MASTER

**CURRENT ENVIRONMENTAL,
HEALTH, SAFETY, AND
SOCIOECONOMIC RESEARCH
ACTIVITIES RELATED TO
OIL SHALE**

September 1980

DRAFT

DISCLAIMER

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September 1980

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This report was prepared by TRW under Contract No. DE-AC01-80RA50211 for DOE, Office of Resource Applications. It is in fulfillment of contract requirements and in particular is Item (1) under task (8), Environmental Assessment.

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PREFACE

This document was prepared for DOE Resource Applications. It provides a compilation of information on current environmental, health, safety and socioeconomic research activities related to oil shale. The information is the most recent available through August 29, 1980. Included are the following:

1. Project Title
2. Administering Agency
3. Contractor
4. Project Status
5. Funding Level
6. Project Schedule
7. Deliverable
8. Key Personnel

The data contained in these reports can be used in environmental impact analyses relating oil shale to various incentives given in the "Alternative Fuels Bill."

The information provided was obtained from computer search printouts, review of respective agency documents and communication with agency personnel. A complete list of references is provided.

ENVIRONMENTAL, HEALTH, SAFETY AND
SOCIOECONOMIC STUDIES RELATED TO OIL SHALE
(Summary Table)

SPONSORING ORGANIZATION	CONCERNS/ISSUES				TOTAL
	ENVIRONMENT	HEALTH	SAFETY	SOCIO-ECONOMIC	
DEPARTMENT OF ENERGY	80	17		13	110
ENVIRONMENTAL PROTECTION AGENCY	77	24		1	102
DEPARTMENT OF AGRICULTURE	8			1	9
DEPARTMENT OF INTERIOR	3				3
SUBTOTAL	168	41		15	224

Note: Based on the limited information available, each study is categorized into one concern/issue. Where a study would address more than one concern/issue, it is assigned to the one representing the major thrust of the effort indicative of its title.

ABBREVIATIONS

BPNL	Battelle Memorial Institute Pacific Northwest Laboratories Richland, Washington (under DOE)	ERL-Athens	Environmental Research Laboratory EPA, Athens, GA
CDH	Colorado Department of Health	ERL-Duluth	Environmental Research Laboratory EPA, Duluth, MN
CSMRI	Colorado School of Mines Research Institute	ERL-GB	Environmental Research Laboratory EPA, Gulf Breeze, FL
CSU	Colorado State University		
DOE	Department of Energy	HERL-RTP	Health Effects Research Laboratory EPA, Research Triangle Park, NC
DOI	Department of Interior		
DRI	Denver Research Institute	HERL-Ci	Health Effects Research Laboratory EPA, Cincinnati, OH
ECTD	Emission Control Technology Division, Office of Air, Noise and Radiation EPA, Ann Arbor, MI	IERL-Ci	Industrial and Environmental Research Laboratory EPA, Cincinnati, OH
EERC	Energy and Environmental Research Corporation Santa Ana, CA	IERL-RTP	Industrial and Environmental Research Laboratory EPA, Research Triangle Park, NC
EMSL-Ci	Environmental Monitoring and Support Laboratory EPA, Cincinnati, OH		
EMSL-LV	Environmental Monitoring and Support Laboratory EPA, Las Vegas, NV	LASL	Las Alamos Scientific Laboratory Los Alamos, NM (under DOE)
EMSL-RTP	Environmental Monitoring and Support Laboratory EPA, Research Triangle Park, NC	LBL	Lawrence Berkely Laboratory Berkely, CA (under DOE)
EPA	Environmental Protection Agency		
ERIC-Ci	Environmental Research Information Center EPA, Cincinnati, OH	LETC	Laramie Energy Technology Center Laramie, WY (under DOE)

LLL	Lawrence Livermore Laboratory Livermore, CA (under DOE)	ORD	Office of Research and Development, EPA
NBS	National Bureau of Standards	ORNL	Oak Ridge National Laboratory Oak Ridge, TN (under DOE)
NIEHS	National Institute of Environmental Health Sciences Research Triangle Park, NC	OSWG	Oil Shale Work Group EPA-Ci
NIOSH	National Institute of Occupational Safety and Health	PETC	Pittsburgh Energy Technology Center
NIH/NIEHS	National Institute of Health National Institute of Environmental Health Studies (DHEW)	R.S. Kerr	Robert S. Kerr Environmental Research Laboratory Ada, OK
OEET	Office of Environmental Engineering and Technology	SAI	Science Applications Incorporated
OEMI	Office of Energy, Minerals and Industry, EPA Office of Research and Development	TOSCO	The Oil Shale Corporation
OEMI-HQ	Office of Energy, Minerals and Industry, Headquarters EPA, Washington, DC	UCLA	University of CA Los Angeles, CA
OEPER	Office of Environmental Processes and Effects Research	USDA	U.S. Department of Agriculture
		USFWS	U.S. Fish and Wildlife Service Department of Interior
		USGS	U.S. Geological Survey, Department of Interior

REFERENCES AND SOURCES

1. EPA Program Status Report: Oil Shale 1979 Update, EPA - 600/7-79-089, March 1979.
2. EPA Program Status Report: Oil Shale 1980 Update, EPA - 600/ , July 1980.
3. USDOE, Assistant Secretary for Fossil Energy and Assistant Secretary for Environment, Environmental Development Plan: Oil Shale, November 1979.
4. Cameron Engineers, Inc. (a Division of the Pace Company Consultants and Engineers, Inc.), Cameron Synthetic Fuels Report, June 1980.
5. Congress of the United States, Office of Technology Assessment, An Assessment of Oil Shale Technologies, Volume 1, June 1980.
6. TRW, Management Support and Systems Engineering for the Naval Oil Shale Reserve Predevelopment Project, May 1980.
7. U.S. Department of Energy, Assistant Secretary for Environment, Inventory of Federal Energy-Related Environment and Safety Research for FY 1978, Volume II, December 1979.
8. U.S. Department of Energy, Assistant Secretary for Environment, Environmental Readiness Document - Oil Shale - Commercialization Phase III Planning, September 1978.
9. U.S. Energy Research and Development Administration, Environmental Development Plan (EDP) - Oil Shale Program FY 1977, June 1977.
10. U.S. Department of Energy, Assistant Secretary for Fossil Energy, Fossil Energy Projects - Fuel Extraction and Advanced Utilization, February 25, 1980.
11. Personal Communications with:
 - Kurt Jakobson - Environmental Protection Agency
 - Harold Thomas - DOE-Fossil Energy
 - Jerry Roberts - Aerospace Corporation
 - John Powers - DOE-Office of Energy Research
 - Richard Poulson - DOE-Laramie Energy Technology Center
 - Paul Petzrick - DOE-Resource Applications
 - Kathy Collins - DOE-Office of Technology Assessment
 - Edward Miller - DOE-Office of Management Support
 - Kenneth Friedman - DOE-Resource Applications

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ENVIRONMENTAL, HEALTH, SAFETY AND SOCIOECONOMIC
STUDIES RELATED TO OIL SHALE

PROJECT TITLE	ADMINISTERING AGENCY/SPONSOR	CONTRACTOR/ PERFORMING ORGANIZATION	PROJECT STATUS	FUNDING LEVEL (\$K)					PROJECT SCHEDULE/ DURATION	DELIVERABLE	KEY PERSONNEL
				FY 79	FY 80	FY 81	FY 82	TOTAL			
OIL SHALE RESOURCE APPLICATIONS (OSRA) STATE GRANT PROGRAM: COLORADO	DOE RESOURCE APPLICATIONS										
1. Planning Work on Reclamation and Permits	DOE-RA	Colorado Department of Natural Resources			70	70					
2. Citizen Participation in Water Study Program	" "	Colorado Department of Natural Resources			51	50					
3. Macro Socioeconomic Growth Monitoring	" "	Colorado Department of Local Affairs			150	250					
4. Micro Socioeconomic Planning & Analysis	" "	Colorado Department of Local Affairs			75	100					
5. Local Planning for Socioeconomic Impact	" "	Rio Blanco County Board of Commissions			36	50					
6. Interagency Agreement on Air Quality Model	" "	Region VIII, EPA			100						
7. Human Services Delivery Plan	" "	Colorado Dept. of Local Affairs			78	100					

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>UTAH</u>											
1. Impact Planning & Development	DOE-RA	Utah Department Of Energy			33	100					
2. Master Plan for Socioeconomic Impact	" "	Utah Department Of Energy			50	200					
3. Energy Supply Planning	" "	"			150	200					
<u>EASTERN</u>											
1. Regulations & Permit Analysis in Kentucky	" "	Kentucky Department of Natural Resources & Environmen- tal Protec- tion			31	31					
2. Feasibility Analysis of Alabama Shale Oil	" "	State of Alabama			75	75					
3. Commercial Assessment of Devonian Oil Shale in Tennessee	" "	State of Tennessee			75	75					
4. Planning for Oil Shale Development in Kentucky	" "	Kentucky Department of Energy			38	75					

ENVIRONMENTAL, HEALTH, SAFETY AND SOCIOECONOMIC
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PROJECT TITLE	ADMINISTERING AGENCY/SPONSOR	CONTRACTOR/ PERFORMING ORGANIZATION	PROJECT STATUS	FUNDING LEVEL (\$K)					PROJECT SCHEDULE/ DURATION	DELIVERABLE	KEY PERSONNEL
				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>NAVAL OIL SHALE RESERVES (NOSR)</u>											
1. Hydrology	DOE/RA	TRW			800	800		1600	79-81	Baseline Data Report	E. Bond (303) 986-5533
2. Meteorology & Air Quality	"	TRW			50	50		100	79-81	Long Range Monitoring Plan	J. Dadiani (703) 734-6480
3. Biological Resources	"	TRW/TOSCO Corp.			100			100	80	Long Range Monitoring Plan	J. Merino (801) 789-5100
4. Geologic Hazards/Fractures Survey	"	TRW/TOSCO Corp			35	25		60	80-81	Baseline Data Report	J. Merino (801) 789-5100
5. Socio-Economics	"	TRW/TOSCO Foundation			110	150		260	79-81	Socio-Economic Impact Analysis	R. Robinson (303) 447-0770
6. EIS Planning	"	TRW			100			100	80	Baseline Data Plan	L. Tipton (703) 734-6480
7. Draft EIS for Development Policy Options	"	TRW			150			150	80	Draft Review Document	H. Leon (703) 734-6480
8. Soil Assessment	"	TRW				25		25	81	Baseline Data Report	R. Walsh (703) 734-6404
9. Site Access Environmental Assessment	"	TRW/C. F. Braun				50		50	81	Environmental Assessment Report	W. Johnstone (213) 570-2655
10. Pipeline Corridor Environmental Assessment	"	TRW/Kaiser Engineers, Inc.				75		75	81	Environmental Assessment Report	A. Anderson (415) 271-5882

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PROJECT TITLE	ADMINISTERING AGENCY/SPONSOR	CONTRACTOR/ PERFORMING ORGANIZATION	PROJECT STATUS	FUNDING LEVEL (\$K)						PROJECT SCHEDULE/ DURATION	DELIVERABLE	KEY PERSONNEL
				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
	DEPARTMENT OF ENERGY ENVIRONMENT (DOE-EV)											
1. Spent Shale as a Control Technology for Oil Shale Retort Water	DOE-EV	LBL	Funded Thru FY82	50	75							J. Fox
2. Assessment of Environmental Controls for Mercury Emissions During Oil Shale Retorting	" "	"	"	30								J. Fox
3. Chromosome Structure and Functions	" "	LASL	"	102	132							L. Deaven
4. Mutagenesis: Shale Oil	" "	"	"	175	162							B. Barnhart
5. Assessment of Teratogenic & Toxic Properties of Products and By Products of Oil Shale Technologies	" "	"	Completed	75						-78		D. Swartzendruber
6. Toxicity of Oil Shale	" "	"	Funded Thru FY82	180	285							L. Holland
7. Biototoxicity of Chemicals	" "	ORNL	Completed	50						-78		A. Hammons
8. Regional Assessment	" "	Battelle Pacific Northwest Lab (BPNL)	Completed	725						-78		D. Hessel
9. Late Effects of Oil Shale Pollution	" "	BPNL	Funded Thru FY82	250	100							R. Renne

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
10. Oil Shale & Tar Sand Effluent Characterization	DOE-EV	BPNL	Funded Thru FY82	280	300							J. Fruchter
11. Oil Shale, Tar Sands, & Coal Conversion Research Materials Preparation Documentation	" "	"	"	100	225							J. Fruchter
12. ECT in In Situ Oil Shale	" "	LLL	Funded Thru FY82	40	100							M. Moody
13. Oil Shale Risk Analysis Program	" "	University of CO	"	357	329							W. Chappell
14. Rehabilitation Potential & Practices of Colorado Oil Shale Lands	" "	Colorado State University	"	280	304							C. Cook
15. Cellular Radio-Biology	" "	University of Calif.	Completed	165						-78		L. Myers
16. Analysis of the Environmental Control Technology for Oil Shale & Tar Sand Development	" "	University of Utah	"	56						-78		N. de Nevers
17. Analysis of Air Quality and Meteorological Baseline Data from Federally Leased Oil Shale Tracts in CO & UT	" "	Oregon State University	Funded Thru FY82		60							W. Slinne
18. Characterization of Organic Species Emitted from Oil Shale Conversion Processes	" "	Colorado State University	Completed	116						-78		D. Natusch

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
19. Assessment of Health Effects Related to Surface Oil Shale Retorting	DOE-EV	LETC	Completed	270						-78		
20. Oil Shale Data Planning Committee	" "	Development Engineering, Inc.	Funded Thru FY82	15	52							R. Heistand
21. Assessment and Control of Water Contamination: Oil Shale Extraction and Processing	" "	LASL	Funded Thru FY82	70	150							E. Wewerka
22. Nature of Nitrogenous Pollutants of In Situ Oil Shale Processes	" "	University of Southern CA	"	17	100							T. Yen
23. Assessment of Environmental Control for Wastewaters in In Situ Oil Shale Retorting	" "	PNL	"	150	205							B. Mercer
24. Control Technology for In Situ Oil Shale Retorts	" "	LBL	"	25	250							J. Fox
25. Evaluation of the Dose Effect Relationships for the Immune Response of Biologically Active Agents Associated with Oil Shale Technology	" "	LASL	Funded Thru FY82	60	65							L. Cram
26. DNA, Oil Shale Interaction	" "	LASL	"	70	75							D. Hoard
27. Interaction of Light-Activated PAH with Chromatin	" "	"	"	85	98							G. Strniste

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
28. Genetic Protective Mechanisms	DOE-EV	LASL	Funded Thru FY82	81	85							D. Smith
29. Atmospheric Boundary Layer Studies	" "	PNL	"	130	130							C. Simpson
30. Terrain Influence on Low Level Meteorological Transport	" "	LASL	"	85	182							S. Barr
31. Terrestrial Effects of Oil Shale and Development	" "	PNL	"	357	432							R. Wildung
32. Oil Shale Workers Study	" "	LASL	"		75							Rudnick
33. In Situ Oil Shale - Ecology	" "	LLL	"		75							R. Ireland
34. Oil Shale Fugitive Air Emissions	" "	PNL	"		100							Sehmel
35. Atmospheric Diffusion in Complex Terrain	" "	"	"		95							Orgill
36. In Situ Oil Shale Retorting	" "	LLL	Funded Thru FY82									Milanovich
37. Analytical Chemistry of Oil Shale	" "	LASL	"									L. Holland
38. ASCOT Management	" "	LLL	"									Dickerson
39. Oil Shale Industrial Hygiene	" "	LASL	"									Tillery
40. Informational and Regulatory Macromolecules	" "	"	"		72							Enger

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
41. Paraho-Navy Co-op Program	DOE-EV		Funded Thru FY82									
42. Pre-Screen for Hazardous Chemicals - Rapid Detector System for Mutagenesis and Repair Response to Health Hazards	" "	University of WY	"		56							J. Smith
43. Oxidant Chemistry in Oil Shale Region	" "	Colorado State Univ.	"									D. Natusch
44. Identification of Sulfur Heterocycles in Coal Liquefac- tion & Shale Oil	" "	Brigham Young Univ.	"		114							
45. Oil Shale Research, Development Program Management Plan	" "	Friends of the Earth										
46. ASCOT Field Evaluation	" "											
47. Aquifer Characterization	" "	University of Utah	Funded Thru FY82									Kao
48. Model Validation	" "	"	"									Kao
49. Mule Deer Study	" "	LASL	"									Hakonson
50. Aerial Photography and Ecological Changes	" "	USC	"									Frei
51. Oil and Grease Removal from Wastewater	" "	University of Calif.	"									

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
52. Environmental Control Study at Occidental	DOE-EV		Funded Thru FY82									
53. Self-Ignition Properties of Oil Shale	" "	NBS	"									
54. Field Study of Control Technology for Oxy Oil Shale Wastewater	" "	LETC	"									
55. Regional Studies Program	" "	ORNL		360								R. Davis
56. Mapping Project on Energy with the Social Sciences	DOE-Division of Regional Assessments	Yale Univ.		136								L. Gould

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
	<u>DEPARTMENT OF ENERGY - FOSSIL ENERGY</u>											
1. Water Conservation with In Situ Oil Shale Dev.	DOE-FE	University of CA										J. Thomas
2. Leaching Rates from Retorted Oil Shale	" "	Texas Tech. University		76								
3. Degradation of Organic Components in Retort Water	" "	University of Southern California		90								
4. Environment and Energy Conservation Support Services	" "	PETC		100								
5. Biochemical Studies with Aqueous Effluents Derived from In Situ Fossil Fuel Processing	DOE-LETC	University of WY		22								K. Nelson
6. Effluent Inventory and Control Technology Review	" "	SAI		30								J. Kotowski
7. Mineralogical & Geo- chemical Study of the Colorado Oil Shale	" "	Colorado School of Mines		62								M. Slaughter
8. Organic Solute Transport Study of Wastewaters Produced by In Situ Oil Shale Retorting	" "	USGS		18								J. Leenheer
9. Chemical and Physical Interactions of Soil with Wastewaters Produced by In Situ Oil Shale Retorting	" "	USGS		33								J. Leenheer

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
10. Animal Toxicity Evaluation of Waters Derived from In Situ Oil Shale Processing	DOE-LETC	Elars Bio-research Labs, Inc.		46								K. Larson
11. Removal of Ammonia & Alkalinity from Oil Shale Retort Water	" "	University of CO		48								K. Linstedt
12. Biological Degradation of the Soluble Organic Components in Retort Waters	" "	University of Southern CA										T. Yen
13. Laboratory Determination of Leaching Rates from Oil Shale Retorted Under Simulated In Situ Retorting Conditions	" "	Texas Tech. University										H. Parker
14. Environmental Aspects of In Situ Oil Shale Processing	" "	LETC										R. Poulson
15. Groundwater Chemical Changes During In Situ Oil Shale Retorting	DOE-LETC/CSM	Engineering Enterprise, Inc.		248								D. Kloepper
16. Fossil Energy Environment and Conservation Concerns	DOE-LETC	LETC										R. Kerr
17. Analysis of Off-Gas Utilization/Control Concepts for an In Situ Oil Shale Retort	" "	SAI		90								J. Kotowski

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
18. Occupational Health Tests with Water	DOE-LETC	ELARS Bio-research Labs										Beck
19. Meteorology	" "	LASL										Clements
20. Soil Microorganism Interactions with Process Waters	" "	University of WY										Williams
21. Plant Response to Process Waters	" "	"										Skinner
22. Aquatic Response to Process Waters	" "	"										Bergman
23. Fractionation of Process Waters	" "	E.W.D. Huffman Labs										Huffman
24. Unit and System Water Treatment Design	" "	Water Purification Association										Probstein
25. Unit Design for Water and Gas Treatment	" "	University of WY										Hines
26. Reclamation Revegetation	" "	"										Skinner
27. Groundwater Hydrology	" "	C.R. McKee Inc.										

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				FY 78	FY 79	FY 80	FY 81	FY 82	TOTAL			
28. Groundwater Regulation	DOE-LETC	Radian Corp										Kamas
29. Groundwater Hydrology	" "	G.E. Temple										Hoylman
30. Multi-Method Testing of Analytical Capability	" "	University of WY										Ahern

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OVERALL ASSESSMENT	ENVIRONMENTAL PROTECTION AGENCY (EPA)										
1. Environmental Perspective on the Emerging Oil Shale Industry	Industrial Environmental Research Lab (IERL-Ci) Cincinnati, OH	Oil Shale Research Group (EPA-OSRG)		121	70						E. Bates (513) 684-4417
2. EPA/Industry Forum to Research Technical & Regulatory Problems for Shale Development	Office of Energy, Minerals & Industry, Headquarters, EPA Washington, D.C. (OEMI-HQ/IERL-Ci)	Geoenergy Corporation	Completed	73	0			73	78-79		K. Jakobson (202) 755-2737
3. Integrated Assessment: Socioeconomic Consequences of Coal and Oil Shale Development	EPA/USDA	U.S. Dept. of Agriculture (USDA)	Pass Thru USDA, Ongoing						80-82		J. Barse (202) 447-2667
4. Oil Shale Symposium: Sampling, Analysis & Quality Assurance	IERL-Ci	Denver Research Institute (DRI)	Completed	22	0			22	78-79		P. Mills (513) 684-4216
EXTRACTION & HANDLING											
1. Develop Recommendations, Guidelines and Criteria for Revegetation of Oil Shale Spoils on SemiArid Lands	EPA/USDA	USDA	Pass Thru USDA	100	100				75-81		R. Hill (513) 684-4410
2. Water Quality Hydrology Affected by Oil Shale Dev.	IERL-Ci	Colorado State Univer. (CSU)		26	0			26	75-80		E. Harris (513) 684-4417
3. Vegetative Stabilization of Spent Oil Shale	IERL-Ci	CSU		44	40				75-81		E. Bates (513) 684-4417

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PROJECT TITLE	ADMINISTERING AGENCY/SPONSOR	CONTRACTOR/ PERFORMING ORGANIZATION	PROJECT STATUS	FUNDING LEVEL (\$K)					PROJECT SCHEDULE/ DURATION	DELIVERABLE	KEY PERSONNEL
				FY 79	FY 80	FY 81	FY 82	TOTAL			
4. Laboratory Study of Leaching Permeability of Spent Oil Shale	EPA/HQ	CSU	EPA Pass Through Funds to DOE	0	92				80-82		E. Bates (513) 684-4417
5. Trace Element Analysis on Cores from the Naval Oil Shale Reserves	IERL-Ci/USN/DOE	Lawrence Berkeley Lab (LBL)		0	0			0	78-80		E. Bates (513) 684-4417
6. Leaching Characteristics of Raw Surface Stored Oil Shale	IERL-Ci	CSU		0	57			57	78-80		E. Bates (513) 684-4417
7. Field Leaching Study of Raw Mined Oil Shale	EPA/HQ	CSU		0	67				80-83		E. Bates (513) 684-4417
8. Vegetative Stabilization of Paraho Spent Oil Shale	IERL-Ci	CSU							3 years		E. Harris (513) 684-4417
9. Fugitive Dust from Oil Shale Extraction	IERL-Ci	TRW							2 years		E. Bates (513) 684-4417
10. Air Emissions from Old In Situ Oil Shale Sites	IERL-Ci/DOE	Science Applications Inc. (SAI)		18	0			18	79-80		E. Bates (513) 684-4417
11. Process Oil Shale Reclamation, Davis Gulch Study	EPA/HQ	Colony		0	350				80-85		E. Bates (513) 684-4417
<u>PROCESSING</u>											
1. Assessment of Environmental Impacts from Oil Shale Dev.	IERL-Ci	TRW/DRI							2 years		T. Powers (513) 684-4363
2. Sampling & Analysis of the Paraho Surface Retort	IERL-Ci	TRW/DRI							3 years		T. Powers (513) 684-4363
3. Analytical Methods Manual for Oil Shale Effluents	IERL-Ci	DRI		150	121				79-82		R. Thurnau (513) 684-4363

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
4. Sampling & Analysis for Retort & Combustion Gases at the Paraho Shale Oil Demo Plant	IERL-Ci	TRW							1 year		T. Powers (513) 684-4363
5. Environmental Characterization of Geokinetics In Situ Oil Shale Retorting Technology	IERL-Ci	Monsanto		120	0			120	79-80		T. Powers (513) 684-4363
6. Assessment of Oil Shale Wastewater Treatment & Control Technology	IERL-Ci	Monsanto		330	400				79-82		W. Liberick (513) 684-4363
7. Air Pollution Investigations of Oil Shale Retorting: In Situ & Surface	IERL-Ci	Monsanto		280	427				78-81		R. Thurnau (513) 684-4363
8. H ₂ S/SO ₂ Control Technology Study for Oil Shale Effluents	IERL-Ci	Monsanto		97	82				- 81		R. Thurnau (513) 684-4363
9. Overview of the Environmental Problems of Oil Shale Dev.	IERL-Ci	DRI		100	152			252	79-80		R. Thurnau (513) 684-4363
10. Distribution of As, Cd, Hg, Pb, Sb and Se During In Situ Oil Shale Retorting	EPA/DOE	LBL	EPA Pass Thru to DOE	109	190			299	78-79		P. Mills (513) 684-4216
11. Portable Zeeman Atomic Absorption Mercury Monitor	EPA/DOE	LBL	EPA Pass Thru to DOE	52	0			52	79-80		P. Mills (513) 684-4216
12. Pollution Control Guidance Document for Oil Shale	EPA/HQ	DRI		0	639				80-81		E. Bates (513) 684-4417

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>ENERGY-RELATED PROCESSES AND EFFECTS: Health Effects</u>											
1. Repository for Alternate Energy Source Material for Toxicity Testing	EPA/DOE	ORNL	Pass Thru Funds to DOE, Completed	207.5				207.5	77-79		D. Coffin (919) 541-2585
2. Morphological Variants in Damaged Sperm	EPA/DOE	Lawrence Livermore Lab (LLL)	Pass Thru Funds to DOE	60	60			120	75-80		D. Smith (301) 353-3682
3. Detection of Early Changes in Lung Cell Cytology by Flow Systems Analysis Techniques	EPA/DOE	Los Angeles Scientific Lab (LASL)	Pass Thru Funds to DOE	50	50				76-In Progress		D. Smith (301) 353-3682
4. Air, Water and Multiroute & Health Effects from Pollutants Associated with Energy Dev.	Health Effects Research Lab (EPA) in Cincinnati, (HERL-Ci)	HERL-Ci							1 year		J. Stara (513) 684-7401
5. Chemical Rate, Detection, Metabolism Bio-accumulation Potential of Shale Oil Components and the Effects of Marine Diesel Fuel on Marine Organisms	Environmental Research Lab (EPA) In Gulf Breeze, (ERL)	ERL-Gulf Breeze							1 year		N. Richards (904) 932-5311
6. Effects of Alternate Energy Source Material on Whole Animal Carcinogenesis by Percutaneous Application of Extracts and Fractions to Mice	EPA/DOE	Oak Ridge National Laboratory	Pass Thru to DOE						2 years		D. Coffin (919) 541-2585
7. Mortality, Morbidity & Industrial Hygiene Study of Oil Shale Workers	National Institute of Organizational Safety & Health (NIOSH)	NIOSH						93	2 years		J. Costello (304) 599-7474

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
8. Determination of the Influence of Mineral Cofactors in Conjunction with Carcinogens from Energy - Related Materials	HERL in Research Triangle Park (RTP)	Northrop Services							32 months		D. Coffin (919) 541-2585
9. In Vivo Screening for Gene Mutation in Mouse Germ and Somatic Cells	EPA/DOE	ORNL	Pass Thru Funds to DOE						1976 - in progress		D. Smith (301) 353-3681
10. The Carcinogenic Effects of Petroleum Hydrocarbons on Selected Marine Estuarine Organisms	EPA/National Institute of Environmental Health Sciences (DHEW)	Univ. of Washington	Complete	45				45	79		P. Schambra (919) 541-3467
11. Determination of the Effects of Material from Alternate Energy Sources on Upper Respiratory Tract Clearance Mechanisms	HERL-RTP	Ball State University							42 Months		D. Gardner (919) 549-8411
12. Quantitative Mutagenesis Testing in Mammalian Culture Systems	EPA/DOE	LLL	Pass Thru Funds to DOE	75	75			150	76-80		D. Smith (301) 353-3681
13. Development of Cytochemical Markers for Cell Transformation & Carcinogenesis	EPA/DOE	LLL	Pass Thru Funds to DOE	135	135			270	76-80		D. Smith (301) 353-3681
14. Somatic Cell Genetics	EPA/DOE	LASL	Pass Thru to DOE						2 year		G. Duda (301) 353-3651
15. Analysis of the Effects of Energy-Related Toxic Materials To Karyotype Stability in Mammalian Cells	EPA/DOE	LASL	Pass Thru to DOE	50	50				76 - in Progress		D. Smith (301) 353-3681

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
16. Effects of Products of Coal & Oil Shale Conversion on Cell Cycle Kinetics and Chromatin Structure	EPA/DOE	LASL	Pass Thru to DOE	50	50				76 - in Progress		D. Smith (301) 353-3681
17. Mutagenicity Assay of Fractionated Coal Conversion & Shale Oil In Situ Retorting Products	EPA/DOE	ORNL	Pass Thru to DOE	135	135				75 - in Progress		D. Smith (301) 353-3681
18. The Quantitative Evaluation of Hazardous Chemicals Using a Closed Aquatic Test System	EPA/DOE	Brookhaven National Labs (BNL)	Pass Thru Funds to DOE	50	0				76 - in Progress		D. Smith (301) 353-3681
19. The Interaction of Chemical Agents Present in Oil Shale with Biological Systems	EPA/NIEHS (DHEW)	NIEHS-RTP	EPA Pass Thru to NIEHS						77 - in Progress		J. Bend (919) 541-3205
20. Development of Permanent Epithelial Cell Lines	EPA/DOE	ORNL	Pass Thru Funds to DOE	60	60				76 - in Progress		D. Smith (301) 353-3681
21. Development of an <u>In Vitro</u> Assay for Carcinogens of Coal/Oil Shale Derivatives	EPA/DOE	UCLA School of Medicine	Pass Thru Funds to DOE	150	150				76 - in Progress		D. Smith (301) 353-3681
22. Biological Screening Study of Shale Oil & H-Coal Liquefaction Operations	EPA/DOE	ORNL	Pass Thru Funds to DOE	200	200				79-81		C. Nauman (202) 426-3974
23. Detection of Oil Shale Related Mutagens Using Human Cell Cultures	EPA/DOE	LASL	Pass Thru Funds to DOE	200	200				79-82		C. Nauman (202) 426-3974
24. Influence of Diet on the Gastrointestinal Absorption of Energy-Related Metallic Pollutants	EPA	University of Tenn.		77	77			154	-80		C. Nauman (202) 426-3974

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>ENERGY-RELATED PROCESSES AND EFFECTS: Ecological Effects</u>											
1. Effects of Pollutants Associated with Coal Gasification & Oil Shale Mining & Processing on the Aquatic Environment	ERL-Duluth/LETC	University of WY	Pass Thru Funds to DOE	50	50			100	76-80		L. Mueller or K. Biesinger (218) 727-6692
2. Chemical & Biological Characterization of Oil Shale Processing & Coal Conversion	ERL-Duluth	CSU		135	157			292	76-80		L. Mueller (218) 727-6692
3. Concentration of Well Waters from an Oil Shale Retorting Site for Biological Testing	EPA/HQ	Monsanto		98				98	-79		P. Mills (513) 684-4216
4. Biological Guidelines for Integrated Environmental Monitoring for Mined Lands	EPA/DOE	US FWS	Pass Thru Funds to DOE	150	150				80-82		H. Quinn (202) 653-5223
5. Developmental Markers & Reproductive Damage	EPA/DOE	ORNL	Pass Thru Funds to DOE	289	300				79-81		C. Nauman (202) 426-3974
6. Develop Markers Repro- ductive Teratological Damage	EPA/DOE	ORNL	Pass Thru Funds to DOE	67	67				79-81		C. Nauman (202) 426-3974
7. Develop Guidelines & Criteria for Use of Non-Mine Wastes as Soil Amendments on Oil Shale	EPA/HQ	USDA Forest Service	Complete	24				24	-79		R. Hill (513) 684-4216

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>ENERGY-RELATED PROCESSES AND EFFECTS: Measurement and Monitoring</u>											
1. Oil Shale Area Meteorological Data Analysis	Region VIII	CDM Limnetics		0	0				16 months		T. Thoem (303) 837-5914
2. Air Quality & Surface Wind Monitoring in Colorado	Region VIII	Colorado Department of Health (CDH)		10	0			10	75-80		T. Thoem (303) 837-5914
3. Upper Air Meteorological Data Collection	OEMI/Region VIII	Aeromet, Inc.		25	25			50	75-80		T. Thoem (303) 837-5914
4. Visibility Monitoring in Piceance Basin	Region VIII	Occidental Petroleum							Start 1979		T. Thoem (303) 837-5914
5. Monitoring the Impact of Oil Shale Extraction on Groundwater Quality	Environmental Monitoring & Support Lab in Las Vegas	GE Tempo		150	130			280	75-80		L. McMillion (702) 736-2969
6. Energy-Related Water Monitoring Data Integration	EMSL-LV	Dalton, Dalton Newport, Inc.		300	130			430	76-80		L. McMillion (702) 736-2969
7. Water Quality & Geochemistry of Shallow Aquifers of Piceance Creek, CO	EPA/USGS-DOI	USGS	Pass Thru Funds to USGS						74-79		F. Kilpatrick (703) 860-6846
8. Water Quality Monitoring on White River, Parachute Creek & Logan Wash in Oil Shale Areas of Western Colorado	EPA/USGS	USGS	Pass Thru Funds to USGS						73-79		F. Kilpatrick (703) 860-6846
9. Collection of Geochemical Data in the Piceance Creek Structural Basin of CO	EPA/USGS	USGS							2 years		K. Kilpatrick (703) 860-6846

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
10. Definition of Potentiometric Surface of Shallow Aquifers in Piceance Creek Impacted by Oil Shale	EPA/USGS	USGS							3 years		J. Weeks (303) 234-5092
11. Water Quality Monitoring Techniques Evaluation	EMSL-LV	EMSL-LV		85	47			132	76-80		W. Kinney (703) 736-2969 X353
12. Assessment of Macroinvertebrate Monitoring Techniques	EMSL-LV	EMSL-LV							1 year		W. Kinney (703) 736-2969 X353
13. Instrumentation & Methods for Characterizing Aqueous Effluents from Oil Shale	EPA/DOE	ORNL							76 - in Progress		B. Clark (202) 755-2673
14. Identification of Com- ponents of Energy-Related Wastes & Effluents	ERL-Athens	Gulf South Research Institute (GSRI)		0	0				78-79		A. Alford (404) 546-3525
15. Comparison of Carbon & Resin Sorption of Organic Materials	EPA/DOE	Iowa State University	Pass Thru Funds to DOE						78-81		G. Goldstein (301) 353-5348
16. Characterization of Dirty Aqueous Effluents from Energy Related Wastes & Effluents	EPA/DOE	Iowa State University	Pass Thru Funds to DOE	112	0				78-81		G. Goldstein (301) 353-5348
17. Quality Assurance & Instrumentation in Air & Water Pollution	EPA/NBS	NBS							4 years		J. McNesby (301) 921-2446
18. Ground Water Research Program	EPA/DOE		Pass Thru Funds to DOE & Various Contractors	300	300				79-82		R. Newport (405) 332-8800

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
19. Western Energy-Related Regional Air Quality Monitoring	EMSL-LV	EMSL-LV		0	0				79-84		D. McNeills (702) 736-2960
20. Water & Air Monitoring Guidelines for Advanced Coal Conversion & Combustion Plants.	EMSL-LV	Dalton, Dalton Newport, Inc.		200	70			270	78-80		R. Bateman (702) 736-2969
21. Study of Raw Materials, Products and Residues of Coal Conversion & Oil Shale Processes for Possible SRM's Oil Shale	EPA/NBS	NBS	Pass Thru Funds to NBS	115	0			115	75-79		C. Gravatt (301) 921-3775
22. Surface, Water Quality Monitoring in Oil Shale Development Areas	EPA/USGS	USGS-WRD	Pass Thru Funds to USGS	8.9	11.6			20.5	-80		R. Brennan (303) 234-3487
23. Adaptation of Advanced Groundwater Monitoring Methodology to In Situ Oil Shale Retorting	EPA	GE Tempo		0	250				-82		L. McMillion (702) 736-2969

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>ENERGY-RELATED PROCESSES AND EFFECTS: Environmental Transport</u>											
1. The Mineralogy of Over Burden as Related to Groundwater Chemical Changes in Strip Mining of Coal, In Situ Coal Gasification and Oil Shale Retorting	ERL-R.S. Kerr	Colorado School of Mines Research Institute (CSMRI)		170	0			170	75-79		R. Newport, (405) 332-8800
2. Organic Fractionation & Solute Transport Study	ERL-R.S. Kerr	LETC							1 year		R. Newport (405) 332-8800
3. Environmental Pathways of Selected Chemicals in Freshwater Systems	ERL-Athens	SRI International							77 - in Progress		R. Lassiter (404) 250-3162
4. Sorption Properties of Sediments & Energy-Related Pollutants	EPA/HQ	University of IL	Completed	0	0			0	-79		D. Brown (404) 546-3592
5. Regional & Stratigraphic Variations of Oil Shale Mineralogy in Piceance and Uinta Basins	EPA/HQ	CSMRI	Completed	76				76	-79		R. Newport (405) 332-8800
6. Potential Air Pollution Effects of Oil Shale Activities in the Piceance Basin	EPA/HQ	Pacific Northwest Lab (PNL)		0	200				80-82		D. Golomb (202) 426-0264

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>END USE</u>											
1. Emission & Process Water Monitoring During Shale Oil Refining	EPA/Dept. of Navy - DOD	Radian Corp.	Completed	0	0			0	-78 (6 months)		W. McCarthy (202) 472-9444
2. Advanced Combustion Systems for Stationary Gas Turbine Engines	IERL-RTP	Pratt & Whitney Aircraft	Completed	27	0			27	-79 (41 months)		W. Lanier (919) 541-2432
3. Development of Optimization of Low-NO _x Burner Designs for Heavy Liquid Fuel - Fired Package Boilers	IERL-RTP	Energy & Environmental Research Corporation (EERC)		52.5	24			76.5	78-80		W. Lanier (919) 541-2432
4. Emissions from Vehicles Using Oil Shale - Derived Fuels	Emission Control Technology Division EPA, Michigan	ECTD							1 year		R. Garbe (313) 668-4262
5. Environmental Aspects of Synthetic Fuel Marketing and End Use	EPA/HQ	TRW			200				80		J. McSorley

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
<u>OTHERS</u>	<u>ENVIRONMENTAL PROTECTION AGENCY (EPA)</u>										
1. Analysis of Selected Samples for Metal Uptake	IERL-C1	Hittman Associates						17			B. Becker
2. Pollution Control Guidance for Oil Shale Development	IERL-C1	Jacobs Engineering Group, Inc. Environmental Services Group						85		Pollution Control Guidance Document for Oil Shale	R. Kristnan
3. Development of Oil in Water Monitor	EMSL-C1	Southwest Research Institute (SRI)						60		Prototype Instrument for Monitoring Wastewaters	H. Silvus
4. New Concept for Fine Particle Control at High Temperature and Pressure	IERL-RTP	Air Pollu- tion Tech- nology, Inc.						200			S. Calvert
5. Nonpoint Source Surface Water Monitoring Technology for Oil Shale Development	EMSL-LV	EPA, Office of R&D, Field Operations Section						57			W. Kinney
6. Relationship Between Mineralogy, & Water Quality in Western Energy Recovery	ERL-R.S. Kerr	CSMRI						264			D. Kloepper

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
7. Toxic Effects on the Aquatic Biota from Coal & Oil Shale Development	ERL-Duluth	CSU						108			R. Thurston
8. Technology Assessment of Western Energy Resource Development	OEMI-HQ	University of OK						315			I. White
9. High Altitude Monitoring Environmental Effects of Geothermal Energy, Coal Strip Mining & Oil Shale Activities	OEMI-HQ	NASA						125			M. Knutson
10. Shale Oil Bioeffects	OEMI-HQ	NIEHS-RTP						80			C. Chignell

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
1. Economics of Coal & Oil Shale Development on Environmental Quality in Rural Areas	DEPARTMENT OF AGRICULTURE Economic Research Service, Natural Resource Economics Division (ERS-NRED)	CSU								Regional Reports on Current & Future Resource Use Associated With Coal & Oil Shale Development	M. Skold or L. Juers
2. Economics of Coal & Oil Shale Development on Environmental Quality in Rural Areas	ERS-NRED	ERS-NRED								Appraisal of the Eco. & Environ. Impli of Coal & Oil Shale Dev. Activ. in Rural Areas	R. Magleby
3. Impact of Strip Mining & Reclamation Processes on the Quality & Quantity of Water in Mined Areas	Agricultural Research Service (ARS), Northeastern Region	Penn. State University									A. Rogowski
4. Oil Shale	DOE/CSU	CSU									C. Cook
5. Vegetative Rehabilitation of Arid Land Disturbed in the Development of Oil Shale & Coal	Cooperative State Research Service (CSRS)	Utah State University (USU)									C. McKeil
6. Rehabilitation Potential & Practices of Colorado Oil Shale Lands	DOA/CSU	CSU									P. Sims

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				FY 79	FY 80	FY 81	FY 82	TOTAL			
7. Erosion Effects & Pollutant Movements from Coal & Oil Shale Strip-Mining Deposition	CSRS	CSU									H. Shen
8. Water Harvesting Parameters on Saline Media Under Arid Conditions	CSRS	USU									C. McKell
9. Socio-Economic Analysis of Economic Development & Environmental Degradation Four Corners Area	USDA	New Mexico State University									T. Stevens
	<u>DEPARTMENT OF INTERIOR (DOI)</u>										
1. Mitigation Goals for Oil Shale	Fish & Wildlife Service (FWS)	Colorado, Cooperative Research Unit						125			K. Russell
2. Oil Shale Hydrology	USGS, CO	USGS						2311		Hydrologic Systems Models & Pre-Develop- ment Baseline Data for EIA	H. Hudson
3. Fraunhofer Luminescence	DOI/NASA	USGS						80			R. Watson