DEER CREEK — LEVEL III
EXECUTIVE SUMMARY

PREPARED FOR
WYOMING WATER DEVELOPMENT COMMISSION

NOVEMBER 1984

BANNER

BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS
620 PLAZA COURT • P.O. BOX 550 • LARAMIE, WY 82070 • (307) 745-7366
CONSULTANT

Banner Associates, Inc.
Consulting Engineers & Architects
620 Plaza Court
P.O. Box 550
Laramie, Wyoming 82070
(307) 745-7366

SUBCONSULTANTS

Chen and Associates, Inc.
Consulting Geotechnical Engineers
900 East “F” Street
Casper, Wyoming 82601
(307) 234-2126

Boyle Engineering Corporation
Consulting Engineers
165 South Union, Suite 200
Lakewood, Colorado 80228
(303) 987-3443

J. Barry Cooke, Inc.
Consulting Engineer
1050 Northgate Drive, Suite 400
San Rafael, California 94903
(415) 479-6151

Western Research Corporation
Economic Consultants
512 University
Laramie, Wyoming 80270
(307) 742-8295

Horizons, Inc.
Aerial Surveying & Mapping
P.O. Box 3134
Rapid City, South Dakota 57709
(605) 343-0280
DEER CREEK - LEVEL III

EXECUTIVE SUMMARY

Prepared For

WYOMING WATER DEVELOPMENT COMMISSION
Cheyenne, Wyoming

Walter J. Pilch, Chairman
James Noble, Vice-Chairman
William J. Kirven, Jr., Secretary
Lewis Freudenthal
Kenneth Kennedy
J.W. Wes Myers
Willard C. Rhoads
Merl Rissler
Nelson E. Wren, Jr.

Michael K. Purcell, Administrator
Victor E. Anderson, Project Manager

November, 1984
# TABLE OF CONTENTS

1.0 Introduction  
1.1 Project Authorization ............................................... 1  
1.2 Nature and Purpose of Study ......................................... 1  
1.3 Project Setting ....................................................... 2  

2.0 Summary of Level III Findings  
2.1 Hydrology .................................................................. 3  
2.2 Geological/Geotechnical ............................................... 4  
2.3 Evaluation of Alternate Dam Configurations .................... 5  

3.0 Conceptual Design of Selected Alternate  
3.1 Conceptual Design ....................................................... 7  
3.2 Cost Estimates ........................................................... 8  

4.0 Hydropower Feasibility Investigation .............................. 9  

5.0 Permits and Land Acquisition  
5.1 Permits ...................................................................... 10  
5.2 Land Acquisition/Easements ......................................... 10  

6.0 Economic Analysis ........................................................ 11  

7.0 Recommendations .......................................................... 12  

Plates  
Plate 1 - Vicinity Map  
Plate 2 - Dam and Reservoir Layout Map  
Plate 3 - Concrete Face Rockfill Dam Layout Plan  
Plate 4 - Concrete Face Rockfill Dam Details  
Plate 5 - Outlet Works  
Plate 6 - Spillway Layout Plan  
Plate 7 - Spillway Detail  
Plate 8 - Project Access Roads (2 Sheets)
1.0 INTRODUCTION

1.1 PROJECT AUTHORIZATION

The Forty-Seventh Legislature of the State of Wyoming (1984 Budget Session) authorized and directed the Water Development Commission to prepare development plans, as defined in W.S. 41-2-114, and in Chapter 52 (1984 Session Laws) for the Deer Creek Level III project. The stated purpose of the Deer Creek project is defined as:

"...To provide flood control and additional water to municipalities along the North Platte River including Casper, Evansville, Douglas, and Glenrock..."

1.2 NATURE AND PURPOSE OF STUDY

The Deer Creek project has been evaluated on several different occasions and by many entities, both private and public, as a source of supply for municipal, industrial, and agricultural interests, as well as flood control. Projects have been investigated since the mid-1950's to the present. Most recently, the State of Wyoming through its Water Development Commission, prepared a Level II feasibility-grade report. As a result of the favorable findings contained in that report, the project was advanced to Level III for development of a conceptual design, and eventually construction plans and bid documents if the project is approved for construction funding.

Investigations and evaluations were undertaken in the Level III study to provide more detailed information for the Water Development Commission. These investigations and evaluations were conducted to provide adequate information to the Commission so that it can determine whether or not to proceed with development of construction plans and documents, and eventually to construction. These investigations and evaluations include:

- Hydrological investigations
- Development of project operating costs
- Evaluation of alternate dam types and configurations
- Cost estimates
- Hydropower evaluation
- Evaluation of geological/geotechnical design criteria
- Economic analysis
- Permitting and land acquisition requirements

Also, additional data were collected in order to proceed with final design. These data include:

- Surveying and mapping
- Geological/Geotechnical investigations
- Water quality background information
- Economics data
- Miscellaneous data acquisition for design consideration

The culmination of these activities was the development of a conceptual design for the Deer Creek Project. The conceptual design presents design criteria, facilities sizing, and preliminary sketches (or narrative descriptions) of the recommended dam type and project configuration. Also, detailed cost estimates, cashflows, and construction schedules were prepared.
A summary of the findings of the Level III investigations and data collection activities are contained in this document, the Executive Summary. Also, an Interim Report and Design Concept Report (both reports in one document), along with Appendices, was prepared and submitted to the Water Development Commission. The Interim Report and Design Concept Report provides considerably more detail than presented herein and serves to substantiate the conclusions made in the Executive Summary.

1.3 PROJECT SETTING

Deer Creek is a tributary of the North Platte River and its drainage basin lies in central Wyoming south of the Town of Glenrock, (see Plates 1 and 2, located at the end of this report). The proposed Deer Creek Dam and Reservoir are located in the Laramie Range and are situated at the south end of lower Deer Creek Canyon. Access to the dam site is approximately 23 miles from Casper via the Hat Six and the Negro Hill Roads.

The dam will be located in the Section 11, T31N, R77W. The proposed reservoir will inundate approximately 1,055 acres of land. The existing land use is grazing. The dam site and a portion of the reservoir are located on BLM land. The reservoir will also inundate lands owned by the State of Wyoming, True Ranches, and the Banner Ranch.
2.0 SUMMARY OF LEVEL III FINDINGS

2.1 HYDROLOGY

Deer Creek is a tributary of the North Platte River with its watershed located in the Laramie Mountains. The mouth of Deer Creek is located at Glenrock where the USGS has maintained a stream gaging station with an almost continuous record since the mid-1910's. A study period of 1928 through 1983 was stipulated by the Commission for the Deer Creek Level III Study. The historical flows of Deer Creek at Glenrock have averaged 42,840 acre-feet per year for the period of record. Flows of Deer Creek near the proposed dam site have not been recorded except for a five-year period from 1947 through 1951. Flows at the proposed dam site were estimated using correlation techniques with historical flows at the mouth of Deer Creek and are estimated at an average of 39,350 acre-feet per year over the study period.

Water supply needs that could be met by the proposed Deer Creek Reservoir include irrigation, industrial, and recreational uses, but current emphasis centers around municipal demands. Communities that could benefit include Glenrock, Casper, Mills, Evansville, Douglas and other communities along the North Platte River. Historical use of Deer Creek water has mainly been for irrigation. Under existing conditions, without reservoir storage in the drainage, even the most senior rights experience shortages by late July. Historically irrigated lands downstream of the proposed reservoir that could benefit from a supplemental supply from reservoir storage include approximately 2,888 acres. Other potential users may include industrial water users, although none have been specifically considered in this study.

In order to analyze the water supply and required storage, the Deer Creek Reservoir Operation Study computer model was developed. The operation study was used to analyze two alternatives: 1) regulation of Deer Creek Reservoir for Deer Creek water rights only, and 2) regulation of Deer Creek Reservoir with consideration of downstream water rights on the North Platte River in Wyoming. Regulation for Deer Creek rights was based on the actual irrigated acreage of 2,888 acres downstream of the dam site. The Deer Creek operation study, using the first alternative (regulation of Deer Creek Reservoir for Deer Creek water rights only) indicates a firm annual yield of 22,500 acre-feet for a reservoir capacity of 65,785 acre-feet could be developed.

The operation of the North Platte River system is very complex and was simulated in a separate computer model known as the "North Platte River Management Model" (NPRMM). The NPRMM generated a table of estimated surplus (in excess of existing rights) water which was then incorporated into the Deer Creek model in order to analyze the second alternative described above. The results indicate that if the proposed Deer Creek Reservoir is regulated to North Platte water rights, the amount that can be stored is severely limited and maximum carry-over storage is required. Under the second alternative a reservoir capacity of 65,785 acre-feet would provide a firm annual yield of approximately 5,300 acre-feet.

Preliminary results of the Deer Creek studies were discussed with representatives of the State Engineer's Office and the Wyoming Water Development Commission. These discussions resulted in the conclusion that the operating criteria should be based on regulation to North Platte priorities. Based on that assumption, a reservoir of 65,785 acre-feet capacity is recommended to maximize carry-over storage with an estimated firm annual yield of 5,300 acre-feet based upon water availability for the period 1928 through 1983.
The study period of 1928 through 1983 includes two severe drought periods; namely July 1933 through March 1942 and June 1952 through April 1964. A low flow duration-frequency analysis was conducted to estimate the frequency of the historical drought periods and to estimate probable reservoir yields under droughts of various frequencies. The return periods for the two worst recorded droughts were estimated to be:

<table>
<thead>
<tr>
<th>Drought Period</th>
<th>Duration (Years)</th>
<th>Total Flow (Acre-Feet)</th>
<th>Estimated Return Period (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 1933 - March 1942</td>
<td>8.8</td>
<td>8,600,000</td>
<td>100</td>
</tr>
<tr>
<td>June 1952 - April 1964</td>
<td>11.9</td>
<td>11,500,000</td>
<td>400</td>
</tr>
</tbody>
</table>

Recognition of the impact of the historical drought periods indicates that the annual yield of 5,300 acre-feet may be an underestimate of the reservoir yield under the second alternative. A more reasonable firm annual yield estimate was obtained assuming the period of simulation includes the 100-year drought instead of the 400-year drought. The estimated annual yield is increased to 9,600 acre-feet if the 100-year drought is assumed. However, the lower yield has been used for more conservative results.

Flood analysis for the Deer Creek Reservoir site was based on the PMF (Probable Maximum Flood) for the design of the flood surcharge pool and spillway. The PMF is estimated to be 73,658 cfs (cubic feet per second) inflow to Deer Creek Reservoir. Various spillway configurations were evaluated to optimize factors such as spillway location, costs, and flood reduction. The recommended spillway width is 150 feet which will require a flood surcharge of approximately 20 feet. The PMF will be attenuated from the peak inflow of 73,658 cfs to a routed outflow of 46,958 cfs.

The 100-year flood analysis at the reservoir site was based on the historically observed flood at Glenrock since the observed flood exceeded estimated floods of this frequency. A flood with a peak flow of 12,800 cfs was transposed to the drainage above the dam site and then routed through the recommended spillway. The proposed Deer Creek Reservoir would reduce the outflow from the 100-year flood to a peak of 5,772 cfs immediately below the dam and would result in a peak flow at Glenrock of 4,949 cfs. However, the storm that generated the historically observed flood in 1965 was centered downstream of the proposed dam site — very little flood reduction could have been provided during this event by the construction of the Deer Creek Project.

### 2.2 GEOLOGICAL/GEO的技术

A detailed field investigation effort was performed during the late summer and fall 1984 to define surficial and subsurface geologic conditions at the Deer Creek Dam and Reservoir sites. The field investigation also concentrated on the availability of construction materials to construct the dam and appurtenant structures.

The dam and reservoir sites are suitable for the proposed project. The geologic and foundation conditions at the dam site are suitable for the construction of a rockfill dam with a concrete face, a rockfill dam with an impervious earth core, an earthfill embankment, a concrete gravity dam, or a roller compacted concrete dam. The geologic and foundation conditions at the site are not suitable for the construction of a thin arch concrete dam because of the depth of weathering and the shear zones in the rock on the abutments which result in highly variable rock deformations.

The geologic and foundation conditions in the valley bottom at the dam site are suitable for the construction of either a cut and cover conduit or a tunneled outlet works. The rock conditions in both abutments are suitable for the excavation of an unlined, overflow spillway. The planned
overflow spillway on the left abutment will require curtain grouting and remedial concrete work at
the crest. Potential under-seepage through the dam foundation will require curtain grouting for all
types of dams being considered. Sufficient rock is available from required excavation and in
potential quarries within the dam site area to provide sufficient construction materials for the two
types of rockfill dams and the concrete aggregate for the two types of concrete dams being
considered. Within the reservoir area, sufficient earthfill materials are available for construction
of an earthfill embankment dam, the impervious earth core of a rockfill dam, and, with processing,
for the construction of the required filter and drainage blankets for both types of dams.

2.3 EVALUATION OF ALTERNATE DAM CONFIGURATIONS

Several types of dams and project configurations were identified and the most promising
alternates evaluated. The project configurations which were evaluated include:

- Concrete face rockfill dam
- Earth-core rockfill dam
- Earthfill dam
- Roller compacted concrete (RCC) dam
- Concrete gravity dam
- Thin arch concrete dam

Three dam configurations were investigated and subsequently eliminated. The earthfill and
congee gravity dams were eliminated due to the high cost of these alternatives. The thin arch
congee dam was eliminated due to inadequate foundation and abutment conditions to safely
adopt this type of dam.

Three other dam configurations were found to be feasible from the standpoint of engineering
and construction feasibility, cost, and materials availability. Construction cost estimates were
prepared for each of these alternate dam configurations. The configuration analysis cost
estimates were based upon costs that were comparable for the three configurations and did not
include inflation to 1986, engineering and administrative costs, and contingencies, also
miscellaneous costs that are the same regardless of type of dam were not included in the
following estimates. These miscellaneous costs include roads, gaging stations, land acquisition,
recreation facilities, etc. These dams include:

**Concrete Rockfill Dam** - This dam will be constructed from compacted rockfill. The rock
source will be from the excavation area for a cascade-type spillway. A concrete slab will be
placed on the upstream face of the dam to act as an impermeable membrane. The outlet
works will be through a 10-foot diameter tunnel in the right abutment. The estimated 1984
construction cost is $21,299,440*.

**Earth-Core Rockfill Dam** - This dam will also be constructed from compacted rockfill
quarried from the cascade spillway area. An internal impervious compacted earth core will
act as a barrier against seepage through the embankment. The outlet works will also consist
of a 10-foot tunneled outlet through the right abutment. The 1984 estimated construction
cost is $20,176,540*.

**Roller Compacted Concrete (RCC) Dam** - This dam will rely upon a lean-mix, zero slump
concrete which can be processed and placed with conventional construction equipment. In
spite of the low cement content, RCC can achieve strengths comparable to conventional
concrete mix designs. Therefore, the volume of material forming the dam is significantly less
than for rockfill or earth dam designs. As a result of its durability characteristics, the
spillway can be incorporated into the dam section. The outlet works will be a 10-foot
diameter conduit through the dam. The 1984 estimated construction cost is $21,375,300 for
this configuration*.

*Note: This estimate does not include costs for miscellaneous construction activities that
are identical for each alternate configuration. Also, inflation, engineering, and
administrative costs are not included. The total project cost for the selected alternate is
shown in Section 3.
On the basis of cost alone, a clearcut selection was not apparent since the spread in the estimates is approximately 6%. This is a smaller variance than can be estimated at this level of study. Therefore, other comparisons were drawn to determine the best dam configuration for the Deer Creek site. A comparison matrix has been prepared to illustrate the advantages and disadvantages of each configuration. The comparison matrix follows this section. It is our opinion that, based upon comparison of the three alternate dam configurations, the concrete face rockfill dam is the best selection due primarily to constructability considerations and the advantages it offers over the other two alternates.

### DAM CONFIGURATION ANALYSIS COMPARISON MATRIX

<table>
<thead>
<tr>
<th>ITEM</th>
<th>RCC DAM</th>
<th>CONCRETE FACE ROCKFILL DAM</th>
<th>EARTH-CORE ROCKFILL DAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Period</td>
<td>A (2 yrs)</td>
<td>D (3 yrs)</td>
<td>D (3 yrs)</td>
</tr>
<tr>
<td>Dependency on Favorable Weather Conditions During Construction</td>
<td>D</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Incorporation of Cofferdam into Finished Embankment</td>
<td>D</td>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>Site Preparation</td>
<td>D</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Foundation Treatment (need for consolidation grouting)</td>
<td>D</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Previous Track Record for Dams at Similar Sites</td>
<td>D</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Construction Work Force and Equipment</td>
<td>A</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Construction Testing and Quality Control</td>
<td>D</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Care of River Prior to Diversion</td>
<td>D</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Potential for Maintenance to Concrete Face</td>
<td>D</td>
<td>D</td>
<td>A</td>
</tr>
<tr>
<td>Ability to Inspect and Maintain Impervious Membrane/Core</td>
<td>A</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>Attenuation of 100-year Flood</td>
<td>A</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Emergency Dewatering of Outlet Works</td>
<td>A</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>Dam Access Road</td>
<td>A</td>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

| TOTAL ADVANTAGE ITEMS | 6  | 7  | 4  |
| TOTAL DISADVANTAGE ITEMS | 8  | 7  | 10 |

A = Advantage
D = Disadvantage
3.0 CONCEPTUAL DESIGN OF SELECTED ALTERNATE

3.1 CONCEPTUAL DESIGN

A conceptual design was performed on the concrete face rockfill dam. The purpose of the conceptual design was to develop design criteria, facility sizing, and preliminary drawings of the recommended dam configuration. This detail allows the development of cost estimates and construction schedules. The proposed Deer Creek Dam and Reservoir Layout Plan is shown on Plate 2. Details of the proposed construction are illustrated on Plates 3 to 7. The Plates are located at the end of this report.

The proposed concrete face rockfill dam will consist of an embankment of compacted rockfill placed in lifts and compacted by a vibratory roller. The material will be quarried from the spillway area. The embankment will rise approximately 280 feet above the channel of Deer Creek. The crest elevation of the dam will be 6720.

The upstream face of the dam will consist of a sloping reinforced concrete slab placed over a well-graded zone of crushed rock material (3-inch max.). The face slab will be supported at the interface with the abutment by a plinth (a reinforced concrete toe slab). The plinth will also serve as cutoff between the face slab and the foundation. The plinth will be dowelled into the rock foundation and will also serve as a grout cap for curtain grouting.

The spillway will be a cascade-type spillway located on the left abutment. The excavation will also serve as a quarry to produce rockfill for the dam. The design will feature a 150-foot wide ogee shaped weir crest at elevation 6700, establishing normal high water line. The ogee shaped weir will be constructed of reinforced concrete. The spillway will pass the Probable Maximum Flood under approximately 20 feet of head. A plunge pool will be excavated at the base of the cascades to dissipate energy prior to discharge into Deer Creek.

The outlet works feature a 10-foot diameter tunnel through the right abutment. The outlet works will be regulated from a control building at the downstream end of the tunnel and short section of cut and cover conduit. Provision will be made to permit construction of hydropower generating facilities if this proposal proves to be economically feasible.

Recreation facilities could be located on the western shore of the reservoir. Access will be provided to the proposed recreational facility via the Negro Hill Road. Recreation opportunities include fishing, boating, picnicking, hiking, and sightseeing. The proposed facilities will include: a concrete boat ramp, gravel surfaced parking area, a day use picnic area, and rest rooms.

Conceptual designs have also been developed for access roads, gaging stations, utilities, telemetry, and a feasibility study of hydropower facilities. Plate 8 (two sheets) shows the location of access roads into the project.
3.2 COST ESTIMATES

Cost estimates for the dam and appurtenant structures, and other miscellaneous facilities were prepared based on the conceptual design. The total project cost is summarized below:

- **Construction Cost (1984)**: $26,719,440
- **Inflation to 1986 (8% per year)**: 4,445,560
- **Construction Cost (1986)**: $31,165,000
- **Contingencies @ 15%**: 4,674,000
- **Total Construction Cost (1986)**: $35,839,000
- **Engineering and Administrative @ 15%**: 5,376,000
- **Total Project Cost (1986)**: $41,215,000
  (Use $41,000,000)

The estimated total project cost, inflated to 1986, is $41,000,000 for budgetary and cashflow purposes.
4.0 HYDROPOWER FEASIBILITY INVESTIGATION

The 56-year period of simulated reservoir operation data were incorporated into an investigation of the potential for hydropower development at the Deer Creek site. However, only the years 1965 through 1983 were selected for this investigation because they represent an extended period without rare events and can be considered typical for economic projections.

Reservoir releases available for hydropower generation include an assumed continuous maintenance flow, irrigation bypasses, releases for senior downstream water rights, and three different levels of municipal releases (5,300, 8,000 and 10,000 acre-feet per year).

Hydroelectric generating facilities would be located immediately upstream from, or beside, the control building. The control building, embankment, and outlet works will be designed to accommodate a future retrofit if hydropower installation is delayed until after the dam is constructed. The results of the feasibility evaluation indicates that a 340 KW, 500 HP turbine and generator best matches the available head and water supply. The estimated 1986 construction cost is $1,071,200 (this cost was not included in the project cost presented in Section 3.2). The estimated pay-back period for the various levels of municipal demand are:

<table>
<thead>
<tr>
<th>Municipal Demand Ac-Ft</th>
<th>Capital Expense 1987-88</th>
<th>First Revenue Year</th>
<th>Year Paid Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,300</td>
<td>1,071,200</td>
<td>1990</td>
<td>2001</td>
</tr>
<tr>
<td>8,000</td>
<td>1,071,200</td>
<td>1990</td>
<td>1998</td>
</tr>
<tr>
<td>10,000</td>
<td>1,071,200</td>
<td>1990</td>
<td>1998</td>
</tr>
</tbody>
</table>

Evaluation of power rate structures indicates that the price of electrical energy is projected to be more favorable after 1993. The price of electrical energy after 1993 makes a small hydropower facility at the Deer Creek dam site clearly profitable after that date. The date of actual construction of the facility and the possibility of staged construction should be reviewed in more detail as plans for the dam and reservoir are defined.
5.0 PERMITS AND LAND ACQUISITION

5.1 PERMITS

Several permits and licenses will be required to construct a water project of this magnitude. Application for permits from federal agencies will most likely trigger the need for preparation of an EIS (Environmental Impact Statement). The following is a list of permits and agencies through which permits will be required:

<table>
<thead>
<tr>
<th>Permit</th>
<th>Issuing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredge and Fill Permit (404)</td>
<td>U.S. Army Corps of Engineers</td>
</tr>
<tr>
<td>State Certification (401)</td>
<td>Wyoming DEQ</td>
</tr>
<tr>
<td>SHPO Clearance</td>
<td>Wyoming State Historical Preservation Office</td>
</tr>
<tr>
<td>Reservoir Permit</td>
<td>Wyoming State Engineer</td>
</tr>
<tr>
<td>Miscellaneous Construction Permits</td>
<td>Wyoming State Engineer</td>
</tr>
<tr>
<td>Safety of Dams Approval</td>
<td>Wyoming State Engineer</td>
</tr>
<tr>
<td>FERC Hydropower License</td>
<td>Federal Energy Regulatory Commission</td>
</tr>
<tr>
<td>Temporary Wastewater Treatment Facility</td>
<td>Wyoming DEQ</td>
</tr>
<tr>
<td>Discharge (NPDES) Permits</td>
<td>Wyoming DEQ</td>
</tr>
<tr>
<td>Mining Permit</td>
<td>Wyoming DEQ</td>
</tr>
<tr>
<td>Bury Permit</td>
<td>Wyoming DEQ</td>
</tr>
<tr>
<td>Burn Permit</td>
<td>Wyoming DEQ</td>
</tr>
<tr>
<td>Fugitive Dust Permit</td>
<td>Wyoming DEQ</td>
</tr>
</tbody>
</table>

5.2 LAND ACQUISITION/EASEMENTS

The construction of a large water development project involves the need for the State to obtain land through direct purchase or the negotiation of easements. Lands required for the Deer Creek project will be for access roads, reservoir area, dam site, gaging station sites, recreation facility areas, and flood easement.

The majority of lands inundated by the reservoir are owned by True Ranches (the VR Ranch). A small portion of the Banner Ranch would be inundated. Lands administered by the State of Wyoming and the BLM will also be inundated and easements will be required for these lands. It is also assumed that easements for utilities, i.e. telephone, power, will be handled by the appropriate utility.
6.0 ECONOMIC ANALYSIS

The primary purposes of the Deer Creek Project are the provision of water for municipal, industrial, and agricultural use and flood control. The degree to which the project derives benefits from each purpose depends upon the realized yield of the reservoir. The reservoir's annual yield is estimated to be either 5,300 acre-feet or 22,500 acre-feet depending upon whether Deer Creek Reservoir is regulated to North Platte River water rights.

Assuming the reservoir yields 5,300 acre-feet annually, benefits from the project will total $31.6 million (in 1984 dollars). The project’s benefit-cost ratio under this assumption is 0.90. Assuming the reservoir yield is 22,500 acre-feet annually, benefits from the project would total $47.2 million (in 1984 dollars). The benefit cost ratio under this assumption is 1.35.

The above estimates are based upon the assumption that no hydropower generation is incorporated into the project design. If hydropower is included as part of the project these benefit-cost ratios become 0.94 and 1.42, respectively.

The allocation of project costs for the Deer Creek project is dependent upon which reservoir yield is assumed, and whether hydropower generation is included in the cost allocation. The costs allocated to municipal water supply enhancement range from 53 to 65 percent of project costs depending upon what assumptions are made. The cost component allocated to recreation and environmental enhancement is the second most significant, ranging between 22 and 31 percent of total costs.

Municipal water supply enhancement and recreation account for the majority of the project’s benefits and allocated costs. Industrial water, agricultural water, hydropower and flood control are associated with relatively minor streams of benefits and costs.
7.0 RECOMMENDATIONS

We recommend that the concrete face rockfill dam configuration be pursued as the preferred alternate if the State elects to proceed with construction of the Deer Creek Project. The proposed N.H.W.L. (normal high water line) elevation will be 6700, with a total storage capacity of 65,785 acre-feet. Assuming the project will be regulated to Deer Creek and North Platte River priorities, the annual yield is estimated to be 5,300 acre-feet.

Also, we recommend that if construction funding is approved by the Legislature for the Deer Creek Project, that the access roads into the project site be improved during the summer of 1985. The existing roads are inadequate to handle projected construction traffic in a safe and efficient manner. The existing roads severely limit the length of the construction season because of their condition. The efficiency of the road improvement efforts will be severely decreased if the road improvement project is delayed until the start of construction on the dam project.

Development of hydropower will be a profitable investment for the Deer Creek site. Further investigation will be required to determine if the hydropower facility should be constructed along with the dam, or be delayed until after 1993 when the price of electrical power is projected to be more attractive.
**Typical Section**

**No Scale**

1. **Plinth**
   - Backfill with impermeable fill
   - Grout curtain
   - Existing grade
   - Strip line (remove vegetation and organic soils)

2. **Parapet Wall**
   - Reinforced concrete
   - Waterstop
   - Grout pipe
   - Rock bolts

3. **Dam**
   - Reinforced concrete slab
   - Emulsified asphalt and compacted sand
   - Processed crushed rock
   - Slightly weathered or sound rock

**Details**

**Concrete Face Rockfill Dam**

**Contact Information**

BANNER ASSOCIATES, INC.
CONSULTING ENGINEERS & ARCHITECTS
620 PLAZA COURT, PO BOX 550
LARAMIE, WY 82070
(307) 745-7366

**Engineering Firm**

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620 PLAZA COURT, PO BOX 550
LARAMIE, WY 82070
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**Project Information**

Deer Creek - Level III

**Scale**

No Scale
OUTLET WORKS PROFILE

NO SCALE

INTAKE STRUCTURE WITH EMERGENCY BULKHEAD
INTAKE TUNNEL PORTAL
EXISTING GRADE
UPSTREAM TUNNEL PORTAL

FUTURE POWERHOUSE
CONNECTION TO OUTLET WORKS CONDUIT AND
BUILDING LOCATION TO BE DETERMINED IN
FINAL DESIGN

CONTROL BUILDING
LOW FLOW BYPASS
ELEV. 6645

10" I.D. CUT AND COVER CONDUIT
10" I.D. CONCRETE LINED TUNNEL
10' 10" CUT AND COVER CONDUIT

DEER CREEK - LEVEL III
CONCRETE FACE ROCKFILL DAM

OUTLET WORKS CONTROL DETAIL

OUTLET WORKS TUNNEL DETAIL

NO SCALE

OUTLET WORKS CONTROL DETAIL

STAINLESS STEEL SETS
6" X .35" X .06" REINFORCED CONCRETE

OUTLET WORKS TUNNEL DETAIL

NO SCALE

BANNER ASSOCIATES, INC. • CONSULTING ENGINEERS & ARCHITECTS
COMMISSION
620 PLAZA COURT PO BOX 550
LARAMIE, WY 82070 (307) 745-7366
ADJUST EXCAVATION LIMITS AS REQUIRED TO PRODUCE ADEQUATE EMBANKMENT QUANTITY