Appendix F Summary of model calibration

F1 Observations targets

Table F1–1 Summary of observation targets for steady state simulation

Observation group description	Simulated output type	Model-to-measurement comparison	Number of targets	
			1947 steady state	1995 steady state
1947 steady state water level estimate – layer 1	Head	Traditional	150	0
1947 steady state water level estimate – layer 2	Head	Traditional	23	0
1947 steady state water level estimate – layer 3	Head	Traditional	29	0
1947 steady state water level estimate – layer 4	Head	Traditional	38	0
1947 steady state water level estimate – layer 5	Head	Traditional	83	0
1947 steady state water level estimate – layer 6	Head	Traditional	77	0
1947 steady state water level estimate – layer 7	Head	Traditional	51	0
1947 steady state water level estimate – layer 9	Head	Traditional	4	0
1947 steady state water level estimate – layer 10	Head	Traditional	1	0
1947 steady state water level estimate – layer 11	Head	Traditional	1	0
1947 steady state water level estimate – layer 12	Head	Traditional	8	0
1947 steady state water level estimate – layer 13–	Head	Traditional	21	0
1947 steady state water level estimate – layer 16	Head	Traditional	10	0
1947 steady state water level estimate – layer 18	Head	Traditional	57	0
1947 steady state water level estimate – layer 19	Head	Traditional	8	0
1947 steady state water level estimate – layer 23	Head	Traditional	13	0
1947 steady state water level estimate – layer 25	Head	Traditional	1	0
1947 steady state water level estimate – layer 30	Head	Traditional	12	0
1995 steady state water level estimate –	Head	Traditional	0	278
1995 steady state water level estimate – MRV	Head	Traditional	0	386
1995 steady state water level estimate – layer 1	Head	Traditional	0	970
1995 steady state water level estimate – layer 1	Head	Asymmetric penalty	0	57
1995 steady state water level estimate – layer 2	Head	Traditional	0	91
1995 steady state water level estimate – layer 2	Head	Asymmetric penalty	0	2
1995 steady state water level estimate – layer 3	Head	Traditional	0	79
1995 steady state water level estimate – layer 4	Head	Traditional	0	103
1995 steady state water level estimate – layer 4	Head	Asymmetric penalty	0	57
1995 steady state water level estimate – layer 5	Head	Traditional	0	261
1995 steady state water level estimate – layer 5	Head	Asymmetric penalty	0	169
1995 steady state water level estimate – layer 6	Head	Traditional	0	270
1995 steady state water level estimate – layer 6	Head	Asymmetric penalty	0	126
1995 steady state water level estimate – layer 7	Head	Traditional	0	243
1995 steady state water level estimate – layer 7	Head	Asymmetric penalty	0	103
1995 steady state water level estimate – layer 9	Head	Traditional	0	25
1995 steady state water level estimate – layer 9	Head	Asymmetric penalty	0	56
1995 steady state water level estimate – layer 10	Head	Traditional	0	10
1995 steady state water level estimate – layer 10	Head	Asymmetric penalty	0	22
1995 steady state water level estimate – layer 11	Head	Traditional	0	2
1995 steady state water level estimate – layer 11	Head	Asymmetric penalty	0	3
1995 steady state water level estimate – layer 12	Head	Traditional	0	69
1995 steady state water level estimate – layer 12	Head	Asymmetric penalty	0	79
1995 steady state water level estimate – layer 13–	Head	Traditional	0	43
1995 steady state water level estimate – layer 13–	Head	Asymmetric penalty	0	240
1995 steady state water level estimate – layer 16	Head	Traditional	0	62
1995 steady state water level estimate – layer 16	Head	Asymmetric penalty	0	121
1995 steady state water level estimate – layer 18	Head	Traditional	0	343
1995 steady state water level estimate – layer 18	Head	Asymmetric penalty	0	606
1995 steady state water level estimate – layer 19	Head	Traditional	0	49
1995 steady state water level estimate – layer 19	Head	Asymmetric penalty	0	224
1995 steady state water level estimate – layer 21	Head	Traditional	0	5
1995 steady state water level estimate – layer 21	Head	Asymmetric penalty	0	24
1995 steady state water level estimate – layer 23	Head	Traditional	0	21
1995 steady state water level estimate – layer 23	Head	Asymmetric penalty	0	180
1995 steady state water level estimate – layer 25	Head	Traditional	0	47

Observation group description	Simulated output type	Model-to-measurement comparison	Number of targets	
			1947 steady state	1995 steady state
1995 steady state water level estimate – layer 25	Head	Asymmetric penalty	0	52
1995 steady state water level estimate – layer 28	Head	Traditional	0	17
1995 steady state water level estimate – layer 28	Head	Asymmetric penalty	0	2
1995 steady state water level estimate – layer 29	Head	Traditional	0	6
1995 steady state water level estimate – layer 29	Head	Asymmetric penalty	0	2
1995 steady state water level estimate – layer 30	Head	Traditional	0	148
1995 steady state water level estimate – layer 30	Head	Asymmetric penalty	0	1
1995 steady state water level estimate – layer 32	Head	Traditional	0	1
1995 steady state water level estimate – layer 34	Head	Traditional	0	108
1995 steady state water level estimate to ameliorate excessive local drawdown near Moonie	Head	One–sided penalty	0	1
1995 steady state water level difference estimated between Condamine and underlying GAB aquifers	Vertical head difference	Traditional	0	96
1995 steady state water level difference estimated between MRV and underlying GAB aquifers	Vertical head difference	Traditional	0	164
Estimated 1995 steady state non-CSG extraction from the Condamine	Flow budget – drains	One–sided penalty	0	1
Estimated 1995 steady state non-CSG extraction from the MRV	Flow budget – drains	One–sided penalty	0	14
Estimated 1995 steady state flux exchange with the Condamine	Flow budget – various	One–sided penalty	0	1
Parallel flow to western GHB – layer 4	Horizontal head	Traditional	34	0
Parallel flow to western GHB – layer 5	Horizontal head	Traditional	35	0
Parallel flow to western GHB – layer 7	Horizontal head	Traditional	36	0
Parallel flow to western GHB – layer 9	Horizontal head	Traditional	32	0
Parallel flow to western GHB – layer 10	Horizontal head	Traditional	32	0
Parallel flow to western GHB – layer 12	Horizontal head	Traditional	5	0
Parallel flow to western GHB – layer 13	Horizontal head	Traditional	8	0
Parallel flow to western GHB – layer 14	Horizontal head	Traditional	12	0
Parallel flow to western GHB – layer 15	Horizontal head	Traditional	23	0
Parallel flow to western GHB – layer 16	Horizontal head	Traditional	34	0
Parallel flow to western GHB – layer 18	Horizontal head	Traditional	23	0
Parallel flow to western GHB – layer 19	Horizontal head	Traditional	23	0
Parallel flow to western GHB – layer 21	Horizontal head	Traditional	3	0
Parallel flow to western GHB – layer 23	Horizontal head	Traditional	8	0

Table F1-2 Summary of observation targets for transient simulation

Observation group description	Simulated output type	Model-to-measurement comparison	Number of targets
Monitored water levels – layer 9	Head	Traditional	1255
Monitored water levels – layer 10	Head	Traditional	994
Monitored water levels – layer 12	Head	Traditional	1931
Monitored water levels – layer 13 – 15	Head	Traditional	3947
Monitored water levels – layer 16	Head	Traditional	2311
Monitored water levels – layer 18	Head	Traditional	3131
Monitored water levels – layer 19	Head	Traditional	1099
Monitored water levels – layer 23	Head	Traditional	802
Monitored water levels – layer 23 (APLNG – Spring Gully and Reedy Creek)	Head	Traditional	1772
Monitored water levels – layer 28 – 29	Head	Traditional	297
Monitored water level changes – layer 9	Temporal head difference	Traditional	1225
Monitored water level changes – layer 10	Temporal head difference	Traditional	971
Monitored water level changes – layer 12	Temporal head difference	Traditional	1878
Monitored water level changes – layer 13 – 15	Temporal head difference	Traditional	3839
Monitored water level changes – layer 16	Temporal head difference	Traditional	2255
Monitored water level changes – layer 18	Temporal head difference	Traditional	3053
Monitored water level changes – layer 19	Temporal head difference	Traditional	1072
Monitored water level changes – layer 23	Temporal head difference	Traditional	764
Monitored water level changes – layer 23 (APLNG – Spring Gully and Reedy Creek)	Temporal head difference	Traditional	1727
Monitored water level changes – layer 28 – 29	Temporal head difference	Traditional	285
Monitored water level differences between Condamine Alluvium and GAB aquifers	Vertical head difference	Traditional	278
Monitored water level differences between Gubberamunda and Springbok Sandstone	Vertical head difference	Traditional	197
Monitored water level differences between Springbok Sandstone and Walloon Coal Measures	Vertical head difference	Traditional	225
Monitored water level differences between Walloon Coal Measures and Hutton Sandstone	Vertical head difference	Traditional	210
Monitored water level differences within Walloon Coal Measures	Vertical head difference	Traditional	785
Monitored water level differences within Hutton Sandstone	Vertical head difference	Traditional	129
Estimated/metered non-CSG extractive volumes (post–derating) – Boxvale Sandstone	Flow budget – wells	One–sided penalty	276
Estimated/metered non-CSG extractive volumes (post–derating) – Clematis Sandstone	Flow budget – wells	One–sided penalty	276
Estimated/metered non-CSG extractive volumes (post–derating) – Gubberamunda Sandstone	Flow budget – wells	One–sided penalty	276
Estimated/metered non-CSG extractive volumes (post–derating) – Hutton Sandstone	Flow budget – wells	One–sided penalty	276
Estimated/metered non-CSG extractive volumes (post–derating) – Precipice Sandstone	Flow budget – wells	One–sided penalty	276
Estimated/metered non-CSG extractive volumes (post–derating) – Springbok Sandstone	Flow budget – wells	One–sided penalty	276
Estimated/metered non-CSG extractive volumes (post–derating) – Walloon Coal Measures	Flow budget – wells	One–sided penalty	276
Maximum allowable water level for reinjection – Precipice Sandstone (APLNG – Spring Gully)	Head	One–sided penalty	1

Observation group description	Simulated output type	Model-to-measurement comparison	Number of targets
Metered CSG water reinjection rates (APLNG – Reedy Creek)	Flow budget – injection	One–sided penalty	35
Metered CSG water reinjection rates (APLNG – Spring Gully)	Flow budget – injection	One–sided penalty	34
Metered CSG water production rates – Total WCM	Flow budget – drains	Traditional	276
Metered CSG water production rates – Total Bandanna	Flow budget – drains	Traditional	276
Metered CSG water production rates – Total Cattle Creek	Flow budget – drains	Traditional	276
Metered CSG water production rates – Company development areas	Flow budget – drains	Traditional	5796
Water levels in Walloon Coal Measures (QGC) from ECLIPSE Dual Phase Flow Simulator	Head	Traditional	4693
Water level differences within Walloon Coal Measures (QGC) from ECLIPSE Dual Phase Flow Simulator	Vertical head difference	Traditional	1658
Water saturations within Walloon Coal Measures (QGC) from ECLIPSE Dual Phase Flow Simulator	Saturation	Traditional	4693
Minimum water level differences within Walloon Coal Measures (non-QGC) from ECLIPSE Dual Phase Flow Simulator	Vertical head difference	One–sided penalty	189
Minimum water level differences within Bandanna Formation from ECLIPSE Dual Phase Flow Simulator	Vertical head difference	One–sided penalty	210
Long-term average water saturations near CSG wells within Walloon Coal Measures (non-QGC) from ECLIPSE Dual Phase Flow Simulator	Saturation	One–sided penalty	973
Long-term average water saturations near CSG wells within Bandanna Formation from ECLIPSE Dual Phase Flow Simulator	Saturation	One–sided penalty	429

F2 Estimable parameters

Table F2-1 Summary of estimable parameters for steady state and transient simulation

Parameter	Parameter type	Number of parameters
Recharge multipliers	Zonal	24
Southern GHB conductance – layer 4	Pilot point	31
Southern GHB conductance – layer 5	Pilot point	31
Southern GHB conductance – layer 7	Pilot point	31
Southern GHB conductance – layer 9	Pilot point	30
Southern GHB conductance – layer 10	Pilot point	30
Southern GHB conductance – layer 12	Pilot point	7
Southern GHB conductance – layer 13	Pilot point	9
Southern GHB conductance – layer 14	Pilot point	13
Southern GHB conductance – layer 15	Pilot point	18
Southern GHB conductance – layer 16	Pilot point	29
Southern GHB conductance – layer 18	Pilot point	21
Southern GHB conductance – layer 19	Pilot point	21
Western GHB head – layer 4	Pilot point	33
Western GHB head – layer 5	Pilot point	35
Western GHB head – layer 7	Pilot point	36
Western GHB head – layer 9	Pilot point	34
Western GHB head – layer 10	Pilot point	34
Western GHB head – layer 12	Pilot point	10
Western GHB head – layer 13	Pilot point	14
Western GHB head – layer 14	Pilot point	17
Western GHB head – layer 15	Pilot point	27
Western GHB head – layer 16	Pilot point	36
Western GHB head – layer 18	Pilot point	29
Western GHB head – layer 19	Pilot point	29
Western GHB head – layer 21	Pilot point	5
Western GHB head – layer 23	Pilot point	11
Kx – layer 1 (excl. Condamine)	Zonal	5
Kx multiplier – layer 1 (Condamine)	Pilot point	88
Kx multiplier – layer 1 (Other surficial units)	Pilot point	417
Kx – layer 3	Pilot point	105
Kx – layer 4	Pilot point	111
Kx – layer 5	Pilot point	118
Kx – layer 7	Pilot point	128
Kx – layer 8	Pilot point	240
Kx – layer 9	Pilot point	304
Kx – layer 10	Pilot point	306
Kx – layer 12	Pilot point	274
Kx – layer 15 (layer 13 and 14 are tied to layer 15)	Pilot point	342
Kx – layer 16	Pilot point	358
Kx – layer 17	Pilot point	291
Kx – layer 18	Pilot point	400
Kx – layer 19	Pilot point	396
Kx – layer 20	Pilot point	288
Kx – layer 21	Pilot point	182
Kx – layer 22	Pilot point	292
Kx – layer 23	Pilot point	262
Kx – layer 25	Pilot point	117

Parameter	Parameter type	Number of parameters
Kx – layer 27	Pilot point	145
Kx – layer 28	Pilot point	148
Kx – layer 29	Pilot point	143
Kx – layer 31	Pilot point	44
Kx – layer 32	Pilot point	44
Kx – layer 33	Pilot point	44
Vertical resistance – layer 2 (Condamine transition zone)	Pilot point	88
Kz multiplier – layer 2 (Condamine transition zone)	Pilot point	88
Kz – layer 2	Pilot point	79
Kz – layer 6	Pilot point	124
Kz multiplier – layer 11	Pilot point	156
Kz – layer 24	Pilot point	114
Kz – layer 26	Pilot point	124
Kz – layer 30	Pilot point	160
Kz – layer 34	Pilot point	59
Vertical anisotropy for Kx (Condamine transition zone)	Layer wide	1
Vertical anisotropy for Kx – layer 2	Layer wide	1
Vertical anisotropy for Kx – layer 6	Layer wide	1
Vertical anisotropy for Kx – layer 11	Pilot point	156
Vertical anisotropy for Kx – layer 24	Layer wide	1
Vertical anisotropy for Kx – layer 26	Layer wide	1
Vertical anisotropy for Kx – layer 30	Layer wide	1
Vertical anisotropy for Kx – layer 34	Layer wide	1
Vertical anisotropy for Kz – layer 1 (Condamine)	Pilot point	88
Vertical anisotropy for Kz – layer 1 (Basalt)	Layer wide	1
Vertical anisotropy for Kz – layer 1 (Main Range Volcanics)	Layer wide	1
Vertical anisotropy for Kz – layer 1 (Cenozoic sediments)	Layer wide	1
Vertical anisotropy for Kz – layer 1 (Weathered Surat/Bowen)	Layer wide	1
Vertical anisotropy for Kz – layer 1 (Other quaternary alluvium)	Layer wide	1
Vertical anisotropy for Kz – layer 3	Layer wide	1
Vertical anisotropy for Kz – layer 4	Layer wide	1
Vertical anisotropy for Kz – layer 5	Layer wide	1
Vertical anisotropy for Kz – layer 7	Layer wide	1
Vertical anisotropy for Kz – layer 8	Pilot point	240
Vertical anisotropy for Kz – layer 9	Pilot point	304
Vertical anisotropy for Kz – layer 10	Pilot point	306
Vertical anisotropy for Kz – layer 12	Pilot point	274
Vertical anisotropy for Kz – layer 15 (layer 13 and 14 are tied to layer 15)	Pilot point	342
Vertical anisotropy for Kz – layer 16	Pilot point	358
Vertical anisotropy for Kz – layer 17	Pilot point	291
Vertical anisotropy for Kz – layer 18	Pilot point	400
Vertical anisotropy for Kz – layer 19	Pilot point	396
Vertical anisotropy for Kz – layer 20	Pilot point	288
Vertical anisotropy for Kz – layer 21	Pilot point	182
Vertical anisotropy for Kz – layer 22	Pilot point	292
Vertical anisotropy for Kz – layer 23	Pilot point	262
Vertical anisotropy for Kz – layer 25	Layer wide	1
Vertical anisotropy for Kz – layer 27	Pilot point	145
Vertical anisotropy for Kz – layer 28	Pilot point	148
Vertical anisotropy for Kz – layer 29	Pilot point	143

Parameter	Parameter type	Number of parameters
Vertical anisotropy for Kz – layer 31	Pilot point	44
Vertical anisotropy for Kz – layer 32	Pilot point	44
Vertical anisotropy for Kz – layer 33	Pilot point	44
Fault core width	Zonal	22
Fault damage zone width	Zonal	22

Table F2-2 Summary of estimable parameters for transient simulation only

Parameter	Parameter type	Number of parameters
Kx enhancement factor for CSG wells – layer 10 to 16 (layer 13 and 14 are tied to layer 15)	Pilot point	502
Kx enhancement factor for CSG wells – layer 28 and 29	Zonal	4
Kx enhancement factor for CSG wells – layer 32 and 33	Layer wide	2
Coal cleat porosity – layer 10 to 16 (layer 13 and 14 are tied to layer 15)	Pilot point	211
Coal cleat porosity – layer 28 and 29	Zonal	4
Coal cleat porosity – layer 32 and 33	Layer wide	2
Coal cleat compressibility – layer 10 to 16 (layer 13 and 14 are tied to layer 15)	Pilot point	206
Coal cleat compressibility – layer 28 and 29	Zonal	4
Coal cleat compressibility – layer 32 and 33	Layer wide	2
Specific storage – layer 8 to 11, 17 to 19 and 23	Pilot point	560
Specific storage multiplier – layer 28 and 29	Zonal	4
Specific storage multiplier – layer 2 to 7, 20 to 22, 24, 26 to 27, 30 to 34	Layer wide	17
Specific yield – layer 1 to 34	Formation wide	24
Dual domain flow transfer rate (DDFTR) factor – layer 12 to 16	Layer wide	3
Dual domain flow transfer rate (DDFTR) factor – layer 28 and 29	Zonal	4
Dual domain flow transfer rate (DDFTR) factor – layer 32 and 33	Layer wide	2
Brooks-Corey parameter for desaturation function – layer 10 to 16 (layer 13 and 14 are tied to layer 15)	Pilot point	209
Brooks-Corey parameter for desaturation function – layer 28 and 29	Zonal	4
Brooks-Corey parameter for desaturation function– layer 32 and 33	Layer wide	2
Correction bubble-point pressure for desaturation function – layer 12 to 16	Layer wide	5
Correction bubble-point pressure for desaturation function – layer 28 and 29	Layer wide	2
Correction bubble-point pressure for desaturation function – layer 32 and 33	Layer wide	2
Kx enhancement factor multiplier for CSG Wells – layer 28 and 29	Pilot point	72
Coal cleat porosity multiplier – layer 28 and 29	Pilot point	72
Brooks-Corey parameter multiplier for desaturation function– layer 28 and 29	Pilot point	72