# TABLE OF CONTENTS

## 1.0 CONCLUSIONS AND RECOMMENDATIONS
- **1.1 Study Purpose**: 1
- **1.2 Conclusions**: 1
- **1.3 Recommendations**: 2
- **1.4 Estimated Costs**: 3
- **1.5 New Plant Evaluation**: 4

## 2.0 INTRODUCTION
- **2.1 General**: 5
- **2.2 History of Water Treatment Plant**: 5
- **2.3 Study Goals**: 6

## 3.0 POPULATION AND EXISTING WATER USE
- **3.1 Population and Area Served**: 8
- **3.2 Future Population**: 8

## 4.0 EXISTING PLANT DESCRIPTION
- **4.1 Existing Treatment Plant**: 9

## 5.0 TREATMENT PLANT EVALUATION
- **5.1 General**: 20
- **5.2 Raw Water Supply and Quality**: 20
- **5.3 Raw Water Intake Structure**: 25
- **5.4 Raw Water Transmission Piping**: 25
- **5.5 Flow Metering System**: 25
- **5.6 Chemical Feed Systems**: 26
- **5.7 Flash Mixing**: 26
- **5.8 Flocculator Tank**: 26
- **5.9 Clarifier**: 26
- **5.10 Filter System**: 27
- **5.11 Storage**: 29
- **5.12 Chlorination System**: 29
- **5.13 Backwash Pond**: 30
- **5.14 General Site Facilities**: 30
- **5.15 Operational Procedures**: 30
- **5.16 Plant Staff**: 31
- **5.17 Finished Water Quality**: 31
- **5.18 Finished Water Demand**: 34
6.0 WATER TREATMENT PLANT MODIFICATIONS
   6.1 General .................................................. 38
   6.2 Raw Water Intake and Transmission Piping .................. 38
   6.3 Plant Flow Metering ...................................... 39
   6.4 Chemical Addition Systems ................................ 39
   6.5 Floc Tank .................................................. 40
   6.6 Clarifier ................................................... 40
   6.7 Filter System .............................................. 41
   6.8 Disinfection System ....................................... 46
   6.9 Finished Water Storage .................................... 47
   6.10 Backwash Ponds ......................................... 47
   6.11 Site Facilities ........................................... 48

7.0 LONG-TERM PLANT MODIFICATIONS
   7.1 Intake Structure ........................................... 49
   7.2 Ozone Disinfection System ................................. 49
   7.3 Long-Term or Ultimate Build Out Estimated Cost ........... 50

APPENDIX A   Unita Engineering Study
APPENDIX B   Plant Operator Recommendations
FIGURES

2-1 Bridger Valley Water Supply - Existing System ........................................ 5
4-1 Existing Facility Layout Plan ................................................................. 8
4-2 Treatment System Layout ................................................................. 9
4-3 Proposed Pioneer Water and Sewer ........................................................
5-1 Raw Color ......................................................................................... 20
5-2 Raw pH ............................................................................................... 21
5-3 Raw Water Turbidity (NTU) ............................................................... 22
5-4 Alkalinity ............................................................................................ 23
5-5 Existing Filter Beds .............................................................................. 26
5-6 Filter Production Rates ....................................................................... 31
5-7 Finished Water Turbidity (NTU) ......................................................... 32
5-8 Raw pH / Finish pH ........................................................................... 35
5-9 Raw Water / Finish Color ................................................................... 36
5-10 Flow (mgd) ......................................................................................... 37
6-1 Filter Production Rates ....................................................................... 42
6-2 Pilot Study Results ............................................................................. 44
1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 STUDY PURPOSE

The purpose of this study was to determine if the existing Bridger Valley Water Treatment Plant has sufficient capacity and adequate water quality to supply culinary water to the Pioneer Water and Sewer District. The study evaluated the existing water treatment plant for its ability to meet expanding needs and the resulting increased treatment capacity. Evaluations were also made of the various components in the treatment process to determine whether or not the plant is currently meeting the most significant EPA and State drinking water requirements.

The Pioneer Water and Sewer District was developed to provide culinary water to approximately 130 users. A primary requirement of the District is to obtain a safe and adequate water supply for those who would be connecting to the new system. The Pioneer District will be incurring substantial costs for installation of the water distribution system and it is imperative that an adequate and safe water supply be obtained so that water can be provided to those who will be paying for the development costs in the Water District.

1.2 CONCLUSIONS

As is shown on Figure 5-10, the peak day demand on the existing Bridger Valley water treatment plant has been in excess of over 1.5 million gallons per day (mgd). It can be seen from Figure 6-1, that the maximum water production capability of the existing water treatment plant under current operating conditions will peak at about 1.2 mgd. It is concluded that under current operating conditions, the existing water treatment plant does not have reserve capacity to provide water to the Pioneer Water and Sewer District. In fact, it is questionable whether they will be able to meet current demands during a typical hot summer month.

In the past, the treatment plant has not had to be taken off-line during the backwash process. Changes in EPA treatment criteria now required that the treatment plant be taken off-line during backwashing. With the restrictions of the single media filter and the frequency of backwashing, the plant capacity is effectively decreased by at least 20% due to the plant being taken off-line for backwashing.

At loading rates of not over 1200 gpm, the treatment plant is able to meet water quality treatment criteria most of the time. There is a question as to the adequacy of trihalomethane removal and the removal of other organic compounds. There is also a question as to whether adequate contact time can be provided at all times for disinfection.

An analysis is currently being performed to determined if 99.9% removal of giardia sized particles is being achieved by the treatment process. Those results will be included in the final editing of this report.
It should also be noted that the City of Lyman obtains water from three (3) separate springs, which are located in Section 16 and 20, Township 15 North, Range 115 West. These springs are collected and pumped through an 8-inch asbestos cement transmission line to the Town of Lyman, Wyoming. The year-round average water production from these springs is 208 gpm and during the summer months of June, July, and August the springs average approximately 265 gpm.

These springs have not been approved by EPA as "true groundwater springs". There is a potential that these springs may not be determined to be "true groundwater springs", but may have surface water influence. If the springs show surface water influence, EPA would require that these springs either be taken off-line or that the water obtained from these springs pass through a filter system to meet EPA criteria. If the springs are taken off-line it would require 208 gpm to be provided from the existing water treatment plant to make-up for this loss. Thus, further increasing the demand of water from the Bridger Valley Water Treatment Plant.

1.3 RECOMMENDATIONS

There are two (2) basic recommendations which involve the Pioneer Water and Sewer District. One is to obtain an alternate source of water for the District, such as wells or a separate water treatment plant. The second alternative is for the District to work with the Joint Powers Board in making modifications to the water treatment plant which would increase the capacity of the water treatment plant to a point where it could meet the increased demand of the Pioneer Water and Sewer District and also provide to provide water for future growth.

It was beyond the scope of this study to evaluate alternate water sources or to develop costs for a complete separate water treatment plant for the Pioneer Water and Sewer District.

If it is determined by Pioneer Water and Sewer District that the best alternative is to work with the Joint Powers Board to increase the capacity of the existing water treatment plant, the following modifications to the water treatment plant are recommended:

- Repair the air relief valves along the raw water transmission line to increase the raw water transmission line capacity to its original design capacity of 1500 gpm.
- Provide automatic controls for the filter backwash, chlorine control, chemical control feed rate, and other modifications so the plant can run at maximum capacity for the full 24-hours per day without being staffed for 24-hours per day.
- Reconstruct the existing filter system to provide a 24-inch filter media bed. This will increase filter run times and will also increase the filter loading rate capability from 3 gpm per square foot to a maximum of 5 gpm per square foot, as allowed by Wyoming DEQ Chapter XII - Section 10(i)(ii)(B)(I).
- Implement recommendations which have been developed by previous studies and by plant operators, such as new and updated chemical feed systems.
• Begin analysis for developing an alternative disinfection system that will decrease the potential for development of disinfection byproducts, such as trihalomethanes.

• Construct a new backwash storage pond and reconstruct the existing storage pond so that proper maintenance can be completed on the two (2) ponds.

• Construct a new administration or add onto the existing building to provide adequate lab space so that adequate quality control procedures can be followed.

• Correct existing safety problems which exist at the plant to provide a safer work place for employees.

• Construct a new filter equal to the existing filter and use the existing filter as a back-up system.

1.4 ESTIMATED COSTS

The development of an alternate water supply for the Pioneer Water and Sewer District was beyond the scope of this study and therefore, no cost projects were made for development of an alternate water supply source.

Of the recommendations which were presented in Section 1.3 above, some should be handled in-house with the existing staff and therefore cost estimates were not prepared for those items.

Costs which were developed for any modifications to the treatment plant were basically divided into two (2) separate phases. The first phase being those modifications which would be required to expand the plant capacity from its existing to approximately 2 mgd (Table 1-1). These modifications would allow for service to existing customers and would allow sufficient capacity in the system to provide water to the Pioneer Water and Sewer District.

The second series of costs which are shown in Table 1-2 are those costs which would carry the capacity of the treatment beyond the 2 mgd and would also provide modifications to the disinfection system such as adding ozone disinfection.

<table>
<thead>
<tr>
<th>TABLE 1-1</th>
<th>ESTIMATED COSTS FOR CURRENTLY NEEDED WTP MODIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Item</td>
<td>Estimated Cost</td>
</tr>
<tr>
<td>Finished Water Metering</td>
<td>$12,000</td>
</tr>
<tr>
<td>Plant Automation</td>
<td>35,000</td>
</tr>
<tr>
<td>Storage Tank Baffles</td>
<td>20,000</td>
</tr>
<tr>
<td>Filter Renovation</td>
<td>120,000</td>
</tr>
<tr>
<td>Additional Backwash Pond (incl. land)</td>
<td>55,000</td>
</tr>
<tr>
<td>Chemical Feed System Modifications</td>
<td>35,000</td>
</tr>
<tr>
<td>Misc. Safety Corrections</td>
<td>10,000</td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td>$287,000</td>
</tr>
<tr>
<td>35% Contingency &amp; Engineering</td>
<td>100,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$387,000</td>
</tr>
</tbody>
</table>
It is also recommended that the Joint Powers Board look seriously at the capability of the existing water treatment plant versus historical peak summer day use periods to determine how they can be met under the current operating criteria. All indications are that there are serious problems which need to be addressed in the very near future. The concept that minor modifications to the existing filter will solve the problem will be very short sighted and may result in water restrictions or a shortage of water supply during a normal or hot summer.

### TABLE 1-2

**ESTIMATED COSTS FOR FUTURE WTP MODIFICATIONS**

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone Disinfection System</td>
<td>$340,000</td>
</tr>
<tr>
<td>Modify River Intake System</td>
<td>147,000</td>
</tr>
<tr>
<td>Modify Clarification System</td>
<td>150,000</td>
</tr>
<tr>
<td>New Filter Bed System</td>
<td>275,000</td>
</tr>
<tr>
<td>Lab/Office Building</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
<td><strong>$962,000</strong></td>
</tr>
<tr>
<td>35% Contingency &amp; Engineering</td>
<td>337,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$1,299,000</strong></td>
</tr>
</tbody>
</table>

An in-depth evaluation of the construction of a completely new water treatment facility was beyond the scope of this study. However, prior to substantial expenditures being made on renovation of the existing plant, the Joint Powers Board should seriously consider the advantages and disadvantages of modification to the existing plant or the construction of a new facility.

The existing facility is constructed on a limited site and was designed around a specific design capacity with very limiting factors for going beyond that capacity. The existing facility has virtually no redundancy for any primary component of the treatment plant. If any major, or at times minor, component fails the treatment plant will need to be taken off-line or water provided to the water users that does not meet EPA and State Water Quality criteria.

Development of this plant much beyond a 2 mgd capacity will be expensive and will not be as effective as plants designed or constructed utilizing present technologies.

If an evaluation determines that a new plant may be the most prudent change for long-term considerations, the new plant should be constructed so that it is expandable to serve the ever growing needs of the area, it should have redundant features so that if failures of critical pieces of equipment happen, safe drinking water can still be provided to the users.

If the springs which are not utilized by the City of Lyman are deemed surface water influents and are in essence lost for culinary use, the alternative to construct a new plant with a higher capacity may need to be seriously considered to meet current and future anticipated water requirements.
2.0 INTRODUCTION

2.1 GENERAL

The Bridger Valley Water Treatment Plant is located south of the Town of Mountain View, Wyoming and supplies treated water to the Bridger Valley area. At the present time, the water treatment plant supplies water through an extensive distribution system to the towns of Lyman and Mountain View and the Water and Sewer Districts of Fort Bridger, Lower Bench, and Blacksfork.

The water treatment plant was constructed in 1977 or 1978 and has provided treated water to an ever growing service area since that time. Since initial construction of the treatment plant, there have been numerous minor modifications to the plant and a major modification to change the chemical feed area and provide an enclosure for a larger portion of the treatment facility. As the distribution system was expanded a remote water storage reservoir was added and numerous miles of distribution system have been added to provide service to outlying areas.

The water treatment plant and a major portion of the distribution system is owned and operated by an organization called the "Bridger Valley Joint Powers Board". This agency was originally formed to provide water supply transmission and distribution to the Bridge Valley area. Members of the Board are representatives of the various areas which are served by the water supply and distribution system.

The water treatment plant and distribution system have been operated adequately since their initial construction. There have been no significant violations of Environmental Protection Agency criteria and no official action has been taken against the Joint Powers Board for non-compliance to State or EPA treatment criteria.

2.2 HISTORY OF THE WATER TREATMENT PLANT

As previously mentioned, the original treatment plant was constructed in 1977 or 1978 and has been in continuous operation since that time. Minor modifications have changed various functions, but the original overall concept of the water treatment plant has not been changed since its original construction. Recent projects that have been completed at the water treatment plant include the enclosing and modifying the chemical feed area, the installation of a high energy rapid mix system for chemical mixing, continuous monitoring of turbidity and chlorine residual, flow wasting during backwash, and numerous other minor modifications.

Over the years various chemical coagulants or filtering aids have been utilized to provide better performance of the water treatment plant.

Approximately two (2) years ago, the filter was taken off-line and the sand filter media was removed and replaced with a new sand media. During this time, numerous underdrain plates were recaulked to minimize loss of filter media around the underdrain plates.
The Joint Powers Board retained Unita Engineering in 1991 to evaluate the water treatment plant and to propose modifications. Subsequently, Unita Engineering retained Snowy Range Water Consultants, Inc. of Laramie, Wyoming to do a further analysis on the existing water treatment plant. Copies of the pertinent portions of their report are included in Appendix A of this Report.

Historically, the treatment plant has been operated in such a manner that during most of the time water quality requirements that were in affect at the time, have been met and no serious water quality violations have occurred.

A consistent on-going problem is the high amount of residual color in the water after treatment. This is not a violation of EPA criteria; however it is an aesthetic factor on the quality of water and, if possible, should be improved to full compliance with the EPA Standard of 15 color units.

2.3 STUDY GOALS

This study is being funded by the Wyoming Water Development Commission primarily to determine whether or not the Bridger Valley Water Treatment Plant has sufficient capacity to provide a safe and adequate water supply to the new Pioneer Water and Sewer District. The District is proposing to connect to the Bridger Valley water treatment and supply system to provide culinary water to approximately 130 new connections. This proposed new system consists of approximately seventeen (17) miles of distribution system to supply water to the areas shown on Figure 2-1.

In order to provide water for these outlying areas, the treatment plant must have the hydraulic capacity to supply the increased volume of water and also to supply the increased volume while still meeting EPA water quality criteria. Therefore, the study will look at two (2) basic areas; one being the hydraulic capacity of the entire treatment system, and the other being the ability of the treatment plant to provide water which meets the new requirements of the Surface Water Treatment Act and other EPA and State DEQ criteria.
3.0 POPULATION AND EXISTING WATER USE

3.1 POPULATION AND AREA SERVED

At present, the treatment plant supplies water to Fort Bridger, Lyman, Blacksfork, Mountain View, and the Lower Bench area. There are approximately 4,735 people served by the water system. Water is retailed to customers at $2.00 per 1,000 gallons and is wholesaled to customers who maintain their own distribution systems at $1.80 per 1,000 gallons.

If the distribution system is expanded to service the proposed new areas, the increased demand on the water treatment plant will be to supply water to between 450 to 600 people. This would require an additional capacity from the treatment plant of 110,000 to 150,000 gallons per day. This is assuming that the average peak day use for the additional customers would be 250 gallons per person per day.

3.2 FUTURE POPULATION

The existing water system supplies water to a large area. There is a steady amount of growth in the area. However, long-term growth projections for the entire service area were not included as a portion of this study. With the large size of the distribution there is a significant potential for increased demand upon the water system both from new construction or growth or from existing residences or commercial enterprises connecting to the water system, which are adjacent to the distribution system but are currently served by private wells.

For estimating purposes a growth of 1% per year for the study area was assumed.
4.0 EXISTING PLANT DESCRIPTION

4.1 EXISTING WATER TREATMENT FACILITIES

The existing treatment plant is considered a conventional treatment system in that it has the primary components of raw water intake, flow metering, chemical condition, rapid mixing, flocculation, clarification, filtration, and final disinfection. A layout of the treatment plant site showing the locations of the various system components is shown of Figure 4-1. Figure 4-2 shows a layout of the actual treatment system. It can be noted from the Figure 4-2 that the existing treatment plant consists of a 14-inch raw water intake line, which then goes through chemical conditioning, rapid mixing, and then into a circular floc mixing tank. The floc mixing tank is very similar to a standard wastewater clarifier with 8.5 foot sidewalls and a 25-foot diameter. Mixing is produced in this tank by paddles which rotate and mix the tank to provide particle to particle contact for building of floc particles.

After the flocculator tank, the flow is transported via an open channel to a large rectangular clarifier. This clarifier is approximately 25-feet wide, 104-feet long, with a 13-foot water depth for a volume of 250,000 gallons. Flow goes from south to north through the clarifier system. The flow is then collected through two (2) v-notch weir assemblies, which extend out into the clarifier, and then passes through a 14-inch pipe to the final filter. The clarifier has a submerged vacuum type cleaning system which is towed across the bottom of the clarifier and removes any sediments from the bottom by a syphon or suction affect.

The existing water filter system is commonly known as an "automatic backwash" system, in which there is no clearwell as normally used for the backwash operation. Finish water for backwashing is obtained from the finished water channel and is pumped back under and up through the filter bed where it and any debris is drawn off by a vacuum type hood assembly for discharge to the backwash storage pond. The existing filter has a single sand media of approximately 11-inches in depth. Recently the sand media was removed, some of the leaking underdrain panels repaired, and new sand installed in the filter bed.

After final filtration, the flow is chlorinated via a manual controlled chlorinator and is then stored in a 500,000 gallon steel storage tank for chlorine contact time and for reserve capacity. This tank is located adjacent to the treatment plant as shown on Figure 4-1.

The existing intake system and other features of the water treatment plant are shown on the following photographs. It can be seen from the photographs that the intake works consist primarily of a weir across the stream to provide the needed head required for the diversion and a rudimentary screen for screening of large objects from entering the pipeline. The intake structure is located approximately 9000 feet upstream of the water treatment plant and some minor problems have occurred with the intake system in the past.
BRIDGER VALLEY
WATER TREATMENT PLANT

RAW WATER INTAKE STRUCTURE

TREATMENT PLANT BUILDINGS
FLOW METERING AND CHEMICAL INJECTION

FLASH MIXING UNIT
CLARIFIER WEIRS
(NOTE VERTICAL WATER DROP)

CLARIFIER WEIR OUTLET TROUGH
AGAIN: NOTE VERTICAL WATER DROP
FINISH WATER FILTER AND BACKWASH BRIDGE ASSEMBLY

FINISHED WATER TROUGH
CHLORINE BUILDING ON LEFT
STORAGE BUILDING ON RIGHT

FINISHED WATER TANK AND
BACKWASH STORAGE POND
The transmission line from the intake structure is a 14-inch diameter asbestos cement pipeline, which primarily follows the river for a good portion of the distance and then traverses the hillside up to the water treatment plant. There are several high points in the line where air accumulation is a problem. Air relief valves were installed, but subsequently many have frozen and broke and are now not in operation.

The chlorination system is a two-bottle, manual chlorinator that feeds through a solution feed system to the finished water going between the treatment plant and the water storage tank. A second chlorination system exists at the remote tank where the water is rechlorinated to increase the chlorine residual so that 0.2 mg/l chlorine residual can be maintained in the distribution system.

The backwash storage pond is located adjacent to the water storage reservoir and is a small clay-lined pond utilized for settling out the residue material from the filtering process and clarification process, and for reuse of the excess water that can be reclaimed. The backwash storage pond shows some signs of leakage and is too small for the treatment plant.

Other site facilities consist of a small office and lab, a single restroom, a workshop area, and other related facilities.

The existing water distribution system is shown on Figure 4-3.
5.0 TREATMENT PLANT EVALUATION

5.1 GENERAL

Each component of the treatment plant system was analyzed both hydraulically and for its capacity to meet the requirement of the Surface Water Treatment Act. Areas where the equipment has functioned properly and changes that have been made or changes that need to be made are addressed for each component of the water treatment plant in the following sections.

5.2 RAW WATER SUPPLY AND QUALITY

Water rights supply for the Bridger Valley Water Treatment Plant and distribution system were addressed in the 1991 study completed by Unita Engineering. An indepth evaluation was completed at that time and further evaluation was not required as a function of this study. The study determined that a peak summer water right existed up to a maximum of 2.7 mgd and that beyond that point additional water rights would have to be acquired. For the purpose of this study 2.7 mgd is considered an adequate water supply up through the study period.

The water supply for the Bridger Valley water treatment plant is diverted from the southfork of the Blacks Fork River. The water supply for this river comes from the Uinta Mountains from unprotected drainages. The area along the river is heavy grazed and is open to livestock and wildlife throughout its length.

Figure 5-1 shows the raw water color from May 1992 through September 1993, Figure 5-2 shows the raw water pH through the same time period, Figure 5-3 shows the raw water turbidity in Nephelometric Turbidity Units (NTU), and Figure 5-4 shows the raw water alkalinity.

The raw water information was collected from the treatment plant records and was summarized for over one (1) year as shown on Figure 5-2 to Figure 5-4 the raw water quality which is treated by the treatment plant. It should be noted that during the high runoff during the early spring months, the raw water color has gone as high as 350 color units and that for a significant amount of time raw water color was greater than 80 color units. The pH during the high runoff period also decreases for short periods of time below 7.0. This change is from a basic to an acidic condition and will affect the effectiveness of the coagulant aids which are used in treating the raw water. The raw water turbidity through May 1993 was exceedingly high. The turbidity was as high as 110 NTU and for an extended period of time it was over 50 NTU.

It should be noted that during this period of time the alkalinity, which normally ranges from 100 to 150 dipped to below 50. This was probably due to a dilution of the natural runoff with low alkalinity snowmelt. After the high runoff period ended, the alkalinity again returned to over 100. The low alkalinity during the month of May increased the difficulty to treat the water and required different chemical combinations.
5.3 RAW WATER INTAKE STRUCTURE

The raw water intake structure is shown on the photographs in Chapter 4.0. It can be seen from this figure that the intake structure is primarily a concrete diversion structure across the stream, which diverts water into a box where a coarse screen prevents large items from entering the pipeline. During high flow at spring runoff, the entire structure has been inundated and was inaccessible for adequate screening of the raw water intake. As can be seen from the photograph, the existing intake system is not fenced or protected in any way from livestock or from potential vandalism.

Problems with the present intake structure are primarily operational and do not significantly affect hydraulic capacity or the ability to adequately treat the raw water. Minor modifications such as replacing and securing the wood coverings over the structure would aid in day-to-day maintenance. Also, the area should be fenced to provide for security both from unauthorized personnel and from livestock or other animals.

During extremely cold periods, the screen system is extremely difficult to clean and could limit flow into the water treatment plant if not adequately cleaned on a regular basis.

5.4 RAW WATER TRANSMISSION PIPING

The raw water transmission piping is a 14-inch asbestos cement pipe of an unknown pipe class. The line was originally constructed to be a gravity pipeline with minimal pressure at the lower end near the treatment plant. There has been some concern in the industry with asbestos cement that if pipe degradation occurs due to low pH, that asbestos fibers could be released into the drinking water. Test values of the raw water for pH indicate that the values typically range from a pH in the low sevens to a high of approximately ten (10). However, as can be seen on Figure 5-2 there are periods when the pH does drop below 7.0. This would indicate that the potential for degradation of the A-C pipeline is minimal and should not be a long-term concern unless EPA initiates new criteria for asbestos fibers in drinking water.

Along the route of the pipeline, it was reported that there have been areas where the streambank has eroded near the pipeline to the point that there is a potential for collapsing of the bank and loss of the raw water transmission line. These areas should be thoroughly inspected and, if necessary, rip-rapping, gabions, or other measures should be taken to secure the bank or to relocate the pipeline a sufficient distance from the stream that a catastrophic failure of the pipeline could not occur.

5.5 FLOW METERING SYSTEM

The only flow metering system which exists at the water treatment plant, is a meter on the raw water intake line. This meter has been recently calibrated and should be sufficiently accurate for plant purposes. The shortcoming of this meter is that it meters only the raw water intake. No metering is done of the actual water which is supplied to the customers or any means provided to determine the amount of water which is lost through the filter backwash operation or the clarifier cleaning operation. This makes it very difficult to do an accurate water audit of the actual
amount of water which is used by the customers versus the amount of water which is produced by the water treatment plant.

5.6 CHEMICAL FEED SYSTEMS

The water treatment plant has several different dry and liquid chemical feed systems to provide for chemical conditioning of the raw water to induce floc formation and to aid in final filtration. The systems are of various vintage and vary in their condition.

During the life of the treatment plant, numerous chemicals and chemical combinations have been tried to determine the most effective chemicals and chemical feed rates.

5.7 FLASH MIXING

During the summer of 1993, plant operators added a end section centrifugal pump to recirculate water from the incoming raw water line downstream of the chemical injection points to induce high turbulence mixing. It appears that the system which was added is providing the necessary rapid mixing required. A picture of mixing system is shown on the photographs in Chapter 4.0.

5.8 FLOCCULATOR TANK

The flocculator tank is not a typical design utilized for water treatment. The floc tank has had problems with low energy levels and also has had problems with solids settling out in the flocculator tank and causing accumulations which decrease the effectiveness of the demixing system. Previous reports have indicated that the installation of deflector veins could be added to increase the energy level of the mixing system. It is not known whether or not these have been added.

5.9 CLARIFIER

The rectangular clarifier is marginally adequate for current treatment requirements. The flow enters the left end of the clarifier (as shown on Figure 4-2). Typical problems have included the uneven distribution of the incoming raw water. During certain periods of the year when water temperatures are just right, the tank develops what is known as “thermal stratification”. The water in the tank is colder than the incoming water and the incoming water tends to flow over the top of the cooler water on the bottom of the tank. This results in short-circuiting of the clarifier and an effective decrease in the volume of the clarifier system. Attempts have been made by the operators to utilize plastic curtains to force the incoming raw water to the floor of the clarifier to try and induce mixing of the thermal stratification zones. This has been somewhat effective; however it is felt by the operator that there is still a problem with effective utilization of the entire clarifier volume.

The clarifier sludge removal mechanism is very light weight in design and the operators have had continual problems with correct functioning of the sludge removal system.
During the majority of the year the clarifier functions adequately. However, as can be seen on Figure 5-3, during May and June there is a period of time when the raw water turbidity exceeds 100 NTU and for an extended period of time exceeds 20 NTU. The particulate load during this time is so great that the ineffectiveness of the clarifier cannot reduce the load on the filter bed to where the high turbidity load can be handled by the single media system. There are often times when the water coming from the clarifier to the filters has a turbidity of 10 or greater. During this one (1) to two (2) month period, filter runs are significantly decreased and often there are times when the quality of the finished water decreases to a point where it is difficult to continually meet EPA criteria.

Single media filters of the type which exists at the treatment plant are not designed for loadings of this type. When the turbidities leaving the clarifier are below 3 or 4 they can usually be handled by the filter system at low loading rates.

During periods when the raw water has a high turbidity, the turbidity levels which enter the filter can have a turbidity as high as 10 NTU. This overloads the filter with material so that filter runs are very short and break through is very common.

The effluent weirs from the clarifier allow the water to fall approximately 12 to 15 inches through v-notch weirs to a collecting trough where it again drops approximately 12 inches to the transfer piping between the clarifier and the filter system. This high amount of agitation is shown in the photographs of Chapter 4.0. The result of this high turbulence is the breakdown of the floc particles which have formed during the flocculation and clarification process. This results in smaller particles which are more difficult to remove during the filtering process. This phenomenon is commonly known as "floc shear". The end result of floc shear is a smaller floc size and less efficient filtering.

5.10 FILTER SYSTEM

The filter system is a typical automatic backwash system, which in the late 70’s was primarily used for filtering of wastewater effluents. This system has a filter bed of approximately 16-feet by 38-feet and is divided into 51 separate underdrain cells. A cross-section of the filter system is shown on Figure 5-5. As can be seen from this drawing, the total filter bed has a depth of 6-feet 4-inches and has a fixed underdrain system. Pictures of the filtering system can be seen in the photographs shown in Chapter 4.0. The filter system has a single media filter consisting of a fine sand which overlays a porous plate underdrain system. There is approximately a 4-inch channel under the filter system which collects the water and transports it through ports in the side of the filter basin wall to the finished water channel.

During a recent inspection of the water treatment plant, approximately 29 of the 51 individual underdrain cells indicated minor to severe leakage of sand past the underdrain system. This indicates that there is a poor seal between the divider plates and the underdrain plates. The result of this is two-fold, first that the filter media is continually lost through the filter and replacement media has to be added to maintain an adequate filter thickness. Secondly, if the sand has the capability of leaking through the underdrain system, then particles or organism
FILTER 6ED
WASHWATER LAUNDER AND BRACKET
INLET PORTS
UNDERDRAIN PLATES
FILTER MEDIA
OUTLET PORTS
12"
16'-0" FILTER WIDTH
6'-4"
BRIDGER VALLEY, WYOMING
EXISTING FILTER BEDS
FIGURE NO. 5-5
PROJECT NO. 93122
which are retained in the filter media can also leak through the underdrain system with a potential for the effective loss of adequate filtering through the media.

The filter system is set-up strictly on a manual backwash. During certain times of the day, the operators will initiate backwash procedures to remove any accumulated material from the filter bed. During the backwash process water is pumped from the finished water channel to the underside of the underdrain plates to provide a reverse flow through the filter. The material which is loosened and flushed upward is then removed by a vacuum type pump system that fits over each individual cell as the backwash process proceeds. This material which is removed is taken to a backwash trough and eventually is carried to the backwash pond shown on Figure 4-1.

During the summer of 1993, provisions were made so that during the manual backwash cycle all water taken through the treatment plant can be wasted for a period of time until the filter is totally backwashed and the filter again stabilizes. This has reduced the increases in turbidity that resulted during the backwashing process. However, this does utilize a significantly greater amount of water for backwashing than previously was utilized and takes the filter system off-line for an average of 100 minutes per backwash. Due to the lack of metering facilities, there is no way to determine the exact amount of water that is utilized during the day for backwashing purposes.

The backwash system consists of a bridge assembly and two (2) pumps; one to pump water from the finished water channel under the filter and the other to remove the uplifted backwash material from the filter bed. These pumps have been in operation for approximately sixteen (16) years and are showing a significant amount of wear.

5.11 STORAGE

There are two (2) water storage reservoirs in the distribution system. A 500,000 gallon steel reservoir is located adjacent to the water treatment plant and a 1,000,000 gallon storage reservoir is located at a remote point in the distribution system. The scope of this study did not include evaluation of the storage facilities and no review was made as to the adequacy of the capacity or the condition of the existing facilities. However, it was reported that the 500,000 gallon tank is in poor condition and is scheduled to be repaired in the near future.

5.12 CHLORINATION SYSTEM

The chlorination system is a manual control, solution feed chlorinator which draws chlorine from a dual 150 pound container. As flowrates in the treatment plant are changed, manual adjustments have to be made to the chlorinator to maintain an adequate level of chlorine being added to the finished water. It was not determined whether adequate safety measures are being taken for handling the chlorine cylinders or for their storage or frequency of change over.

New revisions in EPA criteria more strictly limit the amount of chlorine contact time that any possible organism is in contact with the chlorine solution prior to the first customer using water from the treatment plant. An indepth evaluation of the chlorine contact time at the treatment plant was not a function of this study. However, it was reported by plant operators that during the
summer of 1993 the chlorine injection system was inadvertently left on while the plant was shutdown for backwashing. At this time the demand on the system was approximately 800 gpm and the storage tank was near full. The plant has continual chlorine residual monitoring. This chlorine monitoring system draws water directly from the tank, analyzes it by the residual chlorine analyzer, and records it on a chart. It was noted by the plant operator that approximately 20 minutes after the filter was shutdown for backwashing and the chlorine system was left in operation that a significant increase occurred in the residual chlorine value. This indicates that there is a serious potential for short-circuiting within the storage tank and that the entire volume of the tank can definitely not be utilized calculating chlorine contact time.

It was also reported that during the summer of 1992, that water levels in the storage reservoir dropped as low as one (1) foot due to demand being in excess of supply. This reduces the chlorine contact time in the storage tank to a very minimal amount, far below that required by EPA for adequate reduction of pathogens.

The first user on the water system is only about 1000 feet from the water treatment plant and the contact time which is available in the pipeline at higher flows is very minimal.

5.13 BACKWASH POND

The backwash pond is approximately 150 by 160 feet square, with an approximate working depth of 3 to 4 feet. There is only a single pond which shows some leakage as indicated by wet areas below the backwash pond. Excess water in the backwash pond is pumped back to the water treatment plant by a relatively new pump which was added for backwash water recirculation and reuse. No means are provided for cleaning the pond of the accumulated solids and the pond cannot be taken off-line for cleaning due to the fact that the plant must remain in operation at all times.

5.14 GENERAL SITE FACILITIES

Ancillary facilities include a very small office lab room, a single restroom, and a minimal amount of warehousing for parts storage. The lab is equipped to run minimal testing for color, turbidity, and other minor tests. Bacteriological testing is sent to an outside lab.

5.15 OPERATIONAL PROCEDURES

The plant is staffed for twelve (12) to sixteen (16) hours per day depending upon the demand for treated water by the users. During the summer months the plant has to remain in service for at least twenty-four (24) hours per day to provide an adequate supply of water to the users.

With the single media filter system and high flowrates through the filter, backwash cycles must be accomplished at approximately two (2) to six (6) hour intervals depending on many factors. This results in a downtime of the filter for backwash and also requires that a person be on-site to initiate and monitor the backwash process. At the present time, this limits the capacity of the
water treatment plant. There are no capabilities for plant automation or for automatic flow adjustment depending upon system demand.

In the past, the treatment plant has remained on-line 24 hours a day during high use periods. This has allowed for the plant to run at 1100 to 1200 gpm continuously, which would result in finished water production of between 1.4 to 1.6 mgd. Under new EPA criteria, the plant operators have been required to take the filter system and in essence the plant, off-line during the backwash process. This process often requires that the plant be off-line for as much as five (5) hours per day for backwashing procedures. As the flowrate to the filter is increased, the filter system plugs more quickly and backwashing has to be completed more often. During the spring months when the raw water turbidity is exceeding high, filter runs are also shortened to a point that filter runs of less than four (4) hours often occur. Effectively, this new operational procedure has shortened the time available for actual filtration of water through the treatment plant. It has reduced the effectiveness of the time of filtering from the past 100% to approximately 80% of premodification values. Figure 5-6 shows the net water production, with the existing filter, with the plant being off-line during the backwashing process. It can be seen, that as flowrates increase the frequency of backwashing also increases and usually the length of the backwashing cycle has to be increased to fully remove the particulate matter from the filter bed. As a result, the maximum water that can be produced through the treatment plant is approximately 1.2 mgd. This is far below the maximum rates which have been produced in the past and below past and present future demands.

5.16 PLANT STAFF

The plant is staffed by three (3) full-time personnel, who are well qualified in the operation and maintenance of the water treatment plant. The plant operator has a very thorough and extensive knowledge of water treatment and has made many modifications to the water treatment plant which have enhanced its capability and have resulted in decreased operating costs. The treatment plant is operating well due largely to the qualifications and knowledge of the plant operators.

5.17 FINISHED WATER QUALITY

For the last several years the treatment plant has fairly consistently met State and Federal water quality criteria. Recent changes in the plant, such as wasting during backwash, and continual monitoring of finished water turbidity and finished water chlorine, have resulted in operation which typically produces a finish water with a turbidity of less than 0.5 NTU. Figure 5-7 shows the finish water turbidities for approximately the last thirteen (13) months. During times of high turbidity it is difficult for the treatment plant to meet the 0.5 NTU turbidity requirement. This is primarily due to the high carry over of solids from the clarifier.

During periods of high raw water turbidity, the turbidity which was sent to the filter bed often exceeds 10 NTU.

A single media filter system is typically unable to adequately treat high water turbidity.
GROSS WATER PRODUCTION
W/O BACKWASH TO WASTE

NET WATER PRODUCTION
W/EXISTING FILTER

NET WATER PRODUCTION
W/NEW FILTER SYSTEM

NET WATER PRODUCTION (MGD)

FILTER LOADING GPM

800  900  1000  1100  1200  1300  1400  1500

BRIDGER VALLEY, WYOMING
FILTER PRODUCTION RATES
Figure 5-8 shows the raw water and finished water pH. It can be noted from this figure that typically raw water and finished water pH is above 7.0 and is relatively stable except for short periods when the pH peaks at a high of approximately 10.0.

Figure 5-9 shows both the raw water and finish water color. It can be noted from this graph that most of the year color is not a significant problem in the finish water. However, there is a significant portion of the year where finished water color is in excess of the 15 color units recommended by EPA. Color is more of an aesthetic factor in water than a health issue. For this reason, EPA has not made color a regulatory issue but a suggested value that all finish water be below 15 color units.

The chemicals which cause the color in the water are probably lignins and tannins from decomposing leaves and other organic matter found in the water shed. These can be reduced through proper water treatment; however under the present method of treatment and disinfection, color probably cannot be lowered much beyond the current finished water values.

5.18 FINISHED WATER DEMAND

As expected, the amount of finished water which is produced by the water treatment plant varies significantly throughout the year. High use periods are the summer irrigation periods and, of course, the low use periods are the winter periods when there is no irrigation.

Figure 5-10 shows approximately thirteen (13) months of the amount of water which entered the treatment plant during each day. The amount of water which was lost to backwash has not been subtracted from these readings due to the fact that there is no way of measuring the amount of water lost through backwash. The flows shown are from the plant records, which indicate a flowrate in gallons per minute being feed into the plant times the time period for that flowrate.

It can be seen that a low flow of approximately 250,000 gallons per day occurs during the months of November, December, January, and February. Peaks flows in the range of 1.25 mgd to 1.50 mgd occur during June, July, and August.

From peak flows that are shown, it appears that the plant with its present configuration and operation is beyond capacity. During the high flow periods in the summer the filter must be operated at approximately 1200 gpm to meet demand. This results in filter runs as short as three (3) to four (4) hours and prohibits the operation of the treatment plant at this high feed rate because of the high frequency of backwashing. Due to this fact, the amount of water which can now be produced is limited to approximately 1.1 to 1.2 mgd as shown on Figure 5-6.

There were periods of time during the summer of 1992 when water levels in the plant storage tank dropped as low as one (1) foot and reserve capacity and disinfection contact time did not exist.
6.0 WATER TREATMENT PLANT MODIFICATIONS

6.1 GENERAL

The proposed modifications to the water treatment plant will cover various functions. Some modifications will serve to increase the hydraulic capacity of the treatment plant. Other recommended modifications will aid in compliance with EPA and State water quality requirements. While other recommended modifications will allow for ultimate future expansion or for ease or efficiency in plant operation.

The purpose of this study is to determine basically two (2) facts. 1) Does the existing Bridger Valley Water Treatment Plant have the hydraulic capacity to supply the needed increased flows of between 110,000 to 150,000 gpd to serve the requested new customers, and if not how can it be modified?; and 2) Does the existing water treatment plant meet EPA and State Water Quality criteria, and if not what changes must be made to continually meet the criteria.

In order to delineate recommended changes, each component of the treatment plant was evaluated and recommendations made for various modifications and defined as to whether these modifications would be needed immediately for short-term demand, for long-term demand, and what effect the changes would have on water quality.

6.2 RAW WATER INTAKE AND TRANSMISSION PIPING

Hydraulically the intake structure is not limiting the treatment plant capacity to a point where it is the present restricting factor. As the demand for water increases the intake structure and pipeline combination will limit the ultimate hydraulic capacity of the system. As presently configured, the treatment plant operator indicates that he can obtain no more than 1,350 gallons per minute through the intake structure and pipeline. If measures are taken to remove all air from the high points in the line, the operator can increase this to 1,500 gallon per minute for a relatively short period of time.

It is recommended that the air relief valves which have been removed from the line or are presently inoperative be repaired so that any accumulated air pockets in high points of the line can be removed and the delivery system increased to where it can meet its design potential of 1,500 gpm. The vaults where the air relief valves are place should be adequately insulated so that freezing is not a continual problem and a maintenance schedule needs to be established whereby the air relieve valves are checked on a regular basis to see that they are operating properly.

These recommended changes should be accomplished immediately and will allow the capacity of the raw water supply system to increase from its functional 1,350 gpm at present to the 1,500 gpm as originally designed.
In the future when plant capacities exceed the 1,500 gpm requirement, it is recommended that the intake structure be reconstructed to provide for a fine mesh screening system that is housed in a building to provide for protection from vandalism, livestock, weather, and from freezing of the screening system during the winter months. Also, incorporated with this intake system would be a high volume, low pressure pumping system which would increase the flow in the raw water supply system from 1,500 gpm to over 2,000 gpm. This will allow a total plant flow of 2.7 million gallons per day, which is currently the amount of secure water rights which are available to the water treatment plant. If additional water rights can be obtained and the demand exists, the existing transmission line could be further pressurized to increase flows to possibly as high as 2,500 gpm to the water treatment plant. It is not anticipated that this would be required for many years and is dependant on the population growth and expansion of the use area of the water treatment plant. Due to the fact that this additional capacity should not be required for many years, no costs were determined.

6.3 PLANT FLOW METERING

The existing plant flow meter appears to be operating adequately and there are no recommended changes at this time to the raw water intake flow meter. However, it is advisable that a flow meter be added to the line from the storage tank to the distribution system. This will allow the plant operators to monitor actual water usage and to determine how much water is being supplied to the customers. This then will allow for accurate determinations of water usage and will also aid in overall water audits to compare the amount of water produced versus the amount of water which is utilized by the customers as reported by their individual water meters. This can be done at a relatively low cost and will provide substantial benefit for plant operation.

The combination of the raw water intake meter and the finished water meter can also be incorporated into a plant automation system which will allow for automatic control of water being produced by the water treatment plant.

The estimated cost for a finished water flow meter will vary depending on type and complexity, but should cost between $5,000 and $15,000.

6.4 CHEMICAL ADDITION SYSTEMS

Previous reports have indicated that numerous new chemical addition systems need to be added to provide a myriad of chemicals for water treatment. At the present time, the chemical systems which are being utilized seem to be meeting current needs. Rather than recommending numerous chemical feed systems, a program should be initiated by the plant operators to accurately monitor chemical usage, chemical effectiveness, and to explore alternative chemicals which may or may not prove to be more effective in meeting treatment requirements or to be more cost effective for plant operation.

One modification which may be effective in removal of taste, odor, and color is for a more efficient use of potassium permanganate. A typical installation would provide a ten (10) to fifteen (15) minute pretreatment contact time for the potassium permanganate. This allows the potassium permanganate to react prior to other chemicals being added to the supply water. This is usually
done by providing a small tank or reservoir in the supply line with a mixing upstream, whereby potassium permanganate can be mixed with the raw water prior to its entering the treatment process. This has been found to be a more effective use of potassium permanganate for taste, odor, and coloring removal.

Modifications can be made to most of the existing chemical feed systems to provide automatic operation of the control rates for chemical feed from the various chemical feed systems. This is generally done utilizing a flow signal generated by the raw water intake flow meter, which adjusts the signal up or down as needed to meet water demands and also adjust chemical feed rates so that chemical concentrations remain constant in the water entering the floc and clarifier systems.

As the treatment plant expands and chemical usage increases, additional chemical storage areas will be required. Due to site constraints, additional property may need to be acquired or the area south of the treatment plant excavated to provide additional room at approximately the same level as the existing facility.

With minor modifications to the chemical feed systems this portion of the treatment plant could be capable of handling up to 2.7 mgd. No costs were estimated for chemical system modifications.

6.5 FLOC TANK

At present flows, the floc tank and mixing system appear to be providing sufficient energy so that most of the time water quality requirements can be met. In a previous study, it was recommended that baffles be added to this tank and that the mixer arms be extended to provide for additional energy for mixing. This should be completed as soon as possible if it already has not be accomplished. This would help to more effectively utilize the chemicals which are added to the raw water.

As plant flows increase beyond 2.0 mg per day it may be necessary to abandon the circular floc tank and to construct a two (2) stage floc mixing system with variable speed propeller mixers that can provide variable and adequate energy for the particles to contact and join into large, more stable floc. This would be built adjacent to the existing clarifier so that the treatment plant could remain on-line during construction.

6.6 CLARIFIER

During the majority of the operational year, the clarifier performs adequately at the present flows. However, there are times when thermal stratification occurs and short-circuiting develops. This results in high turbidity water being discharged to the filter system, which ultimately results in short filter runs and lower quality water.

As water usage increases to beyond approximately 2.0 mgd, it will become necessary to do a major renovation to the clarifier system. A typical modification to clarifiers of this type would be to add what is termed a "tube settler" to the clarifier. This is a series of pipes that are placed in the clarifier in sloped banks. This allows for a very short distance of settling in the clarifier before
particles reach the bottom of the tube, accumulate into larger groupings, and then fall to the bottom of the clarifier floor. This modification would also require the replacement of the sludge accumulator and removal system.

Previous reports have also indicated that some crack sealing needs to be completed on the clarifier structure. This work should be done in the near future so that corrosion of rebar and saturation of the soils under the clarifier does not occur.

When any large modifications are made to the clarifier, the transfer piping system between the clarifier and the filter should also be modified to lessen the severe turbulence in the transfer structures. This turbulence tends to shear the floc which has formed, thus creating smaller floc that is more difficult to filter. There are two (2) vertical drops between the clarifier and the filter which need to be eliminated or minimized as much as possible.

The estimated cost to retrofit the clarifier with tube settlers and to replace the sludge removal system is approximately $200,000.

6.7 FILTER SYSTEM

Under present operating conditions, the filter system is the limiting equipment in the treatment process. Figure 6-1 shows the estimated maximum flows that the plant can presently provide. The requirement to waste the treated water during backwash has reduced the plant’s capacity by over 20%.

Previous reports have indicated that the single media filter system should be replaced with a dual media system. This modification would allow for longer filter runs and for better filtration at higher flowrates. An additional alternative to gain more plant flow capacity under the present configuration would be to add monitoring and control equipment to allow the plant to run automatically throughout the night. This would allow a shorter period of time when the plant has to be manned and could allow for operation at higher rates during the night with the plant operating in an automatic backwash and flow control mode.

There are two (2) levels of automation which could be utilized to increase plant capacity. One option would be for the automatic backwash system to be put into use. Backwashing could be initiated by one (1) of the following three methods:

1) Differential head across the filter
2) High finished water turbidity
3) Time differential

The system could be controlled so that if any of the three (3) conditions occurred, automatic backwashing would develop. This would require that a control system be added to the backwash wasting valve so that it would open automatically during backwashing. A motorized valve would have to be added to the plant intake-line to reduce plant flow through the filter to approximately the quantity of water that is wasted during the backwash operation. An interface would also need to be installed between the chlorination system and the chemical feed units so that as the plant shuts down and goes into backwash that chemical feeding and chlorine feeding would shutdown.
This could be done at a fairly minimal cost and would allow for 24 hour operation at high filtration rates. A monitoring system should also be installed which would develop alarms for high water, low water, high finished water turbidity, chlorine failure, failure of the chemical feed systems, or other conditions which may need to be monitored by the plant operators.

A second level of plant operation would be for automatic control of the flowrate through the treatment plant. This could be done by monitoring the flowrate leaving the 500,000 gallon storage tank and providing automatic controls on the raw water intake valve so that the amount of water entering the plant is equal to the amount of water which is utilized in the distribution system. This would require that proportional controls be added to the chlorine and chemical feed systems so that as flow increases or decrease, the amount of chlorine or chemicals would increase or decrease proportionally. Again, this would provide a more automated system which would require less on-site operator time and would also increase plant capacity.

A major shortcoming and repeated recommendation throughout previous studies is for the modification of the existing filter system from a single media filter to a dual media filter.

Under current conditions the filter loading rate cannot exceed approximately two (2) gallons per minute per square foot. At this loading rate, the flow through the treatment plant is approximately 1.75 mgd without wasting during backwashing. However, at the high loading rate backwashing must be done frequently and flow must be terminated through the plant during the backwash process. Figure 6-1 shows the amount of water that can be produced during a 24 hour period. As can be seen, the maximum water produced is approximately 1.2 mgd.

In an attempt to determine whether or not it would be effective to replace the single media filter system with a dual media system, a pilot plant was operated for approximately a one week period. The pilot plant consisted of an 8-inch diameter plastic tube with a plastic media underdrain and 12-inches of a graded sand and 12-inches of a graded anthersite material. The pilot plant was set-up so that it would gravity feed from the clarifier at a rate which could be varied. However, it was operated at a constant head and not at a constant flowrate. Results of the operation of this pilot filter study are shown on Figure 6-2. It can be seen from this graph that even at filter rates as high as 4 to 6 gallons per minute per square foot, that at least four (4) hour filter runs could be obtained and still produce a finished water turbidity of 0.1 to 0.3 NTU. Even at these high loading rates, there was no sign of breakthrough of material through the media and it appeared from the testing that filter cycles between backwashes could be as long as twelve (12) hours. During the pilot operation, the turbidity of the water from the clarifier to the pilot filter was approximately 1.5 NTU.

As previously mentioned, the existing filter has numerous problems besides the single media filtering system. During evaluation of the filter, it was found that approximately 29 of the 51 underdrain cells showed that a significant amount of sand media had leaked past the underdrain plates. This indicates that the seal between the dividers and the plates has broken down and is allowing sand and possibly organic material to leak past the filter system.

The entire filter system is approximately 16 years old and there is evidence that the two (2) pumps on the backwash system are in need of major repair. The bridge system was originally furnished with automatic controls which are not being used.
The replacement of the filtering system would allow for a substantially higher flow quantity to be taken through the filter on a daily basis. It can be seen from Figure 6-1 that if flowrates are increased to even 2.5 gpm per square foot that the flowrate would increase to 1500 gpm. This would equate to almost 1.8 mgd, which exceeds the present and anticipated future supply requirements for the water distribution system. This flowrate would allow for three (3) 22 minute backwash cycles per day. This flowrate is capable of being meet by the raw water supply system and other components in the treatment plant.

The estimated costs to modify the existing filter system to a dual media system can be evaluated under two (2) sets of criteria. One would be strictly the minimal amount of changes required to change to a dual media system and the second would be for the complete replacement of the filter media, underdrains, dividers, bridge, backwash system, etc.

Under the first alternative, it is recommended that the manufacturer of the equipment provide someone on-site to evaluate the existing equipment and to determine if it can be modified, at relatively minimal costs, to change from a single to dual media system. This analysis would cost approximately $5,000 and would develop the exact changes that would need to be made to the filter to change to the dual media system.

A second alternative is for the complete reconstruction of the filter. This would include the removal of all existing equipment including the dividers, underdrain plates, media, backwash bridge, pumps, controls, etc., and the furnishing of a new underdrain system, divider plates, backwash bridge, filter media, and related equipment. The estimated cost to complete this work is approximately $120,000 to $150,000. This would provide all new equipment and would provide at least a fifteen (15) to twenty (20) year operating life for all equipment involved with the filtering system. This would also increase plant flows to at least 1.8 mgd without any other significant modifications to the water treatment plant.

Either method of modification to the filter would have to be carefully scheduled so that water could be supplied to the customers during the time period when the filter is being reconstructed. This could possibly be done in a four (4) to five (5) day period with proper planning, scheduling, and a 24-hour per day construction schedule.

Previous and current recommendations are that the filter system be changed to a dual media system as soon as possible. The existing filter system exhibits many problems, shortcomings, and will not be able to continually meet the EPA criteria for finished water quality.

Other modifications that need to be made to the filtering system are to provide walkways, guardrails, and other safety measures to provide a safe work place for the plant operators. Under current conditions, the operators are required to walk down a narrow wall to performance maintenance on certain parts of equipment. This is extremely dangerous and is not in compliance with OSHA requirements.

Another option to rebuilding the filter system would be to construct a new filter adjacent to the existing filter or clarifier building. This filter would be of equal construction utilizing a two (2) media filtration system. This would not only provide for a filter which would have a higher capacity rate, but would also provide a measure of redundancy for the filtering operation. A separate filter would be housed in a building adjacent to the clarifier. It would be a complete
stand alone filtering system and would be set-up so that either filter could be operated or that both filters could be operated jointly. This would allow for a significant increase in the capacity of the plant, while also providing backup to the existing filtering system. The estimated cost for a new filter are shown in Table 6-1.

<table>
<thead>
<tr>
<th>Work Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Basin</td>
<td>$49,000</td>
</tr>
<tr>
<td>Filter System 20'x44'</td>
<td>140,000</td>
</tr>
<tr>
<td>Piping</td>
<td>24,000</td>
</tr>
<tr>
<td>Electrical</td>
<td>18,000</td>
</tr>
<tr>
<td>Building</td>
<td>44,000</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
<td><strong>$275,000</strong></td>
</tr>
<tr>
<td>35% Contingency &amp; Engineering</td>
<td>96,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$371,000</strong></td>
</tr>
</tbody>
</table>

6.8 DISINFECTION SYSTEM

The existing manual control rate chlorination system is marginally adequate for present operations. The chlorination system is a dual cylinder system which requires the operators to change the chlorine cylinders frequently. At a minimum, the system should be modified so that it meets all current safety requirements and that at least six (6) chlorine containers can be manifolded together and be on-line at one time. This will greatly decrease the frequency that the operators are required to deal with the hazardous chlorine gas.

Under future disinfection byproduct regulations which are being placed into effect by EPA, the amount of chemical byproducts from chlorine disinfection will be more strictly limited. At the present time, the total trihalomethanes (TTHM) that are present in the finished water from the Bridger Valley water treatment plant are at times as high as 10 mg/l. Under future regulations this will be limited to 0.1 mg/l. With the high amount of organics that are present in the raw water entering the treatment plant combined with the very long and slow moving distribution system, it will be very difficult to meet the disinfection byproduct regulations.

Under long-term analysis, it may be cost effective and required to change to a different type of disinfection system.

Besides disinfection byproducts, there are certain organisms which are commonly found in unprotected water supplies that are not inactivated by chlorination. The giardia cyst and cryptosporidium are two (2) organisms which are quite resilient to chlorination. An alternative which is available to increase the effectiveness of disinfection is the use of ozone for partial treatment and disinfection. Ozone has been found to be very effective in removal of taste, odor, color, and in the deactivation of giardia and cryptosporidium. This reduces the negative effect of the
disinfection byproducts and would require a lower amount of chlorine to be added to the line to provide adequate disinfection.

The change to ozone for disinfection is something that may be needed in the future, but is not required under present operating conditions. It was beyond the scope of this study to fully evaluate the effectiveness of ozone disinfection and to develop detailed cost estimates for ozonation at the Bridger Valley water treatment plant. Preliminary costs which were developed are $317,000 for the ozone equipment, and approximately $145,000 for electrical supply, contact chamber and other costs.

Evidence indicates that there is a possibility that short-circuiting exists in the water storage tank next to the treatment plant. This short-circuiting does not allow for adequate contact time of the chlorine with various organisms prior to the water being discharge for customer use. In order to ensure that adequate contact time is available, it may be required to make modifications to the storage tank to induce mixing or baffling so that short-circuiting does not occur. There is also a concern that when water levels in the tank become very low, contact time will also decrease to an unsatisfactory time period. Controls may need to be added to the tank that will limit water being discharged from the tank when the water level drops to a certain point.

The estimated costs for baffling of the tank to provide for adequate mixing was beyond the scope of the study. This needs to be reviewed immediately if the tank is going to be refinished in the near future.

6.9 FINISHED WATER STORAGE

No evaluation was made as to the adequacy of the existing storage or requirements for future storage. Therefore, no recommended changes can be made by this study.

6.10 BACKWASH PONDS

The existing backwash pond, as previously mentioned, is a single pond with no method for cleaning and there are signs of leakage.

It is recommended that a second pond be constructed as soon as possible so that the ponds can be alternated and all settled material be removed and properly disposed of. This pond should be at least equal in size to the existing pond and both ponds should be constructed so that they can be cleaned and that any excess water from the backwash process be recycled through the treatment plant.

The cost for construction of a new backwash pond is estimated to be approximately $55,000 plus the cost of any land which may need to be acquired for construction.
6.11 SITE FACILITIES

The main shortcoming of the existing support facilities is the office/lab area. This area is very small and where the office/lab is used as a office, lab, break room, and visitor area it is impossible to maintain adequate quality control procedures for laboratory testing. The lab equipment is exposed to handling by whomever walks by and the results of the tests can be effected by people unaware of the need to not disturb the test equipment.

A larger office/lab area should be constructed so that adequate lab procedures can be followed and plant records can be maintained. The costs associated with this will vary greatly depending upon the type of construction and the size of the final facility that is designed.
7.0 LONG-TERM PLANT MODIFICATIONS

7.1 INTAKE STRUCTURE

To obtain plant flows in excess of 1,500 gpm, modifications will be required to the intake system. This will also require a pumping system be constructed at the intake system to pressurize the existing transmission line so that flows in excess of 1,500 gpm can be obtained. In conjunction with this, a new raw water intake screening system and building would be constructed. Estimated costs are shown below in Table 7.1.

<table>
<thead>
<tr>
<th>TABLE 7.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>River Division Structure</td>
</tr>
<tr>
<td>Screening System</td>
</tr>
<tr>
<td>Screen Building</td>
</tr>
<tr>
<td>Electrical and Control Systems</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
</tr>
<tr>
<td>35% Contingency and Engineering</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

7.2 OZONE DISINFECTION SYSTEM

A very preliminary cost was developed for construction of an ozone system which would serve the needs of a water treatment plant. Table 7.2 shows the preliminary costs for the construction of a pretreatment ozonation system.

<table>
<thead>
<tr>
<th>TABLE 7.2 - OZONE SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone Equipment</td>
</tr>
<tr>
<td>Ozone Contact Chamber</td>
</tr>
<tr>
<td>Building</td>
</tr>
<tr>
<td>Electrical and Control Equipment</td>
</tr>
<tr>
<td>Piping and Miscellaneous</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
</tr>
<tr>
<td>35% Contingency and Engineering</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>
7.3 **LONG-TERM OR ULTIMATE BUILD OUT ESTIMATED COST**

If it is determined that the existing plant is not worth spending significant amounts of money on to update or modify, a second option is to construct a completely new plant at an adjacent but different site. Depending upon the type of plant that is built, costs would vary from between $2,000,000 to $3,000,000 for a 2.5 to 3.5 mg per day plant. These costs could vary significantly on the amount of redundancy that is built into the system, whether or not ozone treatment is included, and the amount of equipment such as chemical feed systems that could be salvaged from the existing plant. The development of a complete new system was beyond the scope of this study; however these costs are presented for very preliminary consideration.
APPENDIX A
UNITA ENGINEERING STUDY
INTRODUCTION

The Bridger Valley Joint Powers Board is the governing agency which operates the Water Treatment plant, the Water Transmission System and some Water Distribution within the Bridger Valley. In addition to serving water to users within the rural county, the Board provides water to the Towns of Lyman and Mountain View, and the Water and Sewer Districts of Fort Bridger, Lower Bench and Black Fork. The original Board consisted of members appointed by the Town of Lyman, Town of Mountain View and Uinta County. A representative of the Fort Bridger Water and Sewer District has since been added. The Bridger Valley Joint Powers Board was originally organized to provide a water supply, transmission and distribution system and a solid waste landfill for Bridger Valley. The landfill has since been acquired by Uinta County and thus Board's only purpose is to provide a water supply, transmission and distribution system. (Appendix A)

With a series of grants and loans, the Board constructed the existing intake, transmission line, treatment facility and distribution system. The original system was designed to meet EPA and Wyoming DEQ requirements when flowing at approximately 2.2 million gallons per day. The plant presently operates at a peak demand of approximately 1.6 million gallons per day and appears to be currently meeting EPA and DEQ requirements. The existing system is illustrated by Figure 1.

Although the existing system appears to be operating adequately to meet State and Federal requirements, the Board has a concern that they have adequate planning to meet future EPA and DEQ requirements and that they have adequate capacity to meet future growth requirements. The Board therefore authorized Uinta Engineering and Surveying, Inc. to study the existing system and to provide both short term and long term recommendations for the system. This report is the culmination of that study.
SCOPE OF WORK

The scope of work as required by the Bridger Valley Joint Powers Board consisted of studying the existing system and making short term and long term recommendations to allow the Board to properly operate the existing system and to plan for future requirements. As part of this study Uinta Engineering and Surveying, Inc. recommended that additional record keeping be conducted and that repairs and revisions be made to the plant (Appendix B). As part of this study it was originally determined to study the existing distribution system, however since Wyoming Water Development Association had authorized a separate study of the distribution system, it was decided to wait and review the results of that study. This study therefore includes the raw water intake, the transmission line from the intake to the water treatment plant, and the water treatment plant.

This report therefore addresses the Bridger Valley Joint Powers Board Water System from the intake through the water treatment plant. Both short term and long term actions are proposed. Short term actions are those items that need to be accomplished in order to comply with existing regulations and those items that can be accomplished quickly and inexpensively. Long term actions are those items that will need to be accomplished to comply with regulations to be triggered by EPA in the future, those items that require further studying or items that are expensive or time consuming to accomplish. These long term actions will require scheduling, additional studying, budgeting and possibly acquisition of funding through grants or loans.
The existing Bridger Valley Joint Powers Board System as addressed in this study consists of an intake structure located approximately 1 3/4 miles upstream of the water treatment plant, the transmission line from the intake to the plant, the water treatment plant and storage tank. Also included as part of the system and pertinent to the operation of the plant are the existing water rights.

**Water Rights:** The Bridger Valley Joint Powers Board receives water from three sources. The first source acquired and the most important source is water stored in the State Line Dam. This water consists of 1500 acre-feet acquired by the Towns of Lyman and Mountain View. The contract between the United States of America and the Town of Lyman is attached as Appendix C. The contract for the Town of Mountain View is attached as Appendix D. An agreement among the United States of America, Bridger Valley Water Conservancy District and the Towns of Lyman and Mountain View agreeing on criteria relating to the operation and maintenance of the State Line Dam is attached as Appendix E. Assignments from each of the Towns to the Bridger Valley Joint Powers Board are attached as Appendix F and G. This stored water is supposed to be regulated by notifying the Water Conservancy District in writing each month. Of the 1500 acre-feet available, the Bridger Valley Joint Powers Board has 800 acre-feet available June 1 and the amount decreases to 0 acre-feet on October 1. This water provides a firm source of supply of approximately 2 million gallons per day for June and August and 3 million gallons per day for July.

A second water source for the Board is irrigation water that has been transferred to municipal use. This water consists of a total of 2.32 cfs with 0.04 cfs being from the Smith’s Fork and the remaining 2.28 cfs from the Black’s Fork River. A report on this transfer is attached as Appendix H. Consultation with the State Engineers Office and representatives for the State Board of Control indicates that on a dry year only that water right with a priority of 1891 or earlier is good source late in the summer. The 1891 and earlier water rights is approaching 0.9 cfs.

The third source of supply for the Board consists of a 1978 direct flow right from the Smith’s Fork River. This flow is useful only during winter and early spring, but could be used for future storage. This water is approximately 4.4 cfs.
This page possibly missing from original document.
The third potential problem with the line is caused by the A-C (asbestos-cement) pipe material. Because the preliminary indicators from raw water samples taken at the plant indicate the raw water is low pH, there is the potential that the water may be corrosive to the A-C pipe. The raw water quality could change throughout the year, and this problem may be present only during certain types of flows, but the potential for corrosion to the A-C pipe does exist. Also, because this line is A-C and there is concern over asbestos, the potential for future problems associated with asbestos exists. Although DEQ does not currently allow installation of A-C pipe, there has been no effort to require removal of existing pipe, and there appears to be no health hazard caused by existing pipe. The only foreseeable problem could be that of corrosion to the A-C pipe by corrosive water, thus allowing asbestos into the system.

Water Treatment Plant: The existing water treatment plant consists of a chemical feed, floculation basin, clarifier, rapid sand filter disinfection system and a 500,000 gallon storage tank acting as a chlorine contact chamber. There is also a waste pond that receives water from the clarifier sludge, filter backwash and storage tank overflow (Figure 2). The entire plant is a gravity system having approximately 34 feet of static head from the intake. The flow profile for the plant is represented by Figure 3.

As part of this study, considerable time was spent analyzing the existing plant to determine if problems associated with the operation, maintenance and design would require short-term actions or if long-term actions would be required. Consultation with Snowy Range Water Consultants, Inc. and Snowy Range's extensive expertise with design of state-of-the-art water treatment plants was used to assist in analyzing the existing system (Appendix I). To determine what short-term and long-term actions should be considered, the plant was scrutinized at all levels. During the analysis of both short-term and long-term recommendations, it should be remembered that the plant was designed and provided satisfactory operation for approximately 25 years. The plant has been operating under producing water acceptable to current EPA requirements.

The existing control building houses the main control valve, the master flow meter, the chemical feed application, and the rapid mix chamber. At the time of the study, the only chemicals being added were polymer and granular alum, which has since been changed to liquid alum. Areas of concern within the control building are as follows:

1. The master flow meter appears to have never been calibrated and based on flow time required to fill the floc tank, could be reading as much as 20% low.
2. The rapid mix system consists of an inline static mixer. This mixer appears to provide marginal performance, particularly at low flows.

3. The building is designed to allow application of dry alum and there is not adequate room for addition of feed equipment for different chemicals.

4. There is not adequate room to allow storage or placement of bulk chemicals.

Water flows from the control building to the floc tank. The existing floc system consists of a variable speed mechanical mixer inside a 25 foot diameter by 8 feet deep concrete basin. This basin provides approximately 20 minutes detention at the flow of 1500 gpm. Observation of the existing flocculator appears to indicate that there is not enough energy dispersed to the water. There also appears to be a problem with sediment building up in the floc tank and periodically disrupting the floc process.

From the floc tank, the water flows to the clarifier. The clarifier sludge removal system was not operating properly, but during the study the basin was cleaned and the sludge removal system now appears to be functioning adequately. The sludge removal system is a siphon that is suspended from a floating platform and is towed by cable. The sludge is siphoned off the bottom and discharged to the waste pond. The walls of the concrete basin have some cracking and there is evidence that there may be some leakage through the walls. There is also a problem with the operation of the clarifier caused by the water short circuiting along the surface, down one side of the clarifier. This operational problem is only noticable when the raw water temperature rises above that of the clarifier water.

The effluent from the clarifier enters the filter building and passes through the rapid sand filter. As was previously recommended, the sand for this filter has recently been replaced and since that time the effluent turbidity has been within EPA tolerance. The filter is an automatic backwash system. The sand is approximately 11 inches deep and is divided into 51, 8 inch by 16 foot cells. The backwash system operates automatically based on the head on the filter. There is no filter to waste feature on this filter. When the chemical feed, flocculator and clarifier are operating properly, the filter receives water with a turbidity of approximately 2.0 to 2.4 NTU and produces water in the range of 0.2 to 0.7 NTU. In 1993, the EPA will lower the allowable turbidity, to require that the effluent from the plant generally meets a 0.5 NTU maximum. I do not believe the existing filter can comply with the revised limit.
Disinfection: As the water leaves the filter it is chlorinated and then placed in a 500,000 gallon storage tank that is used as the contact chamber. The existing system appears to function adequately although there should be continuous monitoring of the water as it leaves the tank and enters the distribution system. The 500,000 gallon storage tank and the pipelines should provide 3 hours chlorine contact time prior to the first user. This required contact time should be easily provided if there is no short circuiting in the tank.

Storage Tank: The existing storage tank is a 500,000 gallon welded steel tank. The tank level is monitored by a sonic level indicator at the plant office and the level is regulated manually by controlling the plant flow. The tank is in line, thus all treated water passes through the tank. The tank has been visually inspected both inside and out. The outside of the tank is in good repair except several spots that have had the paint removed by what appears to be bullet marks. The interior of the tank has many spots, particularly field weld locations, that have evidence of rust. The overflow for the tank also appears to be set too high for the existing weir elevation.

Daily Monitoring: The plant operators are presently complying with turbidity monitoring requirements by testing the plant effluent every 4 hours. They are also checking chlorine residual throughout the distribution system on a daily basis. However, there is not presently continuous monitoring for the chlorine residual of the filtered effluent as it enters the distribution system.

Waste Pond: Sludge from the clarifier, filter backwash, and storage tank overflow are presently discharged to the waste pond. Current regulations require that alum sludge waste ponds have a volume of 100,000 gallons per 1,000,000 gpd plant capacity. The existing pond has a capacity of approximately 160,000 gallons, thus providing enough capacity for approximately 1.6 mgd through the plant. As originally designed, the water from the waste pond was supposed to be pumped back to the plant for reuse. Since completion of the plant, the pond has had an outlet and a slide gate added, and the waste water is discharged to a surface drainage. The recycle pump has been removed from the pond. In 1988, an inspection of the plant by DEQ was performed and in that report DEQ notified the operator that the Bridger Valley Joint Powers Board must either acquire a discharge permit or eliminate the discharge of the waste water.
The study of the Bridger Valley Joint Powers Boards Water System revealed items that need to be completed to allow the system to operate properly, thus complying with current requirements. It also revealed maintenance and repair items and new technology items that should be accomplished in order to protect the current investment the Board has in the system and to allow the system to properly operate. Those items that are of extreme urgency, those items that must be done to comply with current State and Federal requirements, and those items that can be accomplished without large expense are considered Short Term Recommendations. The Short Term Recommendations as outlined herein should be accomplished as soon as possible to bring the system into compliance with current requirements and to protect the existing investment. The recommendations are tabulated in the order they were discussed under Existing System.

**Water Rights:**

1. In order to protect their surface water rights the Board should document the use of the surface water in writing. This documentation could be by a log kept by the operator indicating the quantity and the time the water is used.

2. The Board should document the use of the storage water from State Line Dam by submitting in writing monthly a request for stored water to the Water Conservancy District.

3. The Board should complete the Robertson Pipeline thus allowing the use of the Blacks Fork River water. Once complete, the use of this water should also be documented.

**Raw Water Intake:**

1. The intake area should be fenced to eliminate livestock from the immediate area.

2. The top to the intake should be revised to secure the lid during high river flows.

3. The existing butterfly valve located near the intake should be removed from the line. The valve is not used and is not necessary since there is a slide gate to open and close flows to the intake.
Transmission Line:

1. The existing broken air release valves should be replaced. The pits housing the valves should then be insulated or otherwise protected from freezing.

2. The existing A-C pipe should be inspected to determine if the low PH water has been corrosive to the pipe.

Water Treatment Plant:

A. Control Building

1. The master flow meter should be calibrated and/or replaced. If the meter is replaced consideration should be given to replacement with a meter that could be used to control chemical feed rate, and be connected to the plant's central control system, since future upgrading of the plant may require more automation of the system.

2. An in-line rapid mix system should be installed. This system should be able to replace the existing in-line static mixer and thus provide a more efficient plant.

3. The plant has been operating on granular alum but is presently operating on liquid alum. Liquid alum, if purchased in bulk is much less expensive than granular, it is easier to maintain the equipment and the liquid performs better. In order to economically operate on liquid, a bulk tank must be purchased and enclosed to protect it from freezing.

It is recommended that a bulk tank be purchased and the existing control building be added on to, or replaced. If the building is replaced, revisions to the plumbing should be considered to allow provision for additional chemical feeds. The proposed location for the building is as indicated in Figure 4.

4. Additional storage needs to be provided at the plant. If the control building is enlarged as recommended under Item 3, an area should be reserved for chemical storage.

B. Flocculation

1. Temporary baffles should be placed within the floc tank to determine if this would increase the efficiency of the floc tank.

2. Additions should be placed on the bottom of the mixer paddles to attempt to prevent large build-up of sediment. These additions have been added but may require some experimentation to determine optimum location.
C. Clarifier

1. The walls of the clarifier should be sealed. The best time to make these repairs will be when the demand drops off in the fall of the year before temperatures get too cold.

2. The water short circuits down the Southeast wall of the clarifier when the temperature of the raw water rises above the temperature in the clarifier. Experimentation with the influent ports and the discharge weirs should minimize this problem.

D. Filter

1. The sand in the existing filter was full of mud balls and needed replaced. The sand has since been replaced and the filter is operating much better.

2. When the existing filter backwashes, it causes the turbidity to rise in the filter effluent. It is recommended that a filter to waste feature be added to increase quality. This feature can be accomplished by retrofitting the existing backwash mechanism or by making revisions to the existing filter basin. Both systems should be explored to compare costs and compatibility with possible future revisions or changes to the filter.

E. Disinfection

1. A tracer test should be conducted on the existing tank to determine if the chlorine contact time is adequate. This test should be done during the high demand period of July or August.

F. Storage Tank

1. The tank interior should be cleaned and painted. The best time of year for this work will be early fall when demand has lowered and before cold weather.

2. The exterior of the tank should be painted. This work can be done in conjunction with the interior painting or it could be done separately in the summer.

3. The overflow elevation for the tank should be checked and adjusted if necessary.

G. Monitoring

1. The Board should install a chlorine residue monitor-recorder to scan the treated water as it leaves the storage tank. This monitoring is required by the EPA.
2. The operators presently monitor filter effluent turbidity every 4 hours. This will need to be continued year round. It is recommended that a turbidity monitor recorder be installed on the filter effluent. Not only will this comply with EPA requirements, but it will provide a valuable tool in evaluating the existing system.

H. Waste Pond

i. The Board should either acquire a discharge permit or prepare to recycle the waste water. It is believed that a discharge permit will not be allowed by DEQ and thus a recycle system should be constructed. The existing pond should be cleaned, the recycle pump installed and the outlet box in the pond either repaired or replaced. The original recycle system appears to have been abandoned because the return water was of very poor quality. The water quality can be improved by adding a second pond and operating the two ponds in series. This second pond would also allow for operational flexibility for cleaning of sludge or repairs to be made. The proposed location for the second pond is shown on Figure 5.

I. Study

i. It is recommended that prior to taking action on any of the long term recommendations a study of the existing system should be performed to determine if revisions to the existing plant can be expected to meet EPA requirements and to verify that the proposed revisions are both economical and practical. This study would provide information such as the types of chemicals most likely to be required, tests on the existing plant equipment, preliminary design and cost estimates for a future expansion.
LONG TERM RECOMMENDATIONS

Long term recommendations as considered herein are for items that should be considered in order to meet future EPA requirements concerning quality of water, and to be able to meet the demands of future growth by providing the quantities required. Although most studies indicate minimal but steady growth as far as population increase for the Bridger Valley Area, there seems to be an increasing demand for connections to existing residences and businesses in outlying areas within Bridger Valley. This steady growth plus the possibility of unforeseen future growth in the area indicates the necessity of long term planning. The recommendations herein are based on the system need to comply with more stringent requirements for improved quality, set to be initiated by EPA in 1993. This would allow enough flexibility for future changes to the system to comply with future EPA requirements. The recommended long term actions are also considered based on increasing the system capacity to approximately 4 mgd. Any major revisions or additions to the system should be designed and installed keeping in mind the above long term goals of quality and quantity.

Water Rights: The Bridger Valley Joint Powers Board presently has adequate water to supply the system, even after expansion, for the period of approximately October 1 through June 1. The period of June 1 to the end of the irrigation period presently does not have adequate water rights to provide the plant a firm supply of water of 4 mgd. With the existing supplies the Board has a firm supply of approximately 2.7 mgd which includes stored water in the State Line Dam and surface flows with a priority of 1891 or earlier. In order to assure an adequate water source it is recommended that the Board continue to acquire existing water rights, particularly water rights with a priority early enough to assure a firm supply of water during the critical period of June 1 through the end of the irrigation season. They should also consider additional storage water to meet future demands. The Board has had extensive work done to locate a reservoir site for storage. The site chosen on Willow Creek, a tributary to Smith Fork River, is located such that it could receive water from both Black Fork and Smith Fork drainage. Another possibility that has been explored by the Board is to acquire additional storage in State Line Dam or storage in Meeks Cabin Dam.
Since there is adequate water rights to supply 2.7 mgd and because the peak plant flows are presently 1.6 mgd, the acquisition of additional water can be pursued over a period of years. The long term recommendations for water rights are therefore:

1. Continue to accumulate existing water rights for use in the existing system and for future storage.
2. Pursue additional storage in State Line Dam, storage in Meeks Cabin Dam and/or storage in a new reservoir on Willow Creek.

Raw Water Intake:

1. Consider placement of infiltration chambers at the intake to allow more consistent and better quality water.
2. Increase capacity of the intake transmission system to allow flows of 4 mgd. This can probably be accomplished most economically by adding a pumping system to the intake. The existing transmission pipe has adequate capacity to handle the increased pressure and the increased flow. This addition could be made with two 40 hp pumps.

Transmission Line:

1. The locations along the transmission line that are close to the river should be monitored to make sure erosion by the river is not encroaching on the pipeline. If the river does begin to encroach, a permit should be acquired from the Corp of Engineers to allow river bank stabilization; or the pipeline should be relocated.

Water Treatment Plant:

A. Control Building

1. A new or enlarged building should be constructed to allow provisions for additional chemical feeds and to provide storage (Figure 4).
2. Additional chemical feed systems should be provided.
3. The plumbing to the building and through the building should be revised.
4. Rapid mix systems within the building should be revised.
B. Flocculation:
1. A two or three stage flocculation system should be added. This can be accomplished by using the existing tank and placing one or two new basins at the head of the clarifier or by placing new basins in the clarifier and using the existing tank for other purposes. If possible, the flocculation basins should be constructed in duplicate to allow parts of the system to be shut down for clearing or maintenance.

C. Clarifier:
1. Revise the clarifier with baffles to allow the top end to be used as flocculation chambers as indicated above.
2. Add tube settlers to the existing clarifier to improve efficiency. This revision to the clarifier would require changing the sludge disposal system.

D. Filter:
1. A second filter should be added to the plant. This filter could possibly be the same type, but in an updated version, of the existing filter. This filter would be designed to meet long term goals. The location of the filter can be located as indicated in Figure 4.
2. The existing filter should be revised to allow the change of the filter media from 11 inches of sand to a dual media either 16" or 24" thick. Other revisions such as filter to waste should be added to allow this revised filter to comply with long term goals.

E. Disinfection:
1. The board should consider changing the chlorinator from 150 pound cylinders to ton containers. This should be done when the plant starts using 40 pounds of chlorine a day. When ton cylinders are used the chlorination building will have to be replaced and/or relocated to allow use of the large cylinders.
2. The chlorination system should be revised to allow the chlorine to be injected at different locations throughout the plant. This revision and the change to larger cylinders could be accomplished by including the building construction with the enlargement of the control building and the Filter Building (Figure 4).
F. Storage Tank

1. An additional storage tank or relocation of the chlorination system should be considered when the plant begins producing water in excess of 2.0 mgd to allow adequate chlorine contact time.

G. Monitoring

1. Additional daily monitoring may be required by the EPA in the future, but effective as of 1993 the items discussed under Short Term Recommendations are the ones currently not being met. As requirements change, additional monitoring may be required.

H. Waste Pond

1. A new larger wastewater pond will be required for a 4 mgd plant. This larger pond can be incorporated with that system addressed under Short Term Recommendations, and as indicated in Figure 5.

2. Chemicals for sludge treatment may be required but can be incorporated under Item A; Control Building.

I. Study

1. Prior to implementing any of these Long Term Recommendations, the Board should be sure that the revisions and changes will fit an overall plan for the upgrading of the system.

The Long Term Recommendations addressed herein can best be accomplished by conducting an in-depth study of the existing system as addressed herein, and incorporating information being addressed in the separate distribution system study. This new study should provide estimated costs, possible phasing of the project and timing for the proposed additions. With the completion of the Short Term Recommendations the existing system should operate adequately until the peak daily plant demand reaches approximately 2.0 mgd or until EPA requirements are revised making compliance impossible. The additional recommendations required are summarized herein.
June 12, 1991

Bridger Valley Joint Powers Board  
P.O. Box 295  
Lyman, WY 82937

Dear Board:

As authorized by the Bridger Valley Joint Powers Board, Uinta Engineering and Surveying, Inc. is in the process of performing a study on the existing treatment and distribution system to make recommendations to the board on necessary repairs, revisions, changes or additions to the system.

We have reviewed current EPA regulations concerning equipment and quality and are in the process of preparing a report outlining short and long range goals to meet current and pending EPA requirements. During the process of acquiring information, we have been involved in the plant operation and we have found several items concerning the equipment and operation of the system that need immediate attention. We also need some information and record keeping to allow us to make proper recommendations in the future concerning additions or changes to the system. We therefore request that the following record keeping be initiated immediately:

1. The following items be sampled on the raw water, clarifier effluent and filter effluent at 4 hour intervals.
   a. Temperature
   b. P.H.
   c. Turbidity

2. The following items be recorded whenever changes are made:
   a. Alum
   b. Polymer
   c. Chlorine
   d. Plant Flow

3. The chlorine residual and turbidity be monitored at select locations throughout the system daily.

We will provide forms for these records if this is acceptable.
In addition to record keeping, the following items should be made to the system immediately:

1. The filter sand should be changed. The sand has been ordered and should be delivered approximately 6/24/91.
2. The alum should be changed from granular to powder or liquid.
3. Baffles should be replaced in the clarifier.
4. Baffles should be placed in the floc tank to assist in coagulation.
5. The floc tank should be cleaned to allow proper changes in the alum feed.
6. The plant needs an onsite operator at least 16 hours per 24 hour day during high flows. This may change once the above repairs are made, but should be done until satisfactory water quality can be sustained.

Our final report will address items that should be considered to allow the existing system to function properly and to meet future EPA requirements. We will attempt to complete this report by the July meeting.

Sincerely,

Kenneth Walker, P.E.

KW:sj

(1990/90-20-04, pg. 1-2)
APPENDIX B
PLANT OPERATOR RECOMMENDATIONS
BRIDGER VALLEY JOINT POWER BOARD SYSTEM SUMMARY
APRIL 14, 1993

TREATMENT FACILITY CONDITION REPORT

1. Rapid Sand Filter:
   - No filter to waste capability.
   - Underdrain structure is in poor condition, there are currently 8 cells that are leaking sand and progressively deteriorating.
   - The maximum filter rate is not enough to accommodate the maximum flow potential of the plant. Filter rate G.P.M. - 1216 and maximum G.P.M. 1500.
   - Sand migration accrues in the filter bed.
   - The finish water N.T.U. spikes on each backwash between 0.4 and 1.2 N.T.U's.

2. Backwash Unit:
   - Wash to waste pump impeller is badly worn and out of balance, thus causing excessive wear on other components of the pump such as the shaft and sleeve bearings. As a result, the life of the existing wash to waste pump is limited.
   - Also the worn impeller causes sand to migrate in the filter, according to the Infilco Degremont O & M manual.

3. Static Mixer:
   - The current static mixer has minimal mixing capability even at maximum flows of 1300 G.P.M. The minimum AWWA standard for baffled inline mixers is 700 feet/sec/ft. of velocity gradient. The water control corporation's figures show that at 32 foot of head on a 14 inch diameter pipe at 1300 G.P.M. the velocity gradient delivered is 84/feet/sec/ft.

4. Pretreatment:
   - The existing flocculation and sedimentation basin does not provide adequate pretreatment to buffer sporadic daily increase in color, P.H. and turbidity, which loads the filter beyond it's capacity which results in shorter filter runs.

5. Chemical Feed System:
   - Was not adequately equipped to deal with organic loading problems that we experienced in March of this year. In the Bridger Valley Water System Study, it was recommended by Snowy Range Water Consultants that provisions to feed potassium permanganate be made in the long term goals of the current system.
   - The current chemical feed application for potassium permanganate is very hazardous because of the lack of appropriate mixing and feed equipment.

6. Chlorination:
   - The current chlorination system is only a single cylinder application, constituting a safety hazard with only one operator on duty per 8 hour shift. The facility needs a dual chlorination system, with an automatic change over valve.
Currently the facility is dosing chlorine between 2.5 to 3.0 mg/L to maintain a trace residual in the far reaching areas of the system. This practice is contributing significantly to high levels of Trihalomethane (T.H.M.) contaminants. These T.H.M. contaminants will be of major concern to the Board in 1995 when monitoring and reporting is implemented for medium and small range systems.

7. Backwash Pond:

- The northeast cell wall is leaking from the base of the pond.
- The capacity of the pond is limited and is not capable of containing the volumes of the sedimentation basin within the treatment facility, thus making it difficult to drain the basin.
- Does not provide provision to operate treatment facility while pond is drained for cleaning while discharging to the ditch illegally.

8. 500,000 Gallon Storage Tank:

- Needs to be relined in the near future to prevent excessive corrosion from occurring.

RECOMMENDATIONS FOR BOARD REVIEW

1. Monitoring:

Based on the Surface Water Treatment Rule (S.W.T.R.) of the Safe Drinking Water Act (S.D.W.A.), Amendment, 1986. A mandate has been issued for June 19, 1993. Wherein, continuous chlorine and turbidity monitoring are required. The Bridger Valley Joint Powers Board will need to have these two pieces of equipment installed and operating prior to the mandate of June 29, 1993 to avoid violations with the E.P.A.

2. Water Treatment Facility:

I feel the existing filter will have a difficult time complying with the S.W.T.R. based on the last two years finished water turbidity reports, where in May, 1992 the turbidity levels exceeded the 0.5 N.T.U. standard 30% of the total readings recorded for the month, where only a 5% margin is allowed. And March, 1993 the 0.5 N.T.U. standard was exceeded 13% of the month's readings.

Also all turbidity spikes during the backwash cycle will have to be reported when they exceed 0.5 N.T.U., because the existing filter is not designed to filter to waste after backwash, where the spike range is from 0.4 to 1.2 N.T.U. which will significantly contribute to the problem. Based on the Bridger Valley Water System Study of 1990, I quote the recommendations of Uinta Engineering & Surveying:

"The E.P.A. will lower the allowable turbidity to require that the effluent from the plant generally meet a 0.5 N.T.U. maximum. We do not believe the existing filter can comply with the revised limit.\'^1

\'^1Uinta Engineering & Surveying, Bridger Valley Water System Study, (Uinta Engineering & Surveying, 1990), p. 6
Also, Snowy Range Water Consultant states "In my opinion, the plant, as configured, cannot be counted on to meet the 0.5 N.T.U. turbidity requirement. The filter system, with 11 inches of sand offers minimum filtration capability."

3. Surface Water Quality:

Surface water characteristics such as taste and odor, high color content and cold low turbid waters are nothing new to the Smiths Fork waters, but was never addressed or equipped in the original design of the facility. These conditions change at various times of the year with various degrees of severity. The Board has been made aware of these types of conditions as early as 1989, but has always had a public relations problem resulting there from. In a letter to the Board's operator, from the D.E.Q. "We also discussed the ability of the filter to pass color and odor during certain times of the year. Your plant is not designed to remove any of the items that contribute to the problem."1

I, as Systems Manager/Chief Operator feel there needs to be a pilot study performed by a firm with demonstrated experience in implementation of the S.D.W.A. amendments, 1986 to determine the most effective and economical way of dealing with these types of water quality problems. This study should be completed as soon as possible, with preliminary designs can be made, and application for funding can be submitted by October 1, 1993.

4. Trihalomethane Reduction:

Based on 1992 unregulated Volatile Organic Compound (V.O.C.) Analysis Report, there is a strong possibility for violation in 1995 when the contaminant level is lowered from 0.1 mg/L to 0.08 mg/L. The V.O.C. report shows contaminant levels at 2.02 mg/L. To reduce the potential for contaminants the Board needs to consider placing a booster station in the far reaching areas of the system. This would greatly reduce the chlorine dosage at the treatment facility, and the risk of high T.H.M. contaminates.2

**IMMEDIATE ACTIONS**

1. Purchase and installation of continuous turbidity monitoring.

2. Purchase and installation of continuous chlorine monitoring, which entail; installation of a pump, vault and running a 2 inch line from the storage tank to the treatment plant, where the monitoring equipment would be housed.

3. Let out a request for proposal to solicit the most qualified firm to perform the pilot study.

**SHORT TERM ACTIONS**

1. Re-design existing treatment facility.

2. Apply for funding by October 1, 1993.

3. Install dual chlorination system.

---

1Snowy Range Water Consultants Letter, Uinta Engineering and Surveying, (July 8, 1991), p.4 General Comments


3Volatile Organic Compound Analysis Report, (June 8, 1992)