

Index

Page numbers in **bold** indicate main discussions.

- Acanthamoeba* 122, 123, 125, **259–261**
Acceptability 7, 23, **210–220**
 biologically derived contaminants
 211–213
 chemical contaminants 146, 156,
 213–219
 desalinated water 112–113
 in emergency and disaster situations
 106
Acceptable daily intake (ADI) 150
 derivation of guideline values 152
 uncertainty factors 150–151
Access to water (accessibility) 90, **91–92**
 definition of reasonable 91
 equitability 105
Acinetobacter 102, 124, **222–224**, 286
Acrylamide **296–297**
 analysis 162
 guideline value 194, 296, 491
Actinomycetes 212
Activated alumina 179
Activated carbon
 adsorption **176–177**
 granular (GAC) 176, 177
 powdered (PAC) 176
Additives 30
Adenoviruses 122, **248–250**, 295
Adequacy of supply, surveillance **90–93**
ADI *see* Acceptable daily intake
Advanced oxidation processes 173
Aeration processes **175**
Aeromonas 102, 124, **224–225**, 286
Aerosols 123
Affordability 90, **92**
Aggressivity, desalinated water 112
Aggressivity index 183
Agricultural activities, chemicals from 147
 analysis 159, 161
 guideline values **187–188**, 189, 190, 191
 treatment achievabilities 169–170
AIDS 124, 270
Air
 chemical intake 152
 radon intake 206–207
Air stripping 175
Aircraft **116–117**
Airports **116–117**
Alachlor **297–298**
 analysis 161
 guideline value 191, 298, 491
 treatment achievability 169, 298
Aldicarb **298–300**
 analysis 161
 guideline value 191, 299, 491
 treatment achievability 169, 299
Aldrin **300–301**
 analysis 161
 guideline value 191, 300, 491
 treatment achievability 169, 300
Algae 213
 blue-green *see* Cyanobacteria
 harmful events 111, 213
 toxins 111
Alkalinity 217
 corrosion and 181, 184
 see also pH
Alkylbenzenes 217
Alpha radiation activity
 measurement 207–208
 screening levels 204, 205, 206
Alumina, activated 179
Aluminium 193, 213, **301–303**, 489

- Alzheimer disease (AD) 302
Americium-241 202
Aminomethylphosphonic acid (AMPA)
190, **379–380**, 489
Amitraz 189, 488
Ammonia 190, **303–304**, 489
taste and odour 213
treatment to remove 220
Amoebae 63
Legionella ingestion 234
persistence in water 125
see also *Acanthamoeba*; *Entamoeba histolytica*; *Naegleria fowleri*
Amoebiasis 266
Amoebic meningoencephalitis, primary (PAM) 123, 272, 273
AMPA 190, **379–380**, 489
Analytical methods
chemicals **157–166**
radionuclides **207–208**
Ancylostoma 124
Animals
in drinking-water 212–213
toxicity studies 148
uncertainty factors 151
Anion exchange 177
Anthrax 225
Antimony **304–306**
analysis 159
guideline value 194, 305, 491
Appearance 7, 210, **211–220**
biologically derived contaminants
211–213
chemical contaminants 213–219
treatments for improving 219–220
Argyria 434
Arsenic 6, **306–308**
analysis 159
in drinking-water sources 146, 306
guideline value 186, 306, 491
priority 35–36
treatment achievability 167, 307
Asbestos 193, **308**, 489
Asbestos–cement pipes 183
Ascariasis (*Ascaris*) 124, 276
Asellus aquaticus 212
Aspergillus 102
Assessing Microbial Safety of Drinking Water: Improving Approaches and Methods
18, 59
Astroviruses **250–251**
Atomic absorption spectrometry (AAS)
159–164
Atomic emission spectrometry (AES) 164
Atrazine **308–309**
analysis 161
guideline value 191, 309, 491
treatment achievability 169, 309
Audit **86–87**, 94
Avoidance, water **79**
Bacillus 221, **225–226**
Bacillus cereus 221, 225, 226
Bacillus thuringiensis israelensis 190
Backflow 62, 63
large buildings 101
Bacteria 221
indicator and index **282–289**
pathogenic 122, **222–247**
persistence in water 125
treatment effects 138–141
Bacteriophages 142, **289–294**
Bacteroides fragilis **292–294**
coliphages **289–292**
Bacteroides fragilis phages **292–294**
Balantidium coli (balantidiasis) 124, **261–262**
Barium **310–311**
analysis 159
guideline value 186, 310, 491
BDCM see Bromodichloromethane
Becquerel (Bq) 201
Benchmark dose (BMD) 152, **153**
Bentazone 190, **311–312**, 489
Benzene **312–313**
analysis 160
guideline value 188, 312, 491
treatment achievability 168, 312
3,4-Benzfluoranthene 429
11,12-Benzfluoranthene 429
Benzo[a]pyrene 428–429, 430
analysis 162
guideline value 194, 428, 491
1,12-Benzpyrene 429
3,4-Benzpyrene 429
Beryllium 187, 488
Beta-Poisson dose–response relation 129
Beta radiation activity 205
measurement 207–208
screening levels 204, 205, 206
Bilharziasis 123
Biofilms 4–5, 63
atypical mycobacteria 235, 236
coliform bacteria 283
desalinated water 113
Klebsiella 233
Legionella 234, 235
Biological denitrification 179

- Biological nitrification 179
- Biologically derived contaminants **211–213**
- Bleach, household 107
- Blooms, cyanobacterial 195, 213, 281
- “Blue-baby syndrome”
(methaemoglobinaemia) 6, 418–420
- Blue-green algae *see* Cyanobacteria
- Body weight 150
assumptions 486
- Boil water orders **79**
- Boiling of water
bottle-fed infants 114
emergencies and disasters 79, 107
travellers 110
- Borehole water supplies 65–66
- Boron **313–314**
analysis 159
guideline value 186, 313, 491
- Bottle-fed infants 114, 418, 419
- Bottled water 113–115
international standards 114–115
potential health benefits 114
travellers 110, 111
- Brackish water 111
- Brass corrosion **182–183**
- Bromate 179, **315–316**
analysis 162
guideline value 194, 315, 491
strategies for reducing 180
- Brominated acetic acids **316–317**
- Bromochloroacetate 193, 316–317, 489
- Bromochloroacetonitrile 193, **380–382**, 489
- Bromodichloromethane (BDCM) **451–454**
analysis 162, 452
guideline value 194, 451, 491
- Bromoform **451–454**
analysis 162
guideline value 194, 451, 491
- Buildings
large **99–104**, 235
plumbing systems 17–18
- Burkholderia pseudomallei* 122, 221,
226–227
- Burns injuries 103
- Cadmium **317–319**
analysis 159
guideline value 188, 317, 491
treatment achievability 168, 317
- Caesium-134 (¹³⁴Cs), 202
- Caesium-137 (¹³⁷Cs), 202
- Calcium, taste threshold 215
- Calcium carbonate
corrosion control 181, 182, 183, 184
scale 183–184, 215–216
see also Hardness
- Calcium hypochlorite 107, 171
- Calcium sulfate 218
- Caliciviruses **251–253**
- Campylobacter* **228–229**
performance target setting 132
risk characterization 129, 130
in source waters 137
- Campylobacter coli* 122, 228
- Campylobacter jejuni* 122, 228
- Campylobacter pylori* *see Helicobacter pylori*
- Cancer
radiation-induced 200
radon-related risk 207
tolerable risk 46–47
see also Carcinogens
- Carbofuran 161, **319–320**
guideline value 191, 319, 491
treatment achievability 169, 319
- Carbon, activated *see* Activated carbon
- Carbon-14 (¹⁴C), 202
- Carbon tetrachloride **320–321**
analysis 160
guideline value 188, 320, 491
treatment achievability 168, 320
- Carcinogens
derivation of guideline values 149
genotoxic 148–149, 154
guideline values 154
IARC classification 149
non-genotoxic 149
tolerable risk 46–47
uncertainty factors 151
- Cascade aeration 175
- Catchments 53, 54, 56–59
control measures 58–59
hazard identification 56–58
mapping, emergency and disaster
situations **108**
new systems 52–53
roles and responsibilities 11, 12–13, 14
see also Source waters
- Categorical regression 152, **153–154**
- Cation exchange 177
- Cement, corrosion **183**
- Cercariae 123
- Certification 16–17, 42
agencies **16–17**
chemicals in water 43
desalination systems 112
- Chemical Safety of Drinking-water: Assessing
Priorities for Risk Management* 18,
36

- Chemical-specific adjustment factors
(CSAF) 152, 154
- Chemicals **6–7, 145–196**
 acceptability aspects 146, 156, **213–219**
 agricultural activities *see* Agricultural activities, chemicals from
 allocation of intake 151–152
 alternative routes of exposure 43–44, 146
 analytical methods 157–166
 achievabilities 157–158, 159, 160–163
 ranking of complexity 158
 categorization by source 147
 desalination systems 111–112
 emergencies involving 79, 108–109
 guideline values *see* Guideline values
 health-based targets 41, 42–43
 health hazards **6–7, 145–147**
 IARC classification 149
 industrial sources and human dwellings
see Industrial sources and human dwellings, chemicals from
 information sources 36, 148, 156
 inorganic
 analytical methods 158, 159
 guideline values 185, 186
 mixtures 156
 naturally occurring *see* Naturally occurring chemicals
 non-guideline 156
 non-threshold 148–149
 derivation of guideline values **154**
 provisional guideline values 155–156
 organic, analytical methods 158, 160–161
 priority setting **35–36**
 on ships 118
 “short-listing” 36
 summary tables **488–493**
 threshold 148, **149–154**
 alternative approaches 152–154
 derivation of guideline values 149–152
 treatment **166–184**
 achievabilities 166–171
 for corrosion control 180–184
 process control measures 179–180
 processes 171–179
 used in treatment/materials in contact
 with water 147
 analysis 159, 162
 guideline values **188–190, 193–194**
see also Disinfection by-products
 water quality
 emergency and disaster situations
108–109
 targets 42–43
 verification **30–31, 72, 73**
- Children
 consumption assumptions 486
 hygiene education 103–104
 radionuclide guidance levels 204
see also Infants
- Chironomus* larvae 212
- Chloral hydrate (trichloroacetaldehyde)
321–322
 analysis 162
 guideline value 194, 322, 491
- Chloramination 63–64, 172
 by-products 179, 180, 192
 nitrite formation 417, 418
- Chloramines 172
 dialysis water 103
see also Monochloramine
- Chlorate 179, **326–329**
 analysis 162
 guideline value 194, 326, 491
- Chlordane **323–324**
 analysis 161
 guideline value 191, 323, 491
 treatment achievability 169, 323
- Chloride 185, **324–325, 489**
 acceptability 213–214, 324
 corrosion and 181, 182, 184
- Chlorinated acetic acids 145, 179, 349–350,
 412–413, 445–446
- Chlorinated anisoles 214
- Chlorinated ketones 179
- Chlorination 61, **171–172**
 breakpoint 171
 by-products 145, 179–180, 192, 451
 in emergencies 79
 marginal 171
 microbial reduction 140
 for travellers 110
- Chlorine 5, 171, **325–326**
 acceptable levels 214
 analysis 162
 gas, liquefied 171
 guideline value 194, 325, 491
 residual
 emergency and disaster situations 107,
 108
 monitoring 69, 82
 treatment *see* Chlorination
- Chlorine dioxide 326
 by-products 179, 180, 192, 326
see also Chlorate; Chlorite
 guideline value 193, 328, 489
 microbial reduction 140

- toxicity 327
- water treatment 173
- Chlorite 179, **326–329**
 - analysis 162
 - guideline value 194, 326, 491
- 3-Chloro-4-dichloromethyl-5-hydroxy-2(5H)-furanone (MX) 193, **414–415**, 490
- Chloroacetones 193, **329**, 489
- Chlorobenzilate 189, 488
- Chloroform 145, **451–454**
 - analysis 162, 452
 - guideline value 194, 451, 491
- 2-Chlorophenol 193, 214, **329–331**, 489
- Chlorophenols 214, **329–331**
- Chlorophenoxy herbicides 341, 342–343, 361–362, 374–375, 439–440
- Chloropicrin 193, **331–332**, 489
- Chlorothalonil 189, 488
- Chlorotoluron **332–333**
 - analysis 161
 - guideline value 191, 332, 491
 - treatment achievability 169, 332
- Chlorpyrifos 190, **333–334**
 - analysis 163
 - guideline value 195, 333, 491
- Cholera 244–245
- Chromatography 164–165
- Chromium **334–335**
 - analysis 159
 - guideline value 186, 334, 491
- Chydorus sphaericus* 212
- Citrobacter* 282, 284
- Clarification 138–139
 - drinking-water for travellers 110
 - emergency and disaster situations 105, 107
- Clostridium perfringens* 142, **288–289**
- Closure, drinking-water supply **79**
- Cloudiness 211
- Co-precipitation method, radionuclide analysis 208
- Coagulation (chemical) 60, **175–176**
 - before disinfection 179–180
 - microbial reduction 138–139
- Coal-tar linings, pipes 428, 430
- Coastal water 111
- Code of good practice 33–34
- Code of Practice for Collecting, Processing and Marketing of Natural Mineral Waters* 115
- Codex Alimentarius Commission (CAC) 114–115
- Coliform bacteria
 - detection methods 144
 - thermotolerant 142, 143, 282, **284–285**
 - total **282–284**
- Coliphages **289–292**
 - F-RNA 290–291
 - somatic 290, 291
- Colitis, amoebic 266
- Collection, water
 - emergency and disaster situations 106
 - household use 71
- Colorimetric methods 158
- Colour 211, 214
- Communication **27–28**
 - emergency and disaster situations 106
 - surveillance information **95–97**
 - water safety plans **82–83**
- Community
 - communication 28, **96**
 - involvement in setting standards 34
 - organizations 12, 96
- Community drinking-water systems **64–67**
 - control measures 65–67
 - development of water safety plans (WSPs) 85
 - ensuring operation and maintenance 94
 - grading schemes 97, 98
 - hazard identification 64–65
 - management **81–82**
 - operational monitoring 71, 82
 - roles and responsibilities 11–12, **14–15**
 - surveillance 87, **88–89**
 - verification testing 74–75
- Concise International Chemical Assessment Documents (CICADs) 36
- Concrete, dissolution **183**
- Confidence intervals 153
- Conjunctivitis, adenovirus 248, 249
- Consumers
 - acceptability to *see* Acceptability
 - interaction with **96**
 - right of access to information 83, 96
 - roles and responsibilities **15–16**
- Consumption, drinking-water, daily per capita 90
 - assumptions 486
 - performance target setting and 128, 133–134
- Contact, transmission via 221
- Contact lenses 238, 260–261

- Continuity of supply 90, **92–93**
- Control measures 26, 49, **68**
 assessment and planning 55–56
 defined 55
 monitoring performance *see* Operational monitoring
 operational and critical limits 70
 prioritizing hazards 53–55
 validation *see* Validation
- Cooling towers 100, 234
- Copper **335–337**
 acceptability 214–215
 analysis 159
 corrosion **182**
 guideline value 194, 336, 491
 impingement attack 182
 pitting 182
- Corrosion **180–184**, 217
 control strategies 184
 galvanic 182
 indices 183–184
 inhibitors 181, 184
 pitting 182
- Costs
 treatment 166–167
 water supply 92
- Coxsackieviruses 253–254
- Crangonyx pseudogracilis* 212
- Critical limits **70**
- Crustaceans 212
- Cryptosporidiosis 259, 262–263
- Cryptosporidium (parvum)* 122, **262–264**
 disinfection 140–141
 oocysts 110, 262, 263
 performance target setting 131–132, 133–134
 risk characterization 130
 in source waters 137
- Ct concept 61
- Culex* larvae 212
- Cyanazine **337–338**
 analysis 161
 guideline value 191, 337, 491
 treatment achievability 169
- Cyanide **339–340**
 analysis 159
 guideline value 188, 339, 491
- Cyanobacteria 147, 192, 221, **279–281**
 acceptability 213
 blooms 195, 213, 281
 health concerns 4
 toxins *see* Cyanotoxins
 treatment 171, 195
- Cyanogen chloride 162, 194, **340**, 491
- Cyanotoxins 4, 280, 281
 classification 192
 guideline values **192–196**
 treatment 171, 195
see also Microcystin-LR
- Cyclops* 212, 276, 277
- Cyclospora cayetanensis* 122, 259, **264–265**
- Cyclosporiasis 264
- Cylindrospermopsin 192, 280
- Cypermethrin 189, 488
- Cystic fibrosis 238
- 2,4-D (2,4-dichlorophenoxyacetic acid) **340–342**
 analysis 161
 guideline value 191, 341, 491
 treatment achievability 169, 341
- DALYs *see* Disability-adjusted life years
- Data
 fitness for purpose 75
 regional use **96–97**, 98
 system assessment and design 53–56
- Day care centres **103–104**
- 2,4-DB 161, 191, **342–343**, 491
- DBCP *see* 1,2-Dibromo-3-chloropropane
- DBPs *see* Disinfection by-products
- DCBs *see* Dichlorobenzenes
- DDT and metabolites 190, **343–345**
 analysis 163
 guideline value 195, 344, 491
 treatment achievability 170, 344
- “Dealkalization” 177
- Dechlorination 171
- DEHA *see* Di(2-ethylhexyl)adipate
- DEHP *see* Di(2-ethylhexyl)phthalate
- Demineralized water 114
- Denitrification, biological 179
- Dermal absorption
 assumptions 486–487
 chemicals 152
- Desalination systems **111–113**, 178
- Detergents, synthetic 218
- Developing countries, urban areas **88**
- “Deviations” 77
- Devices
 certification *see* Certification
 medical, washing 103
- Dezincification of brass 182
- Di(2-ethylhexyl)adipate (DEHA) 187, **362–363**, 489
- Dialkyltins 193, **345–346**, 489
- Dialysis, renal 103

- Diarrhoea
 cryptosporidiosis 262–263
Escherichia coli 230
Giardia 267
 rotavirus 258
 travellers' 109
- Diatomaceous earth 139
- Diazinon 189, 488
- 1,2-Dibromo-3-chloropropane (DBCP)
346–347
 analysis 161
 guideline value 191, 346, 491
 treatment achievability 169, 346
- Dibromoacetate 193, 316, 489
- Dibromoacetonitrile 162, 194, **380–382**,
 491
- Dibromochloromethane (DCBM) **451–454**
 analysis 162
 guideline value 194, 451, 491
- 1,2-Dibromoethane (ethylene dibromide)
347–349
 analysis 161
 guideline value 191, 347, 491
 treatment achievability 169, 348
- Dichloramine 193, 411, 489
- Dichloroacetate 162, 194, **349–350**, 491
- 1,1-Dichloroacetone 329
- Dichloroacetonitrile 162, 194, **380–382**, 491
- 3,4-Dichloroaniline 430
- 1,2-Dichlorobenzene **350–352**
 acceptable levels 215
 analysis 160
 guideline value 188, 350, 491
 treatment achievability 168, 351
- 1,3-Dichlorobenzene 187, **350–352**, 489
- 1,4-Dichlorobenzene **350–352**
 acceptable levels 215
 analysis 160
 guideline value 188, 350, 492
 treatment achievability 168, 351
- Dichlorobenzenes (DCBs) 215, **350–352**
- 1,1-Dichloroethane 187, **352**, 489
- 1,2-Dichloroethane **353–354**
 analysis 160
 guideline value 188, 353, 492
 treatment achievability 168, 353
- 1,1-Dichloroethene 160, 188, **354–355**, 492
- 1,2-Dichloroethene **355–356**
 analysis 160
 guideline value 188, 355, 492
 treatment achievability 168, 355
- Dichloromethane 160, 188, **357–358**, 492
- 2,4-Dichlorophenol 193, 214, **329–331**, 489
- 2,4-Dichlorophenoxyacetic acid *see* 2,4-D
- 1,2-Dichloropropane (1,2-DCP) **358–359**
 analysis 161
 guideline value 191, 358, 492
 treatment achievability 169, 358
- 1,3-Dichloropropane 190, **359–360**, 489
- 1,3-Dichloropropene 161, 191, **360–361**,
 492
- Dichlorprop (2,4-DP) 161, 191, **361–362**,
 492
- Dieldrin **300–301**
 analysis 161
 guideline value 191, 300, 491
 treatment achievability 169, 300
- Dimethoate **364–366**
 analysis 161
 guideline value 191, 365, 492
 treatment achievability 169, 365
- Dinoseb 189, 488
- 1,4-Dioxane 168
- Di(2-ethylhexyl)phthalate (DEHP) 160,
 188, **363–364**, 491
- Diquat 190, **366–367**, 489
- Disability-adjusted life years (DALYs)
45–47
 microbial hazards 129–130
 reference level of risk and 45
- Disasters 63, **104–109**
 chemical and radiological guidelines
 108–109
 microbial guidelines 107–108
 monitoring 106–107
 practical considerations 105–106
 sanitary inspections and catchment
 mapping 108
 testing kits and laboratories 109
see also Emergencies
- Disease burden
 health outcome targets and 134–135
 waterborne infections 129–130
- Disinfectants 188–189
 analysis 162
 DBP formation and 180
 guideline values 193, 194
 residual, piped distribution systems 63
see also specific disinfectants
- Disinfection **5–6**, 61
 in emergency and disaster situations
 105–106, 107
 indicator organisms 283, 284, 286
 limitations 5
 methods **171–173**
 microbial reduction 140–141
 non-chemical 180
 resistant organisms 142

- on ships 120
- for travellers 110
- vendor supplies 15
- Disinfection by-products (DBPs) 5, 145, **179–180**, 189, 192
 - analysis 162
 - desalinated water 111–112
 - guideline values 193, 194
 - strategies for reducing 179–180
 - see also specific chemicals*
- Displaced populations 104
- Distilled water 114
- Documentation **27–28**
 - incidents and emergencies 28, 77
 - supporting 18–21
 - water safety plans **82–83**
- Domestic supplies *see* Household drinking-water supplies
- Domestic Water Quantity, Service Level and Health* 18
- Dose, infectious 129
- Dose–response assessment, microbial pathogens 127, 128–129
- Dracunculus Eradication Programme 276
- Dracunculus medinensis* (guinea worm) 123, 124, 221, **276–277**
 - intermediate host 212
 - significance in drinking-water 122, 277
- Dreissena polymorpha* 212
- Droughts 104
- Dysentery
 - amoebic 266
 - bacillary 240–241
- Earthquakes 104
- Echinococcus* 124
- Echoviruses 253
- Edetic acid (EDTA) **367–368**
 - analysis 160
 - guideline value 188, 367, 492
 - treatment achievability 168, 367
- EDTA *see* Edetic acid
- Education programmes 12, 71, 89
 - establishing 94
 - schools and day care centres 103–104
- Electrode, ion-selective 158
- Electron capture detection (ECD) 165
- Electrothermal atomic absorption spectrometry (EAAS) 164
- ELISA (enzyme-linked immunosorbent assay) 165–166
- Emergencies 76, **104–109**
 - chemical and radiological guidelines 108–109
 - documentation and reporting 28, 77
 - follow-up investigation 77
 - microbial guidelines 107–108
 - monitoring 106–107
 - practical considerations 105–106
 - radionuclide releases 198
 - response plans 76–77, **78–79**
 - sanitary inspections and catchment mapping 108
 - testing kits and laboratories 109
 - see also* Disasters; Incidents
- Emerging diseases 259
- Empty bed contact time (EBCT) 177
- Encephalitis, granulomatous amoebic (GAE) 260, 261
- Encephalitozoon* 270, 271
- Endosulfan 190, **368–369**, 489
- Endrin **369–370**
 - analysis 161
 - guideline value 191, 369, 492
 - treatment achievability 169, 369
- Entamoeba histolytica* 122, **265–267**
- Enteric fever 239
- Enteric pathogens, in source waters 136–137
- Enteric viruses 247–248, **294–295**
 - coliphages as indicator 290–291
 - indicator value 294
 - in source waters 137
- Enterobacter* 282, 284
- Enterococci, intestinal **287–288**
- Enterococcus* spp. 287
- Enterocolitis, *Staphylococcus aureus* 242
- Enterocytozoon* 270
- Enteroviruses 122, 142, **253–254**, 295
- Environmental Health Criteria monographs (EHCs) 36
- Environmental Protection Agency, US (US EPA) 36
- Enzyme-linked immunosorbent assay (ELISA) 165–166
- Epichlorohydrin (ECH) 162, 194, **370–372**, 492
- Equitability, access to water 105
- Escherichia coli* 282
 - detection methods 144
 - emergency and disaster situations 108
 - enterohaemorrhagic (EHEC) 122, 229–230
 - enteroinvasive (EIEC) 229, 230
 - enteropathogenic (EPEC) 229, 230
 - enterotoxigenic (ETEC) 229, 230
 - guideline values 143

- as indicator of faecal pollution 29, 142, 284–285
- pathogenic 122, 229–231
- phages (coliphages) 289–292
- pipelined distribution systems 63
- in source waters 137
- see also* Coliform bacteria
- Ethylbenzene 372–373
 - analysis 160
 - guideline value 188, 372, 492
 - odour and taste thresholds 215
 - treatment achievability 168, 372
- Ethylene dibromide *see* 1,2-Dibromoethane
- Ethylene thiourea 189, 488
- Evaluation of the H₂S Method for Detection of Fecal Contamination of Drinking Water* 19
- Evaporation method, radionuclide analysis 207–208
- Exposure assessment, microbial pathogens 127, 128
- Eye infections
 - Acanthamoeba* 260
 - adenovirus 248, 249
- Faecal–oral route of transmission 122, 221
- Faecal contamination 3–4
 - control measures 5, 59
 - in emergencies 79, 107
 - indicator organisms *see* Faecal indicator organisms
 - large buildings 100
 - on ships 117
- Faecal indicator organisms 29, 281–295
 - community supplies 82
 - criteria 281–282
 - desalinated water 112
 - emergency and disaster situations 107, 108
 - guideline values 143
 - methods of detection 143–144
 - operational monitoring 69
 - presence/absence (P/A) testing 72
 - in source waters 136–137
 - verification testing 72, 74, 142
- Fasciola* 124, 276, 278–279
- Fascioliasis 278–279
- Fasciolopsis* 124
- Fenamiphos 189, 488
- Fenitrothion 190, 373–374, 489
- Fenoprop 161, 191, 374–375, 492
- Field test kits 109, 158
- Filtration 60–61, 173–175
 - after coagulation 176
 - direct 173
 - drinking-water for travellers 110
 - dual-media or multimedia 174
 - granular high-rate 139
 - horizontal 173, 174
 - membrane 139
 - microbial reduction 139–140
 - precoat 139
 - pressure 173, 174
 - rapid gravity 173–174
 - roughing 138, 174
 - slow sand 139, 173, 174–175
- First-flush diverters 66
- Fit for purpose 75
- Flame atomic absorption spectrometry (FAAS) 159
- Flame ionization detection (FID) 165
- Flavobacterium* 124, 286
- Flocculation 60, 138–139, 175–176
- Floods 104
- Flotation, dissolved air 138, 176
- Flow diagrams 52
- Fluoranthene 193, 428, 489
 - health-based values 429, 430
- Fluoride 375–377
 - analysis 159
 - desalinated water 113
 - guideline value 186, 376, 492
 - health concerns 6, 376–377
 - priority 35–36
 - treatment achievability 167, 376
- Fluorosis 376–377
- Food
 - acceptable daily intakes (ADIs) 150
 - intake of chemicals 152
 - production and processing 115–116
 - safety, travellers 109–110
- Food and Agriculture Organization (FAO) 114
- Food poisoning
 - Bacillus cereus* 225, 226
 - Campylobacter* 228
 - Salmonella* 239, 240
 - Staphylococcus aureus* 242
- Formaldehyde 162, 194, 377–378, 492
- Formothion 189, 488
- Framework for safe drinking water 2–3, 22–36
 - health-based targets 24–25
 - key components 22
 - management plans, documentation and communication 27–28
 - operational monitoring 26–27
 - requirements 22–29

- risk assessment 44
- supporting information 22–23
- surveillance of drinking-water quality 28–29
- system assessment and design 25–26
- Fulvic acids 214
- Fungi 212
- β -Galactosidase 282, 283
- Galvanized iron 183
- Gammarus pulex* 212
- Gas chromatography (GC) 165
- Gas chromatography/mass spectrometry (GC/MS) 165
- Gastroenteritis
 - adenovirus 248–249
 - astrovirus 250
 - calicivirus 252
 - Campylobacter* 228
 - rotavirus 258
 - Salmonella* 239
 - Yersinia* 246
- Genotoxic carcinogens 148–149
- Geosmin 212, 213
- Geothermal waters 272, 273
- Giardia (intestinalis)* 122, **267–268**
 - disinfection 140–141
 - in source waters 137
- Giardiasis 267
- β -Glucuronidase 284
- Glyphosate 190, **379–380**, 489
- Gnat larvae 212
- Grading schemes, safety of drinking-water 29, 53–55, 97, 98
- Granular activated carbon (GAC) 176, 177
- Granulomatous amoebic encephalitis (GAE) 260, 261
- Gray (Gy) 201
- Groundwaters
 - Acinetobacter* 222–223
 - arsenic contamination 146
 - control measures 58, 59, 65–66
 - hazard identification 56, 57
 - pathogen occurrence 136–137
 - radon 206
 - system assessment and design 53, 54
- Guide to Ship Sanitation* 118
- Guideline values (GVs) 1–2, 6–7, 25, 30
 - acceptability and 156
 - applying 30–31
 - chemicals by source category **184–196**
 - chemicals excluded 488
 - chemicals of health significance 491–493
 - chemicals without established 489–490
 - derivation 47, **147–156**
 - approaches 148–149
 - data quality 154–155
 - non-threshold chemicals (non-TDI-based) 154–155
 - significant figures 152
 - threshold chemicals (TDI-based) 149–154
 - see also* Tolerable daily intake
 - in emergencies 108–109
 - health-based targets based on 41
 - mixtures of chemicals and 156
 - provisional 31, 148, **155–156**
 - high uncertainty and 151
 - use and designation 155
 - radionuclides **202–204**
 - radon 207
 - summary tables **488–493**
 - treatment achievability 166–171
 - verification of microbial quality 143
- Guillain–Barré syndrome 228
- Guinea worm *see Dracunculus medinensis*
- Haemolytic uraemic syndrome (HUS) 229–230
- Hafnia* 282
- Halogenated acetonitriles **380–382**
- Hardness 185, **382–383**, 489
 - acceptability 215–216
 - corrosion and 182, 184
 - treatment to reduce 220
- Hazard 52
 - identification 127
 - prioritization, for control 53–55
- Hazard Characterization for Pathogens in Food and Water: Guidelines* 19
- Hazardous events 52, 127
- Health-based targets **24–25**, **37–47**
 - benefits 38
 - establishing 43–47
 - microbial hazards **126–135**
 - role and purpose 37–39
 - types 39–43
- Health care facilities
 - drinking-water quality 102–103
 - health risk assessment 100
- Health education 89, 103–104
 - see also* Education programmes
- Health outcome targets 24–25, 40, **43**
 - waterborne infections **134–135**
- Health promotion 89
- Health risks 3–7
 - aircraft and airports 116
 - chemicals 6–7, **145–147**

- large buildings 100
- microbial *see* Microbial hazards
- radiological 7, 198, 200–201
- ships 117–118
- travellers 109
- Helicobacter pylori* 221, **231–232**
- Helminths 4, 221, **275–279**
 - significance in drinking-water 122, 124
- Hepatitis A virus (HAV) 122, 125, **254–256**
- Hepatitis E virus (HEV) 122, **256–257**
- Heptachlor 190, **383–384**, 489
- Heptachlor epoxide 190, **383–384**, 489
- Heterotrophic micro-organisms 69, 286
- Heterotrophic plate counts (HPC) 5, **285–286**
- Heterotrophic Plate Counts and Drinking-water Safety* 19
- Hexachlorobenzene (HCB) 187, **385–386**, 490
- Hexachlorobutadiene (HCBD) **386–387**
 - analysis 160
 - guideline value 188, 386, 492
 - treatment achievability 168, 386
- Hexachlorocyclohexanes 189, 488
- High-income countries, rotavirus
 - performance targets 131–132
- High-performance liquid chromatography (HPLC) 165
- Holistic approach 3
- Hookworm infections 276
- Hospital-acquired (nosocomial) infections
 - Acinetobacter* 222, 223
 - Klebsiella* 232, 233
 - Pseudomonas aeruginosa* 238
- Hospitals
 - drinking-water quality 102–103
 - health risk assessment 100
- Hot water systems 100, 234–235
- Hotels 100
- Household drinking-water supplies
 - collection, transportation and storage of water 71
 - control measures 65–67
 - hazard identification 64–65
 - management **81–82**
 - operational monitoring 71
 - quantity of water collected and used 90–91
 - roles and responsibilities 11–12, 15–16
 - surveillance **89**
 - system assessment **64–67**
 - treatment 141
 - water safety plans (WSPs) 48–49, 85
- Human dwellings, chemicals originating from *see* Industrial sources and human dwellings, chemicals from
- Humic acids 214
- Hydrocarbons, low molecular weight 217
- Hydrogen peroxide 173, 180
- Hydrogen sulfide 185, **387–388**, 490
 - acceptable levels 216
 - treatment to remove 220
- Hydroquinone 118
- Hydroxyl radicals 173
- Hygiene
 - education programmes *see* Education programmes
 - service level and 90, 91
- Hypertension 436
- Hypochlorite 107, 171
- Hypochlorous acid 171
- Ice 110, 113
- Immunity
 - acquired 125, 130–131
 - variations in 121, 125
- Immunocompromised persons 102, 124
 - Aeromonas* infections 224
 - atypical mycobacteria infections 236
 - disease burden estimates 130
 - isosporiasis 269
 - Klebsiella* infections 232
 - Pseudomonas aeruginosa* 238
 - toxoplasmosis 274
 - travellers 111
 - Tsakumurella* infections 243
- Impingement attack 182, 183
- Improvement, drinking-water systems **67–68**
- Incidents 76
 - audit 86–87
 - documentation and reporting 28, 77
 - follow-up investigation 77
 - predictable 77
 - response plans 76–77, 78
 - unplanned events 77–78
 - see also* Emergencies
- Indeno [1,2,3-cd] pyrene 429
- Index organisms **281–295**
- Indicator organisms 29, **281–295**
- Inductively coupled plasma/atomic emission spectrometry (ICP/AES) 164
- Inductively coupled plasma/mass spectrometry (ICP/MS) 164
- Industrial effluents 214

- Industrial sources and human dwellings,
chemicals from
analysis 159, 160
guideline values **185–187**, 188
treatment achievability 168
- Infants
bottle-fed 114, 418, 419
consumption assumptions 486
see also Children
- Infections, waterborne 4, **121–124**,
221
asymptomatic 125–126
emergency and disaster situations 79,
104, 106
health-based targets 39, 43
health outcome targets 134–135
public health aspects 10–11, **125–126**
risk characterization 127, 129–131
routes of transmission 221
ships 117
see also Pathogens
- Infiltration
bankside 138
contamination via 62, 63
- Information channels, establishing 94
- Ingress
non-piped distribution systems 65
piped distribution systems 62, 63
- Inhalation
assumptions 486–487
chemicals 152
micro-organisms 123, 221
radionuclides 197
radon 206–207
- Inorganic tin 193, **388–389**
- Insecticides, aquatic 190
- Intakes
control measures 59
hazard identification 57–58
- Intermittent water supply 63, 92–93,
101
- International Agency for Research on
Cancer (IARC) 149
- International Atomic Energy Agency (IAEA)
201–202
- International Commission on Radiological
Protection (ICRP) 197, 198,
201–202
- International Health Regulations 116
- International Organization for
Standardization (ISO) standards 75,
76, 144, 208
- International standards 2
- Interspecies variation 151
- Intestinal enterococci **287–288**
- Invertebrate animals 212–213
- Iodine **389–390**
guideline value 193, 389, 490
treatment, for travellers 110, 111
- Iodine-131 202
- Ion chromatography 164–165
- Ion exchange 139, **177**
- Ion-selective electrode 158
- Iron 193, **390–391**, 490
acceptable levels 216, 390
corrosion **181**
galvanized 183
priority 35–36
- Iron bacteria 213, 216
- Isoproturon **391–392**
analysis 161
guideline value 191, 391, 492
treatment achievability 169, 391
- Isospora belli* 221, **268–270**
- Isosporiasis 269
- Jar tests 176
- Joint FAO/WHO Expert Committee
on Food Additives (JECFA) 36,
150
- Joint FAO/WHO Meetings on Pesticide
Residues (JMPR) 36, 150
- Keratitis, *Acanthamoeba* 260–261
- Keratoconjunctivitis, epidemic (“shipyard
eye”) 248, 249
- Kits, testing **109**, 158
- Klebsiella* **232–233**
as indicator organism 282, 284, 286
pathogenicity 124, 232
- Laboratories, in emergencies and disasters
109
- Lactose fermentation 282, 283, 284
- Lakes 137
- Land use 12–13
- Langelier index (LI) 184
- Large buildings **99–104**, 235
drinking-water quality 102–104
health risk assessment 100
independent surveillance and supporting
programmes 102
management 101
monitoring 101–102
system assessment 100–101
- Larson ratio 184
- Larvae 212
- Larvicides, aquatic 190

- Latrines, contamination from 186
- Laws, national drinking-water 31–32
- Lead 6, **392–394**
 analysis 159
 corrosion **181–182**
 guideline value 194, 392, 492
 priority 35–36
 sampling locations 73
- Lead-210 202
- Legionella* spp. 4, 123, 221, **233–235**
 control measures 64, 234–235
 health care facilities 103
 large building systems 100, 235
 persistence 125
 significance in drinking-water 122, 234–235
- Legionellosis 100, 123, 233–234
- Legionnaires' disease 123, 233–234
- Likelihood categories 54–55
- Lime softening 139, 179
- Lindane **394–396**
 analysis 161, 395
 guideline value 191, 395, 492
 treatment achievability 169, 395
- Liver flukes *see Fasciola*
- LOAEL *see* Lowest-observed-adverse-effect level
- Local authorities **11–12**
- Low-income countries, rotavirus
 performance targets 131–132
- Lowest-observed-adverse-effect level (LOAEL) 149, **150**
 uncertainty factors 151
- Lung cancer, radon-related risk 207
- Magnesium 215
- Malathion 190, **396–397**, 490
- Management
 aircraft and airports 117
 community and household supplies 81–82
 large buildings 101
 piped distribution systems **76–81**
 plans **27–28**, 49
 roles and responsibilities **8–18**
 ships 119–120
- Managing Water in the Home* 19, 66–67
- Manganese **397–399**
 acceptability 216, 398
 analysis 159
 guideline value 186, 398, 492
 priority 36
 treatment to remove 167, 220
- Mass spectrometry (MS) 164, 165
- MCPA (4-(2-methyl-4-chlorophenoxy)acetic acid) **399–400**
 analysis 161
 guideline value 191, 399, 492
 treatment achievability 169, 399
- MCPB 189, 488
- MCPP *see* Mecoprop
- Mean, arithmetic *vs* geometric 131
- Mecoprop **400–401**
 analysis 161
 guideline value 191, 401, 492
 treatment achievability 169, 401
- Medical devices, cleaning 103
- Melioidosis 226–227
- Membrane processes, water treatment **178**, 180
- Meningoencephalitis, primary amoebic (PAM) 123, 272, 273
- Mercury **402–403**
 analysis 159
 guideline value 188, 402, 492
 treatment achievability 168, 402
- Meringue dezincification 182–183
- Methaemoglobinaemia 6, 418–420
- Methamidophos 189, 488
- Methomyl 189, 488
- Methoprene 190
- Methoxychlor **403–404**
 analysis 161
 guideline value 191, 403, 492
 treatment achievability 169, 403
- 4-(2-Methyl-4-chlorophenoxy)acetic acid *see* MCPA
- 2-(2-Methyl-4-chlorophenoxy) propionic acid *see* Mecoprop
- 2-Methyl isoborneol 212, 213
- Methyl parathion 190, **404–405**, 490
- Methylene chloride *see* Dichloromethane
- Methylmercury 402
- Metolachlor **405–407**
 analysis 161
 guideline value 191, 406, 492
 treatment achievability 169, 406
- Micro-organisms, indicator and index **281–295**
- Microbial aspects **3–5**, **121–144**
- Microbial growth
 bottled water 114
 desalinated water 113
- Microbial hazards **3–4**, **121–126**
 health-based target setting 126–135
 identification 127
 water quality targets 43, 126
- Microbial pathogens *see* Pathogens

- Microbial quality
 assessing priorities **35**
 emergency and disaster situations 79,
107–108
 grading schemes based on 97, 98
 health care facilities 102–103
 verification **29–30, 72, 142–143**
- Microcystin-LR 195–196, **407–408**, 492
- Microcystins 103, 192, 196, 280
- Microfiltration 139, 178
- Microsporidia 221, 259, **270–272**
- Microstraining 138
- Millennium Development Goals 33
- Mineral waters, natural 114–115
see also Bottled water
- Mining activities 186
- Minister of health 33
- Ministries, government 33, 34
- Mirex 189, 488
- Molinate 161, 191, **408–409**, 492
- Molluscs 212
- Molybdenum 159, 186, **410–411**, 492
- Monitoring
 dissolved radionuclides **204–205**
 emergency and disaster situations
 106–107
 operational *see* Operational monitoring
 plans, preparing **80**
see also Sanitary inspection; Surveillance
- Monobromoacetate 193, 316–317, 490
- Monochloramine **411–412**
 acceptability 216–217
 analysis 162
 by-products 179, 180
 disinfection activity 140, 172
 guideline value 194, 411, 492
- Monochloroacetate 162, 194, **412–413**,
 492
- Monochlorobenzene (MCB) 187, 217,
413–414, 490
- Monocrotophos 189, 488
- Moraxella* 286
- Mudslides 104
- Multiagency approach, collaborative 8
- Multiple-barrier concept 3, 5, 56
- MX (3-chloro-4-dichloromethyl-5-
 hydroxy-2(5H)-furanone) 193,
414–415, 490
- Mycobacterium* (mycobacteria) **235–237**
 atypical (non-tuberculous) 122, 124,
 221
 health care facilities 102
- Mycobacterium avium* complex 235, 236
- Mycobacterium kansasii* 235, 236
- Naegleria fowleri* 123, 125, 221, **272–273**
 control measures 64, 273
 significance in drinking-water 122, 273
- Nais* worms 212
- Nanofiltration 140, 178
- National Academy of Sciences (NAS) (USA)
 207
- National drinking-water policy **31–34**
- National performance targets **133–134**
- National priorities, supply improvement
 93
- National standards and regulations **31–32**
 chemical contaminants 146
 developing 2, **32–34**
- Natural disasters 63, 104
- Naturally occurring chemicals 147
 analysis 159
 guideline values **184–185**, 186
 treatment achievability 167
see also Chemicals
- Necator* 124
- Nematodes 212, 276
- New drinking-water supply systems
 assessment and design **52–53**
 source verification 74
- Nickel **415–417**
 analysis 159, 416
 guideline value 194, 416, 492
 leaching **183**
- Nitrate 6, **417–420**
 agricultural sources 187
 analysis 159, 418
 guideline value 191, 417, 492
 treatment achievability 169, 418
- Nitrification, biological 179
- Nitrilotriacetic acid (NTA) **420–421**
 analysis 160, 420
 guideline value 188, 420, 492
 treatment achievability 168
- Nitrite 6, **417–420**
 analysis 159, 418
 desalinated water 113
 guideline value 191, 417, 492
 treatment achievability 169, 418
- Nitrosamines 419
- No-observed-adverse-effect level (NOAEL)
 149, **150**
 uncertainty factors 151
 vs benchmark dose 153
- NOAEL *see* No-observed-adverse-effect
 level
- Non-piped water systems **64–67**
 control measures 65–67
 hazard identification 64–65

- operational monitoring 71
- roles and responsibilities 16
- treatment 141
- Norms, drinking-water 10
- Noroviruses (Norwalk-like viruses) 122, 251
- Nosema* 270
- Nosocomial infections *see* Hospital-acquired infections
- Nuisance organisms 4–5
- Nursing care homes 100

- Octanol/water partition coefficient 177
- Odour 7, 210, **211–220**
 - biologically derived contaminants 211–213
 - chemical contaminants 213–219
 - treatments for removing 219–220
- Oils, petroleum 186, 217
- Operational limits **70**
- Operational monitoring **26–27, 49, 68–71**
 - aircraft and airports 116–117
 - community supplies 71, 82
 - defined 68
 - large buildings 101–102
 - parameters 68–70
 - ships 119
- Organic matter 214
- Organisms, visible 211, 212–213
- Organotins 345–346
- Orthophosphate 181, 182
- Orthoreoviruses **257–259, 295**
- Osmosis 178
 - reverse 140, 178
- Oxamyl 189, 488
- Oxidation processes, advanced 173
- Oxygen
 - dissolved 215
 - transfer 175
- Ozonation **172**
 - by-products 179, 180, 192
 - microbial reduction 141
- Ozone 172, 173

- Packaged drinking-water **113–115**
 - international standards 114–115
 - safety 113–114
 - see also* Bottled water
- Parasites 420
 - persistence in water 125
 - secondary hosts 212
 - waterborne 122, 124
 - see also* Helminths; Protozoa
- Parathion 190, **421–422, 490**

- Particulate matter 211, 219
- Pathogenic Mycobacteria in Water* 19
- Pathogens 121–124
 - alternative routes of transmission 5, 43–44, 122
 - bacterial **222–247**
 - dose–response assessment 127, 128–129
 - exposure assessment 127, 128
 - fact sheets **221–279**
 - health-based targets 39
 - helminth **275–279**
 - occurrence 135, **136–137**
 - performance targets 41–42, 131–134
 - persistence and growth in water **124–125**
 - protozoan **259–275**
 - special properties 142
 - transmission pathways 123
 - treatment **137–141**
 - viral **247–259**
 - see also* Infections, waterborne
- Pendimethalin **422–423**
 - analysis 161
 - guideline value 191, 423, 492
- Pentachlorophenol (PCP) **424–425**
 - analysis 160, 424
 - guideline value 188, 424, 492
 - treatment achievability 168, 424
- Performance targets 25, 40, **41–42, 126**
 - national/local adaptation 133–134
 - pathogens in raw water 131–132, 133
 - risk-based development **131–134**
- Perlite 139
- Permethrin 190, **425–426, 490**
- Pesticides 187
 - used in water for public health 147
 - analysis 161, 163
 - guideline values **190–192, 195**
 - treatment achievability 170
 - see also* Agricultural activities, chemicals
 - from; *specific compounds*
- Petroleum oils 186, 217
- pH 185, **426–427, 490**
 - chemical coagulation 175–176
 - community supplies 82
 - corrosion and 181, 182, 184
 - DBP formation and 179–180
 - emergency and disaster situations 108
 - optimum range 217, 426
 - saturation 184
- Phages *see* Bacteriophages
- Pharyngoconjunctival fever 248
- 2-Phenylphenol (and its sodium salt) 190, **427–428, 490**
- Phorate 189, 488

- Piped distribution systems **61–64**
 assessment and design 54
 control measures 63–64
 hazard identification 62–63
 intermittent supply 63
 large buildings 100, 101
 management procedures **76–81**
 microbial hazards 123
 operational monitoring parameters 69
 on ships 118, 119
 verification testing **74**
- Pipes 17–18
 bursts 62
 cement lining 183
 coal-tar linings 428, 430
 contaminants 193, 194
 corrosion 181, 182, 183
 lead 181
- Pitting corrosion 182
- Platyhelminthes 276
- Pleistophora* 270
- Plumatella* 212
- Plumbing **17–18**
 household 16
 on ships 118
- Plumbosolvency 181–182
- Plutonium-239 (²³⁹Pu) 202
- Pneumonia, *Burkholderia pseudomallei* 226
- Poisson distribution 129
- Policy
 development, wider 10
 national drinking-water **31–34**
- Poliovirus 253, 295
- Polonium-210 (²¹⁰Po) 202
- Polyacrylamides 296
- Polynuclear aromatic hydrocarbons (PAHs)
428–430
- Polyphosphates 181
- Polyvinylchloride (PVC) 456
- Pontiac fever 233, 234
- Pools, stagnant 101
- Port authority 118, 119
- Potassium-40 (⁴⁰K) 205
- Potassium bromate 315
- Powdered activated carbon (PAC) 176
- Presence/absence (P/A) testing 72
- Pressure, water 62, 63
 large buildings 101
 measurement, operational monitoring 69
- Pretreatment 60, 138
- Prevention, disease 6
- Preventive integrated management approach 8
- Priorities
 assessing chemical 35–36
 assessing microbial 35
 identifying **34–36**
 setting 34
- Problem formulation, microbial hazards 127
- Propanil 190, **430–431**, 490
- Propoxur 189, 488
- Protozoa 221
 cysts and oocysts, removal 61
 pathogenic 122, **259–275**
 resistance to treatment 142
 treatment effects 138–141
- Pseudomonas* 286
- Pseudomonas aeruginosa* 102, 122, 124, **237–239**
- Public awareness, establishing 94
- Public health
 authorities, roles and responsibilities **10–11**, 13
 policy context 44
 surveillance 10–11
 waterborne infections and **125–126**
- Purge-and-trap packed-column GC method 165
- Purge-and-trap packed-column GC/MS method 165
- Pylon technique 208
- Pyridate 189, 488
- Pyriproxyfen 190, **431–432**
 analysis 163
 guideline value 195, 432, 492
 treatment achievability 170, 432
- QMRA *see* Quantitative microbial risk assessment
- Quality assurance **75–76**
- Quality control **8–9**, **75–76**
- Quantifying Public Health Risk in the WHO Guidelines for Drinking-water Quality* 19, 47
- Quantitative microbial risk assessment (QMRA) 43, 126–131
 dose–response assessment 128–129
 exposure assessment 128
 problem formulation and hazard identification 127
 risk characterization 129–131
- Quantitative risk assessment 43
- Quantitative service indicators 74–75
- Quantity of supply
 assessment of adequacy **90–91**
 emergency and disaster situations 105
- Quintozene 189, 488

- Radiation
 absorbed dose 201
 background exposures 198
 committed effective dose 201, 205
 dose **201–202**
 effective dose 201
 equivalent dose 201
 exposure through drinking-water **200**
 health risks 7, 198, 200–201
 reference dose level (RDL) 198, 202
 sources **198–201**
- Radioactivity
 measurement 207–208
 screening 204
 units **201–202**
- Radiological aspects 7, **197–209**
- Radionuclides 7, 197–209
 activity concentration 201, 202
 analytical methods 207–208
 dose coefficients 201–202
 emergency and disaster situations
108–109
 guidance levels **202–204**
 monitoring and assessment for dissolved
204–205
 remedial measures 205
 reporting of results 209
 sampling 209
 screening for 204, 206
 sources 200
 strategy for assessing drinking-water 205,
 206
- Radium-226 (²²⁶Ra) 202
 Radium-228 (²²⁸Ra) 202
 Radon (²²²Rn) 197, **206–207**
 in air and water 206
 guidance levels 207
 measurement **208**
 risk 207
 sampling 209
- Rainfall 29–30
- Rainwater
 collection systems 65, 66, 141
 consumption 114
- Records *see* Documentation
 “Red water” 181, 216
- Reference dose level (RDL) 198, 202
 Reference level of risk 44–45, 47, 132–133
- Regional level
 performance target setting **133–134**
 supply improvement 93
 use of data for priority setting **96–97**,
 98
 “Regrowth” 5
- Regulations, national *see* National standards
 and regulations
- Reoviridae 257
- Reporting
 incidents and emergencies 28, 77
 radioactivity analysis **209**
 surveillance information **95–97**
- Reservoirs 54
 control measures 58–59, 64
 hazard identification 57–58
 occurrence of pathogens 137
- Resource protection **56–59**, 81
 control measures 58–59
 hazard identification 56–58
- Respiratory infections, adenoviral 248
- Reverse osmosis 140, 178
- Risk
 defined 52
 judgement of tolerable 2, 37
 reference level **44–45**, 47, 132–133
 scoring 53–55
- Risk–benefit approach 2, 45
- Risk assessment 53–55
 in framework for safe drinking water **44**
 quantitative 43
 quantitative microbial *see* Quantitative
 microbial risk assessment
- Risk characterization, waterborne infection
 127, 129–131
- Rivers, occurrence of pathogens 136, 137
- Roles and responsibilities, management
8–18
- Rotaviruses (HRVs) 122, **257–259**
 performance target setting 131–132, 133,
 134, 135
 risk characterization 129, 130–131
- Roughing filters 138, 174
- Routes of transmission 123
- Safe Piped Water: Managing Microbial Water
 Quality in Piped Distribution Systems*
 19–20
- Salmonella* (salmonellae) 122, 137, **239–240**
Salmonella Enteritidis 239
Salmonella Paratyphi 239
Salmonella typhi 122, 239
Salmonella Typhimurium 239, 240
- Sample numbers, minimum 74
- Sampling
 community-managed supplies 89
 frequencies 72, 73, 75
 ISO standards 75
 locations 73
 radioactive contaminants **209**

- Sanitary code 33–34
 Sanitary inspection 86
 community-managed supplies 71, 74, 75, 89
 emergency and disaster situations **108**
 use of data 97, 98
Sapovirus (Sapporo-like viruses) 122, 251
 Scale, calcium carbonate 183–184, 215–216
Schistosoma spp. 122, 221
 Schistosomiasis 123, 276
 “Schmutzdecke” 174
 Schools 100, **103–104**
 Screening, radionuclides in drinking-water **204**, 206
 Scum 215
 Seasonal discontinuity of supply 93
 Seawater 111, 112
 Sedimentation 60, 138–139, 176
 Selenium 6, **432–434**
 analysis 159, 433
 guideline value 186, 433, 492
 priority setting and 35–36
 treatment achievability 167, 433
Septata 270
 Septic tanks 186
Serratia 124, 282, 286
 Service indicators, quantitative 74–75
 Service levels 90–91
 Severity categories 54–55
Shigella 122, **240–241**
 Shigellosis 240–241
 Ships **117–120**
 health risks 117–118
 management 119–120
 operational monitoring 119
 surveillance 120
 system risk assessment 118
 “Shipyard eye” 248, 249
 Sievert (Sv) 201
 Significant figures 152
 Silicates 181
 Silver **434–435**
 guideline value 193, 490
 treatment, for travellers 110
 Simazine **435–436**
 analysis 161
 guideline value 191, 435, 492
 treatment achievability 170, 435
 Single-hit principle 128–129
 Skin absorption *see* Dermal absorption
 Snails 123, 212
 Sodium 185, **436–437**, 490
 taste threshold 217–218, 436
 Sodium bromate 315
 Sodium hypochlorite 107, 171
 Sodium sulfate 218
 Softening 177
 lime 139, 179
 precipitation 179
 Solids, total dissolved (TDS) 185, 218, **444–445**, 490
 Solubility, water 177
 Source protection **56–59**, 66
 Source waters
 chemical contaminants 147
 community and household systems 71, 82
 control measures 58–59
 desalination systems 111
 emergency and disaster situations 105
 hazard identification 56–58
 microbial hazards 123
 naturally occurring chemicals 185
 new systems 52–53
 operational monitoring 69, 71
 pathogen occurrence 135, 136–137
 seasonal fluctuation 93
 verification **73–74**
 see also Catchments
 Spas 234, 273
 Specified technology targets 25, 40, **41**
Spirometra 124
 Springs 65, 141
 Stagnant pools 101
Standard for Bottled/Packaged Waters 115
Standard for Natural Mineral Waters 114–115
 Standard operating procedures (SOPs) 81
 incident responses 77, 78
 Standards
 bottled drinking-water 114–115
 certification 17
 drinking-water 10
 national *see* National standards and regulations
Staphylococcus aureus **242–243**
 Stomach cancer, radon-related risk 207
 Storage
 after disinfection 61
 emergency and disaster situations 106
 home 71
 large buildings 101
 off-stream/bankside 138
 on ships 119
 systems
 control measures 58–59, 64, 66
 surveillance 89
 Streams, occurrence of pathogens 136, 137

- Streptococci, faecal 142, 287
- Strongyloidiasis (*Strongyloides*) 124, 276
- Strontium-90 (⁹⁰Sr) 202
- Styrene **437–438**
 analysis 160, 437
 guideline value 188, 437, 492
 odour threshold 218
 treatment achievability 168, 437
- Styrene-7,8-oxide 437, 438
- Sulfate 185, **438–439**, 490
 acceptable level 218
 corrosion control 181, 184
 notifiable level 438–439
- Superchlorination/dechlorination 171
- Suppliers, drinking-water
 audit-based surveillance 87
 independence of surveillance 8–9
 legal functions and responsibilities 31–32
 management plans *see* Water safety plans
 roles and responsibilities 9, **13–14**
- Supply, drinking-water
 adequacy **90–93**
 emergency and disaster situations
 105–106
 improved technologies 92
 intermittent 63, 92–93, 101
 planning and implementing
 improvement 93–94
 unimproved technologies 92
- Supporting programmes **80–81**
 aircraft and airports 117
 large buildings 102
 ships 120
- Surface waters
 control measures 58, 66
 emergency and disaster situations 105
 hazard identification 56–57
Helicobacter pylori 231
 pathogen occurrence 136–137
 system assessment and design 53, 54
 verification 73
- Surveillance **8–9, 28–29, 84–98**
 adapted to specific circumstances 88–89
 adequacy of supply 90–93
 agencies 9, 32, 85
 aircraft and airports 117
 approaches 85–87
 audit-based 86–87
 direct assessment 87
 community drinking-water supplies 87,
 88–89
 definition 9, 84
 large buildings 102
 planning and implementation 93–95
 public health 10–11
 reporting and communicating 95–97
 ships 120
 stages of development 94–95
 urban areas in developing countries 88
see also Monitoring
- Swimming pools 249, 272, 273
- System assessment and design **25–26**, 49,
51–68
 aircraft and airports 116
 collecting and evaluating available data
 53–56
 large buildings 100–101
 ships 118
 treatment 59–61
- Systems, drinking-water
 large buildings 99, 100
 maintaining control **68–71**
 new 52–53, 74
 non-piped *see* Non-piped water systems
 operational monitoring *see* Operational
 monitoring
 piped *see* Piped distribution systems
 resource and source protection 56–59
 on ships 118
 upgrade and improvement 67–68, 94
 validation *see* Validation
 verification *see* Verification
- 2,4,5-T (2,4,5-trichlorophenoxy acetic acid)
439–440
 analysis 161
 guideline value 191, 439, 492
 treatment achievability 170, 440
- Taenia solium* 124
- Tankers, water 15
- Tanks, storage 64
- Taps 101
- Targets
 health-based *see* Health-based targets
 health outcome 24–25, 40, 43
 incremental improvements towards 2
 performance *see* Performance targets
 specified technology 25, 40, 41
 water quality *see* Water quality targets
- Taste 7, 210, **211–220**
 biologically derived contaminants
 211–213
 chemical contaminants 213–219
 treatments for removing 219–220
- TBA *see* Terbutylazine
- TDI *see* Tolerable daily intake
- Team, water safety planning 51
- Temephos 190

- Temperature, water
 acceptable levels **220**
Legionella growth/survival 100, 234–235
Naegleria survival 272, 273
- Terbutylazine (TBA) **440–442**
 analysis 161
 guideline value 191, 441, 492
 treatment achievability 170, 441
- Testing kits **109**, 158
- 3,3',4,4'-Tetrachloroazobenzene 430
- Tetrachloroethene **442–443**
 analysis 160, 442
 guideline value 188, 442, 492
 treatment achievability 168, 442
- Thermotolerant coliform bacteria 142, 143, 282, **284–285**
- THMs *see* Trihalomethanes
- Thorium-228 202
- Thorium-230 202
- Thorium-232 202
- Tin, inorganic 193, **388–389**, 490
- Titration, volumetric 158
- Tolerable daily intake (TDI) 149, **150**
 allocation to drinking-water 151–152
 alternative approaches 152–154
 calculation of guideline values 149–150, 152
 uncertainty factors 150–151
- Toluene **443–444**
 acceptability 218
 analysis 160, 443
 guideline value 188, 443, 492
 treatment achievability 168, 443
- Total coliform bacteria **282–284**
- Total dissolved solids (TDS) 185, 218, **444–445**, 490
- Toxaphene 189, 488
- Toxic Cyanobacteria in Water* 20
- Toxic shock syndrome 242
- Toxicity studies, animal 148
- Toxocara* 124
- Toxoplasma gondii* 122, **274–275**
- Toxoplasmosis 274, 275
- 2,4,5-TP *see* Fenoprop
- Trachipleistophora* 270
- Transportation, household water 71
- Travellers **109–111**
- Treatment **59–61**, **166–184**
 achievability **166–171**
 chemicals used in *see under* Chemicals
 community sources 71
 control measures 60–61
 for corrosion control 180–184
 desalinated water 112
 emergency and disaster situations 105, 107
 hazard identification 59–60
 household 71, 89, 141
 indicator organisms 282, 286
 membrane processes 178, 180
 operational monitoring parameters 69
 pathogen removal **137–141**
 performance target setting and 131–132, 133–134
 processes 138–141, 171–179
 control measures 179–180
 ranking of complexity/costs 166–167
 validation 67
see also specific treatments
 for ships 119
 system assessment and design 53, 54
 taste, odour and appearance problems **219–220**
 for travellers 110
 water quality targets 42
see also Disinfection
- Triazophos 189, 488
- Tributyltin oxide (TBTO) 189, 488
- Trichloramine 193, 411, 490
- Trichlorfon 189, 488
- Trichloroacetaldehyde *see* Chloral hydrate
- Trichloroacetic acid 145, **445–446**
 analysis 162, 445
 guideline value 194, 445, 493
- Trichloroacetonitrile 193, **380–382**, 490
- Trichlorobenzenes (TCBs) 187, 218–219, **446–447**, 490
- 1,1,1-Trichloroethane 187, **447–448**, 490
- Trichloroethene **448–449**
 analysis 160, 449
 guideline value 188, 448, 493
 treatment achievability 168, 449
- Trichloronitromethane *see* Chloropicrin
- 2,4,6-Trichlorophenol **329–331**
 acceptable levels 214
 analysis 162
 guideline value 194, 330, 493
- 2,4,5-Trichlorophenoxy acetic acid *see* 2,4,5-T
- 2,4,5-Trichlorophenoxy propionic acid *see* Fenoprop
- Trichuriasis (*Trichuris*) 124, 276
- Trifluralin **450–451**
 analysis 161
 guideline value 191, 450, 493
 treatment achievability 170, 450

- Trihalomethanes (THMs) 145, 179, **451–454**
 analysis 162
 guideline values 194, 451, 493
 strategies for reducing 179–180
- Trimethylbenzene 217
- Tritium (^3H) 202
- True colour units (TCU) 214
- Tsukamurella* 221, **243–244**
- Tubewells 65
- Turbidity 5, 219
 community supplies 82
 emergency and disaster situations 108
 operational monitoring 69
- Turner diagram 184
- Typhoid fever 239, 240
- Ultrafiltration 139, 178
- Ultraviolet (UV) absorption 159
- Ultraviolet (UV) irradiation 141, 173, 180
- Uncertainty factors (UF) 149, **150–151**
 data-derived 154
- United Nations Scientific Committee on the
 Effects of Atomic Radiation
 (UNSCEAR) 198–199, 207
- Unplanned events **77–78**
- Upgrading, drinking-water systems **67–68**,
 94
- Upgrading Water Treatment Plants* 20
- Uranium 6, **454–456**
 analysis 159, 455
 guideline value 186, 454, 493
 priority setting and 35–36
 treatment achievability 167, 455
- Uranium-234 (^{234}U) 202
- Uranium-238 (^{238}U) 202
- Urban areas
 in developing countries **88**
 zoning 88
- Uveitis, *Acanthamoeba* 260
- Validation 26, 50–51, **67**, 136
- Vendors, water **15**
- Verification **29–31**, 51, **71–76**
 chemical quality 30–31, 72, 73
 community-managed supplies 74–75
 microbial safety and quality 29–30, 72,
142–143, 284
 piped distribution systems 74
 quality assurance and quality control
 75–76
 water sources 73–74
- Vessels
 emergency and disaster situations 106
 packaged drinking-water 113
- Vibrio* **244–246**
Vibrio cholerae 122, 125, **244–246**
- Vinyl chloride **456–458**
 analysis 162
 guideline value 194, 457, 493
- Vinylidene chloride *see* 1,1-Dichloroethene
- Viruses 221
 enteric *see* Enteric viruses
 indicator and index **289–295**
 pathogenic 122, **247–259**
 persistence in water 125
 treatment effects 138–141
- Visible organisms 211, 212–213
- Vittaforma* 270
- Volumetric titration 158
- Warm water systems 100
- Wastewater, domestic, chemicals in 186
- Water avoidance orders 79
- Water extraction systems, control measures
 58–59
- Water quality 90
 health care facilities 102–103
 monitoring *see* Monitoring
 sources, in disaster situations 105
see also Guideline values
- Water Quality Monitoring* (Bartram &
 Ballance) 75–76
- Water quality targets (WQTs) 25, 40, **42–43**,
 126
- Water resource management **12–13**
see also Resource protection
- Water Safety Plans* 20, 48, 66
- Water safety plans (WSPs) 4, 24, 26, **48–83**
 aircraft and airports 116
 approval and review 85
 audit 86, 94
 community and household supplies 85
 documentation and communication
 82–83
 health care facilities 103
 key components 49
 large buildings 99, 102
 management 76–82
 model 66
 operational monitoring and maintaining
 control 68–71
 ships 120
 stages in development 50
 supporting programmes 80–81
 surveillance *see* Surveillance
 system assessment and design 51–68
 verification *see* Verification
- Water sources *see* Source waters

INDEX

- Water suppliers *see* Suppliers, drinking-water
- Water treatment *see* Treatment
- Water Treatment and Pathogen Control* 20, 61
- Water vendors **15**
- Waterborne infections *see* Infections, waterborne
- Weight, body *see* Body weight
- Wells 59, 65, 141
- WHO Pesticide Evaluation Scheme (WHOPES) programme 148, 190
- Winter vomiting disease 252
- Wound infections, *Aeromonas* 224
- WQTs *see* Water quality targets
- WSPs *see* Water safety plans
- Xanthomonas* 286
- Xylenes **458–459**
- acceptable level 219
 - analysis 160, 458
 - guideline value 188, 458, 493
 - treatment achievability 168, 458
- Yersinia* **246–247**
- Yersinia enterocolitica* 122, 246, 247
- Yersinia pseudotuberculosis* 246, 247
- Zinc 193, **459–460**, 490
- acceptable level 219, 459
 - corrosion **183**
 - dissolution from brass 182–183
- Zoning, urban areas 88

