Missouri River Basin Commission
Yellowstone River basin and adjacent coal area level B study

mrbc

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General Report

YELLOWSTONE RIVER BASIN AND ADJACENT COAL AREA LEVEL B STUDY

TONGUE-POWDER

MONTANA

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Jeffrey White
Yellowstone Level B--Montana

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CHAPTER I

INTRODUCTION

Background and Authority

The Missouri River Basin Comprehensive Framework Study, published by the Missouri Basin Inter-Agency Committee in December 1971, stated that the principal planning objectives for the Yellowstone Basin were: "the intensification of agricultural production and the processing of agricultural products; development of industrial processing of coal; and expansion of the recreation and tourist industry."

Shortly after completion of the Framework Study, the national energy crisis created increasing needs for careful resource planning in the Yellowstone Basin Area; this together with other recognized needs was the basis for initiation of a number of programs and studies. In general, these studies emphasized the need to follow a comprehensive plan in making resource-use decisions and recognized the need to develop an updated comprehensive/coordinated plan at the earliest possible date.

In February 1974, the Missouri River Basin Commission reacted to the need for a Yellowstone study and gave a high priority to its initiation. On April 1, 1974, a request was submitted to the Water Resources Council for funds to develop a Proposal to Study (PTS). At the May 1974, Commission meeting, a motion was approved by consensus which directed the MRBC Chairman to appoint a special Action Task Force for the Yellowstone River Basin and Adjacent Coal Area.

The Action Task Force proposed that a Level B type study be undertaken. A PTS was prepared and submitted to the Water Resources Council

in July 1974, with a request by the MRBC Chairman for funds to initiate the study in FY 1975.

Funds for initiation of the study were not made available for a FY 1975 start. Thus, the proposal was deferred, but with a priority consideration for FY 1976 funding. The Yellowstone Study was one of two new Level B starts that the President recommended in his FY 1976 budget request. Congressional approval resulted and an appropriation of funds for the Study was provided in December 1975. Work on the Level B Study was begun in early 1976.

Authority for the study is found in the Water Resources Planning Act of 1965 (P.L. 89-80, 42 U.S.C. 1962, as amended) and Section 209 amendments of the Federal Water Pollution Control Act of 1972 (P.L. 92-500, 86 Stat. 816). A Level B Study is regional or river basin in scope and involves a reconnaissance-level evaluation of water and related land resources for the selected area. The intent of a Level B Study is to: (1) resolve the complex problems identified by framework studies and assessments; (2) focus on near and midterm (10 to 25 years--base year is 1975) needs; (3) involve federal, state, and local interests in plan formulation; and (4) identify alternative plans and recommend action plans or programs to be pursued by individual federal, state, and local entities.

Purpose of the Study

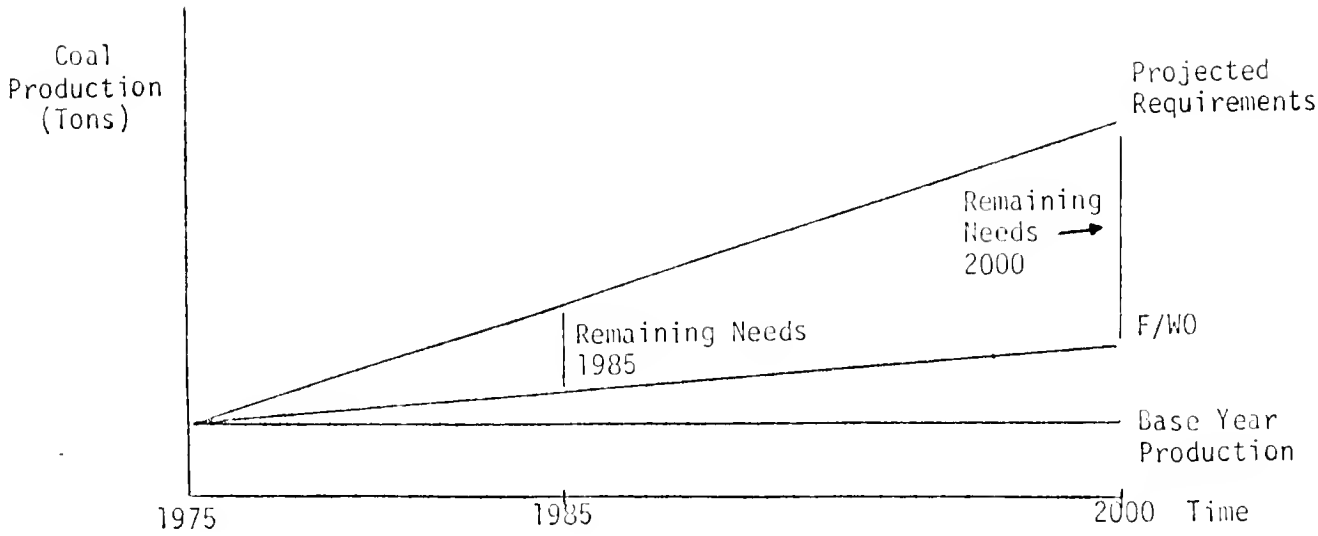
The purpose of the Level B Study is to promote the quality of life by: (1) enhancing the quality of the environment through the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems; and (2) enhancing national economic development by increasing the value

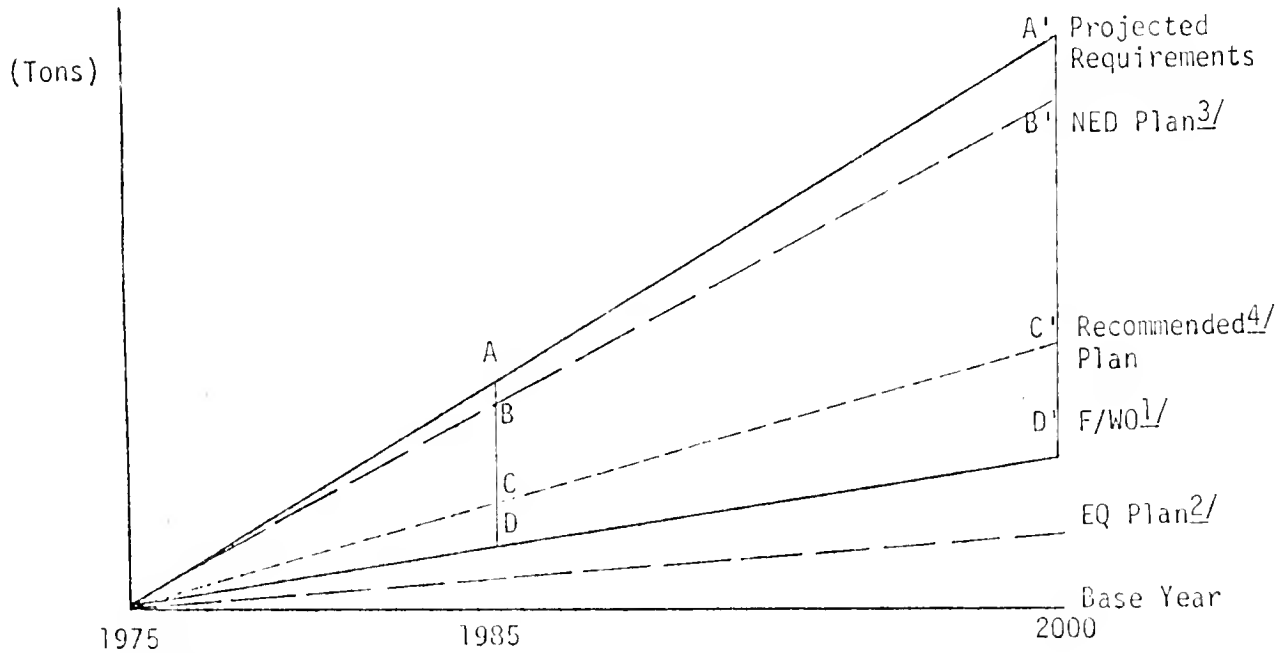
of the Nation's output of goods and services and improving national economic efficiency. The goal of enhanced environmental quality (EQ) and that of expanded national economic development (NED) are equal partners in the Level B planning process.

The planning process (see Figure I-1) includes the development of: (1) projected requirements (i.e, resources necessary to satisfy a water-related need); (2) the future "without" situation (F/WO), which describes development of an area in terms of future private endeavors and ongoing government programs in the absence of a plan; (3) the remaining needs that are not met by the F/WO (the remaining needs may be defined as the difference between the projected requirements and the F/WO, or Projected Requirements minus F/WO = Remaining Needs); (4) the NED and EQ plans which are initiated through local, State, or Federal actions to meet the remaining needs; and (5) the Recommended Plan which evolves from the combination of the EQ and NED plans. The Recommended Plan does not necessarily have to satisfy all of the remaining needs. If it is the judgment of the planning group (State Study Team, see below) that the quality of life in the planning area would not be promoted by satisfying certain remaining needs (e.g., massive coal development to satisfy the needs of other regions), then the group may choose some level of development more compatible with desires of the planning area's population.

The priorities and preferences of the various individuals affected will vary and, accordingly, there will likely not be full agreement among all affected on whether certain effects are beneficial or adverse, or on the relative trade-offs between objectives. However, when any plan is recommended from among the alternative EQ and NED plans, there is an implicit expression of what is considered to be the affected group's priorities and preferences.

Figure I-1. Example of Possible Planning Sequence for Coal Development





1/ Under the F/WO situation, remaining needs are AD, in 2000, A'D'.

2/ The EQ Plan would constrain private development to less than the F/WO.

3/ The NED Plan come nearest to satisfying remaining needs only AB and A'B' remain.

4/ The Recommended Plan satisfies only CD and C'D' and would result in the production of the amounts AC and A'C' being shifted to another coal area.

Scope of Study

Although the Level B Study is new, water and related land planning is not starting anew in the Study Area. Planning agencies at all levels of government have already produced a baseline of data from studies conducted at various investigative levels. In most respects, plan formulation for the Level B Study has involved the reconsideration, reanalysis, reformulation, and rethinking of previously studied programs and projects into alternative plans which are responsive to changing needs and to evolving state, regional, and national goals. The intent has been to complete an analysis in sufficient detail and depth only to provide a reasonable and implementable overall plan, subject to the findings of Level C studies (i.e., feasibility studies) of each element of the plan.

Organization of Study

The Missouri River Basin Commission was responsible for the conduct, supervision, and management of the study. Funding of the Federal portion of the study was through the Water Resources Council to the Missouri River Basin Commission. State participation was funded through regular channels in each State. Public participation was funded by the organizations or individuals participating, except that the mileage costs to and from meetings were paid by the Commission for those organizations or individuals that requested it.

Study Direction

The Study Manager was given full authority and responsibility by MRBC to conduct the study, serving under the general supervision and direction of the MRBC Director of Planning and Technical Services. The Study Manager developed workplans, budgets, and schedules for completion of task activities; reviewed and evaluated completed work assignments,

reports, and studies for quality control, technical adequacy, integration into overall study efforts, compliance with work plan objectives and compliance with WRC Principles and Standards; and prepared recommendation and reports on results of the study efforts. Further, the Study Manager served as Chairman of the Management Group, which advised him on overall management guidance, direction, and control for the study effort.

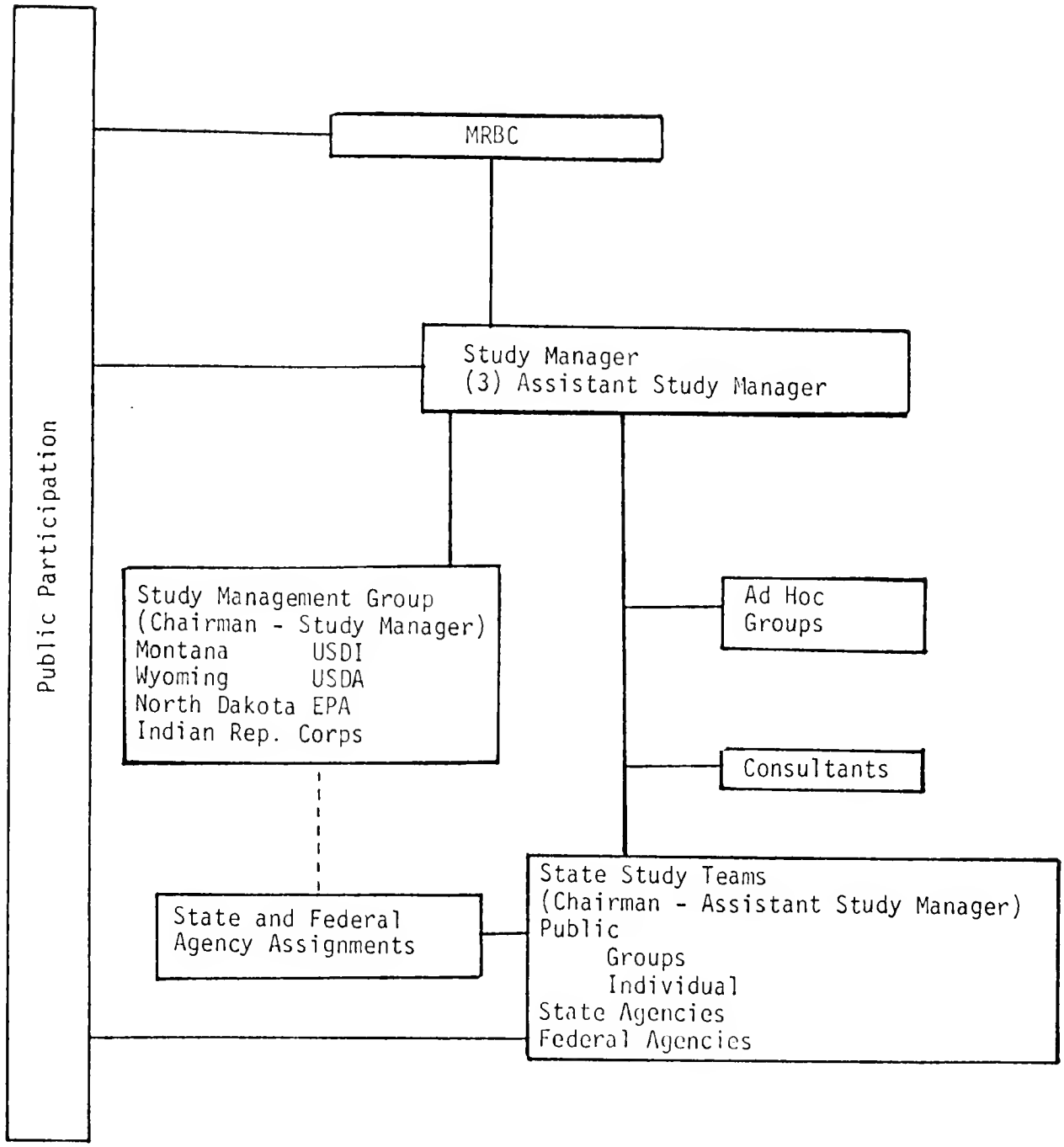
The Study Manager was assisted directly by three Assistant Study Managers. Each of these served as coordinator of planning, and of work activities of the various task groups and study participants, in the respective State of assignment. They also maintained continuing liaison with designated representatives of governmental and nongovernmental entities in their respective states for purpose of delineating and expediting study inputs and outputs.

The Manager and Study Office were located in Billings, Montana, with state offices located in Helena and Billings, Montana; Cody, Wyoming; and Bismarck, North Dakota. Figure I-2 displays the study organization.

Management Group

The Management Group established for the study was composed of the Study Manager and one representative from the Corps of Engineers, Environmental Protection Agency, U.S. Department of Agriculture, and the Federated Indian tribes, and two representatives from each State and the Department of the Interior. The primary function of the Management Group was to mold the seven area plans into a plan for the complete Study Area and provide guidance on management and direction for the study effort. In addition, it provided study performance evaluation, critique, and monitoring and control from a resource allocation context. The Group thus provided assistance to the Study Manager in policy formulation, direction, and study problem resolutions.

Figure I-2. Level B Study Organization



Ad Hoc Groups

During the early phases of the study, certain specific tasks were assigned to ad hoc groups. These groups were composed of agency representatives (Federal, State, local, etc.) with a given expertise and capability to effectively perform the task assignments. The assigned functional areas included: specification of the basic needs of agriculture, outdoor recreation, fish and wildlife, instream flows, energy, and others. Each group prepared a report defining: (1) base conditions (1975); (2) projected future requirements (1985 and 2000); (3) the portion of those requirements that may be satisfied through private initiative; and (4) the remaining needs to be met by time frame 1975-1985 and 1985-2000. Upon completion of their given assignments, the groups were disbanded.

State Study Teams

Plan development, analysis, and associated public participation were handled through State Study Teams under the direction of the Assistant Study Manager in each state. State Study Teams were composed of representatives from Federal and State agencies, interest groups, and industry--as well as private individuals.

The State Study Teams have had the most important role in the study in that they formulated the alternative and recommended plans for each planning area. A typical sequence of events for the State Study Team in an individual planning area was:

1. Preparation of a background report.

2. Development of issue papers by individual agency, group, or citizen involved in the study. Issue papers defined the future of the area without additional federal or state involvement; the problems and needs this would leave unfulfilled; necessary programs to meet those needs; and reconnaissance benefits and costs of suggested programs.

3. Development of Ad Hoc Work Group Reports. The ad hoc group presentation was primarily technical and designed to cover

the entire Study Area with a consistent description of needs in each functional area (e.g., instream flows, flood control, and agriculture). These needs were then disaggregated to individual planning areas where possible.

4. Formulation of alternative plans emphasizing National Economic Development (NED), Environmental Quality (EQ), and State-Regional Development (SRD) objectives and the development of a recommended plan, with involvement of the public. State Study Team meetings were held in the various planning areas in which the information supplied by the issue papers and ad hoc group reports was evaluated and analyzed as part of the planning process.

State Involvement

This Level B study effort has been oriented to a high degree of State agency participation, both in terms of task performance and policy guidance through service on the Study Management Group and on State Study Teams. Additionally, each of the respective states assumed a major role through its cost-sharing portion of the total study effort. In some instances, resources expended on these state-oriented efforts provided input over and above that of the Level B requirements. Similarly, efforts undertaken on the Level B study will provide added information for use in the various state plans and programs.

Public Participation

A continual emphasis on public awareness, involvement, and participation is called for in the U.S. Water Resources Council's Principles and Standards, which provided the basic guidelines for this study. Considering the large geographic size and diversity of interest in the Study Area, it was deemed inadvisable to structure a formal organizational entity such as a Citizens Advisory Committee or Citizens Task Force. Interest groups within the area (both developmental and environmental) were already fairly well organized and operationally established, and some of these organized groups sent representatives to Study Team meetings. Members of the general public also participated directly on the Study Teams.

Interstate and Study Area Planning Coordination

Planning coordination for drainage areas crossing state boundaries were coordinated in three ways: (1) the Assistant Study Mangers for the respective states maintained constant watch, directly and through the Study Manager, on the activities in their respective portions of the Study Area; (2) joint planning meetings between members of affected study teams were scheduled when conflicts were evident in planning philosophies or resource availabilities; and (3) the Assistant Study Managers were called upon by the Study Manager to report to the Management Group at appropriate times during the plan formulation process.

This process provided adequate coordination to provide overall compatability, but at the same time permitted enough freedom at the local and state levels to allow the plans to reflect local conditions and preferences.

A more difficult coordination problem revolved around the multitude of water and/or related land studies being undertaken by individual local, State, and Federal agencies. Many of these studies were related to some single objective, and had a schedule that did not correspond to that of the Level B Study. Attempts were made to coordinate activities with such programs as the "208" water quality studies; the regional coal-related EIS endeavors, and BLM and Forest Service land allocation studies. Even so, the differences in timing often made interchange of data and analytical results very difficult, though representatives of such ongoing studies attended Study Team meetings. As a result of these difficulties, it seems quite likely that the conclusions of some of these ongoing studies may not agree fully with some details of the Level B analysis. On the other hand, the coordination and interchange that has been possible has been

of great help in at least keeping basic philosophies and broad objectives identified and coordinated, so that differences in study outputs, if they occur, would be matters of detail that can be accommodated within the framework of future planning and implementation efforts.

Study Area Description

The Yellowstone Study Area encompasses the 37 counties in Montana, Wyoming, and North Dakota which are wholly or partially within the hydrologic boundary of the Yellowstone River Basin, plus 13 counties in North Dakota and two in Wyoming which are outside the hydrologic boundary but within the coal resource area associated with the Yellowstone Basin. Figure I-3 identifies the counties in each state that are involved in the study. The study does not include Yellowstone National Park, although a substantial part of the Park is drained by the Yellowstone River. The counties are shown below:

Montana

Big Horn	Fallon	Musselshell	Rosebud
Carbon	Gallatin	Park	Stillwater
Carter	Garfield	Powder River	Sweet Grass
Custer	Golden Valley	Prairie	Treasure
Dawson	McCone	Richland	Wibaux
	Meagher		Yellowstone

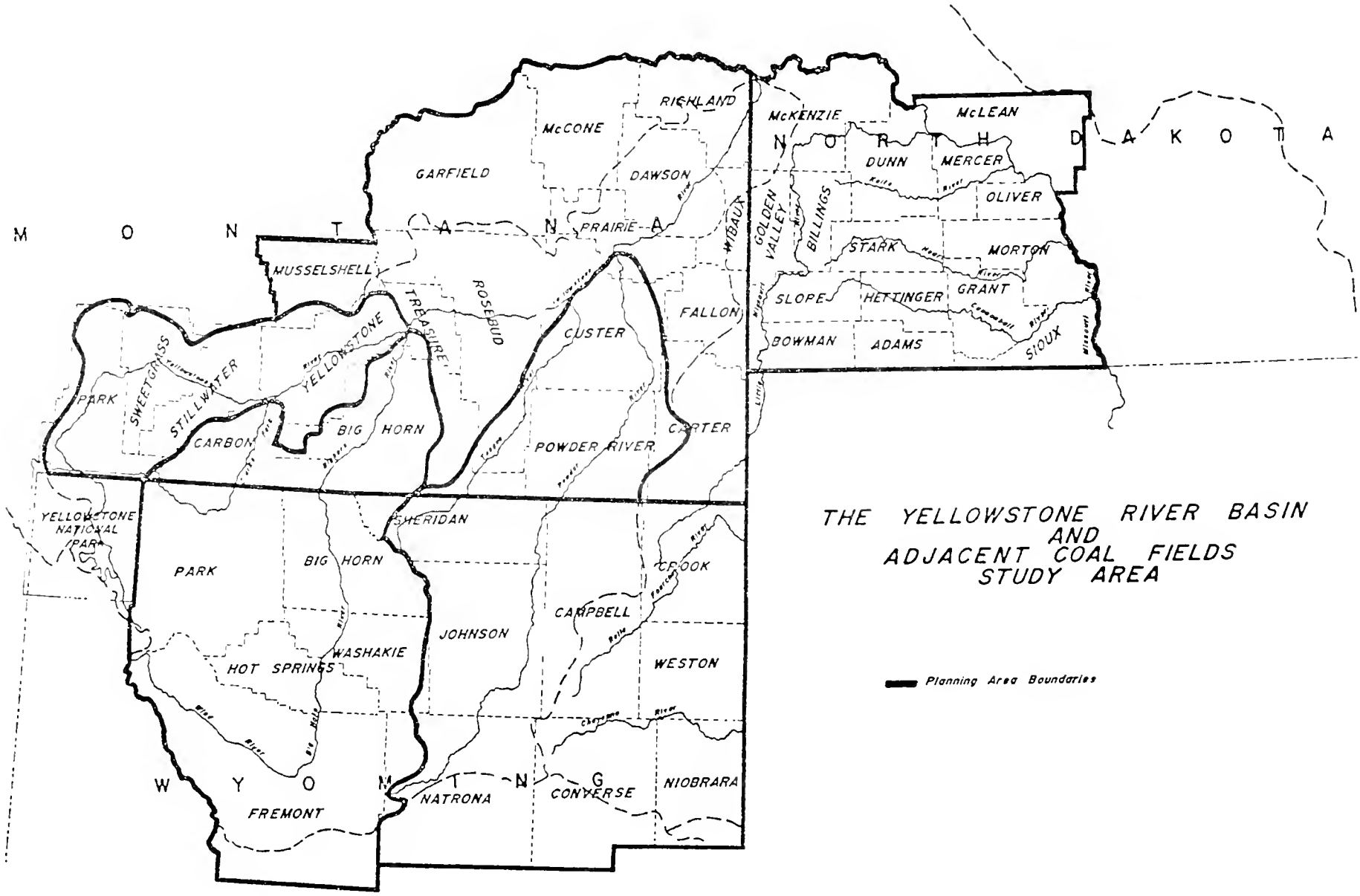
Wyoming

Big Horn	Fremont	Niobrara	Teton
Campbell	Hot Springs	Park	Washakie
Converse	Johnson	Sheridan	Weston
Crook	Natrona	Sublette	

North Dakota

Adams	Golden Valley	McLean	Sioux
Billings	Grant	Mercer	Slope
Bowman	Hettinger	Morton	Stark
Dunn	McKenzie	Oliver	

Figure I-3. Composition of Level B Study Area



For the purposes of this study, the total area, which covers about 123,375 square miles or 78,959,645 acres, has been subdivided by drainage into the seven planning areas listed below and delineated on Figure I-3.

Montana

Mainstem of Yellowstone River above the Bighorn River (Upper Yellowstone, Montana)
Mainstem of Yellowstone River below the Bighorn River, and Adjacent Coal Area (Lower Yellowstone, Montana)
Clarks Fork of Yellowstone and Lower Bighorn Rivers (Clarks Fork-Bighorn, Montana)
Tongue and Powder Rivers (Tongue-Powder, Montana)

Wyoming

Wind, Bighorn, and Clarks Fork Rivers (Northwest Wyoming)
Northeast Wyoming (Northeast Wyoming)

North Dakota

Little Missouri, Knife, Heart, Cannonball, Grand, and Yellowstone Rivers and Adjacent Coal Area (North Dakota Tributaries).

Study Area Objectives

Many of the problems and needs of the Yellowstone Study Area were documented in the Missouri River Basin Comprehensive Framework Study Report, and others have surfaced since that time.

In the main, potential conflicts are between those uses which divert water from the streams and rivers and those uses that require instream flows. Another conflict which affects all other issues is the Federal vs. the State water rights partially as manifested in the Indian and Federal reserved water rights questions.

To better define the areas of potential problems, the staff identified what appeared to be the major water related issues in the Study Area. They were the:

1) Maintenance and expansion of food and fibre production.
2) Maintenance of instream flow levels and water quality.

3) Impact of energy development upon the area's water resources.
4) Indian water resource use.

Upon the definition of these issues, the Level B staff addressed each in a paper. The papers provided guidance to the Management Group and State Study Team as how to dispose of the issues. These papers, coupled with agency and individual issue papers and the ad hoc reports, led to the analysis presented in the following chapters of this study.

CHAPTER II

NATURAL RESOURCE BASELINE

This chapter acquaints the reader with the manmade and natural characteristics of the Tongue-Powder Planning Area. The disucssion presents a brief survey of man and his habitat in this planning area.

Description

The planning area encompasses parts of six Montana counties: Big Horn, Carter, Custer, Powder River, Prairie, and Rosebud. The major portion of the area is made up of Custer and Powder River counties. Where information is not available by drainage basin, data from Custer and Powder River counties will be used to represent the entire planning area. Table II-1 displays its composition. Of the total 5,265,592 acres that comprise the planning area, 3,818,592, or 73 percent, lie within Custer and Powder River counties.

The planning area boundaries represent the combined limits of the Tongue and Powder river drainage systems.

Area History

Francois Antoine Larocque led the first party of white men into the Tongue-Powder area. His party entered southeastern Montana in July of 1805, a year in advance of the Lewis and Clark expedition. The purpose of the expedition was to attempt to gain an advantage on the area's fur trade by becoming acquainted with the Crow Indians who dominated most of the area at that time.

Larocque and his men were agents of the British Northwest Fur Company.

Table II-1. Land and Water Areas by County, Tongue-Powder, Montana[1/]

County	Water Area				
	40 Acres	40 Acres	(Acres)	(Acres)	(Acres)
Big Horn	3,547	95	3,642	434,358	438,000
Carter	---0---	992	992	353,008	354,000
Custer	8,430	6,433	14,863	1,696,073	1,710,936
Powder River	6,518	1,598	8,116	2,099,540	2,107,656
Prairie	464	87	551	93,449	94,000
Rosebud	600	540	1,140	559,860	561,000
Totals	19,559	9,745	29,304	5,236,288	5,265,592

1/ Source: Land Use Update, Land Use Ad Hoc Work Group, January, 1976

When the Company learned of the impending Lewis and Clark expedition, it first sent Larocque to see if he could join them. The Americans politely said "no" and that prompted the Northwest Fur Company into sending Larocque into the area first. The party first joined the Crow Indians and traveled with them from the Little Missouri River to the mouth of Pryor Creek on the Yellowstone. Upon crossing the Powder River he observed: "The current of the river is very strong and the water so muddy that it is scarcely drinkable. The savages say that it is always thus and that it is for this reason that they call the river Powder; for the wind rises and carries from the slope a fine sand which obscures and dirties the water." The party left the Crows at the mouth of Pryor Creek and returned to the Missouri by following the Yellowstone River.

On Clark's return down the Yellowstone one year later, he skirted the Tongue where he observed exposed veins of coal in great quantities. Large amounts of coal were also noted by a U.S. Army expedition that passed through the area in 1859-1860.

As settlers and civilization pushed to the west, the Sioux were forced into the Yellowstone area. Further pressures led to the Indian wars during the period from 1860 to 1880. During these wars the Tongue River Cantonment was built near the mouth of the Tongue River. Milestown was established by civilians that had been ordered out of the fort by the commanding officer, Colonel Miles. The town moved to its present location in 1887 and was renamed Miles City.

Probably the most historic town in the Powder River area was Powderville, which was located at the point where the old stage road between Deadwood, South Dakota, and Miles City crossed the Powder River. Powderville had a post office, saloon, and a place for travelers, called a "Road Ranch." Today it is a ghost town.

After Fort Keogh was established near the present site of Miles City, a vigorous campaign was launched against hostile Indians during the winter of 1876-1877 which did much to clear them from the Powder River Basin. By the fall of 1877 the valley began to absorb white settlers. Buffalo hunters and trappers moved up and down the river, and settlers explored the tributaries of the Powder River seeking good locations for settlement. One of the oldest ranches in Powder River area was the Selway sheep ranch, established in 1881 by John Selway.

Calvin Howes was among the earliest (1881) of the cattlemen who settled in the area. Some of the original buildings are still used on this ranch and the stone fort which was built in 1887 during the area's last Indian scare still stands as a landmark.

Homesteading reached its peak in 1909-1910. This was due to the building of the Chicago, Milwaukee, and St. Paul and Pacific railroad which made the new lands more attractive. Homesteading steadily expanded in this cattle and sheep country, expecially after 1916 when the enlarged 640 acre Homestead Law became effective.

Natural Resources

Physiography and Geology

The Montana portions of the Tongue and Powder Rivers lie in a single physiographic province--that of the unglaciated Missouri Plateau. Of approximately 5.3 million acres that lie within the planning area, 94 percent of those acres is classified as a part of the Northern Rolling High Plains; four percent of the area is made up of the Pierre Shale Plains and Badlands; the balance of the area is split evenly between the Northern Rocky Mountain Foothills in the extreme southwestern portion of the planning area, and the Northern Smooth High Plains that adjoin the eastern-most part of

Custer County.1/

The Tongue and Powder Rivers originate in the mountains of Wyoming and flow northeasterly through Montana to the Yellowstone through rolling plains. The greater part of the area is characterized by a rolling to rough expanse of sharply rounded ridges and hills with occasional bold escarpments formed by the tilted edges of sandstone. Intervening valleys are often broad and flat with numerous deep-cut gullies. The soft shales in places have eroded rapidly so that entire surfaces have been thoroughly dissected to the extent that the original plains character is now distorted and represented only by the crests of remaining ridges.

Almost all of the planning area is underlain by the Fort Union formation of the early Tertiary (Eocene) Age. This relatively flat formation has a total thickness of about 2000 feet in the western part of the area where it is a massive light yellow sandstone containing thick and extensive coal beds. The Fort Union formation was formed 50-60 million years ago in a vast series of shallow freshwater lakes which extended from east-central Wyoming to northern Montana, and from Livingston, Montana, eastward to the center of North Dakota. Broad swamps and lowlands supported the thick forests that eventually formed the base for the existing coal beds. At that time, there existed prolific flora of some 400 species of plants and fauna which included fishes, mollusks, and reptiles.

In some parts of the area, burned-out coal beds along outcrops have left "clinker" or "slags"--resistant masses of overlying based clay--as ledges. and small buttes. These slags, reddish-orange in color, rim the upland areas and have retarded wind and water erosion to form miniature terraces. Drainage courses are mostly intermittent. During heavy downpours, the dry stream beds may carry rushing torrents, sometimes 20 to 30 feet in depth.

1/ See Land Use Update, Land Use Ad Hoc Work Group, January, 1976.

Erosion at such times may be extremely rapid with great masses of soft shale crumbling and being carried away by the water.

The minimum elevation of the Tongue-Powder drainage is approximately 2,250 feet at the confluence of the Powder River and the Yellowstone River in Montana, and the maximum is 13,165 feet at the summit of Cloud Peak in the Big Horn Mountains of Wyoming. About three-quarters of the planning area lies at elevations below 5,000 feet.

Climate[2/]

The climate of this planning area is continental--hot summers and cold winters. In the upper portion of the area at Broadus, summer temperatures average about 3° cooler than along the Yellowstone River in the Miles City area. On the other hand, January minimums average a little colder at Miles City than at Broadus. The fact that upper Powder River area temperatures in summer average about 3° cooler than along the Yellowstone River to the north, in spite of its more southern latitude, arises from its elevation being more than 1,000 feet higher than along the Yellowstone. Conversely, winter minimums are warmer for two reasons: one because of the more southerly latitude of the Powder River area; the other due to cold air drainage northward toward the Yellowstone Valley.

About three-fourths of a normal year's precipitation falls during the April-September growing seasons which ranges from 135 days in the Yellowstone Valley to 100 in the uplands near the Wyoming border. Areas at lower elevations are generally the driest, receiving around 12 inches of moisture a year; some areas that lie on the leeward slopes of mountains are a little drier--receiving an average of only about 10 inches. The highest portions of the area are the wettest, with an annual average of near 20 inches.

2/ The information found here and in many of the following sections of this Chapter has been taken from one or more of the Bureau of Land Management's several Missouri River Basin Investigations.

Severe storms of several types strike the area occasionally. High winds are observed a few times every year but wind speeds greater than 50-60 m.p.h. are uncommon. Heavy snowstorms may occur perhaps once a year but mostly in late fall or early spring when temperatures are not severe. Tornadoes are rare. Thunderstorms, sometimes accompanied by hail or gusty winds, are the most common severe storm type but are mostly confined to July and early August. Large-scale flooding of major streams seldom happens; more common is the ice-jam flooding in late winter or early spring caused by thawing that progresses more rapidly upstream than in downstream areas.

Soils and Vegetation

Soils

Soils in the Tongue River area are derived mainly from sediments of the Fort Union Formation. They vary in slope and depth but are well drained. Soils best suited to cultivated crops are those in the Brown, Chestnut, and the alluvial soil groups. However, most of the area is underlain by shallow and moderately deep soils which are best suited for production of native grasses and other range vegetation.

A limited number of soils have been formed in the alluvium of the valleys. Given proper location, depth, and water relationships, many of these soils have the potential to be highly productive.

Some soils in the Tongue area are affected by salts. These "saline" soils are often structureless and manifest a type of molecular structure that swells and shrinks with changing moisture conditions. The pronounced cracks that form from this action encourage specialized subsurface erosion--that of "piping." Productivity on these soils varies with location but plant cover is usually scant. Low-lying saline soils may be productive if well drained.

Badlands, which are principally in the lower basin, make up only a small

part of the Tongue River area. These are steep, barren wastes where the soil material is removed by wind and water erosion as fast as it develops. Badland soils were formed from raw shales and sandstones.

In general, the soils of the Powder River area, like the soils of the Tongue area, present a variation in development which differs throughout the area. Being derived in most cases from shale formations, these soils are high in soluable salts and low in nitrogen. In a few places, capping of sandy materials over the shale formations has produced areas of sandy loams, but heavy clay soils are dominant within the basin.

Vegetation

Indications, based on early narratives and more recent photographic evidence (Bureau of Land Management), are that the plant cover of the Tongue River Basin has changed relatively little since the days of early exploration (beginning in 1805).

Ponderosa pine, found on the Custer National Forest and the Northern Cheyenne Indian Reservation, is the principal source of lumber in the area; it also has local value for building and repairs on the area's ranches.

Grasses dominate the basin. Western wheatgrass and blue grama are the most common grasses, followed by needle-and-thread and bearded bluebunch wheatgrass. Bearded bluebunch wheatgrass is found in relatively large amounts on nearly two-thirds of the range. Carexes (especially threadleaf sedge) are other important widely distributed plants. Inland saltgrass and alkali sacaton are usually found on the saline flats; rocky slopes support bluestem, sideoats grama, and prairie sandreedgrass.

The most common shrub is a big sagebrush. Broom snakeweed, silver sagebrush, fringed sagebrush, and skunkbrush are all commom also. Chokecherry, curl-leaf mountain mahogany, aspen, snowberry, greasewwod, rose and willows are conspicuous but localized by topography and soils. Junipers

are a common browse of significant value to wildlife.

Poisonous plants are not overly important. Death camas is encountered most frequently in the spring. Lupine, larkspur, and horsebrush are relatively rare. Arrowgrass, although seldom encountered, is strongly poisonous and even the smallest patches are potentially dangerous to livestock. Chockcherry may cause prussic acid poisoning after frost or sudden severe drought, but it is normally considered a valuable forage plants.

Pricklypear cactus is scattered over rangelands of the basin. Early explorers consistently recorded its existence. Annual grasses and weeds increase and decrease from year to year with the changes in rainfall.

The plant cover of the Powder River Basin has changed little since early exploration by the white man and remains much like that of the Tongue Basin. About 93 percent of the Powder Basin is occupied by natural vegetation, the remaining seven percent of the area comprising hay and croplands, water surfaces, roads and waste lands. Grass dominates the basin; the principal grasses are the same as those found in the Tongue drainage. Open stands of Ponderosa pine are found in the Powder River Breaks but are of no commercial value because of their scattered locations. Native vegetation, therefore, is the basis for the principal enterprise--the livestock industry.

Mineral Resources

The State of Montana contains roughly 22.5 percent of the total strippable coal reserves found in the United States. Most of these reserves are subbituminous and lignite coals. The Tongue-Powder Planning Area is underlain with vast amounts of coal--roughly 75 percent of Montana's strippable coal is found within this planning area.

Both oil and gas reserves have been identified in the planning area. However, the only production takes place in Powder River County--mostly stemming from the Bell Creek Field.

Minor deposits of sand and gravel can be found throughout the area.

Deposits of clay suitable for use both as a lightweight aggregate and for ceramic use exist between the Tongue and Powder rivers in the southern part of the area. None has ever been mined.

Pumicite occurs as finely divided volcanic particle; the major uses of pumicite are: for lightweight aggregate; as a carrier for insecticides; as insulation; as an adhesive; and for a soil conditioner. Rosebud and Powder River counties contain deposits of pumicite.

Land Use

The Tongue-Powder Planning Area contains a total of 5,265,592 acres within its boundaries. Approximately 305,649 acres, nearly 6 percent, are cultivated.

Agriculture

There are 198,463 acres of cropland in the planning area; the majority of those acres--129,940--are non-irrigated. The remaining 68,523 acres of cropland are irrigated. Out of a total of 107,186 acres in pasture, only 3,606 of those are irrigated, while 103,580 acres are nonirrigated.

Total irrigated lands (i.e., crop and pasture) sum to 72,129 acres. Of that total, the greatest use of the land is for hay production, which is approximately 66 percent of the total. Corn (for silage and grain) and sugar beets are grown as major crops with oats, barley, and wheat following as minor crops.

The primary dryland crop grown in the planning area is also hay, which amounts to roughly 52 percent of the total. Wheat and barley are the other major dryland crops.

Rangeland accounts for more than 4.2 million acres, which is fourteen times that of crop and pasture lands and seven times greater than forest lands.

Non-Agricultural

There are almost 78,000 acres of barren land in the area, and 17,000 acres classified as urban or builtup.

Land Ownership and Administration

Of the 5,265,592 acres contained in the planning area, 29 percent is federally owned and administrated. There are 29,304 acres of surface water; 66 percent of this lies on federal lands. By land use, the Federal Government owns and administers: 22 percent of the range lands; 42 percent of the forest lands; all of the barren lands; and none of the urban/builtup or agricultural lands.[2A/]

Subsurface ownership and administration data are not available by planning area. However, Federal ownership and administration are available on a limited, county basis.[3/]

State subsurface ownership and administration is available by township and range in the State Land Mineral Ownership Listing.[4/] These data have not been totaled by county and no data exist by drainage basin.

Fish and Wildlife Resources

The Tongue-Powder River Planning area is a land of rolling prairies, river breaks and low mountains which was a favored hunting ground of several nomadic Indian tribes. The grasslands which provided sustenance for huge herds of bison now support cattle.

The bison, elk, wolf, and grizzly bear were all natives of the Tongue-

2A/ Land Use Update, Land Use Ad Hoc Group, January 1976.

3/ U.S. Bureau of Land Management (BLM) State Office, Billings, Montana.

4/ Montana Department of State Lands, January 1976.

Powder area; but since the coming of the white man, these animals have been completely eliminated. Mule deer, whitetailed deer, pronghorn antelope, and a small population of bighorn sheep remain and occupy various portions of the drainage along with the omnipresent coyote.

Sauger, ling, and catfish, native fish species, are generally adapted to warmer and lower water quality streams. No salmonid species are native, although rainbow and brown trout have been introduced into a few reservoirs and streams.

Native grouse species, sage grouse and sharp-tailed grouse, are widely distributed. Man has introduced ring-necked pheasants, Hungarian and chukar partridges and Merriam's turkeys; these species contribute greatly to the upland game bird hunting available in the area.

In general, much of the area's wildlife habitat has been affected by man's activities. With renewed interest in the area's vast coal resources, there is further potential for disruption and destruction of the habitat from coal-related energy activities.

Outdoor Recreation Resources

Outdoor recreation sites in the Tongue Powder area are few with limited facilities. Developed recreational sites only account for a total of 4 acres of picnic areas and 15 acres of camping areas. There are no sites that are water oriented and no community outdoor recreation facilities of area-wide significance.

The major outdoor activities of the people that live in the planning area are hunting and fishing. Although the outdoor recreational opportunities are largely tied to private lands, there are two outstanding public areas that may be utilized for outdoor recreation.

The first is that portion of Custer National Forest that lies between the

Tongue and Powder Rivers in the center of the planning area; the Forest offers potential for a variety of outdoor activities to the populations. The second is the Tongue River Reservoir which has established an excellent reputation as a sport fishery--primarily for warm water species like walleye pike and crappie. The river, below the dam, has the state's only population of rock bass and a self-sustaining smallmouth bass fishery.

Water Resources

Water Rights[5/]

The Montana Water Use Act of 1973 provides a permit system for the appropriation and new use of surface and ground water, procedures for the determination and court adjudication of water rights existing prior to July 1, 1973, and the establishment of a centralized record system of all water rights.

Because of Montana's past lack of documents concerning valid water use, water supply problems, and implications of industrial applications, the Montana Department of Natural Resources (DNRC) decided that the initial determination of existing water rights would be in the Yellowstone River Basin. Field investigations of water right declarations, part of the process of preparing a recommendation to the district court which issues the preliminary and final decree for adjudication, have been underway since the summer of 1974 in the Powder River Basin.

The DNRC estimates that there will be a total of about 11,000 water rights recommended to the district court in the Powder River Basin. Of the 3,000 rights investigated so far, about 75 percent are use rights--rights which have never been filed. Prior to July 1, 1973, use was the only necessary requirement to establish a water right and, except on an adjudicated stream,

5/ The sections discussing water rights, Federal and Indian water rights, water rights litigation, and the Yellowstone River Compact were taken from The Future of the Yellowstone River.....?, Montana Department of Natural Resources and Conservation, January, 1977.

there was no necessity to file. Under the new law, of course, a permit must be obtained for the use of water or there is no right to that water.

The adjudication of the other three interstate tributaries (Tongue, Bighorn, and Clarks Fork Yellowstone) will be completed next. In fact, preparations for the determination of existing rights have begun in the Tongue and Bighorn river basins, but orders for declarations are currently pending because of litigation in federal court over Indian and federal water rights. Adjudication of the mainstem of the Yellowstone River will follow.

Until the adjudication process is completed, quantification of water rights is not possible. Water rights usually are not adequately reflected in historical flow records.

Yellowstone Moratorium

Under the Montana Water Use Act, new water rights are established through the issuance of permits by the Department of Natural Resources and Conservation. Originally, the Yellowstone Moratorium, enacted in 1974, suspended all large applications (diversions of over 20 cfs or storage of over 14,000 af) for water use permits in the Yellowstone Basin until March 10, 1977; in addition, the Moratorium excluded reservations in the basin by Federal agencies for three years. However, since then, the Moratorium was extended to January 1, 1978, and Federal agencies were allowed to file reservation requests. The Board of Natural Resources requested further extension of the Moratorium to July 1, 1978, but the Supreme Court denied this request and stayed proceedings until some unspecified date in the summer of 1978.

Six permit applications, all of which are primarily for industrial water use, were suspended. The language of the Moratorium emphasized the need for reserving water in the Yellowstone Basin for the protection of existing and future beneficial water uses; particular emphasis was given to the need for reservation of water for agricultural and municipal needs,

as well as guaranteed minimum flows for the protection of existing rights, future uses, water quality, and aquatic life.

The significance of water reservations cannot be overestimated; their impacts will be felt long after the decisions are made. Because of the magnitude of the water reservation requests, the wide variety and magnitude of potential water uses, and their basinwide scope, action on these applications could establish future patterns of water use in the Yellowstone Basin.[5A/]

Federal and Indian Water Rights

Present recognition of Indian "reserved" water rights began with the United States Supreme Court's decision in the Winters case in 1908. The Winters Doctrine, as it has been developed over the years, holds that when the Indian tribes ceded their lands to the United States, reserving smaller tracts for their own use, sufficient water to fulfill their needs on the reservation was also reserved. The measure of the reserved right is in dispute, although some courts have measured the right according to the irrigable acreage on the reservation. The reserved right does not depend upon actual use, and is therefore available for future as well as present needs. Thus, even if the quantity of the reserved right is determined, the question arises as to whether that water can be put to uses (such as coal-based industrialization) which were not contemplated when the reservation was created. Since major tributaries of the Yellowstone flow by or through both the Crow and Northern Cheyenne reservations, the Indians' reserved rights will affect other water uses.

Reserved rights attach, not only to Indian lands, but to any lands the United States has withdrawn from the public domain for federal purposes. Upon withdrawing the lands, the United States impliedly withdrew or reserved sufficient water to satisfy the federal purposes. Included in this category are most national forest lands, national parks, recreation areas, and wildlife

5A/ From Environmental Impact Statement on Yellowstone Water Reservations.

refuges. The same problems of quantification seen with Indian rights apply to these federal reserved rights. Further discussion of Indian water rights is found in Chapter IV.

Water Rights Litigation

Aside from the Indian lawsuits (see Chapter IV), another important series of lawsuits concerning water rights in the Yellowstone River Basin involves Intake Water Company, Inc., a wholly-owned subsidiary of Tenneco, Inc., of Houston, Texas. The basis of the three separate actions to which Intake is a party is its claim to an existing right to appropriate 111.4 cfs from the Yellowstone River near Intake, Montana. In the first action, Intake has successfully defended its claim against the state of Montana in district court to a perfected appropriation for sale, rental, and distribution for irrigation, industrial, municipal, and domestic purposes. General plans have been revealed to sell water to "companies with energy generating or conversion plants within or outside the State of Montana," including its parent corporation, Tenneco, Inc. The judgment of the District Court upholding Intake's claimed appropriation is currently under appeal by the state in the Montana Supreme Court.

A separate action instituted by Intake against the Yellowstone River Compact Commission in Federal District Court seeks a declaratory ruling that Article X of the Yellowstone River Compact is unconstitutional in that it requires unanimous consent of the three signatory states before any water can be diverted from the Yellowstone River Basin. This case is currently stayed, pending a resolution of the issues in the lawsuit mentioned in the preceding paragraph, and none of the issues raised has yet been resolved.

In a third separate action, Intake has sued the DNRC in Montana District Court seeking a declaratory ruling that its planned diversion of 111.4 cfs from the Yellowstone River, for the purposes described above, is not subject

to the Montana Major Facility Siting Act. This case is also currently pending.

The outcome of all three of these actions is important because there are several corporations with similar large claims for Yellowstone Basin water for industrial purposes. Furthermore, the action in Federal District Court is the first to interpret and challenge the Yellowstone River Compact. Thus, final resolution of these actions could determine the validity of other claimed rights from the Yellowstone and could significantly affect the future administration of the Yellowstone River Compact.

Another series of lawsuits to which Intake Water Company is a party involves competing water development projects on the Powder River between Intake and Utah International, Inc. The issues raised are complex, but generally involve tne question of whether Intake or Utah International has the prior claim to water from the Powder River. The two lawsuits--one in State District Court and the other in Federal District Court--require interpretation of the Yellowstone River Compact and the water appropriation laws of the states of Montana and Wyoming. Both actions are currently pending, awaiting resolution of preliminary jurisdictional and procedural issues.

Yellowstone River Compact

The Yellowstone River Compact, executed by Montana, Wyoming, and North Dakota, and ratified by the United States Congress in 1950, was designed to allocate water of the Clarks Fork Yellowstone, Bighorn, Tongue, and Powder rivers. The compact recognizes water rights prior to 1950, those rights designated to provide supplemental water supplies to land irrigated prior to 1950, and water rights for irrigation projects started before 1950. The compact divides the remaining water according to percentages of the flow at the mouths of the streams as shown by Table II-2.

Table II-2. Division of Waters Under the Yellowstone River Compact

Stream	Wyoming	Montana
Clarks Fork Yellowstone	60%	40%
Bighorn	80%	20%
Tongue	40%	60%
Powder	42%	58%

Article X of the compact prohibits diversion of water out of the Yellowstone Basin without the unanimous consent of the signatory states. This article has recently become controversial because there are some who would like to divert water out of the basin for energy or other uses. Montana's position at this time is to withhold approval of such diversions until the two states can agree on quantification of the percentages of tirbutary flows. Wyoming has published its estimates of these quantities, as presented in Table II-3. Montana does not necessarily agree and intends to independently calculate its compact share.

Table II-3. Wyoming's Yellowstone Compact Estimates (Acre-Feet)

Stream	Wyoming	Montana
Clarks Fork Yellowstone	429,000	285,000
Bighorn	1,800,000	400,000
Tongue	96,400	144,700
Powder	120,700	166,600
TOTAL	2,446,100	996,300

Source: Wyoming State Engineer's Office 1973.

Drainage Network

The minor streams that originate within the Tongue-Powder Planning Area are plains streams--high in sediment with spring runoff occurring in early spring rather than late spring/early summer. The major streams of the area

show relatively high flows during early spring but peak flows usually occur from mid-June to mid-July, due to snow melt in the mountainous reaches of the steams.

Tongue River

The Tongue River originates in the eastern portion of the Bighorn Mountains in Wyoming. It flows into Montana near Decker, Montana. There are many small reservoirs on the Tongue River drainage in Wyoming which have a minor regulatory effect at the Montana line. The Tongue River flows into Montana for about five miles before emptying into the Tongue River Irrigation Reservoir. There are no major tributaries in this reach.

The Tongue's major tributaries enter the river below the reservoir; these tributaries are Hanging Woman, Otter, and Pumpkin Creeks. These three creeks are intermittent through portions of their drainages and exhibit the typical characteristics of prairie streams.

Powder River

The Powder River originates in the Bighorn Mountains of Wyoming. It flows generally northward into Montana joining the Yellowstone River near Terry.

The Powder River is regulated by three storage reservoirs in Wyoming and several irrigation diversions. There are two tributary streams of the Powder River which have relatively large drainage areas, the Little Powder River and Mizpah Creek. All other tributary streams have small drainage areas and flow only during the spring snow runoff and in response to rainfall. Mazpah Creek originates in the rolling foothills just northwest of Broadus and flows generally northward emptying into the Powder River about ten miles above Locate. Mizpah Creek is an intermittent stream and probably has flow characteristics typical of streams with only prairie drainages. Although there may be distinct reaches of Mizpah Creek which are continuously flowing,

the stream does not have a sustaining base ground water flow.

Little Powder River

The Little Powder River is an intermittant stream which originates on the plains of Northeast Wyoming. The river flows generally northward to its confluence with the Powder River near Broadus; its drainage area in Montana is small. There are a few small diversions along the Little Powder River for irrigation of small hayfields. Although high flows occur in March, there is a flow increase in May due to runoff from the Wyoming drainage.

Historical and Depleted Flows

Tables II-4 through II-9 illustrate: (1) historical and (2) depleted flows of the Tongue and Powder Rivers for the 1975 level of development at the U.S. Geological Survey's (USGS) gaging stations at Miles City and Locate.6/

The peak flow years of the Tongue were 1944 and 1975; its lowest flows were measured in 1940 and 1961. The Powder River had its highest recorded flow in 1944; other good years were 1943, 1962, and 1972. The lowest flows of the Powder were recorded in 1954 and 1961.

The primary use of water in the Planning area is for irrigation and livestock. Miles City (on the Yellowstone mainstem) is the only municipality to utilize surface water. More complete information on the present consumptive uses of water can be found in Chapter IV.

The Tongue River Reservoir is the largest impoundment in the area with a storage capacity of 69,439 acre feet. Water from this reservoir is used for irrigation, recreation, fish and wildlife, and some industrial water has been

6/ Historical flows are the flows that were actually measured at river gaging stations; they are real flows. Depleted flows are historical flows that have been adjusted to reflect some level of development (e.g., the 1975 level of development). Depleted flows illustrate what flows would have been given some level of water consumptive development.

Table II-4
Tongue River at Miles City - Historical Flow

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
						UNITS - 1000 AF							
1938	0.00	0.00	0.00	0.00	0.00	0.00	12.81	62.02	97.17	47.06	1.37	.14	220.57
1939	4.29	10.33	4.43	7.8e	9.89	37.97	18.89	8.67	68.24	8.18	3.12	4.71	186.60
1940	17.78	7.13	8.57	6.6e	7.99	12.03	4.00	9.87	28.23	14.44	2.45	1.76	120.90
1941	19.00	6.04	6.53	6.3+	6.43	8.21	3.70	20.69	55.24	6.48	4.30	19.81	162.77
1942	31.60	34.80	19.50	11.80	8.40	27.40	23.30	44.00	108.00	18.00	.40	9.50	336.70
1943	28.00	31.00	19.50	11.5e	19.00	48.00	71.00	52.00	118.00	18.00	.40	9.50	425.90
1944	17.00	29.50	17.50	10.00	6.00	36.00	30.00	88.00	232.00	112.00	1.00	3.00	582.00
1945	15.00	34.50	18.50	11.80	10.00	26.00	21.50	28.00	136.00	56.00	1.00	11.50	369.80
1946	39.00	30.50	16.00	14.00	12.50	53.00	32.40	43.20	115.30	42.50	10.30	22.90	431.60
1947	40.07	33.72	21.52	24.30	18.35	91.80	47.64	87.81	89.59	55.10	6.70	9.71	526.31
1948	17.22	27.62	17.96	14.38	16.92	47.53	43.12	69.70	91.20	74.45	11.41	5.84	437.35
1949	18.55	32.90	10.63	9.5+	6.38	85.31	29.62	51.05	69.87	7.31	.37	2.41	323.99
1950	10.41	26.69	25.98	10.2e	8.72	21.77	24.55	34.14	40.46	21.30	7.57	14.75	246.62
1951	21.25	24.25	13.15	12.7+	12.42	14.28	14.60	30.32	35.91	30.31	16.46	28.99	254.68
1952	20.19	31.60	11.69	8.44	9.40	31.50	87.25	66.32	62.78	17.30	6.31	7.17	359.95
1953	20.58	13.24	12.68	11.10	9.25	13.50	8.90	27.04	106.30	8.69	2.27	1.21	234.76
1954	15.55	23.50	12.23	10.8e	14.40	14.23	13.72	17.00	18.69	3.13	7.77	2.52	153.62
1955	4.84	12.65	12.80	9.3e	5.84	15.95	27.25	52.23	75.61	26.95	4.27	.73	248.50
1956	2.53	7.80	9.44	9.7e	9.11	29.83	53.00	38.87	62.99	5.25	7.06	4.05	239.69
1957	4.74	17.50	13.76	8.11	7.80	14.77	21.92	29.81	120.90	35.62	6.46	17.53	298.92
1958	15.26	9.83	10.07	10.24	9.44	14.19	12.25	32.28	39.17	34.49	4.96	2.17	194.35
1959	13.26	15.24	14.91	12.13	10.62	91.19	31.92	27.66	24.92	9.77	13.56	11.50	276.68
1960	7.02	9.96	12.90	11.80	10.94	49.76	23.70	5.03	2.89	.77	1.11	.32	136.20
1961	.64	5.52	4.32	4.83	5.64	4.91	.75	1.79	5.92	2.09	.45	4.59	41.44
1962	4.91	4.71	8.17	8.36	15.17	34.84	36.70	49.51	129.50	25.20	8.05	13.29	338.41
1963	14.60	12.24	10.55	8.20	38.32	28.31	13.69	86.67	176.50	22.84	7.77	11.54	431.23
1964	1.57	4.57	4.28	8.7e	10.36	11.98	17.98	52.05	148.50	59.99	17.89	17.66	355.59
1965	12.79	11.45	10.33	13.61	26.61	37.14	100.70	61.00	81.00	47.48	13.19	19.76	435.06
1966	35.26	19.53	11.45	8.76	7.80	15.47	8.22	12.45	13.56	10.10	6.39	6.80	155.79
1967	2.15	5.64	6.36	9.6e	13.03	19.18	20.37	38.83	207.80	67.28	11.78	18.90	421.00
1968	14.21	19.46	14.54	17.45	30.53	47.70	26.69	33.02	162.50	40.74	35.48	35.63	477.95
1969	32.96	18.72	12.28	12.5e	11.90	92.95	62.26	68.10	48.26	55.92	10.05	11.14	437.10
1970	12.44	8.47	13.73	13.2+	14.60	24.93	35.67	94.43	160.00	30.99	8.50	12.46	429.45
1971	16.40	16.86	12.80	11.6e	99.61	109.60	58.25	72.26	100.50	14.39	6.34	13.40	532.03
1972	42.69	21.35	12.38	10.37	18.35	95.09	56.50	47.99	82.11	21.60	14.79	15.31	438.53
1973	23.07	20.33	10.55	14.52	15.51	17.18	18.55	84.68	115.90	25.17	11.93	23.38	380.77
1974	28.93	23.73	10.24	26.00	20.07	18.62	20.50	47.16	75.50	21.59	11.92	8.51	312.77
1975	14.26	18.14	19.93	30.84	9.99	60.04	49.85	109.70	161.70	135.70	43.02	15.51	668.68
AVG	16.84	17.92	12.43	11.63	14.93	36.90	31.15	46.98	91.28	32.48	8.64	11.04	332.22

Table II-5
Tongue River at Miles City- 1975 Depletion Level

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
						UNITS - 1000AF							
1938	1.29	.82	.54	.65	.16	0.00	11.76	56.84	89.15	39.91	0.00	0.00	201.11
1939	5.58	11.15	4.97	8.53	10.05	37.13	17.84	3.49	60.22	1.03	0.00	2.43	162.41
1940	19.07	7.95	9.21	7.30	8.15	11.09	2.95	4.79	20.21	7.19	0.00	0.00	97.89
1941	20.29	6.86	7.07	6.99	6.59	7.27	2.75	15.61	47.32	0.00	.25	17.53	138.51
1942	32.89	35.62	20.04	12.45	8.56	26.56	22.45	39.02	100.18	11.05	0.00	7.22	316.03
1943	29.29	31.82	20.04	12.15	19.16	47.16	70.15	47.02	110.18	11.05	0.00	7.22	405.23
1944	18.29	30.32	18.04	10.65	6.16	35.16	29.15	83.02	224.18	105.05	0.00	.72	560.73
1945	16.29	35.32	19.04	12.45	10.16	25.16	20.65	23.02	128.18	49.05	0.00	9.22	348.53
1946	40.29	31.32	16.54	14.65	12.66	52.16	31.55	38.22	107.48	35.55	6.25	20.62	407.27
1947	41.36	34.54	22.06	24.95	18.51	90.86	47.09	83.33	82.07	48.25	2.65	7.43	503.08
1948	18.41	28.44	18.60	15.03	16.98	46.99	42.57	65.32	83.68	67.60	7.36	3.56	414.52
1949	19.84	33.72	11.17	10.24	6.44	84.67	28.97	46.27	62.25	.36	0.00	.13	304.05
1950	11.60	27.51	26.52	10.93	8.78	21.23	24.00	29.45	32.64	14.35	3.52	12.57	223.09
1951	22.44	24.97	13.69	13.29	12.48	13.74	14.05	25.74	28.09	23.36	12.41	26.81	231.05
1952	21.48	32.32	12.23	8.99	9.46	31.16	86.70	61.94	55.06	10.45	2.16	4.99	336.92
1953	21.87	13.96	13.22	11.65	9.21	13.06	8.35	22.56	98.38	1.84	0.00	0.00	214.08
1954	16.84	24.22	12.67	11.43	14.46	13.79	13.27	12.62	10.77	0.00	3.62	.34	134.01
1955	6.03	13.37	13.24	9.93	5.90	15.71	26.80	47.85	67.49	20.20	.12	0.00	226.62
1956	3.72	8.52	9.88	10.31	9.17	29.49	52.65	34.69	55.77	0.00	2.91	1.87	218.96
1957	5.93	18.22	14.30	8.56	7.86	14.53	21.67	25.73	112.68	28.87	2.31	15.35	275.99
1958	16.55	10.55	10.61	10.69	9.50	14.05	12.00	28.30	30.85	27.74	.81	.09	171.72
1959	14.55	15.96	15.45	12.58	10.68	91.05	31.77	23.78	16.70	3.02	9.41	9.42	254.35
1960	8.21	10.78	13.44	12.25	11.00	49.72	19.75	1.15	0.00	0.00	0.00	0.00	126.28
1961	1.83	6.24	4.86	5.28	5.70	4.77	.69	0.00	0.00	0.00	0.00	2.51	31.87
1962	6.10	5.43	8.71	8.91	15.33	34.70	36.65	45.73	121.08	18.55	4.00	11.21	316.38
1963	15.75	12.96	11.09	8.75	38.48	28.27	13.74	82.98	168.08	16.29	3.82	9.46	409.70
1964	2.76	5.59	5.02	9.31	10.62	12.04	18.13	47.87	143.88	52.24	12.64	14.78	334.86
1965	13.98	12.47	11.07	14.16	26.87	37.10	100.75	57.12	76.48	40.23	8.14	17.08	415.43
1966	36.45	20.45	12.09	9.41	8.06	15.53	8.37	8.57	9.14	2.75	1.54	4.22	136.56
1967	2.64	5.96	6.80	10.13	13.19	19.24	20.52	35.75	204.98	63.53	8.33	16.92	407.97
1968	14.70	19.88	14.98	17.80	30.69	47.86	26.84	30.04	159.68	37.19	32.23	33.75	465.62
1969	33.45	19.04	12.62	12.91	12.06	93.11	62.51	65.22	45.64	52.47	6.90	9.46	425.37
1970	12.83	8.79	13.97	13.48	14.76	25.09	35.92	91.74	157.38	27.84	5.65	10.98	418.42
1971	16.79	17.18	13.04	11.87	99.77	109.76	58.50	69.58	97.88	11.24	3.49	11.92	521.00
1972	43.00	21.61	12.57	10.57	18.48	95.22	56.70	45.85	80.02	19.10	12.51	14.13	429.76
1973	23.31	20.53	10.70	14.67	15.61	17.28	18.71	83.09	114.35	23.31	10.22	22.50	374.27
1974	29.09	23.86	10.34	26.10	20.14	18.69	20.61	46.12	74.49	20.38	10.79	7.93	308.53
1975	14.34	18.21	19.98	30.89	10.03	60.08	49.92	109.21	161.23	135.13	42.46	15.23	666.70
AVG	17.87	18.59	12.90	12.13	15.05	36.59	30.72	43.12	85.20	27.01	5.69	9.20	314.08

Table II-6
Powder River Near Locate - Historical Flow

(UNITS - 1,000 AF)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1939	[illegible]	[illegible]	[illegible]	[illegible]	4.74	130.[illegible]	29.40	41.48	55.34	12.40	1.63	.77	317.94
1940	3.64	3.55	5.54	1.45	2.13	32.64	31.[illegible]	27.42	47.11	34.16	11.49	3.64	205.20
1941	55.[illegible]	7.5[illegible]	12.52	7.42	1.66	26.52	58.63	176.00	74.59	43.90	67.37	53.46	612.07
1942	34.35	21.75	25.62	5.21	11.50	55.34	50.72	87.70	84.25	12.37	15.34	1.69	421.93
1943	[illegible]	[illegible]	[illegible]	11.[illegible]	[illegible]	1[illegible]	74.57	53.67	155.93	42.94	8.24	5.57	761.35
1944	3.72	[illegible]	[illegible]	[illegible]	[illegible]	235.5[illegible]	133.[illegible]	149.50	474.7	93.75	14.45	5.49	1177.73
1945	[illegible]	10.34	8.24	[illegible]	[illegible]	[illegible]	44.35	53.77	157.40	58.33	26.71	16.23	469.25
1946	15.[illegible]	13.[illegible]	4.64	14.42	23.27	63.63	46.44	75.56	107.40	61.83	13.14	25.93	473.16
1947	42.45	19.35	20.15	15.35	34.25	201.90	71.47	141.60	109.90	55.00	4.96	1.75	722.16
1948	7.25	9.37	10.10	6.35	132.50	210.00	39.32	65.19	135.20	79.91	20.04	4.95	691.03
1949	12.74	16.42	5.37	[illegible]	3.44	232.00	44.47	56.47	88.63	17.22	1.12	1.26	499.09
1950	6.44	13.62	3.75	.62	.16	4.73	73.54	48.98	62.44	13.48	5.84	1.66	262.19
1951	16.[illegible]	7.22	7.44	.12	5.55	25.49	24.67	29.71	19.97	14.00	22.24	37.57	216.98
1952	15.55	14.34	23.60	5.71	12.34	107.0[illegible]	112.50	40.97	53.17	27.61	7.02	3.35	486.75
1953	3.30	6.61	5.2[illegible]	7.61	11.40	35.25	20.65	31.03	117.63	8.60	29.12	1.40	278.07
1954	4.55	4.44	7.82	7.35	.17	28.15	18.95	31.02	7.75	2.23	19.46	11.84	163.53
1955	.54	3.65	5.28	3.6[illegible]	4.24	35.43	91.03	54.61	66.17	30.25	13.01	.50	309.16
1956	.74	2.45	4.69	7.16	5.47	75.20	30.72	47.85	48.12	8.23	9.25	2.09	243.09
1957	.44	3.64	7.04	5.23	4.78	25.74	20.61	27.04	141.30	36.23	4.80	5.68	285.06
1958	7.75	11.32	7.66	9.50	10.77	20.31	24.66	50.69	58.96	57.00	14.85	.53	274.24
1959	4.03	4.47	8.44	6.42	7.27	154.50	24.45	39.22	42.43	21.82	.50	.67	330.24
1960	4.24	6.44	10.31	6.36	9.17	128.20	29.31	9.95	11.19	2.88	.14	.01	218.27
1961	.11	.75	.77	1.1[illegible]	2.39	17.91	5.44	6.75	10.95	2.78	.89	4.61	57.50
1962	7.2[illegible]	5.56	3.05	1.35	77.17	53.63	41.45	139.90	268.60	123.20	26.16	12.89	761.10
1963	28.65	16.27	9.92	7.54	63.73	45.62	27.24	56.42	197.50	50.61	4.47	14.23	532.54
1964	7.57	11.25	5.67	7.31	7.45	30.09	34.26	45.96	193.90	59.28	7.23	3.34	424.34
1965	2.58	4.56	5.75	10.32	15.75	16.52	182.20	70.18	112.80	47.79	16.13	10.30	494.88
1966	16.20	13.09	7.65	8.16	7.79	31.32	25.99	26.04	7.31	6.49	1.95	4.14	156.15
1967	4.75	5.09	5.83	[illegible]	11.14	33.20	23.41	73.45	299.00	105.90	9.79	23.87	601.50
1968	15.61	16.44	7.06	6.47	25.42	121.40	31.67	54.32	220.50	43.18	39.81	30.41	613.49
1969	12.11	18.44	8.41	11.27	9.90	135.45	74.70	63.75	30.47	48.25	5.10	.91	426.91
1970	4.11	11.45	5.95	7.24	14.50	55.64	33.20	113.10	132.70	25.45	1.77	.66	406.16
1971	6.54	13.51	7.39	5.45	113.30	175.20	70.54	74.55	156.70	17.74	1.55	2.07	647.54
1972	54.35	22.26	6.31	7.96	79.02	284.50	42.49	63.76	91.81	27.51	22.20	18.60	720.82
1973	20.56	21.60	6.95	11.50	13.54	37.33	44.24	120.20	100.40	26.89	16.24	38.88	458.55
1974	21.04	18.57	8.53	29.22	32.33	45.47	55.05	60.57	40.29	10.06	7.69	8.67	336.82
1975	16.04	19.14	12.53	11.00	13.07	59.43	50.62	122.80	171.00	96.04	11.66	2.95	586.48
AVG	13.14	11.10	8.60	7.59	27.34	87.08	50.35	70.35	112.78	38.98	13.07	9.83	450.36

Table II-7
Powder River Near Locate - 1975 Depletion Level

[illegible]

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1939	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00	277.00
1940	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.71	[illegible]	[illegible]	[illegible]	1.93	162.76
1941	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	64.71	51.71	572.03
1942	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	77.47	[illegible]	[illegible]	[illegible]	0.00	380.44
1943	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	723.61
1944	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.74	1141.74
1945	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	52.79	[illegible]	14.53	427.32
1946	[illegible]	[illegible]	[illegible]	15.52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.38	24.04	435.22
1947	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.30	0.00	606.61
1948	[illegible]	[illegible]	10.21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	74.57	17.28	3.20	655.89
1949	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	466.37
1950	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	246.41
1951	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	142.24
1952	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.60	451.41
1953	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	243.17
1954	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	22.31	[illegible]	[illegible]	[illegible]	10.09	132.20
1955	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	277.96
1956	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.44	212.55
1957	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.34	4.03	255.61
1958	7.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	246.71
1959	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00	302.43
1960	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	0.00	194.23
1961	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.74	[illegible]	[illegible]	0.00	3.05	33.73
1962	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	123.29	[illegible]	[illegible]	24.00	11.34	735.06
1963	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	46.37	2.31	12.68	506.70
1964	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	40.97	[illegible]	55.04	5.07	1.89	400.50
1965	[illegible]	[illegible]	5.76	[illegible]	[illegible]	[illegible]	[illegible]	64.47	[illegible]	[illegible]	13.87	8.85	472.24
1966	[illegible]	[illegible]	7.76	[illegible]	[illegible]	[illegible]	[illegible]	20.63	[illegible]	[illegible]	0.00	2.74	135.21
1967	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8.43	22.92	585.46
1968	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	41.44	38.55	29.46	548.75
1969	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.84	0.00	413.50
1970	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24.01	.51	0.00	344.50
1971	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71.74	[illegible]	[illegible]	[illegible]	1.22	635.60
1972	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21.20	17.92	711.03
1973	20.31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	115.18	99.05	26.05	[illegible]	38.37	451.71
1974	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.31	[illegible]	[illegible]	7.14	8.33	332.29
1975	[illegible]	14.11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45.74	11.37	2.78	584.11
AVG	13.05	[illegible]	[illegible]	7.79	[illegible]	[illegible]	47.10	53.40	106.06	35.11	11.11	8.58	423.42

optioned to the Montana Powder Company.

Surface Water Quality[7/]

Tongue River

The water quality of the Tongue River is better than any other stream in the planning area. Total dissolved solids (TDS) in the Tongue average near 500 mg/l yearly, sometimes reaching 700 mg/l in December and January. Occasional concentrations of 800 mg/l have been recorded. Generally, the water quality in the Tongue is best above Prairie Dog Coulee to the Montana/Wyoming border.

Tributaries of the Tongue, collectively, degrade the water quality in the mainstem by increasing the levels of TDS. This may be especially evident during high flow periods of the plains tributaries which do not correspond to the high flow period of the Tongue mainstem.

Powder River

The Powder River is naturally saline and exhibits an average annual TDS concentration of more than 1100 mg/l. At times, September TDS concentrations have varied as high as 3500 mg/l from a monthly average of 1800 mg/l. At these concentrations, fresh water organisms come under severe strain.

Another major factor affecting the quality of water in the Powder River is suspended sediment. Concentrations greater than 200 mg/l are common in samples; an extreme value of 6,200 mg/l was taken near the mouth of the Powder by the State Water Quality Bureau in 1974.

Effects of the Powder River on the Yellowstone mainstem are most pronounced during peak prairie runoff in March and April; the Yellowstone has

7/ Information found in this section has been taken from one or more of the Water Quality Inventory and Management Plans by the Water Quality Bureau of the Montana Department of Health and Environmental Sciences. Additional information regarding point and nonpoint sources of pollution are also available in these publications or may be found in the "208" Water Quality Plan of the Yellowstone-Tongue Areawide Planning Organization that will be available in the spring of 1978.

relatively low flows at this time. March flow contributions of sediment from the Powder River have been noticed as far downstream as Sidney.

Little Powder River

Water quality of the Little Powder is relatively poor with consistently high sediment loads and TDS concentrations that average greater than those of the Powder.

Ground Waters[8/]

The Tongue and Powder Rivers flow across the Powder River geologic basin. The basin, which is about 3 miles deep, contains important aquifers in late Paleozoic, Mesozoic, Tertiary, and Quaternary rocks.

Water from the Paleozoic Madison Groups grades from about 1,000 milligrams per liter dissolved solids at the state line to about 7,000 milligrams per liter near the mouth of the Powder River. The overlying Minnelusa Sandstone yields water with about 1,500 to at least 29,000 milligrams per liter dissolved solids. Maximum reported yield from the aquifers is 1,300 gallons per minute.

Several Mesozoic sandstone units yield water in the area. The Fox Hills Sandstone is the most widely used aquifer, supplying as much as 200 gallons per minute to wells. Dissolved solids in the water range from about 300 to 2,300 milligrams per liter.

The Tertiary Fort Union Formation yields as much as 50 gallons per minute to wells tapping sandstone and coal beds. Between 200 and 5,000 milligrams per liter dissolved solids usually is found in the water. Water from coal aquifers are sometimes tea colored.

Quaternary alluvial and terrace deposits form aquifers along the Tongue and Powder Rivers and their major tributaries. Wells along the larger

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8/ The technical parts of this section were prepared by Rickard Hutchinson of the U.S. Geological Survey, Billings, Montana.

perennial streams may yield as much as 700 gallons per minute. Water from the Quaternary deposits contain between 280 and 5,600 milligrams per liter dissolved solids.

Since most of the area's surface waters are of a poor quality, ground water is almost totally relied upon to satisfy the municipal and domestic needs of the people.

CHAPTER III

SOCIOECONOMIC CHARACTERISTICS

Population

Population Estimates

As shown in Table II-1, 73 percent of the Tongue-Powder Planning Area lies within Custer and Powder River Counties. Therefore, the socioeconomic characteristics of the planning area as a whole will be taken as those of the two counties. The Decker mine is located within the area but its population impacts are felt most strongly in nearby Wyoming, at and near Sheridan.

The number of people living in the planning area decreased in the decade 1960-1970 and again during the first five years of the 1970's (Table III-1). Powder River County showed extreme fluctuations in the population. The increase in population from 1960-1970 (Table III-1) can be explained by the oil boom of the late 1960's in the Bell Creek Oil Field. The boom ended in the early 1970's which accounted for at least a portion of the near 20 percent outmigration of that time. The much larger and more stable population of Custer County tends to mute the overall population dynamics of the area.

Population changes of the planning area, when compared to the State, show a significant relative loss. The nature of the loss can be attributed to outmigration due to a lack of opportunity in the area's basic agricultural economy.

Racial Characteristics

Nearly ninety-nine percent of the population of the planning area is white. The State as a whole has a much higher percentage of American Indians than does the planning area (Table III-2). Populations of other nonwhites

Table III-1. Population Estimates for Tongue-Powder, Montana

County	1960[1/]	1970[1/]	1975[2/]	Percent Change 1960-70	Percent Change 1970-75
Custer	13,227	12,174	12,000	-8.0	-1.4
Powder River	2,485	2,862	2,300	+15.2	-19.6
Total	15,712	15,036	14,300	-4.3	-4.9
State	674,767	694,409	748,000	+2.9	+7.7
% of State	2.3	2.2	1.9	-	-

1/ U.S. Bureau of Census, 1970 Census of Population.
2/ U.S. Bureau of Census, Estimates of the Population of Montana Counties and Metropolitan Areas, July 1, 1974 and 1975, Series P-26, No. 75-26, June 1976.

Table III-2. County Population Classified by Race, Tongue-Powder, Montana: 1960 and 1970[1/]

County	Year	White		Indian		Other Nonwhite	
		Number	% of Total	Number	% of Total	Number	% of Total
Custer	1960	13,087	98.9	89	0.7	51	0.4
	1970	12,061	99.0	33	0.3	80	0.7
Powder River	1960	2,452	98.6	14	0.6	19	0.8
	1970	2,823	98.6	34	1.2	5	0.2
Montana	1960	650,538	96.4	21,181	3.1	3,048	0.5
	1970	663,043	95.5	26,385	3.8	4,981	0.7
United States	1960	158,837,679	88.6	523,591	0.3	19,964,405	11.1
	1970	178,119,221	87.6	763,594	0.4	24,327,343	12.0

1/ U.S. Bureau of Census, 1960 and 1970 Census of Population.

do not exist in significant numbers.

Rural and Urban

The population of the area, as shown in Table III-3, appears to be predominantly urban; however, the entire urban population is that of Miles City. Actually the area, as a whole, is one of the most sparsely populated places in Montana. A comparison between the number of rural farm inhabitants in the area and State show many more in this area relative to the rest of the State. This more accurately reflects the rural/urban situation in the Tongue-Powder Planning Area.

Miles City, in Custer County, serves as a primary wholesale/retail center for Eastern Montana, although still within the Billings orbit for higher-order goods and services (e.g., health services and specialty items). The population of Miles City (Table III-4) declined from 1960 to 1970, but is expected to increase again due to activities related to coal development in both the Lower Yellowstone and Tongue-Powder Planning Areas.

Education Attainment

Table III-5 illustrates the proportion of people, at least 25 years old, who have no more than a certain amount of formal education. Educational attainment of the area's population appears to be just slightly lower or roughly equivalent to that in the remainder of the State. The presence of Miles City and Dawson Community Colleges probably accounts for the relatively high number of individuals in the area that have at least attended college.

Age Distribution

The age distribution of an area's population may imply the need for certain types of services. For instance, it is readily apparent that recreational and health needs vary among people according to age. Certain

Table III-3. Rural and Urban Populations for Tongue-Powder, Montana: 1960 and 1970[1/]

Population	Tongue and Powder				State of Montana			
	1960		1970		1960		1970	
	No.	%	No.	%	No.	%	No.	%
Urban[2/]	9,665	61.5	9,023	59.9	338,457	50.2	372,344	53.6
Rural	6,047	38.5	6,037	40.1	336,310	49.8	322,245	46.4
Farm[3/]	3,312	21.1	2,593	17.2	105,598	15.6	88,640	12.8
Nonfarm[4/]	2,735	17.4	3,444	22.9	230,712	34.2	233,605	33.6
Total Population	15,712	100.0	15,060	100.0	674,767	100.0	694,589	100.0

1/ U.S. Census of Population: 1960 and 1970.
2/ Urban inhabitants are defined as persons living in places of 2,500 inhabitants or more.
3/ Rural farm inhabitants are defined as persons living on 10 or more acres with farm sales of $50 or more in the preceding calendar year or on places of less than 10 acres with farm product sales of $250 or more in the preceding calendar year.
4/ Rural nonfarm are persons not meeting the urban or rural farm definitions.

Table III-4. Population of Urban Centers of 1,000 or More Persons, Tongue-Powder, Montana: 1960 and 1970[1/]

Location	1960	1970
Miles City	9,665	9,023

1/ U.S. Bureau of Census, 1960 and 1970 Census of Population.

Table III-5. Years of School Completed by Persons 25 Years of Age and Older, Tongue-Powder, Montana: 1970[1/]

Level	Tongue and Powder		Montana	United States	Urban	
					Montana	United States
	No.	%	%	%	%	%
Elementary						
0 to 8 years	786	9.8	8.9	15.5	7.9	14.2
8 years	1,487	18.4	16.2	12.7	13.8	11.4
High School						
Less than 4 years	1,233	15.3	15.7	19.4	14.6	19.2
4 years	2,654	32.9	34.1	31.1	34.2	31.6
College						
Less than 4 years	1,243	15.4	14.1	10.6	15.9	11.5
4 years or more	659	8.2	11.0	10.7	13.6	12.1

1/ U.S. Bureau of Census, 1970 Census of Population.

age groups are more likely to be participants in the labor force. Attitudes of an area can also be influenced by the age composition of its population.

The age distribution (Table III-6) of the planning area corresponds closely to that of the State and Nation. The trend in age distribution over the last decade was the same in the area as in the U.S. and State from 1960 to 1970 and the median age had also decreased by 1970.

Income and Income Distribution for Families

It appears that one of the beliefs of our society is that "more" means "better". Consequently, an individual's income has been viewed as one of the major determinants of how "well off" that individual is. However, other factors may be considered in determining whether or not one group is "better off" than another. Unfortunately, methods do not exist for expressing some of these other factors in comparable and measurable terms (e.g., a preference for living in a small town versus a large city). On the other hand, information concerning income levels is readily available, but it must be viewed in its proper perspective. Income is only one factor that may give an insight into an area's overall well-being.

The distribution of families by income class and the average and median incomes is shown in Table III-7. Relatively more of the families in the Tongue-Powder Area receive less than $10,000 income than the families in the U.S. or the State of Montana. Also, relatively fewer families in the area receive $15,000 or more compared to the U.S. or Montana. The median income in the planning area is also lower than for the State or the Nation. The lower median family income is influenced by the rural nature of the area. As can be observed in Table III-7, the entire income distribution for rural families is skewed towards the lower incomes when compared to urban families.

Table III-6. General Age Distribution of Inhabitants in the Tongue-Powder, Montana[1/]

Level	Tongue-Powder		Montana		United States	
	1960	1970	1960	1970	1960	1970
			Percent			
Under 18 years	38.1	37.3	38.6	36.5	35.9	34.3
18 to 64 years	50.4	50.9	51.7	53.6	55.1	55.8
65 years and older	11.5	11.8	9.7	9.9	9.0	9.9
			Years			
Median age	28.7	28.4	27.6	27.1	29.5	28.5

1/ U.S. Bureau of Census, 1960 and 1970 Census of Population.

Table III-7. Income and Income Distribution of Families in the Tongue-Powder, Montana, and the United States - 1970[1/]

Family Yearly Income[2/]	Tongue-Powder	Montana	United States			
	All Families	All Families	Total	Urban	Rural Nonfarm	Rural Farm
			Percent			
Less than 2,000	3.7	5.5	5.9	4.9	8.1	10.4
2,000 to 3,999	12.2	10.6	9.3	8.1	11.9	14.8
4,000 to 5,999	14.3	13.1	10.8	9.8	13.0	15.3
6,000 to 7,999	17.3	16.5	12.8	12.1	15.1	14.3
8,000 to 9,999	16.2	15.9	13.9	13.6	14.9	12.6
10,000 to 14,999	22.2	24.7	26.6	28.0	23.8	19.2
15,000 to 24,999	9.0	10.7	16.0	18.0	10.7	9.9
25,000 and over	5.2	3.0	4.6	5.3	2.6	3.3
Average Income ($)	10,231	9,662	10,799	11,674	9,251	8,795
Median Income ($)	8,293	8,512	9,590	10,196	8,248	7,296

1/ U.S. Bureau of Census, 1970, "General Social and Economic Characteristics".
2/ Income is the sum of wages or salary income, nonfarm net self-employment income, farm net self-employment income, Social Security or railroad retirement, welfare income, and all "other" income which includes income from interest, dividends, rentals, public and private pensions, etc.

The average income found within the Tongue-Powder Planning Area is actually higher than that of Montana and compares favorably with the U.S. figure. It appears that the average income is brought up by the relatively high proportion of families in the area making $25,000 or more. In this case, the median figure more aptly illustrates the income situation in the planning area.

Earnings by Sector and Per Capita Personal Income

Certain sectors of an economy are defined to be basic and others non-basic. Basic sectors are those whose output exceeds local needs which results in exports to outside areas. The non-basic sectors depend on income generated by the basic sectors for their support. Sales by the retail sector to farmers in the area are examples of non-basic sales but retail sales to nonlocal tourists would be basic sales. A farmer selling his wheat overseas would be making a basic sale. Most economies have both basic and nonbasic sectors. Formal techniques exist for estimating whether or not a given sector is basic but the use of these techniques is beyond the scope of this report.

Agriculture is the main basic industry in the area. Mining and manufacturing are the other basic sectors. Without these basic sectors, many of the other sectors would not be able to sustain their current levels of activity.

Examination of Tables III-8 and III-9 provides a useful insight into the area's economy. For each of the five years shown, farm earnings were the most important of the basic sectors.[1/] Mining and manufacturing have increased

1/ Earnings are the sum of wages and salaries, other labor income, and proprietor's incomes in each industry (U.S. Water Resources Council, 1972 OBERS Projections, Series E, Population , Vol. 1, p. 21). These are estimated by place of work.

Table III-8. Personal Income and Earnings by Sector, 1970-1974, Tongue-Powder, Montana[1/]

	1970	1971	1972	1973	1974
Total Personal Income (1975 $1,000)	70,327	71,053	76,506	81,362	73,250
Per Capita Income (1975 $)	4,653	4,829	5,349	5,765	5,053
Per Capita Income Relative (U.S.=1)	.87	.89	.94	.96	.87
			Thousands of 1975 Dollars		
Total Earnings	53,980	54,193	59,451	62,815	54,182
Farm	10,961	10,468	15,394	17,733	7,377
Mining	1,233	D[3/]	D	1,414	1,451
Contract Construction	4,345	5,580	5,233	4,114	5,863
Manufacturing	979	1,067	1,254	1,189	1,222
Transportation, Communication and Public Utilities	5,090	5,107	5,260	5,597	5,251
Wholesale and Retail Trade	9,970	9,963	9,954	10,497	10,553
Finance, Insurance and Real Estate	1,600	1,614	1,577	1,884	1,992
Services	443	387	383	7,531	7,440
Federal Civilian Government	4,041	4,452	4,788	4,682	4,812
State and Local Government	6,061	6,699	7,220	7,520	7,634
Armed Forces	355	361	378	372	345
Other and Unaccounted For[2/]	8,902	8,495	8,010	282	242

1/ U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, August 5, 1976.

2/ Due to disclosure problems of confidential data, earnings for some sectors for some counties could not be included in the proper sector, but it is included in the total. Consequently, some of those earnings belong to one or more of the other sectors, but there is no way of knowing which sector and how much.

3/ Figure suppressed to avoid disclosure of confidential information.

Table III-9. Percent of Total Earnings by Sector, 1970-1974
Tongue-Powder, Montana[1/]

Sector	Percent of Total Earnings				
	1970	1971	1972	1973	1974
Farm	20.3	19.3	25.9	28.2	13.5
Mining	2.3	D[2/]	D	2.3	2.7
Contract Construction	8.1	10.3	8.8	6.6	10.8
Manufacturing	1.8	2.0	2.1	1.9	2.3
Transportation, Communication and Public Utilities	9.4	9.4	8.9	8.9	9.7
Wholesale and Retail Trade	18.5	18.4	16.7	16.7	19.5
Finance, Insurance and Real Estate	3.0	3.0	2.7	3.0	3.7
Services	0.8	0.7	0.6	12.0	13.7
Federal Civilian Government	7.5	8.2	8.1	7.5	8.9
State and Local Government	11.2	12.4	12.1	12.0	14.1
Armed Forces	0.7	0.7	0.6	0.5	0.6
Other and Unaccounted For	16.4	15.6	13.5	0.4	0.5

1/ Based on Table III-9.
2/ Figure suppressed to avoid disclosure of confidential information.

slightly in importance.[2/] The figures shown in Table III-8 are in constant 1975 dollars, which means that values have been increased to reflect the general inflation level of 1975. The changes in total earnings, therefore, are mainly due to changes in real (physical) output of the economy rather than just general inflation. Some of the fluctuation, however, is caused by fluctuating prices. One must realize that price changes occur for reasons other than inflation. For example, agricultural prices may rise or fall due to changes in supply and demand for/of the commodity. These conditions are also reflected in the 1975 base figures of Table III-8.

Total earnings in 1973 increased by $3.3 million over 1972. Direct earnings in the agricultural sector alone accounted for almost $2.3 million or over two-thirds percent of the increase. In 1974 total earnings fell by $8.6 million from those of 1973. The decline in earnings in the farm sector alone amounted to $10.4 million. The reasons for these large changes in farm earnings will be examined later. Increased earnings in other sectors helped offset some of the impact of the reduced agricultural earnings.

Total personal income and per capita income are greatly affected by the changes in farm sector earnings. In 1973, per capita income in the planning area had increased to nearly the U.S. average. With falling

2/ This data does not include the Decker operation which lies in Big Horn County.

3/ Personal income "consists of wages and salaries (in cash and in kind, including tips and bonuses as well as contractual compensation), various types of supplementary earnings termed other labor income (the largest item being employer contributions to private pension, health, and welfare funds), the net incomes of owners of unincorporated businesses (farms and nonfarm with the latter including the incomes of independent professionals), net rental income, dividends, interest, and government and business transfer payments (consisting in general of disbursements to persons for which no services are rendered currently, such as unemployment benefits, Social Security payments and welfare and relief payment)." U.S. Water Resources Council, 1972 OBERS Projections, p. 20.

agricultural earnings encountered in 1974, came a falling per capita income for the area. In general, per capita personal income has been below that for the U.S. The strong dependence of this region on agriculture helps explain the relative position.

Employment

Sector Employment

Another way of gaging the importance of a specific sector is to look at its changes in employment. Employment figures provide a picture of an economic sector that may be different from that provided by earnings.

Examination of sector employment gives some indication of each sector's temporal growth. While employment does not directly reflect output, it does give one an indication of a level of output that has not been masked by price changes. In most nonagricultural sectors output tends to grow along with employment. However, a change in productivity can color the picture provided by employment. For example, since productivity has continued to increase in the farm sector, output goes up while employment has actually gone down, consequently, employment figures could provide a distorted view of the farm sector.

Total employment increased slowly from 1970-1974 (Table III-10). Most of the growth was in the nonfarm sectors. Contrary to some areas, total farm employment (proprietors plus wage and salary employment) did not significantly fall. The nondisclosure policies of BEA make it somewhat difficult to tell which sectors actually experienced employment growth, but it appears that the trade, construction, and government sectors had the largest increase in numbers of employees.

Mining employment is difficult to read from the Table, but has expanded since 1970.

Table III-10. Employment by Type and Broad Industrial Sources
Full and Part-Time Wage and Salary Employment Plus
Number of Proprietors, Tongue-Powder, Montana 1/

	1970	1971	1972	1973	1974
Total Employment	6,582	6,680	6,633	6,690	7,073
Number of Proprietors	1,633	1,655	1,675	1,662	1,651
Farm Proprietors	813	801	785	774	760
Nonfarm Proprietors	820	854	889	888	891
Wage and Salary Employment	4,949	5,025	4,958	5,028	5,422
Farm	476	516	518	518	562
Nonfarm	4,473	4,509	4,440	4,510	4,860
Government	1,185	1,219	1,231	1,239	1,293
Total Federal	335	329	345	344	373
Federal Civilian	328	323	340	339	369
Military	7	6	5	5	4
State and Local	850	890	886	895	920
Private Nonfarm	3,288	3,290	3,290	3,271	3,567
Manufacturing	109D 2/	118D	130D	127D	132D
Mining	79D	7D	D	100	93
Construction	296	411	351	283	394
Trans., Comm. & Public Utilities	416	390	382	387	387
Trade	1,269	1,250	1,248	1,303	1,355
Fin., Ins. & Real Estate	128D	125D	193	194	222
Services	66D	63D	62D	871	979
Other	2D	D	D	39D	40D

1/ Compiled by Department of Natural Resources & Conservation, State of Montana. Data from U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System.

2/ A "D" indicates that data for one or more counties is not included due to nondisclosure policies of BEA. Total for private nonfarm is correct.

Unemployment

Table III-11 indicates that the planning area has not shown any major unemployment problems since 1972. The increase in unemployment to 5.1 in 1975 from 4.1 in 1974 was probably due to the nationwide economic slowdown experienced at that time. In general, the unemployment rate has historically been lower than either the State or Nation. The stability of the area's agricultural economy probably accounts for the relatively low unemployment rate.

Agriculture

Through time, agriculture has been by far the most important sector of the area's economy. The expenditures by the farm sector for the purchase of inputs (e.g., machinery, fuel, fertilizer) are crucial to the stability of other sectors. If agriculture were to disappear, many other businesses would also disappear. Undoubtedly, the economy will change over time, but it does not appear that agriculture will ever become an unimportant sector.

Farm Size and Income

The number of farms and ranches in the planning area has declined about 20 percent since 1949 (Table III-12). Land in farms and ranches has changed very little over the same period of time; consequently, the average farm/ranch size has increased by about 25 percent from 4,100 acres to over 5,100 acres.

A steady increase in the value of agricultural products sold from 1949 to 1974 can also be discerned from Table III-12. Part of the increase shown is due to increased production. However, a large part of the increase, particularly between 1969 and 1974, was due to price changes. In 1969 the food grain index (wheat is a food grain) had sagged to 87 (price in 1967 = 100);

Table III-11. Average Annual Unemployment Rates, Counties of Tongue-Powder, Montana Planning Area 1972 Through 1975[1/]

County	1972	1973	1974	1975
		Percent		
Custer	5.5	4.9	4.5	5.5
Powder River	2.8	3.0	2.6	3.3
Planning Area	5.0	4.6	4.1	5.1
State of Montana	6.1	6.2	6.7	8.1
United States	5.6	4.9	5.6	8.5

1/ State and local data from Employment Security Division, State of Montana, Department of Labor & Industry; U.S. data from Council of Economic Advisors, Economic Indicators, September 1976.

Table III-12. Farm Size, Value of Production and Farm Expenses
Tongue-Powder, Montana[1/]

	1949	1954	1959	1964	1969	1974
Number of Farms (#)	978	877	782	698	750	789
Land in Farms (Acres)	4,008,454	4,203,032	4,091,453	4,008,000	3,994,025	4,022,951
Average Farm Size	4,099	4,793	5,232	5,742	5,325	5,099
Total Value of All Ag. Products Sold ($1,000)	10,685	11,008	13,286	12,322	21,905	34,419
Value of Crops Sold (Includes Nursery & Hay) ($1,000)	1,863	2,383	2,172	2,097	3,064	10,059
Percent of Total	17.4	21.6	16.3	17.0	14.0	29.2
Value of Livestock, Poultry & Their Products Sold ($1,000)	8,818	8,619	11,115	10,224	18,840	24,346
Percent of Total	82.5	78.3	83.7	83.0	86.0	70.7
Value of Forest Products Sold ($1,000)	5	6	-	-	-	14
Percent of Total	0.1	0.1	0.0	0.0	0.0	0.0
Farm Production Expenses[2/] ($1,000)	NA	NA	NA	NA	17,835	28,136

1/ U.S. Bureau of Census, Census of Agriculture for all farms.
2/ Not available for all farms until 1969.

by 1974 price increases had raised the index to 299.[3/] Feed grain prices (e.g., barley) followed a similar but less spectacular pattern. The index for meat animals was 165 in 1974 compared to 119 in 1969.[4/] The value of all agricultural production doubled in five years; food grain prices more than tripled in contrast to meat animal prices which increased by only 39 percent.

Historically, livestock and livestock products have contributed 80 percent or more to the total value of agricultural production. The year 1974 was an exception because crops accounted for almost 30 percent (10 percent higher than normal) of total value. The major reason for the shift was due to relative price changes rather than a change in the mix of agricultural output.

The reader may recall that farm earnings (Table III-8) dropped sharply in 1974 from 1973 after having increased substantially between 1972 and 1973. Agricultural price indexes help explain that event. The price indexes for the years 1972, 1973, and 1974 were 109, 214, and 299, respectively for food grains; 105, 162, and 242, respectively for feed grains; and 147, 198, and 165, respectively for meat animals. In short, both grain and meat animal prices increased substantially between 1972 and 1973. Between 1973 and 1974 grain prices continued to rise but meat animal prices fell. Since the Tongue-Powder is primarily a livestock area, that fall severely affected agricultural income.

While the value of agricultural products fell between 1973 and 1974, total agricultural expenses increased across the nation by about 12 percent.[5/] It is reasonable to assume that expenses in the study area

3/ U.S. Department of Agriculture, Agricultural Statistics 1975, p. 453.

4/ Ibid.

5/ Ibid, p. 465.

increased in a similar manner. These changes combined to substantially reduce farm earnings in 1974 compared to those of the previous year. Since the agricultural sector is so important and because its success varies according to climatic and market conditions, the income of the area is also highly variable.

One often overlooked aspect of agriculture is the expenditures made by that sector for other items. Even when earnings and net income are down for farmers and ranchers, they must still purchase roughly the same amount of goods and services; consequently, short term income variations are probably not felt very strongly by the supply sectors. If farm income was depressed over several years, the supplying/nonbasic sectors would be affected.

Farmers and ranchers tend to purchase many of their items locally and in doing so they generate large amounts of business for local merchants. Farm production expenses had approached $28 million by 1974 in the study area. A large part of that $28 million expenditure was to local businesses.

Crop and Livestock Production

In the past, wheat has been the largest crop grown in the area (see Tables III-13, 14, and 15). More wheat is now grown on fewer acres than in 1949 due to increased productivity. These increases in productivity reflect improved technology and better management practices.

Hay and feed grain production has also increased steadily. A large part of the production of hay and grain is used locally to feed livestock. As a consequence the value of crops sold (Table III-12) does not fully reflect their true level of production. The value of the roughage and feed grain crops is realized indirectly through sales of livestock.

Table III-13. Historical Production of Irrigated and Nonirrigated Crops
Tongue-Powder, Montana[1/]

Crop	Unit	1949	1954	1959	1964	1969	Base
Wheat	Bu.	336,754	429,359	518,740	492,201	664,770	1,112,363
Rye	Bu.	180	-	2,510	3,270	0	0
Corn for Grain	Bu.	11,365	7,937	16,909	25,067	77,280	37,706
Silage	Tons	-	6,409	5,066	11,126	12,680	64,778
Oats	Bu.	57,705	71,569	106,706	88,809	246,606	274,723
Barley	Bu.	67,199	83,068	143,717	126,985	212,661	273,035
Hay	Tons	39,347	51,835	65,808	53,343	93,351	116,670
Flaxseed	Bu.	5,798	-	860	125	0	920
Sugar Beets	Tons	15,855	22,308	28,561	28,871	36,708	28,161
Irish Potatoes	Cwt.	3,885	4,160	1,758	3,441	496	0
Dry Beans	Cwt.	5	529	246	505	1,363	858

1/ Source of data is U.S. Agricultural Census for years 1949 through 1959. The base is an average of SRS data for years 1972 through 1974 unless noted otherwise.

Table III-14: Historical Acres of Irrigated Crops Harvested, Tongue-Powder, Montana[1/]

Crop	Unit	1949	1954	1959	1964	1969	Base
Wheat	Ac.	1,024	530	1,032	647	1,371	988
Corn for Grain	Ac.	313	203	288	364	896	486
Silage	Ac.	962	1,335	791	701	760	3,444
Oats	Ac.	876	819	906	766	758	925
Barley	Ac.	1,032	483	448	239	339	737
Hay	Ac.	6,793	8,353	10,110	9,343	14,732	23,320
Sugar Beets	Ac.	1,378	1,581	1,834	1,919	1,668	1,378
Irish Potatoes	Ac.	46	48	12	23	10	0
Dry Beans	Ac.	1	75	17	26	61	56

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is an average of SRS data for years 1972 through 1974 unless noted otherwise.

Table III-15: Historical Acres of Nonirrigated Crops Harvested, Tongue-Powder, Montana 1/

Crop	Unit	1949	1954	1959	1964	1969	Base
Wheat	Ac.	28,143	33,831	30,936	25,762	26,436	32,237
Rye	Ac.	31	-	81	129	0	0
Corn for Grain	Ac.	147	56	-	24	6	0
Silage	Ac.	2,169	3,795	1,274	1,166	390	250
Oats	Ac.	1,812	2,677	2,965	1,899	3,661	5,040
Barley	Ac.	2,759	5,790	6,974	5,457	5,997	6,257
Hay	Ac.	50,476	56,690	54,794	40,861	50,675	59,990
Flaxseed	Ac.	1,055	0	110	10	0	107
Irish Potatoes	Ac.	11	11	5	2	1	0
Dry Beans	Ac.	1	0	0	0	0	0

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is an average of SRS data for years 1972 through 1974 unless noted otherwise.

Beef cattle and calves are the most numerous of all livestock produced in the area (Table III-16). The number of cattle and calves has more than doubled since 1949. Sheep and lamb numbers increased from 1949 to 1959 but have fallen by 60 percent since then. Milk cow numbers have declined steadily since 1949.

Table III-16. Number of Head of Livestock, Tongue-Powder, Montana[1/]

Livestock	Unit	1949	1954	1959	1964	1969	Base
All Cattle & Calves	#	88,623	155,176	136,734	151,700	164,963	202,500
Milk Cows	#	2,349	2,030	1,586	1,296	985	500
All Sheep & Lambs	#	27,887	70,262	116,805	102,737	82,689	43,700
All Hogs & Pigs	#	1,949	2,901	2,043	1,381	1,971	3,100
Chickens 4 Months & Older	#	35,274	37,880	28,837	23,437	18,432	24,200
Horses & Ponies	#		4,628	3,991		3,611	3,043[2/]

1/ Source of data is U.S. Agricultural Census for years 1949 through 1969. The base is 1974 data from SRS unless noted otherwise.

2/ State of Montana, Report of the State Department of Revenue - 1974. This estimate is used since Agricultural Census estimates miss horses that are not on farms.

CHAPTER IV

PROJECTED REQUIREMENTS

The source of the information presented in this chapter is a collection of several Ad Hoc Group reports done specifically for this Level B Study. The reader is referred to the individual reports for more detailed explanations of the methodology used for each of the topics that follow.

Agriculture

The base figures shown above (Tables III-13 through III-16) in the discussion of the agricultural sector are also included in the following tables which present the OBERS projections for comparison.1/ Since crop and livestock production and the amount of land used in that production tend to fluctuate from year to year, no one year is truly representative of the agricultural situation. To provide an accurate representation of the base condition, production data from 1972, 1973, and 1974 were averaged to represent the base year of 1975. Actual 1975 data was not used because it was not available at the time this work was undertaken.

The OBERS projections stemmed from work performed by the Office of Business Economics (OBE) and the Economic Research Service (ERS); OBERS is the acronym which combines the abbreviations of the agencies.

1/ The State of Montana requested that 44 percent of the irrigated crop acres in Custer County be included in the Lower Yellowstone area rather than the Tongue-Powder. The State also requested that 70 percent of Custer County's nonirrigated crops be included in the Lower Yellowstone with the remaining 30 percent in the Tongue-Powder. Livestock in Custer County was not apportioned between areas; it was retained entirely within the Tongue-Powder Areas.

The OBERS program arose from a need for a comparable data base that could serve the entire nation and its regions in a consistant and uniform manner. Although the OBERS projections are used in this planning effort, they in no way have restricted the use of other projections in the planning process.

Population growth, per capita income levels, crop and livestock prices, and foreign demand for commodities are a few of the more important variables used to formulate the OBERS projections at the national level. By assuming changes in the action of the variables, different sets of national demands can be projected. This report deals with two sets, the OBERS series E and E' projections.2/

The OBERS E' projections, which are more recent than the E projections, reflect increased grain exports and increased agricultural productivity.

Once national projections were made, they were disaggregated to the various states; from there, they were disaggregated to the individual planning areas by the Agricultural Ad Hoc Group.3/

Nonirrigated Cropland

Table IV-1 illustrates the OBERS projections (E and E') for nonirrigated croplands in the years 1985 and 2000. Projected changes in harvested acres range from a reduction of 25,500 under E to an increase of 12,500 under E' for the year 2000. Only under the assumption of increased exports in series E' do harvested nonirrigated acres increase--apparently in response to increased demand for feed grains.

2/ The Department of Commerce, Bureau of Census, had made several series of population projections which they label as C, D, E, etc. Series E assumes a birth rate which will eventually result in no further population growth in the United States--except for immigration.

3/ See Agricultural Projections and Supporting Data, Agricultural Ad Hoc Work Group Report, February 1977.

Table IV-1. Projected Acres of Harvested Nonirrigated Crops for 1985 and 2000, Tongue-Powder, Montana

Crop	Unit	Base 1/	Series E		Series E'	
			1985	2000	1985	2000
Wheat	Ac.	32,237	23,004	21,030	26,634	26,204
Rye	Ac.	-	42	30	55	50
Corn for Grain	Ac.	0	1,118	0	275	0
Silage	Ac.	543	1,171	1,235	1,479	1,765
Oats	Ac.	5,040	3,738	3,263	4,259	4,950
Barley	Ac.	6,257	5,454	5,908	6,074	6,895
Hay	Ac.	59,990	44,326	47,109	62,518	76,766
Total	Ac.	104,067	78,853	78,575	101,294	116,630

1/ The base is the average of 1972 through 1974 unless noted otherwise.

Irrigated Cropland

Total irrigated acres in the Tongue-Powder Area are projected to decline slightly until 1985 (Table IV-2) under both E and E'. By the year 2000, both of the projections show slight increases; but for all practical purposes, it could be stated that the number of harvested irrigated acres remain nearly constant, according to the OBERS projections.

However, Table IV-3 presents an OBERS forecast of increased cattle production in the planning area under both E and E'. This appears to be in conflict with the stagnant projections shown in Table IV-2.

The Agricultural Ad Hoc Group, felt that OBERS had fallen far short in relating its forecasted red meat (beef) production to the amount of grain and roughage needed to sustain that level of production. To more accurately reflect the effects of increased red meat production on demand for future irrigation, the group devised a means to modify the OBERS projections--so the "third projections" (3E and 3E') were evolved.

The best interpretation that can be given to the third projection is that it represents a high level of demand. That level assumes: (1) the OBERS livestock projections are about right; (2) the historical method of production (i.e., cow-calf rather than feeder operations) of cattle will continue in the future; and (3) there will not be a major shift of crop production away from cash crops such as wheat and sugar beets. Table IV-4 demonstrates needed future production (measured in feed units) of roughage and grain to meet the OBERS livestock projections.4/

Assuming that enough alfalfa is grown to remove the total deficit and to satisfy demand for additional feed units in the Tongue-Powder Area (alfalfa

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4/ One feed unit is the food value of one pound of No. 2 corn. Agricultural Projections and Supporting Data, Part III, February, 1977.

Table IV-2. Projected Acres of Harvested Irrigated Crops for 1985 and 2000, Tongue-Powder, Montana

Crop	Unit	Base1/	Series E		Series E'	
			1985	2000	1985	2000
Wheat	Ac.	988	1,334	1,484	1,316	1,462
Corn for Grain	Ac.	486	333	89	329	90
Silage	Ac.	3,444	1,187	964	1,171	951
Oats	Ac.	925	1,301	1,421	1,283	1,400
Barley	Ac.	737	288	231	284	228
Hay	Ac.	23,320	24,182	26,123	23,844	25,747
Sugar Beets	Ac.	1,378	1,352	1,505	1,929	2,092
Dry Beans	Ac.	56	76	72	67	61
Total	Ac.	31,334	30,053	31,889	30,223	32,031

1/ The base is the average of 1972-1974 unless noted otherwise.

Table IV-3. Projected Livestock Production for 1985 and 2000, Tongue-Powder, Montana

Livestock	Unit	Base[1/]	Series E		Series E'	
			1985	2000	1985	2000
			Thousands			
Beef and Veal	Lbs.	60,545	82,585.2	95,854.7	82,411.8	101,846.9
Pork	Lbs.	1,387	670	677.5	638.9	679.3
Lamb and Mutton	Lbs.	2,070	3,563.9	3,441.5	1,352.9	1,207.3
Chickens	Lbs.	93	61.0	38.7	67.2	42.8
Eggs	Doz.	407	356.9	283.3	333.2	284.5
Milk	Lbs.	3,828[2/]	3,454	2,490	3,776	2,533

1/ 1974 data unless noted otherwise.

2/ Montana State Department of Business Regulation, Milk Price Control Board.

Table IV-4. Livestock Feed Units Produced and Consumed
OBERS Series E and E', 1985 and 2000,
Tongue-Powder, Montana

Series	Feed Units Produced		Feed Units Required		Excess or Deficit Feed Units		
	Roughage	Grains	Roughage	Grains	Roughage	Grains	Total
E (1985)	849,842	77,390	1,020,045	102,238	-220,203	-24,848	-245,051
E' (1985)	870,064	79,374	1,046,059	98,662	-175,995	-19,288	-195,283
E (2000)	927,154	78,414	1,234,209	116,285	-307,055	-37,871	-344,926
E' (2000)	985,558	84,371	1,287,620	120,135	-302,062	-35,764	-337,826

Source: Agricultural Projections and Supporting Data, Agricultural Ad Hoc Group, February, 1977.

contains 1100 feed units per ton) then an additional 57,000 to 76,000 new irrigated acres must be added by 1985 and from 88-89,000 by the year 2000. Another assumption here is that none of the additional demand for roughage is met by expanding nonirrigated acres. If this is the case, then the roughage demand for new irrigated acres is that which is presented by Table IV-5.

Table IV-5. Base Acres, OBERS Projections, 3E, and 3E' for Irrigated Lands, Tongue-Powder, Montana

Projections	Acres	
	1985	2000
Base Year	31,334	31,334
OBERS E	30,053	31,889
OBERS E'	30,223	32,031
3E	108,152	118,437
3E'	92,551	116,664

In using these projections for planning purposes, it must be kept in mind that the 3E and 3E' forecasts indicate a high level of future demand while OBERS E and E' indicate a low level of future demand. Actual demand for agricultural products and related irrigated acres in the future lie somewhere in between.

Plate IV-1 locates existing irrigated lands and irrigable lands; there are approximately 497,600 irrigable acres in the planning area but only a small percentage is feasible for actual irrigation.

Saline Seeps

In recent years, the saline seep problem has been identified as a major threat to agricultural productivity throughout Central and Eastern Montana. According to a recent publication by the Montana Department of Health, another

PLATE IV-1 IRRIGATED AND IRRIGABLE LANDS

Legend

Irrigated Lands

Irrigable Lands

Drainage Boundary

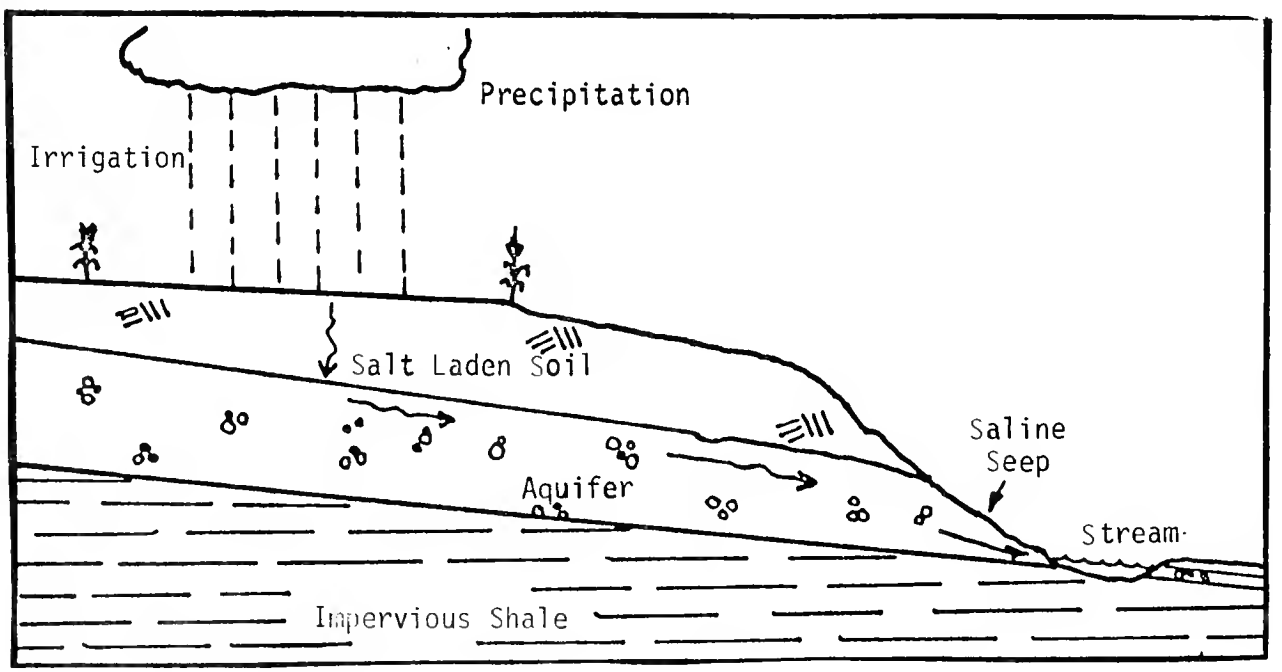
YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

less recognized, but equally important problem is the long-term impact of saline waters on hydrologic systems (i.e., rural and domestic stock wells, ponds, reservoirs, springs, streams and municipal water supplies).5/

The portions of the Yellowstone Basin that have been affected by saline seeps are usually underlain by a thin aquifer which, in turn, lies over some thick, impervious shale or dense clay strata. The potential exists for many of these shallow aquifers to become polluted by saline waters given some impetus by man's farming activities. Shallow ground water represents a particularly valuable resource in Eastern Montana, where it serves as the primary source of water for man and animal alike; there are few alternative sources of water so pollution of the groundwater with salts could cause a real economic hardship in areas so affected.

Figure IV-1 illustrates the dynamics of a saline seep. Water infiltrates

Figure IV-1. Formation of a Saline Condition



5/ See Investigation of Salinity in Hydrological Systems in Montana, Water Quality Bureau--Department of Health and Environmental Sciences, July, 1975.

a salt-laden solution. Naturally occuring salts, found in the soil, go into solution and move with the water through the soil into the aquifer. At this point, the saline water moves laterally through the aquifer above the impervious shale to a discharge area (i.e., a spring, seep, or stream).

In dryland farming areas, saline seeps appear to be directly related to farming methods that leave the land fallow. During wet years the moisture content of the soil will increase to the point where excess moisture percolates through the ground to an extent that a seep condition develops. Salts originating from overuse of water on irrigated lands may also cause seep conditions, and is also a growing problem in Montana.

According to a July, 1975, publication by the Montana Water Quality Bureau: "Investigation of Salinity in Hydrological Systems in Montana", no significant saline seep or irrigation salinity problems have been identified in the Tongue-Powder Planning Area. However, the Yellowstone-Tongue Areawide "208" Planning Organization has estimated that perhaps 1500 acres are so affected within the planning area.

Domestic, Industrial, Non-Energy Mineral, and Livestock Water

Domestic

Table IV-6 shows projected population increases for the Tongue-Powder Planning Area, which relate to possible levels of energy (coal) development in Eastern Montana.[6/] Associated with each population figure is the amount of water consumed by that population. The consumptive use is roughly 35 percent of 185 gallons per person day; approximately 65 percent returns to the water ways as waste-water.[7/] The "most probable" level of development is used, with some adjustments, in both the F/WO and the Recommended Plan.

6/ See Current and Projected Population, Income and Earnings, Ad Hoc Group on Projections.

7/ Ad Hoc Work Group on Unit Water Requirements.

Table IV-6. Population Projections and Associated Consumptive Water Requirements, Tongue-Powder, Montana

Projection	Base Year	1985	2000
Current	14,300	-	-
af/y	826	-	-
Low	-	17,600	20,500
af/y	-	1,016	1,184
Most Probable[1/]	-	21,355	38,970
af/y	-	1,233	2,250
Extensive	-	25,620	60,200
af/y	-	1,479	3,476

1/ Level anticipated for both F/WO and Recommended Plan conditions.

At the present time, public and private wells serve 40 percent of the area's population, while the sole public surface source serves the residents of Miles City--60 percent of the population; some residents are served by both. Ground water is the major source of domestic consumption throughout Eastern Montana.

Industrial and Non-Energy

Within the industrial category is included the manufacture of (1) petroleum, (2) food and kindred products, and (3) other.[8/] Non-energy minerals include: (1) stone, (2) sand and gravel, and (3) lime.[9/] Table IV-7 shows estimates of base and future consumptive water use by these sectors.

Livestock

Water is consumed in two ways in its use by livestock. First through its actual physical consumption and second, through evaporation from

8/ U.S. Department of Commerce, Special Report Series: Water Use in Manufacturing, 1975.

9/ See Non-Energy Mineral Industry Water Needs, Yellowstone River Basin Study Area, 1985 and Year 2000, Ad Hoc Group on Updating Minerals Data, May, 1977.

stock ponds. Evaporation is significantly greater than actual consumption.

Table IV-7. Industrial and Non-Energy Consumptive Use, Tongue-Powder, Montana[1/]

Sector	af/y		
	1975	1985	2000
Industrial[2/]	0	0	0
Non-Energy Minerals	3	6	10
Totals	3	6	10

1/ See Energy for its water requirements.

2/ Industrial consumption of water at Miles City is included in the Lower Yellowstone Planning Area Totals.

According to the OBERS projections (above) the demand for beef is expected to increase over the next 25 years. Tables IV-8 and IV-9 illustrate actual and evaporative consumption based on these projections.

Flood Control

The Corps of Engineers (COE) and the Soil Conservation Service (SCS) were given the task of describing flood damages and streambank erosion damages in the base year of 1975 and projecting those damages for the years 1985 and 2000.[10/]

The COE was given the responsibility for the main stem reaches having at least 400 square miles of drainage area. Complementing this, the SCS was given the tributary streams having less than 400 square miles of drainage area.

Both the COE and the SCS made their estimates and projections based

10/ See Flood Damages and Streambank Erosion Damages Along Main Stem Reaches, Corps of Engineers, December, 1976, and Flood Control and Streambank Erosion Needs: Drainage Areas Less than 400 Square Miles, Soil Conservation Service, November, 1976.

Table IV-8. Livestock Water Requirements, Tongue-Powder, Montana[1/]

Animal Type	Water Requirements: Livestock af/y				
	Base Year	1985		2000	
		E	E'	E	E'
Beef	2,168	2,948	2,948	3,425	3,642
Milk Cow	13	12	13	8	8
Sheep	78	134	51	129	45
Hogs	10	5	5	5	5
Poultry	1	1	1	1	1
Horses	41	41	41	41	41
Totals	2,311	3,141	3,059	3,609	3,742

1/ Exclusive of evaporation from stockwater impoundments--See Table IV-10.

Table IV-9. Evaporation from Stockwater Impoundments, Tongue-Powder, Montana

Ownership	Number			Evaporation af/y[2/]		
	1975	1985	2000	Base	1985	2000
Private	1,865[1/]	2,107	2,257	14,920	16,856	18,056
Federal	359	461	510	2,872	3,104	4,080
Totals	2,224	2,568	2,767	17,792	19,960	22,136

1/ Estimate based on SCS data.

2/ Assume average of 2 acre feet in size and 4 af/y per acre evaporation.

on the Missouri Basin Framework Study and the National Streambank Erosion Assessment. In developing their data, they assumed that (1) current trends toward increased flood plain regulation would continue into the future; and (2) no additional structural measures (past 1975) would be added in the study area.

Table IV-10 shows current flood damages in the Tongue-Powder by category: (1) crop and pasture, (2) other rural, and (3) urban. The SCS data on tributaries is shown in script. Table IV-11 displays current and projected flood damages for 1985 and 2000. Both tables indicate that damages from flooding of the tributaries is greater than that of the main stem reaches.

Existing data regarding streambank erosion damages could not be disaggregated to fit the Level B planning area. Therefore, streambank erosion damages for the Level B Study were developed by state as done in the National Streambank Erosion Assessment. Table IV-12 shows estimated streambank erosion damages for the years 1975, 1985, and 2000 for all of the basin's major rivers and their small Montana tributaries. Streambank erosion may be caused by: the abrasive action of ice jams; banks caving during flood occurrences; and undercutting which may take place throughout the range of streamflows. Streambank erosion may be critical in local areas where it affects facilities such as highways, bridges, irrigation structures, or water plant intakes.

Indian Water Requirements

To understand the situation surrounding Indian water rights in Montana, one must first examine the "Federal reservation system or doctrine." In its simplest form, the reservation doctrine means that if the United States Government reserves a portion of the public domain for a Federal use which will ultimately require water, and intends to reserve unappropriated water for that purpose, then sufficient amounts of water for that use are

Table IV-10. Current (1975) Flood Damages Along Combined Reaches, Tongue-Powder, Montana[1/]

Stream and Reach	Crop and Pasture	Other Rural	Urban	Total
		($1,000)		
Tongue River				
Wyoming Line to Hanging Woman Creek	4	7	0	11
Hanging Woman Creek to Mouth	90	154	105	349
Powder River				
Wyoming Line to Mouth	101	72	7	180
Little Powder River				
Wyoming Line to Mouth	11	12	0	23
Tongue Tributaries	*45*	*0*	*23*	*68*
Powder Tributaries	*6*	*0*	*0*	*6*

1/ The table combines COE and SCS data. The SCS figures are shown in script.

Table IV-11. Current (1975) and Projected Flood Damages Along Combined Reaches, Tongue-Powder, Montana[1/]

Stream and Reach	Area Subject To Flooding	Flood Damages 1975	1985	2000
	(1,000 acres)	($1,000)		
Tongue River				
Wyoming Line to Hanging Woman Creek	3.0	11	12	12
Hanging Woman Creek to Mouth	35.0	349	366	393
Powder River				
Wyoming Line to Mouth	44.4	180	189	203
Little Powder River				
Wyoming Line to Mouth	6.3	23	24	26
Tongue Tributaries	*22.9*	*68*	*82*	*116*
Powder Tributaries	*5.2*	*6*	*7*	*10*

1/ The table combines COE and SCS data. The SCS figures are shown in script.

Table IV-12. Streambank Erosion Damages, Level B Study Area: 1975, 1985, and 2000

Main Stems	Annual Damages 1975	1985	2000
		($1,000)	
Upper and Lower Yellowstone Planning Areas			
Yellowstone River	217	338	382
Main Tributaries[1/]	85	133	150
Upper and Lower Clarks Fork and Bighorn Planning Areas			
Clarks Fork River	32	49	56
Bighorn River	291	453	511
Upper and Lower Tongue and Powder Planning Areas			
Tongue River	55	85	96
Powder River	140	217	245
Montana Tributaries[2/]			
Yellowstone, Clarks Fork, Bighorn, Tongue, & Powder Rivers	61.5	95.7	108.1
Little Missouri River	7.8	12.1	13.6
Totals	69.3	107.8	121.7

1/ Drainages of more than 400 square miles.

2/ Drainages of less than 400 square miles.

reserved from appropriation by private users.

The effect of the doctrine is twofold: (1) when the water is eventually put to use, the water right of the United States will be superior to private water rights which were acquired after the date of the reservation; and (2) the federal use is not subject to state laws regulating the appropriation and use of water. The origin of the doctrine was set forth by the U.S. Supreme Court in the case of United States vs. Rio Grande Dam and Irrigation Company, 174 U.S. 680 (1899).

The cornerstone of the Indian water right issue is found in Winters vs. United States, 207 U.S. 564 (1908) which stated that when the Federal Government created the Fort Belknap Indian Reservation (Montana), it reserved not only the land, but also the use of enough water to irrigate the irrigable portions of those lands. This was based on the supposition that the Indians could not support themselves on the Reservation land without irrigation and that the Government had intended for the Indians to be self-supporting. Subsequent to this decision, other court cases have been added to this to become the body of law that is now known as the Winters Doctrine.

A significant case, United States vs. Ahtanum Irrigation District, 236 F. 2d 231, (CCA-9) (1956), aspects of which were litigated as late as 1964, 330 F. 2d 889 (CA-9((1964), resolved at least three important issues: (1) it was established that rights reserved by treaties are not subject to appropriation under State law; (2) alleged rights to water are not subject to the defense of laches or estoppel (the Indians did not lose their right to the use of the water because of their failure to make timely development); and (3) transferees, of fee patented Indian Allotments, acquired a vested interest in and right to distribution of the water.

Another benchmark case, Arizona vs. California 373 U.S. 601, 835 Ct. 1498, 10 L. Ed. 578 (1963) held that Indian water could be used for industrial

purposes and other uses not contemplated at the time of the treaty, and that the principles underlying the reservation of water rights for Indian Reservations are equally applicable to other Federal establishments.

Tweedy vs. Texas Company (C. 2738) U.S. District C. Montana (June 14, 1968) held that ground water was also included in the Indian Water right.

Litigation concerning Indian water rights in Montana's portion of the study area is currently pending in Federal District Court in Billings. Three lawsuits are pending; two of the actions were brought by the United States on its own behalf and on the behalf of the Crow and Northern Cheyenne tribes. The purpose of the suits is to have the water rights adjudicated in the Tongue and Bighorn River drainages. The third suit was brought by the Northern Cheyenne tribe on its own behalf to adjudicate the water rights in the Tongue River and Rosebud Creek. There are a few thousand private water users and several state agencies named as defendants in the three lawsuits.

Given the complexity and magnitude of the Indian water rights issue, the Yellowstone Level B Study has elected to treat water related developments on the Crow and Northern Cheyenne Indian Reservations in the same manner off-reservation development is being treated. At this time there are potential irrigation projects as well as energy related potentials that exist on Indian lands; the Hardin Bench Unit is the most significant potential irrigation project lying across Indian lands (see Clarks Fork-Bighorn Chapter VI for a discussion of this project).

Instream Flows

The instream flow requirements for the Tongue-Powder Planning Area were developed by the Montana Department of Fish and Game.[11/] The requirements

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11/ See Instream Flow Needs Ad Hoc Work Group, Series of Memorandums from Liter Spence.

found in this section are identical to those used by the Department in its water reservation request to the Montana Board of Natural Resources and Conservation.12/

Tables IV-13 and IV-14 present the instream flow requirements that would assure maintenance of the existing environment in and adjacent to the Tongue and Powder Rivers. These requirements are based on physical/biological needs as follows:

Tongue River - State Line to Tongue River Reservoir: May and June flows given are those flows equaled or exceeded 70 percent of the time as recorded at the U.S. Geological Survey (USGS) gage "Tongue River at State Line, near Decker" for the period 1966-1974. Fish sampling in the Tongue River Reservoir and Tongue River, immediately upstream from the reservoir, suggests that sauger and walleye utilize the river as a spawning-nursery stream. High spring flows may be important in maintaining this spawning run.

Tongue River - Tongue River Dam to T & Y Diversion: May and June flows given are those equaled or exceeded 70 percent of the time as recorded by the USGS gage "Tongue River at Tongue River Dam near Decker" for the period 1949-1974. The higher flows for late May and June would be primarily for flushing and to transport sediment. Tributary runoff normally carries high silt loads during this period and Tongue River flows must be adequate to transport this material. In addition, flows must be adequate year-round to maintain resident populations of smallmouth bass, sauger, channel catfish, and northern pike in the stream reach.

Tongue River - T & Y Diversion to Yellowstone River: May and June flows given are those equaled or exceeded 70 percent of the time as recorded at the USGS gage "Tongue River at Miles City" for the period 1955-1973. Spring flows

12/ See Legal Constraints on Resource Development in the Yellowstone River Basin, June, 1977.

Table IV-13. Instream Flow Requirements in the Tongue River, Montana
(cfs and thousand acre-feet)

Reach	Jan	Feb	Mar	April	May 1-20	May 21-31	June	July 1-15	July 16-31	Aug	Sept	Oct	Nov	Dec
Montana-Wyoming State Line to Tongue River Reservoir	160	160	200	200	700	1200	1350	360	360	100	100	200	200	150
(thousands of acre-feet)	9.83	8.89	12.29	11.90	27.76	24.98	76.67	10.71	11.42	5.87	5.68	11.74	11.36	8.80
Tongue River Dam to Four-Mile Creek	150	150	150	150	700	700	700	150	150	150	150	190	190	150
(thousands of acre-feet)	9.22	8.33	9.22	8.92	27.76	15.47	41.64	20.82	4.76	9.22	8.92	11.68	11.30	9.22
Four-Mile Creek to S-H Diversion	150	150	150	390	390	700	700	700	150	150	150	150	150	150
(thousands of acre-feet)	9.22	8.33	9.22	23.20	15.47	15.27	41.64	20.82	4.76	9.22	8.92	9.22	8.92	9.22
S-H Diversion to T&Y Diversion	190	190	190	400	400	700	700	700	190	190	190	190	190	190
(thousands of acre-feet)	11.68	10.55	11.68	23.80	15.85	15.27	41.64	20.82	6.03	11.68	11.30	11.68	11.30	11.68
T&Y Diversion to Yellowstone River	190	190	525	525	600	600	600	600	225	225	190	190	190	190
(thousands of acre-feet)	11.68	10.55	32.27	31.23	23.80	13.09	35.69	17.85	7.14	13.83	11.30	11.68	11.30	11.68

Source: "Application for Reservation of Water in the Yellowstone River Basin," Montana Fish and Game Commission, November, 1976.

Table IV-14. Instream Flow Requirements in the Powder River, Montana
(cfs and thousand acre-feet)

Reach	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
State Line to Little Powder River (thousand acre-feet)	100 6.15	100 5.55	400 24.59	400 23.80	600 36.88	750 44.62	120 7.38	30 1.80	30 1.78	100 6.15	100 5.95	100 6.15
Little Powder River to Yellowstone River (thousand acre-feet)	80 4.92	80 4.44	500 30.74	500 29.75	800 49.18	800 47.59	200 12.29	40 2.46	40 2.38	80 4.92	80 4.76	80 4.92

Source: "Application for Reservation of Water in the Yellowstone River Basin," Montana Fish and Game Commission, November, 1976.

are required to ensure adequate passage of sauger, shovel-nose sturgeon, paddlefish, and channel catfish that migrate into the Tongue from the Yellowstone River for spawning purposes.

Powder River - Stateline to Little Powder River: Flows given for the spring months are those equaled or exceeded 70 percent of the time as recorded at the USGS gage "Powder River at Moorhead" for the period 1934-1972. Sediment transport and spawning flows for sauger, shovel-nose sturgeon, paddlefish, and channel catfish are the flow needs in this stream reach.

Powder River - Little Powder River to Yellowstone River: The 70 percent exceedence level was used for the spring months. Important considerations for spring flows are adequate passage requirements for sauger, shovelnose sturgeon, paddlefish, and channel catfish migrating from the Yellowstone River for spawning purposes.

Energy

Program Assumptions

The "Analysis of Energy Projections and Implications for Resource Requirements", better known as the "Yellowstone Energy Study", was prepared as part of the Level B study effort by the Harza Engineering Company. The Harza results should not be viewed as representing a goal or recommended plan for energy development; rather, they illustrate the implications of several distinct sets of energy policy and program assumptions.

The three major sets are actually separate forecasts for the years 1985 and 2000. Supply and demand situations for coal are shown on a national basis--with varying implications for their impact on the Yellowstone Study Area. The three sets (scenarios) are more completely described as:

1. A low rate of regional development, including production only to

meet local needs and cover those exports that are already contracted or highly probable.

2. A most probable rate of development that recognizes constraints that may be imposed for environmental, social, or economic reasons.
3. A high rate of development based on the maximum contribution that the Study Area energy resources could reasonably be expected to make in alleviating shortages in domestic nuclear generation and eliminating national reliance on imported oil and gas.

In its report, Harza also has included the following information as part of the three scenarios listed:

A. The amounts of coal used and exported for each of the three states that comprise the Study Area;

B. The type and extent of the transportation systems required to move coal within and without the Area in the future; also number of related coal gasification plants, liquifaction plants, thermal-electric plants, and coal mines that would potentially be developed in the Area;

C. Estimates of the capital, labor, water, land, and mineral resources which would be required to support the probable levels of energy development within the Area;

D. Estimates of the air and water pollutant emissions accompanying potential energy development in the Area.

Conceptual Framework

The Harza study involves two major components: (1) a "macro" level analysis which considers national energy supply and demand interaction and identifies the Northern Great Plains (NGP) share of national energy production, and (2) a "micro" level analysis which focuses on the energy development activity of the Yellowstone Study Area.

The general approach used in these energy studies differs significantly from other recent studies of the Northern Great Plains area. Previous efforts to forecast energy developments in the Study Area have been based primarily on trend extrapolations. As a result, studies published as recently as April 1975 were based on projected prices for oil of about $3 per barrel at the well head. Current expectations are for prices to continue at a level of about $13 per barrel c.i.f. United States, in 1975 dollars. It is to be recognized that the energy crisis precipitated by the oil embargo has caused major discontinuities in historical trends for energy prices and other variables.

A basic assumption in the study approach is that energy resources will be developed in an economically rational manner subject to relevant technological, environmental, social, legal, and institutional constraints. In other words, the location, amount, and type of energy development within the national energy system is subject to limitations imposed by such factors as the availability of resources (e.g. capital, water, labor, minerals); ownership (e.g. private, Federal, State, Indian Reservations); land use (e.g. urban, irrigation, parkland); environment (e.g. air and water quality standards); transportation facilities; equipment availability; and public attitudes and preferences regarding development and conservation.

The Harza models are documented in a manner to facilitate periodic updating as additional data become available or changes occur in such factors as foreign relations, technology, public attitudes, or policy.

Macro Analysis

The purpose of the "macro analysis" is to identify the Northern Great Plains' (NGP) share of national energy production in the years 1985 and 2000 on the basis of comparative economic advantage with other supply regions. Information obtained in the macro analysis provides the basis for estimating

the energy related demands for capital, labor, water, land, and mineral resources in the Yellowstone Study Area under alternative State and regional development assumptions.

The basic assumption used by Harza in developing this study is the "Reference Case". In brief, the case consists of the "business as usual" (BAU) demand and supply situation. The BAU demand includes the conservation effect of higher energy prices and the impact of the conservation ethic as it is reflected in recent trends, but does not assume the passage of any of the energy conservation actions currently under consideration by the Congress and the Administration, or any changes in State legislation.

The Project Independence Evaluation Systems (PIES) developed by the Federal Energy Administration (FEA) was selected as the basic analytical model for the macro analysis.

The PIES model simulates the national energy system, and produces: (1) a demand forecast by region, fuel, and price; (2) estimates of the quantities of energy distributed through the entire transportation network that connects the supply and demand regions; and (3) estimates of the capacity and type of conversion facilities needed in each region.

Macro Results

A continuation of the trend of higher energy prices will significantly reduce the growth rate in energy demands. At current price levels, national energy demand is forecast to increase from 72.9 quadrillion BTU (quads) in 1974 to 98.9 quads in 1985. This represents a growth rate of 2.8 percent, compared with the recent historical rate of 3.6 percent. An active conservation program could further lessen energy demand by the equivalent of 3 million barrels of oil per day, reducing the annual energy growth rate to 2.2 percent through 1985.

The largest growth in energy consumption will occur in electricity use

(electric sector), which will increase at an annual rate of 5.4 percent per year. This is nearly twice the growth rate of overall energy demand, but represents a substantial reduction from the 7 percent per year increase experienced over the past 20 years.

National energy consumption will gradually shift from oil and gas to coal and nuclear power over the study period. These shifts will occur due to dwindling oil and gas reserves, and result in a relative economic advantage for coal.

Over half the U.S. coal production occurs in two regions--the Western Northern Great Plains and Central Appalachia. One of the primary reasons for the concentration of production in these regions is that they both have substantial reserves of low sulfur coal. The Northern Great Plains area is forecast to produce about 305 million tons of coal in 1985 which amounts to about 30 percent of the projected national production for that year.

Variations in oil import prices would have a significant effect on this forecast. For example, if oil import prices dropped from $13 to $8 per barrel, coal production in the Northern Great Plains area would decline nearly 24 percent to 233 million tons under the Reference Case for 1985. On the other hand, if oil import prices increase to $14 per barrel, NGP coal production would increase 7 percent to 325 million tons. These differences are related primarily to the margin at which coal substitutes for oil in the electric utility sector.

Micro Analysis

The purpose of the "micro" analysis is to disaggregate the energy production forecasts made in the "macro" analysis and predict supply responses within the Yellowstone Study Area. A linear programming model was developed that minimized the total overall costs necessary to meet as much of the demand for utility and industrial coal, indicated in the macro analysis,

as is feasible subject to a set of constraints. These constraints include those imposed by laws and regulations that were in force on January 1, 1976, and by physical capacity limits on mining conversion, transportation, resources, and environmental cost components.

Four steps are considered in the process of meeting the demand for coal:

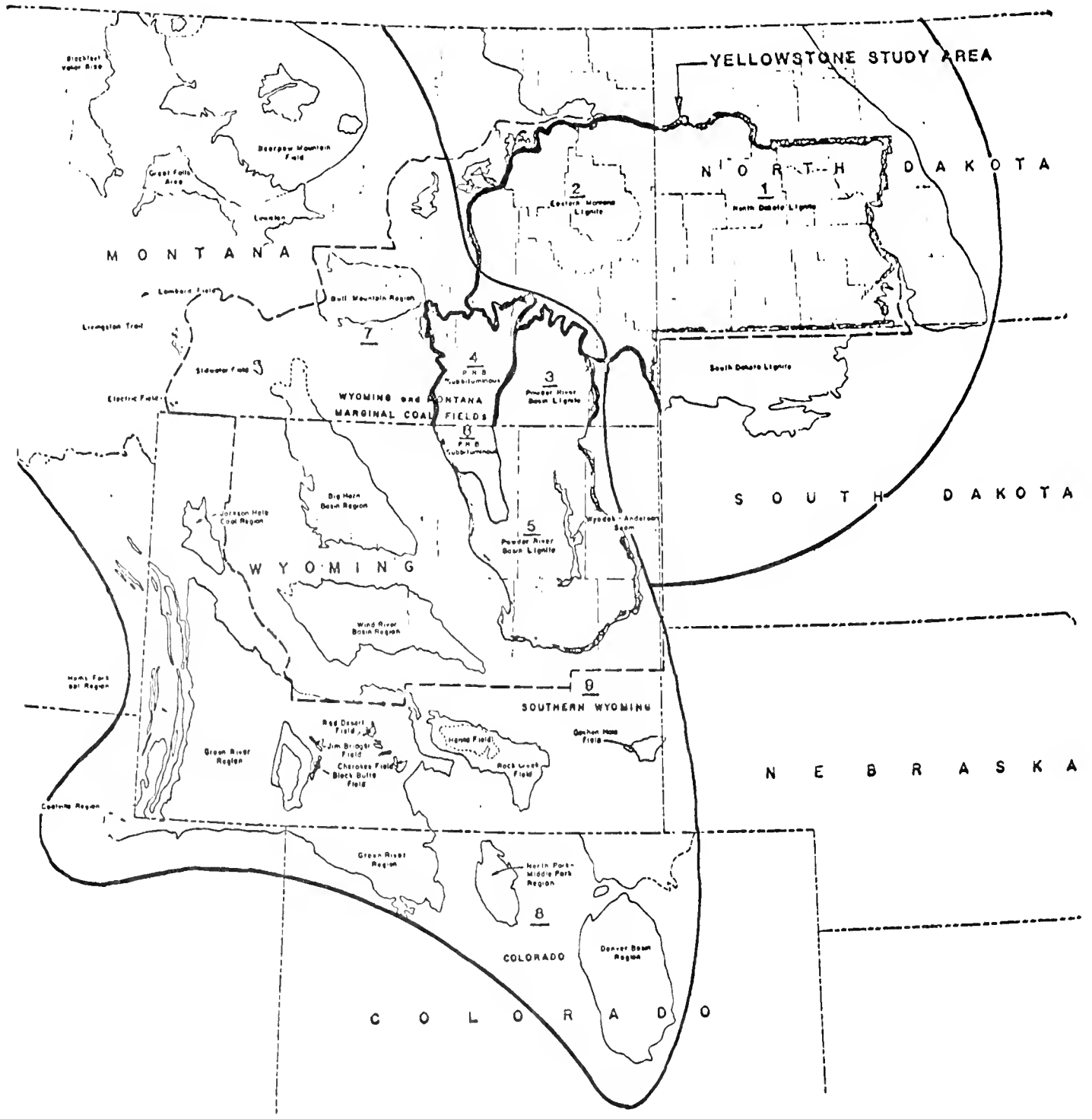
1) Mining: For purposes of the micro analysis the PIES Coal Supply Regions Nos. 7 and 8 were divided into fourteen homogeneous mining areas (which include Montana Mining Area Nos. 2, 3, and 4). The delineation of mining areas was made on the basis of state boundaries, physiographic basin, and rank of coal. A map showing the boundaries of these mining areas is presented as Plate IV-2. The analysis showed that eight of the fourteen mining areas have sufficient potential for development to warrant inclusion in the model. Six of these eight mining areas are within the Yellowstone Study Area. Two are outside the Study Area, but within PIES Coal Supply Regions Nos. 7 and 8.

2) Transportation to Processor: Provisions are made in the model to transport utility coal to a processing site by unit train, slurry pipeline, or a unit train - waterway combination. Industrial coal is transported by conventional train. The processing sites can be located at the demand points, at potential sites in the Study Area, or at mine mouth sites.

3) Processing: At the processing site, the coal can be converted to electricity or synthetic gas, or used for industrial purposes. Electric conversion can take place using wet or dry cooling towers, and with or without scrubbers.

4) Transportation from Processor to Consuming Region: For that coal which is converted to electricity in the Yellowstone Study Area,

Plate IV-2
Mining Areas



LEGEND

- BOUNDARY OF PIES COAL SUPPLY REGIONS
- BOUNDARY OF YELLOWSTONE STUDY AREA
- 0 NUMBER DESIGNATING COAL MINING AREAS
- SHADED AREA DENOTES MAJOR COAL RESERVE AREAS WITHIN YELLOWSTONE STUDY AREA

provisions are included in the model to transport the energy from the point of conversion to the demand point by transmission lines. Pipelines for transportation of synthetic gas were not included in the model because the activity forecast is handled exogenously.

Some constraints also were handled exogenously. For example, some coal reserves are located on lands where mining is not likley to occur because of environmental or other reasons. Here, consideration was given to the significance of reserves that occur (1) within one mile of the corporate limits of existing cities and incorporated towns; (2) under existing State and Federal highways; (3) on irrigated cropland; (4) on valley floors of major streams and tributaries, and (5) in unique environmental areas such as local, State, and National monuments, parks, forests, wildlife refuges, wild lands, and other units of the wilderness preservation system. The studies indicate that significant reserves occur in some of these areas, such as Custer National Forest in mining Area No. 3 and on irrigated land in Mining Area No. 5. However, it was concluded that adequate reserves are available without disturbing these areas to support the levels of mining activities indicated by the PIES model (high regional energy development scenario) beyond the year 2000. Therefore, while the application of these land use constraints affects the pattern of mining development, it does not affect the total amount of coal that would be mined in the Study Area.

Micro Results

The Harza study results indicate that the amount of coal development in the Yellowstone Study Area in the year 1985 and 2000 will depend substantially upon State and Federal energy policies and regulations and, to a lesser extent, on national demands for fuel. The study area contains nearly half the Nation's known strippable coal reserves. A large share of these reserves have a low sulfur content which, under current air emission standards,

permits the burning of this coal in thermal-electric power plants without expensive sulfur removal processes. This provides an economic advantage to the Yellowstone Study Area compared with coal regions producing high-sulfur coal. However, many of the high-sulfur coal areas are located much closer to large energy demand centers, and therefore, have a transportaion advantage when compared with the Yellowstone Study Area. Also, there are nearer low-sulfur coal producing regions, such as Central Appalachia, which are capable of producing large quantities of coal.

Most of the demand for Yellowstone coal occurs at long distances from the mining areas. Therefore, the economics of transporation and electricity transmissions are a critical factor in the determination of the levels of coal production for the different mining areas.

Transportation capacities are a critical constraint on energy development in the Yellowstone Study Area under both the "most probable" and "high" scenarios. With the recent growth in coal production, present transportation modes (i.e. rail and electrical transmission lines) are already approaching the limit of existing capacities. The type and location of transportation facilities will have a profound influence on energy development patterns in the Study Area.

Under the high regional energy development scenario, it is assumed that institutional, social, and environmental obstacles to slurry pipeline construction will be removed in the near future; but it is also assumed that this alternate transportation mode will be used only when the railroads are operating at full capacity.

Under the most probable scenario, the Yellowstone Study Area capacity of coal-fired thermal electric plants would be about 4,700 megawatts (MW) in 1985 and 11,000 MW by the year 2000. The corresponding number of plants would be about 11 in 1985 and 23 by the year 2000. This large amount of

electrical generation in the Study Area in the 2000 occurs primarily because of the anticipated limits on the capacity to transport coal to the demand region.

Under the "high" scenario, coal slurry pipelines are assumed to be available and the amount of coal production increases substantially, but the amount of anticipated generating capacity by the year 2000 is slightly less than under the most probable scenario. Instead, the increased coal production is transported by both slurry pipelines and railroad for conversion in the demand regions.

The PIES forecast and other estimates developed for this study indicate that the cost of producing synthetic natural gas will likely exceed the cost of energy from other sources through the year 1990. Therefore, no coal gasification activity is forecast for the Yellowstone Study Area on the basis of purely economic criteria. However, FEA assumes in the 1985 Reference Case that financial incentives will be provided for synthetic fuel development of 880 million barrels per day oil equivalent in the U.S. This incentive program is expected to result in the construction of one coal gasification plant in the Yellowstone Study area by 1985 under both the "high" and "most probable" regional energy development scenarios. No coal gasification activity is anticipated under the "low" scenario.

Beyond 1990, the financial incentives program coupled with dwindling domestic reserves of natural gas and oil are expected to result in a rapid expansion of coal gasification activity. A total of 15 coal gasification plants with a capacity equivalent to 3,814 million cubic feet per day (MCFD) of pipeline quality gas is projected to be constructed in the Yellowstone Study Area by the year 2000 under the "most probable" scenario. Under the "high" scenario, a total of 21 units is anticipated with a capacity equivalent to 5,354 MCFD.

Projected Energy Requirements--Montana

The Harza "high" scenario was chosen by the Montana State Study Team to present projected energy requirements. In short, this means that under the "high" scenario the State is producing at its optimum "economic" level in the national market for coal or coal related energy products. Table IV-15 illustrates the differences between the three forecasts regarding Montana's coal production and related resource requirements. Note that under the "most probable" and "low" scenarios at year 2000, Montana produces at 62.5 percent and 6 percent of its share of the "requirements" identified in the "high" scenario.

The "high" forecast for Montana, when put in terms of water consumption, totals to a need for 218,933 acre-feet of water per year (af/y) by the year 2000. The five major consumptive uses of water, related to energy development, are projected to be:

	Acre-Feet Per Year	Millions of Tons Per Year
1. Mines	8,602	430.1
2. Reclamation and/or Dust Suppression	25,180	379.9
3. Coal Gasification	60,020	57.0
4. Electric Generation	14,198	3.2
5. Slurry Pipeline	110,932	184.9
Total	218,932	

A total of 33,782 af/y would be required for mining and reclamation operations by the year 2000. Roughly 85 coal mines would be necessary to meet the forecasted production levels.

Coal gasification, according to the "high" forecast, would be underway by the year 2000, with six gasification plants located in the Tongue-Powder Planning Area. It would be necessary to consume a total of 60,021 af/y in the six plants.

A total of 14,198 af/y of water would be consumed by coal-fired plants that already exist in the Lower Yellowstone Planning Area. If Colstrip

Table IV-15. Coal Production and Resource Requirements, Montana: 1985 and 2000.[1]/

Resource	Forecasts					
	Low		Most Probable		High	
	1985	2000	1985	2000	1985	2000
Coal						
(Million Tons/year)	25.5	25.5	104.14	268.84	136.3	430.1
Water[2]/						
(Acre Feet/year)	16,524	16,524	29,969	79,431	49,197	218,932
Labor[3]/						
(Man-year equiv./year)	624	634	2,122	7,948	2,665	12,334
Capital[4]/						
(Million Dollars)	0	0	591	5,497	616	8,237
Land[5]/						
(Acres)	1,803	1,803	4,543	11,487	5,039	16,855

1/ Assumes an adequate water supply can be delivered on a timely basis at a cost of less than $450 per acre-foot.

2/ Annual consumptive use for mining operations, reclamation, coal fired thermal electric plants, coal gasification plants, and coal slurry pipelines.

3/ Operating personnel for mines and coal conversion plants in man-year equivalents per year.

4/ Cumulative construction cost at 1975 price levels of all new mines and coal conversion facilities.

5/ Area in mine and coal conversion sites.

Units #3 and #4 would be built the figure would go to 35,381 af/y.

Although the use of water for interstate slurry operations is not considered to be a beneficial use of Montana's water, it has been assumed that slurry pipelines would be used to transport coal from Montana to eastern demand areas once the railroad began to operate at full capacity. By the year 2000, 110,932 af/y of water would be consumed in slurry pipeline operations.

Projected Requirements - Tongue-Powder Planning Area

According to the Harza Study, Mining Areas 2, 3, and 4 will be active in Montana (see Plate IV-2). Mining Areas 2 and 4 roughly correspond to the Lower Yellowstone Planning Area, while Mining Area 3 roughly corresponds to the Tongue-Powder planning area.[13A/] Table IV-16 shows the resource requirements and air pollution emissions associated with the projected requirements ("high" scenario) for the Tongue-Powder.

If Mining Area 3 was to meet 100 percent of its share of the Nation's demand, it would produce 20 million tons of coal per year by 1985 and 200 million by the year 2000. In comparison, only 9 million tons were produced in the area in 1975.[13/] In 1985 all coal would be exported by rail. However, by the year 2000 two significant changes would take place. The first would be the introduction of an interstate slurry operation which, at present, is not considered to be a beneficial use in Montana water law. The birth of a synthetic coal gasification industry would occur also; six gas plants with a total capacity of 1,500 million cubic feet per day would be built in the planning area. No coal related electrical generation is forecast under the "high" scenario.

The total consumptive water requirement would be 148,779 af/y by the year 2000. Approximately 60,000 af/y (57 million tons of coal) would be

13/ Western Coal Development Monitoring System, Federal Energy Administration, August 1977.

13A/ See Chapter V, Energy, for discussion of necessary adjustments.

Table IV-16. Resource Requirements and Air Pollution Emissions: High Scenario, Mining Area 3, Montana

	Units	1985	2000
Coal Production	Million tons/year	29	200
Exports			
Rail	Million tons/year	29	29
Slurry	Million tons/year	0	144
Conversion			
Thermal Electric	Million tons/year	0	0
Capacity	Megawatts	0	0
Generation	Gigawatt-hours/year	0	0
Syngas	Million tons/year	0	57
Capacity	Million cubic feet/day	0	1,500
Water Requirements	Total acre feet/year	2,224	148,779
Mines	Acre feet/year	584	4,000
Reclamation and/or dust suppression	Acre feet/year	1,640	11,240
Coal Gasification	Acre feet/year	0	60,021
Electrical Generation	Acre feet/year	0	0
Slurry Lines	Acre feet/year	0	73,518
Labor Requirements			
Operating			
Mines	Man years/year	540	3,975
Electrical Generation	Man years/year	0	3,752
Syngas	Man years/year	0	0
Capital			
Mines	Million dollars	152	1,109
Electrical Generation	Million dollars	0	6,004
Syngas	Million dollars	0	0
Land Requirements			
Strip Mines	Acres/year	420	2,880
Sites			
Mines	Acres	876	6,000
Electrical Generation	Acres	0	3,000
Syngas	Acres	0	0
Air Pollution Emissions			
Particulates	Tons/year	0	6,105
Sulfur Oxides	Tons/year	0	67,032
Nitrogen Oxides	Tons/year	0	44,745

consumed in the gasification process, while 73,500 af/y would be (114 million tons of coal) consumed in slurry operations. The balance would be consumed by mining and reclamation operations.

Associated with synthetic coal gasification would be the air pollution emissions shown in Table IV-16.

Outdoor Recreation

The Tongue and Powder Rivers offer the major share of the water based outdoor recreation in the area. Even though approximately 25 percent of the area is federally owned, only a few sites have been developed for recreation. The Ashland District of the Custer National Forest maintains camping and picnic sites for public use. The Bureau of Land Management is becoming more aware of recreational opportunities on its land but is limited by lack of funds and specialized manpower. The Tongue River Reservoir offers outstanding warm-water fishing to those willing to travel a long distance.

Projected Recreation Requirements

The demand figures (Table IV-17) for the Tongue-Powder Planning Area were derived as a function of current and future population estimates.14/ Participation rates were multiplied by future population estimates for the years 1985 and 2000 which produced estimated activity occasions. By using design load factors and standards for recreation activities, the total number of acres of land and water needed to support those activity occasions were obtained. Acreage estimates for demand were developed by using both land and water standards in the base of swimming, water skiing, and boating/canoeing. Winter sports were divided into the two categories of ice skating

14/ See Outdoor Recreation Update, Recreation Ad Hoc Work Group, May, 1977.

Table IV-17. Need for Surface Acres Related to Alternative Outdoor Recreation Requirements, Tongue-Powder, Montana

Activity	LOW			MOST PROBABLE		HIGH	
	1975	1985	2000	1985	2000	1985	2000
Swimming (Beach)	1 WSA[2/] 1 LSA	1 WSA 1 LSA	1 WSA 2 LSA	1 WSA 1 LSA	2 WSA 3 LSA	1 WSA 2 LSA	234 WSA 5 LSA
Water Skiing	425 WSA 2 LSA	558 LSA 2 LSA	710 WSA 3 LSA	677 WSA 3 LSA	1,512 WSA 6 LSA	812 WSA 3 LSA	2,086 WSA 8 LSA
Fishing[1/]							
Picnicking	6 A	9 A	13 A	12 A	33 A	15 A	47 A
Nature Walks	13 A	18 A	24 A	22 A	51 A	26 A	70 A
Boating Canoeing	307 WSA 6 LSA	425 WSA 8 LSA	578 WSA 11 LSA	515 WSA 9 LSA	1,230 WSA 23 LSA	618 WSA 11 LSA	1,697 WSA 31 LSA
Hunting[1/]							
Camping	[3/]	1 A	7 A	4 A	32 A	8 A	50 A
Hiking	7 A	10 A	12 A	12 A	26 A	14 A	36 A
Playing Games/Sports	4 A	5 A	13 A	7 A	16 A	8 A	23 A
Winter Sports	1 ISA 1 SSA	1 ISA 2 SSA	1 ISA 3 SSA	1 ISA 2 SSA	2 ISA 6 SSA	1 ISA 3 SSA	2 ISA 8 SSA

1/ Data to be provided by Fish and Wildlife Ad Hoc Work Group.

2/ Numbers followed by abbreviation "A" indicate Land Surface acres.
LS = Land Surface. WS = Water Surface. IS = Ice Surface. SS = Snow Surface. A = Acres.

3/ Needs are met, and there is a 4-acre surplus.

Source: Bureau of Outdoor Recreation.

and snow skiing. The activities of driving and sightseeing were omitted because no state standards were provided.

Table IV-17 indicates that the only facilities providing for current demand in the area are for camping; however, by 1985 even those facilites become inadequate since this planning area is forecast to receive most of the population growth from energy development. Table IV-17 illustrates the weak recreational base that exists for the present population, and indicates further the tremendous demands on recreational resources that may exist by the year 2000--given energy development.15/

Without Federal or State involvement in the future, it is apparent that outdoor recreational resources will not be significantly expanded.

Land Conservation

An acute awareness of the need for conservation of our basic resources--soil and water--has led to the development and implementation of many conservation programs since 1940. Paramount among these programs are conservation farming techniques and improved forest and range management practices. The Multiple Use-Sustained Act of 1960 for National Forest Lands and the Federal Land Policy and Management Act of 1976 for the Public Domain Lands have added impetus to land conservation by ensuring that conservation values would not be sacrificed to exploit other resources.

Land conservation measures preserve and improve the land, water, and plant resources. Measures specifically designed to control wind and water erosion will also contribute to the reduction of flood hazards in rural and urban areas, improve water disposal in needed areas, and generally enhance

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15/ Since recreation estimates are tied to population estimates based on forecasted levels of coal-related development, the analysis shows requirements under the "low", "most probable", and "high" Harza scenarios.

recreational and fish and wildlife values. While measures may vary from one area to another, the long-term result common to nearly all measures is that of sustained or increased production. Land conservation measures, such as improved irrigation systems, would decrease water diversion requirements.

It has been estimated that stream sedimentation could be expected to decrease by 7 percent for each 10 percent of additional land protected by adequate conservation measures. The draft report of the National Commission on Water Quality estimates that if land conservation measures are applied to all of the Nation's farmland, a 50 percent reduction in stream sediment loads could be achieved--as well as a related reduction in pesticides and nutrients that cling to the soil particles and are carried back into the water-ways.

Soil and land conservation is an ongoing process; and many problems reoccur as time passes. Old conservation methods may be replaced by new ones; new problems replace old problems due to natural or manmade changes; and structural controls wear out or become obsolete. Erosion, from any cause, is a dynamic process and requires constant surveillance and corrective action.

The land conservation status, for 1975, on non-Federal land was developed by the Soil Conservation Service (SCS). The 1967 Conservation Needs Inventory was updated to provide a better understanding of current conservation problems and needs. The land conservation status for 1975 on most Federal land was developed by the Bureau of Land Management (BLM) and the Forest Service (FS). In addition, each of the two agencies estimated the 1985 and 2000 land conservation needs by analyzing trends from ongoing land conservation programs.16/

Land conservation measures were separated into two categories: (1) management only and (2) management--vegetative and mechanical. Management

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16/ See Land Conservation Measures, Ad Hoc Work Group on Updating Land Conservation, May, 1977.

practices that are needed on irrigated land include the proper application of irrigation water, crop-residue management, proper cropping systems, and maintenance of fertility. Some or all of these practices are needed on the remaining portion of the irrigated land. In addition, mechanical measures such as land leveling and smoothing, the installation of drainage ditches, and the improvement of on-farm distribution systems are needed on some lands. A more recent measure is the conversion from flood to sprinkler irrigation which improves water conservation. Costs were developed by the SCS for non-Federal lands and by BLM and FS for Federal lands.

Currently, 2,761,560 acres (53 percent) of total lands are adequately treated in the Tongue-Powder Planning Area.[17/] This includes 885,560 acres of Federal lands and 1,876,000 acres of non-Federal lands.

Table IV-18 illustrates the need for increased land conservation measures on Federal and non-Federal lands in the Tongue-Powder Planning Area. In this area, a significant need for land conservation is tied to private croplands (irrigated as well as non-irrigated). Non-Federal and Federal rangelands also would appear to benefit from increased conservation measures.

In determining the projected requirements for land conservation, it has been assumed that they include all land not now classified as adequately treated. For this reason, the projected requirements are the same for both 1985 and 2000. As of 1975, it is estimated that there were 2,494,000 acres that still needed the application of some land conservation measures before they could be considered as adequately treated. The total estimated cost to install this treatment is $30,323,000.

17/ Land on which the conservation measures essential to its sustained use have been applied.

Table IV-18. Projected Land Conservation Requirements, Tongue-Powder, Montana

Land Use and Ownership	Acres	Dollars[1/]
Non-irrigated Cropland	90,000	4,950,000
Federal	0	0
Non-Federal	90,000	4,950,000
Irrigated Cropland	49,000	9,800,000
Federal	0	0
Non-Federal	49,000	9,800,000
Non-irrigated Pasture	70,000	2,100,000
Federal	0	0
Non-Federal	70,000	2,100,000
Irrigated Pasture	3,000	300,000
Federal	0	0
Non-Federal	3,000	300,000
Range	2,168,400	11,882,000
Federal	299,400	4,685,000
Non-Federal	1,869,000	7,197,000
Forest-Commercial	400	104,000
Federal	400	104,000
Non-Federal	0	0
Forest-Non-Commercial	113,600	1,187,000
Federal	69,600	1,077,000
Non-Federal	44,000	110,000
Other	0	0
Federal	0	0
Non-Federal	0	0
Total	2,494,400	30,323,000
Federal	369,400	5,866,000
Non-Federal	2,125,000	24,457,000

1/ Based on 1975 costs.

Degradation of Habitat

The Tongue-Powder planning area is characterized by rolling prairie, river breaks, and low mountains. Prairie grass that once provided sustenance for huge herds of bison now supports herds of domestic cattle.

Settlement of the area began the degradation and destruction of wildlife habitat. However, it has not been as severe or extensive in this area as in some others because of the basic agricultural use of the land coupled with a sparse population. The new energy industry may pose more of a threat to existing wildlife and its habitat because of the possibility of large coal-related population increases.

Access Sites

Most streams and farm ponds are on private lands or are bordered by private lands; therefore, access to fishing and other water based recreation is a potential problem in the area.

The area provides good waterfowl hunting, mainly along the Tongue and Powder Rivers, but access is a major problem. Offstream storage reservoirs, if developed with waterfowl needs and requirements in mind, could provide additional habitat and access.

Increase in Resource Use

A good warm-water sport fishery consisting of ling, catfish, sauger, and walleye exists in the Lower Yellowstone and Tongue Rivers. The Tongue River also supports a small trout fishery and the only viable smallmouth bass river fishery in the State.

Tables IV-19 and IV-20 show estimates of the present use of streams in the Tongue-Powder and the Lower Yellowstone Planning Areas.

The Montana Department of Fish and Game expects the numbers of sportsmen in the Yellowstone Area to more than double in the period from 1970 to 2020.

Table IV-19
Tongue-Powder Fisheries, 1975

Water Type	Quantity	Fishermen Days Supply	Resident Fishermen	Non-Resident Fishermen
Non-Salmonid Streams	450.5 miles	22,525[1]/		
Lakes and Reservoirs	4,250.5 acres	29,030[2]/		
		51,555	2,637[3]/	568[3]/

1/ Average of 50 man-days per mile of stream
2/ Range of 5 to 40 man-days per acre
3/ Numbers of resident and non-resident fishermen are estimates of those who bought fishing licenses in the Planning Area (3 year average)

Table IV-20
Lower Yellowstone Fisheries, 1975

Water Type	Quantity	Fishermen Days Supply	Resident Fishermen	Non-Resident Fishermen
Non-Salmonid Streams	637.6 miles	31,880[1]/		
Paddlefish Fishery		5,000		
Lakes and Reservoirs	46,144.5 acres	177,360[2]/		
		214,240	8,179[3]/	1,660[3]/

1/ Average of 50 man-days per mile of stream
2/ Range of 3 to 40 man-days per acre
3/ Three-year average of number of people buying fishing licenses in the Planning Area

Source: Montana Department of Fish and Game

CHAPTER V

FUTURE WITHOUT (F/WO) AND REMAINING NEEDS

The future "without" a plan (F/WO) is that level of assumed development that is expected to be initiated and carried through by the private sector, or by ongoing public programs. No new State and/or federally assisted developments are included when determining the F/WO.

The F/WO gives the State Study Team a place to begin its planning effort. If the F/WO meets all of the projected needs, then there is no need to plan for further development, but there may be a need to plan for reduced production. On the other hand, if there are remaining needs beyond the F/WO, the Study Team may want to support development by recommending additional State and/or Federal projects designed to satisfy or mitigate the remaining needs.

The objectives above also apply to environmental needs (e.g., the need to maintain or enhance instream flows)--the process is identical.

Agriculture

Nonirrigated Cropland

In examining trends in nonirrigated cropland, the Agricultural Ad Hoc Work Group summed historical harvested acres and performed a correlation analysis on the data to see if a significant trend existed over time. None of the planning areas in Montana exhibited statistically significant increasing trends for nonirrigated harvested croplands.1/ Based on that analysis, the group projected that the number of nonirrigated acres would hold constant at their base value.

1/ See Agricultural Projections and Supporting Data, Agricultural Ad Hoc Work Group, February, 1977.

Given the above analysis and assumptions, it appears that nonirrigated agriculture will be able to supply (through increases in productivity) some of the roughage called for by the Ad Hoc Group's "third" projections (see Chapter IV). Most of the agricultural production needed to satisfy the projected requirements shown in Chapter IV, will come from irrigated cropland.

Irrigated Cropland

The Study Team has set the F/WO increase in irrigated acreage in the Tongue-Powder planning area at the rate of about 200 acres per year -- through the year 2000.[2/] Table V-1 compares base year irrigated acreages with the F/WO, the OBERS projections (E and E'), and the "third" projections (3E and 3E').

Table V-1. Comparison of Alternative Irrigated Acreages, Tongue-Powder, Montana

Situation	Acres	
	1985	2000
OBERS E	30,053	31,889
OBERS E'	30,223	32,031
Base Year	31,334	31,334
F/WO	33,334	36,334
3E	108,152	118,437
3E'	92,551	116,664

Differences between the F/WO, and the OBERS and "third" projections are shown in Table V-2. The differences are shown in terms of surpluses (+) or shortages (-) in needed irrigated acres and defined as remaining needs.

The entries given in Table V-2 illustrate the gap between the OBERS projections and the "third" projections (see the section on Irrigated Cropland in Chapter IV). Surplus acres occur when comparing the F/WO with the

2/ Montana State Study Team Minutes, July 26-27, 1977.

Table V-2. Surpluses and Remaining Needs After F/WO Development, Tongue-Powder, Montana

Situation	Acres	
	1985	2000
OBERS E	+3,000	+4,000
OBERS E'	+3,000	+4,000
3E	-75,000	-82,000
3E'	-59,000	-80,000

OBERS projections; they simply mean that according to OBERS the Lower Yellowstone will be producing on more acres than needed under the F/WO assumptions. In short, the OBERS projections are pessimistic. The remaining needs for new irrigated acres are shown by the negative values in the table; they reflect the need for additional roughage associated with the OBERS forecasts of increases in beef cattle production. At best, the values shown in Table V-2 may be considered merely to be indicators of the limits of future needs.

Saline Seeps and Irrigation Salinity

Areas of saline seep associated with non-irrigated croplands and irrigation salinity appear to have been increasing over the past several years (see Chapter IV for additional information). However, the F/WO status of saline lands cannot be determined because no data exist that accurately show the trend toward increasing amounts of saline lands; one estimate of the rate of increase in these lands has been 10 percent per year, which seems inordinantly high. The greatest problem is the emergence of saline seeps; however salinity problems associated with irrigation are now being documented and appear to be increasing.

Municipal, Industrial, and Livestock Water

It is assumed that all of the water needed for municipal, industrial, non-energy mineral, and livestock uses will be developed in the without situation. In other words, no matter what the level of development that is forecast for these users, the nature of that development is such that no SRD or NED projects will be needed to support it. The need for water by these users is relatively small, and they will be able to appropriate their own water at any foreseeable level of development. Therefore, there are no remaining needs beyond the F/WO. Table IV-3 illustrates projected water consumption by such users in the Tongue-Powder Planning Area.

Table V-3. F/WO Municipal, Industrial, Non-Energy Mineral, and Livestock Consumptive Water Needs

	af/y		
	Base	1985	2000
Municipal[1/]	826	1,233	2,250
Industrial[2/]	-0-	-0-	-0-
Non-Energy Minerals[3/]	3	6	10
Livestock[4/]	20,100	22,600	24,900
Totals	20,929	23,839	27,160

1/ Based on most probable level of energy development. See F/WO energy section below.

2/ Based on Bureau of Domestic Commerce data. Industrial consumption of water at Miles City is included in the Lower Yellowstone totals.

3/ See Non-Energy Mineral Water Needs, Ad Hoc Group on Updating Minerals Data, May, 1977.

4/ Derived from F/WO Livestock Projections.

Flood Control

The Flood Control Ad Hoc Group, in updating flood damages, assumed that current trends toward increased flood plain regulation would continue into

the future. The group assumed also that no additional structural measures would be added to mitigate flood damages. Therefore, the F/WO is represented by the projected requirements shown in the section on flood control in Chapter IV (See Table IV-11). Table V-4 reintroduces the projected requirements as remaining needs, given no structural F/WO solutions for the Tongue-Powder Planning Area.

Table V-4. Flood Damage Remaining Needs, Tongue-Powder, Montana[1/]

Stream and Reach	Area Subject To Flooding	Flood Damages 1975	1985	2000
	(1,000 acres)	($1,000)		
Tongue River				
Wyoming Line to Hanging Woman Creek	3.0	11	12	12
Hanging Woman Creek to Mouth	35.0	349	366	393
Powder River				
Wyoming Line to Mouth	44.4	180	189	203
Little Powder River				
Wyoming Line to Mouth	6.3	23	24	26
Tongue Tributaries	*22.9*	*68*	*82*	*116*
Powder Tributaries	*5.2*	*6*	*7*	*10*

1/ The table combines COE and SCS data. The SCS figures are shown in script.

Table V-5 depicts the remaining needs for the control of streambank erosion; again, no structural solutions are taken into account. The table reintroduces Table IV-12 of Chapter IV.

Table V-5. Streambank Erosion Remaining Needs
Tongue-Powder, Montana

Main Stems	Annual Damages 1975	1985	2000
		($1,000)	
Upper and Lower Yellowstone Planning Areas			
Yellowstone River	217	338	382
Main Tributaries[1/]	85	133	150
Upper and Lower Clarks Fork and Bighorn Planning Areas			
Clarks Fork River	32	49	56
Bighorn River	291	453	511
Upper and Lower Tongue and Powder Planning Areas			
Tongue River	55	85	96
Powder River	140	217	245
Montana Tributaries[2/]			
Yellowstone, Clarks Fork, Bighorn, Tongue, & Powder Rivers	61.5	95.7	108.1
Little Missouri River	7.8	12.1	13.6
Totals	69.3	107.8	121.7

1/ Drainages of more than 400 square miles.

2/ Drainages of less than 400 square miles.

Indian Water Requirements

At the present time, the water requirements of the Crow and Northern Cheyenne Indian Tribes are unknown. The tribes have been advised not to participate in the Level B Study so as not to prejudice existing and pending litigation concerning the use of water on and adjacent to the two Indian reservations.

However, rather than ignore Indian resources and potentials on tribal lands, the Level B Study considered tribal resources and potential projects (e.g., the Hardin Unit) that were known and treated them in the same manner as those that are found off of the reservations. On this basis no separate F/WO was formulated to account for or estimate Indian water requirements.

Energy

The F/WO for coal related energy development in the Tongue-Powder Planning Area is based on the Harza "most probable."[3/] No energy development is forecast for either the Upper Yellowstone or the Clarks Fork-Bighorn Planning Areas.

Table V-6 shows the resource requirements of the F/WO energy situation in the Tongue-Powder Planning Area. Coal production would go to 20 million tons per year by 1985 and to 98 million by the year 2000. All exports would be made by rail; the use of water for interstate slurry operations is not considered, under Montana law, to be a beneficial use of water. This was the primary reason for choosing Harza's "most probable" forecast as the F/WO situation.

3/ To account for production from the Decker area mines, which are located in the Tongue-Powder planning area but in Mining Area #4 (see Chapter IV), 20 million tons a year in 1985 and 60 million by year 2000 of Area #4 (Lower Yellowstone) production is included in figures for the Tongue-Powder planning area.

Table V-6. Future Without (F/WO) Situation Resource Requirements and Pollution Emmissions, Tongue-Powder, Montana

	Units	1985	2000
Coal Production	Million tons/year	20	98
Exports			
Rail	Million tons/year	20	60
Slurry	Million tons/year	0	0
Conversion			
Thermal Electric	Million tons/year	0	0
Capacity	Megawatts	0	0
Generation	Gigawatt-hours/year	0	0
Syngas	Million tons/year	0	38
Capacity	Million cubic feet/day	0	1,000
Water Requirements	Total acre feet/year	1,520	47,448
Mines[1/]	Acre feet/year	400	1,960
Reclamation and/or dust suppression	Acre feet/year	1,120	5,488
Coal Gasification	Acre feet/year	0	40,000
Electrical Generation	Acre feet/year	0	0
Slurry Lines	Acre feet/year	0	0
Labor Requirements			
Operating			
Mines	Man years/year	410	2,009
Electrical Generation	Man years/year	0	0
Syngas	Man years/year	0	2,502
Capital			
Mines	Million dollars	114	559
Electrical Generation	Million dollars	0	0
Syngas	Million dollars	0	4,003
Land Requirements			
Strip Mines	Acres/year	288	1,411
Sites			
Mines	Acres	600	2,940
Electrical Generation	Acres	0	0
Syngas	Acres	0	2,000
Air Pollution Emissions			
Particulates	Tons/year	0	4,070
Sulfur Oxides	Tons/year	0	44,688
Nitrogen Oxides	Tons/year	0	29,830

1/ A significant portion of the mine labor will probably be housed in Wyoming.

Four synthetic gasification plants would consume 38 million tons of coal per year by 2000. No coal-fired electrical generation facilities would be sited in the area as part of the F/WO situation.

Water consumption by the synthetic gasification plants would be near 40,000 af/y by 2000. Total energy-related water consumption would approach 47,500 af/y.

Air pollution emmissions would become an environmental factor by 2000.4/ The "Class One" air quality standards of the Northern Cheyenne Indian Reservation may have some effect of future construction and operation of any synthetic gasification operations.

Table V-7 illustrates the yearly net economic benefits that would accrue to the planning area at this level of energy development.

The difference between the consumptive water uses of the projected requirements (high level of development) and the F/WO is shown by Table V-8. Base year consumption is also included for comparison.

4/ For comparison of air pollution emissions, see Table VI-6 which follows.

Table V-7. Annual Net Economic Benefits
From the Future Without (F/WO) Energy Situation
Tongue-Powder, Montana[1/]

	(Millions of $)
Yearly Gross Benefits	
Gasification	$ 531.94
Export Coal	177.21
Total Benefits	709.15
Yearly Costs	
Gasification	825.40
Export Coal	150.63
Lost Agricultural Production[2/]	.07
Total Costs	976.10
Net Benefits Per Year	-$ 266.95

1/ Based on data in Analysis of Energy Projections and Implications for Resource Requirements, by Harza Engineering Company, December, 1976, and backup data provided by Harza to study management. Benefits and costs do not include values for moving energy out of area.

2/ This estimate is based on winter wheat (the highest-value alternative) following fallow which nets $80 per cropped acre to land, management, overhead, and risk. Each cropped acre requires one fallow acre; therefore, the acre returns are effectively $40.

Table V-8. Potential Water Requirements for Energy,
Tongue-Powder, Montana

Consumptive Use	af/y		
	1975	1985	2000
Base Year	456	-0-	-0-
Projected Requirements	-0-	2,224	148,779
F/WO	-0-	1,520	47,448
Remaining Potential Requirements	-0-	704	101,331

Outdoor Recreation

Although private enterprise can (and does) provide some measure of water-based outdoor recreation in the Yellowstone Basin, the extent of the industry has not been specifically determined, but it is known to be minor. For purposes of this study, it therefore has been assumed that the projected requirements also represent the remaining needs. The needs are tied directly to population. Table V-9 shows the needs based on the "high" and "most probable" levels of development of the coal industry. The "most probable" is included because it represents the F/WO situation of coal-related development.

Table V-9. Remaining Needs for Outdoor Recreation, Tongue-Powder, Montana[1/]

Activity	MOST PROBABLE		HIGH	
	1985	2000	1985	2000
Swimming (Beach)	1 WSA 1 LSA	2 WSA 3 LSA	1 WSA 2 LSA	234 WSA 5 LSA
Water Skiing	677 WSA 3 LSA	1,512 WSA 6 LSA	812 WSA 3 LSA	2,086 WSA 8 LSA
Picnicking	12 A	33 A	15 A	47 A
Nature Walks	22 A	51 A	26 A	70 A
Boating/Canoeing	515 WSA 9 LSA	1,230 WSA 23 LSA	618 WSA 11 LSA	1,697 WSA 31 LSA
Camping	4 A	32 A	8 A	50 A
Hiking	12 A	26 A	14 A	36 A
Playing Games/Sports	7 A	16 A	8 A	23 A
Winter Sports	1 ISA 2 SSA	2 ISA 6 SSA	1 ISA 3 SSA	2 ISA 8 SSA
Hunting[2/]				
Fishing[2/]				

1/ Estimates of outdoor recreation needs were obtained by subtracting supply from demand. For further explanation see Outdoor Recreation Update, Tongue and Powder Planning Area, Recreation Ad Hoc Work Group, May 1977.
2/ Data furnished for the entire Level B Study Area, but not disaggregated to planning areas.
LS = Land Surface; WS = Water Surface; A = Acres; IS = Ice Surface; SS = Snow Surfac

Land Conservation

It is reasonable to assume that land conservation measures will continue to be implemented in the F/WO situation through ongoing Federal programs. Table V-10 shows the F/WO and the remaining needs for the Tongue-Powder Planning Area, given continuation of existing and ongoing land conservation programs.

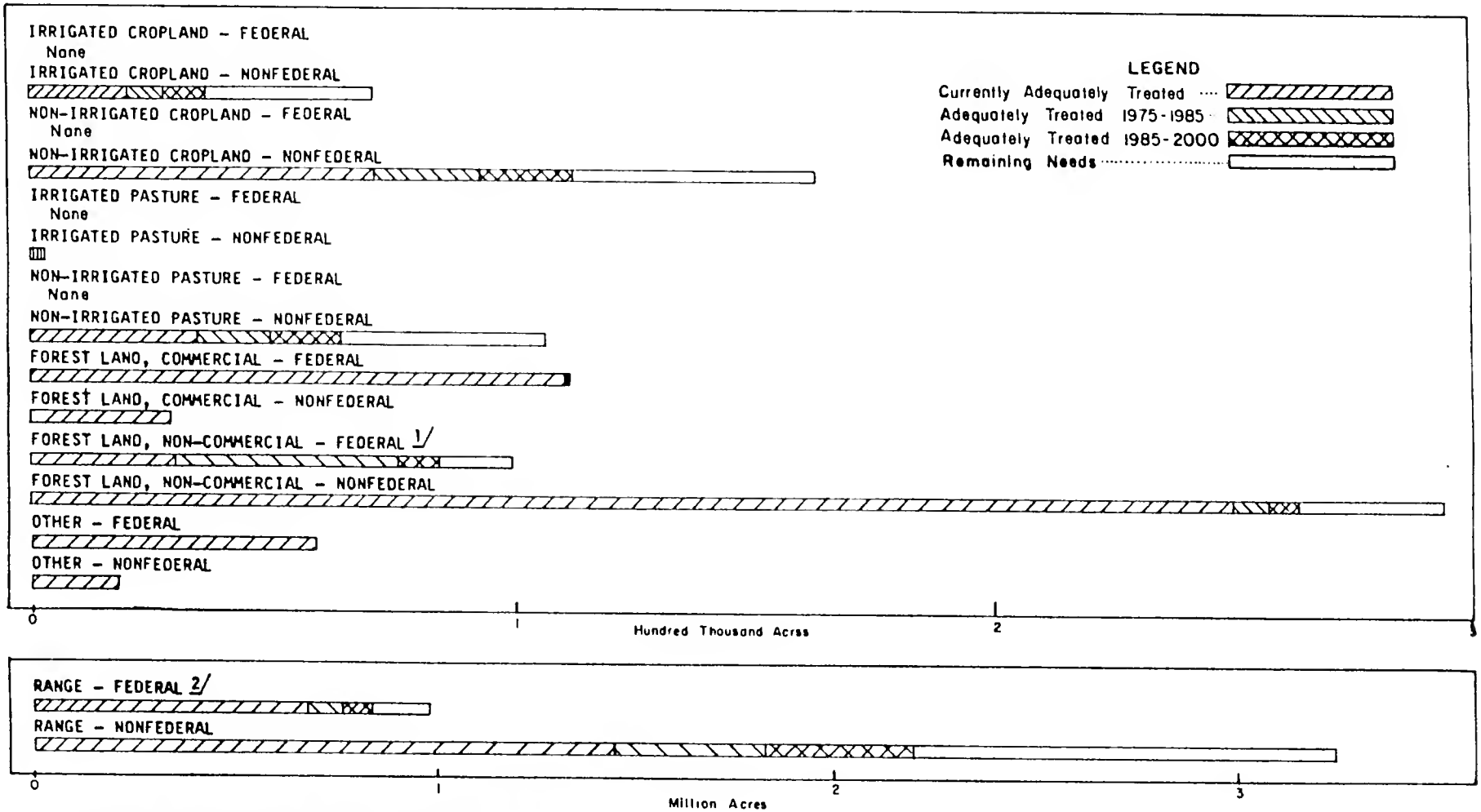
Figure V-1 further explains Table V-10 by illustrating land conservation status over time and by ownership and use. Private range and nonirrigated cropland appear to have the greatest need for land conservation treatment.

Table V-10. F/WO and Remaining Land Conservation Needs on Federal and Non-Federal Lands, Tongue-Powder, Montana[1/]

Situation	Acres		
	1975	1985	2000
Adequately Treated:			
Non-Federal	1,876,000	2,301,000	2,722,000
Federal	885,560	1,016,510	1,094,660
Total Adequately Treated	2,761,560	3,317,510	3,816,660
Remaining Needs:			
Non-Federal	2,125,000	1,700,000	1,279,000
Federal	369,400	238,450	160,300
Total Remaining Needs	2,494,400	1,938,450	1,439,300

1/ Estimates for Federal lands were made by the Bureau of Land Management and Forest Service. The Soil Conservation Service developed the estimates for non-Federal lands. Each Agency developed the 1985 and 2000 F/WO projections by analyzing the trends from ongoing conservation programs.

Figure V-1. Land Conservation Status,
Tongue-Powder, Montana



1/ Includes all BLM forest land as non-commercial
2/ Barren land and tundra are included in range

Fish and Wildlife

According to a draft of the Montana Department of Fish and Game's Strategic Plan, a surplus of salmonoid, non-salmonoid, and waterfowl populations will exist throughout the Yellowstone Area at least to the year 1982; projections of supply and demand beyond this point do not exist. However it is probably safe to say that, due to probable degradation of habitat in the future, the supply of harvestable wildlife will not increase enough to meet increased future demands by hunters and fishermen.

In general, the F/WO is affected by four factors: (1) continuing degradation and loss of habitat; (2) lack of access; (3) a fixed supply; and (4) increasing demand. It is unlikely that the private sector will enter the fish and wildlife business (e.g., big game ranches, private waterfowl and fishing developments) until shortages become apparent and encourage profitable entry. Therefore, until 1982 the remaining needs may be measured as a surplus and private entry into the fish and wildlife industry is not expected. However, the loss and degradation of habitat, as well as limited access to sportsmen, have to be accounted for in a different manner; thus the remaining needs related to habitat and access must be recognized as a shortage.

F/WO Impacts on Water Quantity and Quality

The impact of F/WO development on the area's water resources is shown in the Hydrology Supplement, which is discussed in greater detail in Chapter VII.

Opportunities

In order to meet the remaining needs as they were presented earlier in this chapter, various State and Federal agencies proposed various projects and programs to the State Study Team for consideration. These projects and programs comprised the total set of elements that were considered for the National Economic Development (NED) plan, the Environmental Quality (EQ) plan, and the State/Regional Development (SRD) elements that follow in Chapter VI, and later in the Recommended Plan of Chapter VII. Some of the following projects and programs were not accepted by the Study Team and were eliminated from further consideration for reasons shown in the footnotes.

Multipurpose Projects

	Source	New Irrigation	Supplemental Irrigation	Acre-feet Industrial	MW Power
1. Tongue River Reservoir Modification	DNRC	13,000	--0--	28,750	6
2. Moorhead Reservoir	USBR	5,000	6,300	92,500	--0--

Flood Control

	Source	Protected Acres
Miles City Levee	COE	1,300

Land Conservation

	Source	Treated Acres
1. Accelerated Land Conservation Program	USFS, BLM, SCS	721,300
2. Streambank Greenbelt Program	State Study Team	Not Available

Energy Development

	Source	Coal Production (million tons)	Consumptive Water Use (acre-feet year)
1. Recommendation of a Private NED Level 5/	State Study Team	203	72,460
2. Recommendation of a Private EQ Level	State Study Team	16	1,216

5/ Energy Development is shown at the year 2000.

Fish and Wildlife

	Source
Support the Instream Flow Recommendation made by the Montana Department of Fish and Game (DFG)[6/]	DFG

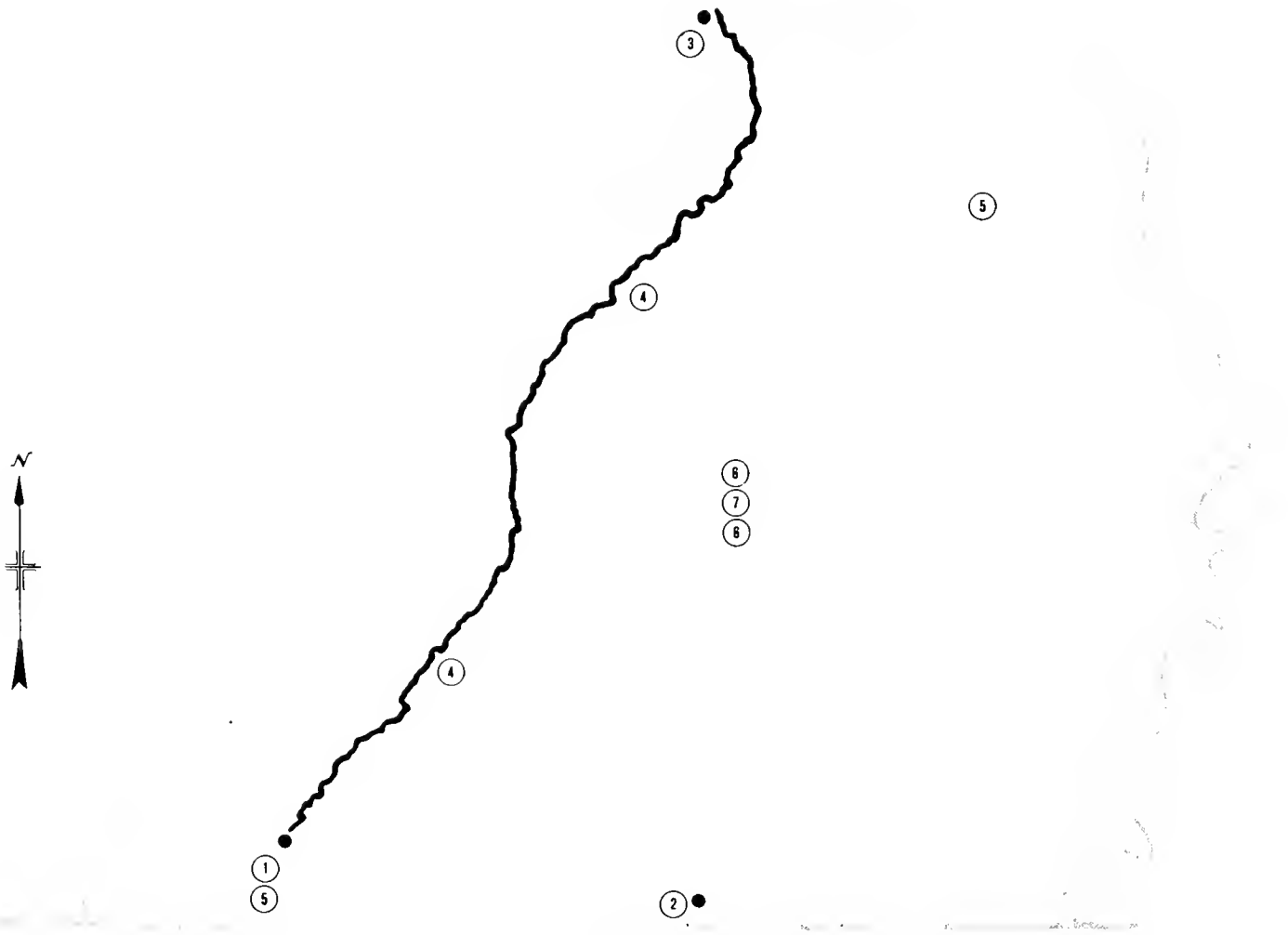
Wild, Scenic, and Recreational Rivers

	Source
Tongue River - 115 miles - State Management	BOR

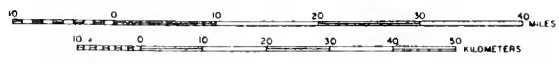
6/ See the section on the Yellowstone Moratorium in Chapter II, the Instream flow section in Chapter IV, and the EQ plan of Chapter VI for additional information.

PLATE V-1 LOCATION OF PROPOSED PROJECTS
AND PROGRAMS (OPPORTUNITIES),
TONGUE-POWDER, MONTANA

1. Tongue River Reservoir Modification
2. Moorhead Reservoir
3. Miles City Levee
4. Tongue River Secnic/Recreational
5. Energy Development (Private Sector)
6. Accelerated Land Conservation Program
7. Streambank Greenbelt Program
8. Minimum Instream Flows



YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION



CHAPTER VI

PLAN FORMULATION

Principles and Standards

Criteria used for the evaluation of projects and formulation of the alternative plans set forth later in this chapter are those established under the multi-objective planning (MOP) approach of the U.S. Water Resources Council. Planning guidelines for the Yellowstone Level B Study conform with the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources, as published in the Federal Register of September 10, 1973.

Alternative plans for resource development and/or management for the Montana planning areas have been formulated to emphasize national economic development (NED), and environmental quality (EQ). A third, but partial, plan emphasizing state/regional development (SRD) has been included to identify projects that produce substantial local or regional benefits but that do not meet NED criteria. A fourth plan, called the Recommended Plan, is a combination of those projects or programs selected from the NED, EQ, and SRD plans that best meet the remaining needs outlined in Chapter V.

Plan formulation for the NED and SRD emphasis plans is tied primarily to the monetary benefit, cost and repayment evaluation of potential projects or programs (elements). The formulation criteria for retaining an element in the NED or SRD plan are that the results of the economic and financial appraisal of that element must show that user benefits exceed costs and that there is an apparent source of repayment of project costs. EQ plan formulation criteria do not relate to rigid economic standards but emphasize

enhancement, preservation, or management as the principal objectives. A combination of selected elements from the NED, SRD, and EQ plans makes up the recommended resource development and/or management plan for the Yellowstone Basin area; each of the four plans is described in more detail later in this chapter.

The beneficial and adverse effects of a proposed development are evaluated for the period of the useful life of the major project facilities, with an upper limit of 100 years. A discount rate of 6-3/8 percent has been used for the Yellowstone study. Benefits and costs occurring in different time frames over the period of analysis have been adjusted to comparable values by the use of the 6-3/8 percent discount rate. All costs and benefits are based on January 1975, prices.

The Four-Account System

Under the MOP procedures, each plan, regardless of which objective (e.g., NED, EQ, or SRD) is emphasized, is evaluated and displayed in terms of a four-account system--national, regional, environmental, and social factors accounts. This means that each project or program that is proposed for consideration in any of the plans is evaluated under the four-account system also.

Benefits and costs for the national and regional accounts are expressed as monetary values but also include a descriptive analysis of beneficial and adverse effects. For the other two accounts--environmental and social factors--the main emphasis is in identifying and evaluating changes that would occur with a plan and describing in a succinct narrative the beneficial or adverse effects associated with the changes. A simplified display chart of the plans and accounts follows:

	Alternative Plan			
	NED	SRD	EQ	Recommended
National Economic Development Account				
Benefits	$	$	$	$
Costs	$	$	$	$
State/Regional Development Account				
Benefits	$	$	$	$
	(-----Descriptive terms-----)			
Costs	$	$	$	$
	(-----Descriptive terms-----)			
Environmental Quality Account				
Beneficial effects	(-----Descriptive terms-----)			
Adverse effects	(-----Descriptive terms-----)			
Social Factors Well Being Account				
Beneficial effects	(-----Descriptive terms-----)			
Adverse effects	(-----Descriptive terms-----)			

National Economic Development Account

Benefits evaluated under the national account are direct user benefits. User benefits are displayed for the traditional project multipurposes of irrigation, flood control, recreation, fish and wildlife, M&I water, power, etc. User benefits are measured as net income increases, damage reductions, or proxy values of alternative actions to direct project beneficiaries. Income increases may include the net increases in salaries or persons who actually work on the project during construction or operation, and who would be unemployed or underemployed in the absence of the project. Benefits may not include second-level effects such as income to businesses resulting from the project. National account costs are measured as the economic values placed on the resources required to implement a plan and place it in operation.

State/Regional Development Account

Benefits and costs evaluated under the regional account are delineated for incidence of occurrence within the boundaries of the Montana study area. These local effects generally are offset by their effects on the "rest of the

Nation," because they would have occurred elsewhere had the expenditures for the project been made elsewhere.

Regional monetary benefits are estimated for four income categories: user benefits, induced and stemming from effects, construction inpacts, and unemployment and underemployment effects. User benefits are defined the same as for the national account.

Induced and stemming effects are estimated as the income generated from implementing plan services that are in addition to user benefits. Construction impacts are estimated as the income increase accruing to the region from wage payments to imported labor forces during the construction period. Income increases to the unemployed and underemployed persons in the region are estimated as portions of the preceding two categories--induced and stemming effects and constructions impacts--and are assumed to be significant only during the early years of project life.

Local costs include local payments toward construction and operation, and regional tax contributions. Both adverse and beneficial effects, not evaluated monetarily, are to be measured in appropriate terms, described, and displayed in the local account.

Environmental Quality Account

A water and land use plan may have a variety of effects--beneficial and adverse--on the environment. While monetary effects do occur, effects on the environment are generally characterized by their non-market, non-monetary nature.

Environmental effects are contributions resulting from the management, preservation, or restoration of one or more of the desirable environmental characteristics of an area under study. Adverse environmental effects are consequences of proposed actions that result in the deterioration of environmental characteristics of an area.

Social Well Being Account

Beneficial and adverse effects on social factors are derived from a plan's success or failure in meeting social needs. The identification and satisfaction of social needs will relate to the social deficiencies expected to prevail in the study area without a plan as compared to the expected changes, social gains, or losses, with a plan.

The MOP guidelines for evaluating social factors were written to emphasize the effects on those users of projects or programs who have, without the project or program, failed to share in rising economic standards. This would seem to focus on the unemployed or underemployed persons which according to regional benefit evaluation criteria would be significant only during the early years of project life because of the assumed long-range, full employment situation nationally.

Procedures are not available to measure the social status of future beneficiaries. Opportunities for improving social status are available through implementation of resource development; however, documentation of the actual benefiting social group is not possible. Social effects are, therefore, evaluated and displayed only for the projects and programs that are included in the alternative plans, and are not considered as an end in themselves.

Display of Data

In order to provide consistency in the display of information for various projects and programs that have been analyzed, data have been set forth in the general format suggested by Figure VI-1. In some cases, the form itself has been used, in other cases, separate sheets have been used for each account, but the arrangement and coverage is the same in either case.

Project Formulation

When data for a project or program that has been suggested for inclusion in the planning area has been evaluated and tabulated under the four-account system, it is then possible and necessary to test the proposal in terms of its acceptabilities for inclusion in the various "objective" plans--National Economic Development (NED); State/Regional Development (SRD); and Environmental Quality (EQ). Each of these plans has specific requirements that must be met if a project or program is to be included in that plan, and to the extent that this is so, the proposal's attractiveness for inclusion in the Recommended Plan is enhanced. The Recommended Plan is a selection of those components of the other three plans that best satisfy the needs identified in Chapter V. No project or program may be included in the Recommended Plan unless it has qualified for at least one of the three objective plans.

Summary--Tongue-Powder Planning Area

The National Economic Development (NED) plan for this planning area is composed of two multipurpose storage projects that can jointly supply 121,250 acre-feet of water for industrial purposes. Also, the two projects could irrigate 18,000 new acres while furnishing enough supplemental water for 6,300 acres (see Table VI-1).

The State-sponsored (Department of Natural Resources and Conservation) Tongue River Reservoir modification could generate 6 MW of electricity and supply 28,750 acre-feet of water for industrial use. The Bureau of Reclamation's Moorhead project would supply 92,500 acre-feet of industrial water.

The NED energy plan (private coal-related energy development) would require 72,460 acre-feet of water by the year 2000 (see Table VI-2); an addi-

tional 85,826 acre-feet is needed by the adjacent Lower Yellowstone Planning Area, bringing the coal field total to 158,286 acre-feet.

In contrast to the NED energy plan, the Environmental Quality (EQ) plan for both the Tongue-Powder and Lower Yellowstone areas limits 1985 and 2000 coal production to a total 75 million tons, demanding only 21,956 acre-feet of water for the two areas, and just 1,216 acre-feet in the Tongue-Powder Area (see Table VI-5).

The other major EQ proposals are for minimum instream flows to maintain existing fish and wildlife habitat and for scenic/recreation designation of the Tongue River under State designation.

There are no State/Regional Development (SRD) elements proposed for this planning area (although the Tongue River Reservoir modification proposal eventually might be considered an SRD element as well as a NED element because it may be built by the State).

Table VI-1. NED Multipurpose Projects, Tongue-Powder, Montana

	Irrigated Acres		Acre-feet	MW
	Full Service	Supplemental	Industrial	Power
Moorhead	5,000	6,300	92,500	--0--
Modified Tongue	13,000	---0---	28,750	6
Totals	18,000	6,300	121,250	6

THE

NATIONAL ECONOMIC DEVELOPMENT

PLAN

National economic development is achieved by increasing the value of the Nation's goods and services, by utilizing additional resources, or by improving the efficiency of existing resource use. Theoretically, the best NED plan would produce the maximum net benefits (excess of projected monetary benefits over monetary costs). A satisfactorily developed plan with NED emphasis would meet the following minimum requirements:

1. User benefits are in excess of total economic costs;
2. Separable costs of each functional component are less than benefits or the alternative cost of producing comparable benefits;
3. Sufficient capability is available to repay all reimbursable costs;
4. Significant local and State support is available; and
5. Output from the plan will be used to meet near-to-intermediate-term needs.

A project or program may not be included in the NED plan unless it meets, or is expected to meet, all of the above requirements at the time of development.

Multipurpose Projects

Tongue River Reservoir Modification

Improvements to the Tongue River Reservoir are needed whether its storage capacity is increased or not. The spillway of the existing dam is inadequatley sized to pass the probable maximum flood; the spillway is also in a deteriorated condition and urgently needs replacement. Therefore, there is a possibility that the Tongue River Dam could fail, leading to possible disaster.

The Montana Department of Natural Resources and Conservation (DNRC) owns and maintains the dam. The Department feels that it has two choices concerning the disposition of the dam. The first is to breech the dam to remove the threat of its collapse. The second is to repair and modify

the structure, including increased storage.

DNRC has chosen to repair and modify the structure and increase its storage capacity. Since the alternative to the repair and modification of the dam is its abandonment, all existing benefits were claimed in the feasibility analysis done by DNRC.

The existing dam would be modified by installation of gates to raise the storage elevation of the reservoir from 3424 feet to 3465. As modified, the reservoir would provide a total firm annual yield of 100,000 acre feet, an increase of 58,000 acre-feet over the existing project.

In addition a 6 MW hydroelectric power plant would be incorporated into the dam modification.

Moorhead and Lower Powder Pumping Units

Moorhead Dam and Reservoir would provide storage for flood control, recreation, irrigation, municipal, and industrial use. The dam would be located in Montana, about 3 miles north of the Montana-Wyoming State line. The lower Powder Units would consist of several pumping plants and distribution systems scattered along Powder River Valley near Broadus, Montana. Irrigated lands would be on low benches and bottoms within the Powder River trench.

Moorhead Dam would be a rolled earthfill structure about 194 feet in height above streambed and about 3,050 feet long at the crest. A gate-controlled, overflow-type spillway would be located on the left side abutment. A river outlet works also would be located through the left abutment. The embankment would contain 9,160,000 cubic yards of fill material.

Moorhead Reservoir would have a surface area of about 18,200 acres, with a maximum width of about 1 mile, and would extend up the Powder River about 30 miles.

Conservation storage is expected to provide a firm ultimate annual yield of 108,000 acre-feet after considering required downstream releases to satisfy prior water rights and to maintain basic flows in the river. Accumultative sediment deposition would encroach on the reservoir storage functions, reducing the space available for conservation storage over a 100-year period to about 460,000 acre-feet. Capacities for each purpose would be adjusted by reducing flood control space or conservation space. An alternative would be to consider increasing the height of the dam, which may be shown to be feasible upon further study. An increase of 11 feet in elevation would provide approximately 2,000,000 acre-feet of additional storage.

Under the NED plan, there would be 92,500 acre-feet per year available for municipal and industrial use in Wyoming and Montana, and 15,000 acre-feet per year for supplemental and full-service irrigation use.

Supplemental water service would be provided for 6,300 acres of land presently being irrigated, and full-service for 5,000 acres of new land. There are 61,600 acres of arable land adjacent to the river, but the area proposed for service was reduced due to lack of interest in irrigation and uncertainty about the water supply.

Unit lands would be located on low benches and bottoms within the Powder River trench. The river meanders within the trench, separating the lands into many segments. Most of the proposed pumping units are thus confined to one or two river bends. Each such unit usually contains some overflow bottom, and one or more bench levels. Thus, the fields are limited in size and irregular in shape. Soils are stratified and of alluvial origin, ranging from sand to clay.

Flood Control

Miles City Levee

The Miles City Levee is a local flood control project at Miles City, Montana. This levee would run for three miles along the right banks of both the Tongue and Yellowstone Rivers. The project would protect 1,300 acres of urban lands and improvements from floods and enhance the health and well-being of 9,000 residents of the community.

Land Conservation

Accelerated Land Conservation Program

Under the accelerated land conservation program, 50 percent of the untreated lands that would have been left by the year 2000, given the present ongoing programs, would be added to the current programs and treated by 2000. About 721,300 acres in the Tongue-Powder Planning Area would be treated under the accelerated program.

Energy

NED Energy Development

The NED energy development scenario is an all-export scenario; coal would be moved out of the area by rail and slurry line. No coal gasification or thermal electric generation is included. Coal gasification is not included in this scenario because it currently does not meet NED criteria (see Chapter IV).

By 1985, one slurry line would take 29 million tons of coal per year from the planning area; that one line would be expanded to four by the year 2000 which would move 114 million tons per year (see Table VI-2).

Table VI-2. NED Energy Development Resource Requirements and Air Pollution Emissions, Tongue-Powder, Montana

Resource	Units	1985	2000
Coal Production	Million tons/year	57	203
Exports			
Rail	Million tons/year	28	89
Slurry	Million tons/year	29	114
Conversion			
Thermal Electric	Million tons/year	---0---	---0---
Capacity	Megawatts	---0---	---0---
Generation	Gigawatt-hours/year	---0---	---0---
Syngas	Million tons/year	---0---	---0---
Capacity	Million cubic feet/day	---0---	---0---
Water Requirements	Total acre feet/year	18,540	72,460
Mines	Acre feet/year	1,140	4,060
Reclamation and/or dust suppression	Acre feet/year	---0---	---0---
Coal Gasification	Acre feet/year	---0---	---0---
Electrical Generation	Acre feet/year	---0---	---0---
Slurry Lines	Acre feet/year	17,400	68,400
Labor Requirements			
Operating			
Mines	Man years/year	1,168.5	4,161.5
Electrical Generation	Man years/year	---0---	---0---
Syngas	Man years/year	---0---	---0---
Capital			
Mines	Million dollars	324.9	1,157.1
Electrical Generation	Million dollars	---0---	---0---
Syngas	Million dollars	---0---	---0---
Land Requirements			
Strip Mines	Acres/year	820.4	2,923.2
Sites			
Mines	Acres	1,710	6,090
Electrical Generation	Acres	---0---	---0---
Syngas	Acres	---0---	---0---
Air Pollution Emissions			
Particulates	Tons/year	---0---	---0---
Sulfur Oxides	Tons/year	---0---	---0---
Nitrogen Oxides	Tons/year	---0---	---0---

Water requirements for slurry make up the bulk of the total water consumption in this area. A total of nearly 72,500 acre-feet of water would be consumed or carried out-of-State by the year 2000 in coal-related developments.

Since no thermal electric generation or coal gasification is included in this scenario, air pollutant emissions are limited to the dust associated directly with the mining process.

Table VI-3 shows primary net yearly benefits of roughly $88 million accruing from mining. Secondary benefits have not been calculated for the planning area.

Table VI-3. NED Account for the Energy National Economic Development Plan, Tongue-Powder, Montana[1/]

	(Millions of $)
Yearly Gross Benefits	
Export Coal	589.06
Total Benefits	589.06
Yearly Costs	
Export Coal	500.70
Lost Agricultural Production[2/]	0.26
Total Costs	500.96
Net Benefits Per Year	$ 88.10

1/ Based on data in Analysis of Energy Projections and Implications for Resource Requirements, by Harza Engineering Company, December 1976, and backup data provided by Harza to study management. Benefits and costs do not include values for moving energy out of area.

2/ This estimate is based on winter wheat following fallow which nets $80 per cropped acre to land, management, overhead, and risk. Each cropped acre requires one fallow acre; therefore, the per acre returns are effectively $40.

Table VI-4 Display of Beneficial and Adverse Effects
NED Plan, Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
MULTIPURPOSE PROJECTS Tongue River Reservoir Modification Tongue River Project Modification Feasibility Study, Montana Department of Natural Resources and Conservation. Big Horn County	First Cost $49,235,000 1/ Annual Benefits 3,622,000 1/ Annual Cost 3,622,000 Net Benefits --	No study has been made to determine environmental impacts. If the dam was breeched the excellent warm-water fishery that presently exists then would be lost.	Regional benefits have not been computed for this project at this time. However, the addition of employment and induced and stemming from benefits would produce positive net benefits under this account.	Beneficial Effects: The restored and expanded reservoir would enable existing irrigation to continue and allows some new irrigation. The industrial water will support expanded energy/industrial development, creating employment opportunities and diversification of the area's economy. Adverse Effects: Short term impact of construction crews on localities.
Moorhead and Lower Powder Pumping Units USBR, Yellowstone Level B Study Powder River County	First Costs $88,083,000 Annual Benefits 8,410,000 Annual Cost 6,346,000 Net Benefits 2,064,000	Beneficial Effects: Expansion of recreation and facilities. Opportunities for pheasant and waterfowl hunting may improve. Project would remove sediment thereby improving water quality. Same level of instream flows could be maintained. Adverse Effects: TDS in reservoir and river would probably increase. River bottom and prairie habitat would be destroyed.	User Benefits 8,410,000 Regional Benefits 16,233,800 Net Benefits 18,297,800	Beneficial Effects: Project would provide employment benefits to area residents, due to agricultural and industrial benefits the reservoir would make possible. Adverse Effects: With economic growth some social problems may occur as the area becomes more populated. Health, transportation, and education systems would come under stress (i.e., from nearby coal/energy related use of the water).

1/ At this value, the annual charge per acre-foot of water for industrial purposes of 52.25 is required. Changes over this amount would raise annual benefits. OM&R not included in capital or annual costs.

Table VI-4 (Cont.) Display of Beneficial and Adverse Effects
NED Plan, Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
FLOOD CONTROL Miles City Levee Corps of Engineers Yellowstone Level B Custer County	First Cost $2,367,000 Annual Benefits 232,000 Annual Cost 170,000 Net Benefits 62,000	Beneficial Effects: Better drainage and mosquito control Adverse Effects: Reduce wildlife habitat due to 18 acres of clearing and grubbing.	User Benefits 232,000 Regional Benefits 607,000 Net Benefits 669,000	Protection of 9,000 residents from flooding and related health problems.
LAND CONSERVATION Accelerated Land Conservation A. State and Private Lands 639,000 acres. B. National Resource Lands 78,000 acres C. Forest Service Lands 4,300 acres.	A. Cap. Cost $7,653,000 *Ann. Equiv. Cost $620,200 B. Cap. Cost $982,000 *Ann. Equiv. Cost $79,600 C. Cap. Cost $1,119,000 *Ann. Equiv. Cost $90,700 *Annual Benefits - Not computed - assumed to be at least equal to costs. 6-3/8 percent interest for 25 years.	Beneficial Effects: Improved downstream water quality for all uses. Improve general aesthetics of the land. Additional reduction of soil loss and sediment yield above future-without condition. Increased vegetative cover resulting from improved management of existing resources Improved quality of Fish and Wildlife habitat, including cover, forage, watering places, waterfowl nesting sites, and establishment of fisheries. Reduce soil nutrients from entering streams and the underground water table. Reduction of undesirable return flows to streams.	Maintain and/or enhance the output of goods and services to users in the region. Provide additional employment in the application and maintenance of proposed measures. Provide additional permanent employment in processing increased goods and services	Preservation of the resource for future generations. There would be improved downstream water quality for all uses. General esthetics of the land would improve.

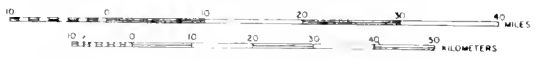
Table VI-4 (Cont.) Display of Beneficial and Adverse Effects
NED Plan, Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
LAND CONSERVATION (Cont.) Accelerated Land Conservation		Adverse Effects: Additional stream flow depletion due to increased consumptive use by added vegetative cover. Increased depletion of water resulting from added surface evaporation from ponds.		
ENERGY Tongue River Power Plant--6 MW	Included under Tongue River Reservoir Modification Project -- above.	See Tongue River Reservoir Modification Project.	See Tongue River Reservoir Modification Project.	See Tongue River Reservoir Modification Project.
NED Energy Development	Private Capital Costs $2,923,200,000 Annual Benefits 589,060,000 Annual Costs 500,960,000 Net Benefits 88,100,000	The NED is an export only scenario using rail and slurry to move coal out of the area. Mine, reclamation, and slurry water requirement total 17,400 acre-feet by 1985 and 68,400 by the year 2000. Nearly 6,100 acres of land would be affected by strip mining by the year 2000. the value of the reclaimed land would be dependent on the level of success of the reclamation program.	Regional benefits are not evaluated; it may be assumed that net benefits would increase substantially.	Increased mining activities would add to social pressures. There would be increased employment opportunities associated with expanded mining operation.

PLATE VI-1 NED PROJECTS

1. Tongue River Reservoir Modification
2. Moorhead Reservoir
3. Miles City Levee
4. NED Energy Development (Private Sector)
5. Accelerated Land Conservation Program

YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION



THE

ENVIRONMENTAL QUALITY

PLAN

The objective of the Environmental Quality (EQ) Plan is the management, conservation, preservation, restoration, or improvement of the area's natural (or cultural) resources and ecological systems. Although the EQ Plan is not subjected to a benefit/cost analysis, the plan should reflect the most efficient and effective way of obtaining desired results.

Environmental Quality is considered fully as important as economic development in the Level B planning process. However, EQ elements are frequently submitted with insufficient economic and/or physical data to be thoroughly evaluated. It is difficult to put a dollar value on environmental change, positive or negative; and often there is a lack of baseline data to properly evaluate the environmental effects of a man-caused change.

Fish and Wildlife[1/]

Instream Flows

The instream flow recommendations found in Tables IV-16 and IV-17 for the Tongue and Powder rivers have been adopted for the EQ Plan; these flows are the same as those requested by the Montana Department of Fish and Game in its instream flow reservation request. The Department of Health and Environmental Sciences has no such reservation request in this planning area.

The Tongue River immediately downstream from the Tongue River Dam represents the only stream trout fishery in the area. While catchable rainbow trout are stocked annually by the Department of Fish and Game, brown trout are reproducing in the stream. Fish population sampling revealed that while the brown trout population is not large, it is a fishable population. Each year, a few "trophy" sized browns are taken. Therefore, it is important to recognize and protect this trout population.

1/ The Montana Department of Fish and Game has furnished much of the EQ narrative in this and the other Montana Level B reports.

Smallmouth bass are the most important sport fish found between Four-mile Creek and the S-H diversion. Smallmouth were planted in the Tongue River during the late 1960's and early 1970's and are reproducing in the river system. This is the only stream supported smallmouth bass population in Montana and is becoming increasingly popular with anglers. Rock bass are also found in large numbers throughout this reach. Other important sport fish are northern pike, sauger and walleye. All are considered resident, self-sustaining fish populations.

Fish population sampling on the Tongue River near Birney and Ashland indicates an excellent population of smallmouth bass. Anglers take many smallmouth, with fish ranging to three pounds reported. Sauger and northern pike are popular with fishermen in the Birney-Ashland area and provide excellent fishing in the spring. The Tongue River supports the only rock bass population in Montana, which should be protected.

Sauger, smallmouth bass and channel catfish are important sport fish found in the section of the Tongue River from the S-H diversion to the T & Y diversion. Rock bass are also found in this area and while they do not provide a fishery, they are important because they are unique to the Tongue River.

Sport fishing in this reach, particularly immediately downstream from the S-H diversion is becoming increasingly popular. Sauger, channel catfish, and smallmouth bass are favorite targets of anglers from Miles City, Ashland, Forsyth, and the surrounding area. Fish population sampling shows fair concentrations of smallmouth bass and sauger and an excellent catfish population.

Resident fish populations in the lower 20 miles of the Tongue River (T & Y diversion to Yellowstone River) include sauger and channel catfish. Migrant sport fish moving out of the Yellowstone include: paddlefish, shovelnose sturgeon, sauger, walleye and ling. Blue suckers, while not

considered a sport fish, are found migrating into the Tongue River during the spring spawning season.

Migrations of spawning populations of shovelnose sturgeon, sauger, and channel catfish into the Tongue River are important to the integrity of the Yellowstone River. Passage and spawning flows identified for these species are important not only to the Tongue River, but to the Yellowstone River as well.

Increased water withdrawals over existing levels will, in the long run, reduce availability of habitat and consequently reduce the number of organisms which can healthily occupy that habitat. There is a limit to the amount of water which can be removed from any stream channel without severely changing the quantity and type of the aquatic species present.

Reduced streamflows also affect the quality of water which is necessary to sustain these organisms. Possible consequences of reduced streamflows are high water temperatures and increased amounts of dissolved solids. In short, there are at least three ways reduced streamflow can adversely effect aquatic organisms: (1) reduction of the physical size or character of living space, (2) alteration of the food chain or reducing availability of food organisms, and (3) change of water quality which alters living conditions for plant and animal life.

Land Conservation

Accelerated Land Conservation Program

Under the accelerated land conservation program, 50 percent of the untreated land that would have been left by the year 2000, given the present ongoing programs, would be added to the current programs and treated by 2000. About 721,300 acres in the Tongue-Powder Planning Area would be treated under the accelerated program (identical to NED proposal).

Streambank Greenbelt Program

This program could be developed with the aid of the SCS, local soil conservation districts, and the 208 programs. Existing denuded areas along the major streams would be restored, and forested and grassed areas would be protected from adverse development. Existing uses would not be impaired. The program would provide: (1) protection from streambank erosion; and (2) improved fish and wildlife habitat.

Wild, Scenic, and Recreational Rivers

Tongue River

The 115-mile reach of the Tongue River from the Tongue River Reservoir to its confluence with the Yellowstone River is proposed as a potential scenic or recreational river to be managed by the State of Montana. The Montana State Comprehensive Outdoor Recreation Plan (SCORP) has identified this segment of the Tongue River as having "a significant amount of recreational potential which until recently was not broadly recognized." The SCORP has also noted that, "In view of the increasing popularity, additional access should be undertaken at strategic points along the [Tongue] river."

Preliminary information indicates that this segment of the Tongue River possesses values that would make it eligible for designation as a scenic and recreational river to be managed by the State. The river and its environment offer visitors recreational opportunities in fishing, hunting, camping, picnicking, sight-seeing, canoeing, rafting, and other water-related activities.

This plan includes acquisition of land in fee title for both major and minor access areas and acquisition of lands in easement for protection of the river and its environment.

EQ Energy Development

The EQ plan for energy in the Tongue-Powder Planning Area restricts coal production to 16 million tons a year by 1985 and holds production at that level through the year 2000. The EQ plan is based on the assumption that commitment for coal production that existed at the time of this study would be honored, but there would be no significant expansion. It is all export approach with the entire production being taken out of the area by rail (see Table VI-5).

Water requirements for coal production are held at 1,216 acre-feet per year. Since there is no energy conversion taking place in the area, there are no air pollution emissions aside from possible dust associated with the mining process.

Table VI-6 shows the benefits associated with the energy component of the EQ Plan; roughly $15.6 million of net yearly benefits would accure to the area from the EQ level of energy development. This is $72.5 million a year less by the year 2000 than the NED energy plan.

Table VI-5. EQ Energy Development Resource Requirements and Air Pollution Emissions, Tongue-Powder, Montana

Resource	Units	1985	2000
Coal Production	Million tons/year	16	16
Exports			
Rail	Million tons/year	16	16
Slurry	Million tons/year	---0---	---0---
Conversion			
Thermal Electric	Million tons/year	---0---	---0---
Capacity	Megawatts	---0---	---0---
Generation	Gigawatt-hours/year	---0---	---0---
Syngas	Million tons/year	---0---	---0---
Capacity	Million cubic feet/day	---0---	---0---
Water Requirements	Total acre feet/year	1,216	1,216
Mines	Acre feet/year	320	320
Reclamation and/or dust suppression	Acre feet/year	896	896
Coal Gasification	Acre feet/year	---0---	---0---
Electrical Generation	Acre feet/year	---0---	---0---
Slurry Lines	Acre feet/year	---0---	---0---
Labor Requirements			
Operating			
Mines	Man years/year	328	328
Electrical Generation	Man years/year	---0---	---0---
Syngas	Man years/year	---0---	---0---
Capital			
Mines	Million dollars	91.2	91.2
Electrical Generation	Million dollars	---0---	---0---
Syngas	Million dollars	---0---	---0---
Land Requirements			
Strip Mines	Acres/year	230.4	230.4
Sites			
Mines	Acres	480	480
Electrical Generation	Acres	---0---	---0---
Syngas	Acres	---0---	---0---
Air Pollution Emissions			
Particulates	Tons/year	---0---	---0---
Sulfur Oxides	Tons/year	---0---	---0---
Nitrogen Oxides	Tons/year	---0---	---0---

Table VI-6. NED Account for the Environmental Quality Energy Plan, Tongue-Powder, Montana[1/]

	(Millions of $)
Yearly Gross Benefits	
Export Coal	104.39
Total Benefits	104.39
Yearly Costs	
Export Coal	88.74
Lost Agricultural Production[2/]	.03
Total Costs	88.77
Net Yearly Benefits	$ 15.62

1/ Based on data in Analysis of Energy Projections and Implications for Resource Requirements, by Harza Engineering Company, December 1976, and backup data provided by Harza to study management. Benefits and costs do not include values for moving energy out of area.

2/ This estimate is based on winter wheat (the highest-value crop) following fallow which nets $80 per cropped acre to land, management, overhead, and risk. Each cropped acre requires one fallow acre; therefore, the per acre returns are effectively $40.

Table VI-7 Display of Beneficial and Adverse Effects, EQ Plan,
Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
FISH AND WILDLIFE Instream Flows Same as the reservation request of the Department of Fish and Game. (See Tables IV-16 and IV-17)	Beneficial Effects: Existing irrigators would benefit from the maintenance of water quality and levels at existing diversions. Adverse Effects: There is little water available for consumptive use over and above the instream needs in the months of July, August, and September. During low flow periods, that occur only one year in ten (on the average), there is no surplus water in any month.	Preservation of existing fish and wildlife habitat and water quality. Prevents any further degradation.	Same as NED	Beneficial Effects: Increased employment for tourist and recreation sector. Adverse Effects: Potential negative effects on agricultural employment, development, and income.
LAND CONSERVATION Accelerated Land Conservation A. State and Private Lands 639,000 acres. B. National Resource Lands 78,000 acres. C. Forest Service Lands 4,300 acres.	A. Cap. Cost $7,653,000 *Ann. Equiv. Cost $620,200 B. Cap. Cost $982,000 *Ann. Equiv. Cost $79,600 C. Cap. Cost $1,119,000 *Ann. Equiv. Cost $90,700 *Annual Benefits - Not computed - assumed to be at least equal to costs. 6-3/8 percent interest for 25 years.	Beneficial Effects: Improved downstream water quality for all uses. Improve general aesthetics of the land. Additional reduction of soil loss and sediment yield above future-without condition. Increased vegetative cover resulting from improved management of existing resources. Improved quality of Fish and Wildlife habitat, including cover, forage, watering places, waterfowl nesting sites, and establishment of fisheries.	Maintain and/or enhance the output of goods and services to users in the region. Provide additional employment in the application and maintenance of proposed measures. Provide additional permanent employment in processing increased goods and services.	Preservation of the resource for future generations.

Table VI-7 (Cont.) Display of Beneficial and Adverse Effects, EQ Plan, Tongue-Powder, Montana

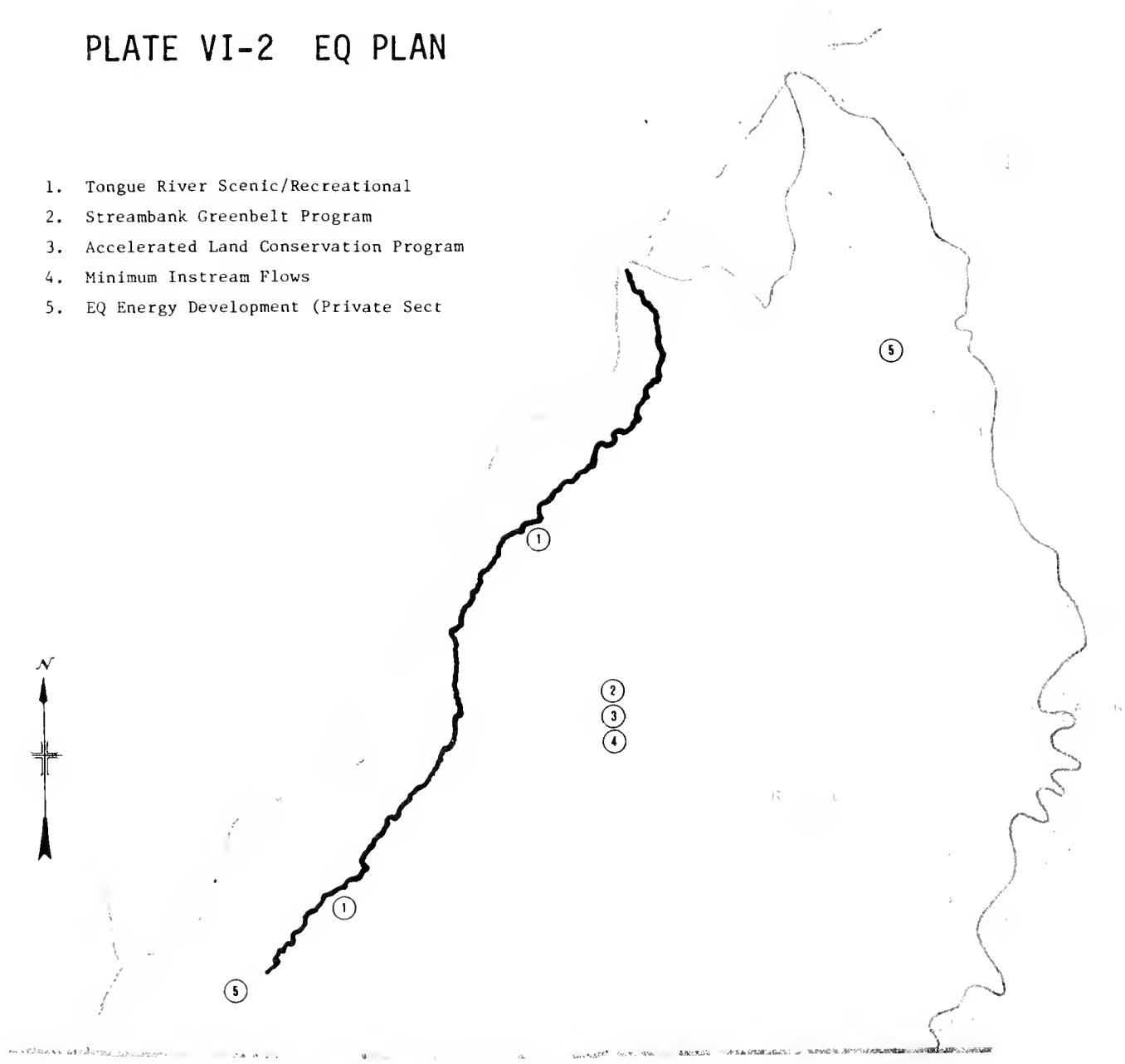
PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
LAND CONSERVATION (Cont.) Accelerated Land Conservation		Beneficial Effects: Reduce soil nutrients from entering streams and the underground water table. Reduction of undesirable return flows to streams. Adverse Effects: Additional depletion of streams due to increased consumptive use by added vegetative cover. Increased depletion of water resulting from added surface evaporation from ponds.		
Streambank Green Belt Program	Not Available	Program would add to fish and wildlife habitat while helping to prevent streambank erosion.	Not Available	Not Available.
WILD, SCENIC, AND RECREATIONAL RIVERS Tongue River Establish State recreation river designation for the Tongue River from the Tongue River Reservoir to Yellowstone River-115 miles.	First Cost 18,398,000 Annual Benefits 586,500 Annual Costs 1,419,400 Net Benefits (832,900) 1/ 1/ Parentheses indicate negative value.	The natural beauty along these reaches of streams would be preserved for present and future generations. Flora and fauna habitat values would be protected. A higher level of recreation use would be offset by better protection of the resource.	Tourism is a major contributor to the area and State economy. Recreation benefits resulting from preservation of these river reaches is in the state-regional interest. Other analyses are not available.	The pleasures associated with river-oriented recreation are important to social well-being. Local residents as well as tourists relax and revitalize themselves through their association with the pleasures provided by natural settings.

Table VI-7 (Cont.) Display of Beneficial and Adverse Effects, EQ Plan
Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
ENERGY				
EQ Energy Development	Private Capital Cost 91,200,000 Annual Benefits 104,390,000 Annual Cost 88,770,000 Net Benefits 15,620,000	Coal production is held at 16 million tons per year. All is exported by rail. Only a total of 1216 acre-feet of water is consumed. Strip mined land totals only 480 acres by the year 2000. It is still three times the production that is currently taking place.	Regional benefits are not available; it may be assumed that net benefits would increase substantially.	Social impacts would be greatly lessened over NED, because thermal electric, coal gasification, or coal slurry lines are present. Population growth is much lower under this scenario.

PLATE VI-2 EQ PLAN

1. Tongue River Scenic/Recreational
2. Streambank Greenbelt Program
3. Accelerated Land Conservation Program
4. Minimum Instream Flows
5. EQ Energy Development (Private Sect



YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

CHAPTER VII

THE RECOMMENDED PLAN

Selection of Plan Elements

The plan described in this chapter is a selection of alternatives from the NED, EQ, and SRD plans that the Study Team considers acceptable for implementation if the necessary water supply can be made available. It is a known fact, however, that the flow in the Yellowstone system is not adequate to serve all of the needs of all of the plan elements. For example, the instream flow element, taken from the EQ plan, would preclude the provision of a full water supply for all of the irrigation described in the future without situation, plus that selected from the NED plan. Conversely, if all of the identified diversions were in fact made, they would significantly infringe on the instream flow needs.

No tradeoff analysis was performed to select the optimum combination of instream flows and irrigation projects. This analysis was not made for several reasons, primary among which were (1) there was little time to do tradeoff analyses after the NED and EQ plans were completed, and more importantly (2) the Montana Departments of Fish and Game, and Health and Environmental Sciences had requests for reservations of water from the Yellowstone Basin pending with the Board of Natural Resources. These agencies were committed to defending their full request and were not able to accept a tradeoff-type Recommended Plan for the Level B Study that would compromise their request for a reservation. Under these conditions, no consensus on instream flows was possible, and the instream flows described in this plan are levels designed to meet a Fish and Wildlife and Water Quality objective rather than a recommended level formulated by tradeoff analysis. When the reservation issue has been decided by the Board of Natural Resources it will be possible to determine how many of the development proposals contained herein are compatible with that decision.

The recommended level of energy development is not inconsistent with recent energy policy statements and decisions of the State of Montana, but it does not represent a definitive statement of Montana's energy policies.

In general, the number of elements that have been selected for the Recommended Plan is, therefore, greater than it would have been if the reservation decision results had been immediately available to the Study Team. Without these results it is difficult to assess the water quantity and quality impacts that would stem from any set or subset of proposed projects. In the case of the Tongue-Powder planning area, only a small number of projects are proposed, but they are intimately related to the reservation question.

Hydrology Supplement

The hydrology studies, released in the form of a supplement to the planning area reports, evaluates the Recommended Plans of each planning area.[1/] In Montana, the following set and subsets of projects (alternatives) will be examined:

1. The F/WO situation.
2. All recommended projects.
3. Recommended projects minus SRD projects.
4. Recommended projects minus pumping and SRD projects.
5. Recommended projects minus storage and SRD projects.
6. Recommended projects minus the Hardin Unit and SRD projects.

In addition, a water quality analysis (total dissolved solids) is tied to each of the alternatives. Each alternative can be compared to the reservation requests (Chapters II, IV, and VI) of the Montana Departments of Fish and Game, and to other levels of instream flow that ultimately may be recommended.

The hydrology studies also assume a certain amount of private development which is represented by the F/WO situation described in Chapter V; therefore, all consumptive uses of water should be accounted for by the studies.

1/ The U.S. Bureau of Reclamation conducted the hydrology studies from its Field Planning Office in Billings, Montana.

Display of the Plan

The elements selected for the Recommended Plan and their suggested implementation dates (subject to Level C studies) are shown in Plate VII-1. A summary of beneficial and adverse affects (four-account analysis) of each element is found at the end of this chapter in Table VII-3. In addition to these Plan elements, the recommendations listed in Chapter X are also part of the Recommended Plan.

Other than the deletion of one NED project and a recommendation regarding private coal/energy development by the State Study Team, the NED and EQ elements were combined literatim to form the Recommended Plan. It must be noted, however, that F/WO developments, coupled with the recommended elements, are bound to affect the instream flow levels sought in this same plan, and compromises ultimately will have to be made.

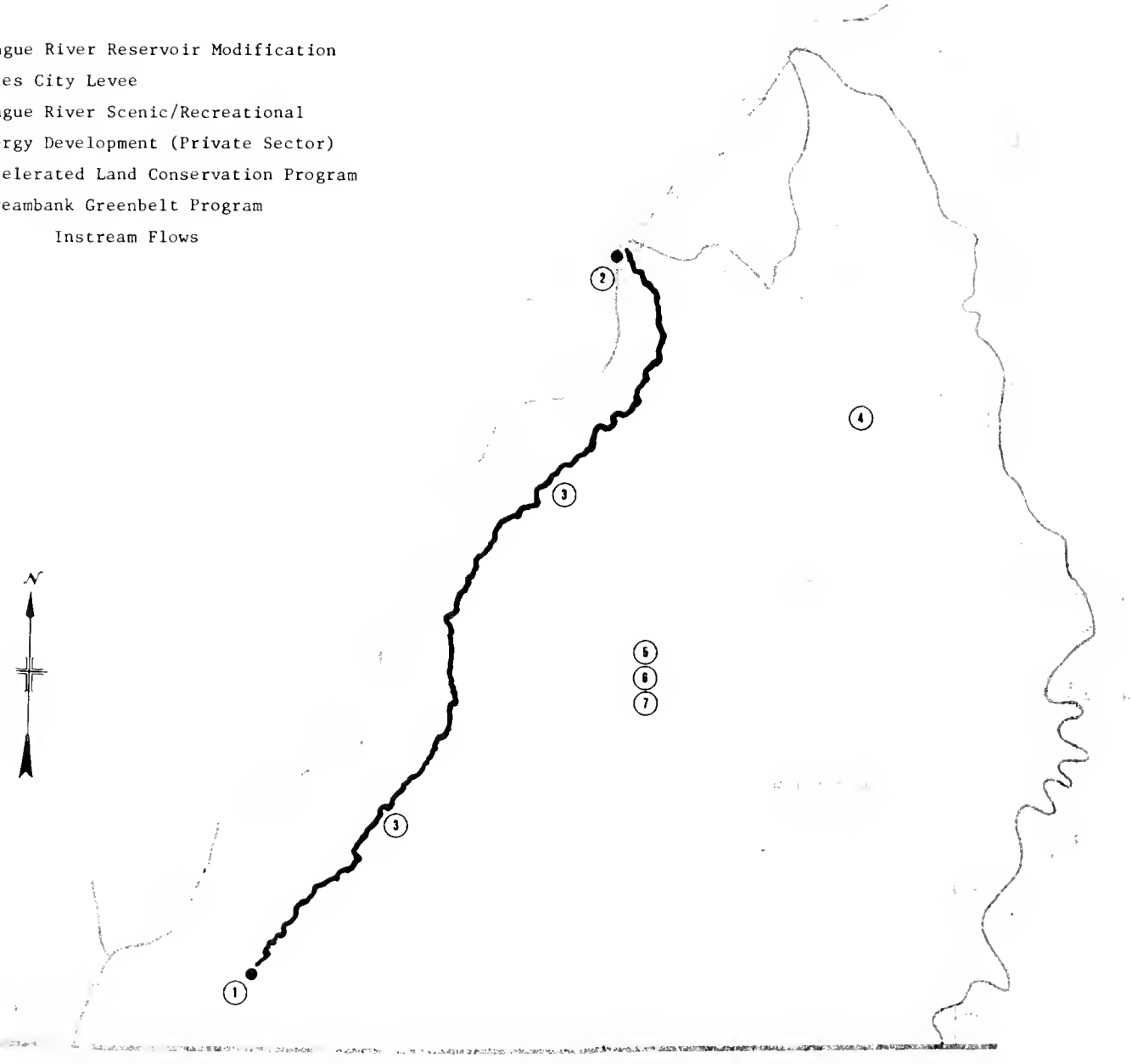
Narratives regarding the elements found in the Recommended Plan have previously been presented in Chapter VI.

Projects Rejected

The State Study Team rejected both the NED and EQ energy plans (Chapter VI) in favor of a compromise recommended energy plan (see below). The Moorhead and Lower Powder Pumping Units were deleted because of: (1) a general lack of interest in expanded irrigation on the Powder River; (2) a projected lack of need for Moorhead's 92,500 acre-feet of industrial water within the basin; and (3) Wyoming's lack of interest in the project because of costly pumping arrangements and high sediment concentrations at the upper end of the reservoir. The proposed Lower Clear Creek Reservoir reportedly would give Wyoming a much better system for a cost similar to its share of the Moorhead project.

PLATE VII-1 ELEMENTS OF THE RECOMMENDED PLAN

1. Tongue River Reservoir Modification
2. Miles City Levee
3. Tongue River Scenic/Recreational
4. Energy Development (Private Sector)
5. Accelerated Land Conservation Program
6. Streambank Greenbelt Program
7. Instream Flows



YELLOWSTONE BASIN AND ADJACENT COAL AREA LEVEL B STUDY
MISSOURI RIVER BASIN COMMISSION

Energy Development

The level of private energy development included in the plan is lower than either the projected requirements (Chapter IV) or the NED level; it is roughly equivalent to the F/WO level of Chapter V, but with some notable differences (see Table VII-1).

Most noticeable is the provision for the export of coal by slurry pipeline from the basin to midwestern load centers. Currently the use of water for interstate slurry operations is not classed as a beneficial use under Montana law. In addition, Article X of the Yellowstone Compact prohibits diversion of water out of the Yellowstone Basin without the unanimous consent of the signatory States. To implement the Recommended Plan, these contraints would have to be overcome.

Also, the level of synthetic coal gasification has been cut to one-fourth of that under the F/WO; and only on the provision that such a gas plant be privately funded and receive no government subsidy.

The rationale for this recommendation is based on a desire by the Study Team to supply what it considered to be a reasonable amount of coal/energy to the rest of the nation without severely jeopardizing the quality of life (see Purpose of Study section in Chapter I) in the State. Therefore, the Study Team is actually espousing an all-export policy with the exception of the synthetic gasification plant (which probably would not be a viable project without government subsidy until the turn of the century).

By the year 2000, ninety-eight million tons of coal per year would be mined in the area, all but ten million tons per year to be exported either by rail or slurry pipeline. The total consumptive use of water associated with this level of development would amount to 34,248 acre-feet per year (af/y). Of the total, 10,000 af/y would be consumed in the gasification process and 16,800 af/y would be used by slurry pipelines. Slurry operations require less Montana

Table VII-1. Recommended Energy Development Resource Requirements and Air Pollution Emissions, Tongue-Powder, Montana

	Units	1985	2000
Coal Production	Million tons/year	20	98
Exports			
Rail	Million tons/year	20	60
Slurry	Million tons/year	0	28
Conversion			
Thermal Electric	Million tons/year	0	0
Capacity	Megawatts	0	0
Generation	Gigawatt-hours/year	0	0
Syngas	Million tons/year	0	10
Capacity	Million cubic feet/day	0	250
Water Requirements	Total acre feet/year	1,520	34,248
Mines	Acre feet/year	400	1,960
Reclamation and/or dust suppression	Acre feet/year	1,120	5,488
Coal Gasification	Acre feet/year	0	10,000
Electrical Generation	Acre feet/year	0	0
Slurry Lines	Acre feet/year	0	16,800
Labor Requirements			
Operating			
Mines 1/	Man years/year	410	2,009
Electrical Generation	Man years/year	0	0
Syngas	Man years/year	0	625
Capital			
Mines	Million dollars	114	559
Electrical Generation	Million dollars	0	0
Syngas	Million dollars	0	1,001
Land Requirements			
Strip Mines	Acres/year	288	1,411
Sites			
Mines	Acres	600	2,940
Electrical Generation	Acres	0	0
Syngas	Acres	0	500
Air Pollution Emissions			
Particulates	Tons/year	0	1,017
Sulfur Oxides	Tons/year	0	11,172
Nitrogen Oxides	Tons/year	0	7,457

1/ A significant portion of the mining personnel will probably be housed in Wyoming.

water than of any considered coal export-conversion mode, except rail, but export of coal by either rail or pipeline imposes a consumptive use of water at the consuming end of the system.

1. Thermal electric generation - 3,750-4,000 af per million tons (water cooled).
2. Synthetic gasification - 600-1,000 af per million tons.
3. Slurry pipeline - 500-600 af per million tons.

Air pollution emissions become a factor in the area's acceptance of synthetic gasification. The "Class One" air quality standards of the Northern Cheyenne Reservation may have an effect on future construction and operation of such a plant.

Population and related impacts (e.g., demands for water based recreation) would be roughly the same as those attributed to the F/WO in Chapters IV and V.

Table VII-2 illustrates the yearly net economic benefits that would accrue at this level of energy development. The reader should note that the gasification benefits shown in this table (and those in Table V-7) do not cover their costs; they reflect the infeasibility of present-day coal gasification. In other words, a subsidy would be required to construct and operate a gas plant at the present time. The Study Team is on record as recommending against State or Federal subsidy, but recognizes the possibility that private industry may subsidize initial developments, as a part of the development process, in anticipation of future profitable operations.

Table VII-2. Annual Net Economic Benefits from Recommended Energy Development, Tongue-Powder, Montana[1/]

	(Millions of $)
Yearly Gross Benefits	
Coal Gasification	$ 69.27
Export Coal	314.63
Total Benefits	383.90
Yearly Costs	
Coal Gasification	107.49
Export Coal	267.43
Lost Agricultural Production[2/]	0.26
Total Costs	375.18
Yearly Net Benefits	$ 8.72

1/ Based on data in Analysis of Energy Projections and Implications for Resource Requirements, by Harza Engineering Company, December 1976, and backup data provided by Harza to study management. Benefits and costs do not include values for moving energy out of area.

2/ This estimate is based on winter wheat following fallow which nets $80 per cropped acre to land, management, overhead and risk. Each cropped acre requires one fallow acre; therefore, the acre returns are effectively $40. Wheat is the highest-value crop raised in the area, so the stated loss is a maximum rather than an average.

Table VII-3. Display of Beneficial and Adverse Effects,
Recommended Plan, Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
MULTIPURPOSE PROJECTS Tongue River Reservoir Modification Tongue River Project Modification Feasibility Study, Montana Department of Natural Resources and Conservation. Big Horn County	First Cost $49,235,000 Annual Benefits 3,622,000 1/ Annual Cost 3,622,000 Net Benefits --- 1/ Does not include OM&R costs. Benefits assumed equal to shown costs for tabulation purposes.	No study has been made to determine environmental impacts. If the dam was breeched the excellent warm-water fishery that presently exists then would be lost.	Regional benefits have not been computed for this project at this time. However, the addition of employment and induced and stemming from benefits would produce positive net benefits under this account.	Beneficial Effects: The restored and expanded reservoir would enable existing irrigation to continue and allows some new irrigation. The industrial water will support expanded energy/industrial development, creating employment opportunities and diversification of the area's economy. Adverse Effects: Short term impact of construction crews on localities.
FLOOD CONTROL Miles City Levee Corps of Engineers Yellowstone Level B Custer County	First Cost $2,367,000 Annual Benefits 232,000 Annual Cost 170,000 Net Benefits 62,000	Beneficial Effects: Better drainage and mosquito control. Adverse Effects: Reduce wildlife habitat due to 18 acres of clearing and grubbing.	User Benefits 232,000 Regional Benefits 607,000 Net Benefits 669,000	Protection of 9,000 residents from flooding and related health problems.
LAND CONSERVATION Accelerated Land Conservation A. State and Private Lands 639,000 Acres B. National Resource Lands 78,000 Acres C. Forest Service Lands 4,300 Acres	A. Cap. Cost $7,653,000 *Ann. Equiv. Cost $620,200 B. Cap. Cost $982,000 *Ann. Equiv. Cost $79,600 C. Cap. Cost $1,119,000 *Ann. Equiv. Cost $90,700 *Annual Benefits - Not computed - assumed to be at least equal to costs. 6-3/8 percent interest for 25 years.	Beneficial Effects: Improved downstream water quality for all uses. Improve general aesthetics of the land. Additional reduction of soil loss and sediment yield above future-without condition. Increased vegetative cover resulting from improved management of existing resources.	Maintain and/or enhance the output of goods and services to users in the region. Provide additional employment in the application and maintenance of proposed measures. Provide additional permanent employment in processing increased goods and services.	Preservation of the resource for future generations.

Table VII-3 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
LAND CONSERVATION (CONT.) Accelerated Land Conservation (Cont.)		Improved quality of Fish and Wildlife habitat, including cover, forage, watering places, waterfowl nesting sites, and establishment of fisheries. Reduce soil nutrients from entering streams and the underground water table. Reduction of undesirable return flows to streams. Adverse Effects: Increased fire hazard from added production of forage plant species. Additional stream flow depletion due to increased consumptive use by added vegetative cover. Increased depletion of water resulting from added surface evaporation from ponds.		
Streambank Green Belt Program	Not available.	Program would add to fish and wildlife habitat while helping to prevent stream-bank erosion.	Not available.	Not available.
ENERGY Tongue River Power Plant--6 MW	Included under Tongue River Reservoir Modification Project -- above.	See Tongue River Reservoir Modification Project.	See Tongue River Reservoir Modification Project.	See Tongue River Reservoir Modification Project.
Recommended Energy Development	Private Capital Cost 1,560,000,000 Annual Benefits 383,900,000 Annual Costs 375,180,000 Net Benefits 8,720,000	Coal production reaches 98 million tons per year by the year 2000. Consumptive water requirements approach 35,000 acre-feet per year. Slurry lines are sited. Air pollution emissions increase due to one synthetic gas plant.	Regional benefits are not available. It may be assumed that net benefits would increase substantially.	Beneficial Effects: Provides employment, tax revenues, and economic stimulus. Over all, development of the resource provides national energy benefits to a nation dependent on foreign oil resources.

Table VII-3 (Cont.). Display of Beneficial and Adverse Effects, Recommended Plan, Tongue-Powder, Montana

PLAN ELEMENT	ACCOUNT			
	NATIONAL ECONOMIC DEVELOPMENT	ENVIRONMENTAL QUALITY	STATE-REGIONAL DEVELOPMENT	SOCIAL WELL-BEING
ENERGY (CONT.) Recommended Energy Development (Cont.)		Stripmines take 1,400 land surface acres per year.		Adverse Effects: Tremendous impacts on traditions and social, health, education, transportation systems. Probably will cause shortages in housing recreational facilities both in Wyoming and Montana.
FISH AND WILDLIFE Instream Flows Same as the reservation request of the Department of Fish and Game. (See Table IV-16 and IV-17.)	Beneficial Effects: Existing irrigators would benefit from the maintenance of water quality and levels at existing diversions. Adverse Effects: There is little water available for consumptive use over and above the instream needs in the months of July, August, and September. During low flow periods, that occur only one year in ten (on the average), there is no surplus water in any month.	Preservation of existing fish and wildlife habitat and water quality. Prevents any further degradation.	Same as NED	Beneficial Effects: Increased income for tourist and recreation sector. Adverse Effects: Potential negative effects on agricultural employment, development, and income.
WILD, SCENIC, AND RECREATIONAL RIVERS Tongue River Establish State recreation river designation for the Tongue River from the Tongue River Reservoir to Yellowstone River-115 miles. (Legislation establishing a State scenic and recreational river system is recommended.)	First Cost $18,398,000 Annual Benefits 586,500 Annual Costs 1,419,400 Net Benefits (832,900)1/ 1/ Parentheses indicate negative value.	The natural beauty along these reaches of streams would be preserved for present and future generations. Water quality to be improved. Flora and Fauna habitat values would be protected. A higher level of recreation use would be offset by better protection of the resource.	Tourism is a major contributor to the area and State economy. Recreation benefits resulting from preservation of these river reaches is in the state/regional interest. Other analyses are not available.	The pleasures associated with river-oriented recreation are important to social well-being. Local residents as well as tourists relax and revitalize themselves through their association with the pleasures provided by natural settings.

CHAPTER VIII

RECOMMENDED PLAN EVALUATION

The remaining needs were defined and presented in Chapter V; the purpose of this chapter is to see how well the elements of the Recommended Plan satisfy those needs.[1/]

Some needs appear to be in direct conflict (e.g., instream flows vs. expansion of irrigated agriculture). Others seem to be fairly compatible (e.g., scenic/recreational rivers and expansion of irrigated agriculture). Since economic development and environmental quality are equal partners in the planning process, there is inevitably conflicting views on how resources should be used. Although there are projects and programs that will enhance or maintain the environment in this report, the effects of economic development inevitably add to the pressures on the environment. On the other hand, most economic development and especially coal/energy development is generally conceded to be in the national interest, even though it may have detrimental effects on the environment.

An evaluation of the Plan, by functional area, is summarized in the following paragraphs.

Energy

The Study Team recommended that the level of private coal-related energy development be near the "most probable" (see the F/WO of Chapter V) Harza forecast but modified to allow for coal export by slurry pipeline. One synthetic gasification plan (non-subsidized) appears in the Plan rather than

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1/ Since the energy portion of the Recommended Plan is very close to the Harza "most probable" forecast, estimates of certain needs (e.g., municipal/domestic water consumption and outdoor recreation) are based on the "most probable" population level shown in Chapter IV.

the four found in the F/WO. By making this recommendation, the Study Team has opted not to meet the projected requirements as shown in Chapter IV. The recommended level of development meets 49 percent of those requirements. It is assumed that coal-related water requirements will be met as part of the F/WO (i.e., through existing storage, such as that in Bighorn Lake, or facilities to be constructed by private interests).

Agriculture

The forecasts used for agriculture have been previously discussed in Chapters IV and V. Table V-2 has shown the possible limits to irrigated acreage according to those forecasts and the probable F/WO situation.

In face of the substantial difference between the upper and lower limits shown by the table, the Recommended Plan takes a conservative stance. Only one project has been proposed for the area: the modification of the Tongue River Reservoir. Included in the modification is provision to irrigate 13,000 new acres. The project has been scheduled for 1985 but the lake would not be raised to capacity until the coal area adjoining the reservoir was fully exploited--probably not until the year 2000.

At present it appears that private irrigation will be able to meet future needs (at least through 1985) for agricultural commodities and will expand or contract according to market conditions.

Flood Control

The only benefits that would accrue to the Tongue-Powder Area, from the Plan, would come from construction of the Miles City Levee and the modification of the Tongue River Reservoir (see Chapter VI). The proposed streambank greenbelt program would reduce damages from streambank erosion.

Outdoor Recreation

Designation of the Tongue River as a wild and scenic river, under State control, would improve the opportunities for use of 115 miles of quality stream which would complement the excellent existing and augmented warm-water fishery of the Tongue River Reservoir. Expansion of the reservoir would provide additional flat-water recreational access. These developments would meet most of the needs outlined in Chapter V.

Land Conservation

The plan includes an accelerated land conservation program that would provide for mechanical and managerial conservation measures on one-half of the Federal and non-Federal lands that would not have been included under existing programs. By the year 2000, 86 percent of the lands needing conservation measures would be treated under the accelerated program at an additional capital cost of $9.75 million.

The streambank greenbelt program would aid in stabilizing streambank erosion problems while concurrently enhancing riparian wildlife habitat.

Fish and Wildlife

The only proposal submitted with the primary purpose of benefiting fish and wildlife is the provision for minimum instream flows requested by the Montana Department of Fish and Game. If these flows are provided, presumably all needs to the year 2000 will be met to the extent that it is economically and physically possible.

Other Functional Areas

The needs of the other functional areas (see Chapters IV and V) will be met without the benefit of a plan--but by the F/WO situation as described previously in Chapter V.

Cost of the Program

Implementation of all of the elements in the Recommended Plan, including private energy investments, would bring new capital expenditures of approximately $1,639.76 million into the Tongue-Powder Planning Area. The total is differentiated by project type in Table VIII-1.

Table VIII-1. Capital Costs, Recommended Plan, Tongue-Powder, Montana

	$ Millions
Multi-purpose	49.23
Energy (Coal)[1/]	(1,560.00)
Flood Control	2.37
Outdoor Recreation	18.40
Land Conservation[2/]	9.75
Total	79.75

1/ Private sector, investment excluded from total.
2/ Capital costs are not available for all land conservation programs.

Annual costs and benefits that would accrue by project type are shown in Table VIII-2. SRD benefits are included.

Table VIII-2. Annual Costs and Benefits, Recommended Plan, Tongue-Powder, Montana

Project Type	$ Millions	
	Annual Costs	Annual Benefits
Multi-purpose	3.62[1/]	3.62[1/]
Energy (Coal)[2/]	(375.18)	(383.90)
Flood Control	0.17	0.23
Outdoor Recreation	1.42	0.59[3/]
Land Conservation	0.79	0.79[4/]
Total	6.00	5.23

1/ OM and R costs and benefits not provided for proposed modifications of the Tongue River Reservoir. For tabulating purposes, benefits assumed to equal costs.
2/ Private sector.
3/ Does not include direct benefits from hunting and fishing or indirect SRD benefits.
4/ Benefits assumed to equal costs. Cost and benefits are not available for all land conservation programs.

Table VIII-3 shows costs allocated by function, which better describes the mix of Plan elements. These costs were allocated by using the Separable Costs-Remaining Benefits method prescribed for use in this Level B Study.

Table VIII-3. Summary of Capital Cost by Function, Recommended Plan, Tongue-Powder, Montana

Function	$ Millions
Irrigation	14.43
Industrial Water	23.33
Energy (Coal)1/	(1,560.00)
Hydroelectric Power	6.89
Flood Control	4.19
Outdoor Recreation	19.78
Land Conservation	9.75
Fish and Wildlife	1.38
Total	79.75

1/ Private sector investment, not included in total.

CHAPTER IX

IMPACTS OF THE RECOMMENDED PLAN

The purpose of this chapter is to compare the impacts stemming from the projects found in the Recommended Plan to the present (1975) and/or the F/WO situations.[1/] However, the reader is reminded that there are elements of the plan that are in direct conflict (e.g., instream flows vs. water consumptive types of development). These conflicts, shown by the Hydrology Supplement can be resolved only after the reservations for future use of Yellowstone water have been established by the State of Montana.

Population

As explained in the preceding chapter, the "most probable" population projection (first shown in Chapter IV, Table IV-7) best represents the population effects stemming from the elements of the Recommended Plan, including private energy development. Inasmuch as the F/WO scenario also anticipates the "most probable" level of energy development, and since the bulk of the anticipated population change stems from energy-related activities, it follows that the non-energy elements in the plan will have relatively small population impacts. Table IX-1 illustrates the magnitude of the population changes expected in this area.[2/] The table shows a population increase of 24,700, or 173 percent, by the year 2000.

1/ Comparisons of the NED, EQ, and Recommended Plans are shown in Chapter VIII of the main report--Yellowstone Level B Study Report--which treats the three States and seven planning areas as a whole.

2/ Due to the position the State Study Team has taken on the synthetic gasification of coal (Chapter VII), population by the year 2000 might range from 2,000-7,000 people lower than shown in the table.

Table IX-1. Population Changes, 1975-2000, Recommended Plan Plus F/WO Development, Tongue-Powder, Montana[1/]

Population	1975	1985	2000
Totals	14,300	21,400	39,000
Differences: 1975		7,100	24,700

1/ Totals rounded to the nearest hundred.

Water Consumption

Table IX-2 shows the major water consuming sectors of the Tongue-Powder Area. These sectors have been previously described in Chapters IV and V. The table shows an increase in water consumption of 80,249 af/y over the 1975 level of development; 49 percent of this increase (39,339 af/y) would come from expanded private (F/WO and public irrigation projects. Of this figure,

Table IX-2. Additional Water Consumption by Sector, 1975-2000, Recommended Plan Plus F/WO, Tongue-Powder, Montana[1/]

Sector	Consumption of af/y
Irrigation[2/]	39,339
Energy[3/]	34,248
Domestic/Municipal	424
Industrial	---0---
Non-Energy Minerals	7
Livestock [4/]	6,231
Total	80,249

1/ Given implementation of all projects, disregarding instream flows.

2/ An increase of 30,039 af/y over the F/WO.

3/ A decrease of 13,200 af/y from the F/WO.

4/ Includes evaporation.

consumption of 30,039 af/y (or 76 percent of the irrigation total) would stem from a public project.3/

The bulk of the remaining overall total, 34,248 af/y (or 43 percent), would be used in coal-energy development; but the recommended level of energy-related water consumption actually would be 13,200 af/y below that of the F/WO energy situation.

Land Use

The largest change in land use patterns over the next 25 years would probably be due to expanded irrigation, given favorable market conditions for agricultural products. Additional lands totaling (F/WO + Recommended Plan) 18,000 acres would be brought under irrigation by the year 2000. Of that total, 5,000 acres would probably be privately (F/WO) developed, while 13,000 are proposed to be developed on the Tongue River. Nearly 3,500 acres of rangeland would be claimed for mines and industrial sites by the energy industry at the year 2000. Table IX-3 illustrates the land use changes associated with elements of the Recommended Plan.

The development of scenic and recreational rivers would not involve significant changes in current land use, but would entail the purchase of easements on 25,300 acres of private lands to prevent future changes.

Environment

Table IX-4 presents the Plan element impacts on the environment. Little of the data from these projects are available in a quantifiable form, so they are presented in the descriptive manner shown below. Instream flows would be affected by new irrigation developments and population growth; those quanti-

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3/ The Tongue River Reservoir Modification.

Table IX-3. Identified Land Use Changes Stemming from Recommended Plan, 1975-2000, Tongue-Powder, Montana

Project or Program	Net Land Use Changes											
	Acres										Other	
	Irrigated Cropland and Pasture	Non-Irrigated Cropland and Pasture	Forest and Woodland	Rangeland	Industrial/Energy	Urban	Water Surface	Private	Public	Streambank (Acres)	Streambank (Miles)	Other
Multipurpose	13,000	-13,000	--	1/	--	--	2,700	1/	1/	-2,700	-6	--
Energy	--	1/	1/	-3,440	3,440	--	--	--	--	--	--	1/
Flood Control	--	--	--	--	--	--	--	--	--	-1,300	1/	--
Land Conservation	1/	1/	1/	1/	1/	--	--	--	--	1/	1/	1/
Instream Flows	--	--	--	--	--	--	--	--	--	--	--	1/
Scenic/Recreational River	--	--	--	--	--	--	--	-136	136	25,436 3/	115 3/	--

1/ Land use changes not determined.
2/ Easements total 25,300 acres.
3/ Represents a change in management practices rather than a change in land use.

Table IX-4. Identified Environmental Impacts Stemming from the Recommended Plan, 1975-2000, Tongue-Powder, Montana[1/]

Environmental Impacts	Projects or Programs						Population
	Multipurpose	Energy	Flood Control	Land Conservation	Instream Flows	Scenic and Recreational Rivers	
Open Space and Greenbelts (Acres)	0	0	0	+	0	+	-
Creation of Fish and Wildlife Habitat (Acres)	+	0	0	0	0	0	0
Improvement or Stabilization of Existing Habitat (Acres)	0	-	-	[3/]	+	+	-
Wilderness, Primitive, and Natural Areas (Acres)	0	0	0	0	0	0	0
Instream Flow Values (Acre-Feet)	-	-	0	0	[4/]	0	-
Native Species (Flora and Fauna)	-	-	-	+	+	+	-
Water Quality--TDS (Mg/L)	[2/]	0	0	+	0	0	-
NO_X (Tons/Year)	0	7,457	0	0	0	0	0
SO_X (Tons/Year)	0	11,172	0	0	0	0	0
Particulates (Tons/Year)	0	1,017	0	0	0	0	0
Streams (Miles)	-6	0	-	+	0	115	0

1/ The nature of the entries of this table illustrate the lack of data related to environmental effects; (-) indicates negative effect, (+) indicates positive effect, and (0) indicates minimal effect.

2/ See Hydrology Supplement for these values.

3/ See Chapters VII and VIII.

4/ See Chapters IV and V.

tive effects can be seen in the Hydrology Supplement. Air pollution emmissions and land reclamation become a problem associated with coal-energy development.

Outdoor Recreation

The Recommended Plan contains one proposal for a reservoir expansion and one proposal for a scenic and recreational river. Table IX-5 illustrates the increased opportunities for outdoor recreation due to these elements. The land and water areas translate into at least 216,500 additional recreation days and 10,000 fishing days upon implementation of these proposals, which would leave a surplus of 86,600 recreation days in the Tongue-Powder Area. The adjacent Lower Yellowstone Area has and will continue to have shortages--the Tongue-Powder surplus could relieve over two-thirds of it.

Table IX-5. Identified Recreation Impacts, Stemming from the Recommended Plan, 1975-2000, Tongue-Powder, Montana

Projects	Land Area (Acres)	Water Area (Acres)	Streams (Miles)	Recreation Days	Fishing Days
Tongue River Reservoir	1/	2,700	-6	44,000	10,000
Scenic and Recreational River	25,436	1/	115	172,500	--
Total 2/	25,436	2,700	109	216,500	10,000

1/ Undetermined

2/ Only partial totals.

Economic Impacts

The economic impacts that would stem from elements of the Recommended Plan are varied and related to the alternative uses that could be put to the area's water resources by the year 2000. The greatest impacts will come from

coal/energy development.

Approximately 510 new jobs directly associated with the energy industry would be created by 1985 and about 1,504 new positions would occur by 2000 in the industry. In addition, new indirect imployment for 545 and 1,805 people by 1985 and 2000, respectively, would be created by the energy plan. These new jobs will provide employment opportunities for the young people of the area and would reduce the numbers leaving. Unemployment has not been a large problem in this area so the plan is not likely to be beneficial in that respect.

Many of the jobs in the energy industry are higher paying than the average income in the area. Income distribution would change as shown in Table IX-6. The average real family income would be expected to rise about $618 by 1985 and $1,958 by 2000.

With the existing low unemployment rates and low population, it is certain that new people will move into the area to construct and operate the energy facilities. New people could alter the existing social characteristics of the region. Information obtained from the public during the study indicates that social changes would generally be considered negative by many area residents. In addition, publicly provided services are likely to be overextended, especially in the short run.

Future development of the agricultural, recreational, coal/energy, and fish and wildlife resources in the Tongue-Powder Area are tied to the water reservation issues that exist throughout the Yellowstone Basin (see Chapter II).

Additional consumption of water by any sector will have the effect of destroying portions of the area's existing river and riparian habitat. When the value of the last environmental unit destroyed equals the value of the last economic unit produced, additional water depletions will presumably end.

Table IX-6. Income Distribution Effects of Recommended Plan for Tongue-Powder, Montana

Income Class	Current[1/]	1985[2/]	2000[2/]
	% of Families by Income Class		
Less than $2,000	3.7	3.4	3.1
2,000 to 3,999	12.2	11.1	10.1
4,000 to 5,999	14.3	13.0	11.8
6,000 to 7,999	17.3	15.8	14.3
8,000 to 9,999	16.2	14.8	13.4
10,000 to 14,999	22.1	24.5	19.6
15,000 to 24,999	9.0	12.6	23.1
25,000 and above	5.2	4.7	4.6

1/ From "Current and Projected Population, Income and Earnings" report of Ad Hoc Work Group on Projections, Yellowstone River Basin and Adjacent Coal Areas Level B Study.

2/ Based on the following assumptions:

(1) Each new worker represents a family;

(2) Salary levels are such that all mine and conversion plant workers earn from $15,000 - $24,999 except 2% who earn over $25,000 and 5.5% who earn between $10,000 and $15,000;

(3) 50% of construction workers earn $10,000 - $14,999 and 50% earn $15,000 - $24,999;

(4) The indirect employment income and "without" family incomes are distributed the same as income in the current period;

(5) All income ranges are held at 1975 real levels.

CHAPTER X

CONCLUSIONS AND RECOMMENDATIONS

The conclusions presented below summarize some of the salient facts garnered from the Level B effort in Montana. The recommendations present the Study Team views on actions that need to be taken if resource development, conservation, and preservation are to be most effective in the years ahead.

The conclusions and recommendations for all of the four Montana planning areas have been combined into this Chapter for the convenience of the reader. This obviates the need for the reader to piece together the individual planning area reports in order to put the entire study into a basinwide perspective.

Conclusions

1. Total additional water consumption (associated with the Plan) in the Yellowstone Basin by the year 2000 will vary from the low option of 350,000 acre-feet per year (af/y) to the Recommended Plan level of 612,000 af/y, depending upon how the instream flow issue is ultimately settled. In this time period, additional water consumed by irrigation will be from 2 to 7 times that of coal/energy uses.
2. The United States has a need for coal/energy production. Montana has substantial coal resources that can help in meeting the national need.
3. It appears that the State's citizens support the State's official coal export "policy" as opposed to in-state conversion of coal to other forms of energy.

4. Export by slurry pipeline consumes less Montana water than conversion of coal to electricity (water-cooled plants) or synthetic gas.
5. Export of coal by rail consumes a negligible amount of water but it adds a burden to land owners and citizens of small communities that cannot gain access to areas "across the tracks," due to the railway traffic. In addition, railway traffic has some air and noise pollution associated with it.
6. Total coal/energy related water consumption in the Basin could range anywhere from 83,000 af/y to 219,000 af/y at the year 2000, depending on the level of development (the Study Teams recommend the lesser; see Chapter VII of the Tongue-Powder and the Lower Yellowstone Reports).
7. Lack of agricultural production is not foreseen to become a major problem in either the Nation or the Yellowstone Basin by the year 2000; private irrigation ventures are expanding, at present, but there does not appear to be a great need for new State or Federal irrigation projects until after 1985 and perhaps not until 2000--depending on market conditions.
8. The 3E projections (based on OBERS E and E' forecasts, see Chapter IV) have indicated a need for increased roughage production to support future expanded cow/calf operations. However, it is unclear whether or not income from hay and alfalfa in conjunction with cow/calf operations can match the costs of bringing substantial land areas under irrigation.
9. No mainstem Yellowstone River reservoir will be needed within the time frame considered in this study.
10. Lack of access is a major recreation problem.
11. Scenic and recreational river designations will not adversely affect or interfere with senior water rights.

12. Outdoor recreation will be of increasing importance in the area, partly as a result of anticipated population increases in the major energy-resource development areas.

Recommendations

The following recommendations are presented as part of the Recommended Plan discussed previously in Chapter VII. The recommendations result from the Study Team's analysis and consideration of problems that may be confronted in moving the plan from the inactive stage to one where it can be used as a flexible guide for future water and related land resource management in the Yellowstone Basin.

Miscellaneous

1. The State of Montana should identify Montana streams of major significance and provide appropriate protection for those streams to supplement the National Wild and Scenic Rivers System.
2. The Yellowstone Compact should be amended to recognize minimum instream flow and water quality values.
3. The Yellowstone River should remain a free-flowing river.
4. Indian and Federal "reserved" water rights should be defined, quantified, and adjudicated at the earliest possible date.

Coal Impacts

1. The Montana State Legislation should reconsider the ban on the use of water in interstate slurry pipeline operations. Such a mode of transportation could supplement rail traffic in the export of Montana coal to the demand regions.

2. The General Accounting Office should audit federally funded stripmine reclamation research projects. The object of this audit would be to identify duplication of effort and note areas not being adequately studied.
3. An evaluation study and public information program should be undertaken by the Department of Interior to illustrate opportunities and techniques for making mineral ownership exchanges between Federal, State, and/or private land owners in order to mitigate potential environmental problems associated with coal production.
4. In order to meet future energy demands, Congress should: (1) adopt a national energy conservation program designed to reduce current and projected energy demands; and (2) provide additional funds for development of innovative renewable energy programs.

Flood Damage Reduction

1. State and Federal land management agencies, in conjunction with private landowners, should institute best management practices in order to retard runoff and reduce flood hazards throughout the study area.
2. City and county governments should continue to improve flood preparedness, and act to ensure adequate and operable flood warning systems.
3. The Congress should continue funding the installation of selected river management projects using variations of different types of structural bank protection measures at 24 key locations between Intake, Montana, and the mouth of the Yellowstone River. These measures should be coordinated with other Federal and State agencies to assure that existing recreational fish and wildlife, and esthetic resources are not adversely affected.[1/]

1/ See Fish and Wildlife comments that follow.

4. The Corps of Engineers West Billings Flood Control Project is not included in the plan elements. Instead the Study Team has recommended a non-structural approach to the flood problem (e.g., flood plain zoning and flood insurance programs).

Irrigation and Industrial Development

1. Federal, State, and local agencies should continue to support and provide technical and financial assistance to landowners in identifying and applying good land and water conservation practices.
2. Strategic off-stream storage sites should be selected and evaluated at a feasibility level to see if such projects can be supported by potential users in the future.

Fish and Wildlife

1. The Broadview-Wheat Basin wildlife refuges should be further developed; plans for improvement should reflect the potentials of the Billings Water/Calamity Jane Project.
2. A study should be made to determine if the diversion structure in the Yellowstone River at Intake, Montana, should be modified to allow for passage of paddlefish. This could reduce the amount of water required for fish and wildlife needs in that reach of the river. Other diversions in the basin might benefit from modifications for fish passage.
3. In a number of tributaries, trout habitat is severely degraded by irrigation diversions in late summer. A study should be made to locate and evaluate off-stream damsites in which water could be stored during periods of excess flow and released to augment the flow during the summer months. The proposed project on Shields River is an example (Antelope Creek Storage).

Domestic and Municipal Water Supply

1. State, county, and local agencies responsible for providing or regulating domestic water supplies in the Yellowstone River Study Area should take advantage of provisions of Federal Safe Drinking Water Act, P.L. 93-523, in order to receive cost sharing and other benefits that would aid in improving domestic water quality.
2. Programs should be accelerated to aid in the discovery and delivery of water to water-short rural communities in Eastern Montana.

Land Conservation

1. The Soil Conservation Service and other State and Federal land management agencies should formulate and implement best management practices throughout the Yellowstone Basin to reduce man-caused sediment and related problems.
2. Overutilized private and public lands in the Shields River Drainage should be inventoried and then managed to achieve rehabilitation of soils, vegetation, and water quality. Organizations such as the Soil Conservation Service and Forest Service should contribute to the effort within the scope of their responsibilities.

Water Quality

1. A method(s) should be devised whereby the costs imposed by a degradation of water quality on present users can be determined, and considered as a cost of future development.
2. The water quality changes brought about by large withdrawals of water and associated return flows should be evaluated more thoroughly by appropriate State and Federal agencies, and the study results should be published as a part of project development impact data.
3. Montana's water quality surveillance system should be evaluated to see if it can meet the demands that will be placed on it with growth of the State's economy.

General Environment

1. The Water Resources Council should be provided the authority to ensure that all Federal water planning agencies, including those dealing directly with the environment, will actively participate in multipurpose planning efforts. State agencies that have responsibilities related to water resources should alse be required to actively participate in State-Federal cooperative studies.
2. Significant archaeological and historical sites in the study area should be identified and preserved.
3. The Congress and State Legislature should be encouraged to fund badly needed Environmental Quality projects, even though calculated benefit-cost relations are unfavorable.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:

August 30, 1977

Mr. Martin Oleson, Study Manager
Montana State Study Team
Missouri River Basin Commission
404 North 31st Street - Room 332
Billings, MT 59101

Dear Mr. Oleson:

We have received a draft copy of chapter ten, "Conclusions and Recommendations," for the Montana portion of the Yellowstone Level B study. Recommendation number three under the "Flood Damage Reduction" section indicates the study team is urging Congress to continue funding the Erosion Control and Demonstration program for the Yellowstone River - Intake, Montana to the mouth which was authorized by the Streambank Erosion Control and Demonstration Act of 1974, plus amendments.

We wish to record our objections to this recommendation based on probable losses to fish and wildlife resources if the program is carried out. Our analysis of this entire program was outlined in a letter dated August 15, 1977, to the Corps of Engineers. A copy of that letter is enclosed for your information.

Sincerely,

Burton W. Rounds
Area Manager

Enclosure
cc: Regional Director, FWS. Denver, CO (ENV)

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION
10597 West Sixth Avenue
Lakewood, Colorado
Across From Federal Center

IN REPLY REFER TO:

ENV

AUG 15 1977

District Engineer
Attention: R. G. Burnett, P.E.
Chief, Engineering Division
Omaha District, Corps of Engineers
6014 U.S. Post Office and Courthouse
Omaha, NE 68102

Dear Sir:

This letter contains U.S. Fish and Wildlife Service (FWS) preliminary comments on the Corps of Engineers document entitled, "Erosion Control Demonstration Program for the Yellowstone River - Intake, Montana to the Mouth," transmitted to us by your letter dated March 15, 1977.

Authorization for the proposed bank stabilization demonstration projects on the Missouri River was granted under Section 32 of the Water Resources Development Act of 1974. Section 155 of the 1976 Omnibus bill amended the original bill by adding two additional reaches of rivers for construction of demonstration projects. The lower Yellowstone River from Intake, Montana, to its mouth was one of the rivers added. Our comments on the proposal were prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401 as amended; 16 U.S.C. 661 et seq.).

The project area was inspected by air on April 7, 1977, by members of this office and the Billings Area Office. Preliminary ground inspection of individual project sites within Montana was conducted on April 19 and 20, 1977, with the cooperation of Montana Fish and Game Department personnel. Project sites in North Dakota were inspected on May 5, 1977, by personnel of the Billings and Bismarck Area Offices of the FWS and the North Dakota Game, Fish and Parks Commission.

This letter briefly discusses the existing situation for fish and wildlife in the area, the erosion problem generally, and the Corps' proposed solution as reflected by the Demonstration Program. An analysis of impacts is presented along with recommendations for acceptable demonstration sites and possible alternative actions.

The Yellowstone River within the project area generally has a large, braided stream channel with many islands, side channels, extensive backwaters, cutoff oxbow lakes, and sand or gravel bars. This stream form is the result of dynamic, ongoing channel formation and adjustment processes. A consequence

The proposed solution includes 24 individual bank stabilization projects designed to prevent erosion and loss of croplands, and man-made structures. The "demonstration" would cost an estimated $3,840,000 to stabilize approximately 26.7 miles of bank along the lower 63 miles of the Yellowstone River (13.8 miles of bank stabilization on Montana and 12.9 miles in North Dakota). Approximately one third of the project sites would protect constructed facilities such as roads, bridges, or irrigation structures; the remainder would primarily protect agricultural lands from natural erosion.

It is the general policy of the Fish and Wildlife Service not to object to the construction of stream alteration projects that are planned with due attention to environmental values. The Service policy is to consider favorably those stream alteration projects which meet the following conditions: 1) The proposal is clearly demonstrated, by substantial evidence, to be warranted in the public interest to protect human life, health, safety, or welfare; and 2) all alternatives to the proposal have been evaluated, and it has been clearly demonstrated to the satisfaction of the Service that none are feasible which could accomplish the demonstrated public need. However, we cannot support such projects where there would be significant damage to fish and wildlife resources and would have only localized, mainly private benefits to a relatively few people.

Implementation of the proposed project would result in cumulative and long-term adverse impacts to wildlife resources. An overall loss of wildlife habitat (primarily brush and tree habitat types) could be expected to occur at an accelerated pace as stabilized lands are cleared and cultivated as a result of protection from bank erosion and the related cycles of land accretion and serial vegetative succession. Bank stabilization on the lower Missouri River and many other streams has demonstrated that such land use changes are induced following bank stabilization projects. That is, once the river banks are stabilized, it becomes feasible for private landowners to clear brush and bottomland forest habitats and put these areas to intensive agricultural use. This indirect impact of bank stabilization has the potential to damage wildlife habitat much more than the direct losses associated with project construction and maintenance. Additional habitat losses can be postulated as an accumulative reduction in anabranches, backwaters,and similar habitat niches takes place.

Still another indirect loss of wildlife habitat may occur downstream from individual project demonstration sites, impacting primarily islands and lands immediately adjacent to the river channel. This could come about if the river channel, now directed at a stabilized bank, becomes redirected into an island or shoreline not protected by the project, thus eroding those banks.

The FWS is prepared to work with the Corps if the Demonstration Program proceeds despite our objections. Certainly, it will be necessary to arrive at acceptable wildlife mitigation measures for individual projects and the cumulative losses associated with this proposal if construction proceeds.

In the past, we agreed to implementation of the portion of the Bank Stabilization and Demonstration Program on the Missouri River without the preparation of an Environmental Impact Statement. However, this was done with the clear understanding that information gained from that experimental project would be used to make decisions regarding future bank stabilization measures. It now appears to us that the Bank Stabilization and Demonstration Program, as proposed on the Lower Yellowstone River, is of such magnitude that it constitutes a major Federal action affecting the quality of the human environment. Thus, an environmental impact statement should be prepared for this portion of the program. This would permit the discussion of nonstructure alternatives such as we have presented in this letter.

Please contact our Billings Area Office for additional consultation and planning assistance.

Sincerely yours,

Marvin P. Duncan
Acting Regional Director

cc: Bismarck Area Office
U.S. Fish and Wildlife Service
Department of Interior
P.O. Box 1897
Bismarck, North Dakota

Montana Fish and Game Department
Helena, Montana 59601

North Dakota Fish and Game Department
2121 Lovett Avenue
Bismarck, North Dakota 58501

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FISH AND WILDLIFE SERVICE

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IN REPLY REFER TO:

ENV

AUG 15 1977

District Engineer
Attention: R. G. Burnett, P.E.
Chief, Engineering Division
Omaha District, Corps of Engineers
6014 U.S. Post Office and Courthouse
Omaha, NE 68102

Dear Sir:

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The project area was inspected by air on April 7, 1977, by members of this office and the Billings Area Office. Preliminary ground inspection of individual project sites within Montana was conducted on April 19 and 20, 1977, with the cooperation of Montana Fish and Game Department personnel. Project sites in North Dakota were inspected on May 5, 1977, by personnel of the Billings and Bismarck Area Offices of the FWS and the North Dakota Game, Fish and Parks Commission.

This letter briefly discusses the existing situation for fish and wildlife in the area, the erosion problem generally, and the Corps' proposed solution as reflected by the Demonstration Program. An analysis of impacts is presented along with recommendations for acceptable demonstration sites and possible alternative actions.

The Yellowstone River within the project area generally has a large, braided stream channel with many islands, side channels, extensive backwaters, cutoff oxbow lakes, and sand or gravel bars. This stream form is the result of dynamic, ongoing channel formation and adjustment processes. A consequence

of the existing channel formation is a large quantity and high quality and diversity of riverine wildlife habitat largely unequalled in this region. Besides a diversity and large number of game mammals and birds occupying this habitat, many nongame species occur including, for example, beavers, wintering eagles, and a myriad of migrating and nesting song birds.

This highly productive fish and wildlife resource area is maintained within and is largely dependent upon the naturally functioning floodplain of the Yellowstone River. There are areas within this floodplain where uplands are being eroded by the river channel (Figure 1), while other areas are being filled in by silt deposition. The lands created by sediment deposition at first support a growth of willow and young cottonwood trees (Figure 2). Then, as time passes and the river channel traverses the floodplain, the newly accreted lands may become a forest of mature cottonwood trees. This bottomland forest in turn succumbs to bank erosion as the river channel returns to its original side of the floodplain. It is largely this continuous process which establishes and maintains the diversity of channels, islands, and differing bank conditions that create the range of habitats and abundance of wildlife present in the lower Yellowstone River.

A stated purpose of the Demonstration Program is to provide basic information on the extent and nature of erosion problems along the lower Yellowstone River and to evaluate the potential solutions for such problems. The erosion problem results from a naturally functioning river system eroding floodplain lands, thus threatening "vital irrigation facilities . . . , prime cropland and other vital facilities such as roads, bridge abutments, power lines, and municipal sewer and water plants." The Montana Department of Natural Resources and Conservation (DNRC) concluded in its EIS for Water Reservation Applications in the Yellowstone River Basin that: "The impact of several decades of water diversion on the morphology of the Yellowstone mainstem has been small, principally because the mainstem is still essentially free flowing . . . . The major influence on channel morphology has been riprap, which stabilizes the banks and limits the operation of natural processes." Thus, solution of the erosion problem creates a conflict between the need to limit the natural processes of the stream by stabilization of its banks and the need to allow the river to function in its dynamic fashion.

The Corps' proposed solution to the erosion problem was formulated by a technical review board composed of agricultural interests, the Bureau of Reclamation, and the Corps of Engineers. The review board concluded that "a comprehensive erosion monitoring and control plan should be developed for the entire reach" of the Yellowstone River within the project area. The review board then selected demonstration sites and design criteria and determined four erosion control techniques to be applied.

The proposed solution includes 24 individual bank stabilization projects designed to prevent erosion and loss of croplands, and man-made structures. The "demonstration" would cost an estimated $3,840,000 to stabilize approximately 26.7 miles of bank along the lower 63 miles of the Yellowstone River (13.8 miles of bank stabilization on Montana and 12.9 miles in North Dakota). Approximately one third of the project sites would protect constructed facilities such as roads, bridges, or irrigation structures; the remainder would primarily protect agricultural lands from natural erosion.

It is the general policy of the Fish and Wildlife Service not to object to the construction of stream alteration projects that are planned with due attention to environmental values. The Service policy is to consider favorably those stream alteration projects which meet the following conditions: 1) The proposal is clearly demonstrated, by substantial evidence, to be warranted in the public interest to protect human life, health, safety, or welfare; and 2) all alternatives to the proposal have been evaluated, and it has been clearly demonstrated to the satisfaction of the Service that none are feasible which could accomplish the demonstrated public need. However, we cannot support such projects where there would be significant damage to fish and wildlife resources and would have only localized, mainly private benefits to a relatively few people.

Implementation of the proposed project would result in cumulative and long-term adverse impacts to wildlife resources. An overall loss of wildlife habitat (primarily brush and tree habitat types) could be expected to occur at an accelerated pace as stabilized lands are cleared and cultivated as a result of protection from bank erosion and the related cycles of land accretion and serial vegetative succession. Bank stabilization on the lower Missouri River and many other streams has demonstrated that such land use changes are induced following bank stabilization projects. That is, once the river banks are stabilized, it becomes feasible for private landowners to clear brush and bottomland forest habitats and put these areas to intensive agricultural use. This indirect impact of bank stabilization has the potential to damage wildlife habitat much more than the direct losses associated with project construction and maintenance. Additional habitat losses can be postulated as an accumulative reduction in anabranches, backwaters, and similar habitat niches takes place.

Still another indirect loss of wildlife habitat may occur downstream from individual project demonstration sites, impacting primarily islands and lands immediately adjacent to the river channel. This could come about if the river channel, now directed at a stabilized bank, becomes redirected into an island or shoreline not protected by the project, thus eroding those banks.

The most significant threat here may be that additional bank stabilization measures could be encouraged. However, potential direct losses of habitat, in some instances, are relatively great as on Crittenden and Seven Sisters Islands.

It appears that several of the selected demonstration sites are designed to protect man-made structures that are not in immediate danger from erosion or are of a nonessential nature. The majority of the proposed sites, moreover, would primarily protect "agricultural" lands from natural erosion. Many of these latter projects will result in secondary clearing of floodplain vegetation and replacement by cultivated crops and other impacts as previously outlined. The FWS cannot support such stabilization proposals which would have only localized, mainly private benefits to a relatively few people and would result in significant damage to fish and wildlife resources. In these cases, the FWS recommends adoption of floodplain management programs in preference to stream channel alteration via bank stabilization measures.

Our cursory inspection of the 24 proposed projects revealed that only four have a clear potential to be in the general public interest: the Sidney Bridge Area, River Road Area, Cartwright Bridge Area, and the Upper Sioux Area. These four projects would protect existing bridges, roads, or irrigation structures (Figure 3). However, even these four projects appear to call for more construction than is needed to protect only the vital facilities. That is, they appear to include protection of associated agricultural lands. Thus, modification of these proposed structures appears warranted.

The 20 remaining projects in the program are unacceptable to the FWS because of potential losses to fish and wildlife resources. In this connection, and as previously noted, the basic stated purpose of the Demonstration Program is to demonstrate and evaluate potential solutions to the bank erosion problem. The Corps already has bank stabilization demonstration projects at several other locations in the Missouri River drainage in North and South Dakota and Nebraska. We recommend that before initiation of the Yellowstone River project, these ongoing demonstrations and other existing bank protection works be fully evaluated to determine their cumulative economic and environmental effects. The magnitude of potential wildlife habitat loss is too great on the lower Yellowstone River to be sacrificed for demonstration purposes, especially when other ongoing projects may achieve the same objective.

Our field inspections revealed that the Bureau of Reclamation also has numerous bank stabilization structures already in place in the lower Yellowstone River. The hard point system proposed for demonstration and evaluation by the Corps exists (at least functionally) at several locations (Figure 4). Some of the Bureau of Reclamation revetments also appear functionally similar to those proposed for evaluation by the Corps. An evaluation of these existing structures may meet some of the Corps objectives.

The FWS is prepared to work with the Corps if the Demonstration Program proceeds despite our objections. Certainly, it will be necessary to arrive at acceptable wildlife mitigation measures for individual projects and the cumulative losses associated with this proposal if construction proceeds.

In the past, we agreed to implementation of the portion of the Bank Stabilization and Demonstration Program on the Missouri River without the preparation of an Environmental Impact Statement. However, this was done with the clear understanding that information gained from that experimental project would be used to make decisions regarding future bank stabilization measures. It now appears to us that the Bank Stabilization and Demonstration Program, as proposed on the Lower Yellowstone River, is of such magnitude that it constitutes a major Federal action affecting the quality of the human environment. Thus, an environmental impact statement should be prepared for this portion of the program. This would permit the discussion of nonstructure alternatives such as we have presented in this letter.

Please contact our Billings Area Office for additional consultation and planning assistance.

Sincerely yours,

Marvin P. Duncan
Acting Regional Director

cc: Bismarck Area Office
U.S. Fish and Wildlife Service
Department of Interior
P.O. Box 1897
Bismarck, North Dakota

Montana Fish and Game Department
Helena, Montana 59601

North Dakota Fish and Game Department
2121 Lovett Avenue
Bismarck, North Dakota 58501

STATE OF MONTANA

DEPARTMENT OF

FISH AND GAME

Helena, Montana
February 21, 1978

Missouri River Basin Commission
Suite 40 3, 10050 Regency Circle
Omaha, Nebraska 68114

Gentlemen:

We are attaching a copy of a letter sent to the Corps of Engineers regarding their proposals for streambank stabilization on the lower Yellowstone River in Montana. We would like you to consider this letter as our comment on item number 3 on page X-5 in the January 1978 Yellowstone Basin and Adjacent Coal Area Level B Study, Volume 3.

Sincerely,

Fletcher E. Newby
Deputy Director

FEN/RWB/gk
cc: Orrin Ferris
Keith Seaburg

Attachment

STATE OF MONTANA

DEPARTMENT OF
FISH AND GAME

Helena, Montana
September 6, 1977

Mr. R. G. Burnett, P.E.
Chief, Engineering Division
Army Corps of Engineers
6014 U.S. Post Office & Courthouse
Omaha, Nebraska 68102

Dear Mr. Burnett:

This correspondence concerns the Corps of Engineers' proposal entitled "Erosion Control Demonstration Program for the Yellowstone River, Intake, Montana to the Mouth." We wrote to your office on April 14, 1977, requesting information on this proposal, and you responded on May 4, 1977, including a description of project proposals.

Since that date we nave inspected all of the sites in Montana where erosion control measures are proposed. This inspection included both the biological and engineering aspects of the proposal, and was performed by this department's and Montana State University personnel. We found, with minor exception, that streambank erosion was not significant enough to justify a program of this scope on even a demonstration and evaluation basis.

It was impossible to comprehend the rationale behind the selection of the proposed sites. In many instances, control structures are being proposed for areas on well vegetated, stable, or near stable banks. In other cases, extensive bank stabilization measures are planned for areas far removed from the main channel, and in one case, on an already diked off flood channel. If the proposed structures are installed and remain functional over any period of time, it will probably be the result of having placed them in areas of minimal erosive activity, rather than of the design of the structures themselves.

Cause of the erosion that now exists, including land clearing and cropping to the river's edge, previous bank stabilization attempts, geomorphology, and basic hydraulic functions, were not adequately identified or addressed in the report. It appears that individual sites were given only cursory field inspection, if any, before including them in the program.

-continued-

There also seemed to be only superficial consideration given to preserving wildlife habitat or other environmental values in areas where control structures are proposed. The outstanding wildlife values on this reach of the Yellowstone stem primarily from the densely vegetated riparian areas interspersed with agricultural lands, and stable islands of willow and cottonwood. On some project sites, much of the established wildlife habitat would be destroyed in the act of constructing the projects. At other sites, the stabilization practices would exert adverse hydraulic pressures on adjacent river banks or on established vegetated islands, most of which contain valuable wildlife habitat.

In light of the above and considering that a similar proposal has been made for sections of the Missouri River, and considering that numerous dikes, revetments, riprap, hardpoints, etc. have already been constructed on probably all of the nation's major rivers and streams (including this section of the Yellowstone River) and that most of these are available for evaluation, we can see no justification for your proposal.

Therefore, in our opinion, your proposal does not conform with the intent of the Fish and Wildlife Coordination Act in protecting wildlife and wildlife habitat, or with the legislative policies of the state of Montana to preserve streams in their natural condition, as is feasible and desirable.

We suggest that a better method of improving river bank conditions in this area would be to carefully remove and properly dispose of existing jacks which are no longer functional. These are esthetically about equal to car body riprap, and also pose distinct hazards to boat navigation. There should also be an intense public informational effort to advise local land owners of the erosion hazard in clearing and cropping land to the river's edge. At least two such projects are now underway with vegetation being disposed of on the river bank which are probably Section 10 or 404 violations.

In your correspondence of May 4, 1977, you pointed out the preliminary and provisional state of this proposal. We appreciate and acknowledge that fact, and hope our general comments at this time will serve to indicate our deep concern that the need for and the ramifications of the proposal need much greater in-depth investigation and public discussion. The Yellowstone River is a valuable natural asset to the State of Montana and should not be subjected to unnatural and unnecessary streambank manipulation.

Sincerely,

Robert F. Wambach

Robert F. Wambach
State Fish and Game Director

RFW/RWB/gk
cc: Congressional Delegation
Governor's Office
Burt Rounds
Keith Seaburg

BURLINGTON NORTHERN

JOHN O. DAVIES
Vice President -- Billings Region

600 First Northwestern Bank Center
175 North 27th Street
Billings, Montana 59101

March 1, 1978

Mr. Paul Shore, Study Manager
Yellowstone Basin and Adjacent
Coal Area. Level B Study
Northfork Star Route
Cody, Wyoming 82414

Dear Mr. Shore:

Copies of your four volumes of the Level B Studies covering Montana have been furnished us, and we feel it is important to the integrity of the study to point out some significant errors in the methodology and findings as they concern coal and coal transportation.

Although the "high scenarios" in the Harza study relating to coal production are disavowed by your conclusion No. 3 on page X-1 in both the Lower Yellowstone and Tongue-Powder studies, the figures and other data relating to this scenario are referred to frequently throughout the text. We wish, therefore, to make it clear that the coal production volumes anticipated are much higher than we anticipate. Our expectations are based on mine-to-mine estimates done with the cooperation of the companies who will actually mine the coal in Montana and Wyoming.

If we can assume by your disclaimer in No. 3 conclusion on page X-1 that you are abandoning the "high" scenario in favor of the "most probable", this changes the base drastically. Either scenario below the "high" would, in our opinion, totally obviate the need for slurry pipelines as "supplemental" or other useful functions in the movement of Montana coal. As a logical follow-up, it would seem it would also destroy the rationale for your recommendation No. 1 under coal impacts, page X-4 in both studies, calling for recognition of water for interstate pipelines as a "beneficial" use in Montana and recommending such recognition by the State Legislature, which has already held such use to be illegal. Also, it was readily conceded at the February 23 meeting of the State Study Team in Billings that the Lower Yellowstone study data does not support or require slurry pipeline transportation, yet the recommendation appears in that study as well as the Tongue-Powder study.

I call attention to a letter to Mr. Jeff White from Mr. Don L. Brown of the Montana Department of Fish and Game, dated December 14, 1977, regarding Chapter X, page 2, items 4 and 5, stating: "Slurry lines appear to be endorsed without proper reference to any adverse impacts they may have, while rail transport is apparently dismissed without benefits it may offer." Likewise, I call your attention to Mr. Brown's further comment on February 22, 1978, referring to the final draft X-2, items 5 and 6, recommending again that these be changed. We feel Mr. Brown's suggestions are firmly based and appropriately taken.

Also, the study assumptions about rail capacity limitations are wrong for reason the study chooses completely to ignore a basic fact about rail capacity, i.e., rail capacity can be expanded faster than volume to be hauled. The "high scenario" coal volumes given in the study for the Lower Yellowstone, for example, exceed our wildest expectations; but even if the volumes were to be in the neighborhood of 100 million tons by 1985, BN could expand its capacity on the line east of Forsyth in plenty of time to handle that entire volume. In addition. there would still be room to move volume by means of our line that runs through Minot as well as over our Wyoming line.

The theoretical model used by Harza to calculate rail capacity does not recognize what practical experience shows to be true. A railroad system is not a static or fixed entity as their model assumes. In reality, when a line segment appears to be approaching its practical limit, adjustments are routinely made to accomodate those limits. We are constantly doing this on our coal lines, with each year's construction providing for the needs of the following year's traffic. This process has been recognized by almost every major study of coal transportation done in recent year, with the prominent exception of the Harza study. Dr. Paul Polzin of the University of Montana in an article in MONTANA BUSINESS QUARTERLY, Spring, 1977, pointed out a study he had done indicated that if the line east of Forsyth were double-tracked and equipped with centralized train control, "it could carry the entire projected annual output of Montana coal for the next thirty years with sufficient leeway to allow significant amounts of Wyoming coal to be routed through the state toward the Upper Midwest."

In summary, unrealistic assumptions about Montana coal production and rail capacity produce a compounding of errors that leads to the false conclusion that massive amounts of water should be exported by means of coal slurry pipelines. In the absence of any logical or factual substantiation, this conclusion is misleading and does significant harm to the overall believability of the study.

Very truly yours,

J. O. Davies

cc: Mr. James R. Walker
Mr. J. U. Dickson
Mr. John Delano
Mr. Jack Knott

United States Department of the Interior
BUREAU OF OUTDOOR RECREATION
MID-CONTINENT REGION

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IN REPLY REFER TO:
D6427

MAR 2 1978

Memorandum

To: Paul Shore, Study Manager

From: Agency Coordinator, Yellowstone Level B Study

Subject: Final Draft of Montana Study Team Reports

We have reviewed the above final draft provided with your memorandum of February 7, 1978. Editorial and figure changes are shown on the enclosed pages copied from the draft report.

Discussion of instream flow requirements in the report did not address recreation requirements directly, except for fishery maintenance. The Heritage Conservation and Recreation Service (HCRS, formerly Bureau of Outdoor Recreation), in cooperation with the Instream Flow Group, Western Energy and Land Use Team, U.S. Fish and Wildlife Service, is developing instream flow requirement methodologies for recreation. Future river recreation planning should utilize the results of this study to best consider what flows are required for various recreation activities and how existing or proposed developments will affect the river recreation environment.

One recommendation submitted by HCRS to be included in Chapter X of the draft report was not included and is therefore presented here.

Outdoor Recreation

Recreation and related environmental data for regional and river basin planning are not comparable to the data available for water development, flood control, and other purposes. In addition, considerable variation exists between States on recreation and related environmental data that do exist. Therefore, Federal, State, and private entities responsible for managing recreation areas should establish a uniform method of inventorying existing recreation resources, reporting use, and identifying recreational use capabilities. This system should be kept current and made available for all resources planning purposes.

Recreation costs and benefits for multipurpose projects were calculated by HCRS with respect to reservoir size estimates given by the assistant study manager. Estimated recreation days attributed to multipurpose reservoir projects were included in Chapter IX; however, estimated costs and benefits were not included in the recommended plan. A table of recreation data for each project is attached.

Although we are pleased with the wild, scenic, and recreation river proposals presented in the recommended plan, discussion of recreation resources needs is sparse and often too generalized.

The HCRS is pleased with the environmental integrity of these reports and would like to commend all those who participated in this study effort.

Emanuel Lauck

Enclosure

cc: Montana SLO

Planning Area	Bighorn-Clarks Fork		Upper Yellowstone		
Project	Elbow Creek	Blue Water - 5 Mile Creek	Flathead Creek	Prior Creek	Antelope Cree
Estimated WSA	340	255	300	250	300
Annual Recreation Days (General Recreation)	95,200	71,400	84,000	70,000	84,000
Annual Fisherman Days	74,800	56,100	66,000	55,000	66,000
Total Recreation Days	170,000	127,500	150,000	125,000	150,000
Land Acres Required for Recreation	366	274	323	269	323
Total Construction Costs	1,791,800	1,343,850	1,581,000	1,317,500	1,581,000
Land Acquisition	102,000	82,200	96,900	80,700	96,900
Annual Operation, Maintenance, and Replacement	102,900	77,100	90,800	75,600	90,800
Annual Equivalent Cost	Not Amortized	Not Amortized	Not Amortized	Not Amortized	Not Amortized
Annual Benefits	564,400	423,300	498,000	415,000	498,000

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Billings Area Office
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:

March 17, 1978

Mr. Paul Shore, Study Manager
Yellowstone Level B Study
Missouri River Basin Commission
Northfork Star Route
Cody, WY 82414

Dear Mr. Shore:

We have reviewed the final draft report (volumes 2 through 5) for the Montana portion of the Yellowstone Basin and Adjacent Coal Area Level B Study. In general, it appears that our concerns regarding the quality of baseline fish and wildlife data (and other environmental information) that would be developed and used in the study have been confirmed.

Although the information presented in the report admittedly represents what is most readily available, it is, in our opinion, neither comprehensive enough nor detailed enough for the intended purpose. Baseline information describing and quantifying even the major fish and wildlife habitat types in the area is extremely limited. Also, no quantified projected requirements for fish and wildlife habitat needs appear in the report, although such needs certainly exist and should have been a major thrust of the study. In addition, environmental baseline information was never assembled in such a manner to permit any meaningful assessments of the impacts and trade-offs of alternative plans. A more formal, systematic, and better documented procedure was, in our opinion, necessary to properly evaluate resource trade-offs and assess impacts.

In the early phases of the study, the Fish and Wildlife Service suggested methods for assembling at least some of the needed natural resource baseline data. It was hoped these suggestions would lead to further discussions and eventual adoption of some procedure for bringing together the essential information. However, the suggestions were rejected and no alternative solutions for gathering the data were proposed. Management personnel insisted that the study be conducted using "existing" data, but no adequate procedure for assembling such existing data was incorporated into the study.

Finally, we question whether the study was conducted entirely in accordance with guidelines set forth in the Water Resource Council's "Principles and Standards" which require that equal consideration be given to the National Economic Development and Environmental Quality Planning Objectives. We do not believe equal emphasis is reflected. To some extent, we believe this particular shortcoming was built into the plan of study. As you may recall, the Service expressed concern on this point on numerous occasions early in the study. In fact, it was our concern with procudrual shortcomings outlined herein that led us to limit our later involvement in the study.

Our specific comments on the draft report follow:

Chapter II - Natural Resource Baseline, Fish and Wildlife Resources (Volumes 2-5)

No quantified data are presented in these sections of the report volumes. While the descriptive information presented is interesting and informative, it does not, in our opinion, give a good picture of the existing fish and wildlife resource base. Some quantified estimates of both terrestrial and aquatic habitats important for fish and wildlife are needed as a basis for later comparisons.

The bald eagle should be included among those species noted in the report as endangered or threatened. The eagle was recently added to the national endangered list. It is probable that bald eagles occur in all four Montana planning areas.

Chapter IV - Projected Requirements, Fish and Wildlife (Volumes 2-5)

The information presented in these sections of the report volumes does not appear to address the primary issue, i.e., "projected requirements" or future needs for fish and wildlife resources. No quantified data relating to resource (fish and wildlife species) needs or use (by man) needs are presented. A very limited and general discussion of the need for stream access is contained in each volume, but only the Upper Yellowstone report contains even a vague idea of specific locations.

It is our opinion that the needs of selected animal species or groups, or for selected habitat types, should be considered in a study of this nature.

Chapter V - Future Without (F/WO) and Remaining Needs, Fish and Wildlife (Volumes 2-5)

The inadequacies pertaining to quantified fish and wildlife resource needs cited previously in comments on chapters II and IV also apply to these sections of the volumes.

Chapter VII - The Recommended Plan (Volumes 2-5)

The only elements of this plan which we could support without detailed fish and wildlife studies are:

1) Removal of fish spawning barriers to tributary streams
2) Proposals for additions to the National Wild and Scenic Rivers System or designation of river segments as State Recreation Rivers

Chapter VIII - Recommended Plan Evaluation, Fish and Wildlife (Volumes 2-5)

It is interesting to note that this section does not describe, in any detail, how the recommended plan will meet future specific needs for fish and wildlife resources. It merely states that plan elements would "maintain and/or enhance existing habitat" or "create new habitat". This may or may not be true; however, in most instances, it can't be definitely stated based on the limited data presented in the report. It was, of course, probably impossible to describe in this section how the recommended plan would meet future fish and wildlife needs since no attempt was made to adequately describe or quantify these needs. However, it seems that any viable plan should certainly address this issue.

Chapter IX - Impacts of the Recommended Plan, Fish and Wildlife (Volumes 2-5)

This section does not in any meaningful way describe or quantify even the major impacts of the recommended plan on fish and wildlife resources. However, it seems obvious that such information should be considered essential for a study of this type. In this instance, the study procedure and the information base incorporated were inadequate to attempt meaningful evaluations.

Chapter X - Conclusions and Recommendations (Volumes 2-5)

Conclusions - We question the validity and advisability of conclusion number ten for two reasons. First, the essentially permanent allocation of a resource as valuable as water in the study area should, in our opinion, be viewed on a long-term need basis rather than a short-term or "immediate" need basis. Secondly, we do not believe fish and wildlife needs in terms of water were analyzed in sufficient detail in this study to permit ranking with other water uses.

Recommendations - Fish and Wildlife - The only recommendation listed which we could support without additional detailed studies is the modification of the diversion structure in the Yellowstone River at Intake, Montana to allow for passage of paddlefish.

In connection with Recommendation 3, page X-5, Volume 5, we reiterate our position as outlined in a letter to the Corps of Engineer's dated August 15, 1977. We note that a copy of that letter is included in your study report. We might also point out that the "24 sites" alluded to in your recommendation and in our letter presently appears to be an

"outdated" concept at best.

In summary, we do not believe the study supports approval of Level C studies since it has been conducted in an inadequate manner with respect to fish and wildlife resources specifically and environmental concerns generally.

Sincerely,

Barry Betts

Barry Betts
Acting Area Manager

cc: Regional Director, USFWS, Denver, CO (ENV)