Policy Area 5:
Water Supply
and
Sewage Treatment

Key Words and Phrases:

Citizen Comments from Town Meeting (literal, unedited):

DESIRED FUTURE

Water and Sewer, Centralized
- City water & sewer
- Protected/adequate water
- Municipal water & sewer

Water and Sewer, Wells
- Protect wells & water supply
- Remain rural, keep wells, no city water, no sewer

Water and Sewer, Choice of Options
- Give choice to citizens to keep well water

UNWANTED FUTURE

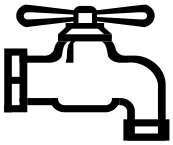
Centralized Water System
- Mandatory connection to town water
- Public water or sewer (don't want)
- No city water/sewer
- Public sewer system

Lack of Water Management/ Protecting Wells
- Lack of water management

Town Council/Zoning Board Comments From Joint Kick Off Meeting:

Consider Future Water Supplies and Sewage Treatment Needs
- Water / waste water – reliable, long term
- Viable sustainability of well & septic vs. potential need for surface water solution
- Water conservation and water use. Short term & long term needs & assessments: possible ordinances

The above *key words and phrases* were gleaned from (1) the Town Meeting for the Comprehensive Plan (2) the Joint Kick-Off Meeting of the Town Council and Zoning Board. These key words and phrases were employed to generate the following **Common Objective** and related **Policies for Water Supply and Sewage Treatment**



Common Objective for Water Supply and Sewage Treatment

The Town of Summerfield recognizes the singular importance of plentiful, safe, potable water to present and future residents and businesses. To preserve the availability of this resource, the Town shall make water supply, water conservation, and groundwater recharge very high priorities and shall encourage its citizens to do likewise. Wastewater treatment technologies shall be employed to work in harmony with growth and development policies to conserve open space and rural character, and to return water to the groundwater system, while protecting the quality of the

Policies for Water Supply and Sewage Treatment

Policy 5.1: The Town should work regionally on a broad range of WATER SUPPLY OPTIONS AND APPROACHES for the long term.

Policy 5.2: To improve short and long-range water supply projections, the Town shall support voluntary as well as institutional efforts to MONITOR GROUNDWATER SUPPLIES underlying the Summerfield community.

Policy 5.3: Recognizing that water and sewer services have a POWERFUL INFLUENCE ON GROWTH AND DEVELOPMENT, the Town of Summerfield shall require that the design and location of water supply and sewage treatment facilities promote desirable development density and growth patterns.

Policy 5.4: To preserve and protect recharge to the groundwater system, and to balance supply and demand, the Town shall facilitate development forms and domestic wastewater systems that maximize the RETURN OF WATER TO THE GROUNDWATER SYSTEM. Generally, this means encouraging greenspace[1] developments, and on-site disposal or land application for treated wastewater.

Policy 5.5: The Town shall encourage site designs that FACILITATE RECHARGE TO THE GROUNDWATER SYSTEM, including but not limited to: (1) the conservation and addition of tree cover and associated forest floor debris, (2) the avoidance of curb and gutter in favor of roadside swales and retention areas (3) the preservation of open space (3) and the design of parking areas and other paved surfaces to encourage stormwater infiltration.

Policy 5.6: To conserve water supplies, developers, as well as area residents, are encouraged to plant TRADITIONAL PLANTS NATIVE TO THE AREA as well as DROUGHT TOLERANT LANDSCAPE MATERIALS.

[1] For this plan, *greenspace development* is synonymous with *cluster development*, meaning that homes are brought together in neighborhood clusters with extensive greenspace located and permanently dedicated around such clusters.

Policy 5.7: **Construction of NATURAL AND MAN-MADE RAINWATER RETENTION SYSTEMS IS ENCOURAGED. Such systems should include but not be limited to rain gardens, bio-retention areas, green roofs, cisterns, and rain barrels.**

Policy 5.8: New developments may be required to size and design water retention facilities to serve as WATER RESERVOIRS TO ENHANCE NEARBY FIRE FIGHTING CAPABILITIES.

Policy 5.9: **WATER SAVING DEVICES are encouraged in new and existing homes and businesses. Such water saving devices include but are not limited to: low-flow shower heads; high efficiency clothes washing machines and dish washers; and, high-efficiency toilets.**

Policy 5.10: The Town shall favor TWO TYPES OF DOMESTIC SEWAGE TREATMENT AND DISPERSAL: (1) individual, on-site septic systems in large lot, low density areas, and (2) cluster or decentralized wastewater treatment systems serving multiple homes where a combination of open space and cluster development is necessary or preferred.

Policy 5.11: CLUSTER OR DECENTRALIZED DOMESTIC WASTEWATER TREATMENT SYSTEMS, when employed, shall direct development to areas best suited for growth and away from areas best suited for open space and/or environmental conservation.

Policy 5.12: EFFLUENT FROM CLUSTER OR DECENTRALIZED DOMESTIC WASTEWATER TREATMENT SYSTEMS shall be disposed of in an environmentally appropriate manner and location.

Policy 5.13: The Town shall encourage the development of domestic sewer services that employ WATER REUSE TECHNOLOGIES for appropriate application of treated effluent in open spaces, golf courses and other areas.

Policy 5.14: COMMERCIAL AND INDUSTRIAL WASTEWATER treatment and disposal shall be in accordance with state permitting standards, including applicable watershed regulations.

The new creek bed is ditched straight as a ruler; it has been 'uncurled' by the county engineer to hurry the runoff. On the hill in the background are contoured strip crops; they've been 'curled' by the erosion engineer to retard the runoff. The water must be confused by so much advice.

--Aldo Leopold
A Sand County Almanac. 1949

Notes and Commentary:

WATER SUPPLY OPTIONS

Summary Statement about Water Supply Options for Summerfield

Since its incorporation, the Town of Summerfield has, from time to time, explored various options for securing a permanent and reliable source of potable water for the community. Currently, all residential and commercial water users in Summerfield rely upon groundwater resources, whether from individual or community wells. The Town does not have a convenient surface water source of the magnitude necessary to establish its own water plant, nor does the community's "charter" as a limited services local government advocate for such a facility. If a centralized water distribution system were to be pursued, the most likely option would be to purchase water wholesale from a nearby supplier and resell it to customers in Summerfield. It remains to be seen

whether such action will be necessary, or whether the community can continue to rely upon groundwater resources for the foreseeable future.

Increased Reliance on Groundwater Supplies

In 1990, some 74,460 Guilford County residents used groundwater for their domestic water supplies. By 2006, this number had increased to 135,000 residents. This trend is expected to continue.

Source: US Census and Guilford County Health Department.

In 2007, the Guilford County Department of Public Health issued a report calling for a groundwater monitoring system in the county. As justification for such a system, the report offered the following findings with regard to the area's growing reliance on groundwater resources, particularly in rural parts of the county:

…In 1990, the population of Guilford County was 347,420 and approximately 74,460 residents used groundwater from wells tapping the fractured crystalline rock aquifer system underlying the county for their domestic water supplies (US Bureau of the Census, 1992). It is estimated that the population of the county in 2006 was approximately 452,000. Approximately 135,000 residents or 30 percent of the population in the county use groundwater for domestic use. The number of residents depending upon groundwater for potable supplies has doubled in the last 15 years and will continue to increase with population growth in the county.

…With the steady population growth in the county, the demand for groundwater has increased. In the last few years, many community wells with daily usage of more than 10,000 gallons have been installed in many new developments in the county, particularly in the northwestern part of the county including Summerfield, Oak Ridge, and Stokesdale areas. Because the amount of groundwater in the bedrock aquifers available in the county for potable water is largely unknown, the availability of groundwater as a present and future resource has been a concern for the water supplies in the suburban communities…[2]

Thus, the report offered two important insights into the situation that residents and business owners in the Summerfield area face with regard to their water supply:

(1) Reliance upon groundwater is increasing all the time, and
(2) The amount of groundwater available is unknown.

These two finding are at the heart of issue with regard to future water supplies within the Town of Summerfield.

The Groundwater Resource Under Summerfield

Several studies have been conducted concerning the nature of the groundwater resources of (1) the Piedmont of North Carolina, (2) Guilford County and the Triad, and (3) northwest Guilford County and the Summerfield area. Most agree on the general nature of the groundwater resource. Hydrogeologist Harry LeGrand describes the geology of the groundwater resource in the Piedmont of North Carolina as follows[3]:

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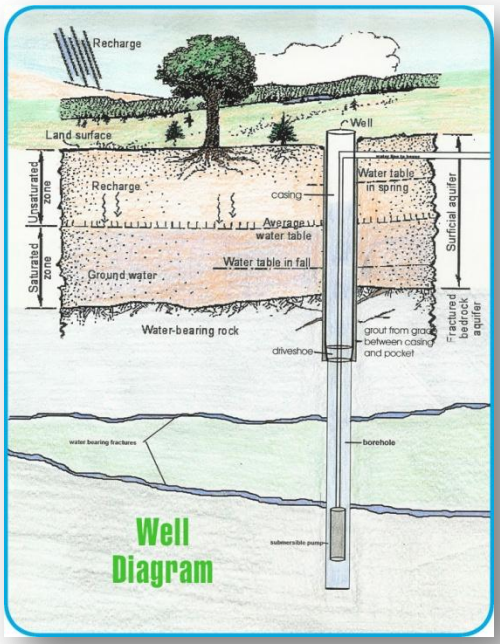
[2] Excerpts from **Guilford County Groundwater Monitoring Network, Status Report,** HERA Team**,** Division of Environmental Health, Department of Public Health, June 2007

[3] Excerpts from **A Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina,** A Guidance Manual, North Carolina Department of Environment and Natural Resources, Division of Water Quality, Groundwater Section, Prepared for the Groundwater Section by Harry E. LeGrand, Sr. Independent Hydrogeologist, 2004

Hydrogeology
…The groundwater system in the region is essentially a two-part system comprised of the regolith and the underlying bedrock. The regolith, which may have a porosity ranging from 35 to 55 percent (Heath, 1980), serves as the principal storage reservoir for the underlying bedrock. Precipitation infiltrates the regolith until it reaches the saturated zone, typically in saprolite, where it is stored as groundwater in inter-granular pore spaces. Where saprolite is very thin, the saturated zone may be entirely contained in fractured bedrock. In many locations, the regolith includes a transition zone between saprolite and fractured bedrock. The transition zone consists of coarse fragments of partially weathered bedrock and lesser amounts of saprolite (Daniel and Dahlen, 2002). Some groundwater moves through the regolith and into interconnected fractures in the underlying bedrock while another component flows through the regolith parallel to the bedrock surface. The destination of both components is an area where groundwater discharges as seepage into streams, lakes, or other surface water bodies, and also as evapotranspiration in lowland areas.



Groundwater Occurrence
…The soil saprolite zone is capable of storing water readily, but transmits it slowly. In contrast, the bedrock fracture system has a relatively low storage capacity but is capable of transmitting water readily where interconnecting fractures occur.[4]

Predictability of Well Yield
The yield of individual wells varies greatly and cannot be predicted within a narrow range of certainty…Wells located in draws where the soil-saprolite zone is thick are likely to have high yields; conversely, wells located on ridges underlain by a very thin soil-saprolite zone are likely to have low yields. Other types of topographic locations and places of intermediate soil-saprolite thickness are likely to have moderate yields…

Large Water Supply System in the Piedmont Relying Upon Groundwater is Unlikely

The Piedmont Triad Council of Governments published a study in 2004 that produced this finding[5]:

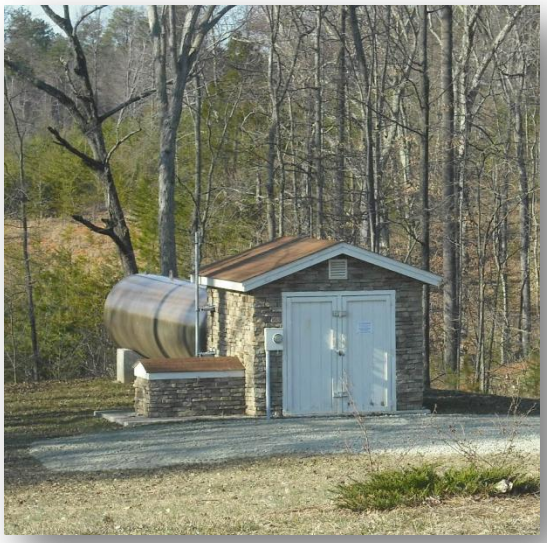
The region's underlying crystalline bedrock aquifer has relatively little storage capacity and well yields are not enough to support a large public water supply system. For that reason, the public drinking water systems in the Piedmont Triad rely primarily on surface water as their supply source.

[4] According to Jim Beeson, a local water and sewer system consultant/designer/contractor, the average depth to bedrock in Summerfield is 90 to 130 feet. The depth to the water table is about 40 feet. Mr. Beeson cites a USGS finding that there are 1 million gallons of water, on average, under every acre in the saprolite under Summerfield. But because the movement of water in the saprolite is slow, a good well needs to go into the bedrock and hit a fracture.
[5] **Water Supply and Wastewater Capacity Assessment for the PTCOG Region**, Piedmont Triad Council of Governments, March 2004

This finding substantiates LeGrand's observations above that the bedrock fracture system underlying the Piedmont region has a "relatively low storage capacity..." Thus, while water stored in fractured bedrock can supply the needs of a smaller well and pump, it is not as suitable for providing the large quantities of water needed to supply a large well and pump system on a continuing basis, such as that associated with a town-wide, centralized water treatment plant.

Development Density and Groundwater Recharge

Daniel and Harned[6] prepared a special groundwater study for Guilford County that is frequently cited as the basis for setting forth a maximum development density in areas of the county dependent upon groundwater for their potable water needs. Specifically, the study concluded that to maintain adequate recharge to the groundwater system of northwest Guilford County (including Summerfield), there should be no less than 60,000 square feet of land area allocated for each housing unit built.



Based on the Daniel/Harned USGS study, this ratio of housing unit to land area allocation was eventually codified into the Town Zoning Ordinance and has been the standard for development density in Summerfield for the past decade. Significantly, in making their calculations, the authors assumed that water drawn from the aquifer would not be returned to the ground (e.g. via septic systems) but rather be transferred out of the groundwater system (e.g. as if collected in a piped network and deposited in a stream outside the watershed). This has drawn some questions about the report with regard to the basis used for the acreage ratio suggested. Regardless of the assumptions made, and from a practical standpoint, an aquifer cannot have too much recharge area available; in contrast, an aquifer can have too little recharge area if intense urban development creates too many roof tops and too much paved area.[7]

Maximizing Groundwater Recharge

In addition to controlling development density and paved areas, there are three things that are best not done if recharge to the groundwater system is to be maximized:

1. Do not remove tree cover and forest floor debris (i.e. leaves, sticks, fungus, decaying detritus materials). Tree cover diminishes evapotranspiration while ground debris soaks up enormous amounts of rainfall, thereby minimizing runoff to streams and maximizing recharge. Do not replace in-ground or land application sewage disposal with a

[6] United States Geological Survey, Groundwater Recharge to and Storage in the Regolith-Fractured Crystalline Rock Aquifer System, Guilford County, North Carolina U.S. Geological Survey Water Resources Investigations Report 97-4140 Prepared in Cooperation with Guilford County Health Department and Guilford Soil and Water Conservation District, By Charles C. Daniel III, and Douglas A Harned.

[7] Groundwater recharge issues aside, large lot sizes might otherwise be justified simply by the will of the people and the desire of the community to maintain its rural character. (Also see Policy Area 6: Housing and Residential Development)

piped sewage collection system and sewer outfall. A piped sewage system does not return water to the groundwater system, but rather delivers it directly to a treatment plant, and then into a stream, thereby eliminating any possibility of groundwater recharge.

2. Do not employ curb and gutter; rather use "naturalized" roadside swales. Curb and gutter collects rainwater from the road surface and directs it to catch basins. After entering the catch basin, the water then enters a piped or ditched system of conveyance to the closest water body. Roadside swales allow street runoff to collect at the roadside and slowly seep back into the groundwater system.

Potential Surface Water Sources for Summerfield[8]

Regardless of whether Summerfield goes into the water business or not, most studies recommend that communities develop backup systems to meet their water needs in times of crisis. For communities that have a centralized water system already in place, this means tying into another community's system as a backup. For communities that are dependent upon groundwater, it means investigating the availability of a backup surface water source. In the case of Summerfield, a community with no access to a surface water source of sufficient volume, the most likely option is to find a nearby system with surplus capacity that is interested in selling water to offset its operating and maintenance costs.

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There are several water supply systems within a serviceable distance of Summerfield. These include Winston-Salem, Rockingham County (from Madison) and Greensboro. While Greensboro has indicated in the past that it would not supply Summerfield with water, this situation could change as water from Randleman Dam comes on line serving the Triad region. Winston-Salem is reportedly 10 years ahead in their design and capacity. Summerfield could buy water from Rockingham County, and tie into Stokesdale (from Winston-Salem) as an emergency connection. Thus there is more than one option available and Summerfield could shop around for the best deal.

Can a Water Distribution System Be Built Within Summerfield Incrementally?

In the mid to late 1990's the Summerfield area began to see a shift from homes with individual wells to larger planned subdivisions with shared community well systems. Examples of this transition included Henson Farms in Summerfield and Ridgewood, just outside Summerfield at Lake Brandt Road. These are managed as private utilities but, from a regulatory standpoint, fall under special permitting rules as a public utility[9]. The question might be asked: "As more community well systems come on-line in the future, could they be designed for eventual combination into a larger, centralized system?" Officials at the State level suggest that while it may be possible, it would be difficult at best and unlikely. They cite, for example, that the pipe sizes for a small community system are much smaller than for those of a centralized public system. Firefighting employing fire hydrants requires much larger flows and therefore

[8]Much of the information on potential surface water sources came from an interview with representatives of the North Carolina Department of Environment and Natural Resources, Division of Water Quality, Winston-Salem Office. (Interview with Corey Basinger and Lee Spencer, April 7, 2009)

[9] Water supply systems serving 25 or more people (e.g. a daycare) or 15 or more homes must be permitted under special public water supply rules.

much larger pipes. If these bigger pipes are initially part of only a small community water system, a big issue arises concerning adequate flow within supply lines to prevent the buildup of carcinogens in stagnant water. To address this problem, water would have to be flushed from the bigger pipes on a routine basis, a waste of large amounts of water that may not be acceptable. Finally, while it is possible to design such a system, it would require a significant engineering effort and overall master plan with which the various community systems would have to conform.

WASTEWATER TREATMENT OPTIONS[10]

Summerfield has developed at a density too low to support a community-wide, centralized sewage treatment system. Wastewater treatment options should therefore focus on a combination of (1) individual, on-site septic systems in large lot, low density areas, and (2) decentralized wastewater treatment systems serving multiple homes in areas where open space and cluster development is necessary or preferred.

Summary Statement about Sewage Treatment Options for Summerfield

To date, the Town of Summerfield has developed at an overall density too low to support the development of a community-wide, centralized sewage collection and treatment system. Community sentiment about future growth also supports a continuation of current low-density development patterns. Even if this sentiment were to change, the costs of centralized systems have become prohibitive, and Federal and State construction grants for such "big pipe" sewer systems no longer exist. Therefore, this plan suggests that wastewater treatment options in Summerfield should focus on a combination of (1) individual, on-site septic systems in large lot, low density areas, and (2) decentralized wastewater treatment systems serving multiple homes in areas where open space and cluster development is necessary or preferred.

Decentralized or Cluster Systems Match Summerfield's Growth Objectives

Until recently, communities had only two options available to meet their wastewater management needs:

1. Continue using traditional, on-site septic systems with in-ground disposal.
2. Install an extensive, large pipe network carrying sewage to one or more centralized sewage treatment plants, with discharge to an area stream.

Option 1 mostly promotes large lot sprawl while option 2 promotes high density development to pay for the construction and maintenance of these large, piped systems. Today, with advanced technologies, there is a third option that is particularly well-suited for a community with growth objectives like those of Summerfield: decentralized or cluster wastewater systems.[11] These systems offer the promise that Summerfield can accommodate new growth while preserving an image that suggests a rural character. The best way to accomplish this, without denying the right of property owners to develop their land, will be to cluster homes on appropriate sites, thereby clearing less land, while preserving generous open spaces along roads and taking in important environmental features between such clusters.

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[10] Much of the information discussed in this section on wastewater treatment options came from a booklet entitled **Choices for Communities: Wastewater Management Options for Rural Areas**, published by the College of Agriculture and Life Sciences at NC State University. March, 2009. Local insights were also obtained from

[11] In 1997, the U.S. EPA reported to the Congress that "Adequately managed decentralized wastewater systems are a cost-effective and long term option for meeting public health and water quality goals, particularly in less densely populated areas." (Ref: EPA 832-R-97-001b)

Decentralized or Cluster Wastewater Systems Described

> *"Cluster systems use small collection networks to bring wastewater from a limited number of homes (usually 5 to 100) to a common treatment and disposal area. Cluster systems utilize alternative collection networks such as small diameter gravity sewers and pressure sewer systems that are less expensive to install than the large pipes used in the centralized approach. Wastewater from a cluster system is pretreated and discharged either into a communal subsurface drainfield or into a land application system that uses irrigation."*[12]

Annual Operating Costs for On-Site, Decentralized and Centralized Treatment Systems

Experts in sewage treatment technologies emphasize the importance of a regular management program for the proper operation and management of the system. This holds true for all three types of systems--centralized systems, cluster systems and on-site systems. A recent study[13] comparing the average annual operation and maintenance costs of the three basic technologies found that developments at densities of 1 home per 1 to 2 acres (i.e. the development density limits set forth in the Summerfield development ordinance) cluster systems can often be the least costly technology. These new cluster systems have technologies that do not require operators to be on-site every day. Weekly or even monthly inspection intervals are adequate for many sites. Further, as cluster systems become more prevalent within the same community, operation and maintenance costs (provided by qualified, circuit-riding maintenance personnel) become even lower.

Decentralized Wastewater Treatment Systems and Development Density

It is well known that traditional centralized sewage treatment systems promote greater development density as necessary to pay for the expensive big pipe collection network and the operationally intensive sewage treatment plant. But is the same true of decentralized systems? The answer is no. Decentralized systems create no overwhelming force to increase development densities. Once a decentralized system is in place, expansion to accommodate higher densities is not as simple as extending a collection pipe to a central sewer plant. Limited economies of scale and land availability for wastewater dispersal place practical limits on the potential for decentralized sewer to foster extensive urban type densities. At the same time, they can provide great flexibility as to where density is best located on a given site. As a practical matter, decentralized sewer systems application requires careful upfront planning to define and lock-in the system capacity for wastewater management.

For developments with densities of 1 home per 1 to 2 acres (i.e. the development density limits set forth in the Summerfield development ordinance) cluster sewage treatment systems can often be the most cost efficient technology to operate and maintain.

Decentralized Systems and Aquifer Recharge

The primary domestic water supply in many rural communities, including Summerfield, is from underlying aquifers. If Summerfield were to join a centralized sewage collection and treatment system, the water drawn from the aquifer would be used and then dumped into the piped system, treated and

[12] **Choices for Communities: Wastewater Management Options for Rural Areas**, published by the College of Agriculture and Life Sciences at NC State University. March, 2009, page 9
[13] "Sustainability Measured, Part 1—Operation and Management" by Craig Goodwin and Anish Jantrania, as reprinted in **Choices for Communities…,** March 2009

released into a surface stream—perhaps even into a different watershed. There would be no opportunity for the used groundwater to recharge the aquifer. Under a decentralized or cluster system, treated wastewater is re-applied to the land through drip or spray irrigation, thereby returning water to the groundwater system.

Decentralized Systems and Affordable Housing

Citizens attending the first Town Meeting for this Comprehensive Plan expressed differing views concerning affordable housing. There were some who felt that Summerfield was becoming too dominated by high end ($300,000+ cost) only homes. Others called for phasing out mobile homes and for prohibiting multi-family housing altogether. An outright prohibition of affordable housing may not be a realistic policy, given the fact that people of modest incomes (e.g. school teachers, firemen, store clerks, etc.) also need a place to live.

One of the biggest challenges to affordable housing in Summerfield, as in many popular places, is the contributing high cost of land relative to total housing costs. One solution is to provide incentives to developers to add a small amount of affordable housing to each clustered subdivision. In other words, no single zoning district would be set aside just for affordable housing; rather, existing low density zoning districts would incorporate a provision to allow a small percentage (say 15%) of the total housing units to be placed on less land per unit. Decentralized sewage treatment makes this possible.

Note: See Policy Area 6: Housing and Residential Development for additional discussion of the affordable housing issue.

Water Reuse Potential in Summerfield

Water reuse is the big topic on the horizon in wastewater and water conservation circles. The so-called “purple pipe” systems take wastewater that has been treated to an appropriate standard and reuse it for non-potable purposes. Water reuse systems require that an additional distribution network of pipes be installed parallel to the potable water system. Advanced duel water distribution systems in new building construction allow reused water to flush toilets inside the home. Since Summerfield has no plans to have a centralized wastewater collection and treatment system, it is unlikely that the town would ever have an advanced, community-wide water reuse system. At a lesser scale, however, spray application of wastewater treated in cluster or decentralized sewage treatment systems offers the potential to achieve the same purpose. As technologies continue to improve, wastewater effluent from decentralized treatment plants should gain broader acceptance and use to water lawns, golf courses, public parks, etc. In Summerfield, water reuse technologies associated with decentralized sewage treatment facilities will allow a limited resource (groundwater) to be used twice before returning to the groundwater system for yet additional use.