

NEIL S. GRIGG

# Water, Wastewater, and Stormwater Infrastructure Management



LEWIS PUBLISHERS

---

# *Contents*

## **Chapter 1 Infrastructure management systems**

Introduction .....	1
Infrastructure management systems.....	2
Building blocks for infrastructure management systems .....	3
Benefits of infrastructure management systems.....	4
Infrastructure integrity.....	4
Current integrity of water, sewer, and stormwater systems .....	5
Investment needs .....	7
Hierarchy of infrastructure systems and components .....	9
Life-cycle management framework for infrastructure systems ....	9
How management systems produce infrastructure integrity ....	11
Assignment of programs to organizational units.....	12
Best practices in infrastructure management.....	13
Conclusion.....	15
References.....	16

## **Chapter 2 Water, sewer, and stormwater systems and services**

Introduction .....	19
Evolution of urban water systems .....	20
Water supply infrastructure systems.....	22
AWWA water supply statistics.....	24
Water supply treatment.....	25
Transmission and distribution system infrastructure .....	27
Distribution pipes.....	29
AWWA data on distribution systems .....	33
Water supply planning .....	33
Management organizations for water supply .....	35
Interest groups .....	35
Trends in water supply systems .....	36
Wastewater infrastructure systems .....	37
Collection and transmission systems .....	39
Wastewater treatment systems .....	40
Classification of wastewater treatment.....	40
Sludge disposal systems.....	42
Management structures .....	42

Interest groups .....	42
Issues.....	42
Stormwater infrastructure systems .....	42
Needs .....	45
Stormwater planning .....	46
Management structure .....	47
Regulatory structure.....	48
Interest groups .....	48
Issues.....	49
Future water management .....	49
References.....	49

### **Chapter 3 Asset management**

Introduction .....	51
Asset management = infrastructure management.....	51
Asset management as a concept .....	51
Definitions of asset management .....	52
Asset management activities.....	53
Asset management for organizational integration.....	53
GASB 34 to reform infrastructure asset accounting.....	54
APWA endorsement of GASB 34 .....	55
Organization of an asset management system .....	56
Applications of asset management.....	56
Financial section.....	56
Planning section.....	56
Engineering and construction .....	56
O&M .....	57
Information systems for asset management.....	57
References.....	58

### **Chapter 4 Capital improvement planning, programming, and budgeting**

Introduction .....	61
Planning process .....	62
From integrated plans to capital improvement programs .....	65
Capital improvement programs .....	65
Water supply capital planning .....	66
Wastewater system planning .....	67
Stormwater system planning .....	68
Evaluation techniques and priority-setting .....	68
Review of capital planning, programming, and budgeting .....	70
References.....	70

### **Chapter 5 Design and construction of infrastructure**

Introduction .....	71
Infrastructure life cycle .....	72

Achieving quality and value in a project .....	73
Planning–design–construction process .....	74
Quality in the constructed project .....	75
Project roles .....	76
Design-build and other project delivery methods .....	77
Project planning .....	78
Project design.....	79
Systems design.....	79
Design by consultants or in-house .....	80
Management of engineering services.....	81
Selection of engineer .....	81
Consultant work .....	82
Design review.....	84
Construction phase .....	85
Construction documents .....	86
Project management .....	87
Project management manuals.....	87
Responsibilities of the owner’s engineer .....	88
Codes, standards, specifications, and model designs.....	88
Standards .....	90
AWWA standards .....	90
WEF standards .....	91
ASCE.....	91
Codes .....	91
Design of water, sewer, and stormwater systems .....	92
Appropriate technologies .....	94
References.....	94

## **Chapter 6 Financial management for water, sewer, and stormwater systems**

Financial environment for water, sewer, and stormwater systems.....	97
Financial tools.....	98
Links between management and finance work .....	98
Public finance, government agencies, and regulated utilities.....	99
Budget process .....	99
Operating budget .....	100
Capital budget.....	101
Politics of budgeting .....	102
Enterprise principle .....	102
Sources of revenue.....	102
Operating revenues .....	102
User charges .....	102
Taxes and user charges .....	103
Capital financing.....	104
Cost control.....	107
Financial planning and projections.....	107

Accounting for financial control and reporting.....	109
Basic principles of accounting.....	109
Rules of accounting.....	110
Principles of government accounting .....	110
Management accounting .....	111
Accounting for fixed assets.....	111
Financial statements.....	113
Accounts for regulated utilities.....	113
Audits .....	113
AWWA financial data.....	114
References.....	116

## **Chapter 7 Operations of water, sewer, and stormwater systems**

Introduction .....	119
Operations management.....	119
Comprehensive improvement programs .....	121
Tasks and skills of operators.....	127
Operator training .....	129
Introduction.....	129
Training and certification .....	129
Organizations .....	130
System applications of operator skills.....	132
Source of supply .....	132
Treatment plant operations.....	132
Future treatment plant operations.....	134
Distribution and collection systems, including stormwater ....	135
SCADA systems.....	135
Operating engineers.....	135
Safety .....	136
Contract operations .....	136
Trends in operations .....	137
References.....	138

## **Chapter 8 Risk management and disaster preparedness**

Introduction .....	139
Risks to water, sewer, and stormwater systems.....	140
Risk management.....	144
Risk assessment, vulnerability analysis, and contingency planning...	147
Mitigation measures, including design and construction.....	149
Emergency management .....	152
Security .....	153
References.....	154

## **Chapter 9 Maintenance and renewal of water, sewer, and stormwater systems**

Introduction .....	157
--------------------	-----

System inventories.....	157
Inventory as an accounting concept.....	158
Accounting field.....	159
Government versus private accounting .....	159
Regulated utilities.....	159
Inventories in asset management systems .....	160
Accounting for fixed assets.....	161
Benefits of maintenance programs.....	162
Maintenance management systems .....	163
Condition assessment.....	164
Preventive maintenance.....	165
Corrective maintenance .....	165
Reliability-centered maintenance .....	166
Facility management .....	166
Computer-based inventory, record, scheduling, and work management systems .....	167
Maintenance of water, sewer, and stormwater systems.....	167
Maintenance management .....	167
System inventories .....	168
Condition assessment of system infrastructure .....	171
Distribution and collection system maintenance .....	173
Renewal: the 3Rs of infrastructure.....	176
Failure mechanisms.....	177
Management issues .....	178
Repair and rehabilitation technologies .....	179
Condition assessment .....	179
Materials .....	180
Future issues and needed research.....	180
References.....	181

<b>Chapter 10 Information technology in water and sewer management</b>	
Introduction .....	183
IT products and technologies .....	184
Office software .....	185
Databases .....	185
GIS.....	185
Models .....	186
Internet.....	187
IT applications .....	188
SCADA .....	188
MMS.....	190
One-Call and Reverse 911 .....	190
Y2K.....	191
Communications.....	191
Design and E-construction.....	192
Information architecture .....	192

Information work.....	193
Decision support work .....	193
Information in regulated industries.....	194
Enterprise systems .....	194
Information technology departments.....	198
Future directions .....	198
References.....	199

## **Chapter 11 Laws and regulations**

Introduction .....	201
Legal scenarios .....	201
Types of laws and regulations.....	202
Environmental law .....	204
Regulation in water, sewer, and stormwater industries .....	205
United States Code (USC) and Code of Federal Regulations (CFR).....	207
Administrative law.....	208
Codes and standards.....	208
Water supply regulation .....	208
Health and Safety: Safe Drinking Water Act .....	209
Water quality of source waters.....	209
Environment and fish and wildlife .....	210
Quantity allocation .....	210
Finance.....	211
Service quality .....	211
Wastewater regulation .....	211
Regulating health and environment: The Clean Water Act .....	211
Financial regulation.....	212
Stormwater and combined sewer system regulation .....	212
Drainage and flood law .....	213
Local stormwater programs.....	213
State programs and areawide districts .....	214
Federal programs.....	215
FEMA .....	215
Enforcement scenarios .....	216
References.....	216

## **Chapter 12 Managing the 21st century water industry**

Introduction .....	219
Management in the public works and utility environment .....	220
Systems view of utility operations .....	222
Business practices affecting infrastructure .....	223
Human resources.....	225
Strategic planning.....	226
Project Management.....	226
Risk management and loss prevention.....	226

Decision making .....	227
Program assessment and management audits .....	227
Quality management.....	227
Public involvement, marketing, and customer relationship management.....	228
Management in a government environment .....	229
Introduction .....	229
Public-sector management .....	229
Clients .....	229
Structure of government .....	230
Functions of government .....	230
Financing.....	231
Politics .....	231
Policy analysis.....	232
Leadership issues for infrastructure managers.....	233
Leading management thinkers.....	233
Decision making .....	234
Leadership issues in the water industry .....	234
Closure .....	236
References.....	236
<b>Index .....</b>	<b>239</b>