Appendix 2

Macroinvertebrate Data

Key to colour coding:

Yellow denotes taxa that were predicted by the AusRivAS models but were not observed during the surveys.

Gold denotes taxa that were both predicted by the models and observed in the samples.

Orange denotes taxa that:

- were not predicted by the models, but were observed in samples collected, or
- were unused by the models.

Taxa that are not highlighted were neither predicted nor observed.

			Spring		Autumn	Combined										
		Sampling event	Spring		Autumn	Combined										
		Habitat Type	Edge	Pool	Pool	Pool						Riffle/run				
		Site number	4	4	8	1	2	3	5	6	7	1	2	3	6	7
	Family	Taxacode														
Acarina (watermites)		LH999999	3	2	0	0	0	0	0	1	0	0	0	0	0	0
Annelida (annelid worms)	Glossiphoniidae	LH019999	0		0	0	0	0	0	0	0	0	0	0	0	0
Aracihnida			0	0	1	0	0	0	0	0	0	0	0	0	0	0
Bivalvia (mussels)	Corbiculidae	KP029999	0	0	0	0	0	0	0	0	0	0	0	1	0	12
	Sphaeriidae	KP039999	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Cladocera (water fleas)	Chydoridae	OG039999	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		OG999999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera (beetles)	cf. Hydraenidae	QCZZ9999	2	0	0	0	0	4	4	1	0	0	0	1	1	3
	Dyticidae	QC099999	0	0	0	0	8	1	0	4	0	0	4	0	0	0
	Dyticidae larvae	QC099999	0	1	0	0	8	1	0	4	0	0	0	0	0	0
	Elmidae	QC349999	7	0	2	1	0	0	6	3	3	17	0	7	4	5
	Elmidae larvae	QC349999	0	0	2	0	0	0	1	3	3	1	0	0	2	0
	Gyrinidae larvae	QC109999	0	0	0	4	2	1	2	0	0	1	3	0	0	0
	Hydraenidae	QC139999	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Hydrophilidae	QC119999	2	0	0	0	1	0	0	1	0	0	0	0	0	0
	Hydrophilidae larvae	QC119999	0	0	0	0	3	1	0	5	1	0	0	0	0	0
	Noteridae	QC089999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Psephenidae	QC379999	3	1	8	0	0	16	8	15	2	11	1	9	3	5
	Scirtidae larvae	QC209999	0	0	0	1	0	0	0	0	0	13	0	0	0	0
	Staphylinidae	QC189999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Collembola (spring tails)		QA999999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepoda (Cyclopoida)		OJ399999	0	0	0	3	6	0	0	1	0	0	0	0	0	0
		OJ999999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decapoda	Atyidae	OT019999	9	13	14	0	17	31	23	26	3	0	28	9	12	1
	Palaemonidae	OT029999	0	13	0	0	0	2	1	1	0	0	0	3	0	0

	Family	Taxacode	Spring Edge 4	Spring Pool 4	Autumn Pool 8	Combined Pool 1	Combined Pool 2	Combined Pool 3	Combined Pool 5	Combined Pool 6	Combined Pool 7	Combined Riffle/run 1	Combined Riffle/run 2	Combined Riffle/run 3	Combined Riffle/run 6	Combined Riffle/run 7
Diptera (true flies)	Athericidae	QD229999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Athericidae	QD249999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Certaopoginae	QD099999	0	0	0	0	2	0	1	2	0	0	0	0	0	0
	Chironomidae (Orthocladinae)	QDAF9999	2	0	1	1	0	1	2	2	1	7	9	6	7	6
	Chironomidae (Chironominae)	QDAJ9999	18	4	18	12	7	15	20	14	17	24	11	14	16	23
	Chrironomidae (Tanypodinae)	QDAE9999	2	49	1	4	0	2	2	3	1	6	3	1	7	5
	Culicidae	QD079999	0	5	0	0	0	0	0	0	1	0	0	0	0	0
	Dixidae	QD069999	0	0	0	0	1	0	0	0	0	0	8	0	1	0
	Dolichopodidae	QD369999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Empididae	QD359999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Simulidae	QD109999	0	0	0	0	0	0	1	0	0	2	0	2	0	10
	Tabanidae	QD239999	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Tipulidae	QD019999	0	0	0	0	0	0	0	0	0	1	0	3	1	0
Ephemoroptera (mayflies)	Ameletopsidae	QE049999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Baetidae	QE029999	2	7	4	31	3	6	24	33	1	19	0	12	41	6
	Caenidae	QE089999	0	0	20	0	0	10	19	6	4	3	0	25	21	5
	Leptophlebiidae	QE069999	0	19	17	81	14	33	59	37	31	47	19	35	17	14
	Prosopistomatidae	QEO99999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Epiproctophora (dragonflies)	Aeshniidae	QO129999	0	0	0	0	1	0	0	0	0	0	11	0	0	0
	cf. Austropetaliidae	QO209999	0	0	0	0	0	0	1	0	0	0	0	1	1	0
	Corduliidae	QO169999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gomphidae	QO139999	0	0	10	0	0	1	14	17	6	0	0	0	8	3
	Hemicorduliidae	QO309999	1	1	1	0	0	5	11	7	2	0	4	6	6	8
	Libellulidae	QO179999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Telephlebiidae	QO219999	0	1	0	1	0	0	0	0	3	3	0	0	4	0

Order	Family	Taxacode	Spring Edge 4	Spring Pool 4	Autumn Pool 8	Combined Pool 1	Combined Pool 2	Combined Pool 3	Combined Pool 5	Combined Pool 6	Combined Pool 7	Combined Riffle/run 1	Combined Riffle/run 2	Combined Riffle/run 3	Combined Riffle/run 6	Combined Riffle/run 7
Diptera (true flies)	Athericidae	QD229999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Athericidae	QD249999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Certaopoginae	QD099999	0	0	0	0	2	0	1	2	0	0	0	0	0	0
	Chironomidae (Orthocladinae)	QDAF9999	2	0	1	1	0	1	2	2	1	7	9	6	7	6
Gastropoda (snails)	Ancylidae	KG069999	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	Bithyniidae	KG039999	0	0	0	0	0	3	0	0	0	0	0	0	1	0
	Hydrobiidae	KG029999	2	0	5	0	0	0	5	5	0	0	0	6	4	0
	Lymnaidae	KG059999	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Physidae	KG089999	7	1	1	0	0	0	0	6	0	1	0	0	0	0
	Planorbiidae	KGO79999	0	0	1	0	0	0	0	0	1	0	0	0	0	0
	Thiaridae	KG049999	1	0	0	0	0	0	0	0	0	0	0	1	0	0
	Viviparidae	KG019999	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Hemiptera (bugs)	Corixidae	QH659999	0	1	0	0	0	19	1	6	3	0	7	1	6	0
	Gelastocoridae	QH649999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gerridae	QH579999	0	0	0	0	0	2	0	0	0	0	0	0	0	0
	Hebridae	QH539999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hydrometridae	QH549999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mesoveliidae	QH529999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Naucoridae	QH669999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nepidae	QH619999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Notonectidae	QH679999	0	2	0	0	4	0	0	1	0	0	0	0	0	0
	Pleidae	QH689999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Velidae	QH569999	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Hirudinea (leeches)	cf - Richardsonianidae	MM999999	3	0	2	7	0	0	5	0	10	5	6	1	1	0
Hydroida (hydrozoans)	Hydridae	IB019999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isopoda	Cirolanidae	OR129999	0	0	0	0	0	1	3	1	0	0	0	2	0	0
Lepidoptera (moths)	cf. Pyralidae	QL999999	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Pyralidae	QL019999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Megaloptera (alderflies)	Corydalidae	QM019999	0	0	3	0	0	5	1	14	0	0	0	17	13	14
	Sialidae	QM029999	0	0	0	0	0	0	1	1	0	0	0	0	0	0

Order	Family	Taxacode	Spring Edge 4	Spring Pool 4	Autumn Pool 8	Combined Pool 1	Combined Pool 2	Combined Pool 3	Combined Pool 5	Combined Pool 6	Combined Pool 7	Combined Riffle/run 1	Combined Riffle/run 2	Combined Riffle/run 3	Combined Riffle/run 6	Combined Riffle/run 7
Diptera (true flies)	Athericidae	QD229999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Athericidae	QD249999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Certaopoginae	QD099999	0	0	0	0	2	0	1	2	0	0	0	0	0	0
	Chironomidae (Orthocladinae)	QDAF9999	2	0	1	1	0	1	2	2	1	7	9	6	7	6
Nematoda (roundworms)		II999999	0	4	1	0	0	0	0	0	0	0	0	0	0	2
Oligochaeta (segmented worms)		LO999999	0	2	1	1	3	0	8	4	10	5	2	1	7	0
Ostracoda		OH999999	0	21	0	0	1	0	0	0	0	0	14	0	0	0
Platyhelminthes (flatworms)	Turbellaria		0	0	0	0	0	0	0	3	0	2	0	0	3	0
Plecoptera (stoneflies)	Eustheniidae	QP019999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Griptopterygidae	QP039999	0	0	0	1	0	0	0	1	0	5	0	10	5	21
Tricladida (flatworms)	Dugesiidae	IF619999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Temnocephalidae	IF499999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tricoptera (caddisflies)	Calamoceratidae	QT249999	2	0	1	1	1	0	0	2	1	0	1	0	0	0
	cf. Calocidae	QT189999	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	cf. Conoesucidae	QT999999	0	0	1	0	1	0	0	0	6	12	0	0	7	3
	Dipseudopsidae	QT269999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ecnomidae	QT089999	0	0	2	0	1	0	0	1	0	11	1	0	0	1
	Glossosomatidae	QT029999	0	0	0	0	0	0	0	0	0	3	1	0	0	0
	Helicopsychidae	QT179999	0	0	0	0	0	1	10	5	0	0	0	1	1	0
	Hydrobiosidae	QT019999	0	0	0	0	0	0	0	0	0	1	2	8	0	21
	Hydropsychidae	QT069999	0	0	0	0	0	6	0	63	0	5	1	117	34	119
	Hydroptilidae	QT039999	2	0	0	3	6	3	7	1	5	2	0	3	7	1
	Leptoceridae	QT259999	57	0	11	0	2	2	1	1	6	0	15	0	5	3
	Odontoceridae	QT229999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Philopotamidae	QT049999	0	0	0	1	0	0	0	0	0	9	0	46	8	9
	Philorheithridae	QT219999	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	Polycentropodidae	QT079999	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		Sampling event	Spring		Autumn	Combined											
		Habitat Type	Edge	Pool	Pool	Pool						Riffle/run					
		Site number	4	4	8	1	2	3	5	6	7	1	2	3	6	7
	Family	Taxacode															
	Coenagrionidae	QO089999	0	1	0	4	1	0	0	2	0	0	2	0	1	0
	Diphlebiidae	QO059999	0	0	0	0	1	0	0	0	3	0	20	0	0	0
	Isocticidae	QO029999	2	0	6	0	0	0	3	1	0	2	3	0	4	0
Zygoptera (damselflies)	Lestidae	QO049999	1	0	0	0	0	0	0	1	3	0	6	0	1	0
	Megapodagrionidae	QO039999	1	0	0	0	0	0	0	0	1	0	0	0	0	0
	Protoneuridae	QO079999	0	0	0	0	0	0	0	1	0	0	1	0	0	0
	Synlestidae	QO099999	0	0	0	0	0	0	3	0	0	0	0	2	0	0
	Eropdellidae	LH059999	0		0	0	0	0	0	0	0	0	0	0	0	0
	Parastacidae	OV019999	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		IJ999999	0		0							0	0	0	0	0

Appendix 3

Zooplankton Data

Taxa	Boat Ramp 3 Benthic	Boat Ramp 3 Pelagic	Des's Den Benthic	Des's Den Pelagic	Rowing Buoys Benthic	Rowing Buoys Pelagic	Water Tower Benthic	Water Tower Pelagic	Ragsies Reach Benthic	Ragsies Reach Pelagic	Golf Course Pelagic	Latimers Crossing Pelagic	Stevens Bridge Pelagic	Stevens Bridge Macrophytes
Oligochaeta	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Diptera: Chironomidae: Chironominae	0	0	1	0	0	0	3	0	0	0	0	0	0	0
Tanypodinae	0	0	0	0	0	0	4	0	0	0	1	0	0	0
Ephemeroptera: Baetidae : *Baetis* sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Cladocera: Daphniidae: *Daphnia lumholtzi*	1	0	0	0	0	0	0	4	0	5	0	0	0	0
Ceriodaphnia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copepoda: Centropagidae: *Boeckella triarticulata*	1	0	0	0	0	0	0	3	0	1	0	0	0	0
Ostracoda: *Stenocypris major*	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Amphibia : (tadpole)	0	0	9	0	0	0	0	0	0	0	0	0	0	0

Appendix 4

Media Release (5/11/06)

ABC Gold & Tweed Coasts Queensland

More About ABC Gold and Tweed Coasts

High mercury levels found in Hinze Dam fish

The Queensland Government is asking councils to test freshwater fish in their local dams, after high levels of mercury were found in fish on the Gold Coast in the state's south-east.

Chief health officer Dr Jeannette Young says several large bass taken from the Hinze Dam were found to contain Mercury.

The Hinze dam is located about 15 kilometres south-west from central Nerang and supplies most of the water for the Gold Coast City Council.

Dr Young says it is possible other fish in the dam would also be affected, and it could be a health risk if people consumed large quantities.

"Now that we are aware of this, it is very important that we get the information out to recreational fishermen so that they know and don't go and consume large amounts of fish from freshwater dams such as the Hinze Dam," she said.

"At this point it is only the Hinze Dam that we have this evidence for, but we suspect it may be true of other freshwater dams."

Your Local Features

Your say

Your local information

News Headlines

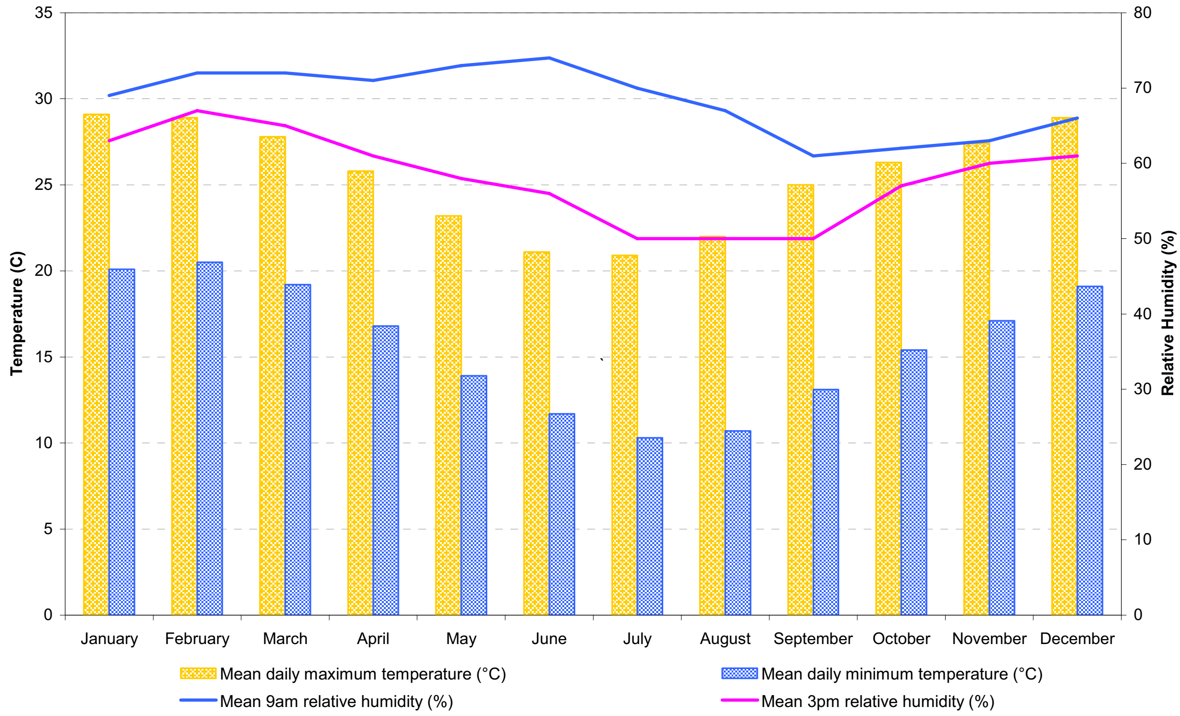
Weather

http://abc.net.au/news/items/200611/1781379.htm?goldcoast

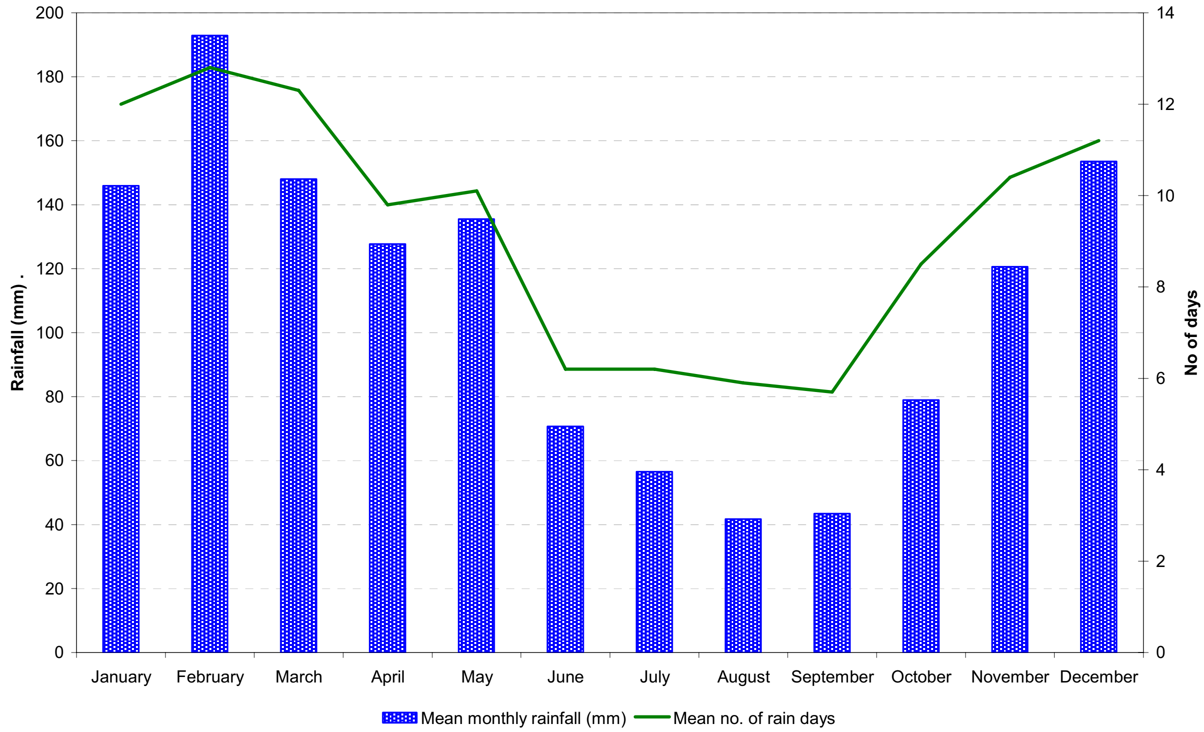
F.11 Air Quality and Greenhouse Gases

F.11.1 Graphs of Climatic Data

- **Figure F.11.1.1 Mean Daily Temperature and Relative Humidity Recorded at Hinze Dam (BoM)**

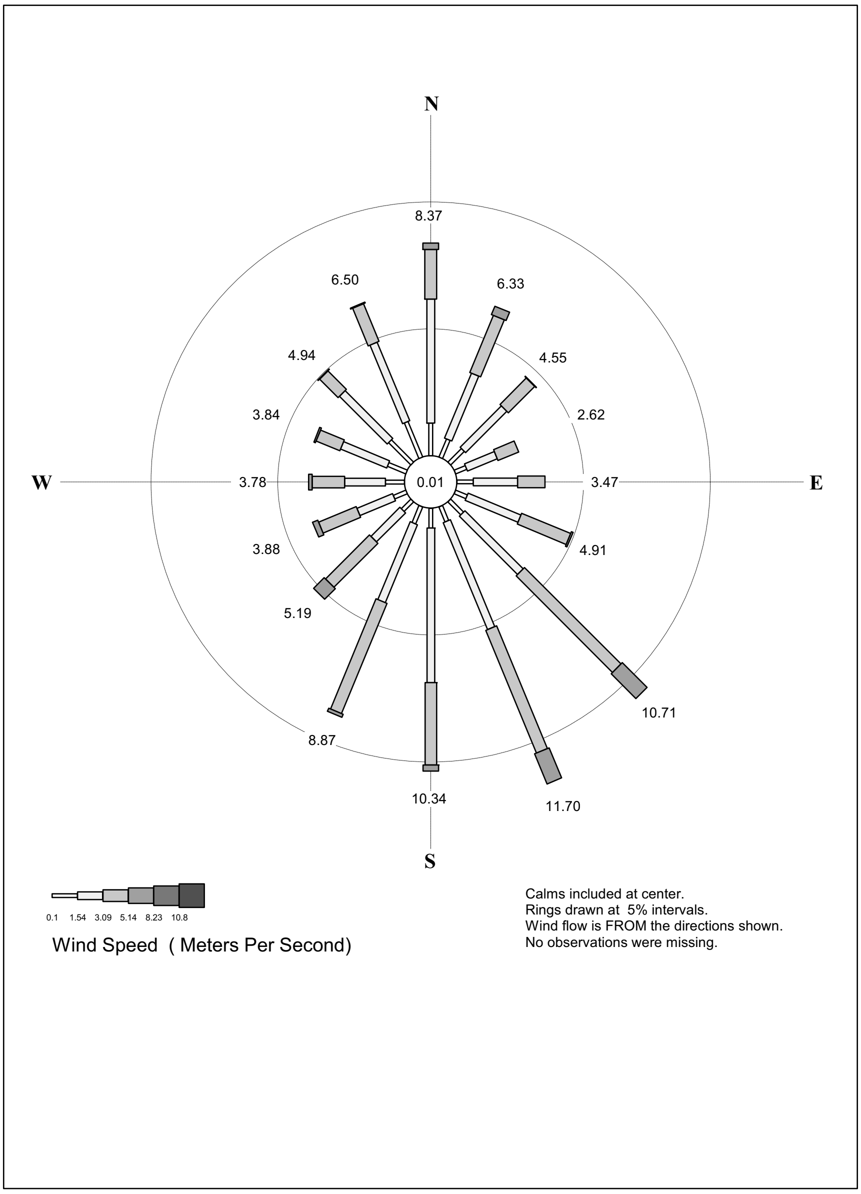


- **Figure F.11.1.2 Monthly Rainfall and Number of Rain Days Recorded at Hinze Dam (BoM)**

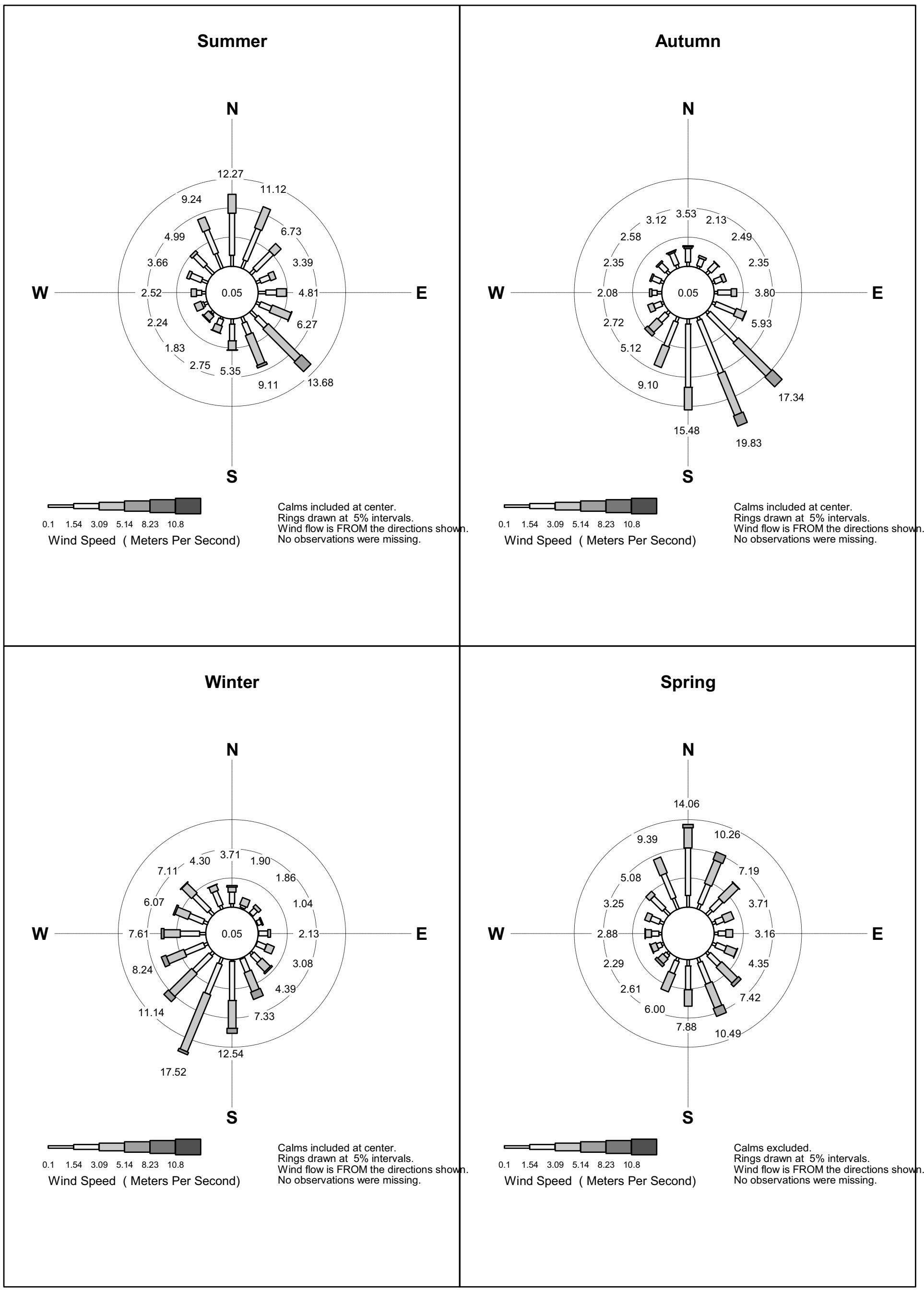


F.11.2 Windroses for Hinze Dam (TAPM)

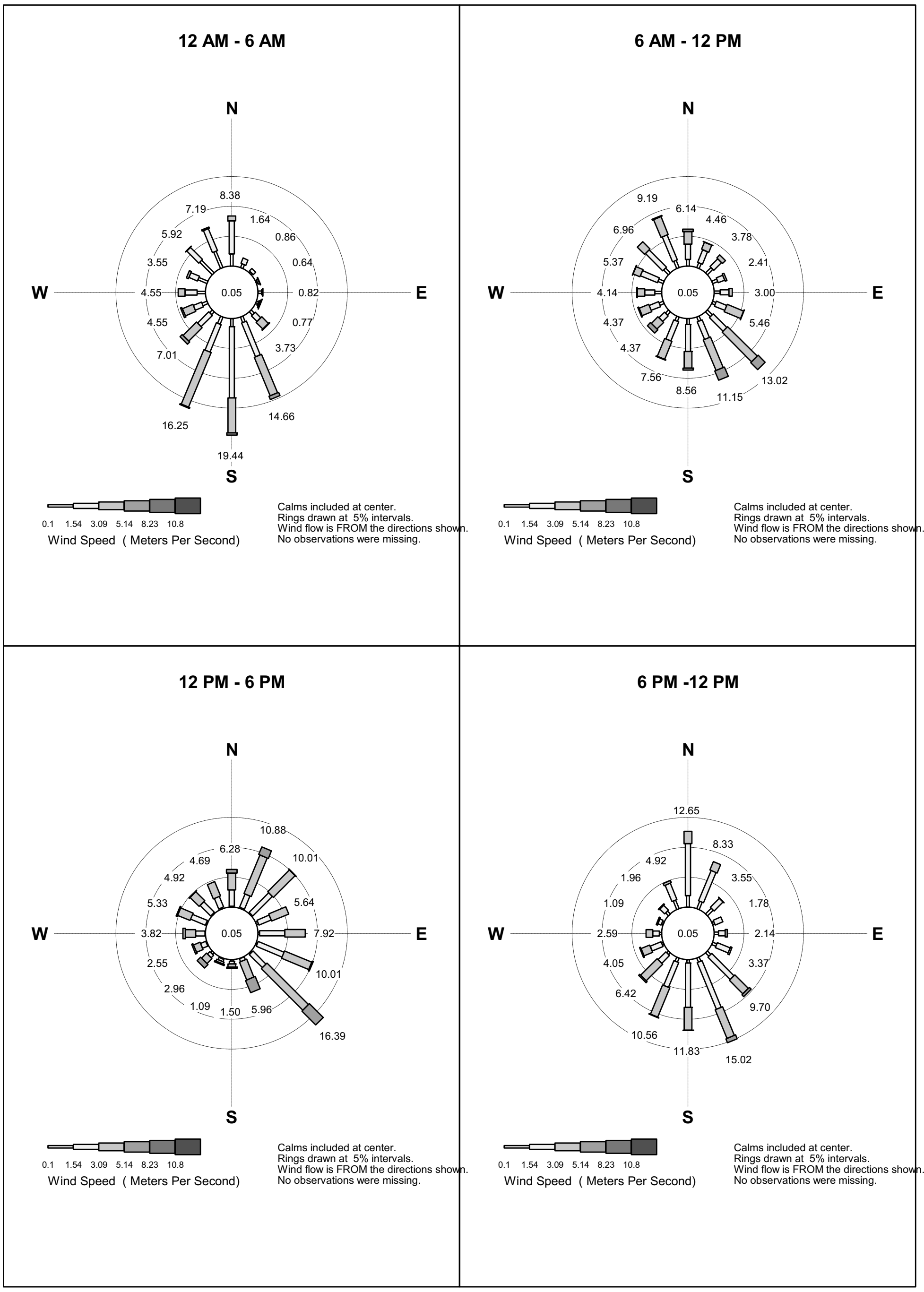
Figure F.11.2.1 All Hours Windrose for TAPM Generated Meteorological Data



■ Figure F.11.2.2 Windroses by Season for TAPM Generated Meteorological Data

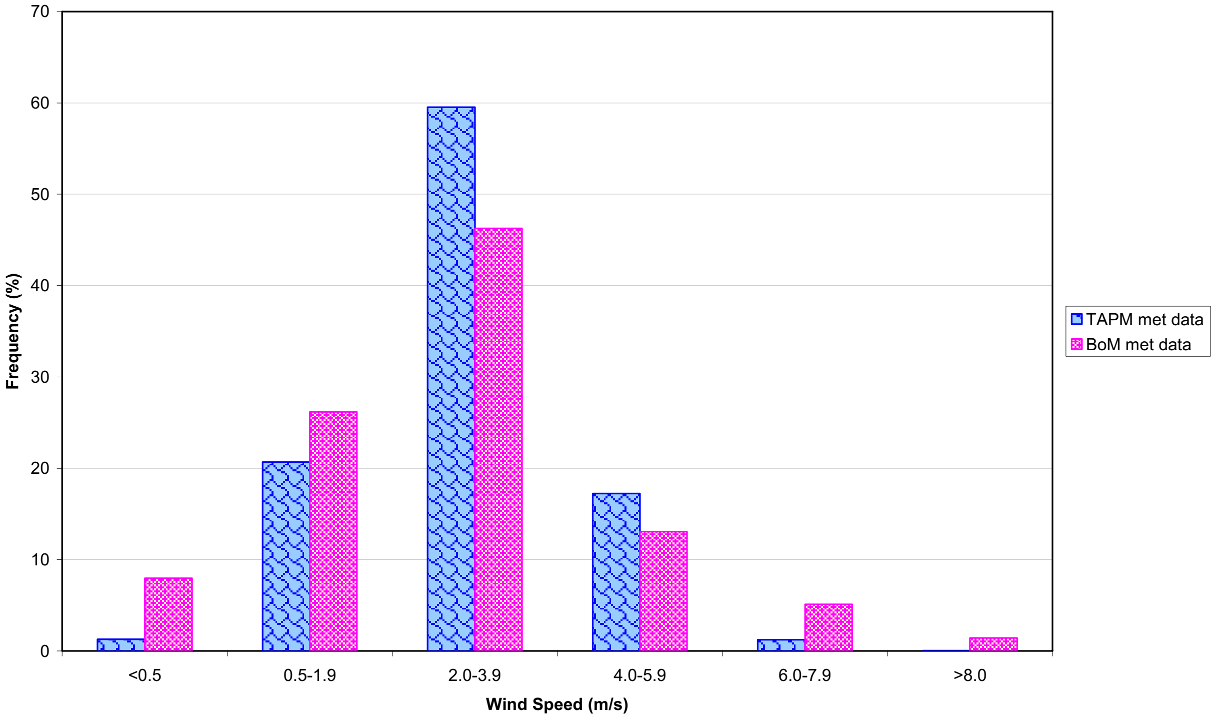


■ Figure F.11.2.3 Windroses by Season for TAPM Generated Meteorological Data

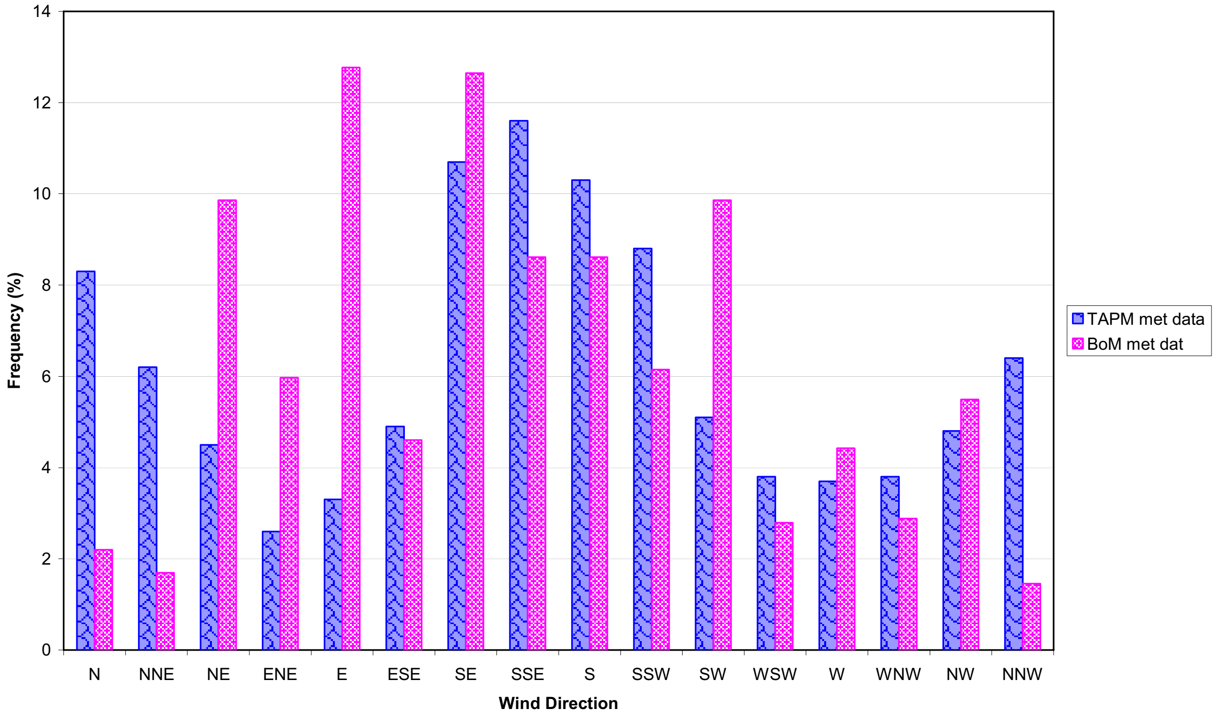


F.11.3 Comparison of TAPM and BoM meteorological data

- **Figure F.11.3.1 Frequency of Wind Speed for TAPM and BoM Meteorological Data**



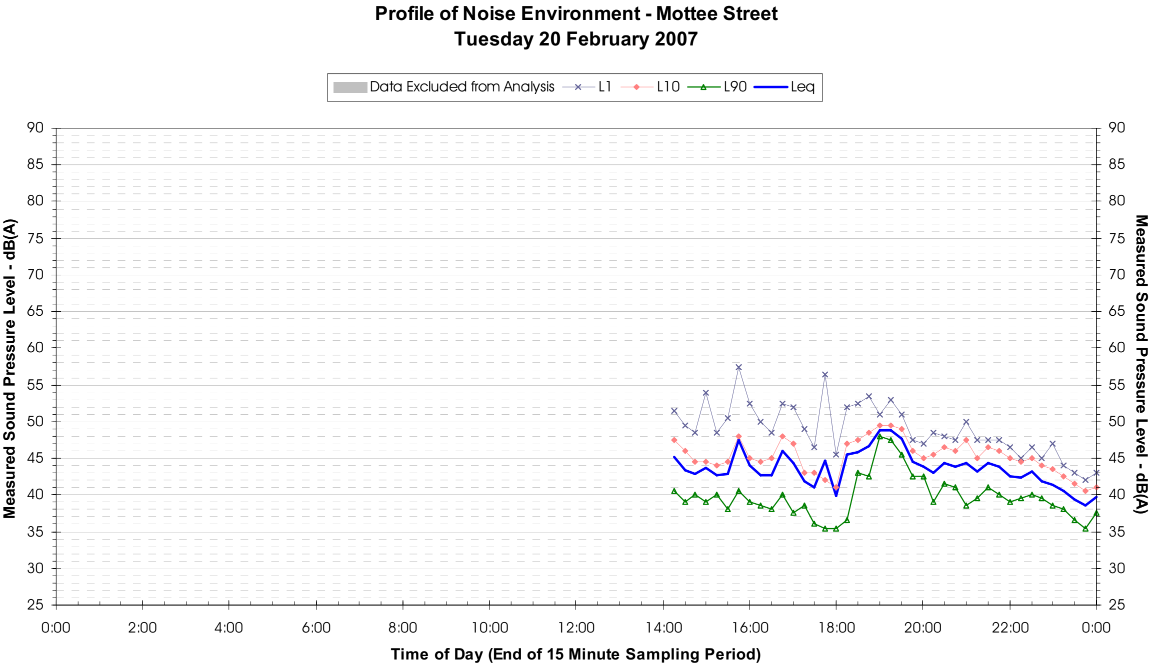
■ **Figure F.11.3.2 Frequency of Wind Speed for TAPM and BoM Meteorological Data**

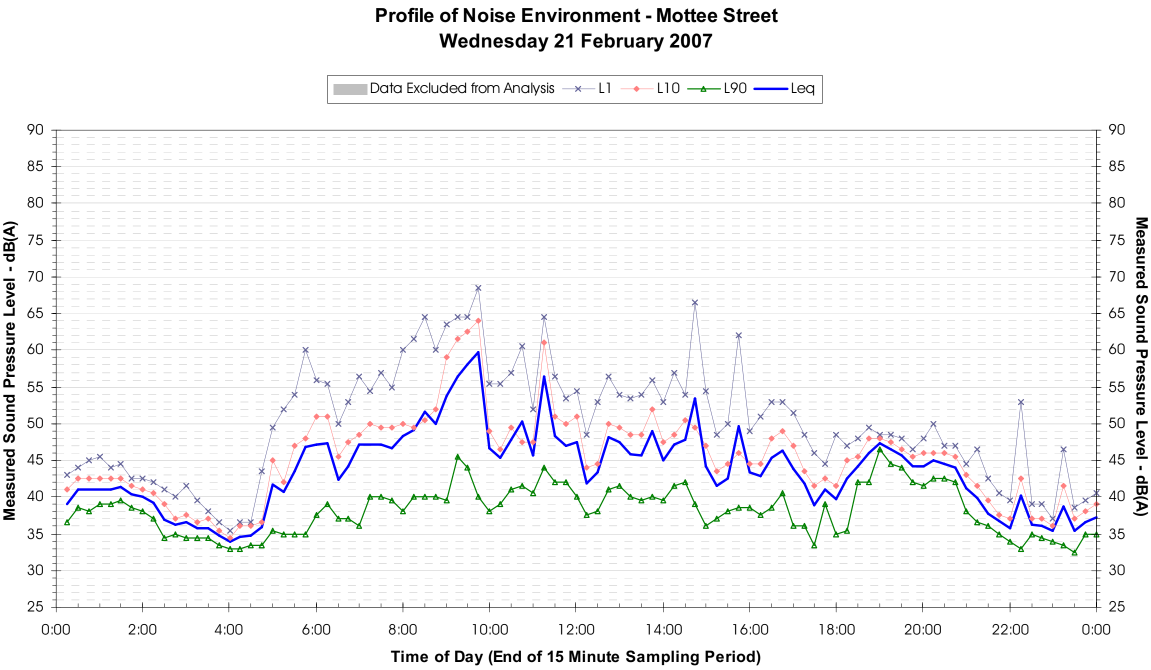


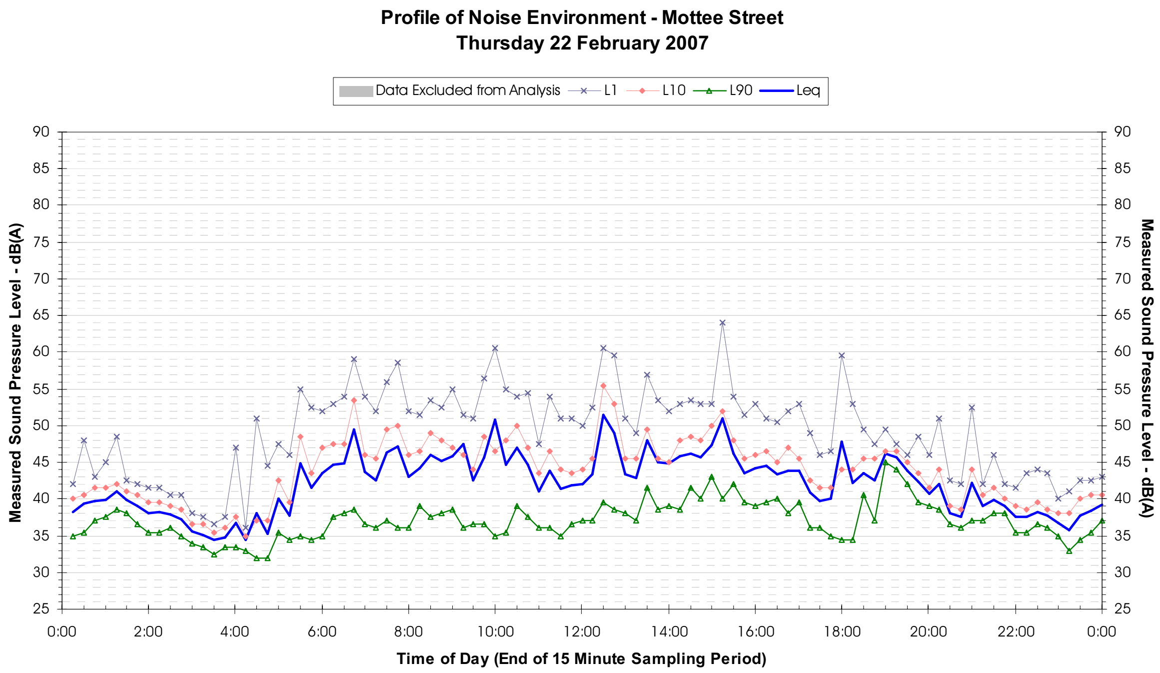
F.12 Noise and Vibration

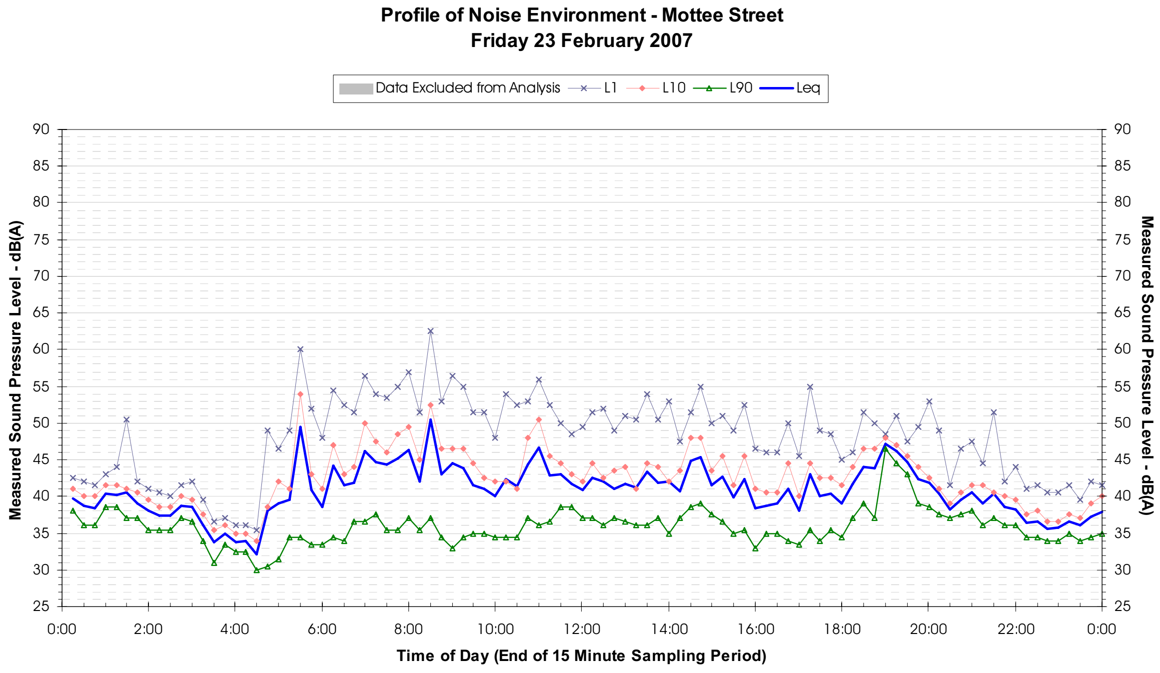
F.12.1 Noise Survey Results

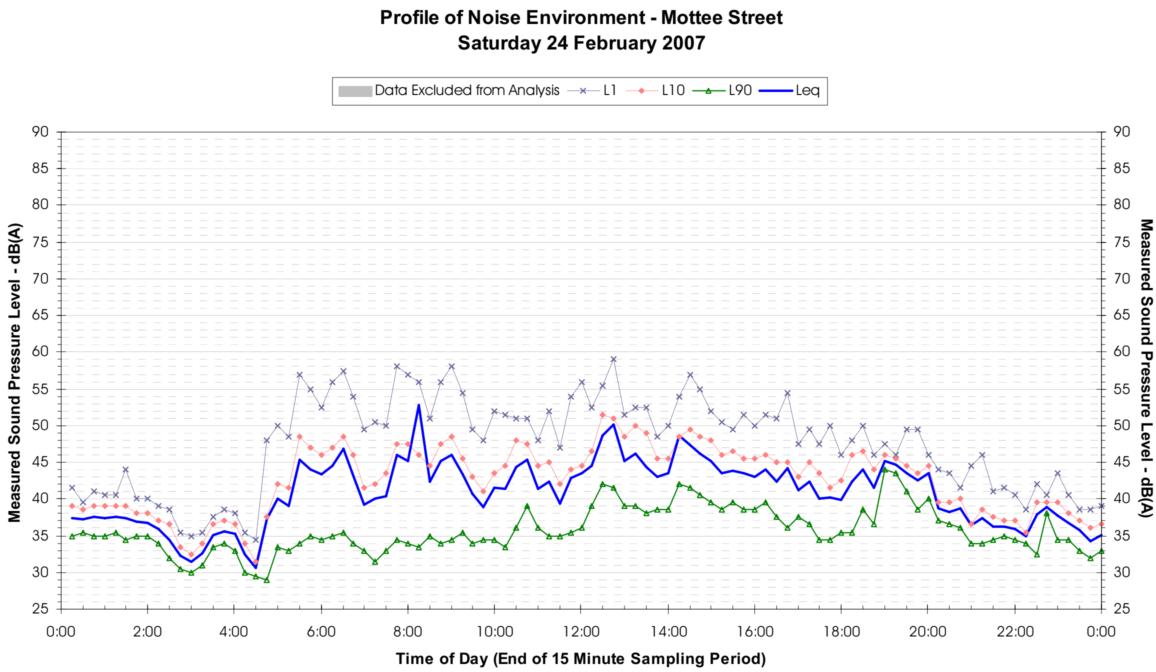
F.12.1.1 Noise Levels Measured at Mottee Court

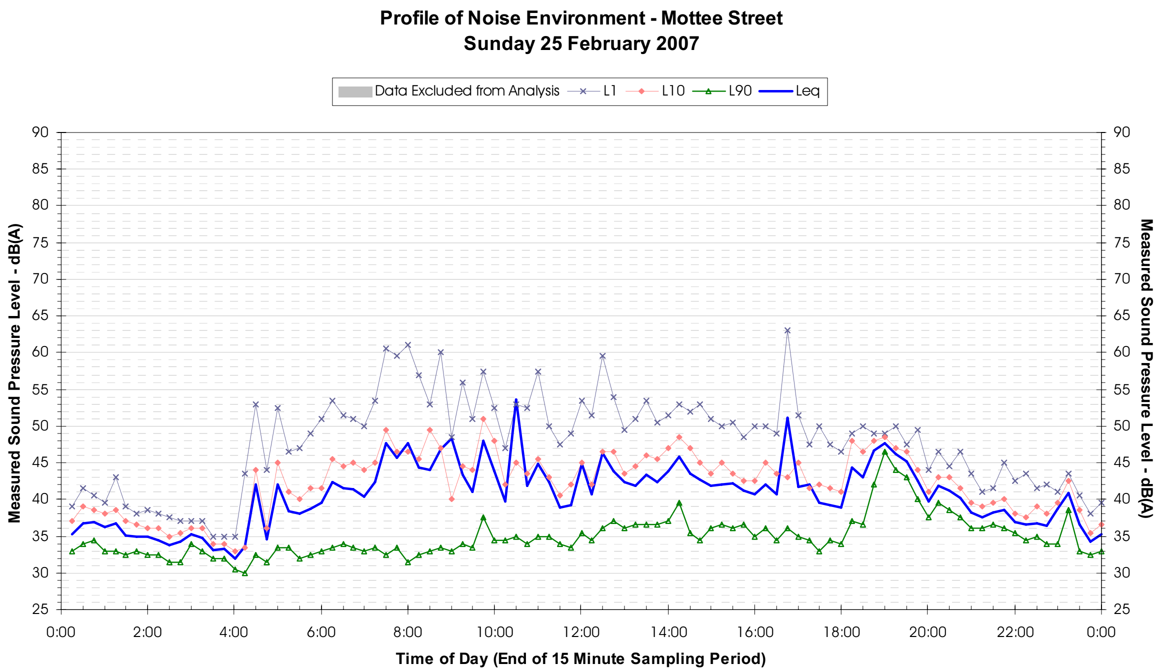


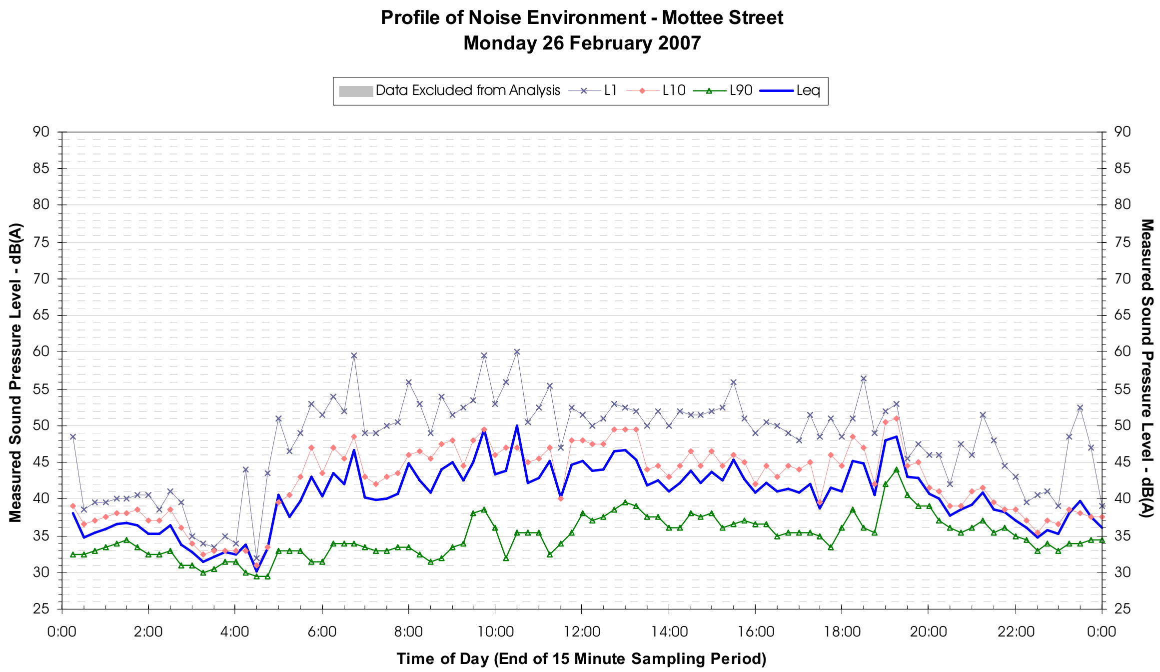


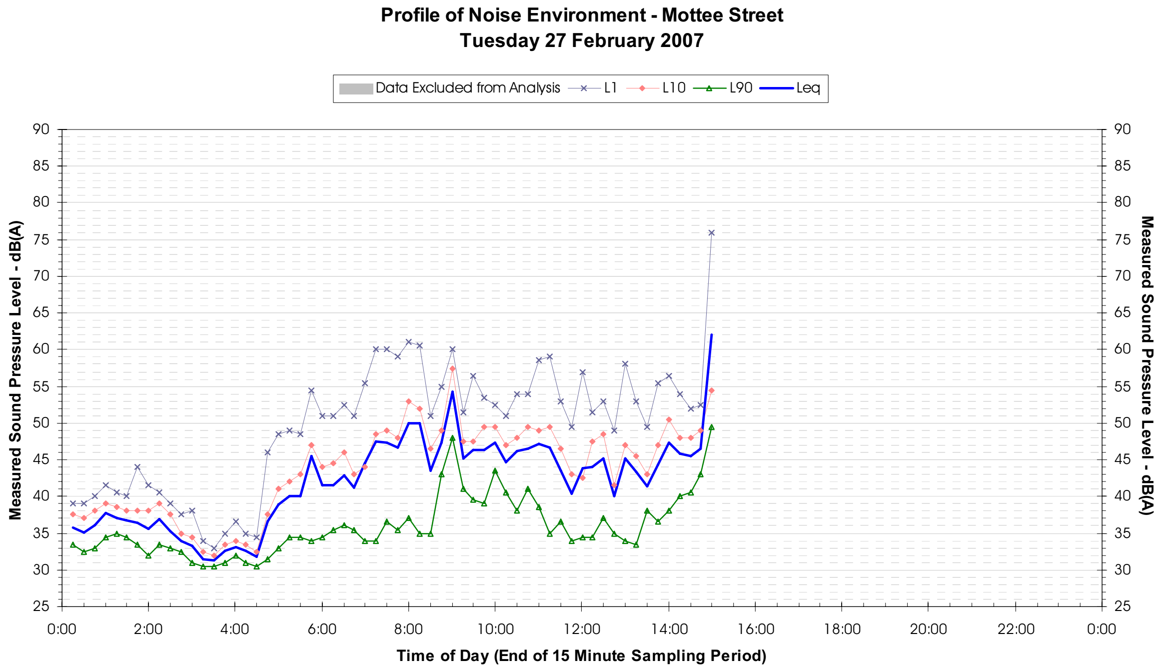

Profile of Noise Environment - Mottee Street
Thursday 22 February 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)


Profile of Noise Environment - Mottee Street
Friday 23 February 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)

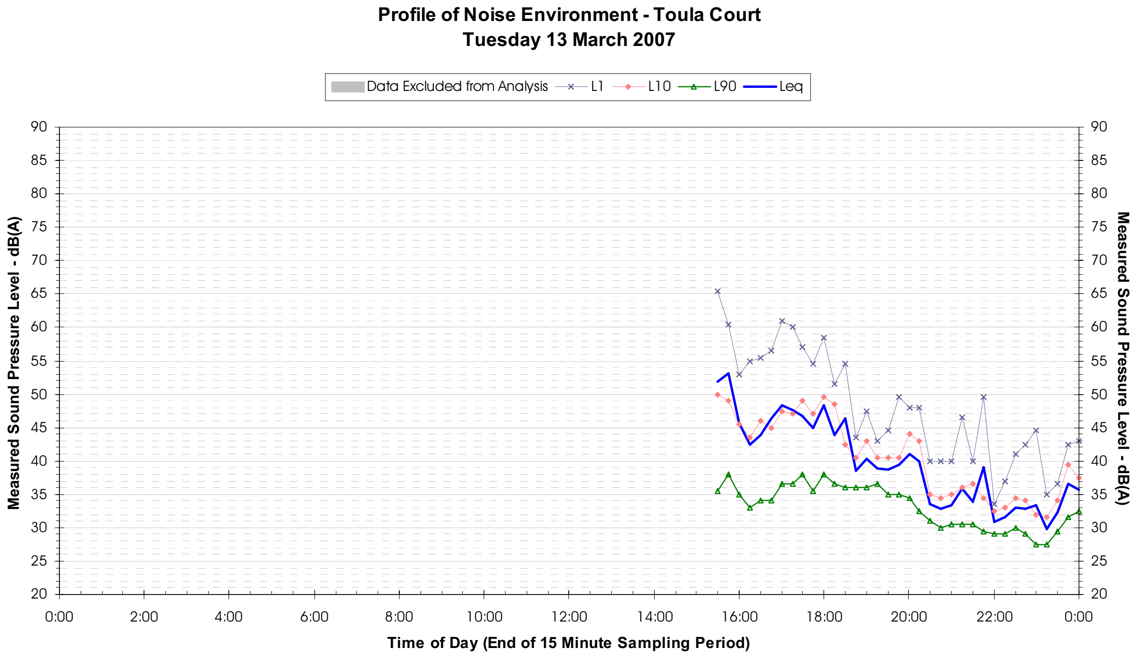

Profile of Noise Environment - Mottee Street
Saturday 24 February 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

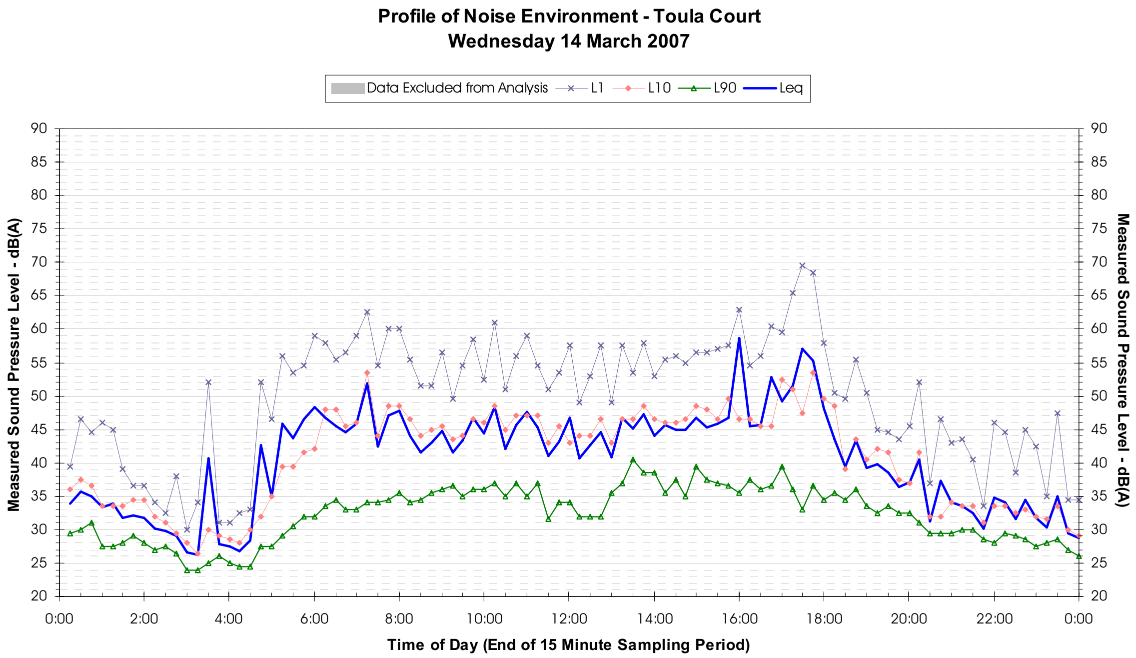

Profile of Noise Environment - Mottee Street
Sunday 25 February 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

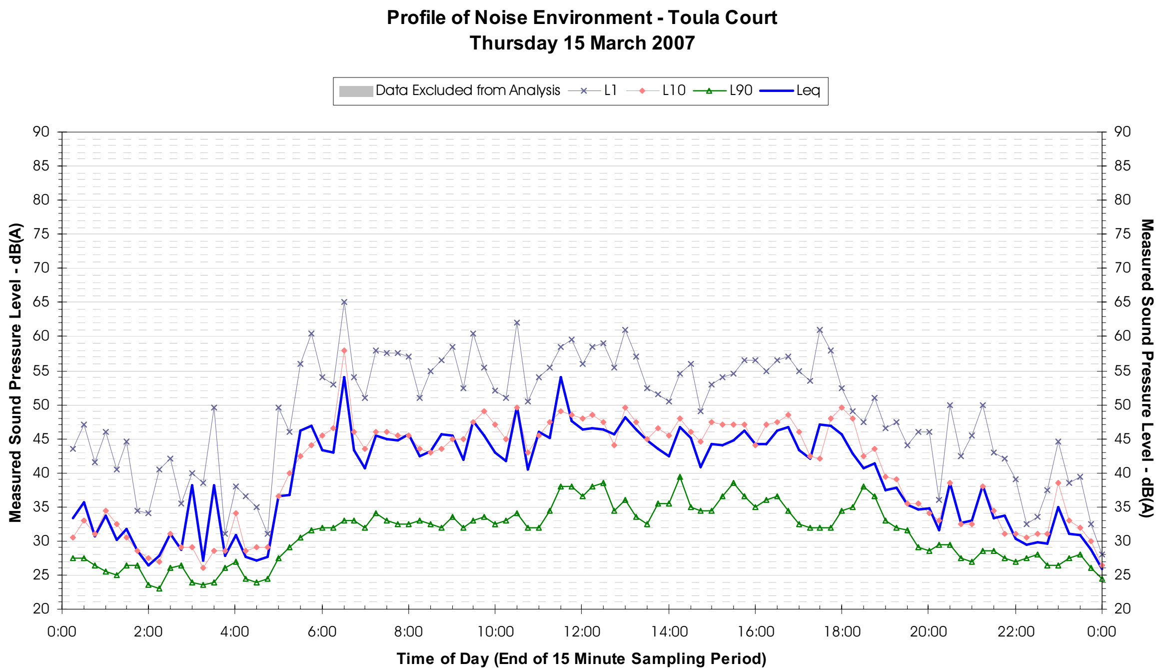

Profile of Noise Environment - Mottee Street
Monday 26 February 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

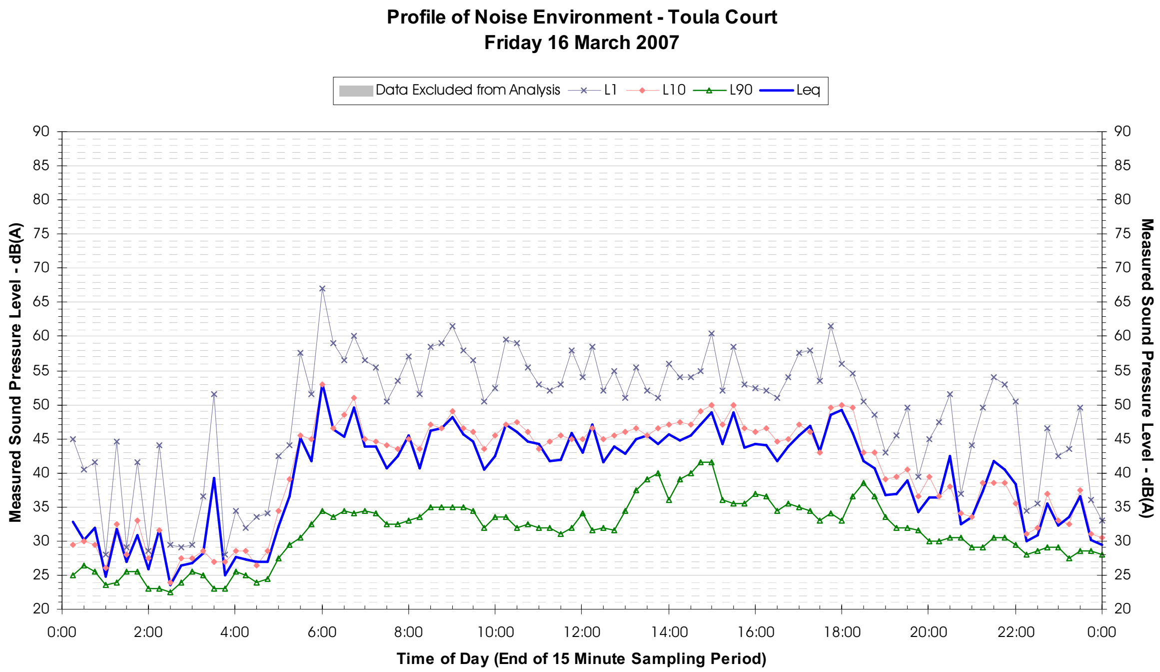

Profile of Noise Environment - Mottee Street
Tuesday 27 February 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

F.12.2.1 Noise Levels Measured at Toula Court

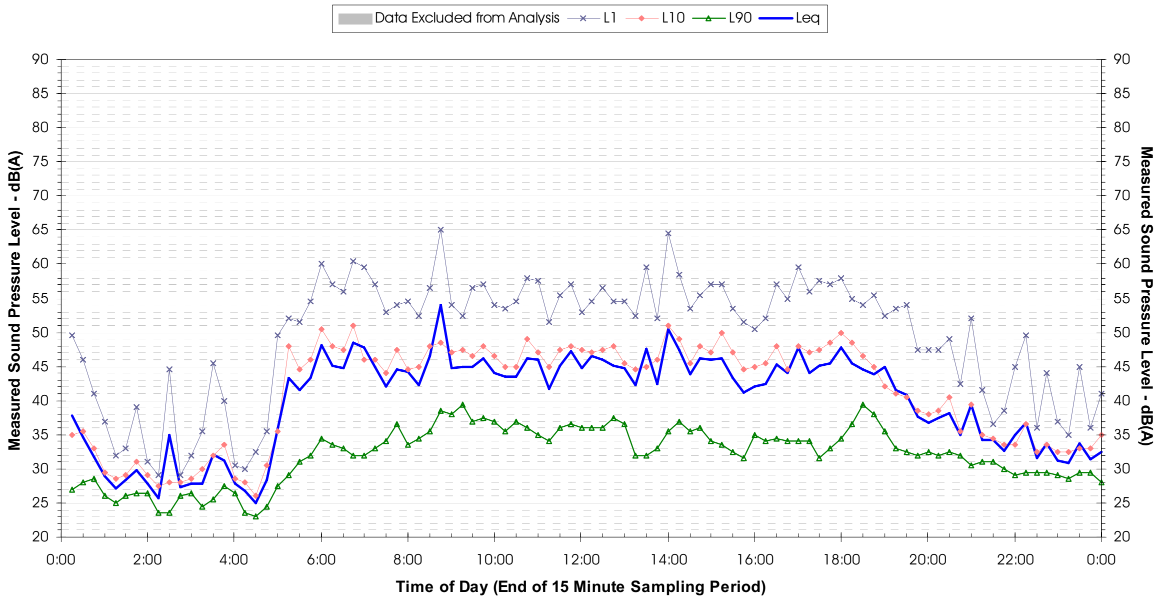




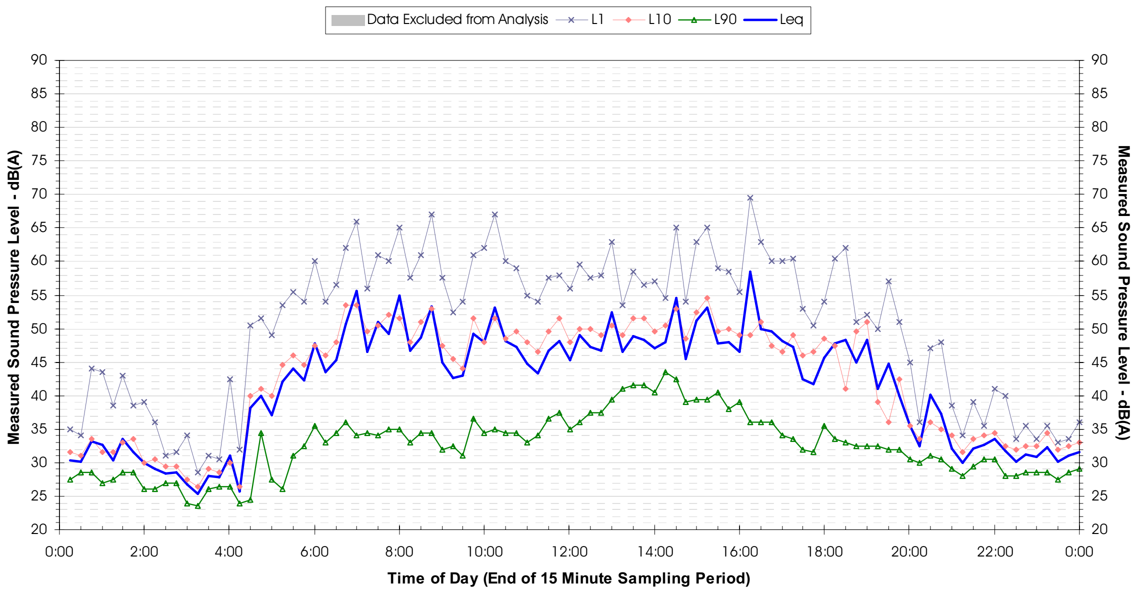

Profile of Noise Environment - Toula Court
Thursday 15 March 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)


Profile of Noise Environment - Toula Court
Friday 16 March 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)

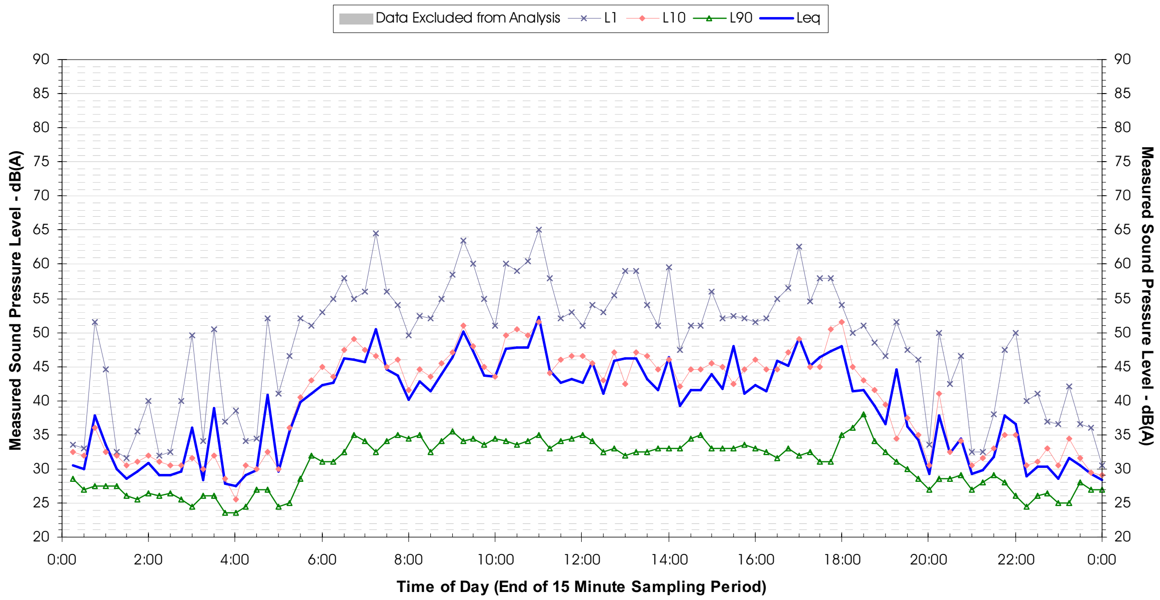
Profile of Noise Environment - Toula Court
Saturday 17 March 2007



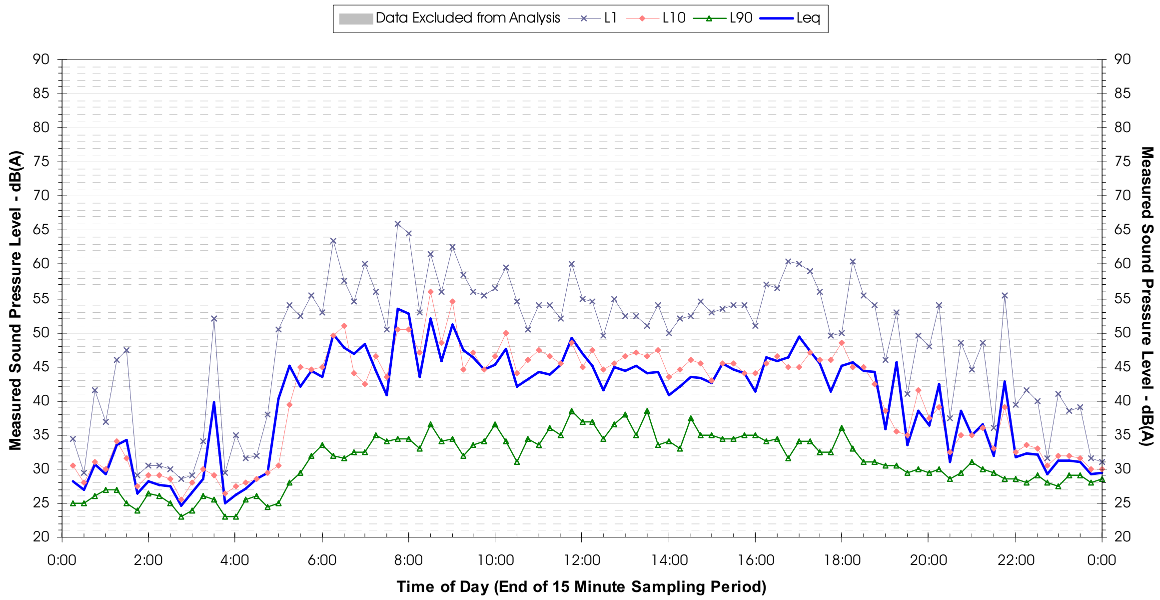
Profile of Noise Environment - Toula Court
Sunday 18 March 2007



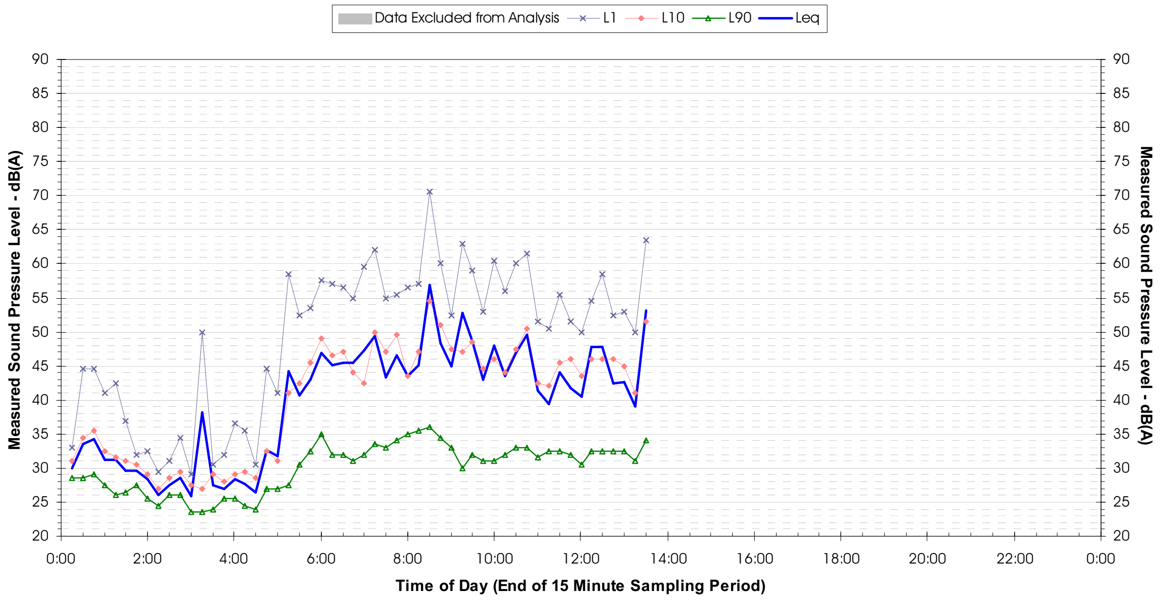
Profile of Noise Environment - Toula Court
Monday 19 March 2007



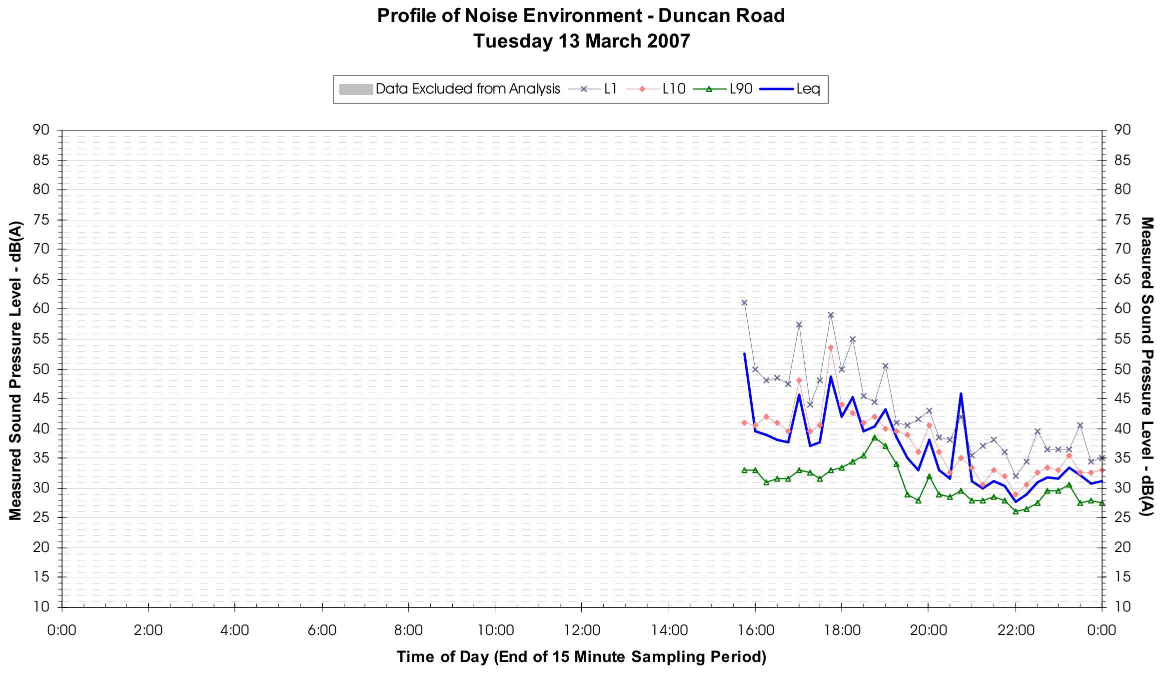
Profile of Noise Environment - Toula Court
Tuesday 20 March 2007

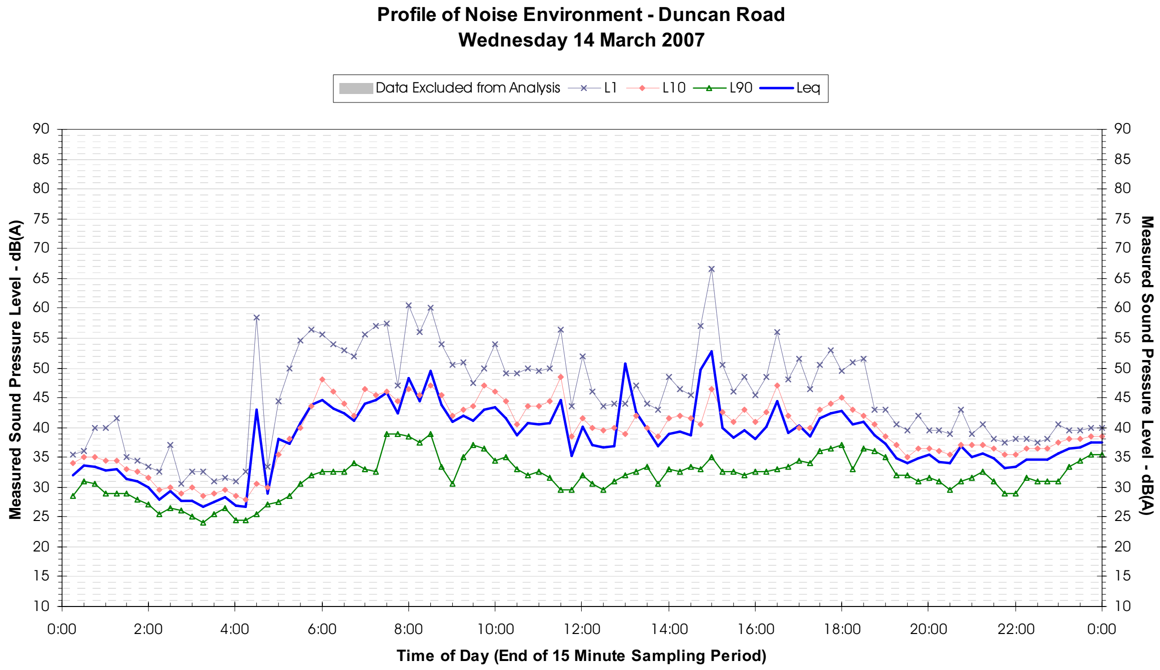


Profile of Noise Environment - Toula Court
Wednesday 21 March 2007

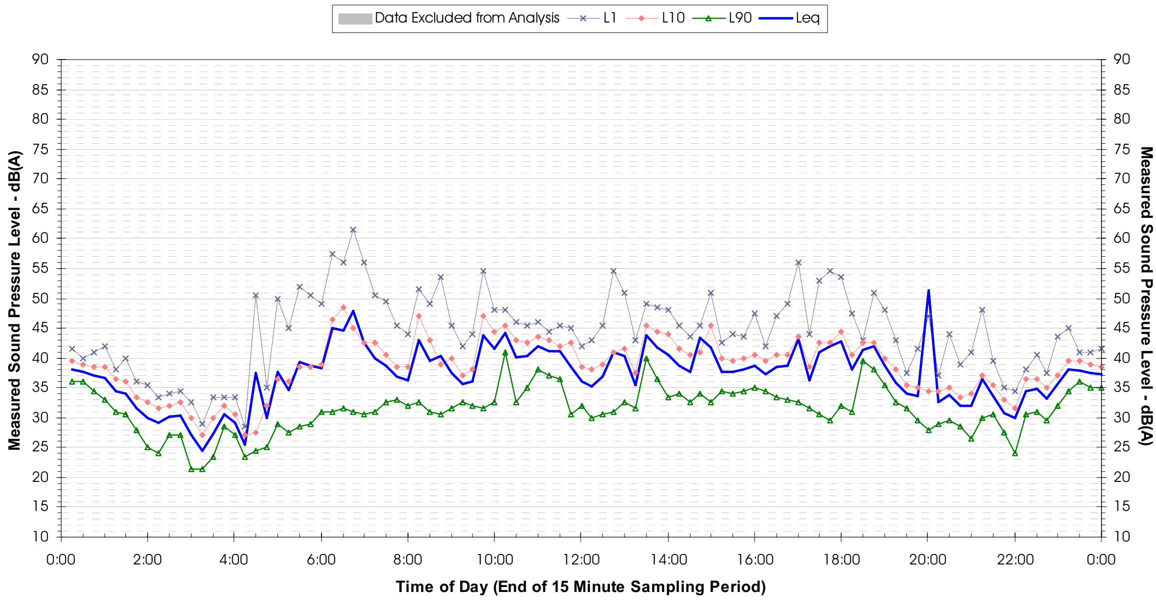


F.12.2.3 Noise Levels Measured at Duncan Road

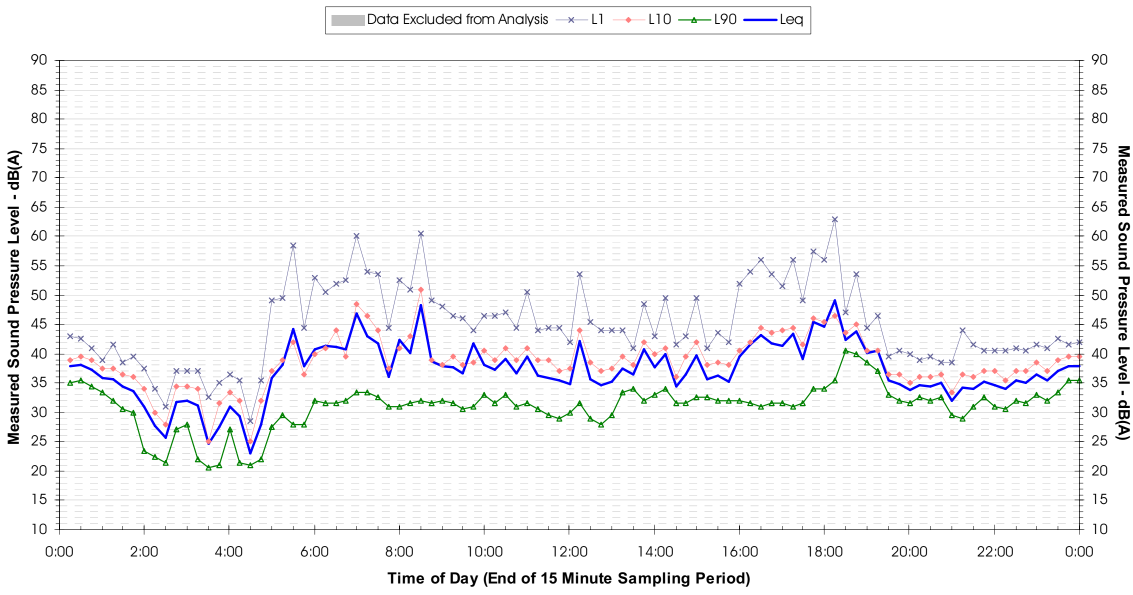


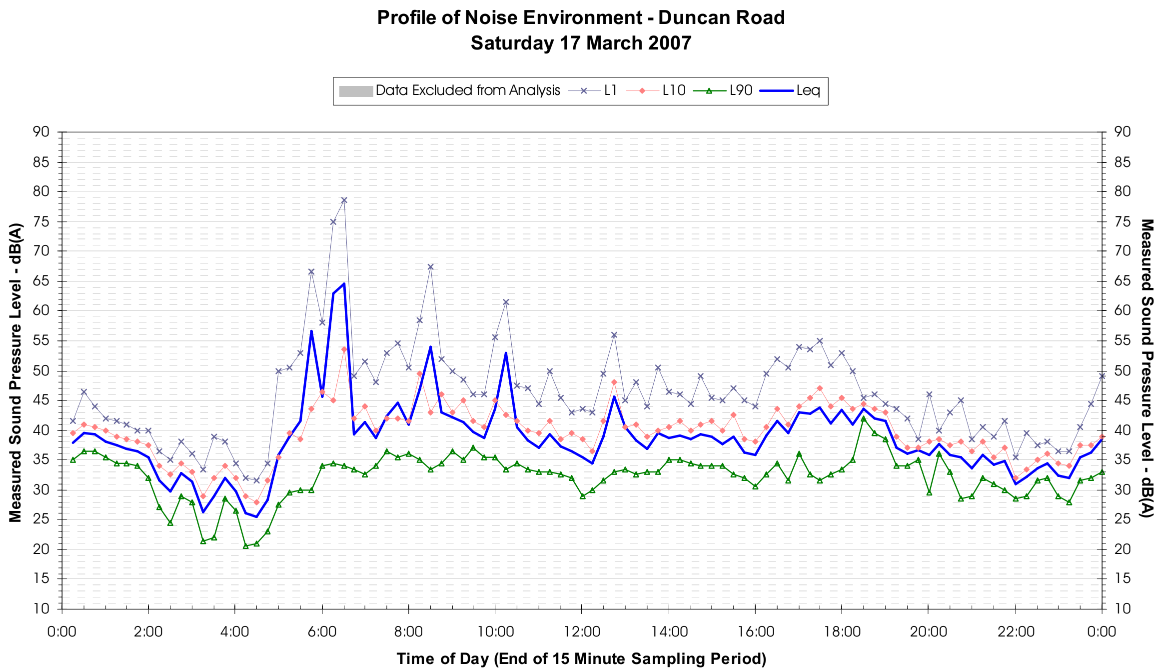


Profile of Noise Environment - Duncan Road
Thursday 15 March 2007

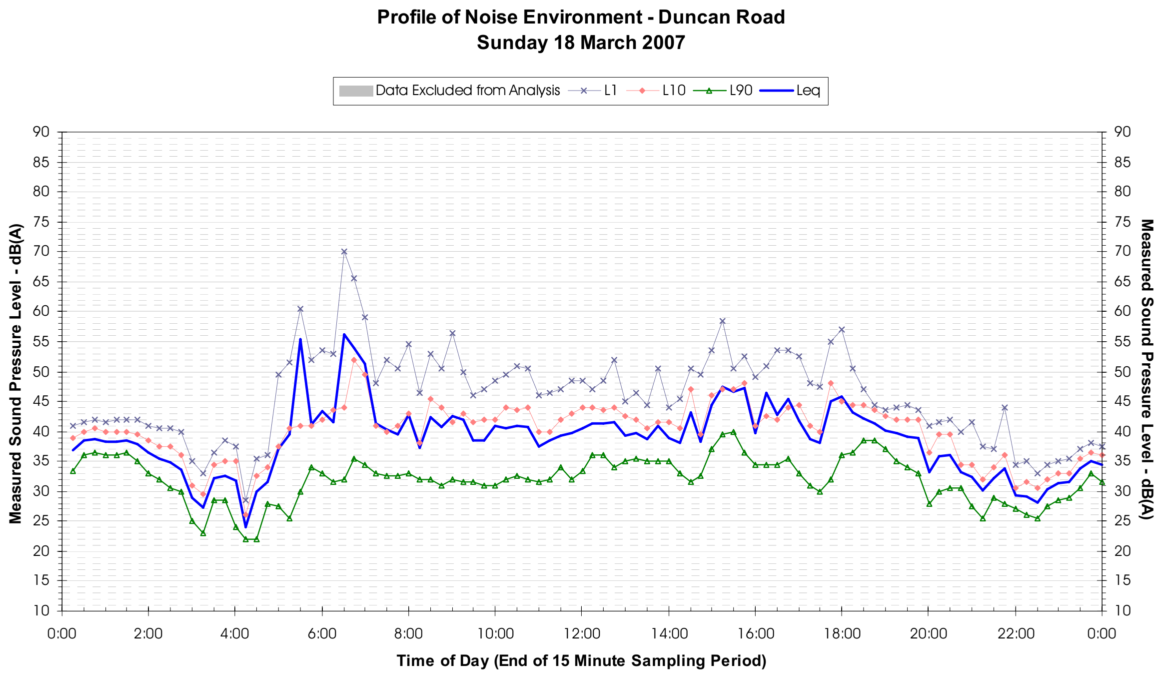


Profile of Noise Environment - Duncan Road
Friday 16 March 2007



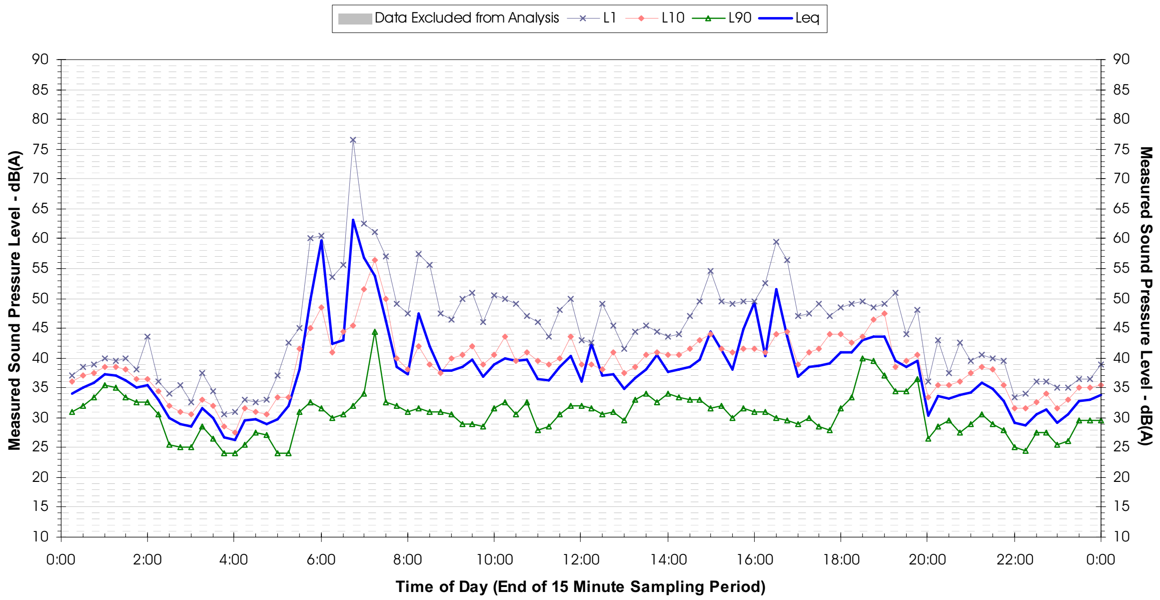


Profile of Noise Environment - Duncan Road
Saturday 17 March 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)

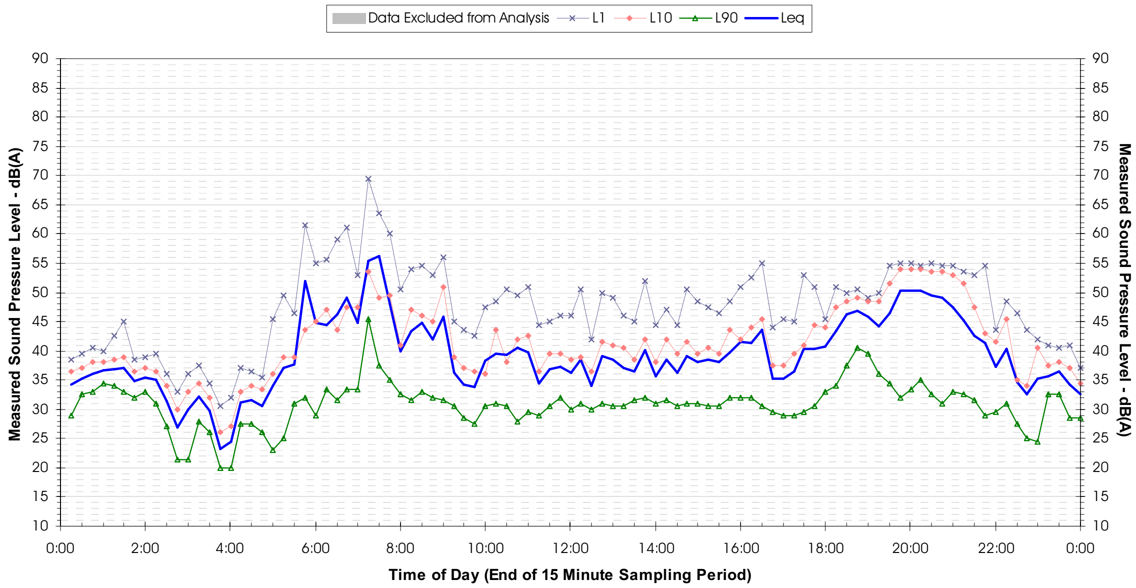


Profile of Noise Environment - Duncan Road
Sunday 18 March 2007
Data Excluded from Analysis
L1
L10
L90
Leq
Measured Sound Pressure Level - dB(A)
Time of Day (End of 15 Minute Sampling Period)

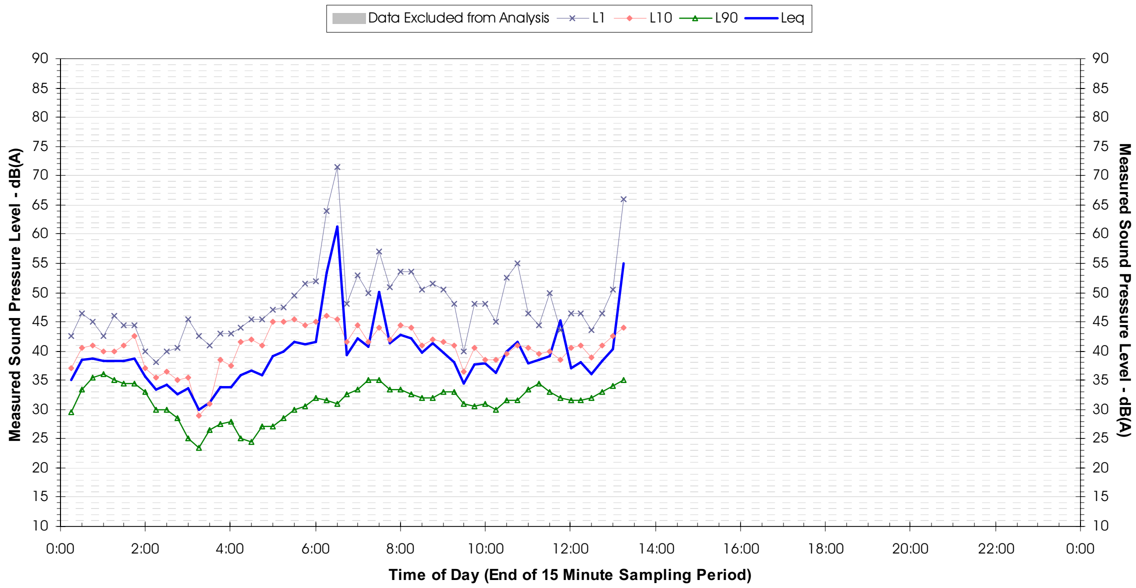
Profile of Noise Environment - Duncan Road
Monday 19 March 2007



Profile of Noise Environment - Duncan Road
Tuesday 20 March 2007



Profile of Noise Environment - Duncan Road
Wednesday 21 March 2007



F.13 Transport and Roads

F.13.1 Construction Period Traffic Estimate

F.13.1.1 Daily Traffic due to Concrete Supply

		2007		
		October	November	December
Ash+ Cement (loads/day)	Semi trailer	0	0	0
	B-Double	1	1	1
Sand (loads/day)	Semi trailer	1	1	1
	B-Double	0	0	0
Total (trucks /day)		**2**	**2**	**2**

		2008											
		January	February	March	April	May	June	July	August	September	October	November	December
Ash+ Cement (loads/day)	Semi trailer	0	0	0	0	0	0	0	0	0	0	0	0
	B-Double	1	1	1	1	1	1	1	1	1	1	1	1
Sand (loads/day)	Semi trailer	1	1	1	1	1	1	1	1	1	1	1	1
	B-Double	2	2	2	2	2	2	2	2	2	2	2	2
Total (trucks /day)		**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**

		2009											
		January	February	March	April	May	June	July	August	September	October	November	December
Ash+ Cement (loads/day)	Semi trailer	0	0	0	0	0	0	0	0	0	0	0	0
	B-Double	1	1	1	1	1	1	1	1	1	1	0	1
Sand (loads/day)	Semi trailer	1	1	1	1	1	1	1	1	1	1	1	1
	B-Double	2	2	2	2	3	2	0	0	0	0	0	2
Total (trucks /day)		**4**	**4**	**4**	**4**	**5**	**4**	**2**	**2**	**2**	**2**	**2**	**4**

		2010									
		January	February	March	April	May	June	July	August	September	October
Ash+ Cement (loads/day)	Semi trailer	0	0	0	0	0	0	0	0	0	0
	B-Double	1	1	1	1	1	1	1	1	1	1
Sand (loads/day)	Semi trailer	1	1	1	1	1	1	1	1	1	1
	B-Double	2	2	2	2	2	2	2	2	2	0
Total (trucks /day)		**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**2**

F.13.1.2 Daily Traffic due to Internal (Quarry) Traffic

Period		Borrow		Quarry		Clearing		Total	
		t/day	50t truck Loads/day[1]	t/day	50t truck Loads/day[1]	t/day	50t truck Loads/day[1]	**t/day**	**50t truck Loads/ day[1]**
2007	October	0	0	0	0	8,200	164	**8,200**	**164**
	November	0	0	0	0	8,200	164	**8,200**	**164**
	December	0	0	0	0	8,200	164	**8,200**	**164**
2008	January	0	0	1,400	29	4,000	80	**5,400**	**109**
	February	0	0	1,400	29	4,000	80	**5,400**	**109**
	March	0	0	5,800	117	3,200	65	**9,000**	**182**
	April	0	0	5,800	117	3,200	65	**9,000**	**182**
	May	0	0	5,800	117	3,200	65	**9,000**	**182**
	June	0	0	5,800	117	0	0	**5,800**	**117**
	July	0	0	5,800	117	0	0	**5,800**	**117**
	August	0	0	5,800	117	0	0	**5,800**	**117**
	September	1,000	20	5,800	117	0	0	**6,800**	**137**
	October	1,000	20	5,800	117	0	0	**6,800**	**137**
	November	2,600	52	5,800	117	0	0	**8,400**	**169**
	December	2,600	52	5,800	117	0	0	**8,400**	**169**
2008	January	2,600	52	5,800	117	0	0	**8,400**	**169**
	February	600	13	6,000	120	0	0	**6,600**	**133**
	March	600	13	6,000	120	0	0	**6,600**	**133**
	April	600	13	6,000	120	0	0	**6,600**	**133**
	May	1,800	36	6,000	120	0	0	**7,800**	**156**
	June	1,100	23	4,400	88	0	0	**5,500**	**111**
	July	1,100	23	4,400	88	0	0	**5,500**	**111**
	August	1,100	23	4,400	88	0	0	**5,500**	**111**
	September	1,100	23	4,400	88	0	0	**5,500**	**111**
	October	1,100	23	4,400	88	0	0	**5,500**	**111**
	November	1,100	23	4,400	88	0	0	**5,500**	**111**
	December	1,100	23	4,400	88	0	0	**5,500**	**111**
2010	January	1,100	23	4,400	88	0	0	**5,500**	**111**
	February	1,100	23	4,400	88	0	0	**5,500**	**111**
	March	1,100	23	4,400	88	0	0	**5,500**	**111**
	April	1,100	23	4,400	88	0	0	**5,500**	**111**
	May	0	0	4,400	88	0	0	**4,400**	**111**
	June	0	0	4,400	88	0	0	**4,400**	**88**
	July	0	0	0	0	0	0	**0**	**0**
	August	0	0	0	0	0	0	**0**	**0**
	September	0	0	0	0	0	0	**0**	**0**
	October	0	0	0	0	0	0	**0**	**0**

[1] Full load

F.13.2 SIDRA Traffic Modelling Outputs

SIDRA INTERSECTION

Movement Summary

Gilston Rd/Alexander Dr/McLaren Rd

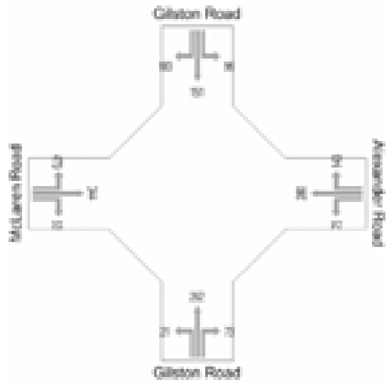
AM Peak

Roundabout

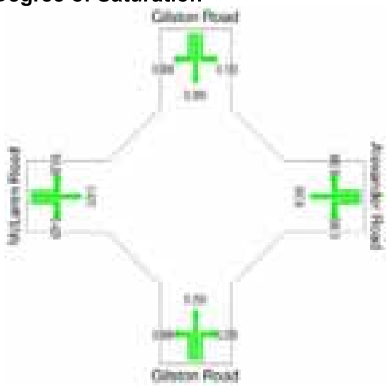
Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gilston Road										
1	L	21	9.5	0.066	8.7	LOS A	4	0.65	0.65	48.1
2	T	262	5.0	0.259	6.7	LOS A	17	0.70	0.61	48.6
3	R	73	1.4	0.259	14.0	LOS B	17	0.71	0.76	43.8
Approach		**356**	**4.5**	**0.259**	**8.3**	**LOS A**	**17**	**0.70**	**0.64**	**47.4**
Alexander Road										
4	L	75	1.3	0.103	8.0	LOS A	4	0.51	0.64	48.6
5	T	280	2.9	0.366	5.6	LOS A	20	0.57	0.52	49.6
6	R	143	2.1	0.366	13.0	LOS B	20	0.57	0.74	44.3
Approach		**498**	**2.4**	**0.365**	**8.1**	**LOS A**	**20**	**0.56**	**0.60**	**47.7**
Gilston Road										
7	L	96	0.0	0.133	8.4	LOS A	6	0.57	0.68	48.3
8	T	151	6.0	0.309	6.5	LOS A	17	0.61	0.58	48.9
9	R	183	2.2	0.309	13.3	LOS B	17	0.61	0.76	44.2
Approach		**429**	**3.0**	**0.308**	**9.8**	**LOS A**	**17**	**0.60**	**0.68**	**46.5**
McLaren Road										
10	L	473	1.1	0.420	7.5	LOS A	23	0.61	0.66	48.0
11	T	344	0.9	0.421	6.7	LOS A	22	0.63	0.61	48.7
12	R	63	12.7	0.420	14.6	LOS B	22	0.63	0.82	43.6
Approach		**880**	**1.8**	**0.421**	**7.7**	**LOS A**	**23**	**0.62**	**0.65**	**47.9**
All Vehicles		**2163**	**2.6**	**0.421**	**8.3**	**LOS A**	**23**	**0.61**	**0.64**	**47.5**

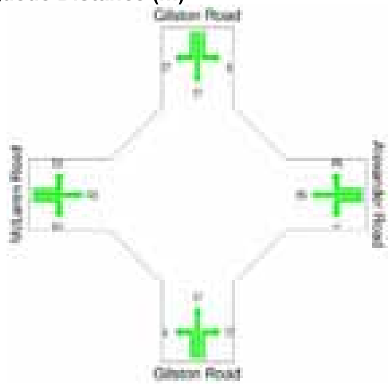
Demand Flows



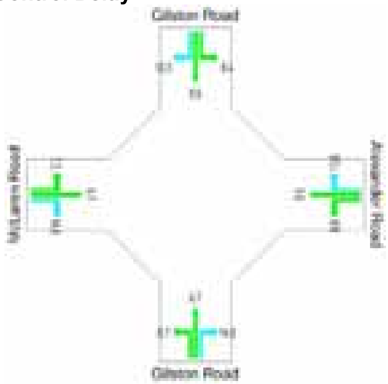
Degree of Saturation



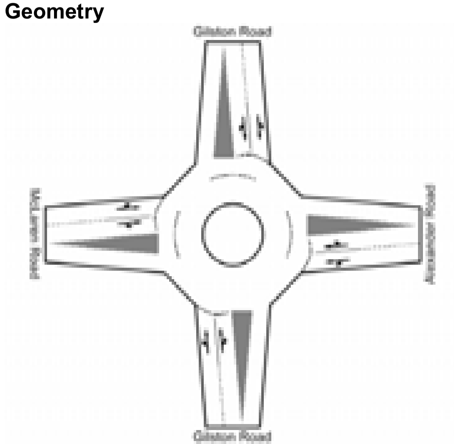
Queue Distance (m)



Control Delay

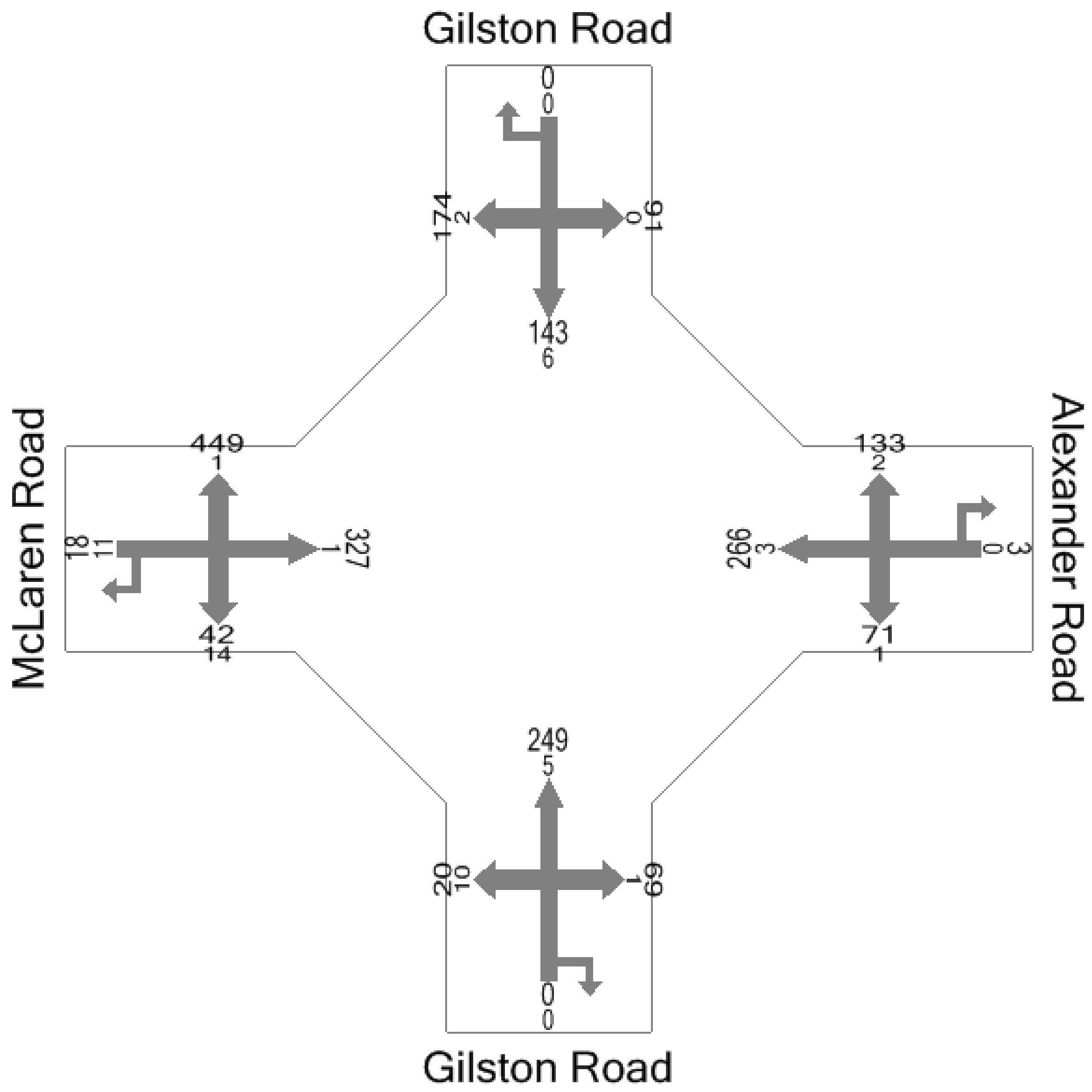


Geometry



Alexander Dr/Gilston Rd/McLaren Rd
2007 AM Peak

Alexander Dr/McLaren Rd/Gilston Rd INTERSECTION



Input Volumes

SIDRA INTERSECTION

Movement Summary

Gilston Rd/Alexander Dr/McLaren Rd

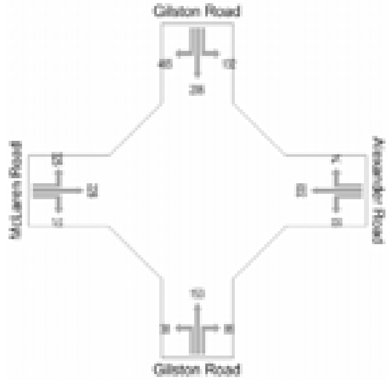
PM Peak Construction Phase

Roundabout

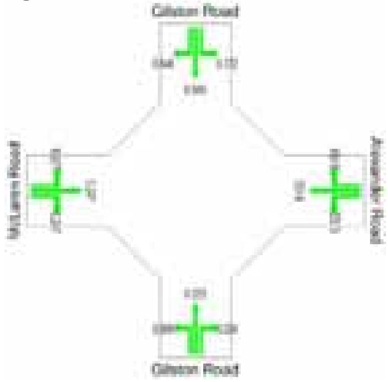
Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gilston Road										
1	L	38	2.6	0.060	9.6	LOS A	4	0.79	0.69	47.3
2	T	153	3.3	0.223	8.3	LOS A	17	0.85	0.73	47.5
3	R	86	2.3	0.224	15.6	LOS B	17	0.85	0.79	43.1
Approach		**278**	**2.9**	**0.223**	**10.8**	**LOS B**	**17**	**0.84**	**0.74**	**45.9**
Alexander Road										
4	L	63	4.8	0.122	10.4	LOS B	6	0.69	0.77	46.9
5	T	333	2.1	0.453	8.0	LOS A	30	0.81	0.76	47.7
6	R	74	0.0	0.454	15.4	LOS B	30	0.82	0.88	43.3
Approach		**470**	**2.1**	**0.453**	**9.5**	**LOS A**	**30**	**0.80**	**0.78**	**46.8**
Gilston Road										
7	L	132	0.8	0.172	7.9	LOS A	7	0.49	0.64	48.7
8	T	206	1.0	0.545	6.3	LOS A	34	0.61	0.57	48.8
9	R	465	1.1	0.546	13.1	LOS B	34	0.61	0.75	44.2
Approach		**803**	**1.0**	**0.546**	**10.5**	**LOS B**	**34**	**0.59**	**0.69**	**45.9**
McLaren Road										
10	L	325	2.1	0.267	6.7	LOS A	14	0.47	0.58	48.8
11	T	228	3.9	0.247	5.7	LOS A	12	0.48	0.51	49.8
12	R	37	8.1	0.247	13.4	LOS B	12	0.48	0.72	44.3
Approach		**591**	**3.2**	**0.267**	**6.8**	**LOS A**	**14**	**0.48**	**0.57**	**48.9**
All Vehicles		**2142**	**2.1**	**0.546**	**9.3**	**LOS A**	**34**	**0.64**	**0.68**	**46.9**

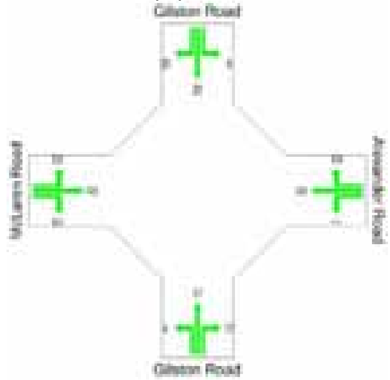
Demand Flows



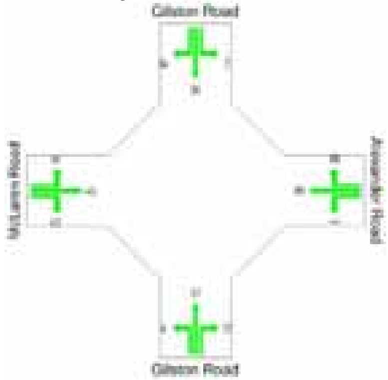
Degree of Saturation



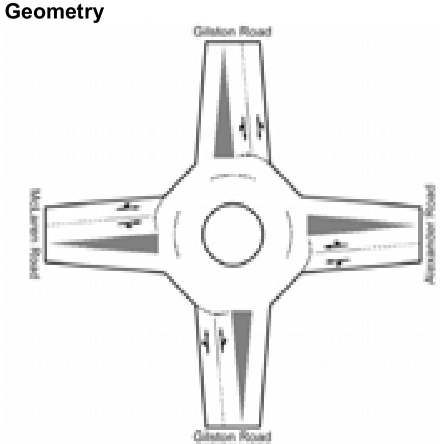
Queue Distance (m)



Control Delay

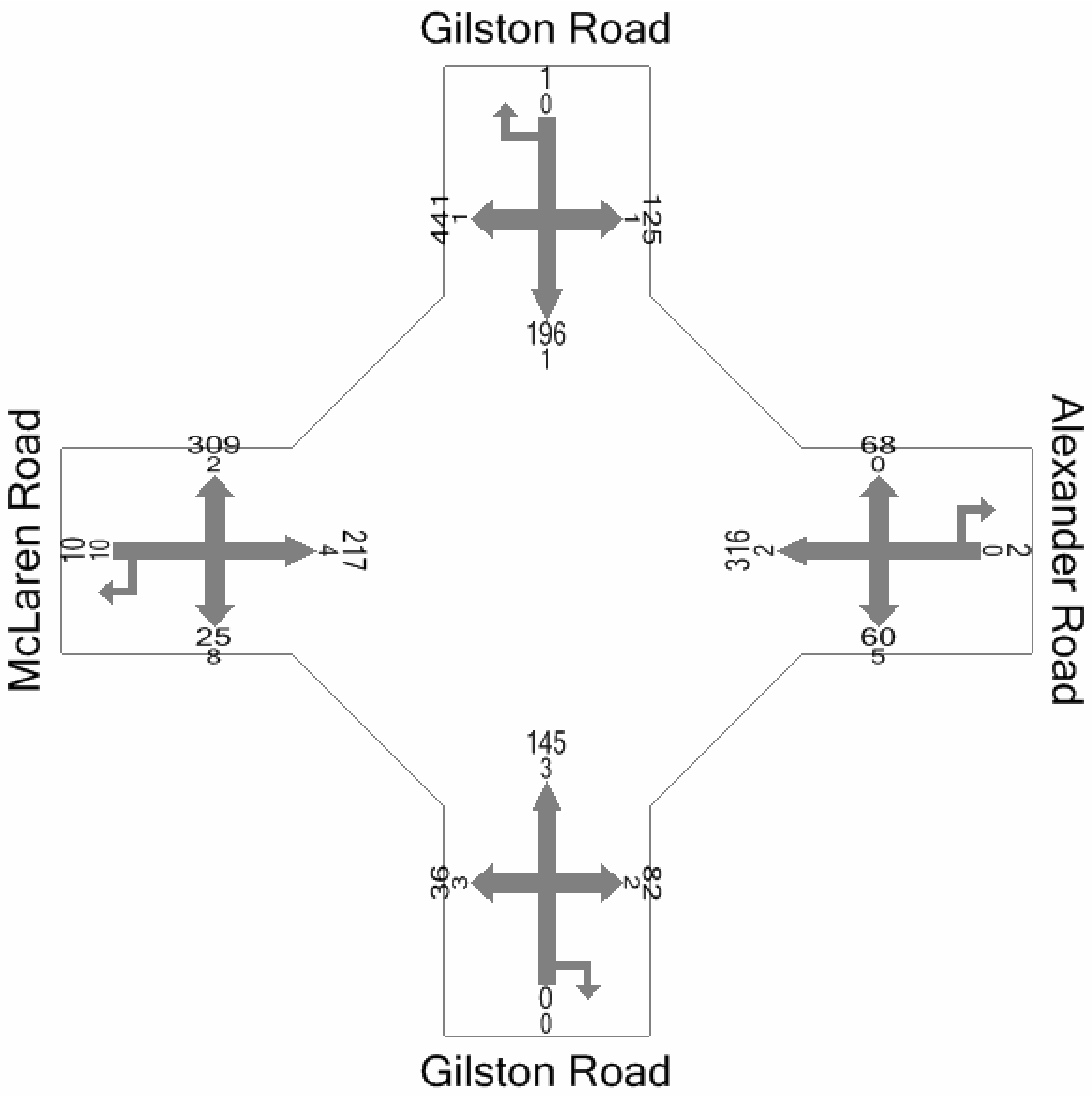


Geometry



Alexander Dr/Gilston Rd/McLaren Rd
2007 PM Peak Construction Phase

Alexander Dr/McLaren Rd/Gilston Rd INTERSECTION



Input Volumes

I

SIDRA INTERSECTION

Movement Summary

Gilston Rd/Alexander Dr/McLaren Rd

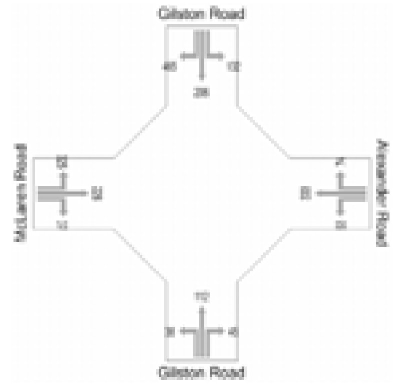
PM Peak

Roundabout

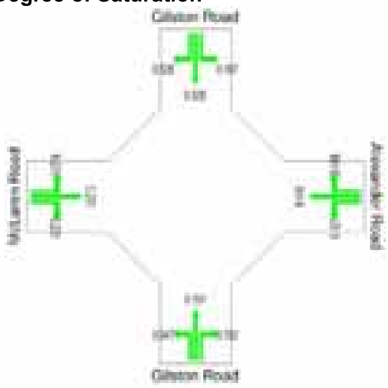
Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gilston Road										
1	L	38	2.6	0.047	9.6	LOS A	3	0.79	0.67	47.3
2	T	112	2.7	0.151	8.1	LOS A	11	0.83	0.70	47.6
3	R	45	2.2	0.152	15.4	LOS B	11	0.83	0.76	43.3
Approach		**194**	**2.6**	**0.151**	**10.1**	**LOS B**	**11**	**0.82**	**0.71**	**46.4**
Alexander Road										
4	L	63	4.8	0.121	10.4	LOS B	6	0.68	0.77	46.9
5	T	333	2.1	0.448	8.0	LOS A	30	0.80	0.75	47.8
6	R	74	0.0	0.448	15.3	LOS B	30	0.81	0.88	43.3
Approach		**470**	**2.1**	**0.448**	**9.4**	**LOS A**	**30**	**0.79**	**0.77**	**46.9**
Gilston Road										
7	L	132	0.8	0.167	7.6	LOS A	7	0.46	0.62	48.9
8	T	206	1.0	0.528	6.0	LOS A	32	0.57	0.54	49.2
9	R	465	1.1	0.528	12.8	LOS B	32	0.57	0.72	44.3
Approach		**803**	**1.0**	**0.528**	**10.2**	**LOS B**	**32**	**0.55**	**0.66**	**46.1**
McLaren Road										
10	L	325	2.1	0.251	6.5	LOS A	12	0.40	0.55	49.3
11	T	228	3.9	0.231	5.4	LOS A	11	0.40	0.49	50.4
12	R	37	8.1	0.231	13.1	LOS B	11	0.40	0.69	44.6
Approach		**591**	**3.2**	**0.251**	**6.5**	**LOS A**	**12**	**0.40**	**0.53**	**49.4**
All Vehicles		**2058**	**2.0**	**0.528**	**9.0**	**LOS A**	**32**	**0.59**	**0.65**	**47.2**

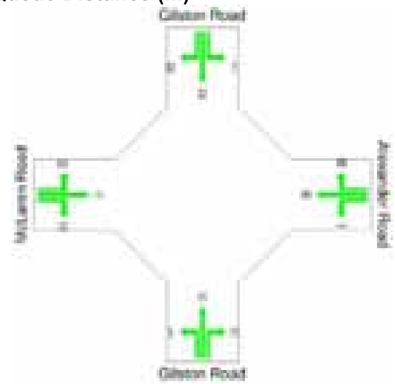
Demand Flows



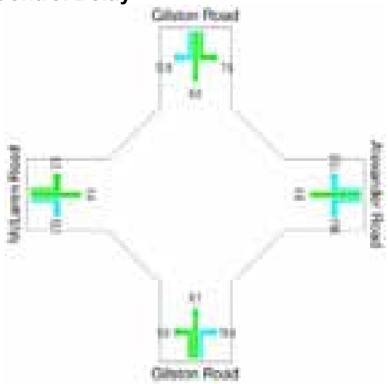
Degree of Saturation



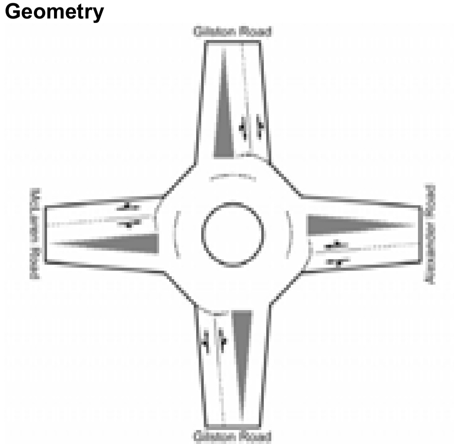
Queue Distance (m)



Control Delay

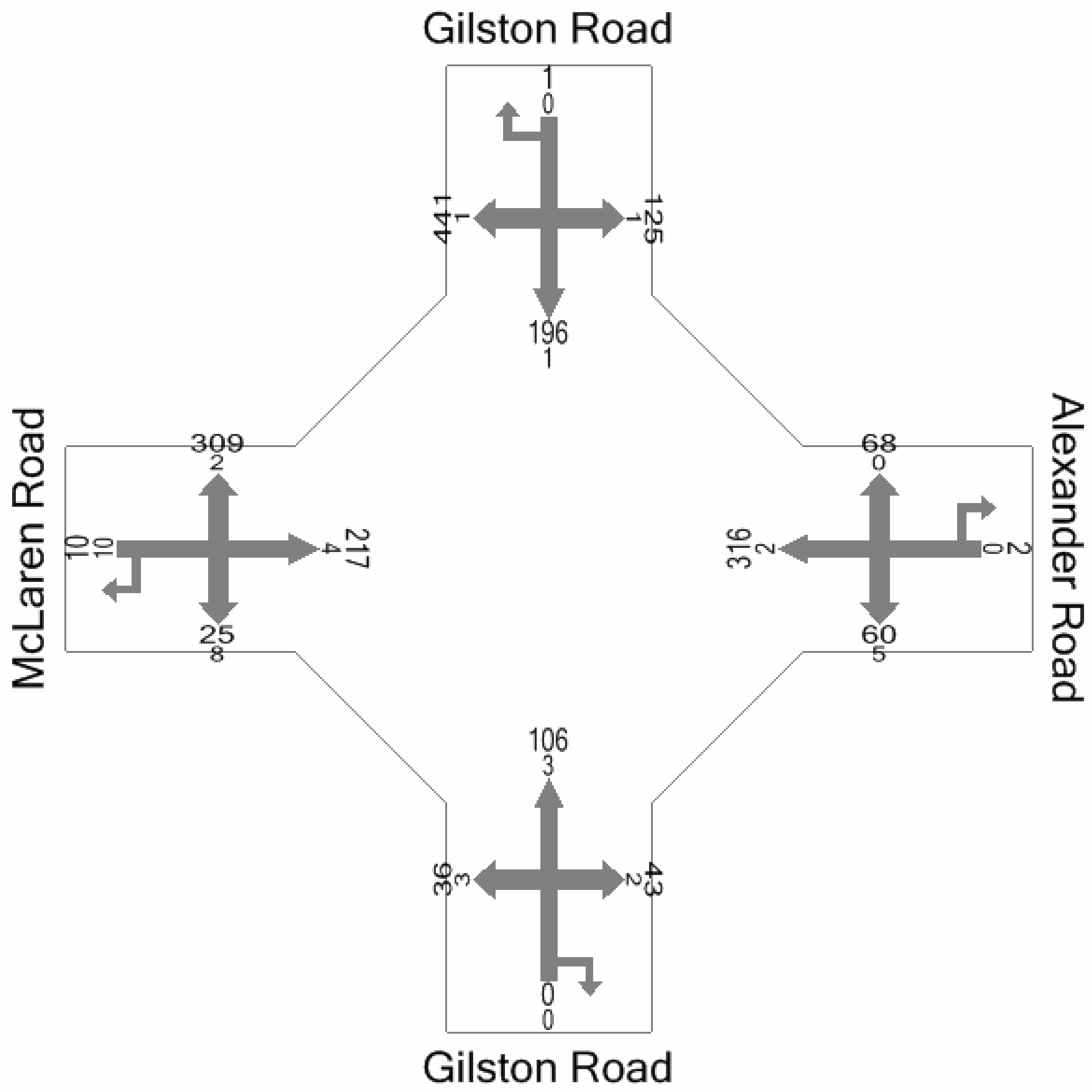


Geometry



Alexander Dr/Gilston Rd/McLaren Rd
2007 PM Peak

Alexander Dr/McLaren Rd/Gilston Rd INTERSECTION



Input Volumes

SIDRA INTERSECTION

Movement Summary

Nerang-Murwillumbah Road/Latimers Crossing

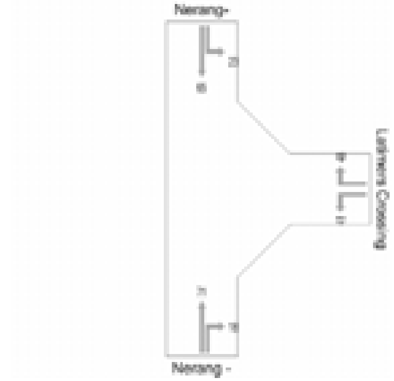
PM Peak

Give-way

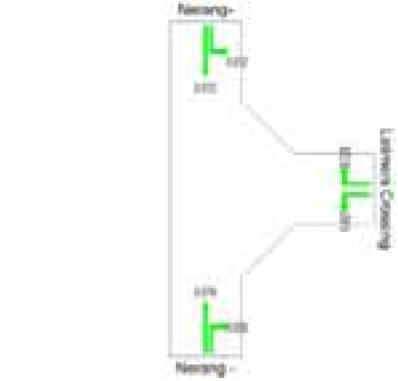
Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Nerang - Murwillumbah Road										
2	T	71	7.0	0.078	0.6	LOS A	3	0.22	0.07	57.1
3	R	18	0.0	0.025	9.7	LOS A	1	0.32	0.64	47.3
Approach		**89**	**5.6**	**0.078**	**2.4**	**LOS A**	**3**	**0.24**	**0.18**	**54.8**
Latimers Crossing Road										
4	L	41	4.9	0.021	7.7	LOS A	0	0.00	0.60	49.8
6	R	48	8.3	0.025	8.6	LOS A	0	0.00	0.68	48.8
Approach		**89**	**6.7**	**0.025**	**8.2**	**LOS A**		**0.00**	**0.65**	**49.3**
Nerang-Murwillumbah Road										
7	L	23	0.0	0.012	7.6	LOS A	0	0.00	0.60	49.8
8	T	65	4.6	0.072	0.7	LOS A	3	0.25	0.08	56.7
Approach		**88**	**3.4**	**0.072**	**2.5**	**LOS A**	**3**	**0.18**	**0.22**	**54.7**
All Vehicles		**266**	**5.3**	**0.078**	**4.4**	**Not Applicable**	**3**	**0.14**	**0.35**	**52.8**

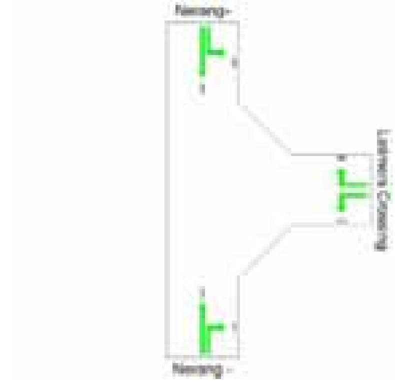
Demand Flows



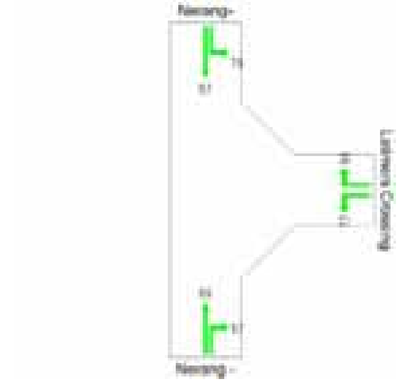
Degree of Saturation



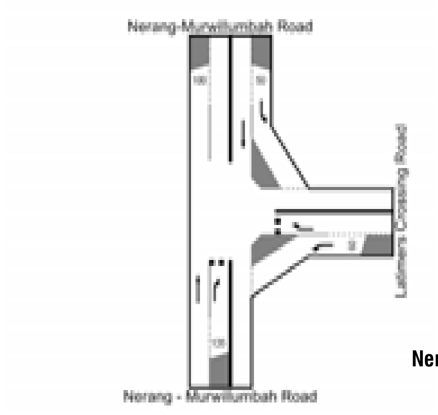
Queue Distance (m)



Control Delay

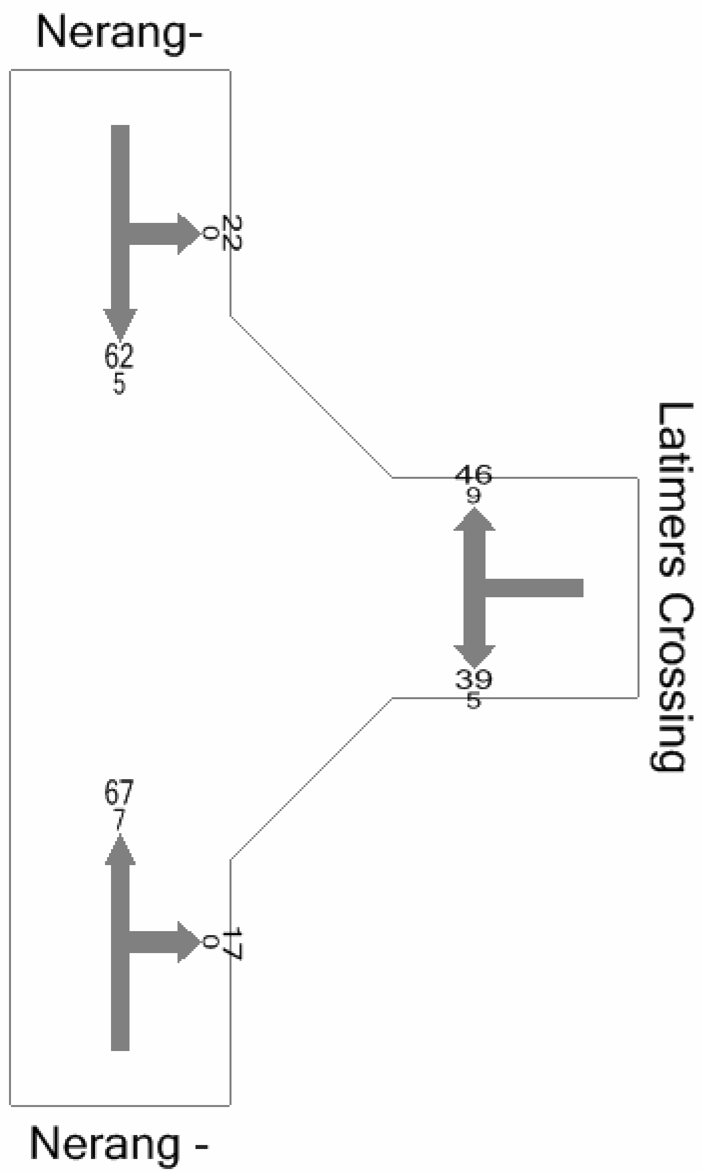


Geometry



Nerang – Murwillumbah Rd/Latimers Crossing Rd 2007 PM Peak

Nerang - Murwillumbah Rd/Latimers Crossing Rd INTERSECTION



Input Volumes

I

F.14 Hazard, Safety and Risk

No Appendices

F.15 Waste Management

No Appendices

F.16 Socio-Economic

F.16.1 Economic Impact Methodology

The following sections provide an outline of the methodologies utilised in the impact assessment for the Hinze Dam upgrade.

Input-Output Analysis

Input-output analysis measures the stimulus from additional economic activity through an economy in different ways, which are commonly measured and discussed as the first and second round effects[1]. These effects may be represented as multipliers. There are commonly four different types of multipliers:

- output;
- value added;
- income; and
- employment.

To estimate the economic impact to an existing economic activity/industry, a shock is applied. In this case the shock is the additional output generated (increased production and cost saving) by the construction activity associated with the upgrade of the Hinze Dam. Any changes in the operation activities associated with the dam are expected to be minimal and have not been examined in this study.

Explanation of Terms

- Output: The output impact measures the increase in gross sales throughout the whole economy by summing all the individual transactions resulting, directly and indirectly, to the economic stimulus. The output impact is also useful in providing an indication of the degree of structural dependence between sectors of the economy. The output impacts are, however, regarded as overstating the impact on the economy as they count all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once;
- Value Added: The value added or gross domestic product[2] (GDP) impact measures only the net activity at each stage of production. GDP is broadly defined as the additional consumption, investment and government expenditure, plus exports of goods and services, minus imports of goods and services. The GDP impacts are the preferred measure for the assessment and contribution of a stimulus to the economy;
- Income: The income impact measures the additional amount of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the stimulus to the economy; and
- Employment: The employment impact measures the number of jobs created by the stimulus, both directly and indirectly. It should be noted that short-term response to increased demand may be for employers to ask existing staff to work overtime and will therefore result in less employment than the number of jobs indicated by the economic impact of the stimulus. This short-term scenario is particularly true where the demand stimulus is seen as temporary.

---

[1] First round or direct effects are those from the expenditure by the industry purchasing additional goods from other industries, where as second round effects are those from the supplying industries increasing their purchases to meet the additional demand. The second and subsequent rounds of purchasing are termed the indirect effects.

[2] In a region, the term used is Gross Regional Product (GRP), at the State level the term used is Gross State Product (GSP), and at the national level, the term used is Gross Domestic Product (GDP).

Limitations of Input-Output Analysis

When using an input-output model, the two key limitations that should be kept in mind when interpreting the results are the constancy assumption of unchanged purchasing patterns between industries and the linearity assumption of constant returns to scale. A list of the key assumptions associated with input-output analysis is outlined below:

- the inputs purchased by each industry are a function of the level of output of that industry. The input function is generally assumed linear and homogenous of degree one (which implies constant returns to scale and no substitution between inputs);
- the total effect of carrying on several types of production is the sum of the separate effects. This rules out external economies and diseconomies and is known simply as the additivity assumption. This generally does not reflect real world operations;
- the system is in equilibrium at given prices. This is not the case in an economic system subject to external influences; and
- in the static input-output model, there are no capacity constraints so that the supply of each good is perfectly elastic. Each industry can supply whatever quantity is demanded of it and there are no capital restrictions. This assumption would come into play depending upon the magnitude of the changes in quantities demanded.

Flood Damage Assessment

The flood damages assessment was undertaken to determine the scope of damages to the community (business, infrastructure, environmental, quality of life, etc.) in existing conditions and to assess the impacts of the upgrade of Hinze Dam and its associated flood mitigation attributes in monetary terms.

Tangible flood damages are those to which a monetary value can be assigned and include property damages (internal, structural, and external), business losses, clean-up and recovery costs. Intangible flood damages are those to which a monetary value cannot be assigned and include anxiety, inconvenience and disruption of social activities. Both are a function of flood magnitude.

A monetary assessment of flood damages focuses predominantly on the tangible damages. Intangible damages are important and are included where they may be quantified and valued.

The Queensland Department of Emergency Services (2002a) Flood Assessment Guidelines presents a methodology for assessing the total economic cost of a flood event. This includes a comprehensive flood damage assessment based on estimates for each of the following categories:

- Direct Tangible Damages: Damages to residential, commercial and industrial properties; damages to infrastructure, vehicles and boats, etc.;
- Indirect Tangible Damages: Loss of value added from affected business, transport and public utilities disruption, tourism impacts, etc.; and
- Intangible Damages: Loss of memorabilia, quality of life, death and injury and health, etc.

The methodology consists of populating a loss and benefit matrix, as shown in the table below.

- **Flood Damages Assessment Framework**

Impact Type	Loss Type	Economic Loss to the Region ($M)	Benefits to the region			Net Economic Loss ($M)
			NDRA ($M)	Insurance ($M)	Total ($M)	
Direct	Residential	X		X	X	X
	Commercial	X		X	X	X
	Infrastructure	X	X	X	X	X
	Agriculture[(a)]					
	Vehicles and boats[(b)]	X		X	X	X
Indirect	Business disruption	X		X	X	X
	Transport network disruption	X				X
	Agriculture[(a)]					
	Tourism	X				X
	Disaster response and relief	X	X		X	X
Intangible	Loss of memorabilia[(b)]					
	Death, injury and health	X				X
	Quality of life[(c)]					
	Environmental	X	X		X	X
	Total	X	X	X	X	X

Notes: NDRA = National Disaster Relief Arrangements. (a) No commercial agriculture of significance in floodplain. (b) Estimates contained in residential and commercial/ industrial damages. (c) Not estimated.

Source: Adapted from Queensland Department of Emergency Services, (2002a)

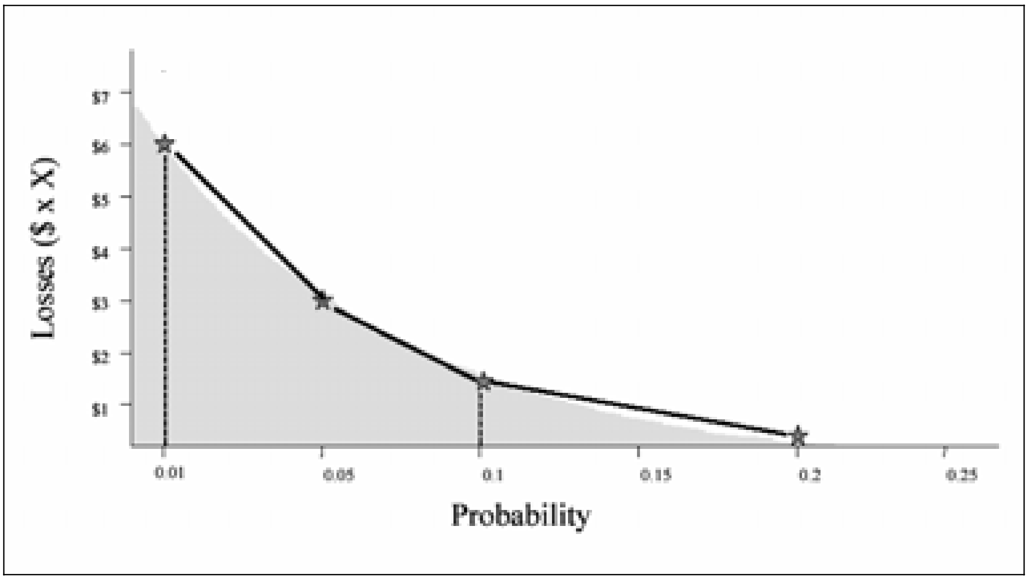
Average Annual Damages (AAD)

The final assessment involves determining total damages for each of a range of flood events under given floodplain conditions (i.e. existing conditions and proposed flood mitigation options). The range of total damage estimates can be combined to determine an average annual damage (AAD) or annual damage cost to the community for accepting a given floodplain condition.

The AAD is commonly used in flood management studies, as it is a useful single value indicator of the financial vulnerability of a community to flooding in existing conditions and of the benefit of proposed mitigation schemes. The benefits of flood mitigation will be the average annual losses prevented by the mitigation measure.

The AAD values are derived by plotting the total economic loss figures for each annual return interval (ARI) event and then calculating the area under the curve in the following figure.

Average Annual Damages (AAD) Curve



Source: Queensland Department of Emergency Services (2002a)

Benefits of the Flood Event

It is important to examine the potential benefits from the event in accordance with 'Disaster Loss Assessment Guidelines' (QDES 2002b). In a regional context inflows of monies to a region that would otherwise not have occurred outside the flood event may be viewed as benefits to the region of the flood event. Generally the benefits are only a proportion of the overall cost incurred by the flood event and occur as national disaster relief arrangement (NDRA) funding or insurance payouts for damages.

From a National context these payments would not be considered.

National Disaster Relief Arrangements (NDRA)

A region may receive assistance from the Government for costs incurred due to a flood event. Typically this assistance includes a contribution toward the cost of repairing vital infrastructure and the direct cost incurred from emergency response and relief activities. The proportion of eligible funding used for this study was identified from the 1998 North Queensland flood and was calculated to be 61.2% of damages to infrastructure and 84% of the cost of emergency response and relief (Queensland Department of Emergency Services 2002b). It is expected this would vary between flood events and has been used in this study to indicate the magnitude that may be expected.

These proportions were applied to the direct infrastructure and emergency response and relief costs identified for each of the flood events to identify the expected level of disaster assistance funding that may be received from the Government following a flood event of the Nerang River.

Insurance Payments

There will be a proportion of properties that have flood insurance that will receive insurance payouts following a flood event. The insurance payable for each flood event for infrastructure and vehicles and boats was based on the proportion of insurance payouts received for the 1998 North Queensland flooding to the total direct damage of the flood event. The insurance payable for residential and commercial properties was set in line with national average coverage for flood events. The proportion of insurance payable to total financial cost for each category of direct damages was identified from Queensland Department of Emergency Services (2002b) to be:

- Residential 10.0%
- Commercial 10.0%
- Infrastructure 0.2%
- Vehicles and Boats 82.5%

These proportions were applied to the direct damage estimates previously identified for each flood event for the respective categories to identify the level of insurance payouts likely to be received.

F.17 Cultural Heritage

No Appendices

F.18 Landscape and Visual Amenity

No Appendices

F.19 Management Plans

F.19.1 Water Quality Monitoring Programmes

Construction Water Quality Monitoring Programme

The water quality objectives and management mitigation measures proposed in the water quality technical report for the Hinze Dam EIS will be discussed and elaborated upon within this water quality monitoring program, which is to be followed during the construction process. The historic water quality monitoring undertaken by GCW, GCCC and EPA will be used as the basis for this water quality monitoring program, to ensure that the water quality monitoring proposed here does not double up on existing programs, but rather value adds to the existing water quality database.

In the first instance, to evaluate the current water quality conditions in the Hinze Dam catchment, the historic water quality data for the upper Hinze Dam catchment, within the Hinze Dam and in the lower catchment were evaluated against a set of water quality objectives provided in the Nerang River Environmental Values and Water Quality Guidelines (EPA 2006), as part of the EIS. In some instances the median concentrations for some analytes and median values for some physico-chemical parameters were reported above the water quality objectives (criteria) highlighted in EPA (2006). This suggests that for some parameters, site specific criteria needed to be derived, to reflect background conditions.

For the purposes of this water quality monitoring program, in these instances, site specific trigger values have been derived based on the 80th and 20th percentiles (DO and pH only) generated from the historic water quality data. For all other parameters, the EPA (2006) objectives were adopted.

The results to be obtained from the current program during construction, will then be compared with the EPA water quality objectives and derived site specific trigger values, to evaluate whether the proposed construction program has impacted on water quality within the catchment.

Environmental Objective

The environmental objective of the water quality monitoring program is to protect the key environmental values of the Hinze Dam catchment, as defined in the Nerang River Environmental Values and Water Quality Guidelines (EPA 2006), during construction.

Performance Criteria

The water quality monitoring program will rely on in the first instance the results of the existing water quality monitoring programs being undertaken by the EPA, GCCC and GCW. However, for undertaking additional monitoring in and around the catchment (as discussed in the **Mitigation Measures** section below), a set of performance criteria have been identified for comparison with any water quality data obtained.

The performance criteria adopted are based on the EPA (2006) water quality objectives or derived site specific trigger values, where applicable. The adopted performance criteria to be applied within each of the key areas are highlighted in **Table 1** to **Table 12**.

Upland Streams

The performance criteria to be used at each of the designated sample locations within the upland streams will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, as highlighted by the shaded cells (i.e for nutrients, DO and pH). Trigger values were derived based on 80th and 20th percentile measurements. The 80th percentile was used as the site specific trigger value for the majority of the parameters (where the parameter causes problems at high levels) and the 20th percentile was used for D.O and pH (where the parameter causes problems at low levels) (ANZECC/ ARMCANZ 2000). If samples need to be taken downstream of these locations, then the trigger value pertaining to the closest possible site should be used.

Table 1 Upland Streams Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	N2	N1	S7	S6	S5	S4	S3	S2	S1
Turbidity (NTU)	<25 NTU	-	-	-	-	-	-	-	-	-
Chlorophyll *a* (µg/L)	<2 µg/L	-	-	-	-	-	-	-	-	-
Total Nitrogen (µg/L)	<250 µg/L	-	**330**	**568**	**518**	-	**520**	**386**	**496**	**374**
Oxides of Nitrogen (µg/L)	<40 µg/L	-	-	**392**	**308**	**109**	**265**	**199**	**239**	**153**
Ammonia N (µg/L)	<10 µg/L	-	**25**	**52**	**23**	**18**	**22**	-	**20**	**21**
Organic N (µg/L)	<200 µg/L	-	-	-	-	-	-	-	-	-
Total Phosphorus (µg/L)	<30 µg/L	-	**50**	-	-	-	-	-	-	-
Filterable Reactive Phosphorus (FRP) (µg/L)	<15 µg/L	-	-	-	-	-	-	-	-	-
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 90-110%	**81 (20^{th})**	**90 (20^{th})**	**64 (20^{th})**	**58 (20^{th})**	**86 (20^{th})**	**74 (20^{th})**	**85 (20^{th})**	**75 (20^{th})**	**78 (20^{th})**
pH	6.5-8.2	-	-	**4.9 (20^{th})**	**4.7 (20^{th})**	**5.4 (20^{th})**	**5 (20^{th})**	**5.7 (20^{th})**	**5.3 (20^{th})**	**5.7 (20^{th})**

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 2005 – February 2007. Number of samples collected for Numinbah = 24; number of samples collected for Springbrook = 26.

Hinze Dam

The performance criteria to be used at each of the designated sample locations within Hinze Dam will be based on the values highlighted in the Nerang River Catchment Objectives column, except in instances when these values have been replaced by site specific trigger values, as highlighted by the shaded cells.

The site specific trigger value to be used to be used will depend on where in the Dam the water samples are to be taken. For samples collected in the northern section of the Dam the Lower Intake trigger value should be adopted, whereas results of water sampling in the southern section of the Dam should be compared with the Upper Intake trigger values.

▪ Table 2 Freshwater Lakes/ Reservoir Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Lower Intake	Upper Intake
Turbidity (NTU)	<5 NTU	-	-
[1]Chlorophyll a (μg/L)	<5 μg/L	-	-
Total Nitrogen (μg/L)	<300 μg/L	470	460
Oxides of Nitrogen (μg/L)	<10 μg/L	91	67
Ammonia N (μg/L)	<10 μg/L	19	23
Organic N (μg/L)	<270 μg/L	-	-
Total Phosphorus (μg/L)	<10 μg/L	16	16
Filterable Reactive Phosphorus (FRP) (μg/L)	<5 μg/L	-	-
Dissolved Oxygen (% saturation)	20th – 80th percentile; 90-110%	90-107	73 (20th)
pH	6.5-8.0	-	-
[2]Iron-total(μg/L)	300	-	-
[3]Manganese (μg/L)	1700	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.3m depth) collected between January 2005 – February 2007. [1] Chlorophyll *a* samples taken by SKM on 13/3/2007 at 0.2m (one off sampling event only). [2] Iron low reliability trigger value is based on the Canadian guidelines. [3] Manganese value based on Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000). Number of samples for lower and upper intakes =112.

For targeted sampling around the Potable water upper intake in Hinze Dam refer to the water quality criteria in **Table 3**.

▪ Table 3 Drinking Water Criteria

Water Quality Parameter	Hazard and critical control point (HACCP) rating (refer to notes 1, 2 for explanation of HACCP levels)
Suspended Soils	▪ Level 1: 30mg/L [1] ▪ Level 2: 100mg/L [2]
Blue-green Algae (Cyanobacteria)	▪ Level 1: > 2000 cells/mL [1] ▪ Level 2: > 5000 cells/mL [2]
Algal Biomass	▪ Level 1: > 30,000 cells/mL Cylindrospermopsin or Microcystin [1] ▪ No Level 2: [2]
Algal Toxin	▪ Level 1: 0.1 μg/L Microcystin of 0.2 μg/L Cylindrospermopsin [1] ▪ Level 2: 4 μg/L Microcystin or 1 μg/L Cylindrospermopsin [2]
E coli (cfu) (n=104)	▪ Level 1: >10 cfu/100mL 1 ▪ No Level 2 [2]
Total Coliforms	▪ Level 1: >500 cfu/100mL 1 ▪ No Level [2]
Total Nitrogen (μg/L)	▪ Level 1: >750 μg/L [1]

(n=36)	▪ Level 2: >2000 µ/L [2]
Total Phosphorus (µg/L) (n=36)	▪ Level 1: >50 µg/L [1] ▪ Level 2: > 100 µg/L [2]
Manganese (Soluble) (µg/L) (n=157)	▪ Level 1: 50 µg/L [1] ▪ Level 2: 200 µg/L [2]
Iron (Soluble) (µg/L) (n=36)	▪ Level 1: 100 µg/L [1] ▪ Level 2: 250 µg/L [2]
Turbidity (NTU) (n=157)	▪ Level 1: 10 NTU [1] ▪ No Level 2 [2]
Colour (HU) (n=157)	▪ Level 1: 50 Hazen units [1] ▪ No Level 2 [2]
Conductivity (µS/cm)	▪ Level 1: 250 uS/cm [1] ▪ Level 2: >50% change from long term median (no treatment options to remove salt) 2
Dissolved Oxygen (mg/L) (n=157)	▪ Level 1: <4 mg/L at surface [1] ▪ No Level 2 [2]
Hydrocarbons	▪ No Level 1 [1] ▪ Level 2: Notification of spills or illegal dumping [2]

Notes:
1. "Level 1" means Level 1 Hazard and Critical Control Point (HACCP) response rating, namely – treatment plant process change required to ensure water quality and quantity to customers is not compromised.
2. "Level 2" means Level 2 Hazard and Critical Control Point (HACCP) response rating, namely – Treatment plant process change required but water quality and quantity to customers may still be compromised.
Data period: 2003-2006. n = number of samples.

Lowland Streams

The performance criteria to be used at each of the designated sample locations within the lowland streams will be based on the values highlighted in the Nerang River Catchment Objectives column (see **Table 4**), except when these values have been replaced by site specific trigger values (i.e. sample location N4 for nutrients and DO at the majority of other locations). If samples need to be taken further upstream or downstream of these locations, then the trigger value pertaining to the closest possible site should be used.

▪ Table 4 Lowland Streams Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (North of wall)	N8	N7	N6	N5	N4	N3
Turbidity (NTU)`	<6 NTU	-	-	-	-	-	-	-	-	-
Chlorophyll a (µg/L)	<4 µg/L	-	-	-	-	-	-	-	-	-
Total Nitrogen (µg/L)	<400 µg/L	-	-	-	-	-	-	-	1300	-
Oxides of Nitrogen (µg/L)	<80 µg/L	-	-	-	-	-	-	-	1000	-
Ammonia N (µg/L)	<20 µg/L	-	-	-	-	-	-	-	46	-
Organic N (µg/L)	<320 µg/L	-	-	-	-	-	-	-	-	-
Total Phosphorus (µg/L)	<50 µg/L	-	-	-	-	-	-	-	114	-
Filterable Reactive	<20 µg/L	-	-	-	-	-	-	-	-	-

Phosphorus (FRP) (µg/L)										
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 85-110%	83 (20^{th})	70 (20^{th})	49 (20^{th})	-	-	83 (20^{th})	-	74 (20^{th})	74 (20^{th})
pH	6.5-8.0	-	-	-	-	-	-	-	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 2005 – February 2007. Number of GCCC samples = 24.

For targeted sampling of micro-organisms in Lowland Streams for protection of human health, refer to the water quality criteria in **Table 5**.

Table 5 Human Health Criteria

EVs	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (north of wall)
Suitability for primary contact recreation	Median faecal coliforms <150 organisms per 100mL	80	100	20
	Secchi depth >1.2(m)	0.3	0.3 (20^{th})	0.3 (20^{th})
Suitability for secondary contact recreation	Objectives as per AWQG, including median faecal coliforms<1000	80	100	20

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 2003 – February 2007. Number of GCCC samples = 61

Upper Estuary

The performance criteria to be used at each of the designated sample locations within the upper estuary will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, as highlighted by the shaded cells for total nitrogen, organic nitrogen, total phosphorus and DO concentrations and secchi depth measurements (see **Table 6**).

▪ Table 6 Upper Estuary Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	EPA Site 1908	EPA Site 1909	EPA Site 1910	GCCC Site 0A
Turbidity (NTU)	<25 NTU	-	-	-	-
Chlorophyll a (µg/L)	<8 µg/L	-	-	-	-
Total Nitrogen (µg/L)	<450 µg/L	-	-	-	700
Oxides of Nitrogen (µg/L)	<15 µg/L	-	-	-	-
Ammonia N (µg/L)	<30 µg/L	-	-	-	-
Organic N (µg/L)	<400 µg/L	-	-	568	-
Total Phosphorus (µg/L)	<30 µg/L	66.8	70	91	92
Filterable Reactive Phosphorus (FRP) (µg/L)	<10 µg/L	-	-	-	-
Dissolved Oxygen (% saturation)	20th – 80th percentile; 80-100%	79 (20th)	78 (20th)	74 (20th)	73 (20th)
pH	7.0-8.4	-	-	-	-
Secchi depth (m)	20th percentile >0.5m	-	-	-	0.3 (20th)

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 1995 – February 2007 (GCCC data) and October 2002 – February 2007 (EPA data). Number of EPA samples = 53; number of GCCC samples = 128.

For targeted sampling of micro-organisms in the Estuary for protection of human health, refer to the water quality criteria in **Table 7**.

▪ Table 7 Human Health Criteria

EVs	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (north of wall)	Site 0A	Site 1A	Site 1B
EVs Suitability for primary contact recreation	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (north of wall)	Site 0A	Site 1A	Site 1B
	Median faecal coliforms <150 organisms per 100mL	80	100	20	160	20	40
Suitability for secondary contact recreation	Secchi depth >1.2(m)	0.3	0.3 (20th)	0.3 (20th)	0.3 (20th)	0.7 (20th)	0.6 (20th)

Table Notes: Data Period: January 2003 – February 2007. Median values calculated from surface water data (0.2m). Number of GCCC samples = 61

Mid Estuary

The performance criteria to be used at each of the designated sample locations within the mid estuary will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, at EPA sample sites 1903 – 1907 (see **Table 8**) and GCCC sample sites 1A and 2A (**Table 9**).

Table 8 Mid Estuary Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Site 1901	Site 1912	Site 1916	Site 1903	Site 1904	Site 1905	Site 1906	Site 1907
Turbidity (NTU)	<5 NTU	-	-	-	-	-	-	8.6	10.2
Chlorophyll a (µg/L)	<4 µg/L	-	-	-	-	-	-	-	-
Total Nitrogen (µg/L)	<300 µg/L	-	-	-	-	-	-	-	496
Oxides of Nitrogen (µg/L)	<10 µg/L				32	32	35	32	45
Ammonia N (µg/L)	<15 µg/L					27	36	40	32
Organic N (µg/L)	<250 µg/L	-	-	-	-	-	-	360	402
Total Phosphorus (µg/L)	<30 µg/L	-	-	-	-	-	-	-	45
Filterable Reactive Phosphorus (FRP) (µg/L)	<10 µg/L	-	-	-	-	-	-	-	-
Dissolved Oxygen (% saturation)	20th – 80th percentile; 80-100%	-	-	-	-	-	-	-	-
pH	7.0-8.4	-	-	-	-	-	-	-	-
Secchi depth (m)	20th percentile >1.0m	-	-	-	-	-	1.0 (20th)	1.0 (20th)	0.8 (20th)

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between October 2002 – February 2007. Number of EPA samples = 53.

Table 9 Mid Estuary Water Quality Criteria Cont.

Water Quality Parameter	Nerang River Catchment Objectives	Gardiniers Creek Site 1	Site 6	Site 3	Site 2A	Site 1A
Turbidity (NTU)	<5 NTU	-	-	-	-	-
Chlorophyll a (µg/L)	n/a	-	-	-	-	-
Total Nitrogen (µg/L)	<300 µg/L	-	-	-	-	500
Oxides of Nitrogen (µg/L)	n/a	-	-	-	-	-
Ammonia N (µg/L)	n/a	-	-	-	-	-
Organic N (µg/L)	n/a	-	-	-	-	-
Total Phosphorus (µg/L)	<30 µg/L	-	-	-	-	60
Dissolved Oxygen (% saturation)	20th – 80th percentile; 80-100%	-	-	-	-	73 (20th)
pH	7.0-8.4	-	-	-	-	-
Secchi depth (m)	20th percentile >1.0m	-	-	-	1.0 (20th)	0.7 (20th)

Table Notes: Data Period: January 1995 – February 2007. Median values calculated from surface water data (0.2m). Number of GCCC samples = 128.

Tidal Canals

The performance criteria to be used at each of the designated sample locations within the tidal canals will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, which include nutrient concentrations reported at Site 1B and Gardiners Site 2 and DO values reported at all three sites (see **Table 10**).

▪ Table 10 Tidal Canal Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Site 1B	Site 4	Gardiners Creek Site 2
Turbidity (NTU)	<8 NTU	-	-	-
Chlorophyll a (µg/L)	<4 µg/L	-	-	-
Total Nitrogen (µg/L)	<300 µg/L	560	-	-
Oxides of Nitrogen (µg/L)	<10 µg/L	-	-	-
Ammonia N (µg/L)	<10 µg/L	-	-	-
Organic N (µg/L)	<280 µg/L	-	-	-
Total Phosphorus (µg/L)	<25 µg/L	39	-	60
Filterable Reactive Phosphorus (FRP) (µg/L)	<6 µg/L	-	-	-
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 85-100%	80 (20^{th})	84 (20^{th})	81 (20^{th})
pH	7.0-8.4	-	-	-
Secchi depth (m)	20^{th} percentile >1.0m	-	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 1995 – February 2007. Number of GCCC samples = 128.

Lower Estuary

The performance criteria to be used at each of the designated sample locations within the lower estuary will be based on the values highlighted in the Nerang River Catchment Objectives column, except in one instance, where the default trigger value for DO at Site 119 shall be used (see **Table 11**). The median reported at Site 119 indicated that DO was above the 20th – 80th percentile range and was highly saturated at this site.

▪ Table 11 Lower Estuary Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Site 117	Site 118	Site 119
Turbidity (NTU)	<8 NTU	-	-	-
Chlorophyll a (µg/L)	<2.75 µg/L	-	-	-
Total Nitrogen (µg/L)	<170 µg/L	-	-	-
Oxides of Nitrogen (µg/L)	<4 µg/L	-	-	-
Ammonia N (µg/L)	<11 µg/L	-	-	-
Organic N (µg/L)	<170 µg/L	-	-	-
Total Phosphorus (µg/L)	<25 µg/L	-	-	-
Filterable Reactive Phosphorus (FRP) (µg/L)	<6 µg/L	-	-	-

Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 90-105%	-	-	97 (20^{th})
pH	8.2-8.4	-	-	-
Secchi depth (m)	20^{th} percentile >1.6m	-	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between October 2002 – February 2007. Number of EPA samples = 54.

Open Coastal

The performance criteria to be used at each of the designated sample locations along the open coastline will be based on the values highlighted in the Nerang River Catchment Objectives column (see **Table 12**).

Table 12 Open Coastal Waters Criteria

Water Quality Parameter	Nerang River Catchment Objectives
Turbidity (NTU)	<1
Chlorophyll a (µg/L)	<1 µg/L
Total Nitrogen (µg/L)	<150 µg/L
Oxides of Nitrogen (µg/L)	<3 µg/L
Ammonia N (µg/L)	<5 µg/L
Organic N (µg/L)	<140 µg/L
Total Phosphorus (µg/L)	<16 µg/L
Filterable Reactive Phosphorus (FRP) (µg/L)	<5 µg/L
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 95-105%
pH	8.2-8.4
Secchi depth (m)	20^{th} percentile >5.0m

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between February 2000 – February 2007. Number of EPA samples = 75.

Mitigation Measures

Event based, as well as some routine sampling is proposed in the upper catchment, Hinze Dam and within Lowland Streams. This is in addition to the existing monitoring programs currently being undertaken by the EPA, GCCC and GCW. The mitigation measures addressed in this program include undertaking monitoring and reporting of elevated physico-chemical parameters and/ or nutrient and metal concentrations.

When and if an individual parameter exceeds the performance criteria, it will be examined to establish cause-and-effect relationships where possible. This approach will be undertaken to inform the implementation of enhanced mitigation measures, such as additional source control measures, cessation of construction activities, cessation of downstream discharges or advice to water treatment plant operators. Details of the suite of mitigation measures will be outlined in a Water Quality Response Plan.

Monitoring Methods

Water quality sampling will be conducted in real time and on a routine basis during construction activities. Physico-chemical analyses will be performed in-situ using hand-held meters and fixed water quality meters and water samples will be collected for analysis using a grab sampler. Event based sampling will also be undertaken after any rain events. A project environmental health and safety plan shall be prepared for the proposed field work undertaken on and adjacent to water.

Sample collection will be in accordance with the Queensland Environmental Protection Agency Water Quality Sampling Manual (1999) and ANZECC/ ARMCANZ (2000) Water Quality and Monitoring Guidelines and will be carried out by suitably experienced environmental scientists/ ecologist. Results will be assessed against the Nerang River Water Quality Objectives (EPA 2006) and ANZECC/ARMCANZ (2000) guidelines, where applicable (i.e. Fe).

Event-based Water Quality Monitoring

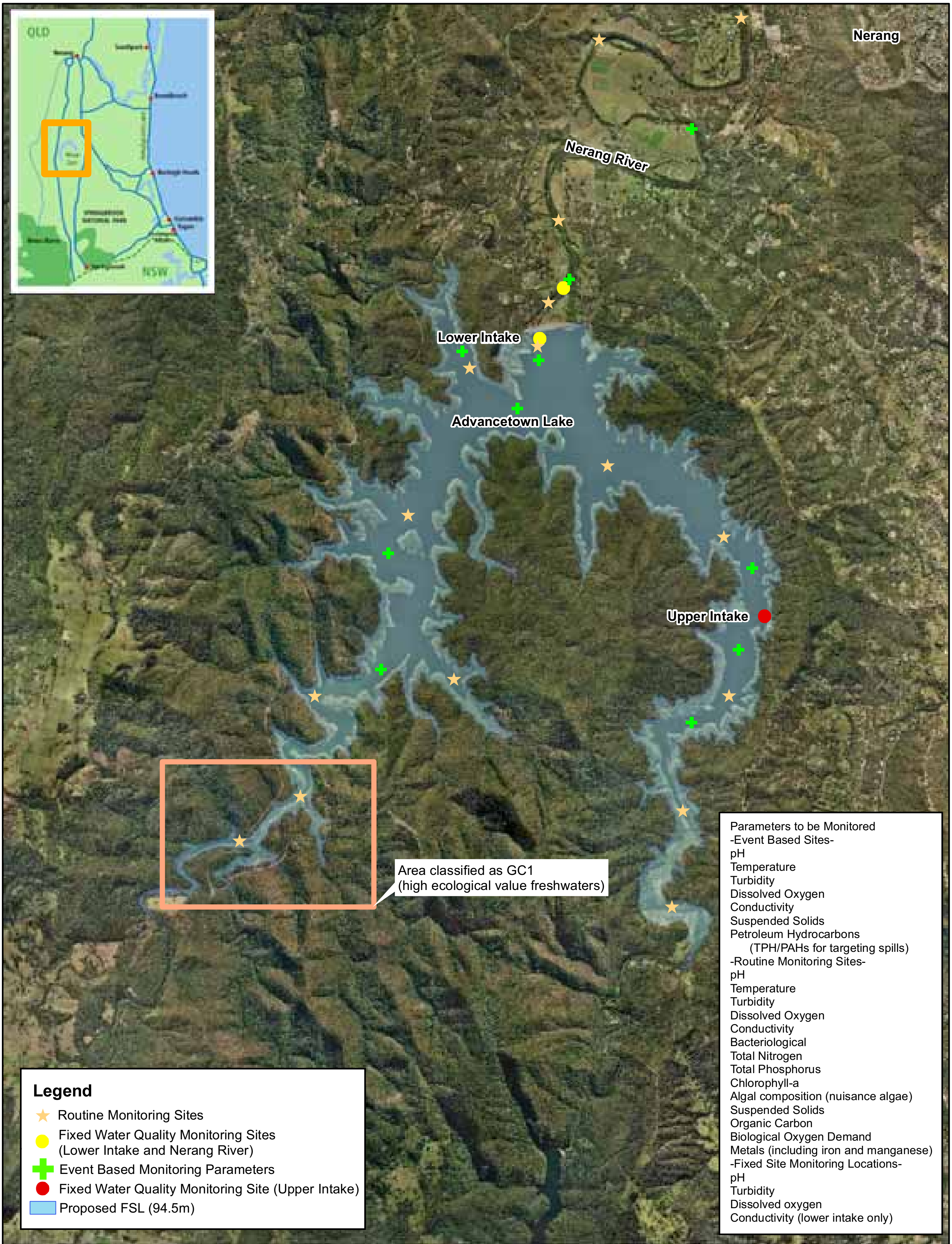
Wastewaters discharged from the settlement ponds (due to flooding and excess water discharge) and localised construction activities adjacent to water shall be monitored for a range of physico-chemical parameters through the water column, within the Dam and in the Nerang River. Targeted sampling of these activities should be event based.

It is accepted that elevated water quality conditions (ie high turbidity) will occur from such activities, so the important issue will be residence time and how long the system takes to return to background conditions. Targeted sampling will need to occur in and around the ‘event’ and if the results of water quality testing indicate exceedance of the site specific trigger values, then sampling will need to continue for 7 days. This targeted monitoring will assist to identify the temporal and spatial extent of the impact.

The 50th percentiles (medians) generated from the daily sampling for seven days, are to be compared to the trigger values highlighted in the tables. If water quality impacts are still occurring and this has the potential to impact on water quality at the intakes, then this shall trigger further action.

The site specific EMPs developed will need to have a response plan which includes the Hinze Dam Alliance informing and working with the EPA and GCW (for the lower intake) and GCW and the Molendinar Water Treatment Plant (for the upper intake), to ensure that conditions return to background as quickly as possible. Mitigation measures may need to be implemented at this stage, such as the installation of silt curtains, or moving the construction works until water quality conditions return to background levels.

The water quality response plan will need to identify issues and review the mitigation procedures to ensure impacts on potable water and water quality downstream of the Dam do not occur.



G:\Spatial\Arc_MXD\EIS\Water_Quality\Fig_1_070528.mxd Produced: 28/05/2007

N

0 0.5 1 2
Kilometres

Scale - 1:60,000
Projection: MGA Zone 56

Figure 1

Water quality monitoring sites during Hinze Dam filling and at full supply level

Hinze Dam Stage 3 EIS

Routine Water Quality Monitoring

A number of water quality programs are currently being undertaken within the Nerang Catchment including the EPA (Ecosystem Health Monitoring Program), Gold Coast City Council, Gold Coast Water and community group water quality monitoring programs.

The EPA EHMP is a regional program involving the EPA, Department of Natural Resources and Water (DNR&W), local councils and universities. This program monitors marine, estuarine and freshwaters reaches of the Nerang River on a monthly basis (see **Figure**). Gold Coast City Council currently monitors water quality monthly in the Nerang Catchment at 13 sites in the marine and freshwater sections of the Nerang River and at 15 sites in the upper catchment (seven sites in the Springbrook area and eight sites in the Numinbah area) (see **Figure**). Gold Coast Water currently undertakes weekly monitoring at two locations in Hinze Dam at the upper and lower intakes (see **Figure**).

The results of these three programs should be used to document on-going water quality conditions in the Nerang Catchment, including Hinze Dam. In addition, some routine water quality monitoring program (weekly) will be conducted by the Hinze Dam Alliance to complement the existing programs. The additional routine water quality monitoring program proposed will target parameters and locations not currently being tested.

A two year vegetation clearance program is proposed around the Hinze Dam and therefore, there is the potential for water quality conditions to be compromised around the Dam. GCW only undertake water quality monitoring at the upper and lower intakes and so, any water quality issues that may arise in other areas of the Dam are currently not considered. Additional sampling is therefore required within the Hinze Dam, on a weekly basis to ensure that any localised exceedences which may occur around the Dam are monitored.

Additional parameters to be tested, which are not currently examined include chlorophyll-a, algal composition, bacteria, suspended solids, organic carbon, colour, BOD and metals (iron and manganese). Chlorophyll-a monitoring should be undertaken in spring, summer and early autumn and when cell counts are reported above the Nerang River Catchment Objective, targeted testing for blue-green (nuisance) algae should be conducted. Bacterial testing is recommended because it is currently not undertaken within the Dam and should be to manage the drinking water supply.

As indicated for event based monitoring, if the results of water quality testing indicate exceedance of the site specific trigger values, then sampling will need to continue for 7 days. This routine monitoring will assist to identify the temporal and spatial extent of the impact. The 50th percentiles (medians) generated are to be compared to the trigger values highlighted in the tables in the **Performance Criteria** section above. The water quality response plan will include implementing mitigation procedures to ensure impacts on potable water and water quality downstream of the Dam do not occur.

G:\Spatial\Arc_MXD\EIS\Water_Quality\Fig_2_070411.mxd Produced: 11/4/2007

Figure 2

EPA Water Quality Monitoring Sites

Hinze Dam Stage 3 EIS

This figure must be read in conjunction with the data disclosure in Appendix H of this document

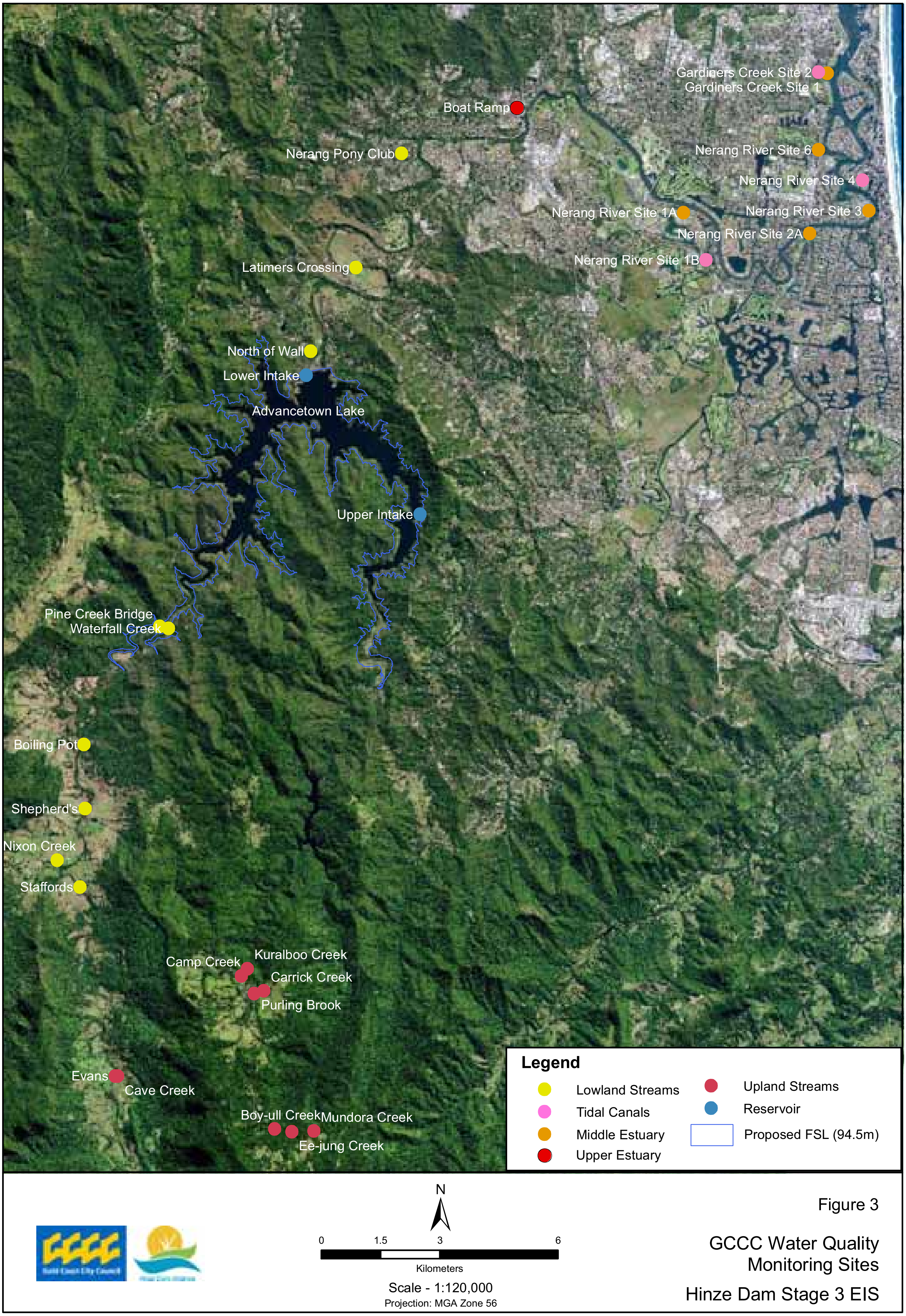
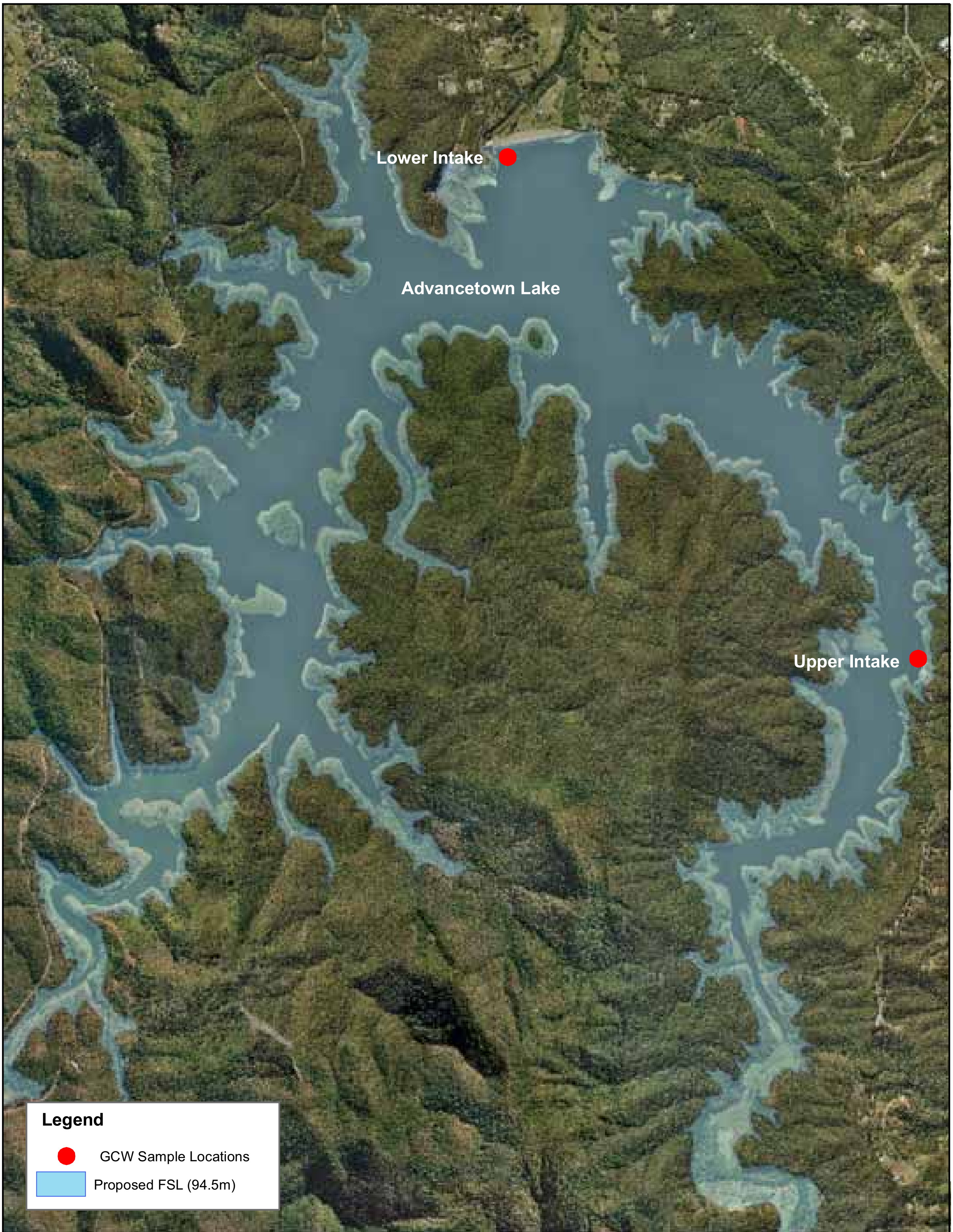
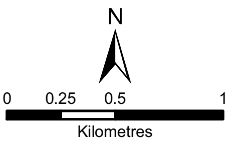


Figure 3

GCCC Water Quality Monitoring Sites

Hinze Dam Stage 3 EIS





Scale - 1:35,000
Projection: MGA Zone 56

Figure 4

GCW Water Quality Monitoring Sites within Hinze Dam

Hinze Dam Stage 3 EIS

Fixed Site Monitoring

Fixed site loggers will be installed upstream of the lower intake and downstream of the Dam wall, to prevent any impacts to water discharged into the Nerang River and at the upper intake, to ensure that water sourced by the Molendinar Water Treatment Plant is of a satisfactory quality. The loggers will need to be installed at a sufficient distance upstream of the intake to ensure sufficient time is available to advise plant operators of any pending water quality problems. The approach will involve the installation of fixed site data loggers with telemetry capability for real-time monitoring. The fixed site loggers will be equipped to measure turbidity, temperature, pH and conductivity (lower intake only).

The fixed site logger installed within the vicinity of the upper intake should be at the same depth as the potable water inlet, at approx. 6–7m depth. Again, if water quality conditions are compromised, the Alliance will need to immediately implement mitigation procedures to ensure impacts on potable water and water quality downstream of the Dam do not occur. The Alliance should also consider the use of thermistors and if installed, they should be placed at 1m intervals in the vicinity of the intakes.

Quality Assurance

Water samples transported in eskies, containing ice bricks will be submitted to the analysing laboratory immediately following sample collection. Bacterial analyses need to be submitted within 24 hours. A field duplicate sample will be taken by the sampler collecting a replicate sample at one location during each weekly sampling event. All water samples submitted to the analysing laboratory will be accompanied by Chain of Custody (CoC) documentation, clearly stating the required analysis method and required limits of reporting (see **Table 13**). A laboratory which is NATA accredited for the proposed analysis will be used to analyse water samples.

Table 13 Parameters and Limits of Reporting

Water Quality Parameter	LORs
Turbidity (NTU)	0.1 NTU
Chlorophyll a (µg/L)	0.1 µg/L
Total Nitrogen (µg/L)	50 µg/L
Kjeldahl Nitrogen (µg/L)	200 µg/L
Ammonia N (µg/L)	3 µg/L
Nitrate and Nitrite (µg/L)	2 µg/L
Total Phosphorus (µg/L)	5 µg/L
Filterable Reactive Phosphorus (FRP) (µg/L)	2 µg/L
Dissolved Oxygen (% saturation)	0.1 mg/L or 0.1%
Secchi depth (m)	0.1 m
pH	0.1 units
[2]Iron-total(µg/L)	10 µg/L
[3]Manganese (µg/L)	0.2 µg/L
E coli (cfu)	<1/100 mL
Total Coliforms	<1/100 mL
Organic Carbon	1 mg/L
Colour	1 Hazen unit
Suspended Solids	1 mg/L
Blue Green Algae	1 cell/ mL
Total Algal Count	1 cell/ mL

Water Quality Parameter	LORs
Toxic Algae	1 cell/ mL

A more detailed sampling procedure should be prepared as part of the site specific environmental management plans, to accurately define exactly what is required for each component of the program. The detailed sampling procedure define the precise locations and depths at which sampling is to be undertaken, the maintenance and calibration requirements of instrumentation, data management requirements and any addition quality assurance procedures.

Reporting

Monthly water quality reports shall be prepared which report on water quality conditions within the Hinze Dam catchment, including data collected as part of the existing EPA, GCCC and GCW. Monthly reports will include any actions/ measures which need to be implemented where non-compliances have been reported and the person/ organisation responsible for implementing the action highlighted.

During and after rainfall, a visual inspection of the construction site will be undertaken to ensure that mitigation measures are in place and no major erosion is occurring. Additional monitoring and reporting will be required to determine the extent of stormwater runoff after pulse events.

EMP auditing will be conducted quarterly including assessing compliance with the mitigation measures highlighted in the EMP and checking the procedures documented in the water quality monitoring program have been followed.

Roles & Responsibilities

On-site Alliance personnel (environmental team) will be required to undertake the routine water quality monitoring and reporting. Reports shall be peer reviewed prior to issue to the EPA. Separate Alliance personnel (suitably trained environmental scientists) shall independently audit the program on a quarterly basis.

A risk workshop is recommended prior to the implementation of the monitoring program, to make sure that the monitoring is consistent with plant operator (and other stakeholder) requirements.

Corrective Action / Contingency Plan

Contaminated waters (elevated turbidity, suspended solids etc) observed flowing from the construction site into Hinze Dam or the Nerang River, will be identified and the appropriate action taken by the "Environmental Manager". Any impacts to downstream water quality shall be reported to the EPA and any impacts to the potable water supply detected at the upper intake, reported to the Molendinar Water Treatment Plant.

Operational Water Quality Monitoring Program

The water quality objectives and management mitigation measures proposed in the water quality technical report for the Hinze Dam EIS have been discussed and elaborated upon within this water quality monitoring program, which is to be followed during operation of the Hinze Dam, post construction. The major issues to be monitored include sediment runoff in cleared areas and changes in dissolved oxygen concentrations through the water column, from vegetation inundation.

In the first instance, to evaluate the current water quality conditions in the Hinze Dam catchment, the historic water quality data for the upper Hinze Dam catchment, within the Hinze Dam and in the lower catchment were evaluated against a set of water quality objectives provided in the Nerang River Environmental Values and Water Quality Guidelines (EPA 2006), as part of the EIS. In some instances the median concentrations for some analytes and median values for some physico-chemical parameters were reported above the water quality objectives (criteria) highlighted in EPA (2006). This suggests that for some parameters, site specific criteria needed to be derived, to reflect background conditions.

For the purposes of this water quality monitoring program, in these instances, site specific trigger values have been derived based on the 80th and 20th percentiles (DO and pH only) generated from the historic water quality data. For all other parameters, the EPA (2006) objectives were adopted.

The results to be obtained from this program during operation, will then be compared with the EPA water quality objectives and derived site specific trigger values, to evaluate whether operational activities have impacted on water quality within the catchment.

Environmental Objective

The environmental objective of the water quality monitoring program is to protect the key environmental values of the Hinze Dam catchment, as defined in the Nerang River Environmental Values and Water Quality Guidelines (EPA 2006), during operational activities.

Performance Criteria

The water quality monitoring program will rely on in the first instance the results of the existing water quality monitoring programs being undertaken by the EPA, GCCC and GCW. However, for undertaking additional monitoring in and around the catchment (as discussed in the **Mitigation Measures** section below), a set of performance criteria have been identified for comparison with any water quality data obtained.

The performance criteria adopted are based on the EPA (2006) water quality objectives or derived site specific trigger values, where applicable. The adopted performance criteria to be applied within each of the key areas are highlighted in **Table 1** to **Table 12**.

Upland Streams

The performance criteria to be used at each of the designated sample locations within the upland streams will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, as highlighted by the shaded cells (i.e for nutrients, DO and pH). Trigger values were derived based on 80th and 20th percentile measurements. The 80th percentile was used as the site specific trigger value for the majority of the parameters (where the parameter causes problems at high levels) and the 20th percentile was used for D.O and pH (where the parameter causes problems at low levels) (ANZECC/ ARMCANZ 2000). If samples need to be taken downstream of these locations, then the trigger value pertaining to the closest possible site should be used.

Table 1 Upland Streams Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	N2	N1	S7	S6	S5	S4	S3	S2	S1
Turbidity (NTU)	<25 NTU	-	-	-	-	-	-	-	-	-
Chlorophyll *a* (µg/L)	<2 µg/L	-	-	-	-	-	-	-	-	-
Total Nitrogen (µg/L)	<250 µg/L	-	**330**	**568**	**518**	-	**520**	**386**	**496**	**374**
Oxides of Nitrogen (µg/L)	<40 µg/L	-	-	**392**	**308**	**109**	**265**	**199**	**239**	**153**
Ammonia N (µg/L)	<10 µg/L	-	**25**	**52**	**23**	**18**	**22**	-	**20**	**21**
Organic N (µg/L)	<200 µg/L	-	-	-	-	-	-	-	-	-
Total Phosphorus (µg/L)	<30 µg/L	-	**50**	-	-	-	-	-	-	-
Filterable Reactive Phosphorus (FRP) (µg/L)	<15 µg/L	-	-	-	-	-	-	-	-	-
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 90-110%	**81 (20^{th})**	**90 (20^{th})**	**64 (20^{th})**	**58 (20^{th})**	**86 (20^{th})**	**74 (20^{th})**	**85 (20^{th})**	**75 (20^{th})**	**78 (20^{th})**
pH	6.5-8.2	-	-	**4.9 (20^{th})**	**4.7 (20^{th})**	**5.4 (20^{th})**	**5 (20^{th})**	**5.7 (20^{th})**	**5.3 (20^{th})**	**5.7 (20^{th})**

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 2005 – February 2007. Number of samples collected for Numinbah = 24; number of samples collected for Springbrook = 26.

Hinze Dam

The performance criteria to be used at each of the designated sample locations within Hinze Dam will be based on the values highlighted in the Nerang River Catchment Objectives column, except in instances when these values have been replaced by site specific trigger values, as highlighted by the shaded cells.

The site specific trigger value to be used to be used will depend on where in the Dam the water samples are to be taken. For samples collected in the northern section of the Dam the Lower Intake trigger value should be adopted, whereas results of water sampling in the southern section of the Dam should be compared with the Upper Intake trigger values.

Table 2 Freshwater Lakes/ Reservoir Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Lower Intake	Upper Intake
Turbidity (NTU)	<5 NTU	-	-
[1]Chlorophyll *a* (µg/L)	<5 µg/L	-	-
Total Nitrogen (µg/L)	<300 µg/L	**470**	**460**
Oxides of Nitrogen (µg/L)	<10 µg/L	**91**	**67**
Ammonia N (µg/L)	<10 µg/L	**19**	**23**
Organic N (µg/L)	<270 µg/L	-	-
Total Phosphorus (µg/L)	<10 µg/L	**16**	**16**
Filterable Reactive	<5 µg/L	-	-

Water Quality Parameter	Nerang River Catchment Objectives	Lower Intake	Upper Intake
Phosphorus (FRP) (µg/L)			
Dissolved Oxygen (% saturation)	20th – 80th percentile; 90-110%	90-107	**73 (20th)**
pH	6.5-8.0	-	-
[2]Iron-total(µg/L)	300	-	-
[3]Manganese (µg/L)	1700	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.3m depth) collected between January 2005 – February 2007. [1] Chlorophyll *a* samples taken by SKM on 13/3/2007 at 0.2m (one off sampling event only). [2] Iron low reliability trigger value is based on the Canadian guidelines. [3] Manganese value based on Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000). Number of samples for lower and upper intakes =112.

For targeted sampling around the Potable water upper intake in Hinze Dam refer to the water quality criteria in **Table 3**.

▪ Table 3 Drinking Water Criteria

Water Quality Parameter	Hazard and critical control point (HACCP) rating (refer to notes 1, 2 for explanation of HACCP levels)
Suspended Soils	▪ Level 1: 30mg/L [1] ▪ Level 2: 100mg/L [2]
Blue-green Algae (Cyanobacteria)	▪ Level 1: > 2000 cells/mL [1] ▪ Level 2: > 5000 cells/mL [2]
Algal Biomass	▪ Level 1: > 30,000 cells/mL Cylindrospermopsin or Microcystin [1] ▪ No Level 2: [2]
Algal Toxin	▪ Level 1: 0.1 µg/L Microcystin of 0.2 µg/L Cylindrospermopsin [1] ▪ Level 2: 4 µg/L Microcystin or 1 µg/L Cylindrospermopsin [2]
E coli (cfu) (n=104)	▪ Level 1: >10 cfu/100mL 1 ▪ No Level 2 [2]
Total Coliforms	▪ Level 1: >500 cfu/100mL 1 ▪ No Level [2]
Total Nitrogen (µg/L) (n=36)	▪ Level 1: >750 µg/L [1] ▪ Level 2: >2000 µ/L [2]
Total Phosphorus (µg/L) (n=36)	▪ Level 1: >50 µg/L [1] ▪ Level 2: > 100 µg/L [2]
Manganese (Soluble) (µg/L) (n=157)	▪ Level 1: 50 µg/L [1] ▪ Level 2: 200 µg/L [2]
Iron (Soluble) (µg/L) (n=36)	▪ Level 1: 100 µg/L [1] ▪ Level 2: 250 µg/L [2]
Turbidity (NTU) (n=157)	▪ Level 1: 10 NTU [1] ▪ No Level 2 [2]
Colour (HU) (n=157)	▪ Level 1: 50 Hazen units [1] ▪ No Level 2 [2]
Conductivity (µS/cm)	▪ Level 1: 250 uS/cm [1]

Water Quality Parameter	Hazard and critical control point (HACCP) rating (refer to notes 1, 2 for explanation of HACCP levels)
	■ Level 2: >50% change from long term median (no treatment options to remove salt) 2
Dissolved Oxygen (mg/L) (n=157)	■ Level 1: <4 mg/L at surface [1] ■ No Level 2 [2]
Hydrocarbons	■ No Level 1 [1] ■ Level 2: Notification of spills or illegal dumping [2]

Notes:
1. "Level 1" means Level 1 Hazard and Critical Control Point (HACCP) response rating, namely – treatment plant process change required to ensure water quality and quantity to customers is not compromised.
2. "Level 2" means Level 2 Hazard and Critical Control Point (HACCP) response rating, namely – Treatment plant process change required but water quality and quantity to customers may still be compromised.
Data period: 2003-2006, n = number of samples.

Lowland Streams

The performance criteria to be used at each of the designated sample locations within the lowland streams will be based on the values highlighted in the Nerang River Catchment Objectives column (see **Table 4**), except when these values have been replaced by site specific trigger values (i.e. sample location N4 for nutrients and DO at the majority of other locations). If samples need to be taken further upstream or downstream of these locations, then the trigger value pertaining to the closest possible site should be used.

■ Table 4 Lowland Streams Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (North of wall)	N8	N7	N6	N5	N4	N3
Turbidity (NTU)`	<6 NTU	-	-	-	-	-	-	-	-	-
Chlorophyll *a* (µg/L)	<4 µg/L	-	-	-	-	-	-	-	-	-
Total Nitrogen (µg/L)	<400 µg/L	-	-	-	-	-	-	-	**1300**	-
Oxides of Nitrogen (µg/L)	<80 µg/L	-	-	-	-	-	-	-	**1000**	-
Ammonia N (µg/L)	<20 µg/L	-	-	-	-	-	-	-	**46**	-
Organic N (µg/L)	<320 µg/L	-	-	-	-	-	-	-	-	-
Total Phosphorus (µg/L)	<50 µg/L	-	-	-	-	-	-	-	**114**	-
Filterable Reactive Phosphorus (FRP) (µg/L)	<20 µg/L	-	-	-	-	-	-	-	-	-
Dissolved Oxygen (% saturation)	20th – 80th percentile; 85-110%	**83 (20th)**	**70 (20th)**	**49 (20th)**	-	-	**83 (20th)**	-	**74 (20th)**	**74 (20th)**
pH	6.5-8.0	-	-	-	-	-	-	-	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 2005 – February 2007. Number of GCCC samples = 24.

For targeted sampling of micro-organisms in Lowland Streams for protection of human health, refer to the water quality criteria in **Table 5**.

Table 5 Human Health Criteria

EVs	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (north of wall)
Suitability for primary contact recreation	Median faecal coliforms <150 organisms per 100mL	80	100	20
	Secchi depth >1.2(m)	0.3	**0.3 (20th)**	**0.3 (20th)**
Suitability for secondary contact recreation	Objectives as per AWQG, including median faecal coliforms<1000	80	100	20

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 2003 – February 2007. Number of GCCC samples = 61

Upper Estuary

The performance criteria to be used at each of the designated sample locations within the upper estuary will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, as highlighted by the shaded cells for total nitrogen, organic nitrogen, total phosphorus and DO concentrations and secchi depth measurements (see **Table 6**).

Table 6 Upper Estuary Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	EPA Site 1908	EPA Site 1909	EPA Site 1910	GCCC Site 0A
Turbidity (NTU)	<25 NTU	-	-	-	-
Chlorophyll *a* (µg/L)	<8 µg/L	-	-	-	-
Total Nitrogen (µg/L)	<450 µg/L	-	-	-	**700**
Oxides of Nitrogen (µg/L)	<15 µg/L	-	-	-	-
Ammonia N (µg/L)	<30 µg/L	-	-	-	-
Organic N (µg/L)	<400 µg/L	-	-	**568**	-
Total Phosphorus (µg/L)	<30 µg/L	**66.8**	**70**	**91**	**92**
Filterable Reactive Phosphorus (FRP) (µg/L)	<10 µg/L	-	-	-	-
Dissolved Oxygen (% saturation)	20th – 80th percentile; 80-100%	**79 (20th)**	**78 (20th)**	**74 (20th)**	**73 (20th)**
pH	7.0-8.4	-	-	-	-
Secchi depth (m)	20th percentile >0.5m	-	-	-	**0.3 (20th)**

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 1995 – February 2007 (GCCC data) and October 2002 – February 2007 (EPA data). Number of EPA samples = 53; number of GCCC samples = 128.

For targeted sampling of micro-organisms in the Estuary for protection of human health, refer to the water quality criteria in **Table 7**.

▪ Table 7 Human Health Criteria

EVs	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (north of wall)	Site 0A	Site 1A	Site 1B
EVs Suitability for primary contact recreation	Nerang River Catchment Objectives	Pony Club	Latimers Crossing	Hinze Dam (north of wall)	Site 0A	Site 1A	Site 1B
	Median faecal coliforms <150 organisms per 100mL	80	100	20	160	20	40
Suitability for secondary contact recreation	Secchi depth >1.2(m)	0.3	**0.3 (20^{th})**	**0.3 (20^{th})**	**0.3 (20^{th})**	**0.7 (20^{th})**	**0.6 (20^{th})**

Table Notes: Data Period: January 2003 – February 2007. Median values calculated from surface water data (0.2m). Number of GCCC samples = 61

Mid Estuary

The performance criteria to be used at each of the designated sample locations within the mid estuary will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, at EPA sample sites 1903 – 1907 (see **Table 8**) and GCCC sample sites 1A and 2A (**Table 9**).

▪ Table 8 Mid Estuary Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Site 1901	Site 1912	Site 1916	Site 1903	Site 1904	Site 1905	Site 1906	Site 1907
Turbidity (NTU)	<5 NTU	-	-	-	-	-	-	**8.6**	**10.2**
Chlorophyll *a* (µg/L)	<4 µg/L	-	-	-	-	-	-	-	-
Total Nitrogen (µg/L)	<300 µg/L	-	-	-	-	-	-	-	**496**
Oxides of Nitrogen (µg/L)	<10 µg/L				**32**	**32**	**35**	**32**	**45**
Ammonia N (µg/L)	<15 µg/L					**27**	**36**	**40**	**32**
Organic N (µg/L)	<250 µg/L	-	-	-	-	-	-	**360**	**402**
Total Phosphorus (µg/L)	<30 µg/L	-	-	-	-	-	-	-	**45**
Filterable Reactive Phosphorus (FRP) (µg/L)	<10 µg/L	-	-	-	-	-	-	-	-
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 80-100%	-	-	-	-	-	-	-	-
pH	7.0-8.4	-	-	-	-	-	-	-	-
Secchi depth (m)	20^{th} percentile >1.0m	-	-	-	-	-	**1.0 (20^{th})**	**1.0 (20^{th})**	**0.8 (20^{th})**

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between October 2002 – February 2007. Number of EPA samples = 53.

▪ Table 9 Mid Estuary Water Quality Criteria Cont.

Water Quality Parameter	Nerang River Catchment Objectives	Gardiniers Creek Site 1	Site 6	Site 3	Site 2A	Site 1A
Turbidity (NTU)	<5 NTU	-	-	-	-	-
Chlorophyll *a* (µg/L)	n/a	-	-	-	-	-
Total Nitrogen (µg/L)	<300 µg/L	-	-	-	-	**500**
Oxides of Nitrogen (µg/L)	n/a	-	-	-	-	-
Ammonia N (µg/L)	n/a	-	-	-	-	-
Organic N (µg/L)	n/a	-	-	-	-	-
Total Phosphorus (µg/L)	<30 µg/L	-	-	-	-	**60**
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 80-100%	-	-	-	-	**73 (20^{th})**
pH	7.0-8.4	-	-	-	-	-
Secchi depth (m)	20^{th} percentile >1.0m	-	-	-	**1.0 (20^{th})**	**0.7 (20^{th})**

Table Notes: Data Period: January 1995 – February 2007. Median values calculated from surface water data (0.2m). Number of GCCC samples = 128.

Tidal Canals

The performance criteria to be used at each of the designated sample locations within the tidal canals will be based on the values highlighted in the Nerang River Catchment Objectives column, except when these values have been replaced by site specific trigger values, which include nutrient concentrations reported at Site 1B and Gardiners Site 2 and DO values reported at all three sites (see **Table 10**).

▪ Table 10 Tidal Canal Water Quality Criteria

Water Quality Parameter	Nerang River Catchment Objectives	Site 1B	Site 4	Gardiners Creek Site 2
Turbidity (NTU)	<8 NTU	-	-	-
Chlorophyll *a* (µg/L)	<4 µg/L	-	-	-
Total Nitrogen (µg/L)	<300 µg/L	**560**	-	-
Oxides of Nitrogen (µg/L)	<10 µg/L	-	-	-
Ammonia N (µg/L)	<10 µg/L	-	-	-
Organic N (µg/L)	<280 µg/L	-	-	-
Total Phosphorus (µg/L)	<25 µg/L	**39**	-	**60**
Filterable Reactive Phosphorus (FRP) (µg/L)	<6 µg/L	-	-	-
Dissolved Oxygen (% saturation)	20^{th} – 80^{th} percentile; 85-100%	**80 (20^{th})**	**84 (20^{th})**	**81 (20^{th})**
pH	7.0-8.4	-	-	-
Secchi depth (m)	20^{th} percentile >1.0m	-	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between January 1995 – February 2007. Number of GCCC samples = 128.

Lower Estuary

The performance criteria to be used at each of the designated sample locations within the lower estuary will be based on the values highlighted in the Nerang River Catchment Objectives column, except in one instance, where the default trigger value for DO at Site 119 shall be used (see **Table 11**). The median reported at Site 119 indicated that DO was above the 20th – 80th percentile range and was highly saturated at this site.

- **Table 11 Lower Estuary Water Quality Criteria**

Water Quality Parameter	Nerang River Catchment Objectives	Site 117	Site 118	Site 119
Turbidity (NTU)	<8 NTU	-	-	-
Chlorophyll *a* (µg/L)	<2.75 µg/L	-	-	-
Total Nitrogen (µg/L)	<170 µg/L	-	-	-
Oxides of Nitrogen (µg/L)	<4 µg/L	-	-	-
Ammonia N (µg/L)	<11 µg/L	-	-	-
Organic N (µg/L)	<170 µg/L	-	-	-
Total Phosphorus (µg/L)	<25 µg/L	-	-	-
Filterable Reactive Phosphorus (FRP) (µg/L)	<6 µg/L	-	-	-
Dissolved Oxygen (% saturation)	20th – 80th percentile; 90-105%	-	-	**97 (20th)**
pH	8.2-8.4	-	-	-
Secchi depth (m)	20th percentile >1.6m	-	-	-

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between October 2002 – February 2007. Number of EPA samples = 54.

Open Coastal

The performance criteria to be used at each of the designated sample locations along the open coastline will be based on the values highlighted in the Nerang River Catchment Objectives column (see **Table 12**).

- **Table 12 Open Coastal Waters Criteria**

Water Quality Parameter	Nerang River Catchment Objectives
Turbidity (NTU)	<1
Chlorophyll *a* (µg/L)	<1 µg/L
Total Nitrogen (µg/L)	<150 µg/L
Oxides of Nitrogen (µg/L)	<3 µg/L
Ammonia N (µg/L)	<5 µg/L
Organic N (µg/L)	<140 µg/L
Total Phosphorus (µg/L)	<16 µg/L
Filterable Reactive Phosphorus (FRP) (µg/L)	<5 µg/L
Dissolved Oxygen (% saturation)	20th – 80th percentile; 95-105%
pH	8.2-8.4
Secchi depth (m)	20th percentile >5.0m

Table Notes: Site specific trigger values were derived from median values calculated from surface water data (at 0.2m depth) collected between February 2000 – February 2007. Number of EPA samples = 75.

Mitigation Measures

This proposed monitoring program is in addition to the existing monitoring programs currently being undertaken by the EPA, GCCC and GCW. The mitigation measures addressed in this program include undertaking monitoring and reporting of elevated physico-chemical parameters and/ or nutrient and metal concentrations.

When and if an individual parameter exceeds the performance criteria, it will be examined to establish cause-and-effect relationships where possible. This approach will be undertaken to inform the implementation of enhanced mitigation measures, such as additional source control measures, cessation of construction activities, cessation of downstream discharges or advice to water treatment plant operators. Details of the suite of mitigation measures will be outlined in a Water Quality Response Plan.

G:\Spatial\Arc_MXD\EIS\Water_Quality\Fig_1_070529.mxd Produced: 29/05/2007

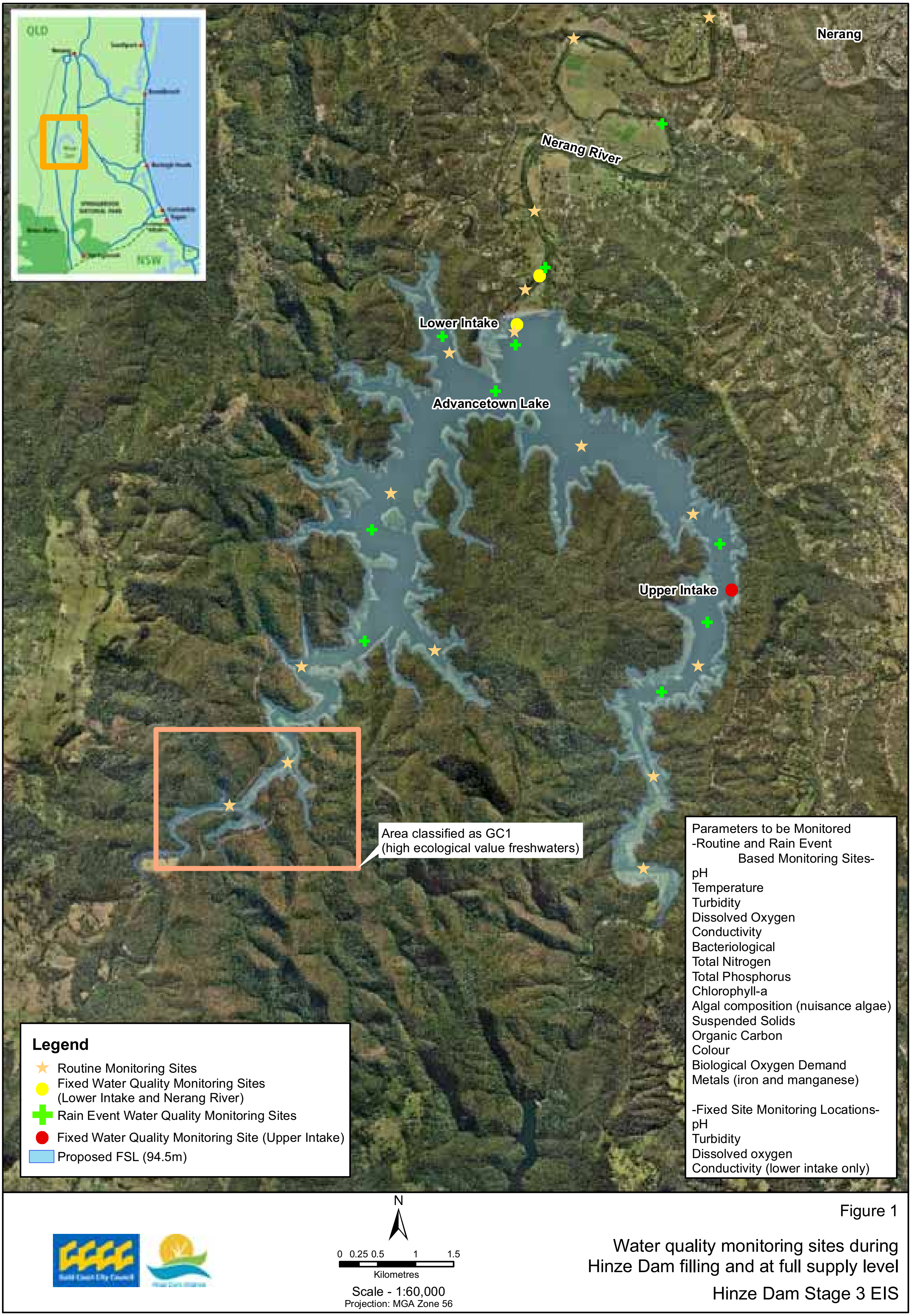


Figure 1

Water quality monitoring sites during
Hinze Dam filling and at full supply level

Hinze Dam Stage 3 EIS

Monitoring Methods

Water quality sampling will be conducted in real time and on a routine basis during operational activities. Physico-chemical analyses will be performed in-situ using hand-held meters and fixed water quality meters and water samples will be collected for analysis using a grab sampler. Targeted sampling is also recommended after any rain events. A project environmental health and safety plan shall be prepared for the proposed field work undertaken on and adjacent to water.

Sample collection will be in accordance with the Queensland Environmental Protection Agency Water Quality Sampling Manual (1999) and ANZECC/ ARMCANZ (2000) Water Quality and Monitoring Guidelines and will be carried out by suitably experienced environmental scientists/ ecologist. Results will be assessed against the Nerang River Water Quality Objectives (EPA 2006) and ANZECC/ARMCANZ (2000) guidelines, where applicable (i.e. Fe).

Routine Water Quality Monitoring

A number of water quality programs are currently being undertaken within the Nerang Catchment including the EPA (Ecosystem Health Monitoring Program), Gold Coast City Council, Gold Coast Water and community group water quality monitoring programs.

The EPA EHMP is a regional program involving the EPA, Department of Natural Resources and Water (DNR&W), local councils and universities. This program monitors marine, estuarine and freshwaters reaches of the Nerang River on a monthly basis (see **Figure**). Gold Coast City Council currently monitors water quality monthly in the Nerang Catchment at 13 sites in the marine and freshwater sections of the Nerang River and at 15 sites in the upper catchment (seven sites in the Springbrook area and eight sites in the Numinbah area) (see **Figure**). Gold Coast Water currently undertakes weekly monitoring at two locations in Hinze Dam at the upper and lower intakes (see **Figure**).

The results of these three programs should be used to document on-going water quality conditions in the Nerang Catchment, including Hinze Dam. In addition, some routine water quality monitoring (weekly) should be conducted by the on-site GCW personnel during operation, to complement the existing programs.

It will take approximately two years for the new full supply level in the Hinze Dam to be reached. Over this time, the vegetation around the Hinze Dam (that which has not been cleared and that which has been introduced following clearing) will become inundated and therefore, there is the potential for water quality conditions to be compromised around the Dam. GCW only undertake water quality monitoring at the upper and lower intakes and so, any water quality issues that may arise in other areas of the Dam are currently not considered. Additional sampling is therefore recommended within the Hinze Dam, on a weekly basis to ensure that any localised exceedences which may occur around the Dam are monitored.

Additional parameters to be tested, which are not currently examined include chlorophyll-a, algal composition, bacteria, suspended solids, organic carbon, colour, BOD and metals (iron and manganese). Chlorophyll-a monitoring should be undertaken in spring, summer and early autumn and when cell counts are reported above the Nerang River Catchment Objective, targeted testing for blue-green (nuisance) algae should be conducted. Bacterial testing is recommended because it is currently not undertaken within the Dam and should be to manage the drinking water supply.

Monitoring should also target rain events, to determine the extent of stormwater runoff, resulting in elevated turbidity and suspended solid concentrations. However, GCW may wish to take water samples from other areas which are more susceptible to sediment runoff. On occasions where sampling is undertaken after rain events, additional routine sampling is not considered necessary.

During monitoring, if the results of water quality testing indicate exceedance of the site specific trigger values (as highlighted in the **Performance Criteria** section, then sampling will need to continue daily for 7 days. This routine monitoring will assist to identify the temporal and spatial extent of the impact. The 50th percentiles (medians) generated are to be compared to the trigger values highlighted in the tables in **Performance Criteria** section. The response plan should include implementing mitigation procedures to ensure impacts on potable water and water quality downstream of the Dam do not occur.

G:\Spatial\Arc_MXD\EIS\Water_Quality\Fig_2_070411.mxd Produced: 11/4/2007

N

0 1 2 4

Kilometres

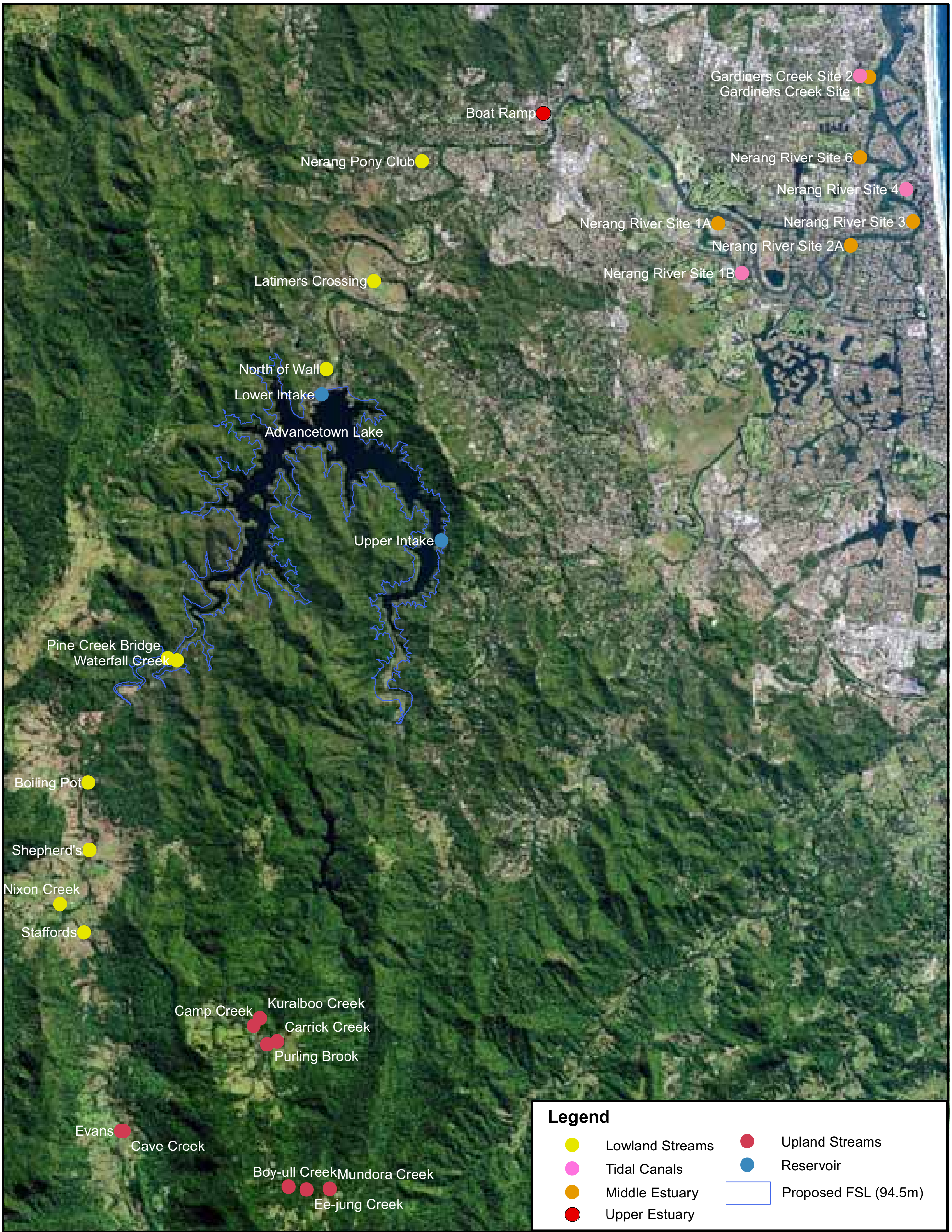
Scale - 1:75,000

Projection: MGA Zone 56

Figure 2

EPA Water Quality Monitoring Sites

Hinze Dam Stage 3 EIS



N

0 1.5 3 6

Kilometers

Scale - 1:120,000

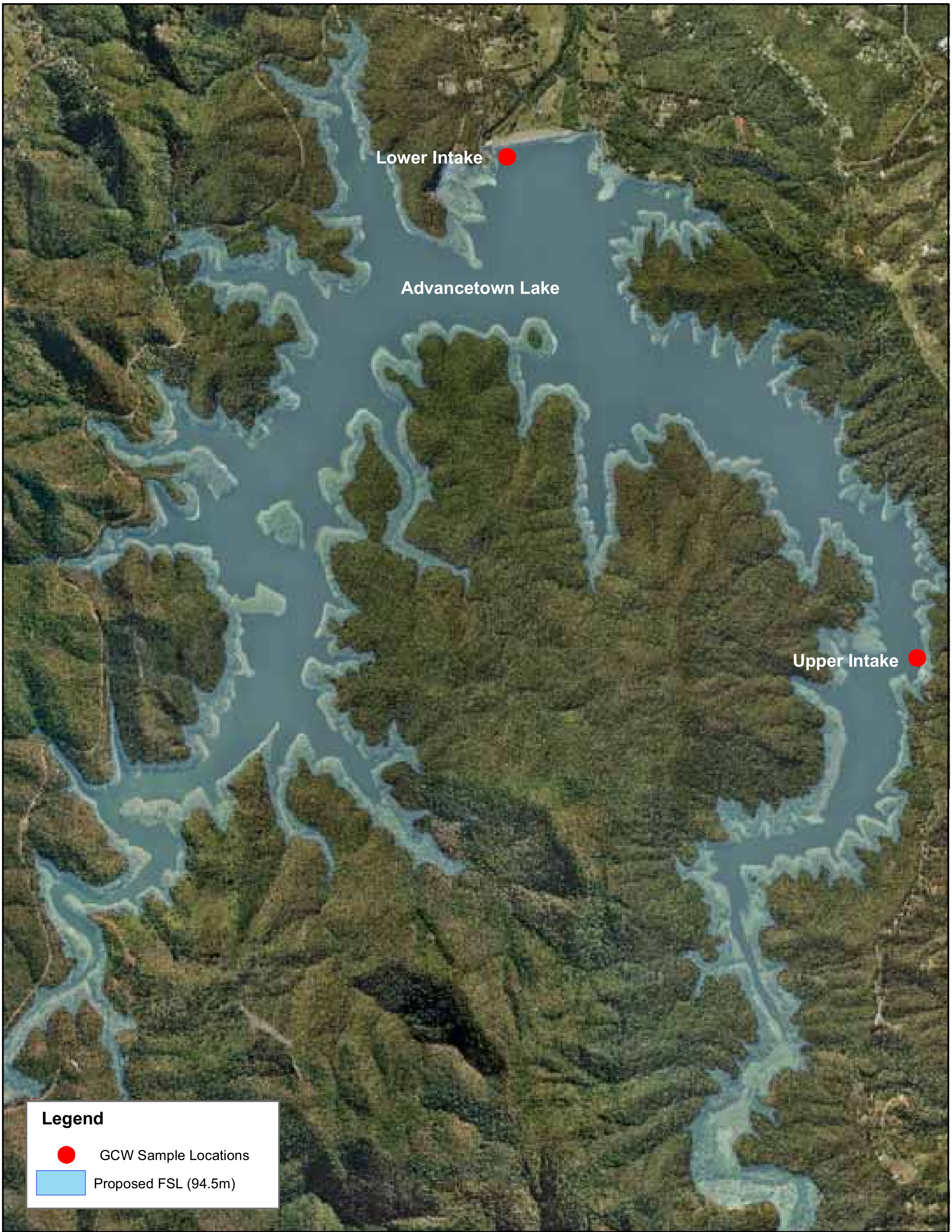
Projection: MGA Zone 56

Figure 3

GCCC Water Quality Monitoring Sites

Hinze Dam Stage 3 EIS

G:\Spatial\Arc_MXD\EIS\Water_Quality\Fig_3_070516.mxd Produced: 16/05/2007



N
0 0.25 0.5 1
Kilometres
Scale - 1:35,000
Projection: MGA Zone 56

Figure 4

GCW Water Quality Monitoring Sites within Hinze Dam

Hinze Dam Stage 3 EIS

Fixed Site Monitoring

Fixed site loggers will be installed during construction and should be kept in place during operation (for at least the first 2 years) at the lower intake and downstream of the Dam wall, to prevent any impacts to water discharged into the Nerang River and at the upper intake, to ensure that water sourced by the Molendinar Water Treatment Plant is of a satisfactory quality. If water quality conditions are compromised, the on site GCW personnel will need to immediately implement mitigation procedures to ensure impacts on potable water and water quality downstream of the Dam do not occur.

Quality Assurance

Water samples transported in eskies, containing ice bricks will be submitted to the analysing laboratory immediately following sample collection. Bacterial analyses need to be submitted within 24 hours. A field duplicate sample will be taken by the sampler collecting a replicate sample at one location during each weekly sampling event. All water samples submitted to the analysing laboratory will be accompanied by Chain of Custody (CoC) documentation, clearly stating the required analysis method and required limits of reporting (see **Table 13**). A laboratory which is NATA accredited for the proposed analysis will be used to analyse water samples.

- **Table 13 Parameters and Limits of Reporting**

Water Quality Parameter	LORs
Turbidity (NTU)	0.1 NTU
Chlorophyll *a* (µg/L)	0.1 µg/L
Total Nitrogen (µg/L)	50 µg/L
Kjeldahl Nitrogen (µg/L)	200 µg/L
Ammonia N (µg/L)	3 µg/L
Nitrate and Nitrite (µg/L)	2 µg/L
Total Phosphorus (µg/L)	5 µg/L
Filterable Reactive Phosphorus (FRP) (µg/L)	2 µg/L
Dissolved Oxygen (% saturation)	0.1 mg/L or 0.1%
Secchi depth (m)	0.1 m
pH	0.1 units
[2]Iron-total(µg/L)	10 µg/L
[3]Manganese (µg/L)	0.2 µg/L
E coli (cfu)	<1/100 mL
Total Coliforms	<1/100 mL
Organic Carbon	1 mg/L
Colour	1 Hazen unit
Suspended Solids	1 mg/L
Blue Green Algae	1 cell/ mL
Total Algal Count	1 cell/ mL
Toxic Algae	1 cell/ mL

Reporting

Quarterly water quality reports should be prepared which report on water quality conditions within the Hinze Dam catchment, including data collected as part of the existing EPA, GCCC and GCW programs (see **Figure 2** and **Figure 3**). Quarterly reports will include any actions/ measures which need to be implemented where non-compliances have been reported and the person/ organisation responsible for implementing the action highlighted.

During and after rainfall, a visual inspection of the construction site will be undertaken to ensure that mitigation measures are in place and no major erosion is occurring. Additional monitoring and reporting will be required to determine the extent of stormwater runoff after pulse events.

EMP auditing is recommended 6 – 12 monthly, including assessing compliance with the mitigation measures highlighted in the EMP and checking the procedures documented in the water quality monitoring program have been followed.

Roles & Responsibilities

On-site GCW personnel will be required to undertake the routine water quality monitoring and reporting. Reports shall be peer reviewed prior to issue to the EPA. Separate Alliance personnel (suitably trained environmental scientists) shall independently audit the program on a 6 – 12 monthly basis.

Corrective Action / Contingency Plan

Any elevated physico-chemical parameters, or nutrient or metal concentrations, observed within the upper catchment, Hinze Dam or in the Nerang River, will be identified and the appropriate action taken by the GMW Environmental Manager. Any impacts to downstream water quality shall be reported to the EPA and any impacts to the potable water supply detected at the upper intake, reported to the Molendinar Water Treatment Plant.

F.19.2 Emergency Procedure Checklist

1. Reassure Caller. Speak slowly and clearly.	Time:	Date:
2. (a) Caller's Name:	**Caller's #:**	

(b) Location:

(c) Type of Incident:	**(d) Number Injured:**

(e) Type of Injuries:	Laceration	Burn	Bite/Sting	Poisoning
	Fracture	Spinal	Fit	Heart Attack
	Other			

(f) Is patient/s conscious: YES / NO	**(g) Is First Aid Attendant required?** YES / NO If YES, number? _______
(h) Is an emergency vehicle required?	YES / NO If YES - what type? ☐ Ambulance - 2WD ☐ Helicopter ☐ Fire Brigade ☐ Water Truck ☐ Specialist Rescue Service _______________ ☐ Other Vehicle (nominate)

(i) Is a Doctor required?

3. Repeat the details back to the caller. State where you are calling from and advise that you will control the emergency. Advise the caller that they are to act as the coordinator for the incident site until relieved.

4. Call required emergency services if required. Notify Police if there is a fatality.

5. Contact HSE Manager, advise of situation regarding emergency assistance and ask for any additional information.

(a) Will someone meet the emergency vehicle? YES / NO	WHO?

(b) Are other services required?	Electrician	Police	Fire
	QR	Others	Council

(c) Medical	Any information the ambulance might need?

(d) First Aid	Has first aid arrived?
(e) On Site	Do you require any other assistance?
7. Once completed, stay on standby in case further communications are needed.	
8. Emergency Numbers: **AMBULANCE: 000 POLICE: 000 or 5578 1311 FIRE: 000** **For additional services numbers refer Attachment B - Emergency Contact No.s**	

F.19.3 Emerency Contact Numbers

To call the emergency services:

Site Contacts	
Rob Campbell (URS Geotech Engineer)	0439 412244
Laurie Fairall (Senior Ranger)	0417 794380
Duty Ranger Office	5581 7645

1. Dial the number
2. Tell the Emergency Services:

- Your name
- Your telephone number
- Where you are calling from
- What has happened
- What help you need

3. Stay calm and obey all directions given by the Emergency Services

	Emergency	**Local contact**
AMBULANCE	000	
FIRE BRIGADE	000	
POLICE (Nerang)	000	5578 1311

SERVICE	**LOCATION**	**NUMBER**
HOSPITAL	Gold Coast Hospital 108 Nerang St Southport	5571 8211
POISONS INFORMATION CENTRE	Brisbane	13 11 26
GOLD COAST CITY COUNCIL	Contact: Darren Stewart	5581 7763
GOLD COAST WATER	Contact: Amit Kelovkar	5582 8003
GOLD COAST WATER CATCHMENT AUTHORITY	Contact: Tim Packer	0414 180846
ENVIRONMENTAL PROTECTION AGENCY		Hotline: 1300 130 372
QLD Division of WH&S	Level 1, 10 Cloyne Rd, Southport	5583 5060

F.19.4 Site Plan

● Assembly Points and location of emergency resource equipment and facilities (e.g. first aid posts, spill kits)