REGIONAL ANALYSIS
PART 1

DRAFT

ENVIRONMENTAL STATEMENT

Development of Coal Resources in Central Utah

Cover:
Artist's sketch of the abandoned portal facilities of the Larson-Rigby mine located in spruce-fir, Wasatch Plateau coal field. The task force found the site used as a mid-day bed ground by a group of does and their fawns.

Since the preparation of this document, significant changes have occurred in the roles of the Office of Surface Mining, U.S. Geological Survey, and the Bureau of Land Management regarding Federal coal management. The basic roles are defined in Division of Functions and Responsibilities Concerning Management of Federal Coal Between the Office of Surface Mining, U.S. Geological Survey, and Bureau of Land Management, signed on July 5, 1978, by Under Secretary of the Interior, James A. Joseph. This draft EIS does not reflect the responsibilities of OSM, BLM, and USGS as outlined in the above-mentioned document. Such changes in responsibility will not affect the impacts defined in this EIS. Appropriate changes will be made in the Final Environmental Statement to reflect the provisions of the agreement.

ENGLISH-METRIC CONVERSION FACTORS

To convert English unit	Multiply by	To obtain Metric unit
Inches (in)	2.54	Centimeters (cm).
Feet (ft)	3.048×10^{1}	Centimeters (cm).
	3.048×10^{-1}	Meters (m).
Miles (mi)	1.609	Kilometers (km).
Square feet (ft^2)	9.290×10^{-2}	Square meters (m^2).
Acres	4.047×10^{-1}	Hectares (ha).
	4.047×10^{-3}	Square kilometers (km^2).
Acre-feet (acre-ft)	1.233×10^{3}	Cubic meters (m^3).
	1.233×10^{-3}	Cubic hectometers (hm^3).
Cubic yards (yd^3)	7.646×10^{-1}	Cubic meters (m^3).
Pounds (lb)	4.536×10^{-1}	Kilograms (kg).
Short tons (tons)	9.072×10^{-1}	Metric tons (t).
Pounds per acre (lb/acre)	4.883	Kilograms per hectare (kg/ha).
Btu/lb	2.326	Kilojoules per kilogram (kJ/kg).
Gallons (gal)	3.785×10^{-3}	Cubic meters (m^3).
Gallons per minute (gal/min)	6.309×10^{-2}	Liters per second (L/s).
Degrees Fahrenheit (°F)	([1])	Degrees Celsius (°C).

[1]Temperature in °C =(temperature in °F − 32)/1.8.

DEPARTMENT OF THE INTERIOR

DRAFT

ENVIRONMENTAL STATEMENT

REGIONAL ANALYSIS-PART 1

DEVELOPMENT OF COAL RESOURCES IN CENTRAL UTAH

Prepared by the
DEPARTMENT OF THE INTERIOR

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U.S. Geological Survey

1978

VOLUME CONTENTS
Part 1
REGIONAL ANALYSIS

Summary

Draft (x)   Final ( )   Environmental Statement

Department of the Interior, U. S. Geological Survey

1. Type of Action: Administrative (x)   Legislative ( )

2. Brief Description of Action: In compliance with the National Environmental Policy Act of 1969 (Public Law 91-190), this statement is an analysis of environmental impacts which could result in the Central Utah region coal development proposals that require Federal approval.

The total Federal lease area included in the M&RP's is 25,749 acres. Additionally, 3,303 acres are under land use application for associated coal development facilities. The total estimated land requirements, including Federal, State, and private, are 37,463 acres. About 382 million tons of coal would be recovered over the life of the proposed mining operations.

This statement is organized into two parts. Part 1 is an analysis of cumulative impacts of proposed coal developments on Federal land and associated ancillary facilities. Part 2 is an analysis of the individual proposals. Involved are:

A. Federal approval of nine underground mining and reclamation plans (M&RP) on existing leases.

B. Federal approval of land use applications associated with the MR&P's.

C. A projected production scenario of 24 million tons of coal per year (mty) by 1990 from the Central Utah region. This includes full production from the nine proposed M&RP's and would supply the peak damand requirements of the proposed Intermountain Power Project (IPP).

3. Summary of Environmental Impacts:

A. Surface disturbance would total 2,924 acres and 30,000-40,000 acres could be subject to surface subsidence. Fractures, surface buckling, and depressions of several feet, but not more than 20 feet, may accompany the subsidence.

B. Based on an overall underground recovery rate of 50 percent, about 383 million tons of coal would be left in the ground.

C. Soils would be disturbed on 2,924 acres and on-site erosion rates could increase by an average of 3 cubic yards per acre per year.

D. Water quality may be lowered temporarily from suspended sediment, if high intensity rainfall occurs during construction when potential erosion rates are greatest.

E. Air quality could be lowered, primarily total suspended particulate (TSP) in the immediate vicinity of the mines and associated unpaved roads and because of the population increase in the region.

F. The present visual quality of the landscape would be changed as a result of mining and the associated transportation and transmission facilities.

G. Vegetation on 2,924 acres would be destroyed as a result of mining and associated activities including community expansion. This vegetation would have provided 126 AUM's per year of grazing for domestic livestock over the average life of the mines and 390 AUM's on the acreage lost to community development.

H. Wildlife habitat would be lost on 2,924 acres including community expansion. Silt and sediment deposits could increase in fish habitat.

I. The population increase at the projected level of coal production of 24 mty would be from 55,000 in 1975 to 70,000-75,000 in 1990. This is only slightly greater than the increase anticipated in the future with no Federal action (the low level production scenario).

J. Population in Carbon County would increase from 19,000 in 1975 to about 33,000 in 1990 and that in Emery County would increase from about 6,700 in 1975 to about 14,000 in 1990. Sevier, Wayne, Piute, and Sanpete Counties would have about 10 percent growth.

K. The increased population would require about 5,900 acre-feet of water annually for domestic and public purposes.

L. About 800 acres of irrigated cropland would be removed from production. This would include community expansion and reallocation of water needed for domestic and public use.

M. Housing requirements would about parallel population increases.

N. About 10 percent of the population, those 65 and older, would be adversely impacted by anticipated rising prices and shortages in public services.

O. Competition for labor would adversely affect existing area businesses.

P. Rapid growth would place temporary financial pressure on local government: quality and quantity of some municipal services may decline, i.e., sewage and solid waste disposal, health care, social services, police and fire protection, recreation facilities, education, etc.

Q. Lasting cultural changes must be expected in Emery and perhaps Sevier and Wayne Counties.

4. <u>Alternatives Considered</u>: The alternatives discussed relate to the Secretary's possible decisions on mining and reclamation plans under consideration. Two alternative production scenarios are presented and provide a basis for evaluating areas of environmental concern or impact sensitivity at low and high production levels. The low-level or no-action scenario projects a production of 18 million tons of coal per year (mty) by 1990. This requires no Federal action, i.e., nonapproval of the proposed MR&P's. The high-level scenario projects a production of 42 mty by 1990. This includes all known mining proposals, involving Federal, State, and private lands and expansion of existing mines. Although the Secretary is not proposing a particular level of production, he can consider actions that will allow Federal coal to be available under environmentally acceptable conditions.

5. <u>Comments on the draft environmental statement have been requested from various agencies, State clearing houses, and interest groups</u>. See Summary Attachment I and chapter IX.

6. <u>Date draft environmental statement was made available to EPA and the public</u>:

SUMMARY ATTACHMENT 1

Comments have been requested from the following:

Department of the Interior:

Bureau of Indian Affairs
Bureau of Mines
Bureau of Reclamation
Fish and Wildlife Service
Heritage Conservation and Recreation Service
National Park Service
Office of Surface Mining

Other Federal Agencies:

Advisory Council on Historic Preservation
Department of Agriculture
- Soil Conservation Service
- USDA Forest Service

Department of Commerce
Department of Energy
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of Labor
- Mining Safety and Health Administration
- Occupational Safety and Health Administration

Department of Transportation
Environmental Protection Agency
Federal Power Commission
Interstate Commerce Commission
Community Services Administration
Office of Management and Budget
Water Resources Council

State and Local Agencies:

State of Arizona Clearing House
State of Colorado Clearing House
State of Idaho Clearing House
State of Nevada Clearing House
State of Utah Clearing House
State of Wyoming Clearing House
Utah State Historic Preservation Officer
Four Corners Regional Commission
Carbon County Commissioners
Emery County Commissioners
Grand County Commissioners
San Juan County Commissioners
Sanpete County Commissioners
Sevier County Commissioners
Utah County Commissioners
Wayne County Commissioners

PART 1 - REGIONAL ANALYSIS

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ILLUSTRATIONS

[Figures indicated as "in pocket" may be found in envelope attached to the inside back cover of part 1]

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UTAH COAL CENTRAL REGIONAL
ENVIRONMENTAL IMPACT STATEMENT

CHAPTER I: DESCRIPTION OF PROPOSAL

A. INTRODUCTION

1. AREA

The Central Utah region includes the Book Cliffs, western part of the Sego, Wasatch Plateau, Salina Canyon, and Emery coal fields in east central Utah, and the communities associated with these fields (fig. I-1). The boundaries were chosen to include present and proposed future development ofwFederal coal resources of the region and associated facilities. The region comprises 3.25 million acres in portions of Carbon, Utah, Emery, Sanpete, Grand, Wayne, and Sevier Counties, Utah (fig. I-2). The principal communities are: Price, Salina, Richfield, East Carbon City, Huntington, Castle Dale, Ferron, Emery, and Scofield. Coal has been mined throughout the area for 100 years. Production steadily increased to 6 million tons per year (mty) in 1920, then decreased until World War II when Utah production again reached 6 mty. Production again decreased in 1957 to less than 5 mty and remained at that level to the early 1970's. Coal mining now has increased to a production level of about 8 mty in 1976.

2. SCOPE

This environmental impact statement (EIS) is an analysis of the individual and cumulative impacts of several individual coal developments located on Federal land and proposed for Federal approval (table I-1). Included also are necessary ancillary off-lease proposals for which right-of-way applications are submitted (table I-2). The basis for analysis includes production from existing mines, future development of private coal mines requiring no Federal authorizations, and other coal related developments occurring or expected to occur within the Central Utah coal region (tables I-3, I-4). Principal among the coal-related developments is a 3,000 MW powerplant planned for construction by IPP (Intermountain Power Project) in one of several localities in or near the central region. Impacts of units 3 and 4 of the Emery Powerplant, of which units 1 and 2 are now under construction, are evaluated only at the high level of production in chapter III. Both the IPP and the Emery 3 and 4 plants are being evaluated in separate site specific statements under preparation by BLM.

Impacts analyzed are significant and are closely associated with the mine and reclamation plans and associated proposals rather than with other actions outside the region. Social and economic factors, air quality, transportation, and recreation have the broadest geographic impact.

The major analysis in the body of this statement is based on a projected coal production of 24 mty by 1990. This production scenario is dependent in part on Federal approval of mining and reclamation plans

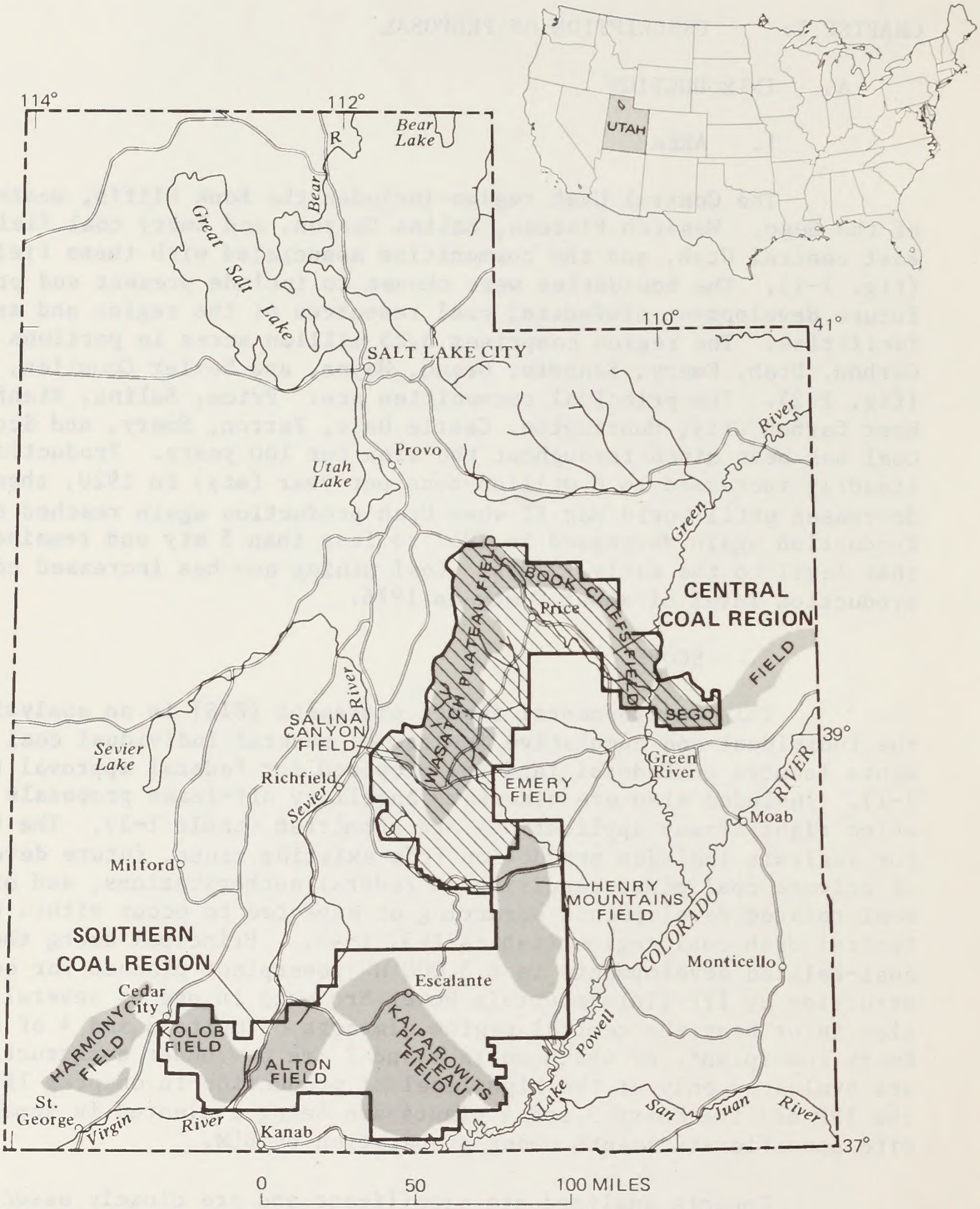

Figure I-1.--Index map showing Southern and Central Utah EIS Coal Regions and the principal coal fields

Table I-1.--Proposed mining and reclamation plans, coal production and reserves

Mine (underground)	Proponent	Development schedule based on production (mty) 1980	1985	1990	Recoverable reserves[1]	Project (life years)
Deadman Canyon	AMCA Coal Leasing, Inc.	0	0.7	1.0	28.5	30
Skumpah Canyon	Energy Reserves Group, Inc.	0	0.7	1.0	41.0	40
Mountain States No. 1	Mountain States Resources Corp.	0	0.5	0.5	10.5	22
Fish Creek	Pacific Gas & Electric Co.	0	1.3	2.3	71.0	40
Dugout Canyon		0	0.7	0.9	40.0	40
McKinnon No. 1	Routt County Development Ltd.	0	1.5	2.5	43.0	20
McKinnon No. 2		0	.7	1.0	88.0	90
B Canyon	United States Steel Corp.	0	0.5	1.0	20.5	25
Belina No. 2	Valley Camp of Utah, Inc.	0	.7	1.0	26.0	25
O'Connor		0	1.0	1.4	13.5	10
Total----------------------------		0	8.3	12.6	382.0	

[1] 50 percent estimated recovery.

Table I-2.--Mining and reclamation plans submitted for Federal approval and applications for associated Federal rights-of-way

Mine and company	Specific proposal[1]	Area (acres) & status of land in mine plan submittals[2] Federal lease	State & other	Land under rights-of-way application[2] Miles	Acres
Deadman Canyon---------- AMCA Coal Leasing, Inc.	Mining & reclamation plan-	2,042	200		
	Access road---------------			5.0	46
	Powerline-----------------			6.0	14
	Telephone line------------			6.0	6
	Solid waste disposal------			--	60
Skumpah Canyon---------- Energy Reserves Group, Inc.	Mining & reclamation plan-	2,500	4,020	--	126
Mine No. 1-------------- Mt. States Resources Company	Mining & reclamation plan-	1,800	0		
Dugout Canyon and------- Fish Creek Pacific Gas & Elec. Company	Mining & reclamation plan-	8,268	1,776		
	Mine plantsite------------			--	560
	Tram road-----------------			5.4	39
	Railroad------------------			13.5	163
	Conveyors-----------------			4.0	24
	Telephone line------------			10.0	48
	Waterline-----------------			8.4	25
	Coal waste waterline------			2.2	7
	Reservoir-----------------			--	24
	Central yard site---------			--	1,280
	Slurry pond site----------			--	560
	Powerline-----------------			13.7	125
McKinnon Nos. 1 & 2----- Routt County Dev. Ltd.	Mining & reclamation plan-	6,220	70		
B Canyon---------------- U.S. Steel Corp.	Mining & reclamation plan-	2,629	1,293		
	Access road---------------			5.2	63
	Railroad------------------			7.5	91
	Powerline-----------------			5.3	64
	Telephone-----------------			4.4	16
	Water pipeline------------			5.2	13
	Mine plantsite------------			--	75
Belina No. 2 and-------- O'Connor Valley Camp of Utah, Inc.	Mining & reclamation plan-	2,290	450	27.6	--
	Total--------------------	25,749	7,809	101.8	3,303

[1]Additional detail in part II, summary of tables of individual mining and reclamation plans and ancillary facilities.

[2]Areas owned or leased and proposed for mining in the mining and reclamation plans also include parts of the road areas, etc., requested for temporary use under rights-of-way applications; see table I-6 for summary of anticipated disturbed areas.

Table I-3.--Coal production by county, central Utah region

County	1975 Producing properties	1975 Production (thousand tons)	1976 Producing properties	1976 Production (thousand tons)	1977 Producing properties	1977 Production (thousand tons)
Carbon---	7	3,658	9	4,471	11	4,899
Emery----	6	2,452	7	2,454	7	2,622
Sevier---	1	827	1	1,043	1	1,336
Total[1]--	14	[2]6,937	17	[2]7,968	19	[2]8,857

[1]Federal lands produce 60 percent, State and private lands 40 percent, less than 500,000 tons is from mines totally on State and (or) private lands.

[2]The Industrial Commission of Utah.

Table I-4.--Potential coal production from State and private lands

Mine	Producer	Land ownership	Proposed production (mty)
Blackie[1] (surface)	Atlas Resources, Inc.	State	0.5
Emery[1] (underground)	Consolidation Coal Co.	Private	0.8
Unnamed (underground)	Canyon Fuel	Private	0.4
Hansen (underground)	Hansen, L. R.	Private	0.7
Columbine #1 (underground)	Itel Resources	Private	1.2
Thompson[1] (underground)	Wes-Pac Energy Corp.	State	0.5
Dog Valley[1] (underground)	Western States Coal Corp.	State	0.5

[1]Existing mine--not in full production.

on existing Federal leases. However, the Secretary of the Interior is not proposing a production level for coal in this region--instead he is considering appropriate actions to insure that Federal coal is available under environmentally acceptable conditions and as-needed to meet market demands and the energy needs of the nation.

The production scenario of 24 mty is chosen to allow cumulative analysis of the full production from all of the new mines proposed for Federal approval. Adding this new proposed production to current production, but limiting the total to a reasonable production by 1990 in terms of possible market and growth (24 mty), limits the scenario to consideration of only a slight increase in production from existing mines.

Actual conditions may not exactly duplicate the resultant production distribution dictated by the scenario but the general regional analysis is reasonably representative. However, the statement analyzes a higher and lower production by 1990, based on different assumptions. A low production level of 19 mty, which assumes no new mine development but only expansion of existing mines, is analyzed in chapter VIII. A high production level of 42 mty, which assumes increased production from existing mines, production from the mines whose detailed and preliminary plans are awaiting approval, and from State, private, and Federal lands that could be producing coal by 1990.

The EIS does not propose new coal leasing nor does it commit the Secretary of the Department of the Interior to a new coal-leasing program or to the issuance of new coal leases. Additionally, any future coal-related actions on Federal lands in central Utah and that are beyond those proposed and analyzed in this statement may require additional environmental assessment prior to granting of permits.

Lease applications submitted by the Braztah Corp. and the Coastal States Energy Co. have been approved by the Courts for consideration under the short-term criteria. Analysis by the Bureau of Land Management (BLM) of these applications is proceeding and will be issued separately. While these applications are not discussed specifically within the regional analysis, higher production projections include these operations.

3. TIMEFRAME OF ANALYSIS

This statement analyzes the impacts of potential coal development within the boundaries of central Utah to the year 1990. The date was chosen to allow reasonably accurate predictions and to ensure uniformity between the several regional coal EIS analyses being made in other parts of the nation. However, most of the proposed mining and reclamation plans considered in this statement anticipate a 25- to 40-year life based on estimated coal reserves and planned annual production (table I-1). In many cases the impacts of roads and powerlines are not analyzed beyond the life of the proposed operation because the land managing agency cannot now identify which of those facilities are to be retained.

It is anticipated that none of the proposed mines will be producing coal by 1980 because of uncertainities in receiving approvals from various Federal and State agencies and the lead time required to acquire equipment and construct surface facilities. The properties could be producing by 1985. The 1985 and 1990 projections and resultant analyses in this statement are based on project approvals by 1980.

4. AGENCY ROLES IN PREPARATION

This analysis is a joint U.S. Geological Survey (USGS)--Bureau of Land Management (BLM) statement prepared under the leadership of the USGS. Other participating agencies are the Forest Service (USFS), Department of Agriculture; U.S. Bureau of Mines (BOM), and U.S. Fish and Wildlife Service (F&WS), Department of the Interior (DOI); and the Interstate Commerce Commission (ICC).

5. FUTURE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REVIEW POINTS

1. Future changes in approved mining and reclamation plans will require approval by USGS and concurrence by land management agencies.

2. Future requests for right-of-way permits or coal-lease applications which meet short-term criteria will be reviewed.

3. The Surface Mine Control and Reclamation Act requires mining permits to be reviewed and renewed at a minimum of every 5 years.

4. U.S. Department of Energy (DOE) - under the Act of 1977, DOE was authorized to set coal production rates on Federal coal leases, and establish diligence requirements for operations conducted on Federal leases. Guidelines and procedures are being developed for coordination of DOE's responsibilities with those of DOI.

5. Preference-Right-Lease Application Status Review: Preference-right-lease applicants were required to prepare an initial showing indicating evidence of commercial quantities of coal. They will be evaluated in technical and environmental assessments to be prepared jointly by BLM and USGS.

6. Coal exploration drilling proposals on Federal coal leases are analyzed and approved where appropriate.

Recent interpretation of the Mineral Leasing Act of 1920 has determined that areas of Federal coal under preference-right-lease application cannot be leased if there exists, on that area, a prior valid existing mining claim under the Mining Act of 1872. Preference-right-lease applicants are required to submit abstracts of any mining claims found on their application area.

On September 27, 1977, the Department of Interior was enjoined from issuing any new coal leases until a supplemental coal programmatic environmental statement correcting the deficiencies of the original statement has been issued in final form and a new coal management program has been developed. Therefore, the existing preference-right-lease applications cannot be issued until this injunction is lifted.

B. SPECIFIC PROPOSED ACTIONS

1. APPLICATIONS

Nine mining and reclamation plans have been submitted to USGS under 30 Code of Federal Regulations (CFR) 211 of May 1976 by seven companies for approval (table I-1). Each of the mines proposed in these plans is a new operation involving development of issued Federal leases. Permit applications related to the specific proposed action were submitted to the BLM (table I-2). The mining and reclamation plans included in this statement were submitted for review prior to the promulgation of initial regulations (30 CFR 700) required under Section 502 of the Surface Mining Control and Reclamation Act of 1977 (SMCRA) (PL 95-87) and have not been officially reviewed for compliance therewith. Therefore, the mining and reclamation plans may not reflect the requirements of the initial regulations. However, in this statement the applicable initial regulations are considered as a required Federal mitigating measure.

The mining and reclamation plans have been returned to the operator together with a request that they be revised in accordance with the applicable initial regulations. As soon as the mining and reclamation plans are revised and returned to USGS, they will be evaluated with the Office of Surface Mining to determine compliance with the requirements of Federal regulations at 30 CFR 211 and 30 CFR 700. The mining and reclamation plans cannot be approved until they conform to all applicable requirements.

2. REQUIRED AUTHORIZATIONS

a. Department of the Interior (DOI)

The assistant Secretary-Energy and Minerals must approve the mining and reclamation plan prior to any commencement of mining operations by the company.

b. U.S. Geological Survey (USGS)

The area mining supervisor of USGS must certify that the mining and reclamation plan meets the requirements of 30 CFR part 211.

c. Office of Surface Mining (OSM)

The OSM reviews the mining and reclamation plan and certifies that it meets the requirements of the Surface Mining Control and Reclamation Act (SMCRA) of 1977 (Public Law 95-87).

d. Bureau of Land Management (BLM)

The BLM must concur with the mining and reclamation plan for mines on public lands before approval is granted by DOI. BLM is also responsible for granting various off-lease rights-of-way for ancillary facilities such as access roads, powerlines, communication lines, and railroad spurs on public lands.

e. USDA Forest Service (USFS)

The USFS must concur with the mining and reclamation plan for mines on National Forest system lands before approval is granted by DOI. USFS is also responsible for granting various off-lease permits for ancillary facilities such as access roads, powerlines, communication lines, and railroad spurs on National Forest system lands.

f. State of Utah

The Division of Oil, Gas, and Mining and the Office of Surface Mining (OSM) are preparing rules and procedures to implement the applicable initial regulations of the SMCRA as delegated by OSM.

C. COAL DEVELOPMENT THROUGH 1990

1. EXISTING COAL DEVELOPMENT

Coal production from existing mines in 1975-1977 ranged from 7 to 9 mty (table I-3). About 60 percent of this production was mined from Federal land and the remaining 40 percent was from State and private lands.

2. PRODUCTION PROJECTIONS

a. Federal Coal

Projected production from proposed detailed mining and reclamation plans is shown on table I-1. This full potential production of 12.6 mty by 1990 is attainable only if the mining and reclamation plans are approved and markets developed. It is unlikely that any of these mines will be in production by 1980. Projected production by 1985 is dependent upon projects being approved by 1980.

b. Non-Federal Coal

Seven mining proposals involving State and private lands are pending final approval by the State of Utah, Board of Oil, Gas, and Mining (table I-4). Four of these involve expansion of existing mines.

3. ANCILLARY FACILITIES

Ancillary facilities include coal related detailed proposals with filed right-of-way applications (table I-2), and preliminary proposals for which no detailed plans have been submitted. The facilities include roads, powerlines, conveyor systems, and various processing plants for storing, crushing, or washing coal.

Several potential projects are related to coal development. These preliminary proposals include the Castle Valley Railroad, Boeing Pacific (BPAC) coal transport system, eight steam electric-generating plants from 800 to 1,000 megawatts proposed by Utah Power & Light (UP&L), and a 3,000 megawatt powerplant (Intermountain Power Project (IPP)). The proposals are discussed in chapter VIII.

D. COAL PRODUCTION SCENARIOS

The annual production scenarios projected to 1990 that form the basis for this analysis are 19, 24, and 42 mty (table I-5).

1. LOW PRODUCTION LEVEL

Market potential for central Utah coal by 1990 could reach 19 mty. An analysis of current operations indicate that this amount could be produced by expansion of existing mines and excluding acquisition of additional Federal coal. It is estimated that operating companies control lands under Federal lease that contain a minimum of 700 million tons of recoverable coal (USGS preliminary estimates). Of this amount, about 200 million tons are on producing Federal leases. They also control an undetermined amount of coal on State and private land. Federal approval would be required for modified mining plans, or for other use of additional Federal land. Environmental impacts associated with this level of production are analyzed in chapter VIII.

2. PROJECTED PRODUCTION LEVEL

An annual production of 24 mty is the projected level evaluated in detail in chapters III to VII of this environmental statement. It includes full production from all detailed proposals (table I-1), added to the 1975 coal production in central Utah (table I-3) and a moderate increase in production from existing mines. The projected level will meet all of the 10 mty coal peak demand of the proposed IPP generating station, in the event that the station purchases its coal from mines in the central Utah coal fields. Market has not been identified for most of the proposed new mines and, therefore, this total only represents what could be produced if markets were developed. It is probable that expansion of existing mines will be a major part of the increased production by 1990. This expansion is evaluated in the low production level analysis (chapter VIII).

Table I-5. --Coal production scenarios
[million tons per year--mty]

Production scenario	1980	1985	1990
Low level (no-action)----------	12.0	17.0	19.0
Projected level ---------------	12.0	17.0	24.0
High level --------------------	12.0	33.0	42.0

Table I-6.--Basic analysis assumptions necessary to support projected production level (24 mty)

		Requirements			
		Water		Acreage	
Facility[1]	Number proposed	acre-feet per year	Miles	Total included	Reclaimed & disturbed
Mine & portal areas-	10	1,500	NA	[2]33,558	[3]270
Offsite coal handling areas-----	3	300	NA	1,225	694
Conveyor systems----	3	NA	9	50	24
Powerlines----------	10	NA	47.3	360	48
Roads---------------	14	300	48.6	436	235
Community[4]----------	--	5,900	NA	1,300	[5]1,300
Railroads-----------	2	NA	20.5	254	254
Telephone lines-----	6	NA	24	150	22
Water systems-------	5	NA	13.9	130	77
Total-------------	--	8,000	--	37,463	2,924

[1]Includes some offsite facilities that are not formally proposed.
[2]Total area in site-specific proposals.
[3]Portal areas, see chapter IV for potential subsidence of mine areas.
[4]Assume existing communities will expand to house additional people.
[5]Will not be reclaimed.

3. HIGH PRODUCTION LEVEL

This production level is 42 mty. It represents a composite production potential from detailed mine proposals (table I-1), expansion of existing mines (chapters II and VIII), preliminary mine plan proposals (chapter VIII), and production from State and private lands (table I-4). Attainment of this level would require market, leasing of applied-for Federal coal, and approval of mine plans.

E. RELATED NONCOAL DEVELOPMENT

Oil and gas exploration is active in the Wasatch Plateau coal field and may conflict with mining owing to drilling or development of wells in mined or proposed mining areas. Explanation or development of oil and gas may preclude the recovery of some coal and alter some mining and reclamation plans. A conflict could develop between coal mining and the future construction of oil and gas pipelines because of potential subsidence and (or) the location of ancillary facilities.

In the southern part of the region there may be competition between coal mining and uranium mining for skilled miners and housing.

F. BASIS FOR ANALYSIS AT PROJECTED LEVEL

The following assumptions and estimates itemized in table I-6 were made to facilitate analysis of the environmental impact of mining and reclamation plans and other coal-related developments considered in this statement.

1. Disturbed lands that are not occupied by permanent structures will be reclaimed to a condition at least equally productive for vegetation as they were prior to disturbance. Technology is available for successful reclamation in compliance with the Surface Mining Control and Reclamation Act of 1977.

2. Annual water use will be at the rate of one acre-foot (326,000 gallons) for four people; for each acre-foot used, one-half acre-foot will be returned to the system for down stream use.[1]

3. Sewage treatment plants are or will be made to conform to State health and (or) EPA standards.

4. Sewage effluent will not be recycled for domestic use.

5. Community development will be at the rate of 18 people per acre.

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[1] Based on available records on water use and sewage effluent.

6. Lands converted to housing will not be returned to agriculture in the future.

7. Coal recovery will be based on a 50 percent recovery rate from underground mines.[2]

8. Mine production will average 15 tons per man-shift for underground mining.[3]

9. Longwall mining methods will be used where technically and economically feasible.

10. Future traffic projections on a given segment of highway will be based on the historic relationship between population and traffic for that segment.

11. Future traffic will be accommodated on the existing and presently proposed highway system. Shortfalls in capacity will be accomodated through expansion of the specific overloaded elements of this system.

12. Proposed mines will not be producing before 1980 but will all be in production by 1985. Full proposed production will be reached by 1990.

G. RELATION OF CENTRAL TO THE SOUTHERN COAL REGION

Generally, the contiguous central and southern coal regions (fig. I-1) have very little direct impact on each other, but an increase in growth in either would affect the State generally. However, coal mining or related development in the Huntsville-Henry Mountain area of the southern region would impact the southern part of the central region. No new coal mines on Federal land are currently planned in the Huntsville-Henry Mountain part of the southern region. If the IPP plant were located west of the central region, near Lynndyl, Utah (I-2), some coal could possibly be produced and transported from southern region coal fields. Finally, coal from the central region could probably be produced more cheaply and require fewer new transportation systems than coal from the southern region. It would seem, except for captive markets, that production from the central region would be at a competitive advantage in capturing new markets.

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[2] USGS Reserve Calculation interim procedure based on mining experience.
[3] 1976 rate in Utah averaged 12.1 tons per man-shift.

4. Lands committed to uses which will not be returned to agriculture in the future.

5. [illegible]

6. [illegible] production will [illegible] for [illegible]

9. [illegible]

10. [illegible]

11. [illegible] this system.

12. [illegible] by 1985 [illegible] will be reached by 1990.

III. [illegible]

Generally, the [illegible]

[illegible]

CHAPTER II: DESCRIPTION OF THE EXISTING ENVIRONMENT

A. NATURAL ENVIRONMENT

1. CLIMATE

The climate of the study area is varied and strongly influenced by topography. The lower elevations, east of the Wasatch Plateau, are dry and either middle latitude steppe or desert. The low amounts of annual precipitation are generally caused by the Sierra Nevada and Cascade Ranges, which rob Pacific storms of their moisture before they reach the study area. However, some of the higher terrain of the western portion is able to cause enough upslope flow to glean over 40 inches of precipitation from the atmosphere, with areas on the lee side receiving less than 8 inches. Figure II-1 presents isopleths of mean annual precipitation.

Temperature is spatially and seasonable variable in central Utah. Figures II-2 and II-3 present mean minimum January and maximum July isotherms. Higher elevation valleys experience the coldest temperatures, while lowlands east of the mountains experience the highest temperatures.

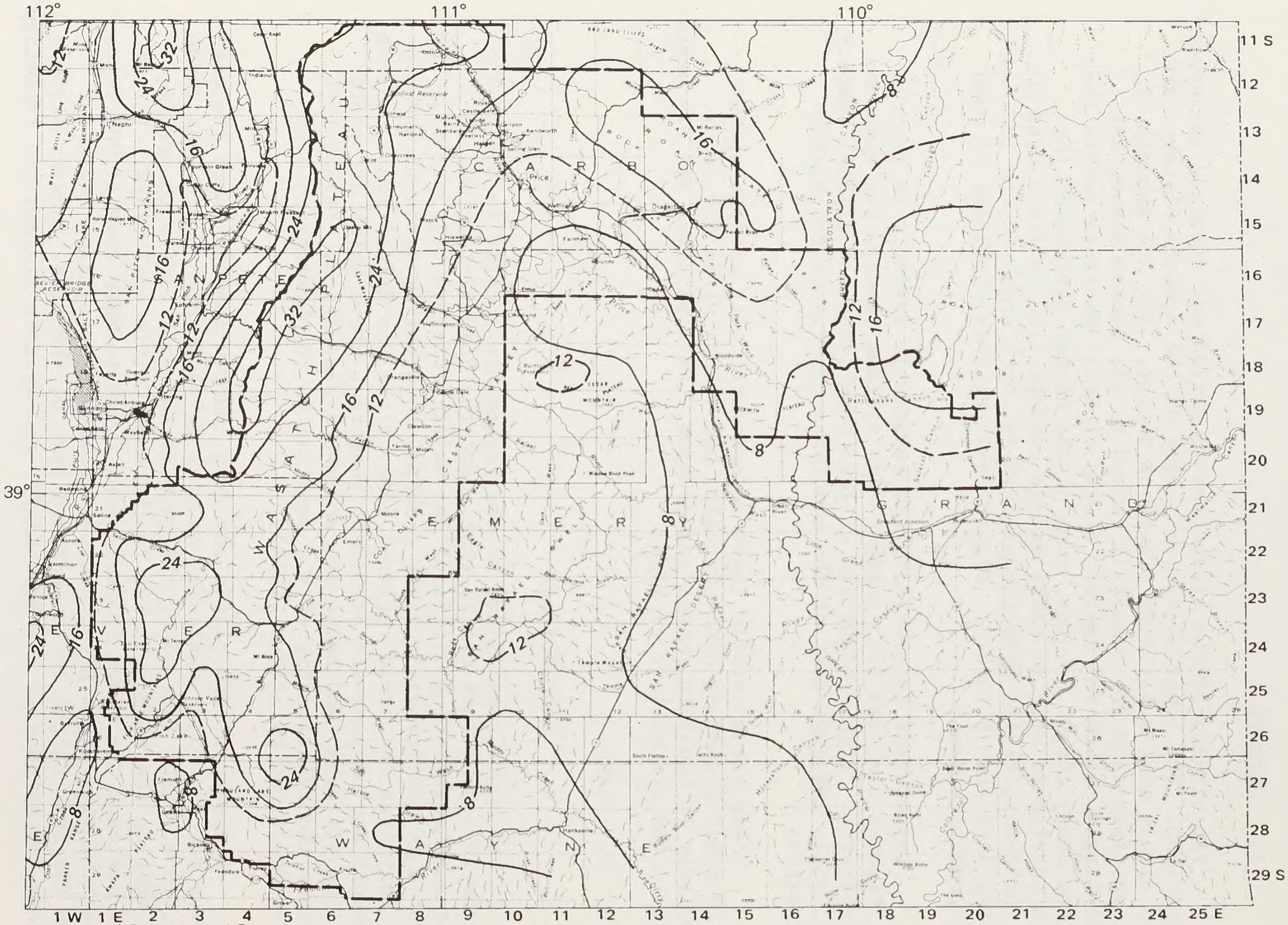
Winds are generally light to moderate, with average speeds below 20 mph. Tornadoes are very rare, but strong winds may occur, particularly in mountain passes and canyons. Flow patterns are discussed further in the air quality section.

2. LAND

a. Land Surface

The major coal fields of the region are located in the south- to southwest-facing Book Cliffs that bound the Roan Plateau and in similar southeast-facing cliffs of the Wasatch Plateau (fig. II-4). The rocks of this continuous, roughly U-shaped band partly surround and dip gently away from the broad regional dome of the San Rafael Swell. Steep escarpments and canyons are prominent features, above which are gentle to rolling plateaus, and below are pediments and plains. Figure II-4 also shows the relationship of the coal fields to physiographic subdivision described by Stokes (1977).

The precipitous cliffs and deep, narrow canyons where the coal beds crop out are major obstacles to coal development. Elevations range from 4,000 to 6,000 feet along the base of the Book Cliffs to nearly 10,300 feet in the highest point in the Book Cliffs coal field. In the Wasatch Plateau, the range is from about 7,000 to more than 11,000 feet. The south-flowing Green River and the tributary Price River both cut through the Book Cliffs in the eastern part of the area. Lesser streams that have cut canyons in the Book Cliffs and Wasatch Plateau are tributary



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-1.--Map showing mean annual precipitation (in.) in central Utah.

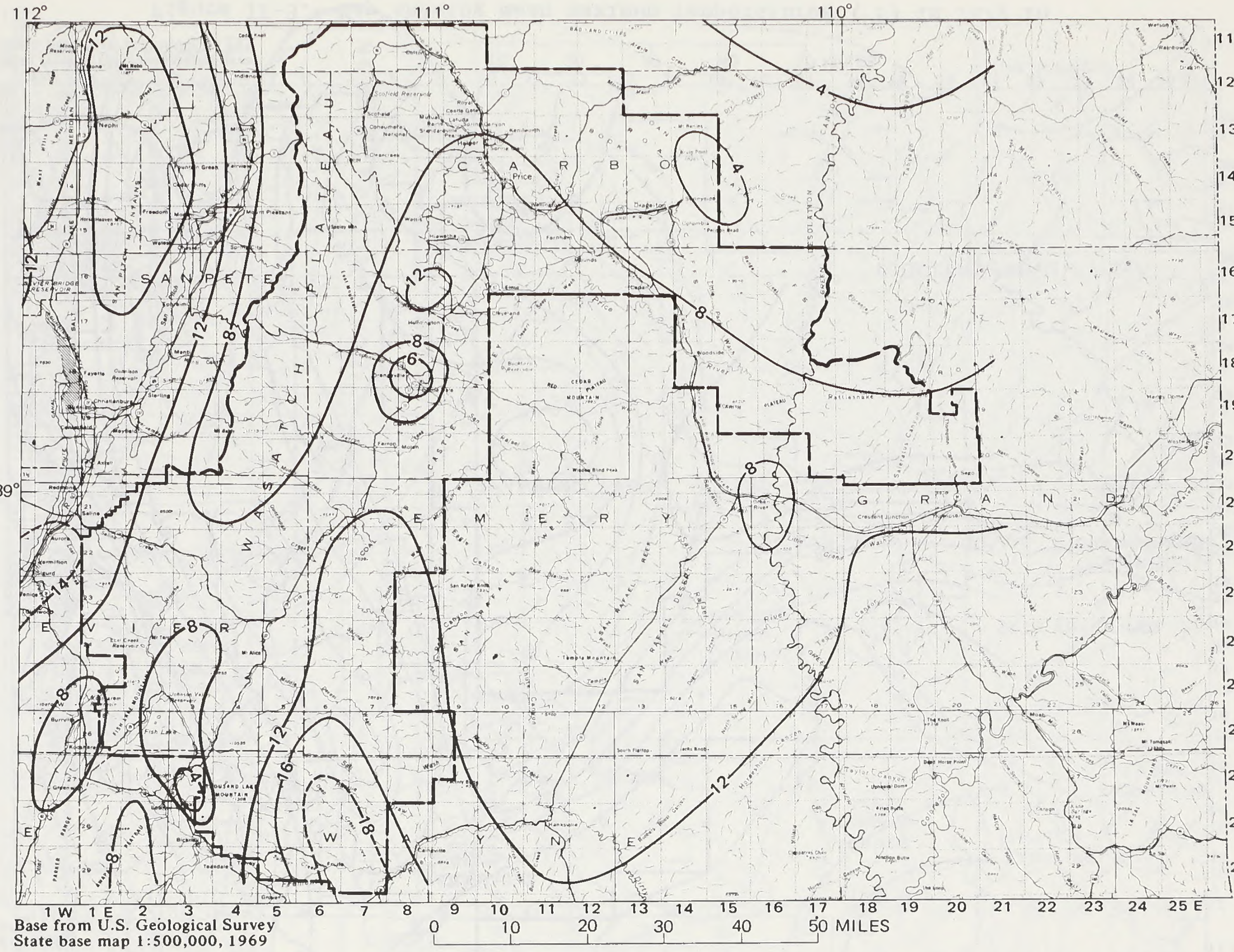
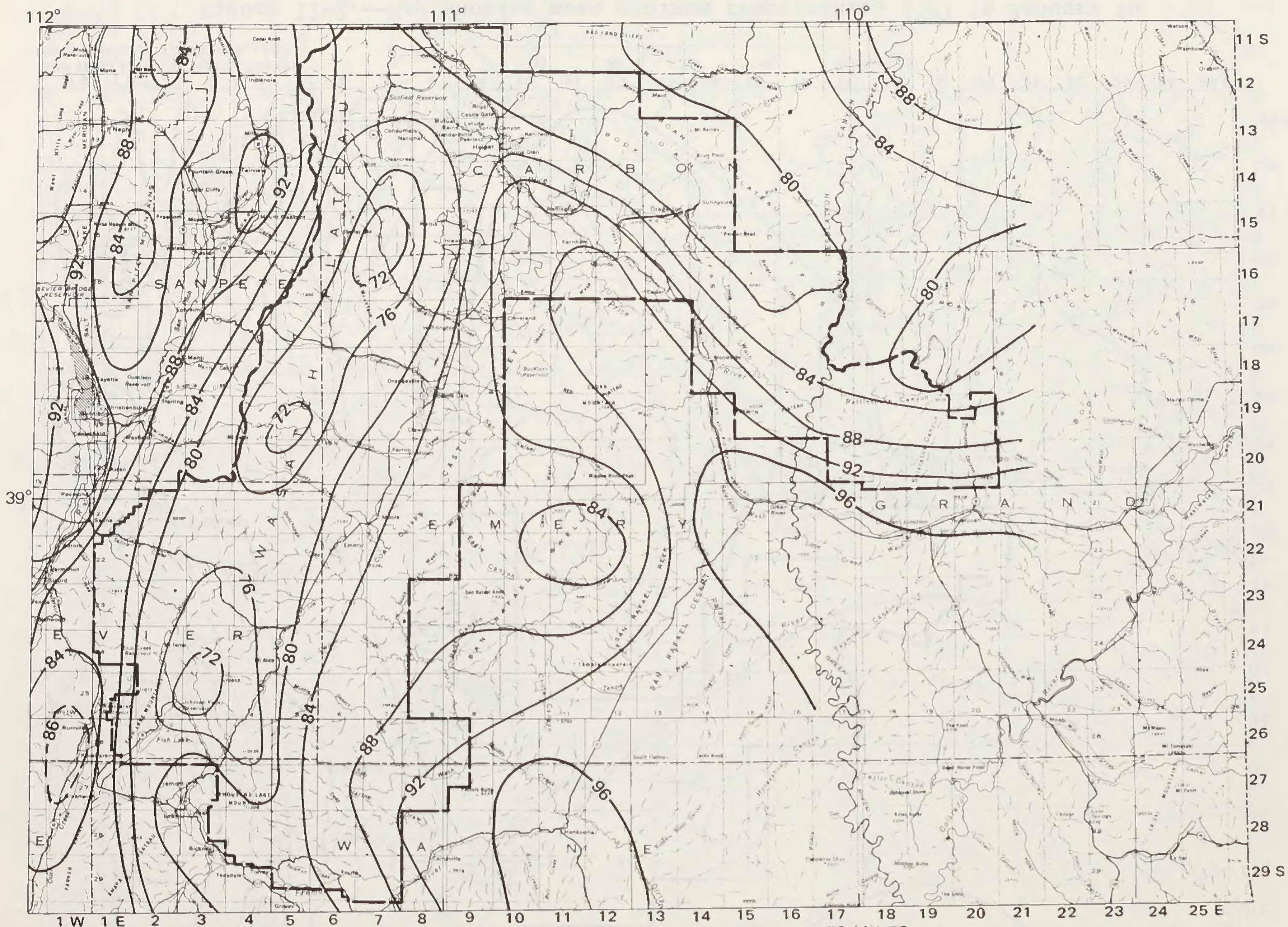


Figure II-2.--Map showing mean minimum temperatures (^{o}F) in January in central Utah.



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-3.--Map showing mean maximum temperatures (^{o}F) in July in central Utah.

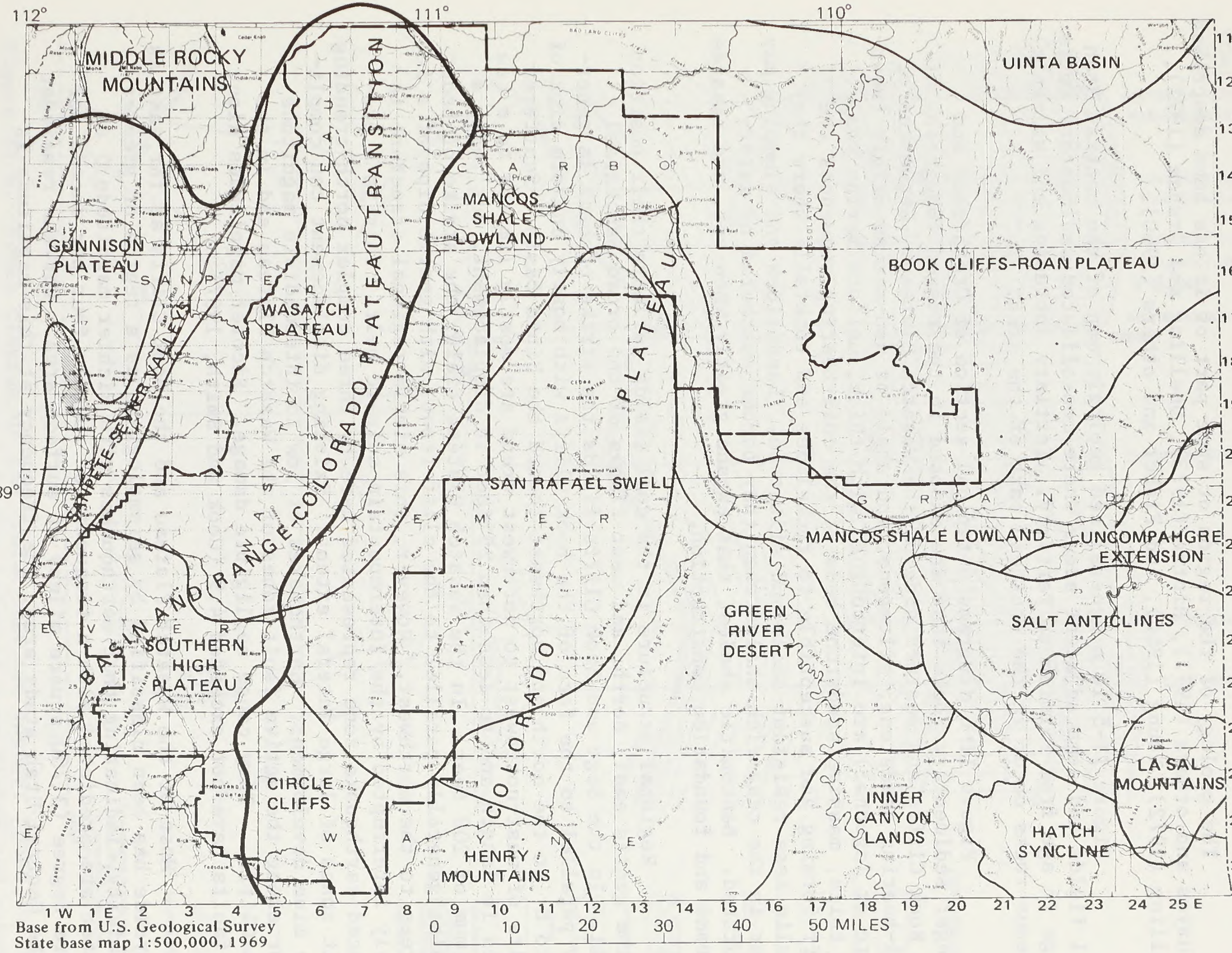


Figure II-4.--Map showing physiographic subdivisions of east-central Utah (after Stokes, 1977, figure 1).

to the Green River through the Price and San Rafael Rivers or to the Colorado River through Muddy Creek and the Dirty Devil River.

b. Geology, Seismicity, and Paleontology

The geology of the region or some part of it has been described by Hayes and others (1977), Hintze (1973), Doelling and Graham (1972), Doelling (1972), Young (1966), and Fisher and others (1960).

Figure II-5 is a generalized geologic map of the central Utah coal fields and some adjacent areas where consolidated sedimentary rocks range in age from Permian to Tertiary. Tertiary intrusive and volcanic igneous rocks occur in the southern part of the area.

Figure II-6 diagrams a typical section of Cretaceous and younger sedimentary rocks that are exposed in the rugged topography of the Book Cliffs and eastern side of the Wasatch Plateau. Sequences of coal-bearing sandstone, siltstone, and shale of non-marine origin (near-shore or lagoonal) are intertongued with thick, uniform marine shale. The thick, massive sandstone beds of the coal-bearing sequences are cliff-forming and susceptible to rockslides and rockfalls where they overlie less resistant shale and siltstone. Landslides and slumping may occur in the clay-rich shales when they become weathered or water-saturated. Bentonitic shales, that expand greatly when wet, are hazards to road and foundation construction.

Regional structure in the coal fields reflects their position on the gentle east, north, and west flanks of the broad San Rafael Swell. In the Sego and Book Cliffs fields the strike of beds is generally parallel to the face of the Book Cliffs with mostly uniform dips of 3 to 8 to the north and northeast toward the Uinta basin. Scattered faults of west-northwest to northwest trend are mostly limited to a few miles in length and to less than 25 feet in displacement, but reach a maximum of 200 feet. In the Wasatch Plateau field, the strike of beds is also generally parallel to the cliff front, with gentle dips of a few degrees to the northwest. However, this simple regional structure is widely interrupted by the intermountain seismic belt. This is a pronounced earthquake zone represented here by three complex north-trending fault zones of large lateral extent. Existing displacement can complicate mine development. Earthquakes of low to intermediate magnitude occur along the active fault zones of the Wasatch Plateau and in the Book Cliffs. They cause negligible damage. Richter magnitudes along the faults have not exceeded 4.9 (Cook and Smith, 1967).

Most of the Wasatch Plateau and the Book Cliffs as far east as Sunnyside has been classified by seismologists as a region of greater seismicity, indicating that earthquakes with Richter magnitude 5 or greater are predicted with a frequency of roughly four per decade per square degree (3,700 square miles) of surface area. For the remainder of the Central Utah study area, the frequency at this magnitude is

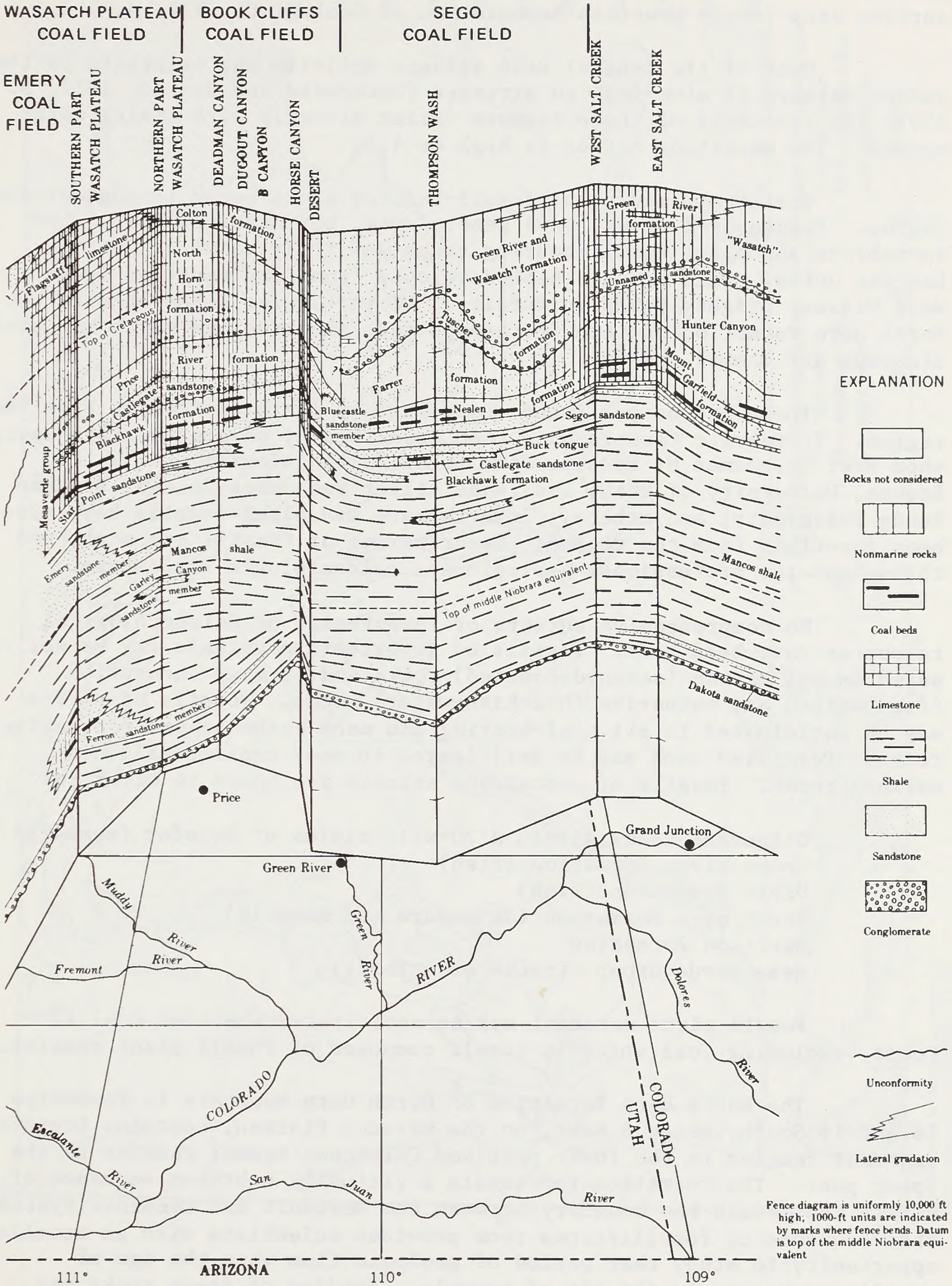


Figure II-6.--Fence diagram of the Cretaceous and younger rocks in the central Utah coal fields (adapted from Fisher and others, 1960, plate 12).

predicted to be one or fewer earthquakes per decade per square degree of surface area (Rocky Mountain Association of Geologist, 1972, p. 50).

Much of the Central Utah seismic activity may originate in the sudden release of mine-induced stresses (Osterwald and Dunrud, 1977, p. 22). The frequency of these tremors varies directly with mining work cycles. The magnitude may be as high as 4.5.

Vertebrate and plant fossil-bearing rocks occur throughout the region. Figure II-7 shows, in a general way, the distribution of the vertebrate and plant fossil-bearing rocks and their value as fossil-bearing units. This map has been developed from data supplied by Dr. Wade Miller, Brigham Young University. Of particular importance is the North Horn Formation of Late Cretaceous and Paleocene age which contains dinosaur and mammal remains.

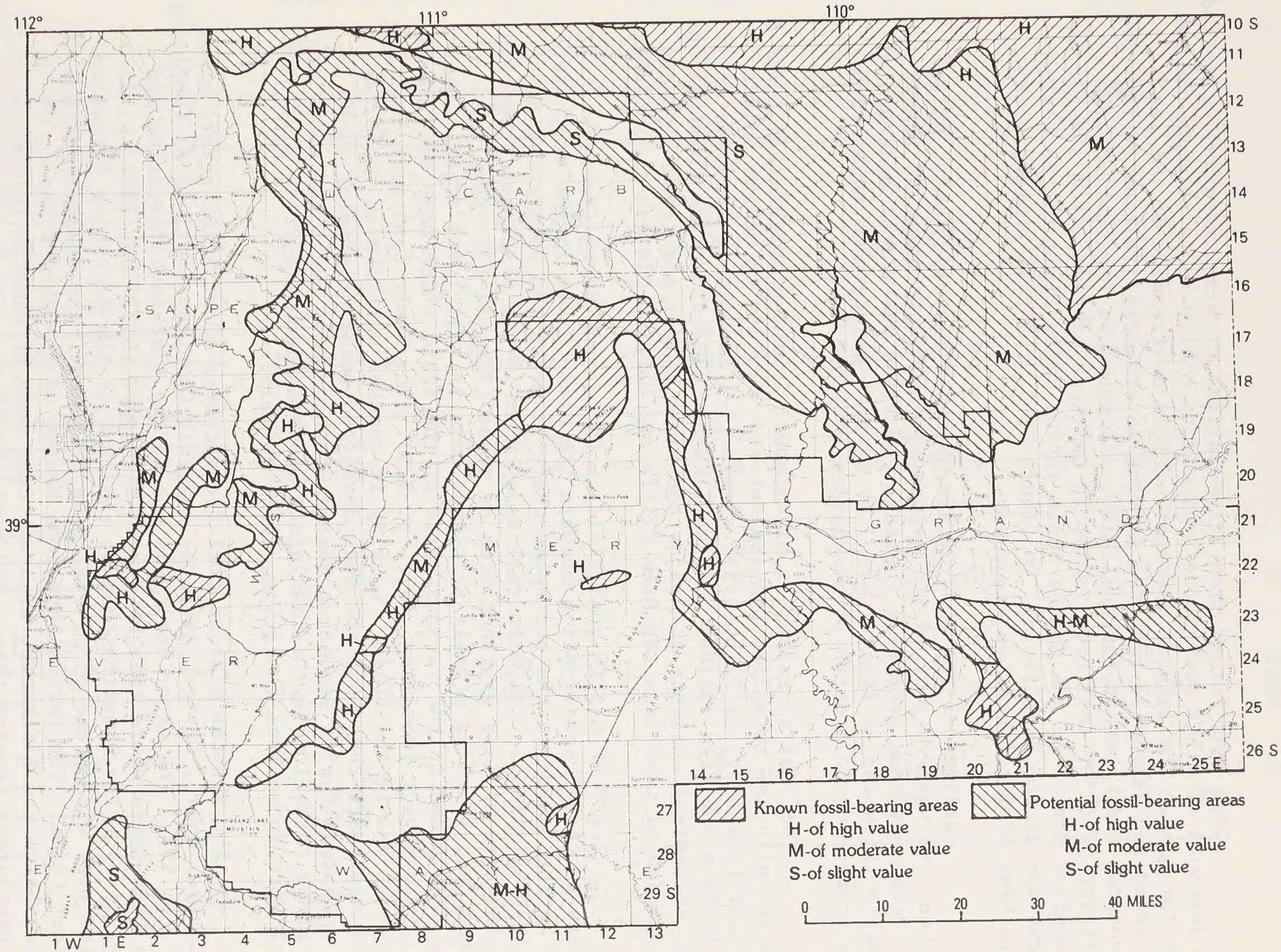
There are no published comprehensive lists of fossils from the region. Vertebrate fossils have been described by several workers among whom are: Dr. James H. Madsen, Utah State Paleontologist; Dr. W. L. Stokes, University of Utah; Drs. Wade Miller and James Jensen, Brigham Young University; and others. Invertebrate and plant fossils have also been described from the region. Descriptions of fossils are scattered throughout the professional geologic and paleontologic literature.

No comprehensive surveys or inventories of paleontological resources have been made. Fossils of invertebrate animals may be anticipated in all marine (ocean-deposited) rocks and in many lacustrine (freshwater) and estuarine (brackish-water) rocks. Fossils of plants may be anticipated in all coal-bearing and many carbonaceous non-marine rocks. Petrified wood may be anticipated in many continental (non-marine) rocks. Fossils of vertebrate animals are known to occur in:

Oligocene rocks within a 20-mile radius of Henefer (mammals)
Green River Formation (fish)
Uinta Formation (fish)
North Horn Formation (dinosaurs and mammals)
Morrison Formation
Mesa Verde Group (tracks of animals)

Fossil plant material may be anticipated wherever coal is found, excluding coal which is itself composed of fossil plant remains.

The North Horn Formation on North Horn Mountain in Townships 18 and 19 South, Range 6 East, on the Wasatch Plateau, contains Cretaceous dinosaur remains in the lower part and Paleocene mammal remains in the upper part. The formation represents a virtually unbroken sequence of strata that cross the boundary between the Mesozoic and Cenozoic Systems. This sequence of fossiliferous rock provides scientists with an excellent opportunity to study that period of geologic time when the age of reptiles gave way to the age of mammals. Studies of these rocks may help provide insight relative to the extinction of the dinosaurs.



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-7.--Map of central Utah coal region showing vertebrate and plant fossil-bearing areas.

c. Coal

Coal beds formed from accumulations of plant material deposited in lagoonal or other near-shore sedimentary environments between the sea and the land. The lateral movement of this environment as the sea advanced and retreated resulted in wide lateral distribution of the rock sequences that contain the coal beds. As shown in figure II-6, the position of major coal beds varies in the rock section, from the Ferron Sandstone Member of the Mancos Shale in the Emery field to the Neslen Formation in the Sego field. In figure II-5, the coal-bearing rocks have been divided into two sequences.

Outlines of the Book Cliffs, Wasatch Plateau, Emery, Salina Canyon, and western part of the Sego coal fields are shown on figure II-8. These outlines generally indicate the areas where coal beds are of minable thickness (4 feet or more) by present underground mechanized mining methods to a depth of overburden of 3,000 feet.

The coal is ranked as bituminous, in the high volatile B and C groups, with low to medium ash content and very low to medium sulfur content (Doelling, 1972, p. 555). Table II-1 summarizes analyses of coals from the five fields. Tables II-2 and II-3 summarize chemical and spectrochemical analyses for major and minor oxides and trace elements in samples of coal from the Book Cliffs and Wasatch Plateau coal fields.

The Book Cliffs coal field in Carbon and Emery Counties covers about 645 square miles between the Green River in the southeast and Spring Canyon in the northwest where it meets the Wasatch Plateau field (fig. II-8). The main coal beds occur in the Blackhawk Formation in nine more or less distinct beds or zones (fig. II-6). They are lenticular, reaching minable thickness only in restricted areas. They have been named in the various parts of the field which have been mined most extensively (Doelling, 1972, p. 325). The Lower Sunnyside coal is the major bed in the field. Locally it reaches a thickness of 18 feet. Minor coal beds that have not been developed occur at greater depth in the unexposed Ferron Sandstone Member of the Mancos Shale and above the Blackhawk Formation in the Castlegate Sandstone and the Price River and North Horn Formations (Doelling, 1972, p. 251).

The Wasatch Plateau coal field covers about 1,100 square miles in Carbon, Emery, Sevier, Sanpete, and Utah Counties (fig. II-8) (Doelling, 1972, p. 59). The major coal beds are in the Blackhawk Formation and have been named where they have been developed (Doelling, 1972, p. 127) (fig. II-6). The Hiawatha coal at the base of the Blackhawk Formation is the most widespread of 22 coal beds or zones. The Hiawatha ranges to 28 feet thick. The Ferron Sandstone Member of the Mancos Shale, which is far below the Blackhawk, also has coal beds of minable thickness, but the overburden is more than 3,000 feet (Doelling, 1972, p. 68). The Dakota Sandstone below the Ferron has minor coal beds.

Table II-1.--Coal content analyses

[Source: Adapted from Doelling, 1972]

	Wasatch Plateau	Book Cliffs	Emery	Sego	Salina Canyon
Moisture content (percent)					
Average	6.1	[1]4.6(4.8)	7.4	9.1	7.6
Range	0.7-14.5	0.6-24.5	2.3-23.6	5.2-20.0	5.7-14.9
Volatile matter (percent)					
Average	42.0	[1]41.2(39.3)	38.0	34.7	41.2
Range	34.4-54.3	16.4-64.3	32.6-43.9	28.7-42.2	34.4-45.5
Fixed carbon content (percent)					
Average	.45.4	[1]47.4(49.1)	45.7	46.8	41.1
Range	28.3-54.4	28.3-74.3	33.3-51.9	38.4-52.6	36.3-48.3
Ash content (percent)					
Average	6.5	6.7	8.9	11.1	9.6
Range	1.4-18.3	3.4-13.2	4.0-23.6	4.2-19.0	4.2-13.2
Sulfur content (percent)					
Average	0.60	[1]0.58(0.85)	0.99	0.60	0.45
Range	0.23-1.60	0.10-3.00	0.31-4.66	0.37-1.00	0.32-0.60
Btu content (per pound)					
Average	12,589	12,762	11,424	10,940	11,367
Range	10,250-13,690	7,045-14,220	7,823-12,970	9,000-12,150	9,690-12,080

[1]Estimate of field average because of the unequal distribution of samples.

Table II-2.--Average (arithmetic mean) composition and observed range of 10 major and minor oxides and 20 trace elements in coal ash, and contents of seven additional trace elements in eight Book Cliffs field coal samples

[Source: Hayes, and others, 1977. All samples were ashed at 525 °C; <, less than]

Oxide or element	Average (arithmetic mean)	Observed range Minimum	Observed range Maximum
Major and minor oxides in ash (percent)			
Ash	8.75	6.0	12.4
Silica (SiO_2)	47	38	62
Aluminum oxide (Al_2O_3)	19	13	25
Calcium oxide (CaO)	8.4	2.5	15
Magnesium oxide (MgO)	1.64	.71	2.65
Sodium oxide (Na_2O)	1.83	.79	3.51
Potassium oxide (K_2O)	.37	.05	.77
Ferric oxide (Fe_2O_3)	5.9	1.5	19
Manganese oxide (MnO)	.13	.003	.39
Titanium dioxide (TiO_2)	1.1	.67	1.5
Sulfur trioxide (SO_3)	4.0	1.7	5.9
Trace elements in ash (parts per million)			
Boron (B)	1,000	700	1,500
Barium (Ba)	1,000	300	2,000
Beryllium (Be)	7	<3	7
Cadmium (Cd)	1.0	<1.0	1.0
Cobalt (Co)	10	<10	15
Chromium (Cr)	50	30	70
Copper (Cu)	59	22	95
Gallium (Ga)	30	20	30
Lithium (Li)	187	63	328
Molybdenum (Mo)	10	<7	15
Niobium (Nb)	20	20	30
Nickel (Ni)	20	15	30
Lead (Pb)	44	30	60
Scandium (Sc)	15	15	30
Strontium (Sr)	1,500	500	3,000
Vanadium (V)	70	70	100
Yttrium (Y)	50	30	70
Ytterbium (Yb)	5	3	5
Zinc (Zn)	72	42	88
Zirconium (Zr)	300	200	300
Trace elements in whole coal (parts per million)			
Arsenic (As)	0.6	0.5	1.0
Fluorine (F)	54	20	110
Mercury (Hg)	.03	.01	.04
Antimony (Sb)	.2	.2	.3
Selenium (Se)	1.9	1.5	2.4
Thorium (Th)	2.6	<3.0	3.9
Uranium (U)	.7	.3	.9

Table II-3.--Average (arithmetic mean) composition and observed range of 10 major and minor oxides and 20 trace elements in coal ash, and contents of seven additional trace elements in 48 Wasatch Plateau field coal samples

[Source: Hayes, and others, 1977. All samples were ashed at 525°C; <, less than]

Oxide or element	Average (arithmetic mean)	Observed range Minimum	Observed range Maximum
Major and minor oxides in ash (percent)			
Ash	11.4	1.8	36.6
Silica (SiO_2)	53	21	84
Aluminum oxide (Al_2O_3)	16	6.2	29
Calcium oxide (CaO)	6.1	.86	25
Magnesium oxide (MgO)	1.05	.42	2.53
Sodium oxide (Na_2O)	3.64	.11	8.41
Potassium oxide (K_2O)	.75	.062	2.2
Ferric oxide (Fe_2O_3)	3.9	.83	12
Manganese oxide (MnO)	.010	.003	.026
Titanium dioxide (TiO_2)	.92	.42	1.7
Sulfur trioxide (SO_3)	4.2	.66	10
Trace elements in ash (parts per million)			
Boron (B)	1,000	200	3,000
Barium (Ba)	700	70	3,000
Beryllium (Be)	15	<3	50
Cadmium (Cd)	.9	1.0	2.0
Cobalt (Co)	15	<10	50
Chromium (Cr)	100	30	200
Copper (Cu)	95	32	266
Gallium (Ga)	30	10	70
Lithium (Li)	111	15	288
Molybdenum (Mo)	10	<7	20
Niobium (Nb)	20	<20	50
Nickel (Ni)	50	10	200
Lead (Pb)	55	<25	195
Scandium (Sc)	20	<10	50
Strontium (Sr)	1,000	100	5,000
Vanadium (V)	100	70	300
Yttrium (Y)	70	30	300
Ytterbium (Yb)	7	3	15
Zinc (Zn)	84	19	237
Zirconium (Zr)	200	100	500
Trace elements in whole coal (parts per million)			
Arsenic (As)	1.0	<0.5	3
Fluorine (F)	70	<20	240
Mercury (Hg)	.05	.01	.21
Antimony (Sb)	.3	<.1	.7
Selenium (Se)	1.7	.8	5.7
Thorium (Th)	1.7	<3.0.	5.2
Uranium (U)	1.3	.2	3.5

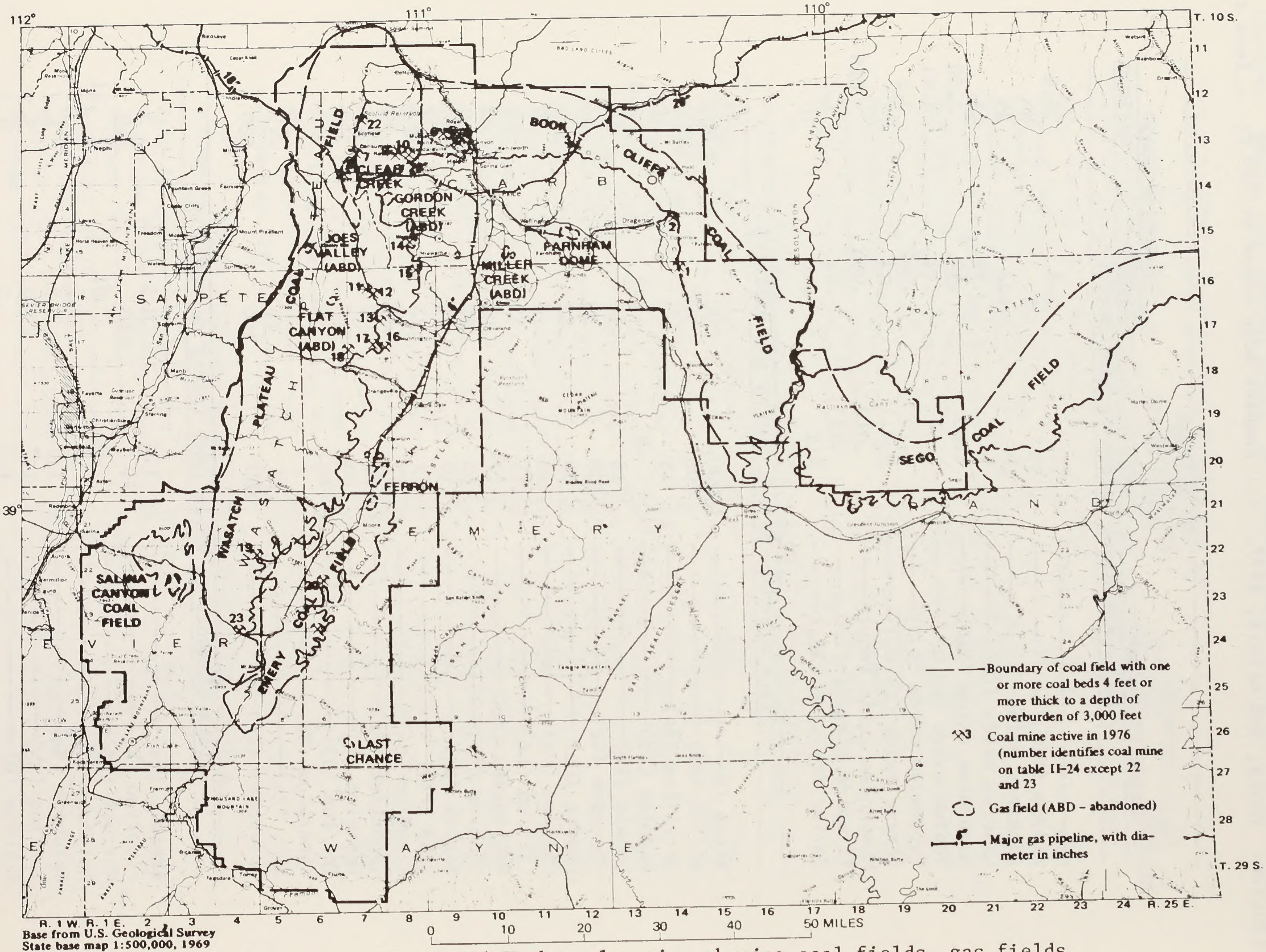


Figure II-8.--Map of central Utah coal region showing coal fields, gas fields, and major gas pipelines.

The Emery coal field covers an area of about 210 square miles (Doelling, 1972, p. 417) in Emery and Sevier Counties and lies east of and parallel to the southern end of the Wasatch Plateau field (fig. II-8). The major coal beds are in the upper part of the Ferron Sandstone Member of the Mancos Shale (fig. II-6) where 13 lenticular, discontinuous coal beds (indicated by letters A-M) have been grouped into lower, middle, and upper zones (Doelling, 1972, p. 438). Most of the coal produced has come from the I bed of the upper zone, which reaches a maximum thickness of 20 feet. Because of the regional dips toward the west, the Ferron coals are more than 3,000 feet deep under the southern part of the Wasatch Plateau coal field to the west of the Emery field. Minor coal beds are present in the Dakota Sandstone that lies below the Mancos Shale (Doelling, 1972, p. 422).

The Salina Canyon coal field is just west of the southern part of the Wasatch Plateau field where the upper part of the coal-bearing Blackhawk Formation is exposed for about 6 miles along the sides of Salina Canyon (fig. II-8). Only the Ivie coal bed in the lower of three coal zones is more than 4 feet thick (Doelling, 1972, p. 40). Maximum known thickness of this bed is 10.8 feet. The eastern boundary of the field is a major north-trending fault which is the western boundary of a downfaulted block or graben (Doelling, 1972, p. 36, 37). The coal beds are also dropped into the subsurface in another graben between north-trending faults in the middle of the field.

The Sego coal field in Grand County covers 390 square miles in the Book Cliffs from the Green River east to the Utah-Colorado line (fig. II-8) (Doelling and Graham, 1972, p. 191). Only the western half of the field is included in the region. The Blackhawk Formation which contains the major coal beds of the Book Cliffs field has only minor coal beds in the Sego field and pinches out near the middle of the field (fig. II-6). The major coal beds occur higher in the section in the Neslen Formation. Four more or less distinct coal zones have been identified (Doelling and Graham, 1972, p. 199). The three lower zones contain most of the coal resources in beds ranging up to 8.7 feet thick. Minor coal beds occur in the Castlegate Sandstone below the Neslen Formation and in the Farrer Formation above it.

In the Price area, coal beds greater than 4 feet thick occur lower in the rock section than the main coal beds of the adjacent Wasatch Plateau and Book Cliffs coal fields. Sparse drill hole data indicate these coal beds extend on to the south west to the Castle Dale area and are probably in the same part of the rock section as the coal beds of the Emery coal field still farther to the southwest. In his monograph of the Central Utah Coal Fields, Doelling (1972) did not designate this area as a coal field, but the later Energy Resources Map of Utah (Utah Geol. and Mineralog. Survey, 1975) and personal communications with Doelling in preparation of this report indicate large potential for reserves in the Price-Castle Dale area.

Coal reserves in the Central Utah coal region are shown by the map and tabulations of figure II-9 and are summarized in table II-4.

d. Other Energy and Mineral Resources

Non-coal energy and mineral resources in east central Utah have been summarized by Hayes and others (1977, p. 72-89), and energy resources of all types are shown on the Energy Resources Map of Utah (Utah Geol. and Mineralog. Survey, 1975).

In addition to coal, energy resources in the region include oil and natural gas, bituminous sandstone, oil shale, and uranium. Source and reservoir beds vary in age from Permian to Tertiary.

Bituminous sandstone and oil shale occur in Tertiary rocks well above the coal-bearing formations and extend only slightly over the northeastern boundaries of the Book Cliffs and Sego coal fields. Exposed rocks that contain commercial deposits of uranium and vanadium south of the coal fields are deeply buried under the coal-bearing formations within the coal fields.

Other non-energy resources in the general area include helium and carbon dioxide in natural gases, veins of ozokerite (a natural mineral of hydrocarbon origin), sulfur associated with springs, gypsum beds and other evaporites including rock salt and potash, barite, clay, and gravel. Except for some of the clay and gravel, all of these resources are outside the coal fields or are in older rocks well below, or in younger rocks well above, the coal-bearing formations.

e. Soils

The soils in the Central Utah coal area represent 11 soil groups composed of 17 different soil associations, which were identified by Wilson and others (1975) and are shown on figure II-10. Table II-5 gives a brief description of the landforms, climate, and use of the soils in various soil groups. The characteristics and classifications of the soils are shown in table II-6.

The soils have formed primarily from sedimentary bedrock materials but vary considerably in response to changes in geology, topography, climatic conditions, and vegetation. A brief discussion of soils within the three major physiographic sections (fig. II-4) of the region is given below.

1. Soils of the Wasatch Plateau Section

Soils along the eastern front of the Wasatch Plateau section are very rocky, occur on steep slopes, and support very little vegetation. Westward from this erosional escarpment, the elevation increases to 8,000 feet or more and annual precipitation is 18-40 inches. A corresponding increase in vegetation and soil development occurs. Most of the

Table II-4--Coal reserves, central Utah coal region

[from figure II-9 of this report]

Coal field	Millions of tons
Sego	244.5
Book Cliffs	3,535.9
Wasatch Plateau	5,978.7
Salina Canyon	69.1
Emery	1,860.7
Price-Castle Dale area	2,285.0
Total	13,973.0

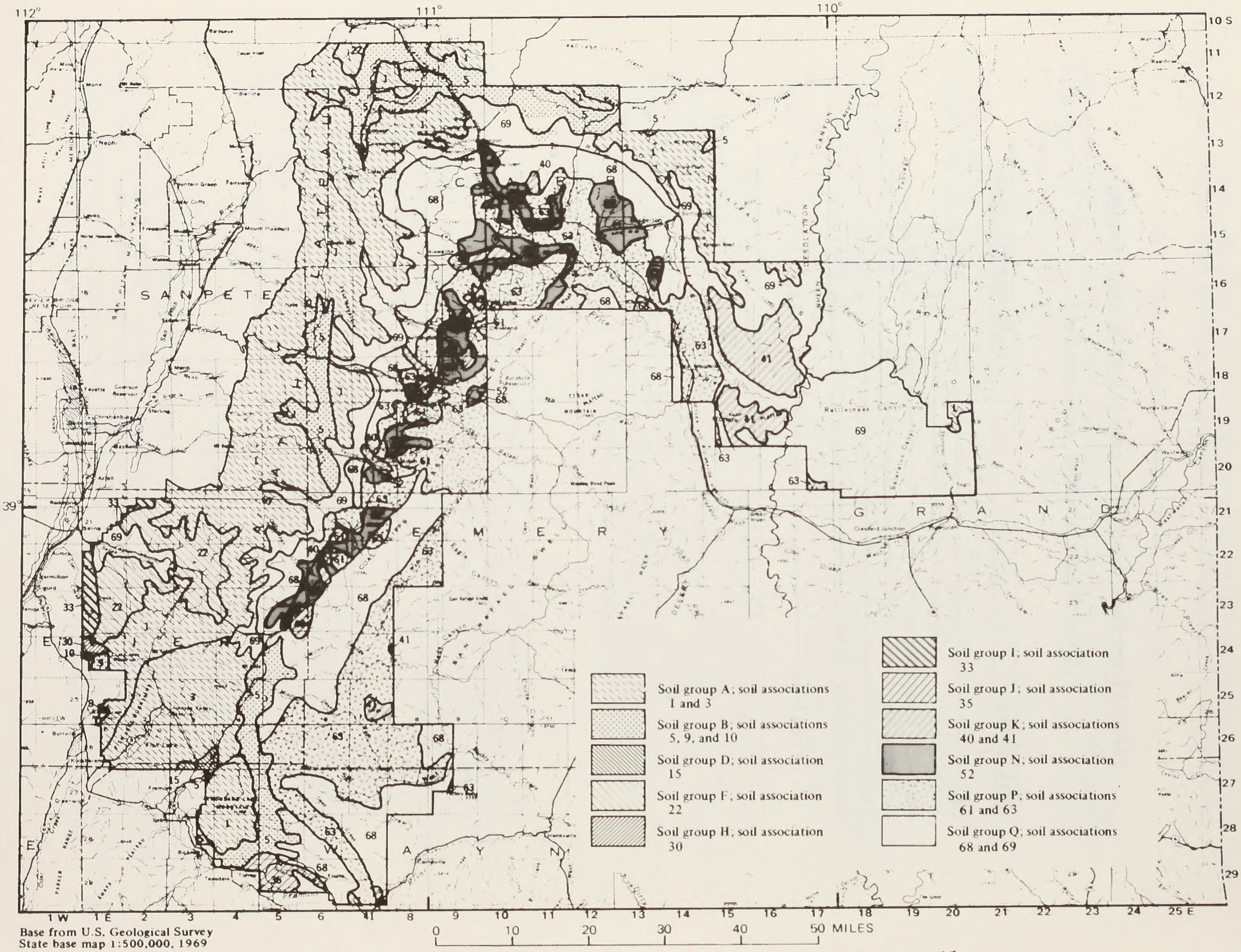


Figure II-10.--Map of the central Utah coal region showing soil groups and soil associations (From: Agricultural Experiment Station Bulletin 492, Soils of Utah, by Wilson and others, 1975).

Table II-5.--Soil group, association, landform, climate, and land use

[Source: Agricultural Experiment Station Bulletin 492, Soils of Utah, 1975, p. 3]

Soil group	Soil association numbers	Landform	Elevation (feet)	Average annual precipitation (inches)	Mean annual soil temperature	Freeze free growing season (days)	Preaent use
A	1, 3	High mountains	8,000-12,000	18-40	Less than 47/F[1]	0-60	Forest, range, wildlife, recreation, watershed.
B	9, 10	Mountains and plateaus	6,000-8,400	14-22	Less than 47/F	60-100	Range, forest, wildlife, recreation, watershed.
D	15	Mountains and foothills	5,500-8,000	12-14	Less than 47/F	80-110	Range, wildlife, recreation.
F	22	Mountains and plateaus, mountain valleys	5,500-8,500	14-22	Less than 47/F	60-100	Range, wildlife, forest, recreation, watershed.
H	30	Mountain foot slopes	6,000-7,000	12-14	Less than 47/F	80-110	Range, wildlife, recreation.
I	33	Foothills, terraces, alluvial fans	4,300-6,000	12-14	47/F-59/F	110-180	Range, dry cropland, irrigated cropland.
J	35	Valleys	6,000-7,000	8-14	Less than 47/F	80-110	Irrigated cropland, range.
K	40, 41	Alluvial fans, mesas and flood plains	3,600-7,000	8-14	47/F-59/F	110-180	Irrigated cropland, range, wildlife.
N	52	Low terraces, fans, and valley plains	4,000-6,000	Less than 10	47/F-59/F	110-180	Range, wildlife, irrigated cropland.
P_1	61	Valley bottoms	4,200-5,500	6-10	42/F-52/F	110-190	Range, wildlife.
P_2	63	Undulating uplands	4,500-5,000	6-18	41/F-50/F	110-150	Range, wildlife.
Q	68, 69	High mountain tops to playas	3,000-13,000	6-40	(See soil association on table II-4)		Recreation, watershed, scenic.area.

[1]Mean summer soil temperature is less than 59°F.

Table II-6.--Soil characteristics and classification[1]

Soil group/ soil association		Taxonomic classification	Soil depth	Drainage class	Surface soil texture	Subsoil texture	Soil reaction	Permeability	Major limiting factors
A	1	Argic Cryoborolls Pachic Cryoborolls Cryic Paleborolls	Deep to moderately deep (20-36"+)	Moderately well to somewhat excessively drained	Silt loam to clay loam	Cobbly loam to clay loam	Slightly alkaline to strongly acid	Slow to to rapid	Steep slopes. Some areas with unstable soils, high elevations, some rocky areas.
A	3	Lithic Cryoborolls Mollic Cryoboralfs Rock Outcrop	Shallow to to moderately deep (10-56"+)	Well to excessively dranied	Loam to cobbly loam	Cobbly loam to cobbly clay loam	Mildly acid to strongly acid	Slow to moderate	Steep slopes, high elevations, shallow soils, cobbly soils, some rocky areas.
B	5	Typic Argiborolls Lithic Argiborolls Typic Haploborolls	Shallow to deep (10-36"+)	Well drained	Cravelly loam to silty clay loam	Cobbly loam to cobbly clay loam	Neutral to moderately alkaline	Slow to moderate	Steep slopes, shallow soils, some areas with unstable soils, somewhat limited precipitation 14-20".
B	9	Lithic Argiborolls Rock Outcrop Typic Argiborolls	Shallow to deep (10-36"+)	Well drained	Cravelly and cobbly loam	Cobbly to gravelly loam and clay loam	Neutral to moderately alkaline	Moderate to slow	Steep slopes, shallow soils, cobbly soils, somewhat limited precipitation 14-20".
B	10	Typic Haploborolls Typic Argiborolls Typic Calciborolls	Deep to moderately deep (20-36"+)	Well drained	Cravelly loam silt loam and sandy loam	Cravelly to cobbly sandy loam and clay loam	Neutral to moderately alkaline	Moderate to rapid	Somewhat limited precipitation 14-20", calcium carbonate accumulation in subsoils.
D	15	Lithic Haploborolls Aridic Calciborolls Borollic Calciorthids	Shallow to deep (10-36"+)	Well to somewhat excessively drained	Cobbly loam and sandy loam on the shallow soils, and gravelly loam to silty clay loam on the deep soils	Gravelly to cobbly loam and clay loam	Mildly to moderately alkaline	Moderate to moderately rapid	Cobbly soils, limited precipitation 12-14", calcium carbonate accumulations in the subsoil, some clayey soils.
E	22	Typic Argixerolls Typic Haploxerolls	Deep to moderately deep (24-36"+)	Moderately well to somewhat excessively drained	Cobbly sandy loam gravelly loam very cobbly, very fine sandy loam and sandy clay loam	Loam to very cobbly loam	Medium acid to mildly alkaline	Moderately rapid to slow	Steep slopes, somewhat limited precipitation 14-20", high coarse fragment contents in some soils.
H	30	Lithic Argixerolls Aridic Haploxerolls Aridic Calcixerolls	Shallow to deep (10-36"+)	Well to somewhat excessively drained	Shallow soils are very cobbly sandy clay loam and stony silt loam, and moderately deep soils are cobbly coarse sandy loam to gravelly loam	Clay loam to very cobbly loam	Medium acid to moderately alkaline	Moderately rapid to rapid	Limited precipitation 12-14", some steep slopes, shallow soils and rock outcrops are common, cobbly to stony surface soils.
I	33	Aridic Calic Arixerolls Aridic Petrocalcic Palexerolls	Shallow to deep (10-36"+)	Well to somewhat excessively drained	Loam to cobbly loam	Cobbly loam to clay loam	Moderately to strongly alkaline	Moderately slow to moderately rapid	Limited precipitation 12-14", hardpan in some soils.
J	35	Ustolloc Torrifluvents Borollic Calciorthids	Deep (4"+)	Well drained	Loam to gravelly loam	Clay loam to gravelly loam	Mildly to strongly alkaline	Moderate to moderately rapid	Limited precipitation 8-14", calcium carbonate accumulations in the subsoil, some clayey subsoils.
K	40	Ustollic Calciorthids Ustollic Haplargids	Moderately deep to deep (20-36"+)	Well drained	Loam to gravelly sandy loam	Clay loam gravelly loam and gravelly sandy loam	Mildly to strongly alkaline	Moderate to rapid	Limited precipitation 8-14", some clayey subsoils, calcium carbonate layers at 12 to 24".
K	41	Lithic Ustollic Calciorthids Lithic Ustic Torriorthents	Shallow to deep (10-36 "+)	Well drained	Cobbly fine sandy loam to loam	Clay loam to very cobbly sandy loam	Mildly to strongly alkaline	Moderate to rapid	Limited precipitation 8-14", some steep slopes, shallow soils and rock outcrops are common, calcium carbonate layers at 6 to 24", cobbly surface soils.
N	52	Typic Torrifluvents Typic Torriorthents	Deep (36"+)	Moderately well to somewhat excessively drained	Silty clay loam loamy fine sand and sandy clay loam	Silty clay loam to sand	Mildly to strongly alkaline	Slow to to rapid	High salt contents, low precipitation (L-10"), high surface temperatures, clayey soils.
P	61	Typic Fluvaquents Typic Salorthids	Deep (36"+)	Very poorly to somewhat poorly drained	Silty clay loam and silty clay	Silty clay	Mildly to moderately alkaline and very strongly alkaline	Moderate to very low	High salt contents, high shrink-swell potentials, low precipitation (L-10"), clayey soils.
P	63	Typic Torriorthents (shallow) Lithic Calciorthids Lithic Natrargids	Shallow to moderately deep (10-36")	Well drained	Silt loam to silty clay loam	Clay loam and loam	Mildly to very strongly alkaline	Moderate to slow	High salt contents, slayey soils, high erosion potential, low precipitation.
Q	68	Rockland	This is a micellaneous landtype. More than 50 percent of the area is rock outcrop.						
Q	69	Badland-Rockland	This is a micellaneous landtype. This area is mainly barren shale and sandstone. The relief is steep to very steep dissected mountains, plateaus, escarpments, and breaks along canyons.						

[1]Compiled from information presented in Soils of Utah, 1975.

soils in this area are identified as high mountain types. Slopes are rolling to very steep.

Some soils within the Wasatch Plateau Section have a potential for mass movement, primarily on the North Horn Formation, although most of the slopes are generally stable. Soil, moisture, and temperature conditions are quite conducive to revegetation over most of the area, with exceptions being on the cold soils at high elevations and on some hot and dry southerly aspects. Steep slopes, with accompanying soil erosion hazards and operational limitations offer off the greatest potential problems to soil management within this physiographic section.

2. Soils of the Book Cliffs-Roan Plateau Section

The steep, rocky, deeply dissected, southfacing Book Cliffs are the dominant feature. The potential use of these soils along the cliffs and in the associated canyons is limited by steep slopes and rockiness, and low available moisture.

Above the Book Cliffs the slopes form gentle to rolling benches. Soils in this area are dominantly dark-colored soils of the mountains and plateaus that are usually moist in some parts during the summer and receive average annual precipitation of 14 to 22 inches. The soils have formed from sandstone, shale, and limestone; and commonly have a silt loam to loam surface and a loam to clay loam subsoil. There is a good potential for revegetation on these soils. The erosion potential is low to moderate. Some problems with engineering could be expected on clayey soil materials and on some sites that are wet due to seeps or poor drainage.

3. Soils of the Mancos Shale Lowlands Section

This section is a large, fairly level tract of land lying east of the Wasatch Plateau and south of the Book Cliffs. It is located on a weakly resistant Mancos Shale Formation. Soils and climatic conditions are limiting factors for land use. The soils are often high in soluble salts and have a silty clay texture. They are very erodible and low in fertility, with a characteristic gray color. Engineering uses are limited by a high shrink-swell potential. The soils include sodic-saline soils on valley bottoms; highly erodible soils; and light-colored soils of the desert valleys, terraces, and alluvial fans that are usually dry in all parts and receive average annual precipitation of less than 10 inches.

3. WATER

a. Water Supply

The use of Colorado River water by Utah is limited by the Upper Colorado River Basin Compact of 1948; under that compact Utah's allotment of water is about 1,400,000 acre-feet per year. In 1975, the estimated annual use was 850,000 acre-feet and approved filings amount to about 550,000 acre-feet per year; thus, only a small portion of Colorado River water, if any, is yet "unappropriated" (Utah Division of Water Resources, 1976).

Water use in Utah, as in other western states is based on the doctrine of prior appropriation, where the State allocates unappropriated water to an individual or corporation upon compliance with the provisions of the State law. First in time, first in right--and beneficial use is the measure and the limit of the right. This right to use has taken on the attributes of private property, and an acquired right may be sold and transferred to another party, or even under certain conditions may be moved from one place to another. Utah water laws do not recognize instream use of water for preservation of aquatic habitat as a beneficial use. Thus, a stream can be completely dewatered by diversion unless a downstream water right requires flows to be bypassed.

The State Engineer, who is the Director of the Division of Water Rights, is responsible for the administration of all water rights within the State and for determining whether or not proposed applications can be approved in light of existing State statutes and law.

Estimates of the use of water in the study area are as follows:

irrigation------------------	80-90 percent
municipal and industrial----	10-15 percent
managed wetlands------------	0-5 percent

The quantity of water applied annually to croplands averages 3.6 acre-feet per acre, and consumptive use on croplands averages 1.6 acre-feet per acre according to reports of the Utah Division of Water Resources (1975, 1976).

Both ground water and surface water are utilized in the study area. In terms of quantities used, surface water is the more important source; relatively large amounts are diverted annually for irrigation--about 90,000 acre-feet in the Price River basin, 150,000 acre-feet in the San Rafael basin, and 25,000 acre-feet in Muddy Creek basin. Coal-fired electric powerplants--in operation or under construction--will use about 62,000 acre-feet of water annually. Ground water is used to some extent for irrigation, for domestic and stock purposes, and public supply. Although the total amount of ground water used is small, ground water is important for it is the principal source of water for the small communities (total domestic use is about 10,000 acre-feet per year). Water from both wells and springs is utilized, but springs provide the greater quantity of water.

Springs and seeps throughout the area are also important sources of drinking water for livestock and wildlife; many have not been mapped, and the number and flow of these springs probably varies with the season and climatic conditions. Some may go dry at times. The total volume of water used is not known, but is presumably small.

1. Surface Water

Most of the study area is drained by tributaries to the Green and Colorado Rivers; principal tributaries are the Price and San Rafael Rivers and Muddy Creek (fig. II-5). The Green River flows through the eastern edge of the study area. A small part of the region (less than 10 percent) along the west edge is drained by Salina Creek, a tributary to the Sevier River, which is in the Great Basin. Precipitation is highest in the higher mountains. Thus, flow is perennial, mainly in small streams in the mountains and in larger streams that head in the higher mountains. Many streams are ephemeral and flow only in direct response to precipitation or snowmelt. Snowmelt is a major contributor to streamflow. Snow is generally stored through most of the winter at higher altitudes and gradually melts during the spring and early summer. Ground water is also a major contributor to streamflow, and it provides the continuity of flow (base flow) in the perennial streams, as well as some seasonal flow to intermittent streams. Summer precipitation does not usually produce much runoff. Intense rainfall may cause heavy flooding at times, but the areas affected are usually small, hence total runoff is small. The 100-year 6-hour precipitation ranges from 1.8 inches at lower elevations to 2.5 inches in the mountains (Miller and others, 1973).

Stream flow data are available at numerous points in or near the study area (fig. II-5 and table II-7). Records show that the minimum flow of many of the streams is zero (U.S. Geological Survey, 1977). Even the major streams--Price and San Rafael Rivers and Muddy and Salina Creeks--have been dry in their lower reaches sometime during the period of record. The flow of all the major rivers and the principal tributaries is affected by diversions of water, mainly for irrigation, and by storage reservoirs. Interbasin diversions are common. Water is diverted from the San Rafael River basin to the Price River basin, from both the San Rafael and Price River basins to the Sevier River basin, and from the Muddy Creek basin to the San Rafael River basin.

2. Ground Water

Geology is the principal factor controlling the occurrence and availability of ground water. Unconsolidated deposits of Quaternary age are the most permeable water-bearing formations in parts of the region; sandstone strata of Jurassic, Cretacious, and Tertiary age contain the most extensive bedrock aquifers (Price and Arnow, 1974). The geologic formations in the region and their water-bearing properties are listed in figure II-5.

The region is not very complex structurally, but hydrologically it is divided into units by structural elements such as the Book Cliffs, the San Rafael Swell, and the Wasatch Plateau. These units are modified

Table II-7.--Streamflow data for Price River, Muddy Creek, San Rafael and Salina Creek drainages (stations are located on figure II-5)

Station Number	Station name	Period of record	Drainage area (mi^2)	Discharge Average (ft^3/s)	Discharge Average (acre-ft)	Discharge Minimum (ft^3/s)	Discharge Maximum (ft^3/s)
Colorado River Basin:							
09308500	Minnie Maud Creek near Myton, UT-------	1950-55 1957-76	30	5.05	3,660	0	1,370
09310000	Gooseberry Creek near Scofield, UT-----	1940-76	16.4	18.4	13,330	0	414
09310500	Fish Creek above Reservoir near Scofield, UT--------------------	1938-76	65	47.4	34,320	0.6	1,160
09312600	White River below Tabbyune Creek near Soldier Summit, UT--------------	1967-76	75	29.8	21,590	1.2	458
09312700	Beaver Creek near Soldier Summit-------	1960-76	26	4.24	3,070	0	135
09312800	Willow Creek near Castle Gate, UT------	1962-76	62	7.60	5,510	0	836
09314250	Price River below Miller Creek near Wellington, UT------------------	1972-76	890	--	--	4.8	2,880
09314280	Desert Seep Wash near Wellington, UT---	1971-76	191	--	--	0.5	1,840
09314500	Price River at Woodside, UT------------	1945-76	1,500	101	73,170	0	8,500
09315000	Green River at Green River, UT---------	1894-99 1904-76	44,850	6,352	4,602,000	255	68,100
09318000	Huntington Creek near Huntington, UT---	1910-17 1921-29 1930-70	188	96.7	70,060	2	2,500
09324500	Cottonwood Creek near Orangeville, UT--	1909-20 1921-27 1932-70 1975-76	205	96.8	70,130	1.2	7,220
09326500	Ferron Creek near Ferron, UT-----------	1911-23 1947-76	138	66.8	48,400	1	4,180
09327550	Ferron Creek below Paradise Ranch near Clawson, UT---------------------	1975-76	221	--	--	0.8	137
09328000	San Rafael River near Castle Dale, UT--	1947-64 1972-76	930	110	79,700	1.3	4,510
09328100	San Rafael River at S. R. Bridge Campground near Castle Dale, UT------	1975-76	1,284	--	--	5.0	257
09328500	San Rafael River near Green River, UT--	1909-18 1945-76	1,670	152	110,100	0	12,000
09329050	Seven Mile Creek near Fish Lake, UT----	1964-76	25	14.9	10,800	2.0	215
09330500	Muddy Creek near Emery-----------------	1910-13 1949-76	105	37.5	27,200	0	3,340
09332100	Muddy Creek below Hwy I-70 near Emery, UT-----------------------	1973-76	418	15.6	11,300	0.05	2,070
09332700	Muddy Creek at Delta Mine near Hanksville, UT------------------	1975-76	841	--	--	0	1,860
09332800	Muddy Creek at mouth near Hanksville, UT------------------	1975-76	1,552	--	--	0	8,320
Sevier River Basin:							
10205030	Salina Creek near Emery, UT------------	1963-76	53	17.2	12,460	1.7	519
10206000	Salina Creek near Salina, UT-----------	1915-16 1917-19 1943-55 1960-76	290	21.1	15,290	0	1,800

by numerous subsidiary folds, faults, and intrusions; and in the upper formations by deeply cut drainage systems. The deep drainage system in some areas drains the exposed bedrock, and the upper water-bearing beds are discontinuous and partially void of water near cliff faces.

Water-table conditions commonly prevail in shallow alluvium along larger streams, and in relatively flat-lying sedimentary rocks. Artesian conditions exist at depth in part of the region, but flowing wells occur only in a few places. In some localities the ground water may be perched, or impeded from deeper infiltration, by one or more confining layers of rock having relatively low permeability.

Ground water is recharged principally in the higher plateaus, which receive the most precipitation and produce most of the runoff. Ground water moves from areas of recharge to discharge areas, which include numerous widely scattered springs, stream courses, and patches of phreatophytes. The direction of movement of water through the bedrock formations cannot be determined with current available data, except perhaps in a few local areas. Withdrawal by wells apparently has not had widespread effects on ground water levels. Changes in ground-water levels (which reflect changes in ground-water storage) are caused chiefly by changes in precipitation and to a lesser extent by evaporation and transpiration.

Ground-water recharge is by direct infiltration of precipitation (probably much less than 5 percent of the annual precipitation) primarily on the Wasatch and Roan Plateaus and by infiltration from perennial streams that flow into the Mancos Shale lowlands. Although the surficial material may be relatively less permeable than the underlying saturated beds, considerable amounts of water infiltrate to the saturated beds because of the large areas through which the infiltration occurs. Ground-water recharge also takes place to a limited extent by infiltration in outcrops (exposures at the land surface) of some of the more permeable and stratigraphically lower formations. The areas of outcrops are small, and thus limit the amount of recharge.

Water enters the alluvium of the region from direct precipitation and from tributary streamflow from the surrounding mountains and ridges. Alluvium in the large valleys is the most accessible source of ground water other than springs. Most valleys with thick alluvium probably contain ground water that could be used as small domestic supplies. Wells that tap several lenses of coarse material in the larger valleys should yield more than 50 gal/min (gallons per minute).

Price and Waddell (1973) state that yields to individual wells and springs are small in most of the region. Wells that tap the consolidated rocks which underlie most of the region, generally yield less than 50 gal/min although some wells produce as much as 1,000 gal/min from these rocks. Yields of 50 to 500 gal/min are generally available from large-diameter wells that tap alluvium in the larger stream valleys such as Green, Price, and San Rafael Rivers. Properly located and constructed wells in the thicker (100 feet or more) alluvial deposits yield 500 to more than 1,000 gal/min.

Depths to ground water range from less than 50 feet to more than 1,000 feet (Price and Waddell, 1973). Ground-water levels are generally less than 50 feet beneath the land surface along alluvial plains of the larger perennial streams (Green, Price, and San Rafael Rivers) and 500 to more than 1,000 feet beneath the land surface on higher plateaus (Price and Waddell, 1973). Local perched ground-water bodies are only a few feet to a few tens of feet below land surface in much of the region. Generally, however, the perched water bodies probably would not sustain large perennial withdrawals from wells. Additional information on the occurrence of ground water is available from Feltis (1966).

b. Water Quality

In general, the chemical quality of surface water is relatively good in the headwater areas but deteriorates downstream. The concentration of dissolved solids in surface water ranges from about 100 to 500 mg/L (milligrams per liter) in headwater areas to about 1,000 to 5,000 mg/L in the lower reaches of most streams (U.S. Geological Survey, 1977). The dominant ions in the headwaters are calcium and bicarbonate; in the middle reaches calcium, magnesium, sodium, bicarbonate, and sulfate with local variations; and in the lower reaches sodium and sulfate (table II-8). Water in the through-flowing Green River contains 250 to 750 mg/L dissolved solids. The concentration of dissolved solids in streams is usually inversely proportional to flow. Thus, the chemical quality of water is usually best during high flow and worst during low flow.

Concentrations of trace elements and heavy metals in the headwater areas are generally less than the maximum limits recommended by the Environmental Protection Agency (1973) for public supply and aquatic life (table II-9); however, in the middle and lower reaches of the Price and San Rafael Rivers and Muddy Creek, concentrations of certain elements including aluminium, arsenic, lead, manganese, selenium, and zinc commonly exceed recommended limits, and cadmium, copper, mercury, nickel, and silver occasionally exceed recommended limits according to recent unpublished data from Southeastern Utah Association of Governments (table II-10). Water in the Green River at Green River, Utah, at times in 1976 contained concentrations of chromium, copper, lead, and zinc in excess of recommended limits (table II-11). Water from some of the coal mines contains greater concentrations of arsenic, iron, manganese, and selenium than are normal in streams according to unpublished data from the Southeastern Utah Association of Governments' 208 Water Quality Program, which may indicate that present enforcement of mitigations is somewhat remiss. Data on concentrations of other metals and trace elements in coal-mine effluent are not available.

Table II-8.--Water quality data,[1] U.S. Geological Survey, 1976 water year

[Constituents in milligrams per liter]

Station number	Station name		TDS	Ca	Mg	Na	K	Cl	So$_4$	HCO$_3$	SS
09314500	Price River at Woodside ----	Min.	1,660	170	85	230	7.0	31	1,000	260	48
		Max.	4,440	310	250	730	12	78	2,800	530	5,630
09315000	Green River at Green River--	Min.	290	41	15	30	1.8	9.7	110	150	332
		Max.	703	82	35	110	3.3	35	300	270	3,400
09324500	Cottonwood Creek near Orangeville----------------	Min.	208	39	20	8.5	0.8	3.4	15	212	00
		Max.	319	56	30	21	1.8	13	73	271	178
09327550	Ferron Creek below Paradise Ranch near Clawson---------	Min.	1,850	150	110	250	6.1	27	1,100	299	110
		Max.	3,730	290	230	550	15	72	2,400	474	735
09328100	San Rafael River at San Rafael Bridge Campground near Castle Dale-----------	Min.	2,400	190	140	370	8.5	35	1,500	251	5503
		Max.	5,150	320	310	870	15	86	3,400	463	4,230
09328500	San Rafael River near Green River----------------	Min.	2,470	190	140	360	8.8	40	1,500	288	445
		Max.	4,300	360	230	660	14	87	2,800	530	1,560
09332700	Muddy Creek at Delta Mine Hanksville-----------------	Min.	2,210	180	77	270	6.2	170	1,200	121	112
		Max.	4,760	480	190	810	16	630	2,600	273	8,960
09332800	Muddy Creek at Mouth near Hanksville-----------------	Min.	3,350	340	84	590	8.0	520	1,500	143	11,020
		Max.	8,100	670	230	1,800	26	1,900	3,400	296	2223,000

[1] TDS = Total dissolved solids; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; Cl = Chloride; SO_4 = Sulfate; HCO_3 = Bicarbonate; SS = Suspended sediment

Table II-9.--Water quality criteria

[Source: EPA, 1973]

Chemical parameter	Public supply limit (mg/L)	Aquatic life threshold (mg/L)
Aluminum	--	0.1
Arsenic	0.1	1.0
Barium	1.0	--
Cadmium	0.01	[1,3] 0.03 [1,4] 0.004
Chloride	250	--
Chromium	0.05	0.05
Cobalt	--	5.0
Copper	1.0	[3] 0.015-0.033 [4] 0.011-0.018
Cyanide	0.2	--
Flouride	[2] 1.4-2.4	--
Iron (soluble)	0.3	--
Lead	0.05	[1] 0.03
Manganese (soluble)	0.05	--
Mercury	0.002	[1] 0.05
Nickel	--	0.01
Nitrate-Nitrogen	10.0	--
Nitrite-Nitrogen	1.0	--
Selenium	0.01	10.0
Silver	--	0.001
Sulfate	250	--
Zinc	5.0	0.005
Unionized ammonia	--	0.02
Free chlorine	--	0.01

[1] Recommended maximum level.
[2] Dependent upon ambient temperature.
[3] Hard water.
[4] Soft water.

Table II-10.--Trace element concentration in Price River near Woodside /Source: Unpublished data, Southeastern Utah Association of Governments/

Element	Times sampled	Exceeded limits	Mg/L highest reading	Mg/L highest recommended limits
Cadmium--------	11	1	0.113	0.03
Copper---------	7	1	.035	.033
Lead-----------	9	2	.038	.03
Mercury--------	6	1	.60	.05
Nickel---------	6	4	.075	.01
Silver---------	6	1	.004	.001
Zinc-----------	7	4	.159	.005

Table II-11.--Trace element concentrations in the Green River at Green River, Utah, 1976

Elements	Concentrations (mg/L) Total	Dissolved
Arsenic------------	0.002-0.015	0-0.033
Cadmium------------	0-<0.010	0-0
Chromium-----------	0-0.096	0-0.010
Cobalt-------------	<0.050-0.050	0-0
Copper-------------	<0.010-0.110	0.001-0.006
Iron---------------	0.590-32.000	0-0.060
Lead---------------	<0.100-0.200	0-0.005
Manganese----------	0.030-1.000	0-0.020
Mercury------------	0-0.0001	0-0.0001
Selenium-----------	0.001-0.003	0.001-0.002
Zinc---------------	0-0.150	0-0.080

It is important to note here that water which meets all standards for public supply and (or) human consumption can be toxic to aquatic life.

In general, concentrations of suspended sediments range from zero to a few thousand mg/L but occassionally may increase to more than 200,000 mg/L (table II-8). Highest concentrations of suspended sediment occur during high-intensity runoff from thunderstorms, and lowest concentrations occur during base flow.

The chemical quality of ground water ranges widely because of great variations in geology, physiography, and climate. Generally, the best quality is in or near recharge areas or areas with sufficient flow to flush out the poorer quality water. Water in shallow saturated beds almost everywhere contains less than 1,000 mg/L of dissolved solids and in some places less than 500 mg/L of dissolved solids. Ground water generally contains less than 500 mg/L of dissolved solids throughout the Wasatch Plateau, 500 to 1,000 mg/L along the fringes of the Plateau and in the Book Cliffs, and 1,000 to 3,000 mg/L in the rest of the area (Price and Waddell, 1973).

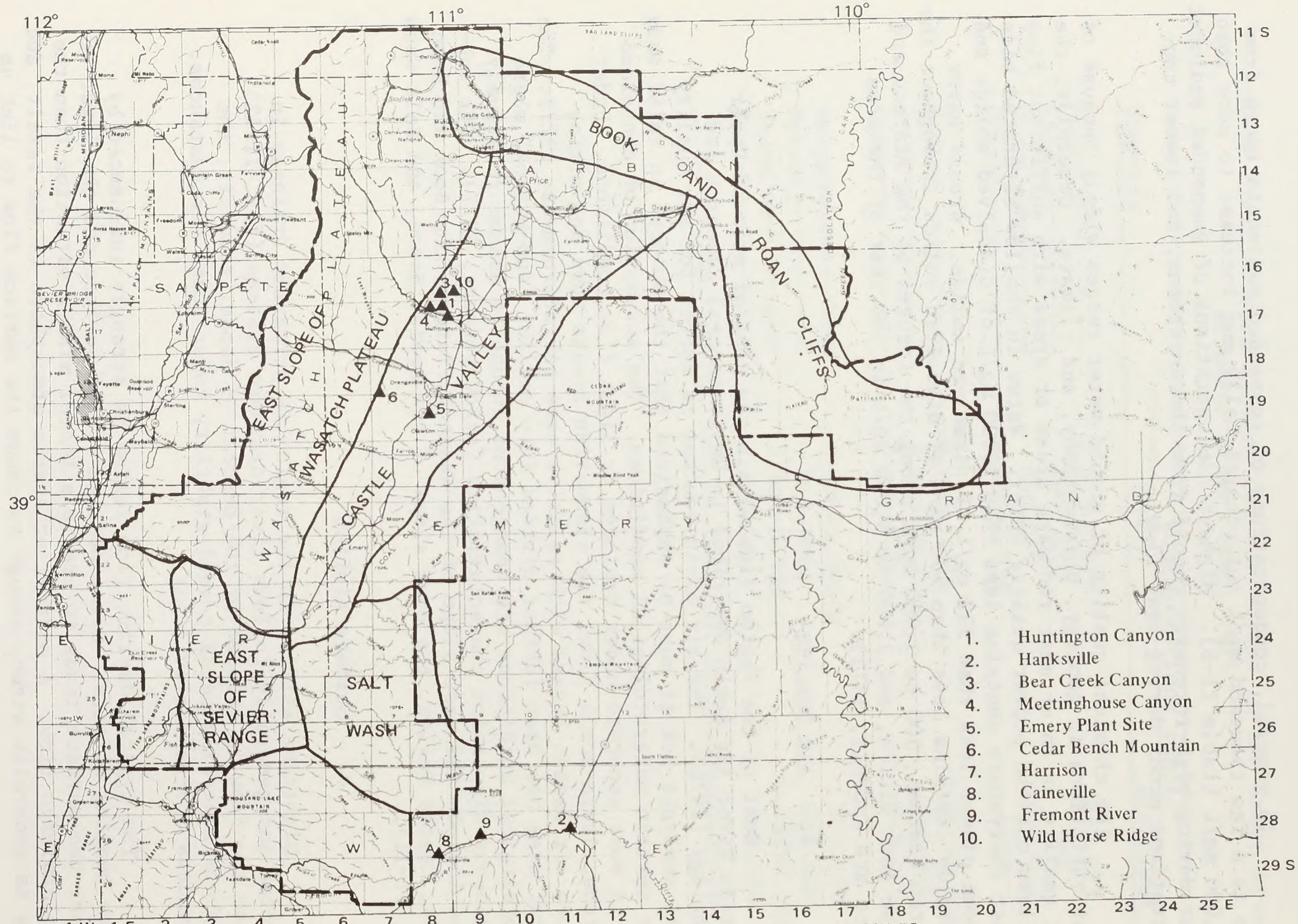
4. AIR QUALITY

Most of the region lies within the central area of Upper Colorado River Air Basin described in Environmental Research and Technology (1976). The air basin concept is useful for air quality impact analysis but it must be emphasized that the concept is valid only under certain meterorological conditions. The assumption of contained flow is most accurate under drainage or light flow conditions. Under vigorous, large-scale flow, the assumption breaks down and mixing between air basins occurs with relative ease (AeroVironment, 1977). The central area has been further divided into smaller "sub-basins" where meteorological conditions are homogeneous enough to assume relatively homogeneous dispersion characteristics (AeroVironment, 1977). The sub-basins include the east slope of the Wasatch Plateau, the Book and Roan Cliffs, Castle Valley, the east slope of the Sevier Range, and Salt Wash (fig. II-11).

a. Surface Airflow

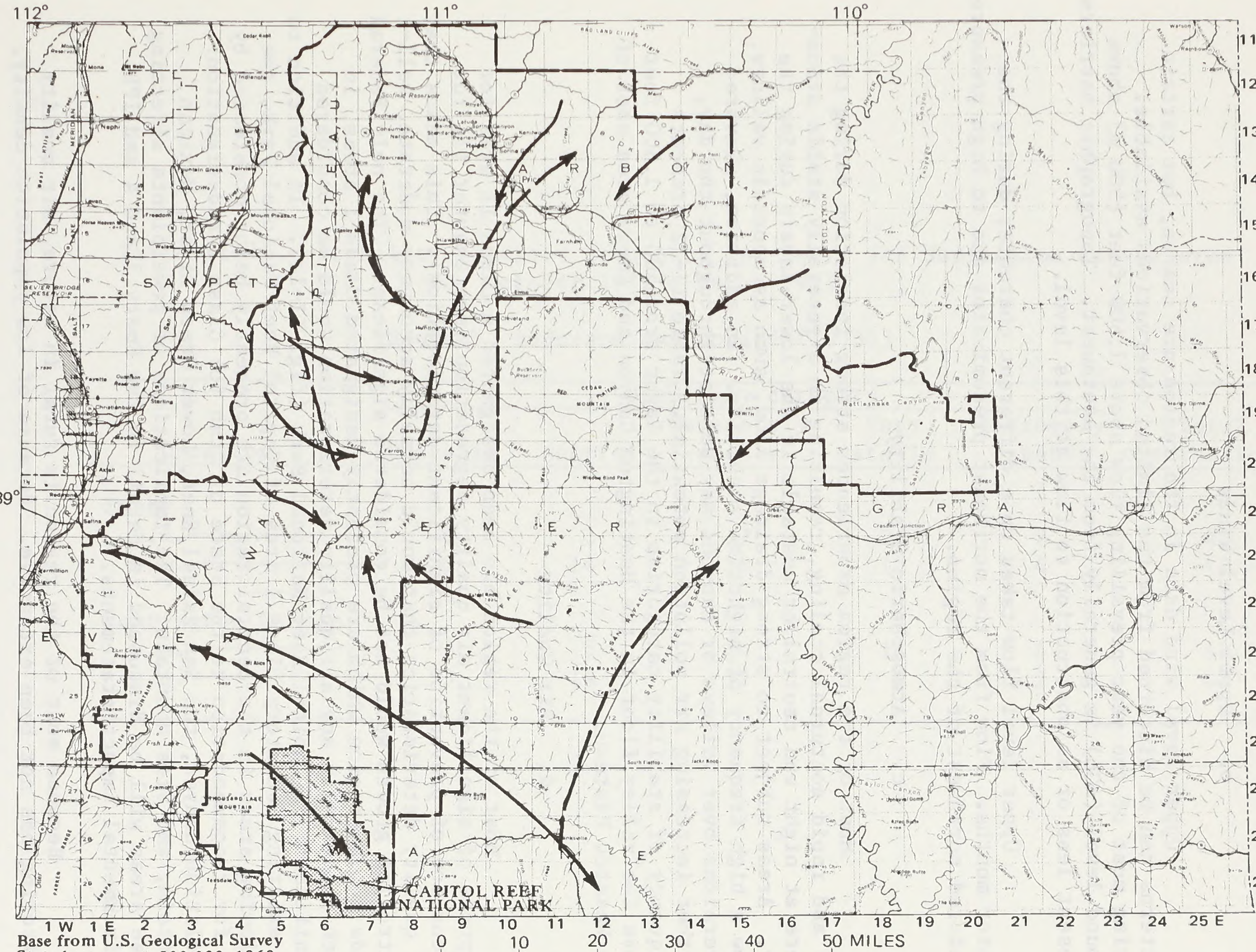
Nighttime airflow in the region is primarily drainage in character and generally follows river drainage systems (fig. II-12). Because the flow is induced by the descent of dense, cold air, the atmosphere generally tends toward stability under these circumstances. Wind speeds are generally light.

The typical daytime flow regime is strongly influenced by surface heating effects. Solar heating of the surface and the layer of air near the surface tends to create a better mixing situation than the stable drainage flow. A neutral or stable atmosphere is the result, and mixing is generally strong enough to cause the surface flow to link up



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-11.--Air sub-basins and air quality monitoring stations in central Utah (Modified from AeroVironment, 1977).



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-12.--Map showing streamlines for nighttime drainage air flow and typical daytime surface flow in central Utah (Modified from AeroVironment, 1977) with the flow aloft, as far as terrain constraints will allow, resulting in a flow from the southwest as depicted in figure II-12. However, the valley flow regime may alter this pattern. Daytime flow in the rugged terrain tends toward up-valley as the higher ridges act as chimneys or raised heat sources in influencing the flow.

b. Upper Level Winds

Upper level wind data in the region are scarce, but certain patterns can be discerned from the limited observations available. During most of the year prevailing flow above 1,600 feet (500 m) above ground level (AGL) is generally from the southwest. Topographic barriers present less of an obstruction to flow at this level.

Upper level flow takes on a different character during the winter months. Flow from the northeast predominates due to high pressure centered northwest of the region.

c. Atmospheric Stability

Most of the region experiences strong insolation during the day and rapid nocturnal cooling, resulting in a generally stable atmosphere at night and neutral or unstable in the lower layers during the day. Areas subject to strong drainage flow, such as mountain valleys, show a high frequency of nighttime stability. In addition, elevated inversions over valleys or canyons may persist throughout the day, further increasing air pollution potential. Table II-12 presents frequency of stability categories in the layer from 500 to 1,500 feet above the valley floor in the Huntington Canyon and Emery area east of the Wasatch Plateau.

d. Air Quality

Most of the region has been designated a Class II area for purposes of significant air quality degradation (see chapter III for discussion of prevention of significant deterioration). This means that air quality deterioration that would normally accompany moderate, well-controlled growth would not be considered significant. The only Federal lands in the region which are presently designated Class I areas, in which practically any air quality deterioration would be considered significant, is Capitol Reef National Park (fig. II-12). In addition to the existing mandatory Class I area of Capitol Reef National Park, the following areas in the central region are presently being considered by BLM for recommendation to the State of Utah for Class I redesignation: Desolation Canyon, the San Rafael Reef, Lower Green River, Mexican Mountain, and Sids Mountain. The implications of powerplants affecting these areas will be discussed in detail in the Emery 3 and 4 and IPP environmental impact statements.

Because most of the region is rural in nature, air quality monitoring has not been extensive. Because of low population density,

Table II-12.--Stability category frequency for Emery and Huntington Canyon area for October 1972 - March 1973

[Source: Anderson and Hovind (1973)]

Location	Stability category: Unstable	Neutral	Moderately stable	Very stable	Extremely stable	Total observations
Emery						
a.m.--------------	1	1	17	22	7	48
p.m.--------------	0	14	19	12	4	49
Huntington Canyon						
a.m.--------------	1	5	24	14	4	48
p.m.--------------	3	19	17	8	2	49

limited human and industrial activity, air quality is generally considered to be good to excellent. Monitoring has been done around potential and existing power plantsites by consultants and in other areas by the Environmental Health Services Branch of the Utah State Division of Health. These data are summarized below. Monitoring locations are shown on figure II-11.

1. Suspended Particulate Matter

Monitoring of total suspended particulates (TSP) in the study area is relatively extensive compared to that for many other pollutants. TSP data from 10 stations are presented in table II-13.

Violation of the primary National Ambient Air Quality Standards (NAAQS) for annual geometric mean (AGM) were recorded at Huntington and Cedar Bench Mountain. Violations of the TSP standards in these areas are generally associated with blowing dust during periods of high wind. Based on 6 months of monitoring, violations of the secondary standard were recorded at Price. Violations of the primary standard for 24-hour average were recorded at two locations, and violations of the secondary standard were recorded at four additional locations.

2. Sulfur Dioxide

Ambient air quality data for sulfur dioxide is available from 12 locations near the region. Table II-14 presents the annual average and maximum 24- and 3-hour averages for the monitoring period.

No violation of any NAAQS for SO_2 has been reported in or near the region. The highest values at more rural sites have been 15 micrograms per cubic meter ($\mu g/m^3$) annual average at Bear Creek Canyon (calculated from 3 months monitoring) and a 216 $\mu g/m^3$ maximum 24-hour and 502 $\mu g/m^3$ maximum 3-hour average at Meetinghouse, both near Huntington Canyon. These values are 19 percent, 59 percent, and 39 percent of the NAAQS, respectively.

3. Oxidant

Only two stations near the region have monitored oxidant. Because it is the major constituent of photochemical smog, it is primarily an urban pollutant. However, monitoring of proposed oil shale tracts northeast of the region (AeroVironment, 1977) has shown that ozone violations can occur in very rural areas in Utah.

Monitoring of ozone at Salt Wash and Price in 1975 have shown no violations of the NAAQS.

4. Oxides of Nitrogen

Nine locations have monitored NO_2 near the region and NO_x has been monitored at one other. Table II-15 presents annual averages and maxiumum 24-hour averages.

Table II-13.--Total suspended particulate readings at stations in and near the study area

Location	Period of observation	Maximum[1] 24-hour average	AGM[2] ($\mu g/m^3$)
Price--------------------	6/75-12/75	181	72
Huntington--------------	1974	356	89
Huntington Canyon-------	1975	191	22
Bear Creek Canyon-------	1974	222	21
Emery plantsite---------	7/74, 12/74	179	--
Castle Dale-------------	7/74, 12/74	86	--
Ferron------------------	7/74, 12/74	150	--
Cedar Bench Mountain----	1971	1016	84
Harrison----------------	1972	56	20
North Emery-------------	1974	119	26

[1]National Ambient Air Quality Standard for Maximum 24-hour secondary standard is 150 $\mu g/m^3$ and 260 $\mu g/m^3$ for the primary standard.

[2]National Ambient Air Quality Standard for the Annual Geometric Mean (AGM) is 60 $\mu g/m^3$ for the primary standard.

Table II-14.--Sulfur dioxide readings at locations in and near the study area

Location	Period of observation (month/year)	Annual average $\mu g/m^3$	Maximum 24-hour average $\mu g/m^3$	Maximum 3-hour average $\mu g/m^3$
Price----------------------	1975	3	26	131
Huntington-----------------	7/74, 12/74-1/75	8	19	--
Huntington Canyon[1]---------	1975	[3]0	52	260
Huntington Canyon[2]---------	1/75	--	69	251
(valley floor)-----------	6/75-8/75	4	13	58
Bear Creek Canyon----------	7/74, 12/74-1/75	15	28	--
Emery plant site-----------	7/74, 12/74	<8	<8	--
Castle Dale----------------	7/74, 12/74	8	<13	--
Ferron---------------------	7/74, 12/74	5	<13	--
Cedar Bench Mountain-------	7/74	<5	<5	--
Harrison-------------------	7/74, 12/74-1/75	8	18	--
Wild Horse Ridge-----------	6/75-8/75	3	13	134
Wild Horse Ridge-----------	1/75	--	161	502
Meetinghouse Canyon--------	6/75-8/75	14	26	202
Meetinghouse Canyon--------	1/75	13	216	472

[1]Measurements made by Environmental Health Services Branch of Utah State Division of Health.

[2]Measurements made by North American Weather Consultants.

[3]Value below detectable limit of instrument.

Table II-15.--Nitrogen dioxide (NO_2) readings at locations in and near the study area

Location	Period of observation (month/year)	Average $\mu g/m^3$	Maximum 24-hour average $\mu g/m^3$
Huntington--------------	11/71-12/71	17	--
Huntington--------------	7/74, 12/74-1/75	7	16
Huntington Canyon (valley floor)---------	7/75-8/75	6	19
Bear Creek Canyon-------	1972	--	34
Bear Creek Canyon-------	7/74, 12/74-1/75	10	24
Castle Dale--------------	7/74, 12/74	14	24
Ferron------------------	7/74, 12/74	7	12
Cedar Bench Mountain----	7/74	2	4
Harrison----------------	7/74, 12/74-1/75	10	22
Emery County------------	8/70	--	[1]55
Meetinghouse Canyon-----	12/74-1/75	5	23
Meetinghouse Canyon-----	6/75-8/75	15	39
Emery plant site---------	7/74, 12/74	4	8

[1]This reading includes both NO and NO_2.

Annual averages are well-below the NAAQS. Two months of monitoring at Huntington in 1971 demonstrated an average of only 17 $\mu g/m^3$, which is 17 percent of the NAAQS for annual average. Averages at other locations are lower.

5. Carbon Monoxide

No data for carbon monoxide are available for the region. However, the fact that the area is essentially rural in nature, leads one to conclude that carbon monoxide levels must be low. Monitoring performed in other rural or suburban parts of Utah and Arizona has shown maximum 8-hour averages of 5 $\mu g/m^3$ at Lindon, Utah, 1 $\mu g/m^3$ at Florence, Ariz. and 3.7 $\mu g/m^3$ at the remote proposed oil shale tracts in the Uinta Basins. Thus, it is unlikely that NAAQS are currently being violated.

6. Hydrocarbons

No monitoring of hydrocarbons has been performed in the region. The relatively small automobile population and lack of industry in the study area implies that concentrations are low. However, measurements in the proposed oil shale tracts and in Florence, Arizona have shown that rural areas may exceed the 6-9 a.m. non-methane hydrocarbon NAAQS guideline levels. Thus, it is not possible to rule out current excesses of the guideline concentrations in the region.

7. Visibility

Measurements of atmosphere visibility (visual range or discoloration) are extremely limited in the region. Values of visual distance in the Huntington area using light-scattering measurements from an integrating nephelometer demonstrated an average of 67 miles for the period September 1970 to March 1971. Average visual range calculated from particle-size distributions at Bear Creek and Huntington Canyons in 1974 was approximately 45 miles.

Analysis of photographs taken at Clawson, Utah from January to June, 1974 indicated 50-mile visibility 49 percent of the time. Visibility was reduced below 5 miles only 12 percent of the time.

Visibility measurements at Cedar Mountain, east of Castle Dale using photographic photometry have shown averages between 94 miles in November-December 1976 and 54 miles in April 1977 (Pueschel and others, 1978).

5. VEGETATION

Vegetative cover differs considerably over the region (fig. II-13). It ranges from low desert shrubs to conifer stands and mountain meadows. Vegetative production also varies from almost nothing to very high. Current annual forage production of the vegetative types range from almost nothing up to 2,000 pounds per acre dry weight with an average of about 300 pounds per acre (BLM & USFS data). Change in elevation, with associated moisture and temperature changes, is the chief factor in the variety of vegetative types. Topography, aspect, elevation, and soil cause modification of the variety. Figure II-14 shows the effect of elevation.

Twelve vegetative types were used to describe this region; they are as follows: 1. Nonproductive, 2. Agricultural land, 3. Streamside, 4. Grassland, 5. Desert Shrubs, 6. Sagebrush-Grass, 7. Pinyon-Juniper Woodland, 8. Mountain Brush, 9. Ponderosa Pine, 10. Aspen, 11. Conifer-Aspen, and 12. Mountain Meadow.

A complete description, including a listing of the common species in each type, is contained in the Task Force files.

The Endangered Species Act of 1973 authorized the Secretary of the Interior to designate threatened and endangered species (including plants). The act also directed the Smithsonian Institution, in conjunction with other agencies, to prepare a list of plants considered to be threatened or endangered.

Threatened or endangered plants of the region and their environs were studied by Welsh (1977). These plants consist of perennial herbs, subshrubs, a few annuals, some shrubs, but no trees. All growth forms exist in arid or moderately moist sites, with aquatic and semiaquatic representatives lacking. There are 27 species or varieties in the region which are proposed in Federal Register publications as either threatened or endangered (table II-16). Of the 13 species listed as endangered, 6 are judged as having critical current status; of the 14 species cited as threatened 6 are thought to be critical (Welsh, 1977). Sixteen of the species listed on table II-16 were collected in or adjacent to the region in 1977 as indicated on figure II-13.

Generally speaking, these plants do not usually grow on the same areas where coal is found (Welsh, 1977). However, because of the lack of time to perform a comprehensive survey and the shortage of moisture during 1977, some of these plants may occur on the lease or facility areas. Some of the threatened and endangered plants do grow on areas subject to urban development and recreational use.

6. WILDLIFE

A large variety of wildlife characteristic of life zones ranging from cold desert to high mountain forest are found in the region. Approximately 90 species of mammals, 270 species of birds, 26 species of reptiles, and 9 species of amphibians are found in the region (Dalton and others, 1977). Only species of significant human interest, and unique, rare, or endangered species are discussed here. A complete list of wildlife species that may be found in the region is on file at the Task Force Office.

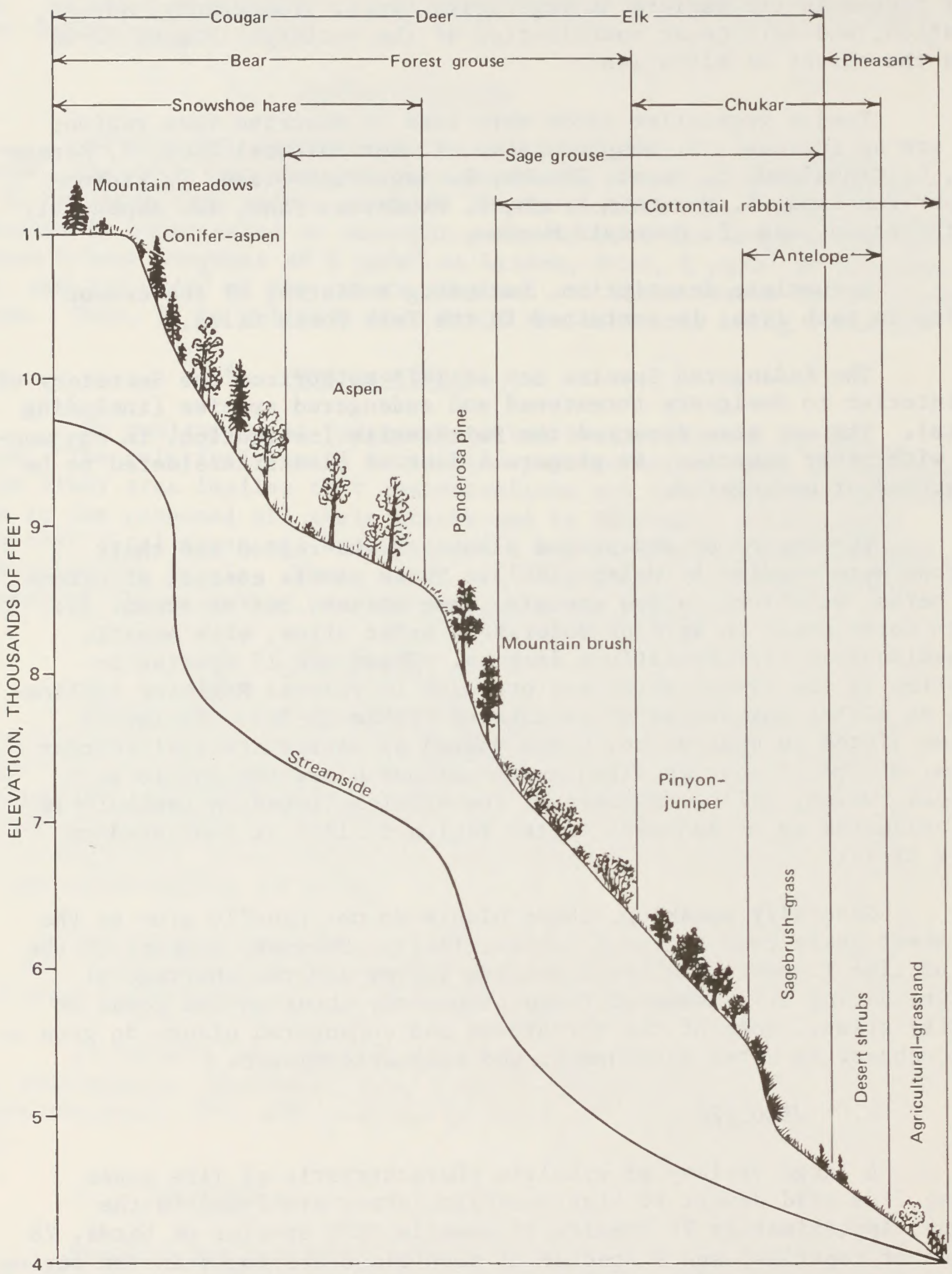


Figure II-14.--Graph showing typical vegetation and game distribution changes with elevation.

Table II-16.--Summary of proposed threatened (T) and endangered (E) plant species

[Source: Welsh, 1977]

Species	Status[1]		County[2]	Critical habitat
Asclepias ruthiae----------	(T)	C	E, Gr, Wy	Sandy soil
Astragalus barnebyi[3]------	(T)	C?	Ga, Wy	Sandy siltstone
Astragalus lentiginosus var. chartaceaus----------	(E)	NC	Se, Sa	Volcanic gravels
Astragalus loanus----------	(E)	NC	Wy, Ga, P, Se	Volcanic gravels
Astragalus pardalinus[4]----	(E)	NC	E	Entrada Sandstone, sand
Astragalus rafaelensis----	(T)	C	E	Morrison, Chinle, Moenkopi
Castilleja scabrida-------	(T)	NC	E, and others	Dakota
Cryptantha jonesiana------	(E)	C	E	Moenkopi
Cryptantha johnstonii-----	(E)	C	E	Carmel
Cycladenia humilis var. jonesii[5]------------	(E)	C	E, Gr	Moenkopi
Eriogonum corymbosum var. davidsei-----------	(E)	C?	C	Sandy loam
Eriogonum intermontanum---	(E)	C?	E, Gr	Green River shale
Eriogonum jamesii var. rupicola-----------	(T)	NC	Wa	Navajo
Eriogonum lancifolium-----	(E)	C	C	Sandy loam
Eriogonum smithii---------	(T)	C	E	Entrada, blow sand
Festuca dasyclada---------	(E)	C?	Sa	Calcareous
Parthenium ligulatum[6]-----	(T)	C	D, E	Carmel, Green River shale
Penstemon abietinus-------	(T)	C?	Se	Sandy loam
Penstemon wardii----------	(T)	C?	Se, Sa	Various habitats
Phacelia argillacea-------	(E)	C	U	Green River shale
Phacelia constancei-------	(T)	NC	E, Ga, K, SJ	Mud-siltstone
Phacelia rafaelensis------	(T)	NC	E, Wy	Moenkopi
Physaria grahamii---------	(E)	C?	Gr, E	Green River shale
Psorothamnus thompsonae[7]--	(T)	NC	E, Ga, K, Wy	Various habitats
Sclerocactus wrightii-----	(T)	C	E, Wy	Mancos Shale
Silene petersonii---------	(T)	C	Sa	Calcareous outcrops
Townsendia apricia--------	(E)	C	Se	Sandy pediment

[1]C = Critical, NC = Not Critical, ? = Uncertain

[2]County Abbreviations: C = Carbon, D = Duchesne, E = Emery, Ga = Garfield, Gr = Grand, K = Kane, P = Piute, Sa = Sanpete, Se = Sevier, SJ = San Jaun, U = Utah, Wa = Washington, Wy = Wayne

[3]Published as Astragalus desperatus var. consepectus.

[4]Published as Phaca pardalina.

[5]Published as Cycladenia jonesii.

[6]Published as Parthenium alpinum var. ligulatum.

[7]Published as Parosella thompsonae.

A relatively large amount of data are available for game species; however, these data were collected for management units that generally do not conform to the boundaries of the region. Data relating to big game, cougars, bears, and furbearers are discussed in terms of Utah Division of Wildlife Resources (UDWR) management units. Data on upland game birds, waterfowl, cottontail rabbits, and snowshoe hares are presented for counties, as compiled by UDWR. The UDWR does not make estimates of current population levels of game species, but trends are known and relative abundance can be inferred from harvest statistics.

Data on nongame species are not generally available, and little quantifiable information on distribution, population density, and trends is known. The importance of these species to the ecosystem is recognized, and a general discussion will be presented where specific data are lacking.

The distribution of game species in relation to elevation and vegetation types is presented on figure II-14. Additional information and harvest data are presented for big game (table II-17) and for upland game and waterfowl (table II-18). These harvest data represents the latest information available at time of writing and indicates the current situation--not long-term trends.

Mule deer are the most numerous big game animal in the region. Deer populations are low and range conditions are improving. Portions of the range could support more deer; however, energy developments and urbanization have encroached on deer winter range, and this limits expansion of deer herds. The amount of productive winter range is the limiting factor for deer in most of the region. In the period from July 1, 1976 to June 30, 1977 a total of 114 deer were killed in the region by vehicles. This figure represents 1.6 percent of the total harvest during 1976. The magnitude of this loss is compounded by the fact that 51.8 percent of the total reported casualties were mature does. The location of deer herd units and the distribution of deer winter range are shown on figure II-15.

The region includes three elk herd units, Manti (12), Fishlake (14), and Book Cliffs (21). The location of these herd units and distribution of other big game species (except deer) are shown on figure II-16. The units total 5,882 square miles, and include some of the most productive elk habitat in the state (table II-17). During the winter of 1976-77 three elk were killed in the region by vehicles. In 1976, 109 elk were transplanted from Horn Mountain to winter range in the Willow Creek area north of Helper because the range is overstocked. It is expected these elk will summer on the Ashley National Forest in Wasatch and Duchesne Counties.

Antelope herds in the region (fig. II-16) are a result of transplanting.

Table II-17.--Big game in the central Utah coal region

Species	Herd unit or area	Vegetation type	Hunting pressure 1976		Harvest 1976		Remarks
			Hunter days	Percent of State total	Number	Percent of State total	
Mule deer[1]	27B, 28B, 29, 32-37, 43-46	Summer: Mountain Meadow, Conifer-Aspen, Aspen, Mountain Brush Winter: Sagebrush-Grass, Pinyon-Juniper, Mountain Brush	85,612	12.6	7,306	12.8	Largest populations on Wasatch Plateau west of Highway U-10 and in Roan Cliff area north of Highway US 50 and 6. There is a total of 2,012,700 acres of summer range and 3,462,800 acres of winter range on these units.
Elk[1]	12, 14, 21	Summer: Mountain Meadow, Conifer-Aspen Winter: Sagebrush-Grass, Mountain Brush	34,691	32	641	26.6	Important elk wintering areas include: Old Woman Plateau; Muddy Creek; Horn Mountain; Trail Mountain; East Mountain; and Beaver Creek.
Antelope[1]	Parker Mtn., Icelander Wash, Cisco	Desert Shrub, Sagebrush-Grass, Pinyon-Juniper	118	27.4	60	3	Herd units include 2,647 square miles.
Cougar[2]	deer herd units 27B, 28B, 29, 32-37, 43-46	same as deer	380	18.1	27	14.6	Associated with deer in remote areas.
Black bear[3]	same as cougar	Conifer-Aspen, Mountain Brush	235	35.7	3	30	In the 10-year period 1967-1977, 33-percent (82 bear) of the total state harvest was from this area.
Moose	Wasatch Plateau	Streamside, Conifer-Aspen Mountain Brush	([4])	([4])	([4])	([4])	Moose introduced to Fish Creek drainage west of Scofield Reservoir in 1974.
Bighorn sheep	Capitol Reef Natl. Park, Desolation Canyon	Desert Shrub, Sagebrush-Grass	([4])	([4])	([4])	([4])	Small bands in remote areas, also several sightings at other locations within the region.

[1]Big Game Harvest Report (UDWR, 1977a).
[2]Cougar Harvest Report 1976-77 (UDWR, 1977b).
[3]Black Bear Harvest Report 1976-77 (UDWR, 1977c).
[4]No hunts held in this area for these species.

Table II-18.--Upland game and waterfowl in the central Utah coal region[1]

Species[2]	Vegetation types	Hunting pressure (1976) Hunter days	Hunting pressure (1976) Percent state of total	Harvest (1976) Number	Harvest (1976) Percent state of total	Remarks
Cottontail rabbit---------	Agricultural Land, Streamside, Sagebrush-Grass, Pinyon-Juniper, Mountain Brush	25,005	19.7	43,863	18.6	Generally found throughout area at elevations below 8,000 feet.
Snowshoe hare---	Conifer-Aspen, Mountain Meadow	2,662	13.1	2,013	13.0	Limited to coniferous forests on Wasatch Plateau and Book Cliffs.
Ringnecked pheasant-------	Agricultural Land	28,807	13.5	20,585	13.6	Largest populations in Castle Valley, Sanpete Valley, Sevier Valley, and Fremont River Valley in Wayne County.
Quail-----------	Agricultural Land, Streamside	1,070	8.1	809	5.6	Both California quail and Gambel's quail are in the area.
Chukar----------	Grassland, Sagebrush-Grass, Desert Shrub	6,180	13.1	6,244	14.3	Areas with larger populations include: Book Cliffs, along Green River, Cedar Mountain, Price River and near Helper, Utah.
Mourning dove---	Agricultural Land, Streamside, Pinyon-Juniper	15,197	14.0	42,328	14.2	The most productive areas are in Emery, Sanpete, and Sevier Counties.
Band-tailed pigeon---------	Conifer-Aspen, Mountain Brush (7,000 to 9,000 foot elevation)	([3])	([3])	([3])	([3])	Isolated sightings in Sanpete and Wayne Counties. More frequent sightings on Fishlake Natl. Forest in Sevier County.
Sage grouse-----	Sagebrush-Grass, Mountain Meadow	3,254	11.5	3,860	15.7	Valley areas of Carbon, Sanpete, Sevier, and Wayne Counties have best populations.
Forest grouse---	Conifer-Aspen, Mountain Meadow, Mountain Brush	6,122	10.8	5,823	9.2	Ruffed grouse are found on the Wasatch Plateau in Sanpete and Sevier Counties. Blue grouse are in the same area, and also extend into Carbon, Emery and Wayne Counties.
Waterfowl[4]------	Streamside, Agricultural Land, streams, and bodies of water	12,299	6.1	18,011	4.4	Areas receiving use include: Desert Lake Waterfowl Management area, Huntington North, Joes Valley, Scofield, and Johnson Reservoirs, Fish Lake, and the Fremont, White, Price, and Green Rivers.

[1]Harvest data are for Carbon, Emery, Grand, Sanpete, Sevier, and Wayne Counties.
[2]Harvest data from Upland Game Annual Report (UDWR, 1977d).
[3]No hunting or harvest of this species.
[4]Harvest data are 10-year averages for period 1962-1971 (Jenson, 1974).

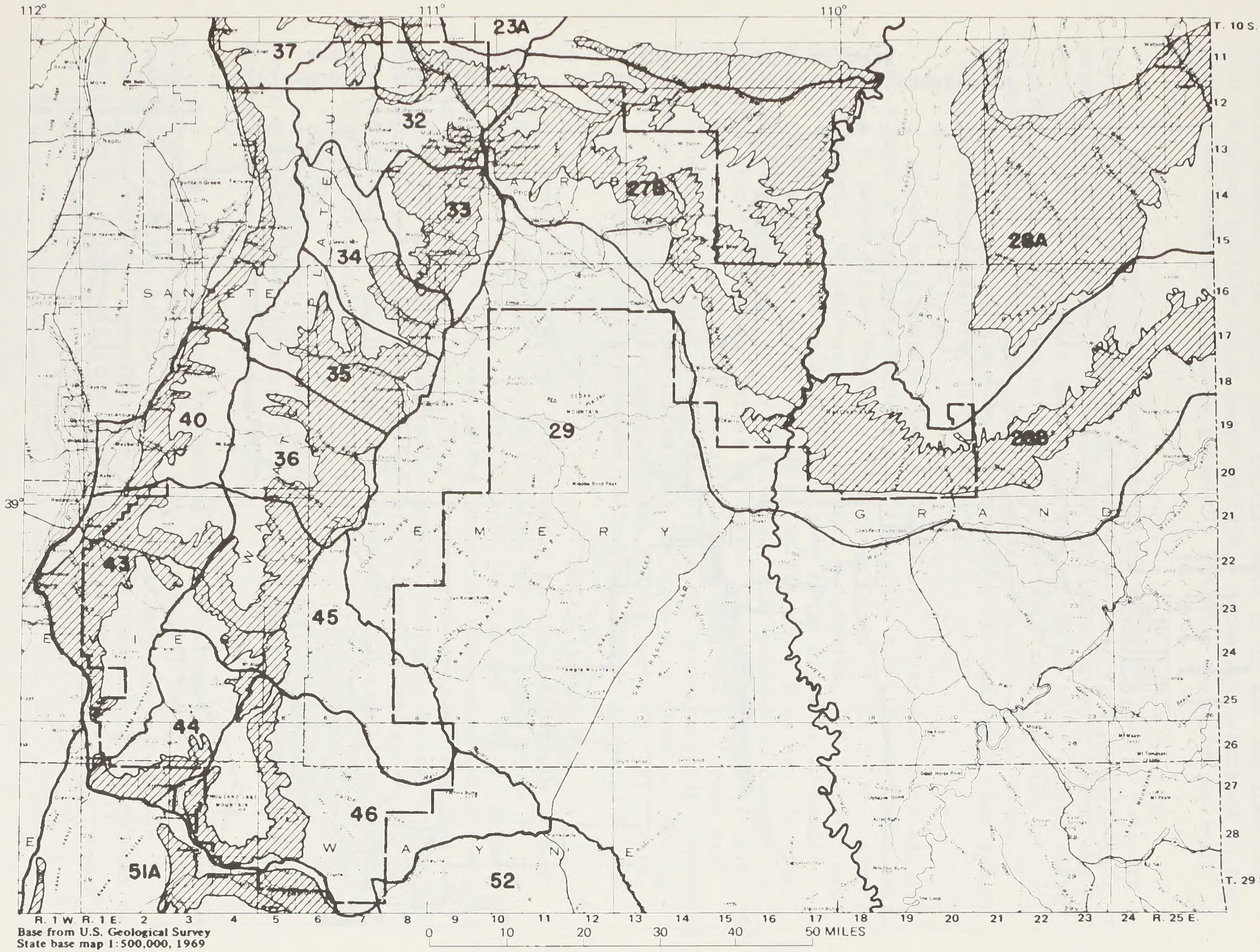
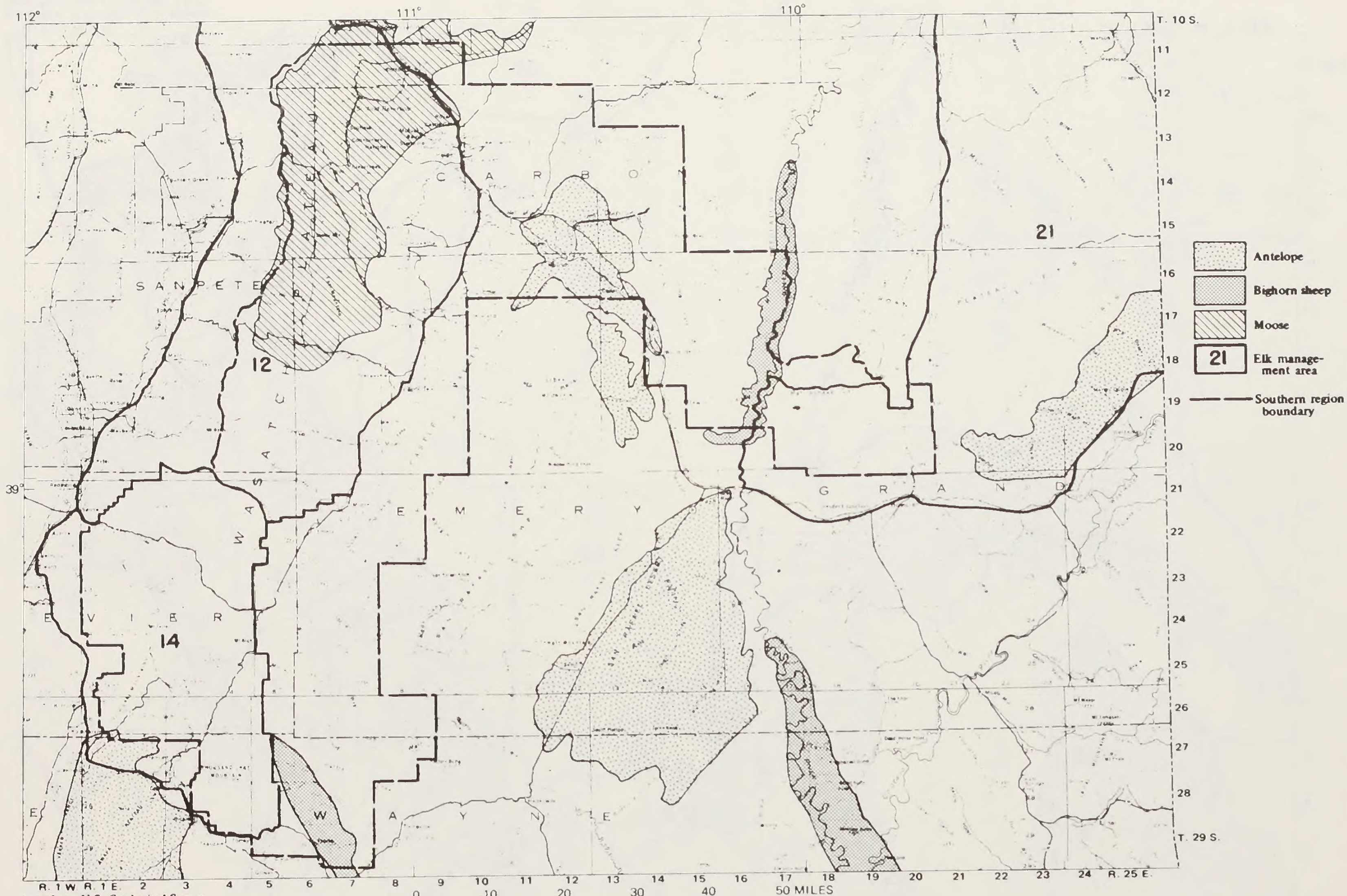


Figure II-15.--Map of the central Utah coal region, showing deer management areas (numbered) and mule deer winter range (hachured).



Base from U.S. Geological Survey
State base map 1:500,000, 1969

Figure II-16.--Map of the central Utah coal region showing elk management areas and distribution of other big-game animals.

Moose were introduced into the Fish Creek drainage west of Scofield Reservoir in 1973. The initial herd of 18 was supplemented with 19 moose in 1974 and 6 moose in 1978. Moose are scattered in that region, but illegal killing is presently limiting expansion of herd size.

Cougar population characterisitcs and distribution data are not available for Utah, but the harvest trend indicates an increasing population (UDWR, 1977b). Studies in California, Nevada, Idaho, and British Columbia indicated home range sizes from 15 to 43 square miles (USFWS, 1976). Population densities of suitable range in Utah are probably similar. The home range of resident female cougar often overlap completely and are also overlapped by resident male home ranges (Siedensticker and others, 1973).

Black bear numbers in the region are not known, but a significant number of the bears harvested in the state are killed in this area. Studies in other states indicate home range sizes of .12 to 50.3 square miles (Amstrup and Beecham, 1976; Lindzey and Meslow, 1977). Bray and Barnes (1967) estimate minimal annual home range sizes of 20 square miles for adult males and 10 square miles for adult females. In areas of suitable habitat in the central region, bear population density is probably near the Bray and Barnes estimate. During the fall of 1976, 19 black bear cubs unaccompanied by adults were observed in Carbon and Emery Counties. The bear cubs were outside the area generally considered bear range, and it was speculated that the cubs were abandoned due to scarcity of food (written commun., Larry Wilson, Oct. 28, 1976; Fair, 1978). This occurrence gives some indication of bear productivity in the area.

Mink, muskrats, and beaver occur in limited numbers in most drainages in the region. Little trapping for mink takes place in the area, but beaver trapping is significant. During the 1976-77 season, trappers harvested 551 beaver on the 10 beaver management units included in the region (Jensen, 1977). This figure represents approximately 15 percent of the total State harvest. Muskrat trapping occurs throughout the region; however, harvest figures are not generally reported. Muskrat trappers at the Desert Lake Waterfowl Management Area harvest up to 300 muskrats annually.

River otter have been trapped in the Fish Creek and Pondtown Creek drainages, and sightings in lower Fish Creek below Scofield Reservoir were reported during 1977.

The UDWR operates the Desert Lake Waterfowl Management Area in Emery County. This area has 2,621 total acres with 544 acres of open water. It provides habitat for 23 species of waterfowl, numerous shorebirds, raptors, and other bird species. Olson Slough, northeast of Desert Lake, provides limited waterfowl and hunter use.

The diversity of life zones in the region, represented by elevations from 11,600 feet in the Fishlake Mountains to 4,000 feet in the Green River drainage, provides habitat for a large variety of birdlife. At least 270 species of game and nongame birds are known to occur in the region.

The endangered American peregrine falcon has been sighted in the region; however, they are probably migrant birds since no active eyries have been identified. A historical eyrie exists near the San Rafael River in Emery County. Recent (1976-77) sightings of peregrine falcons are shown on figure II-17.

Golden eagles occur throughout the region, and several active eyries are present. Northern bald eagles, an endangered species, are winter visitors to the region, and often congregate in groups at roost areas near food sources. A survey of known areas (fig. II-17) in January and February, 1977, recorded 31 bald eagles at 4 roost sites (Boner, 1977).

Ospreys are summer visitors to the region. They have been observed yearly at Joes Valley and Scofield reservoirs. There are active nests at Fish Lake, and migrants have been reported on the Green and Colorado rivers.

Small mammals, such as mice, rats, squirrels, shrews, moles, bats, gophers, and rabbits are distributed throughout the region. They serve as prey for larger predators such as raptors, badgers, foxes, coyotes, bobcats, and skunks. Small mammal populations are subject to extreme short-term fluctuations in response to weather, food supply, predation, and disease. However, no long-term population trends have been identified in the central region. Rabbits, foxes, and coyotes are hunted or trapped for sport and pelts. The inflated price of bobcat pelts has led to increased hunting and trapping of this species and a declining population trend in the region.

The central region includes historical range of the endangered black-footed ferret (Snow, 1972; Scott and others, 1977). Location of this range and sightings of black-footed ferrets are shown on figure II-17. A survey of the potential habitat in the region during 1977 resulted in no direct observation, or location of substantial sign, of ferrets. The study concludes that prairie dog populations that would be affected by developments should be further surveyed for any black-footed ferret occurrence (Boner and others, 1977). The presence of black-footed ferrets is difficult to determine because they spend most of the time underground and are active mainly at night.

A total of 26 species of reptiles and 9 species of amphibians are known to occur in the region. They feed on vegetation, insects, fish, small mammals, reptiles, and amphibians, and are in turn prey for predatory mammals and birds. No threatened or endangered reptiles or amphibians are known to occur in the region.

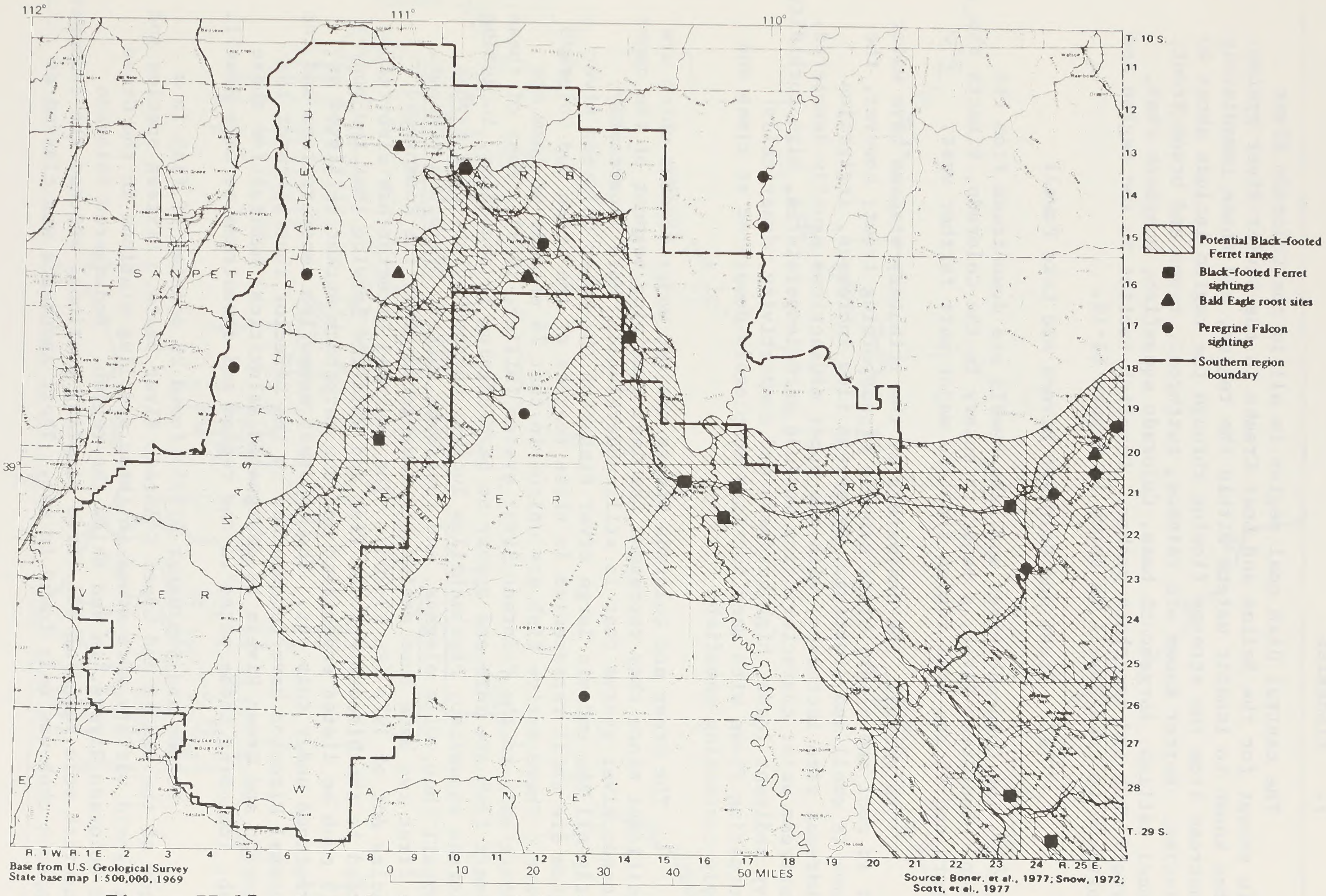


Figure II-17.--Map of the central Utah coal region showing locations of endangered species sightings, and black-footed ferret range.

7. FISHERIES

The central Utah coal region is all in the Colorado River Basin except for the Salina and Lost Creeks in the Sevier River system. Fishes known to inhabit waters within the region, and those immediately downstream from the streams flowing through the region include about 40 varieties. Better known are rainbow, cutthroat, brown and brook trout, channel catfish, largemouth bass, Colorado squawfish, humpback chub, bonytail chub and razorback sucker. Gamefish habitat in the region and downstream to Lake Powell is shown in figure II-18.

a. Green and Colorado Rivers and Lake Powell

The Colorado River and Lake Powell are downstream from the region. The Green River, a major tributary to the Colorado, bisects the eastern end of the coal region from the major part farther west.

In general, the headwaters of the tributary streams have water that is cool and clear, often capable of supporting trout; however, the volume is small and limiting. As stream flow increases, irrigation withdrawal also increases, with the upper midsections usually dewatered. Downstream water characteristics include warm temperatures, high turbidity, heavy sediment loads, high hardness and conductivity, drastically fluctuating flows with many sections completely dewatered at times and rarely containing gamefish.

The Green and Colorado Rivers are two major streams which are significant since they represent the last remaining segment of the upper Colorado River system that is still undeveloped. More importantly, nearly all the endemic large river fishes of the upper Colorado River system are still represented in these reaches of the Green and Colorado Rivers. These native fish are unique in that 74 percent of them are endemic only to the Colorado River system (Miller, 1959). Four of these endemic fish are rare and appear to be declining in abundance, including: Colorado squawfish, _Ptychacheilus lucius_; humpback chub, _Gila cypha_; bonytail chub, _Gila elegans_; and razorback sucker, _Xyrauchen texanus_. The first two have been designated endangered under the Endangered Species Act of 1973 (PL 93-205). The Regional Director has also recommended to the Director of the Fish and Wildlife Service that the bonytail chub be listed endangered and the razorback sucker be listed as threatened under this act. The Colorado squawfish recovery team and the Regional Director have recommended to the Director that parts of the Colorado and Green Rivers be designated as critical habitat for these fish, including those parts in the region and downstream to Lake Powell.

Holden and Stalnaker (1975) found 29 species of fish in a study of the middle and upper Colorado River basin. Sixteen species and one hybrid variety were found in three sampling stations in the Green and Colorado Rivers, in and below the region. Endangered Colorado squawfish were found at all three sampling stations, whereas the endangered humpback chub was only found in one. Their abundance was classed as

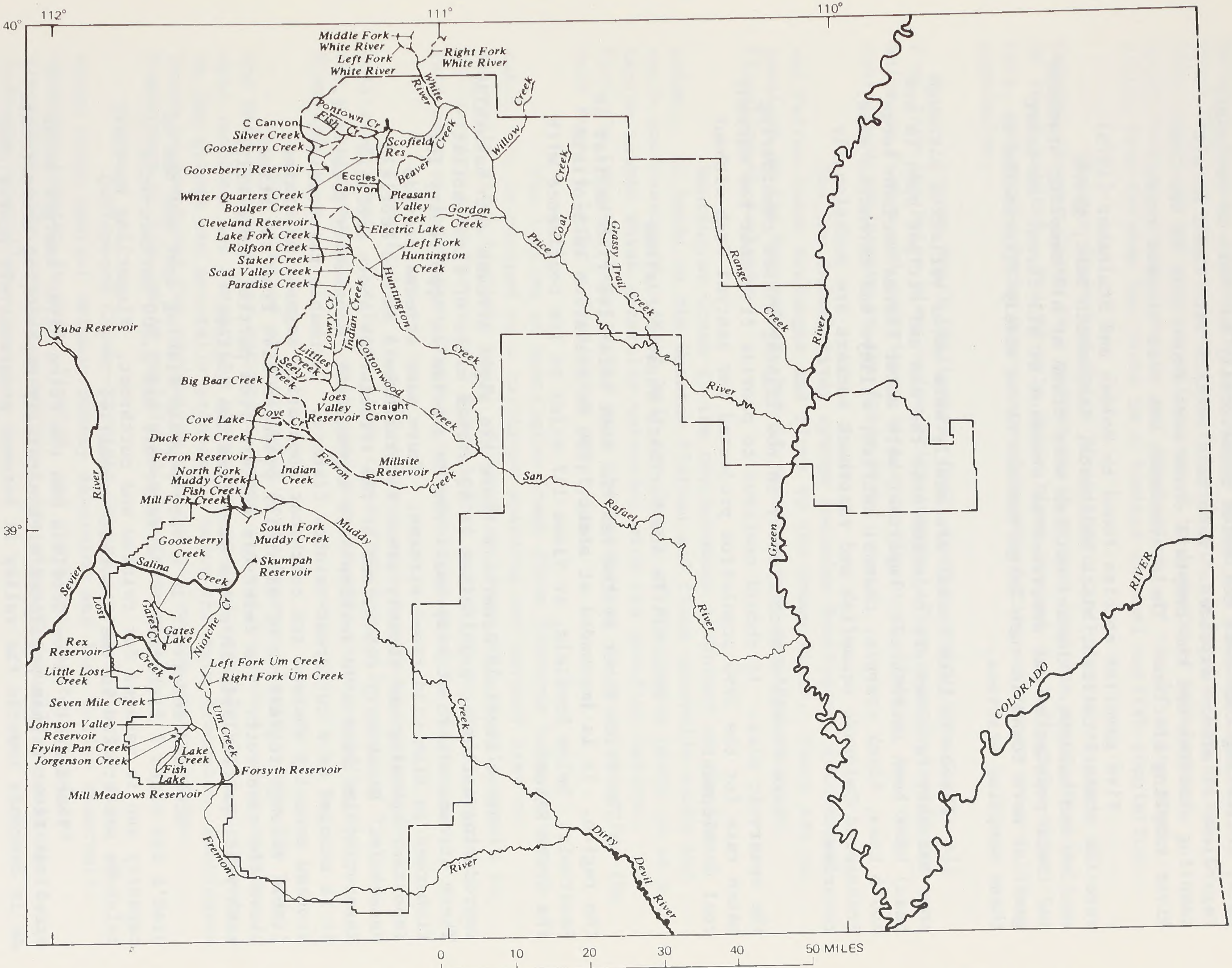


Figure II-18.--Map showing important fish habitat in the central Utah coal region.

rare, indicating they were collected occasionally but with no certainty regardless of effort expended. Razorback suckers were found at all sampling stations and the bonytail chubs were found only in two Green River sampling stations. Their abundance was also classed rare.

Five gamefish species found by Holden and Stalnaker (1975) were the channel catfish, black bullheads, largemouth bass, green sunfish and walleye. Channel catfish were found at all sampling stations and their population was described as abundant at all three. No other gamefish were found in such large numbers or as widely distributed in these sampling stations.

Fishes in Lake Powell are mostly warm water varieties although some hatchery rainbows are released near the dam and striped bass (a sea bass) have been introduced. Important warm water fishes include largemouth bass, black crappie, channel catfish, walleye and threadfin shad. Endangered Colorado squawfish and razorback suckers are occasionally recorded.

Lake Powell's sportfishery is now lightly fished considering the reservoir size. It should continue to provide fish near the current catch rate for the 1990 population projected for central Utah without coal development.

b. Book Cliffs and Northern Wasatch Plateau

The Price River system has the most extensive fish habitat in the region. It is impounded at about 7,700 ft elevation in Scofield Reservoir. Below Scofield, it flows 117 miles to its confluence with the Green River.

Above Scofield Reservoir there are eight streams with naturally reproducing cutthroat populations in 63 stream miles of fish habitat. These streams are relatively small but do provide an opportunity for fishermen to fish wild trout streams. These same streams provide important spawning and nursery areas for cutthroats in the Scofield Reservoir. Gooseberry Creek, one of the tributaries above Scofield Reservoir, includes a 90 surface acre impoundment, Gooseberry Reservoir. It is managed as a cutthroat-rainbow fishery. Catchable rainbows are stocked annually whereas the cutthroat population segment maintains itself through ingression of naturally produced fish from the stream above the reservoir. The reservoir suffers from partial winterkills each year, particularly in areas away from the inflow.

Scofield Reservoir is a very popular fishing spot and one of Utah's few class I fisheries. The reservoir has 2,800 surface-acre capacity and is managed for rainbow and cutthroat. Fingerling hatchery rainbows are stocked in the reservoir annually.

Immediately below Scofield Dam the Price River emerges as an excellent trout stream populated with naturally reproducing brown trout. As it descends towards the valley it becomes progressively poorer fish habitat; however, there are some hardy brown and rainbow trout in it. Sport fish are non-existent from Price Canyon to Farnham Dam because of alteration and bad water quality caused by industrial development, sedimentation, channelization and dewatering. In the 87 miles downstream from Farnham Dam there is a limited channel catfish population.

Beaver Creek and White River enter the Price River above Price Canyon. Beaver Creek is a rather small stream that has about 10 miles of trout habitat. The 38-mile White River system, including the Right, Left, and Middle Forks has a naturally reproducing cutthroat trout population.

Grassy Trail (Whitmore), Coal, Gordon, and Willow Creeks all flow into the Price River below Price Canyon. They have insignificant value to fishes and contribute little to the sport fishing, but they contribute pollutants to the Price River.

The San Rafael River system includes Huntington, Cottonwood and Ferron Creek drainages and flows to the Green River. There are no gamefish in the San Rafael, but it contains some speckled dace and flannelmouth suckers.

Huntington Creek is the northernmost tributary of the San Rafael. It heads on the Wasatch Plateau and flows generally south and south southeastward. About half the length of Huntington Creek is in a narrow canyon which generally coincides with its gamefish habitat. Electric Lake was constructed near the headwaters to store water for the Utah Power & Light's Huntington powerplant.

The 3 miles of Huntington Creek above Electric Lake is very small. It is managed as a cutthroat spawning and nursery area to naturally stock Electric Lake. Fingerling trout will usually remain in the nursery area for up to 2 years before migrating to the reservoir. This part of Huntington Creek is permanently closed to fishing.

Electric Lake is a 476 surface-acre reservoir managed for cutthroat trout. Cutthroat stock comes from naturally produced fish in the upstream nursery area with some supplemental stocking of hatchery fingerlings.

The 22 miles of Huntington Creek between Electric Lake Dam and the Main Diversion has cutthroat, brown and rainbow trout. Some catchable rainbows and fingerling browns are stocked annually while cutthroats in the stream are naturally produced. Below the main diversion, Huntington Creek is dewatered for irrigation use and the return water farther downstream is too low in quality to support gamefish.

Cottonwood Creek--Straight Canyon provides about 9 miles of brown trout habitat between Swasey diversion and Joes Valley Reservoir. Spawning habitat is quite limited, and therefore hatchery-produced fingerling and catchable brown trout are stocked annually to maintain a fishable population.

Cottonwood Creek serves to illustrate what can happen to a stream when inadequate safeguards are taken to protect it from degradation during mine construction work in a narrow canyon site. Current work reopening a coal mine alongside Cottonwood Creek caused excess soil material to be bulldozed into the creek forming a raw, steep-sided embankment. Subsequent runoff over the exposed dirt work area and the embankment carried tremendous sediment loads into the creek. The sediments covered the stream bottom and filled the stream bottom rubble interstices for a long distance downstream. Fish food production undoubtedly was reduced in the silted area, and the limited trout spawning habitat was further reduced. Similar coal developments are contemplated in other narrow canyons throughout the Central Utah coal region. Reasonable enforcement of laws and regulations would have prohibited this occurrence.

Tributaries to Cottonwood Creek add 47 more miles of trout habitat. Seely, Littles, Lowry, and Indian Creeks all have naturally reproducing populations of cutthroat trout while naturally reproducing brook trout are found in Littles and Indian Creeks. Supplemental catchable size hatchery rainbows are stocked each year in the lower 5 miles of Lowry Creek to improve fishing.

Joes Valley Reservoir is an 1,170 surface acre reservoir in the Cottonwood drainage created by a dam across the head of Straight Canyon. The sportfishery is managed for rainbow and cutthroat trout. Hatchery fingerlings are planted to maintain the rainbow population and cutthroats immigrate from wild stock in the tributary streams.

Ferron Creek is the southernmost tributary system to the San Rafael River. The lower 23 miles of Ferron Creek has very few gamefish and the 3 or 4 miles below Millsite Reservoir is essentially dewatered part of the year. Mostly speckled dace and flannelmouth suckers inhabit lower Ferron Creek. Above Millsite Reservoir is a naturally reproducing of cutthroat trout. The tributaries of Big Bear, Cove, Indian, and Duck Fork Creeks add 25 miles of trout water. All are populated by naturally reproducing cutthroat trout.

Three gamefish reservoirs in the Ferron Creek drainage are worth noting. Millsite Reservoir on Ferron Creek near Ferron is a 435 surface-acre impoundment. It is managed for cutthroat and rainbow trout. The 55 surface-acre Ferron Reservoir on Indian Creek is managed for cutthroat and rainbow trout. Cutthroat recruitment comes from natural reproduction in upstream Indian Creek and hatchery rainbow fingerlings and catchables are stocked annually. Cove Lake is an 8 surface-acre reservoir on Cove Creek. It is stocked with catchable rainbows and some wild cutthroats immigrate into the reservoir from Cove Creek.

c. South Wasatch Plateau

The Dirty Devil River is the southernmost stream flowing to the Colorado River from the region. It is formed by the confluence of Muddy Creek and the Fremont River near Hanksville.

Muddy Creek heads on the Wasatch Plateau and exits the region near where it intersects Interstate 70. Gamefish habitat is limited to the upper 4 miles of its headwaters where there is a small wild cutthroat population. The remaining 93 miles has low or intermittent flows and poor water quality. Red shiners, fathead minnows, and flannelmouth suckers are about the only species where the stream has high dissolved solids, high sediments, high summer temperatures, and a shifting silt-sand bottom.

Fish and Mill Creeks add slightly over 2 miles of gamefish habitat to the Muddy Creek system with their small natural cutthroat population. North Fork once had a cutthroat population, but sometime in the 1960's a flood wiped it out. Natural rehabilitation is occurring and the stream has the potential to reevolve to productive cutthroat habitat.

The Fremont River heads in the region but wanders in and out again along its 88-mile channel. Numerous lakes and streams make the region popular for fishing. Extensive water use from the stream causes several sections of otherwise good gamefish habitat to be dewatered. Coal is not present within the Fremont River drainage.

The Sevier River system recieves water from Salina and Lost Creeks. The Sevier River, including Yuba Reservoir below these streams, is populated by warmwater gamefish, primarily channel catfish, walleye, and largemouth bass.

Gamefish waters in the Lost Creek watershed includes 28 stream miles in Lost and Little Lost Creeks. They are small streams but are managed for rainbow trout. Supplemental catchable size rainbows are planted in them annually.

Salina Creek is a 30 mile long stream managed for rainbow trout fishing mainly by stocking catchable size fish. Salina Creek is a small perennial stream that has been greatly abused by channeling during highway construction, sedimentation, and dewatering for irrigation.

The Salina Creek tributaries of Gooseberry, Gates, and Niotche Creeks add 22 miles of trout habitat to the drainage and they too are managed for rainbow trout. Gooseberry is stocked with catchable rainbows each year while Gates and Niotche have natural reproduction.

Four small gamefish reservoirs are scattered about the Salina-Lost Creek drainages which include one-half acre Lost Creek Reservoir; 2-acre Gates Lake; 35-acre Rexs' Reservoir, and Skumpah Reservoir. Lost Creek is stocked with brook trout and the other three are stocked with rainbows.

d. Fishery Water Quality

Water quality rapidly degrades downdrainage in all stream systems throughout this region and some of the pollution comes from existing mines.

Materials from coal mining that pollute fish habitats include trace elements, sediments and dissolved solids. Sediments and trace elements have been suggested as being the most serious to fish habitat (Mc Ada and others, 1977). Values for selected metals indicate that the concentrations at which aquatic life are chronically affected are quite low and variable (table II-8). The Price River at Woodside was found to carry seven materials toxic to aquatic life which exceed prescribed limits for aquatic organisms (table II-10). Tributaries originating in mining areas were contributing to these excesses.

Sediments are a major fishery problem in central Utah. They affect fish in several ways, and surveys have shown that populations generally decrease with increased sediment loads (Ellis, 1936). Increased sediments, (1) reduce aquatic productivity by reducing clearness and lowering light penetration, (2) scour algae and benthos from the substrate, (3) interfere with filter feeding organisms and gills, (4) smother eggs, fish larvae and benthic organisms, and (5) reduce sight-feeders ability to find food and upset predator-prey relationships. Coal from mines in Huntington Canyon is causing a sediment problem in Huntington Creek. Coal spilled off trucks and fugitive coal from mines is being washed into the stream.

B. CULTURAL ENVIRONMENT AND LAND USE

1. LANDS

Recent population growth associated with mining and related industrial development has resulted in some land being changed from irrigated agriculture to community use. The amount of change has not been regionally significant, however.

The Central Utah coal region encompases lands in Federal, State, county, and private ownership (see fig. II-19 and table II-19). Land use management plans for Public and National Forest lands generally allow for mine and mine-related activities. Significant exceptions are lands set aside for study or research, or as roadless, primitive, wilderness areas, and wild and scenic rivers (see fig. II-20).

Public Lands--The BLM recently received instructions to evaluate public lands for restricted use areas. In the region they have identified an instant study area, eight potential roadless areas, two potential primitive or national research areas, and three rivers possessing wild and scenic qualifications (table II-20).

National Forest System Lands--Within the region the RARE-II (Roadless Area Review and Evaluation) study has identified 13 roadless areas on the Manti-La Sal National Forest and 9 roadless areas on the Fishlake National Forest (table II-21).

National Park Lands--The northern portion of Capitol Reef National Park has two wilderness areas and four roadless areas (table

Table II-19.--Land surface ownership within the central Utah coal region

Owner	Acreage	Percentage of total
Federal:		
Public lands (BLM administered)-------	1,327,000	41
National Forest System lands----------	1,014,000	31
National Park Service lands-----------	115,000	4
State------------------------------------	355,000	11
Private----------------------------------	415,000	13
Total----------------------------------	3,226,000	100

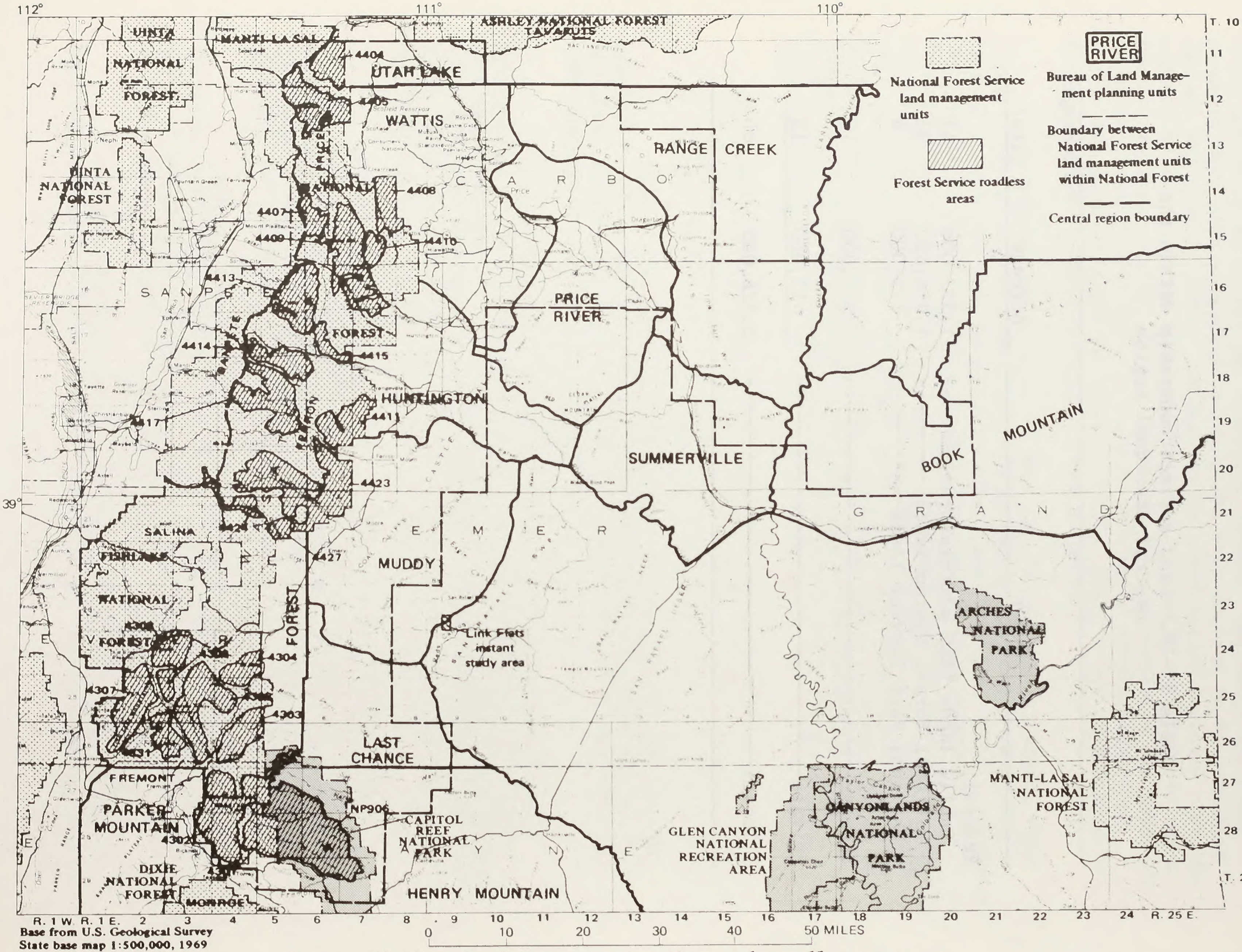


Figure II-20.--Land management units and roadless areas.

Table II-20.--Public lands (BLM administered) with potential restricted use

Type of use	Name and location
Instant study	1) Book Cliffs T. 15 S., R. 25 E., 400 acres 2) Link Flats T. 23 S., R. 9 E., 792 acres
Potential primitive or national research areas	1) North and South Caineville Mesa - the north and south banks and surrounding vicinities of the Fremont River and the area south of Factory Butte. 2) Little Rockies - southeastern portion of the Henry Mountains near Mountain Holmes and Mountain Ellsworth.
Potential roadless areas	1) Book Cliffs Area - northeast of the Book Cliffs Instant Study Area encompassing the area between McCook Ridge and Atchee Ridge, and the drainage into Bitter Creek, and Rat Hole Canyon. 2) Link Flats - includes the Link Flat Instant Study Area and projects an arm eastward to the area surrounding San Rafael Knob and Red Canyon; the balance of the region extends south from Hebes Draw to Caineville; the western border extends from Hebes and Cedar Mountain and bulges to almost include the Emery-Sevier County border while encompassing the Middle Desert, and Wood Bench; the eastern border includes Factory Butte, Moroni Slopes and Tomisch Butte. 3) San Rafael Reef and Mexican Mountain - southern portion of the San Rafael Reef extending south of I-70 to Temple Mountain and Goblin Valley and west to Muddy Creek. 4) Sids Mountain - south of San Rafael River and north of I-70 including the northeastern portion of the San Rafael Swell. 5) San Rafael Swell and Cedar Mountain - north of I-70 including Cedar Mountain and Price River drainage. 6) The Face of Badland Cliffs - adjacent to the northern boundary of the Central Region and south of Ashley National Forest. 7) Desolation/Gray Canyons - west of and surrounding the concourse of the Green River near Ouray Indian Reservation. 8) Labyrinth Canyon - south of Green River City proper between the confluence of the San Rafael River and the northern border of Glen Canyon NRA. 9) Middle Desert Area - adjacent to the southern portion of the Link Flats roadless area on the east and Fishlake National Forest near Mt. Alice on the west.
Wild and scenic rivers	The Green, Muddy, and Dirty Devil Rivers possess potential wild and scenic river qualifications. These rivers must receive interim protection to protect their free-flowing condition and immediate environs for the benefit and enjoyment of present and future generations under the National Wild and Scenic Rivers Act public law 90-542, October 1, 1968. The BLM Management Framework Plans (MFP) propose nominating these rivers for inclusion in the above act.

Table II-21.--Inventoried roadless areas

[Source: RARE-II]

Area number	Roadless area name	Acreage National Forest	Other	Total
Manti-LaSal National Forest:				
04404	Bennion Creek	12,340	--	12,340
04405	Price River	25,560	1,840	27,400
04407	Rolfson-Staker	6,820	460	7,280
04408	Nuck Woodward	12,940	60	13,000
04409	East Mountain	31,100	--	31,100
04410	Gentry Mountain	6,800	--	6,800
04411	Biddlecome - Rock Canyon	17,338	562	17,900
04413	Boulger - Black Canyon	21,640	280	21,920
04414	White Knoll	13,950	--	13,950
04415	Straight Canyon	5,910	390	6,300
04417	Big Bear Creek	31,030	--	31,030
04423	Muddy Creek - Nelson Mountain	62,970	--	62,970
04424	White Mountain	7,900	--	7,900
04427	Wildcat Knolls	5,335	465	5,800
	Acres	261,633	4,057	265,690
Fishlake National Forest:				
04301	Wayne Wonderland	14,700	--	14,700
04302	Thousand Lake Mountain	39,300	--	39,300
04303	Solomon Basin	19,000	400	19,400
04304	Johns Peak - Mount Alice	9,700	--	9,700
04305	Hilgard Mountain	33,700	1,600	35,300
04307	Fishlake Mountain	24,800	640	25,440
04308	U M Plateau	17,600	--	17,600
04831	Mytage	11,728	--	11,728
	Acres	170,528	2,640	173,168
	Total acres	432,161	6,697	438,858

II-22 and fig. II-20). Roadless area boundaries are not shown but collectively comprise all but a few acres of the Park north of U-24 that are not in the wilderness.

2. AGRICULTURE, RANGE, AND TIMBER

The increasing population has been using water coming partly from former irrigation supplies. The amount of irrigated lands which have been removed from tillage rotation for this purpose has not been regionally significant. This has been in addition to direct conversions of irrigated lands to community use.

Historically, the livestock industry has been closely tied to an integral part of the region's economy. Early settlers depended on range land for grazing sheep, cattle, and horses. As time passed, grazing operations became smaller, more numerous, and directly associated with small farms.

As the old timers passed on, operations were further distributed among descendents until about 1960, when consolidation into larger operations began. Table II-23 shows the regional trend in livestock over the last 20 years. The present trend toward fewer sheep numbers and a leveling-off or upswing in cattle numbers should continue over the next several years.

Ranchers usually base their operation adjacent to or within a few miles of their grazing areas, although some individuals trail or truck their stock considerable distances. A typical operation would start out on the BLM early in the spring, move up to the USFS for the summer, return to the BLM in the fall, and then winter on private lands. Some livestock will graze on State or Federal ranges for the entire year. The actual livestock use on and adjacent to the proposed mines is shown in table II-24.

Historically, timber has also been closely tied to and an integral part of the economy of the region, but on a much smaller scale than the livestock industry. Early settlers needed fenceposts, corral poles, house logs, mine timber, railroad ties, and lumber; numerous small sawmills supplied local needs. As time passed and needs changed, most mills went out of business. Only a few small mills still operate.

Current uses of forest products include fenceposts, poles, Christmas trees, and sawtimber. Present levels of use of forest products or an upswing with population growth should occur in the future.

Table II-22.--Wilderness and roadless areas in Capitol Reef National Park

[See fig. II-20]

Type of use	Name	Location	Acres
Wilderness	1)	Bounded by Utah State Highway 24 on the south, the park boundary on the west, the steep escarpment of the Hartnet on the north, and Deep Creek on the east. Waterpocket Fold begins here and the South Desert trough lies parallel.	64,290
	2)	Includes the northern boundary of Capitol Reef and encompasses the Cathedral Valley Formations.	3,900
Roadless	1)	Extends north of Utah State Highway 24 and includes Chimney Rock Canyon and the South Desert.	74,700
	2)	Contains the scenic plateau, the Hartnet.	14,600
	3)	Includes some cathedral formations.	9,000
	4)	Contains the remainder of the cathedral formations.	8,400

Table II-23.--Livestock numbers by county and year[1]

County	Sheep and lamb numbers 1959	1969	1974	Cattle and calf numbers 1959	1969	1974
Carbon---------	34,337	28,874	18,437	9,234	9,384	16,487
Emery----------	24,378	11,402	9,004	27,159	22,960	28,662
Grand----------	3,850	115	38	4,903	6,456	9,000
Sanpete--------	158,413	146,987	117,492	36,106	31,933	41,887
Sevier---------	95,191	82,147	32,314	32,026	38,773	36,505
Wayne----------	27,096	14,440	14,029	12,841	13,120	12,748
Total--------	343,265	283,965	191,314	122,269	122,626	145,289

[1]Utah Agricultural Statistics, State of Utah, Department of Agriculture for the years shown. A small portion of Grand, Sanpete, and Wayne Counties are included in the region. Although a small portion of Utah county also falls within the boundary, the statistics were not included here.

Table II-24.--Domestic livestock range use summary on proposed mining project properties

Proposed mining project	Livestock kinds and numbers	Season	Animal use months (AUM's)[1]	Percentage of total
B Canyon-------------	340 cattle	10/20-6/10	2,320	19
Belina #2 - O'Connor-----------	1,606 sheep	7/1-9/30	946	8
Deadman Canyon-------	562 cattle	4/15-5/31, 10/16-10/31		
	2,100 sheep	1/16-2/28	1,551	12
McKinnon #2----------	2,624 sheep	7/1-9/30	1,482	12
Mountain States #1---	586 cattle	3/6-6/15, 6/1-6/20	2,535	20
Sage Point and Dugout Canyon------	581 cattle	Various	2,647	21
	--- sheep	---	496	4
Skumpah Canyon-------	540 cattle	Spring, fall	540	4
Totals-------------	2,609 cattle 6,330 sheep		12,517	100

[1]Glossary.

3. ENERGY AND MINERALS

a. Coal

Current producing mines are listed on table II-25. These are underground coal mines generally using room-and-pillar methods with continuous mining machines. In room-and-pillar mines, the mined panels are open spaces or rooms; the pillars are supportive walls of unmined coal that are left for roof support. Longwall of shortwall mining methods may be used where mining conditions are suitable; where these methods are used, there is artificial support for the roof which is allowed to collapse as support is withdrawn. Longwall mining is a full extraction method. Coal is mined in a single cut and no pillars are left; caving is induced or permitted as mining progresses. The block of coal to be mined is usually 300 to 600 feet wide and between 2,500 and 7,500 feet long. Shortwall mining is a modification of the longwall system; it is used in smaller blocks than longwall mining. The various underground mining methods have been discussed by Cassidy (1973).

Under present technology, only about 50 percent of the coal within an underground mine can be economically and safely recovered by room-and-pillar methods. The extraction rate can rise to 65 percent or perhaps higher by using longwall methods. Complete extraction in underground mining is limited by the following: (1) coal that is left in pillars and barriers for protection against subsidence and cave-ins and for the protection of deep wells; (2) coal that is not mined because the beds are too thin (less than 4 feet) to be safely or economically mined; (3) beds that are too thick (generally more than 12 feet) to be completely recovered by current mining techniques; and (4) coal that is in multiple beds that lies too near each other (generally 30 feet or less) for all to be safely mined.

Subsidence is generally accelerated and completed sooner by rapid extraction and by pillar removal. It is generally slower and continues over a longer period of time, but is less complete and severe where the overburden is thick (generally 1,000 to 2,500 feet) and resistant, and where coal beds are thick. Above conventional and continuous room-and-pillar panels, subsidence usually begins slowly and irregularly. Upon cessation of mining within a panel or a mine, most (perhaps as much as 90 percent) of the effects of subsidence will have taken place within a year. After that, the ground surface will continue to settle unevenly for a longer, unpredictable period of time. Because of the more rapid and complete extraction in longwall mines, subsidence is more rapid and uniform, and is completed sooner than over room-and-pillar mines. Because continuous coal removal by longwall methods allows the overburden to bend and cave as mining progresses, tensional effects and fractures are minimized and subsidence is generally less disruptive to the overlying land surface.

Mined coal is transported to the surface by electric powered conveyors or trains. At the surface the coal may be crushed to uniform

Table II-25.--Coal mine operations in central Utah in 1976[1]

[Mine locations shown by number on figure II-8]

	Mine and owner	Location: Area	Location: Section(s) T., R.	Mine employment[2]	Coal preparation	Surface transportation	Market and use
1	Geneva Mine[3] U.S. Steel Corp.	Sunnyside	? 16 S., 14 E.	279	Washery at Wellington	Rail	Utah; coke manufacture.
2	Sunnyside Mines 1, 2, 3[3] Kaiser Steel Corp.	Sunnyside	32 14 S., 14 E.	410	Washery at minesite	Rail	California; coke manufacture.
3	Soldier Canyon Mine[3] California Portland Cement Co.	Soldier Canyon	18 13 S., 12 E.	112	Crushing, screening	Truck to railhead	California, Arizona; cement manufacture.
4	Braztah Mines 3, 4, 5[3] Braztah Corp.	Castlegate	4, 10 13 S., 9 E.	167	Washery at Castlegate	Rail	Midwest U.S.; power generation.
7	Utah No. 2 Mine[4] Valley Coal Co.	Pleasant Valley	17 13 S., 7 E.	125	Crushing, screening	Truck to railhead	Western U.S.; power generation.
8	Belina No. 1 Mine[4] Valley Camp Coal Co.	Pleasant Valley	30 13 S., 7 E.	24			
9	Cordon Creek No. 2[4]	Cordon Creek	18 13 S., 8 E.				
10	Swisher No. 3[4]	Cordon Creek	16 13 S., 8 E.	72	Washery at railhead	Truck to railhead	Open market.
11	Swisher No. 4[4] Swisher Coal Co.	Huntington Canyon	16 16 S., 7 E.				
12	Co-op Mine[4]	Huntington Canyon	22 16 S., 7 E.	20	None	Truck	Open market.
13	Deer Creek Mine[4] Utah Power & Light	Huntington Canyon	11 17 S., 7 E.	406	Crushing	Belt conveyor	Power generation near mine.
14	Starpoint 1, 2[4] Plateau Mining Co.	Hiawatha	16 15 S., 8 E.	135	Washery at railhead	Truck to railhead	Open market; power generation.
15	King Mine[4] U.S. Fuel Co.	Hiawatha	3 16 S., 8 E.	275	Washery at mine	Rail	Western U.S., open market; power generation.
16	Beehive Mine, Deseret Mine[4] American Coal Co.	Cottonwood Canyon	26 17 S., 7 E.	215	Crushing, screening	Truck	Local power generation, domestic use.
17	Wilberg Mine[4] Peabody Coal Co.	Cottonwood Canyon	27 17 S., 7 E.	75	None	Truck	Power generation.
18	Trail Mountain Mine[4] John Bell	Cottonwood Canyon	25 17 S., 6 E.	17	None	Truck	Open market.
19	Convulsion Canyon Mine[4] Coastal States Energy Co.	South	12 22 S., 4 E.	180	Crushing	Truck	Power generation, industrial.
20	Browning Mine[5] Consolidation Coal Co.	Muddy	33 16 S., 7 E.	?	None	Truck	Western U.S., open market; power generation.
21	Dog Valley Mine[5] Western States Coal Co.	Dog Valley	32 23 S., 6 E.	31	None	Truck	Open market.

[1]Total 1976 production for coal mine operations in central Utah = 7,968,000 short tons.
[2]Total 1976 mine employment for coal mine operations in central Utah = 2,543.
[3]Rock Cliff Coal Field mines (total production = 2,534,000 short tons).
[4]Wasatch Plateau Coal Field mines (total production = 5,241,000 short tons).
[5]Emery Coal Field mines (total production = 193,000 short tons).

size and screened to remove waste rock. The coal may be washed in a preparation plant to remove impurities such as waste rock, dust, and sulfur, or it may be delivered after crushing, without washing. Dry waste is disposed of in land-fill areas. Wet waste is disposed of in settling ponds and the water may be recycled for use. Coal preparation has been discussed by Leonard and others (1968).

Basic facilities needed to support a mine include an office building, maintenance shop, bathhouse or wash room, storage yard, stockpiles, preparation plant, tipple, and mine fan structures. The surface area required for these various facilities depends upon the amount of coal preparation needed, size of stockpiles, and layout selected. A typical arrangement would require about 40 acres.

In areas to be strip mined, vegetation and overburden are removed to the surface of the coal bed. Unconsolidated material is usually removed by scrapers or front-end loaders and trucks. If necessary, level spots or benches are created by bulldozers to accommodate drilling equipment. The overburden, if consolidated, is broken by drilling and blasting with a suitable explosive. The broken overburden is removed by mechanical shovels, front-end loaders, or draglines. It is hauled from the pits by trucks and dumped, usually adjacent to the initial cut. Overburden from subsequent cuts is usually used to fill cuts which have been mined-out.

After the overburden is removed, the coal is broken by drilling and blasting or by other mechanical means. The broken coal is removed by dragline, frontend loader, shovel, or backhoe and loaded into trucks for transportation to a processing plant. Strip mining methods have been described by Pfleider, 1968.

According to statistics furnished the task force, coal mining in Utah will cause 1 fatality per 2.65 million tons mined and 1 nonfatal accident per 39,000 tons mined (oral comm., 1978, Health and Safety Analysis Center, Mine Safety and Health Administration, Dept. of Labor).

b. Oil and gas

In the general area of this report, 145 producing wells were drilled in 20 oil and gas fields from 1924 to 1976. Fields are mostly small, with 1 to 16 wells, and range in area up to about 22,000 acres. Three gas fields are in the northern half of the Wasatch Plateau coal field, but two are now abandoned (fig. II-8). One gas field is partly within the northern boundary of the Emery field.

4. SOCIOECONOMICS

Carbon, Emery, Piute, Sanpete, Sevier, and Wayne Counties will bear the direct socioeconomic impact in the region. Carbon and Emery, historically the important coal producing areas, are isolated from the other counties and from the State's larger urban centers by distance and by the Wasatch Mountains. Sevier County contains coal resources, and

Sanpete and Piute are economically related to Sevier. Wayne County is a proposed site of the Intermountain Power Project's electricity generating station.

The region's population is small and density is very low. Distances between communities are often great. In 1970 the region's population totaled 44,510 living in a 12,681 square mile area (3.5 persons per square mile). The corresponding United States figure was 57.5 persons per square mile. Carbon, Emery, and Sevier Counties have a combined land area exceeding that of four states.

Of 30,887 people living in those three counties in 1970, over 50 percent resided in the communities of Price, Helper, and East Carbon City, in Carbon County; and in Richfield in Sevier County. Trading and other economic relationships extend outside the region to Provo and Salt Lake City.

The regional economy differs, sometimes significantly, from the State's. Moreover, the counties in the region are not economically homogeneous. Piute and Wayne are dependent upon agriculture, Sanpete has a large manufacturing sector, mining and related construction activity dominate employment in Carbon and Emery, and Sevier is the most dependent of the counties on trade.

The regional economy and resultant population characteristics have changed over time. Population declined by a third between 1950 and 1970. Yet, if current growth rates are maintained, population will double every 16 years, a complete turnabout.

Carbon and Emery Counties are economically dependent upon conditions in the coal market. As a result, from 1950 through 1970, the two counties experienced a significant decline in population and stagnant or declining levels of employment and income. Mining employment in Carbon fell from 3,869 in 1950 to 868 in 1968, a decrease of over 75 percent.

The other counties in the region also lost population from 1950 to 1970 mainly because of changing agricultural circumstances. Sanpete and Sevier experienced the smallest percentage declines, a fact attributable to their more diversified economies. In Sevier, there is a significant amount of employment in such resource-based activities as coal, gypsum, and salt mining, wallboard manufacturing, and lumbering.

A lack of large trade centers and relatively small tourist-generated sales have resulted in a regional trade sector that is small relative to other areas in the State. Tourism accounts for only 8.2 percent of total retail sales in Carbon and Emery, and only 15 percent in Sevier where tourist expenditures are highest.

Much of the recent increase in coal mining has centered in Emery County, where mining employment has increased over 210 percent since 1969. The increase has been more modest in Carbon, 40-50 percent.

Per capita personal income levels in Carbon and Emery are above the State average. Since mining is one of the higher paying employment sectors, incomes will remain high relative to the region and the State as long as mining continues to be a major employer within the two counties. Sevier County's per capita personal income level is about $400 below the State average--a result of the lower paying occupational mix in the county.

a. Regional Economic Characteristics

Examination of the regional or of a county economic base (those industrial sectors which produce goods and services for markets located outside the area being studied) is essential to determine probable future economic conditions and, therefore, characteristics of the population. These basic sectors are a determining force within the local economy. The conditions surrounding growth or decline in these sectors establish the basis upon which statements concerning the future can be made. For each county, employment and income are analyzed to provide information necessary for this purpose.

Employment--Sectors which are the largest employers in the region are mining, government, trade, agriculture, services, manufacturing, and construction. Table II-26 shows the largest employment sectors in each county. Considerable variation exists.

Table II-27 shows the changes in the composition of employment which have occurred since 1950. The decreasing importance of farm employment is apparent, though it is still significant in the region. The farm sector in Utah employs relatively fewer workers than it does in the nation.

A more specific picture of employment and how it has behaved over time can be gained from table II-28 for Carbon, Emery, and Sevier Counties. Regarding coal mining, these are the most important counties in the region.

Income--Employment and the sources of personal income are closely related, but the components of personal income include net earnings (labor and proprietor's income), property income (dividends, rents, and interest), and transfer payments (for example, social security). Much can be learned about the regional economy by examining the relative shares of each.

Per capita personal income for each county is presented in table II-29. By 1975, only Carbon, Emery, and Wayne exceeded average per capita income for Utah; however, they were far below the U.S. average ($5,852). Total personal income is shown in table II-30.

Table II-31 summarizes 1975 personal income data by source for Utah and the region's counties. The region's income characteristics are common for areas having below average income levels--proportionately large property income and transfer payments shares, proportionately

Table II-26.--Percentage of 1975 employment in four largest employment sectors in central Utah coal region counties[1]

[Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System File]

Sector	Carbon	Emery	Piute	Sanpete	Sevier	Wayne
Mining----------	20.35	30.86				
Government------	21.27	14.40	28.81	17.27	18.63	34.20
Trade-----------	17.74		7.81	9.48	21.08	5.06
Farm------------		11.48	30.30	25.21	14.82	26.40
Manufacturing---				20.56	9.81	
Construction----		17.05				
Services--------	8.24		4.65			5.75

[1] Percentages are based only on known employment totals. Knowledge of suppressed employment totals could change the order of employment sectors.

Table II-27.--Employment by type and broad industrial sector, central Utah coal region

[Source: 1950 and 1960 data were obtained from Census of the Population, Vol. 2: Characteristics of the Population, Utah. The census data were aggregated according to the 1967 Standard Industrial Classification Manual (Washington, D.C.: Office of Statistical Standards). 1970 and 1975 data were aggregated on the basis of county data from the Bureau of Economic Analysis, Regional Economic Information System File.]

	1950		1960		1970		1975	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total employment-----	18,997	100.0	15,974	100.0	17,449	100.0	21,671	100.0
Farm-----------------	4,915	25.9	3,046	19.1	3,100	17.8	3,018	13.9
Non-farm-------------	14,082	74.1	12,928	80.9	14,349	82.2	18,653	86.1
Government-----------	1,572	8.3	1,786	11.2	3,717	21.3	4,165	19.2
Private non-farm-----	12,510		11,142		8,217	41.1	11,955	55.2
Manufacturing------	881	4.6	1,084	6.8	D	--	1,891	8.7
Mining-------------	4,427	23.3	2,740	17.2	D	--	D	
Construction-------	930	4.9	885	5.5	D	--	D	
TCU[1]--------------	1,253	6.6	1,082	6.8	D	--	D	
Trade--------------	2,590	13.6	2,843	17.8	2,322	13.3	3,115	14.4
Finance------------	195	1.0	277	1.7	D	--	D	
Services-----------	1,878	9.9	1,974	12.4	D	--	D	
Other--------------	356	1.9	257	1.6	D	--	D	

[1]Transportation, communication, and public utilities.
D = Suppressed to prevent disclosure of confidential data.

Table II-28.--Employment by type and industrial sector by county, 1950-75

[Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System File]

	Carbon County				Emery County				Sevier County			
	1950	1960	1970	1975	1950	1960	1970	1975	1950	1960	1970	1975
Total employment------	7,827	6,317	5,371	6,748	1,987	1,765	2,008	3,555	3,795	3,562	4,217	5,089
Total farm-----------	314	216	237	237	790	416	432	408	1,258	788	773	754
Total non-farm-------	7,513	6,101	5,134	6,511	1,197	1,349	1,576	3,147	2,537	2,774	3,444	4,335
Number of proprietors----	--	--	719	753	--	--	652	643	--	--	1,150	1,150
Farm----------------	--	--	157	145	--	--	381	349	--	--	570	523
Non-farm------------	--	--	562	608	--	--	271	294	--	--	580	627
Wage and salary-------	--	--	4,652	5,995	--	--	1,356	2,912	--	--	3,067	3,939
Farm----------------	--	--	80	92	--	--	51	59	--	--	203	231
Non-farm------------			4,572	5,903			1,305	2,853			2,864	3,708
Government----------	516	550	1,276	1,435	186	267	453	512	335	343	842	948
Total federal------	--	--	170	137	--	--	50	44	--	--	165	193
Federal civilian---	--	--	170	137	--	--	60	44	--	--	165	193
Military-----------	--	--	--	--	--	--	--	--	--	--	--	--
State and local----			1,106	1,298			393	468			677	755
Private non-farm----	6,997	5,551	3,296	4,468	1,011	1,082	782	2,341	2,202	2,431	2,022	2,70
Manufacturing------	195	181	191	275	27	62	(D)	25	398	511	507	49
Mining-------------	3,869	2,189	983	1,373	424	382	364	1,097	45	64	36	(D)
Construction-------	234	296	132	236	86	86	(D)	606	289	248	71	267
TCU[1]--------------	674	532	492	540	104	126	26	(D)	197	227	134	195
Trade--------------	1,090	1,290	946	1,197	182	201	165	294	680	748	814	1,073
FIRE[2]-------------	78	108	139	(D)	6	14	(D)	(D)	61	94	69	119
Services-----------	737	897	406	556	149	159	118	(D)	455	488	365	439
Other--------------	120	58	7	(D)	33	52	--	--	77	51	26	(D)

[1]Transportation, communication, and utilities.
[2]Finance, insurance, and real estate.
(D) = Suppressed to prevent disclosure of confidential data.

Table II-29.--Per capita personal income in central Utah coal region

[Sources: 1970-75, U.S. Department of Commerce, Bureau of Ecnonomic Analysis, Local Area Personal Income 1970-1975, Vol. 8; 1950, 1959, 1965 Regional Economic Information System File]

	1950	1959	1965	1970	1971	1972	1973	1974	1975
Utah------------	$1,310	$1,926	$2,390	$3,227	$3,437	$3,740	$4,185	$4,539	$4,938
Central Utah coal region counties:									
Carbon--------	977	1,683	1,988	3,038	3,155	3,505	4,039	4,402	5,176
Emery---------	912	1,353	1,518	2,135	2,002	3,267	4,452	4,294	5,475
Piute---------	711	1,176	1,329	2,424	2,626	2,536	3,130	3,183	3,497
Sanpete-------	898	1,286	1,850	2,767	2,987	3,328	4,345	3,586	4,045
Sevier--------	991	1,301	1,971	2,729	2,915	3,359	3,905	4,091	4,517
Wayne---------	677	1,079	1,374	3,414	3,699	3,891	4,353	4,681	5,194

Table II-30.--Total personal income in central Utah coal region counties residence adjusted

[Source: 1970-75 U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income 1970-1975, Vol. 8; 1950, 1959, 1965 Bureau of Economic Analysis, Regional Economic Information System File. Personal income given in millions of dallars.]

	1950	1959	1965	1970	1971	1972	1973	1974	1975
Utah----------	$911.5	$1,675.4	$2,368.8	$3,439.5	$3,760.5	$4,216.3	$4,814.1	$5,349.8	$5,954.4
Central Utah coal region---	58.0	72.8	85.8	123.0	131.8	157.5	196.8	202.5	239.3
Carbon-------	24.6	34.7	34.4	47.8	50.8	59.6	69.9	77.5	94.6
Emery--------	5.8	7.3	8.2	11.0	10.6	17.0	25.5	26.5	33.8
Piute--------	1.4	1.7	1.9	2.8	2.9	3.0	3.6	3.9	4.4
Sanpete------	12.6	13.9	19.8	30.4	33.4	38.3	50.1	43.2	47.9
Sevier-------	12.1	13.4	19.3	27.7	30.6	35.6	42.6	45.9	52.4
Wayne--------	1.5	1.8	2.2	3.3	3.5	4.0	5.1	5.5	6.2

Table II-31.--Personal income in central Utah coal region counties by source, in absolute amounts and percent of total, 1975

[Sources: U.S. Department of Commerce, Bureau of Economic analysis, Regional Economic Information System file. For the 1975 U.S. figure, see U.S. Department of Commerce, "Personal Income by Major Sources, 1973-76," Survey of Current Business, Vol. 57, No. 8 (August 1977).]

(thousands of dollars)

	U.S.	Utah	Carbon	Emery	Piute	Sanpete	Sevier	Wayne
Personal income-------	1,246,501,000	5,954,381	94,522	33,824	4,357	47,886	52,409	6,166
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Net earnings[1]-------	899,350,000	4,377,856	68,862	27,109	2,778	30,121	35,384	3,737
	72.2	73.5	72.8	64.2	63.8	62.9	67.9	60.6
Property income-----	170,318,000	860,616	10,503	2,633	685	8,292	8,922	1,273
	13.7	14.5	11.1	16.6	15.7	17.3	17.0	20.6
Transfer payments---	176,833,000	715,909	15,187	4,082	894	9,473	8,103	1,156
	14.2	12.0	16.1	19.2	20.5	19.8	19.8	18.7

[1]Labor and proprietors' income less personal contributions for social insurance by place of residence.

small labor and proprietors' income shares. This pattern derives from (1) a higher than normal portion of elderly persons in the region, (2) a larger than normal portion of persons in the nonworking years generally, (3) relatively few high paying jobs, and (4) an unemployment rate typically higher than the State's. The large number of elderly and the unemployed increase transfer payments. The relatively smaller number of working-age persons plus an occupational mix yielding few high-paying jobs reduces the share of labor and proprietors' income.

Table II-32 shows each industrial sector's relative share of total earnings. In Utah, for example, 2.1 percent of total earnings is generated by the farm sector; in the U.S., 3.0 percent. But in Piute County in 1975, the corresponding figure is 27.5 percent. Because of the low earnings of farm proprietors and farm workers, it is generally true in the region that the farm sector's share of total personal income is less than its share of total employment. Conversely, mining, construction, and government contribute much more to total personal income than they do to total employment in the region. These are the higher wage paying employers.

Unemployment and poverty--Between 1951 and 1976, Utah unemployment rates have ranged from 3.1 percent (the 1952 low) to 7.4 percent (the 1975 high). Sanpete, Emery, and Carbon have generally exceeded the State rate during the period. Sevier County has roughly paralleled the State rate. In Piute and Wayne, the unemployment rate was relatively low in the 1950s; more recently, these rates have been significantly higher than the State's. Table II-33 presents unemployment data for the U.S., Utah, and the region.

Data for 1970 concerning persons whose incomes are below the official poverty level is shown in table II-34. Sanpete, which had the highest rate of unemployment in 1970, also had the region's highest proportion of families with income below poverty level (17.3 percent). Average income for these families ranged from $1,030 in Piute to $2,973 in Wayne. Although Wayne is an exception, the elderly account for about one-fourth of those living at or below poverty level in the region, according to 1970 data.

Community trading relationships--The region is not far from the Wasatch Front where most of Utah's population and economic activity are concentrated. The region is part of the Salt Lake City trading area.

A community's population is only partially suggestive of its relative economic importance. Communities can be ranked on the basis of the economic functions present in each. Such a ranking is given for the region's communities in table II-35. Residents of smaller (lower ranked) communities spend portions of their incomes in higher ranked communities. As all communities in the region are relatively small, even the largest of them cannot provide the full range of goods and services residents may demand, so in varying proportions all are dependent on the State's largest cities.

Table II-32.--Earnings by industrial source as a percentage of total earnings in central Utah coal region counties, 1975

[Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System File. 1975 U.S. figures: U.S. Department of Commerce, "Personal Income by Major Source, 1973-76," Vol. 57, No. 8 (August 1977).]

Source/type earnings[1]	U.S.	Utah	Carbon	Emery	Piute	Sanpete	Sevier	Wayne
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Farm	3.0	2.1	-0.2	0.1	27.5	22.8	7.3	6.8
Manufacturing	25.2	16.9	3.7	0.6	6.8	25.0	11.8	4.7
Mining	1.4	4.5	35.5	47.6	(D)	(D)	(D)	(D)
Construction	5.8	7.1	5.4	29.1	(D)	5.6	10.3	(D)
Trade	17.0	17.8	13.8	5.2	10.3	10.8	21.6	12.0
Finance, insurance, and real estate	5.2	4.4	(D)	(D)	(D)	1.7	2.5	4.0
Transp., commun., and public utilities	7.4	8.4	12.8	(D)	(D)	1.6	6.5	3.8
Services	16.4	14.0	7.2	(D)	0.0	9.0	10.3	5.4
Federal government, civilian	4.4	11.1	3.1	1.3	3.6	3.5	7.0	17.2
Federal government, military	1.9	1.5	0.5	0.3	0.9	0.8	0.6	0.9
State and local government	11.9	11.9	13.7	8.1	30.0	17.4	14.2	29.4
Other	0.4	0.3	(D)	0.0	4.2	(D)	(D)	1.9

[1] Labor and proprietor's income by place of work. Detail may not add to total due to rounding.
(D) = Not shown to avoid disclosure of individual company information.

Table II-33.--Unemployment rates in the central Utah coal region counties, 1950-76 (by percent)

Year	U.S.	Utah	Carbon	Emery	Piute	Sanpete	Sevier	Wayne	Year	U.S.	Utah	Carbon	Emery	Piute	Sanpete	Sevier	Wayne
1950---	5.3	--	5.7	6.3	1.9	7.5	3.5	1.7	1964---	5.2	6.0	9.8	11.4	8.2	8.9	6.1	5.0
1951---	3.3	3.3	5.7	10.4	1.9	6.6	2.8	1.7	1965---	4.5	6.9	7.5	9.4	7.1	7.7	4.7	2.3
1952---	3.0	3.2	5.4	6.3	3.8	12.9	3.6	1.8	1966---	3.8	4.1	8.0	10.7	9.3	6.8	5.1	3.1
1953---	2.9	3.3	3.6	4.1	1.9	6.4	3.9	1.8	1967---	3.8	5.2	8.6	7.8	10.0	8.3	5.3	5.0
1954---	5.5	5.2	11.2	11.5	3.6	16.6	5.5	1.8	1968---	3.6	5.4	9.1	7.9	9.3	10.4	5.9	6.6
1955---	4.4	4.1	6.6	5.6	1.1	16.4	4.2	1.5	1969---	3.5	5.2	8.0	8.2	9.4	10.8	6.2	6.2
1956---	4.1	3.4	5.4	6.5	1.9	10.3	3.9	3.4	1970---	4.9	6.1	10.0	9.5	8.9	12.4	6.8	8.2
1957---	4.3	3.7	3.3	3.9	3.8	9.5	3.4	3.6	1971---	5.9	6.6	11.3	12.9	15.9	11.7	6.0	10.8
1958---	6.8	5.3	8.8	11.5	6.0	10.8	5.2	3.5	1972---	5.6	6.3	10.1	8.3	16.7	10.2	6.4	12.7
1959---	5.5	4.6	15.9	13.0	4.1	15.5	4.4	3.5	1973---	4.9	5.8	8.0	5.9	17.0	9.5	6.1	10.3
1960---	5.6	4.8	9.1	11.0	6.2	13.4	4.5	1.4	1974---	5.6	6.1	8.1	8.5	11.6	9.5	6.4	14.5
1961---	6.7	5.3	9.7	11.8	6.5	9.4	5.8	2.6	1975---	8.5	7.4	8.2	6.7	17.7	11.2	6.7	8.0
1962---	5.5	4.9	10.5	12.2	4.2	7.8	4.1	2.6	1976---	7.7	5.2	6.2	4.3	13.1	9.8	5.6	8.0
1963---	5.7	5.4	10.0	11.5	4.3	8.1	4.8	2.7									

Sources: For county information for 1950-1973 see Utah Labor Market Information, Utah Department of Employment Security, Employment Newsletter, 3/77; for 1974-1976 see Utah Industrial Development Information System, Utah, County Economic Facts 1975, 1976, 1977 editions. For state information see Utah Department of Employment Security Annual Report 1974 and Annual Report 1977. For U.S. unemployment rates see U.S. Department of Labor, Report on Employment and Training Requirements, Resources, and Utilization, 1977.

Table II-34.--Incomes less than proverty level, 1970, central Utah coal region counties

[Source: U.S. Bureau of the Census, Census of Population, 1970, Utah: General Social and Economic Characteristics (Washington, D.C.: U.S. Government Printing Office).]

	Carbon	Emery	Piute	Sanpete	Sevier	Wayne
Families-------------------	442	183	43	484	374	44
Percent of all families--	10.7	14.4	14.2	17.3	13.8	10.5
Mean family income---------	$2,135	$1,848	$1,030	$2,078	$2,191	$2,973
Percent receiving public assistance---------------	24.2	7.7	11.6	20.0	21.1	13.6
Unrelated individuals------	446	152	38	505	307	46
Percent of all unrelated individuals---	48.1	54.3	66.7	60.6	52.8	73.0
Mean income----------------	$1,109	$ 877	$1,104	$ 792	$ 993	$ 849
Percent receiving public assistance---------------	16.1	24.3	--	11.9	23.5	21.7
Persons--------------------	1,912	829	176	2,214	1,614	270
Percent of all persons---	12.3	16.3	15.2	21.0	16.0	16.5
Percent receiving Social Security-----------------	27.7	30.3	24.0	24.4	20.3	9.3
Percent 65 years and over--	25.8	28.3	23.5	28.9	25.8	16.7
Percent receiving Social Security---------	77.1	84.7	88.1	71.2	68.5	55.6

Table II-35.--Service center classifications, current population per capita retail sales, and money income per capita for selected CMCD communities

[Source: Supplementary material on community hierarchies available in an unpublished report prepared for the Utah State Planning Coordinator's Office by the Bureau of Economic and Business Research, University of Utah.]

Community	Service center ranking[1]	1975 Population	1975 Per capita retail sales	1974 Money income per capita
Price-------------	Community	7,391	$5,512	$4,442
Richfield---------	Community	4,947	5,223	3,679
Ephraim[2]---------	Full	2,380	497	2,836
Helper[2]----------	Full	2,198	3,317	4,156
East Carbon------	Hamlet	2,168	2,145	4,445
Manti------------	Full	1,869	1,894	3,183
Mt. Pleasant-----	Full	1,743	2,504	2,976
Salina-----------	Full	1,685	5,652	3,918
Huntington-------	Hamlet	1,303	4,530	3,650
Monroe-----------	Partial	1,235	972	3,444
Gunnison---------	Full	1,193	4,754	3,422
Green River------	Partial	968	8,624	4,348
Castle Dale------	Full	861	3,717	3,940
Ferron-----------	Hamlet	756	1,881	3,376
Orangeville------	Hamlet	655	2,595	3,605
Circleville------	Hamlet	435	1,053	3,202
Loa--------------	Hamlet	341	2,507	3,312

[1]Service centers were defined (see below) on the basis of economic functions available, as of 1975, in each community. Each higher order service must meet all of the criteria of service centers ranked below it.

[2]Community meets the full service center classification but does not meet the partial service center classification.

Hamlet--Both a population of 50 and a post office are required.

Partial Convenience Center--Two of three required: bank, high school, or mortuary.

Full Convenience Center--Three of four required: daily or weekly newspaper, medical doctor, new car dealer, or public library.

Community Service Center--Retail sales of at least $16 million plus two of three required: hospital, radio station, or airport with hard surface.

Regional Service Center--Retail sales of at least $40 million plus two of three required: public higher education, daily newspaper, or scheduled air passenger service.

Metropolitan Service Center--Retail sales of at least $160 million.

National Service Center--Retail sales of at least $1.6 billion.

Price and Richfield are the region's only "community service centers" (see table II-35 for definitions). Price attracted about $11 million in retail sales and services from the surrounding area and smaller communities in 1972; Richfield, about $6.5 million. Castle Dale and Gunnison are of greater trading importance than would be suggested by the size of their populations alone. Helper and East Carbon City are the opposite; being close to larger trading centers (like Price), they exhibit a greater dependence on them.

The importance of a community in this regard influences the ratio of direct and indirect employment and income effects which will occur as a result of normal economic growth processes. As the area grows and develops a larger retail structure, established trading relationships will change, thus affecting community growth patterns.

b. Regional Demographic Characteristics

Since 1950, the region has experienced two population trends: a period of decline from 1950 to 1970, and a period of growth from then on. Currently, Emery and Sevier are among the fastest growing counties in the State, with annual growth rates of 8.5 and 4.3 percent since 1970. Tables II-36 shows population totals and rates of growth for the counties, the region, and the State. Table II-37 presents population data for the region's principal communities for 1950 through 1975. In most instances community population changes explain corresponding county changes.

A close relation exists between the regional economy and population. Table II-38 shows that net migration, which is dependent upon economic conditions (people move in response to relative economic opportunity) is important as an explanation of changes in regional population. From 1950 to 1960, a large natural increase (11,000 persons) occurred. But as emigration was almost twice this amount, total population declined. During the next 10 years, emigration from the region declined more than did the rate of natural increase in the population. Thus, although regional population fell, it did so more slowly. From 1960 to 1970, migration from Carbon was so rapid that it accounted for about 75 percent of regional population decline in those years.

Young adults, who are most responsive to lack of job opportunities and relative rates of pay, were the principal emigrants from the region. In 1970, less than 6 percent of the population of Carbon, Emery, and Sevier were 20-24 years of age. The corresponding State figure was 9.2 percent. This suggests the changes which occurred in the age structure of the region's population between 1950 and 1970. Those 65 years of age and older constituted 12.4 percent of the 1970 regional population, but only 7.3 percent of the State's. Decreases also occurred in the numbers of those of prime importance to the labor force, 20 to 44 years of age (23.7 percent for the region compared to 31.6 percent for the State).

Table II-36.--County population and population growth rates of the central Utah coal region

[Sources: U.S. Bureau of the Census, Census of Population, 1950-1970, Utah: Number of Inhabitants (Washington, D.C.: U.S. Government Printing Office). U.S. Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25, No. 692 (Washington, D.C.: U.S. Government Printing Office, April, 1977). John E. Brockert, "1977 Population Estimates for Utah," Utah Economic and Business Revies, Vol. 37, No. 11-12 (Nov. and Dec., 1977).]

	Population					Growth rate	
	1950[1]	1960	1970	1975	1977	1950-70	1970-77
Carbon------	24,901	21,135	15,647	18,044	20,500	-2.30	+3.80
Emery-------	6,304	5,546	5,137	6,494	9,300	-1.02	+8.53
Piute-------	1,911	1,436	1,164	1,247	1,400	-2.45	+2.58
Sanpete-----	13,891	11,053	10,976	12,028	13,400	-1.17	+2.79
Sevier------	12,072	10,565	10,103	11,763	13,700	-0.89	+4.29
Wayne-------	2,205	1,728	1,483	1,701	1,800	-1.96	+2.71
CUCR Total--	61,284	51,463	44,510	51,277	60,100	-1.59	+4.23
Utah--------	688,862	890,627	1,059,273	1,207,000	1,271,000	+2.17	+2.55

[1] 1950, 1960, 1970 data as of April 1; 1975, 1977 figures as of July 1.

Table II-37.--Total population of selected communities in the central Utah coal region

[Sources: U.S. Bureau of the Census, Census of Population, 1950-1970, Utah: Number of Inhabitants (Washington, D.C.: U.S. Government Printing Office). U.S. Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25, No. 692 (Washington, D.C.: U.S. Government Printing Office, April 1977).]

Community	1950[1]	1960[1]	1970[1]	1975[2]
Aurora	614	465	493	657
Bicknell	373	366	264	282
Castle Dale	715	617	541	861
Circleville	603	478	443	435
East Carbon City[3]	[4]3,453	[4]2,959	1,808	2,168
Ephraim	1,987	1,801	2,127	2,380
Ferron	478	386	663	756
Green River[5]	583	1,075	1,033	968
Gunnison	1,144	1,059	1,073	1,193
Helper	2,850	2,459	1,964	2,198
Huntington	1,029	787	857	1,303
Loa	437	359	324	341
Manti	2,051	1,739	1,803	1,869
Marysvale	520	354	289	325
Monroe	1,214	955	918	1,235
Moroni	1,076	879	894	886
Mount Pleasant	2,030	1,572	1,516	1,743
Orangeville	589	571	511	655
Price	6,010	6,802	6,218	7,391
Richfield	4,212	4,412	4,471	4,947
Salina	1,789	1,618	1,494	1,685

[1]As of April 1.
[2]As of July 1.
[3]Established in August, 1973, by consolidation of Dragerton and Columbia.
[4]Dragerton only.
[5]Includes residents living in Grand County.

Table II-38.--The components of population change: Natural increase versus net migration, central Utah coal region

[Sources: U.S. Bureau of the Census, Current Population Reports, Series P-23, No. 7; and Series P-25, No. 461 (Washington, D.C.: U.S. Government Printing Office).]

	1950-1960			Total	1960-1070			Total
	Net change	Natural increase	Net migration	percentage change	Net change	Natural increase	Net migration	percentage change
CUCR-------	-9,821	10,829	-20,650	-16.0	-6,953	4,200	-11,153	-13.5
Carbon-----	-3,766	5,077	- 8,843	-15.1	-5,488	1,750	- 7,238	-26.0
Emery------	- 758	1,143	- 1,901	-12.0	- 409	591	- 1,000	- 7.4
Piute------	- 475	284	- 759	-24.9	- 272	188	- 460	-18.9
Sanpete----	-2,838	1,725	- 4,563	-20.4	- 77	756	- 833	- 0.7
Sevier-----	-1,507	2,180	- 3,687	-12.5	- 462	744	- 1,206	- 4.4
Wayne------	- 477	420	- 897	-21.6	- 245	171	- 416	-14.2
State------	201,765	191,660	10,105	29.3	168,646	179,604	-10,958	18.9

Previous economic trends and population migration patterns had yielded a smaller than average labor supply in the region by 1970 (see table II-39). Moreover, as table II-40 shows, the rates at which persons in the region participate in the labor force are lower than is typical for the State, further decreasing the size of the regional labor force.

c. Municipal Services

Community services--The region contains small rural communities having minimal ability to provide municipal services. Potential problems in providing adequate levels of services to increasing numbers of people vary according to the quantity and quality of services currently offered. There are significant differences in size among the region's communities and all are smaller than 10,000 persons. The larger communities (Price, Richfield, Helper, and East Carbon) provide a greater variety of services and have made larger investments in facilities than the smaller ones. However, recent economic growth in the region has significantly decreased the potential for many of the communities to provide services to still more people unless additional investment in expansion and improvement of facilities is undertaken. This is particularly true in Carbon and Emery Counties where recent growth has stressed service capacity to the extent that current demands are not adequately met. Most of the affected communities, however, are now improving and expanding facilities.

In contrast, the communities in Sanpete, Sevier, and Wayne Counties have experienced either stable populations or moderate growth. As services have been adequate to the demand (given local community standards), there has been no pressing need for expansion of facilities. The result, generally, is a much more limited capacity to serve more people than will shortly be the case in Carbon and Emery communities.

Thus, the two groups of communities present somewhat different cases. Corresponding differences in capacity are reflected in the summary tables in terms of "improvements planned" (table II-41).

To judge how well community needs are met is difficult as service requirements reflect community preferences and in many cases cannot be compared readily to established standards. Many services are not measurable (police protection, for example) except by local officials' judgments as to adequacy. In spite of such problems, services are rated for adequacy in the following tables. An "adequate" rating is accorded a service currently meeting the needs of the community and in conformance with State regulations or recommended standards. A "marginally adequate" rating means the community realizes the service should be improved but does not have the resources to accomplish the task. The service may or may not be in conformance with State standards. Services rated "inadequate" are not meeting the needs of the community and do not meet State standards.

Table II-39.--Population of the United States, Utah, and central Utah coal region counties by age distribution

[Source: U.S. Bureau of the Census, Census of Population: 1960-1970, Utah: General Population Characteristics; and U.S. Summary: General Population Characteristics (Washington, D.C.: U.S. Government Printing Office).]

[In absolute amounts and percent of total, 1970]

	0-4	5-14	15-19	20-24	25-44	45-64	65 & over	Total
CUCR-----	3,611	9,364	4,982	2,396	8,160	10,487	5,510	44,510
	8.1	21.0	11.2	5.4	18.3	23.6	12.4	100.0
Carbon---	1,167	3,151	1,784	920	2,850	4,068	1,707	15,647
	7.5	20.1	11.4	5.8	18.2	26.0	10.9	100.0
Emery----	454	1,233	491	231	1,071	1,080	577	5,137
	8.8	24.0	9.6	4.5	20.8	21.0	11.2	100.0
Piute----	115	240	108	43	212	297	149	1,164
	9.9	20.6	9.3	3.7	18.2	25.5	12.8	100.0
Sanpete--	910	2,190	1,368	701	1,778	2,416	1,613	10,976
	8.3	20.0	12.5	6.4	16.2	22.0	14.7	100.0
Sevier---	863	2,218	1,064	443	1,984	2,248	1,283	10,103
	4.5	22.0	10.5	4.4	19.6	22.3	12.7	100.0
Wayne----	102	332	167	58	265	378	181	1,483
	6.9	22.4	11.3	3.9	17.9	25.5	12.2	100.0
Utah-----	111,798	240,761	116,607	97,859	237,509	177,188	77,561	1,059,273
	10.6	22.7	11.0	9.2	22.4	16.7	7.3	100.0
U.S.-----	8.4	20.0	9.4	8.1	23.6	20.6	9.9	100.0

Table II-40.--Labor force participation of persons 16 years and over in central Utah coal region counties, 1970

[Source: U.S. Bureau of the Census, Census of Population, 1970, Utah: General Social and Economic Characteristics (Washington, D.C.: U.S. Government Printing Office).]

County	Population	Labor force	Labor force participation rate (by percent)
Central Utah coal region--------	30,432	16,178	53.2
Carbon-----------	10,890	5,569	51.1
Emery------------	3,291	1,671	50.8
Piute------------	780	432	55.4
Sanpete----------	7,640	4,071	53.3
Sevier-----------	6,790	3,891	57.3
Wayne------------	1,041	544	52.3
State total---------	681,326	403,634	59.2

Table II-41.--Description of current community services

County, community population	Service	Adequacy	Excess capacity	Improvement planned	Comments
Carbon County					
East Carbon--- (2,168)	Public water supply-----	M		Total system upgrade	Owned by Kaiser Steel Corp.
	Fire protection---------	A			Volunteer fire department
	Parks and recreation----	A			
	Police protection-------	A			
	Sewage disposal---------	A		New sewer system	Combined with Sunnyside, Utah
	Solid waste disposal----	I		Land fill operation to be established	Joint agreement with Sunnyside, Utah
Helper-------- (2,198)	Public water supply-----	A	2,500 more people		More water can be purchased from the Price River Water Improvement District
	Fire protection---------	A			Volunteer fire department; need a larger fire station
	Parks and recreation----	M		Facilities improvement	West part of town lacking facilities
	Police protection-------	A			
	Sewage disposal---------	A	2,200 more people		
	Solid waste disposal----	I		Yes	Will participate in the planned county-wide fill operation
Hiawatha------ (166)	Public water supply-----	A			U.S. Fuel owns the system
	Fire protection---------	M			Volunteer fire department
	Parks and recreation----	M			
	Police protection-------	A			
	Sewage disposal---------	A			
	Solid waste disposal----	I			Will participate in the planned county-wide fill operation
Price--------- (7,391)	Public water supply-----	A	10,000 more people		Purchases water from the Price River Water Improvement District
	Fire protection---------	A			Volunteer fire department
	Parks and recreation----	M		Recreational facilities	
	Police protection-------	A		New city-county facility	New Criminal Justice Center to be constructed by 1980
	Sewage disposal---------	A	3,700 more people	Replace some lines	
	Solid waste disposal----	I		Yes	Will participate in the planned county-wide fill operation
Scofield------ (49)	Public water supply-----	I		Upgrade entire system	
	Fire protection---------	M			Volunteer department; supplies donated
	Parks and recreation----	M			
	Police protection-------	A			
	Sewage disposal---------	A		Sewage disposal system	Area presently serviced by septic tanks
	Solid waste disposal----	I		Yes	Will participate in the planned county-wide fill operation
Sunnyside----- (517)	Public water supply-----	M		Total system upgrade	Owned by Kaiser Steel Corp.
	Fire protection---------	A			Volunteer fire department
	Parks and recreation----	A			Good recreational facilities
	Police protection-------	A			
	Sewage disposal---------	A		New sewer system	System combined with East Carbon
	Solid waste disposal----	I		Land fill (78) operation to be completed	Joint arrangement with East Carbon
Wellington---- (1,146)	Public water supply-----	A		Distribution system improvements	Purchases water from the Price River Improvement District, need additional storage
	Fire protection---------	A			
	Parks and recreation----	M		Tennis court planned	Need to improve facilities
	Police protection-------	A			
	Sewage disposal---------	A	2,000 more people		System being improved
	Solid waste disposal----	I		Yes	Will participate in the planned county-wide fill operation
Emery County					
Castle Dale--- (861)	Public water supply-----	A		Total upgrade	Should be complete by 1980
	Fire protection---------	A		Yes	Emery County planning to provide county-wide service
	Parks and recreation----	A			
	Police protection-------	A			
	Sewage disposal---------	I		New system, Fall 1978	Joint system with Orangeville
	Solid waste disposal----	I			Town dump
Cleveland----- (315)	Public water supply-----	A			
	Fire protection---------	A		Yes	Emery County planning to provide county-wide service
	Parks and recreation----	M			Additional facilities needed
	Police protection-------	A			
	Sewage disposal---------	A		New system, 1979	Now served by septic tanks
	Solid waste disposal----	I			Town dump
Elmo---------- (176)	Public water supply-----	A			
	Fire protection---------	M		Emery County Plan	Protection provided by Cleveland
	Parks and recreation----	M			Additional facilities needed
	Police protection-------	A			
	Sewage disposal---------	A		New system, Spring '79	Presently has septic tanks
	Solid waste disposal----	I			Town dump
Emery Town---- (219)	Public water supply-----	A	Storage-500 more people, Supply 2,500 more people	Upgrade present system	
	Fire protection---------	A		Yes	Emery County planning to provide county-wide services
	Parks and recreation----	M			Facilities need repair and improvement
	Police protection-------	A			
	Sewage disposal---------	A		Yes	System presently under construction
	Solid waste disposal----	I			Town dump

Table II-41.--Description of current community services--Continued

County, community population	Service	Adequacy	Excess capacity	Improvement planned	Comments
Ferron-------- (756)	Public water supply-----	M	New system: Storage-1,800 Supply-2,000	Upgrade entire system	
	Fire protection---------	A			Emery County planning to provide county-wide service
	Parks and recreation----	A			
	Police protection-------	A			
	Sewage disposal---------	I		Upgrade sewer system	Capacity containment lagoons surpassed
	Solid waste disposal----	I			Town dump
Huntington---- (1,303)	Public water supply-----	A	3,000 more people		Water improvement project completed
	Fire protection---------	A		Yes	Emery County planning to provide county-wide service
	Parks and recreation----	M			Ball fields need improvement, more needed
	Police protection-------	A			
	Sewage disposal---------	A	4,000 more people		System completed in 1977
	Solid waste disposal----	I			Town dump
Orangeville--- (655)	Public water supply-----	A		Total upgrade	Should be complete by 1980
	Fire protection---------	A		Yes	Emery County planning to provide county-wide service
	Parks and recreation----	M			More facilities, eg. tennis courts
	Police protection-------	A			
	Sewage disposal---------	I		New system, Fall '78	Joint system with Castle Dale
	Solid waste disposal----	I			Town dump
Sanpete County					
Centerfield--- (485)	Public water supply-----	M	Storage-93 connections	Distribution system improvements	
	Fire protection---------	M			Agreement with Gunnison; prefer own department; no financing available
	Parks and recreation----	M			Lacks financing for facilities
	Police protection-------	A			
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			
Fairview------ (800)	Public water supply-----				
	Fire protection---------	A			
	Parks and recreation----	A			
	Police protection-------	A			
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			
Gunnison------ (1,193)	Public water supply-----	A	Storage-530 conn. Water rights-835 connections		
	Fire protection---------	M			Need to improve equipment and facilities; problem recruiting volunteers
	Parks and recreation----	A			
	Police protection-------	A			Need a night patrol officer
	Sewage disposal---------	A	440 connections		Lagoon system, 1976
	Solid waste disposal----	I			City dump
Mt. Pleasant-- (1,743)	Public water supply-----	A	Storage-525 conn. Water rights-423 connections		Recently improved
	Fire protection---------	A		Yes	Public Safety Office facility planned
	Parks and recreation----	A			
	Police protection-------	M			Need more office and jail facilities and police
	Sewage disposal---------		1,500 more people		Septic tanks; lagoon system construction planned, September 1978
	Solid waste disposal----	I			City dump
Aurora-------- (657)	Public water supply-----		Storage-390 conn. Water rights-413 connections	Yes	Improvements to be completed by July 1978
	Fire protection---------	M		Yes	Agreement with Salina for services: setting up own department
	Parks and recreation----	A			
	Police protection-------	M			
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			Town dump
Redmond------- (459)	Public water supply-----	M		Yes	Improvement of complete system no time schedule
	Fire protection---------	A			Relies on Salina volunteer fire dept.
	Parks and recreation----	A			Additional facilities under construction
	Police protection-------	M			Due to lack of funds, Town Marshall position was discontinued
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			Town dump
Richfield----- (4,947)	Public water supply-----	M			Does not meet recommended state standards for supply and storage
	Fire protection---------	A			Volunteer fire department
	Parks and recreation----	A		Yes	5-7 Acre park planned
	Police protection-------	A			
	Sewage disposal---------	A			Treatment plant improvements completed in 1977
	Solid waste disposal----	I			City dump

Table II-41.--Description of current community services--Continued

County, community population	Service	Adequacy	Excess capacity	Improvement planned	Comments
Salina-------- (1,685)	Public water supply-----		Supply-486 conn. Storage-1,200 connections		
	Fire protection---------	A			Volunteer fire department
	Parks and recreation----	M			Does not own a park but owns land that could be developed
	Police protection-------	A			Jailing facilities in poor condition
	Sewage disposal---------	I		Yes	Treatment facility being improved
	Solid waste disposal----	A			Landfill system
Sigurd-------- (358)	Public water supply-----				
	Fire protection---------	A			Relies on Richfield fire department
	Parks and recreation----	A			
	Police protection-------	A			Part-time Town Marshall
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			Uses Richfield's dump
Wayne County					
Bicknell------ (282)	Public water supply-----	A	Supply-100 conn. Storage-200 connections		System improved in 1976
	Fire protection---------	A			Volunteer fire department; County provides equipment
	Parks and recreation----	A			
	Police protection-------	M			Need full time officer, and equipment
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			Town dump
Loa----------- (341)	Public water supply-----	A	Supply-184 conn. Storage-79 conn.		
	Fire protection---------	A			Volunteer fire department, county provides equipment
	Parks and recreation----	A			
	Police protection-------	A			Relies on County Sheriff's Office
	Sewage disposal---------	A			Septic tanks
	Solid waste disposal----	I			Town dump
Torrey-------- (104)	Public water supply-----	A	Supply-80 conn. Storage-5 conn.		Considering additional storage facility which could serve 75 connections
	Fire protection---------	I		Yes	Volunteer fire department; fire station under construction
	Parks and recreation----	I			No parks or recreational facilities
	Police protection-------				Provided by County Sheriff's Office
	Sewage disposal---------	I			Septic tanks
	Solid waste disposal----	I			Town dump

County services--Counties also provide several services: fire protection, police protection, libraries, health care, road maintenance, and solid waste disposal. Generally the levels of provided services are adequate or there are plans for improvements.

Financing--Financing of services provided by communities and counties are generally covered by taxes, State and Federal fund transfers and fees and fines. Daily operation and maintenance costs are paid from these sources. Generally the major source of funds is the property tax. For large capital-investment improvements the communities turn to State and Federal grants and (or) issue bonds. The amount a community can borrow through general obligation bonds is limited to a percentage of its total assessed valuation. The financial structure of the local levels of government will be more fully discussed in chapter IV.

Housing--In Sanpete, Sevier, and Wayne Counties the housing situation is relatively stable. There is a predominance of single-family homes. Few vacancies exist.[1] In Carbon and Emery Counties significant increases in housing demand have been experienced since 1970. The result of the increase in demand has been housing shortages and a shift to the increasing use of mobile homes. There are new houses available but at prices that are high relative to income. A local survey found no mobile home lots currently available.

Education

Carbon County School District--The total school capacity in the district is about 5,100. The 1977 enrollment was 3,945. Excess capacity exists in the junior high and high schools. Under expected future conditions, the district would spend $6.5 million to improve or expand facilities and add 92 teachers to meet 1990 needs.

Emery County School District--The 1977 school enrollment was 2,583 students. There is little excess capacity in the existing facilities. About $3 million would have to be expended to meet expected future requirements by 1990 if current growth continues. An additional 79 teachers would be required.

North Sanpete County School District--All the schools in the district are operating beyond capacity. If current growth conditions prevail, about $2.95 million would be required for capital improvements and 6 teachers would be added by 1990.

South Sanpete County School District--Generally, the schools are in poor condition. Operating capacity is 1,500 students, yet 1,702 students are enrolled. It is assumed that $6.14 million will be needed for capital improvements by 1990, and 9 teachers will be added to the staff.

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[1] A housing inventory is provided in Six County Coal Impact Statement, March, 1978, Olympus Research Corporation, Salt Lake City, Utah.

Sevier County School District--The facilities in Sevier County are generally in good condition. Current enrollment is 3,475. Additional space at the junior high and high school levels will be required if current trends continue. The estimated cost would be $4.5 million. An additional nine teachers would be needed in 1985.

Wayne County School District--School enrollment in Wayne County has been stable since 1970. Facilities are at least 20 years old.

5. TRANSPORTATION AND UTILITIES

a. Transportation Facilities

1. Highways

Four highways form the framework of the highway system in the central Utah coal region: I-70, US-89, US-6, and U-10 (fig. II-21). The only Interstate Highway in the region, I-70, has not been completed. Designed to ultimately be a multilane divided highway through east-central Utah to a junction with I-15, it presently has at least two lanes open and terminates at Salina. The other three highways have only two lanes, some with passing lanes. The only exceptions are US-6 between Carbonville and U-33 where it has a divided four-lane configuration, and US-6 crossing the Wasatch Plateau where it has segments of undivided four-lane configurations.

There are a number of small, two-lane State and local roads within this framework which serve to connect points of resource development or population concentration to the four major routes. Three roads, none of which are paved, also cross the Wasatch Plateau between US-89 and U-10.

Most of these highways, in particular those east of the Wasatch Plateau, were designed and constructed some time ago to serve the comparatively light traffic demands of the area. The area is underlain by thick and widespread beds of Mancos shale, which contains substantial amounts of bentonitic material that has high shrink-swell coefficients. This base material makes road maintenance difficult and short-lived. Inadequate pavement thickness and subgrade in some areas, coupled with increasing traffic loads, have resulted in localized deterioration of portions of the highways.

The highways in the region except for I-70, US-89, and US-6 have historically carried comparatively low volumes of traffic. This is in keeping with the rural, undeveloped nature of the area. The higher levels on the Interstate and US routes are explained, in part, by the inter-region and inter-state connections provided by them. For example, over 46 percent of the 1975 traffic on I-70 near Green River (fig. II-21, point 23) was out-of-state automobiles. The roads in the region carry a substantial percentage of heavy trucks; a truck component of the

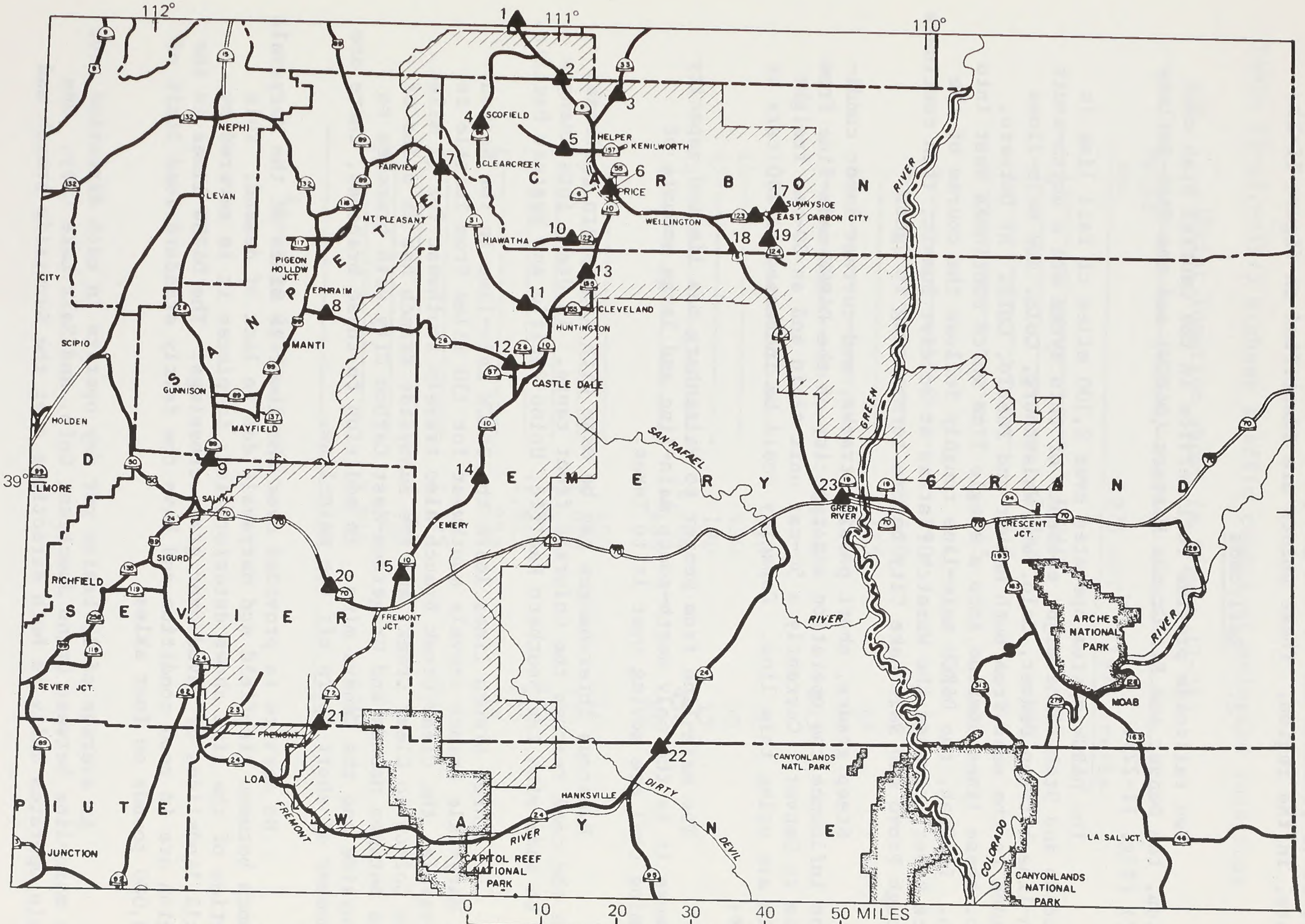


Figure II-21.--Highway map of the central Utah coal region showing selected traffic count points.

total traffic in the range of 10 to 20 percent is not uncommon here. Table II-42 presents the 1975 highway traffic volumes at selected points, in the region. These points are identified on figure II-21.

2. Railroads

Two railroads provide rail service in the Central Utah coal region, the Denver and Rio Grande Western (D&RGW) and the Utah Railway (URY) (fig. II-22).

The D&RGW system operates over 2,100 miles of rail line in Colorado and Utah. The major elements of this sytem are a north-south main-line between Denver, Colo. and Walsenburg, Colo. and main-lines aligned to the west from both Denver and Pueblo, Colo. At Dotsero, Colo. these lines combine into a single line which continues west into Utah. In Utah, the D&RGW main-line roughly follows the course of the Price River, crosses the Wasatch Plateau at Soldier Summit, then continues through Provo and Salt Lake City before terminating in Ogden.

Steep grades, short passing tracks, and current labor conditions influence the operation and capacity of the D&RGW main-line from Price to Denver. Currently a 50-car unit train and an 80-car freight train are using this line. Capacity could be increased to 100 cars or more.

The main-line from Denver to Walsenberg has limited capacity because it is the only north-south main-line and large amounts of Wyoming coal are moving over it to Texas.

Numerous interchanges can be made with midwestern railroads once the coal reaches the Colorado front range. In Utah, interchanges can be made with the Southern Pacific, Union Pacific and Western Pacific.

Three branch lines leave the D&RGW main-line in the Region: The Marysvale Branch travels southwest for 130 miles from Thistle to Marysvale; the Clear Creek branch also travels southwest for 21 miles from Colton to Clear Creek; and the Sunnyside Branch has 26 miles of line between Mounds and Dragerton-East Carbon City with branches to Sunnyside and the Geneva mine. In addition to these branches, there are a number of short spurs off the main-line.

No service is provided over the lower 28 miles of the Marysvale Branch between Richfield and Marysvale due to lack of demand. This section of the line shows deterioration; in places it is severed by small landslides or paved-over grade crossings. The D&RGW lines in the region are in good condition and have the fairly standard load limit of 263,000 pounds on four axles.

An average of 10 trains per day operate in each direction over the main-line between Grand Junction, Colo. and Salt Lake City. One train operates daily in both directions over the Sunnyside branch and

Table II-42.--1975 highway traffic counts at selected locations

[Point location shown in figure II-21]

Point No.	1975 ADT[1]	1975 trucks
1	3,210	475
2	3,365	500
3	215	40
4	345	10
5	50	10
6	3,520	695
7	115	13
8	270	30
9	3,249	435
10	310	20
11	430	50
12	190	15
13	2,700	450
14	480	90
15	450	110
16	1,030	135
17	1,030	135
18	1,615	265
19	250	15
20	1,795	325
21	45	5
22	320	35
23	2,899	420

[1]Average daily traffic.

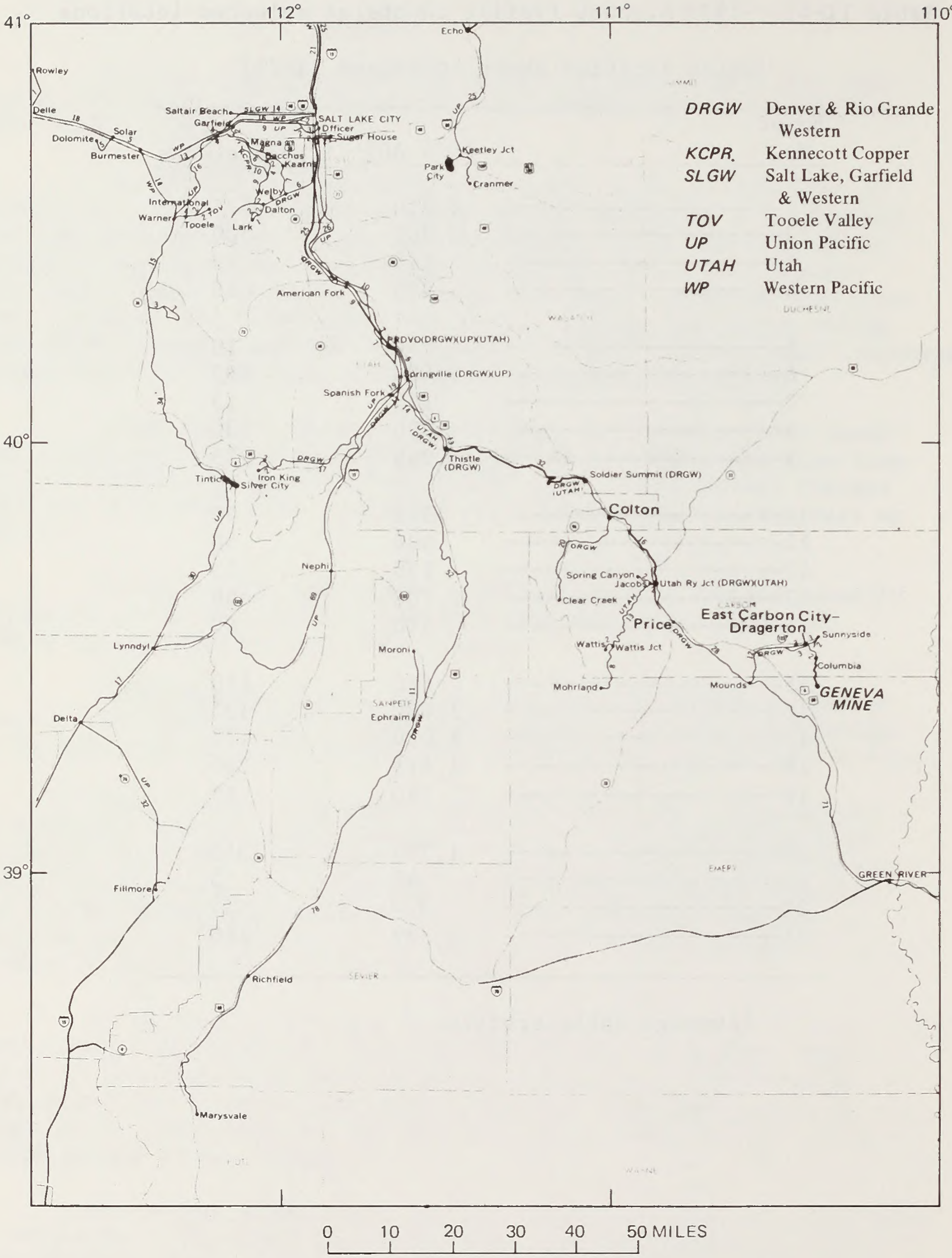


Figure II-22.--Map showing railroads of central Utah.

two to three trains per week operate over the Marysvale branch. Service on the other lines is on an "as needed" basis. Approximately 305,500 carloads of freight were generated in 1977 by the main-lines in Utah and the branches in the region, 68,700 of these cars were coal. This traffic amounted to approximately 19,100,000 net tons of freight of which 6,500,000 net tons were coal.

The Utah Railway (URY) is a short line railroad serving the coal producing areas of western Carbon and northwestern Emery Counties. Traffic for this railroad is primarily generated by approximately 40 miles of rail line between the D&RGW main-line at Utah Railway Junction (near Castlegate) and Mohrland, with short branches to East Hiawatha, Wattis, and Spring Canyon. From Utah Railway Junction, this traffic reaches the URY's terminus at Provo over a double tracked rail segment which it shares with the D&RGW main-line operation and which is maintained by the D&RGW. In Provo, URY interchanges traffic with D&RGW and Union Pacific.

Over 99 percent of the traffic generated by URY is coal. In 1977, this amounted to 2,000,000 net tons. Substantial amounts of this traffic was interchanged with the Union Pacific for delivery to utilities in the Salt Lake Area, in Nevada, and in other destinations to the west. Coal traffic destined to eastern points was interchanged with the D&RGW.

The Utah Railway's alinement crosses unusually difficult terrain with sharp curves and adverse grades as great as 4 percent. This limits the size of trains, dictates the gearing ratio of locomotives and requires helper engines as far west as Soldier Summit. As previously mentioned, the trackage maintained by the D&RGW is in good condition. The track between Utah Railway Junction and Mohrland, however, is in variable condition with some segments in need of major rehabilitation.

The Utah Railway has applied to the Federal Railroad Administration for financial assistance provided for by section 505 of the Railroad Revitalization and Regulatory Reform (4R) Act of 1976. This assistance would be used to rebuild and overhaul the locomotives, improve track alinement, ballasting, installation of 115 pound rail, and upgrading of signal systems. While this project is primarily designed to reverse the effects of years of deferred maintenance, it would also serve to substantially increase the line's operating capacity.

3. Existing Mine Access

Over 75 miles of access roads connect existing mines to major paved public roads. These access roads generally have a graded, drained, and maintained gravel surface and in few instances are paved.

In the Book Cliffs area, two existing mines use mine-mouth rail loadouts and a total of 10.7 miles of railroad spur line. Near Scofield, the Utah No. 2 mine also loads directly onto rail cars.

In Huntington Canyon the Deer Creek mine uses about 2 miles of conveyor to transport coal from the mine mouth to the Huntington generating station of Utah Power & Light Co.

b. Utilities

Telephone service is provided throughout the region by the Mountain Bell system and by independent telephone companies, using overhead lines, underground cables, and some microwave transmission. Although telephone service is not now available at all of the minesites, it can be extended to them.

Several major transmission lines of Utah Power & Light Co. pass through the central Utah region. In addition, electric power is produced by the Carbon, Huntington No. 1 and 2, and Emery No. 1 coal-fired generating stations in the region. The Emery No. 2 generating station is under construction. The existing distribution system is not adequate to meet the power demands of projected coal production at each potential minesite.

6. RECREATION

Figure II-23 outlines the Central Utah coal region recreation influence zone (RIZ) where primary and secondary impacts would accrue to the recreation resource as a result of mining 24 mty of coal in the central region. It also shows the general location of the site specific coal mining areas addressed in part II of this document. Developed public (Federal and State) recreation sites, primary travel routes, and principal population areas, within and adjacent to the region, are also shown, along with major recreation user attractions.

The RIZ is based on past and present recreation use patterns within the region. Travel times from existing communities to recreation areas within the region vary from less than 1 hour up to 3 hours. Areas within the 2-hour travel time not included within the RIZ either (a) lack recreation-user attractions and are lightly used for recreation purposes, or (b) have the recreation-user carrying capacity to accommodate projected increases of use without impairment of resource or individual recreation-user values. Areas within the RIZ that would require more than a 2-hour travel time possess significant recreation-user attractions but are generally lacking in developed facilities, or have administrative restraints on types of use.

Because of the low population density, land ownership status, and lack of other significant industrial developments within the region, nearly all of the area is availabe for outdoor dispersed recreation use.

Table II-43 outlines the major local, regional, and national recreation attractions and use areas within the recreation influence zone. These attractions create the number two industry for the central region, which is recreation and tourism.

Table II-43.--Recreation attractions and use areas within the central Utah coal region recreation influence zone

Administering agency or ownership	Fig. No.	Recreation use area or attraction	1976 recreation visits[1] or visitor days use[2] (where available)	Scenery	Driving	Camping	Picnicking	Hiking	Hunting	Fishing	Boating	Swimming	ORV[3] use	Nature study	Cultural history	Archeology	Paleontology	Geology	Wildlife	Snowmobiling	Solitude	Photography	Comments[4]
Bureau of Land Management:	A	Henry Mountains---------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Heavy use, local; light use, spring and fall.
	T	Cedar Mountain Recreation Area--------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Heavy use, spring and fall; ORV use popular.
	W	Book Cliffs-------------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●			●	Light use, except for hunting and big game.
	S	Desolation Canyon--------	12,170 V	●		●	●	●	●		●	●		●	●	●		●	●		●	●	Moderate use, float boating; National Historical Landmark.
	U	The Wedge Overlook-------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Light use of primitive roads.
	V	Sinbad Country-----------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Moderate use, spring and fall, of secondary roads and for camping.
	K	Labrinth Canyon (Green River)----------	29,000 V	●		●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	Heavy use, family float boating.
	X	Cleveland Lloyd Dinosaur Quarry--------	4,000 V		●		●							●	●		●					●	Light use, August for 1975-76.
	Q	San Rafael Reef----------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Moderate to heavy use, spring and fall; ORV use.
	R	San Rafael Swell---------	records not kept	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Moderate to heavy use, spring and fall; some ORV use.
	Y	Westwater Canyon---------	6,900 V	●		●	●	●		●	●	●		●	●	●		●	●		●	●	Heavy use, float boating.
Estimated visits to all public lands in influence zone administered by the Bureau of Land Management-----			400,000 V	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
U.S. Forest Service: Fishlake National Forest	F	Fishlake Mountains-------	570,600 V/D's	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	Heavy use, summer and fall.
Manti-LaSal National Forest	P	Price, Ferron, San Pete Ranger Districts--	605,700 V/D's	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Heavy use, summer and fall.
Uinta National Forest	Z	Spanish Fork River drainage---------------	---	●	●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	Extreme use, summer and fall.
	Z	East Side Nebo Mountain--	76,600 V/D's	●	●	●	●	●	●	●	●		●	●	●	●		●	●	●	●	●	Moderate use.
Ashley National Forest	Z	Left Fork Indian Canyon--	14,000 V/D's	●	●	●	●	●	●	●			●	●	●	●		●	●	●	●	●	Heavy use.
Dixie National Forest	E	Thousand Lake-Boulder Mountain--------------	89,100 V/D's	●	●	●	●	●	●	●	●		●	●	●	●		●	●	●	●	●	Moderate use.
National Park Service:	J	Arches National Park-----	294,800 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Heavy use, spring and fall, and increasing.
Canyonlands National Park	C	Green and Colorado Rivers----------------	7,300 V	●		●	●	●			●			●	●	●		●	●		●	●	Heavy use, float boating.
	C	The Maze District--------	3,440 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Light use, poor access.
	C	Island in the Sky District-----------	21,780 V	●	●	●	●	●						●	●	●		●	●		●	●	Moderate use, but increasing.
Capitol Reef National Park	D		469,620 V	●	●	●	●	●					●	●	●	●		●	●		●	●	Heavy use, near capacity in North District.
Glen Canyon National Park	B	Bullfrog Campground and Marina-------------	121,300 V	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	Extreme use, spring and fall.
	B	Hite Marina and Campground------------	73,400 V	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	Extreme use, spring, summer, and fall. Exceeds carrying capacity by more than 500 percent.
State of Utah (Division of Parks and Recreation):	H	Goblin Valley State Reserve--------------	---	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Light use, no developments.
	M	Deadhorse Point State Park-----------------	129,230 V	●	●	●	●	●	●				●	●	●	●		●	●		●	●	Extreme use, near capacity.
	L	Green River Recreation Area--------	115,980 V	●		●	●	●		●	●	●										●	Extreme use, above capacity.
	O	Huntington Lake State Beach-----------	104,180 V			●	●		●	●	●	●			●								Moderate to heavy use.
	N	Millsite Lake State Beach------------------	19,140 V			●	●			●	●	●			●				●			●	Light use, local.
	I	Palisade Lake State Recreation Area--------	39,490 V			●	●			●	●	●											Moderate use, increasing.
	AA	Yuba Lake State Recreation Area--------	86,500 V			●	●			●	●	●											Heavy use, spring and fall.
	G	Otter Creek Lake State Recreation Area--------	25,470 V			●	●			●	●	●											Heavy use, summer.
	BB	Scofield Lake State Recreation Area--------	38,570 V	●	●	●	●	●	●	●	●	●	●	●	●				●	●		●	Heavy use, facilities and lakes.
Others (mixed, etc.):	CC	Carbon County Recreation Area--------	2,000 V	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	Moderate use.
	I	Koosharem Reservoir------	6,000 V	●		●	●	●	●	●	●			●		●			●	●		●	Light to moderate use.

[1] V = visit.
[2] V/D's = visitor days use (12 hour period) aggregated by one or more persons.
[3] ORV = Off-the-road vehicle.
[4] Light use = generally below environmental and designed carrying capacity.
Moderate use = approaching carrying capacity.
Heavy use = at carrying capacity during most of use period, but above carrying capacity on weekends and holidays.
Extreme use = usually above acceptable carrying capacity for major use facilities and environment areas visited during managed or open season.

Table II-44 is a listing of developed recreation sites, their capacity, use and condition. Although some use figures are not available, those shown are indicative of the situation that exists during the managed season for the majority of developed recreation sites in the region. Sites receiving more than 40 percent use deteriorate rapidly, are difficult to maintain in usable condition, are highly vandalized, resulting in user dissatisfaction with facilities and recreation experiences (USFS, 1965). Of the 71 sites listed in table II-44, 19 received more than 40 percent use during 1976, 28 received between 20 percent and 40 percent use, and the remaining 24 received less than 20 percent use. Column 8 of table II-44 gives a general indication as to the condition of the developed sites within the region. The majority of sites listed in table II-44 are located within or adjacent to the local regional and national recreation attractions listed in table II-43. The comment column of table II-43 and columns 7 and 8 of table II-44 should be reviewed jointly in order to gain an overall understanding of the recreation situation in the RIZ.

A sharp contrast will be noted between the information in the tables supplied in this chapter and the information related in the site specific statements in part II for the B Canyon (U.S. Steel), Deadman Canyon (AMCA Corp.), Fish Creek and Dugout Canyons (PG&E), Skumpah Canyon (Energy Reserves Group), and Mountain States No. 1 (Mountain State Resources). These site specific proposals are located in areas that generally lack recreation-user attractions and are seldom used for recreation purposes, while adjacent local, regional, and national recreation areas receive heavy to extreme use. The McKinnon Nos. 1 and 2 leases and the Belina and O'Connor leases are located immediately adjacent to heavily used recreation areas and attractions.

Recreation visits (with the exceptions of the Bullfrog and Hite recreation sites and marinas on the north end of Lake Powell) in the recreation influence zone will continue to increase at approximately 7.1 percent annual through 1990 (based on Nat. Park Service use figures from 1966-76). A comparison of recreation visits for 1976, 1985, and 1990 with and without the proposal(s) is shown on table IV-25. Impacts relative to the projected increases in recreation use with and without the proposal(s) are discussed in chapters IV and VIII.

The Bullfrog and Hite Marina areas in the northern district of the Glen Canyon National Recreation Area present a special situation. From 1971 to 1977, recreation visits to these areas increased from 58,500 visits to 228,900 visits or 32 percent per year. If this rate of increase continues, more than 2,784,900 visits will accrue to these areas by 1985 and more than 11,160,400 visits could be expected by 1990. This trend is not expected to continue at the present rate of increase, however, because of limited space, facilities, etc., or because of controls inititated by the National Park Service. The maximum increases in recreation visits to Bullfrog and Hite, as a result of 24 mty coal production in the central region would be 197,600 visits by 1990. Remaining increases would be from non-residents of the coal region.

Table II-44.--Capacity, use, and condition of selected developed recreation sites in the central Utah coal region recreation influence zone

Administering agency or ownership (1)	Fig. No.	Developed site name and type (2)	Season of use and length of season (3)	PAOT[1] (4)	1976 recreation visits[2] (5)	1976 recreation visitor days use[3] (6)	1976 use percent of capacity[4] (7)	Comments: conditions and needs of facilities, season of use, intensity of use compared to carrying capacity, etc. (8)
Bureau of Land Management:								
Price Resource Area	13	Price Canyon Recreation Area-----	4/1-10/15	NA[5]	NA	NA	35	Good condition.
	23	Cleveland Lloyd Dinosaur Quarry--	1/1-12/31 (365 days)	NA	4,000	NA	NA	Light use, good condition.
San Rafael Resource Area	25	San Rafael Campground-----------	-- (210 days)	50	--	5,000	24	Fair condition, some rehabilitation needed.
	24	Cedar Mountain Recreation Area---	-- (180 days)	50	--		30	Good condition.
	26	The Wedge Overlook---------------	-- (210 days)	undeveloped				Not maintained.
Henry Mountains Resource Area	53	McMillan Spring Campground-------	-- (120 days)	50	--		3	Light use, fair condition.
	54	Lonesome Beaver Campground-------	-- (120 days	65	--	400	2	Light use, fair condition.
	58	Hog Springs Campground-----------	1/1-12/31 (365 days)	30	--	1,100	10	Light use, fair condition.
	55	Starr Springs Campground---------	-- (240 days)	75	--	8,100	23	Moderate use, good condition.
U.S. Forest Service:								
Manti-LaSal National Forest	17	Old Folk Flat Campground---------	6/1-9/15 (107 days)	150	16,400	10,500	33	Needs redesign and reconstruction.
	28	Ferron Canyon Campground---------	4/15-9/10 (149 days)	125	7,400	6,800	18	Rehabilitation needed.
	29	Joes Valley Campground-----------	5/15-9/10 (119 days)	240	3,600	21,100	37	Heavy use, needs expansion.
	19	Indian Creek Campground----------	6/15-9/10 (88 days)	450	1,800	7,400	9	Good condition.
	28	Ferron Reservoir Campground------	6/15-9/15 (92 days)	175	14,500	14,500	45	Reconstruction needed.
	32	Twelve Mile Campground-----------	7/1-9/10 (72 days)	140	7,000	8,200	41	Good condition.
	30	Pinchot Picnic Area--------------	6/1-9/10 (102 days)	95	5,200	5,800	30	Rehabilitation needed.
	31	Manti Community Picnic Area------	6/15-9/10 (88 days)	110	8,500	8,000	41	Roads need upgrading.
	16	Lake Hill Campground-------------	6/15-9/10 (88 days)	115	4,500	4,000	20	Rehabilitation needed.
	18	Spring City Picnic Area----------	6/15-9/10 (88 days)	50	1,200	1,000	23	Heavy maintenance needed.
	29	Forks of Huntington Campgground--	6/1-9/15 (107 days)	65	16,400	10,500	75	Reconstruction needed.
	33	Maple Canyon Campground----------	6/1-9/10 (102 days)	115	7,400	4,200	18	Needs redesign and reconstruction.
	14	Flat Canyon Campground-----------	6/15-9/15 (92 days)	130	17,000	10,600	44	Heavy maintenance needed.
	15	Gooseberry Campground------------	6/15-9/15 (92 days)	100	11,900	7,300	39	Some maintenance needed.
	10	Fish Creek Campground------------	6/15-9/10 (88 days)	25	1,700	1,700	39	Total reconstruction needed.
Ashley National Forest	3	Avintaquin Campground------------	5/30-9/15 (109 days)	135	10,200	9,300	32	Good condition.
Uinta National Forest	1	Diamond Fork Campground----------	5/15-9/30 (139 days)	240	14,900	22,900	34	Reconstruction needed.
	10	Bear Canyon Picnic Area----------	5/1-9/30 (153 days)	175	9,900	10,800	40	Good condition.
	9	Cottonwood Campground------------	5/15-9/30 (139 days)	65	8,100	6,100	34	Total rehabilitation needed.
	2	Palmyra Group Picnic and Campground----------------	5/15-9/30 (139 days)	345	35,100	34,400	36	Heavy maintenance needed.
	6	Maple Bench Campground-----------	5/1-9/30 (153 days)	50	8,100	6,000	39	Fair condition, maintenance needed.
	5	Payson Lakes A Campground--------	6/1-9/30 (122 days)	290	8,600	10,400	15	Closed during part of 1976. Major rehabilitation needed.
	4	Payson Lakes B Campground--------	6/1-9/30 (122 days)	80	--	--	--	Not open in 1976. Needs reconstruction.
	8	Ponderosa Campground-------------	5/1-9/30 (153 days)	140	15,700	16,800	39	Good condition.
Fishlake National Forest	37	Johnson Valley Campground--------	6/1-10/15 (137 days)	10	3,000	1,500	55	Parking only, day use.
	35	Gooseberry Campground------------	6/1-9/30 (122 days)	75	1,800	6,200	34	Major rehabilitation needed.
	41	Bowery Picnic Area---------------	6/1-10/15 (137 days)	110	4,200	700	5	Light daytime use.
	40	Mackinaw Campground--------------	6/1-10/15 (137 days)	270	21,600	36,000	49	Heavy use, minor rehabilitation needed.
	39	Twin Creeks Visitor Center-------	6/1-10/15 (107 days)	20	2,600	500	20	Good condition.
	38	Fremont River Complex------------	6/1-10/30 (152 days)	200	11,200	18,700	31	Needs minor maintenance.
	44	Elkhorn Campground---------------	7/1-9/15 (77 days)	78	--	3,000	25	Needs some maintenance.
	45	Sunglow Picnic Area--------------	5/1-11/1 (185 days)	57	2,600	2,200	21	Light use, good condition.
	42	Frying Pan Campground------------	6/1-10/15 (137 days)	55	1,500	3,800	25	Good condition.
	43	Bowery Campground----------------	6/1-10/15 (137 days)	215	15,800	27,100	46	Minor rehabilitation needed.
	40A	Doctor Creek Campground----------	6/1-10/15 (137 days)	150	7,500	12,400	30	Minor rehabilitation needed.
	39A	Twin Creeks Campground-----------	6/1-10/15 (137 days)	150	10,400	2,600	13	Light use, good condition.
	40A	Doctor Creek Picnic Area---------	6/1-10/30 (152 days)	150	1,800	4,700	21	Moderate use, good condition.
Dixie National Forest	48	Singletree Campground------------	5/25-9/15 (135 days)	200	10,600	6,300	14	Moderate use, good condition.
	49	Pleasant Creek Campground--------	5/25-9/15 (135 days)	95	27,200	11,400	53	Heavy use, good condition.
	50	Oak Creek Campground-------------	5/25-9/15 (135 days)	50	8,400	5,800	51	Some heavy maintenance needed.
National Park Service:								
Glen Canyon National Recreation Area	57	Hite Marina and Campground------	1/1-12/31 (365 days)	30	72,400	--	660	Extreme spring/summer/fall use, fair condition.
	56	Bullfrog Campground and Marina--	1/1-12/31 (365 days)	430	121,300	242,600	77	Heavy spring/fall use, good condition.
Capitol Reef National Park	47	Capitol Reef Campground---------	1/1-12/31 (365 days)	265	30,537	35,600	18	Heavy summer use, good condition.
	46	Capitol Reef Picnic Area--------	1/1-12/31 (365 days)	100	100,000	8,340	23	Heavy summer use, good condition.
	70	Capitol Reef Visitor Center-----	1/1-12/31 (365 days)	NA	NA	NA	NA	Heavy use, good condition.
Arches National Park	66	Devils Garden Campground--------	1/1-12/31 (365 days)	270	37,900	NA	26	Moderate use, good condition.
	65	Devils Garden Picnic Area-------	1/1-12/31 (365 days)	85	NA	NA	NA	Moderate use, good condition.
	64	Balanced Rock Picnic Area-------	1/1-12/31 (365 days)	15	1,000	NA	18	Light to moderate use, fair condition.
Canyonlands National Park	61	Green River Overlook------------	1/1-12/31 (365 days)	NA	NA	NA	NA	Moderate use.
	60	Grandview Point Picnic Site-----	1/1-12/31 (365 days)	30	NA	NA	NA	Light to moderate use, good condition.
	59	Upheaval Dome Picnic Site-------	1/1-12/31 (365 days)	25	NA	NA	NA	Light to moderate use, good condition.
State of Utah (Division of Parks and Recreation):								
	22	Huntington Lake State Beach-----	4/15-11/30 (229 days)	500	104,180	Visitor	10	Good condition.
	27	Millsite Lake State Beach-------	6/1-9/15 (107 days)	--	19,140	days use	NA	No developed facilities.
	67	Green River State Recreation Area-------------------------	1/1-12/31 (365 days)	250	115,980	figures	127	Heavy use, good condition.
	52	Goblin Valley State Reserve-----	1/1-12/31 (365 days)	50	18,020	not	100	Good condition.
	69	Deadhorse Point State Park------	1/1-12/31 (365 days)	120	129,230	calculated	295	Good condition.
	34	Palisade Lake State Recreation Area---------------	5/1-10/30 (184 days)	150	36,490	for	130	New development.
	20	Yuba Lake State Recreation Area-	1/1-12/31 (365 days)	120	86,500	State	198	Good condition.
	68	Otter Creek Lake State Beach----	6/1-11/30 (183 days)	180	25,470	facilities	77	Good condition.
	11	Scofield Lake State Recreation Area---------------	6/1-10/15 (137 days)	360	38,570		78	Good condition.
	63	Deadhorse Point Visitor Center--	1/1-12/31 (365 days)	([6])	([6])		--	Good condition.
	62	Deadhorse Interpretative Museum-	1/1-12/31 (365 days)	([6])	([6])		--	Good condition.

[1] Theoretical developed capacity of developed site, expressed in the number of people the site can accomodate.
[2] Recreation Visit - one person visiting the site (no time element calculated or involved).
[3] Recreation Visitor Day Use - an aggregate of 12 hours by one or more persons.
[4] Use as a percent of capacity is based on the managed season of use (length of season multiplied by the PAOT. Well managed sites generally receive betweem 20 and 40 percent use. Beyond 40 percent, sites deteriorate rapidly, require heavy maintenance, and user experience levels diminish from overcrowding (i.e. loss of privacy and solitude, increase in noise, disturbances, etc.).
[5] NA - not available or not applicable.
[6] Included in total for Deadhorse Point State Park.

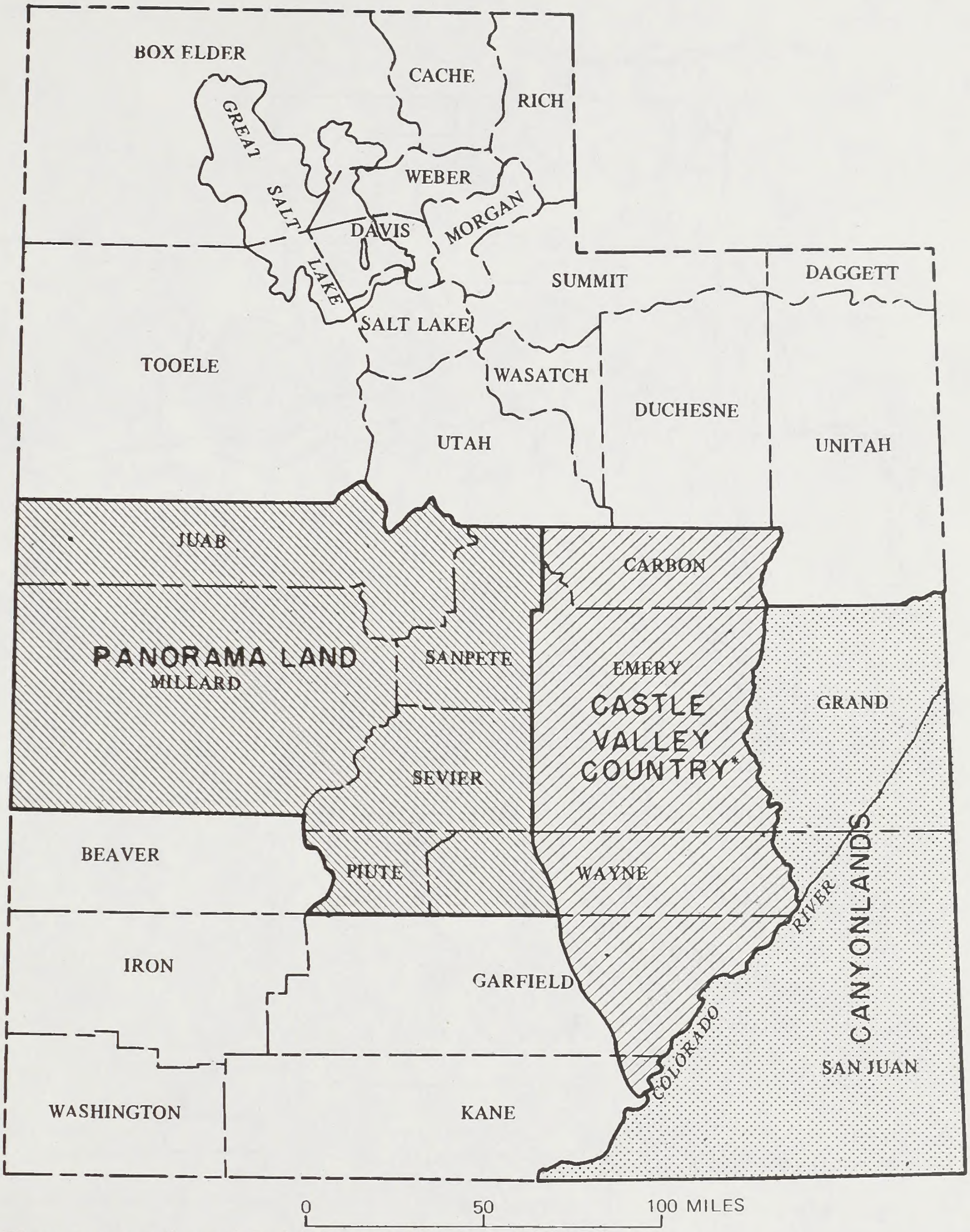
Figures presented in table IV-25 for Panoramaland, especially non-resident visits, are considered high. Panoramaland (fig. II-24) is served by two major interstate highways (I-70 and I-15) and by several other high standard Federal and State highway systems. Accordingly, the number of tourists travelling through this subregion is extremely high. The subregion, however, is void of national recreation- user attractions. Regional and local attractions are numerous, but the majority of recreation visitors are local residents. Studies indicate that non-residents spend less time and money and visit fewer user attractions in Panoramaland per visitation in this subregion multi-county area than in any other in the State of Utah.

7. ARCHEOLOGIC AND HISTORIC VALUES

Under contract with the USGS, the Archeological-Environmental Research Corporation (AERC) collected data that provides the basis for this and subsequent sections dealing with archeology and history (AERC, 1977). The contract area covered ten BLM and three USFS planning units which encompass the entire Central Utah coal region and some areas outside of the region (fig. II-25). Part of the AERC work involved a literature and archival search for records of previously documented archeological and historic sites. This class I survey resulted in a narrative overview of the history and prehistory of the region. Additionally, an intensive field survey of approximately 1 percent of the federally controlled lands in the region was completed. This class II survey was a complete survey of randomly selected 160-acre quarter sections. Basic results of the AERC surveys give numbers of sites and site densities by planning unit (table II-45 and fig. II-26).

The prehistory of the region spans 12,000-14,000 years. Several distinct archeologically defined cultures or cultural periods are represented. Briefly, these are: The Paleo Indians (big game hunters-ca. 12,000 B.C. to ca. 5,000 B.C.), Desert Archaic (hunters/gatherers-ca. 6,000 B.C. to ca. A.D. 1), Fremont-Kayenta Anasazi (sedentary agriculturistic-ca. A.D. 700 to ca. A.D. 1250), Ute-Southern Paiute (hunters/gatherers ca. A.D. 1100 to the historic period). A detailed discussion of these groups may be found in the AERC class I survey report.

A variety of archeological site types were identified by the AERC study. Table II-46 presents a correlation of site types with cultural groups or periods. The AERC report also contains a number of tables correlating site types with various geological, geomorphological and environmental factors and variables. Three particularly germane points can be abstracted from these: (1) the most common type of site in the region is the "lithic scatter", a type that has not been dealt with seriously in previous research archeology in the region; (2) a large number of sites could not be assigned to a particular time or culture, which in part points out the lack of a full understanding of the pre-history of the region; and (3) archeological sites are not randomly located--certain conditions tend to cluster sites and (or) types of sites.



*Those portions of Kane and Garfield Counties shown in Castle Valley Country are actually in the Color Country multi-county subregion. Visits, uses, etc. are more closely aligned with Castle Valley Country populations and use.

Figure II-24.--Map showing multi-county recreation subregions for the central Utah coal region.

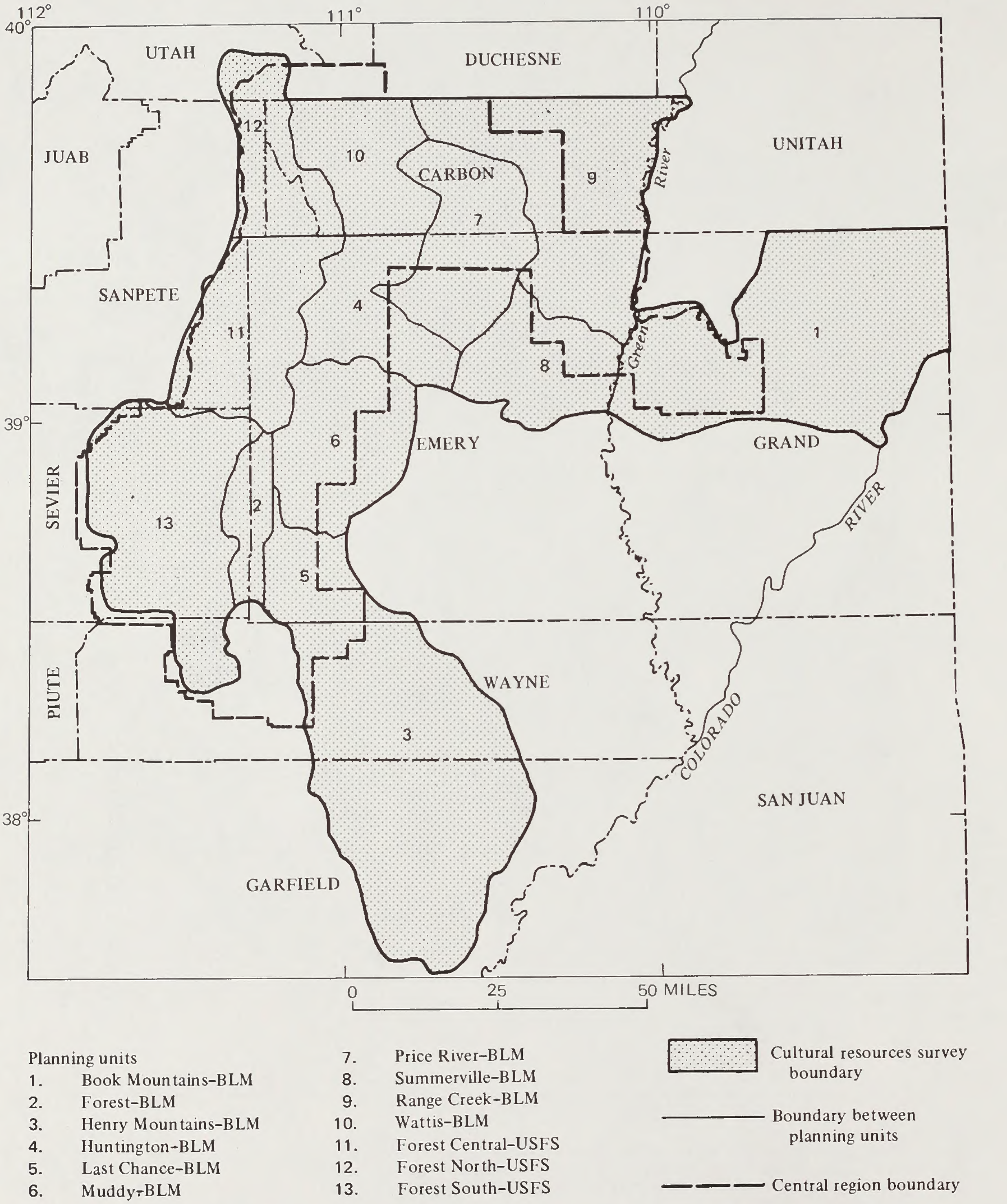


Figure II-25.--Map of central Utah coal region showing cultural resources survey area.

Table II-45.--Class I and Class II[1] archeologic and historic sites and densities by land use planning units

Planning units	General sample area totals		Sites by planning unit				Sample area comparisons			
	Total	Total without sites	Previously recorded Class I	Newly recorded Class II	Totals	Site density[3] Class II	With sites Class II	Site density[4] Class II	Percentage of planning unit area[5] Class II	Density ranking[6] Class II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Book Mountain----	47	38	40	26	66	0.55	9	2.8	.19	ML
Forest-----------	5	2	306	25	331	5.00	3	8.3	.60	H
Henry Mountains--	64	31	377	121	498	1.87	33	3.6	.51	ML
Huntington-------	10	7	25	7	32	0.70	3	2.3	.30	ML
Last Chance------	10	6	41	8	49	0.80	4	2.0	.40	L
Muddy[2]-----------	22	15	289	51	340	2.36	7	7.4	.38	MH
Price River[2]-----	18	9	14	52	66	2.88	9	5.7	.50	M
Range Creek------	29	24	149	8	157	.27	5	1.6	.17	L
Summerville------	15	7	18	19	37	1.26	8	2.3	.53	ML
Wattis[2]----------	8	7	40	1	41	.12	1	1.0	.12	L
Forest Central---	38	25	61	40	101	1.15	13	3.0	.34	ML
Forest North-----	19	18	28	2	30	.10	1	2.0	.05	L
Forest South[2]----	27	18	363	41	404	1.51	9	4.5	.33	M
Total----------	312	207	1,751	401	2,152	--	105	--	.33	--
Mean density---	--	--	--	--	--	1.42	--	3.5	--	--

[1] Class I = the existing site records of the entire planning unit; Class II = AERC survey selected quarter sections of a one percent sample area.

[2] These Class II totals reflect one historic site in each unit, with two in Book Mountain.

[3] Average number of Class II sites per sample area by planning unit (column 4 divided by column 1).

[4] Average number of Class II sites per sample area with sites (column 4 divided by column 7).

[5] This figure represents the percentage of quarter sections that probably contain at least one site in each planning unit (column 7 divided by column 1).

[6] This figure is a ranking based upon the density ratings in column 8.

Key: L = 0 to 2 (low)
ML = 2.1 to 4 (moderately low)
M = 4.1 to 6 (medium)
MH - 6.1 to 8 (moderately high)
H = 8.1 to 10 (high)

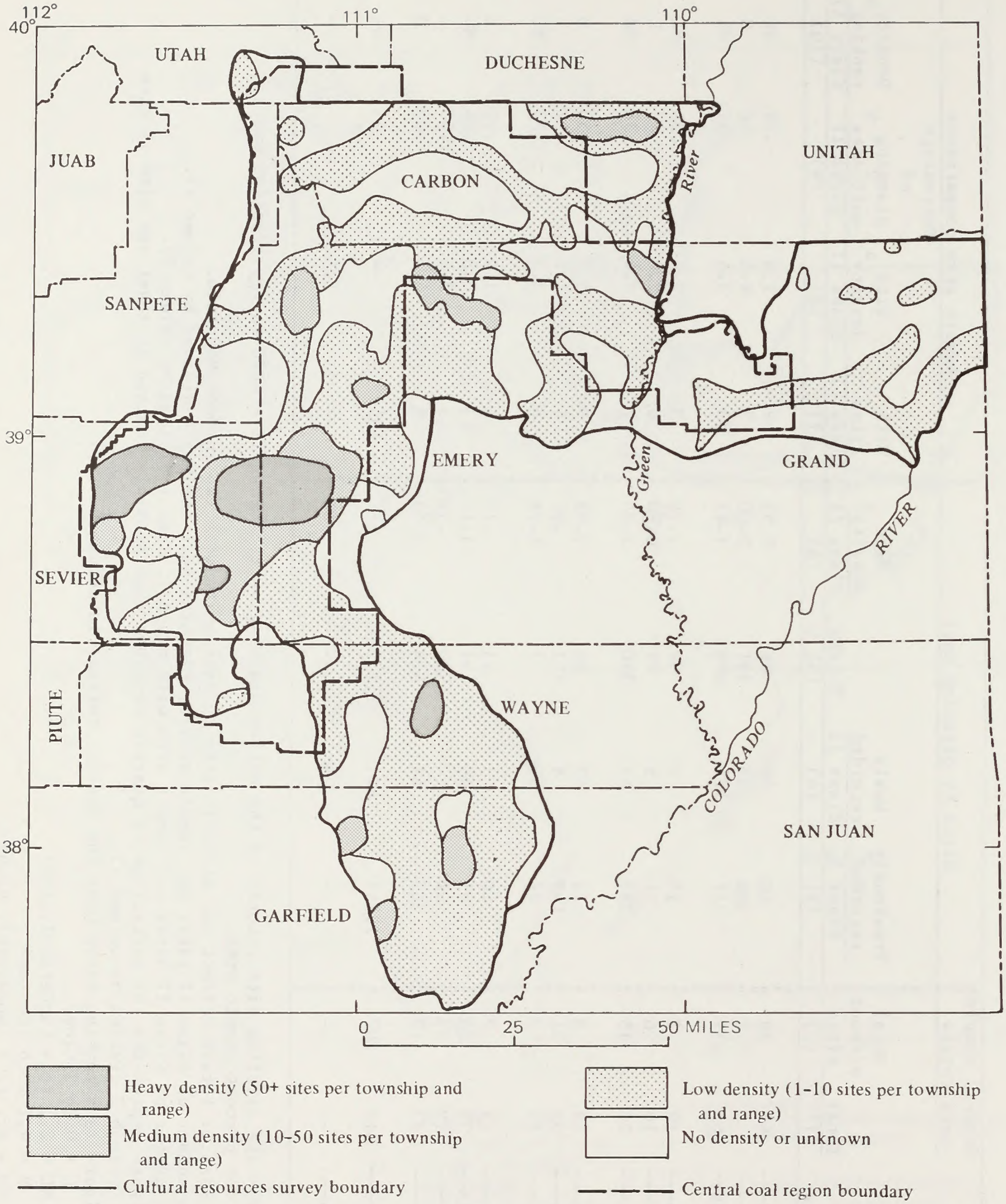


Figure II-26.--Map of the central Utah coal region showing cultural resource density sites. Based on AERC Class I and Class II survey, 1977.

Table II-46.--Occurrence of archeologic and historic sites[1] by cultural affiliation and site type

Cultural affiliation	Lithic scatter	Hunting	Kill/ butchering	Quarry	Camp temporary	Camp extended	Habitat single	Habitat multiple
Unknown	229	6	5	29	23	2	4	
Paleo Indian	--	--	--	--	--	--	--	--
Archaic	10	5	4	1	3	--	--	--
Early	2	--	--	--	--	--	--	--
Middle	--	--	--	1	--	--	--	--
Late	2/6	--	1	1	1	1	--	--
Fremont	3/4	--	1	1	1	--	--	--
Parowan	--	--	--	--	--	--	--	--
Sevier	--	--	--	--	1/1	1	--	--
San Rafael	1	--	--	--	8	10	1	--
Anasazi - PI	--	--	--	--	--	--	--	--
BMII	--	--	--	--	--	--	--	--
San Juan	--	--	--	--	--	--	--	--
Kayenta	--	--	--	--	--	--	--	--
Numic	2	--	--	--	1	--	--	--
Euro-American historic	1	--	--	--	1	--	1	--

Cultural affiliation	Rock art	Burial	Ceremonial	Rock shelter	Mine	Cabin	Sawmill	Kiln	Other
Unknown	--		1	8					1
Paleo Indian	--	--	--	--	--	--	--	--	--
Archaic	--	--	--	1	--	--	--	--	--
Early	--	--	--	--	--	--	--	--	--
Middle	--	--	--	--	--	--	--	--	--
Late	--	--	--	3	--	--	--	--	--
Fremont	--	--	--	1	--	--	--	--	--
Parowan	--	--	--	--	--	--	--	--	--
Sevier	--	--	--	--	--	--	--	--	--
San Rafael	--	--	--	1/7	--	--	--	--	--
Anasazi - PI	--	--	--	--	--	--	--	--	--
BMII	--	--	--	--	--	--	--	--	--
San Juan	--	--	--	--	--	--	--	--	--
Kayenta	--	--	--	1	--	--	--	--	--
Numic	--	--							
Euro-American historic	--	--	--	--	--	1	--	--	1

[1]Probable sites/known sites.

Source: Central Coal Project of Utah, AERC, 1977.

The first documented non-indian exploration of Utah was the 1776-77 Dominguez-Escalante expedition, which did not pass through the Central coal region. The Spanish Trail(s) was established somewhat later and was used for trade with the Indians; more notoriously, it was used for Indian slave trade. Fur trappers became active in the area in the early 1800's. The well known explorers/surveyors John C. Fremont and John W. Gunnison were through the region in the early 1850's.

Very soon after their arrival in the Salt Lake Valley in 1847, the Mormons initiated exploration/colonization "missions" on a substantial scale. Initial attempts in the Central coal region met with failure, however, due mainly to the harshness and marginal agricultural potential of the area. While agrarian-based communities were finally established by the late 1870's, it was actually the discovery of vast coal resources that lead to the establishment of substantial communities and a firm economic base.

Very few historic sites were recorded by the AERC class I and II surveys, in part because many are on private land; much of the "resource" is still in use; and further, very obvious historic sites have not been documented in individual site records, which is the of record AERC mainly worked with. There are, however, a large number of sites and locales in the region that are of considerable historic interest, particularly those associated with early coal development and the unusual (for Utah) ethnic background of some of the area.

Archeological sites and some historic sites have special characteristics that make them extremely vulnerable to certain types of activities. They are localized and immovable, individually unique, nonrenewable, and located on or near the ground surface. They are very valuable to science when undisturbed, but next to valueless when badly disturbed. Further, they are of general interest to the public at large and considered as personal private playgrounds by relic collectors.

As a result, cultural resources have traditionally been highly sensitive to any form of ground disturbing activity, whether construction/development related or related to the vandalism of people who dig and collect for "recreational", acquisitional, and even profit motives. Thus, there has, to date, been a great deal of resource destroyed or damaged, both intentionally and unintentionally, to the point that sites of any size or substance that do not show some damage are almost nonexistant. While there are now better safeguards against construction/development loss, there are still few really effective checks against vandalism, and loss from this source is on-going.

The February 7, 1978, Federal Register has been reviewed along with lists provided by the Utah State Historical Society. While there are several properties in the region that are either on the National Register or have been formally nominated to the Register, there are none that will be directly impacted by coal development, as presently conceived.

There may, however, be other sites found during pre-construction surveys. They will have to be evaluated in accordance with 36 CFR 800 as part of site-specific studies.

8. ESTHETICS

The region encompasses a wide spectrum of topographic, geographic, elevational, climatic, and vegetational features. Separately and in combination these features have created a mix of landscape character ranging in scenic quality from outstanding (both unique and distinctive) to lands which provide the viewer with few if any scenic vistas of interest.

Areas with outstanding scenic quality include the majority of the forested areas on the Wasatch Plateau and Fishlake Mountains; the San Rafael Reef and San Rafael Swell; the Green and Colorado Rivers; Capitol Reef, Canyonlands and Arches National Parks, and Glen Canyon National Recreation Area. Lands adjacent to US Highway 6 between Wellington and Green River (except for some segments of the Book Cliffs, some vegetation along the Price River, and portions of the Cedar Mountain Area) have low to very little scenic quality. The majority of lands making up the region present a common visual scene throughout the area. Little dramatic change is noticeable, and viewing of the landscape character elicits little response or interest on the part of the viewer.

Coal mining and associated activities, since the discovery and initial mining of coal in the Scofield area in 1874, have modified the natural landscape character on portions of the areas on the east side of the Wasatch Plateau from Scofield Reservoir on the north to Salina Canyon on the south and the Book Cliffs area from Castle Gate on the west to Horse Canyon on the east. These same mining activities, to a lesser extent have also influenced the present landscape character in the Emery coal field to the south and east of Ferron and Emery, Utah.

The landscape characters of areas where mining has or is now taking place have all been modified to some extent, from minor impacts to significant and adverse modifications. Man-made intrusions to facilitate mining include small pick and shovel excavations, old abandoned mine workings, active, large, modern mine plant sites and workings, extensive transportation systems (roads, railroads, etc.), powerlines, telephone lines, water lines, conveyor belt systems, coal fired power-plants, and communities of varying size and architectural style adjacent to the mining operations.

The visual character of the region is best described as one of industrial coal development and activities, particularly along the east side of the Wasatch Plateau from Soldier Summit on the north to Salina Canyon on the south and extending eastward some 8 to 10 miles into Castle Valley. It also includes the south side of the Book Cliffs from Castlegate on the west to East Carbon City on the east and extending southward from the Book Cliffs to the Carbon- Emery county line on the south.

The only area under consideration for mining within the Central coal region, where extensive evidence of past mining activities is not present, is Paradise Valley where the Mountain States Resources No. 1 mine is proposed. It is located approximately 10 miles south of Fremont Junction (on I-70) within the Fishlake National Forest.

Although the natural landscape character of the areas described above has been altered by mining facilities, the modifications, except for isolated cases, do not extend into adjacent areas. The modifications for the most part are limited to those areas where scenic quality is low or, at worst, common for the region. Few intrusions of coal mining facilities extend into the areas of outstanding scenic quality described above. The few intrusions that do infringe on these areas are limited to planned roadways, and some power and telephone lines.

C. FUTURE ENVIRONMENT

The trend of the central region since 1970 has been an increase in mining and mining employment, generally replacing agriculture and inducing in-migration to the region. This trend is anticipated at least to 1990 and probably beyond, owing to an increased national demand for coal. Coal has been mined from the region for more than 100 years and the trend toward greater development would be a continuation and expansion of a long-term and dominant regional land use. Therefore, the changes expected are those of amount and location rather than of kind of activity. It seems likely that more mining will develop in the southern Wasatch Plateau part of the region than now occurs there, but in large part, this trend will be aided or slowed by Federal actions on leasing and on mining and reclamation plan approvál.

Recreation use and population in the region have increased substantially since 1970 and 1975 and the trend is expected to continue. These increases will create demand for improved highways, improved and additional recreation sites. It is not anticipated that this growth would create major social or economic problems, but some of the additional construction may be delayed (beyond the time of need) owing to lack of financing capabilities of the concerned governments.

Several powerplants are now being constructed in the region since 1970 and the Emery 3 and 4 units are now planned for completion within the next 5 years. Clearing, coal mining, direct and indirect employment, population expansion, and consumptive water use, all owing to increased power generation, will be a dominant trend in the region in the next 10 years and perhaps longer. Superimposed in this trend may be an increase in uranium mining and milling in the southern part of the region. This trend cannot be accurately quantified now, but a new uranium mill is proposed near Hanksville, Utah, and some of this new industry may change the socioeconomic environment in the southern part of the central region.

CHAPTER III: PLANNING AND ENVIRONMENTAL CONTROLS

This chapter presents the planning and environmental controls under which the proposed coal mines would be required to operate if approved.

The chapter is in four sections: (1) listing of principal planning and environmental legislation and regulations which control Federal, State, and (or) local government action with their respective applications to coal development, (2) a discussion of land use plans, controls, and constraints, (3) a summary discussion of institutional relationships, and (4) general discussion of the relationship of land use plans to the proposed action.

A. FEDERAL COAL LEASING AND MANAGEMENT ARE CARRIED OUT UNDER THE FOLLOWING LAWS, REGULATIONS, AND POLICY GUIDANCE

Two laws that provide the basic authorities for leasing the Federal minerals, including coal, are: Mineral Leasing Act (41 Stat. 437, as amended; 30 U.S.C. 181 et seq.) and Mineral Leasing Act for Acquired Lands (61 Stat. 913; 30 U.S.C. 351-359).

The law that provides the basis for resource management on public lands is the Federal Land Policy and Management Act of 1976 (90 Stat. 2743; 43 U.S.C. 1701-1771).

The laws that provide the basis for resource management on National Forest Lands are: Organic Act of June 4, 1897 (30 Stat. 34, as amended; 16 U.S.C. 473-482, 551) and Multiple Use-Sustained Yield Act of June 12, 1960 (74 Stat. 215; U.S.C. 528-531).

These laws are implemented by the Bureau of Land Management (BLM), USDA Forest Service (USFS), and the U.S. Geological Survey (USGS) under the following regulations:

Title 43 CFR Part 3041 provides procedures to ensure that adequate measures are taken during exploration or surface mining of the Federal coal (among other minerals) to avoid, minimize, or correct damages to the environment (land, water, and air) and to avoid, minimize, or correct hazards to public health and safety. This provides the basis for the technical examination.

Title 43 CFR Part 3500 provides procedures for leasing and subsequent management of Federal coal (among other minerals) deposits.

Title 43 CFR Part 2800 establishes procedures for issuing rights-of-way to private individuals and (or) companies on public lands.

Title 30 CFR Part 211 governs operations for discovery, testing, development, mining, and preparation of Federal coal under leases, licenses, and permits pursuant to 43 CFR Part 3500. The purposes of the current regulations in Part 211 (5/76) are to promote orderly and efficient operations and production practices without waste or avoidable loss of coal or other mineral-bearing formation; to encourage maximum recovery and use of coal resources; to promote operating practices which will avoid, minimize, or correct damage to the environment, including land, water, and air, and avoid, minimize, or correct hazards to public health and safety; and to obtain a proper record of all coal produced.

Surface Mining Control and Reclamation Act of 1977 regulates the surface mining of all coal deposits and is implemented by the Office of Surface Mining under the regulations in Title 30 CFR Part 700. The Act and regulations provide for:

1. Environmental performance standards for surface coal mining and reclamation operations;

2. Inspection and enforcement procedures, including the assessment of civil penalties;

3. Assistance to small operators in meeting permit application requirements;

4. Requirements and approval procedures for state programs;

5. Develop performance standards for the Federal lands program;

6. Develop the initial regulatory program to be incorporated into coal mining permits issued under state law;

7. Requirements and procedures for approval of state mining permits; and

8. Requirements for posting, release, and forfeiture of reclamation performance bonds.

In all cases, pursuant to Section 515 of SMCRA and Federal Regulation 30 CFR 715.13, coal mining operations will be required, as a minimum, to restore the lands affected to a condition capable of supporting the use which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. Mining and reclamation plans will not be approved unless the applicant has demonstrated that reclamation to the proposed post mining land use can be accomplished under the mining and reclamation plan.

1. AIR QUALITY

Applicable legislation and regulations relating to air quality include:

1. Clean Air Act, as amended in 1977;

2. National Ambient Air Quality Standards (NAAQS);

3. New Source Performance Standards (NSPS);

4. National Emissions Standards for Hazardous Air Pollutants (NESHAP);

5. Prevention of significant Air Quality Deterioration (Federal Register, June 19, 1978);

6. Fugitive Dust Policy: SIP's and New Source Review (EPA, August 1, 1177);

7. Utah Ambient Air Quality Regulations.

The Clean Air Act of 1970 specified that each State would be responsible for ensuring the air quality within its borders and for specifying the way it would be achieved and maintained.

On April 30, 1971, the EPA officially announced the primary and secondary NAAQS (National Archives, 1971). The primary standards were established to protect human health, whereas the secondary standards were established to protect the public welfare from any known or anticipated adverse effects. Standards were put into effect for suspended particulate matter, sulfur oxides, nitrogen oxides, photochemical oxidants, carbon monoxide, and hydrocarbons.

Utah Air Conservation Regulations presently in effect were promulgated September 25, 1971, and revised May 22, 1977. These regulations do not officially adopt the NAAQS, but NAAQS are enforceable in the State. Changes to the Utah regulations are presently being developed by the Air Conservation Committee and the State Air Quality Bureau.

The Clean Air Act mandated division of each State and appropriate interstate area into air quality control regions (AQCRs). The Clean Air Act Amendments of 1977 require the States to identify regions and parts of regions that do and do not meet the NAAQS by December 7, 1977, thereby determining which areas are governed by Prevention of Significant Deterioration (PSD) and nonattainment (NA) requirements, respectively. In January 1978, the State of Utah submitted to EPA its initial list of seven NA areas in Utah. The only area potentially impacted by central regional development would be Price (Carbon County).

The State of Utah was initially classified a Class II area with the exception of five national parks: Arches, Canyonlands, Capitol Reef, Bryce, and Zion, which have been classified mandatory Class I. Of these five Class I areas, only Capitol Reef National Park is located in the region (fig. II-23). At present, neither the State of Utah nor the Indian Tribal Councils has definite plans to reclassify any other areas of the State.

The 1970 Act provided authority to establish "emissions standards" for new stationary sources and for existing sources in categories for which national standards of performance has been established.

The 1977 Clean Air Act Amendments contain major revisions of the 1970 Act with respect to: (1) the announcement of a 3-hour (or less) primary standard for NO_2 unless there is "no significant evidence" that such a standard is needed to protect public health, (2) the identification of regions within individual states (air quality control regions) that do and do not meet the NAAQS which determines whether the areas are governed by prevention of significant deterioration (PSD) standards or by nonattainment (NA) requirements, (3) the strengthening of enforcement mechanisms for the PSD standards and the NA requirements, (4) the EPA which is required to promulgate PSD regulations for criteria pollutants other than TSP and SO_2 which already have such regulations, and (5) the NSPS for stationary sources.

Specific regulations needed to fulfill the requirements of these amendments are being drafted by the responsible agencies. However, neither the Federal agencies nor the states are relieved of the responsibility for meeting the requirements of the Clean Air Act Amendments of 1977.

EPA regulations require a review to determine the best available control technology where potential fugitive dust emissions are equal to or greater than 250 tons per year. Each mine operator will have to employ the best management practices for fugitive dust regardless of predicted concentrations during operation. Thus, each mining plan and the Department's approval thereof should use an appropriate combination of the following fugitive dust controls:

1. Pavement or equivalent stabilization of all haul roads used or in place for more than one year;

2. Treatment with semipermanent dust suppresant of all haul roads used or in place for less than one year or for more than two months;

3. Watering of all other roads in advance of and during use whenever sufficient unstabilized material is present to cause excessive fugitive dust;

4. Reduction of fugitive dust at all coal dumps, truck to crusher locations through use of negative pressure bag house or equivalent methods. Inclusion of conveyor and transfer point covering and spraying and the use of coal loadout silos.

2. PALEONTOLOGY

Applicable regulations include the Utah State Antiquities Act (Utah State Code Annotated Sec. 63.18.2-38). This act includes paleontology and requires that a paleontological survey shall be undertaken before mining activities begin, on State land and all provisions of the State Antiquities Act shall be complied with. In the event that paleontological resources are discovered on Federally owned lands, proper Federal authorities shall be notified and their recommendations followed.

The BLM and USGS are currently developing a memorandum of understanding relating to the protection of paleontological resources on Federal lands. Those agencies are also developing technical guidelines to define the resource, provide evaluatory criteria, and measures for protection.

When completed, the provisions of these documents will serve as a basis for management of paleontological resources and appropriate protective programs.

3. WATER QUALITY

Applicable legislation and regulations include:

1. Federal Water Pollution Control Act (FWPCA), as amended in 1972; National standards to restore and maintain the chemical, physical, and biological integrity of the Nation's waters were promulgated by the Federal Water Pollution Control Act (FWPCA), as amended in 1972;

2. Water Quality Standards for Utah, June 21, 1976--Utah water quality standards were issued under authority of Utah Code Annotated, 1953, as amended in 1967. Under Title 73, chap. 14 of the Code, the Utah Bureau of Water Quality is empowered to enforce these water-quality standards. Important prescribed standards include those which specify maximum permissible concentrations of dissolved solids, minimum permissible concentrations of dissolved oxygen, and the permissible temperatures of the waters of the State. Other important aspects of the standards are an anti-degradation policy and a stream classification system with specific criteria for numerous classes of waters. Effluent standards and limitations specifying the maximum amounts of pollution and waste which may be discharged into State waters are described.

4. CULTURAL RESOURCES

Applicable authorities include:

a. Antiquities Act of 1906 (34 Stat. 225; 16 U.S.C. 431-433);

b. Historic Sites Act of 1935 (49 Stat. 666);

c. Reservoir Salvage Act 1960 (74 Stat. 220);

d. National Historic Preservation Act of 1966 (80 Stat. 915; 16 U.S.C. 470);

e. National Environmental Policy Act of 1969 (33 Stat. 852; 42 U.S.C. 4321, et seq.);

f. Executive Order (E.O. 11593);

g. Historical and Archeological Data Preservation Act of 1974 (88 Stat. 174; 16 U.S.C. 469);

h. Federal Lands Policy and Management Act of 1976 (90 Stat. 2743);

i. Utah State Antiquities Act (Utah State Code Annotated, Sec. 63.18.2-38)--The State of Utah has an antiquities law, applicable to State lands, that is similar in scope to the Federal Act of 1906. Additionally, the various Federal agencies have specific authority to add stipulations to leases, licenses, permits, etc., such as are deemed necessary to protect the environment, including cultural resources.

The Bureau of Land Management and the State of Utah have entered into a Cooperative Agreement outlining actions and interactions that have or will be taken to insure full compliance pursuant specifically to the National Historic Preservation Act and EO 11593.

Both Federal and State antiquities acts regulate antiquities excavation and collections, and both protect historical values on public lands. They provide for fines and (or) imprisonment for violators of their provisions. The Historic Preservation Act requires that certain Federal undertakings be submitted for review by the Advisory Council on Historic Preservation. Executive Order 11593 requires all Federal agencies to cooperate with the nonfederal agencies, groups, and individuals to insure that Federal plans and programs contribute to the preservation and enhancement of nonfederally owned historic and cultural values.

No mining or rights-of-way will be approved until the surface management agency has coordinated professional cultural resource (cultural resources include archeological, architectural, and historical remains) surveys with the Utah State Historic Preservation Officer and received his written comments, and review. Additional surveys and mitigation may be necessary if surface evidence indicates further evaluation is necessary.

5. RAILROADS

The Interstate Commerce Act !49 Stat. 543, 49 U.S.C. 1(18)1 requires the prior approval from the Interstate Commerce Commission for the extension or new construction of a line of railroad or the abandonment of operation of a line of railroad. Exempted from this authority are spur, industrial tram, switching, or side tracks located wholly within one state. Commission certification is based on a balancing of the relevant economic, technical, and environmental factors.

6. MINERAL PROTECTION

Oil and gas leases are in effect for much of the area. Priorities for mining or drilling for oil and gas on public lands are established by the Conservation Division of the U.S. Geological Survey. Mining operations approaching wells or bore holes that may liberate oil, gas, water, or other fluid substances must be approved in accordance with 30 CFR 211.17 and 30 CFR 211.63. Impacts on oil and gas areas can be mitigated largely by agreements among operators where significant impact on oil well siting or pipeline location arises. In extreme instances of conflict, technology is adequate through directional drilling, drainage practice, recovery of wells lost, pipeline and flow line relocation, pillar recovery, and mining methods to adequately mitigate impacts which might arise.

7. ENDANGERED SPECIES

Applicable authorities include the Endangered Species Act of 1973 (87 Stat. 844). This Act provides protection for listed species (both flora and fauna) and their critical habitat. Prior to authorization of any significant disturbance of lands under lease or permit, the Department of the Interior will require that a survey be made to determine if listed species or their habitat may be present. If it is determined that listed species or their habitat may be present and could be affected by the proposed activities, appropriate consultation with FWS will be carried out. No activities will be authorized until consultation is completed as per 50 CFR 402 (January 4, 1978).

8. WILDLIFE AND FISHES

Applicable authorities include the Bald Eagle Protection Act of 1969 (16 U.S.C. 668-668c.). Under this law mining operations will not be permitted in any area where such activities would molest or disturb bald and (or) golden eagles and (or) their nests.

Fish and Wildlife Coordination Act (16 USC 661 et. seq.)--States that whenever waters of any stream or other body of water are controlled or modified, adequate provisions will be made for conservation and maintenance of wildlife resources and their habitat.

Migratory Bird Treaty Act (40 Stat. 755 as amended, 44 Stat. 1555) provides protection for song birds and other wild migratory birds.

B. LAND USE PLANS, CONTROLS, CONSTRAINTS

In the region, a large number of separate entities exercise land and resource use controls. The Federal sector includes the National Park Service (Capitol Reef National Park), USFS (Fishlake and Manti-La Sal National Forests), and the BLM (public lands and mineral estate under certain private lands).

Development, management, use, and control of use on Federal lands has been delegated to these agencies. Controls are effected through issuance or non-issuance of a variety of leases, permits, licenses, etc. Each authorization to use Federal lands contains provisions to control that use. Controls exercised by the Federal government for the subsurface estate are governed by the statutes authorizing the disposition and use of that estate. Foremost among these statutes is the authority for leasing coal deposits and authority to require, as a condition of such leases, an operation-management plan and a reclamation-restoration plan.

A number of State agencies base development and administrative authority over state of Utah owned lands. The State does not have a land use planning act.

Except where controls have specifically been delegated by statute to counties or municipalities, Utah retains total jurisdiction over nonpublic and privately-owned lands. Certain of these lands were conveyed to the State as part of the Act admitting Utah to the Union. This legislation granted Sections 2, 16, 32 and 36 of every township to the State for education purposes. Use and control of these lands (including mineral leasing, rights-of-way, etc.) is governed by Utah law.

Under Utah statutes, counties have authority to effect a wide variety of controls in matters not specifically reserved to the State. The authority applies only to those portions of the county that are unincorporated. A county may regulate and restrict location and use of buildings and structures, and use, condition of use, or occupancy of lands for residency, recreation, agriculture, industry, commerce, public use, and other purposes.

Local government regulations directing land development in the region include Carbon, Sevier, Sanpete, Grand, Wasatch, Wayne, and Emery County zoning ordinances, County Master Plans, and County planning documents by the Six County and Southeast Utah Association of Governments and directives from municipal and county development and planning councils. General recommendatiofs and directives permit the following actions:

(1) Mining is permissible under present zoning ordinances. Environmental stipulations for specific use authorizations may be required as well as close coordination with local officials.

(2) Ancillary facilities and mine development must meet local or county utility and service requirements.

C. INSTITUTIONAL RELATIONSHIPS

1. U.S. GEOLOGICAL SURVEY (USGS)

The Secretary of the Department of the Interior has delegated his authority to supervise exploration and mining operations on Federal coal leases to the Director, USGS. The Area Mining Supervisor, acting for the Director, reviews the mining and reclamation plans and when the plan is determined to be acceptable requests concurrence of the surface management portions from the surface managing agency responsible for the land. Under provisiofs of 30 CFR 211, he has further responsibility to supervise prospecting, exploration, testing, development, mining, coal preparation and handling, reclamation, and abandonment operations on Federal coal leases. Inspections can be made by the authorized representative of the Secretary on the basis of information indicating a violation of the Surface Mining Control and Reclamation Act of 1977 or terms of the lease and approved mining and reclamation plan. Inspections are also made on a random basis of at least one complete inspection each 6 months (30 CFR 721.11(c).

2. BUREAU OF LAND MANAGEMENT (BLM)

The BLM, in consultation with the USGS, formulates the requirements to be incorporated in the mining and reclamation plan for the protection of the surface and nonmineral resources and for reclamation obligations and standards of performance required of the lessee on public lands as specified in 30 CFR 211.40. An area of operations for each lease is established by agreement between the BLM and the USGS and includes that area of the leased lands required for development, production, and processing operations, including all related structures and facilities. The USGS is responsible for ensuring compliance on all development, mining, and processing operations conducted within the area of operations of a lease, including the enforcement of the surface protection requirements. The BLM is responsible for compliance on the lease outside the geographical area of operations. Inspections are conducted at least once annually. The BLM must concur with mining and reclamation plans before approval is granted by the USGS for commencement of mining operations. Standards and requirements upon which BLM concurrence is based are specified in 43 CFR 3041.

BLM is responsible for authorizing various ancillary facilities such as access road, powerlines, communication lines, and railroad spurs on public landswnot covered by leases. Rights-of-way are granted pursuant to Title V of the Federal Land Policy and Management Act of October 21, 1976 (P.L. 94-579, 90 Stat. 2743).

The rights-of-way would be approved subject to standard requirements for duration of the grant, right-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions applicable to the right-of-way grants. The terms and conditions applicable to the rights-of-way are those in 43 CFR 2800 plus any other specific standard requirements and terms and conditions for the right-of-way applications in the proposed actions.

Ancillary facilities on the lease area of operations which are owned by the operating company and are a normal part of the mining and reclamation plan are approved by USGS as part of the mining and reclamation plan.

3. USDA FOREST SERVICE (USFS)

The USFS, if consultation with the USGS, formulates the requirements to be incorporated in permits for the protection of the surface and nonmineral resources and for reclamation obligations and standards of performance required of the lessee as specified in 30 CFR 211.40.

The USFS must concur with mining and reclamation plans as pertains to surface management before approval is granted by the USGS for commencement of mining operations. Standards and requirements upon which USFS concurrence is based are specified in 43 CFR 3041.

The USGS is responsible for ensuring compliance on all development, mining, and processing operations conducted within the lease. Inspections are conducted at least once annually.

USFS is responsible for authorizing various ancillary facilities such as access rgads, powerlines, communication lines, and railroad spurs on National Forest lands not covered by leases. Rights-of-way are granted pursuant to Title V of the Federal Land Policy and Management Act of October 21, 1976 (P.L. 94-579, 90 Stat. 2743).

The rights-of-way would be approved subject to standard requirements for duration of the grant, right-of-way widths, fees or costs, and bonding to secure obligations imposed by the terms and conditions of the right-of-way grants.

Ancillary facilities on the lease area which are owned by the operating company and are a normal part of the mining and reclamation plan are approved by USGS as part of the mining and reclamation plan.

4. NATIONAL PARK SERVICE (NPS)

Special land use permits will be required for any crossing of NPS lands for new roads, improvement to existing roads, utility lines, water supply lines or other activity.

5. OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT (OSM)

The OSM was created to carry out the provisions of the Surface Mining and Reclamation Act of 1977 (PL 95-87) (SMCRA).

Section 523 of SMCRA requires that a Federal lands program which includes the requirements of this act be promulgated and implemented no later than August 3, 1978. Until the Federal lands program is implemented, the initial regulations as required in section 502 of SMCRA and published in final form (30 CFR 715 and 716) in the December 13, 1977, Federal Register will apply, as modified to all Federal coal leases. These regulations will be modified under the authority of section 523(c) and 702(B) of this act to meet the requirements of the Federal Coal Leasing Amendments Act of 1975 (30 U.S.C. 181 st seq.) (FCLAA) and the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701-1771) (FLPMA). The basic change in the regulations is that of: (1) postmining land use used to design the reclamation plan, will be that which is found in the surface managing agency's comprehensive land use plan; (2) permanent roads, dams, powerlines, etc., to be constructed on public lands will meet the design standards of the surface managing agency; and (3) resource data collected in the process of developing the land use plan or lease stipulations will be available for use in developing the reclamation plan.

The following is a discussion of the relationship between specific requirements of the three laws and the proposed actions. The course of action described in the specific sections below serve as mitigatory measures.

<u>Alluvial valley floors west of the 100th meridian and prime farmland</u>.--Soil surveys conducted by the surface managing agency are required to inventory lands classified as alluvial valley floors and prime farmland.

Mining and reclamation plans which propose to conduct a surface coal mining operation on or adjacent to alluvial valley floors shall include baseline data and surveys as prescribed in 30 CFR 715.17 (j)(3) to establish standards which insure the preservation of the hydrologic function of these alluvial valley floors as prescribed in 30 CFR 715.17(j).

Prior to approval to mine on lands classified as prime farmlands the operator will have to provide data to demonstrate that his proposed method of reclamation will achieve, within a reasonable time, equivalent or higher devels of yield after mining as existed before mining. If approved, special soils handling and storing stipulations will be included in the mine plan.

Lands classified as unsuitable for surface coal mining.--Prior to designating lands unsuitable for mining, except those specific tracts of land described in section 522(e) of SMCRA, the surface managing agency shall prepare a statement on: (1) the potential coal resources of the area; (2) the demand for the coal resources; and (3) the impact of such a designation on the environment, the economy, and the supply of coal. This statement shall be forwarded to the Secretary of the Department of the Interior for review along with the proposal for mine and reclamation plan approval.

Archeological historical sites and endangered and (or) threatened species.--Inventories will be conducted on the impacted lands by the operator and reviewed by the surface managing agency. Stipulations necessary to protect these resources will be included in the proposed mine and reclamation plan.

Federal lessee protection.--Prior to approval of a mining and reclamation plan the surface of the public lands will be inventoried for legally installed appurtenances. Agreements with the Federal lessee will be reached or bonds will be obtained to insure the lessees investments are protected.

Reclaimability to present use.--The capability of lands to support the post mining land use will be determined where existing leases are involved, prior to approval of any mining plan. Where the determination is made that certain lands cannot be reclaimed to the post mining land use, surface mining will not be permitted on these lands.

Performance bonds.--Surety bonds are required at time of lease issuance and may be readjusted prior to approval of the reclamation plan.

Use of explosives.--The requirements of 30 CFR 715.19 will be included as a requirement of all mining and reclamation plans submitted for approval.

Water rights.--The area around the proposed mining area will be inventoried for water uses and water rights. Special requirements will be included in a mine and reclamation plan to protect the water rights of others.

Revegetation.--The species and pounds per acre of plant seed to be used in the reclamation process will be listed in the mining and reclamation plan. A complete inspection of reclamation associated procedures will be made at least once every 3 months and a partial inspection will be made at least once each month.

Public Health and Safety.--The authorized representative of OSM has the authority to enter and inspect for compliance with the initial performance standards in 30 CFR 715 and 716. He has the authority to order a cessation of mining or reclamation operations if, in the course of an inspection or investigation, he finds conditions, practices, or violations of the initial performance standards which create an imminent danger to the public health or safety or conditions or practices which can be expected to cause significant environmental harm. The mining and reclamation plans included in this statement were submitted for review prior to the promulgation of initial regulations required under Section 501-502 of the Surface Mining Control and Reclamation Act of 1977 RC 95-87. Therefore, in some cases the mining and reclamation plans may not fully reflect the requirements of the initial regulations. However, in this statement the initial regulations are being included as a modification requirement of the mining and reclamation plans. Both Geologic Survey and the Office of the Surface Mining will review the plans which will not be recommended for approval until the plans reflect the requirements of the initial regulations.

6. STATE OF UTAH

Division of Oil, Gas, and Mining.--This division and the Office of Surface Mining are preparing rules and procedures to implement the applicable initial regulations of the SMCRA.

Division of Health.--Reviews air pollution sources, culinary water sources, water treatment, and solid waste disposal areas.

Division of Lands.--Utility lines, roads, and railroads crossing state land would require easements from the division.

Division of Water Rights.--This division authorizes diversion structures, channel modifications, slurry lines, and water use.

Department of Transportation.--Relocation of highways, highway access, utility line crossings of State and Federal aid highways, and wide and heavy loads require authorization from the Department.

D. RELATIONSHIP TO LAND USE PLANS

1. BLM PLANNING

The Management Framework Plans (MFP) for Henry Mountain, Range Creek, Wattis, Huntington, Price River, Summerville, Book Mountain, Muddy, and Last Chance Planning Units include the entire Central region and were completed from 1973 to 1977.

Generally the management decisions of the MFP's allowed the following:

1. Authorize development of coal within lease areas and construction of ancillary facilities for Pacific Gas and Electric leases.

2. Management decisions do not prohibit development of B Canyon and AMCA proposals.

3. Initiate a program for revoking powersite and reclamation and water power project withdrawals along the Green, Muddy, and Dirty Devil Rivers and propose these lands for withdrawal under the wild and scenic river designation.

4. Assure all coal leases or permits provide for minimizing or avoiding environmental damages and rehabilitation of lands affected by the operations.

5. Allow for the disposal of public lands adjacent to the communities of East Carbon City and Sunnyside as they become needed for urban expansion.

6. Maintain the woodland area adjacent to Mountain States Resources in protective management to ensure watershed values.

7. Do not allow construction of a coal tipple and ancillary coal facilities on Last Chance Creek until an EAR is completed and studies show a need for the coal resource.

8. Designate no coal leasing or surface occupancy within travel influence zone of Highways I-70, U-72, and U-10 to protect the scenic and aesthetic values.

9. Specific use authorizations in support of mine development with necessary environmental stipulations would be allowed.

2. USDA FOREST SERVICE PLANNING

The USFS planning governing management in the region is included in the Ferron-Price Land Management Plan (LMP), Salina Land Use Plan (LUP), and the Loa and Fishlake Ranger District Multiple Use Plans (MUP). A draft EIS of the Ferron-Price LMP will be published in June 1978. The Salina LUP was published in July 1976. The Loa and Fishlake MUP were completed in October 1967, and February 1969, respectively.

Management directions found in these planning documents would not prohibit development on the following coal proposals: Mountain States Resources, Belina No. 2, O'Connor, McKinnon No. 1, McKinnon No. 2, and Skumpah Canyon mines.

Generally the management directions allow the following:

1. In the Salina planning unit provide close coordination with the mining industry to insure compatibility with other resources and values, with special emphasis on the protection of watershed and critical elk winter range.

2. In the entire Fishlake National Forest, require extensive transportation planning in conjunction with coal development.

3. Along Interstate Highway 70 Corridor restrict any activities which cannot meet the prescribed visual quality standards and rehabilitate impacts along the freeway on a long-term basis to blend with the surrounding visual quality standard.

3. NATIONAL PARK PLANNING

Management objectives of the Revised Statement for Management of Capitol Reef National Park 8/77, relating to coal development in the Central Region include:

Protect and preserve the environment within the natural area of Capitol Reef National Park. Permit biological, geological, and other natural processes to function with a minimum of human disturbance.

Cooperate with the USDA Forest Service, BLM, other State and Federal agencies, private organizations and interests, and members of the public in:

1. Ensuring that grazing, mining, and other land uses in the park's vicinity are conducted in a manner that minimizes adverse impacts on park resources.

2. Ensuring that regional energy development does not result in deterioration of the Park's air quality, scenic resources, or the experience of its visitors.

CHAPTER IV: IMPACT ANALYSIS

A. NATURAL ENVIRONMENT

1. LAND

Environmental impacts on land resources fall into the general categories of land surface, seismicity, paleontology, coal, other minerals, and soils. Enforcement of 30 CFR 211 regulations on mining leases and other applicable regulations and laws off-lease will substantially reduce potential impacts on land resources.

a. Land Surface

At the projected level of production from central Utah and during the life of the mines, 2,924 acres, or 8 percent of the total land that would be committed to mining, would be disturbed by mine facilities, homes and related community buildings, and by roads, railroads, and powerlines (table I-6). Land-surface disturbance comprises chiefly levelling and construction and cuts and fills. An unknown acreage might be affected by mining-induced landslides.

Subsidence.--Underground mining can cause subsidence of the land surface, where materials overlying the mine settle into the mine workings.

The total amount of surface subject to potential subsidence ranges from slightly less than 1 to 1.3 times about 33,000 acres of underground workings, or from 30,000 to 43,000 acres. This acreage is about 1 percent of the total within the central region boundaries. The probability, location, and amount of subsidence will be controlled by the U.S. Geological Survey (USGS) under 30 CFR 211 regulations. The regulations allow such enforcements as the amount and placement of support pillars, control of volume and pattern of coal or rock removal, and other measures that would reduce the potential for subsidence. Therefore, maximum vertical subsidence would occur in only a small part of the total potential subsidence area and in much of the area subsidence probably would be insignificant and unnoticeable.

Subsidence begins slowly during mining of a panel or area and becomes most prominent in the weeks or months after mining of the panel has been completed. In general, the effects are completed within 3 years following mining. Subsidence and its attendant effects can: 1) result in damage and destruction to mine workings; 2) cause permanent changes in the above-mine topography; 3) change ground water occurrence and flow; 4) disrupt surface water flow above a mine; 5) change the gradient of, damage, or destroy roads, railroad tracks, pipelines, etc., above a mine; 6) tilt, damage, or perhaps even destroy buildings and other surface installations above a mine.

The maximum vertical subsidence above the proposed mines, following Dunrud (1976), potentially could range from 50 to 90 percent of the total mined height, resulting from extracting one or more coal beds. The wide range for potential maximum subsidence is dependent on several variables, including 1) extraction amount and rate; 2) overburden thickness (topography and depth) and strength; 3) mining methods (room-and-pillar, longwall) used, and 4) geometry of mine workings. Subsidence induced by mining deeper beds would be less than from mining shallow beds. Maximum subsidence is not expected to surpass 20 feet at any of the proposed mines.

Surface expression of subsidence can include open and closed fractures or buckles in sandstone to brittle shale and sinkholes and other depressions. Fractures are known in the Colorado Plateau that are 3 feet wide at the surface and that are 950 feet deep. Most open fractures probably would range from less than an inch to several inches wide and the length and depth would rarely be more than a few feet. It is anticipated that the fractures generally would fill with soil or other debris. Subsidence might increase the potential for rockslides and rockfalls along cliffs but reasonable regulation of mining by the USGS will mitigate most of this potential impact. Effects of subsidence on coal beds that overlie mine workings would subject the beds to stress and could cause caving, thus rendering these beds unsuitable for future extraction.

Landslides.--Construction and mining near and below cliffs and canyons can increase the frequency of naturally occurring landslides. Only the proposed McKinnon 1 and 2 mines have a landslide potential which is addressed in the McKinnon No. 1 and 2 statement in part 2. Any induced landslide would probably involve less than an acre of earth material, but the cumulative effect of repeated landsliding within the same area can be much greater. Similarly, rockslides and rock falls, albeit of small and localized extent, can present hazards. Nearly all the formations of the Central Utah coal region are susceptible to downslope movement to some extent. Because of required constraints, construction and mining are expected to cause only minor impacts from reactivated and new landslides, rockslides, and rock falls.

b. Seismicity

Richter magnitudes for mining-induced earthquakes are not expected to be greater than the maximum 4.9 recorded for naturally occurring earthquakes. Mine stress releases as great as 4.5 are expected and could prove hazardous to mine workings, to potential landslide areas, and to existing poorly designed and located earth dams and foundations. The stress releases are unpredictable and the potential impact cannot be quantified. Following proper engineering practices would substantially reduce the hazard of poor location or design to future structures.

c. Paleontology

Impacts to paleontological resources would consist of losses of plant, invertebrate, and vertebrate fossil materials for scientific research, public education (interpretative programs), and to other values. Losses would result from destruction, disturbance or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism.

A beneficial impact of development would be the exposure for scientific examination and collection of fossil materials which otherwise may not have been revealed. Exposure would result from overburden clearance, exposure of rock strata, and mineral excavation.

An undetermined number of uninventoried exposed and unexposed localities would be disturbed or destroyed by mining by 1990.

All exposed fossilferous formations within the region could also be affected by increased unauthorized fossil collecting and vandalism as a result of increased regional population. The extent of this impact cannot be presently assessed due to a general lack of specific data on such activities.

d. Coal

The total commitment of coal to the proposed new mines would be about 765 million tons. Of this total about 382 million tons (table I-1) would be mined, and utilized in power production and perhaps other industrial uses. The coal would replace alternate fossil fuels currently in domestic short supply. The remaining 383 million tons would be left in the ground and be unrecoverable under present mining technology (chapter II). The total commitment of 765 million tons represents only 5.47 percent of the coal reserves of the entire Central Utah coal region (table II-4).

Underground coal mining is a dangerous business. Hazards to underground mining can include cave-ins, bumps (falls of the roof), squeezes (inward movement of the walls), flooding, and dangerous concentrations of methane gas. All can prove extremely hazardous to personnel and property, and their magnitude and frequency may be such as to require the closing of parts or all of a mine, temporarily or permanently. Permanent, or even temporary, abandonment of even parts of a mine would have the added adverse effect of limiting the anticipated production of coal. Required detailed geologic and engineering studies prior to and during mining can largely reduce the potential or occurrence of many of these hazards. Based on M.S.H.A.-supplied statistics, nine fatalities and 618 nonfatal accidents can be expected each year. (See chapter II, Coal.)

Methane may eventually escape from deep workings of closed mines via subsidence fractures or poorly sealed mine openings and leak to the surface, where it might kill nearby vegetation (Dunrud, 1976) and perhaps animals.

Coal-bed fires might cause the loss of an unknown and unquantifiable amount of coal. Fires can occur naturally, through spontaneous combustion and lightning strikes. Such fires can and do occur in abandoned, generally near-surface mine workings and they may be uncontrollable, especially where air is supplied through subsidence cracks. Coal can burn as far inward from the outcrop (lateral distance) as the equivalent thickness of overburden (vertical distance), to about a 1:1 ratio of the lateral and vertical distances (C.R. Dunrud, oral commun., Sept. 28, 1977).

e. Other Minerals

The development of gas fields in the northern half of the Wasatch Plateau coal field between 1950 and 1960 was apparently carried out without interference from mining operations in the area (fig. II-8). Further discoveries and (or) development of present fields would probably not be impacted by coal mining operations.

A major gas pipeline extends southwestward from the gas fields of the Uinta basin and crosses the northern parts of the Book Cliffs and Wasatch Plateau coal fields (fig. II-8) in areas leased for coal or nominated for leasing. Damage to the pipeline might result from surface subsidence if proper precautions were not followed in mining near the pipeline right-of-way.

Other energy and mineral resources mentioned in chapter II would not be impacted to more than a minor degree because they occur outside the coal fields or they extend only slightly into the coal fields where the coal is at the expected maximum depth limit of 3,000 feet for underground mining.

f. Soils

A total of 2,924 acres would be disturbed at the projected level of mining. In addition, expansion of existing mines and ORV use will disturb an unknown amount of soil. The most significant effect of soil disturbance is the potential to increase soil erosion and to lower productivity.

Soil erosion.--The greatest potential for soil erosion would occur when the soils are freshly disturbed and barren of vegetation, as during the construction phases. Erosion by both wind and water would result in onsite soil loss and movement of sediment. Mining and reclamation plans indicate that soils eroding from most of the disturbed sites would be trapped by sediment-retaining structures, so no significant erosion or redeposition will occur if plans are followed and regulations reasonably enforced. Wind erosion is more difficult to control and the airborne soil particles would affect air quality to some degree at all disturbed sites when the soils are dry (chapter IV, Air). If a climatic event occurs which is more severe than that for which erosion control structures are designed or if sediment control regulations are violated, erosion and redeposition could be significant at unspecified sites throughout the region.

Onsite erosion potential owing to mine-caused disturbance will increase to as much as 50 yd^3/acre/yr by water erosion and to as much as 25 yd^3/acre/yr by wind erosion on exposed soils.[1] Average rates of increased erosion on exposed soils would probably be about 2 to 4 yd^3/acre/yr from water erosion and 2 to 5 yd^3/acre/yr from wind erosion. The actual amount of soil erosion would be determined by the climatic conditions during the period of soil exposure, the length of time taken for installation of erosion control structures, and the effectiveness of the erosion control mitigations. After reclamation, many of the sites that were disturbed for mining should have erosion rates less than under the natural conditions as a result of slope modifications, installation of erosion control structures, and revegetation.

In addition to disturbance caused by mining and community development, off-road vehicle use throughout the area would increase soil erosion, displacement, and compaction. This impact can not be quantified but would be proportional to the population increase of about 40 percent (tables IV-7 and IV-8, 55,000 to about 76,000).

Soil productivity.--Impacts on soil productivity depend upon the regulations presented in Federal and State laws, and the effectiveness of implementation of reclamation plans.

Regulations presented in the Surface Mining Control and Reclamation Act of 1977 (Federal Register, Dec. 13, 1977, p. 62,681) indicate that disturbed areas will be returned to a condition capable of supporting the same uses as existed prior to mining and that the disturbed sites will be restored to at least 90 percent of original productivity after reclamation. The regulation allows no more than a 10 percent reduction in soil productivity, which is achievable.

Much concern is expressed about the probability of successful reclamation where annual precipitation is less than 12 inches per year but research shows that success is possible (Thames, 1977; Vories,

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[1]These are estimates based on the universal soil loss equation, SCS phase II system, and the wind erosion equation developed by Chepil, Woodruff, and Siddoway (Soil Conservation Service, Jan. 1976, Nov. 1977, and June 1977).

1976). Precipitation is 12 inches or less at the proposed Deadman Canyon, B Canyon, Fish Creek and Dugout Canyon, and Mountain States No. 1 mines, where a 5-year extension of the mining companies' responsibility for revegetation efforts may be necessary (beyond the 5-year period initially established by regulations in 30(CFR): 211.40(a)(13)(ii) and 43(CFR): 3041.2-2(f)(13)(ii). In Reclamation and Use of Disturbed Land in the Southwest (1977, p. xiii), J. L. Thames states; "The pessimism of just 5 years ago that surrounded the impact of mining and the prospects of reclamation in the arid environment is now yielding, thanks to a growing base of knowledge from imaginative research, to an optimism which holds that even the most fragile and refractory site disturbed by mining can be returned to productive use, perhaps even greater than that before mining." The greatest question is not whether or not a site can be reclaimed but at what level will it be reclaimed. Success in reclamation is directly related to the capital investment for that objective.

Removal and storage of topsoil for later use in reclamation is required at sites that would be occupied by mining facilities. The topsoil quality would change when stockpiled over long periods, but the amount of change can not be clearly identified or quantified. One item of primary concern, however, is the probability that there would be a loss of beneficial soil micro-organisms, such as mycorrhizae (Dr. M. Miller, Argonne National Lab., D.O.E., Oral commun., Feb. 14, 1978). Other impacts from topsoil storage would be the loss of live seed and regenerative plant parts, such as rhizomes (National Academy of Sciences, 1974, Rehabilitation Potential of Western Coal Lands, p. 51); loss of soil structure; and alterations in the soil chemistry.

About 650 acres or half of the 1,300 acres anticipated necessary for community development would lose productivity because of occupation by structures or hard surface.

2. WATER

Surface runoff may be diverted into the ground locally, because of subsidence and subsequent cracking of the material overlying the underground mines. Water that is diverted into the ground would not be lost but would recharge ground water and eventually discharge elsewhere. The quantity of water that might be diverted, if any, cannot be predicted but could not exceed the average annual runoff from the areas involved and probably would range from zero to one-fourth of the annual runoff. One-fourth of the runoff from the 30,000 to 43,000 acres that potentially may subside would be less than one percent of the total runoff from those portions of the Book Cliffs and Wasatch Plateau included in the Central Utah region.

Mining operations in or below water-saturated beds would cause local water-level declines, and change the direction and perhaps the rate of ground-water flow near the mine. Subsidence cracks could possibly drain saturated sandstone beds above the coal beds and increase recharge to lower beds. The flow of some springs might decrease, but the extent of this impact cannot be predicted. The Black Hawk Formation of the Mesaverde Group contains saturated beds that could be disrupted; however, the amount of ground water and volume of saturated sandstone that could be affected is small (fig. II-5). The upper parts of the water-bearing units in about one-half of one percent of the area in the region would be affected. As deeper saturated beds would not be affected, the mines would impact an insignificant percentage of the total saturated strata.

The chemical quality of the water is not likely to be affected by coal-mining or a changed regimen of ground-water movement through mined-out areas because, 1) the sulfur content of the coal is low, generally less than 1 percent and therefore solution would add very little sulfur to ground water, 2) the quantities of water per unit area and rates of water movement associated with the coal and the overburden material are small--average is less than 40 acre-feet per year per square mile, and 3) most of the water in the study area is highly alkaline--concentrations of bicarbonate are 100-300 mg/L--which would allow immediate buffering of acid mine water and some precipitation of sulfur contained in ground water. A recent study of mine drainage and water quality in Colorado shows essentially no coal-mine drainage problems, which is attributed mainly to the low sulfur content of western coal (Wentz, 1974).

Mine drainage may contain concentrations of trace elements, particularly arsenic, iron, manganese and selenium, slightly greater than normally found in natural streams of the area, as experienced in some coal mines in central Utah based on unpublished data from Southeastern Utah Association of Governments. However, total quantities of mine drainage associated with the new mine plans considered in this statement would be less than 1,500 acre-feet per year, and reasonable enforcement of mitigations regarding effluent standards will prevent contamination of streams and saturated sandstone beds.

Water pollution from mine facilities such as storage and loading areas, tailing ponds, waste piles, and conveyor belts will be prevented by adequate enforcement of State of Utah effluent standards and limitations.

Concentrations of suspended sediment may increase severalfold locally in portions of the Dugout, Pleasant Valley, and Salina Creek drainages, particularly if high-intensity rainfall occurs during construction, when potential erosion rates are greatest. However, this increase would be relatively insignificant in terms of sediment movement because the potential sediment source areas are very small--the worst case is Pleasant Valley Creek where four proposed mines would disturb about one-half of one percent of the watershed.

The increased population would cause an increase in waste products which could contaminate aquatic environments if proper sanitation practices are not followed; such potential contamination would be generally of local extent.

Water requirements for the proposed new mines and the resultant additional population at the projected level would total 8,000 acre-feet per year (table I-6). About 5,000 acre-feet per year would be consumed and 3,000 acre-feet per year would be discharged as sewage effluent. Water consumption could and probably would be reduced 300 acre-feet per year by paving or chemically treating haul roads that are not all ready paved. Water would be obtained by diversion from other uses, probably mainly agricultural uses. Change in use of water would not likely affect Utah's share of Colorado River water or the salinity of the Colorado River.

3. AIR

Total suspended particulates.--The central region would have little regional impact at the projected level of development (tables IV-1, IV-2, fig. II-11). About 78 percent of the total emissions would result from vehicle travel on unpaved roads. The remaining emissions would result from area sources (population growth and related activities) and the IPP powerplant proposed at Salt Wash. Considering only mine-related activities, fugitive dust would make up about 94 percent of the total suspended particulate (TSP) emissions. These emissions generally result in air quality impacts that are very localized. Most TSP emission sources at coal mines emit particulates close to the ground, and settling occurs close to the source. Impacts are reduced significantly beyond a mile (1.6 km) or less. Emissions can, however, result in significant local impacts and where likely, are described and evaluated in the individual mining and reclamation plan environmental impact statements in part 2.

Fugitive dust emissions from travel on unpaved roads can be controlled by several measures. Watering, about 50 percent efficient, is evaluated as an analysis assumption. Paving, or treatment with chemical stabilizers which approximate paving, could reduce fugitive dust emissions from watered but unpaved roads by an additional 70 percent (Environmental Research and Technology, 1978). Use of such measures would result in a cumulative central regional TSP emission reduction of 55 percent.

The level of estimated regional impacts can be put into perstive by comparing the calculated pollutant ground-level concentration with the National Ambient Air Quality Standard (NAAQS) established for protection of human health and welfare (although the regulations do not necessarily apply as discussed in chapter III). The worst case analysis of impacts at the projected level (AeroVironment, 1977) shows that the total regional ground-level concentration including an average background of 20 $\mu g/m^3$ would be well under the Federal secondary standard of 150

Table IV-1.--Regional maximum 24-hour average TSP concentrations

[< ,less than]

Modeling areas	TSP concentration (µg/m³): Calculated increased concentration[1]	Calculated average background	Total regional concentrations	NAAQS limitations[2]	Percent of standards
Book and Roan Cliffs------	30	20	50	150	33
East slope of Wasatch Plateau--	<5	20	<25	150	<17
Castle Valley-----	16	20	36	150	24
East slope of Sevier Range-----	<10	20	<30	150	<20
Salt Wash---------	<10	20	<30	150	<20

[1]These concentrations are the result of modeling of existing pollutant sources, as well as sources to be analyzed under the proposed action, but do not include a background TSP concentration which would be primarily wind-blown dust.

[2]NAAQS = National Ambient Air Quality Standards. The secondary standard is shown.

Table IV-2.--Regional annual average TSP concentrations

[< ,less than]

Modeling areas	Annual average TSP concentration (µg/m³)				
	Calculated increased concentration[1]	Calculated average background	Total regional concentrations	NAAQS limitations[2]	Percent of standards
Book and Roan Cliffs------	25	20	45	60	75
East slope of Wasatch Plateau--	< 5	20	<25	60	< 42
Castle Valley-----	11	20	31	60	52
East slope of Sevier Range-----	<10	20	<30	60	<50
Salt Wash---------	<10	20	<30	60	<50

[1]These concentrations are the result of modeling of existing pollutant sources in addition to new projected scenario sources, but do not include a background TSP concentration which would be primarily wind-blown dust.

[2]NAAQS = National Ambient Air Quality Standards. The secondary standard is shown.

μg/m^3 (table IV-1). The scenario analyzed by AeroVironment differs slightly from the projected level scenario identified in chapter I, but the results would not differ significantly. During periods of high winds, dust concentrations can exceed the Federal 24-hour standard as shown in table II-13. Incremental TSP concentrations from the mining related sources, would add to the excess caused by wind-blown dust.

During typical meteorological conditions, impacts in the central region would be lower than quantities derived from the worst case analysis resulting from increased dispersion during the 24 hours. The increased dispersion would be brought on by more normal wind speeds and more meander in the wind direction than considered in the worst case analysis. The regional 24-hour TSP impact from coal development on the class I area of Capitol Reef National Park would be less than the class I increment standard of 10 μg/m^3.

The regional annual TSP concentrations (including background) would be less than the National Ambient Air Quality Standard (NAAQS) of 60 μg/m^3 (table IV-2). The greatest impact would be near Price, in the Roan and Book Cliff areas, and would be caused by human activity and traffic on unpaved roads to the proposed new mines in the area.

The class I area of Capitol Reef National Park, south of the east slope of the Sevier Range modeling area, would be impacted by less than the 5 μg/m^3 incremental limitation.

The impacts of TSP concentrations from one sub-air basin (modeled area) to adjoining ones would be low because of mixing and fallout over the distances involved. Mining activity in the Southern Utah region would not be expected to significantly influence air quality in the Central Utah region.

<u>Sulfur dioxide and nitrogen dioxide</u>.--Coal-fired powerplants would have the most significant effect on the sulfur and nitrogen dioxide concentration in the air. Emissions from mining activities would be negligible. The proposed mining and mining related activities would not, therefore, significantly affect the existing SO_2 and NO_2 concentrations.

The projected production scenario includes the IPP powerplant, but the location is uncertain, so the SO_2 and NO_2 regional impact cannot be quantified or modeled at this time. It will be identified and quantified in a site specific environmental statement being prepared by the BLM.

<u>CO</u>.--CO emissions from coal development will not result in a significant regional impact. CO problems are generally associated with extensive highway networks around cities and as such are localized impacts. The emission amounts associated with mine development would not create a problem in the surrounding countryside because the background levels would be expected to be very low.

Visibility.--There are no guidelines at the present time to assess visibility impacts and their significance. The Clean Air Act Amendments of 1977 direct EPA to promulgate visibility regulations by August of 1979. Any consideration of visibility impacts must therefore be performed without specific guidance. The impact on atmospheric visibility could occur from a general degradation of atmospheric clarity because of particulate matter emitted from the proposed mines and their facilities. Impacts on visual range would occur near Price and in the Castle Valley (fig. I-2). The primary contributors to visibility degradation would be area sources (Price, Emery, Elmo, Cleveland, Ferron, Huntington, Orangeville, and Castle Dale), and traffic on unpaved roads. Average background visibility in the region was estimated to be about 35 miles (60 km) based on an assumed average background TSP concentration of 20 $\mu g/m^3$ (table IV-1). The worst case analysis indicates that the visual range would be reduced to 22 miles (35 km) near Price, 20 miles (32 km) along the Castle Valley, and not less than 25 miles (40 km) in the rest of the central region because calculated increased concentrations are 10 $\mu g/m^3$ or less above a background of 20 $\mu g/m^3$. The assumption of an average visual range of 35 miles based on a 20 $\mu g/m^3$ TSP may be low, based on measurements of visual range by Pueschel and all, 1978. These measurements indicated an average visual range of 54 miles (87 km) to 93 miles (150 km) depending on the time of year.

The annual average NO_2 concentration would be less than 15 $\mu g/m^3$ (even assuming all NO_x converts to NO_2), and general brown discoloration would not occur in the region. A brown atmospheric discoloration might be apparent from powerplant plumes (such as the proposed IPP plant) when very stable atmospheric conditions limit plume dispersion. Some discoloration could occur along roads as a result of fugitive dust suspension in the air from vehicle travel.

Because the annual incremental increase in TSP from mining activities would be less than 5 $\mu g/m^3$ at Capitol Reef National Park, any impairments to visibility at Capitol Reef from mining-related activities would be expected to be small. The location of the IPP powerplant is uncertain; however, if IPP were to be located at the Salt Wash site near Caineville, Utah, it would be expected to have more significant impacts to visibility in Capitol Reef National Park. Until EPA develops regulations regarding visibility in mandatory class I areas, the significance of any visibility impairment in Capitol Reef National Park cannot be determined.

4. VEGETATION

If all of the proposed mines are developed an estimated 1,624 acres of vegetation would be removed over the life of the mines (table I-6). Of the impacted acreage, most would be covered by the following vegetative types: agricultural (43 percent); Pinyon-Juniper Woodland (25 percent); and Sagebrush-Grass (18 percent). Some small areas of the Streamside, Grassland Mountain Meadow, Aspen, and Conifer-Aspen types would also be impacted (table IV-3). Mine mouth structures, roads, plantsites, coal conveyors, and powerlines would cause this loss of vegetation.

Table IV-3.--Acres of impact by vegetative types

[< ,less than]

Vegetative types	Impacted area: Acres	Impacted area: Percent of total impact	Total in region	Percent of total type impacted
Agricultural-----	650	22	46,080	1
Streamside-------	13	--	[1]2,450	<1
Grassland--------	220	7	225,280	<1
Sagebrush-Grass--	1,178	40	284,160	<1
Pinyon-Juniper---	700	24	1,034,240	<1
Mtn. Meadow------	20	1	[1]2,200	<1
Aspen -----------	58	2	540,160	<1
Conifer-Aspen----	85	3	243,200	<1
Total---------	2,924	100	2,377,770	<1

[1]Acreages estimated.

About 1,300 acres of vegetation would be lost owing to urban development. Additional acres would be damaged by the large influx of people pursuing their business or recreational activities in the area. The location and amount of area that might be impacted by these offsite activities cannot be evaluated.

Some areas of thin soils and low precipitation would be difficult to revegetate (Aldon, 1977). However, once established, new vegetation will produce more than the present vegetation. Some undesirable vegetation will invade disturbed sites and improperly reclaimed areas but the amount cannot be quantified.

The mitigations listed in chapter III should prevent any impacts on threatened or endangered plants from the direct activities associated with coal production. However, there may be some inadvertent impacts (loss of individual plants) caused by urban development and activities of the increased population. The distribution and density of growth of these plants is not well enough known in the areas of potential impact to allow better quantification of the probable impact.

The Endangered Species Act of 1973 requires that all Federal departments and agencies shall protect such species. Some steps which will be taken are 1) all lands planned to be disturbed by coal mining operation will be intensively surveyed to determine whether threatened and endangered plants are present; 2) distribution of threatened and endangered plants will be plotted on maps of proposed disturbed area; 3) size of construction activities will be limited to the minimum; 4) critical plants and habitats will be avoided in all construction and operation activities.

The impact to vegetation is not very significant when compared to the total 3 million acres of the region. Further, proper reclamation would increase the vegetative productivity of altered sites by about 40 percent overall.

5. WILDLIFE

General impacts.--A total of 2,924 acres of wildlife habitat would be disturbed by coal mining at the projected level of production. After completion of mining, urbanized areas would probably remain, and 1,300 acres of wildlife habitat would be permanently lost.

The projected population increase attributable to coal mining in the region would result in increased disturbance of wildlife in more areas of their habitat. Formerly remote, undeveloped areas would be irretrievably committed to a more developed character including increased human visitation. Hunting, fishing, hiking, camping, and ORV use would cause direct losses of wildlife and displacement of some species from heavily used areas. Disturbance during nesting, calving, and fawning periods would cause lowered productivity and abandonment of eggs and young. The extent of this impact cannot be quantified. The demand for recreational lots and cabins would increase, and based on current usage, these developments would therefore, cause an additional loss or abandonment of 70 to 300 acres of wildlife habitat. These sites probably would be on private lands in forested mountain areas within the region. This habitat, and the reduced use of habitat owing to disturbance from these developments, would be irreversibly lost. Species that would be affected include deer, elk, bear, and cougar. Animals displaced could be lost as they would move into areas already supporting populations in balance with their habitat.

The increased population would cause added demands for hunting and other recreational pursuits related to wildlife (see recreation section). Legal hunting activities and harvest would be regulated by appropriate regulations and bag limits, but illegal activities and harvest would increase. The amount of increase cannot be predicted, but available data indicate an upward trend (table IV-4). During 1975, 73 percent of wildlife citations issued by UDWR in their Southeastern Region were for violations that directly reduced wildlife populations. The illegal taking of protected species could have a significant impact on: survival of the moose herd on the Wasatch Plateau; establishment of desert bighorn sheep populations on the Book Cliffs, San Rafael Swell, and Green River--Elliot Mountain areas (fig. I-2); establishment of an antelope herd in Clark Valley, near Price; and loss of transient populations of the endangered bald eagle and peregrine falcon.

Construction of new utility lines in the area would provide additional perching and hunting sites for raptors and other birds. This would be a beneficial impact; however, use of these structures along roadsides or in areas open to significant human access would expose the birds to illegal shooting and disturbance. The UDWR records of reported raptor mortality during 1974-1976 indicate shooting was the most common cause of death for all raptors. According to U.S. Fish and Wildlife Service records for 1973 to 1976, death by shooting was the second most common cause of death for bald and golden eagles in the state. Studies in Utah found a significant increase in raptor mortality due to shooting along utility lines paralleled by a road (Ellis and others, 1969). The extent of losses from this activity cannot be quantified, but any loss would be significant if it included birds of national interest. The endangered black-footed ferret may be present in the foothills south of the Book Cliffs. All mining development in the area will not be permitted to cause loss of this species. If any of the animals are present, illegal killing could be significant but is not quantifiable.

The new utility lines would also create an additional flight hazard for all bird species (Stahlecker, 1975; Weir, 1976), and an unknown number of birds would be killed. If birds such as the peregrine falcon or bald eagle, which are limited in number (fig. II-17), are killed, the loss would be significant. This hazard would be an addition to the numerous natural and man-made hazards already present in the area.

Construction and utilization of new roads and increased traffic on existing roads in the area would cause an increase in wildlife highway mortality. According to UDWR records of reported raptor mortality in the State during 1974 to 1976, highway mortality was the second most common cause of death. Studies indicate highway wildlife mortality is directly proportionate to the speed of traffic, traffic density, and

Table IV-4.--Wildlife citations issued in relation to population in Carbon and Emery Counties

[Source: Southeastern Region Office, Utah Division of Wildlife Resources]

Year	Citations	Population		
		Carbon	Emery	Total
1972-----	137	16,500	5,200	21,700
1973-----	152	17,000	6,100	23,100
1974-----	238	17,000	6,200	23,200
1975-----	425	18,500	6,700	25,200
1976-----	454	19,400	8,300	27,700
1977-----	459	20,500	9,300	29,800

adjacent wildlife populations (McClure, 1951; Oxley and others, 1974). Data are not available on present highway mortality, except for big game animals and raptors; therefore, the loss that would occur cannot be quantified for other species. Part of the increased loss would be directly related to coal production, i.e., truck haulage and commuting miners. The balance of the increased loss would be attributable to the increased population associated with the proposed mining. Species most susceptible to highway mortality include:

Deer	American kestrel
Cottontail rabbit	Rough-legged hawk
Jack rabbit	Golden eagle
Skunk	Short-eared owl
Porcupine	Great horned owl
Mice	Burrowing owl
Ground squirrel	Common nighthawk
Pheasant	Mourning dove

Surface expressions of subsidence such as cracks, bulges, and displacements are not expected to directly affect wildlife, but any reduction or elimination of surface-water flows due to subsidence would adversely affect some species. Loss of water sources would result in reduced utilization of habitat by mobile species such as deer, elk, beaver and birds, and elimination of species such as small mammals, reptiles, and amphibians that are unable to relocate to areas where water is available. Because of lack of data on population densities and distribution, and the unpredictability of subsidence and its effects, the number of animals that would be affected cannot be quantified.

Specific impacts.--Impacts on deer from the projected level of mining would be loss of habitat due to occupation by structures or other facilities and displacement from habitat or reduced use due to disturbance associated with coal production (table IV-5). The lost carrying capacity represents only the loss of sufficient habitat to support 260 deer annually. The actual number of deer that may be lost would be dependent upon the relationship of deer population levels to the remaining carrying capacity. This impact would continue for the life of the mines.

The increased traffic in the region, attributable to the projected level of coal production, would increase the highway mortality of deer. Principal areas of deer and elk highway mortality include I-70, Salina Canyon; US 50 and Spanish Fork Canyon; and U 31, Huntington Canyon. Based on the present rate of highway mortality for this area, the deer kill in 1990 would increase by 95 deer annually. About 52 percent of deer killed would be mature does. The total deer highway mortality by 1990 (present level plus projected increase) would be 205 deer. This figure represents 2 percent of the average annual harvest in the region during the ten-year period, 1967-1976.

The cumulative impacts on elk from the projected level of coal mining in the region would be occupation of 353 acres of elk habitat,

Table IV-5.--Impacts on mule deer winter range

Proposed mine	Acres affected		Potential carrying capacity lost annually[3]	Potential fawn production lost annually[4]
	Occupied[1]	Reduced use		
1. Deadman Canyon	198	1,472	80	39
2. Skumpah Canyon	64	566	47	28
3. Mtn. States Mine No. 1	77	1,380	47	25
4. Fish Creek-Dugout Canyon	837	3,148	42	20
5. McKinnon No. 1 / 6. McKinnon No. 2	[2](69)	[2](436)	--	--
7. B Canyon	228	690	44	21
8. Belina No. 2 / 9. O'Connor	[2](22)	[2](782)	--	--
Total[5]	1,404	7,256	260	133

[1]50 percent reduction in use within 1/10 mile of disturbance perimeter.
[2]Summer range only, no data on carrying capacity.
[3]UDWR estimates of carrying capacity (personal correspondence, L. Wilson, Regional Supervisor (UDWR), 1977).
[4]Utah Big Game Investigations and Management Recommendations (UDWR, 1977).
[5]Does not include summer range.

and reduced use on approximately 9,400 acres due to disturbances related to the proposed mining. The area of reduced use would probably be greater than this total because of overlapping disturbance zones and the proximity of proposed mines to existing mines, other proposed mines, and other human developments in the region. The extent of this larger area of reduced use cannot be predicted, but it would further reduce the elk carrying capacity in areas affected. These impacts would continue for the life of the mines. Elk highway mortality would be expected to increase as traffic in the region increases. Three elk were killed in the region during the winter of 1976-77.

Encroachment on mountain lion and black bear home ranges, illegal killing, and loss of prey species such as deer and elk would reduce lion and bear populations by an unknown amount. The increased development and widespread human disturbance would cause abandonment of some home areas and a reduction size or use of others. The result would be a reduced carrying capacity for lion and bear in the region. These impacts would continue for the life of the mines.

Loss of 1,300 acres of habitat due to urbanization associated with the projected level of coal mining in the region would reduce mourning dove and cottontail rabbit populations. The amount of this reduction cannot be quantified. Homes would remain after the life of the mines; therefore, this would be an irreversible commitment of habitat.

A total of approximately 650 acres of pheasant habitat on irrigated agricultural lands would be committed to urbanization associated with increased coal production in the region. Loss of this habitat would result in a yearly reduction of 88 cocks harvested, 118 hunter days, 196 breeding hens, and their annual production of 717 young.

6. FISHERIES

In this analysis, it is assumed that all surface water in the region is parceled out for some beneficial use and that no more water allocations can be made from streams. Instream flows for fish is not a legally recognized beneficial use of water under Utah laws.

Seven trace elements found in coal known to be hazardous to aquatic life have been found in the Price River in amounts exceeding recommended limits (table II-10). New coal mines and increased coal use in the region might possibly increase the frequency of occurrence and the amounts of these in pollutants in the Price River. However, this occurrence is not likely under reasonable enforcement of applicable laws and regulations relative to the proposed mines and future proposed uses. The lower Price River is not a significant gamefish stream; however, it is a tributary to the Green River which is the limited habitat of the endangered Colorado squawfish, humpback chub and the rare bonytail chub and razorback sucker.

If mining regulations and State laws are not reasonably enforced, coal mining in the Salina Creek drainage could add trace element pollution to Salina Creek and possibly to the Sevier River.

No fish habitat pollution from trace elements would be expected from mining coal in the Emery coal field.

Mining coal at the projected level might cause siltation in fish habitat. Some sediment, including soil materials eroded from exposed areas or coal spilled from trucks or originating from sloppy housekeeping around coal transfer sites, would come from non-point sources, making them difficult to control.

Sediment carried with normal runoff from around the existing and proposed mines on the Wasatch Plateau could adversely affect fish habitat in Pleasant Valley Creek, several of its tributaries, and Scofield Reservoir. Cutthroat spawning, nursery and food production areas in these streams would be affected while food production would probably be decreased in Scofield Reservoir. Fish habitat in lower Salina Creek has already been badly abused by development, albeit trout still persist. Normal runoff would be expected to increase sediment loads in Salina Creek below the mines, adding to an already bad situation. No sediment impacts to fish habitat would be expected from the proposed mines in the Book Cliffs or Emery coal fields.

A recent water quality study under the 208 program concluded that coal mining did not contribute significantly to dissolved solid concentrations in waters surrounding the mines in southeastern Utah (Southeastern Utah Association of Governments, 1977). Because the existing mines in that area are underground mines, and all the proposed new mines would be underground mines, it probably could be concluded that no adverse effects would occur to fish habitat because of added dissolved solids at the projected coal-mining level.

New domestic water needs might be satisfied by converting agricultural water rights to domestic water rights. This change in water use would not affect the amount of water taken out of a stream, but it could alter the point of diversion. If diversions are moved upstream it would adversely affect fish habitat; if they are moved downstream it may increase fish habitat; and if they continue using existing diversions it may cause no change in the fish habitat.

It has been assumed 50 percent of the domestic water would be returned to the streams as sewage effluent, thereby increasing downstream flows. This added flow probably would not benefit fishes because the "new" unallocated water would be available for reappropriation for other beneficial uses which does not include instream flows for fishes.

Municipal sewage treatment plants frequently release effluents with un-ionized ammonia and free chlorine where sewage is inadequately treated. Both are highly toxic to aquatic organisms.

More people would increase the demand for fish resources, particularily trout. In 1975 about 31 percent of all Utahn's fished, including about 17,000 residents in the coal region (USFWS, 1977). At the projected level, the number of resident Utah fishermen would increase by 62 percent, to around 27,500. Fishing in Utah traditionally means fishing for trout. This fact is evidenced by a 1975 survey of fishermen that found nearly 6.5 times more man-days were spent fishing for trout than for warm water varieties (USFWS, 1977).

Trout fishing in central Utah is limited to a few small streams and reservoirs, seven larger reservoirs (100 surface acres or more), and Fish Lake. Fishermens' take in some of these waters may now be equal to managements capability to produce catchable fish. There is little opportunity to expand the fishery program to meet the needs of more fishermen. A rise in fishing pressure would cause more waters to be considered "fished out", i.e., in more places the average catch rate would fall below 0.5 fish per hour, the point at which fishermen begin to stop fishing or go to other places. The trout in Fish Lake would be especially hard hit as more immature fish would be caught before spawning.

B. CULTURAL ENVIRONMENT AND LAND USE

1. LANDS

The population growth anticipated by 1990 at the projected level would require about 1,300 acres of land for community use. It is expected that one-half of this settlement, or about 650 acres, would be on presently-irrigated agricultural lands. This is slightly more than 1 percent of the region's irrigated cropland in tillage rotation (table IV-3).

The proposed new coal mines and transportation routes do not intrude directly onto wilderness or roadless areas of the National Forest System or National Parks. A complete analysis of direct impacts on roadless areas on public lands is not possible because of 1) the conceptual nature of much of the utility and transportation systems, and 2) the incomplete status of a roadless inventory program for the purpose of formulating guidelines for identifying the size, location, and characteristics of areas having roadless and wilderness values.

All existing and potential roadless and wilderness areas would be subject, however, to the indirect impact of more intensive use by the increased population at the projected level of coal development. This usage would tend to degrade the natural characteristics of these areas. On a regional basis, the impact is not expected to be significant.

2. AGRICULTURE, RANGE, AND TIMBER

About 650 acres, or an insignificant portion of the region's irrigated cropland in tillage rotation, might be removed from production for community use (table IV-3). If the 5,900 acre-feet of additional community water supply were obtained by purchase from local existing agricultural water rights, a total of about 800 acres, or 150 acres more, would be removed from production. This calculation assumes an average agricultural water application of 3.6 acre-feet per acre and agricultural reuse of the estimated 3,000 acre-feet per year of sewage effluent from the enlarged communities.

About 1,600 acres used for mine facilities would be recovered through revegetation, but 1,300 acres for community development would not (table I-6). The maximum grazing capacity lost, if no lands were revegetated, would be about 15,900 AUM's over the life of the projects, or enough forage to feed 43 cows each year (table IV-6). These figures include land of all ownership.

Construction of the various facilities would block some stock water sources. Roads and facilities would disrupt normal livestock grazing and watering patterns. This impact is locally moderate to insignificant, and these same roads would aid in hauling water for the livestock. A non-quantifiable increase in rustling of livestock would occur with increase of population.

Some minor amounts of woodland products such as corral poles, fenceposts, mine timbers, pinyon nuts, and Christmas trees would be lost. Also, the potential production of these areas would be lost for duration of the various projects.

Approximately 32 acres of sawtimber growing areas would be lost over the life of the projected development. This represents a harvestable volume of sawtimber of 155 million board feet (mbf), most of which would be salvaged ahead of construction.

The range and agricultural impacts would be important and possibly critical on a local basis (to the affected individuals), but they would be minor on a regional basis.

3. SOCIOECONOMICS

a. Economic and Demographic Impacts

Carbon, Emery, Sevier, Sanpete, and Wayne Counties will bear the direct socioeconomic impacts of expanded central Utah coal production as projected at 24 mty. Some impact will accrue also to Piute County, because of its proximity and economic interdependence with Sanpete and Sevier Counties. The counties differ in many economic respects. Their future economic problems and opportunities will be in agriculture, coal mining, travel and tourism, manufacturing, and construction. Assumptions concerning growth or decline in these employment sectors are the basis of the socioeconomic analyses in this statement.

Table IV-6.--Grazing capacity lost--projected level

Project	AUM's per year[1]	Years	Total	Percentage of total
	Range impacts			
B Canyon------------	25	25	625	4
Belina #2-O'Connor--	4	18	72	--
Deadman Canyon------	14	30	420	3
McKinnon 1 & 2------	12	20	240	2
Last Chance Cr. #1--	3	22	66	--
Fish Creek & Dugout Canyon------	63	40	2,520	16
Skumpah Canyon------	5	45	225	1
Subtotal----------	126	--	4,168	26
Community development--------	390	[2]30	11,700	74
Total------------	516	--	15,868	100

[1] AUM explained in glossary.
[2] Projected only to 1990, this impact will likely continue longer.

Expansion of coal mining in the region would most affect Carbon and Emery Counties (table IV-7). How much the other counties would be affected depends not only upon the particular location of coal mining but also upon the accuracy of predicted worker commuting patterns. The most uncertainity applies to mining in the Emery coal field area. Workers there could live either in Sanpete and Sevier Counties or in southern Emery County, or in all of these. Sanpete and Sevier provide more than 60 percent of the region's agricultural employment, so a continuing decrease in agricultural employment would affect these two counties more than it would Carbon and Emery Counties. For projection purposes, it was assumed that farm proprietorship plus annual equivalent wage and salary employment in Sanpete and Sevier would fall from approximately 1,734 in 1975 to 1,053 in 1990, or about 3.5 percent per year. This represents a considerable deterioration in the economic base in these counties.

Travel and tourism in the region are expected to continue growing, but not at unusual rates. For this reason, modest expansion in trade and services may occur in Sanpete and Sevier Counties.

Several industries in the manufacturing sector are substantial in size and basic in nature. Food manufacturing, apparel, nonelectrical machinery, and transportation equipment other than motor vehicles, are large employers in Sanpete or Sevier Counties. The region's future will be affected by the fact that these sectors have about reached their potential and offer little opportunity for expanded employment. They have already absorbed the kind of labor in the area having characteristics they require. Past expansion of manufacturing in the six-county area has depended upon the availability of a less than fully employed work force. Employment opportunities generated by expanded coal mining will diminish the number of such workers.

Carbon and Emery Counties have been affected by heavy construction work on facilities used for exporting the region's coal or energy. Employment in the construction sector will continue to expand as coal mining does, though opportunities here are in part transitory.

Under the low production level of coal mining, Emery County will not attain population and employment higher than corresponding estimates for 1977, but renewal of powerplant construction would bolster employment and population increases after 1980. The socioeconomic analysis at the projected level includes the expected construction after 1980 of the Emery 3 and 4 power generation stations in Emery County. These stations are not located on Federal land and their construction does not require Federal approval. Their impact is evaluated at the high level in chapter VIII for topics other than socioeconomics. Should these plants be built after 1980, appreciable amounts of construction employment would be required both for the energy facilities and for community development. Peak employment in construction is assumed for 1984 or 1985. Population will climb to that point and decline thereafter to more representative levels. Also included in the socioeconomic

Table IV-7.--Distribution of mine work force residence by county, low and projected levels

Minesite Area[1]	County	Work force[2] 1980	County of residence 1980	Work force[2] 1985	County of residence 1985	Work force[2] 1990	County of residence 1990
LOW LEVEL							
Eastern Book Cliffs	Carbon--	410	410 Carbon	410	410 Carbon	410	410 Carbon
Northern Wasatch Plateau	Carbon--	890	790 Carbon 100 Sanpete	1,390	1,290 Carbon 100 Sanpete	1,690	1,590 Carbon 100 Sanpete
and Western Book Cliffs	Emery---	445	340 Carbon 100 Sanpete 5 Emery	555	400 Carbon 100 Sanpete 55 Emery	660	450 Carbon 100 Sanpete 110 Emery
Central Wasatch Plateau	Emery---	1,510	1,050 Carbon 460 Emery	2,265	1,500 Carbon 765 Emery	2,355	1,500 Carbon 855 Emery
Southern Wasatch Plateau	Sevier--	350	90 Sanpete 855 Emery 175 Sanpete	350	90 Sanpete 85 Emery 175 Sanpete	350	90 Sanpete 85 Emery 175 Sanpete
PROJECTED LEVEL							
Eastern Book Cliffs	Carbon------------------			410	410 Carbon	410	410 Carbon
Northern Wasatch Plateau	Carbon------------------			1,390	1,290 Carbon 100 Sanpete	1,670	1,570 Carbon 100 Sanpete
and Western Book Cliffs	Emery------------------			525	370 Carbon 100 Sanpete 55 Emery	650	440 Carbon 100 Sanpete 55 Emery
Central Wasatch Plateau	Emery------------------			2,200	1,450 Carbon 750 Emery	2,610	1,810 Carbon 800 Emery
Southern Wasatch Plateau	Sevier[3]-----------------			350	90 Sanpete[3] 85 Emery 175 Sevier	2,090	180 Sanpete 1,470 Emery 440 Sevier

[1]Eastern Book Cliffs includes eastern Book Cliffs and western Sego coal fields, from near Dragerton and Sunnyside to the eastern boundary of the region. Northern Wasatch Plateau and western Book Cliffs includes western Book Cliffs and northern Wasatch Plateau coal fields, from near Dragerton and Sunnyside to Scofield, centered around Price, Utah. Central Wasatch Plateau includes the Wasatch Plateau coal fields from north of Huntington to Emery. Southern Wasatch Plateau includes Emery and Salina Canyon coal fields.

[2]The mine work force is an estimate based on a requirement of 15 tons per worker-shift for underground mining and 75 tons per worker-shift for strip mining.

[3]The mine work force estimates in the southern Wasatch Plateau area at the projected level (24 mty) is 930 instead of 2,090. The socioeconomic analysis at the projected level evaluated impacts of the work force as given here. Accordingly, impacts on Emery and Sevier Counties would be considerably less than described. Impacts of a work force of 930 in the southern Wasatch area is evaluated at the high level (chapt. VIII).

analysis at the projected level is construction of the IPP plant at Caineville, Wayne County, Utah. The IPP powerplant and associated new town would require construction employment of 2,420. This site now is being compared by the proponent and BLM with several others and it is possible the plant would not be sited at Caineville. For topics other than socioeconomics, the potential major impacts of the several suggested IPP plantsites are itemized in chapter VIII.

With the important exceptions outlined above, no other basic employment sectors in the region offer significant potential for growth by 1990. But the expansion of coal mining predicted in the low production level assures better than a 50 percent expansion in mining employment between 1980 and 1990. With this will come growth in sectors supplying the coal industry. Expansion in these sectors can be estimated using State input-output tables which show each 1,000 jobs in the coal industry requiring, for example, an additional three jobs in communications, 13 jobs in electricity, gas, and sanitation services, and 37 jobs in transportation. In all, 17 sectors are directly affected by increases in coal production. Similarly, input-output tables are used to estimate the employment changes associated with the region's basic employment sectors, as these grow or decline. The net effect of expanded coal mining in the State of Utah as a whole is 182 direct supporting jobs for every 1,000 jobs in coal mining. Of these, 107 are assumed to be filled from within the projection region itself, and the remainder from elsewhere in the State.

A final category of employment must be considered when estimating the impacts of expanded coal mining. This is residentiary employment, or that which arises from provision of goods and services to the residents of the region. Providing education services to the area's children is an example of this kind of employment.

Estimates of a sector's residentiary employment are compared to national trends in population and employment to determine whether relative regional changes might occur. Thus, local projections of residentiary employment are tied to the national projection series of the Bureau of Labor Statistics which incorporate assumptions of changing sector productivity, changing consumption patterns, and the expected impacts of higher energy prices on the structure of the American economy. (The Structure of the U.S. Economy in 1980 and 1985; U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 131, 1976.)

As a consequence of a very small and limited regional economy, employment in some sectors is low. In still other sectors it may be zero. (Goods and services otherwise provided by such sectors are purchased by the region's residents outside the region itself.) As the population grows, employment in such sectors may expand rapidly; new firms would now find it profitable, because of a growing market, to locate in the region.

1. Population Projections

Coal mining at the low and projected levels does not represent a new economic force in the region, although the location and the amounts of coal mining would change. Mining is a large and currently growing component of the area's economic base. But recent economic growth based on coal mining comes after a 20-year decline in regional population. Between 1950 and 1970, population decreased by nearly 30 percent. Expansion since 1970 is rapid enough to overcome this loss before 1980.

Current growth is generating significant stress and limited "boom-town" episodes in the region. Should coal mining reach the low or projected levels, problems will intensify, and the area experiencing them will be larger.

Low Level Scenario.--Coal mining employment would increase to 3,605 in 1980 from an estimated 2,853 in 1976. Associated population would grow to about 62,000 from about 55,000 (table IV-8).

Population growth between 1970 and 1975 occurred at compounded rates of 4.1 percent per year in Carbon County and 5.6 percent per year in Emery. The low level production produces a decrease in these rates: 3.0 and 5.1 percent per year for Carbon and Emery respectively during the 1975 to 1980 period. This occurs because the large work force now present in Carbon and Emery Counties and constructing the Utah Power & Light electricity generating stations will be moving out before the end of the decade.

Production at the low level would expand the current geographic area of coal production impact. Coal mining employment in 1980 in Sevier County will be triple that of 1975 and more than 10 times that of 1970. Although only 10 percent of the regional employment, coal mining constitutes a large and important element of the economic base of Sevier County, offering employment opportunities to workers in Sevier and Sanpete Counties.

At the low level the work force will expand by 60 percent in the central Wasatch Plateau area between 1980 and 1990, and will almost double during the same period in the northern Wasatch Plateau and western Book Cliffs area (table IV-7). This development will substantially boost the economies of Carbon and Emery Counties and result in sustained in-migration to them.

Anticipated growth in the Carbon-Emery area dominates the region as a whole (table IV-8). Because the growth is concentrated in a particular part of the region, lack of similar increases in the economic base of the other counties may promote in-migration from them. But people may not move from one part of the region to another; instead the more mobile in the Sanpete-Sevier area will find opportunities

Table IV-8.--Population change by county, low and projected levels

[Source: 1970; U.S. Census of population. Projection years and intervals for counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Detail may not add to totals because of independent rounding.) (Thousands of persons)]

County	1970 population	Natural increase	Migration	1975 population	Natural increase	Migration	1980 population	Natural increase	Migration	1985 population	Natural increase	Migration	1990 population
LOW LEVEL													
Carbon-----	15.6	+0.7	+2.8	19.1	+1.3	+1.7	22.2	+1.4	+4.3	27.9	+1.5	+2.6	32.0
Emery------	5.1	+ .2	+1.4	6.7	+ .5	+1.4	8.6	+ .7	+1.7	10.9	+ .7	+ .8	12.4
Sevier-----	10.1	+ .4	+2.7	13.1	+ .9	+ .4	14.5	+ .9	-1.9	13.5	+ .5	- .5	13.5
Wayne------	1.5	+0	+ .2	1.7	+ .1	+ .1	1.9	+ .1	- .1	1.9	+ .1	- .1	1.8
Piute and Sanpete--	12.1	+ .4	+1.5	14.0	+ .8	+ .1	15.0	+ .8	-1.8	14.0	+ .4	-0	13.9
Total, six counties	44.5	+1.6	+8.6	54.7	+3.7	+3.7	62.1	+3.8	+2.2	68.1	+3.2	+2.3	73.7
PROJECTED LEVEL													
Carbon-----	15.6	+0.7	+2.8	19.1	+1.3	+2.6	23.0	+1.5	+6.3	30.8	+1.9	+4.8	37.4
Emery------	5.1	+ .2	+1.4	6.7	+ .5	+2.5	9.8	+ .8	+6.5	17.1	+1.5	-3.8	14.9
Sevier-----	10.1	+ .4	+2.6	13.1	+ .9	+ .5	14.6	+ .9	+2.0	17.5	+1.0	- .4	18.1
Wayne------	1.5	+0	+ .2	1.7	+ .1	+1.4	3.2	+ .3	+4.6	8.0	+ .8	-2.6	6.2
Piute and Sanpete--	12.1	+ .4	+1.5	14.0	+ .8	+ .1	15.0	+ .8	-1.2	14.6	+ .5	- .7	14.4
Total, six counties	44.5	+1.7	+8.6	54.7	+3.7	+7.1	65.5	+4.3	+18.2	88.1	+5.6	-2.6	91.0

closer by going north to metropolitan Utah than by going east to Carbon and Emery Counties. Some in-migrants to Carbon and Emery will come from within the region, but typically they will come from elsewhere.

Projected Level Scenario.--The work force at the projected level would not be larger than at the low level until 1985 when large increases would occur in the southern and central Wasatch areas (table IV-7). By 1990, the associated coal mining work force would increase from 350 to 2,090 in the southern Wasatch area; a smaller increase of 225 would occur in the central Wasatch area. The greatest growth owing solely to coal mining, over that anticipated in the low level, would accrue to Emery and Sevier Counties (tables IV-7, IV-8).

Anticipated economic and population changes at the projected level include construction after 1980 of the IPP powerplant in Wayne County and the Emery 3 and 4 powerplants in Emery County (table IV-8). These mask, to an extent, the effects of expansion in coal mining alone, and change considerably the location of the impacts within the region. Resumptions early in the 1980's of construction activity on the Emery 3 and 4 plants, that are assumed only in the socioeconomic impact at the projected level, would again temporarily augment the economic base and cause the disparity between the population impact in Emery County in 1985 at the low level versus that at the projected level (table IV-8). The disparity and impact of Emery 3 and 4 construction is dissipated by 1990 because the construction work force would again move out prior to 1990. Because of the anticipated construction of these plants, regional population would be 30 percent larger in 1985 than in the low level and 25 percent larger in 1990. However, the IPP plant may not be built at the location anticipated in this socioeconomic analysis and therefore, impact accruing from its construction would not occur.

At the county level, population changes are particularly evident. Wayne County would be altered decisively by construction of IPP. By 1985, the construction boom would create an addition to the Wayne County economic base greater than total 1975 Wayne County employment, and a population more than triple what it otherwise would have been. Piute and Sanpete Counties would expand somewhat as compared to the low level scenario. The total increase is small--in the neighborhood of 500 people--and is a result of workers residing there although working in the central and southern Wasatch Plateau coal fields. As a result of declining economic potential, Sevier, Sanpete, and Piute Counties would experience population decreases during the 1985 to 1990 period in the absence of a new component in their economic base. Such a stimulus is provided by coal expansion in the central and southern Wasatch Plateau areas. At the projected level this would add 4,600 people in Sevier County (but see footnotes, table IV-7, regarding work force estimates in the southern Wasatch Plateau area). A correspondingly expanded role for Richfield as a trading and service center accounts for some of this increase. Community development as a result of mining in the southern Wasatch area would occur in the Emery-Moore area of Emery County.

To this point, discussion of the projected level has assumed construction of the IPP at the Salt Wash site, near Caineville in Wayne County. Because it is now considered unlikely that the powerplant will occupy this site, additional population projections have been made to exclude it. The difference in the central region is as follows:

Assumptions	Population		
	1980	1985	1990
Low level-------------------------	62,092	68,117	73,658
Projected level without IPP-------	63,233	74,915	78,362
Projected level with IPP----------	65,532	88,099	91,050

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah.]

Economic interrelationships and assumed worker commuting patterns strongly suggest that construction and operation of the IPP would have ramifications for the entire Central Utah coal region (with the exception of Piute County). The economy of Wayne County would be altered fundamentally and the lack of available services and places of residence for an in-migrating population suggests construction of a new town near Salt Wash. If the project does not occur there, Wayne County's future doubtless would be very much like its recent past (tables IV-8, IV-9).

Without the IPP project the anticipated economies in 1985 of the remaining four counties, Emery, Carbon, Sevier, and Sanpete, would be nearly the same under both the low and projected levels of coal development. The low level implies an increment to the area economic base quite large in comparison to the experience of the recent past, so with the exception of certain localities where impacts might be concentrated, the increased mining at the projected level does not produce significant additional impact.

Development of the IPP would create a new area of concentrated economic activity (a potential growth center) which would have the effect of drawing economic activity away from other established centers in the region. Although economic growth or decline would be expected in such places with or without the power project, the net effect of a new economic center would be to change the relative regional importance of the other places. This can be observed in the figures for the projected level with IPP, table IV-9. The economic rational hinges on the role of the region's communities in providing services to the region's residents. Thus, the region is a very much different place with the power project than without it, even under the coal work force assumptions of the projected level.

Table IV-9.--Population of selected counties and communities,[1] with and without the Intermountain Power Project, 1985 and 1990

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah]

	1985			1990		
	Low level	Projected level without IPP	Projected level with IPP	Low level	Projected level without IPP	Projected level with IPP
Carbon County----	27,924	29,640	30,806	32,033	33,385	37,417
Emery County-----	10,883	13,893	17,139	12,378	13,787	14,856
Sevier County----	13,501	15,302	17,543	13,488	15,131	18,135
Aurora---------	743	832	1,511	742	832	1,625
Redmond--------	540	612	1,268	540	605	1,376
Richfield------	5,670	6,426	6,519	5,665	6,355	6,641
Salina---------	2,025	2,295	3,237	2,023	2,269	3,417
Sigurd---------	405	459	890	405	454	963
Sanpete County---	12,429	12,700	13,043	12,406	12,706	12,900
Centerfield----	497	507	734	496	507	686
Fairview-------	833	851	852	831	881	846
Gunnison-------	1,243	1,270	1,583	1,241	1,276	1,515
Mt. Pleasant---	1,802	1,841	1,821	1,799	1,841	1,814
Wayne County-----	1,854	1,854	8,050	1,834	1,834	6,234
Bicknell-------	297	297	New	293	293	New
Loa------------	389	389	Town:	385	385	Town:
Torrey---------	111	111	6,196	110	110	4,401

[1]Piute County, though a part of the central Utah coal region, is not shown here because the differences with and without IPP were not noteworthy.

Comparison of the Projected Level to the Low Level.--The comparison focuses on significant impacts of expanded coal mining such as changes in the age composition of the population, housing requirements, labor market conditions, and employment.

Age Composition.--A comparison of the anticipated population distribution by age for the low and projected levels shows that higher growth rates not only increase the total size of the population but significantly change its age distribution as well (table IV-10). These alterations are pronounced in Emery County because of the anticipated growth in 1980 and 1985 dominately owing to construction of the Emery 3 and 4 powerplant. During these years, the anticipated in-migration to the county is very large. By 1990, the disparity would diminish owing to completion of the plants and the ultimate growth is similar under both the low and projected level scenarios.

How readily people will move in response to economic opportunity varies with age. Comparing the low and projected levels in 1985 the 5- to 14-year old age group in Emery County would expand by slightly more than 60 percent, while the more mobile 15- to 24-year-old age group would slightly more than double. In the same county the larger 25- to 44-year-old age group increases in the same proportion (by 57 percent) as does the total county population. In 1985, older workers and those of retirement age would increase by about 30 percent from the low to the projected level.

The most striking feature of the age composition of county populations in 1970 is the very high proportion that are 65 years of age or older compared to the nation and to the State (table IV-11). This local age composition resulted from the previous period of sustained movement from the area--a disproportionate in-migration of younger, more mobile, persons.

Relatively small increases in the number of the elderly would occur with expanded coal mining. But, persons 65 years of age and older are among those most prone to experience the adverse impacts of rapid growth. Economic expansion occasioned by large increases in coal mining will increase total and average incomes in the immediate region; the elderly typically have fixed incomes and are exceptionally vulnerable to the adverse effects of the rising prices often associated with strong economic expansion. To the extent an elderly person does not have a marketable skill or an ownership position in a local commercial or land enterprise, he will be confronted with a triple adversity; first, he will face deterioration in cash flow as prices, fees, and taxes paid in the local economy, increase out of step with his money income; second, the older person has a shorter time in which to realize return on an investment in retraining or skills acquisition and, therefore, is less likely to take advantage of expanded area job opportunities; and third, the large increase in population (many of whom will be newcomers), with

Table IV-10.--Population distribution by age group and county for low and projected production level scenarios

[Sources: 1970; U.S. Census of Population; 1975 and other years; UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Details may not add to totals because of independent rounding.) (Population presented in thousands)]

Age groups	1970	1975	1980 Low level	1980 Projected level	1985 Low level	1985 Projected level	1990 Low level	1990 Projected level
				Carbon				
0-4-----	1.17	1.79	2.49	2.56	3.00	3.84	2.99	3.87
5-14----	3.15	3.05	3.52	3.67	5.24	5.89	6.47	7.14
15-24----	2.70	3.98	3.52	3.77	3.56	4.44	4.06	4.88
24-44----	2.85	4.09	6.34	6.60	9.36	10.32	11.34	13.78
45-64----	4.07	4.17	3.90	3.97	3.84	4.08	4.01	4.42
65+ -----	1.71	2.03	2.43	2.47	2.92	3.00	3.17	3.32
Total--	15.65	19.13	22.20	23.03	27.93	30.81	32.03	37.42
				Emery				
0-4-----	.45	.60	.93	1.03	1.23	1.71	1.24	1.53
5-14----	1.23	1.25	1.42	1.64	1.98	3.23	2.50	2.91
15-24----	.72	1.45	1.65	2.02	1.57	3.16	1.59	1.77
25-44----	1.07	1.55	2.50	2.87	3.76	5.92	4.51	5.67
45-64----	1.08	1.17	1.24	1.34	1.41	1.91	1.63	1.96
65+ -----	.58	.71	.81	.87	.93	1.20	.93	1.03
Total--	5.14	6.74	8.57	9.77	10.88	17.14	12.38	14.86
				Sevier				
0-4-----	.86	1.20	1.69	1.70	1.38	1.83	1.15	1.75
5-14----	2.22	2.32	2.38	2.39	2.61	3.35	2.77	3.69
15-24----	1.51	2.82	2.36	2.40	1.56	2.43	1.55	2.16
25-44----	1.98	2.89	4.13	4.16	4.38	5.79	4.49	6.36
45-64----	2.25	2.39	2.34	2.35	2.12	1.81	2.16	2.55
65+ -----	1.28	1.49	1.58	1.58	1.46	1.71	1.38	1.63
Total--	10.10	13.12	14.48	14.57	13.50	17.54	13.49	18.13
				Wayne				
0-4-----	.10	.14	.20	.31	.19	.81	.16	.80
5-14----	.33	.27	.27	.50	.33	1.50	.37	1.18
15-24----	.23	.38	.33	.71	.20	1.59	.18	.68
25-44----	.27	.32	.49	.89	.59	2.80	.62	2.47
45-64----	.38	.38	.35	.46	.30	.79	.27	.70
65+ -----	.18	.21	.23	.29	.24	.56	.23	.40
Total--	1.48	1.70	1.87	3.16	1.85	8.05	1.83	6.23
				Piute-Sanpete				
0-4-----	1.03	1.33	1.71	1.71	1.39	1.47	1.18	1.26
5-14----	2.43	1.42	2.50	2.50	2.73	2.83	2.81	2.93
15-24----	2.22	2.91	2.23	2.24	1.58	1.69	1.66	1.69
25-44----	1.99	2.89	4.31	4.32	4.50	4.73	4.69	4.87
45-64----	2.71	2.59	2.24	2.24	1.95	2.00	1.97	2.02
65+ -----	1.76	1.91	1.98	1.99	1.80	1.84	1.61	1.64
Total--	12.14	14.04	14.97	14.99	13.95	14.56	13.92	14.42

Table IV-11.--Population distribution by age group and county for the low and projected level scenarios, with comparisons to the United States and State of Utah

[Source: 1970 U.S. Census of Population or derived therefrom. United States: Bureau of the Census Current Population Reports, P-25, #643 and 704, Series II. Utah: Office of State Planning Coordinator Alternative Future Zero (1974). Counties: UPED Model Projections, Bureau of Ecomomic and Business Research, University of Utah]

	1970	1975	1980		1985		1990	
			Low level	Projected level	Low level	Projected level	Low level	Projected level
Carbon county								
Percent of population:								
0-15--------------	29.9	27.3	28.5	28.8	30.7	30.4	31.0	30.9
65+ --------------	10.9	10.6	11.0	10.7	10.4	9.7	9.9	8.9
Dependency ratio------	.69	.61	.66	.66	.69	.66	.69	.66
Median age------------	30.8	27.3	27.9	27.7	28.7	28.0	29.9	28.9
Emery county								
Percent of population:								
0-15--------------	34.7	29.8	29.2	29.1	30.8	30.3	31.5	31.3
65+ --------------	11.2	10.5	9.5	8.9	8.4	7.0	7.5	6.9
Dependency ratio------	.85	.66	.64	.61	.64	.59	.64	.62
Median age------------	28.0	25.6	26.4	25.8	27.6	26.0	29.1	29.3
Sevier county								
Percent of population:								
0-15--------------	32.6	29.0	29.6	29.6	30.8	30.9	30.4	31.3
65+ --------------	12.7	10.3	10.9	10.8	10.8	9.8	10.2	9.0
Dependency ratio------	.82	.66	.69	.66	.69	.69	.69	.66
Median age------------	29.8	26.0	27.3	27.3	30.0	28.2	31.8	30.1
Wayne county								
Percent of population:								
0-15--------------	31.5	26.5	28.3	27.3	29.2	30.1	29.8	35.7
65+ --------------	12.2	12.6	12.2	9.2	12.8	7.0	12.6	6.4
Dependency ratio------	.78	.64	.64	.58	.72	.58	.72	.66
Median age------------	32.3	27.7	28.1	25.7	30.3	25.6	32.4	28.5
Piute and Sanpete counties								
Percent of population:								
0-15--------------	30.9	28.5	29.6	29.6	30.8	30.8	30.1	30.5
65+ --------------	14.5	13.6	13.2	13.2	12.9	12.6	11.6	11.4
Dependency ratio------	.83	.73	.75	.75	.78	.77	.71	.72
Median age------------	28.8	26.6	27.8	27.8	30.5	30.3	32.0	31.8
State of Utah								
Percent of population:								
0-15--------------	35.5	33.0	31.5		30.9		29.2	
65+ --------------	7.3	7.4	7.4		7.6		7.8	
Dependency ratio------	.75	.68	.64		.63		.59	
Median age------------	23.1	23.9	25.0		26.6		28.2	
United States								
Percent of population:								
0-15--------------	30.4	27.1	24.3		23.7		23.8	
65+ --------------	9.8	10.5	11.2		11.7		12.1	
Dependency ratio------	.67	.60	.55		.55		.56	
Median age------------	28.0	28.8	30.2		31.5		32.8	

resultant change in the age composition of the local population, will significantly erode the political basis of the elderly to achieve alleviation of their economic distress.

Together, 45.9 percent of the people in Emery county in 1970 could participate but little in the labor force. In 1970, 34.7 percent of Emery County's population was in the 0 to 15 age group (table IV-11). Except as consumers, these persons normally do not participate in the economy. Another 11.2 percent of the 1970 population was 65 years of age or older, the traditional retirement years. Those of working age amounted to 54.1 percent of county population. This means there were 0.85 (.459 ÷ .541) persons in the traditionally nonactive age groups for every person in the economically active group in Emery County (the "dependency ratio"). A similar case is found in each of the region's counties except Carbon. In the United States, for comparison, the 1970 dependency ratio was 0.67. Expected declines in the 0 to 15 age group, offset by an increase in those 65 years of age or older, would yield a dependency ratio after 1980 of about 0.55. Public requirement for services tend to rise with an increase in the dependency ratio and to fall with a decrease in the ratio. Counties anticipated to receive the greatest influx of in-migrants show a falling ratio (1975-1990). The anticipated ratio for the other counties show smaller changes (table IV-11). The high ratios prevalent in 1970 and earlier (see chapt. II) help explain the relatively low per capita increases in the region. Anticipated effects of the resulting changes are discussed further in the following socioeconomic analysis.

Changes in median ages parallel changes in dependency ratios (table IV-11). The anticipated median age (that at which half the population is younger and half older) would increase rapidly in the nation and in the State but would vary rapidly in the region's counties as a result of changes in in-migration and the higher mortality rates in older age groups. A rapid change in the median age presages significant social changes discussed more fully under several topical headings in this socioeconomic analysis.

2. Housing Impacts

The impacts of average household size and housing requirements under the projected production level are, with the notable exception of Wayne County, differences in degree rather than kind of impact (table IV-12). Carbon and Emery Counties have been experiencing rapid economic expansion since early in the 1970's. Growth in Emery County has involved development in sparsely settled areas. In Carbon, the growth has centered in established communities. Growth in housing has already been rapid; it is expected to continue to be so even without the added stimulus of projected level conditions.

Table IV-12.--Housing requirements by county at the low and projected production level with comparisons to the State of Utah

Utah: Alternative Future Zero, Office of State Planning Coordinator (1974). Counties: UPED Model Projections, Bureau of Ecomomic and Business Research, University of Utah]

	1970	1975	1980 Low level	1980 Projected level	1985 Low level	1985 Projected level	1990 Low level	1990 Projected level
Carbon county								
Percent of population in dwelling units--	.99							
Occupied dwelling units (thousands)--	4.94	5.88	6.98	7.20	8.72	9.46	9.92	11.46
Average household size---------------	3.13	3.25	3.18	3.20	3.20	3.26	3.23	3.26
Emery county•								
Percent of population in dwelling units--	.99							
Occupied dwelling units (thousands)--	1.54	1.95	2.54	2.86	3.29	4.97	3.75	4.52
Average household size---------------	3.30	3.46	3.37	3.42	3.31	3.45	3.30	3.29
Sevier county								
Percent of population in dwelling units--	100.							
Occupied dwelling units (thousands)--	3.16	3.90	4.44	4.47	4.26	5.38	4.31	5.63
Average household size---------------	3.19	3.37	3.26	3.26	3.17	3.26	3.31	3.22
Wayne county								
Percent of population in dwelling units--	100.							
Occupied dwelling units (thousands)--	.46	.52	.60	.94	.61	2.31	.60	1.84
Average household size---------------	3.25	3.26	3.13	3.37	3.06	3.49	3.06	3.39
Piute and Sanpete counties								
Percent of population in dwelling units--	.96							
Occupied dwelling units (thousands)--	3.80	4.27	4.68	4.69	4.45	4.62	4.46	4.59
Average household size---------------	3.08	3.29	3.20	3.20	3.14	3.15	3.13	3.14
State of Utah								
Percent of population in dwelling units--	97.3							
Occupied dwelling units (thousands)--	297.93	349.53	428.76		496.40		548.12	
Average household size---------------	3.46	3.36	3.23		3.11		3.02	

At the projected production level, dwelling unit requirements for Carbon County are anticipated to amount to 450 per year (net increase) between 1980 and 1985 as compared to 350 per year at the low level. By "dwelling unit" is meant the facility occupied by a household; household being the group as defined in the 1970 census. Average household size is obtained by dividing the population in household by the number of dwelling units. The situation is more complicated in Emery County. There, the large anticipated impacts in 1980 to 1985 are from temporary housing related to construction workers associated with the IPP and Emery 3 and 4 powerplants. The 1985 to 1990 housing requirement would move south from the Castle Dale area to the central and southern Wasatch Plateau supporting area of Emery and Moore. This latter impact would be lessened substantially because the work force used in this socioeconomic analysis in the southern Wasatch area is 2,090 versus 930 anticipated at the projected level (see table IV-7, also chapt. VIII).

In 1985 and 1990 the need for housing units will increase significantly over that anticipated for the low level (table IV-13). More than 5,000 additional housing units will be needed by 1985. In most of the area single-family homes predominate. However, if the impact has similar results as the increased growth in Carbon and Emery Counties has had in the recent past, much of the housing demand would be met by greater reliance on mobile homes. This has several implications for the communities. Services demanded may change with different life-styles associated with changing housing preferences. Such changes cannot be anticipated accurately. The financial structure of the community would be adversely affected because tax yields are lower on mobile homes than single-family homes.

3. Labor Market Impacts

The ratio of the number of nonworking age to working age persons in the population (the dependency ratio) in the region would decrease or remain about constant from 1975-1990 in both the low and projected levels, owing to economic growth. In addition, three other factors are anticipated to result from predicted employment growing faster than population: 1) an increase in the rates at which persons participate in the labor force, 2) a decrease in part-time workers or those holding two or more jobs, and 3) a decreasing unemployment rate.

Between 1975 and 1985 the number of jobs will grow faster than will the labor force (table IV-14). The size of the labor force indicates those employed or available for work in the region and thus differs from the number of jobs available. Both will grow at approximately the same rates thereafter because the region's 8 percent 1975 unemployment rate will decrease to 6.5 percent by 1980 and to 5 percent before 1990. A low growth for proprietorships reflects the current extraordinarily high rates of self-employment within the region. In 1975, proprietorships accounted for 21.5 percent of all employment in the six counties. The

Table IV-13.--Housing unit requirement anticipated at the projected level

County	Number of existing units	Anticipated additional units needed[1] 1980	1985	1990
Carbon------	6,229	217	747	1,541
Emery-------	2,506	315	1,682	767
Sanpete-----	4,080	8	174	135
Sevier------	4,500	25	1,118	1,321
Wayne-------	695	341	1,698	1,238
Total------------------------------------			5,419	

[1]Represents units needed in addition to housing needs anticipated under the low level predictions. The analysis represents the requirement necessary for the population at the year indicated, i.e.: need in Emery County in addition to need at low level is 315 units in 1980, 1,682 units in 1985 but only 767 units in 1990. The need in 1985 is caused by inclusion of Emery 3 and 4 powerplant construction in this analysis.

Table IV-14.--Projected expansion in regional population and employment, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (in thousands)]

	1975	Interval growth rate (percent per year)	1980	Inverval growth rate (percent per year)	1985	Inverval growth rate (percent per year)	1990
Low level:							
Population-----	54.72	2.6	62.09	1.9	68.12	1.6	73.66
Labor force----	21.57	3.1	25.16	2.2	28.10	1.9	30.77
Jobs (full and part time)---	21.12	3.5	25.03	2.5	28.40	1.9	31.10
Proprietor-----	4.41	-0.6	4.30	-1.2	4.04	-0.2	4.00
Wage and salary-------	16.71	4.4	20.75	3.2	24.32	2.2	27.10
Projected level:							
Population-----	54.72	3.7	65.53	6.1	88.10	0.7	91.00
Labor force----	21.57	4.6	27.10	6.4	36.89	0.8	38.30
Jobs (full and part time)---	21.12	5.0	26.94	6.7	37.29	0.8	38.71
Proprietor-----	4.41	-0.1	4.40	3.2	5.12	-3.5	4.30
Wage and salary-------	16.71	6.2	22.56	7.4	32.20	1.4	34.43

corresponding state figure is 9.4 percent. High rates of proprietorship are found in labor markets with a history of relatively restricted job opportunities. As job opportunities expand, the proportion of proprietorship will decline.

Where job opportunities are limited, low rates of labor force participation are not unusual. Both the low and the projected levels, however, would expand job opportunities, so regional rates would increase from 1975-1990 and would equal the anticipated State rates by 1985.

Changes from 1975-1990 in assumed labor force participation rates, rates of occurrence of proprietorship by sector, unemployment rates, and anticipated changes in the age composition of the population indicate that the region would be increasingly capable of supplying labor as job opportunities increase. Such a growth absorption capacity is nevertheless very limited because of the small numbers of people currently residing within commuting distance of particular mines. Even with rapid growth in population, substantial increases in per capita personal income relative to the State, and especially with respect to current conditions within the region, will occur because of the expansion of high-wage employment.

4. Employment Impacts

Both the anticipated economic expansion and the past period of economic decline in the region result from trends in rates of coal production. Currently, coal mining is the principal force moving the regional economy to higher levels of employment and increasing population. Coal production at the projected level would generate increasing employment in sectors other than mining as shown in table IV-15. Both directly and indirectly, coal mining at the projected level would increase the regional economy's dependence on coal mining. An associated upward pressure on wage rates will not enhance the region's potential for expansion in agriculture or in manufacturing (except in response to the demands of the coal mining industry itself as for example, in supplying mining equipment).

Anticipated changes in employment patterns by county are presented in tables IV-16 to IV-20. Except for Sevier and Wayne Counties, most are changes of degree rather than of kind. The Sevier County change is substantially overstated in this analysis and would result from expansion evaluated here to 2,090 employees in southern Wasatch (table IV-7).

The change would be significant even if many miners commute to Emery County to live. An increase in trade and service employment corresponds both to a larger local population and to the situation of Richfield and Salina regional centers which could serve even southern Emery County.

Table VI-15.--Employment by sector, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. Full and part time, estimated for 1975, anticipated 1980, 1985, and 1990. (Details may not add to totals because of independent rounding.)]

	1975	1980		1985		1990	
		Low level	Projected level	Low level	Projected level	Low level	Projected level
	(in thousands)						
Agriculture------	2.79	2.46	2.45	2.09	2.12	1.80	1.82
Mining-----------	2.78	4.02	4.07	5.39	5.48	5.89	7.92
Construction-----	2.06	2.22	3.51	2.41	6.29	2.68	3.70
Manufacturing----	2.15	2.23	2.23	2.22	2.33	2.23	2.32
TCU[1]-------------	0.93	1.29	1.26	1.55	2.34	1.65	2.74
Trade------------	4.09	5.21	5.43	5.88	7.40	6.57	7.86
Fire[2]------------	0.42	0.61	0.64	0.77	1.01	0.95	1.19
Services---------	2.16	2.74	2.84	3.15	4.00	3.62	4.29
Government-------	3.76	4.28	4.51	4.90	6.31	5.72	6.89
Total----------	21.12	25.03	26.94	28.37	37.29	31.10	38.71
	Percentage allocation						
Agriculture------	13.2	9.8	9.1	7.4	5.7	5.8	4.7
Mining-----------	13.2	16.1	15.1	19.0	14.7	18.9	20.5
Construction-----	9.8	8.9	13.0	8.5	16.9	8.6	9.6
Manufacturing----	10.2	8.9	8.3	7.8	6.2	7.2	6.0
TCU[1]-------------	4.4	5.2	4.7	5.5	6.3	5.3	7.1
Trade------------	19.4	20.8	20.2	20.7	19.8	21.1	20.3
Fire[2]------------	2.0	2.4	2.4	2.7	2.7	3.1	3.1
Services---------	10.2	10.9	10.5	11.1	10.7	11.6	11.1
Government-------	17.8	17.1	16.7	17.3	16.9	18.4	17.8

[1] Transportation, communication and utilities.
[2] Finance, insurance, and real estate.

Table VI-16.--Carbon County changes in employment sectors, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. Full and part time, estimated for 1975, anticipated for 1980, 1985, and 1990. (Details may not add to totals because of independent rounding.)]

	1975	1980		1985		1990	
		Low level	Projected level	Low level	Projected level	Low level	Projected level
	(in thousands)						
Agriculture------	.27	.25	.25	.23	.23	.22	.23
Mining-----------	1.40	1.41	1.41	1.91	1.93	2.22	2.17
Construction-----	.56	.62	.53	.78	.76	.94	1.02
Manufacturing----	.36	.32	.38	.41	.42	.42	.45
TCU[1]-------------	.51	.60	.59	.69	.81	.75	.92
Trade------------	1.43	1.87	1.92	2.39	2.59	2.81	3.19
Fire[2]------------	.15	.22	.23	.32	.36	.41	.48
Services---------	.68	.91	.93	1.18	1.31	1.44	1.63
Government-------	1.30	1.52	1.59	1.95	2.22	2.41	2.80
Total----------	6.66	7.78	7.83	9.86	10.64	11.62	12.88
	Percentage allocation						
Agriculture------	4.1	3.2	3.1	2.4	2.2	1.9	1.8
Mining-----------	21.0	18.1	18.1	19.4	18.1	19.1	16.8
Construction-----	8.3	7.9	6.8	7.9	7.2	8.1	8.0
Manufacturing----	5.3	4.1	4.9	4.1	3.9	3.6	3.5
TCU[1]-------------	7.6	7.7	7.6	7.0	7.6	6.5	7.1
Trade------------	21.5	24.0	24.8	24.2	25.0	24.2	24.8
Fire[2]------------	2.2	2.8	2.9	3.2	3.5	3.5	3.7
Services---------	10.3	11.7	12.0	12.0	12.3	12.4	12.6
Government-------	19.5	19.6	20.3	19.8	20.9	20.7	21.7

[1]Transportation, communication and utilities.
[2]Finance, insurance, and real estate.

Table VI-17.--Emery County changes in employment sectors, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. Full and part time, estimated for 1975, anticipated for 1980, 1985, and 1990. (Details may not add to totals because of independent rounding.)]

	1975	1980		1985		1990	
		Low level	Projected level	Low level	Projected level	Low level	Projected level
	(in thousands)						
Agriculture------	.38	.34	.34	.29	.31	.25	.26
Mining-----------	1.15	2.11	2.13	2.98	3.00	3.18	3.43
Construction-----	.37	.45	1.19	.51	2.43	.57	.94
Manufacturing----	.07	.08	.09	.09	.13	.10	.11
TCU[1]-------------	.09	.30	.36	.50	.71	.53	.68
Trade------------	.51	.73	.83	.94	1.44	1.09	1.28
Fire[2]------------	.05	.09	.10	.13	.20	.17	.20
Services---------	.26	3.73	.43	.48	.76	.58	.69
Government-------	.38	.50	.57	.69	1.05	.86	1.01
Total----------	3.26	4.97	6.02	6.61	10.03	7.33	8.60
	Percentage allocation						
Agriculture------	11.7	6.8	5.6	4.4	3.1	3.5	3.0
Mining-----------	35.2	42.4	35.3	45.1	29.9	43.3	39.9
Construction-----	11.4	9.0	19.7	7.7	24.3	7.8	11.0
Manufacturing----	2.1	1.6	1.4	1.4	1.3	1.3	1.3
TCU[1]-------------	2.6	6.1	6.0	7.6	7.1	7.3	7.9
Trade------------	15.6	14.7	13.8	14.2	14.3	14.9	14.8
Fire[2]------------	1.6	1.8	1.7	2.0	2.0	2.3	2.4
Services---------	8.0	7.5	7.1	7.3	7.6	8.0	8.1
Government-------	11.8	10.1	9.4	10.4	10.5	11.7	11.7

[1]Transportation, communication and utilities.
[2]Finance, insurance and real estate.

Table VI-18.--Sevier County changes in employment sectors, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. Full and part time, estimated for 1975, anticipated for 1980, 1985, and 1990. (Details may not add to totals because of independent rounding.)]

	1975	1980		1985		1990	
		Low level	Projected level	Low level	Projected level	Low level	Projected level
	(in thousands)						
Agriculture------	.69	.61	.60	.51	.52	.43	.44
Mining-----------	.11	.38	.38	.38	.38	.38	2.14
Construction-----	.53	.55	.38	.53	.48	.56	.59
Manufacturing----	.53	.55	.55	.53	.56	.52	.55
TCU[1]-------------	.27	.29	.21	.26	.28	.26	.33
Trade------------	1.53	1.82	1.80	1.69	1.90	1.76	2.06
Fire[2]------------	.13	.17	.17	.18	.22	.20	.26
Services---------	.71	.85	.86	.85	1.02	.93	1.11
Government-------	.86	.98	1.00	1.00	1.34	1.09	1.40
Total----------	5.36	6.20	5.96	5.94	6.70	6.13	8.89
	Percentage allocation						
Agriculture------	12.9	9.8	10.1	8.6	7.7	7.1	5.0
Mining-----------	2.1	6.2	6.4	6.4	5.7	6.2	24.1
Construction-----	9.8	8.9	6.4	9.0	7.2	9.1	6.7
Manufacturing----	9.8	8.9	9.2	9.0	8.3	8.6	6.2
TCU[1]-------------	5.0	4.6	3.5	4.3	4.2	4.3	3.8
Trade------------	28.6	29.4	30.2	28.5	28.3	28.7	23.1
Fire[2]------------	2.3	2.8	2.9	3.0	3.3	3.3	3.0
Services---------	13.3	13.7	14.4	14.3	15.3	15.1	12.4
Government-------	16.1	15.8	16.9	16.9	19.9	17.8	15.7

[1] Transportation, communication and utilities.
[2] Finance, insurance and real estate.

Table VI-19.--Wayne County changes in employment sectors, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. Full and part time estimated for 1975, anticipated for 1980, 1985, and 1990. (Details may not add to totals because of independent rounding.)]

	1975	1980		1985		1990	
		Low level	Projected level	Low level	Projected level	Low level	Projected level
	(in thousands)						
Agriculture------	1.70	.15	.15	.13	.14	.11	.12
Mining-----------	.02	.02	.05	.02	.07	.02	.03
Construction-----	.05	.06	.83	.06	2.01	.06	.50
Manufacturing----	.02	.02	.03	.02	.06	.02	.04
TCU[1]------------	0.	.02	.04	.03	.45	.03	.74
Trade------------	.06	.15	.24	.22	.85	.23	.68
Fire[2]------------	.01	.02	.03	.02	.10	.03	.09
Services---------	.06	.09	.15	.11	.42	.12	.33
Government-------	.14	.15	.22	.16	.53	.17	.46
Total----------	.54	.66	1.74	.77	4.62	.79	2.99
	Percentage allocation						
Agriculture------	32.3	22.8	8.9	16.3	3.1	13.5	3.9
Mining-----------	3.0	2.4	2.9	2.1	1.6	2.0	1.1
Construction-----	9.7	8.3	47.6	7.3	43.5	7.5	16.6
Manufacturing----	3.5	3.0	1.6	2.5	1.2	2.3	1.5
TCU[1]------------	1.0	2.7	2.4	4.1	9.8	4.1	24.6
Trade------------	12.1	22.2	13.9	29.0	18.3	29.5	22.9
Fire[2]------------	1.7	2.4	1.7	3.1	2.2	3.4	3.1
Services---------	11.2	13.1	8.4	14.6	9.0	15.6	11.0
Government-------	25.9	23.1	12.7	12.1	11.4	22.2	15.3

[1] Transportation, communication and utilities.
[2] Finance, insurance and real estate.

Table VI-20.--Piute and Sanpete Counties changes in employment sectors, low and projected levels

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. Full and part time, estimated for 1975, anticipated for 1980, 1985, and 1990. (Details may not add to totals because of independent rounding.)]

	1975	1980		1985		1990	
		Low level	Projected level	Low level	Projected level	Low level	Projected level
	(in thousands)						
Agriculture------	1.27	1.11	1.10	.93	.93	.78	.78
Mining-----------	.10	.10	.10	.10	.10	.10	.09
Construction-----	.55	.55	.58	.53	.60	.55	.64
Manufacturing----	1.18	1.19	1.19	1.17	1.18	1.16	1.16
TCU[1]-------------	.07	.08	.06	.08	.07	.08	.07
Trade------------	.55	.65	.64	.64	.62	.68	.66
Fire[2]------------	.09	.12	.12	.12	.13	.14	.14
Services---------	.44	.52	.50	.52	.52	.66	.56
Government-------	1.07	1.12	1.12	1.10	1.17	1.19	1.22
Total----------	5.30	5.44	5.41	5.19	5.32	5.34	5.34
	Percentage allocation						
Agriculture------	23.9	20.4	20.4	17.9	17.5	14.7	14.7
Mining-----------	1.9	1.9	18.6	1.9	1.9	1.9	1.7
Construction-----	10.4	10.1	10.7	10.1	11.3	10.3	11.9
Manufacturing----	22.2	21.9	22.0	22.6	22.1	21.8	21.8
TCU[1]-------------	1.3	1.5	1.4	1.4	1.4	1.4	1.4
Trade------------	10.3	12.0	12.4	12.4	11.8	12.7	12.4
Fire[2]------------	1.6	2.1	2.1	2.4	2.4	2.7	2.7
Services---------	8.2	9.5	9.3	9.9	9.7	12.3	10.4
Government-------	20.1	20.6	20.7	21.2	22.1	22.3	22.9

[1] Transportation, communication and utilities.
[2] Finance, insurance and real estate.

The anticipated Wayne County impact is an explosive augmentation of a limited economic base owing to consideration here of the possible construction of the IPP plant near Caineville, Utah. The total population of the Hanksville Census County Division in 1970 was 181: the immediate basic employment proposed for the IPP powerplant would be more than three times that magnitude. Because eastern Wayne County is so remote from places which provide higher order services (such as dentists or accountants), a large increase in employment occasioned by operation of the powerplant there will have a dramatic effect on the number of service workers per capita. Such indirect and induced employment growth will be larger than it would be were the plantsite less remote.

b. Municipal Services

Impacts on municipal services are based on anticipated population distribution by community (table IV-21). The new town that would be necessary in Wayne County owing to possible location there of the proposed IPP powerplant would require the provision of the full range of municipal services; however, the cost associated with such development is not included. For the existing communities, the level of operating and maintenance costs, revenues, and capital costs associated with the projected level production scenario can be compared to those reflecting the low level production (table IV-22).[1] The surplus revenue is the difference anticipated between revenues and operating-maintenance costs. Revenue from bonding or grants is not included. Capital investment costs are listed separately. The difference between capital outlays anticipated for each production level provides an indication of the impact of the various anticipated scenarios. The large capital expenditures cannot be met through local revenue-generating means.

Local nonmonetary fiscal methods used to finance large expenditures for municipal services include local government bonding. The two methods of bonding most commonly used are general obligation bonds and revenue bonds, the issuance and amount of the former being restricted by law.[2] General obligation bonds are repaid from a property tax on all real property within the taxing jurisdiction. All general obligation

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[1]Carbon and Emery Counties are discussed using accumulated cost and revenue information, i.e., 1978 to 1980, 1981 to 1985, and 1986 to 1990. The Sanpete, Sevier, and Wayne County community estimates reflect only the impact year information, i.e., 1980, 1985, and 1990 and peak capital cost information.

[2]A discussion of community bonding capacity is available in "Southeastern Utah Impact Study", April 1978, Southeastern Association of Governments, and "Six County Coal Impact Statement", March 1978, Olympus Research Corporation.

Table IV-21.--Community population distribution, projected level

	Total population			Population increase[1]		
	1980	1989	1990	1980	1985	1990
Carbon County						
East Carbon-Sunnyside	3,191	4,197	5,012	83	288	530
Helper	3,232	4,341	5,281	124	432	797
Hiawatha	238	336	427	16	57	107
Price	8,413	11,022	13,144	199	691	1,292
Scofield	185	398	644	74	259	484
Wellington	1,448	2,028	2,674	116	403	753
Emery County						
Castle Dale	1,758	3,085	2,674	216	1,126	446
Cleveland	622	1,216	965	108	563	223
Elmo	391	873	668	48	438	173
Emery	483	1,185	792	144	750	297
Ferron	902	1,996	1,436	216	1,126	446
Huntington	2,162	3,503	3,243	192	1,000	396
Orangeville	977	2,026	1,608	120	938	371
Sanpete County						
Centerfield	551	734	686	11	273	190
Fairview	905	852	846	1	19	5
Gunnison	1,364	1,583	1,515	15	340	274
Mt. Pleasant	1,958	1,821	1,814	1	19	15
Sevier County						
Aurora	814	1,511	1,625	18	768	883
Redmond	597	1,268	1,376	18	728	836
Richfield	6,101	6,519	6,641	20	849	976
Salina	2,200	3,237	3,417	29	1,212	1,394
Sigurd	446	890	963	12	485	558
Wayne County						
Bicknell	Existing communities will remain about the same as under low level.					
Loa						
Torrey				(IPP powerplant at Caineville)		
New town	1,294	6,196	4,401			

[1]Population increase represents increase at projected level from population predicted at low level (see chapter II).

Table IV-22.--Description of projected community needs

County, Community	Production level	Projected needs		Surplus revenues and capital outlays (to the nearest thousand dollars) 1978-80	1981-85	1985-90	Total
Carbon County							
East Carbon	Low level	1980--Fire station and truck in Columbia Library (could be built with Sunnyside) Parks and recreation facilities 1985--Construct cemetery Major street improvements Parks and recreational facilities 1990--Parks and recreational facilities	Surplus	100.3	106.0	44.1	250.4
			Capital outlays	1,425.0	1,370.0	30.0	2,825.0
	Projected level	In addition to the low level needs: 1985--Enlarge sewer collection and treatment system	Surplus	90.0	117.6	93.1	300.7
			Capital outlays	1,425.0	1,400.0	---	2,825.0
	High level	The same as the projected level	Surplus	90.0	125.0	79.8	294.8
			Capital outlays	1,425.0	1,430.0	---	2,855.0
Helper	Low level	1980--Larger fire station Larger library Parks and recreational facilities 1985--Major street improvements Parks and recreational facilities 1990--Parks and recreational facilities	Surplus	0	0	0	0
			Capital outlays	196.0	994.0	150.0	1,340.0
	Projected level	In addition to the low level needs: 1990--Enlarge sewer collection system	Surplus	0	0	0	0
			Capital outlays	218.0	1,024.0	150.0	1,392.0
	High level	In addition to the projected level needs: 1985--Enlarge sewer collection system 1990--Enlarge water distribution system	Surplus	0	0	0	0
			Capital outlays	261.0	1,054.0	235.0	1,550.0
Hiawatha	Low level	This is a small community owned by U.S. Fuel. It has no plans for expansion. Population projections show an increase in population in accordance with scenario assumptions; these may be optimistic.	Surplus	3.3	7.0	9.5	19.8
			Capital outlays	12.0	---	---	12.0
	Projected level	The city anticipates no increase in the levels of city service and no major capital outlays.	Surplus	3.9	9.0	13.8	26.6
			Capital outlays	12.0	---	---	12.0
	High level		Surplus	3.9	12.2	19.5	35.6
			Capital outlays	12.0	---	---	12.0
Price	Low level	1980--Parks and recreational facilities 1985--Parks and recreational facilities 1990--Major street improvements Parks and recreational facilities	Surplus	658.0	1,250.0	1,285.0	3,193.0
			Capital outlays	2,523.0	1,170.0	490.0	4,183.0
	Projected level	In addition to the low level needs: 1985--Library addition 1990--Enlarge sewer collection system	Surplus	750.0	1,295.0	1,532.0	3,577.0
			Capital outlays	2,567.0	1,200.0	535.0	4,302.0
	High level	In addition to the projected level needs: 1985--Enlarge sewer collection system	Surplus	750.0	890.0	530.0	2,170.0
			Capital outlays	2,567.0	1,620.0	715.0	4,902.0
Scofield	Low level	1980--Improve and enlarge water treatment, distribution and storage capacity Sewer collection and distribution system Enlarge fire station Sanitary land fill operation Parks and recreational facilities	Surplus	0	0	0	0
			Capital outlays	100.0	1,689.0	0	1,789.0
	Projected level	In addition to the low level needs: 1985--Library and city hall Parks and recreational facilities	Surplus	0	0	0	0
			Capital outlays	100.0	1,689.0	0	1,789.0
	High level	1990--Enlarge sewer treatment capacity	Surplus	0	0	0	0
			Capital outlays	100.0	1,689.0	0	1,789.0
Sunnyside	Low level	1980--Library (could be built with East Carbon) 1985--Cemetery additions 1990--Major street upgrade	Surplus	15.3	27.0	29.5	2,320.0
			Capital outlays	1,000.0	1,170.0	150.0	2,320.0
	Projected level	In addition to the low level needs: 1985--Municipal building additions 1990--Enlarge sewer collection and treatment plant	Surplus	15.5	27.6	31.0	74.1
			Capital outlays	1,000.0	1,170.0	150.0	2,320.0
	High level	The same as the projected level	Surplus	15.5	28.8	33.0	77.3
			Capital outlays	1,000.0	1,170.0	150.0	2,320.0
Wellington	Low level	1980--A library Parks and recreational facilities 1985--Municipal building Major street improvements Parks and recreational facilities 1990--Parks and recreational facilities	Surplus	54.0	53.8	79.1	156.9
			Capital outlays	220.0	700.0	15.0	935.0
	Projected level	The same as the low level	Surplus	90.0	115.0	70.0	275.0
			Capital outlays	220.0	745.0	40.0	1,005.0
	High level	The same as the projected level	Surplus	90.0	112.0	55.4	257.4
			Capital outlays	220.0	785.0	25.0	1,030.0

Table IV-22.--Description of projected community needs--Continued

County, Community	Production level	Projected needs		Surplus revenues and capital outlays (to the nearest thousand dollars) 1978-80	1981-85	1985-90	Total
Emery County							
Castle Dale---	Low-------- level	1980--Fire station plus equipment Sanitary land fill operation Parks and recreational facilities 1985--New library (2,000 sq. feet) Major street improvements Parks and recreation facilities 1990--Parks and recreation facilities	Surplus---------- Capital outlays--	12.4 1,507.5	23.5 657.5	28.2 ---	64.1 2,165.0
	Projected-- level	In addition to the low level needs: 1990--Enlarge water treatment and distribution	Surplus---------- Capital outlays--	14.2 1,507.5	32.6 685.0	40.5 ---	873.0 2,192.5
	High------- level	In addition to the projected level needs: 1985--Enlarge sewer collection and treatment system	Surplus---------- Capital outlays--	14.2 1,995.0	49.8 815.9	76.8 ---	140.8 2,810.9
Cleveland-----	Low-------- level	1980--Fire station and related equipment Sanitary land fill operation Parks and recreational facilities 1985--Major street improvements Parks and recreational facilities 1990--Parks and recreational facilities	Surplus---------- Capital outlays--	30.0 951.0	59.9 300.0	90.7 ---	180.6 1,251.0
	Projected-- level	In addition to the low level needs: 1985--Enlarge water treatment and distribution system Library Municipal building	Surplus---------- Capital outlays--	43.5 951.0	68.6 322.5	81.1 ---	193.2 1,273.5
	High------- level	In addition to the projected level needs: 1985--Enlarge sewer system treatment capacity Establish muncipal police force	Surplus---------- Capital outlays--	43.5 1,626.0	106.9 385.0	150.0 ---	300.4 2,011.0
Elmo----------	Low-------- level	1980--Fire station and equipment Sanitary land fill operation Parks and recreational facilities 1985--Street improvements Parks and recreational facilities 1990--Parks and recreational facilities	Surplus---------- Capital outlays--	4.0 830.0	0 300.0	2.0 ---	6.0 1,130.0
	Projected-- level	In addition to the low level needs: 1985--Enlarge water treatment and distribution system	Surplus---------- Capital outlays--	12.0 830.0	11.7 300.0	8.1 ---	31.0 1,130.0
	High------- level	In addition to the projected level needs: 1985--Municipal building Enlarge sewer disposal system Library Establish own police force	Surplus---------- Capital outlays--	12.0 830.0	0 1,178.5	0 ---	12.0 2,008.5
Emery---------	Low-------- level	1980--Fire station plus equipment Sanitary land fill operation Parks and recreational equipment 1985--Major street improvements Municipal building Parks and recreational facilities 1990--Parks and recreational facilities	Surplus---------- Capital outlays--	0 1,445.0	0 742.0	0 0	0 2,187.0
	Projected-- level	In addition to the low level needs: 1985--Library 1990--Water treatment and distribution system improvements	Surplus---------- Capital outlays--	0 1,445.0	0 764.5	0 0	0 2,209.5
	High------- level	In addition to the projected level needs: 1985--Enlarge sewer treatment capacity Establish own police force	Surplus---------- Capital outlays--	0 1,865.0	0 874.5	0 0	0 2,739.5
Ferron--------	Low-------- level	1980--Fire station plus equipment Sanitary land fill operation Parks and recreational facilities 1985--Major street improvements Parks and recreational improvements 1990--Parks and recreational improvements	Surplus---------- Capital outlays--	54.0 677.0	114.7 1,340.0	135.4 ---	304.1 2,017.0
	Projected-- level	In addition to the low level needs: 1985--2,000 sq. ft. Library 1990--Enlarge water treatment and distribution system	Surplus---------- Capital outlays--	57.0 677.0	127.5 1,370.0	156.8 ---	341.3 2,047.0
	High------- level	In addition to the projected level needs: 1985--Upgrade sewage collection and treatment capacities Establish own police force	Surplus---------- Capital outlays--	57.0 1,227.0	111.6 2,070.2	225.0 ---	293.6 2,297.2
Huntington----	Low-------- level	1980--Fire station and equipment Sanitary land fill operation Parks and recreational facilities 1985--Parks and recreational facilities Establish municipal police force 1990--Parks and recreational facilities	Surplus---------- Capital outlays--	54.5 1,124.5	107.5 64.5	131.5 27.5	293.3 1,216.5
	Projected-- level	In addition to the low level needs: 1990--Enlarge water treatment capacity	Surplus---------- Capital outlays--	15.0 1,139.5	93.3 92.0	157.5 ---	265.8 1,231.1
	High------- level	In addition to the projected level needs: 1985--Enlarge sewer treatment capacity	Surplus---------- Capital outlays--	15.0 1,139.5	135.5 194.5	252.5 ---	403.0 1,334.0

Table IV-22.--Description of projected community needs--Continued

County, Community	Production level	Projected needs		Surplus revenues and capital outlays (to the nearest thousand dollars) 1978-80	1981-85	1985-90	Total
Orangeville---	Low-------- level	1980--Fire station and equipment (to be provided by (Castle Dale) Sanitary land fill operation Parks and recreational facilities 1985--Library Major street upgrading Parks and recreational facilities 1990--Parks and recreational facilities	Surplus---------- Capital outlays--	8.0 1,335.0	9.3 435.0	4.0 122.5	21.3 1,893.5
	Projected-- level	In addition to the low level needs: 1990--Enlarge water treatment and distribution system	Surplus---------- Capital outlays--	3.7 1,335.0	12.7 500.0	10.8 105.0	27.2 1,941.0
	High------- level	In addition to the projected level needs: 1985--Upgrade sewer collection and treatment system Establish municipal police force	Surplus---------- Capital outlays--	3.7 1,335.0	6.8 630.0	7.4 571.0	17.9 2,536.0
Sanpete County							
Centerfield---	Low-------- level	Recreational facilities Road equipment Water system expansion	Surplus---------- Capital outlays--	10.6 87.9	10.4 ---	10.8 ---	
	Projected-- level	Further expansion of the low level services	Surplus---------- Capital outlays--	10.3 87.9	16.0 175.7	14.8 ---	
	High------- level	Further expansion of the projected level services	Surplus---------- Capital outlays--	10.3 87.9	16.0 175.7	29.2 244.9	
Fairview------	Low-------- level	The needs are the same under these three levels. No expansion is projected.	Surplus---------- Capital outlays--	[1] [12.2] ---	[7.8] ---	[7.8] ---	
	Projected-- level		Surplus---------- Capital outlays--	[12.2] ---	[9.0] ---	[8.8] ---	
	High------- level		Surplus---------- Capital outlays--	[12.2] ---	[9.3] ---	[11.5] ---	
Gunnison------	Low-------- level	Water system expansion Fire department improvements Recreational facilities Street maintenance equipment	Surplus---------- Capital outlays--	6.5 179.8	[8.3] ---	[8.3] ---	
	Projected-- level	Further expansion of the low level services Solid waste disposal equipment	Surplus---------- Capital outlays--	7.9 239.8	34.8 192.5	27.6 ---	
	High------- level	Further expansion of the projected action services	Surplus---------- Capital outlays--	7.9 239.8	48.4 192.5	124.2 52.7	
Mt. Pleasant--	Low-------- level	Water system expansion Fire department equipment Recreational facilities	Surplus---------- Capital outlays--	12.1 170.8	14.2 24.0	14.2 ---	
	Projected-- level	The same as the low level	Surplus---------- Capital outlays--	12.1 170.8	14.2 24.0	14.2 ---	
	High------- level	The same as the projected level	Surplus---------- Capital outlays--	12.1 170.8	14.2 24.0	14.0 ---	
Sevier County							
Aurora--------	Low-------- level	Water system expansion Fire department expansion Street maintenance equipment	Surplus---------- Capital outlays--	0.8 2,034.4	1.2 ---	4.3 ---	
	Projected-- level	Further expansion of the low level services City office building construction Recreational facilities Sewage treatment facilities	Surplus---------- Capital outlays--	0.1 3,928.4	13.5 854.9	16.1 10.0	
	High------- level	Further expansion of the projected level services, except for sewage treatment facilities	Surplus---------- Capital outlays--	0.1 3,908.4	20.7 584.9	3.5 275.4	
Redmond-------	Low-------- level	Water system expansion Street paving	Surplus---------- Capital outlays--	[0.7] 64.3	[0.1] ---	[0.1] ---	
	Projected-- level	Additional office space Recreational facilities Sewage treatment facility Solid waste disposal system Street maintenance equipment	Surplus---------- Capital outlays--	[1.4] 66.6	13.1 621.0	16.8 ---	
	High------- level	Water system expansion Solid waste disposal system Street maintenance equipment	Surplus---------- Capital outlays--	[1.4] 66.6	23.2 597.0	3.3 301.0	

Table IV-22.--Description of projected community needs--Continued

County, Community	Production level	Projected needs		Surplus revenues and capital outlays (to the nearest thousand dollars) 1978-80	1981-85	1985-90	Total
Richfield-----	Low-------- level	Water system expansion	Surplus----------	139.6	114.8	114.4	
		Fire department equipment	Capital outlays--	664.9	85.0	---	
		Recreational facilities					
		Street maintenance equipment					
	Projected-- level	Similar to the low level plus:	Surplus----------	163.7	190.3	198.1	
		Replace sewage treatment facility	Capital outlays--	673.9	462.7	10.0	
		Additional office space					
	High------- level	The same as the projected level except improve sewage treatment system	Surplus----------	163.7	212.5	159.4	
			Capital outlays--	673.9	237.7	28.0	
Salina--------	Low-------- level	Water system expansion	Surplus----------	[104.4]	[69.3]	[69.3]	
		Improve cemetery	Capital outlays--	464.0	---	---	
		Improve fire department					
		Recreational facilities					
		Solid waste disposal system					
		Street paving					
		Street maintenance equipment					
	Projected-- level	Similar to the low level plus more office space	Surplus----------	[145.1]	[431.5]	[790.7]	
			Capital outlays--	844.0	903.3	43.0	
	High------- level	Similar to the projected level except improve sewage treatment facility	Surplus----------	[146.1]	[564.1]	[239.3]	
			Capital outlays--	619.0	903.3	449.7	
Sigurd--------	Low-------- level	Water system expansion	Surplus----------	1.6	2.2	2.2	
			Capital outlays--	18.9	---	---	
	Projected-- level	Similar to the low level plus more office space	Surplus----------	1.2	16.4	20.3	
		Recreational facilities	Capital outlays--	494.9	321.3	20.0	
		Sewage treatment facility					
	High------- level	Similar to the projected level except the sewage treatment facility	Surplus----------	1.2	27.0	1.9	
			Capital outlays--	24.9	331.3	153.9	

[1] Deficits are indicated by brackets.

bonds must be authorized by a referendum election. Interest costs associated with this method of borrowing are generally the lowest going rates available since the full faith and credit of the municipality are behind the bonds. Revenue bonds must be repaid from funds generated by a facility, and service thereof, such as a sewer treatment plant. This limits the use of revenue bonds somewhat, but they are not subject to the debt limitation of a municipality. In addition, revenue bonds do not compete with other projects for tax revenue and are usually most equitable in terms of benefits and costs. When rapid growth is in progress, the lag between the need for debt capital and the generation of debt capital by bonding creates uncertainty in planning. Likewise, uncertainty with respect to planned industrial expansion and the duration of industrial activity often creates risk and high borrowing costs.

New legislation passed in 1975 allows creation of special service districts in Utah and provides for financing front-end costs of certain public services. It also permits a municipality to issue bonds and bond anticipation notes so that a municipality can immediately borrow money in anticipation of future bonding capacity which would result from an increase in the fair cash value of its taxable property. Also, under this legislation municipalities can obtain front-end monies by issuing guaranteed bonds. This requires that one or more taxpayers, such as an energy development company owning property within the district, guarantee the debt service payments. In addition, the creation of special service districts allow more flexibility in determining the geographic areas to be served, since all parts of a special service district need not be contiguous. This may help solve the problem of the geographic imbalance between anticipated tax revenues and population impact. The services, however, that can be provided within a special district are limited to water, sewage, drainage, flood control, garbage, hospital, transportation, recreation, and fire protection.

The 1975 Utah Legislature also enacted the Resource Development Act. This Act authorizes those developing or utilizing natural resources to help governments provide state-related improvements by prepaying State sales and (or) use taxes. Though the private developer is not required to prepay taxes, the law permits a tax prepayment scheme to make money available to local governments before taxes actually become due. Under this legislation all prepaid sales and use tax revenues are credited to a special account within the State General Fund and are then appropriated by the Legislature for State-related public improvements (primarily roads and schools) associated with development or utilization of natural resources.

The 1978 Legislature provided additional relief to growth-impacted communities by allowing 32 1/2 percent of all coal royalties returned to the State to flow through the Utah Department of Community Affairs to local governments (Senate Bill 149). The Department is to disperse these funds to growth-impacted communities on the basis of predetermined priorities.

c. Education[1]

1. Carbon County School District

An increase of more than 1,000 students is anticipated in 1990 under the projected level over that necessary at the low level. This would require a $4 million investment[2] in schools and an additional 40 teachers.

2. Emery County School District

In Emery, a peak increase in the number of students would occur in 1985. An additional 2,000 students would require a $6 million investment in classrooms and equipment and the hiring of an additonal 83 teachers.

3. North Sanpete County School District

The number of students is projected to increase by 82 in 1990. An additional three teachers would be needed and an investment in facilities of $2.9 million over that required under the low level case.

4. South Sanpete County School District

By 1990 an additional 111 students would need to be served. This would require four more teachers and $3.5 million for facilities and equipment.

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[1] More detailed information on educational need is available in earlier referenced reports.

[2] The cost estimates reflect a general upgrading or replacement of facilities in addition to providing the space required to serve more students.

5. Sevier County School District

In 1985 a peak increase of 940 students will have to be served. The schools in Salina and Richfield will be the most severely impacted. An additional 37 teachers will be needed and an investment $4.5 million greater than the amount needed under the low level scenario.

6. Wayne County School District

School enrollment in Wayne County will peak sharply in 1985 with an increase of 1,230 students. This number will decline by 430 by 1990. This pattern reflects the construction phase of the IPP plant at Caineville, Utah.

At the construction peak, an additional 49 teachers and $6.8 million would be needed for adequate facilities.

d. Social Change

At the projected level, the population of the region would increase from 54,700 in 1975 to 91,000 by 1990. Most of this addition would be concentrated in Carbon, Emery, Wayne, and Sevier Counties, where the combined 1975 population of 40,600 would expand to 76,600 by 1990.

The area labor force is small and offers little capacity to supply the requirements of expanding coal mining and powerplant construction and operation. In Wayne County, in-migration of workers and their families would be sufficiently great to outnumber the existing labor force. The effects of in-migration in Carbon, Emery, and Sevier would be less dramatic. Most in-migrants would come from outside the region and the State. The diversity of the backgrounds of the migrants would contrast sharply with the social and cultural characteristics of area residents living in communities and counties unassociated with past or current coal mining or powerplant construction activities.

Coal mining and construction employees would be paid higher wages than are typical of the region (with the exception of Carbon and Emery Counties). Resultant competition for labor would adversely affect existing area businesses. Rising total and average income would spur competition for goods, services, and housing, as limitations to a rapid augmentation of supply exist. This will aggravate the problems of those living on low or fixed incomes, particularly the elderly.

Demand for housing would grow. The region would require 5,000 more dwelling units in 1990 than would be the case in the absence of projected level conditions. The use of mobile homes would increase.

Rapid growth will place temporary unavoidable financial pressure on local governments, particularly in those parts of the region which have yet to cope with population expansion induced by resource development. Both the quality and quantity of some municipal services may decline. This will be truer of communities, where the growing population will reside, than of counties, where tax revenues will rise because of location of coal mining and powerplants. Of note, are the effects of rapid growth on water supply, sewage and solid waste disposal, health care and hospitals, social services for personal and family problems, police and fire protection, recreation facilities, and education.

Rapid growth may have effects on basic community institutions and ways of life. Because the complex assumptions, values, and perspective upon which relationships are based in the community are simply taken for granted, changes in these supports for community life may not be apparent until after normal activities have been disrupted. Drastic, rapid alteration of the local economy will yield difficult, largely unanticipated changes in other areas of life--in family, religious, and political patterns. Such changes would be most likely to occur in parts of Emery, Sevier, and Wayne (and perhaps Sanpete) Counties--where coal mining and powerplant construction have not occurred. Lasting social and cultural changes must be expected there.

Lasting social and cultural changes can be expected for some communities in Wayne, Sevier, Sanpete, and Emery Counties at the projected level. As workers and their families move into these communities from outside the region and State, the communities would become less rural in orientation. Current ways of living would decline, particularly because many communities are very small at present and can be overwhelmed by even the relatively small numbers of migrants anticipated under projected level coal mining and associated activity.

4. TRANSPORTATION AND UTILITIES

a. Highways

Coal movement by truck would be limited in most instances to transporting coal from the mine mouths to loading sites such as railway tipples or conveyor access points. These short haul truck trips, commuter trips and other trips generated by an increased population, would increase the demand on the local highway network (table IV-23, fig. II-26).

About 49 miles of new or upgraded access roads would be required for the proposed new mines. Except for this, no new highways are proposed in the region. Traffic increases, therefore, would have to be accommodated on the existing highway system modified as necessary to handle the additional traffic loads.

Table IV-23.--Traffic levels at selected points--projected level (24 mty)

Segment	1975 ADT[1]	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1----------	3,210	4,024	5,525	6,914	1,564
2----------	3,365	4,344	6,076	7,747	1,611
3----------	215	259	346	420	78
4----------	345	723	1,214	1,857	169
5----------	50	92	153	226	90
6----------	3,520	4,410	5,750	7,079	1,895
7----------	115	252	439	632	76
8----------	270	358	504	548	41
9----------	3,240	3,610	4,308	3,925	831
10----------	310	541	844	1,232	118
11----------	430	607	891	1,027	308
12----------	190	380	642	896	298
13----------	2,700	3,453	4,975	5,666	1,408
14----------	480	623	953	900	210
15----------	450	528	784	1,120	274
16----------	1,030	1,358	1,834	2,339	302
17----------	1,030	1,358	1,834	2,339	302
18----------	1,615	1,926	2,405	2,865	470
19----------	250	302	383	456	227
20----------	1,795	2,575	4,118	4,345	1,426
21----------	45	66	121	103	11
22----------	320	446	761	682	75
23----------	2,800	3,573	5,295	4,925	739

[1] Average daily traffic.

The major increases in traffic occur on highway segments on which improvements already are proposed by the State Department of Transportation, regardless of coal development, or on segments which require upgrading to accommodate normal growth in the region (chapt. II). The major improvement required at the projected level is: expansion of SR 10 to a four lane configuration between US 6 and SR 31, paving the Coal Creek county road from Wellington north to the AMCA minesite, and the addition of passing lanes between SR 31 and SR 29. In addition, intersection improvements may become necessary at various points in the region.

Impacts Associated with Increased Traffic.--Assuming that anticipated traffic increases (table IV-23) are representative of regional traffic growth, highway use in 1990 would be about twice 1975 levels. Approximately 26 percent of this increase is attributed to coal production at the projected level of 24 mty. Although the highway system with the modifications could accomodate the projected traffic increases, more vehicles on the same roads would result in longer travel times and delay. Congestion would be compounded at intersections in the more developed areas. Additionally, the occurrence of traffic accidents would tend to increase at a rate similar to the increase in traffic volumes.

Increased volumes of traffic, in particular increased numbers of trucks, would accelerate deterioration of highway pavements. This would require that normal maintenance schedules be accelerated. Highway construction and maintenance is presently funded from road user taxes whose main component is the tax on fuel. Although increased traffic may increase these revenues, improved fuel efficiencies would tend to reduce these increases. The Utah DOT feels that present funding formulas would be inadequate to meet the demands for highway maintenance precipitated by energy resource development at the projected level.

Increased highway use may result in increased consumption of gasoline and diesel fuel. Based on fuel consumption rates in Utah in 1976 and assuming a 75 percent increase in average fuel efficiency between 1975 and 1990, approximately 6 million additional gallons of motor fuels would be consumed in 1990. Not included in this calculation is the increased consumption of diesel fuel which would be required to truck coal to loading facilities. This compares to the 1975 motor fuel consumption in Utah of 720,443,000 gallons. Approximately 10 million gallons of diesel fuel would be consumed if all 24 million tons of coal would move by truck an average one-way distance of 20 miles. (This distance is an incomplete composite of truck-haul distances for those mines for which markets have been determined and includes truck haul from minemouth to railhead or ultimate destination). About 25 percent of this volume of fuel consumption would be created by the increase in production from the low to the projected level of coal production. This compares to 73,899,000 gallons of diesel fuel consumed by highway use in Utah in 1975.

Higher traffic levels would increase the rate at which highway related wastes enter the environment. Among these wastes would be fuels, motor oils and related motor vehicular fluids, plastics, rubber, various metals, and trash. While most of these wastes are initially deposited on or are adjacent to the highways, storm water flows may cause these wastes to migrate into the aquatic environment. Noise levels at points adjacent to highways would also increase.

b. Railroads

The ultimate market of most coal produced in the Central Utah coal region is presently unknown. Existing and proposed powerplants in the region would be expected to consume a significant but unknown percentage of the production at the projected level. Any coal shipped from the region would most likely move by rail. If all 24 million tons projected for annual production by 1990 moved by rail, approximately 240,000 rail cars (assumes 100-ton net capacity cars) of freight would be generated. Carried in 80-car trains, this would add an average of 16.6 trains per day to the regional rail system; 100-car trains would add an average of 13.3 trains daily.

Two rail spurs from the D&RGW would be constructed, one to the Dugout Canyon mine and one to B Canyon mine, to provide access from these mines to the existing rail system. No other major modifications to the rail system in the region, except those planned by the Utah Railway, would be necessary to accommodate this amount of traffic generated by the projected level of production.

Impacts from Increased Rail Use.--The amount of fuel consumed transporting coal by rail from the region would be dependent on numerous factors, including: the volume moved, the location of the market, train routing, and the type of rail carriage (unit train or general freight). Many of these aspects of the potential coal movement are unknown; therefore, the total amount of fuel consumed moving coal cannot be predicted. Estimates of the rate of fuel consumption were made for two scenarios to assist in understanding the potential magnitude of this impact. One scenario assumed a typical unit train operation for 127 miles and the other assumed the same type operation for 1,625 miles. These distances were based on reports of the shortest extra-regional movement (from the Geneva mine to Orem, Utah) and the longest extra-regional movement (Castlegate to Gary, Ind.) for coal mined in the region. Using a "typical" unit train fuel efficiency of 300-ton miles/-gallon the fuel consumption is as follows:

Distance	Gallons of fuel per ton of mover
127	.42
1,625	5.42

Air quality is impacted by locomotive exhaust and by dust blowing off the coal loaded in open top hopper cars. Neither of these sources are expected to be significant factors in the future regional air quality (see Air).

Increased train frequencies would increase noise levels at points along the rail line. The area in which noise levels exceed USEPA's long term noise control goal (55 decibels "A" scale [dBA]) would expand (fig. IV-1).

The train frequency to noise data is based on noise generated by current rail locomotive and rolling stock. Maximum locomotive and car single exposure noise level standards have been established which would tend to lessen the future magnitude of the noise of rail operations.

Increased rail traffic would bring about a corresponding increase in the number of potential conflicts between trains, motor vehicles, and pedestrians at highway-rail grade crossings. No inventory of grade crossings in the region exist which, together with the uncertainty in the rail movements, prevents a specific prediction of increased grade crossing accidents. However a "typical" grade crossing with an average daily highway traffic of 1,000 vehicles and averaging 28 train crossings per day would expect to be the site of one accident every 10 years. This is not significantly different from projections of accidents if no new mines were developed.

Trains create a barrier at highway-rail grade crossings preventing normal highway movements. A "typical" 80-car unit train moving at 20 miles per hour would physically block a crossing for about 2 1/2 minutes. Warning devices and driver anticipation would further extend the time that a particular crossing is closed. Assuming a 4 minute delay per train, 26 trains would block a particular crossing for 1 hour and 44 minutes. Approximately 16 minutes of this total is attributed to the projected level of development. Under normal conditions, train movements will be spread throughout the entire day, therefore blockages would not normally be longer than 8 to 12 minutes at any one time. Furthermore, the regional rail system is such that few, if any, grade crossings would be subjected to all train movements.

Extra Regional (down line) Impacts.--The generic impacts discussed previously would pertain to rail movement regardless of routing. As could be seen in the discussion of generic impacts, the effect of an individual train would not be significant. It is the repetition of these small impacts which may become significant. The major extra-regional impacts occur where movements of central Utah coal are added to lines with already high rail traffic.

The ultimate destination and routing of much of the potential coal traffic is unknown so an analysis cannot be made of impacts on a specific point outside the region. Potential routes and destinations, however, can be surmised from recent trends in coal utilization and marketing.

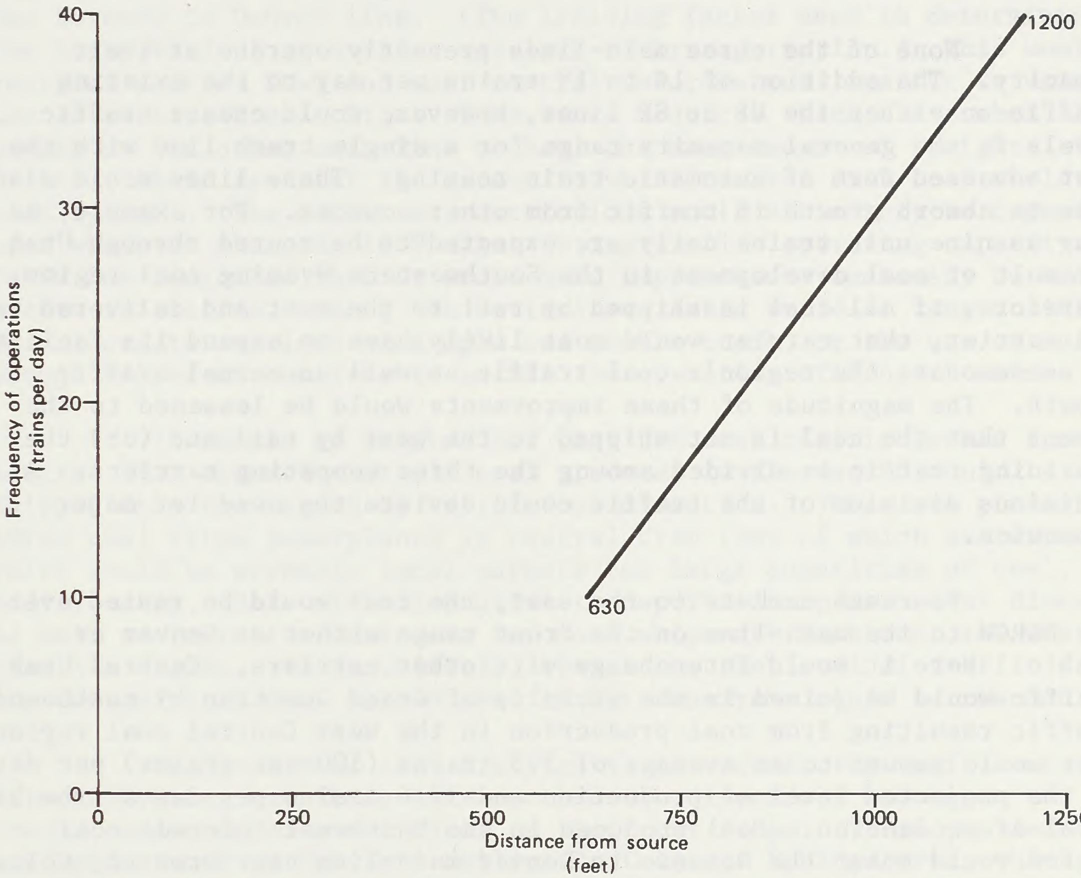

Figure IV-1.--Distance of 55 dBA contour from track (assumes 20 mi/hr speed of train).

Coal might be transported to the west or to the east. A major growth in coal utilization in the Salt Lake area is not expected; the trend has been to build new powerplants in rural and central and southern Utah. Westbound coal traffic, therefore, would have to be interchanged with carriers serving other market areas. Both the URY and D&RGW interchange with the Union Pacific in Provo. D&RGW interchanges with the Union Pacific and Western Pacific in Salt Lake City and with the Southern Pacific in Ogden. Westbound central Utah coal traffic would also be joined by westbound traffic from the West Central Colorado coal region. This would amount to an average of 2 1/2 unit train trips daily at the projected level of production and an average of 5 3/4 trains per day at the high level of production.

None of the three main-lines presently operate at their capacity. The addition of 16 to 19 trains per day to the existing traffic on either the UP or SP lines, however, would create traffic levels in the general capacity range for a single track line with the most advanced form of automatic train routing. These lines would also have to absorb growth in traffic from other sources. For example, as many as nine unit trains daily are expected to be routed through Utah as a result of coal development in the Southwestern Wyoming coal region. Therefore, if all coal is shipped by rail to the west and delivered to one carrier, that carrier would most likely have to expand its facilities to accommodate the region's coal traffic as well as normal traffic growth. The magnitude of these improvments would be lessened to the extent that the coal is not shipped to the west by rail and (or) the remaining traffic is divided amoung the three competing carriers. A judicious division of the traffic could obviate the need for major expansion.

To reach markets to the east, the coal would be routed over the D&RGW to its main-line on the front range either at Denver or Pueblo. Here it would interchange with other carriers. Central Utah traffic would be joined in the vicinity of Grand Junction by eastbound traffic resulting from coal production in the West Central coal region. This would amount to an average of 5.5 trains (100-car trains) per day at the projected level of production and 12.6 trains per day at the high level of production. Coal produced in the Northwest Colorado coal region would enter the Dotsero to Denver main-line near Orestod, Colo. This would amount to an average of 12.6 trains per day at the projected level of production and 23.5 trains per day at the high level.

Central Utah coal by itself could be easily accommodated on either route between Dotsero and the front range. Growth in coal traffic from these other regions, however, would reduce the flexibility of the railroad and shippers.

The volume of traffic generated by the Northwest Colorado coal region would be an important factor in determining the amount of coal capable of being shipped east from the other regions and the route by which this traffic would travel. Traffic growth resulting from the projected level of development in the Northwest Colorado coal region may require improvements to the Dotsero to Denver line to permit more efficient operation of 100-car trains. Such improvements would leave residual capacity sufficient to permit a choice in routing of coal produced in west central Colorado and central Utah at the projected levels of production if it was not concentrated on this line. The flexibility would be significantly lessened if the improvements are not made.

A major problem arises if the Northwest Colorado coal region reaches its high level of production. It can be expected that this region would be utilizing substantially all the available capacity of the Dotsero to Denver line. (The limiting factor used in determining the high level of production was lack of transportation.) This would restrict central Utah and west central Colorado coal traffic to using the Dotsero to Pueblo line. This route requires twice the number of trains as the other main-line to haul the same amount of freight. This in turn, could restrict the extent to which central Utah coal could move east by rail. The extent of restrictions would ultimately be dependent upon whatever changes D&RGW makes to improve its operating capacity. D&RGW has indicated that it would make improvements necessary to handle growth in traffic. Among the options available would be longer sidings (or alternate sections of single and double track) or the use of sufficient enough helper locomotives to permit the operation of longer trains.

It should be pointed out that the coal traffic levels from central Utah assumed that all coal produced in the region would be shipped from the region by rail in one direction. There are presently three coal fired powerplants in central Utah (two of which are expanding) which would be probable local markets for large quantities of coal. Additionally, there are alternative transportation plans under discussion as well as tentative contracts for coal shipments both east and west from the region. It is unlikely, therefore, the level of traffic from the Central Utah coal region used in this analysis could be reached.

The growth of coal traffic, in particular the traffic moving between Wyoming and Texas in a north-south direction, has begun to create rail-community conflicts on the front range. These problems are most pronounced in the Fort Collins to Colorado Springs area, which includes Denver. Routing of central Utah coal over the line from Dotsero to an interchange with another carrier in Denver, although not seriously affecting north-south movements, would add to already high rail congestion in the city. If this traffic then moves south along the front range to Colorado Springs or Pueblo for interchange, it would further aggrevate existing problems.

The rail line (jointly operated D&RGW and AT&SF) on the front range generally passes near the center of communities that it serves. Except in Colorado Springs and Pueblo, little opportunity is afforded to cross the tracks when a train is present. This disrupts the established circulation patterns and effectively separates many essential community facilities from their service areas while the trains are present at the grade crossings. A study performed for the Colorado Department of Highways (URS Company, 1976) has recommended study of 11 new grade-separated crossings in this area. It should be pointed out that this line provides the only rail connection on the front range between Denver and Pueblo and is used by the AT&SF to serve Denver and the BN to ship coal to Texas. Large volumes of Wyoming, Utah, or Colorado coal using this line may require the installation of more frequent passing tracks on the segments with only a single track, the double tracking of these segments, or may serve to force traffic onto other rail lines.

Shipment of coal over the Dotsero to Pueblo line does not create significant problems with delay if shipments do not travel up the front range to Denver. This movement would have the same effect as the reverse movement. Seven rail routes could take coal traffic to potential markets to the east or southeast once it reaches the front range. If all the coal traffic generated in the three regions were to be routed over one or two of these lines, major improvements would be necessary to provide the needed capacity. However, if the traffic is divided among the various lines, no individual line's capacity would be seriously taxed and the impact at any particular point downline from additional train operations would be less than would occur at points in the region.

5. RECREATION

Owing to support of the proposed actions, impacts would accrue from: a) additional use of recreation facilities and use areas (tables IV-24 and IV-25) by increased population associated with an increase in coal mining; b) increased industrial traffic on existing and extended road systems; and c) exclusion of properties, occupied by mine plantsites and some ancillary facilities, for recreation use.

Overall increases by residents in recreation visits and visitor days use (table IV-24) and increases in visits by main recreation purposes (table IV-25) are anticipated. Total resident and non-resident visits to the three multi-county subregion for 1985 and 1990 are shown on table IV-26.

In comparison to increases in recreation visits and use by non-residents of the region, use of the same recreation resource by an increased coal-related population is minor (tables IV-24 and IV-26).

Present (1976) levels of recreation use at many developed recreation sites and of local, regional, and national recreation areas and attractions are above, or nearing user carrying capacities. By 1985 and 1990, projected increases in recreation use and activities at the projected coal production level would further compound impacts described at the low level (chapt. II, future environment).

In addition, increased industrial traffic would increase the

Table IV-24.--Increase in recreation visits (trips) and recreation visitor days use within the central Utah recreation influence zone by residents

-1- Description of action generating population, recreation visits and recreation visitor days	[1]-2- Population of region to support coal production at levels shown in column 1			[2]-3- Recreation visits by residents to Central Utah coal recreation influence zone			[3]-4- Recreation visitor days by residents spent in central Utah coal region recreation influence zone		
	1976	1985	1990	1976	1985	1990	1976	1985	1990
Present level (1976) (8 mty)---------------	59,350	59,350	59,350	385,800	385,800	385,800	1,203,700	1,203,700	1,203,700
Low level (19 mty)---------------	--	68,111	73,655	--	442,700	478,800	--	1,381,200	1,493,900
Projected level (24 mty)---------------	--	74,910 [4](6,799)	78,364 (4,709)	--	486,900 (44,200)	509,400 (30,600)	--	1,519,000 (137,800)	1,589,300 (95,000)
High level (42 mty)---------------	--	110,050	111,984	--	715,300	727,900	--	2,231,700	2,271,000

[1]Population figures from socioeconomic section.
[2]Average out-of-community but within region trips averages 6.50 per year per household or household member.
[3]Each out-of-community but within region recreation trip averages 3.12 visitor days (37.44 hours). Visotor day equals 12 hours aggregated by one or more persons. Both [2] and [3] are from baseline information calculated from figures in Utah Resident Recreation Travel, 1974, 1975, and 1976, by J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool, Institute for the Study of Oudoor Recreation and Tourism, Utah State University, Logan, Utah. Because visits and visitor days are based on trips by household or household member (i.e. may be 1, 2, 3, or total household members) projections based on total population of the region represent "worst case analysis" figures.
[4]Figures in parenthesis are net increases (difference) between the low level and the projected level.

Table IV-25.--Out-of-community, outdoor recreation trips within the central Utah recreation influence zone by residents

[Source: Utah Resident Recreation Travel, 1974, 1975, 1976, Institute, USU, Logan, Utah, J. D. Hunt, W. H. Becker, M. J. Dalton and S. F. McCool. Based on population increases to support coal mining activities at three levels. (Coal production is shown in million tons per year (mty), population numbers in thousands.)]

-1-	-2-		-3-				-4-				-5-			
Recreation activity	Present ranking and no. of trips by activities (1976)[1] (8.0 mty)		Low level[2] (19 mty)				Projected level of production[2] (24 mty)				High level (42 mty)			
			1985	Increase	1990	Increase	1985	Increase	1990	Increase	1985	Increase	1990	Decrease
Driving for pleasure and sightseeing	23.5%	90,700	104,000	13,300	112,500	21,800	114,300	10,300	119,700	7,200	168,100	64,100	171,100	58,600
Fishing	14.9%	57,500	66,000	8,500	71,300	13,800	72,400	6,400	75,900	4,600	106,600	40,600	108,500	37,200
Hiking and backpacking	9.6%	37,000	42,500	5,500	46,000	9,000	46,700	4,600	48,900	2,900	68,700	26,200	69,900	23,900
Water sports (boating, swimming, etc.)	8.9%	34,300	39,400	5,100	42,600	8,300	43,300	3,900	45,300	2,700	63,700	24,300	64,800	22,200
Picnicking	6.9%	26,600	30,500	3,900	33,000	6,400	33,600	3,100	35,200	2,200	49,400	18,900	50,200	17,200
Hunting big game	4.3%	16,600	19,100	2,500	20,600	4,000	21,000	1,900	21,900	1,300	30,700	11,600	31,300	10,700
Camping	4.3%	16,600	19,000	2,400	20,600	4,000	21,000	2,000	21,900	1,300	30,700	11,700	31,300	10,700
Spectator sports (watching sporting events, etc.)	3.8%	14,700	16,800	2,100	18,200	3,500	18,500	1,700	19,400	1,200	27,200	10,400	27,700	9,500
Four-wheel driving and motor cycling (includes ORV use)	3.8%	14,600	16,800	2,200	18,200	3,600	18,500	1,700	19,400	1,200	27,100	10,300	27,600	9,400
Golf	3.3%	12,800	14,600	1,800	15,800	3,000	16,000	1,400	16,800	1,000	23,600	9,000	24,000	8,200
Winter sports (snowmobiling, skiing, tubing, ice skating, etc.)	3.3%	12,700	14,600	1,900	15,800	3,100	16,000	1,400	16,800	1,000	23,600	9,000	24,000	8,200
Hunting small game and shooting	3.0%	11,600	13,300	1,700	14,400	2,800	14,600	1,300	15,300	900	21,500	8,200	21,800	7,400
Other (rock hounding, horseback riding, photography, gathering resource products)[3]	10.4%	40,100	46,100	6,000	49,800	9,700	50,600	4,500	52,900	3,100	74,400	28,300	75,700	25,900
Total	100.0%	385,800	442,700	56,900	478,800	93,000	486,900	44,200	509,400	30,600	715,300	272,600	727,900	249,100

[1]Individuals may or may not have participated in more than one activity, as listed, during each trip. Figures shown are for major purpose of trip and total 100 percent; i.e., trip may have primarily been for fishing, however, visit may have also included picnicking, sightseeing, etc. Thus, trip percentages and number of trips are categorized by main purpose of trip. No time element is involved in this summary sheet.

[2]Includes resident visits and use figures from Piute County which is within the Central Utah coal region recreation influence zone.

[3]Participation by present population during sample period was less than one-half of one percent in any one activity.

Table IV-26.--A comparison of 1976, 1985, and 1990 recreation visits to multi-county subregions within the central Utah recreation influence zone

Multi-county Subregions -1-	[1]1976 Resident and non-resident recreation visits to each subregion -2-	1985 Recreation visits to each subregion at indicated coal production levels				1990 Recreation visits to each subregion at indicated coal production levels			
		[2]8.0 mty	[3]19.0 mty	[3]24 mty	[3]42 mty	[3]8.0 mty	[3]19 mty	[3]24 mty	[3]42 mty
Panoramaland-------	3,800,000	7,045,100	7,487,800	7,532,000	7,760,400	9,927,400	10,406,200	10,436,800	10,655,300
Castle Country-----	2,068,500	3,835,000	4,277,700	4,321,900	4,550,300	5,403,900	5,882,700	5,913,300	6,131,800
Canyonlands--------	2,051,300	3,803,100	4,245,800	4,290,000	4,518,400	5,359,000	5,837,800	5,868,410	6,086,900

[1]Based on Utah Resident Recreation Travel, 1974-1976 and Regional Non-resident Travel, 1974-1976, by J. D. Hunt, W. H. Becker, M. J. Dalton, and S. F. McCool, Institute for the Study of Outdoor Recreation and Tourism, Utah State University, Logan, Utah. Visits to Panoramaland may be misleading. Two major Interstate Highways (I 70 and I 15) serve this multi-county subregion and many visitors pass through the area. Over-night stays, dollars spent and attractions visited are among the lowest in the State according to the above reports. Also, few National recreation attractions are present in the subregion.

[2]Resident and non-resident increase in recreation visits based on a 7.1 percent increase (average annual increase in recreation visits for National Parks and Monuments in Central Utah coal region from 1966 to 1976. Source: National Park Service Recreaction Use Records. Except for the Bullfrog and Hite area within the Glen Canyon NRA, the 7.1 percent increase represents the highest increase in recreation visits to any major recreation use area and attractions in the central region.

[3]All figures shown are recreation visits at the 8.0 mty level plus total recreation visits generated by future populations at each production level to provide "worst case analysis" (Figures have been added to each subregion).

Note: Figures for the three subregions should not be added together to get an overall total for the recreation influence zone. Visits within the recreation influence zone by both residents and non-residents may or may not involve travel in one or more of the subregions. In most cases, at least two subregions are visited during a trip.

probability of more accidents, impeding normal flow of recreation traffic (driving for pleasure and sightseeing), and increase dust, and noise nuisances along and adjacent to travel routes (see chapt. IV, Air).

Sites occupied by mine plant complexes would be removed from recreation use during the life of the mines. Recreation use on adjacent land areas would be altered by a) introducing more people into such areas because of improved access, and b) reducing the current opportunities for hunting, fishing, backpacking, solitude, and unconfined or unaltered back-country recreation use.

Areas used for recreation seem to be extensive. However, if projected increases in use continue at the present rate, critical shortages and serious deterioration of developed facilities and improper or illegal use of undeveloped areas could occur.

The projected increase in use at Bullfrog and Hite (chapt. II, fig. I-2) are principally a function of non-resident visits. Coal production at the projected 24 mty level would generate 140,700 visits by 1985 and 94,300 by 1990 within the Central Utah coal recreation influence zone. This would be compared to total visits to the two areas of 2,784,900 by 1985 and 11,160,400 by 1990 at the present rate of increase (32 percent per annum). This total increase is not expected to continue at the 32 percent per annum, however. Limited space, facilities and administrative restrictions, as well as user dissatisfaction will moderate this increase in use in the future. Overall, the increase in use through 1990 will most likely approach an increase of 5 percent to 8 percent per annum.

6. ARCHEOLOGIC AND HISTORIC VALUES

It is not possible to accurately quantify the number of archeological and historic sites that would be directly or indirectly impacted by coal development. Six archeological sites might be directly impacted on each square mile of ground disturbed, based on extrapolation of the AERC class II inventory data (AERC, 1977). Statistically, the number of sites could vary from less than one to 20 per square mile. The proposed Mountain States No. 1 mine is in an area with a high potential for impacts on cultural sites (fig II-26).

Impacts directly associated with coal mining and related activities would be mainly the result of disturbance by earth moving equipment of previously unidentified (usually buried) sites.

Increased regional population, owing to increased coal development, coupled with the opening of previously inaccessible areas, would result in increased vandalism, primarily to off-project sites. Some impacts would occur simply through greatly increased area use, even without malicious intent.

Loss of sites through necessary salvage constitutes an adverse impact on research potential, although data extracted from them would be preserved.

Some projects may effect substantial changes in the settings or context integrity of sites, particularly historic sites. Stabilization, restoration or moving of buildings or artifacts to other locations is also an adverse impact to context and *in situ* value and integrity.

Positive impacts will also result from coal development. Valuable information has been gathered and other surveys could be necessary prior to any disturbance. The additional surveys will result in the accumulation of data that would otherwise not have been available until the future, or which may have been lost. Any salvage excavation that is required will result in the preservation of data and material (including some that might otherwise be lost to vandalism), although *in situ* value is lost.

7. ESTHETICS

Specific impacts to the visual resource because of increased coal mining of the projected level scenario are described in detail in part II. Except for the Mountain States No. 1 mine, the proposed mines would be located in areas adjacent to existing or old mine workings where similar activities and facilities have existed for more than 100 years.

More urbanization would occur in existing communities; improved and extended access roads and secondary ancillary facilities would be needed. In some cases the visual character of smaller, outlying communities would be changed from rural-ranching to one of more urbanization.

Some secondary impacts would accrue to the visual resource in the region by indiscriminate increases in off-road vehicle use, littering, vandalism; and noise and dust from increased industrial activities.

In addition, road construction and utility line construction would introduce strong axis lines which would change the natural landscape character. To some individuals, this would detract from the enjoyment in viewing the landscape.

CHAPTER V: UNAVOIDABLE ADVERSE IMPACTS

A. NATURAL ENVIRONMENT

1. LAND

a. Land Surface, Seismicity, and Paleontology

Some modifications of the land surface and drainage patterns within the Central Utah coal region will be unavoidable. Following mining and reclamation, traces of some excavations, waste-rock piles, and sludge and settling ponds would remain, but will become less noticeable with each year because of reclamation. Some roads and reservoirs probably would remain permanently, and those on Federal land might be converted to other uses with the mandatory approval and concurrence of the land management agency. The location and extent of many of these modifications are presently unknown, nor can it be predicted which might be retained. These impacts are not significant in terms of the land, but they may present an adverse esthetic impact to some observers (see chapters IV and V, Esthetics).

During mining, and for a short but undeterminable time (probably 3 to 5 years) afterward, some of the ground surface potentially could subside as much as several feet above 30,000 to slightly more than 40,000 acres. In general, monitoring and enforcement of 30 CFR 211 regulations by USGS will limit maximum subsidence to areas of low sensitivity in relation to other potential uses of the land. Subsidence, where it does occur, would be accompanied by shallow to deep open fractures and sinkholes and compressional upbucklings of surface rocks. The pattern of subsidence over room-and-pillar mined areas will be more irregular, resulting in more uneven topography, than over longwall-mined areas. The cracks would fill and heal with soil over time.

Mining-induced earthquake tremors, with magnitudes as great as 4.5, would increase with mining activity. The tremors would be hazardous to mine workings and ancillary facilities, but damage is not expected to be significant to susceptible structures beyond individual mine areas. Underground hazards to miners, including cave-ins, bumps, squeezes, flooding, and dangerous concentrations of methane, are in part unavoidable. About 9 fatalities and 618 nonfatal accidents are anticipated per year owing to coal mining.

Unavoidable destruction, disturbance, and removal of paleontological resources, both exposed and unexposed, would occur. The potential significance of this impact cannot be meaningfully assessed.

b. Minerals

About 382 million tons of coal is proposed for mining and consumption (table I-1) over the entire life of the new mines proposed for Federal approval. A similar amount of coal would be left in place and lost to ultimate recovery. The loss of this quantity of a nonrenewable resource would be an unavoidable adverse impact. Uncontrolled, and uncontrollable coal-bed fires are in part unavoidable. This impact is not quantifiable nor predictable and significance cannot, therefore, be determined.

c. Soils

Soils would be disturbed on 2,924 acres as a result of mining and related activities, including community development, as itemized in table I-6. Enforcement of existing regulations would largely preclude significant adverse impacts pertaining to soil erosion and reductions in soil productivity on reclaimed sites.

Reclamation of soils disturbed by off-road recreation vehicles would not be the responsibility of the mining companies, so the disturbance would constitute an adverse environmental impact where ORV's are used indiscriminately. (See Recreation and Esthetics.)

2. WATER

About 6,000 acre-feet of water probably would be diverted over the long term from agricultural to public water supply. The 2,000 acre-feet per year required for mining is a short-term commitment but may be long term if the level of mining remains as high or higher than the projected level. At this level of use, the quantity involved does not seem to be a significant adverse impact. Mining operations in or below saturated beds would cause local water-level declines and change the magnitude and direction of local ground-water flow patterns. The amount of ground water and saturated beds affected, however, would be small. The area affected by mining would be about one-half of 1 percent of the region. As the deeper saturated beds would not be affected, the mines would impact an insignificant percentage of the total saturated strata. Water levels in some places would recover within a few years after mining ceases; in other places, such as those where water is contained in thin saturated sandstone beds, water levels might never recover. The flow of some springs might decrease, which could restrict the use of some areas by wildlife and livestock.

3. AIR

Little regional air quality impact is anticipated over most of the central region. Assuming paving or chemical stabilization, which approximates paving, impacts to air quality from particulates associated with mining activity would be primarily coal storage, loading, unloading, and conveying. These impacts would be small, highly localized, and site specific. Other TSP emissions include area sources and powerplants. The greatest regional impacts of area sources would occur north of Price and in the Castle Valley. In the Price area, TSP concentrations would be increased to a maximum 24-hour average of 50 $\mu g/m^3$ and an annual average of 45 $\mu g/m^3$. In the Castle Valley, TSP levels would be increased to a maximum 24-hour average of 36 $\mu g/m^3$ and an annual average of 31 $\mu g/m^3$.

The projected production scenario includes the IPP powerplant, but the location is uncertain. If the plant were to be located at the Salt Wash site, class I limitations at Capitol Reef National Park would be violated and impairments to visibility could occur. Until EPA develops regulations regarding visibility in mandatory class I areas, the significance of any visibility impairment in Capitol Reef National Park cannot be determined. These implications will be identified and discussed in the site specific environmental statement being prepared by the BLM.

The worst case analysis (AeroVironment, 1977) indicates that the visual range would be reduced to 22 miles (35 km) near Price, 20 miles (32 km) along the Castle Valley, and not less than 25 miles (40 km) in the rest of the central region. A brown atmospheric discoloration could be apparent from powerplant plumes (such as the proposed IPP plant, if located at Salt Wash) when stable atmospheric conditions limit plume dispersion. Some discoloration could occur along roads as a result of fugitive dust suspension in the air from vehicle travel.

4. VEGETATION

The potential impact to vegetation is not judged to be regionally significant at the projected levels. About 1,624 acres of vegetation would be lost until reclamation to the proposed new mines and ancillary facilities and 1,300 acres would be lost permanently to community development. A few individual threatened or endangered plants may be lost along with an unquantifiable amount of vegetation in general to the unplanned actions of construction activities and the activities of the increased population.

5. WILDLIFE

The temporary loss of 1,624 acres of wildlife habitat resulting from construction and operation of proposed coal mines and ancillary facilities could not be avoided. Permanent loss of about 1,300 acres of wildlife habitat that would be occupied by houses and community facilities is also unavoidable. Loss of wildlife resulting from loss of habitat and increased human disturbance could not be avoided. Loss of habitat or reduced use due to subsidence-caused loss of surface water flows could not be avoided. Any loss of the endangered bald eagle or peregrine falcon or other birds of national interest is not quantifiable but would be significant.

Direct impacts on wildlife that would be unavoidable include deaths resulting from construction and operation of the proposed mines, highway mortality, illegal killing, and deaths from wire strikes. Long-term alteration of migration routes and use patterns would be unavoidable.

6. FISHERIES

Impacts to fisheries would be slight under reasonable enforcement of existing laws and regulations. However, accidental releases of materials toxic to fish and other aquatic organisms might occur.

B. CULTURAL ENVIRONMENT

1. LAND

A total of 1,300 acres surrounding or within existing communities would be converted from existing uses to housing or other higher community uses. An estimated 650 to 800 acres of agricultural land would be converted. These impacts are not significant regionally.

2. AGRICULTURE, RANGE, AND TIMBER

The cumulative impacts to the region are minor. About 800 acres or less than 2 percent of the agricultural land in the region might be converted to community use. The loss of grazing capacity would be about 4,170 AUM's over the life of the proposed mines and 11,700 per year owing to community development.

3. SOCIOECONOMICS

The major impacts at the projected level would associate with a rapid regional population increase from 55,000 in 1975 to 70,000-75,000 in 1990. Population in Emery County would almost double and that in Carbon County would increase by 50 percent. Sevier, Wayne, Piute, and Sanpete would have about 10 percent growth. Housing needs would parallel the population growth. Social impact would be most adverse to those 65 and older, about 10 percent of the regional population. This segment typically is supported by fixed incomes, and not likely to take advantage of expanded job opportunities,,so they will be adversely affected by the rising prices anticipated to accrue from strong economic expansion.

Competition for labor would adversely affect existing businesses; however, this impact would be lessened by the additional revenues that would accrue from economic expansion.

Rapid growth will place temporary financial pressure on local governments and the quality and quantity of local services such as water supply, sewage and solid waste disposal, health, care, social services, police and fire protection, recreation facilities, and education. In addition, lasting cultural changes must be expected in Emery and perhaps Sevier and Wayne Counties.

4. TRANSPORTATION AND UTILITIES

a. Transportation

More intensive use of transportation facilities is a necessary and unavoidable part of resource development. Taking into consideration the historical trends in western coal development, the addition of significant volumes of highway traffic is unavoidable and would result in accelerated deterioration of the regional highway system and increased levels of accidents, fuel consumption, air pollution, noise, and congestion.

The construction or reconstruction of 49 miles of roads to provide direct mine access would require the removal of 315 acres from other use. Of the total mileage, 23.5 would be across federally-administered lands, 10.0 miles would be State lands or State road upgrading, 3.9 miles would be county road upgrading, and the rest would be across private property. Upgrading of the major highway network to meet increased traffic levels in general, especially the expansion of SR-10, may require additional rights-of-way.

The degree to which this action would result in increased rail operations with associated adverse impacts is dependent on the, as yet, undecided fate of the coal produced.

b. Utilities

Unavoidable adverse impacts would result from construction of an unquantified mileage of power distribution lines, plus only partly quantified mileage of service lines to the various mines. Where additional rights-of-ways would be needed, the amount of land required would be approximately 6 acres per miles of line for a 50-foot right-of-way. In some places, it is anticipated that existing lines would be upgraded with little additional environmental impact.

5. RECREATION

Adverse impacts would result from consumptive recreation pursuits: (a) hunting and fishing which would lower populations of animals and fish, resulting in decreased hunter success, shortening of seasons and eventually licensed sportsmen afield, (b) distruction or deterioration of wildlife habitat, archeological sites and back-country areas by ORV use where this type of use is not evident at the present time, and (c) picnicking and camping in developed and undeveloped areas which result in deterioration of natural and man-made resources as a result of over-use or use above carrying capacities.

Adverse impacts would also result from overcrowding on travel routes where additional encounters with other vehicles would cause safety problems and reduce the recreational enjoyment of touring in: back-country areas where uncrowded and unconfined recreation experience levels are sought; in developed and undeveloped recreation areas where privacy would be impacted; and, at spectator sporting events and activities such as boating, golf, skiing, etc., where capacities are limited (i.e. standing in lines, waiting turns, or unavailability because of capacity limitations).

Minor impacts would result from occupancy of sites for coal mining. This would involve onsite exclusion for recreation purposes during the life of the mines. Improved access would be considered as adverse by people seeking back-country experiences in areas now inaccessible by motor vehicles and as favorable by individuals seeking better access and more development.

6. ARCHEOLOGIC AND HISTORIC VALUES

Salvage excavation of threatened archeologic or historic sites would be an unavoidable adverse impact. Data are preserved, but sites or portions of sites would be lost.

Some degree of unavoidable impact would occur for buried sites encountered during dirt-moving operations. Some portion of the site would be lost even if it were recognized rapidly.

Changes in setting of sites, either by the introduction of project activities and facilities or by moving certain things to avoid impacts, are unavoidable.

Impacts on sites in heavy use areas are unavoidable. Vandalism impacts owing to an increased population and easier accessibility are mainly unavoidable.

7. ESTHETICS

Unavoidable adverse impacts to the visual resource would be:

(a) construction and operation of the mine plantsite, transportation and coal haul systems from the McKinnon Nos. 1 and 2 mines and the Belina-O'Connor mines in Eccles Canyon, the Fish Creek mine and Dugout Canyon mines in Clark Valley, and the South Emery No. 1 mine at Paradise Lake;

(b) the establishment of mine plantsites, ancillary facilities, and mining activities where few man-made intrusions now exist (B Canyon and Skumpah Canyon), and where new ancillary facilities cross or parallel main travel routes and viewing the natural landscape character is of primary concern to viewers;

(c) deterioration or destruction of unique scenic features, vegetation, archeological or historical sites and developed facilities by vandalism, littering, off-road vehicle use, and overcrowding of the regional recreation resource.

Impacts as described in chapter IV for communities will be viewed by some people as adverse, others would view changes and growth as an improvement in community development.

CHAPTER VI: SHORT-TERM VERSUS LONG-TERM EFFECTS

The region has an established coal industry and may be facing renewed development of uranium exploration and mining, embryo oil shale development, and other expansion not yet foreseen. The anticipated growth in the coal market is from 8 mty in 1975 to 19 mty in 1990, the low level scenario, which could be achieved with no Federal action on proposals analyzed in this statement. In response to national energy needs, the projected level of development of 24 mty implies approval and development of nine new mines and one power generation station and would increase the region's production potential to 30-35 mty. Coal production could stabilize at about 20 mty in 1990 or continue to expand, depending on market demands. Coal reserves under lease by operating companies and under consideration in this statement are ample for 40-50 years at the projected level of 24 mty. As reserves at individual mines are depleted, other mines are expected to develop and absorb the work force.

The population in the region would increase rapidly from 55,000 to 70,000-75,000 and cause adverse impacts on housing, community services and the over-65 years in age segment (10 percent) of the population. The demand for increased community services, save education, may be met with no lag, or a lag of a few years, by the advance funding possibilities described in Socioeconomics, chapter IV. Advance planning and financing could meet the housing and education demands with little lag. Impacts to the older segment of the society, and social and cultural changes will be largely unmitigated problem areas and may remain so during the period 1975-1990 and beyond, dependent on stabilization and reduction of the rate of population and economic expansion.

It is expected that 1,300 acres of additional community-use land is a permanent commitment. About 1,600 acres, in addition to that currently used, would be lost to other uses during the life of the proposed new mines. The land used for mining will be reclaimed and restored to other uses within 15 to 50 years for most of the proposals (table I-1), including 5 years for reclamation after mining ceases. Subsidence of the land after mining could affect 30,000-40,000 acres, but subsidence is not expected to adversely affect any currently planned land uses in the region.

Other significant impacts anticipated during the life of the mines relate dominantly to the population increase and are principally reduction in wildlife and adverse impact on recreation, esthetic, archeologic, and historic values. The potential loss of archeologic and historic sites, etc., is long term, but the other impacts will be dependent on the long-term population of the region for length of impact.

The projected level of coal-mining probably represents a long-term commitment to expansion of existing activity in the region. Social and economic changes will be sharp and difficult to resolve almost in direct proportion to the rate of change. A rapid reduction in coal mining in the region would also produce negative adverse impacts to the social and economic systems of the region.

Mining and coal, as proposed, would provide a short-term supply of coal for the generation of electricity and perhaps other industrial uses. The use and commitment of about 765 million tons of coal (382 million tons mined, the rest unrecoverable) involves a trade-off between coal and other energy sources, some of which are in short supply. The proposed production from the new mines would reduce coal reserves of the central region by 5 percent. In the short term, use of low-sulfur coal would alleviate short-term energy demands while also meeting current air-quality regulations. Use of this resource would extend use of alternate fossil fuels (chiefly crude oil) in domestic short supply.

The current use of coal because of limitation of current technology might reduce a potentially greater coal recovery and benefit in the future. Improvement in underground mining technique, to allow for a greater rate of recovery than at present, can be expected in the future. Coal-fired electricity-generating plants are relatively inefficient in that only about 33 percent of the fuel energy is converted into electrical energy (Karkheck and others, 1977). Future technology could improve efficiency.

The short-term use of various industrial minerals and metals (concrete aggregates, sand, gravel, limestone, iron and steel, copper, etc.) would meet the construction and technical needs of the projects and of related transportation and population developments. Over the long term, the minerals extracted for these purposes would no longer be available, except for those that could be reclaimed and reused.

An undetermined number of uninventoried, exposed, and unexposed fossils would be lost. However, knowledge of paleontological resources owing to surveys and exposure might never have occurred without excavation.

Soil productive potential would be lost for the long term on about 650 acres for community development. Sites not permanently occupied would be reclaimed. Through proper reclamation techniques, it is projected that the long-term impacts on soil productivity on reclaimed lands would be minimal because the disturbed sites would be returned to a condition capable of supporting the uses that existed prior to mining. There would undoubtedly be some local situations where soil productivity had been reduced below its initial capability, but likewise there would be sites that had increased capabilities because of slope modification, soil amendments, and erosion control structures. Effective reclamation measures on many sites would also result in a reduction in onsite erosion and sediment yield rates.

Soil will erode as a result of increased off-road-vehicle use throughout the area because ORV use will be difficult to monitor and control. It would be the responsibility of the land administering agencies, and not the mining companies, to control such activity. Erosion control measures would not be expected to keep pace with soil damage created by off-road-vehicles in the long term unless strict regulations are imposed and enforced.

The use of about 2,000 acre-feet of water per year for mining is a short-term commitment, but the 6,000 acre-feet, probably to be diverted from agricultural to water-supply use, would be a long-term commitment. Changes in springs and surface flows, owing to mining and associated subsidence, are not predictable but would be a long-term change.

The short-term and long-term regional air quality impacts of coal development are small. Increased traffic on unpaved roads would cause TSP impacts. Paving or chemical treatment of these roads would significantly reduce regional TSP impacts. Short-term air quality degradation would occur owing to burning of coal in local powerplants during the life of the plant.

No significant climatological impacts were identified.

In the short term, vegetation, as described in chapter IV, would be destroyed by the various mines, mine facilities, and urban growth. In the long term, following successful reclamation, the vegetative productivity and range forage that now exists on the affected acreage should be increased by about 40 percent overall. Normal watering and grazing patterns for domestic livestock would be disrupted over both the short and long term. Areas committed to facilities such as roads, railroads, and urban development would be lost from vegetative productivity in the long term. Native plant succession would be retarded by the projects. However, overall vegetative cover and productivity would be quickly restored through proper reclamation. Some individual plants proposed for threatened or endangered status may be lost, but owing to lack of data, no estimate can be made of the potential loss. The loss is not expected to significantly alter the existence of the plants in the region.

The short-term use of the environment for coal production and associated urbanization would result in a long-term loss of 1,300 acres of wildlife habitat and a subsequent reduction in wildlife productivity. Reduction or loss of surface water flows would result in a permanent alteration of wildlife habitat. Disturbance or occupation of habitat for periods as long as 40 years would result in long-term alteration of use patterns and migration routes. Species such as deer, elk, cougars, bears, foxes, and some raptors would retreat from areas of extensive human use or occupied habitat. Other species, compatible with urbanization and human activities, would have a long-term increase in productivity.

Any impacts to fishes resulting from changing water diversions would have long-term effects. Accidental pollution or that resulting from lack of reasonable enforcement would be a short-term event and is not predictable.

The long-term impact of increased mining would be related to population expansion and would cause social and economic changes as described in chapter IV. The short-term impacts on communities and individuals would relate to the rate of expansion and the abilities of the communities or individuals to adapt to rapid change.

Coal production at the projected level would generally result in more intensive use of the existing transportation system which would be upgraded as necessary. After the cessation of coal development, local coal-related transportation movements would terminate. The extent of transportation decline would be dependent on the residual population and remaining economic activities and cannot be quantified at this time.

Some mine access roads may be removed and the right-of-way reclaimed at the request of the land management agency. However, the presence of these roads could have the long-term effect of channeling future transportation in the region.

Utility lines to the individual mines are short term and likely to be salvaged after mining. However, major distribution lines, transmission lines, and other utility facilities are likely to be semi-permanent and would support future mines on other industries opening in the same areas.

Short-term use of regional recreation resources by an increased population associated with new coal mining, added to anticipated growth in recreation use for 1985 and 1990, would have long-term effects. More overcrowding of major recreation use areas and developed sites and facilities would be expected on a long-term basis. Compromises in use and recreation experience levels accompanied by more restrictions and regulations on recreation use and activities (limited length of stays, ORV restrictions, designated area camping only, lowering of bag or creel limits, etc.) will be the long-term result. This situation would result by 1990, without Federal action on the proposals included in the projected 24 mty scenario. In addition, lands which now receive little or no recreation use will be used more on a long-term basis.

Salvage, context changes, or loss of buried archeologic or historic sites owing directly or indirectly to coal mining would negate or seriously impair their long-term value.

Vandalism would increase as a result of increased population, population concentratiions, and improved access. Because the sites are finite and cannot regenerate, they would eventually be destroyed, and long-term scientific-use potential would be greatly impaired. Non-malicious abuse of the resource, because of a population increase, would have the same eventual effect.

Short-term use of the lease areas for mining would have long-term but minimal effects on the visual resource of the sites and the region because mining has occurred in or near most of the proposed mining areas. Roads and utility lines introduced during the life of the mines would most likely remain as instrusions or modifications within the landscape character on a long-term basis. Any mining residues and remnants left on the lease areas would lower the visual quality onsite on a long-term basis.

Changes in community size and architecture would also be long term. Impacts to visual resources from littering and vandalism would be long term, while those from dust, noise, and odor would be short term.

CHAPTER VII: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS

About 765 million tons of coal or 5 1/2 percent of the total reserves of about 14 billion tons in the central region, would be committed to the new mines. Present operators hold leases, some of which are inactive, containing reserves of about 700 million tons. Actively mined leases contain reserves of about 200 million tons. Of the total new reserves of 765 million tons that may be committed to mining, the anticipated total production would be 382 million tons. The coal produced would replace alternate fossil fuels currently in domestic short supply. About 6 million gallons of motor fuel would be committed to transport of coal and the mine work force. The remaining 383 million tons would be irretrievably left in place and probably would not be recoverable in the future. Because of coal extraction and subsequent caving of overlying ground, 30,000 to 40,000 acres of land potentially could subside several feet, but nowhere more than 20 feet. The locality and amount of subsidence can be controlled by regulation of mining and the subsidence is not expected to alter any currently planned land use. The subsidence might divert water from some springs but the amount diverted is expected to be small and not significant enough to cause major impact to wildlife or stock use. Water use would require about 8,000 acre-feet per year of which about 5,000 acre-feet per year would be consumed. Three thousand acre-feet would be consumed for public supplies and is presumed to be a long-term commitment.

A population growth from about 55,000 to 70,000-75,000 is anticipated as a result of increased mining in the region. Much of this growth is anticipated even with no new mines, but approval of the new mines might enhance the possibility of coal-mining expansion. The population growth, and accompanying social, economic, and cultural changes are anticipated to be a long term and irreversible commitment. About 1,300 acres of land would therefore be irreversibly committed to community use. If the market for Utah coal weakened, the region would suffer a recession.

About 9 fatalities and 618 nonfatal accidents are anticipated per year owing to coal mining.

The increase in population would cause an increase in recreation use, including ORV use and vandalism. The change from unrestricted, unregulated and in places uncrowded outdoor recreation to a more restricted experience would be irreversible.

Some wildlife, including mainly deer, pheasant, cottontail rabbit and raptors would be lost during the life of the mines and about 1,300 acres converted to community use probably would be permanently lost. Most wildlife loss would be reversible in the mine areas after reclamation.

Any disturbance or removal of archeologic or historic sites would be irreversible as would be destruction or disturbance of uninventoried fossil localities.

CHAPTER VII: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS

About 140 million tons of coal or 3 1/2 percent of the total reserves of about 4 billion tons in the central region, would be committed to the new mines. Present operators hold leases, some of which are inactive, containing reserves of about 700 million tons. Actively mined leases contain reserves of about 400 million tons. Of the total new reserves of 720 million tons that may be committed to mining, the additional total production would be 280 million tons. The coal produced would replace alternate fossil fuels presently in domestic supply. Several million gallons of water that would be consumed in [illegible] of coal and the site [illegible]. The remaining 440 million tons would be effectively left in place and probably would not be recoverable in the future. Because of coal extraction and subsequent caving of overlying strata, 30,000 to 50,000 acre-feet of good quality water would enter the mines, but [illegible] more than 30 years. The quality and amount of groundwater may be [illegible] by extraction of mining and the subsidence is not expected to alter its [illegible]. Normal [illegible], the subsidence might directly affect some springs and the streams. [illegible] is expected to be small and [illegible] impacts on stream [illegible] of wildlife or livestock. [illegible] [illegible] [illegible] would be [illegible]. These changes would result in [illegible] for public [illegible] and is expected to be a long-term commitment.

A population growth from about 17,000 to 27,000 [illegible] is anticipated as a result of increased mining in the region. Much of this growth would take place in [illegible] [illegible] [illegible] [illegible] [illegible] communities. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. About 1,200 acres of land would therefore be irreversibly committed to [illegible] for the region's [illegible] coal mining and the region would [illegible].

About 30 [illegible] and 400 [illegible] [illegible] [illegible] [illegible] per year during [illegible] mining.

The increase in population would cause an increase in [illegible] use, including [illegible] and [illegible] hunting. The [illegible] from [illegible], [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Some wildlife, [illegible], [illegible] and [illegible], [illegible] [illegible] would be lost during [illegible] of the mines and about 1,000 [illegible] [illegible] [illegible] [illegible] [illegible]. Most wildlife [illegible] would be [illegible] in the [illegible] [illegible] of [illegible].

Any [illegible] or [illegible] of [illegible] or [illegible] [illegible] would be irreversible, as would be destruction or disturbance of [illegible] [illegible] fossil localities.

CHAPTER VIII: ALTERNATIVES

The alternatives to be discussed in this chapter are Administrative Alternatives. The production level scenarios are not alternatives but provide a basis for evaluation to identify areas of environmental concern or impact sensitivity.

Development of alternative sources of energy, energy conservation, Federal development of the coal, and emphasis on coal development in other regions of the United States are considered more appropriately evaluated on a program rather than a regional basis. This was done in the previous Interior Department coal programatic statement and will be updated and revised as necessary in the new programatic statement now underway.

This regional EIS evaluates the impacts of projected coal developments in the central Utah region. The projected production level evaluated is dependent in part on Federal approval of mining and reclamation plans (MRP's) on existing Federal leases. However, the Secretary of the Interior is not proposing a particular production level for coal in this EIS region. Instead, he is considering actions within his authority that will allow Federal coal to be available when needed and under environmentally acceptable conditions to meet market demands and the energy needs of the Nation. The approval actions under review at this time are being considered in this context.

In this regional EIS, decisions regarding MRP's in coal related actions are considered on a regional or subregional basis. Accompanying and future related site-specific statements will evaluate alternatives specific to the individual coal mine proposals. Thus, alternatives for the MRP's in coal related actions are evaluated on an aggregate basis in this statement, providing a means of responding to regional or subregional environmental problems or social and economic concerns.

Additionally, this chapter contains a summary description and evaluation of the IPP generating station. The projected level of coal production (24 mty) is expected to meet all of the 10 mty IPP peak coal demand. The original proposed site is at Salt Wash (fig. VIII-1) but environmental concerns at the Salt Wash site require consideration of other sites. These other sites are not yet analyzed and therefore the IPP proposal, which is being analyzed in detail by BLM, is briefly described and evaluated.

A. ADMINISTRATIVE ALTERNATIVES

The Secretary's action in regard to the Mining and Reclamation Plans under consideration may be approval as proposed, rejection on various environmental grounds, approval in part, or approval subject to such additional requirements or modifications as he may impose under the law. He may also defer decision pending submittal of additional data, completion of required studies or for other reasons. If there are serious

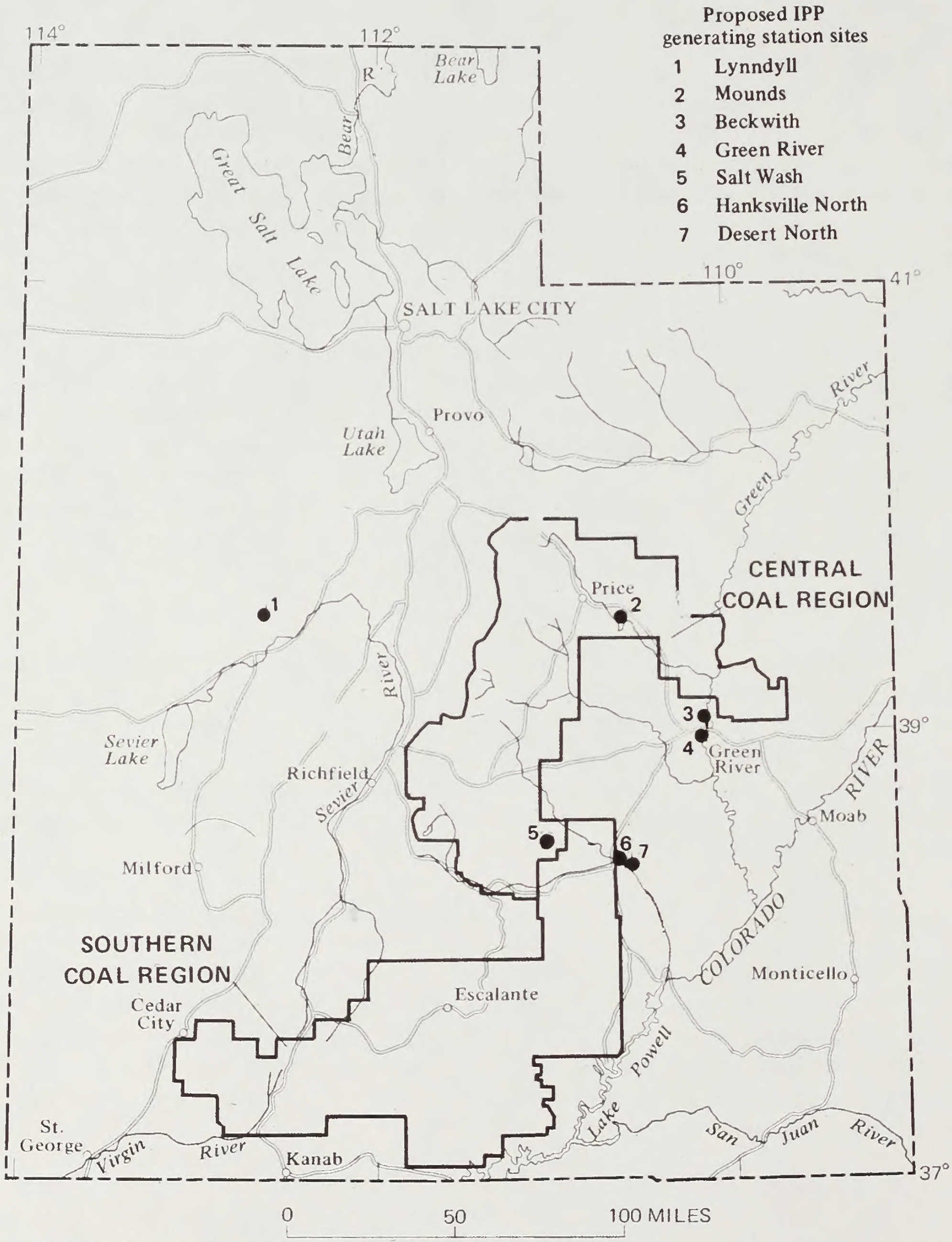

Figure VIII-1.--Proposed Salt Wash and preliminary alternative sites, Intermountain Power Project.

environmental concerns as to the coal development, the Secretary may exercise his exchange authority as to the coal rights or seek Congressional action cancelling the Federal leases involved.

Review of the Federal coal leases and the Mining and Reclamation Plans included in this regional statement indicates that the following administrative alternatives are appropriate for consideration: no action, approval, and approval subject to specific modifications of requirements. Alternate sites for surface facilities, mining technology and methods, coal transport methods, and rates of production on individual operations are considered where appropriate, but no such modifications have been identified which would significantly reduce the adverse impacts of coal production from these lands. Any new alternatives surfaced by the review process will be carefully considered.

1. No Action Alternative

The no action alternative envisages non-approval or rejection of the pending mining and reclamation plans on Federal leases along with any related permits or right-of-ways. Private coal would be developed where support of additional Federal coal is not needed. However Federal coal could be made available to avoid bypass from ongoing private coal development.

2. Approval and Approval Subject to Specific Modifications

The impacts of these alternatives are variable and depend on specific mitigations or modifications needed for individual mine plans. Analysis of mine plan approval under these alternatives is treated cumulatively in chapters IV-VII in part I and specifically in part II.

B. PRODUCTION LEVEL SCENARIOS

The actual production level obtained in 1990 will depend on demand as well as availability of coal. Factors influencing demand include access and economics in relation to other coal sources, transportation, local as well as Federal approvals, and pollution control requirements and technology. Availability of coal will depend increasingly on Federal approvals as the production level rises. As indicated in the low production level scenario, for some time, lower production levels could be attained from lands now under Federal lease and in State and private ownership. Higher levels of production will require Federal approvals of mine and reclamation plans because land ownership patterns make access to much of the State and private coal uneconomical without Federal coal. Further most of the coal in Utah is in Federal ownership. Production could well occur at significantly lower or higher levels than identified at the projected level. The alternative scenarios provide a display of impact change with less or more production.

1. Low Production Level Scenario (19 mty)

The low level scenario analysis anticipates the effect of coal production at the low level or 19 mty by 1990. This production level is the estimate of market demand and existing mine capability by 1990 and can be attained if the no-action alternative (chapter VIII) is selected by the Secretary of Interior.

a. Natural Environment

Utah coal producers' assessment of central Utah's 1990 market potential is 19 mty. Existing mines (table II-25) and mines on State and private lands (table I-4) in central Utah could develop and grow to meet this production level without major Federal action. They hold leases on Federal lands containing a minimum of 700 million tons of recoverable coal and an undetermined amount of coal on State and private lands. Federal approval would be required for mine plan modifications or rights-of-way for off-lease facilities. Population growth of 19,000 people is anticipated resulting in community enlargement on 1,040 acres. It is not possible to quantify the acreage that will be disturbed by mine expansion.

1) Geology, topography, paleontology

It is not known which of the existing mines (table II-25) will, if any, be depleted before 1990. Expansion of existing operations would deplete known coal reserves at a faster rate, hastening the exhaustion and abandonment of mines or making necessary the acquisition of adjacent coal land where mining could continue from the same portal.

The Blackie mine (Atlas Resources, Inc.), on private and State land (table I-4) is the only existing strip mine in central Utah and will require greater surface reclamation measures than the underground mines. Expanded rates of underground mining would expand the area of resulting surface subsidence at a proportionate rate, but would not change the ultimate area or amount of subsidence.

The potential for mining-induced earthquakes and mine fires would increase as a result of the increased mining activity.

Both adverse and beneficial impacts would occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

2) Soils

The expansion of existing mines would cause additional soil disturbance resulting in increased soil erosion and reduction in soil productivity. These impacts cannot be quantified since no plans are available for analysis. Soils would also be disturbed due to increased community development resulting in additional soil erosion and loss of soil productivity where occupied by structures.

3) Water

Changes in the hydrologic system of the region would be imperceptible, although local alterations of saturated sandstone and watershed characteristics may occur as a result of subsidence or community expansion.

4) Air quality

Increased coal production from existing mines would have only minor impacts on air quality. Calculated TSP concentrations are shown in table VIII-1. The estimated regional impacts can be put into perspective by comparing the calculated TSP concentrations with the NAAQS (although the regulations do not necessarily apply, as discussed in chapter III). The greatest impact would occur near Price where the maximum 24-hour average concentration would be 29 percent of the NAAQS, and the annual average concentration would be 63 percent of the NAAQS. During periods of high winds, dust concentrations exceed the 24-hour NAAQS. TSP impacts from the mining-related sources would add to the excess caused by windblown dust.

SO_2 and NO_2--SO_2 and NO_2 emissions from mining activities are negligible, and there are no new powerplants resulting in insignificant impacts from SO_2 and NO_2.

5) Vegetation

Essentially the same kind and level of mitigations would be applied as the projected level (24.0 mty). Therefore, the residual impacts would be of essentially the same kinds but of a lesser volume or size based on the acres of vegetation affected.

The loss of 1,040 acres of vegetation would result in a loss of about 310 AUM's (glossary) of domestic livestock forage per year. Over the average 30-year life of the projects, the total livestock forage lost would be 9,300 AUM's. The loss of forest/woodland products would be small, and the impacts would be insignificant.

6) Wildlife

Direct impacts to wildlife habitat from increaSd coal production in existing mines would be insignificant. The indirect impacts from the increased population, urbanization, coal transportation, recreational home development, and increased traffic would adversely affect wildlife species that are incompatible with man's activities. Species most affected would be elk, deer, cougar, bear, pheasant, and raptors. Species adaptable to urbanization and man's influence would increase. The direct loss of wildlife from illegal shooting, highway mortality, and harrassment would increase. The extent of these impacts cannot be quantified, but it would continue for as long as the increased population is in the area.

Table VIII-1.--Analysis of TSP concentrations for the low level of production (19 mty)

	TSP concentration ($\mu g/m^3$)							
Modeling region	Maximum 24-hour concentration above background	Average background	Total concentration	24-hour NAAQS	Annual average concentration above background	Average background	Total concentration	Annual average NAAQS
I Roan and Book Cliffs----	24	20	44	150	18	20	38	60
II East slope of Wasatch Plateau--------	< 5	20	< 25	150	< 5	20	< 25	60
III Castle Valley-----------	< 10	20	< 30	150	6	20	26	60
IV East slope of Sevier Range-----------	< 10	20	< 30	150	< 10	20	< 30	60
V Salt Wash---------------	(a)	--	--	--	--	--	--	--

(a) No activity associated with coal development occurs in the Salt Wash area for this scenario.

7) Fisheries

Fish habitat would be essentially as previously described. Increased coal production would cause an increase in population and fishermen. This would probably cause more gamefish to be caught, but without adding fish habitat there would be fewer caught per fisherman hour and fishermen would tend to keep smaller fish.

b. Cultural Environment

1) Land uses

The increased population would require an estimated 1,040 acres for community development and could dewater an additional 625 acres of irrigated lands through community water demand. A maximum of 1,145 acres of irrigated agricultural land could be adversely impacted. This would not be a significant proportion of currently irrigated land.

2) Grazing and timber use

The exact character of the lands converted to community use at this level of coal production cannot be accurately predicted; however, it is assumed that 50 percent of the range would be useful for grazing. Based on this assumption, 390 AUM's per year would be lost from domestic livestock grazing starting in 1990. The level of use of forest products will increase.

3) Socioeconomics

Assuming a continuation of current trends, coal production will increase rapidly at first and then at a decreasing rate. From about 8 million tons per year in 1976, coal production is expected to reach 12.4 mty by 1980 (or to grow at 11.7 percent per year) and reach 19 mty by 1990. Coal mining employment will increase to 3,605 from an estimated 2,853. Population changes are shown on table VIII-2 for selected communities and table VIII-3 shows population and components for change by county. At the low level, about 7 fatalities and 490 nonfatal accidents are expected each year owing directly to coal mining.

Population growth between 1970 and 1975 occurred at 4.1 percent per year in Carbon County and 5.6 percent per year in Emery. The normal growth during the period 1975 to 1980 implies a decrease in these rates: 3.0 and 4.9 percent per year for Carbon and Emery respectively during the 1975 to 1980 period. This occurs because the larger construction work force present in Carbon and Emery Counties to work there on Utah Power & Light electricity generating stations will be moving out before the end of the decade. Resumption early in the 1980's of construction activity on the Emery 3 and 4 plants will again temporarily augment the economic base.

Table VIII-2.--Community population projections, low level

	1980	1985	1990
Carbon County			
East Carbon-Sunnyside	3,108	3,909	4,482
Helper	3,108	3,909	4,484
Hiawatha	222	279	320
Price	8,214	10,331	11,852
Scofield	111	139	160
Wellington	1,332	1,625	1,921
Emery County			
Castle Dale	1,542	1,959	2,228
Cleveland	514	653	742
Elmo	343	435	495
Emery	343	435	495
Ferron	686	870	990
Huntington	1,970	2,503	2,842
Orangeville	857	1,088	1,237
Sanpete County			
Centerfield	540	497	496
Fairview	904	833	831
Gunnison	1,349	1,243	1,241
Mt. Pleasant	1,957	1,802	1,799
Sevier County			
Aurora	796	743	742
Redmond	579	540	540
Richfield	6,081	5,670	5,665
Salina	2,171	2,025	2,023
Sigurd	434	405	405
Wayne County			
Bicknell	299	297	293
Loa	393	389	385
Torrey	112	111	110

Table VIII-3.--Population and components of change by county, low level

[Thousands of persons]

County	1970 Population	Interval components of change: Natural increase	Interval components of change: Migration	1975 Population	Interval components of change: Natural increase	Interval components of change: Migration	1980 Population	Interval components of change: Natural increase	Interval components of change: Migration	1985 Population	Interval components of change: Natural increase	Interval components of change: Migration	1990 Population
Carbon-----	15.6	+0.7	+2.8	19.1	+1.3	+1.7	22.2	+1.4	+4.3	27.9	+1.5	+2.6	32.0
Emery------	5.1	+0.2	+1.4	6.7	+0.5	+1.4	8.6	+0.7	+1.7	10.9	+0.7	+0.8	12.4
Sevier-----	10.1	+0.4	+2.7	13.1	+0.9	+0.4	14.5	+0.9	-1.9	13.5	+0.5	-0.5	13.5
Wayne------	1.5	+0.0	+0.2	1.7	+0.1	+0.1	1.9	+0.1	-0.1	1.9	+0.1	-0.1	1.8
Piute and Sanpete---	12.1	+0.4	+1.5	14.0	+0.8	+0.1	15.0	+0.8	-1.8	14.0	+0.4	-0.0	13.9
Total, six counties--	44.5	+1.6	+8.6	54.7	+3.7	+3.7	62.1	+3.8	+2.2	68.1	+3.2	+2.3	73.7

(Detail may not add to totals because of independent rounding.)

Source: 1970; U.S. Census of Population. Projection Years and Intervals for Counties; UPED Model Projections, Bureau of Economic and Business Research, University of Utah.

The low level of production also widens the geographic area of impact of expanding coal production. Coal mining employment in 1980 in the southern Wasatch Plateau in Sevier County will be triple that of 1975 and more than 10 times that of 1970. Though the absolute number is a relatively small portion of regional employment (10 percent), it constitutes a large and important element of the economic base of Sevier County, offering employment opportunities to workers in Sevier and Sanpete Counties.

Coal production will expand by 60 percent in Central Wasatch Plateau between 1980 and 1990, and will almost double during the same period in the Northern Wasatch Plateau-Western Book Cliffs area. These developments will substantially boost the economies of Carbon and Emery Counties, resulting in sustained emigration to them.

Projected growth in the Carbon-Emery area dominates the region as a whole (see table VIII-3). Because the growth is concentrated in a particular part of the region, absence of increases in the economic base of the other counties may promote emigration from them.

4) Transportation and utilities

Highway use would be about 180 percent greater than in 1975, which would create significantly greater demands on the transportation system (table VIII-4). The entire length of U-10 as well as the portion of U-31 east of the National Forest boundary would require reconstruction. The improvements scheduled for US-6 and I-70 would also be further justified and may require their earlier implementation. They are the completion of I-70 to its terminus at I-15, and reconstruction of US-6 to a four-lane expressway between I-15 and I-70. Intersection improvements may become necessary, in particular at the intersections with US-6 of U-90, U-10, and U-123. Approximately 5 additional miles of mine access would also be required.

No major improvements will be needed to the rail system, beyond those planned by the Utah railway. Improved loading facilities, however, may become necessary. Increased levels of transportation use would result in certain impacts. These were described in chapter IV as the base level to which the impacts resulting from the projected level were compared.

5) Recreation

Projected recreation visits within the central region RIZ by multi-county subregions for 1985 and 1990 at the low level are shown on table IV-25. This projected increase would result in (a) shortages in developed sites for camping and picnicking, (b) competition for use of developed and dispersed areas for all types of recreation use, (c) conflicts between hikers and ORV users, boater-water skiers and fishermen, etc., (d) increases in ORV use and resultant damage to other resource

Table VIII-4.--Highway traffic levels at selected points (see fig. II-21) at the low production level

Segment Number[1]	1975 ADT[2]	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1----------	3,210	4,074	4,687	6,252	1,670
2----------	3,365	4,527	4,913	7,198	1,712
3----------	215	249	314	360	67
4----------	345	466	481	687	32
5----------	50	132	73	269	118
6----------	3,520	4,625	5,036	6,704	2,067
7----------	115	128	132	140	16
8----------	270	412	310	594	37
9----------	3,240	3,659	3,251	3,604	794
10---------	310	780	432	1,521	156
11---------	430	745	493	1,186	421
12---------	190	592	218	648	434
13---------	2,700	3,162	3,979	4,563	760
14---------	480	610	563	750	135
15---------	450	513	535	535	131
16---------	1,030	1,379	1,476	2,033	264
17---------	1,030	1,379	1,476	2,033	264
18---------	1,615	1,926	2,257	2,589	425
19---------	250	360	358	556	43
20---------	1,795	2,527	2,107	3,429	1,057
21---------	45	58	71	80	9
22---------	320	399	498	566	62
23---------	2,800	3,308	3,942	4,391	659

[1] See table II-42, figure II-21.
[2] ADT = Average Daily Traffic.

values and, subsequently, more control and regulations on ORV use, (e) increased littering and vandalism, (f) deterioration of natural resources (lands, water quality, vegetation, etc.) and cultural resources (archeological, historical, developed sites, etc.) by over-use, (g) reduction in the opportunity for solitude and back-country recreation experiences because of extended and improved access, and (h) increases in user safety problems because of more traffic on roads.

6) Archeologic and historic values

Archeologic and historic values would be affected by the increased population to the extent that people would disturb sites through recreational or avocational pursuits. The impact would not be as great as in chapters IV and V owing to the smaller population increase.

7) Esthetics

Impacts to the esthetic resource would be the same as those described in chapters IV and V, but to a lesser degree. Urbanization would take place in communities, and more man-made intrusions would be introduced into the landscape character.

2. High Production Level Scenario (42 mty)

Raising central Utah's coal production to 42 mty would require the expansion of existing mines (table II-24) and expansion of existing and development of proposed mines on State and private lands (table I-4). It would also require Federal action to approve the mine and reclamation plans addressed as site specifics in this document (table I-1). It would require submission and approval of mining and reclamation plans for the preliminary coal mining proposals involving Federal coal leases (table VIII-5). It would also require the approval of rights-of-way for ancillary facilities associated with the mines.

Boeing Engineering and construction has proposed a coal-slurry pipeline, the Boeing Pacific (BPAC) Bulk Transportation System from central Utah to Ventura, Calif. This would create a demand for approximately 10 mty of coal with Japan and Korea the eventual market. The proposed route is show in figure I-2.

In addition to the approval of mine and reclamation plans, additional markets would need to be developed. Utah Power & Light Company has proposed 1,000 megawatt power-generating plants at Axtel, Wellington, Green River, Emery, Nephi, East Carbon, Huntington, and South Emery (fig. I-2, table VIII-6).

The movement of this coal to market will require some improvements to the transportation system such as the route proposed by the Castle Valley Railroad Company (CVR).

Table VIII-5.--Preliminary coal mining proposals involving Federal coal leases

Company	Mine (underground)	Fed., State, and private	Proposed production (mty)
Emery Coal, Inc.-------	Mine No. 1	2,240	1.0
Energy Reserves Group--	Rock Canyon	8,130	1.0 - 2.0
Malcolm N. McKinnon Estate---------------	Rilda Canyon	1,200	0.9
Mountain States Resources Co.--------	Mines No. 2-6	[1]13,347	3.0
Routt Co. Development Ltd. (Energy Fuels Corp. - Operator)----	McKinnon No. 3	[2]6,290	0.7
Sanders, John----------	Unnamed	80	--
---------------------	Tip Top	80	--
Swisher Coal Co.-------	Clear Creek No. 7	1,909	0.3
United States Fuel Co.-	King No. 6	6,163	0.8

[1]Total lease area includes Mine No. 1.
[2]Total lease area includes McKinnon No's. 1 and 2.

Table VIII-6.--Steam-electric-generating plant development proposed by Utah Power & Light Company[1]

Proposed generating station	Location	Coal source	General comments
Emery 3 and 4---------------	2 mi. so. of Castle Dale, Utah.	Existing Wilberg & Deer Creek mines & a future mine in North Horn Mountain coal field.	ES under preparation by BLM. Initially coal will be trucked to this plant; eventually it may be conveyed.
Wellington------------------	3 mi. south-southwest of Wellington, Utah.	Emery & Carbon County mines.	Coal would be trucked to this site.
Green River-----------------	3 mi. southwest of Green River, Utah.	Emery & Carbon County mines.	Coal would be rail hauled to this site. It may be trucked initially.
Axtel-----------------------	1 mi. south of Axtel, Utah.	Central Utah coal region mines (possibly southern Utah coal).	Under the proposal southern Utah coal would be slurried to this plantsite.
Nephi-----------------------	10 mi. west of Nephi, Utah.	Central Utah coal region mines (possibly southern Utah coal).	Under the proposal southern Utah coal would be slurried to this plantsite.
East Carbon-----------------	16 mi. east of Wellington, Utah.	Carbon & Emery County mines.	Coal would be delivered to the site by a spur from the D&RGW Railroad.
Huntington 3 and 4----------	30 mi. southwest of Price, Utah at junction of Huntington & Deer Creek canyons.	Existing Deer Creek mine.	Coal would be delivered by truck and (or) conveyors.
South Emery-----------------	4 mi. east of Emery, Utah.	Carbon & Emery County mines.	Coal would be delivered to the site by truck.

[1]Proposal development report submitted to USGS on Nov. 5, 1976.

CVR has applied to the Interstate Commerce Commission for authority to construct and operate a line of railroad from connections with the D&RGW's Castle Valley spur and Utah Railway's Wildcat Siding to a point approximately 4 miles east of Emery. This application has been designated Finance Docket (FD) 28117. Figure VIII-2 identifies the proposed route.

CVR has performed only a basic feasibility study for this line; therefore, precise quantifications of its length and right-of-way requirements are not available. Based on this feasibility study, the line would be approximately 88 miles long and require approximately 1,600 acres of right-of-way. The general nature of the present ownership of the proposed right-of-way from the southern terminus to the Castle Valley Spur (1,180 acres) is as follows:

Public lands administered by BLM-------	20-25 percent
State lands----------------------------	10 percent
private lands--------------------------	70-75 percent

The nature of the ownership of the remaining 420 acres required for the connection to the Utah Railway is unknown.

a. Geology, Topography, Paleontology

The 42 mty that would be mined under this scenario represents almost five times the present annual production. Development of the proposed new mines (tables I-1, I-4, and VIII-5) and expansion of existing mines (table II-24) would probably more than double the amount of present surface disturbance required for surface facilities.

The properties of the site-specific proposals (table I-1) include 27,127 acres of Federal land and 7,736 acres of State and private lands, most of which would be subject to surface subsidence as the coal is mined. Most of the 31,349 acres of Federal, State and private lands involved in the preliminary mining proposals (table VIII-5) would also be subject to subsidence, as well as most of the undetermined area of the underground mining proposals on State and private lands (table I-4). The amount of subsidence would depend on the thickness of coal removed, on the thickness of overburden, on the mining methods used, and on several other lesser factors.

The potential for mine fires and mining-induced earthquakes would be increased in proportion to the increase in mining activity.

Both adverse and beneficial impacts will occur to paleontological resources in approximate proportion to the level of regional development and the area disturbed.

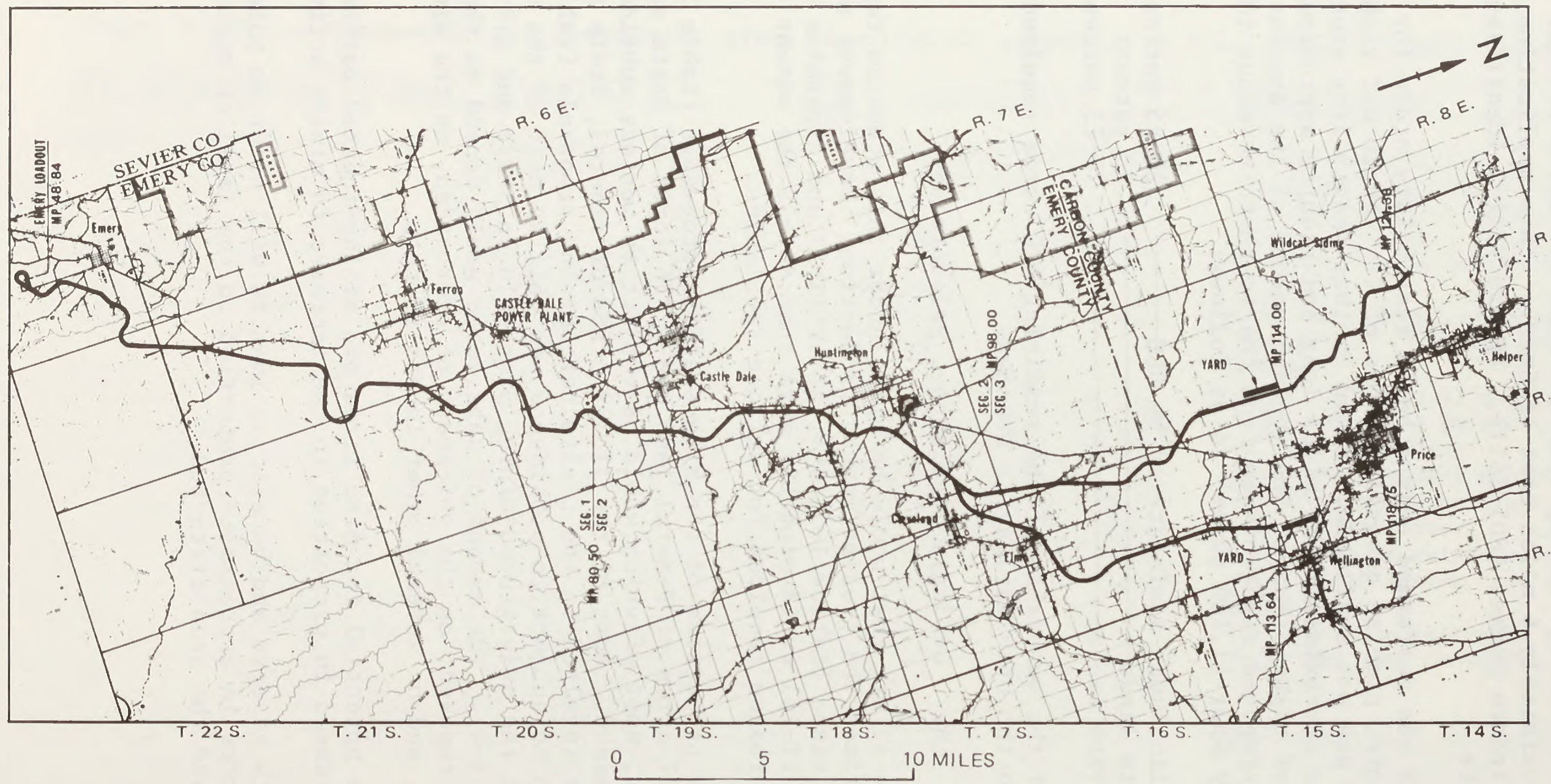

Figure VIII-2.--Map showing the location of the Castle Valley Railroad, Utah.

b. Soils

Detailed plans are not available to evaluate soil impacts for production that exceeds the 24 mty level. By 1990 soils disturbance for underground coal mining at the 42 mty level would be almost 50 percent more than under the projected level. In general, the underground mining operations would result in soil impacts similar to those discussed at the 24 mty level. Two strip mining projects on State and private land, Atlas Resources, Inc.'s, Blackie mine and Consolidated Coal Company's Emery Surface mine, would result in severe soil disturbance in the area mined. The surface mining operations would create extensive soil disturbance and the sites would be difficult to revegetate due to an arid environment, soils which are high in soluble salts, and high wind erosion potentials.

In addition to the new mines, there would be soil disturbance as well as impacts from particulate accumulation from smoke stack emissions if the new powerplants were constructed. About 1,600 acres of land would be disturbed from construction of the Castle Valley railroad resulting in increased soil erosion and land being taken out of production. Soils would also be disturbed on about 3,170 acres from increased community development resulting in soil erosion during construction and loss of soil productivity where occupied by structures.

c. Water

Although the areas affected would be increased, changes in the hydrologic system of the region would be so small as to be difficult to detect. An additional 14,300 acre-feet of water would be needed for community use, although only about 7,150 acre-feet would be consumptively used. The increased area of subsidence would cause a proportionate increased effect on ground-water flows.

d. Air

As shown in the following analysis, coal production at the high production level would produce little regional impact on air quality. The scenario differs somewhat between the 42 mty high production level and the 41 mty analyzed by AeroVironment (1977). However, the impacts of the two levels would be approximately equal. Utilization of coal in powerplants may have major effects on air quality.

TSP results.--The results of the analysis (AeroVironment, 1977) for maximum 24-hour and annual average TSP concentrations for each modeling region are show in table VIII-7. The estimated regional impacts can be put into perspective by comparing the calculated TSP concentrations with the NAAQS and PSD (although the regulations do not necessarily apply, as discussed in chapter III).

The incremental increases of maximum 24-hour TSP concentrations over the low production level scenario are within the class II increment for all modeling regions. When the average background is added in, all modeling regions are well below the NAAQS.

Table VIII-7.--Results of regional analysis of TSP concentration for the 42 mty alternative production level[1]

	Modeling region TSP concentrations $\mu g/m^3$					
	Roan and Book Cliffs	East Slope Wasatch Plateau	Castle Valley	East Slope Sevier Range	Salt Wash	East Book Cliffs
24-hour Average:						
Calculated concentration above background	39	<10	22	<10	<10	<10
No-build concentration above background	24	<5	<10	<10	--	--
PSD allowable increment (class II)	37	37	37	37	37	37
Average background	20	20	20	20	20	20
Total concentration	59	<30	<42	<30	<30	<30
NAAQS	150	150	150	150	150	150
Percent of NAAQS	40	<20	28	<20	<20	<20
Annual average:						
Calculated concentration above background	30	<10	14	<12	<10	<5
No-build concentration above background	18	<5	6	<10	--	--
PSD allowable increment (class II)	19	19	19	19	19	19
Average background	20	20	20	20	20	20
Total concentration	50	<30	34	<32	<30	<25
NAAQS	60	60	60	60	60	60
Percent of NAAQS	83	<50	57	<53	<50	<38

[1]All above figures were derived from a 41 mty analysis by AeroVironment (1977).

The annual average TSP increments over the low production level scenario are also within the class II standard for all modeling regions. The greatest concentrations would occur in the Roan, Book Cliffs, and Castle Valley modeling regions, and would be primarily attributable to the Price and Castle Valley area sources. When background is included all areas are under the NAAQS, although the Price area approaches the standard.

Capitol Reef National Park would be impacted by less than the PSD increments for annual average and 24-hour TSP according to AeroVironment (1977).

<u>SO_2 results</u>.--The results of the maximum 3-hour SO_2 concentration modeling are shown in figure VIII-3. Should the IPP powerplant be located at the Salt Wash site, the impact in Capitol Reef National Park would exceed the class I increment of 25 $\mu g/m^3$. In an analysis of potential impacts to Capitol Reef from the Emery Powerplant expansion of units 3 and 4, Bowers et al. (1978) determined that the Emery units 3 and 4 would consume approximately 26 percent of the class I 24-hour limitation. With the addition of the South Emery proposal to the scenario, and assuming that the emission plumes from both sites would be carried in the same air mass, the class I 24-hour limitation in Capitol Reef could be approached or exceeded. In addition to the existing mandatory class I area of Capitol Reef National Park, the following areas in the central region are presently being considered by BLM for recommendation to the State of Utah for class I redesignation: Desolation Canyon, San Rafael Reef, Lower Green River, Mexican Mountain, and Sids Mountain. The implications of powerplants affecting these areas will be discussed in detail in the Emery 3 and 4 and IPP environmental statements being prepared by BLM.

On a regional basis, all class II areas would be impacted by less than the PSD (prevention of significant deterioration) standard and would be well below the NAAQS (National Ambient Air Quality Standard) (AeroVironment, 1976). Each proposed mining and reclamation plan or powerplant would have to be analyzed individually to determine compliance with qir quality limitations.

Annual average SO_2 impacts would be less than 1 $\mu g/m^3$, which is below the class I increment and far below the class II increment. Including background, the maximum annual SO_2 concentration would be less than 8 $\mu g/m^3$, which is significantly below the NAAQS of 80 $\mu g/m^3$.

<u>NO_2 results</u>.--The annual average NO_2 impacts are well within the standards with the maximum incremental impact over the low production level scenario being less than 2 $\mu g/m^3$. The maximum annual NO_2 concentration, including background, is less than 15 $\mu g/m^3$, which is well below the NAAQS.

The worst case analysis (AeroVironment, 1977) indicates that the visual range would be reduced from an estimated 37 miles (60 km) baseline to 22 miles (35 km) near Price, 20 miles (32 km) along the Castle Valley, and not less than 25 miles (40 km) in the rest of the central region.

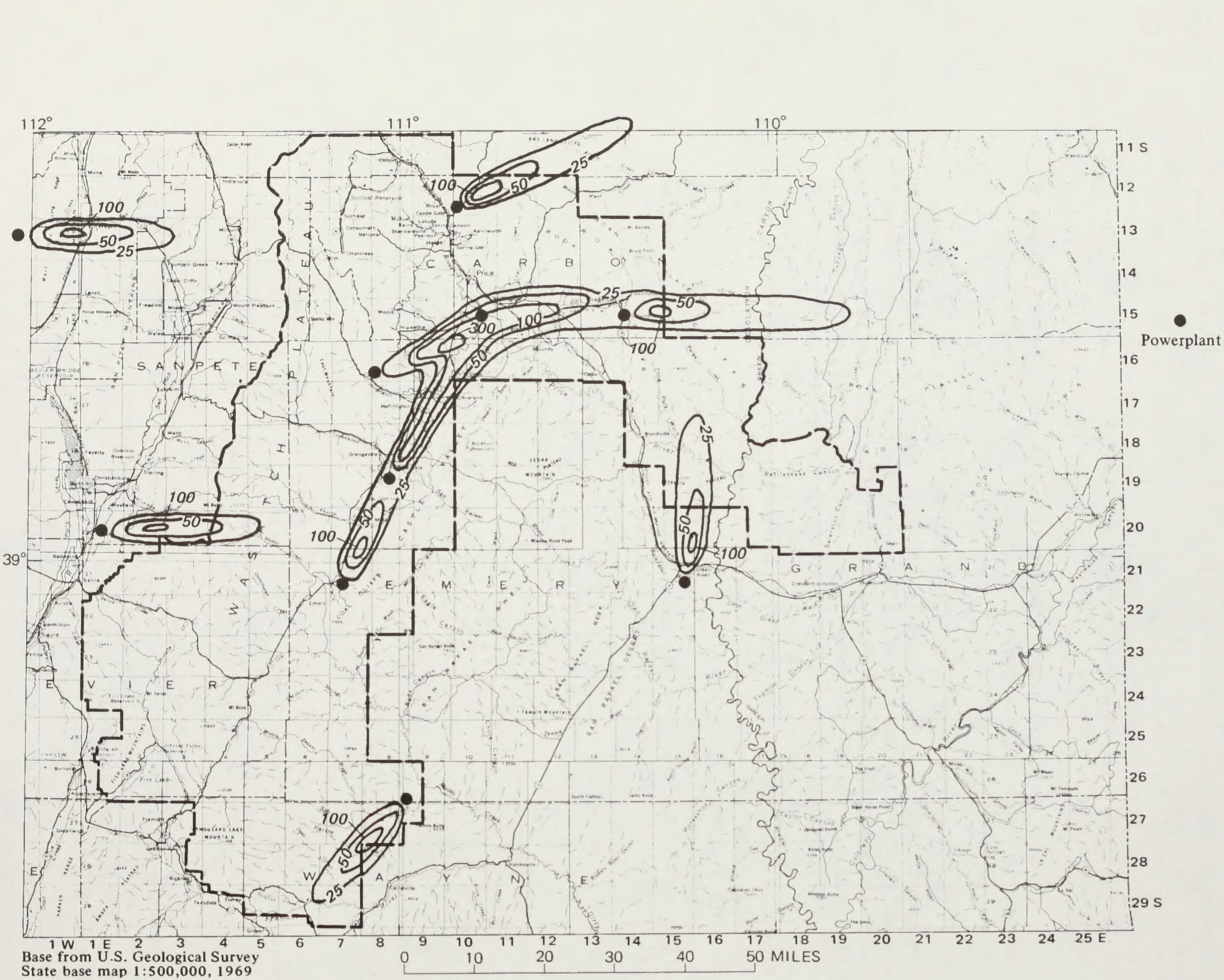

Figure VIII-3.--Maximum 3-hour SO_2 concentrations ($\mu g/m^3$) for the 42 mty alternate production level.

The annual average NO_2 concentration would be less than 15 $\mu g/m^3$ (even assuming all NO_x converts to NO_2), and general brown discoloration would not occur in the region.

A brown atmospheric discoloration might be apparent from specific powerplant plumes when very stable atmospheric conditions limit plume dispersion.

Some discoloration could occur along roads as a result of fugitive dust suspension in the air from vehicle travel.

Because the incremental increase in TSP at Capitol Reef National Park from mining activities would be less than the annual average and maximum 24-hour average limitations of 5 $\mu g/m^3$ and 10 $\mu g/m^3$, respectively, any impairments to visibility at Capitol Reef would be expected to be small. Powerplants, especially IPP, if located at the proposed Salt Wash site, would be expected to have more significant impacts to visibility at Capitol Reef. Until EPA develops regulations regarding visibility in mandatory class I areas, the significance of any visibility degradation in Capitol Reef National Park cannot be determined.

e. Vegetation

Essentially the same kind and level of mitigations would be applied under this alternative as under the projected level (24.0 mty). Therefore, the residual impacts would be of essentially the same kind, but of a greater number or size based on the acres of vegetation affected.

The loss of 3,170 acres of vegetation would result in a loss of about 950 AUM's of domestic livestock forage for one year. Over the average 30 year life of the projects, the total livestock forage lost would be 28,500 AUM's. The forest/woodland products would be moderately impacted on a local scale, but minor on a statewide basis. The impacts caused by the potential development of all of the conceptual mines, railroads, and powerplants would be similar in nature, but unquantifiable because of a lack of essential data. These impacts would be important on both a local and a regional basis.

f. Wildlife

The cumulative impacts on wildlife habitat from this level of production would include those already described for the projected level (24 mty) and the low production level (19 mty). Also included would be occupation or disturbance of wildlife habitat by additional coal mines, powerplants, railroad, and growth of existing communities to house the increased population associated with these projects. Because of the conceptual nature of these plans, the amount of habitat that would be disturbed or occupied cannot be quantified. Species that would be most affected include deer, elk, antelope, pheasant, cottontail rabbit, and mourning dove. Loss of habitat would continue for the life of the projects; however, urbanized areas would probably remain and 3,170 acres of habitat occupied by houses would be irreversibly committed. Other areas would be reclaimed, but they may be altered to the extent that former wildlife inhabitants would not return. Other species may be benefitted by the reclamation and some change of species distribution and use would occur.

Housing for the projected population increase would occupy 1,580 acres of pheasant habitat on irrigated agricultural lands primarily in Carbon, Emery, Sevier, and Wayne Counties. Loss of this habitat would result in a yearly reduction of: 211 cocks harvested, 260 hunter days, 363 breeding hens, and their annual production of 1,389 young. The change of water use from agricultural to industrial and culinary would retire additional acres of irrigated cropland, and pheasant, cottontail rabbit, and mourning dove production on this acreage would be further reduced.

The demand for recreational homes and developments would increase, and additional acres of wildlife habitat would be lost. Based on current ownership, there would be a demand for 713 recreational homes occupying from 178 to 713 acres. The amount of private lands that could be developed in the region may not meet this demand and areas outside the region may be utilized. Most such lots would be in forested mountain areas and would encroach on deer, elk, moose, cougar, and bear habitat. These lands would be irreversibly committed to recreational development, and wildlife productivity on them would be lost.

Adverse impacts on wildlife would be intensified by this higher rate of production. In areas where several mines operate in one canyon or drainage, the zones of disturbance would overlap and the avoidance reaction of deer, elk, cougar, and bear may exclude them from areas much larger than the total area occupied or disturbed by individual mines. This impact would continue for the life of the mines. Lost use of this habitat would reduce the carrying capacity of the region, and subsequently, productivity would be lost.

Highway wildlife mortality would increase because of the increased traffic associated with greater coal production and population growth. The highway kill of all species would be expected to increase; however, due to lack of data the amount of this increase cannot be predicted. Based on the current level of deer highway mortality in relation to traffic, the deer kill on roads in the region would increase by 161 deaths annually. Elk are less susceptible to highway mortality, but the incidence of elk highway kill would also increase.

The increased population associated with the projected developments in the region would result in increased disturbance, harassment, and illegal killing of wildlife. The region would be committed to a more developed setting with increased human visitation and disturbance. Wildlife species sensitive to human disturbance would avoid frequently used areas. Some loss of productivity would be expected due to abandonment of eggs or young and loss of habitat use. Game species and raptors are vulnerable to illegal killing and disturbance, and losses of these species would occur. Small mammals, reptiles, amphibians, and ground nesting birds would be adversely impacted by ORV use. Some would be killed or injured; burrows and nests would be destroyed, and habitat quality further reduced by destruction of vegetation.

The endangered bald eagle and peregrine falcon would be exposed to increased hazards related to the proposed developments and the associated increase in population. Major hazards would be: illegal killing, trapping, highway kills, wire strikes, electrocution, and degradation of the environment by pesticides, effluents, and toxic discharges.

g. Fisheries

Fish habitat would be essentially as described in chapter II. Increased coal production would cause an increase in population and fishermen, this would probably cause more gamefish to be caught, but without adding fish habitat there would be fewer caught per fisherman hour, and fishermen would tend to keep smaller fish.

This production level would amplify all impacts to fish described in the projected level. Aquatic pollutants in sublethal amounts at lower mining rates may reach toxic levels at the high production rate. Fishermen would increase by 70 percent causing all trout populations to be heavily supported by stocking hatching fish. Some self-sustaining trout populations would probably be fished out and not restocked. Proposed generating plants would consume water that now supports fish. Growth of existing communities would cause a need for new water sources that may require changing water diversions. These changes would affect fish habitat as described for the projected level. Increased accidental spills of toxic effluents would occur and increased releases of unionized ammonia and free chlorine from sewage treatment plants would be expected.

h. Land Uses

The increased population would require an estimated 3,170 acres for community development and could dewater an additional 1,900 acres of irrigated land through culinary water demand. A maximum estimated 3,480 acres of irrigated agricultural land, or 1.5 percent of the region's irrigated cropland in tillage rotation, could be adversely impacted.

Preliminary coal mining proposals involving Federal coal leases could conflict with roadless areas. Part of the lease area of Mountain States Resources Co. mines Nos. 2-6 intrude on Fishlake National Roadless Area 04303 (Solomon Basin). Parts of mines Nos. 2-6 also could fall within a BLM potential roadless area.

i. Socioeconomics

The high production level scenario yields extraordinarily high growth rates in the region. Coal mining employment by 1985 would be more than 10 percent larger than that of the projected level scenario in 1990. This implies growth rates of 20 percent per year in coal mining employment between 1980 and 1985, and a growth rate in total jobs of nearly 12 percent per year for the regional economy during these years. From 1985 to 1990, a smaller growth rate in coal employment of 3.9 percent per year would occur. The resulting population is 110,000 in 1985 and 112,000 in 1990, roughly a doubling of the population in less than a decade. The impacts of such growth would be significant in any case, but would be more so because the expansion would be concentrated largely in Emery County.

About 16 fatalities and 1,080 nonfatal accidents are anticipated each year owing to coal mining.

Table VIII-8 displays the work force required in the high level scenario. Though mining jobs are presented by county, socioeconomic impacts are more dependent on the expected distribution of workers by county of residence. Mine workers would commute from Sanpete and Sevier Counties to the Emery Southern Wasatch coal fields. In these fields the high level scenario would yield employment increases of 400 in 1985 and 580 in 1990 over the low level scenario. This is a substantial departure from the constant employment for the area, although it is less than the anticipated changes in the Northern Wasatch Plateau--Book Cliffs coal fields and Central Wasatch coal fields. There would be 3,745 more mining jobs in Carbon and 1,575 in Emery in 1990 than under the low level scenario. A population of 110,000 in 1985 and 112,000 in 1990 would be reached in the high level scenario (table VIII-9). This expansion is in large part the result of high rates of net migration to the region between 1980 and 1985, though some net out-migration would occur in some counties between 1985 and 1990. The out-migration in the latter period is associated with a decline in construction activity and represents an economic condition in which the economy is not growing rapidly enough to support the naturally increasing population.

The most important consequence of the high level scenario is the growth of Emery County. Anticipated 1980 to 1985 expansion would bring about net inmigration of more than twice the amount of the 1980 county population under the projected level scenario. Carbon and Sevier Counties also are anticipated to grow owing both to expansion of coal production and maintenance of regional service center roles.

The rapid growth of western Emery County would suggest expansion of higher order service industries there. This could affect the growth patterns of Wayne and Sevier Counties, possibly decreasing Wayne's projected population and temporarily increasing services. The growth of mining in the Southern Wasatch Plateau--Emery coal fields would affect Sevier more directly than Wayne, as the boom town conditions centered in Emery County could be distributed into closely connected areas in Sevier.

The massive migration that occurs in the high level scenario produces the age composition of the population presented in table VIII-10 The population differs in magnitude from the low level scenario population, but there are only minor differences in the age group proportions of the

Table VIII-8.--High level scenario--assumed labor force and county of residence

Location of mines by field and county	Mining jobs	Assumed county of residence	Mining jobs	Assumed county of residence
	1985		1990	
Eastern Book Cliffs coal field				
Carbon County----------	410	410 Carbon	520	520 Carbon
Western Book Cliffs/ Northern Wasatch Plateau				
Carbon County----------	2,410	2,310 Carbon	2,975	2,875 Carbon
----------		100 Sanpete		100 Sanpete
Emery County-----------	2,400	2,100 Carbon	3,070	2,700 Carbon
----------		100 Sanpete		100 Sanpete
----------		200 Emery		200 Emery
Southern Wasatch Plateau/ Emery coal field				
Sevier County----------	750	180 Sanpete	930	240 Sanpete
----------		380 Emery		450 Emery
----------		190 Sevier		250 Sevier

Table VIII-9.--Population of high production level scenario projected by age group, counties of Carbon, Emery, Sevier, Wayne, and Piute-Sanpete

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Details may not add to totals due to independent rounding.) (in thousands)]

Age groups	High production level scenario 1985	1990
	Carbon	
0-4------	3.53	4.53
5-14-----	7.16	7.94
15-24----	6.13	5.59
25-44----	12.41	15.99
45-64----	4.57	4.87
65+------	3.31	3.51
Total--	37.11	42.42
	Emery	
0-4------	2.72	3.74
5-14-----	6.10	5.80
15-24----	6.94	4.28
25-44----	10.61	12.73
45-64----	3.02	3.44
65+	1.91	1.80
Total--	31.29	31.79
	Sevier	
0-4------	1.96	1.60
5-14-----	3.68	3.19
15-24----	2.86	1.49
25-44----	6.34	5.10
45-64----	2.56	2.39
65+------	1.79	1.48
Total--	19.19	15.24
	Wayne	
0-4------	.76	.83
5-14-----	1.44	1.26
15-24----	1.52	.77
25-44----	2.67	2.61
45-64----	.76	.74
65+------	.54	.44
Total--	7.69	6.65
	Piute-Sanpete	
0-4------	1.50	1.44
5-14-----	2.87	3.20
15-24----	1.73	1.94
25-44----	4.83	5.45
45-64----	2.01	2.13
65+------	1.85	1.72
Total	14.77	15.88

Table VIII-10.--Characteristics of the projected age composition of the high production level scenario for counties of Carbon, Emery, Sevier, Wayne, and Piute-Sanpete

[Source: UPED Model Projection, Bureau of Economic and Business Research, University of Utah]

	High production level scenario 1985	1990
Carbon		
Percent of population:		
0-15	30.1	30.9
65+	8.9	8.3
Dependency ratio	.64	.64
Median age	27.0	28.5
Emery		
Percent of population:		
0-15	29.7	31.5
65+	6.1	5.7
Dependency ratio	.56	.59
Median age	24.9	27.6
Sevier		
Percent of population:		
0-15	30.7	32.7
65+	9.3	9.7
Dependency ratio	.67	.74
Median age	27.7	31.5
Wayne		
Percent of population:		
0-15	30.0	32.9
65+	7.0	6.6
Dependency ratio	.59	.65
Median age	25.6	28.3
Piute-Sanpete		
Percent of population:		
0-15	30.9	30.7
65+	12.5	10.9
Dependency ratio	.77	.71
Median age	30.2	31.0

two. The unusual age composition of the 1970 population was the result of economic decline in the previous years. Inmigration expected in the high level scenario would reduce the dependency ratio for Emery County. The proportion of the population 65 years of age and over in Emery County would decline to 5.7 percent.

Housing requirements are shown in table VIII-11. The requirement for Emery County is 9.4 thousand occupied dwelling units in 1990 as compared to 3.8 thousand in the low level scenario, an indication of the boom conditions that would confront that county.

Projected expansion in regional population and employment is presented in table VIII-12. The high production level is clearly different from that of the low level scenario. In the latter, the expanding economy would grow more rapidly than population because of an existing growth absorption capacity. But at the high production level, that capacity would be overwhelmed, and population would grow apace with the economy.

The structure of employment for the region and its counties is presented in table VIII-13. Differences in numbers of jobs in each sector between the low and high production level scenarios are large, and are due in part to different service industry requirements as the numbers of people change. Further, the numbers of jobs in the substantially basic agriculture and manufacturing sectors increase slightly. Manufacturing jobs are projected to reach 2.4 thousand in 1990 as compared to 2.2 thousand in the low level scenario. However, as a percentage of total employment, the manufacturing sector in 1990 declines from 7.2 percent in the low level scenario to 5.1 percent in the high level scenario. A corresponding decrease in the smaller agricultural sector also occurs. Both are a consequence of the expansion of the economy based on mining. The result is increased concentration in the economic base.

Narrowly based economies (those heavily dependent on a single industry) are not unusual in natural resource extraction areas. This, however, renders the regional economy vulnerable to instability in mining employment because of the potential for displacement and re-entry of the region's higher cost underground coal in distant markets. The consequent local economic effects of depression and boom are more serious than would be the case in a diversified economy. The stability of markets for the region's coal and the potential for decreasing the regional economy's dependence on coal mining (that is, for diversification of economic activity) would become more important as the region's dependence on coal mining increases in the high production level scenario.

Municipal services.--The impacts on municipal services under the assumptions of the high level production scenario are shown in table IV-25, chapter IV.

Table VIII-11.--Housing requirements, high production level scenario counties of Carbon, Emery, Sevier, Wayne, and Piute-Sanpete

[Source: UPED Model Projection, Bureau of Economic and Business research, University of Utah]

High production level scenario	1985	1990
Carbon		
Occupied dwelling units (in thousands)--------------	11.15	12.91
Average household size---------------	3.33	3.29
Emery		
Occupied dwelling units (in thousands)--------------	8.76	9.37
Average household size---------------	3.57	3.39
Sevier		
Occupied dwelling units (in thousands)--------------	5.83	4.75
Average household size---------------	3.29	3.21
Wayne		
Occupied dwelling units (in thousands)--------------	2.20	1.96
Average household size---------------	3.49	3.39
Piute-Sanpete		
Occupied dwelling units (in thousands)--------------	4.68	5.01
Average household size---------------	3.16	3.17

Table VIII-12.--Projected expansion in regional population and employment, high production level scenario

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah]

	1975	Interval growth rate percent/ year	1980	Interval growth rate percent/ year	1985	Interval growth rate percent/ year	1990
Population----	54.72	3.7	65.53	10.9	110.05	0.3	111.98
Labor force---	21.57	4.6	27.10	11.5	46.65	0.3	47.33
Jobs:							
Full and part-time---	21.12	5.0	26.94	11.8	47.15	0.3	47.84
Proprietor----	4.41	- .1	4.40	5.8	5.84	-3.3	4.95
Wage and salary------	16.71	6.2	22.66	12.8	41.31	0.8	42.89

Table VIII-13.--Employment (full and part time) and percentage allocation by sector at the high production level

[Source: UPED Model Projections, Bureau of Economic and Business Research, University of Utah. (Details may not add to totals because of independent rounding.)(number to the nearest thousand)]

County	Year	Employment sector									
		Agriculture	Mining	Construction	Manufacturing	TCU[a]	Trade	Fire[b]	Services	Government	Total
Carbon	1985										
number		.25	2.97	.98	.46	.94	3.07	.43	1.51	2.59	13.21
percent		1.9	22.5	7.4	3.5	7.1	23.2	3.3	11.4	19.6	
	1990										
number		.24	3.61	1.19	.48	1.03	3.61	.55	1.84	3.1	15.65
percent		1.5	23.1	7.6	3.1	6.6	23.1	3.5	11.8	19.8	
Emery	1985										
number		.34	5.85	2.83	.21	.93	2.55	.37	1.26	1.88	16.23
percent		2.1	36.0	17.4	1.3	5.7	15.7	2.3	7.8	11.6	
	1990										
number		.30	6.83	1.43	.21	.93	2.65	.43	1.37	2.09	16.23
percent		1.8	42.1	8.8	1.3	5.7	16.3	2.6	8.4	12.9	
Sevier	1985										
number		.52	.79	.57	.57	.35	2.06	.24	1.08	1.44	7.62
percent		6.8	10.4	7.5	7.5	4.6	27.0	3.1	14.2	18.9	
	1990										
number		.43	.96	.54	.53	.35	1.86	.24	1.02	1.21	7.13
percent		6.0	13.5	7.6	7.4	4.9	26.1	3.4	14.3	17.0	
Wayne	1985										
number		.14	.07	2.01	.05	.45	.8	.09	.39	.51	4.51
percent		3.1	1.6	44.6	1.1	10.0	17.7	2.0	8.6	11.3	
	1990										
number		.12	.03	.51	.05	.75	.76	.1	.35	.48	3.15
percent		3.8	1.0	16.2	1.6	23.8	24.1	3.2	11.1	15.2	
Piute-Sanpete	1985										
number		.93	.1	.36	1.18	.07	.63	.13	.51	1.19	5.36
percent		17.4	1.9	11.8	22.0	1.3	11.8	2.4	9.5	22.2	
	1990										
number		.79	.09	.68	1.18	.08	.71	.16	.6	1.31	5.60
percent		14.1	1.6	12.1	21.1	1.4	12.7	2.9	10.7	23.4	
Total	1985										
number		2.18	9.8	6.87	2.46	2.76	9.1	1.27	4.83	7.9	47.15
percent		4.6	20.8	14.6	5.2	5.9	19.3	2.7	10.2	16.8	
	1990										
number		1.88	11.57	4.30	2.44	3.14	9.58	1.47	5.15	8.31	47.84
percent		3.9	24.2	9.0	5.1	6.6	20.0	3.1	10.8	17.4	

[a] Transportation, communications, and utilities.

[b] Finance, insurance, and real estate.

j. Transportation and Utilities

Highway use at 42 mty would be 140 percent greater than at the projected level. Table VIII-14 presents levels of highway traffic associated with this level of production.

Most of the necessary highway improvements to handle this level of traffic have been discussed as necessary for the other two levels of development. In addition, the capacity of US-89 between Salina and US-6 would have to be increased, most likely through the addition of passing lanes, and the county road between US-89 at Ephraim and SR-29 would have to be upgraded or reconstructed.

Five to six mines would be accessed by way of the Eccles Canyon Road. This road crosses the ridge from Huntington Canyon to US-89 at Fairview and is at best, an improved, graded, and maintained gravel road. One of the few routes to Pleasant Valley, portions of this road are maintained by the USDA Forest Service for summer recreational access. A major concern of the USFS has been the potential conflict between mine traffic and slow speed recreational traffic.

The USFS has studied alternative routes in an attempt to bypass the concentration of mines scheduled for Eccles Canyon while preserving access to Huntington Canyon and points west. In an unpublished report (written communication, R. Geibel and D. Hadley, Manti-LaSal National Forest, 1977) covering six alternative alinements in Winter-quarters Canyon, Green Canyon, and Eccles Canyon, a recommendation was made that further study be made of two possible routes up Green Canyon, immediately to the north of Eccles Canyon, connecting to the existing USFS road out of Eccles Canyon at the ridge top.

No final route has been decided; the availability and source of funds could well be a factor. Detailed engineering design would be required even on a Forest-Service low-standard road because of limiting alinement and grades. Consequently, there is no firm proposal to construct the alternative route. Nevertheless, if a route is constructed conflicts between mine traffic and other traffic in Eccles Canyon could be removed.

Impacts associated with increased highway use discussed in chapter IV in connection with the probable level would occur to a greater extent with this alternative.

Railroads would continue to represent the major means of moving coal to markets outside the region. If all 42 mty of coal produced under this alternative moved by rail, approximately 29-unit train trips per day (including returning empty cars) would be added to the regional rail network. (It should be pointed out that an unknown percentage of the coal production would be consumed locally, which would, in turn, reduce the actual number of trains generated by this alternative.)

Table VIII-14.--Highway traffic levels at selected points (see fig. II-26) for high production level scenario

Segment Number[1]	1975 ADT[2]	1980 ADT	1985 ADT	1990 ADT	1990 Trucks
1--------	3,210	3,975	6,916	8,057	2,026
2--------	3,365	4,273	7,918	9,350	1,228
3--------	215	259	417	417	78
4--------	345	649	2,071	2,690	264
5--------	50	822	237	302	126
6--------	3,520	4,367	6,906	8,053	2,356
7--------	115	189	641	754	90
8--------	270	362	985	1,063	73
9--------	3,240	3,843	6,139	6,442	2,731
10--------	310	525	1,494	1,919	199
11--------	430	643	1,996	2,272	806
12--------	190	426	1,762	2,201	951
13--------	2,700	3,340	6,553	7,183	1,313
14--------	480	613	1,460	1,500	270
15--------	450	634	1,118	1,713	611
16--------	1,030	1,305	2,185	2,585	800
17--------	1,030	1,305	2,185	2,585	800
18--------	1,615	1,926	2,722	3,123	512
19--------	250	302	436	499	30
20--------	1,795	2,799	8,610	9,924	3,850
21--------	45	66	206	208	23
22--------	320	446	1,595	2,075	227
23--------	2,800	3,573	8,397	8,629	1,294

[1]See table II-25, figure II-26, chapter II.
[2]ADT=Average daily traffic.

The 42 mty of coal could be moved by the existing rail system provided that it is properly divided among the existing loading facilities. Certain minor improvements such as additional storage areas or more advanced loading equipment will, no doubt, become necessary.

Movement of coal from the mine mouth to the rail loading facilities, in many cases, would be by truck. This accounts for significant portions of the "1990 trucks" shown in table VIII-14. The Castle Valley Railroad may be able to develop a market for its services at this level of production by substantially reducing the truck-haul distance for mines located in the southern portions of the Wasatch Plateau and Emery coal fields. In some cases the truck haul could be entirely replaced by a conveyor from mine to loading facilities. By removing a large number of trucks from the regional highway network, the overall impact of transporting this level of coal production would be lessened.

The main-line between the region and Provo would have no problem accommodating the westbound movement of this coal traffic. As was mentioned earlier, it is in essence a double-track mainline. The capacity of the line between Provo and Salt Lake City would most likely be exceeded by the addition of this volume of traffic. If no improvements are made to increase capacity, some trains would have to be interchanged with the UP at Provo for shipment to the southwest.

Traffic reaching Salt Lake City would result in a situation similar to the projected level. That is, an individual line most likely could not absorb all the coal traffic plus other traffic growth without increasing its capacity.

The ability to move this volume of traffic east would be dependent on the level of production in the coal regions to the east. It is reasonable to assume that if central Utah reaches the high level of production and if all this coal moves east by rail, the high level of production would likely have been reached in the west central and northwest Colorado coal regions. Without major modifications to the existing D&RGW system, this total volume of traffic could not be handled. Some region(s) would have to find alternative means to transport coal or be prevented from reaching their high level of production.

In realistically summarizing the situation, it is apparent that a substantial percentage of the regional coal production would not move by rail. Additionally, initial reports of the marketing of coal production to be exported from the region have shown such diverse destinations as Indiana, California, and Orem, Utah. As a result it is likely that the increase in coal traffic as a whole would not be as great as 29 trains per day and that this traffic would be divided among several carriers and routes. Therefore, major improvements (such as the installation of a second track) should not be necessary to handle the transportation requirements of this level of production.

k. Recreation

Recreation visits would increase to 329,500 in 1985 and 1,028,000 in 1990. Visitor days use would be 342,100 by 1985 and 1,067,300 by 1990. Use of local and regional recreation attractions would generate to a point where carrying capacities of developed sites and dispersed areas would be exceeded without any increase in non-resident use of the same resources by predicted increased non-resident use. Impacts would be the same as indicated for the 24 mty level of production, except that more lands would be occupied by mine plantsites and ancillary facilities, and overcrowding and safety problems on existing and new highway systems would create acute user safety problems and dissatisfaction. Less areas would be available for dispersed recreation use (hiking, backpacking, solitude, etc.). More regulation and restrictions would be applied to users and activities, and fishermen and hunter success and satisfaction would be lowered because of greater numbers of sportsmen afield and lower number of wildlife populations.

l. Archeologic and Historic Values

Archeologic and historic impacts would be of the same nature as in chapters IV and V but to a greater degree. The increased population would place more remote sites under direct pressure and some archeologic and historic values could be lost.

m. Esthetics

Coal production at any level above the probable level of 24.0 mty would require additional and extended ancillary facilities and population to support increased mining activities. Impacts to the esthetic resource would be the same as those described in chapters IV and V, but to a greater degree. More urbanization would take place in adjacent communities, and more man-made intrusions would be introduced into the landscape character.

C. IPP GENERATING STATION

The Intermountain Power Project proposes to build a 3,000 megawatt electrical generating facility in Utah. Participants in the project are the Intermountain Consumers Power Association (a group of Utah and Nevada municipal utilities) and the California cities of Anaheim, Burbank, Glendale, Los Angeles, Pasadena, and Riverside.

The proposed facility would be coal-fired and would consist of four 750 megawatt generating units. Approximately 50,000 acre-feet of water and 10 mty of coal would be required for the facility. About 1,300 miles of new transmission line would be needed to deliver electricity to Utah, Nevada, and California consumers. About 2,600 construction workers would be required for the project and about 550 workers would be need for plant operation.

Because of air quality conflicts at the primary proposed site, (Salt Wash in Wayne County, Utah, table VIII-15), the State of Utah and the onents began a search for alternative sites (fig. VIII-1). The BLM ad made a preliminary study of the environmen considerations for the tified alternatives (tables VIII-16 to VIII-20). An environmentl statement for IPP is being prepared by BLM is to be completed in October, 1979.

Table VIII-15.--Environmental setting and anticipated significant environmental impacts, IPP Salt Wash site

Environmental Setting

This site is north of Caineville in Wayne County, Utah (the power plant and immediate ancillary facilities would be within the following area of public land: Sections 13, 14, 15, 23, 24, T. 27 S., R. 8 E., SLB&M, also Sections 17, 18, 19, 20, 30, T. 27 S., R. 9 E., SLB&M--approximately 4,640 acres).

The Salt Wash site lies north of Wood Bench in a remote setting about 9.75 miles east of Capitol Reef National Park and about 16 miles west of Hanksville, Utah.

Measurements of ambient concentrations of SO_2, NO_2, O_2, and particulates were made near the Salt Wash site. Measured concentrations are:

	% of Yearly Primary	Maximum	All Seasons Maximum	Maximum	Yearly
SO_2	16	<13 µg/m³	<13	<13	<13
NO_2	14	42			14
O_2	38	134			60
TSP	25			90.3	19

Visibility, in general, in this area of southern Utah is quite good, exceeding 50 miles the majority of the time.

Anticipated Significant Environmental Impacts

Below is a comparison of calculated maximum ground level concentrations and Class II Prevention of Significant Deterioration Regulations (PSDR) increment applicable to the area surrounding the proposed plant site.

	Emissions				
	Sulfur Dioxide			Particulates	
	Annual	24-Hr.	3-Hr.	Annual	24-hr
Class II Increment (µg/m³)	20	91	512	19	37
% Sulfur in Coal	0.56	0.7	0.7	--	--
Maximum Calculated Ground Level Concentrations (µg/m³)					
State[a]	39.4	117	--	7.02	20.57
FRT[b]	7	58	460	1	7
Cramer[c]	1.4	83	217	0.2	11
Westinghouse[d]	7	76	578	--	12
Natural Background Concentrations (µg/m³)	<13	<13	<13	19	90

Note: Each of the independent calculations was performed assuming the plume to have a vertical and lateral gaussian distribution concentration (normal distribution). In each case, a variation of the Gaussian plume model for continuous sources was used as described in Turners workbook (EPA, 1970). Pasquill stability categories were used to classify wind measurements. The effective plume height was calculated by a procedure recommended by Briggs (Briggs, 1972). Each of the models used was developed to predict Pollutant concentrations in mountaineous terrain.

[a] Letter from Utah Bureau of Air Quality, April 14, 1977.

[b] Environmental Research and Technology, Assessment of the Air Quality Impact of Emission from Intermountain Power Project, July, 1977.

[c] H. E. Cramer Co., "Assessment of the Air Quality Impact of Emission from the proposed Intermountain Power Porject Power Plant at the Primary and Three Alternative Sites," July 19, 1977.

[d] Westinghouse, Intermountain Power Project, Preliminary Engineering and Feasibility Study, Environmental Assessment, Vol. 5, art 2, May, 1977.

Table VIII-15.--Environmental setting and anticipated significant environmental impacts, IPP Salt Wash site--Continued

Environmental Setting	Anticipated Significant Environmental Impacts
Soils in the area range from deep alluvial valley soils to shallow clay soils (badlands) and shallow rocky soils (rocklands) (SCS, 1964, 1971, and 1975).	Table 3-4 shows a comparison of studies applicable to the Capitol Reef National Park.

	Emissions				
	Sulfur Dioxide			Particulates	
	Annual	24-hr	3-hr.	Annual	24-hr
Class I Increment ($\mu g/m^3$)	2	5	25	5	10
% Sulfur in Coal	0.56	0.7	0.7	--	--
Maximum Calculated Ground Level Concentrations ($\mu g/m^3$)					
State[a]	3.7	27	--	0.67	8.4
ERT[b]	--	25	104	--	--
Cramer[c]	0.135	24	18.1	0.019	3.0
Westinghouse[d]	0.4	8.7	69	<0.1	1.7
Natural Background Concentration ($\mu g/m^3$)	<13	<13	<13	19	90

Note: Each of the independent calculations was performed assuming the plume to have a vertical and lateral gaussian concentration distribution (normal distribution). In each case, a variation of the Gaussian plume model for continuous sources was used as described in Turners workbook (EPA, 1970). Pasquill stability categories were used to classify wind conditions, with the exception of the Cramer study which used direct turbulance measurements. The effective plume height was calculated by a procedure recommended by Briggs Briggs, 1972). Each of the models used was developed to predict pollutant concentrations in mountainous terrain.

[a]Letter from Utah Bureau of Air Quality, April 14, 1977.

[b]Environmental Research and Technology, Assessment of the Air Quality Impact of Emission from Intermountain Power Project, July, 1977.

[c]H. E. Cramer Co., "Assessment of the Air Quality Impact of Emissions from the Proposed Intermountain Power Project Power Plant at the Primary and Three Alternative Sites," 1978.

[d]Westinghouse, Intermountain Power Project, Preliminary Engineering and Feasibility Study, Environmental Assessment, Vol. 5, Part 2, May, 1977.

Table VIII-15.--Environmental setting and anticipated significant environmental impacts, IPP Salt Wash site--Continued

Environmental Setting	Anticipated Significant Environmental Impact
Both surface water (Fremont River) and ground water (Navajo Sandstone) would be used in the operation of the proposed power plant. Approximately 30,000 acre-feet would be diverted annually from the river while about 20,000 acre-feet annually would be pumped from the Navajo Sandstone aquifer.	About 57 percent of the Fremont River mean annual flow, as measured near near Cainville, would be diverted for consumptive uses. Ground water would be "mined" from the acquifer because withdrawal exceeds recharge. The decline of ground water level would affect as many as 24 springs and seeps discharing from the Navajo Sandstone. A general degradation of ground water quality would occur in project area. When pumping terminates, it could be expected that in excess of 50 years would be required before ground water in the area would return to present equilibrium conditions.
Sparse Stands of salt desert shrub dominate the area. A cactus, Sclerocactus wrigtiae, an endangered species and a previously unknown globe mallow were found in 1974 near the proposed plant site (Harper, et. al., 1975).	Any disturbance of unique areas could alter or destroy vegetative not found elsewhere, such as the Moroni Slopes to the north of plant site, the Entrada and Carmel geologic formations in the vicinity, and North and South Cainville Mesas.
The project area is located mainly on "typical desert habitat." Sites most important to wildlife are Caine Springs, Salt Wash, the lower Fremont River, and agricultural areas near Caineville and Hanksville. The peregrine falcon is the only endangered species found within the primary project area. No game fish or threatened and endangered species of fish exist within the primary project area. There are no unique or rare species of micro-organisms or aquatic life in the lower Fremont River, Caine Springs, or Salt Wash.	
Little recreational use is presently made of the primary project area other than jeep tours, off-road vehicle pleasure driving, and viewing outstanding scenery. Visual quality varies between low to high.	The additional people which the proposed project would bring to Wayne County would significantly increase hunting pressures on the regions's game species including big game, upland game, and waterfowl. An extimated additional 12,150 fisherman days would result from the increased permanent project-related population. Some developed recreation sites in the region could have new pressures leading to facility deterioration.
About 89 percent of the land in Wayne County east of Capitol Reef National Park is in public ownership. Only 1 percent is private. There are about 1,175 acres of farmland in eastern Wayne County.	
The primary project area is near the Hondu region which could have wilderness characteristics.	
Wayne County is sparsely populated with less than 2,000 residences.	Socioeconomic impacts related to the influx of people attracted by the construction and operation of the power plant is being assessed by consultants contracted by U.S. Geological Survey and is currently not available.

Table VIII-16.--Environmental setting and anticipated significant environmental impacts, IPP Mounds alternative site

Environmental Setting	Anticipated Significant Environmental Impacts
The site is 10 miles southeast of Wellington, Utah in Emery County. (Sections 4, 5, 6, 7, 8, 9, 17, T. 16 S., R. 12 E.)	
The Mounds Alternative is encircled by the Wasatch Plateau on the west and the Book Cliffs to the north and east.	
In the absence of on-site meteorological data, the Utah Bureau of Air Quality used a screening model to evaluate the Mounds site. Their preliminary analyses did not identify any potential air quality problems for a 3,000 MW power plant at the Mounds site. Some questions have since been raised concerning particulate concentrations resulting from windblown dust.	Screening studies indicated that SO_2 concentrations would not impact existing Class I airsheds within Capitol Reef and Arches National Parks and Utah Canyonlands. Potential Class I airshed over Sids Mountain and Mexican Mountain could be impacted. Additional study is needed before air quality impacts can be predicted over these potential Class I areas.
Vegetation, supported by generally saline and arid soils, include salt desert shrubs, galleta and blue grama grasses. No threatened or endangered plant species are known for this site. Additional investigations could discover these enities.	
Although the site lies within suitable habitat for the endangered black-footed ferret, none have been observed.	
The peregrine falcon, an endanagered species, has been observed at Mounds within recent years.	Additional investigation is needed to determine if the peregrine falcon actually inhabits the Mounds area.
Pronghorn antelope make use of surrounding hills and benches.	Antelope range would be reduced. The area is important for antelope fawning between May 15 and July 1 of each year.
Little recreational use is made of this alternative project site. Hunters, however, pursue the pronghorn antelope and other recreationists (fisherman, campers, hikers, four-wheel enthusiasts, etc.) enjoy the surrounding semi-deserts and mountains. The project area is about 5 miles southwest of Utah Highway 50-6 and straddles the Denver and Rio Grande railroad. The site does not provide outstanding opportunities for solitude or for primitive and unconfined recreation.	Although wilderness studies have not been completed, this alternative does not appear to have wilderness characteristics.
No agricultural cropland exist within the project area and none are planned. Both sheep and cattle graze this rangeland.	About 400 animal unit months of range forage would be lost.
Rapid growth of towns in Carbon-Emery Counties during the last decade, due to expansion of coal mining and construction of electric power plants, has placed stress on housing and community infrastructures.	Stress on housing and community infrastructures would continue.

Site Advantage: The site is relatively close to coal sources. A railroad (Denver-Rio Grande) extends through the plant site.

Table VIII-17.--Environmental setting and anticipated significant environmental impacts, Beckwith alternative site

<table>
<tr><th>Environmental Setting</th><th>Anticipated Significant Environmental Impacts</th></tr>
<tr><td>Site is about 6 miles west of Green River, Utah and north of Highway 50 (Sections 31, 32. T. 20 S., R. 15 E. SLB&M. Sections 1, 2, 3, T.21 S., R. 15 E. SLB&M.

Site is 2 to 3 miles south of Beckwith Plateau.</td><td></td></tr>
<tr><td>H. E. Cramer Co., consultant to BLM, indicated that ambient air quality data was relatively lacking. They reasoned, however, that the relatively high, short-term particulate concentrations that tend to occur in rural Utah are also likely in the vicinity of Green River. These particulates are mostly wind blown dust associated with semi-desert soils and farming activities.</td><td>Investigations (H. E. Cramer, 1978) estimated that stack emission could result in the following maximum ground level concentrations:
<table>
<tr><th></th><th colspan="3">Concentration ($\mu g/m^3$)
Averaging Time</th></tr>
<tr><th>Pollutants</th><th>3 Hour</th><th>24 Hour</th><th>Annual</th></tr>
<tr><td>SO_2</td><td>320</td><td>32</td><td>1.02</td></tr>
<tr><td>Particulates</td><td>--</td><td>5.0</td><td>--</td></tr>
<tr><td>NO_2</td><td>--</td><td>--</td><td>7.32</td></tr>
</table>
A summary by H. E. Cramer Co. indicated that short-term Class I SO_2 requirements could be met at existing Class I areas in Southeastern Utah. A potential Class I area (Mexican Mountain) could experience pollution levels that would exceed the 3-hour concentrations allowed under a 5 percent variance. Other potential Class I areas, San Rafael Reef and Sids Mountain, would require a variance.</td></tr>
<tr><td>Mancos shales are parent materials for highly erodable soils.</td><td></td></tr>
<tr><td>Vegetation is sparse and principally saltbush and galleta grass. Threatened and endangered vegetative species were not observed by Dames and Moore Company, consultants to the State of Utah, in their fall, 1977 field investigations, but <u>Psorothamus</u> <u>polyadenus</u> var. <u>jonseii</u> has been collected in the site area.</td><td></td></tr>
<tr><td>The endangered black-footed ferret has been sighted on adjacent areas. The Utah Division of Wildlife Resources indicates the site is suitable Habitat.</td><td>Impact cannot be predicted.</td></tr>
<tr><td>The Colorado River squawfish and humpback chub, two endangered species, exist in the Green River between Ouray and Green River, Utah. The Green River is assumed to be the project's water source.</td><td>Impacts to the two endangered fish species have been predicted.</td></tr>
<tr><td>Little recreational use is experienced on this badland area, except that numbers of off-road vehicles are increasing in the area. Motorists on nearby U.S. Highways 50-6 and Interstate I-70 have a panoramic view of the Beckwith Plateau and the badlands extending from the Book Cliffs.</td><td>There are more than 25 recreational attractions within a two hour driving driving distance (e.g., the Henry Mountains, San Rafael Swell, Capitol Reef, Canyonlands, Glen Canyon, Colorado and Green Rivers). Additional recreational use pressures could be experienced. An increase of 11,000 fisherman days per year would be expected from the permanent project-related population and 31,000 days per year from the short-term population. About 500 additional deer hunters would be afield and 300 upland game bird hunters. The plant site would be visible to motorists traveling Highway 50-6 and Interstate Highway I-70.</td></tr>
</table>

Continued

Table VIII-17.--Environmental setting and anticipated significant environmental impacts, Beckwith alternative site--Continued

Environmental Setting	Anticipated Significant Environmental Impacts
Because of the nearness of major highways and the activities of people living in the nearby town of Green River, wilderness characteristics have been reduced even though open space values remain.	The project areas do not seem to have wilderness characteristics even though roadless criteria is meet.
The Beckwith site is situated in a sparsely settled area of extremely limited population and economic structure. Towns, within reasonable commuting distances, are not large enough to provide housing and services for a project-induced population.	A new town would be required should this site be selected.
There are no agricultural lands within project area.	About 60 animal unit months of sheep forage could be lost if the power plant were constructed on this site.
Site Advantages: Site is relatively close to coal sources. Both railroad and highway systems are adjacent to area. Water, if pumped from Green River, would be within a few miles of power plant.	

Table VIII-18.--Environmental setting and anticipated significant environmental impacts, Green River alternative site

(Horse Bench)

Environmental Setting

Site is about 15 miles south southwest from Green River, Utah. Sections 3, 4, 9, 10, T. 23 S., R. 15 E., SLB&M.

Site is about 8 miles east from San Rafael Reef. Cliffs, 2 miles north, form the northern boundary and upsloping benches and hilly terrain reach southward.

The pollutant concentrations below are likely to be representative of the existing air quality at the five alternative sites in southern Utah, except for the particulate concentrations. Particulate concentrations are probably comparable to Castle Valley--which are a 24-hour average maximum concentration 179 μg/m³ (H. E. Cramer Company, 1978).

Summary of Air Quality Measurements
Made Near the Primary Site
(Salt Wash)

Pollutant	Maximum Concentrations* (μg/m³) 1-Hour	3-Hour	24-Hour	Average of All Samples
Sulfur Dioxide (SO_2)	<13	<13	<13	<13
Nitrogen Dioxide (NO_2)	40	--	--	13
Ozone (O_3)	132	--	--	59
Suspended Particulates	--	--	90	19**

*Source: Environmental Systems Department of Westinghouse Electric Corporation.

**Geometric Mean.

The assumption is that 45,000 acre feet of water would be pumped annually from the Green River to supply project needs.

This site is located mainly on a member of Morrison Formation with drainages eroded into the Summerville Formation. Soils are sandy. There is a diversity of vegetation including salt desert shrub, rabbit brush, sanddrop seed galleta. Astragulus pardalinus, an endangered species, is known to occur near the Horse Bench site (Dames and Moore, November, 1977).

Although the site is suitable habitat for the black footed ferret, an endangered species, none have been reported here. A black footed ferret has been reported 7 miles southeast of this site.

The Utah Division of Wildlife Resources report that the Colorado River squawfish and humpback chub, both endangered, are in the Green River from the vicinity of Ouray to Green River, Utah.

Anticipated Significant Environmental Impacts

The H. E. Cramer Company reported that the following maximum ground level concentrations could occur at the Green River Site:

Pollutants	Concentrations (μg/m³) Averaging Time 3 Hour	24 Hour	Annual
SO_3	118	48	1.44
Particulate	--	7	0.21
NO_2	--	--	10.40
Location			
Distance (km)	5.0	2.5	4.0
Bearing (deg)	166	020	030

Compliance with short-term Class I SO_2 requirements at existing Class areas, Capitol Reef, Canyonlands, and Arches is projected. Potential Class I areas (Desolation Canyon, Lower Green River, Mexican Mountain) would require a variance. Projected ground level concentrations of SO_2 on the San Rafael Reef, even with 5 percent variance, would exceed Class I standards.

Table VIII-18.--Environmental setting and anticipated significant environmental impacts, Green River alternative site--Continued

Environmental Setting	Anticipated Significant Environmental Impacts
No irrigated croplands exist within this study power plant site, however, about 2,600 acres of irrigated farmland is being cultivated within the Lower Green River and lower portions of San Rafael hydrologic areas. Approximately 8,500 acre feet of water is needed to irrigate these lands each year.	
Active mineral exploration is being conducted on adjacent areas. The project area apparently meets roadless area requirements but does not appear to have wilderness characteristics.	
Domestic livestock are authorized to graze this area 10 months each year.	
Little recreational use is made in this general area, although it forms a segment of a panorama view taken from the Spotted Wolf Overlook near Interstate Highway-70.	
Green River, Utah, the nearest town, has a population of 1,050. Commercial enterprises depend largely on travelers along Interstate Highway 70 which passes through the area.	Commuting time to communities of sufficient size to provide housing and other basic needs of workers is excessive, thus, a new town would be required.
Site Advantages: Coal sources would likely be those found in the Wasatch Plateau and Book Cliffs areas. The Denver and Rio Grande Railroad is routed through Green River, Utah and is relatively near coal mines.	

Table VIII-19.--Environmental setting and anticipated significant environmental impacts, Desert-Hanksville alternative sites

Environmental Setting	Anticipated Significant Environmental Impacts
The Desert and Hanksville sites are within about 5 miles of each other and are considered together. (Desert site locations are sections 1, 2, 3, 10, 11, 12, T. 27 S., R. 12 E., SLB&M. Hanksville site locations are sections 13, 24, T. 27 S., R. 11 E., and Section 7, 8, 17, 18, 19, T. 27 S., R. 12 E., SLB&M).	
The Desert-Hanksville sites are located on the gently sloping extension of the Southern San Rafael Desert. Soils are sandy and unstable dunes are common.	
Ambient air quality is similar to measurements made near the primary project (Salt Wash) except that the particulate concentrations are probably comparable to the maximum concentrations in Castle Valley which are a 24-hour average of 179 μg/m³ (H. E. Cramer Co., 1978).	The magnitudes and locations of maximum ground-level concentrations calculated for the Desert and Hanksville alternative sites are shown below (Cramer, 1978):

	Concentration (μg/m³)		
	Averaging Time		
Pollutants	3 Hours	24 Hours	Annual
Plant at Desert Site			
SO_2	148	58	1.58
Particulates	--	8	0.23
NO_2	--	--	11.38
Location			
Distance (km)	3.0	3.5	3.9
Bearing (deg)	045	020	028
Plant Hanksville site			
SO_2	200	68	1.80
Particulates	68	9	0.26
NO_2	--	--	12.95
Location			
Distance (km)	2.5	2.5	3.6
Bearing (deg)	045	020	023

Environmental Setting	Anticipated Significant Environmental Impacts
	Both the Desert and Hanksville sites would require a variance in the Capitol Reef National Park, a Class I area, when considering compliance with 3-hour Class I, SO_2 requirements. If the Utah Canyonlands were reclassified to a Class I area, then a variance would also be required.
Water sources would be same as Salt Wash proposal--25,000 acre feet annually from the Fremont River and the remainder (up to 25,000 acre feet per year) from the Navajo Sandstone aquifer.	The Environmental impacts associated wth water use would essentially be the same as Salt Wash site. Two 48-inch pipelines from the Caineville area would be required to convey water eastward to Desert-Hanksville area.
Vegetation is a mixed desert shrub with Mormon tea, sand sage, and galleta are among the common plants. Two threatened and endangered plants species are likely to occur in this general area: _Eriogenum smithii_ and _Astragulus pardalinus_.	About 130 animal unit months of cattle forage would be lost if the power plant were constructed at either of these sites. Threatened or endangered plant species which are assumed to grow in the area have not been observed or reported at this date.
Peregrines falcons have been sighted about 12 miles northeast of the sites. Pronghorn antelope graze the general area.	

Continued

Table VIII-19.--Environmental setting and anticipated significant environmental impacts, Desert-Hanksville alternative sites--Continued

Environmental Setting	Anticipated Significant Environmental Impacts
Little recreational uses is currently being made of proposed immediate project area; however, major recreational attractions are located within the region (e.g., Powell, Henry Mountains, Capitol Reef, Fish Lake, Canyonlands, San Rafael Swell, Robber's Roost, Green River).	Major recreational attractions would all receive significant additional from the influx of people attracted to the area because of IPP. An estimated 12,150 fisherman days per year would result from the increased permanent project-related population and 38,500 fisherman days per year for the short-term population. Buildings, stacks and aircraft warning lights would be highly visible from various points within the regional setting, including Utah Highway 24 leading from Hanksville to Green River, Utah.
Several areas within the region may have wilderness characteristics (i.e., San Rafael Swell, Robber's Roost, Little Rockies, Circle Cliffs, Escalante Canyon). Roadless areas have been identified on Forest Service lands within the regional setting. Some have been designated as Wilderness Study areas.	Those lands with wilderness characteristics could experience some degradation.
Hanksville, population 200, is the nearest town to the project site.	A new community would be required to provide basic needs for construction and operational work forces. Coal source would be Wasatch Plateau and Book Cliffs area of Wayne County and Emery-Carbon Counties.

Table VIII-20.--Environmental setting and anticipated significant environmental impacts, IPP Lynndyl alternative site

Environmental Setting	Anticipated Significant Environmental Impacts
This site is north of Delta, Utah and west of Lynndyl, Utah.	
Because engineering feasibility studies are incomplete, the final site location will not be determined until late May, 1978. The west-central region of Utah is a remanant of ancient Lake Bonneville with relatively broad shallow valleys. The upper reaches bear gravelly alluvial soils and sand dunes, with the lower elevations dominated by clay soils. Vegetation is sparce and predominately salt desert shrub. Farmlands are found north of Delta, while ephemeral wet lands are located south and southwest.	Current assessments of environmental impacts have mainly been directed toward air quality issues; nevertheless ultimate projections relating to air quality impacts must wait until the power plant site is defined. Project proponents are currently negotiating in the Delta area for irrigation water which can be converted to industrial use. Environmental impacts cannot be projected until project plans mature.
No threatened or endangered fish species inhabit the Sevier River drainage (Utah Division of Wildlife Resouces, 1977). Likewise, there are no endangered or threatened plant species known to occur on or near the Lynndyl site (Dames and Moore, 1977).	
Recreational values are low in the project area, however, those within the region are important (e.g., Little Sahara Recreational Area, Fishlake National Forest, House Range, Clear Lake Waterfowl Management Area, Fish Springs National Wildlife Refuge). Other attractions are found in the West Desert of Utah.	
Several areas within the region meet roadless area requirements. It is not known whether any of these areas have wilderness characteristics.	
The native range in the general project area is a low producer of domestic livestock forage.	
Millard-Juab counties would be directly affected by the influx of construction-operational work forces associated with IPP.	The combined population of nine towns likely to be effected in Millard and Juab Counties is 8,820. Anticipated socioeconomic impacts have not been clearly identified, nor have their magnitude been defined. Mitigating measures are also in developmental stages.

CHAPTER IX: CONSULTATION AND COORDINATION

A. TASK FORCE ORGANIZATION

This analysis is a joint Geological Survey (GS) - Bureau of Land Management (BLM) statement prepared under the leadership of the GS. The other participating agencies are the Bureau of Mines and the Fish and Wildlife Service of the Department of the Interior, the Forest Service of the Department of Agriculture, and the Interstate Commerce Commission.

The socioeconomic impact analysis was provided under contract to the GS by the Utah Office of the State Planning Coordinator. The climate and air quality analysis was contracted to Aerovironment Inc., Pasadena, Calif., the regional cumulative historic and archeological impact assessment was done under contract by Archeological Environmental Research Corporation, (AERC), Salt Lake City, Utah, and the endangered and threatened plant species evaluation was contracted to Brigham Young University, Provo, Utah.

B. PUBLIC COMMENTS AND RESPONSES

A series of public information meetings were held starting May 9, 1977 by the Task Force where potential coal-mining and other coal-related activities in central Utah were described to attendees. The purpose of the meetings was to inform the public of the proposed activities and to facilitate receipt of their concerns and comments. The public submitted their comments orally and in writing at the meeting or to the Task Force office. The public meetings in Utah were held May 9 in Kanab; on May 10 at Cedar City; on May 11 at Richfield; on May 12 at Price; and on May 18 in Salt Lake City.

Public hearings will be scheduled to obtain comments on this draft environmental statement in Richfield, Price, and Salt Lake City. News releases, Federal Register notices, and special postings will be issued on specific hearing dates. Copies of this draft EIS are available upon request until supplies are depleted.

C. CONSULTATION AND COORDINATION IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

During preparation of this draft environmental statement federal, state and local agencies and representatives of private industry were consulted. Individuals with special expertise relating to the proposed actions provided information and additional data.

1. The National Park Service has contributed by providing appropriate data.

2. Various departments of the State of Utah have offered appropriate data and suggestions to Task Force members.

3. Local government officials and other community leaders provided direct input into socioeconomic analysis impact identification and mitigating measures.

4. Field personnel of the Bureau of Land Management in Price, Moab, Hanksville, and Richfield participated in field reviews of the proposed actions. Similarly, District and Forest personnel from the Manti-LaSal and Fishlake National Forest participated in field reviews.

5. The Bureau of Land Management and the State of Utah have entered into a cooperative agreement for the protection of cultural resources. (See following agreement, next five pages.)

STATE OF UTAH
Scott M. Matheson, Governor

DEPARTMENT OF DEVELOPMENT SERVICES

Michael D. Gallivan
Executive Director
104 State Capitol
Salt Lake City, Utah 84114
Telephone: (801) 533-5961

June 23, 1978

Mr. Paul Howard
Bureau of Land Management
University Club Building
136 East South Temple
Salt Lake City, Utah 84111

RE: Central Utah Coal Environmental Statement Cooperative Agreement,
Southern Utah Coal Environmental Statement Cooperative Agreement

Dear Mr. Howard:

The staff has reviewed the memorandums of understanding and concur with this cooperative agreement. I have signed the memorandums, and your proposed means to insure the protection of cultural resources is adequate, so long as it is properly implemented should development occur. However, we reserve the right to continually comment on the quality of techniques used in the environmental impact statements.

If you have any questions or concerns, please contact Wilson G. Martin, Preservation Development Coordinator, 307 West 200 South, Salt Lake City, Utah 84101, Utah State Historical Society, 533-6017.

Sincerely,

Michael D. Gallivan
Executive Director
and
State Historic Preservation Officer

WGM:jr

Cultural Resources
Cooperative Agreement
Central Utah Coal Environmental Statement
Between
The Bureau of Land Management
and the
State of Utah

I. Purpose

The Bureau of Land Management, hereinafter referred to as the Bureau, is participating, under leadership of the Geological Survey, in preparation of the Central Utah Region Coal Environmental Statement (Coal ES) under provisions of the National Environmental Policy Act of 1969. The Bureau has determined that cultural resources could be damaged or lost as a result of coal mining proposals at specific sites for which mining plans and applications have been submitted.

The Utah State Historic Preservation Office, hereinafter referred to as the State, is interested in assuring that cultural resources in Utah be protected. The Bureau and the State have consulted and agree as to the measures, outlined in this agreement, which should be undertaken to protect these resources, should authorization be granted to use public lands in Utah administered by The Bureau for the purpose of any of the above mentioned proposed actions. In this agreement, "cultural resources" means data and sites which have archaeological, historical, architectural, or cultural importance and interest. Investigators will be qualified to evaluate these "cultural resources." Qualifications of investigators have been submitted to State Historic Preservation Officer.

II. Authority

This agreement is authorized under the Federal Land Policy and Management Act of 1976 and the National Historic Preservation Act of 1966. It is in accord with Bureau policies and programs. It does not abrogate nor amend any other agreement between the Bureau and the State.

III. Responsibilities and Procedures

The Bureau will comply with 36 CFR 800 in identifying sites which are listed in or eligible for inclusion in the National Register of Historic Places.

A. As part of the planning process and environmental analysis required prior to coal-related management decisions, the Bureau will search for archaeological and historical literature concerning the Central Utah Coal area. The Bureau has had conducted a stratified random sample survey of one percent of the public lands in the Central

Utah Coal area. The strata consisted of vegetative zones, and the sample units were quarter sections. The one percent survey provides for an intensive survey of each chosen quarter section, meaning that all cultural resources observable on the surface of that area are recorded.

B. After completing the planning and environmental analysis processes, should the proposed management be implemented, the Bureau will inform project participants of, monitor compliance with, and enforce the following stipulations:

1. Prior to initiation of ground-disturbing activities, literature searches and intensive surveys will be undertaken in all areas which would be disturbed.

2. Wherever possible and feasible, cultural resources will be avoided by construction and related activities. This will be accomplished mainly by rerouting linear facilities, such as roads, fences, and pipelines, and adjusting locations of other facilities.

3. A professional archaeologist may be required to be present when ground-disturbing operations are underway.

4. Subsurface cultural resources that are encountered during any construction will be salvaged if there is no other recourse in such a situation.

C. Wherever it is not possible and feasible to avoid sites that contain cultural resources, the Bureau will consult with the State to determine the most satisfactory means of mitigating damage, as required by 36 CFR 800.

D. The Bureau will provide cultural resources reports, technical reports, and other pertinent material to the State.

E. The State will provide the Bureau with a letter, for use as an exhibit in the Coal ES, to the effect that the procedures herein proposed by the Bureau, if correctly implemented, will satisfy the State's interest.

IV. The attached list identifies the specific actions that the Bureau anticipates will be included in the Coal ES. The list may be brought up-to-date, as necessary, without amending this agreement in any way.

V. Implementation

A. This agreement will become effective on the date of the last signature of this agreement.

B. Either party may request revision or cancellation of this agreement by written notice, not less than 30 days prior to the time when such action is proposed.

C. Any problems resulting from this agreement which cannot be resolved by the Bureau and the State will be referred to the Secretary of the Interior and the Governor of Utah for resolution.

Paul L. Howard

Date

Utah State Director
Bureau of Land Management
Department of the Interior

6/13/78

Date

Utah State Historic
Preservation Officer

Central

Company and Mine	Specific Proposal Action (applications filed)
AMCA Coal Leasing Inc. Deadman Canyon	Mining & reclamation plan Access road Powerline Telephone line Solid waste disposal
Energy Reserves Group, Inc. Skumpah Canyon	Mining & reclamation plan
Mtn. States Resources Company Mine No. 1	Mining & reclamation plan
Pacific Gas & Electric Co. Dugout Canyon and Fish Creek (Sage Point)	Mining & reclamation plan Tram road Railroad Conveyors (overland belt) Telephone line Waterline Coal waste waterline Reservoir Central yard site Slurry pond site
Routt County Dev. Ltd. McKinnon No. 1 & No. 2	Mining & reclamation plan
U.S. Steel Corp. B Canyon	Mining & reclamation plan Access road Railroad Powerline Telephone Water pipeline Mine plantsite
Valley Camp of Utah, Inc. Belina No. 2 & O'Connor	Mining & reclamation plan

D. COORDINATION IN THE REVIEW OF THE DRAFT ENVIRONMENTAL STATEMENT

1. FEDERAL

Advisory Council on Historic Preservation
Department of Agriculture
  Soil Conservation Service
  USDA Forest Service
Department of Commerce
Department of Energy
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
  Bureau of Indian Affairs
  Bureau of Mines
  Bureau of Reclamation
  Fish and Wildlife Service
  Heritage Conservation and Recreation Service
  National Park Service
  Office of Surface Mining
Department of Labor
  Mining Safety and Health Administration
  Occupational Safety and Health Administration
Department of Transportation
Environmental Protection Agency
Federal Power Commission
Interstate Commerce Commission
Community Services Administration
Office of Management and Budget
Water Resources Council

2. STATE

State of Utah A-95 Clearing House will coordinate comments from all interested State agencies.

State of Arizona Clearing House
State of Colorado Clearing House
State of Idaho Clearing House
State of Nevada Clearing House
State of Wyoming Clearing House
Utah State Historic Preservation Officer
Four Corners Regional Commission

3. LOCAL

Carbon County Commission
Emery County Commission
Grand County Commission
San Juan County Commission
Sanpete County Commission

Sevier County Commission
Wayne County Commission
Utah Association of Counties
Five County Association of Governments
Six County Association of Governments
Southeastern Association of Governments
Carbon Water Conservancy District
Castle Valley Special Service District
Emery County Water Conservancy District
Price River Water Improvement District
Mayors - Utah

Castle Dale	Ferron	Price
Cleveland	Green River	Richfield
East Carbon	Helper	Scofield
Elmo	Hiawatha	Sunnyside
Emery	Huntington	Wellington
Fairview	Orangeville	

Utah League of Cities and Towns

4. WHERE COPIES MAY BE INSPECTED

Copies of the draft environmental statements will be available for public inspection at the locations listed below. Copies may be obtained, as long as supplies last, by writing to the Denver office or picking up a copy at the Task Force office in Salt Lake City.

a. U.S. Geological Survey

U.S. Geological Survey
Preparation Branch
MS 701, Box 25046
Federal Center
Denver, Colorado 80225

Interagency Environmental Task Force on Coal
Room 505, Post Office Building
350 South Main
Salt Lake City, Utah 84101

Area Mining Supervisor's Office
8426 Federal Building
125 South State Street
Salt Lake City, Utah 84138
(801) 524-5646

Director's Office, National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092
(703) 860-7411

Regional Manager's Office
7200 W. Alameda Avenue (Villa Italia)
Lakewood, Colorado 80226
(303) 234-2855

b. Bureau of Land Management

Office of the State Director
Salt Lake City, Utah 84111
(801) 277-8543

Moab District Office
Moab, Utah 84532
(801) 259-7106

Price River Resource
Area Office
Price, Utah 84501

Richfield District Office
Richfield, Utah 84701
(801) 896-5401

Henry Mountain Resource Area Office
Hanksville, Utah 84734

Denver Service Center Library
Bldg. 50, Denver Federal Center
Denver, Colorado 80225
(303) 234-4578

c. USDA Forest Service

Forest Supervisor
USDA Forest Service
Manti-LaSal N.F.
350 East Main Street
Price, Utah 84501

Ferron District Ranger
USDA Forest Service
50 S. Main Street
Ferron, Utah 84523

Forest Supervisor
USDA Forest Service
Fishlake N.F.
170 North Main Street
Richfield, Utah 84701

Richfield District Ranger
USDA Forest Service
55 South 1st East
Richfield, Utah 84701

Teasdale District Ranger
USDA Forest Service
Teasdale, Utah 84773

Loa District Ranger
USDA Forest Service
Loa, Utah 84747

d. Libraries

Utah State University Library
University of Utah Library
Brigham Young University Library
Weber State College Library
Southern Utah State College Library
Dixie College Library
College of Eastern Utah Library
Sevier County Bookmobile
Price Public Library
Northern Arizona University Library
Salt Lake City Public Library
Salt Lake County Public Library
Richfield Public Library
Carbon-Emery County Bookmobile

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CHAPTER XI: GLOSSARY

GEOLOGY

Anticline.--Term applied to rock strata which dip in opposite directions from a common ridge or axis, like the roof of a house.

Bentonite.--A clay mineral formed from decomposition of volcanic ash. Commonly has great ability to absorb or absorb water and swell accordingly.

Dike.--Tabular body of igneous rock that has been injected while molten into a fissure in bedrock.

Dip.--The angle at which a stratum or any other planar feature is inclined from the horizontal.

Fault.--A fracture in bedrock accompanied by a displacement of one side of the fracture with respect to the other in a direction parallel to the fracture.

Fault zone.--A zone of weakness in bedrock consisting of two or more parallel or subparallel faults.

Fold axis.--The line following the apex of an anticline or the lowest part of a syncline.

Graben.--A depressed segment of the earth's crust bounded on at least two sides by faults.

Igneous.--Pertaining to rock formed from the solidification and crystallization of molten material, as from volcanic activity.

Joint.--A fracture in bedrock not accompanied by dislocation along its plane.

Joint system.--A grouping of closely spaced joints that are parallel or nearly so to one another.

Monocline.--A steplike bend in otherwise horizontal or gently dipping beds.

Normal fault.--A fault along which one side has been displaced downward (relative to the other side) along the plane of the fault.

Richter magnitude.--A quantity characteristic of the total energy released by an earthquake, as contrasted to "intensity" which describes its effects at a particular place.

Seismic.--Pertaining to, characteristic of, or produced by earthquakes or earth vibration.

Stratigraphy.--The branch of geology which treats of the formation, composition, sequence, and correlation of the stratified rocks as parts of the earth's crust.

Strike.--The bearing of the outcrop of an inclined bed on a level surface; it is perpendicular to the direction of the dip.

Structural basin.--An ellipical or roughly circular structure in which the rock strata are inclined toward a central point.

Syncline.--A fold in rocks in which the strata dip inward from both sides. The opposite of anticline.

Type locality.--The place at which the type specimen of a species was collected.

Type section.--A stratigraphic section recognized as the standard; generally the one from which a stratigraphic unit received its name.

Alkaline soil.--Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

Alluvial fan.--A sloping, fan-shaped mass of sediment deposited by a stream where it emerges from upland onto a plain.

Alluvial soils.--Soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil forming processes.

Alluvial valley floors.--"Unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits from sheet erosion, deposits by unconcentrated runoff or movement accumulation and windblown deposits"; (as defined in the Federal Register, vol. 42, no. 230, Dec. 13, 1977).

Alluvium.--Clay, silt, sand, and gravel or other rock material transported by flowing water and deposited as sorted or semi-sorted sediments.

Available water-holding capacity (soils).--The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil.

Calcareous soil.--A soil that contains enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibily when treated with cold, dilute hydrocloric acid.

- Slightly calcareous.--1 to 3 percent lime.
- Moderately calcareous.--3 to 15 percent lime.
- Strongly calcareous.--15 to 40 percent lime.
- Very strongly calcareous.--More than 40 percent lime.

Carbonate.--A mineral compound characterized by a fundamental anionic structure of $CO_3^{\pm}$. Calcite and aragonite, $CaCO_3$, are examples of carbonates.

Clay.--As a soil separate, the mineral soil particles are less than 0.002 millimeters in diameter. As a soil textural class, the soil material is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Coarse fragments.--The gravel, cobblestones, or stones in a soil that range in size from 2 millimeters to 3 feet.

Cobbles.--Rounded mineral or rock fragments that range from 3 to 10 inches in diameter.

Colluvial, colluvium.--Loose and incoherent deposits consisting of alluvium and angular fragments of rocks usually at the foot of a slope or cliff and brought there by gravity.

Depth, soil.--The terms and their meanings used to describe depth of the soil over bedrock or over a restricting lay are:

- Deep.--More than 36 inches.
- Moderately deep.--20 to 36 inches.
- Shallow.--10 to 20 inches.
- Very shallow.--Less than 10 inches.

Disturbance, soil.--The act of altering natural soil characteristics, usually by mechanical means. This includes soil exposure (removal of the organic layer and vegetation), mixing of soil materials, compaction, and soil displacement (moving from one place to another).

Excessively drained.--Water is removed from the soil rapidly. The soils are typically sandy and porous.

Well drained.--Water is removed from the soil readily but not too rapidly. There is no evidence of wetness above a depth of 40 inches.

Moderately well drained.--Water is removed from the soil somewhat slowly so that the soil is wet for short but significant, periods of time.

Somewhat poorly drained.--Water is removed from the soil slowly enough to keep it wet for significant periods but not all the time. Wetness is apparent between a depth of 20 and 40 inches.

Poorly drained.--Water is removed from the soil so slowly that the water table is near the surface most of the time. Wetness is apparent within 20 inches of the surface.

Very poorly drained.--Water is removed from the soil so slowly that the water table is at or on the surface most of the time. These soils are generally in low areas or depressions.

Erosion.--The wearing away of the land surface by wind, running water, gravity, and other geological agents.

Erosion pavement.--The small surface gravel which is left on the land after the soil is eroded away.

Gypsum soils.--Soils which contain high amounts of hydrated calcium sulfate ($CaSO_4$, $2H_2O$), occurring in crystals and in masses. Calcium sulfate is water soluble and will dissolve out of the soil profile when exposed to high amounts of water, which in turn creates a piping effect (a downward or lateral movement of water through the soil).

Hardpan.--A hardened or cemented soil horizon, or layer. The soil material may be gravelly, sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substances.

Horizon soil.--A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. The following are major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil, consisting of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus.
The horizon may have lost one or more soluble salts, clay and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon just below an A horizon. The B horizon is in part a layer of change from the overlaying A to the underlying C horizon. The B horizon also has distinctive characteristics caused by 1) by accumulation of clay, sesquioxides, humus, or some combination of these; 2) by prismatic or blocky structure; 3) by redder or stronger colors than the A horizon; or 4) by some combination of these. Combined A and B horizons are usually called the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils, this material is presumed to be like that from which the overlying horizons were formed.

Hydrologic Soil Groups.--The hydrologic soil groups are used to estimate runoff from rainfall. Soil properties which are considered are those that influence the rate of infiltration obtained from a bare soil after prolonged wetting. Soil properties considered are: 1) depth of seasonally high water table, 2) intake rate and permeability after prolonged wetting, 3) depth to very slowly permeable layer. The soils have been classified into four groups, A through D. Group A soils have low runoff potential; group B soils have moderately low runoff potential; group C soils have moderately high runoff potential; and group D soils have high runoff potential.

Parent material.--Unconsolidated and partially weathered geologic material from which soils are presumed to form.

Permeability, soil.--That quality of the soil that enables it to transmit water or air. Terms used to describe permeability in inches per hour are:

Very slow.--Less than 0.06 inches.
Slow.--0.6 to 0.2 inches.
Moderately slow.--0.2 to 0.6 inches.
Moderate.--0.6 to 2.0 inches.
Moderately rapid.--2.0 to 6.0 inches.
Rapid.--6.0 to 2.0 inches.
Very rapid.--More than 20 inches.

pH.--A number that represents the negative logarithm, base 10, of the hydrogen-ion activity of a solution. A pH less than 7 indicates an acid solution; a pH greater than 7, an alkaline solution.

Prime farmland.--Those lands as defined in the Federal Register on Aug. 23, 1977, that have been used for the production of cultivated crops, including nurseries, orchards, and other specialty crops, and small grains for at least 5 years out of the 20 years preceding the date of the mining permit application. A detailed definition is also given in the Federal Register, Dec. 13, 1977.

Profile, soil.--A vertical section of the soil through all its's horizons and extending into the parent material.

Reaction, soil.--The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. The degrees of acidity or alkalinity are expressed in the following words:

Extremely acid.--Below 4.5.
Very strongly acid.--4.5 to 5.0.
Strongly acid.--5.1 to 5.5.
Medium acid.--5.6 to 6.0.
Slightly acid.--6.1 to 6.5.
Neutral.--6.6 to 7.3.
Mildly alkaline.--7.4 to 7.8.
Moderately alkaline.--7.9 to 8.4.
Stongly alkaline.--8.5 to 9.0.
Very strongly alkaline.--9.1 and higher.

Reclamation.--The process of returning disturbed lands to their former uses or other productive uses.

Residual soil.--A soil formed in material weathered from bedrock without transportation from the original location.

Rockiness.--A description of rock expressed as a volume percentage of the surface. General classifications are:

Class 0.--Less than 2 percent.

Class I.--2 to 10 percent (rocky).

Class II.--10 to 25 percent (very rocky).

Class III.--25 to 50 percent (extremely rocky).

Class IV.--50 to 90 percent (rockland).

Class V.--Over 90 percent (rock outcrop).

Sand.--As a soil separate, the individual rock or mineral fragments in soils have diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. As a soil textural class, soil material that is 85 percent or more sand and not more than 10 percent clay.

Saline soil.--A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sediment yield.--The amount of soil an area loses every year through natural processes, usually expressed in acre-feet per square mile per year. One acre-foot per square mile per year, reduced to simpler terms, means that a square mile of land loses about .01 inches of soil every year. This is a result of the normal and ongoing processes of water and wind erosion.

Sheet erosion.--The removal of a fairly uniform layer of soil from the land surface by runoff water.

Shrink-swell.--Describes that soil quality that determines its volume change with change in moisture content.

Silt.--As a soil separate, the individual mineral particles in a soil that ranges in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil material that is 80 percent or more silt and less than 12 percent clay.

Soil.--A natural, three-dimensional body on the earth's surface that supports plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil productivity.--The capacity of a soil in its normal environment for producing a specified plant or sequence of plants under a specified system of management.

Soil structure.--The combination or arrangement of primary soil particles (sand, silt, clay) into secondary particles, units, or peds. The secondary units or soil aggregates are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades, respectively.

Soil texture.--The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam,

loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse, fine, or very fine".

Solum.--This refers to the combined A and B horizons.

Stones.--Rock fragments greater than 10 inches in diameter, if rounded, and greater than 15 inches along the longer axis, if flat.

Subsoil.--Describes the B horizon of the soil profile, roughly the part of the solum below plow depth or below the dark colored A horizon.

Surface layer.--A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon and has no depth limit.

Talus.--An accumulation of rock debris, formed close to a mountain wall, mainly through many small rockfalls.

Terrace.--1) An embankment or combination of an embankment and channel constructed across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope. 2) A level, usually narrow plain bordering a river, lake, or sea. Rivers sometimes are bordered by terraces at different levels.

Topsoil.--The original or present dark-colored upper soil (A horizon) that ranges from a mere fraction of an inch to 2 or 3 feet thick on different kinds of soil.

WATER

Aquifer.--A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Arestian (confined) aquifer.--A water-yielding zone in which ground water is confined under pressure by impervious or semipervious strata.

Perched ground water.--Unconfined ground water separated from an underlying body of ground water by an unsaturated zone.

Head, static.--The height of a column of water above a standard datum that can be supported by the static pressure at a given point.

Water table.--That surface in an unconfined water body at which the pressure is atmospheric.

Acre-foot.--The quantity of water required to cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet for 325,851 gallons.

Base flow.--Sustained or fair weather runoff. In most streams, base flow is composed largely of ground-water effluent.

Bank storage.--The water absorbed into the banks of a stream channel when the water level rises above the water table in the bank formations.

Ephemeral stream.--A stream that flows only in direct response to precipitation, and whose channel is at all times above the water table.

Intermittent stream.--A stream that flows only at certain times of the year when it receives water from springs or form some surface source such as melting snow in mountainous areas.

Usable storage.--The volume of water normal available for release from a reservoir below the stage of the maximum controllable level.

100-year 6-hour precipitation.--The precipitation of 6-hour duration that will be equalled or exceeded once every 100 years on the average.

AIR

Air mass.--A widespread body of air that is approximately homogenous in its horizontal and vertical extent, particularly with reference to temperatue and moisture distribution.

Air pollution.--The presence of material in the air in sufficient amounts and under such circumstances as to interfere significantly with the comfort, health, or welfare of persons, or with full use and enjoyment of property.

Ambient air quality.--Concentration levels in ambient air for a specified pollutant and a specified averaging time period within a given geographic region.

Ambient air quality standard.-- A level of ambient air quality established by Federal or State agencies which is to be achieved and maintained; primary standards are those judged necessary, with an adequate margin of safety, to protect the public health; secondary standards are those judged necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Ambient air pollution isomap.--A graphic portrayal of the ambient burdens of a specific pollutant throughout various areas of a mapped region. Isolines are like the contour lines on a topographic map, but instead of indicating altitude, they indicate the ambient concentrations of a pollutant in the mapped land area to which they relate.

Atmosphere.--The earth's envelope of air containing several subdivisions all bound to the earth by gravitational attraction.

Atmospheric dispersion models.--A mathematical description of the meteorological trend, transport, and dispersion processes of an area on which are superimposed rates of emissions of pollutants from various sources from which one can obtain the concentration of any pollutant at any point in the area under consideration at any time.

Atmospheric dispersion potential.--The ability of the atmosphere over any defined area to diffuse or disperse air pollutants which are introduced into the atmosphere within the defined area from point line or area emission sources.

Atmospheric stability.--The diffusive capacity of the lower atmosphere. In general, stability may be classified as either stable, neutral, or unstable. With stable conditions, the temperature increases with height the intensity of turbulence is low because vertical motions are inhibited. Under these conditons, any pollutant emitted at the ground tends to accumulate, while effluents from elevated sources do not normally reach the ground until many kilometers downwind. Conversely, when temperature decreases rapidly with height, the atmosphere is unstable, and the intensity of turbulence is high causing enhanced vertical motion. Low-level emissions are dispersed rapidly upward while high-level emissions are brought rapidly to the ground. As a result, elevated sources frequently make their maximum contributions to very short-term (less than one hour) ambient pollutant concentrations with unstable conditions. Between the stable and unstable conditions is the situation in which the temperature decreases adiabatically with height (about 1°C per 100 meters). This condition is called neutral stability with near-neutral conditons quite frequent in most locations. For sources with tall stacks the high wind speed neutral conditions supresses plume rise, and is often the case in which the highest ground-level concentrations are observed. For ground-level emissions, the concentrations for near-neutral conditions normally are between those for stable and unstable conditions.

Background level.--In air pollution studies, the concentration of a pollutant that would exist in the absence of the particular source under study; a "standard" against which the contribution of the particular source can be compared.

Clean air act (42 USC 1857 et seq.).--An act for air pollution prevention and control with the purpose of: (1) To protect and enhance public health and welfare and the productive capacity of its population. (2) To initiate and accelerate a national research and development program to achieve the prevention and control of air pollution. (3) To provide technical and financial assistance to State and local governments in connection with the development and execution of their air pollution prevention and control programs. (4) To encourage and assist the development and operation of regional air pollution control programs.

Climate.--The average condition of the weather at a place over a period of years as exhibited by temperature, wind velocity, and precipitation.

Climatology.--The study of the statistical collection of weather conditions during a specified interval time (usually several decades) at a specified area. The study of the long-term manifestations of weather..

Dispersion.--The physical process of diluting the concentration of a substance by molecular and turbulent motion; e.g., smoke in air.

Diurnal.--Showing a periodic alteration of condition with day and night.

Dry adiabatic lapse rate.--Decrease in temperatue with height at a rate of 1°C per 100 meters.

Dust.--Solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size. It imparts a tannish or greyish hue to distant objects. The sun's disk is pale or colorless or has a yellowish tinge at all periods of the day.

Dust cannot be a stable component of the atmosphere because it must eventually fall back to the earth's surface when winds and turbulence become too weak to bear it aloft. Dust is due to many natural and artificial sources, volcanic eruptions, salt spray from the seas, blowing solid particles, plant pollen and bacteria, smoke and ashes of forest fires and industrial combustion processes, etc.

Emission.--The act of discharging into the atmosphere an air contaminant or an effluent which contains an air contaminant, or the effluent so discharged into the atmosphere.

Emission inventory.--A quantitative statement of the types and quantities of air pollutants emitted for specified source categories within a specified place or region over a specified period of time. For any pollutant, emissions usually are expressed in terms of the tons per day emitted from specific source categories.

Emission rate.--The amount of an air pollutant emitted into the atmosphere from a pollution source over a defined period of time.

Emission standards.--Legally defined and enforced prescriptions which prohibit the emission of more than a specified quantity of a pollutant from a specifically designated source of sources, which prohibit the operation of a source or the use of a type of fuel or product, or which require the use of a type of equipment, fuel, or air pollution control system.

Free atmosphere.--(Sometime called free air). That portion of the earth's atmosphere, above the planetary boundary layer, in which the earth's surface friction on the air motion is negligible, and in which the air is usually treated (dynamically) as an ideal fluid. The base of the free stmosphere is usually taken as the geostrophic wind level.

Fugitive dust.--The solid, airborne particulate matter emitted from any source other than through a stack.

Haze.--Fine dust or salt particles dispersed through a portion of the atmosphere. The particles are so small that they cannot be felt or individually seen with the naked eye, but they diminish horizontal visibility and give the atmosphere a characteristic opalescent appearance that subdues all colors.

Implementation plan.--A document which describes a comprehensive plan of action for achieving specified air quality objectives and standards for a particular place or region within a specified time period.

Inversion.--(Also temperature inversion.) A departure from the usual decrease in temperature with altitude. An inversion layer refers to the layer through which this increase in potential temperature with height occurs.

Inversion base.--The level in which the increase in potential temperature begins.

Inversion layer.--A layer in the atmosphere through which the temperature remains constant or increases with altitude.

Isopleth.--A line or contour drawn on a map denoting points having the same numerical value of an element; e.g., similar temperature (isotherm), pressure (isobar), or pollutant concentrations.

Isothermal.--No temperature change with height.

Lapse rate.--The change of temperature with height. A "lapse" condition usually means a decrease with height.

Limited mixing conditions.--A type of fumigation which may occur with light winds when an effluent is released and contained within a limited mixing volume beneath an inversion layer. Under these conditons, a plume will usually rise to the top of the surface based mixing layer and then undergo vetical mixing to the surface.

Looping plume.--Effluent plume being rapidly spread upward and downward by thermally induced eddies. Occurs in a highly unstable atmosphere because of rapid mixing.

Meteorlogical factors or elements.--Types of measurements necessary for the consideration of air pollution problems. Generally, these are pressure, temperature, and humidity of the atmosphere; speed and direction of the wind; and in some cases the amount of insolation (sun intensity).

Meteorology.--A science that deals with the atmosphere and its phenomena, especially with weather and weather forecasting.

Micro-scale.--In meteorology, having characteristic spatial dimensions of about 1 mile and less. Typical micro-scale phenomena include the retention of moisture by crops, etc.

Mixing depth.--Height of the layer of air where well-mixed conditions exist, usually the height of the first significant inversion above the surface.

National ambient air quality standards (NAAQS).--The allowable concentrations of air pollutants in the ambient air specified by the Federal Government and can be found in Title 40, Code of Federal Regulations, Part 50. The ambient air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety, are requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety, are requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air. Welfare is defined as including but not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.

National emission standards for hazardous air pollutants.--Standards of performance for certain identified pollution emission sources for pollutants of asbestos, beryllium, and mercury. The standards are found in Title 40, Code of Federal Regulations, Part 61.

Nephelometer.--General name for instruments which measure, at more than one angle, the scattering function of particles suspended in a medium.

Neutral atmosphere.--An atmospheric condition in which the air cools, as altitude increases at the normal, dry adiabatic temperature lapse rate: 0.98°C for every 100 meters.

Opacity.--The degree to which emissions reduce the transmission of light and obscure the view of an object in the background. A state which renders material partially or wholly impervious to rays of light and causes obstruction of an observer's view.

Oxidant.--A gas that oxidizes: usually ozone.

Particulate matter.--Any material, except water in a chemically uncombined form, that is or has been airborne and exists as a liquid or a solid at standard temperature and pressure conditions. Minute

Photochemical.--Referring to chemical reactions that require light.

Photometry.--A physical method of measurement based on the transmission of light.

Pilot balloon.--A small balloon with known ascent rate whose track is followed by a theodolite (optical tracking instrument similar to a surveyor's transit). In order to obtain data for the computation of speed and direction of winds in the upper air.

Plume.--The volume of air space containing any of the substance emitted from a point source. For practical purposes, the limits of a plume have to be arbitrarily defined according to some minimum concentrations of the substance.

Plume rise.--The height attained by a plume from vertical momentum and bouyancy due to heat and molecular-weight difference of material released into the atmosphere. The behavior of this plume, the material contained in a volume of gas, will be influenced by chimney phenomena, surrounding buildings, terrain, as well as the velocity and buoyancy relative to the air and prevailing meteorological conditons.

Concentration.--A measure of the average density of pollutants usually specified in terms of pollutant mass per unit volume of air (typically in units of micrograms per cubic meter), or in terms of relative volume of pollutants per unit volume of air (typically in units of parts per million.).

Pollution source.--A point, line, area, or volume at which pollution is added to a system, either instantaneously or continuously. Conversely, at a "sink" mass pollution is removed.

Examples of sources in the context of air pollution are as follows: a smokestack is a "point source," a freeway or aircraft trajectory is a "line source;" and an entire city is a "plane source."

Precipitation.--Any of all the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes drizzle, rain, snow, snow pellets, snow grains, ice crystals, ice pellets, and hail.

Prevailing wind--The wind direction most frequently observed during a given period.

Rawinsonde.--Method of upper-air observation consisting of a computation of wind speed and direction, temperature, pressure and relative humidity by means of a balloon-borne radiosonde tracked by radar.

Relative humidity.--Generally, the relative measure of water vapor content in the atmosphere; precisely, the dimensionless ratio of the actual vapor pressure of the air to the saturation vapor pressure (usually given in percent).

Stability.--See Static stability.

Stability wind rose.--Average atmospheric conditons based on short- or long-term meteorological data set of joint fequency, wind direction, wind speed, and atmospheric stability.

Stable.--Pertaining to the atmosphere or an atmospheric layer in the condition of static stability, i.e., an atmosphere whose temperature lapse rate and moisture distribution is such as to suppress the vertical exchange of air.

Stagnation.--With respect to air pollution, the persistence of a given volume of stable air over a region, permitting an abnormal buildup of pollutants from sources within the region.

Static stability.--(Also called hydrostatic stability, vertical stability, convective or convectional stability.) The state of the atmosphere when it is stable relative to vertical displacements. Such an atmosphere tends to remain stratified, in that any air that is displaced vertically is subjected to a buoyant force that tends to restore it to its original level.

Static stability is determined primarily by the temperature lapse rate; an inversion layer is an extreme example of statically stable layer.

State implementation plan.--A document which describes a comprehensive plan of action for achieving specified air quality objectives and standards for a particular place or region within a specified time period.

Standards of Performance for New Stationary Sources (NSPS).--Standards of performance which set limitations on the pollution emissions of defined pollutants from specific pollution sources. The standards are found in Title 40, Code of Federal Regulations, Part 60.

Subsidence inversion.--Air inversion aloft caused by sinking air within a high pressure system which causes the temperature at the top of the layer to increase more than the temperature at the bottom of the layer. The effect is the creation of a limited mixing volume below the stable layer.

Surface winds.--Winds close to the earth's surface which are influenced in direction and speed by frictional interaction with the terrain.

Synoptic pressure pattern.--Pattern of isopleths (see glossary definition) of constant pressure over a horizontal surface (usually mean sea level) at a given time. Can also mean isopleths of height of a given pressure at a given time.

Turbidity.--A measure along the line of sight of the attenuation of solar radiation in a clear sky due to atmospheric suspensoids.

Unstable atmosphere.--A conditon characterized by a temperature decrease with height greater than the standard adiabatic lapse rate of 1°C per 100 meters. Marked vertical mixing occurs and pollutants are rapidly dispersed.

Upper winds.--Winds at sufficient altitude above the earth's surface, such as to be minimally influenced in direction and speed by terrain features.

Variance (as applies to air quality).--An order issued pursuant to law which extends to some person or persons the legal right to operate a specific air pollution source or sources in violation of air pollution laws, regulations, and emissions standards. Usually variances are authorized in order to give the owner or operator of a source sufficient time to comply with an emission standard.

Visibility.--The greatest distance in a given direction of which it is possible to see and identify with the unaided eye a prominent dark object against the sky at the horizon.

VEGETATION AND RANGE

Animal unit month.--The volume of forage consumed by one cow or five sheep in one month. A measure of range carrying capacity.

Carrying capacity.--(Range) The maximum use of the range possible without inducing damage to vegetation or related resources. (Syn., grazing capacity)

Grazing capacity.--Syn., carrying capacity.

Vegetation type.--A plant community with observable features.

WILDLIFE

Browse.--Tender shoots or twigs of shrubs and trees as food for deer, cattle, etc.

Coniferous.--Belonging or pertaining to cone-bearing evergreen trees or shrubs.

Exotic species.--Introduced species. Not native to a given area.

Eyrie.--The nest of a bird of prey.

Hunter-day.--Time spent hunting by one hunter. It may include all or part of one day.

Life zone.--An area characterized by a particular set of organisms, whose presence is determined by environmental conditions.

Omnivores.--An animal or bird that eats all kinds of foods indiscriminately.

Raptor.--Living on prey; a group of carnivorous birds consisting of the hawks, eagles, falcons, vultures, and owls.

Reparian.--Living on or adjacent to a water supply such as a riverbank, lake, or pond.

LANDS

Instant study area.--An area of public lands designated prior to 1975 by the Secretary of the Interior as having wilderness or natural characteristics.

RECREATION

Backcountry.--An area of land used for hiking, backpacking, undeveloped area camping, solitude, fishing and hunting. Generally located some distance from developed roads and the sights and sounds of users can enjoy an unconfined, uncrowded and generally unregulated recreation experience.

Carrying capacity.--The number of people, expressed in PAOT that an area or facility can accomodate without impairment of the natural, cultural or developed resource.

Developed site.--designated area with picnic tables, grills, garbage collection, sanitary facilities, parking and play areas developed primarily by families, organized groups or individuals for overnight camping or day-use activities.

Dispersed area.--General environment areas, including recreation woods, trails, lakes, ponds, streams and general undeveloped areas suitable and used for recreation, and not codified as development sites.

Recreation experience level (5).--

a) Primitive.--Uncrowded, void of developments, where the user feels as though he is a part of nature and his presence and survival is dependent on his own skills and ability.

b) Semi-primitive.--Similiar to primitive, but the user has the feeling that civilization is not far away. Generally located some distance from civilization, but user may have reached destination by motorized carrier and some development and evidence of previous use may be present in area. Solitude and a sense of personal achievement is necessary.

c) Intermediate.--Usually adjacent to developed roads or facilities other people present and some developed facilities and roads exist in the proximity of the area being used.

d) Secondary-modern.--Developed facilities, such as picnic tables, grills, open-vault toilets are present, area is usually occupied by others, evidence of mans activities, developments, etc. are present and substantially noticeable.

e) Modern.--Developed facilities are modern: i.e. flush toilets, trailer hook-ups, hard-surfaced roads, developed play areas, etc. User experience level is definitely associated with use by other individuals and is usually restricted or regulated to a high degree (i.e. travel and camping is restricted to developed and surfaced sites and fees for use are usually charged to the user).

Extreme use.--Of the greatest severity; drastic, excessive.

Heavy use.--Intense or sustained, large in numbers.

Moderate use.--Not excessive or extreme, of medium or average quantity or extent.

Light use.--Of relatively low density, generally non-impactive, insignificant.

NRA.--National Recreation Area - a designated or classified area of land (and water) dedicated for recreation use by the public.

ORV.--Off-road vehicle, including four wheel drive, trail bikes, hovercraft, snowmobiles, etc., but excluding helicopters, fixed wing aircraft and boats, and capable of travelling over land, water, ice, snow, sand, marshes, etc.

PAOT.--People at One Time - used to quantify the number of people an area can accomodate at any one time without deterioration to the natural, cultural or developed character of a given area - see carrying capacity.

Primitive area.--A formally or informally classified area set aside for its wild, undeveloped character, used and maintained for its natural values for nature studies, wildlife, sight-seeing, watershed and recreation. Few if any man-made intrusions exist and man is only a temporary visitor who does not remain.

Rare I - Rare II.--Roadless area resource evaluation system - used to identify and inventory area without developed roads and substantial intrusion by man for inclusion or exclusion in the Wilderness Preservation System. Rare II is an intensified and expanded inventory and evaluation of the Rare I process.

Roadless area.--Without formally designated or developed and maintained roads, or substantial developments and man-made intrusions.

Significant impact.--Important, of consequence, of or pertaining to a major change or impact to an existing situation.

Visit.--The entry of any person upon a site, or area of land or water for recreation purposes. No time element involved; may be for a few minutes or a number of days. Term is usually used to report recreation use by National Park Service, Bureau of Land Management and Utah State Division of Parks and Recreation.

V/D's - Visitor Days Use.--12 visitor-hours which may be aggregated continously, intermittently, or simultaneously by one or more persons for recreation purposes. Term is used primarily by U. S. Forest Service for determining use of recreation areas and resources.

Wilderness area.--A formally classified area under the Wilderness act of 1964, where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. Undeveloped Federal land retaining its primeval character; has outstanding opportunities for solitude or a primitive and unconfined type of recreation and may contain ecological, geological or other features of scientific, educational, scenic or historical value(s).

ARCHEOLOGY AND HISTORY

Artifact.--A single, portable man-made or man-altered object; usually culturally diagnostic.

Ceremonial Site.--A site exhibiting multiple dwelling structures of religious function characterized by religious art and (or) kivas.

Cist.--Storage pit in the ground usually lined with rock slabs.

Cultural resources.--Physical remains of human activity over 100 years old.

Extended camp.--A non-architectural site of varying size, exhibiting hearth or fire pits; ceramics; lithic and grinding tools, especially non-transportable metates.

Historic Site.--A site exhibiting artifacts that postdate the first Mormon settlements in Utah in 1847.

Hunting site.--A location characterized by projectile points or point fragments only.

Kill-butchering site.--A location with points or point fragments and knives, choppers and (or) scrapers.
A location characterized by the predominance of butchering tools, including knives, choppers, utilized flakes, and (or) scrapers.

Lithic scatter site.--Characterized by the presence of flaked tools, chips, cores, or flakes only.

Multiple habitation.--Multiple structures that would accomodate more than one family.

Petroglyph.--Figures, symbols, or scenes pecked or etched in rock.

Pictograph.--Figures, symbols, or scenes painted on rock.

Quarry site.--A lithic mine showing presence of hammerstones, flakes, cores, and unfinished tools.

Rock shelter.--A small or large rock overhang used as a protective dwelling; characterized by the presence of artifacts and smoke-blackened rock overhand.

Single habitation.--Small structure such as a pithouse that would accomodate a single family.

Site.--Locus of human activity identified by a minimum of four flakes within a five-meter radius, from documents, or by archeological techniques.

Temporary camp.--A small site exhibiting no architecture; characterized by a hearth or fire pit, lithic and small grinding tools, and ceramics.

ESTHETICS

Two visual resource inventory and evaluation systems are used for lands involved, Bureau of Land Management system for public lands and the National Forest landscape management system on National Forest lands. National Park Service lands fall within the special classified area designation (see definition above.) Where Bureau of Land Management and Forest Service terms have similar meaning, only one definition is provided. Where a term applies only to public lands, it is footnoted with a [1]. System terms applicable only to National Forest lands are footnoted with a [2]. Additional information concerning the Bureau of Land Management visual resource system may be obtained by writing to: Office of the State Director, Bureau of Land Management, University Club Building, 136 East South Temple, Salt Lake City, Utah 84111, for National Forest information, write to: Regional Forester, Federal Office Bldg, 324-25th Street, Ogden, Utah 84401.

Adverse visual impact.--Any impact on the vegetation, landform, or any introduction of a structure or activity which interrupts or adversely changes the visual character of the landscape and disrupts the harmony of the natural elements.

Background.--The distant part of a landscape, picture, etc.; surroundings, especially those behind something and providing harmony or contrast; surrounding area or surface. Area located from 3-5 miles to infinity from the viewer.

Background.--The area of a visual zone which lies beyond the foreground-middleground. Usually from a minimum of 3-5 miles to a maximum of about 15 miles from a travel route or use area. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

Basic elements.--The four major elements (form, line, color, and texture) which determine how the character of a landscape is perceived.

Characteristic.--That which constitutes a character; that which characerizes; a distinguishing trait, feature, or quality; a peculiarity.

Characteristic landscape.--The established landscape within an area being viewed. This does not necessarily mean a naturalistic character. It could refer to a farming community, an urban landscape, or a primarily natural environment.

Character type.--Large physiographic area of land which has common characteristics of landforms, rock formations, water forms, and vegetative patterns.

Character subtype.--A division of a major character type which is significantly different in visual characteristics from the other subtypes.

Common.--Refers to prevalent, usual, or widespread landscape variety within a character type. It also refers to ordinary or undistinguished visual variety.

Contrast.--The effect of a striking difference in the form, line, color, or texture of an area being viewed.

Distance zones.--Areas of landscapes denoted by specified distances from the observer. Used as a frame of reference in which to discuss landscape characteristics or activities of man.

Distinctive.--Refers to unusual and(or) outstanding landscape variety that stands out from the common features in the character type.

Diverse.--Refers to having variety in landscape character.

Dominance elements.--Form, line, color, and texture. They are the visual recognition parts which make up the characteristic landscape.

Dominant.--Ruling; governing; predominant; exercising great influence.

Dynamic.--Active or changing.

Enhancement.--A short-term management alternative which is done with the express purpose of increasing positive visual variety where little variety now exists.

Evident.--That which is apparent to the casual visitor.

Feature.--A visually distinct or outstanding part, quality, or characteristic of something.

Foreground.--The detailed landscape found within 0 to 1/4-1/2 mile from the observer.

Foreground-middleground.--The area visible from a travel route or use area to a distance of 3-5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants is no longer apparent in the landscape. Vegetation is apparent only in patterns or outline.

Form.--The shape or structure of something as opposed to the material of which it is composed.

Intrusion.--A feature (land, vegetation, or structure) which is generally considered out of context with the characteristic landscape.

Landscape character.--The arrangement of a particular landscape as formed by the variety and intensity of the four basic elements of form, line, color, and texture.

Landscape modifying activities.--Any action which changes the vegetation or landform or places structures on the landscape.

Line.--a. an intersection of two planes. A point that has been extended; silhouette of form.
b. any of various things that are or may be considered as arranged in a row or sequence.

Management activity.--An activity of man imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Maximum modification.--A visual quality objective meaning man's activity may dominate the characteristic landscape but should appear as a natural occurrence when viewed as background.

Middleground.--The space between the foreground and the background in a picture or landscape. The area located from 1/4-1/2 to 3-5 miles from the viewer.

Minimal.--Refers to little or no visual variety in the landscape. Monotonous or below average compared to the common features in the character type.

Modification.--A visual quality objective meaning man's activity may dominate the characteristic landscape but must, at the same time, utilize naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.

Monotony.--Complete repetition; tedious sameness.

Naturalistic character.--A landscape situation where the basic elements are displayed in a composition that appears natural within the surrounding area or character type.

Partial retention.--A visual quality objective which in general means man's activities may be evident but must remain subordinate to the characteristic landscape.

Perception.--a. man's impression of an object or space as based on past and (or) anticipated experiences.
b. making one's self aware of all conditions and applicable factors; comprehension.

Preservation.--P. or I. areas -- a visual quality objective that provides for ecological change only. (see definitions next page.)

Rehabilitation.--A short term management alternative used to return existing visual impacts in the natural landscape to a desired visual quality.

Retention.--R. or II. areas -- a visual quality objective which in general means man's activities are not evident to the casual visitor. (see definitions next page.)

Scenic quality.--The quality of the scenery as determined through the use of the scenic evaluation process or the visual resource inventory and evaluation systems.

Seen area.--Total area observed. May be measured in terms of foreground, middleground, and background.

Seldom seen.--Areas that are seen from low-use volume transportation routes or are beyond the 15-20 mile background zone for other routes.

Sensitivity level(s).--An index of the relative importance or value of visual response to an area in relation to other areas in the planning unit, or a particular degree or measure of viewer interest in the scenic qualities of the landscape.

Special classified area.--Those areas such as Wilderness, historical, biological, or geological sites which are of such significance that specific management direction is given as part of policy or legislation.

Subordinate.--Inferior to or placed below another in size, brightness, etc.; secondary in visual impact.

Texture.--The visual result of the tactile surface characteristic of an object or objectives.

Use volume.--The total volume of visitor use each segment of a travel route or use area receives.

Variety.--The state or quality of being veried and having the absence of monotony or sameness.

Variety class or scenic quality class.--A particular level of visual or diversity of landscape character. (Generally applicable to both Public Lands and National Forest lands. Some difference may apply.)

Visitor.--Temporary inhabitor of an area. Recreation visitor--one who is in an area temporarily for refreshment in body and(or) mind. Usually has a significant conscious or subconscious interest in the scenic qualities of an area.

Visual management unit.--An area of land where there is no variation in the visual zone, sensitivity zone, and scenic quality zone.

[1]Visual resource management classes.--The degree of alteration that is acceptable within the characteristic landscape. It is based upon the physical and sociological characteristics of any given homogeneous area.

Class I: natural ecological changes only.
Class II: changes must not be evident.
Class III: changes may be evident but must remain subordinate to natural landscape characteristics.
Class IV: changes may subordinate but should reflect natural occurrences.
Class V: rehabilitation or enhancement needed.

[2]Visual quality objective.--A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

P preservation
R retention
PR partial retention
M modification
MM maximum modification
reh rehabilitation
e enhancement

Visual resource.--The land, water, vegetative, animal, and other features that are visible on all lands.

Visual zones.--The area that can be seen, such as foreground, middleground, etc. (See previous definitions.)

	CLASS A Distinctive	CLASS B Common	CLASS C Minimal
Landform	Over 60 percent slopes which are dissected, uneven, sharp exposed ridges or large dominant features.	30-60 percent slopes which are moderately dissected or rolling.	0-30 percent slopes which have little variety. No dissection and no dominant features.
Rock forms	Features stand out on landform. Unusual or outstanding, avalanche chutes, talus slopes, outcrops, etc., in size, shape, and location.	Features obvious but do not stand out. Common but not outstanding, avalanche chutes, talus slopes, boulders and rock outcrops.	Small to nonexistent features. No avalanche chutes, talus slopes, boulders and rock outcrops.
Vegetation	High degree of patterns in vegetation. Large old-growth timber. Unusual or outstanding diversity in in plant species.	Continuous vegetative cover with interspersed patterns. Mature but not outstanding old-growth. Common diversity in plant species.	Continuous vegetative cover with little or no pattern. No understory, overstory or ground cover.
Water forms, lakes	50 acres or larger. Those smaller than 50 acres with one or more of the following: (1) Unusual or outstanding shoreline configuration, (2) reflects major features, (3) islands, (4) Class A shoreline vegetation or rock forms.	5 to 50 acres. Some shoreline irregularity. Minor reflections only. Class B shoreline vegetation.	Less than 5 acres. No irregularity or reflection.
Water forms, streams	Drainage with numerous or unusual changing flow characteristics, falls, rapids, pools and meanders or large volume.	Drainage, with common meandering and flow characteristics.	Intermittent streams or small perennial streams with little or no fluctuation in flow or falls, rapids, or meandering.

This chart represents a variety or scenic quality class breakdown of steep mountain slopes. This chart is appropriate for character type only. A similar chart must be developed for other character types according to the characteristics of the i. e., desert lands, transitional lands, etc. Water, for instance, in almost any form on desert lands will elevate the variety or scenic quality class.

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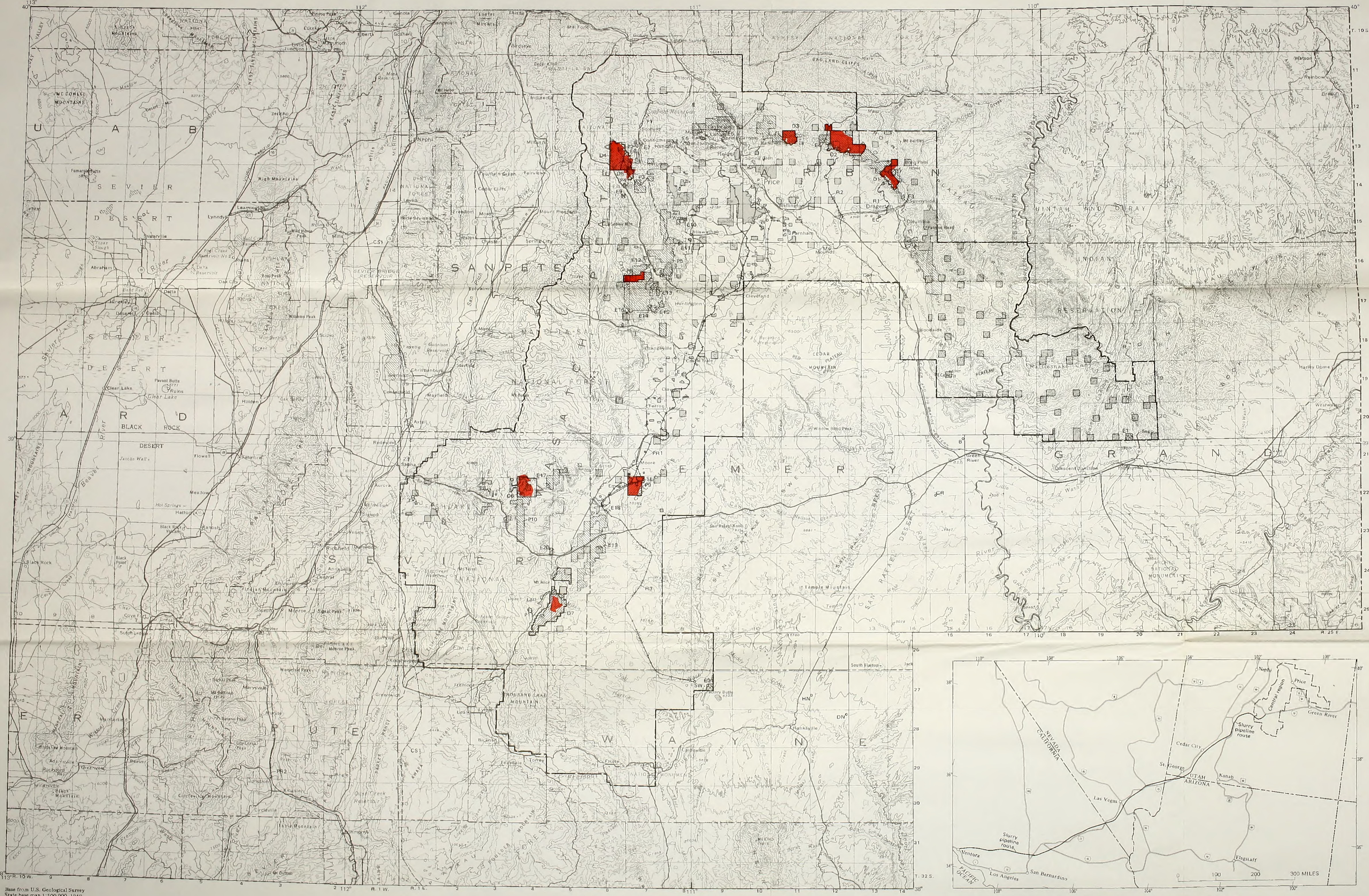
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, CENTRAL UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE I-2



Coal leases
- Existing leases on Federal lands
- Preference Right Lease Applications (PRLA) on Federal lands
- Existing leases on State lands

Proposed mining areas

Detailed mining proposals

D1	B Canyon, U.S. Steel
D2	Fish Creek and Dugout Canyon, Pacific Gas and Electric Co.
D3	Deadman Canyon, AMCA Resources Inc.
D4	McKinnon Nos. 1 and 2, Routt County Development Ltd.
D5	Belina No. 2 and O'Connor, Valley Camp of Utah, Inc.
D6	Skumpah, Emery Reserves Group, Inc.
D7	No. 1 mine, Mountain States Resources Corp.

Preliminary mining proposals

P1	Columbine No. 1, ITEL Resources
P2	McKinnon No. 3, Routt County Development Ltd.
P3	Clear Creek No. 7, Swisher Coal Co.
P4	Tip Top and unnamed, John Sanders
P5	Cedar Creek Canyon, U.S. Fuel Co.
P6	Rilda Canyon, Malcolm McKinnon estate
P7	Sanpete County, Canyon Fuel Co.
P8	Sevier County, L. R. Hansen
P9	Mine No. 1, Emery Coal, Inc.
P10	Rock Canyon, Energy Reserves Group, Inc.
P11	Mines Nos. 2-6, Mountain States Resources Corp.

Existing mines

E1	Thompson, Wes-Pac Energy Corp.
E2	Geneva, U.S. Steel Corp.
E3	Sunnyside, Kaiser Steel Co.
E4	Soldier Canyon, Soldier Creek Coal Co.
E5	Braztah Nos. 3-5, Braztah Corp.
E6	Swisher Nos. 2-4, Swisher Coal Co.
E7	Utah No. 2, Valley Camp of Utah, Inc.
E8	Belina No. 1, Valley Camp of Utah, Inc.
E9	Huntington Canyon No. 5, Swisher Coal Co.
E10	Starpoint Nos. 1 and 2, Plateau Mining Co.
E11	Co-op, Co-op Mining Co.
E12	King, U.S. Fuel Co.
E13	Deer Creek, American Coal Co.
E14	Wilberg, American Coal Co.
E15	Bee Hive, American Coal Co.
E16	Trail Mountain, Trail Mountain Coal Co.
E17	Convulsion Canyon, Coastal States Energy Co.
E18	Emery, Consolidation Coal Co.
E19	Dog Valley, Western States Coal Co.
E20	Knight, Energy Reserves Group, Inc.
E21	Blackie, Atlas Resources, Inc.

o Detailed power-plant proposal
Intermountain Power Project, proposed IPP generating station sites, Salt Wash (SW), Lyndyl (L), Beckwith (B), Mounds (M), Green River (GR), Hanksville North (HN), and Desert North (DN)

o Preliminary power-plant proposals
Utah Power and Light Co. generating stations, Axtell (A), Nephi (N), South Emery (SE), Emery 3 and 4 (E), Huntington 3 and 4 (H), East Carbon (EC), and Wellington (W)

Detailed railroad proposals
U.S. Steel Corp. (R1), Pacific Gas and Electric (R2), Intermountain Power Project (R3)

Preliminary railroad proposals
Castle Valley (PR1) and Utah Power and Light Co. (PR2)

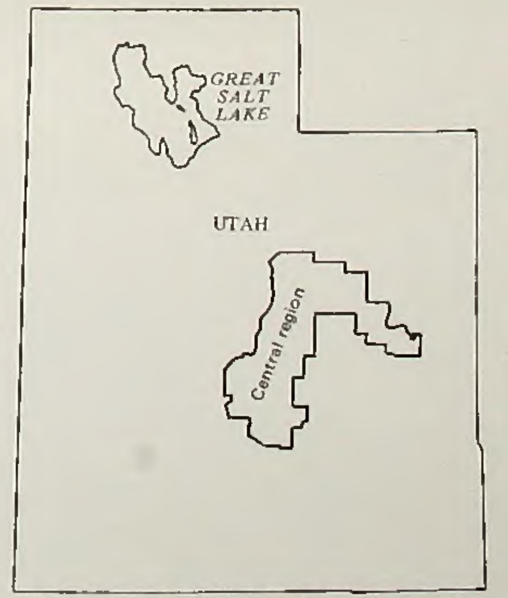
Preliminary coal slurry pipeline proposed as alternative to railroad, Utah Power and Light Co. (CS1)

Central region boundary

Base from U.S. Geological Survey
State base map 1:500,000, 1969
Roads as of 1978

Figure I-2.--Map showing coal development and associated proposals in central Utah.

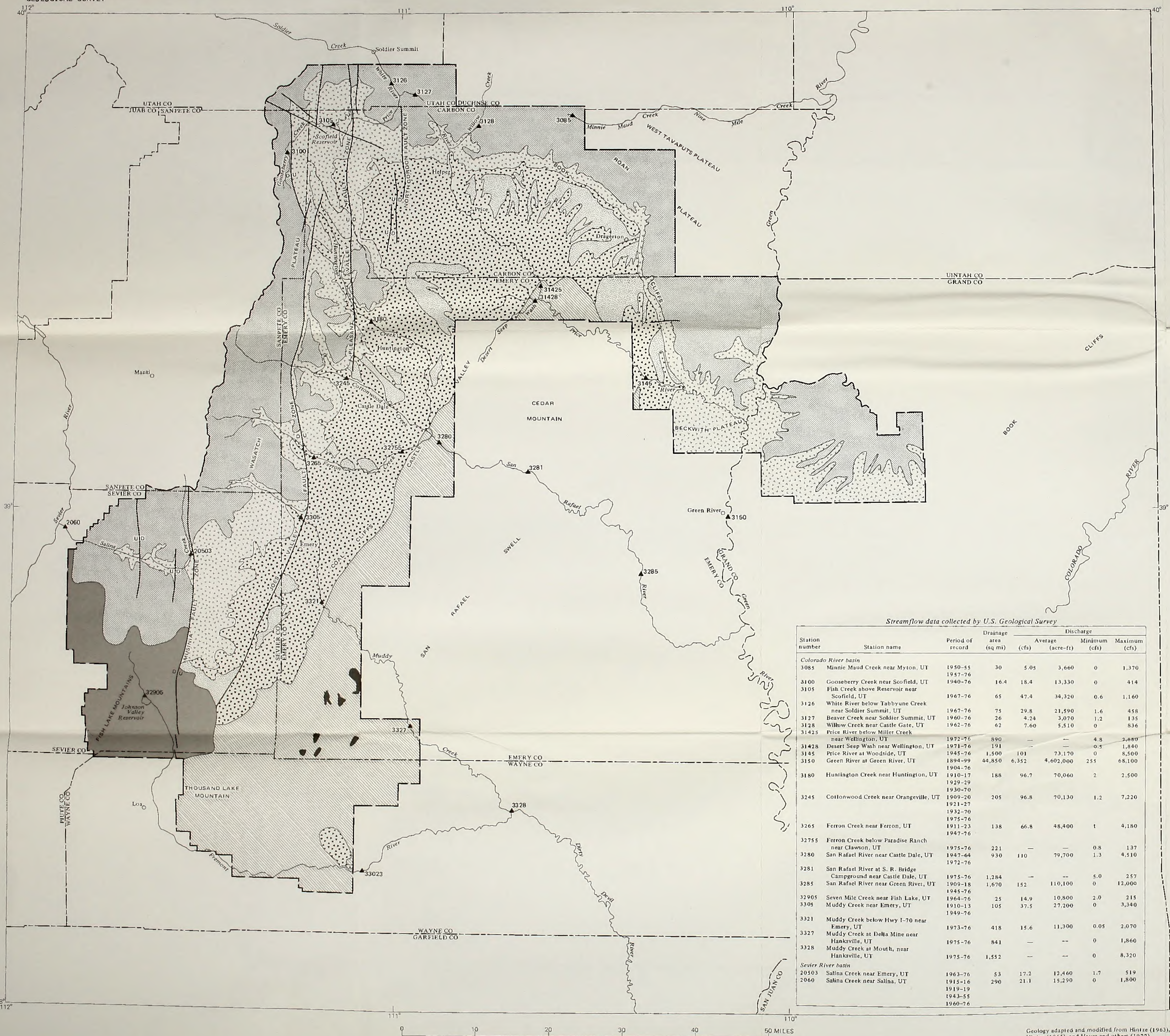
Coal-slurry pipeline route, preliminary proposal by Boeing.



Index map showing location of the Central Utah coal region.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, CENTRAL UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE II-5



Streamflow data collected by U.S. Geological Survey

Station number	Station name	Period of record	Drainage area (sq mi)	Discharge: Average (cfs)	Discharge: Average (acre-ft)	Discharge: Minimum (cfs)	Discharge: Maximum (cfs)
Colorado River basin							
3085	Minnie Maud Creek near Myton, UT	1950-55 1957-76	30	5.05	3,660	0	1,370
3100	Gooseberry Creek near Scofield, UT	1940-76	16.4	18.4	13,330	0	414
3105	Fish Creek above Reservoir near Scofield, UT	1967-76	65	47.4	34,320	0.6	1,160
3126	White River below Tabbyune Creek near Soldier Summit, UT	1967-76	75	29.8	21,590	1.6	458
3127	Beaver Creek near Soldier Summit, UT	1960-76	26	4.24	3,070	1.2	135
3128	Willow Creek near Castle Gate, UT	1962-76	62	7.60	5,510	0	836
31425	Price River below Miller Creek near Wellington, UT	1972-76	890	—	—	4.8	2,080
31428	Desert Seep Wash near Wellington, UT	1971-76	191	—	—	0.5	1,840
3145	Price River at Woodside, UT	1945-76	1,500	101	73,170	0	8,500
3150	Green River at Green River, UT	1894-99 1904-76	44,850	6,352	4,602,000	255	68,100
3180	Huntington Creek near Huntington, UT	1910-17 1929-29 1930-70	188	96.7	70,060	2	2,500
3245	Cottonwood Creek near Orangeville, UT	1909-20 1921-27 1932-70 1975-76	205	96.8	70,130	1.2	7,220
3265	Ferron Creek near Ferron, UT	1911-23 1947-76	138	66.8	48,400	t	4,180
32755	Ferron Creek below Paradise Ranch near Clawson, UT	1975-76	221	—	—	0.8	137
3280	San Rafael River near Castle Dale, UT	1947-64 1972-76	930	110	79,700	1.3	4,510
3281	San Rafael River at S. R. Bridge Campground near Castle Dale, UT	1975-76	1,284	—	--	5.0	257
3285	San Rafael River near Green River, UT	1909-18 1945-76	1,670	152	110,100	0	12,000
32905	Seven Mile Creek near Fish Lake, UT	1964-76	25	14.9	10,800	2.0	215
3305	Muddy Creek near Emery, UT	1910-13 1949-76	105	37.5	27,200	0	3,340
3321	Muddy Creek below Hwy I-70 near Emery, UT	1973-76	418	15.6	11,300	0.05	2,070
3327	Muddy Creek at Delta Mine near Hanksville, UT	1975-76	841	—	--	0	1,860
3328	Muddy Creek at Mouth, near Hanksville, UT	1975-76	1,552	—	—	0	8,320
Sevier River basin							
20503	Salina Creek near Emery, UT	1963-76	53	17.2	12,460	1.7	519
2060	Salina Creek near Salina, UT	1915-16 1919-19 1943-55 1960-76	290	21.1	15,290	0	1,800

EXPLANATION

Quaternary gravel surfaces, mainly terraces and pediments undergoing erosion. May not be associated with active streams

Tertiary volcanic rocks, undifferentiated

Tertiary mafic intrusive rocks, dikes and sills

Tertiary sedimentary rocks

- Green River Formation, as much as 2,400 feet of lacustrine shale and siltstone
- Colton Formation, 300 to 1,500 feet fluvial red beds with channel sandstone
- Flagstaff Limestone, 200 to 1,500 feet of yellow-gray to cream limestone
- North Horn Formation (Lower Tertiary-Upper Cretaceous(?), 500 to 2,500 feet of fluvial sandstone and mudstone
- Tuscher Formation (Lower Tertiary-Upper Cretaceous(?), 130 to 600 feet of conglomeratic fluvial sandstone

Cretaceous sedimentary rocks

Upper coal-bearing sequence

- Price River Formation of Mesaverde Group, 600 to 1,000 feet of fluvial and marine interbedded sandstone and mudstone (Farrer, *coal*-bearing Neslen and Sego Formations in Sego coal field)
- Castlegate Sandstone of Mesaverde Group, 150 to 500 feet of cliff forming, light-colored deltaic sandstone
- Blackhawk Formation of Mesaverde Group, 700 to 1,500 feet of sandstone, mudstone, shale and *coal*: chief coal producing formation in Utah

Lower coal-bearing sequence

- Star Point Sandstone of Mesaverde Group, 90 to 1,000 feet of interbedded light-colored sandstone and gray marine shale
- *Masuk Shale Member of Mancos Shale, 300 to 1,300 feet of gray marine shale
- Emery Sandstone Member of Mancos Shale, 50 to 800 feet of light-colored marine sandstone: non-marine with *coal* in southern part of Wasatch Field
- *Blue Gate Shale Member of Mancos Shale, 1,500 to 2,400 feet of light-colored marine shale
- Ferron Sandstone Member of Mancos Shale, 50 to 950 feet of alternating yellow-gray sandstone, sandy shale and gray shale with important *coal* beds
- *Tununk Shale Member of Mancos Shale, 400 to 650 feet of gray marine siltstone and claystone
- Dakota Sandstone, 0 to 60 feet of light-colored conglomeratic sandstone with minor *coal*

Pre-Cretaceous sedimentary rocks

- Morrison Formation (Upper Jurassic), 0 to 630 feet of sandstone and bentonitic mudstone
- Summerville Formation (Upper Jurassic), 0 to 200 feet of thin-bedded siltstone, locally gypsiferous
- Curtis Formation (Upper Jurassic), 0 to 200 feet of fine-grained sandstone and siltstone
- Entrada Sandstone (Upper Jurassic), 0 to 1,000 feet of siltstone and sandstone
- Carmel Formation (Middle Jurassic), 0 to 1,000 feet of siltstone, sandstone, limestone, and gypsum
- Navajo Sandstone (Triassic(?) and Jurassic), 500 to 2,000 feet of cliff-forming sandstone
- Kayenta Formation (Upper Triassic(?)), about 260 feet of sandstone, siltstone, and shale; minor amounts of limestone
- Wingate Sandstone (Upper Triassic(?)), 0 to 430 feet of cliff-forming sandstone
- Chinle Formation (Upper Triassic(?)), 430 feet to 1,300 feet of sandy, limy, muddy, and bentonitic rocks
- Moenkopi Formation (Lower and Middle(?) Triassic), 100 to 1,100 feet of shale, sandstone, limestone and evaporites

*Special engineering procedures required in construction of surface facilities

Contact

Fault–U, upthrown side; D, downthrown side

▲ U.S. Geological Survey stream gaging station

Central region boundary

WATER-BEARING PROPERTIES

Quaternary sediments–Low to high permeability. Generally yield 10 to 500 gal/min; locally more than 500 gal/min to wells and springs in valley fill

Tertiary sedimentary and volcanic rocks–Permeability generally low to moderate in sandstone but locally high where fractured; low to moderate in rubble and cinders (openings contain fine-grained sediments in places) locally very high in limestone solution channels and fractures. Potential well yields generally 5 to 50 gal/min, locally more than 100 gal/min; limestone solution channels and fractures may yield more than 500 gal/min locally

Cretaceous sedimentary rocks, upper coal-bearing sequence–Moderate permeability in sandstone and conglomerate, particularly along bedding planes, high permeability where fractured. Potential well yields generally 5 to 50 gal/min in sandstones and fractured conglomerates

Cretaceous sedimentary rocks, lower coal-bearing sequence–Permeability in upper sandstones moderate to high, in lower sandstones low to moderate; potential well yields 5 to 50 gal/min. Shales, permeability low, not significant as a source of water

Pre-Cretaceous sedimentary rocks–Potential well yields form the Navajo Sandstone stone generally less than 100 gal/min but may be as much as several hundred gal/min in places. Other formations–potential yield little or no water (generally less than about 50 gal/min) from sandstones and fractures, no yields from shale and dense limestone

Geology adapted and modified from Hintze (1963), Hintze (1964), and Hayes and others (1977)

Figure II-5.--Generalized geologic map of the Central Utah Coal region.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

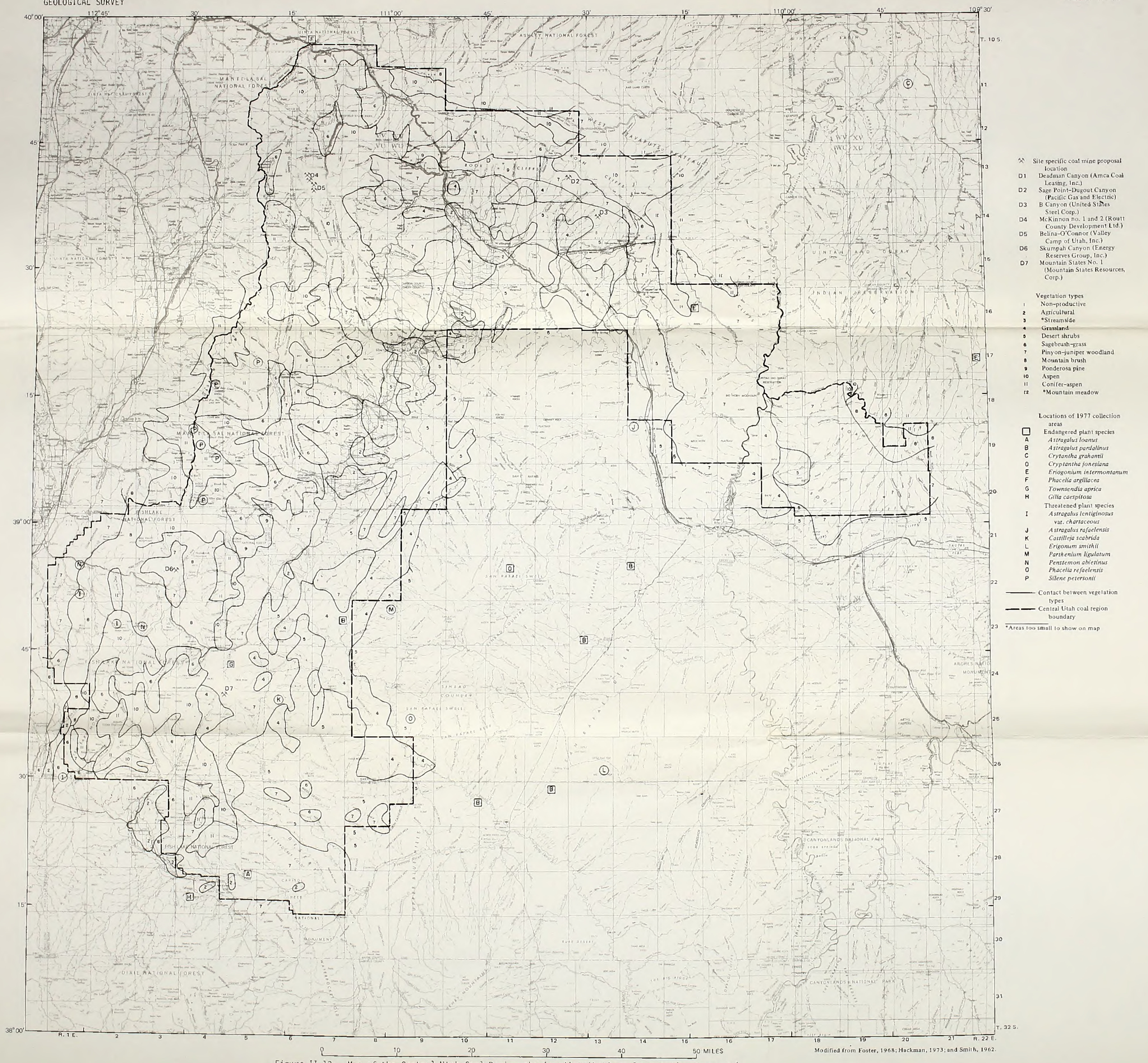
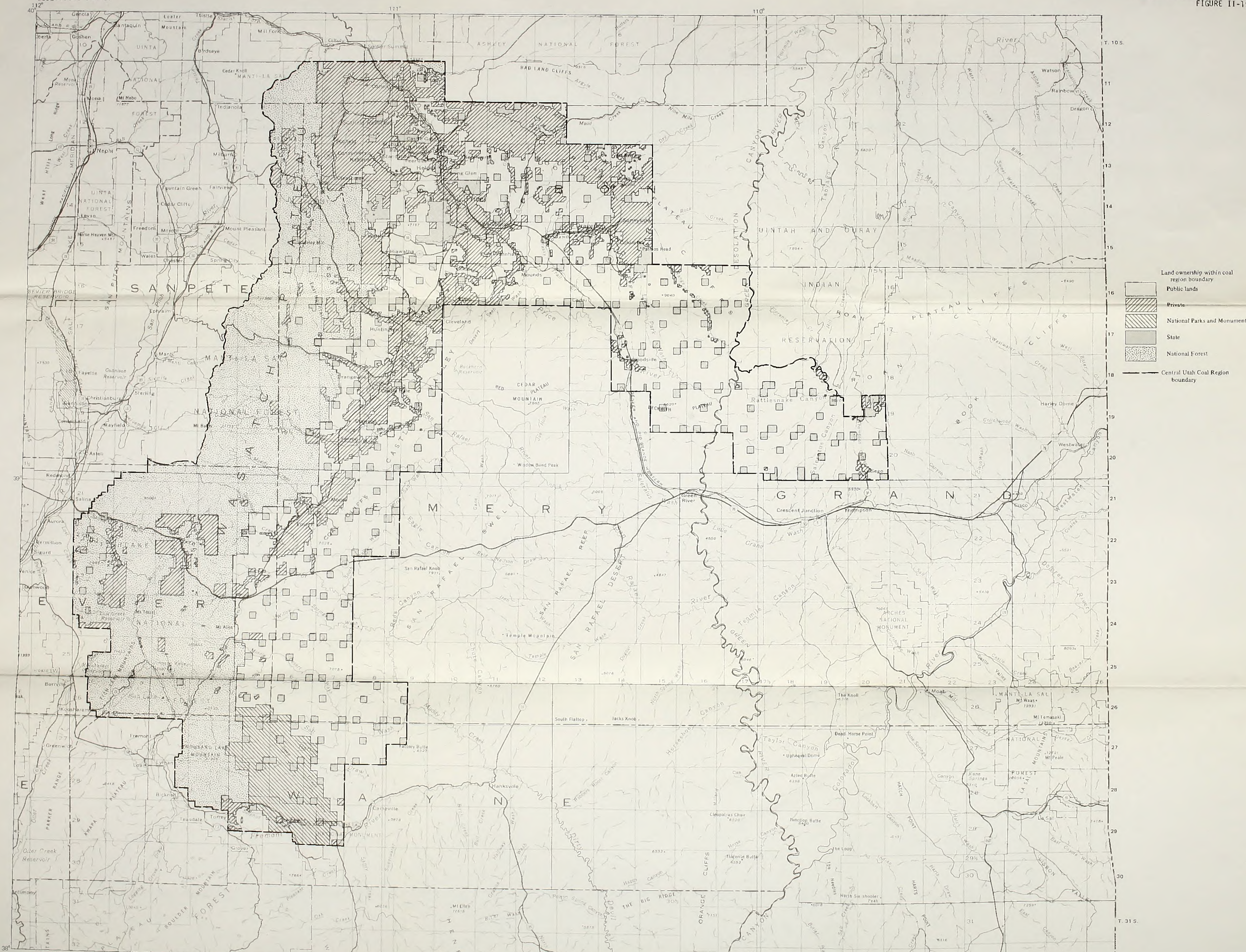


Figure II-13.--Map of the Central Utah Coal Region showing distribution of vegetation types and collection areas of endangered and threatened plant species.



Base from U.S. Geological Survey
State base map 1:500,000, 1969
Roads as of 1978

Figure II-19.--Map of the Central Utah Coal Region showing land ownership.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, CENTRAL UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE II-9

WASATCH PLATEAU, SALINA CANYON, AND EMERY COAL FIELDS, AND PRICE-CASTLE DALE AREA

Coal reserve, in millions of short tons

	AREA	COAL CLASSES I, II	III	I-III	III-IV	I-IV	IV	SUBTOTALS (BY AREA)
WASATCH PLATEAU FIELD	41					341.0		341.0
	42			435.2				435.2
	43						MODERATE	MODERATE
	44	Reserves not quantified; coal present but probably not minable[1]						
	45	Reserves not quantified, because minability less assured than to south[2]						
	46					80.0		80.0
	47						LARGE[3]	LARGE
	48					79.1		79.1

Federal ownership of mineral rights

State and private ownership of mineral rights

Coal, potentially mineable, reserve for area (28) shown in tables

Coal outcrop, dashed where concealed, uncertain, or approximately located; stippled pattern behind outcrop

Inferred limit of potentially mineable coal, generally based on thickness or,

BOOK CLIFFS AND MAIN PART OF SEGO COAL FIELDS

Coal reserve, in millions of short tons

	AREA	COAL CLASSES I, II	II	III	I-III	I-IV	IV	SUBTOTALS (BY AREA)
SEGO FIELD	1		22.4	40.9			<8.4	71.7
	2					105.4		105.4
	3					24.8		24.8
	4					<19.1		19.1
	5					<5.6		5.6
	6	Resources not determined; coal probably thin and of poor quality where present.						
	7A, 7B, 7C, 7D	Area of potential coal reserves where thickness of cover over coal exceeds 3,000 feet. Coal possibly thin and may be of poor quality like to south.						

WASATCH PLATEAU, SALINA CANYON, AND EMERY COAL FIELDS, AND PRICE–CASTLE DALE AREA

Coal reserve, in millions of short tons

	AREA	COAL CLASSES I, II	III	I–III	III–IV	I–IV	IV	SUBTOTALS (BY AREA)
WASATCH PLATEAU FIELD	41					341.0		341.0
	42			435.2				435.2
	43						MODERATE	MODERATE
	44	Reserves not quantified; coal present but probably not minable.[1]						
	45	Reserves not quantified, because minability less assured than to south.[2]						
	46					80.0		80.0
	47						LARGE[3]	LARGE
	48					79.1		79.1
	49					305.0		305.0
	50					164.5		164.5
	51			99.0			140.8	239.8
	52				18.7	138.7		157.4
	53						174.0	174.0
	54						160.5	160.5
	55						91.9	91.9
	56						232.9[4,5]	232.9
	57					45.8	43.1	88.9
	58					95.7		95.7
	59					106.4		106.4
	60					195.4		195.4
	61						LARGE[6]	LARGE
	62						LARGE[5]	LARGE
	63						LARGE[7]	LARGE
	64					275.6		275.6
	65			15.0		366.4	15.0	396.4
	66					166.8		166.8
	67	No coal present according to drill-hole data.						
	68					56.8[4]	34.1[4]	90.9
	69					44.0[8]		44.0
	70					36.9[8]		36.9
	71			219.8[9]				219.8
	72	Not quantified because of lack of data, coal inferred to be present in at least part of the area.						
	73					~60.–106.0		106.0
	74						324.0	324.0
	75						87.0[10]	87.0
	76						106.0	106.0
	77					44.0		44.0
	78					21.2		21.2
	79					11.0[4]	12.5[4]	23.5
	80					63.4		63.4
	81					39.5		39.5
	82					346.3		346.3
	83					146.7		146.7
	84						17.3	17.3
	85	Reserve potential not quantified; coal present and inferred to have thickness and tonnage like areas to north and east, but structure is complex and minability not established.						
	86					241.2[11]		241.2
	87	10.5	124.0				100.0	234.5
	88	Like area 85 to north, except that cover over coal exceeds 3,000 feet.						
	SUBTOTALS, BY CLASS	10.5	124.0	769.0	18.7	3,517.4	1,539.1	
	TOTAL, ALL CLASSES							5,978.7[12]
SALINA CANYON FIELD	89						69.1	69.1
	90	Little or no reserve potential; coal generally thin or absent.						
	91	Like area 90, but also with cover over coal exceeding 3,000 feet.						
EMERY FIELD	92					104.6		104.6
	93					97.3		97.3
	94			0.4		76.8[4,13]	1.0	78.2
	95			215.3		81.5	144.5	441.3
	96						381.6	381.6
	97			222.3[14]				222.3
	98					134.2[15]	0.2	134.4
	99			166.0			10.2	176.2
	100	72.0	98.2				19.8	190.0
	101	34.8						34.8
	102	Reserves not quantified; data lacking.						
	SUBTOTALS, BY CLASS	106.8	98.2	604.0		494.4	557.3	
	TOTAL, ALL CLASSES							1,860.7
PRICE–CASTLE DALE AREA	103					2,185.0[14]		2,185.0
	104	Reserves not quantified; coal probably present but mostly deeply buried.[16]						
	105	Reserves not quantifiable; data sparse.[16,17]						
	106						100.0	100.0
	SUBTOTAES, BY CLASS					2,185.0	100.0[16]	
	TOTAL, ALL CLASSES							2,285.0[13]

[1] Coal bed lies under lake and is probably faulted.
[2] Coal occurs in a more complex geologic setting and is more deeply buried here than to the south, with coal of area generally north-dipping and faulted.
[3] Based on inference that coal is probably like that to the east in persistence, thickness, and tonnage.
[4] Includes some coal thinner than 4 feet.
[5] Some coal may not be minable.
[6] Probably more than 100,000,000 tons.
[7] May not be minable due to faults in area, and locally coal may be deeper than 3,000 feet.
[8] Average thickness is less than 4 feet over much of the area.
[9] Possibly should be classed as I–IV.
[10] Recent drill hole data indicates that this estimate may be too high.
[11] Chiefly classes II–IV.
[12] Plus noted unquantified amounts could possibly add 10–20 percent to the tabulated tonnage.
[13] This quantity may be slightly too low.
[14] Mainly class III.
[15] Includes some 3-foot thick coal.
[16] Coal nowhere exposed. Coal bed is at a much lower stratigraphic position than the minable coal farther west.
[17] Coal may or may not be present in minable quantities, but deep burial generally would preclude mining except perhaps between areas 103 and 106.

Federal ownership of mineral rights

State and private ownership of mineral rights

Coal, potentially mineable, reserve for area (28) shown in tables

Coal outcrop, dashed where concealed, uncertain, or approximately located; stippled pattern behind outcrop

Inferred limit of potentially mineable coal, generally based on thickness or, locally, on other data, such as limits of burned coal; dashed where uncertain or approximately located

Other boundary between reserve areas, such as political, available data, etc.

3,000-foot depth of potentially mineable coal

Fault, dashed where concealed or approximately located

Central region boundary

COAL CLASSES[1]

Class I — *Measured reserves* based on adequate exploration data; properly correlated; control no more than one-half mile apart.

Class II — *Indicated reserves* based on geologic measurement supplemented by limited drill-hole information and limited to 1½ miles from a control point.

Class III — *Inferred reserves* based on geologic inference and projection of the habit of the coal beyond 1½ miles from control points.

Class IV — *Potential reserves* based on geographic and geologic position with little surrounding data; includes coal covered by no more than 3,000 feet of overburden.

Most of the coal reserve is based on surface measurements which are not always as reliable as the drill. The reserve commonly is underestimated because surface measurements usually are smaller than thickness penetrated by drilling. Class I and II figures are combined in these reports; no attempt was made to separate the more reliable figure. The first three reserve classes constitute the principal reserve and more nearly reflect the current potential. The reserves include only coal beds that average 4 feet or greater thickness and are covered by less than 3,000 feet of overburden except where otherwise noted. Less than 50 percent of the total reserves are economically mineable.

[1] The division of coal into four classes generally follows that described by Doelling (1972c, p. 549).

BOOK CLIFFS AND MAIN PART OF SEGO COAL FIELDS

Coal reserve, in millions of short tons

	AREA	COAL CLASSES I, II	II	III	I–III	I–IV	IV	SUBTOTALS (BY AREA)
SEGO FIELD	1		22.4	40.9			<8.4	71.7
	2					105.4		105.4
	3					24.8		24.8
	4					<19.1		19.1
	5					<5.6		5.6
	6	Resources not determined; coal probably thin and of poor quality where present.						
	7A, 7B, 7C, 7D	Area of potential coal reserves where thickness of cover over coal exceeds 3,000 feet. Coal possibly thin and may be of poor quality like to south. Quantity not determined.						
	8	Reserves not determined; coal generally thin, but locally may be 4 feet or more thick, especially in the southeastern part of the area. The ground in the northwestern part of the area has not all been examined for coal.						
	9A, 9B			17.9				17.9
	SUBTOTAES, BY CLASS		22.4	58.8		154.9	8.4	
	TOTAL COAL, ALL CLASSES							244.5
SEGO AND BOOK CLIFFS FIELD	10	Coal present at least locally based on scattered outcrops, but generally thin, with no coal known to exceed 4 feet in thickness, and large areas of thick coal are not expected (Doelling, 1972b, p. 215). Some ground in the northeastern part of the area is unexamined. Eastern part of this area is the west edge of the Sego coal field.						
BOOK CLIFFS FIELD	11	Coal generally too thin to mine, and coal not studied back of the outcrop.						
	12					130.2		130.2
	13					85.3		85.3
	14					151.3		151.3
	15						167.0	167.0
	16A, 16B						360.0[1]	360.0
	17A, 17B	Amount of resource not determined. Area of potential coal reserve where thickness of cover over coal exceeds 3,000 feet.						
	18					41.2		41.2
	19	57.1	6.8	17.2		19.5		100.6
	20				40.3		40.1	80.4
	21			8.4+		24.5	51.6	84.5
	22	24.5[2]				98.8[3,4]		123.3
	23					168.7		168.7
	24					5.0[5]	65.2	70.2
	25				150.0	4.5[5]	121.0[5]	275.5
	26					130.0		130.0
	27	Reserves not quantified; coal close to the 3,000-foot overburden line.						
	28					57.3[5]	17.8[5]	75.1
	29	Coal less than 3 feet thick.						
	30				16.6	26.0	22.8[5]	65.4
	31					89.1[1]		89.1
	32						LARGE	LARGE
	33						240.2[6]	240.2
	34						176.0[6]	176.0
	35						174.2	174.2
	36					152.7[6]		152.7
	37					6.9[7]		6.9
	38				9.0		1.6[7]	10.6
	39						156.1	156.1
	40						421.4[4]	421.4
	SUBTOTALS, BY CLASS	81.6	6.8	25.6	215.9	1,191.0	2015.0	
	TOTAL COAL, ALL CLASSES							3,535.9[8]

[1] Tonnage given is for area 16B and based on coal thicknesses supplied by Hellmut Doelling (oral commun., 1978), but amount of coal far exceeds that estimated by Doelling (1972c, p. 324). Coal of area 16B may well extend into area 16A, for which a coal reserve is inferred without the tonnage being quantified.
[2] Recoverable coal.
[3] Includes 29.8 million tons of coal in one bed that averages 3.8 feet thick.
[4] Some coal is deeper than 3,000 feet.
[5] Includes some coal thinner than 4 feet.
[6] Mostly classes I–III.
[7] Mostly mined out; remaining coal may not be minable.
[8] Plus noted unquantified amount that is only a small percentage of tabulated tonnage.

Base from U.S. Geological Survey
Price and Salina, 1956 revised 1970
Grand Junction and Moab, 1956 revised 1969
1:250,000

0 5 10 15 20 25 MILES

Figure II-9.--Map showing coal resources in Central Utah Coal Region.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRAFT EIS, CENTRAL UTAH COAL
MINING AND RECLAMATION PLAN
FIGURE II-23

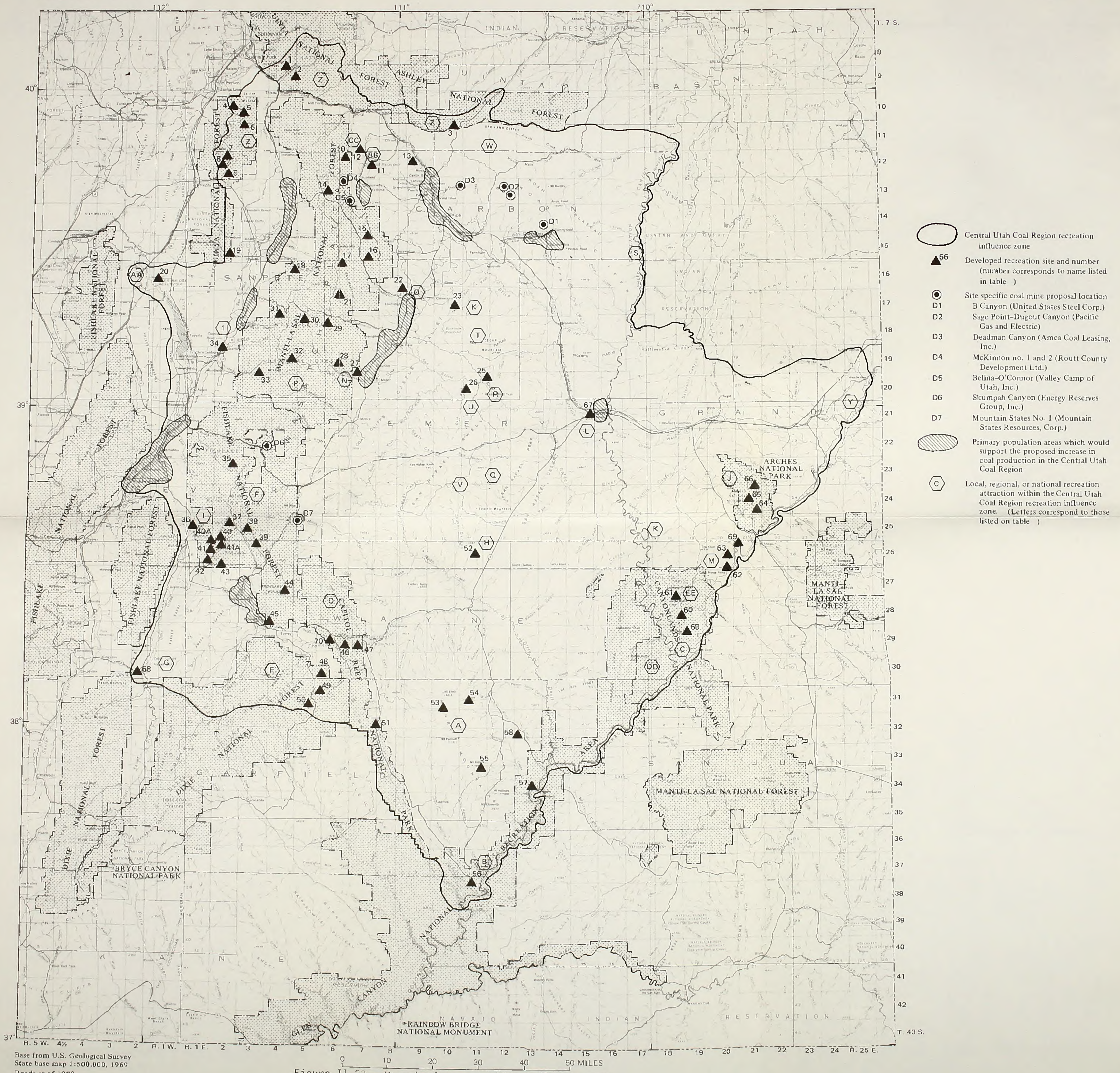
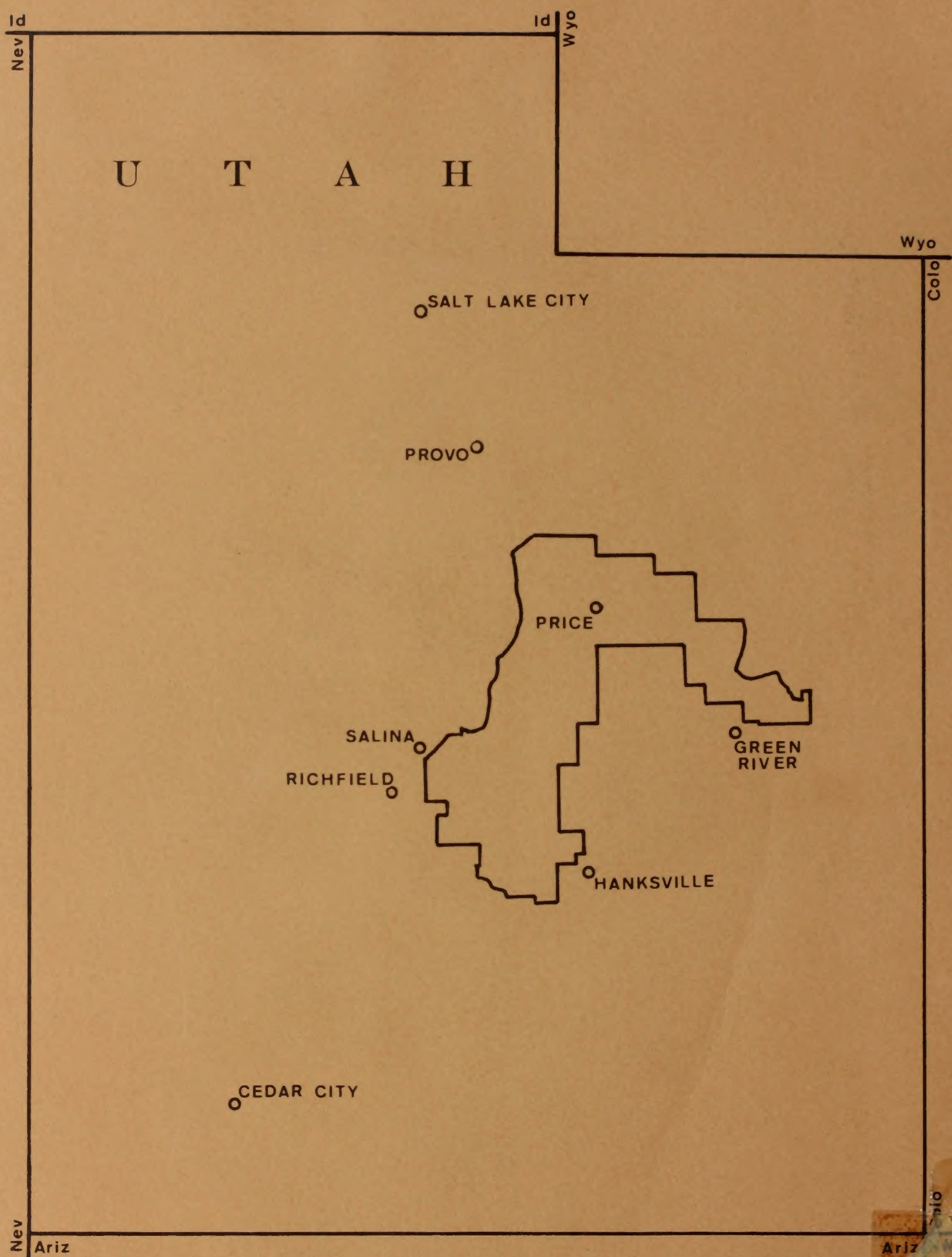


Figure II-23.--Map showing recreation influence zone.


Id
Id
Wyo
Nev
U T A H
Wyo
Colo
SALT LAKE CITY
PROVO
PRICE
SALINA
RICHFIELD
GREEN RIVER
HANKSVILLE
CEDAR CITY
Nev
Ariz
Ariz
Colo