SECTION 3

3 Service Requirements

In order to provide water service to all the potential participants identified in this study, additional delivery pipelines will be required to connect each of the ISDs to the regional system. As noted earlier, these connections will be facilitated by the use of shared service line extensions or in some instances by direct connections to the Regional System infrastructure. For each potential participant, a series of service requirements have been defined to assist in sizing of the infrastructure needed, including: type of service, class of service, delivery requirements, delivery point, and infrastructure needs. The following sections describe these service requirement definitions.

3.1 Types of Service

Service connection provisions have been assumed to eventually be needed for all the potential participants identified for the Regional System, with allowances for some connections to be delayed for a number of years. There will be two types of service connections:

- Type 1 – Service connections to the Madison pipelines, receiving only Madison well field water.
- Type 2 – Service connections to the Gillette water distribution system, receiving only blended water.

Type 1 service connections will be limited to those participants located near the route of the Madison pipelines, either the existing or new pipeline. The service connections along the Madison pipelines could be provided at the pipeline crossovers (as shown in Figure 2) or at other locations along the pipelines (as shown in Figure 3). As the figures indicate, the service connections would be provided from a service line connected to both Madison pipelines, allowing use of either Madison pipeline to supply water to several potential participants. A master meter station would be provided at each service line extension to the individual participants, allowing multiple participants to connect to the same service line. This approach will limit the number of service taps on the Madison pipeline and reduce the risk of potential pipeline failure problems.

Type 1 service connections located downstream of the control station (parallel Madison pipelines divergence) will also need to use service lines where possible. However, since the new Madison parallel pipeline will need to serve several potential participants, the service lines

need to connect to both sides of the pipeline isolation valve, as shown in Figure 4. This will allow shutdown of a segment of the new Madison pipeline without shutting off service to the customers. With this approach, when the pipeline segment shutdown is upstream of the pipeline isolation valve, the water supply for the service line will be supplied from the downstream storage tanks in the City.

Type 2 service connections include those participants not located near the Madison pipelines. As a result, these participants are served by connecting to the City of Gillette water distribution system. The service connections would be extensions from the existing water distribution grid, requiring connection to a major water distribution pipeline to assure adequate capacity. For example, the 24" pipeline being added to connect the existing north and south blending point tanks in the Gillette water distribution system would provide an acceptable connection point for extending service to the southwest and west side of Gillette (See "Overall System Map"). Type 2 service extensions elsewhere would need to be connected to other large distribution system pipelines.

All Type 1 and Type 2 service connections would be provided with master meters to record the amount of water sold to each participant. For those Type 2 service connections without water storage, the rate of water supply will not be controlled and will function based on the HGL provided by the water distribution system and the associated demand of the participants. Type 1 and 2 service connections with storage will need to be controlled to avoid overfilling their tanks and avoid spikes in water demand that would negatively impact Gillette water system operation.

3.2 Classes of Service

For those potential participants within the defined service area of the Regional System and interested in being serviced by the system, there will be several options for class of service provided. The classes of service were developed in conjunction with the JPA process to establish expectations and understanding of the type of service to be received by each of the potential participants and the design requirements for the corresponding connecting waterlines. The potential classes of service identified are as follows:

- Class A – No water service provided by the Regional System.
- Class B – Shared water service with water sold from the participant's water supply to the regional system, with the capability for providing full water service without fire protection from the regional system.

- Class C – Emergency water interconnect only, with water supplied when participant's water supply fails. This is a short-term supply, used only until the system failure is repaired.
- Class D – Supplemental water connection, with water supplied to supplement participant's existing water supply either on a seasonal basis for peaking or a base load basis.
- Class E – Full service water connection without fire protection, with water supplied to replace participant's existing supply.
- Class F – Full service water connection with fire protection, with water supplied to replace participant's existing supply including fire flows.
- Class G – Integration into the Gillette water system, operating as part of their water distribution system.

One or more classes of water service have been assigned to each potential Regional System participant. By assigning the class of service, a general level of water supply is established for each participant that can be used to determine water infrastructure requirements, design basis, and cost estimating. It is recognized other configurations of connections may be viable to provide different levels of service and can be developed to do so as the waterline projects move through the final design process. In addition, an interim and future class of service is assigned to each participant. It is assumed that the interim class of service will be provided immediately after the service connection is installed and activated. The future class of service would be provided after the participant's water supplies fail. These supplies are usually wells which are not expected to be re-drilled, so water will ultimately be provided solely by the Regional System.

The class of service was assigned to the potential participants depending on the needs of each participant and the service available from the Regional System at the participant's connection. A description and list of constraints for each class of service are described below.

3.2.1 Class A – No Service

No Service, Class A, is the default service class for non-participants. Those systems identified with Class A will not receive water service from the Regional System. Some potential participants will have an interim Class A level of service, but will have a higher class of service in the future due to the location of the potential participant or its status of development. Those participants identified as interim Class A which are located along pipeline extensions that serve

participants further downstream may have a tap and blind flange installed at a defined location, if their level of participation changes at some point in the future.

3.2.2 Class B – Shared Service

Shared Service, Class B, is a special class which allows for participants to sell water to the Regional System, but also receive full water service (not including fire flow) at times when the participant's water supplies are either shutdown for maintenance or during emergency conditions. The Class B participants would be paid for water, of approved quality, delivered to the regional system. Water delivered by the participants to the Regional System must meet all existing and future Safe Drinking Water Act (SDWA) requirements for disinfection and any other pertinent requirements (i.e. fluoride levels, lead and copper, etc.). Many of the identified Class B participant's water supplies are drilled into the same aquifers as the City of Gillette in-town wells and are therefore of similar water quality. Additional well capacity above the participant's demands can be delivered to the Regional System. Additional pumping may be required to deliver water into the Regional System at adequate pressures, but needs to be determined on a case by case basis. No fire flow demands will be provided by the Regional System in this class. Fire protection would normally be provided by local participant's water storage tank(s). Adequate local storage volume for fire protection is the responsibility of each participant. When necessary, the regional system will only be responsible to refill the tank at a controlled rate over time after fire flow usage. For this class of service, the regional system benefits from the existing water supplies for each participant by the use of excess supply available by the regional system. Therefore, the participant's wells would likely be re-drilled after their service life is completed to maintain them as a permanent source for the Regional System. Waterlines will be in service year-round but will have the ability to be temporarily taken out of service and drained if required for maintenance or other reasons. A master meter would be installed on both the outgoing supply and incoming demand connections for the participant.

3.2.3 Class C – Emergency Interconnect

Emergency Interconnect, Class C, is the lowest level of limited service to be provided. The purpose of this class of service is to provide water only during emergency conditions. These situations may include failure of the participant's water supply (wells) and infrastructure (pump station, tank), prolonged local power failure, or use during scheduled maintenance of local infrastructure. The water supplied from the regional system is considered very intermittent and limited to only domestic water use (no irrigation, farm-use or fire flow) until the emergency has

been resolved. The participant would have to contact the Regional System authorities to initiate service during an emergency. The pipelines would be kept empty to protect against poor water quality related to water age in the connection line. After the emergency has ended, the pipelines would be drained using blow-offs along the pipeline. A master meter would be provided to measure the amount of water used by the participant during the emergency condition.

3.2.4 Class D – Supplemental Water

Supplemental Water, Class D, is the next level of limited service to be provided. The purpose of this class of service is to provide water to supplement water service during peak demand periods and emergencies conditions. Expected usage would be during the summer months when demands are higher and the participant water supply can not provide the entire local demand. The water supplied from the regional system is considered intermittent and depends on the level of participant demands. Only the water demand not met by local supply would be provided by the Regional System. Supplemental Water service has the possibility of being turned on in the spring and shutoff in the fall based on water use throughout the year, as winter water demands may not be sufficient to maintain adequate water quality in the service extension pipelines. Therefore, pipelines could be kept empty in the wintertime to prevent water quality problems in the connection line. The pipelines could be drained in the fall using blowoffs along the pipeline. A master meter would be provided to measure the amount of supplemental water used by the participant.

3.2.5 Class E – Full Water Service without Fire Flow

Full Water Service without Fire Flow, Class E, is the first level of full service. The purpose of this class of service is to provide all normal water demands to the participant including peak demands. However, no fire flow demands will be provided in this class. Fire protection may be provided by local participant storage. Adequate local storage volume for fire protection is the responsibility of each participant. The regional system will only be responsible to refill the tank at a controlled rate over time after fire flow usage. For this class of service, the regional system is assumed to replace the existing water supplies for each participant, either initially or in the future. The participant may have their own local well(s) but they likely would not be re-drilled after their service life has expired. For planning purposes, the regional system will provide all water use for this class of service except for fire flow. Waterlines will be in service year-round. A master meter would be provided to measure the amount of water used by the participant.

3.2.6 Class F – Full Water Service with Fire Flow

Full Water Service with Fire Flow, Class F, is the complete level of full service. The purpose of this class of service is to provide all normal water demands to the participant including peak demands plus fire flow. Fire flow demands provided by this class of service will be at the anticipated flow for the type of buildings within the area being served. Although, water could be delivered to a participant storage tank, the primary source for fire protection will be from the regional system. If storage is provided, fire flow will be delivered to the tank to maintain the tank level. For this class of service, the regional system is assumed to replace the existing water supplies for each participant. The participant may have their own local well(s) but they likely would not be re-drilled after their service life has expired. For planning purposes, the regional system will provide all water use including fire flow. Waterlines will be in service year-round. A master meter would be provided to measure the amount of water, including fire flow, used by the participant.

3.2.7 Class G – Direct Connection

Direct Connection, Class G, is a total integration into the Regional System, specifically City of Gillette's water distribution system. The Class G participants will become consecutive systems to Gillette's water system. The purpose of this class of service is to provide all normal water demands to the participant including peak demands plus fire flow, similar to an existing City of Gillette system customer. However, the participants may or may not have fire protection depending on the needs of the system and the presence of local fire hydrants and water mains sized for fire flows. The difference between Class F and Class G is that Class G will consist of either participants within Gillette city limits or areas that are very close and will be annexed into the City of Gillette. The connection from the regional system will tie directly into the participant's local distribution system without a master meter. Since there will be no master meter for the direct connection participants, individual service meters will need to be installed at each tap to meter the users the same way an existing City of Gillette system customer would be metered. If possible, local storage will float on the regional system to provide local emergency and fire flow storage. However, if tank is lower than the HGL of the regional system, the existing storage tanks may be taken out of service for the Class G participants. In addition, any local water supplies or pump stations have the possibility of being taken offline and isolated from the system to establish the complete integration of the participant into the regional system.

TABLE 2
POTENTIAL PARTICIPANT CLASSES OF SERVICE

Potential Participant	Interim Class	Future Class
American Road Water and Sewer District	D	E
Antelope Mobile Home Park	C	G
Antelope Valley	B	B
Antelope Valley Business Park Improvement & Service District	D	F
Bennor Subdivision	D	E
Buckskin Meadows Subdivision	D	E
Campbell County Airport	D	E
Cedar Hills Water Association	D	F
Central Campbell County Improvement & Service District	B	B
Cook Road Water District	D	F
Countryside Water Users, Inc.	D	E
Crestview Estates Subdivision	B	B
Eight Mile Subdivision	D	E
Force Road Joint Powers Board	D	E
Fox Park Subdivision	C	G
Fox Ridge	A	E
Freedom Hills Subdivision	D	E
Glory Hole Homeowners Association	A	E
Green Valley Estates Improvement & Service District	A	E
Heritage Village Water and Sewer District	C	G
Hitching Post Trailer Court	D	E
Hoy Mobile Home Park	D	E
Interstate Industrial Park	C	G
Lakeview Mobile Home Park	D	E
Lemaster Enterprises	C	G
Meadow Springs Improvement & Service District	D	E
Means Water and Sewer District	D	E
Mohan Subdivision	G	G
Nickelson Farms Water Company	D	E
Overbrook Subdivision	D	E
Peoples Improvement & Service District	C	G
Rafter D Homeowners Association	D	E
RAG Coal West Inc./Rawhide School	A	E
Ridgeway Community Well Association	A	E

TABLE 2 (CONTINUED)
POTENTIAL PARTICIPANT CLASSES OF SERVICE

Potential Participant	Interim Class	Future Class
Rodeo Flats Water Distribution	D	E
Rozet	E	E
Rozet Ranchettes	D	E
Section 4 Water System, Inc.	D	E
South Fork Estates	D	E
Southside Well Improvement & Service District	C	G
Stone Gate Estates	D	E
Stroup Trailer Court	C	G
Ward Creek Landowners Association	D	F
Wessex Improvement & Service District	D	E
Westridge Water Users Association	C	G
Wrangler Estates	D	E

3.3 Delivery Requirements

Water delivery requirements, including capacity and pressure, have been defined for each potential participant. A range of delivery flows required (average day and peak day average demand) for long-term participant needs has been developed. The delivery flows assume that the participant's local supply is out of service and the Regional System needs to provide all water use for the assigned service class. Required delivery pressures have been established to ensure adequate pressure to deliver water to the participant's water storage tank(s) in a maximum day scenario for the regional system. All participants, other than Class G participants, are responsible for delivering water to their customers including fire flow (except Class F) at an adequate pressure from their storage tank(s) by either by gravity or pumping.

The regional customers' buildout average and maximum day demands were established based on population projections and system inventories from the Master Plan. Buildout demands were based on the existing average and maximum day demands plus the equivalent demand of any planned taps. Some of the average day and maximum day demands had to be estimated since all the inventory forms were not returned. The average day, maximum day and peak hour water demands for the regional customers presented in Table 3 were established to hydraulically analyze the water delivery system, with the maximum water supply required from the Madison parallel pipelines. A peaking factor of 1.6 was used to establish peak hour demands from

maximum day demands. The resulting pressures from the model are considered the delivery pressures available at the delivery point (usually at the inlet of the participant's tank).

TABLE 3
POTENTIAL PARTICIPANT BUILDOUT DEMAND

Potential Participant	Average Day (gpd)	Maximum Day (gpd)	Maximum Day (gpm)	Peak Hour (gpm)
American Road Water and Sewer District	29,340	58,200	40	64
Antelope Mobile Home Park	45,000	51,400	36	58
Antelope Valley	122,230	624,380	434	694
Antelope Valley Business Park Improvement & Service District	5,160	10,810	8	13
Bennor Subdivision	12,110	48,390	34	54
Buckskin Meadows Subdivision	5,750	13,800	10	16
Campbell County Airport	5,720	15,900	11	18
Cedar Hills Water Association	33,170	96,710	67	107
Central Campbell County Improvement & Service District	105,090	138,970	97	155
Cook Road Water District	50,190	145,200	101	162
Countryside Water Users, Inc.	32,280	76,420	53	85
Crestview Estates Subdivision	60,140	140,420	98	157
Eight Mile Subdivision	12,640	23,190	16	26
Force Road Joint Powers Board	24,670	59,200	41	66
Fox Park Subdivision	95,890	192,910	134	214
Fox Ridge	21,875	52,500	36	58
Freedom Hills Subdivision	81,490	136,710	95	152
Glory Hole Homeowners Association	8,750	21,100	15	24
Green Valley Estates Improvement & Service District	27,070	73,910	51	82
Heritage Village Water and Sewer District	86,267	292,000	203	324
Hitching Post Trailer Court	30,000	72,000	50	80
Hoy Mobile Home Park	15,630	19,260	13	21
Interstate Industrial Park	10,680	15,677	11	18
Lakeview Mobile Home Park	3,380	4,871	4	7
Lemaster Enterprises	7,710	18,500	13	21
Meadow Springs Improvement & Service District	4,250	13,130	9	14
Means Water and Sewer District	83,320	139,100	97	155
Mohan Subdivision	271,670	652,000	453	725
Nickelson Farms Water Company	52,050	143,420	100	160

TABLE 3 (CONTINUED)
POTENTIAL PARTICIPANT BUILDOUT DEMAND

Potential Participant	Average Day (gpd)	Maximum Day (gpd)	Maximum Day (gpm)	Peak Hour (gpm)
Overbrook Subdivision	10,990	13,880	10	16
Peoples Improvement & Service District	25,290	64,000	45	72
Rafter D Homeowners Association	8,450	24,750	17	27
RAG Coal West Inc./Rawhide School	1,880	4,500	3	5
Ridgeway Community Well Association	6,040	14,500	10	16
Rodeo Flats Water Distribution	3,300	11,610	8	13
Rozet	64,800	155,500	108	173
Rozet Ranchettes	28,380	68,100	47	75
Section 4 Water System, Inc.	6,360	7,710	6	10
South Fork Estates	17,220	41,328	29	46
Southside Well Improvement & Service District	5,480	41,280	29	46
Stone Gate Estates	39,610	103,100	72	115
Stroup Trailer Court	22,800	54,700	38	61
Ward Creek Landowners Association	12,500	30,000	21	34
Wessex Improvement & Service District	2,740	8,000	6	10
Westridge Water Users Association	30,130	72,300	50	80
Wrangler Estates	49,960	155,000	108	173

3.4 Delivery Point

A delivery point to receive water from the Regional System has been defined for all potential participants. The delivery points are usually at a water storage tank, but in some cases the delivery point is a direct connection into the participant's private distribution system. Most of the delivery points currently exist, however there are a few potential participants where a water storage tank addition is recommended. The estimated available water pressures at the delivery points have been calculated using a hydraulic model developed for the Regional System. If the delivery pressure at the delivery point was below that needed to provide adequate service pressure of 35 psi or to fill the storage tank to the top than a booster pumps station is required.

The general service plan developed to provide service to the potential participants includes a delivery line to fill the participant's tank using an altitude valve. The tank will be kept full either using the local water supply (wells) or Regional System connection depending on the class of

service defined. For Classes B, C and D service, the primary water source will be the local water supply with a full tank level set point and the secondary source will be at a lower tank level set point. If the local water supply can not meet demand, the tank level will fall below the lower set point and a valve at the connection to the Regional System will open and supply the additional water. For Classes E, F, and G, the primary water source will be the Regional System with a full tank level set point.

Provisions may need to be constructed to provide direct service to the potential participants' distribution systems when their storage tanks or pump stations are taken offline for maintenance or are down for repair. This will allow uninterrupted service to the users during periods when the local facilities are offline. These provisions would only be available with additional piping and valving not included in the connection costs in this study. Piping to bypass tanks and pump stations with pressure reducing valves (PRVs) to the participants' local distribution system would be necessary. Only those participants whose service pressure (after any pumping) is lower than the estimated pressure at the delivery would be able to bypass any participant tanks or pump stations for emergency service.

Water delivered to the Type 1 Regional System participants from the Madison pipelines needs to be delivered to a water storage tank. The storage tank will provide the necessary equalization volume needed to meet fluctuating water demands by users (ie. peak hour demand, fire flow) and smoothing out the peak demand periods for the Madison pipelines. Due to the difficulty in adjusting flow rates in the lengthy Madison pipeline, the city will need to control the rate of delivery to the participants (and the rate of pumping back into the pipeline for Class B service), otherwise the hydraulic grade line for the pipeline may fluctuate too rapidly making operation of the system difficult. For Type 2 regional system participants the need for a tank is not essential, but simplifies water delivery and helps minimize the impact of peak demands on the Regional System. Therefore, delivery to a water storage tank will be the standard for each delivery point.

Near the connection to the participant's water system, a master meter will be provided to record flow to the individual participant. The master meter will in most cases include a backflow prevention device, except for Class B and G service, which allow feeding back into the regional water distribution system. After the master meter, the water is the responsibility of the participant both in maintaining water within current drinking water quality standards and in managing water usage.

3.5 Infrastructure Needs

A number of both regional and local improvements are necessary to provide water service to the potential participants. These improvements include waterlines, valves, storage tanks, pump stations, and water quality facilities. The following sections describe these improvements in general and how the regional system potential participant connections were developed. Appendix A contains representative details of these improvements, mostly taken from Denver Water's standards, which were used as a basis of cost estimating.

3.5.1 Waterlines

The typical waterline material assumed to be used in the Regional System is PVC ANSI/AWWA C900 for diameters 12-inches and smaller and ANSI/AWWA C905 for diameters 14-inches and larger, Dimension Ratio (DR) 18. In some areas DR 14 may be required due to high operating pressures. The waterlines were assumed to utilize ductile iron fittings. The waterlines were sized using the sizing standards according to Wyoming Department of Environmental Quality (WDEQ) Chapter 12. The WDEQ waterline sizing standards are:

1. The minimum size of a waterline for providing fire protection and serving fire hydrants shall be 8 inches.
2. The minimum size of a waterline for providing demand without fire protection shall be 6 inches.
3. Any mains smaller than 6 inches shall be justified by hydraulic analysis and future water use projections.

The following concepts were used to size the waterline for the potential participant connections in accordance with WDEQ standards:

1. All new waterline sizes for connections to the potential participants have been sized using estimated future maximum day demands and fire flow (if Class F or G service).
2. Waterline sizes were selected for the participant connections by utilizing a hydraulic model developed for the Regional System.
3. Sizes were selected by balancing between water demand, water age concerns, and relative cost.
4. Slightly larger waterline sizes than needed were sometimes selected to account for future extensions and potential participants outside the current list to accommodate

unanticipated future development. Unanticipated development could occur due to the future presence of regional waterlines or other factors such as regional energy or mining-related activities.

5. A minimum of 8-inch waterlines were used for main systems that connect to multiple participants.
6. For most single participant connections to existing participant tanks, 6-inch waterlines were used unless fire demands were to be provided.
7. All waterlines were designed with velocity criteria of less than 5 fps during peak hour maximum day demands.

The number of taps on the Madison Parallel pipelines was minimized to decrease potential maintenance and operation issues associated with the pipe connections. A general approach was taken to maintain a minimum of one mile between Madison Parallel pipeline taps to help limit the number of connections. The exception to this approach is Ward Creek Line 1, which has a tap downstream of Donkey Creek Pump Station at Rozet Ranchettes to allow use of pressure gained from pump station to provide pressure for Ward Creek and Rozet service.

Special construction, including pipeline bores and encasement, are shown in the service extension mapbooks and accounted are for in the waterline cost estimating. Pipeline crossings will be bored with casing pipe under paved roads and highways, but open cut construction will be used through unpaved roads. In addition, bores will be constructed under major utility conduits (gas lines), major streams and rivers. Pipelines will be encased under minor streams, tributaries, drainage channels, and irrigation ditches. Waterlines will be open cut, using lowered sections under minor utility conduits (waterlines, sewer mains, and telephone and communication lines).

Permanent blowoffs and isolation valves will be installed every half mile along pipelines to assist in emptying the waterlines in the wintertime or for maintenance. Combination air/vacuum valves were placed every mile after the corresponding blowoff and isolation valve locations. Actual combination air/vacuum valve placement may differ depending on topographic high points.

Some of the potential participants already provide fire protection to their users. However, not all of them will have fire flow service from the Regional System and will have to supply fire protection from local storage. Others which are classified as potential participants with fire flow service from the Regional System may not have existing fire hydrants in their distribution system

and would need to construct them and strengthen their water distribution system if they wished to provide fire protection to their users.

3.5.2 Isolation Valves

Isolation valves will be provided every half mile along the potential participant connection waterlines. In addition, isolation valves will be provided at the Madison Pipelines or distribution system taps and in the meter vaults. All isolation valves will be ANSI/AWWA C509 resilient-seated gate valves for diameters 12-inch and smaller and ANSI/AWWA C504 rubber-seated butterfly valves for diameters 14-inch and larger. All buried valves will have a marker post installed to assist in locating them from the surface.

Pressure reducing valves (PRV) may be needed if pressures exceed 200 psi. However, PRVs are not planned where higher pressures are required in some locations in the system to feed higher elevations. One location where a master PRV station with a 4-inch PRV is necessary is on Airport Line 1 at Station 121+00 where pressures exceed 180 psi. All potential participants on Airport Line are down gradient of the PRV station. Additional PRVs may be necessary on main connection to the direct connection systems depending on the local Gillette distribution system pressure. Standard PRV stations will be built where necessary with a properly sized valve.

Altitude valves will be used to supply water to the water storage tanks which will keep them from overflowing when the system pressure is higher. In most cases, a one-way altitude valve will be set to feed the tank at primary or secondary level set points, depending on the defined class of service. Two-way altitude valves may be used to fill Class B and G participant tanks that are allowed to back feed into the system. The standard PRV station detail was assumed replacing the PRV with an altitude valve.

Master meters will be required for all potential participants except those with Class G service. Table 4 presents the standard water meter sizes based on connection size. AWWA M22, "Sizing Water Service Lines and Meters" was used to approximate flow per connection size and select the corresponding meter size. The costs for the meters were based on commercial/industrial turbine-type Sensus Omni C^2 Meters (6-inches and smaller) and W-3500 DR Turbo Meter (8-inches) with radioread Automatic Meter Reading (AMR) transceiver units to allow for simple collection of usage.

Provisions for continuous monitoring for flow, pressure and chlorine residual should be provided at the master meter location to benefit the operation activities of the Regional System. In

addition to the flow meter, a flow control valve, remote telemetry unit (RTU) and pressure gages should be provided inside the master meter vault. A standardized master meter vault with these capabilities should be developed and used through the regional water system to ease operations and maintenance.

TABLE 4
METER SIZES BASED ON CONNECTION SIZE

Connection Size	Meter Size
4-inch	3-inch
6-inch	4-inch
8-inch	6-inch
12-inch	8-inch

Master meters are not necessary for Class G service, since they are direct connections. Instead individual water meters will be necessary at each customer for Class G participants. The individual water meters would need to be read and maintained by the City. Of the identified direct connection potential participants, Fox Park Subdivision, Peoples Improvement Service District, Westridge Water Users Association, and Heritage Village Water and Sewer District all have individual meters. Antelope Mobile Home Park, Interstate Industrial Park, Lemaster Enterprises, Inc., Southside Well Improvement & Service District, and Stroup Trailer Court will need individual meters installed on their service lines.

3.5.3 Water Storage Tanks

New water storage tanks are required at all delivery points for a few potential participants. Steel water tanks in accordance with AWWA D100 and WDEQ Water Quality Rules and Regulations Chapter 12 (Chapter 12) were assumed. The capacity for these new tanks is based on estimated domestic demands and fire protection storage. Water systems serving less than 50,000 gpd on average daily demand must provide clearwell and system storage capacity equal to average daily demand. Water systems serving from 50,000 to 500,000 gallons on average daily demand must provide clearwell and system storage capacity equal to the average daily demand plus fire storage. New water storage tank volumes in the regional system have been estimated based on projected future demands and fire flow volumes, using the WDEQ criteria.

3.5.4 Water Storage Requirements

Any new water storage tanks should meet the following general requirements:

- Operating storage must allow changes in pumping rates without dramatic changes in water storage tank water levels.
- Emergency storage must maintain water supply to customers in the event of short-term loss of operation from elements of the Regional System.
- Ability to allow system operation without storage tank to allow for removal of any tank from service for maintenance (i.e. cleaning and/or painting) either through tank redundancy or distribution system piping.
- System hydraulics stabilization to provide a stable HGL for the pipeline system to maintain consistent operating pressures.

3.5.5 Water Pump Stations

Six regional system pump stations, in addition to the future Madison Well Field and Donkey Creek Pump Stations associated with the new parallel Madison pipeline (not included in this study), are required to provide adequate pressure to some of the potential participants. There are two types of regional pump stations included in the Study, regional pump stations that serve several potential participants and individual pump stations that service only one potential participant. The Regional System participant systems that require a new tank at the delivery point may need individual package pump stations to provide pressure to the water distribution system if the new storage tank can't be located at an elevation that provides adequate pressures by gravity. The Regional System will be responsible for operating and maintaining the regional system pump stations. However, the participants will still be responsible for operating and maintaining their individual pump stations.

The pump stations were preliminarily sized at approximately 1.25 times peak day average day demands. All pump stations are assumed to have three pumps, one jockey pump for nighttime and low flows and two alternating primary pumps for daytime flows. Estimated primary pump operating points for the five regional system pump stations are found in Table 5.

TABLE 5
REGIONAL SYSTEM PUMP STATIONS
ESTIMATED PRIMARY OPERATING POINTS

Pump Station Name	Pump Station Type	Firm Capacity (gpm)	Suction Pressure (feet)	Discharge Head (feet)	Break Horsepower[1] (bhp)
West Gillette	Regional	1,500	75	350	177
Fox Ridge	Individual	150	125	180	9
Peoples	Individual	100	50	150	5
East Gillette	Regional	250	50	120	10
Buckskin Meadows	Individual	50	15	180	3
Antelope Valley	Individual	500	50	100	17

[1]Pump efficiency is assumed to be 75% for planning purposes.

3.5.6 Pump Station Requirements

The existing Madison pipeline pump stations utilize vertical turbine pumps mounted to pressurized suction cans. The City has experienced problems in maintaining these type of pumps, as the pump equipment must be removed in order to do maintenance work. As a result, horizontal centrifugal pumps will be used for the new pump stations.

The new pump stations can be package pump stations for ease and consistency of design, installation, and maintenance. However, the package pump stations should be designed with the following minimum provisions to assure proper operation:

- Provide firm capacity assuming the largest pump at each station is out of operation.
- Provide space and piping for an additional future pump in case of significant downstream growth.
- Provide variable frequency drives (VFD) on one or more of the pumps to allow easily adjusting the rate of pumping.
- Provide pump control/check valves that allow controlled shutdown of the pump in loss of power.
- Provide standby generators to operate the full pump station capacity in the event of loss of power.
- Provide surge control tanks to minimize the pipeline pressure spikes in loss of power or pump failure.

- Provide electrical room with auxiliary cooling to assure proper operation of the electrical switchgear and VFDs.
- Provide building enclosure with adequate access and security provisions.
- Provide automatic controls to monitor and maintain pump station operation under all conditions. The SCADA for the pump stations should utilize the GE Fanuc PAC system products to be consistent with the City of Gillette's water SCADA system.

3.6 Water Quality Considerations

Water quality considerations that need to be addressed in constructing the regional water distribution system and the connections to potential participants include; chlorine residual, fluoride levels, disinfection byproducts (DBPs), and blending for hardness mitigation. The Regional System will be responsible in meeting the SDWA requirements at the master meter for each of the participants. Downstream of the master meter for Classes B through F, the water is the responsibility of the purchasing system both in maintaining water within current drinking water quality standards and in managing water usage.

Water quality issues, including low chlorine residual and DBP formation, can be caused by the long detention times in participant connection waterlines. This can especially be an issue for the Class B, C, and D services when water from the regional system is only used for emergencies or as a supplement to local water supply. Chlorine residual, particularly in the lengthy Green Valley and Ridgeway Lines, will likely be an issue. DBP formation in the Regional System may not be a major issue since the water supply is groundwater with low organic content. However, the Stage 1 Disinfectants and Disinfection Byproducts Rule (DBPR) monitoring and planned Stage 2 DBPR monitoring should continue in the City of Gillette's distribution system. Additional sample points may be necessary at the service extensions of the Regional System.

Water quality in the participant storage tanks may also be an issue. Several participants have already noted a problem with maintaining chlorine residual. Water quality will need to be maintained while in the tank by adding chlorine at the delivery point for some participants. Water will be circulated through the tank as it will serve as the delivery point from the regional system for most of the participants. This service plan may help keep the water age down in the tanks. However, for the direct connection Class G systems, the tank may not be circulated and will have to be closely monitored for quality problems.

To maintain chlorine residual in the distribution pipelines and participant tanks, chlorine booster stations or regular line flushing may be necessary. Those participants one mile or further away from Gillette city limits may be required to have a chlorine booster station near their delivery points. All the potential participants should have the ability to dose chlorine into their water supply to boost chlorine residual when it is low due to prolonged detention time in storage. Most of the potential participants have existing disinfection facilities which should be used to maintain chlorine residual in their water storage tanks and distribution system. Those participants inventoried, which do not have existing disinfection or whose disinfection method is currently unknown, include: Buckskin Meadows Subdivision, Force Road Joint Powers Board, Fox Ridge, Glory Hole Homeowners Association, Lemaster Enterprises, Inc., Mohan Subdivision, and Rag Coal West Inc/Rawhide School. Lemaster Enterprises and Mohan Subdivision would not be required to add disinfection facilities, if currently provided, since they are defined to be direct connections to the City's distribution system. Costs were included for any systems without existing chlorination facilities.

The existing disinfection systems, which consist of either chlorine gas or sodium hypochlorite, should be maintained and/or replaced at each participating Regional System. Online chlorine analyzers should be installed with a feedback loop to the chlorination system to ensure the proper amount of chlorine is fed to maintain chlorine residual throughout the system. For those who require new chlorine booster stations, tablet-type chlorine feeders are recommended for ease of operation and safety reasons. Industry-standard manufacturers include the AccuTab system from PPG and ClorTab system from Severn Trent. Chlorination is also possible at the booster pump stations, if necessary, by adding an extra room with dosing equipment.

Water obtained directly from the Madison Parallel pipelines is entirely Madison formation groundwater and will not be blended with Fort Union formation water, so any of the participants located along the pipeline route will not have an opportunity to receive blended water from the city. Hardness in the Madison formation water will affect these Type 1 participants. Participants located in areas to the west and north of the City will be extended service from the city's water distribution system and will receive blended water from the city, which will have more acceptable hardness levels due to blending Madison water with in-town wells.

The Type 1 participants may need to provide water softening equipment to treat hardness in the water. The water softening equipment could be located at the chlorine booster station or elsewhere before storage. As the majority of the Type 1 potential participants do not have community wastewater collection and treatment systems, waste stream (brine) disposal from

the water softening equipment could prove difficult. Another option is to install cartridge-type salt exchange softening equipment at each service connection; however, it is unsure if they cause problems to the septic systems. There are newer softening technologies that don't use salt and are marketed as septic system safe, but their performance is not proven technology like the salt softeners. Type 1 potential participants that may require water softening include: Ward Creek Landowners Association, Rozet Ranchettes, Rozet, Wessex Improvement & Service District, Cedar Hills Water Association, Freedom Hills Subdivision, American Road Water and Sewer District, Meadow Springs Improvement & Service District, Nickelson Farms Water Company, Rodeo Flats Water Distribution, Central Campbell County Improvement & Service District, Antelope Valley, and Antelope Valley Business Park Improvement & Service District.

3.7 Service Connection Implementation Phasing

The participants that should be connected initially to the Regional System are the Class B participants that could contribute excess Ft Union formation well supply water to the regional system. To help ease near-term water supply shortages, potential Class B participants include: Antelope Valley, Crestview and Sleepy Hollow. Potential participants that are located closest to the new Madison parallel transmission main should be connected concurrently with its installation. Next, waterlines that extend out from the Madison transmission lines or the City of Gillette's distribution system should be gradually built out until those farthest from the central system are completed.

The Class B potential participants interested in providing water to the regional system will most likely be limited to those that can pump water directly into the Madison pipeline, prior to blending point at the southeast water storage tank (Z1R4). These special district wells that benefit the Regional System operation are intended to remain in service and should be re-drilled as needed in the future. Special district wells that fail in the future and are not considered a benefit to Regional System will not be connected to the regional system and will most likely be funded for re-drilling by WWDC only if an extension of the Regional System service is more costly.

The JPA process will further develop the phasing of connections to potential participants by the regional system based on location and condition of the distribution systems and water supply needs.