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**Mailing Address:**
Water Resources Data System
University of Wyoming, Dept 3943
1000 E University Avenue
Laramie, WY 82071

**Physical Address:**
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

**Phone:** (307) 766-6651  
**Fax:** (307) 766-3785

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CASPER RAW WATER PROJECT

prepared for

Casper Parks Department
Casper, Wyoming

by

Wyoming Water Development Commission

November, 1987
Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Map</td>
<td>ii</td>
</tr>
<tr>
<td>Purpose of Study</td>
<td>1</td>
</tr>
<tr>
<td>Water Rights and System Ownership</td>
<td>1</td>
</tr>
<tr>
<td>System Description and Current Problems</td>
<td>4</td>
</tr>
<tr>
<td>Current Studies</td>
<td>6</td>
</tr>
<tr>
<td>Alternatives</td>
<td>7</td>
</tr>
<tr>
<td>Cost Estimates</td>
<td>9</td>
</tr>
<tr>
<td>Financial Analysis</td>
<td>10</td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>12</td>
</tr>
</tbody>
</table>
PURPOSE OF STUDY

On September 5, 1986, the city of Casper submitted an application to the Wyoming Water Development Commission for assistance in conducting a Level II evaluation of the existing Elkhorn Creek storage and transmission facilities. The existing Elk Horn/Sage Creek system has been used to provide irrigation water to the golf course, municipal parks, a cemetery, and the State Children's Home. The work was to include: the evaluation of the condition of 20,000 feet of existing pipeline; the legal and physical availability of water from Elkhorn Creek; an analysis of the condition of Sage Creek Reservoir; the potential for enlarging Sage Creek Reservoir; and obtaining the proper permits for the Golf Course Reservoir. Improvements to the facilities in the Elkhorn/Sage Creek system would reduce the demand on the city's water treatment plant by supplying raw water to city owned green space.

The application was accepted by the Commission, and approved by the Governor for inclusion in the 1987 Water Development Program to be presented to the legislature. However, the authorizing legislation became enmeshed in legislative dispute, and no funds were appropriated for this or other projects in the package.

In order to advance the project as far as possible with the limited resources available, the WWDC staff analyzed water availability and make a reconnaissance level determination of the condition of the existing dam and the potential for rehabilitation or enlargement of the structure. To this end, the staff asked the City Parks Department to acquire and install water meters at key points on the existing transmission lines.

WATER RIGHTS AND SYSTEM OWNERSHIP

The city of Casper obtained certain water rights on Elkhorn Creek many years ago. One of those water rights has a priority of March 1994 for 1.28 cubic feet per second (cfs), of which the city of Casper secured 0.6 cfs in 1894. The city of Casper constructed a waterline from Elkhorn Creek to the city of Casper in 1896, the purpose of which was to supply the city of Casper with municipal water, and in so doing, the city relied on its rights purchased in 1894. Subsequent to that time, the city of Casper applied for, and obtained, an appropriation under Permit Number 7304, with a priority of July 9, 1906, for 5.5 cfs of water for municipal purposes and for reservoir supply for the city of Casper Reservoir (Sage Creek Reservoir). In addition, and at the same time, the city of Casper received Reservoir Permit Number 879 for the city of Casper Reservoir (Sage Creek Reservoir), with the same priority date of July 9, 1906, for 70.6 acre-feet of water for storage coming from both Elkhorn Creek and Sage Creek.

The city of Casper apparently did complete the city of Casper Reservoir Ditch, although its use was discontinued some time ago. The city of Casper constructed and used the Sage Creek Reservoir for many years for storage of water for municipal purposes. In 1951, the city of Casper entered into an agreement with the State of Wyoming Board of Charities and Reform (BCR), in
which the city of Casper assigned to the BCR Sage Creek Reservoir. Included in the assignment was the dam structure and appurtenances, including the eight-inch reservoir pipes from the dam to its junction with the Elkhorn Creek pipeline. The BCR in effect became the owner of Sage Creek Reservoir as constructed under Permit Number 879. The agreement between the BCR and the city also reserved to the city of Casper the right to use the reservoir for discharge of any and all excess waters from its Elkhorn Creek water supply system, and the right of the city of Casper to use any and all waters stored in the reservoir in excess of .47 cfs. The city thereby assigned .47 cfs from the water stored in the reservoir, so long as it would be beneficially applied, to the Youth Treatment Center, a BCR facility. The BCR applied for and received Permit No. 5908 Res., in 1952 for a 29.65 acre-foot enlargement of the reservoir with Sage Creek as its source.

Sometime after the 1951 agreement, the city of Casper discontinued the use of a portion of Elkhorn Creek Pipeline which goes directly from Elkhorn Creek to the city of Casper, and began diverting a majority of the water into the Sage Creek Reservoir by way of a lateral pipeline off the city Elkhorn Creek pipeline. This practice still continues.

The sources of water stored at Sage Creek Reservoir are the natural runoff from the Sage Creek drainage above the reservoir, and water which is piped into the reservoir from Elkhorn Creek. It is my understanding that a majority of the water stored in the reservoir comes from the Elkhorn Creek pipeline.

As mentioned above, the city of Casper Reservoir Ditch was constructed and used. However, some years ago, the use of the ditch was discontinued and the Elkhorn Creek Pipeline was used to convey water from Elkhorn Creek into the reservoir rather than the ditch. The direct flow use of water for municipal purposes in Casper was adjudicated by the Board of Control. However, the storage supply portion of the permit was not adjudicated. Under the current usage, direct flow water for Casper is conveyed from Elkhorn Creek into the reservoir then onto the city in its pipeline facilities. Water stored in the reservoir is used by the Youth Treatment Center and by the city under the city/state agreements.

In the April 26, 1951 agreement with the city, it was noted that in case the Youth Treatment Center may be removed from Casper or its operation terminated, or the State Board neglect the maintenance of the reservoir and its appurtenant works, it should revert to the city. The agreement also contains certain other provisions relative to the operation of the reservoir and pipelines.

On June 1, 1952, the State Board of Charities and Reform signed an agreement with the Casper Community Golf Course Association providing:

1. The BCR allows the Golf Course Association the use of the excess water in storage at the Sage Creek Reservoir over and above the requirements of the Youth Treatment Center Tract, subject to the following restrictions and limitations:
   a. The maximum amount to be diverted on the Golf Course in any calendar year shall be 8.5 acre-feet during period May 1 to November 1.
b. Maximum diversion rate shall be 150 gallons per minute (0.33 cfs) in order that a residual pressure shall be available to operate the sprinkling system at the Youth Treatment Center.

2. Excess water defined as the amount of water in storage over and above the amount to satisfy the prior irrigation requirements for the Youth Treatment Center and the allowance for evaporation and seepage loss from the reservoir and shall be the amount of water in storage above certain minimum water elevation on specified dates referred to the crest of reservoir spillway. (These range from El. 99.2 on May 1 to E. 83.8 on October 15).

3. Golf Course agrees to install accurate meter to determine amount of water used at Golf Course take-off.

By the agreement with the Golf Course Association, the BCR would have remaining a flow of 0.14 cfs of water which, at rate of 1 cfs for 70 acres, is sufficient for the irrigation of 9.8 acres of land, providing sufficient water is in storage. Irrigation at this rate for 120 days would require 33.6 acre-feet.

In April of 1981 the State Board of Charities and Reform by a quitclaim deed for 7.15 acres reverted back to the city, a site to be used for a cemetery. In essence this agreement allowed the State Board of Charities and Reform to use the Youth Treatment Center land for any purpose which supersedes the conditions noted in the deed of 1935 between the Children's Home and the city of Casper. Furthermore, because of this agreement the water flow to the Board of Charities and Reform was reduced to .364 cubic feet of water instead of .47 cubic feet of water stored in the Sage Creek Reservoir.

At the time of the regular meeting of the State Board of Charities and Reform held October 1, 1984, motion was made and carried to have the Board of Charities and Reform join the city of Casper's petition before the State Board of Control concerning the Elkhorn Creek and Sage Creek Reservoir water rights.

Essentially, the need for the petition arises because water rights which have been used by the Board of Charities and Reform at the Youth Treatment Center in Casper for a significant period of time have never been properly adjudicated. Specifically, in the 1800's, water rights were deeded to the Children's Home; however, there has never been any formal Board of Control approval of this conveyance. Therefore, joining in the petition constitutes little more than a housekeeping activity so that the records of the State Engineer will be amended accordingly. This matter is in no manner connected with any other water rights litigation in which the city is involved.

As of November 1, 1987, the enlargement of Sage Creek Reservoir (Permit No. 5908 Res.) is still unadjudicated.

It is apparent that the State of Wyoming, through the Board of Charities and Reform, maintains an active interest in the Sage Creek system and shares some measure of responsibility for the condition of the dam.
In personal conversations with Morris Gardner of the BCR and Mike Guy of the Youth Treatment Center, interest was expressed in again obtaining irrigation water through the Sage Creek system.

SYSTEM DESCRIPTION AND CURRENT PROBLEMS

The existing irrigation storage and transmission system consists of facilities that date back to 1896, and includes the Elkhorn Creek Diversion, Elkhorn Creek Pipeline, Golf Course Pipeline, Children's Home Pipeline, Sage Creek Reservoir, and the Golf Course Reservoir. Historically, these facilities have been used to provide irrigation waters to the city golf course, Highland Park and Cemetery, and the State Children's Home.

Elkhorn Diversion

The Elkhorn Creek Diversion is located on the West Fork of Elkhorn Creek in the SW1 of Section 34, Township 33 North, Range 79 West. The diversion consists of a screened pipe located in a small pond created by a rock diversion dam. A valve is located immediately downstream of the diversion dam and is used for the flushing of sediments that accumulate upstream of the dam. The diversion pipe is an 8-inch pipe equipped with a valve and flow meter. The facilities were constructed in 1896 and are used to divert water between April 15 and September 30.

The existing diversion is operational, however, the screen is damaged and sedimentation frequently blocks the diversion. The diversion needs some minor rehabilitation.

Elkhorn Creek Pipeline

The original pipeline was constructed by the city of Casper in 1896. The pipeline is approximately 20,000 feet in length and extends from the diversion structure to the Casper Reservoir. The pipeline was constructed of 8-inch steel from the diversion structure to the abandoned filtration plant (9000 feet) and 6-inch cast iron (11,000 feet) from the filtration plant to Casper Reservoir. In 1925, the city constructed 2000 feet of 12-inch steel pipeline from the Elkhorn Creek Pipeline at the abandoned filtration plant to Sage Creek Reservoir which was constructed in 1906. The 6-inch cast iron pipe was abandoned in 1951.

This pipeline has experienced numerous leaks in recent years. In some instances the leaks were a result of shallow depth of cover, corrosion and inability to drain some sections. Considering the pipe is steel, is over 90 years old, and is located in corrosive soils, the study concludes that the pipeline should be abandoned or replaced. It has no remaining useful life and would continue to allow water losses if incorporated into a new or rehabilitated system in its present condition.

Golf Course Pipeline

The Golf Course Pipeline extends from Sage Creek Reservoir to the Golf Course Reservoir and consists of 2,750 feet of 8-inch cast iron pipe and 9,850 feet of 7-inch O.D. riveted steel pipe with leaded joints. This pipeline was constructed in 1925. Historically, the city used the Golf
Course Pipeline to fill the Golf Course Reservoir when the Children's Home was not irrigating.

The Golf Course Pipeline is in very poor shape. In the last few years over 30 breaks have been repaired. The pipeline was installed in soils that are very high in sulfides and has experienced severe corrosion. This pipeline should also be replaced, as it will continue to be a source of problems and water loss.

Children's Home Pipeline (Now known as the Youth Treatment Center)

The 6,400 feet of 6-inch cast iron pipeline from the golf course to the Children's Home was constructed in 1952 by the State Board of Charities and Reform. The line was abandoned in 1986, and a tap on the BPU waterline was installed. Reported, the line is not suitable for repair. Casper Parks and Recreation Department and the BCR have discussed delivery of Sage Creek system water to the Youth Treatment Center via a new BPU pipeline to the Highland Park Cemetery. Approximately 1,000 feet of additional 4-inch line would be required to serve the Youth Treatment Center, depending on the location of taps on the Parks Department line.

Sage Creek Reservoir

Sage Creek Reservoir is located in Section 27, Township 33 North, Range 79 West just south of Wyoming Boulevard. The dam was constructed between 1906-1908 and the original reservoir capacity was 70.6 acre-feet. The dam was enlarged in 1952 and the reservoir capacity was increased to 100.25 acre-feet. The reservoir receives water from the Sage Creek basin (Drainage Area = 1 mi²) and from the Elkhorn Creek Pipeline.

Sage Creek Reservoir is in very poor repair. Some of the problems which were cited by the State Engineer's Office Safety of Dams' inspection are as follows:

1. Practically the entire face of the dam is covered with trees, brush, and other debris.

2. A total of 23 auto bodies were counted in the face of the dam. The auto bodies were placed in the face of the dam by the city in 1973. Fill material was placed at that time over the automobiles. However, significant embankment erosion has occurred since then and the majority of the vehicles are exposed.

3. The top of the dam is impassable to vehicular traffic due to trees, fences and erosion.

4. The top four or five feet of the upstream slope is severely eroded due to wave action. The erosion extends into the dam several feet at places, reducing the width of the top of the dam at these points to less than seven or eight feet.

5. The downstream slope of the dam has signs of slumps and settlement in some areas, indicating that seepage is occurring.
6. A small existing reservoir downstream of Sage Creek Reservoir immediately north of Wyoming Boulevard has remained full in the past several summers. Water has rarely breached the spillway at Sage Creek Reservoir. This indicates seepage underneath the dam. According to the inspection report these problems appear to have developed over a long period of time.

Golf Course Reservoir

The Golf Course Reservoir is located at the Casper Municipal Golf Course on Oakcrest Avenue. It has an estimated storage capacity of 13 acre-feet. The reservoir receives water from Sage Creek Reservoir via the Golf Course Pipeline and from an 8-inch tap located on a BPU water line.

A more detailed description of system components and conditions, water rights and availability, use and demand, and system alternatives will be found in the 1986 HNTB report.

There is an area of seepage below the left abutment of the dam. Some rehabilitation is needed to solve the seepage problem. A water right application needs to be filed. In order to file for a water right, considerable data collection must be undertaken. Geotechnical evaluation (boring) of the dam would be required.

The existing data indicates the entire system needs rehabilitation in order to remain functional.

CURRENT STUDIES

Elkhorn Creek and Golf Course Pipelines

The first objective undertaken in 1987 was determine the amount of water lost from the pipeline. The city purchased and installed 8 flow meters along the pipeline route. The meters were observed in August. At that time, the meter at the diversion structure was operating and indicated a flow of 700 gpm in the pipe. This exceeded visual estimates of streamflow at the diversion. The other meters along the pipeline registered flows ranging from zero at the old filtration plant to 1000 gpm just above the Golf Course Reservoir. The flow entering Sage Creek Reservoir could not be determined since the meter was not operating properly.

The outflow from the Golf Course Pipeline into the Golf Course Reservoir was approximately 730 gpm. This estimate was derived using physical measurements taken at the outfall. The flow meter just upstream of the outfall registered 1000 gpm and the second meter upstream of the outfall registered 700 gpm.

The inconsistency of the meter readings is due to the type of meter used. The meters were propeller type requiring a full pipe to accurately measure the flow. Since the pipe was not flowing full at all locations, no reliable information was collected and the study could not accurately assess pipeline losses.
Sage Creek Reservoir

A reconnaissance evaluation of the dam revealed the same problems as previously defined by the SEO inspection. The stability of the dam is questionable.

The study concluded that the dam needs to be reconstructed or breached. The upstream face is in poor condition. Enough material has eroded away to leave a vertical face. This could be corrected by importing fill and reconstructing the upstream face. Reconstruction of the upstream face would not solve the seepage problem, or the slump problems on the downstream face. The conservative approach would be to remove the existing structure and rebuild a new dam with seepage control measures.

In regards to enlarging the reservoir, the study indicates that Sage Creek produces 300 acre-feet/year, and West Elkhorn Creek produces approximately 500 acre-feet/year, on the average. In 1984, the city used approximately 150 acre-feet from West Elkhorn Creek at an average diversion rate of 0.45cfs (202 gpm).

Some additional storage could be justified based on Sage Creek flows, however it would be quite small. As far as diverting more water from the West Fork of Elkhorn Creek, it appears that a new water right would probably not be able to divert except during high runoff years. The Elkhorn Creek drainage has existing direct flow rights of 28.38 cfs and storage rights totaling 280 acre-feet. This can be compared to the average annual flow of Elkhorn Creek which is approximately 3.7 cfs or 2600 acre-feet/year.

Enlarging the dam may be hampered by the location of a residence on the right abutment. Any enlargement would require a relocation of that residence.

If the dam is to remain in operation, it appears that rehabilitation is necessary to insure the safety of downstream areas.

ALTERNATIVES

Alternatives that are available are the rehabilitation of the existing system, modifying the existing system, or abandonment of the system. Some of the options that are available include:

1. Replace entire system

Since the pipelines are extremely old, they could be replaced without any further data collection. This alternative would also include the rebuilding of Sage Creek Dam.

2. Replace pipelines, abandon Sage Creek Reservoir

The Elkhorn Creek and Golf Course Pipelines would be replaced with a new pipeline that extends from the diversion to the Golf Course Reservoir. Sage Creek Reservoir would be abandoned. This would result in less irrigation water and more demand on the BPU system.
3. Replace Sage Creek Reservoir, further study of pipeline

Appropriate flow meters would be installed and the results monitored to determine if individual sections of pipe could be replaced in lieu of full replacement. This option would include the rehabilitation of Sage Creek Reservoir.

4. Abandon Sage Creek Reservoir, further study of pipeline

This is the same as alternative three except a bypass around Sage Creek Reservoir would be installed. Sage Creek Reservoir would be abandoned. The same drawbacks as described in alternative two would apply.
Casper Raw Water Project Cost Estimates

The following represents reconnaissance level cost estimates for various aspects of the project.

A. Abandon Sage Creek Dam and Reservoir

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Excavation of Dam (86,000yd³)</td>
<td>$100,000</td>
</tr>
<tr>
<td>Clearing (trees, car bodies, etc.)</td>
<td>10,000</td>
</tr>
<tr>
<td>Reclamation (15 acres)</td>
<td>75,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$185,000</strong></td>
</tr>
</tbody>
</table>

Use $200,000

B. Remove existing dam and build a new dam with the same length and height

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Excavation (86,000yd³)</td>
<td>$100,000</td>
</tr>
<tr>
<td>Embankment (riprap, cutoff, etc.) (122,500yd³)</td>
<td>430,000</td>
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<tr>
<td>Mitigation</td>
<td>75,000</td>
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<tr>
<td>Clearing (trees, car bodies)</td>
<td>10,000</td>
</tr>
<tr>
<td>Outlet, valves, spillway</td>
<td>50,000</td>
</tr>
<tr>
<td>Care of stream</td>
<td>25,000</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$690,000</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Contingency (20%)</td>
<td>138,000</td>
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<tr>
<td>Engineering and Construction (18%)</td>
<td>124,500</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$952,500</strong></td>
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Use $950,000

C. Replace Pipelines

1. West Elkhorn Creek to filtration
<table>
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<tr>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>9,000 feet of 8-inch line</td>
<td>$216,000</td>
</tr>
<tr>
<td>Contingency, valves, meters (10%)</td>
<td>21,600</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$237,600</strong></td>
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</tbody>
</table>

Use $238,000

2. Filtration plant to Sage Creek Reservoir
<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000 feet of 12-inch line</td>
<td>$ 72,000</td>
</tr>
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<td>Contingency, etc.</td>
<td>10,000</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$ 82,000</strong></td>
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</tbody>
</table>

Use $82,000

3. Sage Creek Reservoir to golf course
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<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>9,850 feet of 8-inch line</td>
<td>$236,400</td>
</tr>
<tr>
<td>Contingency, etc.</td>
<td>23,640</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$260,040</strong></td>
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</table>

Use $260,000

In addition, some work will be needed at the diversion structure. Use $10,000.
FINANCIAL ANALYSIS

In order to evaluate the economic feasibility of rehabilitating the Elkhorn/Sage Creek Raw Water Irrigation System, the annual cost of water acquired from a rehabilitated Sage Creek system will be compared with the cost of obtaining water from an alternative source.

This analysis is complicated by several factors:

1. The total annual firm yield of a reconstructed Sage Creek system is unknown. Records of the existing system are available for only one year. In that year, approximately 48 million gallons were diverted into the system. No records are available to indicate the actual amount delivered after system losses such as leaks, evaporation, etc. For this analysis, it will be assumed that a rehabilitated system will deliver 50 million gallons annually.

2. The annual costs of repaying a construction loan for rehabilitating the Sage Creek system will remain constant over the 35 year loan period. Costs of obtaining water from alternative sources may escalate at an unknown rate during that same period.

3. No consideration will be given in this analysis to the potential economic benefits gained by the joint owners resulting from the elimination of an unsafe dam.

4. Annual cash benefits to the city of Casper will be based on an estimated cost of water from alternative sources of $125 per acre-foot, and a water treatment cost estimated at $.95 per 1,000 gallons.

Repayment costs and estimated benefits will be calculated to determine the actual costs to the project sponsor based on current WWDC funding policies, and to determine the total combined cost to the sponsor and the state.

The analysis will be based on the costs of replacing the entire system, including reconstruction of the Sage Creek Dam. Other alternatives would be less expensive, but system yields would be reduced by an unknown amount.

Repayment cost calculations are based on current WWDC funding policies for rehabilitation projects.

Cost Estimates:

1. Rebuild dam $ 950,000

2. Pipelines
   a. Diversion to old Filtration Plant 238,000
   b. Filtration Plant to Sage Creek Reservoir 82,000
   c. Sage Creek Reservoir to Golf Course 260,000

3. Rehabilitation of Diversion Structure 10,000

TOTAL PROJECT COST $1,540,000
Repayment Calculations

Costs

1. Total Project Cost $1,540,000
2. 50% WWDC Grant (non-reimbursable) $770,000
3. 50% WWDC Loan (35 years at 4%) $770,000
4. Annual Payment $41,255
5. Annual Cost to Casper per 1000 gal. (Assumes 50,000,000 gallons or 150 acre-feet annual project yield) $.83

Cash Benefits

1. Annual cost savings from not breaching the dam ($200,000 at 4% for 35 years) $10,700
2. Annual cost savings, water purchase (150 acre-feet x $125/acre-foot, $.38/1,000 gal.) $18,750
3. Annual cost savings, water treatment ($ .95 per 1,000 gal x 50,000,000) $47,500
   TOTAL ANNUAL CASH BENEFITS $76,950
   (to city of Casper)

Non-Cash Benefits

1. The city and state retain a 100 acre-foot storage right of early priority on the North Platte River. The storage right could not be transferred or retained if the dam is breached.

2. By replacing the dam, the city and state reduce the liability associated with joint ownership of an unsafe dam.

3. In an emergency situation, the Sage Creek system can supply water into Casper's treatment plant and potable water system.

4. There is the potential for recreational benefits if the city allows public access to the reconstructed reservoir.

5. The demand on Casper's current water supply and treatment system will be reduced by 150 acre-feet per year. If Casper sells an equivalent 150 acre-feet of treated water to another entity at the current rate of $.91 per 1,000 gallons, an additional cash benefit of $45,500 would be realized.
CONCLUSIONS AND RECOMMENDATIONS

1. A prompt response should be made to resolve the safety problems at Sage Creek Reservoir. While failure of the dam does not appear to be imminent, there is a potential for extensive damage, and liability to the city, if the dam condition continues to deteriorate and eventually fails.

2. Benefits are approximately equal to annual costs. Non-cash benefits provide an additional incentive to proceed with additional project studies. Reduction of potential liability justifies state grant participation.

3. There is inadequate water supply to support an enlargement of the reservoir.

4. The Board of Charities and Reform should participate in future project planning and construction activities as a co-sponsor with the city of Casper.

5. The project should be advanced to Level II, Phase II.