LEVEL I STUDY

TOWN OF KIRBY
WATER SUPPLY PROJECT

EXECUTIVE SUMMARY

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LEVEL I STUDY

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APRIL 1, 2006

A. PURPOSE

Engineering Associates has been retained by the Wyoming Water Development Commission to conduct the Level I Study to evaluate possible improvements to the water system serving the Town of Kirby. Specific items to be completed under this study are to improve system operations, to identify long term improvements needed to the water system, and to improve record keeping practices by performing the following:

- Survey the location of each various utilities that may impact the cost of construction or repair of water system components, water tanks, vaults, valves, raw water wells, and municipal buildings.
- Perform a leak detection survey.
- Utilize the Record of Survey map and other information on easements, annexations to prepare an AutoCAD map of the Town.
- Generate demands for water use and prepare a water system model in WaterCad to evaluate fire flow and system flows. Verify pipe sizes with the Water Operator.
- Evaluate operation and maintenance needs and implement appropriate changes.
- Assimilate AutoCAD surveying and mapping, water model, operational parameters, historical data, photographs, aerial photos, raw water well data, zoning data, land use data, easement data, and water rights data into an ArcView GIS file.
- Identify priorities for system modifications, replacement and construction of transmission and distribution piping, and funding options.

B. BACKGROUND INFORMATION

The Town of Kirby is located in Hot Springs County within the Big Horn Basin approximately 12 miles north of Thermopolis. Kirby was originally surveyed and platted in June of 1915 and incorporated in August of 1915. The Town currently has 14 blocks plus a few small additions within the corporate limits.

Kirby has approximately sixty residents with many of those individuals working in either Thermopolis or Worland. Historically, the Town has had a population as high as 174 people which likely correlated to a time when the Gebo Mine was in operation. In 2001, the per capita income in Hot Springs County was just over $25,000. It is likely that
many in Kirby have lower incomes than the Hot Springs County average based on discussions with local residents.

Water for the water system is supplied by the Town of Thermopolis via the Lucerne Water and Sewer District pipeline. Water is sold to Lucerne by Thermopolis. Kirby purchases their water from Lucerne at a rate of $3.61 per 1000 gallons. Residents of Kirby generally only use water from the potable water system for domestic needs. The Town has a series of groundwater wells located around Town that are used for irrigation purposes. The use of these wells significantly reduces potable water usage for irrigation in the Town.

In 2000, the Town completed various upgrades to their water system. Modifications included construction of a new 53,000-gallon bolted steel water storage tank, a supply line to and from the tank, and a liquid chlorine disinfection system. As modifications to the water system were completed, it became apparent to the operator and others in the Town that the system was probably not going to operate in a manner that was acceptable to the public or that met public health requirements. At this time, there was no disinfection residual was found in the return line from the tank to the distribution system and there were taste issues associated with the water.

Little data was available on the Town of Kirby water system. Several water system maps and data collected during site surveys were combined to create an electronic Town map. This project was completed to address operational issues discussed previously, provide mapping and modeling of the water system, and identify other modifications and/or operational changes needed by the system.

C. RECOMMENDED LAND USE AND ZONING CHANGES

During the initial scoping meeting for this project there was significant discussion about the need to insure that zoning regulations adequately protect the Town against potential indiscriminate placement of mobile homes and unregulated mixing of home businesses with residential dwellings. We reviewed the current master plan for the Town of Kirby with relation to these issues and in a general manner. Based upon our review, we recommend the following major changes be made:

- Modifying requirements relating to mobile homes to assure a reasonable trailer density (providing space between trailers)
- Defining the various land use classifications within the Town
- Adding a Multiple Use Residential (MUR) land use classification

The Town would like to use the MUR zone as a transition area between the Business and Residential Zones and to establish areas suitable for home occupation businesses. The suggested format for zoning modifications is included in the Final Report.

D. PROJECTED WATER DEMANDS
Historic water usage data for treated water in the Town of Kirby for the last two years has been used to generate average daily demands and maximum daily demands. The projected average rate based on the metering records available is 97 gpd per capita, and the maximum daily demand is 243 gpd per capita. Population estimates were calculated using a growth factor of 0.68% per year for the Town.

![Population Projections](chart.png)

Recently, properties west of Town were connected to the Town water system. These properties have used an average of 5,000 gpd for the last three months. Average Daily Demand is approximately 3 gpm currently and is projected at 4 gpm in 2036. Maximum Daily Demand (MDD) is currently approximately 8 gpm and is projected at 10 gpm by 2036. MDD for 2036 is based on a population projection of 73 people. However, Kirby could see a population increase to 129 people by year 2036. This would change ADD in 2036 to 6 gpm and maximum demand to 15 gpm. Assuming a population of 73 people or 129 people will not dramatically impact the water system since it is designed to provide fire flows in excess of 1,000 gpm.

In order to provide adequate fire protection, the recommended fire flow must be delivered to the area in need while concurrently supplying the maximum daily demand to the remainder of the system. Fire flows are limited by DEQ regulations which require that 20 psi residual pressure be maintained in the distribution system when fire flows are drawn from the system.
### TABLE 1
REQUAIRE FIRE FLOWS BY LAND USE CATEGORY

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Fire Flow (GPM)</th>
<th>Duration (Hours)</th>
<th>Minimum No. of Hydrants</th>
<th>Hydrant Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1,000</td>
<td>2</td>
<td>1</td>
<td>500'</td>
</tr>
<tr>
<td>Commercial</td>
<td>1,500</td>
<td>2</td>
<td>1</td>
<td>500'</td>
</tr>
</tbody>
</table>

### E. EXISTING SYSTEM DESCRIPTION

The Town of Thermopolis supplies water to Kirby through a 6” transmission line operated by Lucerne Water District. Water enters the Kirby system and passes through a manhole containing a strainer and a chlorine injection port. The water then flows to a second manhole containing a flow meter, then flows through a 2” HDPE supply line to an altitude a third manhole near the 53,000 gallon steel tank. From this third manhole, the water can flow into the tank or toward the Town via an 8” PVC transmission line.

This 8” PVC line runs back to the second manhole where another chlorine injection port is located. Chlorine is injected at this location by a manually operating pump. The water then continues on to a fourth manhole containing a continuously monitoring analyzer/controller system which is inoperable. From this location, the water flows into the Town’s distribution system. The water system is shown graphically in the full report.

The Flow Meter in the first manhole is intended to control the amount of chlorine injected upstream of the metering location in the aforementioned manhole. However, due to poor operation of the pulse function and difficulties with the chlorine injection meter, the pump was replaced with a manually operating chlorine injection pump that continuously injects chlorine into the system.

The Town currently has about 10,300 total feet of buried water transmission line with the majority being PVC, and the remainder being DIP. The Town also has 12 fire hydrants, 5 manholes, and 26 valves.

### F. EXISTING SYSTEM EVALUATION

Industrial Systems performed an independent evaluation of equipment used in the Kirby water system. They specialize in supplying and setting up control and process equipment for water and wastewater systems. Their electronics technician found the following during the site visit:

- The flow meter for pacing Chlorine Pump Number One is not providing a usable signal but is recording flows.
• Chlorine Injection Pump Number One has been replaced with a new manually operating pump that does not take an outside signal. It is pumping continuously regardless of demand.

• The chlorine monitoring system probes are out-of-date and the monitoring system needs calibrated. The signal from the monitor to the controller is operating intermittently. There is likely a problem with the control cable or connections in one of the units. This could be due to corrosion as a result of methane gas and condensation in the manhole.

• Chlorine Injection Pump Number Two has been replaced with a new manually operating pump that does not take an outside signal. It is pumping continuously regardless of demand.

The Kirby Water System has several water quality issues that have been identified by Town citizens and other issues that were identified through testing within the system. Issues identified include taste and odors, chlorine concentration, Total Trihalomethanes, and system pressure.

There have been ongoing problems with water quality in the Kirby Water System. A review of system operations and supply offers some insights into why these issues exist. Following are likely causes for these issues:

• Design and Operation of Lucerne Water and Sewer District
• Installation of the New Storage Tank in Kirby
• Design of the New Tank
• Chlorination Equipment Operating Mode

G. HYDRAULIC MODEL - WATERCAD

The base model for this study was developed from records provided by the Town and information provided from the Water System Operator. The calibration of the model was completed using the pressure recorder results. Pressures within the Town of Kirby were measured at four different locations using a continuous pressure recorder. Water system capacities, storage needs, and fire flows were then analyzed to determine appropriate changes to the water system.

H. GEOGRAPHIC INFORMATION SYSTEM MAPPING

A Geographical Information System (GIS) was created and includes a geodatabase with many different feature classes that can be represented by different layers in the GIS. The 2002 Kirby orthophoto and USGS topographic map serves as a base layer over which all other layers can be overlaid.
The 1982 Record of Survey map, showing corporate boundary, block, lot and street information along with easements, annexations and other survey data provided by Rick Hudson, PLS are incorporated into the GIS. The geodatabase feature class for easements and rights-of-way include the easement type, recording date, county, book & page number, and recorded document number. This information can be used to find the recorded document. A zoning feature class is included in the geodatabase based upon Kirby’s existing zoning regulations.

Geodatabase feature classes for treated water lines, valves, fire hydrants and raw water wells were created. Additional geodatabase fields for the treated water lines store the pipe size, material, pressure rating and size type. Similar information on valves and fire hydrants can be added in the future as the information becomes available. The permit number and well head number for the raw water wells is included in the geodatabase.

I. ALTERNATE DESIGNS AND COST ESTIMATES

Extensive consideration was given to options that would help the Town improve water quality and the water system without significantly increasing user costs, compromising public safety, or substantially increasing the complexity of the system. After looking at the various options, the following were selected for further consideration:

- Option 1 - Install a chloramine generation and mixing system
- Option 2 - Elimine the Kirby storage tank
- Option 3 - Install a mixing system in the Kirby tank
- Option 4 – Modify the chlorine control and injection systems
- Option 5 - Implement an aggressive system flushing program
- Option 6 - Install new transmission lines
- Option 7 – Install other upgrades to improve water quality and fire flows

Considering all factors impacting the Kirby Water System, the four options that we recommend implementing are: Option 4 - Modify the Chlorine Control and Injection Systems; Option 5 - Implement a System Flushing Program; Option 7 – Other Water System Upgrades; and Option 6 – Install of New Water Lines. Out of these four options, Option 4, Option 5, and Option 7 should be completed within the next few years. These three options will provide the greatest improvement in water quality and water system in the near future. Unfortunately, all capital improvements included in these options, except replacement of the PRV (which will cost about $1,500), are considered water treatment and do not qualify for WWDC funding. Option 6 should be implemented if the Town starts to realize any significant growth. Much of the work under this option qualifies for WWDC funding. Other options may become viable as the Town grows. Probable annual costs are included in Table 2.

A combined Option 4, 5, and 7 will most likely be the best option for the Town to select to address their water quality issues. This option would add new hydrants to allow flushing the entire system, provide new flow meters to pace chlorine pumps so that all
the water in the system is chlorinated based upon flows, and start a flushing program to clean out the system and improve long-term water quality.

**TABLE 2**
**ANNUAL COST SUMMARY**

<table>
<thead>
<tr>
<th>Description of Cost</th>
<th>Option 4 Modify the Existing Chlorine System</th>
<th>Option 5 Implement System Flushing</th>
<th>Option 6 Install new Waterlines</th>
<th>Option 7 Other Water System Upgrades</th>
<th>Option 4, 5, &amp; 7 Multiple System Upgrades and Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Construction Costs</td>
<td>$154</td>
<td>$0</td>
<td>$11,672</td>
<td>$545</td>
<td>$699</td>
</tr>
<tr>
<td>Operation &amp; Maintenance Cost Increase</td>
<td>$300</td>
<td>$1,250</td>
<td>$1,250</td>
<td>$200</td>
<td>$1,750</td>
</tr>
<tr>
<td>Facility Depreciation</td>
<td>$500</td>
<td>$0</td>
<td>$0</td>
<td>$1,000</td>
<td>$1,500</td>
</tr>
<tr>
<td>Total</td>
<td>$954</td>
<td>$1,250</td>
<td>$12,922</td>
<td>$1,745</td>
<td>$3,949</td>
</tr>
</tbody>
</table>

**J. RATE SCHEDULES**

The Town’s current rate schedule does not adequately fund the water system and raw water well operation and maintenance. Based on the current rate schedule and recent increase in raw water rates to $15 per month, the Town will bill a total of approximately $22,500 annually for water and raw water. The annual cost of operating these facilities based on records from the past two years has been approximately $29,500.

**TABLE 3**
**PROPOSED TREATED AND RAW WATER RATE SCHEDULE AND INCOME**

<table>
<thead>
<tr>
<th>Tap Size</th>
<th>EDU</th>
<th>Total Taps</th>
<th>Base Rate Per Month**</th>
<th>Cost per Usage Over 3,000 Gallons (per 100 Gallons)</th>
<th>Average Water Usage Over 3,000 Gallons</th>
<th>Average Monthly Bill</th>
<th>Total of Monthly Bills</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot; Inactive</td>
<td>1</td>
<td>15</td>
<td>$5.00</td>
<td>$0.75</td>
<td>0</td>
<td>$5.00</td>
<td>75.00</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>1</td>
<td>38</td>
<td>$52.50</td>
<td>$0.75</td>
<td>0</td>
<td>$52.50</td>
<td>1,995.00</td>
</tr>
<tr>
<td>1 1/2&quot; *</td>
<td>4</td>
<td>1</td>
<td>$165.00</td>
<td>$0.75</td>
<td>6000</td>
<td>$210.00</td>
<td>$210.00</td>
</tr>
<tr>
<td>1&quot;</td>
<td>7.11</td>
<td>1</td>
<td>$281.63</td>
<td>$0.75</td>
<td>0</td>
<td>$281.63</td>
<td>$281.63</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total of Monthly Bills</td>
<td>$2,561.63</td>
</tr>
</tbody>
</table>

* 1 1/2" tap serves 3 homes
** Based on EDUs and includes 3,000 gallons
K. ROLES AND REGULATORY REQUIREMENTS

1. Role of the Operator

The water system operator is responsible for insuring the safety of water delivered to customers supplied by their water system. They must have experience and knowledge in the following areas:

- Maintenance and repair of pumping equipment;
- Chlorination practices;
- Chlorine safety procedures;
- Operational characteristics of mechanical equipment used in the maintenance of cross connection and backflow prevention devices;
- Safe and efficient work practices and methods;
- Mathematic principles pertinent to water treatment calculations;
- Drinking Water Regulations as required by the State of Wyoming.

The operator is prohibited by state law from constructing, installing, or modifying a water distribution system unless the correct permit has been obtained as described in Chapter 3 of the Water Quality Rules & Regulations as set forth by the Wyoming DEQ. Ultimately, the operator is responsible for the safety of water provided to individuals served by their water system and needs to be able to act reasonably autonomously of policy makers and financial controllers to assure safe operation of the system.

2. Role of Council and Administration

The council and administration need to insure that accurate and up-to-date records are maintained to successfully manage the water system and keep it financially strong. This entails keeping mapping, operation, and maintenance data up-to-date. The Council needs to work closely with the water system operator on critical issues. Since the operator is responsible for insuring safe operation of the system, he should be consulted with prior to any non-standard agreement being made with users or potential users.

The safety of the public must be maintained at all times by the concerted efforts of the council/administration. This can be best accomplished by setting rates at adequate levels to complete operation, maintenance, and upgrades, ensuring that the water system operator is spending adequate time monitoring the system, and by paying for regular operator training.

L. CONCLUSIONS AND RECOMMENDATIONS

The Town of Kirby Water System has issues with water quality as the result of water that is delivered to the system and operational characteristics of the system. Analysis of personal income levels of those living in the Town and evaluation of the cost of potential improvements suggests that it will be very difficult for the Town to implement a
significant upgrade program from a financial standpoint. Efforts were made to evaluate innovative alternatives to improve operation of the water system and water quality. Four improvements were identified that should be implemented over the next decade. These include: modifying the chlorine control and injection systems, implementing a system flushing program, installing new waterlines, installing two new hydrants for flushing, and replacing the existing pressure reducing valve.

The small population, combined with the low average household income, limit the funding available to make improvements to the water system that will improve water quality or fire flow. There are a few distinct improvements that the Town can implement that will improve water quality in areas of the Town with the worst quality issues. Water quality in Kirby is being impacted by the operation and maintenance of the Lucerne Water System. There are limited changes that the Town of Kirby can make unilaterally to improve water quality. Changing the source of supply will likely also have minimum impact on water quality since the Lucerne Water System operates at a higher pressure and will likely continue to feed water to the Town of Kirby.

While the Town water system is not configured in a manner that facilitates providing fire flows established by the International Fire Code, the urban nature of the community and limited commercial development afford the Town some flexibility in timing on installing additional water transmission lines. Installing a few new waterlines at strategic locations could help improve water quality by facilitating additional flow in dead-end lines. The system was evaluated to determine if the existing storage tank could be eliminated. However, eliminating the tank would reduce fire flows in the Town to 300 gpm which would not be beneficial for long term growth in Kirby. Eliminating the tank will not afford any significant improvement in water quality considering retention time in the Lucerne Water System.

The Town should implement a flushing program to flush their entire water system at least twice per year. The Town should install two new hydrants on existing dead-end lines to facilitate flushing those lines that likely have not been completely flushed in over 20 years. New flow meters and chlorine injection pumps should be installed on the feed to and from the storage tank. The Town should also change its rate structure to charge rates based upon EDU’s and at a level to cover costs of operation and maintenance of the system. The Town is planning to pursue Options 4, 5 and 7 in the near future. The Town will look at the need to pursue Option 6 in five to ten years as the Town evolves.

Please refer to the Final Report dated April 1, 2006 and the project notebook for additional information.