

Contents

Acknowledgements — V

Chapter 1

Introduction — 1

Notes — 3

References — 3

Chapter 2

Innovative water management — 4

Introduction — 4

2.1 Multiple challenges to the water sector — 4

2.1.1 Climate change — 4

2.1.2 Rapid population growth — 6

2.1.3 Urbanisation — 6

2.1.4 Economic growth and resource use — 7

2.1.5 Rising demand for energy — 7

2.1.6 Rising demand for food — 8

2.1.7 Ageing infrastructure and deteriorating water quality — 9

2.1.8 Greenhouse gas emissions — 9

2.1.9 Environmental degradation and biodiversity loss — 10

2.1.10 High customer expectations — 10

2.2 Innovative water management — 10

2.2.1 Innovation in the water sector — 11

2.2.2 Innovative water management technologies — 11

2.2.3 Stakeholder contributions to innovative water management technologies — 12

2.2.4 Barriers to innovative water management technologies — 14

2.2.5 Overcoming barriers — 16

Notes — 17

References — 20

Chapter 3

Conserving and recycling and reusing water — 23

Introduction — 23

3.1 Demand management — 23

3.1.1 Demand management strategies — 24

3.2 Water pricing — 24

3.2.1 Common tariff structures — 25

3.2.2	Irrigation tariff structures —	25
3.3	Water metering —	27
3.4	Leak detection and water distribution network rehabilitation —	28
3.5	Water restrictions —	30
3.6	Water efficiency labelling —	30
3.7	Education and awareness —	31
3.8	Demonstration projects —	33
3.9	Water recycling and reuse —	34
3.9.1	Non-potable use —	34
3.9.2	Potable reuse —	36
	Notes —	38
	References —	40

Chapter 4

Generating renewable energy and recovering resources from wastewater — 43

	Introduction —	43
4.1	Renewable energy generation technologies at wastewater treatment facilities —	43
4.1.1	Biogas from anaerobic digestion —	44
4.1.2	Biomethane —	44
4.1.3	Combined heat and power —	45
4.1.4	Anaerobic co-digestion —	46
4.1.5	Thermal conversion of biosolids —	47
4.1.6	Thermal energy recovery from wastewater —	48
4.2	Renewable energy activities on buildings and surrounding lands —	48
4.2.1	Solar energy —	49
4.2.2	Wind power —	50
4.2.3	Hydropower energy recovery —	50
4.3	Energy efficiency —	51
4.4	Benefits of renewable energy and energy efficiency —	52
4.5	Recovering resources —	53
4.5.1	Nitrogen and phosphorus —	53
4.5.2	Cellulose —	54
4.5.3	Bioplastic —	55
4.5.4	Bricks and tiles —	55
4.5.5	Mining wastewater for metals —	56
	Notes —	56
	References —	58

Chapter 5**Greening of grey water infrastructure — 62**

- Introduction — **62**
- 5.1 Rainwater harvesting — **62**
- 5.2 Rain gardens — **64**
- 5.3 Bioswales — **66**
- 5.3.1 Maintenance of bioswales — **66**
- 5.4 Floodwater detention and retention basins — **68**
- 5.5 Green roofs — **69**
- 5.6 Blue roofs — **70**
- 5.7 Permeable pavements — **72**
- 5.8 Green streets — **73**
- 5.8.1 Stormwater planters — **74**
- 5.8.2 Stormwater bump-outs — **75**
- 5.8.3 Stormwater tree — **75**
- 5.8.4 Stormwater tree trench — **75**
- 5.8.5 Green car parking lots — **75**
- 5.9 Multifunctional spaces — **76**
- Notes — **77**
- References — **79**

Chapter 6**Protecting and restoring water quality in river basins — 83**

- Introduction — **83**
- 6.1 River basin planning to protect and restore water quality — **83**
- 6.1.1 Developing and implementing a successful river basin management plan — **84**
- 6.2 Permits — **87**
- 6.2.1 Tradable permits — **88**
- 6.3 Best management practices — **92**
- 6.3.1 Agricultural best management practices for water quality protection — **92**
- 6.3.2 Industrial best management practices for water quality protection — **94**
- 6.3.3 Urban best management practices for water quality protection — **96**
- 6.4 Source water protection — **98**
- Notes — **99**
- References — **101**

Chapter 7

Smart digital water management and managing customers of the future — 103

Introduction — **103**

7.1 Smart digital water management — **103**

7.1.1 Categories of smart digital water management technologies — **104**

7.1.2 Smart digital water management system components — **105**

7.1.3 Smart water grids and smart water meters — **109**

7.1.4 Artificial intelligence and machine learning — **110**

7.2 Managing customers of the future — **112**

7.2.1 Customer participation — **112**

7.2.2 Enhancing customer experiences across the water distribution network — **117**

Notes — **121**

References — **123**

Chapter 8

Innovative financial instruments and approaches for water projects — 127

Introduction — **127**

8.1 Overcoming barriers to water financing — **127**

8.1.1 Economic and financial instruments — **128**

8.2 Water prices — **129**

8.3 Stormwater fee discounts — **130**

8.4 Stormwater volume credit trading — **131**

8.5 Environmental taxes — **132**

8.6 Subsidies — **133**

8.7 Tradable permits — **134**

8.7.1 Tradable water abstraction rights — **135**

8.7.2 Tradable water pollution rights — **135**

8.8 Payment for watershed ecosystem services — **136**

8.9 Green bonds — **138**

8.9.1 The Green Bond Principles — **138**

8.9.2 Labelling scheme for green bonds — **139**

8.10 Public-private partnerships — **140**

8.10.1 Public-private partnerships for ecosystem restoration — **142**

Notes — **144**

References — **146**

Chapter 9

Best practices and conclusion — 149

Introduction — **149**

9.1 Conserving and recycling and reusing water — **149**

9.2 Generating renewable energy and recovering resources from
wastewater — **151**

9.3 Greening of grey water infrastructure — **154**

9.4 Protecting and restoring water quality in river basins — **155**

9.5 Smart digital water management and managing customers of the
future — **157**

9.6 Innovative financial instruments and approaches for water
projects — **160**

Conclusion — **162**

Index — 165