontal stability.

### *Alternative Comparison*

Although much of the effects to water quality from fire treatments would also be mitigated through BMPs and SWCPs, there may be short term sediment and ash pulses from higher severity burn areas within prescribed fire areas. Alternative D prescribes the most burning treatment acres and therefore the greatest risk to water quality, followed by B, C, then A. At the project level, site specific mitigation would reduce impacts to water quality below significant levels under all alternatives.

## Roads

Numerous studies have identified unpaved roads as a major source of sediment in forested watersheds (Elliott and Foltz, 2001) (Burroughs and King 1989). Sediment is produced from roadbeds, cut slopes and fill slopes and areas where concentrated flows deposit onto forest lands

and flow energy is higher than the resistive forces of ground cover causing rills and gullies (Elliott, 2000). Traffic and road maintenance increase erosion rates, however, these rates can decline with non-use or age (Megahan, 1974). Roads near streams have the greatest impact on water quality as there is less area to filter sediment. Increased road density (miles/unit area) increases drainage density and also can increase the size of peak flows as it reduces the time to concentration of flows. This increases the proportion of sediment delivered as water at higher flows has more energy to scour and carry sediment (Wemple et al. 2001, Troendle et.al 1994).

Road erosion can be reduced over native raw roads by surfacing with gravel, lining inside ditches with gravel, revegetating cut and fill slopes and minimizing blading of road surfaces and ditches (Burroughs and King 1989). Newer road designs would include vegetative filter strips, more frequent drainage, outsloping of the road surface to disperse road runoff, and narrower road surfaces to reduce the size of the road tread, cutslopes and fillslopes. Whenever possible, roads would be replaced in upslope or ridgetop positions rather than along drainages. New temporary roads would be closed, obliterated, and revegetated following use.

### *Alternative Comparison*

New road construction is generally not required for timber harvesting within the planning area, however, the re-opening of level 1 (those roads placed in storage between intermittent uses) increases the amount of open roads and, potentially, the amount of soil erosion and sediment delivered to a stream that occurs during the life of a project. Typically, there is pulse of erosion from roads during the first 2 years following road construction or reopening (MacDonald and Coe 2008; Megahan 1974). Road density, traffic levels, and maintenance all affect the volume of sediment delivery. Alternative C provides the greatest potential for increasing sediment from roads as it has a higher proportion of mechanical treatments/harvest as well as increased emphasis in motorized recreation opportunities. Less mechanized harvesting and restoration treatment acres are proposed in Alternative B, followed by Alternative D, where more burning and non-motorized recreation opportunities are emphasized, then A.

## Recreation Activities

Recreationists are drawn to water as evidenced by the fact that most of the forests' campgrounds are in close proximity to lakes and rivers. **All alternatives** emphasize maintenance of existing developed recreation sites. Managed campgrounds and picnic grounds are hardened and provide a more efficient setting for managed access to water, as well as human and animal waste, as compared to primitive camping. In the **action alternatives**, there is guidance to locate dispersed campsites away from streams or sensitive areas, and facilities or developments would be provided for protection of the environment rather than for convenience of visitors. **Alternative A** does not contain this guidance and would allow campsites to be located in close proximity to the forests' waters. This concentrated unmanaged recreation use could cause damage to vegetation; soil compaction and erosion; and water pollution from human and animal waste, dishwashing, trash, and vehicle fluids.

## Grazing Activities

Water quality can be affected by grazing activities in many ways. Direct consumption and trampling of vegetation, and compaction and displacement from animal hooves in riparian areas reduces streambank stability and changes vegetation composition including the potential of

noxious weed spread. Loss of vegetation reduces the ability of a stream to trap and hold sediment in floodplains and may reduce shading of the stream. Increased sediment can result in increased embeddedness reducing the quality of fish habitat. Defecation and urination into streams directly reduces water quality. Overgrazing can diminish upland conditions, which in turn, may increase storm flows that potentially add sediment to streams reducing water quality.

All of these factors are mitigated, to some extent, with the implementation and monitoring of BMPs and SWCPs for grazing. As allotment management plans are revised and BMPs are incorporated into daily livestock management, degrading factors to water quality are diminished.

### *Alternative Comparison*

The action alternatives would reduce pressure on riparian areas by improving upland vegetation condition (forage condition), thereby reducing impacts to water quality from grazing. In addition, the action alternatives concentrate restoration efforts in focus watersheds. These alternatives would provide comprehensive restoration on a watershed basis and have the most opportunity for improving water quality. Alternative A provides fewer opportunities for improved forage conditions that would relieve grazing pressure in and around the forests' waters.

Water quality can be affected by grazing activities in many ways. Consumption and trampling of vegetation and compaction or displacement from animal hooves in riparian areas reduces streambank stability and can change vegetation composition from the potential spread of noxious weeds. Loss of vegetation reduces the ability of a stream to trap and hold sediment in floodplains and may reduce shading of the stream. Defecation and urination into streams can reduce water quality. Overgrazing can diminish upland conditions, which in turn, may increase storm flows that potentially add sediment to streams reducing water quality.

All of these factors are mitigated, to some extent, with the implementation and monitoring of BMPs and SWCPs for grazing. As allotment management plans are revised and BMPs are incorporated into daily livestock management, degrading factors to water quality are diminished.

## Special Uses

Terms and conditions of special use permits would require site specific BMPs to provide for protection of water quality. There are no differences in effects between alternatives for special use management as all authorized uses would require site specific mitigation. All alternatives would allow the authorization of occupancy and use of NFS land based on public need when services or uses cannot be met on private or other Federal lands.

## Climate Change

Effects to water quality from climate change are similar to effects to soil condition. Reduced vulnerability to the effects of climate change is provided by returning ecosystem health to desired conditions. All alternatives move ecosystems towards vegetation desired conditions, Alternative A trends toward desired conditions at the slowest rate from desired vegetation conditions. In addition, Alternatives B C and D provide an approach to restore focus watersheds, allowing opportunities to provide the highest quality water within those treated watersheds.

### Cumulative Environmental Consequences

The cumulative environmental consequences are spatially bounded by an area much larger than the Apache-Sitgreaves NFs proclaimed boundary. Some effects are limited to local watersheds, while some can have effects downstream of the forests within the thre major watershed basins, the Upper Gila, Little Colorado and Salt River watersheds. The forests are considered headwaters to these major river systems. Cumulative effects to water quality are the result of impacts in both time and space. The nature of cumulative effects from the implementation of the alternatives include effects of the management on national forest plus potential effects from land management on adjacent lands of other ownership (i.e. private, state, other federal agencies, county, etc.). Many of the kinds of impacts to water quality are similar to those on forest lands, such as effects of roads, grazing, material mining, recreation, and fuel reduction/restoration treatments. Others are not, such as urbanization, industrial mining, manufacturing, and power generation. Some are considered point sources of pollution and must meet stringent requirements for release of pollutants.

Acidity in rain, snow, cloudwater, and dry deposition can affect soil fertility and nutrient cycling and can result in acidification of lakes and streams. Sulfate deposition to sensitive watersheds results in increasing soil and surface-water acidification. Deposition of excess nitrogen (nitrate and ammonium) in both terrestrial and aquatic systems can acidify streams, lakes and soils. Aquatic ecosystems in Arizona are generally well-buffered and not subject to episodic or chronic acidification except at the highest elevations in and around the Mount Baldy Wilderness Area. There are pollution sources around the forests that are known to emit elements that form acids of sulfur and nitrogen. The forests waters are currently not impacted by air quality deposition to the extent they are contributing to measureable reduction in water quality and are not expected to in the future (Air Quality Specialist Report).

Since the trend of water quality under all alternatives is estimated to be towards desired conditions, this would reduce or dilute possible off-forest effects of potential pollutants, and would provide better water quality to downstream users. Alternatives B, D, C, and A, in order, provide for this overall water quality improvement.

## Water Yield and Water Rights

### Trends

Water use is expected to remain static over the planning period, as water is considered to be over-allocated in Arizona. The forests' major water uses include: firefighting, road maintenance, domestic and wild ungulate watering and minor amounts for administrative use. Water yields are expected to increase slightly because of implementation and maintenance of ecological restoration treatments that result in a more open forest, woodland and grassland condition. This reduces transpiration and interception losses. Climate change may negate increases. Industrial and Municipal use of the Coconino-DeChelly Aquifer is estimated to be above the recharge rate (Hart, R.J., et.al., 2002.) (USDI/USGS, 2000) and it is expected to continue under all alternatives.

### Forest Restoration Activities

Following timber harvest, there is a potential short term increase in water yield or quantity in the harvest units. However, annual water yield for a watershed is only measurable when 25 percent or

more of the timber volume in a watershed is removed, especially in areas receiving more than 18 inches of precipitation per year (Troendle and Olsen 1994; Troendle et.al. 2001; Grant et.al. 2008 Brown H. E. et.al. 1974, Rich L.R. and J. R. Thompson, 1974). Therefore, alternatives that reduce canopy cover in forest vegetation types will generate additional runoff.

Alternative C will generate the most increased water yield, followed by D, B then A. Generally, as the treatment areas revegetate and begin absorbing soil moisture, water runoff returns to pre-harvest levels. However, desired conditions for much of the forested vegetation types require converting the currently closed overstory condition to open. As these areas would be maintained at a much lower canopy cover over time, water yield increases should remain.

Streamflow responses to prescribed fire would be smaller in magnitude than the responses to wildfire. Prescribed burning generally leaves portions of the organic soil surface (DeBano et. Al. 1996) and, therefore, the change in streamflow discharges are not as severe as those resulting from high severity wildfires.

### Roads

Since the road system (miles, location and maintenance level) is constant for all alternatives, there is no measureable difference in water yield expected between them.

### Recreation Activities

Across all alternatives, there are no new dams or other impoundments planned for recreation within the forests boundary that would require additional water use. Maintenance of existing dams would continue, which may involve rebuilding of spillways and sealing the core. However, no additional capacity is expected to be added.

### Grazing Activities

All alternatives provide for some increase in water yield which may provide more reliable waters for livestock use, especially in areas with greater than 18 inches of precipitation. Areas in lower precipitation zones would probably not see much of an increase due to restoration treatments.

For a pasture to be available for grazing, it has to have sufficient, nutritious forage and adequate water availability. Some pastures rely on wells and developed springs to water livestock, but many utilize tanks built with native material to capture runoff from snowmelt and rainfall during periods of runoff for later use. During the recent droughts, many dirt tanks on the Apache-Sitgreaves NFs dried-up, making many pastures unusable for cattle even though forage may have been available. The 2,240 stock tanks have altered the free-flowing character and water supply to some of the forests' waters. By far, most impoundments are found in ephemeral drainages. Many of these impoundments provide for sediment capture; however, their maintenance often releases or creates sediment that eventually travels to forest streams.

### Special Uses

Easements and special use permits to transmit water from water sources such as springs and streams to private or public holdings are common on the forests. These are subject to terms and conditions that require demonstrating proof of water right ownership and monitoring of flows. Other terms require maintenance of structures and mitigation of possible resource damage. There

are no projected differences between all alternatives for special uses. New special uses for water transmission would require mitigation of damage of downstream uses.

Pumping of groundwater near streams has the potential to reduce streamflow (USFS, 2007). Forest Service policy states that groundwater tests be required to demonstrate whether groundwater dependent resources are affected. Special use permits may be denied or uses would be mitigated to prevent loss of riparian habitat or aquatic species. No new groundwater pumping projects are planned on the forests at this time.

### Climate Change

Changes in water distribution, timing of precipitation, availability, storage, watershed management, and human water uses, may present some of the most important challenges of climate change and national forest management in the Southwest. Terrestrial and aquatic ecosystems and human socioeconomic systems depend on water. Two scenarios are discussed; wetter/warmer and drier/warmer.

In wetter climate scenarios, the potential for flooding is very likely to increase because of earlier and more rapid melting of the snowpack, with more intense precipitation. Even if total precipitation increases substantially, snowpack will likely to be reduced because of higher overall temperatures. However, it is possible that more precipitation would also create additional water supplies, reduce demand, and ease some of the competition among competing uses (Joyce et al. 2001; Smith, et al. 2001).

In contrast, a drier climate scenario is very likely to decrease water supplies and increase demand for such uses as agriculture, recreation, aquatic habitat, and power, thus increasing competition for decreasing supplies (Joyce et al. 2001). Overall, these trends would increase pressures on the already limited water supplies in the Southwest, increase energy demand, alter fire regimes and ecosystems, create risks for human health, and affect agriculture in the region (Swetnam and Betancourt 1997; Sprigg et al. 2000). For greater detail, see Appendix A in the proposed land management plan.

The prospect of future droughts becoming more severe because of global warming is a significant concern, especially because the Southwest continues to lead the Nation in population growth. The most likely future for the Southwest is a substantially drier one. Combined with the historical record of severe droughts and the current uncertainty regarding the exact causes and drivers of these past events, the Southwest must be prepared for droughts that could potentially result from multiple causes. The combined effects of natural climate variability and human-induced climate change could result in a challenging combination of water shortages for the region (Karl et al. 2009).

Development in the Southwest has been primarily dependent upon technology to deliver water resources. The locations of most snow pack and upland reservoirs are on national forests in the Southwest (Smith et al. 2001; State of New Mexico 2005). There are an estimated 3,771 surface acres of perennial lakes and ponds within the Apache-Sitgreaves NFs (U.S. Forest Service 2008). The Apache-Sitgreaves NFs also contains many of the headwater streams for the Little Colorado, Salt, and Upper Gila River Basins. The Apache-Sitgreaves NFs receives a large portion of Arizona’s annual snowpack. Current estimated water yields from the Apache-Sitgreaves NFs are roughly 384,650-acre feet per year (U.S. Forest Service 2008), the majority going to the greater

Phoenix metropolitan area. Some studies predict water shortages and lack of storage capabilities to meet seasonally changing river flow, and transfers of water from agriculture to urban uses, as critical climate-related impacts to water availability (Barnett et al. 2008).

While agriculture remains the greatest water user in the Southwest, there has been a decreased in the amount of water used by agriculture, as Arizona's and New Mexico's booming populations demand more water for municipal and other uses, and irrigation technologies improve; this has been an on-going trend and could affect future agricultural uses. Without upland reservoirs and watersheds important to Arizona's largest metropolitan center (e.g., Little Colorado, Salt and Upper Gila River Basins) managed by the Apache-Sitgreaves NFs, alternative water sources, water delivery systems, and infrastructure support for agriculture would need to be developed (Lenart 2007).

Flash flooding, occurring after extended drought, may increase the number and severity of floods; and accelerate rates of soil erosion. The timing and extent of storm-related precipitation will play a key role in determining the degree to which people and the environment are affected (Swetnam and Betancourt 1997; Swetnam et al. 1999; Lenart 2007). In a drought of the magnitude of the worst one-year drought on record, water demand may exceed supply by 68 percent. According to National Weather Service Data, over the last 110 years; portions of the Apache-Sitgreaves NFs experienced below average precipitation one out of every two years and drought one out of every six. In the five-year scenario modeled after the worst drought in the historical record, water demand in Arizona could exceed supply by 67 percent, and in the ten-year scenario, demand may exceed supply by 59 percent (Lenart 2007). In the Southwest, intense debate will likely continue over water allocation. Add to the mix a highly variable climate, over time and occurring on a large, landscape scale, and the situation becomes even more conflict-prone (Lenart 2007).

Effects to water yield from climate change are similar to effects to soil condition and water quality. Reduced vulnerability to the effects of climate change is provided by returning ecosystem health to desired conditions. Alternatives that reduce canopy cover in higher precipitation zones would allow for more water storage and yield as there is less interception and transpiration loss. **Alternatives B, then D then C** move ecosystems towards vegetation more open canopies while **Alternative A** trends toward desired vegetation conditions at the slowest rate.

### Cumulative Environmental Consequences

Surface water and groundwater are currently a limiting resource in the Southwest. Demands for water are high and surface water is generally over appropriated. The Apache-Sitgreaves NFs forms the headwaters of many of Arizona's streams. Instream flows provide added protection to ensure that fish and riparian vegetation are protected until the streams leaves the forests. Groundwater pumping is not regulated outside of Arizona's Active Management Areas in southern and western Arizona. There are documented studies of effects of groundwater pumping on the Colorado Plateau that predict that streams and wells on the forests will be impacted. Implementation of all alternatives are expected to increase slightly the amount of water leaving the forest and provide more water for aquifer recharge due to the expected reduction of vegetation transpiration and interception (Brewer, 2008; Baker, et.al. 1999) and general improvements of watershed conditions.

## Adaptive Management

## Other Planning Efforts

Little Colorado River Plateau RC & D and Apache Natural Resource Conservation District are developing a plan to restore function to Coyote Creek through the Coyote Creek Watershed Improvement Committee.

Ongoing adjudications for the Little Colorado, Salt and Upper Gila River watersheds.

TMDL Assessments are being scheduled for the Lower Blue River, Lower San Francisco, Bear Canyon Lake.

Implementation of TMDL recommendations for Nutrioso Creek, Little Colorado near Springerville Arizona, Rainbow lake, Luna Lake, Upper San Franciso River near Alpine, and Crescent Lake.

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