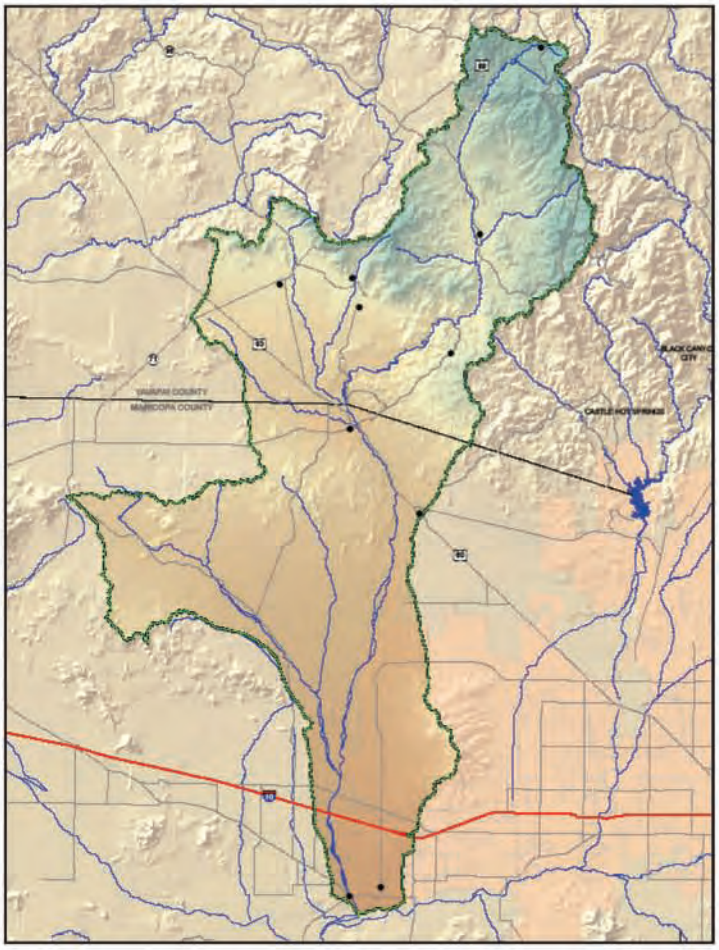
Hassayampa River Watershed - Arizona

Rapid Watershed Assessment

June 2008



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Hassayampa River Watershed
15070103
8-Digit Hydrologic Unit
Rapid Watershed Assessment

Section 1: Introduction

Overview of Rapid Watershed Assessments

A Rapid Watershed Assessment (RWA) is a concise report containing information on natural resource conditions and concerns within a designated watershed. The "rapid" part refers to a relatively short time period to develop the report as compared to a more comprehensive watershed planning effort. The “assessment” part refers to a report containing maps, tables and other information sufficient to give an overview of the watershed and for use as a building block for future planning. RWAs look at physical and socioeconomic characteristics and trends, as well as current and future conservation work.

The assessments involve the collection of readily available quantitative and qualitative information to develop a watershed profile, and sufficient analysis of that information to generate an appraisal of the conservation needs of the watershed. These assessments are conducted by conservation planners, using Geographic Information System (GIS) technology, assessing current levels of resource management, identifying priority resource concerns, and making estimates of future conservation work. Conservation Districts and other local leaders, along with public land management agencies, are involved in the assessment process.

An RWA can be used as a communication tool between the Natural Resources Conservation Service (NRCS) and partners for describing and prioritizing conservation work in selected watersheds. RWAs provide initial estimates of conservation investments needed to address the identified resource concerns in the watershed. RWAs serve as a platform for conservation program delivery, provide useful information for development of NRCS and Conservation District business plans, and lay a foundation for future cooperative watershed planning.

Hassayampa River Watershed

The Hassayampa River Watershed is located in the central-eastern portion of the state of Arizona, northwest of the city of Phoenix. (Figure 1-1). The Hassayampa River watershed drains an area of approximately 1,454 square miles in central Arizona. The headwaters originate in the northern Bradshaw Mountains and flow southward through the Upper Hassayampa ground water basin to the Gila River within the Phoenix AMA. The watershed boundaries are the Bradshaw Mountains to the north and east, the White Tanks to the southeast, and the Weaver, Date Creek, Vulture and Big Horn Mountains to the west (ADWR, 2007).

The watershed comprises 930,560 acres (1,454 square miles), and is located approximately 53% in Maricopa County and about 10% in Yavapai County. Thirty-one percent of the land is managed by the BLM, 28% is privately owned, 27% is State Land, and 13% is managed by the Forest Service. The remaining 1% of the land is

managed by the military, the Bureau of Reclamation, the county and local or state parks.

There are about 8,000 acres of irrigated cropland in the watershed; however, much of this cropland is being rapidly converted to urban uses and this trend is expected to continue in the future. Important crops include alfalfa and cotton. The remaining area is primarily rangeland and urban land, with some forest land in the upper portion of the watershed. Livestock use is dominated by steer operations at the lower elevations, and cow/calf operations at the higher elevations.

Major towns and cities include Wickenburg and a portion of the Town of Buckeye. Conservation assistance is provided through three Natural Resource Conservation Districts: Buckeye Valley, Triangle, and Wickenburg. There are two U.S. Department of Agriculture (USDA) Service Centers in the area, located in Avondale and Prescott Valley.

Resource concerns in the watershed include soil erosion, rangeland site stability, rangeland hydrologic cycle, excessive runoff (causing flooding or ponding), aquifer overdraft, excessive suspended sediment and turbidity in surface water, effect of air quality on visibility and plant health, threatened or endangered plant and animal species, noxious and invasive plants, wildfire hazard, inadequate water for fish and wildlife, habitat fragmentation, and inadequate stock water for domestic animals (NRCS Factsheet).

Section 2: Physical Description

Watershed Size

The Hassayampa River Watershed covers approximately 930,560 acres (1,454 square miles), representing about 2.0% of the state of Arizona. The watershed has a maximum width of about 33 miles east to west, and a maximum length of about 80 miles north to south. The highest point in the watershed is at Mount Tritle in the Bradshaw Mountains, with an elevation of 7,782 feet. The lowest point in the watershed is where the Hassayampa River runs into the Gila River at 800 feet elevation.

The Hassayampa River Watershed was delineated by the U.S. Geological Survey and has been subdivided by the NRCS into smaller watersheds or drainage areas. Each drainage area has a unique hydrologic unit code number (HUC) and a name based on the primary surface water feature within the HUC. These drainage areas can be further subdivided into even smaller watersheds as needed. The Hassayampa River Watershed is an 8-digit HUC of 15070103 and contains the following 10-digit HUCs (Figure 2-1):

- 1507010301 Upper Hassayampa River
- 1507010302 Sols Wash
- 1507010303 Middle Hassayampa River
- 1507010304 Jackrabbit Wash
- 1507010305 Lower Hassayampa River

Geology

The Hassayampa River Watershed straddles two of Arizona's physiographic provinces: the Central Highlands and Basin and Range (Figure 2-2). The Basin and Range Province of southern and western Arizona is an area where the Earth's crust has been stretched and broken by numerous faults so that mountain ranges and basins (broad valleys) have formed by the vertical motion of large crustal blocks. The Basin and Range Province was formed from 28 to 12 million years ago as the Baja California portion of the Earth's tectonic Pacific Oceanic plate began diverging from the continental plate, stretching the continental plate and forming the equivalent of stretch marks in the earth's crust, nearly parallel to the strike (direction) of the plate boundary. As the earth's crust is stretched, blocks of crust break and drop in a pattern of valley basins and high peak ranges, and is known as the Basin and Range Province within Arizona and other regions of Mexico and the western United States.

The Central Highlands Province is a zone of transition between the Basin and Range and Colorado Plateau Provinces, and thus blends the characteristics of both areas. The Central Highlands Province is characterized by tightly clustered ranges and narrow, shallow basins. Most of the mountain ranges in this province are composed of granitic and metamorphic rocks, and are covered by dark, Tertiary basalts (Kamilli and Richard, 1998).

The Hassayampa River originates in the high peaks of the Bradshaw Mountains, a range of Precambrian granite, schist,

and gneiss. The river then flows in a general south-southwest direction until it joins up with Gila River. A metamorphic core complex range made up of Precambrian granite and gneiss called the White Tank Mountains forms the eastern edge of the watershed at its southernmost extent, and the Bighorn Mountains form another barrier to the southwest. The Vulture Mountains, a granitic range with heavy faulting, rise up from the middle of the watershed, and are evidence of an enormous lava plateau (Chronic, 1983).

Soils

Soils within the Hassayampa River Watershed are diverse and formed as the result of differences in climate, vegetation, geology, and physiography. Detail soils information for the watershed is available from the Natural Resources Conservation Service (NRCS) and the U.S. Forest Service (USFS). The USFS maintains Terrestrial Ecosystem Surveys on National Forest Lands within the watershed. Lands outside of National Forests are included within the following NRCS Soil Surveys: "Soil Survey of Yavapai County, AZ, Western Part"; "Soil Survey of Maricopa County, AZ, Central Part"; and "Soil Survey of Aguila-Carefree Area, AZ, Parts of Maricopa and Pinal Counties, AZ." Detailed soils information and maps from these Soil Surveys can be accessed through the NRCS Web Soil Survey website: http://websoilsurvey.nrcs.usda.gov.

Common Resource Areas

The USDA, Natural Resources Conservation Service (NRCS) defines a Common Resource Area (CRA) as a geographical area where resource concerns, problems, or treatment needs are similar (NRCS 2006). It is considered a subdivision of an existing Major Land Resource Area (MLRA). Landscape conditions, soil, climate, human considerations, and other natural resource information are used to determine the geographic boundaries of a Common Resource Area.

The Hassayampa River Watershed is comprised of five Common Resource Areas (Figure 2-3 and Table 2-1).

Beginning at the lower end of the watershed, CRA 40.3 "Colorado Sonoran Desert" occurs at elevations ranging from 300 to 1,200 feet. Precipitation averages 3 to 7 inches per year. Vegetation includes creosotebush, white bursage, brittlebush, Mormon tea, teddybear cholla, elephant tree, smoke tree, ocotillo, and big galleta. The soils in the area have a hyperthermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, medium and moderately coarse-textured, limy soils occur on low fan terraces. Deep, stratified, coarse to fine-textured soils occur on floodplains and alluvial fans. Deep and shallow to a hardpan, limy, gravelly, medium and moderately coarse-textured soils occur on fan terraces.

CRA 40.2 "Middle Sonoran Desert" occurs at slightly higher elevations, ranging from 1,200 to 2,000 feet with precipitation averaging 7 to 10 inches per year. Vegetation includes saguaro, palo verde, creosotebush, triangle bursage, brittlebush, prickly pear, cholla, desert saltbush, wolfberry, bush muhly,

threeawns, and big galleta. The soils in the area have a hyperthermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep and shallow to a hardpan, limy, gravelly, medium and moderately coarse-textured soils occur on fan terraces. Shallow, very gravelly and cobbly, moderately coarse to moderately fine-textured soils and rock outcrop occur on hills and mountains. Deep, stratified, coarse to fine-textured soils occur on floodplains and alluvial fans. Deep, moderately fine and fine-textured and gravelly, moderately fine-textured soils occur on fan terraces.

CRA 40.1 "Upper Sonoran Desert" occurs at elevations ranging from 2000 to 3200 feet with precipitation averaging 10 to 13 inches per year. Vegetation includes saguaro, palo verde, mesquite, creosotebush, triangle bursage, prickly pear, cholla, wolfberry, bush muhly, threeawns, ocotillo, and globe mallow. The soils in the area have a thermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, moderately coarse to moderately fine-textured soils occur on fan terraces. Shallow, cobbly and gravelly soils and rock outcrop occur on hills and mountains.

These three Common Resource Areas (40.3, 40.2 and 40.1) occur within the Basin and Range Physiographic Province which is characterized by numerous mountain ranges rising abruptly from broad, plain-like valleys and basins. Igneous and metamorphic rock classes dominate the mountain ranges and sediments filling the basins represent combinations of fluvial, lacustrine, colluvial and alluvial deposits.

Moving up the watershed, CRA 38.1 "Lower Interior Chaparral" occurs at elevations ranging from 3000 to 4500 feet. Precipitation averages 12 to 16 inches per year. Vegetation includes canotia, one-seed juniper, mesquite, catclaw acacia, jojoba, turbinella oak, ratany, shrubby buckwheat, algerita, skunkbush, tobosa, vine mesquite, bottlebrush squirreltail, grama species, curly mesquite, desert needlegrass and New Mexico feathergrass. The soils in the area have a thermic soil temperature regime and an ustic aridic moisture regime. The dominant soil orders are Aridisols, Entisols, Mollisols and Vertisols. Shallow, cobbly and gravelly, moderately coarse to moderately fine-textured soils and rock outcrop occur on hills and mountains. Shallow to deep, gravelly, cobbly and stony, fine-textured soils occur on basaltic plains, mesas and hills. Deep, moderately fine and gravelly, moderately fine and fine-textured soils occur on floodplains, valley slopes and plains.

CRA 38.2 "Interior Chaparral – Woodlands" occurs at elevations ranging from 4000 to 5500 feet with precipitation averaging 16 to 20 inches per year. Vegetation includes turbinella oak, hollyleaf buckthorn, desert buckbrush, one-seed juniper, alligator juniper, pinyon, algerita, sugar sumac, prairie junegrass, blue grama, curly mesquite, bottlebrush squirreltail, muttongrass, cane beardgrass, plains lovegrass and bullgrass. The soils in the area have a thermic to mesic to frigid soil temperature regime and an aridic ustic soil moisture regime. The dominant soil orders are Alfisols and

Mollisols. Moderately deep and deep, gravelly and cobbly, moderately coarse and fine-textured soils occur on mountains. Shallow, gravelly and cobbly, moderately coarse to moderately fine-textured soils and rock outcrop occur on hills and mountains. These two Common Resource Areas (38.1 and 38.2) occur within the Transition Zone Physiographic Province which is characterized by canyons and structural troughs or valleys. Igneous, metamorphic and sedimentary rock classes occur on rough mountainous terrain in association with less extensive sediment filled valleys.

Table 2-1: Hassayampa River Watershed – Common Resource Areas

Common Resource Area Type	Area (sq. mi.)	Percent of Watershed
38.1 Lower Interior Chaparral	**393**	**27%**
38.2 Interior Chaparral – Woodlands	**68**	**5%**
40.1 Upper Sonoran Desert	**378**	**26%**
40.2 Middle Sonoran Desert	**497**	**34%**
40.3 Colorado Sonoran Desert	**118**	**8%**

Data Sources: GIS map layer "cra". Arizona Land Information System (ALRIS 2004).
Natural Resource Conservation Service (NRCS 2006)

At the lower end of the watershed, CRA 40.1 "Upper Sonoran Desert" occurs at elevations ranging from 2000 to 3200 feet with precipitation averaging 10 to 13 inches per year. Vegetation includes saguaro, palo verde, mesquite, creosotebush, triangle bursage, prickly pear, cholla, wolfberry, bush muhly, threeawns, ocotillo, and globe mallow. The soils in the area have a thermic soil temperature regime and a typic aridic soil moisture regime. The dominant soil orders are Aridisols and Entisols. Deep, gravelly, limy, moderately coarse to moderately fine-textured soils occur on fan terraces. Deep and shallow to a hardpan, limy and gravelly, medium and moderately coarse textured soils occur on fan terraces. Deep, moderately coarse to moderately fine-textured soils occur on floodplains and alluvial fans.

Moving up the watershed, CRA 41.3 "Chihuahuan – Sonoran Semidesert Grasslands" occurs at elevations ranging from 3,200 to 5,000 feet with precipitation averaging 12 to 16 inches per year. Vegetation includes mesquite, catclaw acacia, palo verde, range ratany, fourwing saltbush, tarbush, littleleaf sumac, sideoats grama, black grama, plains lovegrass, cane beardgrass, tobosa, threeawns, Arizona cottontop and bush muhly. The soils in the area have a thermic temperature regime and an ustic aridic soil moisture regime. The dominant soil orders are Entisols, Aridisols, and Mollisols. Deep, gravelly, moderately coarse to moderately fine-textured soils occur on fan terraces. Shallow, cobbly and gravelly soils and rock outcrop occur on hills and mountains.

In the upper portions of the watershed occurs CRA 41.1 "Mexican Oak-Pine Forest and Oak Savannah" with elevations ranging from 4500 to 10,700 feet. Precipitation averages 16 to 30 inches. Vegetation includes Emory oak,

Arizona white oak, one-seed juniper, alligator juniper, California bricklebush, skunkbush sumac, Arizona rosewood, wait-a-bit mimosa, sideoats grama, blue grama, wooly bunchgrass, plains lovegrass, squirreltail, and pinyon ricegrass. The soils in the area have a thermic to mesic temperature regime and an aridic ustic to typic ustic soil moisture regime. The dominant soil orders are Aridisols and Mollisols. Deep, fine-textured and gravelly, moderately coarse to moderately fine-textured soils occur on fan terraces. Shallow, gravelly and cobbly, moderately coarse to moderately fine-textured soils and rock outcrop occur on hills and mountains.

These three Common Resource Areas (CRA 40.1, CRA 41.3, CRA 41.1) occur within the Basin and Range Physiographic Province which is characterized by numerous mountain ranges rising abruptly from broad, plain-like valleys and basins. Igneous and metamorphic rock classes dominate the mountain ranges and sediments filling the basins represent combinations of fluvial, lacustrine, colluvial and alluvial deposits.

Slope Classifications

Slope, as well as soil characteristics and topography, are important when assessing the vulnerability of a watershed to erosion. Approximately 16% of the Hassayampa River Watershed has a slope greater than 15%, while 67% of the watershed has a slope less than 5%. The Lower Hassayampa River Watershed is relatively flat, with only 4% of its area over 15% slope, and 89% with less than 5% slope. The Upper Hassayampa River Watershed is relatively steeper, with 39% of the area greater than 15% slope and 28% with less than 5% slope. (Table 2-2 and Figure 2-4).

Table 2-2: Hassayampa River Watershed Slope Classifications.

Watershed Name	Area (sq. mi.)	Percent Slope		
		<5%	5-15%	>15%
Upper Hassayampa River 1507010301	303	28%	33%	39%
Sols Wash 1507010302	144	86%	8%	6%
Middle Hassayampa River 1507010303	349	50%	26%	24%
Jackrabbit Wash 1507010304	327	88%	9%	3%
Lower Hassayampa River 1507010305	331	89%	7%	4%
Hassayampa River Watershed	1,454	67%	17%	16%

Data Sources: Derived from DEM, obtained from U.S. Geological Survey, April 8, 2003 http://edc.usgs.gov/geodata/

Streams, Lakes and Gaging Stations

The locations of active and inactive gaging stations, and their respective annual mean stream flow, are found in Table 2-3.1. Hassayampa River Near Arlington has the largest active stream flow with 62 cfs. Hassayampa River Near Morristown has the lowest active stream flow with 29cfs. Table 2.3.2 lists major lakes and reservoirs in the Hassayampa River Watershed, as well as their watershed position, surface area, elevation and dam name. Billingsley Reservoir is the largest surface water in the watershed with an area of about 20 acres. Figure 2-5 shows the major streams and their lengths. Stream lengths range from 135 miles for Hassayampa River to 5 miles for Star Wash.

The purpose of the Central Arizona Project (CAP) Canal is to transfer Colorado River water to cities and farms in central and southern Arizona. Fourteen miles, of the total 349-mile long CAP canal, are in the watershed. In addition to the CAP, there are 33 miles of irrigation canals managed by water providers for agricultural water use.

Table 2-3.1: Hassayampa River Watershed USGS Stream Gages and Annual Mean Stream Flow.

USGS Gage ID	Site Name	Begin Date	End Date	Annual Mean Stream Flow (cfs)
	Inactive Gages			
09517000	Hassayampa River Near Arlington, AZ	1960	2006	62
09516500	Hassayampa River Near Morristown, AZ	1939	2006	29

Data Sources: GIS dataset "usgs_gages_utm" USGS 2007; USGS website, National Water Information System http://waterdata.usgs.gov/nwis/

Table 2-3.2: Hassayampa River Watershed Major Lakes and Reservoirs

Lake Name (if known)	Watershed	Surface Area (acres)	Elevation (feet above mean sea level)	Dam Name (if known)
Billingsley Reservoir Number T	Middle Hassayampa River	20	3,399	Billingsley Number Two Dam

Data Sources: GIS data layer "Lakes", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), February 7, 2003 http://www.land.state.az.us/alris/index.html

Table 2-3.3: Hassayampa River Watershed Major Stream and Canal Lengths.

Stream Name	Watershed	Stream Length (miles)
unnamed stream	Jackrabbit Wash	8
Antelope Creek	Middle Hassayampa River	16
Blind Indian Creek	Upper Hassayampa River	15
Box Wash	Jackrabbit Wash	18
Cottonwood Creek	Upper Hassayampa River	10
Groom Creek	Upper Hassayampa River	6
Hassayampa River	Upper Hassayampa River, Middle Hassayampa River, Lower Hassayampa River	135
Jackrabbit Wash	Jackrabbit Wash	52
Martinez Wash	Middle Hassayampa River	23
Sols Wash	Sols Wash	20
Star Wash	Jackrabbit Wash	5
Central Arizona Project (CAP) Canal	Lower Hassayampa River, Jackrabbit Wash	14
Irrigation Canals	Lower Hassayampa River, Jackrabbit Wash	33

Data Sources: GIS data layer "Streams", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), October, 10, 2002.
http://www.land.state.az.us/alris/index.html

Riparian Vegetation

The Arizona Game & Fish Department has identified and mapped riparian vegetation associated with perennial waters in response to the requirements of the state Riparian Protection Program (AZ Game & Fish, 1994). This map was used to identify riparian areas in the Hassayampa River Watershed (Figure 2-6).

Seven of the ten types of riparian areas occur within the Hassayampa River Watershed. Riparian areas encompass approximately 931 acres (1.5 sq. mi.) or about 0.2% of the entire watershed. Mesquite comprises about 241 acres, or 26% of the riparian areas. Cottonwood Willow and Tamarisk comprise about 19% and 16%, respectively, of the watershed (Table 2-4).

The Middle Hassayampa River Watershed has the greatest amount of riparian vegetation with about 508 acres (0.8 square miles). The Lower Hassayampa River Watershed has about 241 acres (0.4 sq. mi.) and the Upper Hassayampa River Watershed has only about 182 acres (0.3 sq. mi.).

Table 2-4: Hassayampa River Watershed Riparian Vegetation (acres) by 10 Digit Watershed (Part 1 of 2).

Riparian Vegetation Community	Upper Hassayampa River 1507010301	Sols Wash 1507010302	Middle Hassayampa River 1507010303	Jackrabbit Wash 1507010304
Conifer Oak	62	-	19	-
Cottonwood Willow	-	-	174	-
Flood Scoured	-	-	52	-
Mesquite	22	-	218	-
Mixed Broadleaf	98	-	22	-
Strand	-	-	23	-
Tamarisk	-	-	-	-
Total Area (acres)	182	-	508	-

Data Sources: GIS data layer "az_riparian_att", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), Dec. 4, 2006 http://www.land.state.az.us/alris/index.html

Table 2-4: Hassayampa River Watershed Riparian Vegetation (acres) by 10 Digit Watershed (Part 2 of 2).

Riparian Vegetation Community	Lower Hassayampa River 1507010305	Hassayampa River Watershed
Conifer Oak	-	81
Cottonwood Willow	2	176
Flood Scoured	-	52
Mesquite	-	241
Mixed Broadleaf	-	120
Strand	89	112
Tamarisk	149	149
Total Area (acres)	241	931

Data Sources: GIS data layer "az_riparian_att", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), Dec. 4, 2006 http://www.land.state.az.us/alris/index.html

Land Cover

The Riparian Vegetation map (Figure 2-6) and Land Cover map (Figure 2-7) were created from the Southwest Regional Gap Analysis Project land cover map (Lowry et. al, 2005). Within the Hassayampa River Watershed, Table 2-5 identifies Scrub/Shrub as the most common land cover type over the entire watershed, encompassing about 89% of the watershed. The next most common type is the Evergreen Forest covering about 8% of the watershed.

Note: There are a total of 26 GAP vegetation categories present within the Hassayampa River Watershed boundary. Some of these categories occur only in small concentrations, and are not visible at the small scale in which the maps are displayed. Some of the vegetation categories were re-grouped in order to increase the legibility of the map. In collaboration with NRCS, staff was able to create a total of 10 grouped GAP vegetation categories, as shown on Table 2-5. Scrub/Shrub is the most common type of land cover, comprising 89% of the watershed.

Table 2-5: Hassayampa River Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of 10-digit Watershed (Part 1 of 2).

Watershed / Land Cover	Upper Hassayampa River 1507010301	Sols Wash 1507010302	Middle Hassayampa River 1507010303	Jackrabbit Wash 1507010304
Agriculture*	<1.0%	-	-	-
Altered or Disturbed	<1.0%	-	-	-
Developed – High Intensity	<1.0%	2.0%	<1.0%	-
Developed – Low Intensity	-	1.0%	1.0%	-
Emergent Herbaceous Wetland	1.0%	<1.0%	5.0%	<1.0%
Evergreen Forest	31%	2.0%	15%	<1.0%
Grassland / Herbaceous Cover	1.0%	<1.0%	<1.0%	-
Open Water	<1.0%	<1.0%	<1.0%	-
Scrub / Shrub	68%	95%	79%	100%
Sparsely Vegetated / Barren	<1.0%	<1.0%	<1.0%	1.0%
Area (sq.mi.)	303	144	349	327

Table 2-5: Hassayampa River Watershed Southwest Regional GAP Analysis Project Land Cover, Percent of 10-digit Watershed (Part 2 of 2).

Watershed / Land Cover	Lower Hassayampa River 1507010305	Percent of Total
Agriculture*	8.0%	2.0%
Altered or Disturbed	-	<1.0%
Developed – High Intensity	<1.0%	<1.0%
Developed – Low Intensity	<1.0%	1.0%
Emergent Herbaceous Wetland	<1.0%	<1.0%
Evergreen Forest	<1.0%	8.0%
Grassland / Herbaceous Cover	-	<1.0%
Open Water	<1.0%	<1.0%
Scrub / Shrub	91%	89%
Sparsely Vegetated / Barren	<1.0%	<1.0%
Area (Sq.mi.)	331	1,454

***Not necessarily irrigated land.*
Data Sources: GIS data layer "Southwest Regional GAP Program", originated by Southwest Regional GAP program, 2005. http://ftp.nr.usu.edu/swgap/

Meteorological Stations, Precipitation and Temperature

For the years 1961-1990, the average annual precipitation for the Hassayampa River Watershed is 14 inches (Table 2-6). The Upper Hassayampa River Watershed received the most rainfall with about 21 inches of rain in an average year, while the Middle Hassayampa River and Sols Wash Watersheds typically received about 15 and 13 inches, respectively. Average Temperature for the Middle Hassayampa River Watershed ranged from 48 ^{o}F to 84 ^{o}F. There are seven active meteorological stations, located in the central and northern areas of the watershed (Figure 2-8).

The Western Regional Climate Center calculates the average minimum and maximum temperatures for each month for the period of record and then takes an annual average.

Table 2-6: Hassayampa River Watershed Meteorological Stations, Temperature and Precipitation.

10-digit Watershed Name	Meteorological Stations and Map ID	Temperature (°F)			Precipitation (in/yr)		
		Avg. Min.	Avg. Max.	Avg	Avg. Min.	Avg. Max.	Weighted Average
Upper Hassayampa River 1507010301	Groom Creek	35	69	52	15	31	21
Sols Wash 1507010302	-	-	-	-	11	17	13
Middle Hassayampa River 1507010303	Stanton Wickenburg	53 48	77 84	65 66	11	23	15
Jackrabbit Wash 1507010304	-	-	-	-	7	15	11
Lower Hassayampa River 1507010305	-	-	-	-	7	17	12
Hassayampa River Watershed	-	-	-	-	*7*	*31*	*14*

Data Sources: GIS data layer "precip_a_az" Water and Climate Center of the NRCS (1998); GIS data layer "NWS_Stations" Western Regional Climate Center (WRCC), Temperature data. July 15, 2004; http://www.wrcc.dri.edu/summary/climsmaz.htm

Land Ownership/Management

There are 8 different land ownership/management entities in the Hassayampa River Watershed (Figure 2-9 and Table 2-7). The Bureau of Land Management is the largest category, representing about 31% of the watershed, followed by Private Land with about 28%, State Trust Land with about 27%, and Forest Service Land comprising 13% of the watershed.

Table 2-7: Hassayampa River Watershed Land Ownership/Management (Percent of each 10-digit Watershed) (Part 1 of 2).

Land Owner	Upper Hassayampa River 1507010301	Sols Wash 1507010302	Middle Hassayampa River 1507010303	Jackrabbit Wash 1507010304
Bureau of Land Management	7%	2%	47%	67%
Bureau of Reclamation	-	-	-	<1.0%
County	-	<1.0%	-	-
Forest Service	63%	-	1.1%	-
Local or State Park	-	-	0.1%	-
Military	-	-	-	-
Private	17%	15%	16%	22%
State	13%	82%	37%	12%
Area (square miles)	*303*	*144*	*349*	327

Data Sources: GIS data layer "ownership", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), October 27, 2007 http://www.land.state.az.us/alris/index.html

Table 2-7: Hassayampa River Watershed Land Ownership/Management (Percent of each 10-digit Watershed) (Part 2 of 2).

Land Owner	Lower Hassayampa River 1507010305	Hassayampa River Watershed
Bureau of Land Management	12%	31%
Bureau of Reclamation	<1.0%	<1.0%
County	-	<1.0%
Forest Service	-	13%
Local or State Park	<1.0%	1.0%
Military	<1.0%	<1.0%
Private	62%	28%
State	22%	27%
Area (square miles)	*331*	*1,454*

Data Sources: GIS data layer "ownership", Arizona State Land Department, Arizona Land Resource Information System (ALRIS), October 27, 2007
http://www.land.state.az.us/alris/index.html

Land Use

The Land Use map was created from the Southwest Regional GAP Analysis Project land cover map (Lowry et. al, 2005).

The land cover condition during the early 1990's was determined using the National Land Cover Dataset (NLCD). The NLCD classification contains 21 different land cover categories (USGS, NLCD Land Cover Class Definitions); however, these categories have been consolidated into five land cover types (Figure 2-10 and Table 2-8). The five groupings for the land cover categories are:

- Crop, which includes confined feeding operations; cropland and pasture; orchards, groves, vineyards, nurseries and ornamental horticulture; other agricultural land.
- Forest, includes areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25-100 percent of the cover
- Water, identifies all areas of surface water, generally with less than 25% cover of vegetation/land cover
- Range, which includes herbaceous rangeland; mixed range; shrub and brush rangeland.
- Urban (high intensity and low intensity), which includes

residential areas; commercial and services; industrial and commercial complexes; mixed urban or built-up land; other urban or built-up land; strip mines quarries and gravel pits; transportation, communication and utilities.

The most common land cover type is Range which makes up about 93% of the watershed. Forest is the next most common type with about 4% of the total area.

2-8: Hassayampa River Watershed Land Use, Percent of 10-digit Watershed

Land Cover/Location	Crop	Forest	Urban High Intensity	Urban Low Intensity	Range	Water	Area (sq.mi.)
Upper Hassayampa River 1507010301	<1.0%	21%	<1.0%	-	79%	<1.0%	303
Sols Wash 1507010302	-	<1.0%	2.0%	1.0%	97%	<1.0%	144
Middle Hassayampa River 1507010303	-	<1.0%	<1.0%	2.0%	98%	<1.0%	349
Jackrabbit Wash 1507010304	-	-	-	-	100%	-	327
Lower Hassayampa River 1507010305	8.0%	-	<1.0%	<1.0%	91%	<1.0%	331
Percent of Hassayampa River Watershed	2.0%	4.0%	<1.0%	1.0%	93%	<1.0%	1,454

Data Sources: GIS data layer "Southwest Regional GAP Program", originated by Southwest Regional GAP program, 2005. http://ftp.nr.usu.edu/swgap/

Mines - Primary Ores

Table 2-9 and Figure 2-11 show the types of ores being mined in the Hassayampa River Watershed. With 194 mines, gold is the most common ore mined in the watershed (Ward, J.S. and Associates. 1973). Other common ore types in the watershed include are copper, silver, manganese and fluorine.

Table 2-9: Hassayampa River Watershed Mines – Primary Ores

Ore Type	Total Number of Mines
Beryllium	4
Calcium	2
Clay	3
Columbium	1
Copper	59
Feldspar	7
Fluorine	18
Gemstone	1
Gold	194
Iron	11
Lead	14
Lithium	6
Manganese	18
Mica	2
Molybdenum	2
Perlite	4
Pumice	1
Sand	6
Silver	33
Stone	1
Strontium	2
Tungsten	9
Uranium	3
Vanadium	3
Vermiculite	1
Zeolites	2
Zinc	1

Note: If a mine contains more than one ore, only the major ore is noted. Data Source: "mines" Arizona Land Information Service, 2006

Section 3: Resource Concerns

Introduction

Conservation Districts and other local leaders, along with NRCS and other resource management agencies, have identified priority natural resource concerns for this watershed. These concerns can be grouped under the broad resource categories of Soil, Water, Air, Plants, or Animals (SWAPA). Refer to Table 3-1 for a listing of priority resource concerns by land use within the Hassayampa River Watershed.

Table 3-1: Hassayampa River Watershed Priority Resource Concerns by Land Use

Resource Category	Cropland Concerns	Rangeland Concerns	Forest Concerns	Urban Concerns
Soil Erosion		Sheet & Rill Erosion	Sheet & Rill Erosion	Roads & Construction Sites
Water Quality		Excessive Suspended Sediment in Surface Water		
Water Quantity	Aquifer Depletion	Aquifer Depletion		Aquifer Depletion
Air Quality				Roads & Construction Sites
Plant Condition		Plant Productivity, Health & Vigor		
Noxious & Invasive Plants		Noxious & Invasive Plants	Noxious & Invasive Plants	Noxious & Invasive Plants
Domestic Animals		Inadequate Quantities & Quality of Feed & Forage & Water		
Species of Concern		T&E Species & Declining Species & Species of Concern		

(NRCS, 2007)

Soil Erosion

Soil erosion is defined as the movement of soil from water (sheet and rill or gully) or wind forces requiring treatment when soil loss tolerance levels are exceeded. Sheet and rill erosion is a concern particularly on rangeland in areas of shallow soils and poor vegetative cover. Soil loss results in reduced water holding capacity and plant productivity. Gully erosion can be a significant problem in areas of steep slopes and deep soils. Loss of vegetative cover and down-cutting of streams contribute to gully formation. Wind erosion is locally significant where adequate vegetative cover is not maintained.

Conservation practices applied to address this resource concern are

generally those that help improve vegetative cover, stabilize sites, and control water flows. Practices may include critical area planting, deferred grazing, grade stabilization structures, herbaceous wind barriers, prescribed grazing, range planting, stream channel stabilization, tree and shrub establishment, water and sediment control basins, water spreading, windbreak establishment, and wildlife upland habitat management

Water Quality

The Arizona Department of Environmental Quality (ADEQ) assesses surface water quality to identify which surface waters are impaired or attaining designed uses and to prioritize future monitoring. Strategies must be implemented on impaired waters to reduce pollutant loadings so that surface water quality standards will be met, unless impairment is *solely* due to natural conditions.

Once surface water has been identified as impaired, activities in the watershed that might contribute further loadings of the pollutant are not allowed. Agencies and individuals planning future projects in the watershed must be sure that activities will not further degrade these impaired waters and are encouraged through grants to implement strategies to reduce loading. One of the first steps is the development of a Total Maximum Daily Load (TMDL) analysis to empirically determine the load reduction needed to meet standards.

The draft *2006 Status of Ambient Surface Water Quality in Arizona* indicates the following surface waters in the Hassayampa River Watershed are impaired:

1. French Gulch, a 10 mile tributary to the Hassayampa River in the Upper Hassayampa River Watershed (HUC1507010301), is impaired by cadmium, copper, and zinc. A TMDL was completed in 2004 and a strategic plan to mitigate mining impacts is being developed (Figure 3-1).
2. A reach of Hassayampa River, the uppermost 11 miles of the river and some of its minor tributaries in the Upper Hassayampa River Watershed, is also impaired by cadmium, copper, zinc, and low pH due to mining. A TMDL was completed in 2002 and a strategic plan to mitigate mining impacts is being developed.
3. The Hassayampa River as it enters the Gila River, a 2.3 mile reach below the Buckeye Canal, is listed as impaired by historically used pesticides found in fish tissue: DDT, toxaphene, chlordane. This impairment is part of a larger contamination issue in the Gila River below the Salt River, the lower reach of the Salt River, and Painted Rocks Reservoir and Painted Rocks Borrow Pit Lake. ADEQ is to initiate a TMDL to identify any current sources and potential mitigation; however, these pesticides have been banned from use for many years. A fish consumption advisory is in place to warn the public concerning risks associated with eating these contaminated fish.

The draft assessment indicates that the following lakes and streams were either attaining all or some of their designated uses (other uses were assessed as “inconclusive”):

1. Hassayampa River, a 20 mile reach from Copper Creek to Blind Indian Creek in the Upper Hassayampa River Watershed, is attaining all uses.
2. Hassayampa River, a 31 mile reach from Cottonwood Creek to Martinez Wash in the Middle Hassayampa River Watershed (HUC1507010303), is attaining some uses.
3. Hassayampa River, a 9 mile reach from Sols Wash to 8 miles below Wickenburg primarily in the Middle Hassayampa River Watershed, is attaining some uses.

Water pollution from suspended sediment and turbidity is a resource concern whenever accelerated soil erosion contributes excessive sediment to perennial waters that support aquatic fauna. Conservation practices used to address this resource concern are generally those that improve vegetative cover and reduce upland and stream bank erosion. Practices may include critical area planting, filter strips, heavy use area protection, prescribed grazing, range planting, sediment basins, stream bank protection, upland wildlife habitat management, and windbreak establishment.

Water Quantity

The headwaters of the Hassayampa River Watershed originate in the northern Bradshaw Mountains and flow southward through the Upper Hassayampa ground water basin to the Gila River within the Phoenix AMA. The watershed boundaries are the Bradshaw Mountains to the north and east, the White Tanks to the southeast, and the Weaver, Date Creek, Vulture and Big Horn Mountains to the west. For planning purposes, this watershed is divided into two parts: the Central highlands planning area, and the Phoenix AMA (ADWR webpage).

Seven miles downstream from Wickenburg, a major fault crosses the Hassayampa River at a place called "the Narrows." The fault is downthrown to the south and virtually the entire runoff of the Hassayampa River sinks into the bed of the river and recharges the aquifer system (ADWR webpage). The Narrows is where the Hassayampa River enters the broad Hassayampa Plain and the Phoenix AMA.

Perennial flow occurs at only a few locations within the Hassayampa River watershed. There is a substantial network of smaller tributary washes that drain the basin. These washes are ephemeral and flow mainly in response to summer rainstorms. Most of the runoff in these washes infiltrates into the ground before reaching the Hassayampa River (ADWR webpage).

The average annual runoff for the upper Hassayampa watershed has been estimated from a compilation of gaging records from 1939 through 1982. A 44-year rounded average of 16,800 acre-feet per year flows into the Hassayampa Plain and infiltrates into the groundwater aquifer. Flow rarely reaches the Gila River confluence during storm runoff.

Most years there is zero flow across the Hassayampa Plain (ADWR webpage).

However, irrigation return flow from Buckeye Irrigation Drainage District and Roosevelt Irrigation District does reach the Gila River via the Hassayampa River.

Water quantity is a resource concern whenever water supplies are inadequate to meet the needs for agricultural or domestic uses. Conservation practices applied to address this resource concern on irrigated cropland are generally those that improve the quantity and efficient distribution of water. Practices may include irrigation land leveling, irrigation system, irrigation water conveyance (ditch or pipeline), irrigation water management, and structure for water control.

Air Quality

The vast majority of the watershed has good air quality (Figure 3-2). Only small sections of the western part of the watershed, that border the Phoenix metropolitan area, are in a PM-10 area.

The EPA defines particulate matter as the term for solid or liquid particles found in the air. Some particles are large enough to be seen as soot or smoke. Other particles are so small they can only be detected with an electron microscope. PM-10 particles are very small and can have adverse health effects because of their ability to reach the lower regions of the respiratory tract. Exposure to PM-10 can result in: effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. Children, older people, and people with chronic lung disease, are particularly sensitive to particulate matter (EPA webpage).

Air quality is a resource concern whenever human activities contribute significantly to airborne sediment and smoke, resulting in property damage and health problems. Conservation practices applied to address this resource concern are generally those that reduce wind erosion and smoke. Practices may include atmospheric resource quality management, critical area planting, heavy use area protection, and windbreak establishment.

Environmental Sites

There are no environmental Superfund or Water Quality Assurance Revolving Fund (WQARF) clean up sites located within the watershed (Figure 3-3). However, in the Goodyear area, about five miles east of the watershed, there is an EPA Superfund Site, and about 15 miles from the watershed, near Tolleson, is a WQARF site.

Plant Condition

Plant condition is a resource concern whenever plants do not manufacture sufficient food to continue the growth cycle or to reproduce. Plant condition is frequently a concern where proper grazing management is not being applied.

Conservation practices applied to address this resource concern are generally those that maintain or improve the health, photosynthetic capability, rooting and reproductive capability of vegetation. Practices may include brush

management, critical area planting, deferred grazing, fencing, herbaceous wind barriers, nutrient management, pest management, prescribed grazing, prescribed burning, range planting, recreation area improvement, wildlife upland habitat management, and windbreak establishment.

Noxious and Invasive Plants

Noxious and invasive plants are a resource concern whenever these species cause unsuitable grazing conditions for livestock or wildlife and due to their potential to out-compete native species which are generally preferred for wildlife habitat value. Increases in noxious and invasive plants can result from poor grazing management, drought, and other human introduction causes.

Conservation practices applied to address this resource concern are generally those that control the establishment or reduce the population of noxious and invasive plant species. Practices may include brush management, deferred grazing, fencing, forest stand improvement, pest management, prescribed burning, prescribed grazing, and wildlife upland habitat management.

Bark Beetle, Drought and Wildfire

Over the past several years, Arizona has experienced increased piñon and ponderosa pine mortality due to outbreaks of several species of bark beetles. The Ips beetle and western pine beetle are the two most common groups of bark beetles responsible for the outbreaks in Arizona (USFS, 2004 USFS, 2007). Low tree vigor caused by several years of drought and excessively dense stands of trees have combined to allow beetle populations to reach outbreak levels. These insects are native to ponderosa pine forests and piñon-juniper woodlands of the Southwest, and normally only attack a small number of diseased or weakened trees. Healthy trees are usually not susceptible to these beetles.

Arizona has been in an extended drought since 1996. Most areas of the state continue to experience record low winter precipitation and snowpack, above-average temperatures, and low soil moisture. These conditions have led to high vegetation stress, high fire potential, below-normal streamflow, decreasing water supplies and deteriorating range and pasture conditions. (adapted from Arizona Drought Preparedness Annual Report, 2006)

The Climate Assessment for the Southwest (CLIMAS) website (www.ispe.arizona.edu/climas) and ADWR Statewide Drought Program website (www.azwater.gov/dwr/drought) provide information on Arizona's drought status. The area of Arizona that encompasses the Hassayampa River Watershed has received less than 50% of average annual precipitation, placing it in moderate drought status. The long-term drought status is severe.

Domestic Animal Concerns

Domestic animal concerns occur whenever the quantity and quality of food are not adequate to meet the nutritional requirements of animals, or adequate quantity and quality of water is not provided. This is frequently a concern on rangeland when changes in species composition resulting from poor grazing management and drought can reduce the availability of suitable forage.

Conservation practices applied to address this resource concern are generally those that maintain or improve the quantity, quality, and diversity of forage available for animals, reduce the concentration of animals at existing water sources, and insure adequate quantity and reliability of water for the management of domestic animals. Practices may include brush management, deferred grazing, fencing, pest management, prescribed burning, prescribed grazing, pipelines, ponds, range planting, water spreading, wells, spring development, watering facility, and wildlife upland habitat management.

Species of Concern

There are 55 threatened and endangered species listed for Arizona (U. S. Fish and Wildlife Service website). In 1990 Arizona voters created the Heritage Fund, designating up to $10 million per year from lottery ticket sales for the conservation and protection of the state's wildlife and natural areas. The Heritage Fund allowed for the creation of the Heritage Data Management System (HDMS) which identifies elements of concern in Arizona and consolidates information about their status and distribution throughout the state. (Arizona Game & Fish website, 2006)

The Hassayampa River Watershed contains 5 species that are either listed, species of concern, or candidate species, under the U.S. Endangered Species Act (USESA) (Table 3-2). The watershed is home to three USESA-listed species that are in imminent jeopardy of extinction: the Gila Topminnow (Poeciliopsis occidentalis), Southwestern Willow Flycatcher (Empidonax traillii extimus), and Yuma Clapper Rail (Rallus longirostris yumanensis).

Table 3-2: Hassayampa River Watershed Species of Concern and Endangered Species Classifications and Observations(1)

Common Name	Species Name	USESA (2)	USFS (3)	STATE (4)
Gila Topminnow	Poeciliopsis occidentalis	LE		WSC
Mexican Spotted Owl	Strix occidentalis lucida	LT	S	
Southwestern Willow Flycatcher	Empidonax traillii extimus	LE	S	WSC
Western Yellow-billed Cuckoo	Coccyzus americanus occidentalis	C	S	WSC
Yuma Clapper Rail	Rallus longirostris yumanensis	LE		WSC

Data Sources: Arizona Land Information System (ALRIS), Natural Resource Conservation Service (NRCS).

Note: Status Definitions as Listed by Arizona Game and Fish Department, November 26, 2006
http://www.gf.state.az.us/w_c/edits/hdms_status_definitions.shtml

(1) Proposed for Listing: **(USEA) Federal U.S. Status**
ESA Endangered Species Act (1973 as amended)
US Department of Interior, Fish and Wildlife Service

(2) Listed:
LE Listed Endangered: imminent jeopardy of extinction.
LT Listed Threatened: imminent jeopardy of becoming Endangered.

Candidate (Notice of Review: 1999):
C Candidate. Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed rules have not yet been issued because such actions are precluded at present by other listing activity.

(3) USFS US Forest Service (1999 Animals, 1999 Plants)
US Department of Agriculture, Forest Service, Region 3
S Sensitive: those taxa occurring on National Forests in Arizona which are considered sensitive by the Regional Forester.

(4) State Status
NPL Arizona Native Plant Law (1993)
Arizona Department of Agriculture

WSC Wildlife of Special Concern in Arizona. Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona (WSCA, in prep).

Resource Concern Summary

The Hassayampa River Watershed is a mosaic of federal, state, and private lands where livestock grazing, agriculture and recreation are the primary land uses. The northern portion of the watershed is primarily managed by the U.S. Forest Service and Bureau of Land Management (BLM). The southern portion of the watershed is a mixture of BLM, state and private lands. Livestock grazing is the primary land use activity in the watershed, with a small agricultural area near its outlet. Historically, mining has been an important activity in the watershed. Wickenberg, located near the center of the watershed, is the largest town.

Several important natural areas are located in the watershed. The Hassayampa River Preserve owned by the Nature Conservancy, is located south of Wickenberg and stretches alongside the river. The riparian area by the river's bank includes a Fremont cottonwood-Goodding willow forest, a rare and important wildlife habitat type. The spring-fed Palm Lake on the preserve which has a four-acre pond and marsh is another wildlife habitat. Over 280 resident and migratory birds have been observed on the preserve. The preserve is also important habitat for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) and the candidate species Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). Other species of concern found in the

watershed include Gila topminnow (*Poeciliopsis occidentalis*), Mexican spotted owl (*Strix occidentalis lucida*), and Yuma clapper rail (*Rallus longirostris yumanensis*).

The Hassayampa River Canyon Wilderness is located north of Wickenberg along the Hassayampa River. Managed by the BLM, the 11,840-acre wilderness is found along a perennial reach of the river and supports a rich riparian habitat. Both the Hassayampa River Preserve and Hassayampa River Canyon Wilderness are important recreation and bird watching areas.

Two headwater tributaries are listed by the Arizona Department of Environmental Quality as impaired due to metals (copper, zinc, and cadmium), most likely due to mining activities. Erosion and sedimentation are also important concerns

The watershed will continue to see development due to population growth in Phoenix. The lower potion of the watershed and the Wickenberg area is likely to see high development densities in the near future. Local flooding and channel degradation are likely without the implementation of progressive watershed management practices. Development in the Wickenberg area is of special concern due to potential impacts on the downstream Hassayampa River Preserve.

Local leaders have identified watershed health as a priority concern for the Hassayampa River Watershed. This includes both the upland areas of the watershed and the riparian or stream course areas. The condition of the upland areas is integral to hydrologic function, such that when precipitation falls on the land its disposition is affected by the soil and vegetation, which in turn are affected by land uses, both historical and current. The amount of the precipitation which immediately runs off the land surface, and that which infiltrates into the soil to either be used for plant growth or to recharge ground water, is dependent on this critical interface.

The main concern in the Watershed is rapidly expanding urbanization of cropland and increased recreational use of public lands, resulting in impacts to vegetation and soil surfaces which may affect hydrologic function and result in accelerated erosion. The desert and semi-desert ecosystems have developed in a climatic regime of wide fluctuations of precipitation, ranging from drought to flood. Human uses superimposed on that climatic regime can tend to exacerbate or ameliorate their effects on soils, vegetation and wildlife.

<u>Conservation Progress/Status</u>

Conservation progress for the previous five years in the Hassayampa River Watershed has focused on addressing the following primary resource concerns:

- ✓ Soil Erosion – Sheet and Rill Erosion
- ✓ Water Quantity – Inefficient Water Use on Irrigated Land
- ✓ Water Quality – Excessive Nutrients and Organics in Surface Water
- ✓ Plant Condition – Productivity, Health and Vigor

- ✓ Domestic Animals – Inadequate Quantities and Quality of Feed and Forage

The following table presents conservation accomplishments in this watershed during fiscal years (FY) 2003 through 2007, according to the NRCS Progress Reporting System.

Table 3-3: Hassayampa River Watershed Conservation Treatment Applied

Hassayampa River Watershed (15070103) Conservation Treatment Applied	FY03-07 TOTAL
Comprehensive Nutrient Management Plan (100) (number)	3
Fence (382) (feet)	7,615
Irrigation Land Leveling (464) (acres)	19
Irrigation Water Conveyance, Ditch and Canal Lining, (428) (feet)	616
Irrigation Water Conveyance, Pipeline, Underground, Plastic (430) (feet)	3,343
Irrigation Water Management (449) (acres)	143
Pipeline (516) (feet)	12,280
Prescribed Grazing (528) (acres)	24,277

Section 4: Census, Social and Agricultural Data

This section discusses the human component of the watershed and the pressure on natural resources caused by humans and by population change.

Population Density, 1990

Census block statistics for 1990 were compiled from information prepared by Geo-Lytics (Geo-Lytics, 1998). These data were linked with census block data and used to create a density map (Figure 4-1) through a normalization process using a grid of 7 km squares. This process involves calculating density per census block and intersecting it with the grid, which is then used to calculate the number of people and thus density per grid square.

Table 4-1 shows the tabulated minimum, maximum and mean number of people per square mile in 1990 for the watershed. In 1990, the mean population density for the entire watershed was about 6 people per square mile (Figure 4-1). Sols Wash Watershed had the highest population mean with about 32 people per square mile, and a maximum of 1,419 people per square mile. Jackrabbit Wash Watershed had the lowest density with a mean of only about 0.5 people per square mile.

Population Density, 2000

The Census Block 2000 statistics data were downloaded from the Environmental Systems Research Institute (ESRI) website (ESRI Data Products, 2003) and are shown in Table 4-2.

A population density map (Figure 4-2) was created from these data. The mean population density in 2000 was about 9 people per square mile. Sols Wash and Middle Hassayampa River Watersheds had the highest mean population density with 42 and 19 people per square mile, respectively. Sols Wash and Middle Hassayampa River Watersheds both had the highest maximum population density of 1,419 people per square mile. Jackrabbit Wash Watershed had the lowest density with a mean of about 0.5 people per square mile.

Population Density Change, 1990-2000

The 1990 and 2000 population density maps were used to create a population density change map. The resulting map and table (Figure 4-3 and Table 4-3) show population increase or decrease over the ten year time frame. Mean population density for the Hassayampa River Watershed increased by about 5 people per square mile during the ten-year time period. Sols Wash Watershed had the largest increase in mean population with about 10 people per square mile.

Table 4-1: Hassayampa River Watershed 1990 Population Density (people/square mile)

10-digit Watershed Name	Area (sq. miles)	Population Density (people/sq.mi.)		
		Min	Max	Mean
Upper Hassayampa River 1507010301	303	0	206	2
Sols Wash 1507010302	144	0	1,419	32
Middle Hassayampa River 1507010303	349	0	1,419	14
Jackrabbit Wash 1507010304	327	0	2	0.5
Lower Hassayampa River 1507010305	331	0	107	4
Total Hassayampa Watershed	*1,454*	*0*	*1,419*	*6*

Note: Adjacent watersheds may share a grid square. Data Sources: Census block statistics for 1990 were compiled from a CD prepared by Geo-Lytics (GeoLytics, Inc.1998. Census 1990. Census CD + Maps. Release 3.0.)

Table 4-2: Hassayampa River Watershed 2000 Population Density (people/square mile)

10-digit Watershed Name	Area (sq. miles)	Population Density (people/sq.mi.)		
		Min	Max	Mean
Upper Hassayampa River 1507010301	303	0	287	3
Sols Wash 1507010302	144	0	1,388	42
Middle Hassayampa River 1507010303	349	0	1,388	19
Jackrabbit Wash 1507010304	327	0	23	0.5
Lower Hassayampa River 1507010305	331	0	305	7
Total Hassayampa Watershed	*1,454*	*0*	*1,388*	*9*

Note: Adjacent watersheds may share a grid square. Data Sources: Census block statistics for 1990 were compiled from a CD prepared by Geo-Lytics (GeoLytics, Inc.1998. Census 1990. Census CD + Maps. Release 3.0.)

Table 4-3: Hassayampa River Watershed Population Density Change 1990 – 2000 (people/square mile)

10-digit Watershed Name	Area (sq. miles)	Population Density Change (people/sq.mi.)		
		Min	Max	Mean
Upper Hassayampa River 1507010301	303	-18	82	0.9
Sols Wash 1507010302	144	-90	430	10
Middle Hassayampa River 1507010303	349	-144	430	4
Jackrabbit Wash 1507010304	327	-2	22	0.1
Lower Hassayampa River 1507010305	331	-67	288	4
Total Hassayampa Watershed	*1,454*	-144	430	5

Note: Adjacent watersheds may share a grid square. Data Sources: Derived from data from the GIS data used for tables 4-1 and 4-2.

Housing Density, 2000 and 2030

The Watershed Housing Density Map for the years 2000 and 2030 were created with data developed by David M. Theobald (Theobald, 2005). Theobald developed a nationwide housing density model that incorporates a thorough way to account for land-use change beyond the "urban fringe."

Exurban regions are the "urban fringe", or areas outside suburban areas, having population densities greater than 0.68 – 16.18 ha (1.68 – 40 acres) per unit. Theobald stresses that exurban areas are increasing at a much faster rate than urban sprawl, are consuming much more land, and are having a greater impact on ecological health, habitat fragmentation and other resource concerns.

Theobald estimates that the exurban density class has increased at a much faster rate than the urban/suburban density classes. Theobald's model forecasts that this trend will continue and may even accelerate by 2030. This indicates that development patterns are shifting more towards exurban, lower density, housing units, and are thereby consuming more land. He suggests that exurban development has more overall effect on natural resources because of the larger footprint and disturbance zone, a higher percent of impervious surfaces, and higher pollution because of more vehicle miles traveled to work and shopping.

Figure 4-4 and Table 4-4, Hassayampa River Watershed Housing Density for 2000, identifies that about 24% of housing is located in "undeveloped private" areas, about 3% is located in "rural" areas, and 0.5% "exurban" population. Figure 4-5 and Table 4-5, Hassayampa River Watershed Housing Density for 2030, projects "undeveloped private" areas being reduced to about 8%, "rural" increasing to 9%, and "exurban" increasing to 11% of the watershed.

Table 4-4: Hassayampa River Watershed Housing Density 2000 (Percent of Watershed) (Part 1 of 2).

Housing Density	Upper Hassayampa River 1507010301	Sols Wash 1507010302	Middle Hassayampa River 1507010303	Jackrabbit Wash 1507010304
Undeveloped Private	15%	7%	12%	22%
Rural	1.3%	6%	5%	0.3%
Exurban	0.5%	1%	0.6%	> 0.00%
Suburban	0.1%	0.4%	0.1%	-
Urban	0.07%	0.2%	0.06%	-

Table 4-4: Hassayampa River Watershed Housing Density 2000 (Percent of Watershed) (Part 2 of 2).

Housing Density	Lower Hassayampa River 1507010305	Hassayampa River Watershed	Hassayampa River Watershed (sq. miles)
Undeveloped Private	57%	24%	355
Rural	4%	3%	42
Exurban	0.3%	0.5%	7
Suburban	0.03%	0.1%	2
Urban	0.01%	0.05%	0.7

Note: the dataset used for this analysis only covers 17% of the entire Little Colorado River Headwaters Watershed. Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: http://www.ecology and society.org/vol10/iss1/art32/

Table 4-5: Hassayampa River Watershed Housing Density 2030 (Percent of Watershed) (Part 1 of 2).

Housing Density	Upper Hassayampa River 1507010301	Sols Wash 1507010302	Middle Hassayampa River 1507010303	Jackrabbit Wash 1507010304
Undeveloped Private	1.3%	0.3%	1%	16%
Rural	10%	1%	6%	5%
Exurban	5%	10%	8%	1%
Suburban	0.5%	2%	1%	-
Urban	0.2%	0.7%	0.2%	-

Table 4-5: Hassayampa River Watershed Housing Density 2030 (Percent of Watershed) (Part 2 of 2).

Housing Density	Lower Hassayampa River 1507010305	Hassayampa River Watershed	Hassayampa River Watershed (sq. miles)
Undeveloped Private	15%	8%	111
Rural	18%	9%	128
Exurban	28%	11%	154
Suburban	0.3%	1%	11
Urban	0.03%	0.2%	3

Note: the dataset used for this analysis only covers 17% of the entire Little Colorado River Headwaters Watershed. Source: Theobald, D. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. [online] URL: http://www.ecology and society.org/vol10/iss1/art32/

Hassayampa River Watershed Agricultural Statistics

Arizona is known as one of the most productive and efficient agricultural regions in the world, with beauty that also provides the food and fiber to sustain life in the desert. Arizona is also one of the most diverse agricultural producing states in the nation, producing more than 160 varieties of vegetables, livestock, field crops and nursery stock. The climate, natural resources, agribusiness infrastructure and farm heritage help make agriculture a $9.2 billion dollar industry employing more than 72,000 individuals.

According to the United States Department of Agriculture's, 2002 Census, there are more than 7,000 farms and ranches, seventy-eight percent of which are owned by individuals or families. The total farmland in Arizona is comprised of more than 26,000,000 acres with irrigated crops on 1,280,000 acres and pasture for animals on 23,680,000.

Most farms in the Hassayampa River Watershed are fairly small. Eighty-three percent of all farms in the watershed are less than 1,000 acres in size, and 50% are less than 50 acres (Table 4-6 and Figure 4-6). Of the 93 farms that have pasture and rangeland, 36 farms (39%) have 100 or more acres (Table 4-7 and Figure 4-7). Out of the 146 farms that harvest crops, 44% are 49 acres or less in size (Table 4-8 and Figure 4-8).

The NASS (National Agricultural Statistics Service, United States Department of Agriculture) has farm data by zip code. We used the U.S. Census Bureau ZIP Census Tabulation Areas (ZCTA) to generate maps. A typical 5-digit ZCTA (there are 3-digit ZCTAs as well) is typically nearly identical to a 5-digit U.S. Postal Service ZIP code, but there are some distinctions. Unlike ZIP codes, ZCTA areas are spatially complete and they are easier to map. The Bureau created special `XX ZCTAs (ZCTAs with a valid 3-digit ZIP but with "XX" as last two characters of the code) which represent large unpopulated areas where it made no sense to assign a census block to an actual ZIP code. Similarly, HH ZCTAs represent large bodies of water within a

3-digit zip area. There is typically no population in either an XX or HH ZCTA.

Data is withheld by NASS for categories with one to four farms. This is to protect the identity of individual farmers. Farm counts for these zip codes are included in the "State Total" category. Some categories only contained stars instead of numbers. Each star was counted as one farm. But because each star could represent as many as 4 farms, each number on the tables is actually greater than or equal to the number listed. In some cases this results in percentages that add up to more or less that 100 percent.

Tables Include data from zip codes both contained within the watershed and zip codes crossing watershed boundaries. It is important to note that the figures in the tables include significant agricultural areas adjacent to but outside of the watershed area along the Santa Cruz and the San Pedro Rivers and other nearby drainages.

NASS assumes that when no agricultural information exists for a zip code, no agricultural activity takes place within that area.

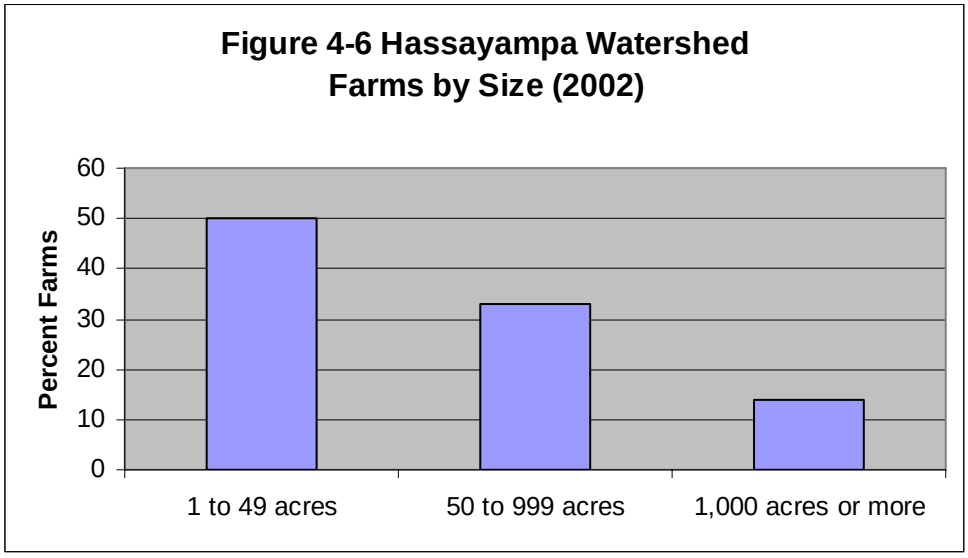

Table 4-6: Hassayampa River Watershed Farms by Size

All farms	1 to 49 acres	50 to 999 acres	>1000 acres
326	50%	33%	14%

NASS defines A "farm" as an operation with at least $1000 in agricultural sales from agriculture. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

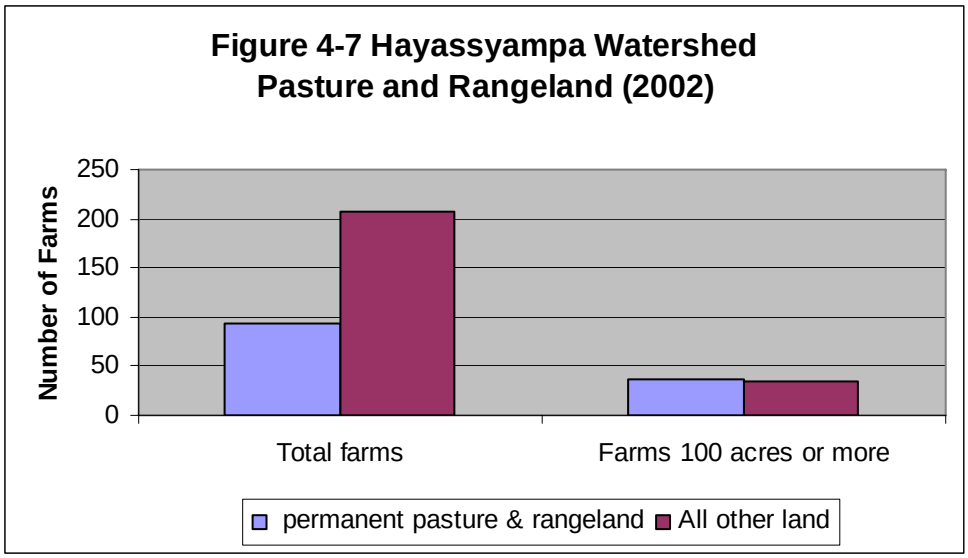

Table 4-7: Hassayampa River Watershed Pasture and Rangeland (2002)

Category	Total farms	Farms 100 acres or more
Permanent pasture and rangeland	93	36
All other land	207	34

Grazing lands are the USDA Pastureland, as defined by NASS, includes cropland used only for pasture or grazing, woodland pastured, and other pastureland and rangeland. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

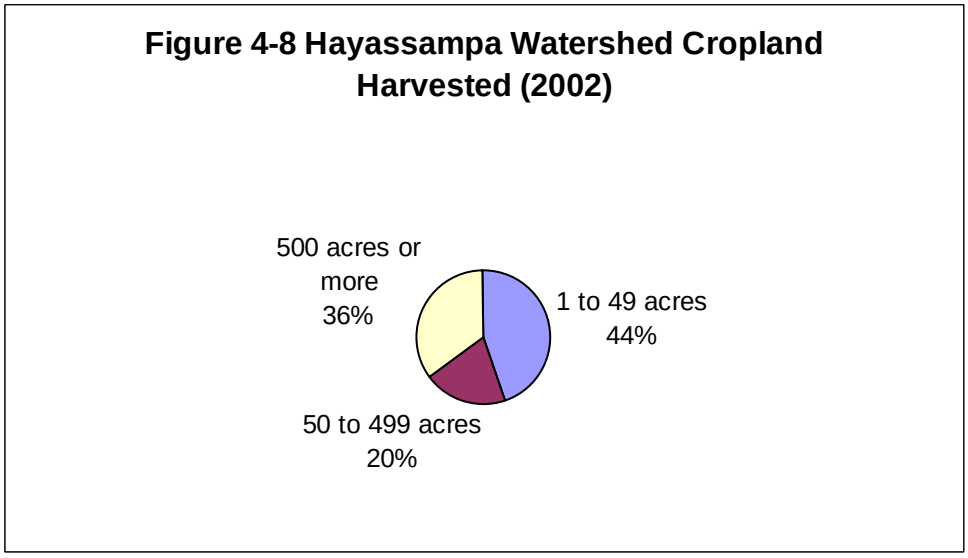

Table 4-8: Hassayampa River Watershed Cropland Harvested

Total farms	1 to 49 acres	50 to 999 acres	>1000 acres
146	44%	20%	36%

According to the NASS, "harvested cropland" includes all land from which crops were harvested, including cut hay: all land in orchards, citrus groves, and nursery and greenhouse crops. Land from which two or more crops were harvested was counted only once even though there was more than one use of that land. Percents rounded. Data source: NASS (National Agricultural Statistics Service, United States Department of Agriculture)

Section 5: Resource Assessment Tables

The following Resource Assessment Tables summarize current and desired future natural resource conditions for the Hassayampa River Watershed. The tables present information on benchmark and future conservation systems and practices, qualitative effects on primary resource concerns, and estimated costs for conservation implementation. Conservation District board members, NRCS conservationists, and other people familiar with conservation work in the watershed were consulted for estimating current and future natural resource conditions.

The tables show three levels of conservation treatment (Baseline, Progressive, Resource Management System) for each of the major land uses (range and urban) within the watershed. **Baseline** is defined as a low level of conservation adoption with landowners who are typically not participating in conservation programs. There are, however, a few practices that have been commonly adopted by all landowners in this watershed. **Progressive** is defined as an intermediate level of conservation adoption with landowners who are actively participating in conservation programs and have adopted several practices but not satisfied all of the Quality Criteria in the NRCS Field Office Technical Guide. **Resource Management System** (RMS) is defined as a complete system of conservation practices that addresses all of the Soil, Water, Air, Plant, and Animal (SWAPA) resource concerns typically seen for this land use in this watershed.

For each land use, the results of the assessment are presented in two parts. Part 1 (Assessment Information) summarizes the conservation practices at each treatment level and the quantities of practices for current benchmark conditions and projected future conditions. Part 1 also displays the four primary resource concerns, along with individual practice effects and an overall Systems Rating (ranging from a low of 1 to a high of 5) indicating the effectiveness of the conservation system used at each treatment level. Part 2 (Conservation Cost Table) summarizes the installation, management, and related costs by conservation practice and treatment level for the projected future conditions by federal and private share of the costs. Part 2 also displays the benchmark and future conservation conditions status bars.

Credit goes to NRCS in Oregon for development of the template for these Resource Assessment Tables.

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103				LANDUSE ACRES	8,000		
LANDUSE TYPE	CROP				TYPICAL UNIT SIZE ACRES	500		
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION	42%		
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Condition – Organic Matter Depletion	Water Quantity – Inefficient Water Use on Irrigated Land	Water Quality – Excessive Nutrients and Organics in Groundwater	Air Quality – Particulate matter less than 10 micrometers in diameter (PM 10)
Baseline				**System Rating ->**	**1**	**5**	**3**	**1**
Irrigation Land Leveling (ac.) 464	1,300	650	0	650	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	10,400	5,200	0	5,200	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	5,200	2,600	0	2,600	1	5	3	1
Total Acreage at Baseline	**5,200**	**2,600**	**0**	**2,600**				
Progressive				**System Rating ->**	**3**	**5**	**4**	**4**
Conservation Crop Rotation (ac.) 328	1,200	900	650	1,550	5	1	3	5
Irrigation Land Leveling (ac.) 464	1,200	1,225	325	1,550	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	9,600	9,800	2,600	12,400	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	4,800	4,900	1,300	6,200	1	5	3	1
Irrigation Water Management (ac.) 449	1,200	900	650	1,550	1	5	5	3
Total Acreage at Progressive Level	**2,400**	**1,800**	**1,300**	**3,100**				
RMS				**System Rating ->**	**4**	**5**	**5**	**5**
Conservation Crop Rotation (ac.) 328	400	700	1,600	2,300	5	1	3	5
Irrigation Land Leveling (ac.) 464	400	1,025	1,275	2,300	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	4,000	9,000	14,000	23,000	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	1,600	4,100	5,100	9,200	1	5	3	1
Irrigation Water Management (ac.) 449	400	700	1,600	2,300	1	5	5	3
Nutrient Management (ac.) 590	400	400	1,900	2,300	1	1	5	5
Pest Management (ac.) 595	400	400	1,900	2,300	1	1	3	3
Residue Management, Seasonal (ac.) 344	400	400	1,900	2,300	5	1	3	5
Total Acreage at RMS Level	**400**	**400**	**1,900**	**2,300**				

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103				LANDUSE ACRES	8,000	
LANDUSE TYPE	CROP				TYPICAL UNIT SIZE ACRES	500	
CONSERVATION COST TABLE					CALCULATED PARTICIPATION	42%	
	FUTURE	FEDERAL			PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Conservation Crop Rotation (ac.) 328	650	$0	$19,500	$3,900	$21,275	$0	$6,500	$10,006
Irrigation Land Leveling (ac.) 464	325	$162,500	$0	$32,500	$195,000	$162,500	$9,750	$203,571
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	2,600	$10,400	$0	$2,080	$12,480	$10,400	$416	$12,152
Irrigation Water Conveyance, Pipeline (ft.) 430	1,300	$6,500	$0	$1,300	$7,800	$6,500	$260	$7,595
Irrigation Water Management (ac.) 449	650	$0	$19,500	$3,900	$21,275	$0	$6,500	$10,006
Subtotal	**1,300**	**$179,400**	**$39,000**	**$43,680**	**$257,829**	**$179,400**	**$23,426**	**$243,330**
RMS								
Conservation Crop Rotation (ac.) 328	1,600	$0	$48,000	$9,600	$52,368	$0	$16,000	$24,630
Irrigation Land Leveling (ac.) 464	1,275	$637,500	$0	$127,500	$765,000	$637,500	$38,250	$798,623
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	14,000	$56,000	$0	$11,200	$67,200	$56,000	$2,240	$65,436
Irrigation Water Conveyance, Pipeline (ft.) 430	5,100	$25,500	$0	$5,100	$30,600	$25,500	$1,020	$29,797
Irrigation Water Management (ac.) 449	1,600	$0	$48,000	$9,600	$52,368	$0	$16,000	$24,630
Nutrient Management (ac.) 590	1,900	$0	$57,000	$11,400	$62,187	$0	$19,000	$29,248
Pest Management (ac.) 595	1,900	$0	$57,000	$11,400	$62,187	$0	$19,000	$29,248
Residue Management, Seasonal (ac.) 344	1,900	$0	$34,200	$6,840	$37,312	$0	$11,400	$17,549
Subtotal	**1,900**	**$719,000**	**$244,200**	**$192,640**	**$1,129,223**	**$719,000**	**$122,910**	**$1,019,158**
Grand Total	**3,200**	**$898,400**	**$283,200**	**$236,320**	**$1,387,052**	**$898,400**	**$146,336**	**$1,262,488**

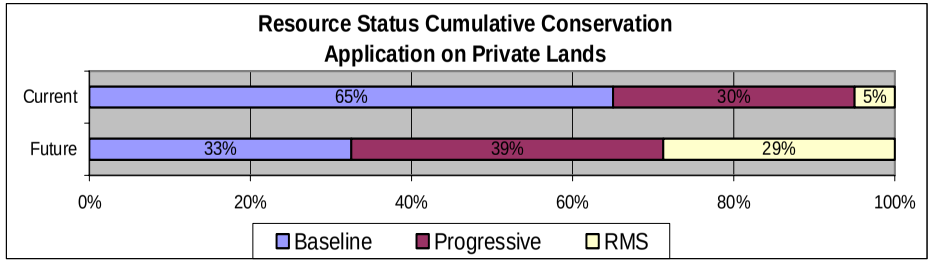

Chart Refers To	
Landuse Type	CROP
Calculated Participation Rate	42%

Average PV Costs per Ac		
System	Federal	Private
Prog	$198.33	$187.18
RMS	$594.33	$536.40

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103				LANDUSE ACRES			40,000
LANDUSE TYPE	FOREST				TYPICAL UNIT SIZE ACRES			40,000
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION			10%
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Erosion – Sheet and Rill	Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water	Plant Condition – Productivity, Health and Vigor	Domestic Animals – Inadequate Quantities and Quality of Feed and Forage
Baseline				**System Rating ->**	**2**	**2**	**2**	**4**
Fence (ft.) 382	4,500	4,050	0	4,050	3	3	3	5
Pipeline (ft.) 516	4,500	4,050	0	4,050	3	3	3	5
Total Acreage at Baseline	**36,000**	**32,400**	**0**	**32,400**				
Progressive				**System Rating ->**	**4**	**4**	**4**	**5**
Fence (ft.) 382	2,500	2,700	1,800	4,500	3	3	3	5
Pipeline (ft.) 516	2,500	2,700	1,800	4,500	3	3	3	5
Prescribed Grazing (ac.) 528	2,000	1,800	1,800	3,600	5	5	5	5
Total Acreage at Progressive Level	**4,000**	**3,600**	**3,600**	**7,200**				
RMS				**System Rating ->**	**5**	**5**	**5**	**5**
Fence (ft.) 382	0	250	250	500	3	3	3	5
Pipeline (ft.) 516	0	250	250	500	3	3	3	5
Prescribed Grazing (ac.) 528	0	200	200	400	5	5	5	5
Upland Wildlife Habitat Management (ac.) 645	0	0	40	40	5	5	5	3
Total Acreage at RMS Level	**0**	**0**	**400**	**400**				

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103				LANDUSE ACRES	40,000		
LANDUSE TYPE	FOREST				TYPICAL UNIT SIZE ACRES	40,000		
CONSERVATION COST TABLE					CALCULATED PARTICIPATION	10%		
	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Fence (ft.) 382	1,800	$2,700	$0	$540	$3,240	$2,700	$108	$3,155
Pipeline (ft.) 516	1,800	$7,200	$0	$1,440	$8,640	$7,200	$288	$8,413
Prescribed Grazing (ac.) 528	1,800	$1,350	$0	$270	$1,620	$1,350	$0	$1,350
Subtotal	**3,600**	**$11,250**	**$0**	**$2,250**	**$13,500**	**$11,250**	**$396**	**$12,918**
RMS								
Fence (ft.) 382	250	$375	$0	$75	$450	$375	$15	$438
Pipeline (ft.) 516	250	$1,000	$0	$200	$1,200	$1,000	$40	$1,168
Prescribed Grazing (ac.) 528	200	$150	$0	$30	$180	$150	$0	$150
Upland Wildlife Habitat Management (ac.) 645	40	$0	$156	$31	$170	$0	$52	$80
Subtotal	**400**	**$1,525**	**$156**	**$336**	**$2,000**	**$1,525**	**$107**	**$1,837**
Grand Total	**4,000**	**$12,775**	**$156**	**$2,586**	**$15,500**	**$12,775**	**$503**	**$14,755**

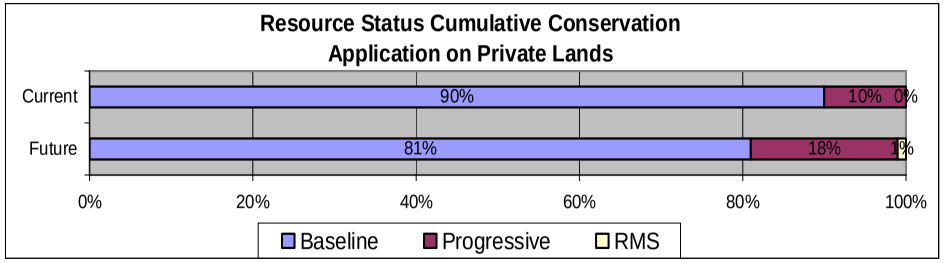

Chart Refers To	
Landuse Type	FOREST
Calculated Participation Rate	10%

Average PV Costs per Ac		
System	Federal	Private
Prog	$3.75	$3.59
RMS	$5.00	$4.59

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103				LANDUSE ACRES	850,000		
LANDUSE TYPE	RANGE				TYPICAL UNIT SIZE ACRES	50,000		
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION	48%		
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Erosion – Sheet and Rill	Water Quality – Excessive Suspended Sediment and Turbidity in Surface Water	Plant Condition – Productivity, Health and Vigor	Domestic Animals – Inadequate Quantities and Quality of Feed and Forage
Baseline				System Rating ->	**2**	**2**	**2**	**4**
Fence (ft.) 382	76,500	38,250	0	38,250	3	3	3	5
Pipeline (ft.) 516	76,500	38,250	0	38,250	3	3	3	5
Total Acreage at Baseline	**765,000**	**382,500**	**0**	**382,500**				
Progressive				System Rating ->	**4**	**4**	**4**	**5**
Fence (ft.) 382	42,500	51,000	76,500	127,500	3	3	3	5
Pipeline (ft.) 516	42,500	51,000	76,500	127,500	3	3	3	5
Prescribed Grazing (ac.) 528	42,500	31,875	95,625	127,500	5	5	5	5
Total Acreage at Progressive Level	**85,000**	**63,750**	**191,250**	**255,000**				
RMS				System Rating ->	**5**	**5**	**5**	**5**
Fence (ft.) 382	0	29,750	182,750	212,500	3	3	3	5
Pipeline (ft.) 516	0	29,750	182,750	212,500	3	3	3	5
Prescribed Grazing (ac.) 528	0	10,625	201,875	212,500	5	5	5	5
Upland Wildlife Habitat Management (ac.) 645	0	0	21,250	21,250	5	5	5	3
Total Acreage at RMS Level	**0**	**0**	**212,500**	**212,500**				

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103	LANDUSE ACRES	850,000
LANDUSE TYPE	RANGE	TYPICAL UNIT SIZE ACRES	50,000
CONSERVATION COST TABLE		CALCULATED PARTICIPATION	48%

	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Fence (ft.) 382	76,500	$114,750	$0	$22,950	$137,700	$114,750	$4,590	$134,085
Pipeline (ft.) 516	76,500	$306,000	$0	$61,200	$367,200	$306,000	$12,240	$357,559
Prescribed Grazing (ac.) 528	95,625	$71,719	$0	$14,344	$86,063	$71,719	$0	$71,719
Subtotal	**191,250**	**$492,469**	**$0**	**$98,494**	**$590,963**	**$492,469**	**$16,830**	**$563,363**
RMS								
Fence (ft.) 382	182,750	$274,125	$0	$54,825	$328,950	$274,125	$10,965	$320,314
Pipeline (ft.) 516	182,750	$731,000	$0	$146,200	$877,200	$731,000	$29,240	$854,170
Prescribed Grazing (ac.) 528	201,875	$151,406	$0	$30,281	$181,688	$151,406	$0	$151,406
Upland Wildlife Habitat Management (ac.) 645	21,250	$0	$82,875	$16,575	$90,417	$0	$27,625	$42,525
Subtotal	**212,500**	**$1,156,531**	**$82,875**	**$247,881**	**$1,478,254**	**$1,156,531**	**$67,830**	**$1,368,414**
Grand Total	**403,750**	**$1,649,000**	**$82,875**	**$346,375**	**$2,069,217**	**$1,649,000**	**$84,660**	**$1,931,777**

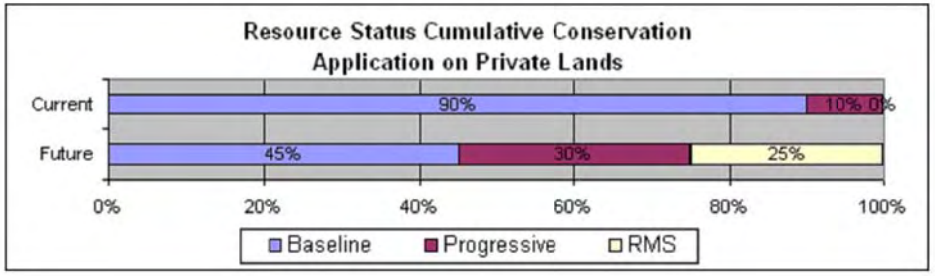

Chart Refers To	
Landuse Type	RANGE
Calculated Participation Rate	48%

Average PV Costs per Ac		
System	Federal	Private
Prog	$3.09	$2.95
RMS	$6.96	$6.44

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103				LANDUSE ACRES		9,000	
LANDUSE TYPE	URBAN				TYPICAL UNIT SIZE ACRES		10	
ASSESSMENT INFORMATION					CALCULATED PARTICIPATION		10%	
	Benchmark Conditions	Future Conditions			RESOURCE CONCERNS			
Conservation Systems by Treatment Level	Total Units	Existing Unchanged Units	New Treatment Units	Total Units	Soil Condition – Organic Matter Depletion	Water Quantity – Inefficient Water Use on Irrigated Land	Water Quality – Excessive Nutrients and Organics in Groundwater	Air Quality – Particulate matter less than 10 micrometers in diameter (PM 10)
Baseline				System Rating ->	0	0	0	0
No Conservation Practices being applied at this level	0	0	0	0	0	0	0	0
Total Acreage at Baseline	**8,100**	**7,290**	**0**	**7,290**				
Progressive				System Rating ->	0	4	2	0
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	22,500	20,250	20,250	40,500	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	22,500	20,250	20,250	40,500	1	5	3	1
Total Acreage at Progressive Level	**900**	**810**	**810**	**1,620**				
RMS				System Rating ->	1	5	5	3
Irrigation Land Leveling (ac.) 464	0	0	90	90	1	5	3	1
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	0	2,250	2,250	4,500	1	5	3	1
Irrigation Water Conveyance, Pipeline (ft.) 430	0	2,250	2,250	4,500	1	5	3	1
Irrigation Water Management (ac.) 449	0	0	90	90	1	5	5	3
Nutrient Management (ac.) 590	0	0	90	90	1	1	5	3
Pest Management (ac.) 595	0	0	90	90	1	1	3	3
Total Acreage at RMS Level	**0**	**0**	**90**	**90**				

WATERSHED NAME & CODE	HASSAYAMPA RIVER - 15070103	LANDUSE ACRES	9,000
LANDUSE TYPE	URBAN	TYPICAL UNIT SIZE ACRES	10
CONSERVATION COST TABLE		CALCULATED PARTICIPATION	10%

	FUTURE	FEDERAL				PRIVATE		
Conservation Systems by Treatment Level	New Treatment Units	Installation Cost 50%	Management Cost - 3 yrs 100%	Technical Assistance 20%	Total Present Value Cost	Installation Cost 50%	Annual O & M + Mgt Costs 100%	Total Present Value Cost
Progressive								
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	20,250	$81,000	$0	$16,200	$97,200	$81,000	$3,240	$94,648
Irrigation Water Conveyance, Pipeline (ft.) 430	20,250	$101,250	$0	$20,250	$121,500	$101,250	$4,050	$118,310
Subtotal	**810**	**$182,250**	**$0**	**$36,450**	**$218,700**	**$182,250**	**$7,290**	**$212,958**
RMS								
Irrigation Land Leveling (ac.) 464	90	$45,000	$0	$9,000	$54,000	$45,000	$2,700	$56,373
Irrigation Water Conveyance, Ditch and Canal Lining (ft.) 428	2,250	$9,000	$0	$1,800	$10,800	$9,000	$360	$10,516
Irrigation Water Conveyance, Pipeline (ft.) 430	2,250	$11,250	$0	$2,250	$13,500	$11,250	$450	$13,146
Irrigation Water Management (ac.) 449	90	$0	$2,700	$540	$2,946	$0	$900	$1,385
Nutrient Management (ac.) 590	90	$0	$2,700	$540	$2,946	$0	$900	$1,385
Pest Management (ac.) 595	90	$0	$2,700	$540	$2,946	$0	$900	$1,385
Subtotal	**90**	**$65,250**	**$8,100**	**$14,670**	**$87,137**	**$65,250**	**$6,210**	**$84,192**
Grand Total	**900**	**$247,500**	**$8,100**	**$51,120**	**$305,837**	**$247,500**	**$13,500**	**$297,150**

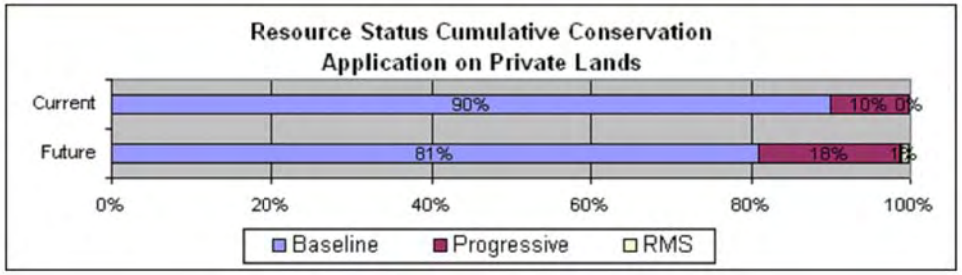

Chart Refers To	
Landuse Type	URBAN
Calculated Participation Rate	10%

Average PV Costs per Ac		
System	Federal	Private
Prog	$270.00	$262.91
RMS	$968.19	$935.46

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GLOSSARY

Drainage Basin	A region or area bounded by a topographic divide and occupied by a drainage system, also known as a watershed.
Drought	There is no universally accepted quantitative definition of drought. Generally, the term is applied to periods of less than average precipitation over a certain period of time; nature's failure to fulfill the water wants and needs of man.
Flood	A flood is an overflow or inundation that comes from a river or other body of water and causes or threatens damage. It can be any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream. It is also a relatively high flow as measured by either gage height or discharge quantity.
Ground Water	The supply of fresh and saline water found beneath the Earth's surface which is often used for supplying wells and springs. Because ground water is a major source of drinking water, there is a growing concern over areas where leaching agricultural or industrial pollutants are contaminating ground water.
Soil Moisture Regimes	**Aridic** is a soil moisture regime that has no water available for plants for more than half the cumulative time that the soil temperature at 50 cm (20 in.) below the surface is >5°C (41° F.), and has no period as long as 90 consecutive days when there is water for plants while the soil temperature at 50 cm (20 in.) is continuously >8°C (46°F.). **Udic** is a soil moisture regime that is neither dry for as long as 90 cumulative days nor for as long as 60 consecutive days in the 90 days following the summer solstice at periods when the soil temperature at 50 cm (20 in.) below the surface is above 5°C (41° F.). **Ustic** is a soil moisture regime that is intermediate between the aridic and udic regimes and common in temperate subhumid or semiarid regions, or in tropical and subtropical regions with a monsoon climate. A limited amount of water is available for plants but occurs at times when the soil temperature is optimum for plant growth.
Soil Orders	A soil order is a group of soils in the broadest category. In the current USDA classification scheme there are 12 orders, differentiated by the presence or absence of diagnostic horizons.
Soil Temperature Regimes	**Hyperthermic** is a soil temperature regime that has mean annual soil temperatures of 22°C (72°F.) or more and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface. **Thermic** is a soil temperature regime that has mean annual soil temperatures of 15°C (59°F.) or more but <22°C (72°F.), and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.

	Mesic A soil temperature regime that has mean annual soil temperatures of 8°C (46°F.) or more but <15°C (59°F.), and >5°C (41° F.) difference between mean summer and mean winter soil temperatures at 50 cm (20 in.) below the surface.
Surface Water	Water on the earth's surface. Lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, wetlands, marshes, inlets, canals, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, navigable or non-navigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or subject to the jurisdiction of the state; except that waters in treatment systems which are authorized by state or federal law, regulation, or permit, and which are created for the purpose of waste treatment.
Watershed	The area of land that contributes surface run-off to a given point in a drainage system and delineated by topographic divides.

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