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University of Wyoming, Dept 3943
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Physical Address:
Wyoming Hall, Room 249
University of Wyoming
Laramie, WY 82071

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

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WATER DEVELOPMENT POTENTIAL
IN THE
TONGUE RIVER BASIN

LEVEL I RECONNAISSANCE STUDY

PREPARED BY
WYOMING WATER DEVELOPMENT COMMISSION

MARCH 1984
Water Development Potential
in the
Tongue River Basin

Level I Reconnaissance Study

Prepared by
Wyoming Water Development Commission

Walter J. Pilch, Chairman        Michael K. Purcell, Administrator

Evan J. Green, Study Editor
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INTRODUCTION

In the 1983 Session, the Forty-Seventh Wyoming State Legislature appropriated two hundred fifty thousand dollars ($250,000) to the Water Development Commission to conduct a Level I Reconnaissance Study and develop a basin-wide water development plan for the Tongue River basin.

The purpose of the study as defined in the legislation is: . . . "to conduct a basin-wide development plan including reservoir storage sites to provide municipal water supplies to the city of Sheridan and areas specified in the Woodland Hills application to the commission and other communities in the Tongue River basin and municipal supplies outside of the basin."

Specific project components were enumerated in the legislation as follows:

(A) Perform a reconnaissance water development plan of the Tongue River basin;

(B) Determine potential surface and groundwater sources of supply for the basin;

(C) Identify potential benefits and beneficiaries of the project, both in-basin and out-of-basin;

(D) Examine relevant water rights, applications and permits and identify conflicts;

(E) Coordinate information from the Little Big Horn and Powder River projects;

(F) Identify legal, institutional, environmental, physical and other constraints;

(G) Evaluate water supply alternatives for the Woodland Hills area.

In addition to these projects components and the tasks outlined for a Level I Study in W.S. 41-2-114, the Water Development Commission was also authorized to perform the following specific tasks:

(A) Locate a source of supply of sufficient quantity and quality to meet the anticipated needs of the Woodland Improvement District;

(B) Update and expand existing cost data for the project;

(C) Determine local beneficiaries and level of project support in the proposed project area;

(D) Develop preliminary financing alternatives.

In March of 1983, the Water Development Commission reviewed the enabling legislation and directed the WWDC staff to prepare a summary of existing studies and unpublished data on various storage and export developments proposed for the Tongue River basin. The Commission's intent was to avoid duplication of effort.
by compiling all available data before additional study was conducted at state expense. The Commission also expressed a desire to consider the results of on-going studies of the Powder River basin and the Little Big Horn River in order to make development decisions in the best interests of the entire northcentral Wyoming area. By considering all sources and a variety of development options and alternatives, the Commission hopes to determine the most beneficial development scenario to utilize the unappropriated waters of the region.
STUDY METHODOLOGY

A search for data on the Tongue River area revealed a large amount of published and unpublished information available for the region.

The volume Wyoming Water Resources: A Bibliography prepared in 1983 by Information Management Specialists, Inc. of Denver, Colorado for the Wyoming Water Development Commission contained 30 references citing studies on the Tongue River or the Tongue River basin. An additional 30 references relating to the proposed study area are found under the headings "Sheridan," "Sheridan County," "Yellowstone River," and "Yellowstone Basin." A listing of these references is found in Appendix A.

In addition, files in the State Engineer's Office, the Department of Economic Planning and Development, and the Water Development Commission contain information relating to individual development project proposals as well as a variety of basin-wide information.

In satisfying the legislative directive to identify a source of water for the Woodland Hills proposed service and improvement district, files were also searched for information relating to groundwater sources in reasonable proximity to the area of potential use. A separate bibliography of groundwater data is included as Appendix B. The data drawn from these sources is summarized in Chapter II.

The goal of the present study is to summarize the most recent and most complete available studies and data in order that the Commission and the Legislature may consider the appropriate course of action in fostering water development in northcentral Wyoming.
EXECUTIVE SUMMARY

The following summary information was presented to the 1984 Legislative Session in support of the Water Development Commission's recommendation for a Level II Feasibility Study.
Project Synopsis:

The 1983 Legislature appropriated $250,000 to the Water Development Commission to develop a basin-wide water development plan for the Tongue River. The purpose of the study is to identify reservoir storage sites to provide municipal, industrial, and agricultural supplies to the water-short areas in the north-central Wyoming, and to develop water allocated to Wyoming under the Yellowstone River Compact. The Commission was also instructed to identify and evaluate groundwater sources which could supplement or replace surface water for these purposes.

The Commission instructed its staff to review and summarize available sources of information and develop recommendations for Level II studies. The Commission's intent was to avoid duplication of effort by compiling all available Level I data before additional study was conducted at state expense. The Commission also expressed a desire to consider the results of studies of the Powder River basin and the Little Big Horn River in order to make development decisions in the best interests of the area. By evaluating a variety of development options and alternatives, the Commission will determine the most beneficial development scenario to utilize the unappropriated waters of the region.

A search for data on the Tongue River area revealed a wealth of published and unpublished information available for the region.

The volume Wyoming Water Resources: A Bibliography prepared in 1983 by Information Management Specialists, Inc. of Denver, Colorado for the Commission contained 30 references citing studies on the Tongue River or the Tongue River basin.

An additional 30 references relating to the proposed study area are found under the headings "Sheridan," "Sheridan County," "Yellowstone River," and "Yellowstone Basin."

In addition, files in the State Engineer's Office, the Department of Economic Planning and Development, and the Water Development Commission contain information relating to individual development project proposals as well as a variety of basin-wide information.

Surface Water Development

Analysis of surface water development on the Tongue River will proceed in two phases. Phase I will examine the potential for small storage development in the Big Goose and Little Goose drainages. An examination will be made of hydrology and water rights to determine the availability of supply, and potential small reservoir sites will be evaluated. This review will be completed by December 31, 1984.

Phase II will be an analysis of development on the North Fork, South Fork and main stem of the Tongue River. The first task under this phase will be
identification of and negotiation with permit holders and applicants for water
rights in the study area. This will be completed by January 1, 1985 and before
additional funds are expended on Phase II.

The most recent comprehensive study of potential surface water development
projects in the study area was prepared by CH2M Hill in March of 1977 for the
Governor's Interdepartmental Water Conference. The report, titled "Prefeasibility Study, Tongue and Little Big Horn River Basin Project" identified and analyzed nine proposed projects individually and in various combinations.

The nine individual projects are: North Fork, South Fork, Rockwood, Upper
Stateline, Prairie Dog, Shutts Flat (Sheridan Canal System), Parkman, Beatty
Gulch, and Fuller.

In determining which projects should be considered for Level II study, the
North Fork and Rockwood sites were eliminated because the dams and reservoirs
would fall within the portion of the Tongue River main stem recommended for Wild
and Scenic designation. It was assumed, based on past experience, that the
Forest Service would deny requests for permits to conduct geotechnical testing
at these two sites. In addition, most of the benefits realized from these two
sites could be achieved at alternate locations.

Parkman, Beatty Gulch, and Fuller were eliminated from consideration at the
present time because the projects depend on the Little Big Horn River as a
source of supply. These three sites should be reevaluated when apportionment of
the Little Big Horn is completed.

Based on the above criteria, South Fork, Shutts Flats, Upper Stateline, and
Prairie Dog remain in consideration. South Fork Reservoir will have consider-
able environmental impact and will be the lowest priority for development.

The attached Cost/Yield chart provides additional information on the
developments that are being recommended for further study.

Groundwater Development

A thorough analysis of groundwater potential in the study area was complet-
ed in 1982 by Western Water Consultants of Laramie and Sheridan. The study,
entitled Potential for Ground Water Development, City of Sheridan, Wyoming was
funded by the Commission under the auspices of the Groundwater Exploration Grant
Program. The focus of the study was to locate a supplemental supply of up to
3,700 gpm for Sheridan. The groundwater potential of a study area encompassing
approximately 500 square miles in the southwestern corner of Sheridan County was
examined. The area includes most of the drainage basins of Big and Little Goose
Creeks above Sheridan, and of the Tongue River from the confluence of North and
South Tongue to Ranchester. Study area boundaries were established with consid-
eration of transmission costs to areas of potential use, aquifer depths, yield,
and water quality.

Three potential exploration sites in the Madison aquifer system have been
identified as having good water quality and a high probability of frac-
ture-enhanced permeability. These sites are shown on Figure 2. Large-yield
Madison wells with high quality water have been completed in Area II, and
intense folding and faulting in Area I make it very probable that groundwater circulation is adequate to provide high quality water in adequate amounts for municipal use. Gulf Exploration is currently drilling an oil well in Area I and reliable water production data may be available soon. Within Area III, enhanced fracture permeability is associated with only minor folding; however, the quality of the groundwater is good. The fracture density of the gentle folding in Area III could prove to be insignificant, and the chances for successfully developing a high yield well in this area are considered much lower than for Areas I or II.

A properly designed and constructed Madison aquifer production well could yield 500 gpm of good quality water.

Madison aquifer production wells in Areas I, II or III could diminish streamflows in Little Goose Creek, Tongue River, and Big Goose Creek drainages, respectively. With the exception of flood flows, these streams are already overappropriated for other uses, and water right conflicts could result from high-volume Madison aquifer production.

Streamflow studies conducted by the Wyoming State Engineer's Office (1976) demonstrate that Little Goose and Big Goose Creeks and the Little Tongue and Tongue Rivers are all in hydraulic continuity (either gain or lose water, or both) with the Madison aquifer along outcrops of the aquifer immediately west of Areas I, II and III.

The percentage of pumped water that would be diverted from the streams depends upon the hydraulic properties of the aquifer, the distance from the pumping wells to the streams and the pumping durations. Accurate assessment of the hydraulic properties of the aquifer could only be made through long-duration pump testing of test wells.

Based on available data, two Madison aquifer test wells are recommended. Test drilling in Area I would determine if a well or well field in that area could supply Big Horn and the rural developments, including the proposed Woodland Hills Improvement and Service District, between Big Horn and Sheridan.

Test drilling in Area II would determine the availability of groundwater for agricultural, industrial and municipal uses in the Tongue River drainage.
Project Budget

Surface Water
Completion of Level II Feasibility Study of four damsites and the Sheridan Canal, including geotechnical analysis $ 500,000

Groundwater
Completion, testing and logging of Area I Madison Well $ 450,000
Completion, testing and logging of Area II Madison Well $ 400,000
Total $1,350,000

Recommended Legislative Action

Appropriation of $1,350,000 for a two-year Level II Feasibility Study. Due date, 1986.
Table 1

TONGUE RIVER SURFACE DEVELOPMENT PROJECTS

<table>
<thead>
<tr>
<th>Project</th>
<th>1983 Capitol Cost ($1000)</th>
<th>Annual Cost 4%, 40 years ($1000)</th>
<th>Total Storage (AF)</th>
<th>Firm Yield Acre-feet</th>
<th>Annual Cost per Acre/ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Fork Dam and Reservoir</td>
<td>33,096</td>
<td>1,672</td>
<td>27,300</td>
<td>20,500</td>
<td>$81</td>
</tr>
<tr>
<td>Upper Stateline Dam and Reservoir</td>
<td>74,259</td>
<td>3,752</td>
<td>204,000</td>
<td>85,800</td>
<td>$43</td>
</tr>
<tr>
<td>Prairie Dog Dam, Reservoir, Pump Station</td>
<td>33,310</td>
<td>1,683</td>
<td>39,000</td>
<td>30,800</td>
<td>$54</td>
</tr>
<tr>
<td>1Sheridan Canal System using South Fork Dam and Reservoir</td>
<td>39,000</td>
<td>1,970</td>
<td>27,300</td>
<td>20,500</td>
<td>$71²</td>
</tr>
<tr>
<td>Prairie Dog Dam and Reservoir plus Upper Stateline Dam and Reservoir</td>
<td>107,568</td>
<td>5,435</td>
<td>243,000</td>
<td>79,100</td>
<td>$69</td>
</tr>
<tr>
<td>Sheridan Canal System with dam and reservoir at Shutts Flats</td>
<td>8,549</td>
<td>432</td>
<td>11,400</td>
<td>8,600</td>
<td>$50</td>
</tr>
</tbody>
</table>

¹ Sheridan Canal may have environmental problems. As proposed, the diversion structure and siphon intake would be within the portion of the Tongue River identified for potential Wild and Scenic designation.

² Cost calculated on 27,600 acre-feet, 20,500 from reservoir and 7,100 acre-feet direct flow from Tongue River.
Index Location Map of Ground-Water Study Area
Near Sheridan, Wyoming

Scale 1: 500,000
This study is the most recent, and most comprehensive in addressing the specific project components recommended for further study.

SUMMARY

Eight surface water resource development projects and numerous combinations of these projects were evaluated in this prefeasibility study. The projects involve development of mainstem Tongue River water through timed storage and release, diversion of mainstem Tongue River water to tributaries, and importation of Little Bighorn River water into the Tongue River basin. The analysis was limited to the existing proposals and preliminary information provided through the Wyoming Water Planning Program.

The development projects were based on private proposals within the study area and this study investigated the proposals with respect to the water management goals of the state. Financial feasibilities of the projects were not examined in detail because specific benefits of the projects were not identified.

Costs and yields for the projects were based on the reservoir, pipeline, and canal capacities specified in the applications for permits or from other planning data.

Operation plans for combination of projects were based on the priority dates given on the applications for permits, except it was assumed that rights could be transferred from South Fork to Shutts Flats and from the small Rockwood Dam and Reservoir to a larger one to enable full utilization of the site.

The projects and combination projects were evaluated to determine not only feasibility factors but also plan flexibility with relationship to water resource development in the study area.

In addition to the projects listed on Table 3, the Wyoming Water Planning Program requested firm yield analysis on the following combinations:

- Shutts Flats project with senior water rights to the Prairie Dog project.
- Shutts Flats project with junior water rights to the Prairie Dog project.
- South Fork project with junior water rights to the Prairie Dog project.

Results of the operation studies are given in the conclusions of the complete report. Anyone interested in detailed information should refer to the original study.
The alternative water development strategies used for project analysis were related to the state of Wyoming goals presented in the original report. Development strategies included—

• Provide supplemental water supply to present uses, particularly irrigation uses and pre-1950 water rights which have a first call on presently undeveloped water under the Yellowstone River Compact.

• Provide for new water uses from Wyoming's portion of the Yellowstone River Compact or otherwise available water supplies without transfer of presently used water rights.

• Provide minimum flows and reservoir pools for fishery, recreation and water quality and to minimize the environmental impacts of the project(s).

The information presented in this report was to provide a basis for the Governor's Interdepartmental Water Conference (now WWDC) to obtain public participation and input with relationship to the development and utilization of water resources development in the study area.

CONCLUSIONS

All projects and combination of projects presented are technically feasible. Projects were not analyzed in depth from a socioeconomic or environmental impact aspect. The following conclusions and recommendations should be reviewed during feasibility-level studies for any project or combination of projects.

• Water is available in the study area to meet existing needs, identified needs for the Sheridan Canal System and the power plant proposed by Pacific Power and Light Company, and other unidentifed needs.

• All projects and combinations that were analyzed in the study cannot be constructed as the yield of the basin including the import system is not sufficient. Under the reservoir operation plans and alternative management goals used in this study, the projects are not mutually exclusive. The firm yield from two or more reservoirs in combination is less than the sum of the firm yields from each reservoir if built alone.

• Streamflow from month to month and from year to year varies greatly, and carry-over storage is required to develop firm yields sufficient to justify surface water resources development.

• Firm yields for reservoirs range from 8,600 acre-feet per year at Shutts Flats to 193,000 acre-feet per year for the combination of Prairie Dog and Upper Stateline. The firm yield depends on the streamflow at the reservoir site, the bypass for downstream irrigation, the criterion for fish-flow bypass, the priority date, the allocation to Wyoming under the Yellowstone River Compact, and the water allocated to the Northern Cheyenne Indian Tribe in Montana.

• Annual costs of surface water development for the various projects range from $17 to $104 per acre-foot of firm yield with Wyoming water only and from $14 to $89 with a cooperative venture with Montana.
An increase in firm yield at most reservoirs can be realized without any increase in storage by reducing the fish-flow bypass or by entering into a cooperative venture with Montana.

Upper Stateline Reservoir and combinations of Upper Stateline Reservoir with Rockwood Reservoir or Prairie Dog Reservoir are capable of developing Wyoming's full compact allocation, but only through a joint venture with Montana.

Refiling of water rights may change the firm yield obtainable from a project.

The Rockwood or South Fork projects appear to be the best alternatives within the study area for the state to encourage through loans or grants for planning, design and construction.

Rockwood, Upper Stateline and the diversion pipeline from the Little Bighorn River appear to create the largest problems with respect to environmental quality. Possibilities for mitigation measures for possible adverse impacts of any of the projects will have to be derived at a feasibility-level study.

The outcome of court cases involving Indian water rights and the impact on water resources development in the study area is uncertain.

In this study, in addition to alternatives presented on Table 3, operations studies were performed for--

- Shutts Flats with senior water rights to Prairie Dog.
- Shutts Flats with junior water rights to Prairie Dog.
- South Fork with junior water rights to Prairie Dog.

As studied for this report, the operations showed the following for the above:

- Impact at Prairie Dog minimal with firm yield reduced approximately 2,000 acre-feet.
- No impact on firm yield of Shutts Flats.
- With South Fork having junior water rights to Prairie Dog, firm yield reduced about 5,000 acre-feet.

RECOMMENDATIONS

The present water users and the public should be involved in the decision process for water resources development in the study area. Specifically, the support for the Sheridan Canal project and the actual amount of irrigation water that can be subscribed from the project should be determined, after pursuing with PP&L or other industrial companies and the state the water pricing and/or public financing incentives that can be applied to set irrigation water prices at
reasonable levels. Also, the communities of the area should be contacted to determine their interest in water storage for future municipal water supplies.

- The state should continue to be involved in the water resources development in the study area to ensure logical development of the water resources. The state of Montana should be contacted to determine possibilities for a joint venture.

- The state should study at a feasibility level the Rockwood or South Fork projects in conjunction with the Sheridan Canal and Prairie Dog project.

- As Tongue River water resources are developed, it becomes increasingly important for the Yellowstone River Compact Commission to administer the Compact through a set of specific guidelines and a system of data collection and interpretation.

- Feasibility studies should include determination of minimum pools and fish-flows so that specific criteria can be derived and benefits and costs allocated.

- Economic feasibilities of the projects cannot be made until uses for the water can be identified and benefits assigned.

- An engineering analysis at the feasibility level should determine the optimum size of the projects in order to meet the water demands.

- The combinations of projects selected for further study should be optimized in feasibility studies by analyzing several different operation plans. Operation studies at the feasibility level should be performed on a monthly basis with one fish-flow provision.

- More detailed analyses of potential environmental impacts should be done for all projects considered to be economically feasible.

- A reconnaissance-level study should be performed on the feasibility of a run-of-the-river hydro facility and a pumped storage facility at the Rockwood site.
Table 2
ENGINEERING INFORMATION ON PROJECTS

<table>
<thead>
<tr>
<th>Dam and Reservoir Site</th>
<th>Applicant</th>
<th>Priority Date</th>
<th>Location</th>
<th>Source of Water</th>
<th>Stated Use</th>
<th>Capacity (1000a.f.)</th>
<th>Area Extent (acres)</th>
<th>Minimum Pool (% of total capacity)</th>
<th>Fish-Flow (% of average daily flow)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Fork</td>
<td>Pacific Power and Light</td>
<td>5-17-58</td>
<td>S3, T55N, R89W</td>
<td>North Tongue River</td>
<td>Irrigation</td>
<td>39.7</td>
<td>814</td>
<td>25</td>
<td>25 or 33</td>
</tr>
<tr>
<td>South Fork</td>
<td>Pacific Power and Light</td>
<td>3-8-60</td>
<td>S33, T56N, R88W</td>
<td>South Tongue River</td>
<td>Irrigation</td>
<td>27.3</td>
<td>484</td>
<td>25</td>
<td>25 or 33</td>
</tr>
<tr>
<td>Rockwood</td>
<td>Pacific Power and Light</td>
<td>3-8-60</td>
<td>S23, T56N, R88W</td>
<td>Tongue River</td>
<td>Irrigation</td>
<td>29.2</td>
<td>737</td>
<td>25</td>
<td>25 or 33</td>
</tr>
<tr>
<td>Upper State-line</td>
<td>Pacific Power and Light</td>
<td>2-28-69</td>
<td>S22, T58N, R88W</td>
<td>Tongue River</td>
<td>Power, Industry</td>
<td>185.0</td>
<td>5,400</td>
<td>20</td>
<td>25 or 33</td>
</tr>
<tr>
<td>Prairie Dog</td>
<td>Pacific Power and Light</td>
<td>2-17-66</td>
<td>S26, T58N, R83W</td>
<td>Tongue River and Prairie Dog Creek</td>
<td>Power, Industry</td>
<td>80.9</td>
<td>1,360</td>
<td>20</td>
<td>0</td>
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<td>Shuttles Flats</td>
<td></td>
<td>1</td>
<td>S9, T55N, R88W</td>
<td>South Tongue River</td>
<td>Irrigation</td>
<td>11.4</td>
<td>250</td>
<td>25</td>
<td>25 or 33</td>
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<tr>
<td>Parkman</td>
<td>TR-12, Inc.</td>
<td>8-25-72</td>
<td>S34, T58N, R87W</td>
<td>Primarily Little Bighorn River</td>
<td>Irrigation</td>
<td>42.6</td>
<td>943</td>
<td>20</td>
<td>0</td>
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<tr>
<td>Beatty Gulch</td>
<td>TR-12, Inc.</td>
<td>10-15-75</td>
<td>S7, T57N, R83W</td>
<td>Primarily Little Bighorn River</td>
<td>Irrigation</td>
<td>27.8</td>
<td>708</td>
<td>20</td>
<td>0</td>
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<tr>
<td>Fuller</td>
<td>D. Fuller</td>
<td>1-30-76</td>
<td>S16, T58N, R89W</td>
<td>Primarily Little Bighorn River</td>
<td>Irrigation</td>
<td>22.8</td>
<td>287</td>
<td>20</td>
<td>25 or 33</td>
</tr>
</tbody>
</table>

1. No current application file.
2. On Class IV or Class V stream (Wyoming Game and Fish Department).
3. First capacity listed is that which is in the application for water rights. Second capacity listed is that used for studies in this report.
4. Maximum water surface area for capacity used in this report.
5. Assumed for studies in this report.
<table>
<thead>
<tr>
<th>Project</th>
<th>Capital Cost ($1000)</th>
<th>Annual Cost ($1000)</th>
<th>Total Storage (1000 Acre-Feet)</th>
<th>0% Firm Annual Cost (1000 Per Acre-Feet)</th>
<th>25% Firm Annual Cost (1000 Per Acre-Feet)</th>
<th>33% Firm Annual Cost (1000 Per Acre-Feet)</th>
<th>Wyoming Compact Water</th>
<th>25% Fish-Flow</th>
<th>33% Fish-Flow</th>
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<tr>
<td>North Fork Dam &amp; Reservoir</td>
<td>$24,850</td>
<td>$1,255</td>
<td>40.2</td>
<td>21.6</td>
<td>$58</td>
<td>15.6</td>
<td>$80</td>
<td>13.8</td>
<td>$91</td>
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<td>South Fork Dam &amp; Reservoir</td>
<td>20,789</td>
<td>1,050</td>
<td>27.3</td>
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<td>51</td>
<td>20.5</td>
<td>51</td>
<td>20.5</td>
<td>51</td>
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<td>Rockwood Dam &amp; Reservoir</td>
<td>50,740</td>
<td>2,563</td>
<td>125.0</td>
<td>68.5</td>
<td>37</td>
<td>68.5</td>
<td>37</td>
<td>65.5</td>
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<td>Upper Stateline Dam &amp; Reservoir</td>
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<td>2,357</td>
<td>204.0</td>
<td>85.8</td>
<td>27</td>
<td>85.8</td>
<td>27</td>
<td>84.7</td>
<td>28</td>
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<td>Prairie Dog Dam, Reservoir &amp; Pump Station</td>
<td>20,923</td>
<td>1,057</td>
<td>39.0</td>
<td>30.8</td>
<td>34</td>
<td>30.8</td>
<td>34</td>
<td>30.8</td>
<td>34</td>
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<tr>
<td>Sheridan Canal w/Dam &amp; Reservoir at Shutts Flats</td>
<td>5,370</td>
<td>271</td>
<td>11.4</td>
<td>8.6</td>
<td>17</td>
<td>8.6</td>
<td>17</td>
<td>8.6</td>
<td>17</td>
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<tr>
<td>Little Bighorn Import</td>
<td>86,200</td>
<td>4,355</td>
<td>70.4</td>
<td>56.2</td>
<td>77</td>
<td>56.2</td>
<td>77</td>
<td>48.6</td>
<td>90</td>
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<tr>
<td>A. Diversion Pipeline to Parkman, Parkman Dam &amp; Reservoir</td>
<td>53,577</td>
<td>2,707</td>
<td>42.5</td>
<td>34.0</td>
<td>80</td>
<td>34.0</td>
<td>80</td>
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</tr>
<tr>
<td>B. &quot;A&quot; Above Plus Pump Station and Pipeline to Tongue River</td>
<td>70,146</td>
<td>3,544</td>
<td>42.5</td>
<td>55.7</td>
<td>64</td>
<td>39.4</td>
<td>90</td>
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<tr>
<td>Beatty Gulch Dam, Reservoir &amp; Supply Canal</td>
<td>16,053</td>
<td>811</td>
<td>27.8</td>
<td>22.2</td>
<td>37</td>
<td>18.0</td>
<td>45</td>
<td>14.5</td>
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<tr>
<td>Fuller Reservoir</td>
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<tr>
<td>Sheridan Canal System using South Fork Dam and Res.</td>
<td>24,497</td>
<td>1,238</td>
<td>27.3</td>
<td>20.5</td>
<td>45</td>
<td>20.5</td>
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<td>Rockwood Dam and Res.</td>
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<td>2,750</td>
<td>125.0</td>
<td>68.5</td>
<td>40</td>
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<td>40</td>
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<tr>
<td>Prairie Dog Dam &amp; Reservoir Plus South Fork Dam &amp; Reservoir</td>
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<td>66.3</td>
<td>45.5</td>
<td>46</td>
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<tr>
<td>Prairie Dog Dam &amp; Reservoir Plus Upper Stateline Dam &amp; Reservoir</td>
<td>67,568</td>
<td>3,414</td>
<td>243.0</td>
<td>76.1</td>
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<tr>
<td>Rockwood Dam &amp; Reservoir Plus Upper Stateline Dam &amp; Reservoir</td>
<td>47,740</td>
<td>2,412</td>
<td>57.0</td>
<td>42.7</td>
<td>56</td>
<td>42.7</td>
<td>56</td>
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<td>Stage 1 Rockwood Only</td>
<td>47,438</td>
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<td>Stage 2 Both Pump Storage Project</td>
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<td>42.7</td>
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<td>42.7</td>
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<tr>
<td>Stage 2 Both</td>
<td>47,740</td>
<td>2,412</td>
<td>57.0</td>
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<tr>
<td>Stage 2 Both</td>
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<td>42.7</td>
<td>56</td>
<td>42.7</td>
<td>56</td>
<td>37.0</td>
<td>65</td>
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</tbody>
</table>

- **Footnotes:**
  0. Annual cost based on 4 percent interest and 40 year payoff crf = .05052.
  1. Limited by physical size of reservoir (firm yield-active storage).
  2. Montana compact allocation (bypass requirement) is larger than fish-flow.
  3. Cost calculated on yield of 15,700 a.f., 8,600 a.f. from storage in reservoir, plus 7,100 a.f. direct flow from Tongue River. Yield obtained more than 7 out of 10 years.
  4. Diversion dam pipeline to Tongue River, Parkman Dam & Reservoir, supply canal to Beatty Gulch Dam & Reservoir.
  5. Cost calculated on yield of 15,700 a.f., 8,600 a.f. from storage in reservoir, plus 7,100 a.f. direct flow from Tongue River. Irrigation demand obtained more than 7 out of 10 years.
  6. Does not include 22,000 a.f. used for pump storage project.
  7. Does not include cost of pump storage reservoir and generation plan.
  8. South Fork senior priority.
CHAPTER II
GROUNDWATER RESOURCES IN THE STUDY AREA

I. Introduction

In any development decisions made by the state of Wyoming for the Tongue River basin, all viable alternatives should be considered.

The use of groundwater to satisfy existing and projected municipal, rural domestic, agricultural, and industrial needs should be weighed against surface water development on the basis of projected yields, project life, construction costs, annual operation and maintenance costs, environmental impacts, and social and political factors to determine which development alternative is the most desirable.

As is the case with proposed surface development, there has been a considerable amount of Level I data accumulated on groundwater resources in the study area. (See groundwater bibliography, Appendix B.)

II. Summaries of Existing Groundwater Studies

Lowery and Cummings (1966) summarized conditions in the study area in USGS Water Supply Paper 1807, as follows:

Sheridan County is in the northcentral part of Wyoming and is an area of about 2,500 square miles. The western part of the county is in the Bighorn Mountains, and the eastern part is in the Powder River structural basin. Principal streams are the Powder and Tongue Rivers, which are part of the Yellowstone River system. The climate is semiarid, and the mean annual precipitation at Sheridan is about 16 inches.

Rocks of Precambrian age are exposed in the central part of the Bighorn Mountains, and successively younger rocks are exposed eastward. Rocks of Tertiary age, which are the most widespread, are exposed throughout a large part of the Powder River structural basin. Deposits of Quaternary age underlie the flood plains and terraces along the larger streams, particularly in the western part of the basin.

Aquifers of pre-Tertiary age are exposed in the western part of the county, but they dip steeply and are deeply buried just a few miles east of their outcrop. Aquifers that might yield large supplies of water include the Bighorn Dolomite, Madison Limestone, Amsden Formation, and Tensleep Sandstone. The Flathead Sandstone, Sundance Formation, Morrison Formation, Cloverly Formation, Newcastle Sandstone, Frontier Formation, Parkman Sandstone, Bearpaw Shale, and Lance Formation may yield small or, under favorable conditions, moderate supplies of water.

Few wells tap aquifers of pre-Tertiary age, and these are restricted to the outcrop area. The meager data available indicate that the water from the Lance Formation, Bearpaw Shale, Parkman Sandstone, Tensleep Sandstone and Amsden Formation, and Flathead Sandstone is of suitable quality for domestic or stock purposes, and that water from the Tensleep Sandstone and Amsden Formation and the Flathead Sandstone is of good quality for irrigation.
Adequate supplies of groundwater for stock or domestic use can be developed throughout much of the report area from the Fort Union and Wasatch Formations of Tertiary age; larger supplies might be obtained from the coarse-grained sandstone facies of the Wasatch Formation near Moncreiffe Ridge. Four aquifer tests were made at wells tapping formations of Tertiary age, and the coefficients of permeability determined ranged from 2.5 to 7.9 gallons per day per square foot. The depths to which wells must be drilled to penetrate an aquifer differ within relatively short distances because of the lenticularity of the aquifers. Water in aquifers of Tertiary age may occur under water-table, artesian, or a combination of artesian and gas-lift conditions.

Water from the Fort Union is usable for domestic purposes, but the iron and dissolved-solids content impair the quality at some localities. Water from the Fort Union Formation is not recommended for irrigation because of sodium and bicarbonate content. The water is regarded as good to fair for stock use. Water from the Wasatch Formation generally contains dissolved solids in excess of the suggested domestic standards, but this water is usable in the absence of other supplies. The development of irrigation supplies from the Wasatch Formation may be possible in some areas, but the water quality should be carefully checked. Water of good to very poor quality for stock supplies is obtained, depending upon the location. Hydrogen sulfide, commonly present in water of the Fort Union and Wasatch Formations, becomes an objectionable characteristic when the water is used for human consumption.

Deposits of Quaternary age generally yield small to moderate supplies of water to wells. Two pumping tests were conducted, and the coefficients of permeability of the aquifers tested were 380 and 1,100 gallons per day per square foot. Usable supplies of groundwater can be developed from the deposits of Quaternary age, principally along the valleys of perennial streams that head in the mountains and from terraces in the western part of the county; the thickest known deposit of alluvium is in the valley of Dutch Creek, which heads in the Powder River structural basin. Water from the alluvium is usable as a stock supply but has objectionable characteristics for domestic and irrigation use.

Recharge to groundwater reservoirs is from precipitation and seepage from streams and irrigation. Recharge conditions are generally better in the western part of the basin, where precipitation is greater and where there are more perennial streams and irrigated lands. Discharge from the groundwater reservoirs is by seepage to streams, evaporation, transpiration, and by wells and springs.

A more recent study was completed by the Water Resources Research Institute of the University of Wyoming in 1981. The report contained the following summary of findings.

1. Four major bedrock aquifer systems have been identified within the Powder River basin. These are the Paleozoic Madison, Lower Cretaceous Dakota, Upper Cretaceous Fox Hills/Lance, and Lower Tertiary Wasatch/Fort Union aquifer systems. Additionally, several minor or local aquifers have been identified, including Permo-Triassic aquifers and the Jurassic Sundance aquifer in the northeastern part, Upper Cretaceous aquifers in the western part, Middle Tertiary aquifers in the southeastern part and unconsolidated Quaternary
alluvial aquifers throughout the basin. Aquifer recharge rates, groundwater flow paths, and the extent of interformational mixing are poorly known. Data concerning hydrologic and hydrochemical properties are sparse, especially for pre-Tertiary strata in the central basin.

2. The Paleozoic Madison aquifer system has excellent potential for producing large quantities of good quality water, and has been extensively investigated as a result of pending industrial developments. The Madison Limestone is the most extensively exploited aquifer of the system, although the Minnelusa/Tensleep and Bighorn/Red River formations also have good development potential. Water from the aquifer system is currently utilized mainly for municipal supply and secondary oil recovery, but proposed future uses also include slurry transport of coal and the synthetic fuels industry. The upper Minnelusa is extensively developed for production of oil and gas through primary and secondary recovery methods.

Aquifer properties are highly variable, are dependent upon secondary permeability, and, with the exception of the Madison aquifer, are very poorly known. Madison Formation transmissivities generally vary from 1,000 to 60,000 gpd/ft, but may exceed 300,000 gpd/ft locally. Specific capacities range from 0.5 to over 50 gpm/ft of drawdown, and are highly yield dependent. Yields generally vary from 600 to 1,200 gallons per minute, but may locally be higher. High-yield wells are often accompanied by several hundred feet of drawdown.

The principal recharge mechanism is outcrop infiltration, and recharge rate estimates for the Madison aquifer of the system range from 8,000 to over 100,000 acre-feet per year. Although the basal Minnelusa and Madison aquifers are hydraulically connected, little interformational mixing occurs between other aquifers comprising the system, except along structurally disturbed zones.

Near outcrop, Madison aquifer waters contain less than 600 mg/l total dissolved solids (TDS) and are primarily calcium-magnesium bicarbonate. Basinwide, TDS increases to over 3,000 mg/l with sodium sulfate-chloride predominating. Near outcrop Minnelusa aquifer waters are generally similar to Madison aquifer waters, although some waters in the east part of the basin show higher (up to 3,000 mg/l) TDS and calcium sulfate enrichment. Deep basin Minnelusa waters contain greater than 10,000 mg/l TDS and are primarily sodium chloride. Objectionably high concentrations of fluoride are often present. Chemical data for other aquifers of the system are sparse, but indicate somewhat similar chemistry.

3. The Lower Cretaceous Dakota aquifer system is a potentially important shallow water source in the northeastern part of the basin. The thick sedimentary sequence can produce large amounts of water at the expense of hundreds of feet of drawdown. Current interest in the aquifer system is limited because in the same area the Madison system is at an economically attractive drilling depth.

The Fall River and Newcastle ("Muddy") formations of the system are significant oil producers through primary and secondary recovery methods. The Lakota and Fall River formations contain important uranium deposits in the Black Hills region.
The lenticular nature of sandstone bodies results in spatially variable aquifer properties. Transmissivity values are poorly known, but are typically estimated between several hundred and several thousand gpd/ft. Specific capacities generally range from 0.1 to 1 gpm/ft. Existing yields are generally under 50 gpm. Higher yields are associated with large drawdowns.

Recharge is primarily through infiltration in outcrop areas. Upper Cretaceous shales (e.g., Pierre) effectively isolate the system from shallow aquifers.

Outcrop waters contain from 277 to 3,300 mg/l TDS. Major ion composition changes basinward from calcium-magnesium sulfate at the outcrop to sodium sulfate to sodium bicarbonate. Deep basin waters contain greater than 10,000 mg/l TDS and are enriched in sodium chloride.

4. The uppermost Cretaceous Fox Hills/Lance aquifer system is used for industrial applications in the northeast part of the basin and for municipal supplies in the southwest and northeast.

Aquifer properties are poorly known. Transmissivities vary from about 100 to 2,000 gpd/ft. Specific capacities are generally between 0.05 and 2 gpm/ft. Well yields up to 350 gpm occur, but are associated with long perforated intervals and large drawdowns.

Recharge occurs principally through downward leakage from overlying aquifers, supplemented locally by outcrop infiltration. Discharge is through subsurface flow to the north, and also to some principal stream valleys.

Outcrop waters contain from 350 to 3,000 mg/l TDS, and show a variable major ion composition. Central basin waters contain 1,000 to 3,500 mg/l TDS, and are sodium bicarbonate-sulfate in character. East basin waters often contain objectionable amounts of fluoride.

5. In the central part of the basin the Tertiary Wasatch/Fort Union aquifer system is the most important source of groundwater. It is developed extensively by shallow domestic and stock wells and also serves as a water source for several municipalities. The Fort Union Formation contains most of the Powder River basin coal reserves and the Wasatch Formation includes extensive uranium deposits.

Aquifer properties are locally unpredictable due to the widely varying lithologies. Transmissivities vary from 1 to 5,000 gpd/ft but locally clinker values are much higher, ranging up to 3,000,000 gpd/ft. Coal and clinker beds generally have higher transmissivities than sandstones. Specific capacities vary from less than 0.1 to 2 gpm/ft, although clinker wells with over 2,000 gpm/ft are reported. Yields of up to 250 gpm have been attained, but are associated with several hundred feet of drawdown or local recharge. Clinker wells may yield several thousand gpm.

Recharge occurs principally through outcrop infiltration but downward water leakage may also occur. Topographic valleys are important discharge points. Although shallow water circulation is under topographically controlled water table conditions, deeper strata have dominantly stratigraphically controlled
horizontal flow. Hydrologic conditions vary from water table to fully confined between and within individual water-bearing zones.

TDS content shows some apparent spatial distribution, ranging from 250 to 6,500 mg/l. Major ion composition varies widely, but deeper zones generally produce waters relatively enriched in sodium bicarbonate. Good quality water is obtainable from water-bearing zones associated with recharge zones.

6. Minor aquifers (Permo-Triassic, Sundance, and Upper Cretaceous aquifers) produce adequate amounts of water for many purposes, but water is of marginal to poor quality for domestic use. The aquifers are only locally exploited, with the Permo-Triassic and Sundance aquifers important in the northeastern part of the basin; and the Upper Cretaceous aquifers important in the southwest. The Sundance and Upper Cretaceous formations are significant oil producers through primary and secondary recovery methods.

Little hydrologic data for these aquifers are available, with the exception of oil field data. Reported water yields are generally small. Recharge is through outcrop infiltration of precipitation, but water circulation through the central part of the basin is likely restricted.

Total dissolved solids often exceed 1,000 mg/l; dissolved sodium sulfate or bicarbonate predominate near the outcrops, and sodium chloride brines in the central part of the basin. Objectionable levels of selenium and fluoride are often present in water from the Upper Cretaceous aquifers.

7. Middle Tertiary aquifers and Quaternary alluvial aquifers are locally important water sources where present in the southeast and in the west and south parts of the basin, respectively, where they provide municipal water supplies.

Reported yields of wells in the Middle Tertiary aquifers exceed 1,000 gpm southeast of the study area; within the area investigated, specific capacities typically range from 0.2 to 4 gpm/ft but can exceed 200 gpm/ft. Precipitation infiltration through outcrops is the principal recharge mechanism.

Wells completed in the Quaternary alluvial aquifers can yield over 1,000 gpm, although much of the yield may be induced recharge from adjacent rivers. Transmissivity of alluvial aquifers is dependent on saturated thickness and sediment size; reported values range from 15 to 64,000 gpd/ft.

Water from the Middle Tertiary aquifers generally has less than 500 mg/l TDS, with dissolved sodium bicarbonate dominant.

Alluvial aquifers often contain water with over 1,000 mg/l TDS, but in places adjacent to the North Platte River TDS concentrations are lower, reflecting the influence of surface water. Alluvial aquifer waters vary in composition, containing sodium, calcium, bicarbonate, and sulfate.

8. Within the Powder River basin, concentrations of water quality parameters that exceed U. S. Environmental Protection Agency primary drinking water standards include selenium, fluoride, radium-226, gross alpha radiation, and occasionally nitrate, mercury, and lead.
Selenium concentrations in excess of 0.01 mg/l Se are geographically confined to the far southwestern part of the basin, and are produced from wells completed in isolated Upper Cretaceous aquifers or associated alluvial aquifers. Fluoride concentrations in excess of 2.4 mg/l were measured in groundwater from a number of geologic formations and many geographic areas within the basin. The Madison system throughout much of the basin, the Fox Hills/Lance in the eastern basin, and isolated Upper Cretaceous aquifers in the southwestern part of the basin typically produce waters with high concentrations of fluoride.

Concentrations of radium-226 greater than the drinking water standard (5 pCi/l) were measured at two Madison aquifer wells, as well as numerous Wasatch/Fort Union wells located near uranium ore zones. Gross alpha radiation in excess of the drinking water standard (15 pCi/l) was measured in two wells from each major pre-Tertiary aquifer system as well as numerous Wasatch/Fort Union wells in uranium ore zones.

Mercury and lead concentrations greater than drinking water standards (0.002 mg/l Hg and 0.05 mg/l Pb) were measured at one mine site in the southwestern portion of the basin in Wasatch Formation groundwater. Nitrate levels which exceed the drinking water standard (10.0 mg/l N) are found sporadically in water from shallow wells in several aquifers.

The secondary standards for sulfate (250 mg/l SO₄⁻obile) and TDS concentrations (500 mg/l) are exceeded throughout much of the basin in all water-bearing units. Waters with less than 500 mg/l TDS concentration are generally restricted to the Madison aquifer system near the basin flanks, to parts of the Wasatch/Fort Union system, and to the Middle Tertiary aquifers and Quaternary alluvial aquifers. Although recommended standards are exceeded, the sulfate-rich groundwaters of the basin are used by many of its residents.

9. A precise tabulation of groundwater use by economic sector and source aquifer is impossible until more actual withdrawal data are available. Approximately 128,000 to 148,000 acre-feet of groundwater are used each year in the Powder River basin, accounting for roughly one-third of all water used within the basin. Estimates identify the petroleum industry as withdrawing the greatest amounts of groundwater, followed by irrigation users and public and private domestic drinking water supplies.

Industry uses roughly 66,000 to 73,000 acre-feet of water within the Powder River basin. Most is groundwater withdrawn by the petroleum industry during oil production.

Overall agricultural water use in the Powder River basin is roughly 250,000 to 300,000 acre-feet per year, of which about 33,000 to 45,000 or more acre-feet per year is groundwater. Irrigation of 37,272 acres accounts for 66 to 76 percent or more (22,000 to 34,000+ acre-feet per year) of the estimated amount of agricultural groundwater used. Stock watering uses about 11,000 acre-feet per year, derived from the shallowest aquifers in any given area through low-yield intermittent production wells.

Public and private domestic drinking water use totals about 33,200 acre-feet per year and groundwater represents slightly more than three-quarters of the total (25,500 acre-feet per year). Community supply systems account for 79 percent of the total domestic use. They use 71 percent groundwater (18,455
acre-feet per year), principally from the Madison and Wasatch/Fort Union aquifer systems in the east and central parts of the basin, respectively, the Quaternary alluvial aquifers in the southwest part of the basin. Municipalities in the northwest part of the basin use surface water, while other community systems nearby tap the Wasatch/Fort Union aquifer system. Non-community public and private domestic water needs are met by numerous shallow, low-yield, intermittently producing wells at the point of use, and aggregate water use is about 7,000 acre-feet per year.

A much more thorough analysis of groundwater potential in the study area was completed in 1982 by Western Water Consultants of Laramie and Sheridan. The study, entitled "Potential for Ground Water Development, City of Sheridan, Wyoming," was funded by the Water Development Commission under the auspices of the Ground Water Exploration Grant Program. Since the focus of the study was to locate a supplemental supply of up to 3,700 gpm for the city of Sheridan, the groundwater potential of a study area encompassing approximately 500 square miles in the southwestern corner of Sheridan County, Wyoming was considered. The area includes most of the drainage basins of Big Goose and Little Goose Creeks above Sheridan, and that of the Tongue River from approximately the confluence of North and South Tongue to the town of Ranchester. Study area boundaries were established with consideration of potential water transmission costs, aquifer depths, and groundwater quality and yield. Figure 2 shows the location of the Sheridan groundwater study area in relation to the principal drainages and towns.

The geologic and hydrologic analyses presented in the Western Water Consultants' report indicate that the combined Lance-Fox Hills and Fort Union Formations and the Madison aquifer system have geologic and hydrologic potential for development of municipal water supply wells. The sandstone of the Mesa Verde group also have some possibilities, but due to questionable water quality and expected low yields the Mesa Verde has less potential than either the Lance-Fox Hills-Fort Union or the Madison aquifer.

1. Madison Aquifer Sites

Three potential exploration sites in the Madison aquifer system have been identified by Western Water Consultants as having good water quality and a high probability of fracture-enhanced permeability. Large-yield Madison wells with high-quality water have been completed in Area II, and intense folding and faulting in Area I make it very probable that groundwater circulation is adequate to provide high-quality water in adequate amounts for municipal use. Gulf Exploration is currently drilling an oil well in Area I and reliable water production data may be available soon. Within Area III, enhanced fracture permeability is associated with only minor folding; however, the quality of the groundwater is good. The fracture density of the gentle folding in Area III could prove to be insignificant, and the chances for successfully developing a high-yield well in this area are considered much lower than for Areas I or II.

A properly designed and constructed Madison aquifer production well could yield 500 gpm of good quality water.

Drilling time costs and material costs for casing, concrete, drill bits and drilling mud were obtained from local drillers and suppliers. Water well drillers experienced in completing Madison aquifer wells in Wyoming estimated independently that the total cost of this well would be about $750,000 to
$800,000 (personal communications with Lawrence Materi, Materi Exploration, and Roger Schocke, Schocke Drilling, July 1982).

The cost estimates are based upon the aquifer depth below the outcrop of the Cody Shale in the eastern one-third of target drilling Area II and the eastern one-half of Area III. This area was chosen for design and cost estimating purposes because production wells locating in this area would be sufficiently removed from the Madison aquifer outcrops that the potential for surface water depletion due to groundwater drawdown would be minimized. The design and cost analysis are not applicable to target area I, where fault displacement of the Madison aquifer along the Little Goose Fault exceeds 9,000 feet. The cost of a production well in Area I would be much greater than for either Areas II or III due to greater well depths required to penetrate the Madison aquifer.

Estimates do not include land acquisition or debt service.

Potential Water Right Conflicts Associated with Madison Aquifer Production Wells

The Western Water Consultants' report indicates that Madison aquifer production wells in Areas I, II or III could potentially diminish streamflows in Little Goose Creek, Tongue River, and Big Goose Creek drainages, respectively. With the exception of flood flows, these streams are already overappropriated for other uses, and water right conflicts would likely result from high-volume Madison aquifer production.

Streamflow studies conducted by the Wyoming State Engineer's Office (1976) demonstrate that Little Goose and Big Goose Creeks and the Little Tongue and Tongue Rivers are all in hydraulic continuity (either gain or lose water, or both) with the Madison aquifer along outcrops of the aquifer immediately west of Areas I, II and III.

The percentage of pumped water that would be diverted from the streams depends upon the hydraulic properties of the aquifer, the distance from the pumping wells to the streams and the pumping durations. Accurate assessment of the hydraulic properties of the aquifer could only be made through long-duration pump testing of test wells.

2. Lance-Fox Hills/Fort Union Site

Quality of groundwater from the combined Lance-Fox Hills and Fort Union Formations is variable, and may have to undergo desalination or be blended with other sources to be suitable for municipal use. However, data from a Lance well located northwest of Dayton (not in the study area) and from another Lance well west of Dayton indicate that a well near the outcrop area could have water quality within the maximum EPA drinking water limits of 500 mg/l TDS. Data indicate that a production well developed in these formations could yield up to 300 gpm.

The yield of a water well developed in the Lance-Fox Hills and Fort Union Formations would be primarily dependent upon the thickness and hydrologic characteristics of the lenticular sandstones existing in the formations at the development site. The occurrence and hydrologic characteristics of sandstones
within these formations are unpredictable, and selection of an optimum drilling site based merely on examination of surficial geology and data from nearby oil exploration holes is not possible. While individual sandstone units are not correlatable over great distances, the number and total thickness of sandstone units are roughly the same throughout the study area. Therefore, one site has about the same yield potential as another provided a recharge source is available. The quality of groundwater in the Lance Formation deteriorates with distance from outcrop recharge areas. For this reason a site selected near the outcrop of the formation has a better potential for encountering groundwater of quality suitable for municipal use.

A development site in the southern one-half of Section 9, Township 55 North, Range 85 West would be near the outcrop zone of the Lance Formation. The Fort Union Formation at this site is about 1,400 feet thick, and the Lance-Fox Hills about 1,800 feet thick. Total well depth would be approximately 3,200 feet. Drilling time and material costs are all dependent upon the geologic and hydrologic conditions existing in the formations at the site, but the total cost is estimated at $190,000 to $200,000. This estimate does not include land acquisition costs or debt service.

Costs for development of the Lance-Fox Hills and Fort Union Formations would probably greatly exceed the single well cost. Because relatively low yields (approximately 300 gpm) are expected from these formations, a battery of production wells would be required in order to provide an adequate, reliable supply.

Potential for Water Right Conflicts Associated with Lance-Fox Hills and Fort Union Production Wells

The permeability of the sediments in the Lance-Fox Hills and Fort Union Formations is dependent primarily upon the assembly (size and packing) of mineral grains (primary permeability), and to a lesser extent upon the density and orientation of fractures (secondary permeability). Because the sandstone units of the Lance-Fox Hills and Fort Union Formations have primary permeability, a component of recharge is from precipitation throughout outcrop areas. Potentially the greatest recharge per unit area occurs where sandstones crop out in the channels or subcrop in the saturated alluvium of perennial streams. Downdip of its outcrop zone, the Lance Formation probably receives some recharge in the form of vertical leakage from the overlying Fort Union Formation.

Insufficient data exist to evaluate the hydraulic continuity between groundwater in the Lance-Fox Hills and Fort Union Formations and streamflows in the vicinity of the most favorable development site of these formations near Beckton, Wyoming. Depending upon the pumping rate and time and the permeability of the aquifer, essentially any groundwater production can eventually begin to draw from surface water sources. The Lance-Fox Hills and Fort Union Formations receive recharge from precipitation over a much broader area than does the Madison, indicating that some groundwater production from these formations may not measurably affect adjacent streamflows. The potential for depleting streamflow through the withdrawal of groundwater from these formations, however, can only be accurately assessed through aquifer pump testing.
III. Potential for Delivery of Groundwater to the Woodland Hills Improvement and Service District and the Town of Big Horn.

A portion of the enabling legislation authorizing the present study directed the Water Development Commission to locate a source of water to supply the Woodland Hills Improvement and Service District, an area encompassing approximately 50 square miles located between the south city limits of Sheridan and the Town of Big Horn.

A project submitted to the Water Development Commission in December of 1982 requested assistance in determining the feasibility of an enclosed rural water distribution system to serve the unincorporated town of Big Horn, the Woodland Park School, and approximately 750 rural homes in the project area.

According to the project application, the area is presently serviced by individual shallow (40 feet to 60 feet deep) wells. Water quality is poor. One household well in the area was tested in 1978 with the following results:

<table>
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<th>ITEM</th>
<th>EPA RECOMMENDATION</th>
<th>TEST RESULTS</th>
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<tr>
<td>TDS</td>
<td>500 mg/l</td>
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</tr>
<tr>
<td>Sodium</td>
<td>200 mg/l</td>
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</tr>
<tr>
<td>Sulfate</td>
<td>250 mg/l</td>
<td>1,012 mg/l</td>
</tr>
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</table>

In addition, some wells are reportedly contaminated by inflow from septic tanks.

An undated study (1979-80?) prepared by the Old West Rural Water Office of the Old West Regional Commission addressed the possibility of developing a rural water for the "urbanized" area of Story, the Big Goose Valley, and Little Goose Valley/town of Big Horn.

The study speculates that a well drilled to a depth of 900 feet near the State Fish Hatchery would penetrate the Madison Formation and produce between 250 and 400 gpm. Data from more reliable sources indicates an insufficient saturated thickness to produce the design amount of water at this location. The study also recommends that "appropriated but unused" water now stored in reservoirs in the Little Goose drainage be obtained to supply an estimated 2,000 households in Big Horn and the Little Goose drainage, including the Woodland Hills Improvement and Service District. The study estimated that a system using surface water and supplying the study area would cost in excess of $6,500,000, not including purchase of water. Operation and maintenance costs, including debt service for 40 years at 5%, were estimated at $475,000 per year. If users assumed all costs, water bills for an estimated 1,200 households would be approximately $34 per month.

As a part of the Level II study, further analysis should be made of both groundwater and small reservoirs on Little Goose Creek as potential sources of domestic supply for this portion of Sheridan County. An important facet of this investigation should be a determination of the willingness of project beneficiaries in the Big Horn-Woodland Hills area to support the project, pay operation and maintenance costs, and repay all or a portion of project...
construction costs. In order for study to proceed past Level II, it may be necessary for potential beneficiaries in the area to form a legal entity.

Conveyance of Madison Water to Service Areas

The Western Water Consultants' study estimated that construction of a pipeline to delivery water from the Madison Drilling Area I to Sheridan's intake structure on Big Goose Creek, a distance of approximately 57,000 linear feet, would cost approximately $720,000 (1982 dollars) for a 6-inch line and $941,000 for a 8-inch line. Annual costs for either line, including pumping costs for the well and debt service, would be approximately $150,000 per year for an annual yield of 730 acre-feet, or approximately $200 per acre-foot of water delivered to the Sheridan intake structure.

Using WWC figures, WWDC staff estimated costs to delivery water to the Woodland Hills Service and Improvement District along a route paralleling Little Goose Creek. Costs are Level I estimates only and should be used only for comparison with other Level I cost estimates.

These estimates indicate that total construction costs for two 3,500 feet Madison wells and a pipeline to the Woodland Hills Improvement and Service District would be approximately $2,350,000. Annual costs are estimated at between $200,000 and $250,000, or a monthly water bill of $15 for the estimated 1,200 households.
**Project**: Tongue River/Woodland Hills  
**Structure**: Pipeline from Madison Drilling Area I to Woodland Hills Subdivision  
**Date**: November 14, 1983

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</table>
APPENDIX A

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1978 42 p. tables
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LOCATIONS: STE
APPENDIX B

Groundwater Bibliography


APPENDIX C

Tongue River Basin
Level I Report on Potential Fishery Impacts
TONGUE RIVER BASIN
Level I Report on Potential Fishery Impacts

Presented to:
State of Wyoming
Wyoming Water Development Commission

January, 1984

By
Wyoming Game and Fish Department
Fish Division
INTRODUCTION

Enrolled Act No. 110, Seventh Legislature of the State of Wyoming enacted a basin-wide evaluation for a water development plan for the Tongue River Basin. This report presents the fishery concerns associated with water development in the Tongue River Basin.

The objective of this Level I report is to identify areas in the Tongue River Basin where fishery concerns could present potential conflicts to water development. This information is presented to aid evaluation and resolution of potential conflicts in the water development planning process.

Stream reaches are identified as having high, moderate, and low or no potential fishery conflict. Although final project design will dictate the actual degree of impact, the aquatic impact potential which might result from a planned or future development activity is addressed by this report. Close coordination with the Game and Fish Department is recommended on those areas with high and moderate potential conflict to incorporate features which will minimize conflicts and avoid development where potentially serious conflicts cannot be eliminated by design features.

Water development projects may offer the opportunity for fisheries enhancements, but until project designs are available, only broad generalities can be made about potential fishery benefits. Areas of low or no conflict present the opportunity for the greatest fishery benefits. These beneficial aspects could include development of reservoir habitat, instream flow enhancement, protection from habitat degradation due to flooding, and increased public access. Determination of beneficial impacts to the fishery resource by stream reach is not possible with current available information. As projects proceed through Wyoming’s water development process (Level I, II, and III) determination of these public benefits will be made. While areas of low or no conflict offer the greatest opportunity for enhancement, increasing degree and number of conflicts will require increasingly intensive mitigation measures with reduced opportunity for beneficial impacts.

METHODS

Stream Evaluation

Stream reaches were evaluated using four criteria. The first was stream class. Classification of stream fisheries is composed of five categories:

Class 1. Premium trout waters, fisheries of national importance.
Class 2. Very good trout waters, fisheries of statewide importance.
Class 3. Important trout waters, fisheries of regional importance.
Class 4. Low production waters, fisheries frequently of local importance but generally incapable of sustaining substantial fishing pressure.
Class 5. Very low production water, often incapable of sustaining a fishery.

Class 1 and 2 streams represent the very best stream fisheries in Wyoming. This very valuable and scarce public resource warrants protection. These streams comprise only 10.4% of the total stream miles in Wyoming. Also, Class 1 and 2 streams typically are streams which have fishery values and characteristics which cannot be replaced by a reservoir. For these reasons, a high degree of conflict with proposed development could exist on any Class 1 or 2 stream reach.

The importance of the fishery resource decreases from Class 3 to Class 5. Moderate conflicts would be expected on Class 3 streams. Class 4 streams present low conflicts and the opportunity may exist to enhance the fishery resource on some of the lower class streams. Information on stream class was obtained from the Wyoming Game and Fish Department (WGF) Stream and Lake Inventory. This computerized inventory and classification of Wyoming fisheries was developed in late 1960's and has been updated annually.

Presence of aquatic species was the second criterion. Species were ranked using the following criteria:

I. Federally listed threatened or endangered species.

II. State listed rare and sensitive (Wyoming Game and Fish, 1977), which include:

1. A species that occupies only a small percentage of the preferred habitat within its range or a species that is found throughout its range in extremely low densities; cannot always be found by a skilled observer even during intensive survey work,

2. Species with known declining populations and/or habitat conditions or with indicators that their populations and/or habitat conditions are declining throughout all or part of their geographic range. Known accidental species records are not included,

3. High priority to maintain or increase current population levels or to document population levels of undetermined species. Species of high interest.

III. Indigenous trout species.

IV. Game fish.

Documented federally listed, threatened or endangered or state listed rare and sensitive species (both game and nongame fish) were ranked as a potentially
Native game fish species were rated as having a moderate conflict and non-native game fish were rated as a low conflict. This criterion only addresses the presence of documented species. Issues pertinent to a particular fish population (e.g., high standing crop, self-sustaining) are addressed in other criteria.

No rare or sensitive fish species have been documented in the Tongue River Basin.

The third criterion was the management concept under which the stream is managed.

The five concepts are: wild, species, trophy, basic yield and put-and-take (Stone 1978).

The objective of the wild concept is to provide fishermen with the opportunity to catch fish which are of wild origin. Such fisheries are supported entirely by natural recruitment. Waters considered for this concept must have those attributes which allow fish to complete their full life cycles in adequate numbers to support a fishery. This excludes the application of this concept from many waters and emphasizes the importance of preserving the integrity of these aquatic ecosystems so that management under this concept can be maintained. The following criteria have been established as guidelines for management under the wild concept:

1. Waters with high natural recruitment potential.

2. Population densities must be capable of sustaining a fishery without supplemental stocking.

The species concept is applied to fisheries where the main management objective is to provide a fishery comprised of a particular species or subspecies. Prime examples are management of certain streams to maintain or reestablish their native trout species.

The trophy concept is nearly self-explanatory. The objective of management under this concept is to provide the opportunity to catch larger than average or trophy fish.

The objective of the basic yield concept is to provide general fishing opportunity. These fisheries are primarily supported by fish which are of hatchery origin but which grew to a catchable size in the wild. This is in contrast with situations where fish raised to a catchable size in a hatchery are stocked.

The put-and-take or catchable concept is based upon the stocking of fish which were raised to a catchable size in the hatchery.

Species present, in addition to the management concept, were used to evaluate the potential conflict for this criterion. Streams with indigenous game fish and managed under the wild, species, or trophy concept were rated as having a potentially high conflict. Streams with non-native game fish managed under
wild, species, or trophy, were rated as moderate conflict. Basic yield regardless of the species was also rated as a moderate conflict. Streams managed under the put-and-take concept have a low conflict.

The fourth criterion, utilization, was used to address the myriad of special uses associated with the lotic resource. Examples of a high conflict special use would be a stream under study for inclusion in the Wild and Scenic River System or serving an irreplaceable state or federal function (e.g., wild brood stock) or intensive public use. An example of moderate conflict would be high public use. A brief explanation is provided for the special uses which have a high or moderate conflict in the matrix analysis.

While not used in the matrix analysis, the U.S. Forest Service has developed a method to insure maintenance of stream channel integrity (Rosgen, 1982). Consultation with the Big Horn National Forest is recommended regarding their use of this methodology. The Big Horn National Forest also provided a list of areas where water development is restricted on the Forest (Appendix A).

**Matrix Analysis**

Each stream or stream reach was ranked in descending order by the degree of potential conflict using matrix analysis (Table 1). Some streams are broken down into stream reaches for the Department's management purposes. These reaches are identified by stream name and water number associated with the particular reach in the Stream and Lake Inventory. A stream reach with a high conflict for each of the four criteria would present the highest potential conflict. Using this logic, a stream with a high conflict under only one criterion, while still having a high conflict, would be rated below a reach which has a high conflict under more than one criterion. The various classification reflects only relative potential impacts and should not be used to obtain a point score or a specific quantitative estimate of impacts.

**Basin Map**

A map was prepared which illustrates the streams and the potential conflict associated with each reach. Bureau of Land Management surface management quad maps were used as the base map. Each stream or stream reach is delineated by name, water number, and degree of potential conflict.
Table 1. Conflict classification summary for level I basin-wide evaluations

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<tr>
<th>Category</th>
<th>Description</th>
<th>Potential</th>
<th>Conflict</th>
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<tr>
<td>Stream Class</td>
<td>1</td>
<td>High</td>
<td>H</td>
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<tr>
<td></td>
<td>2</td>
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<tr>
<td></td>
<td>3</td>
<td>Moderate</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Low</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Species Present</td>
<td>Federally listed threatened or endangered</td>
<td>H</td>
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<tr>
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<td>State listed rare</td>
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<td>H</td>
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<tr>
<td></td>
<td>Native game fish</td>
<td></td>
<td>M</td>
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<tr>
<td></td>
<td>Non-native game fish</td>
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<td>L</td>
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<tr>
<td>Management Concept</td>
<td>Species, Trophy</td>
<td></td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Wild - native game fish</td>
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<td>H</td>
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<td></td>
<td>Wild - non-native game fish</td>
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<td>M</td>
</tr>
<tr>
<td></td>
<td>Basic yield</td>
<td></td>
<td>M</td>
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<td></td>
<td>Put and take</td>
<td></td>
<td>L</td>
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<tr>
<td>Special Use</td>
<td>Wild and Scenic (existing or proposed)</td>
<td>H</td>
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</tr>
<tr>
<td></td>
<td>Serves irreplaceable state or federal function</td>
<td>H</td>
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<tr>
<td></td>
<td>Intensive public use</td>
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<tr>
<td></td>
<td>Serves replaceable state or federal function</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate to high public use</td>
<td></td>
<td>M</td>
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</table>

RESULTS

The conflict classification matrix (Table 2) lists stream reaches in descending order based on the degree and number of potential conflicts; however, it is not a quantitative ordering, only relative potential impacts. The map located in Appendix B is offered to further illustrate the streams and potential conflicts. Some streams which were included on the basin map lack fisheries information.

Information was available to evaluate 76 streams and/or stream reaches in the Tongue River drainage. Five streams show high potential conflict in at least one of the four conflict categories. Moderate potential conflict (but no high conflict) exists on 46 streams. Twenty-four streams with fisheries information were rated as having low or no potential conflict.

The five streams which were identified as having high potential conflicts are:

1. Tongue River - 2 reaches 831104-17 and 931106-17.
4. Babione Creek - 831300-17.
5. Big Goose Creek - 831160-17.
Table 2. Conflict classification matrix for all streams managed by the Wyoming Game and Fish Department in the Tongue River Drainage.

<table>
<thead>
<tr>
<th>Stream and Conflict Classification</th>
<th>Stream Location*</th>
<th>Water Number</th>
<th>Conflict Rating</th>
<th>Stream Class</th>
<th>Species Present</th>
<th>Management Concept</th>
<th>Special Use</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tongue River</td>
<td>R87W,T56N,S9</td>
<td>831-106-17</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>H</td>
<td>H</td>
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<td></td>
</tr>
<tr>
<td>North Tongue River</td>
<td>R88W,T56N,S22</td>
<td>833-030-17</td>
<td>H</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td></td>
</tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>South Tongue River</td>
<td>R88W,T56N,S22</td>
<td>832-600-17</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>M</td>
<td>H</td>
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<td>Tongue River</td>
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<td>831-104-17</td>
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<td>L</td>
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<td>Babione Creek</td>
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<td>H</td>
<td>M</td>
<td>M</td>
<td>H</td>
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</tr>
<tr>
<td>Big Goose Creek</td>
<td>R86W,T55N,S35</td>
<td>831-160-17</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>M</td>
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</tr>
<tr>
<td>E. Fork Big Goose Creek</td>
<td>R86W,T54N,S9</td>
<td>831-270-17</td>
<td>M</td>
<td>M</td>
<td>M</td>
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<tr>
<td>W. Fork So. Tongue</td>
<td>R88W,T54N,S3</td>
<td>832-840-17</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td>M</td>
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<tr>
<td>E. Fork So. Tongue</td>
<td>R88W,T54N,S3</td>
<td>832-910-17</td>
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<tr>
<td>Bull Creek</td>
<td>R89W,T55N,S4</td>
<td>833-240-17</td>
<td>M</td>
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<td>M</td>
<td>M</td>
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</tr>
</tbody>
</table>

Notes: *Location in the form R87W, T56N, S9, where R87, T56, S9 are the respective meridian, township, and range coordinates. Water number format: 831-106-17 indicates a water number of 831, section number 106, and range 17.

- **Conflict Rating**: H (High), M (Medium), L (Low).
- **Stream Class**: H (High Productivity), M (Medium Productivity), L (Low Productivity).
- **Species Present**: M (Present), H (High), L (Low).
- **Management Concept**: H (High), M (Medium), L (Low).
- **Special Use**: H (High), M (Medium), L (Low).
- **Comments**: High productivity-5. High pressure-150 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
- **Pressure**: 334.8 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
- **Pressure**: 546 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
- **Pressure**: 300 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
- **Pressure**: 90 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
- **Pressure**: 290.7 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
- **Pressure**: 306 fm/day/mi/yr. Eligible for inclusion in the Wild and Scenic Rivers System.
Table 2, Continued.

<table>
<thead>
<tr>
<th>Stream Name</th>
<th>Location*</th>
<th>Water Number</th>
<th>Conflict Rating</th>
<th>Stream Class</th>
<th>Species Present</th>
<th>Management Concept</th>
<th>Special Use</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>West Goose Creek</td>
<td>R86W,T54N,59</td>
<td>831-370-17</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>M</td>
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<td>Pressure high-359 fmn.days/mi./yr. Productivity-3.</td>
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<td>Tongue River</td>
<td>R85W,T57N,519</td>
<td>831-102-17</td>
<td>M</td>
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<td>M</td>
<td></td>
<td>High pressure-204 fmn.days/mi./yr. 2830 trout/mi.</td>
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<tr>
<td>Prune Creek</td>
<td>R88W,T55N,54</td>
<td>832-660-17</td>
<td>M</td>
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<td>Pressure high-200 fmn.days/mi./yr. Productivity 2. 1580 trout/mi, 46.8 lb/a.</td>
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<td>Pressure high-280.5 fmn.days/mi./yr. Productivity-3.</td>
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<td>Pressure high-281.6 fmn.days/mi./yr. Productivity-3.</td>
</tr>
<tr>
<td>Prospect Creek</td>
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<td>Pressure high-200 fmn.days/mi./yr. Productivity-3.</td>
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<tr>
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<td>Pressure high-227 fmn.days/mi./yr. Productivity-3.</td>
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<td>Pressure High-147.8 fmn.days/mi./yr. Productivity-3.</td>
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<tr>
<td>Tongue River</td>
<td>R83W,T58N,524</td>
<td>831-100-17</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td></td>
<td>High Pressure-123.2 fmn.days/mi./yr.</td>
</tr>
<tr>
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<td>R84W,T55N,522</td>
<td>831-530-17</td>
<td>M</td>
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<tr>
<td>E. Fork Big Goose Creek</td>
<td>R86W,T53N,521</td>
<td>831-280-10</td>
<td>M</td>
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<td>1,298 trout/mi., 38.95 lb/a.</td>
</tr>
<tr>
<td>West Goose Creek</td>
<td>R87W,T53N,511</td>
<td>831-375-17</td>
<td>M</td>
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<td>L</td>
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<tr>
<td>Columbus Creek</td>
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<tr>
<td>Sheep Creek</td>
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<td>832-460-17</td>
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<td>L</td>
<td>M</td>
<td>396 fmn.days/mi./yr. 54.7 lb/a. Brook trout fishery contains individuals of larger than average size for Big Horn Mountain streams.</td>
</tr>
<tr>
<td>Stream Name</td>
<td>Location*</td>
<td>Water Number</td>
<td>Conflict Rating</td>
<td>Stream Class</td>
<td>Species Present</td>
<td>Management Concept</td>
<td>Special Use</td>
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<td>R88W,T55N,S27</td>
<td>832-800-17</td>
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<td>L</td>
<td><img src="image" alt="Image" /></td>
<td>2013 trout/mi., 43.7 lb/a.</td>
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<td>R89W,T56N,S36</td>
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<td>L</td>
<td><img src="image" alt="Image" /></td>
<td>Pressure high-343 fm.m.days/mi./yr.</td>
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<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
</tr>
<tr>
<td>Sawmill Creek</td>
<td>R87W,T54N,S25</td>
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<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
</tr>
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<td>Coney Creek</td>
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<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
</tr>
<tr>
<td>E. Fork Little Goose</td>
<td>R85W,T53N,S20</td>
<td>831-810-17</td>
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<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
</tr>
<tr>
<td>Wolf Creek</td>
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<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
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<td><img src="image" alt="Image" /></td>
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<td>Amsden Creek</td>
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<td>L</td>
<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
</tr>
<tr>
<td>Big Goose Creek</td>
<td>R85W,T55N,S10</td>
<td>831-155-17</td>
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<td>L</td>
<td>L</td>
<td>M</td>
<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
</tr>
<tr>
<td>Little Tongue River</td>
<td>R86W,T57N,S32</td>
<td>832-340-17</td>
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<td>L</td>
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<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
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<tr>
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<td>R86W,T54N,S8</td>
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<td>M</td>
<td><img src="image" alt="Image" /></td>
<td>High pressure-123.2 fm.m.days/mi./yr.</td>
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<td>Soldier Creek</td>
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<td><img src="image" alt="Image" /></td>
<td>Productivity low-2.</td>
</tr>
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<td>831-500-17</td>
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<td><img src="image" alt="Image" /></td>
<td>Productivity low-1.</td>
</tr>
<tr>
<td>Cross Creek</td>
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<td><img src="image" alt="Image" /></td>
<td>Productivity low-1.</td>
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<tr>
<td>Teepee Creek</td>
<td>R85W,T54N,S33</td>
<td>831-760-17</td>
<td>M</td>
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<td>L</td>
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<td><img src="image" alt="Image" /></td>
<td>Productivity-2. Area around Sibley Lake receives high recreational and fishing use.</td>
</tr>
<tr>
<td>Stream Name</td>
<td>Location*</td>
<td>Water Number</td>
<td>Conflict Rating</td>
<td>Stream Class</td>
<td>Species Present</td>
<td>Management Concept</td>
<td>Special Use</td>
<td>Comments</td>
</tr>
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</tr>
<tr>
<td>Willow Creek</td>
<td>R85W, T53N, S8</td>
<td>831-860-17</td>
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<td>L</td>
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<td>Low pressure-15 fmn.days/mi./yr.</td>
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<td>Prairie Dog Creek</td>
<td>R83W, T58N, S23</td>
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<td>Pompey Creek</td>
<td>R83W, T54N, S15</td>
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<td>M</td>
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<td></td>
</tr>
<tr>
<td>Meade Creek</td>
<td>R83W, T55N, S28</td>
<td>831-090-17</td>
<td>M</td>
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<td>Pressure-high 211.1 fmn.days/mi./yr.</td>
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</table>

H = High Potential Conflict
M = Moderate Potential Conflict
L = Low Potential Conflict
N = No Potential Conflict

* Location represents downstream end of stream reach.
One reach on the Tongue River (831106-17) is a Class 1 water, the only Class 1 water in the Tongue River drainage. It is managed under the Wild concept and supports populations of cutthroat trout, brown trout, rainbow trout, brook trout, and mountain whitefish. This stream reach is also under study by the U.S. Forest Service for inclusion in the Wild and Scenic River System. A second reach on the Tongue River (831104-17) would also pose high potential conflict. This reach is a Class 2 water which provides a readily accessible public fishing area. Fishing pressure is approximately 1,300 fisherman days per mile per year, the highest of any stream reach in the drainage. Catchable rainbow trout (8+"") are stocked to augment the wild fish populations.

The North Tongue River (833030-17) and South Tongue River (831600-17) are both Class 2 waters. The South Tongue supports populations of rainbow, brown and brook trout. The North Tongue supports populations of rainbow, brook, and cutthroat trout. Both streams are managed under the Basic Yield concept with catchable rainbow trout stocked in each stream. The North Tongue is also stocked with fingerling (2"-4") cutthroat trout. The stocking is required because of the high fishing pressure received by both streams. Fishing pressure is approximately 635 fisherman days per mile per year on the North Tongue River and 546 on the South Tongue River. The entire North Tongue River and the South Tongue River study mouth upstream to R88W, T56N, S33 are under study by the U. S. Forest Service for inclusion in the Wild and Scenic River System.

Babione Creek (831300-17) supports a unique isolated population of grayling. Management is under the Species concept because grayling are the only species present from Weston Reservoir to Grayling Lake in the headwaters. The stream provides anglers with the opportunity to catch the uncommon grayling. Only 71.6 stream miles contain grayling in the entire state (0.4% of total stream miles).

One reach on Big Goose Creek (831160-17) is a Class 2 water. It is managed as a Wild fishery with self-sustaining populations of rainbow and brown trout.

DISCUSSION

Eight surface water resource development projects and numerous combinations of these projects have been evaluated (CH2M HILL, Inc. 1977). They involve development of mainstem Tongue River water through timed storage and release, diversion of mainstem Tongue River water to tributaries, and importation of Little Big Horn River water into the Tongue River Basin.

Alternatives, which are proposed for Level II analysis (Evan Green, WWD, December 1983), include:

1. South Fork Reservoir, T55N, R88W.
2. Upper State Line Reservoir, T58N, R83W.
3. Prairie Dog and State Line Reservoir, T58N, R83W.
4. Sheridan Canal using South Fork Reservoir, T56N, R87W.

The proposed South Fork Reservoir, located on the South Tongue River, is upstream of the Wild and Scenic River Corridor, but the fishery values of the
stream would pose high potential conflict. Reservoir construction at this site would impact the fisheries at the site by inundating stream habitat. The reservoir could also impact downstream fisheries through flow alterations.

Both the Upper State Line and Prairie Dog reservoirs are located on streams which would pose moderate conflict (Tongue River and Prairie Dog Creek, respectively). Primary concern in Wyoming would be the loss of stream habitat. Close coordination with Montana Department of Fish and Game will be required to address impacts to downstream fisheries through flow alterations.

If the South Fork Reservoir is developed in conjunction with the Sheridan Canal, the alternative would pose high potential conflict as previously stated. A simple diversion of water from the Tongue River may have beneficial impacts to the fishery resource if the diversion is limited to the spring high flow period. The locations and type of diversion structure as well as the timing and amount of water diverted will dictate the degree of impact.

RECOMMENDATIONS

1. Recognize the high and moderate potential conflict waters at the earliest stages of water development planning.

2. Emphasize development on low potential conflict waters first and moderate potential impact waters second.

3. Develop measures to minimize or avoid, if possible, impacts to the moderate and high potential impact waters if alternatives affecting these waters are considered. This should be done as early as possible.
Selected References


Wyoming Game and Fish Department. 1983. Stream and lake inventory. Wyoming Game and Fish Department, Cheyenne, Wyoming.
Appendix A
Mr. Allen Conder  
Wyoming Game and Fish Department  
5400 Bishop Blvd.  
Cheyenne, WY 82002

Dear Mr. Conder:

Your letter of June 21, 1983, requested our identification of stream reaches where new water development projects would present moderate or high potential conflicts with Bighorn National Forest management objectives. We have no site specific information of this type; however, water development is restricted on the following areas of the Forest.

1) Wild and Scenic River Study Area. Based upon the criteria in the Wild and Scenic Rivers Act, the Tongue (including South Tongue and North Tongue) and Little Bighorn Rivers have been determined to be eligible for inclusion in the Wild and Scenic Rivers System. Rivers which meet the criteria for eligibility must undergo further study to determine their suitability. A recommendation for management of the river results from this study. If the recommendation is to designate the river as a National Wild and Scenic River, it is presented in a legislative FEIS. Until such time as the suitability study and future management determination are completed, the rivers will be managed to retain those characteristics that resulted in the rivers being eligible.

2) Cloud Peak Primitive Area. The Primitive Area was classified under Regulation L-20 on March 5, 1932. Federal regulations (36 CFR 293.17) state that development of water storage projects which do not involve road construction may be permitted subject to such restrictions as the Chief, Forest Service, deems desirable.

3) RARE II.  
   Wilderness - roadless areas placed in this category are to be recommended to Congress for classification. The areas will not be available for activities that reduce the wilderness potential of the area.

Further Planning - areas placed in this category will be considered for all uses, including wilderness, during development of land and resource management plans. Activities that may reduce wilderness potential of the land will be prohibited except where prior legal rights exist.
Non-wilderness - these areas will remain essentially undeveloped until Forest land and resource management plans are completed unless the activities are already covered in existing multiple use, unit, or resource plans, i.e., timber sales under the existing timber plan.

If the present wilderness bill before Congress is passed, this will release further planning areas and non-wilderness to multiple uses other than wilderness.

I hope this information is useful to you. If you need additional information or have questions, please contact Bill Wood at 672-0751.

Sincerely,

EDWARD L. SCHULTZ
Forest Supervisor
APPENDIX D

Tongue River Basin
Level I Report on Terrestrial Wildlife Impacts
TONGUE RIVER PROJECT

Final
Level I Terrestrial Wildlife
Impact Report

Prepared by:
Bob Luce
Special Projects Biologist

Wyoming Game and Fish Department
Sheridan, WY

February, 1984
INTRODUCTION:

This Level I Report includes a review of data in the files of the Game and Fish Department and U.S. Forest Service, and one year of collection of limited field data on the potential impacts of the Tongue River Project on terrestrial wildlife and wildlife habitat. Wildlife present in the project area are listed, as well as habitats which will be impacted. A project area map is shown in Figure 1.

Preparation of this report included a review of Soil Conservation Service data on various aspects of the project, and review of CH2M Hill's report: "Pre-feasibility Study - Tongue and Little Bighorn River Basin Project" (March, 1977). Information in the Pre-feasibility Study was used for identification of potential developments since it provides the latest available data on the Tongue River Project.

PROJECT DESCRIPTION:

A number of potential water users have shown interest in water development in the Tongue River Basin in past years: 1) Pacific Power and Light (PP&L) for a coal-fired, steam generating power plant on Prairie Dog Creek; 2) the City of Sheridan for municipal water; 3) irrigators along Little Tongue, Wolf Creek, and Soldier Creek for supplemental irrigation water for 7,920 acres or replacement water which would allow development of up to 1,280 acres of new agricultural land along Big Goose Creek; and 4) industrial concerns associated with coal development. Hydroelectric facility development may be an option on one or more sites.

The current WWDC project is to further evaluate reservoir sites and canals which have been identified for possible development. Ninety-six
Figure 1. Tongue River Project Study Area.
(96) percent of current water use in the Upper Tongue Basin is for irrigation (Figure 1.1), and the greatest demand for additional water is also for irrigation. There were approximately 66,800 irrigated acres in the basin in 1975. The Soil Conservation Service estimates that 272,000 acres in the area are suitable for irrigation. The 1950 Yellowstone River Compact allocates 60% of Tongue River water to Montana and 40% to Wyoming.

Potential developments identified in the Prefeasibility Study include 7 reservoir sites, the Tongue River Diversion, and Sheridan Canal, which would transmit either South Fork Reservoir, Shutts Flat Reservoir, or Rockwood Reservoir water to a low elevation reservoir where it would be more available for use.

High elevation reservoir sites include North Fork, South Fork, Shutts Flat, and Rockwood (Figure 2-5). Lower elevation reservoir sites include Upper Stateline, Prairie Dog, and Beatty Gulch (Figures 6-8). Sheridan Canal and the Tongue River Diversion are shown in Figures 1a and 1b. Since there are a number of combinations of reservoir sites, some including Sheridan Canal or the Tongue River Diversion, terrestrial wildlife impacts of each proposed development are evaluated separately in this report.

PROJECT AREA DESCRIPTION:

The Tongue River heads in the Bighorn Mountains and flows 79 miles through Wyoming before leaving the state northeast of Sheridan. It continues through Montana and enters the Yellowstone River near Miles City. The Wyoming portion of the Upper Tongue River Basin is almost all in Sheridan County. Elevations range from 11,809 feet in the mountains to 3,460 feet at the Wyoming/Montana border. All of the proposed high eleva-
Figure 1.1 Irrigated Acreage in The Tongue River Basin. (Source Wyoming Water Planning Program)
Figure 2 North Fork Reservoir Study Area Map with Critical Habitat Plotted

LEGEND

- Moose Parturition & Summer Range
- Moose Summer Range
Figure 3 South Fork Reservoir Study Area Map with Critical Habitat Plotted
Figure 4 Shuts Flats Reservoir Study Area Map with Critical Habitat Plotted
Figure 6. Stateline Reservoir Study Area Map with Prairie Dog Towns Plotted.

LEGEND

- Prairie Dog Towns •
- H = High Density
- M = Medium Density
- L = Low Density
Figure 7. Lower Prairie Dog Reservoir with Prairie Dog Towns Plotted
LEGEND

Prairie Dog Towns •
L = Low Density
M = Medium Density

Figure 8. Beatty Gulch Reservoir Study Area Map with Vegetation Plotted
tion reservoirs are on National Forest land, and the North Fork and Rockwood sites are in a Wild and Scenic Rivers Study Area.

Low elevation reservoir sites are on private land except for scattered tracts of state land. Detailed land ownership has not been plotted, but a majority of the private land is owned by or optioned to coal companies or Pacific Power and Light.

HABITAT DESCRIPTION:

North Fork:

The North Fork Reservoir site is located on the North Fork of the Tongue River approximately three miles west of Burgess Junction. A reservoir of 814 surface acres would inundate approximately 100 acres of willow/Englemann spruce, 300 acres of willow, 300 acres of mountain grassland, some of which has stands of shrubby cinquefoil, and 114 acres of sagebrush grassland (Figure 2a). All vegetation north of the reservoir site is sagebrush grassland, and all vegetation south of the site is lodgepole pine. The willow complex which will be flooded by the proposed reservoir is unique along the North Fork for several miles upstream and downstream from the site.

South Fork:

Most of the 484 acres in the proposed reservoir is lodgepole pine, with sedge/grass/rush meadows along the river and sagebrush grassland or grassland on open slopes (Figure 3a). Lodgepole pine is the predominant habitat on both sides of the river.
Figure 2a North Fork Reservoir Study Area Map with Vegetation Plotted
Shutts Flat:

A reservoir of 250 acres would inundate two major habitats, lodgepole pine and rush meadow with scattered willow (Figure 4a). The 125 acres of rush meadow are most important to terrestrial wildlife since lodgepole pine is abundant in the vicinity.

Rockwood:

Rockwood Reservoir is located below the confluence of the North and South Forks of the Tongue River. A reservoir of 737 acres would inundate a narrow band of willow along the river, but most of the habitat is mountain grassland or lodgepole pine (Figure 5a). Since these two habitats adjoin the river within most of the proposed reservoir site, the wildlife value of this area is high.

Upper Stateline:

The proposed reservoir would inundate about 5,400 acres of land. All of the floodplain from the dam upstream approximately 10 miles would be covered, including the riparian zone, agricultural land, and some sagebrush grassland (Figure 6a). The cottonwood riparian zone is very valuable wildlife habitat since all of the surrounding area is dry sagebrush grassland.

Lower Prairie Dog:

The Prairie Dog Reservoir site will cover approximately 1,360 acres of land. The lower end of the reservoir site along the creek contains a riparian cottonwood zone which changes to boxelder at the upper end (Figure 7a). Most of the land adjacent to the creek is farmed. Sagebrush grassland borders the creek in some locations.
LEGEND

- Lodgepole pine
- Sagebrush/Grassland
- Willow
- Mountain-Footills Grassland
- Sedge/Grass/Rush Meadow
- Rock outcrop/rock piles

Figure 3 - South Fork Reservoir Study Area Map with Vegetation Plotted
Figure 6a: Stateline Reservoir Study Area Map with Vegetation Plotted
Figure 7a. Lower Prairie Dog Reservoir Study Area Map with Vegetation Plotted
Beatty Gulch:

This reservoir would inundate about 708 acres. The site is sagebrush grassland except the wheat fields along the west side and three small ponds with cattail stands in the bottom of the gulch (Figure 8a).

WILDLIFE IN THE PROJECT AREA:

Big game in the mountainous segment of the project area include elk, moose, white-tailed deer, and mule deer. Black bear, mountain lion, sandhill crane, blue grouse, sage grouse, and turkey are present. Mule deer, white-tailed deer, and antelope are found at low elevations in the project area along with turkey, sharp-tailed grouse, chukar, pheasant, gray partridge, sage grouse, Canada goose, and several species of ducks. There are numerous species of non-game birds and mammals in the project area.

The following sections list wildlife found on each proposed development site, and potential impacts and/or benefits of project developments.

North Fork Reservoir Site:

Elk:

The reservoir site is within elk summer range, but the site is not elk habitat. There is elk movement through the area, but no major migration routes. The most important elk habitat in the vicinity is immediately north of the reservoir site. These south facing sagebrush slopes and adjacent lodgepole pine stands are used for calving and spring/summer range.

The project area is in the Northeast Bighorn Elk Herd Unit, hunt area 38. The 1982 post-season population was estimated to be 2,087 animals.
Figure 8a. Beatty Gulch Reservoir Study Area Map with Vegetation Plotted
The herd is currently decreasing, and the objective is to increase numbers. Elk hunting takes place around, but not directly on, the reservoir site.

Moose:

The reservoir site is in moose yearlong range, most of which is considered critical range for this population (Figure 2). Moose inhabit the willow stands along the river all year except during the summer when fishermen use is high, or when large numbers of cattle graze the river bottom.

The project area is in the Goose Creek Moose Herd Unit, hunt area 1. The estimated 1982 post-season population was 152. The herd is increasing and the objective is a further increase in the population. The hunting season was closed in 1983, but 5 moose were harvested in 1982.

Mule Deer:

The proposed reservoir is in mule deer summer range in the East Bighorn Mule deer Herd Unit, hunt area 25. The herd is increasing and the objective is a further increase. Deer hunting is popular in the vicinity of the reservoir site, but not directly on it.

Non-game:

Table 1 lists 23 species observed on breeding bird censuses conducted in the six habitats found on the high elevation project sites in 1983. Appendix A contains bird species which might occur in the project area based on their general distribution in Wyoming.

Table 2 lists 9 non-game mammals trapped in the six habitats sampled in 1983. Appendix B contains mammal species which might occur in the area.
Other Game:

Other game or trophy game animals which inhabit the project area include black bear, mountain lion, blue grouse, sandhill crane, common snipe, and turkey.

South Fork and Shutts Flat Reservoir Sites:

Elk:

The reservoir sites are in elk summer range, and may lie in a migration corridor between summer range and the Amsden Creek Elk Winter Range. Most of the South Fork site is marginal elk range due to lack of elk habitat, human development in the area, and the presence of Highway 14. The herd unit and hunt area are the same as the North Fork Reservoir Site.

Moose:

The proposed reservoirs are in moose critical yearlong range and overlap several documented calving areas (Figure 3). Willow stands along the river are the main yearlong habitat component used by moose. Some of the South Fork site is not used because of disturbance from Highway 14 and human developments. The herd unit and hunt area are the same as described for the North Fork Reservoir Site.

Other Wildlife:

Mule deer and other game and non-game animals and birds are the same as described for the North Fork site since the same habitats are found on each site.
Rockwood Reservoir Site:

Elk:

The reservoir site is in high value elk range (Figure 5.1). Most of the site is elk calving area, and the lower part of the proposed reservoir adjoins critical winter range. There is general elk movement throughout the area, and two well documented movement corridors cross the reservoir site. The area is presently accessible only by foot or horseback from the north and by one 4-wheel drive road from Highway 14. The herd unit and hunt area were described for the North Fork Reservoir site.

Moose:

All of the proposed reservoir site is yearlong moose range. The lower part is critical moose range used for calving and winter range (Figure 5). The value of this area for moose is partially due to its remoteness. The herd unit and hunt area were described for the North Fork Reservoir site.

Endangered Species:

No endangered species have been seen on any of the high elevation reservoir sites, however, there is habitat for the bald eagle and peregrine falcon, and one or both may occur on these sites.

Other Wildlife:

Mule deer and other game and other non-game species are the same as described for the North Fork site.
Upper Stateline Reservoir Site:

Mule Deer:

The project site is in winter/yearlong mule deer range. There is no critical habitat on or adjacent to the project site. The Powder River herd unit, hunt area 23, which is east of the Tongue River, has had a rapidly increasing deer population in the last few years. The objective is to decrease the herd. The East Bighorn Mule Deer Herd Unit, hunt area 24, west of the Tongue River, also has an increasing population, but the objective is to further increase the herd.

White-tailed Deer:

The project is located in yearlong white-tailed deer range of high value to this species due to the wide riparian zone along the river. The Powder River white-tailed deer herd unit includes hunt areas 23 and 24. Most of the land in the herd unit is not usable range since deer are found only in riparian areas along rivers and streams.

Game Birds/Small Game:

The riparian zone along the Tongue River is high value habitat for turkey, gray partridge, pheasant, and mourning doves. Riparian areas are the only major habitat in the vicinity which supports these species. Cottontail rabbits occupy all habitats on the project area.

Endangered Species:

Several black-tailed prairie dog towns are located on or near the reservoir site (Figure 6). Black-footed ferrets may be present. A bald
eagle nested on the Tongue River near the lower end of the proposed reservoir in 1983 and possibly one or two years previously. The nest was successful and fledged two young eagles in 1983. Bald eagles winter along the Tongue River, and a roost is located downstream from Acme.

Waterfowl:

The Tongue River is used by Canada geese and a number of species of ducks during all seasons of the year. Since the project area is included in land owned or leased by Peter Kiewit & Sons Mining Company, their personnel have conducted waterfowl surveys on the river for several years. Breeding species identified include: Canada goose, mallard, common merganser, American wigeon, blue-winged teal, common teal, and wood duck (Brent Stettler, personal communication). The Game and Fish Department considers the Canada goose and wood duck priority waterfowl for which habitat loss would be especially significant.

Non-Game:

Table 3 lists 19 species observed on breeding bird censuses conducted in riparian cottonwood habitat along the Tongue River in 1983. PKS Mining Company personnel conducted aerial censuses along the Tongue River to locate raptor nests in 1983. Nesting species on the reservoir site included four red-tailed hawks, three great-horned owls, and a bald eagle (Brent Stettler, personal communication). A prairie falcon eyrie is located in Section 19, T58N, R84W, approximately one mile north of the river.
Upper Stateline Reservoir Site:

Mule Deer:

The project site is in winter/yearlong mule deer range. There is no critical habitat on or adjacent to the project site. The Powder River herd unit, hunt area 23, which is east of the Tongue River, has had a rapidly increasing deer population in the last few years. The objective is to decrease the herd. The East Bighorn Mule Deer Herd Unit, hunt area 24, west of the Tongue River, also has an increasing population, but the objective is to further increase the herd.

White-tailed Deer:

The project is located in yearlong white-tailed deer range of high value to this species due to the wide riparian zone along the river. The Powder River white-tailed deer herd unit includes hunt areas 23 and 24. Most of the land in the herd unit is not usable range since deer are found only in riparian areas along rivers and streams.

Game Birds/Small Game:

The riparian zone along the Tongue River is high value habitat for turkey, gray partridge, pheasant, and mourning doves. Riparian areas are the only major habitat in the vicinity which supports these species. Cottontail rabbits occupy all habitats on the project area.

Endangered Species:

Several black-tailed prairie dog towns are located on or near the reservoir site (Figure 6). Black-footed ferrets may be present. A bald
eagle nested on the Tongue River near the lower end of the proposed reservoir in 1983 and possibly one or two years previously. The nest was successful and fledged two young eagles in 1983. Bald eagles winter along the Tongue River, and a roost is located downstream from Acme.

Waterfowl:

The Tongue River is used by Canada geese and a number of species of ducks during all seasons of the year. Since the project area is included in land owned or leased by Peter Kiewit & Sons Mining Company, their personnel have conducted waterfowl surveys on the river for several years. Breeding species identified include: Canada goose, mallard, common merganser, American wigeon, blue-winged teal, common teal, and wood duck (Brent Stettler, personal communication). The Game and Fish Department considers the Canada goose and wood duck priority waterfowl for which habitat loss would be especially significant.

Non-Game:

Table 3 lists 19 species observed on breeding bird censuses conducted in riparian cottonwood habitat along the Tongue River in 1983. PKS Mining Company personnel conducted aerial censuses along the Tongue River to locate raptor nests in 1983. Nesting species on the reservoir site included four red-tailed hawks, three great-horned owls, and a bald eagle (Brent Stettler, personal communication). A prairie falcon eyrie is located in Section 19, T58N, R84W, approximately one mile north of the river.
Prairie Dog Reservoir Site:

Mule Deer:

The project site is winter/yearlong mule deer range. The riparian zone along Prairie Dog Creek is important mule deer cover because of its relative scarcity in the vicinity. Croplands along the creek are used by deer and the possibility of over population is present because deer are drawn to the riparian zone and adjacent fields. The project is in the Powder River deer herd unit, hunt area 23. The population has been increasing for several years because of mild winters, but the objective is to decrease the herd to prevent damage to private crops.

White-tailed Deer:

The project is located in yearlong white-tailed deer range and the riparian zone along the creek is a necessary habitat component for white-tails in the area.

Antelope:

The project area is yearlong antelope range, and the creek bottom and croplands which will be inundated are used by antelope yearlong.

Game Birds/Small Game:

The riparian zone along Prairie Dog Creek is high value habitat for pheasant, gray partridge, mourning dove, and wild turkey. Cottontail rabbits are found in all habitats on the project area.
Endangered Species:

Several black-tailed prairie dog towns are located on or near the reservoir site (Figure 7). Black-footed ferrets may be present. Bald eagles forage along the creek most of the year. A golden eagle has nested in a cottonwood tree on the reservoir site for several years.

Non-game:

Non-game birds and mammals on this site are similar to those described for the Upper Stateline site.

Beatty Gulch Reservoir Site:

Mule Deer:

The project site is winter/yearlong range. Sagebrush slopes are used by deer, but no large concentrations have been recorded. Herd unit and hunt area data are the same as the Prairie Dog site.

Antelope:

The reservoir site is partly yearlong range and partly winter/yearlong range. As many as 50 antelope have been observed in the gulch, and they utilize most of the site. This area is in the Clearmont Antelope Herd Unit, hunt area 15. The population has been declining, and the objective is to maintain a stable population at a level above the present site.

Game Birds/Small Game:

Mourning doves, sharp-tailed grouse, sage grouse, and scattered populations of chukar are found on the reservoir site. There is a sharp-tail
dancing ground which had 10 displaying males in 1981 in Section 19, T57N, R83W. This is on or very near the proposed reservoir, and all of the site is considered nesting habitat. There is a sage grouse lek in the Si, Section 17, T57N, R83W, which had 5 displaying males in 1982. The reservoir is within the nesting area surrounding this lek. Cottontail rabbits are found in all habitats on the reservoir site.

Endangered Species:

Several black-tailed prairie dog towns are located on or near the proposed development (Figure 8). Black-footed ferrets might be present.

Waterfowl:

Small ponds in the gulch attract a small number of ducks, which feed in shallow water, and some nesting probably occurs in the area.

Non-game:

Non-game birds in grassland, sagebrush, and marsh habitats on the site number 10-20 species. A lone cottonwood tree near one of the ponds in the gulch has contained a red-tailed hawk nest for several years, including 1983. Non-game mammals on this site number 5-10 species.

Sheridan Canal:

The CH2M Hill Prefeasibility Report project area map shows the canal beginning about two miles below Rockwood Reservoir. The first segment is shown as pipeline and the rest of the system as open canal. An alternate pipeline would begin in Section 9, T55N, R88W adjacent to Shutts Flat Reservoir.
Assuming that both options are viable, they are both evaluated in general terms below:

1) **Rockwood Alternative:**

The elk range description for the pipeline and upper end of the canal is similar to that given for the Rockwood reservoir site. The pipeline route crosses critical elk winter range and intersects several elk movement corridors. The area is also winter/yearlong mule deer range. There are three sharp-tailed grouse dancing grounds and three sage grouse leks between the City of Sheridan and the mountains. The pipeline may intersect one or more of these leks and the adjacent nesting areas.

2) **Shutts Flat Alternative**

The canal would pass through elk summer range, critical elk winter range, and winter/yearlong mule deer range, as described for the Rockwood alternative. The grouse leks mentioned for the Rockwood Canal Alternative may also be impacted by this alternative.

**Tongue River Diversion:**

Three sage grouse leks and three sharp-tailed grouse leks are near the proposed diversion canal route. Mule deer and white-tailed deer inhabit the area yearlong. There may be prairie dog towns which could support black-footed ferret along the canal route.

**Potential Impacts to Wildlife:**

Since this project is still in the feasibility stage, the developments which may take place have only been described in general terms, and
wildlife impacts are addressed in the same way. As noted previously, this report evaluates all reservoir sites and canals which have been studied in the past. The possibility exists that other sites may be proposed, in which case a new evaluation would be necessary. Development of new irrigated cropland and construction of power plants or coal related industry are projects which could have a number of direct and indirect effects on terrestrial wildlife. Since details of potential developments are unclear at present, they have not been addressed.

The following potential impacts to terrestrial wildlife have been identified.

**North Fork:**

The filing on this site by PP&L is for a reservoir of approximately 814 surface acres. This would inundate all of the riparian willow, spruce, and willow/cinquefoil habitat along a two mile stretch of the North Tongue River, and almost a mile up Bull Creek. Habitat loss will severely impact several species. Moose frequent the reservoir site most of the year. The site is valuable moose habitat due to the wide willow band and the wide, flat character of the river bottom compared to segments of the North Fork above and below the proposed reservoir. Habitat loss will impact at least 17 species of non-game birds and 7 species of non-game mammals. Common snipe which nest each spring on the proposed reservoir site will be displaced.

The project will require relocation of Highway 14A, which could cause further habitat loss. If the new highway is moved south of the reservoir, it will pass through what is now dense lodgepole pine forest, causing some habitat loss, but since lodgepole is abundant, the loss may not be signifi-
cant for wildlife. An increase in road kills of big game, especially deer, may result until animals get accustomed to the new location. If the highway were moved north of the reservoir, sagebrush grassland habitat, which is more important for wildlife than lodgepole pine, would be impacted.

**South Fork:**

This reservoir of 484 acres would inundate only a small amount of elk summer range, but could impede migration since it lies in a movement corridor and is over 2 miles long. Fifty (50) to 100 elk move up and down the Tongue River drainage between summer range south of the reservoir site and the Amsden Creek Elk Winter Range. Moose use the reservoir site, especially the upper end which is away from highway and human developments. Several moose probably calve on the reservoir site as well.

Habitat loss will negatively impact non-game birds and mammals as described for the North Fork site. Highway relocation which would impact lodgepole pine habitat east of the reservoir would be preferable to disturbance of lodgepole pine forest with grassland parks west of the reservoir site. Relocation of Arrowhead Lodge, Camp Bethel, and two U.S. Forest Service campgrounds and several cabins could cause indirect impacts to wildlife habitat.

**Shutts Flat:**

This reservoir would flood at least 250 acres of land. Sedge/grass/rush meadow and willow stands which are critical moose habitat will be permanently lost. The moose which frequent the vicinity will be displaced from the reservoir site and an area up to 1 mile from it when public use is high. As mentioned previously, this habitat is irreplaceable
and very important to the moose population in this hunt area. Habitat loss will also negatively impact non-game birds and mammals. Elk migration could be affected by this development as described for the South Fork site. The reservoir is smaller than South Fork, but the site is more remote and thus more important to elk for general use and a movement corridor.

**Rockwood:**

The Pacific Power & Light Company filing on this site is for a reservoir about 29,000 acre feet. The CH2M Hill Report uses a reservoir of 98,000 acre feet, with a surface area of 737 acres, so it is assumed that this is the largest reservoir which would be built. Habitat which would be lost is valuable to elk due to the contiguous grassland and lodgepole habitats, the remoteness of the area and the proximity of Amsden Creek Elk Winter Range. Construction activity, road building, and public recreational use will decrease useable elk habitat around the site. Some loss will be temporary, but the long term effect will be degradation of the elk range and possibly reproductive loss and increased winter mortality of the 50-100 elk which utilize this area most of the year.

This site also contains critical habitat for calving and winter use by moose. Moose utilize the riparian zone and adjacent habitats yearlong. This is high value moose range because of its remote character as well as the habitat type.

**Upper Stateline:**

Flooding over 4,000 acres of riparian bottom and agricultural land would be a very significant habitat loss for mule deer, white-tailed deer, several game birds, and a number of non-game species. This habitat is
essentially irreplaceable in the area since it is surrounded by sagebrush grassland.

The bald eagle nest in a cottonwood tree on the reservoir site would be destroyed by the reservoir. Bald eagles which forage along the Tongue River in winter may lose feeding habitat.

Golden eagles and prairie falcons nest in the vicinity and feed on the river bottom all year. Prairie dog towns on the site provide habitat for the burrowing owl and possibly the endangered black-footed ferret. Wooded riverine waterfowl habitat important to the wood duck will be inundated.

**Lower Prairie Dog:**

Flooding of riparian habitat and agricultural land is the main impact of this development. Losses are similar to those described for the Upper Stateline site, except only 1,360 acres will be flooded. The riparian zone is not as extensive, so losses are less than those at the Upper Stateline site. Bald and golden eagles forage in the vicinity. There are several prairie dog towns which contain burrowing owl, and could contain black-footed ferrets. However, in this area, prairie dog towns have been extensively poisoned.

**Beatty Gulch:**

Mule deer and pronghorn winter range will be flooded by this reservoir. An estimated 50 antelope and 50 mule deer use the area part of the year. Wheat acreage and sagebrush habitat are utilized by several game birds. A sharp-tailed grouse dancing ground and possibly a sage grouse lek may be lost or disturbed.
There are at least three prairie dog towns on or near the proposed reservoir which could contain black-footed ferrets.

**Sheridan Canal:**

Potential impacts of the canal include: 1) a possible barrier to big game movement; 2) loss of big game animals by drowning; 3) disturbance of sharp-tail and sage grouse leks; 4) disturbance of critical elk range with either alternative; and 5) habitat loss in, and local disturbance of, mule deer winter range. Either canal route could cross prairie dog towns which may contain black-footed ferrets.

**Tongue River Diversion:**

Potential impacts of the diversion canal include: 1) a barrier to deer movement; 2) disturbance of sharp-tailed grouse and sage grouse leks or nesting areas; 3) loss of deer by drowning; 4) disturbance of black-footed ferret habitat; and 5) degradation of Tongue River riparian habitat.

**Potential Benefits to Wildlife:**

None of the high elevation sites would appreciably benefit terrestrial wildlife. All of the low elevation sites have potential for waterfowl habitat developments such as marsh development, nesting island construction, and nesting structure installation. Shorebirds would also benefit from marsh development; and osprey nest structures could add non-game benefits.
Mitigation Considerations:

Since this project is in the prefeasibility stage, it is difficult to make recommendations except on the relative impact of the sites being considered. Of the high elevation sites which were evaluated, Rockwood Reservoir has the most potential impact on terrestrial wildlife because of its remoteness and value as critical elk and moose range. North Fork Reservoir would also have a significant impact because it is critical moose range due to habitat characteristics and the relative scarcity of this habitat on the North Fork of the Tongue River.

Shutts Flat and South Fork reservoir sites overlap, but Shutts Flat has better wildlife habitat because the highway passes through South Fork. The amount of impact depends upon the size of the reservoir; but a reservoir on the South Fork site, even with highway relocation, is preferable to Shutts Flat because of less impact on wildlife habitat. The smaller the reservoir, the less habitat loss can be expected since the important habitat is along the river. Table 5 lists the potential impacts of the high elevation reservoirs.
Table 5. Proposed Tongue River high elevation water development projects and their potential impact on terrestrial wildlife.

<table>
<thead>
<tr>
<th>PROPOSED DEVELOPMENT</th>
<th>WILDLIFE IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockwood Reservoir</td>
<td>Critical elk winter range, elk calving areas impediment to elk movements, moose critical range - winter and calving, loss of riparian habitat.</td>
</tr>
<tr>
<td>North Fork Reservoir</td>
<td>Critical moose range - winter, severe riparian habitat loss for moose and non-game</td>
</tr>
<tr>
<td>Shutts Flat Reservoir</td>
<td>Critical moose range habitat loss, impediment to elk movement, loss of riparian habitat</td>
</tr>
<tr>
<td>South Fork Reservoir</td>
<td>Moose range, possible impediment to elk movement, loss of riparian habitat</td>
</tr>
<tr>
<td>Sheridan Canal</td>
<td>Critical elk winter range, a concrete-lined canal would be a barrier to elk and deer movement</td>
</tr>
</tbody>
</table>

Of the low elevation reservoir sites, Upper Stateline has the greatest potential to cause wildlife habitat loss, regardless of its size. The bald eagle nest is obviously quite important if its use continues, but general riparian habitat loss is also important for deer and many game and non-game birds, including wintering bald eagles. The Lower Prairie Dog site will have less impact, but riparian and agricultural land losses are significant. Beatty Gulch Reservoir will cause the least habitat loss and the least impact on wildlife, but may require movement of or mitigation for loss of a sharp-tailed grouse dancing ground. The presence of black-tailed prairie dogs towns on all of the low elevation reservoir sites will require extensive searches for black-footed ferrets before any commitment for development is made. Table 6 lists the potential impact of the low elevation reservoirs.
Table 6. Proposed Tongue River low elevation water development projects and their potential impact on terrestrial wildlife.

<table>
<thead>
<tr>
<th>PROPOSED DEVELOPMENT</th>
<th>WILDLIFE IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Stateline Reservoir</td>
<td>Loss of riparian habitat - severe for game birds, mule deer, white-tailed deer, non-game; bald eagle nest site and winter habitat loss; flooding of prairie dog towns; possible loss of black-footed ferret habitat</td>
</tr>
<tr>
<td>Lower Prairie Dog Reservoir</td>
<td>Loss of riparian habitat - see Upper Stateline; flooding of prairie dog towns</td>
</tr>
<tr>
<td>Beatty Gulch Reservoir</td>
<td>Loss of antelope and mule deer range; loss or disturbance of (1) sharp-tailed grouse lek; flooding of prairie dog towns</td>
</tr>
<tr>
<td>Sheridan Canal</td>
<td>Possible disturbance of (3) sharp-tail leks and (3) sage grouse leks; possible disturbance of prairie dog towns.</td>
</tr>
<tr>
<td>Tongue River Diversion</td>
<td>Possible disturbance of grouse leks; a concrete-lined canal will cause loss of deer by drowning &amp; a barrier to deer movement; possible riparian habitat loss due to de-watering of the Tongue River; flooding of prairie dog towns</td>
</tr>
</tbody>
</table>
Table 1. Non-game birds observed on breeding bird censuses in habitats found on the high elevation project sites in 1983.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>HABITAT TYPE</th>
<th>TOTAL BIRDS</th>
<th>% OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LUDGEPOLE PINE</td>
<td>RIPARIAN WILLOW</td>
<td>WILLOW/ CINQUEFOIL</td>
</tr>
<tr>
<td>Pine Siskin</td>
<td>12</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Yellow-rumped Warbler</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Dark-eyed Junco</td>
<td>12</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Gray Jay</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Chipping Sparrow</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Brewers Blackbird</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Olivesided Flycatcher</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>American Robin</td>
<td>1</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Spotted Sandpiper</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Yellow Warbler</td>
<td>3</td>
<td>2</td>
<td>2(1)</td>
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<tr>
<td>Wilson's Warbler</td>
<td>11</td>
<td>10</td>
<td>12(6)</td>
</tr>
<tr>
<td>Tree Swallow</td>
<td>2</td>
<td>3</td>
<td>2(1)</td>
</tr>
<tr>
<td>Song Sparrow</td>
<td>7</td>
<td>2</td>
<td>16(8)</td>
</tr>
<tr>
<td>Red-tailed Hawk</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Mountain Chickadee</td>
<td>3</td>
<td></td>
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TABLE 1. Continued

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>LODGEPOLE PINE</th>
<th>RIPARIAN WILLOW</th>
<th>WILLOW</th>
<th>WILLOW/*/CINQUEFOIL</th>
<th>GRASSLAND/MTN FORB*</th>
<th>MTN BIG* SAGEBRUSH</th>
<th>TOTAL BIRDS</th>
<th>% OF TOTAL</th>
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<tbody>
<tr>
<td>White-crowned Sparrow</td>
<td>6(3)</td>
<td></td>
<td></td>
<td>22(11)</td>
<td></td>
<td>14</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Common Raven</td>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Common Nighthawk</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Green-tailed Towhee</td>
<td></td>
<td></td>
<td></td>
<td>4(2)</td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Savannah Sparrow</td>
<td>20(10)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Violet-green Swallow</td>
<td></td>
<td></td>
<td></td>
<td>2(1)</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Killdeer</td>
<td>(1)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Common Flicker</td>
<td>2(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL BIRDS</strong></td>
<td><strong>36</strong></td>
<td><strong>34</strong></td>
<td><strong>32</strong></td>
<td><strong>56</strong></td>
<td><strong>17</strong></td>
<td><strong>25</strong></td>
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<tr>
<td><strong>TOTAL SPECIES</strong></td>
<td><strong>9</strong></td>
<td><strong>9</strong></td>
<td><strong>10</strong></td>
<td><strong>10</strong></td>
<td><strong>5</strong></td>
<td><strong>6</strong></td>
<td><strong>23</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Route run twice-used average in ( ) in totals.
TABLE 2. Non-game mammals trapped in the habitats found on the high elevation project sites in 1983.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>LODGEPOLE PINE</th>
<th>RIPARIAN WILLOW</th>
<th>WILLOW/CINQUEFOIL</th>
<th>MOUNTAIN GRASSLAND</th>
<th>MOUNTAIN SAGEBRUSH</th>
<th>MOUNTAIN RUSH/GRASS</th>
<th>TOTAL ANIMALS</th>
<th>% OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least Chipmunk</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Deer Mouse</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>Gapper's Red-backed Vole</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>5</td>
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<tr>
<td>Western Jumping Mouse</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Montane Vole</td>
<td>1</td>
<td>1</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Heather Vole</td>
<td></td>
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<td></td>
<td>1</td>
<td></td>
<td></td>
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<td>Meadow Vole</td>
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<td></td>
<td>1</td>
<td></td>
<td></td>
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<td>7</td>
</tr>
<tr>
<td>Vagrant Shrew</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
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<td>5</td>
</tr>
<tr>
<td>Dwarf Shrew</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
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<td>5</td>
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<tr>
<td><strong>TOTAL ANIMALS</strong></td>
<td><strong>8</strong></td>
<td><strong>9</strong></td>
<td><strong>4</strong></td>
<td><strong>1</strong></td>
<td><strong>15</strong></td>
<td><strong>2</strong></td>
<td><strong>39</strong></td>
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</tr>
<tr>
<td><strong>TOTAL SPECIES</strong></td>
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<td><strong>5</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
<td><strong>5</strong></td>
<td><strong>1</strong></td>
<td><strong>9</strong></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 3. Non-game birds observed on breeding bird censuses in riparian habitats on low elevation project sites in 1983.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>6-9-83</th>
<th>6-20-83</th>
<th>TOTAL BIRDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brewers Blackbird</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Tree Swallow</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>American Robin</td>
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<tr>
<td>Black-headed Grosbeak</td>
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<td>Rough-winged Swallow</td>
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</tr>
<tr>
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<tr>
<td>Common Grackle</td>
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<tr>
<td>Least Chipmunk</td>
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<tr>
<td>Deer Mouse</td>
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<td>Gapper's Red-backed Vole</td>
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<tr>
<td>Heather Vole</td>
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<tr>
<td>Vagrant Shrew</td>
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<td><strong>TOTAL ANIMALS</strong></td>
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<td><strong>TOTAL SPECIES</strong></td>
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## APPENDIX A. Tongue River Project List of Potential Bird Species.

<table>
<thead>
<tr>
<th>Common Loon</th>
<th>Yellow-billed Loon</th>
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<tbody>
<tr>
<td>Arctic Loon</td>
<td>Red-throated Loon</td>
</tr>
<tr>
<td>Red-necked Grebe</td>
<td>Horned Grebe</td>
</tr>
<tr>
<td>Eared Grebe 3/</td>
<td>Western Grebe 1/</td>
</tr>
<tr>
<td>Pied-billed Grebe 3/</td>
<td>White Pelican 1/</td>
</tr>
<tr>
<td>Double-crested Cormorant 1/</td>
<td>Great Blue Heron 3/</td>
</tr>
<tr>
<td>Snowy Egret 3/</td>
<td>Black-crowned Night Heron 3/</td>
</tr>
<tr>
<td>American Bittern 3/</td>
<td>White-faced Ibis 3/</td>
</tr>
<tr>
<td>Whistling Swan*</td>
<td>Turkey Vulture 3/</td>
</tr>
<tr>
<td>Goshawk $ #</td>
<td>Sharp-shinned Hawk $ $</td>
</tr>
<tr>
<td>Cooper's Hawk$</td>
<td>Red-tailed Hawk $ $</td>
</tr>
<tr>
<td>Swainson's Hawk$</td>
<td>Long-billed Curlew$ 3/</td>
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<tr>
<td>Rough-legged Hawk $ $</td>
<td>Ferruginous Hawk</td>
</tr>
<tr>
<td>Golden Eagle $ $</td>
<td>Bald Eagle* $ $</td>
</tr>
<tr>
<td>Marsh Hawk $ $</td>
<td>Osprey 3/</td>
</tr>
<tr>
<td>Prairie Falcon $ $</td>
<td>Peregrine Falcon (endangered) ++1/</td>
</tr>
<tr>
<td>Merlin</td>
<td>American Kestrel $ $</td>
</tr>
<tr>
<td>American Avocet</td>
<td>Semipalmated Plover</td>
</tr>
<tr>
<td>Killdeer $ $</td>
<td>American Golden Plover</td>
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<tr>
<td>Snowy Plover</td>
<td>Mountain Plover</td>
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<tr>
<td>Black-bellied Plover</td>
<td>Marbled Godwit</td>
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<tr>
<td>Upland Sandpiper</td>
<td>Greater Yellowlegs 3/</td>
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<td>Lesser Yellowlegs 3/</td>
<td>Solitary Sandpiper 3/</td>
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<tr>
<td>Willet 3/</td>
<td>Spotted Sandpiper $ # 3/</td>
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<td>Northern Phalarope</td>
<td>Wilson's Phalarope</td>
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<td>Sanderling</td>
<td>Semipalmated Sandpiper</td>
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<td>Western Sandpiper</td>
<td>Least Sandpiper</td>
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<td>White-rumped Sandpiper</td>
<td>Baird's Sandpiper</td>
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<tr>
<td>Pectoral Sandpiper</td>
<td>Stilt Sandpiper</td>
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<tr>
<td>Herring Gull</td>
<td>California Gull</td>
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<tr>
<td>Ring-billed Gull</td>
<td>Franklin's Gull</td>
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<td>Bonaparte's Gull</td>
<td>Common Tern</td>
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<td>Forster's Tern</td>
<td>Black Tern</td>
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<tr>
<td>Caspian Tern</td>
<td>Rock Dove</td>
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<tr>
<td>Band-tailed Pigeon</td>
<td>Black-billed Cuckoo$ 3/</td>
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<td>Yellow-billed Cuckoo$ 3/</td>
<td>Screech Owl</td>
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<td>Barn Owl 1/</td>
<td>Snowy Owl</td>
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<tr>
<td>Great Horned Owl$</td>
<td>Burrowing Owl @##1/</td>
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<tr>
<td>Pigmy Owl</td>
<td>Long-eared Owl$</td>
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<tr>
<td>Great Gray Owl 1/</td>
<td>Saw-whet Owl</td>
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<tr>
<td>Short-eared Owl</td>
<td>Common Nighthawk $ $</td>
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<tr>
<td>Poor-will</td>
<td>White-throated Swift</td>
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<td>Chimney Swift</td>
<td>Anna's Hummingbird (only 1)</td>
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<tr>
<td>Black-chinned Hummingbird</td>
<td>Rufous Hummingbird#</td>
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<tr>
<td>Broad-tailed Hummingbird$</td>
<td>Belted Kingfisher $ $</td>
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<tr>
<td>Caliope Hummingbird</td>
<td>Red-headed Woodpecker $ $</td>
</tr>
<tr>
<td>Common Flicker $ $</td>
<td>Yellow-bellied Sapsucker $ 3/</td>
</tr>
<tr>
<td>Lewis' Woodpecker#</td>
<td></td>
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</tbody>
</table>
Williamson's Sapsucker
Downy Woodpecker
Northern Three-toed Woodpecker
Western Kingbird
Eastern Phoebe
Willow Flycatcher
Dusky Flycatcher
Western Wood Pewee
Barned Lark
Tree Swallow
Rough-winged Swallow
Cliff Swallow
Gray Jay
Steller's Jay
Black-billed Magpie
Common Crow
Clarks Nutcracker
Mountain Chickadee
Red-breasted Nuthatch
Brown Creeper
House Wren
Rock Wren
Canon Wren
Gray Catbird
Sage Thrasher
Hermit Thrush
Eastern Bluebird
Mountain Bluebird
Blue-gray Gnatcatcher
Ruby-crowned Kinglet
Sprague's Pipit
Cedar Waxwing
Loggerhead Shrike
Solitary Vireo
Philadelphia Vireo
Yellow-rumped Warbler
Tennessee Warbler
Nashville Warbler
Yellow Warbler
Black-throated Blue Warbler
Townsend's Warbler
Chestnut-sided Warbler
Ovenbird
MacGillivray's Warbler
Yellow-breasted Chat
Sage Sparrow
House Sparrow
Western Meadowlark
Red-winged Blackbird
Rusty Blackbird
Common Grackle
Western Tanager

Hairy Woodpecker
Black-backed Three-toed Woodpecker
Eastern Kingbird
Cassin's Kingbird
Say's Phoebe
Least Flycatcher
Western Flycatcher
Olive-sided Flycatcher
Violet-green Swallow
Bank Swallow
Barn Swallow
Purple Martin
Blue Jay
Scrub Jay
Common Raven
Pinon Jay
Black-capped Chickadee
White-breasted Nuthatch
Pygmy Nuthatch
Dipper
Long-billed Marsh Wren
Veery
Mockingbird
Brown Thrasher
American Robin
Swainson's Thrush
Western Bluebird
Townsend's Solitaire
Golden-crowned Kinglet
Water Pipit
Bohemian Waxwing
Northern Shrike
Starling
Red-eyed Vireo
Warbling Vireo
Myrtle Warbler
Orange-crowned Warbler
Northern Parula
Magnolia Warbler
Yellow-rumped Warbler
Blackburnian Warbler
Blackpoll Warbler
Northern Waterthrush
Common Yellowthroat
Wilson's Warbler
American Redstart
Boblink
Yellow-headed Blackbird
Northern Oriole
Brewer's Blackbird
Brown-headed Cowbird
Scarlet Tanager
Black-headed Grosbeak
Indigo Bunting* 3/
Dickcissel
Purple Finch
House Finch
Gray-crowned Rosy Finch
Hoary Redpoll
Pine Siskin* 3/
Lesser Goldfinch#
White-winged Crossbill
Rufous-sided Towhee#
Savannah Sparrow* 3/
Baird's Sparrow
Vesper Sparrow* 3/
Slate-colored Junco
Dark-eyed Junco* 3/
Tree Sparrow
Clay-colored Sparrow
Field Sparrow
Whitewing Sparrow* 3/
Lincoln's Sparrow 3/
McCown's Longspur
Chestnut-collared Longspur

Blue Grosbeak 3/
Lazuli Bunting#
Evening Grosbeak
Cassin's Finch
Pine Grosbeak 3/
Black Rosy Finch
Common Redpoll* 3/
American Goldfinch* 3/
Red Crossbill
Green-tailed Towhee#
Lark Bunting
Grasshopper Sparrow
LeConte's Sparrow
Lark Sparrow#
Oregon Junco
Gray-headed Junco
Chipping Sparrow* 3/
Brewer's Sparrow* 3/
Harris' Sparrow
White-throated Sparrow
Song Sparrow* 3/
Lapland Longspur
Snow Bunting

Waterfowl

Canada Goose* 3/
Mallard* 3/
Pintail* 3/
Blue-winged Teal* 3/
American Wigeon* 3/
Wood Duck* 3/
Ring-necked Duck* 3/
American Coot* 3/
Common Goldeneye* 3/
Aplomado Falcon* 3/
Bufflehead* 3/
Ruddy Duck* 3/
Common Merganser* 3/
Virginia Rail* 3/
Common Snipe* 3/

Blue Goose* 3/
Gadwall* 3/
Green-winged Teal* 3/
Cinnamon Teal* 3/
Northern Shoveler* 3/
Redhead* 3/
Canvasback* 3/
Lesser Scaup* 3/
Barrow's Goldeneye* 3/
Harlequin Duck* 3/
Hooded Merganser* 3/
Red-breasted Merganser* 3/
Sora* 3/

Upland Game Birds

Blue Grouse* 3/
Sharp-tailed Grouse* 3/
Ring-necked Pheasant* 3/
Gray Partridge* 3/
Sandhill Crane* 3/

Ruffed Grouse* 3/
Sage Grouse*
Chukar*
Turkey* 3/
Mourning Dove 3/

* - High Priority Species (Research/Management). High priority to maintain or increase current population levels or to document population levels of undetermined species.

- Considered rare and indications are that the population is declining.
1/ - Biological Status. Species with known declining populations and/or habitat conditions or with indicators that their populations and/or habitat conditions are declining throughout all or part of their geographic range. Known accidental species records are not included.

2/ - A species which is completely dependent on riparian habitat during one or more stages of its life cycle. An alternate habitat will not satisfy the critical riparian-dependent stage(s) in the species life cycle. Destruction of riparian habitat would cause species population decline from 67-100%.

+ - Considered rare and more information is needed to determine if the population is declining.

# - Mammals or birds documented on or near low elevation project sites.

$ - Mammals or birds documented on or near the high elevation project sites.
APPENDIX B. Tongue River Project List of Potential Mammal Species.

Merriam's Shrew
White-tailed Jackrabbit#
Least Chipmunk $ #
Wyoming Ground Squirrel
Black-tailed Prairie Dog
Red Squirrel $ #
Northern Pocket Gopher
Olive-backed Pocket Mouse
Plains Harvest Mouse
Deer Mouse $ #
White-footed Mouse
Gapper's Red-backed Vole $#
Montane Vole $# 3/
Prairie Vole
Norway Rat
Western Jumping Mouse $ 3/
Coyote $ #
Red Fox # $
Raccoon 3/
Black-footed Ferret (endangered) @*1/
Spotted Skunk
Little Brown Myotis
Hoary Bat
Big Brown Bat
Heather Vole $ #
Dwarf Shrew $

Mammals

Masked Shrew 3/
Black-tailed Jackrabbit
Yellow-bellied Marmot $ #
Thirteen-lined Ground Squirrel $ #
White-tailed Prairie Dog
Fox Squirrel
Plains Pocket Gopher
Ord's Kangaroo Rat
Western Harvest Mouse
Northern Grasshopper Mouse
Bushy-tailed Wood Rat
Meadow Vole $ #3/
Long-tailed Vole
Sagebrush Vole
House Mouse
Porcupine $ #
Gray Fox
Swift Fox*
Fisher (protected)
Striped Skunk
River Otter (protected) 3/
Small-footed Myotis
Townsend's Big-eared Bat
Meadow Jumping Mouse $
Vagrant Shrew $ #

Furbearers

Beaver $ 3/
Long-tailed Weasel $ #
Badger
Pine Marten $

Small Game

Muskrat $ 3/
Mink 3/
Bobcat $ #

Mountain Cottontail $
nowshoe Hare $

Big Game

Mule Deer* $ #
Elk $
Pronghorn* #
White-tailed Deer* $ 3/
Moose* $ 3/

* - High Priority Species (Research/Management). High priority to maintain or increase current population levels or to document population levels of undetermined species.

- Considered rare and indications are that the population is declining.
1/ Biological Status. Species with known declining populations and/or habitat conditions or with indicators that their populations and/or habitat conditions are declining throughout all or part of their geographic range. Known accidental species records are not included.

3/ A species which is completely dependent on riparian habitat during one or more stages of its life cycle. An alternate habitat will not satisfy the critical riparian-dependent stage(s) in the species life cycle. Destruction of riparian habitat would cause species population decline from 67-100%.

$ - Mammals or birds documented on or near low elevation project sites.

$ - Mammals or birds documented on or near high elevation project sites.

- Rich Straw, Wyoming Game and Fish Department and Helen Downing contributed bird and mammal data for these lists.