CONTENTS

Contributors - MA Tourne Description of the Contributor - MA Tourne Description of the Contributor - MA Tourne Description of the Contributor - MA Tourne Description - MA Tourne - MA Tourne Description - MA Tourne - MA	ix
Series Editor's Preface	xi xi
Preface	XV
1. Hydraulic Fracturing: The Technology Explained George E. King and Danny Durham	1
Water Use in Energy Production	6
Establishing Barriers: Building a Better, Tighter Well	8
3. Regulations and Regulators	13
References	16
Further Reading	16
2. Unconventional Oil and Gas Production: Waste Management and the Water Cycle	17
Tiffany Liden, Billy G. Clark, Zacariah L. Hildenbrand, and Kevin A. Schug	
1. Introduction	18
2. The Life Cycle of Water	24
3. Summary	40
Acknowledgments	41
References	41
3. Chemicals in Drilling, Stimulation, and Production	47
George E. King and Danny Durham	
1. Introduction	47
2. Drilling Muds and Additives	48
3. Fracturing Additives	52
4. Chemicals Used in Production Operations	57
5. Chemicals in Oilfield-Produced Water	58
6. Summary	59
References	60
Further Reading	61
4. Hydraulic Fracturing Chemical Disclosure: Can the Public Know What's Going Into Oil and Natural Gas Wells?	63
Dusty Horwitt	
1. Introduction	64
2. Rationale for Hydraulic Fracturing Chemical Disclosure	66
	V

3. What Chemicals Are Likely to be of Concern?	68
4. Elements of Meaningful Disclosure	72 /
5. Fracking Chemical Disclosure Rules in the United States	76
6. U.S. Nationwide and International Fracking Chemical Disclosure	99
7. Toxic Substances Control Act	99
8. Occupational Safety and Health Administration	102
9. Emergency Planning and Community Right to Know Act and	
Comprehensive Environmental Response, Compensation,	104
and Liability Act 10. Conclusion	104
Acknowledgment	106 106
References	106
Further Reading	111
Tuttlet Reading	
5. The Human Health Implications of Oil and Natural Gas	
Development	113
Anne C. Epstein	
1. Introduction	114
2. Benzene	115
3. Ozone	127
4. Well Blowouts, Explosions, and Fires	131
5. Public Health Studies	134
6. Conclusions	139
References	141
6. Public Health Concerns and Unconventional Oil and Gas	
Development	147
Paula Stigler Granados	
1. Introduction	148
2. Air Quality and Health	151
3. Water Quality and Health	156
4. Wastewater, Disposal, and Treatment	160
5. Community Health Impacts	161
6. Conclusion	163
References	163
7. Societal Implications of Unconventional Oil and Gas Developme	nt 167
Sabrina Habib, Melanie S. Hinojosa, and Ramon Hinojosa	107
	160
 Hydraulic Fracturing and Human Health Legislation and Rights 	169 175

vi Contents

3	. What Chemicals Are Likely to be of Concern?	68
4	Elements of Meaningful Disclosure	72
5	 Fracking Chemical Disclosure Rules in the United States 	76
6	. U.S. Nationwide and International Fracking Chemical Disclosure	99
7	. Toxic Substances Control Act	99
8	Occupational Safety and Health Administration	102
9	. Emergency Planning and Community Right to Know Act and	
	Comprehensive Environmental Response, Compensation,	
	and Liability Act	104
10	. Conclusion	106
Ac	knowledgment	106
Re	ferences	106
Fu	rther Reading	111
5. Th	ne Human Health Implications of Oil and Natural Gas	
De	evelopment	113
Ar	nne C. Epstein	
1.	Introduction	114
2.	Benzene	115
3.	Ozone	127
4.	Well Blowouts, Explosions, and Fires	131
5.	Public Health Studies	134
6.	Conclusions	139
Re	ferences	141
6. Pu	ublic Health Concerns and Unconventional Oil and Gas	
De	evelopment	147
Pa	ula Stigler Granados	
1.	Introduction	148
2.	Air Quality and Health	151
3.	Water Quality and Health	156
4.	Wastewater, Disposal, and Treatment	160
5.	Community Health Impacts	161
6.	Conclusion	163
	ferences graduation and the second se	163
7. Sc	ocietal Implications of Unconventional Oil and Gas Development	167
	brina Habib, Melanie S. Hinojosa, and Ramon Hinojosa	
1.	Hydraulic Fracturing and Human Health	169
2.	Legislation and Rights	175

3. Power Relations 4. Conclusion Acknowledgments References Further Reading	183 186 187 187 192
Analytical Approaches for High-Resolution Environmental Investigations of Unconventional Oil and Gas Exploration Doug D. Carlton Jr., Zacariah L. Hildenbrand, and Kevin A. Schug	193
 Introduction Experimental Design Compound Classes and Measurement Techniques Case Studies of High-Resolution Environmental Investigation Closing Remarks Acknowledgments References 	194 196 201 211 219 220 220
Considerations and Pitfalls in the Spatial Analysis of Water Quality Data and Its Association With Hydraulic Fracturing Jesse M. Meik and A. Michelle Lawing	227
 Introduction Overview of Spatial Data Exploratory Analyses Incorporating Spatial Dependency Geographically Weighted Regression Hot Spot Analysis Discussion Conclusions References 	228 231 233 237 239 245 249 253 254
Hydrocarbon Emissions: Anthropogenic and Natural Sources George E. King and Danny Durham	257
 Introduction Liquid Pollution Well Integrity Pollution Challenges and Advances and a Bit of History Summary References 	257 267 270 271 272
THE STATE OF THE S	///

11. Henry's Law and Monitoring Methane in Groundwater Wells Bryce Payne	275
1. Introduction	276
2. Back to the Basics: Returning to Classical Laws and Principles	277
3. Sampling	282
4. Potential for Improvement	316
5. Conclusions	317
References	318
12. The Characterization of BTEX in Variable Soil Compositions Near Unconventional Oil and Gas Development	321
Emmanuel Varona-Torres, Doug D. Carlton Jr., Bryce Payne,	
Zacariah L. Hildenbrand, and Kevin A. Schug	
1. Introduction	322
2. Materials and Methods	327
3. Results and Discussion	332
4. Summary	347
Acknowledgments	347
References	348
13. Mass Spectrometry for the Study of Microbial Communities in Environmental Waters	353
Inês C. Santos, Zacariah L. Hildenbrand, and Kevin A. Schug	333
4 Colored Section 1997	
1. Introduction	354
2. Analytical Microbiology	358
3. MALDI-TOF MS	360
4. Concluding Remarks	375
References	376
14. Best Management Practices From the "Responsible	
Shale Energy Extraction" Conference: Guiding Industry	
in Environmental Stewardship	381
Alison Paige Wicker, Zacariah L. Hildenbrand, and Kevin A. Schug	
1. Introduction	382
2. Air Quality	384
3. Groundwater and Surface Water Quality	389
4. Water and Waste Management	394
5. Induced Seismicity	396
6. Light Pollution	398
7. Conclusions	400
Acknowledgments	401