GL00676

REPORT TO THE LEASING POLICY DEVELOPMENT OFFICE, DEPARTMENT OF ENERGY

on

ENERGY RESOURCES AND THE BUREAU OF LAND MANAGEMENT WILDERNESS PROGRAM: REGIONAL ENERGY RESOURCE COMPILATION AND ANALYSIS

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Prepared by

SCIENCE APPLICATIONS, INC.

For

THE RESOURCE ANALYSIS GROUP OF OAK RIDGE NATIONAL LABORATORY

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MAJOR FINDINGS AND RECOMMENDATIONS

Oil and gas, coal, and uranium are expected to supply most of U.S. energy needs in the short term (1980-2000). The BLM Wilderness Program, which can extend through 1993, will probably have relatively little impact on these short-term needs, particularly as a large number of the Roadless Areas are in geologic environments not generally considered favorable for these dominant types of energy resources. Although the overall impact may be minimal, unavoidable reduction of exploration by industry will occur in several regions because of restrictions imposed by BLM interim-management procedures and ultimate land withdrawals.

In this preliminary study, which for the most part, considers only the short-term 20-year impact on domestic energy supply, we have recognized four regions of significant conflict between potential multiple energy resources and Roadless Areas. These regions, as shown in Figure 1, are: (1) southeastern Utah and southwestern Colorado (coal, uranium, and oil and gas); (2) the southwestern part of Wyoming (oil and gas, uranium, coal and oil shale); (3) south-central Utah (coal, uranium, and oil and gas); and (4) northwestern Nevada and south-eastern Oregon (geothermal and uranium).

In addition to these regions of high conflict, a few small areas have a somewhat lower degree of conflict usually with only one or two resources. These areas are: (1) to the north of San Francisco Bay (geothermal),

(2) west-central Arizona (uranium); (3) east-central California (geothermal and uranium); (4) north-central Montana (gas); and (5) several areas along the Cordilleran fold and thrust belt (oil and gas).

On an individual energy resource basis, conflicts with Roadless Areas are shown in subsections of this report. Major oil and gas conflicts are in: (l) south-central Montana; (2) the Big Horn Basin, Wyoming; (3) the Greater Green River Basin, Wyoming; and (4) the region along the Utah-Colorado border. Major uranium conflicts are concentrated in: (1) the Greater Green River Basin, Wyoming; (2) parts of the Colorado Plateau in Utah, Arizona, and Colorado; and (3) in northwestern Nevada. Coal is in conflict with Roadless Areas largely in: (1) the southeastern Montana part of the Powder River Basin; (2) southwestern Wyoming; and (3) central and south-central Utah. Oil shale and heavy oil have only minimal conflict with Roadless Areas. Geothermal resources and Roadless Areas are also only in minimal conflict, although significant problems may arise chiefly in the region around the Geysers to the north of San Francisco Bay in California and in northwestern Nevada. Hydroelectric resources have minimal conflict with Roadless Areas. On the other hand, their development would impair the use of other resources.

Recommendations

The importance of oil and gas, coal, and uranium in our near-term energy needs suggests that Roadless Area conflicts with these resources be examined as soon as the Final Intensive Inventory of roadless tracts is completed. Although some states have essentially completed this review, all evaluations are not expected until September 1980. The Cordilleran fold and thrust belt (Fig. 1) has a variable moderate to high potential for oil and gas over its extent from north to south. It is currently the most active new exploration region for these resources in the conterminous United States. Consequently, the thrust belt should be among the regions of conflict to be reviewed in greater detail as early as possible. Early review with recommendations from DOE to BLM may help to free certain areas of high potential from some of the restrictions imposed by interim land-management procedures. Other regions of high conflict, particularly those with multiple energy resources, are also suggested for early study. Such regions would include the four mentioned above, namely, southeastern Utah and southwestern Colorado, southwestern Wyoming, south-central Utah, and northwestern Nevada and the adjacent part of south-eastern Oregon. The order in which these regions are given does not necessarily imply order of importance. Certain areas of essentially single-resource conflict are also recommended for early consideration, such as the high uranium potential in west-central Arizona and the gas potential of north-central Montana.

While it is realized that in some regions a whole Roadless Area may be in conflict with a potential energy resource, it must also be emphasized that many site-specific conflicts can be resolved by recommending minor boundary changes. Again, however, the regional resource patterns must be established and reviewed with local specialists before such site-specific modifications can be recommended.

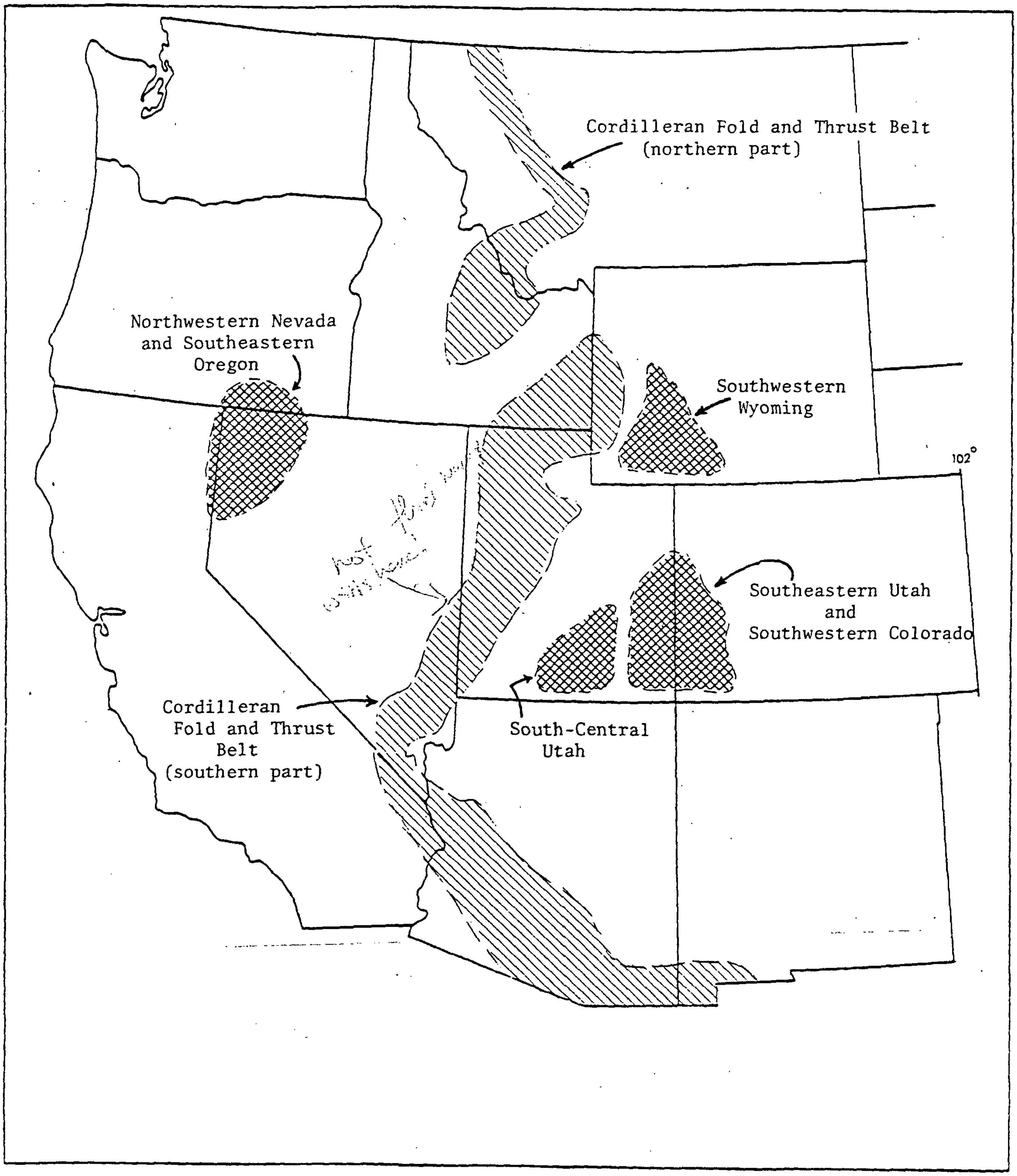


Figure 1. Regions recommended for immediate study.

1.0 INTRODUCTION

1.1 The BLM Wilderness Program

The Federal Land Policy and Management Act of 1976 mandated that the Bureau of Land Management (BLM) begin a study of the approximately 470 million acres of BLM land for possible inclusion in the National Wilderness Preservation System. Approximately 175 million acres of this land is in the conterminous United States west of 102°W longitude. The remaining 295 million acres is in Alaska. By October 21, 1991, the BLM must accomplish three tasks: (1) identify areas of 5,000 acres or more that are roadless and may have wilderness characteristics (hereinafter referred to as Roadless Areas), (2) study the Roadless Areas to determine their suitability for wilderness designation as a part of the Unit Planning Process, and (3) report these findings to the President with land use recommendations for each Roadless Area. The President will then submit his recommendations to Congress, and Congress will decide what Roadless Areas will become wilderness.

1.2 Purpose of Study

A significant part of this nation's existing and future supply of energy resources are in the western United States. Depending on the ultimate location and extent of proposed wilderness areas, the BLM program could have an adverse impact on the future supply of energy resources. To help determine these potential impacts, the Department of Energy (DOE) funded a 4-month study by the Resource Analysis Group of Oak Ridge National Laboratory (ORNL). Science Applications, Inc. Oak Ridge, Tennessee was the chief subcontractor on this project and coordinated the work of project personnel. The purposes of the study are as follows:

1. to build a broad, regional overview of six energy resource groups by plotting the distribution and importance of Western energy-resource patterns. The output of this effort can be the starting point for a number of resource analyses by DOE, BLM and others concerned with energy resource questions.

2. to identify regions in which the possible designation of wilderness areas under the current wilderness program of the BLM will conflict with the orderly development of energy resources.

3. to recommend priorities for conducting wilderness area studies based on the identified conflict regions.

The region studied lies within the conterminous United States west of 102°W longitude, but does not include Texas. The energy resource groups considered are: (1) oil and gas; (2) uranium; (3) coal; (4) oil shale and heavy oils; (5) geothermal; and (6) hydroelectric.

2.0 MAP DESCRIPTIONS

2.1 Introduction

The blueline maps accompanying this report consist of one BLM Roadless Area map and ten energy-resource maps prepared at a scale of 1:2,500,000 (1 inch equals 40 miles). A master copy of each map was prepared on a mylar base from which the blue lines were copied. In addition, acetate copies were made to use as overlays on other maps of the same scale and projection. The 1:2,500,000 scale maps are titled.

- Roadless Area Map 1 - BLM roadless areas as of April 1, 1979
- Oil and Gas Map 1 - Oil and gas fields in the western United States
- Oil and Gas Map 2 - Oil and gas favorability in the western United States
- Uranium Map 1 - Uranium occurrences in the western United States
- Uranium Map 2 - Potential uranium resources in the western United States
- Coal Map 1 - Coal-bearing rocks in the western United States
- Coal Map 2 - Federal coal-producing regions showing Known Recoverable Coal Resource Areas and coal mines
- Oil Shale and Heavy Oil Map 1 - Oil shale, heavy oil, and asphalt in the western United States
- Geothermal Map 1 - Geothermal resources in the western United States
- Geothermal Map 2 - Potential geothermal resources in the western United States
- Hydroelectric Map 1 - Hydroelectric resources in the western United States: Developed and undeveloped power sites

The 1:2,500,000 map scale was used for this study because this is about the largest scale at which the various resource data can be shown at a convenient size on a single map panel. In addition, this scale, as well as the map projection, are the same as many other maps showing geologic and geographic data and can be compared directly.

A series of much smaller scale maps showing conflict (coincidence) of Roadless Areas with regions of potential energy resources have also been prepared and included as figures in the body of the report. Figure 1 represents a synthesis of individual conflict maps.

2.2 The BLM Roadless-Area Map

The Roadless Area map was compiled from a variety of larger-scale maps supplied to us by the BLM. The distribution of Roadless Areas shown on the map is complete as of April 1979. However, Roadless Area deletions, additions, and boundary modifications have occurred since this date. An up-dated Roadless Area map at a scale of 1:2,500,000 will be prepared by ORNL when the BLM identifies only those Roadless Areas that will undergo final intensive wilderness inventory. Because of the small-scale of all the maps prepared by ORNL (a line defining a tract boundary is approximately one-half mile wide), the user is cautioned not to make site-specific conclusions.

2.3 The Energy-Resource Maps

The energy resource maps are designed to give the user a rapid and general understanding of the regional distribution of existing and potential resources. For some energy resources, such as hydroelectric and oil shale, one map shows both existing and potential resources. The other energy resources are illustrated on two maps in which the potential resources are generally distinguished from areas of known resources (reserves).

The maps are useful as a means of illustrating and comparing the potential energy resource importance of one western geologic province with another. They should not be used to draw site-specific conclusions regarding apparent conflicts of energy resources with Roadless Areas. An estimate of the energy potential of a specific Roadless Area can be made only after studying much larger-scale maps.

Many of the map symbols are large and some cover tens of square miles. This was done for two reasons: to discourage the user from trying to pinpoint an energy resource within a Roadless Area without using larger-scale maps; and second, larger symbols make it easier to see broad, regional patterns--exactly the type of information the maps are meant to convey.

The resource maps can be used without any additional information. Each map contains a list of selected references used in the compilation, a title, a basic description of the resource region, a legend, and other pertinent information.

The nomenclature used to describe resources is confusing. To aid the non-geologist, as well as the geologist who is not familiar with resource terminology, Table I was prepared to show a correlation of terms used by the U. S. Geological survey in mineral resource investigations and terms from other sources as used in this study.

Table 1. *Resource Terminology and Correlations With This Study*

U.S. Geological Survey Classification Scheme

	Identified Resources	Undiscovered Resources	
		In Known Districts	In Undiscovered Districts
Recoverable	Reserves	Hypothetical	Speculative
Sub-Economic	Conditional Reserves		

↑ Feasibility of Economic Recovery Increasing

← Certainty of Existence Increasing ←

Correlation With This Study

Resource	This Study	USGS Diagram Above
Oil and Gas	(same terminology)	
Uranium	Reserves	Reserves
	Potential Resources	Conditional, Hypothetical and Speculative Resources
	(1) Probable	Conditional Reserves and part of Hypothetical Resources
	(2) Possible	A part of both Hypothetical and Speculative Resources
	(3) Speculative	Speculative
Coal	(same terminology)	
Oil Shale	(same terminology)	
Geothermal (after Muffler, 1978)	*Resource Base*	Includes <u>all</u> categories on diagram, plus all inaccessible, and accessible but useless energy in earth's crust
	Useful and Accessible Resources called "Geothermal Resources" in this Study	All categories in Diagram
	All other geothermal resource terms are identical to those in diagram	
Hydroelectric	(USGS Resource terminology does not apply)	

3.0 THE POTENTIAL IMPACT OF BLM WILDERNESS WITHDRAWALS ON THE FUTURE AVAILABILITY OF ENERGY RESOURCES

3.1 Assumptions

Many individuals and groups have expressed concern over the possible impact of BLM wilderness designation on the future availability of domestic energy resources. This section describes and assesses possible impacts of the BLM program over the short-term (1980-2000) and to a limited degree, the long-term (beyond 2000). Many assumptions and generalizations were required to make this assessment. However, the uncertainties of both resource supply and demand made the development of assumptions very difficult. Resource related uncertainties include such questions as:

- Will U.S. energy consumption increase continually over the next 20 years?
- What will be the rate of increase?
- Will major technological breakthroughs in the use of such resources as solar energy rapidly lower our dependence on fossil fuels?
- Will our relations with such countries as those of the Middle East and Mexico become better or worse?
- Will our standard of living and associated life styles change significantly and, if so, how?

We have chosen the following assumptions in belief that major shifts in demand and useage are unlikely in the short term.

1. U.S. energy consumption will continue to increase annually at a rate equal to the sum of the average annual rates of the past five years.
2. Oil, gas, and coal will continue to supply approximately 85 percent of total U.S. energy requirements, although some major technological breakthroughs permitting the use of alternate energy resources seem likely over the next 20 years.
3. Significant imports of oil and gas will develop from Mexico, but the availability of OPEC oil, particularly from the Middle East, will decline as worldwide competition increases for this rapidly dwindling resource.
4. In order to simplify the impact assessment, only one "wilderness" scenario is considered: that all BLM Roadless Areas identified in the inventory of April 1979, totalling about 57 million areas, will become wilderness. Past experience with the Forest Service RARE II Program indicates much less land will ultimately be withdrawn. However, the worst case scenario is a useful analysis tool. If little impact is experienced with the maximum withdrawal, then one can safely predict minimum impact.

Certain generalizations, in addition to the above assumptions, have also been made:

1. All maps in this section show clustered data. For example, the Roadless Areas Map (Fig. 3) shows broad regions of "roadlessness". This map was derived by subjectively clustering (drawing boundaries around) areas that contain a high percentage of the designated Roadless Areas. Hence, a certain portion of the area within the boundaries of these clusters are <u>not</u> roadless. The concept of the "degree or density of roadlessness" is based on the contiguity or near contiguity of numerous BLM Roadless Areas.

2. In a similar manner, areas with high energy resource potential have been clustered (Figs. 5-7 and 9-11). For example, areas of high geothermal potential are shown in Figure 10. Clearly, parts of such regions will have only minimal geothermal potential. Where questions arise regarding specific regional information, it is suggested the reader refer to the larger-scale energy-resource blue line maps. This suggestion is valid not only for geothermal conflicts, but for all other energy resource conflict maps as well (Fig. 4-6 and 8-10).

3. Areas of resource potential outlined on each energy-resource conflict map are restricted to those areas with relatively high resource potential. For example, the Uranium Conflicts Map (Fig. 6) includes areas with significant production, as well as with probable and possible potential resources (see Table 1 for a discussion of 'probable' and 'possible' uranium resources). Areas with less favorability are not

included as it is unlikely that they will contribute significant quantities of U_3O_8 in the near future. In fact, some of these lower ranked favorable areas, if not many, may never be economically productive.

3.2 Energy Resources and BLM Lands

To determine the possible impacts of BLM land withdrawals on future energy supplies, the present energy role of western lands in the national energy picture must be established. Figure 2 shows the estimated past, present, and projected future contributions that each source of energy makes to our energy needs. Currently , our total energy demand is estimated at about 80 quads* (Fig. 2). As our oil imports represent about 20 quad-equivalents,* domestic energy production represents about 75 percent of our total energy consumption. Table 2 shows a rough breakdown, by percent, of U.S. energy-resource production from the eastern and western conterminous United States. Of the 60 quads (Fig. 2) of domestic energy production for 1977-1978, we estimate 16 quad-equivalents to have come from the western U.S. (Table 3). Of the total 16 quad-equivalents produced from the western U.S. in 1977-1978, we estimate only about 3 quad-equivalents to have come from BLM lands. Thus, BLM lands produce less than 5 percent of the domestic energy supply, yet they occupy more than 9 percent of the land area of the lower-48 states. According to these percentages BLM lands presently do not contribute their share of national energy-resource needs, although the percentages suggest that BLM land may not contribute significantly to the total energy-resource supply if fully developed.

*A quad of energy equals 1015 BTU (1 quadrillion British Thermal Units) whereas a quad-equivalent is a measure of the potential energy of the energy resource.

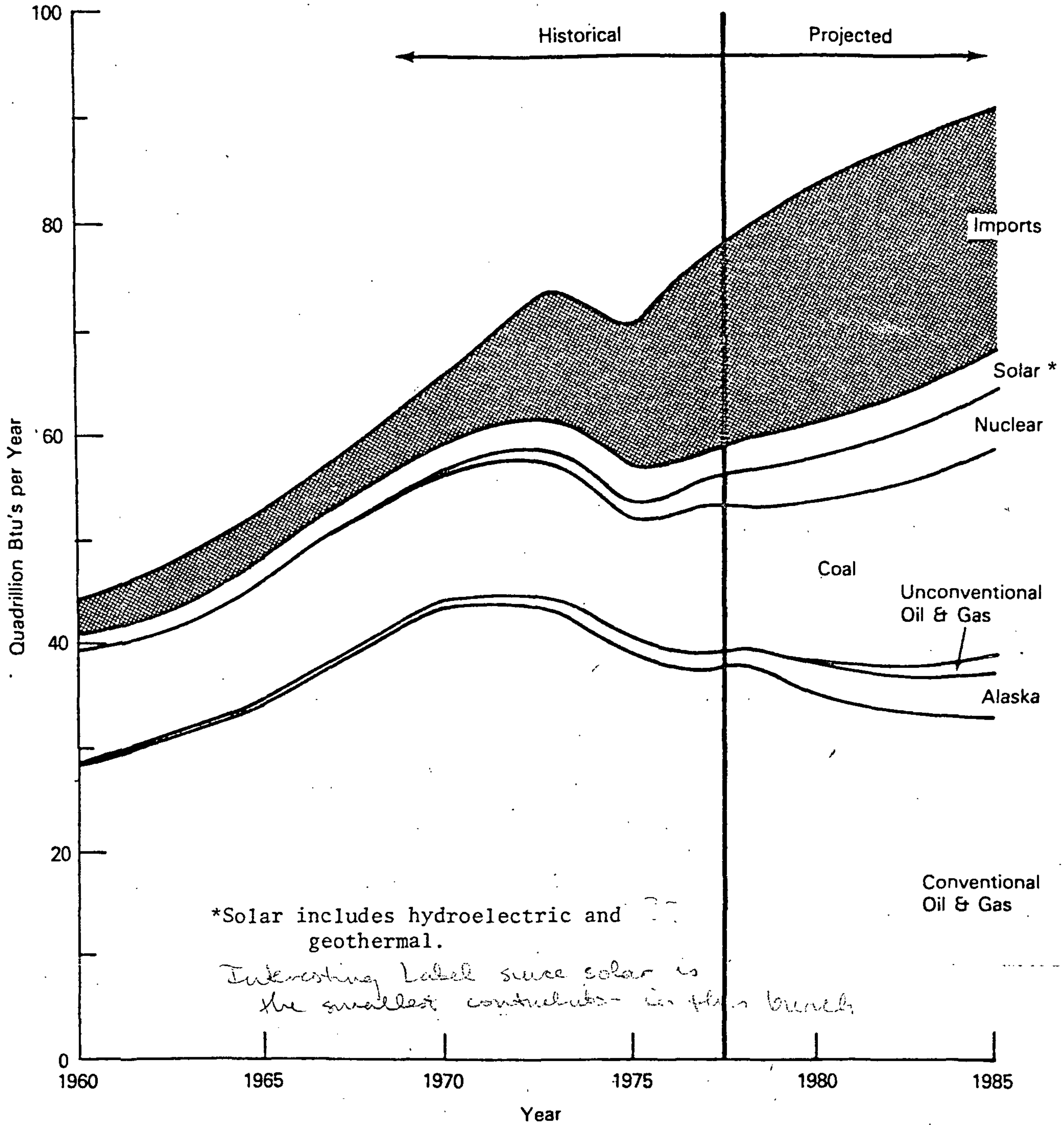


Figure 2. U.S. energy consumption in the near-term.

(source: National Energy Plan II, 1979)

Table 2. Production of Energy Resources in the Western United States Compared With the Eastern United States. (Does not include Alaska)

	Western U.S. (west of 102°W longitude) includes North and South Dakota	Eastern U.S. (east of 102°W longitude) includes Texas
Oil (1977)[1]	24%	76%
Gas (1977)[1]	18%	82%
Coal (1978)[1]	22%	78%
Uranium (1978)[2]	89%	11%

[1]Data compiled from State Mineral Profiles prepared by the U.S. Bureau of Mines. These publications are not referenced in bibiography, but are available free, upon request, from the U.S. Bureau of Mines. The year shown on the Table indicates the most recent year for which a complete data set is available.

[2]DOE (1979a).

Table 3. Production of Energy Resources in Estimated Quad-Equivalents

	Western U.S.	Eastern U.S.	Imports	Total ≅ 77 quads (1977-1978)
Oil (1977)[1]	4 quads	14 quads	16 quads	34 quads
Gas (1977)[1]	4 quads	16 quads	-	20 quads
Coal (1978)[1]	3.5 quads	12.5 quads	-	16 quads
Uranium (1978)[2]	2.5 quads	0.5 quads	-	3 quads
Other:[3] Geothermal Hydroelectric Solar and Others	2 quads (estimated)	2 quads (estimated)	- -	4 quads
Total	16 quads	45 quads	16 quads	≅ 77 quads

[1] See Footnote 1 on Table 2.

[2] See Footnote 2 on Table 2.

[3] DOE (1979a).

Geologic complexity as well as remoteness from markets and poor accessibility have impaired resource development on many BLM lands. Thus, detailed information on the energy-resource potential of these lands is limited. This data-poor condition might suggest the possibility of large undiscovered deposits. However, a large part of the BLM lands lie in relatively unfavorable areas for many of the energy resources and their energy potential, therefore, is low. To help illustrate this point, we have prepared a small-scale generalized Geologic Terrain Map (Fig. 3) of the western United States. Only four geologic terrains are illustrated on this map; their relationship to energy resources is shown in Table 4. The Geologic Terrain Map can be compared directly with the Roadless Area Map (Fig. 4) to determine the magnitude of roadlessness in each terrain.

From this comparison, it can be concluded that much BLM land may indeed not have much significance in our future supply of energy resources. At this scale, and with these generalized maps, it seems evident that geothermal resource development will be the most severally impaired if all Roadless Areas become wilderness. But as illustrated on figure 2, geothermal energy is not expected to make a significant contribution to future energy needs. Moreover, as discussed in the following section, the most important geothermal propects are on non-federal land. The next sections describe and assess the potential impacts to each energy resource that may result from the BLM Wilderness Program.

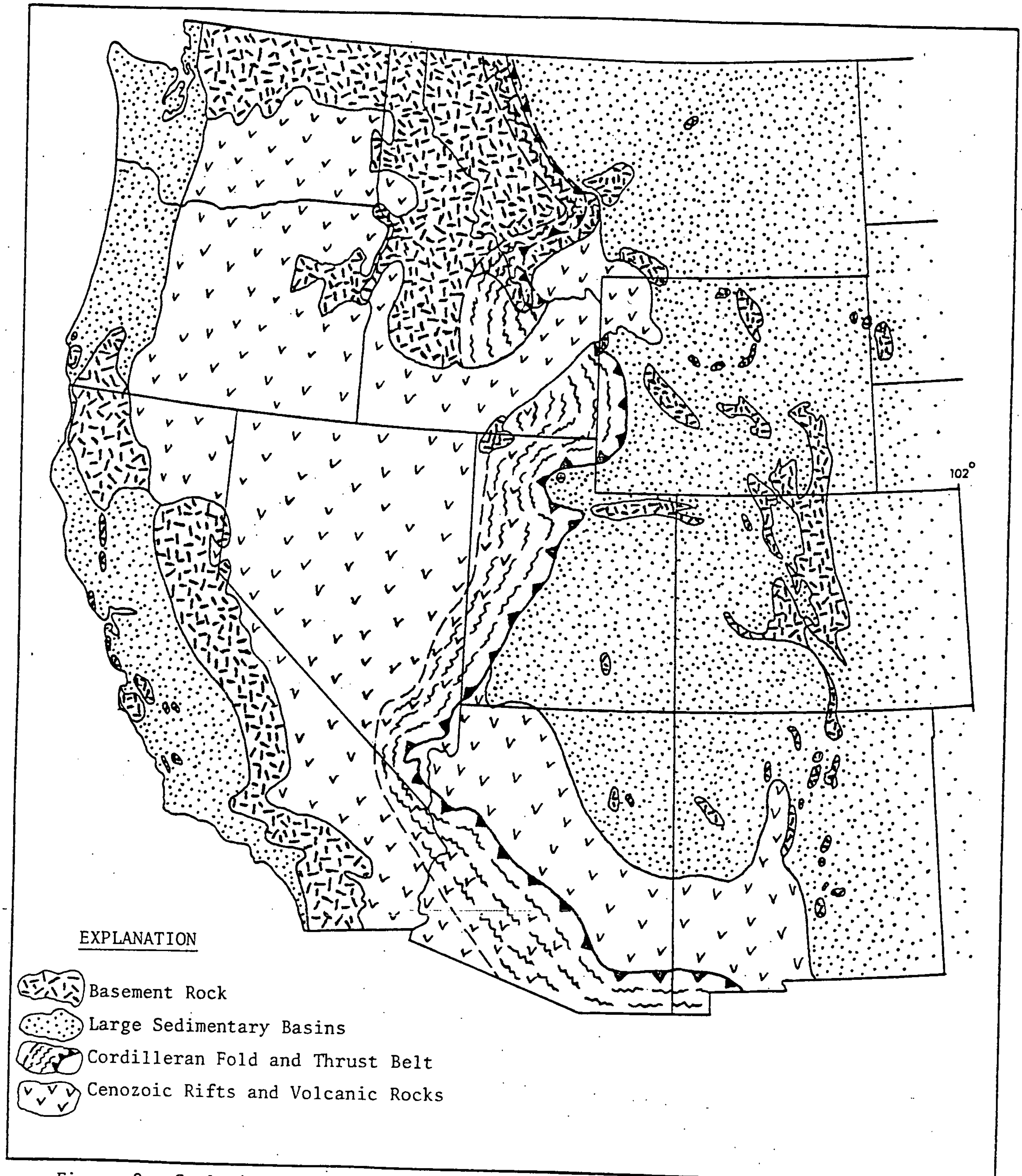


Figure 3. Geologic Terrain Map. See Table 4 for the relationship between these terrains and the energy resources.

Table 4. Relationship between geologic terrains illustrated on Figure 3 and the energy resources assessed. "High", "Moderate", and "Low" refer to the potential of the geologic terrain to contain significant amounts of energy resources. Hydroelectric potential ranges from "High" to "Low" in each geologic terrain.

	OIL AND GAS	COAL	URANIUM	GEOTHERMAL	OIL SHALE
BASEMENT ROCK	LOW	LOW	LOW	LOW TO MODERATE	LOW
LARGE SEDIMENTARY BASINS	HIGH	HIGH	HIGH	LOW[1]	HIGH
CORDILLERAIN FOLD AND THRUST BELT	MODERATE (Text early says HIGH)	LOW	LOW[2]	LOW[3]	LOW
CENOZOIC RIFTS AND VOLCANIC ROCKS	LOW	LOW	LOW TO MODERATE	HIGH[4]	LOW

Why is this shown as high priority [illegible] when large sed 'basins' apparently have a higher resource potential

[1] On Figure 2, the Geysers Geothermal Area north of San Francisco Bay is shown within "Large Sedimentary Basins". The Geysers area actually lies in a terrain of structurally complex metavolcanic rocks.

[2] In the Idaho and Wyoming segment of the Cordilleran Fold and Thrust Belt low-grade uranium resources occur in the Phosphoria Formation.

[3] Geothermal potential is high from southwest to central Utah, where the terrain of "Cenozoic Rifts and Volcanic Rocks" coincides with the "Cordilleran Fold and Thrust Belt".

[4] Except on the Columbia Plateau in Washington and Oregon (see Geothermal Map 2 for details).

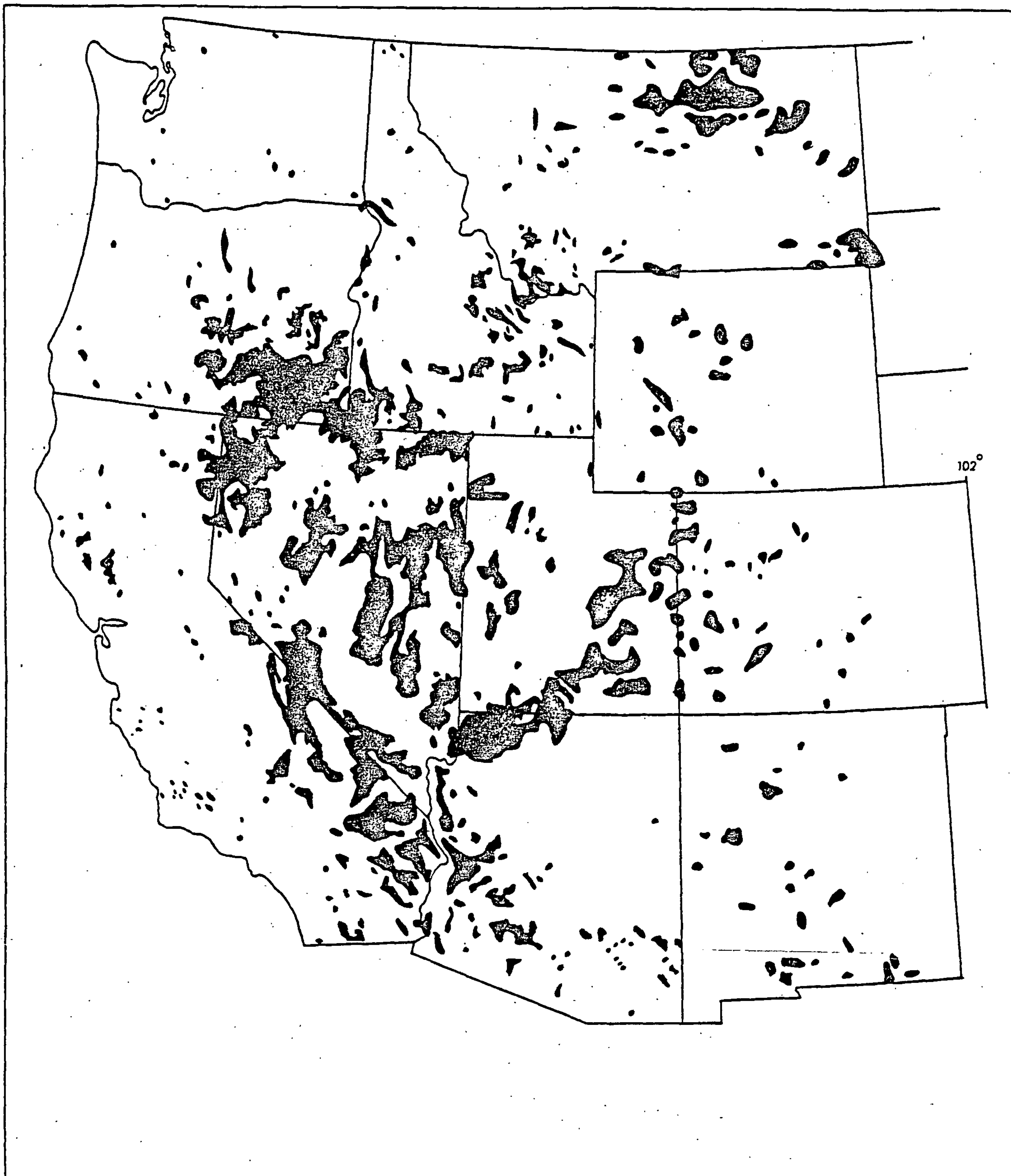


Figure 4. BLM Roadless Areas map showing clusters of densely spaced Roadless Areas in black.

3.3 Oil and Gas

Oil and Gas Map 1 shows the distribution of major petroleum provinces and fields throughout the western United States. Oil and Gas Map 2 shows the oil and gas favorability of these regions. Five levels of favorability are identified on Map 2. They range from very low to no favorability over basement rock, to moderate and high favorability in large sedimentary basins. For this discussion, regions assigned a favorability less than 3 are not considered further (see explanation on Oil and Gas Map 2 for the meaning of favorability ratings).

The Oil and Gas Conflicts Map (Figure 5) shows all regions assigned a favorability greater than or equal to 3 on Oil and Gas Map 2, as well as the Roadless Area conflicts within these regions. The Rocky Mountain region (excluding the thrust belt) is by far the largest and most important oil- and gas-producing region west of 102° longitude. The oil and gas rating assigned to the Rocky Mountain region, and all other regions on Oil and Gas Map 2, is an estimate of the maximum oil and gas potential of that region. Many areas within these regions have a much lower favorability and to avoid map clutter, areas of basement rock in the Rocky Mountain region (Figure 3) which have virtually no favorability for oil and gas are not shown.

The most important areas of production within the Rocky Mountain region are in sedimentary basins, the axes of which are shown on Figure 5. Production from these basins has been largely along the sedimentary flanks (see Oil and Gas Map 1). Future exploration will continue along the flanks, as well as within the deeper, more central

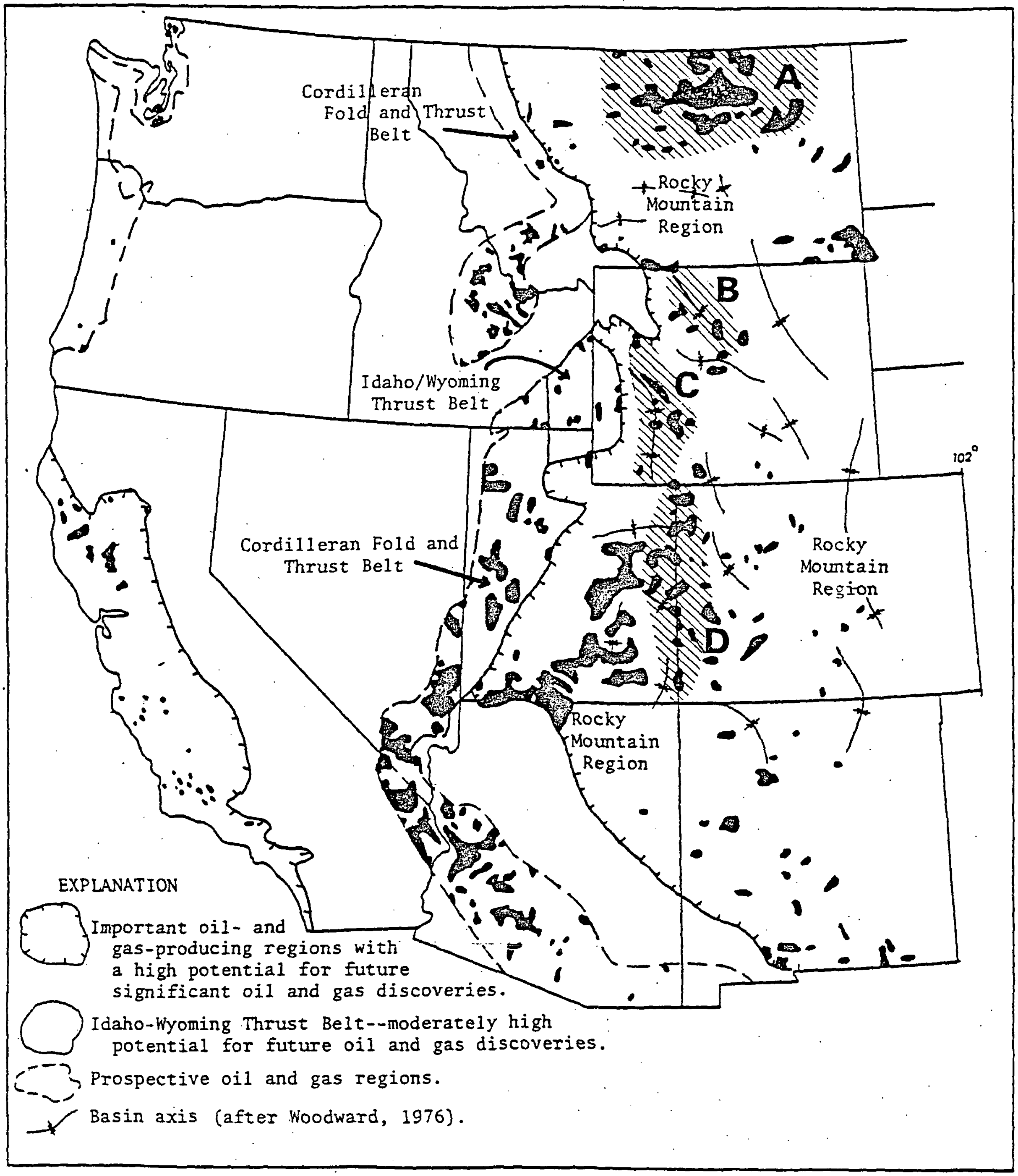


Figure 5. Oil and Gas/Roadless Area conflicts. Clustered Roadless Areas are shown in black. Significant conflicts are in north-central Montana (A), Big Horn Basin, Wyoming (B), Greater Green River Basin, Wyoming (C), and the region along the Utah-Colorado border (D).

parts of each basin. The chief oil and gas/Roadless Area conflicts in the Rocky Mountain region (Figure 5) are as follows:

A. North-central Montana

B. Big Horn Basin, Wyoming

C. Greater Green River Basin, Wyoming

D. The region along the Utah-Colorado border.

In California, there are no significant conflicts between oil and gas favorability and Roadless Areas (Figure 5). The lack of conflict is due largely to the small acreage of BLM land in the Great Valley and in the coastal basins, which are the prime on-shore areas of oil and gas exploration in California.

Another favorable geologic terrain for oil and gas is the Cordilleran fold and thrust belt extending from Montana to New Mexico (Figure 5). A particularly favorable part of the central segment of the thrust belt lies in western Wyoming, southeastern Idaho, and north-central Utah, collectively called the Idaho-Wyoming thrust belt (Figure 5). Although this area is currently one of the most active on-shore exploration targets in the U.S., the BLM roadless acreage is small. The other segments of the thrust belt are at present considered less favorable, but the Roadless Area conflicts are generally greater (Figure 5).

There are no significant oil and gas/Roadless Area conflicts in Oregon (is this true) and Washington (Figure 5).

Conclusion - If all BLM Roadless Areas are designated wilderness, our future potential for domestic oil and gas resources will be reduced, but not significantly. However, significant short and long term impacts would be experienced in some parts of the Rocky Mountain region, particularly in north-central Montana, the Big Horn Basin, Wyoming, the Greater Green River Basin, Wyoming, and the region along the Utah-Colorado border (Fig. 5). The north-central Montana conflict region is considered important because it has current production, a high potential for future production, and a high density of Roadless Areas. The Wyoming conflict regions have fewer Roadless Areas but are currently being extensively explored and have a high potential for future production. The Utah-Colorado border conflict region has fairly high potential and an intermediate number of Roadless Areas.

While the long-term impact of wilderness designation is a reduction in the potential for production, a more serious problem may prove to be the interim-management procedures followed by BLM during the 10-year duration of the wilderness program. Although these procedures allow access and limited exploration in Roadless Areas, they do not encourage exploration. To reduce delays in the oil and gas development cycle in critical regions, BLM should be encouraged to study Roadless Areas in these regions early in their program. A large number of inventory areas may then be released for multiple-use development.

3.4 Uranium

Uranium Map 1 shows uranium occurrences and areas of production in the western United States and Uranium Map 2 shows areas favorable for additional uranium resources. Three levels of resource potential are shown on Uranium Map 2: possible-probable, speculative, and favorable--in decreasing order of favorability (see map for details). In the following discussion, only the highest levels of resource favorability, that is, possible-probable, are considered.

Figure 6 shows the conflicts (coincidence) of Roadless Areas with areas of high favorability for potential uranium resources. The most important areas for future uranium discoveries are where past and present production are high, that is, in the Wyoming Basins and in the Colorado Plateau (Uranium Maps 1 and 2). Roadless Area conflicts in these regions are important. As illustrated in Figure 6, the most significant conflicts that might affect future discoveries and production are in central and southwestern Wyoming (A), and parts of the Colorado Plateau in Utah, Arizona and Colorado (B and C).

Conclusion - If all BLM Roadless Areas are designated wilderness, our future potential for uranium resources could be reduced significantly. Recent studies (Chenoweth, 1979) have shown that 46.8, 40.4, and 31.1 precent of domestic reserves, probable-possible resources, and speculative resources, respectively, are on public land administered by BLM and the Forest Service. Furthermore, much geologic terrain deemed favorable in the search for new uranium resources lies on BLM lands. Uranium occurs in a wide diversity of geologic environments, and industry is in the process of developing new models of deposit occurrences and exploration techniques. Withdrawal of large parts of the lands from entry for evaluation could seriously impede the building of the uranium-resource base needed by the nation in the coming half

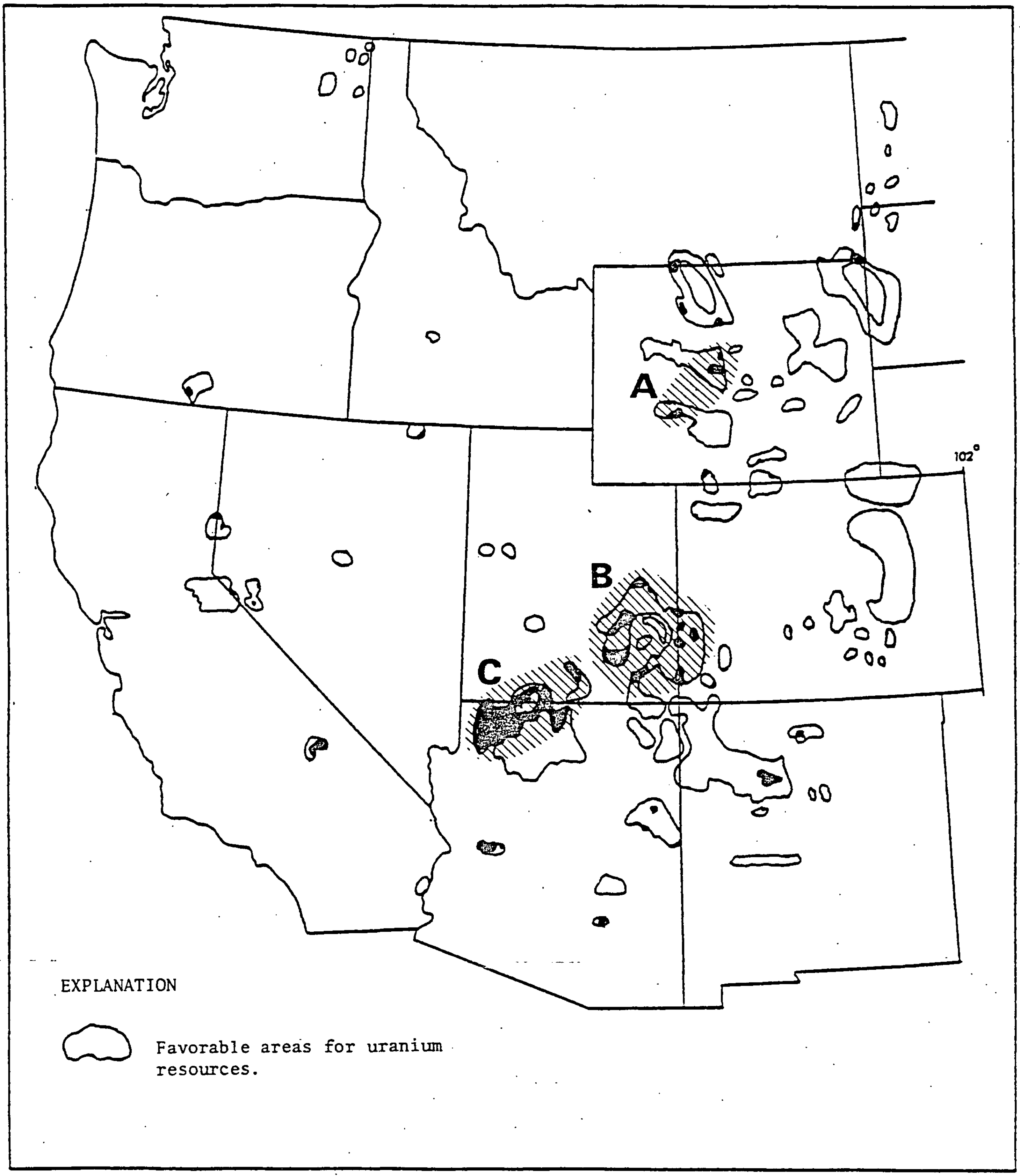


Figure 6. Uranium/Roadless Area conflicts. Clustered Roadless Areas are shown in black. Significant conflicts are in the Greater Green River Basin (A), and on the Colorado Plateau in Utah and Colorado (B) and Utah and Arizona (C).

century. It is hoped that early recognition of the broader areas of high conflict with designated Roadless Areas can lead to early review for decisions on land status so that as little time as possible is lost in continuing exploration programs.

3.5 Coal

Coal Map 1 shows the distribution of coal-bearing rocks in the western United States and Coal Map 2 shows the most important areas for future coal production. Almost all the coal areas shown on Coal Map 2 were identified by the U.S. Geological Survey and called "Known Recoverable Coal Resource Areas" (KRCRAs). Because most federal coal is contained in KRCRAs and by definition BLM Roadless Areas are only on federal land, we therefore decided to use the KRCRAs, with some additions, to show the conflicts between coal resources and Roadless Areas (Figure 7).

Based on current Department of Interior (1979) and DOE (1979) projections, the Powder River Basin in Wyoming and Montana will play an ever-expanding role in meeting our nation's future coal production goals (Figure 8). The only conflict areas in this important basin are in southeastern Montana (A). Other conflict areas are in central and southcentral Utah (B). (The Kaiparowitz Plateau and Black Mesa coal-producing areas in south-central Utah and northern Arizona, respectively, have not yet been designated as KRCRAs.)

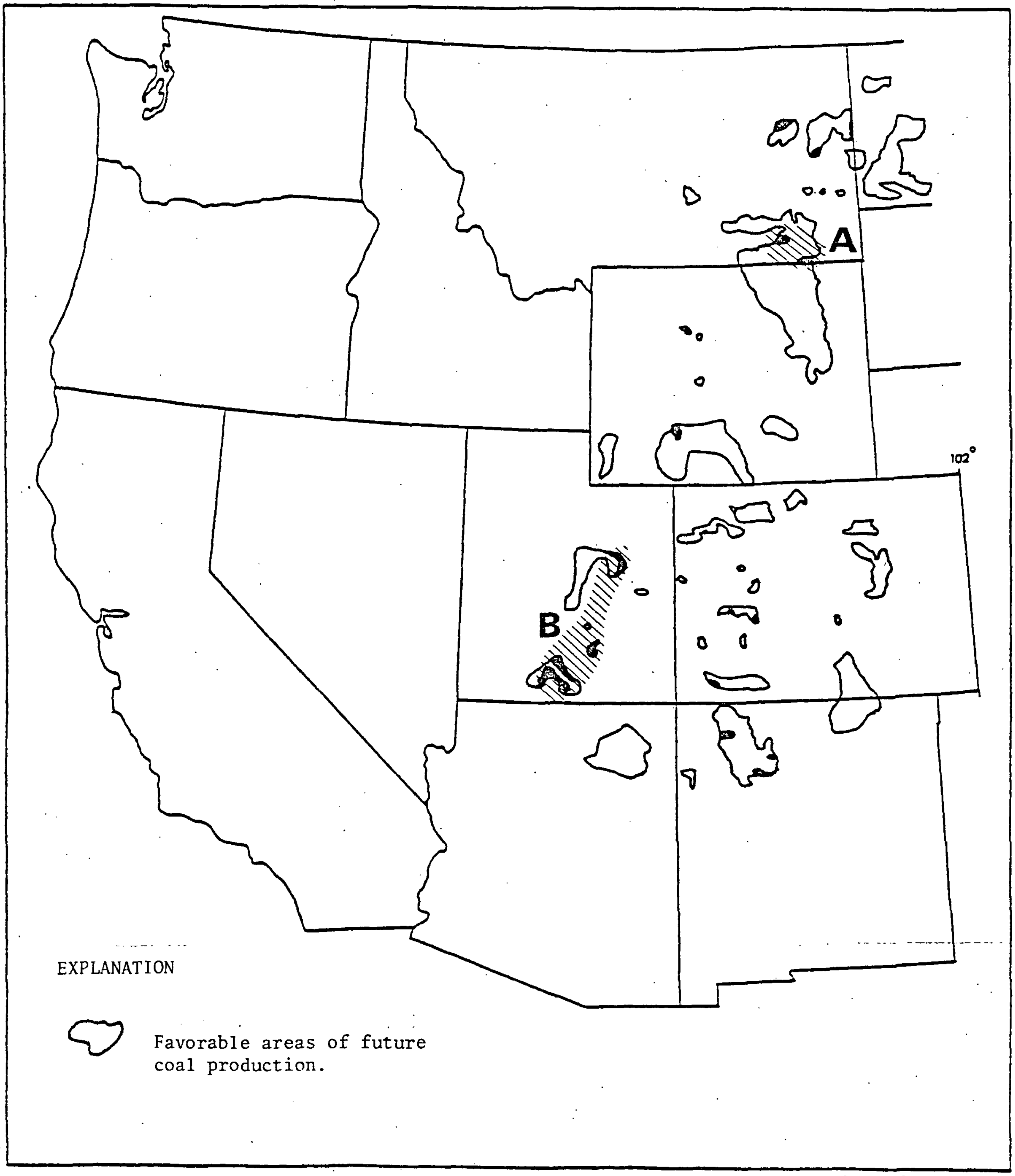
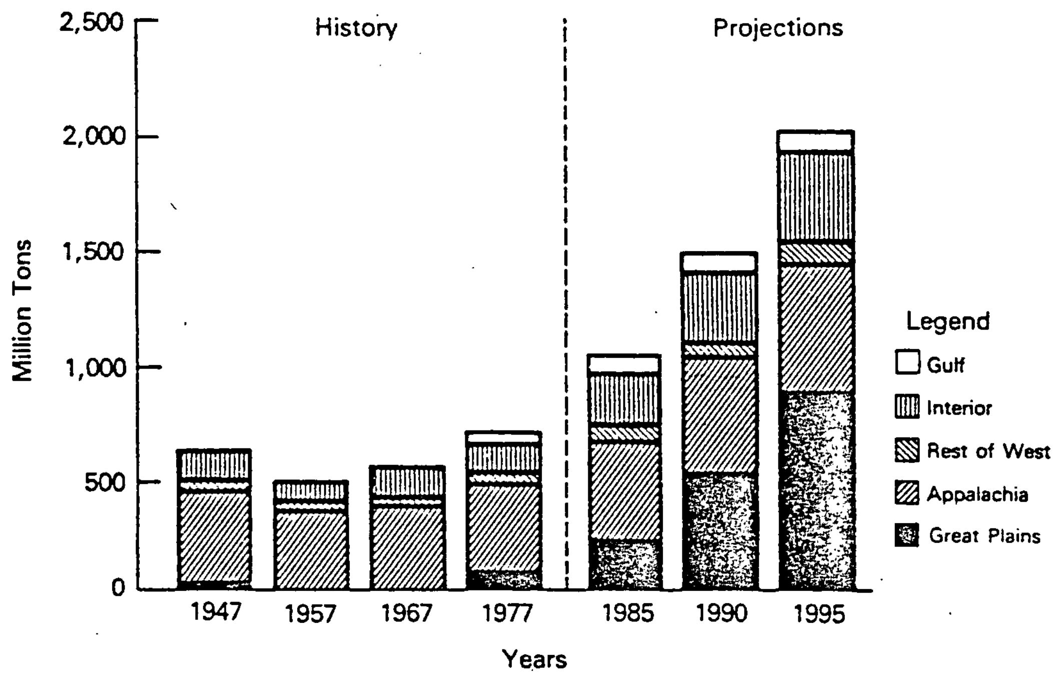


Figure 7. Coal/Roadless Area conflicts. Clustered Roadless Areas are shown in black. Significant conflicts are in the Powder River Basin of southeastern Montana (A), and in central and southcentral Utah (B).



(source: DOE, 1979)

Figure 8. Graph showing the anticipated production of coal through 1995. Note that the major increase in coal production is expected in the Great Plains--mainly from Montana, Wyoming, North Dakota, and South Dakota.

Conclusion - If all BLM Roadless Areas are designated wilderness, the impacts to the development of future coal resources will be minimal. This conclusion stems from the abundance of coal in the U.S. and minimal conflicts between federal coal and BLM Roadless Areas.

3.6 Oil Shale and Heavy Oil

Oil Shale Map 1 shows the distribution of the most favorable areas of oil shale and heavy oil in the western United States. If the price of oil and gas continues to rise--which is a reasonable assumption, future economic production of oil from shale and heavy oil will likely begin.

DOE (1979b) estimates that domestic oil production from oil shale in Utah, Colorado, and Wyoming could be 100,000 barrels a day in 1985 and 450,000 barrels a day by 1995. Oil production from heavy oils in Utah and in lesser amount from California could achieve an additional 150,000 barrels per day by 1995, bringing the total oil production from oil shale and heavy oils to approximately 600,000 barrels per day by 1995 (DOE, 1979b). This is projected to be about 5 percent of total domestic oil production for the period 1985-1995 (DOE, 1979b).

Figure 9 shows the conflicts (coincidence) between Roadless Areas and areas with high potential for oil-shale and heavy-oil development. The most important area for oil shale development is in the Piceance Basin (A) of northwest Colorado. Some Roadless Areas are identified in the Piceance Basin, but the total roadless acreage is low. The acreage of Roadless Areas in the Uinta Basin (B) of Utah and the Greater Green River Basin (C) of Wyoming is relatively high, but the oil shale in

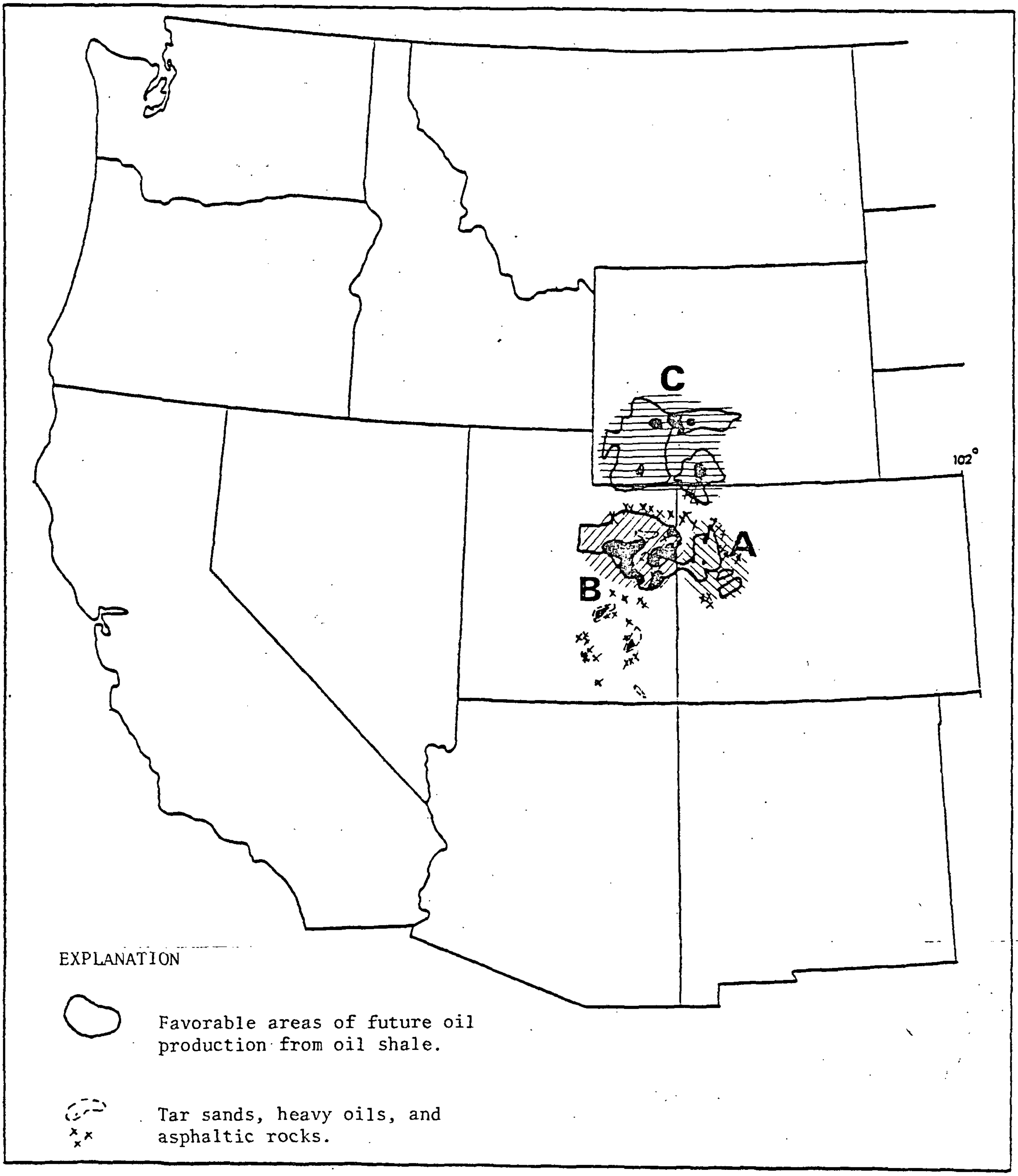


Figure 9. Oil Shale/Roadless Area conflicts, and Heavy Oil/Roadless Area conflicts. Clustered Roadless Areas are shown in black. Piceance Basin (A), Uinta Basin (B), Greater Green River Basin (C). Significant conflicts with heavy oils occur in the Uinta Basin (B). Oil shale conflicts are minimal.

these basins has a lower potential for near-term development. The most important areas for potential development of heavy oils are in Utah, particularly in the Vinta Basin (B) and farther south in central Utah (Figure 9). The coincidence of Roadless Areas and heavy oils is significant.

Conclusion - If all BLM Roadless Areas are designated wilderness, the impacts to the future potential development of oil shale resources will be minimal. The first sites likely to be developed by industry are in the Piceance Basin where roadless acreage is low. The Uinta and Green River Basins, where some Roadless Area conflicts exist, would probably not be targets for industry development until oil-shale technology has been thoroughly tested and developed in the Piceance Basin. Impacts to the potential development of heavy oils are more significant than oil shale, especially in the Uinta Basin.

3.7 Geothermal

Geothermal Maps 1 and 2 show the distribution of geothermal resources in the western United States. Currently, the Geysers in California is the only area in the United States that has produced electrical energy from geothermal resources. However, direct use of geothermal waters for heating and other drying purposes is currently being studied for selected areas in the western United States. The rate of introduction of geothermal technology is expected to be low in the next 20 years. no
One of the major problems that contributes to a reluctance by the public utilities to move rapidly into geothermal-resource development is the uncertainty that surrounds the understanding of the depletion rates of this lesser known energy-resource.

Figure 10 shows the conflicts (coincidence) between Roadless Areas and areas of geothermal potential. This map differs from other conflict maps in two ways: (1) the areal extent of geothermal resources shown on Figure 10 is much greater than the extent of other resources; and (2) the conflicts with Roadless Areas appear greater than with other resources. However, the more important (hotter) geothermal prospects appear to occur largely on non-federal land. Nevertheless, significant conflicts do occur in northwestern Nevada and southeastern Oregon (A) north of San Francisco Bay (B), and east-central California (C). (see Geothermal Map 1 and 2, and Figure 10).

Conclusion - If all BLM Roadless Areas are designated wilderness, short-term (1980-2000) impacts to exploration and possible development of geothermal resources will be minimal. Such minimal impact is forecast because sufficient private land as well as nonroadless BLM land with excellent geothermal potential are available for the investigations needed to develope the technology for large scale and broad use of this lesser known energy resource. Long-term impact is also minimal because of high cost and low efficiency related to the transport of electricity to major population centers. However, smaller demands for electric power in certain rural systems may be satisfied by the development of more remote geothermal resources. Conflict of individual or relatively small clusters of Roadless Areas with such potential needs should then be evaluated on a site-specific basis.

Assumes all geothermal
development [illegible]

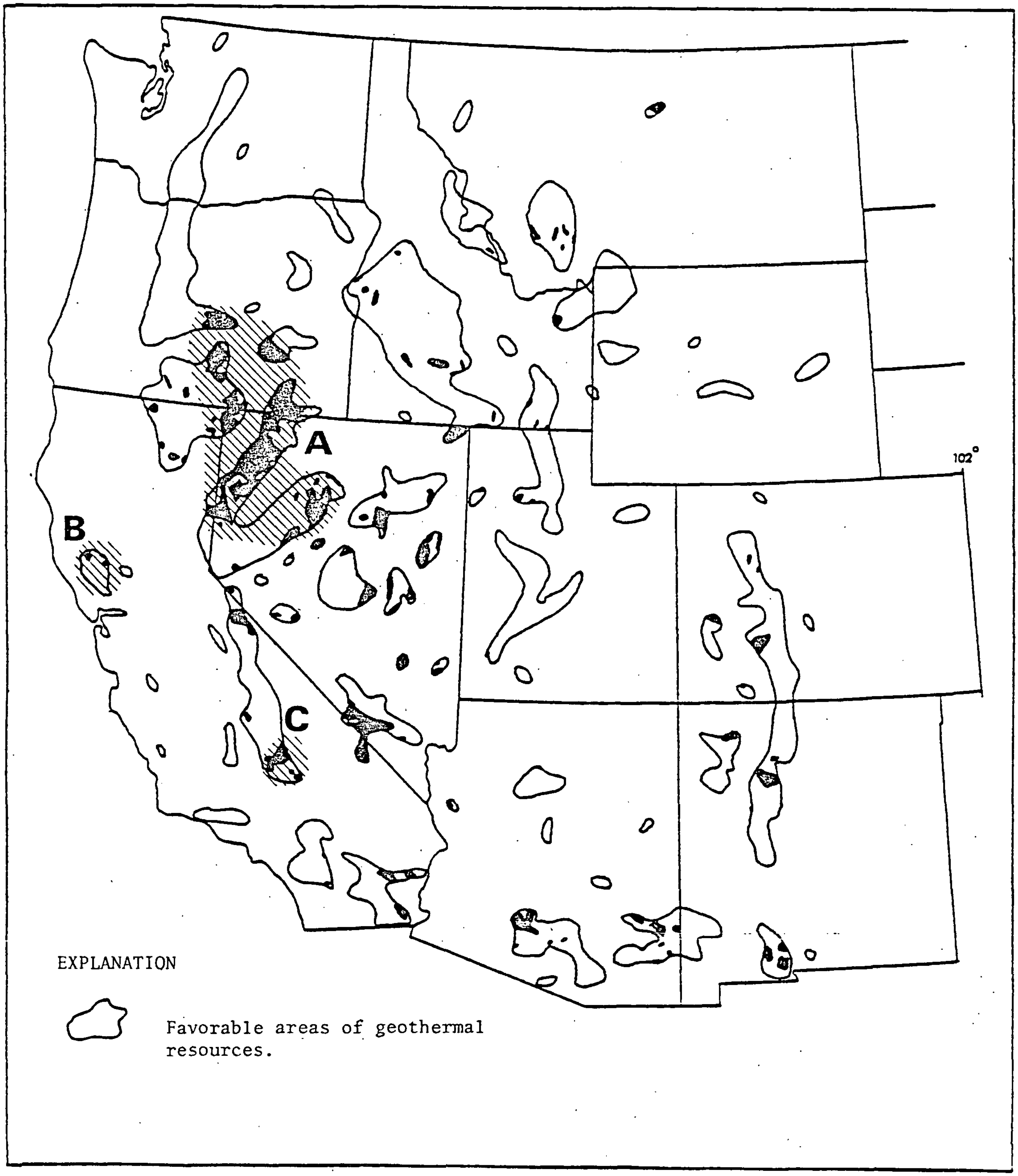


Figure 10. Geothermal/Roadless Area conflicts. Clustered Roadless Areas are shown in black. The most important conflicts occur in northwestern Nevada and southeastern Oregon (A), north of San Francisco Bay (B), and east-central California (C).

3.8 Hydroelectric

Hydroelectric Resource Map 1 of the western United States shows existing and potential hydroelectric sites. The minimum generating capacity for a potential site is generally 5 megawatts, but the information used to illustrate the map was so diverse that some lower-potential sites have no doubt been included (see references on Hydroelectric Map).

Figure 11 shows the conflicts (coincidence) of Roadless Areas with potential hydroelectric sites. The only region with conflicts is southwestern Idaho and southeastern Oregon (A). In general, however, the most important potential hydroelectric sites are in Washington and Oregon where there are minimal conflicts with Roadless Areas.

Conclusion - If all Roadless Areas are designated wilderness, the impacts to future development of hydroelectric resources will be minimal. This is because the majority of BLM lands are in lowland areas and significant conflicts with hydroelectric sites are relatively few. Most conflicts that do exist are with potential low-head hydro sites which would provide electrical energy only to a local area.

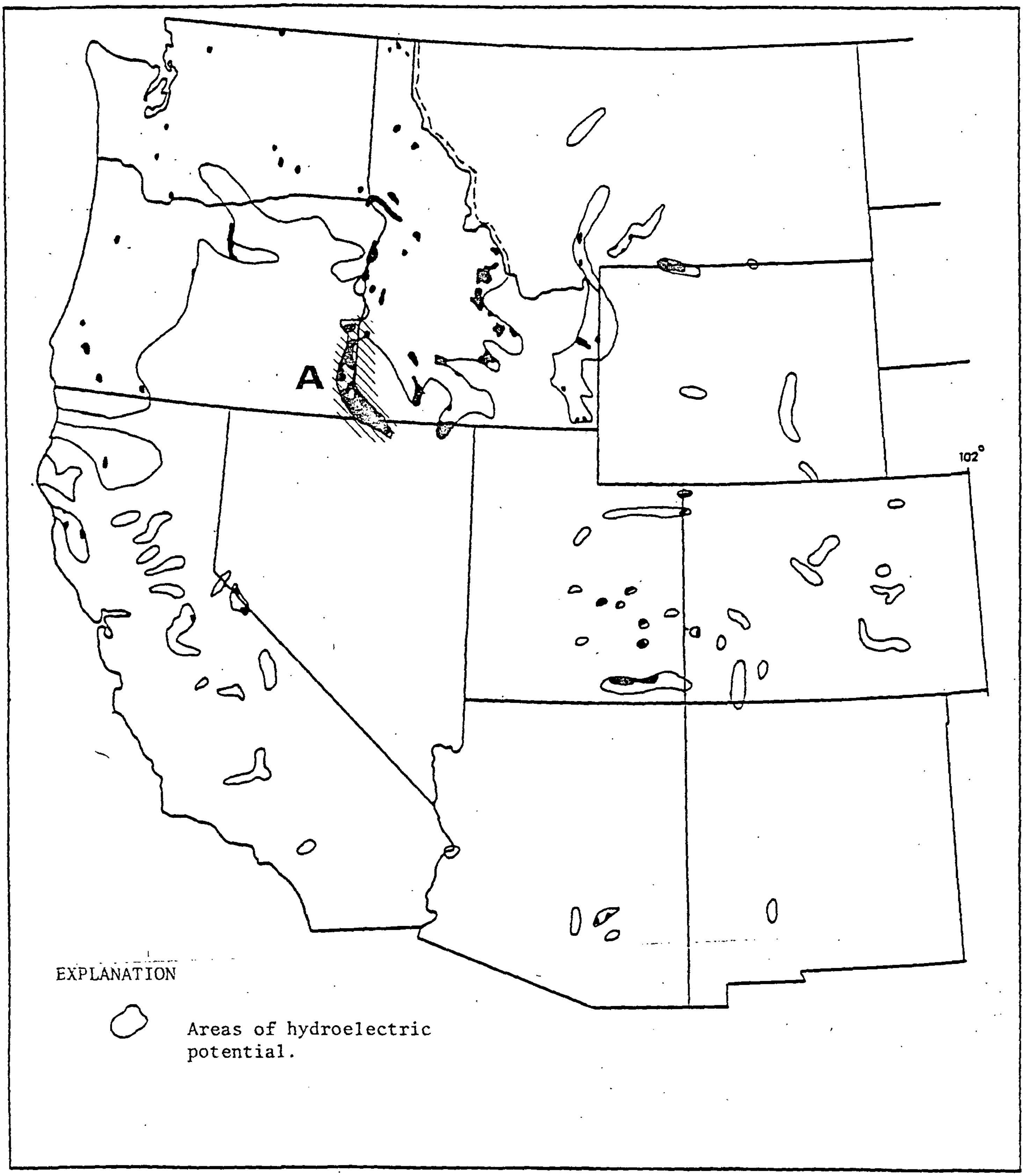


Figure 11. Hydroelectric/Roadless Area conflicts. Clustered Roadless Areas are shown in black. No significant conflicts exist. 'A' is southwestern Idaho and southeastern Oregon.

4.0 SUMMARY

Figure 1 shows regions where the greatest competition is expected between wilderness areas and regions of existing and potential energy resources.

The first step in compiling Figure 1 was to use the derivative Roadless Area map (Fig. 4) wherein densely spaced Roadless Areas are clustered within a single boundary. A coincidence map was then prepared by superimposing the six resource conflict maps (Figs. 5-7 and 9-11) and by applying the following two conflict criteria: (1) the relative importance of a resource, and (2) the number of coincident energy resources in an area. These criteria are discussed below.

1. The relative importance of an energy resource. The criteria used to determine the relative importance of an energy resource for this study are as follows:

   - The abundance or potential abundance, or the lack thereof, of the resource elsewhere. This criterion tends to lower the importance of coal and increase the importance of oil and gas, oil shale, and uranium.

   - The present and projected (1980-2000) contributions to the energy requirements of the nation. This significantly increases the importance of oil and gas, increases the importance of coal, and somewhat lowers the importance of uranium, and lowers the importance of oil shale and geothermal resources.

- The end-use of the energy resource. A variety of end-uses, such as in electrical generation, and in the transportation, residential, commercial, and industrial sectors, tends to increase the importance of a resource. Oil and gas are therefore the most important resources in this regard.

Based on these criteria, we consider oil and gas to be the most important energy resource, followed by uranium, coal, and oil shale. Hydroelectric and geothermal resources are not ranked because electrical energy generated from these resources is largely used near the source. This is in contrast to oil and gas, uranium, coal, and synfuels which can be transported anywhere in raw form and then used for electrical generation. Therefore, the importance of a resource that cannot be transported great distances is region-specific. For example, hydroelectric power contributes only a small percent of total U.S. energy requirements, but it supplies a significantly greater amount of the energy needs in the Northwest.

2. <u>The number of coincident energy resources in an area.</u> The overlap of existing and/or potential energy resources increases the energy importance of Roadless Areas. This is despite the fact that development of one resource, such as hydroelectric, may preclude development of other resources, such as uranium and coal. Nevertheless, the potential does exist to develop some

resources simultaneously at the same site. It should be kept in mind, however, that this study is not designed to determine the most suitable resource to be developed at a site.

Based on these criteria, we have identified four regions of significant conflict (Fig. 1) between potential multiple energy resources and Roadless Areas. These regions, along with the Cordilleran fold and thrust belt which is currently being explored actively for oil and gas, are recommended for immediate study.

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