
LANDSCAPE PLANNING

Environmental Applications

Fourth Edition

William M. Marsh

University of British Columbia



WILEY

John Wiley & Sons, Inc.

CONTENTS

Preface	vii
An Introduction to the Book and the Field	1
0.1 Opening Statement	2
0.2 Background Concept	2
0.3 Content and Organization	2
0.4 Landscape Planning, Environmentalism, and Environmental Planning	3
0.5 The Spatial Context: Sites and Regions	4
0.6 Finding the Appropriate Scale	4
CHAPTER 1	
Landscape Planning: Roots, Problems, and Content	7
1.1 Introduction: Roots	8
1.2 The Problem: Change and Impact	10
1.3 The Purpose of Planning	13
1.4 Planning Realms: Decision Making, Technical, and Design	13
1.5 Environmental Impact Assessment	14
1.6 Areas of Activity in Landscape Planning	15
1.7 Methods and Techniques	19
1.8 Environmental Ordinances	20
1.9 The Planning Professions and Participating Fields	22
1.10 Case Study: Planning for a Sustainable Landscape	23
1.11 Selected References for Further Reading	24
CHAPTER 2	
The Physiographic Framework of the United States and Canada	25
2.1 Introduction	26
2.2 The Canadian Shield	29
2.3 The Appalachian Region	32
2.4 The Interior Highlands	36
2.5 The Atlantic and Gulf Coastal Plain	36
2.6 The Interior Plains	41
2.7 The Rocky Mountain Region	44
2.8 The Intermontane Region	47
2.9 The Pacific Mountain Region	50
2.10 The Yukon and Coastal Arctic Region	53
2.11 Selected References for Further Reading	53

CHAPTER 3		
Landscape Form and Function in Planning		55
3.1	Introduction	56
3.2	Essential Processes of the Landscape	56
3.3	The Nature of Landscape Change	59
3.4	The Concept of Conditional Stability	60
3.5	Perspectives on Site	62
3.6	Spatial Dimensions of the Site	62
3.7	Sources of Environmental Data for Site Planning	65
3.8	Theoretical Perspectives on Landscape	67
3.9	Selected References for Further Reading	73
CHAPTER 4		
Topography, Slopes, and Land Use Planning		75
4.1	Introduction	76
4.2	Slope Problems	76
4.3	Building Slope Maps for Land Use Planning	77
4.4	Interpreting Slope Steepness and Form	80
4.5	Assessing Slopes for Stability	84
4.6	Applications to Community Planning	88
4.7	Why Slope Maps May Not Work in Some Areas	90
4.8	Case Study: Slope as a Growth-Control Tool in Community Planning	91
4.9	Selected References for Further Reading	92
CHAPTER 5		
Soil, Land Use Suitability, and Waste Disposal		93
5.1	Introduction	94
5.2	Soil Composition	94
5.3	Soil Texture	95
5.4	Soil Moisture and Drainage	98
5.5	Soil, Landforms, and Topography	98
5.6	Applications to Land Planning	100
5.7	Planning Considerations in Solid Waste Disposal	105
5.8	Hazardous Waste Regulation and Disposal	107
5.9	Case Study: Mapping Soil at the Site Scale for Private Development	109
5.10	Selected References for Further Reading	110
CHAPTER 6		
Soils and Wastewater Disposal Systems		111
6.1	Introduction	112
6.2	The Soil-Absorption System	112
6.3	Environmental Impact and System Design	114
6.4	Assessing Soil Suitability for Onsite Disposal	117
6.5	Alternatives to Standard SAS	120
6.6	Small-Flow Wetland Systems	121
6.7	Case Study: Planning for Wastewater Disposal Using Soil Maps, Nova Scotia	122
6.8	Selected References for Further Reading	124

CHAPTER 7		
Groundwater, Land Use, and Aquifer Protection		127
7.1	Introduction	128
7.2	Groundwater Sources and Features	128
7.3	The Groundwater Flow System	131
7.4	Groundwater Withdrawal and Aquifer Impact	135
7.5	Sources of Groundwater Contamination	136
7.6	Applications to Landscape Planning	137
7.7	Community Wellhead Protection	141
7.8	Case Study: Planning for Groundwater Protection Using a Geographic Information System	142
7.9	Selected References for Further Reading	145
CHAPTER 8		
Stormwater Discharge, Water Management, and Landscape Change		147
8.1	Introduction	148
8.2	Overland Flow	148
8.3	Computing Runoff from a Small Watershed	151
8.4	Using the Rational Method	154
8.5	Other Runoff Models and Concepts	155
8.6	Trends in Stormwater Discharge	156
8.7	Stormwater Mitigation	160
8.8	The Concept of Performance	163
8.9	Comprehensive Water Management Planning	164
8.10	Case Study: A Case for Green Infrastructure in Stormwater Management, Surrey, British Columbia	165
8.11	Selected References for Further Reading	167
CHAPTER 9		
Watersheds, Drainage Nets, and Land Use		169
9.1	Introduction	170
9.2	The Organization of Networks and Basins	170
9.3	Mapping the Drainage Basin	173
9.4	Trends in the Development of Small Drainage Basins	174
9.5	Planning and Management Considerations	176
9.6	Land Use Planning in the Small Drainage Basin	179
9.7	Case Study: Watershed Concepts Applied to Industrial Site Management, Saltillo, Mexico	181
9.8	Selected References for Further Reading	184
CHAPTER 10		
Streamflow, River Valleys, and Flood Hazard		185
10.1	Introduction	186
10.2	Sources of Streamflow	186
10.3	Methods of Forecasting Streamflow	188
10.4	The Size and Shape of Valleys and Floodplains	193
10.5	Applications to Land Planning	194
10.6	Floodplain Mapping	197

10.7	Case Study: Flood Risk and the Impacts of Fire in a Forested Watershed	199
10.8	Selected References for Further Reading	201
 CHAPTER 11		
Water Quality, Runoff, and Land Use		203
11.1	Introduction	204
11.2	Pollution Types, Sources, and Measurement	204
11.3	Stormwater, Land Use, and Water Quality	207
11.4	Water Quality Mitigation on Land	209
11.5	Eutrophication of Waterbodies	213
11.6	Lake Nutrient Loading and Land Use	214
11.7	Planning for Water Quality Management in Small Watersheds	218
11.8	Case Study: Sediment and Nutrient Trapping Efficiency of a Constructed Wetland, Delavan Lake, Wisconsin	221
11.9	Selected References for Further Reading	224
 CHAPTER 12		
Soil Erosion, Land Use, and Stream Sedimentation		225
12.1	Introduction	226
12.2	Soil Erosion, Bioclimate, and Land Use	226
12.3	The Soil Erosion-Sediment System	229
12.4	Factors Influencing Soil Erosion	232
12.5	Computing Soil Erosion from Runoff	233
12.6	Applications to Land Planning and Environmental Management	237
12.7	Considerations in Watershed Management	239
12.8	Case Study: Erosion and Sediment Control on a Creek Restoration Project, South Lake Tahoe, California	241
12.9	Selected References for Further Reading	243
 CHAPTER 13		
Best Management Practices, Watersheds and Development Sites		245
13.1	Introduction	246
13.2	The Watershed Runoff System and BMP Opportunities	246
13.3	The Site Stormwater System	249
13.4	Production BMPs	250
13.5	Site Removal (Release) BMPs	252
13.6	Delivery BMPs	253
13.7	Steps to BMP Planning	255
13.8	Summary and Recommendations	255
13.9	Selected References for Further Reading	257
 CHAPTER 14		
Streams, Channel Forms, and the Riparian Landscape		259
14.1	Introduction	260
14.2	Hydraulic Behavior of Streams	260

14.3	Stream Erosion and Sediment Transport	262
14.4	Channel Dynamics and Patterns	264
14.5	Channel Forms, Meanders, and Related Processes	266
14.6	Floodplain Formation and Features	269
14.7	Riparian and Channel Habitats	271
14.8	Management Problems and Guidelines	273
14.9	Case Study: Stormwater Management and Channel Restoration in an Urban Watershed	278
14.10	Selected References for Further Reading	280

CHAPTER 15

Shoreline Processes, Sand Dunes, and Coastal Zone Management

281

15.1	Introduction	282
15.2	Wave Action, Currents, and Nearshore Circulation	282
15.3	Net Sediment Transport and Sediment Mass Balance	285
15.4	Trends in Shoreline Change	287
15.5	Sand Dune Formation and Nourishment	288
15.6	Applications to Coastal Zone Planning and Management	291
15.7	Site Management Considerations	295
15.8	Case Study: Biotechnical Applications to Shoreline Stabilization, Puget Sound, Washington	298
15.9	Selected References for Further Reading	300

CHAPTER 16

Sun Angles, Solar Heating, and Environment

303

16.1	Introduction	304
16.2	Sun Angle and Incident Radiation	304
16.3	Variations in Sun Angle with Seasons and Topography	305
16.4	Radiation Balance and Solar Heating	308
16.5	Implications for Land Use, Vegetation, and Soil	312
16.6	Implications for Buildings and Living Environments	313
16.7	Case Study: Solar Considerations in Midlatitude Residential Landscape Design	316
16.8	Selected References for Further Reading	318

CHAPTER 17

Microclimate, Air Pollution, and the Urban Environment

319

17.1	Introduction	320
17.2	The Urban Heat Island	320
17.3	Microclimatic Variations Within the Urban Region	322
17.4	Air Pollution Management in the Urban Region	329
17.5	Climate in Urban Planning	331
17.6	Climatic Criteria for Urban Planning and Design	331
17.7	Case Study: Modifying Urban Climate and Reducing Energy Use Through Landscape Design	334
17.8	Selected References for Further Reading	337

CHAPTER 18		
Ground Frost, Permafrost, Land Use, and Environment		339
18.1	Introduction	340
18.2	Daily and Seasonal Variations in Soil Heat	341
18.3	Controls on Soil Heat and Ground Frost	342
18.4	Permafrost	347
18.5	Land Use and Frozen Ground	349
18.6	Planning Applications	350
18.7	Case Study: Permafrost and the Trans-Alaska Pipeline	353
18.8	Selected References for Further Reading	354
CHAPTER 19		
Vegetation, Land Use, and Environmental Assessment		355
19.1	Introduction	356
19.2	Description and Classification of Vegetation	356
19.3	Trends in Vegetation Change	357
19.4	The Concept of Sensitive Environments	362
19.5	Vegetation as a Tool in Landscape Planning	364
19.6	Approaches to Vegetation Analysis	368
19.7	Sampling Vegetation	370
19.8	Vegetation and Environmental Assessment	371
19.9	Case Study: Wildlife Habitat Considerations in Residential Planning, Central Texas	372
19.10	Selected References for Further Reading	375
CHAPTER 20		
Landscape Ecology, Land Use, and Habitat Conservation Planning		377
20.1	Introduction	378
20.2	The Biogeographical Foundation	378
20.3	Habitat, Land Use, and Biodiversity	380
20.4	Endangered, Threatened, and Protected Species	384
20.5	Patterns and Measures of Landscape Fragmentation	385
20.6	Habitat Conservation Planning	388
20.7	Case Study: Marsh Restoration of a Bird Habitat in the Fraser River Valley, British Columbia	391
20.8	Selected References for Further Reading	393
CHAPTER 21		
Wetlands, Habitat, and Land Use Planning		395
21.1	Introduction	396
21.2	Wetland Hydrology	397
21.3	The Wetland Ecosystem	398
21.4	Wetland Types and Settings	400
21.5	Comprehensive Wetland Classification System	403
21.6	Wetland Mapping	406
21.7	Management and Mitigation Considerations	407

21.8	Case Study: In Search of Better Wetland Regulation and Management	410
21.9	Selected References for Further Reading	412
GLOSSARY		415
APPENDIX A	U.S. and Canadian Soil Classification Systems	429
APPENDIX B	Landforms and Soil Materials and their Drainage Characteristics	433
APPENDIX C	U.S. Raw Surface Water Standards for Public Water Supplies	435
APPENDIX D	U.S. National Air Quality Standards	437
APPENDIX E	U.S. Noise Standards	439
APPENDIX F	Common and Scientific Names of North American Wetland Plants	441
CREDITS		447
INDEX		449