CHAPTER 6

REGIONAL WATER SUPPLIES

6.1 INTRODUCTION

There are a number of water systems that surround the Gillette municipal water system. Some of these surrounding systems lie within the planning district boundary (PDB). These systems generally include developments with their own water systems that lie outside of the current City of Gillette water system. At this time, there are no large municipal entities or industrial users that can be feasibly enjoined in a regional water system with Gillette. There are no other regional water systems in the area that the City of Gillette could join that are capable of meeting Gillette's water needs.

6.1.1 Campbell County Improvement District (Sleepy Hollow)

Currently the Campbell County Improvement District (hereafter referred to as "Sleepy Hollow") system is serving 420 homes with the capacity to serve 300 more. The average water use during the summer is 400,000 gallons per day and the average use in the winter is 84,000 gallons per day. During the summer, peak demand reaches 633,000 gallons per day.

The wells that supply water to Sleepy Hollow draw from the Fort Union Aquifer and water is treated with a chlorination system. Based on discussions with the systems operator, they believe their water quality is superior to the City of Gillette's and they have no interest in joining the city system at this time.

Water is supplied from five (5) wells. According to the operator, the older wells have seen declines in production. According to the operator, the latest well produces 500 gallons per minute. The well was drilled with an 8-inch casing using reverse circulation and gravel packing the casing the entire length. The 8-inch casing limits pump size and production. Records show it is capable of pumping 500 gallons per minute for three months with 300 feet of draw down. This production rate has not been confirmed for significant periods of pump time. They plan on drilling two more wells in the near future.

6.1.2 Antelope Valley

Currently the Antelope Valley system is serving 350 homes with the capacity to serve the 160 homes in the Crestview area. The average water use during the summer is 200,000 gallons per day and the average use in the winter is 70,000 gallons per day. Peak water consumption is 650,000 gallons of water per day during the summer. Antelope Valley supplies water to Crestview when they have an emergency. Six times throughout last summer they sold 100 gallons per minute to Crestview. Doing so allowed Crestview to maintain their system.

The wells that supply water to Antelope Valley draw from the Fort Union Aquifer and water is treated with a chlorination system. Based on discussions with the system operator, they believe their water quality is superior to the City of Gillette's. They claim that appliances such as water heaters have twice the lifespan as similar ones on the city system. They are under negotiations to be annexed into the city. After annexation they are hoping to be connected to the city water system but only utilizing city water during emergencies. A two year timeline is predicted to finalize annexation agreements.

Water is supplied from four (4) wells. Aquifer drawdown measurements are taken monthly. After plotting monthly measurements, the year of 2006 is the first time they have seen appreciable draw down. The 2006 measurement indicate the Fort Union Aquifer at the Antelope Valley well field dropped ten to fifteen feet. Antelope Valley doesn't have any plans of expanding its current water system.

6.1.3 Crestview

Currently the Crestview system is serving 160 homes and plans to add an additional 50 apartment units. The average water use during the summer is 130,000 gallons per day and the average use in the winter is 34,000 gallons per day. Peak water consumption is 141,000 gallons of water per day during the summer. During emergencies Crestview purchases water from Antelope Valley.

The well for the Crestview subdivision draws water from the Fort Union Aquifer. Crestview is currently treating its water with a chlorination system. Discussions with the system operator

indicate Crestview is hoping to be annexed into the city in the near future and receive city services.

Water is supplied from one well that is producing 110 gallons per minute. In the past Crestview has experienced trouble with their pumps but haven't seen any decline in production of their well.

6.2 RECOMMENDED ACTION

At some time during the 30-year planning period, Sleepy Hollow, Antelope Valley and Crestview subdivisions will likely be connected to the City's system and annexed. This section summarizes what would be required for treatment if the subdivisions of Sleepy Hollow, Antelope Valley and Crestview were connected and became a part of the City of Gillette's water supply system. All three subdivisions currently get their water from wells in the Fort Union formation. Currently, these subdivisions use a combined total of 730,000 gallons per day during Summer Average, and 1,424,000 gallons per day during Summer Peak. Table 6.1 shows the current water use for these existing subdivisions.

TABLE 6.1
Flow Data

Subdivision Name	Summer Average gpd	Summer Peak gpd	Summer Peak gpm
Sleepy Hollow	400,000	633,000	439
Antelope Valley	200,000	650,000	451
Crestview	130,000	141,000	98
Total	**730,000**	**1,424,000**	**988**

The recommended action for serving these subdivisions consists of two parts 1) replacing and upgrading infrastructure within and between the subdivisions such that they can operate as a combined system away from the Gillette system for the time being, and 2) eventually connect them to the City of Gillette water system when development has spread to a point that makes this connection economically sensible.

Phase 1 improvements will include a new 1 million gallon storage tank in Antelope Valley near the existing Antelope Valley tanks, a raw water line and booster station to provide water from the Sleepy Hollow wells to the Antelope Valley reservoir site, an onsite gas removal and chlorination facility located at the Antelope Valley reservoir site, a finished water line to Sleepy Hollow from Antelope Valley, and a finished water line from Antelope Valley to Crestview with pressure reducing equipment. These improvements will allow all of the water to be pumped to a central site where it will be blended, stored, and treated before being redistributed. This setup minimizes risk as multiple wells can now be used to combine as a common supply. This mitigates the problems associated with a well being out of service. The general layout of these improvements is shown in Figure 6-1.

Phase 2 improvements will include a connection to the existing City of Gillette system. The exact nature of this connection will vary depending on when it can be made and the configuration of the surrounding infrastructure at that time. In order to minimize the short-term improvements needs of the Gillette system, this connection should not be made until after the long-term water supply is built and commissioned. The unknowns of the future system geometry and build-out at the time of connection makes this phase difficult to provide cost estimates for. It will need to be accomplished regardless of the long-term alternative chosen, so a cost estimate is not included herewith.

All of the subdivisions have existing wells that draw from the Fort Union Aquifer and they report that the quality of the water supplied by their existing 10 wells is superior. Additional water quality reports are not available from these specific wells, however the 2004 City of Gillette – Water Master Plan indicates that the Fort Union Aquifer is classified as very soft and dissolved solids of 473 mg/L, below the EPA maximum of 500 mg/L. In addition, water from the Fort Union Aquifer typically contains dissolved methane and hydrogen sulfide gases.

6.2.1 Treatment

The treatment facility would be located near the new proposed Antelope Valley reservoir site.

The anticipated treatment method for the water would be a gas chlorination system and iron oxidation/dissolved gas removal system with a forced or induced draft PVC air stripping tower.

Figure 6-1

Chlorine gas was analyzed and the disinfectant of choice in this study, although other disinfection systems are available, such as sodium hypochlorite.

The water from the subdivisions is currently classified as groundwater. Current regulations do not require that groundwater systems provide 4-log (99.99%) virus inactivation/removal, however, it is recommended 4-log virus inactivation/removal be provided for additional public safety. The EPA published the Ground Water Rule on November 8, 2006 (*Federal Register*, Vol. 71, No. 216) and public water systems must comply with the regulatory requirements by December 1, 2009. The Ground Water Rule will require "triggered monitoring" for groundwater system that do not provide 4-log (99.99%) virus inactivation, unless the State makes an exception. Therefore, the chlorination system will be designed to provide 4-log (99.99%) removal/inactivation of viruses.

City data shows the Fort Union water has a temperature of between 16 and 18° C and a pH of between 7.4 and 7.8. For a pH between 6.0- 9.0, the required CT value for 4-log inactivation of viruses by free chlorine at 16° C would be 3.8 mg-min/L; at 18° C it would be 3.4 mg-min/L. Assuming the worst-case scenario which is the coldest water temperature of 16° C, the CT required is 3.8 mg-min/L. These values are from EPA's Table E-7 in Appendix E of the SWTR title "Inactivations Achieved by Various Disinfectants."

Typically, the chlorine residual used by municipalities is in the range of 0.8 mg/L to 1.5 mg/L. Assuming a chlorine residual of 0.8 mg/L, a worst-case detention time of 4.75 minutes is required prior to the first user. As long as the first user is located far enough away to provide adequate detention time to meet CT, no other arrangements would be needed. For the purposes of this report, it was assumed the detention time could be met in the piping configuration leaving the pump station.

The iron oxidation/dissolved gas removal unit will be sized based on the maximum peak volume and to effectively remove methane and other undesirable gases.

6.2.2 Pump Station – Phase 1

The new pump station would be used to raise the water from the hydraulic grade line (HGL) in Sleepy Hollow to the HGL in Antelope Valley. The pump station will be sized based on the maximum current peak flow rate available from Sleepy Hollow. The pump station will need to have a wet well with internal baffling for the pumps to work properly that is at least 20' in depth. The pump station should incorporate the safety features and devices required by the use of a chlorination system.

6.2.3 Chlorination Room – Phase 1

The chlorination room is shown in Figure 6-2. The chlorination room was assumed to be a separate room with a window designed per the 2003 IFC (3704.2.2.7, Treatment Systems) requirements, although code requirements should be verified with the local fire official before final design. The 2003 IFC requirements call for chlorine storage and use rooms to have a scrubber unless the following requirements are met: a) gas detection system with a sensing interval not exceeding 5 minutes; b) an approved automatic-closing fail safe valve located immediately adjacent to the existing chlorine cylinder valves.

The chlorination process for the Fort Union Wells will withdraw chlorine gas from one cylinder (one ton capacity) with a second cylinder (one ton capacity) on standby. The chlorination process will be controlled using an automated V Notch Chlorinator and associated equipment. The estimated chlorine demand will be between 7.0 and 8.0 mg/L. Chlorine demand was estimated using the demand at existing Pump Station #1, which also utilizes the Fort Union Aquifer. In addition to the chlorine treatment, fluoride concentrations will also be tracked.

6.2.4 Iron Oxidation/Dissolved Gas Removal – Phase 1

The iron oxidation and dissolved gas removal process will utilize two 8.5' square, 10' tall air stripping tower (aeration) units. Dissolved gas removal will be achieved through the use of three aeration units. Each aeration unit is rated at 1,750 gpm for a total capacity of 3,500 gpm and firm capacity of 1,750 gpm. Removal efficiencies of the aerators are dependent upon the nozzle size and the flow rate through the aeration unit. Optimal gas removal efficiencies are

Figure 6-2

achieved at the rated flow of the aeration units. During low water demands, flow rates through the treatment area may drop as low as 150 gpm. During low water demands, the treatment should be run with only one aeration unit operating to maximize gas removal efficiencies. The recommended iron oxidation media is 1" PVC piping that is easily removed for cleaning and maintenance.

6.2.5 Pump Configuration – Phase 1

The pump station will be sized to supply a peak flow of 1,100 gallons per minute to match Sleepy Hollow's current well capacity. To satisfy this demand, it is estimated that 4 – 30 hp vertical turbine pumps will need to be installed in parallel to provide firm capacity. Room for a fifth 367 gpm pump should be reserved in the pump station in the event Sleepy Hollow goes forward with their plans to drill another well. The proposed pumping configuration should be able to supply approximately 1,100 gpm at approximately 190' TDH.

The ultimate size and number of pumps will need to be verified when the location of the pump station is determined and when service requirements for each subdivision is finalized.

6.2.6 System Storage – Phase 1

The current storage in the Sleepy Hollow, Antelope Valley, and Crestview subdivisions are shown in Table 6-2.

TABLE 6-2
Current Storage Capacity

Reservoir Name	Storage Capacity, MG
CCCI & SD No. 1	0.350
CCCI & SD No. 2	0.190
Antelope Valley No. 1	0.210
Antelope Valley No. 2	0.096
Antelope Valley No. 3	0.630
Crestview No. 1	1.000
Total Capacity	**2.476**

The proposed storage after Phase 1 is complete is shown in Table 6-3.

TABLE 6-3
Proposed Storage Capacity

Reservoir Name	Storage Capacity, MG
CCCI & SD No. 1	0.350
CCCI & SD No. 2	0.190
Antelope Valley No. 4	1.000
Crestview No. 1	1.000
Total Capacity	**2.540**

Wyoming Department of Environmental Quality (WYDEQ) requires storage of 25% of the maximum daily demand for systems with an average daily demand of 500,000 gpd or more. The maximum daily demand for this area is 1.4 MGD. The required 25% storage is 350,000 gallons. All three subdivisions are residential with a legislated fire flow of 1,500 gpm for 3 hours, or 270,000 gallons. The cumulative storage available in the three subdivisions after the completion of Phase 1 is 2.54 MG which is in excess of the required storage of 620,000 gallons.

6.2.7 Interconnecting Piping – Phase 1

Phase 1 will require raw water piping from Sleepy Hollow to Antelope Valley and finished water piping from Antelope Valley to Sleepy Hollow. Without exact elevations, demands, and connection points it is difficult to precisely size this line. For estimating purposes, 25,000 lf of new 12" PVC line was assumed to Sleepy Hollow with a pressure reducing station estimated for the connection to Sleepy Hollow. Since Antelope Valley periodically sells water to Crestview already, it is assumed sufficient connecting infrastructure between these two communities is sufficient.

6.2.8 System Connection – Phase 2

It is anticipated that growth in Gillette will drive development south and east from the existing edge of development toward this area. At some point, connection to the primary City of Gillette water system will become economically feasible. At this point, the City of Gillette's primary source will also become the primary source for these subdivisions. Due to the unknown exact water chemistry in this well water, and the operational challenges of operating two independent systems long-term, the uncertainty surrounding the sustainable production rates form these wells and the Fort Union aquifer in general, the flow from these wells has not been included in the long-term source supply for Gillette. The possibility of some hybrid of these systems does exist, but is difficult to speculate upon at this point in time. Cost of service, then-current regulatory issues, and public and political input should all be considered in this decision.

6.3 COST ESTIMATE

A preliminary cost estimate has been prepared for Phase 1 improvements. Phase 2 improvements have not been estimated as the majority of the infrastructure needed to complete the Phase 2 tie-in will likely be driven by other development in the area. The pipe needed to make the Phase 2 connection will be predominantly driven by the development and should be financed and planned for from that standpoint. The pipe infrastructure installed in Phase 1 should make the cost of tying into any supply line extended down Wyoming State Highway 59 minimal.

A detailed and itemized cost estimate for Phase 1 can be found in Appendix A.

The total capital costs for Phase 1 improvements is: $10.7 Million