

Yavapai County Water Advisory Committee
Report on Options for Water Management
Strategies



Report to the Yavapai County Water Advisory Committee
From the Water Management Workgroup
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Table of Contents

	Page No.
Executive Summary	3
Introduction	5
Historical Perspective	5
Current Conditions	7
Water Resources	7
Ecological Resources	7
Water Uses	8
Water Quality	9
Pending Water Acquisition Projects	9
<i>Potential Purchase of the JWK Foundation Ranch</i>	9
<i>Verde Valley Cities</i>	9
Cost of Water	10
Current Water Management	11
Water Issue Visibility	12
Yavapai County Water Needs and Projections	12
Possible Policy Solutions and Impacts	12
<i>Economic Impacts</i>	13
<i>Ecological Impacts</i>	13
<i>Growth</i>	14
<i>Watershed Yield</i>	14
<i>Water Importation</i>	14
<i>Management Practices</i>	15
Current Issues and Challenges	15
State Issues	15
Federal Issues	15
Additional Regulation	15
Burden of Litigation	15
Cost of Infrastructure	15
Water Augmentation in other Areas	15
Drought and Drought Planning	16
Water Management Strategy	17
Water Management Options	19
<i>Status Quo</i>	20
<i>Managed Planned Depletion</i>	20
<i>Safe Yield</i>	22
<i>Sustainability</i>	23
<i>Integrated Management</i>	24
Next Steps	26
Appendix A – WAC Goals and Objectives	27
Appendix B - Comparison of Water Management Goals	29
Appendix C – Maps of Yavapai County Watersheds and Streams	32

Executive Summary: WAC Water Management Report

In December 2003, the Yavapai County Board of Supervisors instructed the Yavapai County Water Advisory Committee (WAC) to develop a menu of possible approaches to water management and conservation in Yavapai County. Yavapai County is one of the fastest growing regions in the United States, has limited water resources, and is currently plagued by long-term drought. Because water is a significant economic resource in the Southwest, proper use of the resource is essential. A well-constructed water management plan will help provide for the long-term health of the region's economy by sustaining water resources.

Although the Arizona Department of Water Resources regulates groundwater use in the basin located beneath the communities of Prescott, Prescott Valley, and Chino Valley, the remainder of the County has no water management plan. Water resource issues and lack of planning in rural Arizona has gained the attention of State and Federal lawmakers and agencies. The Yavapai County General Plan lists careful stewardship of the water supply and securing and protecting water resources as primary goals. A key objective of the WAC is to develop regional water management and conservation strategies. The lack of integrated planning for water resources is an item of concern for the WAC and Yavapai County.

A management plan must necessarily be based on a goal. The WAC explored a wide range of previously defined management goals and has developed the following broad menu of approaches:

- Status Quo: Continue with existing water management practices.
- Managed Planned Depletion: Preserve existing economies for as long as feasible; allow pumping to deplete groundwater to a predefined level that must be maintained.
- Safe Yield: By a predetermined date, achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn and discharged within a groundwater basin and the annual amount of natural and artificial recharge.
- Sustainability: Provide a reliable source of water for use within the County to promote and support a viable economy and high quality of life while preserving existing flowing streams at a defined level and protecting riparian resources.
- Integrated management: Integrate management of water, land, and ecological resources to sustain use in an equitable fashion.

These approaches are discussed in more detail within this report. In general, however, the WAC found that these water management goals can be differentiated as “pay now or pay later” options. For example, the Status Quo goal would result in a “pay later” scenario since the community will have to develop other sources of water in the future to manage the impacts of doing nothing now. Conversely, options farther down the list may result in a “pay now” scenario, as they may be more costly to implement in the near term, but could result in a more stable water supply, help avoid more expensive water

development options, and help preserve the value of investments. Options 4 and 5 above also protect the flow of springs and streams.

This report is intended to provide an initial assessment of the available options. The scope of this paper is intentionally limited to providing a menu of water management options and possible implications. There are a number of outstanding issues not addressed in this paper and that require guidance from the WAC and/or Board of Supervisors. The implementation strategies are not fully discussed, nor are there quantifiable estimates of cost for each option. The WAC hopes that the Board of Supervisors, and perhaps others, will provide further direction on which options it thinks is worthy of more exploration. There are also a number of broader concerns about which WAC seeks direction and proposes a study session with the Board of Supervisors in order to gain more focus.

The identified issues and anticipated process for moving forward on these plans are identified in the Next Steps chapter of this report (page 27) and include such items as: what steps are envisioned for public participation and stakeholder involvement, who will take responsibility for the water management goals, what resources will be needed, how to phase in the implementation of the goal, and what type of management tools will be needed. The anticipated outcome of these discussions and public involvement will be selection of a management goal and the development of specific measures required for implementing a management plan.

Introduction:

The Yavapai County Water Advisory Committee (WAC) was established in January 1999 as a vehicle to address water resource issues in Yavapai County. As a fast growing region, Yavapai County is faced with significant long-term concerns about how to provide adequate water resources for its current and future residents and its important aquatic habitat. The goals and objectives of the WAC are described in Appendix A.

At the first examination of water resource issues, it was quickly discovered that the region simply did not have enough solid information about hydrologic realities to make sound decisions. Knowledge about how much water is contained in groundwater aquifers and how water uses impact aquatic resources must form a primary basis for decision-making. To develop this requires an information base, the WAC developed a partnership with the Arizona Department of Water Resources and the U.S. Geological Survey to undertake a detailed multi-year study of the Upper and Middle Verde River watershed hydrology. This study will have two significant parts, a hydrologic analysis and conceptual model report that will be available in winter of 2004, and a numerical groundwater model available in 2007. The first deliverable will provide a snapshot of how the hydrologic system operates currently and is intended to provide decision makers with adequate information to make general decisions on water management structures. The numerical model is intended to provide a decision support tool for testing future impacts of specific water resource acquisition plans, such as the impact on downstream water users from groundwater pumping.

While waiting for the hydrologic analysis to be completed, the WAC has become self-educated on the water management plans currently in place throughout Arizona and the West. This work has exposed the committee to a large number of different management goals and allowed the WAC insight into what may work or not work within Yavapai County. In December 2003, the Board of Supervisors authorized the WAC to start working on a suite of different water management and conservation options for Yavapai County. The goal is to explore several options available to the region, develop a menu of approaches and possible implementation strategies, and present these ideas to the Board of Supervisors when complete.

To complete this task, the WAC assembled two working subcommittees, The Water Conservation and Water Management subcommittees. Volunteers were selected from the WAC, WAC alternates, and interested members of the public. The two subcommittees met in a series of meetings, twice a month from April through July to develop and discuss numerous ideas and construct a menu of possible approaches. This document discusses the menu of approaches and the specific information these committees think is necessary for making an informed selection from the list.

Historical Perspective:

Yavapai County is a diverse area in terms of natural resources. Its rugged topography has, until recent decades, allowed the region to remain relatively isolated from the rest of the state and nation. This same topography has also created a desirable place to live with stunning vistas and mild four-season climate. Until the 1970s, the primary economy was

based on farming, ranching, and mining. Then with improved access and services, the County has become a destination for people looking to relocate to a better way of life.

From the 1920s to the 1960s, the population of the County remained relatively stable at around 25,000 people. From the period 1970 to present, the population has increased from 37,000 to approximately 190,000 people, a 5-fold increase in just over 3 decades (Yavapai County General Plan). Growth is expected to continue and be a substantial part of the economy into the foreseeable future. Yavapai County has an abundant supply of private and state lands that can be developed; land availability is not a limiting factor for growth.

Obviously, along with this growth comes an increase in demand for water. Historically, the primary use of water has been for irrigation of crops. The demand for water by residents is catching up with agricultural uses and in some basins, has surpassed that use. One of the common water management strategies within Active Management Areas (AMAs) to help reach or maintain a balance for water withdrawals is to encourage the transfer of irrigation water rights to the residential and commercial sector. This has been occurring in the Prescott AMA, but has not occurred throughout the rest of the County. Overall, residential and commercial water use is increasing while irrigation water use has remained relatively stable.

In 1983, the Arizona Department of Water Resources issued allocations of Central Arizona Project water to several communities in Yavapai County. This allocation of water rights was provided to these communities upon their request as a potential future water source. The original concept for delivery of the water allocations was to use upstream diversions from tributary streams in exchange for providing CAP water to users within the CAP service area. This was a different concept from actually constructing a delivery system and proved to be infeasible for rural communities to complete. Yavapai County communities were still being charged for delivery on a “take or pay” basis in spite of the fact that there was no feasible way to obtain the water. Ultimately, these communities sold their CAP allocation to other communities in central Arizona because of the cost burden associated with the CAP allocation. Money associated with this sale, after paying off the delivery cost debt, has been placed in trust funds administered by the Department of Water Resources for the purpose of helping those communities pay for replacement water supplies. Thus far, replacement supplies have cost more than double what was received from the sale on a unit basis. The City of Prescott used their trust fund for the purchase of water rights in the Chino Valley Irrigation District (CVID) and received about half the amount of water compared to their original CAP allocation. This project was part of a larger issue to settle outstanding Indian water rights claims of the Yavapai-Prescott Tribe – now placing the responsibility of supplying the Tribe on the City of Prescott. Cottonwood Water Works has used some of their trust fund to drill new wells, without any significant success at finding a long-term supply.

Current Conditions

Water Resources:

Yavapai County contains several groundwater basins and watersheds, each with unique characteristics. The groundwater basin boundaries in Yavapai County are coincidental with the surface watersheds that supply them, meaning that the water in each basin ultimately is delivered by precipitation (see Appendix C for maps).

Almost all precipitation received on Yavapai County watersheds is used by plants or evaporates. During larger events, a significant portion makes its way into stream channels and can be captured in reservoirs for later use. Only a small percentage, approximately 2-8% on an annual basis, is estimated to recharge the aquifers. For an example, the Prescott AMA groundwater basin receives around 300,000 to 400,000 acre-feet of water as precipitation in an average year, yet only about 6,000 acre-feet of that (1-2%) may be captured in reservoirs (USGS stream gauging records and various estimates), and about 10,000 acre-feet (3%) may actually recharge the aquifer (Prescott AMA Hydrologic Monitoring Report). In a natural system, a state of equilibrium is reached whereby groundwater inflow equals groundwater outflow, somewhat like an overflowing bathtub. The outflow supports perennial streams and plants located above shallow groundwater, but just in the amount of average inflow. Human influence upsets this natural balance and ultimately creates changes in the natural outflow, although those changes may occur so slowly that humans do not notice them, or the change may take many years to become apparent.

Although the community at large does not have adequate knowledge of the supply available in many of the basins, a general concern about water is whether or not the water in storage should be mined. Mining groundwater means that human uses are taking out more water, over the long term, than is recharged through natural or artificial means. If mining of a groundwater basin continues for a long time, the resource will eventually be exhausted. Long before this happens, springs that are fed by the groundwater basin will cease to flow and riparian habitat will diminish. These are items that in part contribute to the quality of life and desirability of the area, ultimately impacting the economy, value of homes and other investments.

Most, if not all, of the groundwater held in aquifer storage was placed there prior to the invention of the turbine pump. This occurred during wetter periods or over a long period of time, or both. Once depleted, only a significant period of non-pumping or an outside source of water can replace it.

Ecological Resources:

Yavapai County is fortunate to have a significant percentage of Arizona's perennial (about 15% of total by length, 1993, Arizona Game & Fish) and intermittent streams (about 24% of total by length, 1997, Arizona Game & Fish). The 40 miles of Verde River below Camp Verde is the State's only designated wild and scenic river. As a rare resource in dry environments, these stream resources provide key habitat to wildlife and become even more important during drought periods. These ecological resources are also important to the economy. Hunting, fishing, and wildlife watching and other outdoor

recreation activities often center around or are dependent upon County streams. A 2001 survey of expenditures for hunting, fishing, and wildlife viewing revealed that this is a \$1.5 billion per year industry in Arizona. Area residents also often state that the existence of nearby surface water resources is a part of their quality of life. Home values and the value of other investments depend in part on quality of life issues.

Water Uses:

Potable water deliveries make up approximately 40% of the water demand in Yavapai County; most of it is derived from groundwater supplies. Of the total potable deliveries, municipally owned water companies provide approximately 35%. These water companies have an advantage over private water companies in their capability to react to water supply conditions. They can issue warnings or rules about the use of water and set their own water rates. The City of Prescott, Town of Prescott Valley, and the Town of Jerome own municipal water systems in Yavapai County. The City of Cottonwood has recently purchased three water companies and is negotiating the purchase of a fourth with the Town of Clarkdale as a partner.

There are approximately 55 private water companies in Yavapai County that serve water in both incorporated and unincorporated communities. Water sales are the source of revenue for the private companies so they generally have little incentive to help consumers conserve water. The Arizona Corporation Commission regulates the rates charged by private water companies. Altering water rates for purposes of conserving water is a complicated and expensive process for private water companies.

Domestic Water Improvement Districts are governed by an elected board, either as officers elected solely to oversee the water district or by a body that also oversees other functions, such as a town council. In Yavapai County, there are 8 water districts. These water districts enjoy many of the capabilities of the municipal water companies in how they can set rates and manage the water system.

There are approximately 20,000 small domestic wells in Yavapai County that are the primary supply source for residential uses (ADWR Wells55 database). About 12,000 are drilled in areas presumed to be a primary aquifer. The remaining 6,000 wells appear to be drilled in hard rock or small aquifers and depend on water that is located in cracks, fissures or perched aquifers. In general, these wells are not as dependable as wells that are completed in a primary aquifer since the water source is more prone to drought and impact from competing water users. Small domestic wells currently provide the main water source for residents in Chino Valley, Paulden, Bridgeport, Cornville, about ½ of the residents in Camp Verde, and in most of the rural areas of the County. The only stipulations on the use or placement of these wells are that they be located 100 feet away from a septic tank. Inside of the Prescott AMA, they also must have a pumping capacity of 35 gallons per minute or less.

Approximately 11,500 acres of land were irrigated in Yavapai County in 2002 (DWR, Prescott AMA, Verde Valley Water Budgets, Big Chino Historic, Current, and Projected Water Uses, Various Unpublished Maps, WAC). About 5,400 were irrigated by surface

water diversions in the Verde Valley, and although a few acres were irrigated by surface water in other portions of the county, the vast majority of the remaining 6,100 acres depend on groundwater. Much of the irrigated land in the Prescott AMA have been extinguished and the water converted to use by the residential and commercial sector.

Industrial and Mining uses are not well quantified in Yavapai County, but the primary water users are the Phoenix Cement Plant in Clarkdale and the Phelps-Dodge Bagdad mine. A number of other small industrial users depend on their own wells, but the majority is supplied by a central water system.

Water Quality

Water quality is an ever-present concern when determining the fate of water resources. Poor quality water can reduce the amount of water available to a community or increase treatment costs. Preserving the generally good quality of water should continue to be a concern when managing water resources.

Primary water quality concerns relate to the new standard for arsenic that will go into effect in 2006, requiring some areas of the County to treat groundwater for naturally occurring arsenic. Another concern is the potential for trace Organic Wastewater Compounds in treated effluent. As effluent becomes an increasingly important source of water for communities, care should be taken to properly manage effluent to avoid long-term damage to groundwater supplies.

Pending Water Acquisition Projects

Potential purchase of the JWK Foundation Ranch by the City of Prescott:

Arizona Revised Statutes 45-555(E) provides legal access to groundwater in the Big Chino subbasin to the City of Prescott. Conceivably, the volume of water is based in part on the CAP allocations originally granted to the City and the Yavapai-Prescott Tribe. The City of Prescott is working with the Town of Prescott Valley and the Town of Chino Valley to bring this water to serve the tri-city area. The cost to acquire the Ranch is \$23.0 million and the city contemplates pumping 8,717 acre-feet of groundwater. The City is working on a mitigation plan that would offset the effects of this pumping. Solutions include retirement of the approximately 1,500 acres of agricultural land on the Ranch.

Verde Valley Cities:

The City of Cottonwood has recently acquired three private water companies and is in the process of working with Clarkdale to acquire a private system that serves parts of both towns. These two communities will likely have to purchase surface water rights from within the valley to continue withdrawals of water from wells located within the subflow zone.

Town of Chino Importation Rights Acquisition

The Town of Chino Valley has begun to explore possible acquisition of historically irrigated lands in the Big Chino subbasin that are eligible for water transfer to the Prescott AMA. Under ARS § 45-555, sections A-D, lands that were irrigated between

January 1, 1975 and January 1, 1990 are can be retired and the water transferred to an AMA city at the rate of 3 acre-feet per acre. The concept behind this transfer eligibility is that by retiring irrigated acreage, the groundwater withdrawals from the Big Chino subbasin would stay in balance.

Cost of Water:

Water costs can be thought of in two separate categories; the cost of the water resource and the cost to pump, treat and distribute the water. Outside of AMAs, the water resource costs have been a very minor component, DWR grants access to all the groundwater that can be pumped from a single well for \$150. The true cost of that resource will ultimately be borne by future generations as they shoulder the burden of mitigating impacts or developing more expensive sources of water.

Because surface water is managed under a different set of laws, the cost components are slightly different. Most of the available surface water resources were appropriated by the beginning of the last century. Maintaining the use to that right contains some costs, and therefore should provide intrinsic value to the right. However a number of issues combine to make surface water an apparent poor choice for residential development in the County. Competition with groundwater is one main issue; inexpensive and perceived to be drought proof, groundwater becomes the supply of choice for residential development if it is available. Additionally, the costs and insecurity brought on by the general stream adjudication create concerns about the future legal availability of water supplies. In order to convert surface water from agricultural to municipal use, the water right must be severed and/or transferred. Severance and transfers of surface water rights is a more difficult and time consuming process in comparison to acquiring a groundwater source, creating additional inequity in the accessibility of groundwater compared to surface water.

Within the Prescott AMA, groundwater restrictions have created a market system that adds value to groundwater rights. The original allocation of ground water resources after the passage of the 1980 Groundwater Management Act were granted based on water use or intended water use prior to the passage of the Act. Subsequent appropriations of groundwater up to the date of the Groundwater Mining Declaration in 1999 were also granted. Since that time, users wishing to acquire additional resources have been required to obtain them from a party with an existing right, usually at a cost. For instance, the City of Prescott purchased surface water rights and Irrigation Grandfathered Rights from Chino Valley Irrigation District shareholders in order to increase its water portfolio.

Current Water Management:

Yavapai County currently falls under two groundwater management systems that are administered by the Arizona Department of Water Resources. The Prescott AMA is regulated by one of the strictest systems of groundwater management in the United States. Groundwater access is limited to only those users with a water right, new users are required to demonstrate an Assured Water Supply by either acquiring a grand fathered right or demonstrating long-term access to another source of water (surface water or

effluent). Groundwater users are also placed under strict conservation requirements. One exception to the rule allows access to groundwater for small wells pumping less than 35 gallons per minute, irrigating less than two acres of land or using less than 10 acre-feet per year for industrial purposes. Since these small wells are not subject to water management under the groundwater code, they are called “exempt wells”. New non-exempt wells (wells pumping more than 35 gpm) must also adhere to well spacing rules, requiring that new non-exempt wells prove that they will not harm existing exempt or non-exempt wells.

There are few groundwater regulations outside of the Active Management Areas. All that is required for a new well is that it not be drilled within 100 feet of a septic tank. Developments must also demonstrate whether they have a 100 year Adequate Water Supply, but can develop regardless of whether the 100 year Adequate Water Supply exists or not; they are only required to notify the first owner of a subdivided lot within the development.

Surface water use is administered by a different set of rules than groundwater. Regardless of location inside or outside of an AMA, a surface water user is administered under the doctrine of prior appropriation, meaning that the most senior user of the water gets first “call” on the water supply. Surface water appropriators are required to file their claim with the State, where the majority of “rights” in Yavapai County remain as un-affirmed “claims”. Few users have had their rights affirmed by the Court or Legislature. The on-going General Stream Adjudication is currently attempting to catalogue surface water rights in terms of extent and priority. Barring this finding, there is no active administration of surface water rights in Yavapai County, often leaving the senior rights in no better standing than junior users when the water supply is inadequate to meet all needs.

Effluent is also administered by a different set of rules from surface water or groundwater. Effluent, unlike the other water sources, is considered to be a private commodity, allowing the owner of the effluent to do what they want with the water, although still subject to water quality rules regulating the quality and points of discharge. Effluent is becoming a valuable source of water in the AMA since access to groundwater is strictly controlled and surface water supplies are limited. Treated effluent is often applied to golf courses to reduce the overall demand on groundwater. Treated effluent that is recharged to the groundwater system provides the owner with credits that may be withdrawn at other points within the basin. Although the withdrawn water is legally considered effluent, it is essentially the same as groundwater in the form of its chemical composition.

Water Issue Visibility

Rural Arizona (areas not served by the Central Arizona Project) water issues have risen to the highest level of visibility by State and Federal parties since the Groundwater Transportation issue of the early 1990s. Water management bills were nearly introduced at the State Legislature during the 2004 session. Senator McCain has recently introduced a bill that will lead to a report about how to manage water resources in the Verde River

watershed, if passed in current form. The Arizona Policy Forum, with committee makeup from rural and urban Arizona, has produced a discussion paper and draft legislation to ensure long-term water resources for new developments. And the U.S. Bureau of Reclamation has identified parts of Yavapai County as areas where water conflict and crises are highly likely by 2025. This visibility may help Yavapai County region acquire needed political support as it moves toward ensuring a secured water supply.

Yavapai County Water Needs and Projections.

By 2050, water demand for municipal/household water users in the more populated regions of Yavapai County (Prescott Tri-Cities, Verde Valley, and Big Chino) is expected to increase by 44,000 acre-feet in excess of existing demand and/or rights (NAMWUA Water Demand Projections, Big Chino Historic, Current, and Projected Water Uses). Current use in this sector is approximately 29,000 acre-feet, meaning that the total demand would increase to 73,000 acre-feet in 46 years.

The question is whether or not this amount of water is locally available for future use by county residents. Many water resource professionals feel that there is water in aquifer storage to meet these needs, but it will come at a cost to ecological resources and at the expense of the region's economic sustainability. To help avoid these costs, existing water rights currently being exercised by other use sectors will have to be converted to residential/commercial use.

The increase in demand could be met in part by retiring existing agricultural uses, perhaps yielding up to 30,000 acre-feet of the total need. Increasing the efficiency of use (conserving) and reusing or recharging the generated effluent can further stretch this supply. This plan would require several concessions in order to work: 1) it would require that irrigated agricultural water rights be extinguished and transferred, 2) it will require a conservation plan, and 3) it will require a water management plan that will protect the investment of those who convert water rights.

Not all watersheds in the County face the same consequences; water management and conservation in those areas may be able to follow a different plan.

Possible Policy Solutions and Impacts

Water is a finite resource. In Yavapai County, water users are currently dependent on the amount of precipitation that falls within each watershed and is stored in reservoirs and the groundwater basin. Prior to human intervention, the same amount of water that entered the basin left the basin in the form of natural discharge, including discharge from evaporation, plant transpiration, and stream, spring or groundwater discharge. Because people add a new factor to the natural balance, human water use activities will have impacts on downstream (or down gradient) water users or ecological resources. The community will either have to accept consequences of policies or attempt to avoid those consequences.

Some of the solutions and consequences that could result from general policy decisions fall into several broad categories: 1) economic impacts 2) ecological impacts and groundwater declines, 3) growth management, 4) increase the useful yield of the watershed, 5) import more water, or 6) attempt to strike a balance between possible solutions and consequences by initiating water management practices

1) Economic Impacts

Water is a necessary component of nearly every type of economic activity. The same axiom is true in Yavapai County. Having a guarantee about the long-term availability of water provides additional certainty to capital investment in the area. Conversely, uncertainty about the availability of water dulls the competitive edge for attracting additional capital investment.

Central Arizona provides an example of the link between the economy and water. In the late 1970s, the story about water supply problems began to circulate to investors throughout the country. Bond ratings of the municipalities began to fall and capital investments began to show concern. The passage of the 1980 Groundwater Management Act essentially provided a guarantee that water would be available far into the future. The current economic vitality of central Arizona certainly cannot be disputed.

Ignoring the fact that water is a limited resource in Yavapai County will lead to a less diverse and vibrant economy as capital investment in industry and commerce fails to provide opportunities for area residents. A secured water supply, accomplished through water management and development of new water sources will help to avoid this consequence.

2) Ecological Impacts

As previously mentioned, human uses of water have begun to alter the regional ecology. Del Rio Springs, the site of the first territorial capital, is predicted to cease flowing in approximately 30 years; some cienegas and subirrigated grasslands have already disappeared. These changes typically occur over a long period, spanning generations in some cases, and often go unnoticed by individuals. Additional impacts to ecological resources will likely occur from the human water uses that are now occurring within the County, additional new water demands would also create long-term impacts. Decision makers and water managers could ignore these impacts, but have to consider the implications of the Endangered Species Act, requiring mitigation of impacts to key ecological resources, such as the Upper Verde River, and potential lawsuits from environmental concerns. Another issue is the quality of life perceptions created by having nearby ecological resources and the likely event that a lowered quality of life will also reduce the value of investments in the region.

3) Growth

Population growth is a large part of the regional economy in terms of demand for new housing and commerce. Future water supply concerns would be significantly cheaper and easier to deal with if the County grew at a slower pace. In the long term, growth

may be limited by the amount of available water and a new economic base would be needed to employ the population. Ultimately, a more diversified economy that reduces impacts of new water demands on the regional water supply will need to be developed. In the near-term, there appears to be no quick fix to this issue without creating unemployment and possible damage to the ability of local governments to govern, including their ability to manage water resources.

4) Watershed Yield

There is a large potential water supply that could be attained by changing the runoff characteristics of the watershed. In an example stated earlier in this report, less than 10% of the rainfall received in the Prescott AMA is available as captured runoff or aquifer recharge. Experience has demonstrated that a healthy watershed will create the best long-term benefit in terms of the amount of precipitation that flows toward streams and recharges aquifers. A healthy watershed concept also helps to preserve the quality of water. Past attempts to increase runoff (for example, removing vegetation) have often resulted in reduced groundwater recharge, while other attempts to increase groundwater recharge have conflicted with downstream surface water rights.

It should be noted that the Tonto, Prescott and Coconino National Forests within Yavapai County were originally created for the purpose of watershed management. After the Newlands Reclamation Act was enacted in 1902, the shareholders of the Salt River Valley Water Users Association (now SRP) urged the Federal Government to preserve lands in the watersheds that contribute water to their Reclamation project, thereby protecting their investment in Roosevelt Dam.

Since approximately 50% of Yavapai County and about 65% of the Verde River watershed is under Federal stewardship, it seems obvious that federal partners should be involved in the process of creating healthy watersheds.

5) Water Importation

Importing water from a distant region is another possible solutions for meeting increased water demands, but it is an expensive option that comes with its own implications. Without importing a renewable source of water, the growth in Yavapai County will eventually be limited by existing resources.

Planning horizons for water importation projects often span decades, impacts to the point of origin need to be considered, environmental rules must be complied with, water rights must be acquired, a revenue source developed, and political will needs to be properly aligned. Gaining necessary political support will, at a minimum, require that water users in Yavapai County optimize use of existing resources. Optimizing existing water resources can only be accomplished by enacting a water management plan.

6) Management Practices:

A sixth approach is to try to achieve a balance between the previously discussed issues and concerns. A properly constructed approach to water resource issues can accomplish this and has proven successes in other areas. The key to success in these other areas has

been the ability to balance the concerns and potential impacts in a manner that is acceptable to the majority of the stakeholders. This approach would make up a water management plan that could impose restrictions on existing water users and would likely impose restrictions on new water users. Some of the benefits of a management plan can include any or all of the following:

- Optimize use of existing water supplies to reduce water costs
- Protect or strengthen the economy
- Protect ecological resources that depend on water
- Pave the way for additional or outside sources of water
- Allow local control instead of federal or state mandates on the use of water

Current Issues and Challenges:

Assuming there is adequate water in the county to meet projected uses, there are a number of issues that could restrict access to those supplies.

State Issues:

Water users generally downstream of the County, are keenly aware of the potential impacts to their supply from water uses in Yavapai County. The General Stream Adjudication will eventually decide which water users in Arizona enjoy the right of first access to surface water resources. Within the Verde Valley, the decisions of the Adjudication Court has the potential to impact thousands of water users who depend on wells located next to the Verde River and its tributaries. These decisions will also ultimately impact water users in many other County watersheds, excluding the Bill Williams River and its tributary watersheds.

Federal Issues:

Federal agencies are beginning to show interest in Yavapai County water resources and how they are managed. The U.S. Congress, Bureau of Reclamation and Fish and Wildlife Service all have expressed recent interest in local activities. A map published by the U.S. Bureau of Reclamation shows that much of Yavapai County has a “High potential for water resource conflict” by year 2025. It is Reclamation’s position that such conflicts should be avoided and they are beginning to direct resources to this cause. Although the additional resources are positive, history shows that Reclamation has exerted pressure on certain regions to adopt management plans. Also, the Yavapai Ranch land trade proposal being considered in Congress has certain water restrictions placed on those lands, indicating an increased Federal interest in and awareness of Yavapai County’s water resource issues. Additionally, the Endangered Species Act, administered by the U.S. Fish and Wildlife Service, has the potential to aggressively protect ecological resources, especially aquatic-dependent species, that could be damaged by groundwater pumping, surface water diversions, or effluent releases.

Additional Regulation:

The regulatory environment regarding water and its use will continue to increase. New standards for arsenic in drinking water will have to be met by water providers by 2006, creating increased costs of treatment. Water quality regulations under the Safe Drinking

Water Act are anticipated to increase over time. The Clean Water Act challenges past water treatment and discharge practices in order to protect the water quality of rivers and streams. The National Pollutant Discharge Elimination System, Section 404 Dredge and Fill Program, Aquifer Protection Permits Program, well permitting, Groundwater Management Act, Assured and Adequate Water Supply Program, to name a few, will impact water resource decisions into the future.

Burden of Litigation:

Without considering direct costs of litigation, there are significant costs associated with protecting a water supply from litigation in order to increase its security as a long-term supply.

Cost of infrastructure:

The farther away the water, the more expensive it is to move it. Yavapai County has been fortunate in that it has been able to meet water demands of economic growth based on nearby water supplies. If water is legally available in other locations, water providers that go to those locations for additional supplies will pay substantially more than for locally available supplies. This will also impact the ability for areas from which the water supply is removed to grow. This idea formed the basis of the 1992 Groundwater Transportation Act, making it illegal for cities in AMAs to “farm” rural areas for their water supply.

Another concern if water tables are allowed to decline is the additional costs of drilling deeper wells and energy costs associated with pumping from greater depths.

Water Augmentation in other Areas:

A March 2001 study by the Morrison Institute studied four areas in the West that had enacted water augmentation projects and compared them to the concept of importing water from Lake Powell to the Navajo and Hopi Indian Reservations and Coconino County. The four areas have some similarity to Yavapai County. The findings from this report conclude the following:

- Water tends to flow toward economic growth, but does not, alone, create growth
- Infrastructure and the decision on who gets water affects where and how the region grows
- Water projects can produce long-term economic benefits, and they can protect regional aquifers.
- Surface water projects can damage downstream resources.
- New water supplies tend to undercut water conservation efforts.

Drought and Drought Planning

Yavapai County has experienced drought conditions in 8 of the past 9 years, with the last wet year occurring in 1998. This reduced precipitation has impacted the region’s forests, streams and wells. Many experts agree that the Southwest is in the beginning stages of a long-term drought based on past precipitation trends. Some of these scientist also believe that the region is experiencing a permanent climate shift and weather patterns may not

return to what many have come to believe are normal conditions. Whether a drought or a climatic shift, reduced precipitation over the long-term will have significant consequences to groundwater aquifers and streams. The solutions are either pragmatic or idealistic – we either plan for worst-case scenarios or simply hope for more favorable weather.

Water Management Strategy:

Water management means administering how people use and acquire water in order to achieve a certain goal. In many cases, the goal entails making the best use of the water supply for the existing economy while still leaving some water for the future. Reaching the goal usually requires the ability to implement water conservation measures and to restrain access to certain water supplies. A water management goal should be consistent within a basin, but can be different from basin to basin if they are not hydrologically connected.

Water management plans tend to fall under two categories, voluntary and regulatory. Voluntary structures employ agreements by all of the water users in a basin who agree to meet certain water use criteria established by the broader group of stakeholders. Regulatory structures enforce laws regarding the use of water. Both approaches tend to create a market value for water resources with the idea that the market will then dictate the best economic use of the water supply.

After adopting a water management goal it will need to be implemented through either a voluntary or regulatory approach. Local governments in Yavapai County do not now have the ability to regulate water use to the degree necessary to meet most of the goal options identified. A phased approach will be necessary to both allow time for the necessary tools to be adopted and to avoid immediate economic consequences.

Implementation Strategy: Water management plans are often implemented in a phased approach to minimize economic impacts. In general, an implementation plan should be phased in steps over a period of years and should include “triggers” that gauge the success of the plan and possibly initiate a new phase of the management plan.

A general implementation strategy that could apply to any management goal is outlined below. Most water management strategies envisioned for Yavapai County could follow this general procedure; the difficulty is in setting the hydrologic parameters that will allow the goal to be achieved and developing the tools, timing and steps required to reach the goal. Without a doubt, most of the goals outlined on the menu of possible approaches will require additional tools that are not currently at the disposal of local governments. Regulatory controls that might be needed include the ability to decide if new users will have access to the water supply and the ability to regulate existing water users. Voluntary measures may be established that are adequate for existing users, but still do not address the imminent threat to meeting goals – rapid growth.

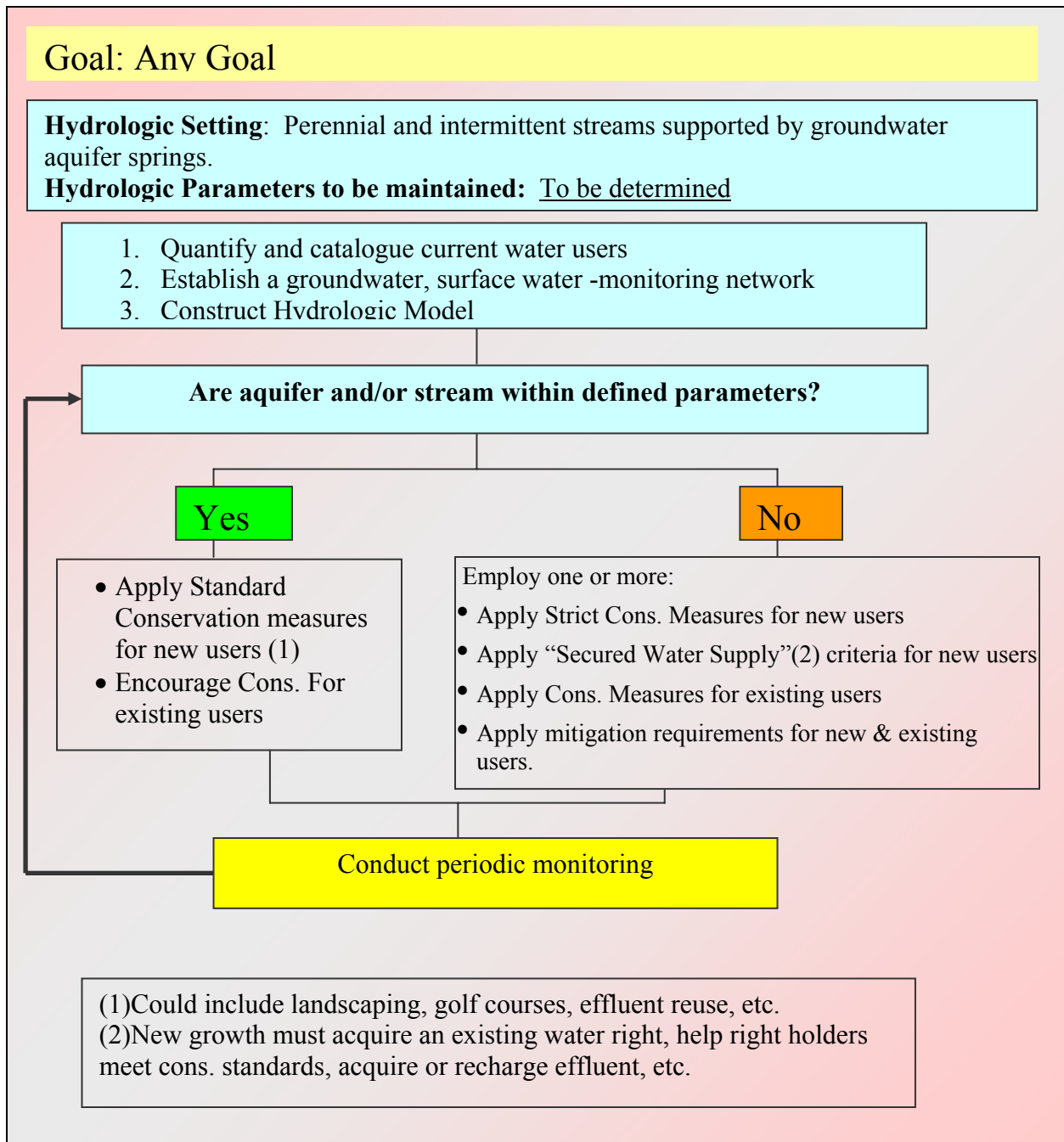


Figure 1: A general implementation strategy for water management.

Examples of Water Management Plans:

Active Management Areas employ State Statute and Administrative Code to achieve a goal of safe yield. The Department of Water Resource has the ability to restrict access to a common groundwater supply in order to help reach this goal. Through implementing a five-step phased approach, the safe yield goal is to be reached by year 2025. Each one of the first four steps is a decade-long period whereby a management plan is developed and implemented. Typically, each subsequent management period is more restrictive than the last, forcing all users in an AMA to share the responsibility of meeting the goal.

Santa Cruz AMA: Employs a slightly different goal from the other AMAs, administering surface and groundwater resources to maintain a balance between the groundwater table and the stream flow in the Santa Cruz River.

Surface Water Decrees: A few areas in Arizona have Court Decreed surface water rights. Adherence to the decree is overseen by a Judge, and in some cases, the daily operation of the decree is administered by a Court appointed commissioner. One case is the Gila Decree, which administers the rights to surface water along the Gila River from the New Mexico Border to Pinal County. Surface water rights are administered on a call system; each year the available surface water resources are estimated and use is granted to the most senior users first and on down the list to the more junior appropriators based on the quantity of water available. In dry years, only the most senior appropriators will receive surface water, in wetter years, the junior appropriators also receive water.

New Mexico: The New Mexico State Engineer makes a determination of available water resources and water right claims in certain “declared” groundwater basins. If the amount of available water is less than or equal to the claimed volume of water, the groundwater basin is closed to new appropriations. This closure notice causes anybody who wishes to acquire water to purchase an existing water right.

Water Management Options

The WAC established a Subcommittee to develop a menu of possible water management options. This Water Management Subcommittee explored at length five water management goals that span a wide variety of possible approaches.

Status Quo: Continue with existing water management practices.

Managed Planned Depletion: Preserve existing economies for as long as feasible; allow pumping to deplete groundwater to a predefined level that must be maintained.¹

Safe Yield: By a predetermined date, achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn and discharged within a groundwater basin and the annual amount of natural and artificial recharge.²

¹ The planned depletion goal of the Pinal AMA allows agricultural pumping to deplete groundwater reserves down to 1,000 feet below ground surface. This goal is different from the Pinal AMA goal as discussed in text.

Sustainability: Provide a reliable source of water for use within the County to promote and support a viable economy and high quality of life while preserving existing flowing streams at a defined level and protecting riparian resources.³

Integrated management: Integrate management of water, land, and ecological resources to sustain use in an equitable fashion.

Status Quo: Continue with existing water management practices.

Objectives: Continue with existing water management practices which includes the safe yield goal, conservation requirements, wells spacing regulations and assured water supply rules for the Prescott AMA and provides only for adequate water supply determinations and well permitting requirements for the remainder of the County.

Implications:

- No additional near term costs associated with bureaucracy or infrastructure
- Water management is not an obstacle to near term growth
- Adverse effects to streams and riparian areas
- Low cost of water
- Few bureaucratic hurdles
- No new legislation required
- No need to quantify water resources
- Risk of uncertainty about water resources
 - Possibility of running out of water and increased water costs to develop outside sources
 - Potential loss of venture capital and vitality of the economy
 - Possible political effects
 - Wells at risk (possibility of continually deepening wells)
 - Possibility of Litigation due to the Endangered Species Act, impacts to downstream water rights, etc.
 - Possible decrease in property values
 - Loss of riparian habitat and supporting streams
- Possible land subsidence

Managed Planned Depletion: Preserve existing economies for as long as feasible; allow pumping to deplete groundwater to a predefined level, which must be maintained. [Augmentation of water supplies will be required].

Objectives: Allow groundwater mining to continue to a predefined level. Implement Safe-Yield criteria to achieve a stable water table at the predefined level. Establish tools necessary to stabilize the water table at the predefined level:

² Adapted from Safe Yield definition for Active Management Areas, (ARS §45-561). Adaptations include the addition of “groundwater...discharged” and “within a groundwater basin”.

³ Adapted from a proposed San Pedro River partnership goal

- Implement Assured Water Supply type of program with the ability to deny or approve new uses within framework of the goal
- Grandfather existing water right holders
- Additional hydrologic studies and groundwater models

A declining water table, as called out in this goal, necessarily means that the resource is over committed and certain uses will have to be reduced or eliminated to reach an eventual balance. If the primary water use cannot be retired (such as domestic use), this strategy may not work.

Discussion: If the objective includes preservation of rivers and riparian areas, the predefined draw down of the water table will need to be established to maintain a specific river or riparian area, resulting in a different set of implications than if the objective were not to maintain stream flows and riparian areas. However, inclusion of this objective may make the goal indistinguishable from the sustainability and integrated management goals. For the list of implications provided below, it was assumed that the objective does not include

maintenance of streams and riparian areas.

This goal may not be possible to achieve in most areas in Yavapai County. This goal as originally intended for use in the Pinal AMA is assumed workable because once the predefined draw down of the water table is reached; uses such as agricultural pumping can be reduced or converted to other uses so that the water table can be maintained.

Since extensive agricultural uses don't exist in Yavapai County, there may be no way to turn off pumps supplying homes and businesses. A declining water table, as called out in this goal, necessarily means that the resource is over committed and certain uses will have to be reduced or eliminated to reach an eventual balance. Either an outside source of water will be required to achieve this, or it may be possible to strictly manage the existing uses and increase conservation and water reclamation and reuse to achieve the goal.

Also noted was the idea that if the introduced legislation requiring Adequate Water Supply determinations for all developments outside AMAs were to pass, a similar goal would essentially be mandated throughout the non-AMA portions of the state.

Implications:

- Possible adverse effects to streams and riparian areas
- Difficult to determine water level of the aquifer
- Impacts to downstream water users
- Not an obstacle to near-term growth
- Long term economic impacts
 - Growth limitations may be imposed
- Increased certainty of water supply compared to status quo:
 - Decreased possibility of running out of water
 - and increased water costs to develop outside sources
 - Potential loss of venture capital and vitality of the economy

- Possible political effects
- Wells at risk (possibility of continually deepening wells)
- Possibility of Litigation due to the Endangered Species Act, Water Rights, etc.
- Possible decrease in property values
-
- Less likely to run out of water compared to Status Quo, but still possible
- Loss of venture capital after the groundwater draw down limit is reached
- Possible ground subsidence
- Increased costs associated with deepening wells
- Water rationing and disrupted supplies possible after groundwater draw down limit is reached
- Additional short and long-term costs associated with management
- Additional short and long-term costs associated with monitoring, hydrologic studies

Safe Yield: By a predetermined date, achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn and discharged within a groundwater basin and the annual amount of natural and artificial recharge.

Objectives: Assess the state of groundwater basins to determine if they are in safe yield or not. Set a deadline for attaining safe yield in basins that are mining groundwater. Prevent basins that are in safe yield status from mining groundwater. Apply similar objective to basins that are interconnected. Allow water users to access the quantity of water that is naturally and artificially recharged.

Discussion: The safe yield goal defined here closely resembles the goal as defined in state statute. One general concern about the safe yield goal is that it does not address surface water resources and can often be implemented to the detriment of rivers and streams. One notable exception is the implementation of safe yield in the Santa Cruz AMA whereby surface water and groundwater resources are managed conjunctively.

A question arose about how AMAs are established. ARS §45-415 states that either the Director of the Department of Water Resources can create AMAs or they can be created by petition of 10 percent of the population residing within the proposed basin and subsequent election by voters within the basin.

Implications:

-
- Possible adverse effects to streams and riparian habitat
- Will require an increase in management
- Increased bureaucracy
- Increased cost of infrastructure
- Need to develop additional hydrologic information
- Need monitoring network

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- Need to quantify water resources and water rights (grandfather existing users)
- Increased short and long-term costs of implementation
- Water costs will increase in both the short and long-term
- Ground subsidence is possible
- Conservation requirements will be imposed
- Negative political implications due to imposing regulations and costs
- Chances of Litigation may or may not be affected
- Will require changes to legislation
- Increases certainty of water supply
- Increases confidence of capital investment
- Does not ensure unlimited growth
- Growth impacts on community when developers are required to pay for or bring own water.
- Responsible to future generations for quality of life, economy, property values.

Sustainability: Provide a reliable source of water for use within the County to promote and support a viable economy and high quality of life while preserving existing flowing streams at a defined level and protecting riparian resources.

Objectives:

- Develop an assessment of resources
- Determine the baseline level of streams.
- Provide a renewable source of water for use within the County
- Support the vitality of the economy
- Maintain a high quality of life
- Preserve flowing streams and riparian resources
- Provide water for future generations

Discussion: The sustainability goal may come at a higher price in the short term, but investments will be protected and likely have an added value in the long term. Also, something that is a factor for most residents is protecting the water supply for future generations.

Implications:

- Increases certainty about the ability to renew the water supply
- Acts in a responsible fashion for future generations
- Protects streams and riparian habitat
- Impacts extend beyond Yavapai County – migratory birds and wildlife
- Protects economic basis for tourism
- Protects property values, tax base, commerce
- Contributes to a healthy, diversified economy may be the outcome
- Increase certainty for capital investment
- Outside renewable sources of water will be essential

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Integrated management: Integrated management of water, land, and ecological resources promotes conservation and sustainable use in an equitable fashion.

Objectives:

- Maintain ecosystem functions and services
- Support livelihoods
- Broad participation of stakeholders
- Ensure equitable sharing of benefits and costs among stakeholders
- Promote adaptive management to enable people to make informed choices
- Empower people to manage their resources within participatory management goals
- Foster regional cooperation to achieve greater effectiveness through partnerships (eg. State and Federal agencies, Stakeholders, etc)
- Integrate Land Use and Planning with water management and management of ecological resources.
- Enhance watersheds
- Develop Open Spaces
- Facilitate Land Exchanges
- Develop diversified land uses and land use densities
- Educate the stakeholders

Integrated management is a concept that extends to the edge of the watershed and beyond, pointing to the fact that key resources are interrelated.

Discussion: Integrated management is a concept that extends to the edge of the watershed and beyond, in some cases. The concept points to the fact that key resources are interrelated and because of water; are interconnected. Potential impact to the watershed that occur from outside of the watershed also need to be considered. For example, Flagstaff has plans to develop deep wells just inside of the watershed boundary that have the potential to impact groundwater contributions to a Verde River tributary.

This goal is likely to have the highest degree of success but will be challenging to enact. The broader scope of this goal incorporates tools that are directly related to future water use, i.e. land and ecological resource management. All human water use is ultimately tied to the use of the land, having the ability to conjunctively manage these resources makes sense. An indication of this concept lies in the creation of several National Forests in Arizona when the shareholders of the Salt River Valley Water Users Association urged the Federal Government to preserve lands in the watersheds that contribute water to their Reclamation project. The Tonto, Coconino, Prescott and Apache-Sitgreaves National Forests were ultimately created – demonstrating the key link between land and water resources.

Integrated Management is likely to have the highest degree of success but will be challenging to enact

Implications:

- Provides land and water resources for future generations

- Protects property values
- Forces entities to plan for the long-term
- Sensible approach for the future
- Holistic management approach
- Empowerment to ensure quality of life
- Requires significant commitment of time, money and stakeholder involvement
- Increased management and bureaucracy
- Water resource litigation may decrease, litigation over land management may increase
- Will enable political powers to change how business is done and integrate land and water uses.
- More tools for managers and elected officials
- Assures certainty in water supply
- Huge positive effect for investment capital
- Improves quality of life.
- Avoids duplicity of efforts, i.e. Habitat Conservation Plans
- Averts State/Federal control of resources

Next Steps:

The scope of this paper is intentionally limited to providing a menu of water management options and possible implications. There are a number of outstanding issues not addressed in this paper and that require guidance from the WAC and/or Board of Supervisors.

Things to consider:

1. There does not appear to be a single approach that applies to all basins within the County, although interconnected basins, such as the Verde Valley, Big Chino subbasin and the Little Chino portion of the Prescott AMA, should have complementary management policies.
2. Does the County, as a region, want to develop local controls for water management? It appears as though the State or Federal governments will eventually impose a water management regime if the local governments do not.
3. Not every aspect of the water management/conservation options is covered in this paper; implementation strategies have not been discussed in full. It would be helpful if the Board could indicate which options it feels should be more fully explored prior to developing that level of detail.
4. Discussion about the options explored in this paper should be fully explained in a work session with the Board, and possible public sessions.
5. Stakeholder involvement and public education will be a key component of a plan.
6. Other issues for general discussion
 - a. Tools needed
 - i. Changes in statute
 - ii. Ability to regulate proliferation of small wells
 - iii. Ability to allocate water
 - b. Define Acceptable Consequences
 - i. Consequences to private property rights, both developed and undeveloped land
 - ii. Economic impacts
 - iii. Consequences to ecological resources
 - c. Define local control, what is it, who has it
 - i. Do existing jurisdictions enact water management or is it the role of an overarching agency (partnership or regional authority), or a combination?
 - d. Understand the legal consequences of potential remedies
 - i. Endangered species concerns and the Habitat Conservation Plan process
 - ii. Legal standing of downstream water users.

APPENDIX A:

Water Advisory Committee Goals and Objectives:

Charter: The Yavapai County Water Advisory Committee is a coalition of communities and selected stakeholders that is dedicated to developing a management plan for the sustainable use of our regional water supply.

Mission Statement: The Yavapai County Water Advisory Committee is committed to preserving sustainable water resources for future generations while enhancing the economic viability of our County. We are dedicated to meeting the long-term water resource needs of our customers - the citizens of the Yavapai County region. We will accomplish our goals by developing and enacting a regional water management strategy through a consensus of our coalition members.

Situational Analysis: Historic uses of water and new demands for water may have created changes to the conditions of the water resources of the region. Water levels have declined in some local aquifers, pointing to a change in the water resource system. It is imperative that measures are taken to obtain a better understanding of the county's water resources and to ensure the good health of our surface water and groundwater systems.

Critical Planning Assumptions: The factors and events that are likely to occur with a high degree of probability in the near future:

1. The Prescott AMA Tri-City Communities will continue with plans to construct a pipeline and develop the Big Chino groundwater basin as well as mitigate impacts from pumping.
2. The Verde River Downstream water right holders and residents (to date) plan to oppose this proposed pipeline.
3. Other groups represented by committee members will also move forward with water acquisition & infrastructure projects.
4. Growth (and demand for water) will continue.
5. Hydrologic and other scientific studies will continue.
6. New legislation will change how we do business within AMAs and with AMAs.
7. Additional or new water supplies will be needed for the Yavapai County region.
8. Water Rights, Water Law and the Regulatory Framework of water management will play a very significant role in the development of water resources.
9. The least costly sources of water have already been developed; additional water sources will likely be more expensive.

Key Objectives.

- I. Goal No. 1: Develop regional Yavapai County water management and conservation strategies that ensure sustained use of water resources and that protect the base flows of the County's rivers and streams.
- II. Goal No. 2: Establish strong communication links among federal, tribal, state, county, local government, individual citizens and all other stakeholders.

- III. Devise and promote enabling legislation that will provide a local basis for management of water resources.

Tactics:

- I. For Goal No. 1: Develop regional Yavapai County water management and conservation strategies that ensure sustained use of water resources and that protect the base flows of the County's rivers and streams.
 - a. Inventory municipal, private, tribal and downstream ownerships of water resources.
 - b. Inventory the location of all known sub-basin aquifers
 - c. Inventory existing scientific studies to include total water resources (e.g. surface, ground and effluent).
 - d. Through development of scientific information, allow the water resource to drive the water management strategy.
 - e. Participate in local, state, federal water policy issues that impact our ability to manage regional water resources.
 - f. Outcome: Yavapai Countywide consensus on water resource use and its management.
 - g. Develop a subcommittee structure to address specific issues such as, but not limited to, conservation and education issues.
 - II. For Goal No. 2: Establish strong communication links among federal, tribal, state, county, local government, individual citizens and all other stakeholders.
 - a. Develop trust among citizens, cities & towns, and individuals via news media(s) and town hall meetings.
 - b. Continue timely reporting to the Yavapai County Board of Supervisors.
 - c. Keep current on legislative and regulatory issues.
 - d. Provide opportunities for representation and presentations from regulatory agencies.
 - e. Outcome: Heightened awareness of total water management and support of those goals.
2. Support implementation of goals 1 and 2 by utilizing the collective strength of the WAC membership .

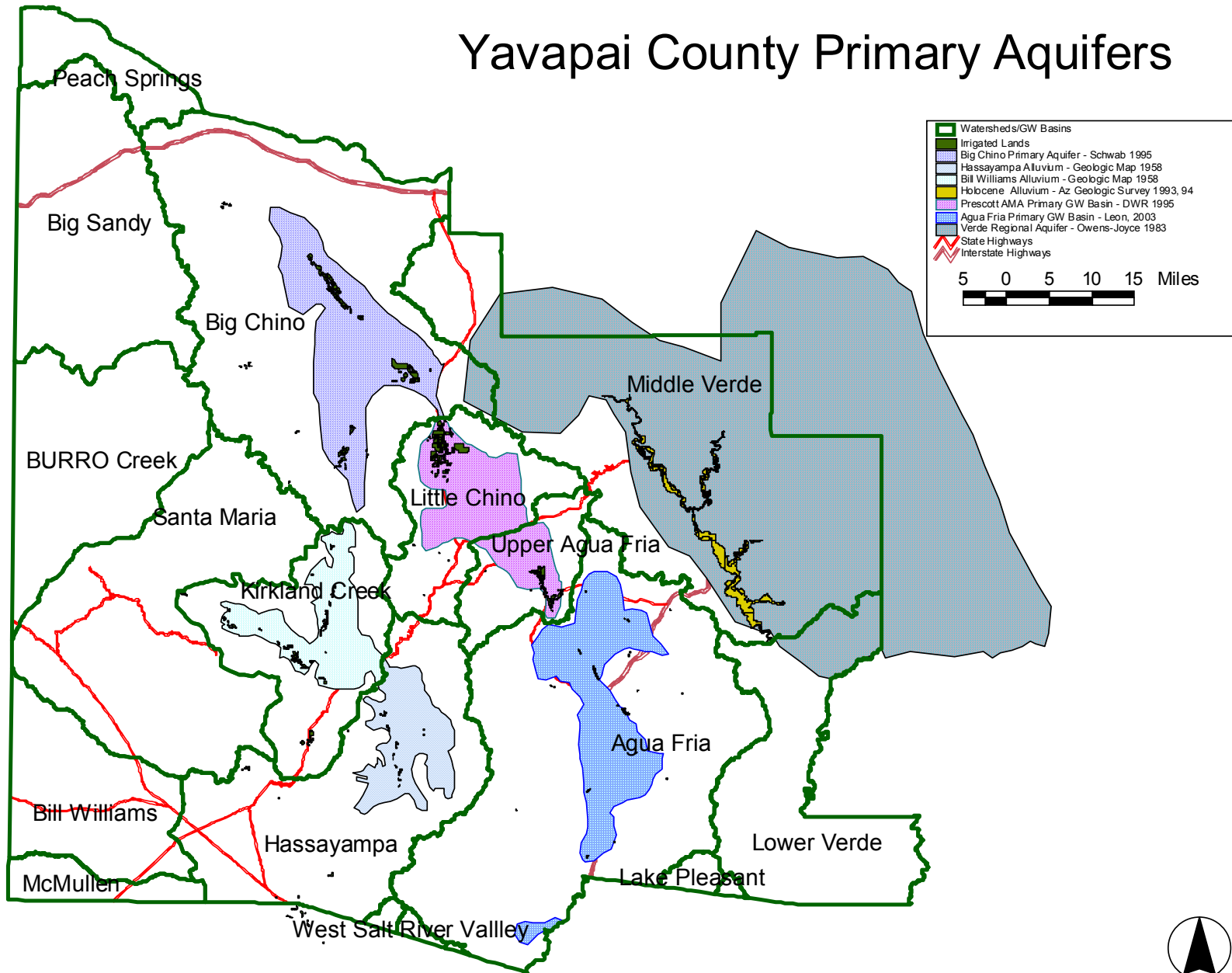
Appendix B – Comparison of Water Management Goals

Category	Status Quo	Managed Planned Depletion	Safe Yield	Sustainability	Integrated Management
Short-term costs of implementation	No additional costs associated with bureaucracy or infrastructure	Additional costs <ul style="list-style-type: none"> • hydrology • monitoring • water rights 	Additional costs <ul style="list-style-type: none"> • hydrology • monitoring • water rights 	Additional costs <ul style="list-style-type: none"> • hydrology • monitoring • water rights 	Additional costs <ul style="list-style-type: none"> • hydrology • monitoring • water rights
Long-term costs of implementation	Possible increased infrastructure costs	Additional costs due to management of uses	Additional costs due to management of uses	Additional costs due to management of uses	Additional costs due to management of uses
Short-term cost of water	Low initial cost of water, increased pumping costs associated with lowered water tables	Low initial cost of water, increased pumping costs associated with lowered water tables	Increased due to infrastructure requirements	Increased due to infrastructure requirements, pumping costs should stabilize	Increased due to infrastructure requirements, pumping costs should stabilize
Long-term cost of water	Additional costs associated with acquisition of new sources, if available	Cost will increase when defined GW level is reached	Increased due to infrastructure requirements	Increased due to infrastructure requirements, pumping costs should stabilize	Increased due to infrastructure requirements, pumping costs should stabilize
Short-term economic impacts	Water management is not an obstacle to near term growth	Not an obstacle to near term growth	Possibly not an obstacle to near term growth depending on Safe Yield status in basin	Likely obstacle to near term growth depending on available water resources.	Likely obstacle to near term growth depending on available water resources.
Long-term economic impacts	Potential loss of venture capital and vitality of the economy Possible decrease in property values	Obstacle to long-term growth possible, likely loss of venture capital after limit is reached. Possible decrease in property values	Obstacle to long-term growth possible – limits based on water availability	Likely obstacle to long-term growth – limits based on water availability	Likely obstacle to long-term growth – limits based on water availability

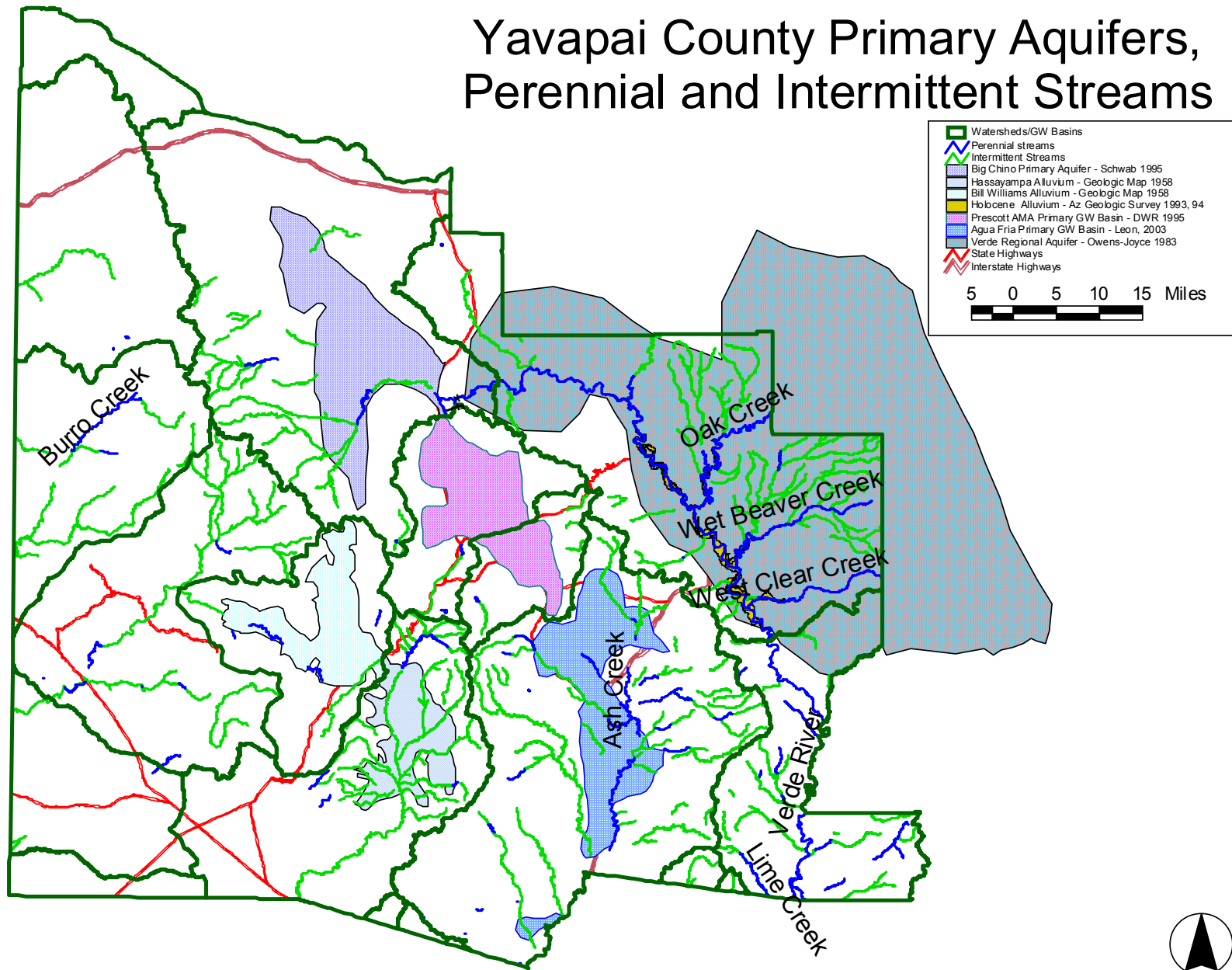
Category	Status Quo	Managed Planned Depletion	Safe Yield	Sustainability	Integrated Management
Impacts to water resources	Possibility of running out of water, need to develop outside sources, declining water tables	Less likely to run out of water	Less likely to run out of water	Long term water supply is assured	Long term water supply is assured
Impacts to other aquatic resources (streams, riparian habitat, species)	Would adversely affect riparian habitat and supporting streams	Likely adverse effects to streams and riparian habitat	Possible adverse effect to streams and riparian habitat	Riparian habitats and streams are protected	Riparian habitats and streams are protected
Impacts to other natural resources	Possible ground subsidence	Possible ground subsidence	Possible ground subsidence	Ground subsidence less likely	Ground subsidence less likely, land management aspects need to be included
Political Implications	Possible effects	Possible long-term effects	Possible effects due to regulations	Possible effects due to regulations	Possible effects due to regulations
Legal Impacts (litigation)	Possibility of Litigation due to the Endangered Species Act, Water Rights, etc.	Litigation possible from downstream water right holders.	Litigation somewhat less likely	Litigation much less likely	Litigation much less likely
Legal Implications (legislative)	No new legislation required	New legislation will be required	New legislation will be required	New legislation will be required	New legislation will be required
Bureaucratic hurdles	None	Increased Bureaucracy	Increased Bureaucracy	Increased Bureaucracy	Increased Bureaucracy
Risk assessment	Uncertainty about water resources Wells at risk (possibility of continually deepening wells)	Some uncertainty due to possible over commitment of resource	Less uncertainty for capital investment,	Less uncertainty for capital investment	Less uncertainty for capital investment

Category	Status Quo	Managed Planned Depletion	Safe Yield	Sustainability	Integrated Management
Data/Scientific Requirements	None	Quantify resources, groundwater monitoring network, groundwater models	Quantify resources, groundwater monitoring network, groundwater models, water rights	Quantify resources, groundwater monitoring network, groundwater models, surface water models, water rights	Quantify water, land and ecological resources, r monitoring network, models for land, water and ecology

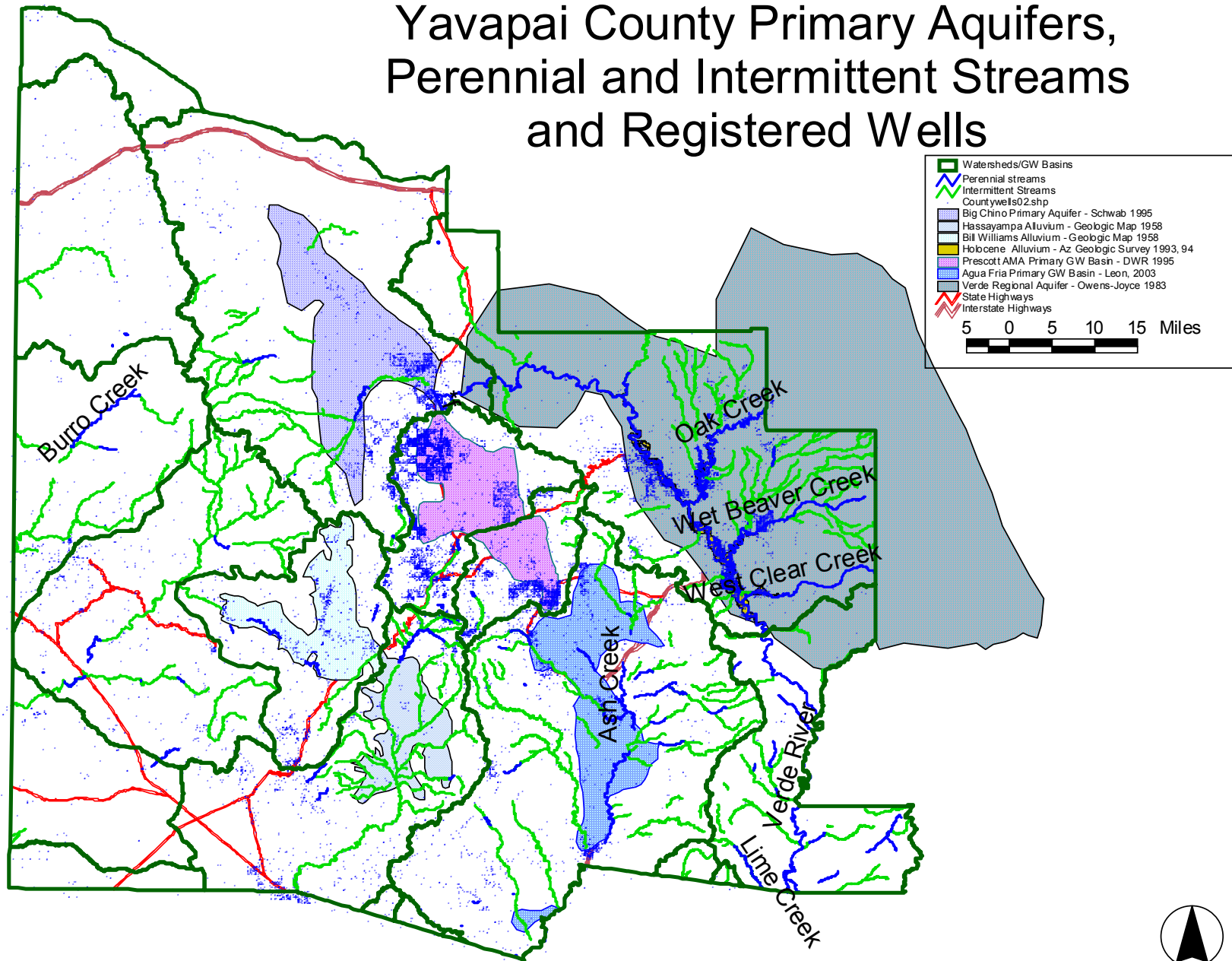
Appendix C – Maps of Yavapai County Watersheds, Groundwater Basins and Streams



Yavapai County Primary Aquifers, Perennial and Intermittent Streams



Yavapai County Primary Aquifers, Perennial and Intermittent Streams and Registered Wells



Yavapai County Watersheds and Landownership

