
Field Hydrogeology

SECOND EDITION

Rick Brassington

Consultant Hydrogeologist

Contents

Preface	ix
Acknowledgements	xi
Chapter 1	Introduction.....1
	1.1 Why investigate groundwater? 1
	1.2 The hydrological cycle..... 2
	1.3 Stages of an investigation 5
Chapter 2	Instruments and Equipment..... 9
	2.1 Water-level dippers10
	2.2 Continuous water-level records18
	2.3 Water sampling 22
	2.4 Ground-level measurements 38
	2.5 Soil and rock samples41
	2.6 Tool box 45
Chapter 3	Sources of Information47
	3.1 Topographic maps 48
	3.2 Geological information..... 49
	3.3 Groundwater levels51
	3.4 Surface water measurements51
	3.5 Rainfall and evaporation51
	3.6 Abstraction records 52
	3.7 Groundwater chemistry 53
	3.8 Aerial photographs and remote sensing..... 53
Chapter 4	Desk Study..... 54
	4.1 Defining the area 55

	4.2 Identifying the aquifers	55
	4.3 Groundwater levels	57
	4.4 Surface water	58
	4.5 Recharge	59
	4.6 Groundwater use	61
	4.7 Groundwater chemistry	62
	4.8 Aerial photographs and satellite imagery	63
	4.9 Planning a fieldwork programme	65
Chapter 5	Field Evaluation of Aquifers	66
	5.1 Hydraulic properties of aquifers	66
	5.2 Hydraulic properties and rock types	70
	5.3 Assessing hydraulic properties	79
	5.4 Using hydraulic properties information	81
Chapter 6	Groundwater Levels	86
	6.1 Compiling a well catalogue	88
	6.2 Field surveys for wells, boreholes and springs	91
	6.3 Interpretation of abstraction borehole water levels	98
	6.4 Observation borehole networks	100
	6.5 Groundwater-level fluctuations	101
	6.6 Managing groundwater-level data	107
	6.7 Constructing groundwater contour maps and flow nets	108
	6.8 Interpretation of contour maps and flow nets	112
	6.9 Using other groundwater information	115
Chapter 7	Rainfall, Springs and Streams	116
	7.1 Precipitation	116
	7.2 Evaporation	120
	7.3 Springs	121
	7.4 Stream-flow measurement	124
	7.5 Stage–discharge relationships	132
	7.6 Choosing the best method	135
	7.7 Processing flow data	137
	7.8 Using artificial tracers	139
Chapter 8	Pumping Tests	144
	8.1 What is a pumping test?	144
	8.2 Planning a pumping test	146
	8.3 Pumps and pumping	146
	8.4 On-site measurements	150
	8.5 Pretest monitoring	160
	8.6 Test set-up	160
	8.7 Step tests	162

	8.8 Constant rate tests	164
	8.9 Recovery tests	165
	8.10 Tests on single boreholes	166
	8.11 Packer tests	167
	8.12 Pumping-test analysis	167
Chapter 9	Groundwater Chemistry.	180
	9.1 Analytical suites and determinands	181
	9.2 Sampling protocols	182
	9.3 Down-hole geophysics.	185
	9.4 Monitoring networks	188
	9.5 Using chemical data	191
Chapter 10	Recharge Estimation.	194
	10.1 Water balance	195
	10.2 Rainfall recharge.	198
	10.3 Induced recharge.	199
	10.4 Other sources of recharge	199
Chapter 11	Special Groundwater Investigations	202
	11.1 New groundwater supplies	202
	11.2 Loss of yield	206
	11.3 Lowered groundwater levels	208
	11.4 Rising water tables.	212
	11.5 Groundwater contamination	214
	11.6 Waste disposal sites	215
	11.7 Groundwater clean-up	217
	11.8 Groundwater modelling	218
Chapter 12	Report Writing and Presentation	220
	12.1 Summary	222
	12.2 Introduction	222
	12.3 Topography and drainage	222
	12.4 Geology	223
	12.5 Hydrogeology	224
	12.6 Groundwater chemistry	224
	12.7 Water resources	224
	12.8 Conclusions and recommendations	225
	12.9 Appendices	225
	12.10 Illustrations.	225
Appendix I	Good Working Practice	227
	I.1 Safety codes	227
	I.2 Clothing and equipment	228

I.3 Distress signals	229
I.4 Exposure	230
I.5 Heat exhaustion	230
I.6 Working near wells and boreholes	231
I.7 Hygiene precautions	232
I.8 Trial pits	232
I.9 Electrical equipment	232
I.10 Filling fuel tanks	233
I.11 Using heavy equipment	233
I.12 Waste disposal sites	233
I.13 Current-meter gauging	234
I.14 Bibliography	234
Appendix II Units	235
II.1 Volume	235
II.2 Aquifer characteristics	235
II.3 Discharge rate	235
II.4 Conversion factors	236
Appendix III Grain-size scales	238
Bibliography	239
Index	243