

## SECTION 2

### DESCRIPTION OF PLANNING AREA

#### INTRODUCTION

This section of the regional Water Quality Management Plan (WQMP) provides basic background information on the SouthEastern Arizona Governments Organization (SEAGO) region, including a physical description of the planning area, land use information, and socio-economic data. Information contained in this section includes:

- Geologic and physiographic features.
- Climate information.
- Surface and groundwater hydrology.
- Ecoregion description.
- Riparian areas and other critical habitats.
- Land ownership and land use.
- Current population estimates and projections.
- Current economic activity.

#### LOCATION AND SIZE OF THE PLANNING AREA

The SEAGO region is a boot-shaped region located in the southeast corner of Arizona. The region borders New Mexico to the east, Navajo and Apache Counties to the north, and Pinal and Pima Counties to the west, and shares an international boundary with Mexico to the south. Willcox the geographic center of the region, is situated about 80 miles east of Tucson and 200 miles southeast of Phoenix, the two largest metropolitan areas in Arizona (See Map 1: State of Arizona).

The SEAGO region is comprised of Cochise, Graham, Greenlee, and Santa Cruz Counties (Map 2: SEAGO region). In general, the region can be characterized as rural. Fourteen incorporated communities lie within the region: seven in Cochise County (Benson, Bisbee, Douglas, Huachuca City, Sierra Vista, Tombstone, and Willcox); three in Graham County (Pima, Safford, and Thatcher); two in Greenlee County (Clifton and Duncan); and two in Santa Cruz County (Nogales and Patagonia). These communities are scattered throughout the region forming widely dispersed activity centers. The land use within the unincorporated county areas is primarily ranching and farming, scattered residential development, public lands, and recreational areas.

The SEAGO region encompasses 13,925 square miles or 8,912,000 acres of land. Cochise County, the largest county, is 6,219 square miles, or 45 percent of the region. Graham County is second largest occupying 4,630 square miles or 33 percent of the region. Greenlee County is third largest in terms of land area, but has the smallest population. Greenlee County occupies 1,838 square miles or 14 percent of the region. Santa Cruz County has the second largest population but is smallest in terms of area. Santa Cruz County occupies 1,238 square miles or 9 percent of the region. Tables 2-1 and 2-2 provide additional information on land size by county and incorporated community.

#### GEOLOGICAL AND PHYSIOGRAPHIC FEATURES

The SEAGO region is located in two major physiographic provinces, the Central Highlands and Basin and Range Provinces. The Central Highlands Province is an elevated area extending diagonally across the northern portion of Graham and Greenlee Counties. The Central Highlands were formed by differential movements along large-scale, complex fault systems. There is no general trend to the systems, although the general trend of the province itself is northwesterly, roughly parallel to the mountain blocks in the Basin and Range Provinces. The southern half of Graham and Greenlee and all of

Santa Cruz and Cochise Counties are located within the Basin and Range Provinces. This province is characterized by extremely dry desert lowlands with annual precipitation ranging from only 4 to 12 inches. The valleys are separated by linear trending mountain ranges, filled with unconsolidated deposits which form the major aquifers of the region. The ranges are rocky fault-block mountains without much soil, flanked by broad alluvial fans that slope away from the base of the ranges. (See Map 3, Physiographic Provinces of Arizona).

The geology of the region's mountains is generally complex and variable. The rocks consist of mostly Precambrian phyllites, schists and gneiss; lower to mid-Paleozoic limestones and shales; and volcanic rocks from numerous ages, ranging from Precambrian through Cenozoic. Little is known about the geology of the valleys because of the sediment cover.

The SEAGO region is a high desert area containing the northern extension of the Sonoran Desert. Elevations range from 2,675 feet at the spot where the Gila River exits the region at the western edge of Graham County, to 10,713 feet at the peak of Mt. Graham, the highest point in the region, also in Graham County. Terrain includes high mountain ranges, three major river basins, and large areas of plains and desert grasslands.

Thirty-four percent of the region is moderate to steep mountain terrain where development is limited. The Huachuca and Chiricahua Mountains reach elevations more than 9,000 feet in Cochise County. Santa Cruz County also has several mountain ranges with elevations more than 9,000 feet to include the Santa Rita Mountains. Mountainous terrain is the predominant land type in Greenlee County, with the White Mountains reaching elevations more than 10,000 feet.

## **CLIMATE**

The SEAGO region lies within an arid to semi-arid climactic zone, with both Sonoran and Chihuahuan Desert vegetation found throughout. Large portions of the district include oak and conifer woodlands, although these are limited primarily to the mountain ranges. Average annual rainfall for the region ranges from 8-16 inches, with about half of the annual rainfall occurring in the summer "monsoon" season, the months of July and August. This usually takes the form of brief heavy thunderstorms when as much as two inches of rain can fall in an hour.

As a high desert region, climatic conditions vary widely between days and nights, and between valleys and mountain peaks. As a general rule, average daily high and low temperatures vary 30-40 degrees. Although the summers are more moderate than the state's two metropolitan areas, the average daily temperatures outside of the mountain peaks range from 90-100 degrees, Fahrenheit. Conversely, average daily temperatures in the winter are somewhat cooler, with freezing temperatures common in the nights and daily highs averaging in the upper 50s to mid-60 degree range.

Table 2-3 describes the average rainfall and maximum and minimum temperatures in January and July of typical communities in the four SEAGO counties.

## **HYDROLOGY**

### **Surface Water**

Limited surface water is found along the courses of the three major rivers and tributaries located in the SEAGO region. The beds of these rivers flow underground with only intermittent above ground flow, usually in the spring after the snow melts and during the summer "monsoon" rain season. A limited number of the higher elevation tributaries run year-round, primarily the Blue and San Francisco Rivers in Greenlee County and Sonoita Creek in Santa Cruz County. Surface water may

appear plentiful along the Gila River Valley in Graham and Greenlee Counties, however, the water rights are considered to be fully allocated with no significant surplus.

Three major river basins are located in the SEAGO region, along with several smaller basins. The major basin is the Upper Gila River Basin. The Gila River flows through the southern portion of Greenlee County and the north/central part of Graham County forming the Gila Valley. Several major tributaries such as the San Francisco and Blue Rivers flow into this river from the White Mountains in Greenlee County.

The San Pedro River Basin, formed by the San Pedro River and its tributaries, flows the length of the western side of Cochise County. The river flows northward and empties into the Gila River. A stretch of the Santa Cruz River flows through west/central Santa Cruz County, also flowing northward and emptying into the Gila River.

### **Surface Water Basins**

Arizona has been divided into 13 surface water basins, five of which are located in the SEAGO region. These include the Upper Gila in Graham and Greenlee Counties; the Willcox Playa, a portion of the Rios de Mexico, the San Pedro River in Cochise County, and the Santa Cruz River in Santa Cruz County. Map 4 identifies the surface water drainage basins in the region. The Rios de Mexico Basin is actually a composite of several basins along the Arizona/Mexico border, which are not part of the greater Colorado River drainage system. The portion of the Rios de Mexico that lies within the SEAGO region was formerly known as Whitewater Draw, and is located in the southeastern quadrant of Cochise County and flowing south into Mexico. Water in the basin flows only after precipitation. The Santa Cruz River Basin flows from Mexico through Santa Cruz County into the Tucson metropolitan area in Pima County. Major drainages in the Upper Gila River Basin include the Gila and Blue Rivers. The San Pedro River Basin is similar to the Santa Cruz River Basin in that water flows northerly from Mexico.

### **Lakes**

There are numerous lakes in the region, with the exception of Greenlee County. Greenlee County, though, in conjunction with the U.S. Forest Service, is undertaking a feasibility study for development of a new manmade lake at Pigeon Creek.

Graham County has more lakes than the other counties combined. These include Riggs Flat and Snow Flat in the Pinaleno Mountains, Roper Lake (a state park), ponds at Fry Mesa and Bryce, Cluff Ponds, and Dankworth Ponds. In addition, the San Carlos Reservoir is located in Graham County on the San Carlos Indian Reservation and is used for both irrigation and recreation.

There are two lakes in Santa Cruz County: Pena Blanca and Patagonia. Cochise County also offers two lakes: Rucker in the Chiricahua Mountains, and Parker Canyon in the Huachuca Mountains. Numerous public and private ponds are located along the San Pedro River and on Fort Huachuca. In addition there are numerous other stock tanks or water catchments throughout the region.

### **Groundwater**

Water resources are a critical factor affecting development in the region. Although some surface water resources are available, the region is primarily dependent on groundwater. Groundwater is defined as water occupying voids within a volume of rock. Aquifers are layers of rocks which contain groundwater and allow its movement in appreciable quantities. Water enters the rock substrata in places known as recharge areas, which are located where water from lakes, rivers, streams, or washes infiltrate into the ground and percolate downward to the water table. The presence of groundwater does not necessarily imply that the aquifer is being recharged, as Arizona's groundwater supply has formed over many years and through many cycles of alluvial deposits and wetter geologic ages.

The amount of water in an aquifer is dependent on the porosity of the rocks. Due to the volumes of rock that make up an aquifer, large quantities of water can be present even though the porosity may be low and the voids very small.

Recharge occurs mainly along mountain fronts and stream courses. Mountain front recharge occurs when precipitation events of sufficient intensity and duration cause runoff in washes which flow from the mountains toward the desert floor. Flows of longer duration in stream channels along the floors of valleys

contribute recharge to the younger alluvium.

As in the state as a whole, the region has depleted groundwater at a rate faster than it is being recharged. Table 2-4 shows that Cochise County receives approximately 85,000 acre feet of water per year. However, agricultural requirements alone of approximately 335,000 acre feet per year would indicate that the county is depleting groundwater at a rate 4.2 times faster than it can be replenished.

The Arizona Department of Water Resources (ADWR) has developed groundwater basin boundaries. These basins are defined based on physiography, surface drainage patterns, subsurface geology, and aquifer characteristics. There are four Active Management Areas (AMAs) in the state, encompassing the largest population centers where most water use occurs and groundwater is threatened by overdraft. There are also 46 additional groundwater basins which are outside the AMA areas and are grouped into ten planning regions. See Map 5 which shows the 46 groundwater basins within the state.

The majority of the SEAGO region falls within either the San Pedro or Upper Gila groundwater region. The exception is the western half of Santa Cruz County, including Nogales, which is part of the Tucson AMA. In 1985, the Department of Water Resources (DWR) estimated that 59 percent of the water consumed in the San Pedro region and 53 percent in the Upper Gila region was groundwater. As a comparison, it was estimated that 70 percent of the water consumed in the AMAs was groundwater.

The region has two designated Sole Source Aquifers (SSAs), the Tucson AMA and the Bisbee-Naco watershed in southern Cochise County. A Sole Source Aquifer refers to the fact that this aquifer has been identified by the EPA as the only source of drinking water for the communities in that watershed area. This program provides for EPA review of all federal financially assisted projects planned for the area to determine their potential for contaminating the aquifer. Based upon this review, no commitment of federal financial assistance may be made for projects "which the administrator determines may contaminate the aquifer," although federal funds may be used to modify projects to ensure that they will not contaminate the aquifer. As of October 1986, there were 21 designated SSAs nationwide.

The Douglas area in Cochise County has also been designated as an "Irrigation Non-Expansion Area, (INA) under the 1980 Groundwater Management Act. An INA is designated by the Director of ADWR when it is determined that there is insufficient groundwater to provide a reasonably safe supply for irrigation of cultivated lands in the area at the current rate of withdrawal. However, the establishment of a more stringent Active Management Area (AMA) is not appropriate at this time.

Once an area is designated as an irrigation non-expansion area, a user may irrigate only acres of land which were irrigated at anytime during the five years preceding the designation. To date, irrigation within the Douglas INA has not been an issue brought before SEAGO or its Environmental Review Committee.

## **Flooding**

The topography of SEAGO creates some flooding concerns. As a high desert region, flash flooding tends to occur throughout. Rains come in short, heavy bursts, and soil conditions promote runoff rather than water absorption. The topography of "mountain islands" compounds runoff problems as higher elevations receive greater amounts of precipitation than the valleys, where natural drainage patterns can direct runoff flow. Areas most susceptible to flooding are located along drainage ways within the five surface water basins. Few of the rivers carry surface flows year-round, but flow freely during periods of heavy rains.

Primary flood areas are in northern Cochise County around the Willcox area, throughout the Gila Valley in Graham County; and the Towns of Clifton and Duncan in Greenlee County. Southern Cochise County experiences intermittent problems with flash flooding and has some risk of flooding from heavy flows in the San Pedro River. Santa Cruz County has the potential for flooding from heavy flows in the Santa Cruz River.

## **ECOREGION DESCRIPTION**

In 1987, the EPA divided the United States into 76 ecoregions. An ecoregion is defined as an area of relative homogeneity based on land use, soils, topography, and potential natural vegetation. Ecoregions or

ecosystems provide a means of grouping surface water and groundwater basins exhibiting similar characteristics such as physical habitat, hydrology, water chemistry, and biotic communities. There exists a homogeneity between water bodies located within the same ecoregion and heterogeneity between water bodies of different ecoregions. The Arizona Department of Environmental Quality (ADEQ) anticipates using ecoregions to establish surface and groundwater quality standards and develop ecoregion specific biological criteria to prioritize water quality monitoring in the future.

The SEAGO region is located in three distinct ecoregions, the Arizona/New Mexico Mountains, Southern Deserts, and Southern Basin and Range. The northern portions of Graham and Greenlee Counties lie within the Arizona/New Mexico Mountains ecoregion, while the southern portions of those two counties and all of Santa Cruz and Cochise Counties are in the Southern Desert ecoregion. The Southern Basin and Range ecoregion borders the western transition line of Santa Cruz, Cochise, and Graham Counties, with a small enclave located in west-central Graham County. Map 6, depicts the state's ecoregions. The Arizona/New Mexico mountain's ecoregion consists of low to high mountains with grazed forests and woodlands. The Southern Desert ecoregion supports desert shrubland on a desert plain, with abrupt high mountains providing "mountain islands" for higher elevation ecosystem fauna and flora communities. The Southern Basin and Range ecoregion is characterized by desert valleys supporting desert shrubland separated by low mountains.

## **RIPARIAN AREAS AND OTHER CRITICAL HABITATS**

Despite its desert image, Arizona's history was one of year-round flowing rivers and streams. These perennial streams and the extensive riparian forests provided water for domestic use, fish and game for food, fertile soil and water for agriculture, and wood for lumber, fence posts and fuel. A riparian area is defined as an area of land directly influenced by permanent water, either surface water or free subsurface water in the rooting zone of water dependent vegetation. Riparian areas are valuable because of their importance to watershed protection, water quality, aquatic and terrestrial wildlife to include threatened and endangered species, livestock management, cultural resources, and recreation opportunities.

Man's need for water in this arid climate has resulted in alterations to the environment. River impoundments, channelization, groundwater pumping, surface water diversions and agricultural development have all contributed to the decline in Arizona's wetlands/riparian areas. Once common along the state's drainage ways, riparian areas are now one of Arizona's most rare and threatened natural communities. Through a variety of land and conservation programs, riparian areas in Arizona are being recognized for their importance and actions are being taken to preserve those areas that remain and encourage their return to an original state.

The Arizona State Parks Board estimates that only 5-10 percent of the original riparian habitat remain today. Data on Arizona's historic wetlands/riparian areas is very limited. Generally speaking, Arizona has experienced a steady decline in the abundance of native grasslands and an increase in shrubs native to desert plains and foothills. Also evident are the significant loss of perennial in-stream flows in all major rivers and substantial changes in fish and wildlife population dependent on wetlands/riparian habitats.

Additionally, increased emphasis is being given to other wetland areas. Wetland areas outside of stream beds have always been very rare in Arizona. Today, wetland or marshland areas (cienegas) or riparian areas bordering Arizona's surface waterways can still be found, although to a much lesser degree than in the past. These areas continue to provide the primary habitat for fish and wildlife and support a variety of plant species.

The Arizona State Parks Board, as part of its 1989 Statewide Comprehensive Outdoor Recreation Plan (SCORP), identified 16 streams in Arizona which should receive priority consideration for conservation. The Upper Gila River and the San Francisco River in Graham and Greenlee Counties have been targeted for conservation. The San Pedro River in Cochise County and Sonoita Creek in Santa Cruz County are also included.

The U.S. Fish and Wildlife Service has identified the following wetlands in the region as priorities for conservation and preservation: Sheehy Springs in Santa Cruz County, Hooker Cienega in Graham County, and Kiper Springs and Leslie Canyon in Cochise County. In addition, the Bureau of Land Management

(BLM) has nominated numerous other areas within the region as Areas of Critical Environmental Concern (ACEC), a public land area where special management attention is required to protect important historic, cultural, or scenic values.

## **LAND OWNERSHIP AND LAND USE**

Table 2-5 identifies the percent of land by ownership. The United States government owns almost half the land in the region. Federal lands include lands owned by the Department of Defense, the Forest Service, the National Parks Service, the Bureau of Land Management, U.S. Fish and Wildlife Service, and Indian land. Because of the unique nature and mission of each of these federal agencies there are distinct impacts on water quality planning for the region. Some of these agencies have management plans that address water and wastewater issues. These plans will be addressed later in the Continuing Planning Process section and were briefly mentioned in the region specific report. There is some discussion as to whether the state and ADEQ have the authority to hold federal agencies and Indian tribes to the same standards as public or semi-public systems. Currently, these federal lands support a variety of activities ranging from cattle grazing to recreational use. Additionally, there are several recent instances of land trades between these various federal agencies and the Nature Conservancy, a private, non-profit conservation group, to ensure that riparian and ecologically sensitive areas are protected for public use. Arizona owns approximately 23 percent, while the private sector owns the remaining 27 percent.

Table 2-6 identifies land use by county. Rangeland activities dominate the land use in the SEAGO region, comprising 96-98 percent of the total. Rangeland can be either public or privately-owned since grazing is allowed on much of the federal and state land in the region. Total acreage devoted to agriculture is small, but crops do play an important role in the economy of the region. Fruit and nut crops are increasing in Cochise and Graham Counties, and in Pima cotton, one of the finest cotton varieties in the world, is grown throughout Graham County. Vineyards are also beginning to play a role in the economy of Santa Cruz County.

The 1992-93 Directory of Active Mines and Mineral Resources lists seven active mines in the region. Mining (primarily copper) has played an important role in the region since the 19th century. Modernization of mining techniques and shifting world demand have caused this role to change during the decade between 1980 and 1990. The industry, however, continues to be an important economic factor. The region's largest mining operation is the Phelps Dodge Mine located in Clifton/Morenci. This open pit mine is the leading copper producer in the United States. In recent years, Phelps Dodge has replaced obsolete smelters with a modern and more efficient solvent extraction-electrowinning plant. Its two concentrators have a combined capacity of 100,000 tons of ore per day. In addition to its existing operations, Phelps Dodge is considering reopening operations in Bisbee, which, at the turn of the century, was the largest copper mine in the country.

While copper represents the largest mining concern, gold and silver are still mined from the area surrounding the historic mining City of Tombstone, and approximately 1,000 tons of lime a day are extracted from a quarry in Cochise County. Although no active mines are located in Santa Cruz County, the county was the scene of significant mining operations in the past. Exploration continues in and around these old mining areas and intermittent operations still occur.

Additionally, 13 sand and gravel operations are dispersed throughout the region, providing a vital resource for the construction industry. Six operations are within Cochise County, three in Santa Cruz County, with three in Graham County and one in Greenlee County.

These types of land use patterns in the region have the potential to adversely impact the water quality of the area, in particular in the form of nonpoint source pollution. Any effective water quality planning for the region must recognize and address these issues. Additional information on mining and sand and gravel operations can be found in the nonpoint source section of the plan.

## **CURRENT POPULATION ESTIMATES AND PROJECTIONS**

Historically, the region's population has grown at rates significantly less than the state as a whole. This trend, however, appears to be changing and SEAGO should grow at about the same rate as the state over

the next five decades. In fact, the Arizona Department of Economic Security (DES) projects that southern rural Arizona will experience greater employment opportunities than Pima County (Tucson).

The U.S. Census Bureau reported 161,862 persons resided in the SEAGO region as of April 1, 1990, representing about 4.4 percent of the total Arizona population. Cochise County has the largest population in the region with 97,624 people or 60 percent. This population is dispersed throughout 6,200 square miles, with pockets of development in small and medium sized towns and cities. Santa Cruz County is the second most populous county in the region with 29,676 residents (about 18 percent of the region's population). Graham County is the third with 26,554 persons or 16 percent of the population. Greenlee County is the least populous county, having 8,008 residents or 5 percent of the region's population. Table 2-7 identifies the 1990 population for each city and county as reported by the 1990 Census.

The 1991 population estimates for the region were consistent with the expected growth rates for the SEAGO region, with the exception of Greenlee County. This is attributable in part to the statistical method used to determine the population estimate, the "Housing Unit Method" (HUM). This method uses persons per household and vacancy rates established during the previous decennial census, with the number of new building permits issued. Greenlee County officials claim a significant inward migration of persons due to the increased operations at the Phelps Dodge mine at Clifton/Morenci, concurrent with closing down mining operations in nearby New Mexico. Much of this inward migration has chosen to occupy the existing Phelps Dodge housing in Clifton/Morenci, and subsequently the number of new building permits issued in Greenlee County, the major factor in estimating population using the HUM method, has been relatively small. Additionally, the vacancy rate for structures in the county, another important HUM variable, is reported to have decreased significantly.

Table 2-8 compares the 1980 population, the 1990 population, and the 1991 estimate. The 1990 Census shows Cochise County experienced an increase in population since 1980, however, the number of persons residing in the incorporated cities and towns in the county with the exception of Sierra Vista and Huachuca City has actually declined. Graham County is the second fastest growing county in the region, but Safford, its largest city, had the least growth in the county. Greenlee County did experience a 30 percent loss of population between 1980 and 1990, with only the Town of Duncan showing any growth. This is directly attributable to declines in the copper industry, the major employer in Greenlee County, and conversion to a less labor intensive extraction process. During the same period, the area experienced massive flooding, another factor attributing to a net outward migration of personnel. Santa Cruz County accounted for most of the growth in the region, with a 45 percent increase since 1980. Nogales, its major city, increased population by 24 percent.

Table 2-9 identifies the historic growth rates in the SEAGO region from 1940-1990. The rate of growth in the SEAGO region during the decade of the 80s slowed to a 15 percent rate compared to the rate of 37 percent for the previous decades. This current rate is about one-half the rate of growth for the state. Growth in Santa Cruz County was 45 percent, three times the region's rate and about one-third faster than the state.

The Arizona Department of Economic Security, in accordance with Executive Order No. 88-10, produces population projections for Arizona counties and places. The most recent projections were developed in 1992 and project population out to the year 2040. The projections are based on a "COHORT - SURVIVAL" model that uses the 1990 Census figures as a baseline. The projections for SEAGO indicate that total population will continue to grow during the next 50 years. However, the "COHORT - SURVIVAL" model has as one of its variables the migration trends for the decade between the last two census. The population for some member entities during that particular period showed a decline, however the outward migration has now stabilized, and the population trend should show a steady increase. The rate of growth for the region as a whole is projected to be equal to or greater than growth rates in the 80s. Cochise, Graham, and Santa Cruz Counties are all projected to grow at similar rates to the overall region and the state. Greenlee County is the exception. Although projections indicate relative stability with some small increases and declines, actual population in future decades may depend on continued high employment in the copper industry or diversification of the employment base. Table 2-10 identifies the population projections for all four counties and the state for the period 1990-2040.

Table 2-11 identifies the population densities which can be used to draw inferences about the region when

compared with the state and the two metropolitan counties. While overall density in the region has been increasing, the 1990 density was still only about 12 persons per square mile. Arizona is considered a rural state with a density of 32 persons per square mile, and when compared to the two metropolitan counties, Maricopa County at 232.5 and Pima County at 72.6 persons per square mile, the rural nature of the SEAGO region becomes even more apparent. Santa Cruz County is the most densely populated county in the region with 24 persons per square mile and is increasing at a faster rate than the state.

## **ECONOMIC ACTIVITY**

This section of the plan focuses on the changes or areas of concern impacting the region's economy as it relates to water quality planning. SEAGO was recently recognized by the U.S. Department of Commerce as the first Economic Development District (EDD) in Arizona. The economy of SEAGO has seen little change since designation as an EDD. Standard economic measures which assess the well-being of the region indicate that the region is economically depressed, (i.e. increased unemployment, increases in cyclical mining and construction labor force, depressed value of housing stock, decreases in manufacturing, and per capita incomes lower than the rest of the state.) As this new EDD begins planning to improve the economic health of the region, care must be taken to ensure water quality issues are considered in developing an overall economic development plan. Increased economic activity in the region in the areas of mining, cattle, and agriculture all have the potential to adversely impact water quality.

Transportation plays an important role in the economic viability of an area. Over the past year, the Arizona Department of Transportation has been working on small area transportation studies in Cochise County, Graham County, Nogales, the I-19 Corridor, SR 90, and the Kartchner Cavern's Corridor. These studies will provide information relative to the overall transportation needs of the communities. In addition to the studies, the Arizona Department of Transportation (ADOT) has funded numerous road improvement projects that are currently underway or planned for in the near future, as well as expansion projects at the Sierra Vista Municipal and Santa Cruz County International Airports.

The region experienced a crisis when the Southern Pacific Railroad announced their intention to abandon spur lines in the area. The lines in question run parallel to I-10, in the north, and north/south on the eastern side of the region. The condition of the north/south line has deteriorated to the point where all freight service had to be stopped. One firm has recently purchased the section of the north/south track which runs from Benson to Douglas and has announced its intention to reinstate freight service and develop a touristic excursion train, much like the one in the Grand Canyon.

Although the labor force statistics showed a marginal decrease in the total employment in the region between 1990 and 1991, the annual unemployment rate remained the same. The mining and quarrying industry saw a 10 percent increase, and the construction industry experienced a 13 percent increase over 1990 levels. The expansion of the Phelps Dodge mine in Morenci accounts for a majority of the increase in employment for this industry, and expansion of the mine has in turn increased the number of construction jobs in the area. The manufacturing sector experienced a 12 percent decline from 1990 to 1991.

Santa Cruz County continues to have one of the highest unemployment rates anywhere in the state of Arizona. In 1991, Santa Cruz County's average unemployment rate, was 13.1 percent while the state's rate was 5.6 percent. This high unemployment rate is exacerbated by the population of the county, most significantly in Nogales, is also one of the fastest growing in the state.

Additionally, the geographic location of the region causes additional factors affecting the economy, especially at the border communities. Currently, all four international border crossings are either undergoing expansion or are in the planning stages for such projects. Increasing the number of commercial and private vehicles passing through these border crossings has a detrimental impact on the water quality of the local communities. The expansion of border crossing facilities increases the number of employees, which in turn increases the population, which in turn places additional stress upon the infrastructure of the border communities, specifically water and wastewater treatment facilities. Some of these border communities are already serving a population much greater than originally intended. Concerns are being raised as to the impact that the passage of a North American Free Trade Agreement (NAFTA) will have on these already stressed communities.

In summary, economic activity in the region is slow, with the exception of some of the border communities, and the future of economic growth in these communities is closely tied to the NAFTA. Economic activity in the region is geared towards attracting tourists and winter visitors. Its immediate effect on water quality planning will be the seasonal increase in water and wastewater requirements. Those communities that intend to take advantage of these tourist dollars must ensure that they have sufficient water and wastewater capacity to accommodate a large influx of non residents.

## **PLANNING IMPLICATIONS**

### **Population Growth**

The region has experienced a 15.3 percent population increase over the last decade, increasing from 140,413 to 161,862 persons. Santa Cruz County's population increased by 45.1 percent from 20,459 to 29,676, followed by Graham at 16.2 percent from 22,862 to 26,554, while Cochise County's population increased by 13.9 percent from 85,686 to 97,624. Greenlee County was the only county to experience a decrease in population of 29.8 percent from 11,406 to 8,008.

There exists a direct relationship between population growth and its impact on land use patterns, water availability and quality, wastewater treatment capacity and solid waste handling. Population growth increases the demand for land and housing, and is usually accompanied by a subsequent increase in the region's economy. Such growth also equates to increased demand for services provided by public entities.

Public entities must plan for growth in their communities in order to coordinate land use, and ensure sufficient water, wastewater, and solid waste facility capacity. As existing facilities approach capacity, improvements, expansions, or new facilities must be planned. Communities need to accumulate funds necessary to maintain current facilities and accommodate population growth. The WQM Plan update needs to address the growth potential of the region so that the communities and responsible entities can be proactive and better anticipate the future demands on dwindling resources. All entities must compete for limited federal, state, and local funding.

### **Population Distribution**

The dispersed nature of the region's population has several implications for water quality planning, particularly for drinking water and wastewater systems. These are:

1. With a widely dispersed population, there is greater reliance on individual systems or very small systems where there are clusters of homes. However, these systems may be relatively expensive to install if climate, geology, or hydrology of the area make traditional septic systems inappropriate. Another problem to be addressed is correct operation and maintenance of alternative systems where operators may not be adequately trained.
2. In unincorporated areas with greater numbers of people, development may warrant a cluster or centralized system. However, there is generally no entity with the legal authority to operate a water or wastewater system. Special districts or sanitary districts must be considered as an alternative to individual or private systems.

Similar problems may occur in unincorporated "suburbs" of larger communities, such as around Sierra Vista. Urban service boundaries are typically established to encourage in-fill development, but these have an impact on areas outside those boundaries. In some cases, there may be geographic reasons for limiting service areas, but in others the boundaries may be based primarily on political jurisdiction. When communities or sanitary districts want to expand their boundaries, they may let existing small facilities deteriorate, and possibly oppose grants or loans to those facilities, so that the cost to take them over is lower.

3. Where incorporated areas have relatively low population densities, as in Huachuca City or Willcox, the question arises as to when centralized systems become appropriate and/or cost effective or necessary because of impacts of increasing population on existing systems.

### **Land Activity**

Mining and rangeland activities, and their associated land use patterns have the potential to adversely impact the water quality of the area, in particular, in the form of nonpoint source pollution. The large amounts of both federal and state lands in the SEAGO region create other nonpoint source pollution concerns, especially in the area of recreation. Tourism and recreation effects on the numerous national parks, monuments and wilderness areas are potentially numerous and include both water quality and solid waste issues.

Additionally, both manufacturing and industrial activities have the potential to create problems for air and water quality, as well as solid waste depending on the specific type of activity. All of these sectors need to be recognized as potential polluters or sources of pollution. They can also serve as opportunities for community action and involvement to address the water quality and general pollution concerns of the region.

### **Federal and State Laws Impact**

Congress and EPA have made significant revisions to the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) during the last ten years. These significant rules and regulations that have an impact on water quality are further discussed in Section 1, Rules and Regulations summary, which contain summaries of the major federal and state laws, programs and other significant regulations that impact the public and private entities with respect to water quality.

The passage of Arizona's Groundwater Management Act (GMA) of 1980 and the creation of the Arizona Department of Water Resources (ADWR), has had an impact on the SEAGO Region. The only area of the region directly affected by the GMA is the western half of Santa Cruz County which is located in the Tucson AMA, and Douglas which is designated as a sole source aquifer. The Rules and Regulation Section of the WQM Plan provides a brief summary of the 1980 GMA and its requirements.

In 1987, the state passed the Environmental Quality Act (EQA) which created the Arizona Department of Environmental Quality (ADEQ), primarily responsible for regulating water and air quality, hazardous and solid waste. As such, ADEQ is delegated the authority to adopt water quality standards for surface water and groundwater and to establish numerous permit programs such as the Aquifer Protection Permit (APP) Program whose purpose is to regulate the quality of discharges from nonpoint sources and develop Best Available Demonstrated Control Technologies (BADCT) for water, wastewater and solid waste facilities. ADEQ is also delegated responsibility to develop Best Management Practices (BMP) for various activities that could be considered nonpoint sources of pollution such as agriculture and range management. Another responsibility is to assist EPA in the National Pollution Discharge Elimination System Permit (NPDES) which regulates the quality of discharges from point sources. The impact of these programs, as well as the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) are addressed further in Section 1 of the plan.

TABLE 2-1  
SEAGO REGION SIZE IN ACRES AND SQUARE MILES

| Location   | Square Miles | Acres     | Percent of Region |
|------------|--------------|-----------|-------------------|
| Cochise    | 6,219        | 3,980,160 | 45                |
| Graham     | 4,630        | 2,963,200 | 33                |
| Greenlee   | 1,838        | 1,176,320 | 13                |
| Santa Cruz | 1,238        | 792,320   | 9                 |
| REGION     | 13,925       | 8,912,000 | 100               |

SOURCE: Arizona Statistical Review, 45th Edition, December 1989, Valley National Bank.

TABLE 2-2

INCORPORATED COMMUNITIES BY SIZE  
IN SQUARE MILES AND ACRES

| Community     | Square Miles | Acres   | Percent of Region |
|---------------|--------------|---------|-------------------|
| Bisbee        | 5.40         | 3,456   | .03               |
| Benson        | 8.50         | 5,440   | .06               |
| Clifton       | 15.00        | 9,600   | .10               |
| Douglas       | 4.75         | 3,040   | .03               |
| Duncan        | 4.00         | 2,560   | .03               |
| Huachuca City | 3.00         | 1,920   | .02               |
| Nogales       | 20.40        | 13,060  | .15               |
| Patagonia     | 2.25         | 1,434   | .02               |
| Pima          | 2.00         | 1,280   | .01               |
| Safford       | 4.40         | 2,816   | .03               |
| Sierra Vista  | 129.53       | 82,899  | .90               |
| Thatcher      | 2.55         | 1,632   | .02               |
| Tombstone     | 4.00         | 2,560   | .03               |
| Willcox       | 6.80         | 4,352   | .05               |
| TOTAL         | 210.75       | 134,877 | 1.53              |

SOURCE: Arizona Statistical Review, 45th Edition, December 1989, Valley National Bank.

TABLE 2-3  
TEMPERATURE AND RAINFALL

| Location          | Average Daily Temperature |      |       |      | Average Rainfall Per Year |
|-------------------|---------------------------|------|-------|------|---------------------------|
|                   | January                   |      | July  |      |                           |
|                   | Max                       | Min  | Max   | Min  |                           |
| COCHISE COUNTY    |                           |      |       |      |                           |
| Benson            | 62.0                      | 30.0 | 96.0  | 67.0 | 11.00                     |
| Bisbee            | 56.9                      | 33.7 | 89.3  | 64.5 | 16.21                     |
| Douglas           | 64.0                      | 29.0 | 99.0  | 64.0 | 13.05                     |
| Sierra Vista      | 58.0                      | 34.0 | 89.0  | 66.0 | 14.64                     |
| Willcox           | 58.0                      | 25.0 | 95.0  | 60.0 | 11.00                     |
| GRAHAM COUNTY     |                           |      |       |      |                           |
| Safford           | 61.0                      | 30.0 | 99.7  | 70.0 | 8.43                      |
| GREENLEE COUNTY   |                           |      |       |      |                           |
| Clifton           | 61.0                      | 31.0 | 101.0 | 71.0 | 12.06                     |
| Duncan            | 58.3                      | 22.9 | 94.1  | 64.3 | 9.38                      |
| SANTA CRUZ COUNTY |                           |      |       |      |                           |
| Nogales           | 63.0                      | 27.0 | 93.0  | 64.0 | 15.49                     |

SOURCE: Arizona Community Profiles, Arizona Department of Commerce, July 1990.

TABLE 2-4  
 ESTIMATED ANNUAL WATER SUPPLY  
 (NORMALIZED 1970 CONDITIONS)  
 Unit: 1,000 Acre Feet

|               | Irrigated<br>Agriculture | Municipal/<br>Industrial | Mineral<br>Industry | Other | Total<br>Depletion | Total<br>Supply | D/S<br>Ratio |
|---------------|--------------------------|--------------------------|---------------------|-------|--------------------|-----------------|--------------|
| Cochise       | 335                      | 9                        | 8                   | 1     | 353                | 85              | 4.2          |
| Graham        | 157                      | 2                        | 0                   | 0     | 159                | 132             | 1.2          |
| Greenlee      | 17                       | 2                        | 14                  | 0     | 33                 | 33              | 1.0          |
| Santa<br>Cruz | 11                       | 2                        | 0                   | 0     | 13                 | 5               | 2.6          |
| REGION        | 520                      | 15                       | 22                  | 1     | 558                | 225             | 2.5          |
| STATE         | 4,294                    | 329                      | 131                 | 60    | 4,814              | 2,821           | 1.7          |

SOURCE: Arizona State Water Plan, Inventory of Resource and Uses, 1975, Arizona Water Commission.

TABLE 2-5  
 LAND OWNERSHIP IN SEAGO REGION  
 (Percent of Land Area)

| Owner                     | Cochise | Graham | Greenlee | Santa Cruz | Total Region |
|---------------------------|---------|--------|----------|------------|--------------|
| U.S. Forest Service       | 12.34   | 12.08  | 63.57    | 52.95      | 23.85        |
| U.S. Bureau of Land Mgmt. | 8.85    | 24.59  | 13.56    | .35        | 13.97        |
| Indian Reservation        | 0       | 36.43  | 0        | 0          | 12.00        |
| State                     | 34.06   | 16.07  | 14.82    | 7.79       | 23.64        |
| Other Public Land         | 3.11    | 0.02   | 0        | 0.11       | 0.41         |
| TOTAL PUBLIC LAND         | 58.09   | 90.54  | 91.95    | 61.02      | 74.02        |
| Private Land              | 41.01   | 9.46   | 8.05     | 38.08      | 25.98        |
| TOTAL                     | 100.00  | 100.00 | 100.00   | 100.00     | 100.00       |

SOURCE: MAJOR LAND OWNERSHIP BY OWNER, ALRIS GIS LAND STATUS, June 4, 1993.

TABLE 2-6  
EXISTING LAND USE BY COUNTY

| Location   | Total Acres* | Urban Acres | Percent of County | Agri-Cultural Acres | Percent of County | Range Land Acres** | Percent of County**<br>* |
|------------|--------------|-------------|-------------------|---------------------|-------------------|--------------------|--------------------------|
| Cochise    | 3,980,160    | 103,667     | 2.60              | 35,225              | 0.90              | 3,858,426          | 96.50                    |
| Graham     | 2,963,200    | 5,728       | .19               | 32,600              | 1.12              | 2,871,740          | 98.68                    |
| Greenlee   | 1,176,320    | 12,160      | 1.20              | 1,900               | 0.20              | 933,487            | 98.50                    |
| Santa Cruz | 792,320      | 14,494      | 1.80              | 60                  | .007              | 777,341            | 98.00                    |
| REGION     | 8,912,000    | 136,049     | 1.57              | 69,785              | 0.80              | 8,440,994          | 97.61                    |

NOTES:

\*Includes both public and private land.

\*\*May not equal 100 percent since small miscellaneous land uses are not calculated.

SOURCE: Arizona State Land Department, December 11, 1986.

TABLE 2-7  
POPULATION BY COUNTY AND CITY  
1990

| Location          | County  | City   | County as a<br>Percent of Region |
|-------------------|---------|--------|----------------------------------|
| COCHISE COUNTY    | 97,624  |        | 60.3                             |
| Benson            |         | 3,824  |                                  |
| Bisbee            |         | 6,288  |                                  |
| Douglas           |         | 12,822 |                                  |
| Huachuca City     |         | 1,782  |                                  |
| Sierra Vista      |         | 32,093 |                                  |
| Tombstone         |         | 1,220  |                                  |
| Willcox           |         | 3,122  |                                  |
| GRAHAM COUNTY     | 26,554  |        | 16.4                             |
| Pima              |         | 1,725  |                                  |
| Safford           |         | 7,359  |                                  |
| Thatcher          |         | 3,763  |                                  |
| GREENLEE COUNTY   | 8,008   |        | 5.0                              |
| Clifton           |         | 2,840  |                                  |
| Duncan            |         | 662    |                                  |
| SANTA CRUZ COUNTY | 29,676  |        | 18.0                             |
| Nogales           |         | 19,489 |                                  |
| Patagonia         |         | 888    |                                  |
| REGION TOTAL      | 161,862 |        | 100.0                            |

SOURCE: U.S. Census Bureau, 1990 Census.

TABLE 2-8  
POPULATION CHANGE  
1980 - 1991

|                   | 1980      | 1990      | %<br>Change | 1991      | %<br>Change |
|-------------------|-----------|-----------|-------------|-----------|-------------|
| COCHISE COUNTY    | 85,686    | 97,624    | 13.9%       | 99,575    | 2.0%        |
| Benson            | 4,190     | 3,824     | -8.7%       | 3,880     | 1.5%        |
| Bisbee            | 7,154     | 6,288     | -12.1%      | 6,375     | 1.4%        |
| Douglas           | 13,058    | 12,822    | - 1.8%      | 12,920    | .8%         |
| Huachuca City     | 1,661     | 1,782     | 7.3%        | 1,880     | 5.5%        |
| Sierra Vista      | 24,937    | 32,983    | 32.3%       | 33,275    | .9%         |
| Tombstone         | 1,632     | 1,220     | -25.3%      | 1,235     | 1.2%        |
| Willcox           | 3,243     | 3,122     | - 3.7%      | 3,165     | 1.4%        |
| GRAHAM COUNTY     | 22,862    | 26,554    | 16.2%       | 27,500    | 3.6%        |
| Pima              | 1,599     | 1,725     | 7.8%        | 1,775     | 2.9%        |
| Safford           | 7,010     | 7,359     | 5.0%        | 7,525     | 2.3%        |
| Thatcher          | 3,374     | 3,763     | 11.5%       | 3,875     | 3.0%        |
| GREENLEE COUNTY   | 11,406    | 8,008     | -29.8%      | 8,025     | .2%         |
| Clifton           | 4,245     | 2,840     | -33.1%      | 2,840     | 0%          |
| Duncan            | 603       | 622       | 9.8%        | 670       | 1.2%        |
| SANTA CRUZ COUNTY | 20,459    | 29,676    | 45.1%       | 30,400    | 2.4%        |
| Nogales           | 15,683    | 19,489    | 24.3%       | 19,715    | 1.2%        |
| Patagonia         | 980       | 888       | - 9.4%      | 915       | 3.0%        |
| REGION            | 140,413   | 161,862   | 15.3%       | 165,500   | 2.3%        |
| ARIZONA           | 2,718,215 | 3,665,228 | 34.8%       | 3,767,000 | 2.8%        |

Source: U.S. Census Bureau - 1990 Census and POPTAC Estimates.

TABLE 2-9  
HISTORIC POPULATION GROWTH  
1940 TO 1990

| County     | 1940    | 1950    | % Change | 1960      | % Change | 1970      | % Change | 1980      | % Change | 1990      | % Change |
|------------|---------|---------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| Cochise    | 34,627  | 31,488  | -9%      | 55,039    | 75%      | 61,918    | 12%      | 85,686    | 39%      | 97,624    | 14%      |
| Graham     | 12,113  | 12,985  | 7%       | 14,045    | 10%      | 16,578    | 18%      | 22,862    | 38%      | 26,554    | 16%      |
| Greenlee   | 8,698   | 12,805  | 47%      | 11,509    | -10%     | 10,330    | -10%     | 11,406    | 10%      | 8,008     | -29%     |
| Santa Cruz | 9,482   | 9,344   | -1%      | 10,808    | 29%      | 13,966    | 46%      | 20,459    | 46%      | 29,676    | 45%      |
| Region     | 64,920  | 66,222  | 3%       | 91,401    | 12%      | 102,792   | 37%      | 140,413   | 37%      | 161,862   | 15%      |
| Arizona    | 499,261 | 749,587 | 50%      | 1,302,161 | 36%      | 1,775,399 | 53%      | 2,716,546 | 53%      | 3,665,228 | 35%      |

SOURCE: U.S. Census Bureau - 1980-90 Census.

TABLE 2-10

POPULATION PROJECTIONS BY COUNTY  
1990 TO 2040

| County        | 1992      | 2000      | %<br>Change | 2010      | %<br>Change | 2020      | %<br>Change | 2030      | %<br>Change | 2040      | %<br>Change |
|---------------|-----------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| Cochise       | 100,525   | 109,903   | 9.33        | 122,263   | 11.25       | 135,916   | 11.17       | 150,313   | 10.59       | 165,579   | 10.16       |
| Graham        | 27,409    | 30,033    | 9.57        | 32,806    | 9.23        | 35,299    | 7.60        | 37,078    | 5.04        | 37,933    | 2.31        |
| Greenlee      | 7,473     | 6,337     | -15.2       | 6,068     | -4.24       | 6,337     | 4.43        | 6,813     | 7.51        | 7,551     | 10.83       |
| Santa<br>Cruz | 32,018    | 41,253    | 28.84       | 54,360    | 31.77       | 68,966    | 26.87       | 85,757    | 22.90       | 102,849   | 21.35       |
| Region        | 167,425   | 187,526   | 12.01       | 215,497   | 14.49       | 246,518   | 14.40       | 345,100   | 13.16       | 313,912   | 12.53       |
| Arizona       | 3,850,800 | 4,664,125 | 21.12       | 5,760,100 | 23.50       | 6,982,275 | 21.22       | 8,219,925 | 17.73       | 9,402,975 | 14.39       |

SOURCE: Population Statistics Unit, DES, July 1992.

TABLE 2-11  
 POPULATION DENSITY  
 SEAGO REGION COMPARED TO METROPOLITAN  
 COUNTIES AND THE STATE

Population Per Square Mile

|                   | Square Miles | 1970  | 1980  | % Change | 1990  | % Change |
|-------------------|--------------|-------|-------|----------|-------|----------|
| Cochise County    | 6,219        | 10.0  | 14.0  | 40.0%    | 15.7  | 12.1%    |
| Graham County     | 4,630        | 3.5   | 5.0   | 30.0%    | 5.7   | 14.0%    |
| Greenlee County   | 1,838        | 5.6   | 6.2   | 10.7%    | 4.4   | -29.0%   |
| Santa Cruz County | 1,238        | 11.0  | 16.5  | 50.0%    | 24.0  | 45.5%    |
| SEAGO Region      | 13,925       | 7.3   | 10.0  | 37.0%    | 11.6  | 16.0%    |
| Maricopa County   | 9,127        | 106.0 | 165.0 | 56.0%    | 232.5 | 40.9%    |
| Pima County       | 9,188        | 38.0  | 58.0  | 53.0%    | 72.6  | 25.2%    |
| Arizona           | 113,506      | 16.0  | 24.0  | 50.0%    | 32.3  | 34.6%    |

Source: Arizona Statistical Review, 45th Edition, December 1989, Valley National Bank.