Countryside Homeowners Association Preliminary Engineering Report for Water System Improvements

Countryside

Submitted to:

South Dakota Department of Environment and Natural Resources

Joe Foss Building
523 East Capitol Avenue
Pierre, South Dakota 57501-3182

September 2012

Submitted by:

cetec
ENGINEERING SERVICES, INC.

1560 Concourse Drive
Rapid City, SD
57703

Ⓟ 605.341.7800
Ⓕ 605.341.7864

www.cetecengineering.com

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REGISTERED PROFESSIONAL ENGINEER
REG. NO. 8315
RICHARD A. MARSH
SOUTH DAKOTA
9-25-12

Submitted by:

cetec
ENGINEERING SERVICES, INC.

1560 Concourse Drive
Rapid City, South Dakota
57703

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I. Introduction

This document assesses the Countryside Homeowners Association (CSHOA) water system infrastructure for future service within the existing subdivision/water service area. Conceptual plans for improvements to the existing system are presented in this report, along with estimated costs.

The CSHOA water system consists of four wells, two well houses, one bolted steel storage tank and a network of 4-inch to 8-inch diameter distribution piping to serve the existing system customers. The anticipated long-term water needs are not expected to grow substantially as the subdivision is essentially fully built out. It is possible that a few adjacent lots to the subdivision could request to be connected, but future connections are estimated to be less than five services. Improvements needed to serve the existing system are mainly due to the ageing system, water quality and quantity.

The water system improvements recommended in this report are for planning purposes and are based on the best available information. The historical and estimated future water demands, supply or storage volumes are not necessarily complete or correct in every detail. Engineering judgment as well as engineering standards and criteria have been used to evaluate the infrastructure conditions and needs. Water system demands and capacities fluctuate on a frequent basis due to seasonal demands and mechanical failures respectively. The intent of the study is to provide data with the correct order of magnitude so the CSHOA can evaluate the benefits and disadvantages of proposed system modifications. Every water system operates differently based on specific needs of the system. The CSHOA has the authority to set certain local water system standards and operating criteria based on system needs not necessarily regulated by EPA and SDDENR. The standards used in the report can be modified based on CSHOA's needs and operating style.

The report is based on a site visit and water system data and maps provided by the CSHOA and SDDENR. The actual future climate conditions and hydro-geological conditions are beyond our control and will always be variable for the system.

The life expectancy and condition of existing water system infrastructure has been assumed and will vary based on actual usage, maintenance programs, site conditions, acts of God, quality of the original facility components, material defects, and related factors. Typical replacement times have been reviewed for this project based on similar water systems.

New water system infrastructure costs are compared with recent historical construction cost data for similar work. The cost estimates are not based on surveys, detailed designs or actual quantity tabulations. The cost estimates identify the magnitude of the project. Costs will be dependent upon final designs and bidding climate at the time of construction. Current local costs were reviewed in preparing this estimate, but may not necessarily reflect future costs. The costs should be updated on an annual basis and reviewed prior to final construction planning.

II. Project Planning Area

The initial water system for the Countryside Subdivision was built in the early 1980's. CSHOA became the trustees for the water system in 1993 as part of an agreement made with the subdivision developers in the infancy of the development. In order to continue to effectively serve existing demand, the CSHOA proposes to improve its aging water distribution system through a series of rehabilitation and upgrade projects. Many of the existing wells, well house components and distribution components have reached the end of their useful life and are in need of complete replacement or major rehabilitation. The goal of the project is to address the needs of the system.

A. Location

The Countryside Subdivision is located southwest of the City of Rapid City in Pennington County, South Dakota. Adjacent property on the north, east and west sides of the subdivision were annexed into the City of Rapid during the development of Red Rocks Subdivision.

Access to Countryside subdivision is off of Sheridan Lake Road. Figure 1 shows the location with respect to the Rapid City. All of the water system components included within the system are located within the subdivision except the water storage tank located southwest of the subdivision in the adjacent Tract A and a single water service line to the Paulson property located between the south side of the subdivision and Sheridan Lake Road. The water storage tank is located on a permanent easement within Tract A. Existing water system component locations are shown in Figure 2.

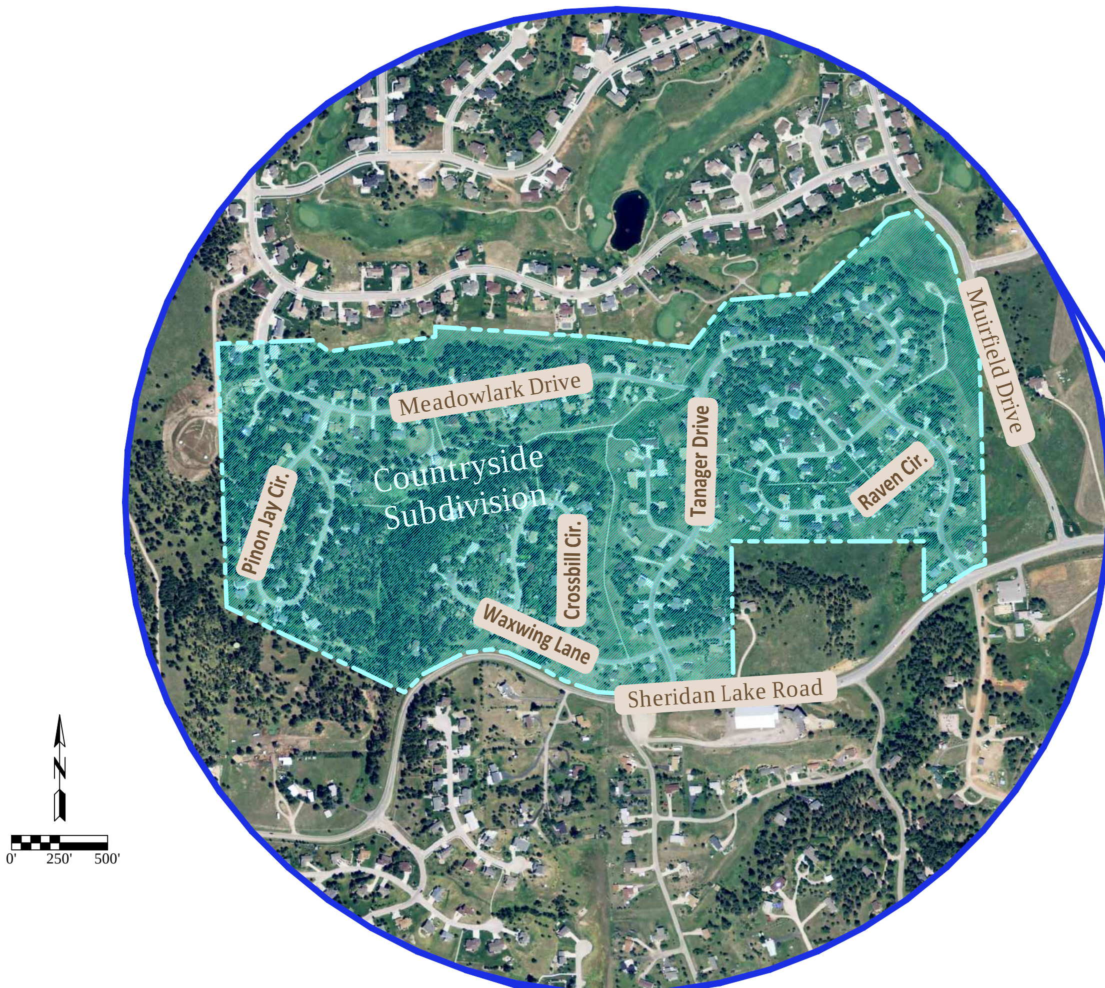
B. Environmental Resources Present

An environmental report (ER) has not been written to date as a proposed project is not yet finalized. Once a proposed project is selected an ER will be done and should be reviewed for detailed environmental references. Environmental issues are not anticipated due to the previously disturbed areas with the subdivision.

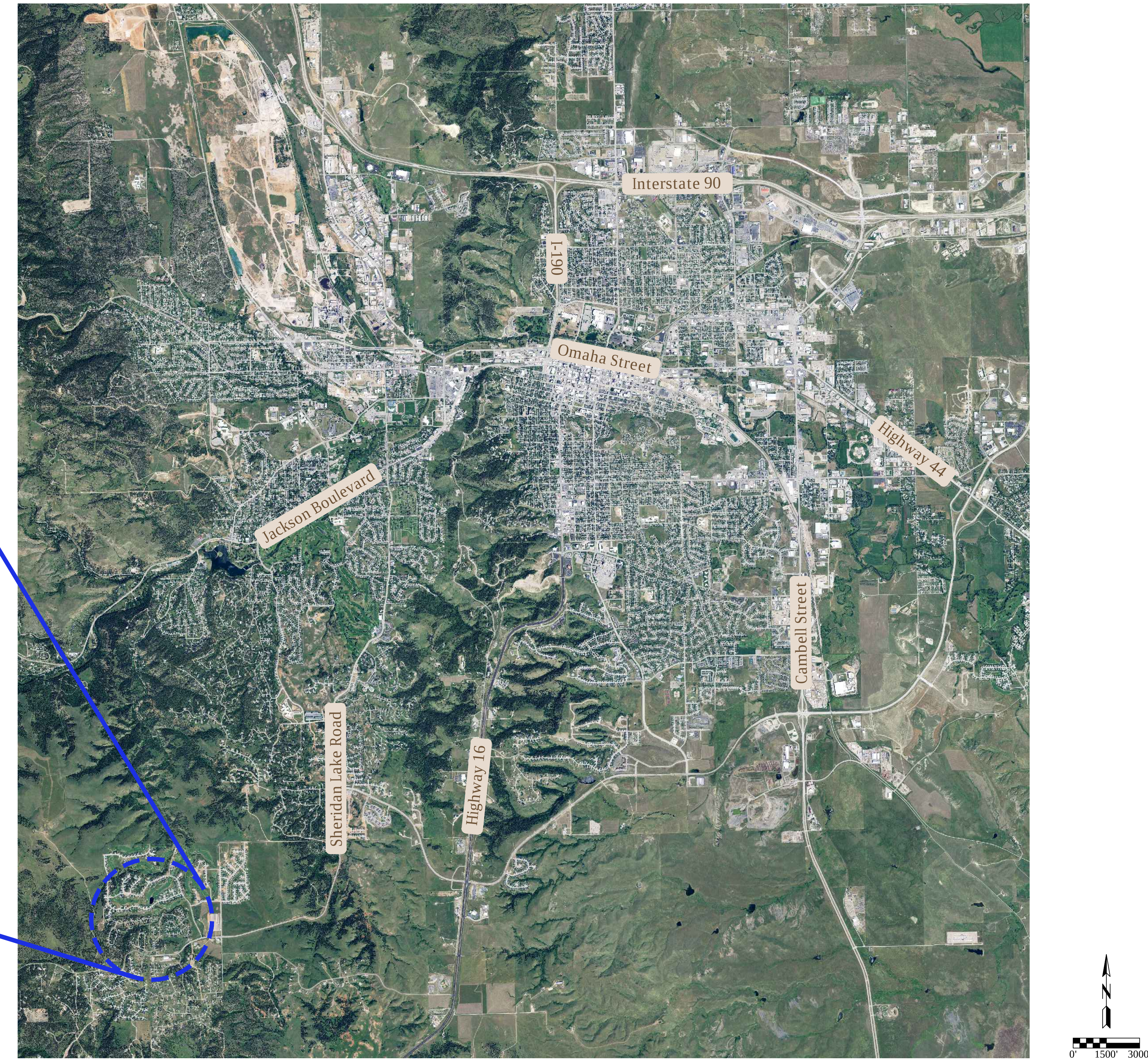
C. Growth Areas and Population Trends

The Countryside subdivision is fully developed and is not expected to grow or shrink substantially in the future due to its desirable location adjacent to the City of Rapid City. It is possible that additional subdivision of adjacent Tract A and the Paulson property could add a few (2-5) more water service connections but the impacts to the system for the purposes of this report would be negligible.

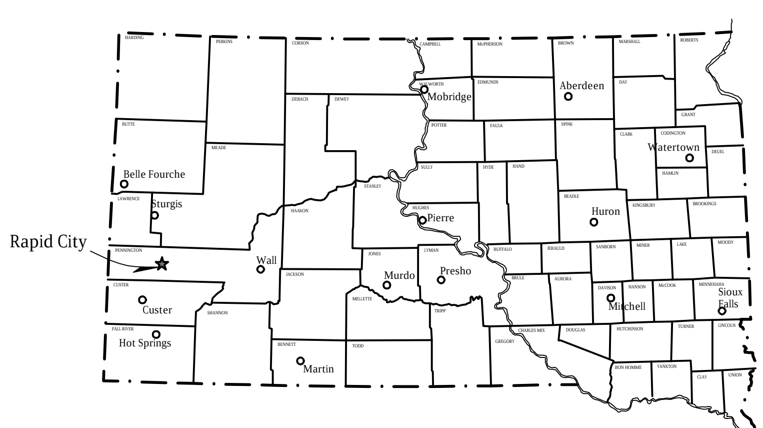
CSHOA currently has 197 (196+Paulson) water service connections and serves on average 493 people (estimated at 2.5 persons/dwelling unit).



PROJECT LOCATION



CITY of RAPID CITY



SOUTH DAKOTA

Figure 1
STUDY AREA

Countryside Water System Improvements

cetec ENGINEERING SERVICES, INC.

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Drawing: FIGURE1.DWG (Schille) (\\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\)

Figure 2
EXISTING WATER SYSTEM LAYOUT
Countryside Water System Improvements

cetec ENGINEERING SERVICES, INC.

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Drawing: FIGURE2.DWG (Schille) (\\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\)

III. Existing Facilities

The Countryside Subdivision is an area with aging infrastructure. Existing wells and system components have reached the end of their useful life and are in need of major rehabilitation and or complete replacement.

A. Location Map and System Layout

A summary of the existing system layout is provided in Figure 2. The water system provides potable water to 197 residential services. All but one service is within the Subdivision limits. The supply source is groundwater from the Madison, Minnelusa, and Deadwood aquifers at depths ranging from 610 feet to 1,407 feet below the surface. Four wells with submersible pumps deliver water directly to the distribution system with no start up bypass pumping. Wells #1 and #4 are located adjacent to each other off of Waxwing lane and are routed through a common well house where sodium hypochlorite (chlorination) and fluosilicic acid (fluoridation) are added as well as metering. Wells #2 and #3 are adjacent to each other and are located off of Tanager Court. Similar to wells #1 and #4 chemical addition as well as metering happens within a common well house. Water storage is provided by a single bolted steel 176,000 gallon ground-level tank at elevation which pressurizes the distribution system. The distribution system is a network of 4-inch to 8-inch diameter PVC mains. A significant pressure differential happens across the system due to over 200 feet of elevation difference without system pressure reducing valves. It is likely that homes in the higher elevations have booster pumps and those at lower elevations have in-home pressure reducing valves.

Existing mapping indicates that water services are copper however the water system operator and other water system information indicate that water service lines were originally installed with polybutylene pipe. The following observations and inventory was recorded during the water system site visit and operator interview.

B. History

Below is information summarized from the Countryside Water System Welcome Letter, (Barth Lippert, March 11, 2012):

> *The initial water system for the Countryside Subdivision was built in the early 1980's. In early 1993 the CSHOA purchased the original water system from the Builders Development Group for $1.00 as a part of an agreement made with financiers in the infancy of the development. The original water system consisted of two deep water wells, one storage tank, and approximately 10 miles of pipeline. Well #1, located near Waxwing, was drilled 1981 into the Deadwood Formation. Well #2, located behind Tanager Court, was drilled in 1988 into the Deadwood Formation. The storage tank is located on a permanent easement off Pinon Jay Circle at the top of the hill.*
>
> *In 2001, Well #3 was drilled into the Minnelusa/Madison Formation. This well was located with Well #2 behind Tanager Court. Well #4 was drilled in 2002 into the Minnelusa/Madison Formation and is located with Well #1 near Waxwing. It was later determined that wells #1 and #2 contain radiological contaminants that need to be monitored and can only be used for 4 months of the year. Thus wells #3 and #4 are the primary wells. Wells*

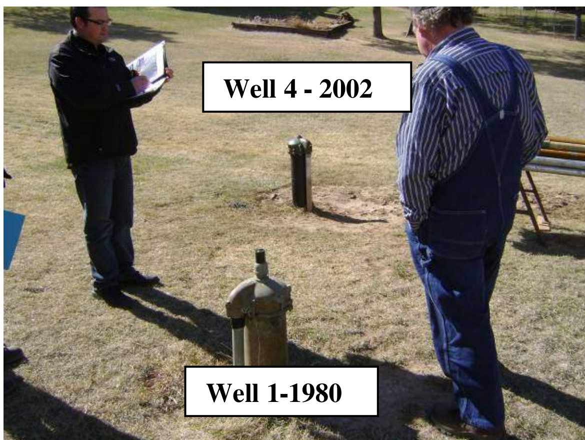
#1 and #2 are normally used during the summer months when there is an increase in demand.

The water well pump for Well 4 was replaced in April of 2012. There are not many water system records that exist and it is not known when other system components were upgraded or replaced. It is estimated that components have been replaced on an as needed basis. This is based on observations of the existing conditions found in well houses (1 and 4) and (2 and 3).

Financial accounting records for Countryside indicate that there was some well work completed by Cimarron Drilling and Dakota Pump and Control, Inc. in 2008.

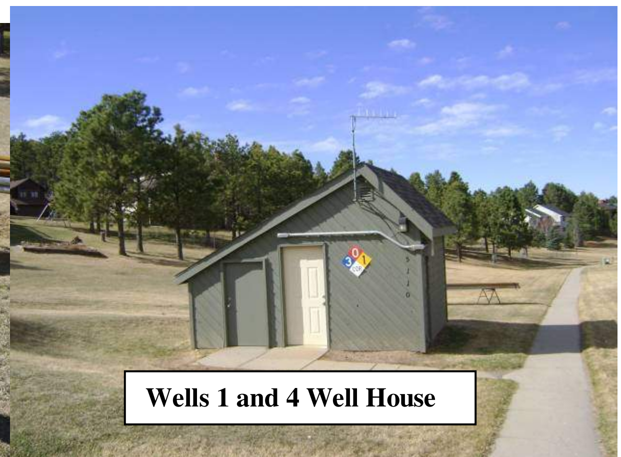
C. Condition of Facilities

1. SUPPLY -- Wells 1 and 4 and Combined Well House

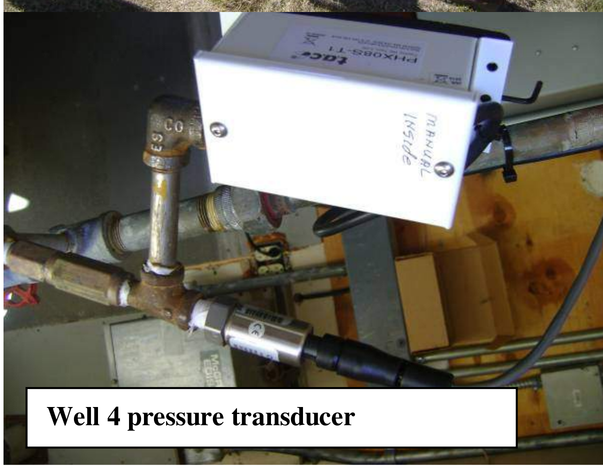


Well 4 - 2002

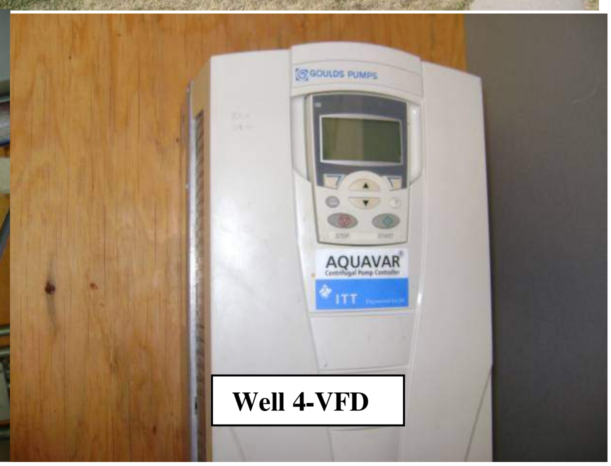
Well 1-1980



Wells 1 and 4 Well House

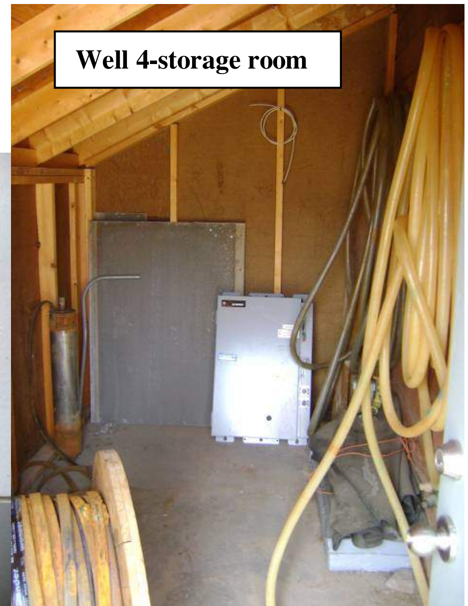


Well 4 pressure transducer

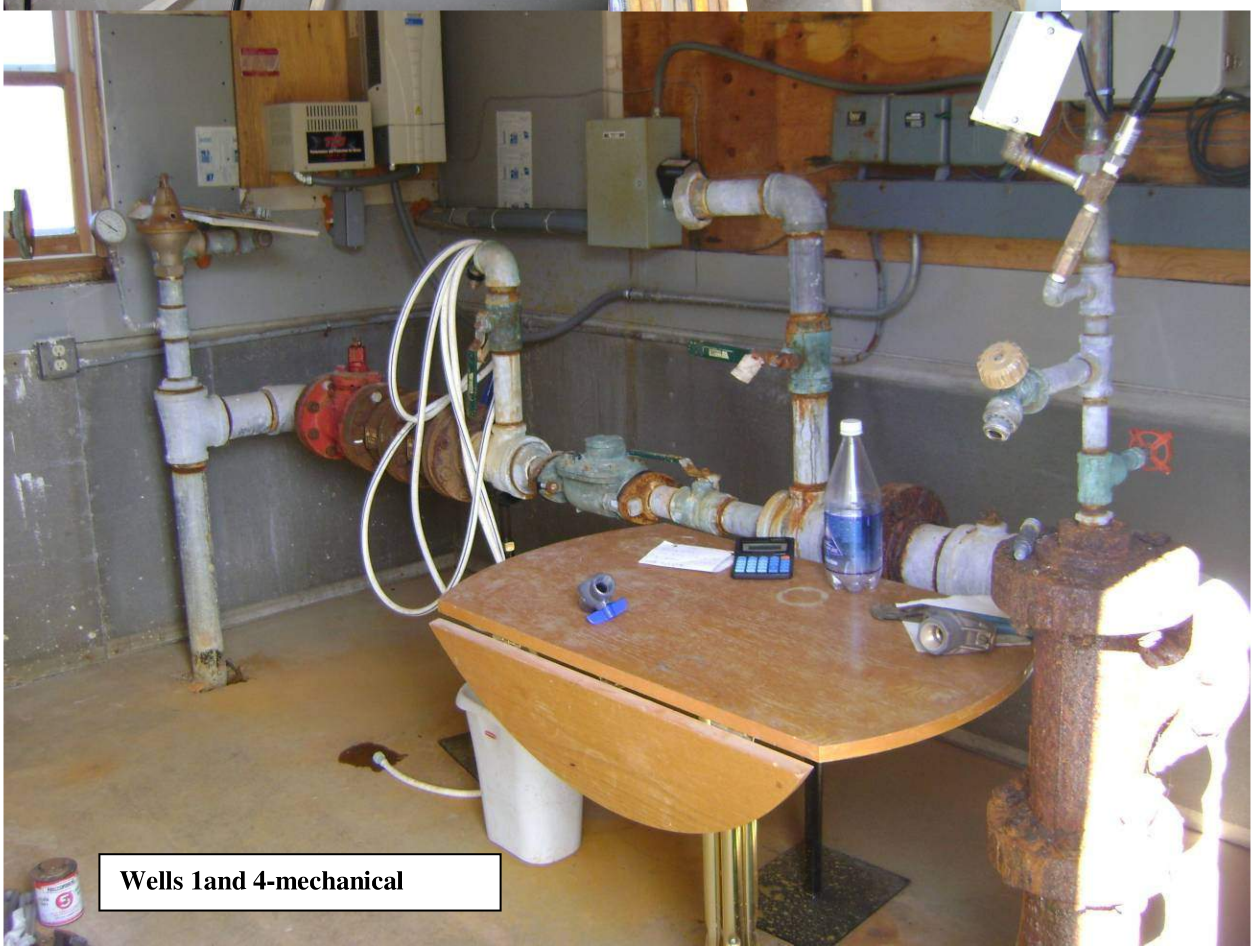


Well 4-VFD

Well 4-chlorine and fluoride pumps



Well 4-storage room



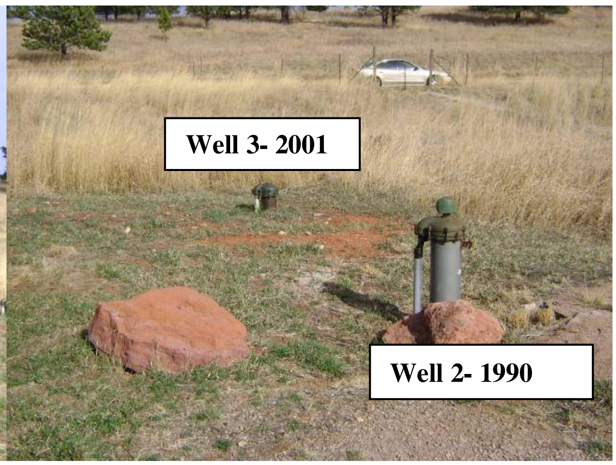
Wells 1and 4-mechanical

Well 1 is located within the Deadwood Formation and can produce approximately 102 gallons per minute (GPM). Well 1 was drilled in 1980. Due to the high level of radiological contaminants, it is not suitable for permanent use and its designated status is “Emergency” with the South Dakota Department of Environment and Natural Resources (SDDENR). Currently it is inoperable as there is no hardware (soft start or Variable Frequency Drive VFD) to start the pump. Verbal interview indicated that it has been several years since Well 1 has been run. Water from Well 1 could be mixed with Well 4 water in high demand conditions within the summer months, however additional water quality testing would be necessary to ensure contaminant levels are not exceeded. In addition, well start up by-pass pumping would likely be needed to flush fine particles that are often present at pump start up or high pumping rates. If Well 1 was operational treatment could only consist of chlorination (sodium hypochlorite) and fluoridation (Fluosilicic acid).

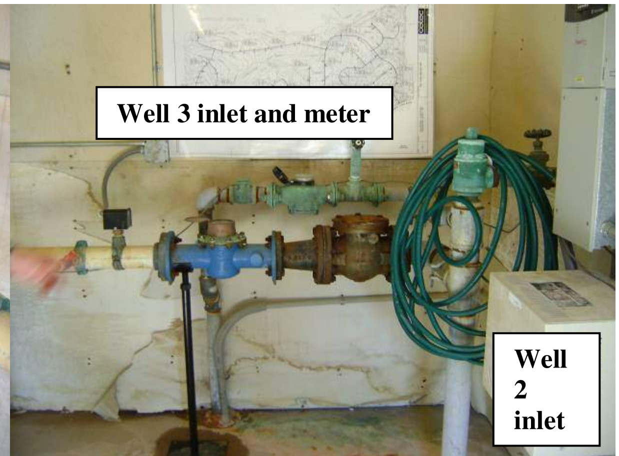
Well 4 was drilled in 2002. It is located within the Madison Formation and produces roughly 31 GPM. This is down from the 2002 estimate of 40 gallons per minute from the well driller’s log. Loss of production is possible over time due to varying elevations of aquifer potentiometric surface and aquifer plugging. Since 2002, Well 4 has been the work horse for the water system pumping virtually 24 hours a day when in operation. Due to its location within the system, Well 4 pumps against less static head and thus is more efficient to run than Well 2 or Well 3. Water quality from Well 4 is in compliance will all physical and chemical parameters regulated by the Federal Safe Drinking Water Act and SDDENR Drinking Water Standards with the exception of iron concentrations which have tested as high as 2.75 mg/l and as low as undetectable. It is recommended that additional sampling take place to determine an average for Well 4. Well 4 is suitable for continued use. Existing treatment of Well 4 water consists of chlorination (sodium hypochlorite) and fluoridation (fluosilicic acid).

Combined Well House for Wells 1 and 4 is the original well house for the water system and was likely constructed after completion of Well 1. It is located off of Waxwing lane. Access to this well house limited. Parking is located in Waxwing lane and there is a steep sidewalk down to the well house. It appears that the exterior of the well house has been painted and the roof replaced at some point in the past. The interior of the well house is in deteriorated condition. System piping is rusted and galvanized pipe has been replaced as needed over the years. Well 4 is plumbed such that it crosses the middle of the room and the operator must walk underneath the plumbing to get to the well control Variable Frequency Drive (VFD). Well 1 pump controls are not present and the electrical system has been modified over the years. It is not clear what within the electrical system is active and what is abandoned. Interior sheetrock has been replaced with concrete board in various locations. There is a window but no exhaust fans within the main room or adjacent storage room. Chemicals are located next to each other and within the same room as the mechanical piping. The supervisor control and data acquisition (SCADA) system monitors temperature, loss of power, and intrusion. Recommendations from the 2010 SDDENR Survey included adding personal protective safety equipment including gloves, goggles, and aprons. Also recommended was adding secondary containment for the chlorine and fluoride chemical tanks. The well house is suitable for continued use, but significant upgrades to the interior of the well house should be considered and are discussed within this report.

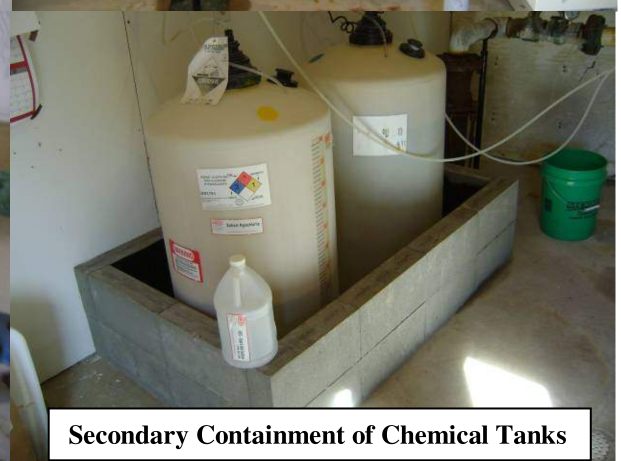
2. SUPPLY -- Wells 2 and 3 and Combined Well House

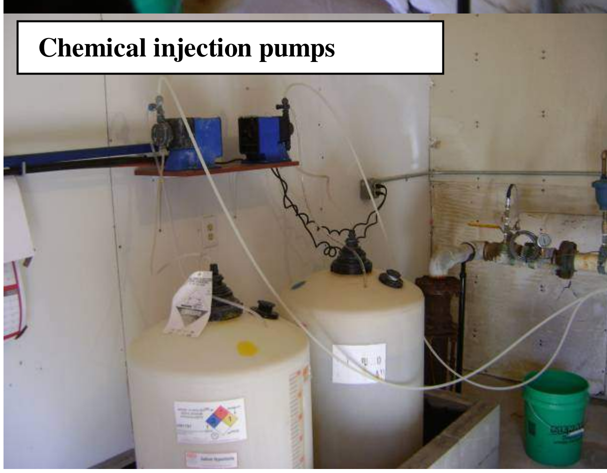



Wells 2 and 3 outlet to distribution


Well 3 inlet and meter

Well 2 inlet


Secondary Containment of Chemical Tanks


Chemical injection pumps


VFD's and Electrical

Well 2 is located within the Deadwood Formation and can produce approximately 126 gallons per minute (GPM). It was drilled in 1990. Due to the high level of radiological contaminants, it is not suitable for permanent use and traditionally has been used only during the summer months during peak use periods. It is mixed with Well 3 water when in use. Its designated status is "Standby" with the (SDDENR). In 2010, the SDDENR noted the following in regards to chemical monitoring at wells 2 and 3:

> *Chemical monitoring has been required only from Well 4 since 2004 when it began operating as the primary source of water for Countryside. Wells 2*

and 3, because of elevated radiological chemicals, became standby sources.
The Drinking Water Program requires chemical monitoring from any source used more than 4 months a year, and at our option, if the source provides more than 25% of the supply. According to water production records obtained during the inspection, Wells 2 and 3 (combined entry point) provided half of the water during 2009. Check pumpage records to verify the frequency and volume of use from each of the wells (entry points). Chemical monitoring of Wells 2 and 3 may again be required if they continue to provide a significant percentage of the water supply.

Treatment of Well 2 water consists of chlorination (sodium hypochlorite) and fluoridation (fluosilicic acid).

Well 3 information indicates that it is located within the Minnelusa Formation and can produce approximately 40-44 gallons per minute (GPM). Potentiometric levels within the well indicate that it is likely under the influence of the Madison aquifer. It was drilled in 2001. Well 3 water is suitable for continued use. It is designated as “Standby” with the SDDENR, however pumping records indicate that it was used as the secondary well in 2010 and the primary well in 2011 when Well #4 was out of service. At the time of this report, discussions with the SDDENR to update the designation of this well were not finalized. It could not be determined from the water sampling records if the results were a combination of Well 2 and Well 3 water or only Well 3 water, however operator interview indicated that Well 3 water is in compliance with physical and chemical parameters regulated by the Federal Safe Drinking Water Act and SDDENR Drinking Water Standards. Treatment of Well 3 water consists of chlorination (sodium hypochlorite) and fluoridation (fluosilicic acid). Similar to the Madison Formation, the Minnelusa Formation can produce fine particles from the rock formation at start-up or high pumping rates. Currently there is no start-up by-pass for Well 3.

Combined Well House for Wells 2 and 3 is located east of Tanager Court and is accessed via an access road off of Tanager Drive (Refer to Figure 2). The exterior of the well house has been maintained, but the wood siding is showing signs of deterioration. The interior of the well house has had recent electrical improvements (estimated 2008) as well as a new variable frequency drive (AB Powerflex 700). Chemical tanks are located within secondary containment. Chemical pumps are diaphragm due to high system pressure (130 psi) at the injection point. Some of the interior sheet rock has been replaced while other sheet rock is warping and peeling. There is no ventilation within the well house. Interior piping is a mixture of ductile iron, galvanized steel, and PVC pipe. Metallic piping is rusting and in deteriorated condition. Chlorine and fluoride are located next to each other and within the same room as the mechanical piping. There is no pump by-pass for Well 2 or Well 3. System piping routes flow from Well 3 through Well 2 meter so it must be subtracted to obtain actual Well 2 productions.

Well Summary

Figure 2 shows the locations of the four existing wells. The numbering indicates the sequence in which the wells were constructed and placed into service. Well 1 dates from the 1980 and Well 4 was constructed in 2002. The current pumping rates, age, conditions, and recommendations are shown below.

WELL SUMMARY

Well No.	Typical Pumping Rate	Initial Service Date	Current Well Age	Water Quality Issues	Recommendations
1	102	1980	32 years	Yes	Retain as Emergency Standby
2	126	1990	22 years	Yes	Replace or Treat Water
3	40	2001	11 years	No	Upgrade Well house
4	31	2002	10 years	No	Upgrade Well house
Total(GPM):	**299**	**Average:**	**19 years**		

Well maintenance costs and records were reviewed for the past five years to review the number of well service calls and costs. The CSHOA has spent approximately $83,900 over the past 5 years to make repairs to the system including meter maintenance, water leaks, repairs, maintenance, pump and well work, and electrical upgrades. The costs were not necessarily for new improvements, but for repairs to keep the wells operational.

The problem for the CSHOA lies in the months of July and August when demand is highest and wells are required to keep up with peak period/day demand. Based on the age, quality, and condition of Wells 2, 3, and 4, it is recommended that the system provide an adequate safety factor on well supplies for the system.

Water system records from 2005, 2006, 2007, 2010, and 2011 were reviewed. These records were complete and not missing data. Also 2005-2007 were much drier years than 2010 and 2011 so peak summer demands could be reviewed compared to climatic changes. The system records show that from 2005-2007 and 2010-2011, the water system typically produced between 29 MG/year and 31 MG/year. Water loss records are incomplete with the exception of 2011 which is estimated at 33%. Polybutylene pipe was used for water services and it is likely at the end of its useful life. Additional water system leaks specifically related to the water services are possible in the next 5-10 years. It is recommended that the system should plan and budget appropriately for such events by providing an adequate safety factor for the system. It is also recommended that all of the water services be leak tested and budgetary measures be taken to resolve water system leaks.

The CSHOA available water supply is reviewed in the following tables. The Supply Situations below identify different scenarios for existing possible conditions. Because the subdivision is fully built out, water system usage is not expected to significantly increase in the future. The ability of the wells to provide adequate supply must be evaluated on an annual basis or more frequently.

Although continuous pumping is not recommended long term, the theoretical current maximum daily water production rate, with 24 hours of continuous pumping, is as follows:

<u>Maximum Daily Water Production Scenarios</u>

Wells 1(102 GPM) , 2(126 GPM), 3(40 GPM), 4(31 GPM):

299 GPM x 24 hrs/day x 60 min./hr. = 430,000 gal./day

Well 1 is currently inoperable and has not been in operation for several years due to high radium levels. Well 2 is also high in radium levels and is currently blended with Well 3. As previously noted, the DENR has allowed the use of Well 2 for four months of the year and only 25% of the total water for the system which has been exceeded in recent years. Exact radium level for Well 2 is unknown. Bringing Well 1 back online and estimating a blend rate of 50/50 by volume for wells (1 and 4) and wells (2 and 3), production would be as follows:

Wells 1(31 GPM), 2(40 GPM), 3(40 GPM), 4(31 GPM):

142 GPM x 24 hrs/day x 60 min/hr = 204,500 gal./day

Current production is lower due to Well 1 being offline and designated emergency. Removing Well 1 yields the following:

Wells 2(40 GPM), 3(40 GPM), 4(31 GPM):

111 GPM x 24 hours/day x 60 min/hr = 160,000 gal./day

During dry years, pumping production records indicate that average summer day demand exceeds the pumping capacity. Pumping records indicate that Well 2 has been mixed at a higher ratio in the past to make up this shortfall. Well 2 has likely been operated between 40 GPM and 126 GPM which would be the following:

Wells 2(100 GPM), 3(40 GPM), 4(31 GPM):

171 GPM x 24 hours/day x 60 min/hr = 246,000 gal./day

3. STORAGE

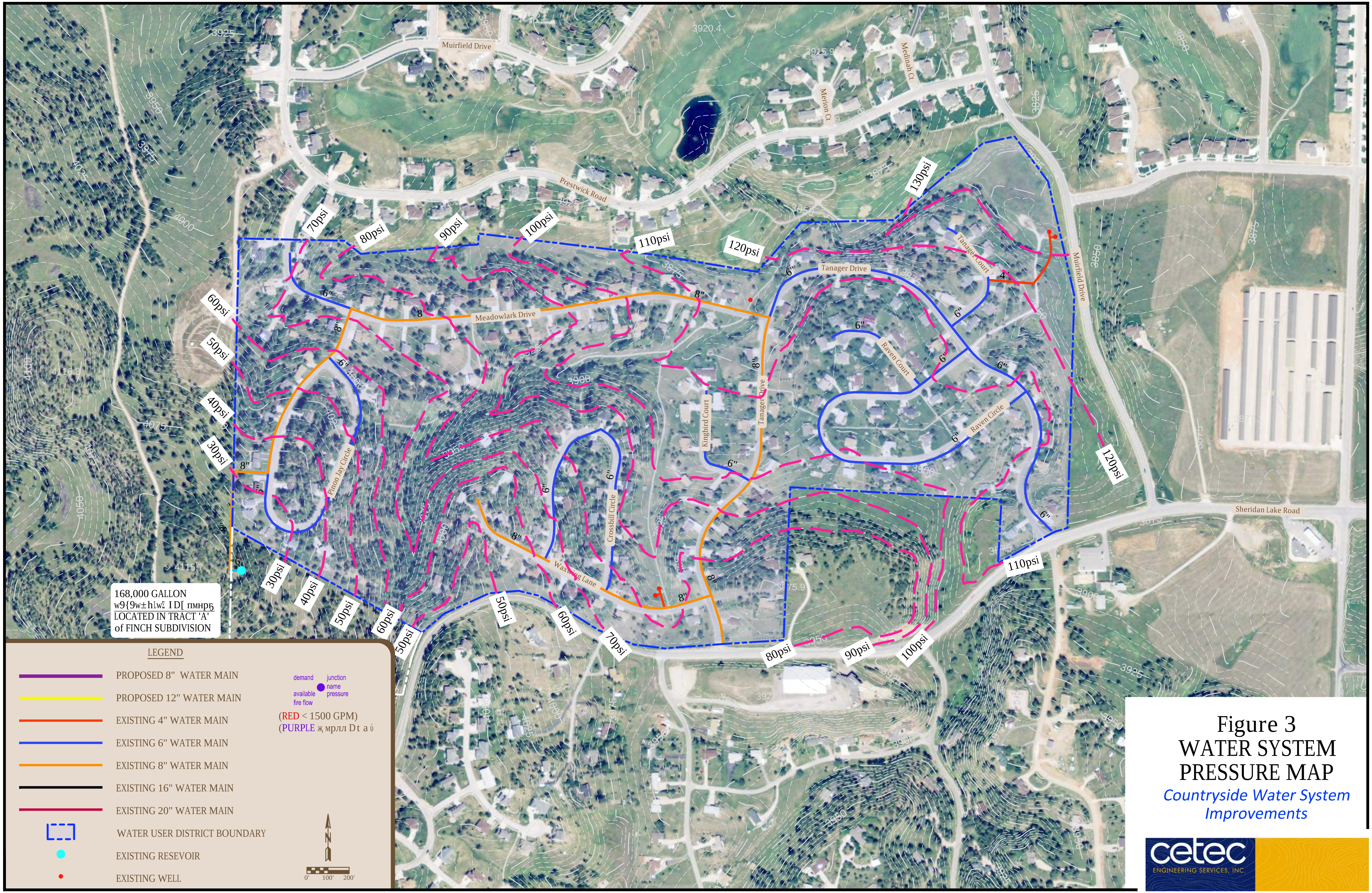
Water storage is provided by a single ground-level bolted steel storage tank. The tank is roughly 168,500 gallons and is located southwest of the subdivision within a permanent easement. Refer to Figure 2. High-water elevation of the tank is estimated at 4,130 ft based off of approximate ground elevation and gauge pressure readings within the well houses. This elevation provides service pressure above the recommended 35-psi minimum to approximately 189 of the 197 service connections. Homeowners with low water pressure have indicated concerns to the Association. It is likely that others have booster pumps installed within the homes. The existing water tank is aging and leaks have occurred in the past. Refer to photo below and inspection reports included in the appendices.

System pressures are monitored continuously via pressure transducers within each of the well houses. The variable frequency drives (VFD's) turn the well pumps on and off automatically in response to system pressures however due to system head losses; the operator has to create set points on the system to offset the head losses. It is recommended to install the pressure transducers within the tank if supervisor control and data acquisition (SCADA) improvements to the system are made.

168,500 Gallon Water Storage Tank

4. DISTRIBUTION SYSTEM

The existing distribution system is a mix of 4" to 8" PVC pipe. Refer to Figure 2. The distribution system supplies water to customers at working pressures in the range of 25 psi to 120 psi. System pressures at ground level are estimated based on aerial contours on Figure 3. No pressure reducing valves are used within the system and it is likely that homes with higher pressure have installed pressure reducing valves at the water service termination points. Ten State Standards recommends working pressures within the system stay above 20 psi in all flow conditions and recommends system pressures of 60-80 psi, but not less than 35 psi. It is preferable for pressures to be in the 40-80 psi range but specific criteria vary by municipality. When pressures are less than 40 psi complaints of annoying pressure drops and reduced flows are common when more than one appliance is operating. When pressures are above 80 psi, faucets and other spigots with rubberized seals not designed for high pressure can leak. The City of Rapid City Infrastructure Design Criteria Manual requires a minimum static pressure of 40 psi and a maximum static pressure of 135 psi. When pressures are above 90 psi, the use of system pressure reducing valves can be considered based on the number of homes served. It may be more cost effective to install pressure reducing valves on each home.



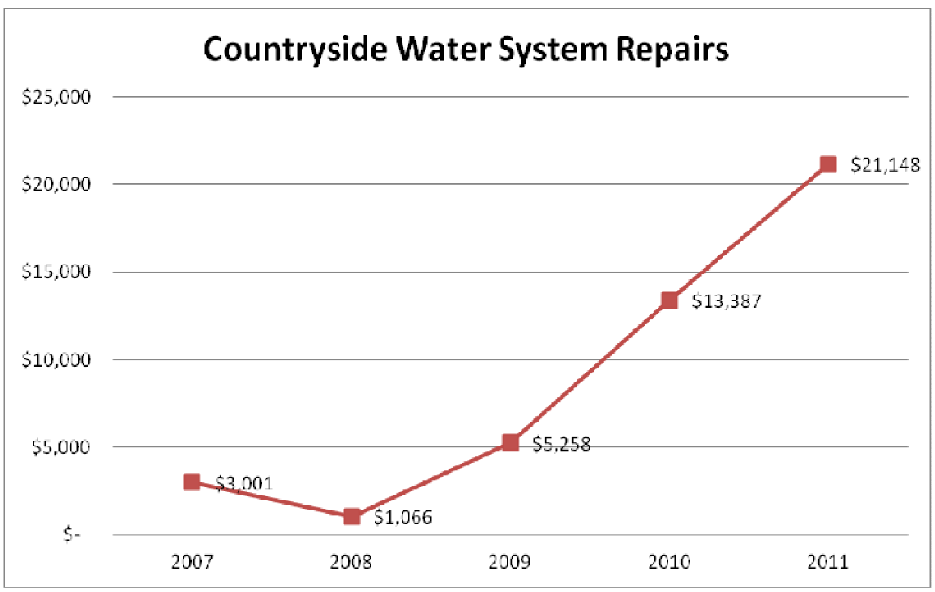
September 25, 2012 8:26:33 a.m. Drawing: FIGURE3.DWG (Schille) (\\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\ )

As indicated in the well summary section, water services were installed with blue polybutylene pipe. Polybutylene is a form of plastic resin that used in the manufacture of water supply piping from the late 1970's to the mid 1990's. Polybutylene piping systems were used for underground water mains and as interior water distribution piping. It is thought that the use of oxidants in the public water supply systems, such as chlorine (sodium hypochlorite) react with the polybutylene piping causing the pipe to become brittle and lose tensile strength. Every system is different and system failures are unpredictable. It is recommended that water service connections be leak tested and budgetary measures be implemented to respond to potential future leaks. Because water pressures within the system are significantly above accepted levels, water system loss could be amplified.

D. Existing Financial Status and Water Rates

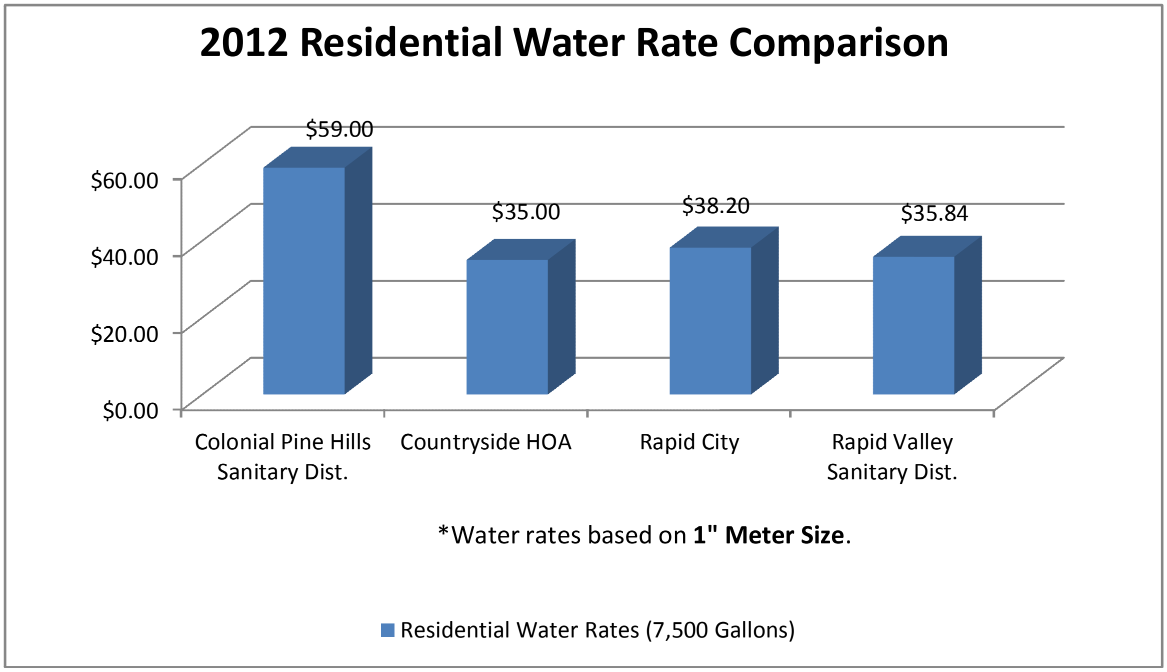
Financial statements from the subdivision will be submitted under separate cover. As of June 30, 2011 current cash assets included $64,712 in checking, $91,369 in money market/savings and $177,700 in CD's for a total of $333,781. The Association maintains a reserve at all times.

Major system expenses involve system repairs, water operator salaries and operational costs, such as electricity. Maintenance costs for the system are trending up and leaks within the system are a continual problem. The chart below indicates maintenance only costs since 2007.



Countryside Homeowners Association has been saving for capital improvements for several years by the use of a $15 capital improvements fee in addition to the water rate. On January 10, 2012, the Board of Directors proposed to increase the water rates to $20 for the first 1,000 CuFt and an additional progressive usage rate for water after the first 1,000 CuFt. Proposed rate increases are $2.05 per 100 CuFt from 1001 to 2,000 CuFt, $2.10 per 100 CuFt from 2001 to 3,000 CuFt and so on. The rate increase was a result of an internal review which indicated that the system was running in the red roughly $750/month.

Water rates were reviewed for some of the surrounding water systems and are summarized below:



IV. Need for Improvements

The primary need for improvements is the deterioration of the existing system components along with water supply and storage deficiencies. Other factors include security, operation, and maintenance.

A. Health, Sanitation and Security

There are health and sanitation concerns with the system. The primary concern with the system is the Deadwood Formation Wells (1 and 2). These wells have much higher production than the Madison and Minnelusa wells but are high is radiological contaminants and can only be used for 4 months of the year. In addition, wells 1 and 2 can only produce less than 25% of the annual water. There is no way to bypass pump from either well site to keep solids from being pumped into the system at well start up. Security concerns exist at all facilities. Although hidden well in the trees, the existing water storage tank is not located within security fencing. The well houses and well heads are unprotected by security fencing however door locks and entry alarms are present in the well houses. Ventilation at the well houses is non-existent. This has contributed to mold on the drywall and insulation. Chemicals are located adjacent to each other within the well houses and have caused severe mechanical piping oxidation. There is no secondary containment at combined well house 1 and 4 for chemicals.

B. System Operation and Maintenance

Operation and maintenance is an ongoing requirement with the aging system. The SCADA system is antiquated and is essentially an alarm system. It lacks "logic" to properly control the VFD's for the wells. Well shut off and start up is not always predictable due to current configuration.

The system currently does not have adequate looping for fire flow availability within the system and the subdivision is located within and adjacent to heavily wooded areas.

The water service lines in the system are polybutylene and should be replaced. Some of the water service lines have failed, but specific records for repairs do not exist. It is anticipated that system leaks will continue to be on ongoing maintenance issue.

C. System Capacity

The existing system capacity is dependent on the capabilities of the wells and the amount of storage available. The adequacy of the system's capacity depends on the water system demands and its hydraulic capacity to deliver water to the services.

1. Water Demand

Water consumption changes with the seasons, the days of the week, and hours of the day, and fluctuations are greater in small systems than in large communities. Variations in water consumption are normally expressed as ratios to the average day demand and these ratios are called peaking factors or coefficients. There are three historical water demand rates involved in water supply design. These water demand factors are:

- Average Daily Demand: the average of the total amount of water used each day during a one-year period.
- Peak Daily Demand: the maximum total amount of water used during any 24-hour period in a three-year period.
- Peak Hourly Demand: the maximum amount of water used in any single hour, of any day, in a three-year period.

Water supply design is normally based on peak day demands plus fire flow requirements. At a minimum, the source of supply should be capable of meeting the peak-day system demand and storage should not be relied upon for shortfalls in supply. The American Water Works Association (AWWA) recommends supply safety factors between 1.25 and 2.0 for peak day. Demand near peak day may occur over several consecutive days and this must be considered by the system planner/designer. It is common for systems to provide a source of supply that meets peak day demands with additional supply for peak hour demand coming from storage. Consideration must also be given to water demand during emergencies or when ground water wells are out of service. In most cases, water supply is designed to meet peak-day demands with one of its larger wells out of service.

Daily meter readings were not available for the system, however, based on meter readings, averaged over several days, demands for the system are:

Average Day Demand: .... 73,000-84,000 GPD
Average Summer Day Demand: .... 137,000-192,000 GPD
Peak Day Demand (Estimated):.......... 270,000 GPD

Peak Days (270,000 GPD 8/12/2004)(222,000 GPD 7/28/2006)(254,000 GPD 7/9/2007)

Recommended Supply (1.25)(270,000 GPD) = 337,500 GPD = 234 GPM

These demands were derived from summarized meter records tabled on the next page.

Water records were reviewed and demands were computed based on complete data sets. 2005-2007 were relatively dry years while 2010-2011 were relatively wet years so the range in demands could be evaluated based on differing climatic conditions. Results for each of the data sets are shown in the following table.

	SYSTEM PUMPING SUMMARY (Wells 1, 2, 3, 4)				
	Total	**Average Day Demand**			
	Gallons/yr	GPD	GPD/DU	GPM	GPM/DU
2005	30,728,600	84,188	427	58	0.30
2006	30,812,700	84,418	429	59	0.30
2007	30,106,200	82,483	419	57	0.29
2010	26,652,400	73,020	371	51	0.26
2011	29,344,800	80,397	408	56	0.28
	Total Gallons	**Average Peak Summer Day Demand (July & August)**			
	for Peak Period	GPD	GPD/DU	GPM	GPM/DU
2005	9,012,600	160,939	817	112	0.57
2006	10,118,000	190,906	969	133	0.67
2007	9,808,800	192,329	976	134	0.68
2008	8,424,700	162,013	822	113	0.57
2010	9,143,900	147,482	749	102	0.52
2011	8,495,000	137,016	696	95	0.48
	Total Gallons	**Peak Day Demand (Estimated)**			
	for Peak Period	GPD	GPD/DU	GPM	GPM/DU
-	270,000	270,000	1,371	188	0.95

GPD= Gallons per Day
GPD/DU= Gallons per Day per Dwelling Unit
GPM= Gallons per Minute
GPM/DU= Gallons per Minute/Dwelling Unit

CSHOA water system demands are similar to the demands for Colonial Pine Hills Sanitary District located adjacent to CSHOA on the south side of Sheridan Lake Road. Average Peak Summer Day Demands average between 0.46 to 0.71 GPM/DU (data from 2003 to 2008). These demands are typical for residential neighborhoods with sprinkler systems and are above the City of Rapid City average of 0.52 GPM/DU(source: Planning Report for Skyline, Terracita, Southwest, Carriage Hills, and Future Southwest Rapid City Water Service Zones, CETEC Engineering Services, Inc., April 25, 2006)

Production Safety Factor operating wells 2 (100 GPM), 3(40 GPM), 4(31 GPM) (24 hour continuous production)

$$\frac{\text{Maximum Production}}{\text{Peak Day Use}} = \frac{246{,}000\text{ GPD}}{337{,}500\text{GPD}} = 0.73$$

Production Safety Factor operating Wells 2 (40 GPM) and 3 (40 GPM) at 50% blend and Well 4 (31 GPM) (24 hour continuous production)

$$\frac{\text{Maximum Production}}{\text{Peak Day Use}} = \frac{160{,}000\text{ GPD}}{337{,}5000\text{GPD}} = 0.47$$

Water production capacity must be equal to or greater than peak-day demand to avoid depleting fire reserves and emergency storage. American Water Works Association (AWWA) references recommend that public systems have the capacity to meet peak-day demand with one principal source of supply out of service. The safety factor with Well 2 out of service is as follows:

Production Safety Factor operating Well 3 (40 GPM) and 4 (31 GPM) (24 hour continuous production)

$$\frac{\text{Maximum Production}}{\text{Peak Day Use}} = \frac{102{,}000\text{ GPD}}{337{,}500\text{GPD}} = 0.30$$

Production capacity is not adequate for peak day demands. It is marginal for peak summer daily demand only with Well 2 operating at peak capacity and all three wells pumping 24 hours. A failure of Well 2 would require emergency storage to be used and likely a loss of service to some of the customers located at high elevations within the subdivision near the water storage tank. The water system supply is not adequate without the use of Well 2 which exceeds radiological contaminant levels.

Storage

Water storage in a water system is needed to provide for flow equalization (or "operating storage") during peak use periods when water use exceeds production capacity, and for firefighting reserves and other emergency conditions.

Needed storage is calculated based upon the following general formula:

SSR = OS + (larger of FR or ER)

Where

SSR = Supply Storage Required

OS = Operating Storage

FR = Fire Reserves (needed fire flow x duration)

ER = Emergency Reserves (storage needed to meet domestic demands when some or all supply sources are out of service, such as extended power outage).

Operating storage equal to 25 percent of peak-day demand is typically sufficient to meet diurnal peak-use-period demands, and is the value recommended for storage analysis.

Fire flow requirements based upon current International Fire Code Standards are as follows:

Fire Flow

Single Family Residential (under 3600 SF): 1,000 GPM for 2 hrs. = 120,000 Gal.

Due to subdivision being located within a wooded area and adjacent to areas that border the national forest, an increased fire flow criteria should be considered. Local City of Rapid City residential fire flow criteria is 1500 GPM for 2 hours.

1,500 GPM for 2 hrs. = 180,000 Gal.

For the purposes of this report, 180,000 gallons will be used.

Reserve storage needs for non-fire emergencies is a local decision based upon reliability of supply sources, electrical systems, emergency backup power and well service company availability.

Because the system has multiple sources of supply and power within the system is reliable, large emergency reserves do not appear to be warranted. For purposes of this study, the reserve storage is estimated to be one day of storage during summer use demand roughly 190,000 gallons. Storage reserves are assumed to be the controlling criteria, and are used for calculating storage needs.

The needed storage reserves for the system are calculated as follows:

Supply Storage Required

SSR = OS + ER
= .25(270,000 gal.) + 190,000 gal.
= 258,000 gallons

The existing water storage tank is 168,500 gallons which is 90,000 gallons less than recommended and is not adequate for the system.

Summary

The existing water production capacity is not adequate for current users without the use of Well 2 which can only be used for four months of the year.

A safety factor for emergency conditions does not exist unless Well 1 becomes operational.

The existing storage capacity within the system does not meet recommended criteria.

The recommended criteria for evaluating the system are summarized following.

Planning Criteria for Water System for Hydraulic Modeling

Production Capacity: Meet Peak-Day Demand with a Minimum Safety Factor of 1.25.

Storage Volume: 25% of Peak-Day Demand plus Emergency Reserve of 190,000 gallons.

Distribution Sizing/Looping: Minimum 35 psi @ Average Demand
Minimum 20 psi @ Peak-Day Demand + Fire Flow, Velocity 12 fps.
Minimum 6" pipe size

Distribution Sizing and System Pressure

Water main sizing is critical in the delivery of peak hour demands and for providing adequate fire flows. The Ten States Standards state the minimum size of water main for serving fire hydrants shall be 6-inch diameter. Large sized mains may be required to provide required flow for system demands.

Hydrants should be located at all dead ends for flushing purposes and should generally be spaced at 450 ft. to 600 ft. throughout the system. A regular flushing schedule is recommended for all systems on an annual basis or as required. System dead ends may require more frequent flushing to remove solids and improve water quality.

The normal working pressure in the distribution system should be approximately 60 to 80 psi and not less than 35 psi according to the Ten States Standards. Low pressures, below 30 psi, cause annoying flow reductions when more than one water-using device is in service and high pressures may cause valves and faucets to leak. The Uniform Plumbing Code requires that water pressures not exceed 80 psi at service connections, unless the service is provided with a pressure-reducing device.

Hydraulic Modeling and Results

Hydraulic analysis of the water system was completed through an electronic water model of the distribution system. The model includes existing storage, wells and distribution layouts.

The software model is a collection of network piping connected at junctions where sources enter the system and demand is used from the system. System data such as junction elevations, reservoir elevations, peak day demands, pipe size and length is input to develop a system model. The software calculates node pressures, velocity, and hydraulic grade lines from the input data. There are several parameters that affect the model including pipe roughness coefficients and the demands assigned to each junction. The Hazen-Williams formula is used to determine pipe flow and velocity using the selected pipe roughness, diameter and energy grade line. Minor losses are pipe losses that occur at fittings, valves and other appurtenances in a water system.

The following scenarios were developed for consideration of alternative designs when reviewing the Countryside Homeowners Association water system. Because backup power does not exist at any of the well locations, system capacity was reviewed based on water supply from the reservoir only. Please refer to Figures 4-8 and the appendices for the results of the scenarios. Scenarios 1 & 2 analyze the existing system and its capacity. Scenario 3 analyzes the existing system with conceptual improvements completed within the subdivision. These improvements are detailed in sections 5, 6, and 7 of this report. Scenarios 4 & 5 analyze regionalization connections to the City of Rapid City and the splitting of the subdivision into two pressure zones in order to tie to the City system. Again, these improvements are detailed in sections 5, 6, and 7 of this report.

Scenario 1 – Existing System – Average Day Demand

Scenario 1 analyzed the existing system for average day demand with capacity and pressure only coming from the water storage tank. The analysis was used to define the existing system and understand the current fire flow availability of the system. This scenario was also utilized as a base for comparison with results obtained in all possible future scenarios.

Scenario 2 – Existing System - Peak Day Demand

Scenario 2 was used to analyze the existing system for peak day demands plus fire flow demands. Results obtained were used as a base for comparison with possible future scenarios and system improvements.

Due to the existing distribution system network size and layout, the recommended 1500 GPM is not available within the subdivision.

Scenario 3 – Proposed Peak Day Demand w/Looping and Main Upsize from Tank to System

Scenario 3 was used to analyze proposed looping and other system alternates that could be implemented within the CSHOA water system. 8" PVC water main loops were installed from Waxwing to Pinion Jay and from Raven Circle to Tanager. The water transmission main from the tank to the distribution system was also upsized from 8” to 12” PVC.

Due to the looping and transmission main upsize, fire flows within the system can be significantly improved with virtually all of the subdivision less the 6” mains in the cul-de-sacs at or above the 1500 GPM requirement.

Scenario 4 – Peak Day Demand Connection to City of Rapid City Carriage Hills Zone

Scenario 4 was used to analyze part of the system for the regional water system connection alternate to the City of Rapid City (CORC) System. Due to elevations within the existing CSHOA system, connection would require the system to be split into two pressure zones, the Selador Zone with HGL of 4220 and Carriage Hills Zone with HGL 4025. Scenario 4 analyzed the connection to the Carriage Hills Zone. Water for the Carriage Hills Zone is stored in the Red Rock Tank located on the west side of Countryside. Scenario 4 analyzed:

- 8” connection to the existing CORC 16” main in Prestwick
- 8” connection to the existing CORC 8” main in Muirfield
- 8” interior system loop from Raven Circle to Tanager.
- Removal of CSHOA water storage tank.

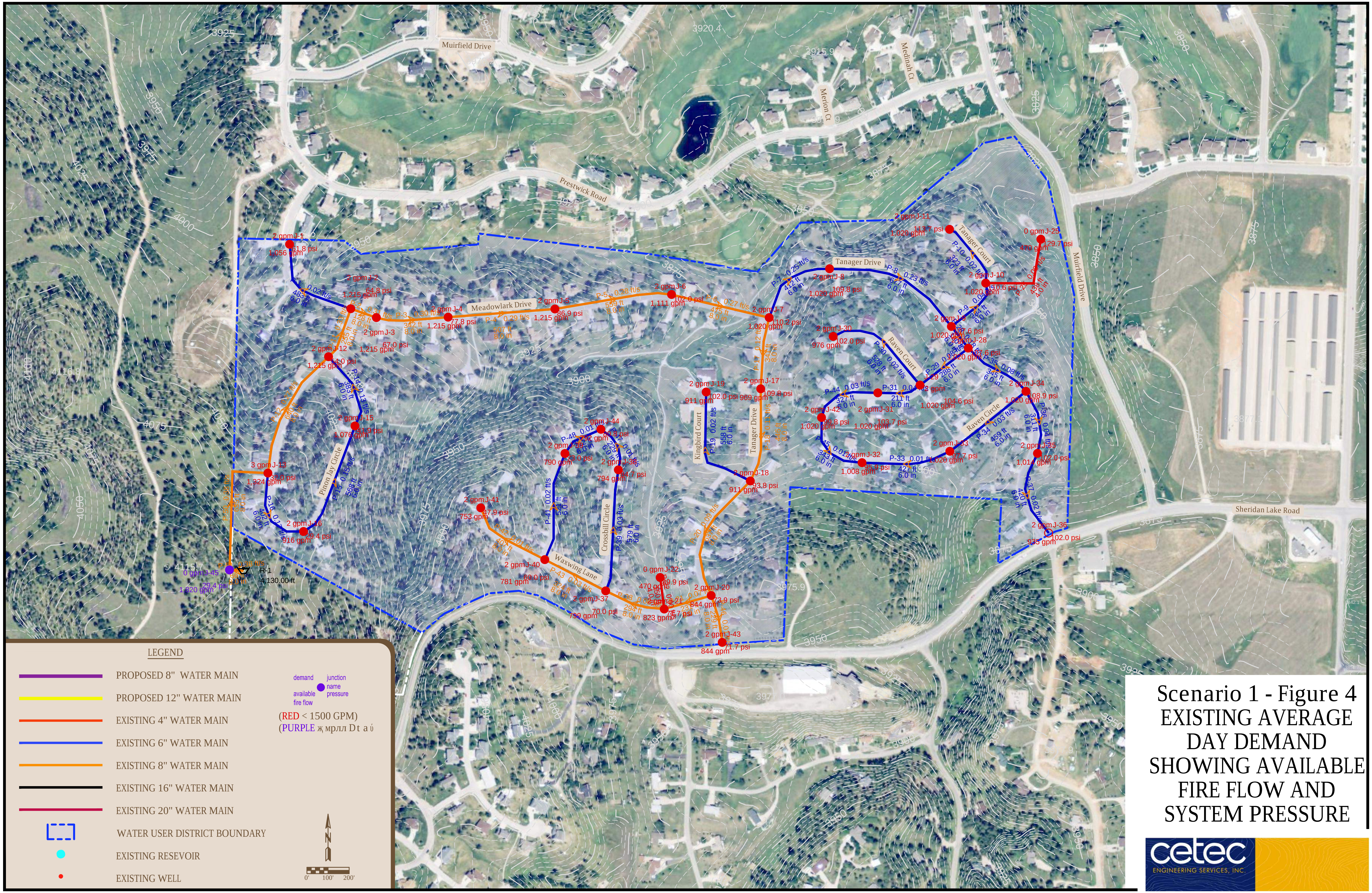
Although system pressures would be reduced by approximately 43 PSI in the low elevation areas of Countryside, fire flow is at or above the 1500 GPM requirement except in the 6” mains in the cul-de-sacs.

Scenario 5 – Peak Day Demand Connection to City of Rapid City Selador Zone

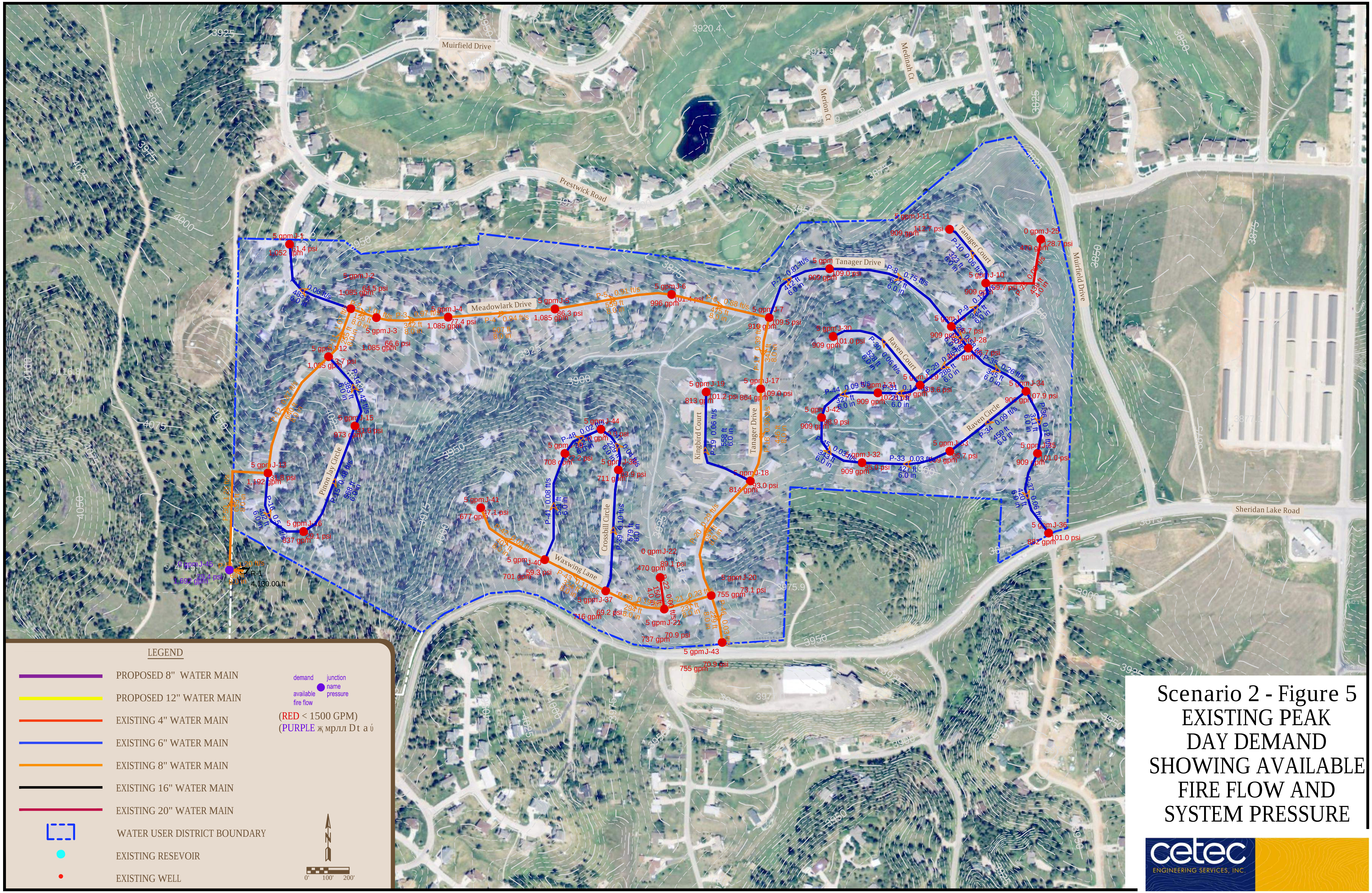
Similar to scenario 4, scenario 5 was used to analyze the regional water system connection alternate to the City of Rapid City. Scenario 5 analyzed the part of the system that would be connected to the Selador Zone. Water for the Selador Zone is provided via the constant pressure Red Rock Booster Station that pumps water from the Carriage Hills Zone to the Selador Zone. Pumps within the booster station would need to be upsized to pump the required fire flows. Scenario 5 analyzed:

- 8” Connection to the existing CORC 8” main in Meadowlark Drive.
- 8” Connection to the existing CORC 8” main in Prestwick
- 8” interior system loop from Waxwing to Pinion Jay
- Removal of CSHOA water storage tank.

Pressures were determined to be adequate in nearly all parts of the system after the connections; however the model indicated low elevation areas within the Selador Zone above maximum pressure criteria. If this alternate is selected, exact locations for system separation should be determined to minimize the need for pressure reducing valves. Potential connections to the City of Rapid City system should be coordinated with future city expansions to limit capital cost.

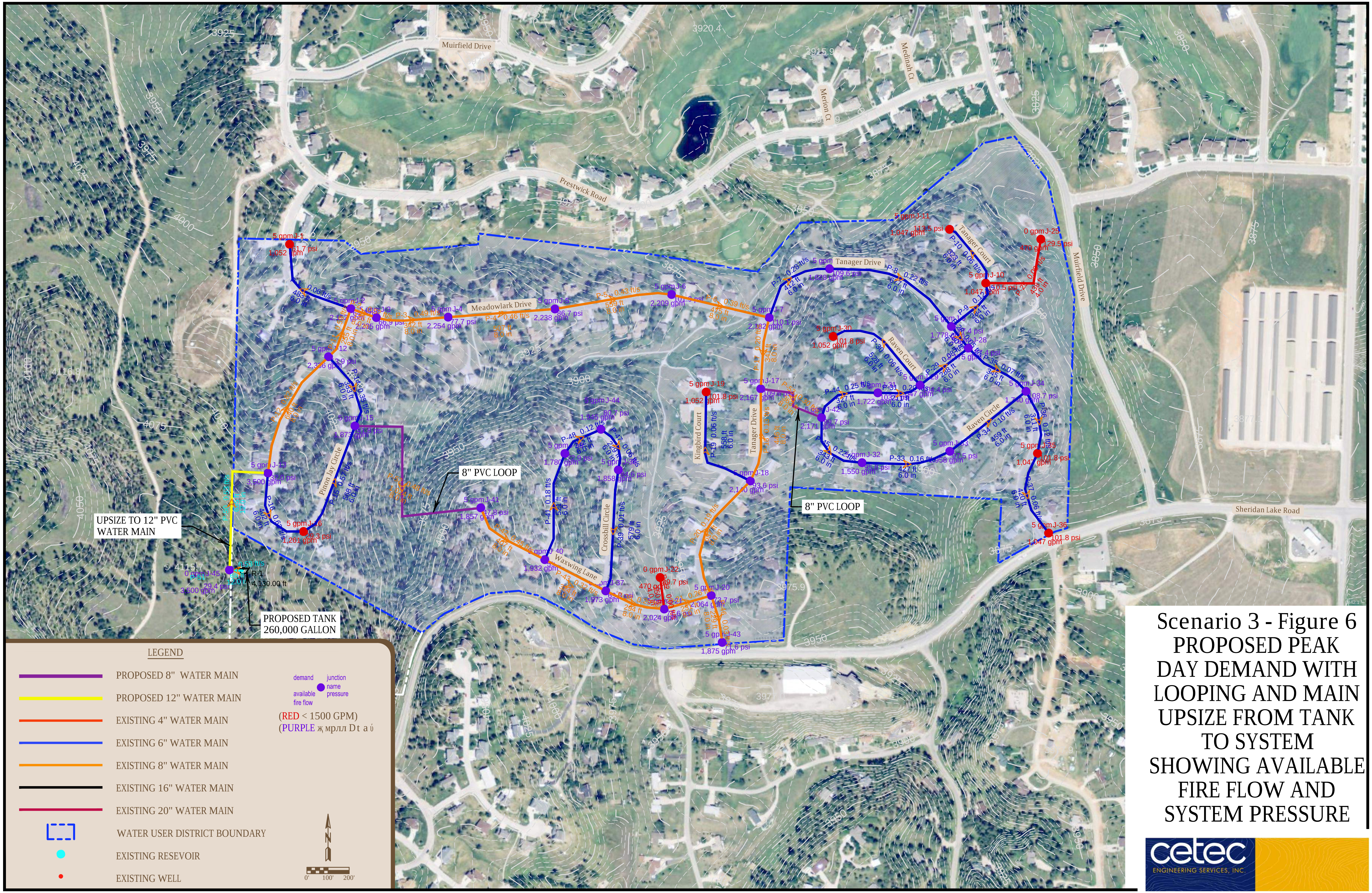


September 05, 2012 4:05:25 p.m. Drawing: FIGURE4.DWG (Schille) (\\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\)



Scenario 2 - Figure 5
EXISTING PEAK DAY DEMAND SHOWING AVAILABLE FIRE FLOW AND SYSTEM PRESSURE

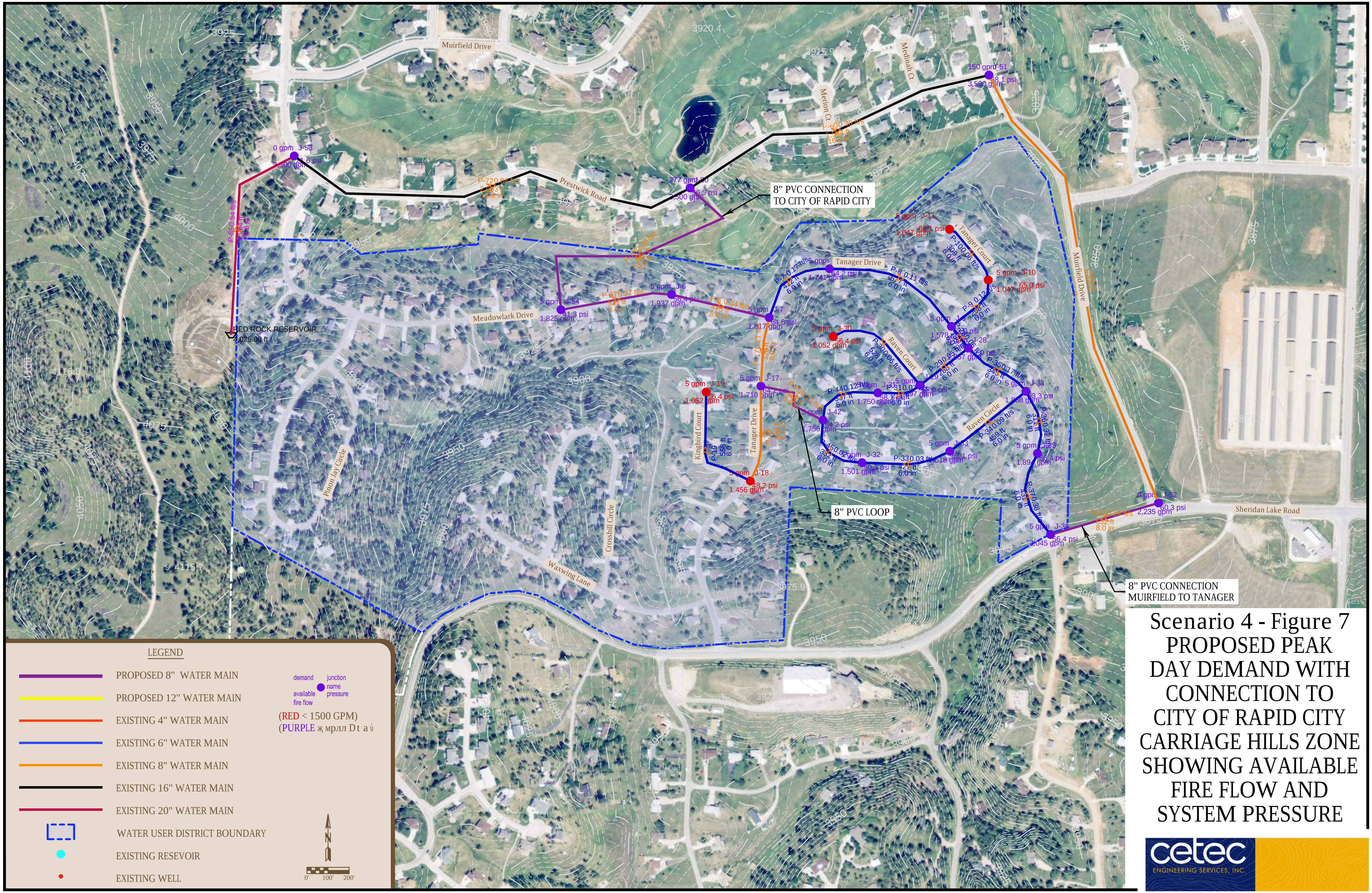
September 25, 2012 8:28:37 a.m.
Drawing: FIGURES.DWG (Schille) (\\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\)



Scenario 3 - Figure 6

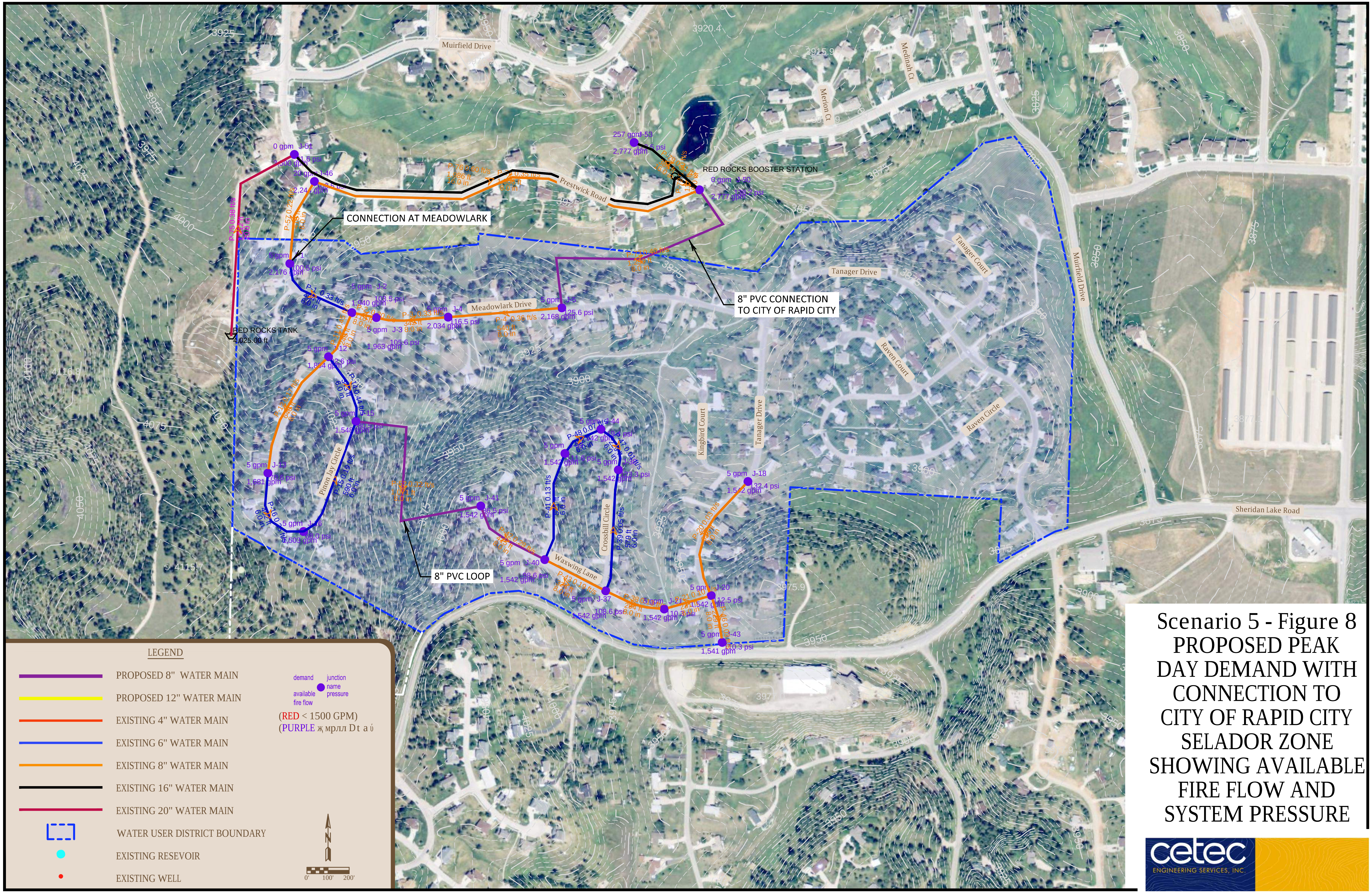
PROPOSED PEAK DAY DEMAND WITH LOOPING AND MAIN UPSIZE FROM TANK TO SYSTEM SHOWING AVAILABLE FIRE FLOW AND SYSTEM PRESSURE

September 25, 2012 8:30:37 a.m.
Drawings: FIGURE6.DWG (Schille) \\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\



Scenario 4 - Figure 7
PROPOSED PEAK DAY DEMAND WITH CONNECTION TO CITY OF RAPID CITY CARRIAGE HILLS ZONE SHOWING AVAILABLE FIRE FLOW AND SYSTEM PRESSURE

September 25, 2012 8:33:01 a.m.
Drawing: FIGURE7.DWG (Schille) \\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\



Scenario 5 - Figure 8
PROPOSED PEAK DAY DEMAND WITH CONNECTION TO CITY OF RAPID CITY SELADOR ZONE SHOWING AVAILABLE FIRE FLOW AND SYSTEM PRESSURE

September 25, 2012 8:35:08 a.m. Drawing: FIGURE8.DWG (Schille) (\\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\)

Summary of Known Existing System Issues

A. Production capacity is not adequate for peak day demands.

B. Production capacity is marginal for Peak Summer Daily Demand only with Well 2 operating at peak capacity and all three operational wells pumping 24 hours per day.

C. Production capacity is not adequate without the use of Well 2 which exceeds regulatory radiological contaminant levels.

D. Based on a recommended minimum safety factor of 1.25, supply shortfall is roughly (100-165 GPM).

E. Based on recent records, CSHOA has used more water from Well 2 than currently permitted by SDDENR (<25% of total for year and 4 months of operation).

F. Exact amount of unaccounted water loss is unknown but ranges up to 33%.

  a. Rural Water evaluated the system and estimated system leaks at roughly 13 GPM.
  b. Several water system leaks are discovered in service lines every year.

G. There are not multiple technical managers or operators that are knowledgeable about the system.

  a. Midwest Assistance Program is currently working on an emergency response plan for CSHOA.

H. Existing water storage tank is nearing its design life and will likely need increased maintenance in the future. Leaks have been fixed every time it has been inspected. Corrosion of support column connections was noted in 2007. Recommended water storage based on system demand and fire flows is 258,000 gallons vs. 168,000 actual.

I. SCADA system is dated, lacks logic, and only acts as an alarm system.

J. The extent of polybutylene water service lines is unknown and is a concern. It is likely that these service lines will continue to be a source of future water system leaks.

K. Water system looping is not adequate to convey water for fire flows at the recommended 1500 GPM.

L. Existing well houses are showing signs of deterioration

  a. Chemical storage tanks should be separated from mechanical and electrical systems.
  b. Secondary containment should be provided.

c. Ventilation should be incorporated due to chemical storage and to regulate temperature. Mold is also an issue in both well houses.

d. Mechanical piping is severely oxidized and should be replaced.

e. System piping in well house 2/3 requires the subtraction of the meter reading from Well 3 from the total meter reading to compute Well 2 production due to mechanical system piping.

M. Water system pressures exceed recommended low and high pressure limits.

N. There are no well bypass flushing locations to remove solids at pump start up prior to pumping into the distribution system.

O. Security of well heads is deficient.

P. Security of water storage tank is deficient.

Q. Access and parking to well house1/4 and the water storage tank is deficient.

V. Alternatives Considered

Several alternatives were considered to improve various aspects of the system. Alternatives included regionalization with other water systems, onsite improvements, and offsite improvements. In some cases there are several alternatives within an alternative for components of the system. The alternatives focused on increasing system supply, providing system improvements to increase fire flow, and correcting known system deficiencies within estimated budget constraints of the subdivision.

A. Do Nothing Alternative:

The Do Nothing Alternative would not correct any of the known system deficiencies and would continue to operate as it has in the past.

1. During high pumping volume years from Well 2, CSHOA water system would continue to be in nonconformance with SDDENR regulations.

In 2010 the SDDENR completed a Public Water System On-Site Evaluation and presented the board with a report of the findings. Below are paragraphs from the SDDENR report that discuss chemical monitoring at wells 2 & 3:

Chemical monitoring has been required only from well #4 since 2004 when it began operating as the primary source of water for Countryside. Wells 2 & 3, because of elevated radiological chemicals, became standby sources.

The Drinking Water Program requires chemical monitoring from any source used more than 4 months a year, and at our option, if the source provides more than 25% of the supply. According to the water production records obtained during the inspection, wells 2 & 3 (combined entry point) provided half of the water in 2009.

Check pumpage records to verify the frequency and volume of use from each of the wells (entry points). Chemical monitoring of wells 2 & 3 may again be required if they continue to provide a significant percentage of water supply.

Based on recent records, CSHOA has continued to use more water from Well 2 than currently permitted by SDDENR (<25% of total for year and 4 months of operation). If the system continues to operate outside of the permitted limits of the SDDENR, the system could receive a formal enforcement action from the State Drinking Water Program to treat the radiological issue or stop using well 2.

"The goal of a formal enforcement action is to provide a mechanism for a water system to return to compliance with the State's drinking water regulations. A formal enforcement action will contain information as why the enforcement action is being issued, an administrative order outlining specific requirements a system must take to return to compliance, and enforceable penalties should a system fail to meet the requirements of the administrative order. In extreme cases a system may be referred to the Attorney General's Office for further legal action should the system continue to fail to comply."(State of South Dakota Drinking Water Program Enforcement Response Policy and Enforcement Targeting Tool)

2. **Maintenance costs would likely continue to rise as the system components reach their design life.**
3. **If system demand remains constant without an increase in supply, water outages would continue.**
4. **Unaccounted for water is not resolved.**
5. **Avoids or delays large capital expenditures**
6. **Water storage tank would continue to deteriorate to the point of failure.**

The Countryside Homeowners Association Board of Directors does not consider the Do Nothing alternative as an option for the system.

B. Connect to Regional Water Systems:

1. Colonial Pine Hills Sanitary District

The Colonial Pine Hills Sanitary District (CPHSD) is an incorporated sanitary district generally located on the south side of Sheridan Lake Road immediately south of CSHOA. The District provides water service to over 1,200 people with roughly 420 customers. The system has several Madison and Deadwood formation wells similar to CSHOA with similar issues of high radium levels in the Deadwood Wells and low production Madison wells. The system is currently in the process of planning a water filtration plant to treat well water under the influence of surface water to maintain system production. Connection to the system would likely require CPHSD to annex CSHOA thus 60% of the association and district would need to agree to a merger. If annexation would take place CSHOA would likely be split into two pressure zones and looping would take place at multiple locations across Sheridan Lake Road to merge the systems.

Another option would be a single connection bulk water sale from CPHSD high zone with a pressure reducing valve to the CSHOA system.

Since CPHSD does not have excess production capacity of 100-165 GPM to provide to CSHOA, this alternate is not preferred by the Board.

2. City of Rapid City

Bulk Water Sale w/No Annexation: Initial review of options to connect to the City of Rapid City water system revolved around bulk water sale options and included:

a. Connection to the CORC Selador Zone at Meadowlark Drive at the separation point between Countryside and Red Rocks Subdivision. A pressure reducing valve would be used to reduce system pressure from HGL 4220 to 4120+/-. This option would act as an emergency source of water and would draw water from the Selador Zone and maintain a minimum water pressure in the CSHOA system. Infrastructure would likely consist of a vault type structure with PRV and water meter.
b. Connection to CORC Carriage Hills Zone and Booster Pump Station off of Muirfield Drive. This option would pump water from the Carriage Hills Zone into the CSHOA system via a new booster pump station located near well house 2/3.

Both of these alternates would provide water supply in recommended quantity and quality to the CSHOA water system but would not address any of the additional system issues discussed above in the Summary of Known System Issues.

CETEC and two board members from CSHOA met with City of Rapid City staff to further vet bulk water sale options. City of Rapid City staff referred to City policy 100.009 titled "Resolution Establishing a Policy Regulating the Provisions of City Utility Services to Property Located Outside of the City Limits." The policy states "If the property is contiguous to the City limits at the time the City utility services are requested, the property shall be annexed prior to services being provided." Staff indicated that because CSHOA is contiguous to the City of Rapid City, staff would recommend to the Common Council to follow the policy. Further engineering evaluation of these options was not completed. A copy of the policy is attached in the appendices. Bulk water options from the CORC carry the following stipulations:

- Water cost of 150% of the retail water rate
- Property owner agrees not to annex into any other system
- Property owner will agree to annexation in future or cost of water is 300% of retail cost

Annex into the City of Rapid City:

At the above referenced meeting, City Staff indicated, in good faith, several water system improvements that would be necessary if CSHOA decided to annex into the City. The list below summarizes items from said meeting. This list may or may not be complete and actual items will not be finalized until an annexation request is brought forward.

a. City would own and operate the water system, thus CSHOA would no longer be in the water business.

b. A new water storage tank would not be needed.

c. CSHOA would be split into the CORC Selador Pressure Zone and Carriage Hills Pressure Zone.

d. Selador Zone would receive water from Red Rock Booster station. Red Rock Booster Station pumps would need to be replaced with pumps of greater pumping capacity in order meet fire flow requirements.

e. Two connections from CSHOA to each CORC zone will be required.

f. Polybutylene services lines would not need to be replaced, but would remain the responsibility of the homeowner all the way to the water main.

g. Each property Owner would be a customer of the City of Rapid City.

h. Water meters would need to conform or be modified to work with CORC meter system.

i. Location of existing utilities would need to be established for the City.

j. Non-conforming services would need to be identified. Lines would be permitted non-conforming.

k. Water service to the Paulson Lot(adjacent to Sheridan Lake Road) would need to be discussed and determine if that property would be annexed as well. This lot is not currently part of the CSHOA.

l. Water main looping within the subdivision would be necessary to meet fire flows requirements of 1000 GPM for structures under 3600 square feet and 1500 GPM for structures over 3600 square feet.

Scope of Improvements for City of Rapid City Annexation:

Based on the above meeting comments the estimated scope of improvements necessary to connect to the City of Rapid City include but may not be limited to the following:

a. 8" PVC water main loops for Selador and Carriage Hills Zones, Meadowlark to Prestwick – this improvement would install two water mains from Prestwick Street in Red Rocks Subdivision to Meadowlark Drive in Countryside Subdivision. This would make one connection each for each zone. Location for this connection would have to cross the existing Red Rocks Golf Course. Exact location for this connection would be decided based on availability of easements. These connections are not immediately necessary and could be phased at a later date.

b. 8" PVC connection at Meadowlark Drive. This connection would connect the existing mains at the boundary between the subdivisions and would be the second connection to the CORC Selador Zone.

c. 8" PVC connection from Tanager to Muirfield. This connection would be the second connection to the CORC Carriage Hills Zone. The likely location for this connection would be within the Sheridan Lake Road Right-of-Way.

d. 8" PVC water main loop Tanager to Raven Circle – This loop would be necessary to increase fire flows to recommended levels within the subdivision.

e. 8" PVC water main loop Waxwing to Pinon Jay – This loop would be necessary to increase fire flows to recommended levels within the subdivision. This connection would also be necessary to connect Waxwing and Crossbill Circle to the Selador Pressure Zone.

f. Pump Upgrades within Red Rocks Booster Station – City Staff indicated that the existing booster pumps within the Red Rock Booster Station would need to be upsized in order to provide recommended fire flows to CSHOA. Total pump capacity of the booster station would need to include peak day plus fire flows of 1500 GPM.

g. Locate water system components for the CORC – CSHOA would be required to GPS/GIS all of the water system components within the subdivision so location of the all of the infrastructure would be known at the time of transfer.

h. If it is determined that the existing wells within CSHOA will not be used for further use, the wells would need to be abandoned per SDCL 74:02:04:67.

i. Abandon and remove the existing steel water storage tank and distribution piping to the tank. The existing tank would not be needed if the CSHOA system is tied to the CORC water system.

j. Isolation valve in Tanager – An isolation valve would need to be installed in Tanager Drive near the intersection of Kingbird Court to create a pressure separation between the Selador and Carriage Hills Pressure Zones within the existing CSHOA system.

Locations for these improvements are shown on Figure 10.

C. Existing Water System Improvements

The alternates evaluated in this section focused on cost effective ways to optimize, improve, and replace existing system components. Goals include a gain in supply, provide water quality in conformance with SDDENR standards, improve system reliability, increase fire flow and reduce customer service interruptions. These alternates assume no regionalization and City connections would not be completed.

Supply

Well 1 is not currently in operation due to high levels of radium and is classified as emergency only.

One alternate would involve bringing Well 1 back online and blending with Well 4 water to produce a higher volume of water with quality meeting SDDENR radium regulations. Exact blending ratio is unknown, but it is estimated that an additional 30 GPM could be added to the production capacity by bringing Well 1 back online. It would likely require a new well pump and pump control (VFD etc.). The unknown in this alternate is the condition of the existing well casing. It is 30+ years old and this option may only add 10-20 years of utility to this well.

A second alternate that was reviewed would treat the radium water at Well 1 with a radium removal technology. Access to Well 1 and Well 4 is limited and requires parking on Waxwing Lane and walking down a steep sidewalk to the well house, this alternate was not evaluated further. Access is essential for system operation to be able to load and unload radium removal treatment equipment.

A third alternate considered building a transmission main from Well 1 to Well 2/3 site for treatment, but was dismissed due to high cost.

Protection of the well head should be considered in any alternate.

Well 2 is currently in operation and is typically pumped in the summer peak demand times only. Similar to Well 1, its radium levels exceed water quality regulations and it is currently blended with Well 3.

One alternate would involve treating Well 2 with radium removal technology. In order to bring Well 1 back online and to be used to blend with Well 4, Well 2 would need to be treated. The advantage of this alternate is the site location at Well 2 is easily developed and there is room to place necessary buildings along with existing utilities. This alternate would purchase radium removal equipment and build a new well house. Well 3 would be routed and metered within the new well house. Treating Well 2 would also allow the well to be operated at peak pumping capacity at roughly 126+ GPM. Well bypasses at this location can also be easily implemented.

Protection of the well head should be considered in any alternate.

<u>Well 3</u> is currently in operation and is used to supplement Well 4.

Well 3 was reviewed to see if the well could be drilled out and extended to the Madison aquifer to gain additional supply. The existing well is only 5" and thus would require a 4" casing to be slipped in from the existing casing depth down to the Madison. The 4" casing would require a 3" pump which would limit pumping capacity to the limit of the existing well.

A second alternate would leave the well itself along and involve replacing the existing Well 2/3 house as discussed in the Well 2 treatment alternate. Well 3 would not go through the radium removal process but chlorine and fluoride would be added in the combined use well house.

Protection of the well head should be considered in any alternate.

<u>Well 4</u> is the newest well and would not have any changes other than protection of the well head.

It is recommended that ventilation; chemical separation, secondary containment, replacement of insulation and wall coverings, SCADA improvements, and replacement of well house mechanical piping take place within the combined well house for Wells 1 and 4.

<u>Drill New Well – Onsite</u>

Several well logs including all wells for the CSHOA system, the Cregut well south of Sheridan Lake Road, the State owned test well, and the Red Rock well were reviewed. Generally speaking, the Madison Aquifer formation under CSHOA is a tight limestone formation and produces wells in the 20-50 gallon per minute range. It is likely that a new well would yield roughly 40 gallons per minute. Due to the uncertainty, risk, and cost associated with drilling a new well, this alternate was not considered further. Preference of the board would be to treat existing Well 2 as existing capacity is a known quantity.

<u>Drill New Well – Offsite</u>

Due to synclines and anticlines in the Madison formation east of the subdivision confirmed by existing well data (most notably Well 12 of the CORC), the probability of success in drilling a higher yielding well increases substantially roughly 5,000-7,000 feet east of the subdivision. Well 12 of the City of Rapid City pumps at 1600 GPM.

This alternate would involve securing a well site/easement, drilling a well, pumping water from the well west 5,000-7,000 feet to the subdivision and either treating the water at the new well site or through modifications of Well house 2/3. Conceptual costs for this alternate are $1.5M+ unknown easement costs. When this cost is combined with necessary internal system improvements such as a new storage tank etc., this option is not considered further due to high cost.

Storage

The existing storage tank is nearing the end of its design life. The existing capacity is 90,000 gallons less than the recommended 258,000 gallons. The tank is 30+ years old and leaks in the tank continue to form but have been repaired each time it has been inspected. Settlement of the foundation was also noted in the inspection reports. A copy of the inspection reports from 2007 and 2011 are included in the appendices.

One alternate would be to replace the existing tank with a new tank located on the same tank easement. The proposed tank would be 258,000 gallons and would provide necessary operating storage with fire flow reserves. It is recommended to include SCADA upgrades with the construction of a new tank and run the system off of pressure transducers with the storage tank. Since the existing tank is nearing its design life, has corrosion of interior structural components, and settlement of the foundation around the inlet/outlet piping, rehabilitation may or may not be an option. It is recommended that the existing tank continue to be used until such time that maintenance (fixing leaks etc) of the tank does not fiscally appropriate. It is also recommended to increase the inlet/outlet works on the storage tank to increase fire flow availability. Existing maps of the system indicate that the inlet/outlet works may have been reduced to a 6" diameter. pipe.

The Do Nothing alternate would leave the system susceptible to future system leaks, increased maintenance costs and potential tank failure.

Distribution

Figure 2 illustrates the existing distribution system. Except the well feed lines to the system, the distribution system is a mix of 8" and 6" PVC distribution mains. Estimates of design life for PVC mains vary, but it is common to use 50-75 years for PVC mains. The existing mains are roughly 30 years old and thus may have 20-40 year of design life remaining. Cathodic protection of the water main fittings is unknown and the fittings may corrode before the estimated design life of the PVC pipe. Design alternates for distribution are focused on system looping to increase fire flow availability. Service line materials are known to be inferior and will have a shorter life than the water mains.

One alternate would be to create a loop from Raven Circle to Tanager Drive. Fire flows for the east side of CSHOA are limited due to the 6" PVC distribution main starting at the intersection of Tanager Drive and Meadow Lark. The proposed loop would follow the existing sidewalk connection from Raven Circle to Tanager Drive and provide a secondary route for water to be conveyed to the eastern part of the subdivision. Proposed loop would be 8" in size. Refer to the water model scenario 3 for modeled fire flow increases.

A second alternate involves creating a water system loop from Waxwing to Pinon Jay Circle. Similar to the loop for Raven Circle, the connection provides a secondary route for water to be conveyed to the system thus increasing fire flows throughout the system. Currently, if there was a water main break in Meadowlark, the majority of the system would be out of water unless the well pumps were turned on to pressurize the system. This loop increases system reliability and reduces the dependence on the well pumps if there is a main break on Meadowlark. Refer to the water model Scenario 3 for modeled fire flow increases as a result of this connection.

A third alternate involves increasing the size of the main from the storage tank to the distribution system. The existing size of the main is unknown. Existing mapping indicates both 8" and 6". The existing scenario was modeled at 8" in diameter. It is recommended to increase the size of the main from 8" to 12". This increase allows ample water to flow from the tank to the distribution system. This alternate is essential to improve the fire flows within the system and is required in order for Alternate One and Alternate Two to increase flows to the recommended 1500 GPM.

A final alternate would not install any looping within the system. Fire flow capacity would remain at levels less than recommended based on recommended design criteria.

SCADA System Upgrades

The existing SCADA system consists of a variety of components of various ages. Pressure transducers within the tank were abandoned in the past and installed within the well houses to control pump start up and shut down. Shut off points for the well pumps have to be offset from actual due to head losses within the well house piping.

Any alarm for the system requires the operator to travel to the system to trouble shoot. VFD's must be controlled manually. The system lacks a logic controller and is essentially an alarm system.

New radio equipment, software, computer, and remote login capability would allow the system to reduce water operator time and thus cost over time. In addition, remote login would allow the possibility of remotely troubleshooting an issue.

Due to the age of the current system and components, a system wide approach is recommended for the SCADA system. Recommended improvements include: transducer in tank, new radio controls from tank to well houses, HMI panels in well houses, PLC and computer control system with backup power in well house 2/3 with system remote access. Remote access should allow access to the system with capabilities to start pumps and control and trouble shoot the system from any login computer terminal.

It is also recommended that several individuals from the CSHOA water committee be trained by the water operator on system operations in the unlikely event of an emergency where the operator could not respond.

A final alternative would be to leave the system as is. This does not address the issue with the aging system and does not improve response time or control capabilities. System efficiencies are not improved.

Figure 9
RECOMMENDED ON-SITE WATER SYSTEM IMPROVEMENTS

Countryside Water System Improvements

cetec ENGINEERING SERVICES, INC.

September 25, 2012 8:36:43 a.m.
Drawing: FIGURE9.DWG (Schille) \\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\

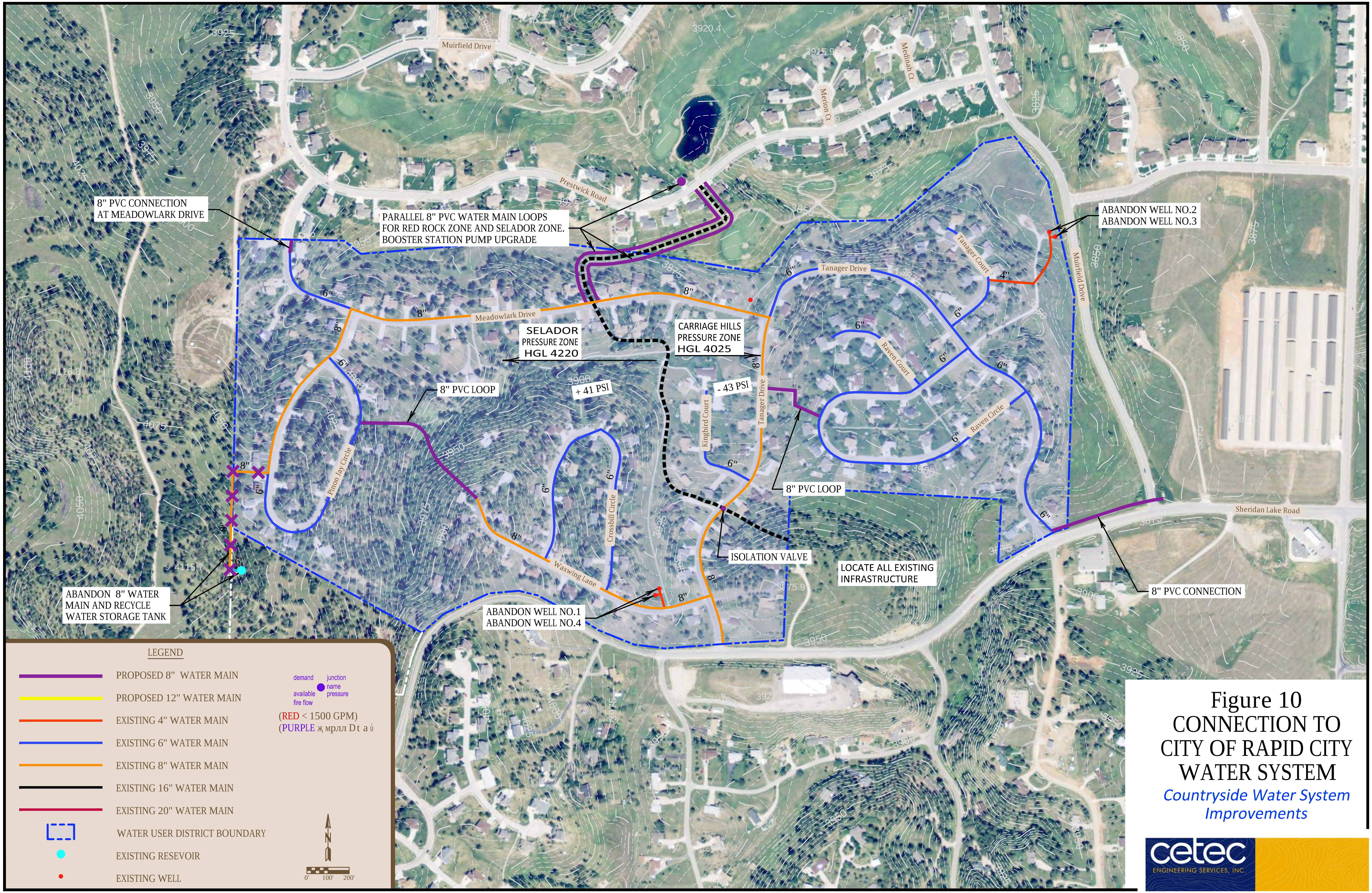


Figure 10
CONNECTION TO CITY OF RAPID CITY WATER SYSTEM

Countryside Water System Improvements

September 25, 2012 8:37:27 a.m.
Drawing: FIGURE10.DWG (Schille) \\MAIN-DATA\CETEC\PROJECTS & PROPOSALS\12107.00 COUNTRYSIDE WATER SYSTEM EVALUATION AND IMPROVEMENTS\DRAWINGS\FIGURES\

VI. Selection of an Alternative

At the time of this report, CSHOA requested that two alternates be reviewed. One alternate would involve system improvements necessary to bring the system up to current design standards/ recommendations and the second alternate would involve improvements necessary to connect to the City of Rapid City per discussions. Based on the alternatives considered, recommendations for the most necessary and appropriate improvements were determined and are discussed below. The locations of the recommended alternates are shown in Figures 9 and 10.

1. Existing Water System Improvements

Item	Description	Advantages	Disadvantages
Well 1	• Bring Well 1 back online and blend with Well 4 to meet summer peak demand and to use as an emergency source. • Provide well by-pass • Replace interior system piping and interior wall coverings. Install vent fans and louvers • Provide secondary containment within well house	• Uses existing infrastructure and developed site. • Increases system supply by 31 GPM. • Reduces sediment from well from being pumped into distribution system • Creates maintainable system piping. • Separates system chemicals • Provides secondary containment per regulations	• Cost of VFD or other well drive equipment and possibly a well pump. • Per regulations, limited allowable volume of water and can only be used in summer months due to water quality. • Casing life is unknown. • Only an option if Well 2 is treated for radium • Cost of well house piping and interior improvements
Well 2	• Treat Well 2 with radium removal technology • Provide well by-pass	• Would allow Well 2 to be used at peak pumping capacity increasing system supply • Would provide quality water per regulations. • Uses existing well infrastructure • Existing site is conducive to further system development. • Easements will not be needed. • Reduces sediment from well from being pumped into distribution system	• Expensive technology and upfront capital costs • Cost of system maintenance and cost of disposal of radioactive waste • Multi-year service contracts. • Will require new well house to house treatment equipment. • Would likely only be needed in summer months

Item	Description	Advantages	Disadvantages
Well 3	• Route Well 3 into new well house required for Well 2 treatment • Provide well by-pass	• Provides central location for Well 2 and 3 treatment and chemicals • Replaces deteriorated mechanical piping and deteriorated well house • Reduces sediment from well from being pumped into distribution system	• Cost • Supply from Well 3 will not be increased.
Well 4	• Replace interior system piping and interior wall coverings • Provide well by-pass • Provide secondary containment within well house	• Uses existing infrastructure. • Creates maintainable system • Reduces sediment from well from being pumped into distribution system • Provides secondary containment per regulations	• Does not increase system supply from Well 4.
Water Storage Tank	• Construct new 260,000 gallon water storage tank	• Provides system with recommended supply for equalization storage and fire reserves. • Replaces existing aging water storage tank.	• Cost of new infrastructure • Existing easement will need to be amended. • Does not address high and low pressures within the system.
Upsize water Main from Tank to Pinon Jay 8” to 12”	• Upsize main from tank to distribution piping in Pinon Jay	• Increases system capacity to provide fire flows throughout the system. Improves system hydraulics • Is required for other loop options to significantly increase fire flow	• Cost
8” PVC Water Main Loop Raven Circle to Tanager Dr	• New distribution main loop from Raven Circle to Tanager Drive	• Increases system capacity to provide fire flows • Provides secondary water supply route if main break in Tanager	• A water main easement will be necessary • Cost • Temporary easements
8” PVC Water Main Loop Waxwing to Pinon Jay	• New distribution main loop from Waxwing Lane to Pinon Jay Circle	• Increases system capacity to provide fire flows • Provides secondary water supply route if main break in meadowlark	• Cost • Construction difficulties associated with steep terrain • Mature tree removal

Item	Description	Advantages	Disadvantages
SCADA System Upgrades	• Upgrade system components and improve system communication capabilities. Implement security upgrades when possible.	• Replaces antiquated system • Allows for more accurate system operation and system reporting • System operation can happen remotely via computer login. • Alarms can be categorized so operator can respond accordingly and efficiently	• Cost • Requires communication system components at major facilities.

2. Connect to Regional Water System – City of Rapid City

Description	Advantages	Disadvantages
▪ 8" Water Main connections for Carriage Hills and Selador Pressure zones, Meadowlark to Prestwick	▪ Creates connection from CORC pressure zones to CSHOA system ▪ Connects to reliable supply with regulated quality and recommended quantity. ▪ Improves system hydraulics. ▪ Improve system reliability. ▪ Increases pressure in high elevations (+36 psi+/-) and decreases pressure in low elevations (-48 psi+/-) resolving CSHOA pressure issues.	▪ Most direct alignment crosses golf course and in between developed residential areas. ▪ Easements will be necessary for direct route ▪ Cost of new infrastructure.
▪ 8" Water Main connection at Meadowlark for Selador Pressure Zone	▪ Creates second loop connection to CORC Selador pressure zone. ▪ Connects to reliable supply with regulated quality and recommended quantity ▪ Improves system hydraulics. ▪ Improves system reliability ▪ Increases pressure above pressure zone boundary (+36 psi +/-) ▪ Connection can be made within existing CORC ROW and CSHOA easements	▪ Cost of new infrastructure.

Description	Advantages	Disadvantages
▪ 8" Water Main connection from Muirfield to Tanager, Carriage Hills Pressure zone	▪ Creates second loop connection to CORC Carriage Hills pressure zone ▪ Connects to reliable supply with regulated quality and recommended quantity ▪ Improves system hydraulics ▪ Improves system reliability ▪ Decreases pressure below pressure zone boundary (-48 psi +/-) ▪ Connection can be made within existing ROW's and CSHOA easements	▪ Cost of new infrastructure
▪ 8" PVC Water Main Loop, Raven Circle to Tanager Drive	▪ Increases system capacity to provide fire flows ▪ Provides secondary water supply route if main break in Tanager	▪ A water main easement will be necessary ▪ Cost ▪ Temporary easements
▪ 8" PVC Water Main Loop, Waxwing Lane to Pinon Jay Circle	▪ Required to provide Selador Pressure to homes on Waxwing Lane, Crossbill Circle and a portion of Tanager Drive. ▪ Increases system capacity to provide fire flows by improving system hydraulics	▪ Cost ▪ Construction difficulties associated with steep terrain ▪ Mature tree removal
▪ Pump Upgrades at Red Rock Booster Station to increase pumping capacity	▪ Would allow existing booster station to provide 1500 GPM fire flows to Selador Pressure Zone. ▪ Recommended fire flows would be provided to Selador Pressure Zone.	▪ Cost ▪ Money not spent directly improving CSHOA.
▪ Install pressure zone isolation valve in Tanager Drive	▪ Necessary to crease pressure zone separation between Selador and Carriage Hills pressure zones.	▪ Cost

Description	Advantages	Disadvantages
▪ Locate existing CSHOA Water System Components (valves, mains, curb stops, water services)	▪ Knowing where system components are located allows for improved system operation, maintenance, leak detection, and minimizes extent of water outages when repairs are needed ▪ Allows for mapping of system ▪ Accurate mapping of system components aids in emergency repairs completed by people that are unfamiliar with the system	▪ Cost to find and map existing system components. ▪ May require excavation in landscaped areas
▪ Abandon Existing Wells	▪ In compliance administrative rule 74:02:04:67	▪ Cost associated with abandoning well. ▪ Abandonment requires well to be plugged so once abandoned, process cannot be reversed

3. Factors for Consideration:

1. The extent of the polybutylene service lines within the subdivision is not known and thus was not included in the above discussion. If the system connects to the City of Rapid City water system, responsibility for the service line within the right-of-way will transfer from CSHOA to the homeowner. If the system does not connect to the City of Rapid City, responsibility within the right-of-way will remain with CSHOA. It is likely that the polybutylene water service line leaks will continue and it is recommended that CSHOA budget accordingly to be able to respond to leaks within the right-of-way or replace portions within the right-of-way when homeowners replace failing lines on easements and private properties.

2. Connection to the City of Rapid City would provide a reliable source of quality water for CSHOA; however per policy 100.009, annexation will be required. Below is a summary of additional items for consideration for annexation. The items are based on the previously referenced discussion with City of Rapid City Staff:

   a. Tax cost would increase 3%-5% based on previous studies of subdivisions nearby. Example: existing property taxes are $3000. Estimated taxes would increase by $150 to $3150.

   b. CSHOA would need ¾ of the registered voters to sign petition and ¾ of the property value. Total valuation is $40,751,900 so ¾=$30,563,925.

   c. Garbage collection by CORC.

   d. Snow removal by CORC

   e. Opportunity to vote in CORC elections

   f. CSHOA would continue ownership and maintenance of all common property.

   g. Rule of thumb - Building permits, rezoning, and subdividing will trigger review of city building requirements for streets, sidewalk, street lights etc.

h. Water service to the Paulson Property would need to be discussed. Determination if property would annex with CSHOA or not and non conforming water service would need to be addressed.

i. Sewer, streets, curb and gutter, sidewalk, and lights would need to be discussed in detail. In general, the CORC did not indicate that specific upgrades would be necessary. Septic tanks would be permitted non-conforming and would fall under the CORC septic policy.

j. CSHOA members would become customers of the City of Rapid City. Thus CSHOA would no longer operate a water system.

    i. Existing system components not needed for distribution would likely be removed or abandoned over time.

    ii. CORC is not interested in acquiring of the existing wells, buildings, storage tank etc.

    iii. CSHOA would no longer require a water system operator, water system chemicals, electricity for pumps etc.

k. Ownership of the debt/loan incurred to complete the improvements to the water system was discussed without option determination:

    i. One option would involve the City of Rapid City completing the water system improvements and adding a surcharge onto the water bills to pay for the necessary improvements. This option would simplify the logistics of collecting water fees and paying off the improvement costs. The option would also allow the CORC to phase and coordinate the improvements with its own comprehensive utility system master plan.

    ii. Another option would be for CSHOA to acquire the loans, complete the improvements and then the City acquire the debt when annexed. Again a surcharge on the water bill would be used to pay off the loans.

    iii. Another option would be for the HOA to acquire the loans and complete the improvements. The City would have an operator agreement with CSHOA to run, operate, and maintain the water system until the debt is paid off. The City would then take ownership.

VII. Proposed Project – Recommended Alternative

At the date of this report, the CSHOA Board of Directors was still in the process of gaining input from the subdivision homeowners and thus a proposed project – recommended alternate has not been decided. Below is a summary of the estimated costs for improvements listed for each project in chapter VI of this report. Additional cost estimate details are located in the appendices. Locations for the improvements are shown on Figures 9 and 10.

1. Recommended On-Site CSHOA Water System Improvements:

i. Supply

- Treat existing Well 2 to remove radiological contaminants
  - Would require a new well house near existing Well house 2/3. Estimated building size would be 20' x 30'
  - Would allow Well 2 to be used at peak pumping capacity.
  - Large capital costs and long term maintenance contract for disposal of radiological contaminated material…Additional $16,000/year.
  - Would likely only be needed during summer months.
- Rehabilitate Well 1 so it can be blended with Well 4 water.
  - Well 1 water contains radiological contaminants thus it would only be used in the summer during peak demands. Well 1 would be restricted to only 4 months of use and less than 25% of total volume of year.
- Supply Summary
  - Well 1 – 31 GPM (blend 50/50 with Well 4 for summer or emergency use only)
  - Well 2- 120 GPM
  - Well 3 – 40 GPM
  - Well 4 – 31 GPM
  - TOTAL 222 GPM, which is close to 234 GPM recommended. NOTE: In emergencies or if Well 2 is out of service then increase flow on Well 1.

ii. Storage

- Construct 260,000 gallon water storage tank and upsize main from Tank to Pinon Jay to increase system Fire Flow.
- Remove and Recycle Existing Storage tank when leak fixing and maintenance become cost prohibitive.
- Does not resolve low and high pressures within the existing system.

iii. Distribution

- 8" Water Main Loop Raven Circle to Tanager
- 8" Water Main Loop Waxwing to Pinon Jay
- Well House 1 and 4 Upgrades

- Replace mechanical piping and valving
- Ventilation louvers
- New insulation and interior wall paneling
- VFD's for Well 1 and 4
- Electrical upgrade allowance

iv. Controls – SCADA System Upgrades

- Install transducer within tank
- Auto-dialer and related work
- HMI panels in well houses 1 and 4 and 2 and 3
- PLC Controller and related work
- Digital based radio system
- PC and Software.

The total estimated project costs for the projects recommended are summarized below. The costs shown include contingency and engineering fees, and were completed with the best information available prior to actual design. Detailed cost information is provided in Appendices. All costs are in 2012 dollars.

Preliminary Estimate of Recommended On-Site Water System Costs

8" Water Main Loop Raven Circle to Tanager		$65,000
8" Water Main Loop Waxwing to Pinon Jay		$120,000
Well House Upgrade for wells 1 and 4		$55,000
Radium Removal Treatment of Well 2 and New well house for wells 2 and 3**		$400,000
New 260,000 Gallon Water Storage Tank and Water Main Upsize		$500,000
SCADA Upgrades		$65,000
Legal Allowance		$20,000
SUBTOTAL		$1,225,000
Estimated TOTAL with 5% project cost inflation per year	2013	$1,286,250
	2014	$1,350,562
	2015	$1,418,090

**Does not include annual cost of $16,000 for disposal of radiological contaminated material.

Annual Operating Budget

Countryside Subdivision currently operates at or very near a balanced budget. Prior to 2011, the subdivision did not have separate accounting for the water system. The subdivision recently increased water rates as a result of an internal study that indicated that the water system was being subsidized by homeowner's dues by approximately $750/month. Total expenses in 2011 were $141,381 and $66,389 was related to water system cost so it is estimated that between 45%-50% of the expenses each year were costs associated with running the water system. Revenue specific water information was not available for comparison, but average cost per customer to operate and manage the system in 2011 was $66,389/197/12 = $28.08/month/customer.

	2006	2007	2008	2009	2010	2011
Total Revenue	$103,325	$109,907	$125,335	$139,760	$135,982	$144,525
Total Expenses	$96,876	$98,266	$101,693	$107,563	$125,105	$141,381
Increase in Net Assets	$6,449	$11,641	$23,642	$32,197	$10,877	$3,144
Assets - Cash, CD's, Savings, Interest	$206,889	$233,422	$232,285	$283,210	$312,617	$333,781
Assets - Property & Equipment less Depreciation	$120,533	$105,641	$130,420	$111,692	$93,162	$75,142
Assets - Unrestricted Beginning of Year	$320,973	$327,422	$339,063	$362,705	$394,902	$405,779
Assets - Unrestricted End of Year	$327,422	$339,063	$362,705	$394,902	$405,779	$408,923

Estimated Monthly Water Rate Cost Analysis Per Customer: 20 Year Loan at 3%.

2014 Project Cost: .... ($1,350,000)

CSHOA Funds: .... $300,000 ($30,000 remaining for debt service and short lived assets)

Total Estimated Loan Amount: .... ($1,050,000)

Monthly Water Bill (Based on 7500 gallons) $35.00

Loan Payment for $1,050,000 (20 yr at 3%)..................................$29.56

Estimated Radium Disposal ($16,000/197/12) ....$ 6.77

Total Estimated Monthly Water Bill using minimum usage: **$71.33**

It is recommended to keep the water rate at $35.00 to maintain a capital reserve for water service leak repairs and replacements in the future.

2. Connect to Regional Water System – City of Rapid City

i. Supply

- CSHOA would be split into two pressure zones:
  - Carriage Hills Zone would provide water via ground storage reservoirs to approximately 91 of 197 water users
  - Selador Zone would provide water via constant pressure booster station (Red Rock Booster) to approximately 106 of 197 water users.
- Existing supply sources for CSHOA would not be used to provide service to the system
- Abandon existing water wells.

ii. Storage

- Water for Carriage Hills Zone is stored in a 3 MG water storage reservoir located on the west side and adjacent to Countryside Subdivision. The reservoir is commonly referred to as the Red Rock Reservoir.

- Pump upgrades in Red Rock Booster Station - Per CORC staff comments, even with the addition of 106 water users to the Red Rock Booster Station, there is still not enough volume to trigger the construction of the future Selador water tank thus water will be boosted from Carriage Hills zone to Selador zone via constant pressure booster station.

iii. Distribution

- 8” Water Main Loop Raven Circle to Tanager
- 8” Water Main Loop Waxwing to Pinon Jay
  - This loop is necessary to connect Waxwing and Crossbill to the Selador Pressure Zone.
- 8” Connection at Meadowlark
- 8” Connection for each pressure zone, Meadowlark to Prestwick
- 8” Connection Tanager to Muirfield
- Locate all of the existing water system components for CORC.
- Install an isolation valve or separate pressure zones within Tanager Dr. at pressure zone boundary between Carriage Hills and Selador Pressure Zones.

iv. Controls – SCADA

- City of Rapid City SCADA system would control

The total estimated project costs for the regionalization of the system are summarized below. The costs shown include contingency and engineering fees, and were completed with the best information available prior to actual design. Detailed cost information is provided in Appendices. All costs are in 2012 dollars:

Preliminary Estimate of Regionalization Water System Costs

8” Water Main Connection for Each Zone, Meadowlark to Prestwick	$200,000
8” Water Main Connection Tanager to Muirfield (Carriage Hills Zone)	$55,000
8” Water Main Loop Raven Circle to Tanager	$65,000
8” Connection at Meadowlark (Selador Zone)	$10,000
8” Water Main Loop Waxwing to Pinon Jay	$120,000
Pump Upgrade *Allowance in Red Rocks Booster	$50,000
Locate water system components for CORC	$7,000
Abandon existing water wells	$50,000
Isolation valve for pressure zones in Tanager	$7,000
Legal Allowance	$20,000
Easement Allowance	$20,000
SUBTOTAL	$604,000

*Because the pump upgrade will benefit the CORC and CSHOA the cost allowance is estimated on pump replacement only and does not include any potential ancillary (mechanical, electrical, SCADA) costs.

Estimated TOTAL with 5% project cost inflation per year .... 2013 .... $634,200
.... 2014 .... $665,910
.... 2015 .... $699,205

Estimate Monthly Water Rate Budget Cost Analysis Per Customer: 20 Year Loan at 3%.

2014 Project Cost: .... ($665,910)	
CSHOA Funds: .... $300,000 ($30,000 remaining for debt service and short lived assets)	
Total Estimated Loan Amount: .... ($365,910)	
Monthly Water Bill (Based on 7,500 gallons at CORC Rate)	$38.20
Estimated increase in property taxes $150/yr	$12.50
Loan Payment for $365,910 (20 yr at 3%)	$10.39
Total Estimated Monthly Water Bill using minimum usage:	**$61.09**

VIII. Conclusions and Recommendations

The Countryside Homeowners Association water system is in need of rehabilitation. Water supply and storage quantities are at less than recommended levels. Peak summer water demands require Deadwood Formation Well 2 to be used to supplement supply in excess of regulated radium levels. The existing well houses and SCADA system are in need of refurbishment and replacement respectfully.

Upgrades, including general system repairs and complete system replacements, are recommended. Several alternatives were reviewed and have been presented. One Alternate includes rehabilitation and replacement of various system components and CSHOA would continue to own and operate its water system. A second alternate would connect CSHOA to a City of Rapid City regional water system but would require annexation to the City of Rapid City. At the time of this report, a final decision by CSHOA on which Alternate to pursue was not made.

Either alternate will benefit the system by providing a reliable water supply, enhanced system hydraulics for fire flows, and improved capabilities for monitoring and quickly responding to system problems.

Appendix A

City of Rapid City Policy 100.009 Resolution Establishing a Policy Regulating the Provisions of City Utility Services to Property Located Outside of the City Limits

A RESOLUTION ESTABLISHING A POLICY REGULATING THE PROVISION OF CITY UTILITY SERVICES TO PROPERTY LOCATED OUTSIDE THE CITY LIMITS

WHEREAS the City of Rapid City has established water and sewer systems; and

WHEREAS the City of Rapid City is growing and new property is regularly annexed into the City; and

WHEREAS the City of Rapid City desires to support orderly growth and development and extension of infrastructure; and

WHEREAS the City of Rapid City desires to ensure the beneficiaries of the extension of City utility service bear the cost thereof rather than the utility customers; and

WHEREAS the utility services provided by the City of Rapid City to property located outside of the City limits constitutes an expense to the taxpayers of the City of Rapid City; and

WHEREAS the City of Rapid City determines it is in the best interests of the City of Rapid City to establish a policy that encourages the annexation of property located outside of the City limits that receives City utility service;

NOW, THEREFORE, BE IT RESOLVED by the City of Rapid City that the City hereby adopts the following policy to regulate extraterritorial provision of utility services:

The Rapid City Council will consider providing water and/or sewer utility services to property located outside of the corporate limits when the utility extensions are necessary to serve either existing or proposed development. If utility services are provided to property located outside of the City's corporate limits, it is desirable that both water and sewer services be extended when physically and economically feasible. If the City Council decides to extend utility services outside the corporate limits the applicant will comply with the following requirements:

1. The water and wastewater service shall be sold/provided at 150% of the retail water/wastewater rate charged to customers within Rapid City.

2. If the property is contiguous to the City limits at the time the City utility services are requested, the property shall be annexed prior to services being provided. If the property is not contiguous to the city limits at the time service is requested, the owners of all property served shall, pursuant to SDCL 9-4-4.1, enter into an irrevocable agreement and covenant running with the property. The covenant agreement shall contain the following provisions:

    A. The property owner will agree to voluntary annexation of the property at such time as the property becomes contiguous to the City limits.

B. The property owner will agree that should they refuse to consent to annexation at the time that the property becomes contiguous to the City limits that they will pay 300% of the retail water/wastewater rate charged to customers within Rapid City. Prior to the higher rate being imposed the property owner will have 60 days from the date they are requested by the City to agree to a voluntary annexation to consent to the annexation.

C. The property owner will agree not to join a rural water, sanitary, or any other district that is involved in providing water/sewer services.

3. Once the property is annexed into the City, the rate charged for services shall be the same rate as the rate charged to all customers residing within the corporate limits of Rapid City.

4. Those requesting service shall pay all of the costs of improvements, including but not limited to the master planning of facilities, as well as the design and oversizing costs required to extend the utility services. All improvements shall be constructed in accordance with the adopted standards of the City of Rapid City and the State of South Dakota. System improvements shall be transferred to the City, at no cost to the City, at the time water or sewer service is provided by the City. No service shall be provided by the City until the system improvements have been donated to the City. If the property is annexed into another municipality, the City of Rapid City shall no longer provide utility services.

5. The same conservation standards shall apply to property located outside the corporate limits as those applied to property located inside the corporate limits.

6. This Resolution will not apply to any existing contracts unless the existing contracts are expanded on or revised at which time they will become subject to this resolution.

DATED this 16 day of May, 2005.

CITY OF RAPID CITY

[signature]

Mayor

ATTEST:

[signature]

Finance Officer

(SEAL)

APPROVED AS TO FORM
CITY ATTORNEY'S OFFICE

[signature] 6-14-05

Attorney Date

Appendix B

MIDCO Diving and Marine Service
Water Tank Inspection Reports

Diving & Marine Services, Inc.

Report of Procedures and Findings

From Inspection of

Countryside HOA
Rapid City, SD
Potable Water Storage Tank

2007

By
Midco Diving & Marine Services, Inc.

P.O. Box 513 Rapid City, South Dakota 57709
800.479.1558
800.238.0217 fax
www.midcodiving.com
info@midcodiving.com

Diving & Marine Services, Inc.

P.O. Box 513 Rapid City, South Dakota 57709
800.479.1558
800.238.0217 fax
www.midcodiving.com
info@midcodiving.com

May 10, 2007

Countryside HOA
Mr. Bob Powles
PO Box 9111
Rapid City, SD
57702-9111

Re: Potable Water Storage Tank Clean, Inspect and Repair

INTRODUCTION

Following is a summary of a visual and video inspection of the Countryside HOA storage tank system. This inspection was undertaken on Wednesday May 8, 2007 by Midco Diving & Marine Services, Inc., of Rapid City, SD. The findings of this inspection report are a supplement to the inspection video and worksheets, which are found under the same cover The Reservoir, which is the subject of this report, was initially constructed in the mid 1970's. It is a Steel Bolted on-grade tank and appears to be of conventional design and construction.

METHODOLOGY

The reservoir was inspected by a surface-supplied commercial air diver. The diver was equipped with real-time high-resolution color video and a halogen lighting system as well as live voice communication between the inspecting diver and the surface team. All procedures were carried-out in accordance with Midco Diving's *Standards and Procedures*. Prior to entering your reservoir the diver and equipment were disinfected with a 200 parts per million chlorine solution per ANSI/AWWA C652-92 standards.

FINDINGS

EXTERIOR FINDINGS

Upon visual inspection of the exterior of the structure, the reservoir appears to be in good condition. The following exterior discrepancies were noted.

1. Three separate areas were leaking. Two were at panel seams and one near the roof to wall joint. All were repaired from the interior of the tank utilizing a two part NSF approved epoxy. All leaks were stopped.

INTERIOR FINDINGS

Upon visual inspection of the structure above and below the water line, the overall condition of the tank appears to be in fair condition. However, some discrepancies were noted as follows

1. Corrosion noted on the floor connecting hardware.
2. Corrosion noted on the wall joint channel iron.
3. Areas of floor sinking especially around the inlet/outlet.
4. Heavy corrosion noted on center roof rafter support column, above water line.
5. Heavy corrosion noted on most rafter to wall connections, above water line.

COUNTRYSIDE HOA

OVERVIEW OF RESERVOIR INSPECTION

JOB NUMBER:	**0500080701**
UTILITY:	**COUNTRYSIDE HOA**
DATE:	**May 9, 2007**
MANAGER:	**Bob Powles**
ADDRESS:	**PO Box 9111** **Rapid City, SD** **57702-9111**

DIVE TEAM LEADER: **Robert Greenspan**

Reservoir:	**Countryside HOA Storage Tank**
Diameter:	**26'**
Height:	**32'**
Gallons:	**179,000**
Water Depth:	**31' +/- (at full capacity)**
Date Built:	**1975 approx.**
Floor sqft:	**530**
Construction:	**Bolted Steel On-grade**

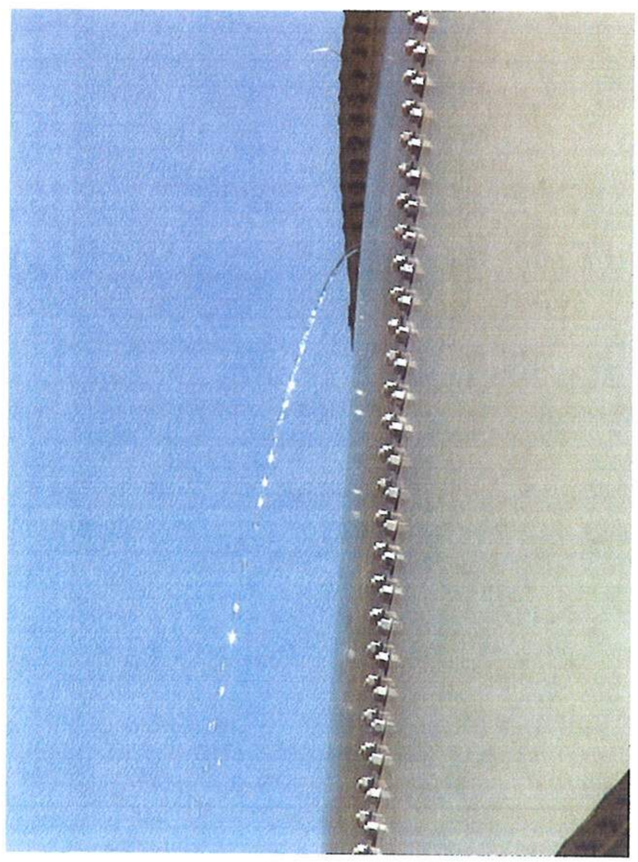
N/A -not applicable Excellent
(Ex.) -like new condition, no repairs needed.
Good -Cosmetic only problems, repairs if wanted.
Fair- Minor problems, repairs needed, not immediate.
Poor-Major problems, structural or like, immediate repairs needed.

Component	Condition NA	Ex.	Good	Fair	Poor	Comments
Site Security			X			
Gate			X			
Fence			X			
Locks			X			
Alarm	X					
Reservoir Exterior			X			
Coating			X			
Foundation			X			
Cleanliness			X			
Seams				X		Three separate new leaks (repaired)
Exterior Roof			X			
Coating			X			
Cleanliness			X			
Seams			X			
Exterior Ladder			X			
Coating	X					
Caged			X			
Safety Climb			X			
Roof Vents			X			
Coating			X			
Screen			X			
Side Vents	X					
Coating	X					
Screen	X					
Exterior Telemetry	X					
Coating	X					
Functioning	X					
Manual Level Indicator	X					

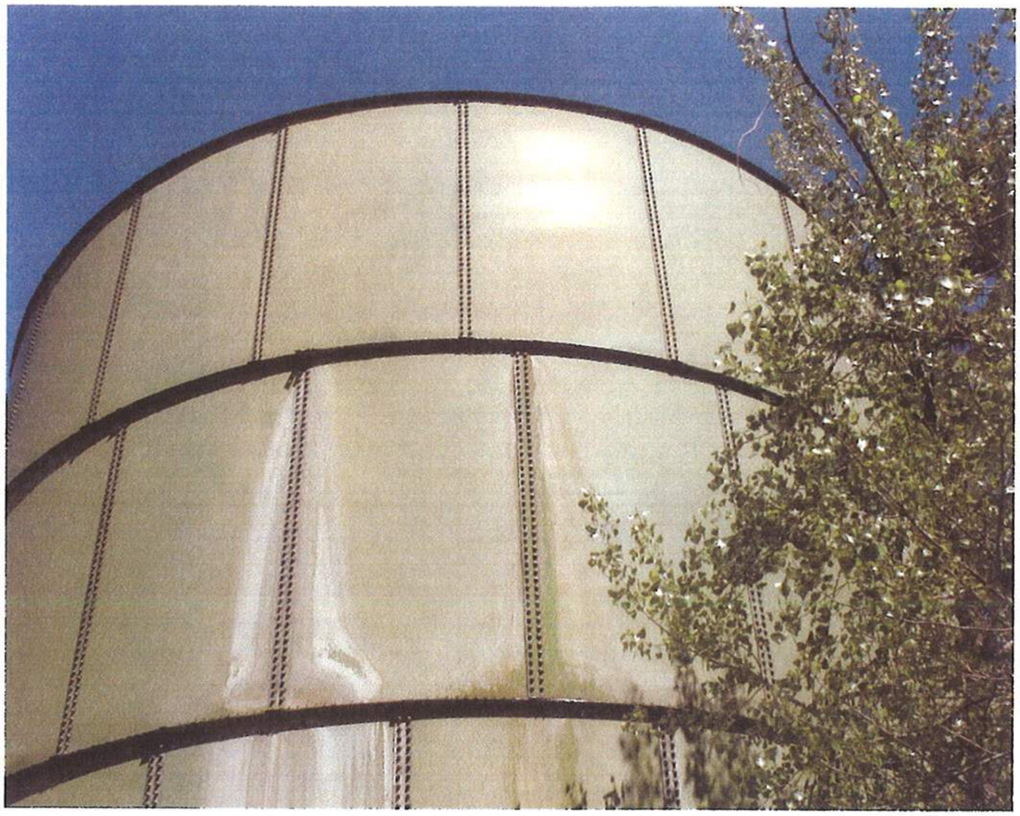
Component	Condition					Comments
	NA	Ex.	Good	Fair	Poor	
Tag	X					
Cable	X					
Indicator	X					
Pulleys	X					
Man Entries			X			
Coating			X			
Gasket			X			
Exterior Inlet	X					
Coating	X					
Valve	X					
Exterior Outlet	X					Size:
Coating	X					
Valve	X					
Exterior Drain/Scour	X					
Coating	X					
Valve	X					
Exterior Water Tap	X					Size:
Coating	X					
Valve	X					
Exterior Overflow			X			
Coating			X			
Stand-offs			X			
Screen	X					
Entry Hatch			X			
Weather Stripping	X					
Coating			X			
Hinges			X			
Lock			X			
Safety Railing			X			
Interior Ladder	X					
Caged	X					
Safety Climb	X					
Telemetry Sensor	X					
Functioning	X					

Component	Condition NA	Ex.	Good	Fair	Poor	Comments
Float	X					Size:
Interior Floor			X			Areas of floor settling
Coating				X		Corrosion noted on floor bolts
Sediment					X	Depth: 1" to 3" Iron and debris
Seams/Joints			X			
Interior Walls			X			Very minor corrosion noted on some panel ends
Coating			X			
Seams/Joints				X		Corrosion noted on connecting hardware
Interior Roof					X	Corrosion noted on roof support structure and roof rafter to wall connections
Interior Man Entries			X			
Coating			X			
Gasket			X			
Support Columns			X			
Coating				X		
Base			X			
Top					X	
Cathodic Protection	X					
Anodes	X					
Wires	X					
Sacrificial Anodes	X					% left:
Interior Overflow Pipe			X			
Coating	X					
Connections/Flange			X			
Interior Inlet			X			Floor
Coating	X					
Riser	X					
Interior Outlet			X			
Coating	X					
Riser	X					
Interior Drain/Scour			X			
Coating	X					
Riser	X					

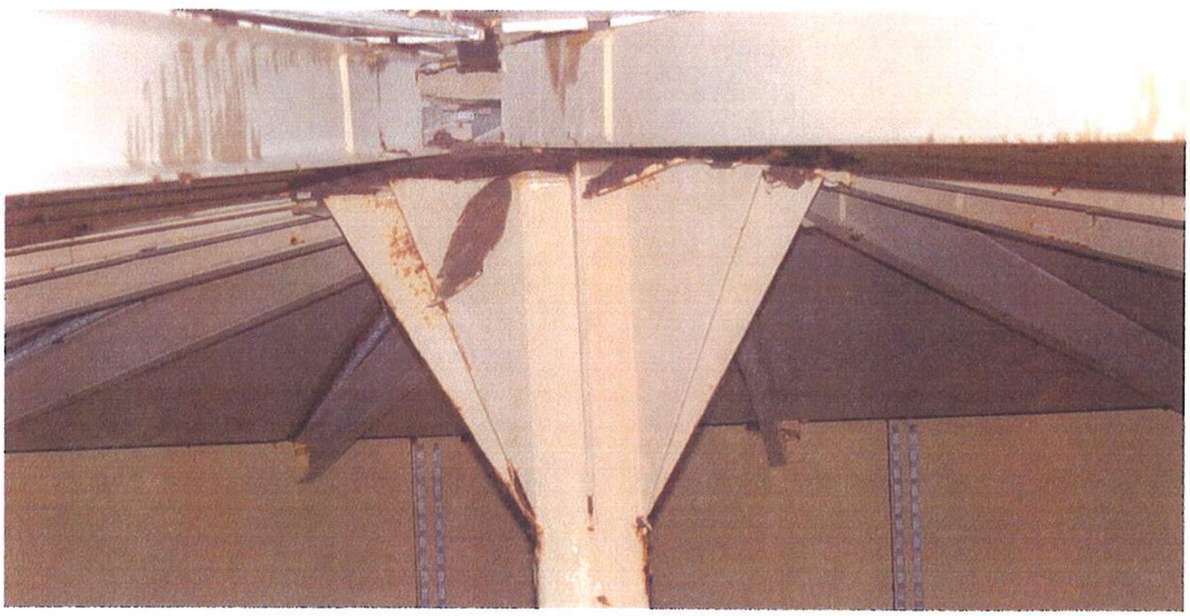
Tank at Overflow



Leak at roof rafter to wall connection

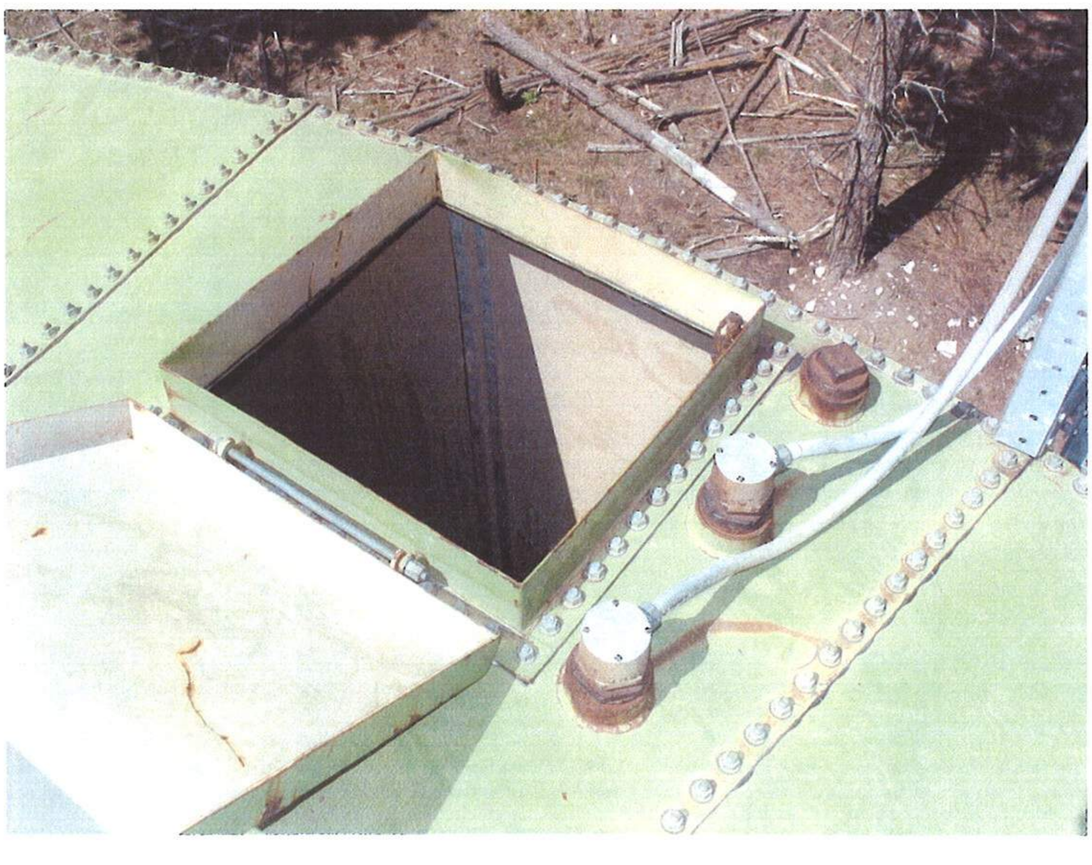


Seam Leak



Corrosion at Center Column/Roof Rafters

Interior Walls with Three Separate Epoxy Leak Repairs (2004 and 2007)



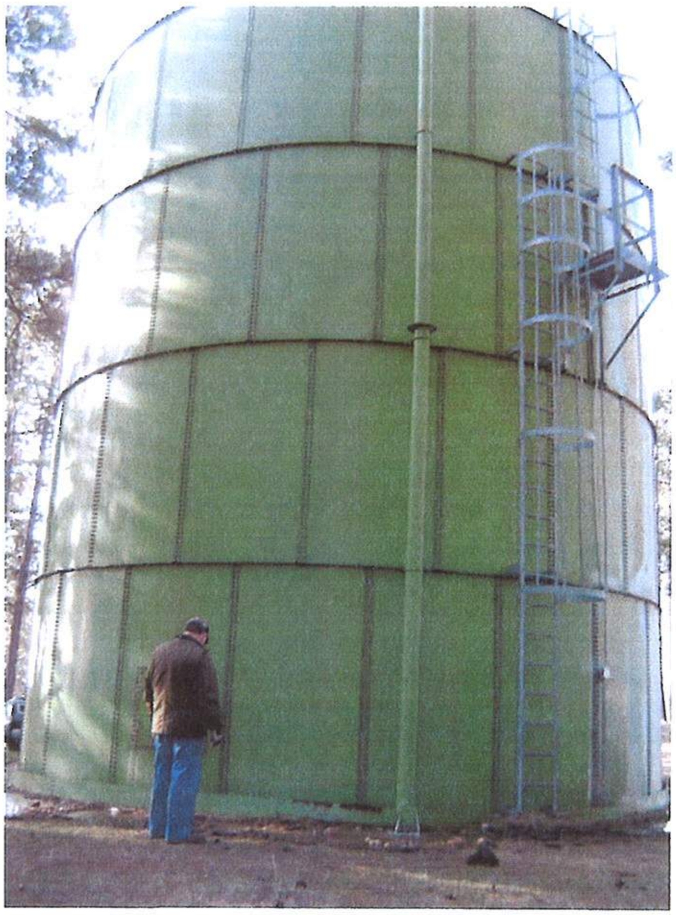
Access Hatch

Roof Vent

Diving & Marine Services, Inc.

Report of Procedures and Findings From the Cleaning and Inspection of the On Grade Tank Countryside HOA Rapid City, SD

2011



By Midco Diving & Marine Services, Inc.

800.479.1558
www.midcodiving.com
info@midcodiving.com
Home Office P.O. Box 513 Rapid City, South Dakota 57709 605-791-3030
Regional Office P.O. Box 7396 Loveland, Colorado 80537 970-744-2097

Diving & Marine Services, Inc.

July 13, 2011

Countryside HOA
Attn: Jay Chittim
PO Box 9662
Rapid City, SD 57709

INTRODUCTION

Following is a summary of a visual and video inspection of the On Grade Tank for Countryside HOA, SD. This inspection was undertaken on April 16, 2011 by Midco Diving & Marine Services, Inc., of Rapid City, SD. The findings of this inspection report are a supplement to the inspection video and worksheets, which are found under the same cover.

The Reservoir, which is the subject of this report, appears to be of conventional design and construction.

METHODOLOGY

The reservoir was inspected by a surface-supplied commercial air diver. The diver was equipped with real-time high-resolution color video and a halogen lighting system as well as live voice communication between the inspecting diver and the surface team. All procedures were carried-out in accordance with Midco Diving's *Standards and Procedures*. Prior to entering your reservoir the diver and equipment were disinfected with a 200 parts per million chlorine solution per ANSI/AWWA C652-02 standards.

ON GRADE TANK FINDINGS

EXTERIOR FINDINGS

Upon visual inspection of the exterior of the structure, the reservoir appears to be in good condition. The following findings were noted:

1. Staining on the reservoir exterior due to leaking

INTERIOR FINDINGS

Upon visual inspection of the structure above and below the water line, the overall condition of the tank appears to be good, consistent with a reservoir of this age and type. The following findings were noted:

1. Repaired 1" hole on interior floor

Countryside HOA

JOB NUMBER:	04161101
UTILITY:	Countryside HOA
DATE:	April 16, 2011
MANAGER:	Jay Chittim
ADDRESS:	PO Box 9662 Rapid City, SD 57709

DIVE TEAM LEADER:	Derrick Clauson
Reservoir:	On Grade
Gallons:	179,000 gallons
Water Depth:	28 feet
Height:	40 feet
Construction:	Steel Bolted
Date Built:	1975
Last Cleaned:	Approx. 2009
Last Inspected:	Approx. 2009

Recommendations:

1. Clean and Inspect every 2-3 years
2. Monitor previous epoxy repairs and any potential leaks throughout the tank

Diving & Marine Services, Inc.

N/A -not applicable
Excellent (Ex) - like new condition, no repairs needed.
Good -Cosmetic only problems, repairs if wanted.
Fair- Minor problems, repairs needed, not immediate.
Poor-Major problems, structural or like, immediate repairs needed.

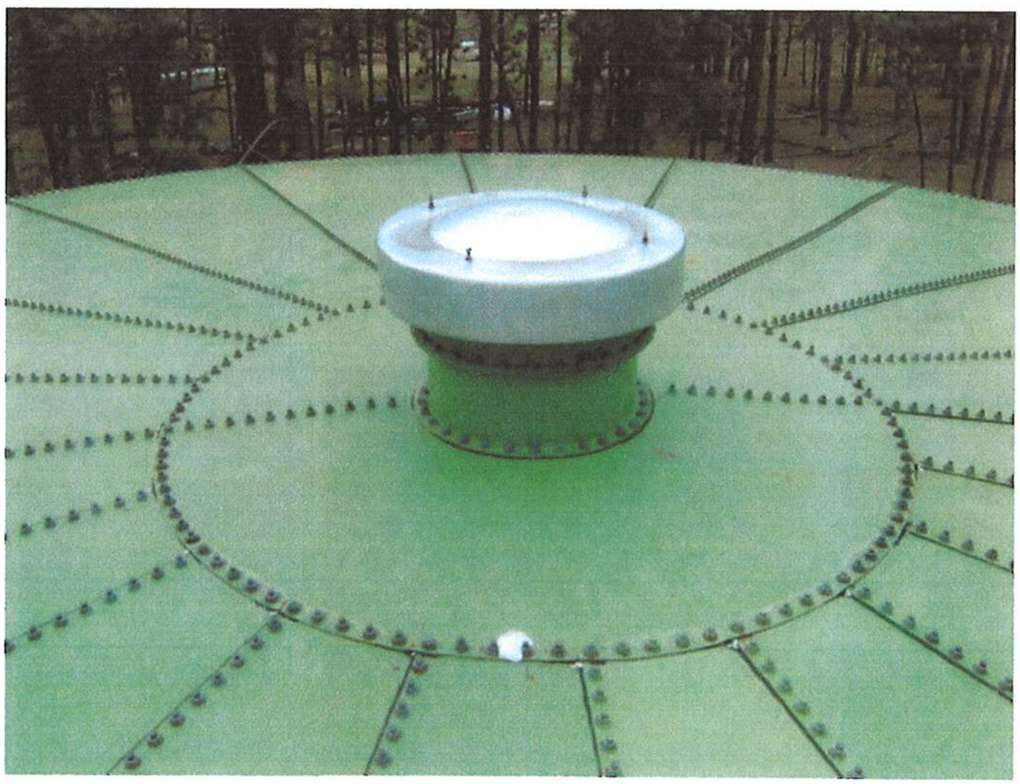
Component	Condition NA	Ex.	Good	Fair	Poor	Comments
Site Security	X					
Gate	X					
Fence	X					
Locks	X					
Alarm	X					
Reservoir Exterior				X		Staining from leaks
Coating			X			
Foundation			X			
Cleanliness			X			
Seams/Joints				X		
Exterior Roof			X			
Coating			X			
Cleanliness			X			
Seams/Joints			X			
Exterior Ladder			X			
Coating	X					
Caged			X			
Safety Climb	X					
Roof Vents			X			
Coating			X			
Screen			X			
Side Vents	X					
Coating	X					
Screen	X					
Exterior Telemetry	X					
Coating	X					
Functioning	X					

Component	Condition					Comments
	NA	Ex.	Good	Fair	Poor	
Manual Level Indicator	X					
Tag	X					
Cable	X					
Indicator	X					
Pulleys	X					
Base	X					
Man Entries			X			
Coating			X			
Gasket	X					
Exterior Inlet	X					Size: N/A
Coating	X					
Valve	X					
Exterior Outlet	X					Size: N/A
Coating	X					
Valve	X					
Exterior Drain/Scour	X					
Coating	X					
Valve	X					
Exterior Water Tap	X					Size: N/A
Coating	X					
Valve	X					
Exterior Overflow			X			
Coating			X			
Stand-offs			X			
Screen			X			
Entry Hatch			X			Size: 3' Diameter
Weather Stripping	X					
Coating			X			
Hinges			X			
Lock			X			
Safety Railing			X			

Component	Condition NA	Ex.	Good	Fair	Poor	Comments
Interior Ladder	X					
Caged	X					
Safety Climb	X					
Telemetry Sensor					X	Broken
Functioning					X	
Float	X					Size: N/A
Guide Wires	X					
Interior Floor				X		1" Hole in floor 12 o'clock position near wall
Coating			X			
Sediment				X		Depth: 1" Iron manganese
Seams/Joints			X			
Interior Walls			X			
Coating			X			Staining
Seams/Joints			X			
Interior Ceiling			X			
Coating			X			
Rafters			X			
Interior Man Entries			X			
Coating			X			
Gasket			X			
Support Columns			X			# of Columns: 1 Center
Coating			X			
Base			X			
Top			X			
Cathodic Protection	X					
Anodes	X					
Wires	X					
Sacrificial Anodes	X					% left: N/A

Component	Condition NA	Ex.	Good	Fair	Poor	Comments
Interior Overflow Pipe			X			
Coating			X			
Top/Cap			X			
Connections/Flange			X			
Interior Inlet			X			Common pipe
Coating				X		
Riser			X			
Interior Outlet			X			Common pipe
Coating				X		
Riser			X			
Interior Drain/Scour	X					
Coating	X					
Riser	X					
Interior Water Tap	X					Size: N/A
Coating	X					
Valve	X					

Foundation



Vent

800.479.1558
www.midcodiving.com
info@midcodiving.com
Home Office P.O. Box 513 Rapid City, South Dakota 57709 605-791-3030
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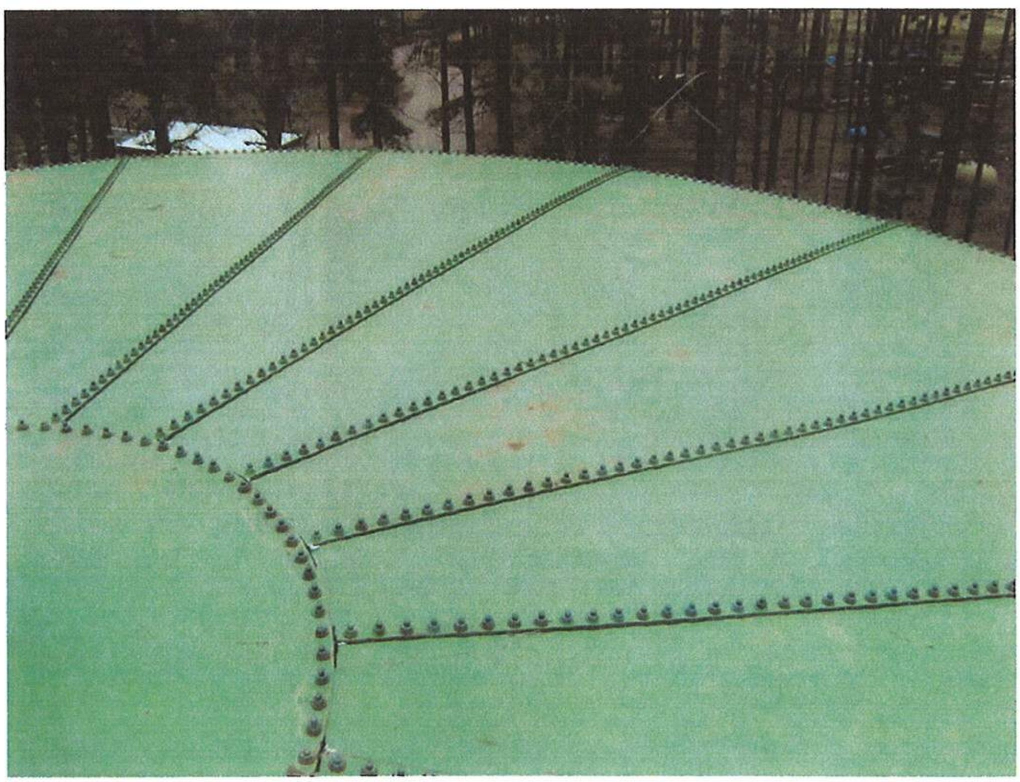
Roof



Roof

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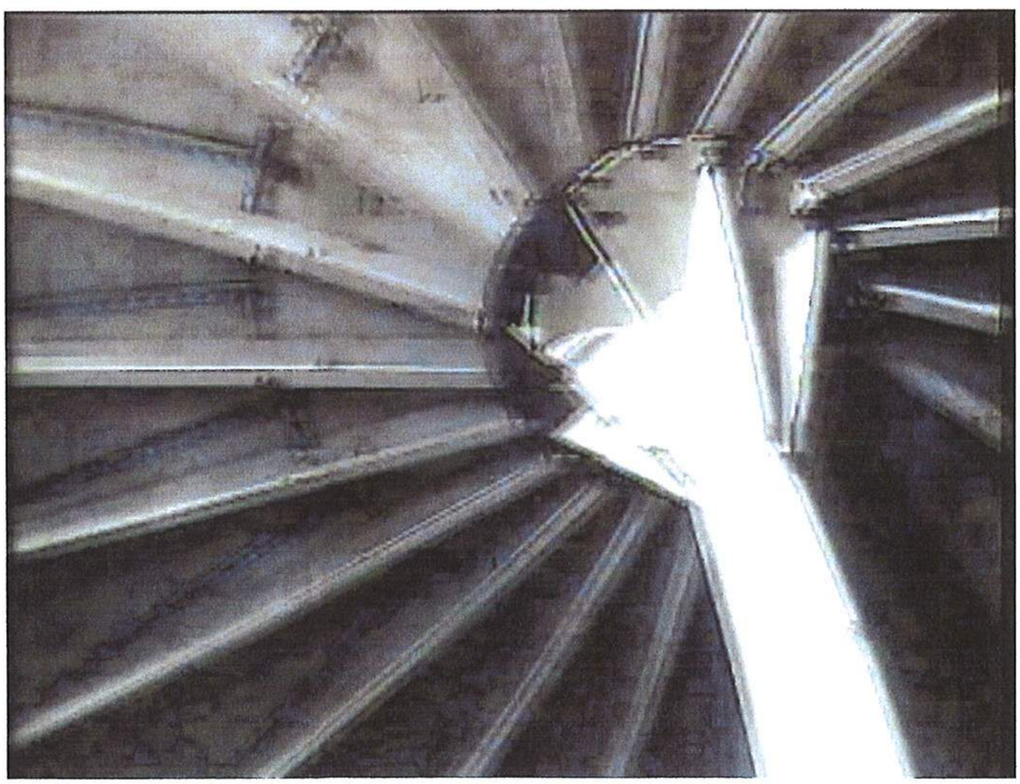
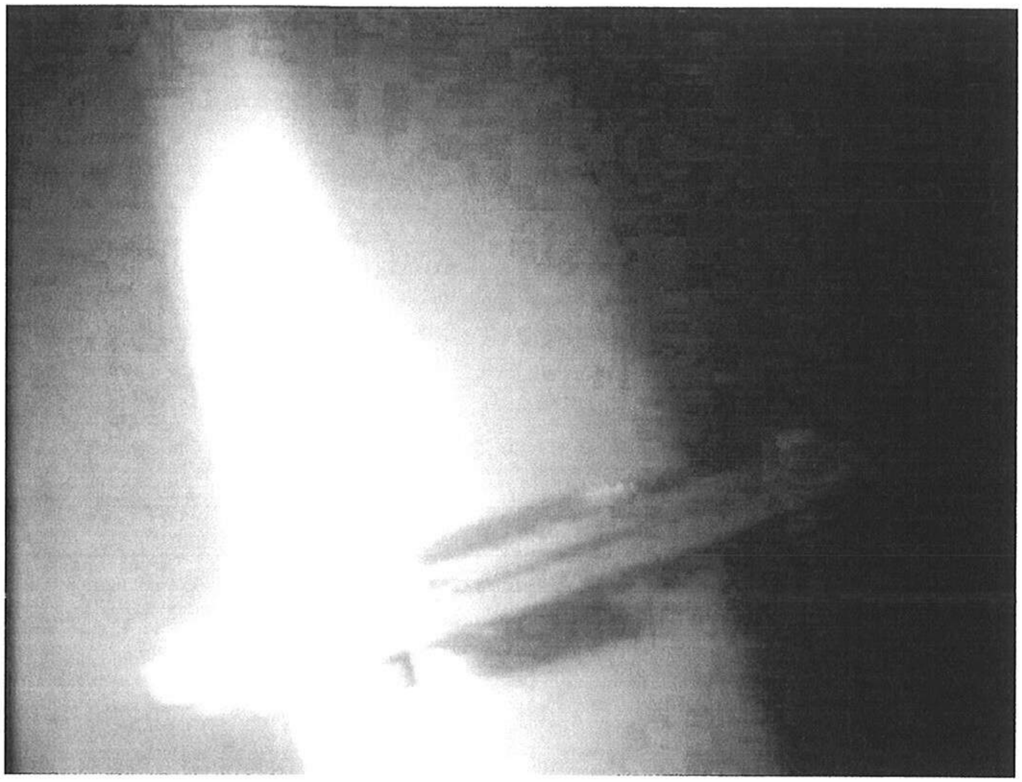
Overflow

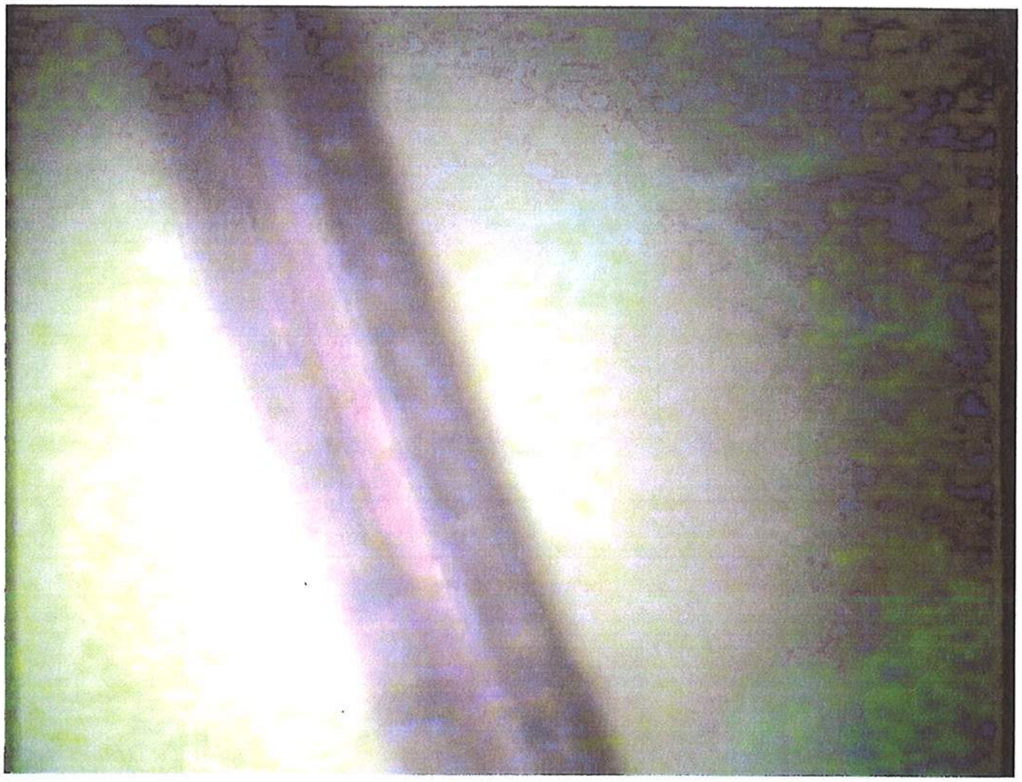


Ceiling



Center Column

Center Column



Wall Seam

Floor to Wall Seam

800.479.1558
www.midcodiving.com
info@midcodiving.com
Home Office P.O. Box 513 Rapid City, South Dakota 57709 605-791-3030
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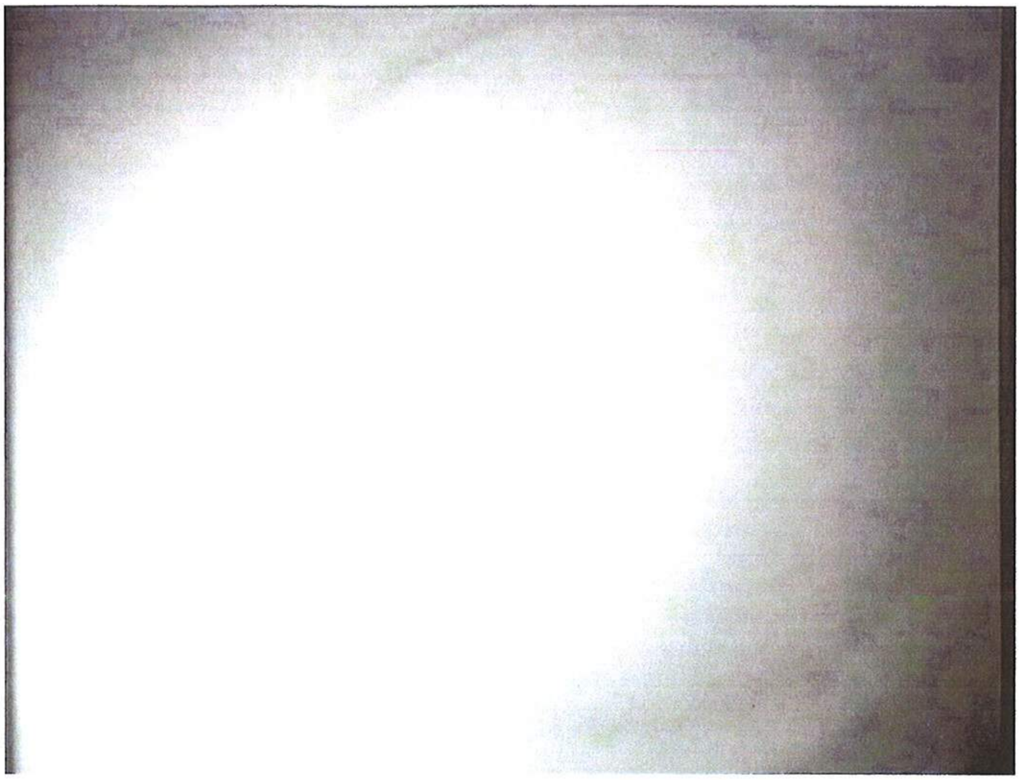
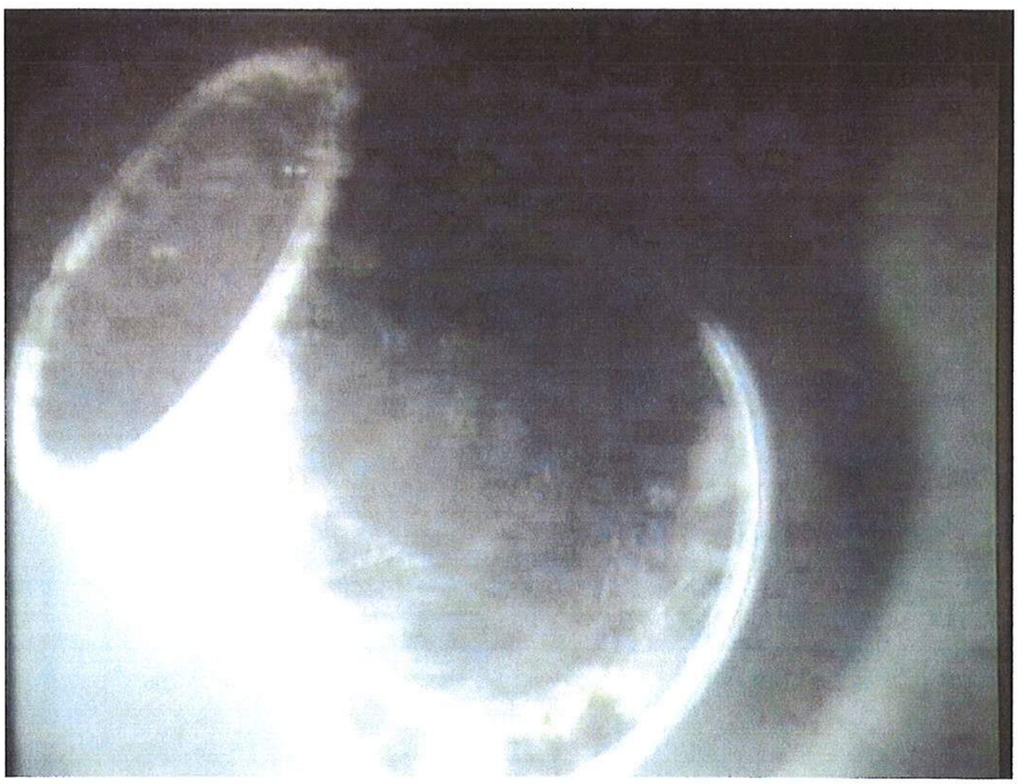


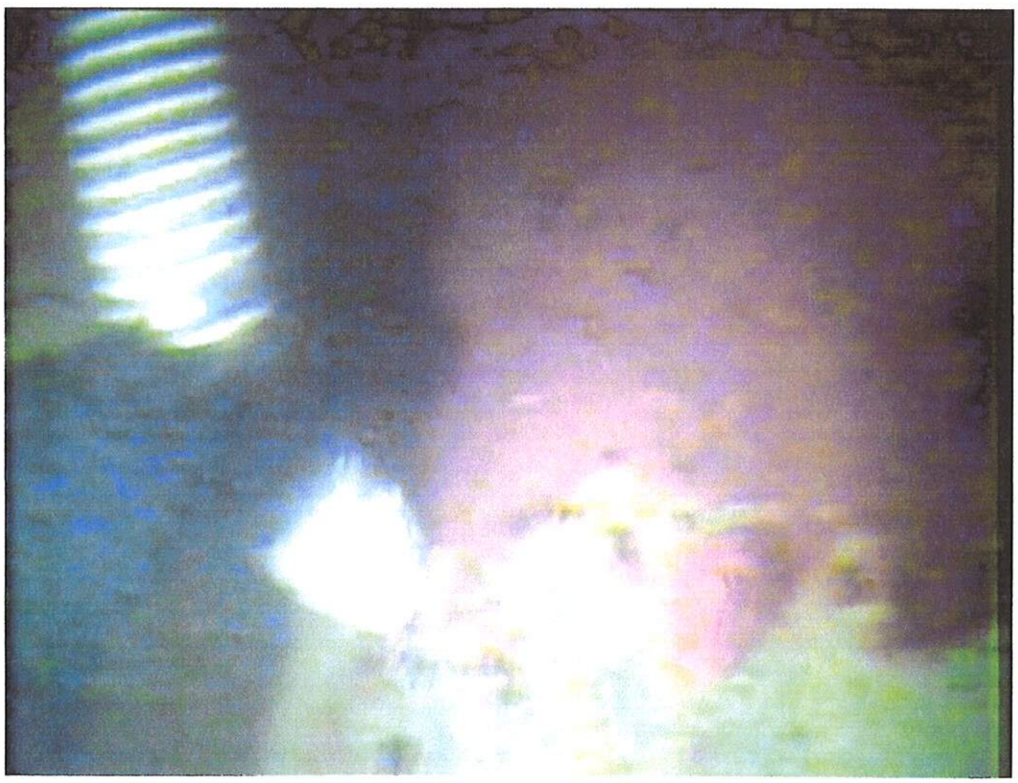
Man Entry



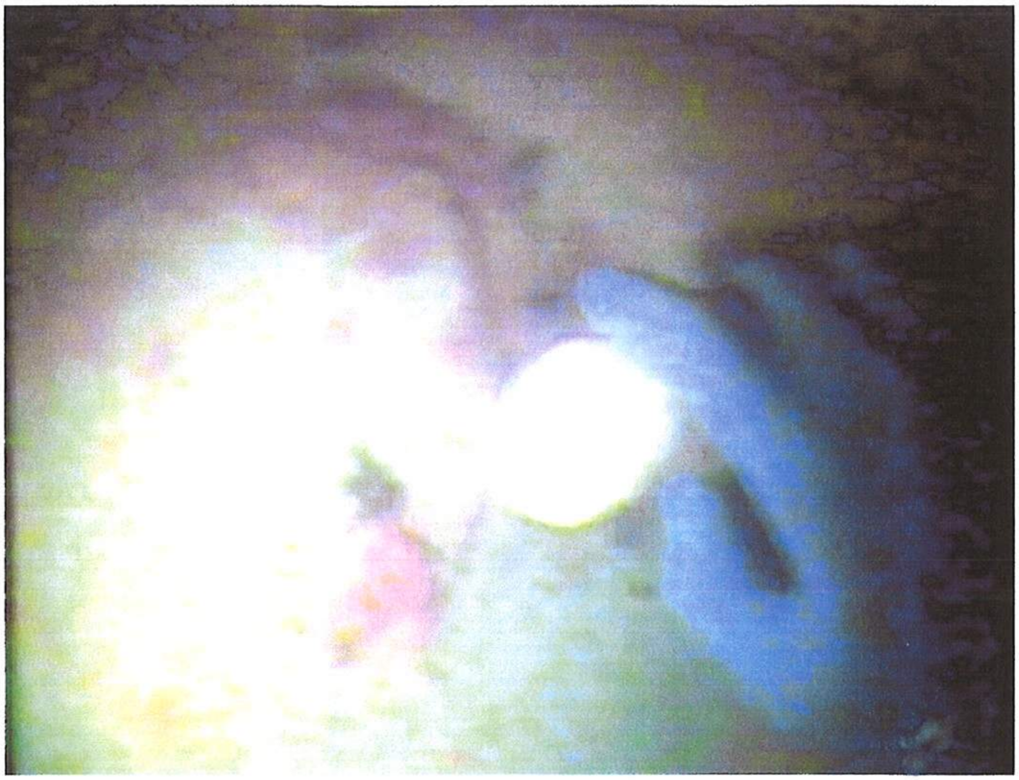
Interior Plumbing

800.479.1558
www.midcodiving.com
info@midcodiving.com
Home Office P.O. Box 513 Rapid City, South Dakota 57709 605-791-3030
Regional Office P.O. Box 7396 Loveland, Colorado 80537 970-744-2097

Previous Epoxy Repair



Sediment Removed



New Epoxy Repairs

New Epoxy Repairs

800.479.1558
www.midcodiving.com
info@midcodiving.com
Home Office P.O. Box 513 Rapid City, South Dakota 57709 605-791-3030
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Appendix C

On-Site Water System Improvement Detailed Cost Estimates

Estimate of Probable Construction Costs

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Water Main Loop Raven Circle to Tanager

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$3,000.00	$3,000.00
2	Remove Concrete Sidewalk	190	SqYd	$6.00	$1,140.00
3	8" PVC Water Main	330	Ft	$40.00	$13,200.00
4	8" Bends	4	Ea	$400.00	$1,600.00
5	8" Gate Valve w/box	2	Ea	$2,000.00	$4,000.00
6	8" x 8" Tee	1	Ea	$600.00	$600.00
7	6" x 6" Tee	1	Ea	$600.00	$600.00
8	6" Couplings	2	Ea	$300.00	$600.00
9	8" Couplings	2	Ea	$400.00	$800.00
10	Sodding	1100	SqYd	$7.50	$8,250.00
11	4" Concrete Sidewalk	1650	SqFt	$8.00	$13,200.00
				SUBTOTAL:	**$46,990.00**
				Mobilization (8%):	**$3,759.20**
				Contingency (10%):	**$4,699.00**
				Engineering & Contract Administration (15%):	**$7,048.50**
				TOTAL:	**$62,496.70**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Estimate of Probable Construction Costs

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Loop Waxwing to Pinon Jay

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$5,000.00	$5,000.00
2	Remove Concrete Sidewalk	140	SqYd	$6.00	$840.00
3	Remove Trees	30	Ea	$400.00	$12,000.00
4	8" PVC Water Main	800	Ft	$40.00	$32,000.00
5	8" Bends	12	Ea	$400.00	$4,800.00
6	8" Gate Valve w/box	2	Ea	$2,000.00	$4,000.00
7	6" x 6" Tee	1	Ea	$600.00	$600.00
8	8" x 6" Reducer	1	Ea	$500.00	$500.00
9	6" Couplings	2	Ea	$400.00	$800.00
10	Seed, Fertilize, and Fiber Mulch	3000	SqYd	$1.50	$4,500.00
11	4" Concrete Sidewalk	1250	SqFt	$8.00	$10,000.00
12	Trees	30	Ea	$500.00	$15,000.00
				SUBTOTAL:	**$90,040.00**
				Mobilization (8%):	**$7,203.20**
				Contingency (10%):	**$9,004.00**
				Engineering & Contract Administration (15%):	**$13,506.00**
				TOTAL:	**$119,753.20**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Estimate of Probable Construction Costs

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: Well House 1 & 4 Upgrades

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Remove and dispose of existing piping	1	LS	$2,000.00	$2,000.00
2	Ventilation fans	1	Ea	$2,000.00	$2,000.00
3	4" DIP Mechanical Piping	30	LF	$110.00	$3,300.00
4	New insulation and interior wall paneling	1	LS	$4,000.00	$4,000.00
5	well 1 & 4 VFD's	2	Ea	$8,000.00	$16,000.00
6	4" Cla-Val Valves	2	Ea	$3,000.00	$6,000.00
7	4" Gate Valves	3	Ea	$700.00	$2,100.00
8	Electrical Allowance	1	LS	$5,000.00	$5,000.00
				SUBTOTAL:	**$40,400.00**
				Mobilization (8%):	**$3,232.00**
				Contingency (10%):	**$4,040.00**
				Engineering & Contract Administration (15%):	**$6,060.00**
				TOTAL:	**$53,732.00**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Estimate of Probable Construction Costs

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: Radium Removal for Well 2 & New Well House

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Treatment Equipment**	1	LS	$105,900.00	$105,900.00
3	New Well House 20x30	600	SqFt	$300.00	$180,000.00
4	Well House Sitework	500	CuYd	$10.00	$5,000.00
5	Well bypass piping	200	Ft	$30.00	$6,000.00
				SUBTOTAL:	**$296,900.00**
				Mobilization (8%):	**$23,752.00**
				Contingency (10%):	**$29,690.00**
				Engineering & Contract Administration (15%):	**$44,535.00**
				TOTAL:	**$394,877.00**

**Does not inlclude treatment disposal cost of roughly $16,046/YR

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Estimate of Probable Construction Costs

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: New Water Storage Tank and Main Upsize

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Excavation & Disposal	350	CY	$10.00	$3,500.00
2	Base Course	450	TON	$22.00	$9,900.00
3	12" DI Pipe	20	LF	$70.00	$1,400.00
4	12" PVC Pipe	600	LF	$50.00	$30,000.00
5	12" Gate Valve	2	EA	$3,000.00	$6,000.00
6	12" Tee	1	EA	$1,500.00	$1,500.00
7	12" x 8" Reducer	1	EA	$1,000.00	$1,000.00
8	12" x 6" Reducer	1	EA	$1,000.00	$1,000.00
9	12" Bend	4	EA	$900.00	$3,600.00
10	256,000 Water Storage Tank	1	LS	$300,000.00	$300,000.00
11	Drain/Overflow manhole	1	LS	$10,000.00	$10,000.00
12	8" PVC Drain Line	40	LF	$40.00	$1,600.00
13	Compost Filter Sock	200	LF	$5.00	$1,000.00
14	Seed Fertilize and Mulch	200	SY	$1.50	$300.00
15	Site Restoration	1	LS	$10,000.00	$10,000.00
				SUBTOTAL:	**$380,800.00**
				Mobilization (8%):	**$30,464.00**
				Contingency (10%):	**$38,080.00**
				Engineering & Contract Administration (15%):	**$57,120.00**
				TOTAL:	**$506,464.00**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Estimate of Probable Construction Costs

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: SCADA Upgrades

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Well 1 & 4 Conversion	1	LS	$4,000.00	$4,000.00
2	Well 2 & 3 Conversion	1	LS	$4,000.00	$4,000.00
3	Tank Conversion & transducer	1	LS	$3,000.00	$3,000.00
4	Auto-Dialer and related work	1	LS	$4,000.00	$4,000.00
5	Well 1 & 4 HMI Panel	1	LS	$5,300.00	$5,300.00
6	Well 2 & 3 HMI Panel	1	LS	$5,300.00	$5,300.00
7	PLC Controller and related work	1	LS	$10,000.00	$10,000.00
8	Digital Based Radio System	1	LS	$8,000.00	$8,000.00
9	PC & Software	1	LS	$6,000.00	$6,000.00
				SUBTOTAL:	**$49,600.00**
				Mobilization (8%):	**$3,968.00**
				Contingency (10%):	**$4,960.00**
				Engineering & Contract Administration (15%):	**$7,440.00**
				TOTAL:	**$65,968.00**

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Appendix D

Connect to Regional Water Supply
City of Rapid City
Detailed Cost Estimates

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Water Main Loops for Low & High zones, Meadowlark to Prestwick

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$2,000.00	$2,000.00
2	Remove Asphalt Pavement	200	SqYd	$10.00	$2,000.00
3	Remove Concrete Sidewalk	10	SqYd	$6.00	$60.00
4	Remove Concrete Curb and Gutter	8	Ft	$8.00	$64.00
5	Remove Trees	4	Ea	$400.00	$1,600.00
6	8" PVC Water Main (High Zone)	1100	Ft	$40.00	$44,000.00
7	8" PVC Water Main (Low Zone)	1100	Ft	$40.00	$44,000.00
8	8" Bends	12	Ea	$400.00	$4,800.00
9	8" Gate Valve w/box	4	Ea	$2,000.00	$8,000.00
10	16" x 8" Tapping Tee & Valve	1	Ea	$3,000.00	$3,000.00
11	8" x 8" Tee	1	Ea	$600.00	$600.00
12	8" Couplings	4	Ea	$400.00	$1,600.00
13	Sodding	2000	SqYd	$7.50	$15,000.00
14	Asphalt Concrete Composite	60	Ton	$200.00	$12,000.00
15	4" Concrete Sidewalk	90	SqFt	$8.00	$720.00
16	Type B66 Concrete Curb and Gutter	8	Ft	$21.00	$168.00
17	Replace Tree	4	Ea	$500.00	$2,000.00
18	Traffic Control	1	LS	$3,000.00	$3,000.00
				SUBTOTAL:	**$144,612.00**
				Mobilization (8%):	**$11,568.96**
				Contingency (10%):	**$14,461.20**
				Engineering & Contract Administration (15%):	**$21,691.80**
				TOTAL:	**$192,333.96**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actua cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Loop Tanager to Muirfield

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$2,000.00	$2,000.00
2	Remove and Reset Fence	400	Ft	$6.00	$2,400.00
3	Remove Asphalt Pavement	32	SqYd	$10.00	$320.00
4	Remove Concrete Sidewalk	5	SqYd	$6.00	$30.00
5	Remove Concrete Curb and Gutter	16	Ft	$8.00	$128.00
6	8" PVC Water Main	520	Ft	$40.00	$20,800.00
7	8" Bends & Fittings	5	Ea	$400.00	$2,000.00
8	8" Gate Valve w/box	2	Ea	$2,000.00	$4,000.00
9	6" Couplings	1	Ea	$400.00	$400.00
10	8" Couplings	1	Ea	$400.00	$400.00
11	Seeding, Fertilizing, Fiber Mulching	1800	SqYd	$1.50	$2,700.00
12	Asphalt Concrete Composite	10	Ton	$200.00	$2,000.00
13	4" Concrete Sidewalk	45	SqFt	$8.00	$360.00
14	Type B66 Concrete Curb and Gutter	16	Ft	$21.00	$336.00
15	Traffic Control	1	LS	$3,000.00	$3,000.00
				SUBTOTAL:	**$40,874.00**
				Mobilization (8%):	**$3,269.92**
				Contingency (10%):	**$4,087.40**
				Engineering & Contract Administration (15%):	**$6,131.10**
				TOTAL:	**$54,362.42**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actua cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Water Main Loop Raven Circle to Tanager

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$3,000.00	$3,000.00
2	Remove Concrete Sidewalk	190	SqYd	$6.00	$1,140.00
3	8" PVC Water Main	330	Ft	$40.00	$13,200.00
4	8" Bends	4	Ea	$400.00	$1,600.00
5	8" Gate Valve w/box	2	Ea	$2,000.00	$4,000.00
6	8" x 8" Tee	1	Ea	$600.00	$600.00
7	6" x 6" Tee	1	Ea	$600.00	$600.00
8	6" Couplings	2	Ea	$300.00	$600.00
9	8" Couplings	2	Ea	$400.00	$800.00
10	Sodding	1100	SqYd	$7.50	$8,250.00
11	4" Concrete Sidewalk	1650	SqFt	$8.00	$13,200.00
				SUBTOTAL:	**$46,990.00**
				Mobilization (8%):	**$3,759.20**
				Contingency (10%):	**$4,699.00**
				Engineering & Contract Administration (15%):	**$7,048.50**
				TOTAL:	**$62,496.70**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Connection at Meadowlark

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$500.00	$500.00
2	Remove Concrete Sidewalk	10	SqYd	$6.00	$60.00
3	8" PVC Water Main	40	Ft	$40.00	$1,600.00
4	8" Bends	2	Ea	$400.00	$800.00
5	8" x 6" Reducer	1	Ea	$400.00	$400.00
6	6" Couplings	1	Ea	$400.00	$400.00
7	Sodding	100	SqYd	$7.50	$750.00
8	4" Concrete Sidewalk	90	SqFt	$8.00	$720.00
				SUBTOTAL:	**$5,230.00**
				Mobilization (8%):	**$418.40**
				Contingency (10%):	**$523.00**
				Engineering & Contract Administration (15%):	**$784.50**
				TOTAL:	**$6,955.90**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actua cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: 8" Loop Waxwing to Pinon Jay

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$5,000.00	$5,000.00
2	Remove Concrete Sidewalk	140	SqYd	$6.00	$840.00
3	Remove Trees	30	Ea	$400.00	$12,000.00
4	8" PVC Water Main	800	Ft	$40.00	$32,000.00
5	8" Bends	12	Ea	$400.00	$4,800.00
6	8" Gate Valve w/box	2	Ea	$2,000.00	$4,000.00
7	6" x 6" Tee	1	Ea	$600.00	$600.00
8	8" x 6" Reducer	1	Ea	$500.00	$500.00
9	6" Couplings	2	Ea	$400.00	$800.00
10	Seed, Fertilize, and Fiber Mulch	3000	SqYd	$1.50	$4,500.00
11	4" Concrete Sidewalk	1250	SqFt	$8.00	$10,000.00
12	Trees	30	Ea	$500.00	$15,000.00
				SUBTOTAL:	**$90,040.00**
				Mobilization (8%):	**$7,203.20**
				Contingency (10%):	**$9,004.00**
				Engineering & Contract Administration (15%):	**$13,506.00**
				TOTAL:	**$119,753.20**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: Booster Station Upgrade

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Upgrade pumps in Red Rocks Booster Station	1	LS	$50,000.00	$50,000.00
				SUBTOTAL:	**$50,000.00**
				Contingency (10%):	**$5,000.00**
				Engineering & Contract Administration (15%):	**$7,500.00**
				TOTAL:	**$62,500.00**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actua cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: Locate Water System for CORC

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	GIS/Survey Crew	50	Hr	$114.00	$5,700.00
2	Data organization and transfer	8	Hr	$75.00	$600.00
				SUBTOTAL:	**$6,300.00**
				Contingency (10%):	**$630.00**
				TOTAL:	**$6,930.00**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Project: CSHOA, Water System Preliminary Engineering Report
Prepared By: CETEC Engineering Services, Inc.
For: Countryside Homeowners Association
Date: July 25, 2012
Scope of work: Abandon Wells

Bid Item Number	Item	Quantity	Unit	Unit Price	Extended Price
1	Clearing and Grubbing	1	LS	$3,000.00	$3,000.00
2	Set Up for Grouting	2	Ea	$4,000.00	$8,000.00
3	Grouting	1000	CuFt	$20.00	$20,000.00
4	Surface Restoration	1	Ea	$3,000.00	$3,000.00

SUBTOTAL:	**$34,000.00**
Mobilization (8%):	**$2,720.00**
Contingency (10%):	**$3,400.00**
Engineering & Contract Administration (15%):	**$5,100.00**
TOTAL:	**$45,220.00**

CETEC Engineering Services Inc. has no control over the cost of estimated quantities. Costs fluctuate with the availability of materials, labor, equipment, incidentals, and other factors that control market costs. CETEC Engineering Services Inc. makes no warrenty that the estimated construction costs will match the actual cost of construction.

Appendix E

Water Model Report Tables
for
Scenarios 1 - 5

FlexTable: Pipe Table (Model.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-11	255	J-2	J-12	8.0	135.0	-52	0.33
P-22	150	J-21	J-22	4.0	135.0	0	0.00
P-21	231	J-20	J-21	8.0	135.0	11	0.07
P-20	637	J-18	J-20	8.0	135.0	14	0.09
P-19	558	J-18	J-19	6.0	135.0	2	0.02
P-18	446	J-17	J-18	8.0	135.0	17	0.11
P-17	341	J-7	J-17	8.0	135.0	19	0.12
P-16	402	J-16	J-13	6.0	135.0	-15	0.17
P-15	599	J-15	J-16	6.0	135.0	-13	0.15
P-1	483	J-1	J-2	6.0	135.0	-2	0.02
P-12	640	J-12	J-13	8.0	135.0	-42	0.27
P-29	288	J-28	J-29	6.0	135.0	7	0.08
P-10	323	J-10	J-11	6.0	135.0	2	0.02
P-9	284	J-9	J-10	6.0	135.0	3	0.04
P-8	677	J-8	J-9	6.0	135.0	20	0.23
P-7	412	J-7	J-8	6.0	135.0	22	0.25
P-6	475	J-6	J-7	8.0	135.0	42	0.27
P-5	559	J-5	J-6	8.0	135.0	44	0.28
P-4	507	J-4	J-5	8.0	135.0	46	0.29
P-3	342	J-3	J-4	8.0	135.0	47	0.30
P-2	128	J-2	J-3	8.0	135.0	49	0.31
P-14	352	J-12	J-15	6.0	135.0	-11	0.13
P-39	579	J-37	J-38	6.0	135.0	3	0.03
P-52	1,066	J-41	J-15	8.0	135.0	(N/A)	(N/A)
P-51	66	J-45	R-1	8.0	135.0	-60	0.38
P-50	635	J-13	J-45	8.0	135.0	-60	0.38
P-48	212	J-44	J-39	6.0	135.0	0	0.01
P-47	229	J-38	J-44	6.0	135.0	1	0.01
P-46	229	J-20	J-43	8.0	135.0	2	0.01
P-45	343	J-42	J-32	6.0	135.0	1	0.01
P-44	327	J-31	J-42	6.0	135.0	2	0.03
P-43	324	J-40	J-37	8.0	135.0	-5	0.03
P-25	438	J-10	J-25	4.0	135.0	0	0.00
P-41	521	J-39	J-40	6.0	135.0	-2	0.02
P-28	130	J-9	J-28	6.0	135.0	16	0.18
P-38	294	J-21	J-37	8.0	135.0	9	0.06
P-37	420	J-35	J-36	6.0	135.0	2	0.02
P-36	311	J-34	J-35	6.0	135.0	3	0.04
P-35	345	J-34	J-28	6.0	135.0	-7	0.08
P-34	459	J-33	J-34	6.0	135.0	-2	0.03
P-33	427	J-32	J-33	6.0	135.0	-1	0.01
P-31	211	J-29	J-31	6.0	135.0	4	0.04
P-30	528	J-29	J-30	6.0	135.0	2	0.02
P-53	363	J-42	J-17	8.0	135.0	(N/A)	(N/A)
P-42	394	J-40	J-41	8.0	135.0	2	0.01

FlexTable: Junction Table (Model.wtg)

Current Time: 0.000 hours

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	Pressure (Calculated Residual) (psi)	Pressure Head (ft)
28	J-1	3,987.00	2	4,129.89	61.8	33.8	142.89
29	J-2	3,980.00	2	4,129.89	64.8	49.5	149.89
31	J-3	3,975.00	2	4,129.88	67.0	50.2	154.88
33	J-4	3,950.00	2	4,129.86	77.8	57.1	179.86
35	J-5	3,929.00	2	4,129.83	86.9	60.4	200.83
37	J-6	3,894.00	2	4,129.80	102.0	74.1	235.80
39	J-7	3,875.00	2	4,129.78	110.2	82.3	254.78
41	J-8	3,876.00	2	4,129.75	109.8	68.5	253.75
43	J-9	3,881.00	2	4,129.72	107.6	44.6	248.72
45	J-10	3,874.00	2	4,129.72	110.6	38.7	255.72
47	J-11	3,867.00	2	4,129.72	113.7	31.7	262.72
49	J-12	4,005.00	2	4,129.90	54.0	41.6	124.90
51	J-13	4,056.00	3	4,129.94	32.0	22.6	73.94
55	J-15	4,033.00	2	4,129.91	41.9	28.4	96.91
57	J-16	4,062.00	2	4,129.92	29.4	20.0	67.92
60	J-17	3,876.00	2	4,129.77	109.8	81.9	253.77
62	J-18	3,913.00	2	4,129.77	93.8	65.9	216.77
64	J-19	3,894.00	2	4,129.77	102.0	60.0	235.77
66	J-20	3,959.00	2	4,129.77	73.9	46.0	170.77
68	J-21	3,964.00	2	4,129.76	71.7	43.8	165.76
70	J-22	3,922.00	0	4,129.76	89.9	71.4	207.76
76	J-25	3,830.00	0	4,129.72	129.7	88.2	299.72
82	J-28	3,881.00	2	4,129.71	107.6	40.4	248.71
84	J-29	3,888.00	2	4,129.71	104.6	32.1	241.71
86	J-30	3,894.00	2	4,129.71	102.0	20.0	235.71
88	J-31	3,890.00	2	4,129.71	103.7	29.0	239.71
90	J-32	3,908.00	2	4,129.71	95.9	20.0	221.71
92	J-33	3,904.00	2	4,129.71	97.7	20.9	225.71
94	J-34	3,878.00	2	4,129.71	108.9	35.7	251.71
97	J-35	3,894.00	2	4,129.71	102.0	20.0	235.71
99	J-36	3,894.00	2	4,129.71	102.0	20.0	235.71
101	J-37	3,968.00	2	4,129.76	70.0	42.1	161.76
103	J-38	3,934.00	2	4,129.76	84.7	53.0	195.76
105	J-39	3,961.00	2	4,129.76	73.0	41.5	168.76
107	J-40	3,991.00	2	4,129.76	60.0	32.1	138.76
109	J-41	4,019.00	2	4,129.76	47.9	20.0	110.76
112	J-42	3,899.00	2	4,129.71	99.8	23.0	230.71
115	J-43	3,964.00	2	4,129.77	71.7	42.6	165.77
117	J-44	3,943.00	2	4,129.76	80.8	48.9	186.76
122	J-45	4,062.00	0	4,129.99	29.4	27.9	67.99

Fire Flow Node FlexTable: Fire Flow Report (Model.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (gpm)	Flow (Total Available) (gpm)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity (Upper Limit) (ft/s)	Pressure (Residual Lower Limit) (psi)
J-1	1,056	1,058	22.1	J-16	12.00	20.0
J-2	1,215	1,216	20.0	J-16	12.00	20.0
J-3	1,215	1,216	20.0	J-16	12.00	20.0
J-4	1,215	1,217	20.0	J-16	12.00	20.0
J-5	1,215	1,217	20.0	J-16	12.00	20.0
J-6	1,111	1,113	20.0	J-41	12.00	20.0
J-7	1,020	1,022	20.0	J-41	12.00	20.0
J-8	1,020	1,022	20.0	J-41	12.00	20.0
J-9	1,020	1,022	20.0	J-41	12.00	20.0
J-10	1,020	1,022	20.0	J-41	12.00	20.0
J-11	1,020	1,022	20.0	J-41	12.00	20.0
J-12	1,215	1,216	20.0	J-16	12.00	20.0
J-13	1,324	1,327	20.0	J-16	12.00	20.0
J-15	1,086	1,087	20.0	J-16	12.00	20.0
J-16	916	918	27.1	J-13	12.00	20.0
J-17	969	970	20.0	J-41	12.00	20.0
J-18	911	913	20.0	J-41	12.00	20.0
J-19	911	913	20.0	J-41	12.00	20.0
J-20	844	846	20.0	J-41	12.00	20.0
J-21	823	825	20.0	J-41	12.00	20.0
J-22	470	470	27.6	J-16	12.00	20.0
J-25	470	470	27.6	J-16	12.00	20.0
J-28	1,020	1,022	20.0	J-41	12.00	20.0
J-29	1,020	1,022	20.0	J-41	12.00	20.0
J-30	976	977	22.1	J-41	12.00	20.0
J-31	1,020	1,022	20.0	J-41	12.00	20.0
J-32	1,008	1,009	20.6	J-41	12.00	20.0
J-33	1,020	1,022	20.0	J-41	12.00	20.0
J-34	1,020	1,022	20.0	J-41	12.00	20.0
J-35	1,014	1,016	20.0	J-36	12.00	20.0
J-36	935	937	23.5	J-16	12.00	20.0
J-37	799	800	20.0	J-41	12.00	20.0
J-38	794	795	20.0	J-41	12.00	20.0
J-39	790	791	20.0	J-41	12.00	20.0
J-40	781	783	20.0	J-41	12.00	20.0
J-41	753	755	25.3	J-16	12.00	20.0
J-42	1,020	1,022	20.0	J-41	12.00	20.0
J-43	844	846	20.0	J-41	12.00	20.0
J-44	792	793	20.0	J-41	12.00	20.0
J-45	1,820	1,820	27.8	J-16	12.00	20.0

FlexTable: Pipe Table (Model.wtg)

Current Time: 0.000 hours

Scenario 2 Peak Day Demand

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-11	255	J-2	J-12	8.0	135.0	-168	1.07
P-22	150	J-21	J-22	4.0	135.0	0	0.00
P-21	231	J-20	J-21	8.0	135.0	36	0.23
P-20	637	J-18	J-20	8.0	135.0	46	0.29
P-19	558	J-18	J-19	6.0	135.0	5	0.06
P-18	446	J-17	J-18	8.0	135.0	56	0.36
P-17	341	J-7	J-17	8.0	135.0	61	0.39
P-16	402	J-16	J-13	6.0	135.0	-47	0.54
P-15	599	J-15	J-16	6.0	135.0	-42	0.48
P-1	483	J-1	J-2	6.0	135.0	-5	0.06
P-12	640	J-12	J-13	8.0	135.0	-136	0.87
P-29	288	J-28	J-29	6.0	135.0	23	0.26
P-10	323	J-10	J-11	6.0	135.0	5	0.06
P-9	284	J-9	J-10	6.0	135.0	10	0.12
P-8	677	J-8	J-9	6.0	135.0	66	0.75
P-7	412	J-7	J-8	6.0	135.0	71	0.81
P-6	475	J-6	J-7	8.0	135.0	137	0.88
P-5	559	J-5	J-6	8.0	135.0	142	0.91
P-4	507	J-4	J-5	8.0	135.0	147	0.94
P-3	342	J-3	J-4	8.0	135.0	152	0.97
P-2	128	J-2	J-3	8.0	135.0	157	1.01
P-14	352	J-12	J-15	6.0	135.0	-37	0.42
P-39	579	J-37	J-38	6.0	135.0	9	0.10
P-52	1,066	J-41	J-15	8.0	135.0	(N/A)	(N/A)
P-51	66	J-45	R-1	8.0	135.0	-188	1.20
P-50	635	J-13	J-45	8.0	135.0	-188	1.20
P-48	212	J-44	J-39	6.0	135.0	-2	0.02
P-47	229	J-38	J-44	6.0	135.0	3	0.04
P-46	229	J-20	J-43	8.0	135.0	5	0.03
P-45	343	J-42	J-32	6.0	135.0	3	0.03
P-44	327	J-31	J-42	6.0	135.0	8	0.09
P-43	324	J-40	J-37	8.0	135.0	-17	0.11
P-25	438	J-10	J-25	4.0	135.0	0	0.00
P-41	521	J-39	J-40	6.0	135.0	-7	0.08
P-28	130	J-9	J-28	6.0	135.0	51	0.58
P-38	294	J-21	J-37	8.0	135.0	30	0.19
P-37	420	J-35	J-36	6.0	135.0	5	0.06
P-36	311	J-34	J-35	6.0	135.0	10	0.12
P-35	345	J-34	J-28	6.0	135.0	-23	0.26
P-34	459	J-33	J-34	6.0	135.0	-8	0.09
P-33	427	J-32	J-33	6.0	135.0	-2	0.03
P-31	211	J-29	J-31	6.0	135.0	13	0.14
P-30	528	J-29	J-30	6.0	135.0	5	0.06
P-53	363	J-42	J-17	8.0	135.0	(N/A)	(N/A)
P-42	394	J-40	J-41	8.0	135.0	5	0.03

FlexTable: Junction Table (Model.wtg)

Current Time: 0.000 hours

Scenario 2 Peak Day Demand

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	Pressure (Calculated Residual) (psi)	Pressure Head (ft)
28	J-1	3,987.00	5	4,129.03	61.4	31.2	142.03
29	J-2	3,980.00	5	4,129.03	64.5	49.6	149.03
31	J-3	3,975.00	5	4,128.96	66.6	50.3	153.96
33	J-4	3,950.00	5	4,128.78	77.4	57.4	178.78
35	J-5	3,929.00	5	4,128.53	86.3	61.0	199.53
37	J-6	3,894.00	5	4,128.28	101.4	74.2	234.28
39	J-7	3,875.00	5	4,128.07	109.5	82.4	253.07
41	J-8	3,876.00	5	4,127.86	109.0	70.0	251.86
43	J-9	3,881.00	5	4,127.55	106.7	48.5	246.55
45	J-10	3,874.00	5	4,127.55	109.7	44.3	253.55
47	J-11	3,867.00	5	4,127.55	112.7	39.1	260.55
49	J-12	4,005.00	5	4,129.19	53.7	41.6	124.19
51	J-13	4,056.00	5	4,129.46	31.8	22.6	73.46
55	J-15	4,033.00	5	4,129.25	41.6	28.8	96.25
57	J-16	4,062.00	5	4,129.36	29.1	20.0	67.36
60	J-17	3,876.00	5	4,128.04	109.0	81.9	252.04
62	J-18	3,913.00	5	4,128.00	93.0	65.9	215.00
64	J-19	3,894.00	5	4,128.00	101.2	62.6	234.00
66	J-20	3,959.00	5	4,127.97	73.1	46.0	168.97
68	J-21	3,964.00	5	4,127.96	70.9	43.8	163.96
70	J-22	3,922.00	0	4,127.96	89.1	67.9	205.96
76	J-25	3,830.00	0	4,127.55	128.7	83.4	297.55
82	J-28	3,881.00	5	4,127.52	106.7	44.9	246.52
84	J-29	3,888.00	5	4,127.50	103.6	37.4	239.50
86	J-30	3,894.00	5	4,127.50	101.0	21.5	233.50
88	J-31	3,890.00	5	4,127.49	102.8	34.7	237.49
90	J-32	3,908.00	5	4,127.49	95.0	24.5	219.49
92	J-33	3,904.00	5	4,127.49	96.7	27.0	223.49
94	J-34	3,878.00	5	4,127.49	107.9	41.2	249.49
97	J-35	3,894.00	5	4,127.49	101.0	26.3	233.49
99	J-36	3,894.00	5	4,127.49	101.0	20.1	233.49
101	J-37	3,968.00	5	4,127.95	69.2	42.1	159.95
103	J-38	3,934.00	5	4,127.94	83.9	53.6	193.94
105	J-39	3,961.00	5	4,127.94	72.2	42.1	166.94
107	J-40	3,991.00	5	4,127.95	59.3	32.1	136.95
109	J-41	4,019.00	5	4,127.95	47.1	20.0	108.95
112	J-42	3,899.00	5	4,127.49	98.9	29.1	228.49
115	J-43	3,964.00	5	4,127.97	70.9	42.8	163.97
117	J-44	3,943.00	5	4,127.94	80.0	49.6	184.94
122	J-45	4,062.00	0	4,129.95	29.4	27.9	67.95

Fire Flow Node FlexTable: Fire Flow Report (Model.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (gpm)	Flow (Total Available) (gpm)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity (Upper Limit) (ft/s)	Pressure (Residual Lower Limit) (psi)
J-1	1,052	1,058	20.4	J-16	12.00	20.0
J-2	1,085	1,091	20.0	J-16	12.00	20.0
J-3	1,085	1,091	20.0	J-16	12.00	20.0
J-4	1,085	1,090	20.0	J-16	12.00	20.0
J-5	1,085	1,091	20.0	J-16	12.00	20.0
J-6	996	1,001	20.0	J-41	12.00	20.0
J-7	909	915	20.0	J-41	12.00	20.0
J-8	909	915	20.0	J-41	12.00	20.0
J-9	909	915	20.0	J-41	12.00	20.0
J-10	909	915	20.0	J-41	12.00	20.0
J-11	909	915	20.0	J-41	12.00	20.0
J-12	1,085	1,091	20.0	J-16	12.00	20.0
J-13	1,192	1,197	20.0	J-16	12.00	20.0
J-15	980	985	20.0	J-16	12.00	20.0
J-16	837	842	26.6	J-13	12.00	20.0
J-17	864	869	20.0	J-41	12.00	20.0
J-18	814	819	20.0	J-41	12.00	20.0
J-19	813	818	20.0	J-41	12.00	20.0
J-20	755	760	20.0	J-41	12.00	20.0
J-21	737	742	20.0	J-41	12.00	20.0
J-22	470	470	26.6	J-16	12.00	20.0
J-25	470	470	26.6	J-16	12.00	20.0
J-28	909	915	20.0	J-41	12.00	20.0
J-29	909	915	20.0	J-41	12.00	20.0
J-30	909	915	20.0	J-41	12.00	20.0
J-31	909	915	20.0	J-41	12.00	20.0
J-32	909	915	20.0	J-41	12.00	20.0
J-33	909	915	20.0	J-41	12.00	20.0
J-34	909	915	20.0	J-41	12.00	20.0
J-35	909	915	20.0	J-41	12.00	20.0
J-36	882	887	21.3	J-41	12.00	20.0
J-37	716	721	20.0	J-41	12.00	20.0
J-38	711	716	20.0	J-41	12.00	20.0
J-39	708	713	20.0	J-41	12.00	20.0
J-40	701	706	20.0	J-41	12.00	20.0
J-41	678	683	24.8	J-16	12.00	20.0
J-42	909	915	20.0	J-41	12.00	20.0
J-43	755	760	20.0	J-41	12.00	20.0
J-44	710	715	20.0	J-41	12.00	20.0
J-45	1,692	1,692	27.6	J-16	12.00	20.0

Scenario 2 Peak Day Demand Fire Flow

FlexTable: Pipe Table (Model.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-11	255	J-2	J-12	8.0	135.0	-92	0.59
P-22	150	J-21	J-22	4.0	135.0	0	0.00
P-21	231	J-20	J-21	8.0	135.0	-40	0.25
P-20	637	J-18	J-20	8.0	135.0	-30	0.19
P-19	558	J-18	J-19	6.0	135.0	5	0.06
P-18	446	J-17	J-18	8.0	135.0	-20	0.13
P-17	341	J-7	J-17	8.0	135.0	32	0.21
P-16	402	J-16	J-13	6.0	135.0	-54	0.62
P-15	599	J-15	J-16	6.0	135.0	-49	0.56
P-1	483	J-1	J-2	6.0	135.0	-5	0.06
P-12	640	J-12	J-13	8.0	135.0	-128	0.82
P-29	288	J-28	J-29	6.0	135.0	-7	0.08
P-10	323	J-10	J-11	6.0	135.0	5	0.06
P-9	284	J-9	J-10	6.0	135.0	10	0.12
P-8	677	J-8	J-9	6.0	135.0	19	0.22
P-7	412	J-7	J-8	6.0	135.0	24	0.28
P-6	475	J-6	J-7	8.0	135.0	62	0.39
P-5	559	J-5	J-6	8.0	135.0	67	0.43
P-4	507	J-4	J-5	8.0	135.0	72	0.46
P-3	342	J-3	J-4	8.0	135.0	77	0.49
P-2	128	J-2	J-3	8.0	135.0	82	0.52
P-14	352	J-12	J-15	6.0	135.0	31	0.35
P-39	579	J-37	J-38	6.0	135.0	-1	0.01
P-52	1,066	J-41	J-15	8.0	135.0	-76	0.48
P-51	66	J-45	R-1	12.0	135.0	-188	0.53
P-50	635	J-13	J-45	12.0	135.0	-188	0.53
P-48	212	J-44	J-39	6.0	135.0	-11	0.12
P-47	229	J-38	J-44	6.0	135.0	-6	0.06
P-46	229	J-20	J-43	8.0	135.0	5	0.03
P-45	343	J-42	J-32	6.0	135.0	19	0.22
P-44	327	J-31	J-42	6.0	135.0	-22	0.25
P-43	324	J-40	J-37	8.0	135.0	50	0.32
P-25	438	J-10	J-25	4.0	135.0	0	0.00
P-41	521	J-39	J-40	6.0	135.0	-16	0.18
P-28	130	J-9	J-28	6.0	135.0	4	0.05
P-38	294	J-21	J-37	8.0	135.0	-45	0.29
P-37	420	J-35	J-36	6.0	135.0	5	0.06
P-36	311	J-34	J-35	6.0	135.0	10	0.12
P-35	345	J-34	J-28	6.0	135.0	-6	0.07
P-34	459	J-33	J-34	6.0	135.0	9	0.10
P-33	427	J-32	J-33	6.0	135.0	14	0.16
P-31	211	J-29	J-31	6.0	135.0	-17	0.20
P-30	528	J-29	J-30	6.0	135.0	5	0.06
P-53	363	J-42	J-17	8.0	135.0	-47	0.30
P-42	394	J-40	J-41	8.0	135.0	-70	0.45

FlexTable: Junction Table (Model.wtg)

Current Time: 0.000 hours

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	Pressure (Calculated Residual) (psi)	Pressure Head (ft)
28	J-1	3,987.00	5	4,129.63	61.7	39.1	142.63
29	J-2	3,980.00	5	4,129.63	64.7	42.7	149.63
31	J-3	3,975.00	5	4,129.61	66.9	40.8	154.61
33	J-4	3,950.00	5	4,129.56	77.7	45.0	179.56
35	J-5	3,929.00	5	4,129.49	86.7	48.3	200.49
37	J-6	3,894.00	5	4,129.43	101.9	59.6	235.43
39	J-7	3,875.00	5	4,129.38	110.1	66.1	254.38
41	J-8	3,876.00	5	4,129.35	109.6	70.3	253.35
43	J-9	3,881.00	5	4,129.32	107.4	59.2	248.32
45	J-10	3,874.00	5	4,129.32	110.5	81.8	255.32
47	J-11	3,867.00	5	4,129.32	113.5	74.2	262.32
49	J-12	4,005.00	5	4,129.68	53.9	34.9	124.68
51	J-13	4,056.00	5	4,129.93	32.0	24.0	73.93
55	J-15	4,033.00	5	4,129.64	41.8	22.8	96.64
57	J-16	4,062.00	5	4,129.80	29.3	20.0	67.80
60	J-17	3,876.00	5	4,129.37	109.6	65.3	253.37
62	J-18	3,913.00	5	4,129.38	93.6	50.0	216.38
64	J-19	3,894.00	5	4,129.37	101.8	70.6	235.37
66	J-20	3,959.00	5	4,129.39	73.7	34.7	170.39
68	J-21	3,964.00	5	4,129.40	71.6	34.5	165.40
70	J-22	3,922.00	0	4,129.40	89.7	78.4	207.40
76	J-25	3,830.00	0	4,129.32	129.5	98.8	299.32
82	J-28	3,881.00	5	4,129.32	107.4	40.6	248.32
84	J-29	3,888.00	5	4,129.32	104.4	42.6	241.32
86	J-30	3,894.00	5	4,129.32	101.8	64.9	235.32
88	J-31	3,890.00	5	4,129.33	103.5	59.6	239.33
90	J-32	3,908.00	5	4,129.33	95.8	56.4	221.33
92	J-33	3,904.00	5	4,129.32	97.5	30.7	225.32
94	J-34	3,878.00	5	4,129.32	108.7	56.6	251.32
97	J-35	3,894.00	5	4,129.31	101.8	69.9	235.31
99	J-36	3,894.00	5	4,129.31	101.8	56.1	235.31
101	J-37	3,968.00	5	4,129.42	69.8	35.5	161.42
103	J-38	3,934.00	5	4,129.42	84.5	35.1	195.42
105	J-39	3,961.00	5	4,129.42	72.9	27.7	168.42
107	J-40	3,991.00	5	4,129.44	59.9	27.8	138.44
109	J-41	4,019.00	5	4,129.49	47.8	20.0	110.49
112	J-42	3,899.00	5	4,129.35	99.7	47.7	230.35
115	J-43	3,964.00	5	4,129.39	71.6	32.6	165.39
117	J-44	3,943.00	5	4,129.42	80.7	26.7	186.42
122	J-45	4,062.00	0	4,129.99	29.4	28.7	67.99

Scenario 3 Peak Day w/System Improvements

Fire Flow Node FlexTable: Fire Flow Report (Model.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (gpm)	Flow (Total Available) (gpm)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity (Upper Limit) (ft/s)	Pressure (Residual Lower Limit) (psi)
J-1	1,052	1,057	26.8	J-16	12.00	20.0
J-2	2,149	2,154	21.0	J-16	12.00	20.0
J-3	2,232	2,237	20.3	J-16	12.00	20.0
J-4	2,272	2,277	20.0	J-16	12.00	20.0
J-5	2,256	2,261	20.0	J-16	12.00	20.0
J-6	2,229	2,234	20.0	J-16	12.00	20.0
J-7	2,203	2,208	20.0	J-16	12.00	20.0
J-8	1,628	1,633	23.7	J-16	12.00	20.0
J-9	1,778	1,783	22.8	J-16	12.00	20.0
J-10	1,047	1,052	26.6	J-16	12.00	20.0
J-11	1,047	1,052	26.6	J-16	12.00	20.0
J-12	2,346	2,351	20.0	J-16	12.00	20.0
J-13	3,500	3,505	21.3	J-16	12.00	20.0
J-15	1,902	1,907	20.0	J-16	12.00	20.0
J-16	1,257	1,262	29.3	J-45	12.00	20.0
J-17	2,189	2,194	20.0	J-16	12.00	20.0
J-18	2,158	2,163	20.0	J-41	12.00	20.0
J-19	1,052	1,058	26.5	J-16	12.00	20.0
J-20	2,047	2,053	20.0	J-41	12.00	20.0
J-21	2,008	2,013	20.0	J-41	12.00	20.0
J-22	470	470	28.5	J-16	12.00	20.0
J-25	470	470	28.5	J-16	12.00	20.0
J-28	2,196	2,201	20.0	J-16	12.00	20.0
J-29	2,047	2,052	21.1	J-16	12.00	20.0
J-30	1,052	1,058	26.6	J-16	12.00	20.0
J-31	1,723	1,728	23.2	J-16	12.00	20.0
J-32	1,550	1,555	24.2	J-16	12.00	20.0
J-33	1,958	1,963	21.7	J-16	12.00	20.0
J-34	1,740	1,745	23.1	J-16	12.00	20.0
J-35	1,047	1,052	26.6	J-16	12.00	20.0
J-36	1,047	1,052	26.6	J-16	12.00	20.0
J-37	1,957	1,962	20.0	J-41	12.00	20.0
J-38	1,858	1,863	21.6	J-16	12.00	20.0
J-39	1,780	1,786	22.1	J-16	12.00	20.0
J-40	1,917	1,922	20.0	J-41	12.00	20.0
J-41	1,846	1,851	21.4	J-16	12.00	20.0
J-42	2,193	2,198	20.0	J-16	12.00	20.0
J-43	1,875	1,880	21.8	J-16	12.00	20.0
J-44	1,930	1,935	20.0	J-41	12.00	20.0
J-45	3,500	3,500	28.6	J-16	12.00	20.0

Scenario 3 Peak Day w/System Improvements

FlexTable: Pipe Table (CORC Red Rocks Model.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-35	345	J-34	J-28	6.0	135.0	15	0.17
P-7	412	J-7	J-8	6.0	135.0	15	0.17
P-8	677	J-8	J-9	6.0	135.0	10	0.11
P-9	298	J-9	J-10	6.0	135.0	10	0.12
P-10	309	J-10	J-11	6.0	135.0	5	0.06
P-17	328	J-7	J-17	8.0	135.0	33	0.21
P-18	458	J-17	J-18	8.0	135.0	10	0.06
P-19	558	J-18	J-19	6.0	135.0	5	0.06
P-28	130	J-9	J-28	6.0	135.0	-6	0.06
P-29	288	J-28	J-29	6.0	135.0	4	0.05
P-30	528	J-29	J-30	6.0	135.0	5	0.06
P-31	211	J-29	J-31	6.0	135.0	-6	0.07
P-6	475	J-6	J-7	8.0	135.0	53	0.34
P-34	459	J-33	J-34	6.0	135.0	-8	0.09
P-78	1,289	J-50	J-54	8.0	130.0	63	0.40
P-36	311	J-34	J-35	6.0	135.0	-28	0.32
P-37	431	J-35	J-36	6.0	135.0	-33	0.38
P-44	337	J-31	J-42	6.0	135.0	-11	0.12
P-45	332	J-42	J-32	6.0	135.0	2	0.02
P-53	377	J-42	J-17	8.0	135.0	-18	0.12
P-60	1,521	J-50	J-51	16.0	135.0	188	0.30
P-61	2,226	J-51	J-52	8.0	135.0	38	0.24
P-62	532	J-52	J-36	8.0	135.0	38	0.24
P-65	1,004	RED ROCK RESERVOIR	J-53	20.0	135.0	529	0.54
P-67	531	J-6	J-54	8.0	130.0	-58	0.37
P-72	2,026	J-53	J-50	16.0	130.0	529	0.84
P-33	427	J-32	J-33	6.0	135.0	-3	0.03

FlexTable: Junction Table (CORC Red Rocks Model.wtg)

Current Time: 0.000 hours

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	Pressure (Calculated Residual) (psi)	Pressure Head (ft)
37	J-6	3,894.00	5	4,024.36	56.4	27.7	130.36
39	J-7	3,875.00	5	4,024.33	64.6	36.0	149.33
41	J-8	3,876.00	5	4,024.32	64.2	24.9	148.32
43	J-9	3,881.00	5	4,024.31	62.0	31.0	143.31
45	J-10	3,874.00	5	4,024.30	65.0	39.9	150.30
47	J-11	3,867.00	5	4,024.30	68.1	32.8	157.30
60	J-17	3,876.00	5	4,024.32	64.2	36.0	148.32
62	J-18	3,913.00	5	4,024.32	48.2	20.0	111.32
64	J-19	3,894.00	5	4,024.31	56.4	21.9	130.31
82	J-28	3,881.00	5	4,024.31	62.0	24.7	143.31
84	J-29	3,888.00	5	4,024.31	59.0	22.6	136.31
86	J-30	3,894.00	5	4,024.31	56.4	23.1	130.31
88	J-31	3,890.00	5	4,024.31	58.1	20.0	134.31
90	J-32	3,908.00	5	4,024.31	50.3	20.0	116.31
92	J-33	3,904.00	5	4,024.31	52.1	20.0	120.31
94	J-34	3,878.00	5	4,024.32	63.3	28.7	146.32
97	J-35	3,894.00	5	4,024.35	56.4	20.0	130.35
99	J-36	3,894.00	5	4,024.40	56.4	20.0	130.40
112	J-42	3,899.00	5	4,024.31	54.2	23.3	125.31
148	J-50	3,894.00	277	4,024.56	56.5	48.4	130.56
151	J-51	3,867.00	150	4,024.51	68.1	56.2	157.51
153	J-52	3,885.00	0	4,024.42	60.3	21.6	139.42
158	J-53	3,975.00	0	4,024.94	21.6	20.5	49.94
161	J-54	3,929.00	5	4,024.41	41.3	20.0	95.41

Scenario 4 Connection to Carriage Hills Zone

Fire Flow Node FlexTable: Fire Flow Report (CORC Red Rocks Model.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (gpm)	Flow (Total Available) (gpm)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity (Upper Limit) (ft/s)	Pressure (Residual Lower Limit) (psi)
J-6	1,937	1,942	20.0	J-54	12.00	20.0
J-7	1,817	1,822	20.0	J-18	12.00	20.0
J-8	1,741	1,746	21.2	J-53	12.00	20.0
J-9	1,578	1,584	21.3	J-53	12.00	20.0
J-10	1,047	1,052	21.4	J-53	12.00	20.0
J-11	1,047	1,052	21.4	J-53	12.00	20.0
J-17	1,710	1,715	20.0	J-18	12.00	20.0
J-18	1,456	1,461	21.3	J-53	12.00	20.0
J-19	1,052	1,058	21.4	J-53	12.00	20.0
J-28	1,857	1,862	20.0	J-18	12.00	20.0
J-29	1,697	1,702	20.0	J-30	12.00	20.0
J-30	1,052	1,058	21.4	J-53	12.00	20.0
J-31	1,750	1,756	21.2	J-53	12.00	20.0
J-32	1,501	1,506	21.3	J-53	12.00	20.0
J-33	1,518	1,523	21.3	J-53	12.00	20.0
J-34	1,868	1,873	20.0	J-33	12.00	20.0
J-35	1,894	1,900	21.2	J-53	12.00	20.0
J-36	2,045	2,050	21.1	J-53	12.00	20.0
J-42	1,756	1,761	20.0	J-18	12.00	20.0
J-50	3,500	3,777	20.5	J-53	12.00	20.0
J-51	3,500	3,650	20.5	J-53	12.00	20.0
J-52	2,235	2,235	20.0	J-36	12.00	20.0
J-53	3,500	3,500	40.2	J-54	12.00	20.0
J-54	1,825	1,830	21.2	J-53	12.00	20.0

Scenario 4 Connection to Carriage Hills Zone

FlexTable: Pipe Table (CORC Selador Model.wtg)

Current Time: 0.000 hours

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)
P-42	415	J-40	J-41	8.0	135.0	-46	0.29
P-2	118	J-2	J-3	8.0	135.0	-47	0.30
P-3	342	J-3	J-4	8.0	135.0	-52	0.33
P-4	540	J-4	J-5	8.0	135.0	-57	0.36
P-11	240	J-2	J-12	8.0	135.0	71	0.45
P-12	640	J-12	J-13	8.0	135.0	27	0.17
P-14	343	J-12	J-15	6.0	135.0	39	0.44
P-15	590	J-15	J-16	6.0	135.0	-17	0.19
P-16	402	J-16	J-13	6.0	135.0	-22	0.25
P-20	628	J-18	J-20	8.0	135.0	-5	0.03
P-21	231	J-20	J-21	8.0	135.0	-15	0.10
P-38	294	J-21	J-37	8.0	135.0	-20	0.13
P-1	404	J-1	J-2	6.0	135.0	29	0.33
P-41	521	J-39	J-40	6.0	135.0	-11	0.13
P-79	386	J-50	J-53	16.0	135.0	257	0.41
P-43	324	J-40	J-37	8.0	135.0	30	0.19
P-46	229	J-20	J-43	8.0	135.0	5	0.03
P-47	229	J-38	J-44	6.0	135.0	-1	0.01
P-48	212	J-44	J-39	6.0	135.0	-6	0.07
P-52	1,071	J-41	J-15	8.0	135.0	-51	0.32
P-57	416	J-46	J-1	8.0	135.0	34	0.22
P-72	131	RED ROCKS BOOSTER STATION	J-50	16.0	135.0	374	0.60
P-73	1,259	J-50	J-5	8.0	135.0	62	0.40
P-74	1,906	J-46	J-50	8.0	135.0	-54	0.35
P-75	1,012	RED ROCKS TANK	J-51	20.0	135.0	374	0.38
P-76	1,986	J-51	RED ROCKS BOOSTER STATION	16.0	135.0	374	0.60
P-39	579	J-37	J-38	6.0	135.0	4	0.05

FlexTable: Junction Table (CORC Selador Model.wtg)

Current Time: 0.000 hours

ID	Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	Pressure (Calculated Residual) (psi)	Pressure Head (ft)
28	J-1	3,987.00	5	4,219.19	100.5	42.2	232.19
29	J-2	3,980.00	5	4,219.15	103.5	55.5	239.15
31	J-3	3,975.00	5	4,219.16	105.6	57.1	244.16
33	J-4	3,950.00	5	4,219.19	116.5	66.6	269.19
35	J-5	3,929.00	5	4,219.23	125.6	74.3	290.23
49	J-12	4,005.00	5	4,219.12	92.6	44.7	214.12
51	J-13	4,056.00	5	4,219.11	70.6	20.5	163.11
55	J-15	4,033.00	5	4,219.07	80.5	32.3	186.07
57	J-16	4,062.00	5	4,219.09	68.0	20.0	157.09
62	J-18	3,913.00	5	4,218.96	132.4	35.6	305.96
66	J-20	3,959.00	5	4,218.96	112.5	26.0	259.96
68	J-21	3,964.00	5	4,218.96	110.3	27.7	254.96
101	J-37	3,968.00	5	4,218.96	108.6	31.0	250.96
103	J-38	3,934.00	5	4,218.96	123.3	34.8	284.96
105	J-39	3,961.00	5	4,218.96	111.6	24.2	257.96
107	J-40	3,991.00	5	4,218.97	98.6	24.9	227.97
109	J-41	4,019.00	5	4,218.99	86.5	20.0	199.99
115	J-43	3,964.00	5	4,218.96	110.3	20.1	254.96
117	J-44	3,943.00	5	4,218.96	119.4	30.6	275.96
142	J-46	3,987.00	20	4,219.21	100.5	41.0	232.21
178	J-50	3,900.00	0	4,219.36	138.2	90.2	319.36
182	J-51	3,975.00	0	4,024.97	21.6	20.6	49.97
188	J-53	3,920.00	257	4,219.34	129.5	80.8	299.34

Scenario 5 Connection to Selador Zone

Fire Flow Node FlexTable: Fire Flow Report (CORC Selador Model.wtg)

Current Time: 0.000 hours

Label	Fire Flow (Available) (gpm)	Flow (Total Available) (gpm)	Pressure (Calculated System Lower Limit) (psi)	Junction w/ Minimum Pressure (System)	Velocity (Upper Limit) (ft/s)	Pressure (Residual Lower Limit) (psi)
J-1	2,176	2,181	20.0	J-16	12.00	20.0
J-2	1,940	1,945	20.0	J-16	12.00	20.0
J-3	1,963	1,968	20.0	J-16	12.00	20.0
J-4	2,034	2,040	20.0	J-16	12.00	20.0
J-5	2,168	2,173	20.0	J-16	12.00	20.0
J-12	1,804	1,809	20.0	J-16	12.00	20.0
J-13	1,681	1,686	20.0	J-16	12.00	20.0
J-15	1,548	1,554	21.3	J-51	12.00	20.0
J-16	1,503	1,508	21.4	J-51	12.00	20.0
J-18	1,542	1,547	20.0	J-41	12.00	20.0
J-20	1,542	1,547	20.0	J-41	12.00	20.0
J-21	1,542	1,547	20.0	J-41	12.00	20.0
J-37	1,542	1,547	20.0	J-41	12.00	20.0
J-38	1,542	1,547	20.0	J-41	12.00	20.0
J-39	1,542	1,547	20.0	J-41	12.00	20.0
J-40	1,542	1,547	20.0	J-41	12.00	20.0
J-41	1,542	1,547	21.3	J-51	12.00	20.0
J-43	1,541	1,547	20.1	J-41	12.00	20.0
J-44	1,542	1,547	20.0	J-41	12.00	20.0
J-46	2,244	2,264	20.0	J-16	12.00	20.0
J-50	2,777	2,777	20.0	J-16	12.00	20.0
J-51	3,500	3,500	66.9	J-16	12.00	20.0
J-53	2,777	3,034	20.0	J-16	12.00	20.0

Scenario 5 Connection to Selador Zone