CONTENTS

1.0 INTRODUCTION 1-1

1.1 Purpose of Report 1-1

1.2 Lands Involved and Record Data 1-2

2.0 DESCRIPTION OF GEOLOGY 2-1

2.1 Physiography 2-1

2.2 Stratigraphy 2-4
2.2.1 Precambrian Era 2-4
2.2.2 Paleozoic Era 2-4
2.2.2.1 Cambrian System 2-4
2.2.2.2 Ordovician System 2-6
2.2.2.3 Silurian System 2-6
2.2.2.4 Devonian System 2-6
2.2.2.5 Mississippian System 2-6
2.2.2.6 Pennsylvanian System 2-6
2.2.2.7 Permian Period 2-7
2.2.3 Mesozoic Era 2-7
2.2.3.1 Triassic System 2-7
2.2.3.2 Jurassic System 2-7
2.2.3.3 Cretaceous System 2-8
2.2.4 Cenozoic Era 2-9
2.2.4.1 Tertiary System 2-9
2.2.4.2 Quaternary System 2-10

2.3 Structural Geology and Tectonics 2-10

2.4 Geophysics and Geochemistry 2-12

2.5 Historical Geology 2-12
2.5.1 Precambrian Era 2-12
2.5.2 Paleozoic Era 2-12
2.5.2.1 Cambrian to Mississippian Periods 2-12
2.5.2.2 Pennsylvanian-Permian Periods 2-13

CONTENTS (Cont'd)

2.5.3 Mesozoic Era 2-13
2.5.3.1 Triassic-Jurassic Periods 2-13
2.5.3.2 Cretaceous Period 2-13
2.5.4 Cenozoic Era 2-14
2.5.4.1 Tertiary Period 2-14
2.5.4.2 Quaternary Period 2-15

3.0 DESCRIPTION OF MINERAL RESOURCES 3-1

3.1 Leaseable Minerals 3-2
3.1.1 Non-Coalbed Hydrocarbons 3-3
3.1.1.1 Origin, Occurrence, and Trapping 3-3
3.1.1.2 Non-CBM Hydrocarbon Development and Production 3-6
3.1.2 Coalbed Methane 3-27
3.1.3 Coal 3-30
3.1.3.1 Green River Coal Region 3-32
3.1.3.2 Hams Fork Coal Region 3-33
3.1.3.3 Historic Coal Production 3-34
3.1.4 Oil Shale 3-36
3.1.5 Phosphate 3-36
3.1.6 Sodium 3-37

3.2 Locatable Minerals 3-38
3.2.1 Uranium 3-38
3.2.2 Gypsum 3-39
3.2.3 Metallic Minerals 3-40
3.2.3.1 Gold 3-40
3.2.3.2 Copper 3-40
3.2.4 Jade 3-41
3.2.5 Bentonite 3-42

3.3 Saleable Minerals 3-43
3.3.1 Aggregates (Sand and Gravel) 3-43
3.3.2 Decorative Stone 3-46
3.3.2.1 Moss Rock 3-46
3.3.2.2 Boulders 3-47
3.3.3 Common Clay 3-48
3.3.4 Petrified Wood 3-48

CONTENTS (Cont'd)

4.0 MINERAL RESOURCE POTENTIAL 4-1

4.1 Leaseable Minerals 4-1
4.1.1 Hydrocarbon Plays 4-1
4.1.2 Hydrocarbon Resources 4-2
4.1.3 Hydrocarbon Occurrence Potential 4-18
4.1.4 Projections of Future Activity 4-21
4.1.4.1 Oil and Natural Gas Price Estimates 4-21
4.1.4.2 Leasing 4-23
4.1.4.3 Seismic Surveys 4-27
4.1.4.4 Projections of Future Drilling Activity 4-27
4.1.5 Coal 4-39
4.1.6 Oil Shale 4-41
4.1.7 Phosphate 4-41
4.1.8 Sodium 4-42

4.2 Locatable Minerals 4-42
4.2.1 Uranium 4-43
4.2.2 Gypsum 4-44
4.2.3 Metallic Minerals 4-45
4.2.3.1 Gold 4-45
4.2.3.2 Copper 4-45
4.2.4 Jade 4-46
4.2.5 Bentonite 4-46

4.3 Saleable Minerals 4-47
4.3.1 Aggregates (Sand and Gravel) 4-48
4.3.1.1 Oil and Gas Industry (Direct) Demand 4-50
4.3.1.2 Oil and Gas Industry Aggregate Demand Projections 4-51
4.3.1.3 Resource Roads 4-52
4.3.1.4 Local Roads 4-52
4.3.1.5 Collector Roads 4-53
4.3.1.6 State/County/Municipal Demand 4-53
4.3.1.7 Other Aggregate Demand 4-54
4.3.2 Decorative Rock 4-55
4.3.2.1 Moss Rock 4-55
4.3.2.2 Boulders 4-56
4.3.3 Common Clay 4-59

CONTENTS (Cont'd)

4.3.4 Petrified Wood 4-60

4.4 Mineral Potential Summary 4-61

5.0 RECOMMENDATIONS 5-1

6.0 REFERENCES 6-1

APPENDIX A – OIL AND GAS OPERATIONS

LIST OF TABLES

3-1 Oil and Gas Fields and Cumulative Production in the RMPPA[1] 3-7
3-2 Summary of Wells Drilled in the RMPPA from 1970 to 2001 3-9
3-3 Pinedale RMPPA Well Status as of April 1, 2002 3-12
3-4 Summary of Data for all Deep Wells (>15,000 Feet) Drilled in RMPPA 3-21
3-5 Secondary and Tertiary Recovery Units in the RMPPA 3-24
3-6 Former Mines or Prospects Within the La Barge Coal Field 3-34
3-7 Annual Coal Production Data – Sublette County 3-35
4-1 USGS Conventional Play Data for the Wyoming Thrust Belt Province (036) 4-5
4-2 USGS Conventional Play Data for Southwestern Wyoming Province (037) 4-6
4-3 USGS Unconventional Play Data for Southwestern Wyoming Province (037) 4-13
4-4 USGS Conventional Play Resources of the Wyoming Thrust Belt Province (036) 4-15
4-5 USGS Conventional Play Resources of the Southwestern Wyoming Province (037) 4-16
4-6 USGS Unconventional Play Resources of the Southwestern Wyoming Province (037) 4-17
4-7 Distribution of Federal Acreage Covered by Active Federal Oil and Gas Leases in the RMPPA 4-24
4-8 Oil and Gas Development Potential Classifications Determined for the RMPPA 4-31
4-9 Summary of the Cumulative Production of Oil, Gas and Water from 1974 to 2002 4-33
4-10 Coalbed Gas Development Potential Classifications Determined for the RMPPA 4-36
4-11 Projections of Short-Term and Long-Term (2020) Drilling Activity, with Associated Surface Disturbance 4-39
4-12 Wyoming Coal Production – 2000 4-40
4-13 Designated Community Pits 4-49
4-14 Estimated Gravel Resource Requirement 4-50
4-15 Estimated Aggregate Demand for Oil and Gas Development 4-51
4-16 Estimated Gravel Requirements for State/County/Municipal Roads 4-54
4-17 Moss Rock Demand Projection 4-57
4-18 Boulder Demand Projection 4-58
4-19 Decorative Boulder Permitted Areas and Identified Potential Boulder Resource Areas 4-59

LIST OF FIGURES

1-1 General Location Map of the RMPPA....1-3
2-1 Physiographic Provinces in Relation to the Wyoming Basin....2-2
2-2 Physiographic and Structural Elements of the Northern Green River Basin....2-3
2-3 Stratigraphic Nomenclature Chart....2-5
2-4 Schematic Geologic Cross Section....2-11
3-1 Trap Types....3-5
3-2 Number of New Wells Drilled, by Year, in the RMPPA Since 1970....3-8
3-3 Wells Drilled in the RMPPA from 1950 to 2001....3-10
3-4 New Field Wildcat Wells in the RMPPA from 1970 to 2001....3-10
3-5 Development Wells Drilled in the RMPPA from 1970 to 2001....3-11
3-6 Well Depth Distribution for Wells Drilled in the RMPPA Since 1990....3-11
3-7 Wells Drilled for Oil and Gas....3-13
3-8 Yearly Total Non-coalbed Gas Production, Production from Federal and Non-federal Lands, and Production Without Madison Limestone Production in the RMPPA....3-14
3-9 Yearly Total Oil Production and Production from Federal and Non-federal Wells in the RMPPA....3-16
3-10 Yearly Total Producing Wells and Federal and Non-federal Producing Wells in the RMPPA....3-16
3-11 Deep Reservoir Potential, Deep Wells, and Location of Deep Madison Limestone Reservoir....3-18
3-12 Federal Unit Agreement Areas....3-26
3-13 Typical CBM Well Production Profile....3-29
3-14 Wyoming Coalfields....3-31
3-15 Surficial Geology....3-45
4-1 Location of USGS Conventional Wyoming Thrust Belt Province Plays....4-3
4-3 Location of USGS Conventional Southwestern Wyoming Province-Moxa Arch, La Barge and Subthrust Plays....4-7
4-4 Location of USGS Conventional Southwestern Wyoming Province-Basin Margin Anticline and Jackson Hole Plays....4-8
4-5 Location of USGS Conventional Southwestern Wyoming Province-Deep Basin Structure Play....4-9
4-6 Location of USGS Conventional Southwestern Wyoming Province-Cloverly-Frontier Basin-centered Gas Play....4-10
4-7 Location of USGS Conventional Southwestern Wyoming Province-Mesaverde Basin-centered Gas Play....4-11
4-8 Location of USGS Conventional Southwestern Wyoming Province-Fox Hills-Lance

LIST OF FIGURES (Cont'd)

Basin-centered Gas Play 4-12
4-9 Undiscovered, Technically Recoverable, Natural Gas Resources 4-19
4-10 Hydrocarbon Occurrence Potential....4-20
4-11 Historical Spot Gas Prices for Northwest Pipeline at Opal, Wyoming, with Projections to 2020....4-22
4-12 Plot of Historical Wyoming Crude Oil Prices, with Projections to 2020....4-22
4-13 Location of Federal Oil and Gas Leases 4-25
4-14 Summary of Federal Acres Offered for Oil and Gas Leasing and Acres Leased Competitively, by Year, for the 1996-2001 Period....4-26
4-15 Summary of the Total Amount of Bonus Money Received from Federal Oil and Gas Leasing and the Average Bid, by Year, for the 1996-2001 Period....4-26
4-16 Approved Seismic NOIs, by Year, on BLM-managed Surface in the RMPPA 4-28
4-17 Non-Coalbed Methane Development Potential Areas 4-30
4-18 Coalbed Gas Production as a Percent of Total Natural Gas Produced in Wyoming....4-34
4-19 Location of USGS Unconventional Southwestern Wyoming Province-Coalbed Gas Play....4-35
4-20 Coalbed Methane Development Potential Areas 4-37