Appendix F: Currently identified reference sites in Queensland

The following is a list of sites that have been used as reference sites in the past by the Department of Environment and Resource Management. These are provided as a resource for users wishing to identify reference sites for a particular purpose. However, before using these sites for reference purposes it is recommended that users check their current condition as this may have changed in recent times.

Freshwater reference sites		LATITUDE	LONGITUDE
REGION	SITE NAME		
East Cape York	Harmer River at Middle Peak	-11.9786	142.8481
East Cape York	Olive River at Jon's Swamp	-12.2581	142.7869
East Cape York	Lockhart River at Nundah	-13.1061	143.3972
East Cape York	Pascoe River at Fall Creek	-12.8814	142.9818
East Cape York	Pascoe River at Garraway	-12.6608	143.0477
East Cape York	Stewart River at Telegraph Line	-14.174	143.3968
Wet Tropics	McIvor River at Parkers Hut	-15.1208	145.0739
Wet Tropics	Stewart River at main road bridge	-16.2936	145.3181
Wet Tropics	Little Falls Creek at Whyanbeel Creek junction	-16.3936	145.3378
Wet Tropics	Daintree River at Creb Crossing	-16.1997	145.2908
Wet Tropics	Emmagen Creek at Cape Tribulation	-16.0411	145.4578
Wet Tropics	Hutchinson Creek at Cape Tribulation	-16.2164	145.4228
Wet Tropics	Clohesy River at Reids Pocket	-16.9242	145.5878
Wet Tropics	Stoney Creek at picnic area	-16.8756	145.6672
Wet Tropics	Freshwater Creek downstream of Crystal Cascades	-16.9572	145.6861
Wet Tropics	Freshwater Creek at Lower Freshwater Rd Crossing	-16.8769	145.6997
Wet Tropics	Mulgrave River at Goldsborough	-17.2514	145.7733
Wet Tropics	Fishery Falls Creek at Bruce Hwy	-17.1853	145.8839
Wet Tropics	Tributary at Goldsborough	-17.2461	145.7753
Wet Tropics	Behana Creek at Flick's Bridge	-17.1533	145.8211
Wet Tropics	Henrieta Creek at Palmerston Hwy	-17.5994	145.7569
Wet Tropics	Nth Johnstone River at Malanda Falls	-17.3561	145.5853
Wet Tropics	Nth Johnstone River at Nerada	-17.5322	145.845
Wet Tropics	Thiaki Creek at Meragallan Rd	-17.4208	145.5369
Wet Tropics	Ithaca Creek at Clarks Track	-17.3942	145.6208
Wet Tropics	Sth Johnstone River at Corsi's	-17.6	145.8997
Wet Tropics	Sth Johnstone River at Forestry Camp	-17.6533	145.7169
Wet Tropics	Bombeeta Creek at Trambridge	-17.7069	145.9419
Wet Tropics	Kaarru Creek at causeway	-17.6475	145.7306
Wet Tropics	Boulder Creek at Tully Intake	-17.8722	145.9108
Wet Tropics	Jarrah Creek at Army	-17.8219	145.7911
Wet Tropics	Tully River at Old Culpa	-17.9256	145.6281
Wet Tropics	Bulgun Creek at Alligators Nest Park	-17.8878	145.9292
Wet Tropics	Five Mile Creek at swimming hole	-18.3294	146.0422
Wet Tropics	Nth Murray River at Aladoon Rd	-18.0939	145.7761
Wet Tropics	Sunday Creek at rail crossing	-18.4939	146.1744
Wet Tropics	Herbert River at Cashmere crossing	-18.1375	145.3372
Wet Tropics	Vine Creek at Mt Ronald	-17.6703	145.4358
Wet Tropics	Millstream Creek at Diversion Weir	-17.6736	145.4122
Wet Tropics	Millstream Creek upstream of Vine Creek	-17.6736	145.4114
Wet Tropics	Herbert River below gorge	-18.4028	145.7578
Wet Tropics	Herbert River at Gunnawarra	-17.9222	145.21
Wet Tropics	Elphinstone Creek at Elphinstone Rd	-18.4919	146.0178
Wet Tropics	Broadwater Creek at Broadwater Park	-18.4228	145.9453
Wet Tropics	Herbert River at Mandalee Crossing	-17.7267	145.2525
Wet Tropics	Waterview Creek at forestry plot	-18.8467	146.1239
Wet Tropics	Ripple Creek at Genas Rd.	-18.5822	146.1314
Wet Tropics	Dalrymple Creek at Hawkins Creek Rd	-18.5492	146.0375
Wet Tropics	Hann_R Kalinga Homestead	-15.2026	143.8564
Wet Tropics	Jungle_Ck Kalinga	-15.3492	143.7736
Wet Tropics	Normanby River at Battlecamp	-15.2822	144.8377

Freshwater reference sites		LATITUDE	LONGITUDE
REGION	SITE NAME		
Wet Tropics	Laura River at Coalseam Creek	-15.6173	144.4842
Wet Tropics	Kennedy R. at Fairlight	-15.5654	144.019
Wet Tropics	Deighton	-15.4922	144.5281
Wet Tropics	E. Normanby River at D'ment Rd.	-15.7727	145.0136
Wet Tropics	West Normanby River at Mt Selheim	-15.7592	144.9746
Wet Tropics	Jeannie R. Warooka Rd	-14.7601	144.8551
Wet Tropics	Starcke River at Causeway	-14.8175	144.9697
Wet Tropics	Endeavour River	-15.4249	145.0729
Wet Tropics	Endeavour River at Flaggy	-15.4253	145.0636
Wet Tropics	Annan River at Mt. Simon	-15.6455	145.1921
Wet Tropics	Annan River at Beesbike	-15.6894	145.2075
Wet Tropics	Daintree River at Bairds	-16.1817	145.2808
Wet Tropics	Bloomfield River at China Gap	-15.99	145.2861
Wet Tropics	Saltwater Creek at O'Donoghue Rd	16.4297	145.3478
Wet Tropics	Whyanbeel Creek at upstream of Little Falls Creek	-16.3914	145.3369
Wet Tropics	Hartleys Creek upstream of Vievers Creek	-16.6531	145.5513
Wet Tropics	Flaggy Creek at recorder	-16.7808	145.5297
Wet Tropics	Clohesy1	-16.9117	145.5633
Wet Tropics	Kauri Creek at main road	-17.1356	145.5975
Wet Tropics	Hills Creek at Hamilton Rd	-16.9456	145.8289
Wet Tropics	Taylors Creek at Warraker	-17.5181	145.9128
Wet Tropics	Nitchaga Creek at Upper Tully	-17.8275	145.5628
Wet Tropics	Cochable Creek at powerline	-17.745	145.6281
Wet Tropics	Koolmoon Creek at Ebony Rd	-17.7361	145.555
Wet Tropics	Herbert1	-18.1383	145.3383
Wet Tropics	Blencoe River at Blencoe Falls	-18.205	145.5372
Wet Tropics	Millstr1	-17.6036	145.4769
Wet Tropics	Cameron_	-18.0681	145.3408
Wet Tropics	Millstream River downstream of Archer Creek	-17.6522	145.3408
Wet Tropics	Blunder Creek at Wooroora	-17.7375	145.4364
Wet Tropics	Rudd Creek at Gunnawarra	-17.9161	145.1497
Central	Little Crystal Creek at Paluma Rd	-19.0164	146.2658
Central	Little Crystal Creek at Moodys	-18.9819	146.2856
Central	Bluewater Creek at foothills	-19.2397	146.4894
Central	Alligator Creek at Bowling Green Bay NP	-19.4367	146.9458
Central	St Margaret Creek at Bruce Hwy	-19.4777	147.0386
Central	Burdekin River at Reedy Brook	-18.6992	145.0556
Central	Burdekin River at Valley of Lagoons	-18.6447	145.1186
Central	Star River at Hervey Range Road	-19.4342	145.9889
Central	Fletcher Creek at main road	-19.8158	146.0539
Central	Reedy Brook at Reedy Brook	-18.6867	145.0469
Central	Burdekin River at Big Bend	-19.8469	146.1422
Central	Burdekin River at Hervey Range Rd	-19.4392	145.8594
Central	Lolworth Creek at Lochwall	-19.8719	145.8472
Central	Urannah Creek upstream of station	-20.9117	148.3797
Central	Sandy Creek at Cathu Plateau	-20.7539	148.45
Central	Lizzy Creek at pipeline	-21.1814	148.3492
Central	Small Creek at Mt William	-21.0353	148.5972
Central	Menildon	-20.1692	148.1608
Central	Don River at Pretty Bend Crossing	-20.353	148.1202
Central	Dryander Creek near quarry	-20.2781	148.5806
Central	Impulse Creek at state forest	-20.3531	148.7264
Central	Repulse Creek upstream of Impulse Creek junction	-20.3642	148.7353
Central	Boulder Creek near Mt Charlton	-21.0106	148.7181
Central	O'Connell River at Cathu	-20.8322	148.6123
Central	Pandanus Creek at Cathu Forest Stn	-20.7992	148.5417
Central	Macquarie Creek at McKays Rd	-21.0197	148.8356
Central	Murray Creek below Mt Charlton	-21.0142	148.7378
Central	Boundary Creek at Mt Bullock	-20.6975	148.5281
Central	Cattle Creek at North Branch	-21.1233	148.575

Freshwater reference sites		LATITUDE	LONGITUDE
REGION	SITE NAME		
Central	Finch Hatton Creek at picnic grounds	-21.0747	148.6364
Central	Finch Hatton Creek at swimming hole	-21.09	148.6317
Central	Blackwaterhole Creek at Junction	-21.3172	148.8533
Central	Middle Creek upstream of Teemburra Dam	-21.1822	148.6422
Central	Rocky Dam Creek near deer farm	-21.7042	149.2686
Central	Carmila Creek at Carmila West	-21.8969	149.3078
Central	Stony Creek at Blackdown	-23.7842	149.0072
Central	Nogoa River at Spyglass Peak	-24.8258	147.1914
Central	Mimosa Creek at Eastbrook	-23.9014	149.2325
Central	Mimosa Creek at Blackdown Tableland	-23.7869	149.0772
Central	Denison Creek at Retreat	-21.4814	148.8114
Central	Funnel Creek at Bolingbroke	-21.6022	149.0753
Central	Carnarvon Creek at gorge	-25.0633	148.2311
Central	Calliope River at Mt Alma	-24.0764	150.8361
Central	Colosseum Creek at Bruce Highway	-24.4444	151.5597
Central	Granite Creek at Korenan	-24.4653	151.6642
Central	Baffle Creek at Westwood Range	-24.3089	151.6494
Central	Eurimbula Creek at Eurimbula NP	-24.2	151.7889
Central	Possum Creek at Mungy Rd	-25.2561	151.5086
Central	Holsworthy Creek upstream of Campoven Creek	-24.8211	150.6689
Central	St. Johns Creek at AMTD 7.1km	-25.5897	151.1475
Central	W. Burnett River at Goondicum	-24.8869	151.4331
Central	Burnett River upstream of Upper Burnett Dam site	-25.0586	151.3264
Central	Auburn River at AMTD 4.64km weir site	-25.66	151.175
Central	Auburn River at Auburn Homestead	-25.9567	150.6142
Central	Sandy Creek at environmental park	-25.1394	152.1681
Central	Bluewater Creek at Bluewater	-19.1825	146.5483
Central	Mt Picca	-19.775	146.9569
Central	Major_Creek	-19.6719	147.0247
Central	Burdekin River at Sellheim	-20.0003	146.4372
Central	Burdekin5	-20.6425	147.1401
Central	Bogie River	-20.1547	147.5417
Central	Keelbottom Creek at Keelbottom	-19.3719	146.3589
Central	Basalt River at Bluff Downs	-19.6825	145.5394
Central	Burdeki2	-19.1683	145.4194
Central	Burdekin River at Blue Range	-19.1719	145.4269
Central	Fletcher	-19.8172	146.0519
Central	Burdekin River at Mt Fullstop	-19.2073	145.495
Central	Burdekin River at Lucky Downs	-18.8789	144.9733
Central	Star_R L	-19.3795	146.0458
Central	Clarke River	-19.5861	144.8222
Central	Kangaroo	-18.9333	145.6658
Central	Gray Creek	-19.0233	144.9786
Central	Maryvale	-19.5883	145.2186
Central	Wyandotte Creek at Wyandotte	-18.7472	144.8322
Central	Burdeki7	-18.5022	145.2447
Central	Fanning_	-19.7164	146.4381
Central	Running River at Mt Bradley	-19.132	145.9085
Central	Burdekin River at Lake Lucy dam site	-18.5154	145.1843
Central	Bowen River	-20.9867	148.1353
Central	Emu Creek T	-20.8008	148.1636
Central	Grant_Ck	-20.82	148.3089
Central	Broken River at old racecourse (GS)	-21.1958	148.4458
Central	Belyando River at Gregory Developmental Rd	-21.5353	146.8589
Central	Cape River at Inland Hwy	-21.0003	146.4227
Central	Suttor_1	-21.229	146.9134
Central	Suttor River at St Anns	-21.2289	146.9153
Central	Cape_R P	-20.4769	145.4736
Central	Pallaman	-20.6075	146.6425
Central	Mistake Creek at Twin Hills	-21.9565	146.9422
Central	Don_R Id	-20.2917	148.1158

Freshwater reference sites		LATITUDE	LONGITUDE
REGION	SITE NAME		
Central	Elliot River	-19.935	147.8389
Central	Don River at Reeves	-20.1508	148.1539
Central	Jolimont Creek at Mt Roy	-21.0358	148.8589
Central	Connors River at Mt Bridget	-22.0383	149.1286
Central	Connors	-22.3408	148.9508
Central	Funnel Creek at Main Rd	-21.7783	148.9267
Central	Lotus Creek	-22.35	149.1047
Central	Calliope River at Castlehope	-23.9861	151.0992
Central	Calliop1	-24.0719	150.8272
Central	Baffle Creek at Roadview	-24.5156	151.7356
Central	Baffle Creek at Mimdale	-24.515	151.7356
Central	Kolan River at Springfield	-24.7544	151.5858
Central	Gin Gin Creek at dam site	-24.9692	151.8894
Central	Three Moon Creek at Meldale	-24.6858	150.9619
Central	Three Moon Creek at Cania Gorge	-24.7253	151.0069
Central	Monal Creek at Upper Monal	-24.6147	151.1122
Central	Baywulla Creek at The Gorge	-25.0845	151.3788
Central	Splinter Creek at Dakiel	-24.7472	151.2586
Central	Burnett River at Yarrol	-24.9939	151.3464
Central	Eastern Creek at Lands End	-25.2142	151.2728
Central	Barambah Creek at West Barambah	-26.3194	152.0642
Central	Auburn River at Glenwood	-25.6836	151.015
Central	Cadarga Creek at Brovinia Station	-25.9394	151.0189
Central	Sandy Creek at Eureka	-25.3389	152.1425
South-east	Widgee Creek at Upper Widgee	-26.2053	152.4383
Southeast	Widgee Creek at Kilkivan Road	-26.0947	152.5086
Southeast	Coonoon Gibber Creek at Brooloo	-26.4956	152.7111
Southeast	Peters Creek at pump site	-26.6822	152.6064
Southeast	Bundaroo Creek at Peters Creek Road	-26.6967	152.615
Southeast	Little Yabba Creek at Sunday Creek Road	-26.6044	152.6128
Southeast	Amamoor Creek at Amamoor Range West	-26.3744	152.5033
Southeast	Eli Creek at The Mouth	-25.2981	153.2214
Southeast	Rocky Creek at Ungowa Rd	-25.4742	153.0086
Southeast	Searys Creek at Bracken Log	-25.9747	153.0719
Southeast	Petrie Creek at Hunchy	-26.6656	152.9233
Southeast	Mooloolah River at Diamond Valley Sawmill	-26.7536	152.9256
Southeast	Caboolture River at Rocksberg	-27.0017	152.8375
Southeast	Rush Creek at Pioneer Concrete weir	-27.1931	152.8617
Southeast	Enoggera Creek at Brisbane Forest Park	-27.4292	152.8394
Southeast	Brisbane River WBr at Crossing 26	-26.5894	152.1642
Southeast	Capembah Creek at Myora Springs	-27.4692	153.4258
Southeast	Cravens Creek at Moreton Island	-27.115	153.3683
Southeast	Eagers Creek at Moreton Island	-27.1475	153.4297
Southeast	Spitfire Creek at Moreton Island	-27.0722	153.4503
Southeast	Running Creek at Drynans	-28.3283	153.0172
Southeast	Burnett Creek at Pete's Place	-28.2611	152.5714
Southeast	Mt Barney Creek at Mt Maroon	-28.2386	152.7294
Southeast	Albert River at Lost World	-28.2617	153.0886
Southeast	Currumbin Creek at Mt Cougal NP	-28.2367	153.3567
Southeast	Coomera River at Tuckers Lane	-28.0581	153.1764
Southeast	Glastonbury Creek at Glastonbury 1	-26.2053	152.5267
Southeast	Munna Creek at Marodian	-25.9028	152.3492
Southeast	Munna Creek at Marodian	-25.905	152.3481
Southeast	Teewah Creek near Coops Corner	-26.0589	153.0417
Southeast	Fifteen	-27.4586	152.0994
Southeast	Logan River at Forest Home	-28.2011	152.7747
Murray Darling	Weir River (Retreat) at Moonie Gundi Rd	-27.9017	150.3472
Murray Darling	MacIntyre Brook at Barongarook	-28.4228	151.4719
Murray Darling	Moonie River at Cambridge Crossing	-27.4139	150.4856

Freshwater reference sites		LATITUDE	LONGITUDE
REGION	SITE NAME		
Murray Darling	Balonne River at Morroco	-27.4883	148.7597
Murray Darling	Sth Spring Creek at Browns Falls	-28.3397	152.3814
Murray Darling	Upper Condamine at Cowboy Crossing	-28.2947	152.3847
Murray Darling	Swan Creek downstream of gauging station	-28.1783	152.2469
Murray Darling	Amby Creek at railway	-26.5522	148.1897
Murray Darling	Nebine Creek at Balonne Hwy	-27.9983	146.8114
Murray Darling	Ward River at Byrganna	-25.5953	146.0878
Murray Darling	Ward River at Quilpie Rd	-26.5108	146.0858
Murray Darling	Nive River at four-tonne bridge	-25.6103	146.5011
Murray Darling	Paroo River at Mt Alfred	-27.1906	145.3572
Murray Darling	Paroo River at Eulo	-28.1636	145.0356
Murray Darling	Bulloo River at Thargomindah	-27.9956	143.8319
Murray Darling	Weir River at Talwood	-28.5189	149.5061
Murray Darling	Pike Creek at Pikedale	-28.65	151.6186
Murray Darling	Dumaresq River at Farnbro	-28.9186	151.5836
Murray Darling	Broadwater Creek at dam site	-28.5983	151.8883
Murray Darling	Moonie River at Nindigully	-28.4292	148.8153
Murray Darling	Yuleba Creek at forestry	-26.8497	149.4728
Murray Darling	Long Xin	-28.325	152.3411
Murray Darling	Elbow Va	-28.3736	152.1611
Murray Darling	Emu_Ck E	-28.2275	152.2483
Murray Darling	Spring_Ck	-28.3539	152.3353
Murray Darling	Canal_Ck	-28.0321	151.5856
Murray Darling	Granite	-28.2804	151.8392
Murray Darling	Sheep Ya	-28.2822	151.844
Murray Darling	Maranoa River at Old Cashmere	-27.7331	148.4719
Lake Eyre	Eyre Creek at Bedourie	-24.3658	139.4578
Lake Eyre	King Creek at Bedourie	-24.5344	139.5636
Lake Eyre	Hamilton River at Westwood Ho	-23.0408	140.33
Lake Eyre	Georgina River at Glenormiston Crossing	-22.8981	138.8628
Lake Eyre	Hamilton River near Toolebuc	-22.1633	140.8525
Lake Eyre	Burke_R	-22.9125	139.9128
Lake Eyre	Roxborou	-22.5133	138.8417
Lake Eyre	Cooper Creek at Currareva	-25.3267	142.7311
Lake Eyre	Barcoo River at Avington Road	-24.3064	145.3147
Lake Eyre	Barcoo River at Retreat	-25.1831	143.2533
Gulf	Hann River at Cape York Road	-15.1931	143.8719
Gulf	Morehead River at Kennedy Highway	-15.0243	143.6625
Gulf	North Kennedy River at Hann Crossing	-14.7678	144.0789
Gulf	Normanby River at Kalpower Crossing	-14.9131	144.2106
Gulf	Normanby River at 12 Mile Hole	-15.1975	144.4256
Gulf	St George River at Pat. Call'n Bdge	-15.6133	144.0206
Gulf	O'Shannassy River at Riversleigh Crossing	-19.0239	138.7612
Gulf	Woolgar River at Soap Spa	-19.7272	143.3883
Gulf	Flinders River at Reedy Springs	-19.9647	144.6889
Gulf	Fountain Springs at Wee McGregor Mine	-20.9683	139.9317
Gulf	Gilbert River at Stirling	-17.1717	141.7656
Gulf	Fossilbrook Creek at Vince Ray Causeway	-17.8164	144.3886
Gulf	Luster Creek at road crossing	-16.6603	145.2483
Gulf	Lynd River at Mitchell Junction	-16.4653	143.31
Gulf	Mitchell River at Mt Mulgrave	-16.3764	143.9747
Gulf	Alice River at Pormpuraaw Road Crossing	-15.3794	142.02
Gulf	Glenroy Creek at Palmerville Rd	-15.9222	144.0869
Gulf	Holroyd River upstream of Honeysuckle Junction	-14.3122	142.89
Gulf	Archer River at Shady Lagoon	-13.4286	142.5969
Gulf	Lankelly Creek at Coen water supply	-13.9417	143.2047
Gulf	Coen River downstream Emu Creek	-13.7808	142.8114
Gulf	Jardine River at Pedro's swamp	-11.4606	142.6931
Gulf	Gregory River at Gregory Downs	-18.6436	139.2525

Freshwater reference sites		LATITUDE	LONGITUDE
REGION	SITE NAME		
Gulf	Gregory River at Riversleigh No. 2	-18.9717	138.8022
Gulf	Connolly	-17.885	138.2642
Gulf	O Shanna	-19.1147	138.7547
Gulf	Seymour_	-19.3414	139.0125
Gulf	Mining C	-18.2201	138.3633
Gulf	Leichhardt River at Kajabbi	-20.0742	139.9394
Gulf	Paroo Creek	-20.3414	139.5175
Gulf	Floravil	-18.2567	139.8825
Gulf	Leichhardt River at Floraville	-18.2567	139.8825
Gulf	16 Mile	-18.8778	139.3586
Gulf	Flinders River at Walkers Bend	-18.1654	140.8572
Gulf	Porcupine Creek at Mt Emu Plains	-20.1625	144.5183
Gulf	Flinders River at Glendower	-20.7133	144.5247
Gulf	Cloncur1	-21.0761	140.4167
Gulf	Dugald River at railway crossing	-20.2017	140.2236
Gulf	Williams River at Landsborough Hwy	-20.8728	140.8322
Gulf	Norman River	-19.5436	143.2625
Gulf	Alehvale	-18.2775	142.3397
Gulf	Robin Ho	-18.7867	143.6031
Gulf	Gilbert_River	-19.2708	143.6933
Gulf	Agate Creek	-18.9339	143.4678
Gulf	Percy River	-19.1619	143.4997
Gulf	Little River at Inournie	-18.2703	142.675
Gulf	Gilbert1	-17.335	141.9378
Gulf	Robertson River	-18.7764	143.3581
Gulf	Possum P	-18.8931	144.4189
Gulf	Einasle1	-17.9819	143.9044
Gulf	Minnies	-17.6361	142.7103
Gulf	Elizabeth	-18.025	144.02
Gulf	Etheridge	-18.0839	143.2706
Gulf	Spanner	-19.0872	144.1672
Gulf	Mentana Creek at Mentana Yards	-16.3764	142.0983
Gulf	Staaten River at Dorunda	-16.5347	142.0608
Gulf	Mary Creek	-16.5847	145.1845
Gulf	Mary River at Mary Farms	-16.5686	145.1922
Gulf	Lynd_R L	-17.8261	144.4422
Gulf	Rifle Creek at Font Hills	-16.6809	145.2262
Gulf	Lynd River at Torwood	-17.4347	143.8194
Gulf	Hodgkins	-16.7122	144.8129
Gulf	Tate_R T	-17.3264	143.8497
Gulf	Mitchell River at Koolatah	-15.9483	142.3767
Gulf	Mcleod River at Mulligan Highway	-16.499	145.0012
Gulf	Mitchell River at Cooktown Crossing	-16.5661	144.8892
Gulf	Palmer_3	-15.91	143.3603
Gulf	Palmer River at Drumduff Crossing	-16.0433	143.0353
Gulf	North Palmer River at Maytown	-16.0142	144.2883
Gulf	Walsh River at Trimbles Crossing	-16.5469	143.7836
Gulf	Walsh River at Rookwood	-16.9822	144.2864
Gulf	Elizabeth Creek at Greenmantle	-16.6614	144.105
Gulf	Coleman River_	-15.1383	141.8075
Gulf	Holroyd River at Strathgordon	-14.4814	142.1877
Gulf	Archer River at telegraph line	-13.4191	142.9196
Gulf	Coen_R C	-13.9455	143.1955
Gulf	Coen River at Racecourse	-13.9553	143.1781
Gulf	Watson River at Jackin Creek	-13.1223	142.0531
Gulf	Embley River	-12.8175	142.1748
Gulf	Wenlock River at Moreton	-12.4562	142.6377
Gulf	Wenlock River at Wenlock	-13.0999	142.9411
Gulf	Wenlock1	-12.4106	142.3036
Gulf	Ducie River at Bertiehaugh	-12.1286	142.3744
Gulf	Dulhunty River at Doug's Pad	-11.834	142.4196

Freshwater reference sites

REGION	SITE NAME	LATITUDE	LONGITUDE
Gulf	Swordgra	-11.8272	142.5064
Gulf	Jardine_	-11.1536	142.3535
Gulf	Jardine River at Monument	-11.1503	142.3517

Estuary & marine reference sites

REGION	WATER TYPE	SITE NAME	LATITUDE GDA94	LONGITUDE GDA94
Wet Tropics	Enclosed Coastal	Coopers Creek 0.1km from mouth	-16.2017	145.4453
Wet Tropics	Enclosed Coastal	Daintree River Grid Reference 346996 (AMTD 0.0)	-16.2883	145.4522
Wet Tropics	Enclosed Coastal	Hinchinbrook Channel Grid Reference 018801 (Northern - Site 1)	-18.2675	146.0611
Wet Tropics	Enclosed Coastal	Hinchinbrook Channel Grid Reference 151667 (Mid-Channel - Site 2)	-18.3856	146.1969
Wet Tropics	Enclosed Coastal	Hinchinbrook Channel Grid Reference 245551 (Southern - Site 3)	-18.4942	146.2889
Wet Tropics	Estuary	Daintree River (Ferry Crossing) 8.7km from mouth (287015)	-16.2592	145.3981
Wet Tropics	Estuary	Daintree River 12.6km from mouth (249018)	-16.2583	145.3672
Wet Tropics	Estuary	Daintree River 16.4km from mouth (235025)	-16.2517	145.3481
Wet Tropics	Estuary	Daintree River 21.3km from mouth (200024)	-16.2492	145.3167
Central	Open Coastal	Cleveland Bay Grid Reference 915785 (Mid Bay)	-19.1839	146.9211
Central	Enclosed Coastal	Baffle Creek 4.1km from mouth	-24.5253	152.0358
Central	Enclosed Coastal	Boyne River at mouth	-23.9336	151.3567
Central	Enclosed Coastal	Boyne River 2.7km from mouth	-23.9578	151.3592
Central	Enclosed Coastal	Burrum River at mouth at junction with Gregory River	-25.1778	152.5564
Central	Enclosed Coastal	Elliot River 2.0km from mouth	-24.9306	152.4733
Central	Estuary	Baffle Creek 8.5km from mouth	-24.5153	151.9975
Central	Estuary	Baffle Creek 9.0km from mouth	-24.515	151.9917
Central	Estuary	Baffle Creek 10.0km from mouth	-24.5158	151.9814
Central	Estuary	Baffle Creek 11.0km from mouth	-24.5136	151.9719
Central	Estuary	Baffle Creek 16.0km from mouth	-24.5081	151.9272
Central	Estuary	Baffle Creek 23.5km from mouth	-24.5422	151.9039
Central	Estuary	Boyne River 5.1km from mouth at junction with South Trees Inlet	-23.9722	151.3447
Central	Estuary	Boyne River 8.6km from mouth	-23.9836	151.3178
Central	Estuary	Boyne River 12.0km from mouth	-24.0047	151.3419
Central	Estuary	Burrum River 5.5km upstream of junction with Gregory River	-25.2206	152.5422
Central	Estuary	Burrum River 12.7km upstream of junction with Gregory River	-25.2658	152.5689
Central	Estuary	Elliot River 5.5km from mouth	-24.9519	152.4589
Central	Estuary	Kolan River 5.3km from mouth	-24.6936	152.1639
Central	Estuary	Kolan River 8.1km from mouth	-24.6994	152.1839
Central	Estuary	Kolan River 12.0km from mouth	-24.7178	152.1744
Central	Upper Estuary	Baffle Creek 35.8km from mouth	-24.6017	151.8439
Central	Upper Estuary	Burrum River 19.2km upstream of	-25.3153	152.5889

Estuary & marine reference sites			LATITUDE	LONGITUDE
REGION	WATER TYPE	SITE NAME	GDA94	GDA94
		junction with Gregory River		
South-east	Open Coastal	Great Sandy Straits grid reference 000003 Woody Island / Little Woody Island	-25.3236	153.0061
Southeast	Open Coastal	Moreton Bay Grid Reference 336670 (EHMP) Site 506	-27.4183	153.3411
Southeast	Open Coastal	Moreton Bay Grid Reference 388712 (EHMP) Site 507	-27.3808	153.3928
Southeast	Open Coastal	Moreton Bay Grid Reference 287811 (EHMP) Site 510	-27.2883	153.2911
Southeast	Open Coastal	Moreton Bay Grid Reference 330960 (EHMP) Site 512	-27.17	153.3278
Southeast	Open Coastal	Moreton Bay Grid Reference 377783 (EHMP) Site 522	-27.3064	153.3831
Southeast	Open Coastal	Moreton Bay Grid Reference 346043 (EHMP) Site 524	-27.0778	153.3611
Southeast	Open Coastal	Moreton Bay Grid Reference 275995 (EHMP) Site 525	-27.1225	153.2761
Southeast	Open Coastal	Moreton Bay Grid Reference 230904 (EHMP) Site 527	-27.21	153.2331
Southeast	Open Coastal	Moreton Bay Grid Reference 357955 (EHMP) Site 528	-27.1625	153.3644
Southeast	Open Coastal	Southern Broadwater (430070) B (EHMP) Site 4000	-27.9511	153.4386
Southeast	Open Coastal	Southern Broadwater (450100) D (EHMP) Site 4001	-27.9264	153.4675
Southeast	Open Coastal	Southern Broadwater (420130) A (EHMP) Site 4002	-27.9056	153.4364
Southeast	Enclosed Coastal	Great Sandy Strait Grid Reference 924585 Boonooroo / Poona	-25.6894	152.9208
Southeast	Enclosed Coastal	Great Sandy Strait Grid Reference 929721 Boonlye Point	-25.5642	152.9275
Southeast	Enclosed Coastal	Great Sandy Strait Grid Reference 951657 Stewart Island	-25.625	152.9517
Southeast	Enclosed Coastal	Great Sandy Strait Grid Reference 972882 Yellow X Beacon mouth Mary River	-25.4214	152.9733
Southeast	Enclosed Coastal	Great Sandy Strait Grid Reference 979534 Tinnanba	-25.7358	152.9803
Southeast	Enclosed Coastal	Great Sandy Strait Grid Reference 984797 opposite Ungowa Jetty	-25.4994	152.9839
Southeast	Enclosed Coastal	Waterloo Bay Grid Reference 231612 (220610) (EHMP) Site 404	-27.4717	153.235
Southeast	Enclosed Coastal	Waterloo Bay Grid Reference 217636 (EHMP) Site 405	-27.45	153.2203
Southeast	Enclosed Coastal	Waterloo Bay Grid Reference 229642 (EHMP) Site 406	-27.4442	153.2328
Southeast	Enclosed Coastal	Moreton Bay Grid Reference 310507 (EHMP) Site 500	-27.5667	153.315
Southeast	Enclosed Coastal	Moreton Bay Grid Reference 330542 (EHMP) Site 501	-27.5344	153.3353
Southeast	Enclosed Coastal	Moreton Bay Grid Reference 263642 (EHMP) Site 518	-27.445	153.2678
Southeast	Enclosed Coastal	Deception Bay Grid Reference 165015 (EHMP) Site 1117	-27.11	153.1694
Southeast	Enclosed Coastal	Raby Bay Grid Reference 277568 (EHMP) Site 1200	-27.5083	153.2811
Southeast	Enclosed Coastal	Toondah Harbour Grid Reference 289543 Site 2 (EHMP) Site 1201	-27.5333	153.2942
Southeast	Enclosed	Noosa River 0.3km from mouth	-26.3819	153.0792

Estuary & marine reference sites

REGION	WATER TYPE	SITE NAME	LATITUDE GDA94	LONGITUDE GDA94
	Coastal	near North Head (EHMP) Site 1601		
Southeast	Enclosed Coastal	Noosa River 3.9km from mouth opposite Cloudsley Street, Noosaville (EHMP) Site 1603	-26.3958	153.0586
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 400220 (previously Station 17) (EHMP) Site 105	-27.8244	153.4069
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 381266 (EHMP) Site 106	-27.7828	153.3875
Southeast	Enclosed Coastal	Northern Broadwater grid reference 413086 (EHMP) Site 118	-27.9464	153.42
Southeast	Enclosed Coastal	Northern Broadwater (411108) (EHMP) Site 119	-27.9275	153.4186
Southeast	Enclosed Coastal	Northern Broadwater (EHMP) Site 120	-27.9094	153.4167
Southeast	Enclosed Coastal	Northern Broadwater (EHMP) Site 121	-27.8911	153.4158
Southeast	Enclosed Coastal	Northern Broadwater (EHMP) Site 122	-27.8486	153.3994
Southeast	Enclosed Coastal	Northern Broadwater (EHMP) Site 123	-27.7978	153.4119
Southeast	Enclosed Coastal	Northern Broadwater (409270) (EHMP) Site 124	-27.7819	153.4144
Southeast	Enclosed Coastal	Northern Broadwater (EHMP) Site 125	-27.7667	153.4311
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 430312 (previously Station 14) (EHMP) Site 301	-27.7411	153.4372
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 317446 (previously Station 5) (EHMP) Site 308	-27.6206	153.3222
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 333492 (previously Station 6) (EHMP) Site 309	-27.5789	153.3383
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 357508 (EHMP) Site 310	-27.5644	153.3625
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 402466 (EHMP) Site 313	-27.6022	153.4083
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 397441 (previously Station 10) (EHMP) Site 314	-27.6247	153.4033
Southeast	Enclosed Coastal	Northern Broadwater Grid Reference 389393 (previously Station 11) (EHMP) Site 315	-27.6683	153.3953
Southeast	Enclosed Coastal	Pumicestone Passage Grid Reference 130070 (EHMP) Site 1301	-27.0536	153.1339
Southeast	Enclosed Coastal	Pumicestone Passage Grid Reference 100090 (EHMP) Site 1302	-27.0281	153.1011
Southeast	Enclosed Coastal	Pumicestone Passage Grid Reference 110300 (EHMP) Site 1311	-26.8436	153.1175
Southeast	Enclosed Coastal	Pumicestone Passage Grid Reference 120320 (EHMP) Site	-26.8061	153.1289

Estuary & marine reference sites

REGION	WATER TYPE	SITE NAME	LATITUDE GDA94	LONGITUDE GDA94
		1312		
Southeast	Enclosed Coastal	Pumicestone Passage (EHMP) Site 1313	-27.0756	153.1506
Southeast	Enclosed Coastal	Tin Can Inlet Grid Reference 043376 (AMTD 6.4)	-25.8786	153.045
Southeast	Enclosed Coastal	Tin Can Inlet Grid Reference 028353 (AMTD 9.1)	-25.8986	153.0297
Southeast	Enclosed Coastal	Tin Can Inlet Grid Reference 017339 (AMTD 11.2)	-25.9117	153.0181
Southeast	Enclosed Coastal	Tin Can Inlet Grid Reference 035320 (AMTD 14.9)	-25.9286	153.0378
Southeast	Enclosed Coastal	Tin Can Inlet Grid Reference 021296 (AMTD 17.6)	-25.95	153.0225
Southeast	Enclosed Coastal	Tin Can Inlet Grid Reference 011269 (AMTD 20.5)	-25.9747	153.0131
Southeast	Estuary	Coomera River 0.0km at mouth (EHMP) Site 100	-27.8717	153.3969
Southeast	Estuary	Coomera River 2.8km from mouth 500m upstream of Coombabah Creek (EHMP) Site 101	-27.8722	153.3819
Southeast	Estuary	Coomera River (EHMP) Site 126	-27.8564	153.3789
Southeast	Estuary	Coomera River (EHMP) Site 127	-27.8467	153.3575
Southeast	Estuary	Noosa River 5.3km from mouth near western end of Goat Island (EHMP) Site 1604	-26.3933	153.0425
Southeast	Estuary	Pumicestone Passage Grid Reference 070150 (EHMP) Site 1304	-26.9797	153.075
Southeast	Estuary	Pumicestone Passage Grid Reference 050180 (EHMP) Site 1306	-26.9483	153.0564
Southeast	Estuary	Pumicestone Passage Grid Reference 070220 (EHMP) Site 1308	-26.9142	153.0739
Southeast	Estuary	Pumicestone Passage Grid Reference 090240 (EHMP) Site 1309	-26.8939	153.0997
Southeast	Estuary	Pumicestone Passage Grid Reference 110280 (EHMP) Site 1310	-26.8708	153.1167
Southeast	Estuary	Lake Weyba on Weyba Creek Bridge Noosa Parade (EHMP) Site 1616	-26.3942	153.0786
Southeast	Upper Estuary	Coomera River 13.1km from mouth at Pacific Highway Bridge (EHMP) Site 104	-27.8767	153.3144
Southeast	Upper Estuary	Noosa River 16.0km from mouth (EHMP) Site 1608	-26.3217	153.0203
Southeast	Upper Estuary	Noosa River 18.6km from mouth at Tronson's Drain (EHMP) Site 1615	-26.3178	152.9942
Southeast	Upper Estuary	Noosa River 21.5km from mouth on Lake Cootharaba (EHMP) Site 1609	-26.3044	152.9894
Southeast	Upper Estuary	Noosa River 26.0km from mouth on Lake Cootharaba (EHMP) Site 1610	-26.2669	153.0161

Appendix G: Salinity guidelines (expressed in conductivity units) for Queensland freshwaters

Deriving salinity guidelines

Salinity values in Queensland freshwaters show significant regional variation around the state. This variation is related principally to regional variations in soils/geology and rainfall. Human activities have undoubtedly affected natural salinity levels in a few areas but this is thought to be significant only at local or, at most, sub-regional scales.

To derive guidelines it is necessary to take into account this high degree of natural regional variation. The approach used is outlined in detail in the attached report. Briefly, on the basis of many years of salinity data collected by the Department of Environment and Resource Management, Queensland has been divided into a total of 18 zones. Each zone represents an area within which salinity is reasonably consistent. The selected zones are described and mapped in the attached report. Table G.1 in the attached report shows calculated salinity percentiles for each zone.

It is proposed that the 75th percentile value for each zone be used as a preliminary guideline value. This value would be compared with the median value at test sites within a zone. The use of the 75th rather than the 80th percentile is proposed because with this indicator the 80th percentile is usually significantly higher than the median and allows for too much change when compared to the median (refer to Figures G.5–G.7 in the attached report). As with all indicators, further investigation at a local level could be used to modify these proposed guideline values.

NOTE: Salinity is expressed in terms of conductivity units throughout this appendix. All conductivity values are corrected to 25^{0}C.

Attachment: Report on salinity zones defined for Queensland streams

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May 2004

Executive summary

This report presents an overview of salinity ranges in streams throughout Queensland. Eighteen salinity zones have been mapped on the basis of observed salinity characteristics while maintaining an awareness of regional management divisions (Figure G.1). Percentiles of EC recorded within each zone are presented as Table G.1. These zones are sufficient to identify sites or sub-catchments where the EC is unusually high or low when compared to the regional norm.

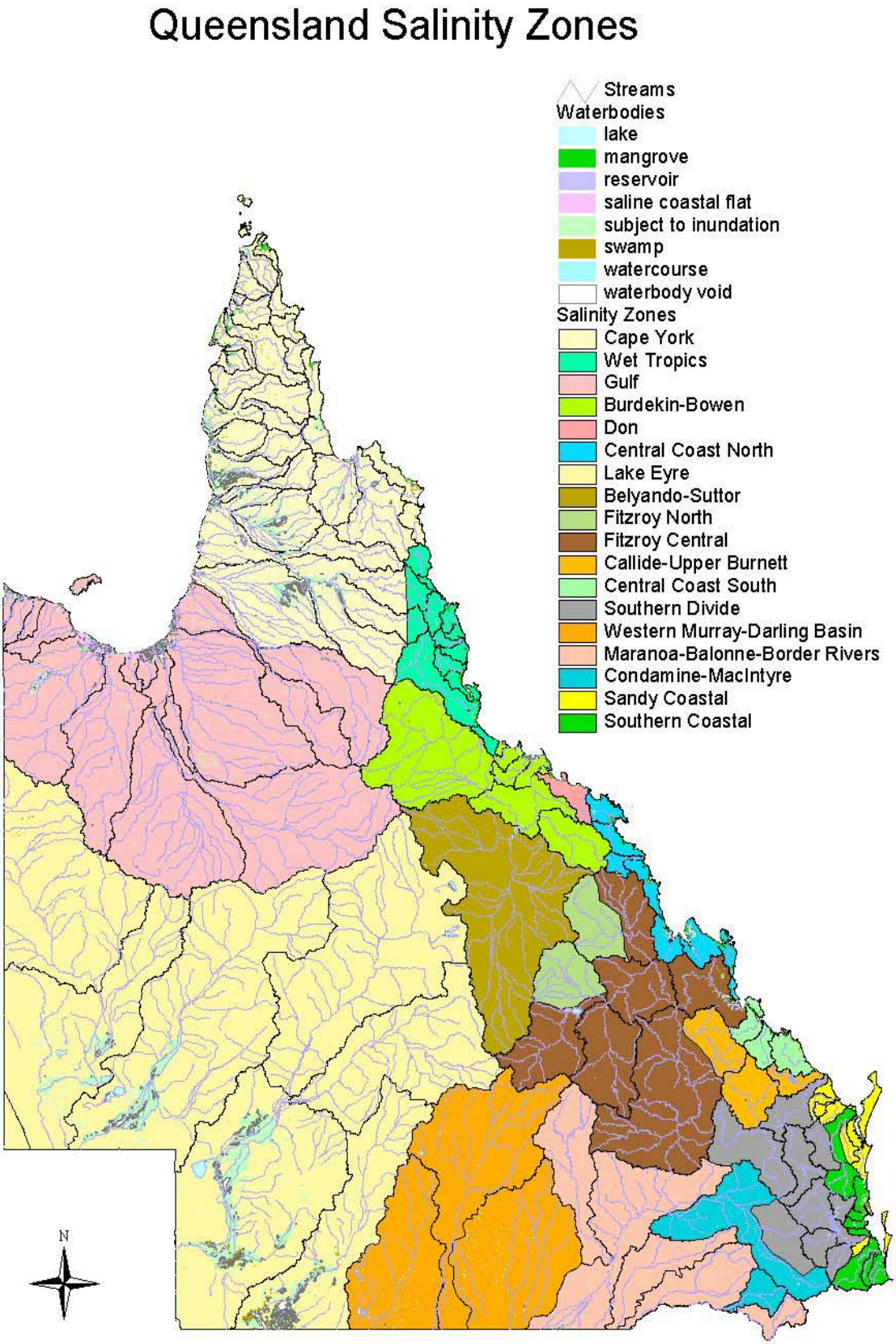
Table G.1: EC percentiles for Queensland salinity zones

Zone	Site used	Data used		Percentiles of EC µS/cm							Relative salinity
		Sites	ECs	90	80	75	50	25	20	10	
Cape York	All	92	3166	198	140	125	82	57	52	42	Mainly low, quite variable
Wet Tropics	Rateable	49	6199	130	100	92	71	50	46	36	Generally very low
Burdekin–Bowen	Rateable	18	1944	470	310	271	176	129	120	98	Moderately low but some high outliers
Belyando–Suttor	Rateable	5	271	225	180	168	135	109	100	80	Low
Don	All	10	372	1058	814	680	346	214	200	170	High
Central Coast North	Rateable	17	1916	560	440	375	200	120	110	88	Low to moderate, variable
Fitzroy North	Rateable	11	755	1250	840	720	355	209	187	130	Moderately high and variable
Fitzroy Central	Rateable	42	4376	510	380	340	242	175	161	130	Low to moderate
Central Coast South	Rateable	6	653	1500	1100	970	640	444	390	230	High and variable
Southern Divide	Rateable	59	5935	1570	1244	1120	760	481	425	289	Generally very high
Callide Upper Burnett	Rateable	28	2501	1450	890	760	500	339	310	240	High, very variable
Southern Coastal	Rateable	45	6717	732	578	520	340	212	182	121	Moderate but variable
Sandy Coastal	Rateable	11	1195	1310	730	626	368	216	188	90	Moderate to high, very variable
Condamine–Macintyre	Rateable	33	4003	755	555	500	355	255	235	189	Moderate to high
Maranoa–Balonne–Border rivers	Rateable	28	2872	471	356	325	234	165	152	123	Moderately low
Western Murray–Darling basin	All	36	253	312	195	169	118	88	82	70	Appears to be low
Lake Eyre	Rateable	4	383	410	230	200	128	90	82	71	Low
Gulf	Rateable	12	565	630	550	500	245	157	134	100	Moderate

The assessment is based on about 63 000 EC measurements from streams throughout Queensland collected by NRM&E, EPA and a number of other organisations.

The zones vary in size and complexity, with greater definition in the south-east, where most of the data has been collected. However, it is reasonable to assume that the eastern part of the state is also the region where most natural variation would occur, owing to the more complex geology and climate, and relatively recent geomorphological changes. The zones mainly follow catchment boundaries but some are related to the properties of a watershed. Each zone still contains regional variability and it is possible that further refinement could take place for strategic monitoring.

Figure G.1:


Queensland Salinity Zones
Streams
Waterbodies
lake
mangrove
reservoir
saline coastal flat
subject to inundation
swamp
watercourse
waterbody void
Salinity Zones
Cape York
Wet Tropics
Gulf
Burdekin-Bowen
Don
Central Coast North
Lake Eyre
Belyando-Suttor
Fitzroy North
Fitzroy Central
Callide-Upper Burnett
Central Coast South
Southern Divide
Western Murray-Darling Basin
Maranoa-Balonne-Border Rivers
Condamine-MacIntyre
Sandy Coastal
Southern Coastal
N

The saline zones are found towards the east of southern and central Queensland, but contain mainly low-discharge streams with limited impact on big river systems. By contrast, the far north and south-west of the state have characteristically low-salinity streams. Some zones have been defined for the convenience of catchment management, although they are virtually identical in terms of salinity and water chemistry. These particularly include parts of the Murray Darling basin and adjoining sections of the Fitzroy basin that were kept separate to be consistent with NAP regionalisation. Other zones may be combined, subdivided or redefined, but this would best be done on the basis of local input or in a joint review, including biological boundaries or other water quality parameters.

The question that cannot be fully answered is whether ranges of EC that are truly natural can be estimated when virtually all of Queensland has been disturbed to some extent, particularly in the lower catchments of major streams. Accordingly, the ranges calculated refer to the salinity that has existed over the period of collection, beginning in the 1960s and 1970s, and not necessarily to the natural or desirable salinity. Despite this there is sufficient consistency in magnitude, variability and chemical composition to infer that the percentiles obtained are close to normal. In addition, trend analyses previously carried out by NRM&E and CSIRO indicate that longer term stream EC trends have been slight in comparison with observed variability since at least about 1970 and tend to be cyclical in nature.

There has, of necessity, been a high degree of subjectivity in the outlining of zones, so supporting information is provided in the appendices of the main report to allow for review of boundaries if required. No attempt has been made to discuss the processes behind the variability in this broad-scale review, and trends and cycles are also beyond the scope of this work.

Issues raised include the need for strategic monitoring of certain areas to clearly define ambient salinity ranges, regardless of other monitoring needs such as compliance or trends analysis. These particularly include low-lying coastal areas and islands between the mouth of the Fitzroy and the NSW border; and the western part of the state, including the Gulf catchments, the Lake Eyre catchment, and the portion of the Murray Darling basin west of the Balonne. More input is needed on the effect of stream regulation and other forms of development on stream salinity, and related impacts on biota.

In summary, the percentiles as presented do not constitute salinity targets, but provide a tool to assist in the development of such targets by providing baseline information about ambient ranges. These can be used to identify anomalously high or low sites that have been sufficiently monitored, but local investigation will be required to disclose whether their salinity state is natural, or contributed to by human factors.

Introduction

Many factors contribute to variability in stream salinity. They can be both environmental and anthropogenic in nature. Broad-scale natural determinants are climate, geology, palaeoclimate, recent geological history including sea-level fluctuations, and the physiography of the landscape including maturity of stream reaches and depth of the alluvium. Smaller scale natural anomalies result from, for instance, tidal influences in low-lying coastal areas, or rain shadowed sub-catchments containing saline sediments and soils. Some recognised anthropogenic impacts on stream salinity are clearing, irrigation, effluent discharges, and upstream storages.

This report presents an overview of salinity ranges in streams throughout Queensland. The analysis was based on salinity measurements stored in the NRM&E HYDSYS surface water database, supplemented by collections of salinity data in terms of electrical conductivity (EC) from several other organisations recognised as having a high degree of data quality control. The combined data supplied some coverage over virtually all parts of the state. The definition of zones was based around observed spatial similarity in the magnitude and variability of salinity as displayed through individual sites. Only sites with a specified degree of data adequacy were used for zone definition, but all other data was used to support the conclusions. Water chemistry in terms

of major ion content was also considered, and because much of the process has been necessarily subjective, supporting material has been included in the appendices.

Eighteen salinity zones have been mapped on the basis of existing salinity characteristics, while maintaining an awareness of regional management divisions. The zones identified vary in size and complexity, with greater definition in the south-east, where most of the data has been collected. It is possible that further refinement could take place as more comprehensive data becomes available. The salinity ranges for each zone are presented in terms of percentiles, which were calculated from the amalgamated records of reliable sites where possible. In some zones with very few or poorly distributed reliable sites, all riverine data was used for percentile calculation, although it is recognised that bias may occur in these cases. Strategic monitoring is recommended for these zones.

Although the zones identified indicate the ambient magnitude and range of stream EC, these may not be the only significant factors in terms of ecosystem salinity requirements. Temporal trends, seasonality and flow relationships may be important also; however, the percentile ranges are sufficiently precise to provide a tool to assist in the development of salinity targets by providing baseline information.

Data

Quality controlled freshwater data sets, containing salinity as EC, have been collected through ambient monitoring by the EPA and NRM&E and by various organisations for specific projects. These were amalgamated, amounting to around 63,000 independent EC readings. Missing flows or GIS coordinates were affixed where possible. The project specific data sets are from Condamine Balonne Water Committee, described in CBWC (1999); Western streams water quality monitoring project (Humphery, 1996); Border rivers, Border River Catchment Management Association (McGloin, 2001); NRM&E and Australian Centre for Tropical Freshwater Research (Congdon, 1991; McNeil et al., 2000); and the Fitzroy National Landcare Program (Noble et al., 1997).

Assessment methods

The procedure used to subdivide Queensland into salinity zones was carried out in stages:

1. Establishing site reliability
2. Categorising reliable sites in terms of percentiles of EC and defining salinity zones
3. Inspecting results to refine boundaries and determine data adequacy to calculate percentiles.

Site reliability

Site reliability in terms of adequacy of data is calculated by the same method used for the Queensland State of the Environment Report (EPA, 2004) and other recent reports. The reliability of data sets was rated in terms of excellent, good, moderate and poor, while sites lacking sufficient or comprehensive data were labelled as unrateable (Table G.2).

Figure G.2: Factors considered in assessing the reliability of data sets at each site

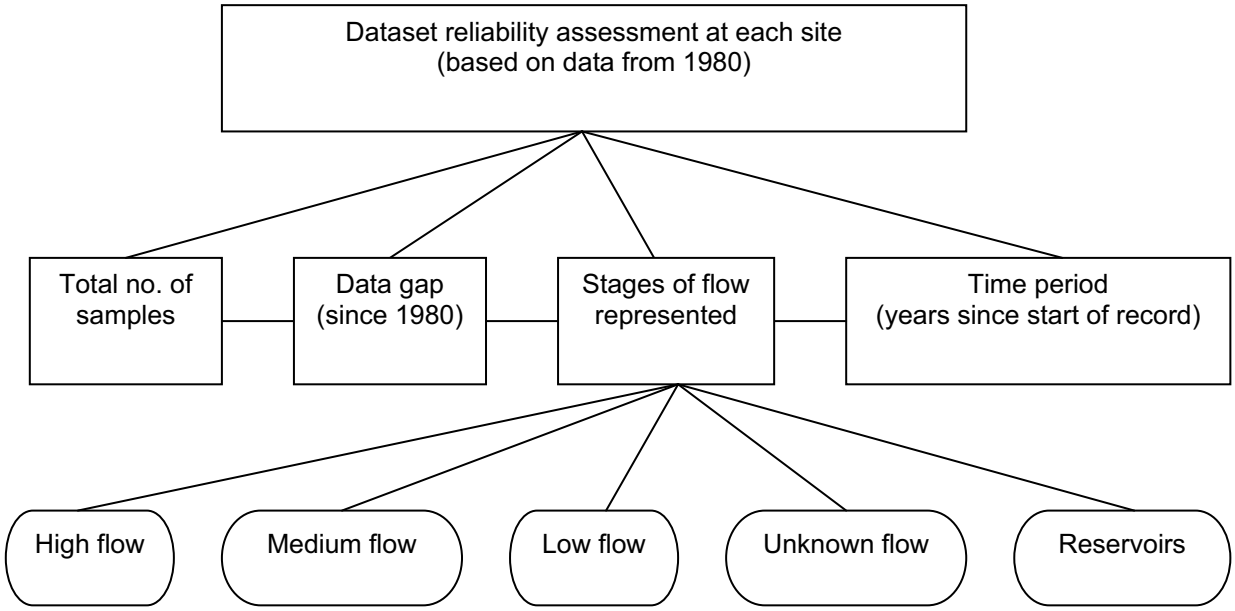


Table G.2: Criteria used to assess the reliability of data sets at each site

Time period (years)	Data gap (years)	Total no. of samples	Stages of flow represented (number of samples)					Reliability rating
			Low	Medium	High	Unknown	Reservoir	
>20	<5	>70	>7	>20	>18	–	–	Excellent
>15	<3	>60	>6	>18	>15	–	–	Good
>15	<3	>60	–	–	–	–	>60	Good
>10	–	>40	>4	>10	>10	–	–	Moderate
>10	<3	>60	–	–	–	–	>50	Moderate
>10	<3	>120	–	–	–	>120	–	Moderate
>10	<3	>50	–	–	–	–	–	Moderate
>5	–	>20	>2	>6	>5	–	–	Poor
>5	–	>20	–	–	–	–	>30	Poor
>5	–	>20	–	–	–	>60	–	Poor
>5	–	>30	–	–	–	–	–	Poor

Defining salinity zones

Lists of percentiles were produced for each reliable site and the resulting table was examined to find a method that would classify the site salinity in terms of both absolute levels and variability. A scheme that satisfied both criteria, and when plotted on GIS produced a good geographical coherence, is based on the 50th and 80th percentiles, and is summarised in Table G.3. Briefly, there is a strong regional pattern that differentiates tropical, central, southern and inland characteristics, as well as providing some local definition.

Table G.3: Salinity categories (EC in uS/cm)

Type	50 percentile EC	80 percentile EC	Salinity description
1	<100	<=100	Very low
2	50–200	100–200	Low
3	50–200	200–500	Generally low but variable
4	200–500	200–500	Moderate
5	200–500	500–1000	Generally moderate but variable
6	500–1000	>500	High
7	>1000	>1000	Very high

The salinity categories were colour coded, and the sites plotted on two working maps of the state:

1. showing all classifiable sites with sizes based on annual flow volume. This was useful for separating headwater and minor tributary ranges from those applicable to lower catchments; and
2. showing all sites with sizes based on data adequacy. There were few excellent sites, and some large catchments with no suitable representative sites; but there was a wide scatter of unrateable locations where data has been collected, and it was possible to amalgamate these to produce provisional percentile ranges for some areas.

From these maps, with reference also to the chemistry of the local salts, regional or sub-basin salinity zones were drawn which are reasonably homogeneous and have relevance where possible to NAP and NHT 2 boundaries.

These zones were then defined as shapes within ArcGIS. The starting point was the shapefile for the basin sub-area polygons available from the GIS server. Where necessary new sub-areas were created by splitting an existing polygon. The zones were then created as aggregates of sub-areas. All the sites within a particular zone could then be selected and labelled as belonging to that zone. When all the sites were so labelled, the data could then be exported from ArcGIS and statistically summarised for each zone.

The final salinity zones with the categorised sites used to define them, as well as the locations of the unrateable sites, are shown in Figure G.3. A summary of the salt chemistry from McNeil (2002) is shown in Figure G.4.

Determining percentiles and data adequacy

As Figure 3 indicates, many zones, particularly those outside the east coast, have either an inadequate number of, or distribution of, classifiable sites. Therefore a box and whisker plot for EC was produced for each site within each zone, colour-coded as to site reliability, and visually inspected for outliers or inconsistencies. This led to some redefining of the zones. The box and whisker plots are contained in Appendix 1 (not included in the QWQG), with the 10^{th} and 90^{th} zone percentiles marked on the plots for comparison.

It was considered desirable to base zone percentiles exclusively on rateable sites where possible, because unrateable sites may be biased in a number of ways, and may not always represent normal stream data. But it was clear that for some zones, ranges would have to be based on, or at least supported by, the unrateable sites. Accordingly, percentiles were initially calculated within each zone for all riverine data, and also for the subset of reliable sites. The results were compared as plots in Appendix 2 (not included in the QWQG) and a subjective decision made as to which set to select as the final percentiles for each zone. In most cases the results were very similar, even when there were few classifiable sites in apparently unrepresentative locations. It should be noted that no attempt was made to identify and exclude sites on the basis of human interference. This was not possible within the timeframe of this project, nor considered necessary, as the volume of available data was sufficient to exclude outliers through the percentile selection. Appendix 1 (not included in the QWQG) demonstrates that the selected percentile ranges will identify anomalous sites.

Results

The final salinity zone map is illustrated in Figures G.3 and G.4. The percentiles for each zone, summarised on Table G.1, are listed with more supporting information on Table G.4. The 18 salinity zones on the maps vary in size and complexity, with greater definition in the south-east where most of the data has been collected. It is anticipated that further refinement would be possible through comments from people with local knowledge as well as through future data collection. However, it is reasonable to assume the eastern part of the state is also the region where most natural variation would occur, because of the more varied geology and climate, and the relatively recent geomorphological development. The zones mainly follow catchment boundaries, but some such as the Southern Divide are related to headwater environments and watersheds.

Figure G.3:

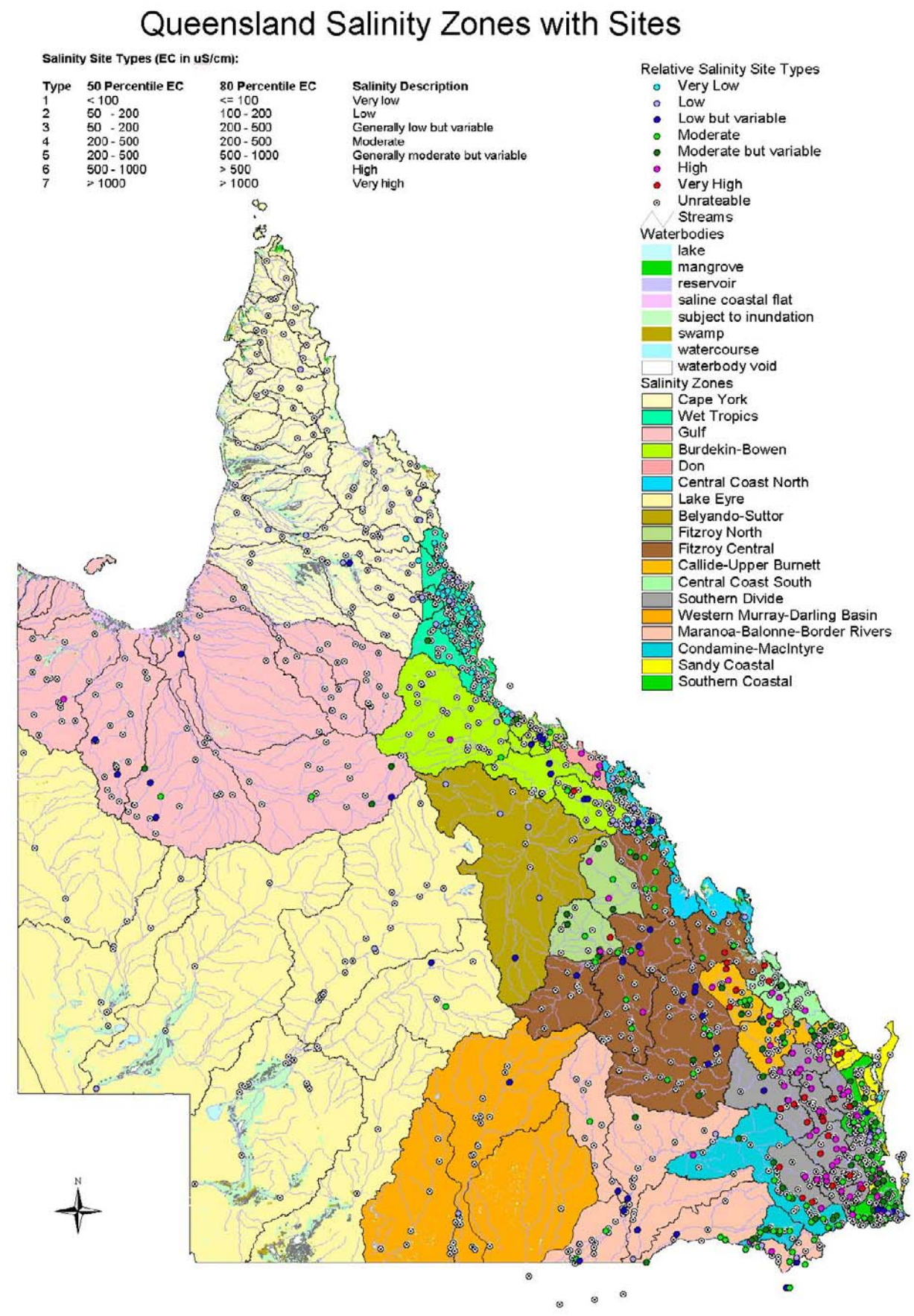
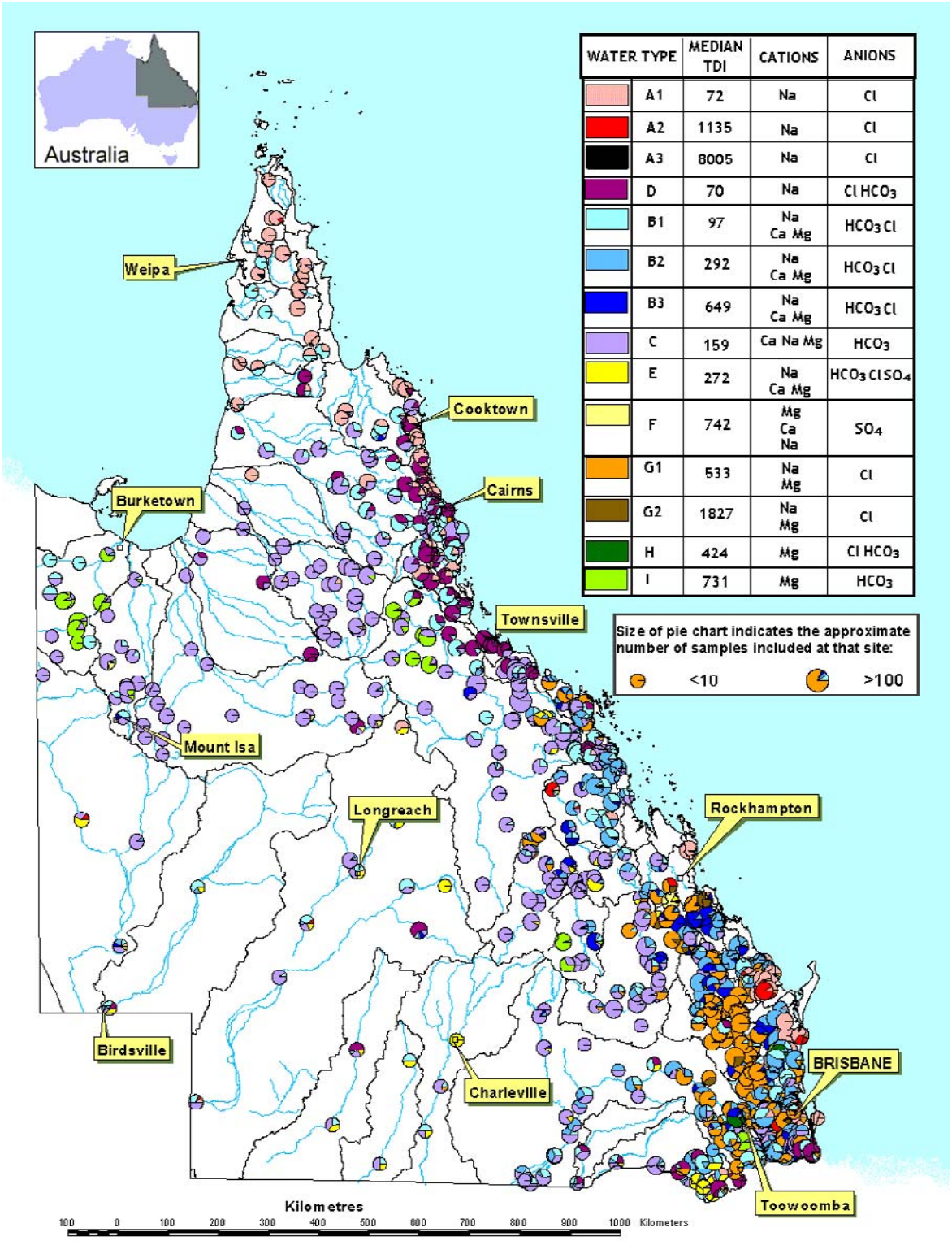

Queensland Salinity Zones with Sites
Salinity Site Types (EC in uS/cm):
Type 50 Percentile EC 80 Percentile EC Salinity Description
1 < 100 <= 100 Very low
2 50 - 200 100 - 200 Low
3 50 - 200 200 - 500 Generally low but variable
4 200 - 500 200 - 500 Moderate
5 200 - 500 500 - 1000 Generally moderate but variable
6 500 - 1000 > 500 High
7 > 1000 > 1000 Very high
Relative Salinity Site Types
Very Low
Low
Low but variable
Moderate
Moderate but variable
High
Very High
Unrateable
Streams
Waterbodies
lake
mangrove
reservoir
saline coastal flat
subject to inundation
swamp
watercourse
waterbody void
Salinity Zones
Cape York
Wet Tropics
Gulf
Burdekin-Bowen
Don
Central Coast North
Lake Eyre
Belyando-Suttor
Fitzroy North
Fitzroy Central
Callide-Upper Burnett
Central Coast South
Southern Divide
Western Murray-Darling Basin
Maranoa-Balonne-Border Rivers
Condamine-MacIntyre
Sandy Coastal
Southern Coastal
N

Figure G.4: Distribution of water types for drainage systems in Queensland



WATER TYPE		MEDIAN TDI	CATIONS	ANIONS
	A1	72	Na	Cl
	A2	1135	Na	Cl
	A3	8005	Na	Cl
	D	70	Na	Cl HCO_3
	B1	97	Na Ca Mg	HCO_3 Cl
	B2	292	Na Ca Mg	HCO_3 Cl
	B3	649	Na Ca Mg	HCO_3 Cl
	C	159	Ca Na Mg	HCO_3
	E	272	Na Ca Mg	HCO_3 Cl SO_4
	F	742	Mg Ca Na	SO_4
	G1	533	Na Mg	Cl
	G2	1827	Na Mg	Cl
	H	424	Mg	Cl HCO_3
	I	731	Mg	HCO_3

Figure 7. Distribution of water types for drainage systems in Queensland.
Pie diagrams show what proportion of the stream water samples from a gauging station were of each water type.
Similar types are shown in similar colours.
The table includes the median Total Dissolved Ions in mg L^{-1}

Table G.4: EC percentiles for salinity zones for all riverine data as well as for rateable sites only

Zone	Site type	Data used		Percentiles of EC							Area	Sufficiency of data	Relative salinity	General chemistry		Comments
		Sites	ECs	90	80	75	50	25	20	10				Cations	Anions	
Cape York	All	92	3166	198	140	125	82	57	52	42	Cape York north of Gilbert and Einasleigh rivers, and west of Wet Tropics and Atherton Tablelands	Few rateable sites not sufficiently representative, so all data used	Mainly low but quite variable	sodium	chloride	Similar to Wet Tropics but difference in chemistry affects EC:salt ratio.
	Rateable	11	1222	152	125	118	81	57	54	46						
Wet Tropics	All	252	8912	135	105	95	71	49	45	36	Endeavour to Black rivers and Atherton Tablelands	Sufficient rateable	Generally very low	sodium	chloride bicarbonate	Generally lowest salinity in Queensland
	Rateable	49	6199	130	100	92	71	50	46	36						
Burdekin Bowen	All	111	3678	560	378	325	186	125	115	91	Burdekin basin excluding Suttor – Belyando, with Bowen, Ross, Haughton and Barratta	Sufficient rateable	Moderately low, but variable	all	bicarbonate	Some high outliers which may have estuarine influence
	Rateable	18	1944	470	310	271	176	129	120	98						
Belyando Suttor	All	11	415	235	190	170	135	109	102	81	Suttor and Belyando river systems in south-west Burdekin basin	Sufficient rateable	Low	all	bicarbonate	Significantly less saline than rest of Burdekin basin
	Rateable	5	271	225	180	168	135	109	100	80						
Don	All	10	372	1058	814	680	346	214	200	170	Don catchment on coast south of Townsville	Rateable data unevenly distributed so all data used	High	sodium magnesium	chloride bicarbonate	Small high salinity catchment, needs strategic monitoring
	Rateable	3	206	1153	980	920	562	360	319	200						
Central Coast north	All	95	2537	560	431	373	202	124	110	89	Proserpine to Waterpark, just north of Rockhampton	Rateable sufficient, although higher in midrange	Low to moderate, variable	sodium others	bicarbonate chloride	Some high outlier sites
	Rateable	17	1916	560	440	375	200	120	110	88						
Fitzroy north	All	21	843	1250	811	690	330	195	175	125	Nogoa basin north of Emerald, and upper Isaac River to junction with Funnel Creek	Rateable sufficient	Moderately high and variable	sodium others	bicarbonate chloride	Higher salinity zone in north-west quadrant of Fitzroy
	Rateable	11	755	1250	840	720	355	209	187	130						

Zone	Site type	Data used		Percentiles of EC							Area	Sufficiency of data	Relative salinity	General chemistry		Comments
		Sites	ECs	90	80	75	50	25	20	10				Cations	Anions	
Fitzroy central	All	141	5891	604	405	360	250	178	165	134	Dawson apart from the Callide, Don and Dee, Comet and southern Nogoa basins	Rateable reasonably representative	Low to moderate	all	bicarbonate	Basically a continuation of Lower Murray–Darling basin
	Rateable	42	4376	510	380	340	242	175	161	130						
Central Coast South	All	22	764	1440	1050	950	690	470	413	250	Coast south of Rockhampton, i.e. Calliope, Boyne and Baffle catchments, Curtis Is.	Rateable sufficient	High and variable	sodium others	bicarbonate chloride	Similar to Southern Divide, but different chemically and slightly less saline
	Rateable	6	653	1500	1100	970	640	444	390	230						
Southern Divide	All	228	8406	1550	1200	1075	697	438	376	276	Brisbane catchment, Burnett apart from Three Moon Ck in north, and adjoining tributaries of Mary and Condamine	Rateable sufficient	Generally very high	sodium magnesium	chloride	Most generally saline zone in Queensland
	Rateable	59	5935	1570	1244	1120	760	481	425	289						
Callide Upper Burnett	All	70	3314	1277	890	772	490	324	293	233	Three Moon Creek, Kolan and the Callide, Don and Dee systems	Rateable sufficient	High, very variable	sodium others	all	Callide, Don and Dee systems resemble adjoining upper Burnett rather than Dawson
	Rateable	28	2501	1450	890	760	500	339	310	240						
Southern Coastal	All	211	8281	754	580	520	340	202	170	120	Maroochy Caboolture and Pine rivers, upper and central Mary Valley, and south coast including Logan and Albert rivers	Rateable sufficient	Moderate but variable	sodium others	bicarbonate chloride	Small to medium catchments around mouth of Brisbane River
	Rateable	45	6717	732	578	520	340	212	182	121						

Zone	Site type	Data used		Percentiles of EC							Area	Sufficiency of data	Relative salinity	General chemistry		Comments
		Sites	ECs	90	80	75	50	25	20	10				Cations	Anions	
Sandy Coastal	All	48	1563	1126	650	580	318	187	160	95	Elliot, Gregory, Isis, Burrum and Noosa rivers and larger sand islands around Morton Bay	Rateable sufficient, although unevenly distributed	Moderate to high very variable	sodium	chloride	Low-lying coast and islands, high in NaCl with some tidal influence, needs monitoring
	Rateable	11	1195	1310	730	626	368	216	188	90						
Condamine MacIntyre	All	89	4989	720	550	492	346	250	230	180	Condamine River, excluding eastern tributaries between Warwick and Dalby, and Macintyre Brook	Rateable sufficient	Moderate to high	sodium magnesium	chloride bicarbonate	Higher salinity and different chemically from downstream Queensland MDB
	Rateable	33	4003	755	555	500	355	255	235	189						
Maranoa–Balonne–Border rivers	All	92	3660	450	345	310	230	165	154	124	Balonne–Maranoa–Culgoa to border, and border rivers excluding Macintyre Brook	Rateable sufficient	Moderately low	all	bicarbonate	Most of MDB discharges into NSW. Basically identical to Central Fitzroy
	Rateable	28	2872	471	356	325	234	165	152	123						
Western Murray–Darling basin	All	36	253	312	195	169	118	88	82	70	MDB west of the Balonne–Culgoa, including the Mungallala Creek system, Warrego and Paroo	Only one rateable site, all riverine data used	Appears to be low	sodium others	bicarbonate chloride sulphate	Similar and geographically connected to Belyando Suttor. More monitoring needed
	Rateable	2	82	282	195	173	127	96	85	76						

Zone	Site type	Data used		Percentiles of EC							Area	Sufficiency of data	Relative salinity	General chemistry		Comments
		Sites	ECs	90	80	75	50	25	20	10				Cations	Anions	
Lake Eyre	All	58	767	377	231	205	134	94	86	71	Catchments draining to Lake Eyre and other inland salt lakes, including the Bulloo, Barcoo, Thompson, Coopers Ck, Diamantina and Georgina	Few rateable but reasonably representative	Low	sodium others	bicarbonate chloride sulphate	Very large area with variable chemistry. May be subdivided after more monitoring
	Rateable	4	383	410	230	200	128	90	82	71						
Gulf	All	109	1980	603	500	435	195	105	92	69	Catchments south of Cape York draining into the Gulf of Carpentaria, from the Gilbert River in the east to the NT border	Few rateable but reasonably representative. Slightly higher but more reliable	Moderate	all	bicarbonate	Salinity slightly higher than in Lake Eyre region. May subdivide after more monitoring
	Rateable	12	565	630	550	500	245	157	134	100						

The spatial distribution of site salinity types on Figure G.3 reveals that EC characteristics vary significantly in a regional manner, and that the zones can be differentiated into salinity categories. The plots of percentiles in low, moderate and high categories are shown in Figures G.5, G.6 and G.7, with the two most saline zones in the lower categories being duplicated in the category above for comparison. This creates fuzzy divisions that reflect real spatial salinity relationships better than sharp division. The saline zones are found towards the east of southern and central Queensland, but contain mainly low-discharge streams with limited impact on big river systems. By contrast, the far north and south-west of the state have characteristically low salinity streams. The Central Fitzroy and Balonne–Maranoa zones are very similar both chemically and in terms of salinity, as are the western Murray Darling basin and Belyando–Suttor, but these zones were kept separate to be consistent with NAP regionalisation.

Discussion

This technical report presents an overview of salinity ranges in streams throughout Queensland in terms of 18 zones, which are reasonably homogeneous in terms of natural salinity and chemical characteristics. Each zone still contains regional variation, and the exact boundaries or subdivisions of zones may be further refined by expert local knowledge. No attempt has been made to discuss the processes behind the variability in this broad-scale review, or the relationship between salinity variation and biological provinces, as these are the focus of studies both within NRM&E and other organisations. Temporal salinity in terms of trends and cycles are also beyond the scope of this work.

Because there has, of necessity, been a high degree of subjectivity in the outlining of zones, supporting information is provided in the appendices to allow for review of the boundaries if required.

The question that cannot be fully answered is whether ranges of EC that are truly natural can be estimated when virtually all of Queensland has been disturbed to some extent, particularly in the lower catchments of major streams. Accordingly, the ranges calculated refer to the salinity that has existed over the period of collection, beginning in the 1960s and 1970s, and not necessarily to the natural or desirable salinity. Despite this, there is sufficient consistency in magnitude, variability and chemical composition to imply that the percentiles obtained are close to normal. Previous trend analyses, i.e. DPI (1994), Jolly et al. (2000) McNeil and Cox (2002), support this by indicating that EC trends in Queensland streams since at least 1970 have been slight in comparison with natural variability (usually of the order of less than 1 µS/cm/year), and tend to be cyclical rather than monotonic.

These arguments add confidence that the ranges presented here are sufficient to identify sites or sub-catchments where the EC is unusually high or low compared with the regional norm. However, the assumption of near natural EC would be violated using this methodology, if a very large proportion of a zone were to be in an unnatural condition. One possible case is the Macintyre Brook catchment. This strongly regulated system resembles the adjoining Condamine catchment, also subject to regulation, rather than the remainder of the border rivers, which are consistent with the lower Balonne.

In summary, the percentiles as presented provide a tool to assist in the development of guidelines by providing baseline information about ambient ranges. These can be used to identify anomalously high or low sites that have been sufficiently monitored. Local investigation is desirable to disclose whether their salinity state is natural or contributed to by human factors.

Figure 5: EC Percentiles for Low Salinity Zones, (overlapping with moderate category)

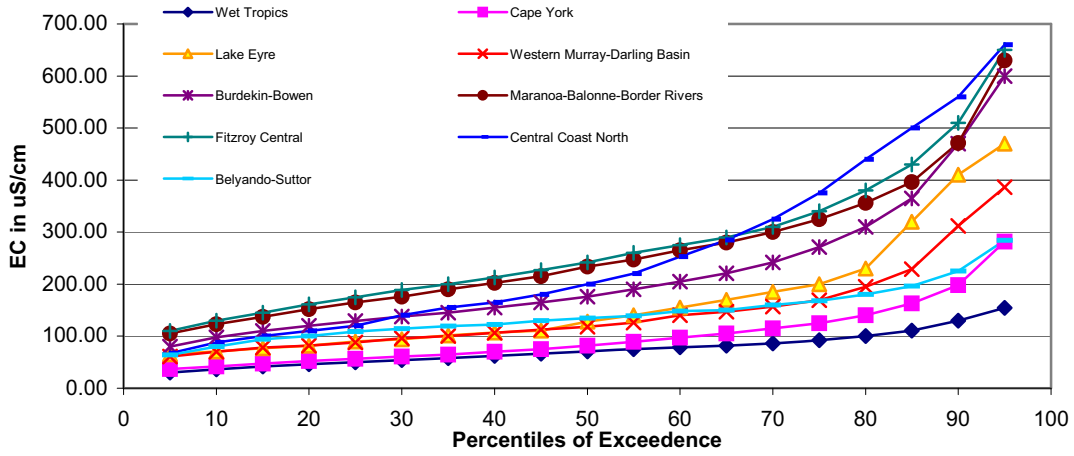


Figure 6: EC Percentiles for Moderate Salinity Zones, (overlapping with low and high)

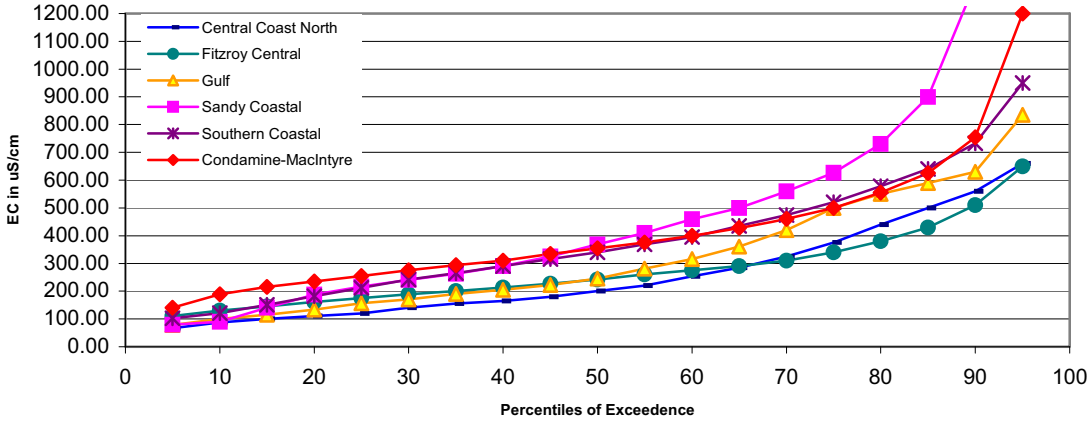
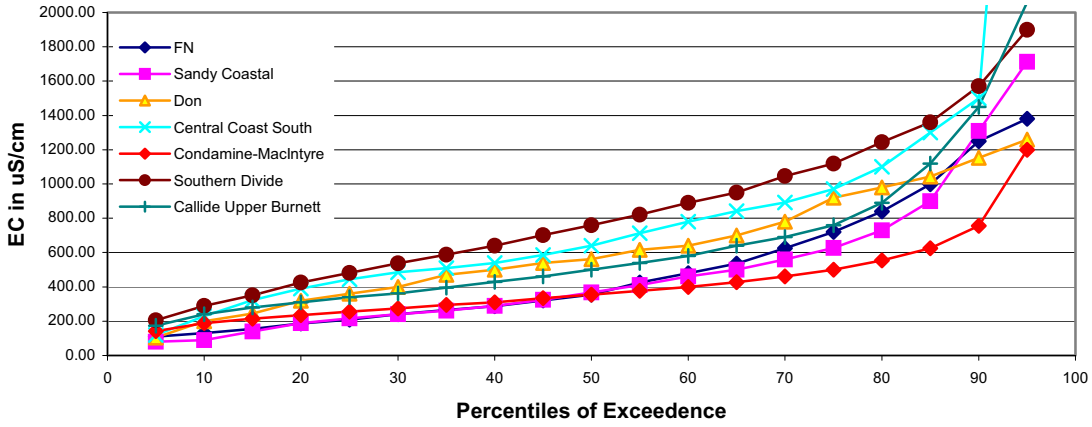


Figure 7: EC Percentiles for High Salinity Zones, (overlapping with moderate category)



Conclusions

In most zones there is a high degree of similarity between percentiles calculated for all riverine data and those using only data from sites with a reliability rating. This suggests that established sites with a reasonable history are sufficiently representative. However, it is clear that some areas of Queensland would benefit from strategic monitoring to clearly define ambient salinity ranges, regardless of other monitoring needs such as compliance or trends analysis. These particularly include low-lying coastal areas and islands between the mouth of the Fitzroy and the NSW border; and the western part of the state, including the Gulf catchments, the Lake Eyre catchment, and the portion of the Murray Darling basin west of the Balonne.

Some zones have been defined for the convenience of catchment management, although they are virtually identical in terms of salinity and water chemistry. These particularly include parts of the Murray Darling basin and adjoining sections of the Fitzroy basin.

Other zones may be combined, subdivided or redefined, but this would best be done on the basis of local input or in a joint review, including biological boundaries or other water quality parameters.

More input is needed on the effect of stream regulation and other forms of development on stream salinity, and related impacts on biota.

References

CBWC, 1999. *Water quality in the Condamine–Balonne catchment*. Condamine–Balonne Water Committee Inc, Dalby, Queensland.

Congdon, R.A., 1991. *Effects of irrigation discharge on the Barratta Wetlands*. Report No. 91/06, Australian Centre for Tropical Freshwater Research, James Cook University, Townsville, Qld.

DPI, 1994. *Queensland water quality atlas*, Queensland. Department of Primary Industries, Brisbane, Qld.

EPA, 2004. *Queensland state of the environment report 2003*. Queensland Environmental Protection Agency, Brisbane, Qld.

Humphery, V., 1996. *Western streams water quality monitoring project: Lake Eyre catchment and Warrego/Paroo catchment, final report.* Queensland Department of Natural Resources (West Region), and National Landcare Program, Longreach, Qld.

Jolly, I.D. et al., 2000. Historical stream salinity trends and catchment salt balances in the Murray–Darling Basin, Australia. *Marine and Freshwater Research*, 51.

McGloin, E., 2001. *Water quality and management options in the Border Rivers catchment*, Border River Catchment Management Association: Part of the Natural Heritage Trust. Cranbrook Press, Toowoomba, Qld, 210 pp.

McNeil, V.H., 2002. *Assessment methodologies for very large, irregularly collected water quality data sets with special reference to the natural waters of Queensland.* PhD Thesis, Queensland University of Technology, Brisbane, Qld.

McNeil, V.H. et al., 2000. *Evaluation of the surface water quality of the Haughton–Barratta wetland system*, Water Monitoring Group, Queensland Department of Natural Resources, Brisbane, Qld.

McNeil, V.H. and Cox, M.E., 2002. *Relationships between recent climate variation and water tables on stream salinity trends in northern Australia*. IAH International Groundwater Conference, Balancing the groundwater budget. International Association of Hydrogeologists, 12–17 May, Darwin, Northern Territory.

Noble, R.M., Duivenvoorden, L.J., Rummenie, S.K., Long, P.E. and Fabbro, L.D., 1997. *Downstream effects of land use in the Fitzroy catchment*. Department of Natural Resources, Qld.

Appendix H: Suite of environmental values that can be chosen for protection

Environmental Values	ICON	Definitions
Aquatic Ecosystems		The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas – for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, ground waters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes, lagoons, canals, natural and artificial channels and the bed and banks of waterways. See below for details of three possible "levels of protection" contained in the Australian water quality guidelines (AWQG).
		Level 1: High ecological/conservation value (HEV) ecosystems *"effectively unmodified or other highly valued systems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations. While there are no aquatic ecosystems in Australia and New Zealand that are entirely without some human influence, the ecological integrity of high conservation/ecological value systems is regarded as intact." (AWQG 2000; 3.1-10)*
		Level 2: Slightly–moderately disturbed (SMD) ecosystems *"Ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity. The biological communities remain in a healthy condition and ecosystem integrity is largely retained. Typically, freshwater systems would have slightly to moderately cleared catchments and/or reasonably intact riparian vegetation; marine systems would have largely intact habitats and associated biological communities. Slightly–moderately disturbed systems could include rural streams receiving runoff from land disturbed to varying degrees by grazing or pastoralism, or marine ecosystems lying immediately adjacent to metropolitan areas."* (AWQG 2000; 3.1-10) (Note: EPP Water 2009 recognises the potential to distinguish slightly from moderately disturbed systems and establish different management intents – see EPP Water)
		Level 3: Highly disturbed (HD) ecosystems *"These are measurably degraded ecosystems of lower ecological value. Examples of highly disturbed systems would be some shipping ports and sections of harbours serving coastal cities, urban streams receiving road and stormwater runoff, or rural streams receiving runoff from intensive horticulture. The third ecosystem condition recognises that degraded aquatic ecosystems still retain, or after rehabilitation may have, ecological or conservation values, but for practical reasons it may not be feasible to return them to slightly–moderately disturbed condition." (AWQG 2000; 3.1-10)*

Environmental Values	ICON	Definitions
Primary industries		**Irrigation:** Suitability of water supply for irrigation - for example, irrigation of crops, pastures, parks, gardens and recreational areas.
		**Farm Water Supply:** Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
		**Stock Watering:** Suitability of water supply for production of healthy livestock.
		**Aquaculture:** Health of aquaculture species and humans consuming aquaculture foods (such as fish, molluscs and crustaceans) from commercial ventures.
		**Human Consumers of Aquatic Foods:** Health of humans consuming aquatic foods - such as fish, crustaceans and shellfish (other than oysters) from natural waterways.
Recreation and aesthetics		**Primary Recreation:** Health of humans during recreation which involves direct contact and a high probability of water being swallowed - for example, swimming, surfing, windsurfing, diving and water-skiing
		**Secondary Recreation:** Health of humans during recreation which involves indirect contact and a low probability of water being swallowed – for example, wading, boating, rowing and fishing.
		**Visual Recreation:** Amenity of waterways for recreation which does not involve any contact with water - for example, walking and picnicking adjacent to a waterway.
Drinking Water		Suitability of raw drinking water supply. This assumes minimal treatment of water is required – for example, coarse screening and/or disinfection.
Industrial uses		Suitability of water supply for industrial use - for example, food, beverage, paper, petroleum and power industries. Industries usually treat water supplies to meet their needs.
Cultural and spiritual values		Indigenous and non-indigenous cultural heritage - for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities; • symbols, landmarks and icons (such as waterways, turtles and frogs); and • lifestyles (such as agriculture and fishing).