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Appendix A: SEO Well Permits

Appendix B: Well Water Quality Test Results
Background

The original public water system for the Town of Rolling Hills was constructed by the developer of the subdivision approximately 30 years ago. The original system consisted of Well No.1 and the adjacent water storage tank. As the development grew, Well No. 2 was added and a booster pump station to improve pressures to the higher elevations served by the water system. Rolling Hills was incorporated as a Town in the State of Wyoming in 1984. The Wyoming Water Development Commission (WWDC) funded the siting, drilling and development of Well No.’s 4, 5, and 6 and the drilling and redevelopment of Well No. 2 for the Town of Rolling Hills. The system currently consists of: four wells providing potable water (Well No.’s 2, 4, 5, and 6); Well No. 1 is used for wholesale water sales; two welded steel water storage tanks; and two booster stations to provide water to the residents of Rollins Hills.

The Town of Rolling Hills applied to the WWDC for funding to complete a Level I Water System Master Plan in 2009. The project was approved and funded by the Legislature in April 2010 and Civil Engineering Professionals, Inc. (CEPI) was retained by the WWDC in June 2010 to complete the water system Master Plan. The scope of services for the master plan included water system growth projections, completion of accurate aerial mapping, development of a comprehensive Geographic Information System (GIS) database for the water system, hydraulic modeling and system analysis, and recommendations for needed improvements to meet current and projected development in the Town of Rolling Hills. The Master Plan was needed to address the successful long term operation of the water system, and to complete the hydraulic modeling and GIS data base for the system.

Acknowledgements

CEPI would like to thank the people who assisted with the completion of this Master Plan. Without their help the Master Plan would be inaccurate and incomplete.

- WWDO (Wyoming Water Development Office) – Keith E. Clarey, PG for the direction and management necessary to complete the Master Plan, and the Wyoming Water Development Commission for their commitment to water related projects in the state of Wyoming.
Rolling Hills Water System Master Plan

Section 1 – Introduction

- **Rolling Hills Public Utilities** – Joe Percko and Megan Lockwood, the system operators, for their knowledge and input into the process. The operation of the existing system is quite challenging given the number of undocumented modifications to the system and the overall complexity of the system. Joe and Megan were extremely helpful and cooperative in understanding the existing system and evaluating the operation of the system. Joe and Megan’s historic knowledge of the system and commitment to the safe and reliable operation of the system are valuable assets to the Town of Rolling Hills.

- **Rolling Hills Town Clerk** – Teresa Montgomery, the Town Clerk for her patience with the continuous additional requests for financial information. Teresa has tremendous pride in the Town of Rolling Hills; she is committed to the thorough and complete analysis and management of the operations and finances of the Town.

**Study Layout**

The Master Plan is presented in a total of ten sections supported by appendices, the GIS database, the detailed hydraulic model, and the financial model for the water enterprise account. The contents of the ten sections are briefly detailed below:

- **Section 1 – Introduction**: this section provides general background information regarding the Town of Rolling Hills; provides acknowledgements for the individuals who assisted with the completion of this study; and provides an overview of the layout of the Master Plan.

- **Section 2 – Service Area and Population**: this section identifies the existing and potential water system service area boundary; provides a historical perspective of the population in the service area; and provides population growth estimates for the service area for the 10- and 20-year planning horizons (2020 and 2030).

- **Section 3 – Water Usage**: this section details the historic water usage for the Town of Rolling Hills; provides estimates for current and projected average day demands, maximum day demands and peak hour demands for the 2020 and 2030 planning
horizons; and identifies and quantifies the unaccounted-for water in the Rolling Hills water system.

- **Section 4 – Groundwater Supply Analysis**: this section details the components included in the Town of Rolling Hills groundwater supply system, including well integrity, production potential, and water quality.

- **Section 5– Water System Operation**: this section of the study provides an overview of the operation of the water system in the Town of Rolling Hills and makes recommendations for operational changes to the system.

- **Section 6 – GIS Development**: this section identifies the steps taken for the development of the Geographic Information System (GIS) database for the Town of Rolling Hills including the completion of the aerial imagery and development of the metadata for all of the water system components. The value of the GIS database goes well beyond this master plan; it serves as a platform for the long term mapping, planning and operation of the water system.

- **Section 7 - Hydraulic Analysis**: this section describes and defines the detailed steps taken to develop the current hydraulic water system model for the Town of Rolling Hills. The section describes the development of the geographical water system model, the process for distributing the water demands throughout the system, and the steps taken to calibrate the model. This section provides a detailed analysis of the capacity and sizing of the existing water system including: source supply, storage, and distribution and transmission of water to meet the demands in the service area.

- **Section 8–Proposed System Improvements**: this section provides conceptual designs for the proposed water system improvements identified to address current water system needs and proposed improvements for the future development of the water system. Detailed cost estimates for the proposed improvements and a project schedule for the implementation of the preferred alternative are provided.
Section 9 – Financial Analysis: this section of the study provides a detailed analysis of the historic and projected water enterprise account and the ability of the system to meet current and projected financial demands. This section provides an analysis of the current rate schedule to meet the financial needs of the Town and identifies proposed rate modifications to fund the proposed system improvements.

Section 10 – Project Funding: this section identifies the potential funding resources that are available in the State to provide grant and loan funds for the design and construction of the proposed system improvements identified in the Master Plan.
Service Area Description and Growth Area

The Town of Rolling Hills currently provides water to the customers located inside the corporate boundaries and several residential and commercial properties adjacent to the corporate limits. Figure 2-1 graphically identifies: the corporate limits for the Town of Rolling Hills, the water users outside the corporate limits, and potential growth area around the Town of Rolling Hills.

The potential growth areas identified in Figure 2-1 were developed based upon discussions with the Town of Rolling Hills, the Town’s growth planning goals and objectives, and the potential for undeveloped areas to connect to the water system based on the location and elevation of the properties. Current and anticipated land uses were also taken into consideration when predicting the type of growth that may occur within the potential service area boundary. The growth areas include future residential development and commercial and industrial development. Table 2-1 details the acreage and type of projected growth for each area identified in Figure 2-1.

<table>
<thead>
<tr>
<th>Description</th>
<th>Acreage</th>
<th>Residential Unit Size (acre/lot)</th>
<th>Residential Units</th>
<th>Commercial &amp; Industrial (acres)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monkey Road. – Developed¹</td>
<td>440</td>
<td>5.5</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Northwest Corner – Undeveloped²</td>
<td>20</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>West Side - Undeveloped</td>
<td>160</td>
<td>5.5</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>North Side - Undeveloped</td>
<td>125</td>
<td>5.5</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>745</strong></td>
<td><strong>132</strong></td>
<td></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

¹Does not include current water users outside corporate boundary
²Acreage within Potential Growth Boundary which can be served by water system

Population Projections

The historic population for the Town of Rolling Hills over the past 27 years (the Town of Rolling Hills incorporated in 1984) is graphically displayed in Figure 2-2. The historic population for the nearby Town of Glenrock over the past 41 years is also displayed in Figure 2-2 and the historical population for Converse County is displayed in Figure 2-3 for
comparison purposes. The population estimates are based upon census records from the Wyoming Department of Administration and Information (DAI).

Figure 2-2
Rolling Hills and Glenrock Historic Population

Figure 2-3
Converse County Historic Population
The population trends for Rolling Hills, Glenrock, and Converse County are very similar. The communities have experienced positive and negative growth patterns with the strength of oil, gas and mineral development in the region. Growth declined dramatically in the mid-1980’s and began recovering in the mid-1990’s. Figure 2-4 graphically identifies the average annual growth rate for the Town of Rolling Hills over the past 20 years; Figure 2-5 graphically identifies the average annual growth rates for the Town of Glenrock and Converse County over the past 50 years.
Over the past 20 years, the Town of Rolling Hills’ population has increased at an average rate of approximately 1.5-percent per year. However, this trend dramatically changed over the last ten years. The 2000 US Census population for the Town of Rolling Hills was 449 people; the 2010 Census estimates for the Town of Rolling Hills is 440 people, a decrease of nine people or approximately two percent. Over the past 50 years, the Town of Glenrock’s population has increased at an average rate of approximately 1.1-percent per year and Converse County’s population has increased at an average rate of approximately 1.5-percent per year. The annual growth rates can vary significantly from year to year (i.e., boom during 1970’s and early 1980’s and subsequent bust in the late 1980’s); however, the growth rates identified in the figures provide a consistent average over the 50-year period.

The average growth rate of 1.5-percent per year for the Town of Rolling Hills is similar to the growth rates experienced in the Town of Glenrock and Converse County. However, as identified above, the Town of Rolling Hills has experienced a decrease in population over the past ten years. Growth rates can vary significantly and are greatly impacted by the economic condition in the State and more specifically the market for oil, minerals, and natural gas, especially in the smaller towns. During previous boom periods in the Wyoming economy, small communities in the state experienced dramatic growth with the development of oil, minerals and gas in the state. The growth peaks in these small communities were directly attributed to mine, petroleum, or wind energy development in the immediate proximity of the community.

Figure 2-6 provides population estimates for the Town of Rolling Hills for the 10- and 20-year planning horizons; Table 2-2 also provides population estimates for the planning horizons. Three different growth rates were considered for the Town of Rolling Hills:

- DAI – The Wyoming Department of Administration and Information publishes growth projections for communities in Wyoming for the 20-year planning horizon. The DAI has not published the updated growth projections since the 2010 Census and the population projections for the year 2010 were off by 72 people (DAI 2010 population projection of 512 people, 2010 Census population of 440 people). The 2020 DAI growth estimate for the Town of Rolling Hills was based upon their 2020 population estimate of 512. It is approximately equal to 0.6-percent per year (approximately 1.4-
percent per year growth rate using the current 2010 Census population of 440). This growth rate is shown graphically on the figure as the dark blue line.

- 1.5-percent – The average growth rate for the Town of Rolling Hills over the past 20 years is 1.5-percent per year. This growth rate is shown graphically on the figure as the magenta line.

- 2.75-percent - The final growth rate projection shown on Figure 2-6 is an annual population growth estimate of 2.75-percent per year. This growth rate is shown graphically on the figure as the light blue line.

### Table 2-2 Rolling Hills Population Estimates

<table>
<thead>
<tr>
<th>Growth Rate</th>
<th>Year/Planning Horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
</tr>
<tr>
<td>DAI – 0.6% per Year</td>
<td>512</td>
</tr>
<tr>
<td>1.5% per Year</td>
<td>440</td>
</tr>
<tr>
<td>2.75% per Year</td>
<td>440</td>
</tr>
</tbody>
</table>

![Figure 2-6](image-url)
The Town of Rolling Hills may experience growth from the recent exploration and
development of oil, natural gas, uranium, and wind energy in the region. The Town will also
continue to be home for the employees at the Dave Johnston Power Plant, the local wind farms
and the neighboring coal mines and uranium mines. Additionally, the Town will serve as a
“bedroom” community for people working in Glenrock, Casper, or Douglas who desire a
smaller, neighbor-friendly town with rural living on large lots. As described earlier, the
population in the Town of Rolling Hills has grown at an average rate of 1.5-percent per year
over the past 20 years. The estimated growth rate recommended for this study is the higher
growth rate of 2.75-percent per year. The higher growth rate is recommended primarily
because of the residents along Monkey Road. If these residents annex into the corporate limits,
the population will increase by approximately 280 people (80 residential units w/ 3.5 people
per unit) for a total population of 720. The recommended annual growth rate of 2.75-percent
per year encompasses the projected oil, gas, uranium, and wind development in the area, the
residents along Monkey Road., and the continued development of Rolling Hills as a bedroom
community.
Water Usage

This section of the study provides: a summary of the historical water consumption for the Town of Rolling Hills, identifies the average per capita water usage, presents an estimate of unaccounted-for water (i.e., water that is consumed or lost in the system but not metered), and presents water use projections for the 10- and 20-year planning horizons.

Historical Water Usage

Analyzing the water usage for the Town of Rolling Hills was difficult due to the limited data available. The Town has accurate water billing records dating back to May of 2008. The water billing records that pre-date May 2008 were tampered with by a previous employee, rendering them inaccurate, and they were not utilized in this study. Additionally, irrigated parcels owned by the Town have not been metered until recently. The following sites had meters installed in August 2010, however, they are still not included in the water billing records: the Fire Hall, the bike path (not operable yet), and the Town Park. The Town Hall and the Town Shop are still not metered. Figure 3-1 graphically presents the historical monthly water usage; units on the figure are gallons per day (gpd). Figure 3-1 includes the billed water usage and does not include the unmetered or recently installed meters previously discussed.

Figure 3-2 graphically presents the current monthly water usage since the recent meters have been installed. The figure includes water usage data from the water billing records, the meters for the Fire Hall and the Town Park, and estimated usage values for the Town Hall, the Town Shop, and the bike path based upon discussions with the Town of Rolling Hills. The estimated value for the Town Hall is 1,000 gallons per month; the Town Shop is estimated to use 100 gallons per month; and the bike path usage estimate is 1,000 gallons per month from June through September. The actual billing records are also included in Figure 3-2 for comparison purposes.
Figure 3-3 graphically presents the total water usage for the past three years. The total water usage includes the assumptions discussed earlier for the Town Hall, Town Shop, and bike path;
and assumes the same usage values that were recorded since August 2010 for the unbilled meters.

![Figure 3-3: Total Yearly Water Usage](image)

During the past three years, the total water usage has ranged from 19.8 million gallons per year to 22.7 million gallons per year. The usage increased by approximately 6-percent the first year and approximately 7-percent the second year for a total of a 13-percent increase over the three year period. A town’s water usage typically fluctuates from year to year, depending on several factors including, population, precipitation, and conservation.

Per capita water consumption for many towns has reduced over the past decade. The following is a list of several factors that have contributed to the reduced usage per capita over the past decade:

- Regional drought – residents have reduced frivolous usage of water based upon several years of drought conditions in the early 2000’s.
- Conservation – in recent years, society is more aware of conservation and preserving natural resources. Regionally, per capita water usage has dropped during the past 10 to 20 years based upon a heightened awareness and desire to conserve natural resources.
• Water rates – higher drinking water quality standards and production costs have increased water rates resulting in reduced demand and waste.
• Irrigation – customers have installed automatically controlled irrigation systems; reducing and controlling the amount of water used for irrigation purposes.

**Peaking Factors**

There are three demand peaking factors used in analyzing a water system as defined by the American Water Works Association (AWWA). The three factors are:

- **Average Day Demand (ADD)** – the average water consumption per day for a water system. ADD is calculated by dividing the total water production/consumption in a water system over a year by 365 days. With only three full years of billing records, the ADD for this study was established by averaging the 2008 to 2011 water billing records while accounting for the unbilled customers. The current ADD for the Town of Rolling Hills is approximately 58,000 gpd or 40 gallons per minute (gpm).

- **Maximum Day Demand (MDD)** - the maximum consumption of water over a 24-hour period in a water system. MDD typical occurs in the summer when water demands for irrigation are at their highest in the system. The MDD factor is calculated by dividing the MDD by the ADD. The Town of Rolling Hills does not have daily records of the water usage in the system. The monthly usage was analyzed to determine the MDD factor. As shown in Figure 3-1, the highest water usage has been during the month of July over the last three years. The following table displays the July usage over the last three years (including unbilled users) and the maximum month peaking factor, July Water Usage divided by the ADD.

**Table 3-1 Maximum Month Peaking Factor**

<table>
<thead>
<tr>
<th>Year</th>
<th>ADD (gpd)</th>
<th>July Water Usage (gpd)</th>
<th>Peaking Factor (Maximum Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>54,000</td>
<td>142,000</td>
<td>2.6</td>
</tr>
<tr>
<td>2009</td>
<td>58,000</td>
<td>143,000</td>
<td>2.5</td>
</tr>
<tr>
<td>2010</td>
<td>62,000</td>
<td>168,000</td>
<td>2.7</td>
</tr>
</tbody>
</table>
The MDD is undoubtedly higher than the maximum month peaking factor. The MDD factor assumed for Rolling Hills is 3.0 times ADD, or a MDD of 174,000 gpd or 121 gpm.

- **Peak Hour Demand (PHD)** – is defined as the maximum consumption of water during a one hour period in a water system during a single day. The peak hour demand typically occurs in the summer during high demand periods and is a result of daily fluctuations (i.e., diurnal) in water consumption. With no SCADA information and no daily consumption records, this study assumed a PHD factor of 6 times ADD or a PHD of 348,000 gpd or 240 gpm. PHD factors are typically range from 3.0 and 6.0. Smaller water systems typically experience much higher MDD and PHD demand factors. An individual user irrigating their lawn in a town of 440 people has a much greater impact on the total water usage than an individual user irrigating their lawn in a much larger community. The PHD factor assumed for the Town of Rolling Hills was 6.0 based upon the relatively small size of the system, the large lot size, and the relatively large family size in the community.

**Per Capita Water Usage**

The water consumption data in this section were combined with the population estimates for the Town of Rolling Hills service area provided in the previous section to calculate per capita average day demands; expressed in terms of gallons per capita per day (GPCD). The per capita water usage over the past three years is presented in Table 3-2.

The per capita water usage over the past three years is presented in Table 3-2 below; the average per capita water usage is approximately 132 GPCD. These figures are significantly lower than the Town of Glenrock’s per capita water usage which is estimated to be 247 GPCD and the City of Casper’s which is estimated to be 190 GPCD, but is typical for larger un-irrigated rural parcels. This study will assumed a per capita water usage at 140 GPCD for the Town of Rolling Hills.
Table 3-2 Town of Rolling Hills per Capita Water Usage

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Day Demand (kgal/day)</th>
<th>Service Area Population</th>
<th>Per Capita Water Usage (GPCD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2008 – April 2009</td>
<td>54.2</td>
<td>442</td>
<td>123</td>
</tr>
<tr>
<td>May 2009 – April 2010</td>
<td>58.4</td>
<td>441</td>
<td>132</td>
</tr>
<tr>
<td>May 2010 – April 2011</td>
<td>62.1</td>
<td>440</td>
<td>141</td>
</tr>
<tr>
<td>Average</td>
<td>0.58 kgal/day</td>
<td></td>
<td>132 GPCD</td>
</tr>
</tbody>
</table>
Well Evaluation Program

As required under the scope of work for this project, the five Rolling Hills municipal wells were evaluated during December of 2010 and January of 2011. This section summarizes the results of the investigations conducted by Weston Engineering, Inc. (WESTON). The purpose of this task was to evaluate the Rolling Hills municipal wells in terms of well integrity, production potential, and water quality to provide a baseline from which to compare future performance. The scope of work included review of data from the following sources:

- Town of Rolling Hills files;
- Wyoming State Engineers Office (SEO) files;
- Wyoming Department of Environmental Quality - Water Quality Division (DEQ) files;
- Reports by engineering firms; and
- Interviews with water system operators, drillers, and engineers associated with drilling and construction of the wells.

Between December 13, 2010 and January 24, 2011, the pumps were removed from the wells, video logs were performed to assess the down-hole integrity of the wells, and pumping tests were conducted on the wells to assess production capacity.

Water System Summary

The Town of Rolling Hills water supply system (PWS ID #WY5600782) is comprised of five water supply wells, liquid hypochlorite disinfection systems, two water storage tanks, and a distribution system with 155 active service connections. The locations of the wells and the municipal boundaries are shown in Figure 4-1. The water from Well Nos. 1 and 2 is pumped into the 98,000-gallon tank located on the south side of the Town adjacent to Well No. 1 and water from Well Nos. 4, 5, and 6 is pumped into the 230,000-gallon tank located on the north side of Town adjacent to Well No. 4. Water is pumped to the tanks through dedicated transmission lines and the two tanks are connected to one another with a pipeline. The pumps in the wells are actuated by water-level sensors in the tanks. Typically, Well No. 6 is the lead
ROLLING HILLS LEVEL I STUDY
WELL LOCATION MAP
FIGURE 4-1
well, with Well No. 5, then Well No. 4 being turned on as needed to maintain tank levels. Well No. 1 is used only for loading water trucks because of elevated iron concentrations. Well No. 2 is operated only during summer months because of water quality concerns and because non-irrigation month demands can be met with the other wells in the system.

**Geologic and Hydrogeology Overview**

The Town of Rolling Hills is located along the southeastern margin on the Powder River structural Basin. The Town is immediately underlain by the Lower Tertiary Fort Union Formation and the Upper Cretaceous Lance Formation. These formations generally strike in a northwest-southeast direction and dip an estimated 15 degrees to the north-northeast, based on measurements conducted by WESTON staff on outcrops near Well No. 2 and geologic mapping prepared by Gibbons and White (1956). The configuration of the Fort Union and Lance Formations in the vicinity of Rolling Hills is illustrated in Figure 4-2, a north-south geologic cross section that depicts the subsurface geology beneath the Town.

The continental deposits of the Upper Cretaceous Lance Formation are composed of interbedded light yellow gray, fine to medium grained, crossbedded, lenticular sandstones, gray carbonaceous shales and siltstones. The Lance Formation also contains thin coals and bentonitic beds. Individual discontinuous sandstone beds within the Lance Formation range in thickness from a few inches to several feet. The thickness of the Lance Formation in the southern Powder River Basin ranges from 1,600 to 3,000 feet (Whitcomb, 1965). The Lance Formation is conformably overlain by the Tullock Member of the Fort Union Formation.

The Tullock Member of the Fort Union Formation is stratigraphically similar to the Lance Formation but is generally lighter in color, more evenly bedded, and richer in coal (Robinson and others, 1964). The Tullock Member of the Fort Union Formation ranges in thickness from about 370 feet in the northern Powder River Basin to 1,440 feet in the southern part of the basin.

The lower Tullock Member of the Fort Union Formation and the underlying Lance Creek Formation are generally considered to be part of the Fox Hills/Lance Aquifer System, as defined by Feathers and others (1980). As depicted in Figure 4-2, all of the Rolling Hills wells
ROLLING HILLS
LEVEL I STUDY
CROSS SECTION A - A'
FIGURE 4-2

SCALE
VERTICAL 1" = 500'
HORIZONTAL 1" = 1,000'

- STATIC WATER LEVEL
- SCREENED INTERVAL
- SANDSTONE INTERVALS

ELEVATION IN FEET ABOVE SEA LEVEL

WELL NO. 1
T.D. = 990'
T.D. = 1,853'

WELL NO. 2

WELL NO. 4
T.D. = 1,516'

WELL NO. 5

FORT UNION FORMATION
LANCE FORMATION

WELL NO. 4
T.D. = 1,516'

WELL NO. 2
T.D. = 1,853'

WELL NO. 1
T.D. = 990'

WELL NO. 2
T.D. = 1,853'

WELL NO. 4
T.D. = 1,516'

WELL NO. 5

3,000 3,500 4,000 4,500 5,000 5,500

A' SOUTH

A NORTH
are completed in the Lance Formation and develop water from the discontinuous sandstone lenses within the formation. Correlation of sandstones penetrated by the wells suggests that Well Nos. 4 and 5 are in direct hydraulic communication with one another and that the sandstones are recharged at or near the Town corporate limits.

Well Evaluation

The following is a description of the construction of each of the Town of Rolling Hills wells according to the Statements of Completion on file with the SEO, records maintained by the Town of Rolling Hills, project reports, and as confirmed by the video logs. Also included is a discussion of the work WESTON performed on each of the Rolling Hills wells and an assessment of the overall integrity and capacity of each well.

Rolling Hills Well No. 1

Permitting. The SEO permit number for the Rolling Hills #1 Well (Well No. 1) is U.W. 125023, which has a priority date of February 23, 1988. The well was drilled in 1978 and permitted under U.W. 64211 (J&J #93 Well). When the well was permitted for municipal use, the priority date was set at the date of application. The well is not adjudicated for municipal use because a Plat of Beneficial Use has only recently been filed with the SEO. The permitted maximum pumping rate is 50 gallons per minute (gpm) and there is currently no cap on total annual production. Permit conditions required by the SEO permit include the following:

- A water meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from the well;

- An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period;

- The report shall identify the well by name, location, permit number, and shall identify the type of meter used for the measurement;
• The report shall contain at least two semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was “shut-in” prior to obtaining the measurements must be specified; and

• The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

A copy of the well permit is presented in Appendix A to this study.

**Well Drilling and Construction Data.** Well No. 1, which is located on the south side of the Town of Rolling Hills, was drilled and constructed in 1978 by D&D Drilling of Glenrock, Wyoming. Construction details for Well No. 1 from the Statement of Completion and the video log performed by WESTON on December 10, 2010, are provided in Table 4-1 and on Figure 4-3.

**Table 4-1**

**Well No. 1 Summary**

<table>
<thead>
<tr>
<th>State Engineer Permit No.:</th>
<th>U.W. 125023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>NE1/4, NE1/4 Section 28, Township 34 North, Range 75 West, Lot 99; 42°53’42.54”N, 105°51’9.27”W</td>
</tr>
<tr>
<td>Surface Elevation:</td>
<td>5,393.23 feet, ground level</td>
</tr>
<tr>
<td>Total Depth:</td>
<td>1,000 feet: drilled</td>
</tr>
<tr>
<td></td>
<td>990 feet: completed</td>
</tr>
<tr>
<td></td>
<td>891 feet: bottom on video log</td>
</tr>
<tr>
<td>Formations:</td>
<td>0 – 1,000 feet: Lance Formation</td>
</tr>
<tr>
<td>Hole Diameter:</td>
<td>Unknown</td>
</tr>
<tr>
<td>Casing:</td>
<td>0 - 990 feet: 7-inch steel casing</td>
</tr>
<tr>
<td></td>
<td>890 feet: Tag bottom on video log</td>
</tr>
<tr>
<td>Producing Intervals:</td>
<td>700–800 feet: 80 1/16 x 12-inch slots (Statement of Completion)</td>
</tr>
<tr>
<td></td>
<td>681 – 881 feet: per video log</td>
</tr>
</tbody>
</table>
Static Water Level: 220 feet (January, 1978)
207 feet (March 10, 2005)
201 feet (March 25, 2010)
210 feet (January 19, 2011)

Air Line Setting: 672 feet (2011)

Drilling and Completion Date: January 1978

Testing Rates: 50 gpm with 100 feet of drawdown after 24 hours (1978)
90 gpm with 284 feet of drawdown after 380 minutes (2011)

Pump Information: Grundfos Model 85S200-18 Pump, SN 40512US126
Franklin 20-HP Submersible Motor, Model 2366140020, SN 00J19-28-0130, 2000 Date Code
Set on 2-inch galvanized pipe with intake at 672 feet (TOC)

Engineering During Well Construction: None known

Drilling Contractor: D&D Drilling (Glenrock, WY)

Pumping Testing Contractor: J&J Development (Rolling Hills, WY), 1978
Weston Engineering, Inc. (Upton, WY), 1/24/11

The Statement of Completion for Well No. 1 reports that the well has a total depth of 1,000 feet and is completed with 7-inch steel casing to a depth of 990 feet with 1/16 by 12 inch slots in the casing from 700 to 800 feet. The video log however, showed that the well has slots in the casing from 681 to 881 feet. The video log also encountered either the bottom of the well or an obstruction in the well at 891 feet.

The lithologic log for Well No. 1 consists of a three-line entry on the Statement of Completion. It states that from the ground surface to a depth of 60 feet the materials encountered in the borehole consisted of sand, gravel, and clay. From 60 to 680, feet the well penetrated shale and from 680 to 730 feet the well encountered salt and pepper sand. No lithology is recorded for strata below 730 feet.
UNKNOWN INTERVAL: CEMENT GROUT

+1.0 - 1,000 FEET: 7-INCH O.D. STEEL CASING

0 - 1,000 FEET: UNKNOWN BOREHOLE DIAMETER

2-INCH GALVANIZED PUMP COLUMN AND # 8 AWG WIRE, AIRLINE SET AT 672 FEET

T.D. = 1,000 FEET

NOT TO SCALE

ROLLING HILLS
LEVEL I STUDY
AS-BUILT DIAGRAM WELL NO. 1
FIGURE 4-3
**Downhole Well Inspection.** On December 9, 2010, WESTON mobilized a pump service rig and removed the downhole pumping equipment from Well No. 1. The upper eight joints of the pump column were new in appearance. The remaining 24 joints had varying degrees of encrustation and corrosion. At a depth of 384 feet, the pump column had a hole that was approximately 2 inches in diameter. The pump column joints from 384 to 486 feet had small holes or spots of corrosion that nearly penetrated the pump column wall. One check valve was located at a depth of 288 feet. WESTON replaced five joints of the most severely corroded pump column and moved some of the less corroded pipe above the static water level. The total length of the pump column is 672 feet. The #8 AWG, flat jacketed, three-wire pump cable is in very good condition and the pump and motor appear to be in good working order.

A letter dated March 15, 2005 from Pronghorn Pump and Repair, of Glenrock, Wyoming, reported that the pump in Well No. 1 had been removed on March 10, 2005. It appears that the pump was removed because it was not yielding adequate quantities of water. The letter states that there was a 0.5-inch diameter hole in the pump column at a depth of 378 feet and that the pump column should be replaced. Date codes on the pump column pulled by WESTON indicate that the pump column was replaced in 2005.

When the pump was reinstalled in the well by WESTON and turned on it was only able to yield 27 gpm. WESTON staff had cut the pump cable in the room where the well is located to facilitate winding of the cable during pump removal. When the pump was reinstalled the four conductors were spliced with like-color to like-color. The 27 gpm production rate is far lower than the pump curve indicated for a static water level of 210 feet. WESTON personnel opened the pump panel and switched two of the wires in the panel. When the pump was subsequently turned on it yielded over 100 gpm, which is consistent with the pump curve.

Observations from the video log performed on Well No. 1 on December 10, 2010 are summarized in Table 4-2. The slots in the casing are difficult to identify in the downhole view of the well. The late part of the video log shows side views of the slots, which reveal significant plugging of most slots observed. The side view also shows the extensive development of mineral scale, which has a white hue, and possible bacterial build-up, which has a fluffy appearance. Plugging of the slots could result in lower yields from the well.
Pump Testing. The Statement of Completion for Well No. 1 reports that a 24-hour pumping test was conducted by J&J Development, of Rolling Hills in 1978. The pumping rate was 50 gpm and the drawdown at the end of the test was 100 feet. WESTON was unable to obtain any detailed pumping test data for analysis. The specific capacity computed from the data is 0.5 gpm/foot of drawdown. An estimate of the aquifer transmissivity, based on the pumping test data using the method developed by Driscoll (1986), is 1,000 gallons per day per foot (gpd/ft).

On January 24, 2011 WESTON conducted a pumping test of Well No. 1. The permanent pump and wellhouse discharge piping was used, including the 2-inch Micrometer flow meter. Based on observations of water levels during the pump check conducted when the pump was reinstalled, it was decided to allow the well to be pumped wide open. This method of operation closely mimics how the well would be used when loading water trucks. The initial airline reading was 193 psi, which equals a static water level of 226 feet below ground level. The well was tested at an average rate of 90 gpm for a period of 380 minutes. The drawdown at the end of the test was 284 feet. The specific capacity of the well using the drawdown data from the end of the test was 0.32 gpm/ft, which is slightly lower than the specific capacity calculated when the well was first drilled.

Table 4-2
Well No. 1 Video Log Description (December 10, 2010)

<table>
<thead>
<tr>
<th>Interval (feet)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Top of casing.</td>
</tr>
<tr>
<td>0 - 113</td>
<td>Steel casing with threads exposed. Slightly pitted.</td>
</tr>
<tr>
<td>113</td>
<td>Increased scale on casing.</td>
</tr>
<tr>
<td>210</td>
<td>Static water level. Water is very turbid, was not able to flush well.</td>
</tr>
<tr>
<td>334</td>
<td>Bare spot on casing, shows other parts of casing have developed mineral scale.</td>
</tr>
<tr>
<td>379</td>
<td>Scale from casing coming off as camera scrapes casing.</td>
</tr>
<tr>
<td>640</td>
<td>Scale is heavier.</td>
</tr>
<tr>
<td>671</td>
<td>Stainless steel band from pump column.</td>
</tr>
<tr>
<td>679</td>
<td>Stainless steel band from pump column.</td>
</tr>
<tr>
<td>680</td>
<td>Bulbous scale on casing. Appears to be biologic growth.</td>
</tr>
<tr>
<td>681 - 881</td>
<td>Vertical slots, most heavily encrusted and appear to be at least partially obstructed.</td>
</tr>
<tr>
<td>888</td>
<td>Side view of scale and possible bacterial growth.</td>
</tr>
<tr>
<td>891</td>
<td>Bottom of well, filled with debris.</td>
</tr>
</tbody>
</table>
Figure 4-4 is a time-drawdown plot of the constant-rate pumping test data from Well No. 1 using the method developed by Cooper and Jacob (1946). The aquifer’s transmissivity, as determined from the late-time drawdown data from Well No. 1, is 165 gallons per day per foot (gpd/ft). The drawdown data were affected by turning off the pump briefly after the discharge hose blew out and a new section of hose was added. No storage coefficient is available for Well No. 1 because no observation wells are available.

At the conclusion of the pumping test, recovery data were collected from Well No. 1 for 420 minutes. The recovery data are plotted on Figure 4-5 using the method developed by Cooper and Jacob (1946). The residual drawdown is plotted versus the ratio of the time since the pump was started (T) over the time since the pump was turned off (T’). Later time recovery data plot to the left of the diagram. The late-time recovery data yield an aquifer transmissivity of 350 gpd/ft. The transmissivity computed from the late-time recovery data is nearly two times higher than that computed from the pumping data, but is within the same order of magnitude.

**Water-Level Trends.** Tracking of water levels and water production rates can be valuable in assessing the sustainability of an aquifer in the vicinity of a well or wellfield. From 1978, when the well was constructed to December 10, 2010 only three water-level measurements are known to have been collected from Well No. 1. The water level in January 1978 was 220 feet and according to Pronghorn Pump and Repair, it was 207 feet on March 10, 2005. On March 25, 2010, the water level was 201 feet, as measured by WESTON. During the well evaluation in December 2010 and January 2011, the water level was 210 feet. The well had not been in operation before the 2010 water level measurements. There does not appear to be a significant water-level decline in Well No. 1 during the time since the well was completed.

**Well Production Capacity.** The pumping testing of Well No. 1 resulted in an estimated aquifer transmissivity of 165 gpd/ft and 350 gpd/ft based on the pumping and recovery data, respectively. Although the demand for Well No. 1 is currently for loading water trucks, in the event of water system emergencies the well could be used to meet drinking water demands. The pump in Well No. 1 is set at a depth of 672 feet and the static water level is 210 feet, resulting in an available drawdown of approximately 437 feet (allowing for 25 feet of pump
Figure 4-4
Rolling Hills Well No. 1
Time Drawdown Plot (January 24, 2011)

Q = 90 GPM

T = 165 GPD/FT

TURN OFF PUMP TO ADJUST DISCHARGE HOSE

FIGURE 4-4
Figure 4-5
Rolling Hills Well No. 1
Drawdown Recovery Plot (January 24, 2011)

T = 350 GPD/FT

T = 165 GPD/FT

Q = 90 GPM

TURN OFF PUMP TO ADJUST DISCHARGE HOSE
submergence). A straight-line extension of drawdown data presented in Figure 4-4 indicates that the well could sustain a pumping rate of 90 gpm for approximately three days.

The Jacob Equation was used to estimate the drawdown in Well No. 1 over an extended pumping period. The inputs for the analysis are as follows:

- Pumping rate of 50 gpm (permitted yield);
- Aquifer transmissivity of 350 gpd/ft from the pumping test recovery data;
- An assumed aquifer coefficient of storage of $10^{-3}$; and
- A seasonal pumping duration of 180 days.

The results of the analysis indicate that the well could potentially yield 50 gpm continually for 180 days with a resultant drawdown of approximately 275 feet.

**Water Quality.** A review of records maintained by the Town of Rolling Hills reveals that water quality samples have never been collected directly from Well No. 1. To comply with the requirements of the Safe Drinking Water Act (SDWA) for public water supply systems, the Town of Rolling Hills has been collecting water samples from each water storage tank. Tank 1, located on the south side of the Town, receives water primarily from Well Nos. 1 and 2, but can also receive water from the three northern wells.

At the present time, the Town of Rolling Hills does not use Well No. 1 except for loading water hauling trucks. If Well No. 1 is to be used for drinking water purposes in the future, water quality samples should be collected directly from the well for all SDWA constituents. The well should also be pumped to waste before putting water from Well No. 1 into the water storage tank to clear the well of turbid water.

As part of this project, a water sample was collected from Well No. 1 on January 24, 2011 and submitted to Energy Laboratories in Casper, Wyoming for an abbreviated suite of analytes. The results of the analysis and the EPA standard for each constituent are summarized in Table 4-3. Copies of the laboratory reports are provided in Appendix B. The results indicate that the...
## Table 4-3
Rolling Hills Wells
Water Quality Analysis Results

<table>
<thead>
<tr>
<th>ANALYSIS</th>
<th>STANDARD</th>
<th>WELL NO. 1</th>
<th>WELL NO. 2</th>
<th>WELL NO. 4</th>
<th>WELL NO. 5</th>
<th>WELL NO. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Sampled</td>
<td></td>
<td>1/24/11</td>
<td>12/21/10</td>
<td>1/6/11</td>
<td>1/13/11</td>
<td>1/19/11</td>
</tr>
<tr>
<td>Alkalinity (as CaCO₃), mg/L</td>
<td>None</td>
<td>208</td>
<td>168</td>
<td>230</td>
<td>200</td>
<td>187</td>
</tr>
<tr>
<td>Calcium, mg/L</td>
<td>None</td>
<td>100</td>
<td>27</td>
<td>4</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Corrosivity, no units</td>
<td>Non-corrosive</td>
<td>0.5</td>
<td>0.4</td>
<td>0.002</td>
<td>0.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Chloride, mg/L</td>
<td></td>
<td>250</td>
<td>13</td>
<td>7</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Hardness (as CaCO₃), mg/L</td>
<td>None</td>
<td>400</td>
<td>101</td>
<td>15</td>
<td>34</td>
<td>108</td>
</tr>
<tr>
<td>Iron, mg/L</td>
<td>0.3</td>
<td>3.79</td>
<td>0.66</td>
<td>1.28</td>
<td>0.61</td>
<td>0.10</td>
</tr>
<tr>
<td>Magnesium, mg/L</td>
<td>None</td>
<td>36</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Manganese, mg/L</td>
<td>0.05</td>
<td>0.38</td>
<td>0.05</td>
<td>0.07</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Nitrate+Nitrite, mg/L</td>
<td>1.0</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>pH, standard units</td>
<td>6.5 – 8.5</td>
<td>7.73</td>
<td>8.18</td>
<td>8.48</td>
<td>8.40</td>
<td>8.38</td>
</tr>
<tr>
<td>Potassium, mg/L</td>
<td>None</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sodium, mg/L</td>
<td>None</td>
<td>88</td>
<td>73</td>
<td>130</td>
<td>117</td>
<td>79</td>
</tr>
<tr>
<td>Sulfate, mg/L</td>
<td>250</td>
<td>353</td>
<td>99</td>
<td>77</td>
<td>86</td>
<td>99</td>
</tr>
<tr>
<td>TDS, mg/L</td>
<td>500/1000</td>
<td>749</td>
<td>294</td>
<td>351</td>
<td>342</td>
<td>338</td>
</tr>
<tr>
<td>A/C Balance, %</td>
<td>None</td>
<td>0.304</td>
<td>-3.40</td>
<td>-3.68</td>
<td>-2.23</td>
<td>-3.67</td>
</tr>
<tr>
<td>Iron Bacteria, CFU/mL</td>
<td>None</td>
<td>11,000</td>
<td>NA</td>
<td>&lt;1</td>
<td>530</td>
<td>2,100</td>
</tr>
</tbody>
</table>

*Red indicates results exceed standards for public water supply source.*
water developed by the well is dominated by sodium and sulfate and the water quality standards for TDS, iron, and manganese were exceeded. The TDS concentration of 749 mg/L is significantly higher than the TDS concentrations in other Rolling Hills municipal wells. The secondary standard for TDS is 500 mg/L, except where better quality water cannot be obtained. The sulfate concentration of 353 mg/L exceeds the EPA secondary standard 250 mg/L. Consumption of water with a sulfate concentration greater than 250 mg/L has a laxative effect on those not accustomed to the water. The iron concentration of 3.79 mg/L exceeds the secondary standard of 0.3 mg/L by over a factor of 10. The turbidity of the water when the sample was collected was measured in the field at a concentration of 6.49 NTU. The sample was allowed to remain in a beaker during the pumping test and two hours later the turbidity of the same water sample was measured at 36.3 NTU. The increase in turbidity was most likely a result of precipitation of iron in the sample. Water with an elevated iron concentration will stain clothes and plumbing fixtures. As shown on Table 4-3, the manganese concentration in the sample from Well No. 1 is 0.38 mg/L, which is 7.5 times higher than the secondary standard for public water supply wells. Elevated manganese concentrations also stain laundry and plumbing fixtures.

Well No. 1 was also sampled for iron bacteria because slime was observed on the pump column. The laboratory results indicated an iron bacteria concentration of 11,000 CFU/mL. Iron bacteria do not pose a health risk to humans from water consumption, but can cause fouling and plugging of wells and have an offensive odor.

**Conclusions and Recommendations.** Well No. 1 is limited to a yield of 50 gpm by the SEO well permit. Currently the pump in the well will yield 90 gpm. Water from Well No. 1, which exceeds secondary standards for TDS, sulfate, iron, and manganese, has been aggressive to the pump column and caused pitting and corrosion of the pipe. Because aggressive water will be an on-going maintenance concern, if it is anticipated that Well No. 1 will be used in the future the Town should budget to replace the submerged pump column approximately once every five years.

The most recent Rolling Hills water system sanitary survey, conducted on September 30, 2010, made note that the Well No. 1 wellhead is not properly sealed and that there is no screened
A well seal equipped with ports for the pump cable and for installing a screened vent should be installed in Well No. 1. The sanitary survey also stated that water quality samples should be collected from Well No. 1 if water is to be used for drinking purposes. The EPA should be contacted to confirm which samples to collect from Well No. 1 to remain in compliance.

Based upon water quality concerns, WESTON recommends that Well No. 1 not be used for drinking water purposes except in the event of water supply emergencies. If it is anticipated that Well No. 1 will be pumped at a rate that exceeds the permitted instantaneous yield of 50 gpm, an enlargement should be filed with the SEO to increase the permitted yield. If water is pumped into trucks for use outside of the municipal boundaries, a temporary use agreement will need to be filed with the SEO for that specific use.

Rolling Hills Well No. 2

The original Rolling Hills #2 Well (Well No. 2) was located approximately 50 feet southeast of the current Well No. 2. The original Rolling Hills #2 Well was called the 28-1 well and was drilled by Pronghorn Drilling to a total depth of 1,200 feet in 1980. The well was completed with slotted pipe with 60 1/16th by 8-inch slots between 700 and 800 feet. The well was tested at a rate of 50 gpm, with a drawdown of 400 feet after 24 hours. The quality of the water from the well was poor characterized by red staining from elevated concentrations of iron and manganese (Wester-Wetstein, 2001). The well also produced significant sediment and had a bad odor, according to the application to the WWDC for a new well. To alleviate the water quality issues and potentially increase the capacity of the well, the Town of Rolling Hills requested funds from the WWDC to replace the well. In 2001 Wester-Wetstein conducted a well replacement program and the old Well No. 2 was plugged and abandoned on May 29, 2001 as part of the program.

Permitting. The SEO permit number for Well No. 2 is U.W. 125024, which has a priority date of February 23, 1988. When the well was permitted for municipal use, the priority date was set at the date of application. The well has not been adjudicated for municipal use because a Plat of Beneficial Use has only recently been filed. The permitted maximum pumping rate is 75
gpm and there is currently no cap on total annual production. Permit conditions required by the SEO permit include the following:

- A water meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from the well;

- An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period;

- The report shall identify the well by name, location, permit number, and shall identify the type of meter used for the measurement;

- The report shall contain at least two semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was “shut-in” prior to obtaining the measurements must be specified; and

- The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

The well was drilled and completed under DEQ Permit to Construct No. 00-426. A copy of the well permit is provided in Appendix A.

**Well Drilling and Construction Data.** Well No. 2, which is located on the south side of the Town of Rolling Hills, was drilled and constructed in 2001 by Ruby Drilling of Gillette, Wyoming. Construction details for Well No. 2 from the Statement of Completion and the well construction and testing report prepared by Wester-Wetstein (2001) and the video log performed by WESTON on December 16, 2010, are provided in Table 4-4 and on Figure 4-6.
### DESIGN DETAILS

**STATIC WATER LEVEL**
- 104 FEET (2001)
- 127 FEET (12/16/2010)

**3-INCH GALVANIZED PIPE AND STEEL COLUMN PIPE AND #2 AWG PUMP CABLE, AIRLINE SET AT 932 FEET**

**932 FEET: Grundfos 85S400-28 PUMP WITH FRANKLIN 40-HP MOTOR**

**SCREENED INTERVALS**
- 938.1' 970.0'
- 1,065.3' 1,075.9'
- 1,153.3' 1,163.9'
- 1,318.7' 1,339.3'
- 1,451.0' 1,456.6'
- 1,482.3' 1,502.9'
- 1,529.4' 1,535.0'
- 1,630.0' 1,671.9'
- 1,685.9' 1,729.0'
- 1,772.8' 1,794.0'

**T.D. = 1,853 FEET**

**NOT TO SCALE**

- **0 - 49 FEET:** 13 3/4-INCH BOREHOLE AND 10 3/4-INCH SURFACE CASING
- **0 - 705 FEET:** 65 SACKS LITE CEMENT AND 50 SACKS TYPE G CEMENT GROUT
- **49 - 1,853 FEET:** 9 7/8-INCH BOREHOLE
- **0 - 807.5 FEET:** 7 5/8-INCH O.D. 26.4 #/FT STEEL CASING
- **807.5 FEET:** 7 5/8 X 7-INCH REDUCER
- **807.5 - 1,826 FEET:** 7-INCH O.D. STEEL CASING 23 #/FT
- **938 - 1,794 FEET:** 7-INCH SCREEN WITH SLOT SIZE OF 0.015-INCHES
- **938 - 1,794 FEET:** 7-INCH SCREEN WITH SLOT SIZE OF 0.015-INCHES
- **1,826 FEET:** CEMENT GUIDE SHOE
Table 4-4

Well No. 2 Summary

State Engineer Permit No.: U.W. 125024, Unadjudicated

Location: NE, NE Section 28, Township 34 North, Range 75 West
          42°53’35.31”N, 105°51’14.96”W

Surface Elevation: 5,255.11 feet, ground level

Total Depth: 1,853 feet: drilled
              1,826 feet: completed

Formations: 0 – 1,853 feet: Lance Formation

Hole Diameter: 0 – 49 feet: 13 3/4 inches
               49 – 1,853 feet: 9 7/8 inches

Casing: 0 - 49 feet: 10 3/4 inch steel casing
        0 – 807.5 feet: 7 5/8 inch steel casing (26.4 lb/foot)
        807.5 – 1,826 feet: 7 inch O.D. steel casing (23 lb/foot)

Producing Intervals: 938.1 – 970.0 feet, 1,065.3 – 1,075.9 feet,
                       1,153.3 – 1,163.9 feet, 1,318.7 – 1,339.3 feet,
                       1,451.0 – 1,456.6 feet, 1,482.3 – 1,502.9 feet,
                       1,529.4 – 1,535.0 feet, 1,630.0 – 1,671.9 feet,
                       1,685.9 – 1,729.0 feet, and 1,772.8 – 1,794.0 feet:
                       7-inch, stainless steel well screens, 15 slot size

Static Water Level: 104 feet (May 22, 2001)
                    127 feet (December 16, 2010)

Air Line Setting: 932 feet (December 2010)

Drilling and Completion Date: May 9 – 21, 2001

Testing Rates: 68 gpm with 615.62 feet of drawdown after 48.5 hours (2001)
                76 gpm with 661 feet of drawdown after 16 hours (2010)
Pump Information: Grundfos Model 85S400-28 Pump, SN 7941532
Franklin 40-HP Submersible Motor, Model 2366179025, 2006 Install date, Set on 3-inch galvanized and black iron pipe, intake at 932 feet

Engineering During Well Construction: Wester-Wetstein (Laramie, WY)

Drilling Contractor: Ruby Drilling (Gillette, WY)

Pumping testing Contractor: Ruby Drilling (Gillette, WY), 5/22-25/01
Weston Engineering, Inc. (Upton, WY), 12/20-21/10

Wester-Wetstein (2001) provides a detailed lithologic log and a geophysical log for Well No. 2 in their project report. The lithologic and geophysical logs were used to identify sandstones for placement of screens in the well. The Statement of Completion and well construction report by Wester-Wetstein (2001) for Well No. 2 reports that the well was drilled to a total depth of 1,853 feet and is completed with 7 5/8-inch steel casing from ground level to 807.5 feet and 7-inch O.D. casing and stainless steel well screens at select intervals from 807.5 to 1,794 feet. The well was cemented using 65 sacks of Lite cement and 50 sacks of Type G cement pumped through cement ports at a depth of 705 feet. The well screens are natural packed. The static water level when the well was drilled was 104 feet. Upon completion of well construction, Well No. 2 was equipped with a 40-HP Berkeley 6T115 submersible pump set at a depth of 890 feet. The pump was capable of yielding 75 gpm.

Downhole Well Inspection. On December 10, 2010 WESTON mobilized a pump service rig to remove the pumping equipment from Well No. 2. WESTON observed that the pump column has a diameter of three inches and is comprised of both black iron and galvanized pipe. The black iron pipe joints were so corroded that the slips used to hold the pump column in place would not hold the pipe. Each joint required brushing with a wire brush to keep it from slipping. The galvanized pipe was slightly corroded, but in overall good condition. One Danfoss check/drain valve is in the pump column at a depth of 205 feet and a second Danfoss check/drain valve is in the pump column at a depth of 575 feet. Both valves appear to be in good working order.
Several places in the sheathing of the #2 AWG flat pump cable were rubbed through to the insulation on the individual wires. A letter from Pronghorn Pump and Repair dated April 21, 2006 indicated that the pumping equipment had been removed from Well No. 2 to replace the pump and motor and that the lower 100 feet of pump cable had been “skinned up” and was moved to the top of the pump column. Several rubber centralizers had been taped over the pump cable where the cable sheathing had been compromised. Green vinyl tape also covered several minor scrapes in the pump cable. Because Well No. 2 was drilled in only four days it is likely that deviation control was inadequate and as a consequence the casing is out of plumb, resulting in the rubbed cable.

The letter from Pronghorn Pump and Repair dated April 21, 2006 reports that the pump installed in the well in 2001 was replaced with the pump that is currently in the well. Additional pump column was installed in the well to replace three 25-foot joints of pump column and to deepen the pump setting to a depth of 932 feet. The reason for dropping the pump setting was not given, but it is assumed that pumping water levels were dropping.

At the time the pump was pulled by WESTON, the water in the pump column was dark black to dark black-green and had a mildly offensive odor. The discolored water was likely a result of elevated iron and manganese concentrations in the water that had been stagnating in the pump column since the summer months. White deposits observed on the pump column and pump cable below 351 feet appear to roughly correlate to a leak in the well casing.

Observations from the video log performed on Well No. 2 on December 16, 2010 are summarized in Table 4-5. The video log indicates that there is some scaling on the inside of the casing and mineral deposits noted at 378 feet are the result of a leak in the casing. The green vinyl tape observed in the well at a depth of 572 feet presumably came off the pump column when WESTON removed the pumping equipment. The well screens are partially covered in a dark fluffy material that may be iron-reducing bacteria. Mineral deposits were also observed in the casing. Part of a rubber centralizer is wedged in the well casing at a depth of 1,769 feet which prevented the video camera from reaching the bottom of the well.
Table 4-5

Well No. 2 Video Log Description (December 16, 2010)

<table>
<thead>
<tr>
<th>Interval (feet)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Top of casing.</td>
</tr>
<tr>
<td>7.3</td>
<td>Pitless adaptor spool.</td>
</tr>
<tr>
<td>9.3</td>
<td>Pitless adaptor weld. Casing below weld is in good condition.</td>
</tr>
<tr>
<td>128</td>
<td>Static water level. Water is very turbid and cable guard is floating on water. Iron scale seen in water.</td>
</tr>
<tr>
<td>152 - 157</td>
<td>Side view, minor scaling on casing.</td>
</tr>
<tr>
<td>185 - 187</td>
<td>Side view, minor scaling on casing.</td>
</tr>
<tr>
<td>212.6 – 213.7</td>
<td>Bare spots on casing with scale from pump column lying on casing wall. Other instances observed at greater depths.</td>
</tr>
<tr>
<td>235</td>
<td>Slight increase in scale on casing.</td>
</tr>
<tr>
<td>260</td>
<td>Water is more clear, floating material appears to be bacterial.</td>
</tr>
<tr>
<td>378.2</td>
<td>Extensive encrustation on casing joint, joint is leaking mineralized water.</td>
</tr>
<tr>
<td>572.3</td>
<td>Green tape from pump column.</td>
</tr>
<tr>
<td>607.7</td>
<td>Base spot on casing from pump column lying on casing.</td>
</tr>
<tr>
<td>675.6</td>
<td>Leak in casing at joint.</td>
</tr>
<tr>
<td>701.2</td>
<td>Three holes in casing, cementing ports from casing installation.</td>
</tr>
<tr>
<td>717.0</td>
<td>Top of 7-inch O.D. casing.</td>
</tr>
<tr>
<td>808</td>
<td>Hit one-half of rubber centralizer. Centralizers were taped on pump column by previous pump installer.</td>
</tr>
<tr>
<td>818</td>
<td>Tubercles and pitting on casing. Side view at 829 shows pitting.</td>
</tr>
<tr>
<td>935.1 – 953.0</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings.</td>
</tr>
<tr>
<td>955.5 – 958.7</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings.</td>
</tr>
<tr>
<td>961.2 - 964.1</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings. Can see formation behind screens in some intervals.</td>
</tr>
<tr>
<td>1,061.3 – 1,069.0</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings.</td>
</tr>
<tr>
<td>1,148.6 – 1,156.5</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings.</td>
</tr>
<tr>
<td>1,157 – 1,177</td>
<td>Water is very turbid, from stirring bacterial deposits.</td>
</tr>
<tr>
<td>1,188.6</td>
<td>Leaking joint in casing.</td>
</tr>
<tr>
<td>1,188 – 1,214</td>
<td>Increase in scale on casing.</td>
</tr>
<tr>
<td>1,312.6 – 1,330.5</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings.</td>
</tr>
<tr>
<td>1,350 – 1,364</td>
<td>Increase in scale on casing.</td>
</tr>
</tbody>
</table>
### Interval (feet) Comments

<table>
<thead>
<tr>
<th>Interval (feet)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,443.8 – 1,446.9</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings.</td>
</tr>
<tr>
<td>1,474.8 – 1,492.6</td>
<td></td>
</tr>
<tr>
<td>1,521.4 – 1,524.4</td>
<td></td>
</tr>
<tr>
<td>1,530</td>
<td>More scale on casing.</td>
</tr>
<tr>
<td>1,621.3 – 1,639.1</td>
<td>Stainless steel well screens. Dark colored, fluffy materials that have appearance of bacterial deposits and white to yellow mineral deposits in screen openings. Interval at 1,715 obscured by thick turbid water.</td>
</tr>
<tr>
<td>1,641.8 – 1,649.7</td>
<td></td>
</tr>
<tr>
<td>1,652.3 – 1,660.2</td>
<td></td>
</tr>
<tr>
<td>1,676.8 – 1,694.6</td>
<td></td>
</tr>
<tr>
<td>1,697.2 – 1,700.2</td>
<td></td>
</tr>
<tr>
<td>1,702.9 – 1,706.0</td>
<td></td>
</tr>
<tr>
<td>1,708.5 – 1,715</td>
<td>Progress is obstructed by rubber centralizer. Cannot get camera deeper into well.</td>
</tr>
<tr>
<td>1,763.2 – 1,769.7</td>
<td></td>
</tr>
</tbody>
</table>

### Pump Testing

Wester-Wetstein supervised a pumping test program of Well No. 2 that was performed by Ruby Drilling after the well was drilled. The pumping test program consisted of a step-rate test and recovery and a constant-rate test and recovery. The step-rate test was performed with five steps of increasing pumping rates with a duration of 40 minutes per step. The pumping rates, drawdown, and specific capacity are summarized in Table 4-6. The specific capacities computed from the step-rate test are slightly elevated because the results are impacted by casing storage. Wester-Wetstein (2001) estimated that the effects of casing storage influenced drawdown for at least 113 minutes. The effects of casing storage are to overestimate the specific capacity. The specific capacity computed by Wester-Wetstein (2001) from the constant-rate test data was 0.11 gpm/ft.

### Table 4-6

**Well No. 2 – 2001 Step-Rate Pumping Test Summary**

<table>
<thead>
<tr>
<th>Pumping Rate (gpm)</th>
<th>Drawdown at End of Step (feet)</th>
<th>Specific Capacity (gpm/foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>228.7</td>
<td>0.17</td>
</tr>
<tr>
<td>60</td>
<td>352.2</td>
<td>0.17</td>
</tr>
<tr>
<td>80</td>
<td>507.1</td>
<td>0.16</td>
</tr>
<tr>
<td>87</td>
<td>589</td>
<td>0.15</td>
</tr>
</tbody>
</table>
The constant-rate test performed on Well No. 2 in 2001 was initiated at 75 gpm, but after 782 minutes of pumping the rate was decreased to 65 gpm. The drawdown at the conclusion of the pumping test was 680 feet and the transmissivity computed from the drawdown data was 190 gpd/ft. Recovery data were collected from Well No. 2 for 8.5 hours after the pump was turned off. The well recovered to 90 percent of the pre-test water level, which left a residual drawdown of 68 feet. The transmissivity calculated from the recovery data was 155 gpd/ft. Wester-Wetstein (2001) estimated that the safe yield of Well No. 2 was 65 gpm.

After performing the video log of Well No. 2, WESTON reinstalled the permanent pumping equipment in the well and landed the pump column in the pitless adaptor to conduct pumping testing. Water levels in the well were measured using an airline and flow rates were measured with a two-inch flow meter and controlled by adjusting a two-inch ball valve. The well was pumping tested by WESTON at a rate of 76 gpm for 16 hours. The drawdown in the well at the end of the test was 661 feet, resulting in a pumping water level of 788 feet. The specific capacity of the well from the 2010 pumping test is 0.11 gpm/foot of drawdown. This specific capacity is identical to the specific capacity computed from the 2001 test, which suggests that the efficiency of the well has not changed. The lack of change in the specific capacity indicates that the deposits on the well screens have not slowed the entry of water into the well.

Figure 4-7 is a time-drawdown plot of the constant-rate pumping test data from Well No. 2 using the method developed by Cooper and Jacob (1946). The aquifer’s transmissivity, as determined from the late-time drawdown data from Well No. 2, is 335 gpd/ft. The transmissivity value is similar to the value computed for the pumping test conducted on the well in 2001. No storage coefficient is available for Well No. 2 because no observation wells are available.

At the conclusion of the pumping test, recovery data were collected from Well No. 2 for 460 minutes. The residual drawdown was 104 feet 460 minutes after the pump was turned off, which equals 16 percent of the total drawdown. The recovery data are plotted on Figure 4-8 using the method developed by Cooper and Jacob (1946). The residual drawdown is plotted versus the ratio of the time since the pump was started (T) over the time since the pump was turned off (T'). Later time recovery data plot to the left of the diagram. The recovery data
Figure 4-7
Rolling Hills Well No. 2
Time Drawdown Plot (December 20-21, 2010)

Q = 76 GPM
T = 335 GPD/FT
Figure 4-8
Rolling Hills Well No. 2
Drawdown Recovery Plot (December 21, 2010)

T = 120 GPD/FT

T = 65 GPD/FT

Q = 76 GPM
have two apparent trends in recovery. The earlier recovery data yield an aquifer transmissivity of 65 gpd/ft, while the later data yield an aquifer transmissivity of 120 gpd/ft. Although the transmissivity computed from the late-time recovery data is nearly two times higher than that computed from the early pumping data it is within the same order of magnitude. These values are similar to the 155 gpd/ft transmissivity value computed from the 2001 recovery data.

**Water-Level Trends.** Tracking of water levels and water production rates can be valuable in assessing the sustainability of an aquifer in the vicinity of a well or wellfield. Between 2001, when the well was constructed, and December 2010, only two water-level measurements are known to have been collected from Well No. 2. The water level measured on May 22, 2001 was 104 feet and on December 16, 2010 the water level was 127 feet. Although the water level is currently lower than when the well was drilled, there are insufficient data to determine whether the lower water level is the result of aquifer mining or from seasonal water-level variations.

**Well Production Capacity.** The pumping testing of Well No. 2 yielded aquifer transmissivities of between 65 and 335 gpd/ft. A straight-line extension of the drawdown data in Figure 4-7 indicates that the well could produce 75 gpm into the foreseeable future without drawing the water level to the pump intake. However, the recovery data collected at the end of the Well No. 2 pumping test indicate that the aquifer transmissivity is lower than indicated in the drawdown data and that the aquifer is slow to recover. The proximity of the well to the northern edge of the aquifer could also have the effect of increasing the rate of drawdown with extended pumping intervals.

The Jacob Equation was used to estimate the drawdown in Well No. 2 over an extended pumping period. The inputs for the analysis are as follows: varied pumping rates; aquifer transmissivity of 120 gpd/ft from the pumping test recovery data; an assumed aquifer coefficient of storage of 5x10^{-3} (confined aquifer conditions); and a seasonal pumping duration of 120 days. For the purposes of this analysis it is assumed that the available drawdown in Well No. 2 is equal to 780 feet, which is the difference between the static water level of 127 feet and the pump setting of 932 feet, less a reserve of 25 feet for pump submergence. The
Table 4-7
Well No. 2 Predicted Drawdowns and Pumping Water Levels

<table>
<thead>
<tr>
<th>Drawdown/Pumping Water Level at average pumping rate of 40 gpm*</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 50 gpm*</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 60 gpm*</th>
</tr>
</thead>
<tbody>
<tr>
<td>527 feet / 649 feet</td>
<td>653 feet / 780 feet</td>
<td>783 feet / 910 feet</td>
</tr>
</tbody>
</table>

* Duration of 120 days

The results of the analysis are summarized in Table 4-7. The Jacob Equation analysis predicts that Well No. 2 could sustain an average pumping rate of 60 gpm for a 120-day operating season.

**Water Quality.** A complete suite of water samples were collected from Well No. 2 shortly after it was drilled on June 24, 2001. The results of the 2001 sampling event and the EPA standards for each constituent are provided in Table 4-8. The TDS concentration was 391 mg/L, which is well under the EPA secondary standard of 500 mg/L. Overall the Well No. 2 water quality was good; however, the pH, iron, and turbidity concentrations exceeded the water quality standards. Although the turbidity standard applies to surface water sources, the turbidity concentration of the Well No. 2 sample indicates that well development was not complete before the pumping test was conducted. The iron and pH concentrations are slightly above the standards. The water sample from Well No. 2 had a positive result for total coliform during the 2001 test. Additionally, the well showed an iron bacteria concentration of 5,000 CFU/mL.

On December 21, 2010 water samples were collected from Well No. 2 for an abbreviated suite of analytes. The results of the testing are provided in Table 4-3. Overall, the differences in the water quality results between the 2001 and 2011 samples were minor. However, the 2011 sample exceeded the secondary standards for iron and manganese while the TDS decreased from 391 mg/L in 2001 to 294 mg/L in 2011, the manganese concentration increased from 0.01 mg/L in 2001 to 0.05 mg/L in 2011, and the iron concentration increased from 0.34 mg/L in 2001 to 0.66 mg/L in 2011.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Microbiological</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacteria, Total Coliform</td>
<td>Safe/unsafe</td>
<td>Unsafe</td>
<td>Unsafe</td>
<td>Unsafe</td>
</tr>
<tr>
<td>Bacteria, E-Coli Coliform</td>
<td>Safe/unsafe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacteria, Iron Related (CFU/mL)</td>
<td>NS</td>
<td>5000</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td><strong>Primary EPA Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulated Organic Chemicals</td>
<td>Various</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Antimony (mg/L)</td>
<td>0.006</td>
<td>&lt;0.001</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Arsenic (mg/L)</td>
<td>0.01</td>
<td>&lt;0.005</td>
<td>&lt;0.002</td>
<td>ND</td>
</tr>
<tr>
<td>Barium (mg/L)</td>
<td>2.0</td>
<td>&lt;0.10</td>
<td>0.06</td>
<td>ND</td>
</tr>
<tr>
<td>Beryllium (mg/L)</td>
<td>0.004</td>
<td>&lt;0.0005</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Cadmium (mg/L)</td>
<td>0.005</td>
<td>&lt;0.0005</td>
<td>&lt;0.01</td>
<td>ND</td>
</tr>
<tr>
<td>Chromium (mg/L)</td>
<td>0.10</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>ND</td>
</tr>
<tr>
<td>Cyanide, Total (mg/L)</td>
<td>0.2</td>
<td>&lt;0.005</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Fluoride (mg/L)</td>
<td>4.0</td>
<td>0.46</td>
<td>0.48</td>
<td>0.45</td>
</tr>
<tr>
<td>Lead (mg/L)</td>
<td>0.015</td>
<td>&lt;0.001</td>
<td>&lt;0.005</td>
<td>ND</td>
</tr>
<tr>
<td>Mercury (mg/L)</td>
<td>0.002</td>
<td>&lt;0.0005</td>
<td>&lt;0.0002</td>
<td>ND</td>
</tr>
<tr>
<td>Nickel (mg/L)</td>
<td>0.1</td>
<td>&lt;0.02</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Nitrogen, Nitrite as N (mg/L)</td>
<td>10</td>
<td>&lt;0.10</td>
<td>0.09</td>
<td>ND</td>
</tr>
<tr>
<td>Selenium (mg/L)</td>
<td>0.05</td>
<td>&lt;0.005</td>
<td>&lt;0.001</td>
<td>ND</td>
</tr>
<tr>
<td>Thallium (mg/L)</td>
<td>0.002</td>
<td>&lt;0.0004</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Turbidity, NTU</td>
<td>5</td>
<td>6.20</td>
<td>8.46</td>
<td>14</td>
</tr>
<tr>
<td>Uranium (mg/L)</td>
<td>0.03</td>
<td>NA</td>
<td>&lt;0.001</td>
<td>ND</td>
</tr>
<tr>
<td>Uranium, Activity, pCi/L</td>
<td>20</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Radium 226, pCi/L</td>
<td>5</td>
<td>NA</td>
<td>0.2</td>
<td>ND</td>
</tr>
<tr>
<td>Radium 228, pCi/L</td>
<td>5</td>
<td>NA</td>
<td>2.9</td>
<td>ND</td>
</tr>
<tr>
<td>Radium 226+Radium 228, pCi/L</td>
<td>5</td>
<td>NA</td>
<td>NA</td>
<td>ND</td>
</tr>
<tr>
<td>Gross alpha, pCi/L</td>
<td>15</td>
<td>&lt;1.0</td>
<td>3.1</td>
<td>ND</td>
</tr>
<tr>
<td>Gross beta, pCi/L</td>
<td>50</td>
<td>NA</td>
<td>3.0</td>
<td>ND</td>
</tr>
<tr>
<td><strong>Secondary EPA Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (no units)</td>
<td>6.5-8.5</td>
<td>8.59</td>
<td>8.35</td>
<td>8.4</td>
</tr>
<tr>
<td>Total Dissolved Solids (mg/L)</td>
<td>500</td>
<td>391</td>
<td>350</td>
<td>380</td>
</tr>
<tr>
<td>Conductivity (micromhos/cm @ 25°C)</td>
<td>NS</td>
<td>596</td>
<td>544</td>
<td>550</td>
</tr>
<tr>
<td>Acidity, Total as CaCO3 (mg/L)</td>
<td>NS</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
<td>ND</td>
</tr>
<tr>
<td>Alkalinity, Total as CaCO3 (mg/L)</td>
<td>NS</td>
<td>132</td>
<td>190</td>
<td>180</td>
</tr>
<tr>
<td>Aluminum (mg/L)</td>
<td>NS</td>
<td>0.2</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Bicarbonate (mg/L)</td>
<td>NS</td>
<td>154</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>Boron (mg/L)</td>
<td>NS</td>
<td>NA</td>
<td>0.23</td>
<td>0.37</td>
</tr>
<tr>
<td>Calcium (mg/L)</td>
<td>NS</td>
<td>18.0</td>
<td>10.7</td>
<td>40</td>
</tr>
<tr>
<td>Carbonate (mg/L)</td>
<td>NS</td>
<td>3.4</td>
<td>6.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Chloride (mg/L)</td>
<td>250</td>
<td>11.5</td>
<td>8.0</td>
<td>11</td>
</tr>
<tr>
<td>Color (color units)</td>
<td>15</td>
<td>&lt;1.0</td>
<td>5</td>
<td>ND</td>
</tr>
<tr>
<td>Copper (mg/L)</td>
<td>1.3</td>
<td>&lt;0.01</td>
<td>0.01</td>
<td>NA</td>
</tr>
<tr>
<td>Corrosivity</td>
<td>Noncorrosive</td>
<td>NA</td>
<td>0.2</td>
<td>0.95</td>
</tr>
<tr>
<td>Hardness as CaCO3 (mg/L)</td>
<td>NS</td>
<td>63.5</td>
<td>38</td>
<td>110</td>
</tr>
<tr>
<td>Iron (mg/L)</td>
<td>0.3</td>
<td>0.34</td>
<td>0.535</td>
<td>0.67</td>
</tr>
<tr>
<td>Magnesium (mg/L)</td>
<td>NS</td>
<td>4.5</td>
<td>2.8</td>
<td>10</td>
</tr>
<tr>
<td>Manganese (mg/L)</td>
<td>0.05</td>
<td>0.01</td>
<td>0.057</td>
<td>0.11</td>
</tr>
<tr>
<td>Odor (T.O.N.)</td>
<td>3</td>
<td>Odor Number</td>
<td>ND</td>
<td>1.0</td>
</tr>
<tr>
<td>Potassium (mg/L)</td>
<td>NS</td>
<td>2.5</td>
<td>5.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Silica (mg/L)</td>
<td>NS</td>
<td>NA</td>
<td>11.6</td>
<td>7.7</td>
</tr>
<tr>
<td>Silver (mg/L)</td>
<td>0.1</td>
<td>NA</td>
<td>&lt;0.001</td>
<td>NA</td>
</tr>
<tr>
<td>Sodium (mg/L)</td>
<td>NS</td>
<td>113</td>
<td>120</td>
<td>84</td>
</tr>
<tr>
<td>Sulfate (mg/L)</td>
<td>250</td>
<td>150</td>
<td>94</td>
<td>69</td>
</tr>
<tr>
<td>Surfactants, MBAs (mg/L)</td>
<td>NS</td>
<td>NA</td>
<td>&lt;0.1</td>
<td>ND</td>
</tr>
<tr>
<td>Zinc (mg/L)</td>
<td>5</td>
<td>NA</td>
<td>&lt;0.01</td>
<td>ND</td>
</tr>
</tbody>
</table>

NS = No Standard; ND = Not Detected; NA = Not Analyzed
Indicates that constituent exceeds MCL
The water discharged during the 2011 pumping test was very turbid, with dark gray very fine-grained material present in the water. Although the activity of removing and reinstalling the pumping equipment was partly responsible for some of the turbid water, the dark, fluffy materials observed on the well screens also contributed to the turbidity. The water had an odor indicative of the presence of iron bacteria and it took approximately 170 minutes for the water to clear during the test. Discussions with Joe Perko indicate that each year the well must be pumped to waste because the water in the well is turbid after the well is inactive for long periods of time. It may be desirable to routinely pump Well No. 2 to waste during the winter months to clear turbid water from the well and minimize the development of bacteria unless electrical demand charges are excessive.

**Conclusions and Recommendations.** Well No. 2 is permitted and equipped to pump 75 gpm and is used only during peak demand times. It is estimated that the well can yield an average of 60 gpm for a 120-day season each year. The quality of water developed from Well No. 2 is characterized by elevated iron and manganese concentrations, which have increased since the well was drilled in 2001. The black iron pipe in the pump column has significant rust which is probably responsible for some of the elevated turbidity and iron in the produced water. The pump column will probably need to be replaced within the next 10 years. The pump cable is in poor condition and will need to be replaced the next time the pump is pulled. It may be beneficial to install armored cable and centralizers to minimize the potential for damage to the replacement cable.

The most recent EPA sanitary survey made note that there is no fence surrounding Well No. 2 and stated that a fence and locking gate should be installed to protect the facility.

The water level in Well No. 2 should be measured and recorded at least monthly using the airline that is in the well. A routine comparison of the static and pumping water levels, coupled with the Well No. 2 production data, will facilitate the identification of trends in well performance. In accordance with the SEO permit conditions, water level and production data should be reported to the SEO in an annual report.
Rolling Hills Well No. 3

Rolling Hills Well No. 3 was drilled by Tri-J Drilling of Glenrock, Wyoming for J&J Development. The well, named the J&J #119-4 Well, was permitted as a test well with an SEO permit number of U.W. 64212. The well was located in Lot 119 of Rolling Hills. Well No. 3 was drilled in January 1983 to a depth of 500 feet and was completed with 8-inch PVC casing with 1/16th inch wide by 12-inch long sawn slots from 320 to 360 feet and from 420 to 460 feet. The static water level in the well was 60 feet. Two pumping tests were conducted on the well. One test was run at 50 gpm for four hours and the water level drew down to the pump intake at 460 feet. The second test was conducted at 35 gpm for four hours with a total drawdown of 357 feet. The well was plugged and abandoned on April 15, 1992.

Rolling Hills Well No. 4

Rolling Hills #4 (Well No. 4) is located adjacent to the north water storage tank, 1,180 feet south of Well No. 5, and 2,400 feet east of Well No. 6. The well was constructed in 1985 and placed on line in 1986.

Permitting. The SEO permit number for Well No. 4 is U.W. 70662, which has a priority date of June 12, 1985. The well has not been adjudicated for municipal use because a Plat of Beneficial Use has only recently been filed with the SEO. The permitted maximum pumping rate is 75 gpm and there is currently no cap on total annual production. Permit conditions required by the SEO permit include the following:

- A water meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from the well;

- An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period;

- The report shall identify the well by name, location, permit number, and shall identify the type of meter used for the measurement;
• The report shall contain at least two semi-annual measurements of the pumping water level in the well as measured after a minimum of twenty-four (24) consecutive hours of pumping. The dates the measurements were obtained and the period of time the well was pumped prior to obtaining the measurements must be specified;

• The report shall contain at least two semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was “shut-in” prior to obtaining the measurements must be specified; and

• The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

A copy of the well permit is provided in Appendix A. The well was drilled and completed under DEQ Permit to Construct No. 86-050.

**Well Drilling and Construction Data.** Well No. 4 was drilled and constructed in 1985 by Pronghorn Drilling of Glenrock, Wyoming. Construction details for Well No. 4 from the Statement of Completion, invoicing from the driller, and the video log performed by WESTON on January 4, 2010, are provided on Figure 4-9 and in Table 4-9.

An invoice dated September 25, 1985 from Pronghorn Drilling, of Glenrock, Wyoming, bills the Town of Rolling Hills for 60 feet of surface casing, 1,548 feet of 11-inch borehole, 1,516 feet of 7-inch O.D. casing, a lump sum cement job at $1,500, and 9 hours of well development. In contrast, the Statement of Completion filed with the SEO reports that the total depth of the well was 1,540 feet and that the 7-inch O.D. casing extended to the total depth. Well No. 4 was completed by cementing 7-inch casing from the ground surface to the total depth of the well and then shooting perforations in the well. An invoice dated July 12, 1985 from Strata Data, of Casper, Wyoming, indicates that the well was perforated at 2 shots per foot from 913 to 950 feet, from 1,117 to 1,130 feet, from 1,413 to 1,433 feet, and from 1,500 to 1,512 feet. These perforations are reported on the Statement of Completion filed with the SEO. An invoice from Strata Data dated August 8, 1985 indicates that the well was also perforated at 2 shots per foot from 610-640 feet, 4 shots per foot from 785-795 feet, 2 shots per foot from 1,165-1,175 feet,
and 2 shots per foot from 1,248-1,260 feet. These perforations are not reported on the Statement of Completion. The well completion details presented in Table 4-9 are primarily based on the billing statement from the driller.

The static water level when the well was first drilled and perforated was 172 feet (JMM, 1989). The static water level was then reported to be 350 feet on the Statement of Completion. It is not known how either of the static water levels were measured or the accuracy of the readings. According to the Statement of Completion filed with the SEO on December 31, 1986, Well No. 4 was equipped with a 20-HP Franklin motor and a Goulds submersible pump set at a depth of 714 feet. The pump was capable of yielding 75 gpm. Billing records maintained by the Town of Rolling Hills show that the Town was invoiced on January 3, 1986 for a 50-HP pump and motor and 740 feet of pump cable installed in Well No. 4 on August 8, 1985.

**Table 4-9**

**Well No. 4 Summary**

<table>
<thead>
<tr>
<th>State Engineer Permit No.:</th>
<th>U.W. 70662, Unadjudicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>SW, SW Section 15, Township 34 North, Range 75 West 42°54’38.02”N, 105°50’57.89”W</td>
</tr>
<tr>
<td>Surface Elevation:</td>
<td>5,390.10 feet, ground level</td>
</tr>
<tr>
<td>Total Depth:</td>
<td>1,608 feet: drilled</td>
</tr>
<tr>
<td></td>
<td>1,516 feet: completed</td>
</tr>
<tr>
<td></td>
<td>1,476 feet: fill in well from video log</td>
</tr>
<tr>
<td>Formations:</td>
<td>0 – 40 feet: Quaternary Dune Sand Deposits</td>
</tr>
<tr>
<td></td>
<td>40 – 615 feet: Fort Union Formation</td>
</tr>
<tr>
<td></td>
<td>615 – 1,608 feet: Lance Formation</td>
</tr>
<tr>
<td>Hole Diameter:</td>
<td>0 – 60 feet: unknown</td>
</tr>
<tr>
<td></td>
<td>60 – 1,608 feet: 11 inches</td>
</tr>
<tr>
<td>Casing:</td>
<td>0 - 60 feet: surface casing, unknown diameter</td>
</tr>
<tr>
<td></td>
<td>0 – 1,516 feet: 7-inch O.D. steel casing (23 lb/foot)</td>
</tr>
</tbody>
</table>
Producing Intervals:  610 – 640 feet, 785 – 795 feet, 913 - 950 feet, 1,117 – 1,130 feet, 1,248 – 1,260 feet, 1,413 – 1,433 feet, 1,500 – 1,512 feet: shot perforated

Static Water Level:  172 feet (1985, per JMM (1989))
                350 feet (1986, Statement of Completion)
                373 feet (January 5, 2011)

Air Line Setting:  932 feet (January 2011)

Drilling and Completion Date:  September 1985 – September 1986

              60 gpm with 533 feet of drawdown after 14.5 hours (2011)

Pump Information:  Grundfos 85S300-23, Model A12360023-P1-003-970
              Franklin 30-HP Submersible Motor, Model 2366169020,
              1999 Date Code, Set on 3-inch galvanized pipe with intake
              at 935 feet

Engineering During Well Construction:  Robert Hartley, Town of Rolling Hills Engineer

Drilling Contractor:  Pronghorn Drilling (Glenrock, WY)

Pumping testing Contractor:  JMM (Laramie, WY), 1989
                           Weston Engineering, Inc. (Upton, WY), January 5-6, 2011

**Downhole Well Inspection.** On January 3, 2010 WESTON mobilized a pump service rig to remove the pumping equipment from Well No. 4. WESTON observed that the pump column has a diameter of 3 inches and is comprised of 44 21-foot joints of galvanized pipe and one five foot pup joint. The galvanized pipe was slightly corroded, but in overall good condition. The bottom 24 joints of pump column had vinyl centralizers attached to them. It is assumed that the centralizers were installed to keep the pump cable from being rubbed on the pipe joints as the pump was installed. A check/drain valve at the bottom of the pump column was no longer functioning and was replaced by WESTON when the pump was reinstalled. Red slime was observed on the pump column below the static water level. The slime has the appearance of iron bacteria and extended down several joints of pipe.
The pump cable in Well No. 4 is #4 AWG solid wire armored flat pump cable which was likely installed because of problems with standard cable being rubbed through to the wire conductors during pump installation. The problem appears to be severe enough to require installation of the nylon centralizers. The pump cable had three intervals in which the galvanized armor had been abraded away but the wire’s insulation was still intact. The pump cable has been corroded and will probably need to be replaced the next time the pump is removed from the well.

The Grundfos pump that is currently installed in Well No. 4 appears to be in good working order. The 30 HP Franklin motor has some wear in the radial bearing, but was in adequate condition for additional service life. The date code on the motor indicates that it was installed in 1999. The current pump setting is 935 feet. The original pump setting, according to the Statement of Completion filed with the SEO, was 714 feet. JMM (1989) reported that the pump setting was 882 feet when the well was tested in 1989. The pump setting was probably lowered in response to dropping water levels in the well.

Observations from the video log performed by WESTON on January 4, 2011 are summarized in Table 4-10. The video log indicates that the water was very turbid during the logging operation because removal of the pumping equipment scraped scale and debris off of the well casing and there was no means for flushing the well prior to conducting the video log. There is some scaling on the casing that appears to be iron bacteria associated with repeated exposure of the casing to air as the well is pumped. Several intervals of perforations were visible between 919.5 and 1,427 feet and many were plugged or partially plugged. Because of material growth on some of the perforations, it was not possible to determine whether those perforations were successful in fully penetrating the well casing and cement. There was no indication from the video log that the well is in danger of failing in the near future.

**Pump Testing.** The Statement of Completion for Well No. 4 reports that a pumping test was to be completed on the well in 1987, but no records were found of the actual pumping test. JMM conducted a 231-minute pumping test on Well No. 4 on October 12, 1989 using the existing pumping equipment. The static water level in the well prior to the pumping test was measured at 437 feet using a well sounder. Drawdown in the well during the test was measured using an airline. The average pumping rate was 60 gpm. The drawdown at the conclusion of
the 231-minute pumping test was 321 feet, which equals a pumping water level of 758 feet. JMM (1989) calculated a transmissivity of 179 gpd/ft from the drawdown data. The specific capacity of the well at the conclusion of the test was 0.19 gpm/ft. Recovery data were collected from the well for 300 minutes before the pump in Well No. 4 was turned on automatically to fill the storage tank. The residual drawdown after 300 minutes was 85.47 feet, which equals a recovery of 73 percent of the pre-test static water level.

After performing the video log of Well No. 4, WESTON reinstalled the permanent pumping equipment in the well and landed the pump column on top of the well to conduct pumping testing. Water levels in the well were measured using an airline and flow rates were measured with a two-inch flow meter and controlled by adjusting a two-inch ball valve. The January 5-6, 2011 pumping test was started at a pumping rate of 75 gpm, but was turned down to 60 gpm 60 minutes into the test when it appeared that the well could not sustain the higher pumping rate. The pumping test was run for 14.5 hours and the drawdown at the end of the test was 533 feet. The specific capacity of the well, according to the final drawdown, is 0.11 gpm/ft. Although the specific capacity from the 2011 pumping test is lower than that of the 1989 test, the 2011 test was significantly longer, resulting in a greater drawdown.

### Table 4-10

Well No. 4 Video Log Description (January 4, 2011)

<table>
<thead>
<tr>
<th>Interval (feet)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Top of casing.</td>
</tr>
<tr>
<td>8.2</td>
<td>Pitless adaptor. Outlet (3-inch) observed at 8.5 feet. Can see flow meter impeller through outlet.</td>
</tr>
<tr>
<td>378</td>
<td>Static water level. Cable guard floating on water.</td>
</tr>
<tr>
<td>492</td>
<td>Water is very turbid, light source on camera is obscured.</td>
</tr>
<tr>
<td>545</td>
<td>Light on camera is turned up to maximum luminosity.</td>
</tr>
<tr>
<td>625</td>
<td>Water is clearing with depth.</td>
</tr>
<tr>
<td>675</td>
<td>Water is much clearer, observe bacterial deposits on casing. Some bare spots on casing from removal of the pump.</td>
</tr>
<tr>
<td>919.5 – 928.6</td>
<td>10 visible perforations, all open.</td>
</tr>
<tr>
<td>1,116.5 – 1,128</td>
<td>16 visible perforations, 6 plugged.</td>
</tr>
<tr>
<td>1,413.8 – 1,427</td>
<td>14 visible perforations, 5 plugged or partially plugged.</td>
</tr>
<tr>
<td>1,476</td>
<td>Well fill and green tape.</td>
</tr>
</tbody>
</table>
Figure 4-10 provides a time-drawdown plot of the constant-rate pumping test data from Well No. 4 using the method developed by Cooper and Jacob (1946). The aquifer’s transmissivity in the vicinity of Well No. 4, as determined from the late-time drawdown data is 230 gallons per day per foot (gpd/ft). The transmissivity value is similar to the value computed from the pumping test conducted on the well in 1989.

At the conclusion of the pumping test, recovery data were collected from Well No. 4 for 394 minutes. The residual drawdown 394 minutes after the pump was turned off was 97 feet, which equals 18 percent of the total drawdown. The recovery data are plotted on Figure 4-11 using the method developed by Cooper and Jacob (1946). The residual drawdown is plotted versus the ratio of the time since the pump was started (T) over the time since the pump was turned off (T’). Later time recovery data plot to the left of the diagram. The recovery data yield an aquifer transmissivity of 100 gpd/ft, which is slightly lower than the value computed from the drawdown data and from the 1989 test.

Water levels were observed in Well No. 5 during the Well No. 4 pumping test. Figure 4-12 is a plot of the observation well data using the method developed by Cooper and Jacob (1946). The plot shows that the water level in Well No. 5 began to draw down after Well No. 4 had been pumping for 200 minutes. The rate of drawdown in Well No. 5 increased dramatically after an elapsed time of 514 minutes. The aquifer transmissivity, based on the late time drawdown data, was determined to be 60 gpd/ft. The drawdown in Well No. 5 at the conclusion of the Well No. 4 pumping test was 63.5 feet. The coefficient of storage for the aquifer open to the wells was computed to be $4.65 \times 10^{-2}$, which suggests that the aquifer is semi-confined. The transmissivity and coefficient of storage values determined from the Well No. 5 data may not accurately describe aquifer conditions since the two wells do not share all of the same producing intervals. JMM (1989) estimated that the coefficient of storage for the aquifer penetrated by Well No. 4 is 0.1, which is representative of an unconfined aquifer. However, the JMM estimate was based on a very brief pumping test and the accuracy is questionable. One recovery measurement was collected from Well No. 5 after Well No. 4 was turned off. The residual drawdown in Well No. 5 was 10.4 feet 334 minutes after the pump in Well No. 4 was turned off. The residual drawdown was 16 percent of the pre-test level.
Figure 4-10
Rolling Hills Well No. 4
Time Drawdown Plot (January 5 - 6, 2011)

\[ Q = 75 \text{ GPM} \]

DECREASE PUMPING RATE TO 60 GPM

\[ T = 230 \text{ GPD/FT} \]
Figure 4-11
Rolling Hills Well No. 4
Drawdown Recovery Plot (January 6, 2011)

T = 100 GPD/FT
Q = 60 GPM
Figure 4-12
Rolling Hills Well No. 4 Pump Test
Well No. 5 Time Drawdown Observation (January 5 - 6, 2011)

\[ r = 1,180 \text{ FEET} \]
\[ t_0 = 480 \text{ MINUTES} \]
\[ S = 4.65 \times 10^{-2} \]
\[ Q = 60 \text{ GPM} \]
\[ T = 60 \text{ GPD/FT} \]
Water Level Trends. As reported above, the static water level when Well No. 4 was drilled and perforated was 172 feet (JMM, 1989). The static water level was then reported to be 350 feet on the Statement of Completion. It is not known how either of the static water levels were measured or how accurate the readings were. JMM (1989) stated that during annual testing in 1987 the static water level was 282 feet. The static water level in the well measured using a well sounder on October 12, 1989 was 437 feet (JMM, 1989). WESTON measured the static water level in the well at 373 feet on January 5, 2011 using a well sounder. The water level in Well No. 4 has dropped since the well was drilled. The deeper water levels reported in 1989 are probably the result of Well No. 4 being the main well used by the Town of Rolling Hills before Well Nos. 5 and 6 were constructed. However, since Well Nos. 5 and 6 were constructed, Well No. 4 has been third in the sequence for operation, which has apparently allowed the well to recover.

Well Production Capacity. The pumping testing of Well No. 4 yielded aquifer transmissivities of between 60 and 230 gpd/ft. A straight-line extension of the drawdown data in Figure 4-10 indicates that the well could produce 60 gpm for 15 hours before the pumping water level draws down to within 25 feet of the pump intake. However, Well Nos. 4 and 5 are in hydraulic communication with one another. If Well No. 5 is pumped, it will cause the water level in Well No. 4 to drop and the production capacity of Well No. 4 will decrease.

The Jacob Equation was used to estimate the drawdown in Well No. 4 over an extended pumping period. The inputs for the analysis are as follows:

- Varied pumping rates;
- Average aquifer transmissivity of 80 gpd/ft, a value that closely predicts the observed drawdown in Well No. 4 during the 2011 pumping test conducted by WESTON;
- An assumed aquifer coefficient of storage of $4.65 \times 10^{-2}$ from the Well No. 5 observation data; and
- A pumping duration of 1, 5, and 10 years.
For the purposes of this analysis it is assumed that the available drawdown in Well No. 4 is equal to 537 feet. The available drawdown in Well No. 4 is equal to the difference between the static water level of 373 feet and the pump setting of 935 feet, less a reserve of 25 feet for pump submergence. The results of the analysis are summarized in Table 4-11. The Jacob Equation analysis predicts that Well No. 4 could sustain an average pumping rate of 25 gpm for a 10 year period. The analysis ignores the effects of pumping Well No. 5.

Table 4-11
Well No. 4 Predicted Drawdowns and Pumping Water Levels

<table>
<thead>
<tr>
<th>Time</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 10 gpm</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 20 gpm</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>174 feet / 547 feet</td>
<td>348 feet / 721 feet</td>
<td>435 feet / 808 feet</td>
</tr>
<tr>
<td>5 Years</td>
<td>197 feet / 570 feet</td>
<td>394 feet / 767 feet</td>
<td>493 feet / 866 feet</td>
</tr>
<tr>
<td>10 Years</td>
<td>207 feet / 580 feet</td>
<td>414 feet / 787 feet</td>
<td>517 feet / 890 feet</td>
</tr>
</tbody>
</table>

**Water Quality.** WESTON was unable to find any water quality data for Well No. 4. Because samples collected for Safe Drinking Water Act (SDWA) compliance were collected from the Rolling Hills tank, the water sampled is a mixture of water from Well Nos. 4, 5, and 6. There is currently no sampling tap to facilitate collection of a water quality sample from Well No. 4.

On January 6, 2011 water samples were collected by WESTON from Well No. 4 for an abbreviated suite of analytes. The results of the testing are provided in Table 4-3. The Well No. 4 sample has a TDS concentration of 351 mg/L, which is well below the secondary standard of 500 mg/L for a public water supply source. The pH result of 8.48, is slightly below the maximum standard of 8.5. The Well No. 4 sample exceeded the secondary standards for iron and manganese, as shown in Table 4-3. The sample also contained less than 1 CFU/mL of iron bacteria, an indication that the bacteria are not pervasive in the well.
Conclusions and Recommendations. Well No. 4 is permitted and equipped to pump 75 gpm; however, pumping testing conducted by WESTON in 2011 indicates that the well cannot sustain a 75 gpm pumping rate. It appears that the long-term production capacity of Well No. 4 is 25 gpm. Pumping of Well No. 4 also causes drawdown in water levels in Well No. 5, which has the effect of reducing the combined long-term capacity of the two wells to less than the individual capacity of the wells.

The water level in the well should be measured and recorded at least monthly using the airline that is in the well. Routine comparison of the static and pumping water levels, coupled with the production data, will facilitate the identification of trends in well performance. In accordance with the SEO permit conditions, water level data and production data should be reported to the SEO in an annual report.

The flow meter for Well No. 4 is currently not working. Additionally, the meter is located in a pit that is immediately adjacent to a 4-inch by 2-inch reducer attached to the outlet on the pitless adaptor. Because a flow meter located next to a pitless adaptor and reducer is not accurate, it will be necessary to install a new meter pit or modify the plumbing in the meter pit to allow for the proper installation of a 2-inch meter on the well.

There is currently no sampling tap or flushing hydrant for Well No. 4. In the event of a contamination event and/or the need to sample Well No. 4, the pump will have to be lifted out of the pitless adaptor and the water pumped out at the ground surface. Because water is pumped directly from Well No. 4 to the tank, there is no easy way to install a sanitary sampling tap for the well. WESTON recommends that a flushing hydrant and gate valves be installed on the line from Well No. 4 to facilitate sampling.

Because the pump cable in Well No. 4 has several rubbed spots and the galvanized armor has extensive rust and corrosion, WESTON recommends that the pump cable be replaced the next time the pumping equipment is removed from the well.

Rolling Hills Well No. 5

Rolling Hills No. 5 (Well No. 5) is located 1,200 feet north of Well No. 4 and was drilled as part of a WWDC Level II water supply project conducted by JMM in 1990.
Permitting. The SEO permit number for Rolling Hills Well No. 5 is U.W. 81833, which has a priority date of January 24, 1990. A copy of the well permit is provided in Appendix A. The well was drilled under DEQ Permit to Construct No. 90-025. The well has not been adjudicated for municipal use because a Plat of Beneficial Use has only recently been filed with the SEO. The permitted maximum pumping rate is 75 gpm and there is currently no cap on total annual production. Permit conditions required by the SEO permit include the following:

- A water meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from the well;
- An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period;
- The report shall identify the well by name, location, permit number, and shall identify the type of meter used for the measurement;
- The report shall contain at least two semi-annual measurements of the pumping water level in the well as measured after a minimum of twenty-four (24) consecutive hours of pumping. The dates the measurements were obtained and the period of time the well was pumped prior to obtaining the measurements must be specified;
- The report shall contain at least two semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was “shut-in” prior to obtaining the measurements must be specified; and
- The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

Well Drilling and Construction Data. Well No. 5 was drilled and constructed in 1990 by D.C. Drilling of Lusk, Wyoming. Construction details for Well No. 5 from the Statement of Completion, the 1990 JMM report, and the video log performed by WESTON on December 9, 2010, are provided on Figure 4-13 and in Table 4-12.
ROLLING HILLS
LEVEL I STUDY
AS-BUILT DIAGRAM WELL NO. 5
FIGURE 4-13

DESIGN DETAILS

T.D. = 1,763 FEET
NOT TO SCALE

0 - 83 FEET: 10 3/4-INCH DIAMETER STEEL CASING CEMENTED IN PLACE

0 - 801 FEET: CEMENT GROUT

0 - 801: FEET 7 5/8-INCH O.D. 26.4 LB/FT STEEL CASING

83 - 802 FEET: 9 7/8-INCH DIAMETER BOREHOLE

741 FEET: GOLDS 65L15 PUMP AND 20-HP FRANKLIN MOTOR

802 - 1,763 FEET: 6 1/4-INCH DIAMETER BOREHOLE

756 FEET: LINER-HANGER

756 - 1,750 FEET: 4 1/2-INCH GRADE B STEEL CASING

4-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

1,750 FEET: STEEL PLATE

SCREENED INTERVALS

851' - 861'
892' - 902'
1,010' - 1,015'
1,111' - 1,131'
1,424' - 1,429'
1,471' - 1,481'
1,521' - 1,531'
1,572' - 1,582'
1,618' - 1,648'
1,670' - 1,700'
1,730' - 1,740'

741 FEET: GOULDS 65L15 PUMP AND 20-HP FRANKLIN MOTOR

2 1/2-INCH GALVANIZED COLUMN PIPE AND # 6 AWG PUMP CABLE, AIRLINE SET AT 741 FEET

STATIC WATER LEVEL
230 FEET (APRIL 1990)
325 FEET (12/10/2010)

BAKER PITLESS ADAPTOR

741 FEET: GOULDS 65L15 PUMP AND 20-HP FRANKLIN MOTOR

1,750 FEET: STEEL PLATE

2 1/2-INCH GALVANIZED COLUMN PIPE AND # 6 AWG PUMP CABLE, AIRLINE SET AT 741 FEET

756 FEET: LINER-HANGER

802 - 1,763 FEET: 6 1/4-INCH DIAMETER BOREHOLE

756 - 1,750 FEET: 4 1/2-INCH GRADE B STEEL CASING

4-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

1,750 FEET: STEEL PLATE

NOT TO SCALE

0 - 83 FEET: 10 3/4-INCH DIAMETER STEEL CASING CEMENTED IN PLACE

0 - 801 FEET: CEMENT GROUT

0 - 801: FEET 7 5/8-INCH O.D. 26.4 LB/FT STEEL CASING

83 - 802 FEET: 9 7/8-INCH DIAMETER BOREHOLE

741 FEET: GOLDS 65L15 PUMP AND 20-HP FRANKLIN MOTOR

802 - 1,763 FEET: 6 1/4-INCH DIAMETER BOREHOLE

756 FEET: LINER-HANGER

756 - 1,750 FEET: 4 1/2-INCH GRADE B STEEL CASING

4-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

1,750 FEET: STEEL PLATE

NOT TO SCALE
### Table 4-12

#### Well No. 5 Summary

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Engineer Permit No.</td>
<td>U.W. 81833, Unadjudicated</td>
</tr>
<tr>
<td>Location</td>
<td>SW, SW Section 15, Township 34 North, Range 75 West</td>
</tr>
<tr>
<td>Surface Elevation</td>
<td>5,428.75 feet, ground level</td>
</tr>
<tr>
<td>Total Depth</td>
<td>1,763 feet: drilled, 1,750 feet: completed</td>
</tr>
<tr>
<td>Formations</td>
<td>0 - 60 feet: Quaternary Sand Dune Deposits, 60 – 582 feet: Fort Union Formation, 582 – 1,763 feet: Lance Formation</td>
</tr>
<tr>
<td>Hole Diameter</td>
<td>0 – 83 feet: 12 1/4 inches, 83 – 802 feet: 9 7/8 inches, 802 – 1,763 feet: 6 1/4 inches</td>
</tr>
<tr>
<td>Casing</td>
<td>0 - 83 feet: 10 3/4 inch steel casing (32.75 lb/foot), 0 – 801 feet: 7 5/8 inch steel casing (26.4 lb/foot), 756 – 1,750 feet: 4 1/2 inch steel casing (11.6 lb/foot)</td>
</tr>
<tr>
<td>Producing Intervals</td>
<td>851 – 861 feet, 892 – 902 feet, 1,010 – 1,015 feet, 1,111 – 1,131 feet, 1,424 – 1,429 feet, 1,471 – 1,481 feet, 1,521 – 1,531 feet, 1,572 – 1,582 feet, 1,618 – 1,648 feet, 1,670 – 1,700 feet, and 1,730 – 1,740 feet: 4 ½ inch, stainless steel well screens, 15 slot size</td>
</tr>
<tr>
<td>Static Water Level</td>
<td>230 feet (April, 1990), 325 feet (December 10, 2010)</td>
</tr>
<tr>
<td>Air Line Setting</td>
<td>741 feet (January 2010)</td>
</tr>
<tr>
<td>Drilling and Completion Date</td>
<td>March 22 – April 12, 1990</td>
</tr>
<tr>
<td>Testing Rates</td>
<td>77 gpm with 489 feet of drawdown after 119 hours (1990), 65 gpm with 277 feet of drawdown after 15.75 hours (2011)</td>
</tr>
</tbody>
</table>
Pump Information: Goulds Model 65L15 Pump, SN 102G05310  
Franklin 20-HP Submersible Motor, Model 2363148120, 2010 Date Code  
Set on 2 1/2-inch galvanized pipe, intake at 741 feet

Engineering During Well Construction: James M. Montgomery Consulting Engineers (Laramie, WY)

Drilling Contractor: D.C. Drilling (Lusk, WY)

Pumping testing Contractor: D.C. Drilling (Lusk, WY), 4/17-21/90  
Weston Engineering, Inc. (Upton, WY), 1/12-13/11

The Statement of Completion for Well No. 5 reports that the well has a total depth of 1,763 feet. The well was completed with 83 feet of 10 ¾-inch surface casing. A 9 7/8-inch borehole was advanced to a depth of 802 feet and 7 5/8-inch casing was installed to a depth of 801 feet. After the 7 5/8-inch casing was cemented, a 6 ¼-inch diameter borehole was drilled to a depth of 1,763 feet. A suite of geophysical logs were run on the borehole to identify permeable sandstones and a 4 ½-inch string of casing and stainless steel well screen was installed in the well from 756 to 1,750 feet. Screens were placed across the sandstones identified on the logs. The screens are natural packed and each screened interval has shale baskets above to minimize the entry of fine grained materials. The well was developed by jetting and airlifting for 30 hours following well construction.

**Downhole Well Inspection.** On December 9, 2010, WESTON mobilized a pump service rig and removed the downhole pumping equipment from Well No. 5. Thirty-five joints of 2 ½-inch galvanized pipe were removed from the well. Several of the joints have been corroded, with the most significant corrosion occurring at the threads on the ends of the pipe. It is assumed that the pump column is original to the well and was installed in July 1990, according to billing records maintained by the Town of Rolling Hills. WESTON anticipates that up to 11 joints of the pipe will need to be replaced the next time the pump is removed from the well. Pump column joints below 399 feet were found to be slimy on the interior and exterior. The slime appears to be iron bacteria colonies. A check valve at 651 feet was found to be in good working order. The pump setting is 741 feet. When WESTON mobilized to Well No. 5 it was known that the pump in the well was not working. WESTON found that the shaft on the pump
had been broken off. WESTON replaced the pump and motor with the equipment listed in Table 4-12. The #6 AWG, flat-jacketed, three-wire pump cable was found to be worn and spliced in several locations and the wire insulation was nearly compromised. WESTON replaced the pump cable with new #6 AWG, flat-jacketed, three-wire cable.

Observations from the video log performed on Well No. 5 on December 9, 2010 are summarized in Table 4-13. The slots in the casing are difficult to identify in the downhole view of the well. The video log side views of the liner reveal significant plugging of most of the screens observed. The side view also shows the extensive development of mineral scale, which has a white hue, and possible bacterial build-up, which has a fluffy appearance. Plugging of the screens could result in lower yields from the well. The video camera encountered the bottom of the well at a depth of 1,769.7 feet, which is deeper than the reported total well depth of 1,750 feet. It is possible that the video camera footage counter is off.

**Pump Testing.** JMM supervised a pumping testing program of Well No. 5 that was performed by D.C. Drilling after the well was drilled in 1990. The pumping test program consisted of a step-rate test and recovery and a constant-rate test and recovery. The step-rate test was performed with three steps of increasing pumping rates of 55, 95, and 110 gpm with a duration of 100 minutes per step. The specific capacity computed from the step-rate tests were 0.26 and 0.27 gpm/ft (JMM, 1990). JMM noted a gassy odor, possibly methane, from the produced water during the step-rate test.

The constant-rate test performed on Well No. 5 in 1990 was initiated at 96 gpm, but after 500 minutes the rate was decreased to 77 gpm because the pumping water level was within 20 feet of the pump intake. Gas production in the well resulted in anomalies in the drawdown and was the cause of a shut-down of the pumping test. The drawdown at the conclusion of the 119-hour pumping test was 489 feet, which equals a pumping water level of 719 feet. JMM (1990) reported that the transmissivity from the late-time drawdown data was 300 gpd/ft. Recovery data were collected from Well No. 5 for 400 minutes after the pump was turned off. The well recovered to 71 percent of the pre-test water level, which left a residual drawdown of 141 feet. The transmissivity calculated from the recovery data was 200 gpd/ft. Water levels were monitored at Well No. 4 during the testing at Well No. 5. Although JMM (1990) reported that
there were no changes in the water level in Well No. 4 during the pumping test, it is likely that the airline in Well No. 4 was pinched and not properly measuring the water level in the well, as observed when WESTON removed the pump from the well in 2010. JMM (1990) recommended that the well be equipped with a pump capable of yielding 75 gpm.
After installing the new pump and motor in Well No. 5, WESTON conducted a pumping test on the well. Water levels in the well were measured using an airline and flow rates were measured with the water meter in the well’s meter pit. Well No. 5 was pumped into the Town’s water storage tank to maintain service to the tank and prevent Well Nos. 4 and 6 from turning on. The well was pumping tested at a rate of 65 gpm for 16 hours. The drawdown in the well at the end of the test was 294.5 feet, resulting in a pumping water level of 619.5 feet. The specific capacity of the well, based on data from the 2010 pumping test, was calculated at 0.22 gpm/foot of drawdown. The specific capacity from the 1990 test at approximately the same elapsed time was 0.17 gpm/ft. The increase in specific capacity suggests that the well has become more efficient with time, which is probably a result of the production of fine grained materials from the well since it was put into production.

Figure 4-14 is a time-drawdown plot of the constant-rate pumping test data from Well No. 5 using the method developed by Cooper and Jacob (1946). The aquifer’s transmissivity in the vicinity of Well No. 5, as determined from the drawdown data, is 230 gpd/ft. The transmissivity value is similar to the value computed for the pumping test conducted on the well in 1990. A straight-line extension of the drawdown data indicates that Well No. 5 could pump at a rate of 65 gpm continually for a period of approximately 21 days before drawing the pumping water level to within a few feet of the pump intake.

At the conclusion of the pumping test, recovery data were collected from Well No. 5 for 1,735 minutes. The residual drawdown at the end of recovery data collection was 20.8 feet, which equals 7 percent of the total drawdown. The recovery data are plotted on Figure 4-15 using the method developed by Cooper and Jacob (1946). The recovery data yield an aquifer transmissivity of 215 gpd/ft, which is similar to the value determined from the drawdown data.

Water levels were observed in Well No. 4 during the Well No. 5 pumping test. Figure 4-16 is a plot of the observation well data using the method developed by Cooper and Jacob (1946). The plot shows that the water level in Well No. 4 began to draw down after Well No. 5 had been pumping for 220 minutes. The rate of drawdown in Well No. 4 was very steep for the entire observation period and showed no indication of slowing. The aquifer transmissivity of the observation well data is 380 gpd/ft, which is similar to the values determined from the pumping
Figure 4-14
Rolling Hills Well No. 5
Time Drawdown Plot (January 12 - 13, 2011)

Q = 65 GPM

T = 230 GPD/FT
Figure 4-15
Rolling Hills Well No. 5
Drawdown Recovery Plot (January 13 - 14, 2011)

T = 215 GPD/FT
Q = 65 GPM
Figure 4-16
Rolling Hills Well No. 5 Pump Test
Well No. 4 Time Drawdown Observation (January 12 - 13, 2011)

$r = 1,180$ FEET
$t_0 = 100$ MINUTES

$Q = 65$ GPM

$S = 6.14 \times 10^{-2}$

$T = 380$ GPD/FT
The drawdown in Well No. 4 at the conclusion of the Well No. 5 pumping test was 53 feet. The coefficient of storage for the aquifer open to the two wells was computed to be $6.14 \times 10^{-2}$, which suggests that the aquifer is semi-confined. Recovery data were collected from Well No. 4 for 344 minutes after the pump was turned off. The residual drawdown in Well No. 4 at the end of the data collection period was two feet, which is four percent of the pre-test level. The recovery data are plotted on Figure 4-17. The transmissivity from the recovery data was 745 gpd/ft, which is significantly higher than all other transmissivity values obtained from pumping testing of Well Nos. 4 and 5.

**Water Level Trends.** The static water level when Well No. 5 was drilled in 1990 was 230 feet (JMM, 1990). The only other known water level measurement is from the 2010 well evaluation program, when the water level was measured by WESTON at 325 feet. The 95-foot drop in the water level in Well No. 5 indicates that the aquifer has not sustained recharge greater than the withdrawals from the wells. The Town of Rolling Hills should routinely measure the water level in Well No. 5 to facilitate the identification of trends in the water level. These data could then be used to manage the Rolling Hills wellfield and aid in long-term water resource planning.

**Well Production Capacity.** The pumping testing of Well No. 5 yielded aquifer transmissivities of between 200 and 745 gpd/ft. The average transmissivity calculated from the two pumping tests, excluding the value of 745 gpd/ft which was anomalously high, is 265 gpd/ft. A straight-line extension of the drawdown data in Figure 4-14 indicates that the well could produce 65 gpm for 21 days before the pumping water level draws down to within 25 feet of the pump intake. However, Well Nos. 4 and 5 are in hydraulic communication with one another. If Well No. 4 is pumped it will cause the water level in Well No. 5 to drop and the production capacity of Well No. 5 will decrease. The Jacob Equation was used to estimate the drawdown in Well No. 5 over an extended pumping period. The inputs for the analysis are as follows:
Figure 4-17
Rolling Hills Well No. 5 Pump Test
Well No. 4 Drawdown Recovery Observation (January 13 - 14, 2011)

- $r = 1,180\ \text{FEET}$
- $t_0 = 4.8\ \text{MINUTES}$
- $S = 5.78 \times 10^{-3}$
- $T = 745\ \text{GPD/FT}$
- $Q = 65\ \text{GPM}$
• Varied pumping rates;

• Average aquifer transmissivity of 265 gpd/ft, an average transmissivity value that closely predicts the observed drawdown in Well No. 5 during the 2011 pumping test conducted by WESTON;

• An assumed aquifer coefficient of storage of $5.8 \times 10^{-3}$ from the observation data from Well No. 4; and

• A pumping duration of 1, 5, and 10 years.

For the purposes of this analysis, it is assumed that the available drawdown in Well No. 5 is equal to 391 feet. The available drawdown in Well No. 5 is equal to the difference between the static water level of 325 feet and the pump setting of 741 feet, less a reserve of 25 feet for pump submergence. The results of the analysis are summarized in Table 4-14. The Jacob Equation analysis predicts that Well No. 5 could sustain an average pumping rate of 50 gpm for a 10-year period. The analysis ignores the effects of pumping Well No. 4. Because Well Nos. 4 and 5 are in direct hydraulic communication and because the impacts are significant, the production capacity of Well Nos. 4 and 5 is limited to the 25 gpm estimated for Well No. 4 or the 50 gpm estimated for Well No. 5.

**Table 4-14**

<table>
<thead>
<tr>
<th>Time</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 30 gpm</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 40 gpm</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 50 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>200 feet / 525 feet</td>
<td>267 feet / 592 feet</td>
<td>334 feet / 659 feet</td>
</tr>
<tr>
<td>5 Years</td>
<td>221 feet / 546 feet</td>
<td>295 feet / 620 feet</td>
<td>369 feet / 694 feet</td>
</tr>
<tr>
<td>10 Years</td>
<td>230 feet / 555 feet</td>
<td>306 feet / 631 feet</td>
<td>384 feet / 709 feet</td>
</tr>
</tbody>
</table>
Water Quality. A complete suite of water quality samples were collected from Well No. 5 during the initial pumping test in 1990. The analytical results of the 1990 sample and the EPA standards for each constituent are summarized in Table 4-8. The overall water quality was good with a TDS of 350 mg/L, which is under the secondary EPA standard of 500 mg/L. However, the iron, manganese, and turbidity concentrations exceeded the secondary standards for a public drinking water supply source. The elevated turbidity concentration indicates that well development was not complete before the pumping test was conducted. The elevated iron and pH concentrations indicate that the water from Well No. 5 has a potential for staining plumbing fixtures and clothing that comes into contact with the water. The water sample from Well No. 5 also tested positive for total coliform coliform during the 1990 test.

On January 13, 2011, water samples were collected from Well No. 5 by WESTON for an abbreviated suite of analytes. The analytical results, which are summarized in Table 4-3, are very similar to the 1990 results. The Well No. 5 sample exceeded the secondary standards for iron and manganese. In addition, iron bacteria were present in the sample at a concentration of 530 CFU/mL. This concentration is not likely to have a significant impact on the well.

Conclusions and Recommendations. Well No. 5 is permitted for a yield of 75 gpm and equipped to pump 65 gpm; however, pumping testing conducted by WESTON in 2011 indicates that the long-term capacity of the well is 50 gpm. Pumping of Well No. 5 also causes drawdown in water levels in Well No. 4, which has the effect of reducing the combined long-term capacity of the two wells to less than the individual capacity of the wells.

The water level in the well should be measured and recorded at least monthly using the airline that is in the well. Routine comparison of the static and pumping water levels, coupled with the production data will facilitate the identification of trends in well performance. In accordance with the SEO permit conditions, water level data and production data should be reported to the SEO in an annual report.

The remote readout for the flow meter for Well No. 5 is currently not working. Reading the meter requires removing the cover from the meter pit, which can be difficult. The remote readout should be replaced. The pump column in Well No. 5 has been corroded and will need to be replaced within the next 10 years or the next time the pump is removed from the well.
Rolling Hills Well No. 6

The Rolling Hills #6 Well (Well No. 6) is located 2,400 feet west of Well No. 4 and was drilled in 1995 as part of a WWDC Level II Study conducted by TriHydro (1996).

**Permitting.** The SEO permit number for the Rolling Hills #6 Well (Well No. 6) is U.W. 125025, which has a priority date of April 3, 2000. The well is not adjudicated for municipal use because a Plat of Beneficial Use has only recently been filed with the SEO. A copy of the well permit is presented in Appendix A. The well was drilled under DEQ Permit to Construct No. 95-123. The permitted maximum pumping rate is 80 gallons per minute (gpm) and the the annual maximum production volume is 10,789,000 gallons. Permit conditions required by the SEO permit include the following:

- A water meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from the well;

- An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period;

- The report shall identify the well by name, location, permit number, and shall identify the type of meter used for the measurement;

- The report shall contain at least two semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was “shut-in” prior to obtaining the measurements must be specified; and

- The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

**Well Drilling and Construction Data.** Well No. 6 was drilled and constructed in 1995 by D.C. Drilling of Lusk, Wyoming. Construction details for Well No. 6 from the Statement of Completion, the 1996 Trihydro report, and the video log performed by WESTON on January
ROLLING HILLS
LEVEL I STUDY
AS-BUILT DIAGRAM WELL NO. 6
FIGURE 4-18

DESIGN DETAILS

0 - 103.5 FEET: 10 3/4-INCH DIAMETER STEEL CASING CEMENTED IN PLACE
CEMENT GROUT

0 - 810 FEET: 7 5/8-INCH O.D. STEEL CASING

103.5 - 810 FEET: 10 3/4-INCH DIAMETER BOREHOLE

810 - 1,785 FEET: 6 1/4-INCH DIAMETER BOREHOLE

808 - 1,785 FEET: 4 1/2-INCH DIAMETER STEEL CASING

4 1/2-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

MONITOR PITLESS ADAPTOR

STATIC WATER LEVEL
271.74 FEET (10/20/95)
310.6 FEET (1/14/11)

3-INCH GALVANIZED PUMP COLUMN AND #4 AWG SOLID WIRE, ARMORED PUMP CABLE AIRLINE SET AT 783 FEET

783 FEET:
Goulds 85S256-20 PUMP
FRANKLIN 25-HP MOTOR

SCREENED INTERVALS
1.126 - 1.132
1.227 - 1.238
1.291 - 1.312
1.338 - 1.369
1.370 - 1.401
1.429 - 1.445
1.471 - 1.482
1.502 - 1.508
1.574 - 1.600
1.647 - 1.673
1.719 - 1.730
1.749 - 1.775

808 - 1,785 FEET: 4 1/2-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

T.D. = 1,786 FEET
NOT TO SCALE

103.5 - 810 FEET: 10 3/4-INCH DIAMETER BOREHOLE

MONITOR PITLESS ADAPTOR

0 - 103.5 FEET: 10 3/4-INCH DIAMETER STEEL CASING CEMENTED IN PLACE
CEMENT GROUT

0 - 810 FEET: 7 5/8-INCH O.D. STEEL CASING

103.5 - 810 FEET: 10 3/4-INCH DIAMETER BOREHOLE

810 - 1,785 FEET: 6 1/4-INCH DIAMETER BOREHOLE

808 - 1,785 FEET: 4 1/2-INCH DIAMETER STEEL CASING

4 1/2-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

T.D. = 1,786 FEET
NOT TO SCALE

MONITOR PITLESS ADAPTOR

0 - 103.5 FEET: 10 3/4-INCH DIAMETER STEEL CASING CEMENTED IN PLACE
CEMENT GROUT

0 - 810 FEET: 7 5/8-INCH O.D. STEEL CASING

103.5 - 810 FEET: 10 3/4-INCH DIAMETER BOREHOLE

810 - 1,785 FEET: 6 1/4-INCH DIAMETER BOREHOLE

808 - 1,785 FEET: 4 1/2-INCH DIAMETER STEEL CASING

4 1/2-INCH STAINLESS STEEL SCREEN WITH SLOT SIZE OF 0.015-INCHES

T.D. = 1,786 FEET
NOT TO SCALE
13, 2011, are provided in Table 4-15. An as-built diagram of Well No. 6 is provided in Figure 4-18.

The Statement of Completion for Well No. 6 reports that the well has a total depth of 1785.91 feet. The well was completed with 103.5 feet of 10 3/4-inch surface casing. A 10 1/4-inch borehole was advanced to a depth of 810 feet and 7 5/8-inch casing was installed to a depth of 810 feet. After the 7 5/8-inch casing was cemented, a 6 1/4-inch diameter borehole was drilled to a depth of 1,811 feet. A suite of geophysical logs were run on the borehole to identify permeable sandstones and a 4 1/2-inch string of casing and stainless steel well screen was installed in the well from 1,126 to 1,775 feet. Screens were placed across the sandstones identified on the logs. The screens are natural packed and shale baskets were installed above each screened interval to minimize the entry of fine grained materials. The well was developed by jetting and airlifting for 55 hours following well construction.

| Table 4-15                                      |
| Well No. 6 Summary                              |

| State Engineer Permit No.: U.W. 125025, Unadjudicated |
| Location: SW SE Section 16, Township 34 North, Range 75 West; 42°54’38.66”N, 105°51’29.82”W |
| Surface Elevation: 5,430.09 feet, ground level |
| Total Depth: 1,811 feet: drilled 1,785.9 feet: completed |
| Formations: 0 – 39 feet: Quaternary Sand Dune Deposits 39 – 190 feet: Fort Union Formation 190 – 1,811 feet: Lance Formation |
| Hole Diameter: 0 – 103.5 feet: 16 inches 103.5 – 810 feet: 10 1/4 inches 810 – 1,811 feet: 6 1/4 inches |
| Casing: 0 – 103.5 feet: 10 3/4 inch steel casing 103.5 – 810 feet: 7 5/8 inch steel casing 810 – 1,785.91 feet: 4 1/2 inch steel casing |
Producing Intervals: 810 – 1,785.91 feet: 4 ½ inch, stainless steel well screens, 15 slot size

Static Water Level: 271.74 feet (October 20, 1995)
310 feet (January 13, 2011)

Air Line Setting: 783 feet (January 2011)

Drilling and Completion Date: September 20, 1995 – October 10, 1995

Testing Rates: 79.5 gpm with 450 feet of drawdown after 151 hours (1995)
80 gpm with 368 feet of drawdown after 24 hours (2011)

Pump Information: Goulds 85S256-20, Franklin 25 HP Submersible Motor, date code August 2000
Set on 3-inch galvanized pipe, intake at 783 feet

Engineering During Well Construction: Trihydro Corporation (Laramie, WY)

Drilling Contractor: D.C. Drilling (Lusk, WY)

Pumping testing Contractor: D.C. Drilling (Lusk, WY), 10/21-30/95
Weston Engineering (Upton, WY), 1/18-19/11

**Downhole Well Inspection.** On January 13, 2011, WESTON mobilized a pump service rig and removed the downhole pumping equipment from Well No. 6. Thirty-seven joints of 3-inch galvanized pipe were removed from the well. The pump column and a check valve at 756 feet were found to be in good working order. The pump setting is 783 feet. The pump cable is #4 AWG solid wire flat armored cable. Old cable sitting on the ground to the west of the well was not armored. It is suspected that the old cable was replaced because of wear on the cable during pump installation. The pump and motor are in good working condition and the date code on the motor suggests that the pump and motor were installed in 2000. No records of the pump installation were found.

Observations from the video log performed on Well No. 6 on January 13, 2011 are summarized in Table 4-16. It was not possible to flush the well before video logging to clarify the water. The video log reveals that the well in good physical condition; however, the screens below a depth of 1,461 feet are mostly plugged. It is likely that the majority of the water production...
Table 4-16

Well No. 6 Video Log Inspection (January 13, 2011)

<table>
<thead>
<tr>
<th>Interval (Feet)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Top of casing.</td>
</tr>
<tr>
<td>8.7</td>
<td>Pitless adaptor spool. Outlet on pitless spool at 9.0 feet.</td>
</tr>
<tr>
<td>305.5</td>
<td>Static water level. Cable guards floating on water surface. Slight mineral scale on casing that increases with depth, consistent below 323 feet.</td>
</tr>
<tr>
<td>400</td>
<td>Observe tubercles on casing that increase with depth. Very pronounced below 440 feet.</td>
</tr>
<tr>
<td>700</td>
<td>Less scale on casing.</td>
</tr>
<tr>
<td>802</td>
<td>Liner hanger assembly. Black scale on casing below liner hanger.</td>
</tr>
<tr>
<td>1,019</td>
<td>Duct tape.</td>
</tr>
<tr>
<td>1,118.7 – 1,124.7</td>
<td>Stainless steel screen</td>
</tr>
<tr>
<td>1,218.8 – 1,229.7</td>
<td>Stainless steel screen, some encrustation on screen.</td>
</tr>
<tr>
<td>1,282.0 – 1,300.0</td>
<td>Stainless steel screen.</td>
</tr>
<tr>
<td>1,302 – 1,391</td>
<td>Stainless steel screen. Slight plugging of screen observed, could be screen lying against borehole wall.</td>
</tr>
<tr>
<td>1,418 – 1,435</td>
<td>Stainless steel screen.</td>
</tr>
<tr>
<td>1,461 – 1,471.4</td>
<td>Stainless steel well screens, plugged except near bottom of interval.</td>
</tr>
<tr>
<td>1,491 – 1,497 +/-</td>
<td>Stainless steel well screens, all plugged, very dirty water. Appears that no water is produced below this interval.</td>
</tr>
<tr>
<td>1,563.5 – 1,588</td>
<td>Stainless steel well screens, mostly plugged.</td>
</tr>
<tr>
<td>1,634.5 – 1,661.1</td>
<td>Stainless steel well screens, mostly plugged.</td>
</tr>
<tr>
<td>1,705.0 – 1,716.3</td>
<td>Stainless steel well screens, mostly plugged.</td>
</tr>
<tr>
<td>1,735.6 – 1,754.0</td>
<td>Stainless steel well screens, mostly plugged.</td>
</tr>
<tr>
<td>1,754</td>
<td>Bottom of well.</td>
</tr>
</tbody>
</table>

from the well is from the upper screens. The bottom of the well was encountered at a depth of 1,754 feet, which results in 21 feet of screens being covered by debris.

**Pumping Test.** The 1996 Level II Report (Trihydro, 1996) indicates that a step-rate test was conducted at rates of 40, 60, 80, 100, and 105 gpm for 120 minutes each to determine the specific capacity of the well and to select an optimal pumping rate for the constant rate discharge test. The results of the step-rate test are summarized in Table 4-17. The specific capacity values ranged from 0.26 to 0.30 for the step-rate test data.
Table 4-17
Well No. 6 - 1995 Step-Rate Pumping Test Summary

<table>
<thead>
<tr>
<th>Pumping Rate (gpm)</th>
<th>Drawdown at End of Step (feet)</th>
<th>Specific Capacity (gpm/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>132</td>
<td>0.30</td>
</tr>
<tr>
<td>60</td>
<td>200</td>
<td>0.30</td>
</tr>
<tr>
<td>80</td>
<td>284</td>
<td>0.28</td>
</tr>
<tr>
<td>100</td>
<td>365</td>
<td>0.27</td>
</tr>
<tr>
<td>105</td>
<td>403</td>
<td>0.26</td>
</tr>
</tbody>
</table>

A 151-hour constant-rate pumping test was conducted by D.C. Drilling from October 24 to October 30, 1995. The pumping rate was 79.5 gpm and the drawdown at the end of the test was 450 feet. The specific capacity from the end of the test was 0.18 gpm/ft. The well recovered to 95.4 percent of drawdown after 11,500 minutes of recovery time. An estimate of the aquifer transmissivity, using the method developed by Driscoll (1986), is 229 gpd/ft using the drawdown data and 244 gallons per day per foot (gpd/ft) using the recovery data.

After re-installing the pump and motor in Well No. 6, WESTON conducted a pumping test on the well on January 18-19, 2011. Water levels in the well were measured using an airline and flow rates were measured with a two-inch totalizing flow meter. Rates were controlled with a 2-inch ball valve. The well was pumping tested at a rate of 80 gpm for 24.75 hours. The drawdown in the well at the end of the test was 368 feet, resulting in a pumping water level of 679 feet. The specific capacity of the well, based on data from the 2011 pumping test, was calculated at 0.22 gpm/foot of drawdown. The specific capacity from the 1995 test at approximately the same elapsed time was 0.21 gpm/ft.

Figure 4-19 provides a time-drawdown plot of the constant-rate pumping test data from Well No. 6 using the method developed by Cooper and Jacob (1946). The aquifer’s transmissivity surrounding Well No. 6, as determined from the drawdown data, is 315 gpd/ft.
Figure 4-19
Rolling Hills Well No. 6
Time Drawdown Plot (January 18 - 19, 2011)

Q = 80 GPM
T = 315 GPD/FT
The transmissivity value is similar to the value computed for the pumping test conducted on the well in 1995. A straight-line extension of the drawdown data indicates that Well No. 6 could pump at a rate of 80 gpm continually for a period of approximately 14 days before drawing the pumping water level to within 25 feet of the pump intake.

At the conclusion of the pumping test, recovery data were collected from Well No. 6 for 28 hours. The residual drawdown at the end of recovery data collection was 26.6 feet, which equals seven percent of the total drawdown. The recovery data are plotted on Figure 4-20 using the method developed by Cooper and Jacob (1946). The recovery data yield an aquifer transmissivity of 270 gpd/ft, which is similar to the value determined from the drawdown data. Water levels were observed in Well No. 4 during the Well No. 6 pumping test. Cyclical pumping of Well No. 5, which was required to keep the tank full, prevented the collection of meaningful data. No indication of interference from Well No. 6 on Well No. 4 was observed.

**Water Level Trends.** Tracking of water levels and water production rates can be valuable in assessing the sustainability of an aquifer in the vicinity of a well or wellfield. From October 1995, when the well was constructed, to January 2011 only three water level measurements are known to have been collected from Well No. 6. The water level on October 20, 1995 was 271.74 feet and on January 13, 2011 the water level in Well No. 6 was 310 feet. Well No. 6 is the lead well for the Rolling Hills water system and the well is pumped first when water is needed to fill the tank. Long-term pumping or seasonal water level fluctuations are the probable cause of the 38-foot decline in the water level since the well was completed. Monthly water level readings should be taken from Well No. 6 to facilitate tracking of water levels versus production.

**Well Production Capacity.** The 2011 pumping testing of No. 6 resulted in an estimated aquifer transmissivity of 270 gpd/ft and 315 gpd/ft from the pumping and recovery data, respectively. A straight-line extension of the drawdown data indicates that Well No. 6 could pump at a rate of 80 gpm continually for a period of approximately 14 days before drawing the pumping water level to within 25 feet of the pump intake.
Figure 4-20
Rolling Hills Well No. 6
Drawdown Recovery Plot (January 19 - 20, 2010)

T = 270 GPD/FT

Q = 80 GPM
The Jacob Equation was used to estimate the drawdown in Well No. 6 over an extended pumping period. The inputs for the analysis are as follows:

- Varied pumping rates;
- Average aquifer transmissivity of 270 gpd/ft, the transmissivity value from the 2011 pumping test recovery data;
- An assumed aquifer coefficient of storage of $5.8 \times 10^{-3}$ from the observation data from Well No. 4; and
- A pumping duration of 1, 5, and 10 years.

For the purposes of this analysis it is assumed that the available drawdown in Well No. 6 is equal to 448 feet, the difference between the static water level of 310 feet and the pump setting of 783 feet, less a reserve of 25 feet for pump submergence. The results of the analysis are summarized in Table 4-18. The Jacob Equation analysis predicts that Well No. 6 could sustain an average pumping rate of 60 gpm for a 10-year period. The analysis assumes that there is no interference from Well Nos. 4 and 5.

Table 4-18
Well No. 6 Predicted Drawdowns and Pumping Water Levels

<table>
<thead>
<tr>
<th>Time</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 40 gpm</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 50 gpm</th>
<th>Drawdown/Pumping Water Level at average pumping rate of 60 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Year</td>
<td>262 feet / 572 feet</td>
<td>328 feet / 638 feet</td>
<td>393 feet / 703 feet</td>
</tr>
<tr>
<td>5 Years</td>
<td>290 feet / 600 feet</td>
<td>362 feet / 672 feet</td>
<td>434 feet / 744 feet</td>
</tr>
<tr>
<td>10 Years</td>
<td>301 feet / 611 feet</td>
<td>377 feet / 687 feet</td>
<td>452 feet / 762 feet</td>
</tr>
</tbody>
</table>
Water Quality. Well No. 6 was sampled for the full suite of midpoint and endpoint water quality samples required by the WWDC during pumping testing in October 1995. As shown in Table 4-8, concentrations of all secondary drinking water constituents were below the water quality standards with the exception of turbidity, iron, and manganese. Elevated levels of these constituents are common in groundwater developed from the Lance Creek Formation in the Rolling Hills area.

Water samples were collected from Well No. 6 by WESTON on January 19, 2011 and submitted to Energy Laboratories in Casper, Wyoming. The results and the EPA standard for each constituent are summarized in Table 4-3. Copies of the laboratory reports are provided in Appendix B. Similar to the first sampling round in 1995, the results indicate that the water developed by Well No. 6 meets the EPA primary and secondary standards for the constituents analyzed, with the exception of manganese. The iron concentration decreased from the 1995 level of 0.67 mg/L to 0.10 mg/L in 2011.

Conclusions and Recommendations. Well No. 6 is permitted and equipped to pump 80 gpm. Analysis of pumping test data indicates that the long-term pumping capacity of the well is 60 gpm. The water level in the well should be measured and recorded at least monthly using the airline that is in the well. Routine comparison of the static and pumping water levels, coupled with the production data will facilitate the identification of trends in well performance. In accordance with the SEO permit conditions, water level data and production data should be reported to the SEO in an annual report.

Well No. 6 is in good condition, with the exception of some well screens exhibiting a degree of plugging. However, the plugging of the screens does not appear to have affected the performance of the well since the specific capacity is the same as when the well was drilled.

The most recent Rolling Hills water system sanitary survey, conducted on September 30, 2010, made note that the Well No. 6 well casing does not extend up at least 18 inches above grade. The sanitary survey indicates that the casing should be extended upward. Because the wellhead completion is a pitless adaptor, which can be difficult to modify and still maintain operational integrity, it may be easier to regrade the site surrounding the well to achieve the desired clearance. Care should be taken to ensure that the ground surface slopes away from the well to
prevent surface water from moving to the well. Also, care should be taken during regrading to prevent wind erosion of the sand dune deposits which are naturally stabilized by vegetation.

**Wellfield Summary**

The Town of Rolling Hills obtains water from five water supply wells. Well No. 1 is currently not used for drinking water purposes because of water quality issues. Well No. 2 is pumped during the summer months to meet water supply needs during high demand periods. Well Nos. 4, 5, and 6 are the primary wells in the water system and are used throughout the year to meet water supply demands. Overall, the physical condition of the wells is good. The wells do exhibit mineral and biological encrustation, but pumping test results indicate that the encrustation has not diminished the production capacities of the wells. Down-hole video inspection of the wells did not reveal any indication that the wells are in danger of physical failure; however, routine replacement of the drop pipe and pump cable will be necessary in the future.

The overall quality of water produced from the wells, with the exception of Well No. 1, is good. However, elevated iron and manganese concentrations can cause problems with staining. WESTON recommends that Well No. 1 not be used for drinking water unless necessary because of the elevated TDS, iron, and manganese concentrations. The construction methods used for the wells, coupled with the low permeability of the sandstones in the Lance Formation appears to have led to the production of fine-grained materials. In 2002 approximately six inches of silt were removed from the north tank. The silt is entrained in water from the wells, which is often exacerbated when pumping water levels drop. If the depth of silt in the tank exceeds the height of the silt trap in the floor of the tank, then the silt will move into the distribution system. The movement of silt into the distribution system could be the cause of turbid water that has been periodically reported by residents.

Analysis of the wells and the pumping test data was used to predict the production capacity of the Rolling Hills wells. The results of the analysis is summarized in Table 4-19. The total source capacity of the wells is estimated to be 170 gpm during the summer months when Well No. 2 is in operation. The capacity of the wells is greater than the estimated average day demand of 40 gpm and the maximum day demand estimate of 120 gpm.
Table 4-19
Rolling Hills Wellfield Summary

<table>
<thead>
<tr>
<th>Well No.</th>
<th>Static Water Level (feet)</th>
<th>Pump Setting (feet)</th>
<th>Available Drawdown^ (feet)</th>
<th>Permitted Well Yield (gpm)</th>
<th>Current Well Yield (gpm)</th>
<th>Predicted Maximum Well Yield (10 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>210</td>
<td>672</td>
<td>437</td>
<td>50</td>
<td>90</td>
<td>90 (3 days) 50 (180 days)</td>
</tr>
<tr>
<td>2</td>
<td>127</td>
<td>932</td>
<td>780</td>
<td>75</td>
<td>75</td>
<td>60 (180 days)</td>
</tr>
<tr>
<td>4</td>
<td>373</td>
<td>935</td>
<td>537</td>
<td>75</td>
<td>60 (Test)</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>325</td>
<td>741</td>
<td>391</td>
<td>75</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>310</td>
<td>783</td>
<td>448</td>
<td>80</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>355</td>
<td>371</td>
<td>170*</td>
</tr>
</tbody>
</table>

^ Available drawdown equal to pump setting minus static water level and 25 feet for pump submergence.
* Assumes Well No. 1 not pumped into system and Well Nos. 4 and 5 pumped at a combined rate of 50 gpm.

Pumphouse Controls

The pump house controls in the northern pump house have undergone many modifications since the facility was first constructed. Several items in the pump control panels need attention to provide adequate protection for the well pump motors. When the service disconnect on the Well No. 4 panel is turned to the “off” position, it shuts off all three of the well pump panels. It appears that the single lightning arrestor on the Well No. 4 panel is the only lightning protection for the wells. The panels should be rewired so that each of the three well panels have individual lightning protection. The Well No. 4 panel has a 777 Motor Saver, but it has been bypassed. A new Franklin Submonitor could be installed for $1,500. The Submonitor will provide protection for the pump and a lightning arrestor is provided with the Submonitor. The heaters in the Well No. 4 panel are not the proper heaters. Installation of the correct heaters will cost approximately $150. The Well No. 5 panel has a Subtrol that has been bypassed. A new Franklin Submonitor should be installed, along with new, properly-sized
heaters. The estimated cost for these improvements is $1,650. The 777 Motor Saver in the Well No. 6 panel has been bypassed and should be replaced with a Franklin Submonitor, at a cost of approximately $1,650.

**Recommended Improvements and Cost Estimates**

As presented in the well evaluations, there are repairs and improvements that should be performed on some of the Rolling Hills wells. This section summarizes the improvements and repairs and provides cost estimates.

Well No. 1 needs to have a new well seal installed on the top of the casing and have a proper vent installed in the wellhead. A commercial well seal that will fit the 7-inch casing and allow the 2-inch pump column to pass through will cost approximately $55. To install the well seal, the pump column will have to be lifted and set in slips to facilitate passage of the top of the pump column, air lines, and pump cable through the seal. The total estimated cost for installation of the well seal and vent is $1,500. It is estimated that the pump column in Well No. 1 will have to be replaced once every five years if the well remains in use. The 23 joints that are submerged will cost approximately $6.00 per foot for pipe, for a materials cost of $500. Mobilization and rig time for pulling the pumping equipment could cost up to $2,500 for a total cost of $3,000.

Well No. 2 should have a fence installed around the wellhead per the sanitary survey. The fenced area should be large enough to accommodate a pump pulling unit inside the fenced area with room to lay down the 21-to 25-foot long pump column and spool the pump cable. A fenced area similar to that found at Well No. 6 would be adequate. A 50 foot by 100 foot fence with a gate will cost approximately $10,000. Replacement of the 3-inch drop pipe in Well No. 2 with new galvanized drop pipe will cost $12.00 per foot for pipe. If the entire string of drop pipe is replaced the cost for materials will be $11,250 plus $2,500 for mobilization and rig time. It is recommended that when the pump column and/or pump is replaced that the pump cable be replaced with #2 AWG armored cable to prevent rubbing of the cable and short circuits. The cost for the armored pump cable is $18.00 per foot at current copper prices. The total cost for the pump cable, with banding and splicing is approximately $17,300. The total replacement costs for the pump column and cable is $31,050.
Well No. 4 will need new pump cable the next time the pump is replaced. The #4 AWG armored cable will cost $14.25 per foot at current copper prices. Replacing 940 feet of pump cable, with $2,500 for mobilization and rig time, and splicing and banding will cost approximately $16,000. The flow meter on Well No. 4 needs to be replaced but the meter pit is not large enough to accommodate a two inch meter, reducers, and a check valve while maintaining adequate distances of straight pipe to ensure meter accuracy. Additionally, there is no means for pumping water from Well No. 4 to waste. The existing meter pit and equipment should be replaced with a new, larger vault. Installation of the vault will require excavating the existing line and replacing the line towards the tank, which currently elbows down in the meter pit. The estimated cost for installing a new meter pit, with a two-inch blow-off assembly is $12,000.

The pump column in Well No. 5 will need to be replaced because it is being corroded at the threads. At least 11 joints of the 2 1/2-inch pump column will need to be replaced the next time the pump is pulled. The estimated costs for the pipe is $7.50 per foot for a total materials cost of $1,732, plus $2,500 for mobilization and rig time for a total cost of $4,232.

The sanitary survey indicated that there is an unused well north of Well No. 1. WESTON staff inspected the well and found that it is completed with 8-inch PVC. The estimated depth, which was determined using a sand line on the pump pulling unit, is 420 feet. WESTON was unable to locate any records on the well and it should be properly plugged and abandoned. Plugging the well using 3/8-inch bentonite chips or concrete will cost approximately $3,000.

**Well Siting Study**

While the existing wells meet the current average and maximum day demand, they will not meet the projected maximum day demand for the 20-year planning horizon. As part of this project, WESTON conducted a well siting study to determine the optimal location for a new water supply well capable of yielding approximately 150 to 200 gpm at a location near the new tank site in Section 16. To determine the potential for achieving this goal, WESTON reviewed the lithologic logs for the existing Rolling Hills wells. WESTON also accessed the oil and gas well data from the Wyoming Oil and Gas Conservation Commission (WOGCC) and the Wyoming State Engineer’s online database to determine whether any existing wells located
within the vicinity of the proposed location for the new well (Well No. 7) could provide useful information. In addition, WESTON reviewed the Well Field Expansion Study conducted by Wester-Wetstein for the Town of Rolling Hills and reported in a letter to the Mayor dated May 23, 2002 to further evaluate the proposed well locations presented in the 2002 study.

As discussed in previous sections of this report, the sand dunes that characterize the topography in the Rolling Hills area are underlain by the Tullock Member of the Fort Union Formation. Denson and Horn (1975) report that the Tullock Member is comprised of: “Interbedded sandstones, siltstones, shales, carbonaceous shales, and thin coal beds.” The lower Tullock Member of the Fort Union Formation is considered to be part of the Fox Hills/Lance Aquifer System by Feathers and others (1980). The thin, discontinuous sandstones in the Tullock Member yield water to domestic wells in the area. SEO records were obtained from the on-line water well database for wells in Sections 9, 15, and 16, as summarized in Table 4-20. With the exception of the Town of Rolling Hills wells, there are a total of 28 wells in the area with depths ranging from 90 to 440 feet, all of which are most likely completed in the Fort Union Formation. The yield of the wells ranges from 2 to 25 gpm, with an average yield of 12.5 gpm. Because these yields are significantly lower than desired for this project, it appears that a well completed in the upper portion of the Fort Union Formation in the vicinity of the proposed well site will not meet the Town’s goal. Based on the data found in the SEO well inventory, there are no wells completed below 440 feet in the area. As a result, the water bearing potential of the lower portion of the Fort Union Formation in the vicinity of the proposed well site is unknown.

The 2002 well siting study conducted by Wester-Wetstein proposed two well sites located approximately two to three miles northeast of Rolling Hills and a third site located approximately six miles northeast of Town. Given the considerable cost of constructing a pipeline to any of these proposed well sites weighed against the uncertainty of obtaining suitable quantities and quality of water from either the Fort Union or Lance Formations, WESTON has determined that a well location at the proposed tank site is just as likely to meet the needs of the town as any of the locations proposed in the 2002 study.
### Table 4-20
Cost Estimate for Drilling, Constructing and Testing
Rolling Hills Well No. 7

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Total Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization and Demobilization</td>
<td>1</td>
<td>L.S.</td>
<td>$30,000.00</td>
<td>$30,000.00</td>
</tr>
<tr>
<td>2</td>
<td>Drill for, Furnish, Install, and Cement</td>
<td>120</td>
<td>L.F.</td>
<td>$150.00</td>
<td>$18,000.00</td>
</tr>
<tr>
<td></td>
<td>12-inch Surface Casing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Drill 6 1/4-inch Diameter Hole</td>
<td>2,480</td>
<td>L.F.</td>
<td>$20.00</td>
<td>$49,600.00</td>
</tr>
<tr>
<td>4</td>
<td>Open Hole Geophysical Logging</td>
<td>1</td>
<td>L.S.</td>
<td>$7,500.00</td>
<td>$7,500.00</td>
</tr>
<tr>
<td>5</td>
<td>Ream to 11 5/8-inch Diameter Hole</td>
<td>2,480</td>
<td>L.F.</td>
<td>$32.00</td>
<td>$79,360.00</td>
</tr>
<tr>
<td>6</td>
<td>Furnish and Install 7 5/8-inch O.D. Steel Casing</td>
<td>2,300</td>
<td>L.F.</td>
<td>$10.00</td>
<td>$23,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Furnish and Install 7-inch Stainless Steel Well Screens</td>
<td>300</td>
<td>L.F.</td>
<td>$90.00</td>
<td>$27,000.00</td>
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<td>8</td>
<td>Furnish and Install Cement Seal</td>
<td>1</td>
<td>L.S.</td>
<td>$15,000.00</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>9</td>
<td>Furnish and Install Sand Pack</td>
<td>1</td>
<td>L.S.</td>
<td>$24,000.00</td>
<td>$24,000.00</td>
</tr>
<tr>
<td>10</td>
<td>Well Development and Rig Time</td>
<td>24</td>
<td>Hours</td>
<td>$375.00</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>11</td>
<td>Air Lift Development</td>
<td>36</td>
<td>Hours</td>
<td>$425.00</td>
<td>$15,300.00</td>
</tr>
<tr>
<td>12</td>
<td>Furnish, Install, and Remove Pump Testing Equipment</td>
<td>1</td>
<td>L.S.</td>
<td>$17,000.00</td>
<td>$17,000.00</td>
</tr>
<tr>
<td>13</td>
<td>Conduct Pump Test</td>
<td>176</td>
<td>Hours</td>
<td>$150.00</td>
<td>$26,400.00</td>
</tr>
<tr>
<td>14</td>
<td>Disinfect Well</td>
<td>1</td>
<td>L.S.</td>
<td>$2,500.00</td>
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</tr>
<tr>
<td>15</td>
<td>OPTION: Plug and Abandon Well</td>
<td>1</td>
<td>L.S.</td>
<td>$25,000.00</td>
<td>$25,000.00</td>
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**TOTAL ESTIMATE (Items 1-15)** $368,660.00
The Lance Formation was encountered at a depth of 190 feet in Well No. 6, which is located approximately 3,000 feet south of the proposed location for Well No. 7. Based on the measured dip of the top of the Lance Formation of 15 degrees and the distance between the two wells, it is estimated that the top of the Lance Formation will be encountered at a depth of about 1,000 feet at the proposed well site and the water bearing sandstones that yield water to Well No. 6 will lie at a depth of approximately 2,100 feet at the Well No. 7 site. This assessment assumes that the sandstone units within the Lance Formation are continuous between the two sites. However, because the sandstones lenses within the Lance Formation are by nature discontinuous, there is no way to accurately predict the presence or thickness of these units at the new well site.

The water quality of a well at the proposed location will most likely be similar to that of Well No. 6 which is characterized by elevated levels of iron and manganese. The levels of TDS, iron, and manganese in the proposed new well may be slightly higher than those encountered in Well No. 6 because the water bearing sandstones in the proposed new well are expected to be significantly deeper than in Well No. 6. Because the location of Well No. 7 is approximately 3,000 feet from Well No. 6 and Well No. 5, interference issues should be minimal.

Figure 4-21 is a proposed design diagram of Well No. 7. WESTON recommends drilling for and setting the surface casing to stabilize the borehole through unconsolidated deposits and then drilling a 6 ¼-inch diameter borehole. Geophysical logs can be run on the open borehole to determine the lithology and facilitate well design and screen placement. A cost estimate for drilling and testing Well No. 7 is presented in Table 4-21.
T.D. = 2,600 FEET

NOT TO SCALE

0 - 120 FEET: STEEL SURFACE CASING

0 - 2,090 FEET: CEMENT GROUT

+1.5 - 2,100 FEET: 7-INCH NOMINAL DIAMETER STEEL CASING

120 - 2,600 FEET: 10 1/2-INCH DIAMETER BOREHOLE

2,090 - 2,600 FEET: TREMIED SAND PACK

2,100 - 2,600 FEET: 0.015-INCH STAINLESS STEEL V-NOTCH SCREEN

2,600 FEET: STEEL PLATE
REFERENCES CITED


James M. Montgomery Consulting Engineers (JMM), 1989, Rolling Hills Groundwater Exploration Program, Phase I: Consultant’s Report Submitted to the Town of Rolling Hills and WWDC.

James M. Montgomery Consulting Engineers (JMM), 1990, Report of Drilling and Testing Rolling Hills Well No. 5: Consultant’s Report Submitted to the Town of Rolling Hills and WWDC.


This section of the study provides an overview of the operation of the Rolling Hills water system, primarily focusing on the operation and control of the supply and distribution system. The operational assessment of the distribution system is addressed in Section 7 – Hydraulic Analysis. In general, water is supplied from a series of five wells (only four are used for domestic consumption). Water is pumped from the wells into the adjacent water storage tanks; two pump stations supply water from the water storage tanks into the distribution system. At least one of the pump stations pumps water 24-hours-a-day to provide adequate operational pressures in the distribution system. This section details the control and operation of the wells, chlorination system, storage tanks and pump stations for the supply of water into the distribution system. This section also provides recommendations for improvements to the operation of the water system.

Overview
Source water for the Town of Rolling Hills is provided from four wells as detailed in Section 4 – Well Evaluation. The fifth well, Well No. 1, has high turbidity and total dissolved solids levels; it is only used to fill commercial haul trucks not intended for potable use. As detailed in Section 4, all four of the supply wells for the Town of Rolling Hills are drilled to depths ranging from 1,500 to 1,800 feet in depth and produce water from the Lance Creek Formation. The total long-term supply capacity from the four wells is summarized in Table 5-1 below. The parenthetic figure identifies the capacity of Well No. 2 for a 180-day period of sustained pumping. The other totals are projected long term (10 year) capacities for the wells.

<table>
<thead>
<tr>
<th>Well</th>
<th>Production Capacity (gpm)</th>
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<tbody>
<tr>
<td>Well No. 2</td>
<td>60 (180 days)</td>
</tr>
<tr>
<td>Well No. 4</td>
<td>25</td>
</tr>
<tr>
<td>Well No. 5</td>
<td>50</td>
</tr>
<tr>
<td>Well No. 6</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total Supply Capacity</strong></td>
<td><strong>170</strong>*</td>
</tr>
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</table>

*Assumes Well No. 1 not pumped into system and No. 4 and 5 pump at combined rate of 50 gpm.
Water from the wells is pumped into the adjacent water storage tanks. Water supplied from Well No. 2 is pumped into the southern water storage tank. Water supplied from Well No.’s 4, 5, and 6 is pumped into the northern storage tank. The water storage tanks supply water for the booster pumping stations which supply water into the distribution system. The pumps in both pump stations are controlled by pressure and motor frequency to maintain downstream pressures in the distribution system. The southern pump station (Pump Station No. 1) is equipped with two pumps; one pump has a variable frequency drive and the other pump is an older hydro-constant pump. The northern pump station (Pump Station No. 2) is equipped with three pumps: two pumps are equipped with variable frequency drives and the third pump (fire pump) is equipped with a hydro-constant drive.

Both water storage tanks are equipped with liquid hypochlorite chlorination systems which draw water from pump station discharge piping, add hypochlorite solution with a chemical feed pump and then pump the chlorine solution into the water storage tanks. The chlorination system is manually controlled by changing the speed of the hypochlorite feed pump. The system operator checks the chlorine residual in the system at least once per day and adjusts the chlorine feed pump as necessary to maintain a proper residual chlorine level in the tanks.

Figure 5-1 on the following page provides a water supply system schematic and hydraulic profile for the Rolling Hills water system. The figure identifies all of the critical system components and the connectivity of the water system along with the capacities and elevations of the water storage tanks. The approximate elevations of the system components are identified along with the schematic piping of the system. The well depths are not accurately shown based upon the scale of the figure. The dashed line at the top of the figure identifies the hydraulic grade that is maintained in the system by the booster pumping stations.

**Well System Operation**

As described above, Well No. 2 supplies water into the southern storage tank and Well No.s 4, 5 and 6 supply water into the northern storage tank. Well operation is controlled by a local supervisory control and data acquisition (SCADA) system. Pressure transducers in the water storage tanks monitored by the SCADA system allow the individual wells to be started to maintain water levels in the water storage tanks. As the tank levels drop the wells are
Figure 5-1
Town of Rolling Hills Water Supply System Schematic & Hydraulic Profile

LEGEND:
- Flow Direction
- Cl₂ Point of Chlorination
- Water Storage Tank
- Pump/Cl₂ Building
- M Water Meter
- M Elevation in Feet

Town of Rolling Hills Distribution System
Elevation 5310 to 5390

Well #1
Well #2
Well #4
Well #6

Pump Station No. 1
Pump Station No. 2

South Storage Tank
North Storage Tank

98,000 gal.
Base = 5401
OF = 5439

230,000 gal.
Base = 5394
OF = 5438

Pump Station Hydraulic Grade = 5529 feet
energized to start to fill the water storage tanks. When the tanks are full the wells are directed to shut-down by the SCADA system. Each well/tank/booster site is equipped with a local SCADA system to control the operation of the wells, tank levels and booster station operation. The SCADA systems provide local control and operation of each system (well(s), tank and booster pumps); the two systems do not communicate with each other. None of the wells are equipped with level transducers to monitor water levels in the wells and shut down well operation when water levels drop in the wells. Additionally, as identified in Section 4, several of the motor savers, heaters and starters are inoperable or improperly sized for the system. There is no lightning or transient voltage protection equipment operable on any of the wells in the system.

**Pump Station Operation**

It is hypothesized that the original system (Well No. 1 and the southern water storage tank) was initially installed to supply water to the Rolling Hills development by gravity. Well No. 1 would pump water into the adjacent storage tank and the tank would supply water to the downstream customers. Pressure in the system was maintained by gravity based upon the elevation of the stored water in the tank. As the community grew and houses were constructed at higher elevations near the southern tank, the hydro-constant pump station was installed to improve operational pressures in the distribution system.

The current booster station operation consists of two pumps at the southern pump station and three pumps at the northern pump station. A summary of the pump station equipment (motor horsepower, design flow rate and total dynamic head) is provided in Table 5-2 on the following page. Piping and pumping schematics for the tanks and booster stations are provided on Figures 5-2 through 5-6.

The SCADA systems at each site are programmed to maintain constant discharge pressures immediately downstream of the pump stations. The discharge pressure is set on the SCADA system (approximately 58 psi) and the VFD’s ramp the pump speeds to maintain a constant discharge pressure. If the discharge pressure falls below a set point, the hydro-constant pumps are energized to start. In general, the hydro-constant start pressures are set at approximately 30 psi; these pumps are only energized when system demands exceed normal flows and pressures
dramatically drop in the system, typically caused from flushing or fire flow activities in the system. The VFD’s control pump speed solely based upon discharge pressure. If one VFD is at or near its peak (60 Hz), the second pump is energized to start and help maintain downstream pressure. It was noted during system operational testing that the start and stop points for the second pump in pump station no. 2 overlapped the start and stop points for the first pump. Once the second pump started, it would not stop and both pumps were simultaneously running when observed. The pump start and stop frequencies were adjusted on the SCADA system and the system then began to operate in a more traditional and efficient manner. One pump would supply the system; when it reached its maximum speed and could not supply the required discharge pressure the second pump would start. When the frequency or speed for the second pump later dropped to a set point, the pump would stop, and pump no. 1 would again meet the system demands.

<table>
<thead>
<tr>
<th>Pump No.</th>
<th>Flow (gpm)</th>
<th>Total Dynamic Head (ft)</th>
<th>HP</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump No. 1</td>
<td>240</td>
<td>160</td>
<td>15</td>
<td>VFD</td>
</tr>
<tr>
<td>Pump No. 2</td>
<td>250</td>
<td>100</td>
<td>10</td>
<td>Hydro-constant</td>
</tr>
</tbody>
</table>

It is very challenging to operate pump stations solely with speed and pressure controls. Neither pump station is equipped with a meter on the discharge piping to monitor the water supplied into the distribution system. Metering discharge from pump stations is required by WDEQ and is essential for the monitoring and control of the system. Additionally, meters would greatly aid in the operation and control of the pump stations. Discharge flow rates would provide essential start and stop levels for the secondary pumps and would ensure that the pumps only operate when necessary reducing electrical demand and wear on rotational equipment.
FIGURE 5-2
Pump House #1 Schematic
Scale: 1" = 5'
FIGURE 5-3
Pump House #2 Schematic
Scale: 1" = 5'

- Chlorine Solution Feed to Tank
- Hypochlorite Tank & Pump
- Electrical & SCADA Panels
- Pump 1
- Pump 2
- Pump 3
- From Tank
- To Distribution System
Seasonal Operation
The Town of Rolling Hills only operates the southern tank, pump station and Well No. 2 during the summer when demands peak. In early September, the Town drains the southern tank and shuts down the southern supply system. During the months of September through June, the northern supply system (Well No.’s 4, 5 and 6, the northern tank and booster station) supplies all of the water for the Town of Rolling Hills. In late June, the Town chlorinates and fills the southern water storage tank and energizes the southern pump station. During the peak demand periods (late June through early September), the two pump stations operate in parallel to supply the system.

Recommended Operational Improvements
During the completion of the study several items were identified which will improve the operation and control of the system. Many of the proposed operational improvements addressed below assume that the Town maintains the current system operation. If the Town chooses to implement the proposed improvements recommended in Section 8 of this study, some of the recommended improvements (i.e., pump station improvements) will not be necessary. The proposed operational and maintenance recommendations are summarized below:

- **Well Pump Equipment** – None of the wells are equipped with level transducers. Monitoring water levels in the wells is essential for the operation of the system and the assessment of the long-term capacity of the wells. Well transducers and a SCADA monitoring and recording system are recommended to protect the well pumps and monitor the water levels in the wells and aquifer. The existing pump starters, motor savers and heaters are all fairly old and in various states of operation and repair. New motor savers, pump starters (as necessary) and transient voltage surge suppression equipment should be installed on all of the pumps. The meter on Well No. 4 is inaccurate and does not have a remote readout. All of the meters on the pumps should be improved to include SCADA recording of flow rates and flow totalizers. All of the wells, especially, Well No. 2, should be equipped with the necessary bypass pumping piping and valving to allow the pumps to be discharged to daylight periodically for
cleaning and pump testing. Wells No. 4 and No. 2 are the primary wells which need some minor piping modifications to allow for pumping to daylight.

- **Pump Station Equipment** – As detailed above, the pump stations are operated based upon pressure set-points and VFD control of the primary supply pumps. In general, with the exception of the VFD’s, the existing pumps and starters are fairly old. The Town does a good job of maintaining the pump equipment but the equipment is not properly designed. This is evidenced by the dramatically different total dynamic head (TDH) ratings for the various pumps. Both of the hydro-constant pumps have dramatically lower TDH than the primary pumps (60 to 100 feet). The pump design of the booster pumps should be closely reviewed and pumps should be sized to meet the system demands and work synchronously. During observation of the northern pump station operation when both pumps were running, it was estimated that Pump No. 2 was supplying all of the water into the system and Pump No. 1 was idling at a very low frequency. Long-term operation of VFD’s at very low frequencies produces a lot of heat in the VFD’s. The operation at low frequencies may also produce pump rates below the minimum levels required to cool and lubricate the pumps. This method of operation will undoubtedly reduce pump and VFD life expectancy and result in premature failures of the equipment. In addition to the pump equipment, meters on the discharge of the pump stations should be installed to better control the system operation. The suction and discharge piping on both stations includes a lot of unnecessary equipment; e.g., altitude valves connected to the discharge piping on both pump stations. The suction and discharge piping should be simplified and re-plumbed to provide consistent and logical piping with a low flow bypass equipped with a single 2-inch pressure relief valve. Simplifications of the pump station operation and piping would results in a more reliable and easily maintained pump station.

- **SCADA System Remote Monitoring** – With a total of four well pumps, five booster pumps, two chlorination systems and two water storage tanks in operation, remote monitoring and alarming is necessary for the efficient operation of the system. Radios should be installed in both pump stations to allow the pump stations to communicate and coordinate operation. Additionally, a spread spectrum radio system or a virtual
private network (VPN) radio system should be installed to allow for the remote
operation and monitoring of the system. The system operators make several trips to the
pump stations every day to monitor the operation. Remote monitoring of the system
coupled with an alarm system would make the operation of the system more efficient
and would warn the operators in the event of a system failure (booster pump, well pump
chlorination system, etc.).

- **Chlorination Equipment** – As detailed above, the existing chlorination system consists
  of tanks of hypochlorite solution and manually controlled chemical feed pumps
discharging highly chlorinated water into the tanks with little mixing. The existing
system is a hazard to operate with exposure to large volumes of liquid hypochlorite.
Additionally, the manual control of the system coupled with limited mixing in the water
storage tanks results in inconsistent chlorine residuals. As demands change in the
system and well pumps cycle on and off, the chlorination system injects a set amount of
chlorine solution into the tanks. New chlorination systems are recommended at both
tank sites. Tablet chlorination systems are very easy to operate and control. The
discharge meters for each well pump would communicate with the chlorinator at each
site and would inject a variable rate of chlorine solution into the well pump discharge
piping based upon the flow rate at the discharge meters. The tablet chlorination systems
are efficient and provide consistent chlorine residual to meet the changing demands in
the distribution system.

- **Valve Exercising and Cleaning** – during the completion of the study, every valve in the
  system was inspected and operated to verify the proper operation and position of the
  valve (i.e., open or closed). Several of the valve boxes had to be cleaned in order to
  access the valve operating nut and verify the operation and position. Access and
  operation of water valves is imperative for the operation and control of a water system
  especially when the Town experiences a leak and needs to isolate a section of the water
  system. It is recommended that the Town develop an exercising program to access and
  operate every valve in the system at least once per year. The Town should develop a
  form for reporting the proper operation and identifying malfunctions with the valves.
The operations form could be placed into the GIS database for the system to develop a
historical operational database to monitor and schedule valve maintenance and replacement.

- **Fire Hydrant Flushing** – the Town currently does not operate and flush the fire hydrants in the system on a regular basis. During the completion of this study, approximately 20-percent of the hydrants were operated and flow rates, static and residual pressures were recorded. During the flow testing, very dirty water was encountered at nearly all of the fire hydrants operated. It is recommended that the Town formalize the flushing and maintenance program for fire hydrants in the system. The fire hydrants need to be operated to verify the proper operation and to maintain water quality in the system. Water quality flushing should occur at least twice per year to flush all of the water mains in the system. Every hydrant should be operated at least once per year to verify the proper operation and identify maintenance and repair needs. The Town should develop a form for reporting the proper operation and identifying malfunctions with the fire hydrants. The operations form could be placed into the GIS database for the system to develop a historical operational database to monitor and schedule fire hydrant maintenance and replacement.

- **Tank Inspection** – the Town has performed regular inspection of their water storage tanks over the past ten years. The Town is encouraged to continue with the inspection program and is required by EPA to inspect the water storage tanks at least once every three years. The easiest and most thorough way to inspect water storage tanks is with divers. There are several companies in the region that are certified to dive, inspect and repair tanks while they are in operation. The inspection companies provide a video and paper log of their findings which can be incorporated into the GIS database to develop an operational log of tank structure and coating condition.

- **Unmetered Service Connections** – the Town recently installed meters on the Town Park, the Fire Hall, and the pathway irrigation system. However, the Town Hall and Town Shop are currently not metered. The Town should attempt to meter all of the water users and track flushing water to accurately account for produced water versus billed water usage.
• **Operation and Maintenance Manual** – the Town does not appear to have operation and maintenance manuals for any of the components in their water system. It is recommended that the Town develop a comprehensive operations and maintenance manual for the water system including specific references to the individual pieces of equipment (pump stations, well pumps, chlorination systems, etc.). The items identified in this section of the report should be included to develop a database to document and record the operation and maintenance of the system.
Geographic Information System (GIS) Development

This section of the study defines the creation the Geographic Information System (GIS) database for the Town of Rolling Hills Master Plan. The GIS database provides high quality aerial imagery with contours and a detailed database for all of the water system components. The GIS database is a tool to be used by the Town for viewing and analyzing their water system. The GIS database is also a valuable tool for documenting the ongoing maintenance and operation of the water system. The GIS database includes all of the water features in the system (valves, hydrants, tanks, wells, etc.) with specific information regarding each feature including age, materials of construction, size, date installed and references to design drawings for the components. This section details the development of the GIS database; however, the true product of the Master Plan is the completed and ongoing digital GIS database tool for operating, maintaining and referencing the water system.

Overview

The following components are included in the GIS database to provide the Town of Rolling Hills with a solid base of geospatial data for the water system and to provide a platform to further develop the GIS database in other areas of critical infrastructure management. The components included in the GIS database include:

1. **Geodatabase** – A geodatabase is a database specifically designed to support the collection, maintenance, analysis and visualization of spatial data. The geodatabase developed for this project was designed to store water system, topographic, cadastral and transportation features and to support the implementation of water system improvements in the Town of Rolling Hills that were identified in the Master Plan document.

2. **Contours** – topographic data provide a highly accurate representation of relief for a given area. These data were developed and incorporated in the geodatabase design to identify opportunities and constraints for further development of the overall water transmission and distribution system.
3. **Aerial Photography** – high spatial and temporal accuracy aerial imagery provides a consistent backdrop for the production of mapping products as well as serving as a valuable resource for further spatial data development. Aerial imagery was acquired specifically for the study area.

These three components form the foundation of the GIS system that will provide the Town of Rolling Hills and the WWDC with a living extension to the Level I Master Plan. Presented in the following sections, are detailed breakdowns of the development of each component.

**Geodatabase Development**

Geodatabase development began with a preliminary geodatabase schema outlining the feature classes, attributes, and domains. This initial schema was followed by several iterations that culminated in a final, Town of Rolling Hills, geodatabase schema detailed in Figure 6-1. The final schema incorporates advanced functionality, while still maintaining a useful, efficient and interoperable mechanism for the distribution and maintenance of the water system feature developed during the study.

Construction of the geodatabase deliverable began after receipt of the hydraulic model exports for the water system. These initial data were received in shapefile format and contained attributes from the *WaterGems* software. Prior to use, these data were visually inspected for completeness and assigned the NAD83(86) Wyoming State Plane East Zone (4901) projection. Following inspection and projection assignment, each shapefile’s structure was modified to match the structure needed for importation into the project geodatabase. These modifications involved the creation of new fields within each shapefile with the names and data types called for in the final geodatabase schema. Once the new fields were created, each was populated with the values found in the raw *WaterGems* export fields. For attributes using domain values, the raw *WaterGems* export field values were translated to their corresponding domain value. Examples of these translations can be seen with pipe materials. Material types exported from *WaterGems* were represented by text fields. A text value, such as “PVC” was translated to the corresponding domain value of “0” and entered into the new attribute fields for importation.
Rolling Hills WWDC - 14091

Geodatabase Version 1.0 - 'utility_water' feature dataset

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<tr>
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Legend

- **Feature Class Name**
- **Attribute Name**
- **Domain Name**

### Valves

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<tr>
<td>1</td>
<td>Tyler</td>
</tr>
<tr>
<td>2</td>
<td>Dresser</td>
</tr>
<tr>
<td>3</td>
<td>American Brass</td>
</tr>
<tr>
<td>4</td>
<td>Mueller Co.</td>
</tr>
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<td>5</td>
<td>Pacific States</td>
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<tr>
<td>6</td>
<td>MSCPS Co.</td>
</tr>
<tr>
<td>7</td>
<td>Fire Society</td>
</tr>
<tr>
<td>8</td>
<td>Kirksville 150</td>
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<td>9</td>
<td>TBD</td>
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### Hydrants

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<td>Tyler</td>
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<td>3</td>
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<td>8</td>
<td>Kirksville 150</td>
</tr>
<tr>
<td>9</td>
<td>TBD</td>
</tr>
</tbody>
</table>
Following modification, the shapefiles were imported into personal geodatabase feature classes using ArcInfo data import tools. After importation, each feature class was inspected to ensure all records were correctly loaded and that all significant digits were preserved. The completely loaded water system features were then used to construct a topology feature class within the geodatabase. This topology feature class was used to inspect the geometric integrity of the features. Errors in the topological relationships between the system features were identified and corrected. Once all topological errors were addressed each feature class was added to an ArcMap workspace where location attributes were added for each record.

Following the completion of location attributes was metadata production. All geospatial datasets are constructed with accompanying eXtensible Markup Language (XML) files that contain information on how a particular dataset was developed. The inclusion of high quality and complete metadata is critical to the long-term utility of a given dataset, as metadata describes how these data were constructed and what methods were employed in its development. All datasets prepared were given complete metadata. These metadata include much of the narrative here as well as additional information regarding domain translations. The importance of domain translations in the metadata cannot be understated, as feature classes exported from a geodatabase to shapefile format do not retain the domain values. An example of this would again be found with pipe materials. In the geodatabase ‘PVC’ is displayed to the user as text, but the value ‘0’ is stored in the pipe material attribute field for that record. Without metadata, a third party user given a shapefile export from the geodatabase would see the integers in the pipe material attributes and think that an error had been made and attempt to recreate the materials in a new field. This would be an unnecessary manipulation of the dataset that the metadata seeks to circumvent.

**Aerial Photography/Contours**

Acquisition of aerial imagery commenced during the fall of 2010. Fugro Horizons collected imagery utilizing an analogue camera system at a flying height appropriate for compiling data at a final mapping scale of 1” = 100’. The following ground control was established before the flight:

- Horizontal Datum: North American Datum 1983 / NAD83(86)
• Vertical Datum: North American Vertical Datum 1988 / NAVD88(Geoid09)

The coordinate system utilized for the flight was Wyoming State Plane East Zone (4901) and the unit of measure was the US Survey Foot. The final orthophoto files were high accuracy 6-inch resolution color imagery “.tif” format files. An additional Enhanced Compression Wavelet (.ecw) file was also created. The “.ecw” file combines the eight “.tif” files into one “.ecw” file. The “.ecw” file is a compressed image file with minimal quality loss allowing for a quicker rendering of the image.

The Digital Terrain Model (DTM) was created with the use of LiDAR. LiDAR is an acronym for “Light Detection and Ranging.” It is an airborne technology that uses a laser to send bursts of energy at an object (i.e., the ground). The return signal from the initial burst is used to calculate distances from the aircraft to the ground. These measured distances are then resolved into elevations and referenced to a vertical datum. The DTM, topographic, and planimetric data were delivered in AutoCAD “.dwg” format. The DTM was converted into 2-foot contours and the “.dwg” features were exported to shapefiles. The Shapefiles were then imported into the appropriate feature classes in the project geodatabase.

Conclusion
A detailed account of the development and acquisition of GIS materials for the Town of Rolling Hills Level I Master Plan has been provided in this section. Slight alterations aside the proceeding narrative has been maintained throughout the GIS development process and will continue to be maintained until final delivery of these materials to the Town of Rolling Hills and the WWDC. Through a deliberate and thoughtful process, a comprehensive set of GIS deliverables have been provided that work efficiently and effectively with the Master Plan Level I document. These deliverables will provide the Town of Rolling Hills and the WWDC with a living extension of the master plan document that will assist these organizations as they implement improvement schedules over the lifespan of the Master Plan and beyond.
Analysis of Water System

This section of the Rolling Hills Level I Master Plan provides a detailed assessment of the Town of Rolling Hill’s water system. This section of the study is divided into two components:

- **Hydraulic Model Development** – defines the process for performing the hydraulic analysis of the water system including a detailed description of the hydraulic model developed to analyze the performance of the system, the methodology for developing the hydraulic model, and the methods used to verify and calibrate the hydraulic model.

- **Analysis of Water System** - addresses the performance of the water system and its ability to meet current and projected development in the service area for the Town of Rolling Hills. This section addresses the water storage capacity, distribution system capacity, distribution system’s fire flow capacity, and the current condition of the distribution system.

Hydraulic Model Development

The Town of Rolling Hills hydraulic water model is a powerful tool for evaluating the Town’s water system. Utilizing the *WaterCAD* hydraulic water model and *WaterGEMS*, the Geographic Interface System (GIS) companion to *WaterCAD*, the model can accurately evaluate the performance of the water system by examining system pressures, distribution pipeline flows, fire flows, water storage tank balance, and overall system operation.

Developing the hydraulic water model included three key steps: identifying and modeling the water system infrastructure, assigning demands throughout the system, and verifying and calibrating the model. Once the 2010 hydraulic water model was developed, it was expanded to include an analysis of the ultimate capacity of the system with all of the areas identified in the growth areas fully developed.

*WaterCAD/WaterGEMS*

The hydraulic model developed for the Town of Rolling Hills 2011 Master Plan utilizes *WaterCAD* hydraulic modeling software developed by Haestad Methods, Inc. and currently sold and supported by Bentley Systems, Incorporated. *WaterCAD* can be operated as a stand-alone...
hydraulic modeling engine or it can operate inside of MicroStation or AutoCAD platforms; utilizing the powerful drawing tools of the CAD platforms to graphically represent the water system infrastructure. *WaterCAD* also operates seamlessly inside of ESRI’s GIS software utilizing the companion software *WaterGEMS*. This interface allows for the integration of GIS components and information into the hydraulic model.

*WaterCAD* utilizes either the Hazen and Williams or Darcy-Weisbach equations for analyzing and solving the pipe network system. *WaterCAD* utilizes a “link-node” description of a water system to develop a detailed layout of the water system. The links represent pipelines and, in general, the nodes represent junctions along the pipelines or water storage tanks. Links can also include control valves (pressure sustaining, pressure reducing, altitude, etc.). Nodes occur at valves, fire hydrants, tees, crosses, transitions, and at water storage facilities (tanks or reservoirs). Nodes have defined elevations, and demands in the system are identified at nodes (i.e., water usage at that point); these demands can be associated with residential or commercial use or fire flow demands. Figure 7-1 illustrates a generic link node description for basic water system components. The Town of Rolling Hills hydraulic model includes every pipe, isolation valve, and fire hydrant in the water system.

![Figure 7-1 Link-Node Description](image)

**Water System Infrastructure**

In order to develop a comprehensive hydraulic model to represent the operation of the Town of Rolling Hill’s water system, all of the components of the water system had to be incorporated into the model. The water system infrastructure includes all waterlines, pump stations, water storage tanks, valves, fire hydrants, and air release valves. As part of the Master Plan all of the valves, fire hydrants, tanks, wells, pump stations, blow-off valves, and air release valves in the water system were surveyed. Surface elevations of all of the features were determined and coordinates were established for all of these critical water system elements. A Trimble 5800
fixed base station GPS system was utilized to survey the water system components with sub-centimeter accuracy both horizontally and vertically tying the water system components to the State Plane coordinate system. Pipeline materials and connectivity were determined based upon a close review of the record drawings kept on file at the Town of Rolling Hills. The final hydraulic model accurately represents all of the water system components based upon the best available information.

**Demand Allocation**

In order to distribute the water system demands into the hydraulic model, historic billing records were coupled with the address shapefiles obtained from the Converse County GIS department. Water billing records from the Town of Rolling Hills were collected and analyzed for the past three years (May 2008 through December 2010). The records provide the monthly water usage billed for every customer in the system and the address of the water customer. The records were thoroughly analyzed to make sure there were no irregularities from month to month. The billing records for the month of August 2010 were chosen to import into the hydraulic model for the demand allocation. Utilizing the August 2010 records assured that the irrigation use was reflected in the demands. Following the analysis of the billing data base records, the billing addresses were cross checked with the address shapefile provided by the Converse County GIS Department. The two address data fields were compared and minor spelling and directional annotations were rectified; for example, one data field may identify the address as “101 North Main Street” and the other as “101 N Main St”. By digitally comparing the address files and rectifying the nomenclature, every billing address was matched with the County GIS address shapefile.

Following the comparison of the two data files (GIS and billing); the demands were assigned to every address in the GIS system. In order to incorporate the demands into the hydraulic model, the demand builder feature in WaterGEMS was utilized. The hydraulic model, through the WaterGEMS companion software, assigns the demands from every house in the system to the nearest pipe in the hydraulic model and then to the nearest node. The resultant demand allocation represents the exact monthly demand for every residence throughout the hydraulic model. The demands for any month can be incorporated into the hydraulic model utilizing the data base developed to couple the address shapefiles to the billing records. Following the
allocation of the demands, the demands were then globally edited inside of WaterCad to reflect the ADD scenario and the unbilled customer water usage was assigned to the closest node (e.g. Town Hall and Shop). For the completion of the 2010 Hydraulic model, the water demands for July and September, 2010 were incorporated into the hydraulic model to develop the ADD, MDD, PHD, and the calibration scenario.

**Verification and Calibration**

The primary method used to calibrate the hydraulic model and to confirm the piping configuration and estimated pipeline material roughness, was a series of fire hydrant flow tests throughout the water system. A total of 15 fire hydrants were flow tested. A flow trailer equipped with a magnetic flow meter and control valve was utilized to throttle and measure flow rates from the hydrants; static and residual pressures were measured and recorded for all flow conditions. The fire hydrant test locations are identified by their unique fire hydrant identifier (e.g. H-13) and are graphically shown on Figure 7-2. In addition to the flow and pressure recording at the test hydrant, adjacent pressures at two other fire hydrants were monitored and recorded. The pressures were recorded with digital pressure recorders at ten-second intervals to monitor the pressure drop in the adjacent waterlines from the induced flow at the test fire hydrant. The hydrants were step tested at three different flow rates with a peak flow rate of approximately 600 GPM. During the fire hydrant flow testing, the pumps in the south pump station were turned off. The larger pump over-heats and would provide instability in the testing process. Static pressures were recorded before and after flow testing as well as residual (i.e., flowing) pressures during the step testing.

The water system for the Town of Rolling Hills was difficult to calibrate primarily due to the way the system operates as previously described in Section 5. With five different pumps pressuring the system controlled with VFD’s and hydrodynamic pumps, the system becomes quite challenging to model. For the flow testing, only the North Pump Station was operated to simplify the operations. Following the first day of fire hydrant flow testing one additional issue was discovered. The fire pump in North Pump Station cycled on and off during the flow testing based upon drops in system pressures. The pressure on the downstream side of the North Pump Station would drop below 30 psi and the fire pump would start. Approximately 20 to 40
Figure 7-2
Fire Hydrant Node Map

Diameter
- 6"  
- 8"

Fire Hydrant
seconds later, the pressure would reach almost 50 psi and the fire pump would turn off. The flow at the fire hydrant being tested would increase when the fire pump turned on, and would decrease accordingly when the fire pump turned off. This made it very difficult to record the pressure and flow at the hydrant as well as trying to emulate this operation scenario in the hydraulic model. The decision was made to turn off the fire pump and throttle the flows at the fire hydrant so that the pressure would not fall below 30 psi on the downstream side of the North Pump Station.

Following the fire hydrant flow testing the hydraulic model was utilized to compare modeled flow test results to the field test results. In order to accurately model the field flow test results, the demands for the specific date of the test, and the water storage tank levels from the SCADA data were incorporated into the hydraulic model. The demand allocation for the month of September was incorporated into the hydraulic model. The tank levels and downstream pressure from the North Pump Station were monitored every minute by the temporary SCADA system installed. Tank levels and downstream pressure were incorporated into the hydraulic model to accurately match the field conditions at the time of the test. Isolating the system operational parameters (i.e., tank levels and downstream pressure) resulted in an accurate calibration test for pipeline roughness.

Figures 7-3 through 7-6 graphically display the field fire hydrant testing results compared to the hydraulic modeling results for all 15 of the fire hydrants tested in the system. The X-axis identifies the time of day in hours and minutes; the Y-axis identifies the pressure and has units of pounds per square inch (psi). The red lines and dark blue lines extending across the entire graph identify the recorded pressure from the digital pressure recorders located at the two adjacent fire hydrants; the hydrant locations of the pressure recorders are identified at the top and bottom of the chart in the same color. The light purple lines identify the modeled pressures at the fire hydrants. The light blue lines identify the field pressure test results for tested fire hydrants; the hydrant locations for the tested fire hydrants are identified by the label in the blue box with the arrow. The green lines identify the modeled pressures for the same flow tested fire hydrant with the same flows assigned. The results in Figure 7-5 and 7-6 do not include results from two pressure recorders on adjacent fire hydrants. After the third day of testing was
Figure 7-5
FH Testing - Modeled vs. Actual

Figure 7-6
FH Testing - Modeled vs. Actual
completed, it was noticed that one of the pressure recorders was not working that day. So the calibration was analyzed utilizing only one pressure recorder on an adjacent hydrant that day.

Nearly all of the modeled results for the adjacent hydrants equipped with the digital pressure recorders were within one or two psi of the field recorded pressures. The modeled results for the flowing fire hydrants were also very encouraging. Most of the modeled results for the flowing fire hydrants matched the field pressure records within three to six psi. The larger difference is fairly typical in the flowing hydrant. There are additional friction losses associated with the flowing hydrant (fire hydrant vertical pipe, foot valve, and 90-degree bend) that are more challenging to model. The most important component of the testing is to measure the pressure drops in the system at the adjacent fire hydrants which represents the friction losses in the distribution system. The pressure loss in the adjacent hydrants is utilized to calibrate the Hazen Williams “C” factors utilized in the hydraulic model for the pipeline materials. All of the buried pipelines in the system are Polyvinyl Chloride (PVC) pipe. One of the desirable qualities of PVC pipe is over time it’s Hazen Williams “C” factor does not vary appreciably. The calibration efforts determined the Hazen Williams “C” factor for PVC pipe materials in the system was 150 for the hydraulic model.

**Evaluation of the Water System**

The calibrated hydraulic model was utilized to analyze the performance of the water system for the current system demands and the ultimate development of the water system. The following sections address the performance of the water system components and the ability of the supply, storage, and distribution system to meet the current and projected system demands. The first section addresses the capacity of the supply sources; the second section evaluates the system storage capacity and the distribution system pumping capacity; the final section addresses the capacity of the distribution system including the systems ability to provide the necessary fire flow protection.

**Source Supply Capacity**

In general, source water supply is designed to convey the Maximum Day Demand (MDD) into the storage tanks of a water system. The storage tanks and booster pumping stations are
designed to supply the water demands for the larger daily diurnal demands or the Peak Hour Demands (PHD).

The ground water supply components were detailed and evaluated in Section 4 of this study. The Table 7-1 provides a summary of the wellfield capacity for the Town of Rolling Hills; Table 7-2 summarizes the Average Day Demand (ADD) and the MDD for the Town Hills service area for the current (2010) and the 10- and 20-year planning horizons.

### Table 7-1 Rolling Hills Wellfield Supply Capacity Summary

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<th>Well No.</th>
<th>Production Capacity (gpm)</th>
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<td>1</td>
<td>90 (3 days); 50 (180 days)</td>
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<tr>
<td>2</td>
<td>60 (180 days)</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total Supply Capacity</strong></td>
<td><strong>170</strong>*</td>
</tr>
</tbody>
</table>

*Assumes Well No. 1 not pumped into system and No. 4 and 5 pump at combined rate of 50 gpm.

### Table 7-2 Rolling Hills Water Usage Summary 2010, 2020, and 2030

<table>
<thead>
<tr>
<th>Year</th>
<th>Service Area Population</th>
<th>Per Capita Water Usage (GPCD)</th>
<th>Average Day Demand (ADD)</th>
<th>Maximum Day Demand (MDD)</th>
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</thead>
<tbody>
<tr>
<td>2010</td>
<td>440</td>
<td>132</td>
<td>58,000 gpd 40 gpm</td>
<td>174,000 gpd 121 gpm</td>
</tr>
<tr>
<td>2020</td>
<td>577</td>
<td>140</td>
<td>81,000 gpd 56 gpm</td>
<td>243,000 gpd 169 gpm</td>
</tr>
<tr>
<td>2030</td>
<td>757</td>
<td>140</td>
<td>106,000 gpd 74 gpm</td>
<td>318,000 gpd 221 gpm</td>
</tr>
</tbody>
</table>

The current supply capacity for the Town of Rolling Hills meets the current and year 2020 Maximum Day Demands; however, the current supply capacity does not meet the projected year 2030 Maximum Day Demands given the potential for dramatic growth from the addition of the Monkey Road residents to the system. The current firm supply capacity from the Rolling Hills wellfield is 170 gpm; the projected year 2030 Maximum Day Demands that the wellfield will need to supply is 221 gpm. In order to meet the projected 2030 Maximum Day Demands, an additional 51 gpm of capacity is necessary for the aggressive growth projections assumed.
**Storage Capacity**

The Town of Rolling Hills has two water storage tanks as defined in section 5 of this study, the Well House No. 1 Water Storage Tank and the Well House No. 2 Water Storage Tank. The dimensions and operational storage for these two tanks are summarized in Table 7-3.

**Table 7-3 Water Storage Tank Summary**

<table>
<thead>
<tr>
<th>Tank Name</th>
<th>Base Elevation</th>
<th>Diameter</th>
<th>Overflow Height (ft)</th>
<th>Overflow Elevation</th>
<th>Total Storage Capacity (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well House No. 1</td>
<td>5394.0</td>
<td>30-feet</td>
<td>43.7</td>
<td>5437.7</td>
<td>231,000</td>
</tr>
<tr>
<td>Well House No. 2</td>
<td>5401.0</td>
<td>21-feet</td>
<td>37.9</td>
<td>5438.9</td>
<td>98,000</td>
</tr>
<tr>
<td><strong>Total Storage Available</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>329,000</strong></td>
</tr>
</tbody>
</table>

The Town of Rolling Hills currently has a total of 329,000 gallons of water storage available to serve the needs of the distribution system.

Water storage tanks are designed to provide water storage for varying water system demands and allow for the cyclical operation of the supply system. A graphical representation of the sizing criteria of water storage tanks is shown in Figure 7-7. It includes three components: emergency storage, equalization storage, and fire flow storage. Historically, water storage tanks were significantly oversized providing large volumes of stored and treated water to reduce the burden on the supply system and provide emergency storage in the event of a supply transmission main failure. However, significant water stagnation problems have occurred in water systems with excess water storage. In evaluating the distribution water storage requirements for the Town of Rolling Hills water quality was closely balanced and addressed along with emergency storage.

The sizing recommendations for each of these components are summarized as follows:

- **Emergency Storage** – is provided for emergency situations, e.g., power outages, supply system failures, transmission line breaks, and natural disasters. For the Town of Rolling Hills, emergency storage was calculated as ten hours...
of maximum day demand with no supply available from the wells. This calculation is based
upon a power failure for all of the wells and the assumption that ten hours is the longest time
the power would be out. If the power is also out at both well house pumps, the system would
not be capable of providing the required pressures to the distribution system. The system
would still have water available; however, the pressure would be significantly lower.

- **Fire Storage** – is provided to fight fires in the system. The amount of fire flow storage is
dependent upon the flow rate of the fire hydrant, the type of structure (commercial,
residential, industrial, high-rise structures, etc.), standby power/pumping capacities at the
sources, and Insurance Service Office (ISO) requirements. Based upon the distance between
the structures in Rolling Hills and the materials of construction, fire flow requirements were
established at 750 gpm for two hours.

- **Equalization Storage** – is used to simplify system operation and to meet peak hour
demands. With the source supply and transmission designed to meet maximum day
demands, equalization storage allows for water storage to meet diurnal demand cycles above
maximum day demands. Two methods were used to calculate equalization storage in this
study:
  - **Method 1** - calculates the equalization storage as the peak hour demand (gpm) less the
    maximum day demand (gpm) for a three hour period. Since the source supply capacity
    should be designed to provide maximum day demands, the equalization storage should
    be capable of providing three hours of the difference between peak hour demand and
    maximum day demand
  - **Method 2** - from AWWA M32, calculates the equalization storage as 10 to 15-percent of
    the maximum day demand for large systems and up to 30-percent for small service areas.
    The equalization storage calculated for Method 2 will be 25-percent of maximum day
demand.

Table 7-4 summarizes the calculated distribution storage required for the Town of Rolling Hill’s
water system. The table identifies the recommended emergency storage, fire flow storage, and
equalization storage. Additionally, the three components are additive when in fact they are
normally not required simultaneously (i.e., fire flow demand during peak hour demand with the
wells out of service).
The Wyoming Department of Environmental Quality (WDEQ) Water Quality Division Chapter 12 requires that water systems ranging in size from 50,000 to 500,000 gallons per day (ADD) provide finished water storage equal to average day demand (ADD) plus the required fire storage. These figures are summarized in the last rows of Table 7-4. The Town of Rolling Hills has adequate storage to meet the design requirements established by WDEQ.

### Table 7-4 Water Storage Calculation

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD</td>
<td>40 gpm</td>
<td>56 gpm</td>
<td>74 gpm</td>
</tr>
<tr>
<td>MDD</td>
<td>121 gpm</td>
<td>169 gpm</td>
<td>221 gpm</td>
</tr>
<tr>
<td>PHD</td>
<td>242 gpm</td>
<td>338 gpm</td>
<td>442 gpm</td>
</tr>
<tr>
<td>Emergency Storage (10 hours X MDD)</td>
<td>72,600 gal</td>
<td>101,400 gal</td>
<td>132,600 gal</td>
</tr>
<tr>
<td>Fire Flow Storage (750 gpm for 2 hours)</td>
<td>90,000 gal</td>
<td>90,000 gal</td>
<td>90,000 gal</td>
</tr>
<tr>
<td>Equalization Storage (minimum and maximum)</td>
<td>21,800 gal</td>
<td>30,400 gal</td>
<td>39,800 gal</td>
</tr>
<tr>
<td>Method 1 – 3 hrs X (PHD – MDD)</td>
<td>21,800 gal</td>
<td>30,400 gal</td>
<td>39,800 gal</td>
</tr>
<tr>
<td>Method 2 – 25% of MDD</td>
<td>43,600 gal</td>
<td>60,800 gal</td>
<td>79,500 gal</td>
</tr>
<tr>
<td>Calculated Storage Required (minimum and maximum)</td>
<td>184,400</td>
<td>221,800</td>
<td>262,400</td>
</tr>
<tr>
<td>Current Available Storage (Total)</td>
<td>329,000 gallons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEQ Equalization Storage (ADD)</td>
<td>57,600 gal</td>
<td>80,600 gal</td>
<td>106,600 gal</td>
</tr>
<tr>
<td>DEQ Fire Storage (750 gpm for 2 hours)</td>
<td>90,000 gal</td>
<td>90,000 gal</td>
<td>90,000 gal</td>
</tr>
<tr>
<td>Calculated DEQ Min. Storage Required</td>
<td>147,600 gal</td>
<td>170,600 gal</td>
<td>196,600 gal</td>
</tr>
</tbody>
</table>

The recommended volume of water storage for the current and the 10- and 20-year projected demands is 300,000 gallons. The available water storage provided by the Well House No. 1 and Well House No. 2 water storage tanks is 329,000 gallons. The current water storage volume is adequate for the 10- and 20-year planning horizons.
Distribution Pump Capacity

The distribution system is basically a closed system. The elevations of the water storage tanks are not high enough to provide adequate pressure to the water distribution system by gravity flow. The pumps provide the required system pressure for the distribution system. They pump water from the water storage tanks into the distribution system utilizing variable-frequency drives (VFD’s) and hydroconstant drives to prevent over pressurizing the system. There are five distribution pumps with three VFD’s and two hydroconstant drives. Table 7-5 provides a performance summary of the five distribution pumps.

Table 7-5 Distribution Pump Performance Summary

<table>
<thead>
<tr>
<th>Pumphouse No. 1</th>
<th>Pump</th>
<th>Flow (gpm)</th>
<th>Total Dynamic Head (ft)</th>
<th>HP</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump No. 1</td>
<td>240</td>
<td>160</td>
<td></td>
<td>15</td>
<td>VFD</td>
</tr>
<tr>
<td>Pump No. 2</td>
<td>250</td>
<td>100</td>
<td></td>
<td>10</td>
<td>Hydroconstant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pumphouse No. 2</th>
<th>Pump</th>
<th>Flow (gpm)</th>
<th>Total Dynamic Head (ft)</th>
<th>HP</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump No. 1</td>
<td>240</td>
<td>160</td>
<td></td>
<td>15</td>
<td>VFD</td>
</tr>
<tr>
<td>Pump No. 2</td>
<td>280</td>
<td>200</td>
<td></td>
<td>20</td>
<td>VFD</td>
</tr>
<tr>
<td>Pump No. 3</td>
<td>250</td>
<td>100</td>
<td></td>
<td>10</td>
<td>Hydroconstant</td>
</tr>
</tbody>
</table>

Because the distribution pumps pump from the water storage tank into the distribution system, they need to be capable of supplying ADD, MDD, PHD, and MDD with the required fire flow. The pumps are capable of supplying the current, 2020, and 2030 ADD, MDD, PHD; however, they are not capable of supplying the required fire flow of 750 gpm. With Pumphouse No. 1 not in operation (Pumphouse No. 1 is only in operation during the summer) the distribution pumps can only supply approximately 600 gpm. The fire flow will be discussed in more detail later in this section. This value of 600 gpm was replicated with the hydraulic model and was experienced during the fire hydrant flow testing for the hydraulic model calibration discussed previously in this section.
The Town of Rolling Hill’s closed water distribution system is a very inefficient water system, especially when there are two water storage tanks in the water system. The water storage tanks should have been located so that the distribution system can “float” off of the tanks. This closed water distribution system increases operational costs, maintenance costs, and is difficult to operate. If the Town of Rolling Hills decides to keep this closed water distribution system, it is recommended that a new fire pump be installed capable of supplying the required fire flow for the town.

**Distribution System Assessment**

The hydraulic water models developed for the master plan assessed the water system’s ability to meet the current and projected water system demands for ADD, MDD, and PHD. The general minimum guidelines for the operation of a water system are: maintain 35 psi in the system under all “normal” operating conditions (peak hour) and keep pipeline velocities below 8 to 10 feet per second in the transmission and distribution mains. The Town of Rolling Hill’s water distribution system is currently capable of meeting these minimum guidelines for the current, 2020, and 2030 demands. The hydraulic water models showed that the lowest pressure during PHD is around 60 psi at the west end of Rimrock Road.; the highest pressure during ADD is around 95 psi at east end of 55 Ranch Road. The pipeline velocities were all less than 3 feet per second during PHD.

**Fire Flow Assessment**

Required fire flow rates are dependent upon several factors including: the types of structure (commercial, residential, industrial, high-rise structures, etc.), distance between structures, the amount of water storage, standby power/pumping capacities at the source, and Insurance Service Office (ISO) requirements. Based upon these factors, the fire flow requirement established for the Town of Rolling Hills is 750 gpm for a two hour duration. Fire flows are customarily analyzed in the hydraulic model during the MDD scenario.

The current system is unable to provide adequate fire flow to any part of the water distribution system. The pumps are not adequately sized to provide 750 gpm. The three pumps in Pumphouse No. 2 have three different pump curves. In order for all three pumps to be running at the same time, the fire pump will be running full speed; however, the VFD’s in the other two pumps will significantly ramp down the flows to match the total dynamic head of the fire pump.
The design flows for the three pumps are not additive; the VFD driven pumps must be operated at a significantly reduced speed to match the total dynamic head of the fire pump. Also, when the flow increases, the total dynamic head of the system curve increases. This pushes the duty point (point where the system curve crosses the pump curve) back on its pump curve, reducing the flow.

Aside from the booster pump capacity, the distribution system is also unable to convey the required fire flows. The distribution system is fairly well looped; however, it is primarily made up of 6-inch diameter mains. The capacity of a 6-inch diameter main is adequate if the entire system is looped, but the capacity is greatly reduced in dead-end mains or single transmission mains. There are a two “bottlenecks” in the distribution system that should be addressed. The 6-inch diameter main supplying water from Pumphouse No. 2 to Cougar Road is a major bottleneck in the system during fire flows. During the 2030 MDD Fire Flow scenario, this pipe is carrying approximately 960 gpm. The pressure loss through this 6-inch diameter main is approximately 30 psi. If this main is upsized to a 12-inch diameter main, the pressure loss will only be one psi. The other area which is unable to provide adequate fire flows is the area in the north-east corner along Dunham Road. The dead-end portion of this 6-inch diameter main is approximately 3,000 feet in length. That equates to approximately 45 psi of pressure loss through the 3,000 feet of 6-inch diameter main with 750 gpm fire flows.

Improvements are needed to the booster pumping stations and the distribution system to meet the required 750 gpm minimum fire flow requirements.

**Distribution System Condition**

The majority of the distribution system for the Town of Rolling Hills was installed in 1978. The distribution system has been in operation for more than 33 years. To determine the condition of the water mains and metallic components (valves, fittings, etc.), the water main and metallic component were exposed at three locations; 81 South Coyote, 31 and 21 North Coyote, and 1 South Badger. Soil sample were collected and tested for their soil resistivity and pH. A map of the three locations is provided in Figure 7-8.

The water mains in the distribution system are all polyvinyl chloride (PVC) pipe with gasketed-joints. PVC is a popular water main material with desirable flow characteristics. It is light
weight, has high strength, smooth interior (low friction), low reactivity, and is corrosion resistant. PVC is a relatively new material. In the United States, it has been utilized in water mains since the late 1970’s and early 1980’s. In Europe, it was installed in the 1930’s and studies have suggested that the useful life of PVC is approximately 100 years or more. The PVC water main pipe in the Rolling Hills distribution system is in good shape and is expected to last for many more years.

The exposed metallic fittings and valves were all unprotected (no coating or other cathodic protection). It is assumed that all of the metallic components in the water distribution system are all unprotected. The concern with unprotected metallic components is that they will corrode and eventually leak and fail. The corrosion in metallic components is related to the soil resistivity and the pH of the soil. Ionic current flow is associated with soil corrosion reaction, the higher the soil resistivity, the longer it will take to corrode the metallic component. Another factor associated with corrosion is the pH of the soil. More acidic soils increase the rate of corrosion in the metallic components. Alkaline soils tend to have high magnesium and calcium contents, which actually can form a calcareous deposit on the metallic component. The calcareous deposits can actually protect the metallic component from corrosion. Table 7-6 identifies the soil test results completed by Tetra Tech.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Minimum Resistivity (ohm-cm)</th>
<th>pH</th>
<th>Corrosive Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 South Coyote</td>
<td>3,200</td>
<td>8.4</td>
<td>Medium Soil Corrosivity</td>
</tr>
<tr>
<td>21 and 31 North Coyote</td>
<td>6,600</td>
<td>8.2</td>
<td>Low Soil Corrosivity</td>
</tr>
<tr>
<td>1 South Badger</td>
<td>13,000</td>
<td>8.6</td>
<td>Low Soil Corrosivity</td>
</tr>
</tbody>
</table>

Typically in this region, all metallic components require a fusion-bonded epoxy coating or a coal- tar epoxy coating. Most areas also require sacrificial anodes. The general guidelines for which type of anodes to use is detailed in table 7-7.
Figure 7-8
Soil Sample Locations

Pipe Diameter
- 6"
- 8"

Test Location
- 21 and 31 North Coyote
- 1 South Badger
- 81 South Coyote
The metallic components that were exposed at the three test locations were all in reasonably good condition. There was some surface staining around the metallic components; however, no penetrating or damaging corrosion was seen on any of the components. The soil in two of the three test locations was classified as low corrosivity. It had high resistivity and higher more alkaline pH. The third test location was classified as medium corrosivity. It had medium resistivity and a higher more alkaline pH. Figures 7-9 through 7-11 provide pictures of the metallic components at the test locations.

The test locations revealed that the soils around the Town of Rolling Hills are not very aggressive and corrosion is not a major concern. Even though the corrosion experienced in the three test locations is minimal, the soil classification can vary significantly. Table 7-6 reveals that the minimum resistivities range from 3,200 to 13,000 ohm-cm. If there is an area with aggressive soils, corrosion could become a major concern, especially in unprotected metallic components. It can greatly reduce the life-span of the metallic components and create leaks and failures in the water distribution system. Cathodic protection should be installed on all new fittings and valves installed or replaced in the system (e.g., coatings on valves and fittings as well as stainless steel hardware and sacrificial anodes). The additional costs for the cathodic protection are relatively small and it could greatly increase the life-span of the metallic components.

### Table 7-7 General Anode Guidelines

<table>
<thead>
<tr>
<th>Resistivity</th>
<th>Corrosive Classification</th>
<th>Anode Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1,500 ohm-cm</td>
<td>High Soil Corrosivity</td>
<td>Zinc Anode</td>
</tr>
<tr>
<td>1,500 to 5,000 ohm-cm</td>
<td>Medium Soil Corrosivity</td>
<td>Galvanic Anode</td>
</tr>
<tr>
<td>&gt; 5,000 ohm-cm</td>
<td>Low Soil Corrosivity</td>
<td>No Anode Required</td>
</tr>
</tbody>
</table>
Figure 7-9 Gate Valve – 81 South Coyote

Figure 7-10 Fire Hydrant Shoe – 21 and 31 North Coyote

Figure 7-11 Gate Valve – 1 South Badger
Proposed System Improvements

This section of the study identifies the proposed system improvements to the Rolling Hills water system that were developed as a part of the master planning process. This section is divided into three subsections: water supply alternatives, selection of the recommended water supply alternative and miscellaneous water system improvements. Detailed cost estimates are provided for all of the supply alternatives as well as the recommended alternative and the miscellaneous improvements. The cost estimates are based upon current (2011) construction costs for similar projects recently completed in central Wyoming. The cost estimate format is in accordance with the WWDC standards for construction cost estimates including construction contingencies, engineering fees, permitting and mitigation, and legal fees.

This section of the study also examines the 30-year life-cycle costs for the water supply alternatives. The life-cycle costs were based upon a net present value of the anticipated equipment repair and replacement costs and the electricity consumption. The discount rate (i.e., time value of money) used for the net present value was assumed to be three-percent; this represents the potential investment rate of return if the money was invested. The inflationary factor used for the pumping equipment was also three percent based upon a review of the historic inflationary figures in the region. The inflation factor assumed for electrical consumption was seven-percent. This higher electrical inflationary factor is based upon a review of the historic electricity costs in the region and recent requests by Rocky Mountain Power to the Wyoming Public Services Commission for rate increases. The inflationary rate on electricity is high but warranted given the future potential environmental impacts on coal-fired electricity production. Additionally, labor for repairs and maintenance of the electrical equipment was not included in the life-cycle cost assessment; the elevated inflationary factor on electricity helps to quantify the increased operation and maintenance cost of the more energy dependent water supply alternatives.

Water Supply Alternatives

As detailed in this study, the Town of Rolling Hills pumps their water twice in order to supply potable water to the customers in the system; water is pumped into the tanks from the wells and is then pumped into the distribution system. The first rule of hydraulics, water supply and
treatment is to pump the water the least number of times in supplying it to the customer. The long term operational and maintenance costs of rotating equipment (e.g., pumps) normally exceed the costs of designing the system to utilize gravity to supply water to the customers. In completing the analysis of the water system three alternatives were considered:

- Alternative 1 – Repair and/or Replacement of Existing Facilities
- Alternative 2 – Install New Water Storage Tank at Higher Elevation
- Alternative 3 – Connect to the Town of Glenrock

Descriptions of the three alternatives are provided below followed by construction cost estimates for the proposed improvements and the life cycle cost assessment of all three alternatives.

**Alternative 1 – Repair and/or Replacement of Existing Facilities**

This alternative includes replacement of the existing aging pumping equipment coupled with the system improvements necessary to provide for the long-term reliable operation of the pump stations. Alternative 1 includes the following system improvements:

- **South Pump Station Improvements**
  - Installation of new pump starter, soft start controls and transient voltage surge suppression equipment on Well No. 2 and a level transducer to monitor water levels in well;
  - Installation of a new tablet chlorinator to flow pace chlorination into the pipeline before it enters the water storage tank and the necessary building improvements to house the tablet chlorinator;
  - Installation of two new 15-horsepower centrifugal pumps with a new variable-frequency drive (VFD) on one of the booster pumps (one booster pump has an existing VFD drive) and the associated suction and discharge piping equipment with a pressure reducing valve bypass line;
  - SCADA system improvements to remotely monitor the water level in Well No. 2 (120-volt transformer and spread spectrum or VPN radio to communicate with pump station), and radio equipment to communicate pump station operation to the North Pump Station.
• **North Pump Station Improvements**
  - Installation of new pump starters, soft start controls and transient voltage surge suppression equipment on Well No.’s 4, 5, and 6, level transducers to monitor water levels in the wells, and metering equipment and blow-off for Well No. 4;
  - Installation of a new tablet chlorinator to flow pace chlorination of water into the pipeline before it enters the water storage tank, the necessary building improvements to house the tablet chlorinator, and a magnetic flow meter to meter water flowing from wells into the tank and control the chlorination system;
  - Installation of two new 15-horsepower centrifugal booster pumps and a 25 horsepower fire pump with a new variable-frequency drive (VFD) (two of the existing pumps have VFD drives) and the associated suction and discharge piping equipment with a pressure reducing valve bypass line;
  - SCADA system improvements to remotely monitor water levels in Well No.’s 5 and 6 (120-volt transformer and spread spectrum or VPN radio to communicate with pump station), and radio equipment to communicate pump station operation to SCADA base station.

• **SCADA Control System**
  - An Ethernet communication system and VPN radio to allow for remote monitoring and control of the system, SCADA base station with storage equipment at Town Hall to store system data and allow for remote monitoring and control of the system. North Pump Station will serve as the communication and control center for the SCADA system with the system data communicated through the Ethernet connection.

• **Transmission Pipeline – Roundup Road**
  - Installation of an 8-inch diameter transmission pipeline along Roundup Road to interconnect two dead-end pipelines and improve system operation and fire flows in the northern region of the distribution system.

The total estimated cost for Alternative No. 1 is $640,000 as detailed in Table 8-1 on the following page. It is anticipated that 67-percent of the project costs would be eligible for
Table 8-1
Alternative 1 - Construction Cost Estimate

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation of Final Design and Specification</td>
<td></td>
<td></td>
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<td>$44,010.00</td>
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<tr>
<td>Permitting and Mitigation</td>
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<td>Legal Fees</td>
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<td>$5,000.00</td>
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<td>Acquisition of Access and Right-of-way</td>
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<td><strong>Construction Costs</strong></td>
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<td><strong>Subtotal Transmission Pipeline</strong></td>
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<td>93,000.00</td>
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<td>North Pump Station Improvements</td>
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<tr>
<td>SCADA Control System</td>
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<td>Transmission Pipeline Roundup Road</td>
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<td><strong>Construction Cost Subtotal No. 1</strong></td>
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<td>Engineering Services During Construction (10%)</td>
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<td>Inflation to 2013 Construction (3% per year)</td>
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<td>Contingency (15% of CCS No. 2)</td>
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<td><strong>TOTAL PROJECT COST</strong></td>
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<td>640,000.00</td>
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<tr>
<td>WWDC Grant Funding</td>
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<td>SRF Loan Funding</td>
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<td>SRF Loan Funding 25-percent Principle Forgiveness</td>
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<td>SRF Loan Funding (Interest Rate = 2.5%, term = 20 years)</td>
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<tr>
<td>Annual SRF Loan Payment</td>
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<td>10,160.91</td>
</tr>
</tbody>
</table>
WWDC-grant funding. Two alternatives were considered for the matching funds: WWDC loan (interest rate of 4-percent per year; 30-year term) and State Revolving Fund (SRF) Loans (interest rate of 2.5-percent per year; 20-year term). The SRF loans offer very desirable interest rates and there is a high probability that the Town of Rolling Hills will be eligible for a 25-percent principal forgiveness on this loan. Given the potential for the principle forgiveness and the favorable interest rate, SRF funding is recommended for the alternatives considered. If the principle forgiveness is not available for the Rolling Hills project, the Town should closely consider the regulatory requirements of the two loans and possibly opt to utilize the WWDC loan funds.

**Alternative 2 – Install New Water Storage Tank at Higher Elevation**

This alternative includes decommissioning the existing booster pump stations, installing a new 300,000-gallon water storage tank at a higher elevation and installing new well pumps to convey the water from the wells to the higher tank elevation. The alternative also includes new chlorination equipment and the necessary transmission system piping to supply the tank and allow for gravity service of the distribution system. Alternative 2 is graphically shown on Figure 8-1 on the following page. The figure identifies the existing system along with the proposed tank location and the sizes and locations of the proposed transmission pipelines. Alternative 2 includes the following system improvements:

- **Transmission Pipeline**
  - Installation of an 8-inch diameter PVC pipeline to supply chlorinated water from Wells No. 4, 5, and 6 to the new water storage tank (Well No. 2 will be chlorinated and supplied into the system through existing transmission and distribution system piping); installation of a new 12-inch diameter pipeline from the water storage tank to the point of connection with the distribution system at the corner of Roundup Road and 55 Ranch Road; installation of an 8-inch diameter transmission pipeline along Roundup Road to interconnect two dead-end pipelines and improve system operation and fire flows in the northern region of the distribution system.
• **300,000-Gallon Water Storage Tank**
  o Preparation of the site and installation of a 300,000-gallon glass-lined bolted steel water storage tank;
  o Installation of the necessary yard piping including the tank drain and overflow piping and discharge structure;
  o Installation of fencing around the site and base course around the tank site; Installation of a pressure transducer to measure tank levels and the necessary SCADA system (spread spectrum or VPN radio) to communicate tank levels to the North Pump Station and a solar electrical panel and battery to power the transducer and radio.

• **South Pump Station Improvements**
  o Installation of new pump, pump cable, column pipe, pump starter, soft start controls and transient voltage surge suppression equipment on Well No. 2 and a level transducer to monitor water levels in well;
  o Installation of a new tablet chlorinator to flow pace chlorination into the pipeline before it enters the distribution system and minor building improvements to install the chlorinator in place of existing booster pump equipment;
  o Demolition of the existing water storage tank;
  o SCADA system improvements to remotely monitor the water level in Well No. 2 (120-volt transformer and spread spectrum or VPN radio to communicate with pump station), and radio equipment to communicate well and chlorination system operation to the North Pump Station.

• **North Pump Station Improvements**
  o Yard piping modifications to isolate water supply from wells and convey into the new 8-inch diameter tank supply pipeline;
  o Installation of new pump, pump cable (Well No. 4 only), pump starters, soft start controls and transient voltage surge suppression equipment on Well No.’s 4, 5, and 6, level transducers to monitor water levels in wells, and metering equipment and blow-off for Well No. 4;
Figure 8-1
Alternative 2 - New Water Storage Tank at Higher Elevation

Fire Flow
- < 650 gpm
- 650 - 750 gpm
- > 750 gpm

Other Water Features
- Well

Existing Mains
- 6" Main
- 8" Main

Proposed Mains
- 8" Main
- 12" Main

Proposed 300,000 Gallon Water Storage Tank
Base Elev. = 5470
Overflow Elev. = 5510

Proposed Water Transmission Mains
6" PVC Inlet Main
12" PVC Outlet Main

Proposed 300,000 Gallon Water Storage Tank
Base Elev. = 5470
Overflow Elev. = 5510
• **North Pump Station Improvements (continued)**
  o Installation of a new tablet chlorinator to flow pace chlorination into the pipeline before it is conveyed to the new water storage tank, the minor building improvements to house the tablet chlorinator in place of the existing booster pump equipment, and a magnetic flow meter to meter water flowing from wells into the tank and control the chlorination system;
  o Demolition of the existing water storage tank;
  o SCADA system improvements to remotely monitor well level in Well No.’s 5 and 6 (120-volt transformer and spread spectrum or VPN radio to communicate with pump station), and radio equipment to communicate pump station operation to SCADA base station; the pressure transducer for Well No. 4 will be wired directly to the PLC in the south pump station.

• **SCADA Control System**
  o An Ethernet communication system and VPN radio to allow for remote monitoring and control of the system, SCADA base station with storage equipment at Town Hall to store system data and allow for remote monitoring and control of the system. North Pump Station will serve as the communication and control center for the SCADA system with the system data communicated through the Ethernet connection.

The total estimated cost for Alternative No. 2 is $1,878,000 as detailed in Table 8-2 on the following page. It is anticipated that 67-percent of the project costs would be eligible for WWDC-grant funding with the remainder of the project costs provided by an SRF loan with 25-percent principle forgiveness as identified earlier in this section.
## Table 8-2
### Alternative 2 - Construction Cost Estimate

<table>
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<tr>
<th>Construction Costs</th>
<th>Description</th>
<th>Quantity</th>
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<th>Total</th>
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Alternative 3 – Connect to Town of Glenrock

This alternative includes decommissioning the existing water supply system for the Town of Rolling Hills and installing a transmission pipeline and pump station to supply water from the Town of Glenrock into the Rolling Hills system. This option also includes the installation of a new water storage tank and associated transmission pipeline to store water supplied from the Town of Glenrock for use by the Town of Rolling Hills. Alternative 3 is graphically shown on Figure 8-2. The figure identifies the existing system along with the proposed transmission pipelines, water storage tank and pump station. Alternative 3 includes the following system improvements:

- Pump Station and Transmission Pipeline
  - Installation of an 8-inch diameter transmission pipeline from the Town of Glenrock along Highway 95 to the point of connection at the Town of Rolling Hills at the South end of Coyote Road including the necessary highway bore and North Platte River Crossing;
  - Installation of a new pump station with two 50 horsepower centrifugal pumps (300 gpm at 300 feet Total Dynamic Head) including the necessary piping, and backup generator to allow for the reliable conveyance of water to the Town of Rolling Hills;
  - Installation of a SCADA system to communicate with the Town of Glenrock’s SCADA system and the water storage tank to allow for the cyclical operation of the pump station, VPN radios and SCADA programmable logic controller (PLC) to monitor pump station operation and cycle pumps.

- 300,000-Gallon Water Storage Tank
  - Preparation of the site and installation of a 300,000-gallon glass-lined bolted steel water storage tank;
  - Installation of the necessary yard piping including the tank drain and overflow piping and discharge structure;
  - Installation of fencing around the site and base course around the tank site;
  - Installation of a pressure transducer to measure tank level and the necessary SCADA system (VPN radio) to communicate tank levels to the North Pump Station and electrical service to the site to power transducer and radio.
Figure 8-2
Alternative 3 - Connect to Town of Glenrock

- Existing Water Mains
- 8" Proposed Main
- 12" Proposed Main
- Proposed Pump Station
- Proposed Water Storage Tank

Proposed 8" Water Transmission Main
Proposed 12" Water Transmission Main
Proposed 300,000 Gallon Water Storage Tank
Base Elev. = 5470
Overflow Elev. = 5510

Proposed Pump Station
Two 300 gpm 15 hp Pumps

TOWN OF ROLLING HILLS
TOWN OF GLENROCK
**Transmission Pipelines**
- Installation of a new 12-inch diameter pipeline from the water storage tank to the point of connection with the distribution system at the corner of Roundup Road and 55 Ranch Road; installation of an 8-inch diameter transmission pipeline along Roundup Road to interconnect two dead-end pipelines and improve system operation and fire flows in the northern region of the distribution system.

**SCADA Control System**
- An Ethernet communication system and VPN radio to allow for remote monitoring and control of the system, SCADA base station with storage equipment at Town Hall to store system data and allow for remote monitoring and control of the system.

The total estimated cost for Alternative No. 3 is $3,245,000 as detailed in Table 8-3 on the following page. It is anticipated that 67-percent of the project costs would be eligible for WWDC-grant funding with the remainder of the project costs provided by an SRF loan with 25-percent principle forgiveness as identified earlier in this section.
## Table 8-3
### Alternative 3 - Construction Cost Estimate

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Total</th>
</tr>
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<td>65,000.00</td>
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<td>8-inch PVC Pipeline</td>
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<td>SCADA Control System</td>
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<tr>
<td>Ethernet Communication System</td>
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<td><strong>Subtotal SCADA Control System</strong></td>
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<td>2,231,190.00</td>
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<td>Engineering Services During Construction (10%)</td>
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<td>223,110.00</td>
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<td><strong>Construction Cost Subtotal No. 2</strong></td>
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<td>2,454,300.00</td>
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<td>Inflation to 2013 Construction (3% per year)</td>
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<td></td>
<td></td>
<td>149,500.00</td>
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<td>Contingency (15% of CCS No. 2)</td>
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<td>368,140.00</td>
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<td><strong>Construction Cost Total</strong></td>
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<td>2,971,940.00</td>
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<td>2,174,150.00</td>
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<td><strong>Annual SRF Loan Payment</strong></td>
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<td></td>
<td>551,518.96</td>
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Life-Cycle Cost Analysis

In order to fairly compare the three alternatives presented above, a life-cycle cost analysis was completed. The life-cycle cost analysis considered major repair items and major utility costs. Well pump repair and replacement was addressed based upon the results of the assessment identified in Section 4. All rotating pump equipment was assumed to have a service life of twenty years; i.e., twenty years after the estimated installation date of the booster pumps and the well pumps it was assumed that they must be replaced. Additionally, it was assumed that the existing water storage tanks, if kept in service, would have to be sand blasted and recoated in twenty years.

The time value of money used for the net present worth calculation was three-percent per year. The inflation rate for all equipment replacement and repairs was also assumed to be three-percent per year. With the time value of money and the inflation rate equal, the calculation for the repair and replacement of the pumps and coating the tank was very simple; the present value of the future replacement cost is roughly equal to the current estimated replacement or repair cost. The inflation rate for electrical costs was assumed to be seven-percent per year based upon historic rate increases and planned rate increases over the next ten years by Rocky Mountain Power.

Table 8-4 on the following page presents the life-cycle cost analysis for all three options. The first item addressed in the analysis was the present value of the series of twenty loan payments for 33-percent of the total project cost. As detailed earlier in this section, it was assumed that a WWDC-grant would be utilized for 67-percent of the proposed project improvements and the remaining 33-percent would be funded with an SRF loan with 25-percent principle forgiveness. The second row addresses the estimated electrical consumption for the well and booster pumps. The annual electrical usage for Alternative 1 was based upon the historic actual electrical costs at the north and south well houses which includes all five of the well pumps. The electrical cost for Alternative 2 was based upon the calculated electrical usage historically for the well pumps and the estimated horsepower of the future pumps. This figure was compared to estimated pump run times with an average electrical cost of $0.085 per kilowatt-hour. The electrical cost for Alternative 3 was based upon the pump horsepower, estimated run times and electrical cost of $0.085 per kilowatt-hour. The remaining replacement and repair costs were
based upon the current estimated repair and replacement cost estimates for the existing and proposed system components.

### Table 8-4
**30-Year Life-Cycle Cost Analysis**

#### Alternative 1 - Repair and Replacement of Existing Pumping Facilities

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost</th>
<th>Net Present Worth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt Service for Alternative No. 1</td>
<td>$10,161</td>
<td>$151,169</td>
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<tr>
<td>Electrical Costs per Year</td>
<td>$24,000</td>
<td>$1,441,805</td>
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<tr>
<td>Well No. 2 - Replace Column Pipe and Cable (year 2021)</td>
<td>$32,000</td>
<td>$32,000</td>
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<tr>
<td>Well No. 4 - Replace Pump Cable (year 2021)</td>
<td>$17,000</td>
<td>$17,000</td>
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<tr>
<td>Sandblast and Recoat Existing Water Storage Tanks (year 2021)</td>
<td>$180,000</td>
<td>$180,000</td>
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<tr>
<td>Well Pump Replacement Costs (year 2031) Four Wells at $16,000 per Well</td>
<td>$64,000</td>
<td>$64,000</td>
</tr>
<tr>
<td>Booster Pump Replacement Costs (year 2031) Five Pumps at $6,500 per Pump</td>
<td>$32,500</td>
<td>$32,500</td>
</tr>
</tbody>
</table>

**Alternate No.1 - 30 Year Net Present Worth** $1,918,474

#### Alternative 2 - Install New Water Storage tank at Higher Elevation

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost</th>
<th>Net Present Worth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt Service for Alternative No. 2</td>
<td>$29,816</td>
<td>$443,585</td>
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<tr>
<td>Electrical Costs per Year</td>
<td>$13,000</td>
<td>$780,978</td>
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<tr>
<td>Well Pump Replacement Costs (year 2031) Four Wells at $16,000 per Well</td>
<td>$64,000</td>
<td>$64,000</td>
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**Alternate No.2 - 30 Year Net Present Worth** $1,288,563

#### Alternative 3 - Connect to the Town of Glenrock

<table>
<thead>
<tr>
<th>Description</th>
<th>2011 Cost</th>
<th>Net Present Worth</th>
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</thead>
<tbody>
<tr>
<td>Debt Service for Alternative No. 3</td>
<td>$51,519</td>
<td>$766,472</td>
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<td>Electrical Costs per Year</td>
<td>$6,400</td>
<td>$384,481</td>
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<tr>
<td>Water Cost Per Year ($2.625 per 1,000 gallons 24 Million Gallons per Year)</td>
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<td>$1,890,000</td>
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<tr>
<td>Booster Pump Replacement Costs (year 2031) Two Pumps at $9,000 per Pump</td>
<td>$18,000</td>
<td>$18,000</td>
</tr>
</tbody>
</table>

**Alternate No.3 - 30 Year Net Present Worth** $3,058,953
The life-cycle cost assessment for Alternate 3 assumed that the Town of Glenrock would charge the Town of Rolling Hills $2.625 per 1,000 gallons of water purchased which by ordinance is 1.5 times the commodity charge for residential customers in Glenrock ($1.75 per 1,000 gallons).

As detailed in Table 8-4 the estimated life-cycle cost for Alternatives 1, 2, and 3 are approximately $1.9 Million, $1.3 Million and $3.1 Million respectively. Alternative 2 has the lowest life-cycle cost over the 30-year term of the analysis.

The life-cycle cost analysis did not consider minor cost items (e.g., operator time, chemical cost, heat, lights, etc.) which can be significant. The most significant of these items is operation and maintenance of the system. The first alternative is the most operator intensive. It requires monitoring, operation and maintenance of five additional pumps (booster pumps) and two water storage tanks. The proposed improvements identified in Alternative 1 will undoubtedly simplify and automate the system (e.g., chlorination and SCADA system monitoring) but the alternative ultimately includes more time for the operators to monitor the pumps and maintain this rotating equipment. Alternative 3 would be the simplest to operate; water would be supplied from the Town of Glenrock and Rolling Hills would be responsible for operating the booster pump station and the water storage tank. The second alternative includes operating and maintaining the four municipal wells, operation of Well No. 1 for bulk water sales, two chlorinators and the new water storage tank.

Alternate 2 – Install New Water Storage Tank at Higher Elevation is the preferred alternative. This is based upon the life-cycle cost analysis and the relative ease of operation. The life-cycle cost for Alternative 2 is the lowest of all three considered and over the design life of the project; this system will be more economical than simply maintaining the existing system with few major improvements. The thirty year net present value (i.e., life-cycle cost) for the electrical costs to operate the existing system is estimated to be $1.4 Million; the net present value of the electrical costs to operate Alternative 2 with the four well pumps in service is estimated to be $780,000. The difference between these two figures is $620,000; the 33-percent match for the construction of Alternative 2 is coincidentally estimated to be $620,000. Simply stated the project will pay for itself over the 30-year design life of the project given the
estimated electrical costs savings. Additionally, the project will greatly simplify the operation of the system and provide a more reliable system for the Town of Rolling Hills. The conceptual design of Alternative 2 is detailed earlier in the section of the study and graphically displayed on Figure 8-1.

The project schedule for the funding and construction of Alternative 2 is provided in Table 8-5. Table 8-5 assumes that the WWDC will fund the design of the project this fiscal year and will fund the construction of the project in the next fiscal year.

Table 8-5
Alternative 2 Proposed Project Schedule

<table>
<thead>
<tr>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>Apply for WWDC Funding (Design Costs)</td>
<td>October 1, 2011</td>
</tr>
<tr>
<td>WWDC Funding Consideration</td>
<td>October 2011 – January 2012</td>
</tr>
<tr>
<td>Legislative Approval of Funding (Design Costs)</td>
<td>February – April 2012</td>
</tr>
<tr>
<td>Project Agreements Completed and Funding Available</td>
<td>June 2012</td>
</tr>
<tr>
<td>Apply for SRF Loan Funding and Principle Forgiveness</td>
<td>June – August 2012</td>
</tr>
<tr>
<td>SRF Loan Funding</td>
<td>October 2012</td>
</tr>
<tr>
<td>Design and Permitting</td>
<td>August 2012 – June 2013</td>
</tr>
<tr>
<td>Apply for WWDC Funding (Construction Costs)</td>
<td>October 1, 2012</td>
</tr>
<tr>
<td>WWDC Funding Consideration</td>
<td>October 2012 – January 2013</td>
</tr>
<tr>
<td>Legislative Approval of Funding (Construction Costs)</td>
<td>February – April 2013</td>
</tr>
<tr>
<td>Project Agreements Completed and Funding Available</td>
<td>June 2013</td>
</tr>
<tr>
<td>Bidding Services</td>
<td>June – July 2013</td>
</tr>
<tr>
<td>First Loan Payment Due</td>
<td>June 2015</td>
</tr>
</tbody>
</table>
Miscellaneous Improvements

This section of the study identifies miscellaneous system improvements, which were not essential for the successful operation of the water system immediately, but could be considered in the future for the potential expansion of the water system or if complaints continue regarding water quality.

Monkey Road Water Main

The primary growth opportunity identified in the study was the expansion of the water system to serve the customers along North and South Monkey Road. These developed rural residential lots currently use shallow wells for their drinking water. Historically, the residents along Monkey Road have expressed some interest in receiving water service from the Town of Rolling Hills but Town ordinances and zoning requirements along with the cost of the improvements have impeded the expansion of the water system to serve the residents along Monkey Road.

Figure 8-3 on the following page identifies the proposed water system improvements necessary to serve the residents along Monkey Road. In general the expansion consists of 8-inch diameter PVC water main along Monkey Road and the associated fire hydrants, valves, fittings and water services. Table 8-6 provides a cost estimate for the proposed system improvements to serve Monkey Road. The total estimated cost for the design and installation of the Monkey Road water line extension is approximately $1,255,000. The project would serve an additional 72 lots; this results in a cost per tap of approximately $17,500. Grant funding for the project could be available from the WWDC if they considered the water line extension in Monkey Road a transmission pipeline and not a distribution system; this would be a challenging argument to make given the number and frequency of services along Monkey Road and the fact that the pipeline does not significantly enhance the transmission of water in the Rolling Hills Water System. A State Lands and Investment Board Mineral Royalty Grant could be pursued for this project. Detailed project funding alternatives are provided in Section 10 of this study. If and when the residents along Monkey Road desire to pursue project funding for the project grant and loan funding resources could be pursued.
Figure 8-3
Monkey Road Water Main

Proposed Mains
- 8" Main

Existing Mains
- 6" Main
- 8" Main
- Well

Legend:
- Proposed 8" Water Distribution Main
- Proposed 8" Water Distribution Main
Iron and Manganese Removal

The primary water supply wells in the Town of Rolling Hills all have iron and manganese levels above the EPA secondary MCL. Iron concentrations in Wells No.’s 2, 4, 5, and 6 range from 0.10 to 1.28 mg/L; manganese concentrations in the wells range from 0.05 to 0.09 mg/L. High levels of iron and manganese do not pose any known adverse health risks. The U.S. Environmental Protection Agency (EPA) has not set maximum contaminant levels (MCL) for iron and manganese in the National Primary Drinking Water Regulations. Secondary maximum contaminant levels (SMCL) recommended in the National Secondary Drinking Water Regulations are set for esthetic reasons and are not enforceable by EPA, but are intended as guidelines. The SMCL for iron is 0.3 milligrams per liter (mg/L) and the SMCL for manganese is 0.05 mg/L.

Iron and manganese occur naturally in water, especially groundwater. Neither of the elements causes adverse health effects; they are essential to the human diet. However, water containing
excessive amounts of iron and manganese can stain clothes, discolor plumbing fixtures, and sometimes add a “rusty” taste and look to the water.

Iron and manganese in water also promote the growth of iron bacteria, a group of organisms that obtains its energy for growth from the chemical reaction that occurs when iron and manganese mix with dissolved oxygen. These bacteria form thick slime growth on pipe walls and well screens. Iron bacteria will use even small amounts of iron present in the ferrous (+2) state, oxidize it, and then use the energy. The manganese (+2) ion is used in a similar manner by other bacteria to form organics, which contribute to the iron bacteria slime in the well and/or water system. The deposits are rust-colored from the iron and black-colored from the manganese. Variations in flow can cause these slime growths to come loose, resulting in dirty water in the system.

The growth of iron bacteria can be controlled by chlorination. However, when water containing iron is chlorinated, the iron is converted from the ferrous (+2) state to the ferric (+3) state (i.e., rust) and manganese is converted into black manganese dioxide. These materials form a coating on the inside of the water main and can result in dirty water complaints from customers.

Treatment processes for iron and manganese typically involve pH adjustments and chemical addition to facilitate the oxidation of the ions followed by filtration. Lime softening can also remove iron and manganese. Most traditional treatment techniques require conventional chemical addition, flocculation and filtration processes. These processes would require that the well pumps discharge the water into a treatment process and then the water would have to be pumped into the water storage tank. This process would eliminate the advantages of Alternative 2 by requiring secondary pumping of the water.

Numerous companies provide natural treatment media installed in pressure vessels. Permanganate, chlorine, chlorine dioxide or sulfur dioxide is added to oxidize the iron and manganese and then the water flows through the media removing the oxidized iron and manganese. The filter media is periodically backwashed to remove the iron and manganese and clean the filter media. Examples of pressure filter media for iron and manganese removal are Greensand and Electromedia which is manufactured by Filtronics.
The proposed iron and manganese filtration system for Rolling Hills would consist of a single pressure vessel approximately 60-inches in diameter and 54-inches tall filled with Electromedia and the necessary piping, valving and pump to allow for the down-flow filtration of the water during normal operation and the up-flow backwashing of the filter media. Figure 8-4 provides a piping configuration for the Filtronics Electromedia system. The filter would be housed adjacent to the existing north pump house in a small building addition. Backwash from the filter can be decanted and solids removed. The backwash water would have to be discharged into an evaporation and percolation pond adjacent to the facility.

**Figure 8-4**

*Filtronics Electromedia Filtration Vessel*

The total estimated cost of the system including engineering design and construction is estimated to be $190,000. As a treatment process the project would not be eligible for WWDC-grant or -loan funding but could be considered for SLIB-grant and -loan funding.

The Town of Rolling Hills has been providing water to its customers with heightened iron and manganese levels of nearly 30 years. The customers have complained periodically regarding
dirty or black water but have rarely complain about iron staining. With the successful implementation of Alternative 2, the Town will have gravity flow to their distribution system and improved hydraulics in the distribution and transmission system. It is recommended that the Town undertake an aggressive water main flushing program, flushing all of the water mains at least twice per year. Aggressive water main flushing can be accomplished with the necessary water system improvements identified in Alternative 2 and will reduce the occurrence of the dirty water complaints. Given the complexity of the treatment process coupled with the additional capital and operations costs, it is recommended that the town utilize an aggressive water main flushing program to improve water quality and not construct a treatment system at this time. If water quality complaints continue following the flushing program the Town could consider funding options for the construction of the iron and manganese filtration system.
Financial Analysis

As the financial consultant engaged by Civil Engineering Professionals, Inc. Killmer & Associates, PC is developing long-term financial forecasts for the City’s water utility. The analysis of the existing rate structure assesses the ability of the water fund to be self-sustaining to meet projected annual operating and maintenance expenses, as well as funding the necessary operating and capital reserves. Additionally, the analysis provides a financial model for developing funding strategies to meet increases in capital improvements, as identified in the Master Plan.

Killmer & Associates analyzed the data supporting the water system and also the existing controls in the accounting system. The assumptions and results of this analysis are presented below. It is expected that the financial model will be adjusted as the Town of Rolling Hills undertakes the implementation of the proposed Master Plan improvements.

Study Assumptions:
- Reference made to a fiscal year is defined as a year ended June 30.
- The water rates in effect as of April 2009 are designated as existing rates.
- Revenue under existing rates equals approximately $80,000 annually.
- Additional revenue from water sales for park irrigation will begin in fiscal year 2012.
- Water usage during the five-year analysis period will remain fairly constant due to minimal growth.
- Operating reserves will be maintained equal to 90-days of operating expenses, equal to $22,000 for fiscal year 2012. Current cash reserves at year-end 2011 equal $36,664.
- Cost of electricity will escalate at 7-percent annually, while other costs increase 3-percent annually.
- Capital reserves will accrue at $5,000/year over the five-year period to reach $25,000 by fiscal year 2017.
- Interest rates on reserve accounts are estimated at a conservative 0.25-percent.
- Annual median household income for the study residents is $71,646.
- Capital improvements to fund the improvements identified in the Master Plan total $1,880,000

- Funding of the capital improvements will be provided by a 67-percent/33-percent split of WWDC-grant funding and SRF-loan, respectively; 25-percent of the SRF loan will qualify for principle forgiveness. The loan amount of $464,805 (20 years at 2.5-percent interest) will require debt service of $30,000 annually, beginning in June, 2015

- In order to apply for SRF loan funding for the project in August 2012 the Town must have a rate schedule in place to service the debt on the loan and provide for a capital reserve account

- Additional utility savings generated by capital improvements will total $11,000 annually; the savings are a result of the reduced electrical costs of the proposed system improvements; these savings will not be realized until the project is fully operational and complete in June, 2016

**Operation and Maintenance Expense (O&M)**

O&M consists of employee wage expense, utilities to service wells, supplies, maintenance of building and grounds, and minor equipment purchases. In fiscal year 2011 O&M expense was $85,300, rising to $93,000 by 2016. Table 9-1 illustrates the detail of O&M for the base period, fiscal year 2011 and each of the fiscal years comprising the study period, 2012 to 2017. With revenue of only $80,000 annually under the existing rate structure, it is evident the water system is not generating enough income to cover basic operating costs. Rate increases will be necessary, not only to fund O&M expenses, but to establish operating and capital reserves to allow for funding of unexpected expenditures above budgeted amounts.
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<td>Water Utility Collection</td>
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<td>318</td>
<td>328</td>
<td>338</td>
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<td>State Water Lease</td>
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<td>Travel/Training</td>
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<td>3,594</td>
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<td>Bldg/Ground Maint</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vehicle Gas &amp; Oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Operating Supplies</td>
<td>8,000</td>
<td>8,240</td>
<td>8,487</td>
<td>8,742</td>
<td>9,004</td>
<td>9,274</td>
<td>9,552</td>
</tr>
<tr>
<td>Maint/Contract Services</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Supplies</td>
<td>17,300</td>
<td>17,819</td>
<td>18,354</td>
<td>18,904</td>
<td>19,471</td>
<td>20,055</td>
<td>20,657</td>
</tr>
<tr>
<td>Capital Outlay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other Equipment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Total Capital Outlay</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total O&amp;M</td>
<td>85,300</td>
<td>88,827</td>
<td>92,528</td>
<td>96,412</td>
<td>100,490</td>
<td>93,003</td>
<td>96,680</td>
</tr>
</tbody>
</table>

**Capital Improvement Program (CIP)**

The CIP is calculated to be $1.88 million during the study period and includes design, legal, permitting and right-of-way access fees in addition to the construction, and engineering costs of the 2013 Water System Improvement Project. Annual inflation of project costs is calculated at 3-percent for the interim period of 2012 and 2013. A contingency fee of 15-percent of Construction costs is included, but not inflated. Table 9-2 provides the detail of the expected costs.
### Debt Service

The water system does not currently have existing debt obligations. The Water System Improvements will require financing through SRF at 2.5-percent interest for a 20-year period; payments to begin one year after the substantial completion of construction, projected for June 2014, resulting in the first payment due on June 2015. Table 9-3 identifies the timing of debt payments at approximately $30,000 annually.

### Cash Flow Analysis

**Capital Fund Reserves**

The water system currently does not have a capital reserve account. It is important within a strong financial model to maintain some reserves for unexpected capital requirements.
Table 9-4 demonstrates the cash flows for the capital fund for the study period. Transfers from the operating account increase the capital account to $25,000 by 2017.

<table>
<thead>
<tr>
<th>Description</th>
<th>2011</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning Fund Balance</td>
<td>0</td>
<td>0</td>
<td>5,000</td>
<td>11,750</td>
<td>15,000</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Source of Funds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer FROM Operating Fund</td>
<td>0</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Plant Investment Fees</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bond Proceeds</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grant Proceeds</td>
<td>0</td>
<td>0</td>
<td>100,000</td>
<td>1,160,000</td>
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<tr>
<td>State &amp; Other Loan Proceeds</td>
<td>0</td>
<td>0</td>
<td>50,000</td>
<td>570,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interest</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Sources</strong></td>
<td>0</td>
<td>5,000</td>
<td>155,000</td>
<td>1,735,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Uses of Funds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer TO Operating Fund</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Capital Improvements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduled</td>
<td>0</td>
<td>0</td>
<td>148,250</td>
<td>1,731,750</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Deferred</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Subtotal CIP</strong></td>
<td>0</td>
<td>0</td>
<td>148,250</td>
<td>1,731,750</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Debt Service Reserve</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Debt Issuance Expense</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Uses</strong></td>
<td>0</td>
<td>0</td>
<td>148,250</td>
<td>1,731,750</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Annual Surplus (Deficiency)</strong></td>
<td>0</td>
<td>5,000</td>
<td>6,750</td>
<td>3,250</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Ending Balance</strong></td>
<td>0</td>
<td>5,000</td>
<td>11,750</td>
<td>15,000</td>
<td>20,000</td>
<td>25,000</td>
</tr>
</tbody>
</table>

**Operating Fund**

Operating fund revenue requirements include O&M, proposed debt service, and transfers to the capital fund. Projected water sales revenue is based upon the fiscal year 2011 water usage and assumes the number of accounts remain fairly stagnant. Projected interest income is based upon annual earnings of 0.25-percent on the cash reserves.
O&M costs include personnel, utilities, materials, and supplies for maintaining and distributing water. Utility costs are projected to increase at 7-percent annually, although efficiencies from the Water System Improvement Project will capture an electrical usage savings $11,000 starting in 2016 with the completion of the project. All other expenses are projected to increase at 3-percent annually.

Debt service consists of annual payments on the proposed obligations to finance 24.75-percent of the proposed capital improvements, beginning in 2015. The remaining 74.25-percent of the proposed capital improvements will be funded from WWDC-grant funds and SRF principle forgiveness.

Transfers from the Operating fund will establish the Capital fund reserve to the target balance of $25,000 by fiscal year 2017.

Revenue for the fiscal year 2011 was $82,000 with O&M expenses of $85,000, indicating the existing rate structure is insufficient to support revenue requirements. The financial model suggests a rate increase is necessary to increase water revenue to meet operating and cash reserve needs. In addition, the Town Parks use a significant amount of water during the summer months and should contribute to water sales revenue accordingly. The proposed rates include billing for water usage of the Town Parks. An increase in annual water sales revenue of 45-percent in 2012 will stabilize the operating fund, while providing sufficient transfers to fund the capital reserve account.

Table 9-5 demonstrates the cash flow analysis for the Operating fund.
# Table 9-5
## Water Utility Operating Fund Cash Flow Analysis
*Fiscal Year Ending June 30*

<table>
<thead>
<tr>
<th>Description</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning Fund Balance</td>
<td>36,664</td>
<td>67,318</td>
<td>89,272</td>
<td>107,210</td>
<td>91,117</td>
<td>82,968</td>
</tr>
<tr>
<td><strong>Revenues</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Sales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From Adopted Water Rates</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
</tr>
<tr>
<td>From Rate Adjustments</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Water Sales Revenue</strong></td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
<td>119,150</td>
</tr>
<tr>
<td><strong>Transfers FROM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Fund</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Transfers</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Miscellaneous Revenue</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Interest</td>
<td>331</td>
<td>332</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total Revenues</strong></td>
<td>119,480</td>
<td>119,482</td>
<td>119,350</td>
<td>119,350</td>
<td>119,350</td>
<td>119,350</td>
</tr>
<tr>
<td><strong>Revenue Requirements</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation &amp; Maintenance Expense</td>
<td>88,827</td>
<td>92,528</td>
<td>96,412</td>
<td>100,490</td>
<td>93,003</td>
<td>96,680</td>
</tr>
<tr>
<td>Debt Service</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Proposed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>29,953</td>
<td>29,495</td>
<td>29,494</td>
</tr>
<tr>
<td><strong>Total Debt Service</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>29,953</td>
<td>29,495</td>
<td>29,494</td>
</tr>
<tr>
<td><strong>Transfers TO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Fund</td>
<td>0</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Total Transfers</strong></td>
<td>0</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Total Revenue Requirements</strong></td>
<td>88,827</td>
<td>97,528</td>
<td>101,412</td>
<td>135,443</td>
<td>127,498</td>
<td>131,174</td>
</tr>
<tr>
<td><strong>Annual Surplus (Deficiency)</strong></td>
<td>30,653</td>
<td>21,954</td>
<td>17,938</td>
<td>(16,093)</td>
<td>(8,149)</td>
<td>(11,825)</td>
</tr>
<tr>
<td><strong>Ending Balance</strong></td>
<td>67,318</td>
<td>89,272</td>
<td>107,210</td>
<td>91,117</td>
<td>82,968</td>
<td>71,143</td>
</tr>
<tr>
<td><strong>Minimum Operating Reserve (a)</strong></td>
<td>22,000</td>
<td>23,000</td>
<td>24,000</td>
<td>25,000</td>
<td>23,000</td>
<td>24,000</td>
</tr>
</tbody>
</table>

(a) 90 days of operation and maintenance expense.
Water Rate Structure

This financial model considers the existing rate structure and identifies adjustments necessary to meet ongoing revenue needs of the water system. Industry best practices indicate a rate structure should be equitable, legally defensible, understandable, policy compliant, and implemented with consistency. The Town of Rolling Hills’ existing water rates have been in effect since April 2009 and consist of a base charge and a volume charge. The base charge varies depending on property location (within the Town or outside of Town). The volume charge consists of seven brackets, depending upon usage, and applies an aggressive conservation rate.

Recommended Rate Structure Changes

Base Charge – Beginning in fiscal year 2012, increase the base charge to $38 for property in town and to $51 for property located outside of town. In addition, water usage for Town Parks is not currently invoiced. It is recommended that a base charge of $38 be implemented for Parks.

Volume Charge – Beginning in fiscal year 2012, increase each existing block rate structure by $1.00.

Proposed rates are projected to increase annual water sales revenue by 45-percent in fiscal year 2012.

Table 9-6 details the comparison of existing monthly base rates to proposed rates and Table 9-7 identifies the existing and proposed monthly charges based upon volume.
Rolling Hills Water System Master Plan

Section 9 – Financial Analysis

Table 9-6
Water Utility
Comparison of Existing and Proposed Monthly Base Charges

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Monthly Charge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In town</td>
<td>$30.00</td>
<td>$38.00</td>
<td>$38.00</td>
<td>$38.00</td>
<td>$38.00</td>
</tr>
<tr>
<td>Out of Town</td>
<td>$45.00</td>
<td>$51.00</td>
<td>$51.00</td>
<td>$51.00</td>
<td>$51.00</td>
</tr>
<tr>
<td>Parks</td>
<td>$ -</td>
<td>$38.00</td>
<td>$38.00</td>
<td>$38.00</td>
<td>$38.00</td>
</tr>
</tbody>
</table>

Table 9-7
Water Utility
Comparison of Existing and Proposed Monthly Volume Charges

<table>
<thead>
<tr>
<th>Customer Class</th>
<th>Existing Rate</th>
<th>Proposed Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Town/Parks</td>
<td>$/kgal</td>
<td>$/kgal</td>
</tr>
<tr>
<td>First 10,000 gallons</td>
<td>0.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Over 10,000-20,000</td>
<td>1.50</td>
<td>2.50</td>
</tr>
<tr>
<td>Over 20K-50K</td>
<td>2.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Over 50K-100K</td>
<td>2.50</td>
<td>3.50</td>
</tr>
<tr>
<td>Over 100K-120K</td>
<td>3.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Over 120K-150K</td>
<td>3.50</td>
<td>4.50</td>
</tr>
<tr>
<td>Over 150K</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Out of Town</td>
<td>$/kgal</td>
<td>$/kgal</td>
</tr>
<tr>
<td>First 10,000 gallons</td>
<td>1.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Median Income Comparison

The median income for calendar year 2010 for the Town of Rolling Hills was $71,646. Typically, the cost of water usage on an annual basis should not exceed 2.5-percent of the annual median income for the study area. Table 9-8 illustrates the comparison of the proposed rates on this limit. At 45,000-gallons of average monthly usage, the monthly bill would exceed 2.5-percent of the median income. For the fiscal year 2010, all users fell below that average monthly usage.
Table 9-8
Water Utility
Typical Residential Monthly Bill
Under Existing and Proposed Rates

<table>
<thead>
<tr>
<th>Usage (kgal)</th>
<th>FY 2012 Rates ($)</th>
<th>FY 2012 Annual Bill ($)</th>
<th>2.5% of FY 2012 Median Income ($)</th>
<th>Difference ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.50</td>
<td>474</td>
<td>1,791</td>
<td>1,317</td>
</tr>
<tr>
<td>5</td>
<td>45.50</td>
<td>546</td>
<td>1,791</td>
<td>1,245</td>
</tr>
<tr>
<td>10</td>
<td>53.00</td>
<td>636</td>
<td>1,791</td>
<td>1,155</td>
</tr>
<tr>
<td>15</td>
<td>65.50</td>
<td>786</td>
<td>1,791</td>
<td>1,005</td>
</tr>
<tr>
<td>20</td>
<td>78.00</td>
<td>936</td>
<td>1,791</td>
<td>855</td>
</tr>
<tr>
<td>25</td>
<td>93.00</td>
<td>1,116</td>
<td>1,791</td>
<td>675</td>
</tr>
<tr>
<td>30</td>
<td>108.00</td>
<td>1,296</td>
<td>1,791</td>
<td>495</td>
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<tr>
<td>35</td>
<td>123.00</td>
<td>1,476</td>
<td>1,791</td>
<td>315</td>
</tr>
<tr>
<td>40</td>
<td>138.00</td>
<td>1,656</td>
<td>1,791</td>
<td>135</td>
</tr>
<tr>
<td>45</td>
<td>153.00</td>
<td>1,836</td>
<td>1,791</td>
<td>(45)</td>
</tr>
<tr>
<td>50</td>
<td>168.00</td>
<td>2,016</td>
<td>1,791</td>
<td>(225)</td>
</tr>
<tr>
<td>55</td>
<td>185.50</td>
<td>2,226</td>
<td>1,791</td>
<td>(435)</td>
</tr>
<tr>
<td>60</td>
<td>203.00</td>
<td>2,436</td>
<td>1,791</td>
<td>(645)</td>
</tr>
</tbody>
</table>

Summary of Findings

Revenue under the existing rate structure is insufficient to meet the needs of the Water System. The proposed rates provide adequate revenue to meet budgeted O&M expenses, provide debt service on proposed improvements, and maintain adequate capital and operating reserves to stabilize the system throughout the study period fiscal year 2012 – 2017.
Project Funding Sources

There are several sources of funding available for the construction of the Rolling Hills Water System Improvements. This section of the study identifies the potential financial opportunities for the Town of Rolling Hills to fund the water system improvements identified in this study. Each funding source has restrictions that limit the types of projects it can fund, as well as restrictions as to which entities can be funded. In general, funding is currently available from all of the sources identified below. This study summarizes the potential funding resources available to the Town of Rolling Hills.

- Capital Facility Tax (countywide excise tax)
- State Loan & Investment Board (SLIB) Consensus and/or Federal Mineral Royalty Grants
- Wyoming Joint Powers Act Loans
- State Revolving Fund Loans
- Abandoned Mine Lands Funding for Public Facility Projects
- Wyoming Water Development Commission
- Wyoming Workforce Housing Program
- Community Development Block Grant Program
- Wyoming Business Council/Business Ready Community Grant & Loan program
- U.S. Department of Agriculture/Community Facility Grant & Loan program

Each of these potential funding sources has certain attributes to be considered, including their respective costs, uses, and likelihood of availability. They are each discussed below.
Capital Facilities Tax

Counties have the ability to levy optional sales and use taxes and special purpose local option sales and use taxes. A special purpose tax, (also known as a capital facilities tax), is an excise tax of not more than 2% levied with all other sales and use taxes collected in the county. It must be approved by a popular vote. The revenues from the specific purpose local option tax must be used to pay for specific capital needs identified in the ballot proposition. To put a capital facility tax on the ballot, the board of county commissioners and two-thirds of incorporated municipalities in the county must first pass a resolution authorizing a ballot issue. There are four municipalities in Converse County (Douglas, Glenrock, Rolling Hills and Lost Springs); meaning three of these municipalities must approve any ballot resolution. Projects must be approved when the tax is approved, and the tax ends when the amount of money approved has been collected. This method is good to utilize to raise matching funds and to provide evidence of support by the community for the project.

Although several capital facility ballot propositions have been put before Converse County voters in the past 30 years, none has been successful. Converse County does levy an optional general purpose tax for 1%. A new 1% capital facilities tax could generate about $3.65 million of revenue annually, but it is likely that it would need to be shared with projects in other Converse County communities in order to entice at least three municipalities to approve a new ballot measure. There is statutory authority to impose a capital facilities tax of up to 2%, if the Optional General and Specific Purpose taxes together do not exceed 3% (Wyoming Statute 39-15-204-iv). A new countywide vote would be required to implement a special purpose tax (it can be levied in increments of 0.5%, up to the statutory maximum).

In order to get the project underway while collecting the tax revenues, the community would probably want to consider issuing revenue bonds to allow for construction of the facility. The community could pledge future revenue from a specific purpose local option sales and use tax to finance bonds that allow for early construction of the approved project. There are a number of quality firms within the State of Wyoming who, in anticipation of selling the bonds once the question passes, provide election assistance developing promotional brochures, framing the question and helping generate support for the project. George K. Baum and Associates in
Cheyenne is one such firm. It is also recommended that Rolling Hills seek special bond counsel advice in the development of any capital financing that would result in the issuance of bonds.

**State Loan and Investment Board**

The Office of State Lands and Investments serves as a clearinghouse for many of the funding programs identified. They are responsible for receiving and processing funding applications through the following programs:

**Mineral Royalty Grants (MRG)**

The Federal Mineral Royalties and Bonus Payments provide funding pursuant to Wyoming Statute 9-4-604. The State Loan and Investment Board (SLIB) provides Federal Mineral Royalty Grant (MRG) funds. The MRG revenue stream is funded by the royalties from federal leases on public land in Wyoming. The amount varies from year to year and is subject to legislative appropriation based on revenues received by the state from the federal government. The allocated amount for the 2011-2012 biennium is $33 million, which is significantly less than previous allocations. Eligible entities are counties, municipalities, joint powers boards and certain special districts, including hospital districts.

The funds are provided in the form of grants ranging from 50% to 75% of eligible project costs. Municipalities with a population less than 1,300, or that are in a county where the three-year average of state sales and use tax is less than 70% of statewide average are eligible for 75% grant funding, larger municipalities are limited to 50%. Since the 2010 population of Rolling Hills is 440, the municipality would qualify for the 75% grant.

The SLIB Board reviews applications and prioritizes them by urgency. Emergencies that pose an immediate threat to health, safety and welfare get top priority. The second priority is compliance with federal or state mandates, and the third priority is to provide an essential public service. The Board considers water and sewer projects, storm drainage projects, street and road projects and solid waste disposal projects, among others, to be essential public services.
SLIB uses the following additional criteria in awarding Mineral Royalty Grants:

- The extent of the match committed to the project from all sources;
- The applicant has made a significant commitment of local resources;
- The applicant has matching funds for the project from other than state grants;
- The project is appropriately sized in relation to the population to be served by the project;
- The relative urgency of the project;
- The applicant is current on all its repayment obligations to the Board;
- The extent to which the applicant is utilizing, or plans to utilize, available and qualified Wyoming based professional firms and contractors on the project;
- The financial need of the applicant, as determined by the Board; and
- The percentage of the applicant's population directly served by the project.

It is possible that Rolling Hills could make a case that SLIB funding is necessary to alleviate an emergency that poses a threat to the residents of the community. In any event, the proposed water improvements would certainly qualify for funding as an essential public service.

SLIB reviews applications at their Semi-Annual meetings. The next scheduled standard MRG application due date is September 15, 2011 for the SLIB MRG meeting scheduled for January 19, 2012. The Board's current available balance is $7,184,918 through June 30, 2012.

SLIB Mineral Royalty funds are also allocated to Wyoming’s counties and municipalities through the Countywide Consensus Allocation (referred to as Section 342 funding within the supplemental legislative funding appropriations to local government entities). Section 342 appropriates $35,000,000 from the State's general fund to SLIB to be allocated to counties in formula block grants and expended for capital projects via the countywide consensus process. For 2011, Converse County has been allocated a total distribution of $823,550. Local
governments have until September 16, 2011 to make decisions on how those funds will be used. At a May 10, 2011 Converse County governmental entity meeting, entities tentatively allocated all but $212,000 of the available consensus funds. Rolling Hills had two minor well projects totaling $11,000 (Well House #2 Fence and Well House #1 Roof), of which 50% would be eligible for SLIB funds under the matching provision guidelines in place in Converse County. Rolling Hills could ask that this project receive additional assistance through the consensus process for an allocation of at least some of these funds for this project. The matching requirements are not required by SLIB - they are simply in place in Converse County to maximize the use of available funds.

**Wyoming Joint Powers Act Loans (JPA)**

The JPA funding (Wyoming Statute 16-1-109), is a $60 million allocation from the Permanent Mineral Trust Fund. The JPA funding is in the form of loans and only provides funding for revenue generating public facilities projects (such as this water project). The revenue must be sufficient to service the debt and represent prudent use of state funds. Loan terms are up to 40 years, depending on the life of the project. The interest rate for Joint Powers Act Loans is 4.98% through December 31, 2011. In January of each year, the State Treasurer's Office will calculate the five-year average that will provide the next annual interest rate for Joint Powers Act Loans.

Eligible applicants include counties, municipal corporations, and certain other districts. The loan funds can be used for planning, construction, acquisition, improvement, emergency repair, and refinancing of existing debt. There are no matching fund requirements, provided the facility can generate sufficient revenues to service the debt and is a prudent use of state funds. The JPA program has no set priority list or numerical ranking system for projects.

The SLIB board will consider completed loan applications at any of its regular meetings or special sessions. Due dates for application submittal would be November 24, 2011 for the December 8, 2011 meeting and January 5, 2012 for the January 19, 2012 meeting.
State Revolving Fund Loans (SRF)

The Wyoming SRF program is composed of two separate but similar funds that make loans to public entities for infrastructure improvements. The two funds are the Drinking Water State Revolving Fund (DWSRF) and the Clean Water State Revolving Fund (CWSRF). The DWSRF provides funds for drinking water systems including source, treatment plant, storage tank, and transmission and distribution lines. The CWSRF provides funds for sanitary sewer collection and treatment, storm water control, and other water pollution control projects.

DWSRF loans are available to state agencies, counties, municipalities, joint powers boards and other special districts. Wyoming Statute 16-1-303(c)(vi) vests the SLIB with the responsibility of giving final authorization and adoption of the annual Intended Use Plan (IUP), as well as final priority listing of eligible projects for funding. The Wyoming Department of Environmental Quality (WDEQ), the Wyoming Water Development Office (WWDO) and the SLIB jointly developed the 2012 IUP. This list has 203 total projects with an estimated cost of $305,664,000. Eligible projects must be on the IUP to be eligible to receive a loan from the program. Rolling Hills has one project described as "add well; distribution extensions" which is currently ranked 190 out of 203 total eligible projects (it has just two ranking points). The Town of Rolling Hills should place the proposed project on the IUP for consideration in the following year. The IUP is open for new projects in the first quarter of every year.

Ranking criteria and scoring is listed below:

- Public Health issues - 200 points maximum
- Compliance issues - 240 points maximum
- System deficiencies that may affect public health or ability to comply - 85 points maximum
- Affordability - 30 points maximum

Loan applicants must adhere to federal and state requirements, including federal environmental review processes. Completed loan applications can be submitted at any time during the year.
but must be submitted a minimum of 45 days prior to the bimonthly SLIB meeting to be on the agenda. The current loan rate is 2.5% with a maximum of a 20 year term. The SLIB is currently offering principle forgiveness for DWSRF loans. The principle forgiveness or grant portion of the funding has ranged from 25- to 50-percent of the eligible project costs. Based upon recent conversations with SLIB staff members it is anticipated that the proposed Rolling Hills water project could be eligible for 25-percent principle forgiveness. This additional grant funding for the project makes the SRF loan very desirable. Due to the federal nature of the funding, SRF loans require environmental assessments of the proposed area affected by the project. Additionally, federal prevailing wage standards and other federal project requirements slightly increase the “cost” of the SRF funding but the potential for principle forgiveness outweighs the costs associated with the funding requirements.

Abandoned Mine Lands (AML)

The Surface Mining Reclamation and Control Act allowed the State of Wyoming to establish an Abandoned Mine (AML) Program. Originally established to reclaim abandoned mine sites using funds collected by the U.S. Secretary of Interior, the law now allows AML to fund public facilities in communities adversely affected by past mining. The program is administered by the Wyoming Department of Environmental Quality Abandoned Mine Land Division with final review and approval by SLIB.

Chapter 6 of the Abandoned Mines Lands Rules and Regulations allows for funding of public facilities projects in counties that are, or have been impacted by mining with excess funds remaining after fully funding their reclamation and rehabilitation projects. These excess AML funds can be used for funding costs associated with site evaluation, engineering and design, site preparation, construction, equipment purchase, and maintenance. Eligible projects include existing public facilities and utilities serving the public that were adversely affected by mining practices prior to 1977, and new public facilities and utilities in communities affected by mining. Applicants are restricted to incorporated cities and towns, counties, special districts or joint powers boards who would own the new facility. The Glenrock Coal Mine and other Converse County coal mines in operation prior to 1977 make Converse County communities eligible for possible AML funding.
Qualifying projects are given a priority ranking based on the following criteria:

- Availability of funds from other sources, local community tax base and financial support for the proposed project.

- The mitigation extent for impacts from mining, with first priority given to public health and safety and second to providing basic services and infrastructure.

- The need and cost effectiveness of the project to the community and the state.

This funding is limited to any excess amount beyond the amount needed to fund the State’s reclamation plan. In recent years the funds received by the State for AML projects has only been sufficient enough to implement the state’s Reclamation Plan and there hasn’t been excess funding available for public facilities projects. However, it appears that the AML program will have funds available for funding water system improvement projects in the immediate future.

More information about the various Wyoming SLIB grant and loan programs can be found online at [http://lands.state.wy.us/](http://lands.state.wy.us/).

**Wyoming Water Development Commission (WWDC)**

WWDC funding is provided by severance tax distributions, and is limited to projects that are associated with new water source development, storage and transmission. The WWDC does not provide funding for distribution, individual service or water treatment projects. Applicants must be public entities that can legally receive state funds, incur debt and generate revenues to repay loan.

The WWDC has two main divisions: Planning and Construction. Water development projects are divided into three levels. Level 1 funding is dedicated to project planning and preliminary reconnaissance work. Level 2 funding is for feasibility studies and plan development. Level 3 funding is for the construction of the project. WWDC provides 100% grant funding for Level 1 and Level 2 projects. Level 3 funding is provided through a combination of grants (67%) and loans (33%) depending upon the project and the community. The current interest rate for WWDC program loans is the statutory minimum of 4%. Wyoming Statute 41-2-121 specifies
that the term of the loans cannot exceed fifty (50) years or the expected life of the project. The proposed project must serve twenty (20) or more municipal/domestic water taps with individual meters for each tap.

All applications for funding for Level I and Level 2 projects must be submitted no later than August 15 of any given year. The WWDC receives applications for grant funding of ongoing projects until October 1 every year. The projects are then considered by the WWDC and the Select Water Committee from the State Legislature. Following review and approval by these groups in the fall, grant and loan funding for projects is included in the Omnibus Water Bill and is considered by the legislature every year. Project funding becomes available in June of the year following application.

WWDC funded this Level 1 Study, so the Town of Rolling Hills should consider WWDC funding for any new water source development, storage and transmission identified in the study.

WWDC has developed a priority list relative to the types of water projects it should pursue. The types of projects the WWDC currently emphasizes in order of preference are:

- Multipurpose projects - projects that serve two or more of the following functions: agriculture, municipal, industrial, rural domestic, recreation, environmental, flood control, erosion control and hydropower
- Storage projects - dams and reservoirs
- Supply projects - groundwater wells, alluvial wells, diversion dams and other structures that put un-appropriated water to beneficial use or supply existing uses
- Supply systems - systems that bring source water closer to the point of use through pipeline and canal systems. Major water transmission facilities that deliver water to distribution systems that serve users or that access water treatment plants are included in this category. Water treatment facilities are not eligible unless used to fund disinfection facilities needed to connect groundwater wells to a supply system.
Distribution systems that transport water from one point to another for later distribution to customers are also not included

- Hydropower project
- Purchase of existing storage
- Recreation
- Reimbursement of temporary or emergency funding

**Wyoming Workforce Housing Infrastructure Program (WHIP)**

In 2006, the Wyoming Workforce Housing Infrastructure Program was created in Wyoming State Statute 9-12-901 et. seq. to provide funding for cities, towns, counties and joint powers boards for workforce housing infrastructure. The purpose is to promote development of infrastructure to create additional housing affordable to Wyoming's workforce. Funding is available on a county by county basis based on the average cost of housing and availability and affordability of rental housing. Sewer and water distribution projects are included in the list of eligible projects. Funds may only be used for new housing, not existing housing areas.

Funding may include grants or loans. Loans may be made at zero interest rate, up to an annual interest rate equal to the average prime interest rate. The program is administered by the Wyoming Business Council although a lack of recent legislative funding has created an inactive program for the time being.

**Wyoming Business Council – Community Development Block Grant Program**

The primary intent of the Community Development Block Grant (CDBG) program is to provide funding to local governments to pay for community or economic development activities. The CDBG program is a federally funded pass through grant program funded by the United States Department of Housing and Urban Development and administered by the Wyoming Business Council (WBC). The WBC receives an annual CDBG funding allocation that has varied between $2.2 million and $3.75 million. The agency also has three subcategories for better allocation and distribution of the funds. The sub-category for the
Rolling Hills water system is the Public Infrastructure grant, which can provide up to $500,000 in grant funds. There is not a required match; however, an integrated effort with matching funds would be desirable. CDBG funding is limited to cities, towns, counties, joint powers boards, and further income restrictions applied.

One of three national objectives must be met to qualify for CDBG funds:

- Benefit low and moderate income persons
- Aid in the prevention or elimination of slums or blight
- Activity designed to meet community development need having a particular urgency

The most feasible objective for Rolling Hills would be the "activity designed to meet community development need having a particular urgency." A case would have to be made that funding is necessary to alleviate an emergency situation. The “benefit to low to moderate income persons” objective does not work for the Rolling Hills community at this time. For a given community, there must be at least 51% of the households with low to moderate incomes. According to the most current data used by the WBC, just 24.7% of Rolling Hills residents have low to moderate incomes. Therefore, as a community, Rolling Hills would not appear to qualify. However, if the project was to serve only certain areas of the community, then only those affected households may meet the income requirements.

In addition to the national objectives listed, other criteria for successful CDBG funding include meeting a project objective and expected outcome of the project. The relevant project objective would be "activities that benefit communities/families/individuals by addressing issues in their living environment." The outcome to be met would be "sustainability (activities that promote livable or viable communities and neighborhoods by providing services)."

CDBG applications need to be submitted by September 1, 2011 to be considered by the WBC Board of Directors at their December 2011 meeting. CDBG grants are federal grants so there are stringent environmental review criteria and detailed project monitoring and compliance steps to be taken. Rolling Hills should consult with the Kim Rightmer, Regional WBC Director in Casper, to assist in determining eligibility. If the federal objectives can be met, this
potential funding source may be a better fit than the Community Readiness Program described below.

**Wyoming Business Council (WBC) – Community Readiness Program**

Funds for the Wyoming Business Council Investment Ready Communities Grant and Loan Program are appropriated by the State Legislature. The 2011-2012 biennium appropriation is $50 million. Some of those funds have already been awarded, but $41.3 million remain at this time. After the WBC staff and Board of Directors have reviewed funding requests and made their recommendations, final approvals are considered by the Wyoming SLIB at their bimonthly board meetings. BRC grants can only be made to governmental bodies (city, town, county or joint powers board).

To distribute funds to eligible projects, the BRC has developed six subcategories based on differing criteria and objectives. The subcategory that applies to the Rolling Hills Water System Master Plan is Community Readiness Projects. This program is intended to assist in preparing a community through infrastructure improvements and expansions in support of primary economic development. The improvements have to be part of an approved comprehensive plan and the applicant must demonstrate that the potential exists for the creation of new primary jobs. It also must demonstrate that appropriate planning has been conducted and capacity exists to accommodate new business development in order to insure success for the project.

The maximum award is $1 million with a 15% local match. The next BRC grant application deadline is March 12, 2012, with funding decisions expected to be made in June 2012. The Wyoming Business Council is more likely to provide grant funds if the cash reserve, and the debt portion of project costs are already identified by that time. This source of funding does not seem very likely unless a clear link between project completion and the creation of primary jobs can be made. Involvement by local economic development officials and the Regional WBC Director would be helpful to make this connection.
More information about the WBC Business Ready Community Grant and Loan program can be found online at http://www.wyomingbusiness.org/program/business-ready-community-program/1246.

**USDA Funding - Rural Development Water and Waste Disposal Loans/Grants**

The United States Department of Agriculture (USDA) Rural Development makes direct loans, loan guarantees, and grants to build or improve essential public use facilities for drinking water systems and development, as well as sanitary sewer, solid waste, and storm drainage facilities. The program is administered through the Water and Environmental Programs (WEP) and Rural Utilities Service (RUS) program. RUS provides funding for rural areas and cities and towns with a population of 10,000 or less. They also provide funding for public bodies, non-profit organizations, and recognized Indian tribes.

Loans are available to qualified borrowers (Rolling Hills would be an eligible public entity) who are unable to obtain needed funds from other sources at reasonable rates and terms. The project is based on taxes, assessments, revenues, fees or other satisfactory sources of money sufficient for operation, maintenance and reserve, as well as to retire the debt. There is no maximum dollar amount for the loan. The amount is determined by the amount necessary to meet the applicant's needs and its ability to handle the repayment schedule. Interest rates vary depending on the median household income of the service area with the lowest rate available being 4.5%. Loan rates are recalculated on a quarterly basis. The maximum loan term is 40 years or the useful life of the project, whichever is less. Applications are accepted at any time through the USDA Rural Development State and Area Offices. Converse County is served through the East Area Office in Torrington.

Grant funding is used to supplement loans to reduce debt service where necessary to achieve reasonable user rates. Areas with median household incomes above $37,769 are not grant eligible. The amount of grant assistance depends upon the median household income, the population in the community where the project is to be located, and the availability of grant funds. Grant assistance may be available for up to 75% of project costs but is typically limited to either $50,000 or 50% of a state's annual allocations, whichever is greater. Grant funding limitations are based on population and income, economic feasibility, and availability of funds.
Rolling Hills 2009 median family income was $71,646 placing it well above the USDA threshold for grant eligibility.

This program is directly administered by USDA. As a direct federal program not passed through to a state agency for implementation, applicants may find the application process to be quite daunting. Grant and loan regulations can be found in the Code of Federal Register, Title 7, Part 1780 - Water and Waste Loans and Grants.

More information about these USDA programs can be found online at http://www.rurdev.usda.gov/UWP-disdirectloansgrants.htm.
Appendix A
APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER
FOR OFFICE USE ONLY

PERMIT NO. U.W. 125023
WATER DIVISION NO. 1 DISTRICT 18-5
U.W. DISTRICT Converse Co.

NAME AND NUMBER OF WELL Rolling Hills #1 Well

1. Name of applicant(s) Town of Rolling Hills
   Phone: 436-5346
   38 South, Badger, Rolling Hills, WY

2. Address of applicant(s) Coal Co. Rte. Box 42, Glenrock, WY
   Zip: 82637

3. Name & address of agent to receive correspondence and notices R.F.I. Associates P. O. Box 1659
   Glenrock, WY 82637

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [x]
   Industrial [ ] Miscellaneous [ ] (Describe completely and accurately) Well is to serve a population of approximately 500 people. There are 172 lots in the town. 155 lots are single-family dwellings and 15 are commercial.

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE¼ NW¼ of Sec. 12, Township 14 North, Range 66 West.)
   Converse County, NE ¼ NE ¾ of Sec. 28
   T. 34 N., R. 75 W., Sec. 99, Block 99, Converse Hills Subdivision (or Add'n)

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.

7. Estimated depth of the well is 1000 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 50 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below.

10. If for irrigation use:
    a. Describe MAXIMUM acreage to be irrigated in each 40-acre sub-division in the tabulation below.
    b. [ ] Land will be irrigated from this well only.
    c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

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   Original Point of Use Lot 50 Rolling Hills Subdivision No. 4

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc.

STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002

SEE REVERSE SIDE

Permit No. U.W. 125023
Book No. 940 Page No. 24
12. The well is to be constructed on lands owned by ____ Town of Rolling Hills
   (The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by ____ Town of Rolling Hills
   (If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: This is a refiling of Cancelled Permit No. U.W. 64211 (J & J #93 Well)
Water from this well will be commingled with water from Rolling Hills #4 Well,
   Permit No. U.W. 70662, Rolling Hills #2 Well, Permit No. U.W. 22926
   and Rolling Hills #3 Well, Permit No. U.W. 54351.
   Permit No. W. 22926, 54351 and Rolling Hills #6 Well, Permit No. 2447, 125023.
Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

[Signature]
Signature of Applicant or Authorized Agent

[Date]
Date

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES
(Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)
$10.00

IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS
$25.00

MONITOR (For water level measurements or chemical quality sampling)
NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING

STATE ENGINEER'S OFFICE

This instrument was received and filed for record on the 23rd day of February, A.D. 1988, at 9:30 a.m.

Permit No. U.W. 125023

for State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

This permit and accompanying notices serve to register an existing well and establish a valid water right for the same. Notice of Commencement is waived. Time limit for completion of construction and completion of beneficial use waived.

FOR ADDITIONAL CONDITIONS AND LIMITATIONS SEE ATTACHED STATUS SHEET

Approval of this application may be conditioned or authorization is premised with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, including pump installation.

Completion of construction and completion of the beneficial use of water for the purposes specified in Item 4 of this application will be made by December 31, 1988.

The amount of appropriation shall be limited to the quantity to which the permittee is entitled as determined at time of proof of application of water to beneficial use.

Witness my hand this 29th day of April, 1988, A.D. 1988.

[Signature]
Gordon W. Fasset, State Engineer

February 16, 1988—Proof of Beneficial Use on April, 1980 received.
PERMIT NO. U.W. 125023
T.F. No.19-6-402

PERMIT STATUS

Priority Date February 23, 1988    Approval Date APR 2 9 2000

March 21, 2000 - SEO letter mailed to applicant advising of North Platte River implications.

April 3, 2000 - Written confirmation of applicant's appraisal of the situation received with instructions to proceed with the application review and approval. See both letters filed in Miscellaneous Notices under Permit No. U.W. 125023

ADDITIONAL CONDITIONS AND LIMITATIONS:

1. A meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from this well.

2. An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period.

3. The report shall identify the well by name, location, permit number and shall identify the type of meter used for the measurement.

4. The report shall contain at least two (2) semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was "shut-in" prior to obtaining the measurements must be specified.

5. The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

The water appropriated under this ground water permit has been determined to constitute one source of supply and the provisions of Section 41-3-916, Wyoming Statutes, shall apply as follows:

"41-3-916. Priority of rights when 1 source of supply. Where underground waters in different aquifers are so interconnected as to constitute in fact one source of supply, or where underground waters and the waters of surface streams are so interconnected as to constitute in fact one source of supply, priorities of rights to the use of such interconnected waters shall be correlated and such single schedule of priorities shall relate to the whole common water supply. The state engineer may by order adopt any of the corrective controls specified in section 17 of this act [41-3-916]. Source: Laws 1957, ch. 169, 18; W.S. 1957, 41-133."

As such, any required regulation of water rights in the future shall consider this permit under the priority date shown, together with all other rights to use water.

Date of Approval
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER

IF WELL IS TO BE ABANDONED, SEE STATEMENT OF COMPLETION AND DESCRIPTION OF WELL
ITEM 15, PAGE 4

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 125023 NAME OF WELL Rolling Hills #1

1. NAME OF OWNER 360 Badger, Rolling Hills, WY
   Town of Rolling Hills

2. ADDRESS Coal Co. Hts. Box 42, Glenrock, WY Zip Code 82637

3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☒ Industrial ☐ Miscellaneous ☐

4. LOCATION OF WELL: NE ¼, NE ¼ of Section T 34 N, R 75 W, of the 6th P.M. (or W.R.M.),
   Wyoming, being specifically
   (Bearing and Distance)
   Strike out words not needed.
   or ______ ft. North and ______ ft. East from the ______ corner of Section ______ T ______ N, R ______ W.

5. TYPE OF CONSTRUCTION: Drilled ☒ ROTARY ☐ Dug ☐ Driven ☐ Jetted ☐
   Other ☐

6. CONSTRUCTION: Total Depth of Well 1000 ft. Depth to Static Water Level 220 ft.
   a. Casing Schedule New ☒ Used ☐
      ______ diameter from ______ ft. to ______ ft. Material ______ Gage ______
      ______ diameter from ______ ft. to ______ ft. Material ______ Gage ______
      ______ diameter from ______ ft. to ______ ft. Material ______ Gage ______
   b. Perforations: Type of perforator used ______
      Size of perforations ______ inches by ______ inches.
      Number of perforations and depths where perforated:
      ______ perforations from ______ ft. to ______ ft.
      ______ perforations from ______ ft. to ______ ft.
   c. Well screen installed? Yes ☒ No ☐
      Diameter: ______ slot size: ______ set from ______ feet to ______ feet.
      Diameter: ______ slot size: ______ set from ______ feet to ______ feet.
   d. Well gravel packed? Yes ☒ No ☐ Size of gravel 3/8" ☐
   e. Surface casing used? Yes ☒ No ☐
      Was it cemented in place? Yes ☒ No ☐

7. NAME & ADDRESS OF DRILLER ______ D & D Drilling, Glenrock, WY

8. DATE OF COMPLETION OF WELL (including pump installation) January, 1978

9. PUMP INFORMATION: Manufacturer ______ Type ______
    Source of power electricity Horsepower ______ Depth of Pump Setting ______
    Amount of Water Being Pumped ______ Gallons Per Minute. (For springs or flowing wells, see Item 11.)
10. PUMP TEST: Was a pump test made? Yes ☐ No ☐

If so, by whom J & J Development
Address Box T-3, Glenrock, Wy

Yield: 50 gal/min. with 100 foot drawdown after 24 hours.
Yield: ____ gal/min. with ____ foot drawdown after ____ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is ____ gal/min. Surface pressure is ____ lb/sq. inch, or ____ feet of water.
The flow is controlled by: valve ☐ cap ☐ plug ☐
Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled 1090 feet.

Depth of completed well 990 feet. Diameter of well 7 inches.
Depth to first water bearing formation 200 feet.
Depth to principal water bearing formation, Top 680 feet to Bottom 730 feet.

Ground Elevation, if known Approximately 5200'

<table>
<thead>
<tr>
<th>From Feet</th>
<th>To Feet</th>
<th>Material Type, Texture, Color</th>
<th>REMARKS (Cementing, Shutoff, Packing, etc.)</th>
<th>Indicate Water Bearing Formation</th>
<th>Indicate Perforated Casing Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<tr>
<td>680</td>
<td>730</td>
<td>Salt &amp; pepper sand</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QUALITY OF WATER INFORMATION:
Was a chemical analysis made? Yes ☐ No ☐ (See microfilm for Permit No. U.W. 64611)
If so, please include a copy of the analysis with this form.
If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

u.w. 125023
13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Sec.</th>
<th>NE¼</th>
<th>NW¼</th>
<th>SW¼</th>
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<tr>
<td>Area of use -- within Corporate limits of Town of Rolling Hills</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL NUMBER OF ACRES TO BE IRRIGATED

Original Supply _______ acres
Additional Supply _______ acres

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

Scale: 2" = 1 Mile

REMARKS:
15. IF WELL IS TO BE ABANDONED, complete items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and
details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and
to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true,
correct and complete.

Signature of Owner or Authorized Agent

Date

u.w. 125023

Date of Receipt: FEB 16, 1988

Date of Priority: February 23, 1988

Date of Approval: April 29, 2000

for State Engineer.
STATE OF WYOMING  
OFFICE OF THE STATE ENGINEER  

PROOF OF APPROPRIATION AND BENEFICIAL USE OF GROUND WATER  
This form is required for submitting Parts I and II of this form. Part III will be prepared by a State Engineer Representative at time of inspection.  

PART I  

WATER DIVISION I (c)  
STATEMENT OF CLAIM  
PERMIT NO. U.W.  
WELL REGISTRATION  
NAME OF WELL Rolling Hills #1  

1. Name of Claimant(s) Town of Rolling Hills  
2. Address 36 South Badger, Rolling Hills, WY  
3. For What Purpose(s) is Water Used? Use: Municipal Date First Used April 1980  
   Use: Date First Used June 19  
If use is for irrigation, give date irrigation was completed on all lands under this Permit:  

SEE T. MAP # 2245E  

PART II  

For Irrigation, Industrial, Municipal and Miscellaneous Wells  

A plat which has been certified by a licensed professional engineer or land surveyor shall be submitted to accompany this form. The plat shall be in accordance with Sec. 33-29-111 Wyoming Statutes 1977 or see Chapter V and VI, Manual of Regulations and Instructions issued by the State Engineer’s Office. (Minimum scale shall be 2” = 1 mile.) The map shall be prepared with waterproof black ink on tracing linen or an acceptable equivalent and shall show on a suitable scale the legal subdivisions, the accurate location of the well or wells, storage facilities, if any, main canals, streams, highways and other important cultural features. Land ownership will be shown, if there is more than one owner under the permit.  

IRRIGATION WELLS  

Acreage irrigated under terms of this permit will be clearly shown with a distinctive pattern and a distinction clearly made between lands having an original supply and those provided a supplemental supply. Where use is for supplemental supply for lands with a right from another source, indicate the priority or permit number of the source, the source of supply and the name of the ditch, pipe line or other well. Conveyance system will be shown and described. Indicate method of irrigation being used.  

INDUSTRIAL WELLS  

In addition to the information outlined above, industrial users will locate and describe conveyance facilities to the point(s) of use, giving as accurately as possible the location of points of use. Permits for other sources of water must be identified.  

MUNICIPAL WELLS  

The plat will show the area of use and show and describe the means of conveyance of the water from the well to the connection with the distribution system for a municipal water system.  

MISCELLANEOUS WELLS  

1. The linen plat for wells where the use is described as miscellaneous and where the yield flow of the well exceeds twenty-five (25) gallons per minute must show the area of use and describe and show the means of conveyance from the well to the distribution system and/or points of use.  

2. The plat for wells where the use is described as miscellaneous and where the yield or flow is twenty-five (25) gallons per minute or less may be a 7½ minute United States Geological Survey Quadrangle map in lieu of a linen tracing provided the U.S. Geological Survey Quadrangle map is in compliance with the following conditions:  

(a) The entire United State Geological Survey quadrangle map must be submitted to the State Engineer’s Office.  

(b) The scale on said quadrangle map must be one to twenty-four thousand.  

(c) An identified section corner or quarter corner must be shown on said quadrangle map along with Section, Township and Range.  

(d) The section in which the well is located and the section(s) where the area(s) or point(s) of use are located must be subdivided into forty (40) acre tracts and the well location and area(s) or point(s) of use clearly labeled and described.  

(e) Said quadrangle map showing the well location and area(s) or point(s) of use must be certified by a professional engineer or land surveyor licensed to practice within the State of Wyoming.
A "CERTIFICATE OF OWNERSHIP" FROM THE COUNTY CLERK'S OFFICE SHOWING OWNERSHIP OR CONTROL OF LAND(S) INVOLVED MUST ACCOMPANY THIS FORM.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

[Signature]
Signature of Owner or Authorized Agent

2-11
Date

[Signature]
U.W. 125023

Date of Receipt: FEB 16, 1988
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 125024

NAME AND NUMBER OF WELL

Rolling Hills #2 Well

1. Name of applicant(s) Town of Rolling Hills
   36 South Badger, Rolling Hills, WY 82077
   Phone: 436-5343

2. Address of applicant(s) Carbon Co. Rte. 1 Box 12 Glenrock, WY
   Zip: 82077

3. Name & address of agent to receive correspondence and notices
   Black & Associates P.O. Box 1629
   Glenrock, WY 82077

4. Use to which the water will be applied: Domestic [ ] Stock Watering [X] Irrigation [ ] Municipal [XX]
   Industrial [ ] Miscellaneous [ ] (Describe completely and accurately. Well is to serve a population of approximately 500 people. There are 174 lots in the Town. 155 lots are single-family dwellings and 16 lots are commercial.
   
5. Location of the well: (Note: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE Seat NW ¼ of Sec. 12, Township 14 North, Range 68 West.)
   Converse County, NE ¼ NW ¼ of Sec. 28
   T. 36 N., R. 75 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot/Block enlargement of the Town of Rolling Hills Subdivision (or Addn) of	

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.

7. Estimated depth of the well is 1200 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 25 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute.
   SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations.
   After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below.

10. If for irrigation use:
   a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
   b. [ ] Land will be irrigated from this well only.
   c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Sec.</th>
<th>NE¼</th>
<th>NW¼</th>
<th>SW¼</th>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

   Original Point of Use Lot 55 Rolling Hills Subdivision NE ¼

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc.

Permit No. U.W. 125024
SEE REVERSE SIDE

Book No. 940
Page No. 25
12. The well is to be constructed on lands owned by ____________________________
   (Town of Rolling Hills)
   (The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant’s. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by ____________________________
   (Town of Rolling Hills)
   (If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: Water from this well will be commingled with water from the Rolling Hills #4 Well, Permit No. U.W. 70662, Rolling Hills #1 Well, Permit No. U.W. 123023, and Rolling Hills #12 Well, Permit No. U.W. 123023. Rolling Hills No. 3 Well, Permit No. U.W. 48232, and Rolling Hills No. 4 Well, Permit No. U.W. 123024. This is a refilling of Cancelled Permit No. U.W. 54588 and U.W. 64210 (28-1 Well and Enr. 28-1). Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Signature of Applicant or Authorized Agent ____________________________
Date 2-11-88

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES ____________________________
$10.00

(Domestic use is defined as a single-family dwelling and the watering of lawns and
gardens not exceeding one (1) acre)

IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS ____________________________
$25.00

(Monitor (For water level measurements or chemical quality sampling)
NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING ____________________________

STATE ENGINEER'S OFFICE ____________________________

This instrument was received and filed for record on the 23rd day of February, A.D. 1988, at 9:30 o’clock AM.

Permit No. U.W. 125024 ____________________________

155 State Engineer ____________________________

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

This permit and accompanying notices serve to register an existing well and establish a valid right for the same. Notice of Commencement is waived. Time limit for completion of construction and completion of beneficial use waived.

FOR ADDITIONAL CONDITIONS AND LIMITATIONS SEE ATTACHED STATUS SHEET

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, including pump installation.

Completion of construction and completion of the beneficial use of water for the purposes specified in Item 4 of this application will be made by December 31, 19_____.

The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.

Witness my hand this day of ____________________________

__________________________
Gordon W. Fassett State Engineer

February 16, 1988—Statement of Completion on June 11, 1980 received.
February 16, 1988—Proof of Beneficial Use on February 1, 1983 received.
12. The well is to be constructed on lands owned by ___________________________ Town of Rolling Hills
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by ___________________________ Town of Rolling Hills
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: Water from this well will be commingled with water from the Rolling Hills #4 Well, Permit No. U.W. 706672, Rolling Hills #2 Well, Permit No. U.W. 424703, and Rolling Hills #1 Well, Permit No. U.W. 425074. This is a renewal of Permit No. U.W. 425074, and Rolling Hills No. 2 Well, Permit No. U.W. 425075. This is a renewal of Permit No. U.W. 52439 and U.W. 62410.
(28-4 Well and Enf. 28-1)
Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Signature of Applicant or Authorized Agent ___________________________ Date: 2 - 11 - 1988

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES $10.00
(Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)
IRRIGATION. MUNICIPAL, INDUSTRIAL, MISCELLANEOUS $25.00
MONITOR (For water level measurements or chemical quality sampling) NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING __________
) ss.

STATE ENGINEER'S OFFICE __________

This instrument was received and filed for record on the ______th day of ______, A.D. 1988, at ______ o'clock ______ AM.

Permit No. U.W. __________

[Signature] State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

This permit and accompanying notices serve to register an existing well and establish a valid water right for the same. Notice of Commencement is waived. Time limit for completion of construction and completion of beneficial use waived.

FOR ADDITIONAL CONDITIONS AND LIMITATIONS SEE ATTACHED STATUS SHEET.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filled within thirty (30) days of completion of construction, including pump installation.

Completion of construction and completion of the beneficial use of water for the purposes specified in item 4 of this application will be made by December 31, 1988.

The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.

Witness my hand this day of ______, A.D. ______

[Signature]

Gordon W. Fassett
State Engineer

February 16, 1988—Statement of Completion on June 11, 1980 received.
February 16, 1988—Proof of Beneficial Use on February 1, 1983 received.
APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

APPLICATION FOR WELLS AND SPRINGS

Note: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic and/or stock watering, will be considered as ground water appropriations.

NAME AND NUMBER OF WELL or SPRING: Rolling Hills #2 Replacement Well

1. Name of applicant(s): Town of Rolling Hills
   Phone: (307) 436-5398

2. Address of applicant(s):
   38 South Badger, Rolling Hills, WY 82637
   (CITY) (STATE) (ZIP)

3. Name & address of agent to receive correspondence and notices:
   Walter-Wetstein & Associates, Inc.
   P.O. Box 29, Laramie, WY 82073
   Phone: (307) 742-9220
   (Mailing Address) (CITY) (STATE) (ZIP)

4. Use to which the water will be applied:
   [ ] Domestic: Use of water in 3 single family dwellings or less, noncommercial watering of lawns and gardens totaling one acre or less. Number of households served: ______
   [ ] Stock Watering: Normal livestock use at four tanks or less within one mile of well or spring. Stockwatering pipelines and commercial feedlots are a miscellaneous use. Number of stock tanks: ______
   [ ] Irrigation: Watering of commercially grown crops (large-scale lawn watering of golf courses, cemeteries, recreation areas, etc., is miscellaneous use).
   [ ] Municipal: Use of water in incorporated Towns and Cities (use of water in unincorporated towns, subdivisions, improvement districts, mobile home parks, etc. are classified as miscellaneous use).
   [ ] Industrial: Long term use of water for the manufacture of a product or production of oil/gas or other minerals (oil field water flood operations, power plant water supply, etc.). (Describe in REMARKS)
   [ ] Miscellaneous: Any use of water not defined under previous definitions such as stockwatering pipelines, subdivisions, mine dewatering, mineral/oil exploration drilling, recreation purposes, potable and sanitary supplies in offices or light manufacturing, animal waste management, etc. Describe miscellaneous use completely:
   [XX] Monitor, Observation or Test Well: (Describe in REMARKS)

5. Location of the well or spring: (NOTE: Quarter-quarter (40 acre subdivision) MUST be shown. EXAMPLE: SE 1/4 NW 1/4 of Sec. 12, Township 14 North, Range 68 West.)
   Converse County, NE 1/4 NE 1/4 of Sec. 28, T. 34 N., R. 75 W. of the 6th P.M., (or W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot __ Block __ of the Subdivision (or Addn) of ______. Resurvey Location: Tract __________, (Lot) ________.

6. Estimated depth of the well or spring is ______ feet.

7. (a) MAXIMUM instantaneous flow of water to be developed and beneficially used: _______ gallons per minute.
   Note: If for domestic and/or stock use, this application will be processed for a maximum of 25 gallons per minute. For a spring, after approval of this application, some type of artificial diversion or improvement must be constructed to qualify for a water right.
   (b) MAXIMUM volumetric quantity of water to be developed and beneficially used per calendar year: _________.
   Circle appropriate units: (Gallons) (Acre Feet) A four person family utilizes approximately one (1) acre-foot of water per year or 325,000 gallons.

8. Mark the point(s) or area(s) of use in the tabulation box below.

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<th>TWP</th>
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<th>SEC</th>
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<th>NW 1/4</th>
<th>SW 1/4</th>
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<th>NE 1/4</th>
<th>NW 1/4</th>
<th>SW 1/4</th>
<th>SE 1/4</th>
<th>TOTAL</th>
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</tbody>
</table>

9. If for irrigation use:
   a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation box above.
   b. [ ] Land will be irrigated from this well only.
   c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

10. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc.: ____________________________________________________________
11. The well or spring is to be constructed on lands owned by ____________ Town of Rolling Hills, Wyoming ____________.
(The granting of a permit does not constitute the granting of right-of-way. If any easement or right-of-way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not the co-applicant.)

12. The water is to be used on lands owned by ____________ N/A ____________.

   (If the landowner is not the applicant, a copy of the agreement relating to the usage of appropriated water on the land should be submitted to this office. If the landowner is included as co-applicant on the application, this procedure need not be followed.)

REMARKS: This is a test well to determine the feasibility of setting and replacing the existing Rolling Hills No. 2 well (U.W. 125024). If this well is successful a petition will be submitted to the Board of Control to permanently change the location of U.W. 125024 to this location.

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

Signature of Applicant or Authorized Agent

OCTOBER 30, 2000

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES $25.00

(Domestic use is defined as use of water in 3 single family dwellings or less,
noncommercial watering of farms and gardens totaling one acre or less.)

IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS $50.00

MONITOR (For water level measurements or chemical quality sampling) or TEST WELL NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING 

STATE ENGINEER'S OFFICE 

This instrument was received and filed for record on the 1ST day of November, A.D.

# 2000 at 9:30 o'clock A.M.

Permit No. U.W. 130615

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 168, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use without loss of water into sub-surface formations or at the land surface.

This application is for test purposes only. No water will be beneficially used. This permit will be automatically cancelled on December 31, 2001 or upon receipt of an acceptable Statement of Completion. PROOF OF APPROPRIATION AND BENEFICIAL USE OF GROUND WATER (FORM U.W. 8) IS WAIVED UNDER THIS PERMIT.

Approval of this application may be considered as authorization to proceed with construction of the proposed well or spring. A Statement of Completion will be filed within thirty (30) days of completion of construction.

Completion of construction and completion of the beneficial use of water for the purposes specified in Item 4 of this application will be made by December 31, 2001.

Witness my hand this 3rd day of November, A.D. 2000.

Carol Lucas

for State Engineer

SEP 28 '01 NOTICE OF EXPIRATION OF TIME FOR COMPLETION MAILED

WACNU FILMED OCT 29 2001
PERMIT NO. U.W.  130615

PERMIT STATUS

Priority Date  November 1, 2000       Approval Date  November 3, 2000

This permit cancelled per request of applicant. See letter received November 29, 2001.

11/17/2000
Date of Approval

for

Richard G. Stockdale,
Deputy State Engineer

MAR 29 2002
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
NOTE: Do not fold this form. Use typewriter or print neatly with black ink.

PERMIT NO. U.W. 125024
NAME OF WELL Rolling Hills #2
(Original Well)

1. NAME OF OWNER Town of Rolling Hills
2. ADDRESS 38 South Badger, Rolling Hills, WY 82671
   Zip Code 82671
3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☑ Industrial ☐ Miscellaneous ☐
4. LOCATION OF WELL: NE ¼ NE ¼ of Section 28, T. 34 N., R. 75 W., of the 6th P.M. (or W.R.M.),
   Wyoming, being specifically S 52° 17' 42" W., 1685.76' from NE cor. of Sec.
   (Bearing and Distance)
   or _______ ft. North and _______ ft. East from the _______ corner of Section _______, T. ______ N., R. ______ W.
   (Strike out words not needed).
5. TYPE OF CONSTRUCTION: Drilled ☑ Rotary ☐ Dug ☐ Driven ☐ Jetted ☐
   Other
6. CONSTRUCTION: Total Depth of Well _______ ft. Depth to Static Water Level _______ ft.
   a. Casing Schedule New ☑ Used ☐
      7 in. (OD) diameter from ______ ft. to ______ ft. Material Steel Gage ______
       ______ diameter from ______ ft. to ______ ft. Material ______ Gage ______
       ______ diameter from ______ ft. to ______ ft. Material ______ Gage ______
   b. Perforations: Type of perforator used slits
      Size of perforations ______ inches by ______ inches.
      Number of perforations and depths where perforated:
      ______ perforations from ______ ft. to ______ ft.
      ______ perforations from ______ ft. to ______ ft.
   c. Was well screen installed? Yes ☐ No ☑
      Diameter: ______ slot size: ______ set from ______ feet to ______ feet.
      Diameter: ______ slot size: ______ set from ______ feet to ______ feet.
   d. Was well gravel packed? Yes ☑ No ☐ Size of gravel ______
   e. Was surface casing used? Yes ☐ No ☑ Was it cemented in place? Yes ☑ No ☐
7. NAME & ADDRESS OF DRILLER Prong Horn Drilling, Glenrock, WY
8. DATE OF COMPLETION OF WELL (including pump installation) June 11, 1980
9. PUMP INFORMATION: Manufacturer Berkeley Type Submersible
   Source of power electricity Horsepower ______ Depth of Pump Setting ______
   Amount of Water Being Pumped ______ Gallons Per Minute. (For springs or flowing wells, see item 11.)

Permit No. U.W. 125024
Book No. 940
Page No. 25
10. PUMP TEST: Was a pump test made? Yes ☑ No □
   If so, by whom J & J Development Co. Address Box T-3, Glenrock, WY □
   Yield: 50 gal/min. with 400 foot drawdown after 24 hours.
   Yield: _______ gal/min. with _______ foot drawdown after _______ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).
   If well yields artesian flow, yield is _______ gal/min. Surface pressure is _______ lb./sq. inch, or _______ feet of water.
   The flow is controlled by: valve □ cap □ plug □
   Does well leak around casing? Yes □ No □

12. LOG OF WELL: Total depth drilled _______ feet.
   Depth of completed well _______ feet. Diameter of well _______ inches.
   Depth to first water bearing formation _______ feet.
   Depth to principal water bearing formation. Top _______ feet to Bottom _______ feet.
   Ground Elevation, if known App. _______ feet.

<table>
<thead>
<tr>
<th>From Feet</th>
<th>To Feet</th>
<th>Material Type, Texture, Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
<td>Sand &amp; gravel</td>
</tr>
<tr>
<td>30</td>
<td>500</td>
<td>Shale</td>
</tr>
<tr>
<td>500</td>
<td>550</td>
<td>sand</td>
</tr>
<tr>
<td>550</td>
<td>700</td>
<td>shale</td>
</tr>
<tr>
<td>700</td>
<td>750</td>
<td>salt &amp; pepper sand</td>
</tr>
<tr>
<td>750</td>
<td>850</td>
<td>shale</td>
</tr>
<tr>
<td>850</td>
<td>1200</td>
<td>shale &amp; clay</td>
</tr>
</tbody>
</table>

QUALITY OF WATER INFORMATION:
Was a chemical analysis made? Yes ☑ No □ (See microfilm for Permit No. U.W. 64210)
If so, please include a copy of the analysis with this form.
If not, do you consider the water as: Good ☑ Acceptable □ Poor □ Unused □
13. TABULATION

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Sec.</th>
<th>NE¼</th>
<th>NW¼</th>
<th>SW¼</th>
<th>SE¼</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area of use -- Corporate limits of the Town of Rolling Hills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL NUMBER OF ACRES TO BE IRRIGATED**

Original Supply ________ acres

Additional Supply ________ acres

14. PLAT

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

![Plat Diagram](image)

**Scale: 2" = 1 Mile**

REMARKS: ________________________________________

______________________________________

______________________________________
15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

[Signature]
Signature of Owner or Authorized Agent

[Date]
Date

u.w. 125024

Date of Receipt: FEB 16, 1988
Date of Priority: February 25, 1988
Date of Approval: April 29, 2000

[Signature]
for State Engineer
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
HERSCHEL BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

FOR OFFICE USE ONLY

PERMIT NO. U.W. 70662
WATER DIVISION No. 1 DISTRICT 82
U.W. DISTRICT Converse Co.

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.
All items must be completed before application is acceptable.

NAME AND NUMBER OF WELL

Rolling Hills #4

1. Name of applicant(s) Town of Rolling Hills Phone: 36-5348
2. Address of applicant(s) Coal Co. Rte. Box U-12 Glenrock, WY Zip: 82637
3. Name & address of agent to receive correspondence and notices E.C.H. & Associates P.O. Box 2699
Glenrock, WY 82637

4. Use to which the water will be applied: Domestic [ ] Stock Watering [ ]
Industrial [ ] Miscellaneous [ ] (Describe completely and accurately)

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE4/NW4 of Sec. 12, Township 14 North, Range 68 West.)
Converse County, SW 1/4 SW 1/4 of Sec. 15
T. 35 N., R. 73 W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot N/A, Block N/A of the
Subdivision (or Add'n) of N/A

6. Mark the well location on the section grid on the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.

7. Estimated depth of the well is 1,400 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 150 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stock watering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below.

10. If for irrigation use:
   a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
   b. [ ] Land will be irrigated from this well only.
   c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Sec.</th>
<th>NE 1/4</th>
<th>NE 1/4</th>
<th>NW 1/4</th>
<th>NW 1/4</th>
<th>SW 1/4</th>
<th>SW 1/4</th>
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<td>75</td>
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<td>75</td>
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<tr>
<td>34</td>
<td>75</td>
<td>28</td>
<td>x</td>
<td>x</td>
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<td>x</td>
<td>x</td>
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<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc.

Permit No. U.W. 70662 SEE REVERSE SIDE

Book No. 486 Page No. 90
12. The well is to be constructed on lands owned by _________________________________.

(Town of Rolling Hills)
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by _________________________________.

(Town of Rolling Hills)
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriative water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: _________________________________.

Under penalty of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

F.E. 2794 - Town Engineer

Signature of Applicant or Authorized Agent: _________________________________.

Date: _______________________________.

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES: $10.00

(Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)

IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS: $25.00

MISCELLANEOUS: NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING

STATE ENGINEER’S OFFICE

This instrument was received and filed for record on the 12th day of June, 1985, at 9:45 A.M.

Permit No. U.W. 70662

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

FOR ADDITIONAL CONDITIONS AND LIMITATIONS SEE ATTACHED STATUS SHEET

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, including pump installation.

Completion of construction and completion of the beneficial use of water for the purposes specified in Item 4 of this application will be made by December 31, 1985.

The amount of appropriation shall be limited to the quantity to which permittee is entitled at time of proof of application of water to beneficial use.


George L. Christopoulos
State Engineer

NOTICE OF EXPIRATION OF TIME OF COMMENCEMENT MAILED

MAR 31 1986

SEE: PERMIT STATUS SHEET.
PERMIT NO. U.W. 70662
T.F. 18-1-250
PERMIT STATUS

Priority Date June 12, 1985 Approval Date July 23, 1985

ADDITIONAL CONDITIONS AND LIMITATIONS:

1. A meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from this well.

2. An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period.

3. The report shall identify the well by name, location, permit number and shall identify the type of meter used for the measurement.

4. The report shall contain at least two (2) semi-annual measurements of the pumping water level in the well as measured after a minimum of twenty-four (24) consecutive hours of pumping. The dates the measurements were obtained and period of time the well was pumped prior to obtaining the measurements must be specified.

5. The report shall contain at least two (2) semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was "shut-in" prior to obtaining the measurements must be specified.

6. The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

July 23, 1985
DATE OF APPROVAL

George L. Christopoulos, State Engineer

December 4, 1986 - Notice of Commencement on September 1, 1985 received in affidavit form.

January 5, 1987 - Statement of Completion on October 1, 1986 received.

January 5, 1987 - Proof of Beneficial Use on October 22, 1986 received.

July 16, 1987 - Linen Map received. (TM 2245-E)

December 26, 1991 - Revised Mylar Map received. T.M. Number 2564-E.
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL

PERMIT NO. U.W. 70662 NAME OF WELL Rolling Hills #4

1. NAME OF OWNER Town of Rolling Hills

2. ADDRESS Coal Co. Rte. Box U-12 Glenrock, WY Zip Code 82637

3. USE OF WATER: Domestic ☐ Stock Watering ☐ Irrigation ☐ Municipal ☑ Industrial ☐ Miscellaneous ☐

4. LOCATION OF WELL: SW 1/4 SW 1/4 of Section 15, T. 34 N. R. 75 W. of the 6th P.M. (or W.R.M.), Wyoming, being specifically

   (Bearing and Distance)
   or 60 ft. North and 70 ft. East from the SW corner of Section 15, T. 34 N. R. 75 W.
   (Strike out words not needed)

5. TYPE OF CONSTRUCTION: Drilled ☑ Rotary ☐ Dug ☐ Driven ☐ Jetted ☐

   Other

6. CONSTRUCTION: Total Depth of Well 1540 ft. Depth to Static Water Level 350 ft.

   a. Casing Schedule New ☐ Used ☑

      7" diameter from 0 ft. to 1540 ft. Material Steel Gage 23 lbs/ft 0.317 wall thickness

      diameter from ft. to ft. Material

      diameter from ft. to ft. Material

   b. Perforations: Type of perforator used 2 Jet Shots/ft Using 22.7 Gram Aluminum Capsules

      Size of perforations ______ inches by ______ inches.

      Number of perforations and depths where perforated:

      2/ft perforations from 913 ft. to 1117 ft. feet.

      2/ft perforations from 1243 ft. to 1433 feet.

      2/ft perforations from 1500 ft. to 1512 feet.

   c. Was well screen installed? Yes ☐ No ☑ Diameter: ______ slot size: ______ set from ______ feet to ______ feet.

   d. Was well gravel packed? Yes ☐ No ☑ Size of gravel ______

   e. Was surface casing used? Yes ☑ No ☐ Was it cemented in place? Yes ☐ No ☐

7. NAME & ADDRESS OF DRILLER Pronghorn Drilling Box 805 Glenrock, WY 82637

8. DATE OF COMPLETION OF WELL (Including pump installation) 10/1/86

9. PUMP INFORMATION: Manufacturer Franklin Elec. & Gould Pumps Type Submersible

   Source of power PPL 3-phase Horsepower 20 Depth of Pump Setting 714

   Amount of Water Being Pumped 75 Gallons Per Minute, (For springs or flowing wells, see Item 11.)

Permit No. U.W. 486

Book No. 10 Page No. 90
10. PUMP TEST: Was a pump test made?  Yes ☐ No ☑

If so, by whom: Is being made by Anderson & Kelly  Address: Laramie, WY

Yield: ________ gal/min. with ________ foot drawdown after ________ hours.
Yield: ________ gal/min. with ________ foot drawdown after ________ hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is ________ gal/min. Surface pressure is ________ lb/sq. inch, or ________ feet of water.

The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing?  Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled ________ feet.

Depth of completed well ________ feet. Diameter of well 11" ________ inches.

Depth to first water bearing formation ________ feet.

Depth to principal water bearing formation. Top ________ feet to Bottom ________ feet.

Ground Elevation, if known ________

<table>
<thead>
<tr>
<th>From Feet</th>
<th>To Feet</th>
<th>Material Type, Texture, Color</th>
<th>REMARKS (Comalting, Stroff, Packing, etc.)</th>
<th>Indicate Water Bearing Formation</th>
<th>Indicate Perforated Casing Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SEE ATTACHED LITHOLOGIC LOG</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QUALITY OF WATER INFORMATION:

Was a chemical analysis made?  Yes ☑ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as:  Good ☑ Acceptable ☐ Poor ☐ Unusable ☐
## LITHOLOGIC LOG

**Rolling Hills No. 4**

T34N - R75W - 15SWSW

<table>
<thead>
<tr>
<th>Depth</th>
<th>Principal Lithology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-40</td>
<td>sand and sandstone</td>
<td>yellow-brn, f-cg, mod sort, ang-sub rnd, friable to unconsol, qtz-feld rich sst; 10-15% dark mafics</td>
</tr>
<tr>
<td>40-50</td>
<td>sand, gravel, and conglomerate</td>
<td>yellow-brn, fg-gravel, poorly sorted, poorly cemented cgl; clasts - buff, thin lam sh, gry-brn-red chert, red-org-buff fg sst</td>
</tr>
<tr>
<td>50-100</td>
<td>shale</td>
<td>gry, mod hard, thin lam, sli carb interlayers; detrital coal chips in sh matrix at 80</td>
</tr>
<tr>
<td>100-120</td>
<td>shaly coal</td>
<td>gry and blk speck, fg, qtz-rich sst; gry sh aa; granule-size detrital coal</td>
</tr>
<tr>
<td>120-160</td>
<td>sandy shale</td>
<td>gry, firm sh; 5-10% vfg-fg snd; abund. thin carb sh layers at 140</td>
</tr>
<tr>
<td>160-180</td>
<td>clayey shale</td>
<td>gry, v sli calc, firm; abund dess cracks on surf</td>
</tr>
<tr>
<td>180-260</td>
<td>sandy-clayey shale</td>
<td>gry, v sli calc, thin lam, aa; inc in carb material at 200; sst in thin stringers at 240</td>
</tr>
<tr>
<td>260-300</td>
<td>sandy-clayey shale &amp; siltstone</td>
<td>gry, aa; grn-gry, mod hard siltst; fg gyp-anhy(?)</td>
</tr>
<tr>
<td>300-360</td>
<td>sandy siltstone, sandstone, and claystone</td>
<td>gry and blk speck, mod hard, friable; vfg, qtz-rich, interbedded gry, sli calc, mod hard clyst at 340</td>
</tr>
<tr>
<td>360-380</td>
<td>siltly shale</td>
<td>gry and blk speck to grn-gry, mod hard</td>
</tr>
<tr>
<td>380-420</td>
<td>clayey shale, siltstone and coal</td>
<td>gry to grn-gry, firm to hard carb; grn to grn-gry, hard, non-calc siltst; blk-brn coal</td>
</tr>
<tr>
<td>420-440</td>
<td>siltstone, shale and carbonaceous shale</td>
<td>gry to gry-grn, mod hard, friable sltst; gry clayey sh; dk brn to gry, firm carb sh</td>
</tr>
<tr>
<td>440-500</td>
<td>sandstone, shale, and siltstone</td>
<td>gry to gry-grn, friable, vfg-fg sst; gry sh aa; gry, hard sltst at 460</td>
</tr>
<tr>
<td>500-560</td>
<td>siltstone and sandstone</td>
<td>gry to dk gry, mod hard, thin lam; gry-gry, vfg-mg, friable sst; tr carb material at 520</td>
</tr>
<tr>
<td>560-600</td>
<td>siltstone and shale</td>
<td>gry, carb aa; sly sh at 580</td>
</tr>
<tr>
<td>600-640</td>
<td>sandstone, siltstone, and clayey shale</td>
<td>gry to grn-gry, vfg to fg, poorly sorted, friable, w/ thin gyp (?) veinlets; gry, firm sltst; grn-gry, greasy text sh</td>
</tr>
<tr>
<td>640-660</td>
<td>siltstone and shale</td>
<td>gry, mod ind, thin lam; grn-gry, carb sh</td>
</tr>
<tr>
<td>660-740</td>
<td>shale, siltstone, and claystone</td>
<td>gry, firm to mod hard to v hard sh; gry to grn-gry sltst aa; gry-white, mod soft clyst</td>
</tr>
<tr>
<td>740-770</td>
<td>claystone and shale</td>
<td>grn-gry to dk gry, carb, thin lam</td>
</tr>
<tr>
<td>770-800</td>
<td>siltstone and shale</td>
<td>aa in 640</td>
</tr>
<tr>
<td>800-820</td>
<td>siltstone</td>
<td>gry, mod ind, slf friable, thin lam</td>
</tr>
<tr>
<td>820-840</td>
<td>siltstone and shale</td>
<td>sltst aa; dk gry carb sh</td>
</tr>
<tr>
<td>840-880</td>
<td>clayey shale</td>
<td>gry, fissile, slf carb sh</td>
</tr>
<tr>
<td>880-920</td>
<td>sandstone, siltstone, and shale</td>
<td>gry, friable, vfg sst; gry-grn sltst; gry sh; sst content inc at 900</td>
</tr>
<tr>
<td>920-960</td>
<td>clayey sandstone, siltstone and shale</td>
<td>gry-white, vfg, friable sst; gry sltst aa; gry sh aa</td>
</tr>
<tr>
<td>960-980</td>
<td>shale</td>
<td>gry, mod hard to v hard, &lt;5% detrital coal chips</td>
</tr>
<tr>
<td>Layer</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------</td>
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</tr>
<tr>
<td>980-1100</td>
<td>shale and sandstone</td>
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<tr>
<td>1100-1120</td>
<td>siltstone and shale</td>
<td></td>
</tr>
<tr>
<td>1120-1160</td>
<td>clayey sandstone, sandstone and shale</td>
<td></td>
</tr>
<tr>
<td>1160-1200</td>
<td>shale, carbonaceous shale, and sandstone</td>
<td></td>
</tr>
<tr>
<td>1200-1260</td>
<td>shale, siltstone, and sandstone</td>
<td></td>
</tr>
<tr>
<td>1260-1300</td>
<td>shale, carbonaceous shale, and sandstone</td>
<td></td>
</tr>
<tr>
<td>1300-1380</td>
<td>shale and sandstone</td>
<td></td>
</tr>
<tr>
<td>1380-1400</td>
<td>clayey sandstone and shale</td>
<td></td>
</tr>
<tr>
<td>1400-1410</td>
<td>shale and sandstone</td>
<td></td>
</tr>
<tr>
<td>1410-1440</td>
<td>sandstone and shale</td>
<td></td>
</tr>
</tbody>
</table>

- sh aa; white-gry, vfg, friable sst
- gry, thin lam slst and sh
- yellow-brn to white-gry, vfg to fg, mod well sort, friable sst; gry sh; detrital (?) coal at 1140
- gry, massive, mod hard, slf slty; dk brn-blk, fissile, carb sh; gry-grn vfg, friable, slty sst
- gry to dk gry, slf carb to carb sh, mod hard to hard; gry, massive, mod ind slst; lt gry-grn, vfg, friable sst
- gry, massive, mod hard sh; dk brn-blk, fissile, soft sh; sst aa
- gry sh and carb sh aa; sst aa; detrital coal at 1340
- white-gry, vfg, friable sst; gry sh aa
- gry, massive to carb, firm sh; grn-gry, vfg, slty sst
- sst as at 1380; gry sh aa
13. **TABULATION**

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the “Remarks” section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If the proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the “Remarks” section under Item 14.

<table>
<thead>
<tr>
<th>Town</th>
<th>Range</th>
<th>Sec.</th>
<th>NE %</th>
<th>NW %</th>
<th>SW %</th>
<th>SE %</th>
<th>NE %</th>
<th>NW %</th>
<th>SW %</th>
<th>SE %</th>
<th>TOTALS</th>
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</thead>
<tbody>
<tr>
<td>34</td>
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<td>15</td>
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<td></td>
<td></td>
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<tr>
<td>34</td>
<td>75</td>
<td>22</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>34</td>
<td>75</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>75</td>
<td>28</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL NUMBER OF ACRES TO BE IRRIGATED:** 438.15

Original Supply ________ acres

Additional Supply ________ acres

14. **PLAT**

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or points and describe method of conveyance of water to points of use on plat and in “Remarks” section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

Scale: 2” = 1 Mile

**REMARKS:** Well to supply the Town of Rolling Hills, Converse County, Wyoming
15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

[Signature]

Signature of Owner or Authorized Agent

Robert C. Hartley, P.E. No. 2794
Town Engineer/Rolling Hills

Date

Dec. 31 1986

Date of Receipt: JAN 5 1987

Date of Priority: June 12 1985

Date of Approval: March 11 1987

[Signature]

for State Engineer

Bruce R. Bankman
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER

PROOF OF APPROPRIATION AND BENEFICIAL USE OF GROUND WATER

The owner is responsible for submitting Parts I and II of this form. Part III will be prepared by a State Engineer Representative at time of inspection.

PART I

WATER DIVISION 1 (15-5) ____________________________

STATEMENT OF CLAIM ____________________________

PERMIT NO. U.W. 70662 ____________________________

WELL REGISTRATION ____________________________

NAME OF WELL Rolling Hills 94 ____________________

U.W. DISTRICT Converse Co _______________________

DATE OF PRIORITY June 12, 1985 ___________________

LOCATION, 54° 42' 46" N., 105° 14' 46" W. of Section 15 ____________________________

T. 54 N., R. 76 W. ____________________________

1. Name of Claimant(s) ____________________________

   Town of Rolling Hills ____________________________

2. Address Coal Co. Rte. Box U-12 Glenrock, WY ____________________________

   Zip Code 82637 ____________________________

3. For What Purpose(s) is Water Used? Use: Municipal ____________________________

   Date First Used 10/22/1986 ____________________________

   Use: Municipal ____________________________

   Date First Used 10/22/1986 ____________________________

   If use is for irrigation, give date irrigation was completed on all lands under this Permit: ____________________________

PART II

For Irrigation, Industrial, Municipal and Miscellaneous Wells

A plat which has been certified by a licensed professional engineer or land surveyor shall be submitted to accompany this form. The plat shall be in accordance with Sec. 33-29-111 Wyoming Statutes 1977 or see Chapter V and VI, Manual of Regulations and Instructions issued by the State Engineer's Office. (Minimum scale shall be 2' = 1 mile.) The map shall be prepared with waterproof black ink on tracing linen or an acceptable equivalent and shall show on a suitable scale the legal subdivisions, the accurate location of the well or wells, storage facilities, if any, main canals, streams, highways and other important cultural features. Land ownership will be shown, if there is more than one owner under the permit.

IRRIGATION WELLS

Acreage irrigated under terms of this permit will be clearly shown with a distinctive pattern and a distinction clearly made between lands having an original supply and those provided a supplemental supply. Where use is for supplemental supply for lands with a right from another source, indicate the priority or permit number of the source, the source of supply and the name of the ditch, pipe line or other well. Conveyance system will be shown and described. Indicate method of irrigation being used.

INDUSTRIAL WELLS

In addition to the information outlined above, industrial users will locate and describe conveyance facilities to the point(s) of use, giving as accurately as possible the location of points of use. Permits for other sources of water must be identified.

MUNICIPAL WELLS

The plat will show the area of use and show and describe the means of conveyance of the water from the well to the connection with the distribution system for a municipal water system.

MISCELLANEOUS WELLS

(1) The linen plat for wells where the use is described as miscellaneous and where the yield flow of the well exceeds twenty-five (25) gallons per minute must show the area of use and describe and show the means of conveyance from the well to the distribution system and/or points of use.

(2) The plat for wells where the use is described as miscellaneous and where the yield or flow is twenty-five (25) gallons per minute or less may be a 7½ minute United States Geological Survey Quadrangle map in lieu of a linen tracing provided the U.S. Geological Survey Quadrangle map is in compliance with the following conditions:

(a) The entire United States Geological Survey quadrangle map must be submitted to the State Engineer's Office.

(b) The scale on said quadrangle map must be one to twenty-four thousand.

(c) An identified section corner or quarter corner must be shown on said quadrangle map along with Section, Township and Range.

(d) The section in which the well is located and the section(s) where the area(s) or point(s) of use are located must be subdivided into forty (40) acre tracts and the well location and area(s) or point(s) of use clearly labeled and described.

(e) Said quadrangle map showing the well location and area(s) or point(s) of use must be certified by a professional engineer or land surveyor licensed to practice within the State of Wyoming.
A "CERTIFICATE OF OWNERSHIP" FROM THE COUNTY CLERK'S OFFICE SHOWING OWNERSHIP OR CONTROL OF LAND(S) INVOLVED MUST ACCOMPANY THIS FORM.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

[Signature of Owner or Authorized Agent]

Robert C. Hartley, P.E. No. 2794
Town Engineer/Rolling Hills

Date of Receipt: JAN 5 1987

Dec. 31 1986

Date
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
HERSCHLER BUILDING
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER
FOR OFFICE USE ONLY

PERMIT NO. U.W. 81833
WATER DIVISION NO. __ DISTRICT 155
U.W. DISTRICT Convers Co.

NOTE: Do not fold this form. Use typewriter or print neatly with black ink.
ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE.

Temporary Filing No. U.W. 21-3-17

NAME AND NUMBER OF WELL  Rolling Hills No. 5

1. Name of applicant(s)  Town of Rolling Hills, Wyoming  Phone: 436-5346

2. Address of applicant(s)  Coal Co. Route, Box U-12  Zip: 82067

3. Name & address of agent to receive correspondence and notices  James M. Montgomery  170 N. 5th St., P.O. Box 29, Laramie, Wyoming 82070

ATTN: Todd Jarvis (712-9220) or Larry Werser

4. Use to which the water will be applied: Domestic [ ]  Stock Watering [ ]  Industrial [ ]  Miscellaneous [ ]  (Describe completely and accurately) To be commingled with water from Rolling Hills (R.H.) No. 1, R.H. No. 2, R.H. No. 3 and R.H. No. 4 to serve the needs of the Rolling Hills community.

5. Location of the well: (NOTE: Quarter-quarter (40-acre subdivision) MUST be shown. EXAMPLE: SE4 NW4 of Sec. 12, Township 14 North, Range 68 West.)

Converse County, SW 1/4 of Sec. 15
T. 34 N.  R.  7S.  W. of the 6th P.M. (or W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot ______ of the ___________ Block ______ of the _________ Subdivision (or Add'n) of _______.

6. Mark the well location on the section grid to the right. LOCATION SHOWN IN ITEM 5 MUST AGREE WITH GRID. If the proposed well is for irrigation use, sketch and label all irrigation ditches and canals, stream, reservoirs and other wells. Indicate the point of use or lands to be irrigated from other sources.

7. Estimated depth of the well is 1500 feet.

8. MAXIMUM quantity of water to be developed and beneficially used: 150 gallons per minute. NOTE: If for domestic or stock use, this application will be processed for a maximum of 25 gallons per minute. 

SPRINGS: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic or stockwatering, will be considered as ground water appropriations. After approval of this application, some type of artificial diversion must be constructed to qualify for a water right.

9. If use is not irrigation, mark the point(s) or area(s) of use in the tabulation below.

10. If for irrigation use:
   a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation below.
   b. [ ] Land will be irrigated from this well only.
   c. [ ] Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

Township  Range Sec.  NE1/4  NW1/4  SW1/4  SE1/4
   N  NW1/4  NE1/4  N  NW1/4  NE1/4  N  NW1/4  NE1/4
   N  NW1/4  NE1/4  N  NW1/4  NE1/4  N  NW1/4  NE1/4
   N  NW1/4  NE1/4  N  NW1/4  NE1/4  N  NW1/4  NE1/4

11. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc.

SEE REVERSE SIDE

Permit No. U.W. 81833

Book No. 599  Page No. 34
12. The well is to be constructed on lands owned by The Town of Rolling Hills, Wyoming
(The granting of a permit does not constitute the granting of right of way. If any easement or right of way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not a co-applicant.)

13. The water is to be used on lands owned by residents of Rolling Hills community.
(If landowner is not the applicant, a copy of the agreement relating to usage of appropriated water on the land should be submitted to this office. If the landowner is included as a co-applicant on the application, this procedure need not be followed.)

REMARKS: The water from this well is to be commingled with that of Rolling Hills No. 1 (P5169W & P54210W), Rolling Hills No. 2 (P54211W), Rolling Hills No. 3 (P64212W), and Rolling Hills No. 4 (P70662W) within the water distribution system of the Rolling Hills community.

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

[Signature]
Signature of Applicant or Authorized Agent

January 24, 1996
Date

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES
$10.00

(Domestic use is defined as a single-family dwelling and the watering of lawns and gardens not exceeding one (1) acre)

IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS
$25.00

MOUNT (For water level measurements or chemical quality sampling)
NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

THE STATE OF WYOMING

STATE ENGINEER'S OFFICE

This instrument was received and filed for record on the 24th day of January, A.D. 1996, at 1:30 o'clock P.M.

Permit No. U.W. 81833

For State Engineer

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1957, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use, without loss of water into surface formations or at the surface.

FOR ADDITIONAL CONDITIONS AND LIMITATIONS SEE ATTACHED STATUS SHEET

Approval of this application may be considered as authorization to proceed with construction of the proposed well.

Construction of well will begin within one (1) year from date of approval. A Statement of Completion will be filed within thirty (30) days of completion of construction, including pump installation.

Completion of construction and completion of the beneficial use of water for the purposes specified in Item 4 of this application will be made by December 31, 1996.

The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.

Witness my hand this 24th day of February, A.D. 1996.

[Signature]
State Engineer

Gordon W. Fassett

SCANNED JUL 07 2006
PERMIT NO. I.M. 81833

PERMIT STATUS

Priority Date January 24, 1990 Approval Date February 24, 1990

ADDITIONAL CONDITIONS AND LIMITATIONS:

1. A meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from this well.

2. An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period.

3. The report shall identify the well by name, location, permit number and shall identify the type of meter used for the measurement.

4. The report shall contain at least two (2) semi-annual measurements of the pumping water level in the well as measured after a minimum of twenty-four (24) consecutive hours of pumping. The dates the measurements were obtained and period of time the well was pumped prior to obtaining the measurements must be specified.

5. The report shall contain at least two (2) semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was "shut-in" prior to obtaining the measurements must be specified.

6. The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.

February 24, 1990
Gordon W. Fassett, State Engineer

DATE OF APPROVAL

April 30, 1990 - Notice of Commencement on March 22, 1990 received.

December 04, 1990 - Statement of Completion on August 15, 1990 received.

December 04, 1990 - Gamma Ray Log Received and filed in Electric Log Drawer.

SEP 30 '91 NOTICE OF EXPIRATION OF TIME FOR COMPLETION OF BENEFICIAL USE EVALUATION

Microfilmed Aug 22 '91

December 26, 1991 - Proof of Beneficial Use form on August 15, 1990 received.

December 26, 1991 - Linen Map received. (T.M.# 2564-E)

Microfilmed Jun 10 1992

Scanned Jul 07 2006
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER

PERMIT NO. U.W. 81833  NAME OF WELL  Rolling Hills No. 5

1. NAME OF OWNER  Town of Rolling Hills, WY

2. ADDRESS  Town Hall, 38 S. Badger Road, Coal Route, Box U-12  Zip Code 82637

3. USE OF WATER: Domestic ☐  Stock Watering ☐  Irrigation ☐  Municipal ☒  Industrial ☐  Miscellaneous ☐

4. LOCATION OF WELL: SW 1/4 SW 1/4 of Section 15  T. 34 N, R. 75 W, of the 6th P.M. (or W.R.M.), Wyoming, being specifically

<table>
<thead>
<tr>
<th>Bearing and Distance</th>
<th>East or West</th>
</tr>
</thead>
<tbody>
<tr>
<td>1227 ft. North</td>
<td>50 ft.</td>
</tr>
</tbody>
</table>

or

<table>
<thead>
<tr>
<th>Strike out words not needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1227 ft. North</td>
</tr>
<tr>
<td>50 ft. West</td>
</tr>
</tbody>
</table>

5. TYPE OF CONSTRUCTION: Drilled ☒  Midway 2250 Rotary ☐  Dug ☐  Driven ☐  Jetted ☐

6. CONSTRUCTION: Total Depth of Well 1763 ft. Depth to Static Water Level 230 ft.

   a. Casing Schedule  New ☒  Used ☐

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Material</th>
<th>Gage</th>
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</thead>
<tbody>
<tr>
<td>6-3/4&quot;</td>
<td>steel</td>
<td>0.279&quot;</td>
</tr>
<tr>
<td>7-5/8&quot;</td>
<td>steel</td>
<td>0.328&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>steel</td>
<td>0.237&quot;</td>
</tr>
</tbody>
</table>

   b. Perforations: Type of perforator used

<table>
<thead>
<tr>
<th>Size of perforations</th>
<th>set from</th>
<th>to</th>
</tr>
</thead>
<tbody>
<tr>
<td>inches by inches</td>
<td>1521 feet</td>
<td>1531 feet</td>
</tr>
</tbody>
</table>

   Number of perforations and depths where perforated:

<p>| perforations from | to |</p>
<table>
<thead>
<tr>
<th>ft.</th>
<th>ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1572</td>
<td>1582</td>
</tr>
<tr>
<td>1618</td>
<td>1648</td>
</tr>
<tr>
<td>1670</td>
<td>1700</td>
</tr>
<tr>
<td>1730</td>
<td></td>
</tr>
</tbody>
</table>

   c. Was well screen installed? Yes ☒  No ☐

   Diameter: 4-inch slot size: 0.015" set from 851 feet to 861 feet.

   Diameter: 4-inch slot size: 0.015" set from 1010 feet to 1111 feet.

   Diameter: 4-inch slot size: 0.015" set from 1424 feet to 1481 feet.

   d. Was well gravel packed? Yes ☒  No ☐

   Size of gravel

   e. Was surface casing used? Yes ☒  No ☐

   Was it cemented in place? Yes ☒  No ☐

7. NAME & ADDRESS OF DRILLER D. C. Drilling Co., P. O. Box 756, Lusk, WY 82225

8. DATE OF COMPLETION OF DRILL (including pump installation) 8/15/90

9. PUMP INFORMATION: Manufacturer  Gould's Pumping  Type J-20

   Source of power  Electricity  Horsepower 20  Depth of Pump Setting 738

   Amount of Water Being Pumped 75 Gallons Per Minute. (For springs or flowing wells, see item 11.)
10. PUMP TEST: Was a pump test made? Yes ☑ No ☐

If so, by whom: James M. Montgomery, Cons. Engr. Address: 170 North 5th, Laramie, WY 82070

Yield: 77 gal/min. with 489 foot drawdown after 119 hours.
Yield: 120 gal/min. with 400 foot drawdown after 1 hours.

11. FLOWING WELL (Owner is responsible for control of flowing well).

If well yields artesian flow, yield is _______ gal/min. Surface pressure is _______ lb/sq. inch, or _______ feet of water.
The flow is controlled by: valve ☐ cap ☐ plug ☐

Does well leak around casing? Yes ☐ No ☐

12. LOG OF WELL: Total depth drilled _______ feet.

0-801 = 7 5/8" 756-1750 = 4" inches.

Depth of completed well _______ feet. Diameter of well _______ inches.

Depth to first water bearing formation _______ feet.

Depth to principal water bearing formation. Top _______ feet to Bottom _______ feet.

Ground Elevation, if known _______ 5433

<table>
<thead>
<tr>
<th>From Feet</th>
<th>To Feet</th>
<th>Material Type, Texture, Color</th>
<th>REMARKS (Cementing, Shutoff, Paching, etc.)</th>
<th>Indicate Water Bearing Formation</th>
<th>Indicate Perforated Casing Location</th>
</tr>
</thead>
</table>

See attached lithologic log

QUALITY OF WATER INFORMATION:

Was a chemical analysis made? Yes ☑ No ☐

If so, please include a copy of the analysis with this form.

If not, do you consider the water as: Good ☐ Acceptable ☐ Poor ☐ Unusable ☐
13. **TABULATION**

a. If for irrigation, the land proposed to be irrigated should be described in the following tabulation. Describe in the "Remarks" section, under Item 14, the means of conveying the water to the lands and the method of irrigation.

(Give irrigable acreage in each legal subdivision. If proposed use is for additional supply for lands with a right from another source, indicate in the tabulation the priority or permit number, the source of supply and the name of the ditch or other well.)

b. If not used for irrigation, show the area and point(s) of use and location of well in the tabulation below. Also describe the method of conveyance in the "Remarks" section under Item 14.

<table>
<thead>
<tr>
<th>Town Ship</th>
<th>Range</th>
<th>Sec.</th>
<th>NE 1/4</th>
<th>NW 1/4</th>
<th>SW 1/4</th>
<th>SE 1/4</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>34N 75W</td>
<td>15</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>Well Location</td>
</tr>
<tr>
<td>34N 75W</td>
<td>15</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>Points of Use</td>
</tr>
<tr>
<td>34N 75W</td>
<td>22</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>Town Limits</td>
</tr>
<tr>
<td>34N 75W</td>
<td>28</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Town Limits</td>
</tr>
</tbody>
</table>

**TOTAL NUMBER OF ACRES TO BE IRRIGATED**

Original Supply __________ acres

Additional Supply __________ acres

14. **PLAT**

a. If the well is to be used for irrigation, industrial, miscellaneous or municipal use, show the location of the well on the plat below. For such uses, a plat certified by a licensed engineer or land surveyor is required to be submitted at the time the Proof of Appropriation and Beneficial Use of Ground Water is submitted.

b. For other uses, accurately show the well location, point of use or uses and describe method of conveyance of water to points of use on plat and in "Remarks" section below. Make certain location on plat agrees with written description.

c. A separate map may be submitted if the information required cannot be shown on this plat.

REMARKS: Water from well to be conveyed to existing storage tank for later distribution in Town's existing distribution system.
15. IF WELL IS TO BE ABANDONED, complete Items 1 through 8, Item 12 (Log of Well) and state reason for abandonment and details of the plugging below.

It is the responsibility of the owner to properly plug or fill in the well in order to prevent contamination of ground water and to cover or cap the well at ground level.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Signature of Owner or Authorized Agent

Date

Date of Receipt DEC 4 1990
Date of Priority JANUARY 24, 1990
Date of Approval DEC 13 1990

for State Engineer
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER

PROOF OF APPROPRIATION AND BENEFICIAL USE OF GROUND WATER

The owner is responsible for submitting Parts I and II of this form. Part III will be prepared by a State Engineer Representative at time of inspection.

PART I

WATER DIVISION: 1 (15-5)

STATEMENT OF CLAIM

PERMIT NO. U.W. 81833

WELL REGISTRATION

NAME OF WELL: Rolling Hills No. 5

U.W. DISTRICT: Converse Co.

DATE OF PRIORITY: January 24, 1990

LOCATION: SW ¼ SW ¼ of Section 15

T. 34 N, R. 75 W.

1. Name of Claimant(s)
   Town of Rolling Hills, Wyoming

2. Address
   Box U-12 Coal Co. Route
   Zip Code: 82637

3. For What Purpose(s) is Water Used? Use: Municipal
   Date First Used: August 15, 1990
   Uses: Date First Used: , 19

If use is for irrigation, give date irrigation was completed on all lands under this Permit:

PART II

For Irrigation, Industrial, Municipal and Miscellaneous Wells

A plat which has been certified by a licensed professional engineer or land surveyor shall be submitted to accompany this form. The plat shall be in accordance with Sec. 33-29-111 Wyoming Statutes 1977 or see Chapter V and VI, Manual of Regulations and Instructions issued by the State Engineer's Office. (Minimum scale shall be 2" = 1 mile.) The map shall be prepared with waterproof black ink on tracing linen or an acceptable equivalent and shall show on a suitable scale the legal subdivisions, the accurate location of the well or wells, storage facilities, if any, main canals, streams, highways and other important cultural features. Land ownership will be shown, if there is more than one owner under the permit.

IRRIGATION WELLS

Average irrigated under terms of this permit will be clearly shown with a distinctive pattern and a distinction clearly made between lands having an original supply and those provided a supplemental supply. Where use is for supplemental supply for lands with a right from another source, indicate the priority or permit number of the source, the source of supply and the name of the ditch, pipe line or other well. Conveyance system will be shown and described. Indicate method of irrigation being used.

INDUSTRIAL WELLS

In addition to the information outlined above, industrial users will locate and describe conveyance facilities to the point(s) of use, giving as accurately as possible the location of points of use. Permits for other sources of water must be identified.

MUNICIPAL WELLS

The plat will show the area of use and show and describe the means of conveyance of the water from the well to the connection with the distribution system for a municipal water system.

MISCELLANEOUS WELLS

1. The linear plat for wells where the use is described as miscellaneous and where the yield flow of the well exceeds twenty-five (25) gallons per minute must show the area of use and describe and show the means of conveyance from the well to the distribution system and/or points of use.

2. The plat for wells where the use is described as miscellaneous and where the yield flow is twenty-five (25) gallons per minute or less may be a 7½ minute United States Geological Survey Quadrangle map in lieu of a linear tracing provided the U.S. Geological Survey Quadrangle map is in compliance with the following conditions:

   (a) The entire United State Geological Survey quadrangle map must be submitted to the State Engineer's Office.

   (b) The scale on said quadrangle map must be one to twenty-four thousand.

   (c) An identified section corner or quarter corner must be shown on said quadrangle map along with Section, Township and Range.

   (d) The section in which the well is located and the section(s) where the area(s) or point(s) of use are located must be subdivided into forty (40) acre tracts and the well location and area(s) or point(s) of use clearly labeled and described.

   (e) Said quadrangle map showing the well location and area(s) or point(s) of use must be certified by a professional engineer or land surveyor licensed to practice within the State of Wyoming.
A "CERTIFICATE OF OWNERSHIP" FROM THE COUNTY CLERK'S OFFICE SHOWING OWNERSHIP OR CONTROL OF LAND(S) INVOLVED MUST ACCOMPANY THIS FORM.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

Signature of Owner or Authorized Agent
Robert C. Hartley P.E. #2794
Town Engineer

Date of Receipt: DEC 26 1991

December 19, 1991 Date
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
HERSCHLIER BLDG., 4-E
CHEYENNE, WYOMING 82002

APPLICATION FOR PERMIT TO APPROPRIATE GROUND WATER

APPLICATION FOR WELLS AND SPRINGS

Note: Only springs flowing 25 gallons per minute or less, where the proposed use is domestic and/or stock watering, will be considered as ground water appropriations.

FOR OFFICE USE ONLY

Temporary Filing No. U.W. 22-7-251
NOTE: Do not fold this form. Use typewriter or print neatly with black ink.
ALL ITEMS MUST BE COMPLETED BEFORE APPLICATION IS ACCEPTABLE

PERMIT NO. U.W. 125025

WATER DIVISION NO. 1 DISTRICT 15-5
U.W. DISTRICT Converse Co.

NAME AND NUMBER OF WELL or SPRING Rolling Hills #6 Well

1. Name of applicant(s) Town of Rolling Hills
   Phone: (307) 436-5368

2. Address of applicant(s) 38 South Badger, Rolling Hills, WY 82637
   (MAILING ADDRESS) (CITY) (STATE) (ZIP)

3. Name & address of agent to receive correspondence and notices
   Phone:
   (MAILING ADDRESS) (CITY) (STATE) (ZIP)

4. Use to which the water will be applied:
   - Domestic: Use of water in 3 single family dwellings or less, noncommercial watering of lawns and gardens totaling one acre or less. Number of houses served?
   - Stock Watering: Normal livestock use at four tanks or less within one mile of well or spring. Stockwatering pipelines and commercial feedlots are a miscellaneous use. Number of stock tanks?
   - Irrigation: Watering of commercially grown crops (large-scale lawn watering of golf courses, cemeteries, recreation areas, etc., is miscellaneous use).
   - Municipal: Use of water in incorporated Towns and Cities (use of water in unincorporated towns, subdivisions, improvement districts, mobile home parks, etc. are classified as miscellaneous use).
   - Industrial: Long term use of water for the manufacture of a product or production of oil/gas or other minerals (off line water flood operations, power plant water supply, etc.). (Describe in REMARKS)
   - Miscellaneous: Any use of water not defined under previous definitions such as stockwatering pipelines, subdivisions, mine dewatering, mineral / oil exploration drilling, potable supplies in office, etc. Describe in remarks.
   - Coal Bed Methane Water produced in production of coal bed methane gas.
   - Monitor, Observation or Test Well: (Describe in REMARKS)

5. Location of the well or spring: (NOTE: Quarter-quarter (40 acre subdivision) MUST be shown. EXAMPLE: 9E 1/4 NW 1/4 of Sec. 12, Township 14 North, Range 86 West.)
   Converse County, SW 1/4 SE 1/4 of Sec. 16, T. 41 N., R. 75 W. of the 6th P.M. (W.R.M.), Wyoming. If located in a platted subdivision, also provide Lot/Tract Block of the Subdivision (or Add't) of Resurvey Location: Lot , Tract , Block of the

6. Estimated depth of the well or spring is 1785.91 feet.

7. (a) MAXIMUM instantaneous flow of water to be developed and beneficially used: 100 gallons per minute. NOTE: If for domestic and / or stock use, this application will be processed for a maximum of 25 gallons per minute. For a spring, after approval of this application, some type of artificial diversion or improvement must be constructed to qualify for a water right.
   (b) MAXIMUM volumetric quantity of water to be developed and beneficially used per calendar year: 340.0 Circle appropriate units: (Gallons) (Acres Feet) A four person family utilizes approximately one (1) acre-foot of water per year or 325,000 gallons.

8. Mark the point(s) or area(s) of use in the tabulation box below.

<table>
<thead>
<tr>
<th>TWP</th>
<th>RING</th>
<th>SEC</th>
<th>NE 1/4</th>
<th>NW 1/4</th>
<th>SW 1/4</th>
<th>SE 1/4</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>75</td>
<td>15</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
</tr>
<tr>
<td>34</td>
<td>75</td>
<td>22</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>34</td>
<td>75</td>
<td>27</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>34</td>
<td>75</td>
<td>28</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

9. If for irrigation use:
   a. Describe MAXIMUM acreage to be irrigated in each 40 acre subdivision in the tabulation box above.
   b. Land will be irrigated from this well only.
   c. Land is irrigated from existing water right(s) with water from this well to be additional supply. Describe existing water right(s) under REMARKS.

10. If for irrigation use, describe method of irrigation, i.e. center pivot sprinkler, flood, etc.: ________

Permit No. U.W. 125025 SEE REVERSE SIDE
Book No. 940 Page No. 26
11. The well or spring is to be constructed on lands owned by ____________________________ State of Wyoming
   (The granting of a permit does not constitute the granting of right-of-way. If any easement or right-of-way is necessary in connection with this application, it should be understood that the responsibility is the applicant's. A copy of the agreement should accompany this application, if the land is privately owned and the owner is not the co-applicant.)

12. The water is to be used on lands owned by ____________________________ Town of Rolling Hills
   (If the landowner is not the applicant, a copy of the agreement relating to the usage of appropriated water on the land should be submitted to this office. If the landowner is included as co-applicant on the application, this procedure need not be followed.)
   NOTE: Water rights attach to the area(s) and/or point(s) of use.

REMARKS: This is a refiling of Permit No. U.W. 99726 (cancelled) which was approved for test purposes only. Water from this well will be commingled with water from the
   Rolling Hills No. 1 Well, Permit No. U.W. 125023
   Rolling Hills No. 2 Well, Permit No. U.W. 125024
   Rolling Hills #4 Well, Permit No. U.W. 70662
   and the Rolling Hills No. 5 Well, Permit No. U.W. 819833.

Under penalties of perjury, I declare that I have examined this application and to the best of my knowledge and belief it is true, correct and complete.

[Signature of Applicant or Authorized Agent] 3-27 2000

THE LEGALLY REQUIRED FILING FEE MUST ACCOMPANY THIS APPLICATION

DOMESTIC AND/OR STOCK WATERING USES
   Domestic use is defined as use of water in 3 or more family dwellings or less,
   noncommercial watering of lawns and gardens totaling one acre or less.)

IRRIGATION, MUNICIPAL, INDUSTRIAL, MISCELLANEOUS, COAL BED METHANE

MONITOR (For water level measurements or chemical quality sampling) or TEST WELL
   NO FEE

IF WELL WILL SERVE MULTIPLE USES, SUBMIT ONLY ONE (THE HIGHER) FILING FEE.

   THIS SECTION IS NOT TO BE FILLED IN BY APPLICANT

THE STATE OF WYOMING

STATE ENGINEER'S OFFICE

This instrument was received and filed for record on the 3RD day of APRIL, A.D. 2000, at 10:30 o'clock A.M.

Permit No. U.W. 125025

[Signature of State Engineer]

THIS IS TO CERTIFY that I have examined the foregoing application and do hereby grant the same subject to the following limitations and conditions:

This application is approved subject to the condition that the proposed use shall not interfere with any existing rights to ground water from the same source of supply and is subject to regulation and correlation with surface water rights, if the ground and surface waters are interconnected. The use of water hereunder is subject to the further provisions of Chapter 169, Session Laws of Wyoming, 1967, and any subsequent amendments thereto.

Granting of a permit does not guarantee the right to have the water level or artesian pressure in the well maintained at any specific level. The well should be constructed to a depth adequate to allow for the maximum development and beneficial use of ground water in the source of supply.

If the well is a flowing artesian well, it shall be so constructed and equipped that the flow may be shut off when not in use without loss of water into sub-surface formations or at the land surface.

Coal Bed Methane wells have Additional Conditions and Limitations on attachment sheet.

This permit and accompanying notices serve to register an existing well and establish a valid water right for the same. Time limit for Completion of Construction and Completion of Beneficial Use is waived.

FOR ADDITIONAL CONDITIONS AND LIMITATIONS SEE ATTACHED STATUS SHEET.

[Signature of State Engineer]

The amount of appropriation shall be limited to the quantity to which permittee is entitled as determined at time of proof of application of water to beneficial use.

Witness my hand this 29th day of APRIL, A.D. 2000

[Signature of State Engineer]
PERMIT NO. U.W. 125025  
T.F. No. 28-7-251  

PERMIT STATUS  

Priority Date April 3, 2000  
Approval Date APR 29, 2000  

March 21, 2000 - SEO letter mailed to applicant advising of North Platte River implications.  
April 3, 2000 - Written confirmation of applicant’s appraisal of the situation received with instructions to proceed with the application review and approval. See both letters filed in Miscellaneous Notices under Permit No. U.W. 125025  

ADDITIONAL CONDITIONS AND LIMITATIONS:  
1. A meter acceptable to the State Engineer is required to accurately measure the total quantity of water produced from this well.  
2. An annual report shall be submitted to the State Engineer no later than February 15 of each year stating the total amount of water produced from this well each month during the previous January 1 to December 31, twelve (12) month period.  
3. The report shall identify the well by name, location, permit number and shall identify the type of meter used for the measurement.  
4. The report shall contain at least two (2) semi-annual measurements of the static water level in the well as measured twenty-four (24) consecutive hours after pumping has ceased. The dates the measurements were obtained and the period of time the well was “shut-in” prior to obtaining the measurements must be specified.  
5. The State Engineer may, upon written request, waive all or any portion of these conditions and limitations.  

The water appropriated under this ground water permit has been determined to constitute one source of supply and the provisions of Section 41-3-916, Wyoming Statutes, shall apply as follows:  

"41-3-916. Priority of rights when 1 source of supply. Where underground waters in different aquifers are so interconnected as to constitute in fact one source of supply, or where underground waters and the waters of surface streams are so interconnected as to constitute in fact one source of supply, priorities of rights to the use of such interconnected waters shall be correlated and such single schedule of priorities shall relate to the whole common water supply. The state engineer may by order adopt any of the corrective controls specified in section 17 of this act [41-3-915]. Source: Laws 1957, ch. 169, 18; W.S. 1957, 41-133."

As such, any required regulation of water rights in the future shall consider this permit under the priority date shown, together with all other rights to use water.  

4/29/2000  
Date of Approval  

GORDON W. FASSETT, State Engineer  

APPROVED NOV 13, 2006  

April 3, 2000 - Statement of Completion on May 17, 1997 received.  
April 3, 2000 - Proof of Beneficial use on May 17, 1997 received.
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER
HERSCHEL BUILDING
CHEYENNE, WYOMING 82002
(307) 777-5899

STATEMENT OF COMPLETION AND DESCRIPTION OF WELL OR SPRING

PERMIT NO. U.W. 125025

NAME OF WELL (SPRING) Rolling Hills #6 Well

1. NAME OF OWNER Town of Rolling Hills

2. ADDRESS 38 South Badger
   City Rolling Hills State WY Zip Code 82017 Phone No. (307) 436-5348

3. USE OF WATER: Domestic [ ] Stock Watering [ ] Irrigation [ ] Municipal [X] Industrial [ ] Miscellaneous [ ]
   Monitor or Test [ ] Coal Bed Methane [ ] Explain proposed use (Example: One single family dwelling)

4. LOCATION OF WELL (SPRING): SW 1/4 SE 1/4 of Section 16, T. 34 N., R. 75 W., of the 6th P.M. (or W.R.M.),
   Subdivision Name
   Lot
   Block
   If surveyed, bearing, distance and reference point: N 88° 37' W, 2305 ft from a point on the east line
   of Section 16, which is 61 feet North of the Southeast corner of

5. TYPE OF CONSTRUCTION: Drilled [X] Midway 2250 series mud rotary Dug [ ] Driven [ ] Other [Sec.16]
   (Type of Rig)
   Describe: direct circulation mud rotary

6. CONSTRUCTION: Total Depth of Well/Spring 1785.91 ft.
   Depth to Static Water Level 271.74 ft. (Below land surface) (on 10/20/95)
   a. Diameter of borehole (Bit size) 6¼ inches.
   b. Casing Schedule New [X] Used [ ]
   10 3/4" diameter from 0 ft. to 103.50 ft.
   7 5/8" diameter from 0 ft. to 810.00 ft.
   Material carbon steel Gage 0.250" wall
   Material carbon steel Gage 0.4375" wall
   4.5" diameter from 808.20 ft. to 1785.91 ft. (liner) Carbon steel & welded screen 0.406" wall
   c. Was casing cemented: Yes [X] No [ ]
   Cemented Interval, From 0 feet to 810 feet.
   d. Number of sacks of cement used 200 type of cement API Class G Portland Cement
   e. Perforations: Type of perforator used No perforations were used, only well screen.
      Size of perforations ______ inches by ______ inches.
      Number of perforations and depths where perforated:
      ______ perforations from ______ ft. to ______ ft.
      ______ perforations from ______ ft. to ______ ft.
   f. Was well screen installed? Yes [X] No [ ] stainless steel continuous wire-wrap construction (double
      Diameter: 4.5-inch slot size: 0.015-inch set from 1126.7 ft. to 1132.2 ft.,
      Diameter: 2.500-inch slot size: 2.500-inch set from 1227.7 ft. to 1238.2 ft.,
      1338.5-1369.5; 1370.7-1401.7; 1429.7-1445.7;
      g. Was well gravel packed? Yes [X] No [ ]
      Size of gravel — 1471.7-1482.2; 1502.7-1508.2;
      h. Was surface casing used? Yes [X] No [ ]
      Was it cemented in place? Yes [X] No [ ]
      1647.7-1673.7; 1719.7-1730.2;
   i. If well yields artesian flow or if spring, yield is ______ gal/min. Surface pressure is ______ lb/sq. inch, or ______ feet of water.
   j. The flow is controlled by: valve [ ] cap [ ] plug [ ]
   k. Does well leak around casing? Yes [ ] No [X]

7. NAME & ADDRESS OF DRILLING COMPANY D.C. Drilling Co., PO Box 749,
   Lusk, WY 82225

8. DATE OF COMPLETION OF WELL (including pump installation) OR SPRING (first used) 5/17/97

9. PUMP INFORMATION: Manufacturer Grundfos Type Submersible
   Source of power Pacific Power/Lighthouse 25 Depth of Pump Setting or intake 700 feet
   Amount of Water Being Pumped 80 Gallons Per Minute. (For Springs or flowing wells, see item 10.)
   Total Volumetric Gallons Used Per Calendar Year. 10,789,000.

10. FLOWING WELL OR SPRING (Owner is responsible for control of flowing well).
    If well yields artesian flow or if spring, yield is ______ gal/min. Surface pressure is ______ lb/sq. inch, or ______ feet of water.
    The flow is controlled by: valve [ ] cap [ ] plug [ ]
    Does well leak around casing? Yes [ ] No [X]

Permission No. U.W. 125025
Book No. 940 Page No. 26

SEE REVERSE SIDE
11. If spring, how was it constructed? (Some method of artificial diversion, i.e., spring box, cribbing, etc., is necessary to qualify for a water right.)

12. PUMP TEST: Was a pump test made? Yes ☑ No ☐
   If so, by whom: D.C. Drilling Co. & TriHydro Corp.  Address
   Yield: 79.5 gal./min. with 449.92 foot drawdown after 151.2 hours (9,070 minutes — continuous 24-hours a day pumping)
   Yield: ☐ gal./min. with ☐ foot drawdown after ☐ hours.

13. LOG OF WELL: Total depth drilled 1,811 feet.
   Depth of completed well 1,785.91 feet. Diameter of well 4.5 inches.
   Depth to first water bearing formation 57 feet.
   Depth to principal water bearing formation. Top 1126 feet to Bottom 1776 feet.
   Ground Elevation, if known 5420'

DRILL CUTTINGS DESCRIPTION:

<table>
<thead>
<tr>
<th>From Feet</th>
<th>To Feet</th>
<th>Material Type, Texture Color</th>
<th>Remarks (Cementing, Shutoff)</th>
<th>Indicate Water Bearing Formation &amp; Name</th>
<th>Indicate Perforated Casing Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEE ATTACHMENT</td>
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14. QUALITY OF WATER INFORMATION:

Does a chemical and/or bacteriological water quality analysis accompany this form? Yes ☐ No ☐

It is recommended that chemical and bacteriologic water quality analyses be performed and that the report(s) be filed with the records of this well. (Contact Department of Agriculture, Analytical Lab Services, Laramie, 742-2984.)

If not, do you consider the water as:  Good ☐ Acceptable ☐ Poor ☐ Unusable ☐

REMARKS: For additional information see "Final Report, Level II Water Supply Project, Rolling Hills, Wyoming" dated February 29, 1996, prepared by TriHydro Corporation and PMPC (Saratoga, WY) for the Wyoming Water Development Commission and the Town of Rolling Hills, WY.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

X Larry L. Lindeman
Signature of Owner or Authorized Agent

3-27, 2000
Date

U.W. 125025
FOR STATE ENGINEER'S USE ONLY

APR 3, 2000
Date of Receipt

APR 3, 2000
Date of Priority

April 22, 2000
Date of Approval

for State Engineer
<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Lithologic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 39</td>
<td>Quaternary sand dune deposits were penetrated from ground surface to 39 feet in depth. The ground surface is vegetation stabilized. Possibly 1 to 2 feet of ground water was encountered at the bottom of the sand dune deposits in perched ground water conditions. <strong>Sand</strong>: Tan to light brown, lithic type (salt &amp; pepper), very fine to fine grained, silty, frosted quartz grains, subrounded to well rounded, well sorted, unconsolidated, vegetation roots abundant from 0 to 10 feet in depth, possible perched water zone at bottom of sand dune deposits from 38 to 39 feet.</td>
</tr>
<tr>
<td>39 - 190</td>
<td>The top of the Paleocene Fort Union Formation was encountered at 39 feet below ground surface. The top of the Fort Union Formation is a weathered erosional unconformity and is covered with soft yellow/brown clay at the top of the unit. <strong>Shale</strong> (100%): Dark to medium gray, silty in part, carbonaceous in part with traces of coal, clayey in part, soft to poorly indurated. <strong>Sandstone</strong> (trace): Light gray, lithic type (salt &amp; pepper), very fine to fine grained, silty in part, rounded to subrounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>190 - 200</td>
<td>The top of Late Cretaceous Lance Formation was encountered at approximately 190 feet below ground surface. The Lance Formation was not completely penetrated by this well. <strong>Siltstone</strong> (70%): Light to medium gray, lithic type (salt &amp; pepper), trace very fine grained sand, subrounded, well sorted, poorly to moderately cemented with clay and calcite cements. <strong>Shale</strong> (30%): Dark to medium gray, carbonaceous in part with traces of coal, silty, clayey, soft to moderately indurated, fissile in part.</td>
</tr>
<tr>
<td>200 - 370</td>
<td><strong>Shale</strong> (100%): Dark to medium gray, carbonaceous in part with traces of coal, silty, clayey, soft to moderately indurated, fissile in part. <strong>Sandstone</strong> (trace): Light to medium gray, lithic type (salt &amp; pepper), very fine to fine grained, silty in part, rounded to subrounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>370 - 580</td>
<td><strong>Shale</strong> (100%): Dark to medium gray, carbonaceous in part with traces of coal, moderately to well indurated and fissile in part. <strong>Sandstone</strong> (trace): Light gray, lithic type (salt &amp; pepper), very fine to fine grained, silty in part, rounded to subrounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>580 - 680</td>
<td><strong>Shale</strong> (100%): Medium to dark gray, silty in part, clayey in part, carbonaceous in part with traces of coal, friable, moderately to well indurated. <strong>Sandstone</strong> (trace): Light gray, lithic type (salt &amp; pepper), very fine grained, silty in part, subrounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>680 - 696</td>
<td><strong>Shale</strong> (100%): Dark brown-gray, silty, friable, moderately to poorly indurated. <strong>Sandstone</strong> (trace): Light gray, lithic type (salt &amp; pepper), very fine grained, silty in part, subrounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>696 - 740</td>
<td><strong>Shale</strong> (100%): Gray to graybrown, silty, moderately to well indurated. <strong>Sandstone</strong> (trace): Light gray, lithic type (salt &amp; pepper), very fine grained, fine grained in part, silty in part, subrounded to rounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>740 - 750</td>
<td><strong>Shale</strong>: Dark gray/brown, gray, silty, moderately indurated. Increasing amounts of unconsolidated, gray/white, very fine sand.</td>
</tr>
<tr>
<td>750 - 810</td>
<td><strong>Shale</strong> (100%): Gray to graybrown, silty, moderately to well indurated. <strong>Sandstone</strong> (trace): Light gray, lithic type (salt &amp; pepper), very fine grained, fine grained in part, silty in part, subrounded to rounded, well sorted, predominantly unconsolidated.</td>
</tr>
<tr>
<td>810 - 850</td>
<td><strong>Shale</strong>: Medium gray, tabular, smooth to rough and silty, moderately indurated.</td>
</tr>
<tr>
<td>850 - 900</td>
<td><strong>Shale</strong>: Medium to dark gray, tabular, blocky in part, smooth, moderately indurated.</td>
</tr>
<tr>
<td>900 - 930</td>
<td><strong>Shale</strong> (80%): Medium gray, dark gray in part, tabular, blocky in part, moderately indurated. <strong>Sandstone</strong> (20%): White to light gray, very fine grained to silty, rounded, unconsolidated to clay cemented, friable.</td>
</tr>
<tr>
<td>930 - 990</td>
<td><strong>Shale</strong> (90 to 100%): Medium to light gray, tabular to platy, smooth to silty in part, moderately indurated. <strong>Sandstone</strong> (trace to 10%): White to light gray, very fine grained, rounded, unconsolidated.</td>
</tr>
</tbody>
</table>
990 - 1000  
**Shale**: Medium gray, light gray in part, tabular to platy, predominantly smooth, moderately indurated.

1000 - 1030  
**Shale** (95 to 100%): Medium gray, dark gray in part, tabular to platy, blocky in part, smooth, moderately indurated. **Sandstone** (trace to 5%): White-clear, very fine to fine grained, rounded, unconsolidated.

1030 - 1050  
**Shale** (90 to 95%): Medium to light gray, tabular to platy, smooth, moderately indurated. **Sandstone** (10% to 5%): Clear, very fine grained, rounded, unconsolidated to embedded within a non-indurated, gray/white clay matrix.

1050 - 1100  
**Shale**: Medium gray, light gray in part, tabular, smooth to gummy, poorly indurated, moderately indurated in part. **Sandstone** (trace): Clear, very fine grained, rounded, unconsolidated.

1100 - 1130  
**Shale**: Medium to light gray, tabular to amorphous shape, gummy to smooth, poorly indurated.

1130 - 1180  
**Shale**: Medium gray, amorphous shape to tabular, gummy, very poorly indurated to non-indurated.

1180 - 1190  
**Shale** (70%): Medium gray, amorphous shape to tabular, gummy, very poorly indurated to non-indurated. **Sandstone** (30%): Clear, fine to medium grained, rounded to subrounded, unconsolidated.

1190 - 1220  
**Shale** (90%): Medium gray, amorphous to tabular, gummy to smooth, poorly to very poorly indurated. **Sandstone** (10%): Clear, fine grained to medium grained in part, subrounded to rounded, unconsolidated.

1220 - 1230  
**Sandstone** (90%): Clear, medium to coarse grained, subrounded to subangular in part, moderately sorted, unconsolidated. **Shale** (10%): Medium gray, gummy to tabular, poorly indurated.

1230 - 1260  
**Sandstone** (50 to 70%): Clear, medium grained to coarse grained in part, subrounded, well sorted, unconsolidated. **Shale** (15% to 30%): Medium to light gray, amorphous to tabular, gummy, poorly indurated.

1260 - 1290  
**Sandstone** (30%): Clear, predominantly fine grained, subrounded to rounded, well sorted, unconsolidated. **Shale** (70%): Medium to light gray, amorphous to tabular, gummy, poorly indurated.

1290 - 1310  
**Sandstone** (70 to 80%): Clear, medium grained to fine grained in part, rounded to subrounded in part, well sorted, unconsolidated. **Shale** (30 to 20%): Medium to light gray, amorphous to tabular, gummy to smooth, poorly to very poorly indurated.

1310 - 1350  
**Shale** (70 to 80%): Medium to light gray, dark gray in part, tabular to blocky, gummy to smooth, poorly indurated to moderately indurated in part. **Sandstone** (30 to 20%): Clear, medium to fine grained, rounded to subrounded, unconsolidated.

1350 - 1380  
**Sandstone** (80 to 90%): Clear to white, medium to coarse grained, rounded to well rounded, well sorted, unconsolidated to very poorly cemented with clay cement. **Shale** (20 to 10%): Medium to light gray, dark gray to black carbonaceous shale in part, tabular to platy, moderately indurated.

1380 - 1400  
**Sandstone** (90%): Clear to white, medium to coarse grained, rounded to well rounded, well sorted, unconsolidated to very poorly cemented with clay cement, good intergranular porosity. **Shale** (10%): Medium to light gray, tabular to platy, moderately indurated.

1400 - 1410  
**Sandstone**: White to clear to brown/white, predominantly medium grained, rounded to well rounded, moderately sorted, unconsolidated to very poorly cemented with clay and slightly calcareous cements, good intergranular porosity.

1410 - 1420  
**Sandstone**: White to grey/white, fine to very fine grained, rounded, well sorted, moderately to poorly cemented with calcite cement.

1420 - 1460  
**Sandstone** (90 to 100%): White to clear, predominantly fine to medium grained, rounded, unconsolidated, some very fine to fine grained consolidated sandstone, rounded, well to moderately sorted, moderately to poorly cemented with calcite cement. **Shale** (10% to trace): Light gray, amorphous, gummy, very poorly indurated.

1460 - 1500  
**Sandstone** (50 to 60%): White to brown/white, very fine to fine grained, silty in part, rounded to subrounded, well to moderately sorted, poorly cemented with clay and calcite cements, poor intergranular porosity. **Shale** (50% to 40%): Medium to light gray, tabular to amorphous, smooth to gummy, poorly to very poorly indurated.


1500 - 1530  
Shale [50 to 60%]: Medium to light gray, tabular to amorphous, gummy to smooth, very poorly to poorly indurated. Sandstone [30 to 20%]: Brown to white, very fine to fine grained, subrounded to rounded, well to occasionally moderately sorted, very poorly to poorly cemented with clay cement and clay filling, poor intergranular porosity.

1530 - 1570  
Sandstone [50 to 70%]: Gray to white to brown to white, lithic type (salt & pepper), very fine to fine grained, silty fine grained in part, rounded, well sorted, poorly to moderately cemented in part with clay and calcite cements, poor intergranular porosity. Shale [15% to 30%]: Medium to light gray, platy to tabular to amorphous, smooth to gummy, poorly to very poorly indurated.

1570 - 1590  
Sandstone [80 to 100%]: Clear to white, fine to medium grained in part, rounded to well rounded, well sorted, predominantly unconsolidated. Shale [10% to trace]: Medium to light gray, platy to tabular to amorphous, smooth to gummy, poorly to very poorly indurated.

1590 - 1600  
Sandstone [80%]: White to clear, fine to medium grained, rounded, well sorted, predominantly unconsolidated. Limestone [20%]: White, chalky, soft.

1600 - 1640  
Sandstone [80 to 100%]: Clear to white, white to tan to white, lithic type (salt & pepper), very fine to fine grained, medium grained in part, silty in part, rounded to subrounded, well sorted to moderately sorted in part, poorly to moderately cemented with clay and calcite cements, poor to fair intergranular porosity, and grades into siltstone. Siltstone [10% to trace]: Tan white, includes very fine grained sand, moderately cemented with calcite.

1640 - 1660  
Sandstone [50 to 70%]: Gray to white to brown to white, lithic type (salt & pepper), very fine to fine grained, silty fine grained in part, rounded, well sorted, poorly to moderately cemented in part with clay and calcite cements, poor intergranular porosity. Shale [15% to 30%]: Medium to light gray, platy to tabular to amorphous, smooth to gummy, poorly to very poorly indurated.

1660 - 1670  
Sandstone [90%]: White to clear, white to gray to white, lithic type (salt & pepper), very fine to medium grained, rounded to well rounded, well sorted, unconsolidated to moderately cemented with clay and calcite cements, poor to fair intergranular porosity. Limestone [10%]: White, chalky, soft, locally included quartz sand grains.

1670 - 1700  
Sandstone [80 to 90%]: White to clear to gray to white, tan to white, lithic type (salt & pepper), predominantly fine to very fine grained, rounded to well rounded, well sorted, unconsolidated to moderately cemented with clay and calcite cements, poor to trace intergranular porosity. Shale [20% to 10%]: Light to medium gray, tabular to amorphous, smooth, very poorly to poorly indurated.

1700 - 1740  
Sandstone: White to clear, clear to white, gray to white in part, medium to very fine grained, coarse grained in part, rounded to well rounded, well sorted, unconsolidated to very poorly cemented with clay and calcite cements, fair to poor intergranular porosity.

1740 - 1770  
Sandstone [80%]: White to clear, fine to medium grained, rounded to well rounded, well sorted, unconsolidated to very poorly cemented with clay and calcite cements, fair to good intergranular porosity. Shale [20%]: Medium to light gray, blocky in tabular, smooth to silty in part, poorly to moderately indurated.

1770 - 1811  
Shale [80% to 90%]: Medium gray to brown to gray to light gray, tabular to amorphous, smooth, poorly indurated. Sandstone [20% to 10%]: White to clear, grey white to white in part, medium to very fine grained, coarse grained in part, rounded to well rounded, well sorted, unconsolidated to very poorly cemented with clay cement, fair to poor intergranular porosity.

Total Depth Drilled = 1,811 feet below ground surface.
STATE OF WYOMING
OFFICE OF THE STATE ENGINEER

PROOF OF APPROPRIATION AND BENEFICIAL USE OF GROUND WATER

The owner is responsible for submitting Parts I and II of this form. Part III will be prepared by a State Engineer Representative at time of inspection.

PART I

WATER DIVISION L (15-5) U.W. DISTRICT Converse Co.
PERMIT NO. U.W. 125025 DATE OF PRIORITY April 3, 2000
NAME OF WELL Town of Rolling Hills LOCATION SW 1/4 SE 1/4 of Section 16

1. Name of Claimant(s) Town of Rolling Hills
2. Address 38 South Badger, Rolling Hills, WY Zip Code 82637
3. For What Purpose(s) is Water Used? Use: Municipal Date First Used May 17, 1997

X

If use is for irrigation, give date irrigation was completed on all lands under this Permit:

PART II

For Irrigation, Industrial, Municipal and Miscellaneous Wells

A plat which has been certified by a licensed professional engineer or land surveyor shall be submitted to accompany this form. The plat shall be in accordance with Sec. 33-29-111 Wyoming Statutes 1977 or see Chapter V and VI, Manual of Regulations and Instructions issued by the State Engineer's Office. (Minimum scale shall be 2" = 1 mile.) The map shall be prepared with waterproof black ink on tracing paper or an acceptable equivalent and shall show on a suitable scale the legal subdivisions, the accurate location of the well or wells, storage facilities, if any, main canals, streams, highways and other important cultural features. Land ownership will be shown, if there is more than one owner under the permit.

IRRIGATION WELLS

Average irrigated under terms of this permit will be clearly shown with a distinctive pattern and a distinct color made between lands having an original supply and those provided a supplemental supply. Where use is for supplemental supply for lands with a right from another source, indicate by priority or permit number of the source, the source of supply and the name of the ditch, pipe line or other well. Conveyance system will be shown and described. Indicate method of irrigation being used.

INDUSTRIAL WELLS

In addition to the information outlined above, industrial users will locate and describe conveyance facilities to the point(s) of use, giving an accurate as possible the location of points of use. Permits for other sources of water must be identified.

MUNICIPAL WELLS

The plat will show the area of use and show and describe the means of conveyance of the water from the well to the connection with the distribution system for a municipal water system.

MISCELLANEOUS WELLS

(1) The line of the well used is described as miscellaneous and where the yield flow of the well exceeds twenty-five (25) gallons per minute must show the area of use and describe and show the means of conveyance from the well to the distribution system and/or points of use.

(2) The plat for wells where the use is described as miscellaneous and where the yield or flow is twenty-five (25) gallons per minute or less may be a 7½ minute United States Geological Survey Quadrangle map in lieu of a line tracing provided the U.S. Geological Survey Quadrangle map is in compliance with the following conditions:

(a) The entire United States Geological Survey quadrangle map must be submitted to the State Engineer's Office.

(b) The scale on said quadrangle map must be one to twenty-four thousand.

(c) An identified section corner or quarter corner must be shown on said quadrangle map along with Section, Township and Range.

(d) The section in which the well is located and the section(s) where the area(s) or point(s) of use are located must be subdivided into forty (40) acre tracts and the well location and area(s) or point(s) of use clearly labeled and described.

(e) Said quadrangle map showing the well location and area(s) or point(s) of use must be certified by a professional engineer or land surveyor licensed to practice within the State of Wyoming.

SEE REVERSE SIDE
A "CERTIFICATE OF OWNERSHIP" FROM THE COUNTY CLERK'S OFFICE SHOWING OWNERSHIP OR CONTROL OF LAND(S) INVOLVED MUST ACCOMPANY THIS FORM.

Under penalties of perjury, I declare that I have examined this form and to the best of my knowledge and belief it is true, correct and complete.

X

Signature of Owner or Authorized Agent

Date

[Signature]

3-27

2000

U.U. 125025

Date of Receipt: APR 03 2000
Appendix B
February 07, 2011

Weston Engineering
1050 N 3rd St Ste E
Laramie, WY 82072

Workorder No.: C11010676
Project Name: Rolling Hills

Energy Laboratories, Inc. Casper WY received the following 1 sample for Weston Engineering on 1/24/2011 for analysis.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Client Sample ID</th>
<th>Collect Date</th>
<th>Receive Date</th>
<th>Matrix</th>
<th>Test</th>
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</thead>
<tbody>
<tr>
<td>C11010676-001</td>
<td>Well No.1</td>
<td>01/24/11 12:15</td>
<td>01/24/11</td>
<td>Drinking Water</td>
<td>Metals by ICP/ICPMS, Dissolved Metals by ICP/ICPMS, Total Alkalinity</td>
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<td>QA Calculations</td>
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<td>Bacteria, Iron Related</td>
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<td>Conductivity</td>
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<td>Corrosivity, Calculated</td>
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<td>Sample Filtering</td>
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<td>Hardness</td>
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<td>E300.0 Anions</td>
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<td></td>
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<td>Nitrogen, Nitrate + Nitrite</td>
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<td></td>
<td>pH</td>
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<td>Metals Preparation by EPA 200.2</td>
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<tr>
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<td></td>
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<td>Solids, Total Dissolved</td>
</tr>
</tbody>
</table>

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

\[Signature\]
Report Proofing Specialist

Digitally signed by
Kathy Hamre
Date: 2011.02.07 09:34:33 -07:00
DOMESTIC WATER ANALYSIS EXPLANATIONS

Alkalinity- is a measure of the water's capacity to neutralize acid. Water with a high alkalinity (above 300 mg/L), when boiled for an extended period of time, may form a deposit or develop an unpleasant taste. Water with a very low alkalinity (below 30 mg/L) corrodes pipes and plumbing.

Bicarbonate- is a buffer ion in water, derived from carbonate rocks and atmospheric CO2. Water with pH 7.8 will be 60 90% buffered by bicarbonate. If water is heated, bicarbonate can combine with calcium or magnesium to form scale, which can clog pipes and precipitate in sinks and laundry.

Calcium- is an essential human nutrient for bones and teeth. Excessive calcium with magnesium produces hard water, which causes taste problems, scale in pipes, tubs, and sinks and excessive soap consumption. Water softeners remove calcium but replace it with sodium, which may be harmful to people on low sodium diets.

Carbonate- along with bicarbonate, this ion accounts for the buffering capacity of waters with a pH greater than 9. It is most often present as salts (CaCO3, MgCO3) which precipitate at a high pH.

Chloride- less than 250 mg/L is recommended to prevent unpleasant taste. The normal range for drinking water is 5-20 mg/L. High values may be an early indicator of contamination. Chloride also makes water more corrosive towards the distribution system.

Conductivity (Specific Conductance)- a measure of the water's ability to conduct an electrical current, it increases as the amount of dissolved minerals increase. Conductivity is used as a check on the total dissolved solids in the water.

Hardness- caused mainly by calcium and magnesium, it produces incrustation on pipes, kitchen utensile, and tubs as well as excessive soap consumption. Upon heating, hard water may form scale deposits, alternately, soft water may result in a corrosion of water pipes. In general, 80-100 mg/L is considered acceptable, 200-500 mg/L is considered tolerable, and greater than 500 mg/L is considered unacceptable.

Iron- the level of 0.3 mg/L is a general guideline based on aesthetics and taste. It is an essential human nutrient; however, at levels greater than 0.3 mg/L, it stains laundry and plumbing fixtures, and causes undesirable taste in beverages. When exposed to air, iron precipitates causing a reddish-brown color.

Magnesium- is an essential human nutrient for the heart and nervous system. Greater than 50 mg/L may have a laxative effect on first time users. Guidelines are often based on aesthetics (taste). Along with calcium, magnesium contributes to water hardness.

Nitrate + nitrite as N- 10 mg/L maximum contaminant level. Acutely toxic in infants under 6 months of age, nitrate produces a blood disorder called methemoglobinemia (blue baby syndrome), which limits the amount of oxygen the bloodstream can carry.

pH- is an aesthetic parameter. Low pH may cause corrosion of water pipes-while high pH may cause incrustation of pipes.

Potassium- is an essential human nutrient. It is necessary for nerve impulses. Moderate concentrations are acceptable, but greater than 2000 mg/L may be harmful to nervous and digestive systems.

Sodium- is an essential human nutrient necessary for nerve impulses. If a water softener is used to remove hardness, calcium is replaced by sodium. People on low sodium diets using water softeners should have the sodium level of their water checked and consult a physician. Less than 20 mg/L is ideal.

Sulfate- is recommended to be below 500 mg/L for health and aesthetic reasons. The major physiological effects when exceeded are catharsis (laxative effect) and gastrointestinal irritation. Sulfate may produce noticeable taste.

Total dissolved solids- represents the dissolved minerals in water. High values-above 1500 mg/L may cause taste, corrosion, scaling and a laxative effect.

All "J" qualified analyze concentrations are below the laboratory minimum recommended Reporting Limit (RL) and above the calculated method detection limit (MDL). Inorganic analytes reported with "J" qualifiers should be verified against the corresponding method blank and continuing calibration blanks. Inorganic "J" quantities near the MDL may be suspect due to possible method background levels, sample matrix effects, and/or daily variability in instrument signal-to-noise levels.
# LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Weston Engineering
Project: Rolling Hills
Lab ID: C11010676-001
Client Sample ID: Well No.1

Report Date: 02/07/11
Collection Date: 01/24/11 12:15
Date Received: 01/24/11

Matrix: Drinking Water

## MICROBIOLOGICAL

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Result</th>
<th>Units</th>
<th>Qualifiers</th>
<th>RL</th>
<th>MCL/ QCL</th>
<th>Method</th>
<th>Analysis Date / By</th>
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<tbody>
<tr>
<td>Bacteria, Iron Related</td>
<td>11000</td>
<td>CFU/ml</td>
<td>1.0</td>
<td>IRB-BART</td>
<td>01/24/11 14:28 / rodh</td>
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<td>~ 92 hours incubation time</td>
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## MAJOR IONS

<table>
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<tr>
<th>Analyses</th>
<th>Result</th>
<th>Units</th>
<th>Qualifiers</th>
<th>MCL/ QCL</th>
<th>Method</th>
<th>Analysis Date / By</th>
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<tr>
<td>Alkalinity, Total as CaCO3</td>
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<td>mg/L</td>
<td>5</td>
<td>A2320</td>
<td>01/24/11 19:14 / jba</td>
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<td>Calcium</td>
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<td>mg/L</td>
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<td>E200.7</td>
<td>01/25/11 16:25 / cp</td>
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<td>Chloride</td>
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<td>Magnesium</td>
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<tr>
<td>Sulfate</td>
<td>353</td>
<td>mg/L</td>
<td>D</td>
<td>E300.0</td>
<td>01/26/11 18:56 / ijl</td>
<td></td>
</tr>
</tbody>
</table>

## PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Result</th>
<th>Units</th>
<th>Qualifiers</th>
<th>Method</th>
<th>Analysis Date / By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosivity</td>
<td>0.5</td>
<td>unitless</td>
<td></td>
<td>Calculation</td>
<td>02/03/11 15:21 / kbb</td>
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<tr>
<td>Conductivity @ 25 C</td>
<td>1040</td>
<td>umhos/cm</td>
<td>1</td>
<td>A2510</td>
<td>01/24/11 16:12 / lr</td>
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<tr>
<td>Hardness as CaCO3</td>
<td>400</td>
<td>mg/L</td>
<td>1</td>
<td>A2340</td>
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<tr>
<td>pH</td>
<td>7.73</td>
<td>s.u.</td>
<td>0.01</td>
<td>A4500-H B</td>
<td>01/24/11 16:12 / lr</td>
</tr>
<tr>
<td>Solids, Total Dissolved TDS @ 180 C</td>
<td>749</td>
<td>mg/L</td>
<td>10</td>
<td>A2540</td>
<td>01/27/11 14:28 / lmc</td>
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## METALS - TOTAL

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Result</th>
<th>Units</th>
<th>Qualifiers</th>
<th>Method</th>
<th>Analysis Date / By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>3.78</td>
<td>mg/L</td>
<td>0.03</td>
<td>E200.7</td>
<td>01/27/11 22:00 / cp</td>
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<tr>
<td>Manganese</td>
<td>0.38</td>
<td>mg/L</td>
<td>0.01</td>
<td>E200.7</td>
<td>01/27/11 22:00 / cp</td>
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## DATA QUALITY

<table>
<thead>
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<th>Result</th>
<th>Units</th>
<th>Qualifiers</th>
<th>Method</th>
<th>Analysis Date / By</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/C Balance (± 5)</td>
<td>0.304</td>
<td>%</td>
<td></td>
<td>Calculation</td>
<td>02/03/11 15:21 / kbb</td>
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<tr>
<td>Anions</td>
<td>11.9</td>
<td>meq/L</td>
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<td>Calculation</td>
<td>02/03/11 15:21 / kbb</td>
</tr>
<tr>
<td>Cations</td>
<td>12.0</td>
<td>meq/L</td>
<td></td>
<td>Calculation</td>
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<tr>
<td>Solids, Total Dissolved Calculated</td>
<td>736</td>
<td>mg/L</td>
<td></td>
<td>Calculation</td>
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<tr>
<td>TDS Balance (0.80 - 1.20)</td>
<td>1.02</td>
<td></td>
<td></td>
<td>Calculation</td>
<td>02/03/11 15:21 / kbb</td>
</tr>
</tbody>
</table>

Report Definitions:
- RL - Analyte reporting limit.
- QCL - Quality control limit.
- MCL - Maximum contaminant level.
- ND - Not detected at the reporting limit.
- D - RL increased due to sample matrix.
# Workorder Receipt Checklist

**Weston Engineering**

<table>
<thead>
<tr>
<th>Login completed by:</th>
<th>Hailey Ackerman</th>
<th>Date Received:</th>
<th>1/24/2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewed by:</td>
<td>BL2000\owagner</td>
<td>Received by:</td>
<td>ckw</td>
</tr>
<tr>
<td>Reviewed Date:</td>
<td>1/25/2011</td>
<td>Carrier name:</td>
<td>Hand Del</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
<th>Not Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping container/cooler in good condition?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custody seals intact on shipping container/cooler?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custody seals intact on sample bottles?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chain of custody present?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chain of custody signed when relinquished and received?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chain of custody agrees with sample labels?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samples in proper container/bottle?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample containers intact?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sufficient sample volume for indicated test?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All samples received within holding time?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container/Temp Blank temperature:</td>
<td>9°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water - VOA vials have zero headspace?</td>
<td></td>
<td></td>
<td>☑</td>
</tr>
<tr>
<td>Water - pH acceptable upon receipt?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact and Corrective Action Comments:</td>
<td>None</td>
<td></td>
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</tr>
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</table>
### Chain of Custody and Analytical Request Record

**Company Name:** Weston Engineering, Inc.  
**Report Mail Address:** 1051 N 3rd Street, Suite E, Laramie, WY 82070  
**Contact Name:** Ben Jordan  
**Phone/Fax:** 307-745-6988  
**Email:** bijordan@westonengineering.com  
**Sample Origin State:** WY  
**Contact E&L prior to RUSH sample submittal for charges and scheduling – See Instruction Page**  

**SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)**  
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Collection Date</th>
<th>Collection Time</th>
<th>Matrix</th>
<th>Rushed</th>
<th>Standard Turnaround (DAT)</th>
<th>Notes</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>4/29/11</td>
<td>12:15</td>
<td>Yes</td>
<td>2</td>
<td>1/1</td>
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<tr>
<td>9</td>
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<tr>
<td>10</td>
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</tr>
</tbody>
</table>

**Custody Record MUST be Signed**

**Received by (print):**  
Date/Time: 12/4/11 13:00  
Signatures: [Signature]

**Rejected by (print):**  
Date/Time: 12/4/11 13:00  
Signatures: [Signature]

**Sample Disposal:** Return to Client:  
Lab Disposal: [Yes]

---

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All subcontract data will be clearly noted on your analytical report.
January 07, 2011

Weston Engineering
1050 N 3rd St Ste E
Laramie, WY 82072

Workorder No.: C10120700
Project Name: Rolling Hills

Energy Laboratories, Inc. Casper WY received the following 1 sample for Weston Engineering on 12/21/2010 for analysis.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Client Sample ID</th>
<th>Collect Date</th>
<th>Receive Date</th>
<th>Matrix</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10120700-001</td>
<td>Well No. 2</td>
<td>12/21/10 7:00</td>
<td>12/21/10</td>
<td>Drinking Water</td>
<td>Metals by ICP/ICPMS, Dissolved Metals by ICP/ICPMS, Total Alkalinity OA Calculations Conductivity Corrosivity, Calculated Sample Filtering Hardness E300.0 Anions Nitrogen, Nitrate + Nitrite pH Metals Preparation by EPA 200.? Solids, Total Dissolved</td>
</tr>
</tbody>
</table>

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy, Casper, WY 82601. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report. The QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

Kathryn Hamre
Report Proofing Specialist
DOMESTIC WATER ANALYSIS EXPLANATIONS

Alkalinity- is a measure of the water’s capacity to neutralize acid. Water with a high alkalinity (above 300 mg/L), when boiled for an extended period of time, may form a deposit or develop an unpleasant taste. Water with a very low alkalinity (below 30 mg/L) corrodes pipes and plumbing.

Bicarbonate- is a buffer ion in water, derived from carbonate rocks and atmospheric CO2. Water with pH 7.8 will be 60-90% buffered by bicarbonate. If water is heated, bicarbonate can combine with calcium or magnesium to form scale, which can clog pipes and precipitate in sinks and laundry.

Calcium- is an essential human nutrient for bones and teeth. Excessive calcium with magnesium produces hard water, which causes taste problems, scale in pipes, tubs, and sinks and excessive soap consumption. Water softeners remove calcium but replace it with sodium, which may be harmful to people on low sodium diets.

Carbonate- along with bicarbonate, this ion accounts for the buffering capacity of waters with a pH greater than 9. It is most often present as salts (CaCO3, MgCO3) which precipitate at a high pH.

Chloride- less than 250 mg/L is recommended to prevent unpleasant taste. The normal range for drinking water is 5-20 mg/L. High values may be an early indicator of contamination. Chloride also makes water more corrosive towards the distribution system.

Conductivity (Specific Conductance)- a measure of the water’s ability to conduct an electrical current, it increases as the amount of dissolved minerals increase. Conductivity is used as a check on the total dissolved solids in the water.

Hardness- caused mainly by calcium and magnesium, it produces incrustation on pipes, kitchen utensils, and tubs as well as excessive soap consumption. Upon heating, hard water may form scale deposits, alternately, soft water may result in a corrosion of water pipes. In general, 80-100 mg/L is considered acceptable, 200-500 mg/L is considered tolerable, and greater than 500 mg/L is considered unacceptable.

Iron- the level of up to 0.3 mg/L is a general guideline based on aesthetics and taste. It is an essential human nutrient; however, at levels greater than 0.3 mg/L, it stains laundry and plumbing fixtures, and causes undesirable taste in beverages. When exposed to air, iron precipitates causing a reddish-brown color.

Magnesium- is an essential human nutrient for the heart and nervous system. Greater than 10 mg/L may have a laxative effect on first time users. Guidelines are often based on aesthetics (taste). Along with calcium, magnesium contributes to water hardness.

Nitrate- nitrite as N- 10 mg/L maximum contaminant level. Acutely toxic in infants under 6 months of age, nitrate produces a blood disorder called methemoglobinemia (blue baby syndrome), which limits the amount of oxygen the bloodstream can carry.

pH- is an aesthetic parameter. Low pH may cause corrosion of water pipes while high pH may cause incrustation of pipes.

Potassium- is an essential human nutrient. It is necessary for nerve impulses. Moderate concentrations are acceptable, but greater than 2000 mg/L may be harmful to nervous and digestive systems.

Sodium- is an essential human nutrient necessary for nerve impulses. If a water softener is used to remove hardness, calcium is replaced by sodium. People on low sodium diets using water softeners should have the sodium level of their water checked and consult a physician. Less than 20 mg/L is ideal.

Sulfate- is recommended to be below 500 mg/L for health and aesthetic reasons. The major physiological effects when exceeded are catharsis (laxative effect) and gastrointestinal irritation. Sulfate may produce noticeable taste.

Total dissolved solids- represents the dissolved minerals in water. High values above 1500 mg/L may cause taste, corrosion, scaling and a laxative effect.

All "J" qualified analyte concentrations are below the laboratory minimum recommended Reporting Limit (RL) and above the calculated method detection limit (MDL). Inorganic analytes reported with "J" qualifiers should be verified against the corresponding method blank and continuing calibration blanks. Inorganic "J" quantitations near the MDL may be suspect due to possible method background levels, sample matrix effects, and/or daily variability in instrument signal-to-noise levels.
LABORATORY ANALYTICAL REPORT
Prepared by Casper, WY Branch

Client: Weston Engineering
Project: Rolling Hills
Lab ID: C10120700-001
Client Sample ID: Well No. 2

Report Date: 01/07/11
Collection Date: 12/21/10 07:00
Date Received: 12/21/10
Matrix: Drinking Water

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Result</th>
<th>Units</th>
<th>Qualifiers</th>
<th>RL</th>
<th>MCL/ QCL</th>
<th>Method</th>
<th>Analysis Date / By</th>
</tr>
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<tr>
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<tr>
<td>Alkalinity, Total as CaCO3</td>
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<td>E200 7</td>
<td>12/23/10 17:28 /cp</td>
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<tr>
<td>Chloride</td>
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<td>mg/L</td>
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<td>E300 0</td>
<td>12/28/10 20:49 /ml</td>
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<tr>
<td>Magnesium</td>
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<td>mg/L</td>
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<td></td>
<td>E200 7</td>
<td>12/23/10 17:28 /cp</td>
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<tr>
<td>Nitrogen, Nitrate+Nitrite as N</td>
<td>ND</td>
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<td>E353 2</td>
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<td>E200 7</td>
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<td>Sodium</td>
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<td>E200 7</td>
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<tr>
<td>Sulfate</td>
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<td>mg/L</td>
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<td>E300 0</td>
<td>12/28/10 20:49 /ml</td>
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<td><strong>PHYSICAL PROPERTIES</strong></td>
<td></td>
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<td></td>
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<td></td>
<td>Calculation</td>
<td>01/05/11 12:57 /khh</td>
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<tr>
<td>Conductivity @ 25 C</td>
<td>525</td>
<td>uS/m</td>
<td>1</td>
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<td>A2510 B</td>
<td>12/21/10 15:46 /fr</td>
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<tr>
<td>Hardness as CaCO3</td>
<td>101</td>
<td>mg/L</td>
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<td></td>
<td>A2340 B</td>
<td>12/23/10 17:28 /khh</td>
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</tr>
<tr>
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<td>A4500-H B</td>
<td>12/21/10 15:46 /fr</td>
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<td></td>
<td>A2540 C</td>
<td>12/22/10 15:25 /fr</td>
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<td><strong>METALS - TOTAL</strong></td>
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</tr>
<tr>
<td>Iron</td>
<td>0.66</td>
<td>mg/L</td>
<td>0.03</td>
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<td>E200 7</td>
<td>12/28/10 18:06 /cp</td>
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<td>Manganese</td>
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<td>mg/L</td>
<td>0.01</td>
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<td>E200 7</td>
<td>12/28/10 18:06 /cp</td>
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</tr>
<tr>
<td><strong>DATA QUALITY</strong></td>
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</tr>
<tr>
<td>A/C Balance (± 5)</td>
<td>±3.40</td>
<td>%</td>
<td></td>
<td></td>
<td>Calculation</td>
<td>01/05/11 12:57 /khh</td>
<td></td>
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<tr>
<td>Anions</td>
<td>5.67</td>
<td>meq/L</td>
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<td></td>
<td>Calculation</td>
<td>01/05/11 12:57 /khh</td>
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<tr>
<td>Cations</td>
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<td></td>
<td>Calculation</td>
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<tr>
<td>Solids - Total Dissolved Calculated</td>
<td>335</td>
<td>mg/L</td>
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<td></td>
<td>Calculation</td>
<td>01/05/11 12:57 /khh</td>
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<tr>
<td>IDS Balance (0.80 - 1.20)</td>
<td>0.880</td>
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<td></td>
<td></td>
<td>Calculation</td>
<td>01/05/11 12:57 /khh</td>
<td></td>
</tr>
</tbody>
</table>

Report Definitions:
RL - Analyte reporting limit
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
# QA/QC Summary Report

Prepared by Casper, WY Branch

**Client:** Weston Engineering  
**Project:** Rolling Hills  
**Report Date:** 01/07/11  
**Work Order:** C10120700

<table>
<thead>
<tr>
<th>Method</th>
<th>Count</th>
<th>Result</th>
<th>Units</th>
<th>RL</th>
<th>%REC</th>
<th>Low Limit</th>
<th>High Limit</th>
<th>RPD</th>
<th>RPDLimit</th>
<th>Qual</th>
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</thead>
<tbody>
<tr>
<td>Sample ID: MBLK</td>
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<td>Method Blank</td>
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<td></td>
<td>Run: MANTECH_101221A</td>
<td>12/21/10 15:59</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity, Total as CaCO3</td>
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<td>1</td>
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<tr>
<td>Sample ID: LCS</td>
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<td>Laboratory Control Sample</td>
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<td></td>
<td>Run: MANTECH_101221A</td>
<td>12/21/10 16:14</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity, Total as CaCO3</td>
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<td>mg/L</td>
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<td>90</td>
<td>110</td>
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<tr>
<td>Sample ID: C10120700-001ADUP</td>
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<td>Sample Duplicate</td>
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<td>1.68</td>
<td>mg/L</td>
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<td>Sample Matrix Spike</td>
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<td>Alkalinity, Total as CaCO3</td>
<td>3.01</td>
<td>mg/L</td>
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**Qualifiers:**  
RL - Analyte reporting limit  
ND - Not detected at the reporting limit
### QA/QC Summary Report

**Client:** Weston Engineering  
**Project:** Rolling Hills  
**Report Date:** 01/07/11  
**Work Order:** C10120700  

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| Method: A2510 B  
Sample ID: ICV2_101221_1  
Conductivity @ 25 C | 1350 | umhos/cm | 1.0 | 96 | 90 | 110 | Analytical Run: ORION555A-2_101221A | 12/21/10 15:18 |
| Method: A2510 B  
Sample ID: MBLK1_101221_1  
Conductivity @ 25 C | 0.6 | umhos/cm | 0.2 | Run: ORION555A-2_101221A | 13/21/10 15:13 |
| Sample ID: C10120713-001ADUP  
Conductivity @ 25 C | 6830 | umhos/cm | 1.0 | Run: ORION555A-2_101221A | 12/21/10 15:57 | 0.0 | 10 |

**Qualifiers:**  
RL - Analyte reporting limit  
NUJ - Not detected at the reporting limit
## QA/QC Summary Report
Prepared by Casper, WY Branch

**Client:** Weston Engineering  
**Project:** Rolling Hills  
**Report Date:** 01/07/11  
**Work Order:** C10120700

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<td>Solids, Total Dissolved TDS @ 180 C</td>
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<td>Solids, Total Dissolved TDS @ 180 C</td>
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**Qualifiers:**
- RL: Analyte reporting limit
- ND: Not detected at the reporting limit
# QA/QC Summary Report

**Client:** Weston Engineering  
**Project:** Rolling Hills  
**Report Date:** 01/07/11  
**Work Order:** C10120700

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<td>Sample ID: ICV1_101221_1</td>
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<td>pH</td>
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<td>s.u.</td>
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**Analytical Run:** ORION55A-2_101221A  
**Batch:** 101221_1_PH-W_555A-2  
**Run:** ORION55A-2_101221A  
**Date:** 12/21/10 15:57

---

**Qualifiers:**

- **RL:** Analyte reporting limit.  
- **ND:** Not detected at the reporting limit.
### QA/QC Summary Report

**Client:** Weston Engineering  
**Project:** Rolling Hills  
**Report Date:** 01/07/11  
**Work Order:** C10120700

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<td>ND</td>
<td>mg/L</td>
<td>0.2</td>
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<td>0.50</td>
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<td>Magnesium</td>
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<td>mg/L</td>
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**Sample ID:** MB-10123A  
**Method:** E200.7  
**Batch:** R141232

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<tr>
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**Sample ID:** C10120698-001GMa2  
**Sample ID:** C10120698-001BwSU  
**Method:** E200.7  
**Batch:** 28618

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**Sample ID:** LCS3-26818  
**Sample ID:** C10120700-001CMSJ  
**Sample ID:** C10120706-001CMSD

**Qualifiers:**  
**RL** - Analyte reporting limit  
**NU** - Not detected at the reporting limit.
# QA/QC Summary Report

Prepared by Casper, WY Branch

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**Qualifiers:**

- RL - Analyte reporting limit
- ND - Not detected at the reporting limit.

- A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.
## QA/QC Summary Report

**Client:** Weston Engineering  
**Project:** Rolling Hills  
**Report Date:** 01/07/11  
**Work Order:** C10120700

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**Qualifiers:**

- **RL:** Analyte reporting limit.
- **NU:** Not detected at the reporting limit.
## Workorder Receipt Checklist

**Weston Engineering**

Login completed by: Halley Ackerman  
Reviewed by: BL2000/cwagner  
Reviewed Date: 12/22/2010

Date Received: 12/21/2010  
Received by: ha  
Carrier name: Hand Del

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<tr>
<td>Custody seals intact on shipping container/cooler?</td>
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<tr>
<td>Custody seals intact on sample bottles?</td>
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<td>Chain of custody signed when relinquished and received?</td>
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<td>Chain of custody agrees with sample labels?</td>
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<tr>
<td>All samples received within holding time?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container Temp. Blank temperature:</td>
<td>13°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water - VOA vials have zero headspace?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water - pH acceptable upon receipt?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contact and Corrective Action Comments:
## Chain of Custody and Analytical Request Record

**Please Print** (Provide as much information as possible.)

**Company Name:** Weston Engineering

**Report Mail Address:** 1058 3rd street, Suite E

Laramie, WY 82072

**Invoice Address:** Same

**Special Report/Formats:**
- [ ] DW
- [ ] POTW/WWTP
- [ ] Other: ________
- [ ] EDD/EDT (Electronic Data)
- [ ] LEVEL IV
- [ ] NELAC

**Sample Origin**

- **State:** Wyoming

**Sample Name, PWS, Permit, Etc.:** Rolling Hills

**Contact Name:** Ben Jordan

**Phone/Fax:** 307 745-6148

**Email:** bjordan@westonengineering.com

**Sample Order:** (Please Print)

- Ben Jordan

**Purchase Order:** 32175

**Invoice Contact & Phone:** Same

**ANALYSIS REQUESTED**
- [ ] Contact ELI prior to RUSH sample submittal
- [ ] for charges and scheduling – See Instruction Page

**Comments:**

**Sample Disposal:**

- **Returned to Client:**
- **Lab Disposal:**

---

**Custody Record MUST be Signed**

- **Received by (print):**
- **Date/Time:**
- **Signature:**

- **Relinquished by (print):**
- **Date/Time:**
- **Signature:**

- **Returned to Client:**
- **Date/Time:**
- **Signature:**

---

In certain circumstances, samples submitted to Energy Laboratories Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our website at www.energylab.com for additional information, downloadable fee schedule, forms, and links.
January 20, 2011

Weston Engineering
1050 N 3rd St Ste E
Laramie, WY 82072

Workorder No.: C11010161
Project Name: Rolling Hills

Energy Laboratories, Inc. Casper WY received the following 1 sample for Weston Engineering on 1/6/2011 for analysis.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Client Sample ID</th>
<th>Collect Date</th>
<th>Receive Date</th>
<th>Matrix</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>C11010161-001</td>
<td>Well No. 4</td>
<td>01/06/11 05:30 01/06/11</td>
<td>Aqueous</td>
<td>Metals by ICP/ICPMS, Dissolved Metals by ICP/ICPMS, Total Alkalinity QA Calculations Bacteria, Iron Related Conductivity Corrosivity, Calculated Sample Filtering Hardness E300.0 Anions Nitrogen, Nitrate + Nitrite pH Metals Preparation by EPA 200.2 Solids, Total Dissolved</td>
<td></td>
</tr>
</tbody>
</table>

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82001. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By: Stephanie Waldrop
Reporting Supervisor
Digitally signed by Stephanie Waldrop
Date: 2011.01.20 11:00:52.67:00
DOMESTIC WATER ANALYSIS EXPLANATIONS

Alkalinity- is a measure of the water's capacity to neutralize acid. Water with a high alkalinity (above 300 mg/L), when boiled for an extended period of time, may form a deposit or develop an unpleasant taste. Water with a very low alkalinity (below 30 mg/L) corrodes pipes and plumbing.

Bicarbonate- is a buffer ion in water, derived from carbonate rocks and atmospheric CO2. Water with pH 7.8 will be 60-90% buffered by bicarbonate. If water is heated, bicarbonate can combine with calcium or magnesium to form scale, which can clog pipes and precipitate in sinks and laundry.

Calcium- is an essential human nutrient for bones and teeth. Excessive calcium with magnesium produces hard water, which causes taste problems, scale in pipes, tubs, and sinks and excessive soap consumption. Water softeners remove calcium but replace it with sodium, which may be harmful to people on low sodium diets.

Carbonate- along with bicarbonate, this ion accounts for the buffering capacity of waters with a pH greater than 9. It is most often present as salts (CaCO3, MgCO3) which precipitate at a high pH.

Chloride- less than 250 mg/L is recommended to prevent unpleasant taste. The normal range for drinking water is 5-20 mg/L. High values may be an early indicator of contamination. Chloride also makes water more corrosive towards the distribution system.

Conductivity (Specific Conductance)- a measure of the water's ability to conduct an electrical current, it increases as the amount of dissolved minerals increase. Conductivity is used as a check on the total dissolved solids in the water.

Hardness- caused mainly by calcium and magnesium, it produces incrustation on pipes, kitchen utensils, and tubs as well as excessive soap consumption. Upon heating, hard water may form scale deposits, alternately, soft water may result in a corrosion of water pipes. In general, 80-100 mg/L is considered acceptable, 200-500 mg/L is considered tolerable, and greater than 500 mg/L is considered unacceptable.

Iron- the level of 0.3 mg/L is a general guideline based on aesthetics and taste. It is an essential human nutrient; however, at levels greater than 0.3 mg/L, it stains laundry and plumbing fixtures, and causes undesirable taste in beverages. When exposed to air, iron precipitates causing a reddish-brown color.

Magnesium- is an essential human nutrient for the heart and nervous system. Greater than 50 mg/L may have a laxative effect on first time users. Guidelines are often based on aesthetics (taste). Along with calcium, magnesium contributes to water hardness.

Nitrate + nitrite as N- 10 mg/L maximum contaminant level. Acutely toxic in infants under 6 months of age, nitrate produces a blood disorder called methemoglobinemia (blue baby syndrome), which limits the amount of oxygen the bloodstream can carry.

pH- is an aesthetic parameter. Low pH may cause corrosion of water pipes-while high pH may cause incrustation of pipes.

Potassium- is an essential human nutrient. It is necessary for nerve impulses. Moderate concentrations are acceptable, but greater than 2000 mg/L may be harmful to nervous and digestive systems.

Sodium- is an essential human nutrient necessary for nerve impulses. If a water softener is used to remove hardness, calcium is replaced by sodium. People on low sodium diets using water softeners should have the sodium level of their water checked and consult a physician. Less than 20 mg/L is ideal.

Sulfate- is recommended to be below 500 mg/L for health and aesthetic reasons. The major physiological effects when exceeded are catharsis (laxative effect) and gastrointestinal irritation. Sulfate may produce noticeable taste.

Total dissolved solids- represents the dissolved minerals in water. High values above 1500 mg/L may cause taste, corrosion, scaling and a laxative effect.
LABORATORY ANALYTICAL REPORT
Prepared by Casper, WY Branch

Client: Weston Engineering
Project: Rolling Hills
Lab ID: C11010161-001
Client Sample ID: Well No. 4

Report Date: 01/20/11
Collection Date: 01/06/11 05:30
Date Received: 01/06/11
Matrix: Aqueous

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<th>Result</th>
<th>Units</th>
<th>Qualifier</th>
<th>RL</th>
<th>MCL/QCL</th>
<th>Method</th>
<th>Analysis Date / By</th>
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<td><strong>MICROBIOLOGICAL</strong></td>
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<tr>
<td>Bacteria, Iron Related</td>
<td>&lt; 1</td>
<td>CFU/ml</td>
<td>1.0</td>
<td></td>
<td></td>
<td>IRB-BART</td>
<td>01/06/11 12:29 / rodh</td>
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<td><strong>MAJOR IONS</strong></td>
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<tr>
<td>Alkalinity, Total as CaCO3</td>
<td>230</td>
<td>mg/L</td>
<td>5</td>
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<td>A2320 B</td>
<td>01/06/11 19:37 / jba</td>
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<tr>
<td>Calcium</td>
<td>4</td>
<td>mg/L</td>
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<td>E200.7</td>
<td>01/07/11 16:11 / cp</td>
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<td>Chloride</td>
<td>7</td>
<td>mg/L</td>
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<td></td>
<td>E500.0</td>
<td>01/11/11 20:47 / lji</td>
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<td>Magnesium</td>
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<td>mg/L</td>
<td>1</td>
<td></td>
<td>E500.0</td>
<td>01/11/11 20:47 / lji</td>
<td></td>
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<tr>
<td>Nitrogen, Nitrate+Nitrite as N</td>
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<td>mg/L</td>
<td>0.1</td>
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<td>Sulfate</td>
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<td>mg/L</td>
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<tr>
<td><strong>PHYSICAL PROPERTIES</strong></td>
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<td>Corrosivity</td>
<td>0.002</td>
<td>unitless</td>
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<td>Calculation</td>
<td>01/20/11 09:02 / kbh</td>
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<tr>
<td>Conductivity @ 25 C</td>
<td>593</td>
<td>umhos/cm</td>
<td>1</td>
<td></td>
<td>A26150 B</td>
<td>01/06/11 14:50 / lmc</td>
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<tr>
<td>Hardness as CaCO3</td>
<td>15</td>
<td>mg/L</td>
<td>1</td>
<td></td>
<td>A2340 B</td>
<td>01/07/11 16:11 / kbh</td>
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<tr>
<td>pH</td>
<td>8.48</td>
<td>s.u.</td>
<td>0.01</td>
<td></td>
<td>A4500-H B</td>
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<tr>
<td>Solids, Total Dissolved TDS @ 180 C</td>
<td>351</td>
<td>mg/L</td>
<td>10</td>
<td></td>
<td>A2540 C</td>
<td>01/06/11 14:52 / l</td>
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<td><strong>METALS - TOTAL</strong></td>
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</tr>
<tr>
<td>Iron</td>
<td>1.28</td>
<td>mg/L</td>
<td>0.03</td>
<td></td>
<td>E200.7</td>
<td>01/12/11 01:24 / cp</td>
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<tr>
<td>Manganese</td>
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<td>mg/L</td>
<td>0.01</td>
<td></td>
<td>E200.7</td>
<td>01/12/11 01:24 / cp</td>
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<td>A/C Balance (± 5)</td>
<td>-3.88</td>
<td>%</td>
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<td>Calculation</td>
<td>01/20/11 09:02 / kbh</td>
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<td>Anions</td>
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<td>Calculation</td>
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<td>Cations</td>
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<td>Solids, Total Dissolved Calculated</td>
<td>372</td>
<td>mg/L</td>
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<td>Calculation</td>
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<td>TDS Balance (0.80 - 1.20)</td>
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<td></td>
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<td>Calculation</td>
<td>01/20/11 09:02 / kbh</td>
</tr>
</tbody>
</table>

Report Definitions:
- RL - Analyte reporting limit.
- MCL - Maximum contaminant level.
- QCL - Quality control limit.
- ND - Not detected at the reporting limit.
## Workorder Receipt Checklist

**Weston Engineering**

Login completed by: Corinne Wagner  
Reviewed by: BL2000/edwards  
Reviewed Date: 1/7/2011

Date Received: 1/6/2011  
Received by: ckw  
Carrier name: Hand Del

<table>
<thead>
<tr>
<th>Condition</th>
<th>Status</th>
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<tbody>
<tr>
<td>Shipping container/cooler in good condition?</td>
<td>Yes</td>
</tr>
<tr>
<td>Custody seals intact on shipping container/cooler?</td>
<td>Yes</td>
</tr>
<tr>
<td>Custody seals intact on sample bottles?</td>
<td>Yes</td>
</tr>
<tr>
<td>Chain of custody present?</td>
<td>Yes</td>
</tr>
<tr>
<td>Chain of custody signed when relinquished and received?</td>
<td>Yes</td>
</tr>
<tr>
<td>Chain of custody agrees with sample labels?</td>
<td>Yes</td>
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<tr>
<td>Samples in proper container/bottle?</td>
<td>Yes</td>
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<tr>
<td>Sample containers intact?</td>
<td>Yes</td>
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<tr>
<td>Sufficient sample volume for indicated test?</td>
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<tr>
<td>All samples received within holding time?</td>
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</tr>
<tr>
<td>Container/Temp Blank temperature:</td>
<td>7°C</td>
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<td>Water - VOA vials have zero headspace?</td>
<td>No</td>
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<td>Water - pH acceptable upon receipt?</td>
<td>Yes</td>
</tr>
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Contact and Corrective Action Comments:

None
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<tr>
<th>Date/Time</th>
<th>Signature</th>
<th>Date/Time</th>
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<tbody>
<tr>
<td>11/6/11</td>
<td></td>
<td>10:15</td>
<td></td>
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</tbody>
</table>

**Sample Disposal:** Return to Client: X

**Lab Disposal:**

---

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly noted on your analytical report. Visit our web site at <www.energy-laboratories.com> for additional information, downloadable fee schedule, forms, and links.
January 26, 2011

Weston Engineering
1050 N 3rd St Ste E
Laramie, WY 82072

Workorder No.: C11010394
Project Name: Rolling Hills

Energy Laboratories, Inc. Casper WY received the following 1 sample for Weston Engineering on 1/13/2011 for analysis.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Client Sample ID</th>
<th>Collect Date</th>
<th>Receive Date</th>
<th>Matrix</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>C11010394-001</td>
<td>Well No.5</td>
<td>01/13/11 09:00</td>
<td>01/13/11</td>
<td>Drinking Water</td>
<td>Metals by ICP/ICPMS, Dissolved Metals by ICP/ICPMS, Total Alkalinity</td>
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<tr>
<td></td>
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<td>QA Calculations</td>
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<tr>
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<td>Bacteria, Iron Related</td>
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<td>Corrosivity, Calculated</td>
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<td>Sample Filtering</td>
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<td>Hardness</td>
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<tr>
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<td>Nitrogen, Nitrate + Nitrite</td>
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<tr>
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<td>pH</td>
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<td>Metals Preparation by EPA 200.2</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Solids, Total Dissolved</td>
</tr>
</tbody>
</table>

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By: ___________________________   Digitally signed by Stephanie Waldrop
Stephanie D. Waldrop
Reporting Supervisor   Date: 2011.01.27 09:59:39 -07:00
DOMESTIC WATER ANALYSIS EXPLANATIONS
Alkalinity- is a measure of the water's capacity to neutralize acid. Water with a high alkalinity (above 300 mg/L), when boiled for an extended period of time, may form a deposit or develop an unpleasant taste. Water with a very low alkalinity (below 30 mg/L) corrodes pipes and plumbing.

Bicarbonate- is a buffer ion in water, derived from carbonate rocks and atmospheric CO2. Water with pH 7.8 will be 60-90% buffered by bicarbonate. If water is heated, bicarbonate can combine with calcium or magnesium to form scale, which can clog pipes and precipitate in sinks and laundry.

Calcium- is an essential human nutrient for bones and teeth. Excessive calcium with magnesium produces hard water, which causes taste problems, scale in pipes, tubs, and sinks and excessive soap consumption. Water softeners remove calcium but replace it with sodium, which may be harmful to people on low sodium diets.

Carbonate- along with bicarbonate, this ion accounts for the buffering capacity of waters with a pH greater than 9. It is most often present as salts (CaCO3, MgCO3) which precipitate at a high pH.

Chloride- less than 250 mg/L is recommended to prevent unpleasant taste. The normal range for drinking water is 5-20 mg/L. High values may be an early indicator of contamination. Chloride also makes water more corrosive towards the distribution system.

Conductivity (Specific Conductance)- a measure of the water's ability to conduct an electrical current, it increases as the amount of dissolved minerals increase. Conductivity is used as a check on the total dissolved solids in the water.

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Iron- the level of 0.3 mg/L is a general guideline based on aesthetics and taste. It is an essential human nutrient; however, at levels greater than 0.3 mg/L, it stains laundry and plumbing fixtures, and causes undesirable taste in beverages. When exposed to air, iron precipitates causing a reddish-brown color.

Magnesium- is an essential human nutrient for the heart and nervous system. Greater than 50 mg/L may have a laxative effect on first time users. Guidelines are often based on aesthetics (taste). Along with calcium, magnesium contributes to water hardness.

Nitrate + nitrite as N- 10 mg/L maximum contaminant level. Acutely toxic in infants under 6 months of age, nitrate produces a blood disorder called methemoglobinemia (blue baby syndrome), which limits the amount of oxygen the bloodstream can carry.

pH- is an aesthetic parameter. Low pH may cause corrosion of water pipes-while high pH may cause incrustation of pipes.

Potassium- is an essential human nutrient. It is necessary for nerve impulses. Moderate concentrations are acceptable, but greater than 2000 mg/L may be harmful to nervous and digestive systems.

Sodium- is an essential human nutrient necessary for nerve impulses. If a water softener is used to remove hardness, calcium is replaced by sodium. People on low sodium diets using water softeners should have the sodium level of their water checked and consult a physician. Less than 20 mg/L is ideal.

Sulfate- is recommended to be below 500 mg/L for health and aesthetic reasons. The major physiological effects when exceeded are catharsis (laxative effect) and gastrointestinal irritation. Sulfate may produce noticeable taste.

Total dissolved solids- represents the dissolved minerals in water. High values above 1500 mg/L may cause taste, corrosion, scaling and a laxative effect.
LABORATORY ANALYTICAL REPORT
Prepared by Casper, WY Branch

Client: Weston Engineering  
Project: Rolling Hills  
Lab ID: C11010394-001  
Client Sample ID: Well No.5  
Report Date: 01/26/11  
Collection Date: 01/13/11 09:00  
Date Received: 01/13/11  
Matrix: Drinking Water

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<th>Analyses</th>
<th>Result</th>
<th>Units</th>
<th>Qualifier</th>
<th>RL</th>
<th>MCL/</th>
<th>Method</th>
<th>Analysis Date / By</th>
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<tr>
<td><strong>MICROBIOLOGICAL</strong></td>
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<td></td>
<td></td>
<td></td>
<td>QCL</td>
<td></td>
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<tr>
<td>Bacteria, Iron Related</td>
<td>530</td>
<td>CFU/ml</td>
<td>1.0</td>
<td>5</td>
<td>IRB-BART</td>
<td></td>
<td>01/13/11 13:23 / rodh</td>
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<tr>
<td>~ 6 days incubation</td>
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<td></td>
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<tr>
<td><strong>MAJOR IONS</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity, Total as CaCO3</td>
<td>200</td>
<td>mg/L</td>
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<td>1</td>
<td>A2320</td>
<td>B</td>
<td>01/13/11 18:21 / jba</td>
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<td>01/18/11 06:08 / ljl</td>
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<td>01/17/11 16:17 / cp</td>
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<td>01/17/11 17:46 / cp</td>
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<td>A/C Balance (± 5)</td>
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<td></td>
<td>Calculation</td>
<td></td>
<td>01/24/11 10:59 / kbb</td>
</tr>
<tr>
<td>Anions</td>
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<td>01/24/11 10:59 / kbb</td>
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</tbody>
</table>

Report Definitions:
- RL - Analyte reporting limit.
- MCL - Maximum contaminant level.
- QCL - Quality control limit.
- ND - Not detected at the reporting limit.
- ID - RL increased due to sample matrix.
Workorder Receipt Checklist

Weston Engineering

Login completed by: Halley Ackerman
Reviewed by: BL2000\tedwards
Reviewed Date: 1/13/2011

Date Received: 1/13/2011
Received by: tae
Carrier name: Hand Del

Shipping container/cooler in good condition? Yes ☑ No ☐ Not Present ☐
Custody seals intact on shipping container/cooler? Yes ☑ No ☐ Not Present ☐
Custody seals intact on sample bottles? Yes ☑ No ☐ Not Present ☐
Chain of custody present? Yes ☑ No ☐
Chain of custody signed when relinquished and received? Yes ☑ No ☐
Chain of custody agrees with sample labels? Yes ☑ No ☐
Samples in proper container/cottle? Yes ☑ No ☐
Sample containers intact? Yes ☑ No ☐
Sufficient sample volume for indicated test? Yes ☑ No ☐
All samples received within holding time? Yes ☑ No ☐
Container/Temp Blank temperature: 17°C
Water - VOA vials have zero headspace? Yes ☑ No ☐ Not VOA vials submitted ☑
Water - pH acceptable upon receipt? Yes ☑ No ☐ Not Applicable ☐

Contact and Corrective Action Comments:

Domestic sample was subsampled and preserved in lab upon receipt for metals with 2 mL HNO3 and for Nitrate+Nitrite with 2 mL H2SO4 to pH <2.
# Chain of Custody and Analytical Request Record

**PLEASE PRINT** (Provide as much information as possible.)

<table>
<thead>
<tr>
<th>Company Name:</th>
<th>Western Engineering Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Name, PWS, Permit, Etc.:</td>
<td>Rolling Hills</td>
</tr>
<tr>
<td>Sample Origin State:</td>
<td>WY</td>
</tr>
<tr>
<td>Report Mail Address:</td>
<td>1050 N 3rd St, Suite E Laramie, WY 82072</td>
</tr>
<tr>
<td>Contact Name:</td>
<td>Ben Jordan</td>
</tr>
<tr>
<td>Phone/Fax:</td>
<td>307-745-6961 307-745-6488</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:bjordan@westerneng.com">bjordan@westerneng.com</a></td>
</tr>
<tr>
<td>SAMPLER:</td>
<td>Ben Jordan</td>
</tr>
<tr>
<td>Invoice Address:</td>
<td>Same</td>
</tr>
<tr>
<td>Invoice Contact &amp; Phone:</td>
<td>Same</td>
</tr>
<tr>
<td>Purchase Order:</td>
<td>32715</td>
</tr>
<tr>
<td>Quote/Bottle Order:</td>
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</tbody>
</table>

**ANALYSIS REQUESTED**

- **RUSH**
- **SCHEDULED**
- **COMMENTS**

<table>
<thead>
<tr>
<th>SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)</th>
<th>Collection Date</th>
<th>Collection Time</th>
<th>MATRIX</th>
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<tbody>
<tr>
<td>Well No. 5</td>
<td>11/21/11 09:00</td>
<td>2111</td>
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**CUSTODY RECORD MUST BE SIGNED**

<table>
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<th>Requisitioned by (print):</th>
<th>Date/Time: 11/21/11 10:45</th>
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<td>Received by (print):</td>
<td>Date/Time:</td>
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<tr>
<td>Returned to Client:</td>
<td>Date/Time:</td>
</tr>
<tr>
<td>Lab Disposal:</td>
<td>Date/Time:</td>
</tr>
</tbody>
</table>

**In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly noted on your analytical report.**
February 02, 2011

Weston Engineering
1050 N 3rd St Ste E
Laramie, WY 82072

Workorder No.: C11010545
Project Name: Rolling Hills

Energy Laboratories, Inc. Casper WY received the following 1 sample for Weston Engineering on 1/19/2011 for analysis.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Client Sample ID</th>
<th>Collect Date</th>
<th>Receive Date</th>
<th>Matrix</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>C11010545-001</td>
<td>Well No. 6</td>
<td>01/19/11 8:30</td>
<td>01/19/11</td>
<td>Aqueous</td>
<td>Metals by ICP/ICPMS, Dissolved Metals by ICP/ICPMS, Total Alkalinity QA Calculations Bacteria, Iron Related Conductivity Corrosivity, Calculated Sample Filtering Hardness E300.0 Anions Nitrogen, Nitrate + Nitrite pH Metals Preparation by EPA 200.2 Solids, Total Dissolved</td>
</tr>
</tbody>
</table>

This report was prepared by Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By: Kathy Hamre
Report Proofing Specialist

Digitally signed by Kathy Hamre
Date: 2011.02.02 09:32:56 -07:00
DOMESTIC WATER ANALYSIS EXPLANATIONS
Alkalinity- is a measure of the water's capacity to neutralize acid. Water with a high alkalinity (above 300 mg/L), when boiled for an extended period of time, may form a deposit or develop an unpleasant taste. Water with a very low alkalinity (below 30 mg/L) corrodes pipes and plumbing.

Bicarbonate- is a buffer ion in water, derived from carbonate rocks and atmospheric CO2. Water with pH 7.8 will be 60-90% buffered by bicarbonate. If water is heated, bicarbonate can combine with calcium or magnesium to form scale, which can clog pipes and precipitate in sinks and laundry.

Calcium- is an essential human nutrient for bones and teeth. Excessive calcium with magnesium produces hard water, which causes taste problems, scale in pipes, tubs, and sinks and excessive soap consumption. Water softeners remove calcium but replace it with sodium, which may be harmful to people on low sodium diets.

Carbonate- along with bicarbonate, this ion accounts for the buffering capacity of waters with a pH greater than 9. It is most often present as salts (CaCO3, MgCO3) which precipitate at a high pH.

Chloride- less than 250 mg/L is recommended to prevent unpleasant taste. The normal range for drinking water is 5-20 mg/L. High values may be an early indicator of contamination. Chloride also makes water more corrosive towards the distribution system.

Conductivity (Specific Conductance)- a measure of the water’s ability to conduct an electrical current, it increases as the amount of dissolved minerals increase. Conductivity is used as a check on the total dissolved solids in the water.

Hardness- caused mainly by calcium and magnesium, it produces incrustation on pipes, kitchen utensils, and tubs as well as excessive soap consumption. Upon heating, hard water may form scale deposits, alternately, soft water may result in a corrosion of water pipes. In general, 80-100 mg/L is considered acceptable, 200-500 mg/L is considered tolerable, and greater than 500 mg/L is considered unacceptable.

Iron- the level of 0.3 mg/L is a general guideline based on aesthetics and taste. It is an essential human nutrient; however, at levels greater than 0.3 mg/L, it stains laundry and plumbing fixtures, and causes undesirable taste in beverages. When exposed to air, iron precipitates causing a reddish-brown color.

Magnesium- is an essential human nutrient for the heart and nervous system. Greater than 50 mg/L may have a laxative effect on first time users. Guidelines are often based on aesthetics (taste). Along with calcium, magnesium contributes to water hardness.

Nitrate + nitrite as N- 10 mg/L maximum contaminant level. Acutely toxic in infants under 6 months of age, nitrate produces a blood disorder called methemoglobinemia (blue baby syndrome), which limits the amount of oxygen the bloodstream can carry.

pH- is an aesthetic parameter. Low pH may cause corrosion of water pipes-while high pH may cause incrustation of pipes.

Potassium- is an essential human nutrient. It is necessary for nerve impulses. Moderate concentrations are acceptable, but greater than 2000 mg/L may be harmful to nervous and digestive systems.

Sodium- is an essential human nutrient necessary for nerve impulses. If a water softener is used to remove hardness, calcium is replaced by sodium. People on low sodium diets using water softeners should have the sodium level of their water checked and consult a physician. Less than 20 mg/L is ideal.

Sulfate- is recommended to be below 500 mg/L for health and aesthetic reasons. The major physiological effects when exceeded are catharsis (laxative effect) and gastrointestinal irritation. Sulfate may produce noticeable taste.

Total dissolved solids- represents the dissolved minerals in water. High values-above 1500 mg/L may cause taste, corrosion, scaling and a laxative effect.
LABORATORY ANALYTICAL REPORT
Prepared by Casper, WY Branch

Client: Weston Engineering
Project: Rolling Hills
Lab ID: C11010545-001
Client Sample ID: Well No. 6

Report Date: 02/02/11
Collection Date: 01/19/11 08:30
Date Received: 01/19/11
Matrix: Aqueous

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<th>MCL/ QCL</th>
<th>Method</th>
<th>Analysis Date / By</th>
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<td>Nitrogen, Nitrate+Nitrite as N</td>
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<td>Calculation</td>
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<tr>
<td>Conductivity @ 25 C</td>
<td>550</td>
<td>umho/cm</td>
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<td>mg/L</td>
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<td>E200.7</td>
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<td>E200.7</td>
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<td>01/21/11 17:19 / cp</td>
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<td><strong>DATA QUALITY</strong></td>
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<td>A/C Balance (± 5)</td>
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<td></td>
<td>01/28/11 15:05 / kbb</td>
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</tbody>
</table>

Report Definitions:
- RL - Analyte reporting limit.
- MCL - Maximum contaminant level.
- QCL - Quality control limit.
- ND - No detected at the reporting limit.
- D - RL increased due to sample matrix.

Page 3 of 5
**Workorder Receipt Checklist**

**Weston Engineering**

Login completed by: Edith McPike
Reviewed by: BL2000/hackerman
Reviewed Date: 1/19/2011

Date Received: 1/19/2011
Received by: ckw
Carrier name: Hand Del

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<tr>
<td>Custody seals intact on shipping container/coolers?</td>
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</tr>
<tr>
<td>Custody seals intact on sample bottles?</td>
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<td></td>
</tr>
<tr>
<td>Chain of custody present?</td>
<td>☑</td>
<td></td>
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</tr>
<tr>
<td>Chain of custody signed when relinquished and received?</td>
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<td>Chain of custody agrees with sample labels?</td>
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<tr>
<td>Sample containers intact?</td>
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<tr>
<td>Sufficient sample volume for indicated test?</td>
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</tr>
<tr>
<td>All samples received within holding time?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container.Temp Blank temperature:</td>
<td>12°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water - VOA vials have zero headspace?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water - pH acceptable upon receipt?</td>
<td>☑</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contact and Corrective Action Comments:

Samples for dissolved metals were subsampled, filtered and preserved with 2 mL HNO3 in lab upon receipt to pH <2.
Chain of Custody and Analytical Request Record

**PLEASE PRINT** (Provide as much information as possible.)

**Company Name:** Western Engineering, Inc  
**Project Name, PWS, Permit, Etc.:** Rolling Hills  
**Sample Origin:**  
**EPA/State Compliance:** Yes ☐ No ☐

**Report Mail Address:** 1050 N 3rd Street, Suite E  
**Contact Name:** Ben Jordan  
**Phone/Fax:** 307-745-6118  
**Email:** benjordan@westernengineering.com  
**Sampled (Please Print):** Ben Jordan

**Invoice Address:** Same  
**Invoice Contact & Phone:**  
**Purchase Order:** Quote/Bottle Order:

**Special Report/Formats:**
- DW ☒  
- POTW/MMTP ☐  
- State: ☐  
- Other: ☐

**ANALYSIS REQUESTED**
- Domestic Water ☐  
- Edible/Edible ☐  
- Edible/Non Edible ☐  
- Nutrient Analysis ☐  
- Sediment ☐  
- Corrosivity ☐  
- See Attached Standard Turnaround (TAT)

**Contact ELI prior to RUSH sample submittal for charges and scheduling - See Instruction Page**

**Comments:**

**Sample Identification**

<table>
<thead>
<tr>
<th>Sample Identification</th>
<th>Collection Date</th>
<th>Collection Time</th>
<th>Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well # 26</td>
<td>1/19/11</td>
<td>08:30</td>
<td>W</td>
</tr>
</tbody>
</table>

**Custody Record MUST be Signed**

Date: 1/19/11  
Time: 08:45  
Signatures:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly noted on your analytical report.

Visit our web site at [www.energylab.com](http://www.energylab.com) for additional information, downloadable fee schedule, forms, and links.