ARIZONA COOPERATIVE EXTENSION
THE UNIVERSITY OF ARIZONA
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Well Owners' Guide to Ground Water Resources in Yavapai County

What is a Water Resource?

An individual in an industrialized urban society may use from one million to five million gallons of water during their lifetime. If the share of industrial, agricultural, and recreational usage is counted, the total amount of water may exceed ten million gallons per capita. Water resources are those sources of water that meet the need of the individual and society, and the value of that resource depends on demand and availability.

Our arid climate, coupled with increasing demands on water supply and the over—allocation of surface water resources, forces much of Yavapai County to rely on ground water wells for potable use. This primer has been prepared to provide the homeowner with a basic understanding of where your water comes from in Yavapai County, and for the well-based water-supply system owner to understand some of the vulnerabilities of their water supply.

Ground Water Management Act

Fresh water is a renewable resource, with every rain drop and snowflake that does not evaporate in our arid climate contributing to availability, yet water demand already exceeds supply across most of Arizona. The Arizona Ground Water Management Act (Title 45 of the Arizona Revised Statutes) was passed in 1980 to help address the issue of water supplies across Arizona. The Act has three primary goals:

- Control the severe ground water overdraft occurring in many parts of the state;
- Provide a means to allocate the state's limited ground water resources to most effectively meet the changing needs of the state; and,
- Augment Arizona's ground water through water supply development.

To accomplish these goals, the Act set up a comprehensive management framework and established the Arizona Department of Water Resources (ADWR) to administer the Act's provisions. In central Yavapai County, the Act established the Prescott Active Management Area (AMA) to manage this limited renewable natural resource.

The Prescott AMA is a 485 square mile area (6% of the total area of the county) and has a statutory goal of achieving safe-yield by 2025. Safe-yield means that the amount of ground water pumped from the aquifer on an average annual basis must not exceed the amount that is naturally or artificially recharged. The safe-yield goal is a basin-wide balance. This means that water level declines in one portion of the AMA can be offset by recharge in another part of the AMA.

All wells in Arizona are regulated by ADWR. Before anyone can drill a new well or deepen or modify an existing well, that person must obtain authorization from ADWR. The well must meet minimum construction standards and must be drilled by a licensed well drilling contractor. Within AMAs, owners of large wells must report their pumpage, but small wells – those with a pump capacity of 35 gallons per minute (GPM) or less, and used to irrigate less than 2 acres – are exempt from reporting requirements and conservation regulations. Outside the AMA, there are no pumping restrictions or reporting rules. All new wells are permitted through the Yavapai County Development Services, in cooperation with the ADWR.

Public Water Providers in Yavapai County

A Public Water System provides water for human consumption through pipes or other constructed conveyances and has at least fifteen service connections, or regularly services at least twenty-five persons for at least sixty days a year. There are 27 public water providers across Yavapai County, most located

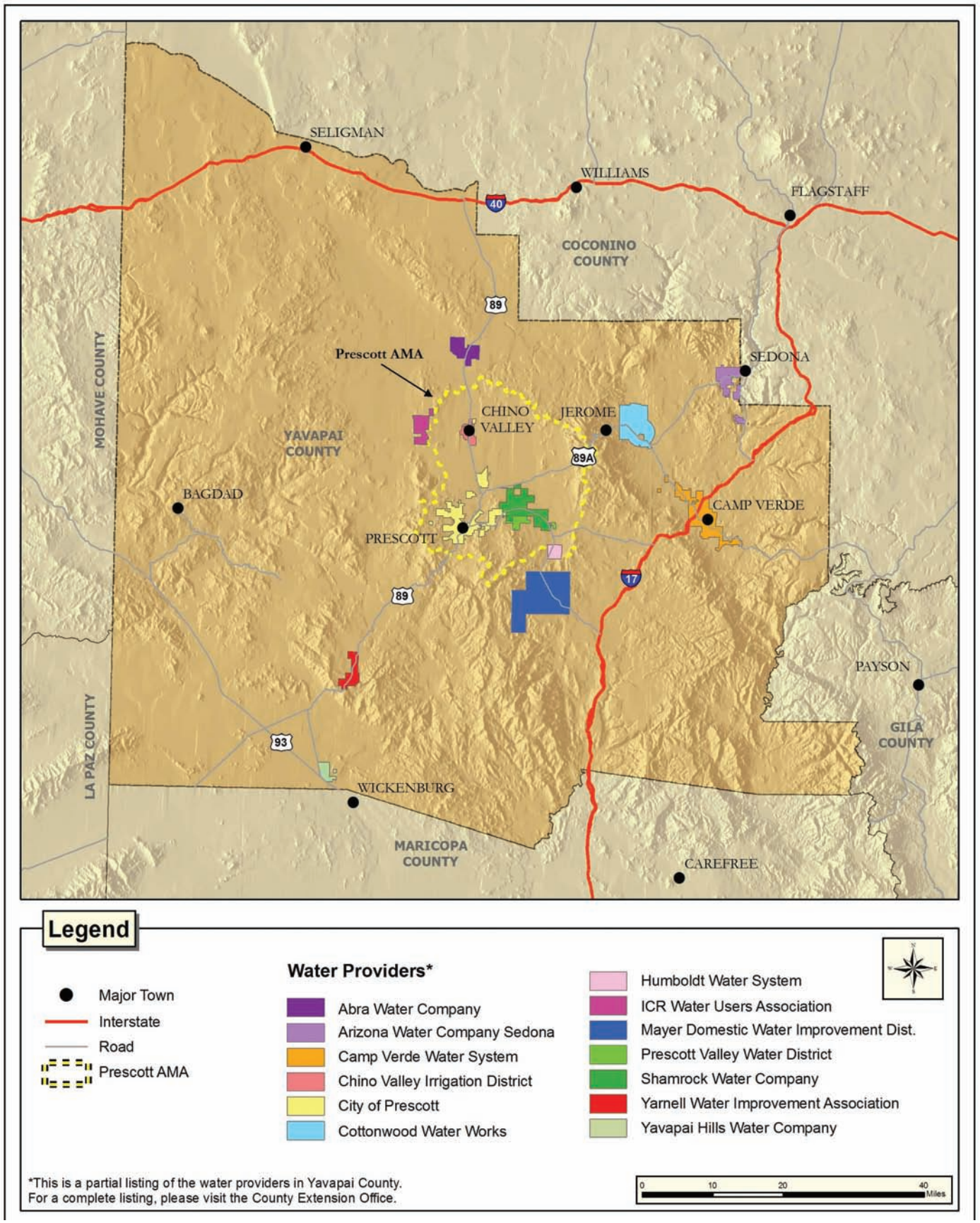

Figure 1. Yavapai County Water Providers
Note that the City of Cottonwood acquired four local privately owned water companies, including Cottonwood Water Works, Verde Santa Fe, Clemenceau and Cordes Lakes Water Companies, and operates them as one interconnected municipal system.

near population centers and housing developments (Figure 1). The Arizona Department of Environmental Quality (ADEQ) regulates all public water systems involved in the collection, storage, treatment or distribution of potable water. Municipal public systems are regulated by the city or town council. Similarly, water improvement districts are governed by the county in which they operate.

Shared Wells

If a well does not meet the criteria of a Public Water System but serves more than one household, this is a Private Shared Well System. There is no agency that enforces or regulates Private Shared Well agreements, and the agreement is considered a civil matter between neighbors. In some circumstances, if the service of water from a well is off the premises, the well may be subject to regulation by the Arizona Corporation Commission (ACC). The ACC is the regulatory authority with jurisdiction over private water (and sewer) companies as well as investor-owned utilities.

Exempt Wells

Private, domestic wells designed to pump no more than 35 gallons per minute are called "exempt wells" because they are exempt from reporting requirements and regulation. More exempt wells are drilled in Yavapai County than any other Arizona county. Currently **over 30% of all the new wells drilled in Arizona are in Yavapai County, and within Yavapai County** the greatest concentration of wells is within the Prescott AMA with just over 11,200 registered wells (ADWR, 2008).

While some of these wells are drilled in subdivisions requiring hydrologic analysis prior to permitting, many are drilled on lots created through "lot splits" for which no hydrologic analysis is conducted. A lot split, or "land division" by Arizona statute, is land in an unincorporated area of a county that has been divided into five or fewer parcels, any of which is ten acres or smaller in size. Once platted, the land divider is able to build and sell houses on the divided land even through a reliable water supply might not be available.

Unlike their authority over subdivisions, in most circumstances county boards of supervisors do not have the discretion to prevent a lot split from occurring. A lot split must be approved if the divider's application meets certain minimum requirements outlined in statute, regardless of water availability.

Lot split and subdivision statutes are increasingly being examined for potential changes to provide tighter management of ground water resources. The reason for this is the common tie between lot splits and exempt wells – wherever there is a lot split, there is likely to be an unregulated, exempt well that provides water to the homeowner.

Other than registration with ADWR, no agency enforces or regulates water supply or quality in exempt wells. For this reason, well-based water-supply system owners must realize their responsibility to understand some of the vulnerabilities of their personal water supply and commit to monitoring the quality of their water.

Ground Water Quality in Yavapai County

Ground water quality is considered excellent in most of the county. Water pH is usually between 6.5 and 8.5, and total dissolved solids (TDS) are usually at or below 500 ppm. However, some areas of the county have high concentrations of arsenic, nitrate, and radon in the water. Ground water quality is dependent on the geology of the aquifer material, which may contribute naturally occurring chemical constituents that are of concern if found in elevated concentrations (such as arsenic) and may be affected by land use activities that may leach chemicals through the soils (such as agricultural nitrates).

An aquifer is an underground geologic formation capable of transmitting and yielding usable quantities of water to a well or spring. Depending on the geologic formation, water is typically held in subsurface fractures and cracks of rock, or in interconnected pores and void spaces between grains of sand and gravel or soil. Aquifer material types include both **unconsolidated** and **consolidated** rock materials, examples of which range from the unconsolidated alluvial sands and gravels of the Big Chino Wash, to the dense consolidated granite of Skull Valley and the Black Canyon, and the basalts near Cordes Junction. Sedimentary rocks, such as the red sandstone cliffs in and around Sedona combine the characteristics of both consolidated and unconsolidated materials (Figure 2), with water transmitted through both the porous sand and the factures and cracks of the rock.

In sedimentary rocks, ground water is filtered through porous void spaces as "porous flow", or in fractures and cracks as "fractured flow", and/or in a combination of these flow types. Fractured flow can rapidly transmit contaminants through the subsurface as there is little opportunity for natural filtration of pollutants. Porous sands allow for more filtration of the water, and more natural protection from land surface contaminants seeping through the soils. It is important to understand which flow type is prevalent in your aquifer to protect your water supply from contamination.

Ground water in contact with naturally occurring minerals of the rocks and alluvium will dissolve and transport those minerals to your well and water supply. In Yavapai County, the most common naturally occurring water supply contaminants are arsenic and radon.

Arsenic: The Verde Formation is of particular importance when discussing ground water quality in Yavapai County because of naturally occurring arsenic in concentrations sometimes exceeding health based standards. Within the past 2 to 5 million years, the Verde Valley was formed and the arsenic rich Supai Sandstone formation was eroded and redeposited as the Verde Alluvium Formation, which now forms the aquifer of the Big Chino and Verde Valley. The highest concentration of arsenic in ground water in Arizona was found near Pauldin, Arizona, with a concentration of 2,900 parts per billion in a private, domestic (exempt) well (ADEQ, 2006). The USEPA has set a health-based limit of 10 part perbillion as a Maximum Contaminant Limit (MCL) allowable for a public water supply.

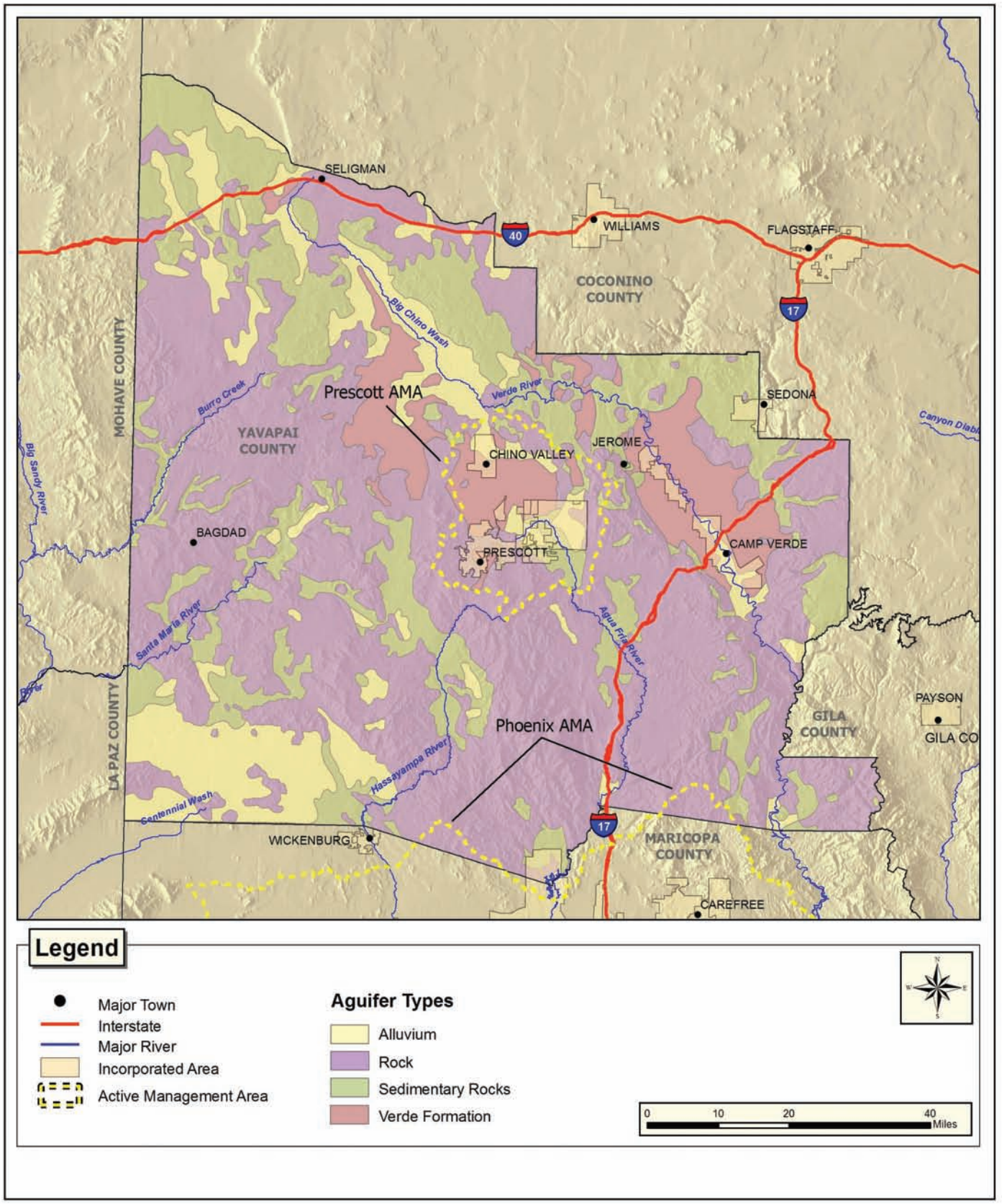

Figure 2. Yavapai County Aquifer Types and Prescott AMA

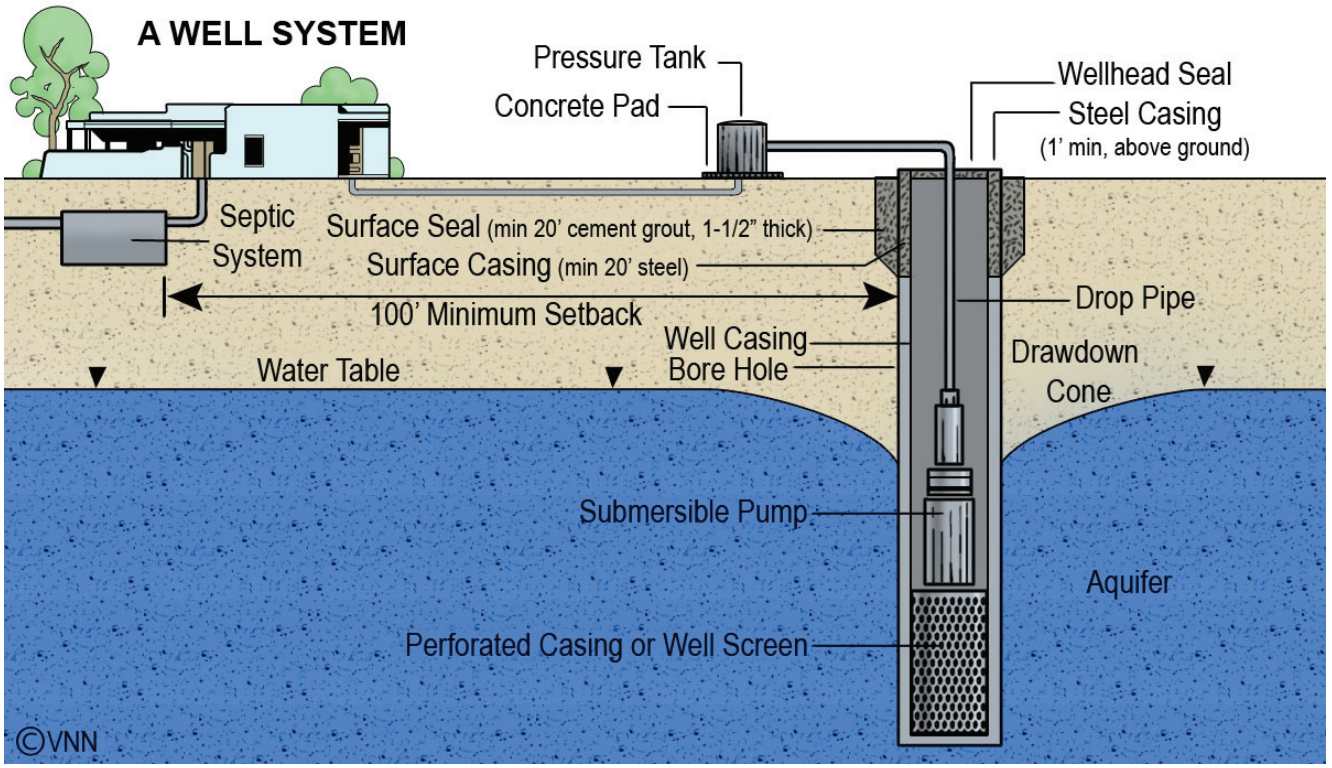

Figure 3. Base Well Diagram. Adapted from ADWR Well Owners Guide

Because arsenic mobility is a function of water pH and oxygen content, it is generally true that any *change* in the geochemistry of an aquifer may elevate or reduce arsenic concentrations. As ground water elevations dropped due to drought in the Verde Valley, arsenic concentrations increased due to the introduction of oxygen to the aquifer. The reverse is also true in that arsenic concentrations can be lowered by changing water pH and oxygen concentration, potentially making arsenic contamination of well water readily treatable with technologies available to the well owner.

Radon: Naturally occurring radioactivity in ground water is produced principally by dissolved constituents within the water – in Arizona the most common source of radioactivity is dissolved uranium and dissolved radon gas. Radioactive minerals containing uranium (760 million year half-life) and thorium (4.46 billion year half-life) are found in many Arizona granites. A half-life is the time period in which half the initial number of atoms of a given quantity of a radioactive element disintegrates. This disintegration forms a series of radioactive "daughter" products, most of which are short-lived. Disintegration products of both uranium and thorium include radium (half life of 1,620 years), which then disintegrates to radon—an "alpha" radiation emitting gas with a half life of 3.8 days. Radon is an odorless, colorless, tasteless gas that dissolves in ground water and may also migrate upward though the soils to eventually dissipate to the atmosphere. The US Environmental Protection Agency has estimated that radon in drinking water causes about 168 cancer deaths per year across the United States, 89 percent from lung cancer caused by breathing radon released from water, and 11 percent from stomach cancer caused by drinking radon-containing water (USEPA, 2008). Radon levels that exceed drinking water standards have been detected in granitic formations around Prescott, and may require domestic well owners situated in hard rock areas to start receiving treated water from large providers.

Radon contamination of well water is treatable with technologies that allow the gas to dissipate – much like bubbles in soda. However, if radon gas is trapped within a structure, such as a basement, the concentration of radon gas may exceed health standards. The USEPA estimates that one in 15 US homes contains a high level of the gas (www.epa.gov/rado/radontest.html).

Nitrate: Nitrate contamination is most often caused by human activity on the land, and has been linked to irrigated agriculture, concentrated livestock facilities, large turf areas and septic systems. Yavapai County requires a 100 foot set-back between a water supply well and sewage disposal system (such as a septic tank and leach field), but in areas of shallow ground water or consolidated rock aquifers, this may provide insufficient protection (Figure 3).

Several locations in Yavapai County have exhibited elevated nitrate levels, including near Dewey, Chino Valley, northwest Prescott, Clarkdale, Cottonwood, Bridgeport, Camp Verde, and Cornville. If your property is near an agricultural field or farm, or if your property was ever farmed in the past, you may be at risk of nitrate contamination of your well water. You are also at greater risk of water contamination if you don't know the location of your septic system – or your neighbor's septic system – in relation to your well location.

Ground Water Availability: The most common water supply well system problem in Yavapai County is dropping ground water elevations. If the water table drops below the well casing, flow of water into the well screen becomes turbulent as the cascading water mixes with air. In an uncased, bedrock well, as the water table drops and air is introduced into formerly saturated cracks and fractures; the mixture of water and air begins to erode the aquifer. The first sign of system failure (and dropping ground water elevations) is the build-up of sediment in tanks, pipes, and plumping fixtures. If the well continues to pump gritty sands, the pump itself will grind to a stop and will need to be replaced.

These simple steps will help protect your system and water quality

- Always use an Arizona licensed well driller and pump installer when a well is constructed, a pump is installed, or the system is serviced.
- Be aware of the geology of your aquifer. Know that a well installed in consolidated rock is more vulnerable to contaminant transport, whereas an unconsolidated aquifer retains more filtering capacity. If a known contaminant release occurs in your neighborhood—such as a hazardous waste spill or a leaky underground gasoline storage tank – your well may be at risk. The geology of your aquifer may protect your water supply—or may make your well more vulnerable to contamination.
- Practice well head protection. Keep hazardous chemicals, such as paint, degreasers, fertilizer, pesticides, kerosene, and motor oil away from your well head.
- Periodically check the well cover or well cap to ensure it is in good repair. Do not allow surface water to puddle near your well, if necessary construct berms around the well to divert surface runoff away from the wellhead.
- Always maintain separation between your well and buildings, septic systems, chemical storage facilities, garage, or car maintenance area. Your professional contractor will know the rules on appropriate distances for new construction.
- Don't dispose of chemicals in your septic system, and read the label of any cleaners or additives advertised for septic systems. De-greasers contain industrial solvents that persist in the environment and may seep into the aquifer. Pharmaceuticals and prescription medicines flushed down the toilet may also seep into the aquifer and enter your water supply.
- Don't allow back-siphonage. Install a back-flow preventer on outdoor hoses when mixing pesticides, fertilizers, or other chemicals; don't put the hose inside the tank or container.
- When landscaping, keep the top of the well at least one foot above the ground. Slope the ground surface away from your well head for proper drainage.
- A damaged casing could jeopardize the sanitary protection of your well. Don't pile landscaping or construction materials near your well.
- Be aware of changes in your well, the area around your well, or the smell, taste or color of your water.
- Monitor the sediment build-up in your toilet tank. If the sediment is soft and does not feel gritty, this is not of concern unless you notice a significant increase in volume. If the sediment is gritty, or if you notice sand in the tank, contact a licensed well pump installer. Soft, fine clays will not feel gritty if rubbed across your tooth, whereas grit wears down pumps and plumbing!
- An annual well maintenance check, including water quality testing, is recommended. The water quality should be checked any time there is a change in taste, odor, or appearance, or anytime a water supply system (such as pump replacement) is serviced.

Testing your well water: Cooperative Extension and the National Ground Water Association (NGWA, 2007) recommends well owners test their water annually for bacteria, nitrates, arsenic, and radon. Testing may need to be more frequently if:

- Your well is located in a consolidated rock aquifer where contaminants can be rapidly transmitted to your well and a new contamination source appears.
- If there is a change in the taste, odor, or appearance of the well water.
- If your well occasionally goes dry or if the ground water elevations are dropping – the change in chemistry in the aquifer may release naturally occurring minerals, such as arsenic.
- After your well has been chlorinated – the change in chemistry in the aquifer due to the introduction of chlorine may release naturally occurring minerals, such as arsenic.
- If family members or house guests have recurrent incidents of gastrointestinal illness.
- If an infant is living in the home; infants are more susceptible to nitrates and other contaminants.
- If you wish to monitor the efficiency and performance of a home water treatment equipment.

A list of Arizona Department of Health Services Certified Drinking Water Laboratories can be found at:

http://www.azdhs.gov/lab/license/index.htm

State and County Contacts / Links

Arizona Department of Environmental Quality – Water Quality Division (ADEQ) http://www.azdeq.gov/environ/water/index.html

- Delegated authority by the state to inspect wells. ADEQ gives Yavapai County the regulatory authority to do inspections (in most counties, the state does them directly)
- Gets involved if more than 25 people or 15 hook-ups onto a shared well (in which case, the group is considered a water provider)

Arizona Department of Water Resources (ADWR) Prescott AMA

- If existing well is older than 1980, it must be permitted by ADWR.
- Provides info on regulations on well construction (http://www.azwater.gov/dwr/Content/Find_by_Program/Wells/Practical_Guide_for_web_07_06.pdf

Yavapai Citizens Water Advocacy Group (CWAG) http://www.cwagaz.org/reports.html

The Mission of the *Citizen´s Water Advocacy Group (CWAG)* is to promote a sustainable water future in the Upper Verde River Basin and the Prescott Active Management Area. They advocate the conservation of water and encourage informed and responsible governmental decision making regarding development and use of water.

The Yavapai County *Water Advisory Committee*: is a committed coalition of communities and selected stakeholders that are dedicated to developing a management plan for the sustainable use of our regional water supply. It consists of concerned citizens and retired professionals interested in the challenge of water/development projects in the county, especially with arsenic problems that are occurring as the Little Chino aquifer is over-used.
http://www.co.yavapai.az.us/content.aspx?id=20562

References

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Arizona Department of Water Resources [ADWR], 2008 http://www.azwater.gov/CkWaterSupply/Yavapai.aspx

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US Environmental Protection Agency [USEPA], 2008 http://www.epa.gov/OGWDW/radon/proposal.html

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WELL OWNERS' GUIDE TO GROUND WATER RESOURCES SERIES : YAVAPAI COUNTY

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