List of figures

Figure 1.1 Major dams (greater than 500 GL capacity), large irrigation areas and selected drainage divisions across Australia 3

Figure 1.2 Schematic diagram of key components and concepts in the establishment of a greenfield irrigation development 7

Figure 2.1 The Flinders and Gilbert catchments within the Gulf region of northern Australia 10

Figure 2.2 The Gilbert catchment 11

Figure 2.3 Soil sampling sites and airborne geophysical survey flight lines of the Gilbert catchment 14

Figure 2.4 Schematic representation of digital soil mapping method 15

Figure 2.5 Availability of rainfall data availability in the Gilbert catchment 16

Figure 2.6 Crop yield (peanuts) and applied irrigation water 27

Figure 3.1 Schematic diagram of key natural components and concepts in the establishment of a greenfield irrigation development 34

Figure 3.2 Simplified surface geology of the Gilbert catchment 37

Figure 3.3 Map of soil generic group (SGG) classes for the Gilbert catchment 41

Figure 3.4 Surface soil pH of the Gilbert catchment 43

Figure 3.5 Minimum soil depth of the Gilbert catchment 43

Figure 3.6 Surface texture of soils in the Gilbert catchment 44

Figure 3.7 Soil permeability of the Gilbert catchment 45

Figure 3.8 Plant available water capacity in the Gilbert catchment 46

Figure 3.9 Electrical conductivity in the top 10 cm of soils of the Gilbert catchment 47

Figure 3.10 Typical synoptic systems influencing the Gilbert catchment 48

Figure 3.11 Mean annual rainfall and potential evaporation under Scenario A 49

Figure 3.12 Potential evaporation under Scenario A for the Gilbert catchment 50

Figure 3.13 Rainfall under Scenario A for the Gilbert catchment 50

Figure 3.14 Rainfall deficit under Scenario A for the Gilbert catchment 50

Figure 3.15 Rainfall and potential evaporation under Scenario A averaged across the Gilbert catchment 51

Figure 3.16 Mean annual rainfall and potential evaporation averaged over the Gilbert catchment 52

Figure 3.17 Rainfall variability around Australia under Scenario A 53

Figure 3.18 Runs of wet and dry years in the Gilbert catchment 54

Figure 3.19 Percentage change in mean annual rainfall under Scenario C relative to Scenario A 55

Figure 3.20 Spatial distribution of mean annual rainfall across the Gilbert catchment under scenarios Cwet, Cmid and Cdry 55

Figure 3.21 Mean monthly rainfall and potential evaporation for the Gilbert catchment under scenarios A and C 56

Figure 3.22 Schematic diagram of terrestrial water balance in the Gilbert catchment 57

Figure 3.23 Major aquifers of the Gilbert catchment 58

Figure 3.24 Schematic cross-section highlighting the connectivity between aquifers of the Carpentaria and Karumba basins of the Great Artesian Basin 59

Figure 3.25 Groundwater salinity in the Gilbert catchment with the recharge area of the Great Artesian Basin and the location of airborne electromagnetic flight lines shown in Figure 3.26 and Figure 3.27 60

Figure 3.26 Satellite image and conductivity-depth section for flight line 20070 61

Figure 3.27 Map of mean annual groundwater recharge in the Gilbert catchment under Scenario A 63

Figure 3.28 Likelihood of groundwater inflow at river and pool sampling sites in the Gilbert catchment 65

Figure 3.29 Main rivers and streamflow gauging stations of the Gilbert catchment 66

Figure 3.30 Change in catchment area along the Gilbert River from Gilberton 67

Figure 3.31 Change in catchment area along the Einasleigh River from the confluence of the Einasleigh River and Bundock Creek 67

Figure 3.32 Mean annual rainfall and runoff across the Gilbert catchment under Scenario A 68

Figure 3.33 Map showing 20%, 50% (median) and 80% exceedance annual runoff across the Gilbert catchment under Scenario A 68

Figure 3.34 Runoff in the Gilbert catchment under Scenario A 69

Figure 3.35 Gilbert River downstream of Rockfields streamflow gauging station (October 2012) 69

Figure 3.36 Median annual streamflow (i.e. 50% exceedance) in the Gilbert catchment 72

Figure 3.37 20% and 80% exceedance of annual streamflow in the Gilbert catchment 72

Figure 3.38 Flood inundation map of the Gilbert catchment 74

Figure 3.39 Spatial extent and temporal variation of inundation during simulated flood events of (a) 2001, (b) 2008, (c) 2009 and (d) 2011 75

Figure 3.40 Instream waterhole evolution 76

Figure 3.41 Location of key aquatic refugia identified in the Gilbert catchment 77

Figure 4.1 Schematic diagram of key components of the living and built environment to be considered in the establishment of a greenfield irrigation development 80

Figure 4.2 Gilbert River 83

Figure 4.3 Fish distribution in the Gilbert catchment 85

Figure 4.4 Saw-shelled turtle captured in the Gilbert catchment 86

Figure 4.5 Example of a typically clear waterhole in the Einasleigh River, Gilbert catchment 88

Figure 4.6 Status of regional ecosystem biodiversity for the Gilbert catchment 91

Figure 4.7 Spatial representation of important ecological assets across the Gilbert catchment 93

Figure 4.8 Photographic collage of early colonial mining on the Etheridge goldfields (Lees, 1899) 96

Figure 4.9 Current native title determinations and applications in the Gilbert catchment 98

Figure 4.10 Indigenous land use agreements and Indigenous-controlled pastoral leases in the Gilbert catchment 99

Figure 4.11 Total live cattle export from Australia, September 1992 to September 2012 112

Figure 4.12 Current mining and mineral exploration and development leases in the Gilbert catchment 113

Figure 4.13 Petroleum, geothermal and coal exploration licences in the Gilbert catchment 114

Figure 4.14 Downstream face of Kidston Dam (officially known as Copperfield River Gorge Dam) on the Copperfield River 115

Figure 4.15 Multi-combination vehicles 116

Figure 4.16 Queensland infrastructure map showing accessibility of heavy vehicles, ports and railways in Queensland and the Gilbert catchment 117

Figure 4.17 Gilbert catchment infrastructure map showing accessibility of heavy vehicles, ports, railways and high voltage powerlines 118

Figure 5.1 Schematic diagram of key engineering and agricultural components to be considered in the establishment of a greenfield irrigation development 128

Figure 5.2 Schematic diagram of an embankment dam 131

Figure 5.3 DamSite model results for the Gilbert catchment overlain on transparent geology and shaded relief map 134

Figure 5.4 Mount Noble range looking upstream along Einasleigh River 138

Figure 5.5 Cost of water in $/ML versus cumulative divertible yield at 85% annual time reliability 139

Figure 5.6 Kidston Dam looking upstream 141

Figure 5.7 Dam cross-section, height, volume and reservoir surface area for Kidston Dam 141

Figure 5.8 Raised Kidston Dam extent of inundation and property boundaries (indicated by coloured shading) 142

Figure 5.9 Annual time reliability and volumetric reliability for Kidston Dam under scenarios A and C 143

Figure 5.10 Comparisons of inundated area with and without the raising of Kidston Dam under Scenario A 143

Figure 5.11 Regional ecosystems inundated by the raised Kidston Dam reservoir at full supply level 144

Figure 5.12 Dagworth potential dam site, looking upstream 145

Figure 5.13 Dam cross-section, height, volume and reservoir surface area for Dagworth dam site 146

Figure 5.14 Dagworth dam depth of inundation and property boundaries (indicated by coloured shading) 146

Figure 5.15 Annual time reliability and volumetric reliability for Dagworth dam under scenarios A and C 147

Figure 5.16 Comparisons of inundated area with and without the construction of Dagworth dam under Scenario A 147

Figure 5.17 Regional ecosystems inundated by the potential Dagworth dam reservoir at full supply level 148

Figure 5.18 Green Hills upstream potential dam site, looking upstream 149

Figure 5.19 Dam cross-section, height, volume and reservoir surface area for Green Hills potential dam site 150

Figure 5.20 Green Hills upstream potential dam depth of inundation and property boundaries (indicated by coloured shading) 150

Figure 5.21 Annual time reliability and volumetric reliability for Green Hills dam under scenarios A and C 151

Figure 5.22 Comparisons of inundated area with and without construction of Green Hills dam under Scenario A 152

Figure 5.23 Regional ecosystem inundated by the potential Green Hills dam reservoir at full supply level 152

Figure 5.24 Schematic diagram of sheet piling weir 153

Figure 5.25 Ring tank in the Flinders catchment 156

Figure 5.26 Annual volume of streamflow extracted versus annual time reliability for streamflow gauge 917111A 157

Figure 5.27 Annual volume of streamflow extracted versus annual time reliability for streamflow gauge 917001D 157

Figure 5.28 Annual volume of streamflow extracted versus annual time reliability for streamflow gauge 917102A 158

Figure 5.29 Annual volume of streamflow extracted versus annual time reliability for streamflow gauge 917107A 158

Figure 5.30 Land suitability map for offstream water storages in the Gilbert catchment 160

Figure 5.31 Reported conveyance losses from irrigation systems across Australia (ANCID, 2001) 165

Figure 5.32 Efficiency of different types of irrigation systems 166

Figure 5.33 Probability of crop yield potential for dryland and fully irrigated mungbean sown in Georgetown climate on 15 February 176

Figure 5.34 Probability of crop yield potential for dryland and fully irrigated sorghum (grain) sown in Georgetown climate on 15 January 176

Figure 5.35 Probability of crop yield potential for dryland and fully irrigated cotton sown in Georgetown climate on 15 January 176

Figure 5.36 Crop yield plotted against applied irrigation water in Georgetown climate 178

Figure 5.37 Applied irrigation water for planting on the 15th day of each month for sorghum (grain) at Georgetown 182

Figure 5.38 Crop yield for planting on the 15th day of each month for sorghum (grain) at Georgetown 183

Figure 5.39 The area associated with each land suitability class for a selection of 14 crops in the Gilbert catchment 186

Figure 5.40 Modelled land suitability for sorghum (grain). Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 188

Figure 5.41 Sorghum (grain) 188

Figure 5.42 Modelled land suitability for mungbean. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 191

Figure 5.43 Mungbean 191

Figure 5.44 Modelled land suitability for Rhodes grass and sorghum (forage). Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 195

Figure 5.45 Bambatsi 195

Figure 5.46 Modelled land suitability for lablab and lucerne. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 198

Figure 5.47 Lablab 198

Figure 5.48 Modelled land suitability for cotton. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 202

Figure 5.49 Cotton 202

Figure 5.50 Modelled land suitability for sugarcane. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 205

Figure 5.51 Sugarcane 205

Figure 5.52 Modelled land suitability for sweet corn and tomato. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 208

Figure 5.53 Sweet corn 208

Figure 5.54 Modelled land suitability for cassava and peanuts. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 211

Figure 5.55 Peanuts 211

Figure 5.56 Modelled land suitability for mango and Indian sandalwood. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 214

Figure 5.57 Indian sandalwood 214

Figure 5.58 Modelled land suitability for mango and Indian sandalwood. Note that this land suitability map does not take into consideration flooding, risk of secondary salinisation or availability of water 218

Figure 5.59 Mangoes 218

Figure 6.1 Schematic diagram of key components and concepts in the establishment of a greenfield irrigation development 226

Figure 6.2 Growth patterns of beef cattle in northern Australia 229

Figure 6.3 Land tenure in the Gilbert catchment 248

Figure 7.1 Schematic diagram of key components and concepts in the establishment of a greenfield irrigation development 252

Figure 7.2 Steady-state watertable level for (a) various recharge rates and hydraulic conductivities (K) and (b) an irrigation area of 100 ha, at varying distances to the river 258

Figure 7.3 Steady-state watertable level for an irrigation area of 1000 ha, plotted against distance to the river 258

Figure 7.4 Steady-state watertable level at varying distances to the river for an irrigation area of (a) 250 ha and (b) 500 ha 258

Figure 7.5 Steady-state watertable level at varying distances (d) to the river for (a) an irrigation area of 1000 ha and (b) various irrigation area and distance combinations 259

Figure 7.6 Watertable level for various aquifer diffusivities (D) and distances to river (d), for an irrigation area of 100 ha and recharge rate of 100 mm/year 259

Figure 7.7 Flux response for different aquifer diffusivities, for different hydraulic conductivities (K), specify yields (Sy) and distances to river (d) 260

Figure 7.8 Variation in watertable level beneath two neighbouring 500-ha irrigation developments at different distances of separation 261

Figure 7.9 Conductivity–depth section (lower panel) for flight line 10090. Location of flight line on a satellite image is shown in upper panel. This flight line transects the Gilbert River and Etheridge River downstream of Georgetown 262

Figure 8.1 Schematic diagram illustrating the components of the case study for a dam and irrigation development near Green Hills station 273

Figure 8.2 (a) Satellite map and (b) relief and flood map of the area surrounding Green Hills dam 276

Figure 8.3 (a) Soil generic group map and (b) land suitability map of the area surrounding the Green Hills site for spray-irrigated cotton 278

Figure 8.4 Landscape near the potential Green Hills dam irrigation development 279

Figure 8.5 (a) Monthly rainfall and (b) monthly potential evaporation under Scenario A at Green Hills 280

Figure 8.6 (a) Maximum monthly temperature and (b) minimum monthly temperature under Scenario A at Green Hills 280

Figure 8.7 Annual streamflow on the Gilbert River at the Green Hills dam site under Scenario A 281

Figure 8.8 Crop yield versus applied irrigation water under Scenario A for (a) cotton, (b) peanuts and (c) sorghum (forage) 286

Figure 8.9 Mean annual applied irrigation water supplied to the field in (a) cotton, (c) peanuts and (e) sorghum (forage) in ML, and (b) cotton, (d) peanuts and (f) sorghum (forage) in ML/ha, under Scenario B for the irrigation development associated with the Green Hills dam 289

Figure 8.10 (a) Median annual applied irrigation water supplied to the field and (b) percentage of years that the maximum area is planted under Scenario B for the irrigation development associated with the Green Hills dam 290

Figure 8.11 (a) Ratio of evaporation from the reservoir to the applied irrigation water and (b) percentage of time the volume of the reservoir is less than 20% of the full supply level volume under Scenario B for the irrigation development associated with the Green Hills dam 291

Figure 8.12 Median annual streamflow quotient at (a) gauge 917001D and (b) gauge 917009A for the irrigation development associated with the Green Hills dam 292

Figure 8.13 (a) Cotton, (c) peanuts and (e) sorghum (forage) median of the 30-year mean (M30M) values for crop yield, and (b) cotton, (d) peanuts and (f) sorghum (forage) M30M values for specific yield, under Scenario B for the irrigation development associated with the Green Hills dam 293

Figure 8.14 (a) Median of the 30-year mean (M30M) values for gross margin and (b) M30M values for gross margin per hectare under Scenario B for the irrigation development associated with the Green Hills dam 295

Figure 8.15 (a) Median of the 30-year net present values and (b) standard deviation of the 30-year net present values under Scenario B for the irrigation development associated with the Green Hills dam 296

Figure 8.16 (a) Median of the 30-year farm-scale net present values and (b) standard deviation of the 30-year farm-scale net present values under Scenario B for the irrigation development associated with the Green Hills dam 297

Figure 8.17 Gross margins for cotton under Scenario B for the irrigation development associated with the Green Hills dam, with a scheme area of 12,000 ha and crop area decision of 4 ML/ha: (a) time series and (b) box plot 298

Figure 8.18 Gross margins for peanuts under Scenario B for the irrigation development associated with the Green Hills dam, with a scheme area of 12,000 ha and crop area decision of 4 ML/ha: (a) time series and (b) box plot 298

Figure 8.19 Gross margins for sorghum (forage) under Scenario B for the irrigation development associated with the Green Hills dam, with a scheme area of 12,000 ha and crop area decision of 4 ML/ha: (a) time series and (b) box plot 299

Figure 8.20 Combined gross margins for cotton, peanuts and sorghum (forage) under Scenario B for the irrigation development associated with the Green Hills dam, with a scheme area of 12,000 ha and crop area decision of 4 ML/ha: (a) time series and (b) box plot 300

Figure 8.21 Percentage exceedance plots of (a) net present value and (b) internal rate of return under Scenario B for the scheme-scale 12,000-ha irrigation development associated with the Green Hills dam 301

Figure 8.22 Percentage exceedance plots of (a) net present value and (b) internal rate of return under Scenario B for the farm-scale 12,000-ha irrigation development associated with the Green Hills dam 302

Figure 8.23 Change in depth to watertable for different values of saturated hydraulic conductivity (K): (a) lower recharge rate of 120 mm/year and (b) higher recharge rate of 200 mm/year 304

Figure 9.1 Schematic diagram illustrating the components of the case study for the irrigation developments associated with Green Hills and Dagworth dams 311

Figure 9.2 (a) Satellite image and (b) relief map area surrounding Green Hills and Dagworth dams 314

Figure 9.3 Photo of the landscape near the potential Green Hills dam irrigation development 317

Figure 9.4 (a) Soil generic group map and (b) land suitability map for the middle reaches of the Gilbert and Einasleigh rivers for spray-irrigated sugarcane 318

Figure 9.5 (a) Monthly rainfall and (b) monthly potential evaporation, under Scenario A at Dagworth 319

Figure 9.6 (a) Maximum monthly temperature and (b) minimum monthly temperature, under Scenario A at Dagworth 319

Figure 9.7 Annual streamflow on the Gilbert River at the Green Hills dam site under Scenario A 320

Figure 9.8 Annual streamflow on the Einasleigh River at the Dagworth dam site under Scenario A 321

Figure 9.9 Crop yield versus applied irrigation water under Scenario A for sugarcane for a sand or loam over relatively friable clay subsoil 327

Figure 9.10 (a) Mean annual total applied irrigation water supplied to the field (ML) and (b) ML applied per hectare under Scenario B for the irrigation developments associated with Green Hills and Dagworth dams 329

Figure 9.11 Ratio of evaporation from the reservoir to the applied irrigation water under Scenario B for (a) Green Hills dam and (b) Dagworth dam 330

Figure 9.12 Percentage of time the volume of the reservoir is less than 20% of the full supply level volume under Scenario B for (a) Green Hills dam and (b) Dagworth dam 330

Figure 9.13 Median streamflow quotient at (a) Green Hills dam (gauge 917001D) and (b) Dagworth dam (virtual gauge 355) 331

Figure 9.14 (a) Median of the 30-year mean (M30M) values for crop yield and (b) standard deviation of the 30-year mean values (S30M) for crop yield, under Scenario B for the irrigation development associated with the Green Hills and Dagworth dams. Circles in (a) correspond with lines in Figure 9.15 331

Figure 9.15 Crop yield from the combined scheme area under Scenario B for three different scheme areas marked in Figure 9.14a 332

Figure 9.16 (a) Median of the 30-year mean values (M30M) for specific yield and (b) percentage of time 2 million t of sugarcane is exceeded under Scenario B for the irrigation developments associated with the Green Hills and Dagworth dams 333

Figure 9.17 (a) Median of the 30-year mean (M30M) values for crop gross margin and (b) M30M values for gross margin per hectare under Scenario B for the irrigation developments associated with the Green Hills and Dagworth dams 334

Figure 9.18 a) Median of the 30-year mean (M30M) values for scheme-scale net present value and (b) standard deviation of the 30-year mean (S30M) values for scheme-scale net present value under Scenario B for the irrigation developments associated with the Green Hills and Dagworth dams 335

Figure 9.19 Median of the 30-year mean values for farm-scale net present values and (b) standard deviation of the 30-year mean values for farm-scale net present value, under Scenario B for the irrigation developments associated with the Green Hills and Dagworth dams 336

Figure 9.20 Gross margins for sugarcane ($/ha) under Scenario B for the irrigation development associated with Green Hills dam: (a) time series and (b) box plot 337

Figure 9.21 Gross margins for sugarcane ($/ha) under Scenario B for the irrigation development associated with Dagworth dam: (a) time series and (b) box plot 337

Figure 9.22 Percentage exceedance plots of (a) net present value and (b) internal rate of return under Scenario B for the scheme-scale irrigation development of 16,000 ha associated with the Green Hills dam 338

Figure 9.23 Percentage exceedance plots of net present value, under Scenario B for the scheme-scale irrigation development of 16,000 ha associated with the Dagworth dam 339

Figure 9.24 Percentage exceedance plots of (a) net present value and (b) internal rate of return under Scenario B for the farm-scale irrigation development of 16,000 ha associated with the Green Hills dam 340

Figure 9.25 Percentage exceedance plots of (a) net present value and (b) internal rate of return under Scenario B for the farm-scale irrigation development of 16,000 ha associated with the Dagworth dam 340

Figure 9.26 Change in depth to watertable for different values of saturated hydraulic conductivity (K): (a) low recharge rate 130 mm/year and (b) high recharge rate of 215 mm/year 343

Figure 10.1 Schematic diagram illustrating the components of the case study for an irrigation development associated with Kidston Dam 349

Figure 10.2 (a) Satellite image and (b) relief map of the area surrounding Kidston Dam 352

Figure 10.3 (a) Soil generic group map and (b) land suitability map of the area surrounding Kidston Dam for spray-irrigated Rhodes grass 354

Figure 10.4 Landscape of the potential Kidston Dam irrigation development 355

Figure 10.5 Conductivity–depth section (lower panel) for flight line 20060 356

Figure 10.6 Conductivity–depth section (lower panel) for flight line 20070 356

Figure 10.7 (a) Monthly rainfall and (b) monthly potential evaporation under Scenario A at Einasleigh 357

Figure 10.8 (a) Maximum monthly temperature and (b) minimum monthly temperature under Scenario A at Einasleigh 358

Figure 10.9 Annual streamflow at the Kidston Dam under Scenario A 359

Figure 10.10 Crop yield versus applied irrigation water under Scenario A for Rhodes grass hay in the Einasleigh area 363

Figure 10.11 Mean annual applied irrigation water supplied to the crop in (a) ML and (b) ML/ha equivalent under Scenario B for the irrigation development associated with the Kidston Dam 364

Figure 10.12 Median annual applied irrigation water supplied to the crop under Scenario B for the irrigation development associated with the Kidston Dam 365

Figure 10.13 (a) Ratio of evaporation from the reservoir to the applied irrigation water and (b) percentage of time the volume of the reservoir is less than 20% of the full supply level volume under Scenario B for the irrigation development associated with the Kidston Dam 365

Figure 10.14 Median streamflow quotient at (a) gauge 917106A and (b) gauge 917009A under or the irrigation development associated with the Kidston Dam 366

Figure 10.15 (a) Median of the 30-year mean values (M30M) for crop yield and (b) standard deviation of the 30-year mean values (S30M) for crop yield under Scenario B for the irrigation development associated with the Kidston Dam 366

Figure 10.16 Crop yield from the total scheme area under Scenario B for three different scheme areas 367

Figure 10.17 (a) Median of the 30-year mean values (M30M) for specific yield and (b) standard deviation of the 30-year mean values (S30M) for specific yield under Scenario B for the irrigation development associated with the Kidston Dam 367

Figure 10.18 (a) Median of the 30-year mean values (M30M) for gross margin per hectare and (b) median of the 30-year mean values (M30M) for gross margin under Scenario B for the irrigation development associated with the Kidston Dam 368

Figure 10.19 (a) Median of the 30-year mean values (M30M) for net present value and (b) standard deviation of the 30-year mean values (S30M) for net present value under Scenario B for the irrigation development associated with the Kidston Dam 369

Figure 10.20 (a) Median of the 30-year mean values (M30M) for net present value and (b) standard deviation of the 30-year mean values (S30M) for net present value under Scenario B for the irrigation development associated with the Kidston Dam 370

Figure 10.21 Gross margins for Rhodes grass under Scenario B for the irrigation site associated with the Kidston Dam, with a scheme area of 1000 ha: (a) time series and (b) box plots 371

Figure 10.22 Percentage exceedance plots for (a) net present value and (b) internal rate of return under Scenario B for the scheme-scale irrigation development of 1000 ha associated with Kidston Dam 372

Figure 10.23 Percentage exceedance plots of net present value under Scenario B for the farm-scale irrigation development of 1000 ha associated with the Kidston Dam 373

Figure 10.24 Change in depth to watertable for different values of saturated hydraulic conductivity (K): (a) low recharge rate of 135 mm/year and (b) high recharge rate of 215 mm/year 374