MOORCROFT
LEVEL II
WATER SUPPLY STUDY
EXECUTIVE SUMMARY

NOVEMBER 2002

SUBMITTED TO

WYOMING WATER DEVELOPMENT COMMISSION
AND
THE TOWN OF MOORCROFT

WESTON
GROUNDWATER • ENGINEERING
WESTON ENGINEERING, INC.
MOORCROFT LEVEL II WATER SUPPLY PROJECT
EXECUTIVE SUMMARY

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MOORCROFT
LEVEL II WATER SUPPLY STUDY

INTRODUCTION

The Town of Moorcroft is located in Crook County in northeastern Wyoming (Figure 1). The Town is a residential community with an elevation of approximately 4,430 feet. It is located approximately 30 miles east of Gillette at the intersection of Interstate-90 (I-90) and U.S. Highways 14 and 16.

The current population is 807, as recorded in the 2000 census. Broad swings in the Town's population have occurred over the last several decades because of fluctuations in the number of people employed in the oil, gas, and coal industries. For example, the 1980 and 1990 censuses reported 1,158 and 768 residents, respectively.

The Moorcroft water service area is limited to the municipal boundaries and the Wyoming Department of Transportation rest area along I-90 (see Figure 1). Some new residential areas are developing along the eastern edge of Moorcroft and north of I-90. Residences north of I-90 are not included in the current service area.

The purpose of the Moorcroft Level II Water Supply Study is to provide a reconnaissance-level assessment of the existing water supply wells; design, construct, and test an exploration well; and prepare preliminary designs and cost estimates for various well completion alternatives. Included in the study is an analysis of the water supply sources, water supply needs, population projections, and future water demands. Except for the existing wells, the water supply, storage, and disinfection systems are fairly new, and hence are not anticipated to present operation and maintenance problems in the near future. Alternatives for enhancing Moorcroft's water supply are presented and ranked and probable costs for all feasible options are provided in the Level II Report.

PRESENT AND FUTURE WATER NEEDS

For water system planning purposes, the population of the service area has been projected 20 years into the future, to the year 2022. The Wyoming Department of Administration and Information’s (DAI), Economic Analysis Division estimates a 0.6-percent annual growth rate for the Town of Moorcroft and a one percent annual growth rate for Crook County. However, these projections should be tempered by an understanding that the accuracy of predicting the future population of Moorcroft is limited because of the dependency of the Town on the energy industry. The boom-bust cycles of the energy industry have resulted in periodic population explosions during peaks in energy prices, followed by marked declines during lows in energy prices. Additionally, population projections do not account for expansion of the service area via annexation. The large decline in population, followed by the slow growth of the 1990s, demonstrates the difficulty of projecting populations in small towns affected by boom-bust cycles. To
MOORCROFT LEVEL II WATER SUPPLY PROJECT
LOCATION MAP
FIGURE 1

(Map adapted from USGS Sundance 30x60 Quadrangle, 1979)
conservatively estimate the 2022 population of Moorcroft for planning purposes, a 1.0 percent growth rate was selected, which predicts a population of 1,004 persons.

The average daily demand for Moorcroft is 172 gallons per capita per day (gpcd) and the anticipated average daily demand for the estimated 2022 population of 1,004 residents is 172,688 gallons per day. The source capacity needed to meet the 2022 average daily demand is estimated at 120 gpm. The peak daily demand is 560 gpcd and the maximum daily demand for 2022 is projected to be 370,476 gallons per day, which will require a source capacity of 257 gpm.

INVENTORY OF EXISTING WATER SUPPLY SYSTEM

Three wells, Well Nos. 1, 6, and 8, and a tap on the Gillette-Madison pipeline currently comprise the water supply for the Town of Moorcroft. The three wells owned by Moorcroft are completed in the Lance and Fox Hills Formations and produce a total of approximately 116 gallons per minute (gpm), according to Mr. Ron Feehan, the Moorcroft Public Works Director (Personal Communication, Ron Feehan, September 12, 2002). Although these wells function acceptably, several problems have plagued the wells over the past several years. These problems include wells that have exceeded typical life expectancy, tool-cut perforations, sand and/or gas production, declining water levels, and marginal water quality. Table 1 provides a summary of pertinent well data.

Infrequent laboratory analyses indicate that the groundwater from the Moorcroft wells contains between 785 and 1,394 mg/L total dissolved solids (TDS). The Secondary Standard for TDS is 500 mg/L, or 1,000 mg/L if water of better quality is not available. The iron standard is based on the tendency for iron to stain plumbing fixtures and, in high concentrations, to discolor the water. Sulfate and TDS can give the water an objectionable taste, and in large concentrations, sulfate can act as a laxative for people unaccustomed to it. The maximum contaminant level (MCL) for sulfate is 250 mg/L and water from Well Nos. 1 and 8 have concentrations of 468 and 674 mg/L, respectively. The concentration of sodium in water developed by Well No. 8 also exceeds the secondary standard of 250 mg/L. Elevated sodium concentrations can be problematic for individuals requiring a low-sodium diet. No regulated volatile organic compounds have been detected in the Moorcroft wells and radionuclide concentrations are well below the MCLs.

The minimum recommended storage for a community with a water demand of between 50,000 and 500,000 gallons per day is the average daily demand plus fire flow storage. The present storage capacity of 500,000 gallons exceeds the 352,688 gpd required to meet the projected demand (172,688 gpd) and fire flow storage (180,000 gallons).

GROUNDWATER EXPLORATION PROGRAM

Drilling and construction of the exploration well was performed from August 21 and October 4, 2001 by the drilling contractor, Layne-Western from Denver, Colorado, using a Challenger 360-200 drilling rig. As depicted in Figure 2, an as-built diagram that provides construction details of the Moorcroft Madison Well, a 9 5/8-inch O.D. threaded steel casing string was installed from 1.5 feet above grade to a depth of 1,482 feet. A 7-inch O.D. threaded steel casing string was installed using a liner-hanger assembly. The top of
the liner-hanger assembly was placed at 1,415 feet and the bottom of the 7-inch casing extended to 3,596 feet. The well has an open-hole completion in the Madison Limestone from 3,596 to 3,742 feet.

**TABLE 1**
**MOORCROFT EXISTING WATER SUPPLY WELL SUMMARY**

<table>
<thead>
<tr>
<th>Permit No.</th>
<th>Well No.1</th>
<th>Well No. 6</th>
<th>Well No. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion Date</td>
<td>1947</td>
<td>1979</td>
<td>1993</td>
</tr>
<tr>
<td>Appropriation (gpm)</td>
<td>25</td>
<td>90</td>
<td>150</td>
</tr>
<tr>
<td>Production Rate, 2002 (gpm)</td>
<td>18</td>
<td>64</td>
<td>34</td>
</tr>
<tr>
<td>Total Depth (feet)</td>
<td>500</td>
<td>769</td>
<td>914</td>
</tr>
<tr>
<td>Producing Intervals (feet)</td>
<td>Unknown</td>
<td>290-296</td>
<td>792.5-884</td>
</tr>
<tr>
<td>Pump Setting (feet)</td>
<td>420</td>
<td>663</td>
<td>610</td>
</tr>
<tr>
<td>Water Quality, TDS (mg/L)</td>
<td>1,050-1,220</td>
<td>785</td>
<td>1,394</td>
</tr>
</tbody>
</table>

A step-test of the Moorcroft Madison Well was conducted on December 14, 2001. Discharge rates for the step-test were 212, 335, 425, and 620 gpm. The minimum and maximum pumping rates equaled the minimum and maximum production capacity of the test pumping equipment. The test was ended after the 620 gpm step and the well was allowed to recover. The 602 gpm pumping rate used for the long-term pump test was determined from the results of the step-test and was selected to maximize stress on the aquifer to identify possible hydrogeologic boundaries. The total drawdown in the well after seven days of pumping was 76 feet. With a static water level of 340.6 feet, the pumping water level at the end of the test was approximately 417 feet.

Two sets of water samples were collected from the Moorcroft Madison Well for laboratory analyses, in accordance with Wyoming Water Development Commission (WWDC) requirements. TDS, a general indication of water quality, was reported to be 810 mg/L for the final test, which is above the recommended concentration of 500 mg/L but is acceptable for drinking water purposes. The water is also extremely hard, with a hardness of 605 mg/L (as CaCO₃), and may require treatment for specific uses. Microbiological analyses of the raw (untreated) well water were performed to determine if bacteria and viruses are present in the groundwater developed by the Moorcroft Madison Well. Microbiological analyses from the final sample detected the presence of heterotrophic bacteria. The heterotrophic plate count only indicates the presence of bacteria but does not provide an indication of the species.
EVALUATION OF WATER SUPPLY ALTERNATIVES

Following drilling, construction, and testing of the Moorcroft Madison Well, three alternatives for meeting the drinking water demands of Moorcroft have been identified. The alternatives are: (1) do nothing, (2) connect the Madison Well to the Moorcroft water system without treatment for hardness, and (3) connect the Madison Well to the Moorcroft water system and treat the water for hardness. A brief description of each of the alternatives is provided below

Alternative No. 1, the Do Nothing Alternative, assumes that the Moorcroft Madison Well will not be tied into the water system. To meet the water supply needs of the Town, the three existing wells would be pumped at the maximum rates, and shortfalls in production would be derived by purchasing water from the City of Gillette. Because the productivity of the existing Moorcroft wells continues to decline and the most productive well has reached beyond the typical service life for a water well, the Town would become increasingly dependent upon the Gillette Madison pipeline under this alternative. To use water from the Gillette Madison pipeline on a non-emergency basis, the Town of Moorcroft would need to modify the existing agreement with the City of Gillette.

Under Alternative No. 2, the proposed conceptual design for connecting the Madison Well to the Moorcroft water system without treatment for hardness includes construction of infrastructure to incorporate the new Moorcroft Madison Well as the primary water supply, terminating the use of the existing connection to the Gillette Madison pipeline, and utilizing the existing, operational Moorcroft water wells as a secondary supply. The conceptual design directly related to utilizing water from the Moorcroft Madison Well includes: (1) well site development, (2) equipping the well with pumping equipment, (3) construction of a well house with electrical, pump control, and chlorination equipment, (4) construction of a 200,000 gallon storage tank, and (5) construction of approximately 42,000 feet of 16-inch transmission line. Completing this alternative will provide the system with a reliable source of water and will allow the individual water user to treat water as needed for specific uses.

Under Alternative No. 3, a centralized water softening system would be added to the components identified in Alternative No. 2. The water softening infrastructure would consist of an ion exchanger vessel and rejuvenation system at the well site. The rejuvenation system brine would require construction of an evaporative pond and disposal of the brine at the municipal landfill. A disadvantage of selecting this alternative for construction includes treating a significant amount of water that would be used for irrigation and other uses that do not require treatment. Additionally, operational costs for this alternative would be significantly higher than not constructing a centralized softening system and would require disposal of treatment by-products.

PROPOSED WATER SUPPLY SYSTEM IMPROVEMENTS

The preferred alternative for Level III construction, as proposed by WESTON and approved by the Town of Moorcroft, is Alternative No. 2, connecting the Moorcroft Madison Well to the water system without a centralized water softening system. This alternative offers the advantages of providing a high volume
Executive Summary

water supply source, treating only the water requiring softening and allowing the individual user to control the degree of softening desired. The recommended alternative also provides significant cost savings for both capital and operational costs.

PROJECTED COSTS AND ECONOMIC ANALYSIS

The conceptual level cost estimate for capital components of the preferred alternative is $2,536,172. Table 2 summarizes the cost estimates for completion of the project, including engineering fees, permitting, legal fees, rights-of-way acquisition, and a 15 percent contingency. The $3,559,234.78 project cost is eligible for a 50 percent grant and 50 percent loan from the WWDC and 50 percent grant and 50 percent loan from the Rural Utility Service (RUS). The current interest rate for RUS loans is 4.74 percent. Purchase of the Madison Well from the WWDC will cost $161,289.25. Because the cost of the well has already accounted for a 50 percent grant, that portion of project costs is loan-eligible only.

Table 3 provides a summation of the grant/loan funding package. After accounting for the WWDC and RUS grants, the total dept service for the Level III package is expected to be $970,453.32. The annual dept payment for 20 and 30 years will be $76,587.11 and $61,629.54, respectively.

Water Customer Costs

**Equivalent Dwelling Unit (EDU) Costs.** Construction, operation, and maintenance of the Moorcroft Madison Well and the Level III Project, financed with a 30 year loan, is projected to increase monthly water rates by $12.64, expressed as dollars per month per EDU. Completion of the project will eliminate the need to obtain water from Gillette and reduce the Town of Moorcroft’s annual water expenditures by $18,013 or $2.66 per month per EDU. This results in a net monthly water rate increase of $9.98 per month per EDU. The water budget over the last six years indicates that the average monthly water rate is $14.11 per month per EDU. Adding the current operational costs and the new debt service, less the Gillette service, the projected monthly water rate would be approximately $24.09 per month per EDU.

**Per Tap Costs.** The average monthly per tap cost of the construction, operation, and maintenance of the Moorcroft Madison Well and the Level III Project, financed with a 30 year loan, is projected to increase monthly water rates by $18.11. Completion of the project will eliminate the need to obtain water from Gillette and reduce the Town of Moorcroft’s annual water expenditures by $18,013 or $3.89 per month per tap. This results in a net monthly water rate increase of $14.22 per month per tap. The water budget over the last six years indicates that the average monthly water rate is $20.76 per month per tap. Adding the current operational costs and the new debt service, less the Gillette service, the projected average monthly water rate would be approximately $34.98 per month per tap.
TABLE 2
FINAL COST ESTIMATES FOR ALTERNATIVE NO. 2

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design, Permitting, and Acquisition Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Preparation of Final Designs and Specifications</td>
<td>$253,617</td>
</tr>
<tr>
<td>Permitting and Mitigation</td>
<td>$11,150</td>
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<tr>
<td>Legal Fees</td>
<td>$4,000</td>
</tr>
<tr>
<td>Acquisition of Access and Rights-of-Way</td>
<td>$82,210</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$350,977</td>
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<tr>
<td><strong>Construction Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Cost of Project Components (See Table V-3), Subtotal #1</td>
<td>$2,536,172</td>
</tr>
<tr>
<td>Construction Engineering Costs (10% of Subtotal #1)</td>
<td>$253,617</td>
</tr>
<tr>
<td>Construction Cost, Subtotal #2</td>
<td>$2,789,789</td>
</tr>
<tr>
<td>Contingency (15% of Subtotal #2)</td>
<td>$418,468</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$3,208,258</td>
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<tr>
<td><strong>Project Total Construction Cost</strong></td>
<td>$3,559,235</td>
</tr>
</tbody>
</table>
TABLE 3

DEBT SERVICE FROM LEVEL III PROJECT
ALTERNATIVE NO. 2

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>COST</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Level III Costs (Table V-4)</td>
<td>$3,559,234.78</td>
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<tr>
<td>2</td>
<td>WWDC Grant (50 Percent of Item 1)</td>
<td>$1,779,617.39</td>
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<tr>
<td>3</td>
<td>Level III Balance (50 Percent of Item 1)</td>
<td>$1,779,617.39</td>
</tr>
<tr>
<td>4</td>
<td>Moorcroft Madison Well Purchase (Table V-2)</td>
<td>$161,289.25</td>
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<tr>
<td>5</td>
<td>RUS Funding Application (Items 3 and 4)</td>
<td>$1,940,906.64</td>
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<tr>
<td>6</td>
<td>RUS Grant (50 Percent of Item 5)</td>
<td>$970,453.32</td>
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<tr>
<td>7</td>
<td>4.75 Percent RUS Loan (50 Percent of Item 5)</td>
<td>$970,453.32</td>
</tr>
</tbody>
</table>

TOTAL DEBT SERVICE FOR ALTERNATIVE NO. 2  $970,453.32

CONCLUSIONS AND RECOMMENDATIONS

The Moorcroft Level II Water Supply Project was designed to locate and secure a viable, economical drinking water source for the Town of Moorcroft. The project consisted of siting, drilling, constructing, and testing an exploration well drilled into the Madison Limestone east of the Town. Additional project components included developing conceptual level design and cost estimates for completion of the well and a transmission line to the existing water storage tank.

The Moorcroft Level II Water Supply Project successfully sited, drilled, and constructed an exploration well completed in the Madison Aquifer. The well is capable of yielding large quantities of water for municipal use and will provide a more reliable source of water than the existing Moorcroft municipal wells.

The Moorcroft Town Council has decided to pursue Alternative No. 2 and will request funding from the WWDC and RUS for the Level III Project.