## Contents

Preface		XII
Prologue		x
Author		xix
	Abbreviations, and Conversion Factors	
	2000-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	
oro <del>ti</del> o		
SECTIO	N I Sediment Fundamentals	
Chapter 1	Transformation from Mountain to Sediment	3
Chapter 1		
	How Mountains Become Sediment	
	Another Perspective	5
Chapter 2	Setting the Stage	C
Chapter 2		
	Benthic Habitat	
	Benthic Plants and Animals	
	Benthic Macroinvertebrates	
	Water Quality and Sediments	
	Key Terms and Definitions	12
	References and Recommended Reading	15
Chapter 3	Surface Water Sediments	17
	Introduction	17
	Surface Water	
	Advantages and Disadvantage of Surface Water Supplies	
	Surface Water Hydrology	
	Surface Water Quality	
	Soil vs. Dirt	
	Soil Basics	
	Soil Properties	
	Soil Formation	
	References and Recommended Reading	29
Chapter 4	Sediment Properties	31
-	Introduction	
	Origin of Sediments	
	Origin of Sediments	ال

	Disintegration	32
	Decomposition	33
	Carbonation	
	Hydration	34
	Oxidation	34
	Solution	34
	Particle Characteristics	35
	Size	
	Shape	36
	Specific Gravity	36
	Size Distribution of Sediments	37
	Fine-Grain Separation	37
	Sieve Separation	37
	Fall Velocity	38
	Sediment Deposit Sorting	
	Glacial and Other Ice-Action Deposits	38
	Alluvial Fan Deposits	39
	Beach Deposits	39
	Alluvial Deposits	
	Colluvial Deposits	40
	Eolian Deposits	40
	Deflation, Desert Pavement, and Wind-Lag Deposits	
	Igneous Rock to Volcanic Dust	43
	Chemical Deposits and Evaporites	
	References and Recommended Reading	56
Chapter 5	Erosion	59
	Introduction	
	Sheet Erosion	
	Factors Involved	
	Channel Erosion	
	Streams	
	Wind Erosion	
	Limitations of the Equation	
	Mass Movement	
	Gravity	
	Water	
	Freezing and Thawing	
	Undercutting	
	Organic Activities	
	Shock Waves or Vibrations	
	Kinds of Mass Movements	
	Desertification	
	Estimation Procedures	/8

	Other Types of Erosion	79
	Wave Erosion	
	Erosion from Stripmining and Construction	80
	Ice Erosion	
	References and Recommended Reading	
Chapter 6	Transport of Sediment by Water	
	Introduction	
	Factors Affecting Sediment Transport	
	Characteristics of Water as the Transporting Medium	83
	Laminar Sublayer	
	Characteristics of Transportable Materials	85
	Mechanism of Entrainment	
	Forces Acting on Discrete Particles	85
	Tractive Force	85
	Determining Critical Tractive Stress	86
	Determining Critical Velocity	86
	Hydraulic Considerations	
	Fixed Boundaries	87
	Movable Boundaries	87
	Movement of Bed Material	88
	Application and Limitations of Formulas	
	Example Channel Problem	96
	Procedures for Evaluating Bed Material Transport Problems.	
	Transport of Suspended Sediment	
	Suspension Mechanism	
	References and Recommended Reading	
Chapter 7	Sediment Yield	104
Chapter /	Introduction	
	Interrelated and Interdependent Processes	
	Sediment Sources	
	Determining the Relative Importance of Various Sources	
	Sediment Yield	
	Climatic Factors	
	Watershed Factors	
	Methods of Determination	
	Sediment Delivery Ratio	
	Influencing Factors	
	Procedure for Estimating the Sediment Delivery Ratio	
	Bottom Line for Estimating Sediment Delivery Ratio	
	References and Recommended Reading	115

## **SECTION II** Sediment Damage

Chapter 8	Yellow Boy	119
	Gold King Mine Spill	119
	Case Study 8.1. Still Waters?	
	Solids Released	125
	Timeline of USEPA Actions from	
	August 12 to September 3, 2015	125
	August 12, 2015	126
	August 14, 2015	
	August 15–16, 2015	
	August 17, 2015	
	August 18, 2015	
	August 25, 2015	127
	August 27, 2015	129
	September 3, 2015	129
	Bottom Line on Gold King Mine Spill	130
	Persistence! Persistence! Persistence!	
	Bottom Line on Yellow Boy	
	References and Recommended Reading	
Chapter 9	Physical Sediment Damage	133
	Introduction	133
	Sediment Damage	
	Infertile Deposition	
	Swamping	
	Reservoir Sedimentation	
	Water Treatment	
	Hydroelectric Power Facility Damage	
	Damage to Transportation Facilities	
	Drainage Ditch and Irrigation Canal Sedimentation	
,	Damage to Navigation Channels	
	Increased Flood Stages	
	Damage to Urban and Rural Fixed Improvements	
	Recreational Losses	
	References and Recommended Reading	
Chapter 10	Biologically Contaminated Sediments	139
	Hercules' Fifth Labor	139
	Biological Particles	
	Biological Organisms and the Particle Interface	
	Animal Waste Contaminants	
	Setting the Stage	

Water Supply, Use, and Wastewater Treatment	. 143
Animal Feeding Operations and Animal Waste Treatment	. 145
Animal Waste Treatment and Lagoons	. 147
Animal Waste Pollutants of Concern	. 148
Nutrients	. 148
Pathogens	. 152
Organic Matter	. 153
Salts and Trace Elements	. 154
Antibiotics	. 156
Pesticides and Hormones	. 156
Other Pollutants of Concern	. 157
Surface Water Contamination	. 158
Surface Discharges	. 158
Other Discharges to Surface Water	. 161
Pollutant-Specific Transport	. 162
Potential Hazards from CAFO Pollutants	. 169
Primary Nutrients	. 170
Ecology and Human Health	
Ammonia	. 175
Pathogens	. 175
Salts and Trace Elements	
Solids	. 183
Antibiotics and Antibiotic Resistance	. 183
Hormones and Endocrine Disruption	. 187
Other Pollutants of Concern	. 188
Human-Generated Biological Contaminants in Surface Water	. 189
Biochemical Oxygen Demand	
Nutrients	. 190
pH	. 191
Solids	. 192
Fats, Oil, and Grease	. 193
Pathogenic Organisms	
Toxic Pollutants	.206
References and Recommended Reading	.207
Chemically Contaminated Sediments	. 217
Introduction	. 218
Sediment Interface/Interaction with	
	. 221
Transformation Processes.	
	Animal Feeding Operations and Animal Waste Treatment

X

	Sorption and Bioconcentration	231
	Environmental Behavior	234
	Suspended and Surficial Sediment Fractions	238
	Inorganic Particles	238
	Humic Substances	
	Transport of Contaminated Sediments	
	Selected Chemical and Elemental Contaminants	
	Mercury/Methylmercury	
	Cadmium	
	Lead	
	Polychlorinated Biphenyls or Aroclors	
	Copper	
	Arsenic	
	Acenaphthene	
	Disulfoton	
	Fluoranthene	
	Heptachlor	
	Diazinon	
	Dicofol	
	Pyrene	
	Anthracene	
	Benzo(g,h,i)Perylene	
	Chlorpyrifos	
	Pharmaceuticals and Personal Care Products	
	References and Recommended Reading	
<b>SECTIO</b> !	N III Sediment Sampling	
Chapter 12	Sampling Sediments	265
	The House of E. coli	265
	Biomonitoring	
	Advantages of Using Periphytons	
	Advantages of Using Fish	
	Advantages of Using Macroinvertebrates	268
	Sediment Sampling in Freshwater Systems	
	Sampling Purpose and Projects	
	Sampling Plan	
	Data Quality Objectives	
	Sampling History	
	Dates of Collection	
	Sampling Station Selection	
	Estimating Particle Size Percentage	
	Sampling Frequency and Notes	

	Sampling Equipment and Sample Types	277
	Sampling Equipment	277
	Sample Types	
	Types of Sediment Samplers	281
	Sample Suitability	289
	Sample Containers	289
	Recordkeeping: Measurements and Observations	
	Equipment Decontamination	
	References and Recommended Reading	
Chapter 13	Collection of Porewater	297
	Interstitial Water Collection and Sampling	297
	In Situ Collection	298
	Peeper Methods	
	Suction Methods	
	Processing of Field-Collected Interstitial Water Samples	
	Ex Situ Extraction of Interstitial Water	
	Centrifugation	
	Sediment Squeezing	
	Pressurized and Vacuum Devices	
	References and Recommended Reading	307
Chapter 14	Sediment Physicochemical Characteristics	315
-	Introduction	
	Sediment Physicochemical Parameters and Measurement	
	pH	
	Ammonia in Porewater	
	Total Organic Carbon Content	
	Particle Size Distribution (Percent Sand, Silt, and Clay)	
	Percent Water or Moisture Content	
	Salinity of the Porewater (Marine Sediments)	
	Conductivity of the Porewater (Freshwater Sediments)	
	Acid-Volatile Sulfides	
	Simultaneously Extracted Metals	
	Metals	321
	Synthetic Organic Compounds	
	(Pesticides, PCBs, TCDD-Dioxin)	322
	Oil and Grease	
	Petroleum Hydrocarbons and PAHs	
	Total Sulfides	
	Sediment Oxygen Demand	
	Sediment Biochemical Oxygen Demand	325
	Sediment Chemical Oxygen Demand	325

Redox Potential of Sediments	326
Total Inorganic Carbon	326
Total Volatile Solids	
Dissolved Organic Carbon in Porewater	327
Alkalinity and Hardness of the	
Porewater (Freshwater Sediments)	327
References and Recommended Reading	
Glossary	339
Inday	357
INGEV	43