Southwest New Mexico Regional Water Plan

Volume 1:
Report Text, Appendix A

Prepared for:

Southwest New Mexico Regional Water Plan Steering Committee
City of Deming, New Mexico, Fiscal Agent

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List of Acronyms

ac-ft/day	acre-foot per day
ac-ft/yr	acre-foot per year
AIRFA	American Indian Religious Freedom Act
ASR	aquifer storage and recovery
AWC	available water content
AWSA	Arizona Water Settlement Act
AWWA	American Water Works Association
bgs	below ground surface
BOD	biological oxygen demand
BOR	U.S. Bureau of Reclamation
CAP	Central Arizona Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFRP	Collaborative Forest Restoration Program
cfs	cubic feet per second
cfu/100 mL	colony-forming units per 100 milliliters
CUFA	Consumptive Use and Forbearance Agreement
CWA	Clean Water Act
DBS&A	Daniel B. Stephens & Associates, Inc.
DEM	digital elevation model
EIS	environmental impact statement
ESA	Endangered Species Act
ET	evapotranspiration
ft^2/d	square feet per day
ft msl	feet above mean sea level
FWS	free water surface
GAC	granular activated carbon
GAP	New Mexico Gap Analysis Program
GCC	Gila Conservation Coalition
GIS	geographic information system
gpcd	gallons per capita per day
gpd	gallons per day
gpd/ft	gallons per day per foot
gph	gallons per hour
gpm	gallons per minute
gpm/ft	gallons per minute per foot
GRIC	Gila River Indian Community
GWSI	USGS Ground Water Sites Inventory
hp	horsepower
HUC	hydrologic unit code

List of Acronyms (Continued)

IALC	International Arid Lands Consortium
in/yr	inches per year
IPCC	Intergovernmental Panel on Climate Change
ISC	Interstate Stream Commission
JPA	Joint Powers Authority
km^2	square kilometer
LEPA	low energy precision application (irrigation system)
MCL	maximum contaminant level
mgd	million gallons per day
µg/L	micrograms per liter
mL	milliliters
mm/d	millimeters per day
MMD	Mining and Minerals Division
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NHPA	National Historic Preservation Act
NLCD	National Land Cover Data
NMASS	New Mexico Agricultural Statistics Service
NMDA	New Mexico Department of Agriculture
NMED	New Mexico Environment Department
NMEMNRD	New Mexico Energy, Minerals and Natural Resources Department
NMSA	New Mexico Statutes Annotated
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List (Superfund)
NMWQCA	New Mexico Water Quality Control Act
NMWQCC	New Mexico Water Quality Control Commission
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Commission
NTU	nephelometric turbidity units
OSE	New Mexico Office of the State Engineer
PDO	Pacific Decadal Oscillation
PDOI	Pacific Decadal Oscillation Index
PDSI	Palmer Drought Severity Index
PDTI	Phelps Dodge Tyrone, Inc.
PVC	polyvinyl chloride
SAT	soil-aquifer treatment
SCS	Soil Conservation Service
SNOTEL	snowpack telemetry

List of Acronyms (Continued)

STATSGO	State Soil Geographic Database
SWAPP	New Mexico Source Water Assessment and Protection Program
SWCD	Soil and Water Conservation District
SWE	snow water equivalent
SWPG	Southwest Water Planning Group
SWPM	Southwest Planning and Marketing
SWR	Strategic Water Reserve
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
TMDL	total maximum daily load
TWDB	Texas Water Development Board
UGWA	Upper Gila Watershed Alliance
UIC	underground injection control
USFWS	United States Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	United States Geological Survey
UST	underground storage tank
UVDs	Upper Valley Defendants
WATERS	Water Administration Technical Engineering Resource System Database
WRAS	watershed restoration action strategy
WRCC	Western Regional Climate Center
WRRI	New Mexico Water Resources Research Institute
WWTP	wastewater treatment plant

Glossary

abandoned:	A term used to describe a water right that can no longer be used; for example, when a building is constructed over a previously irrigated field, the water right is considered to be abandoned.
acre-foot:	Volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot, equivalent to 325,872 gallons.
adjudication:	A legal proceeding in which a court determines the validity, priority, and amount of a water right.
alluvium:	General term for deposits of clay, silt, sand, gravel, or other particulate material deposited by a stream or other body of running water in a streambed, on a floodplain, on a delta, or at the base of a mountain.
anion:	A negatively charged ion.
appropriate (verb):	To take the legal actions necessary to create a right to take water from a natural stream or aquifer for application to beneficial use.
appropriation:	The right to take water from a natural stream or aquifer for beneficial use at a specified rate of flow, either for immediate use or to store for later use. Usually confirmed by a water court decree (see also *prior appropriation*).
aquifer:	A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.
artesian water:	Groundwater under sufficient pressure to rise above the level at which the water-bearing bed is reached in a well. The pressure in such an aquifer commonly is called artesian pressure, and the formation containing artesian water is called an artesian aquifer.
artificial recharge:	The addition of water to the groundwater reservoir by human activities, such as through an infiltration gallery or injection well.
base flow:	Sustained or fair-weather runoff—generally that portion of the streamflow derived from discharging groundwater or other delayed sources.
bedrock:	General term for consolidated (solid) rock that underlies soils or other unconsolidated material.
beneficial use:	The use of water by humans for any purpose from which benefits are derived, such as domestic, municipal, irrigation, livestock, industrial, power development, and recreation. Under the New

Glossary (Continued)

	Mexico Constitution, beneficial use is the basis, the measure, and the limit of the right to use water; therefore, beneficial use of public water is an essential element in the development of a water right.
biochemical oxygen demand (BOD):	The quantity of oxygen used primarily in the biochemical oxidation of organic matter in a specified time and at a specified temperature.
bolson:	An alluvium-floored basin, depression, or wide valley, mostly surrounded by mountains and drained by a system that has no surface outlet. Bolson fill is the alluvial detritus that fills a bolson—also commonly called bolson deposits.
brownfields	Areas of land, typically former locations of industrial and commercial activity, that are abandoned, vacant, or underutilized, where contamination is real or perceived, and where the possible existence of contamination is a deterrent for redevelopment.
bypass flow:	Water that is allowed to flow past a diversion structure or storage facility.
call:	A demand that holders of upstream water rights with more recent (junior) priority dates than the holder of the calling right cease diverting; in "calling" for his or her water rights, a senior water right holder requires junior water right holders to allow water to pass to the senior water right holder.
cation	A positively charged ion.
closed basin:	A basin is considered closed with respect to surface flow if its topography prevents the occurrence of visible outflow. It is closed hydrologically if neither surface nor underground outflow can occur. This term is also used in water rights administration to refer to a basin in which no new water rights are available.
coliform:	A bacterium that originates in the digestive system of mammals. If found in water, it indicates that pathogens might be present.
cone of depression	A depression in the potentiometric surface of a body of groundwater that develops around a well from which water is being withdrawn. It defines the area of influence of a well.
confining bed:	A rock formation that will not readily transmit water and that retards or stops the free movement of water underground. Confining beds have also been called aquicludes, aquitards, or semiconfining beds.

Glossary (Continued)

conjunctive water use:	Combined use of groundwater and surface water.
consumptive irrigation requirement (CIR):	The quantity of irrigation water (exclusive of precipitation), stored soil moisture, or groundwater that is required consumptively for crop production.
consumptive use:	The quantity of water that is consumed and not returned to the water system. For example, in irrigation a portion of the water is consumed through plant evapotranspiration or evaporation and is therefore lost to the water system (the remaining portion becomes return flow). See also *depletion* (synonym).
Continental Divide:	An imaginary boundary line that runs north to south through the Rocky Mountains, separating rivers that flow west to the Pacific Ocean from those that flow south and east toward the Gulf of Mexico and the Atlantic Ocean.
conveyance loss:	Water that is lost in transit from a canal, conduit, or ditch by leakage or evaporation.
cubic foot per second (cfs):	The rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second. It is equivalent to 7.48 gallons per second, or 448.9 gallons per minute.
declared underground water basin:	An area of the state proclaimed by the State Engineer to be underlain by a groundwater source having reasonably ascertainable boundaries. By such proclamation the State Engineer assumes jurisdiction over the appropriation and use of groundwater from the source.
depletion:	That part of a withdrawal that has been evaporated, transpired, incorporated into crops or products, consumed by man or livestock, or otherwise removed. See also *consumptive use* (synonym).
discharge:	Rate of flow at a given instant in terms of volume per unit of time; for example, pumping discharge (which equals pumping rate), usually given in gallons per minute (gpm), or stream discharge, usually given in cubic feet per second (cfs). With respect to groundwater, the movement of water out of an aquifer. Discharge may be natural (e.g., from springs or by seepage), or it may be artificial (e.g., through constructed drains or from wells).
dissolved oxygen (DO):	The amount of free (not chemically combined) oxygen in water. The DO content indicates the degree of water oxygenation, which reflects the general health of a watercourse with regard to

Glossary (Continued)

supporting aquatic organisms; the larger the DO percentage, the more likely that a healthy fishery can be supported.

diversion: A turning aside or alteration of the natural course of a flow of water, normally considered physically to leave the natural channel. In New Mexico this can include consumptive use directly from a stream, such as by livestock watering, as well as such actions as directing water through a canal or conduit.

domestic water use: Water for normal household purposes—such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns, gardens and livestock—supplied from a domestic source. Also called residential water use. The water can be obtained from a public supply or can be self-supplied.

domestic well: A well that provides domestic water. Domestic water rights are also known as "72-12-1" water rights, after the section of the water code that requires the State Engineer to approve all applications for a well to supply a household for domestic uses. A regulation adopted by the State Engineer allows domestic well users to use up to 3 acre-feet per year, except in areas where water rights are administratively restricted by court decree.

drainage basin: A part of the surface of the earth that is occupied by a drainage system that consists of a surface stream or body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

drawdown (groundwater): The depression or decline of the water level or potentiometric surface in a pumped well or in nearby wells caused by pumping. At the well, it is the vertical distance between the static and the pumping level.

drought: A long period of below-average precipitation.

environmental impact statement (EIS): Detailed analysis of the impacts of a project on all aspects of the natural environment, required by the National Environmental Policy Act for federal permitting or use of federal funds.

ephemeral stream: A stream or portion of a stream that flows only in direct response to precipitation. Such flow is usually of short duration. Most of the dry washes of the region may be classified as ephemeral streams.

evaporation: Process by which water is changed from the liquid state to the vapor state.

Glossary (Continued)

evaporation, net reservoir:	The evaporative water loss from a reservoir after making allowance for precipitation on the reservoir. Net reservoir evaporation equals the total evaporation minus the precipitation on the reservoir surface.
evapotranspiration:	The combined processes of simple evaporation and plant transpiration by which water is converted to vapor and lost to the system.
fallow:	Cropland, either tilled or untilled, that is allowed to lie idle during all or most of the growing season.
fecal coliform bacteria:	Bacteria that are present in the gut or the feces of warm blooded animals; they are indicators of possible sewage pollution.
firm annual yield:	The yearly amount of water that can be dependably supplied from the raw water sources of a given water supply system.
forfeiture	If a water right is not used for a four-year period and for one additional year after notification, the right is forfeited. Water rights not used prior to 1965 do not require a one-year period of non-use after notification.
freshwater:	Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L is considered undesirable for drinking and many industrial uses.
gaging station:	A particular site on a stream, canal, lake, or reservoir where systematic observations of water level, flow, or discharge are made.
gaining stream:	A river, or reach of a stream or river, that gains flow from groundwater seepage or from springs in or alongside the channel.
graywater	Domestic wastewater that has not come in contact with human or animal wastes and does not contain pathogens; typically water from showers and washing machines.
groundwater:	Generally, all subsurface water as distinct from surface water, specifically, that part of the subsurface water in the saturated zone (a zone in which all voids, large and small, ideally are filled with water under pressure equal to or greater than atmospheric).
groundwater mining:	The condition that exists when the withdrawal of water from an aquifer exceeds the recharge, causing a decline in the groundwater level.

Glossary (Continued)

groundwater recharge:	The addition of water to the zone of saturation. Infiltration of precipitation and its movement to the water table is one form of natural recharge.
hydraulic conductivity	A rate of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity (Fetter, 1988, p. 571).
hydraulic gradient (groundwater):	The gradient or slope of the water table or potentiometric surface in a specific direction.
hydrograph:	A graph showing the stage, flow, velocity, or other property of water with respect to the passage of time. Hydrographs of wells show the changes in water levels during the period of observation.
hydrologic cycle:	The movement of water from the atmosphere to the earth and back again to the atmosphere. The three stages are precipitation, runoff or infiltration, and evaporation.
impairment:	The diminishing quantity or quality of the water supply of an existing user by a new use or change in an existing use.
impermeable:	Not capable of transmitting fluids or gases in appreciable quantities. Few rocks are completely impermeable, but some—such as unweathered granite, dense basalt, welded tuff, dense limestone, and well cemented conglomerate—may be considered so for practical purposes.
instream flow:	Water in a stream or river for fish, wildlife, recreation, watershed or other purposes.
intermittent stream:	A stream that flows for only a part of the time. Flow generally occurs for several weeks or months in response to seasonal precipitation, due to groundwater discharge, in contrast to an ephemeral stream that flows for just a few hours or days following a single storm.
interstate compact:	An agreement between two or more states that has been approved by the U.S. Congress and allocates the water in the rivers and streams flowing through those states.
irrigated area:	The gross area upon which water is artificially applied.

Glossary (Continued)

irrigation:	Generally, the controlled application of water to arable lands to supply water requirements of crops not satisfied by rainfall.
irrigation conveyance loss:	The loss of water in transit from a reservoir, point of diversion, or groundwater pump to the point of use, whether in natural channels or in artificial ones, such as canals, ditches, and laterals.
irrigation efficiency:	The percentage of the irrigation water diverted from a water source that is consumed.
irrigation return flow:	That part of irrigation water that is not consumed by evapotranspiration and that drains from the irrigated area to an aquifer or surface water body.
junior rights:	Water rights that were obtained more recently and therefore are junior in priority to older or more senior rights. (see *priority date*)
karst:	A type of topography that is formed on limestone, dolomite, gypsum beds, and other rocks by dissolution and is characterized by closed depressions, sinkholes, caves, and underground drainage.
maximum contaminant level:	The highest allowable amount of a constituent in water. Drinking water quality criteria are established by the U.S. Environmental Protection Agency as regulatory standards.
mayordomo:	Executive officer or ditch boss of a community ditch or acequia.
National Pollution Discharge Elimination System (NPDES) permit:	A permit required under Section 401 of the Clean Water Act regulating discharge of pollutants into the nation's waterways.
National Environmental Policy Act (NEPA):	The federal law enacted to ensure the integration of natural and social sciences and environmental design in planning and in decision making that may impact the quality of the human environment.
nonpoint source:	The source of pollution discharged over a wide land area, as opposed to from one specific area, that finds its way into streams, lakes and oceans; examples of nonpoint source pollution are runoff from streets, parking lots, lawns, agricultural land, individual septic systems, and construction sites.
nonpotable water:	Water not suitable for drinking.

Glossary (Continued)

nontributary groundwater:	Groundwater in an aquifer that neither draws from nor contributes to a natural surface stream in any measurable degree.
outflow (from sub-basin):	Groundwater discharge across sub-basin boundaries.
per capita use:	The average amount of water used per person during a standard time period, generally one day.
perched groundwater:	Water in a saturated zone of material underlain by a relatively impervious stratum that acts as a barrier to downward flow.
perennial stream:	A stream that normally has water in its channel at all times.
phreatophyte:	A plant that habitually obtains its water supply from the zone of saturation.
playa:	Flat-floored bottom of an undrained desert plains basin.
point source:	The source of pollution discharged from any identifiable point, including ditches, channels, sewers, tunnels, and containers of various types.
porosity:	The ratio of the total volume of pore space (voids) in a rock or soil to its total volume, usually stated as a percentage. Effective porosity is the ratio of the volume of interconnected voids to the total volume. Unconnected voids contribute to total porosity but are ineffective in transmitting water through the rock.
potable water:	Water that is safe and palatable for human consumption.
potentiometric surface:	An imaginary surface representing the static head of groundwater in tightly cased wells that tap a water-bearing rock unit (aquifer) or, in the case of unconfined aquifers, the water table.
precipitation:	Includes atmospheric hail, mist, rain, sleet, and snow that descends upon the earth; the quantity of water accumulated from the above events.
prior appropriation:	The water law doctrine that confers priority to use water from natural streams based upon when the water rights were acquired. In New Mexico and most other western states, holders of senior rights have first claim to withdraw water over holders who have filed later claims (see also *water right, priority date, appropriation*).
priority date:	The date indicating when the water right was first exercised or applied for. The priority date determines the seniority of the water

Glossary (Continued)

right. Senior water rights holders are entitled to receive their full water right before junior water rights holders receive any water.

recharge: The addition of water to an aquifer by infiltration, either directly into the aquifer or indirectly by way of another rock formation. Recharge may be natural, as when precipitation infiltrates to the water table, or artificial, as when water is injected through wells or spread over permeable surfaces for the purpose of recharging an aquifer.

recoverable groundwater: The amount of water that may be physically and economically withdrawn from the groundwater reservoir.

reservoir: A body of water used to collect and store water.

return flow: The part of a diverted flow that is not consumptively used and that returns to a water body.

reuse: To use again, recycle; to intercept, either directly or by exchange, water that would otherwise return to the stream system for subsequent beneficial use.

reverse osmosis: A water treatment technique that forces water through a dense membrane to remove impurities.

riparian: The habitat and life forms along streams, lakes, and wetlands.

runoff: Water that is not absorbed by the soil or landscape to which it is applied. The part of the precipitation that appears in surface streams. Runoff occurs when water is applied quickly (application rate exceeds infiltration rate), particularly if there is a severe slope. Stormwater runoff is created by natural precipitation rather than human-caused or applied water use.

saline water: Water that contains more than 1,000 milligrams per liter of dissolved solids. It generally is considered unsuitable for human consumption and less desirable for irrigation because of its high content of dissolved solids. Salinity generally is expressed as milligrams per liter (mg/L) of dissolved solids, with 35,000 mg/L defined as seawater. A general salinity scale is:

Salinity	Dissolved Solids (mg/L)
Slight	1,000-3,000
Moderate	3,000-10,000
Very	10,000-35,000
Brine	more than 35,000

Glossary (Continued)

secondary treatment:	Treatment of wastewater to a nonpotable level so that it may be returned to the stream (see also *tertiary treatment, nonpotable water*).
specific capacity:	In groundwater hydrology, the yield of a well after a period of sustained pumping, usually expressed in gallons per minute per foot of drawdown.
specific yield:	The quantity of water that a unit volume of aquifer will yield by gravity after it is saturated, expressed as either a ratio or a percentage of the aquifer volume; specific yield is a measure of the water available to wells.
storage:	Water held in a reservoir for later use.
streamflow:	The discharge that occurs in a natural channel of a surface stream course.
stream gain	The amount of water that flows into a stream from springs or seeps from an aquifer
stream loss:	The amount of water that seeps out of a stream and recharges the aquifer.
surface water:	An open body of water, such as a stream or a lake.
surface water inflow:	The amount of water that annually enters an area as surface runoff.
suspended sediment:	Sediment that is transported in suspension by a stream. Fragmental material, both mineral and organic, that is maintained in suspension in water by the upward components of turbulence and currents and/or by colloidal suspension.
sustainability:	A decision-making concept describing development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
tertiary treatment:	Treatment of wastewater to a level beyond secondary treatment but below potable (see also *secondary treatment, nonpotable water, potable water*).
total dissolved solids (TDS):	An aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc., of calcium, magnesium, manganese, sodium, potassium, and other cations that form salts. High TDS concentrations exert varying degrees of osmotic pressure and often become lethal to the biological inhabitants of an aquatic

Glossary (Continued)

	environment. The common and synonymously used term for TDS is "salt."
total maximum daily load (TMDL):	Described as a watershed or basin-wide budget for pollutant influx to a watercourse.
transmissivity:	The rate at which water of a prevailing density and viscosity is transmitted through a unit width of an aquifer or confining bed under a unit hydraulic gradient. It is a function of the properties of the liquid, the porous media, and the thickness of the porous media.
transpiration:	The process by which water is absorbed by plants, usually through the roots. The residual water vapor is emitted into the atmosphere from the plant surface.
tributary:	A stream or river that flows into a larger one.
tributary drainage:	The area from which water drains by gravity into a water course.
tributary groundwater:	Water below the earth's surface that is physically or hydrologically connected to natural stream water so as to affect its flow, whether in movement to or from that stream.
turbidity:	The opaqueness or reduced clarity of a fluid due to the presence of suspended matter.
unaccounted-for water:	The difference between the total amount of water leaving treatment facilities and the total amount of water measured at customers' meters. Besides system losses, it also includes beneficial uses such as unmetered fire fighting and water used in system maintenance, along with meter under-registration.
wastewater:	Water that contains dissolved or suspended solids as a result of human use.
water budget:	An accounting of the inflow to, outflow from, and storage changes of water in a hydrologic unit.
water right:	Legal right to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose.
watershed:	An area from which water drains and contributes to a given point on a stream or river.
water table:	The upper surface of zone of saturation (see also *potentiometric surface*).

Glossary (Continued)

withdrawal:	Water removed from the ground or diverted from a surface water source for use.
xeriscape:	Landscaping concept that incorporates vegetation that is suited to local soils and climate, typically requiring less water. The term is derived from the Greek word *xeros*, meaning dry.
yield (water):	The supply of water produced by a given stream or water development; average annual yield is the amount of water given over a period of 12 months.
zone of saturation:	The zone in which all the connected interstices or voids in permeable rock or soil formation are filled with water under pressure equal to, or greater than atmospheric pressure.

Acknowledgements

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Executive Summary

The Southwest New Mexico Water Planning Region (Southwest Region), which includes Catron, Grant, Hidalgo, and Luna Counties (Figure ES-1), is one of 16 water planning regions in the State of New Mexico that are in the process of developing a regional water plan. Regional water planning was initiated in New Mexico in 1987, its primary purposes being (1) to demonstrate an in-state need for water, thereby providing a legal basis for denying an out-of-state appropriation and protecting water resources for New Mexico citizens and (2) to ensure that each region is prepared to meet future water demands. Regional water planning activities have been funded through and overseen by the New Mexico Interstate Stream Commission (ISC).

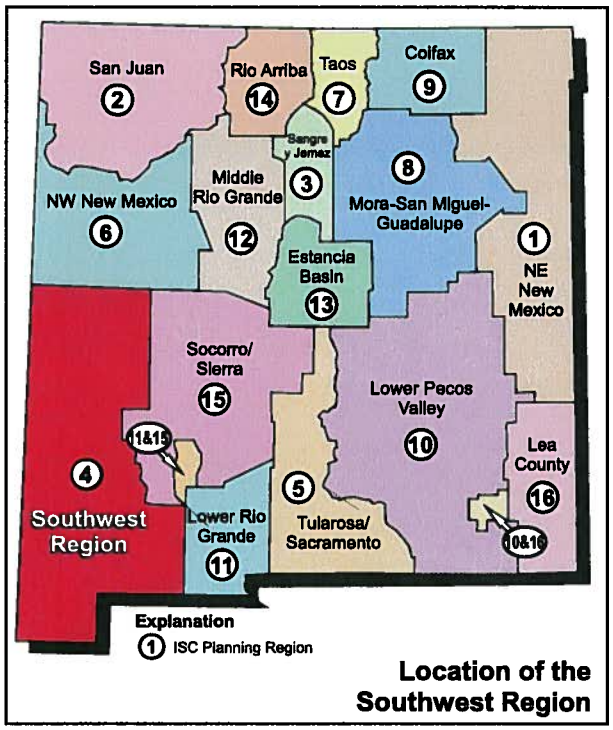


Figure ES-1

All of the Southwest Region water planning activities are overseen by a steering committee consisting of representatives of the counties, municipalities, agricultural and mining water users, and others with water interests in the region, and the fiscal agent is the City of Deming. The City retained the team of Daniel B. Stephens & Associates, Inc. (DBS&A), Engineers, Inc., and Southwest Planning and Marketing to develop the regional water plan.

Key water issues in the Southwest Region include:

- Declining groundwater levels in the Animas, Mimbres, and Nutt Hockett Basins (central and southern part of the region) due to heavy pumping for municipal and agricultural use

- Use of Central Arizona Project water, a renewable resource, to meet current and future needs

- Protection of natural environment of the Gila and San Francisco Rivers (which supply agricultural demands in the northern to central part of the region) to support recreation uses and endangered species

- Watershed management in National Forest and private forested lands to guard against catastrophic forest fires, to protect water quality, and potentially to increase yields in key areas

- Agricultural sector (the largest water use in the region) issues, including agricultural water conservation and mechanisms for short-term leasing of agricultural water rights

- Protection of and planning for water resources that are shared with Mexico

Regional water planning in New Mexico is guided by the template outlined in the ISC *Regional Water Planning Handbook* (ISC, 1994), which defines the scope and content of regional water plans. According to the template, a regional water plan must address the following key questions:

1. What is the water supply available to the region?

2. What is the region's current and projected future demand for water?

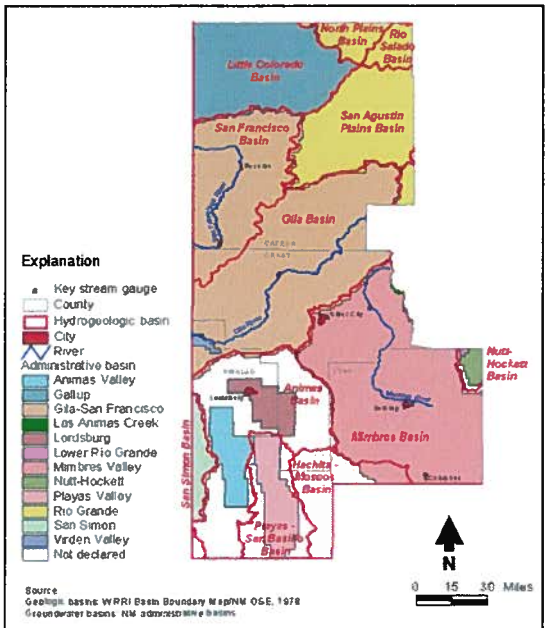
3. What are the region's alternatives for using available supplies to meet projected future water demands and how will they be implemented?

To address these questions, this plan discusses both the physical availability of water and the water rights and legal constraints that affect the availability of water, projects future demands for water, and identifies and evaluates alternatives for meeting future demands.

Water Supply

As required by ISC guidance, existing sources of information about surface water and groundwater supplies in the four counties (Catron, Grant, Hidalgo, and Luna) were used to

characterize the regional water supply. The sources of information used to assess water supply included documents by federal, state, and local agencies, academic research, and privately funded works.



Major Rivers and Groundwater Basins

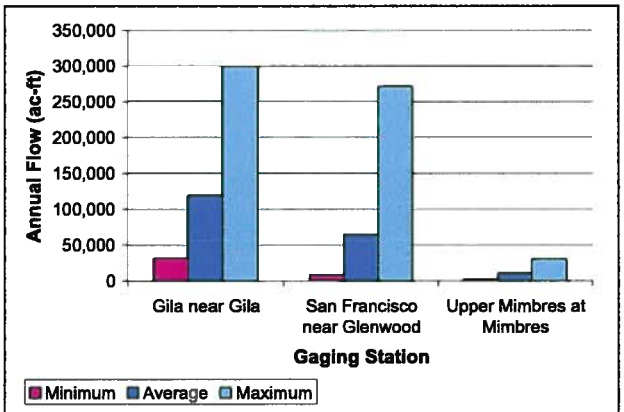
Figure ES-2

Surface Water

The majority of surface water in the planning region is found within the Gila River Basin, San Francisco River Basin, and the upper Mimbres River Basin. These three rivers and a few of their larger tributaries are the primary perennial (year-round) streams in the planning region (Figure ES-2).

Surface water flows originate primarily in the higher elevations, as snowmelt during the spring and as monsoonal rainfall during the late summer. Flows are highly varied from year to year, and the streams are typically characterized by prolonged durations of low flows punctuated by short-duration, high-volume flows. Figure ES-3 shows annual flows observed at the Gila River near Gila, New Mexico, the San Francisco River near Glenwood, and the Mimbres River at Mimbres U.S. Geological Survey gaging stations.

Water in the three river basins in the planning region is used primarily for irrigation and mining. Major cities within the planning region do not rely on the rivers for domestic supply purposes. The surface water resources, particularly the Gila and San Francisco River systems, are used for fishing and other types of recreation, and there is considerable interest in protecting the natural ecosystems in these areas.



Typical Surface Water Flows, 1950-2002

Figure ES-3

Groundwater

The Southwest Region contains 12 hydrogeologic basins and 10 separate groundwater basins declared by the New Mexico Office of the State Engineer (OSE), as well as several other areas that have not been declared (Figure ES-2). Nearly all of the groundwater resources within the planning region are contained within the declared basins. Groundwater availability is controlled to a large extent by the nature of the geology present, which in the planning region falls into three distinct geologic regions or "provinces."

Hidalgo, Luna, and southern Grant Counties are within the Mexican Highland Section of the Basin and Range province, where the predominant aquifers are comprised of basin (or bolson) fill and the Gila Conglomerate. These aquifers are good sources of water, with water tables typically within 200 feet of ground surface and moderate to high permeabilities (which allow higher pumping rates). These aquifers are recharged along the surrounding mountain fronts.

The northwestern corner of Catron County lies within the Navajo Section of the Colorado Plateau Province, where groundwater occurs primarily within Mesozoic sedimentary formations. The water tables in these formations are often below 200 feet from ground surface and permeabilities are low (which prevents higher pumping rates); thus these aquifers are not as good a water supply as those in the Mexican Highland Section. The most extensive regional aquifer in this province is the Dakota Sandstone. Other sedimentary formations and alluvium provide small amounts of water for stock tanks and private domestic wells.

The remainder of Catron County and northern Grant County lie within the Mogollon-Datil section of the Transition Zone Province. This area is characterized by localized uplifts from Tertiary igneous intrusions and volcanics that are separated by intermontane basins. Aquifers in these units can be good or poor sources of groundwater, depending upon location. Productive aquifers in this area are located in the San Agustin Basin and the Baca Formation, where groundwater can be found within 200 feet of ground surface and localized fracturing produces high permeabilities.

As pumping from these groundwater sources increases, exceeding natural recharge in some areas, water tables are dropping. Areas within the region where groundwater infrastructure is unlikely to meet future demand include the municipal well fields of Santa Clara, Bayard, Silver City, and Columbus-Deming, and agricultural wells in the Animas Valley, Playas Valley, and Lordsburg declared basins. As an example, a recent OSE study estimates that by 2020 agricultural use in the Animas Valley Basin will have decreased water levels by 100 feet below pre-development levels. Additional wells and deepening of existing wells can in most cases preserve production levels, but long-term planning should focus on reducing depletion rates in order to preserve water availability for the future.

Water Quality

Both surface water and groundwater quality is generally very good throughout the Southwest Region. It is well suited for agriculture use and for private domestic wells and is easily treated for use in public water supply systems. There are, however, a number of existing water quality concerns:

- Surface water resources in the planning region include 67.3 river miles that have been identified by the New Mexico Environment Department as being impacted. However, NMED is reviewing its standards for determining which streams are impacted, and the outcome may affect the designated impacts in each stream. The water quality in most lakes and reservoirs in the planning region is good, but there are concerns about potential impacts from excessive nutrients.

- Groundwater quality in the planning region is impacted in localized areas by leaking gasoline storage tanks, elevated sulfates and total dissolved solids from mining operations, and nitrates from septic tanks.

- Although the vast majority of surface water and groundwater resources are not impacted, watershed protection planning would help ensure that these resources remain healthy and should be a priority in developing a regional water plan.

Legal Issues

Regional water planning is subject to "laws relating to impact on existing rights" (NMSA 72 14-44C(7)) and planners have no authority over allocation or ownership of water rights. However, legal issues can place limits on the water supply in certain circumstances and must therefore be fully understood and incorporated into actions or recommendations included in the Southwest New Mexico Regional Water Plan.

Water Rights in New Mexico

The right to use water in New Mexico is based on the following principles of State water law:

- The State of New Mexico has sole authority to grant or recognize rights to use waters of New Mexico.
- The granting of rights to use New Mexico groundwaters and surface waters is based on beneficial use. Examples of beneficial use include agricultural, municipal, domestic, and industrial uses, among others.
- The first person to put water to beneficial use has a prior right and must continue to use the right in order to maintain it.

The agency responsible for managing water rights in New Mexico is the OSE. To withdraw groundwater or divert surface water, a user must have a water right or obtain a water permit from the OSE. Water permits list (1) how much water a user can withdraw within any given year, (2) the location and type of well or surface water diversion that will be used to withdraw the water, and (3) the beneficial use of the water.

Within the Southwest Region are all or parts of 10 groundwater basins that have been "declared" by the OSE (Figure ES-2), that is, proclaimed by the State Engineer as a groundwater source that has reasonably ascertainable boundaries. Once an underground basin is declared, the OSE requires a permit for new groundwater withdrawals and may also impose additional administrative criteria that further limit usage, especially in declining or mined aquifers.

Water rights may be transferred, sold, or leased, but such transactions are subject to protest, cannot impair existing water rights, and must not be contrary to public welfare or conservation. If water rights are not used during four consecutive years, they may be lost (after notice from the OSE).

Major Legal Issues in Southwest New Mexico Region

A number of unique issues facing the Southwest region are described below.

The ***Globe Equity Decree*** of 1935 was the result of a settlement among water users in the Upper Gila River of Arizona and the Virden Valley in New Mexico. A provision of this decree directs a court-appointed Water Commissioner to apportion for diversion to the water users in the upper Gila River Valley the amount of water being stored in San Carlos reservoir, regardless of the priority rights of the San Carlos Apache Tribe and Gila River Indian Community below the dam. This use of stored water acts as a buffer against curtailment of the upper valley users' junior right. Over the last 15 years, litigation concerning the decree has become intense, as the San Carlos Apache and Gila River Indian Community tribes in Arizona have sought to increase river flows to their lands. In addition, New Mexico water users, who were unhappy with the resulting distribution of water under the decree, violated the decree and have been found in contempt of court.

In a 1964 decree commonly referred to as the ***Gila River Apportionment,*** the U.S. Supreme Court adopted a stipulation by the states of Arizona and New Mexico decreeing an equitable apportionment of Gila River waters between the two states. The decree limits surface water and groundwater uses in the Gila Basin in New Mexico, except for the Virden Valley

In 1968, the ***Central Arizona Project*** (CAP) was authorized by the Colorado River Basin Project Act (43 U.S.C. 1524). Section 304 of the Act directed the Secretary of the Interior to contract with water users in New Mexico for water from the Gila River, its tributaries, and underground water sources. In any period of 10 consecutive years, the amounts that can be contracted must permit consumptive use of water in New Mexico of up to 180,000 acre-feet over and above the consumptive uses provided for by the Gila River Apportionment. The Act authorizes the construction of a reservoir as a unit of the CAP to allow New Mexico to consume

the average annual amount of 18,000 acre-feet. In exchange for New Mexico's diversion, Section 304 also directed the Secretary to deliver CAP water to water users in Arizona in sufficient quantities to fully replace any diminution of Gila River System water by water users in New Mexico. However, New Mexico never built facilities or contracted with the Secretary of the Interior to try to utilize the exchange water.

The 1968 Act was amended in 2004 by the ***Arizona Water Settlements Act*** (AWSA). This legislation resolves the disputes between Arizona and New Mexico and the major water users on the Gila and finalizes issues related to the CAP. The AWSA includes the Central Arizona Project Settlement Act of 2004, the Gila River Indian Community Water Rights Settlement Act of 2004, and the Southern Arizona Water Rights Settlement Amendments Act of 2004. After much negotiation, the AWSA became law in December 2004.

Section 212 of the AWSA describes the New Mexico Unit of the CAP, reduces the annual amount of exchange water allowed from 18,000 acre-feet to 14,000 acre-feet, and approves the New Mexico Consumptive Use and Forbearance Agreement (CUFA), a lengthy document negotiated between the two States (New Mexico and Arizona) and Arizona water users. The agreement includes provisions for delivery of CAP water to the Gila River Indian Community and the San Carlos Irrigation and Drainage District in exchange for the right of the New Mexico unit of the CAP to divert Gila water. The agreement also contains provisions by which upper Gila River Valley users will not object to the New Mexico unit's diversions as long as the unit abides by river bypass minimums, or in other words, only diverts when there are specified high flows.

Section 107 of the Act allows for the disbursement from the Lower Colorado Basin Development Fund of $66 million to $128 million to pay for construction of the New Mexico unit. Even if no New Mexico CAP unit is built, up to $66 million may be used for water-related projects and planning in the Southwest Region. The funding would be available beginning in 2012.

The bulk of the legislation is the Gila Settlement Agreement which, except for the San Carlos Apache claims, settles the litigation over the Globe Equity Decree. The Agreement reduces or extinguishes the rights of users in the upper Gila River Valley by generally prohibiting irrigation of lands that have not been irrigated since 1997 and by further reducing lands irrigated by these

users by about 8 percent of the total, including about 240 acres in the Virden Valley. It also protects domestic wells in the Virden Valley by allowing the withdrawal of 1 acre-foot per year per household. Overall, the Gila Settlement appears to be favorable to Virden Valley farmers and domestic well owners and to New Mexico

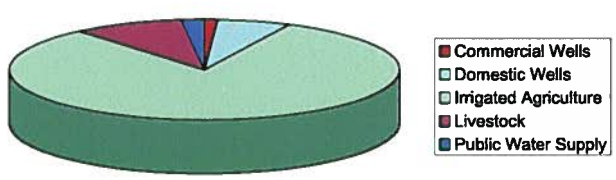
Population and Water Use

In order to plan for future water needs, regional water planners must estimate future population growth. Accordingly, population projections for each county in the Southwest Region were developed. Additionally, water demand by sector for each county was analyzed as a tool for understanding water use in each county.

The population projections were based on information from interviews with selected community representatives, from historical population trends, and from the University of New Mexico Bureau of Business & Economic Research population projections. Based on this information, both high growth rate and low growth rate scenarios for future population development were determined. The population projections do not take into account the large transient population present in the region during the tourism season; however, the transient demand is incorporated into commercial water use projections.

Under the high growth scenario, population is expected to increase by about 38,000, from 65,800 people in 2000 to 103,900 in 2004. More than 70 percent of this growth is projected to occur in Luna County.

In ***Catron County,*** irrigated agriculture has historically used and continues to use the largest amount of water, accounting for 81 percent of water consumption (Figure ES-4). Accordingly, changes in irrigated agriculture will likely drive water consumption more than changes in population. New industrial activities such as lumber mills are not expected to have a large impact on population or water use. Reopening of the Mogollon Mining District due to an increase in the price of silver and gold could increase the demand for industrial water and would also increase the population of the county.



Catron County Water Use in 2000

Figure ES-4

The population of Catron County is projected to remain flat (low growth scenario) or grow at a slow rate (high growth scenario), driven primarily by new subdivisions in the northeastern part of the county.

Mining has historically used and continues to use the largest amount of water in ***Grant County,*** consuming 62 percent, followed by irrigated agriculture which consumes approximately 23 percent. Combined mining and irrigated agriculture account for approximately 85 percent of the water consumed in Grant County (Figure ES-5).

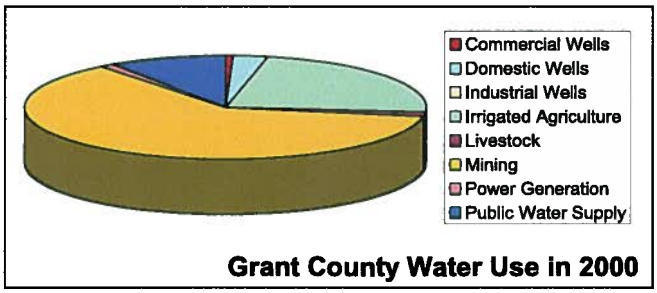


Figure ES-5

Water use in mining operations fluctuates with the minerals market, and due to a drop in world copper market prices in recent years, Phelps Dodge Mining Company has significantly curtailed their mining operations near Silver City. Copper prices are rising again, and it is expected that mining operations (and water usage) will rebound.

An area of potential growth in Grant County is residential development. The population projections for the county indicate a growth trend in this segment and consequently a rise in water usage for this purpose, primarily in Silver City and surrounding communities in the mining district.

Irrigated agriculture has historically used and continues to use the largest amount of water in ***Hidalgo County,*** consuming 82 percent (Figure ES-6). Consequently, trends in this sector will have more impact on water use than population growth. Although irrigated agriculture and its associated water use is expected to remain steady, a 20,000-head cattle feedlot is expected to begin operating in 2004 or 2005, with the possibility of another 20,000-head feedlot in the next five years. These large feedlots may require increased water.

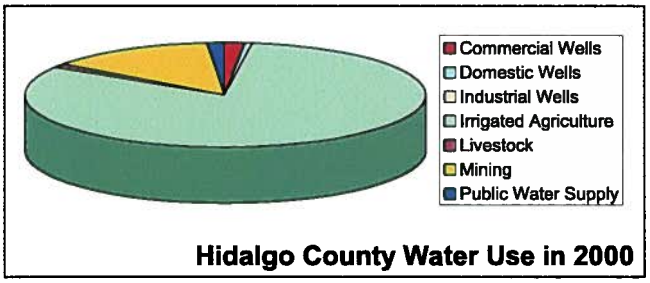


Figure ES-6

The low population projection for Hidalgo County is an extrapolation of historical trends. The high population projection takes into account research and training activities in the community of Playas, which are expected to provide several hundred new jobs in Hidalgo. This could help to increase the population by 500 to 1,000 new residents over the next 20 years, increasing demand for water in the residential, commercial, and municipal sectors.

Irrigated agriculture has historically used and continues to use the largest amount of water in ***Luna County,*** consuming 95 percent (Figure ES-7), and trends in this sector will thus have more impact on water use than population growth. The amount of acreage with irrigation water rights has reportedly been as high as 73,950 acres, but the Natural Resources Conservation Commission indicated that only about 32,000 acres were irrigated in 2000. Nonetheless, Luna County has the most land in irrigated agriculture in the Southwest Region.

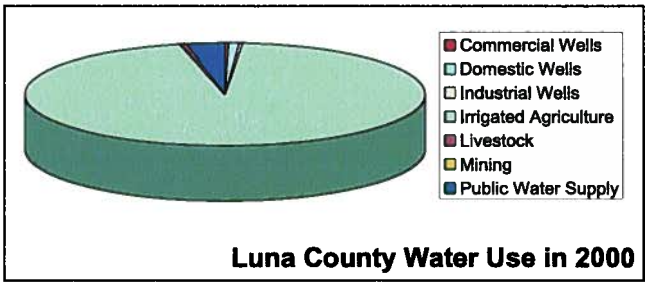


Figure ES-7

Other sectors in which growth may affect water use are power generation and industrial uses. Substantial growth is expected in the power generation sector over the next 10 to 20 years. In addition, with one of the largest industrial parks in the region located in Deming, industrial activity and its associated water use may increase in Luna County, dependent on transportation access, land availability, and apparent water availability for future growth.

Industrial and retirement community development in the county's major population center, Deming, and along the U.S.-Mexico border will be the primary drivers for population growth in Luna County.

Water Budget

A water budget is an accounting of total inflow and total outflow of water in a given area, such as a surface water or groundwater basin. Like a financial budget, a water budget takes into account each of the primary sources of inflow and each of the primary sources of outflow in

order to determine if one is greater than the other. Groundwater budgets were developed for each of the 12 hydrogeologic basins shown on Figure ES-2, and surface water budgets were developed for the three perennial stream systems in the region (i.e., San Francisco, Gila, Mimbres).

The inflow and outflow sources for groundwater and surface water were estimated or obtained from the best available information in the literature. Groundwater diversions are metered for large municipal and industrial wells and represent the best known component of the water budget. Precipitation and streamflow are also measurable water sources, although they are typically measured at only a few locations. By comparison, evaporation, evapotranspiration by plants, infiltration, return flows, movement of groundwater between sub-basins, domestic well usage, and spring and seep discharges are usually estimated. Consequently, because they rely heavily on estimates (based on prior studies and expert judgment) instead of actual measurements, water budget calculations generally have a high degree of uncertainty and should be used with considerable caution. This is especially true for groundwater because a region-wide groundwater assessment has never been done.

Groundwater budgets for the 12 hydrogeologic groundwater basins were prepared to evaluate the current balance between inflows and outflows. To maintain water levels, the total inflow and outflow components in a groundwater budget should be equal. However, if outflow is greater than the inflow, as shown in the water budget for the Mimbres Basin (Figure ES-8), water levels will lower in the aquifer and the volume of water in storage will decrease. Outflows also exceed inflows in the Animas and Nutt-Hockett Basins, where widespread water level declines confirm that the aquifer is being mined. Figure ES-8 shows the estimates for inflow and outflow components for all 12 of the basins analyzed.

Surface water budgets for the San Francisco, Gila, and Mimbres basins were prepared based on the surface water inflow and outflow components for both average and drought conditions. The major input—runoff from rain and snowmelt—was quantified based on gaged streamflows for average conditions as well as for drought conditions, the latter of which were based on 10th-percentile streamflows (flows at a level that 10 percent of all flows fall below and 90 percent above).

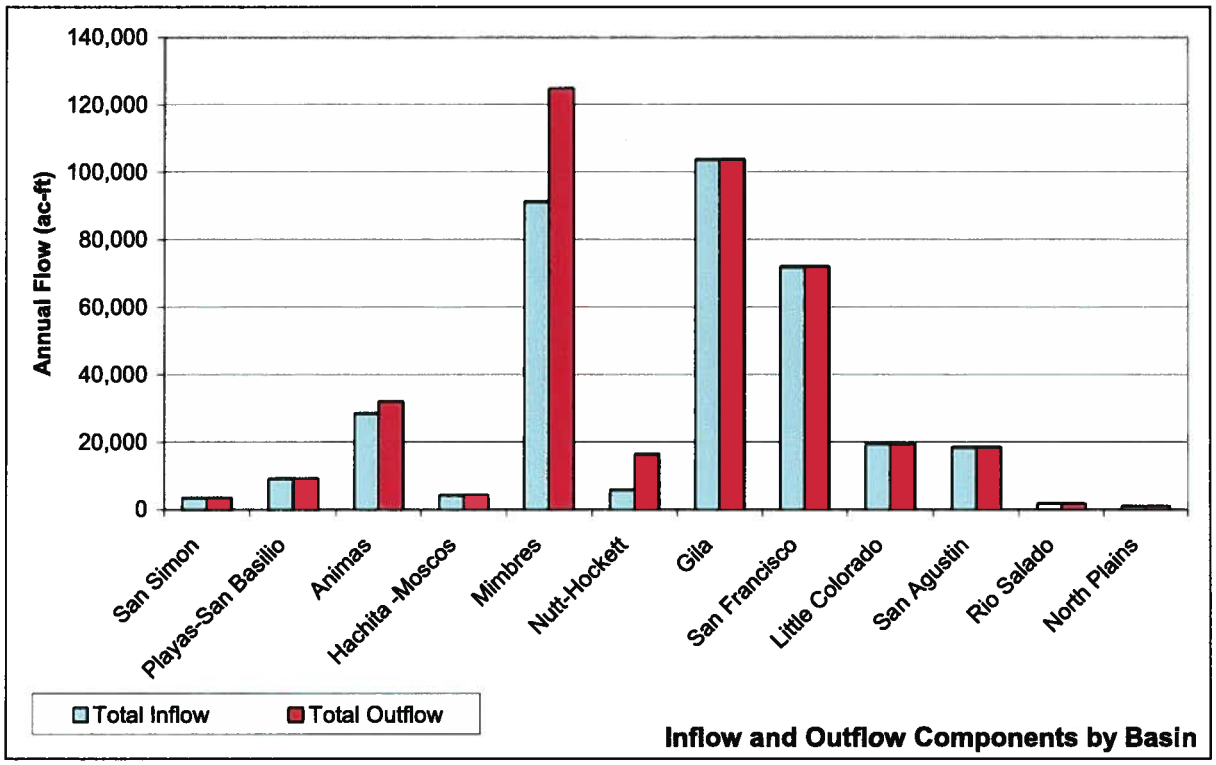


Figure ES-8

The results of the surface water budgets showed that inflows were greater than outflows in the San Francisco and Gila systems for both average and drought conditions. However, due to legal restrictions on the use of surface water, no excess surface water is currently available to meet new demands in these systems, although some new water may be available in the future from the 14,000 acre-feet of Gila River water authorized under the CAP. In the Mimbres system, inflows were greater than outflows under average conditions and approximately equal to outflows in drought conditions, but again, no excess surface water is available to meet new demands in the Mimbres due to legal restrictions.

Alternatives

Once the region has studied their water supply and projected future demand for water, the next key component of the regional water plan is to develop alternatives for meeting the projected water demand. Alternatives are actions that the region can take to increase supply, reduce demand, protect or improve water quality, or better manage water resources so that the water supply of the region continues to be viable.

To identify and select alternatives for meeting the projected gap between supply and demand in the Southwest Region, an initial list of potential alternatives was developed at meetings of the Southwest New Mexico Regional Water Planning Steering Committee, which are open to the public, and at public meetings. The Steering Committee also identified criteria to help determine which of the alternatives were the most important to analyze and include in the regional water plan. These criteria included:

- Economic feasibility/practicality
  - Local costs
  - Project costs

- Institutional feasibility
  - Equity of cost/benefit
  - Regional political and stakeholder support
  - Technical feasibility
  - Legal feasibility

- Water resources enhancement
  - Water quality
  - Water quantity

- Quality of life enhancement
  - Environment
  - Social and cultural impacts
  - Economic vitality of the region

As an initial evaluation, these criteria were used to score all of the alternatives. Scores for financial, legal, and technical criteria were prepared by DBS&A and were reviewed and revised by the Steering Committee. Scores for quality of life and political criteria were prepared by the Steering Committee.

Based on the scores and weightings assigned to individual criteria by the Steering Committee, a list of priority alternatives was developed:

- Municipal conservation and management
- Agricultural water conservation
- Watershed management
- Enhancement of surface recharge
- Provide water for natural riparian and aquatic habitat on the Gila and San Francisco Rivers
- Aquifer storage and recovery of Gila River flows
- Water banking
- Groundwater development

In accordance with the ISC template, these priority alternatives were evaluated with regard to their technical feasibility, political feasibility, social and cultural impacts, financial feasibility, and hydrologic and environmental impacts.

In addition to the priority alternatives, the Steering Committee identified several other alternatives that are important actions but that do not warrant as much analysis. For these alternatives, background information, key issues, and implementation considerations were evaluated. The alternatives that received limited analysis are:

- Water quality protection
- Groundwater management planning
- Border groundwater management
- Rain harvesting
- Industrial conservation
- Restrictions on domestic wells

For each of the alternatives, implementation is feasible in the region; however, there are financial, legal, and institutional challenges that must be overcome for successful implementation of these alternatives. Alternative implementation will be carried out by local governments, soil and water conservation districts, and other entities that can pursue individual projects. Leadership and education will be required for successful alternative implementation.

1. Introduction

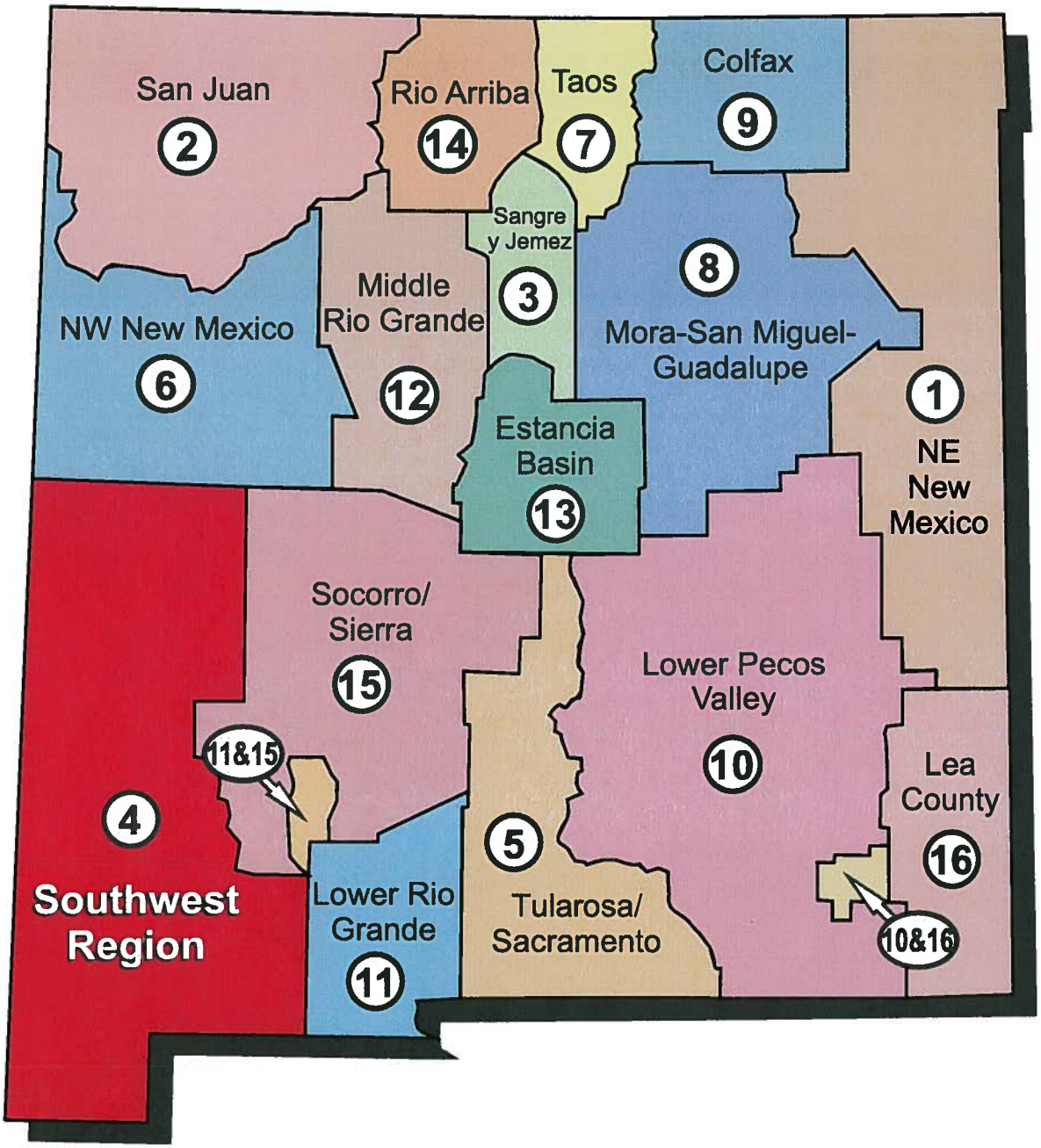
The Southwest New Mexico Water Planning Region (Southwest Region), which includes Catron, Grant, Hidalgo, and Luna Counties (Figure 1-1), is one of 16 water planning regions in the State of New Mexico that are in the process of developing a regional water plan. The New Mexico Legislature passed the Regional Water Planning Statute in 1987 in response to a lawsuit by the City of El Paso challenging New Mexico's ban on out-of-state appropriation of groundwater (El Paso v. Reynolds 563 F. Supp. 379 (D.N.M. 1983) and 597 F. Supp. 694 (D.N.M. 1984)). The Supreme Court determined that water is subject to the Commerce clause in the U. S. Constitution, and that if the transport of water is "not contrary to the conservation of water . . . and (is) not otherwise detrimental to the public welfare of the citizens of New Mexico," it could be transported across state lines. Regional water planning was thus instituted in order to demonstrate an in-state need for water and provide a basis for denying an out-of-state appropriation, thereby protecting water resources for New Mexico citizens. Additionally, regional water planning is intended to ensure that each region is prepared to meet future water demands.

Regional water planning activities have been funded through and overseen by the New Mexico Interstate Stream Commission (ISC). The designated fiscal agent for the Southwest Region is the City of Deming. The City of Deming retained the team of Daniel B. Stephens & Associates, Inc. (DBS&A), Engineers, Inc., and Southwest Planning and Marketing (SWPM) to develop the regional water plan. All of the regional water planning activities have been overseen by a steering committee consisting of representatives of the counties, municipalities, agricultural and mining water users, and others with water interests in the region. Additional information on the steering committee is provided in Section 2.

Regional water planning in New Mexico is guided by the template outlined in the ISC *Regional Water Planning Handbook* (NM ISC, 1994), which defines the scope and content of regional water plans. According to the template, a regional water plan must address five key questions:

1. What is the water supply available to the region?

2. What is the region's current and projected future demand for water?



Explanation

1 ISC Planning Region

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Location of Southwest Region

Daniel B. Stephens & Associates, Inc.

4-28-05

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Figure 1-1

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3. What are the region's alternatives for using available supplies to meet projected future water demands, including reduction of demand, to the extent needed, to live within available supplies?

4. What are the advantages and disadvantages of each alternative with respect to local values and criteria?

5. What are the best water supply alternatives and how will they be implemented?

This report is organized to be consistent with the regional water planning template (NM ISC, 1994):

- Background information regarding the public involvement process and the characteristics of the planning area is provided in Sections 2 and 3, respectively.

- To address the first question, this report discusses both the water rights and legal constraints that affect the availability of water (Section 4) and the physical availability of surface water and groundwater, as well as water quality constraints (Section 5).

- To address the second question, historical and current water demand in the region was evaluated, and projected population and economic growth were analyzed. Based on the results, projections of future water demand were developed and are presented in Section 6. A discussion of the water budget of the region, which links the water supply to the water demand, is included in Section 7.

- The final sections specified in the ISC handbook (1994) are an analysis of possible alternatives for closing the gap between supply and demand and recommendations for further action. Alternatives for meeting future demands and recommendations for implementation are included in Section 8. In accordance with the ISC handbook (1994) the evaluation of alternatives included an analysis of technical and financial feasibility, hydrologic, environmental and social cultural impacts, and political feasibility.

1.1 Previous and Ongoing Regional Water Planning Efforts

An initial Southwest Regional Water Plan was completed in 1991 (RTI, 1991). This effort was overseen by the Southwest New Mexico Council of Governments and the Black Range Resource Conservation and Development Council. The initial planned effort focused largely on characterization of surface water supplies and surface water modeling and also considered projected demands in the area. After the initial plan was developed, the Regional Water Planning Handbook was developed in 1994, requiring that additional analyses and plan updates be completed.

In addition to the current regional planning effort, water planning in relation to use of Central Arizona Project (CAP) water in the Gila-San Francisco Basin is currently being undertaken by the Southwest Water Planning Group. Additional information regarding use of CAP water in the region is discussed in Section 8.

1.2 Issues Specific to the Southwest Region

Key water issues in the Southwest Region include:

- In the central and southern part of the region, water for municipal and agricultural use is supplied almost entirely by groundwater. In areas where heavy pumping is occurring, such as the Animas, Mimbres, and Nutt Hockett Basins, water levels are dropping, raising concerns about the potential for land subsidence to occur and for water supplies to deepen to the point that pumping is no longer economic. Planning should therefore include policies that will support sustainable development.

- In the northern to central part of the region, surface water from the Gila and San Francisco Rivers supplies agricultural demands. These rivers are also used for recreation and for support of endangered species, and there is considerable interest in protecting the rivers' natural environments. Recent legislation has provided a mechanism for allowing greater withdrawals from the Gila and San Francisco Rivers in exchange for use of Central Arizona Project (CAP) water downstream. Determining how

to use the additional water without adverse environmental impacts is a key planning issue.

- A large portion of the Southwest Region consists of National Forest and private forested lands. Watershed management in these areas is important, to guard against catastrophic forest fires, to protect water quality, and potentially to increase yields in key areas.

- The largest water use in the region is irrigated agriculture. Water planning issues associated with the agricultural sector include the potential for agricultural water conservation, as well as mechanisms for short-term leasing of agricultural water rights, such as water banking

- Because the region borders Mexico to the south, issues related to protection of and planning for shared resources are important.

1.3 Data Sources

To answer water planning questions 1 and 2, reference materials pertaining to the water supply, water quality, and water demand in the Southwest Region were compiled and reviewed. Much of the information used in the water supply and water quality assessment was derived from climate and hydrologic records available electronically from state and federal agencies:

- Climatic data were obtained through the National Climatic Data Center (NCDC) web site (www.ncdc.noaa.gov), a subscription service administered by the National Oceanic and Atmospheric Administration (NOAA) that compiles climate data from various sources and provides them electronically. Climate data were also obtained directly from the Western Regional Climate Center (WRCC) web site (http://www.wrcc.dri.edu/).

- Monthly Palmer Drought Severity Index (PDSI) data from 1900 through 2002 were obtained from the National Climate Data Center web site (http://www.ncdc.noaa.gov/paleo/usclient2.html).

- Streamflow data through water year 2002 were obtained from the United States Geological Survey (USGS) web site (http://nm.waterdata.usgs.gov/nwis/). Provisional streamflow data for water year 2003 were also obtained from the USGS web site.

- Water quality data were obtained from the New Mexico Environment Department (NMED) web site (www.nmenv.state.nm.us), the New Mexico Water Quality Control Commission (NMWQCC, 2002), and the USGS.

- Information on water rights and wells was obtained from the New Mexico Office of the State Engineer (OSE) Water Administration Technical Engineering Resource System (WATERS) Database (http://seowaters.ose.state.nm.us/awdProd/) and individual water right owners. Other related well information was obtained from the USGS.

- Information on National Pollutant Discharge Elimination System (NPDES) permits, underground storage tanks (USTs), and total maximum daily loads (TMDLs) was obtained from the NMED web site (http://www.nmenv.state.nm.us).

- Land use, geology, and other reference maps were prepared by the New Mexico Water Resources Research Institute (WRRI) and by DBS&A geographic information system (GIS) technical staff.

- Information on water rights administration and administrative decrees was provided by OSE staff and Sheehan, Sheehan and Stelzner, who prepared the majority of Section 4 of this report. Additional information on water rights was obtained by Engineers, Inc. from individual water rights holders, as discussed in Section 4.6.

- Information on historical water use was obtained from the OSE and directly from water users within the region. Records regarding municipal water use were obtained directly from the municipalities, and records regarding agricultural and livestock water use were obtained from the New Mexico Department of Agriculture (NMDA) (www.nmdaweb.nmsu.edu) and the New Mexico Agricultural Statistics Service (NMASS) (www.nass.usda.gov/nm/nmbulletin).

Numerous other sources were used in compiling this report, as cited throughout the report and listed in the References section. Additional information on the sources of data and information used in this report is included in Sections 4, 5, and 6. A complete bibliography of all the documents available to DBS&A in developing this water plan is included in Appendix A1.

2. Public Involvement

Public participation is an important component of the Southwest Region planning effort. This section describes the public participation process used in developing this regional water plan and provides the public welfare statement that was developed as part of the public process.

2.1 Public Involvement

Water planning efforts in the Southwest Region are overseen by a steering committee that has representation from:

- The four counties
- Ten municipalities
- Six Soil and Water Conservation Districts (SWCDs)
- Phelps Dodge and Duke Energy
- Several representatives from the public, including agricultural and watershed interests

The Southwest Region Steering Committee oversees all aspects of the regional water planning process and has been active in development of this water plan. Steering committee meetings are held every other month. All steering committee meetings are advertised in local newspapers and are open to the public, and each meeting allows time for public comment.

Additionally, eight public meetings were held as part of the development of this plan. Two public meetings were held in June 2003, one each in Lordsburg and Reserve (Hidalgo and Catron Counties), and two meetings were held in Silver City and Deming (Grant and Luna Counties) in September 2003. The focus of the 2003 public meetings was to educate and inform citizens in the Southwest Region regarding the regional water planning process and water supply and demand in the region and to solicit feedback from the public regarding major water concerns and ways to maximize public involvement in ongoing regional water planning efforts. Four public meetings were also held in October 2004, one each in Catron, Grant, Hidalgo and Luna Counties. Attendance at meetings was variable.

In addition to the steering committee and public meetings, public involvement in the regional water planning process is facilitated by providing key regional water planning documents in public locations, including libraries and/or government offices in each county. Also, fact sheets on water supply, water demand, population projections, and legal issues, and a brochure on the Southwest Region water planning effort were prepared and distributed at public meetings and steering committee meetings. Public participation is further documented in Appendix B.

2.2 Public Welfare

In 1987, the New Mexico legislature amended a number of water statutes to give the State Engineer authority to deny an application for a new water right or a water right transfer if it is contrary to conservation of water or detrimental to the public welfare of the state. The legislature did not define public welfare, nor has the OSE or the ISC. However, a definition of public welfare, adopted by a region could provide the OSE guidance with respect to processing water rights applications. Should a proposed water right application appear to be contrary to a regionally defined public welfare criterion, the OSE could potentially rely on this criterion to deny or place a condition on an application. In this way, the public welfare statement is a potential mechanism for protecting regional values.

At the November 2004 Steering Committee meeting, the Steering Committee adopted the following definition of public welfare for the Southwest Planning Region

> The Southwest Regional Water Planning Steering Committee recognizes the unique values of the diverse ecology of the Gila Basin and other surface water resources in the region. In implementation of the alternatives and recommendations put forth in this plan, the Steering Committee recommends use of the best available science to fully assess the ecological impacts of any water utilization project in Southwest New Mexico, including the Gila River, its tributaries and associated riparian corridors, and to also consider the traditions, cultures and customs affecting historic uses of and future demands for water in the Region.

Other public welfare values that are important to the region include:

- Health and safety
- Economic consequences, including impacts on the existing economy and area of origin of water rights, maintenance of traditional rural and agricultural economies, recreation, and external costs
- Encouragement of conservation and discouragement of waste or impractical or unreasonable uses of water
- Environmental and ecological consequences, including impacts on fish, wildlife and plants, ecologically critical areas, riparian ecosystems, wetlands, and watershed management
- Sustainability, sustained yield, groundwater recharge, and aquifer management
- Water quality protection and improvement
- Protection and enhancement of historic, cultural, and natural resources and aesthetic values
- Preservation of public and trust lands, water, and open space

3. General Description of the Planning Region

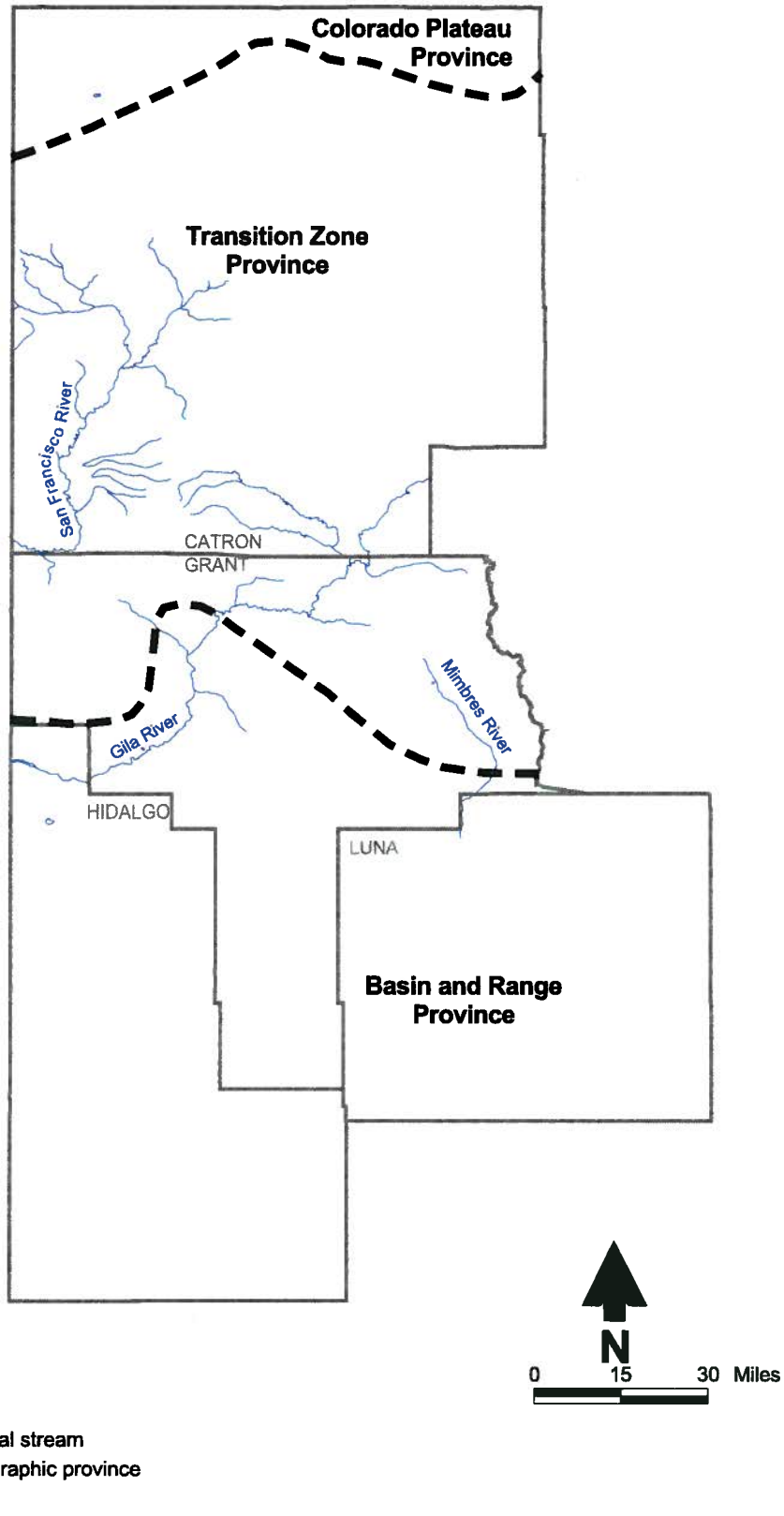
In accordance with the regional water planning template (NM ISC, 1994), this section provides a general description of the planning region, climate, water resources, and water use. Additional detail on the climate, water resources, and demographics and water use of the region is provided in Sections 5 and 6. Maps illustrating the land use and general features of the region were prepared by WRRI and are provided in Appendix A2.

The Southwest Region is located in the southwest corner of New Mexico and is comprised of four counties: Hidalgo, Luna, Grant, and Catron. The region is bounded on the north by Cibola County, on the west by Arizona, on the south by Mexico, and on the east by Socorro, Sierra, and Doña Ana Counties. The total area of the Southwest Region is approximately 17,000 square miles. Elevations range from over 10,000 feet above mean sea level (ft msl) in the Gila Wilderness to about 3,000 feet in the southern basins.

The region includes parts of three major geologic physiographic provinces, as shown in Figure 3-1:

- The northwestern corner of the Southwest Region (northern Catron County) lies within the Navajo Section of the Colorado Plateau Province. The Colorado Plateau extends throughout a vast area, including portions of New Mexico, Arizona, Colorado, and Utah, but is present in only a small portion of the planning region. The topography is characterized by large flat plateaus and buttes separated by wide valleys and locally incised canyons (OSM, 1996). The Colorado Plateau Province is comprised mainly of numerous sedimentary rock formations that are locally overlain by Quaternary/Tertiary alluvium and basalt.

- The remainder of Catron County and much of Grant County lies within the Datil-Mogollon section of the Transition Zone province. As the name implies, this area is a transitional zone between the Colorado Plateau Province and the Basin and Range province to the south (RTI, 1991). The Datil-Mogollon section is comprised of intermontane basins filled with sediments and large-scale intrusive plutons and associated extrusive volcanics.



Explanation

- Perennial stream
- Physiographic province
- County

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Physiographic Provinces

Daniel B. Stephens & Associates, Inc.

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Figure 3-1

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- South of the Transition Zone province lies the Mexican Highland section of the Basin and Range province, which covers the remainder of the Southwest Region. The geology of the Basin and Range province is characterized by north-south trending mountain ranges separated by basins that have been partially filled with sediment eroded from the mountains. The mountains are comprised of bedrock and encompass approximately 20 percent of the Basin and Range province in New Mexico (Hawley et al., 2000).

These physiographic provinces are discussed further in Section 5.3.1.

Vegetation in the planning region is greatly influenced by elevation differences and ranges from the spruce, fir, pine, and aspen forests of the mountains through a transition of open piñon-juniper to the grasslands of the basin floors. Natural resources in the area include coal, methane gas, and base metals, particularly copper.

3.1 Climate

The varied terrain of the Southwest Region, which ranges from the Continental Divide to the Chihuahuan Desert, results in significant climate variations. For example, temperatures range from lows that are well below 0 degrees Fahrenheit (°F) in the mountains to highs of more than 100°F in the basins.

The average annual temperatures in the four-county area for 1950 through 2002 ranged between about 46°F in the higher elevations and 61°F in the lower elevations. Average annual temperatures increased slightly over the period of record, mostly due to rising minimum temperatures.

Precipitation also varies across the region, influenced by location and by elevation. Weather systems may enter the region from the west (Pacific), northeast (Arctic air masses from the plains), and southwest (Gulf of Mexico), and systems from each point of origin bring unique sets of temperatures and moisture to the region. Average precipitation, including both snowmelt and rainfall, ranges from about 11 inches in the lower elevations to 17 inches in the higher elevations. On average, 16 to 25 percent of precipitation in the region falls during winter months.

3.2 Major Surface Water and Groundwater Sources

Approximately 20 percent of the water currently used in the planning region is supplied by surface water, which is primarily used for irrigated agriculture. Surface flows originate primarily in the higher elevations, as snowmelt during the spring and as monsoonal rainfall during the late summer. Flows are highly varied from year to year, and the streams are typically characterized by short-duration high flows, with prolonged durations of low flows. The dominant waterways flowing in the region (Figure 3-1) are in the Upper Gila River Basin (southeastern Catron County, western Grant County, and northern Hidalgo County), the San Francisco River Basin (southwestern Catron County and northwest corner of Grant County), and the Mimbres River Basin (southeastern Grant County and Luna County). The region's rivers and variability in their supply are discussed in Section 5.2.1, and Section 5.2.2 presents information on the lakes and reservoirs within the planning region. Surface water availability varies greatly from year to year, depending on the amount of precipitation in the region.

The occurrence of groundwater in the region is highly varied, and is controlled to a large extent by the geologic province in which the aquifer is located.

- Within the Colorado Plateau portion of the planning region, groundwater exists primarily in sedimentary formations, most predominantly the Dakota Sandstone (Basabilvazo, 1997). Tertiary volcanics and Quaternary/Tertiary alluvium also contain localized groundwater, but they are not extensive enough to be considered a regionally important groundwater source.

- Within the Transition Zone province, groundwater is found in Quaternary alluvium, Gila Group, and Tertiary intrusive volcanics. The Gila Group is the most extensive productive aquifer, while the alluvial and volcanic aquifers are areally limited but known to produce locally significant amounts of water.

- Within the Basin and Range province, the main aquifers are the basin fill, which includes several units of Quaternary alluvial and lacustrine deposits, as well as the Tertiary Gila Group. The basin fill contains most of the readily available (inexpensive) groundwater

resources within the Southwest Region. In general, the basin fill aquifers are moderately to highly permeable, the water table in them is within 200 feet of ground surface, and the water is of good quality.

3.3 Demographics, Economic Situation and Land Use

Current statistics on the population, economy, and land use in each county in the Southwest Region were compiled from the New Mexico Economic Development web site (NMEDD, 2003) and are summarized in Table 3-1. Additional detail on demographics, economics, and land use within the region is provided in Section 6. As shown in Table 3-1, from 1990 to 2001 the population increased in three of the four counties, with the only decrease occurring in Hidalgo County. Per capita income increased in all four counties, and the number of business establishments increased in all the counties except Hidalgo. Agriculture is an important industry in the planning region, especially in Luna and Hidalgo Counties, but the largest employment categories generally across the region are government (local, state, and federal), accommodations/food service, retail, and health care/social services, with mining and manufacturing employing large numbers in Grant and Luna Counties, respectively.

Table 3-1. Summary of Demographic and Economic Statistics for the Southwest New Mexico Water Planning Region

County	Population in 2000 [a]	Average Per Capita Income ($/yr)		No. of Businesses		Farms			Largest Agricultural Commodities	Largest Employment Categories, 2001	
		1990	2001	1990	2001	No.	Acreage Total	Acreage Average		Industry [b]	No. Employed
Catron	3,567	11,768	14,003	48	73	236	1,795,362	8,274	Cattle Hay Wheat	Government Hospitality Retail Agriculture Health/social	394 60 41 36 16
Grant	31,083	12,457	18,955	605	671	154	1,173,599	4,103	Cattle Horses Hay/silage Nursery crops Fruit/nuts/berries	Government Retail Hospitality Health/social Construction	3,076 1,146 1,100 810 670
Hidalgo	5,929	12,837	17,258	113	101	85	1,104,820	7,567	Vegetables Cattle Nursery crops Corn for grain Cotton	Government Agriculture Hospitality Retail Health/social	7,191 [c] 539 337 162 139
Luna	25,189	11,219	15,565	346	403	192	603,428	3,143	Vegetables Cattle Cotton Hay/silage Fruit/nuts/berries	Agriculture Government Manufacturing Retail Hospitality	2,287 1,752 1,842 1,075 552

Source: NMEDD, 2003, unless otherwise noted.

[a] Southwest Planning & Marketing estimate (Section 6.2)

[b] Government = Local, state, and federal government
Hospitality = Accommodations/food service
Health/social = Health care/social services
Transportation = Transportation/warehousing

[c] The web site listed the number employed by federal government as 6,771. As the county population is only 5,343, this number may be inaccurate.

4. Legal Issues Affecting Water Use and Supply in the Southwest New Mexico Water Planning Region

In order to have an understanding of the available water supply with the Southwest Region, it is necessary to understand the legal constraints that govern the use of the water supply. Accordingly, this section addresses federal, state, and local laws and administrative policies that affect the use of water. Information on the physical water supply is included in Section 5.

Within the Southwest Region there are specific legal issues that distinguish the area from other water planning regions. These issues include federal issues impacting the apportionment of water in the planning region, state and federal water quality law, and the regulation of water use by both ditch commissions and local governments. Further, the Southwest Region encompasses all or parts of a number of different administrative basins, each with its own particular way of administrating appropriations of water in the planning region.

4.1 New Mexico Water Law

Throughout the State of New Mexico, water use is governed by a number of generalized state laws. New Mexico water laws affecting the Southwest Region are found in the New Mexico Constitution, New Mexico Statutes Annotated (NMSA), and the case law interpreting and applying the existing law. Additional legal constraints include OSE regulations governing groundwater and surface water as well as OSE policy for administering various groundwater basins throughout the state. A general overview of New Mexico water law is provided in Appendix C; state legal issues of particular relevance to the Southwest Region are discussed in Sections 4.3.3, 4.4, and 4.5.

4.2 Federal Issues

4.2.1 Federal Law Governing Use of Water in the Region

Use of surface water and groundwater within the Southwest Region is governed by judicial and congressional action. Two court decrees, discussed in Sections 4.2.1.1 and 4.2.1.2, limit use in

the Gila River system. Conversely, water use may be expanded through the Central Arizona Project (Section 4.2.1.3). Additionally, issues arising out of water use disputes, primarily in Arizona, are the subject of federal legislation, as discussed in Section 4.2.1.4

4.2.1.1 United States v. Gila Valley Irrigation District, Globe Equity Decree No. 59 (1935)

In 1925, the year after Congress authorized construction of the Coolidge Dam, the United States, on its own behalf and on behalf of Indian tribes on the Gila River in Arizona, sued the irrigation districts, canal companies, and individual farmers (Upper Valley Users or Upper Valley Defendants) who were diverting above the planned San Carlos Reservoir, to assure that the supply of water to Indian lands would not be diminished. New Mexico farmers irrigating in the Virden Valley personally submitted to the jurisdiction of the Arizona federal court and were part of a comprehensive consent decree entered by the court in 1935 known as the Globe Equity Decree No. 59 (often referred to by the courts as the Gila Decree). Although the Globe Equity Decree was the result of a settlement among water users in the Upper Gila River of Arizona and the Virden Valley in New Mexico, it has been the subject of substantial litigation since its entry.

Because the Upper Valley Users have priority dates around 1872, the San Carlos Apache Tribe's earlier priority date of 1846 for irrigation of 6,000 acres and the Gila River Indian Community's (GRIC's) time immemorial right for irrigation of 35,000 acres made priority administration an unwelcome prospect to the Upper Valley Users. The Globe Equity Decree was palatable, however, because it used the stored water in the San Carlos Reservoir as a means of "apportioning" water out of priority to the Upper Valley Users.

Article VIII(2) of the Globe Equity Decree allows Upper Valley Users to take "apportioned water" from the river up to a maximum, seasonal, actual consumptive use limit of 120,000 acre-feet on the 40,000 acres irrigated by the Upper Valley Users. In essence, this provision directs the Water Commissioner appointed by the court to apportion for diversion to the Upper Valley Users the amount of water being stored in the reservoir regardless of GRIC's time immemorial right to irrigate its lands, which are below the dam. This use of stored water as a buffer against curtailment of their junior right was the primary reason the Upper Valley Users agreed to the settlement that resulted in the Globe Equity Decree. As a result, Upper Valley Users may divert "priority water" when there are sufficient flows to divert in priority, but even when such flows are

not sufficient, diversions of apportioned water can continue until used up. Another important provision of the Decree is Article V, which limits each Upper Valley User to a diversion of 6 acre-feet per annum per acre, whether supplied by priority or apportioned water or a combination thereof.

Unhappy with the resulting distribution of water under the Decree, New Mexico water users violated the Decree and were found in contempt of court. In 1941 the Ninth Circuit Court of Appeals upheld the district court's contempt finding against the New Mexico users, based on the court's jurisdiction and authority to administer the Decree even in New Mexico (*Brooks v. United States,* 119 F.2d 636 (9th Cir. 1941)). In a contemporaneous opinion, the Ninth Circuit first interpreted the meaning of water "stored" in the reservoir for purposes of making apportionments to the Upper Valley Users, holding that after January 1 of each year, water stored in the reservoir was only the amount that inflows exceed releases within that year (*Gila Valley Irr. Dist v. United States,* 118 F.2d 507 (9th Cir. 1941)).

4.2.1.2 Arizona v. California (1964)

In 1964, the United States Supreme Court in *Arizona v. California* (376 U.S. 340 (1964)), adopted a stipulation by the states of Arizona and New Mexico decreeing an equitable apportionment between the two of the waters of the Gila River. The *Arizona v. California* decree (hereinafter referred to as "the Gila River Apportionment") implemented the Court's earlier decision (*Arizona v. California,* 373 U.S. 546 (1963)) and incorporated the terms of the Globe Equity Decree. The original suit in the case was brought by the State of Arizona against the State of California and seven of its public agencies. Later, Nevada, New Mexico, Utah, and the United States became parties. The basic controversy before the Court was over how much water each state has a legal right to use out of the waters of the Colorado River and its tributaries, including San Simon Creek, the San Francisco River, and the Gila River.

By recognizing the terms of the Globe Equity Decree, the Gila River Apportionment equitably established New Mexico's uses below Red Rock in the Virden Valley and adopted the Globe Equity Decree by recognizing that the State of New Mexico may only divert from the Gila River and its underground water sources in the Virden Valley water "for use on lands determined to have the right to the use of such water by the [Globe Equity Decree] and except pursuant to and

in accordance with the terms and provisions of the Gila Decree" (*Arizona v. California,* 376 U.S. 340 (1964), at 347-349). The Supreme Court decree did not enjoin the use of underground water on specified lands or domestic use of water in either case "unless and until such uses are adjudged by a court of competent jurisdiction to be an infringement or impairment of rights confirmed by the Gila Decree" (*Arizona v. California,* 376 U.S. 340 (1963), at 350).

The Gila River Apportionment set specific limits for three stream segments in the Virden Valley:

- On San Simon Creek, the Gila River Apportionment limited water use and irrigation as provided in Article IV(A), which enjoined the State of New Mexico from "diverting or permitting the diversion of water from San Simon Creek, its tributaries and underground water sources for the irrigation of more than a total of 2,900 acres during any one year, and from exceeding a total consumptive use of such water, for whatever purposes, of 72,000 acre-feet during any period of ten consecutive years; and from exceeding a total consumptive use of such water, for whatever purpose, of 8,220 acre-feet during any one year" (*Arizona v. California,* 376 U.S. 340 (1963), at 348).

- On the San Francisco River, the Gila River Apportionment limited water use and irrigation as provided in Article IV(B), which enjoined the State of New Mexico from "diverting or permitting the diversion of water from the San Francisco River, its tributaries and underground water sources for the irrigation of" more than 2,269 acres, with each of the following areas limited as follows: Luna Area (225 acres), Apache Creek Aragon Area (316 acres), Reserve Area (725 acres), and Glenwood Area (1,003 acres). The Gila River Apportionment limited the total consumptive use of such water, for whatever purposes, to 31,870 acre-feet during any period of ten consecutive years and to 4,112 acre-feet during any one year (*Arizona v. California,* 376 U.S. 340 (1963), at 348).

- On the Gila River above the Virden Valley, the Gila River Apportionment limited water use and irrigation as provided in Article IV(C), which enjoined the State of New Mexico from "diverting or permitting the diversion of water from the Gila River, its tributaries (exclusive of the San Francisco River and San Simon Creek and their tributaries) and underground water sources for the irrigation of" more than 7,057 acres, with each of the

following areas limited as follows: Upper Gila Area (287 acres), Cliff-Gila and Buckhorn-Duck Creek Area (5,314 acres), and Red Rock Area (1,456 acres). The Gila River Apportionment limited the total consumptive use of such water (exclusive of uses in Virden Valley), for whatever purposes, to 136,620 acre-feet during any period of ten consecutive years and to 15,895 acre-feet during any one year (*Arizona v. California,* 376 U.S. 340 (1963), at 348).

Interestingly, the Supreme Court did not denote the Arizona federal district court administering the decree as the "court of competent jurisdiction" but left the question open.

One issue of concern to some livestock operators in the Southwest Region are numerous stock water uses that were overlooked in the Gila Decree. These uses were in place at the time of the decree and continue, yet they were not included in the hydrographic survey nor in the decree, and the OSE has not recognized these rights. Efforts to quantify those uses and resolve this issue are underway (personal communication with Howard Hutchinson, April 27, 2005).

4.2.1.3 The Colorado River Basin Project

In 1968, the Central Arizona Project (CAP) was authorized by the Colorado River Basin Project Act, 43 U.S.C. 1524 (the "1968 Act"). Section 304 of the 1968 Act directs the Secretary of the Interior to contract with water users in New Mexico for water from the Gila River, its tributaries, and underground water sources in amounts that will permit consumptive use of water in New Mexico of up to 180,000 acre-feet in any period of ten consecutive years over and above the consumptive uses provided for by Article IV of the Gila River Apportionment (*Arizona v. California,* 376 U.S. 340 (1964)). The Act authorizes the construction of "Hooker Dam or suitable alternative" as a unit of the CAP to allow New Mexico to consume the average annual amount of 18,000 acre-feet.

The mechanism for New Mexico's diversion is an exchange. Section 304 directs the Secretary to deliver to water users in Arizona sufficient quantities of CAP water to fully replace any diminution of Gila River system water at the Ashurst-Hayden Dam near Phoenix resulting from the consumptive use of Gila River system water by water users in New Mexico.

The 1968 Act was amended in 2004 by the Arizona Water Settlements Act (AWSA), as discussed in Section 4.2.1.4.

4.2.1.4 Arizona Water Settlements Act

Over the last 15 years, litigation regarding the Globe Equity Decree has escalated, as the Indian tribes have sought to enforce the Decree and increase downstream flows for their benefit. On March 16, 2001, the United States, the San Carlos Apache Tribe, the GRIC, and the San Carlos Irrigation and Drainage District (the "Plaintiffs") filed a Pumping Complaint, seeking judicial relief from groundwater pumping by other parties in the upper portion of the Gila River in Arizona and the Virden Valley in New Mexico.

In March of 2002, the court held a three-day trial on the groundwater issue. The court, however, stayed ruling on the claims because they would be resolved, except for the claims of the San Carlos Apaches, by the pending AWSA, introduced in February 2003 by Senator Jon Kyl of Arizona.

After much negotiation, the AWSA became law in December 2004 (P.L. 108-451). This comprehensive, 200-page bill is comprised of three titles:

- Title I: The settlement of allocation and funding disputes for the Central Arizona Project, entitled the "Central Arizona Project Settlement Act of 2004"

- Title II (the bulk of the legislation): The "Gila River Indian Community Water Rights Settlement Act of 2004" (hereinafter, "Gila Settlement")

- Title III: The "Southern Arizona Water Rights Settlement Amendments Act of 2004"

Of particular importance to the Region is the Gila Settlement, which, except for the San Carlos Apache claims, settles the Pumping Complaint. The parties to the Gila Settlement are the United States, the San Carlos Irrigation and Drainage District, and the GRIC (Plaintiffs) and the Upper Valley Defendants (UVDs), which include the New Mexico water users in the Virden Valley.

The Gila Settlement approves settlement of the Pumping Complaint between and among all of the settling parties. The basic agreement is that, in exchange for the UVDs reducing current irrigation by 3,000 acres, the UVDs may pump groundwater up to 6 acre feet per acre regardless of priority of the settling Plaintiffs. As a result, the Gila Settlement reduces or extinguishes UVD rights in two ways: first, generally by prohibiting irrigation of lands that have not been irrigated since 1997, and second, by further fallowing the lands that have been irrigated by 3,000 acres, including approximately 240 acres in the Virden Valley.

Although the Gila Settlement does not include settlement with the San Carlos Apache Tribe, it does establish a limit on future reductions of 3,000 additional irrigated acres in the event of such a settlement. Further, the Gila Settlement protects domestic wells in the Virden Valley by allowing the withdrawal of 1 acre-foot per year (ac-ft/yr) per household. Overall, the Gila Settlement appears to be favorable to Virden Valley farmers and domestic well owners and to New Mexico, and includes specific protections for the rights confirmed in the Virden Valley by the Gila River Apportionment (*Arizona v. California,* 376 U.S. 340 (1964)).

Section 107 of the AWSA allows for the disbursement from the Lower Colorado Basin Development Fund of $66 million to $128 million to pay for construction of the New Mexico unit. The State of New Mexico has stated publicly that any such project would not dam and impound the Gila River, that water storage, if any, would occur off-stream. Even if no New Mexico CAP unit is built, up to $66 million may be used for water projects and related activities in the Southwest Region. The funding would be available beginning in 2012.

Section 212 of the AWSA describes the New Mexico Unit of the CAP, reduces the annual amount of exchange water allowed from 18,000 acre-feet to 14,000 acre-feet, and approves the New Mexico Consumptive Use and Forbearance Agreement (CUFA), a lengthy document negotiated between the two States (New Mexico and Arizona) and Arizona water users. The agreement includes provisions for delivery of CAP water to the GRIC and the San Carlos Irrigation and Drainage District in exchange for the right of the New Mexico unit of the CAP to divert Gila water. The agreement also contains provisions by which Upper Valley Users will not object to the New Mexico unit's diversions as long as the unit abides by river bypass minimums, or in other words, only diverts when there are specified high flows. More information about CUFA as it relates to New Mexico's Gila River entitlement is provided in Section 8.6.

4.2.2 Federally Reserved Water Rights Within the Southwest Region

In regions with federal enclaves, it is important to determine whether these enclaves have federally reserved water rights that could affect water allocations in the region. In the Southwest Region, the Supreme Court decision in *Mimbres Valley Irrigation Co. v. Salopek,* 90 N.M. 410, 564 P. 2d 615 (1977), which involved reserved rights in the Gila National Forest, largely resolved this question. Federally reserved water rights for the other enclaves in the region, if raised, are likely to be small, because water use in these enclaves is not significant. Consequently, federally reserved water rights are not a major issue and should not impact water supplies or water planning in the region.

Several federal enclaves exist within the planning region. Although most notable are the Gila National Forest, Gila Wilderness, and Gila Cliff Dwellings National Monument, small segments of the Coronado, Cibola, and Apache National Forests and other wilderness areas, as well as a small amount of United States military land, are also present in the planning region. The Gila National Forest was established by presidential proclamations in 1899, 1905, 1907, 1908, and 1910. Portions of other national forests were later transferred to the Gila National Forest, so its boundaries now comprise approximately 3.3 million acres of land within the Southwest Region. Of that acreage, approximately 92,000 acres are privately owned. The 558,065-acre Gila Wilderness, the 202,016-acre Aldo Leopold Wilderness, and the 29,304-acre Blue Range Wilderness are all located within the Gila National Forest. These wilderness areas were authorized by the Wilderness Act of 1964 (16 U.S.C. § 1132), and some additional National Forest acreage areas were established by 96 P.L. 550 in 1980.

The federally reserved rights doctrine, as it applies to federal enclaves, was first recognized by the United States Supreme Court in *Winters v. United States,* 207 U.S. 564 (1908). The issue in that case was whether the United States, at the time of the creation of the Fort Belknap Indian reservation in Montana, had impliedly reserved a water right for future use of the Indians upon those lands. The Court upheld the power of the federal government to reserve the waters and exempt them from appropriation under state laws.

In *Arizona v. California,* 373 U.S. 546 (1963) (Section 4.2.1.2), the Court extended the reservation doctrine to non-Indian federal enclaves. Although it did not specifically discuss

whether a certain amount of water was reserved, it did state that the United States "intended to reserve water for the future requirements of . . . the Gila National Forest" (*Arizona v. California,* 373 U.S. 546 (1963) at 601). However, in *Cappaert v. United States,* 426 U.S. 128 (1976), the Court held that the implied reservation of water doctrine reserves only that amount of water necessary to fulfill the purpose of the reservation and no more (*Cappaert v. United States,* 426 U.S. 128 (1976), at 141).

The specific issue of what purpose(s) the Gila National Forest was originally established for and whether those purposes necessarily require an implied reservation of water was decided by the New Mexico Supreme Court in *Mimbres Valley Irrigation Co. v. Salopek,* 90 N.M. 410, 564 P. 2d 615 (1977). This decision was affirmed by the United States Supreme Court in *United States v. New Mexico,* 438 U.S. 696 (1978). In this case the United States claimed a reserved water right in the Gila National Forest for minimum instream flow to supply aesthetic, environmental, recreational, and "fish" purposes. Upon analysis of the Organic Act of 1897, 16 U.S.C. § 475 (the statute setting forth the purposes for which forests were withdrawn) and the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. § 528 *et seq.* [the statute that broadened the purposes for which national forests had previously been administered]), the Court held that the United States had not reserved water rights in the Gila National Forest for its claimed purposes of instream flow, instead concluding that the original purposes for which the Gila National Forest was created were to ensure favorable conditions of water flow and to preserve the timber in the forest. As such, a reserved right for aesthetic, recreational, wildlife-preservation, and stock-watering purposes was not contemplated (*United States v. New Mexico* supra at 718). The state court adjudicating the water rights on the Rio Mimbres t granted to the United States a reserved surface water right of 5.0 ac-ft/yr for the purpose of watershed management (*Mimbres Valley Irrigation Co. v. Salopek,* Cause No. 6326, Subfile 914, Amended Stipulation on the United States' Water Right Claims, filed August 31, 1990). This small surface right will not affect water allocations in the Southwest Region.

4.2.3 Endangered Species Within the Region

As shown by the recent decision by the Tenth Circuit Court of Appeals involving the silvery minnow and the Middle Rio Grande, the Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544), first enacted in 1973, can play a prominent role in determining the allocation of

water, especially of stream and river flows. In *Rio Grande Silvery Minnow v. Keys,* 2003 U.S. App. LEXIS 11672 (June 12, 2003), the Court held that the Bureau of Reclamation, through the works of diversion systems and dams, has discretion to reduce deliveries of available water under its contracts with irrigation districts and cities to make more water available to the silvery minnow to comply with the ESA. Currently, there are no federal projects on the Gila River in New Mexico, but the New Mexico Unit of the CAP (Section 4.2.1.3) would be subject to approval under the ESA.

The protections of the ESA are triggered by listing a species as "threatened" or "endangered." The goal of the Act is to protect such listed species and the habitat on which they depend (16 U.S. C. § 1531(b)) and ultimately to "recover" species so they no longer need protection under the Act.

The ESA provides several mechanisms for accomplishing these goals:

- The Act makes it unlawful for anyone to "take" a listed species unless an "incidental take" permit or statement is first obtained from the Interior Department (16 U.S.C. §§ 1538, 1539). "Take" is very broadly defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct" (16 U.S.C. § 1532(19)).

- In addition, federal agencies must use their authority to conserve listed species and must make sure that their actions do not jeopardize the continued existence of listed species or destroy or harm habitat that has been designated as "critical" for such species (16 U.S.C. § 1536 (2000)).

- Federal agencies are also required to consult with the United States Fish and Wildlife Service (USFWS) to determine whether federal actions or federally sponsored actions will affect or jeopardize threatened or endangered species or critical habitats. Whenever a private or public entity undertakes an action that is "authorized, funded, or carried out" wholly or in part by a federal agency, the consultation requirement is triggered and the potential impacts of the undertaking on threatened and endangered species are analyzed by the USFWS (16 U.S.C. § 1536(a)(4) (2000)).

- Local governments and individuals may have a role in the consultation process if they are "applicants" under the ESA. Entities or persons become applicants when federal agency approval is required for a proposed action (50 C.F.R. 402.02). For example, if a local government agency were to undertake an action requiring a federal permit, or a federal permit holder requires modifications or renewals to the permit, federal approval would be required. The agency or permit holder would then be considered an applicant in the consultation process that is triggered by the issuance or renewal of a federal permit. Federal regulations and guidelines allow applicants to:

  - Participate in selection of the non-Federal representative to prepare a biological assessment (50 C.F.R. 402.08)

  - Request early consultation (50 C.F.R. 402.11(b))

  - Submit information to be considered during the consultation (USFWS, 1998)

  - Review and comment on draft biological opinions (USFWS, 1998)

  - Provide expertise in identifying reasonable and prudent alternatives to an action if jeopardy or adverse modification of critical habitat is determined (USFWS, 1998)

- Species in the Southwest Region that are protected by the ESA include the spike dace, loach minnow, Chiricahua leopard frog, and southwest willow flycatcher:

- The USFWS listed the spike dace and loach minnow in 1986 as threatened species under the ESA and in 1994 designated 202 miles of the Gila River and its tributaries in New Mexico and Arizona as critical habitat for the two threatened fish.

- The USFWS listed the Chiricahua leopard frog in 2002 as a threatened species under the ESA. Critical habitat was not proposed for the frog.

- The USFWS listed the southwestern willow flycatcher as an endangered species in 1995. River regulation and dewatering by dams and diversions, which impact native

riparian vegetation and ecosystems, have been cited as the principal causes for the decline of the flycatcher. The largest concentration of the flycatcher is along the Gila River in the Cliff-Gila Valley.

In 2001, the USFWS recommended that the Gila chub also be listed.

The listed species could potentially affect water planning in the Region. In particular, protection and recovery of the listed species may impact the development of the CAP discussed in Section 4.2.1.3 Any actions that are likely to reduce water flows in the Gila River or harm habitat used by listed species will be subject to strict review and possible limitation.

4.3 State and Federal Water Quality Law

Both federal and state laws and regulations govern water quality within the Region. Nonetheless, most water quality laws have their genesis in federal law. An understanding of the federal water statutes and how they interrelate with state law is thus critical to understanding the regulation of water quality in the area.

4.3.1 The Clean Water Act

Several federal laws address water quality issues, but clearly, the most significant one is the Clean Water Act (CWA) (33 U.S.C. §§ 1251 to 1387 (2002)). The CWA is a 1977 amendment to the Federal Water Pollution Control Act of 1972 that set the basic structure for regulating discharges of pollutants to navigable waters of the United States. It is important to note that "navigable waters" has been broadly defined to include every creek, stream, river, or body of water that may in any way affect interstate commerce, including arroyos or ditches (*Friends of Santa Fe County v. LAC Minerals, Inc.,* 892 F. Supp. 1333 (D.C.N.M. 1995)). A recent Supreme Court case excluded from this definition isolated, intrastate, non-navigable waters where the sole basis for asserting CWA jurisdiction is the actual or potential use of waters as habitat for migratory birds that cross state lines (*Solid Waste Agency of Northern Cook County v. United states Army Corps of Engineers et al.,* 531 U.S. 159 (2001)). The degree to which this decision has limited EPA and Army Corps of Engineers jurisdiction over this class of water is the subject of much litigation (U.S. EPA and DOA, 2003).

The CWA's objective is to "restore and maintain the chemical, physical and biological integrity" of the waters of the United States (33 U.S.C. § 1251(a) (2002)). The CWA has several ways to reach this goal:

- It allows water quality standards for specific segments of surface waters (33 U.S.C. § 1313 (2002))

- It makes it unlawful for a person to discharge any pollutant into waters without a permit.

- It allows for the designation of "Total Maximum Daily Loads" (TMDLs) for pollutants threatening the water quality of stream segments (33 U.S.C. § 1313(d) (2002)). TMDLs are identified for those waters where an analysis shows that discharges may result in a violation of water quality standards (33 U.S.C. § 1313(d)(1)(C) (2002)). The TMDL process can be best described as determining and planning a watershed or basin-wide budget for pollutant influx to a watercourse. TMDLs identified for waterbodies within the Southwest Region are discussed in Section 5.4.1.

By enacting the CWA, Congress gave the U.S. Environmental Protection Agency (EPA) broad authority to address water pollution. With this authority, the EPA has developed a variety of regulations and programs to reduce pollutants entering surface waters. For example, applicable water quality standards, discharge permit requirements, and TMDLs are all defined by regulation.

Groundwater pollution is not specifically addressed by the CWA, and pollution from sources such as mining, agricultural and construction runoff (referred to as "nonpoint sources") is addressed mainly through voluntary management efforts, called "best management practices," rather than through regulation (40 C.F.R. § 130.2 (2002)). Nonetheless, a recent court decision found that the EPA and states have the power to list and issue TMDLs for waters polluted only by nonpoint sources of pollution (*Pronsolino v. Marcus,* 91 F. Supp 2d. 1337, 1356 (N.D. Ca. 2000), affirmed by *Pronsolino v. Nastri,* 291 F.3d 1123 (9th Cir. 2002)).

The CWA also calls for effluent limitations. Very simply speaking, an effluent limitation is a restriction on discharges into surface waters from the "end of the pipe," or point source. These

discharges are regulated through the issuance of National Pollutant Discharge Elimination System (NPDES) permits (33 U.S.C. § 1342 (2002)), which limit the discharge of a variety of pollutants and control the characteristics (e.g., temperature) of the discharge. NPDES permits also regulate stormwater discharges entering surface water (33 U.S.C. § 1342(p) (2002)). Although EPA can delegate the administration of the NPDES program to individual states (33 U.S.C. § 1251(b) (2002)), they have not done so with New Mexico.

The CWA allows the EPA to delegate many permitting, administrative, and enforcement responsibilities to state and tribal governments (33 U.S.C. §§ 1251(g), 1377 (2002)). For example, states and tribes have the power to adopt water quality standards for surface waters within their jurisdictions. A water quality standard generally is a standard that is established to sustain and protect existing or sustainable uses of surface water. A water contaminant is any substance that alters the physical, chemical, biological, or radiological qualities of the water (NMSA 1978, § 74-6-2 (A) (1967)). A contaminant becomes a pollutant when it exceeds an acceptable concentration or standard.

Under the CWA, states are required to adopt water quality standards that protect certain designated uses for each river, stream segment, and lake within its borders (33 U.S.C. § 1313 (2002)), and New Mexico has adopted its own surface water quality standards (20.6.4 NMAC). The New Mexico Water Quality Control Commission has the responsibility for enacting regulations under the New Mexico Water Quality Control Act, (NMWQCA) which implements certain water quality provisions of the Clean Water Act (74-6-3(E), 74-6-4(E)). Numerous other state agencies are constituents of the Commission and therefore have authority to carry out some provisions of the NMWQCA.

Tribes meeting certain criteria under the CWA have the same powers as states for waters within tribal lands (33 U.S.C. § 1377(a) (2002)). Designated uses generally include recreation, wildlife habitat, domestic water supply, irrigation, livestock water, and in the case of Indian tribes, culturally significant or sacred uses. Standards must be reviewed every three years and, as appropriate, modified or replaced (33 U.S.C. § 1313(c)(1) (2002)).

In order to understand a water quality standard, it is helpful to look at a particular reach of a river. For example, one segment of the Gila River in the Southwest Region is the main stem of the Gila River from the New Mexico-Arizona line upstream to New Mexico Highway 464 in Red Rock and the perennial reaches of streams in Hidalgo County. For this reach of the Gila River, the designated uses are irrigation, limited warmwater fishery, livestock watering, wildlife habitat, and primary contact. The standards adopted for this reach include pH within the range of 6.6 to 9.0, temperature less than 32.2 degrees centigrade, and fecal coliform less than 200 colonies per 100 milliliters (mL).

The CWA also plays an important non-regulatory role in the Southwest Region through several EPA-administered water resource grant programs. Many watershed projects underway in the Southwest Region, especially in Catron and Grant Counties, derive their funding from these CWA programs.

4.3.2 The Safe Drinking Water Act

The Safe Drinking Water Act, 42 U.S.C. § 300f *et seq.* (2002), protects the quality of drinking water in the United States. This law focuses on all waters actually or potentially designed for drinking use, whether from aboveground or underground sources. The Act authorizes the EPA to establish safe standards and requires all owners or operators of public water systems to comply with the standards. New Mexico has promulgated drinking water regulations that adopt, in part, federal drinking water standards (20.7.10 NMAC).

4.3.3 Groundwater Standards and Regulations

As noted above, the CWA focuses primarily on surface water pollution. Groundwater pollution not caused by hazardous waste is addressed directly by the State and tribes, pursuant to the New Mexico Water Quality Act and its regulations (NMSA 1978, § 74-6-1 *et seq.* (1967); 20 NMAC 6.2). In New Mexico, groundwater pollution is caused by a number of sources, including septic tank systems and cesspools, spills and leaks of hazardous materials, solid waste disposal sites, overuse of fertilizers and pesticides, and mines. Except for liquid waste and hazardous waste, which are regulated separately, these sources are required to have discharge plans under the water quality act (NMSA 1978, § 74-6-1 *et seq.* (1967); 20 NMAC 6.2).

Improperly installed or maintained domestic septic systems can be a source of groundwater pollution in New Mexico. New Mexico's Environmental Improvement Board is charged with promulgating regulations for liquid waste disposal and has promulgated regulations applicable to domestic septic systems (NMSA 1978, § 74-1-8 (1971); 20 NMAC 7.3). Releases of hazardous waste are regulated pursuant to regulations found at 20 NMAC 4.1.

4.4 Local Government and Ditch Commission Regulation of Water Use

4.4.1 Local Government Regulation

The availability of an adequate water supply is increasingly a limiting factor on population growth and development expansion. The provision of an adequate water supply not only poses physical constraints on growth, but may also be used as a regulatory mechanism to further restrain and manage growth. Both counties and cities have the authority to adopt ordinances conserving and regulating the use of water within their jurisdictions.

For example, subdivision and other land use approvals are increasingly being conditioned upon demonstration of the availability of an adequate water supply. In 1995, the New Mexico legislature amended the State Subdivision Act to require that county subdivision ordinances obligate a subdivider seeking approval of a preliminary plat to show that the subdivider can furnish water of sufficient quantity and quality to meet the needs of the subdivision (NMSA 1978, § 47-6-11 (F) (1973)). As part of the approval process, both the OSE and the NMED must review the subdivider's documentation demonstrating satisfaction of these requirements (NMSA 1978, § 47-6-11 (F) (1973)). Likewise, municipalities are charged with the power to adopt city ordinances governing land platting, planning, and zoning (NMSA 1978, §§ 3-19-1 through 12 (1965); NMSA 1978, §§ 3-20-1 (1979) through 3-20-16 (1966)). Specifically, municipal subdivision regulations may govern the extent and manner in which water will be provided to the subdivision as a condition of plat approval (NMSA 1978, § 3-19-6 (B)(5)(b) (1965)).

County and municipal regulations may also be important in the regulation of domestic wells. Under the New Mexico Water Code, an applicant may receive a domestic well permit from the State Engineer without acquiring commensurate groundwater rights or retiring offsetting surface water rights (NMSA 1978, § 72-12-1 (1931)). Because obtaining a domestic water right permit

is essentially a ministerial process, it is viewed by many as both a loophole in the regulation of groundwater withdrawals and an obstacle to the use of water supply as a growth management tool. However, municipalities have the power to restrict the drilling of new domestic water wells. Municipal water providers have the authority to deny new domestic well permit applications where the applicant's property is located within the exterior boundaries of the municipality and the property line is within 300 feet of the provider's existing water distribution lines (NMSA 1978, § 3-53-1.1(A) (2001)). Existing wells are not affected by this law.

In order to exercise this authority, a municipality must adopt a well regulation ordinance and file it with the OSE. An applicant in a municipality with a new well ordinance must obtain a permit to drill from the municipality subsequent to OSE approval (NMSA 1978, § 3-53-1.1(E) (2001)). A municipality must notify the State Engineer of its denial of drilling permits, and an applicant may appeal a denial to the district court (NMSA 1978, § 3-53-1.1(G) (2001)). The State Engineer has the power to grant a permit for a domestic well within municipal boundaries provided it conforms to all applicable municipal ordinances (NMSA 1978, § 72-12-1(A) (1931); NMSA 1978, § 3-53-1.1 (1965)).

A municipality may not deny a new domestic well permit if the total cost to the applicant of extending the municipal water lines, meter and hookup exceeds the cost of drilling a new well (NMSA 1978, § 3-53-1.1(B) (2001)), and a municipality declining to authorize a new domestic well must provide domestic water service within 90 days at regular rates (NMSA 1978, § 3-53-1.1(C) (2001)).

Municipalities and counties may also regulate water use by assuming responsibility for supplying water to their residents. By owning and operating a water utility, a county or municipality may regulate water use, including imposition of conservation measures, as described below.

- Municipalities may exercise their powers of eminent domain to establish or expand water utilities. A municipality "within and without the municipal boundary" may condemn various water supplies, water rights, rights-of-way "or other necessary ownership for the acquisition of water facilities" (NMSA 1978, § 3-27-2(A)(1) (1965)).

- Counties may also own utilities. County authority arises from statutory law providing that all "counties are granted the same powers that are granted municipalities . . . [including those powers] necessary and proper to provide for the safety, preserve the health, promote the prosperity and improve the morals, order, comfort and convenience of any county or its inhabitants" (NMSA 1978, § 4-37-1 (1975)). Certain class B counties are specifically authorized by statute to purchase, own, operate, and sell water and sewer utilities (NMSA 1978, § 4-36-8 (1993)). Furthermore, counties are specifically empowered to condemn water rights (NMSA 1978, §§ 72-4-2 through 12 (1959)). Class H counties also have the power to condemn property for water facilities because they are included in the definition of municipality in the water code (NMSA 1978, §§ 3-27-2(A), 3-1-2(G) (1965)). In the Southwest Region, Catron is a class C county (i.e., cannot purchase, own, operate, and sell water and sewer utilities), while Grant, Hidalgo, and Luna are class B counties (i.e., can purchase, own, operate, and sell water and sewer utilities).

4.4.2 Soil and Water Conservation Districts

SWCDs play an important watershed management and protection role throughout New Mexico and are very active in the Southwest Region. Under New Mexico Law, the purpose for creating SWCDs under the Soil and Water Conservation District Act is to:

- Control and prevent soil erosion (NMSA 73-20-26 B(1))
- Prevent floodwater and sediment damage (NMSA 73-20-26 B(2))
- Further the conservation, development, beneficial application and proper disposal of water (NMSA 73-20-26 B(3))
- Promote the use of impounded water for recreation, fish and wildlife propagation, irrigation, and urban and industrial needs (NMSA 73-20-26 B(4))
- Conserve and develop the natural resources of the state, provide for flood control, preserve wildlife, protect the tax base, and promote the health, safety and general welfare of the people of New Mexico (NMSA 73-20-26 B(5))

SWCDs are a political subdivision of the state and have general powers such as providing technical and financial assistance, conducting research and disseminating information, planning, cooperating with other agencies, and implementing projects to carry out their mission. Like most subdivisions of the state, SWCDs have specific powers such as contracting, borrowing money, and improving, renting/leasing, and selling district property among others (NMSA 73-20-45). They also have the ability to sue or be sued (NMSA 73-20-45(A)) and to levy assessments (NMSA 73-20-46). One unique power conferred to the SWCDs through the Water Quality Act is the ability to issue compliance orders. As a constituent agency to the Water Quality Control Commission, the SWCD may issue compliance orders for violations of the Water Quality Act (NMSA 74-6-10).

4.4.3 Ditch Commission Regulation

Community ditches, or acequias, are ditch systems that are managed by a community and used for irrigation purposes. The first acequias were used in the Southwest by Pueblo Indians, and early Spanish settlers adopted this water distribution method (Getches, 1997, p. 419). In New Mexico, settlements were formed along the banks of perennial rivers or in the mountain valleys where water from springs and creeks was reasonably certain to be available for irrigation at the needed times (*Snow v. Abalos,* 18 N.M. 681, 694-695, 140 p. 1044, 1048-1049 (1914)). Community ditches were established by individuals or community members to convey water. A main canal was constructed with lateral ditches to distribute the water and serve their individual lands (*Snow v. Abalos,* 18 N.M. 681, 694-695, 140 p. 1044, 1045 (1914)).

The water rights were owned by the individuals, but the ditch was collectively owned by the individuals on the ditch as tenants-in-common (*Snow v. Abalos,* 18 N.M. 694-695, 140 p. 1044, 1048-1049 (1914)). When a landholder on a community ditch conveyed his land, his right to the use of water as a member of the community passed with his land (*Snow v. Abalos,* 18 N.M. 681, 692, 140 p. 1044, 1045 (1914)).

In New Mexico, community ditches continue to operate statewide, but their management is now governed by statute (NMSA 1978, §§ 73-2-1 (1874) through 73-2-68 (1993); NMSA 1978, §§ 73-2A-1 through 73-2A-3 (1988); NMSA 1978, §§ 73-3-1 through 11 (1903)). All New Mexicans have the right to construct and use either private or common ditches (NMSA 1978, § 73-2-1

(1874)). Members of a community ditch or acequia are not entitled to compensation for the ditch or ditches crossing their respective properties (NMSA 1978, § 72-2-3 (1851-1852)). After construction, the ditches belong to the ditch members, and no other person can use the ditch without a majority consent from the owners and payment of a share of ditch construction costs proportionate to the amount of water to be used (NMSA 1978, § 72-2-7 (1882)). Ownership of the ditch is still separate from the right to use water that the ditch conveys (*Holmberg v. Bradford,* 56 N.M. 401, 403, 244 p. 2d 785, 787 (1952)).

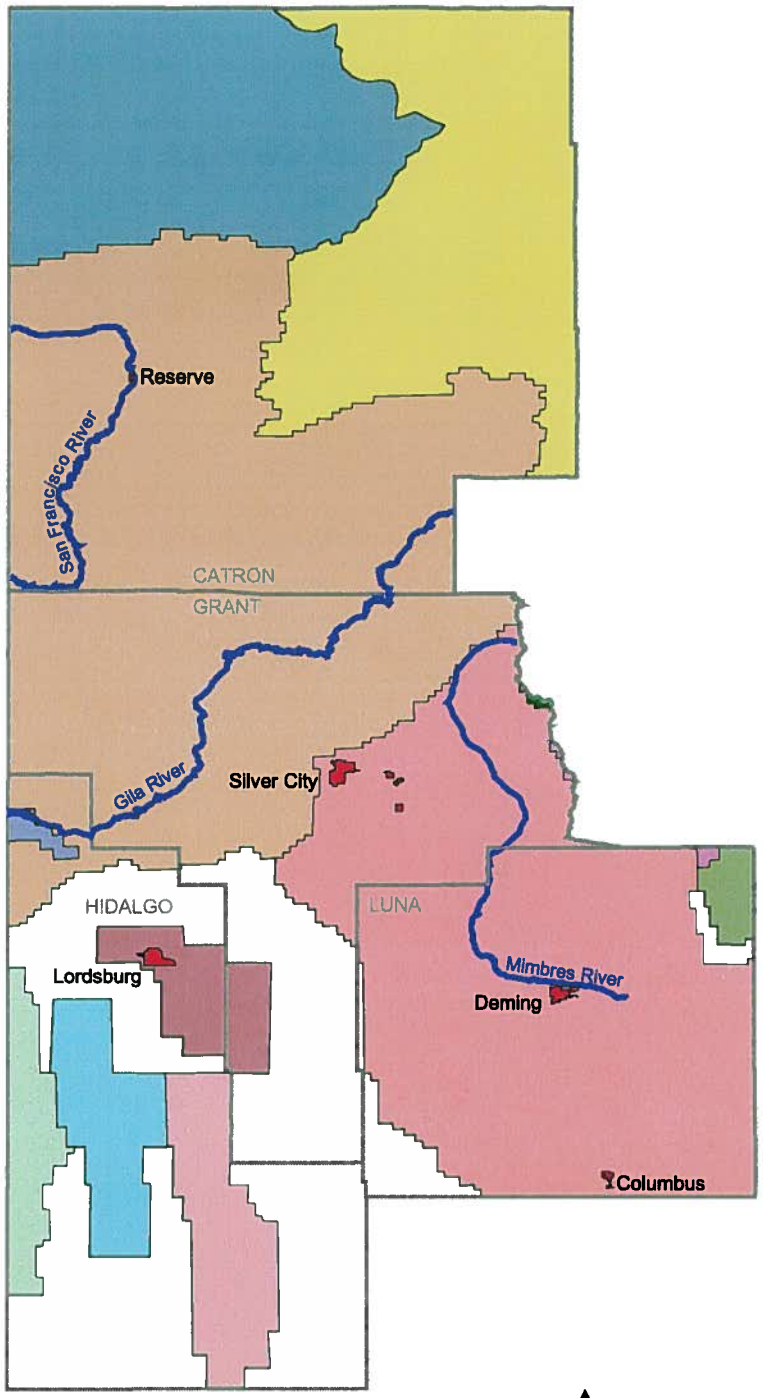
Officials elected by the community manage the ditch or ditches with respect to construction, operation, maintenance, and water allocation, and the ditch members provide the necessary labor to construct and maintain the ditch (*Snow v. Abalos,* 18 N.M. 681, 691-4, 140 p. 1044, 1047-9 (1914)). Ditches have three elected commissioners and one superintendent, or mayordomo, each of whom must own an interest in the ditch or a water right (NMSA 1978, § 73-2-12 (1895)). The officers have the authority to manage the affairs of the ditch, including contracting and making assessments to provide payment of expenses related to the ditch, distributing water, supervising ditch maintenance and operation, and collecting fines (NMSA 1978, § 73-2-21 (1895)).

Ditch associations are corporations with the power to sue and be sued (NMSA 1978, § 73-2-21 (1895)). Moreover, ditch associations are considered political subdivisions of the State (NMSA 1978, § 73-2-28 (1965)). This status is significant because it allows them to condemn land (1969 Opinion of the Attorney General No. 69-96). It also enables ditch associations to receive loans from the Interstate Stream Commission for ditch improvements and exempts them from payment of taxes on irrigation works (1964 Opinion of the Attorney General No. 64-95).

Community ditches within the Southwest Region include 16 ditches located in Catron County, 19 in Grant County, and 2 in Hidalgo County.

4.5 Administrative Policies of the State Engineer

Within the Southwest Region are a number of groundwater areas, referred to as declared (because they have been declared by the State Engineer) (Figure 4-1). A declared groundwater basin is defined by the OSE as "an area of the state proclaimed by the State Engineer to be



Explanation

- County
- City
- River

Declared groundwater basin

- Animas Valley
- Gallup
- Gila-San Francisco
- Las Animas Creek
- Lordsburg
- Lower Rio Grande
- Mimbres Valley
- Nutt-Hockett
- Playas Valley
- Rio Grande
- San Simon
- Virden Valley
- Not declared

N

0 15 30 Miles

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Declared Groundwater Basins

Daniel B. Stephens & Associates, Inc.

7-6-04 11:39AM JN WR03.0004

Figure 4-1

(S:\PROJECTS\WR03.0004\GIS\PROJECTS (PROJECT = sw_regional_water_plan_0703.apr) (VIEW EXTENTS = TEMP) (VIEW NAME = V05 - W) (LAYOUT = L05 - W 305280)

underlain by a groundwater source having reasonably ascertainable boundaries" (NM OSE, 2003a). By declaring a groundwater basin, the State Engineer assumes jurisdiction over the appropriation and use of groundwater from the source, and any person wishing to appropriate groundwater for beneficial use within that basin must first apply for a permit from the OSE.

These declared basins do not necessarily coincide with the physical hydrogeologic basins in the planning region, and some hydrogeologic basins that are present in the planning area are undeclared. For example, the two OSE-declared basins of Animas and Lordsburg are both within the same geologic groundwater basin (Animas). (To distinguish the two, the OSE-declared Animas Basin is referred to in this report as the Animas Valley Basin.) Of the approximately 17,700 square miles within the planning region, 85 percent falls into a declared basin (15 percent of the region is undeclared). Because the OSE regulation is of the OSE-declared basins, the following discussion of the OSE's administrative policies (Sections 4.5.1 through 4.5.9) is organized by the OSE-declared basins. Within these declared basins, administrative criteria may be in place to manage water resources within areas of higher use.

4.5.1 Gila-San Francisco and San Simon Declared Basins

The Gila-San Francisco and the San Simon declared basins are unique in that the rules and regulations for them are determined by *Arizona v. California,* 376 U.S. 340 (1964) (discussed in Section 4.2.1.2). The Virden Valley and the San Simon Basins are also part of the Gila-San Francisco area, but they are quite different from the rest of the Gila-San Francisco Basin and from each other and are therefore discussed separately (Sections 4.5.1.2 and 4.5.1.3, respectively). Three hydrographic surveys have been completed in the area: the Gila River above Virden Valley, the San Francisco River, and the San Simon Creek. The subsequent adjudication of the water rights in these stream systems was completed in three separate court proceedings.

4.5.1.1 Gila and San Francisco Administrative Sub-Basins

The Gila-San Francisco declared basin is comprised of two hydrologic basins, the Gila and the San Francisco. There are eight administrative sub-basins within the Gila-San Francisco Basin. The San Francisco Basin includes the Luna sub-basin, the Apache Creek Aragon sub-basin, the Reserve sub-basin, and the Glenwood sub-basin. The Gila Basin includes the Upper Gila sub-

basin, the Cliff-Gila sub-basin, the Buckhorn-Duck Creek sub-basin, and the Red Rock sub-basin. In these sub-basins, which have been adjudicated, water rights have been fully allocated. However, additional domestic wells for indoor use are permitted, since indoor use is considered non-consumptive use. If outdoor use is proposed, the applicant must find a seller willing to sell their water right and transfer at least the amount required for the outdoor use to the applicant. A condition for metering the wells is included in all approved domestic well permits.

Consumptive water rights cannot be transferred between the sub-basins of the Gila-San Francisco Basin. Non-consumptive water rights can be transferred between the sub-basins, and if the applicant desires water for their non-commercial lawn, trees, or yard, then the applicant can petition for a change in use from a consumptive use to a domestic, non-consumptive use. However, each sub-basin has its own consumptive use requirement, or the amount of water required to raise a crop. For example, the Luna sub-basin requires less water per acre to raise a crop than does the Cliff-Gila sub-basin. Therefore, if an applicant wishes to transfer a water right from Cliff-Gila to Luna, the acreage purchased in Cliff-Gila must be shrunk to compensate for the higher consumptive rate in the Cliff-Gila. The converse is not true; that is, if an applicant wants to transfer water from Luna to Cliff-Gila, the acreage does not expand.

Under the decree issued in *Arizona v. California,* the total consumptive use for whatever purpose in the San Francisco Basin cannot exceed 31,870 acre-feet during any period of ten consecutive years or 4,112 acre-feet in any one year. Additionally, the amount of land irrigated by diversions from the San Francisco River cannot exceed a maximum number of acres per year in the four San Francisco sub-basins (Table 4-1).

The Gila Basin cannot exceed a total consumptive use for all purposes of 136,620 acre-feet during any period of ten consecutive years or 15,895 acre-feet in any one year. The Gila sub-basins also have a maximum number of acres that are allowed to be irrigated under the Arizona decree (Table 4-1).

Table 4-1. Maximum Allowable Irrigated Acreage Using Diversions from the San Francisco and Gila Rivers

Sub-Basin	Maximum Irrigated Acres per Year
San Francisco Basin	
Luna	225
Apache Creek Aragon	316
Reserve	725
Glenwood	1,003
Gila Basin	
Upper Gila	287
Cliff-Gila and Buckhorn-Duck Creek	5,314
Red Rock	1,456

4.5.1.2 Virden Valley

In the Virden Valley, applications for domestic and stock wells are approved for an amount of water not to exceed 3.0 acre-feet per year for domestic and livestock uses and 1.0 acre of non-commercial lawn, garden, or trees. Under the Arizona decree, a total of 265 acre-feet consumptive use is allowed (376 U.S. 340, 350) in addition to the uses confirmed by the Globe Equity Decree.

The 3.0 acre-feet per year refers to the total volume of water, regardless of the number of supplemental wells that exist for a given acreage. That is, the total diversion of water from all wells associated with the acreage may not exceed 3.0 acre-feet per acre per year delivered at the wells. The combined diversion of water from all sources for all uses shall not exceed 6.0 acre-feet per acre per year. The maximum total consumptive use of the underground water in the entire basin is limited to 838.3 acre-feet per year.

At this time, metering regulations do not exist for Virden Valley, and the volume of water diverted is not measured by any modeling system.

4.5.1.3 San Simon Basin

The San Simon Basin was declared in 1960 and extended in 1963. It covers an area of 263 square miles. Groundwater use is limited in the basin, pursuant to the Globe Equity Decree (Section 4.2.1.1).

Applications for domestic and stock wells in the San Simon Basin are approved for an amount of water not to exceed 0.6 ac-ft/yr and not to exceed 0.10 acre of non-commercial lawn, garden, and trees. San Simon Basin residents cannot divert underground water sources for irrigation purposes for more than a total of 2,900 acres per year. Within the San Simon Creek and Basin areas, consumptive water use for any purpose cannot exceed 72,000 acre-feet during any period of ten consecutive years or 8,220 acre-feet during any one year.

Metering of wells is not currently required in the San Simon Basin.

4.5.2 Mimbres Valley Basin

The Mimbres Valley Basin encompasses 4,279 square miles, of which approximately 1,003 square miles are closed. The Mimbres Valley Basin was first declared in 1931 and originally encompassed an area of 762 square miles. In 1956, the Mimbres Valley Basin was extended. At the same time, the entire basin was closed to the appropriation of water for irrigation, industrial, and municipal purposes. In 1959, the State Engineer reopened the Franklin area (Eastern Extension) and extended the boundaries of the basin further, without closing the newly extended areas. The Mimbres Valley Basin Adjudication is complete. The water rights identified in the adjudication are listed in a nine-volume publication; no summary listing the total adjudicated water rights exists (Whatley, 2004).

Based on a study conducted by the OSE, the economic non-pumping level is 128 feet. In other words, the non-pumping water level in any of the administrative blocks that the basin is divided into cannot be lower than 128 feet. Blocks where a projected non-pumping level for existing rights is less than 128 feet indicate that water may be available for appropriation. The 1,003 square miles that were closed by the State Engineer will remain closed to new appropriations of groundwater.

Applications for groundwater appropriations from the Mimbres Valley Basin are reviewed by considering administrative blocks consisting of four sections. The average non-pumping water level that is calculated for existing rights within each administrative block is assumed to be the non-pumping water level at the beginning of the irrigation season. Applications will be considered on the basis of the non-pumping level of 128 feet and calculated water level declines resulting from the exercise of existing rights and new appropriations projected. A nine-block

template area (36 sections) will be considered in which the proposed diversion point will be located in the center or subject block. In general, any well for a proposed appropriation should be located at least ¼ mile from an existing well. An exception may be made if the calculations show that the local effects caused by the proposed appropriation will not impair existing rights or if the applicant can demonstrate that it is not feasible to locate the new well ¼ mile from the existing well.

A new groundwater appropriation may be granted within a subject block if the calculated average water level decline rate is less than 2.50 feet per year. The proposed appropriation cannot exceed the non-pumping level of 128 feet. When the new groundwater appropriations cause the non-pumping water level to reach 128 feet or cause the annual water level decline to exceed 2.50 feet per year, the block will be labeled "critical" and no new groundwater appropriations will be granted in that block. If a new appropriation causes an adjoining block to become critical, further restrictions apply. A groundwater appropriation may be granted in a subject block that adjoins a critical block if the accumulated calculated effect of pumping does not exceed a water level decline rate of 2.0 feet per year in the critical block. No further appropriation will be granted in a subject block that will cause a water level decline rate exceeding 2.0 feet per year in the critical block.

Proposed groundwater appropriations in the Eastern Extension will be considered based on these same criteria. In addition, applications for new groundwater appropriations in the Eastern Extension will also be limited to the shallow aquifer, and the well depth will be limited to the clay bed encountered at about 230 feet below ground surface (bgs). The OSE will determine the maximum depth to which each well may be completed after reviewing a well log or drill cuttings.

Existing conditions and water level declines for pending and future application will be estimated using a computer model. In this model, it is assumed that where the transmissivity is 2,500 square feet per day (ft^2/d) or greater, a well is capable of producing 1,000 gallons per minute. If the transmissivity is 1,500 ft^2/d or less, a well would produce 500 gallons per minute.

Because the Gila and Mimbres Rivers are fully appropriated, new groundwater appropriations that cause a depletion in surface flows of more than 0.10 ac-ft/yr will not be granted unless the surface water depletion is fully offset.

In the Mimbres Valley Basin north of Township 21S, the surface water depletion due to the proposed appropriation cannot exceed 0.25 ac-ft/yr unless the depletion is offset. The nine-block template is not used to determine the effects on the surface water in this area.

In general, the amount of water that can be appropriated will vary from well to well. Table 4-2 summarizes the transmissivity, the volume production of the well, and allowable diversions for an application. The application can be approved for irrigation or for other uses. These acreages and volumes can be amended if the applicant can show to the OSE's satisfaction that the proposed criteria do not apply at the place of the appropriation.

Table 4-2. Guidelines for Groundwater Appropriation

Transmissivity (ft^2/d)	Volume produced (gpm)	Acres Allowed for Irrigation	Acre-Feet Allowed for Uses Other than Irrigation
500	300	60	300
1500	500	100	500
2500	1000	200	1000

ft^2/d = Square feet per day gpm = Gallons per minute

The Mimbres Valley Basin has several subsections, including (1) the artesian aquifers located below the Gila Group and (2) the San Vicente Arroyo channels. Requirements for these two units are:

- Applications to appropriate from the artesian aquifers located below the Gila Group will be considered on a case-by-case basis. These aquifers are located generally south of Silver City. No proposed appropriations will be granted if the criteria set out above are not met. The nine block template will not be used because the substantial effect of the artesian appropriation would occur beyond the nine block area. If the proposed appropriation is from a known aquifer, the applicant must specify whether the proposed source is shallow or artesian.

- The San Vicente Arroyo and its tributaries travel into the vicinity of Silver City, Tyrone, Bayard, and Hurley. For each application to appropriate water from the alluvium of the channels of the San Vicente, a study must be conducted to determine the amount of

water in storage in the alluvium, the amount of existing rights pumping from that source, and the amount of water, if any, available for appropriation. In general, new appropriations in the alluvium should not impact existing alluvium wells to the extent that the existing wells are required to be deepened into the underlying formation in an attempt to regain a water supply lost as a result of the new appropriation. The transmissivity of the lower beds might be very low and there is no assurance that sufficient water would be obtained by deepening.

4.5.3 Rio Grande Basin

The Rio Grande Basin covers 26,209 square miles along the Rio Grande in the center of the state. Only a small portion of the basin lies within the Southwest Region. Although specific administrative criteria exist for the area near the river (Rio Grande), the OSE has no unique administrative criteria for the portion of the Rio Grande Basin that lies within the Southwest Region. Water rights applications will be evaluated to determine whether the granting of the application will impair existing water rights or be detrimental to the public welfare or contrary to the conservation of water.

4.5.4 Lower Rio Grande Basin

The Lower Rio Grande Basin is an area encompassing 3,858 square miles, located generally south of Elephant Butte Reservoir and north of the Mexico/New Mexico boundary. Only a small portion of the basin falls within the Southwest Region (Figure 4-1). Since the Rio Grande is fully appropriated, proposed groundwater diversions must not impair existing water rights in wells of other ownership, and any decrease in surface water resources resulting from additional groundwater pumping would need to be offset. Further, the proposed appropriation cannot impair the existing water quality for domestic, municipal, agricultural, industrial, and other beneficial uses. A groundwater appropriation may be granted if unappropriated water is available to the well from the aquifer at the proposed point of diversion. When determining whether to grant a water right application, the OSE will also consider whether the appropriation is contrary to water conservation within the state or whether it is detrimental to the public welfare of the state.

4.5.5 Gallup Basin

The OSE declared the Gallup basin in 1980 and significantly extended it in 1994. The basin covers a total area of 5,424 square miles, the southwestern portion of which lies in northwest Catron County and covers 1,924 square miles. The OSE has no unique administrative criteria for the Gallup Basin. Water rights applications will be evaluated to determine whether the granting of the application will impair existing water rights or be detrimental to the public welfare or contrary to the conservation of water.

4.5.6 Animas Valley Basin

The Animas Valley Basin was declared in 1948 and covers 426 square miles in Hidalgo County. The OSE considers the basin to be fully appropriated and will not accept applications for new appropriations. The OSE will accept water rights permits for domestic and livestock uses under NMSA 72-12-1. However, Hidalgo County subdivision regulations allow only 0.6 acre-foot per household, which is more restrictive than the 3 acre-feet allowed under the statute. Transfers of existing water rights are evaluated to determine whether the granting of the application will impair existing water rights or be detrimental to the public welfare or contrary to the conservation of water.

4.5.7 Playas Valley Basin

The OSE declared the 515-square mile Playas Valley Basin in 1956. The basin lies entirely within Hidalgo County and is fully appropriated. The OSE will accept only water rights permits for domestic and livestock uses under NMSA 72-12-1. However, Hidalgo County subdivision regulations allow only 0.6 acre-foot per household, which is more restrictive than the 3 acre-feet allowed under the statute.

In the past, some water rights have been cancelled or withdrawn through non-use, in which cases the water became available for appropriation. Applicants interested in appropriating water in the basin (as well as in any other fully appropriated basin) should contact the OSE to discuss whether new appropriations may go forward due to a permit cancellation.

Administration of water within the Playas Valley Basin is based on 3-mile-wide strips across the basin in an east-west direction. Transfers between these strips are not allowed. Transfers within strips will be evaluated to determine whether the granting of the application will impair existing water rights or be detrimental to the public welfare or contrary to the conservation of water.

4.5.8 Lordsburg Basin

The Lordsburg Basin is a 330-square mile basin on the border between Hidalgo and Grant Counties. The OSE declared the basin in 1960 and considers it to be fully appropriated, which means that no new appropriations will be allowed, although the OSE will accept permits for domestic and livestock under NMSA 72-12-1. Again, however, Hidalgo County subdivision regulations allow only 0.6 acre-foot per household, which is more restrictive than the 3 acre-feet allowed under the statute.

Administration of water within the Lordsburg Basin is based on four-section blocks, each having a drawdown limit of 200 feet below land surface. Transfers between blocks are not allowed. Impacts of transfers within one block are calculated with respect to the four surrounding blocks. If the proposed transfer would increase drawdown in these other blocks, the OSE will not approve the transfer.

4.5.9 Nutt-Hockett Basin

The Nutt-Hockett Basin covers 133 square miles, 98 of which are in Luna County. The basin was declared in 1961 and was extended in 1965. The OSE has completed a hydrographic survey of all the lands and water rights in the basin, including field surveys that determine the actual acreage of valid water rights. Approximately 11,500 acres of land have water rights in this basin. No surface water rights exist. A comprehensive list of all water rights in the Nutt-Hockett basin is available on the OSE website (http://www.ose.state.nm.us/water-info/legal/nutt-hockett/nutt-hocket-menu.html).

This basin is part of an active adjudication, and the actual amounts of the water rights, diversion, and consumptive use per acre have yet to be determined by the Court. The OSE has

issued offers of judgment to all claimants for the amounts listed in the hydrographic survey. Many individuals have accepted offers of judgment and orders have been entered in those subfiles, thus finalizing most of the water rights acreage in this basin. The United States is currently negotiating acceptance of an offer of judgment for one water right.

The basin is fully appropriated and no new water rights applications will be processed, although the OSE will process domestic and livestock permits under NMSA 72-12-1. In order to obtain water rights in this basin, a person must either purchase or lease existing ones and have the water right transferred to the new point of diversion and place of use. Water rights in the portions of the basin that were established in the 1965 extension may not be moved into the portions declared originally in 1961. The 1965 extension area includes T19S R4W Sections 19, 20, and 28-34, T19S R5W Sections 20 through 29, and T20S R4W Sections 3 through 5, 8, 9, 16, 17, 19, 20, and 30.

4.6 Major Water Rights Holders in the Region

In addition to the water rights defined by the various decrees discussed in Section 4.2.1, major water rights and irrigated landholders in the planning region were identified from various sources, including the OSE WATERS database and conversations with community personnel, regional ranchers, agriculture extension agents, and the water resource managers for the copper mines and plants in Grant and Hidalgo Counties. Water rights held by some of the key users in the region are shown in Table 4-3. Although the WATERS database has much information on water rights, these data have not been verified and cannot be relied on to determine the number of water rights in the region. In addition, the Southwest New Mexico Regional Water Planning Steering Committee did not consider much of the information provided in the OSE WATERS database to be accurate; hence, that information is not included in this water plan.

In New Mexico, water rights are based on actual use. Validation of existing water rights takes place through an adjudication by the OSE that begins with a hydrographic survey, which documents all water rights in place. The Southwest Region contains numerous surface water areas and 10 OSE-declared groundwater basins, some of which have been adjudicated. The

Table 4-3. Water Rights Held by Public Water Systems

Water Rights Holder	Water Rights Amount (ac-ft/yr)
Catron County	
Aragon MDWCA	8.54
Homestead Landowners Association	10
Pietown MDWCA	30
Quemado Water Works MDWCA	19.36
Rancho Grande Water Association	30
Reserve Water Works	146.84
Grant County	
Arenas Valley	150 from SVC
Bayard Municipal Water	397 + 70
Casa Adobes	77
Santa Clara Water System	514.8
Silver City Water System	4,430.92
Whiskey Creek Mobile Ranch	23.31
Hidalgo County	
Animas School System	42
Glen Acres Water Coop	149.705
Lordsburg Water Supply System	2,030
Playas Townsite Water System	340
Virden Water System	26.49
Luna County	
Columbus Water System	119.1 757.2 654
Deming Municipal Water System	4,444

Note: Information provided by water rights holders to Engineers, Inc. in 2003; this information has not been independently verified

ac-ft/yr = Acre-feet per year
MDWCA = Mutual domestic water consumers association
SVC = Silver City

water rights in the region that have been adjudicated are summarized in Table 4-4. The remainder of the region has not been adjudicated. Not all adjudications included groundwater, although the OSE manages the groundwater basins to protect surface water. Additionally, withdrawals from domestic wells can take place in basins that have been adjudicated, resulting in additional water use in the basin above and beyond the adjudicated amount. Basins that have been adjudicated include:

- *Nutt-Hockett Basin:* The Basin is fully adjudicated except for one sub-file involving water rights of the United States. The total amount of adjudicated water rights has not been compiled (Hoffman-Dooley, 2004).

- *Mimbres Basin:* A Final Decree for the Mimbres River Stream System and Mimbres Underground Water Basin was entered in the District Court of the Sixth Judicial District, Luna County, New Mexico, on January 14, 1993. Nine volumes of the computerized record file compiling the court orders in each sub-file are available for review at the Clerk's Office of the Luna County Courthouse in Deming, and the OSE Deming and Santa Fe offices. The total amount of adjudicated water rights has not been compiled (Whatley, 2004).

- *Gila, San Francisco, and San Simon Basins:* These basins have been adjudicated as discussed in Section 4.2.1 and are administered as described in Section 4.5.1.

For areas not included in adjudications, no comprehensive inventory exists that allows for a determination of total water rights. In order to fully identify water rights in unadjudicated areas, the OSE would have to conduct a hydrographic survey that inventories the rights.

Finally, a significant portion of the underground water in Hidalgo County and lesser portions in Luna and Grant Counties are undeclared. The OSE has no jurisdiction over these undeclared areas, and therefore, no public record of water rights in those areas exists.

Table 4-4. Summary of Adjudicated Water Rights
Southwest New Mexico Water Planning Region

Basin [a]	Owner	Decree / Act	Year	Stream	Total Irrigated Acreage (acres)	Water Rights (acre-feet)	
						Per Year	10-Year Period
Gila	Upper Valley Defendants (including Virden Valley irrigators)	Globe Equity Decree No. 59 (Gila Decree)	1935	San Carlos Reservoir (Gila River)	40,000	120,000 [b]	---
Gila-San Francisco	Virden Valley irrigators	*Arizona v. California* Decree (1964 decree)	1964	San Simon Creek	2,900	8,220	72,000
				San Francisco River	2,269 [c]	4,112	31,870
				Gila River above the Virden Valley	7,057 [d]	15,895	136,620
Gila-San Francisco	New Mexico water users	Colorado River Basin Project Act	1968	Gila River, its tributaries and groundwater	---	18,000 [e]	180,000 [e]
Gila-San Francisco	Gila National Forest	*Mimbres Valley Irrigation Co. v. Salopek*, Amended Stipulation	1990	---	---	5	---
Mimbres	Multiple New Mexico water users	Final Decree for the Mimbres River Stream System and Mimbres Underground Water Basin	1993	Mimbres River	---	Not compiled (Whatley, 2004)	
Nutt-Hockett [f]	Multiple New Mexico water users	Offers of judgment and subfile orders for individual water rights holders	1999 to 2004	Groundwater only	---	Not compiled [g] (Hoffman-Dooley, 2004)	

[a] No adjudications have been completed for the Playas Valley, Lordsburg, Gallup, Animas Valley, or portions of the Rio Grande Basins that fall within the Southwest Region.

[b] Individual users are limited to 6 acre-feet per year per acre. The 120,000 total includes Arizona as well as New Mexico Upper Valley Users.

[c] Limits for individual areas:

Luna Area	225 acres
Apache Creek Aragon Area	316 acres
Reserve Area	725 acres
Glenwood Area	1,003 acres

[d] Limits for individual areas:

Upper Gila Area	287 acres
Cliff-Gila and Buckhorn-Duck Creek Area	5,314 acres
Red Rock Area	1,456 acres

[e] Recent legislation limited the CAP allotment to 14,000 ac-ft/yr on average or 140,000 acre-feet over a 10-year period.

[f] Fully adjudicated except for one sub-file involving water rights of the United States (Hoffman-Dooley, 2004)

[g] Duty of water per acre of land has not yet been determined (Order Regarding Postponement of Adjudication of Amount of Water in Offers of Judgment and Subfile Orders Nunc Pro Tunc, June 12, 2003)

— = Not specified

5. Water Supply

This section provides an overview of the water supply in the Southwest Region, including weather conditions (Section 5.1), surface water and groundwater supplies (Sections 5.2 and 5.3), and water quality (Section 5.4). The information presented is drawn from water supply studies conducted in the planning region by a number of researchers, as referenced throughout this section; a complete bibliography of reference materials available to the DBS&A team is provided in Appendix A1. In conjunction with preparing this regional water plan, DBS&A identified uncertainties in the available data regarding supply and demand in the Southwest Region. These data gaps are discussed in Appendix D1. Section 7, which discusses groundwater budgets, provides further detail regarding the knowledge of the groundwater system in each geologic basin and the reconciliation of surface water and groundwater supplies with projected demand.

5.1 Climate

The varied terrain of the Southwest Region, which ranges from mountains to the Chihuahuan Desert, results in significant climate variations. For example, temperatures range from lows well below 0 degrees Fahrenheit (°F) in the mountains to highs in excess of 100°F in the plains.

DBS&A identified 48 climate data collection stations that have historically been and/or are currently located in the Southwest Region. Of these 48 stations, 19 were used to characterize climatic conditions in the region. Only stations that had complete data sets were used for evaluation. In addition to completeness of the records, the 19 weather stations were selected based on location and how well they represented conditions in the county. For example, where two stations are located in close proximity, the station with the longest record was selected to be representative of local conditions in that area. Table 5-1 lists the periods of record for the 48 identified weather stations in the Southwest Region and indicates the 19 stations analyzed in more detail; Figure 5-1 shows the locations of the 19 selected stations.

6. Water Demand

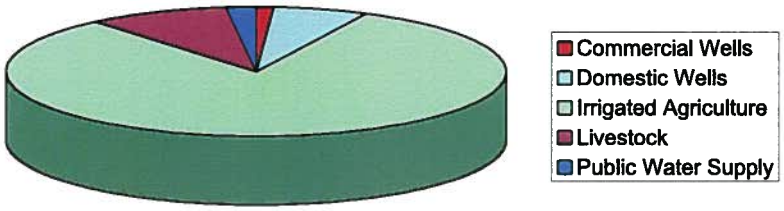
This section focuses on the second regional water planning question: What is the region's current and projected future demand for water? To address this question, current and historical water uses within the Southwest Region have been evaluated and are presented in Section 6.1. In order to estimate future water demand, it is important to understand demographic and economic trends in the region, and these are presented in Section 6.2. Based on current and historical uses and demographic and economic trends, projected future water demands for the region are presented in Section 6.3.

6.1 Present Uses

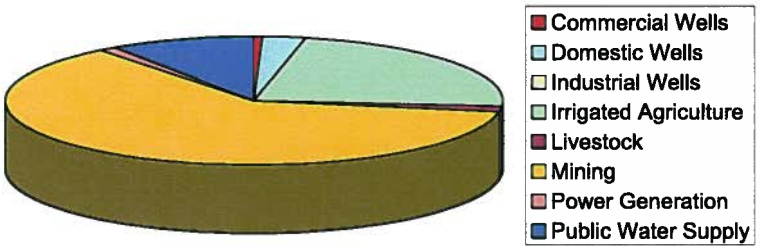
Present and historical water use (Figures 6-1 and 6-2, respectively) was determined based on information from the OSE, which tracks water use in New Mexico, supplemented with information contributed by water users within the region. OSE tracks withdrawals, depletions, and return flow in several categories, including public water supply and self-supplied domestic, irrigated agriculture, self-supplied livestock, self-supplied commercial, industrial, mining, power, and reservoir evaporation. Table 6-1 shows withdrawals and depletions in each category for the years 1975, 1980, 1985, 1990, 1995, and 2000 based on the OSE inventories for those years, and Figure 6-2 shows withdrawals for the same years (Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003). No data from before 1975 are available. Appendix E1 provides the same data by county.

Over the years, the OSE has made a few changes in the way that water demand is categorized and reported, including:

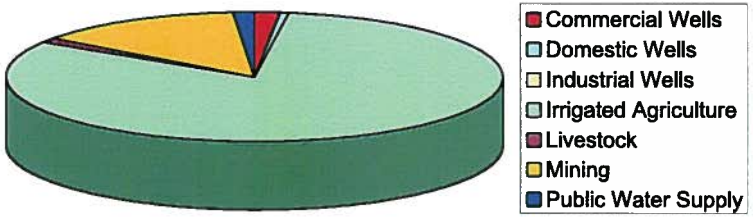
- Fish and wildlife and recreation were previously (1975 through 1985) reported as separate categories, but are now included in the commercial category.
- Rural, urban, and military uses were separate categories until 1990, when they were replaced with the public water supply and self-supplied domestic categories.
- The OSE stopped reporting stock pond evaporation (which was previously a separate category) after 1985.



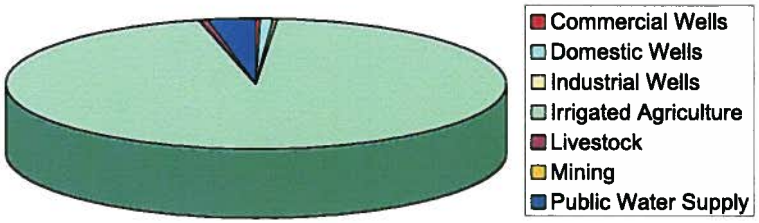
Catron County



Grant County



Hidalgo County



Luna County

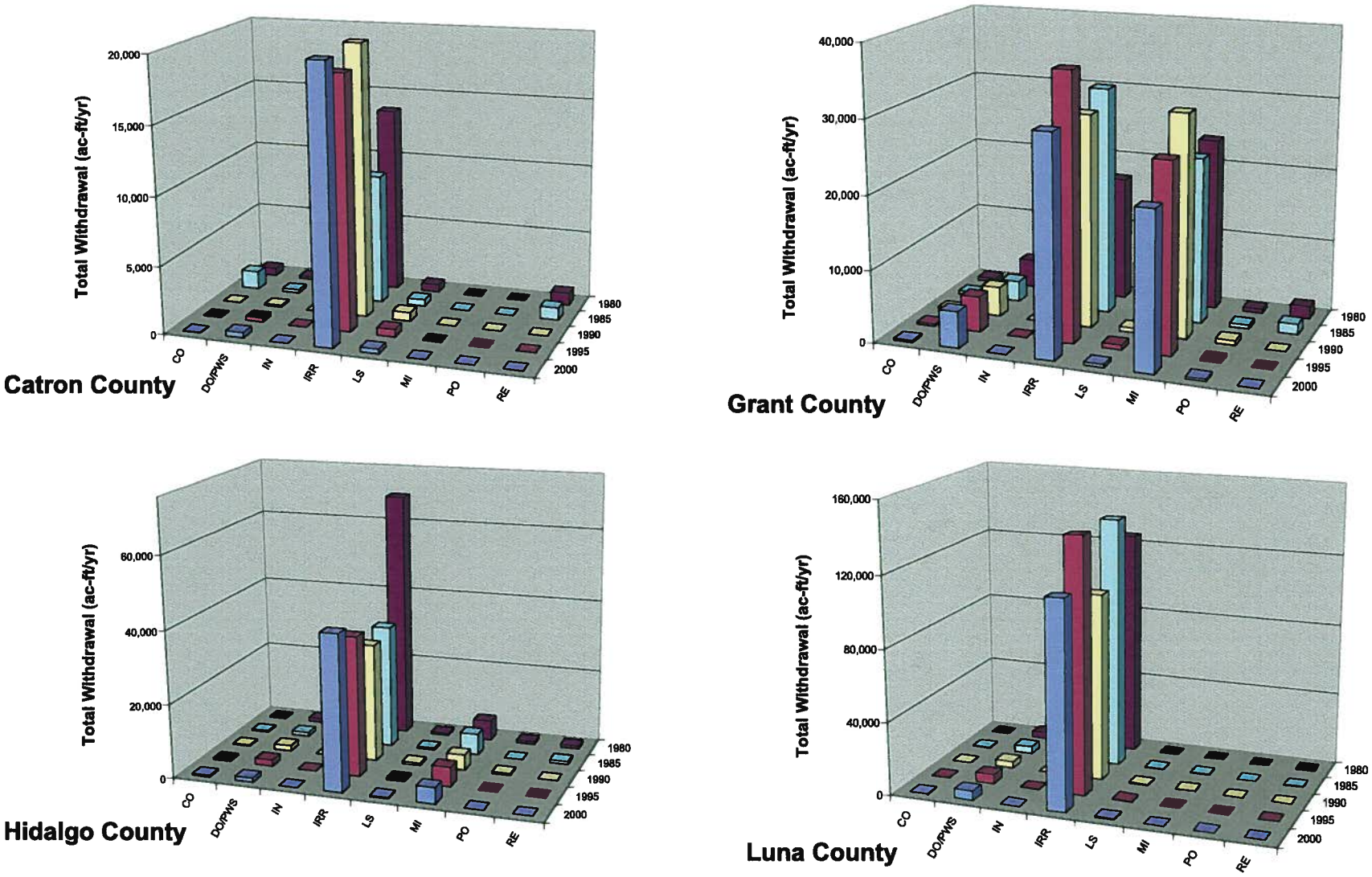
Figure 6-1

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Current Water Use

Daniel B. Stephens & Associates, Inc.

5/25/05



CO = Commercial (self-supplied)
DO/PWS = Self-supplied domestic/public water supply
IN = Industrial (self-supplied)
IRR = Irrigated agriculture
LS = Livestock (self-supplied)
MI = Mining (self-supplied)
PO = Power (self-supplied)
RE = Reservoir Evaporation

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Historical Withdrawals

Daniel B. Stephens & Associates, Inc.

5/25/05

Figure 6-2

Table 6-1. Water Use in the Southwest New Mexico Water Planning Region, 1975 Through 2000
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Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
2000 Water Year									
Commercial (self-supplied)	8	973	8	861	0	112	981	869	112
Domestic/public supply	176	11,461	88	7,216	88	4,245	11,637	7,304	4,333
Industrial (self-supplied)	0	72	0	56	0	16	72	56	16
Irrigated agriculture	76,645	129,256	21,102	81,125	55,543	48,131	205,901	102,227	103,674
Livestock (self-supplied)	502	993	502	993	0	0	1,495	1,495	0
Mining (self-supplied)	0	25,832	0	21,330	0	4,502	25,832	21,330	4,502
Power (self-supplied)	0	280	0	280	0	0	280	280	0
Reservoir evaporation	0	0	0	0	0	0	0	0	0
Totals	77,331	168,866	21,700	111,860	55,631	57,006	246,197	133,561	112,637
1995 Water Year									
Commercial (self-supplied)	8	916	8	558	0	358	924	566	358
Domestic/public supply	126	11,717	63	6,355	63	5,362	11,843	6,418	5,425
Industrial (self-supplied)	0	143	0	89	0	54	143	89	54
Irrigated agriculture	77,738	156,245	19,383	93,418	58,355	62,827	233,983	112,801	121,182
Livestock (self-supplied)	760	1,339	760	1,339	0	0	2,099	2,099	0
Mining (self-supplied)	0	31,277	0	25,547	0	5,730	31,277	25,547	5,730
Power (self-supplied)	0	283	0	283	0	0	283	283	0
Reservoir evaporation	0	0	0	0	0	0	0	0	0
Totals	78,632	201,920	20,214	127,589	58,418	74,331	280,552	147,803	132,749
1990 Water Year									
Commercial (self-supplied)	8	709	8	447	0	262	717	455	262
Domestic/public supply	126	9,345	63	5,000	63	4,345	9,471	5,063	4,408
Industrial (self-supplied)	0	172	0	134	0	38	172	134	38
Irrigated agriculture	57,285	127,748	11,741	76,935	45,544	50,813	185,033	88,676	96,357
Livestock (self-supplied)	809	1,533	809	1,531	0	2	2,342	2,340	2

Note: A breakdown of water use by county is provided in Appendix E1.
Source: Wilson et al., 2003. See note at the end of the table for general description of the procedures used to obtain these estimates.

SW = Surface water
GW = Groundwater

Table 6-1. Water Use 1975 Through 2000, Southwest New Mexico Water Planning Region
Page 2 of 3

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
1990 Water Year (continued)									
Mining (self-supplied)	0	35,015	0	28,753	0	6,262	35,015	28,753	6,262
Power (self-supplied)	0	1,123	0	1,123	0	0	1,123	1,123	0
Reservoir evaporation	0	0	0	0	0	0	0	0	0
Totals	58,228	175,645	12,621	113,923	45,607	61,722	233,873	126,544	107,329
1985 Water Year[a]									
Commercial	1,752	820	962	444	790	376	2,572	1,406	1,166
Domestic/Public Supply	0	7,890	0	3,938	0	3,952	7,890	3,938	3,952
Industrial	0	10	0	5	0	5	10	5	5
Irrigated Agriculture	70,195	144,220	14,702	69,118	55,493	75,102	214,415	83,820	130,595
Livestock	1,049	1,122	1,049	1,115	0	7	2,171	2,164	7
Minerals	10,087	18,885	4,156	14,743	5,931	4,142	28,972	18,899	10,073
Power	0	556	0	556	0	0	556	556	0
Reservoir Evaporation	3,373	0	3,373	0	0	0	3,373	3,373	0
Totals	86,456	173,503	24,242	89,919	62,214	83,584	259,959	114,161	145,798
1980 Water Year[a]									
Commercial	1,015	570	984	355	31	215	1,585	1,339	246
Domestic/Public Supply	0	8,637	0	4,309	0	4,328	8,637	4,309	4,328
Industrial	0	10	0	6	0	4	10	6	4
Irrigated Agriculture	37,680	186,190	12,650	116,730	25,030	69,460	223,870	129,380	94,490
Livestock	1,108	1,140	1,108	1,133	0	7	2,248	2,241	7
Minerals	9,936	19,683	4,019	15,248	5,917	4,435	29,619	19,267	10,352
Power	0	1,243	0	1,243	0	0	1,243	1,243	0
Reservoir Evaporation	3,622	0	3,622	0	0	0	3,622	3,622	0
Totals	53,361	217,473	22,383	139,024	30,978	78,449	270,834	161,407	109,427

Note: A breakdown of water use by county is provided in Appendix E1.
Source: Wilson et al., 2003. See note at the end of the table for information regarding the procedures used to obtain these estimates.
[a] Water use categories originally reported by OSE in 1975, 1980, and 1985 revised to reflect current OSE reporting categories

SW = Surface water
GW = Groundwater

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Table 6-1. Water Use 1975 Through 2000, Southwest New Mexico Water Planning Region
Page 3 of 3

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
1975 Water Year [a]									
Commercial	802	0	802	0	0	0	802	802	0
Domestic/Public Supply	0	7,978	0	3,984	0	3,994	7,978	3,984	3,994
Industrial	0	162	0	97	0	65	162	97	65
Irrigated Agriculture	30,730	229,270	13,490	133,430	17,240	95,840	260,000	146,920	113,080
Livestock	1,176	1,174	1,176	1,174	0	0	2,350	2,350	0
Mining	9,393	15,553	4,978	10,921	4,415	4,632	24,946	15,899	9,047
Power	0	336	0	336	0	0	336	336	0
Reservoir Evaporation	15,852	0	15,852	0	0	0	15,852	15,852	0
Totals	57,953	254,473	36,298	149,942	21,655	104,531	312,426	186,240	126,186
1975 to 2000 Average [a]									
Commercial	599	665	462	444	137	220	1,263	906	357
Domestic/Public Supply	71	9,505	36	5,134	36	4,371	9,576	5,169	4,407
Industrial	0	95	0	64	0	30	95	64	30
Irrigated Agriculture	58,379	162,155	15,511	95,126	42,868	67,029	220,534	110,637	109,896
Livestock	901	1,217	901	1,214	0	3	2,117	2,115	3
Mining	4,903	24,374	2,192	19,424	2,711	4,950	29,277	21,616	7,661
Power	0	637	0	637	0	0	637	637	0
Reservoir Evaporation	3,808	0	3,808	0	0	0	3,808	3,808	0
Totals	68,660	198,647	22,910	122,043	45,751	76,604	267,307	144,953	122,354

Note: As outlined by Wilson et al. (2003), these water use values are a combination of measured and estimated values. Statewide, the portion of withdrawals that are directly measured are:

Commercial:	67.96%	Livestock	21.14
Domestic:	0.0	Mining	99.98
Public water supply:	96.00	Power	99.98
Industrial	99.94	Reservoir evaporation	95.77
Irrigated agriculture	52.54		

Note: A breakdown of water use by county is provided in Appendix E1.

SW = Surface water
GW = Groundwater

[a] Water use categories originally reported by OSE in 1975, 1980, and 1985 revised to reflect current OSE reporting categories

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The OSE data include only the amount of water that is used by people or is indirectly used through a man-made structure (i.e., reservoir evaporation) and thus do not include natural riparian consumption. Estimates for riparian consumption are provided in the water budget discussed in Section 7. Information for each of the current OSE categories is summarized and discussed in Sections 6.1.1 through 6.1.5.

Water use data were also obtained from selected communities in the region. These data include pumped and metered water quantities for the years of 2000 through 2002 (Appendix E2). This information was used to help develop the water use projections presented in Section 6.3. Water use in each surface water and groundwater basin is also discussed in Section 7.

6.1.1 Public Water Supply and Self-Supplied Domestic

These two OSE categories include domestic use from both public water supplies that serve whole communities and private domestic wells that serve only one or a few residences, as discussed in Sections 6.1.1.1 and 6.1.1.2, respectively.

6.1.1.1 Public Water Supply

This category includes community water systems that rely on surface water and/or groundwater diversions other than private domestic wells and that consist of common collection, treatment, storage, and distribution facilities operated for the delivery of water to multiple service connections (Wilson et al., 2003). Water used for the irrigation of self-supplied golf courses, playing fields, and parks, or water used to maintain the water level in ponds and lakes owned and operated by a municipality or water utility is also included in this category. Inclusion of these uses allows comparison of the total amount of water used by the system to the water rights owned by these public water suppliers.

Information on public water systems in the four counties was compiled from the New Mexico Rural Water Association records and is summarized in Appendix E2, Tables E2-1 through E2-4. As indicated on these tables, 37 public water systems in the planning region are registered with the New Mexico Rural Water Association. The public water systems listed include both

incorporated municipalities and smaller mutual domestic associations, such as mobile home communities.

The water use details in Appendix E2 are summarized in Table 6-2. All of the municipalities listed rely totally on groundwater, and the amounts shown on Table 6-2 represent total system pumping (or total withdrawals). To aid in assessing seasonal variability, available information on monthly withdrawals (well pumping), based on metered water diversions for each municipality, is shown in Appendix E2. As indicated by the figures in Appendix E2, most of the municipalities show increased diversions in the summer months, corresponding to increased outdoor watering.

Table 6-2. Summary of Municipal and Per Capita Water Demand

Location	Estimated Population Served [a]	Water Pumped				Estimated Per Capita Demand (gpcd)		
		2001		2002				
		M gal	ac-ft	M gal	ac-ft	2000 [b]	2001	2002 [c]
Catron County								
Reserve	318	25.6	78.6	28.7	88.1	NA	221	247
Grant County								
Bayard	2,536	106.3	326.2	109.7	336.6	126	115	118
Santa Clara	1,944	82.0	251.6	74.6	228.9	117	116	105
Silver City [d]	13,700	928.0	2,847.5	918.8	2,819.2	234	186	184
Hidalgo County								
Lordsburg	3,300	NA	NA	254.5	780.9	216	NA	211
Luna County								
Columbus	1,765	NA	NA	67.9	208.3	126	NA	105
Deming	16,000	1,310.0	4020.5	1,328.0	4,074.8	223	224	227
Total	39,563	2,451.9	7,524.4	2,782.2	8,536.9	---	---	---

[a] Estimated population in the water service area may differ from the estimated population in the incorporated community discussed in Section 6.2.
[b] Source: Wilson, 2001
[c] Gallons pumped based on water system records supplied to Engineers Inc., divided by population served.
[d] Silver City's water system provides bulk water to Arenas Valley, Pinos Altos, Rosedale, and Tyrone.

M gal = Million gallons
ac-ft = Acre-feet
gpcd = Gallons per capita per day
NA = Not available

Table 6-3 shows the overall per capita demand for each county based on the total diversions for all public water supply systems presented in Appendix E2.

Table 6-3. Summary of Total Diversions and Per Capita Demand for Public Supply Wells in 2000

County	Municipal Well Diversions (ac-ft/yr)	Population Served by Public Wells	Per Capita Demand	
			(ac-ft/yr)	(gpd)
Catron	150	860	0.17	156
Grant	3,920	21,860	0.18	160
Hidalgo	880	3,940	0.22	199
Luna	4,320	18,250	0.24	211

ac-ft/yr = Acre-feet per year gpd = Gallons per day

6.1.1.2 Self-Supplied Domestic Wells

This category includes self-supplied residences, which may be single-family dwellings or multi-family dwellings, with wells permitted by the OSE under NMSA Section 72-12-1 (Section 4.4.1; Appendix C).

Diversions from domestic wells were estimated based on the 2000 census minus the population served by municipal wells (as reported by Wilson et al. [2003] and modified by Engineers Inc.) and multiplied by a per capita demand of 0.1 acre-foot per person (90 gpcd). This per capita demand value is based on the OSE (Wilson et al., 2003) estimates of average domestic use, which range between 80 and 100 gpcd. The growth rate for residential, commercial and municipal uses was equal, and therefore, the self-supplied and public supply sectors were projected to grow at the same rate. The OSE report also provides estimates of total domestic use (self-supplied domestic) in each county. Comparison of DBS&A's estimates to the OSE's for each county in the Southwest Region (Table 6-4) reveals that, overall, DBS&A's estimates are 8 percent higher than the OSE estimates. The difference is due to the revised estimates for the population served by public water supplies to adjust for some overestimates in the OSE report (Wilson et al., 2003). For instance, in Grant County, the OSE report lists both the Central Water System and the Santa Clara Village, which are actually the same system, thus effectively doubling the estimated population served by that system.

Actual diversions from domestic wells may be higher in the Gila and San Francisco Basins, where water rights have reportedly been transferred to domestic wells for extensive gardening (Howard Hutchison, personal communication with John Burkstaller, April 2005).

Table 6-4. Comparison of Estimates of Domestic Well Diversions by County

Estimate Source	Estimated Domestic Well Diversions (ac-ft/yr[a])				
	Catron	Grant	Hidalgo	Luna	Total
DBS&A	268	923	200	676	2,067
OSE[b]	224	778	193	717	1,913
Difference	44	144	6	-41	154
Difference (%)	20	19	3	-6	8

[a] Unless otherwise noted

[b] Wilson et al., 2003

6.1.2 Self-Supplied Commercial, Industrial, Mining, and Power

Wilson et al. (2003) define these categories as follows:

- Commercial includes self-supplied businesses (e.g., motels, restaurants, recreational resorts, and campgrounds) and institutions. Self-supplied golf courses that are not watered by a public water supply are also included, as are off-stream fish hatcheries engaged in the production of fish for release.

- Industrial includes self-supplied enterprises engaged in the processing of raw materials or the manufacturing of durable or non-durable goods. Water used for the construction of highways, subdivisions, and other construction projects is also included.

- Mining includes self-supplied enterprises engaged in the extraction of minerals occurring naturally in the earth's crust, including (1) solids, such as coal and smelting ores, (2) liquids, such as crude petroleum, and (3) gases, such as natural gas. Water used for drilling and/or processing at a mine site is also included.

- Power includes all self-supplied power-generating facilities. Water used in conjunction with coal mining operations that are contiguous with a power-generating facility that owns and/or operates the mines is also included.

As shown in Table 6-1, the self-supplied commercial, industrial, and power categories are a relatively small part of the planning region's water demand, although water use in the power

sector is expected to increase in the future (Section 6.3). The higher commercial water uses shown in 1975, 1980, and 1985 are due to the inclusion of fish and wildlife and recreation water use estimates, which were reported for those years but are no longer estimated. The mining category in Grant County has been and will likely continue to be a major component of the water demand, as discussed below. In addition, the Mogollon Mining District in Catron County could reopen with the increase in the price of silver and gold.

Copper mining and processing in Grant County has generally taken place in primarily two areas: Tyrone, south of Silver City, and at Chino/Santa Rita, near Hurley. Water use at the mines has typically involved processing, dust control, mine dewatering, heap-leach operations, and slurry disposal of tailing materials. Phelps Dodge Mining Company (Phelps Dodge) provided information regarding water use and rights at its mines in the planning region, as summarized in Sections 6.1.2.1 through 6.1.2.4.

6.1.2.1 Chino Mine

The Chino Mines Company water rights are all based on permits in the Mimbres River Basin. The water rights information provided by Phelps Dodge (2003a) was compared, by permit number, to the data in the OSE's WATERS database, and in some instances, the WATERS information was different or missing. According to Phelps Dodge, Chino Mines Company currently retains 25,306 acre-feet of water rights in the Mimbres Valley (groundwater) Basin for use at the mine and processing facilities.

Due to reductions in mining and processing of copper ore, reported water diversions at the Chino facility has been declining in the past few years (Phelps Dodge, 2003a):

- 1999: 19,104 acre-feet
- 2000: 17,229 acre-feet
- 2001: 11,091 acre-feet
- 2002: 4,947 acre-feet

The reduction in production was in response to market conditions. As market conditions continue to improve, it is expected that use of water at the facility will approach that of more typical operation years, such as 1999.

Chino Mines Company also retains surface water diversion rights, currently in the amount of 12,138 acre-feet. Some of these surface waters may be diverted in the future for processing once the James Canyon dam/reservoir project is completed. The James Canyon reservoir will hold about 950 acre-feet of water at its normal pool elevation (URS Greiner-Woodward Clyde, 2000).

As part of ore processing, water is stored in various reservoirs or tailing ponds at the Chino facility. The mine is permitted by the OSE to store up to 4,585 acre-feet of water in their processing and tailing ponds. Based on data provided by Chino Mines Company, the water being stored is about 1,680 acre-feet, or 37 percent of the maximum.

6.1.2.2 Cobre Mine

The Cobre Mining Company division of Phelps Dodge also has permitted water rights for mining and ore processing. Based on data provided by Chino Mines Company, the annual permitted water use at the Cobre Mine is 4,753 acre-feet (Phelps Dodge, 2003b). Water use at the Cobre Mine has also declined recently due to ore production curtailment:

- 1999: 796.7 acre-feet
- 2000: 359.8 acre-feet
- 2001: 57.9 acre-feet
- 2002: 54.1 acre-feet

6.1.2.3 Tyrone Mine

Water use at the Tyrone Mine is obtained from surface diversion of the Gila River, which is pumped into Bill Evans Lake, and from wells that are in both the Gila-San Francisco and Mimbres Valley Basins. The permitted diversions are (Phelps Dodge, 2003c):

- Gila River: About 9,425 acre-feet
- Gila-San Francisco Basin: 1,309 acre–feet
- Mimbres Valley Basin: 2,090 acre-feet

The total permitted annual diversion at the Tyrone Mine is about 12,825 acre-feet. The total amount permitted for consumptive use at the mine is 8,137 acre-feet, not including 1,272 acre-

feet of water (consumptive use) that has been temporarily leased to a local rancher in the Gila River Valley. The reported water diversions for 2002 at Tyrone were about 5,021 acre-feet (Phelps Dodge, 2003c).

6.1.2.4 Hidalgo Smelter

Phelps Dodge also has permitted water rights in Hidalgo County, where they formerly operated a copper smelter. The smelter was closed in 1999 and water use at the facility has dropped considerably. The primary current water uses at the plant are maintenance and environmental compliance. The permitted, consumptive water rights for the plant are reportedly 6,648.8 acre-feet (Phelps Dodge, 2003c). An additional 340 acre-feet of water has been permitted for the company town site of Playas.

6.1.3 Self-Supplied Livestock

Livestock water use will vary from year to year in response to fluctuating numbers of livestock as market and forage conditions dictate. Limited data were available regarding livestock numbers for the Southwest Region. The total withdrawals and depletions for self-supplied livestock in the region, as presented in the last three OSE water use reports (Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003), are provided in Table 6-5. The values presented in Table 6-5 include withdrawals (also referred to as diversions) and depletions of both surface water and groundwater.

Table 6-5. Livestock Water Use

Reporting Year	Total Withdrawal (acre-feet)				Total Depletion (acre-feet)			
	Catron	Grant	Hidalgo	Luna	Catron	Grant	Hidalgo	Luna
1990	640	626	557	518	640	626	556	517
1995	557	654	441	447	557	654	441	447
2000	332	419	320	424	332	419	320	424

Virtually all the livestock in the region are cattle. The number of cattle in the four counties was estimated from New Mexico Agricultural Statistics (NMASS, 2003) (Table 6-6).

Table 6-6. Estimated Number of Cattle by County

Year	Catron	Grant	Hidalgo	Luna
2000	28,050	36,000	27,000	37,000
2001	24,000	36,000	27,000	34,000

Source: NMASS, 2003

Using the water depletion values from the OSE and cattle numbers for 2000, the water consumption per animal can be estimated, assuming that other livestock such as sheep and horses are minimal in number compared to cattle.

- Catron: 10.6 gallons per day per head (gpd/head)
- Grant: 10.4 gpd/head
- Hidalgo: 10.6 gpd/head
- Luna: 11.1 gpd/head

These per-head or per-capita consumption rates are consistent with the values presented as typical in Section 5.6 of the OSE's 2000 water use report (Wilson et al., 2003). Livestock use represents a relatively small proportion (about 1 percent) of the total depletions in the region.

Much of the livestock grazing in Grant and Catron Counties is done on federally owned forest land. Local ranchers have allotments from the U.S. Forest Service within the Gila National Forest area. In order to support grazing in the National Forest, wells, springs, and dirt tanks have been developed by the ranchers. The U.S. Forest Service has 745 recorded but not declared water use sites in the Gila National Forest, including wells, springs, and stock tanks (USFS, 2003a). Some of the sites have first use dates of around 1880. The water use breakdown (in acre-feet) at these sites is:

- Domestic: 25
- Irrigation: 40
- Stock watering: 917.15
- Recreation: 93
- Total: 1,074.60

As indicated, the majority of the water use is for stock watering. Most of the sites are springs and stock tanks that have declared water rights, typically ranging from 0.5 to 4 acre-feet. The springs and stock tanks typically respond to wet season runoff and often evaporate to very low or no volumes in the late spring. Because most of these water use sites are in the Gila-San Francisco Basin, the development of a spring or construction of a dirt stock tank that is not on the declared list can only be done if a declared site is retired and/or breached.

The USFS also maintains a list of wells within the Gila-San Francisco watershed. Currently they have 61 wells listed in that basin (USFS, 2003b).

6.1.4 Irrigated Agriculture

Irrigated agriculture is one of the largest water uses in the Southwest Region, particularly in Catron, Hidalgo, and Luna Counties. The water used for agriculture irrigates a variety of crops, ranging from primarily hay in Catron, Grant, and Hidalgo counties to a wide variety of vegetables, grains, and hay crops in Luna County.

The water use for irrigated agricultural is obtained from both surface water and groundwater sources. Luna and most of Hidalgo counties rely on groundwater sources, while irrigation in Catron, Grant, and northwest Hidalgo counties is based primarily on surface diversion from the Gila, San Francisco, and Mimbres Rivers.

Where legal decrees exist, the number of acres that can legally be irrigated are established in the decree (Section 4). However, a review of recent data indicates that the number of acres that are being or have recently been actually irrigated (referred to herein as *irrigated* land) is less than the reported total acreage that legally can be irrigated (i.e., holds water rights), referred to herein as *irrigable* land. This deviation appears to be related to variable and poor agricultural market conditions, the lack of surface water for diversion, and the transfer of agricultural water rights to municipalities and power plants. A localized reversal of this trend appears to be ongoing as the water rights owned by Phelps-Dodge's Hidalgo Smelter in southern Hidalgo County are being put back into agricultural use.

Sections 6.1.4.1 through 6.1.4.4 discuss the reported water use and irrigated acres by county in the Southwest Region, as reported by several researchers. Table 6-7 compares total irrigated crop acreage data from three of the major data sources for irrigated agricultural data: the OSE, the WRRI (Lansford et al., 1991, 1992, 1993, 1995, 1996, 1997), and the New Mexico Agricultural Statistics (NMASS). The total cropland acreage provided in the WRRI reports is based on the acreages reported by the U.S. Bureau of Indian Affairs (for Indian lands) and the U.S. Bureau of Reclamation (for Reclamation projects), acreages set forth in adjudications and court decrees and in State Engineer licenses and permits, and, where these data are lacking, recent aerial photography.

As shown in Table 6-7, differences between OSE and WRRI data are generally less than 1 percent, although in a few cases, significant differences occur that are difficult to reconcile, such as the difference between total irrigated acreage reported in Catron County in 1995 by the two agencies. The NMASS consistently under-reports total irrigated acreages relative to the other two data sources, in part because, as a national agricultural data service, it does not include in its crop totals locally important crops such as chile and other vegetable cash crops.

Table 6-7. Total Irrigated Acreage by County, 1995

County	Total Acres Irrigated in 1995		
	OSE (Wilson et al, 1997)	WRRI (Lansford et al., 1996)	NMASS (2003)
Catron	1,489	2,315	1,400
Grant	3,327	3,315	1,100
Hidalgo	10,513	10,640	5,800
Luna	45,135	45,135	19,300

The *New Mexico Stockman* (a publication of the New Mexico Cattle Growers Association) was also used as a reference for cropping patterns and irrigated acreage totals, although 1995 data were not available to compare directly with the other data sources listed above. Overall, the acreages reported in the New Mexico Stockman in 2000 and 2001 are similar to those reported by the other data sources for those years. The reference sources and data are presented in more detail in Appendix E3. In addition to the reported acreages, the total withdrawals estimated by the OSE for irrigated agriculture, as reported by the OSE, are shown on Figure 6-2, and withdrawals and depletions are summarized in Table 6-1.

6.1.4.1 Catron County

According to conversations with ranchers and farmers in Catron County (Appendix E3), most of the agriculture water use is for hay crops, including alfalfa hay, meadow hay and all other hay types. In the San Francisco and Tularosa River basins, water diverted from the rivers for irrigation is distributed by lateral ditches that are subsequently connected by gated entrances to farmland. The water is distributed based on a system of timed shares rather than by acres irrigated.

Table 6-8 summarizes the irrigated acres and use of surface water and groundwater as reported by the OSE (Sorenson, 1976, 1981; Wilson, 1986, 1992; Wilson and Lucero, 1997; Wilson et al., 2003) for Catron County.

Table 6-8. Irrigation Surface Water and Groundwater Use in Catron County

Reporting Year	Total Acres Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	NA	4,870	2,060
1980	NA	13,660	2,630
1985	NA	9,505	1,300
1990	1,541	20,022	3,033
1995	1,489	18,486	2,733
1999	1,937	19,963	2,934

NA = Information not available

Acreages reported in the New Mexico Agricultural Statistics (NMASS, 2003) and the *New Mexico Stockman* (2001, 2002) vary slightly from those presented by the OSE. Based on these sources, the total irrigable land (acreage with water rights) is about 4,000 acres while the land actually irrigated for hay crops in 2000 and 2001 ranged from about 2,300 to 2,500 acres. The reason for this discrepancy is likely due to economics: the costs of pumping water and producing the crop have increased sufficiently to remove adequate incentive to farm all the land available at all times.

According to ranchers and farmers along the San Francisco River (Appendix E3), the amount of land that is irrigated has decreased in recent years due to low flows in the river and the lateral

ditches. Thus, the irrigated acres in Catron County will likely range from about 2,000 acres (actual irrigated acreage as reported by the OSE [Wilson et al., 2003], New Mexico Agricultural Statistics Service [NMASS, 2003], and *New Mexico Stockman* [2001, 2002]) to about 4,000 acres (the estimated maximum permitted acreage). The total depletions due to irrigation fluctuate some from year to year, but have generally remained fairly constant over the past 15 years.

6.1.4.2 Grant County

Cropland in Grant County is irrigated by a combination of surface water and groundwater. According to the *New Mexico Stockman* (2001, 2002) the distribution of irrigable land in Grant County is 3,690 acres of groundwater irrigation rights, 1,840 acres of surface water irrigation rights, and 1,420 acres of combined water rights, for a total of 6,950 acres. This total irrigable acreage is the same as that reported in the New Mexico Agricultural Statistics (NMASS, 2003) and similar to the 7,340 acres of prime and important farmland shown on the Soil Conservation Service (SCS) *Important Farmlands Map* (1983).

The actual cropland that was apparently irrigated appears to vary somewhat, based on the source of the data and the dates reported. The OSE (Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003) reported that the irrigated acreage ranged from 3,327 to 3,493 acres in the period of 1990 to 2000 (Table 6-9).

Table 6-9. Irrigation Surface Water and Groundwater Use in Grant County

Reporting Year	Total Acres Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	NA	17,540	9,270
1980	NA	17,090	7,790
1985	NA	31,405	4,738
1990	3,493	29,238	5,813
1995	3,327	36,492	5,813
2000	3,422	29,871	5,813

NA = Information not available

Irrigated acres reported in the New Mexico Agricultural Statistics (NMASS, 1986, 1998) were 4,110 acres in 1986 and 4,893 acres in 1998. The *New Mexico Stockman* (2001, 2002) reported that about 2,300 acres of hay was grown in 2000 and 2,100 acres in 2001.

Irrigated agriculture in Grant County occurs primarily along the Gila and Mimbres Rivers. Much of the water that was formerly used for irrigation along the Gila River, east of U.S. Highway 180, has been acquired by the Phelps Dodge Tyrone Mine. According to mine personnel (Phelps Dodge, 2003d), 4,087 acres of irrigable acreage along the Gila River was converted to mining/industrial use and is diverted to Bill Evans Lake. The original diversion for the 4,087 acres was based on a source diversion of 2.9 acre-feet per acre or 11,853 ac-ft/yr. However, the mining/industrial diversion for this acreage is based on 1.6 acre-feet per acre or 6,582 ac-ft/yr.

Phelps Dodge Tyrone has recently leased some of the water back to a local rancher for hay production and cattle grazing. The Nature Conservancy also owns 113 acres of water rights land (2.9 acre-feet per acre) along the Gila River, above the U.S. Highway 180 bridge. About five or six farmers and ranchers are believed to also have acreage with water rights, generally ranging in size from 40 to 80 acres, above the U.S. Highway 180 bridge.

The consumptive irrigation requirement for surface irrigated land in Grant County is reported to range from 0.907 to 2.083 acre-feet per acre along the Gila River, from the upper reaches to Red Rock, respectively (Wilson et al., 2003).

Irrigation along the Gila River also occurs near Red Rock, in the southwest part of the county. The principal crop in this area appears to be alfalfa hay.

The irrigable land in the Mimbres River valley is used primarily by small ranchers and farmers to grow fruits and vegetables, along with some hay and pasture for cattle grazing. According to information provided by the OSE during a June 12, 2003 Water Master hearing for the Mimbres River, 1,485 acres of adjudicated acreage exists in the upper part of the river (above San Lorenzo). However, based on discussions at that meeting, the actual acreage irrigated is less than that amount due to very low flows recently in the river. One of the major sources of water to this part of the river is Bear Canyon Lake; however, the lake only provides 270 acre-feet of water annually to ditches along the river and thus cannot alone meet the needs of the system.

The consumptive irrigation requirement for surface irrigated land in the Mimbres River area is reported to be 1.509 acre-feet per acre (Wilson et al., 2003). The USFS (2003c) reports that diversion in the Mimbres Valley is 2.7 acre-feet per acre.

Irrigable land below San Lorenzo along the Mimbres River is also used for fruit production and some hay and cattle grazing. Based on the SCS *Important Farmlands Map* (1983), the irrigable acreage below San Lorenzo is 1,000 acres or less. The USFS (2003c) reports that a total of 2,626 acres of land with irrigation water rights exists in the Mimbres Valley. Irrigation withdrawals nearly doubled between 1980 and 1985, but although they fluctuate some from year to year, total depletions due to irrigation have generally remained fairly constant over the past 20 years.

6.1.4.3 Hidalgo County

According to the *New Mexico Stockman* (2001), the primary source of irrigation water in Hidalgo County is groundwater. Except for the Virden Valley, which is supplied primarily with surface water and some supplemental groundwater, irrigation use in the county is supplied by groundwater from the San Simon, Animas Valley, Lordsburg, Gila-San Francisco, and Playas Valley administrative basins. The reported total of irrigable acreage ranges from 40,420 acres (*New Mexico Stockman*, 2001) to 38,420 acres (NMASS, 1998). The latter figure does not include an estimated 3,300 acres of irrigable land in the Virden area, which is administered by the Gila Water Commission, based in Safford, Arizona.

The acreage that has actually been recently irrigated for crop production is estimated to be less than 50 percent of the total available irrigable acreage. Again, this discrepancy occurs because the costs of pumping water and producing the crop have increased sufficiently to remove adequate incentive to farm all the available land at all times. Table 6-10 summarizes the irrigated acreage and water withdrawals as presented by the OSE (Sorenson, 1976, 1981; Wilson, 1986, 1992; Wilson and Lucero, 1997; Wilson et al., 2003).

The New Mexico Agricultural Statistics Service (NMASS, 1986, 1998) reported that actual areas irrigated were 13,361 acres in 1986 and 12,663 acres in 1998. The *New Mexico Stockman* (2001, 2002) also reported major crop production acreage totaling 7,800 in 2001 and 8,100 acres in 2000 (Table 6-11).

Table 6-10. Irrigation Surface Water and Groundwater Use in Hidalgo County

Reporting Year	Total Acres Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	NA	75,390	44,170
1980	NA	67,600	41,300
1985	NA	33,618	16,640
1990	9,090	31,966	18,844
1995	10,513	37,670	21,770
2000	11,627	41,884	24,672

NA = Information not available

Table 6-11. Crop Acreage in Hidalgo County in 2000 and 2001

Crop	Irrigated Acreage	
	2000	2001
Alfalfa	1,000	1,000
All other hay	300	300
Chile	2,600	2,200
Corn	1,800	2,700
Cotton	600	700
Sorghum	1,100	1,100
Wheat	900	1,100
Other grain	NA	NA
Total	8,300	9,100

Source: NMASS 2004
NA = Not available

Phelps Dodge's Hidalgo Smelter owns irrigation rights to 9,000 acres in south-central Hidalgo County. Although the company has not been using the groundwater associated with this acreage for agriculture, this land has recently been leased to a local farmer/rancher, and an estimated 3,000 to 3,500 acres of the land are being irrigated this year. The primary crops being irrigated are chile and alfalfa, and approximately 500 acres are being irrigated for hay/grass for cattle grazing.

The water diversion rate for the Hidalgo Smelter land is reported to be 3 acre-feet per acre. The diversion for irrigation in the Virden Valley (the Globe Equity decree area) is 6 acre-feet per acre.

According to the OSE (Wilson et al., 2003), the consumptive irrigation requirements for groundwater range from a low of 1.111 to a high of 2.908 acre-feet per acre, for the San Simon Valley and the Playas Valley, respectively. OSE-reported withdrawals (Figure 6-2) show a sharp decline in water use between 1980 and 1985, from about 68,000 ac-ft/yr to 34,000 ac-ft/yr. Since 1985, withdrawals have fluctuated between 32,000 and 42,000 ac-ft/yr.

6.1.4.4 Luna County

The primary source of irrigation water in Luna County is reportedly groundwater (*New Mexico Stockman*, 2001, 2002). The total irrigable acreage for Luna County has been reported to be as high as 73,950 acres (NMASS, 1998), but the acreage that has actually been irrigated is considerably less than the maximum acreage. Table 6-12 summarizes the acreage irrigated and the water withdrawals as presented by the OSE (Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003). Based on the figures in Table 6-12, the water depletion is about 58 percent of the total reported withdrawals.

Table 6-12. Irrigated Surface Water and Groundwater Use in Luna County

Reporting Year	Total Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	NA	162,200	91,420
1980	NA	125,520	77,660
1985	NA	139,887	61,142
1990	44,250	103,807	60,986
1995	45,135	141,335	81,404
2000	42,302	114,183	68,211

NA = Information not available

The New Mexico Agricultural Statistics Service (NMASS, 1986, 1998) reported that 38,246 acres were irrigated in 1986 and 38,662 in 1998.

The Luna County Farm Service Agency provided a detailed breakdown of the various crops and acreages from 1990 to 2002 (NRCS, undated). Table 6-13 summarizes the major crops for selected years and the total acres reported.

Table 6-13. Crop Acreage in Luna County, 1990 through 2000

Crop	Irrigated Acreage		
	1990	1995	2000
Alfalfa	2,056	1,950	1,888
Chile	10,029	7,083	6,213
Corn	821	891	1,920
Onions	2,147	3,010	2,832
Sorghum	1,707	1,849	2,297
Cotton	6,089	4,606	4,807
Wheat	1,165	2,942	3,459
Estimated totals	33,187	26,817	32,215

Source: (NRCS, undated)

The irrigated water diversion rate from groundwater (except for a small amount of flood water potential along the Mimbres River, 99 percent of irrigation water use is from groundwater) for Luna County is 3 acre-feet per acre. According to the OSE (Wilson et al, 2003), the consumptive irrigation requirement for groundwater ranges from 1.53 acre-feet per acre to 1.713 acre-feet per acre in the Nutt-Hockett and Mimbres Valley areas, respectively.

Some irrigated acreage water rights have recently been acquired by the City of Deming and Duke Energy. The City of Deming has acquired water rights for 2,500 acres of agricultural land. The consumptive (municipal) use from this land is 1.6 acre-feet per acre or 4,000 ac-ft/yr. Duke Energy acquired apparently about 2,900 acre-feet of former cropland water for cooling their power plant equipment (NM OSE, 2003b). The power plant is currently under construction. Assuming a consumptive use of 1.6 acre-feet per acre, this amount of water diversion would reduce the land available for agriculture by about 4,300 acres. Since 1980, OSE-reported withdrawals in Luna County have varied between 125,000 and 141,000 ac-ft/yr.

6.1.5 Reservoir Evaporation

Although the OSE-reported depletions of surface water resulting from evaporation dropped greatly from 1975 to 1990 (Table 6-1), these decreases are due more to a change in the way the OSE reported evaporation data, rather than actual decreases in evaporation. In 1975 the reservoir evaporation category listed in Table 6-1 included reservoir, stock pond, and playa lake evaporation. However, playa lake and stock pond evaporation were no longer inventoried by the OSE after 1975 and 1985, respectively. In addition, since 1990 the OSE has reported reservoir evaporation only for reservoirs with 5,000 or more acre-feet of storage, and because there are no reservoirs of this size in the planning region, no water use has been reported in this category since 1990.

Despite these reporting changes, current reservoir evaporation can be estimated based on the three years of available OSE reservoir and stock pond evaporation data, which more accurately reflect the total evaporation in the region. OSE-reported depletions for these categories was 3,752 acre-feet in 1975 (after subtracting the playa lake evaporation component) (Sorensen, 1976), 3,622 acre-feet in 1980 (Sorensen, 1981), and 3,373 acre-feet in 1985 (Wilson, 1986). All reservoir evaporation is a consumptive use; there is no return flow in this category.

6.2 Projected Demographics

Future water demand in the Southwest Region depends on the future growth of the region's population and economy. Accordingly, Southwest Planning & Marketing (SWPM) projected growth in 10-year increments from 2000 to 2040. The projections were based on two different growth scenarios: a low-growth scenario and a high-growth one. The results of SWPM's analysis are provided in Appendix E4 and summarized below.

The population projections developed by SWPM under both low and high growth scenarios are summarized in Table 6-14 and depicted on Figure 6-3. Factors expected to affect the rate of population change include:

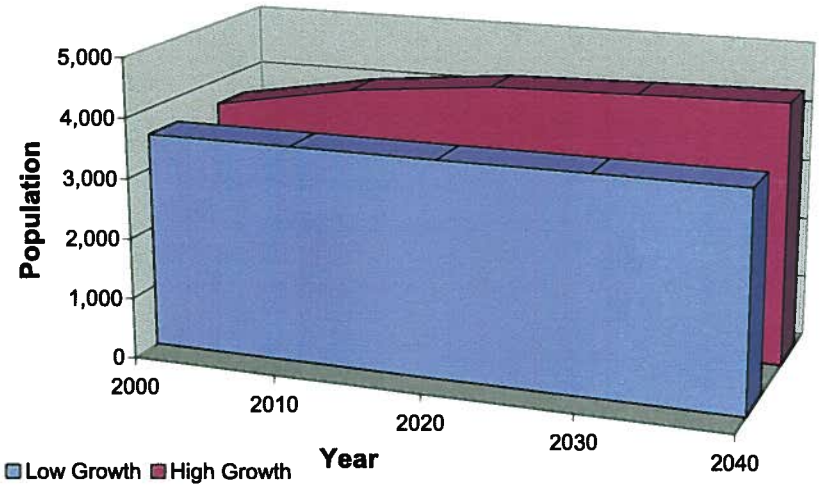
- *Catron County:* The low projection assumes that population will increase to some degree, due to the conversion of ranch land to low-density residential developments that

Table 6-14. Estimated Population Growth 2000 to 2040
Southwest New Mexico Water Planning Region

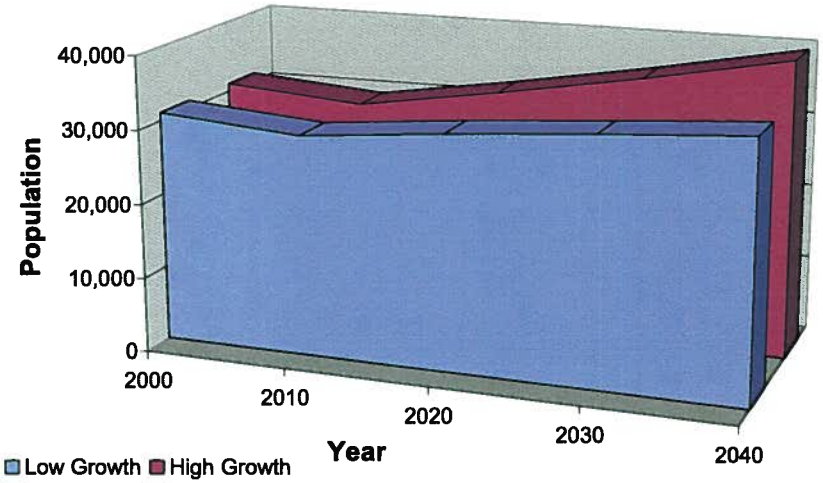
County	Current (2000) Population	Growth Scenario		Estimated Population			
		Type	Description [a]	2010	2020	2030	2040
Catron	3,567	Low	No growth or decline	3,567	3,567	3,567	3,567
		High	Slow growth	3,999	4,233	4,288	4,336
Grant	31,083	Low	Initial decline followed by moderate growth	29,563	31,417	32,958	34,335
		High	Initial decline followed by higher growth	29,563	32,656	36,073	39,847
Hidalgo	5,929	Low	Increasingly negative growth rate	5,800	5,623	5,380	5,117
		High	Initial decline followed by no growth or decline	6,720	7,085	7,120	7,127
Luna	25,189	Low	Moderate growth	28,493	31,598	34,253	36,510
		High	Significant growth	32,181	39,499	46,339	52,572
Total Southwest Region	65,858	Low	Sum of low population projections for four counties	67,423	72,205	76,158	79,529
		High	Sum of high population projections for four counties	72,463	83,473	93,820	103,882

[a] More detailed descriptions of the low and high growth scenarios are provided in Appendix E4.

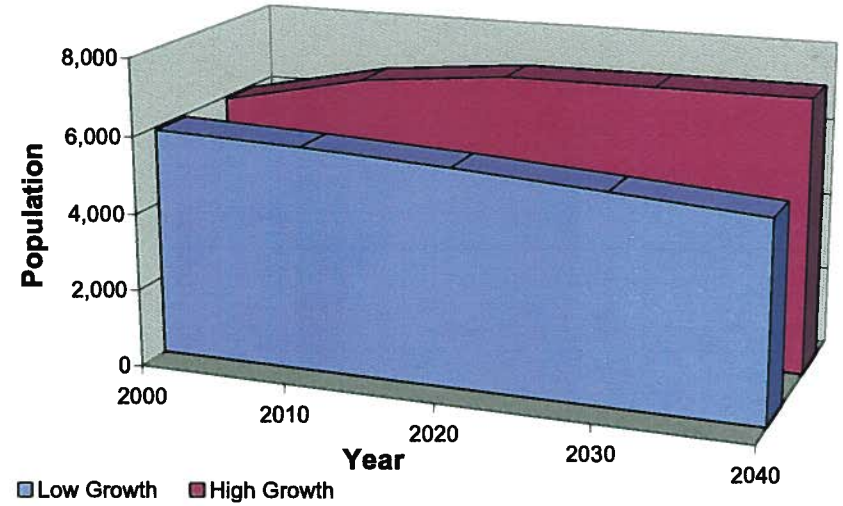
BBER = Bureau of Business and Economic Research



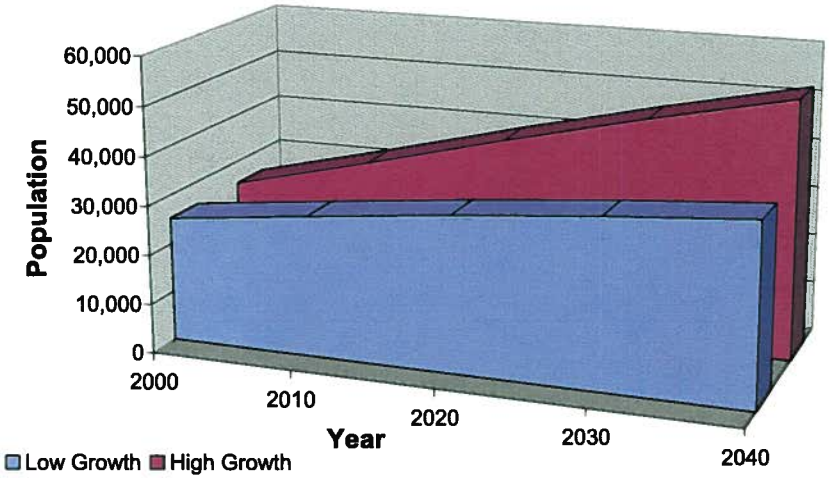
Catron County



Grant County



Hidalgo County



Luna County

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Projected Population

Figure 6-3

Daniel B. Stephens & Associates, Inc.

5/25/05

are primarily being populated through in-migration of retirees and people purchasing second homes or vacation properties, but that such in-migration may be balanced by out-migration due to a lack of economic opportunity and declining ranching activities resulting from drought and environmental concerns. The high projection assumes that a slow rate of growth will occur.

- *Grant County:* The economy of Grant County has historically been driven by the mining sector, and recent layoffs in that and other sectors are resulting in some out-migration. However, a variety of economic development efforts are ongoing, and the area is increasingly becoming an attractive location for retirees. In addition, it is expected that employment in the mining sector will at least partially recover as the market for copper improves to a point that the area's mines once again can continue to be economically viable.

- *Hidalgo County:* The majority of the population in Hidalgo County is in Lordsburg, which is therefore expected to drive changes in population in the county. The closure of Phelps Dodge's mining operations in Playas is expected to cause an initial decline in population, but the purchase of the town of Playas by New Mexico Tech for use as a research and training facility is expected to slowly reverse the population down-trend in that area.

- *Luna County:* Industrial and retirement community development in the county's major population center, Deming, and along the U.S.-Mexico border will be the primary drivers for population growth in Luna County.

SWPM also analyzed how economic activity and/or the projected growth (or decline) in population will affect water use in eight use sectors:

- Residential (self-supplied)
- Commercial (self-supplied)
- Municipal water supply
- Industrial (self-supplied)
- Power (self-supplied)

- Mining (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)

The reservoir evaporation water use category is not driven by population growth.

Future water demand in the residential, commercial, and municipal sectors depends in large part on the degree of population growth and therefore varies throughout the Southwest Region, from stable to slowly increasing population in Hidalgo County to moderate growth in Luna County. Any growth will likely be driven by tourism and in-migration of residents.

The industrial sector is not large in the Southwest Region, but power generation is becoming increasingly prominent and mining has been a major factor in the economy of Grant County for decades. All of these sectors have the potential to use large amounts of water. Water use related to mining will continue to fluctuate with the copper market. Growth in the industrial sector is expected to be relatively small, limited primarily to Luna County with small initial growth spurts in Grant and Hidalgo Counties within the next 10 to 20 years. The largest increase will likely be seen in the power generation sector, which has the potential for significant growth in Hidalgo and Luna Counties within the next 10 to 20 years.

For the most part, the irrigated agriculture sector and is projected to either remain constant or decline slightly in the Southwest Region, and the livestock sector is expected to remain steady or slightly increase to earlier levels. The one exception is Hidalgo County, where livestock is expected to grow significantly over the next 10 years due to the addition of one and possibly more head cattle feedlots in the county. Irrigation in Hidalgo County has increased recently due to the transfer of water rights from the recently closed Playas Smelter. Additionally, irrigated agriculture may increase locally if water becomes available through the CAP (Section 6.3).

6.3 Projected Water Uses for 40-Year Planning Horizon

This section provides estimates of future water use in the region. To assist in bracketing the uncertainty of the projections, low and high water use estimates were developed, based on growth projections in the various sectors for each county (Section 6.2; Appendix E4) and input

from the steering committee. Sections 6.3.1 through 6.3.7 describe the methods or assumptions used in projecting future water use for the various use sectors in each county. Estimates of projected municipal water use in the Southwest Region are provided on Table 6-15 and estimates of projected future water use in all sectors in the entire region are shown on Table 6-16. Projections of future water use for each sector, segregated by County and showing the growth rates and assumptions used to project future water use, are included in Appendix E5. Better estimates could be made if the regional aquifers were modeled; however, this section uses the best information available. Reconciliation of demand with supply is addressed in Section 7.

For planning purposes Table 6-16 also includes a safety factor for selected uses to account for the possibility of underestimating the population projections. The reason for adopting this safety factor is that there is inherent uncertainty in estimating population growth and associated water uses, and by the time any underestimate of population becomes evident, some options for developing renewable water supplies may no longer be viable. Accordingly, a safety factor of 20 percent was applied to the highest projection for public, commercial, power, industrial, domestic, and livestock uses.

The safety factor for domestic well diversions also includes an increase of 1,120 ac-ft/yr to account for a 0.6-acre-foot per capita demand for self-supplied wells in the Gila and San Francisco Basins. This amount was set based on concern that the 2,420 residents currently supplied by domestic wells in these basins have transferred water rights to their domestic wells and have extensive gardens. The value of 0.6 ac-ft/yr per person is 0.5 acre-feet more than the amount used for all other domestic wells in the region.

Figure 6-4 shows the projected water use by sector in 2040 for the low and high projections, as well as the 20 percent safety factor projection for selected uses. Figure 6-5 shows the projected gap between supply and demand in 2040 for the public, domestic, commercial, and industrial use sectors. The total projected gap in 2040 under the low, high, and 20 percent safety factor projections is about 3,000, 11,600, and 16,400 ac-ft/yr, respectively. Most of this gap is in Luna and Grant Counties, for which the gap under the high projection is about 6,300 and 5,000 ac-ft, respectively. The projected gap in 2040 in Catron and Hidalgo Counties is less than 1,000 ac-ft, even under the 20 percent safety factor projection.

Table 6-15. Estimated Future Public Water Supply Use in the Southwest Region

Location	Estimated 2002 Per Capita Use (gpcd)	Growth Scenario [a]	Projected Withdrawals (ac-ft/yr) by Public Systems			
			2010	2020	2030	2040
Catron County						
Public systems	156	Low	150	150	150	150
		High	170	180	190	190
Grant County						
All public systems	160	Low	3,690	3,940	4,160	4,350
		High	3,690	3,940	4,590	5,130
Rural public	70	Low	410	420	430	440
		High	410	430	450	470
Silver City	235	Low	2610	2810	2980	3130
		High	2610	2940	3320	3740
Mining district [a]	107	Low	670	710	750	790
		High	670	740	830	930
Hidalgo County						
All public systems	199	Low	860	830	800	760
		High	980	1,030	1,030	1,030
Rural public	152	Low	90	90	90	80
		High	150	170	180	180
Lordsburg	205	Low	760	740	710	670
		High	830	850	860	860
Luna County						
All public systems	211	Low	4,990	5,560	6,060	6,480
		High	5,660	7,020	8,300	9,490
Rural public	161	Low	820	840	860	870
		High	840	860	840	810
Deming	227	Low	4170	4720	5200	5610
		High	4820	6160	7460	8680
	Total	Low	9,690	10,490	11,160	11,740
		High	10,500	12,340	14,110	15,840

[a] Bayard, Hurley and Santa Clara

gpcd = Gallon per capita day
gpd = Gallons per day

Table 6-16. Projected Withdrawals in the Southwest Region

Sector	2000 Total Withdrawal (ac-ft)	Growth Scenario	Projected Withdrawals (ac-ft)			
			2010	2020	2030	2040
Public supply	9,260	Low	9,690	10,490	11,160	11,740
		High	10,530	12,340	14,110	15,840
		High + 20%	12,600	14,810	16,940	19,010
Commercial	980	Low	980	1,000	1,010	1,020
		High	1,090	3,980	4,350	4,750
		High + 20%	1,310	4,780	5,230	5,700
Industrial	80	Low	90	110	125	150
		High	120	170	220	260
		High + 20%	150	210	270	310
Mining	25,830	Low	21,930	21,930	21,930	21,930
		High	39,470	39,470	39,470	39,470
Power	280	Low	280	280	280	280
		High	2,120	3,200	3,200	3,230
		High + 20%	2,540	3,840	3,840	3,840
Irrigated agriculture	205,900	Low	202,790	183,400	165,870	150,010
		High	225,470	225,470	225,470	225,470
Livestock	1,500	Low	1,920	1,920	1,920	1,920
		High	2,370	2,490	2,610	2,750
		High + 20%	2,840	2,990	3,140	3,300
Domestic	2,070	Low	2,110	2,240	2,390	2,480
		High	2,270	2,600	2,880	3,160
		High + 20% + Gila/SF Basin [a]	3,280	4,180	4,910	5,240
Reservoir evaporation	—	Low [b]	3,580	3,580	3,580	3,580
		High [c]	3,750	3,750	3,750	3,750
Total	245,900	Low	243,400	225,000	208,300	193,100
		High	287,200	293,500	296,100	298,600
		High + 20%	345,800	353,400	356,500	359,600

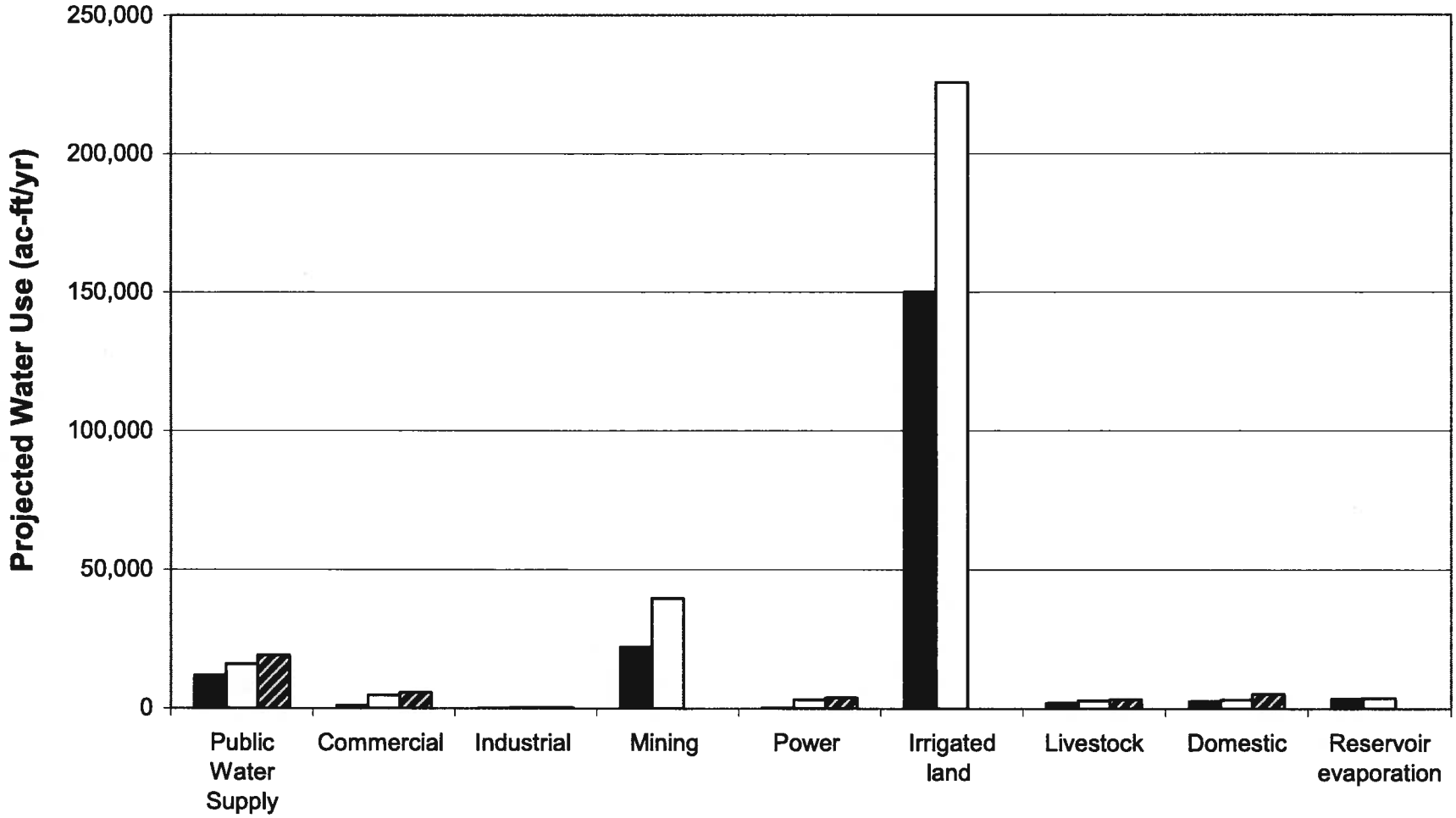
[a] Domestic use per capita in the Gila & SF River Basin set to 0.6 af/person, which increases diversions by1,210 afy.

[b] Average 1975 through 1985 use (years when stock pond and small reservoir evaporation were estimated), excluding playa lake evaporation

[c] Based on 1975 data, when stock pond, small reservoir, and playa lake evaporation were estimated by OSE

ac-ft = Acre-feet

— = Reservoir evaporation is no longer calculated by the OSE for the Southwest Region since there are no reservoirs greater than 5,000 ac-ft in size.



Projection:

- Low
- High
- High +20%

Figure 6-4

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SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Projected Water Use in 2040

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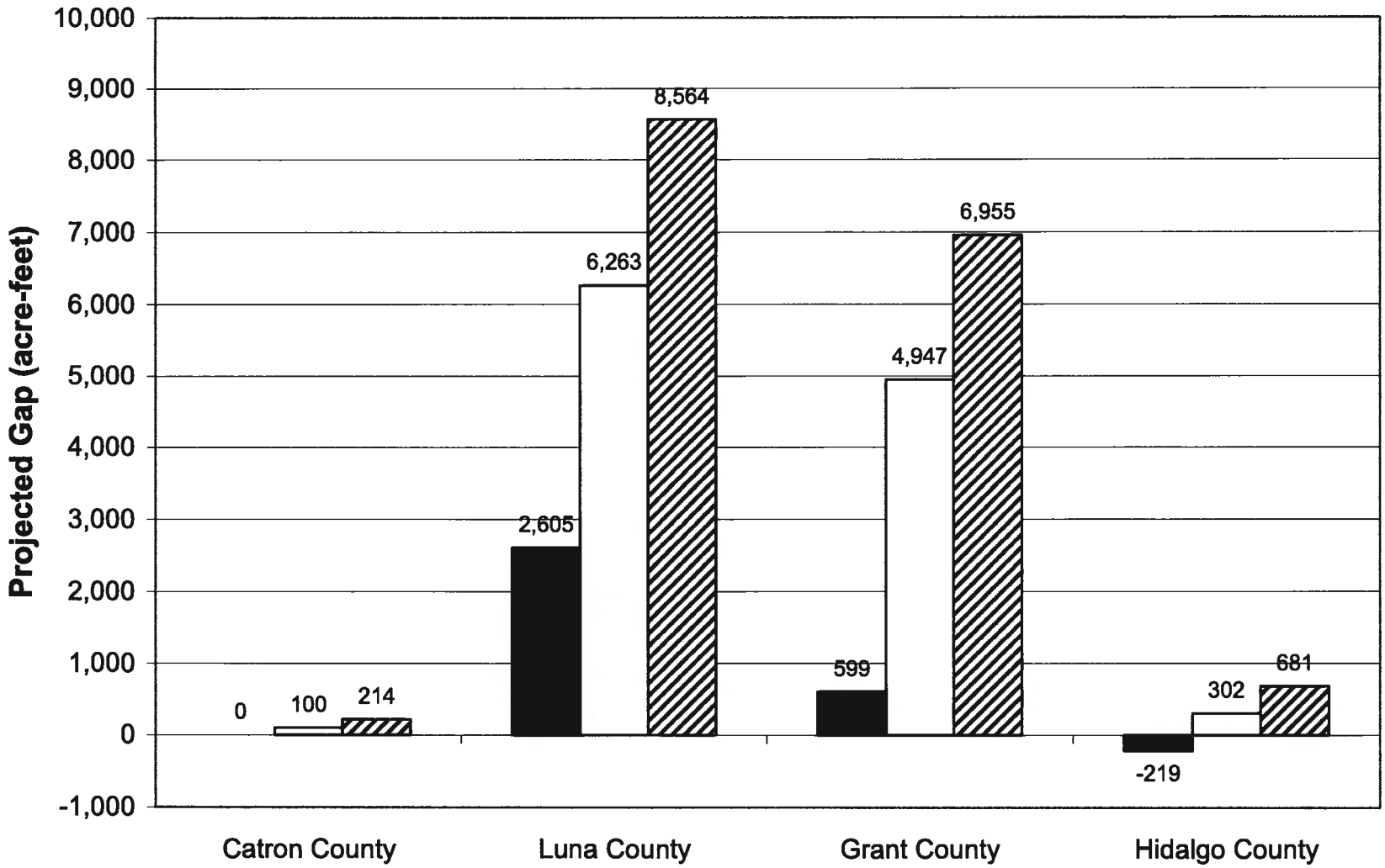

Projection:

- Low
- High
- 20% Safety Factor

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Projected Combined Gap Between Supply and Demand for Public, Domestic, Commercial, and Industrial Uses in 2040

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Figure 6-5

6.3.1 Public Water Supply and Self-Supplied Domestic

The public water supply projections are based on the county and municipal population growth estimates developed by SWPM (Section 6.2; Appendix E4). The per capita use for individual communities, based on pumping and population records, varied from about 50 gallons per capita per day (gpcd) to more than 200 gpcd, and county average per capita use rates varied from 156 gpcd to 211 gpcd. Future water use was projected by multiplying the current county average usage rate by the high population projections to determine the high water use projection. Likewise, the low water use projection was determined by multiplying the same per capita demand figures by the low population projection. The per capita water use rate was calculated based on the total public supply system pumping divided by the population served by these systems (Table 6-3). While the projected water use could be reduced through conservation efforts as discussed in Section 8.2, the projections presented here illustrate what could result if no alternatives are implemented to reduce water demand.

The domestic self-supplied projections were based on DBS&A estimates of domestic use (Section 6.1.1.2) and the population growth projections for each county as presented by SWPM (Appendix E4). The results are presented in Table 6-16.

6.3.2 Commercial and Industrial

Commercial and industrial water use is typically very small in the region. The low and high projections for this sector (Table 6-16) were developed based on growth rates that are proportional to the population projections (Section 6.2; Appendix E4). One exception to this methodology is the assumption for the high water use scenario that about 2,800 ac-ft/yr of water from the CAP allocation would be available for commercial use around 2020 in Grant County.

6.3.3 Irrigated Agriculture

For the past 10 years, the acreage of irrigable land (land that holds irrigation water rights) in the region appears to have remained relatively consistent. Typically the land areas that are actually irrigated are considerably smaller than the total acreage with irrigation water rights (Section 6.1.4).

For the low water use projection, the projected irrigated agriculture water use (Table 6-16) was reduced by 1 percent a year from the 2000 OSE levels for irrigated agriculture (Table 6-1; Wilson et al., 2003). For the high water use projection, some increases in irrigated land uses were included in Hidalgo, Grant, and Catron Counties, assuming that CAP water would be available around 2010. Luna County irrigated land water use was not increased for CAP water, due to the distance from the Gila River to the primary agriculture areas in the County.

6.3.4 Livestock

The low water use projection assumed that the livestock numbers would remain similar to the 2000 OSE values (Wilson et al., 2003) for the next 40 years, except in Hidalgo County, where a 20,000-head feedlot is expected to begin operating in 2004 or 2005. The high water use projections assumed a small growth, 5 per cent every 10 years, except for Hidalgo County, where another new 20,000-head feedlot planned in the county is included in the 2010 projection (Table 6-16; Appendix E5).

6.3.5 Power

The low power water use assumption for the region (Table 6-16; Appendix E5) is based on the current (2000) OSE-reported values for the power sector (Wilson et al., 2003). The high use projections assume that an additional power plant will be on-line in about 2005, consuming about 1,000,000 gpd (1,120 ac-ft/yr) in Luna County. Additional water use in the power sector is assumed in Luna and Hidalgo Counties as new power plants will likely be built after 2005. Biomass power plants are also being considered in Catron County, which may affect future water demands.

6.3.6 Mining

The principal area for mining in the region is located in Grant County. Since about 2000, the copper mines in the county have been in reduced production and therefore using less water than a few years prior to 2000. Nevertheless, it is expected that copper mining and reclamation will continue in the region for the next 30 to 40 years or more. Water previously used for mining operations may be used for reclamation activities. For instance, Phelps Dodge estimates that

nearly 9,000 ac-ft/yr of fresh water will be required to be blended with contaminated groundwater.

The low water use projections for the mining sector in each county are based on the 2000 OSE values (Wilson et al., 2003) and no growth in this sector (Table 6-16). The high water use projections are based on the estimated current water rights (groundwater) for the Phelps-Dodge Chino, Cobre, and Tyrone mines in Grant County. No future water use was assumed for the Fence Lake Mine in Catron County, because the mining company has recently announced that it doesn't intend to pursue the project. Additional mining activities (such as the Fence Lake Mine) could occur over the 40-year period; however, no data to accurately predict likely uses is currently available.

In addition to the potential Fence Lake Mine, the Bureau of Land Management is soliciting bids for helium reserves in northeastern Catron County, and the Mogollon Mining District in southern Catron County could become active if silver and gold prices rise. The 1992 water plan estimated 1,000 ac-ft for such projects. Additionally, though somewhat speculative at this time, there is a potential for carbon dioxide (CO_2) extraction in western Catron County. The high water use projection for this county includes an estimated usage of 1,000 ac-ft/yr for the potential mine; however, the amount of water usage for such an operation is highly uncertain, as the project is still in very preliminary stages of development.

6.3.7 Reservoir Evaporation

As with irrigated agriculture, reservoir evaporation is dependent on climatic conditions. Additionally, any potential for new or reduced storage must be considered in developing reservoir evaporation estimates. Two scenarios were again used to bracket the possible conditions:

- Low water use: This scenario assumed that reservoir evaporation over the planning period is equal to the average use for this category (3,582 acre-feet), based on the three years of available OSE data (1975, 1980, and 1985).

- High water use: This scenario assumed that reservoir evaporation over the planning period is equal to the maximum use for this category (3,752 acre-feet in 1975, not including playa lake evaporation), based on the three years of available OSE data (1975, 1980, and 1985).

7. Water Budget

A water budget is an accounting of the input and output volumes of water for the different components of the hydrologic cycle and for a specified hydrologic system. The hydrologic cycle is a continuous set of processes through which water evaporates from the oceans to the atmosphere, falls on the land, and eventually flows back to the oceans. Components of the cycle include the following:

- Evaporation from open water and transpiration from plants and other living organisms
- Precipitation, part of which is intercepted by vegetation or other surfaces and subsequently evaporated and part of which becomes runoff.
  - Some precipitation seeps (infiltrates) into the ground to become soil moisture, part of which is taken up by plant roots and returned to the atmosphere through the process of transpiration. It is difficult to separate this transpiration from evaporation, so they are typically combined into a single term known as evapotranspiration (ET).
  - Precipitation that is not intercepted or infiltrated flows across the land surface and through channels, from which it may be diverted for various consumptive uses or used to fill reservoirs, where it is stored until used or evaporated.
- When soil moisture storage capacity is exceeded, recharge to groundwater occurs. Groundwater may reside in storage until withdrawn from a well, or where physical conditions allow, it may discharge into streams or lakes.

The hydrologic cycle is thus a complex movement of water through several subsystems. A hydrologic budget is a quantification of the amounts of water moving in and out of a specified subsystem of the overall hydrologic cycle.

For a given region, the overall hydrologic budget can be expressed by the equation (Viessman and Lewis, 1996):

$$P - R - G - E - T = \Delta S$$

Where P = precipitation

R = surface runoff

G = groundwater flow to and from other basins

E = evaporation

T = transpiration

ΔS = change in aquifer storage

Except for precipitation, subsets of these parameters apply differently to budgets computed above or below the surface. For example, losses to infiltration from the surface are realized as an input to the subsurface system, and losses from subsurface discharges are sometimes realized as an input to the surface system. It is therefore convenient to view surface water systems and groundwater systems as separate, interconnected subsystems of the hydrologic cycle.

The Southwest Region covers a very large area based on political (county line) boundaries and contains 3 major stream systems and 12 hydrogeologic groundwater basins. Separate water budgets were developed for each hydrologic system.

7.1 Groundwater Budgets

The water budgets presented in this section provide a broad overview of the supply and demand in each of the basins shown in Figure 5-12; however, they should not be used as an indicator of availability of supply to meet demand in individual localities, as that ability depends on water rights, infrastructure, and adequate local surface water and/or groundwater supplies.

The water budgets for the Southwest Region were developed using data from previous investigations, where available, and supplemented with estimates made by DBS&A. The terms and methodology used to estimate the groundwater budget components are described in Section 7.1.1.

Gaps in understanding of the water budgets exist where data are insufficient to quantify a component of flow. Groundwater budgets for individual systems with hydrologic boundaries can

be developed more accurately than those with subsurface groundwater flow between basins. The degree to which the water budget components are understood and areas in which additional studies are necessary to fill the gaps is included in the discussions of each geologic basin in Sections 7.1.2.1 through 7.1.2.12. Surface water budgets for the Gila, San Francisco, and Mimbres Basins are discussed in Section 7.2. Details of each water budget are provided in Appendix F.

7.1.1 Groundwater Budget Terms and Methodology

The groundwater budget components (Figure 7-1) consist of the following inflow and outflow components:

- *Inflow:* Recharge, stream loss, sub-flow from adjacent basins, and return flow from municipal, mining, or irrigation uses

- *Outflow:* Pumping from municipal, commercial, domestic, irrigation, industrial, livestock, mining, and power generation wells, evapotranspiration, discharge to springs, and sub-flow to other basins.

A water budget is the balance between inflow and outflow:

- If the total inflow and outflow components are equal, water levels will not rise or fall.

- If outflow is greater than the inflow, water levels in the aquifer will decline and the volume of water in storage will decrease.

- If inflow is greater than outflow, water levels in the aquifer will rise and the volume of water in storage will increase.

In other words, where the change in storage is negative, water levels in the basin are dropping and where the value is positive, water levels are rising. It is possible for water levels to be dropping in one location and rising in another within the same basin.

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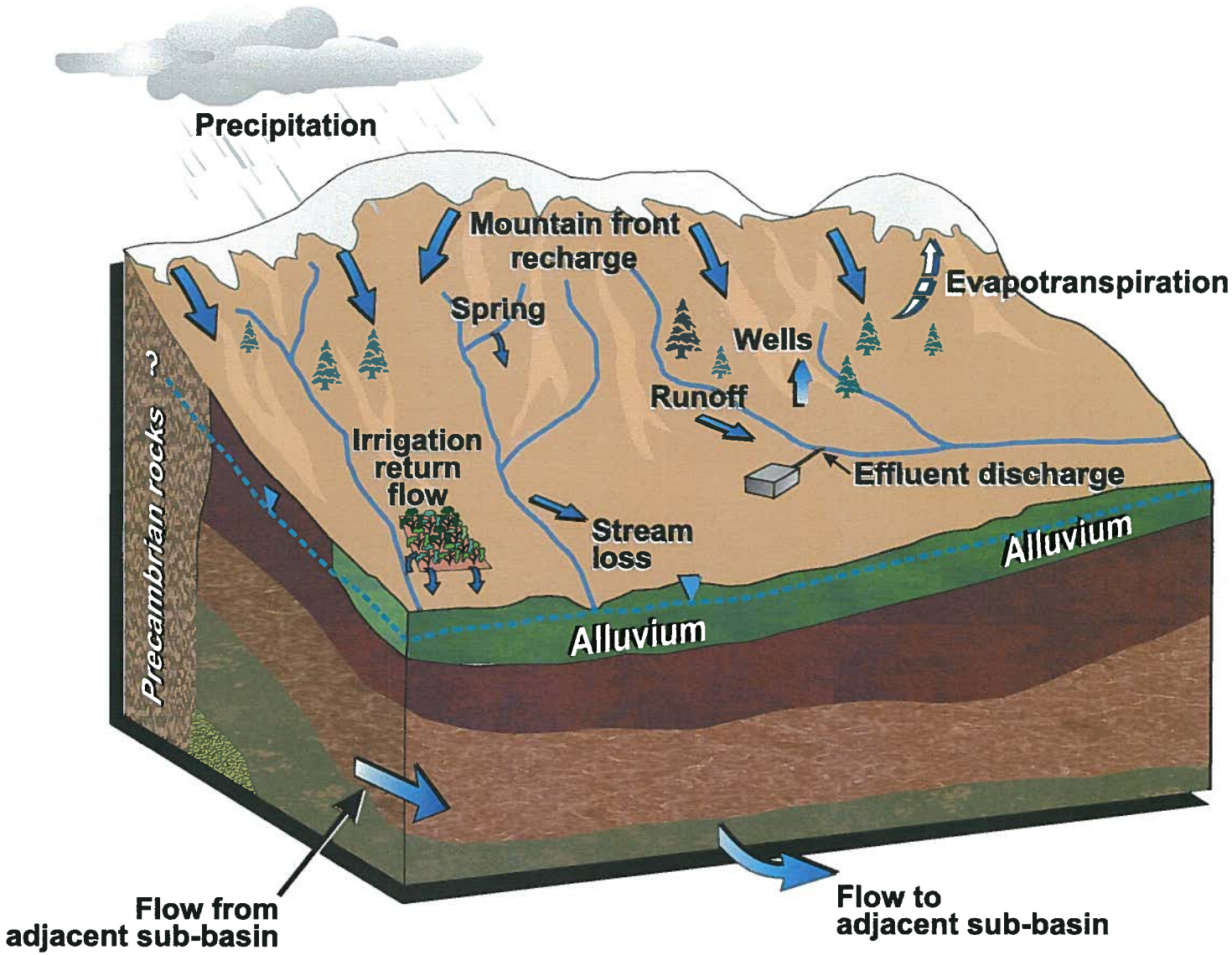

Not to Scale

Figure 7-1

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Water Budget Components

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Where the water budget components are poorly understood, the difference between inflow and outflow components may be a result of error in or lack of knowledge of the basin rather than an indication of changes in groundwater storage. Where inflow in the Southwest Region was estimated to be significantly greater than the estimated outflows, DBS&A balanced the water budget by assuming that either the outflow would occur as sub-flow to another basin or as evapotranspiration, depending on the water level flow directions.

The procedures used to estimate the inflow and outflow components for the Southwest Region groundwater budgets are discussed in Sections 7.1.1.1 and 7.1.1.2.

7.1.1.1 Inflow Components

Recharge consists of the addition of water to an aquifer by infiltration, either directly into the aquifer or indirectly by way of another rock formation. Recharge as estimated here is the natural recharge from precipitation that infiltrates to the water table. Artificial recharge, as when water is injected through wells or spread over permeable surfaces for the purpose of recharging an aquifer, is considered part of the "return flow" component described below. The method of estimating recharge is described in Section 5.3.4.

Stream loss represents the recharge to the aquifer from seepage losses that occur from streams. Estimates of stream loss require stream gaging stations in appropriate locations with sufficient periods of record to establish the average annual losses to groundwater in a losing reach. Such losses vary from day to day and year to year depending on the amount of precipitation. Stream losses that result from infiltration of treated effluent that is discharged to an ephemeral stream are considered part of return flow from municipal use, described below. Estimates of stream loss in the Southwest Region are available only for the Mimbres Basin.

Sub-flow from adjacent basins is the water that flows underground across basin boundaries. Estimates of this inflow component from previous investigations are available for about half the basins. Evaluation of water level contours and flow directions combined with balancing the water budget can also provide insight into relative gains or losses between the geologic basins. Where a basin falls only partly within the Southwest Region, flow out of the portion of the basin within the planning region is included in the water budget.

For some uses, a portion of the diverted flow is not consumptively used and returns to a water body; the returned water is called ***return flow***. In general, all commercial uses are assumed to be fully depleted, and return flow from self-supplied domestic wells is not included in the water budgets. The water budgets in Section 7.1.2 include, as applicable, estimates of return flow to groundwater from municipal, mining, and irrigation, based on OSE estimates of return flow and irrigation efficiencies (Wilson et al., 2003):

- The OSE estimate generally assumes that 50 percent of municipal uses are returned to the groundwater system.

- Wilson et al. (2003) estimates that about 20 percent of water diverted for mining returns to the groundwater.

- The estimates of irrigation return flow are based on a combination of conveyance losses and estimated irrigation efficiencies (which differ from basin to basin, ranging in the Southwest Region from 40 percent for flood irrigation to 85 percent for drip irrigation). For example, an irrigation water right of 1,000 ac-ft with a system conveyance efficiency of 60 percent and an on-farm efficiency of 70 percent will lose 400 ac-ft to return flow before it reaches the farm and 30 percent of the remaining 600 ac-ft, or 180 ac-ft, for a total return flow of 580 ac-ft. A portion of the losses may go to evaporation or evapotranspiration and not result in return flow. Such losses are called "incidental depletions." The estimates of return flow based on Wilson et al. (2003) do not identify such losses. All return flow from irrigation, whether from surface water or groundwater diversions, is assumed to be to groundwater. In reality, some of the conveyance losses—for example, from a surface water canal—may return to the stream system relatively immediately.

7.1.1.2 Outflow Components

The estimates of ***well diversions*** for municipal, commercial, irrigation, industrial, livestock, mining, and power uses were all derived from OSE's water use report for 2000 (Wilson et al., 2003) and modified by Engineers Inc., as described in Section 6.1.

The ***evapotranspiration*** component of the water budget is the discharge of groundwater through the roots of trees or other vegetation that taps the aquifer directly. It does not include the evapotranspiration of precipitation that does not recharge the aquifer and it does not include riparian evapotranspiration (which is included in the surface water budgets). Evapotranspiration (as it relates to groundwater budgets) occurs where the depth to water is shallow. The only published estimates of evapotranspiration from groundwater in the Southwest Region are for the Mimbres Basin. For this water plan, DBS&A also estimated evapotranspiration for the Playas and Hachita-Moscos basins based on the water balance and water level contours.

Discharge to springs and streams occurs where the groundwater level intersects the ground surface or the elevation of a stream. Discharge to springs can either be directly measured, where a spring issues at a single location, or can be estimated in the same way that stream losses are estimated, by evaluating the water budget on a stream system using stream gages. The latter method was used in this study, recognizing that the lack of estimates of flow from ungaged tributaries may result in an overestimation of spring flow. Outflow to springs and streams was estimated for the three basins that have stream gages, the Gila, San Francisco, and Mimbres.

Sub-flow out of a basin is the water that flows underground out of a basin boundary. Estimates for this outflow component from previous investigations are available for about half the basins. Evaluation of water level contours and flow directions can also provide insight into relative gains or losses between the geologic basins.

7.1.2 Summary of Basin Groundwater Budgets

Table 7-1 summarizes the groundwater budget for 12 geologic basins in the Southwest Region, and Table 7-2 summarizes the groundwater budgets by county. Additional details on the basin groundwater budgets are provided in Appendix F. (The planning region also includes a small area of the San Bernadino Basin in the southwest corner of Hidalgo County and a small part of the Middle Rio Grande Basin in southeastern Catron County, both of which are not included in the water budget summary due to the lack of water use in these areas and insufficient data.) Sections 7.1.2.1 through 7.1.2.12 briefly discuss the estimates of inflow and outflow to each basin.

Table 7-1. Groundwater Budget Components for the Southwest New Mexico Water Planning Region

Component	Groundwater Flow by Basin (ac-ft/yr)												
	San Simon	Playas-San Basilio	Animas	Hachita-Moscos	Mimbres	Nutt-Hockett	Gila	San Francisco	Little Colorado	San Agustin	Rio Salado	North Plains	Total
Inflow													
Recharge	2,910	8,050	16,130	4,230	24,990	270	72,980	55,950	18,290	18,320	1,800	980	224,900
Stream loss	0	0	0	0	10,000	0	0	0	0	0	0	0	10,000
Flow from adjacent basins	0	0	0	7	0	0	2,700	0	0	0	0	0	2,710
Return flow M&I	8	0	410	0	3,610	0	590	50	20	0	0	0	4,690
Return flow mining	0	220	0	0	3,810	20	470	0	0	0	0	0	4,520
Return flow irrigation	540	890	11,970	0	48,730	5,500	27,020	15,940	1,270	150	0	0	112,010
Total Inflow	3,460	9,160	28,510	4,240	91,140	5,790	103,760	71,940	19,580	18,470	1,800	980	358,830
Outflow													
Municipal wells	16	13	830	0	7,210	0	1,040	110	40	0	0	0	9,260
Commercial [a]	4	0	500	0	200	0	120	20	4	4	0	0	850
Domestic wells [a]	5	20	180	20	1,470	8	100	140	60	60	0.4	3	2,070
Irrigation wells	1,340	1,980	27,810	0	78,290	16,430	3,070	0	0	340	0	0	129,260
Industrial [a]	0	0	0	0	40	0	20	0	0	0	0	0	60
Livestock [a]	0	0	0	60	410	0	350	30	30	50	50	0	980
Mining [a]	0	4,330	0	0	18,720	30	2,740	0	0	0	0	0	25,820
Power [a]	0	0	0	0	280	0	0	0	0	0	0	0	280
Evapotranspiration	0	2,810	0	2,300	13,400	0	0	0	0	18,020	0	0	36,530
Springs/stream gain	0	0	0	0	4,800	0	54,600	59,930	0	0	0	0	119,330
Sub-flow out	2,100	7	2,700	1,860	0	0	41,680	11,720	19,440	0	1,750	980	82,240
Total Outflow	3,470	9,160	32,020	4,240	124,820	16,470	103,720	71,950	19,570	18,470	1,800	980	406,670
Error and/or change in storage [b]	–10	0	–3,510	0	–33,680	–10,680	40	–10	10	0	0	0	–47,840

[a] Self-supplied
[b] Errors of 10 acre feet per year (ac-ft/yr) are due to rounding of the values.

Shaded values represent estimate based on water budget balance and water level contours.
M&I = Municipal and industrial

Table 7-2. Summary of Groundwater Budgets by County

Component	Groundwater Flow by County (ac-ft/yr)				
	Catron	Grant	Hidalgo	Luna	Total
Inflow					
Recharge	122,990	69,870	29,110	3,880	225,850
Stream loss	0	0	0	10,000	10,000
Flow from adjacent sub-basin	0	0	2,710	0	2,710
Return flow municipal	70	2,020	430	2,160	4,680
Return flow mining	20	4,270	220	30	4,520
Return flow irrigation	17,360	24,210	19,690	50,760	112,020
Total Inflow	140,420	100,370	52,160	66,830	359,780
Outflow					
Municipal wells	150	3,910	880	4,320	9,260
Commercial (self-supplied) [a]	30	140	510	180	860
Domestic wells	270	920	200	680	2,070
Irrigation wells	340	4,100	33,140	91,670	129,250
Industrial (self-supplied) [a]	8	11	3	40	61
Livestock (self-supplied)	180	220	260	340	1,000
Mining (self-supplied)	0	21,460	4,330	40	25,830
Power (self-supplied)	0	280	0	0	280
Evapotranspiration	18,020	3,960	4,540	10,000	36,520
Springs/stream gain	59,930	59,400	0	0	119,330
Sub-flow out[b]	22,170	0	5,700	970	28,840
Total Outflow	101,100	94,401	49,560	108,240	353,298
Error and/or change in storage	39,323	5,969	2,600	–41,410	

[a] Outflow for commercial and industrial wells is based on the depletion amount (return flow was not included for the few wells where OSE estimates a small amount of return flow).

B Sub-flow out is only shown for basin contained entirely in one County, thus totals differ from Table 7-1.

Ac-ft/yr = acre feet per year

Figure 7-2, which shows the overall groundwater balance between inflows and outflows for each basin, reveals that inflows are less than outflows in the Animas, Mimbres, and Nutt-Hockett hydrogeologic basins, indicating that groundwater mining is occurring. Groundwater mining may also be occurring locally in the vicinity of well fields in the other basins. As shown in Figure 7-3, the Mimbres Basin has by far the greatest amount of groundwater diversions, approaching 100,000 ac-ft/yr. Additional discussion of each basin is provided in Sections 7.1.2.1 through 7.1.2.12.

7.1.2.1 San Simon Basin

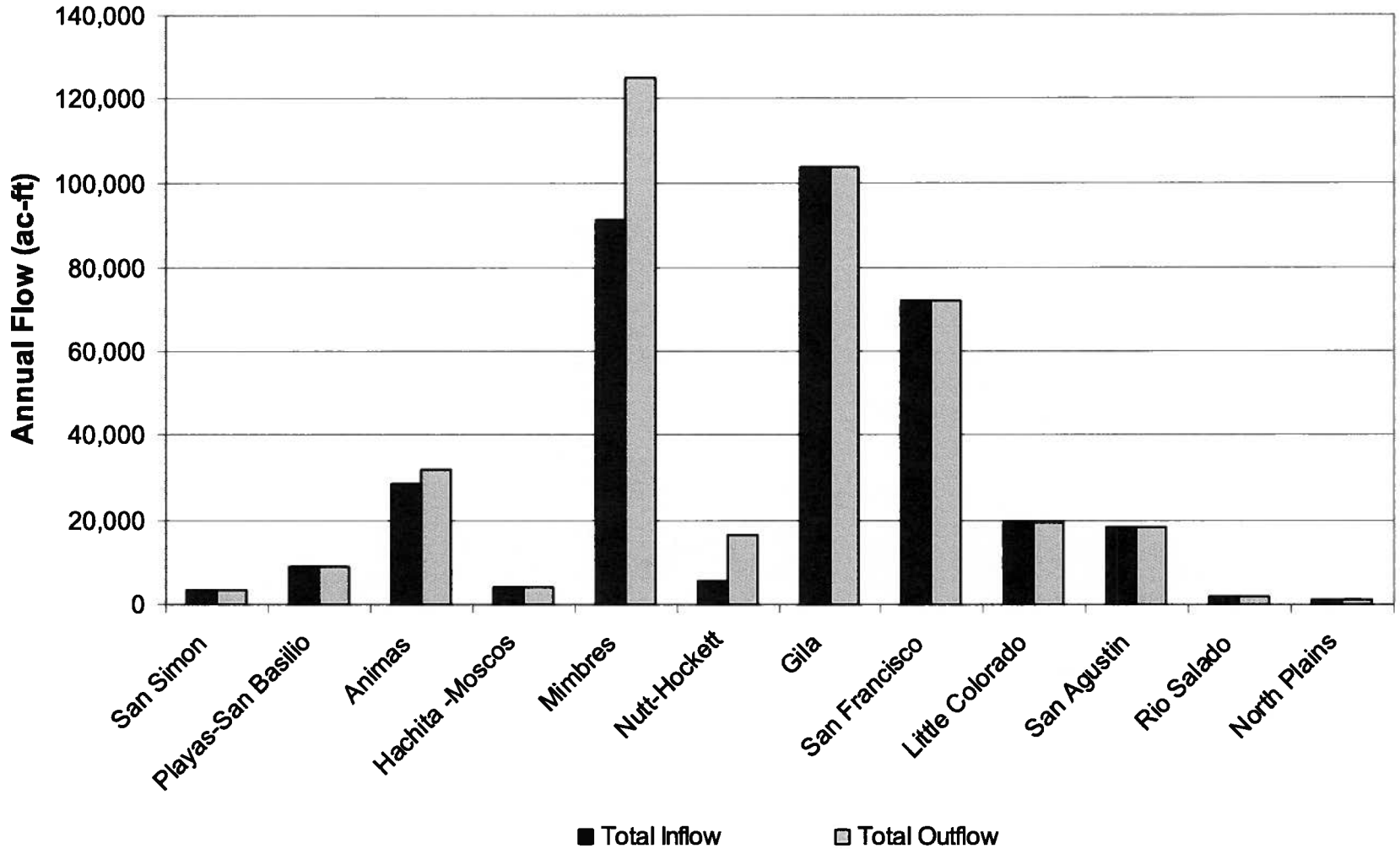
Inflow to the San Simon Basin occurs through recharge and municipal and irrigation return flow, while estimated outflows are due to groundwater pumping from municipal, domestic, commercial, and irrigation wells (Appendix F, Table F-2). The irrigation return flow is based on an irrigation efficiency of 55 percent for flood irrigated lands and 65 percent for sprinkler irrigation from the 1,340 ac-ft/yr of groundwater diversions.

The total estimated outflow from documented sources is approximately 2,100 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimates of the sub-flow out of the basin. Examination of water table contours indicates that groundwater is flowing to the west out of New Mexico, and DBS&A has estimated that sub-flow to be 2,100 ac-ft/yr.

7.1.2.2 Animas Basin

Inflow to the Animas Basin occurs through recharge and municipal and irrigation return flow, while estimated outflows are due to groundwater pumping from municipal, domestic, commercial, industrial, and irrigation wells and to sub-flow to the Gila Basin (Appendix F, Table F-3). The estimated irrigation return flow is based on an irrigation efficiency of 55 percent for flood irrigated lands and 65 percent for sprinkler irrigation from groundwater diversions of almost 28,000 ac-ft/yr.

The total estimated outflow is about 3,500 ac-ft/yr more than the estimated inflows, which may indicate a decrease in the amount of storage in this basin. Examination of water level hydrographs shows a steady decline since the 1950s.



SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Total Annual Inflow and Outflow for Each Groundwater Basin

Figure 7-2

Daniel B. Stephens & Associates, Inc.

5/25/05

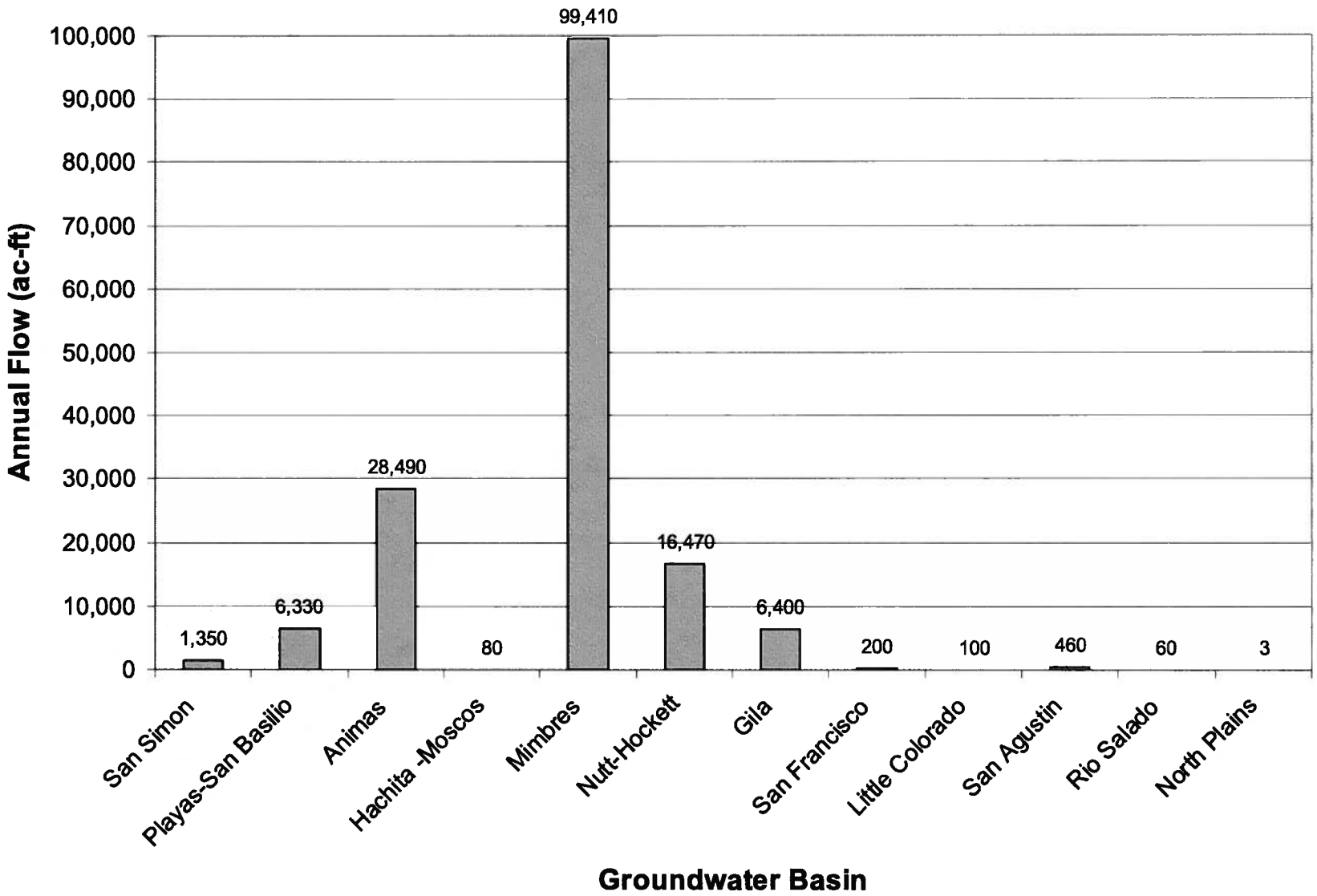


Figure 7-3

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Annual Groundwater Pumping by Basin

Daniel B. Stephens & Associates, Inc.

5/25/05

7.1.2.3 Playas-San Basilio Basin

Inflow to the Playas-San Basilio Basin occurs through recharge and mining and irrigation return flow, while estimated outflows are due to groundwater pumping from municipal, domestic, irrigation, and mining wells and to sub-flow out of the basin (Appendix F, Table F-4). The irrigation return flow estimate is based on an irrigation efficiency of 55 percent.

The total estimated outflow from documented sources is about 2,800 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimates for the evapotranspiration out of the basin. Examination of water table contours indicates that groundwater flow converges in the center of the basin and may exit through evapotranspiration; therefore, evapotranspiration may be about 2,800 ac-ft/yr.

7.1.2.4 Hachita-Moscos Basin

Inflow to the Hachita-Moscos Basin occurs through recharge (no return flow is calculated for the small amount of diversions from wells), while estimated outflows are due to groundwater pumping from domestic and stock wells and to sub-flow out of the basin (Appendix F, Table F-5). The total estimated outflow is about 2,300 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimates for the evapotranspiration component or to error in estimation of other components. Examination of water table contours indicates that groundwater levels have not changed significantly over a 50-year period.

7.1.2.5 Mimbres Basin

Inflow to the Mimbres Basin, the largest and most heavily used of the basins in the Southwest Region, occurs through recharge and return flow, while estimated outflows are due to groundwater pumping from all types of wells and to springs or stream gain (Appendix F, Table F-6):

- Most of the recharge occurs in the portion of the Mimbres Basin within Grant County, where an average 2.8 percent of the precipitation results in recharge. Although more than half of the area of the basin lies within Luna County, that area receives less than 8 inches of annual precipitation, which does not result in any recharge based on the method applied in this study. In reality, some intense thunderstorms may produce runoff

that would result in small amounts of recharge through ephemeral channels within Luna County, but no estimate is available for this analysis.

- The return flow from irrigation is based on both conveyance losses from surface water diversions and on-farm efficiencies of both surface and groundwater diversions.

- The estimate for stream loss is from the Mimbres River in Luna County. The 6,500 ac-ft/yr of sub-flow south to Mexico previously estimated by Hanson et al., 1994 is not included, because Hawley et al., 2000 noted that a reversal in groundwater flow directions at the U.S. border indicates that groundwater is no longer flowing to the south, but may instead be entering the basin.

- Estimated evapotranspiration may range from 0 to 45,000 ac-ft/yr. Hanson et al. (1994) estimated predevelopment evapotranspiration to be 42,000 ac-ft/yr in Luna County and 3,400 ac-ft/yr in Grant County. However, Hawley et al. (2000) suggest that the irrigation wells are capturing most of the water that was previously discharged through evapotranspiration. Their study shows a value of 10,000 ac-ft/yr for the evapotranspiration within Luna County, but recognizes that this value may range from 0 to more than 10,000 ac-ft/yr. The total evapotranspiration of 13,400 ac-ft used in DBS&A's water budget for the Southwest Region represents 10,000 ac-ft in Luna County and 3,400 ac-ft in Grant County.

- Part of the municipal supply for the Mimbres basin is derived from the Silver City Frank's well field in the Gila Basin. Return flow from all of the municipal diversion for Silver City returns to the Mimbres Basin.

The total estimated outflow is about 34,000 ac-ft/yr more than the estimated inflows, which may be due to an overestimation of evapotranspiration or an underestimation of recharge in Luna County. However, at least some of the difference likely reflects a change in the amount of water in storage, as evidenced by water level hydrographs, which show that the water table has dropped about 50 feet over the past 50 years.

7.1.2.6 Nutt-Hockett Basin

Inflow to the Nutt-Hockett Basin occurs through recharge and mining and irrigation return flow, while estimated outflows are due to groundwater pumping from domestic, mining, and irrigation wells (Appendix F, Table F-7). Return flow from irrigation is the largest inflow component (5,500 ac-ft/yr) and is based on an irrigation efficiency of 60 percent for flood irrigated lands, 65 percent for sprinkler irrigation, and 85 percent for drip irrigation from the 16,430 ac-ft/yr pumped from irrigation wells.

The total estimated outflow is about 10,700 ac-ft/yr more than the estimated inflows, which may represent a change in storage. Examination of one water level hydrograph available for the Nutt-Hockett Basin shows a decline of almost 150 feet over a 40-year period. Examination of recent USGS water level elevations indicates that the water levels are higher than those in the Rio Grande Basin to the east and higher than the water levels in the Mimbres Basin to the west; therefore, it is unlikely that sub-flow from other basins is recharging the Nutt-Hockett Basin significantly. Thus the change in storage suggested by the water budget is likely fairly accurate.

7.1.2.7 Gila Basin

Inflow to the Gila Basin occurs mostly through recharge and irrigation return flow, with municipal and mining return flow and sub-flow from the Animas Basin contributing lesser amounts (Appendix F, Table F-8). The irrigation return flow estimate is based on conveyance losses and an on-farm irrigation efficiency ranging from 40 to 55 percent for surface water diversions of 31,200 ac-ft/yr and groundwater diversions of 3,070 ac-ft/yr.

Some of the estimated outflows occur due to groundwater pumping from municipal, commercial, domestic, irrigation, industrial, livestock, and mining wells (Appendix F, Table F-8); however, the largest component of estimated outflows is springs and stream gain. Discharge of groundwater to the Gila River is estimated to be 54,600 ac-ft/yr based on the median flows at two stream gages: the Gila River near Gila and the Gila River below Blue Creek, near Virden. The gain to the Gila River on this reach is 28,130 ac-ft/yr which, when adjusted to account for the irrigation diversions along this reach of 22,460 ac-ft/yr and riparian evapotranspiration of 4,010 ac-ft, results in a total gain of 54,600 ac-ft/yr. Tributary inflow from ungaged perennial tributaries in this reach, if known, would lower the estimated flow from groundwater to surface water.

Additional gains may occur in the Virden Valley downstream of this reach. The gain between the Gila River near Redrock and the Gila River near Virden, where no perennial streams contribute to the flow of the Gila, is about 8,000 ac-ft/yr, confirming a significant groundwater contribution to the Gila River.

The total estimated outflow is more than 41,680 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimate for the sub-flow out of the basin. Examination of water table contours indicates that groundwater is flowing to the west out of New Mexico. Accordingly, the water budget was balanced by adjusting the value for sub-flow out of the basin to be 41,680.

7.1.2.8 San Francisco Basin

Inflows to the San Francisco Basin are due to recharge and to return flow from municipal and irrigation use (Appendix F, Table F-9). The irrigation return flow estimate is based on conveyance losses of 13,500 ac-ft/yr and 2,460 ac-ft from on-farm returns (an irrigation efficiency of 40 percent for the 4,100 ac-ft/yr of surface water delivered to the farms). The bulk of outflows are due to springs and stream gain, with lesser amounts due to groundwater pumping from municipal, industrial, commercial, domestic, and livestock wells (Appendix F, Table F-9).

The irrigation return flow is assumed to recharge the aquifer, which will ultimately result in groundwater discharge to the San Francisco River, or part of the 59,930 ac-ft/yr estimated as spring flow from the groundwater. The discharge to the river from groundwater was calculated by subtracting the median flows at the San Francisco River near Reserve (12,160 ac-ft/yr) from those at the gage near Glenwood (50,030 ac-ft/yr) and adjusting for the surface water diversions of 17,600 ac-ft/yr and calculated riparian evapotranspiration of 4,490 ac-ft/yr. This method does not account for the inflow from ungaged tributaries to the San Francisco River within this reach.

The total estimated outflow is more than 11,720 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimate for the sub-flow out of the basin. Examination of water table contours indicates that groundwater is flowing to the west out of New Mexico, and therefore, the water budget was balanced by showing 11,720 ac-ft/yr as sub-flow to the west.

7.1.2.9 San Agustin Basin

Estimated inflows to the San Agustin Basin are due to recharge and irrigation return flow, while documented outflows are due to pumping from commercial, domestic, irrigation, and livestock wells (Appendix F, Table F-10). The irrigation return flow estimate is based on an irrigation efficiency of 55 percent.

The total estimated outflow is about 18,000 ac-ft/yr less than the estimated inflows (Appendix F, Table F-10), which may be due to a lack of estimate for evapotranspiration from Lake San Agustin Playa. The detailed water level maps of the complex aquifer system in this basin (Myers et al., 1994) do not show sub-flow to adjacent basins, but rather indicate a convergence of flow directions toward the center of the basin in both the San Agustin bolson-fill aquifer and the deeper Datil aquifer. Based on the available water level and water budget data, the water budget was adjusted to show evapotranspiration of about 18,000 ac-ft/yr.

7.1.2.10 Little Colorado Basin

Estimated inflows to the Little Colorado Basin are due to recharge and municipal and irrigation return flow, while outflows are due to pumping from municipal, commercial, domestic, and livestock wells (Appendix F, Table F-11). Return flow from irrigation is based on an irrigation efficiency of 45 percent for surface water diversions in the vicinity of Quemado and conveyance losses of 620 ac-ft/yr.

The total estimated outflow is about 19,400 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimate for the sub-flow out of the basin. Examination of water table contours indicates that groundwater is flowing to the west out of New Mexico, and therefore, sub-flow to the west is estimated to be 19,400 ac-ft/yr.

7.1.2.11 North Plains Basin

Estimated inflows to the North Plains Basin are due solely to recharge, and the only withdrawals of groundwater in the North Plains Basin are from domestic wells serving the 30 people living in this basin (Appendix F, Table F-12). The total estimated outflow is about 980 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimate for the sub-flow out of the basin. Examination of water table contours indicates that groundwater is flowing to the west toward the

Little Colorado Basin, and therefore the water budget was balanced by assuming a sub-flow out of 980 ac-ft/yr.

7.1.2.12 Rio Salado Basin

Estimated inflows to the Rio Salado Basin are due solely to recharge, and the only withdrawals of groundwater are from livestock and a minimal amount from domestic wells serving the tiny population in this basin (Appendix F, Table F-13). The total estimated outflow is about 1,750 ac-ft/yr less than the estimated inflows, which may be due to a lack of estimate for the sub-flow out of the basin. Examination of water table contours indicates that a groundwater mound occurs in the center of the basin, resulting in groundwater flow to the east toward the Rio Grande and to the west toward the North Plains Basin. Therefore, to balance the water budget, sub-flow to other basins is estimated to be about 1,750 ac-ft/yr.

7.1.2.13 Groundwater Budget Data Gaps

As suggested by the discussions in Sections 7.1.2.1 through 7.1.2.12, more information on the amount of evapotranspiration and sub-flow in and out of each basin is needed to obtain a better understanding of the water budgets. Return flow estimates could be improved by measuring surface diversions and canal losses. Detailed water level maps could help define the flow regimes in each basin. However, despite the uncertainty in quantifying the water budget components, groundwater mining does appear to be occurring in the Animas, Mimbres, and Nutt-Hockett Basins.

7.2 Surface Water Budget

Surface water budgets were prepared for the three principal perennial streams in the region: San Francisco, Gila, and Mimbres Rivers.

7.2.1 Surface Water Budget Terms and Methodologies

As with groundwater budgets, surface water budget analyses rely heavily on estimates (based on prior studies and expert judgment) instead of actual measurements. Although precipitation and streamflow are measurable water sources, they are typically measured at only a few

locations. By comparison, evaporation, evapotranspiration by plants, infiltration, return flows, spring and seep discharges are usually estimated. Consequently, surface water budget calculations generally have a high degree of uncertainty and should be used with considerable caution.

7.2.1.1 Inflow components

Inflow sources for surface water include surface inflow, stream/spring gain, and return flow.

Runoff from rain and snowmelt provides ***surface inflow*** to a stream, that is, the volume of water that flows in the streams from the precipitation that has not been intercepted or evaporated from non-riparian vegetation.

The estimated precipitation volume for the entire planning region is 12,200,000 acre-feet (based on the precipitation contours in Figure A2-4), but the vast majority of this inflow does not show up as streamflow, due to upland ET and other factors. About 10 to 20 percent of precipitation wets and adheres to aboveground objects (generally vegetation) and is subsequently returned to the atmosphere through evaporation. However, interception in areas with dense forests may be as much as 25 percent of total annual precipitation (Viessman and Lewis, 1996). In addition, non-riparian ET can exceed 90 percent of precipitation in some watersheds (Brooks et al., 1991). Measurements of non-riparian ET in the Los Alamos, New Mexico area showed that ET losses were between 75 and 87 percent of total precipitation (Gray, 1997).

Therefore, the water budget discussed herein is based on the amount of surface water available in the three main drainages in the planning region, rather than the precipitation volume. Inflows, as calculated here, are comprised of gaged streamflow volumes measured at USGS gages on these three drainages. The streamflows used in the water budget are the median values for the period 1950 through 2002, as presented in Section 5.2.1, with the annual yields corrected for the number of irrigated acres upstream of the gage site.

Inflow from springs and seeps is the ***spring/stream gain, which is*** estimated by the increased flow volume between an upstream and downstream gage. The spring/stream gain used in the water budget for the Southwest Region was based on values cited in the literature or on the stream gain along a reach between two gages, adjusted for irrigation diversions and riparian

evapotranspiration for the reach. The spring/stream gain reflects the amount of water that is discharged from the aquifer and inflow from ungaged tributaries.

Return flow from irrigation with surface water is assumed to recharge groundwater and ultimately return to the stream through spring/stream gain. The return flow is calculated using the procedures by Wilson et al. (2003) described in Section 7.1.1.1.

Return flow from municipal, mining, and industrial users discharged directly to streams was estimated to be zero based on Wilson et al. (2003).

7.2.1.2 Outflow components

Outflows are comprised of surface water depletions and flow past the state line. The depletions were determined as follows:

- Estimates of ***irrigation diversion*** are from OSE annual water use report for 2000 (Wilson et al., 2003).

- Water diverted for ***municipal/commercial*** and ***mining*** water supplies are from New Mexico OSE annual water use report (Wilson et al., 2003).

- Stream ***seepage*** into the groundwater is the amount of water that is lost from the stream and recharges the aquifer. Although the Gila and the San Francisco Rivers appear to be gaining through most of the planning region, it is possible that reaches within these stream systems are losing; however, data on seepage losses were not available to make reliable estimates of these quantities for most of the basins in the Southwest Region. Estimates of stream seepage are included in the water budget only for the Mimbres River.

- Since 1990, the OSE has reported ***reservoir evaporation*** only for reservoirs with 5,000 or more acre-feet of storage. Therefore, estimates of reservoir evaporation are based on the OSE reservoir and stock pond evaporation data for 1985, which more accurately reflect the total evaporation in each river basin.

- ***Evapotranspiration*** (water lost from plants, such as transpiration through tree leaves, and direct evaporation from surface water) is based on the riparian acreage within the reaches between gages. As discussed in Section 5.1.3, DBS&A estimated riparian ET to be 19,900 ac-ft/yr based on an estimated riparian acreage of approximately 6,700 acres and average riparian ET rates in New Mexico. The estimated depletions for the reaches between the stream gages on the three rivers total 12,090 ac-ft/yr.

- ***Surface outflow*** from the region is based on values cited in the literature or stream gage data for the downstream reach.

7.2.2 Summary of Surface Water Budgets by Stream Basin

Surface water budgets for the San Francisco, Gila, and Mimbres basins were prepared based on the surface water inflow and outflow terms presented above. The major input—runoff from rain and snowmelt—was quantified based on gaged streamflows for average conditions as well as for drought conditions, the latter of which were based on 10th-percentile streamflows (flows at a level that 10 percent of all flows fall below and 90 percent above).

The available information available on surface water budget components is presented in Table 7-3. The results of the surface water budgets showed that inflows were greater than outflows in the San Francisco and Gila systems for both average and drought conditions (Table 7-3). However, due to legal restrictions on the use of surface water (Section 4), no excess surface water is available to meet new demands in these systems. In the Mimbres system, inflows were greater than outflows under average conditions and approximately equal to outflows in drought conditions (Table 7-3), but again, no excess surface water is available to meet new demands in the Mimbres due to legal restrictions.

Table 7-3. Surface Water Budgets

	San Francisco River				Gila River						Mimbres River			
	Catron County (Reserve to Glenwood)		Grant County		Catron County		Grant County (Gila to Virden)		Hidalgo County (Virden to Stateline)		Grant County (Mimbres to Faywood)		Luna County (Faywood to Deming)	
Sub-Basin	Amount (ac-ft/yr)	Reference	Amount (ac-ft/yr)	Reference	Amount (ac-ft/yr)	Reference	Amount (ac-ft/yr)	Reference	Amount (ac-ft/yr)	Reference	Amount (ac-ft/yr)	Reference	Amount (ac-ft/yr)	Reference
Inflow														
Average surface inflow[a]	12,160	USGS stream gage San Francisco River near Reserve median flow (1950–2002)	NA	No gages	NA	No gages	102,660	USGS Gage Gila near Gila median flow (1950–2002)	NA	No gages	7,510	Median, Mimbres near Mimbres	10,000	Hawley et al., 2000
Springs/stream gain	59,930	See Table F-9	NA		NA		54,600	See Table F-8	NA		4,800	Hanson et al., 1994	0	Hanson et al., 1994
Return flow of irrigation from surface water only[b]	*15,940*	Wilson et al., 2003, applied to groundwater	0	Wilson et al., 2003	0	Wilson et al., 2003	*20,190*	Wilson et al., 2003, applied to groundwater	*5,380*	Wilson et al., 2003, applied to groundwater	*2,130*	Wilson et al., 2003, applied to groundwater	*12,740*	Wilson et al., 2003, applied to groundwater
Return flow from municipal uses[c]	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003
Outflow														
Irrigation diversion (depletion)	17,560 (1,620)	Wilson et al., 2003, San Francisco River	0	Wilson et al., 2003	0	Wilson et al., 2003	22,460 (2,270)	Wilson et al., 2003, Gila	8,740 (3,365)	Wilson et al., 2003, Virden Valley	3,310 (1,180)	Wilson et al., 2003, Mimbres Basin	22,510 (9,775)	Wilson et al., 2003, Mimbres Basin
Livestock (depletion = diversion)	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	140	Wilson et al., 2003	50	Wilson et al., 2003	60	Wilson et al., 2003	80	Wilson et al., 2003
Municipal/commercial diversion (depletion)	1	Wilson et al., 2003, Glenwood Fish Hatchery	0	Wilson et al., 2003	0	Wilson et al., 2003	150 (75)	Tyrone Water System and Fort Bayard Medical Center	0	Wilson et al., 2003	26 (13)	Wilson et al., 2003, Santa Clara Village	0	Wilson et al., 2003
Mining	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003
Seepage	NA		NA		NA		NA		NA		NA		10,000	Hawley et al., 2000
Reservoir evaporation	0	Wilson et al., 2003	0	Wilson et al., 2003	140	Wilson et al., 2003, Snow Lake and Wall Lake	390	Wilson et al., 2003, Bill Evans Dam and Lake Roberts	0	Wilson et al., 2003	55	Bear Canyon	205	King Reservoir and stock ponds (Wilson, 1985)
Riparian evapotranspiration	4,490	DBS&A Calc.	0	DBS&A Calc.	410	DBS&A Calc.	4,010	DBS&A Calc.	1,620	DBS&A Calc.	1,130	DBS&A Calc.	430	DBS&A Calc.
Average surface outflow	50,030	USGS stream gage San Francisco River near Glenwood median flow (1950–2002)	0	San Francisco River does not enter Grant County	NA	No gages	130,790	USGS stream gages Gila below Blue Creek, near Virden, median flow (1950–2002)	NA	No gages	10,000	Hawley et al., 2000	0	Hanson et al., 1994

[a] Use of surface water in Gila, San Francisco, and Mimbres Rivers is restricted by water rights adjudication; therefore, surface inflow does not represent water available for use in the region.

[b] Applied to groundwater that ultimately becomes stream gain if not intercepted by wells; therefore, italicized numbers not included in total inflow.

[c] 941 acre-feet per year of treated effluent that is discharged from Silver City wastewater treatment plant to San Vicente Arroyo is treated as return flow to the groundwater.

ac-ft/yr = Acre-feet per year
NA = Not available
USGS = U.S. Geological Survey

8. Analysis of Alternatives for Meeting Future Demand

Once the region has studied their water supply and projected future demand for water, the next key component of the regional water plan is to develop alternatives for meeting the projected water demand. Alternatives are actions that the region can take to increase supply, reduce demand, protect or improve water quality, or better manage water resources so that the water supply of the region continues to be viable. This section provides information on the process used to identify and screen alternatives and analyzes the feasibility of priority alternatives selected by the Steering Committee. The purpose of this alternative analysis is to provide decision makers an overview of the technical, legal, environmental, and political issues with regard to each alternative. This section does not rank the alternatives nor compare their relative merits, for it is likely that combinations of multiple alternatives will be implemented, and each governmental entity will ultimately make the decision on the degree to which each alternative is implemented.

8.1 Identification and Selection of Alternatives

The region initiated the current phase of regional water planning in January 2004. A complete list of potential alternatives for addressing water supply needs was developed at Steering Committee meetings, which were advertised and open to the public, held in the winter and spring of 2004. In developing the potential alternatives, the Steering Committee also considered input from public meetings held in 2003. Public participation during this planning process is outlined in Appendix B.

To help determine which of the alternatives were the most important to identify and analyze in the regional water plan, the Steering Committee requested that DBS&A assist in developing a formal decision analysis process. The decision analysis process is a structured way of thinking about the ramifications of actions taken as a result of a specific decision and provides a structured way to consider diverse values in making the decision (Spradlin, 1997). The intent is to provide a group of stakeholders with insight into their preferences and values, as well as their attitudes toward risk, as they relate to the potential alternatives. In the absence of complete "hard data" regarding some of the water supply choices to be made, particularly regarding intangibles such as public/institutional and regulatory acceptability, the evaluation and ranking of

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Appendix A

Resource Information and Maps

Appendix A1

Bibliography

Southwest New Mexico Water Planning Region
Data Inventory

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Appendix A2

WRRI Maps

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Southwest New Mexico Water Plan
Planning Region

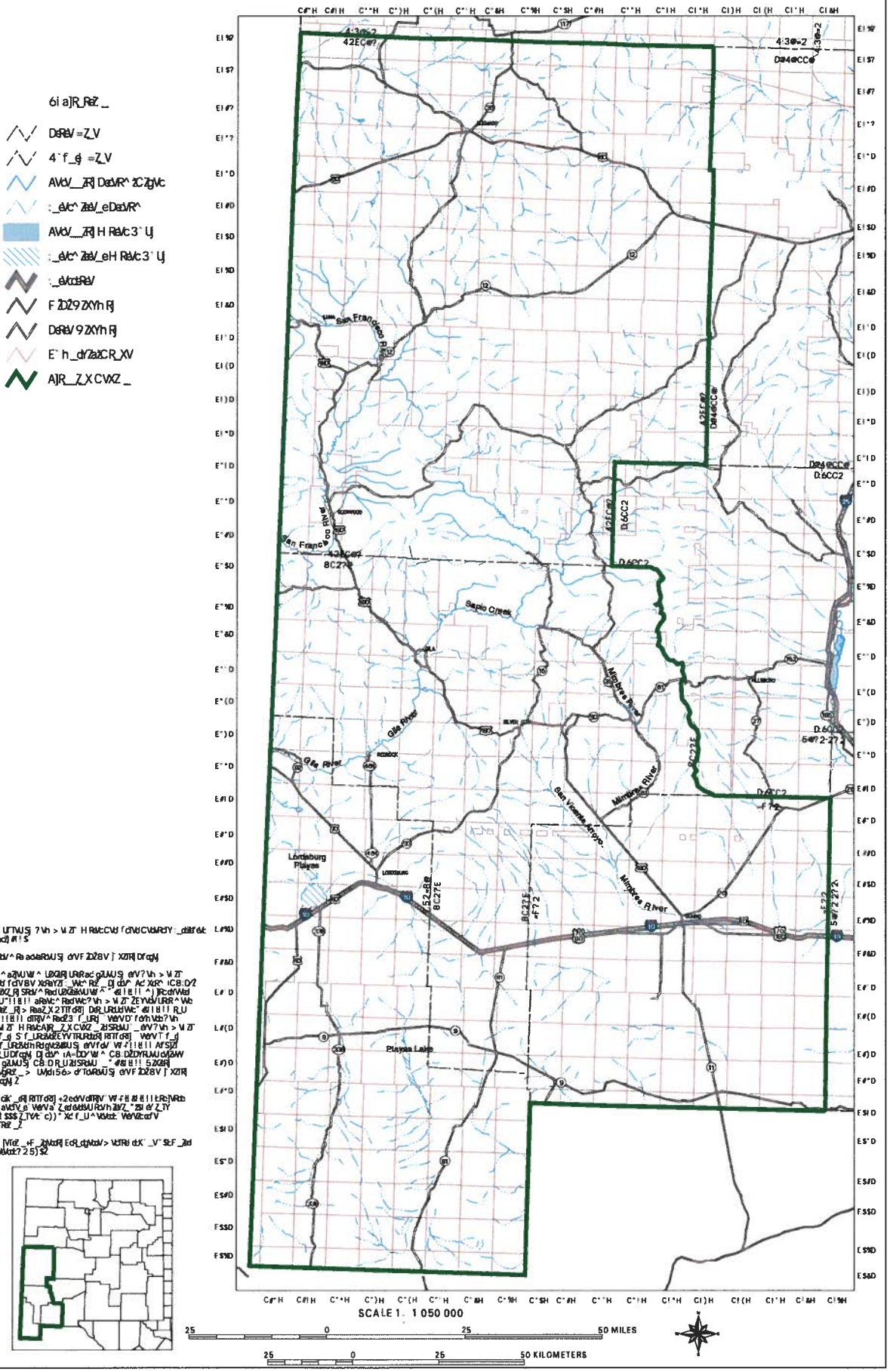

Figure A2-1

Appendix C. Water Law and Regional Water Planning

C.1 Introduction

In an effort to provide general background information for stakeholders in the water planning region, this section outlines the basic concepts of water law in New Mexico. This basic legal background is particularly important for regional water planning, because all regional planning efforts are subject to "laws relating to impact on existing water rights" (NMSA 72-14-44C(5)). New Mexico water law is codified in Chapters 72 (Water Code) and 73 (Special Districts) of the New Mexico Statutes Annotated. Chapter 73 details the powers and authorities of various water management agencies in the State such as conservancy districts, irrigation districts, and soil and water conservation districts.

Article XVI of the New Mexico Constitution establishes the basic principles underlying New Mexico water law, including prior appropriation and beneficial use: until appropriated, all water belongs to the State of New Mexico. Thus, the State has the sole authority to grant or recognize rights to use that water. Water rights "are subject to appropriation for beneficial use, in accordance with the laws of the state" and "priority of appropriation shall give the better right" are two tenets arising out of the Constitution (N.M. Constit. Art. XVI Sec. 2).

- The concept underlying the principle of prior appropriation is that the first person to use water for a beneficial purpose has a prior right to use that water against subsequent appropriators. "First in time, first in right" is the phrase often used to describe prior appropriation. Water rights acquired through this system of prior appropriation are a type of property right and may be sold or leased. In all cases, however, the essential basis of water right ownership is "beneficial use."

- The principle of beneficial use is that a water right arises out of a use that is productive or beneficial, such as agricultural, municipal, industrial, and domestic uses, among others. "Beneficial use shall be the basis, the measure and the limit of a water right" (N.M. Constit. Art. XVI, Sec. 3). This provision has also been incorporated into case law, which is the law developed by New Mexico courts. As recognized in *State ex rel.*

Reynolds v. Mendenhall, beneficial use is the "measure and limit of the right to the use of waters" (68 N.M. 467, 473 (1961)).

The Office of the State Engineer (OSE) administers water rights for the State of New Mexico, as discussed in Sections C.2 through C.5.

C.2 Administration of Groundwater and Surface Water in New Mexico

C.2.1 Groundwater

To actively manage groundwater resources in New Mexico, the OSE has the authority, as set forth in the Water Code, to delineate groundwater basins that require a permit for groundwater withdrawals, referred to as "declared underground water basins." Those basins that fall within the Southwest planning region are depicted on Figure 4-1 in the body of this report. To withdraw water from these declared basins, a user must have put water to beneficial use prior to the declaration of the basin or must obtain a water permit from the OSE that specifies (1) how much water a user can withdraw within any given year, (2) the location and type of well that will be used to withdraw the water, and (3) the use to which the water will be put. Many water right permits have special conditions that further define the use and quantity of water allowed under the permit.

Transfers of valid water rights must not be "contrary to the conservation of water within the state and not detrimental to public welfare of the state" (NMSA 72-5-23, 72-12-3(D)). Further, and of critical importance, is the requirement that any transfers not impair existing rights. Methods of obtaining water rights are discussed in Section C.3.

Water rights files are public records and can be reviewed in the OSE District Offices, as well as in the main OSE office in Santa Fe. Also, general information about water rights for New Mexico is compiled in the OSE Water Administration Technical Engineering Resource System (WATERS) database, which can be accessed through the internet (http://seowaters.ose.state.nm.us/awdProd/). The database is a useful tool for understanding general information about the water rights. However, water rights files are complex and the

database does not necessarily provide verification of the current status of the water rights. Consequently, it cannot be used to validate water rights. In order to determine whether a water right is valid, the water rights file must be abstracted.

C.2.2 Surface Water

Like groundwater, the diversion of water from New Mexico's surface waters requires either a declaration, a permit, a license, or court decree to divert the water. Surface water appropriations follow the same standards as groundwater rights in that a transfer or lease cannot impair existing water rights and must not be contrary to public welfare or conservation (NMSA 72-5-23, 72-12-3(D)).

Many of New Mexico's surface waters are governed by interstate compacts that require set amounts of water to be delivered to specified delivery points. The Interstate Stream Commission, an adjunct commission to the OSE, has responsibility for ensuring that specific rivers in New Mexico meet their obligations under the interstate compacts.

C.3 Water Right Ownership

Ownership of water rights by individuals or other entities is established by diversion and application to beneficial use. It may be demonstrated administratively through the declaration or permit process. In the case of groundwater rights, a declaration may be filed for water uses that were instituted prior to the declaration of the groundwater basin. In the case of surface water, a declaration may be filed for water uses that were instituted before 1907, the year the State Engineer assumed jurisdiction over all surface water use in New Mexico. A water right declarant may make and file in the office of the state engineer a declaration in a form with the date of first application to beneficial use, continuity thereof, location of the source of water, and description of the land where used (NMSA 72-1-3). However, this declaration constitutes a claim of ownership only; it does not guarantee that the declarant will be entitled to the entire amount of water claimed.

Individuals or entities that wish to acquire a new water right must file a permit application with the OSE and go through the entire permitting process (described in Section C.3.1). Permits are granted only for unappropriated waters of the State. The judicial recognition of water rights on a stream system takes place through an adjudication. An adjudication is a "suit for the determination of a right to use the waters of any stream system" (NMSA 72-4-17). Upon completion of the adjudication proceeding, an order and decree are entered establishing the priority, amount, purpose, periods and place of use, and specific tracts of land to which the right is appurtenant.

The water right permitting process is discussed in more detail in Section C.3.1. Although the permitting process is the primary method of obtaining water rights for water in declared groundwater basins and for surface water, the right to use water may also be obtained through purchase, lease, or through the pre-1907 surface water declaration process, as discussed in Section C.3.3. The loss of ownership of a water right is discussed in Section C.3.4.

C.3.1 Water Right Permitting Process

The water right permitting process includes the following steps:

1. The applicant submits an application to the OSE.

2. The OSE publishes a notice of the filing of the application. This provides public notice so that individuals or entities who believe their rights would be impaired by the approval of the permit or believe that the granting of the permit would be detrimental to the public welfare or contrary to the conservation of water have the opportunity to submit a protest to the application.

3. If no protest is submitted and if the OSE determines that the water exists and that appropriation of it would not impair other water rights or adversely impact public welfare and conservation, the OSE approves the water right application.

4. In the case of a protest, the OSE Hearings Unit must evaluate whether the applied-for water right would meet the statutory criteria for approval (no impairment and no adverse effects on public welfare and conservation). The permit application then goes through the contested hearing process before a hearing examiner. Through the examination of the specific conditions of the application and the protestants, the hearing officer makes a determination, and the application is either granted or denied.

5. If a water right is granted, the OSE may place specific conditions in the permit to protect surrounding water rights holders (*City of Albuquerque v. Reynolds,* 71 N.M. 428, 440 (1962)). Examples of conditions placed on permit holders may include monitoring or metering requirements, restricting use to certain months of the year, or disallowing use under specific conditions (low flow, for example). Further, the State Engineer retains jurisdiction over the permit, to ensure that the permittee complies with permit conditions.

C.3.2 Other Types of Water Rights

In addition to water rights established through the permitting process, discussed above, two other types of water rights exist in New Mexico. These water rights, prebasin wells and domestic and livestock wells, are established as described below.

C.3.2.1 Prebasin Wells

Since many of the underground water basins were declared after wells had been drilled and water put to beneficial use, the Water Code recognizes these rights as valid. Section 72–12-4 states that "existing water rights based upon application to beneficial use are hereby recognized." Even if actual beneficial use does not take place prior to the declaration, actions that demonstrate an intent to appropriate are sufficient to establish a prebasin water right. The priority date of this water right will "relate back" to these actions (*State ex rel. Reynolds v. Mendenhall,* 68 N.M. 467, 475 (1961)).

C.3.2.2 Domestic and Livestock Watering Wells

As in many other western states, most New Mexico homeowners with private wells are allowed to use up to 3 acre-feet per year of groundwater for household use or for limited irrigation or

livestock watering (NMSA 72-12-1). Livestock uses are permitted under NMSA 72-12-1.2, and temporary uses not to exceed 3-acre-feet in one year for mining, oil and gas, and highway use, among others, are permitted under NMSA 72-12-1.3. This rule applies except in areas where there are court restrictions on domestic wells, such as in the Gila-San Francisco Basin. In non-restricted locations, homeowners must file a document indicating that they will use the water, but these "applications" are granted automatically and are neither published nor subject to protest (NMSA 72-12-1). Local municipalities have some control over domestic well permitting. By statute the State Engineer can issue domestic well permits, provided that permits for domestic use within municipalities are conditioned to require the permittee to comply with all applicable municipal ordinances (NMSA 72-12-1.1).

The OSE does not allow a change in place of these domestic well uses; that is, it does not allow the water right to be moved to another location. In that sense, the domestic well is a right of use only and is not to be sold separately from that intended location and purpose of use. However, non-permitted prebasin domestic wells (Section C.3.2.1) are not subject to this limitation and may therefore be transferred.

C.3.2.3 Stock Ponds

Many livestock water users impound surface water into ponds. Until recently, individuals could construct such impoundments for livestock purposes without approval from the State Engineer. In 2004, however, because of concern about the number of unregulated stock ponds, the New Mexico legislature amended the water code to give the State Engineer jurisdiction over stock ponds, and the OSE now requires a permit for new surface water impoundments of any kind, including livestock water impoundments (NMSA § 72-9-3, 19.26.2.14 NMAC). If an application is submitted for a livestock pond located on or fed by a perennial stream, the applicant must comply with the surface water appropriation regulations (NMSA § 72-9-3 (A)(B), 19.26.2.14 (D) NMAC). Therefore, stock ponds will be allowed in a perennial stream system only when unappropriated water is available or if an existing water right can be transferred to that use.

To address the issue of so-called "livestock ponds" built for aesthetic and recreational purposes, the regulations specifically state that water for livestock does not include "the impoundment of surface or groundwater in any amount for fishing, fish propagation, recreation, or aesthetic

purposes" (19.26.2.14 NMAC). Accordingly, a valid water right is now required to fill such structures, and an application must be submitted to the OSE and reviewed under the existing surface water regulations or, should the applicant wish to use groundwater to fill a pond, groundwater regulations. Given that most surface water and hydrologically connected groundwater in the region is already appropriated, along with the requirement that such an impoundment not impair existing senior water rights holders, it may be difficult for an applicant to obtain a new water right. Again, a landowner wishing to construct a fishing or recreational pond could seek instead to purchase an existing water right and transfer it to a new place of use for a new purpose of use.

C.3.3 Water Rights Transactions

Water rights transactions include transfers to other users, through sales or leases, and changes in point of diversion or in purpose or place of use. These transactions must follow an administrative procedure similar to the one used for appropriating a new water right. An application is filed, and notice is published within a certain time limit within which a protest must be submitted. The standards for reviewing these applications are impairment, public welfare, and conservation.

C.3.4 Loss of Water Rights

The Water Code specifies that nonuse for a period of four consecutive years when water is physically available may lead to forfeiture of the water right. Prior to 1965, water rights were automatically forfeited following a four-year period of nonuse. Legislation passed in 1965 requires the OSE to notify a water rights holder that the right is subject to forfeiture. After the OSE has provided notice, the water user has one year to put the water to beneficial use; however, if the nonuse continues after the OSE has provided notice, the water right is forfeited (NMSA 72-5-28, 72-12-8).

The forfeiture provision of the statute contains several exceptions. Of particular interest to the regional water planning community is the exemption for placing water in "state engineer approved water conservation plans" (NMSA 72-5-28(G), 72-12-8(D)). This provision applies to

individuals and entities that own water rights, conservancy and irrigation districts, and acequia and community ditch associations. Further, municipalities, counties, water user associations, public utilities, community water systems, and state universities are protected from claims of forfeiture by implementing 40-year water plans (NMSA 72-1-9, 72-5-28(C), 72-12-8(F)) (Section C.4).

Water rights may also be lost through abandonment. Abandonment requires an intent to abandon in addition to discontinued use by the owner of the water, whereas forfeiture does not require an intent to relinquish the right (*State ex. rel. Reynolds v. South Springs Col.,* 80 N.M. 144 (146-47)). An example of abandonment would be to develop land formerly used for irrigation into a building, parking lot, or housing complex, thus clearly demonstrating that the owner of the land no longer intends to put their irrigation water right to use.

C.3.5 City and County Regulation of Water

The availability of an adequate water supply is a potential limiting factor on population growth and development expansion. The provision of an adequate water supply poses physical constraints on growth but it may also impose even further constraints as a regulatory mechanism that may be used to manage growth. Both counties and cities have the authority to adopt ordinances conserving and regulating the use of water within their jurisdictions. Likewise, municipalities and counties can adopt comprehensive plans that may include water supply availability requirements or other local government preferences regarding water use (NMSA 3-21-21 and 3-21-5). These preferences become regulatory tools through the adoption of implementing regulations and ordinances.

For example, subdivision and other land use approvals are increasingly being conditioned upon the developer demonstrating an adequate water supply. In 1996, the New Mexico legislature amended the State Subdivision Act to require that county subdivision ordinances obligate a subdivider seeking approval of a preliminary plat to show that the subdivider can furnish water of sufficient quantity and quality to meet the needs of the subdivision (NMSA 47-6-11 (F)). As part of the approval process, both the OSE and the New Mexico Environment Department must

review the subdivider's documentation demonstrating satisfaction of these requirements (NMSA 47-6-11 (F)).

Likewise, municipalities are charged by State law with the power to adopt city ordinances governing land platting, planning, and zoning (NMSA 1978, 3-19-1 through 12; NMSA 3-20-1 through 3-20-16). Specifically, municipal subdivision regulations may govern the extent and manner in which water will be provided to the subdivision as a condition of plat approval (NMSA 3-19-6 (B)(5)(b)).

County and municipal regulations may also be important in the regulation of domestic wells. Under the New Mexico Water Code, an applicant may receive a domestic well permit from the State Engineer without acquiring commensurate groundwater rights or retiring surface water rights to offset the effects of domestic well pumping on hydrologically connected surface water (NMSA 72-12-1). Since a domestic water right permit is granted by the State Engineer as a matter of right, it is viewed by many both as a loophole in the regulation of groundwater withdrawals and as an obstacle to the use of water supply as a growth management tool.

Municipalities do have the power to restrict the drilling of new domestic water wells. Municipal water providers have the authority to deny new domestic well permit applications where the property is located within the exterior boundaries of the municipality and the applicant's property line is within 300 feet of the provider's existing water distribution lines (NMSA 3-53-1.1(A)).

A municipality may not deny a new domestic well permit if the total cost to the applicant of extending the municipal water lines, installing a meter, and hooking up to the system exceeds the cost of drilling a new well (NMSA 3-53-1.1(B)). In addition, a municipality declining to authorize a new domestic well must provide domestic water service within 90 days at regular rates (NMSA 3-53-1.1(C)). Existing wells are not affected by this law.

In order to exercise this authority, a municipality must adopt a well regulation ordinance and file it with the OSE. An applicant in a municipality with a new well ordinance must obtain a permit to drill from the municipality subsequent to State Engineer approval (NMSA 3-53-1.1(E)). A municipality must notify the State Engineer of its denial of drilling permits, and an applicant may

appeal a denial to the district court (NMSA 3-53-1.1(G)). The State Engineer has the power to grant a permit for a domestic well within municipal boundaries provided it conforms to all applicable municipal ordinances (NMSA 72-12-1.1, NMSA 3-53-1.1).

Furthermore, municipalities and counties may regulate water use by assuming responsibility for supplying water to their residents. By owning and operating a water utility, a county or municipality may regulate water use, including imposition of conservation measures. Municipalities may also exercise their powers of eminent domain to establish or expand water utilities. A municipality "within and without the municipal boundary" may condemn, under certain conditions, various water supplies, water rights, rights-of-way "or other necessary ownership for the acquisition of water facilities" (NMSA 3-27-2(A)(1)). However, condemnation of water rights in a public water supply has not occurred in New Mexico (Clark, 1987).

Counties may also own utilities. County authority arises from statutory law providing that all "counties are granted the same powers that are granted municipalities . . . [including those powers] necessary and proper to provide for the safety, preserve the health, promote the prosperity and improve the morals, order, comfort and convenience of any county or its inhabitants" (NMSA 4-37-1). Certain class B counties are specifically authorized by statute to purchase, own, operate, and sell water and sewer utilities (NMSA 4-36-8). Furthermore, counties are specifically empowered to condemn water rights (NMSA 72-4-2). Incorporated and class H counties also have the power to condemn property for water facilities because they are included in the definition of a municipality in the water code (NMSA 3-27-2(A), 3-1-2(G)).

C.3.6 Federal Water Rights

Certain water rights are created under federal law. These include federally reserved rights and water rights through federal regulation, most importantly the Endangered Species Act. These rights are discussed in Sections C.3.6.1 and C.3.6.2.

C.3.6.1 Federal Reserved Rights

The doctrine of federally reserved water rights developed over the course of the Twentieth Century. Simply stated, federally reserved rights are created when the United States sets aside

land for specific purposes (thereby withdrawing the land from the general public domain), and there is implied, if not expressed, a concomitant intent to reserve that amount of water required to fulfill the purpose for which the land was set aside. Federally reserved water rights are not created by or limited by State law.

On federal lands (e.g., Indian reservations, U.S. Forest Service lands, National Park Service lands), water rights are reserved by the United States for use on those lands. The priority date of federally reserved water rights is the date on which the United States reserved the land for the particular use. In some cases, the United States may have State law rights under the prior appropriation system if, for instance, the United States acquires lands with existing water rights.

In *United States v. New Mexico* (438 U.S. 696, 700 (1978)), the court stated that federally reserved claims must be "carefully examined" for their "primary purposes" and that reserved water rights should not be implied unless "without the water the purposes of the reservation would be entirely defeated." In that case, which involved federal claims in the Gila National Forest, the court found that the primary purposes of the national forest did not include fish, wildlife, recreation, or aesthetic purposes, but only timber production and watershed protection.

C.3.6.2 Endangered Species Act

Western states, including New Mexico, have traditionally recognized the right to put water to beneficial use on land. Such water rights are proprietary in nature and are a form of real property. Even federal and Indian water rights have been tied to lands reserved by the federal government for a specified purpose and are called federal and Indian reserved rights. In contrast, over the last three decades a new federal water right has emerged, based not on land ownership but on the preemptive effect of federal regulatory authority. This right is known as a federal "non-reserved" right or a federal regulatory right (Tarlock, 1985).

Federal regulatory rights may be created through three major federal legislative schemes: Section 404 of the Clean Water Act, the Federal Power Act, and of particular importance to the planning regions, the Endangered Species Act. The regulatory water rights created by these statutes differ significantly from proprietary rights, whether held by the government or by private entities. All property rights share common characteristics, but the difference between regulatory

and proprietary water rights has prompted concerns in the western states about integrating these rights with traditional state-created water rights. For example, although federally reserved rights have a priority date, regulatory rights have no priority date and may supersede prior appropriative rights. Furthermore, they are not subject to the beneficial use or reasonableness requirement (Tarlock, 1985).

Pursuant to regulatory water rights, minimum stream flows may be required to meet water quality standards, avoid jeopardy to protected species, or satisfy hydroelectric licensing requirements. The Endangered Species Act (ESA) (16 U.S. C. §§ 1531-1544 (2000 and 2002 Cum. Supp.)) can play a prominent role in determining the allocation of water, especially of stream and river flows. The ESA was enacted in 1973 and, with limited exceptions, has remained in its current form since then.

The protections of the ESA are triggered by listing a species as "threatened" or "endangered." The goal of the Act is to protect threatened and endangered species and the habitat on which they depend (16 U.S. C. § 1531(b) (2000)). The Act's ultimate goal is to "recover" species to the point that they no longer need protection under the Act.

The ESA provides several mechanisms for accomplishing these goals:

- The Act makes it unlawful for anyone to "take" a listed species unless an "incidental take" permit or statement is first obtained from the Interior Department (16 U.S.C. §§ 1538, 1539 (2000)). "Take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct" (16 U.S.C. § 1532(19) (2000)).

- In addition, federal agencies must use their authority to conserve listed species and must make sure that their actions do not jeopardize the continued existence of listed species or destroy or harm habitat that has been designated as "critical" for such species (16 U.S.C. § 1536 (2000)).

- Federal agencies are also required to consult with the United States Fish and Wildlife Service (USFWS) to determine whether federal actions or federally sponsored actions will affect or jeopardize threatened or endangered species or critical habitats. Whenever a private or public entity undertakes an action that is "authorized, funded, or carried out," wholly or in part, by a federal agency, the consultation requirement is triggered and the potential impacts of the undertaking on threatened and endangered species are analyzed by the USFWS (16 U.S.C. § 1536(a)(4)(2000)).

If the exercise of a federal regulatory right greatly impinges on the use of or takes private property away from its owners, it can give rise to "takings" litigation. In takings litigation, the court will review whether the governmental or regulatory action has resulted in the taking of private property without just compensation. A summary of court decisions regarding ESA-related takings litigations is provided by Meltz (2003).

C.4 Setting Aside Water for Future Use

Through various provisions in the Water Code, the New Mexico legislature has created a mechanism to allow certain organizations to set aside water for use in the future. Although this notion is contrary to the well known "use it or lose it" concept at the heart of the prior appropriation system, it is essential for long-term water planning.

The entities that have acquired special status for water planning under the code are municipalities, counties, state universities, member-owned community water systems, special water users' associations, and public utilities supplying water to municipalities or counties. These entities are allowed a 40-year water use planning period, and water rights for these entities are based upon a water development plan, which must be implemented within the 40-year period (NMSA 72-1-9(B) Cum Supp. 2000). This provision of the statute will allow entities in the Southwest regional water planning area to legally appropriate and preserve water that they cannot currently use, but will need to meet projected water requirements for the region. These entities will be required to develop a 40-year water plan for their individual water supplies. The future demand study component of a 40-year plan can serve as partial

justification for the appropriation. The Southwest regional water plan's future demand study could also support an application to appropriate water for future use.

Municipalities and counties are specifically exempt from forfeiture of unused water rights if those rights have been appropriated for the implementation of a water development plan or for preservation of water supplies (NMSA 72-12-8 (F)). These provisions are the same for both surface water and groundwater (NMSA 72-5-28(C)).

Conservancy districts also have special provisions that allow them to manage water without application of the forfeiture provisions. NMSA 72-5-28 (G) allows "periods of nonuse when water rights are acquired and placed in a state-engineer approved water conservation program" by a conservancy district organized pursuant to NMSA, Chapter 73, Articles 14 through 19.

C.5 Conjunctive Use

Conjunctive use is the legal and administrative recognition that a hydrologic connection exists between surface water and groundwater. Because of this recognition, New Mexico water law has evolved to incorporate a system whereby the OSE can manage groundwater and surface water in conjunction, as opposed to other western states such as Texas and California, which manage groundwater and surface water resources separately (Archer and Patrick, 1994, p. 152). From a water resources management perspective, the authority to manage these resources conjunctively has great benefit.

The recognition of the impact of groundwater pumping on surface flows extends back to early cases in New Mexico. For example, in *Templeton v. Pecos Valley Conservancy District* (65 N.M. 59 (1958)), groundwater pumping reduced the flow of the Rio Felix such that a senior surface water right holder could not fully exercise his water right. The water right holder applied to drill for water in the aquifer that was hydrologically connected to the river. The court agreed that exercising the water right by drilling a well was merely a change in point of diversion of the surface water right, thus recognizing the interconnection between the shallow aquifer and the river itself.

The OSE incorporated the concept of conjunctive management by requiring applicants for groundwater in stream-related basins to purchase surface water rights in an amount equivalent to the proposed application in order to offset the impacts the groundwater pumping would have on the river. The City of Albuquerque challenged these conditions when its application for 6,000 acre-feet of groundwater was conditioned upon an offset of surface water. In *City of Albuquerque v. Reynolds* (71 N.M. 428 (1962)) the court upheld the OSE decision, stating that the OSE has the authority to impose these conditions.

The OSE has subsequently integrated this policy into its groundwater administrative criteria in various basins, which require that applicants purchase surface water rights that would offset groundwater pumping in a permit application. In other stream-related basins, the OSE has developed criteria to manage groundwater appropriations in order to protect surface water rights.

C.6 Water Quality

Federal and state laws and regulations govern water quality within all planning regions within the State. Most water quality laws have their genesis in federal law. An understanding of the federal water statutes and how they interrelate with state law is critical to understanding the regulation of water quality in the area. In particular, water quality can have a specific impact on the quantity of water within a planning region, since minimum instream flows may be necessary to meet water quality standards.

C.6.1 The Clean Water Act

Several federal laws address water quality issues. Clearly, the most significant federal law is the Clean Water Act (CWA) (33 U.S.C. §§ 1251 to 1387 (2002)). The CWA is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating discharges of pollutants to navigable waters of the United States. "Navigable waters" has been broadly defined to include every creek, stream, river, or body of water that may in any way affect interstate commerce, including arroyos or ditches (*Friends of Santa Fe County v. LAC Minerals, Inc.,* 892 F. Supp. 1333, 1355-6 (D.C.N.M. 1995)).

The Act's objective is to "restore and maintain the chemical, physical and biological integrity" of the waters of the United States (33 U.S.C. § 1251(a) 2002). The CWA has several ways to reach this goal:

- It allows water quality standards for specific segments of surface waters (33 U.S.C. § 1313 (2002)).

- It makes it unlawful for a person to discharge any pollutant into waters without a permit.

- It allows for the designation of "Total Maximum Daily Loads" (TMDLs) for pollutants threatening the water quality of stream segments (33 U.S.C. § 1313(d) (2002)). TMDLs are identified for those waters where an analysis shows that discharges may result in a violation of water quality standards (33 U.S.C. § 1313(d)(1)(C) (2002)). The TMDL process can be best described as determining and planning a watershed or basin-wide budget for pollutant influx to a watercourse.

By enacting the CWA, Congress gave the United States Environmental Protection Agency (EPA) broad authority to address water pollution. With this authority, the EPA has developed a variety of regulations and programs to reduce pollutants entering surface waters. For example, applicable water quality standards, discharge permit requirements, and TMDLs are all defined by regulation.

Groundwater pollution is not specifically addressed by the CWA, and pollution such as mining, agricultural, and construction runoff (referred to as "nonpoint sources") is addressed mainly through voluntary management efforts, called "best management practices," rather than through regulation (40 C.F.R. § 130.2 (2002)). Nonetheless, a recent court decision found that the EPA and states have the power to list and issue TMDLs for waters polluted only by nonpoint sources of pollution (Pronsolino v. Marcus, 91 F. Supp 2d. 1337, 1356 (N.D. Ca. 2000), affirmed by Pronsolino v. Nastri, 291 F.3d 1123 (9th Cir. 2002)).

The CWA also calls for effluent limitations. Simply speaking, an effluent limitation is a restriction on discharges into surface waters from the "end of the pipe," or point source. These discharges

are regulated through the issuance of National Pollutant Discharge Elimination System (NPDES) permits (33 U.S.C. § 1342 (2002)). These permits limit the discharge of a variety of pollutants and control the characteristics, such as temperature, of the discharge. NPDES permits also regulate stormwater discharges entering surface water (33 U.S.C. § 1342(p) (2002)). Although EPA can delegate the administration of the NPDES program to individual states (33 U.S.C. § 1251(b) (2002)), they have not done so with New Mexico.

The CWA allows the EPA to delegate many permitting, administrative, and enforcement aspects to state and tribal governments (33 U.S.C. §§ 1251(g), 1377 (2002)). For example, states and tribes have the power to adopt water quality standards for surface waters within their jurisdictions. A water quality standard generally is a standard that is established to sustain and protect existing or sustainable uses of surface water. A water contaminant is any substance that alters the physical, chemical, biological, or radiological qualities of the water (NMSA 74-6-2 (A)). A contaminant becomes a pollutant when it exceeds an acceptable concentration or standard. Under the CWA, states are required to adopt water quality standards that protect certain designated uses for each river, stream segment, and lake (33 U.S.C. § 1313 (2002)), and New Mexico has adopted its own surface water quality standards (20 NMAC 6.4). Tribes meeting certain criteria under the CWA have those same powers for waters within tribal lands (33 U.S.C. § 1377(a) (2002)). Designated uses include recreation, wildlife habitat, domestic water supply, irrigation and livestock water, or in the case of Indian tribes, culturally significant or sacred uses. The water quality standards must protect the designated use for the surface water at issue. Standards must be reviewed every three years and be modified or replaced as appropriate (33 U.S.C. § 1313(c)(1) (2002)). This process is known as the "Triennial Review."

C.6.2 The Safe Drinking Water Act

The Safe Drinking Water Act (42 U.S.C. § 300f et seq. (2002)), protects the quality of drinking water in the United States. This law focuses on all waters actually or potentially designed for drinking use, whether from aboveground or underground sources. The Act authorizes EPA to establish safe standards and requires all owners or operators of public water systems to comply with the standards. New Mexico has promulgated drinking water regulations that adopt, in part, federal drinking water standards (20 NMAC 7.10).

C.6.3 Groundwater Standards and Regulations

As noted in Section C.6.1, the CWA focuses primarily on surface water pollution. Groundwater pollution not caused by hazardous waste is addressed directly by the state and tribes, pursuant to the New Mexico Water Quality Act and its regulations (NMSA 74-6-1 et. seq.; 20 NMAC 6.2). In New Mexico, groundwater pollution is caused by a number of sources, including septic tank systems and cesspools, spills and leaks of hazardous materials, solid waste disposal sites, overuse of fertilizers and pesticides, and mines. Except for hazardous and liquid wastes, which are regulated separately, these sources are required to have discharge plans under the Water Quality Act and its implementing regulations (NMSA 74-6-1 et. seq.; 20 NMAC 6.2).

Improperly installed or maintained domestic septic systems can be a source of groundwater pollution in New Mexico. New Mexico's Environmental Improvement Board is charged with writing regulations for liquid waste disposal and has promulgated regulations applicable to domestic septic systems (NMSA 74-1-8; 20 NMAC 7.3). Releases of hazardous wastes are regulated pursuant to regulations found at 20 NMAC 4.1.

References

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Meltz, R. 2003. *The Endangered Species Act and claims of property rights "takings": A summary of the court decisions.* Report for Congress, available through the Congressional Research Service Web, Order code RL31796. March 10, 2003.

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Appendix D

Hydrologic Information

Appendix D1

Data Gaps

Appendix D1. Data Uncertainties in Southwest Regional Supp ly and Demand Study

As requested by the Southwest New Mexico Regional Water Planning Steering Committee, Daniel B. Stephens & Associates, Inc. (DBS&A) has identified uncertainties in the available data regarding supply and demand in the Southwest Region. Section 1 summarizes the data uncertainties for each of the key types of data that were evaluated in the water supply, demand, and water budget components of the study. Section 2 provides overall conclusions about the ability of the supply to meet demands within the region, given the uncertainties in the available data.

D1.1 Data Uncertainties

The following summary discusses data uncertainties primarily as they pertain to the overall goal of regional water planning, which is to characterize the available water supplies and projected demands so that appropriate plans for meeting future water supply needs can be developed. While there is always some degree of uncertainty in evaluating hydrologic conditions based on available data, in some cases the uncertainty does not have a large impact on planning for future water demand, while in other cases, even lower degrees of uncertainty may have a great impact on the ability to accurately plan for future water needs. The following discussion therefore concentrates on uncertainties that affect the development of a reliable water plan for the Southwest Region. As the steering committee requested, we are also including a numeric scoring, based on our professional judgment, of the data uncertainties as they impact the ability to accurately plan for future water needs (Table 1).

D1.1.1 Water Supply

D1.1.1.1 Climate

The climate data used in the study were obtained from the National Oceanic and Atmospheric Administration (NOAA) and Natural Resources Conservation Service (NRCS) SNOTEL stations. The data that do exist are considered to be reliable and of high quality. Uncertainties regarding climatic data arise primarily from the distribution of climate stations within the region.

Table D1-1. Reliability of Supply and Demand Data for Southwest New Mexico Water Planning Region

Data Type	Data Certainty Rating [a]
Water supply	
Climate	
Precipitation	8
SNOTEL	7
Surface water	7
Reservoirs	6
Groundwater	
Hydrogeologic setting	8
Water levels	6
Aquifer properties	5
Recharge	4
Sustainable yields	3
Water quality	8
Legal issues	
Existing water rights	6
Water demand	
Commercial, industrial, power	9
Domestic water supply	6
Public water supply	8
Livestock	8
Irrigation	6
Mining	9
Reservoir evaporation	6
Riparian evaporation	3
Water budget	
Ability of supply to meet demand	5

[a] Based on a scale of 1 to 10, with 1 being the lowest level of data certainty.
— = Not estimated as part of the supply/demand study

Due to local orographic and other climatic conditions, precipitation and snowfall patterns vary considerably within the region, and uncertainty arises when the concentration of precipitation stations is insufficient to reflect areal variations in climatic conditions. However, since the vast majority of precipitation (greater than 90 percent) is not seen as streamflow, it may be more useful to focus water supply planning efforts on actual streamflow measurements rather than on precipitation data. Conversely, to the extent that precipitation data are used to develop recharge estimates, it would be useful to have more up-to-date contoured precipitation data than the data available to WRRI for developing precipitation maps. Also, additional SNOTEL stations could help water resource managers provide better forecasts of spring snowmelt in the region.

D1.1.1.2 Surface Water

In general, we consider the data available from the USGS to be a reasonably accurate accounting of surface water flow. The uncertainties in surface water data that do exist are also related to the distribution of gaging stations within the region. Additionally, uncertainties arise

when the locations of stations were moved or stations were not operational for some period(s) of time.

For the most part the distribution of stream gaging stations on the main stem of the San Francisco and Gila Rivers and on the Mimbres River upstream of the Luna County line provides good data coverage. Conversely, little to no data are available within the planning region for the Mimbres River downstream of the Luna County line or for ephemeral stream reaches outside these three river basins. Additionally, the presence of ungaged tributaries presents some uncertainty regarding streamflow in each sub-basin.

Gaps in station operation occurred for several of the key stations. In such cases data for the missing time periods were estimated on a monthly or annual basis by developing relationships with nearby stations that did record streamflow data during the missing period, as described in Section 5.2 and Appendix D3. The specific stations and time periods that were used to estimate missing data are noted on the graphs in Appendix D3.

In addition, streamflow data after September 30, 2001 (water year 2002) had not been fully checked by the USGS at the time this analysis was completed and are therefore considered provisional. Some provisional daily data were missing from the periods of record of several gage stations due to equipment malfunctions or lack of reporting. Where such gaps existed, daily values were estimated as described in the report. Even though some surface water data were estimated, we feel that we have a reasonably accurate understanding of the range of surface water flows that occur within the region.

D1.1.1.3 Reservoirs

Information regarding reservoirs in the region, including storage volumes, sedimentation, and operation information, was difficult to obtain and in many instances was incomplete. The majority of information came from the New Mexico Office of the State Engineer (OSE), which prior to 1985 estimated the amount of evaporation from all reservoirs within the planning region; for years after 1985 the OSE only provides information for larger reservoirs. Additionally, more recent information was obtained through personal communication with the New Mexico and Arizona Game and Fish Departments and from available reservoir reports. However, detailed

information on operations was not available for all reservoir locations, and in some cases, several different storage capacities were given in the various reports, as noted in Table 5-8.

D1.1.1.4 Groundwater

Data uncertainties regarding groundwater in the region are discussed based on the following categories:

- Hydrogeologic setting. A great deal of good information regarding the general geology of the Southwest Region is available. Because of the geologic complexities of the region, local geologic conditions are not as well understood in some locations as in others, but the overall understanding of the hydrogeologic setting should be accurate for regional water planning purposes.

- Water levels. The USGS maintains monitoring wells in which water level data are recorded. These wells are not pumping wells and we consider the water level data from the wells to be accurate. Some uncertainty results from the scarcity of monitoring wells, particularly in Catron County where there are only two monitoring wells.

- Aquifer properties. From a regional perspective, quantitative data regarding aquifer properties such as transmissivity, storage coefficients, and specific yield are lacking. Although aquifer properties were found for certain locations of each major aquifer, these properties can vary substantially over small distances and at different depths within the same aquifer. Thorough quantification of the aquifers would require considerably more data than are currently available. Additional quantitative data would be valuable for calibration of groundwater models, which would be useful in developing quantitative estimates of the longevity of groundwater supplies in the region.

- Recharge. Estimates of recharge for the region have a high degree of uncertainty. Recharge varies considerably based on elevation and local conditions, yet there is a lack of field recharge measurements within the region. Additionally, water that infiltrates into the ground may take many years to reach the regional water table, if it reaches it at all. Recharge estimates may be more accurate in the locations for which groundwater

models exist (Silver City, Deming, and Lordsburg well fields), but even in those areas recharge remains uncertain.

- Sustainable yields. The models already developed by the OSE provide good assessments of the available water supplies for the areas evaluated, but have not been designed to provide quantitative estimates regarding sustainable yields and/or the amount of time that groundwater resources will be available to supply the region. The scenarios considered in the modeling efforts provide estimates of the ability of the well fields to meet demand over a 40-year time frame, but do not provide quantitative estimates of how long supplies will last without incurring subsidence, non-economic pumping costs, or other issues that may be relevant for regional water planning purposes. Additionally, the lack of good recharge information that can be reconciled with water demands at a local level creates difficulty in determining how much water can be withdrawn from renewable supplies.

D1.1.2 Water Quality

In general, data regarding total maximum daily loads (TMDLs) and locations of potential contaminant sources such as National Pollutant Discharge Elimination System (NPDES) permitted sites, Superfund sites, and UST sites are considered to be accurate and complete. Information regarding these sites was gathered from databases accessible on the Internet, and therefore is subject to the accuracy of periodic updates that are provided by the agencies making this data available to the public.

Uncertainty in water quality data comes primarily from two areas: (1) lack of comprehensive information about the locations of septic tanks and the quality of water in the vicinity of those tanks, and (2) lack of comprehensive data regarding background water quality that can potentially affect the usability of the water resources, in particular arsenic and salinity or total dissolved solids.

D1.1.3 Legal Issues

Overall, the understanding of legal issues affecting the region is good. Uncertainty in this area arises from incomplete knowledge of the water rights within the region. Water rights specified under the applicable decrees are defined, but there is a lack of comprehensive, accurate information about all water rights within the region.

D1.1.4 Water Demand

Estimates of data uncertainty by category of demand are provided below. These estimates are based on historical and current records. The uncertainty of future water use projections is even greater because of uncertainties regarding where and how growth will occur within the region.

- Commercial, industrial, and power categories. The data for these categories of water use are considered to be accurate and complete. Additionally, since these categories represent relatively small portions of the regional water use, any uncertainty in these estimates will not greatly affect the Region's ability to appropriately plan for future water use.

- Public water supply. Estimates regarding water use from public providers were generally available and were based on metered data, which should be accurate.

- Domestic water supply. Estimates of water supply by domestic wells have a greater degree of uncertainty because no records are kept regarding the amount of water used by domestic wells, and the WATERS database, which records the locations of domestic wells, is not complete and/or up to date.

- Livestock. Livestock numbers in the region appear to have remained relatively constant throughout the past few years, and estimates regarding water use for livestock are considered to be reliable. In addition, this category represents a relatively small portion of the regional water use, and any uncertainty in these estimates will not greatly affect the Region's ability to appropriately plan for future water use.

- x Irrigation. The acreage that can potentially be irrigated (due to current water rights) was evaluated based on several different sources, and we have confidence in our understanding of this acreage. However, because both the diversions and return flows are generally estimated, rather than measured, there is uncertainty in the amount of water actually used for irrigation.

- x Mining. Estimates regarding recent and existing mining use were for the most part provided by the mining companies in the region and are considered to be reliable.

- x Reservoir evaporation. Estimates of reservoir evaporation are currently developed by the OSE only for lakes or reservoirs with a storage capacity greater than 5,000 acre-feet. We based our estimates of evaporation on earlier records when the smaller reservoirs and ponds were included. This approach helped to mitigate the uncertainty created by not including all of the reservoirs, but an up-to-date inventory of ponds with estimated surface areas and storage volumes would be required to develop more reliable estimates of reservoir evaporation within the region.

- x Riparian evaporation. Riparian evaporation was estimated by multiplying estimated riparian areas by a representative riparian evapotranspiration rate. The estimates of riparian areas are uncertain, however, because they were based on digital elevation model (DEM) topographic coverage and selected aerial photographs, rather than on comprehensive mapping of riparian areas, which does not exist for the region. Additionally, site-specific data regarding riparian evapotranspiration rates are lacking for the region.

- x Fish and wildlife, recreation. The OSE categories of water use do not consider instream flow needs for fish and wildlife and/or recreation (though recreation may be considered part of the commercial category in some instances). If meeting instream flow needs is a concern for the region, then estimates for this category would need to be developed, and the currently available data on this subject are sparse.

D1.1.5 Water Budget/Ability of Supply to Meet Demand

As discussed in Section 7 of the report, water budgets were developed for each basin by reconciling inflows to and outflows from each basin. The uncertainties in the water budgets are dependent on the accuracy or certainty of each of the inflow (e.g., recharge, return flow) and outflow (e.g., human withdrawals) components, which are discussed in Sections D.1.2 and D.1.4. Therefore, the water budget estimates are highly uncertain due to the combined uncertainty of each of the inflow and outflow terms. A greater degree of certainty could be achieved by developing and calibrating basin-scale groundwater models, by conducting more field investigations of components such as recharge, and by more metering of withdrawals and return flows.

D1.2 Summary of Water Supply and De mand Conditions in the Southwest Region

Based on the available data for the Southwest Region as well as the uncertainties regarding that data, the following conclusions regarding the summary of water supply and demand can be made:

- The areas that have the greatest uncertainty with regard to understanding available water supplies in the region are groundwater recharge and quantitative estimates of the longevity of groundwater supplies. Falling water levels in the vicinities of major well fields indicate that groundwater resources in those areas are declining, and it is anticipated that reliance on nonrenewable groundwater resources may not be viable in the long term. The effort to use renewable supplies, such as Central Arizona Project water on the Gila when available, can help to offset these declines. Quantitative evaluation of the longevity of groundwater supplies, through development of comprehensive groundwater models, would help future planning efforts.

- Similarly, sustainable yield is one of the greatest areas of uncertainty in the regional water planning process. Additional field data to better characterize the distribution of

aquifer properties, in conjunction with additional groundwater modeling, is needed to develop a more accurate assessment of sustainable yield.

- The greatest uncertainty in historical and current demand estimates is in riparian evapotranspiration. Additionally, estimates of instream flow needs have not been developed. These two uses could be a substantial part of the demands in the region, and additional data in these areas would improve demand estimates. More comprehensive measurement (as opposed to estimates) of agricultural diversions and return flows is also needed to more accurately characterize demands.

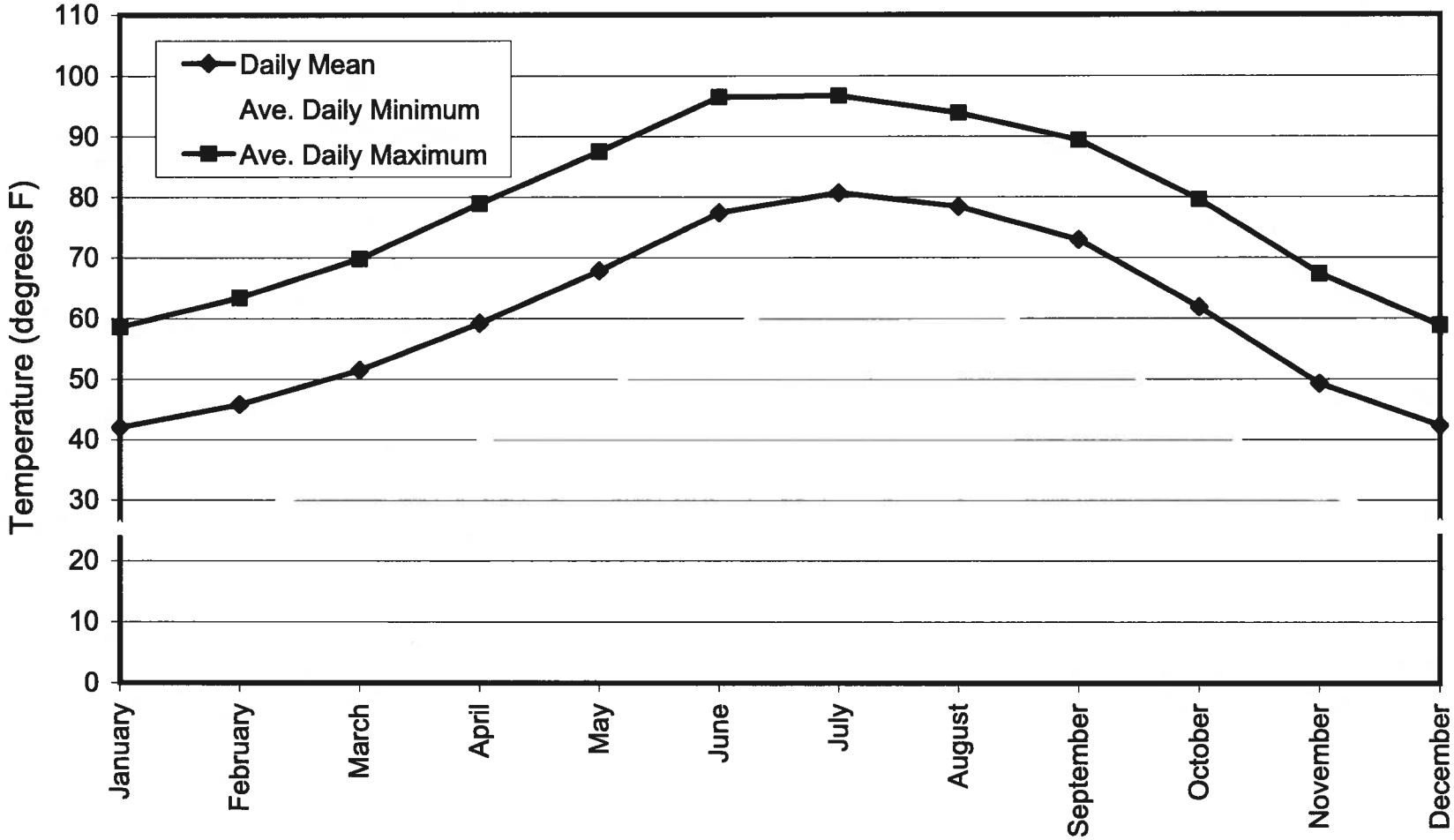
- The development of estimates of future water demand is affected by the legal availability of water in the planning region. For example, the amount of land that can legally be irrigated has remained relatively steady in the region (there is no growth trend that can be projected forward). This does not necessarily mean, however, that demand for additional water for irrigation would not be greater if more water were available. Additionally, unknowns regarding future development (i.e., whether mining will occur, how population growth will proceed, etc.) introduce further uncertainty in the future demand projections.

Appendix D2

Climate Statistics

Lordsburg 4 SE

Monthly Temperature Statistics for Period of Record



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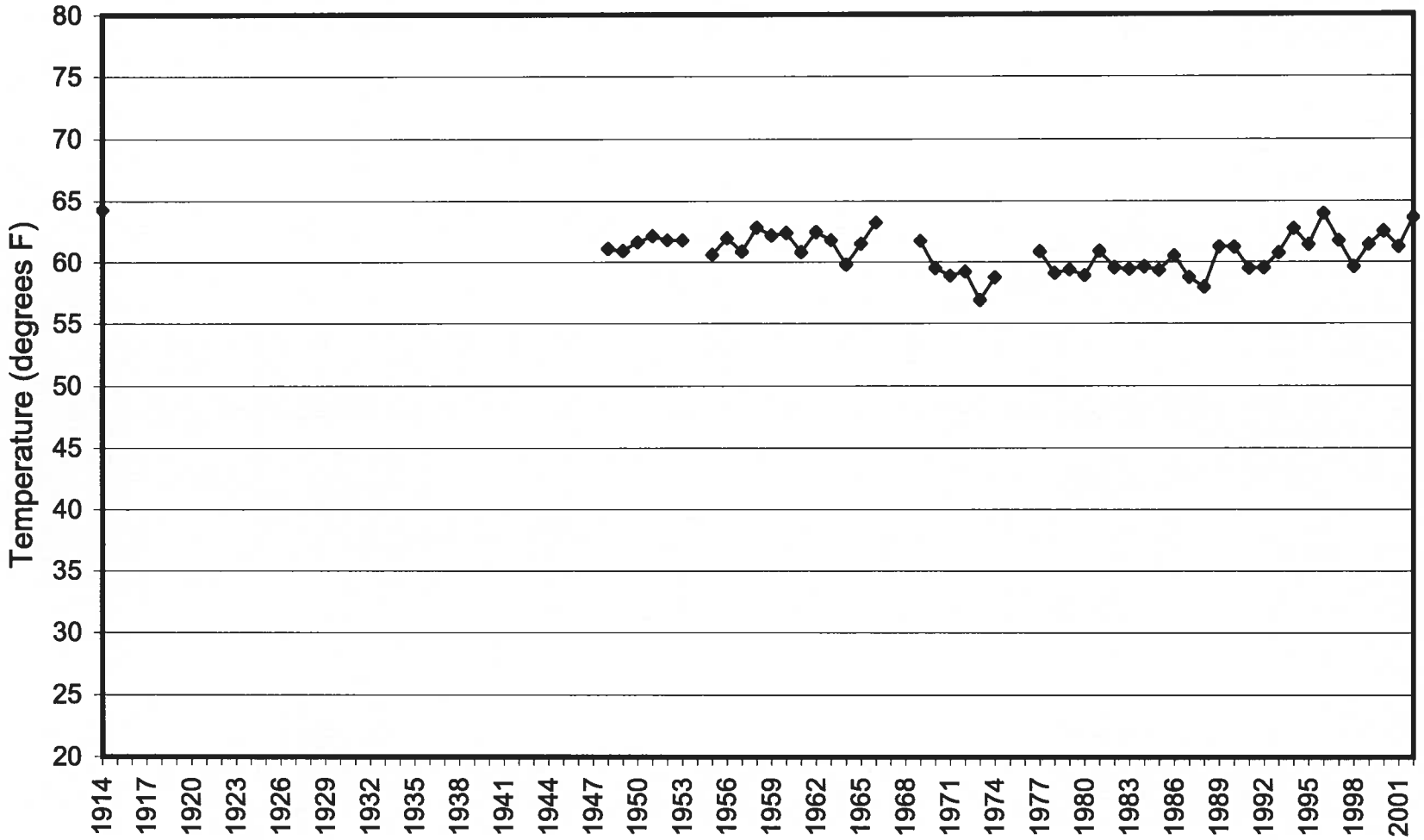
Lordsburg 4 SE

Average Annual Temperatures for Period of Record



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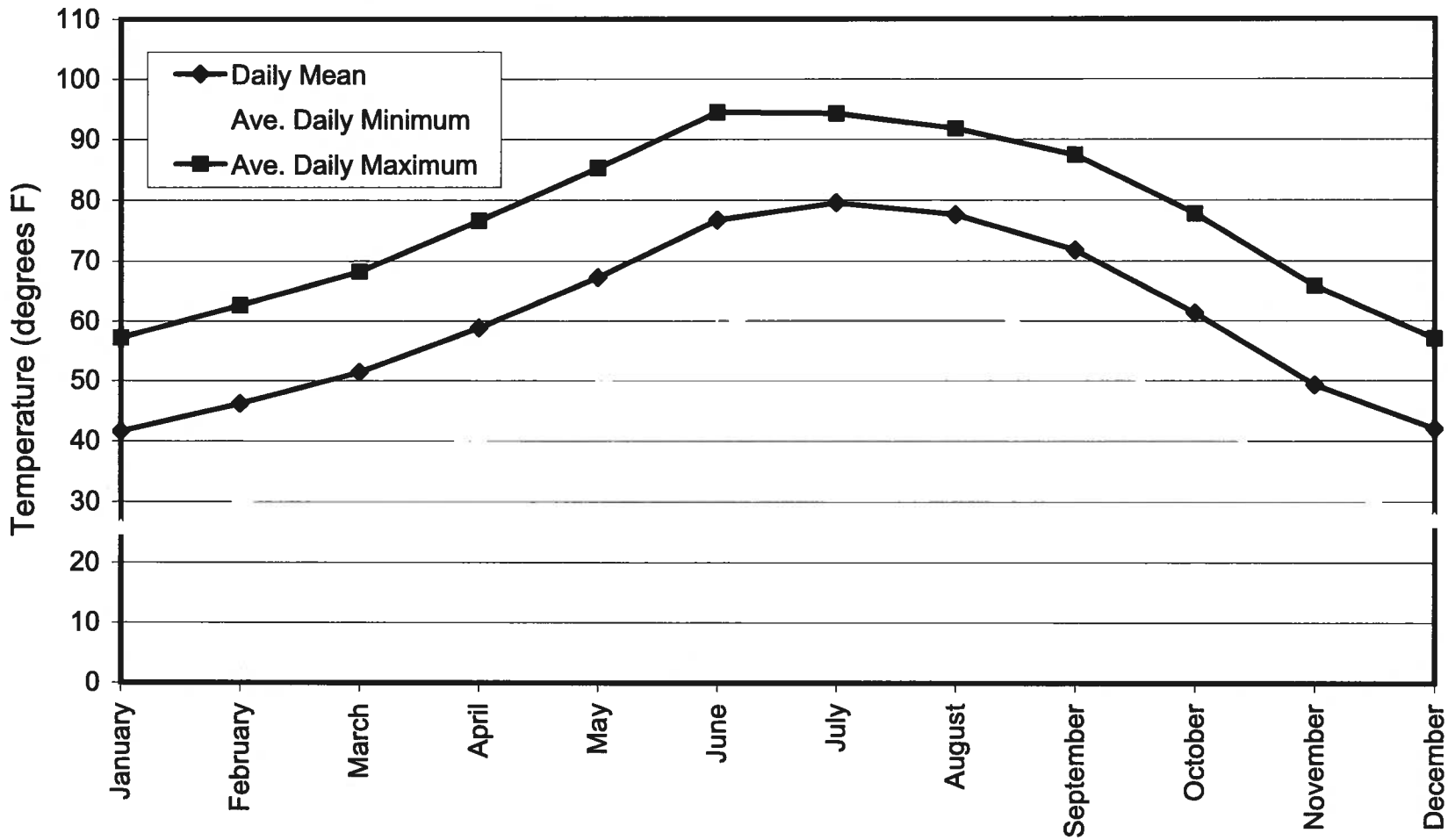
Deming

Monthly Temperature Statistics for Period of Record



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Deming

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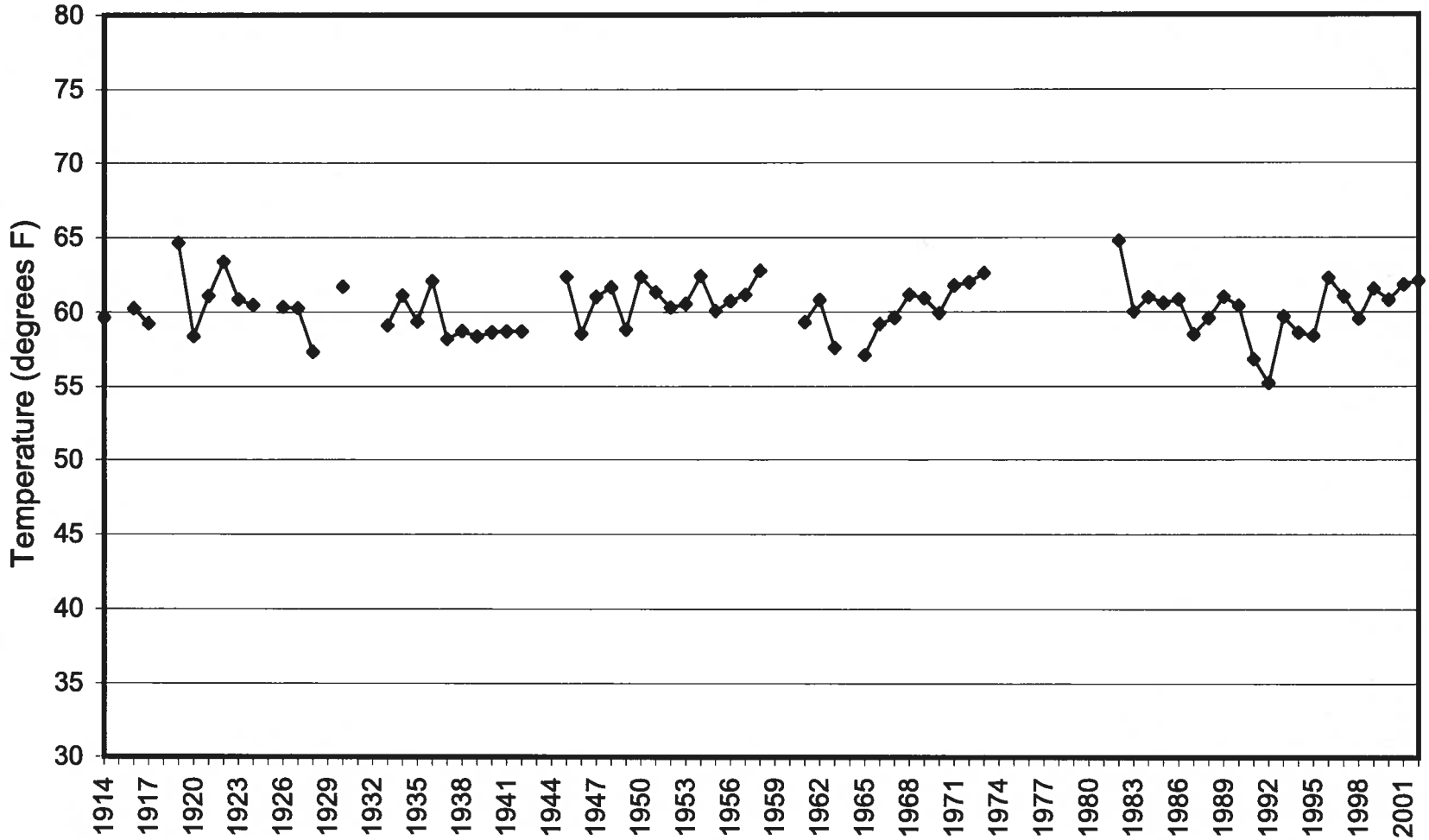

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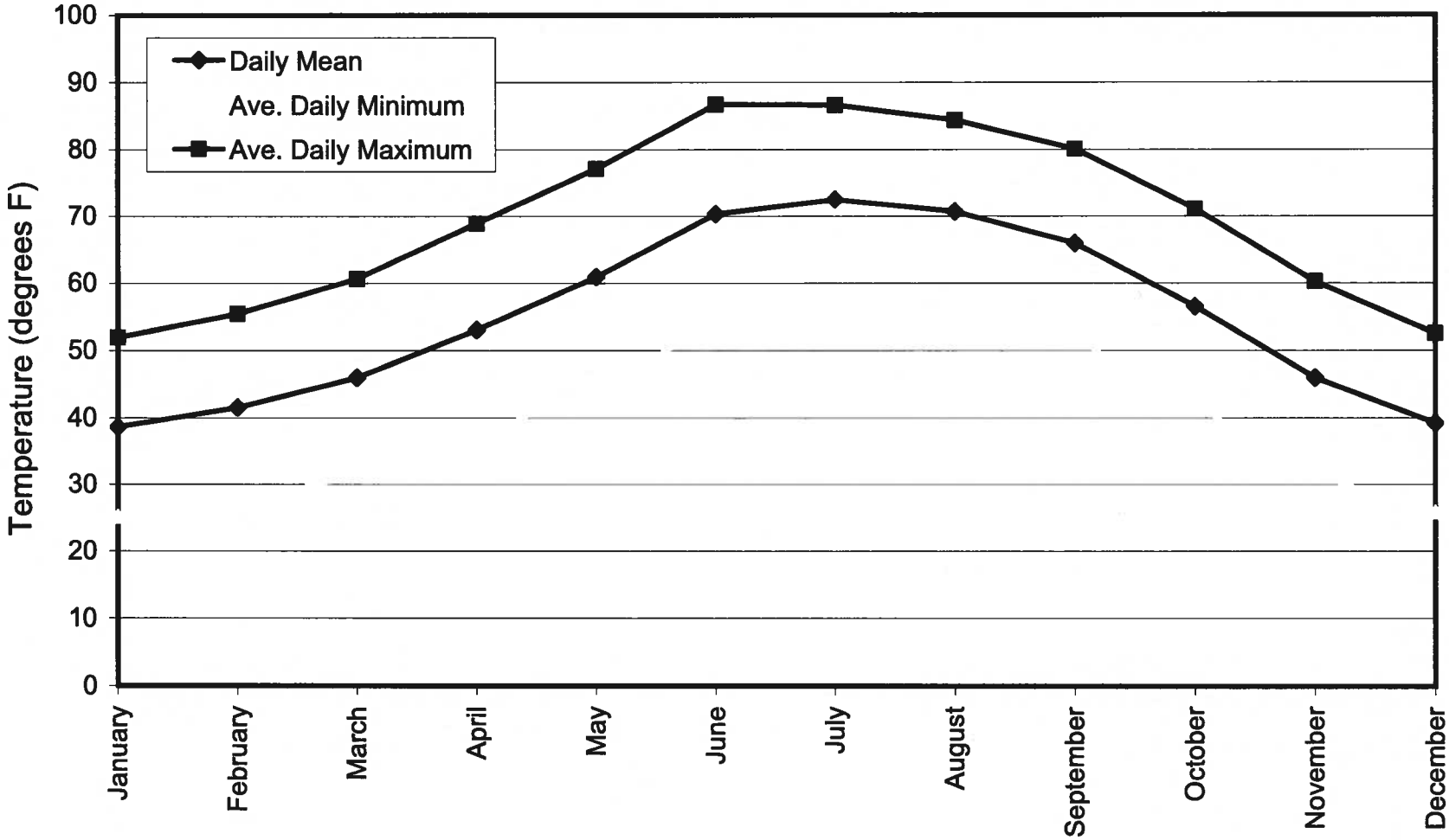
Fort Bayard

Monthly Temperature Statistics for Period of Record



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Fort Bayard

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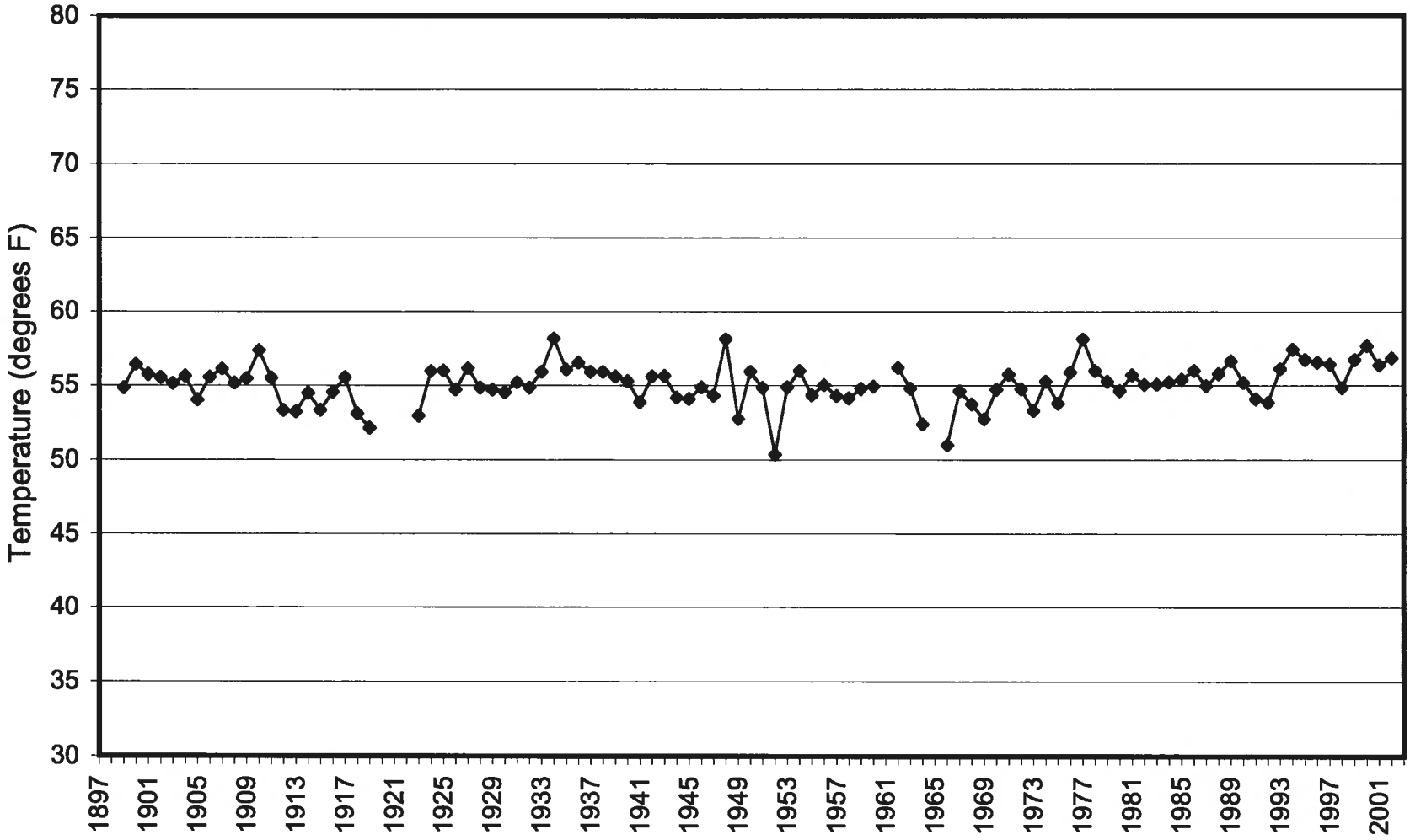

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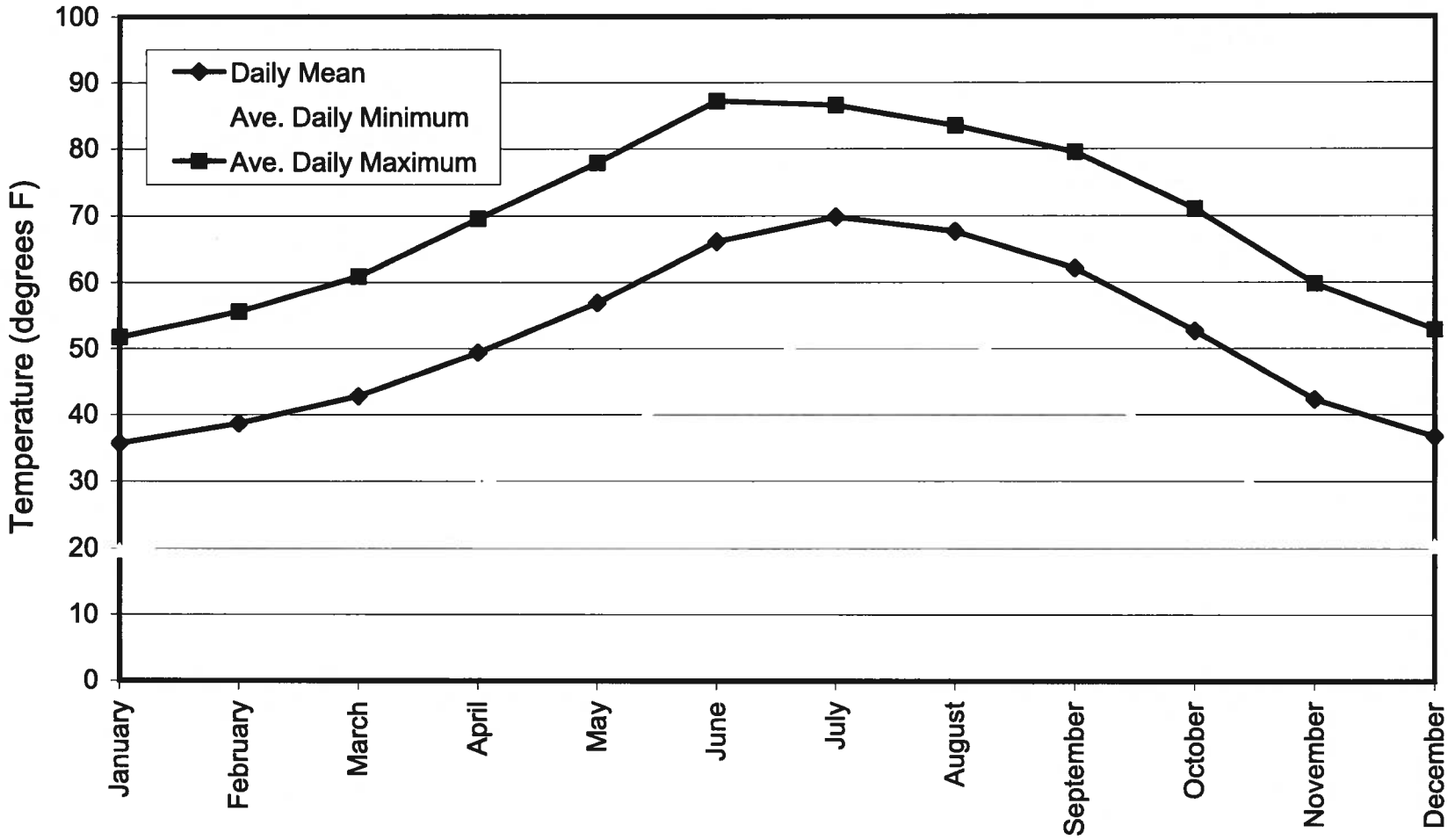
Mimbres Ranger Station

Monthly Temperature Statistics for Period of Record



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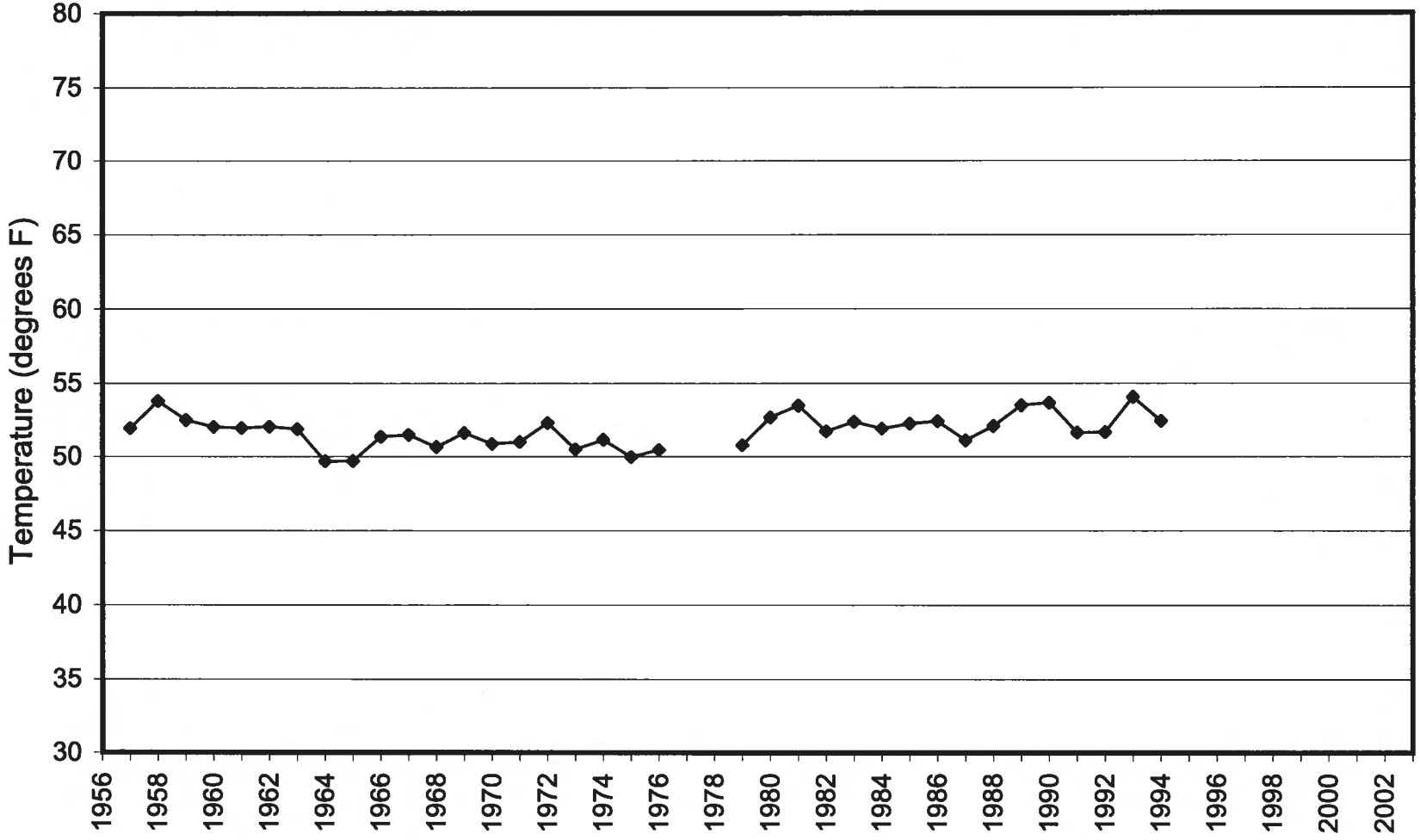
Mimbres Ranger Station

Average Annual Temperatures for Period of Record



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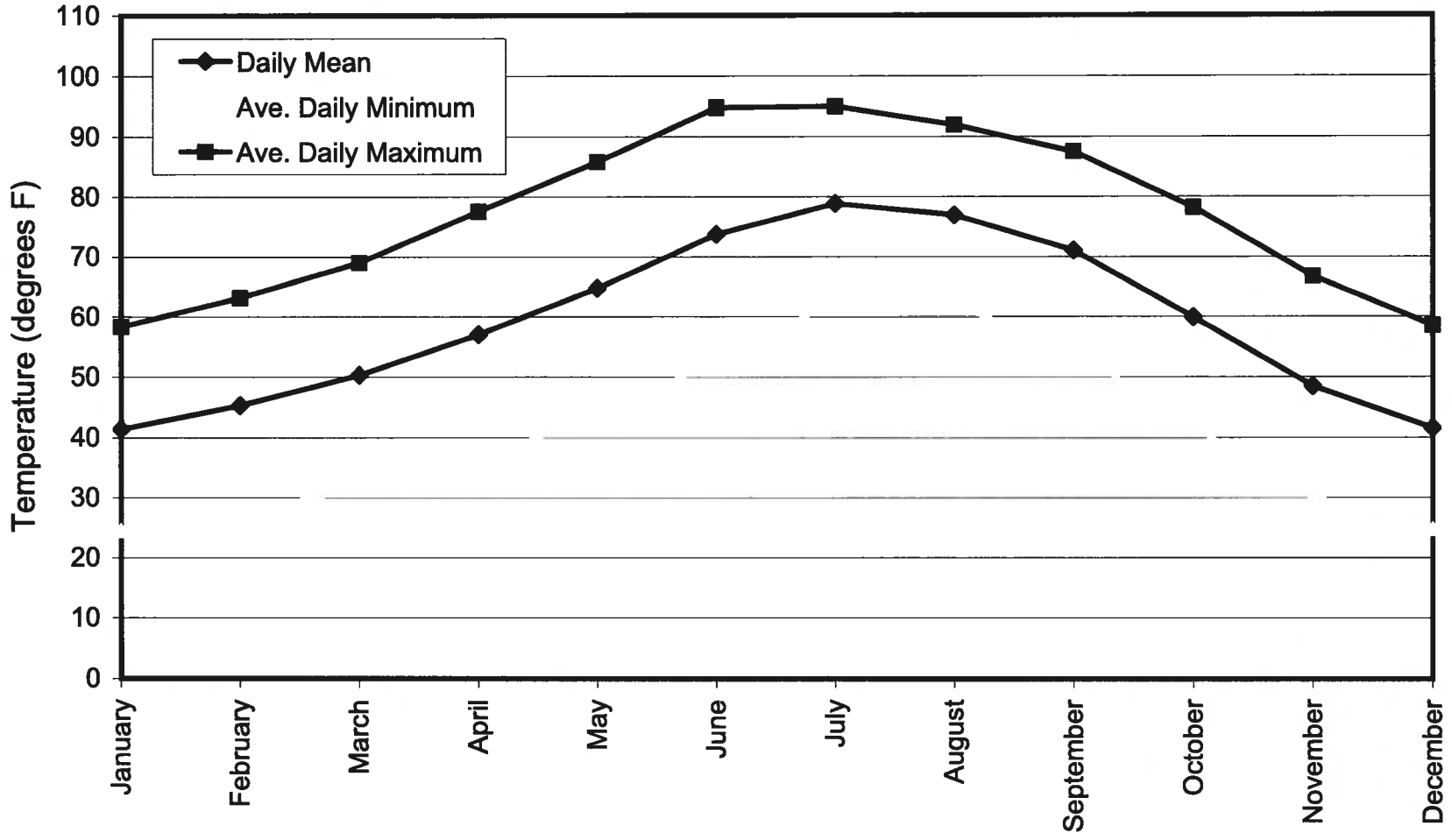
Redrock 1 NNE

Monthly Temperature Statistics for Period of Record



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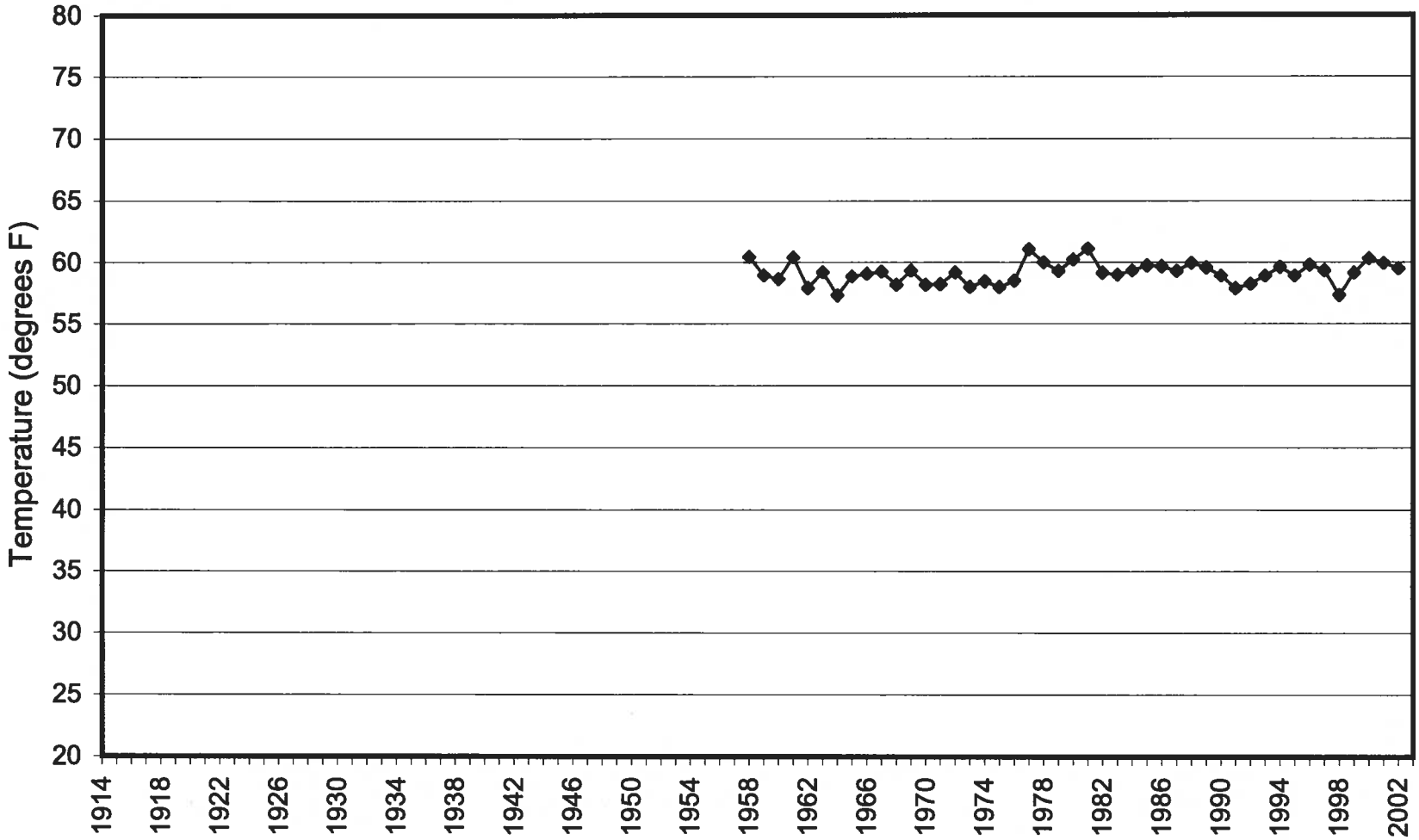
Redrock 1 NNE

Average Annual Temperatures for Period of Record



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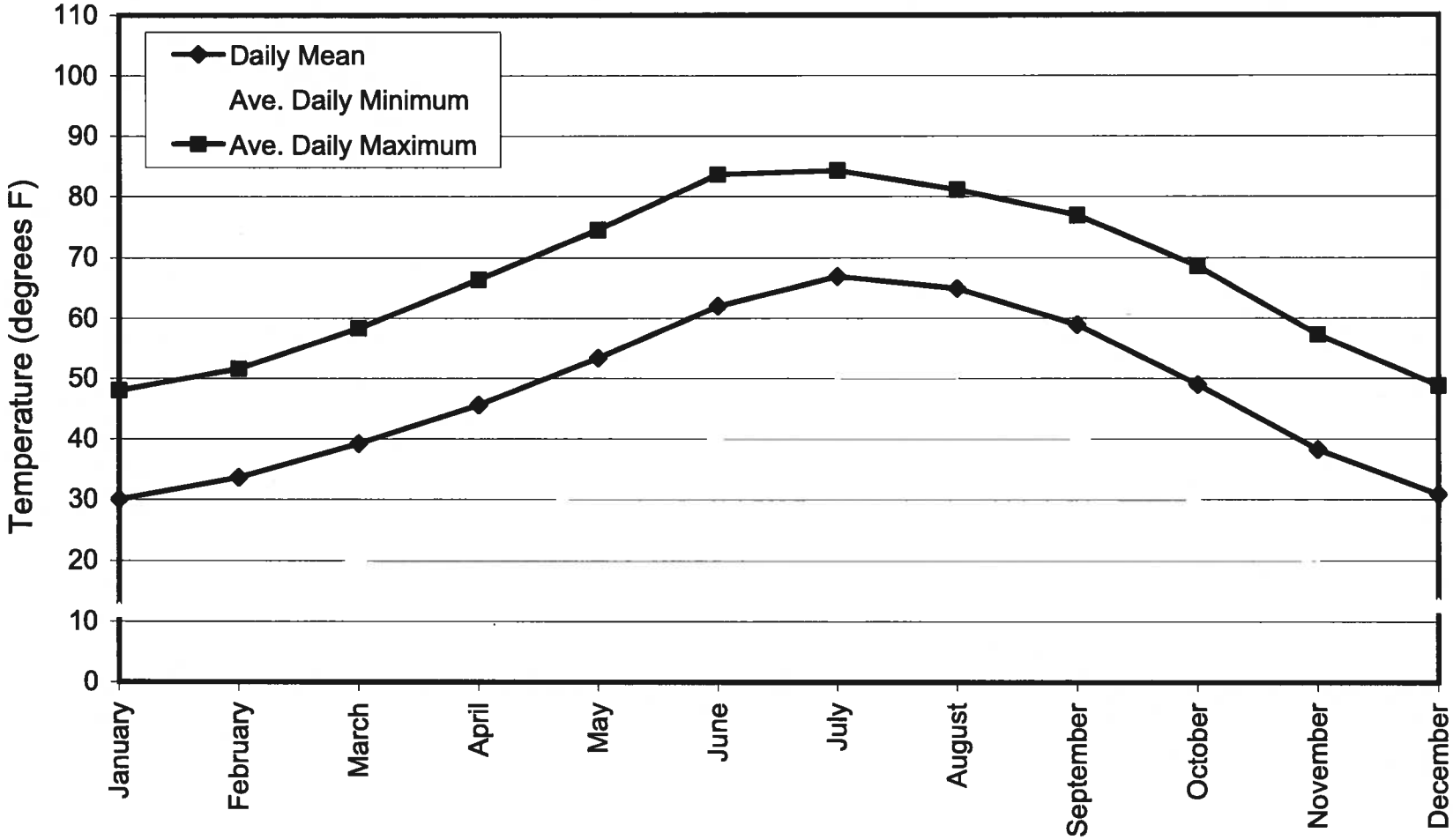
Beaverhead Ranger Station

Monthly Temperature Statistics for Period of Record



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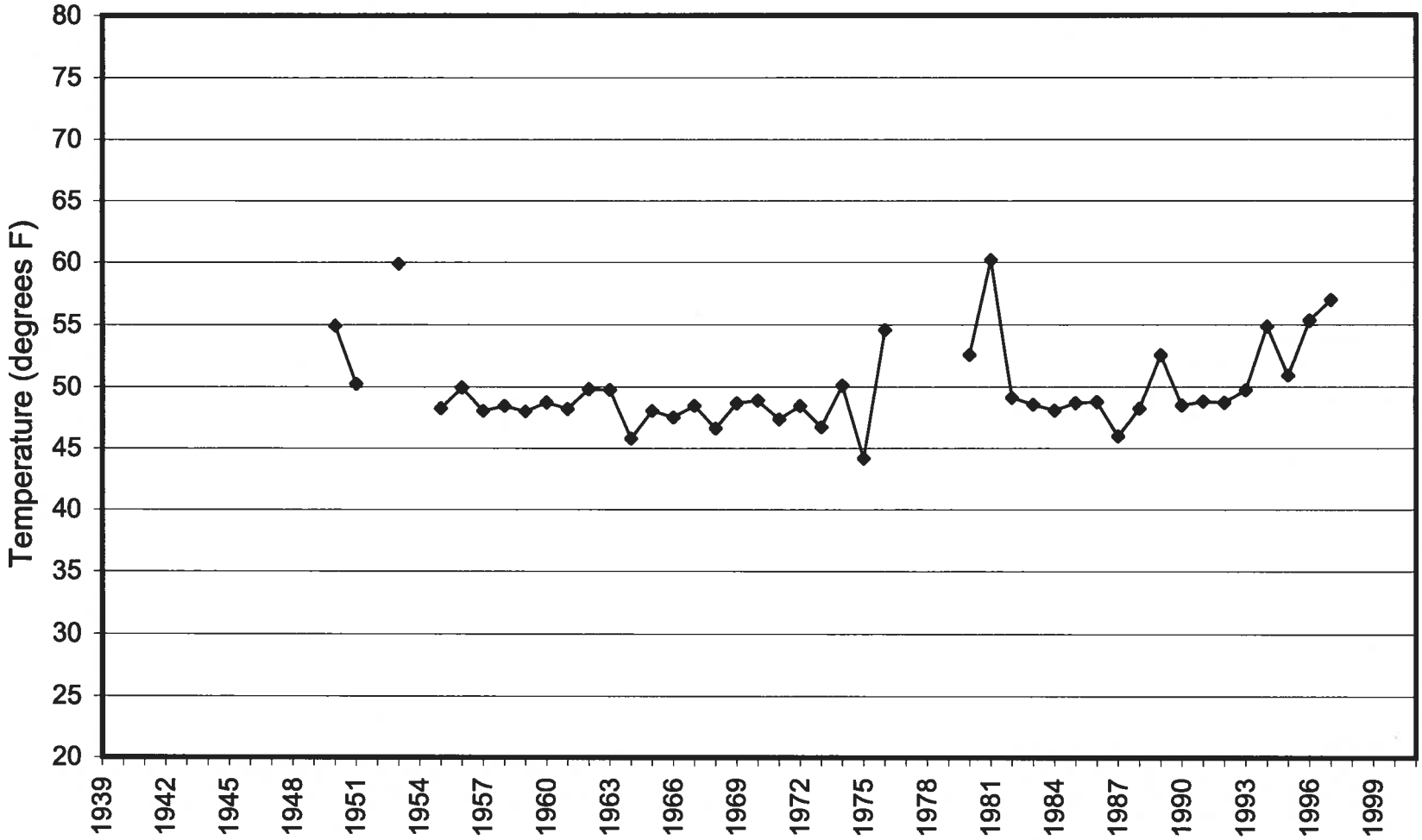
Beaverhead Ranger Station

Average Annual Temperatures for Period of Record



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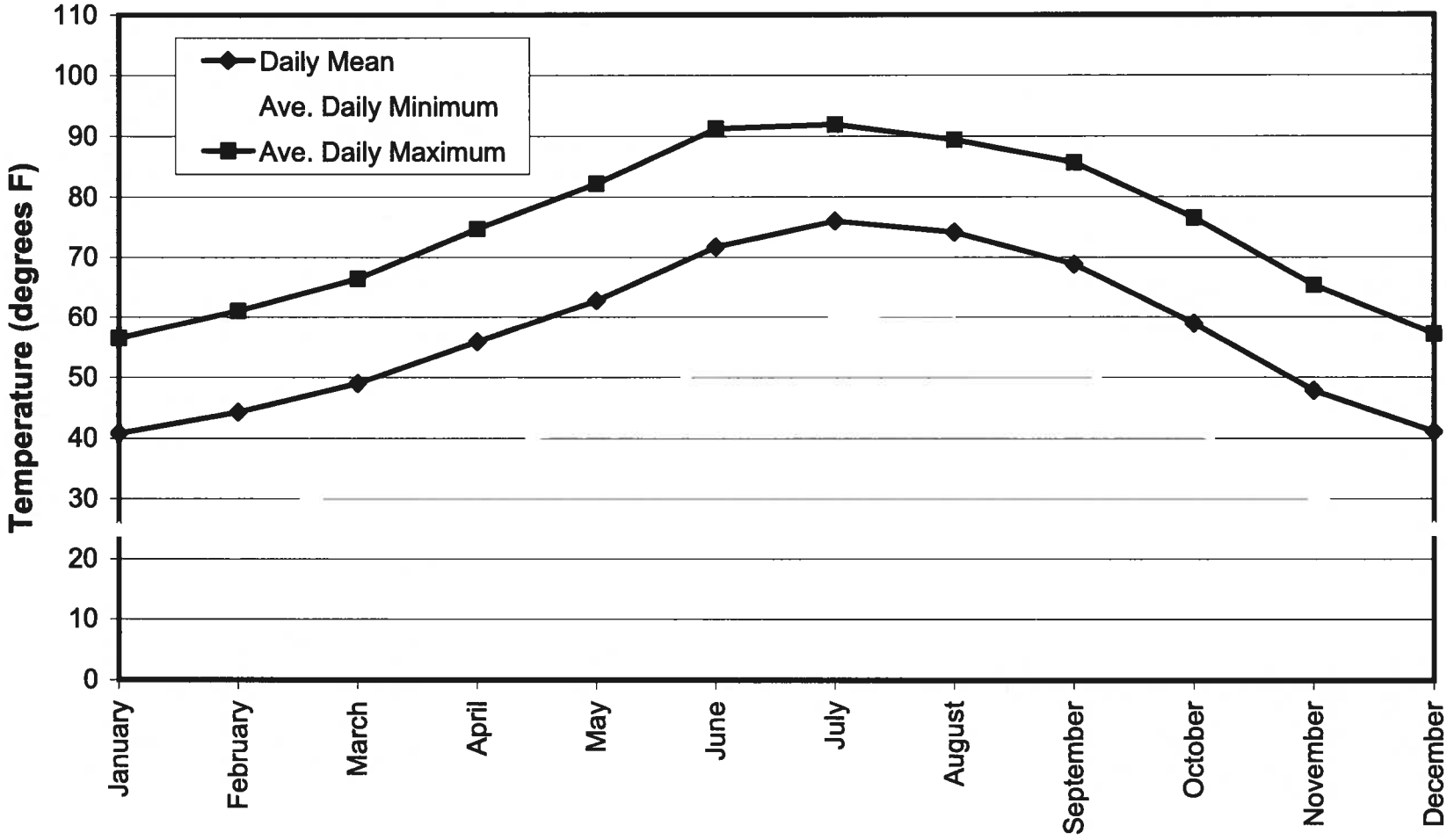
Glenwood

Monthly Temperature Statistics for Period of Record



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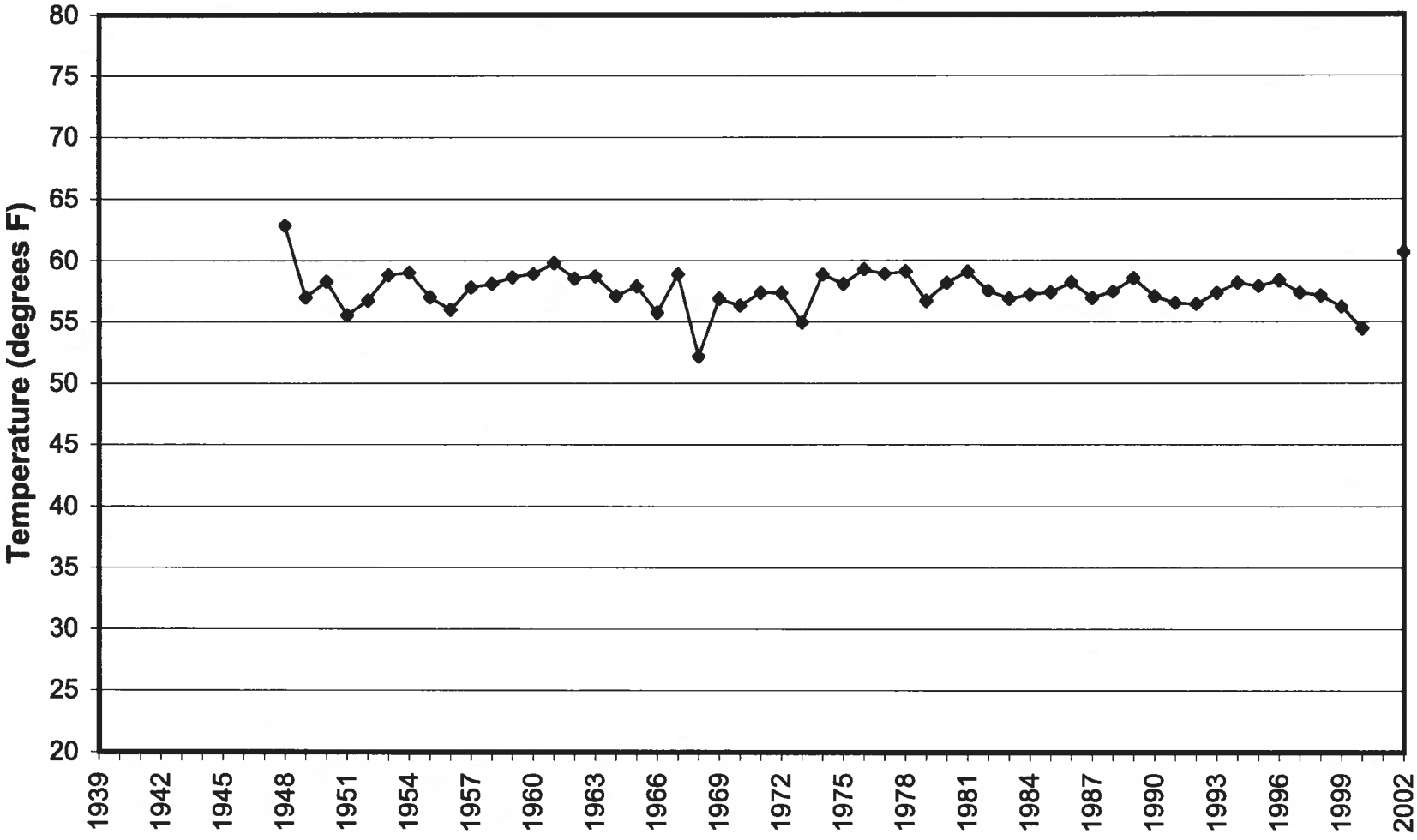
Glenwood

Average Annual Temperatures for Period of Record



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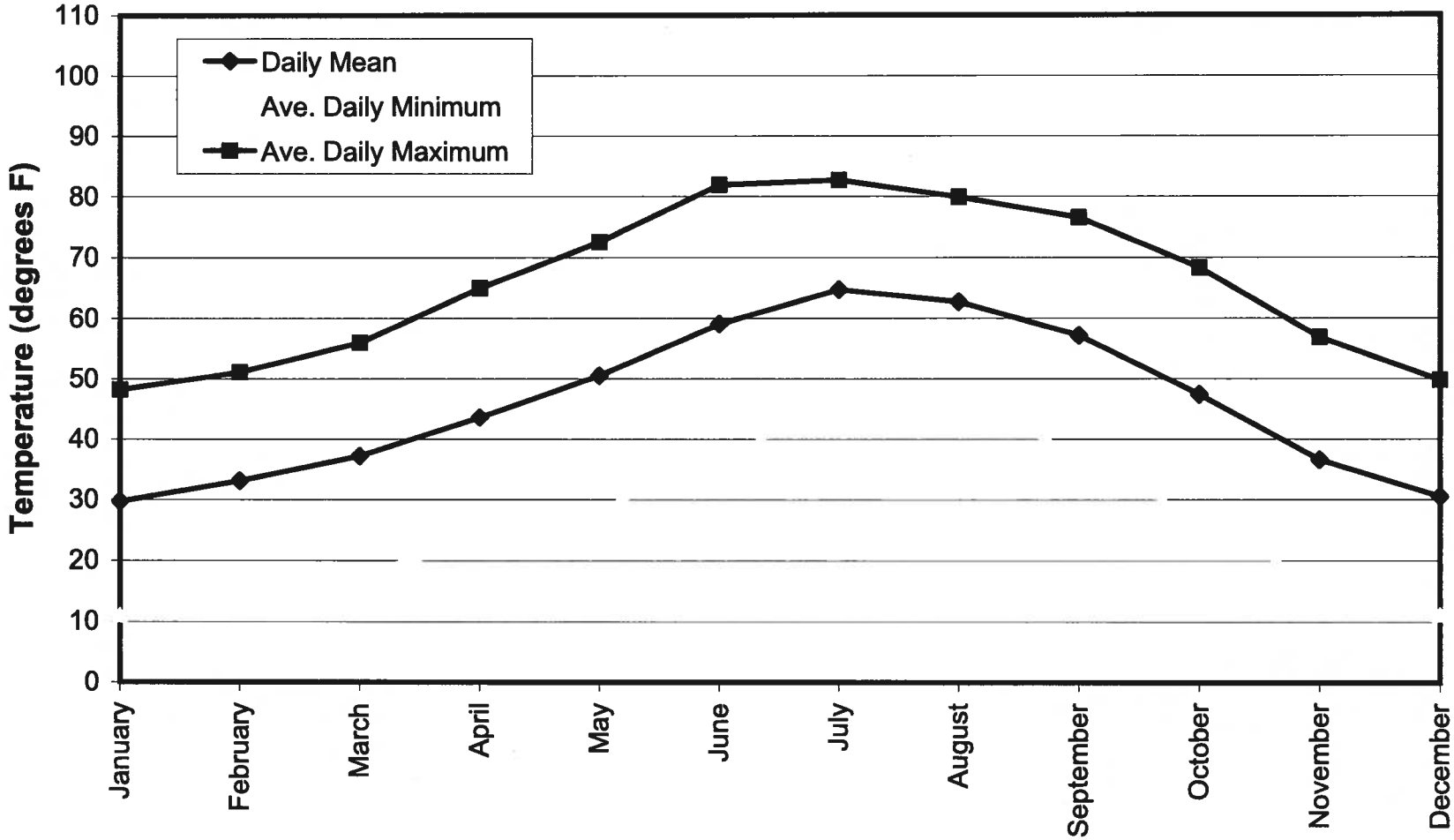
Luna Ranger Station

Monthly Temperature Statistics for Period of Record



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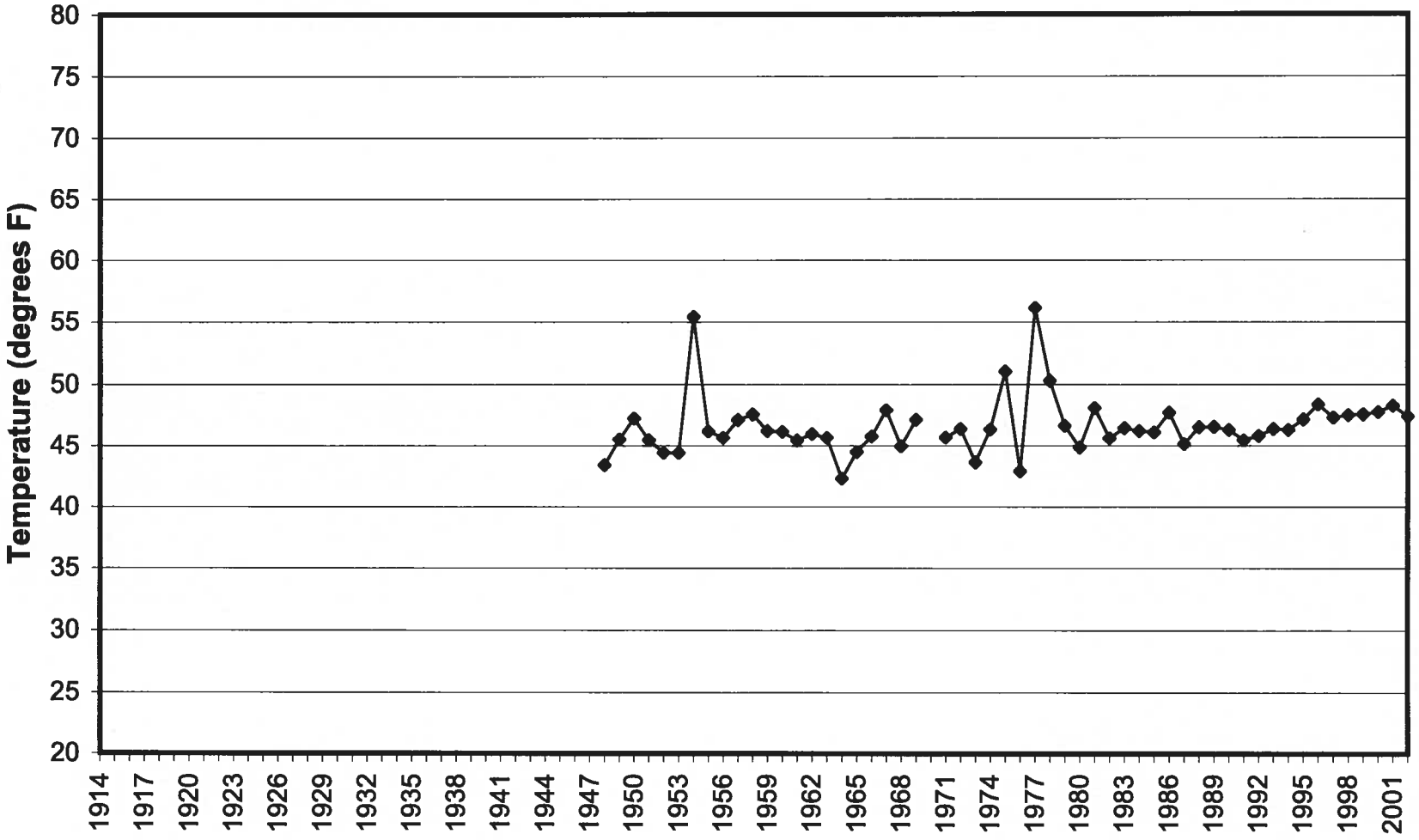
Luna Ranger Station

Average Annual Temperatures for Period of Record



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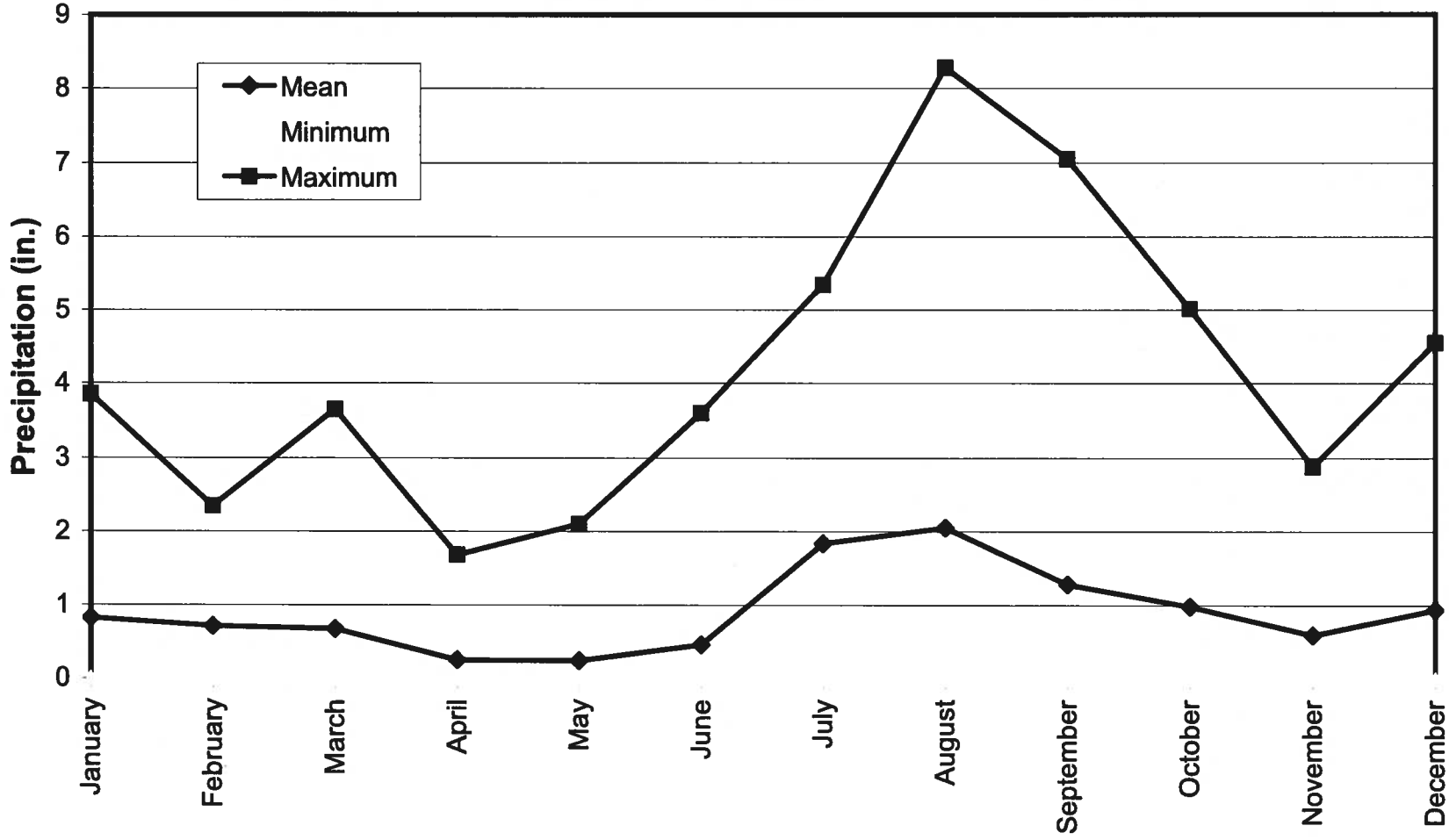
Lordsburg 4 SE

Monthly Precipitation Statistics for Period of Record



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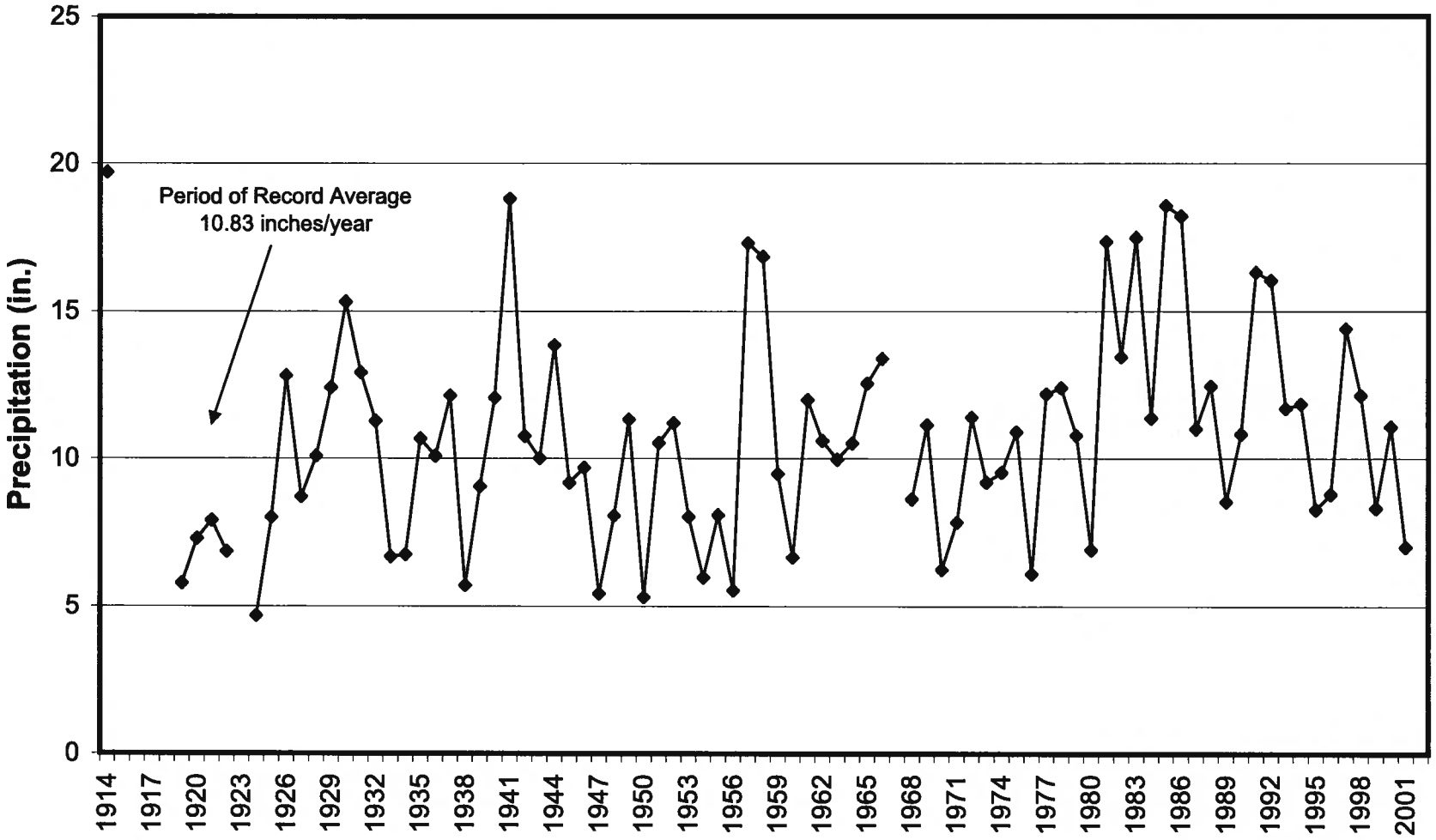
Lordsburg 4 SE

Total Annual Precipitation for Period of Record



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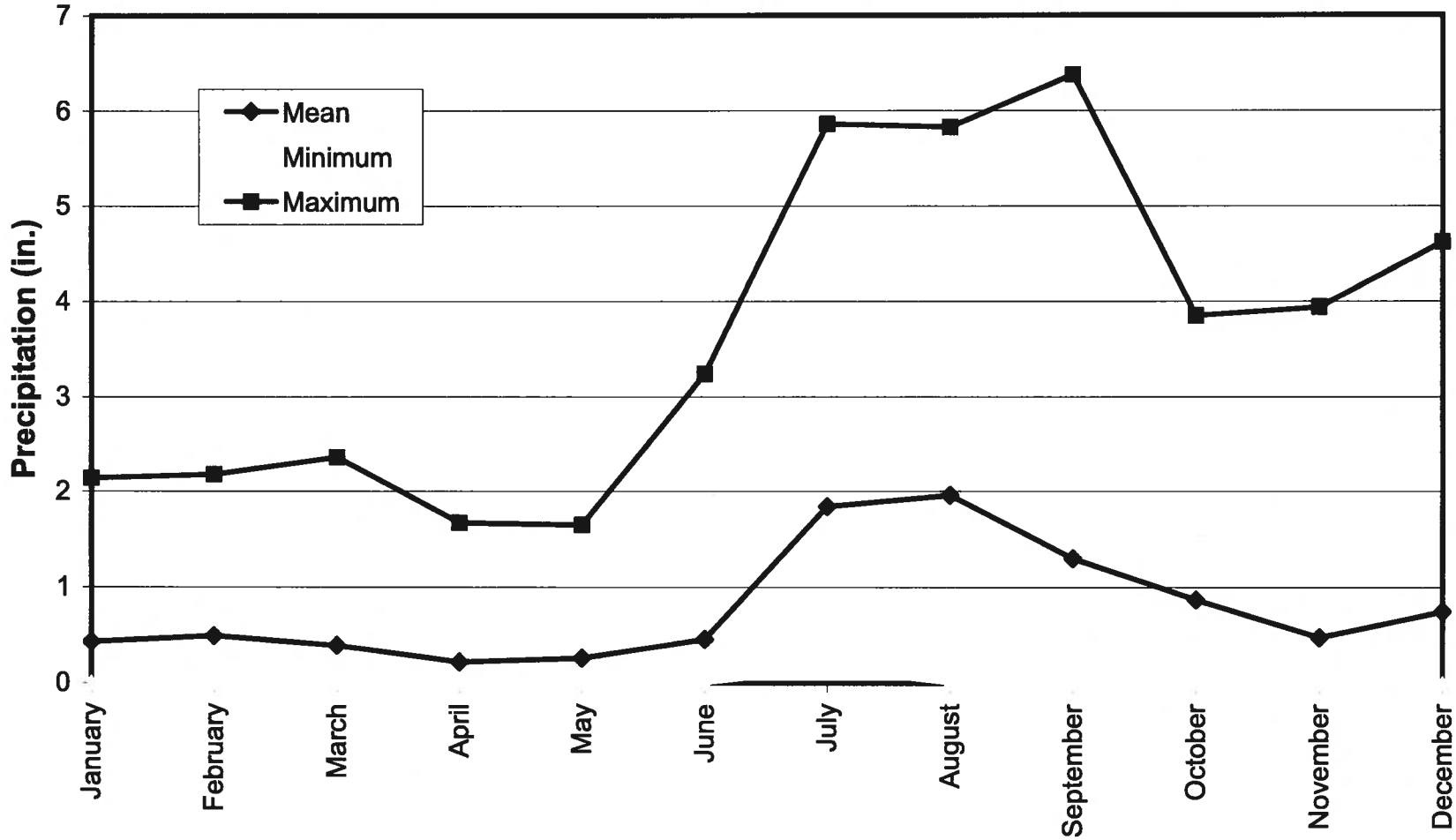
Deming

Monthly Precipitation for Period of Record



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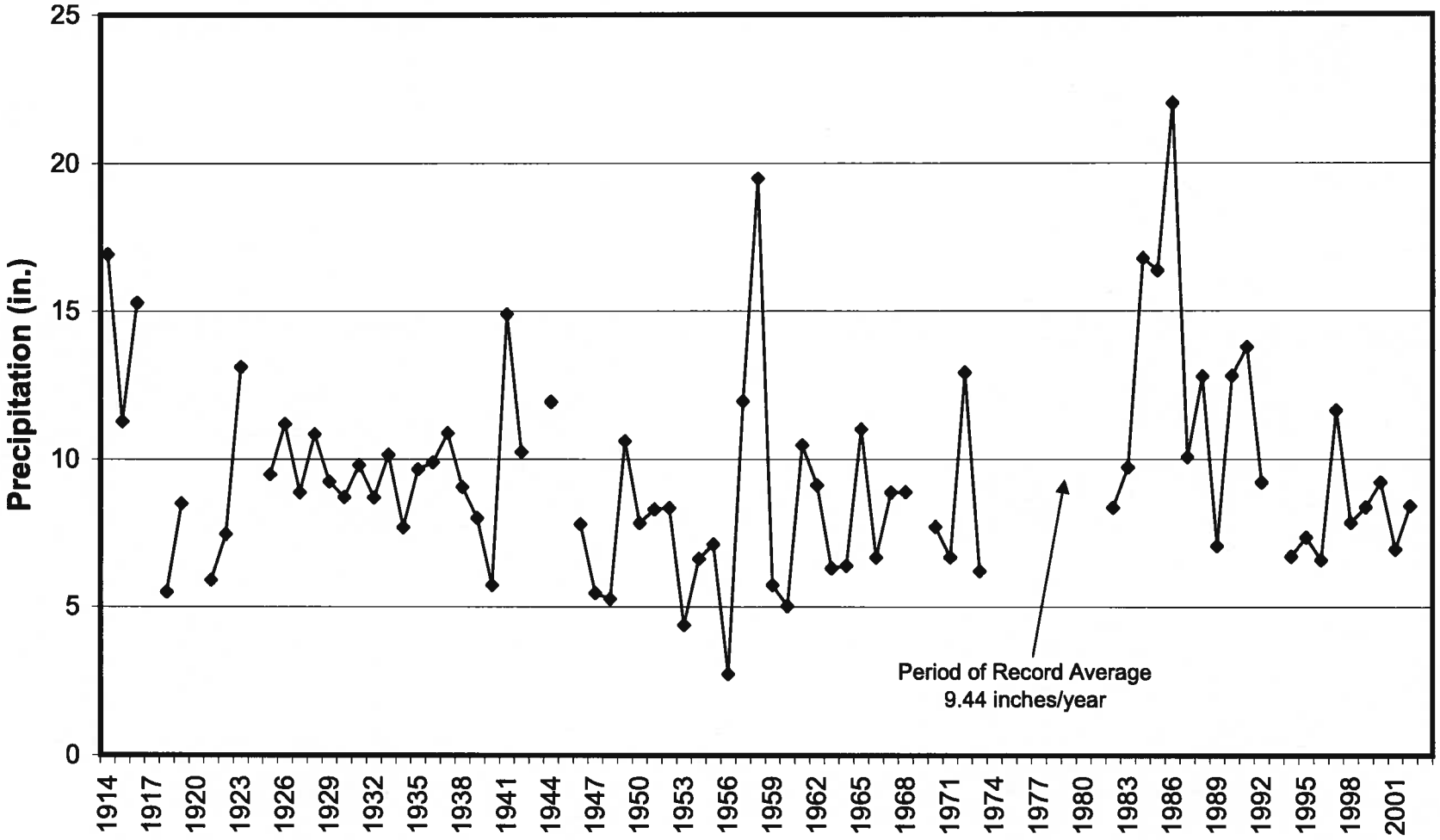
Deming

Annual Total Precipitation for Period of Record



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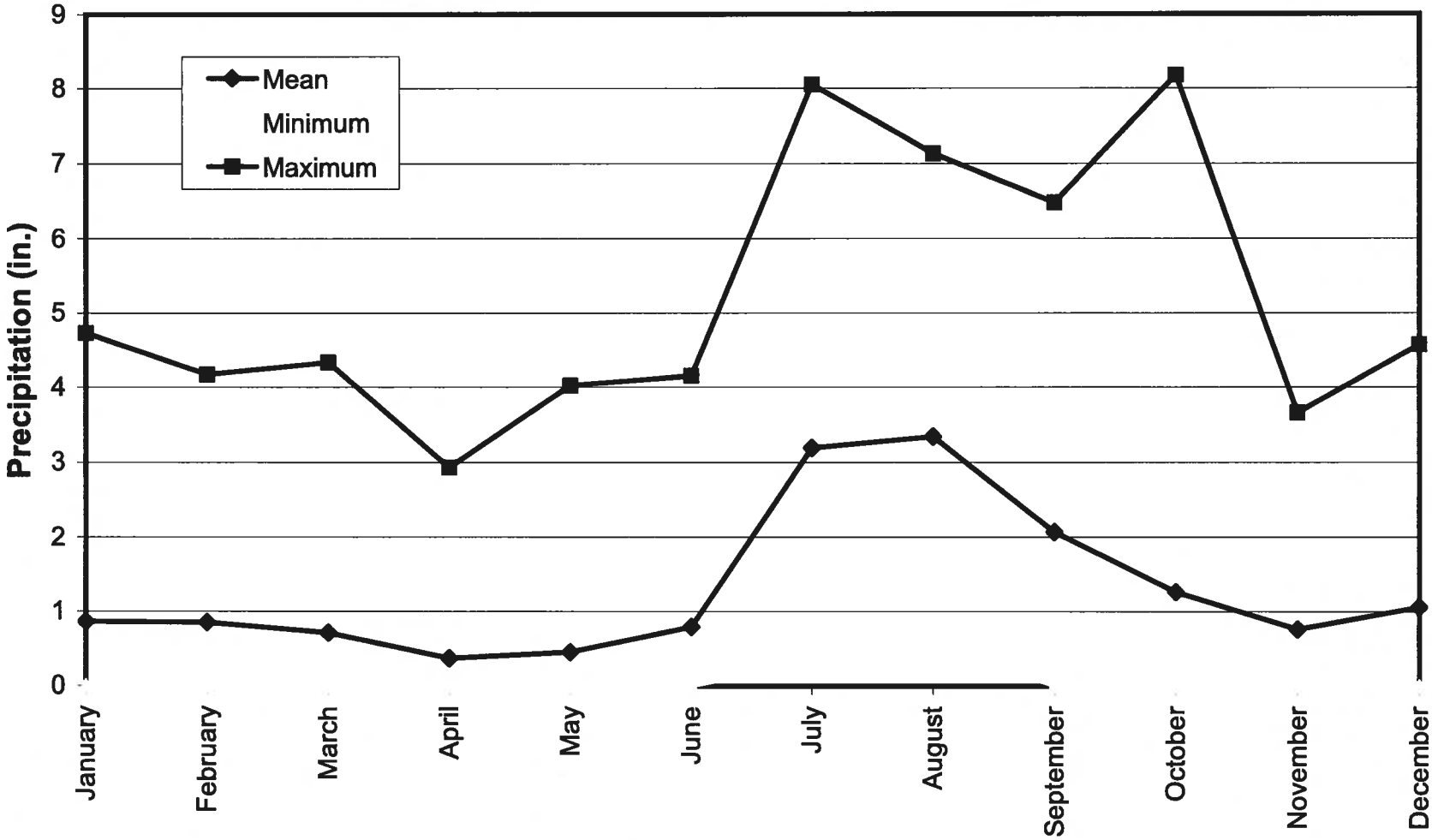
Fort Bayard

Monthly Precipitation Statistics for Period of Record



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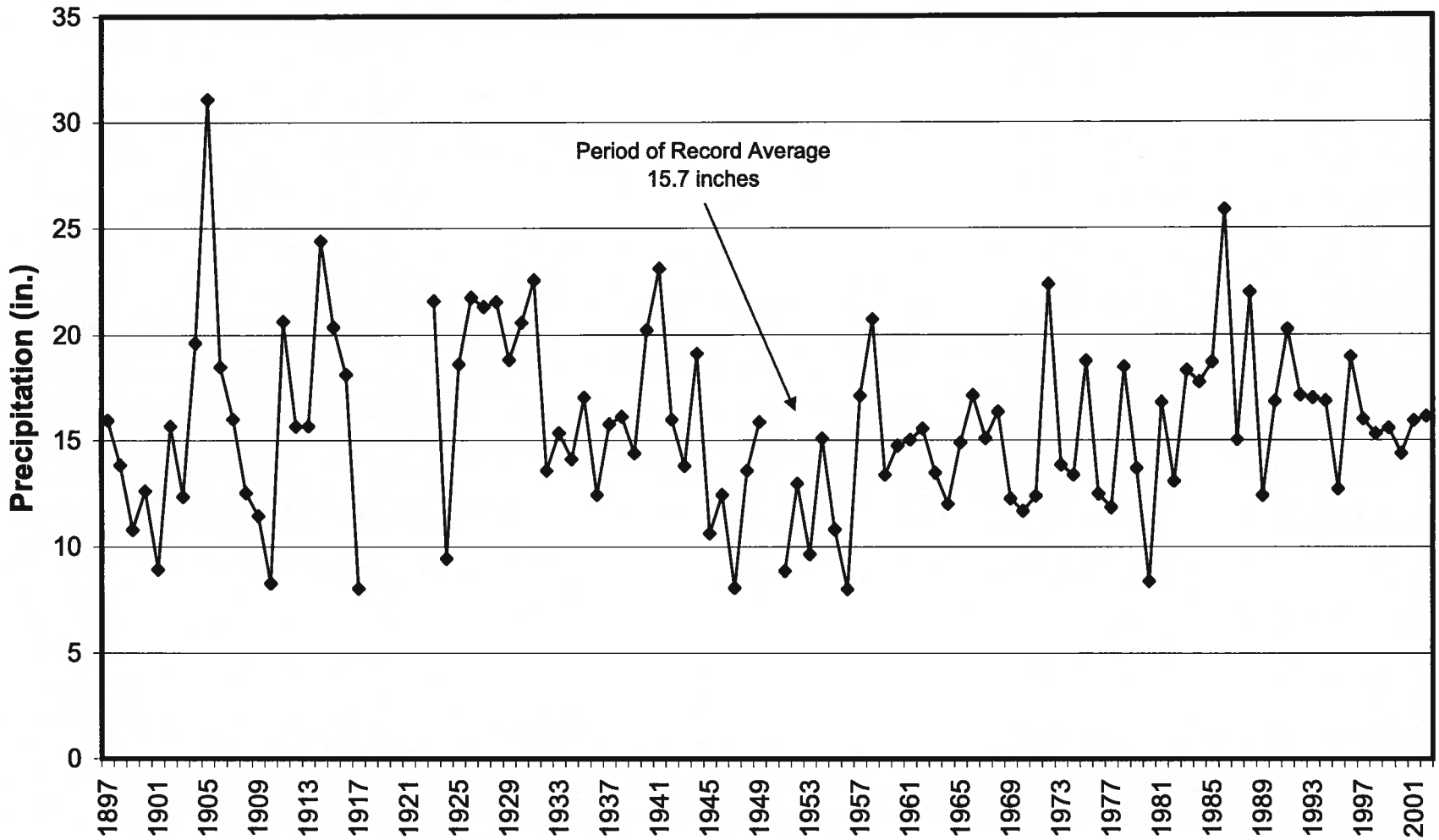
Fort Bayard

Total Annual Precipitation for Period of Record



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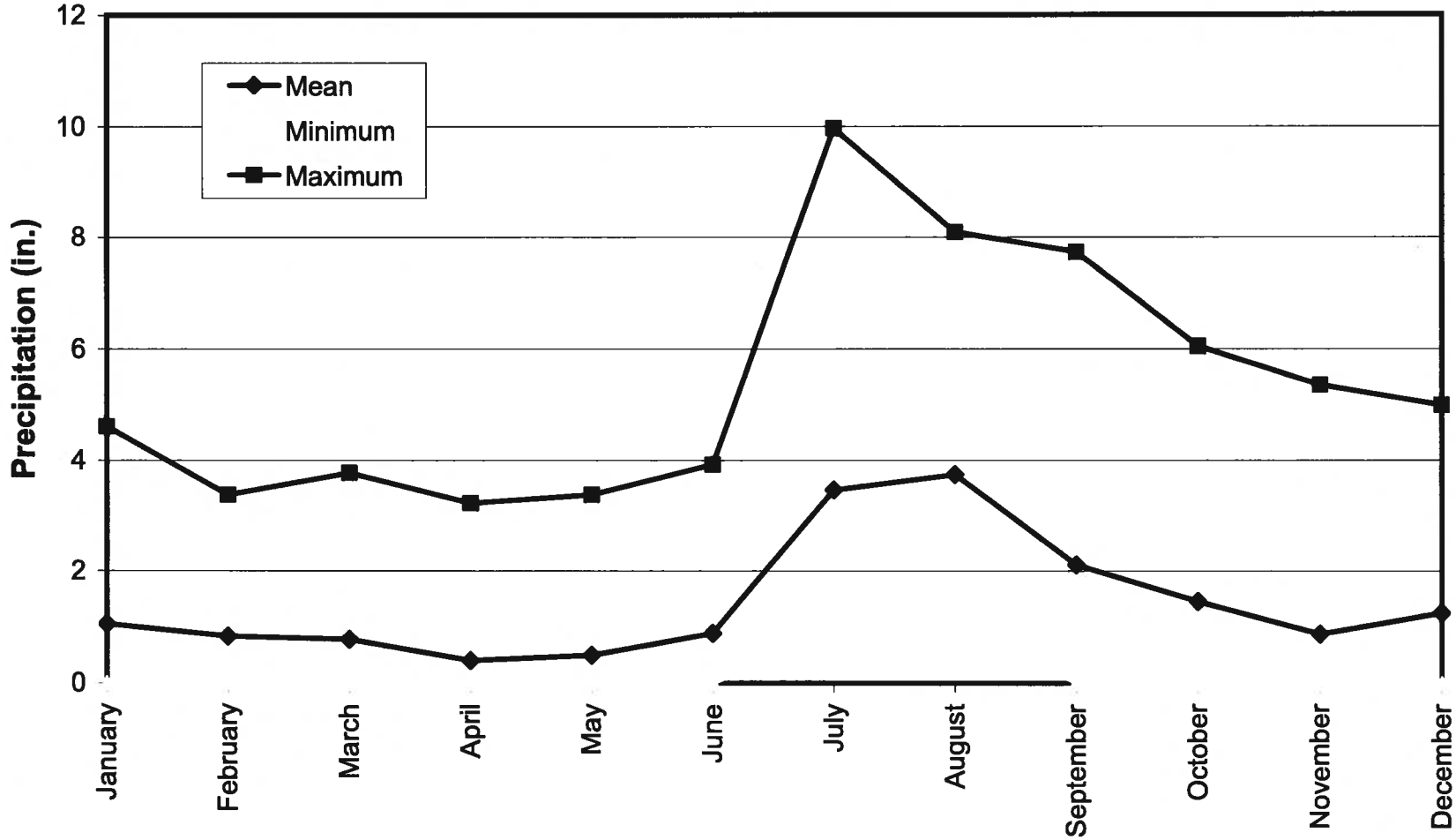
Mimbres Ranger Station

Monthly Precipitation Statistics for Period of Record



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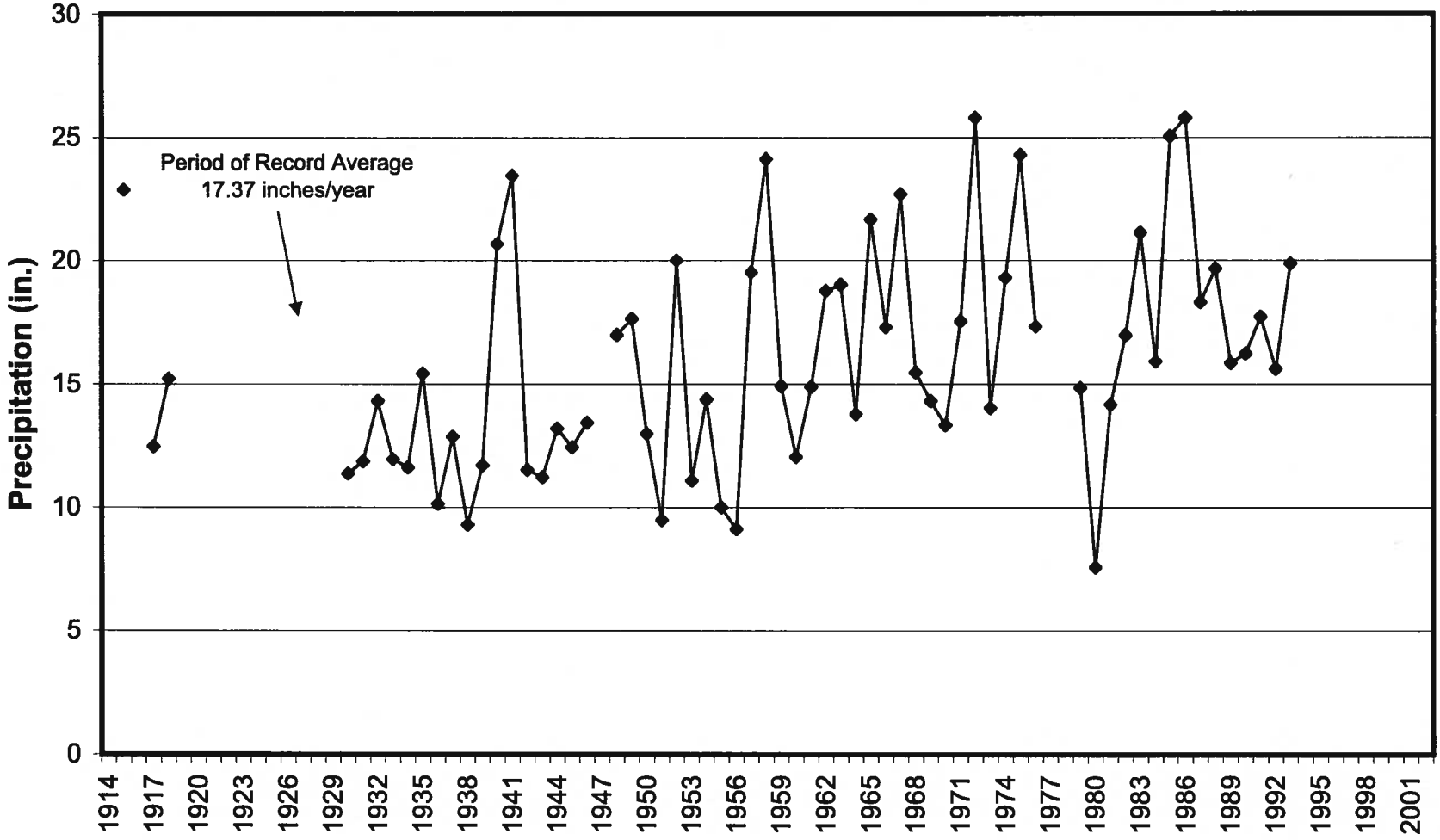
Mimbres Ranger Station

Total Annual Precipitation for Period of Record



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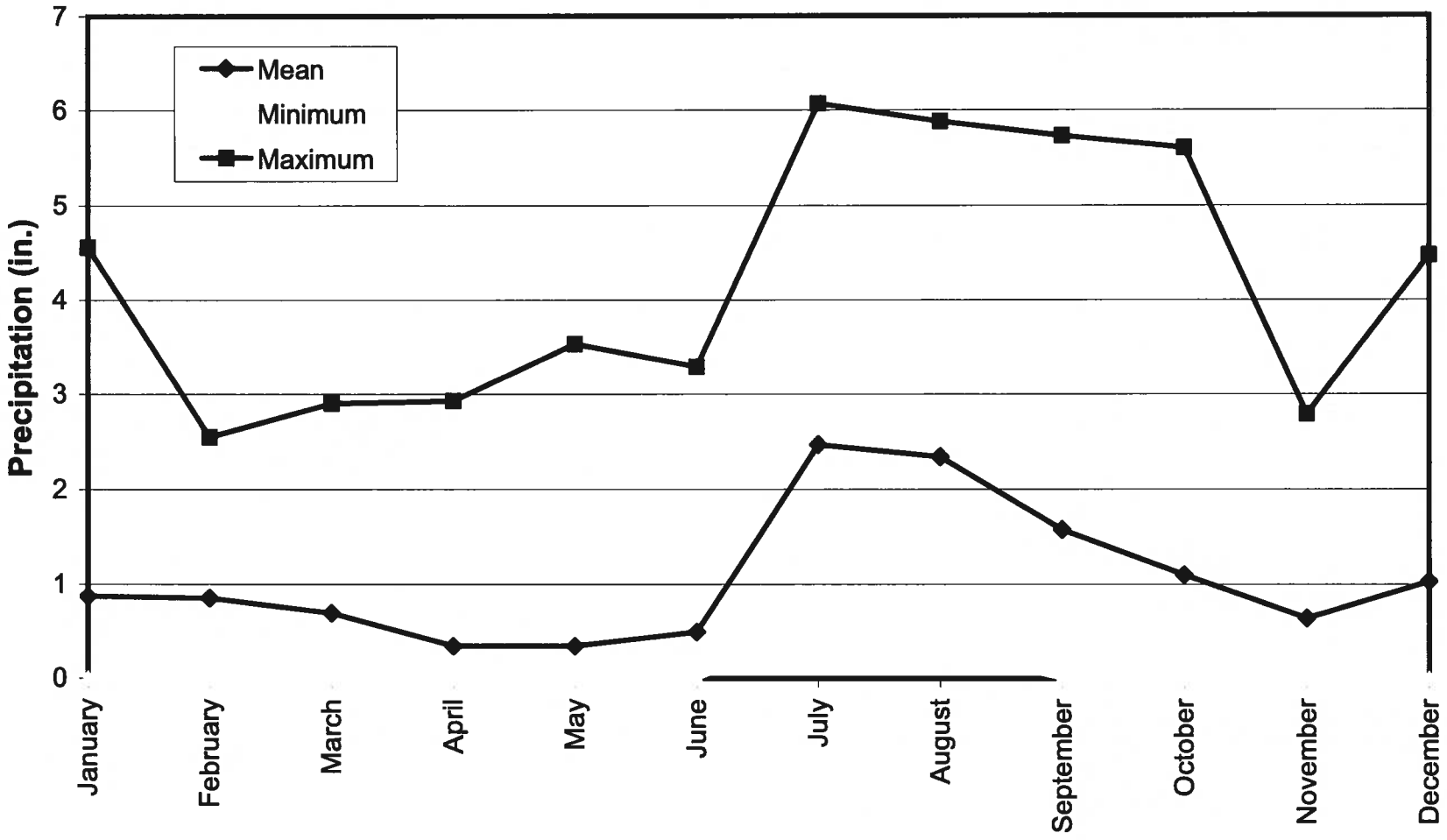
Redrock 1 NNE

Monthly Precipitation Statistics for Period of Record



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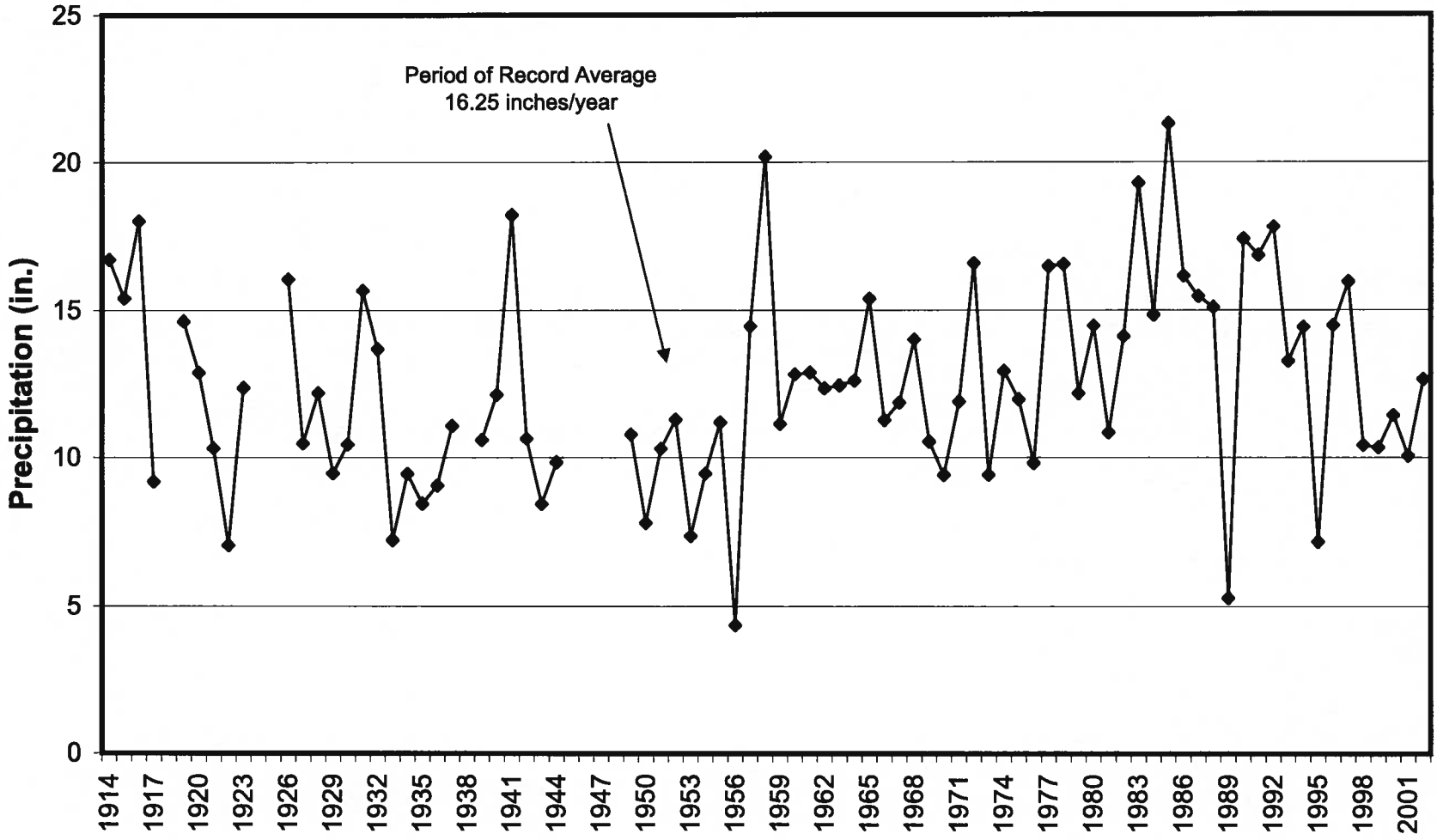
Redrock 1 NNE

Total Annual Precipitation for Period of Record



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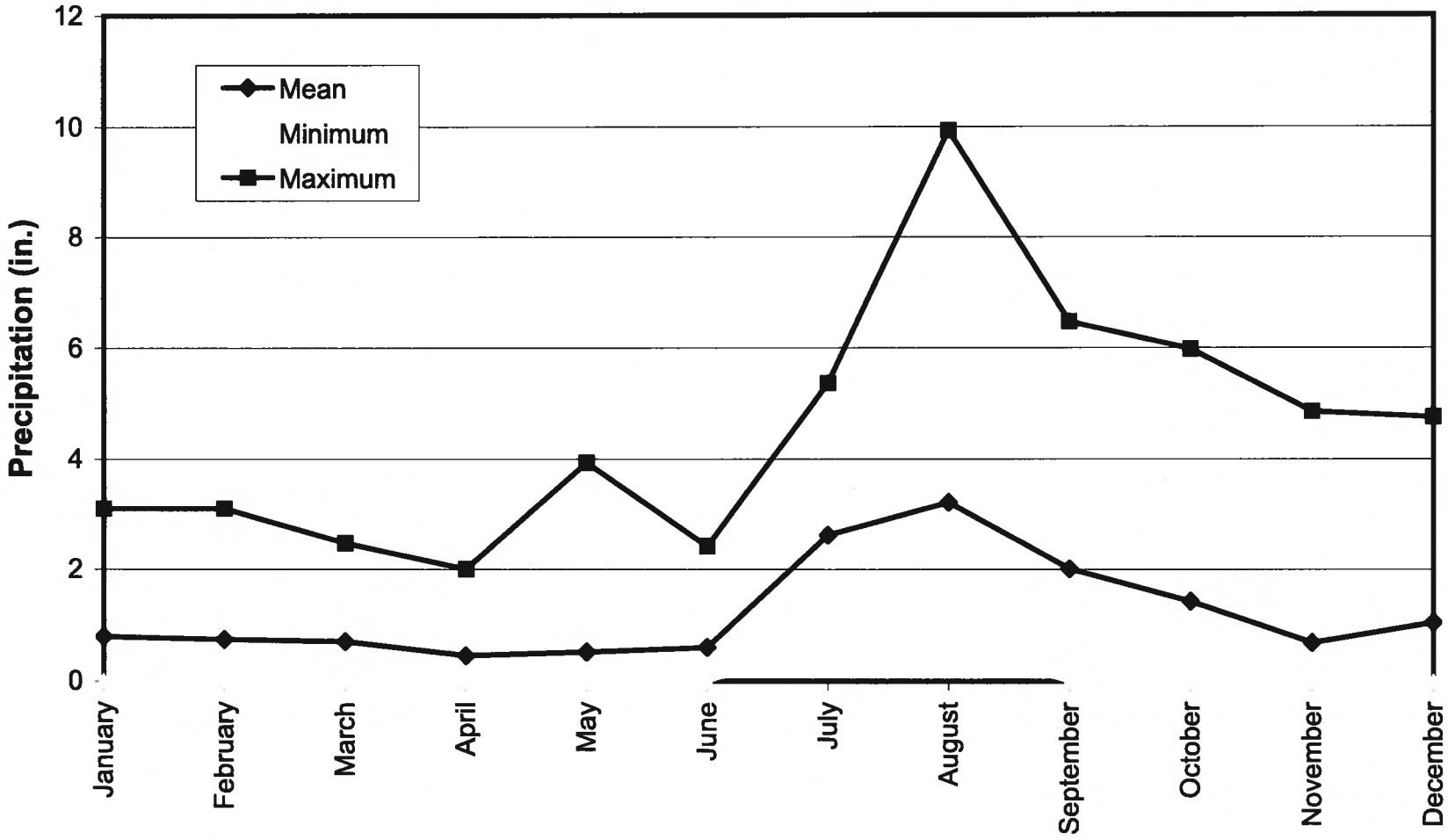
Beaverhead Ranger Station

Monthly Precipitation Statistics for Period of Record



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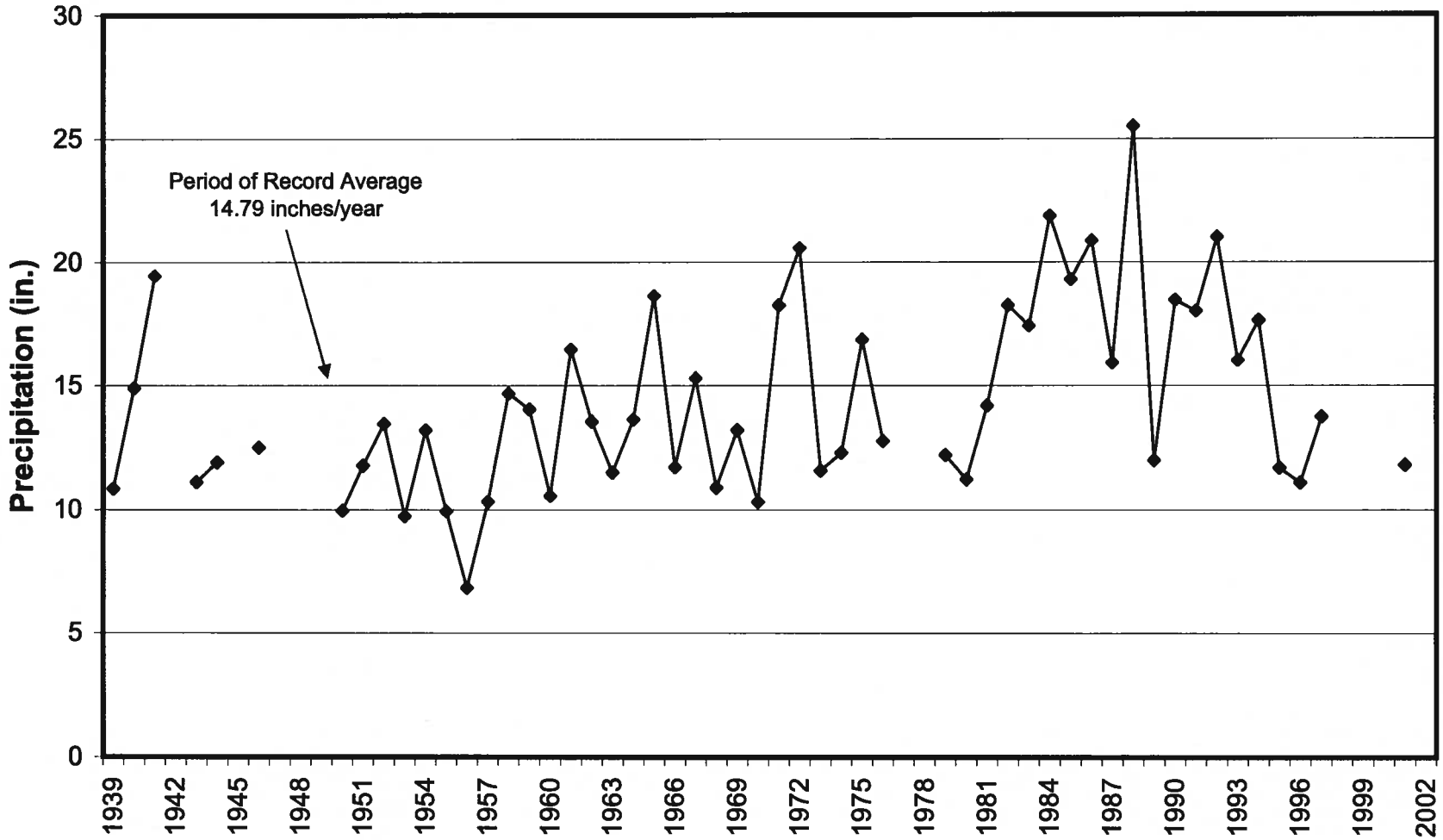
Beaverhead Ranger Station

Annual Total Precipitation for Period of Record



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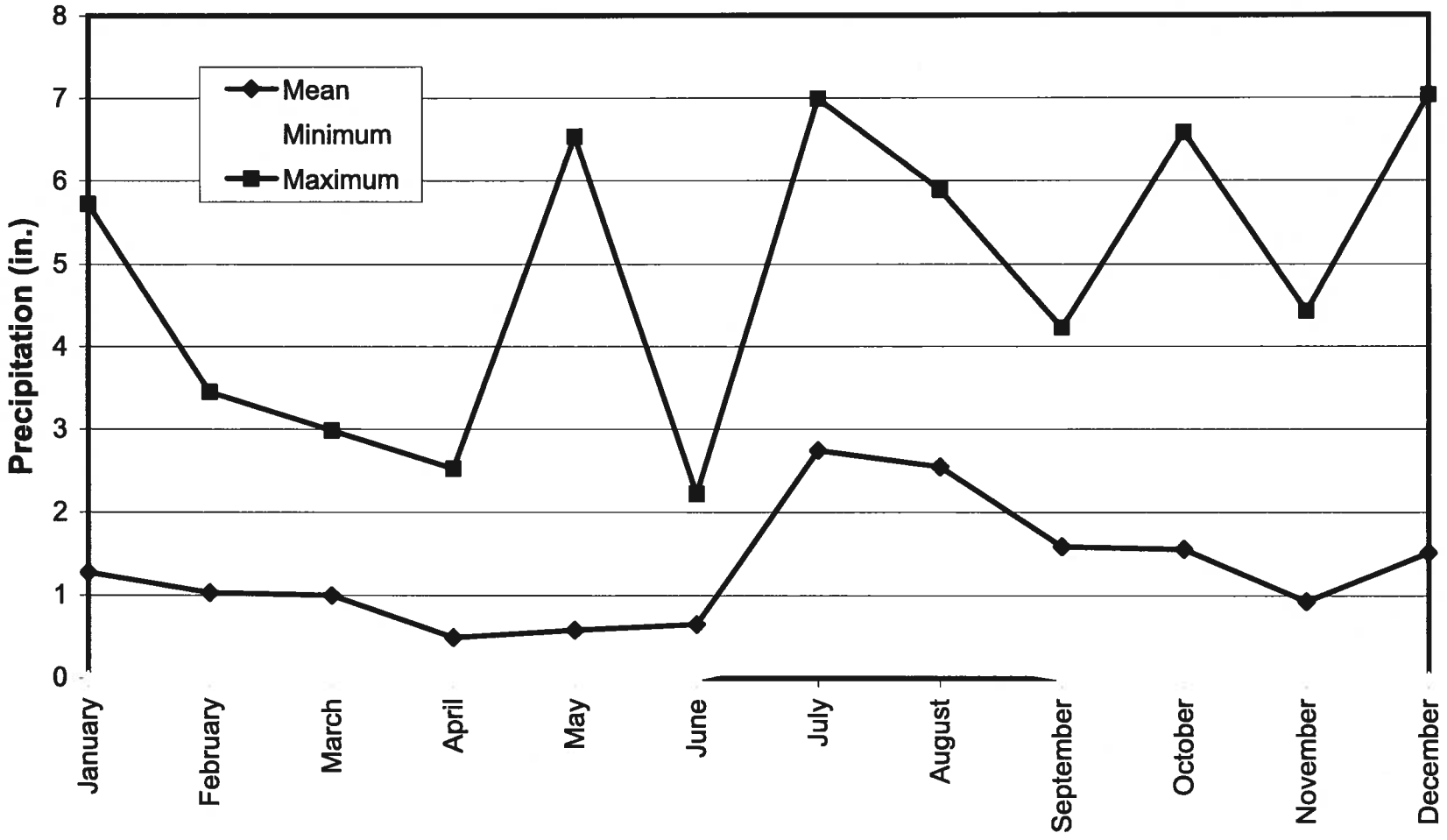
Glenwood

Monthly Precipitation Statistics for Period of Record



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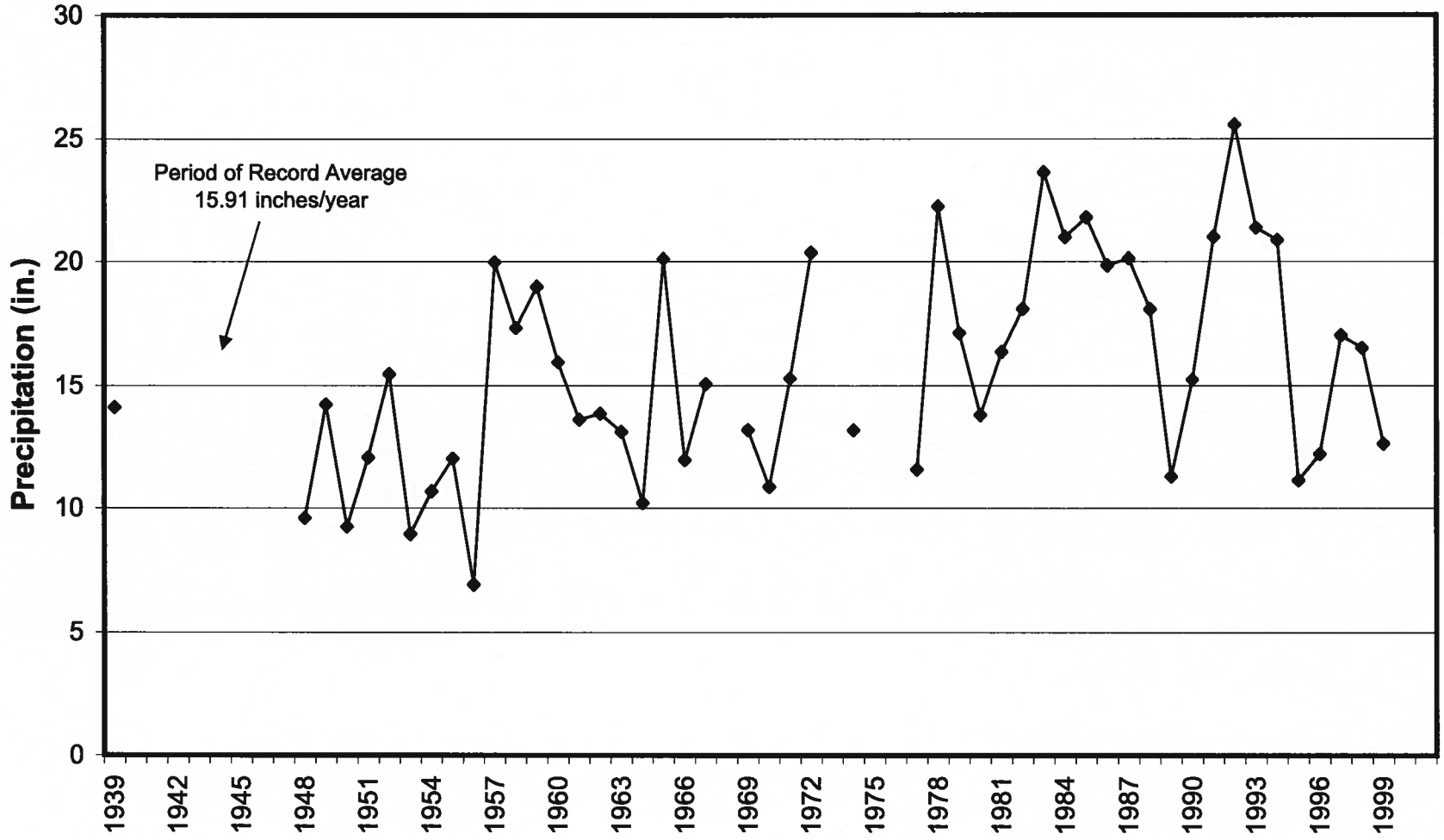
Glenwood

Total Annual Precipitation for Period of Record



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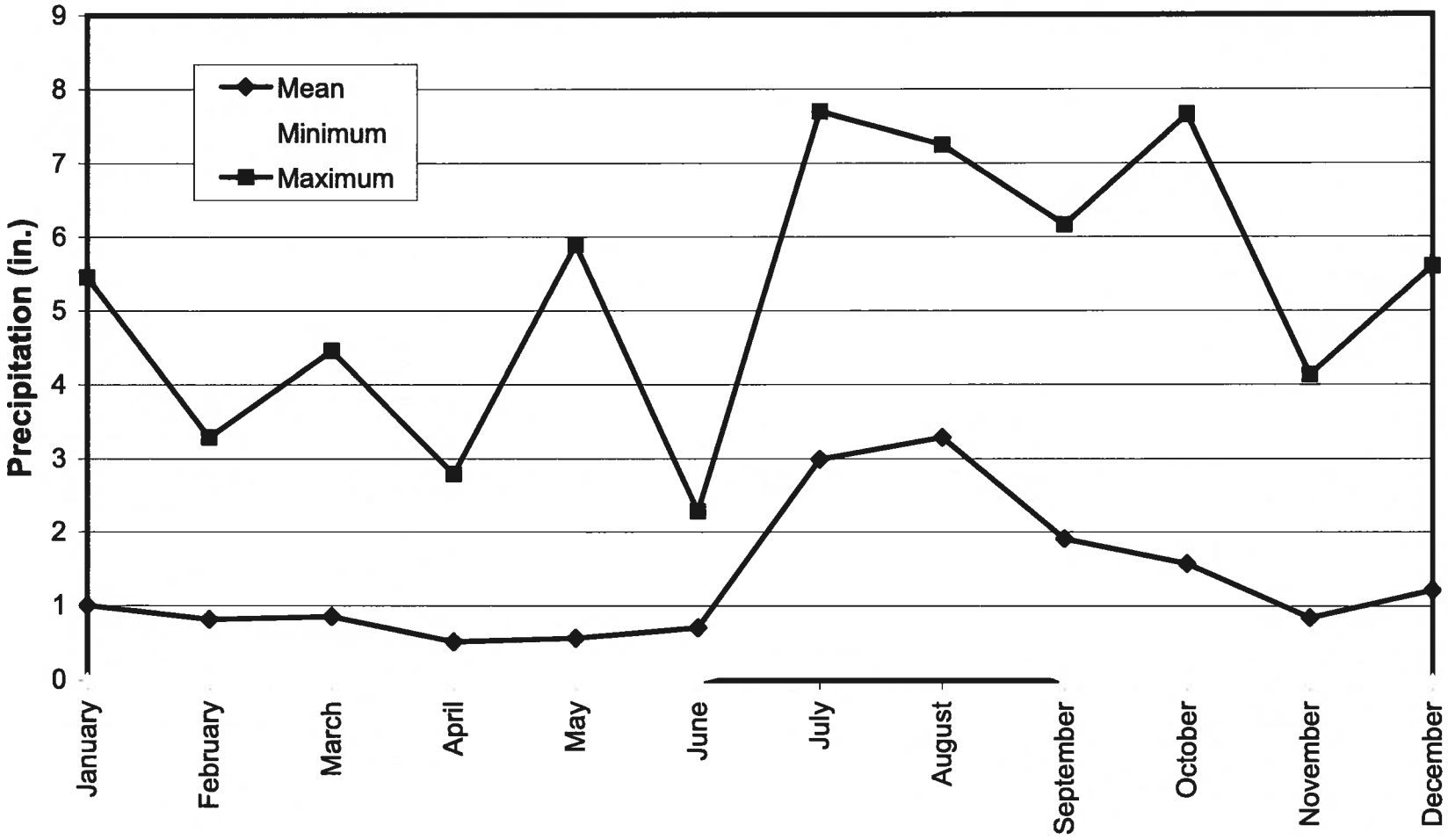
Luna Ranger Station

Monthly Precipitation Statistics for Period of Record



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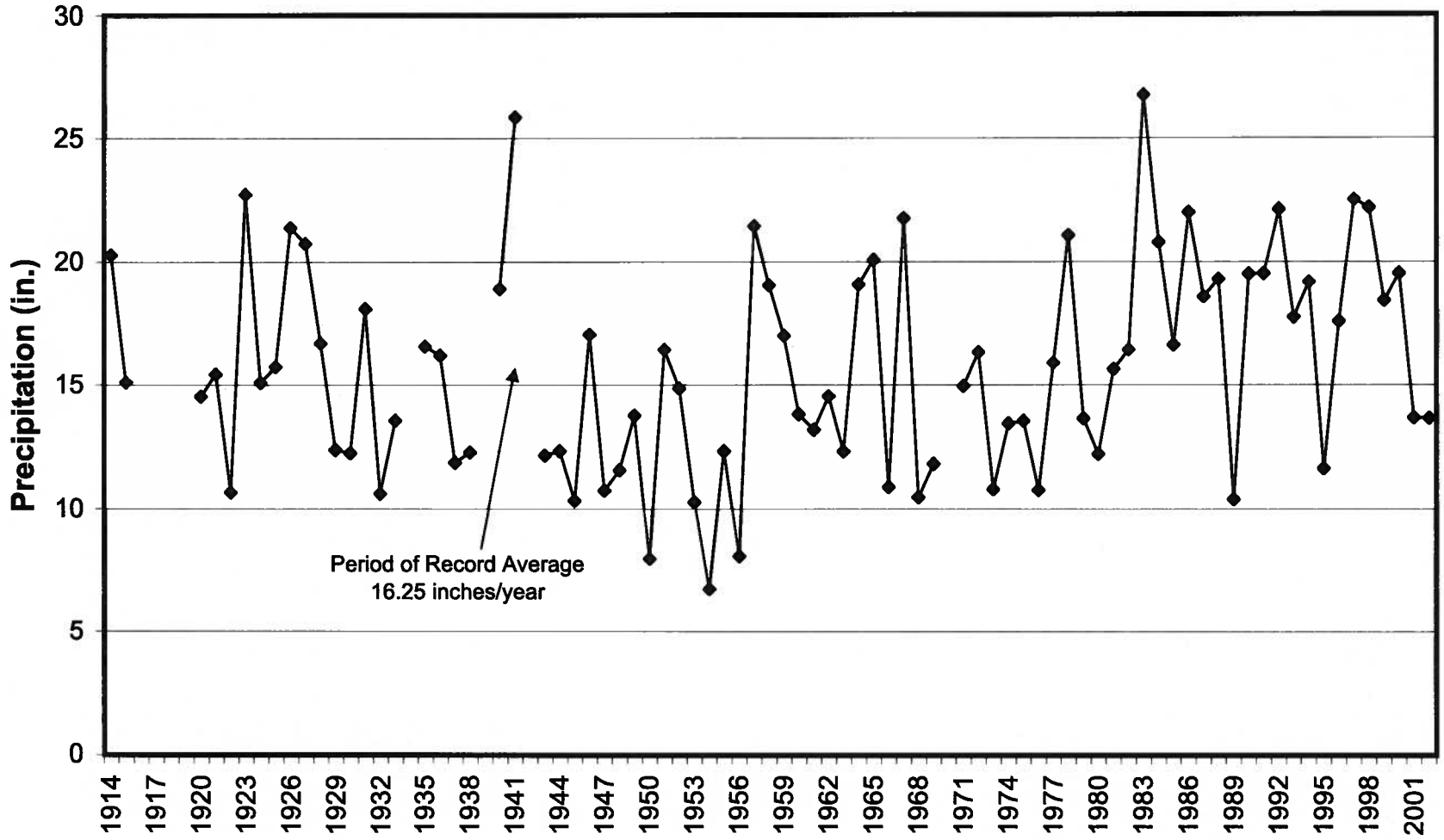
Luna Ranger Station

Total Annual Precipitation for Period of Record



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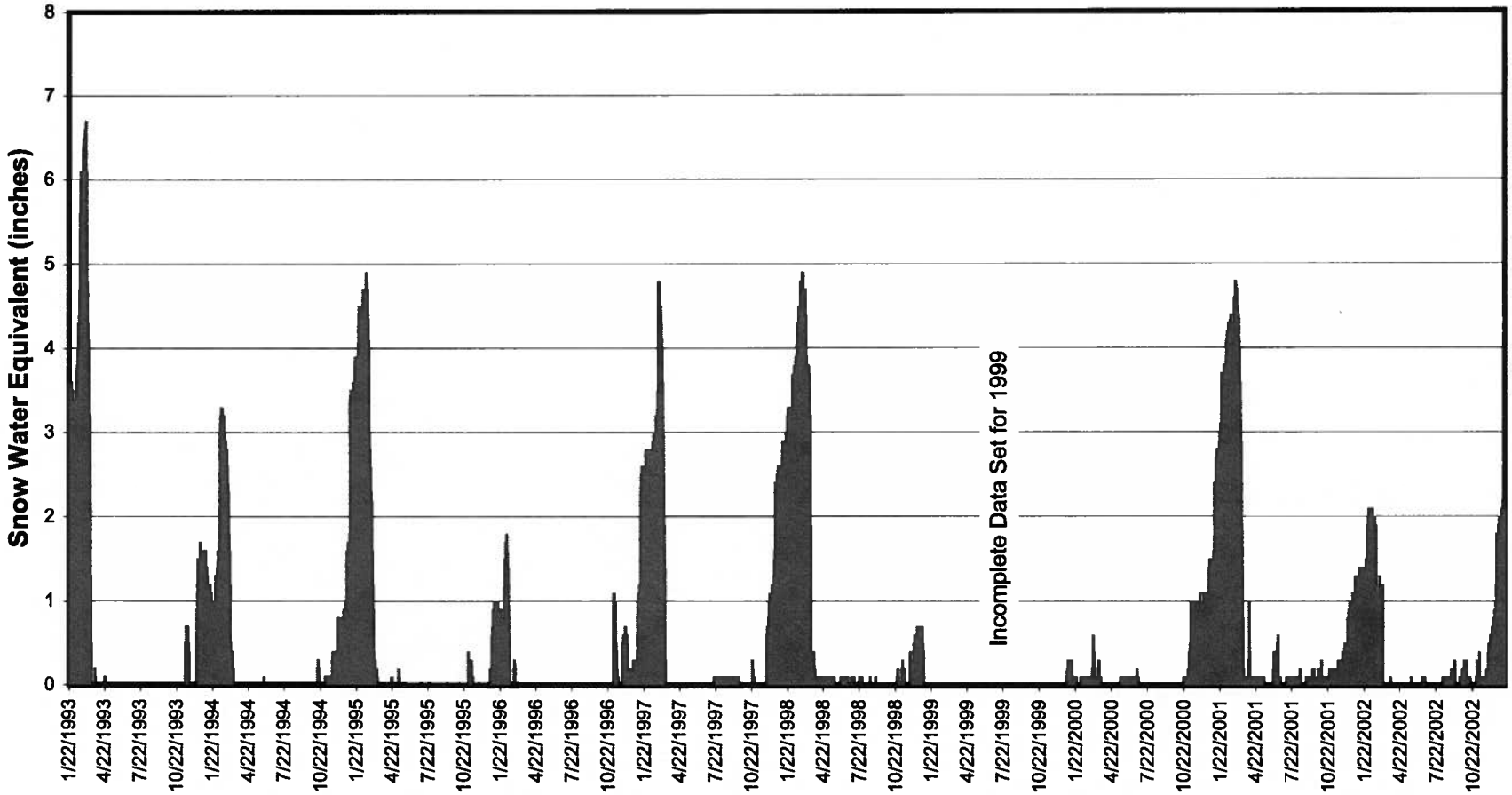
Frisco Divide SNOTEL Station

Daily Snow Water Equivalents for Period of Record



Note: Snow water equivalent shows the amount of snow pack on the ground in terms of the depth of water if the snow melted. On average, about 1 inch of water equals 10 inches of snow, however this can vary depending on the character of the snow and the degree of compaction.

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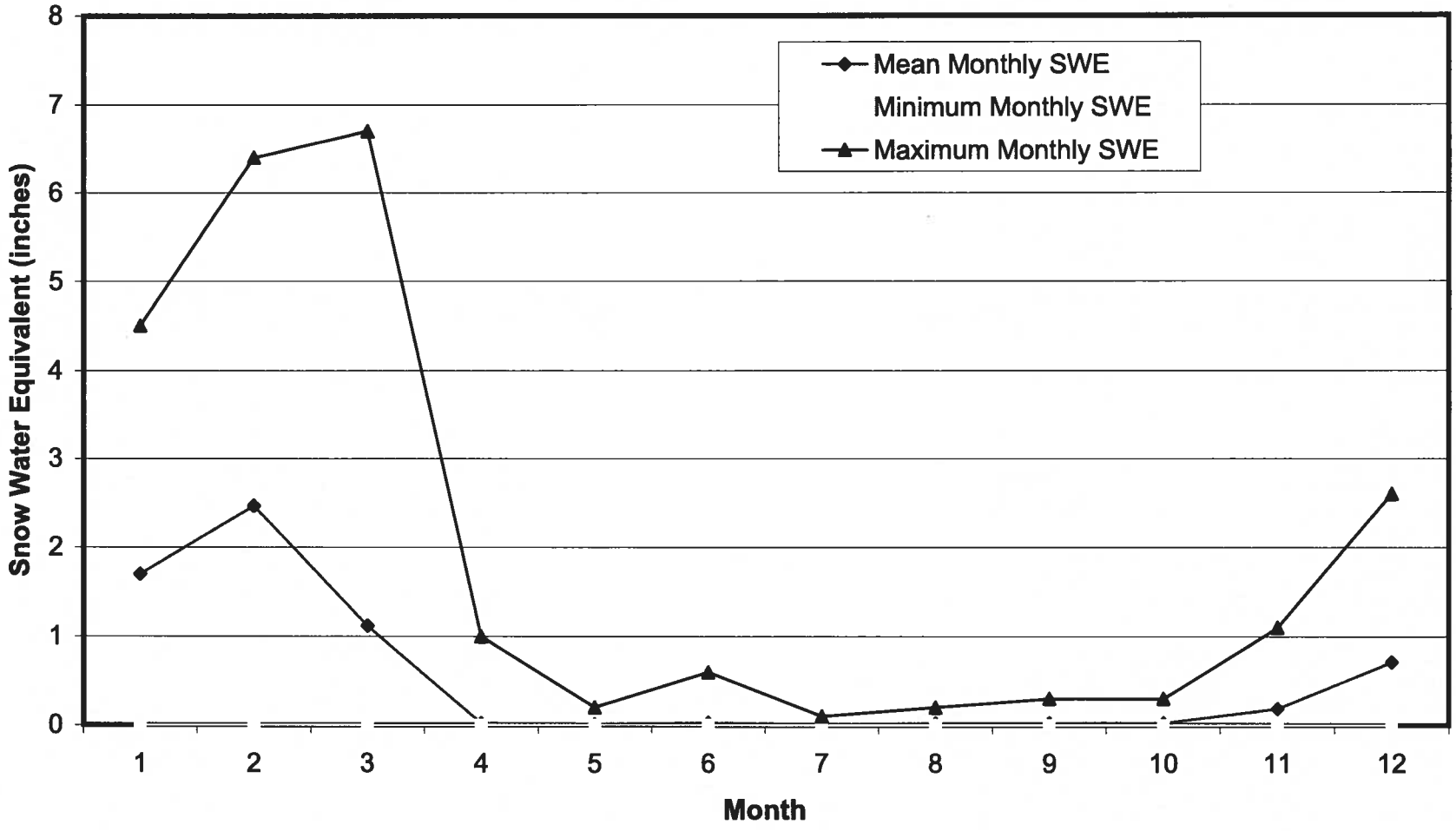
Frisco Divide SNOTEL Station

Monthly SWE Statistics for Period of Record



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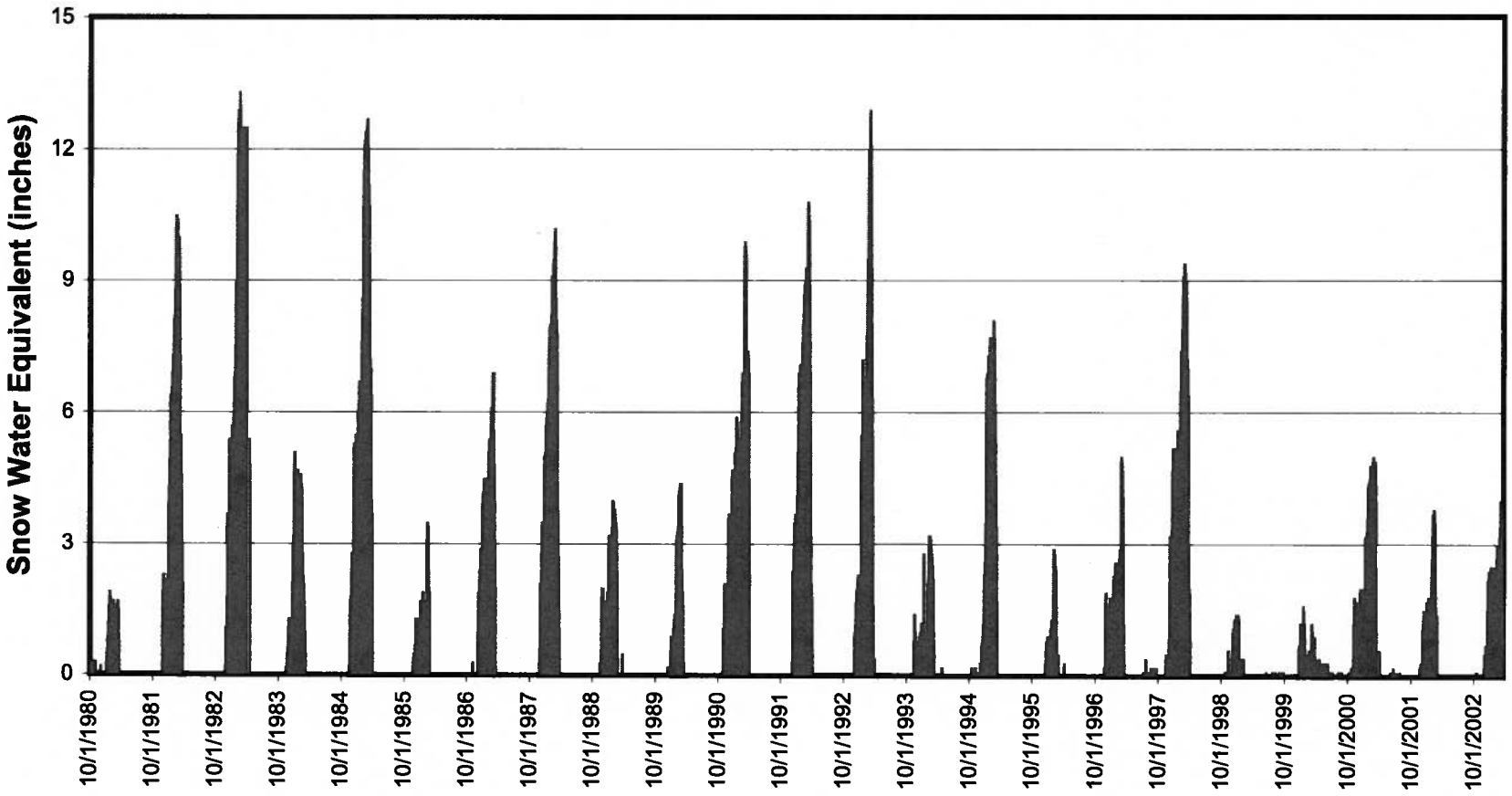
Signal Peak SNOTEL Station

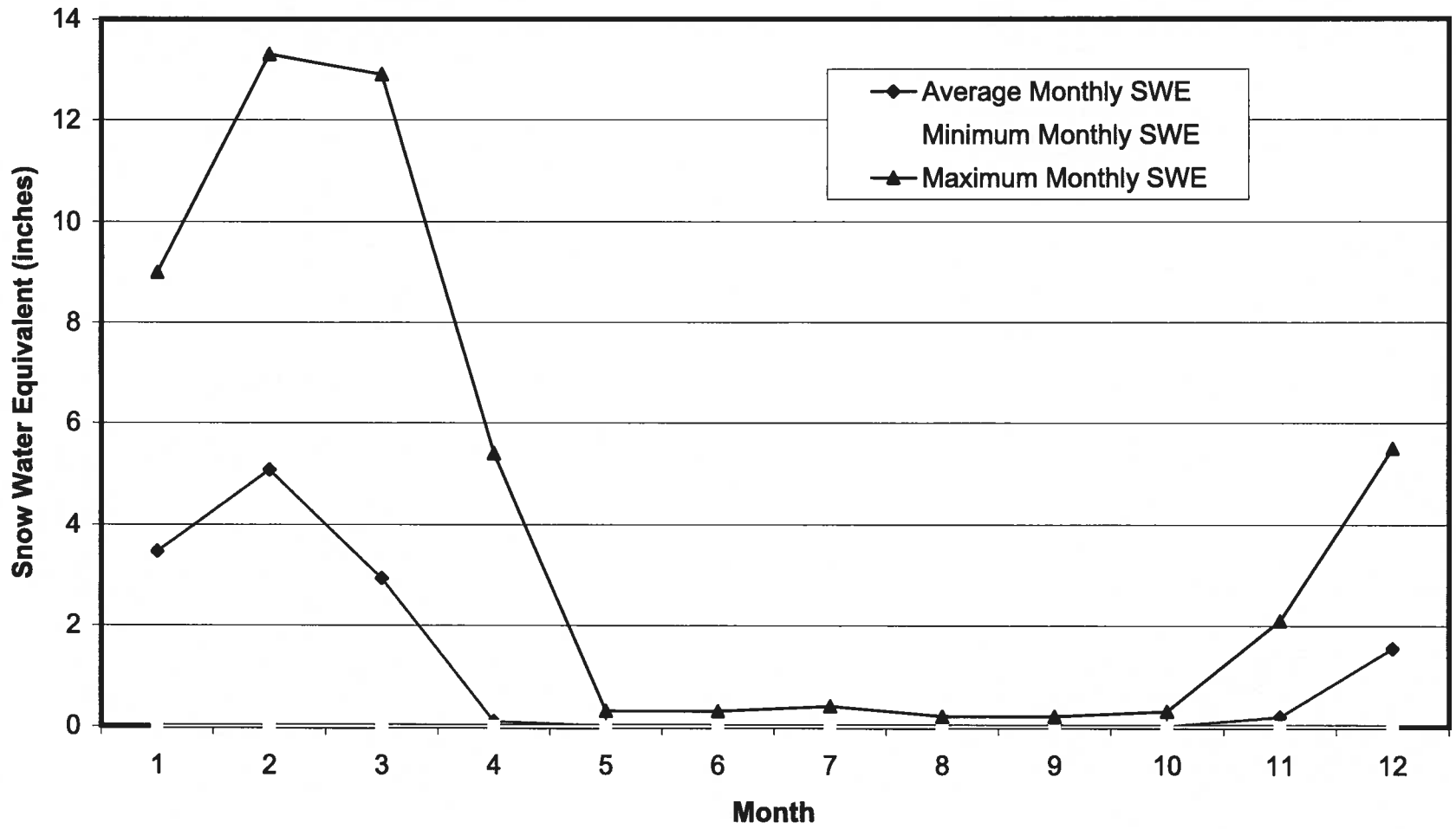
Daily Snow Water Equivalents for Period of Record



Note: Snow water equivalent shows the amount of snow pack on the ground in terms of the depth of water if the snow melted. On average, about 1 inch of water equals 10 inches of snow, however this can vary depending on the character of the snow and the degree of compaction.

Signal Peak SNOTEL Station

Monthly SWE Statistics for Period of Record



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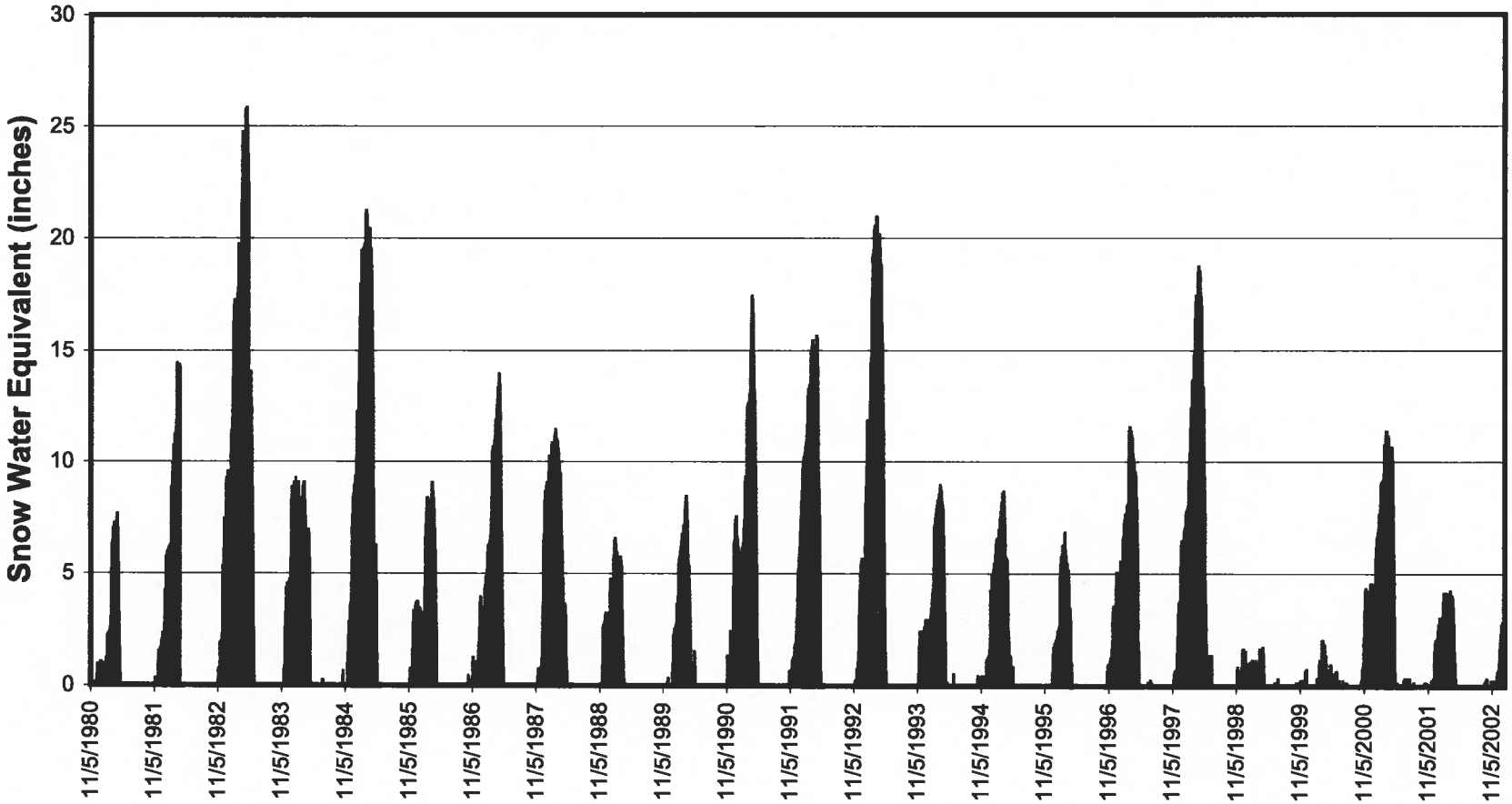
Silver Creek Divide SNOTEL Station

Daily Snow Water Equivalents for Period of Record



Note: Snow water equivalent shows the amount of snow pack on the ground in terms of the depth of water if the snow melted. On average, about 1 inch of water equals 10 inches of snow, however this can vary depending on the character of the snow and the degree of compaction.

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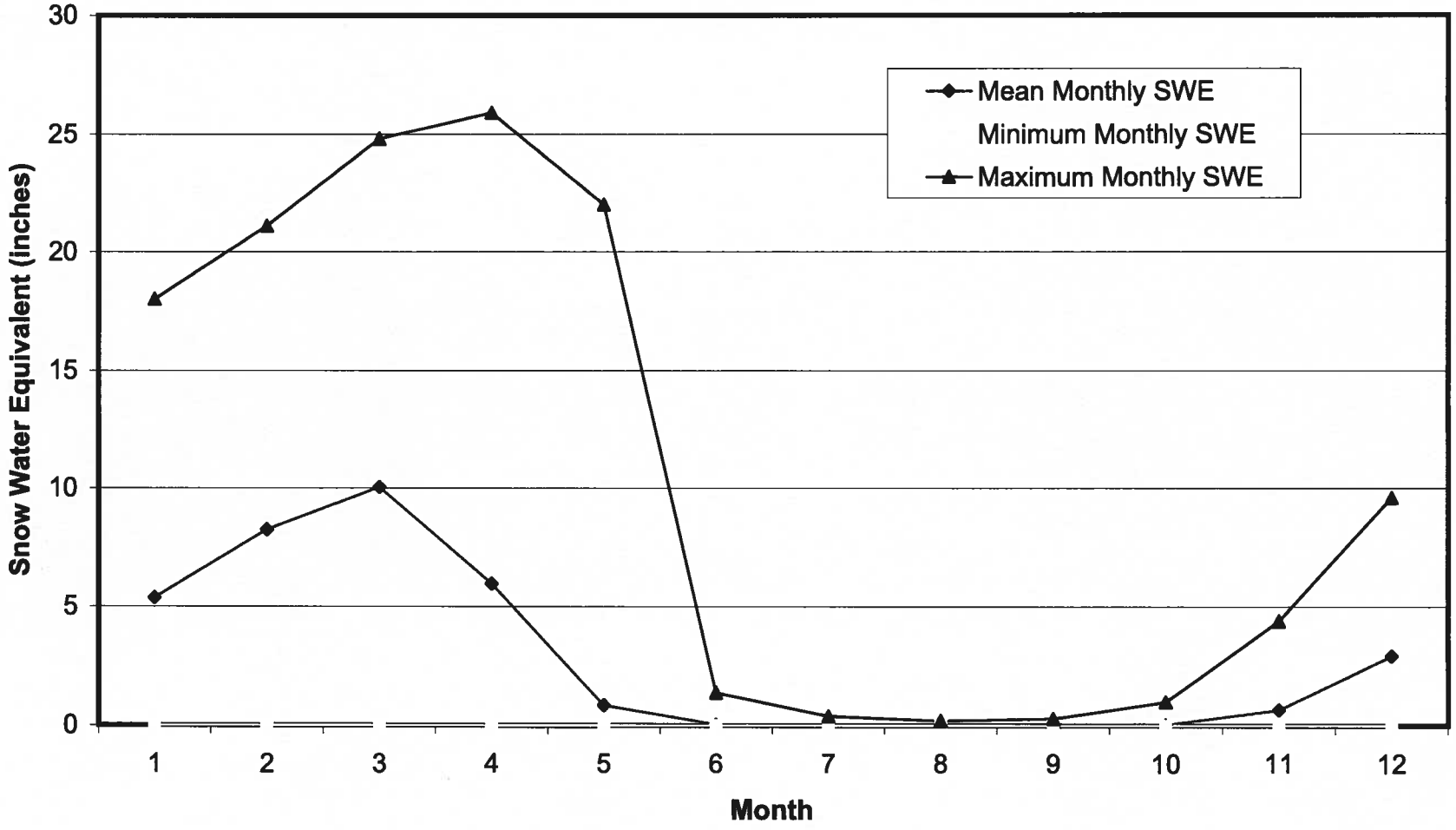
Silver Creek Divide SNOTEL Station

Monthly SWE Statistics for Period of Record



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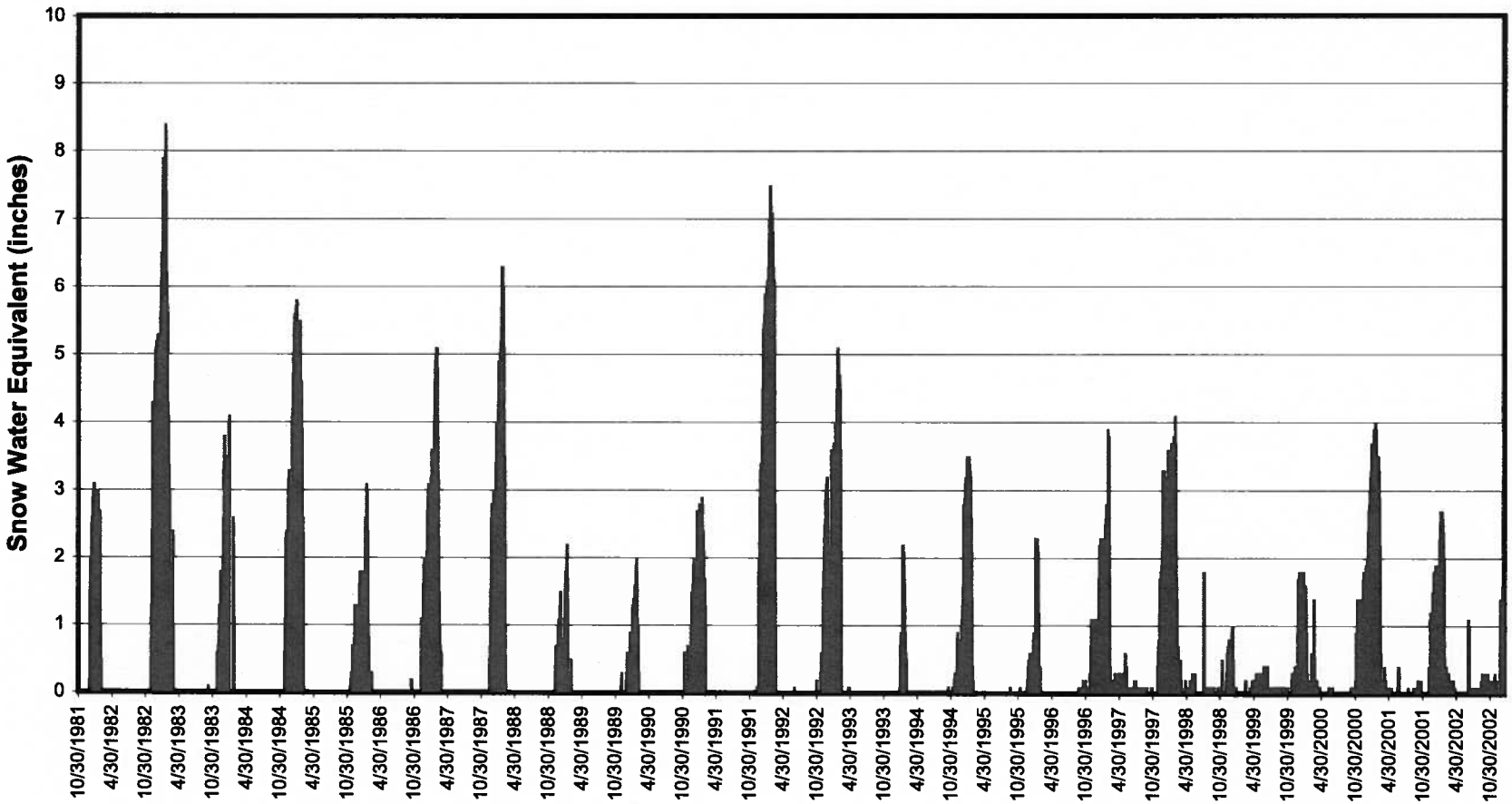
Lookout Mountain SNOTEL Station

Daily Snow Water Equivalents for Period of Record



Note: Snow water equivalent shows the amount of snow pack on the ground in terms of the depth of water if the snow melted. On average, about 1 inch of water equals 10 inches of snow, however this can vary depending on the character of the snow and the degree of compaction.

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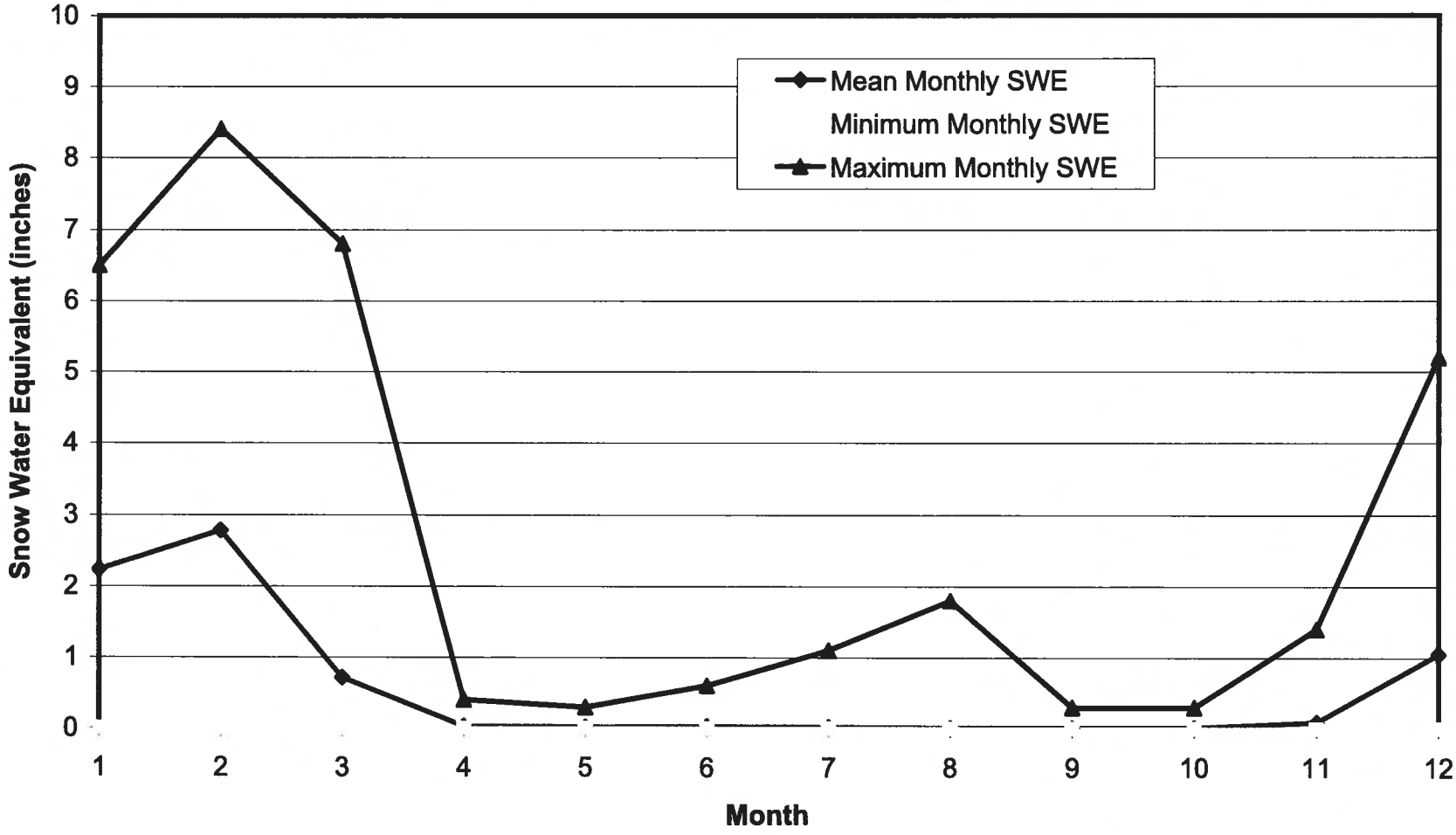
Lookout Mountain SNOTEL Station

Monthly SWE Statistics for Period of Record



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Appendix D3

Streamflow Data

Appendix D3. Streamflow Data

For several of the key stations, streamflow data were missing for discrete time periods, such as when the stream gage was not operational. Data for these time periods were estimated on a monthly or annual basis by developing relationships with nearby stations that recorded streamflow data during the missing period. For example, no data were available for the San Francisco River near Reserve prior to March 1959; therefore, annual yields prior to 1959 were estimated from the San Francisco River near Glenwood station. The specific stations and time periods that were used to estimate missing data are noted on the hydrographs in Appendix D3.

In addition, streamflow data after September 30, 2001 (water year 2002) had not been fully checked by the USGS at the time this report was developed and are therefore considered provisional. Some provisional daily data were missing from the periods of record of several gage stations due to equipment malfunctions or lack of reporting. Where such gaps existed, daily values were calculated using the following procedures:

- If the difference between daily discharges on either side of the data gap was large (10 or more cubic feet per second [cfs]), it was divided by the number of missing daily values. The resultant value was added (or, if flow decreased, subtracted) to the last reported value before the data gap. The resultant value was then added (or subtracted) to each subsequent estimated daily value until the data gap was filled.

- If the change in daily discharge over the missing period was small (only a few cubic feet per second), the average of the daily discharges on either side of the data gap was used to estimate daily discharges during the data gap period.

USGS Streamgage Information for Southwest New Mexico Counties Water Planning Region

USGS Site Name	Location				Drainage Area (sq. mi.)	Drainage Area (acres)	Irrigated land upstream of gage (acres)	Type of Record	Start Date	End Date	Number of Missing Days for Daily Streamflow
	USGS Site Number	Latitude	Longitude	Elevation							
Catron County, New Mexico											
SWINGLE CANYON NR DATIL, NM	08500000	34 11 17	107 53 55	7,600.0	6.4	4,064	NA	peak streamflow	7/16/1977	8/15/1994	
LARGO CREEK NR MANGAS, NM	09386050	34 08 30	108 30 05	7,600.0	63.0	40,320	NA	daily streamflow	10/1/1960	9/30/1966	0
LARGO CREEK NR. QUEMADO, NM	09386100	34 19 25	108 31 40	6,900.0	151.0	96,640	NA	daily streamflow	10/1/1998	9/30/1999	0
								peak streamflow	8/6/1954	unknown 1995	
CARRIZO CREEK NEAR SALT LAKE, NM	09386200	34 30 39	109 01 35	NA	560.0	358,400	NA	peak streamflow	1/1/1957	9/3/1994	
SNOW CREEK NR. MOGOLLON, NM	09429900	33 24 50	108 29 40	7,270.0	89.6	57,344	NA	peak streamflow	unknown 1958	7/29/1967	
MAIL HOLLOW NR LUNA, NM	09442630	33 47 38	108 56 59	7,084.0	4.2	2,688	NA	peak streamflow	8/19/1970	7/14/1976	
ROMERO CRK NR N.M.-ARIZ. ST. LINE NR LUNA, NM	09442650	33 57 00	108 59 00	8,250.0	10.8	6,912	NA	peak streamflow	unknown	10/20/1972	
TROUT CREEK NR LUNA, NM	09442653	33 53 24	109 00 38	8,050.0	27.1	17,344	NA	daily streamflow	12/17/1968	1/11/1973	0
TROUT CREEK AT LUNA, NM	09442660	33 51 00	108 58 00	7,310.0	31.9	20,416	NA	peak streamflow	unknown 1954	8/20/1955	
SAN FRANCISCO RIVER NEAR RESERVE, NM	09442680	33 44 12	108 46 14	5,820.0	350.0	224,000	280	daily streamflow	3/1/1959	9/30/2001	0
								peak streamflow	7/19/1959	8/3/1999	
							NA	water quality samples	1/7/1976	12/10/1976	
TULAROSA RIVER NEAR ARAGON, NM	09442690	33 54 15	108 30 15	6,750.0	89.0	56,960	NA	peak streamflow	8/20/1955	unknown 1967	
TULAROSA RIVER ABOVE ARAGON, NM	09442692	33 53 29	108 30 54	6,750.0	94.0	60,160	0	daily streamflow	7/1/1966	9/30/1996	0
								peak streamflow	7/24/1967	5/18/1996	
								water quality samples	1/8/1976	12/10/1976	
NEGRO CANYON AT ARAGON, NM	09442695	33 53 00	108 33 00	6,640.0	9.6	6,157	NA	peak streamflow	9/27/1958	7/30/1971	
APACHE CREEK NR. APACHE CREEK, NM	09442700	33 55 50	108 39 45	6,760.0	94.6	60,544	NA	peak streamflow	8/24/1957	10/20/1972	
TULAROSA RIVER NEAR RESERVE, NM	09442740	33 44 00	108 42 10	5,900.0	426.0	272,640	NA	peak streamflow	7/28/1956	7/6/1999	
SAN FRANCISCO R NR ALMA, NM	09443000	33 22 05	108 54 35	4,842.0	1,546.0	989,440	1600 [a]	daily streamflow	2/1/1964	9/30/1986	0
								peak streamflow	7/18/1964	7/16/1986	
								water quality samples	1/4/1976	11/26/1976	
WHITEWATER CR NR MOGOLLON, NM [b]	09443500	33 22 00	108 48 30	NA	34.0	21,760	NA	daily streamflow	10/1/1909	6/30/1923	641
SAN FRANCISCO RIVER NEAR GLENWOOD, NM	09444000	33 14 48	108 52 47	4,560.0	1,653.0	1,057,920	2000	daily streamflow	10/1/1927	9/30/2001	0
								peak streamflow	7/28/1928	9/13/1999	
								water quality samples	4/2/1963	8/22/2001	
Grant County, New Mexico											
MIMBRES R AT MCKNIGHT DS NR MIMBRES, NM	08476300	32 56 14	108 00 55	6,236.7	97.3	62,272	NA	daily streamflow	11/1/1963	10/31/1972	0
								peak streamflow	8/18/1964	9/14/1972	
								water quality samples	8/15/1967	11/30/1972	
MIMBRES RIVER NEAR MIMBRES, NM	08477000	32 52 28	107 59 05	5,972.0	152.0	97,280	300	daily streamflow	10/1/1930	9/30/1976	0
								peak streamflow	8/10/1931	9/15/1976	
								water quality samples	1/15/1976	11/16/1979	
MIMBRES RIVER AT MIMBRES, NM	08477110	32 51 17	107 58 23	5,920.0	216.0	138,240	none reported	daily streamflow	3/1/1978	9/30/2001	0
								peak streamflow	11/25/1978	8/5/1999	
								water quality samples	1/20/1978	8/20/1986	
IRON CR NR KINGSTON, NM	08477200	32 54 50	107 46 35	7,680.0	0.7	474	NA	peak streamflow	7/11/1955	10/20/1972	
LITTLE WALNUT CREEK NEAR SILVER CITY, NM	08477560	32 48 20	108 17 35	6,050.0	5.1	3,264	NA	peak streamflow	8/14/1959	8/11/1960	
SILVA CREEK TRIB. AT SILVER CITY, NM	08477570	32 47 42	108 16 47	5,990.0	2.1	1,357	NA	peak streamflow	8/21/1958	9/3/1975	
SILVA CREEK AT SILVER CITY, NM	08477580	32 46 41	108 16 41	5,900.0	10.0	6,400	NA	peak streamflow	8/21/1958	7/17/1994	
PINOS ALTOS CREEK AT SILVER CITY, NM	08477590	32 46 52	108 16 04	5,925.0	4.6	2,963	NA	peak streamflow	8/21/1958	9/13/1999	
SAN VICENTE ARROYO AT SILVER CITY, NM	08477600	32 46 15	108 16 30	5,862.6	26.5	16,960	none reported	daily streamflow	10/1/1953	9/30/1965	0
								peak streamflow	9/9/1938	9/1/1965	

USGS Streamgage Information for Southwest New Mexico Counties Water Planning Region

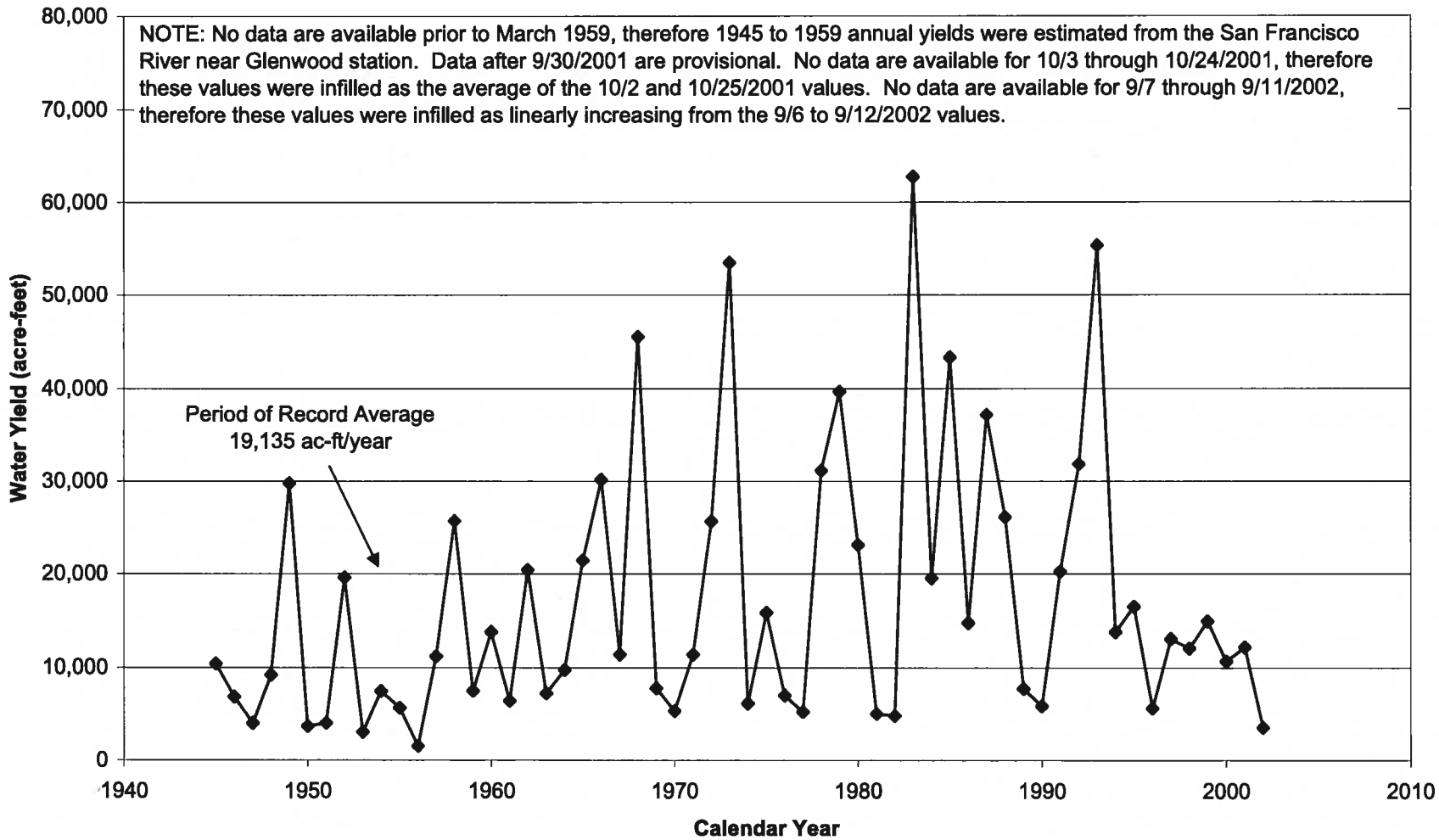
USGS Site Name	Location				Drainage Area (sq. mi.)	Drainage Area (acres)	Irrigated land upstream of gage (acres)	Type of Record	Start Date	End Date	Number of Missing Days for Daily Streamflow
	USGS Site Number	Latitude	Longitude	Elevation							
CAMERON CREEK AT CENTRAL, NM	08478000	32 47 00	108 10 00	5,990.0	18.8	12,032	NA	peak streamflow	9/25/1954	9/25/1954	
GILA R NR SILVER CITY, NM	09430000	33 10 30	108 12 30	5,530.0	1,600.0	1,024,000	NA	daily streamflow	7/1/1912	5/31/1919	0
SAPILLO CREEK BELOW LAKE ROBERTS, NM	09430150	33 01 56	108 10 06	5,990.0	78.0	49,920	NA	daily streamflow	6/1/1964	10/1/1971	0
								peak streamflow	9/23/1964	8/13/1971	
COPPERAS CANYON NR PINOS ALTOS, NM	09430300	33 04 42	108 12 14	6,340.0	4.0	2,528	NA	peak streamflow	8/4/1963	2/9/1993	
GILA RIVER NEAR GILA, NM	09430500	33 03 40	108 32 12	4,654.8	1,864.0	1,192,960	500	daily streamflow	12/1/1927	9/30/2001	0
								peak streamflow	8/23/1928	8/6/1999	
								water quality samples	12/26/1959	11/25/1976	
MOGOLLON CREEK NEAR CLIFF, NM	09430600	33 10 00	108 38 57	5,440.0	69.0	44,160	none reported	daily streamflow	2/21/1967	9/30/2001	0
								peak streamflow	8/12/1967	8/5/1999	
								water quality samples	2/21/1967	1/10/1996	
DUCK CREEK AT CLIFF, NM	09430900	32 58 00	108 36 00	4,500.0	228.0	145,920	NA	peak streamflow	8/13/1957	8/19/1959	
GILA RIVER NEAR CLIFF, NM	09431000	32 56 20	108 36 20	4,454.5	2,438.0	1,560,320	NA	daily streamflow	1/1/1942	9/30/1951	0
								peak streamflow	9/12/1942	9/18/1970	
MANGAS CREEK NEAR CLIFF, NM	09431130	32 51 39	108 34 01	NA	NA		NA	peak streamflow	7/30/1989	8/5/1999	
GILA RIVER NEAR REDROCK, NM	09431500	32 43 37	108 40 30	4,090.0	2,829.0	1,810,560	5000	daily streamflow	10/1/1930	9/30/2001	2557
								peak streamflow	11/26/1905	8/5/1999	
								water quality samples	7/19/1967	8/22/2001	
GILA RIVER BELOW BLUE CREEK, NEAR VIRDEN NM	09432000	32 38 53	108 50 43	3,875.0	3,203.0	2,049,920	6200	daily streamflow	7/1/1927	9/30/2001	153
								peak streamflow	9/22/1997	8/6/1999	
								water quality samples	3/25/1987	6/5/2001	
Hidalgo County, New Mexico											
DEER CREEK TRIB. NR. ANTELOPE WELLS, NM	08479300	31 23 00	108 42 15	5,170.0	4.3	2,752	NA	peak streamflow	8/21/1959	9/12/1994	
SUNSET CANAL NR VIRDEN, NM	09433000	32 39 20	108 56 00	NA	NA		NA	daily streamflow	10/1/1960	12/31/1967	0
NEW MODEL CA NR VIRDEN, NM	09436000	32 40 30	108 59 30	NA	NA		NA	daily streamflow	10/1/1960	12/31/1967	0
ANIMAS CREEK NR. CLOVERDALE, NM	09438200	31 34 15	108 52 30	5,020.0	157.0	100,480	NA	peak streamflow	unknown 1959	7/29/1960	
STEINS CREEK AT STEINS, NM	09455800	32 13 47	109 00 01	4,300.0	1.3	806	NA	peak streamflow	unknown 1959	7/23/1999	
GILA RIVER NR VIRDEN, NM	323922108571901	32 39 22	108 57 19	3,760.0	NA		NA	water quality samples	8/12/1993	8/12/1993	
Luna County, New Mexico											
MIMBRES RIVER NEAR FAYWOOD, NM	08477500	32 35 10	107 55 10	5,033.0	440.0	281,600	1750	daily streamflow	10/1/1930	9/30/1968	2983
								peak streamflow	8/10/1931	8/6/1968	
MIMBRES R NR SPALDING, NM	08477530	32 27 55	107 56 50	4,749.8	472.0	302,080	NA	daily streamflow	10/1/1963	9/30/1968	0
								peak streamflow	7/26/1964	8/12/1968	
WAMEL CANAL AT HEAD NR DEMING, NM	08478300	32 18 05	107 53 45	NA	NA		NA	daily streamflow	10/1/1963	9/30/1968	0
MIMBRES R BL WAMEL CA NR DEMING, NM	08478400	32 18 05	107 53 45	4,468.9	1,101.0	704,640	NA	daily streamflow	10/1/1963	9/30/1968	0
								peak streamflow	12/23/1965	8/13/1967	
MIMBRES RIVER AT DEMING, NM	08478500	32 17 00	107 45 35	4,330.0	1,370.0	876,800	NA	peak streamflow	8/7/1954	8/5/1999	
MIMBRES BASIN TRIB. NR. FLORIDA, NM	08478600	32 21 25	107 37 35	4,410.0	0.6	352	NA	peak streamflow	unknown 1959	unknown 1994	
SEVENTYSIX DRAW TRIB NEAR WATERLOO, NM	08478800	31 56 34	107 44 38	4,190.0	0.2	128	NA	peak streamflow	8/4/1967	8/5/1999	

[a] Station is not active, unable to confirm irrigated acreage above gage.

[b] Station was moved at least 3 times, drainage area was 24 square miles (15,360 acres) before October 1, 1911.

NA = not available

Annual Water Yield
San Francisco River near Reserve



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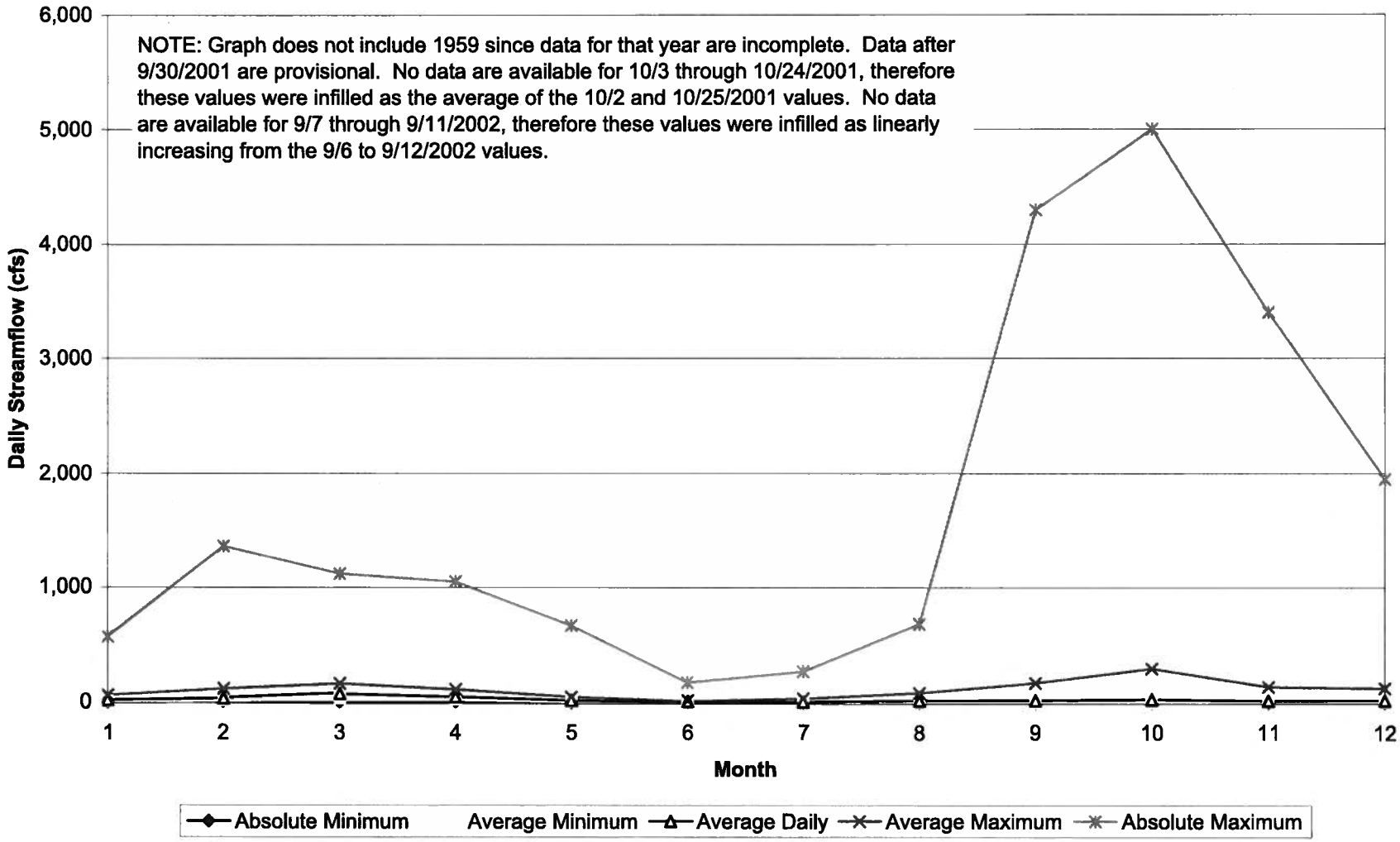
Daily Average Streamflow for Each Month, 1960 through 2002
San Francisco River near Reserve



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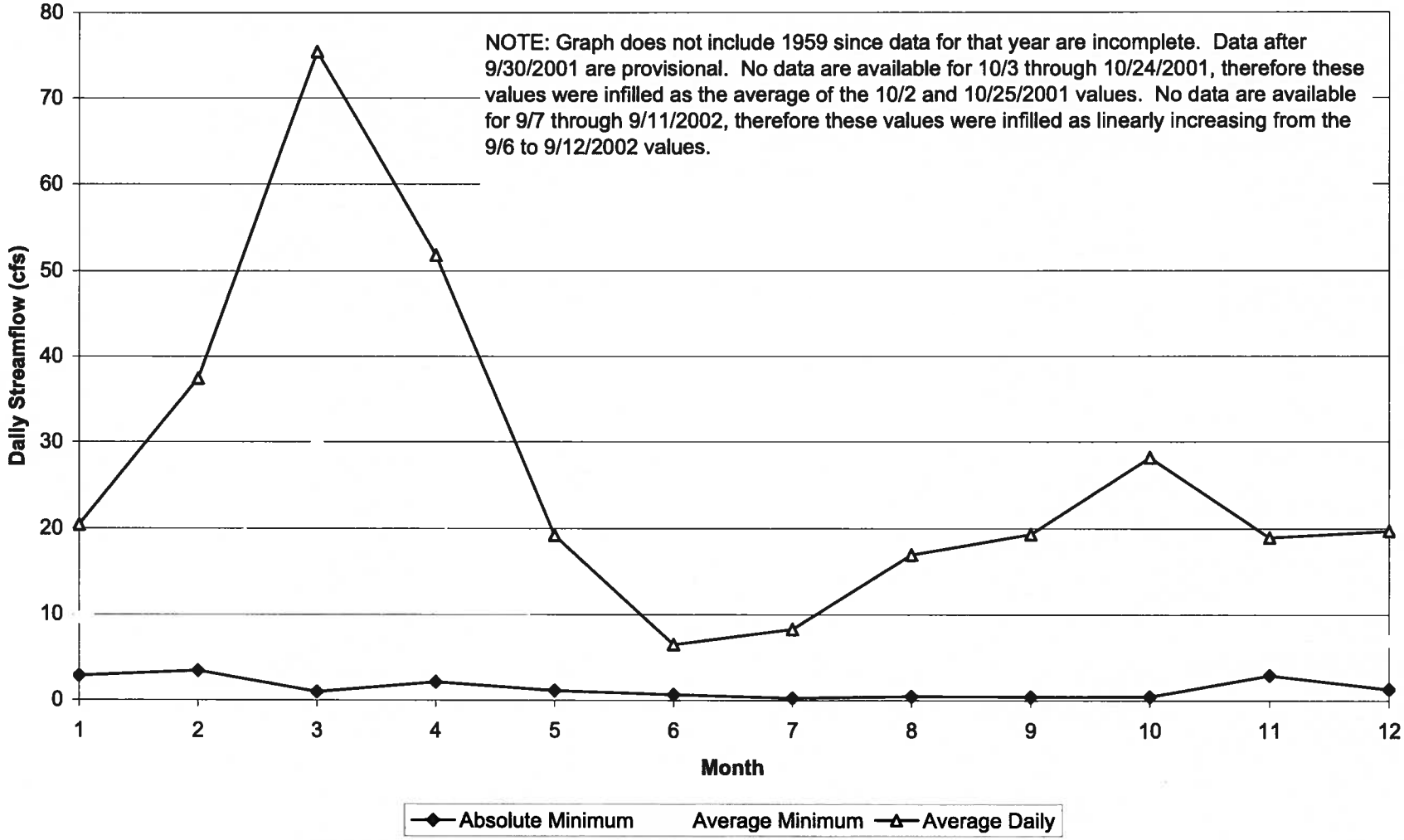
Daily Average Streamflow for Each Month, Excluding Maximums, 1960 through 2002
San Francisco River near Reserve



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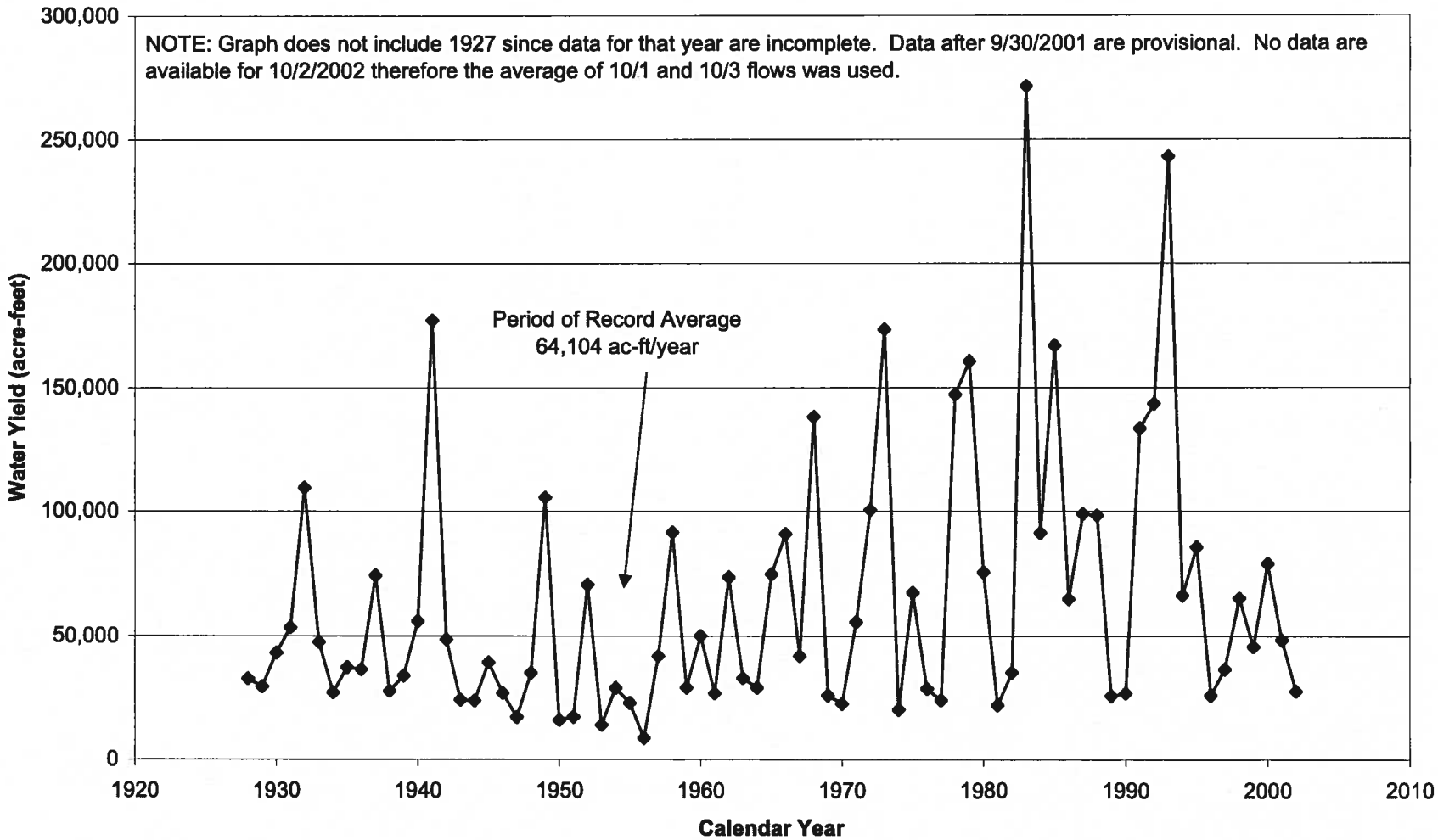
Annual Water Yield
San Francisco River near Glenwood



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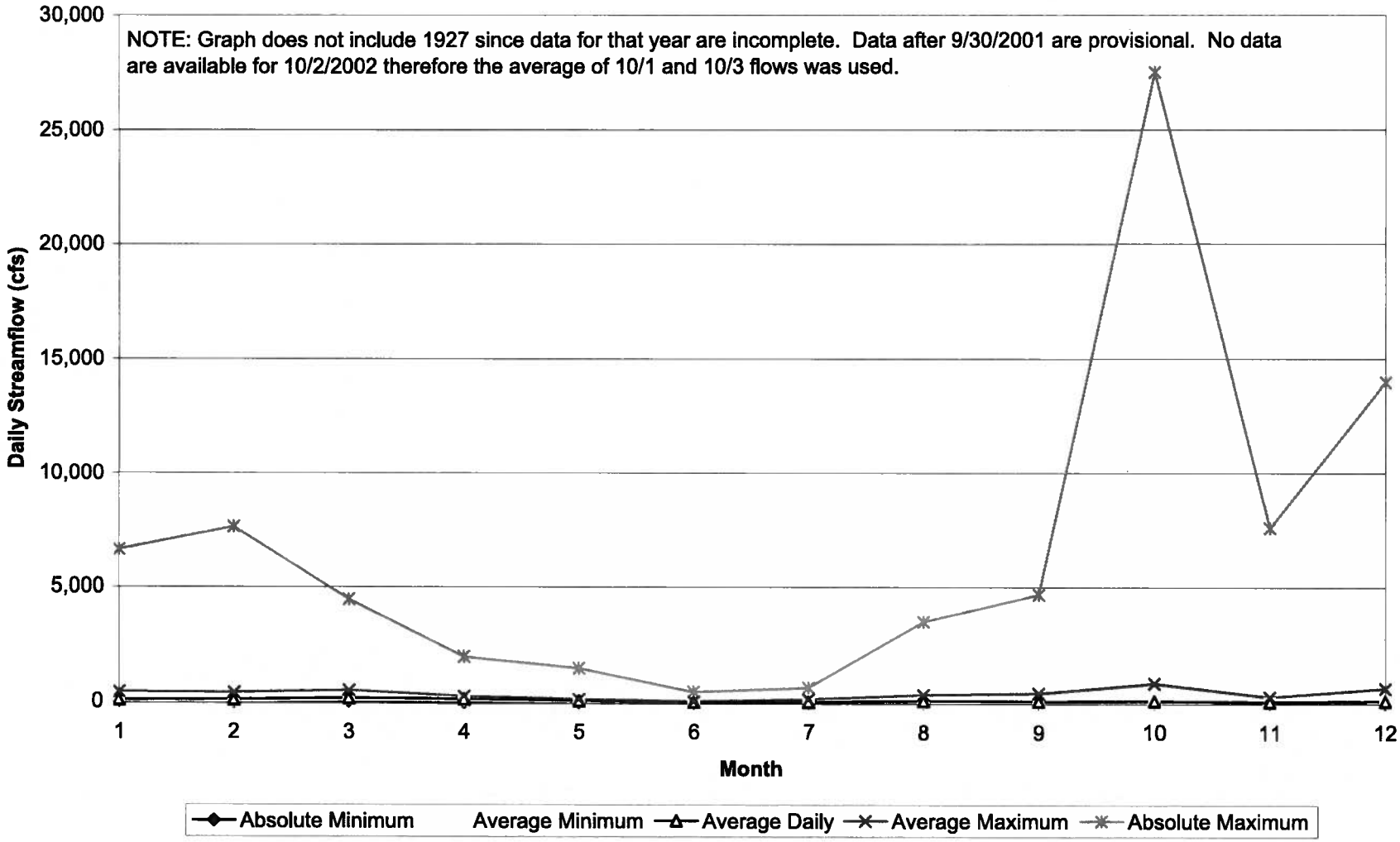
Daily Average Streamflow for Each Month, 1928 through 2002
San Francisco River near Glenwood



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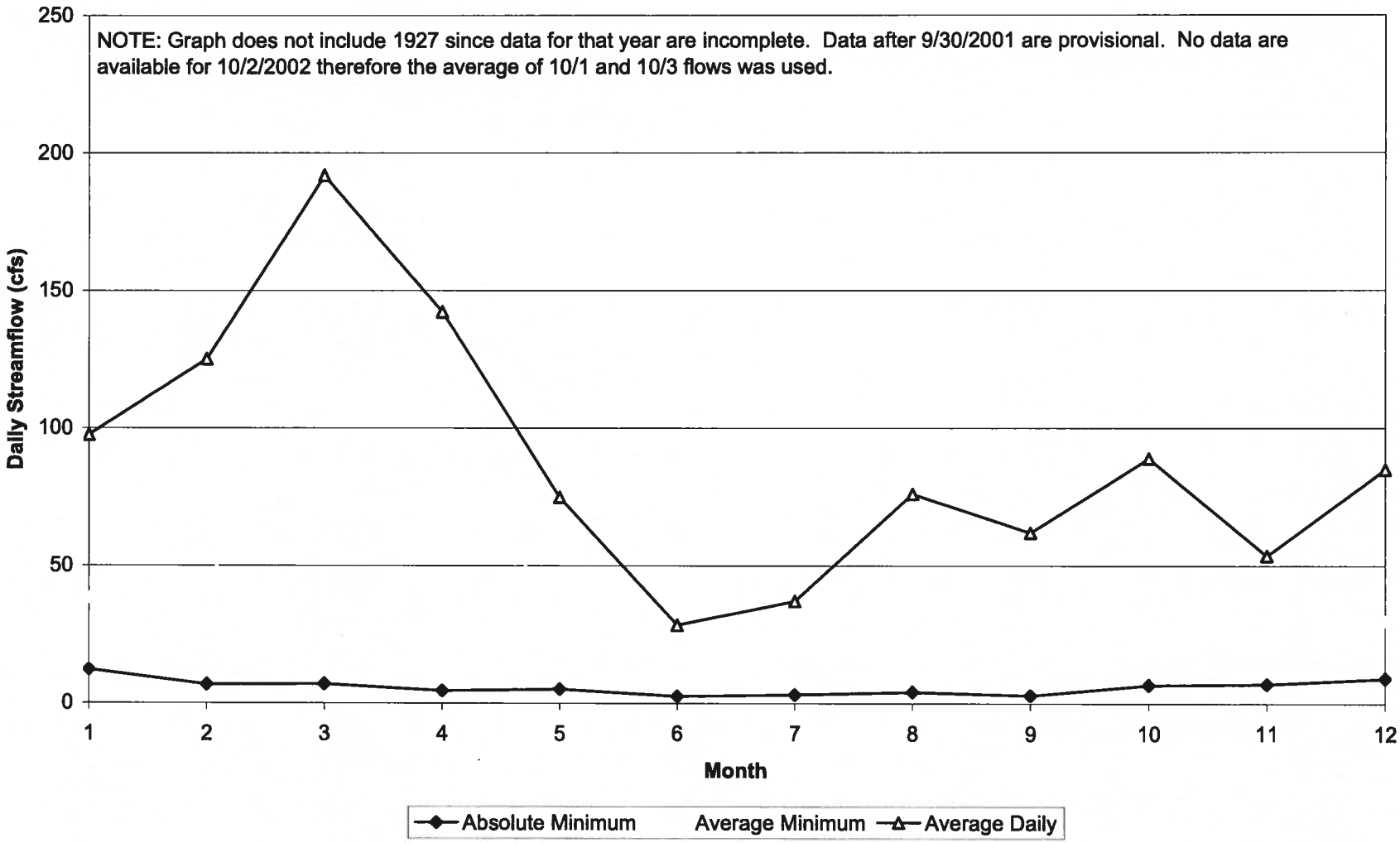
Daily Average Streamflow for Each Month, Excluding Maximums, 1928 through 2002
San Francisco River near Glenwood



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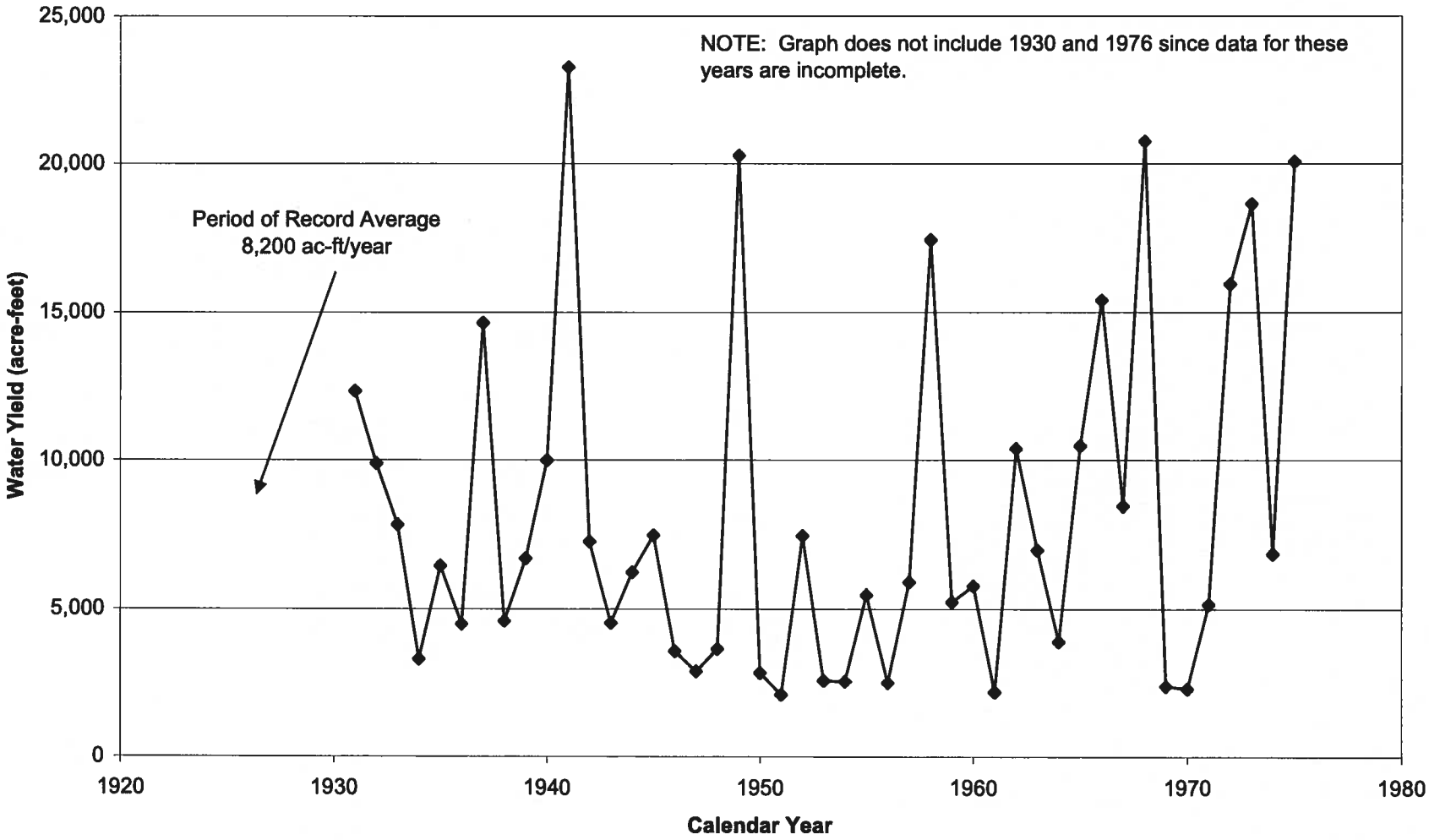
Annual Water Yield
Mimbres River near Mimbres



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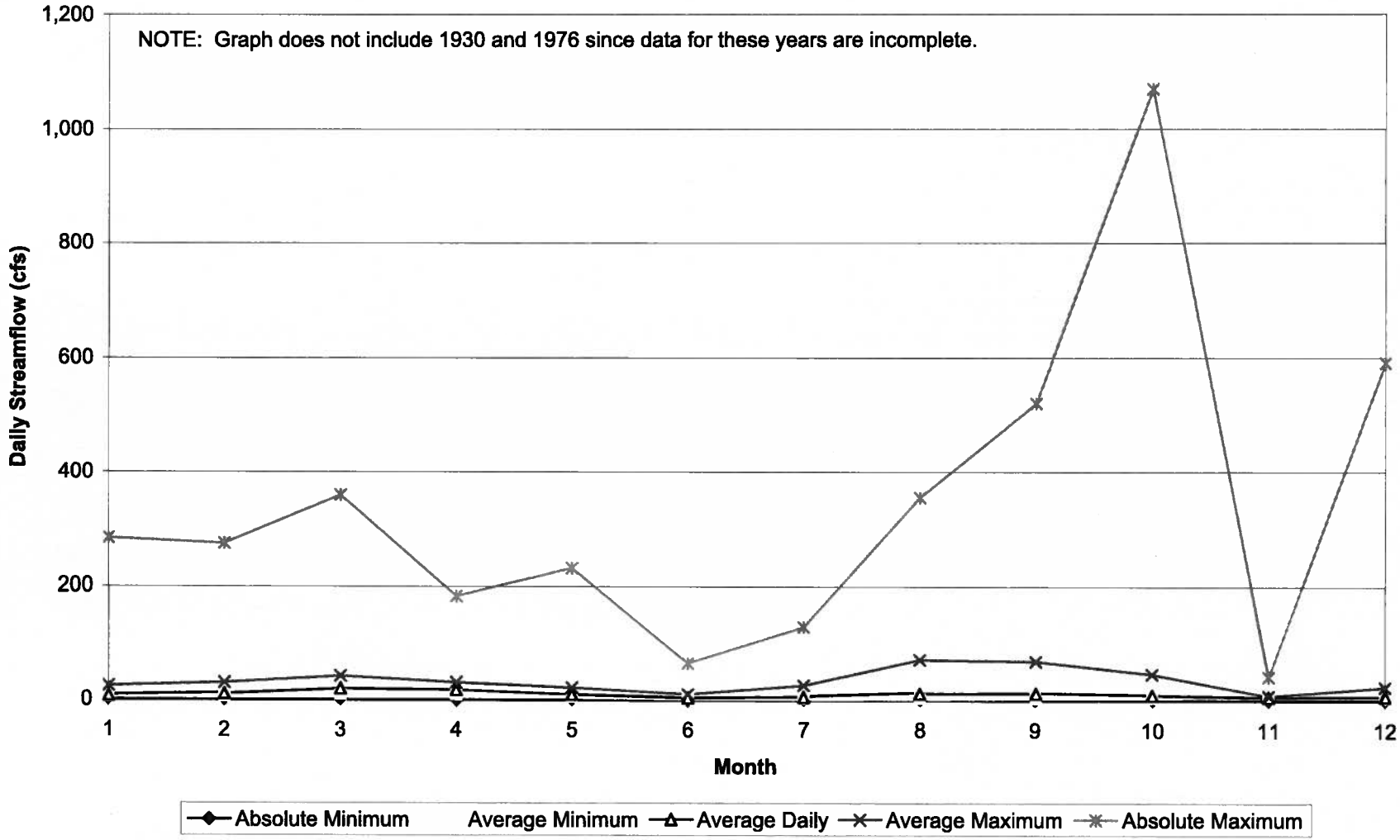
Daily Average Streamflow for Each Month, 1931 through 1975
Mimbres River near Mimbres



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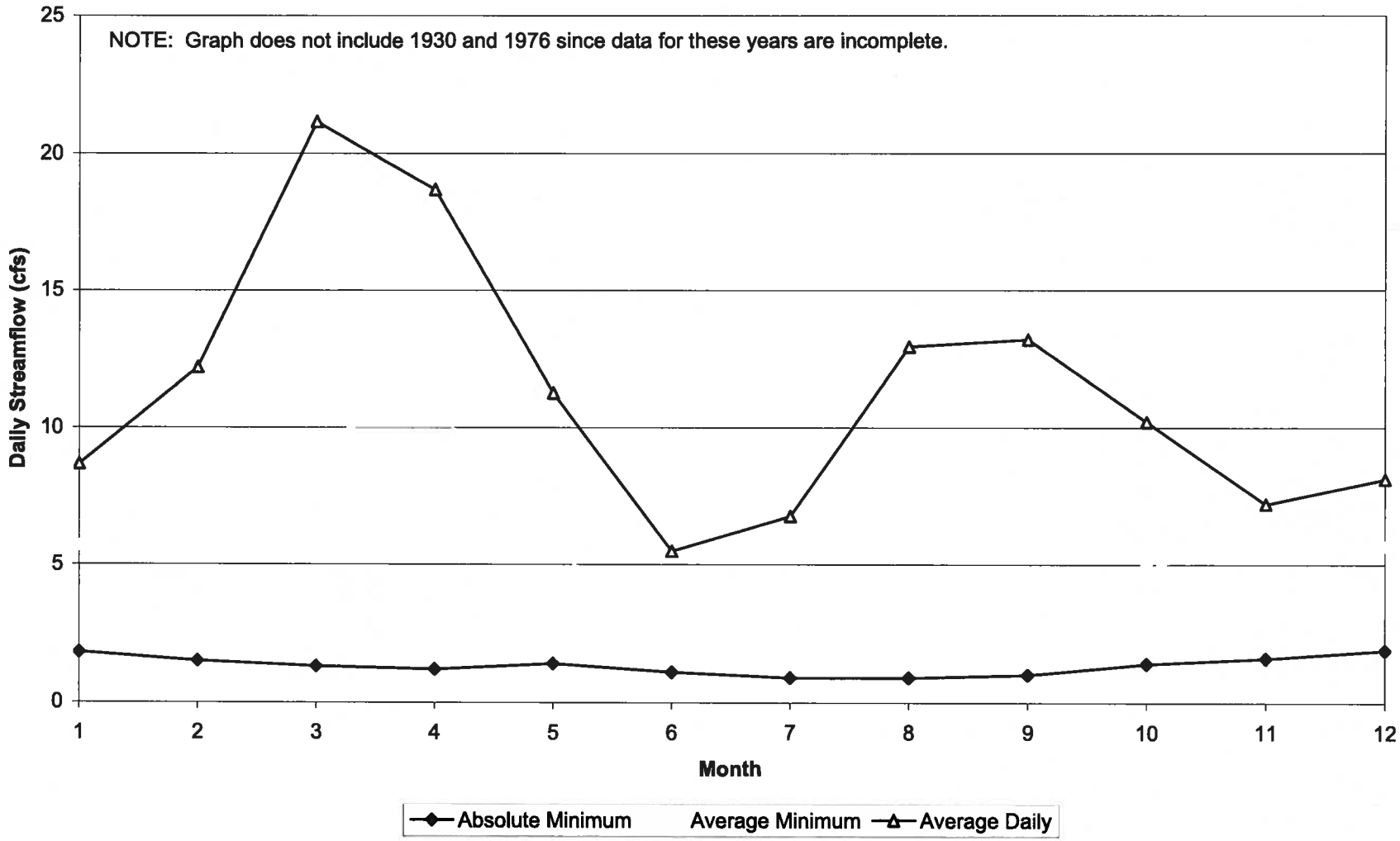
Mimbres River near Mimbres



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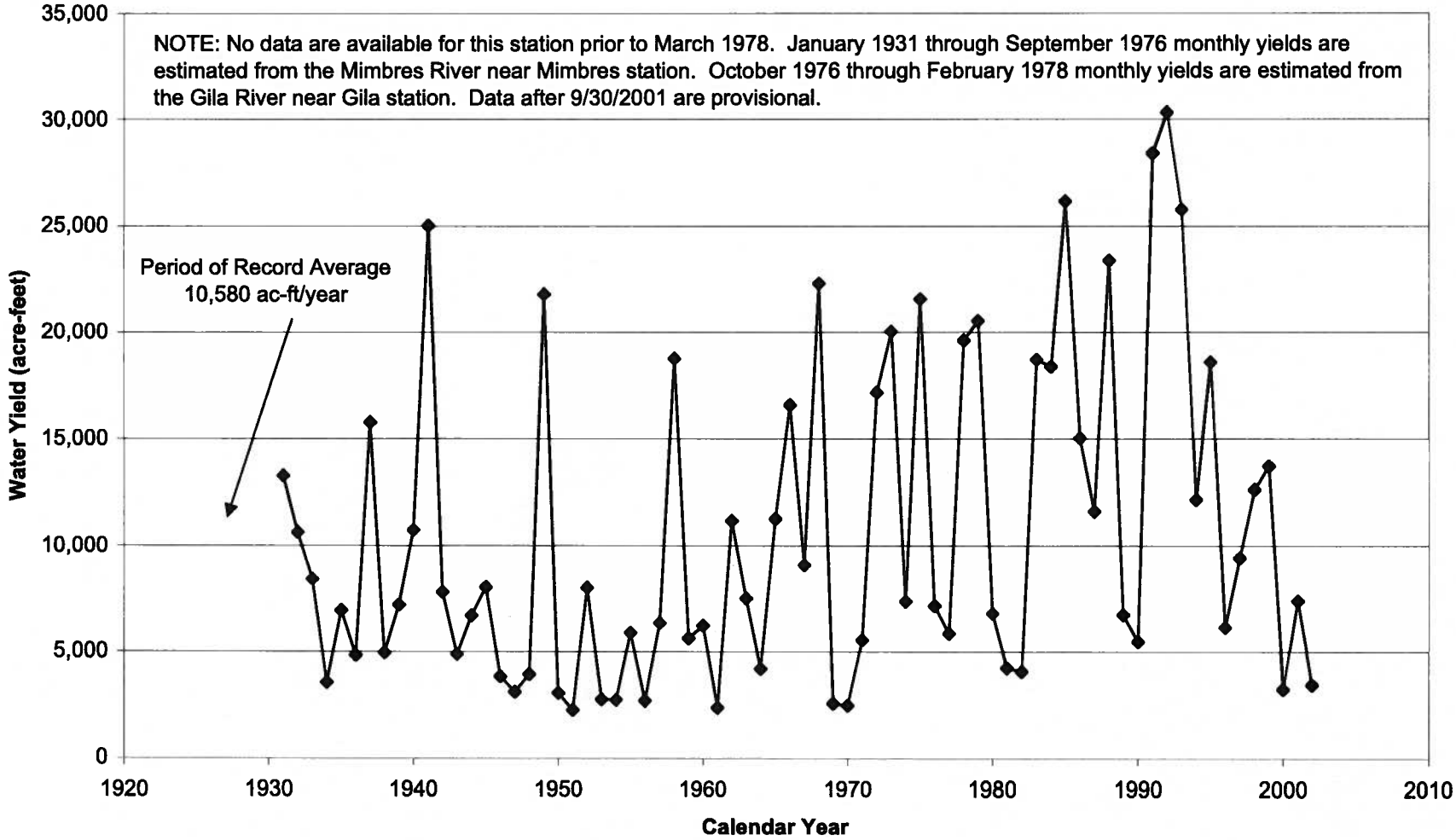
Annual Water Yield
Mimbres River at Mimbres



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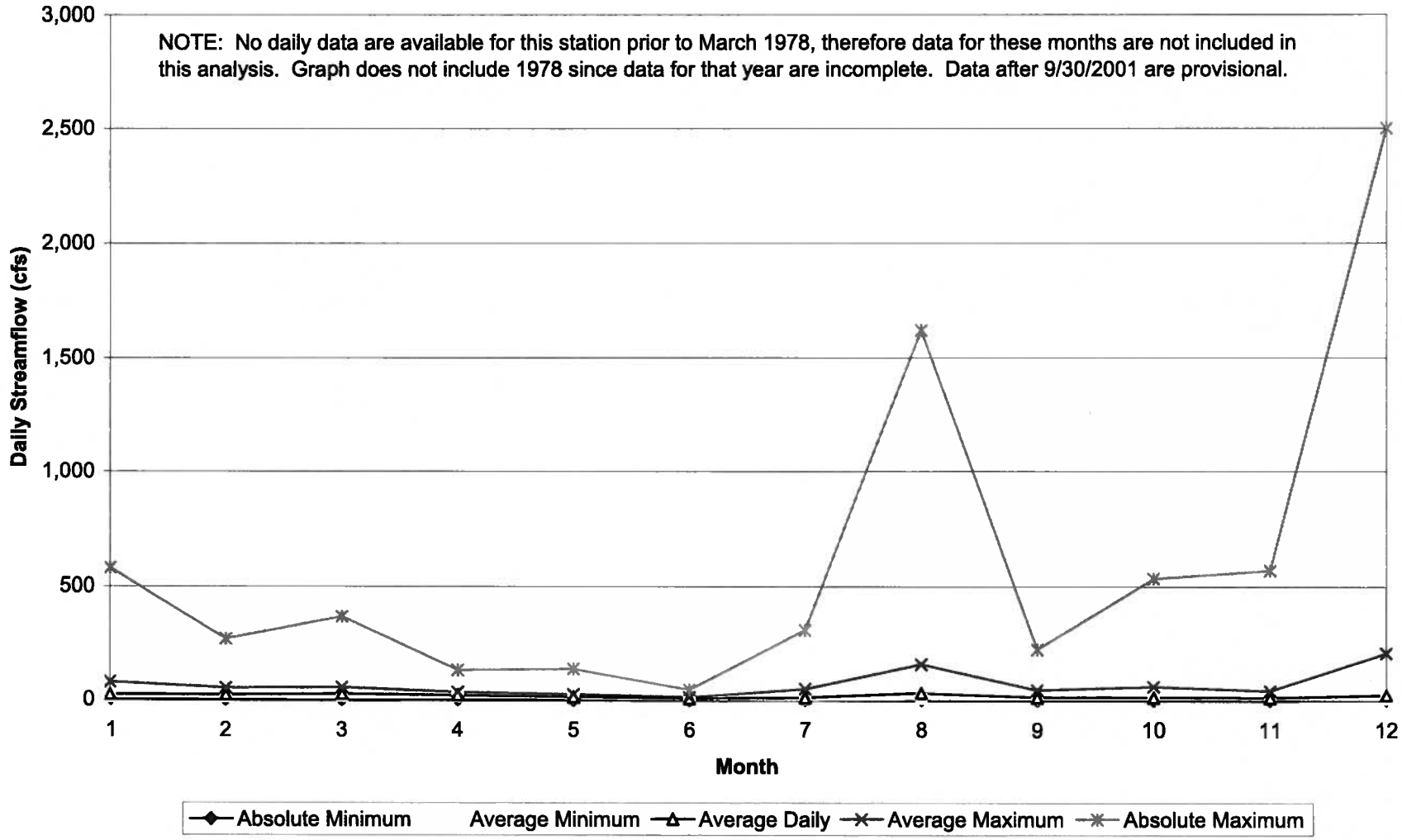
Daily Average Streamflow for Each Month, 1979 through 2002
Mimbres River at Mimbres



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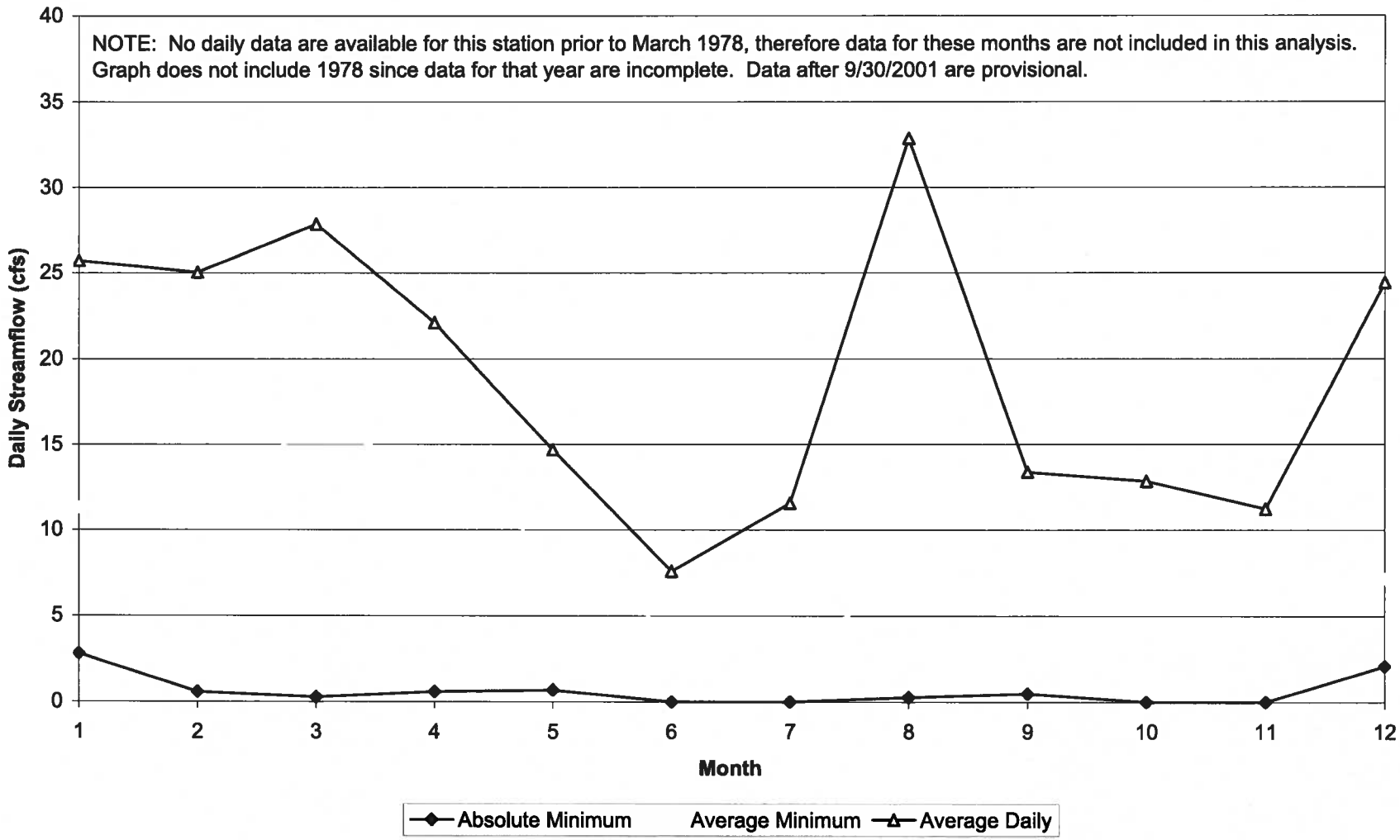
Daily Average Streamflow for Each Month, Excluding Maximums, 1979 through 2002
Mimbres River at Mimbres



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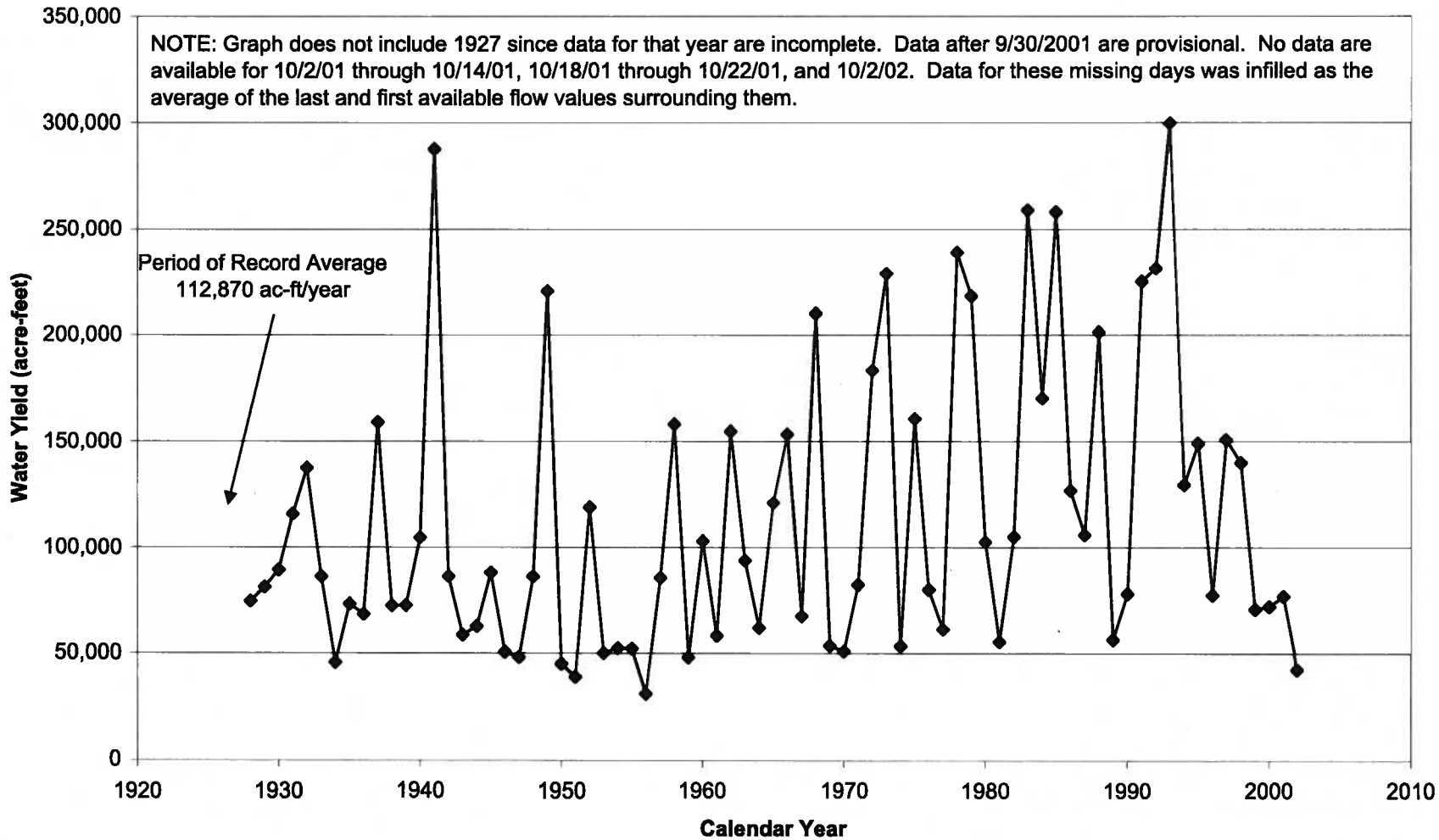
Annual Water Yield
Gila River near Gila



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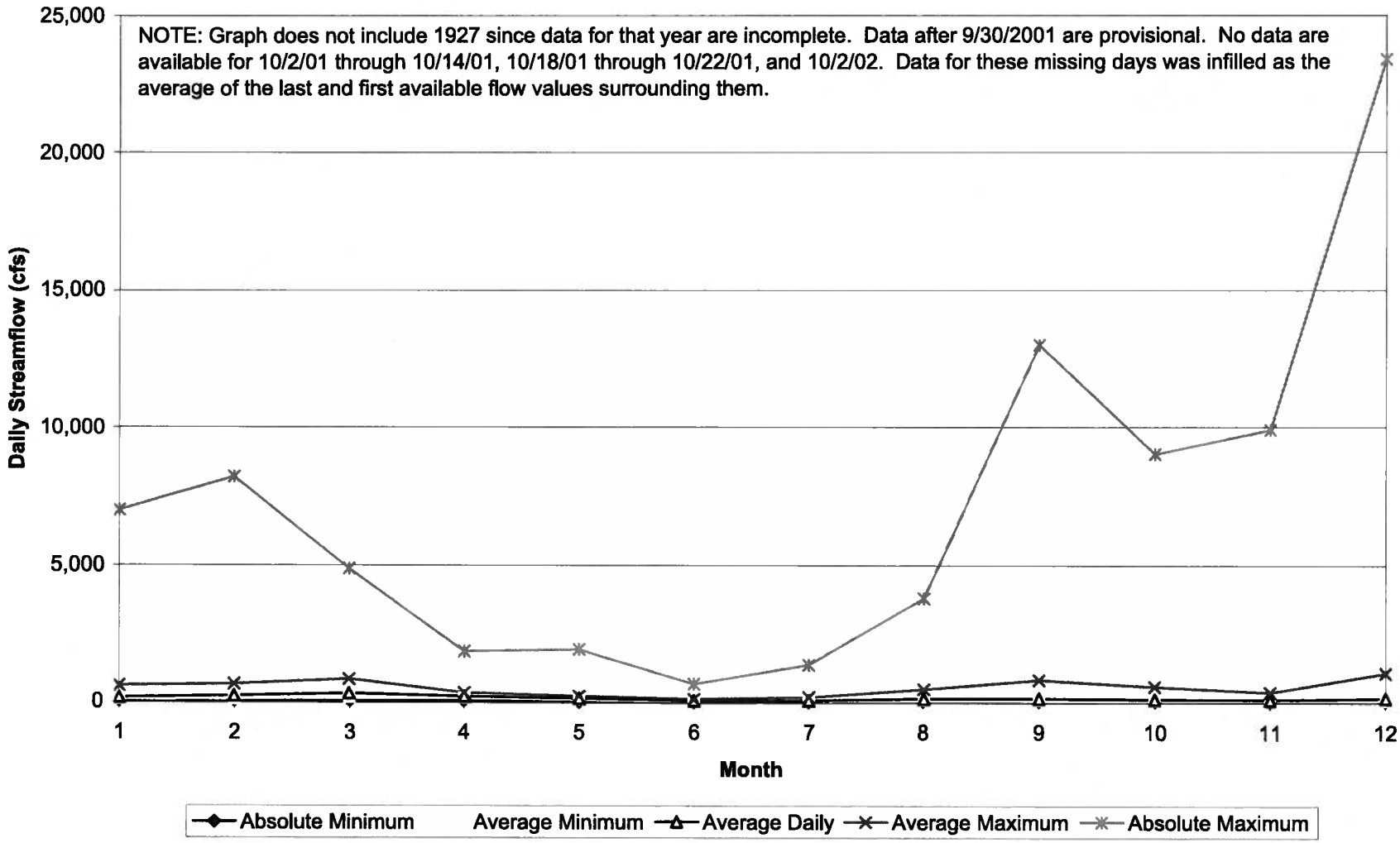
Daily Average Streamflow for Each Month, 1928 through 2002
Gila River near Gila



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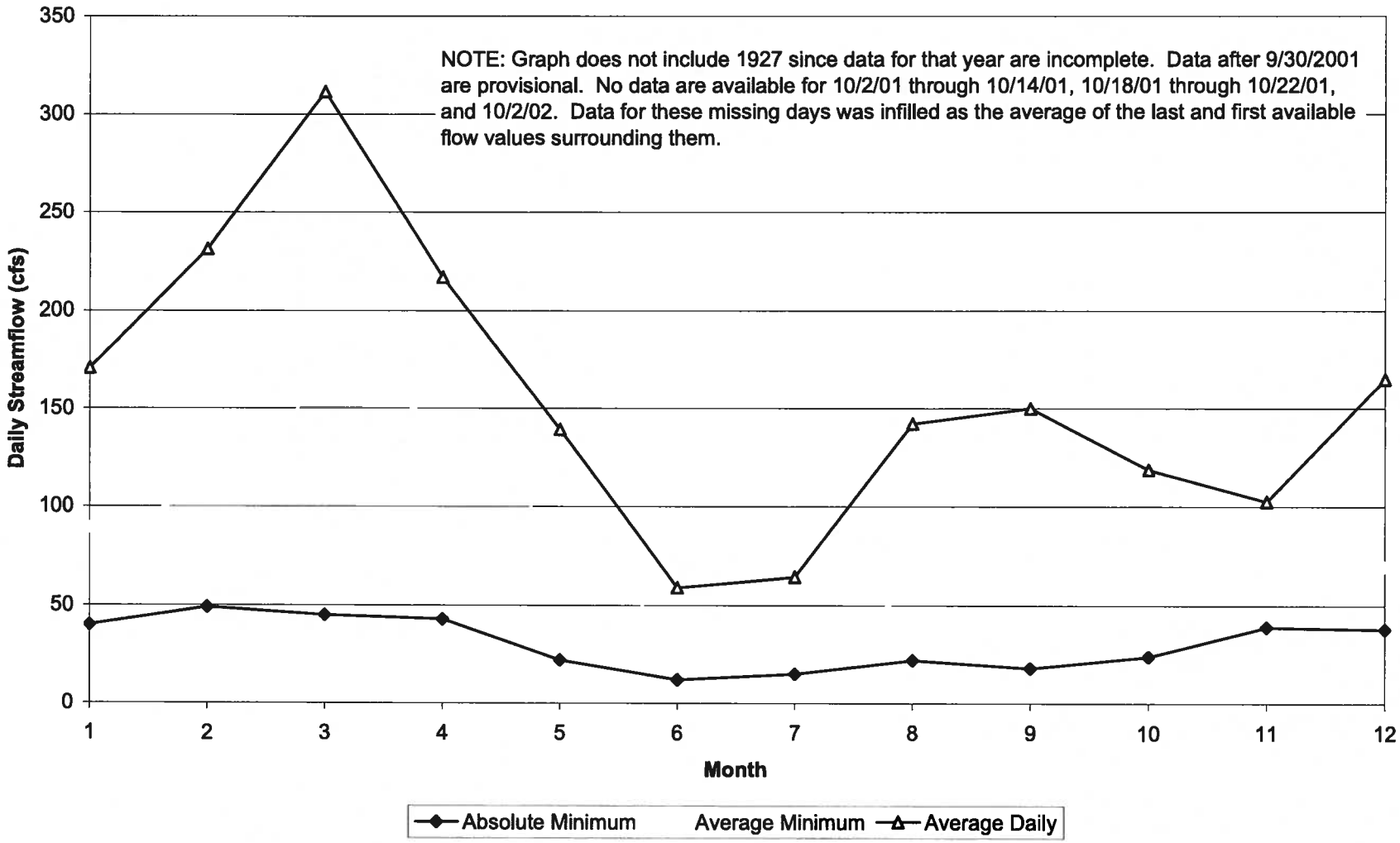
Daily Average Streamflow for Each Month, Excluding Maximums, 1928 through 2002
Gila River near Gila



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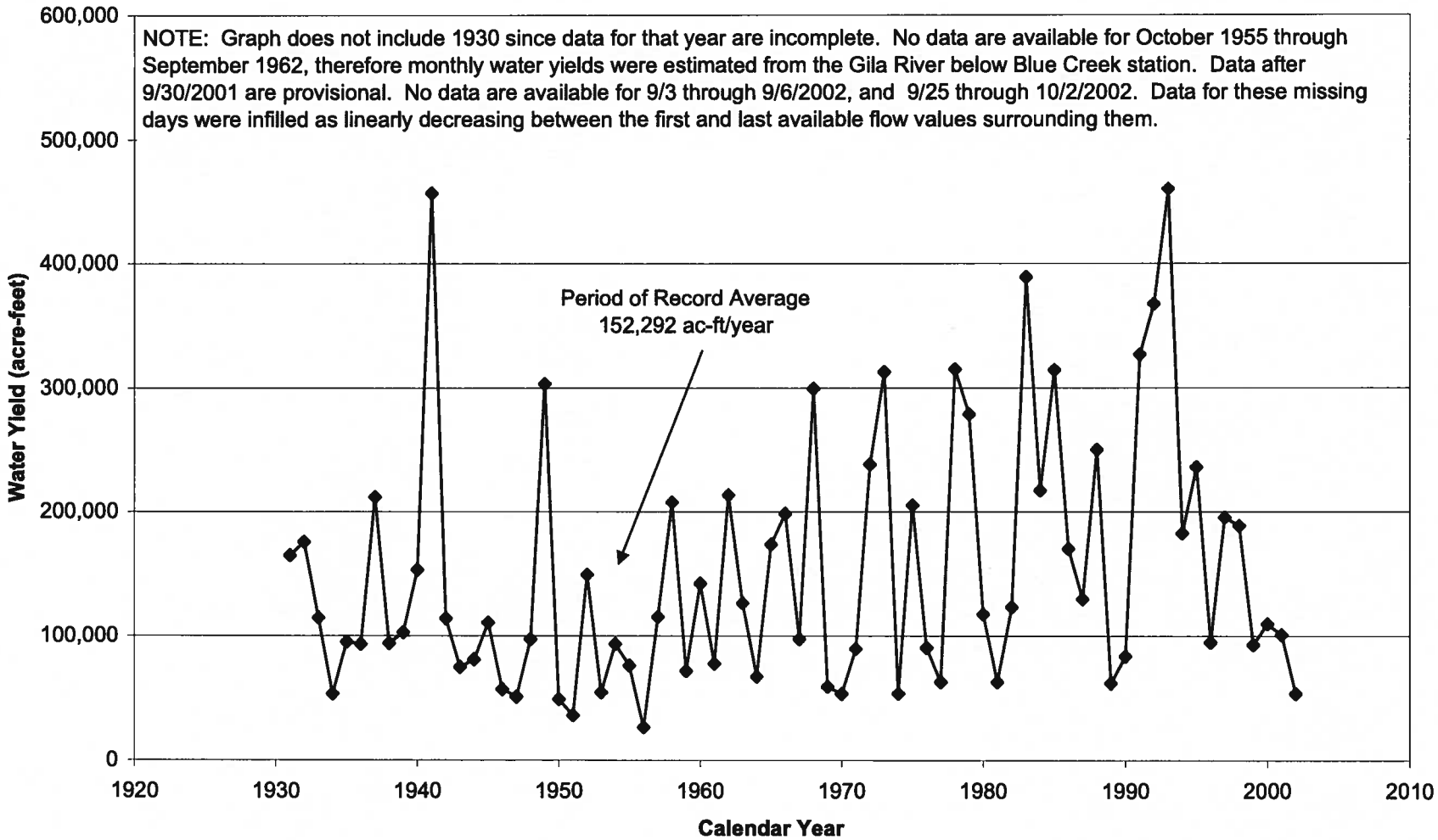
Annual Water Yield
Gila River near Redrock



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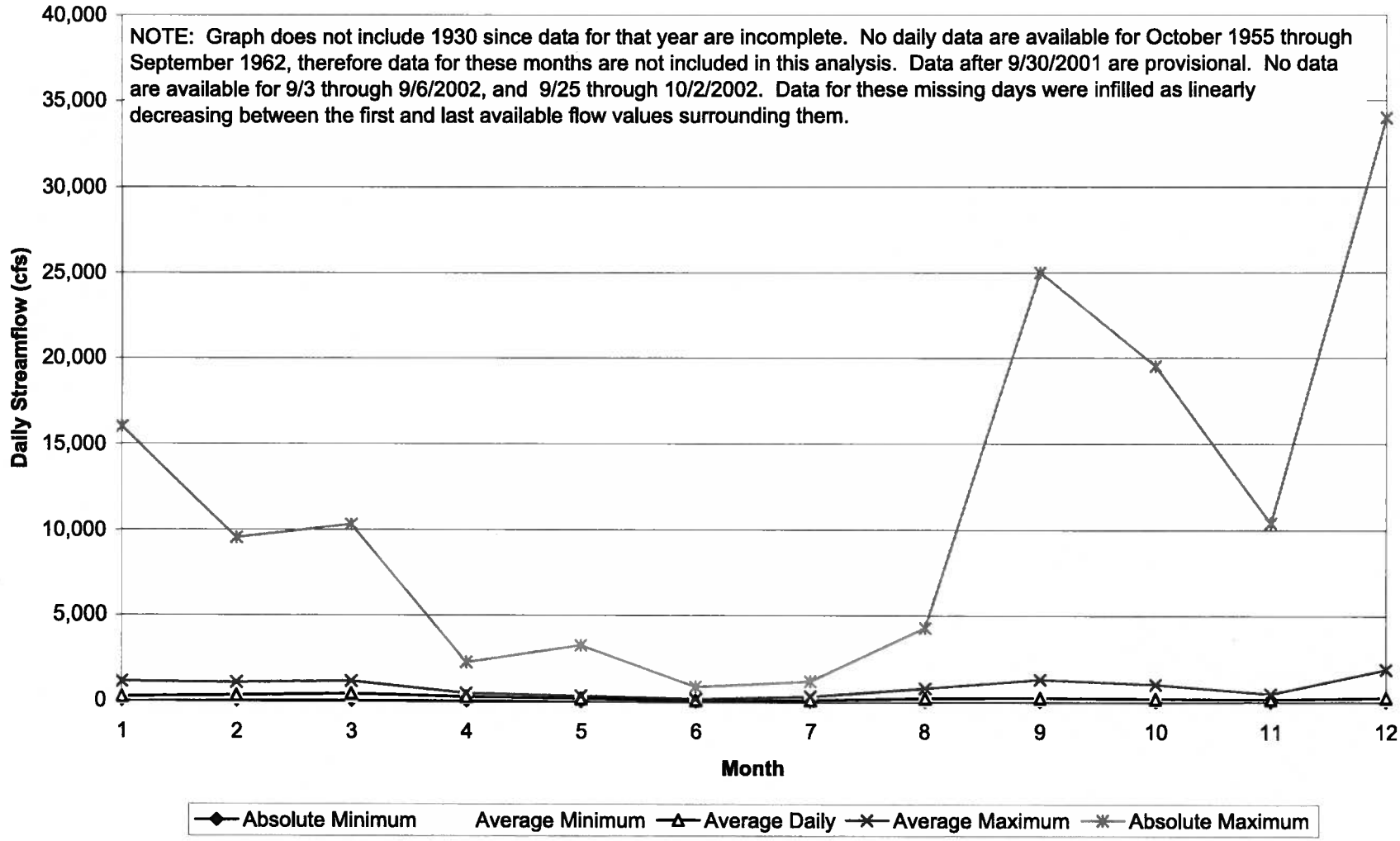
Daily Average Streamflow for Each Month, 1931 through 2002
Gila River near Redrock



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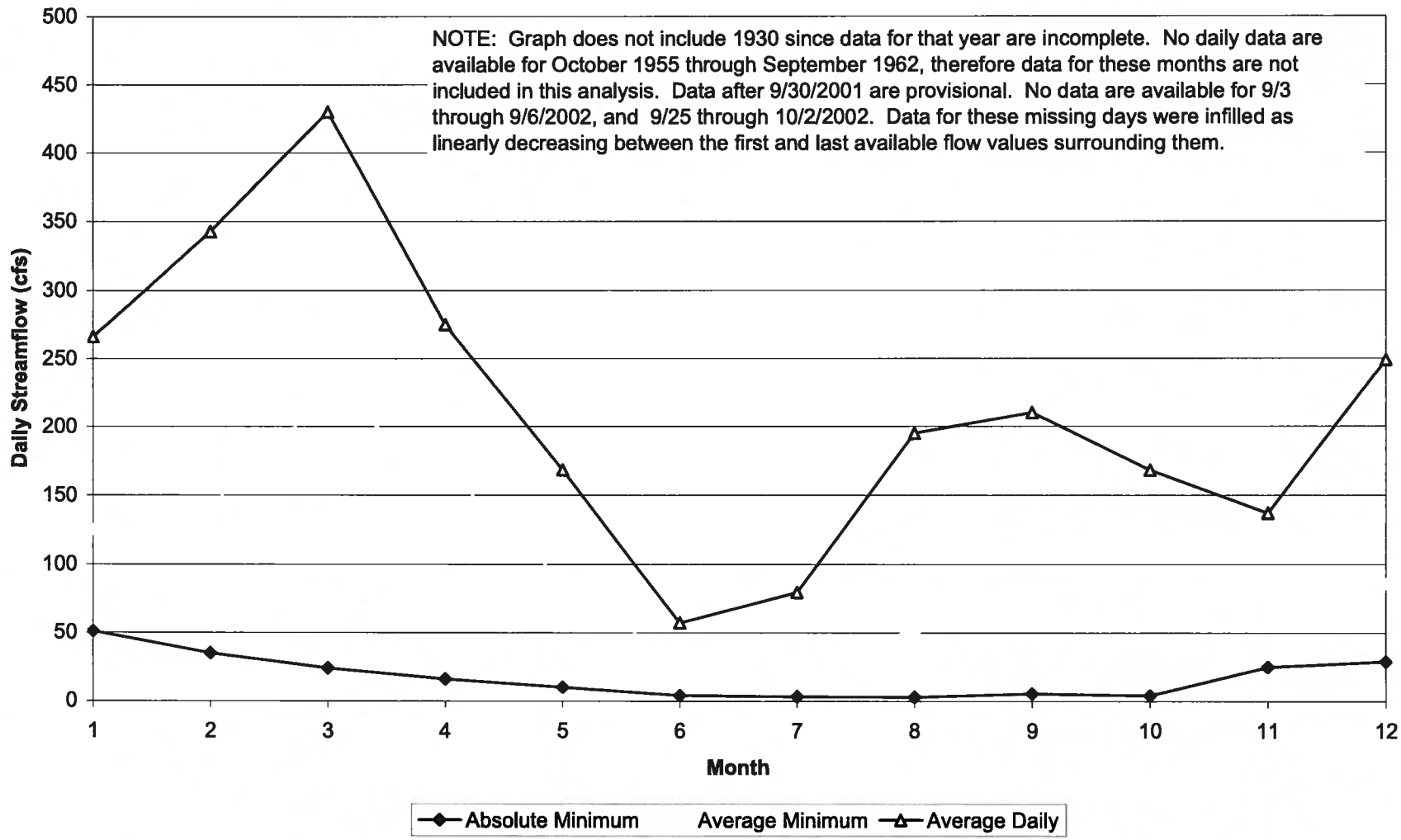
Daily Average Streamflow for Each Month, Excluding Maximums, 1931 through 2002
Gila River near Redrock



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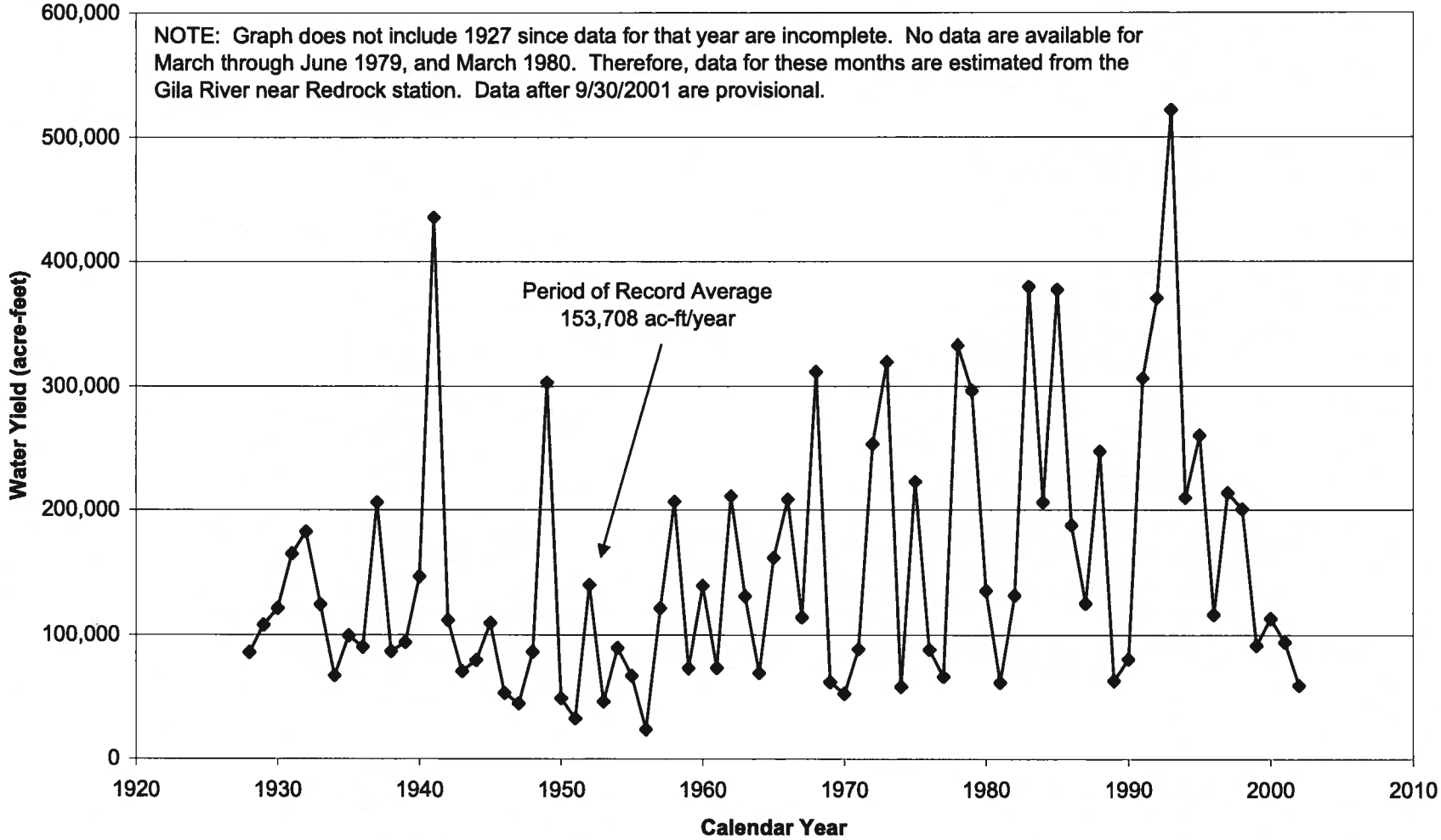
Annual Water Yield
Gila River below Blue Creek near Virden



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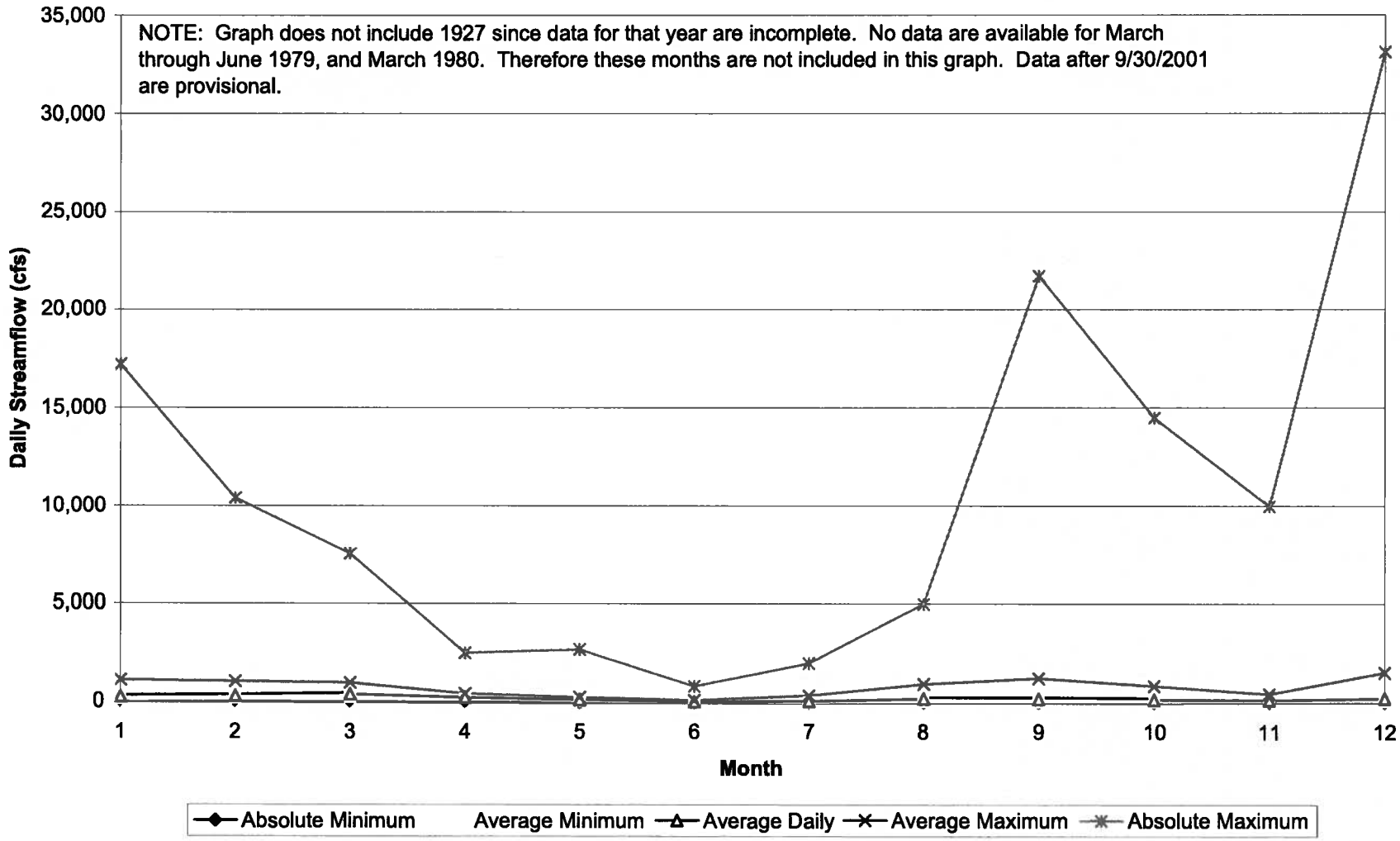
Daily Average Streamflow for Each Month, 1928 through 2002
Gila River below Blue Creek near Virden



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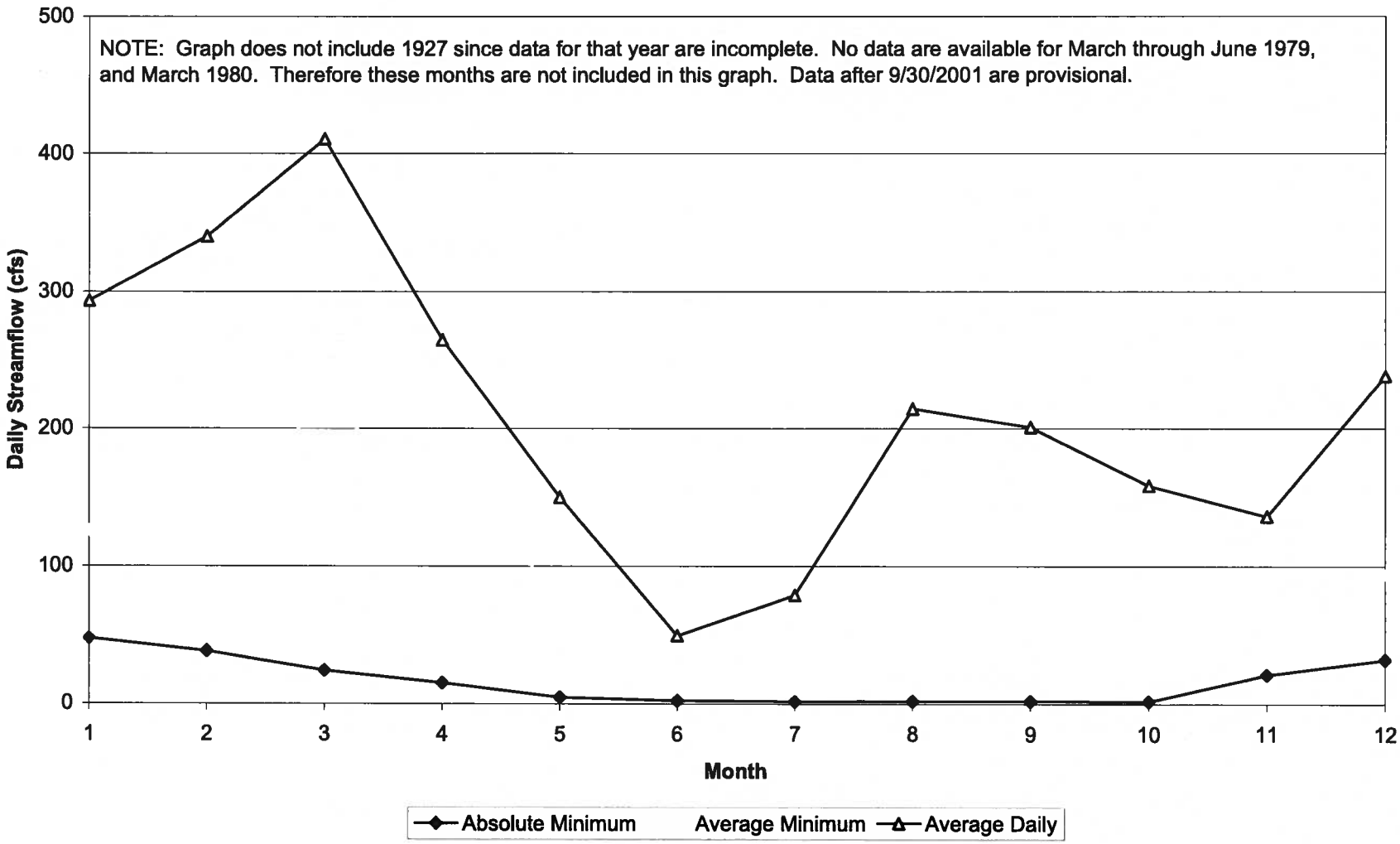
Daily Average Streamflow for Each Month, Excluding Maximums, 1928 through 2002
Gila River below Blue Creek near Virden



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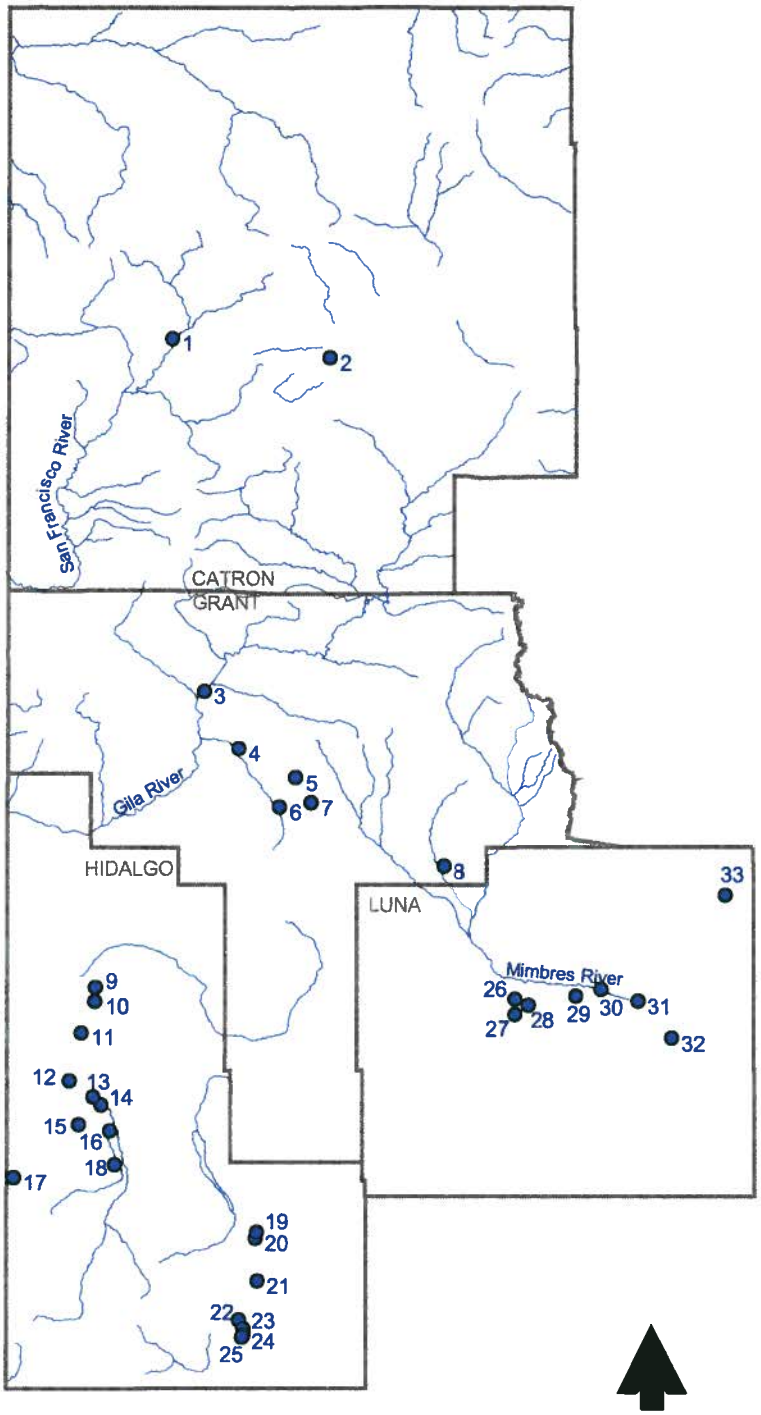
Appendix D4

Groundwater Hydrographs



N

0 15 30 Miles

Explanation

- Hydrograph well
- Stream
- County

SOUTHWEST NEW MEXICO REGIONAL WATER PLAN

Hydrograph Wells

Daniel B. Stephens & Associates, Inc.

8-20-03 11:18AM

JN WR03.0004

(S:\PROJECTS\WR03.0004\GIS\PROJECTS (PROJECT = sw_regional_water_plan_0703.apr) (VIEW EXTENTS = TEMP) (VIEW NAME = V10 - H) (LAYOUT = L10 - H 300280)

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334516108173902	2	033 45 16	108 17 39	basin fill	Catron
325812108351901	3	032 58 12	108 35 19	basin fill	Grant
325008108302501	4	032 50 08	108 30 25	basin fill	Grant
324600108222501	5	032 46 00	108 22 25	gila	Grant
324153108243801	6	032 41 53	108 24 38	gila	Grant
324231108201401	7	032 42 31	108 20 14	gila	Grant
323332108013501	8	032 33 32	108 01 35	basin fill	Grant
321624108504001	9	032 16 24	108 50 40	basin fill	Hidalgo
321423108504301	10	032 14 23	108 50 43	basin fill	Hidalgo
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314154108275101	19	031 41 58	108 27 52	basin fill	Hidalgo
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313502108275001	21	031 35 02	108 27 50	basin fill	Hidalgo
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321236107513601	27	032 12 36	107 51 36	basin fill	Luna
321352107493901	28	032 13 52	107 49 39	basin fill	Luna
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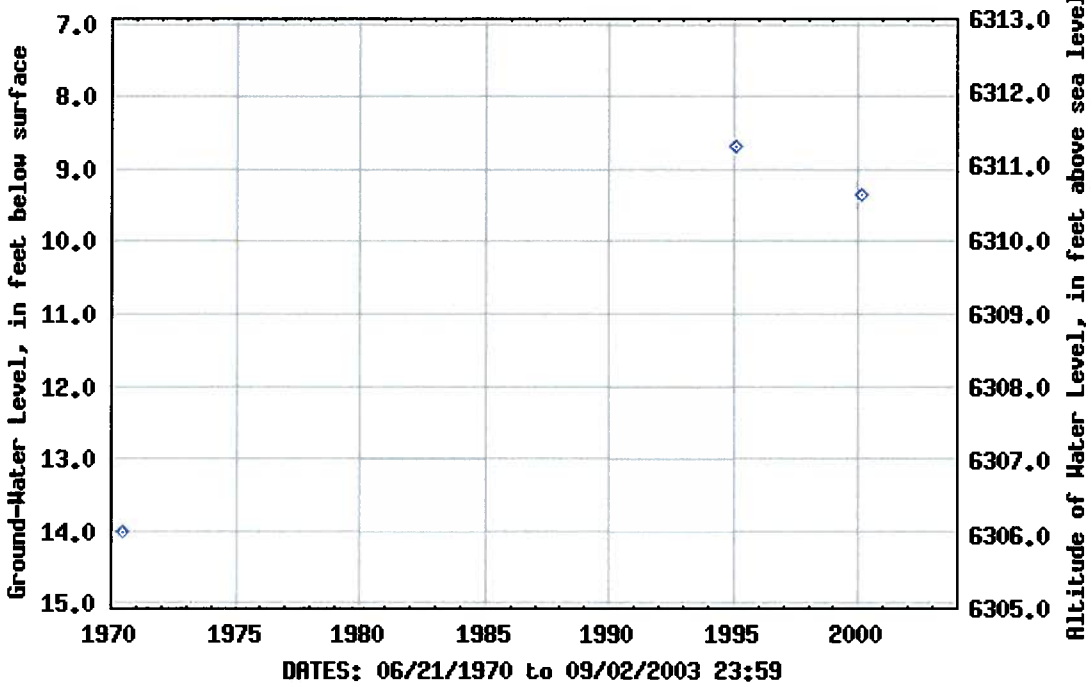

Provisional Data Subject to Revision

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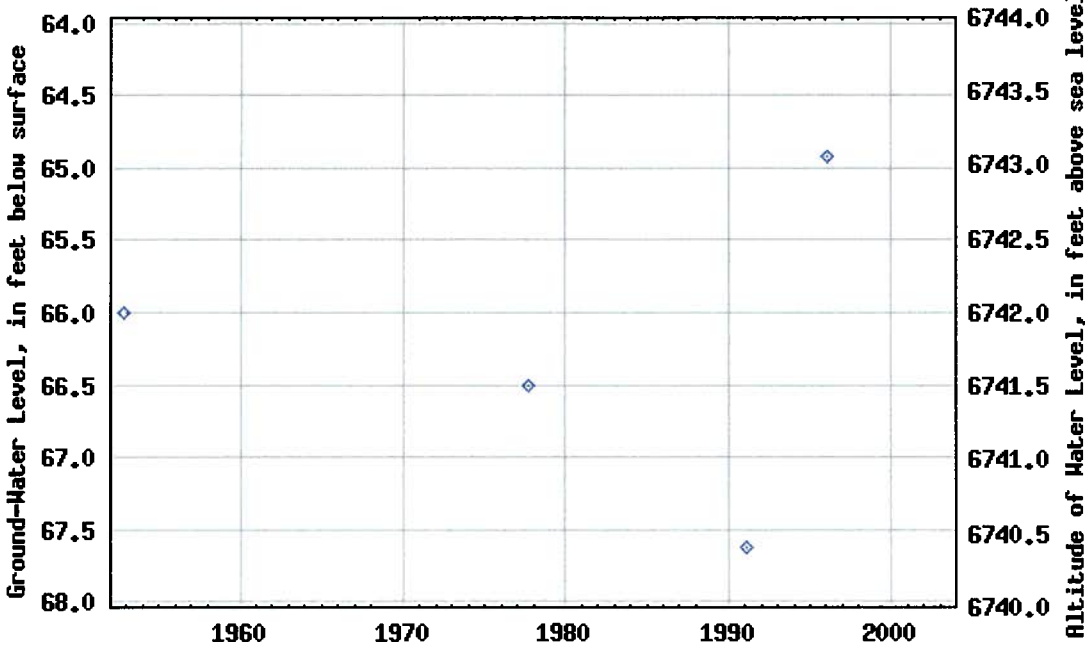

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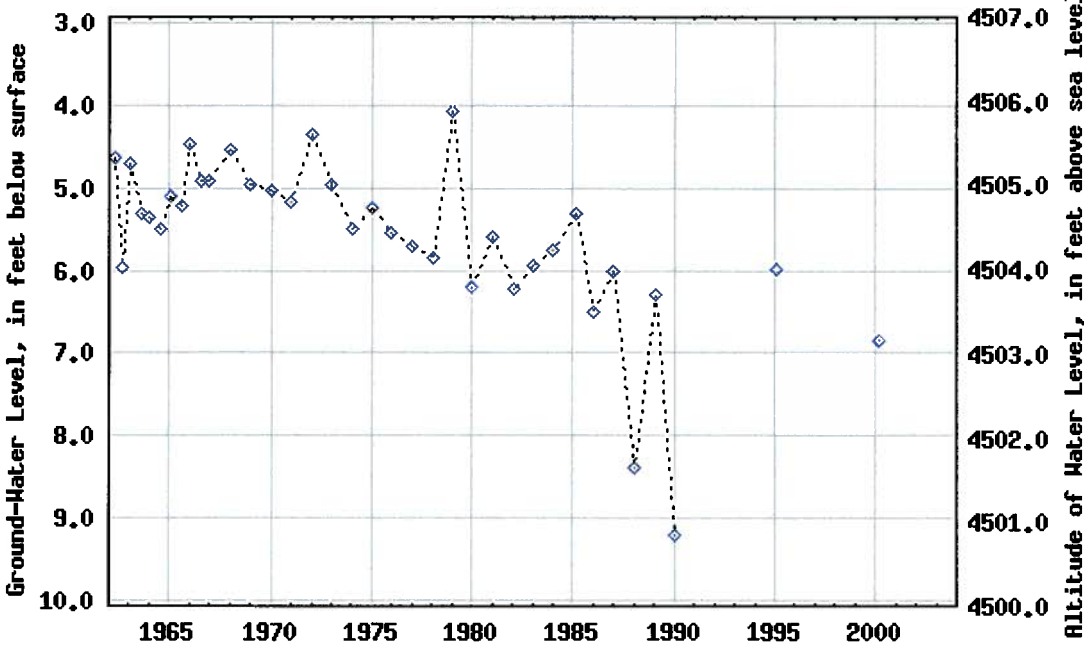

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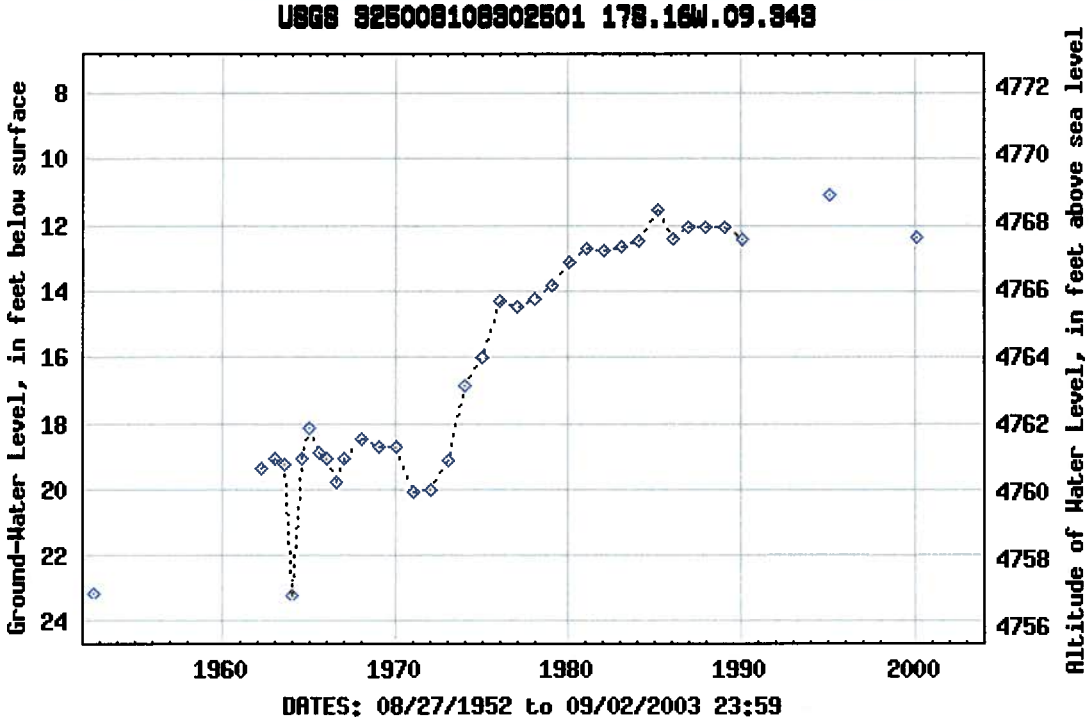

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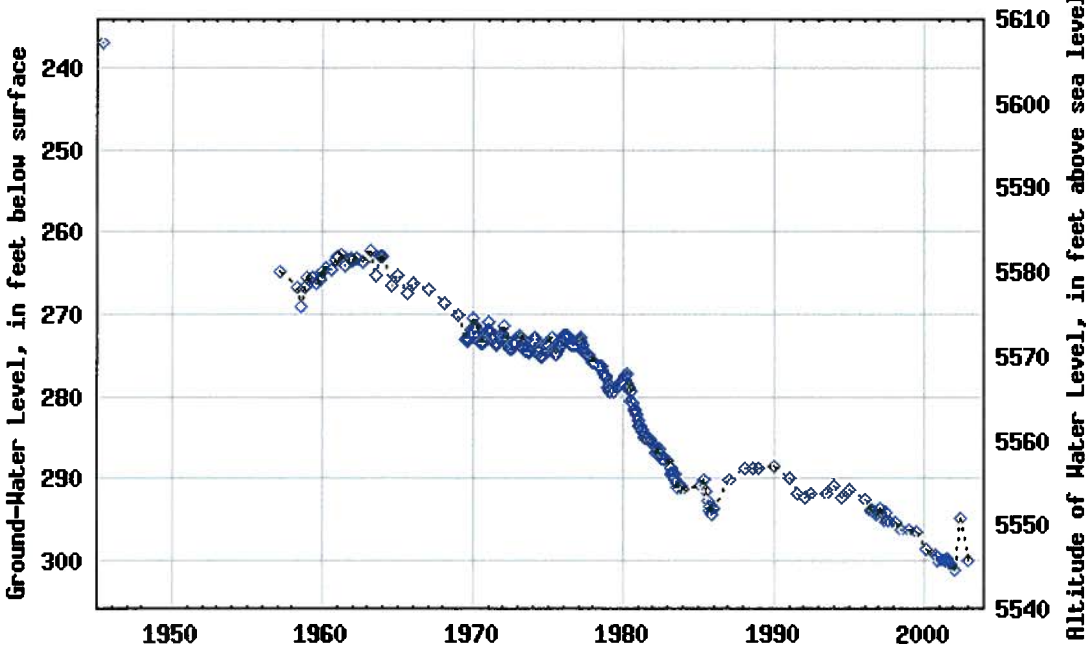

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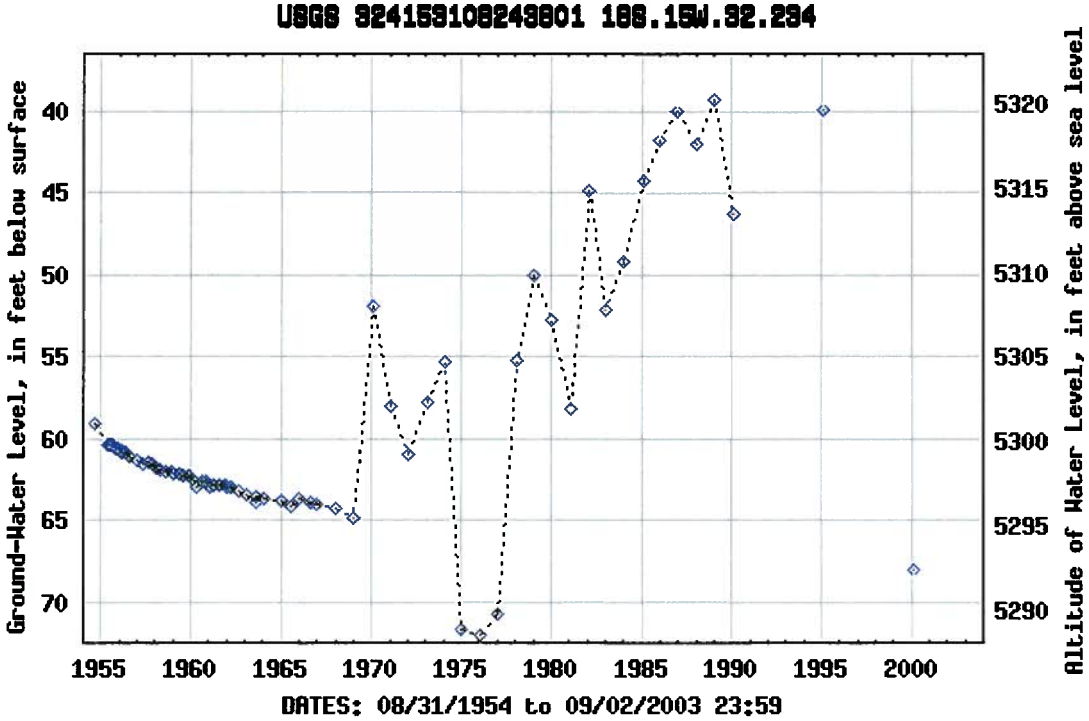

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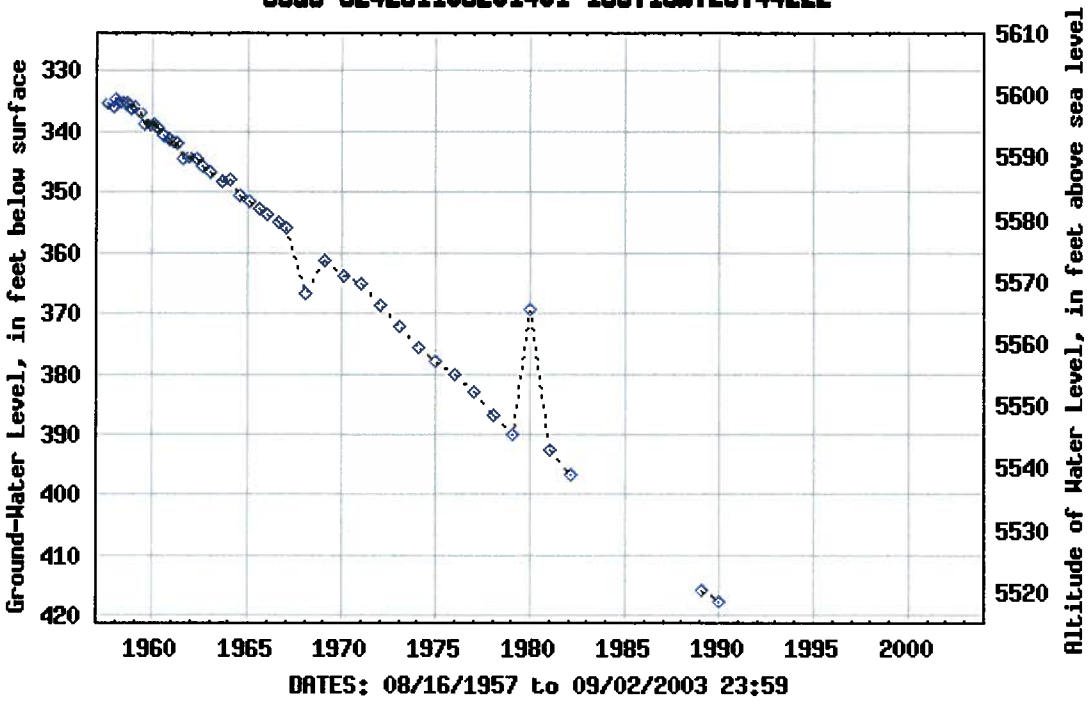

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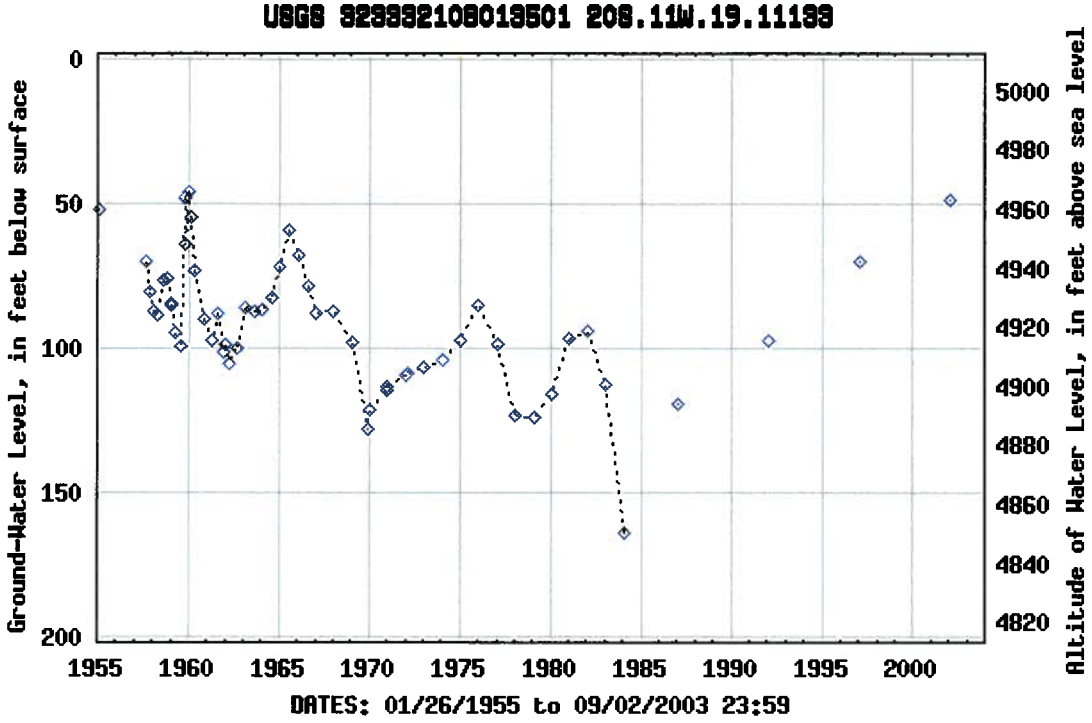

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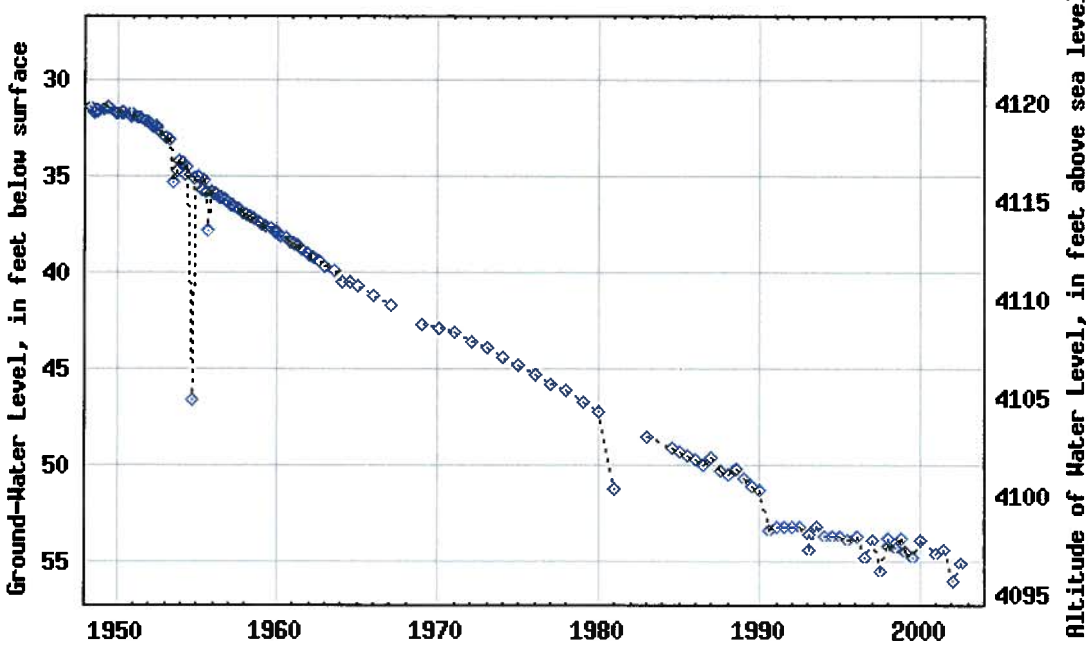

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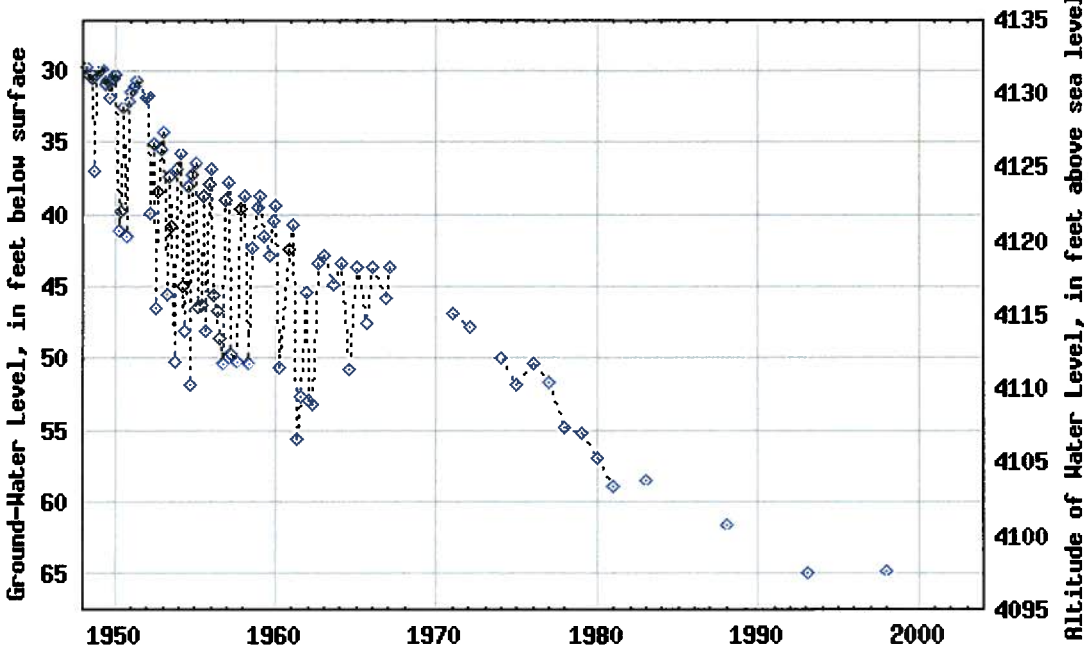

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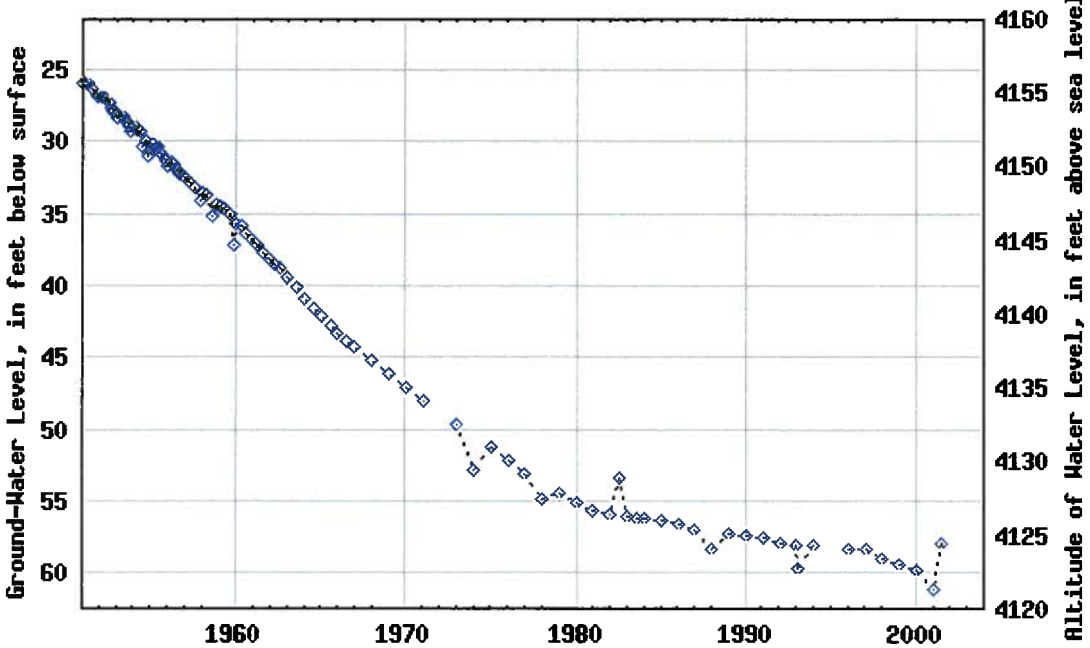

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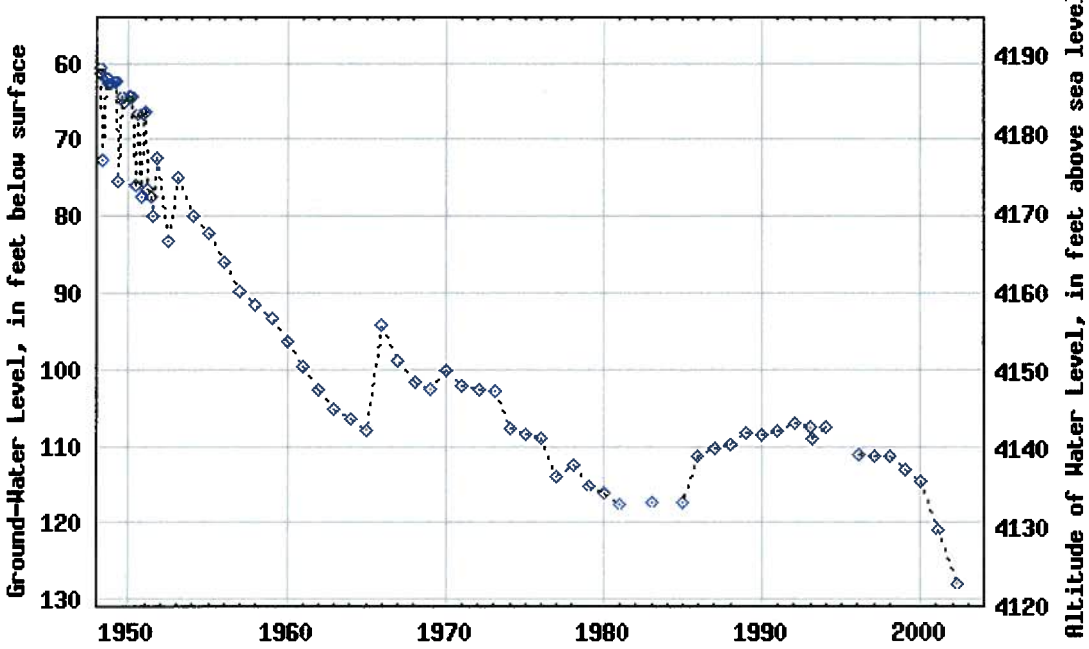

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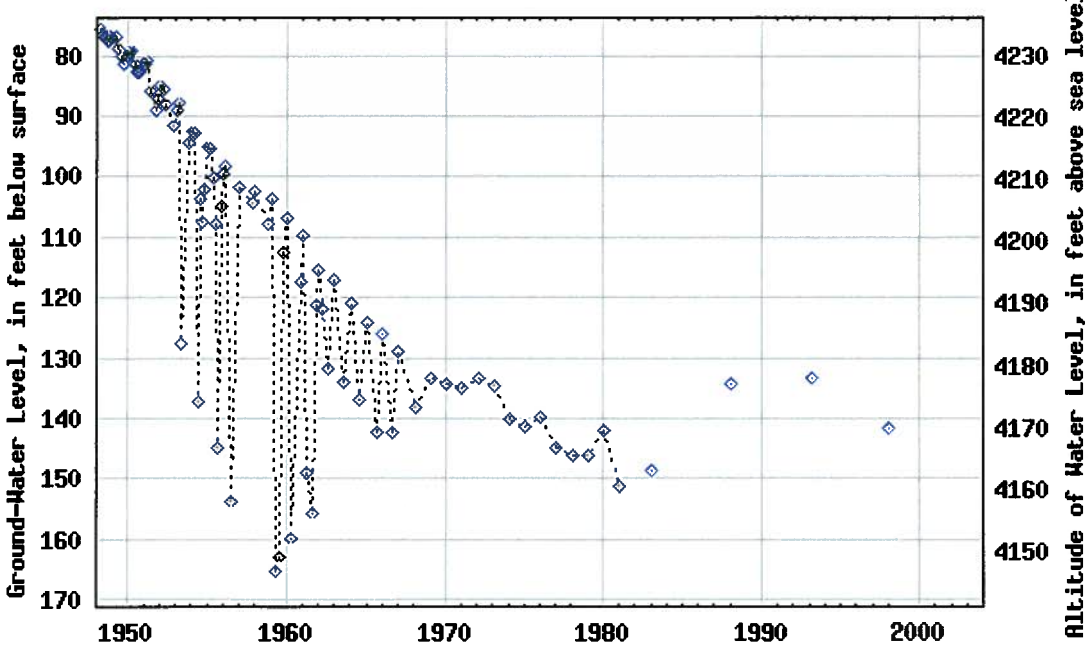

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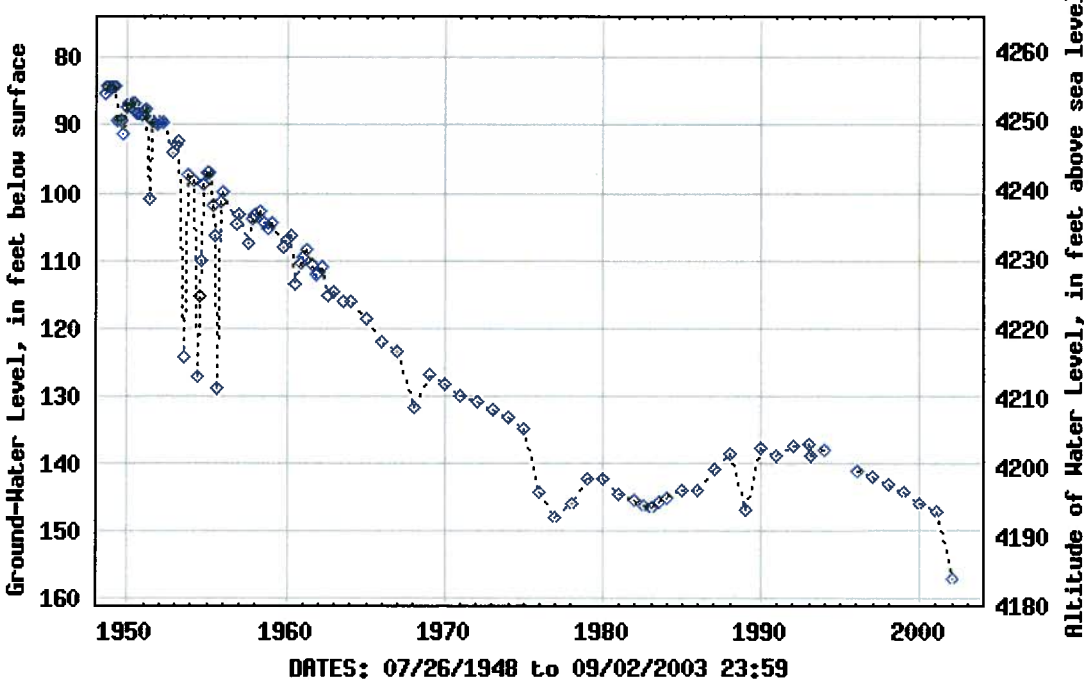

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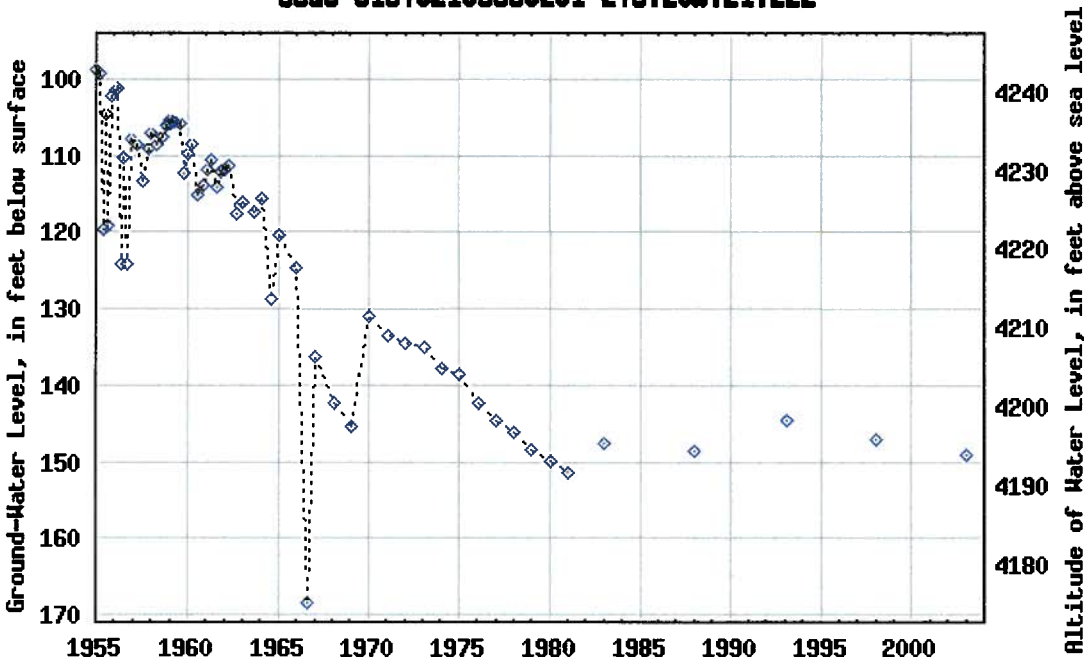

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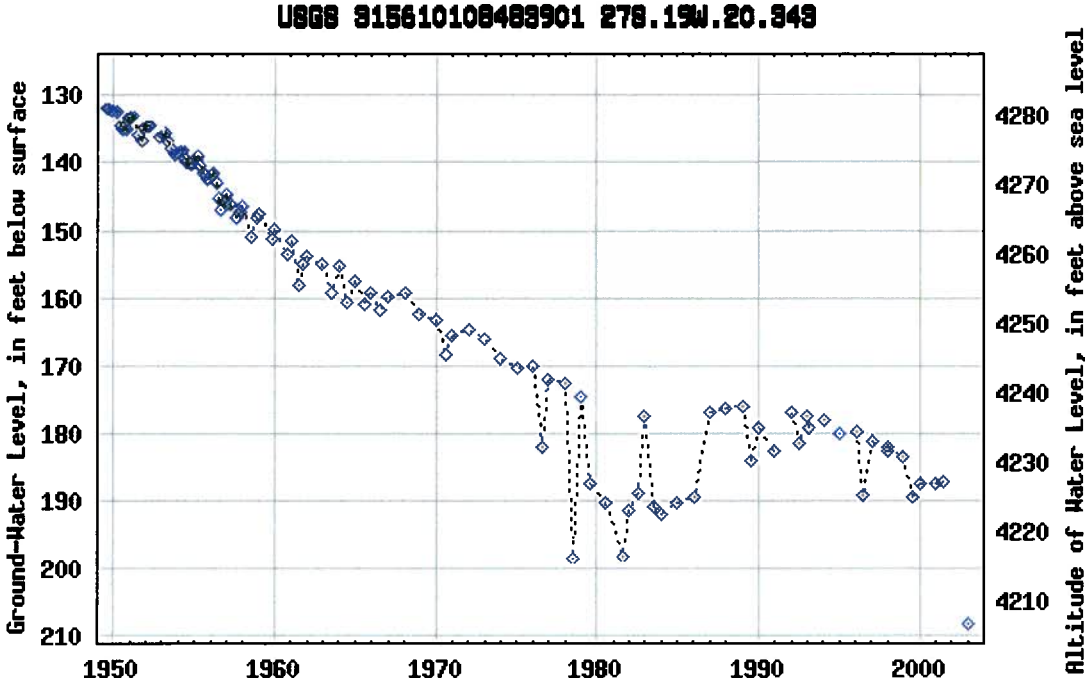

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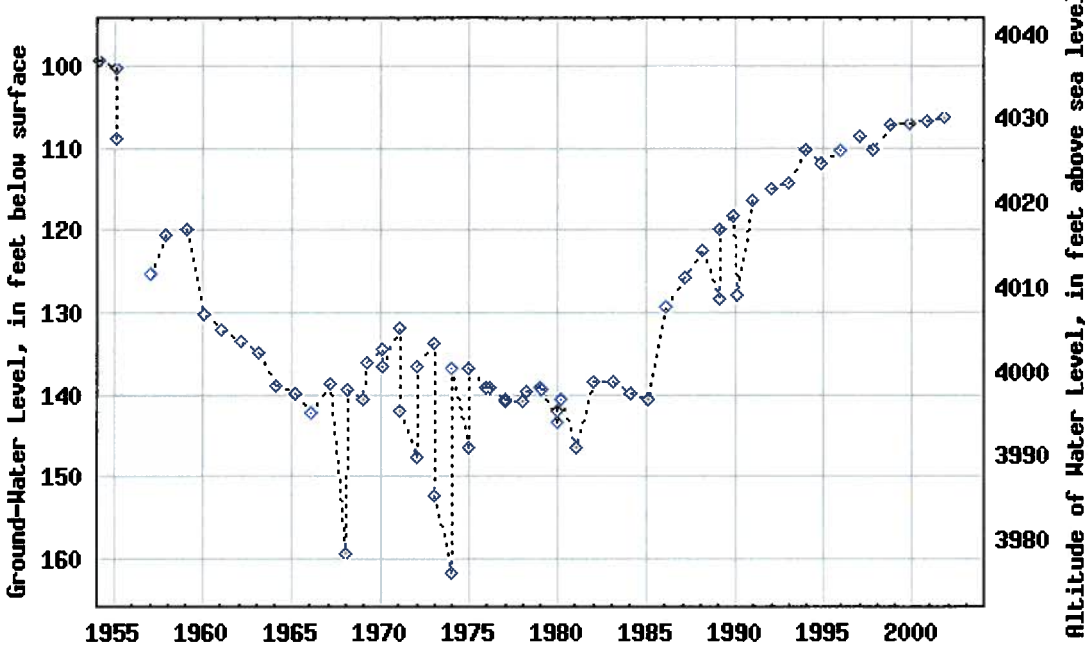

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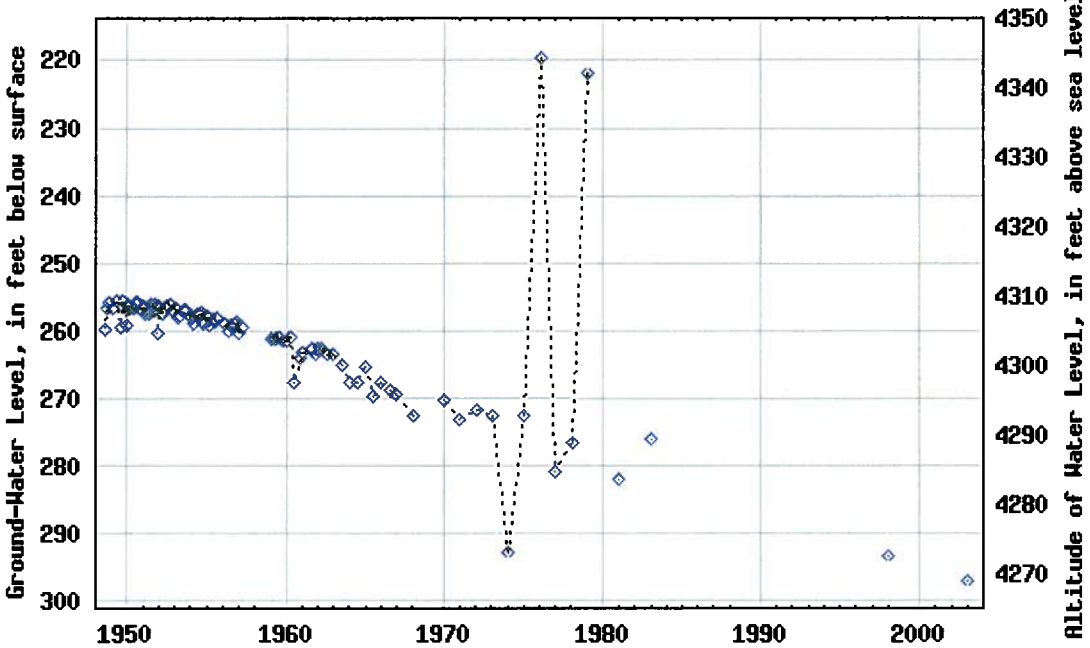

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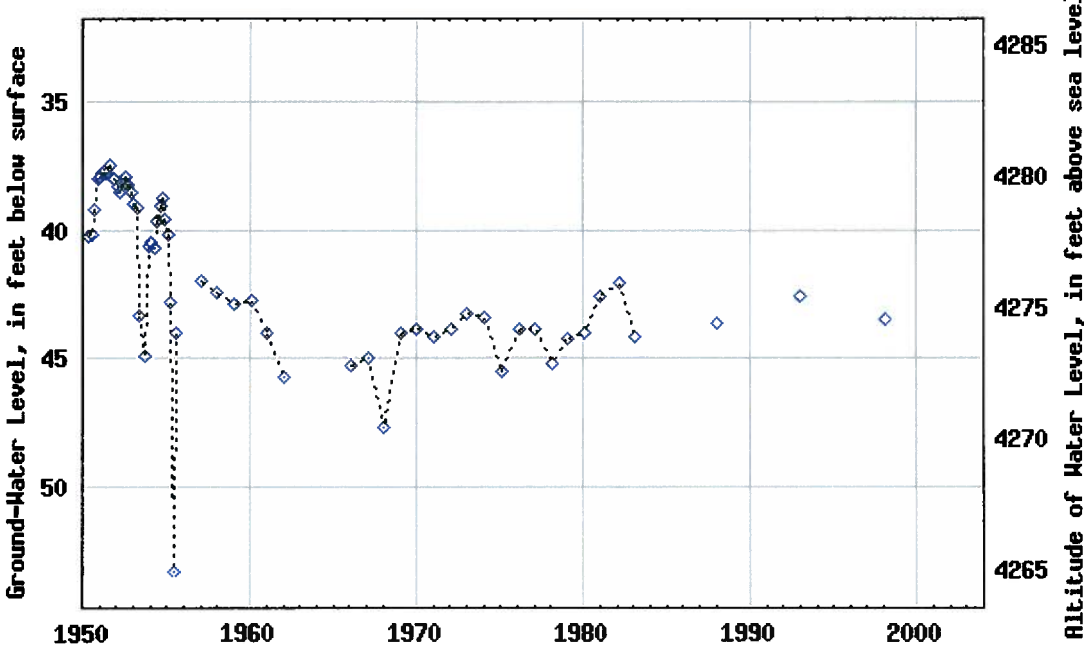

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Provisional Data Subject to Revision

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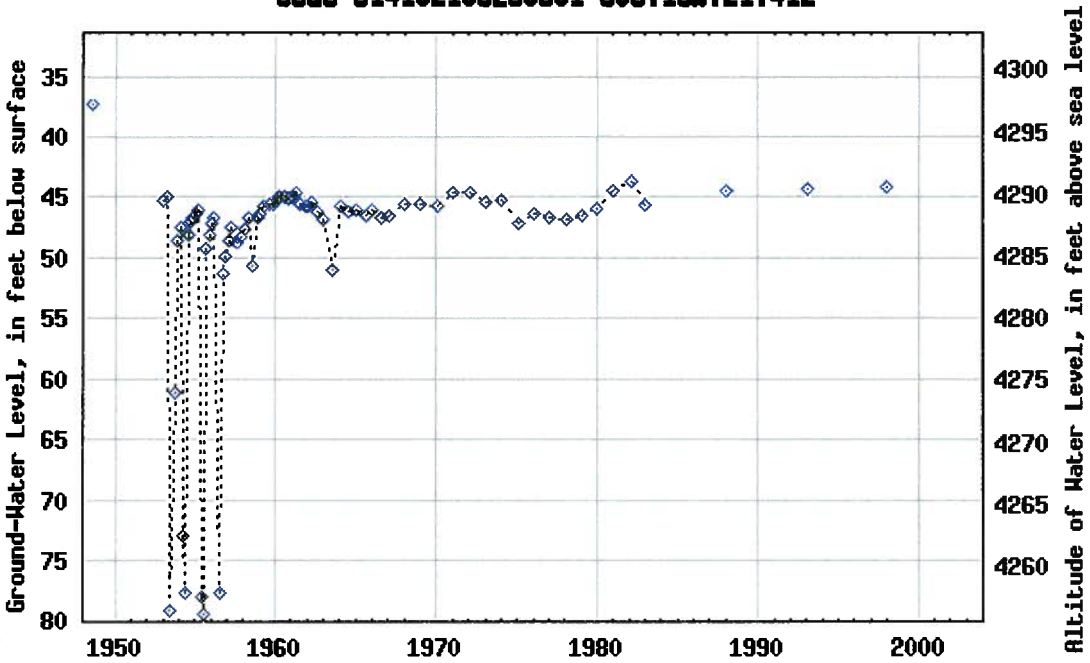

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Provisional Data Subject to Revision

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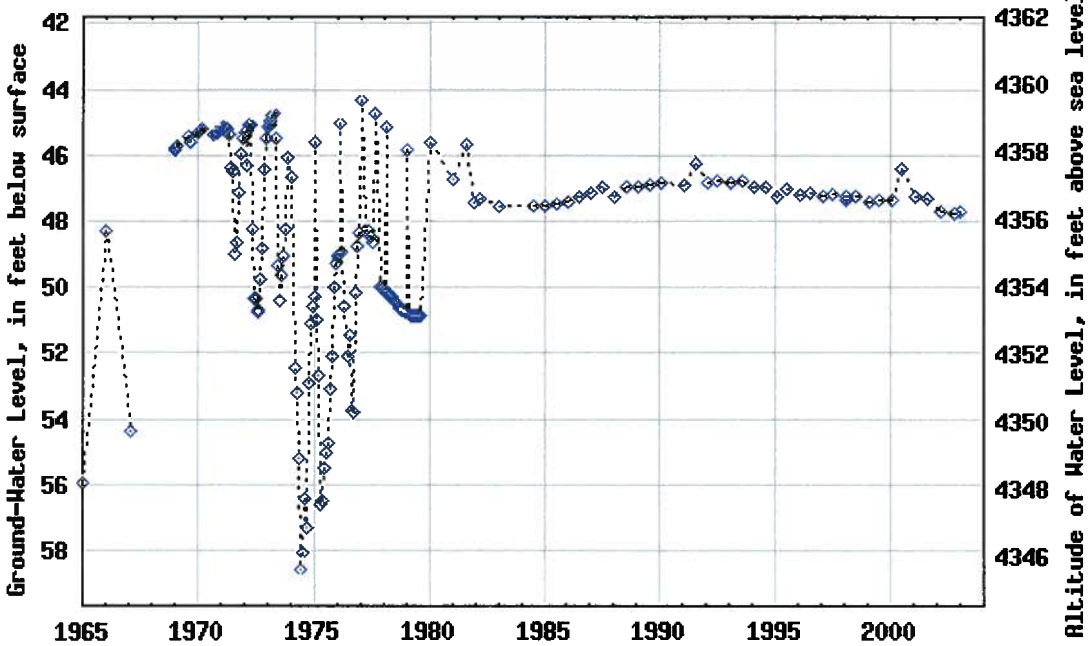

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Provisional Data Subject to Revision

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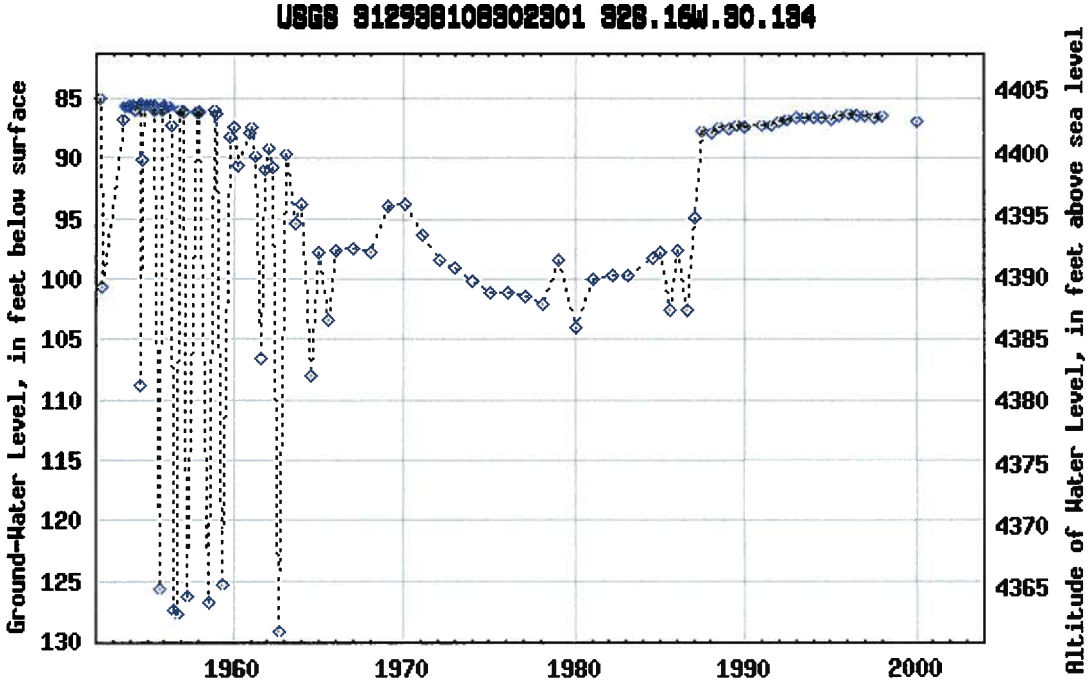

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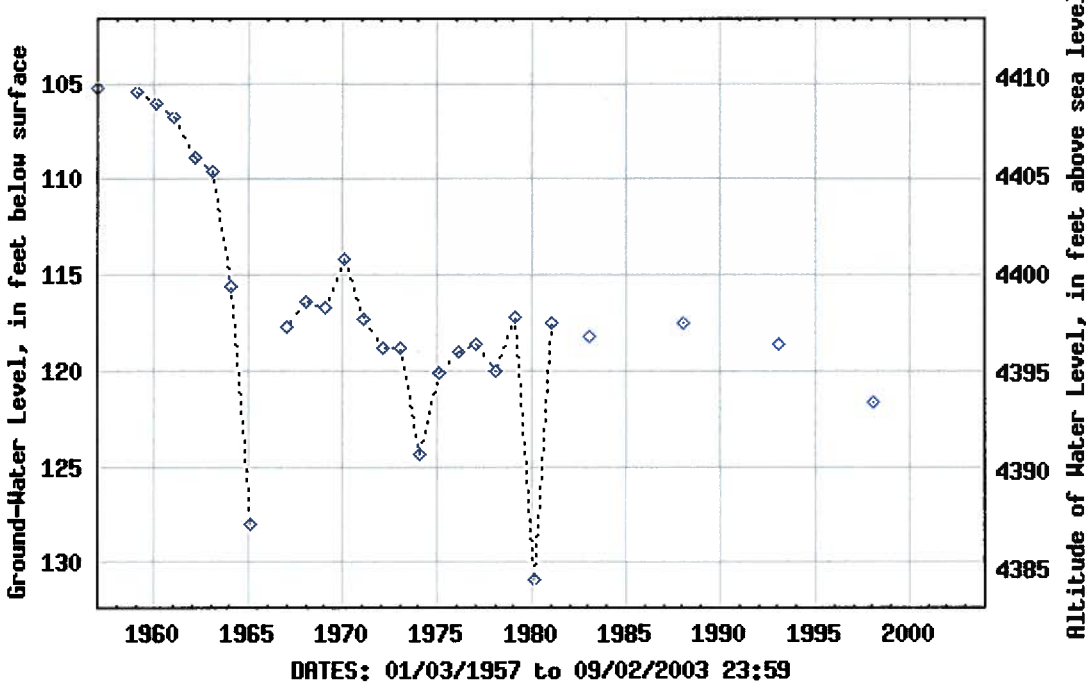

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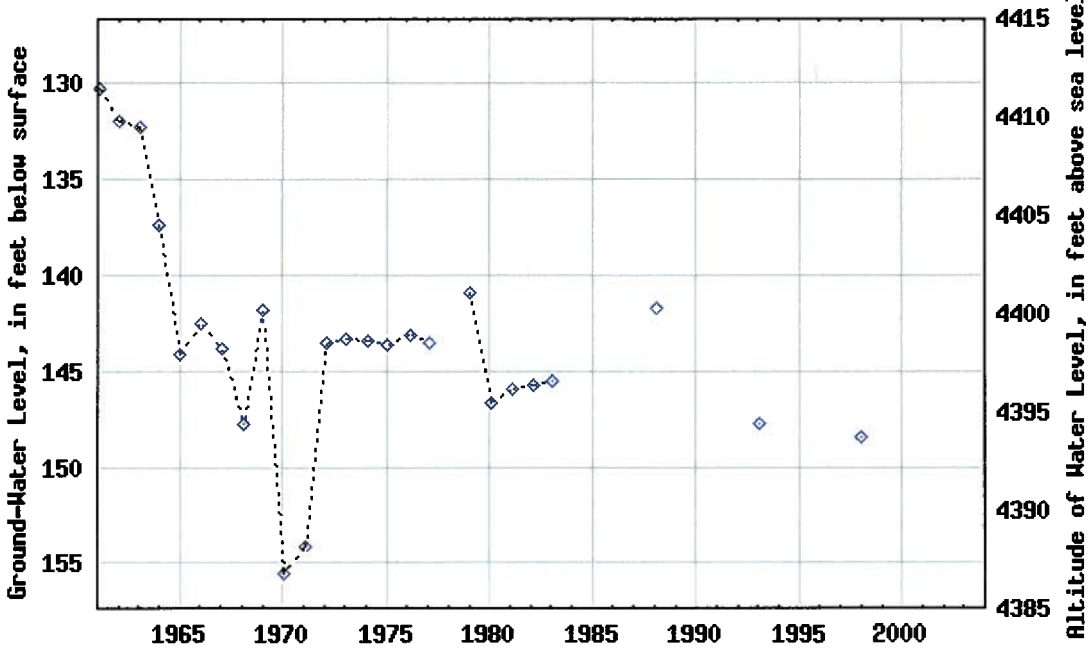

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Provisional Data Subject to Revision

Appendix E

Water Demand Information

Appendix E1

Water Use by County

Table E1-1. Catron County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
2000 Water Year									
Commerical (self-supplied)	8	33	8	33	0	0	41	41	0
Domestic (self-supplied)	0	224	0	224	0	0	224	224	0
Industrial (self-supplied)	0	0	0	0	0	0	0	0	0
Irrigated Agriculture	19,624	339	2,738	196	16,886	143	19,963	2,934	17,029
Livestock (self-supplied)	157	175	157	175	0	0	332	332	0
Mining (self-supplied)	0	0	0	0	0	0	0	0	0
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	169	0	72	0	98	169	72	98
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	19,789	941	2,903	700	16,886	241	20,729	3,603	17,127
1995 Water Year									
Commerical (self-supplied)	8	35	8	16	0	19	43	24	19
Domestic (self-supplied)	0	154	0	69	0	85	154	69	85
Industrial (self-supplied)	0	0	0	0	0	0	0	0	0
Irrigated Agriculture	18,143	343	2,536	197	15,607	146	18,486	2,733	15,753
Livestock (self-supplied)	269	288	269	288	0	0	557	557	0
Mining (self-supplied)	0	0	0	0	0	0	0	0	0
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	144	0	59	0	85	144	59	85
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	18,420	964	2,813	629	15,607	335	19,384	3,442	15,942

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-1. Catron County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1990 Water Year									
Commerical (self-supplied)	8	16	8	7	0	9	24	15	9
Domestic (self-supplied)	0	137	0	62	0	75	137	62	75
Industrial (self-supplied)	0	11	0	6	0	5	11	6	5
Irrigated Agriculture	18,153	1,869	1,592	1,441	16,561	428	20,022	3,033	16,989
Livestock (self-supplied)	308	332	308	332	0	0	640	640	0
Mining (self-supplied)	0	4	0	0	0	4	4	0	4
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	125	0	52	0	73	125	52	73
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	18,469	2,494	1,908	1,900	16,561	594	20,963	3,808	17,155
1985 Water Year									
Commercial	0	10	0	5	0	5	10	5	5
Urban	0	0	0	0	0	0	0	0	0
Rural	0	229	0	104	0	125	229	104	125
Industrial	0	10	0	5	0	5	10	5	5
Irrigated Agriculture	9,128	377	1,127	173	8,001	204	9,505	1,300	8,205
Livestock	240	243	240	242	0	1	483	482	1
Minerals	0	3	0	0	0	3	3	0	3
Power	0	0	0	0	0	0	0	0	0
Stockpond Evaporation	886	0	886	0	0	0	886	886	0
Military	0	0	0	0	0	0	0	0	0
Fish and Wildlife	1,321	1	531	1	790	0	1,322	532	790
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	24	0	24	0	0	0	24	24	0
Totals	11,599	873	2,808	530	8,791	343	12,472	3,338	9,134

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-1. Catron County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1980 Water Year									
Urban	0	0	0	0	0	0	0	0	0
Rural	0	163	0	73	0	90	163	73	90
Irrigated Agriculture	13,240	420	2,390	240	10,850	180	13,660	2,630	11,030
Livestock	274	280	274	279	0	1	554	553	1
Stockpond Evaporation	886	0	886	0	0	0	886	886	0
Commercial	0	10	0	6	0	4	10	6	4
Industrial	0	10	0	6	0	4	10	6	4
Minerals	0	4	0	3	0	1	4	3	1
Military	0	0	0	0	0	0	0	0	0
Power	0	0	0	0	0	0	0	0	0
Fish and Wildlife	554	0	554	0	0	0	554	554	0
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	25	0	25	0	0	0	25	25	0
Totals	14,979	887	4,129	607	10,850	280	15,866	4,736	11,130
1975 Water Year									
Urban	0	0	0	0	0	0	0	0	0
Rural	0	122	0	55	0	67	122	55	67
Irrigated Agriculture	4,170	700	1,740	320	2,430	380	4,870	2,060	2,810
Manufacturing	0	18	0	11	0	7	18	11	7
Minerals	0	0	0	0	0	0	0	0	0
Military	0	0	0	0	0	0	0	0	0
Livestock	311	310	311	310	0	0	621	621	0
Stockpond Evaporation	815	0	815	0	0	0	815	815	0
Power	0	0	0	0	0	0	0	0	0
Fish and Wildlife	590	0	590	0	0	0	590	590	0
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Playa Lake Evaporation	200	0	200	0	0	0	200	200	0
Totals	6,086	1,150	3,656	696	2,430	454	7,236	4,352	2,884

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-2. Grant County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
2000 Water Year									
Commerical (self-supplied)	0	242	0	144	0	98	242	144	98
Domestic (self-supplied)	0	778	0	778	0	0	778	778	0
Industrial (self-supplied)	0	11	0	11	0	0	11	11	0
Irrigated Agriculture	25,771	4,100	4,008	2,402	21,763	1,698	29,871	6,410	23,461
Livestock (self-supplied)	202	217	202	217	0	0	419	419	0
Mining (self-supplied)	0	21,458	0	17,188	0	4,271	21,458	17,188	4,271
Power (self-supplied)	0	280	0	280	0	0	280	280	0
Public Water Supply	176	4,084	88	2,584	88	1,500	4,260	2,672	1,588
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	26,149	31,170	4,298	23,603	21,851	7,567	57,319	27,901	29,418
1995 Water Year									
Commerical (self-supplied)	0	231	0	104	0	127	231	104	127
Domestic (self-supplied)	0	823	0	370	0	453	823	370	453
Industrial (self-supplied)	0	7	0	7	0	0	7	7	0
Irrigated Agriculture	31,309	5,183	3,875	3,019	27,434	2,164	36,492	6,894	29,598
Livestock (self-supplied)	319	335	319	335	0	0	654	654	0
Mining (self-supplied)	0	25,848	0	20,567	0	5,281	25,848	20,567	5,281
Power (self-supplied)	0	283	0	283	0	0	283	283	0
Public Water Supply	126	3,931	63	2,573	63	1,358	4,057	2,636	1,421
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	31,754	36,641	4,257	27,258	27,497	9,383	68,395	31,515	36,880

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-2. Grant County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1990 Water Year									
Commerical (self-supplied)	0	200	0	90	0	110	200	90	110
Domestic (self-supplied)	0	666	0	300	0	366	666	300	366
Industrial (self-supplied)	0	2	0	2	0	0	2	2	0
Irrigated Agriculture	25,241	3,997	3,429	2,384	21,812	1,613	29,238	5,813	23,425
Livestock (self-supplied)	302	324	302	324	0	0	626	626	0
Mining (self-supplied)	0	30,466	0	24,681	0	5,785	30,466	24,681	5,785
Power (self-supplied)	0	645	0	645	0	0	645	645	0
Public Water Supply	126	3,290	63	1,975	63	1,315	3,416	2,038	1,378
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	25,669	39,590	3,794	30,401	21,875	9,189	65,259	34,195	31,064
1985 Water Year									
Commercial	0	10	0	6	0	4	10	6	4
Urban	0	1,667	0	834	0	833	1,667	834	833
Rural	0	1,226	0	614	0	612	1,226	614	612
Industrial	0	0	0	0	0	0	0	0	0
Irrigated Agriculture	27,738	3,667	2,817	1,921	24,921	1,746	31,405	4,738	26,667
Livestock	330	336	330	335	0	1	666	665	1
Minerals	10,087	12,797	4,156	9,022	5,931	3,775	22,884	13,178	9,706
Power	0	520	0	520	0	0	520	520	0
Stockpond Evaporation	836	0	836	0	0	0	836	836	0
Military	0	0	0	0	0	0	0	0	0
Fish and Wildlife	431	0	431	0	0	0	431	431	0
Recreation	0	11	0	10	0	1	11	10	1
Reservoir Evaporation	632	0	632	0	0	0	632	632	0
Totals	40,054	20,234	9,202	13,262	30,852	6,972	60,288	22,464	37,824

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-2. Grant County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1980 Water Year									
Urban	0	2,457	0	1,228	0	1,229	2,457	1,228	1,229
Rural	0	1,445	0	723	0	722	1,445	723	722
Irrigated Agriculture	9,750	7,340	3,320	4,470	6,430	2,870	17,090	7,790	9,300
Livestock	352	361	352	359	0	2	713	711	2
Stockpond Evaporation	836	0	836	0	0	0	836	836	0
Commercial	0	3	0	2	0	1	3	2	1
Industrial	0	0	0	0	0	0	0	0	0
Minerals	9,936	13,842	4,019	9,777	5,917	4,065	23,778	13,796	9,982
Military	0	0	0	0	0	0	0	0	0
Power	0	520	0	520	0	0	520	520	0
Fish and Wildlife	431	0	431	0	0	0	431	431	0
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	870	0	870	0	0	0	870	870	0
Totals	22,175	25,968	9,828	17,079	12,347	8,889	48,143	26,907	21,236
1975 Water Year									
Urban	0	2,112	0	1,056	0	1,056	2,112	1,056	1,056
Rural	0	1,254	0	627	0	627	1,254	627	627
Irrigated Agriculture	6,860	10,680	3,390	5,880	3,470	4,800	17,540	9,270	8,270
Manufacturing	0	78	0	47	0	31	78	47	31
Minerals	9,393	11,305	4,978	7,903	4,415	3,402	20,698	12,881	7,817
Military	0	0	0	0	0	0	0	0	0
Livestock	344	344	344	344	0	0	688	688	0
Stockpond Evaporation	862	0	862	0	0	0	862	862	0
Power	0	0	0	0	0	0	0	0	0
Fish and Wildlife	202	0	202	0	0	0	202	202	0
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	1,400	0	1,400	0	0	0	1,400	1,400	0
Playa Lake Evaporation	0	0	0	0	0	0	0	0	0
Totals	19,061	25,773	11,176	15,857	7,885	9,916	44,834	27,033	17,801

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-3. Hidalgo County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
2000 Water Year									
Commerical (self-supplied)	0	512	0	509	0	4	512	509	4
Domestic (self-supplied)	0	193	0	193	0	0	193	193	0
Industrial (self-supplied)	0	6	0	3	0	3	6	3	3
Irrigated Agriculture	8,741	33,143	3,931	20,741	4,810	12,402	41,884	24,672	17,212
Livestock (self-supplied)	60	259	60	259	0	0	320	320	0
Mining (self-supplied)	0	4,332	0	4,115	0	217	4,332	4,115	217
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	907	0	453	0	453	907	453	453
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	8,801	39,353	3,991	26,274	4,810	13,079	48,154	30,265	17,889
1995 Water Year									
Commerical (self-supplied)	0	458	0	299	0	159	458	299	159
Domestic (self-supplied)	0	177	0	80	0	97	177	80	97
Industrial (self-supplied)	0	74	0	38	0	36	74	38	36
Irrigated Agriculture	6,501	31,169	2,924	18,846	3,577	12,323	37,670	21,770	15,900
Livestock (self-supplied)	85	356	85	356	0	0	441	441	0
Mining (self-supplied)	0	5,173	0	4,914	0	259	5,173	4,914	259
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	1,468	0	734	0	734	1,468	734	734
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	6,586	38,875	3,009	25,267	3,577	13,608	45,461	28,276	17,185

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-3. Hidalgo County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1990 Water Year									
Commerical (self-supplied)	0	349	0	232	0	117	349	232	117
Domestic (self-supplied)	0	135	0	61	0	74	135	61	74
Industrial (self-supplied)	0	2	0	1	0	1	2	1	1
Irrigated Agriculture	8,611	23,355	4,425	14,419	4,186	8,936	31,966	18,844	13,122
Livestock (self-supplied)	103	454	103	453	0	1	557	556	1
Mining (self-supplied)	0	4,170	0	3,961	0	209	4,170	3,961	209
Power (self-supplied)	0	478	0	478	0	0	478	478	0
Public Water Supply	0	1,334	0	667	0	667	1,334	667	667
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	8,714	30,277	4,528	20,272	4,186	10,005	38,991	24,800	14,191
1985 Water Year									
Commercial	0	153	0	96	0	57	153	96	57
Urban	0	836	0	418	0	418	836	418	418
Rural	0	199	0	101	0	98	199	101	98
Industrial	0	0	0	0	0	0	0	0	0
Irrigated Agriculture	267	33,351	179	16,461	88	16,890	33,618	16,640	16,978
Livestock	244	266	244	265	0	1	510	509	1
Minerals	0	5,663	0	5,423	0	240	5,663	5,423	240
Power	0	36	0	36	0	0	36	36	0
Stockpond Evaporation	780	0	780	0	0	0	780	780	0
Military	0	0	0	0	0	0	0	0	0
Fish and Wildlife	0	228	0	59	0	169	228	59	169
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	10	0	10	0	0	0	10	10	0
Totals	1,301	40,732	1,213	22,859	88	17,873	42,033	24,072	17,961

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-3. Hidalgo County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1980 Water Year									
Urban	0	769	0	384	0	385	769	384	385
Rural	0	197	0	98	0	99	197	98	99
Irrigated Agriculture	6,290	61,310	2,970	38,330	3,320	22,980	67,600	41,300	26,300
Livestock	257	262	257	261	0	1	519	518	1
Stockpond Evaporation	790	0	790	0	0	0	790	790	0
Commercial	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0
Minerals	0	5,410	0	5,178	0	232	5,410	5,178	232
Military	0	0	0	0	0	0	0	0	0
Power	0	723	0	723	0	0	723	723	0
Fish and Wildlife	0	228	0	60	0	168	228	60	168
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	10	0	10	0	0	0	10	10	0
Totals	7,347	68,899	4,027	45,034	3,320	23,865	76,246	49,061	27,185
1975 Water Year									
Urban	0	987	0	494	0	493	987	494	493
Rural	0	114	0	57	0	57	114	57	57
Irrigated Agriculture	7,680	67,710	3,780	40,390	3,900	27,320	75,390	44,170	31,220
Manufacturing	0	4	0	2	0	2	4	2	2
Minerals	0	2,488	0	2,348	0	140	2,488	2,348	140
Military	0	0	0	0	0	0	0	0	0
Livestock	295	295	295	295	0	0	590	590	0
Stockpond Evaporation	655	0	655	0	0	0	655	655	0
Power	0	336	0	336	0	0	336	336	0
Fish and Wildlife	10	0	10	0	0	0	10	10	0
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Playa Lake Evaporation	11,900	0	11,900	0	0	0	11,900	11,900	0
Totals	20,540	71,934	16,640	43,922	3,900	28,012	92,474	60,562	31,912

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-4. Luna County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
2000 Water Year									
Commerical (self-supplied)	0	186	0	176	0	10	186	176	10
Domestic (self-supplied)	0	717	0	717	0	0	717	717	0
Industrial (self-supplied)	0	55	0	42	0	13	55	42	13
Irrigated Agriculture	22,509	91,674	10,425	57,786	12,084	33,888	114,183	68,211	45,972
Livestock (self-supplied)	83	342	83	342	0	0	424	424	0
Mining (self-supplied)	0	41	0	27	0	15	41	27	15
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	4,388	0	2,194	0	2,194	4,388	2,194	2,194
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	22,592	97,403	10,508	61,283	12,084	36,120	119,995	71,791	48,204
1995 Water Year									
Commerical	0	192	0	139	0	53	192	139	53
Domestic	0	810	0	365	0	445	810	365	445
Industrial	0	62	0	44	0	18	62	44	18
Irrigated agriculture	21,785	119,550	10,048	71,356	11,737	48,194	141,335	81,404	59,931
Livestock	87	360	87	360	0	0	447	447	0
Mining	0	256	0	66	0	190	256	66	190
Power	0	0	0	0	0	0	0	0	0
Public water supply	0	4,210	0	2,105	0	2,105	4,210	2,105	2,105
Reservoir evaporation	0	0	0	0	0	0	0	0	0
Totals	21,872	125,440	10,135	74,435	11,737	51,005	147,312	84,570	62,742

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-4. Luna County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1990 Water Year									
Commerical (self-supplied)	0	144	0	118	0	26	144	118	26
Domestic (self-supplied)	0	285	0	128	0	157	285	128	157
Industrial (self-supplied)	0	157	0	125	0	32	157	125	32
Irrigated Agriculture	5,280	98,527	2,295	58,691	2,985	39,836	103,807	60,986	42,821
Livestock (self-supplied)	96	423	96	422	0	1	519	518	1
Mining (self-supplied)	0	375	0	111	0	264	375	111	264
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public Water Supply	0	3,510	0	1,755	0	1,755	3,510	1,755	1,755
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Totals	5,376	103,421	2,391	61,350	2,985	42,071	108,797	63,741	45,056
1985 Water Year									
Commercial	0	12	0	7	0	5	12	7	5
Urban	0	3,196	0	1,598	0	1,598	3,196	1,598	1,598
Rural	0	537	0	269	0	268	537	269	268
Industrial	0	0	0	0	0	0	0	0	0
Irrigated Agriculture	33,062	106,825	10,579	50,563	22,483	56,262	139,887	61,142	78,745
Livestock	235	277	235	273	0	4	512	508	4
Minerals	0	422	0	298	0	124	422	298	124
Power	0	0	0	0	0	0	0	0	0
Stockpond Evaporation	190	0	190	0	0	0	190	190	0
Military	0	0	0	0	0	0	0	0	0
Fish and Wildlife	0	0	0	0	0	0	0	0	0
Recreation	0	395	0	260	0	135	395	260	135
Reservoir Evaporation	15	0	15	0	0	0	15	15	0
Totals	33,502	111,664	11,019	53,268	22,483	58,396	145,166	64,287	80,879

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Table E1-4. Luna County Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	Surface Water	Ground Water	Surface Water	Ground Water	Surface Water	Ground Water			
1980 Water Year									
Urban	0	3,094	0	1,547	0	1,547	3,094	1,547	1,547
Rural	0	512	0	256	0	256	512	256	256
Irrigated Agriculture	8,400	117,120	3,970	73,690	4,430	43,430	125,520	77,660	47,860
Livestock	225	237	225	234	0	3	462	459	3
Stockpond Evaporation	190	0	190	0	0	0	190	190	0
Commercial	0	53	0	32	0	21	53	32	21
Industrial	0	0	0	0	0	0	0	0	0
Minerals	0	427	0	290	0	137	427	290	137
Military	0	0	0	0	0	0	0	0	0
Power	0	0	0	0	0	0	0	0	0
Fish and wildlife	0	0	0	0	0	0	0	0	0
Recreation	0	276	0	255	0	21	276	255	21
Reservoir Evaporation	15	0	15	0	0	0	15	15	0
Totals	8,830	121,719	4,400	76,304	4,430	45,415	130,549	80,704	49,845
1975 Water Year									
Urban	0	2,954	0	1,477	0	1,477	2,954	1,477	1,477
Rural	0	435	0	218	0	217	435	218	217
Irrigated Agriculture	12,020	150,180	4,580	86,840	7,440	63,340	162,200	91,420	70,780
Manufacturing	0	62	0	37	0	25	62	37	25
Minerals	0	1,760	0	670	0	1,090	1,760	670	1,090
Military	0	0	0	0	0	0	0	0	0
Livestock	226	225	226	225	0	0	451	451	0
Stockpond Evaporation	20	0	20	0	0	0	20	20	0
Power	0	0	0	0	0	0	0	0	0
Fish and Wildlife	0	0	0	0	0	0	0	0	0
Recreation	0	0	0	0	0	0	0	0	0
Reservoir Evaporation	0	0	0	0	0	0	0	0	0
Playa Lake Evaporation	0	0	0	0	0	0	0	0	0
Totals	12,266	155,616	4,826	89,467	7,440	66,149	167,882	94,293	73,589

Source: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

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Appendix E2

Municipal Water Use Data

Table E2-1. Catron County Public Water System Summary

Water System Name	Well Field/ Water Rights[a] (ac-ft/yr)	System Mailing Address / Phone Number	Type of System	Estimated Population Served	Estimated Number of Meter Connections	2002 Well System Production[b] (ac-ft/yr / gpy)	Metered Water[b] (ac-ft/yr / gpy)	Water Source Classification	System Source	Number of Active Wells	2002 Estimated Well Pumping Capacity (ac-ft/yr)	Number of Tanks	Total Capacity of Tanks (gallons)	% Loss[c]
Aragon MDWCA	8.54	P O Box 13 Aragon, NM 87820 (505) 533-6627	Unincorporated Community	45	12	5.5 1,792,000	—	Ground	Well	—	—	—	—	—
Homestead Landowners Association	10	P O Box 62 Datil, NM 87821 (505) 772-5599	Unincorporated Community	40	53	8.4 2,737,000	—	Ground	Wells	4	—	—	—	—
Pietown MDWCA	30	P O Box 3-N Pie Town, NM 87827 (505) 772-2608	Municipal	84	48	9.2 3,000,000	—	Ground	Well	3	56	1	40,000	—
Quemado Lake Estates	—	P O Box 188 Quemado, NM 87829 (505) 773-4651	Unincorporated Community	20	76	—	—	Ground	—	—	—	—	—	—
Quemado Water Works MDWCA	19.36	P O Box 42 Quemado, NM 87829 (505) 773-4775	Municipal	240	142	30.7 10,000,000	—	Ground	Well	1	—	1	100,000	—
Rancho Grande Water Association	30	P O Box 353 Reserve, NM 87830 (505) 533-6765	Unincorporated Community	150	83	12.2 3,969,000	—	Ground	Spring	—	58	1	65,000	—
Reserve Water Works	146.84	P O Box 587 Reserve, NM 87830 (505) 533-6276	Municipal	318	220	88.2 28,745,100	74.2 24,193,470	Ground	Well	1	565	2	200,000	14.3

[a] Water rights at or near current production well system.
[b] From records supplied by individual water systems to Engineers Inc.
[c] Based on pumped vs. metered

ac-ft/yr = Acre-feet per year
gpy = Gallons per year
— = Municipality meters water use, but data were not provided for this study.

Table E2-2. Grant County Public Water System Summary

Water System Name	Well Field/ Water Rights[a] (ac-ft/yr)	System Mailing Address / Phone Number	Type of System	Estimated Population Served	Estimated Number of Meter Connections	2002 Well System Production[b] (ac-ft/yr / gpy)	2002 Metered Water[b] (ac-ft/yr / gpy)	Water Source Classification	System Source	Number of Active Wells	2002 Estimated Well Pumping Capacity (ac ft/yr)	Number of Tanks	Total Capacity of Tanks (Gallons)	% Loss[c]
Arenas Valley	from SVC	Unit 64, Box 6 Silver City, NM 88062 388-1750	Municipal	1,141	390	—	100.7 (32,799,000)	Ground	Silver City Wells	—	—	—	—	—
Bayard Municipal Water	397 + 70	P O Box 728 Bayard, NM 88023 537-3327	Municipal	2,536	945	336.4 109,600,000	268.5 (87,500,000)	Ground	Wells	6	Estimated 325 (6/02)	3	1,375,000	20.2
Casa Adobes	77	HC 68, Box 2540 Mimbres, NM 88049 534-1238	Unincorporated Community	150	102	26.8 8,729,000	26.8 (8,729,000)	Ground	Well	2	—	3	30,000	—
Ft. Bayard Medical Center	—	6000 Isleta SW Albuquerque, NM 87105 841-8978	Hospital	600	50	—	—	Ground	Well	—	—	—	—	—
G & S Water Works	—	8321 E. Fourth St. Tucson, AZ 85710 520-885-1176	Unincorporated Community	67	46	—	—	Ground	Well	—	—	—	—	—
Hanover MDWCA	—	P O Box 38 Hanover, NM 88041 537-6193	Municipal	300	145	20.5 6,680,500	15.9 (5,182,000)	Ground	Well	—	—	—	—	22.5
Hurley Water Supply (Phelps Dodge)	—	P O Box 65 Hurley, NM 88043 537-2287	Municipal	1,600	625	—	184.2 (60,028,000)	Ground	PD Wells	From PD	—	2	690,000	—
North Hurley MDWCA (from Hurley)	—	P O Box 583 Hurley, NM 88043 537-2714	Municipal	475	111	—	26.9 (8,756,000)	Ground	Hurley	—	—	0	0	—
Pinos Altos MDWCA	From SVC	P O Box 53027 Pinos Altos, NM 88053 534-9367	Municipal	382	132	—	31.4 (10,231,000)	Ground	Silver City Wells	—	—	—	—	—
Rio de Arenas Mobile Manor	—	P O Box 2995 Silver City, NM 88062 538-2176	Mobile Home Park	240	84	—	—	Ground	—	—	—	—	—	—
Rosedale MDWCA	From SVC	P O Box 5208 Silver City, NM 88062 538-0957	Unincorporated Community	337	102	—	—	Ground	Silver City Wells	—	—	—	—	—
Santa Clara Water System	514.8	P O Box 316 Santa Clara, NM 88026 537-2443	Municipal	1,944	714	228.9 74,586,000	177.1 (57,711,000)	Ground	Gallery and Wells	3	570	2	800,000	23.5
Silver City Water System[d]	4,430.92	P O Box 1188 Silver City, NM 88062 538-3731	Municipal	10,545	5,744 (2002)	2820.0 918,849,800	2147.2 (699,606,566)	Ground	Wells	4 Well Fields	9,355	12	8,340,000	14.6
Tyrone MDWCA	Part from SVC	P O Box 402 Tyrone, NM 88065 538-5443	Municipal	200	70	—	0.9 (300,000)	Ground	Silver City Wells	—	—	—	—	—
Tyrone Town Site Water System	From SVC	P O Box 649 Silver City, NM 88062 388-1543	Municipal	1,050	323	—	107 (34,863,681)	Ground	Silver City Wells	—	—	—	—	—
Whiskey Creek Mobile Ranch	23.31	200 Racetrack Road Silver City, NM 88061 538-2052	Mobile Home Park	63	42	3,376,250		Ground	Well	2	—	3	40,000	—

[a] Water rights at or near current production well system.
[b] From records supplied by individual water systems to Engineers Inc.; production records represent total withdrawals and do not account for return flows.
[c] Based on pumped vs. metered
[d] Includes Arenas Valley, Pinos Altos, Rosedale, and Tyrone

ac-ft/yr = Acre-feet per year
gpy = Gallons per year

— = Municipality meters water use, but data were not provided for this study.

Table E2-3. Hidalgo County Public Water System Summary

Water System Name	Well Field/ Water Rights[a] (ac-ft/yr)	System Mailing Address / Phone Number	Type of System	Estimated Population Served	Estimated Number of Meter Connections	2002 Well System Production[b] (ac-ft/yr / gpy)	Metered Water[b] (ac-ft/yr / gpy)	Water Source Classification	System Source	Number of Active Wells	2002 Estimated Well Pumping Capacity (ac-ft/yr)	Number of Tanks	Total Capacity of Tanks (Gallons)	% Loss[c]
Animas School System	42	P O Box 85 Animas, NM 88020 (505) 548-2299	School	350	22	3.9 1,281,604	—	Ground	Well	2	—	1	12,000	—
Burgett Geothermal Greenhouses	—	P O Box 256A Animas, NM 88020 (505) 548-2353	Agriculture	100	15	—	—	Ground	Well	—	—	—	—	—
Glen Acres Water Coop	149.705	505 Dale Douglas Lordsburg, NM 88045 (505) 548-2353)	Mobile home park	200	72	—	—	Ground	Well	—	—	—	—	—
Lordsburg Water Supply System	2,030	206 S. Main Lordsburg, NM 88045	Municipal	3,380	1,100	781.0 254,486,000	—	Ground	Well	3	1280	2	2,800,000	—
Playas Townsite Water System	340	Phelps Dodge P O Box 67 Playas, NM 88009 (505) 436-2211	Municipal	329	240	—	—	Ground	Well	—	—	—	—	—
Rodeo MDWCA		P O Box 256 Rodeo, NM 88056 (520-805-0238)	Municipal	200	60	11.9 3,861,400	—	Ground	Well	—	—	1	—	—
Virden Water System	26.49	Route 1, Box 157-3 Duncan, AZ 85534 (505) 358-1000	Municipal	146	42	—	—	Ground	Well	1	130	1	47,000	—

[a] Water rights at or near current production well system.
[b] From records supplied by individual water systems to Engineers Inc.
[c] Based on pumped vs. metered

ac-ft/yr = Acre-feet per year
gpy = Gallons per year
— = Municipality meters water use, but data were not provided for this study.

Table E2-4. Luna County Public Water System Summary

Water System Name	Well Field/ Water Rights [a] (ac-ft/yr)	System Mailing Address / Phone Number	Type of System	Estimated Population Served	Estimated Number of Meter Connections	2002 Well System Production [b] (ac-ft/yr / gpy)	Metered Water [b] (ac-ft/yr / gpy)	Water Source Classification	System Source	Number of Active Wells	2002 Estimated Well Pumping Capacity (ac-ft/yr)	Number of Tanks	Total Capacity of Tanks (Gallons)	% Loss [c]
Columbus Water System	119.1 757.2 654	P O Box 350 Columbus, NM 88029 (505) 531-2663	Municipal	1,765	714	208.5 67,924,000	—	Ground	Well	2	—	2	250,000	—
Deming Municipal Water System	4444	P O Box 706 Deming, NM 88031 (505) 544-0462	Municipal	16,000	5,000	4,075 1,328,000,000	3,927 1,279,050,000	Ground	Well	10	8,226	2	1,000,000	3.8
Gunter Mobile Home Park	—	P O Box 229 Deming, NM 88031 (505) 544-0462	Mobile Home Park	60	20	—	—	Ground	Well	—	—	—	—	—
Hidden Valley Ranch	—	12100 Hidden Valley Ranch Rd. Deming, NM 88030 (505) 546-3071	Mobile Home Park	150	163	—	—	Ground	Well	—	—	—	—	—
Pecan Park MDWCA	—	Lewis Lane, NE, SR 37 Deming, NM 88030 (505) 546-4698	Mobile Home Park	90	42	—	—	Ground	Well	—	—	—	—	—
Peoples Water Coop	—	P O Box 1592 Deming, NM 88031 (505) 546-3857	Community	118	24	—	—	Ground	Well	—	—	—	—	—
Pueblo de Luna Water System	—	P O Box 632 Silver City, NM 88062 (505) 388-5433	Community	70	36	—	—	Ground	Well	—	—	—	—	—

[a] Water rights at or near current production well system.
[b] From records supplied by individual water systems to Engineers Inc.
[c] Based on pumped vs. metered

ac-ft/yr = Acre-feet per year
gpy = Gallons per year
— = Municipality meters water use, but data were not provided for this study.

Appendix E3

Water Use Information Sources: Personal Contacts and Unpublished Data

SOURCES OF WATER USE INFORMATION COMPILED BY ENGINEERS INC.

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Appendix E4

Growth Projections

PROJECTION OF SOUTHWEST REGIONAL GROWTH, 2000-2040
Southwest Planning & Marketing
July, 2004 (revised)

To project future water demand in the counties of the Southwest region of New Mexico, it is necessary to project the future growth of the area's population and economy. Growth must be forecast in each of eight sectors (two other sectors, fish and wildlife and reservoir evaporation, are not driven by demand):

1. Residential (self-supplied)
2. Commercial (self-supplied)
3. Municipal water supply
4. Industrial (self-supplied)
5. Power (self-supplied)
6. Mining (self-supplied)
7. Irrigated Agriculture
8. Livestock (self-supplied)

Growth is forecast in ten-year increments from 2000 to 2040. In the balance of this report, we project growth in each of these sectors. For convenience of organization, we have grouped the eight sectors into three categories:

1. Residential, municipal and commercial,
2. Industrial, mining, and power generation,
3. Irrigated agriculture and livestock.

The growth of the first category of water users – self-supplied-residential, self-supplied commercial and municipal users – parallels the growth of the regional population.

Process

We have projected the future growth of the population and growth of the sectors of the economy for the Southwest region on a County and sub-region level as a first step toward making a determination of potential future water use in the region. All projections are made using two different growth scenarios, referred to as Low and High.

We collected data on historic population growth in each of the counties and their communities, and examined other growth forecasts. In addition, we examined trends in land use, changes and trends in each sector, and proposed or potential future development. We used this information to guide the development of our High and Low growth forecasts and projected changes for each sector.

The county projections have further been broken down into sub-region figures in Grant, Hidalgo, and Luna counties. No sub-regions are included in Catron County because there are no large concentrations of people. The sub-regions are:

Grant County

1) Silver City
2) Mining District, referring to the area that includes the communities of Bayard, Hurley, and Santa Clara.
3) Balance of the County

Hidalgo County

1) Lordsburg
2) Balance of the County

Luna County

1) Deming
2) Balance of the County

Population Growth Projections

Future water supply requirements in New Mexico and the Southwest region will depend in large measure on the degree of future population growth. All the counties in the Southwest region are rural. There has been a national trend for businesses and self-employed individuals to relocate to rural communities with a high quality of life. This trend has spurred in-migration into the Rocky Mountain States to communities such as Santa Fe, Flagstaff, and Durango. This trend is partly a result of the Information Revolution and attendant telecommuting and partly a result of new wealth allowing the purchase of second homes. Rural migration is also bolstered by retirement to the Sunbelt. To the degree that this trend continues and communities in the Southwest region position themselves to take advantage of it; there will be additional growth in population.

To develop the population growth scenarios, we began with Bureau of Business and Economic Research (BBER) forecasts of population growth for the Southwest counties through 2060 (Alcantara and Lopez, 2003), prepared for the Interstate Stream Commission for the purpose of regional water planning. BBER used historic trends dating from 1960 to project population at the State and County levels. The current forecasts are based on these historic trends and data from the 2000 Census. We have modified the BBER forecasts to reflect economic factors and conditions as well as recent population trends that will affect population growth or decline in each of the counties. The BBER report (Alcantara and Lopez, 2003) was used as the high forecast in Catron and Luna Counties and as the low forecast in Grant and Hidalgo Counties. The process used to develop the estimates was to gather additional information and conduct interviews within the region to supplement BBER data.

Catron County

There is a trend toward converting ranch land to subdivisions in Catron County. Six subdivisions were approved by the County in 2000, ten subdivisions were approved in 2001, seven subdivisions were approved in 2002, five subdivisions were approved in 2003, and to date in 2004, two subdivisions have been approved by the County. The subdivisions range in size from the 16,000 acre Wild Horse Ranch subdivision, slated for development in 10 phases, to a 30 acre subdivision in the northeastern part of the county. Most have yet to be developed in any significant way. Many subdivisions are primarily

marketed to retirees and people who are purchasing second homes and vacation properties, particularly in the northern part of the county. This trend suggests that the population of Catron County will increase due to in-migration.

As a low estimate, we project the population of Catron County will remain constant, assuming that the in-migration due to new residential development will be balanced by out-migration and the County's negative natural population increase (births minus deaths). Reasons for out-migration might include a lack of economic opportunity and declining ranching activities because of governmental and environmental pressures.

As our High estimate, we used BBER population projections for Catron County. In this scenario we assume that the County's population will grow at a slow rate. We believe this growth will be driven by a rate of in-migration, particularly related to the new subdivisions, that is greater than the rate of out-migration and the negative natural population increase.

Catron Co. Population Projections

Estimated Annual County Growth Rate

'10	'20	'30	'40	
0.00%	0.00%	0.00%	0.00%	Low
1.15%	0.57%	0.13%	0.11%	High

Estimated County Population

'00	'10	'20	'30	'40	
3,567	3,567	3,567	3,567	3,567	Low
3,567	3,999	4,233	4,288	4,336	High

Grant County Population Projections

The economy of Grant has historically been driven by the mining sector. Despite recent economic diversification that includes a growing tourism industry and a retiree population, the local economy is still significantly affected by changes in the mining sector. Grant County recently experienced a large drop in employment opportunities that is showing its effects on the population of the County. As the savings and unemployment benefits run out, families of miners and others that are affected by the economic downturn, including 600 employees laid off from Stream International call center in Silver City, are beginning to move away from the area to find work.

However there are a variety of economic development efforts aimed at creating new employment opportunities, and the area is increasingly becoming an attractive location for retirees. Silver City and the Mining District -- an area that includes Santa Clara, Bayard and Hurley – are increasingly attracting retirees due to quality-of-life, favorable climate, recreational opportunities, and institutions such as Western New Mexico University and Gila Regional Medical Center. In addition, it is expected that area mines will begin to rehire employees when the price of copper on the world market reaches a price that once again makes it economically feasible to mine in the area.

We used the BBER projection as our Low growth scenario, with the exception of showing a decline from 2000 to 2010. This initial decline is due to the effects of mine layoffs and the continuing economic downturn in the County. After 2010 we project moderate growth to 2040 in expectation of renewed mining activities and increasing in-migration, particularly by retirees. Our High population projection follows this same logic, but has mine employment returning to 1998 levels and shows a more robust in-migration for quality-of-life reasons and retirement. The majority of the growth in the County will happen in Silver City and the Mining District, with the remainder of the County showing a similar pattern, but at a lesser growth rate.

Grant Co. Population Projections

Estimated Annual County Growth Rate

'10	'20	'30	'40	
-0.50%	0.61%	0.48%	0.41%	Low
-0.50%	1.00%	1.00%	1.00%	High

Estimated County Population

'00	'10	'20	'30	'40	
31,083	29,563	31,417	32,958	34,335	Low
31,083	29,563	32,656	36,073	39,847	High

Silver City Population Projections

Estimated Annual Silver City Growth Rate

'10	'20	'30	'40	
-0.60%	0.73%	0.58%	0.49%	Low
-0.60%	1.20%	1.20%	1.20%	High

Estimated Silver City Population

'00	'10	'20	'30	'40	
10,545	9,929	10,680	11,312	11,881	Low
10,545	9,929	11,187	12,604	14,201	High

Mining District Population Projections

Estimated Annual Mining District Growth Rate

`10	`20	`30	`40	
-0.55%	0.67%	0.53%	0.45%	Low
-0.55%	1.10%	1.10%	1.10%	High

Estimated Mining District Population

`00	`10	`20	`30	`40	
5,942	5,623	6,012	6,337	6,629	Low
5,942	5,623	6,273	6,998	7,808	High

Grant Balance Population Projections

Estimated Annual Balance Growth Rate

`10	`20	`30	`40	
-0.41%	0.49%	0.39%	0.33%	Low
-0.41%	0.82%	0.81%	0.80%	High

Estimated Balance Population

`00	`10	`20	`30	`40	
14,596	14,011	14,725	15,309	15,825	Low
14,596	14,011	15,196	16,470	17,838	High

Hidalgo County Population Projections

BBER population projections show an increasingly negative growth rate for Hidalgo County projected to 2040. We use those projections as our Low growth scenario with the exception of a slightly higher decline in population from 2000 to 2010 due to the loss of population resulting from Phelps Dodge completely closing operations in the town of Playas, causing virtual abandonment of the town of approximately 500 to 1000 people.

Our High growth scenario projects that the declining population trend will be reversed due in large part to the sale of Playas to New Mexico Tech for use as a research and training facility. New Mexico Tech projects that activities at Playas will provide jobs for between 83 and 110 full-time employees, and an additional 66 to 94 part-time employees by 2006. These numbers do not include any additional employment generated by companies that may locate in the proposed Playas research facility or the County's business park. We project that Lordsburg, which contains the majority of Hidalgo's population, will continue to be a major factor in determining overall population changes in the county and it will grow at rate less than the rest of the county.

The Low growth scenario assumes that a general decline in the overall county population will continue in Hidalgo and economic development projections for Playas will not be fully realized, thus Playas will not significantly impact the overall population of the County.

Hidalgo Co. Population Projections

Estimated Annual County Growth Rate

'10	'20	'30	'40	
-0.22%	-0.31%	-0.44%	-0.50%	Low
1.26%	0.53%	0.05%	0.01%	High

Estimated County Population

'00	'10	'20	'30	'40	
5,929	5,800	5,623	5,380	5,117	Low
5,929	6,723	7,085	7,121	7,129	High

Lordsburg Population Projections

Estimated Annual Lordsburg Growth Rate

'10	'20	'30	'40	
-0.22%	-0.32%	-0.45%	-0.51%	Low
0.63%	0.27%	0.03%	0.01%	High

Estimated Lordsburg Population

'00	'10	'20	'30	'40	
3379	3,304	3,201	3,060	2,908	Low
3379	3,598	3,695	3,704	3,706	High

Hidalgo Balance Population Projections

Estimated Annual Balance Growth Rate

'10	'20	'30	'40	
-0.21%	-0.30%	-0.43%	-0.49%	Low
2.80%	1.00%	0.08%	0.01%	High

Estimated Balance Population

'00	'10	'20	'30	'40	
2,550	2,496	2,422	2,320	2,209	Low
2,550	3,361	3,713	3,742	3,746	High

Luna County Population Projections

We used BBER growth projections for Luna County as our High growth scenario. This scenario assumes that planned border developments will be built and the County's major population center, Deming, will show significant growth, particularly in developments similar to the Country Club Estates retirement community now under construction near the Rio Mimbres Country Club golf course. The Deming City government has recently purchased agricultural water rights to support future growth. The City allocated $300,000 in 2001, $150,000 in 2002, and $150,000 in 2003 to purchase water rights. Economic development efforts, particularly the industrial park in Deming, also suggest that the County has the potential to support significant population growth. Our Low growth scenario assumes that national economic health and other factors dampen the growth projected in the High growth scenario by approximately half.

Luna Co. Population Projections

Estimated Annual County Growth Rate

`10	`20	`30	`40	
1.24%	1.04%	0.81%	0.64%	Low
2.48%	2.07%	1.61%	1.27%	High

Estimated County Population

`00	`10	`20	`30	`40	
25,189	28,493	31,598	34,253	36,510	Low
25,189	32,181	39,499	46,339	52,572	High

Deming Population Projections

Estimated Annual Deming Growth Rate

`10	`20	`30	`40	
1.49%	1.25%	0.97%	0.77%	Low
2.98%	2.48%	1.93%	1.52%	High

Estimated Deming Population

`00	`10	`20	`30	`40	
14,116	16,363	18,524	20,405	22,027	Low
14,116	18,927	24,190	29,291	34,074	High

Luna Balance Population Projections

Estimated Annual Balance Growth Rate

`10	`20	`30	`40	
0.92%	0.75%	0.58%	0.45%	Low
1.81%	1.45%	1.08%	0.82%	High

Estimated Balance Population

`00	`10	`20	`30	`40	
11,073	12,130	13,075	13,848	14,482	Low
11,073	13,255	15,309	17,048	18,498	High

Southwest New Mexico Population Projections

The overall growth of the region is the sum of the individual population projections for each county. We project the Southwest region will grow from a population of under 66,000 in 2000 to a population of almost 80,000 in the Low growth scenario to 102,000 in the High growth scenario by 2040. Under the Low growth scenario, most of the growth will occur after 2010. The growth for the region under the high projection is 53% after the year 2030 which is in line with BBER's national projection of U.S. population increase by 33% in the year 2030 with a majority of the growth in the Southwestern U.S. (Roepke, 2005).

Southwest Regional Projections

Estimated Regional Population

`00	`10	`20	`30	`40	
65,858	66,996	71,744	75,619	78,929	Low
65,858	71,116	81,761	92,073	102,128	High

1) Residential, Commercial, & Municipal Sector Projections

Introduction

Future water demand by residential self-supplied, commercial self-supplied and municipal users will depend in large part on the degree of future population growth. (Of course, demand will also be affected by other factors, such as the cost of water and electricity and the availability of new water-conserving technologies.) The Low scenario for each of the counties assumes that the residential, commercial, and municipal sectors will follow the Low population projection for its corresponding county, and the High projection assumes that the same sectors will follow the High population projection for its corresponding county.

We conducted extensive interviews within the region to identify factors that could affect growth in the County as a whole and within each of the sub-regions. (See list of Contacts.) What follows are sector growth projections, tables with projected annual

growth rates, and narratives describing factors that could affect sector growth in each county.

Catron

There is a trend toward converting ranch land to subdivisions in Catron County. The anticipated scale and rate of development are not expected to have a substantial impact on future water consumption rates. This type of development is typically very low density, consisting of large lots or "ranchettes" rather than urban subdivision forms that have much higher densities.

Catron is a rural county, and the municipal and commercial sectors currently consume very little water. The largest community in Catron is Reserve, with a population of just 387 residents. A small labor force, underdeveloped infrastructure, and scarce services will limit large-scale municipal and commercial growth between now and 2040 in both Reserve and the remainder of the County.

Catron County Annual Growth Rate

	'10	'20	'30	'40	
Residential	0.00%	0.00%	0.00%	0.00%	Low
	1.15%	0.57%	0.13%	0.11%	High
Municipal	0.00%	0.00%	0.00%	0.00%	Low
	1.15%	0.57%	0.13%	0.11%	High
Commercial	0.00%	0.00%	0.00%	0.00%	Low
	1.15%	0.57%	0.13%	0.11%	High

Grant

Growth of the residential, municipal, and commercial sectors in Grant County will most likely be driven by increased tourism and in-migration of residents seeking quality of life, including retirees. The largest increase in new residents is expected to happen in the Silver City area, and especially in the Mining District communities of Bayard, Hurley, and Santa Clara, due to their proximity to services, well-developed infrastructure, leisure activities, and reasonably-priced housing stock. Increased tourism is currently shifting and will continue to shift the focus of commercial development toward services for people who visit the area, including lodging facilities, restaurants, and other similar businesses. In addition to the focus on tourism, businesses that serve County residents will also continue to locate in the Silver City area, which is the center of the County's commerce with many restaurants and stores, including a Super Wal-Mart.

Grant County Annual Growth Rate					
	'10	'20	'30	'40	
Residential	-0.50%	0.61%	0.48%	0.41%	Low
	-0.50%	1.00%	1.00%	1.00%	High
Municipal	-0.50%	0.61%	0.48%	0.41%	Low
	-0.50%	1.00%	1.00%	1.00%	High
Commercial	-0.50%	0.61%	0.48%	0.41%	Low
	-0.50%	1.00%	1.00%	1.00%	High

Hidalgo

Hidalgo County, much like Catron County, has a very low population, with only 5,929 residents in 2000. Unlike Catron, however, a large percentage of the County's population can be found in a single population center. The population of Lordsburg in 2000 was 3,379. Lordsburg is the commercial center of the County and also caters to travelers on Interstate 10. Unlike Grant and Catron Counties, Hidalgo County is not expected to grow significantly due to in-migration of new residents seeking second homes, retirement homes, or relocation for quality-of-life reasons. Near-term and long-term development--including housing developments, tourism projects, and the purchase of the community of Playas by New Mexico Tech – are not expected to substantially alter the growth rate of these sectors in Hidalgo County.

Our Low estimate anticipates there will be no growth in the residential, municipal and commercial sectors in Hidalgo County between now and 2040, due to the lack of a large population to support large-scale commercial development. Our High estimate anticipates that there will be slight growth based on in-migration due to the development and expansion of Playas, and economic development initiatives that will attract new residents and businesses to the area.

Hidalgo County Annual Growth Rate					
	'10	'20	'30	'40	
Residential	-0.22%	-0.31%	-0.44%	-0.50%	Low
	1.26%	0.53%	0.05%	0.01%	High
Municipal	-0.22%	-0.31%	-0.44%	-0.50%	Low
	1.26%	0.53%	0.05%	0.01%	High
Commercial	-0.22%	-0.31%	-0.44%	-0.50%	Low
	1.26%	0.53%	0.05%	0.01%	High

Luna

Luna County has nearly five times the population of neighboring Hidalgo County. Like Hidalgo, it has one major city, Deming, with a population of 14,116 residents in 2000. The growth of the residential, municipal, and commercial sectors in Deming will be driven to some extent by "snowbirds" who retire to the area for the mild climate, much as they retire to Phoenix and Tucson for the same reason. This is already happening with several retirement communities being built or planned, particularly the Country Club Estates retirement community southeast of the City near the golf course. Commercial and municipal growth and water needs in Deming will be driven by the needs of these citizens, as well as catering to tourists and travelers on Interstate 10.

The growth of the municipal sector and its respective water use is based on population growth and does not take into account the power generating facility currently under construction that will use municipal water.

The remainder of the County will maintain its predominantly agricultural character and is not projected to have any significant residential, municipal, or commercial growth.

Luna County Annual Growth Rate

	'10	'20	'30	'40	
Residential	1.24%	1.04%	0.81%	0.64%	Low
	2.48%	2.07%	1.61%	1.27%	High
Municipal	1.24%	1.04%	0.81%	0.64%	Low
	2.48%	2.07%	1.61%	1.27%	High
Commercial	1.24%	1.04%	0.81%	0.64%	Low
	2.48%	2.07%	1.61%	1.27%	High

Growth projection for the municipal sector does not include potential water use in power generation.

2) Industrial, Power Generation & Mining Sectors

Introduction

Although the Industrial sector in the Southwest counties is not a large driver of the region's economy, power generation is becoming increasingly prominent and mining has been one of the major economic drivers of Grant County for decades. These sectors have the potential to use huge amounts of water, depending on the scale, type, and processes used to mine, generate power or produce industrial products. It is important to determine each county's development capacity and growth potential for these sectors.

Catron

Catron County has few assets in terms of transportation or infrastructure, and it has a small labor force, indicating that industrial development or power generation are unlikely to be developed in the County. The exception is industrial activity related to the harvesting and processing of small-diameter timber. A new sawmill in Catron County, the first since the forestry industry collapsed in the early 1990s, is currently employing 5 full-time workers. It is expected that the mill will eventually employ up to 25 people, and it will support an additional 25 people in value-added businesses.

Catron currently has no mining activity. The Fence Lake Coal Mine Project, planned for an area 14 miles north of Quemado, partially in Catron County, never materialized. The mine would have covered 18,000 acres and yielded up to 80 million tons of coal over 50 years.

Catron County Annual Growth Rate

	'10	'20	'30	'40	
Industrial	0.00%	0.00%	0.00%	0.00%	Low
	0.00%	0.00%	0.00%	0.00%	High
Mining	0.00%	0.00%	0.00%	0.00%	Low
	0.00%	0.00%	0.00%	0.00%	High
Power Generation	0.00%	0.00%	0.00%	0.00%	Low
	0.00%	0.00%	0.00%	0.00%	High

Grant

The mining industry has dominated the economy of Grant County for most of the twentieth century and has historically used the largest amount of water, accounting for 62 percent of all consumption. Recently, however, Phelps Dodge Mining Company has curtailed operations at their Cobre mine near Bayard and their Tyrone mine south of Silver City due to a drop in copper prices. There is no foreseeable new mining activity in the region that will dramatically increase water use. Water use associated with mining in the next twenty to forty years in the Silver City area will primarily be in reclamation of the area mines.

We project the mining sector to hold steady at its present rate of use as a Low estimate or increase to previous levels of use similar to those of full-scale operation as the High estimate as Phelps Dodge transitions to reclamation activities.

Potential growth in the industrial sector is limited in Grant County. There are several small-scale industrial parks, including the Grant County industrial park at the regional airport and several parks in communities near Silver City. These parks will not accommodate large-scale industrial development, which would be more likely to locate in Deming. As a High estimate, we project that growth will initially be strong in the industrial sector as some companies locate in the industrial parks, but will significantly decrease in the next forty years. The Low scenario shows no growth for this sector.

Grant County Annual Growth Rate

	'10	'20	'30	'40	
Industrial	0.00%	0.00%	0.00%	0.00%	Low
	5.00%	3.00%	1.00%	0.00%	High
Mining	0.00%	0.00%	0.00%	0.00%	Low
	2.00%	2.00%	2.00%	2.00%	High
Power Generation	0.00%	0.00%	0.00%	0.00%	Low
	0.00%	0.00%	0.00%	0.00%	High

Hidalgo

Hidalgo does not currently have either significant industrial or mining activities in the County. The closure of the Phelps Dodge smelter in Playas represents an almost complete cessation of mining-related activity in Hidalgo County, aside from some small-scale aggregate mining. There is the potential for industrial development in Lordsburg because of the town's proximity to transportation routes, land availability, and nearby power plants. A business park currently under development in Hidalgo County is expected to build out in the next ten years and include up to twenty businesses. The businesses are expected to employ 600 to 1000 people, mostly in manufacturing, and particularly in machining jobs to support activities at nearby Playas. In addition, a research facility will be located at Playas that will provide space for companies whose business focus is homeland security research, development, or training.

The county is well suited for small-scale, gas-fired power plants that provide additional power to the grid during peak capacity times. The area is ideal for this type of development due to access to natural gas lines, land availability, and close proximity to existing power transmission lines. In fact, PNM built an 80 megawatt power plant in Lordsburg in 2002 and Tri-State Generation & Transmission Association is currently completing a 160 megawatt plant in the County.

Our High growth projection for this sector, particularly power generation, assumes that the West will continue to grow, demanding increasing amounts of power. In this scenario we predict that the power generating capacity currently found in the county will double. As a Low growth scenario, we assume that the current generating capacity in the county, coupled with power plant projects outside the county and the state, will satisfy current demand and population growth will taper off. Using these assumptions, we feel the sector will show no further growth in the next forty years.

Hidalgo County Annual Growth Rate

	'10	'20	'30	'40	
Industrial	0.00%	0.00%	0.00%	0.00%	Low
	1.00%	1.00%	0.00%	0.00%	High
Mining	*	0.00%	0.00%	0.00%	Low
	*	0.00%	0.00%	0.00%	High
Power Generation	**	0.00%	0.00%	0.00%	Low
	**	7.00%	0.00%	0.00%	High

* Change to near zero activity due to the closure of the smelter at Playas.

** Growth from a zero base due to development of 240 MW of generating capacity.

Luna

Duke Energy is constructing a 160 Megawatt power generation plant east of Deming similar to the type of plants recently built in Hidalgo County. It uses combustion turbines to supply electricity during peak demand. The State requires that the water use at the plants be metered. The State Engineers Office indicated that the plant is permitted to use up to 3000 acre-feet of water per year. The water that will be used is not self-supplied, but instead is part of the City of Deming municipal system. This plant is representative of a trend in locating power generation facilities in the area. Power generation is one of the sectors in which has the potential for significant growth in the next ten to twenty years, given the right economic circumstances.

Deming has one of the largest industrial parks in the region. This is an area of potential growth considering transportation access, land availability and apparent water availability for future growth.

Luna County Annual Growth Rate

	'10	'20	'30	'40	
Industrial	2.00%	2.00%	2.00%	2.00%	Low
	5.00%	4.00%	3.00%	2.00%	High
Mining	0.00%	0.00%	0.00%	0.00%	Low
	0.00%	0.00%	0.00%	0.00%	High
Power Generation	*	0.00%	0.00%	0.00%	Low
	*	7.00%	0.00%	0.00%	High

* Growth from a zero base due to development of 160 MW of generating capacity.

3) Irrigated Agriculture & Livestock

Agriculture has traditionally been the mainstay of the economies of both Luna and Hidalgo counties. Since 1970 Catron, Hidalgo, and Luna counties have seen an increase in the amount of irrigated cropland. Only Grant County has seen a decline in irrigated agriculture.

In examining the irrigated agriculture sector for the Southwest region, we use the US Department of Agriculture figures for Acres of Irrigated Cropland as one of the sources for making projections in this sector. This figure, published annually, includes land that has the potential to be irrigated or has previously been irrigated, even if it is idle, fallow, or diverted to other uses during the reporting year. Typically the amount of land that is actually irrigated in any given year is some fraction of the Acres of Irrigated Cropland figure. For example, in 1986 Luna County had 73,950 acres of irrigated cropland. However, only 38,246 acres were actually planted with crops that required irrigation that year. Nevertheless, we use the Irrigated Cropland figure because it represents the amount of land that has the potential to be irrigated in a given year, assuming there are no limiting factors such as low crop prices, drought, the need to let land lie fallow, or other factors that prevent farmers from planting crops that require irrigation. In effect it represents the total amount of land that could potentially require water for irrigation in a County in a given year.

The following are factors that contribute to the potential for changes in both the irrigated agriculture and livestock sectors in the Southwest region.

Catron

Livestock has, and continues to be, the primary economic driver of the economy of Catron County, despite the irrigated agriculture in the County.

Compared to the other counties in the region, irrigated agriculture is relatively small, with total irrigated cropland at 4,360 acres. In 1998, of the 4,360 acres of available irrigated cropland, 3,385 of those acres were actually irrigated. However, despite the increase in irrigated cropland, it is not expected that the amount of irrigated agriculture will significantly increase in the next forty years. Our high estimate is that it will remain at its current levels, and our low estimate is that it will decline due to drought.

Most of the activity in the livestock sector consists of range grazing, primarily of cattle. This requires widely dispersed wells feeding stock tanks. One head typically consumes 20 gallons per day. Pressure from environmentalists that oppose grazing on the grounds that it damages the environment, a continuing drought that will limit the number of head that can be supported per acre, and the conversion of some ranches to low density housing subdivisions are all factors that could limit the amount of future livestock grazing in Catron County. Therefore, we project that, as a High estimate, the livestock sector will have a low growth rate, and as a Low estimate, it will remain at current levels.

Catron County Annual Growth Rate

	'10	'20	'30	'40	
Irrigated Agriculture	-1.00%	-1.00%	-1.00%	-1.00%	Low
	0.00%	0.00%	0.00%	0.00%	High
Livestock	0.00%	0.00%	0.00%	0.00%	Low
	0.50%	0.50%	0.50%	0.50%	High

Grant

The second largest water user in the County, after mining, is irrigated agriculture, which consumes approximately 23 percent of the total water used in the County. The amount of land in irrigated agriculture declined approximately 13% from 1970 to 1984 and has since held steady at 6,950 acres. We project that irrigated agriculture will either continue to hold steady (High estimate) or show a gradual decline (Low estimate).

There is little significant livestock activity in the County, and there are no foreseeable trends that will change to this sector. We project that water use associated with the livestock sector will grow at a low rate as a High projection, or will have no growth as a Low projection.

Grant County Annual Growth Rate

	'10	'20	'30	'40	
Irrigated Agriculture	-1.00%	-1.00%	-1.00%	-1.00%	Low
	0.00%	0.00%	0.00%	0.00%	High
Livestock	0.00%	0.00%	0.00%	0.00%	Low
	0.50%	0.50%	0.50%	0.50%	High

Hidalgo

Irrigated agriculture has historically used, and continues to use the largest amount of water in Hidalgo County, consuming 82 percent. Of all of the counties in the Southwest region, it is projected the Hidalgo has the most potential and impetus to increase the amount of irrigated agriculture it supports. The total amount of irrigated cropland in the County has increased from 35,240 acres in 1970 to 38,420 acres in 2000. We project that the amount of irrigated agriculture will show a moderate increase as a High estimate and will maintain current levels as a Low estimate.

A 20,000 head feedlot for cattle is expected to begin operating in 2004-05 in Hidalgo, significantly increasing the amount of livestock in the County. In addition, there is the possibility of another 20,000 head feedlot being built in the next five to seven years.

Assuming that one head will consume approximately 20 gallons of water per day, 20,000 head will require 400,000 gallons of water per day. 400,000 gallons equates to about one and a quarter acre-feet. For an entire year, 20,000 head would consume almost 450 acre-feet of water.

In both our High and our Low projection for the Livestock sector we show a large increase in the 2000-2010 time period due to the construction of proposed feed lots. In both scenarios we show the sector returning to a zero to low growth scenario after 2010.

Hidalgo County Annual Growth Rate

	'10	'20	'30	'40	
Irrigated Agriculture	0.00%	0.00%	0.00%	0.00%	Low
	1.00%	1.00%	1.00%	1.00%	High
Livestock	8.82%	0.00%	0.00%	0.00%	Low
	13.46%	0.50%	0.50%	0.50%	High

Luna

Irrigated agriculture has historically used, and continues to use, the largest amount of water in Luna County, consuming 95 percent. Of all the counties in the Southwest region, Luna has the most land in irrigated agriculture, holding steady at 73,950 acres. This is an increase of almost 2,500 acres since 1970. However, power producers and the City of Deming are buying agricultural water rights for future use in residential, commercial and industrial development. Therefore, we predict that the amount of irrigated agriculture will remain at near current levels as a High estimate or slowly decline over the next forty years as a Low estimate.

We do not foresee any significant changes in the livestock sector that would suggest large changes in water use in the County.

Luna County Annual Growth Rate

	'10	'20	'30	'40	
Irrigated Agriculture	-1.00%	-1.00%	-1.00%	-1.00%	Low
	0.00%	0.00%	0.00%	0.00%	High
Livestock	0.00%	0.00%	0.00%	0.00%	Low
	0.50%	0.50%	0.50%	0.50%	High

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Appendix E5

Projected Water Use

Projected Water Uses by Sector and County

Catron County	2000 Total Withdrawal (acre-feet)	10 Year % Growth by 2010	2010 Water Use (acre-feet)	10 Year % Growth by 2020	2020 Water Use (acre-feet)	10 Year % Growth by 2030	2030 Water Use (acre-feet)	10 Year % Growth by 2040	2040 Water Use (acre-feet)
commercial low	41 (1)	0	41	0	41	0	41	0	41
commercial high (3)	41	12	46	5.8	49	1.3	49	1.1	50
industrial low	8 (1)	0	8	0	8	0	8	0	8
industrial high	8	0	8	0	8	0	8	0	8
mining low	0 (1)	0	0	0	0	0	0	0	0
mining high (4)	0	0	1,000	0	1,000	0	1,000	0	1,000
power low	0	0	0	0	0	0	0	0	0
power high	0	0	0	0	0	0	0	0	0
irrigated land low	19,963 (1)	-9.6	18,055	-9.6	16,329	-9.6	14,768	-9.6	13,356
irrigated land high	19,963	14	22,764 (2)	0.0	22,764	0.0	22,764	0.0	22,764
livestock low	332 (1)	0	332	0	332	0	332	0	332
livestock high	332	5.1	349	5.1	367	5.1	386	5.1	405
domestic low	268 (5)	0	268	0	268	0	268	0	268
domestic high	268	12	301	5.8	318	1.3	322	1.1	326
domestic highest	268	12.11	301	12.11	337	12.11	377	12.11	422
Safety Factor	916		1,008		1,029		1,034		1,039

(1) OSE 2000 value

(2) Assumes 20%± of 14,000 acre feet of CAP water available by 2010 in Catron County.

(3)

Estimated Annual Growth Rates			
2010	2020	2,030	2040
0.0 Low	0.0 Low	0.0 Low	0.0 Low
1.15 High	0.57 High	0.13 High	0.11 High
1.15 Highest	1.15 Highest	1.15 Highest	1.15 Highest

(4) Assumes CO_2 mining is underway by 2010.

(5) DBS&A estimate

P:_Wr03-004_04-032\RegWtrPln.5-05\AppxE\E5_sectorprojectedwater_Final.xls Catron

Projected Water Uses by Sector and County

Grant County	2000 Total Withdrawal (acre-feet)	10 Year % Growth by 2010	2010 Water Use (acre-feet)	10 Year % Growth by 2020	2020 Water Use (acre-feet)	10 Year % Growth by 2030	2030 Water Use (acre-feet)	10 Year % Growth by 2040	2040 Water Use (acre-feet)
commercial low (3)	242 (1)	-4.9	230	6.2	244	5	256	4	266
commercial high	242	-4.9	230	1,100	3,030 (2)	10.46	3,347	10.46	3,697
industrial low	11 (1)	0	11	0	11	0	11	0	11
industrial high	11	62.9	18	34.4	24	10.5	27	0	27
mining low	21,458 (1)	0.0	21,458	0.0	21,458	0.0	21,458	0.0	21,458
mining high	21,458 (4)	77	38,000	0	38,000	0	38,000	0	38,000
power low	280 (1)	0	280	0	280	0	280	0	280
power high	280	0	280	0	280	0	280	0	280
irrigated land low	29,871	-9.6	27,015	-9.6	24,433	-9.6	22,097	-9.6	19,984
irrigated land high	29,871	4.7	31,272	0.0	31,272	0.0	31,272	0.0	31,272
livestock low	419 (1)	0	419	0	419	0	419	0	419
livestock high	419	5.1	440	5.1	463	5.1	487	5.1	511
domestic low	923 (1)	-5	876	6.2	931	5	1,017	4	1,057
domestic high	923	-5	876	10.5	968	10.5	1,070	10.5	1,182
domestic highest	923	10.5	1,019	10.5	1,126	10.5	1,245	10.5	1,375
Safety Factor	1,213		1,342		1,453		1,575		1,709

(1) OSE 2000 value

(2) Assumes 10% of 14,000 acre-feet of water available by 2010, for irrigation and 20% by 2020 for commercial.

(3)

Estimated Annual Growth Rates			
2010	2020	2030	2040
-0.50 Low	0.61 Low	0.48 Low	0.41 Low
-0.50 High	1.00 High	1.00 High	1.00 High
1.00 Highest	1.00 Highest	1.00 Highest	1.00 Highest

(4) High value based on 29,000 acre feet available at Chino/Cobre and 9,000 acre-feet use at Tyrone.

Projected Water Uses by Sector and County

Hidalgo County	2000 Total Withdrawal (acre-feet)	10 Year % Growth by 2010	2010 Water Use (acre-feet)	10 Year % Growth by 2020	2020 Water Use (acre-feet)	10 Year % Growth by 2030	2030 Water Use (acre-feet)	10 Year % Growth by 2040	2040 Water Use (acre-feet)
commercial low (3)	512 (1)	-2.2	501	-3.1	486	-4.3	465	-4.9	442
commercial high	512	13.4	580	5.4	612	0.5	615	0.1	616
industrial low (3)	6 (1)	0.0	6	0.0	6	0.0	6	0.0	6
industrial high	6	10.5	7	10.5	7	10.5	8	10.5	9
									0
mining low	4,332 (1)	-90 (6)	433	0.0	433	0.0	433	0.0	433
mining high (4)	4,332	-90 (6)	433	0.0	433	0.0	433	0.0	433
									0
power low	0 (1)	--	0	0	0	0	0	0	0
power high	0	--	720 (5)	0	720	0	720	0	720
									0
irrigated land low	41,884 (1)	30 (7)	54,449	-9.6	49,244	-9.6	44,536	-9.6	40,278
irrigated land high	41,884	36.7 (2,7)	57,247	0	57,247	0	57,247	0	57,247
									0
livestock low	320 (1)	132.9	745	0.0	745	0.0	745	0.0	745
livestock high	320	254 (4)	1,131	5.1	1,189	5.1	1,250	5.1	1,314
domestic low (3)	200 (8)	-2.2	195	-3.1	189	-4.3	181	-4.9	172
domestic high	200	13.3	226	5.4	239	0.5	240	0.1	240
domestic highest	200	13.3	226	13.3	256	13.3	291	13.3	329

(1) OSE 2000 value

(2) Assumes 20% of 14,000 acre-feet of CAP water available by 2010 in Hidalgo County (2,800 ac-ft per year).

(3)

Estimated Annual Growth Rates			
2010	2020	2030	2040
-0.22 Low	-0.31 Low	-0.44 Low	-0.5 Low
1.26 High	0.53 High	0.05 High	0.01 High

(4) Assumes one 20,000 head feedlot by 2010.

(5) Assumes power generation is increased to historical high level in 1980.

(6) Declined due to closure of Hidalgo Smelter in Playas.

(7) Transfer of water rights from the Hidalgo smelter to irrigation (for 3,500 acres at 3.6 ac-ft/acre)

(8) DBS&A estimate

Projected Water Uses by Sector and County

Luna County	2000 Total Withdrawal (acre-feet)	10 Year % Growth by 2010	2010 Water Use (acre-feet)	10 Year % Growth by 2020	2020 Water Use (acre-feet)	10 Year % Growth by 2030	2030 Water Use (acre-feet)	10 Year % Growth by 2040	2040 Water Use (acre-feet)
commercial low (3)	186 (1)	13	210	11	233	8	252	6.5	268
commercial high	186	28	238	23	293	17	343	13	387
industrial low (3)	55 (1)	22	67	22	82	22	100	22	121
industrial high	55	63	90	48	133	34	178	22	217
mining low	41 (1)	0	41	0	41	0	41	0	41
mining high	41	0	41	0	41	0	41	0	41
power low	0	0	0	0	0	0	0	0	0
power high	0 (2)	0	1,120	96 (4)	2,203	0	2,203	0	2,203
irrigated land low	114,183 (1)	-9.56	103,267	-9.56	93,395	-9.56	84,466	-9.56	76,391
irrigated land high	114,183	0	114,183	0	114,183	0	114,183	0	114,183
livestock low	424 (1)	0	424	0	424	0	424	0	424
livestock high	424	5.1	446	5.1	468	5.1	492	5.1	518
domestic low (3)	676 (5)	13	764	11	848	8	916	6.5	976
domestic high	676	28	866	23	1,065	17	1,246	13	1,408
domestic highest	676	27.76	864	27.76	1,104	27.76	1,410	27.76	1,802

(1) OSE 2000 value

(2) Assumes Duke Power plant is on-line using about 1,000,000 gallons per day by 2005.

(3)

Estimated Annual Growth Rates			
2010	2020	2030	2040
1.24 Low	1.04 Low	0.81 Low	0.64 Low
2.48 High	2.07 High	1.61 High	1.27 High

(4) Assumes power generation is doubled about 2020.

(5) DBS&A estimate

Appendix F

Groundwater Budgets

Table F-1. Recharge Estimates for the Southwest New Mexico Water Planning Region

Basin	County	Precipitation (Inches)	Area (square miles)	Area (acres)	Recharge Coefficient (%)	Recharge (acre-ft)	Percentage of Precipitation that Recharges Groundwater
Animas	Grant	10	205	131,143	1.0	1,093	
Animas	Grant	12	131	84,102	1.5	1,262	
Animas	Grant	16	7	4,197	4.7	263	
Animas	Grant	8	334	213,477	0.0	0	
Animas	Hidalgo	10	604	386,502	1.0	3,221	
Animas	Hidalgo	12	444	284,200	1.5	4,263	
Animas	Hidalgo	16	139	89,093	4.7	5,583	
Animas	Hidalgo	20	8	4,870	4.7	382	
Animas	Hidalgo	8	487	311,877	0.0	0	
Animas	Luna	10	10	6,168	1.0	51	
Animas	Luna	12	1	863	1.5	13	
Animas	Luna	8	26	16,800	0.0	0	
Total			**2,396**	1,533,292		**16,130**	**1.2**
Gila	Catron	12	708	453,343	1.5	6,800	
Gila	Catron	16	335	214,194	4.7	13,423	
Gila	Catron	20	145	93,033	4.7	7,288	
Gila	Catron	25	61	38,883	4.7	3,807	
Gila	Catron	30	5	3,038	4.7	357	
Gila	Grant	10	115	73,863	1.0	616	
Gila	Grant	12	1,045	668,940	1.5	10,034	
Gila	Grant	16	593	379,725	4.7	23,796	
Gila	Grant	20	103	66,022	4.7	5,172	
Gila	Grant	25	10	6,218	4.7	609	
Gila	Hidalgo	10	169	108,028	1.0	900	
Gila	Hidalgo	12	18	11,662	1.5	175	
Gila	Hidalgo	8	45	28,566	0.0	0	
Total			**3,352**	**2,145,516**		**72,976**	**3.0**
Hachita - Moscos	Grant	10	49	31,481	1.0	262	
Hachita - Moscos	Grant	12	6	4,029	1.5	60	
Hachita - Moscos	Grant	8	60	38,666	0.0	0	
Hachita - Moscos	Hidalgo	10	181	115,925	1.0	966	
Hachita - Moscos	Hidalgo	12	193	123,682	1.5	1,855	
Hachita - Moscos	Hidalgo	16	3	1,666	4.7	104	
Hachita - Moscos	Hidalgo	18	0	90	4.7	6	
Hachita - Moscos	Luna	10	164	104,834	1.0	874	
Hachita - Moscos	Luna	12	11	7,033	1.5	105	
Hachita - Moscos	Luna	8	85	54,123	0.0	0	
Total			**752**	**481,529**		**4,234**	**1.0**

Table F-1. Recharge Estimates for the Southwest New Mexico Water Planning Region

Basin	County	Precipitation (inches)	Area (square miles)	Area (acres)	Recharge Coefficient (%)	Recharge (acre-ft)	Percentage of Precipitation that Recharges Groundwater
Little Colorado	Catron	10	537	343,615	1.0	2,863	
Little Colorado	Catron	12	665	425,802	1.5	6,387	
Little Colorado	Catron	16	206	131,654	4.7	8,250	
Little Colorado	Catron	20	16	10,007	4.7	784	
Little Colorado	Catron	6	10	6,505	0.0	0	
Little Colorado	Catron	8	372	237,958	0.0	0	
Total			**1,806**	**1,155,541**		**18,285**	**1.7**
Lower Rio Grande	Grant	20	0.1	49	4.7	4	
Lower Rio Grande	Grant	25	0.4	253	4.7	25	
Lower Rio Grande	Grant	30	0.1	33	4.7	4	
Total			**97.2**	**62,220.0**		**961**	**1.5**
Mimbres	Grant	10	228	145,755	1.0	1,215	
Mimbres	Grant	12	459	293,483	1.5	4,402	
Mimbres	Grant	16	242	154,592	4.7	9,688	
Mimbres	Grant	20	99	63,285	4.7	4,957	
Mimbres	Grant	25	29	18,442	4.7	1,806	
Mimbres	Grant	30	5	2,958	4.7	348	
Mimbres	Grant	8	58	37,127	0.0	0	
Mimbres	Luna	10	329	210,410	1.0	1,753	
Mimbres	Luna	12	64	40,718	1.5	611	
Mimbres	Luna	16	5	3,311	4.7	207	
Mimbres	Luna	8	2,135	1,366,334	0.0	0	0.2
Total			**3,651**	**2,336,414**		**24,987**	**1.3**
North Plains	Catron	10	160	102,336	1.0	853	
North Plains	Catron	12	14	8,797	1.5	132	
North Plains	Catron	8	121	77,637	0.0	0	
Total			**295**	**188,770**		**985**	**0.7**
Nutt - Hocket	Luna	10	50	31,775	1.0	265	
Nutt - Hocket	Luna	8	89	57,071	0.0	0	
Total			**139**	**88,846**		**265**	**0.4**
Playas - San Basilio	Grant	10	37	23,720	1.0	198	
Playas - San Basilio	Grant	12	6	3,680	1.5	55	
Playas - San Basilio	Hidalgo	10	400	255,750	1.0	2,131	
Playas - San Basilio	Hidalgo	12	389	248,809	1.5	3,732	
Playas - San Basilio	Hidalgo	16	39	24,690	4.7	1,547	
Playas - San Basilio	Hidalgo	18	6	3,928	4.7	277	
Playas - San Basilio	Hidalgo	20	2	1,405	4.7	110	
Playas - San Basilio	Hidalgo	8	48	30,792	0.0	0	
Total			**926**	**592,774**		**8,050**	**1.5**

Table F-1. Recharge Estimates for the Southwest New Mexico Water Planning Region
Page 3 of 3

Basin	County	Precipitation (inches)	Area (square miles)	Area (acres)	Recharge Coefficient (%)	Recharge (acre-ft)	Percentage of Precipitation that Recharges Groundwater
Rio Grande	Catron	16	1	593	4.7	37	
Rio Salado	Catron	10	134	85,510	1.0	713	
Rio Salado	Catron	12	94	60,401	1.5	906	
Rio Salado	Catron	16	4	2,352	4.7	147	
Rio Salado	Catron	8	4	2,757	0.0	0	
Total			**237**	**151,613**		**1,803**	**1.3**
San Agustin Plains	Catron	10	508	325,231	1.0	2,710	
San Agustin Plains	Catron	12	779	498,531	1.5	7,478	
San Agustin Plains	Catron	16	192	122,893	4.7	7,701	
San Agustin Plains	Catron	20	9	5,524	4.7	433	
San Agustin Plains	Catron	8	53	33,634	0.0	0	
Total			**1,540**	**985,813**		**18,322**	**1.9**
San Bernadino	Hidalgo	12	17	10,892	1.5	163	
San Bernadino	Hidalgo	16	18	11,399	4.7	714	
San Bernadino	Hidalgo	20	1	871	4.7	68	
Total			**36**	**23,161**		**946**	**3.4**
San Francisco	Catron	12	651	416,768	1.5	6,252	
San Francisco	Catron	16	808	517,425	4.7	32,425	
San Francisco	Catron	20	202	129,337	4.7	10,131	
San Francisco	Catron	25	45	28,654	4.7	2,806	
San Francisco	Catron	30	4	2,608	4.7	306	
San Francisco	Grant	12	70	45,066	1.5	676	
San Francisco	Grant	16	81	51,554	4.7	3,231	
San Francisco	Grant	20	3	1,617	4.7	127	
Total			**1,864**	**1,193,029**		**55,954**	**3.7**
San Simon	Hidalgo	10	121	77,263	1.0	644	
San Simon	Hidalgo	12	60	38,639	1.5	580	
San Simon	Hidalgo	16	42	26,977	4.7	1,691	
San Simon	Hidalgo	8	20	12,818	0.0	0	
Total			**243**	**155,697**		**2,914**	**2.0**

Table F-2. San Simon Basin Groundwater Budget

Component	Hidalgo Co. part	
	Flow (ac-ft/yr)	Reference
Inflow		
Recharge	2,914	See Table F-1
Stream loss		Unknown
Flow from adjacent basin		Unknown
Return flow Municipal	8	50% of municipal diversions
Return flow mining	0	Wilson et al., 2003
Return flow irrigation	543	Wilson et al., 2003
Total Inflow	3,465	
Outflow		
Municipal wells	16	Wilson et al., 2003, see Table F-14
Commercial (self-supplied)	4	Wilson et al., 2003, see Table F-14
Domestic wells	5	See Table F-15
Irrigation wells	1,339	Wilson et al., 2003, see Table F-14
Industrial (self-supplied)	0	Wilson et al., 2003
Livestock (self-supplied)	0	Wilson et al., 2003
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14
Power (self-supplied)	0	Wilson et al., 2003
Evapotranspiration		Unknown
Springs/stream gain		Unknown
Sub flow out	2,101	Balance budget, based on WL contours
Total Outflow	3,465	
Error and/or change in storage	0	

EF = On farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

Table F-3. Animas Basin Groundwater Budget

Component	Luna Co. part		Grant Co. part		Hidalgo Co. part		Total Basin Flow (ac-ft/yr)
	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	
Inflow							
Recharge	64	See Table F-1	2,617	See Table F-1	13,449	See Table F-1 (12,758 Hawley et al., pg 90)	16,130
Stream loss		Unknown		Unknown		Unknown	0
Flow from adjacent basin		Unknown		Unknown		Unknown	0
Return flow Municipal	0	Wilson et al., 2003	0	Wilson et al., 2003	415	Wilson et al., 2003	415
Return flow mining	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Return flow irrigation	0	Wilson et al., 2003	262	Wilson et al., 2003, 55% EF	11,711	Wilson et al., 2003	11,973
Total Inflow	64		2,879		25,575		28,518
Outflow							
Municipal wells	0	Wilson et al., 2003	0	Wilson et al, 2003	830	Wilson et al., 2003 and Eng. Inc., see Table F-14	830
Commercial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	502	Wilson et al., 2003, see Table F-14	502
Domestic wells	0	see Table F-15	39	see Table F-15	139	see Table F-15	177
Irrigation wells	0	Wilson et al., 2003	582	Wilson et al., 2003, see Table F-14	27,225	Wilson et al., 2003, see Table F-14	27,807
Industrial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	3	Wilson et al., 2003, see Table F-14	3
Livestock (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Power (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Evapotranspiration		Unknown		Unknown		Unknown	0
Springs/stream gain		Unknown		Unknown		Unknown	0
Sub flow out		Unknown		Unknown	2,700	Reeder, 1957 pg 25 to Gila	2,700
Total Outflow	0		621		31,398		32,019
Error and/or change in storage	64		2,258		-5,823		-3,501

EF = On farm irrigation efficiency (Wilson et al., 2003)

Table F-4. Playas-San Basilio Groundwater Basin Water Budget

Component	Grant Co. part		Hidalgo Co. part		Total Basin Flow (ac-ft/yr)
	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	
Inflow					
Recharge	253	see Table F-1	7,798	see Table F-1 (5,670 Hawley et al., 2000 pg 70)	8,051
Stream loss		unknown		unknown	0
Flow from adjacent basin		unknown		unknown	0
Return flow Municipal	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Return flow mining	0	Wilson et al., 2003	216	Wilson et al., 2003	216
Return flow irrigation	0	Wilson et al., 2003	892	Wilson et al 2003 (55% EF)	892
Total Inflow	253		8,906		9,159
Outflow					
Municipal wells	0	Wilson et al., 2003	13	Eng. Inc, see Table F-14	13
Commercial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Domestic wells	0	see Table F-15	19	see Table F-15	19
Irrigation wells	0	Wilson et al., 2003	1,983	Wilson et al., 2003, see Table F-14	1,983
Industrial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Livestock (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14	4,332	Wilson et al., 2003	4,332
Power (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Evapotranspiration	253	Balance budget, based on water level contours	2,552	Balance budget, based on water level contours	2,805
Springs/stream gain		unknown		unknown	0
Sub flow out		unknown	7	Hawley et al., 2000 pg 70	7
Total Outflow	253		8,906		9,159
Error and/or change in storage	0		0		0

EF = On-farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

Table F-5. Hachita-Moscos Basin Groundwater Budget

Component	Luna Co. part		Grant Co. part		Hidalgo Co. part		Total Basin
	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)
Inflow							
Recharge	979	See Table F-1	323	See Table F-1	2,932	See Table F-1	4,234
Stream loss		Unknown		Unknown		Unknown	0
Flow from adjacent basin		Unknown		Unknown	7	Hawley, 2000, pg 70	7
Return flow Municipal	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Return flow mining	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Return flow irrigation	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Total Inflow	979		323		2,939		4,241
Outflow							
Municipal wells	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Commercial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Domestic wells	13	See Table F-15	9	See Table F-15	0.4	See Table F-15	22
Irrigation wells	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Industrial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Livestock (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	60	Wilson et al., 2003, RG	60
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Power (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Evapotranspiration		Unknown	310	Balance budget, based on water level contours	1,990	Balance budget, based on water level contours	2,300
Springs/stream gain		Unknown		Unknown		Unknown	0
Sub flow out	970	Hawley et al., 2000, pg 57	0	Hawley et al., 2000	890	Hawley, 2000, pg 55	1,860
Total Outflow	983		319		2,940		4,241
Error and/or change in storage	-4		4		-1		0

EF = On-farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

Table F-6. Mimbres Basin Groundwater Budget

Component	Luna Co. part		Grant Co. part		Total Basin Flow (ac-ft/yr)
	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	
Inflow					
Recharge	2,572	See Table F-1 (30,000 Hanson et al., pg 39)	22,415	See Table F-1 (25,200 Hanson et al., pg 39, 14,300 Trauger [pg 62)	24,987
Stream loss	10,000	Hawley et al., pg 39 (13,300 Hanson, et a; pg 39)	0	Hanson et al.	10,000
Flow from adjacent basin	0	Hanson et al., 1994 pg 43, Hawley et al., 2000	0	Hawley et al., 2000 pg 39	0
rF	2,160	50% of Municipal Diversions	1,507	50% of Municipal Diversions	3,667
Return flow mining	6	Wilson et al., 2003	3,804	Wilson et al., 2003	3,810
Return flow irrigation	45,256	RF from SW and GW	3,470	55 and 65% EF from GW and SW	48,726
Total Inflow	59,994		31,196		91,190
Outflow					
Municipal wells	4,320	Wilson et al., 2003 & Eng. Inc, see Table F-14	3,013	Wilson et al., 2003 & Eng. Inc, see Table F-14	7,333
Commercial (self-supplied)	176	Wilson et al., 2003, see Table F-14	24	Wilson et al., 2003, see Table F-14	199
Domestic wells	656	see Table F-15	817	see Table F-15	1,473
Irrigation wells	75,242	Mimbres River	3,044	Wilson et al., 2003, see Table F-14	78,286
Industrial (self-supplied)	42	Wilson et al., 2003, see Table F-14	0	Wilson et al., 2003	42
Livestock (self-supplied)	342	RG (part may be in Nutt-Hocket area)	69	Wilson et al., 2003	410
Mining (self-supplied)	7	Wilson et al., 2003 see Table F-14	18,714	Wilson et al., 2003	18,721
Power (self-supplied)	0	Wilson et al., 2003	280	Wilson et al., 2003	280
Evapotranspiration	10,000	Range is probably 0 to more than 10,000 afy. WRRI et al 2000 suggest that irrigation wells are diverting the majority of the predevelopment ET estimate of 42,000 by Hanson et al., 1994.	3,400	Hanson et al., 1994 pg 39	13,400
Springs/stream gain			4,800	Hanson et al., 1994 pg 39 (14,300 Trauger, 1972)	4,800
Sub flow out	0	Hawley et al., 2000	0	Hanson et al., 1994, pg 43	0
Total Outflow	90,784		34,161		124,945
Error and/or change in storage	-30,790		-2,965		-33,755

EF = On farm irrigation efficiency (Wilson et al., 2003)

Table F-7. Nutt-Hockett Basin Groundwater Budget

Component	Luna Co. part	
	Flow (ac-ft/yr)	Reference
Inflow		
Recharge	265	See Table F-1
Stream loss		Unknown
Flow from adjacent basin		Unknown
Return flow Municipal	0	Wilson et al., 2003
Return flow mining	20	Wilson et al., 2003
Return flow irrigation	5,500	Wilson et al., 2003
Total Inflow	5,786	
Outflow		
Municipal wells	0	Wilson et al., 2003
Commercial (self-supplied)	0	Wilson et al., 2003
Domestic wells	8	DBS&A Calc, see Table F-15
Irrigation wells	16,432	Wilson et al., 2003, see Table F-14
Industrial (self-supplied)	0	Wilson et al., 2003
Livestock (self-supplied)	0	Wilson et al., 2003
Mining (self-supplied)	34	Wilson et al., 2003 see Table F-14
Power (self-supplied)	0	Wilson et al., 2003
Evapotranspiration		Unknown
Springs/stream gain		Unknown
Sub flow out		Unknown
Total Outflow	16,474	
Error and/or change in storage	-10,688	

EF = On farm irrigation efficiency (Wilson et al., 2003)

Table F-8. Gila Basin Groundwater Budget

Component	Catron Co. part		Grant Co. part		Hidalgo Co. part		Total Basin
	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)
Inflow							
Recharge	31,675	See Table F-1	40,226	See Table F-1 (60,000 Trauger 1972)	1,075	See Table F-1	72,976
Stream loss		Unknown		Unknown		Unknown	0
Flow from adjacent basin		Unknown			2,700	Reeder, 1957, pg 25 from Animas	2,700
Return flow Municipal	0	Wilson et al., 2003	593	50% of municipal diversions (including surface diversions)	12	50% of municipal diversions	605
Return flow mining	0	Wilson et al., 2003	467	Wilson et al., 2003, Tyrone	0	Wilson et al., 2003	467
Return flow irrigation	0	Wilson et al., 2003	20,475	return from GW and SW div	6,543	from GW and SW	27,018
Total Inflow	31,675		61,761		10,330		103,766
Outflow							
Municipal wells	0	Wilson et al., 2003	1,053	Wilson et al., 2003, see Table F-14	25	Wilson et al., 2003, see Table F-14	1,077
Commercial (self-supplied)	0	Wilson et al., 2003	121	Wilson et al., 2003, see Table F-14	2	Wilson et al., 2003, see Table F-14	123
Domestic wells	15	See Table F-15	51	See Table F-15	36	See Table F-15	102
Irrigation wells	0	Wilson et al., 2003	474	Upper Gila, Gila & Red Rocks	2,596	Wilson et al., 2003, see Table F-14	3,070
Industrial (self-supplied)	8	Wilson et al., 2003, see Table F-14	11	Wilson et al., 2003	0	Wilson et al., 2003	18
Livestock (self-supplied)	0	Wilson et al., 2003	148	Wilson et al., LC	200	LC	348
Mining (self-supplied)	0	Wilson et al., 2003	2,744	Wilson et al., 2003, see Table F-14	0	Wilson et al., 2003	2,744
Power (self-supplied)	0	Wilson et al., 2003 see Table F-14	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Evapotranspiration		Unknown		Unknown		Unknown	0
Springs/stream gain		Unknown	54,604	see calc below (60,000 Trauger, pg 61)		Unknown	54,604
Sub flow out		Unknown		Unknown		Unknown	41,680
Total Outflow	23		59,205		2,858		103,766
Error and/or change in storage	31,652		2,556		7,472		0

EF = On farm irrigation efficiency (Wilson et al., 2003)
Shaded values represent estimate based on water budget balance and water level contours

130,788	Median flow, Gila River below Blue Creek, near Virden
102,656	Less median flow, Gila River near Gila
28,132	Gain
22,462	Plus adjustment for surface water diversions
4,010	Plus adjustment for riparian ET
54,604	**Total stream gain**

Table F-9. San Francisco Basin Groundwater Budget

Component	Catron Co. part		Grant Co. part		Total Basin
	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)	Reference	Flow (ac-ft/yr)
Inflow					
Recharge	51,920	See Table F-1	4,033	See Table F-1	55,953
Stream loss	0	DBS&A Estimate		Unknown	0
Flow from adjacent basin		Unknown		Unknown	0
Return flow municipal	53	50% of municipal diversions	0	Wilson et al., 2003	53
Return flow mining	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Return flow irrigation	15,941	Wilson et al., 2003	0	Wilson et al., 2003	15,941
Total Inflow	67,914		4,033		71,947
Outflow					
Municipal wells	106	Wilson et al., 2003, see Table F-14	0	Wilson et al., 2003	106
Commercial (self-supplied)	24	Wilson et al., 2003, see Table F-14	1	Wilson et al., 2003, see Table F-14	25
Domestic wells	133	See Table F-15	7	See Table F-15	140
Irrigation wells	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Industrial (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Livestock (self-supplied)	33	Wilson et al., 2003, split with Little Colorado	0	Wilson et al., 2003	33
Mining (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Power (self-supplied)	0	Wilson et al., 2003	0	Wilson et al., 2003	0
Evapotranspiration		Unknown		Unknown	0
Springs/stream gain	59,927	DBS&A Calc, see below		Unknown	59,927
Sub flow out		Unknown		Unknown	11,717
Total Outflow	60,223		8		71,947
Error and/or change in storage	7,691		4,025		0

EF = On-farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

50,034	Median flow, San Francisco River near Glenwood
12,161	Less median flow, San Francisco River near Reserve
37,873	Gain
17,564	Plus adjustment for surface water diversions
4,490	Plus adjustment for riparian ET
59,927	Calculated gain from groundwater

Table F-10. San Agustin Plains Basin Groundwater Budget

Component	Catron Co. part	
	Flow (ac-ft/yr)	Reference
Inflow		
Recharge	18,322	See Table F-1
Stream loss		Unknown
Flow from adjacent basin	0	Meyers et al., 1994
Return flow municipal	0	Wilson et al., 2003
Return flow mining	0	Wilson et al., 2003
Return flow irrigation	153	Wilson et al., 2003 (55% EF)
Total Inflow	18,475	
Outflow		
Municipal wells	0	Wilson et al., 2003
Commercial (self-supplied)	4	Wilson et al., 2003, see Table F-14
Domestic wells	58	See Table F-15
Irrigation wells	339	Wilson et al., 2003, see Table F-14
Industrial (self-supplied)	0	Wilson et al., 2003
Livestock (self-supplied)	55	half of Wilson's estimate for Rio Grande in Catron Co.
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14
Power (self-supplied)	0	Wilson et al., 2003
Evapotranspiration	18,019	Balance budget, based on water level contours
Springs/stream gain		Unknown
Sub flow out	0	Meyers et al., 1994
Total Outflow	18,475	
Error and/or change in storage	0	

EF = On-farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

Table F-11. Little Colorado Basin Groundwater Budget

Component	Catron Co. Part	
	Flow (ac-ft/yr)	Reference
Inflow		
Recharge	18,285	See Table F-1
Stream loss		Unknown
Flow from adjacent basin	0	
Return flow municipal	21	50% of municipal diversions
Return flow mining	0	Wilson et al., 2003
Return flow irrigation	1,267	Wilson et al., 2003 (from SW Diversions
Total Inflow	19,573	
Outflow		
Municipal wells	41	Wilson et al., 2003, & Eng. Inc. see Table F-14
Commercial (self-supplied)	4	Wilson et al., 2003, see Table F-14
Domestic wells	59	See Table F-15
Irrigation wells	0	Wilson et al., 2003
Industrial (self-supplied)	0	Wilson et al., 2003
Livestock (self-supplied)	33	Wilson et al., 2003, split between San Francisco drainage
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14
Power (self-supplied)	0	Wilson et al., 2003
Evapotranspiration		Unknown
Springs/stream gain		Unknown
Sub flow out	19,436	Balance budget, based on water level contours
Total Outflow	19,573	
Error and/or change in storage	0	

EF = On-farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

Table F-12. North Plains Basin Groundwater Budget

Component	Catron Co. part	
	Flow (ac-ft/yr)	Reference
Inflow		
Recharge	985	See Table F-1
Stream loss		Unknown
Flow from adjacent basin		Unknown
Return flow municipal	0	Wilson et al., 2003
Return flow mining	0	Wilson et al., 2003
Return flow irrigation	0	Wilson et al., 2003
Total Inflow	985	
Outflow		
Municipal wells	0	Wilson et al., 2003
Commercial (self-supplied)	0	Wilson et al., 2003
Domestic wells	3	DBS&A Calc, see Table F-15
Irrigation wells	0	Wilson et al., 2003
Industrial (self-supplied)	0	Wilson et al., 2003
Livestock (self-supplied)	0	Wilson et al., 2003
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14
Power (self-supplied)	0	Wilson et al., 2003
Evapotranspiration		Unknown
Springs/stream gain		Unknown
Sub flow out	982	Balance budget, based on water level contours
Total Outflow	985	
Error and/or change in storage	0	

Shaded values represent estimate based on water budget balance and water level contours

Table F-13. Rio Salado Basin Groundwater Budget

Component	Catron Co. part	
	Flow (ac-ft/yr)	Reference
Inflow		
Recharge	1803	See Table F-1
Stream loss		Unknown
Flow from adjacent basin		Unknown
Return flow municipal	0	Wilson et al., 2003
Return flow mining	0	Wilson et al., 2003
Return flow irrigation	0	Wilson et al., 2003
Total Inflow	1803	
Outflow		
Municipal wells	0	Wilson et al., 2003
Commercial (self-supplied)	0	Wilson et al., 2003
Domestic wells	0	See Table F-15
Irrigation wells	0	Wilson et al., 2003
Industrial (self-supplied)	0	Wilson et al., 2003
Livestock (self-supplied)	55	half of Wilson's estimate for Rio Grande in Catron Co.
Mining (self-supplied)	0	Wilson et al., 2003 see Table F-14
Power (self-supplied)	0	Wilson et al., 2003
Evapotranspiration		Unknown
Springs/stream gain		Unknown
Sub flow out	1748	Balance budget, based on water level contours
Total Outflow	1803	
Error and/or change in storage	0	

EF = On-farm irrigation efficiency (Wilson et al., 2003)

Shaded values represent estimate based on water budget balance and water level contours

Appendix G

OSE Guidance for Drought Management Plans

A WATER CONSERVATION GUIDE FOR PUBLIC UTILITIES

NEW MEXICO OFFICE OF THE STATE ENGINEER

MARCH 2001

1-800-WATER-NM

EMERGENCY ACTION PLAN FOR DROUGHT MANAGEMENT

PLANNING AHEAD TO AVOID CONFUSION

Recurring drought is a natural part of New Mexico's arid climate. Drought, which is defined as a prolonged period of below-normal rainfall, can have a widespread impact on communities—especially if those communities have not prepared for periods of drought or water shortages.

Drought contingency plans improve a water utility's efficiency and response time during a drought or water emergency. Planning ahead will enable the water utility to avoid confusion during a crisis when immediate action is required and ensure better results from water use reduction programs. The following procedure may be used to develop an emergency action plan for drought management.

DEVELOPING AN EMERGENCY ACTION PLAN

Water shortages may not be predictable, but preparations can be made so that the effect of water shortages—whether caused by drought, natural disaster, or other emergency—can be minimized.

Step 1: Form a Drought Task Force and Define its Structure and Membership

The responsibilities of the Drought Task Force must be clearly defined, and will typically include:

(1) supervising and coordinating the development of the plan
(2) public education
(3) monitoring reservoir levels, groundwater levels, and precipitation to estimate water shortages
(4) assessing the impact of shortages on each customer class and the economic livelihood of the community
(5) coordinating the implementation of drought mitigation actions
(6) monitoring compliance

Step 2: Prepare a History of Droughts in the Area

Prepare a chronological history of droughts in the study area and describe the effects on the community based upon articles published in newspapers, journals, professional papers, public records, and interviews with the public. Determine the reductions in demand that were necessary to provide adequate amounts of water to customers. Based on this information, what will be the impacts on the community with reduced allocations of water in the next drought? This information will play an important role in educating the public and gaining their support for the emergency action plan.

Step 3: Identify Supply Constraints

Identify constraints affecting the water utility's ability to meet water demand. These will include limits on supply and limits on system capacity.

- **Limits on Supply.** What are the limits on the utility's sources of water such as stream diversions, reservoir levels, aquifer yield, and water supply contracts? The firm yield of surface water and groundwater supplies should be established. The firm or sustainable yield of a stream or reservoir may be defined as the maximum quantity of water that can be withdrawn on a dependable basis, during a repetition of the most critical drought on record. The firm or sustainable yield of an aquifer may be defined as the average annual recharge from snowmelt and precipitation, seepage

from watercourses, and return flow from surface and groundwater withdrawals for water-use activities. Sustainable aquifer yield may also be defined as the annual withdrawal that does not result in a long-term decline in the water table.

- **Limits on System Capacity.** What are the limits on production, treatment, storage, and distribution capacity? During droughts, customer demand typically increases. However, older systems or systems serving rapidly growing areas may not have the infrastructure capacity to meet above-average demands.

Step 4: Examine Additional Supply Options

If the available supply is the limiting factor in meeting demand, evaluate supply augmentation options. The following questions must be asked:

- Are there existing wells or reservoirs that can be used?
- Can water be purchased from another water utility?
- Can unaccounted-for-water losses be reduced?
- Can wastewater be reused for non-potable water requirements?

In the event that a community is close to exhausting its water supplies entirely, additional options must be considered. These can include actions such as setting up agreements with neighboring communities to lease or share supplies and laying emergency pipelines to supply water on a temporary basis.

Step 5: Identify Necessary Infrastructure Improvements

If system capacity is the limiting factor in meeting demand, identify the critical system components that are vulnerable to failure or need to be upgraded and enlarged to meet the projected peak demand. Evaluate the feasibility of making infrastructure improvements and rank each option based on (1) feasibility of implementation and (2) effectiveness in increasing capacity.

When evaluating the effectiveness of a proposed change, the relationships between system components must be considered. For example, increasing pumping capacity at the source of supply will not increase the amount of water that can be delivered to customers if the treatment plant or distribution mains cannot handle the increased flow rate.

Step 6: Define Criteria That Will Trigger Drought Responses

Define trigger criteria that will determine the level of response required based upon the severity of drought. Acceptable triggers include the Palmer Index, precipitation, reservoir/lake storage, streamflow, groundwater levels, soil moisture, or any combination of these parameters. Criteria for the phaseout or a downgrade of the condition's severity should also be considered. The following are examples of trigger conditions that might be used for various levels of severity.

Phase 1 Trigger: Water Shortage Advisory

Snowpack, precipitation, streamflows, and reservoir levels are only 70% of normal.

Phase 2 Trigger: Water Shortage Watch

(1) Water demand has reached or exceeded a specific percentage of the firm capacity of the system.
(2) Reservoir or well levels are still high enough to provide an adequate supply, but the levels (specify level) are low enough to disrupt some other beneficial activity, such as recreation.
(3) The water supply is still adequate, but the reservoir or well levels are low enough that there is a possibility that the supply situation may become critical if the drought or emergency continues. An example is a reservoir that has a 12-month supply in storage, if no more rain occurs, or a well that has dropped to a specified level.

Phase 3 Trigger: Water Shortage Warning

(1) Water demand has reached the predetermined limit of the system, beyond which the failure of a pump or some other piece of equipment could cause a serious disruption of service to part or all of the system. An example might be that daily demand has exceeded 90% of the capacity of the system for three consecutive days.
(2) Reservoir levels, well levels, or streamflows have reached the second impact level, beyond which operational problems will occur.
(3) Water supply storage levels have declined to the second impact level.

Phase 4 Trigger: Water Shortage Emergency

(1) The imminent or actual failure of a major component of the system has occurred which will cause an immediate health or safety hazard.
(2) Water demand has reached or exceeded the third impact level. An example might be that demand exceeds the system's capacity on a regular basis, thereby presenting the imminent danger of a major system failure.
(3) Reservoir levels, well levels, or streamflows have declined to the third impact level. An example might be that reservoir levels (specify a level in feet above mean sea level) are so low that diversion or pumping equipment will not function properly.
(4) Water levels in the distribution storage reservoirs are too low to provide adequate fire protection.

Step 7: Specify Actions To Be Taken

Define the level of response and actions that will be taken in each phase. The following are examples of actions that might be taken for various levels of severity.

Phase 1 Response: Voluntary Conservation

(1) Provide the public with information on current storage levels in reservoirs and streamflows and the long-range forecasts for precipitation. Alert water customers to the possibility of implementing mandatory conservation measures if drought conditions persist.
(2) Inform the public by mail and through the news media that they should try to reduce their water use.
(3) Inform the public daily whether they should water or not water their lawns.

Phase 2 Response: Mandatory Conservation—Level 1

It is important that the water utility take a lead role in setting an example on efficient water use. Before the utility can expect cooperation from its customers, it must put its own house in order. The utility can demonstrate its intent to improve the efficiency of operations and minimize waste by pursuing any or all of the first three actions listed in this section.

(1) Implement leak detection and repair program.
(2) Reduce flushing of water mains, sewers, storm drains, and streets to the minimum necessary to maintain sanitary conditions.
(3) Reduce frequency and duration of irrigation at public landscape sites such as golf courses, athletic fields, parks, cemeteries, and greenbelts. Adopt irrigation schedules based on the results of water audits if available.
(4) Impose a mandatory lawn watering schedule such as alternate day sprinkling and restrictions on time of day for watering.
(5) Prohibit nonessential water uses such as ornamental fountains; pool filling; car, bus, and heavy equipment washing; washing and steam cleaning of building exteriors.

Phase 3 Response: Mandatory Conservation-Level—2

In addition to the above:
(1) Implement a special pricing structure.
(2) Distribute water-saving plumbing fixture kits.
(3) Curtail irrigation at athletic fields, parks, cemeteries, and greenbelts.
(4) Curtail fairway irrigation at all public and private golf courses using public water supplies, and reduce watering of tees and greens to a minimum.
(5) Prohibit all outdoor water use.

Phase 4 Response: Rationing

In addition to the above:
Limit the amount of water each customer can use and take legal action as needed to achieve compliance. For example, restrict residential water users to 45 gallons per capita per day and require a percentage reduction by commercial, institutional, and industrial users.

Step 8: Establish a Public Education Program

No drought plan will be successful without a comprehensive public education program. Customers must understand why their cooperation is needed before they will sacrifice water uses.

Customers must also be instructed in how to conserve. Often they are willing to cooperate but do not know how. The utility's credibility is crucial to the success of any drought program. Customers must believe that the utility is an authority on the drought situation and that the emergency action programs are necessary and effective. To maintain credibility, the utility must be consistent:

- each spokesperson must report the same data or advice
- each education effort must be coordinated
- programs should proceed without major changes.

Step 9: Establish Implementation Procedures

Procedures for the implementation of the emergency action plan should define when and how customers, other utilities, and government agencies are informed that the emergency action plan is going into effect. Procedures may include:

(1) automatic regulatory implementation provisions
(2) prearranged media notification or press release procedures
(3) direct notification procedures including mail, or, if needed, telephone notification systems
(4) prearranged contract procedures to obtain emergency water supplies from other sources if needed
(5) checklists or operating procedures as necessary.

Step 10: Establish Procedures for Termination Notification

The termination of water restrictions procedure should define when and how customers and others are informed that the emergency has passed and the program is being shut down. The establishment of termination triggers and the decision to terminate must be based on sound judgment by appropriate city or utility authorities.

Step 11: Obtain Legal Authority

Obtain the required legal authority and regulatory permits for implementing the individual measures in the emergency action plan. It is generally advantageous to adopt an ordinance or regulation providing authorization to a designated official to begin immediate implementation of contingency measures when a trigger condition is reached.

Prepare memorandums of agreement (MOA), and contracts as needed, with all agencies that will be players in the implementation of the drought action plan so that the role of all participants is clearly understood. Because verbal agreements are easily forgotten or compromised by changes in priorities or personnel within an agency, agreements must be documented in writing to ensure that they will be honored in time of need.

EMERGENCY ACTION PLAN FOR DROUGHT MANAGEMENT

SANTA FE WATER ORDINANCE RESTRICTIONS CHART

This table highlights the four stages of water restrictions outlined in the water conservation ordinance adopted by the Santa Fe City Council on June 25, 1997. Each of the stages is tied to projected shortages of water. This drought management plan was instrumental in the summer of 2000 when water shortages prompted Santa Fe to declare its first Stage 2 Water Alert and Stage 3 Water Warning. (For more information, see the Santa Fe case study on page 157.)

	Stage 1 Water Watch	**Stage 2 Water Alert (City Manager)**	**Stage 3 Water Warning (City Council)**	**Stage 4 Water Emergency**
Voluntary (V) or Mandatory (M)	V	M	M	M
Demand deficiency*	15%	16% - 35%	36% - 50%	> 50%
Residential				
Outdoor landscape watering	All elements of Stage 2 apply on voluntary basis from 10 a.m. to 4 p.m.	All elements of Stage 2 apply on voluntary basis from 10 a.m. to 4 p.m. No watering on Mondays, then every other day depending on address; No watering between 10 a.m. and 4 p.m. Handheld buckets, shut-off hoses can be used anytime. Reclaimed and greywater may be used anytime.	Permitted only on Tuesdays and Fridays, even for hose with shut-off. May water anytime if by hand-held container or drip irrigation, or if using reclaimed or greywater.	Prohibited except for plants that are rare, exceptionally valuable or essential to well being of public or rare animals. Trees and shrubs only with shut-off hose, hand-held container or drip. Greywater okay on fruit trees, ornamental trees and shrubs.
Car washing		Anytime if bucket or shut-off hose is used.	All vehicle washing at a residence is prohibited.	Prohibited
Spas and Swimming Pools		One initial filling for recirculating pools only, no draining and refilling.	Filling and refilling prohibited except when used for water storage. Pool must be covered when not in use.	Prohibited except as water storage
Water runoff from property; washing down pavement, sidewalk		Prohibited	Prohibited	Prohibited
Ornamental Fountains		Allowed only if water is recirculated	Prohibited	Prohibited

EMERGENCY ACTION PLAN FOR DROUGHT MANAGEMENT

SANTA FE WATER ORDINANCE RESTRICTIONS CHART (cont.)

	Stage 1 Water Watch	Stage 2 Water Alert (City Manager)	Stage 3 Water Warning (City Council)	Stage 4 Water Emergency
Voluntary (V) or Mandatory (M)	V	M	M	M
Demand deficiency*	15%	16% - 35%	36% - 50%	> 50%
Commercial				
Car washing	All elements of Stage 2 apply on voluntary basis from 10 a.m. to 4 p.m.	Anytime on immediate premises	Anytime on premises, but if business does not use reclaimed or recycled water, volume will have to be reduced.	All car washes must reduce usage.
Nurseries		Must curtail all non-essential watering and encouraged to use conservation practices, but exempt from irrigation restrictions.	Reduce use.	Reduce use; may use greywater to irrigate fruit trees, groundcovers and ornamental trees and shrubs.
Restaurants		Only serve water on request	Only serve water on request	Only serve water on request
Construction Projects		Limited to water use required by regulatory agencies (e.g. dust control). Must use reclaimed water if reasonably available.	Limit to new construction meters; water used only for purposes required by regulatory agencies. Effluent water used for dust control only.	No new construction meters will be issued. Construction water not used for earth work or road construction. Effluent water used for dust control only.
Golf courses		Only during designated hours/days	Only during designated hours/days	Prohibited

*Applies during periods when the possibility exists that the utility will not be able to meet all of the water demands of its customers by up to X% of the annual demand projection.