

# Contents

|   |      |
|---|------|
| <b>Introduction</b> . . . . .                           | xiii |
| <b>1. The State of Water</b> . . . . .                  | 1    |
| The Colorado . . . . .                                  | 1    |
| The Aral . . . . .                                      | 2    |
| Talupula . . . . .                                      | 2    |
| Worldwide . . . . .                                     | 3    |
| Spread of deserts . . . . .                             | 4    |
| War and conflict . . . . .                              | 5    |
| Where there is hope . . . . .                           | 6    |
| Just add water! . . . . .                               | 6    |
| References . . . . .                                    | 7    |
| <b>2. A Look at the Past</b> . . . . .                  | 9    |
| Petra . . . . .   | 9    |
| References . . . . .                                    | 12   |
| <b>3. How Water Moves in the Environment</b> . . . . .  | 13   |
| The hydrological cycle . . . . .                        | 13   |
| The path of water . . . . .                             | 15   |
| Hydrology 101 . . . . .                                 | 19   |
| The layout of landscapes . . . . .                      | 23   |
| References . . . . .                                    | 27   |
| <b>4. Designing for the Whole Environment</b> . . . . . | 29   |
| Permaculture and sustainability . . . . .               | 29   |
| The design process . . . . .                            | 30   |
| Permaculture strategies . . . . .                       | 32   |
| Source to sink . . . . .                                | 33   |

|   |           |
|---|-----------|
| Reading the land . . . . .                                | 34        |
| The potential for overharvesting . . . . .                | 35        |
| Permitting and legal restrictions . . . . .               | 38        |
| Working with crews . . . . .                              | 39        |
| References . . . . .                                      | 40        |
| <b>5. Elements of Design and Implementation . . . . .</b> | <b>41</b> |
| Rain volumes . . . . .                                    | 41        |
| Climate effects . . . . .                                 | 41        |
| Temperate climates . . . . .                              | 42        |
| Tropical climates . . . . .                               | 44        |
| Coral atolls . . . . .                                    | 44        |
| Drylands . . . . .  | 45        |
| Decoupling catchments . . . . .                           | 46        |
| The path of water . . . . .                               | 47        |
| Soil . . . . .  | 47        |
| Slope stability . . . . .                                 | 47        |
| Finding contour . . . . .                                 | 48        |
| Laser level . . . . .                                     | 48        |
| Farmer's level . . . . .                                  | 50        |
| Builder's level . . . . .                                 | 50        |
| Water level . . . . .                                     | 50        |
| A-Frame . . . . .   | 51        |
| LIDAR . . . . .   | 51        |
| Mapping . . . . .   | 52        |
| Determining slope . . . . .                               | 53        |
| Earthmoving machines . . . . .                            | 53        |
| Types of machines . . . . .                               | 54        |
| Bulldozers . . . . .                                      | 54        |
| Excavators . . . . .                                      | 56        |
| Loaders . . . . .   | 57        |
| Backhoes . . . . .  | 57        |
| Compactors . . . . .                                      | 58        |
| Safety . . . . .  | 59        |
| Topsoil and erosion . . . . .                             | 60        |
| References . . . . .                                      | 60        |

|  |     |
|--|-----|
| <b>6. Water Storage Techniques . . . . .</b>                   | 61  |
| Ponds . . . . .  | 61  |
| Cisterns . . . . .   | 63  |
| Dams . . . . .   | 64  |
| References . . . . .   | 83  |
| <b>7. Interception Techniques . . . . .</b>                    | 85  |
| Swales . . . . .   | 85  |
| Case Study: The Green Tree Foundation swales project . . . . . | 91  |
| Bench terraces . . . . .                                       | 98  |
| Land imprinters . . . . .                                      | 104 |
| Trees . . . . .  | 105 |
| Spate irrigation . . . . .                                     | 111 |
| Diversion drains . . . . .                                     | 116 |
| References . . . . .   | 116 |
| <b>8. Applying Permaculture Strategies . . . . .</b>           | 119 |
| Goal setting, planning, adjusting . . . . .                    | 119 |
| Zone planning . . . . .  | 120 |
| Sector planning . . . . .                                      | 121 |
| Stacking functions and functional connectivity . . . . .       | 123 |
| Variations in structure and shape . . . . .                    | 125 |
| Flow . . . . .   | 128 |
| Efficiency . . . . .   | 130 |
| Where to start . . . . .                                       | 130 |
| Case Study: Circle Organic ridge point dam . . . . .           | 131 |
| References . . . . .   | 134 |
| <b>9. Cautions . . . . .</b>                                   | 135 |
| The dynamics of slides . . . . .                               | 136 |
| The role of water . . . . .                                    | 138 |
| Sensitive clays . . . . .                                      | 139 |
| Landslide triggers . . . . .                                   | 140 |
| Post-slide treatment . . . . .                                 | 141 |
| What went wrong at Aberfan? . . . . .                          | 142 |
| References . . . . .   | 142 |
| <b>Appendices . . . . .</b>                                    | 145 |
| 1. Calculating Areas and Volumes . . . . .                     | 147 |

|   |            |
|---|------------|
| 2. Calculating Runoff Volumes . . . . .       | 151        |
| 3. Finding Slopes and Heights . . . . .       | 153        |
| 4. Swale Spacing . . . . .                    | 155        |
| 5. Terracing . . . . .                        | 159        |
| 6. Costing Earthworks . . . . .               | 161        |
| <b>Index . . . . .</b>                        | <b>169</b> |
| <b>About the Author . . . . .</b>             | <b>177</b> |
| <b>About New Society Publishers . . . . .</b> | <b>178</b> |