Water Quality Pollutant Types and Sources Report: Black Ross Water Quality Improvement Plan

Appendices

September 2009

Appendix A

NPI Extracts

Appendix A - NPI Extracts

General information

Emissions are for all destinations i.e. air, land and water. All emissions have been rounded to two significant figures. Note that totals may differ from the sum of the individual amounts because of this rounding. Substance emissions are ranked on a scale of 1-100: 1=lowest; 100=highest. Rankings are shown as: =0-25; =26-50; =51-75; =76-100. Actual rankings are shown in brackets [ ].

The NPI reports on emissions of chemical substances and where and from what sources they are generated. The ultimate fate of these substances and therefore exposure to humans and the environment as pollution cannot be determined from the NPI. Numerous factors such as height of emission (high stacks versus ground level vehicle exhausts), nature of receiving environment, chemical reactivity of the substance and prevailing meteorological conditions determine whether an emission is felt as ground level pollution. Since NPI does not attempt to collect these parameters, the data can only reflect pollutant generation at source.

Facility Ranking: Individual substance emissions from each facility are compared against the maximum emission of that substance from all of the facilities reported on the NPI, on a scale of 1-100 (from lowest to highest) - if the total emission of a substance is 10% of the maximum reported to the NPI, the emission ranking would be **10**; if the total emission is 95% of the maximum, the ranking would be **95**. A score of 100 means that the facility is the highest facility emitter of that substance - in some cases many facilities may score 100, due to rounding. Top substances are those substance emissions that are ranked highest for any individual facility.

For example, a small rural sewage treatment plant may report a very small Total Nitrogen emission in comparison with a large metropolitan facility. If the rural facility reported an emission that is 7% of the maximum Total Nitrogen emission in Australia it would attract a ranking of 7. This ranking tells you that there are many other facilities that have much larger emissions of Total nitrogen. On the other hand a metropolitan sewage treatment plant may have a very large Total Nitrogen emission and therefore attracts a ranking of 100 for this substance. This only means that this particular facility has approximately the largest individual emission of that substance in Australia.

List of facilities, emission pathway/s and NPI report years

Facility	Condon Sewage Treatment Plant p.6
Address	Lot 52 Bowhunters Road Condon Qld 4815
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Emissions to	Water and Land
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Deeragun Sewage Treatment Plant p.7
Address	Kayleen Court Deeragun Qld 4818
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Emissions to	Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Mt Low Sewage Treatment Plant p.8
Address	Brabon Road Mt Low Qld 4818
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Emissions to	Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Cleveland Bay Sewage Treatment Plant p.9
Address	Cleveland Bay Townsville Qld 4810
Main activities	Treatment of wastewater as part of wastewater service provided to TCC declared sewage treatment areas.
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2003/2004 and 2001/2002

Facility	Mt St John Sewage Treatment Plant p.10
Address	Mt St John Road Townsville Qld 4818
Main activities	Treatment of wastewater as part of wastewater service provided to TCC declared sewage treatment areas.
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2003/2004 and 2001/2002

Facility	Douglas Water Treatment Plant p.11
Address	Upper Ross River Road Douglas Qld 4814
Main activities	Treatment of water for municipal purposes.
Emissions to	Air
NPI Report Years	2005/2006

Facility	Townsville Power Station pp.12-13
Address	Lot 1 Greenvale Street Yabulu QLD 4818
Main activities	Power generation
Emissions to	Air
NPI Report Years	2005/2006, 2003/2004 and 2001/2002

Facility	Townsville Terminal (Shell Co of Aust Ltd) pp.14-15
Address	Hubert Street Townsville Qld 4810
Main activities	Hydrocarbon storage and distribution Bitumen Blowing
Emissions to	Air
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Townsville Airport Fuelling Service (Shell) p.16
Address	Stinson Avenue Garbutt Qld 4814
Main activities	Aircraft refuelling
Emissions to	Air
NPI Report Years	2005/2006

Facility	Sun Metals Zinc Refinery pp.17-18
Address	1 Zinc Avenue Stuart QLD 4811
Main activities	Zinc refinery processing up to 400,000 tonnes per annum of zinc concentrates to produce 190,000 tonnes zinc metal and 350,000 tonnes sulphuric acid.
Emissions to	Air and Land
NPI Report Years	2005/2006, 2003/2004 and 2001/2002

Facility	Southern Cross Fertilisers - Townsville Port Facility p.19
Address	Centenary Drive Port of Townsville Qld 4810
Main activities	Fertiliser and sulphur storage
Emissions to	Air
NPI Report Years	2005/2006

Facility	Queensland Terminals p.20
Address	Benwell Road South Townsville Qld 4810
Main activities	Sulphuric Acid Storage and Transfers
Emissions to	Air
NPI Report Years	2005/2006

Facility	Stuart Railway Facility p.21
Address	Jurekey Street Stuart Qld 4811
Main activities	Railway rollingstock maintenance, servicing and fuelling
Emissions to	Air
NPI Report Years	2005/2006

Facility	QNI Yabulu Refinery - Materials Handing Facility p.22
Address	Berth 2 Port of Townsville Qld 4810
Main activities	Unloading of nickel ore from vessels to train carriages for transport to the QNI Yabulu Refinery
Emissions to	Air and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	QNI Townsville Port Bulk Fuel Facility p.23
Address	Herbert Street South Townsville Qld 4810
Main activities	Storage & handling of bulk petroleum fuel
Emissions to	Air
NPI Report Years	2005/2006

Facility	QNI - Yabulu Refinery pp. 24-26
Address	1 Greenvale Street Yabulu QLD 4818
Main activities	Processing of ore through roasting, ammonia leach and solvent extraction processes to produce high grade nickel and cobalt products.
Emissions to	Air and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Northern shipping and Stevedoring - Townsville Port p.27
Address	Suter Pier Wharf Townsville 4810
Main activities	Stevedoring, i.e. unloading or loading ships. Products are handled in containers, bulk bags and in bulk form. Equipment used in the operation includes shore cranes, ships cranes, forklifts, excavators, skid steer loaders, end loaders and hoppers
Emissions to	Air
NPI Report Years	2005/2006

Facility	Hanson Townsville Quarry p.28
Address	Flinders Highway Townsville 4810
Main activities	Quarrying
Emissions to	Air
NPI Report Years	2005/2006

Facility	Bohle Quarry p.29
Address	Ingham Road Bohle 4818
Main activities	Quarry materials sand and gravel producers
Emissions to	Air
NPI Report Years	2005/2006

Facility	Xstrata Copper - Townsville Port Operations pp.30-31
Address	Berth 7 Lennon Drive Townsville 4810
Main activities	Stockpilig and shiploading of mineral concentrates
Emissions to	Air and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Xstrata Copper - Townsville Operations pp.32-34
Address	Hunter Street Stuart 4811
Main activities	Electro-refining of copper
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	BP Australia - Townsville Terminal pp.35-36
Address	Hubert Street South Townsville Qld 4810
Main activities	Bulk Petroleum Storage Facility
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Air BP Townsville p.37
Address	Airside GA Area Townsville Airport 4810
Main activities	Bulk petroleum storage facility
Emissions to	Air
NPI Report Years	2005/2006

Facility	BOC Townsville p.38
Address	384 Ingham Road Garbutt 4814
Main activities	Stores gas, fills cylinders and distributes product.
Emissions to	Air
NPI Report Years	2005/2006

Facility	Cannington Port Facility pp. 39-40
Address	Townsville Port Townsville 4810
Main activities	Storage and Loading of Lead and Zinc Concentrates
Emissions to	Air and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Townsville Abattoir pp. 41-44
Address	Bruce Highway Aitkenvale via Townsville 4814
Main activities	Meat Processing
Emissions to	Air
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Facility	Industrial Galvanizers North Queensland p.45
Address	9 Commercial Avenue Bohle 4818
Main activities	Hot Dip Galvanizing
Emissions to	Air
NPI Report Years	2005/2006

Facility	Origin Energy Mt Stuart p.46
Address	Cnr Hunter Street and Bruce Highway Stuart 4811
Main activities	Peak Power Generation from Fossil Fuels
Emissions to	Air
NPI Report Years	2005/2006

Townsville NPI Point Source Emissions – Summary by facility

Facility Details

Facility	Condon Sewage Treatment Plant
Address	Lot 52 Bowhunters Road Condon Qld 4815
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Primary ANZSIC Industry Class	Sewerage and Drainage Services
ANZSIC Industry Group	Water Supply, Sewerage and Drainage Services
Cleaner production activities	A4. Modified process, equipment, layout, or piping

Emissions (2005/06)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Chlorine	1,400	5.9	0.4	940	67	410	29	Low -2
Total Nitrogen	4,900			3400	69	1500	31	Low –1
Total Phosphorus	9,600			6600	69	3000	31	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=5082

Emissions (2002/03)

		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	28,000	20,000	71.4	6,200	22.1	Low - 1
Chlorine	1,200	860	71.7	360	30	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2003; jur_fac_id=5082#Emissions

Emissions (1999/2000)

		Water		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Total Nitrogen	3,400	3,400	100	Low –1
Total Phosphorus	2,700	2,700	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2000;jur_fac_id=5082#Emissions

Facility Details

Facility	Deeragun Sewage Treatment Plant
Address	Kayleen Court Deeragun Qld 4818
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Primary ANZSIC Industry Class	Sewerage and Drainage Services
ANZSIC Industry Group	Water Supply, Sewerage and Drainage Services
Cleaner production activities	None reported

Emissions (2005/06)

		Land		Water		
Substance	**Total (kg)**	**Kg**	**%**	**kg**	**%**	**Ranking**
Chlorine	300	7	2.3	300	100	Low -1
Total Nitrogen	4,300	160	3.7	4,100	95.3	Low –1
Total Phosphorus	2,000	43	2.2	1,900	95	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=5083

Emissions (2002/03)

		Land		Water		
Substance	**Total (kg)**	**Kg**	**%**	**kg**	**%**	**Ranking**
Chlorine	210	29	13.8	190	90.5	Low -1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2003;jur_fac_id=5083#Emissions

Emissions (1999/2000)

		Land		Water		
Substance	**Total (kg)**	**Kg**	**%**	**kg**	**%**	**Ranking**
Total Nitrogen	1,700			1,700	100	Low –1
Total Phosphorus	1,400			1,400	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2000;jur_fac_id=5083#Emissions

Facility Details

Facility	Mt Low Sewage Treatment Plant
Address	Brabon Road Mt Low Qld 4818
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Primary ANZSIC Industry Class	Sewerage and Drainage Services
ANZSIC Industry Group	Water Supply, Sewerage and Drainage Services
Cleaner production activities	None reported

Emissions (2005/06)

		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Chlorine	1,100	1,000	90.9	47	4.3	Low -1
Total Nitrogen	920	420	45.6	500	54.3	Low –1
Total Phosphorus	250			250	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=5084

Emissions (2002/03)

		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Chlorine	110	110	100			Low -1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2003;jur_fac_id=5084#Emissions

Emissions (1999/2000)

		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Total Nitrogen	1,100			1,100	100	Low –1
Total Phosphorus	450			450	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2000;jur_fac_id=5084#Emissions

Facility Details

Facility	Cleveland Bay Sewage Treatment Plant
Address	Cleveland Bay Townsville Qld 4810
Main activities	Treatment of wastewater as part of wastewater service provided to TCC declared sewage treatment areas.
Primary ANZSIC Industry Class	Sewerage and Drainage Services
ANZSIC Industry Group	Water Supply, Sewerage and Drainage Services
Cleaner production activities	Modified process, equipment, layout, or piping

Emissions (2005/06)

		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	110,000	21,000	19.1	92,000	83.6	Low - 3
Hydrogen sulphide	26,000	4,800	18.5	22,000	84.6	Low – 14
Total Nitrogen	140,000			140,000	100	Low – 3
Total Phosphorus	42,000			42,000	100	Low - 4

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=33011

Emissions (2003/04)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	80,000			24,000	30	56,000	70	Low – 2
Hydrogen sulphide	21,000	21,000	100					Low – 10
Total Nitrogen	84,000					84,000	100	Low – 2
Total Phosphorus	29,000					29,000	100	Low - 3

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2004;jur_fac_id=33011

Emissions (2001/02)

		Water		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Ammonia (total)	89,000	89,000	100	Low – 2
Boron and compounds	2,100	2,100	100	Low – 2
Chlorophenols (di, tri, tetra)	5,200	5,200	100	Low – 18
Hydrogen sulfide	26,000	26,000	100	Low - 2
Manganese and compounds	1,300	1,300	100	Low – 1
Total nitrogen	150,000	150,000	100	Low – 3
Total phosphorous	43,000	43,000	100	Low – 4
Total volatile organic compounds	14,000	14,000	100	Low - 1
Zinc and compounds	2,000	2,000	100	Low - 1

Facility Details

Facility	Mt St John Sewage Treatment Plant
Address	Mt St John Road Townsville Qld 4818
Main activities	Treatment of wastewater as part of wastewater service provided to TCC declared sewage treatment areas.
Primary ANZSIC Industry Class	Sewerage and Drainage Services
ANZSIC Industry Group	Water Supply, Sewerage and Drainage Services
Cleaner production activities	Modified process, equipment, layout, or piping

Emissions (2005/06)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	54,000	0.1	<0.1	5,900	10.9	48,000	88.9	Low - 2
Hydrogen sulphide	13,000			1,400	10.8	11,000	84.6	Low – 7
Total Nitrogen	130,000					130,000	100	Low – 3
Total Phosphorus	24,000					24,000	100	Low - 2

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=32872

Emissions (2003/04)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	40,000			6,000	15	34,000	85	Low - 1
Hydrogen sulphide	23,000	12,000	52.2	1,800	7.8	9,900	43	Low – 11
Total Nitrogen	100,000					100,000	100	Low – 2
Total Phosphorus	18,000					18,000	100	Low - 2

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2004;jur_fac_id=32872

Emissions (2001/02)

		Water		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Ammonia (total)	37,000	37,000	100	Low - 1
Boron and compounds	800	800	100	Low – 1
Chlorophenols (di, tri, tetra)	2,000	2,000	100	Low – 7
Hydrogen sulfide	10,000	10,000	100	Low - 1
Manganese and compounds	500	500	100	Low – 1
Total Nitrogen	120,000	120,000	100	Low – 2
Total Phosphorous	30,000	30,000	100	Low – 3
Total Volatile Organic Compounds	5,300	5,300	100	Low - 1
Zinc and compounds	800	800	100	Low – 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2002;jur_fac_id=32872

Facility Details

Facility	Douglas Water Treatment Plant
Address	Upper Ross River Road Douglas Qld 4814
Main activities	Treatment of water for municipal purposes.
Primary ANZSIC Industry Class	Water Supply
ANZSIC Industry Group	Water Supply, Sewerage and Drainage Services
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Chlorine	31,000	31,000	100	Low - 25

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=32994

Facility Details

Facility	Townsville Power Station
Address	Lot 1 Greenvale Street Yabulu QLD 4818
Main activities	Power generation
Primary ANZSIC Industry Class	Electricity Supply
ANZSIC Industry Group	Electricity Supply
Cleaner production activities	Change to coal seam methane during NPI year
Installation of Pollution Control Equipment	E9. Low NOx burner

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Arsenic & compounds	1	1.1	100	Low - 1
Beryllium & compounds	0.065	0.065	100	Low - 1
Cadmium & compounds	5.9	5.9	100	Low - 1
Carbon monoxide	450,000	450,000	100	Low - 1
Chlorine	0.00	0.00	100	Low - 0
Chromium (III) compounds	7.2	7.2	100	Low - 1
Chromium (VI) compounds	0.38	0.38	100	Low - 1
Copper and compounds	4.6	4.6	100	Low - 1
Lead and compounds	3.1	3.1	100	Low - 1
Mercury and compounds	1.4	1.4	100	Low - 1
Nickel and compounds	11	11	100	Low - 1
Oxides of nitrogen	1,800,000	1,800,000	100	Low - 4
Particulate matter 10.0um	41,000	41,000	100	Low - 1
Polychlorinated dioxins and furans	0.00010	0.00010	100	Low - 1
Polycyclic aromatic hydrocarbons	12	12	100	Low - 1
Sulphur dioxide	3,200	3,200	100	Low - 1
Total volatile organic compounds	12,000	12,000	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=32939

Emissions (2003/04)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Antimony and compounds	0.3	0.3	100	Low – 1
Arsenic & compounds	0.1	0.1	100	Low – 1
Boron and compounds	0.9	0.9	100	Low – 1
Cadmium & compounds	0.1	0.1	100	Low - 1
Carbon monoxide	650	650	100	Low - 1
Chromium (III) compounds	0.6	0.6	100	Low – 1
Cobalt and compounds	0.1	0.1	100	Low – 1
Copper and compounds	18	18	100	Low - 1
Lead and compounds	0.8	0.8	100	Low - 1
Magnesium oxide fume	3.1	3.1	100	Low - 0
Manganese and compounds	4.7	4.7	100	Low - 1
Nickel and compounds	16	16	100	Low - 1
Oxides of nitrogen	2,600	2,600	100	Low - 1
Particulate matter 10.0um	410	410	100	Low - 1
Selenium and compounds	0.1	0.1	100	Low - 1

Sulphur dioxide	150	150	100	Low - 1
Total volatile organic compounds	230	230	100	Low – 1
Zinc and compounds	9.1	9.1	100	Low – 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2004;loc_type=state;loc_state=QLD;jur_fac_id=32939

Emissions (2001/02)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Antimony and compounds	3	3	100	Low – 1
Arsenic & compounds	0.7	0.7	100	Low – 1
Boron and compounds	8.9	8.9	100	Low – 1
Cadmium & compounds	0.6	0.6	100	Low - 1
Carbon monoxide	6,500	6,500	100	Low - 1
Chromium (III) compounds	6.4	6.4	100	Low – 1
Cobalt and compounds	1.2	1.2	100	Low – 1
Copper and compounds	180	180	100	Low – 1
Lead and compounds	7.9	7.9	100	Low - 1
Magnesium oxide fume	32	32	100	Low - 1
Manganese and compounds	48	48	100	Low – 1
Mercury and compounds	0.1	0.1	100	Low – 1
Nickel and compounds	170	170	100	Low – 1
Oxides of nitrogen	27,000	27,000	100	Low - 1
Particulate matter 10.0um	4,200	4,200	100	Low - 1
Selenium and compounds	0.7	0.7	100	Low - 1
Sulphur dioxide	1,500	1,500	100	Low - 1
Total volatile organic compounds	2,300	2,300	100	Low – 1
Zinc and compounds	92	92	100	Low – 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2002;loc_type=state;loc_state=QLD;jur_fac_id=32939

Facility Details

Facility	Townsville Terminal (Shell Co of Aust Ltd)
Address	Hubert Street Townsville Qld 4810
Main activities	Hydrocarbon storage and distribution Bitumen Blowing
Primary ANZSIC Industry Class	Petroleum Product Wholesaling
ANZSIC Industry Group	Mineral, Metal and Chemical Wholesaling
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	850	850	100	Low - 1
Carbon monoxide	890	890	100	Low - 1
Cumene (1-methylethylbenzene)	150	150	100	Low - 1
Cyclohexane	8	8	100	Low - 1
Ethylbenzene	170	170	100	Low - 1
Formaldehyde (methyl aldehyde)	8.6	8.6	100	Low - 1
n-Hexane	920	920	100	Low - 1
Oxides of nitrogen	1,800	1,800	100	Low - 1
Particulate matter 10.0um	180	180	100	Low - 1
Polycyclic aromatic hydrocarbons	0.21	0.21	100	Low - 1
Sulphur dioxide	3,300	3,300	100	Low - 1
Toluene (methylbenzene)	1,300	1,300	100	Low - 1
Total volatile organic compounds	110,000	110,000	100	Low - 1
Xylenes (individual or mixed isomers)	690	690	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=5154

Emissions (2002/03)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	840	840	100	Low - 1
Carbon monoxide	1,100	1,100	100	Low - 1
Cumene (1-methylethylbenzene)	43	43	100	Low - 1
Cyclohexane	5	5	100	Low - 1
Ethylbenzene	85	85	100	Low - 1
Formaldehyde (methyl aldehyde)	12	12	100	Low - 1
n-Hexane	1,100	1,100	100	Low - 1
Oxides of nitrogen	4,500	4,500	100	Low - 1
Particulate matter 10.0um	250	250	100	Low - 1
Polycyclic aromatic hydrocarbons	0.26	0.26	100	Low - 1
Sulphur dioxide	4,000	4,000	100	Low - 1
Toluene (methylbenzene)	1,100	1,100	100	Low - 1
Total volatile organic compounds	100,000	100,000	100	Low - 1
Xylenes (individual or mixed isomers)	390	390	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2003;loc_type=state;loc_state=QLD;jur_fac_id=5154

Emissions (1999/00)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	1,600	1,600	100	Low - 1
Carbon monoxide	720	720	100	Low - 1
Cumene (1-methylethylbenzene)	31	31	100	Low - 2
Cyclohexane	8	8	100	Low - 1
Ethylbenzene	130	130	100	Low - 4
n-Hexane	2,300	2,300	100	Low - 2
Oxides of nitrogen	3,000	3,000	100	Low - 1
Particulate matter 10.0um	180	180	100	Low - 1
Sulphur dioxide	3,100	3,100	100	Low - 1
Toluene (methylbenzene)	2,000	2,000	100	Low - 1
Total volatile organic compounds	200,000	200,000	100	Low - 3
Xylenes (individual or mixed isomers)	660	660	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2000;loc_type=state;loc_state=QLD;jur_fac_id=5154

Facility Details

Facility	Townsville Airport Fuelling Service (Shell)
Address	Stinson Avenue Garbutt Qld 4814
Main activities	Aircraft refuelling
Primary ANZSIC Industry Class	Petroleum Product Wholesaling
ANZSIC Industry Group	Mineral, Metal and Chemical Wholesaling
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	3.9	3.9	100	Low - 1
Cumene (1-methylethylbenzene)	0.06	0.06	100	Low - 1
Cyclohexane	4.1	4.1	100	Low - 1
Ethylbenzene	0.70	0.70	100	Low - 1
n-Hexane	17	17	100	Low - 1
Oxides of nitrogen	1,800	1,800	100	Low - 1
Particulate matter 10.0um	180	180	100	Low - 1
Polycyclic aromatic hydrocarbons	0.21	0.21	100	Low - 1
Sulphur dioxide	3,300	3,300	100	Low - 1
Toluene (methylbenzene)	2.3	2.3	100	Low - 1
Total volatile organic compounds	77	77	100	Low - 1
Xylenes (individual or mixed isomers)	4.5	4.5	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25159

Facility Details

Facility	Sun Metals Zinc Refinery
Address	1 Zinc Avenue Stuart QLD 4811
Main activities	Zinc refinery processing up to 400,000 tonnes per annum of zinc concentrates to produce 190,000 tonnes zinc metal and 350,000 tonnes sulphuric acid.
Primary ANZSIC Industry Class	Copper, Silver, Lead and Zinc Smelting, Refining
ANZSIC Industry Group	Basic Non-Ferrous Metal Manufacturing
Cleaner production activities	None reported

Emissions (2005/06)

		Air		Land		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	6.3	6.3	99.8	0.01	0.2	Low - 1
Cadmium & compounds	71	71	99.9	0.1	0.1	Low - 1
Carbon monoxide	23,000	23,000	100			Low - 1
Cobalt and compounds	1.1	1.1	100			Low - 1
Copper and compounds	260	260	99.996	0.01	<0.1	Low - 1
Fluoride compounds	2.8	1.7	61	1.1	39	Low - 1
Lead and compounds	890	890	99.994	0.05	<0.1	Low - 1
Mercury and compounds	0.84	0.84	100			Low - 1
Nickel and compounds	0.67	0.66	98.5	0.01	1.5	Low - 1
Oxides of nitrogen	100,000	100,000	100			Low - 1
Particulate matter 10.0um	38,000	38,000	100			Low - 1
Polycyclic aromatic hydrocarbons	0.1	0.1	100			Low - 1
Sulphur dioxide	280,000	280,000	100			Low - 1
Sulphuric acid	19,000	19,000	100			Low - 2
Total volatile organic compounds	29	29	100			Low - 1
Zinc and compounds	22,000	22,000	99.96	8.1	0.04	Low - 7

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25204

Emissions (2003/04)

		Air		Land		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	11	9.2	83.6	2.2	20	Low - 1
Cadmium & compounds	180	76	42.2	100	55.6	Low – 5
Carbon monoxide	36,000	36,000	100			Low - 1
Cobalt and compounds	2.7	2.3	85.2	0.37	13.7	Low - 1
Copper and compounds	200	200	100	1.2	0.6	Low - 1
Fluoride compounds	1.7	1.7	100			Low – 1
Lead and compounds	870	870	100	1.1	0.1	Low - 1
Mercury and compounds	1.1	0.72	65.5	0.39	35.5	Low - 1
Nickel and compounds	1.4	1	71.4	0.36	25.7	Low - 1
Oxides of nitrogen	97,000	97,000	100			Low - 1
Particulate matter 10.0um	39,000	39,000	100			Low - 1
Polycyclic aromatic hydrocarbons	0.1	0.1	100			Low - 1
Sulphur dioxide	410,000	410,000	100			Low - 1
Sulphuric acid	25,000	25,000	100			Low - 2
Total volatile organic compounds	27	27	100			Low - 1

Zinc and compounds	23,000	23,000	100	490	2.1	Low - 7

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2004;loc_type=state;loc_state=QLD;jur_fac_id=25204

Emissions (2001/02)

		Air		Land		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	5.1	3	58.8	2.1	42	Low - 1
Cadmium & compounds	140	39	27.8	98	70	Low – 2
Carbon monoxide	28,000	28,000	100			Low - 1
Cobalt and compounds	7.4	1.5	20.3	5.9	79.7	Low - 1
Copper and compounds	39	37	94.8	1.8	4.6	Low - 1
Fluoride compounds	51	1.2	2.4	50	98	Low – 1
Lead and compounds	540	540	99.4	3.5	0.6	Low - 1
Mercury and compounds	1	0.52	52	0.52	52	Low - 1
Nickel and compounds	2.3	0.55	23.9	1.7	73.9	Low - 1
Oxides of nitrogen	74,000	74,000	100			Low - 1
Particulate matter 10.0um	27,000	27,000	100			Low - 1
Sulphur dioxide	300,000	300,000	100			Low - 1
Sulphuric acid	46,000	45,000	97.8	560	1.2	Low - 1
Zinc and compounds	19,000	19,000	100	240	<0.1	Low - 7

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2002;loc_type=state;loc_state=QLD;jur_fac_id=25204

Facility Details

Facility	Southern Cross Fertilisers - Townsville Port Facility
Address	Centenary Drive Port of Townsville Qld 4810
Main activities	Fertiliser and sulphur storage
Primary ANZSIC Industry Class	Storage n.e.c.
ANZSIC Industry Group	Storage
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Chromium (III) compounds	0.24	0.24	100	Low - 1
Copper and compounds	0.39	0.39	100	Low - 1
Fluoride compounds	43	43	100	Low - 1
Manganese and compounds	5.7	5.7	100	Low - 1
Nickel and compounds	0.21	0.21	100	Low - 1
Zinc and compounds	1.2	1.2	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25196

Facility Details

Facility	Queensland Terminals
Address	Benwell Road South Townsville Qld 4810
Main activities	Sulphuric Acid Storage and Transfers
Primary ANZSIC Industry Class	Inorganic Industrial Chemical Manufacturing n.e.c.
ANZSIC Industry Group	Basic Chemical Manufacturing
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Sulphuric acid	100	100	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25196

Facility Details

Facility	Stuart Railway Facility
Address	Jurekey Street Stuart Qld 4811
Main activities	Railway rollingstock maintenance, servicing and fuelling
Primary ANZSIC Industry Class	Rail Transport
ANZSIC Industry Group	Rail Transport
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	0.19	0.19	100	Low - 1
Ethylbenzene	0.32	0.32	100	Low - 1
Polycyclic aromatic hydrocarbons	0.13	0.13	100	Low - 1
Toluene (methylbenzene)	2.3	2.3	100	Low - 1
Total volatile organic compounds	2,300	2,300	100	Low - 1
Xylenes (individual or mixed isomers)	5.9	5.9	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25235

Facility Details

Facility	QNI Yabulu Refinery - Materials Handing Facility
Address	Berth 2 Port of Townsville Qld 4810
Main activities	Unloading of nickel ore from vessels to train carriages for transport to the QNI Yabulu Refinery
Primary ANZSIC Industry Class	Basic Non-Ferrous Metal Manufacturing n.e.c.
ANZSIC Industry Group	Basic Non-Ferrous Metal Manufacturing
Cleaner production activities	None reported

Emissions (2005/06)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	0.79	0.79	100			Low - 1
Boron & compounds	0.27	0.27	100			Low - 1
Cadmium & compounds	0.8	0.79	98.8	0.0089	1.1	Low - 1
Chromuim (III) compounds	370	370	99.7	1.8	0.3	Low - 1
Cobalt and compounds	50	50	100	0.010	0.02	Low - 1
Copper and compounds	4.1	4.1	99.7	0.012	0.3	Low - 1
Fluoride compounds	110	110	100			Low - 1
Manganese and compounds	220	220	100	0.0050	0.002	Low - 1
Nickel and compounds	560	560	100	0.45	0.08	Low - 1
Selenium and compounds	0.82	0.82	100			Low - 1
Zinc and compounds	11	11	99.7	0.037	0.3	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=14841

Emissions (2002/03)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Cadmium & compounds	0.001			0.001	100	Low - 1
Chromuim (III) compounds	470	470	100			Low - 1
Cobalt and compounds	0.018			0.018	100	Low - 1
Copper and compounds	0.0032			0.0032	100	Low - 1
Manganese and compounds	330	330	100	0.0081	<0.1	Low - 1
Nickel and compounds	570	570	100	0.19	<0.1	Low - 1
Zinc and compounds	0.022			0.022	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2003;loc_type=state;loc_state=QLD;jur_fac_id=14841

Emissions (1999/2000)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Cobalt and compounds	2.4	2.4	100			Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2000;loc_type=state;loc_state=QLD;jur_fac_id=14841

Facility Details

Facility	QNI Townsville Port Bulk Fuel Facility
Address	Herbert Street South Townsville Qld 4810
Main activities	Storage & handling of bulk petroleum fuel
Primary ANZSIC Industry Class	Petroleum Product Wholesaling
ANZSIC Industry Group	Mineral, Metal and Chemical Wholesaling
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	0.23	0.23	100	Low - 1
Carbon monoxide	510	510	100	Low - 1
Cumene (1-methylethylbenzene)	1.6	1.6	100	Low - 1
Fluoride compounds	3.8	3.8	100	Low – 1
n-Hexane	0.0006	0.0006	100	Low - 1
Hydrochloric acid	35	35	100	Low - 0
Oxides of Nitrogen	5,600	5,600	100	Low - 1
Particulate matter 10.0um	4.2	4.2	100	Low - 1
Polycyclic aromatic hydrocarbons	12	12	100	Low - 1
Sulphur dioxide	40	40	100	Low - 1
Total volatile organic compounds	550	550	100	Low - 1
Xylenes (individual or mixed isomers)	0.17	0.17	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25186

Facility Details

Facility	QNI - Yabulu Refinery
Address	1 Greenvale Street Yabulu QLD 4818
Main activities	Processing of ore through roasting, ammonia leach and solvent extraction processes to produce high grade nickel and cobalt products.
Primary ANZSIC Industry Class	Basic Non-Ferrous Metal Manufacturing n.e.c.
ANZSIC Industry Group	Basic Non-Ferrous Metal Manufacturing
Cleaner production activities	The Yabulu site has recently undergone a project that converted the Synthesis Gas Plant and Final Nickel Calciner from utilising liquid fuel (naphtha) to Coal Seam Methane gas. This has facilitated a reduction in greenhouse gas emissions

Emissions (2005/06)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	1,300,000	880,000	67.7	400,000	30.8	Low - 25
Arsenic & compounds	140	140	100			Low - 1
Benzene	540	540	100			Low - 1
Beryllium & compounds	14	14	100			Low - 1
Boron & compounds	30	30	100			Low - 1
Cadmium & compounds	97	97	100	0.07	<0.1	Low - 2
Carbon monoxide	520,000	520,000	100			Low - 1
Chromium (III) compounds	40,000	40,000	100	2.1	<0.1	Med - 45
Chromium (VI) compounds	9.4	9.4	100			Low - 1
Cobalt and compounds	5,400	5,400	100			Med - 31
Copper and compounds	960	960	100			Low - 1
Cumene (1-methylethylbenzene)	3.2	3.2	100			Low - 1
Fluoride compounds	37,000	37,000	100			Low - 2
n-Hexane	120	120	100			Low - 1
Hydrochloric acid	200,000	200,000	100			Low - 1
Lead and compounds	62	60	96.8	1.7	2.7	Low - 1
Manganese and compounds	23,000	23,000	100			Low - 3
Mercury and compounds	18	18	100			Low - 1
Nickel and compounds	61,000	60,000	98.4	780	1.3	Med - 69
Oxides of nitrogen	2,700,000	2,700,000	100			Low - 6
Particulate matter 10.0um	2,800,000	2,800,000	100			Low - 13
Polychlorinated dioxins and furans	0.0003	0.0003	100			Low - 1
Polycyclic aromatic hydrocarbons	42	42	100			Low - 1
Selenium and compounds	320	320	100			Low - 4
Sulphur dioxide	3,800,000	3,800,000	100			Low - 2
Sulphuric acid	21,000	21,000	100			Low - 3
Total volatile organic compounds	30,000	30,000	100			Low - 1
Xylenes (individuals or mixed isomers)	5.5	5.5	100			Low - 1
Zinc and compounds	1,800	1,800	100	17	0.94	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=14736

Emissions (2002/03)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Ammonia (total)	790,000	790,000	100			Low - 16
Arsenic & compounds	51,000	51,000	100			Low - 1
Benzene	130	130	100			Low - 1
Beryllium & compounds	15	15	100			Low - 1
Boron & compounds	27	27	100			Low - 1
Cadmium & compounds	12	12	100	0.001	<0.1	Low - 2
Carbon monoxide	460,000	460,000	100			Low - 1
Chromium (III) compounds	35,000	35,000	100	0.45	<0.1	Med - 63
Chromium (VI) compounds	9.2	9.2	100			Low - 1
Cobalt and compounds	4,600	4,600	100	0.018	<0.1	Med - 26
Copper and compounds	100	100	100	0.0032	<0.1	Low - 1
Cumene (1-methylethylbenzene)	3.8	3.8	100			Low - 1
Fluoride compounds	26,000	26,000	100			Low - 5
n-Hexane	20	20	100			Low - 1
Hydrochloric acid	210,000	210,000	100			Low – 3
Lead and compounds	59	59	100	0.001	<0.1	Low - 1
Manganese and compounds	25,000	25,000	100	0.0081	<0.1	Low - 3
Mercury and compounds	18	18	100			Low – 2
Nickel and compounds	44,000	44,000	100	0.19	<0.1	Med - 55
Oxides of nitrogen	2,400,000	2,400,000	100			Low - 6
Particulate matter 10.0um	2,600,000	2,600,000	100			Low - 12
Polychlorinated dioxins and furans	0.0004	0.0004	100			Low - 1
Polycyclic aromatic hydrocarbons	46	46	100			Low - 1
Sulphur dioxide	3,900,000	3,900,000	100			Low - 2
Sulphuric acid	22,000	22,000	100			Low – 1
Total volatile organic compounds	23,000	23,000	100			Low - 1
Xylenes (individuals or mixed isomers)	5.5	5.5	100			Low - 1
Zinc and compounds	0.022			0.022	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2003;loc_type=state;loc_state=QLD;jur_fac_id=14736

Emissions (1999/00)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	99	99	100			Low - 1
Benzene	120	120	100			Low - 1
Cadmium & compounds	19	19	100			Low - 1
Carbon monoxide	200,000	200,000	100			Low - 1
Chromium (VI) compounds	9.3	9.3	100			Low - 1
Cobalt and compounds	2,800	2,700	96.4	110	3.9	Low - 15
Fluoride compounds	28,000	28,000	100			Low - 4
Lead and compounds	110	110	100			Low - 1
Mercury and compounds	17	17	100			Low – 1
Oxides of nitrogen	6,100,000	6,100,000	100			Low - 16
Particulate matter 10.0um	450,000	450,000	100			Low - 2
Polycyclic aromatic hydrocarbons	30	30	100			Low - 1

Sulphur dioxide	5,800,000	5,800,000	100			Low – 1
Total Nitrogen	1,200,000	1,200,000	100			Low - 5
Xylenes (individuals or mixed isomers)	0.3	0.3	100			Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2000;loc_type=state;loc_state=QLD;jur_fac_id=14736

Facility Details

Facility	Northern Shipping and Stevedoring - Townsville Port
Address	Suter Pier Wharf Townsville 4810
Main activities	Stevedoring, i.e. unloading or loading ships. Products are handled in containers, bulk bags and in bulk form. Equipment used in the operation includes shore cranes, ships cranes, forklifts, excavators, skid steer loaders, end loaders and hoppers
Primary ANZSIC Industry Class	Stevedoring
ANZSIC Industry Group	Services to Water Transport
Cleaner production activities	• Improved procedures for loading, unloading and transfer operations • Dust suppression - water sprays / chemical suppression • Dust suppression - wind breaks / covered / enclosed stockpiles

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Carbon monoxide	62,000	62,000	100	Low - 1
Fluoride compounds	0.98	0.98	100	Low - 1
Oxides of nitrogen	340,000	340,000	100	Low - 1
Particulate matter 10.0um	4,000	4,000	100	Low - 1
Polycyclic aromatic hydrocarbons	0.12	0.12	100	Low - 1
Sulphur dioxide	69,000	69,000	100	Low - 1
Total volatile organic compounds	19,000	19,000	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=14839

Facility Details

Facility	Hanson Townsville Quarry
Address	Flinders Highway Townsville 4810
Main activities	Quarrying
Primary ANZSIC Industry Class	Gravel and Sand Quarrying
ANZSIC Industry Group	Construction Material Mining
Cleaner production activities	

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Carbon monoxide	8,100	8,100	100	Low - 1
Oxides of nitrogen	13,000	13,000	100	Low - 1
Particulate matter 10.0um	15,000	15,000	100	Low - 1
Polycyclic aromatic hydrocarbons	0.64	0.64	100	Low - 1
Sulphur dioxide	1,200	1,200	100	Low - 1
Total volatile organic compounds	1,100	1,100	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25143

Facility Details

Facility	Bohle Quarry
Address	Ingham Road Bohle 4818
Main activities	Quarry materials sand and gravel producers
Primary ANZSIC Industry Class	Gravel and Sand Quarrying
ANZSIC Industry Group	Construction Material Mining
Cleaner production activities	

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Carbon monoxide	12,000	12,000	100	Low - 1
Oxides of nitrogen	25,000	25,000	100	Low - 1
Particulate matter 10.0um	47,000	47,000	100	Low - 1
Polycyclic aromatic hydrocarbons	0.037	0.037	100	Low - 1
Sulphur dioxide	2,300	2,300	100	Low - 1
Total volatile organic compounds	3,000	3,000	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25210

Facility Details

Facility	Xstrata Copper - Townsville Port Operations
Address	Berth 7 Lennon Drive Townsville 4810
Main activities	Stockpilig and shiploading of mineral concentrates
Primary ANZSIC Industry Class	Port Operators
ANZSIC Industry Group	Services to Water Transport
Cleaner production activities	The Yabulu site has recently undergone a project that converted the Synthesis Gas Plant and Final Nickel Calciner from utilising liquid fuel (naphtha) to Coal Seam Methane gas. This has facilitated a reduction in greenhouse gas emissions

Emissions (2005/06)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Antimony and compounds	5	5	100	0.04	0.8	Low - 1
Arsenic & compounds	27	27	100	0.06	0.2	Low - 1
Cadmium & compounds	9.9	9.3	93.9	0.61	6.1	Low - 1
Carbon monoxide	12,000	12,000	100			Low - 1
Chlorine	0.19	0.19	100			Low - 1
Chromium (III) compounds	0.62	0.37	59.7	0.25	40.3	Low - 1
Cobalt and compounds	8.5	8.1	95.3	0.33	3.9	Low - 1
Copper and compounds	2,600	2,600	100	43	1.7	Low - 1
Cumene (1-methylethylbenzene)	3.2	3.2	100			Low - 1
Fluoride compounds	5.7	5.7	100			Low - 1
Lead and compounds	590	580	98.3	14	2.4	Low - 1
Manganese and compounds	9.6	3.1	32.3	6.5	67.7	Low - 1
Mercury and compounds	0.19	0.18	94.7	0.015	7.9	Low - 1
Nickel and compounds	5.3	1.5	28.3	3.8	71.7	Low - 1
Oxides of nitrogen	64,000	64,000	100			Low - 1
Particulate matter 10.0um	1,200	1,200	100			Low - 1
Polycyclic aromatic hydrocarbons	0.28	0.28	100			Low - 1
Selenium and compounds	1.5	0.27	18	1.2	80	Low - 1
Sulphur dioxide	13,000	13,000	100			Low - 1
Total volatile organic compounds	4,400	4,400	100			Low - 1
Zinc and compounds	3,200	3,000	93.8	140	4.4	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=14838

Emissions (2002/03)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Acetaldehyde	120	120	100			Low - 1
Antimony and compounds	2.1	2	95.2	0.024	1.1	Low - 1
Arsenic & compounds	9.2	9.2	100	0.041	0.5	Low - 1
Benzene and compounds	67	67	100			Low – 1
Cadmium & compounds	5.2	4.9	94.2	0.027	0.5	Low – 1
Carbon monoxide	13,000	13,000	100			Low – 1
Chlorine	0.26	0.26	100			Low – 1
Cobalt and compounds	8.2	8.1	98.8	0.14	1.7	Low – 1
Copper and compounds	2,500	2,500	100	14	0.6	Low – 1

Ethylbenzene	0.011	0.011	100			Low – 1
Fluoride compounds	54	54	100			Low - 1
Formaldehyde (methyl aldehyde)	430	430	100			Low – 1
n-hexane	55	55	100			Low – 1
Lead and compounds	180	180	100	1.9	1	Low - 1
Manganese and compounds	6.5	1.7	26.2	4.8	73.8	Low - 1
Mercury and compounds	0.1	0.1	100	0.0037	3.7	Low - 1
Nickel and compounds	3.4	1.2	35.3	2.2	64.7	Low - 1
Oxides of nitrogen	69,000	69,000	100			Low - 1
Particulate matter 10.0um	1,000	1,000	100			Low - 1
Polycyclic aromatic hydrocarbons	0.0044	0.0044	100			Low - 1
Selenium and compounds	1.3	0.32	0.99			Low - 1
Sulphur dioxide	14,000	14,000	100			Low – 1
Toluene (methyl benzene)	68	68	100			Low – 1
Total volatile organic compounds	4,400	4,400	100			Low - 1
Zinc and compounds	1,700	1,600	94.1	75	4.4	Low - 1

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Emissions (1999/2000)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	1.3	1.3	100	0.044	3.4	Low - 1
Cadmium & compounds	1.1	1	90.9	0.14	12.7	Low – 1
Cobalt and compounds	1.3	1.2	92.3	0.11	8.5	Low – 1
Fluoride compounds	3.5	3.5	100			Low - 1
Lead and compounds	31	23	74.2	8.2	26.5	Low - 1
Mercury and compounds	0.023	0.022	95.6	0.001	4.3	Low - 1

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Facility	Xstrata Copper - Townsville Operations
Address	Hunter Street Stuart 4811
Main activities	Electro-refining of copper
Primary ANZSIC Industry Class	Copper, Silver, Lead and Zinc Smelting, Refining
ANZSIC Industry Group	Basic Non-Ferrous Metal Manufacturing
Cleaner production activities	

Emissions (2005/06)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	120	0.83	0.7	14	11.7	110	91.7	Low - 1
Benzene	72	72	100					Low - 1
Beryllium & compounds	0.0089	0.0089	100					Low - 1
Cadmium & compounds	0.26	0.26	100					Low - 1
Carbon monoxide	6,700	6,700	100					Low - 1
Chromium (III) compounds	0.1	0.1	100					Low - 1
Copper and compounds	570	64	11.2	4.5	0.8	500	87.7	Low - 1
Ethylbenzene	6.5	6.5	100					Low - 1
Fluoride compounds	0.74	0.74	100					Low - 1
n-Hexane	94	94	100					Low - 1
Lead and compounds	3.2	3.2	100					Low - 1
Mercury and compounds	0.027	0.027	100					Low - 1
Nickel and compounds	40	1.6	4	4.6	11.5	34	85	Low - 1
Oxides of nitrogen	9,400	9,400	100					Low - 1
Particulate matter 10.0um	700	700	100					Low - 1
Polychlorinated dioxins and furans	0.00000006	0.00000006	100					Low - 1
Polycyclic aromatic hydrocarbons	0.073	0.073	100					Low - 1
Sulphur dioxide	1,600	1,600	100					Low - 1
Sulphuric acid	210	210	100					Low - 1
Toluene (methylbenzene)	93	93	100					Low - 1
Total volatile organic compounds	7,900	7,900	100					Low - 1
Xylenes (individuals or mixed isomers)	50	50	100					Low - 1

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Emissions (2002/03)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Acetone	8.9	8.9	100					Low - 1
Ammonia (total)	8.9	8.9	100					Low – 1
Antimony and compounds	15			13	86.7	2	13.3	Low – 1
Arsenic & compounds	0.016	0.016	100					Low - 1
Benzene	18	12	66.7	5.8	32.2	0.0028	<0.1	Low - 1
Beryllium & compounds	0.2	0.2	100					Low - 1
Biphenyl (1,1-biphenyl)	0.001	0.001	100					

Cadmium & compounds	0.42	0.42	100					Low - 1
Carbon monoxide	150,000	150,000	100					Low - 1
Chromium (III) compounds	0.2	0.2	100					Low - 1
Copper and compounds	16	13	81.2	2.6	16.25	0.0081	<0.1	Low - 1
Cumene (1-methylethylbenzene)	5.9	5.9	100					Low – 1
Cyclohexane	29	29	100					Low - 1
Ethyl acetate	14	14	100					Low - 1
Ethylbenzene	42	42	100					Low - 1
Formaldehyde (methyl aldehyde)	41	41	100					Low - 1
n-Hexane	260	260	100					Low - 1
Lead and compounds	0.95		100					Low - 1
Manganese and compounds	0.4	0.4	100					Low – 1
Mercury and compounds	0.2	0.2	100					Low - 1
Methyl ethyl ketone	3.8	3.8	100					Low – 1
Methyl isobutyl ketone	2.5	2.5	100					Low – 1
Nickel and compounds	7.8	5.4	69.2	2.3	3	0.14	1.8	Low - 1
Oxides of nitrogen	13,000	13,000	100					Low - 1
Particulate matter 10.0um	680	680	100					Low - 1
Polycyclic aromatic hydrocarbons	1.9	1.9	100					Low - 1
Sulphur dioxide	34,000	34,000	100					Low - 1
Sulphuric acid	1,800	1,800	100					Low - 1
Toluene (methylbenzene)	400	400	100					Low - 1
Total volatile organic compounds	9,600	9,600	100					Low - 1
Xylenes (individuals or mixed isomers)	260	260	100					Low – 1
Zinc and compounds	0.26	0.26	100					Low - 1

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Emissions (1999/2000)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Arsenic & compounds	170	4.6	2.7	14	8.2	150	88	Low - 1
Benzene	16	16	100					Low - 1
Cadmium & compounds	0.63	0.63	100					Low - 1
Carbon monoxide	150,000	150,000	100					Low - 1
Lead and compounds	1.7	1.7	100					Low - 1
Mercury and compounds	0.26	0.26	100					Low - 1
Oxides of nitrogen	17,000	17,000	100					Low - 1
Particulate matter 10.0um	870	870	100					Low - 1
Sulphur dioxide	45,000	45,000	100					Low - 1
Sulphuric acid	900	900	100					Low - 1
Toluene (methylbenzene)	51	51	100					Low - 1
Total volatile organic compounds	1,900	1,900	100					Low - 1

Xylenes (individuals or mixed isomers)	49	49	100					Low – 1

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Facility Details

Facility	BP Australia - Townsville Terminal
Address	Hubert Street South Townsville Qld 4810
Main activities	Bulk Petroleum Storage Facility
Primary ANZSIC Industry Class	Petroleum Product Wholesaling
ANZSIC Industry Group	Mineral, Metal and Chemical Wholesaling
Cleaner production activities	None reported

Emissions (2005/06)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Benzene	630	630	100	0.12	<0.1	6.5	1	Low - 1
Cumene (1-methylethylbenzene)	25	3.3	13.2	0.02	<0.1	22	88	Low - 1
Cyclohexane	1,100	1,100	100	0.17	<0.1	22	2	Low - 1
Ethylbenzene	170	160	94.1	0.32	0.19	3.1	1.8	Low - 1
n-Hexane	1,600	1,600	100	0.22	<0.1	22	1.4	Low - 1
Styrene (ethenylbenzene)	23	1.3	5.7	0.01	<0.1	22	95.6	Low - 1
Toluene (methylbenzene)	1,800	1,800	100	1.6	<0.1	6.5	0.36	Low - 1
Total volatile organic compounds	200,000	200,000	100	16	<0.1	110	<0.1	Low - 1
Xylenes (individual or mixed isomers)	720	710	98.6	1.7	0.24	8.3	1.2	Low - 1

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Emissions (2002/03)

		Air		Land		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**kg**	**%**	**Ranking**
Benzene	3,100	3,100	100	0.54	<0.1	6.5	0.2	Low - 1
Cumene (1-methylethylbenzene)	42	19	45.2	0.94	2.2	22	52.4	Low - 1
Cyclohexane	680	660	97.1	0.072	<0.1	22	3.2	Low - 1
Ethylbenzene	150	150	100	0.41	0.3	3.1	2.1	Low - 1
n-Hexane	3,600	3,600	100	0.34	<0.1	22	0.6	Low - 1
Styrene (ethenylbenzene)	2,900	2,900	100	1.7	<0.1	6.5	0.2	Low - 1
Total volatile organic compounds	300,000	300,000	100	44	<0.1	110	<0.1	Low - 1
Xylenes (individual or mixed isomers)	1,100	1,100	100	2.6	0.2	8.3	0.8	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2003;loc_type=state;loc_state=QLD;jur_fac_id=5265

Emissions (1999/2000)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Benzene	1,300	1,300	100	6.5	0.5	Low - 1
Cumene (1-methylethylbenzene)	46	26	56.5	20	43.5	Low - 3

Cyclohexane	160	140	87.5	20	12.5	Low - 1
Ethylbenzene	58	58	100	3	5.2	Low - 2
n-Hexane	1,200	1,200	100	20	1.7	Low - 1
Toluene (methylbenzene)	1,100	1,100	100	6.5	0.6	Low - 1
Total volatile organic compounds	120,000	120,000	100	110	<0.1	Low - 2
Xylenes (individual or mixed isomers)	460	450	97.8	8	1.7	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2000;loc_type=state;loc_state=QLD;jur_fac_id=5265

Facility Details

Facility	Air BP Townsville
Address	Airside GA Area Townsville Airport 4810
Main activities	Bulk petroleum storage facility
Primary ANZSIC Industry Class	Petroleum Product Wholesaling
ANZSIC Industry Group	Mineral, Metal and Chemical Wholesaling
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Benzene	14	14	100	Low - 1
Ethylbenzene	5.5	5.5	100	Low - 1
Toluene (methylbenzene)	15	15	100	Low - 1
Total volatile organic compounds	1,300	1,300	100	Low - 1
Xylenes (individual or mixed isomers)	19	19	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=32911

Facility Details

Facility	BOC Townsville
Address	384 Ingham Road Garbutt 4814
Main activities	Stores gas, fills cylinders and distributes product.
Primary ANZSIC Industry Class	Industrial Gas Manufacturing
ANZSIC Industry Group	Basic Chemical Manufacturing
Cleaner production activities	None reported

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Acetone	310	310	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=25294

Facility Details

Facility	Cannington Port Facility
Address	Townsville Port Townsville 4810
Main activities	Storage and Loading of Lead and Zinc Concentrates
Primary ANZSIC Industry Class	Water Transport Terminals
ANZSIC Industry Group	Services to Water Transport
Cleaner production activities	

Emissions (2005/06)

		Air		Water		
Substance	**Total (kg)**	**kg**	**%**	**kg**	**%**	**Ranking**
Antimony and compounds	0.49	0.49	100	0.0033	0.7	Low - 1
Arsenic & compounds	0.18	0.18	100	0.0003	0.17	Low - 1
Benzene	0.0012	0.0012	100			Low - 1
Beryllium and compounds	0.0023	0.0023	100			Low - 1
Cadmium & compounds	0.018	0.0023	12.8	0.016	88.9	Low - 1
Carbon monoxide	27	27	100			Low - 1
Chromium (III) compounds	0.0016	0.0016	100			Low - 1
Chromium (IV) compounds	0.0007	0.0007	100			Low - 1
Copper and compounds	0.006	0.0046	76.7	0.0014	23.3	Low - 1
Ethylbenzene	0.0003	0.0003	100			Low - 1
Fluoride compounds	0.52	0.16	30.8	0.36	69.2	Low - 1
Formaldehyde (methyl aldehyde)	0.26	0.26	100			
Lead and compounds	160	180	100	1.6	1	Low - 1
Manganese and compounds	0.33	0.0046	1.4	0.33	100	Low - 1
Mercury and compounds	0.0023	0.0023	100			Low - 1
Nickel and compounds	0.0023	0.0023	100			Low - 1
Oxides of nitrogen	110	110	100			Low - 1
Particulate matter 10.0um	140	140	100			Low - 1
Polychlorinated dioxins and furans	0.000000017	0.000000017	100			Low - 1
Polycyclic aromatic hydrocarbons	0.0065	0.0065	100			Low - 1
Selenium and compounds	0.014	0.012	85.7	0.0015	10.7	Low - 1
Sulphur dioxide	100	100	100			Low - 1
Toluene (methylbenzene)	0.034	0.034	100			Low - 1
Total volatile organic compounds	1.8	1.8	100			Low - 1
Xylenes (individual or mixed isomers)	0.0006	0.0006	100			Low - 1
Zinc and compounds	47	43	91.5	4.2	8.9	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=5752

Emissions (2002/03)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Arsenic & compounds	0.31	0.31	100	Low - 1
Benzene	0.47	0.47	100	Low - 1
Cadmium & compounds	1.4	1.4	100	Low - 1
Carbon monoxide	570	570	100	Low - 1
Copper and compounds	4.1	4.1	100	Low - 1
Fluoride compounds	0.76	0.76	100	Low - 1
Lead and compounds	760	760	100	Low - 1

Mercury and compounds	4.3	4.3	100	Low - 1
Nickel and compounds	2.4	2.4	100	Low - 1
Oxides of nitrogen	1,800	1,800	100	Low - 1
Particulate matter 10.0um	1,100	1,100	100	Low - 1
Sulphur dioxide	90	90	100	Low - 1
Toluene (methylbenzene)	5.7	5.7	100	Low - 1
Total volatile organic compounds	250	250	100	Low - 1
Xylenes (individual or mixed isomers)	15	15	100	Low - 1
Zinc and compounds	260	260	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2003;loc_type=state;loc_state=QLD;jur_fac_id=5752

Emissions (1999/2000)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Arsenic & compounds	0.003	0.003	100	Low - 1
Cadmium & compounds	0.00024	0.00024	100	Low - 1
Carbon monoxide	2,400	2,400	100	Low - 1
Fluoride compounds	0.024	0.024	100	Low - 1
Lead and compounds	0.6	0.6	100	Low - 1
Mercury and compounds	0.00012	0.00012	100	Low - 1
Oxides of nitrogen	3,900	3,900	100	Low - 1
Particulate matter 10.0um	420	420	100	Low - 1
Polycyclic aromatic hydrocarbons	0.17	0.17	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2000;loc_type=state;loc_state=QLD;jur_fac_id=5752

Facility Details

Facility	Townsville Abattoir
Address	Bruce Highway Aitkenvale via Townsville 4814
Main activities	Meat Processing
Primary ANZSIC Industry Class	Meat Processing
ANZSIC Industry Group	Meat and Meat Product Manufacturing
Cleaner production activities	A1. Improved maintenance scheduling, record keeping, or procedures A7. Installed overflow alarms or automatic shut-off valves A11. Implemented inspection or monitoring program for potential spill or leak sources A14. Dust suppression - wind breaks/covered/enclosed stockpiles Recycle water
Installation of Pollution Control Equipment	E5. Scrubber E7. Cyclone Wastewater treatment Effluent irrigation

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Acetaldehyde	1.5	1.5	100	Low - 1
Ammonia (total)	3,500	3,500	100	Low - 1
Antimony & compounds	0.15	0.15	100	Low - 1
Arsenic & compounds	18	18	100	Low - 1
Benzene	3	3	100	Low - 1
Beryllium & compounds	3.1	3.1	100	Low - 1
Cadmium & compounds	1.8	1.8	100	Low - 1
Carbon disulfide	0.29	0.29	100	Low - 1
Carbon monoxide	13,000	13,000	100	Low - 1
Chloroform (trichloromethane)	0.23	0.23	100	Low - 1
Chromium (III) compounds	54	54	100	Low - 1
Chromium (VI) compounds	0.18	0.18	100	Low - 1
Cobalt and compounds	0.36	0.36	100	Low - 1
Copper and compounds	0.45	0.45	100	Low - 1
Cumene (1-methylethylbenzene)	0.01	0.01	100	Low - 1
Cyanide (inorganic) compounds	5.9	5.9	100	Low - 1
Dichloromethane	0.68	0.68	100	Low - 1
Ethylbenzene	0.21	0.21	100	Low - 1
Fluoride compounds	340	340	100	Low - 1
Formaldehyde (methyl aldehyde)	1.4	1.4	100	Low - 1
n-Hexane	0.15	0.15	100	Low - 1
Hydrochloric acid	2,700	2,700	100	Low - 1
Lead and compounds	22	22	100	Low - 1
Magnesium oxide fume	25	25	100	Low - 1
Manganese and compounds	95	95	100	Low - 1
Mercury and compounds	0.68	0.68	100	Low - 1
Methyl ethyl ketone	0.91	0.91	100	Low - 1
Methyl methacrylate	0.05	0.05	100	Low - 1
Nickel and compounds	46	46	100	Low - 1

Oxides of nitrogen	21,000	21,000	100	Low - 1
Particulate matter 10.0um	18,000	18,000	100	Low - 1
Phenol	0.04	0.04	100	Low - 1
Polychlorinated dioxins and furans	0.0000004	0.0000004	100	Low - 1
Polycyclic aromatic hydrocarbons	0.09	0.09	100	Low - 1
Selenium & compounds	2.9	2.9	100	Low - 1
Styrene (ethenylbenzene)	0.06	0.06	100	Low - 1
Sulphur dioxide	82,000	82,000	100	Low - 1
Sulphuric acid	3,100	3,100	100	Low - 1
Tetrachloroethylene	0.1	0.1	100	Low - 1
Toluene (methylbenzene)	0.72	0.72	100	Low - 1
Total volatile organic compounds	270	270	100	Low - 1
Xylenes (individual or mixed isomers)	0.13	0.13	100	Low - 1
Zinc and compounds	430	430	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=14755

Emissions (2002/03)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Acetaldehyde	2	2	100	Low - 1
Ammonia (total)	5,100	5,100	100	Low - 1
Antimony & compounds	0.16	0.16	100	Low - 1
Arsenic & compounds	21	21	100	Low - 1
Benzene	3.8	3.8	100	Low - 1
Beryllium & compounds	3.7	3.7	100	Low - 1
Cadmium & compounds	1.6	1.6	100	Low - 1
Carbon disulfide	0.35	0.35	100	Low - 1
Carbon monoxide	15,000	15,000	100	Low - 1
Chloroform (trichloromethane)	0.16	0.16	100	Low - 1
Chromium (III) compounds	64	64	100	Low - 1
Chromium (VI) compounds	0.21	0.21	100	Low - 1
Cobalt and compounds	0.4	0.4	100	Low - 1
Copper and compounds	0.53	0.53	100	Low - 1
Cumene (1-methylethylbenzene)	0.01	0.01	100	Low - 1
Cyanide (inorganic) compounds	6.9	6.9	100	Low - 1
Dichloromethane	0.8	0.8	100	Low - 1
Ethylbenzene	0.25	0.25	100	Low - 1
Fluoride compounds	400	400	100	Low - 1
Formaldehyde (methyl aldehyde)	1.8	1.8	100	Low - 1
n-Hexane	0.18	0.18	100	Low - 1
Hydrochloric acid	3,200	3,200	100	Low - 1
Lead and compounds	26	26	100	Low - 1
Magnesium oxide fume	29	29	100	Low - 1
Manganese and compounds	110	110	100	Low - 1
Mercury and compounds	0.8	0.8	100	Low - 1
Methyl ethyl ketone	1.1	1.1	100	Low - 1
Methyl methacrylate	0.05	0.05	100	Low - 1
Nickel and compounds	54	54	100	Low - 1
Oxides of nitrogen	26,000	26,000	100	Low - 1

Particulate matter 10.0um	21,000	21,000	100	Low - 1
Phenol	0.04	0.04	100	Low - 1
Polychlorinated dioxins and furans	0.0000048	0.0000048	100	Low - 1
Polycyclic aromatic hydrocarbons	0.14	0.14	100	Low - 1
Selenium & compounds	3.5	3.5	100	Low - 1
Styrene (ethenylbenzene)	0.07	0.07	100	Low - 1
Sulphur dioxide	96,000	96,000	100	Low - 1
Sulphuric acid	3,700	3,700	100	Low - 1
Tetrachloroethylene	0.12	0.12	100	Low - 1
Toluene (methylbenzene)	0.92	0.92	100	Low - 1
Total volatile organic compounds	380	380	100	Low - 1
Xylenes (individual or mixed isomers)	0.21	0.21	100	Low - 1
Zinc and compounds	500	500	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;loc_type=state;loc_state=QLD;year=2003;jur_fac_id=14755

Emissions (1999/2000)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Acetaldehyde	1.1	1.1	100	Low - 1
Ammonia (total)	5,900	5,900	100	Low - 1
Antimony & compounds	0.03	0.03	100	Low - 1
Arsenic & compounds	14	14	100	Low - 1
Benzene	2.4	2.4	100	Low - 1
Beryllium & compounds	2.5	2.5	100	Low - 3
Cadmium & compounds	1.1	1.1	100	Low - 1
Carbon disulfide	0.2	0.2	100	Low - 1
Carbon monoxide	9,200	9,200	100	Low - 1
Chloroform (trichloromethane)	0.1	0.1	100	Low - 1
Chromium (III) compounds	44	44	100	Low - 1
Chromium (VI) compounds	0.1	0.1	100	Low - 1
Cumene (1-methylethylbenzene)	0.01	0.01	100	Low - 1
Cyanide (inorganic) compounds	4.8	4.8	100	Low - 1
Dichloromethane	0.6	0.6	100	Low - 1
Ethylbenzene	0.2	0.2	100	Low - 1
Fluoride compounds	270	270	100	Low - 1
Formaldehyde (methyl aldehyde)	0.4	0.4	100	Low - 1
n-Hexane	0.1	0.1	100	Low - 1
Hydrochloric acid	2,200	2,200	100	Low - 1
Lead and compounds	18	18	100	Low - 1
Magnesium oxide fume	20	20	100	Low - 2
Manganese and compounds	77	77	100	Low - 1
Mercury and compounds	0.6	0.6	100	Low - 1
Methyl ethyl ketone	0.7	0.7	100	Low - 1
Methyl methacrylate	0.04	0.04	100	Low - 1
Nickel and compounds	36	36	100	Low - 0
Oxides of nitrogen	16,000	16,000	100	Low - 1
Particulate matter 10.0um	14,000	14,000	100	Low - 1
Phenol	0.03	0.03	100	Low - 1
Polychlorinated dioxins and furans	0.000003	0.000003	100	Low - 1
Polycyclic aromatic hydrocarbons	0.16	0.16	100	Low - 1

Selenium & compounds	2.4	2.4	100	Low - 1
Styrene (ethenylbenzene)	0.05	0.05	100	Low - 1
Sulphur dioxide	65,000	65,000	100	Low - 1
Tetrachloroethylene	0.08	0.08	100	Low - 1
Toluene (methylbenzene)	0.4	0.4	100	Low - 1
Total volatile organic compounds	97	97	100	Low - 1
Xylenes (individual or mixed isomers)	0.07	0.07	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2000;jur_fac_id=14755;loc_type=state;loc_state=QLD

Facility Details

Facility	Industrial Galvanizers North Queensland
Address	9 Commercial Avenue Bohle 4818
Main activities	Hot Dip Galvanizing
Primary ANZSIC Industry Class	Metal Coating and Finishing
ANZSIC Industry Group	Fabricated Metal Product Manufacturing
Cleaner production activities	

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Particulate matter 10.0um	120	120	100	Low - 1
Zinc and compounds	95	95	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=32964

Facility Details

Facility	Origin Energy Mt Stuart
Address	Cnr Hunter Street and Bruce Highway Stuart 4811
Main activities	Peak Power Generation from Fossil Fuels
Primary ANZSIC Industry Class	Electricity Supply
ANZSIC Industry Group	Electricity Supply
Cleaner production activities	

Emissions (2005/06)

		Air		
Substance	**Total (kg)**	**kg**	**%**	**Ranking**
Arsenic & compounds	1.5	1.5	100	Low - 1
Benzene	0.95	0.95	100	Low - 1
Beryllium & compounds	0.042	0.042	100	Low - 1
Cadmium & compounds	0.67	0.67	100	Low - 1
Carbon monoxide	1,600	1,600	100	Low - 1
Chromium (III) compounds	1.1	1.1	100	Low - 1
Chromium (VI) compounds	0.45	0.45	100	Low - 1
Ethylbenzene	3.2	3.2	100	Low - 1
n-Hexane	1.9	1.9	100	Low - 1
Lead and compounds	1.9	1.9	100	Low - 1
Mercury and compounds	0.17	0.17	100	Low - 1
Nickel and compounds	0.64	0.64	100	Low - 1
Oxides of nitrogen	22,000	22,000	100	Low - 1
Particulate matter 10.0um	1,700	1,700	100	Low - 1
Polychlorinated dioxins and furans	0.0000027	0.0000027	100	Low - 1
Polycyclic aromatic hydrocarbons	5.4	5.4	100	Low - 1
Sulphur dioxide	3,200	3,200	100	Low - 1
Toluene (methylbenzene)	9.5	9.5	100	Low - 1
Total volatile organic compounds	200	200	100	Low - 1
Xylenes (individual or mixed isomers)	6.3	6.3	100	Low - 1

http://www.npi.gov.au/cgi-bin/npireport.pl?proc=facility_report;instance=public;year=2006;loc_type=state;loc_state=QLD;jur_fac_id=14700

Appendix B

Sewage Treatment Plant

Appendix B Sewage Treatment Plant (STPs)

Condon

Facility	Condon Sewage Treatment Plant (see Appendix A, p.2)
Address	Lot 52 Bowhunters Road Condon Qld 4815
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Condon STP Location

Deeragun

Facility	Deeragun Sewage Treatment Plant (see Appendix A, p.3)
Address	Kayleen Court Deeragun Qld 4818
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Emissions to	Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Deeragun STP location

Mt Low

Facility	Mt Low Sewage Treatment Plant (see Appendix A, p.4)
Address	Brabon Road Mt Low Qld 4818
Main activities	Sewage treatment by activated sludge (extended aeration) to a secondary standard
Emissions to	Land and water
NPI Report Years	2005/2006, 2002/2003 and 1999/2000

Mt Low STP location

Cleveland Bay STP

Facility	Cleveland Bay Sewage Treatment Plant (see Appendix A, p.5)
Address	Cleveland Bay Townsville Qld 4810
Main activities	Treatment of wastewater as part of wastewater service provided to TCC declared sewage treatment areas.
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2003/2004 and 2001/2002

Source: J Gunn

Source: J Gunn

Cleveland Bay STP location

The Cleveland Bay Wastewater Purification Plant (CBPP) is receiving a $65 million upgrade in order to meet more stringent Environmental Protection Agency (EPA) licence conditions that come into force in January 2008. Over 16 months, the plant will be completely rebuilt. When finished, the Cleveland Bay facility will be the largest membrane bioreactor wastewater treatment plant of its type in the southern hemisphere, recycling about 20 megalitres of treated effluent each day.

The membrane bioreactor technology allows the effluent to be treated to a very high standard by significantly reducing the level of nitrogen and phosphorous.

As part of the upgrade, a $9 million Biosolids Dewatering Facility has also been constructed which turns sewage sludge into a soil conditioner, suitable for the agricultural sector. This has further enhanced the environmental sustainability of the plant.

(Formerly available online at http://www.townsville.qld.gov.au/citiwater/cleveland.asp)

Mt St John

Facility	Mt St John Sewage Treatment Plant (see Appendix A, p.6)
Address	Mt St John Road Townsville Qld 4818
Main activities	Treatment of wastewater as part of wastewater service provided to TCC declared sewage treatment areas.
Emissions to	Air, Land and water
NPI Report Years	2005/2006, 2003/2004 and 2001/2002

Mt St John STP location

Mt St John Wastewater Treatment Plant (MSJ) is one of Townsville's major wastewater treatment plants. It started operations in 1972 and has been continually upgraded since then to meet the demands of an ever increasing population.

MSJ Wastewater Treatment Plant consists of a primary screen, aerated grit tank, primary clarifiers, biofilters, secondary clarifiers, sludge digestion tanks, sludge drying beds and UV disinfection. Sewage at this plant goes to primary and secondary levels of treatment.

MSJ receives between 11 and 13 million litres of raw sewage every day. Some treated effluent is reused to irrigate the plant grounds, the RAAF Base, Rowes Bay Golf Course, and Pallarenda foreshore.

Operation conditions for MSJ comply with the International Quality Management System ISO 9001 and effluent treatment and release is in accordance with EPA licensing agreements.

(Formerly available online at http://www.townsville.qld.gov.au/citiwater/mtstjohn.asp)

Magnetic Island

Nelly Bay

The Nelly Bay facility is now ownly utilised by a a small number of households in the vicinity of the plant and accepts trade waste from around the island. The predominant use it to treat the trade waste as it is problematic for the newer facilities at Picnic Bay and Horseshoe Bay. There is no discharge from the plant as the treatment volume is low and evaporation is equivalent to the input volume.

Picnic Bay

Magnetic Island Water Recycling (MIWR) was successfully commissioned in October 2002. It is the first use in Australia of a membrane biological reactor in a wastewater treatment facility. The facility treats wastewater to one of the highest levels achieved in the world, with a 100% re-use target of the final product for irrigation purposes.

The key points regarding Magnetic Island Water Recycling are:

- MIWR is built to world best practice;
- It is the first use of a new technology in Australia;
- MIWR has world significance, as it the first use in the world of nutrient removal processes ahead of membrane technology;
- MIWR provides a sustainable solution for the use of scarce resource water on Magnetic Island, with the treatment of wastewater to one of the highest levels achieved in the world and the development of 100% recycling of water;
- Nutrients such as nitrogen and phosphorous are reduced to the lowest levels possible in terms of world best practice.

MIWR is environmentally sensitive in other ways:

- The treatment facility has NO OUTFALL to the Great Barrier Reef Marine Park;
- The minimal sludge produced is re-used on the Island;
- Recycled water is stored during wet weather;
- A wetland system further filters any recycled water, released in the aftermath of tropical storms, before it reaches the ocean.

(Formerly available online at http://www.townsville.qld.gov.au/citiwater/MIWR.asp)

Horseshoe Bay

The wastewater treatment plant at Horseshoe Bay forms the heart of an innovative water recycling scheme that provides greater protection to the Great Barrier Reef Marine Park.

The facility was commissioned in September 2006 and uses advanced membrane bioreactor technology (MBR) - a technology also used at the treatment plant at Picnic Bay.

This technology has many benefits including its ability to produce high quality treated effluent by filtering out small particles that would not be removed during conventional treatment, and its vastly reduced reliance on chemicals such as chlorine.

By using this recycled water to irrigate some of Magnetic Island's local recreational areas, Citiwater is ensuring there is no discharge into Horseshoe Bay.

Dry Tropics Rainforest
This rainforest was purpose-built to receive the water from the treatment plant. It covers 2.5 hectares and consists of more than 8000 plants from 86 different species. These plants are flourishing, in part because of some of the nutrients that remain in the water.

Planted with the assistance of the Magnetic Island community, the park has become a sanctuary for native birds while greatly improving the area's biodiversity.

(Formerly available at http://www.townsville.qld.gov.au/citiwater/horseshoebay.asp

Maunsell 2008, *Wastewater Upgrade Program Planning Report*, Townsville City Council, Townsville.

Executive Summary

The Townsville region is undergoing significant population growth and this is placing pressure on the region's wastewater infrastructure. Table 1 below shows the projected population growth till 2025 and the corresponding capacities at each of the region's wastewater purification plants (WPP).

Table 1 – Population Projections

2008 2009 2010 2015 2025Available plant capacity

	Projected population (EP) for various end of calendar years					
	2008	2009	2010	2015	2025	Available plant capacity (EP)
Cleveland Bay WPP Catchment						
Eastern /Western/Southern	102,000	103,050	104,100	109,358	120,799	
Sub-Total Cleveland Bay	102,000	103,050	104,100	109,358	120,799	126,000
Mt St John WPP Catchment						
Mt Louisa	5,200	5,460	5,730	7,310	11,920	
Mather St PS Balance Area	18,400	18,400	18,400	18,400	18,400	
Kirwan	27,200	27,600	28,000	30,000	32,100	
Sub-Total Mt St John	50,800	51,460	52,130	55,710	62,420	45,000
Condon WPP Catchment						
Condon/Kelso/Rasmussen	17,000	17,600	18,200	20,600	24,200	
Bohle Plains	1,500	2,000	2,600	8,100	14,700	
Sub-Total Condon	18,500	19,600	20,800	28,700	38,900	23,000
Mt Low WPP Catchment						
Mt Low/ Bushland Beach	4,000	4,900	5,800	9,250	13,790	
Sub-Total Mt Low	4,000	4,900	5,800	9,250	29,340	3,000
Deeragun WPP Catchment						
Deeragun/ Burdell	3,550	4,520	5,870	9,120	15,550	
Sub-Total Deeragun	3,550	4,420	5,870	9,120	15,550	4,300
Overall Total All Catchments	178,850	183,430	188,700	212,138	267,009	201,300

The figures highlight that there is only a small amount of capacity remaining in existing wastewater treatment infrastructure. A number of existing treatment plants have reached or will soon reach their maximum treatment capacity and hence there is an imperative that the new Townsville City Council (TCC) ensures the timely delivery of additional treatment infrastructure to meet the ongoing growth needs of the Townsville community.

Submissions for Pre-Amalgamation Projects

Prior to the amalgamation of Townsville City Council and the City of Thuringowa (COT) Council in March 2008 to form the New Townsville City Council, each entity was responsible for their own catchments and infrastructure. The MCU applications were made by the new Townsville City Council for the previous City of Thuringowa projects for the following works:

- Interim plant upgrades to Mt Low and Deeragun WPP's to provide sufficient capacity and treatment capability to meet the load requirements till 2010.
- Upgrades to Mt Low WPP and Condon WPP's. Deeragun WPP was to be decommissioned.

In addition to the MCU applications, the new TCC had also submitted applications for subsidy for the upgrades required to the three plants (both the interim and major upgrades at Mt Low were applied for). TCC had recently upgraded their Cleveland Bay WPP, and were considering a quality upgrade to their Mt St John WPP to meet EPA discharge limits.

Environmental Constraints

Subsequent to the MCU applications for Mt Low and Condon, the EPA had revised their discharge limits for discharges from Condon (which discharges into the upper freshwater reaches of the Bohle River) and for Mount Low (which discharges into the mouth of the Black River). These revised limits were much more stringent and were based on the receiving waters for both these discharges being not suitable to receive the proposed nutrient loads.

For Condon, the EPA has indicated previously that they would prefer that no additional flows should be discharged to the Bohle River as it is an Ephemeral Stream at the discharge location of Condon WPP.

Also for the Mt Low discharge to the Black River, EPA's position was that the assimilation capacities of the Black River were not well understood.

To comply with these new limits required significantly more capital infrastructure. That is capital estimates went from $152.9M to $267.7M, an increase of $114.8M.

Post Amalgamation - A Regional Strategy

The amalgamation of the two councils provided a previously unrealisable opportunity to review the strategies in a more regional context. At the same time the New Townsville City Council was reviewing their potable water regional strategy with a view to looking at potable water replacement opportunities as a means of deferring a potable water upgrade to their Toonpan WTP. The new TCC asked the project design team to develop and review a number of regional strategies for wastewater treatment against the existing approach to ensure the best long-term approach is adopted.

After investigating a wide range of potential scenarios, the project team settled on two broad strategies to conduct an in depth comparison, a decentralised and a centralised option. The pre-amalgamation approach detailed above was considered a decentralised approach with upgrades to three of the WPPs (ie. Mt St John, Condon, and Mt Low). This was compared to a single large upgrade at the Mt St John WPP and the diversion of the major growth areas to this plant, referred to as the centralised approach.

A combination of cost (capital, operating and lifecycle (NPV)) and non-financial criteria were used to assess the two options including:

1) Capital Cost
2) Operating & Maintenance (O&M) Cost implications.
3) Environmental Considerations including GHG considerations and immediate and long term impacts on receiving waters.
4) Opportunity of the option for generating future reuse opportunities.
5) Social Considerations including potential odour, noise and visual impacts.
6) That the infrastructure provides a sound long term base for the future.
7) Project Timing

Table 2 shows the cost summary for the two options (from the report titled, Regional Strategy Review & Preliminary Business Case, June 2008):

Table 2 – Capital Cost Comparison

	Decentralised	**Centralised**
Overall Capital Cost	$264m	$189m#
Operations & Maintenance at 2025	$5m	$4m
Life Cycle Cost (Total Present Value over at 7% over 15 years to 2025)	$306m	$236m

Note: # includes costs only estimated for items in the Business Case Report.

On the basis of the of the approximate $75M capital cost saving, net present value, and the non financial analysis, the business case for the centralised option was compelling and was endorsed by council on 22 July, 2008.

Integrated Water Management

TCC recognise the importance of considering the WPP upgrades in light of any future integrated water management strategy developed for the region. Potable water replacement initiatives for recycling effluent have real and tangible benefits in deferring water infrastructure requirements for the Townsville region and this was considered in the regional strategy developed.

TCC have commenced an investigation into the feasibility of deferring capital for the upgrade to Toonpan WTP through the introduction of both two tiered water pricing and potable water replacement strategies. However, this is only the first phase of this study. Council is likely to require some time (more than 2-3 years) to develop a market for reuse. This is because there is a need to align the current price of potable water to represent the margin cost of providing future potable capacity. A full understanding of the future costs of both potable and recycled water in Townsville needs to be attained before a plan for future recycling in the region can be developed and assessed. As a result effluent re-use and potable water replacement does not form part of this planning report.

A Three Stage Approach

The new Townsville City Council has undertaken a thorough re-evaluation of wastewater upgrade options from a regional perspective. Given the population growth pressures and time constraints a staged approach is required to ensure infrastructure can meet short and long terms needs of the community. Three stages are proposed:

1. Stage One will involve interim upgrades at the existing Deeragun and Mt Low sites to allow these plants to meet EPA requirements until new infrastructure can be provided around 2010 to meet the region's longer term needs. Both these sites will be decommissioned once Stage Two works are fully operational.

2. Stage Two is focused on providing the necessary wastewater treatment infrastructure to meet the requirements to 2025 and is the main focus of this planning report.

3. Stage Three is focused on providing the additional infrastructure required to further reduce nutrient discharge from all discharge locations. The focus will be on developing a regional water management plan. The aim of this plan is to consider water supply in Townsville in an integrated way. It is likely from this plan that effluent reuse can be used to offset the need or defer the next potable replacement upgrade. This will also reduce the nutrient discharges to the environment resulting in a "win win" outcome. TCC intend to seek additional Federal funding to assist with the implementation of Stage Three infrastructure and will be the subject of a separate planning report.

Stage 1 – Interim Upgrades

The objective of the interim upgrades to Mount Low and Deeragun WPP's is to provide sufficient short term capacity to enable the design, construction and commissioning of the major upgrade to Mt St John WPP to be completed without failure of the plant's licence conditions.

Improvements to the plant capacity are to be achieved through minor plant changes such as:

- Bypassing of wet weather flows in excess of 3 x ADWF;
- Upgrades to disinfection systems;
- Additional aeration capacity to the oxidation ditches;
- Aerobic digestion of the sludge.

The interim upgrade works will be issued for tender in September, with works expected to commence late November 2008. The estimated capital requirement for these works (both plants) is $3.2M.

Stage 2 – Centralised Strategy
A summary of the capital works includes the following:

- Construction of a 106,500EP BNR upgrade to Mt St John WPP;
- Diversion of sewer flows from Bushland Beach/Deeragun to Mt St John WPP;
- Diversion of sewer flows from Kirwan/Bohle Plains to Mt St John WPP;
- Transfer of Bohle Industrial WPP effluent to Mount St John WPP;
- Decommissioning of Mt Low / Deeragun WPPs.

The existing plant at Condon would remain and provide treatment to the Upper Ross catchment only (Condon/Kelso/Rasmussen) avoiding the need for a capacity upgrade to Condon until 2025.

Conclusion & Recommendation
TCC has developed a systematic and logical three stage strategic approach to address the population growth on Townsville's wastewater treatment infrastructure. The three stage approach prioritises action given the timing imperative to deliver the overall wastewater upgrade program.

The adopted strategy is the correct investment decision for the following reasons [part only]:

- It reduces the loads and environmental impact to the sensitive receiving waterways of the upper freshwater reaches of the Bohle.
- It eliminates discharge to the sensitive receiving waterways of the Black River.
- It upgrades the existing Mt St John WPP leading to significant load reduction to the estuary of the Bohle River (70% nitrogen, 62% phosphorus and >98% ammonia). These levels can be further improved by increased effluent reuse.

It is therefore recommended that the three stage strategy implemented by TCC be endorsed and funding be assessed on the full capital works value of $206.9 M.

Appendix C

Atmospheric Emission Dispersion Modelling

Appendix C Atmospheric Emission Dispersion Modelling

Yabulu Dispersion Modelling

Dispersion modeling is generally carried out prior to the construction of industrial facilities to determine the potential pollutant levels associated with atmospheric emissions, generally from chimney stacks. Follow up studies are often undertaken to check the known emissions from a stack and calibrate models with monitored outputs.

A recent modeling study was commissioned by BHP Billiton Yabulu Refinery for one of the stacks at the Yabulu nickel refinery. A summary of the results from the report is provided below. Creek to Coral would like to acknowledge BHP Billiton Yabulua for making the report available (Pacific Air and Environment 2007, *QNI Air Quality and Health Risk Assessment Report*, Queensland Nickel Industries Limited).

The stacks at Yabulu are listed in Table A. The subject of the report was stack 330.

Table A Stacks at Yabulu

Stack	Height
330 Stack	77m
320 Stack	77m
380/514	92m
380 line 2 stack (new)	65m
514 stack (new)	92m

The scope of the study was to predict ground level concentrations for particulates (PM_{10}), NO_2, SO_2, benzene, toluene, ethylbenzene, xylenes and odour.

"*Dispersion modelling was performed using the CALPUFF dispersion model utilizing three-dimensional output from the CALMET meteorological pre-processor.*

The results of the dispersion modelling indicate that pollutant concentrations surrounding the Yabulu Refinery due to emissions from Stack 330 remain within the relevant state and federal air quality criteria."
(PAE, p.iii)

The concentrations of pollutants in ambient air are essential in characterising the airborne exposure pathway and in the overall risk assessment process. The modelling output for the study is reported as a concentration of pollutants in the air column in micro grams per cubic metre for all pollutants.

Pollutant concentrations are used to estimate the health risk or hazards associated with the emissions from industrial facilities. Concentrations and dispersion patterns of atmospheric pollutants can also be used to provide an indication of potential issues for water quality.

As with most situations monitoring is the most accurate way to determine pollutant concentrations. With air quality monitoring "*it is time consuming, costly and is typically limited to a few receptor locations. Air dispersion modelling, by contrast, is relatively inexpensive, is less time consuming, and also provides greater flexibility in terms of receptor locations, assessment of individual and cumulative source contributions, and characterisation of concentration over greater spatial extents.*

Models have therefore become a primary analytical tool in most air quality assessments. However, monitoring can be used in a complementary manner to dispersion models, and is particularly useful in assessing the accuracy of model estimates, especially when the relevant authority's air quality guidelines are approached."
(PAE, p.1)

The main factors in determining the fate of atmospheric emissions from stacks are weather related. This includes wind speed and direction, atmospheric turbulence and mixing height.

"*Wind direction dictates the direction in which the plume travels. Thus, over a long period, the temporal variation of wind directions determines the spatial pattern of average ground level concentrations. Wind speed influences the initial dilution of the plume as it leaves the source and also affects plume rise, with higher wind speeds resulting in smaller plume rise. Broadly, higher wind speeds result in lower ground level concentrations*." (PAE, p.5)

"*An important aspect of plume dispersion is the level of turbulence in the atmospheric boundary layer. Turbulence acts to dilute or diffuse a plume by increasing the cross-sectional area of the plume due to random motions. As turbulence increases, the rate of plume dilution, or diffusion, increases. Weak turbulence limits diffusion and is a critical factor in causing high plume concentrations downwind of a source.*

Turbulence is related to the vertical temperature gradient, the condition of which determines what is known as stability, or thermal stability". (PAE, p.6)

"*Mixing height is variable in space and time, and typically increases during fair-weather daytime over land from tens to hundreds of metres around sunrise up to one to four kilometres in the mid-afternoon, depending on the location, season and day-to-day weather conditions.*

Two different types of temperature inversion frequently develop and may lead to air pollution episodes. These are:

- *Radiation or surface inversions that form overnight through rapid cooling of the ground and surface air layers; and*
- *Subsidence inversions that form at various heights above the ground due to subsiding air associated with the anticyclone.*

Radiation inversions are usually short-lived and rarely persist beyond mid-morning. Subsidence inversions may persist for up to six days while the associated anticyclone is in the vicinity. Short periods of severe air pollution can occur with radiation inversions but sustained pollution events result from subsidence inversions.

Average mixing heights during the night and early morning hours are generally lower than 150 m, increasing after sunrise to an average maximum of 900 m (90th percentile of 1300 m) by mid-afternoon in response to convective mixing that results from solar heating of the earth's surface." (PAE, p.8)

The model calculated concentration or deposition for each point on the grid, and then used a suitable interpolation method to draw a continuous contour line (see Figure A).

"*Ground level concentrations were calculated over a grid of uniformly spaced receptor points 250 m apart over an area of 15 km by 15 km. In addition to this, concentrations over eight sensitive receptors, representing populated areas, were also calculated*." (PAE, p.16)

For PM_{10} there were no incidences of exceedance over the entire domain.

For NO_2 there were no incidences of exceedance over the entire domain for any of the averaging periods assessed.

For SO_2 there were no incidences of exceedance over the entire domain for any of the averaging periods assessed.

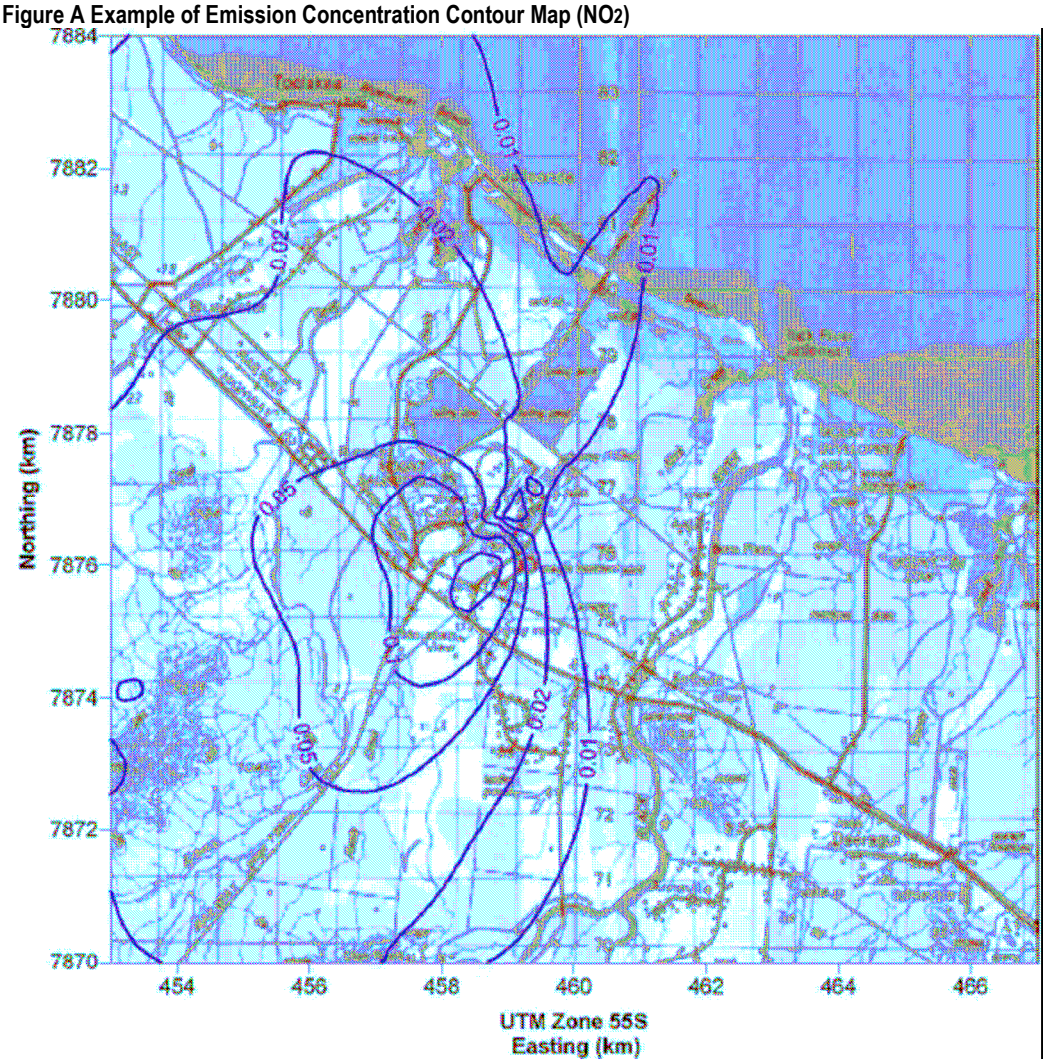
Similarly there were no incidences of exceedance for Benzene, Toluene, Xylenes or Ethyl Benzene. Results are listed in Table B.

Table B Summary Results from Dispersion Modelling

Pollutant	Emission rates (g/s)	Annual Ave	Guideline	Hour	Guideline
PM_{10}	16.87	1	50	5 (24 hr)	150
NO_2	2.94	<1	30	10 (1 hr)	320
SO_2	22	1	60	50 (1 hr)	570
Benzene	11.77	1	10.4		
Toluene	1.68			0.5 (24 hr)	8,000
Xylenes	0.8			0.2 (24 hr)	947
Ethyl benzene	0.21			1 (3 minute)	14,500

Source: PAE, p.14 Notes: Emission rates are those leaving the stack. Concentrations of pollutants are expressed in micro grams per cubic metre. Annual Ave (average) and Hour columns are results of the modeling study with guideline values for the pollutant in the column on the right. Maximum concentrations over various time frames are measured for different pollutants and this is expressed in the Hout column with the actual time period expressed in brackets.

Figure A Example of Emission Concentration Contour Map (NO_2)



Source Figure 5.4 (PAE, p.21) Average Annual Concentration of NO_2

Appendix D

Diffuse Emission Calculations for Townsville

Aircraft and Airport Emissions

Data below is sourced from *Townsville International Airport - Environment Strategy 2004* (Australian Airports (Townsville) Pty Ltd (AAL)) available at http://www.townsvilleairport.com.au/environment.php

Total emissions from airport operations for 1999 were calculated for inclusion in the Environment Strategy for Townsville Airport (see Table A).

Table A Total Emissions released from Townsville Airport operations for 1999

Pollutant	Total Emissions	
	Kilograms	Tonnes
Hydrocarbons (HC)/Volatile Organic Compounds (**VOC**s)	82,694	82.5
Carbon monoxide (**CO**)	220,109	220
Oxides of nitrogen (**NOx**)	47,675	47.5
Sulphur dioxide (SO_2)	6,535	6.5
Particulate matter (**PM**)	7,332	7

Source: (AAL 2004, p.125 [undertaken by Air Noise Environment Pty Ltd])

In addition to the substances listed in Table A there are unquantified emissions of:

- Ozone (O3);
- Chlorofluorocarbons (CFCs); and
- Other greenhouse gases.

The figures presented above should be used only as a baseline of air emissions from Townsville Airport. Nevertheless, estimates of air emissions from the airport are relatively low and were assessed as having a negligible impact on the airshed. There was no mention of potential water quality impacts associated with emissions to air.

The major sources of these air emissions at Townsville airport are:

- Combustion of aviation fuels during landing, take off and engine idling;
- Exhaust emissions from non-aircraft vehicles and ground service equipment;
- Refuelling of aircraft and other vehicles;
- Storage of fuel;
- Lawn mowing;
- Ground operation of helicopters;
- Maintenance of aircraft;
- Maintenance of ground service equipment.

Additional minor sources of air emissions include:

- Air conditioning;
- The use of generators and pumps;
- Venting of aircraft fuel;
- Surface painting and paint stripping;
- Fumigation; and
- Fire fighting exercises and operations.

Water bodies adjacent to the Townsville airport include:

- Louisa Creek;
- Rowes Bay Canal; and
- Bohle River estuary.

Drainage from the airport flows to the Rowes Bay Canal. Rowes Bay Canal is the third largest drainage basin in urban Townsville. The western arm of the canal drains the airport environs bounded to the west by the airport runway 01/19 embankment, combined with the drainage of the Garbutt area in the north. The catchment area is approximately 334 hectares, and drains into Rowes Bay, which is a part of the Great Barrier Reef World Heritage Area. (AAL 2004, p.33)

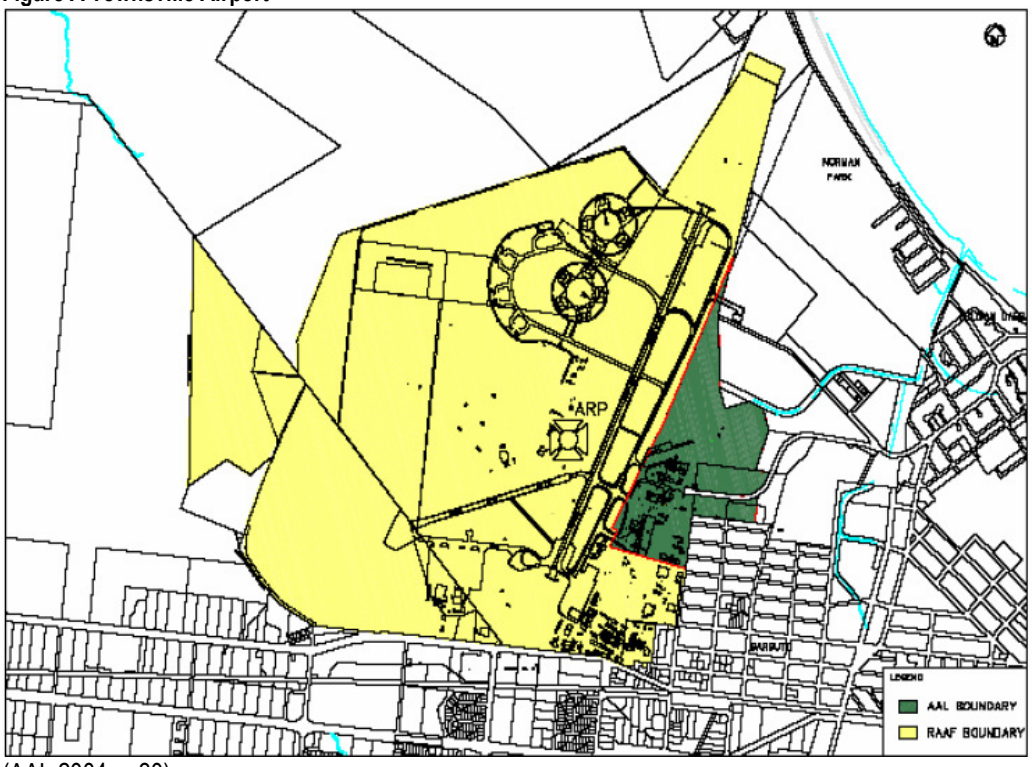
Activities associated with airport operations that have the potential to impact on water quality include:

- Increased erosion and sedimentation;
- Oil, lubricant and fuel leakage spills;
- Untreated oil, grease and detergents being released into water systems;
- Venting of fuel from aircraft;
- Runoff of herbicides and pesticides around airport grounds; and
- Untreated sewage being released into water systems.

(AAL 2004, pp.125-127)

The civil aviation section of the Townsville Airport is leased and operated by AAL and covers an area of 82 hectares. The remainder of the airport, including the runways, is controlled and operated by the RAAF (approximately 800 hectares). The RAAF Base Townsville has its own Environment Management System (EMS) certified to the international best practice standard for Environmental Management Systems ISO 14001. (AAL 2004, pp.27-31)

Figure A Townsville Airport



(AAL 2004, p.30)

Airport Stormwater Drainage System

Run-off from the international and domestic terminal areas flows via an underground system of pipe work into the open lined drain running along the eastern boundary of the airport. Another piped system drains the developed section of the northern building area. Stormwater samples are routinely taken downstream from these outlets. The northern part of the AAL leased area drains into an open eastern drain, north of the Airport Access Road, which in turn also drains into the western arm of the Rowes Bay Canal (which is part of the Great Barrier Reef World Heritage Area).

The Airport Drainage Canal flows in a generally northeasterly direction until it meets the western arm of the Rowes Bay Canal. This combined canal flows through Old Common Road until it meets the Rowes Bay Canal 170m upstream of the Townsville City Council Tide Gates. These Tide Gates are situated near Evans Street, Belgian Gardens, and some 700m from the outlet. The canal outlets onto the beach at Rowes Bay approximately 730m northwest of the Bundock Street/Heatley's Parade intersection.
(AAL 2004,pp.33-36)

Stormwater quality is important due to its eventual discharge into downstream estuarine environments. Investigations into sources of stormwater contamination and sources at the airport had been commenced in 1999. Stormwater monitoring undertaken by AAL during the period between 1999 and 2004 has indicated the presence of potential contaminants in low levels including metals, petroleum hydrocarbons, detergents, nutrients, oils, grease and BTEX in stormwater samples. AAL has implemented a range of measures to improve the stormwater quality within the airport.

Based on earlier full scans of potential contaminants, monitoring is targeted towards contaminants of concerns including metals and TPH. Such monitoring focuses on representative samples at four rising stage samplers across the wet season (December – March) each year, including first flush samples when quality is prone to be poor. (AAL 2004, p.36)

The Draft Townsville International Airport Environment Strategy identified the discharge of contaminated stormwater as one of the high-risk environmental issues for Townsville International Airport (AAL 2004, pp.131-134).

Annual Air Traffic Movement

Data associated with Townsville air traffic movement (see Table B and Table C) shows trends, which indicate that emissions associated with the Townsville Airport may have decreased from 1998 to 2004 before air traffic started to increase again. Estimates of air emissions made in 1999 are likely to be greater than for 2008 and would be well within one order of magnitude variation giving confidence that calculations made using these figures will be an overestimate of current emissions.

Table B Aircraft movements at Townsville Airport 1998 to 2007

Year	>136 tonne	7-136 tonne	< 7 tonne	Helicopter	Unknown	Military	Total
1998	4	24,116	35,028	3,280	1,076	14,360	77,864
1999	68	22,580	35,782	1,790	94	9,214	69,528
2000	56	24,722	32,842	1,938	278	9,802	69,638
2001	134	20,676	31,152	2,110	190	11,302	65,564
2002	124	16,756	25,522	1,938	332	9,622	54,294
2003	60	18,818	23,428	1,866	138	8,364	52,674
2004	10	20,046	18,690	1,424	24	6,760	46,954
2005	38	21,518	19,020	1,498	282	5,744	48,100
2006	76	25,248	23,110	1,564	-	6,162	56,160
2007	46	25,290	28,052	1,620	-	5,020	60,028

Note: 1998 figures extrapolated from six months data July to December. 1998 to 2005 derived from AVCHARGES data by Airservices Australia. 2006 and 2007 data sourced from the Operational Data Warehouse by Airservices Australia (Source: http://www.airservices.gov.au/projectsservices/reports/default.asp)

Table C Ratio of aircraft movements by type at Townsville Airport 1998 to 2007

Year	>136 tonne	7-136 tonne	< 7 tonne	Helicopter	Unknown	Military
1998	0.01	30.97	44.99	4.21	1.38	18.44
1999	0.10	32.48	51.46	2.57	0.14	13.25
2000	0.08	35.56	47.24	2.79	0.40	14.10
2001	0.20	31.54	47.51	3.22	0.29	17.24
2002	0.23	30.86	47.01	3.57	0.61	17.72
2003	0.11	35.73	44.48	3.54	0.26	15.88
2004	0.02	42.69	39.80	3.03	0.05	14.40
2005	0.08	44.74	39.54	3.11	0.59	11.94
2006	0.14	44.96	41.15	2.78		10.97
2007	0.08	42.13	46.73	2.70		8.36

Assuming a potential settling area for the air emissions of 700 hectares i.e. approximate area of the airport. Particulate matter - 7 tonnes per annum / 700 hectares is 0.01 tonne per hectare, which is roughly equivalent to a thickness of 0.001 mm. Oxides of nitrogen – 47 tonnes per annum / 700 hectares is 0.07 tonnes per hectare or 70 kg per hectare. It is unlikely that this quantity of NO_x would settle out in the vicinity of the airport as it is by nature more mobile than particulate matter and would be dispersed throughout the airshed. If 10% (7kg per hectare) of the NO_x emissions settled within the 700 hectare catchment the quantity is not significant and would not constitute a risk to water quality. In comparison cane farms apply approximately 180 kg/hectare per annum of nitrogen to crops.

Similarly sulphur dioxide, at 7 tonnes per annum, is not a significant quantity and would not constitute a risk to water quality.

Passenger Numbers

While aircraft movements have decreased the number of passengers has increased steadily (see Table D) reflecting the increase in capacity of aircraft and higher utilisation rates. The increase in utilisation rates was triggered by the introduction of lower priced airfares after the demise of Ansett and the entry of Virgin Blue into the domestic market in 2000.

Table D Passenger numbers at Townsville Airport

Year	Domestic	Regional	International	Total
1990/91	316,828	82,112	11,311	410,251
1991/92	350,899	102,023	-	452,922
1992/93	446,276	105,934	2,874	555,084
1993/94	389,140	119,391	5,557	514,358
1994/95	435,518	139,558	1,611	576,687
1995/96	454,567	143,548	-	598,115
1996/97	463,585	143,474	94	607,426
1997/98	478,228	149,528	146	627,902
1998/99	492,584	159,622	658	652,864
1999/2000	509,439	172,199	-	681,638
2003/04				920,000
2004/05				980,000
2005/06				1,150,000
2006/07				1,385,000
2007/08				1,485,000

Notes: Regional airline data is known to be incomplete. Domestic airline data was affected by a change in definition following 1991/92 and data from 1992/93 may include passengers in transit. Source of data for 1990 to 2000 was the Department of Transport and Regional Development 2001 (http://previous.townsville.qld.gov.au/atlas/economic_6.asp). 2003 to 2008 data interpreted from http://www.townsvilleairport.com.au/statistics.php

Townsville Airport handled 1,485,000 passengers to 30 June 2008, with most passengers originating from domestic sources, particularly within Queensland. Between 06/07 and 07/08 Townsville Airport experienced a 7.2% growth in passengers. Over the past six years the Airport has seen an 11.6% Average Annual Growth Rate (Source: http://www.townsvilleairport.com.au/ statistics.php).

Updated Flight Info for Townsville Airport

Analysis of flight information from the airlines operating into and out of Townsville International Airport show that approximately 500 flights operate in the region each week (see Table C). The airlines of interest are QANTAS, Jetstar, Virgin Blue, MacAir and SkyTrans as well as occasional flights by the tourist airplane the Red Baron.

Table E Breakdown of Townsville International Airport flight activity

	Small Inbound	Small Outbound	Large Inbound	Large Outbound	Red Baron	TOTAL
Monday	18	18	17	17	5	**75**
Tuesday	16	16	18	18	5	**73**
Wednesday	16	16	20	20	5	**77**
Thursday	17	17	18	18	5	**75**
Friday	17	17	20	20	5	**79**
Saturday	15	15	11	11	5	**57**
Sunday	12	12	16	16	5	**61**
Weekly Total	**111**	**111**	**120**	**120**	**35**	**497**
Annual Total	5,772	5,772	6,240	6,240	1,820	25,844

Note: The annual total is based on multiplying the weekly totals by 52. This may not be a true reflection of the actual number of flights

The busiest day of the week is Friday (79 flights in total), while Saturday has the least activity (57 flights in total). The predominant flight type was large incoming and outbound flights, mainly operated by QANTAS, Jetstar and Virgin Blue.

Large inbound and outbound flights most often used Boeing 737 and Airbus Industrie A320 aircraft. Smaller flights were mostly operated on De Havilland DHC-8 Series aircraft.

The Red Baron is a Grumman Sea-Cat tourist charter plane and as such does not have a fixed flight schedule. Management of the Red Baron estimate the plane to operate approximately 5 times each day depending on demand and local weather conditions.

This breakdown of flights into and out of Townsville has taken into account all available information. However, a large portion of aircraft activity in the Townsville air shed is operated by the Australian military and updated information was not publicly available. Similarly, information on charter flights operated by Alliance Airlines and other operators was not available. Consequently the listed activity relates to general commercial aircraft only. The flight activity listed above was compiled in late October 2008.

Lawnmower Emissions

Emissions from lawn mowers have been calculated based on assumptions of 30,000 two stroke mowers and 30,000 four stroke mowers in the Townsville region and usage of 1 hour per mower per fortnight i.e. 780,000 two stroke lawn mower hours per year and 780,000 four stroke lawn mower hours per year.

If we assume that the mowing footprint is 150 square kilometres (the same as for gross pollutants) and all of the oxides of nitrogen and particulate matter settles within the mowing footprint then we have a contribution from lawn mowers of 0.43 kg/ha per year of particulate matter and 0.33 kg/ha year of oxides of nitrogen.

Table F Estimate of Lawnmower Emissions for Townsville

Emission type	2 stroke EF	Kg/year	4 stroke EF	Kg/year	Total/year	
					Kg	Tonne
Benzene	17	13260	2.3	1794	15054	15
1,3-Butadiene	2.16	1684.8	0.292	227.76	1912.56	1.9
Carbon monoxide	731	570180	489	381420	951600	952
Chromium (III) compounds	0.00332	2.5896	0.000219	0.17082	2.76042	0.003
Chromium (VI) compounds	0.00138	1.0764	0.000091	0.07098	1.14738	0.001
Cobalt and compounds	0.0047	3.666	0.00031	0.2418	3.9078	0.004
Copper and compounds	0.0047	3.666	0.00031	0.2418	3.9078	0.004
Cyclohexane	0.517	403.26	0.07	54.6	457.86	0.5
Ethylbenzene	3.96	3088.8	0.534	416.52	3505.32	3.5
Formaldehyde	2.8	2184	0.68	530.4	2714.4	2.7
Lead and compounds	0.0002	0.156	0.001	0.78	0.936	0.001
n-Hexane	0.548	427.44	0.74	577.2	1004.64	1
Manganese and compounds	0.0047	3.666	0.00031	0.2418	3.9078	0.004
Nickel and compounds	0.0047	3.666	0.00031	0.2418	3.9078	0.004
Oxides of nitrogen	1.45	1131	4.85	3783	4914	4.9
Particulate matter ≤ 10 µm	7.8	6084	0.515	401.7	6485.7	6.5
Polycyclic aromatic hydrocarbons	0.895	698.1	0.121	94.38	792.48	0.8
Styrene	0.304	237.12	0.041	31.98	269.1	0.3
Sulphur dioxide	0.3	234	0.206	160.68	394.68	0.4
Toluene	28.6	22308	3.87	3018.6	25326.6	25
Total volatile organic compounds (VOCs)	304	237120	41.1	32058	269178	269
Xylenes	21	16380	2.83	2207.4	18587.4	18.6
Zinc and compounds	0.0047	3.666	0.00031	0.2418	3.9078	0.004

Notes: EF is the emission factor for each substance for lawn mowers in grams per hour.

A comparison of calculated emissions for Townsville to emissions from Australia as calculated by the NPI is provided in Table G.

Table G Lawn Mower Emissions Australia 2006/2007

	Kilograms per year emissions to air		
Substance	**Australia**	**Townsville 1**	**Townsville 2**
Benzene	910,000	9,100	15,000
Biphenyl (1,1-biphenyl)	63	0.63	
1,3-Butadiene (vinyl ethylene)	110,000	1,100	1,900
Carbon disulfide	570	5.7	
Carbon monoxide	86,000,000	860,000	952,000
Chloroethane (ethyl chloride)	1,800	18	
Chloroform (trichloromethane)	3,200	32	
Chromium (III) compounds	120	1.2	2.8
Chromium (VI) compounds	80	0.8	1.1
Cobalt & compounds	200	2	3.9
Copper & compounds	330	3.3	3.9
Cumene (1-methylethylbenzene)	82	0.82	
Cyanide (inorganic) compounds	2.6	0.03	
Cyclohexane	90,000	900	458
1,2-Dibromoethane	2,700	27	
Dibutyl phthalate	250	2.5	
1,2-Dichloroethane	3,700	37	
Dichloromethane	4,800	48	
Ethanol	8,600		
2-Ethoxyethanol	2,300	23	
2-Ethoxyethanol acetate	2,300	23	
Ethyl acetate	2,800	28	
Ethylbenzene	310,000	3,100	3,500
Ethylene glycol (1,2-ethanediol)	2,300	23	
Ethylene oxide	2,400	24	
Formaldehyde (methyl aldehyde)	210,000	2,100	2,717
n-Hexane	200,000	2,000	1,004
Hydrogen sulfide	0.020	-	
Lead & compounds	690	6.9	1
Manganese & compounds	240	2.4	4
Methanol	8,900	89	
2-Methoxyethanol	2,500	25	
Methyl ethyl ketone	7,700	77	
Methyl isobutyl ketone	3,600	36	
Methyl methacrylate	2,900	29	
Nickel & compounds	200	2	4
Oxides of Nitrogen	390,000	3,900	4,900
Particulate Matter 10.0 um	540,000	5,400	6,486
Phenol	2,800	28	
Polychlorinated dioxins and furans	0.00000067	-	
Polycyclic aromatic hydrocarbons	35,000	350	792
Styrene (ethenylbenzene)	28,000	280	269
Sulphur dioxide	88,000	880	395
Tetrachloroethylene	4,400	44	
Toluene (methylbenzene)	1,800,000	18,000	25,236
Total Volatile Organic Compounds	19,000,000	190,000	269,178
1,1,2-Trichloroethane	2,200	22	
Trichloroethylene	2,700	27	

Vinyl Chloride Monomer	2,700	27	
Xylenes (individual or mixed isomers)	1,500,000	15,000	18,587
Zinc and compounds	350	3.5	3.9

Source: http://www.npi.gov.au/cgi-bin/npireport.pl?proc=source;instance=public;year=2007;source=6;loc_type=national

Note: Townsville 1 calculations are based on the assumption that emissions are related to population and that Townsville population is approximately 1% of Australia's population. Townsville 2 calculations are translated from Table F.

Vehicle Emissions

The Townsville region displays a growing industrial sector and booming population. With permanent infrastructure such as a major Australian Defence Force Base (Lavarack Barracks), regional facilities such as James Cook University and the Townsville General Hospital, the Townsville population will only continue to grow.

With relatively limited public transport services and expanding urban and peri-urban land uses, private vehicular traffic has been and continues to be the predominant mode of transport. The urban road network is well developed and is being continually expanded to account for the growing population and driver demand.

Table D Registered Motor Vehicles in the Townsville and Thuringowa areas

Area	1997	2001	2008	Change % (1997-2001)	Change % (2001-2008)	Change % (1997-2008)
Townsville	51,248	58,209	-	13.6%	-	-
Thuringowa	20,108	29,343	-	46.0%	-	-
Townsville Region	71,356	87,552	122,976	22.7%	40.4%	72.3%

Note: Figures are exclusive of registered motorbikes and trailers.

Figures from the Queensland Department of Transport show that with a growing population (a 9.9% increase between 1996 and 2001), the number of registered vehicles is also increasing (see Table D). In the Townsville region, the number of registered vehicles, excluding registered motorbikes and trailers, rose by 22.7% between 1997 and 2001. This was mirrored between 2001 and 2008 with a rise of 40.4%.

Calculations from data provided by the QLD Department of Transport show that significant levels of emissions are released from road traffic each year (see Table E).

These emissions were calculated using three components:

- The number of registered vehicles in Townsville (information provided by Qld Department of Transport, Townsville) (including information on the fuel type, year of manufacture and vehicle type),
- EPA emissions factors (information provided by the Environment Protection Agency); and
- The number of vehicle kilometres travelled (VKT).

VKT was calculated by dividing the total 2006 QLD VKT (44,373,000,000) by the total number of registered QLD vehicles (excluding trailers) to give the VKT per individual QLD vehicle. This was then multiplied by the number of Townsville registered vehicles to give a final VKT value of 1,739,306,120.

The final emissions estimate was calculated as follows:

- Registered vehicles were divided into types of manufacture, petrol types and years of manufacture,
- These categories were used to calculate specific VKT values for each vehicle/year/fuel combination,
- Specific emissions values and VKT values were fed into the calculation for vehicular emissions,
- These results were tabulated to find overall emissions.

The final emissions calculations may be underestimated due to several factors.

- A constant speed of 60km/hr was assumed for all vehicles. As many of Townsville's roads are limited to lower speed limits and others allow higher speed limits, 60km/hr was adopted as an intermediate value to provide consistency to the calculations. This may introduce small inaccuracies into the final emissions.
- Calculations do not account for the multiple stops involved in urban driving (lights, traffic, intersections etc). This will result in lower emissions calculations.

- The emissions factors used were developed for southeast Queensland. The higher ambient temperatures experienced in Townsville increase fuel evaporation rates and mean that total hydrocarbon emission calculations will be underestimated.
- As emissions factors were unavailable for some vehicle types the closest available fuel emissions were used (this occurred particularly for petrol-fueled trucks and buses).

Nevertheless, this estimation demonstrates that vehicle pollution is a measurable process and provides an indication of the magnitude and type of emissions for inclusion in environmental assessment.

Table E Vehicular emissions (tonnes per year) in the Townsville City Council area

	Car	LCV	Bus	Truck	Motorcycle	Totals
NOx	883	468	89	440	13	**1,893**
CO	5,773	2,098	11	87	2,911	**10,881**
THC	391	134	3	17	227	**771**
PM10	67	41	3	17	2	**130**
SO_2	58	34	3	14	3	**112**
CO_2	283,616	124,651	9,281	43,811	8,788	**470,147**
CH4	43	14	0	2	23	**83**
N_20	55	12	0	1	0	**69**
Totals	**290,886**	**127,453**	**9,391**	**44,390**	**11,967**	**484,086**

Note: LCV is light commercial vehicle. Figures exclude trailers, farming machinery and mobile campervans. Values are expressed as tonnes per year. Assumed potential deposition area for the pollutants is 250 square kilometres.

Assuming all the NO_x is translated to land and water through rainfall then 1,900 tonnes of NO_2 divided by the assumed area of the airshed i.e. 250 square kilometres would give 7.6 tonnes per square kilometre or 0.076 tonnes per hectare (76 kg/ha). Similarly for particulate matter 0.52 tonnes per square kilometre, 0.0052 tonnes per hectare (5.2 kg/ha) and sulphur dioxide 0.45 tonnes per square kilometre, 0.0045 tonnes per hectare (4.5 kg/ha).

The majority of the emissions released from vehicles in Townsville compromised of carbon dioxide and carbon monoxide.

When examined by vehicle type, the majority of emissions are released by cars and light commercial vehicles (see Figures 3), which is a reflection of the number of those vehicle types on the road.

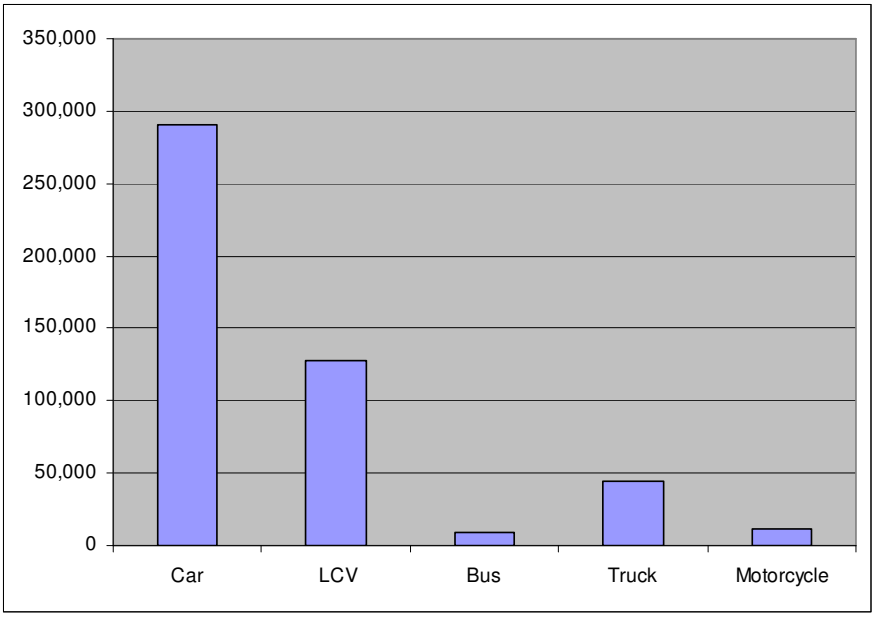


Figure 3. Magnitude of emissions by vehicle type.

The calculations show that almost half a million tonnes of emissions are released from vehicles in Townsville each year. If the greenhouse gases (carbon dioxide, methane and nitrous oxide) are adjusted by their global warming potential (by a factor of 21 for methane and 270 for nitrous oxide), total CO_{2e} emissions amount to approximately 490, 512 tonnes per year.

While there are implications for air quality and global warming associated with the vehicle emissions calculated for the Townsville region the immediate and localised impacts on water quality are less tangible.

Emissions from motor vehicles have been documented to have significant impacts on the environment, including on water quality. Contributions to the atmospheric reservoir as well as residues on road surfaces increase the amount of potential for atmospheric deposition and transport of pollutants in urban stormwater runoff to receiving water bodies.

Benthic Sediment sampling sites (Butler 2008, p.6)

Site	Description	Latitude	Longitude	Site Type
S1	Landsdowne Creek	S19°35'34.20"	E146°48'48.84"	Freshwater Control Sites
S2	Antill Plains Creek	S19°26'02.94"	E146°51'19.92"	
S3	Stonehouse Ck (Toonpan)	S19°28'19.01"	E146°51'26.26"	
S4	Central Creek	S19°28'54.69"	E146°38'47.56"	
S5	Sachs Creek (Oak Valley)	S19°26'36.10"	E146°48'46.30"	Freshwater Monitoring Sites
S6	Central Creek	S19°27'24.30"	E146°43'45.00"	
S7	Black Weir (below dam)	S19°23'45.97"	E146°43'48.79"	
S8	Palmetum drain (Aplins)	S19°18' 35.35"	E146°45' 52.83"	
S9	Black Weir (Rasmussen)	S19°21' 28.17"	E146°44' 00.68"	
S10	Condon drain (Black Weir)	S19°20' 03.59"	E146°43' 39.65"	
S11	Lower end Black Weir	S19°19' 07.51"	E146°44' 05.93"	
S12	Riverside drain (Black Weir)	S19°19' 16.32"	E146°44' 00.34"	
S13	Drain mouth (Gleesons)	S19°19' 05.04"	E146°44' 41.87"	
S14	Riverside drain (Aplins Weir)	S19°19' 05.42"	E146°44' 55.00"	
S15	Douglas drain (Aplins Weir)	S19°18' 43.35"	E146°45' 26.80"	
S16	Aplins Weir (Cranbrook side)	S19°18' 51.59"	E146°45' 9.97"	
S17	Aplins Weir (Aitkenvale side)	S19°18' 15.08"	E146°46' 46.93"	
S18	Annandale drain (Aplins Weir)	S19°18' 31.94"	E146°46' 33.19"	
S19	Lavarack Creek (Annandale)	S19°19' 02.11"	E146°47' 11.56"	
S20	Stuart Creek (Upstream)	S19°22'06.54"	E146°50'43.54"	
S21	Stuart Creek (Cluden)	S19°19'03.96"	E146°50'13.14"	
S22	Stuart Creek (upper estuary)	S19°17'37.50"	E146°49'58.50"	Estuarine Monitoring Sites
S23	Ross R (Bowen Road bridge)	S19°18'14.94"	E146°48'4.80"	
S24	Ross R (below Fairfield W)	S19°17'13.68"	E146°48'15.05"	
S25	Lavarack Creek (tidal end)	S19°18'25.44"	E146°47'54.48"	
S26	Ross R (below Rooneys Br)	S19°17'12.48"	E146°49'14.46"	
S27	Gordon Creek (near Ross R)	S19°17'30.00"	E146°49'33.12"	
S28	Ross R (above NP ramp)	S19°16'56.34"	E146°49'29.28"	
S29	Ross R (near Goondi)	S19°16'40.14"	E146°49'51.90"	
S30	Goondi Creek (mouth)	S19°16'28.92"	E146°49'42.00"	
S31	Gordon Creek (near tidal limit)	S19°18'35.96"	E146°49'24.44"	
S32	Ross R (Flying Fox Ck mouth)	S19°16'17.34"	E146°50'4.86"	
S33	Ross R (mouth reclaim)	S19°15'47.70"	E146°50'13.92"	
S34	Tidal drain (Benwell Rd)	S19°15'41.82"	E146°50'11.58"	
S35	Cocoa Creek	S19°17'17.43"	E146°50'11.58"	Estuarine Control

	Silver	Arsenic	Cadmium	Chromium	Copper	Nickel	Lead	Antimony	Zinc
ISQG low	1	20	1.5	80	65	21	50	2	200
ISQG high	3.7	70	10	370	270	52	220	25	410

Appendix E

Event Monitoring Calculations EMC

TSS (Combined old and new values)

Dominant land use	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
Established urban	Woolcock St drain	06/07	22	24	20	29	22	24	20
		07/08	15	10	51	17	8.8	26	
	Captain Creek	06/07	15	15	25	12	7.4	15	
Developing urban (Coastal plain)	Kern drain	06/07	339	278	612	284	185	360	795
		07/08	502	445	637	770	389	599	
	Gordon Creek	06/07	409	351	783	444	184	470	
		07/08	662	130	4600	500	123	1741	
Dev. urban (hillslope) *	Riverview Creek		11142	4975					11140
Light industrial	Hill St drain	07/08	49	43	100	46	26	57	57
Urban / industrial	Stuart Ck (ds)	06/07	237	200	257	305	169	244	129
	Louisa Creek	06/07	14	12	21	15	7.8	15	
Rural residential	Sachs Creek	06/07	29	7.1	139	21	5.6	55	35
	Bluewater Ck (ds)	06/07	27	8.3	40	45	4.4	30	
	Alligator Ck (ds)	06/07	20	19	20	14	24	19	
Minimal use	Stuart Ck (us)	06/07	96	63	41	224	49	105	56
	Hencamp Ck	06/07	27	9.3	46	47	14	36	
	Campus Ck	06/07	14	3.5	10	49	1.9	20	
	Bluewater Ck (us)	06/07	55	18	130	48	9	62	
Conservation	Alligator Ck (us)	06/07	12	7	34	19	4.6	19	19
Dry savanna grazing	Stuart Ck (us)	06/07	96	63	41	224	49	105	130
	Black River	06/07						240	
	Black River	07/08						230	
	Bluewater Ck (us)	06/07	55	18	130	48	9	62	
Green space (dry)	Alligator Ck (us)	06/07	12	7	34	19	4.6	19	25
	Campus Creek	06/07	14	3.5	10	49	1.9	20	
	Hencamp Ck	06/07	27	9.3	46	47	14	36	
Wet Tropics grazing	Davidson Ck	05-07	29	12					25
	Warrami Creek	05-07	25	13					
Green space (wet)	Murray Falls	05-07	1	0.35					4
	Tully Gorge	05-08	7	4					
	North Hull River	05-07	10	4					

Note: Minimal Use and Conservation replaced with grazing and green space, wet and dry categories (shaded)

Nitrogen

Initial TN calculations

Dominant land use	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
Established urban	Woolcock St drain	06/07	716	643	653	724	798	725	**744**
		07/08	793	826	770	684	825	760	
	Captain Ck	06/07	740	642	632	570	1020	740	
Developing urban (Coastal plain)	Kern drain	06/07	767	806	695	625	869	729	**748**
		07/08	830	666	744	987	832	854	
	Gordon Ck	06/07	746	694	758	555	794	702	
Light industrial	Hill St drain	07/08	858	648	684	821	973	826	**822**
Urban industrial	Stuart Ck (ds)	06/07	674	642	772	698	587	685	**626**
	Louisa Ck	06/07	572	533	542	526	611	560	
Rural residential	Sachs Ck	06/07	568	564	801	487	537	608	**510**
	Bluewater Ck (ds)	06/07	403	368	498	436	311	414	
	Alligator Ck (ds)	06/07	432	363	392	680	368	480	
Minimal use	Stuart Ck (us)	06/07	632	644	498	729	603	611	**482**
	Hencamp Ck	06/07	400	397	402	219	444	354	
	Campus Ck	06/07	447	327	552	305	363	407	
	Bluewater Ck (us)	06/07	529	421	672	429	497	533	
Conservation	Alligator Ck (us)	06/07	331	254	699	270	253	407	**404**

Established Urban

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Woolcock St drain	06/07	419	426	437	208	537	394	**364**
		07/08	369	334	229	252	422	301	
	Captain Ck	06/07	380	359	403	369	369	380	
PN	Woolcock St drain	06/07	144	61	89	419	34	181	**221**
		07/08	256	303	392	261	234	296	
	Captain Ck	06/07	204	169	150	97	366	204	
NOx	Woolcock St drain	06/07	114	114	106	82	146	111	**127**
		07/08	135	115	110	145	135	130	
	Captain Ck	06/07	134	72	62	97	242	134	
Ammonia	Woolcock St drain	06/07	39	24	21	15	81	39	**29**
		07/08	33	32	39	26	34	33	
	Captain Ck	06/07	22	16	17	7.0	43	22	
TN	Woolcock St drain	06/07	716	625	653	724	798	725	**741**
		07/08	793	784	770	684	825	760	
	Captain Ck	06/07	740	616	632	570	1020	741	

Developing urban (Coastal plain)

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Kern drain	06/07	449	399	448	391	475	438	**397**
		07/08	457	417	357	412	498	422	
	Gordon Ck	06/07	382	402	404	294	395	364	

PN	Kern drain	06/07	175	135	132	79	240	150	**190**
		07/08	264	196	244	483	234	320	
	Gordon Ck	06/07	154	140	209	79	145	144	
NOx	Kern drain	06/07	103	87	78	101	119	99	**122**
		07/08	84	81	109	81	76	89	
	Gordon Ck	06/07	161	140	113	147	192	151	
Ammonia	Kern drain	06/07	40	36	37	54	35	42	**38**
		07/08	25	16	34	11	24	23	
	Gordon Ck	06/07	49	42	32	35	62	43	
TN	Kern drain	06/07	767	657	695	625	869	730	**747**
		07/08	830	710	744	987	832	854	
	Gordon Ck	06/07	746	724	758	555	794	702	

Light Industrial

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Hill St drain	07/08	415	318	301	386	495	394	**394**
PN	Hill St drain	07/08	324	215	259	319	360	313	**313**
NOx	Hill St drain	07/08	102	89	99	107	100	102	**102**
Ammonia	Hill St drain	07/08	17	18	25	9.0	18	17	**17**
TN	Hill St drain	07/08	858	640	684	821	973	826	**826**

Urban industrial

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Stuart Ck (ds)	06/07	281	226	309	308	242	286	**313**
	Louisa Ck	06/07	362	343	362	273	381	339	
PN	Stuart Ck (ds)	06/07	309	265	382	304	260	315	**210**
	Louisa Ck	06/07	108	95	75	100	136	104	
NOx	Stuart Ck (ds)	06/07	81	95	79	78	84	80	**94**
	Louisa Ck	06/07	90	92	96	146	80	107	
Ammonia	Stuart Ck (ds)	06/07	3.4	<0.2	2.0	8.4	0.7	3.7	**6.9**
	Louisa Ck	06/07	12	5.5	9.3	7.0	14	10	
TN	Stuart Ck (ds)	06/07	674	586	772	698	587	686	**623**
	Louisa Ck	06/07	572	536	542	526	611	560	

Rural Residential

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
Rural residential	Sachs Ck	06/07	257	248	286	320	237	281	**228**
	Bluewater Ck (ds)	06/07	183	170	225	199	141	188	
	Alligator Ck (ds)	06/07	203	224	192	269	187	216	
Rural residential	Sachs Ck	06/07	121	69	303	123	81	169	**114**
	Bluewater Ck (ds)	06/07	64	40	68	84	47	66	
	Alligator Ck (ds)	06/07	110	113	123	107	93	108	
Rural residential	Sachs Ck	06/07	188	181	204	41	218	154	**149**
	Bluewater Ck (ds)	06/07	152	142	196	148	122	155	
	Alligator Ck (ds)	06/07	92	55	30	297	82	136	
Rural residential	Sachs Ck	06/07	2.4	2.0	8.0	2.5	1.1	3.9	**9.6**
	Bluewater Ck (ds)	06/07	4.4	1.7	9.0	4.8	0.8	4.9	

	Alligator Ck (ds)	06/07	27	7.0	47	7.0	6.0	20	
Rural residential	Sachs Ck	06/07	568	500	801	487	537	608	**501**
	Bluewater Ck (ds)	06/07	403	354	498	436	311	415	
	Alligator Ck (ds)	06/07	432	399	392	680	368	480	

Dry savanna grazing

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Stuart Ck (us)	06/07	270	284	255	298	259	271	**240**
	Black River	06/07						300	
	Black River	07/08						210	
	Bluewater Ck (us)	06/07	210	206	147	169	278	198	
PN	Stuart Ck (us)	06/07	175	138	124	270	136	177	**175**
	Black River	06/07						22	
	Black River	07/08						230	
	Bluewater Ck (us)	06/07	211	152	409	95	156	220	
NOx	Stuart Ck (us)	06/07	165	131	75	136	191	134	**105**
	Black River	06/07						100	
	Black River	07/08						59	
	Bluewater Ck (us)	06/07	104	87	107	164	61	111	
Ammonia	Stuart Ck (us)	06/07	22	5.0	44	25	17	29	**15**
	Black River	06/07						13	
	Black River	07/08						8	
	Bluewater Ck (us)	06/07	3.9	2.0	9.0	1.0	2.3	4.1	
TN	Stuart Ck (us)	06/07	632	558	498	729	603	610	**535**
	Black River	06/07						435	
	Black River	07/08						507	
	Bluewater Ck (us)	06/07	529	447	672	429	497	533	

Greenspace (dry)

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Alligator Ck (us)	06/07	171	174	164	184	169	172	**200**
	Campus Creek	06/07	245	200	271	199	229	233	
	Hencamp Ck	06/07	240	211	198	145	269	204	
PN	Alligator Ck (us)	06/07	128	58	500	50	54	201	**125**
	Campus Creek	06/07	92	91	149	92	7.8	83	
	Hencamp Ck	06/07	93	63	124	50	100	91	
NOx	Alligator Ck (us)	06/07	28	28	33	30	26	30	**50**
	Campus Creek	06/07	107	54	127	12	125	88	
	Hencamp Ck	06/07	57	52	38	22	67	42	
Ammonia	Alligator Ck (us)	06/07	4.0	1.0	2.0	6.0	4.0	4.0	**8.0**
	Campus Creek	06/07	3.3	2.0	5.3	2.0	1.0	2.8	
	Hencamp Ck	06/07	9.7	3.0	42	1.5	7.8	17	
TN	Alligator Ck (us)	06/07	331.0	261.0	699.0	270.0	253.0	407.3	**383.0**
	Campus Creek	06/07	447.3	347.0	552.3	305.0	362.8	406.7	
	Hencamp Ck	06/07	399.7	329.0	402.0	218.5	443.8	354.8	

Wet Tropics grazing

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Davidson Ck	05-07	115	90					**160**
	Warrami Creek	05-07	210	137					
PN	Davidson Ck	05-07	60	48					**90**
	Warrami Creek	05-07	123	70					

NOx	Davidson Ck	05-07	306	307					**500**
	Warrami Creek	05-07	1132	1090					
Ammonia	Davidson Ck	05-07	12	7.0					**18**
	Warrami Creek	05-07	24	26.0					
TN	Davidson Ck	05-07	493	452					**768**
	Warrami Creek	05-07	1489	1323					

Greenspace (wet)

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
DON	Murray Falls	05-07	87	66					**90**
	Tully Gorge	05-08	93	92					
	North Hull River	05-07	96	82					
PN	Murray Falls	05-07	34	31					**45**
	Tully Gorge	05-08	40	24					
	North Hull River	05-07	61	40					
NOx	Murray Falls	05-07	8	7					**50**
	Tully Gorge	05-08	94	35					
	North Hull River	05-07	66	28					
Ammonia	Murray Falls	05-07	2	2.0					**8**
	Tully Gorge	05-08	5.5	4.0					
	North Hull River	05-07	18	18.0					
TN	Murray Falls	05-07	131	106					**193**
	Tully Gorge	05-08	233	155					
	North Hull River	05-07	241	168					

Phosphorus

Established Urban

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Woolcock St drain	06/07	226	214	241	149	258	216	**152**
		07/08	173	155	91	116	202	136	
	Captain Ck	06/07	129	138	131	134	121	129	
PP	Woolcock St drain	06/07	53	58	52	71	43	55	**69**
		07/08	79	86	135	91	68	98	
	Captain Ck	06/07	61	46	93	23	67	61	
DOP	Woolcock St drain	06/07	35	25	15	48	52	38	**60**
		07/08	105	88	86	158	93	112	
	Captain Ck	06/07	46	18	55	73	8.2	45	
TP	Woolcock St drain	06/07	314	297	308	268	353	310	**281**
		07/08	357	329	312	365	363	347	
	Captain Ck	06/07	236	202	279	230	196	235	

Developing urban (Coastal plain)

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Kern drain	06/07	203	186	191	217	204	204	**130**
		07/08	130	88	90	85	151	109	
	Gordon Ck	06/07	102	124	96	117	100	104	
PP	Kern drain	06/07	123	117	161	141	94	132	**128**
		07/08	158	185	188	257	131	192	
	Gordon Ck	06/07	93	84	124	80	79	94	
DOP	Kern drain	06/07	27	18	42	28	19	30	**19**
		07/08	50	55	85	44	39	56	
	Gordon Ck	06/07	18	9	10	10	26	15	
TP	Kern drain	06/07	353	321	394	386	317	366	**277**
		07/08	338	328	363	386	321	357	
	Gordon Ck	06/07	213	217	230	207	205	214	

Light Industrial

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Hill St drain	07/08	219	89	50	265	270	195	**195**
PP	Hill St drain	07/08	124	99	137	93	140	123	**123**
DOP	Hill St drain	07/08	122	36	173	97	116	129	**129**
TP	Hill St drain	07/08	465	224	360	455	526	447	**447**

Urban industrial

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Stuart Ck (ds)	06/07	87	83	79	85	93	86	**104**
	Louisa Ck	06/07	117	134	106	142	121	123	
PP	Stuart Ck (ds)	06/07	181	122	196	214	147	186	**111**
	Louisa Ck	06/07	42	36	29	27	54	37	
DOP	Stuart Ck (ds)	06/07	14	14	13	16	12	14	**15**

	Louisa Ck	06/07	20	17	28	3.0	18	16	
TP	Stuart Ck (ds)	06/07	282	219	288	315	252	285	**231**
	Louisa Ck	06/07	179	187	163	172	193	176	

Rural Residential

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Sachs Ck	06/07	34	29	72	39	25	45	**26**
	Bluewater Ck (ds)	06/07	6.4	6.1	6.2	6.7	6.4	6.4	
	Alligator Ck (ds)	06/07	28	20	31	14	31	25	
PP	Sachs Ck	06/07	22	19	33	21	19	24	**20**
	Bluewater Ck (ds)	06/07	12	11	14	21	5.4	13	
	Alligator Ck (ds)	06/07	27	22	39	13	15	22	
DOP	Sachs Ck	06/07	9.4	3.9	28	8.6	5.6	14	**10**
	Bluewater Ck (ds)	06/07	4.9	4.4	8.4	2.9	3.7	5.0	
	Alligator Ck (ds)	06/07	11	8.6	11	7	14	11	
TP	Sachs Ck	06/07	65.4	51.9	133.0	68.6	49.6	83.7	**56**
	Bluewater Ck (ds)	06/07	23.3	21.5	28.6	30.6	15.5	24.9	
	Alligator Ck (ds)	06/07	66.0	50.6	81.0	33.9	60.0	58.3	

Dry savanna grazing

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Stuart Ck (us)	06/07	53	55	55	74	44	58	**29**
	Black River	06/07						31	
	Black River	07/08						13	
	Bluewater Ck (us)	06/07	6.3	5.1	8.2	2.8	7.3	6.1	
PP	Stuart Ck (us)	06/07	70	69	53	100	60	71	**70**
	Black River	06/07						68	
	Black River	07/08						73	
	Bluewater Ck (us)	06/07	68	38	87	67	57	70	
DOP	Stuart Ck (us)	06/07	19	11	9	16	22	16	**11.0**
	Black River	06/07						13	
	Black River	07/08						14	
	Bluewater Ck (us)	06/07	5.3	4.9	6.0	8.0	3.1	5.7	
PP	Stuart Ck (us)	06/07	142	135	117	190	126	144	**110.0**
	Black River	06/07						112	
	Black River	07/08						100	
	Bluewater Ck (us)	06/07	80	48	101	78	67	82	

Greenspace (dry)

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Alligator Ck (us)	06/07	17	15	3.0	31	18	17	**25**
	Campus Creek	06/07	59.0	54.0	74.0	25.0	54.0	51.0	
	Hencamp Ck	06/07	7.3	5.1	4.9	9.9	7.0	7.3	
PP	Alligator Ck (us)	06/07	11	10	12	23	7.6	14	**20**
	Campus Creek	06/07	31	23	29	60	19	36	
	Hencamp Ck	06/07	13	13	12	8	15	12	
DOP	Alligator Ck (us)	06/07	3.2	3.5	6.4	0.0	3.2	3.2	**6.0**
	Campus Creek	06/07	12	12	14	9.3	11	11	
	Hencamp Ck	06/07	5.2	5.5	3.3	4.7	5.5	4.5	
TP	Alligator Ck (us)	06/07	31.2	28.5	21.4	54.0	28.8	34.7	**51.0**
	Campus Creek	06/07	102.0	89.0	117.0	94.3	84.0	98.4	
	Hencamp Ck	06/07	25.5	23.6	20.2	22.7	27.5	23.5	

Wet Tropics grazing

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Davidson Ck	05-07	7.5	6.0					**7**
	Warrami Creek	05-07	7.0	6.0					
PP	Davidson Ck	05-07	11	10					**14**
	Warrami Creek	05-07	16	15					
DOP	Davidson Ck	05-07	6.0	5.0					**6**
	Warrami Creek	05-07	7.0	6.0					
TP	Davidson Ck	05-07	24.5	21.0					**27**
	Warrami Creek	05-07	30.0	27.0					

Greenspace (wet)

Parameter	Site	Year	Mean (all data)	Median (all data)	Rise (mean)	Peak (mean)	Fall (mean)	Mean rise, peak and fall	Mean EMC mg/L
FRP	Murray Falls	05-07	3.0	3.0					**3**
	Tully Gorge	05-08	5.0	5.0					
	North Hull River	05-07	2.0	2.0					
PP	Murray Falls	05-07	4	3					**8**
	Tully Gorge	05-08	8	6					
	North Hull River	05-07	11	8					
DOP	Murray Falls	05-07	6.0	6.0					**4**
	Tully Gorge	05-08	3.0	2.0					
	North Hull River	05-07	4.0	4.0					
TP	Murray Falls	05-07	13.0	12.0					**15**
	Tully Gorge	05-08	16.0	13.0					
	North Hull River	05-07	17.0	14.0					

Appendix F

Catchment Modelling Load Calculations

Preliminary results by modelled catchments (17/02/09)

Sub catchment	Area (Ha)	Area (km2)	Flow ML/yr	TSS kg/yr	TN kg/yr	TP kg/yr
SC #1 Bohle River	13	0.1	49.5	6181.1	44.2	6.3
SC #2 Bohle River 2	5,214	52.1	17944.0	2254824.0	13781.2	1974.2
SC #3 Picnic Bay MI	147	1.5	1009.2	56764.8	523.5	119.8
SC #4 Pallarenda	1,753	17.5	7600.2	148849.9	3342.8	410.0
SC #5 Esplanade	281	2.8	1403.4	131820.5	1065.9	244.1
SC #6 Bohle River	976	9.8	5108.8	542419.2	4415.0	1059.6
SC #7 Stuart Creek (SB)	11,158	111.6	41942.9	1813320.0	21255.3	3115.8
SC #8 Crocodile Creek	9,062	90.6	32797.4	267740.6	12299.0	1296.1
SC #9 Ross River (btdam)	2,149	21.5	8010.1	391046.4	5045.8	706.4
SC #10 Bohle River	134	1.3	555.0	4415.0	203.4	22.0
SC #11 Bohle River 2	464	4.6	1807.0	197415.4	1242.5	175.7
SC #12 Ross River (btdam)	394	3.9	1387.6	91139.0	1037.5	143.2
SC #13 Alligator Ck (L)	7,966	79.7	28666.2	372124.8	12645.9	1352.9
SC #14 Lorna Ck/Ollera Ck	1,202	12.0	12551.3	1501113.6	11132.2	1602.0
SC #15 Nelly Bay MI	766	7.7	5329.6	180385.9	2349.4	441.5
SC #16 Bohle River	1,647	16.5	7253.3	290446.6	3752.8	618.1
SC #17 Esplanade	91	0.9	476.2	46042.6	381.6	90.8
SC #18 Ross River (btdam)	633	6.3	3721.2	394200.0	2595.4	630.7
SC #19 Ross Creek	1,486	14.9	7915.5	857779.2	6370.3	1570.5
SC #20 Bohle River	1,201	12.0	6086.4	611798.4	4951.2	1182.6
SC #21 Rollingstone Ck	7,611	76.1	68433.1	1879545.6	28950.0	3942.0
SC #22 Arcadia MI	256	2.6	1769.2	62441.3	791.6	154.2
SC #23 Mundy Creek	763	7.6	3563.6	283193.3	2671.1	517.2
SC #24 Ross Creek	443	4.4	2418.8	250711.2	1813.3	457.3
SC #25 Cocoa Creek	1,830	18.3	7158.7	58972.3	2642.7	280.4
SC #26 Bohle River 2	10,523	105.2	37212.5	4478112.0	29265.4	4635.8
SC #27 Bohle River	1,198	12.0	6528.0	700099.2	5140.4	1252.0
SC #28 Bohle River	2,981	29.8	13276.7	1542110.4	10943.0	1753.4
SC #29 Ross River (btdam)	4,733	47.3	20340.7	1472731.2	14380.4	2661.6
SC #30 Ross River (btdam)	755	7.5	3626.6	318513.6	2806.7	621.3
SC #31 Bohle River	6,369	63.7	27594.0	3099988.8	19930.8	3216.7
SC #32 Bohle River	2,435	24.4	10438.4	82939.7	3815.9	413.1
SC #33 Sleeper Log Ck	7,020	70.2	37212.5	3910464.0	25607.2	3595.1
SC #34 Station Creek	884	8.8	7379.4	85777.9	2721.6	350.0
SC #35 Wild Boar Creek	382	3.8	3342.8	28161.6	1160.5	148.5
SC #36 Hencamp Creek	3,703	37.0	38789.3	1356048.0	18858.5	2749.9
SC #37Scrubby Creek	1,584	15.8	13812.8	1050148.8	8483.2	1144.8
SC #38 Ollera Creek SC	704	7.0	7284.8	618105.6	4888.1	674.9
SC #39 Lorna Creek	415	4.1	4352.0	567648.0	3216.7	469.9
SC #40 Crystal Creek	1,1890	118.9	160202.9	6685632.0	77578.6	11100.7
SC #41 Ollera Creek	4,577	45.8	51719.0	1854316.8	21759.8	3049.5
SC #42 Two Mile Creek	1,588	15.9	8325.5	990230.4	6023.4	857.8
SC #43 Bluewater Ck (L)	1,688	16.9	9050.8	649641.6	5708.0	750.6
SC #44 Deep Creek	9,781	97.8	45411.8	5108832.0	32166.7	4730.4
SC #45 Black River (L)	5,409	54.1	27499.4	2497651.2	18732.4	3144.1
SC #46 Cape Cleveland	621	6.2	3405.9	30968.4	1207.8	151.1
SC #47 Alligator Ck (U)	6,727	67.3	37843.2	378432.0	14159.7	1712.4

SC #48 Black River (U)	2,4850	248.5	88931.5	10028448.0	63387.4	8987.8
SC #49 Ross River (U)						
SC #50 Leichhardt Creek	5,138	51.4	28256.3	1280361.6	13907.4	1731.3
SC #51 Saltwater Creek	5,605	56.1	44465.8	542419.2	16493.3	2141.3
SC #52 Bluewater Ck (U)	8,897	89.0	55188.0	7095600.0	35951.0	5550.3
SC #53 Unnamed RollCk	575	5.8	4856.5	239042.9	2743.6	438.4
SC #54 Surveyors Creek	1,791	17.9	13055.9	482500.8	6212.6	763.2
SC #55 Rollingstone Bay MI	164	1.6	1091.1	9208.5	381.6	48.3
SC #56 Five Bch Bay MI	437	4.4	2970.7	25039.6	1040.7	131.5
SC #57 Horseshoe Bay MI	1,298	13.0	8924.7	124882.6	3374.4	466.7
SC #58 Radical Bay MI	342	3.4	2330.5	19678.5	816.8	103.1
SC #59 West Coast MI	1,514	15.1	9807.7	88931.5	3469.0	441.5
SC #60 Cape Cleveland	1,160	11.6	6717.2	56449.4	2365.2	295.5
Totals	195,369	1,954	1,116,203	70,193,806	624,001	92,396
			Totals (tonne/year)	70,194	624	92

Note: U is upper and L is lower. SB is sub basin. MI is Magnetic Island. Upper Ross River (SC#49) has no t been included in the modelling as the dam is considered as a sediment trap and flow over the spillway is not a regular feature of catchment flow. Pollutant loads delivered to the dam will be calculated and a component of pollutant load will be added to the end of catchment loads for the Ross River.

Preliminary Results by WQIP Sub Basin and Catchment (17/02/09)

Model SC	Hectares	Catchment	No.	Flow	TSS	TN	TP
		Crystal Creek SB	**1**	**ML/yr**	**t/yr**	**kg/yr**	**kg/yr**
40	11,890	Crystal Creek	1-1	160,203	6,686	77,579	11,101
39	415	Lorna Creek	1-2	4,352	568	3,217	470
14	1,202	Lorna/Ollera Ck	1-2	12,551	1,501	11,132	1,602
38	704	Ollera Creek	1-3	7,285	618	4,888	675
41	4,577	Ollera Creek	1-3	51,719	1,854	21,760	3,050
37	1,584	Scrubby Creek	1-4	13,813	1,050	8,483	1,145
36	3,702	Hencamp Creek	1-5	38,789	1,356	18,859	2,750
SB total	24,074			288,712	13,633	145,917	20,792
		Rollingstone Creek SB	**2**	**Flow**	**TSS**	**TN**	**TP**
21	7,611	Rollingstone Creek	2-1	68,433	1,880	28,950	3,942
53	575	Unnamed	2-2	4,857	239	2,744	438
54	1,791	Surveyors Creek	2-3	13,056	483	6,213	763
35	382	Wild Boar Creek	2-4	3,343	28	1,161	149
34	884	Station Creek	2-5	7,379	86	2,722	350
51	5,605	Saltwater Creek	2-6	44,466	542	16,493	2,141
51		Cassowary Creek	2-7				
50	5,138	Leichhardt Creek	2-8	28,256	1,280	13,907	1,731
SB total	21,986			169,790	4,538	72,189	9,515
		Bluewater Creek SB	**3**	**Flow**	**TSS**	**TN**	**TP**
33	7,020	Sleeper Log Creek	3-1	37,212	3,910	25,607	3,595
42	1,588	Two Mile Creek	3-2	8,326	990	6,023	858
52	8,897	Bluewater Creek (U)	3-3	55,188	7,096	35,951	5,550
43	1,688	Bluewater Creek (L)	3-3	9,051	650	5,708	751
44	9,781	Deep Creek	3-4	45,412	5,109	32,167	4,730
SB total	28,974			155,189	17,755	105,456	15,484
		Black River SB	**4**	**Flow**	**TSS**	**TN**	**TP**
48	24,850	Black River (Upper)	4-1	88,932	10,028	63,387	8,988
45	5,409	Black River (Lower)	4-1	27,499	2,498	18,732	3,144
		Alice River	4-2				
SB total	30,258			116,431	12,526	82,120	12,132
		Bohle River SB	**5**	**Flow**	**TSS**	**TN**	**TP**
1,6,10,16,20, 27,28,32,31	16,954	Bohle River	5-1	76,890	6,880	53,197	9,524
2,11, 26	16,201	Bohle River 2	5-2	56,963	6,930	44,289	6,786
4		Shelly Beach	5-3				
SB total	33,155			133,854	13,811	97,486	16,309
		Lower Ross River SB	**6**	**Flow**	**TSS**	**TN**	**TP**
4	1,753	Pallarenda	6-1	7,600	149	3,343	410
23	763	Mundy Creek	6-2	3,564	283	2,671	517
5 and 17	371	Esplanade	6-3	1,880	178	1,448	335
19 and 24	1,929	Ross Creek	6-4	10,334	1,108	8,184	2,028
9,12,18, 29,30	8,663	Ross River (btdam)	6-5	37,086	2,668	25,866	4,763
SB total	13,478			60,464	4,386	41,511	8,053
		Upper Ross River SB	**7**	**Flow**	**TSS**	**TN**	**TP**
49		Ross River (atd)	7-1				
49		Six Mile Creek	7-2				

49		Toonpan Lagoon	7-3				
49		Antill Plains Creek	7-4				
49		Sachs Creek	7-5				
49		Mt Stuart	7-6				
SB total							
		Stuart Creek SB	**8**	**Flow**	**TSS**	**TN**	**TP**
7	11,158	Stuart Creek	8-1				
7		Sandfly Creek	8-2				
SB total	11,158			41,943	1,813	21,255	3,116
		Alligator Creek SB	**9**	**Flow**	**TSS**	**TN**	**TP**
13	7,966	Alligator Creek	9-1	28,666	372	12,646	1,353
47	6,727	Alligator Creek	9-1	37,843	378	14,160	1,712
8	9,062	Crocodile Creek	9-2	32,797	268	12,299	1,296
25	1,830	Cocoa Creek	9-3	7,159	59	2,643	280
46	621	Cape Cleveland	9-4	3,406	31	1,208	151
60	1,160	Cape Cleveland	9-4	6,717	56	2,365	295
SB total	27,366			116,589	1,165	45,320	5,088
		Magnetic Island	**10**	**Flow**	**TSS**	**TN**	**TP**
59	1,514	West Coast	10-1	9,808	89	3,469	442
3	147	Picnic Bay	10-2	1,009	57	523	120
15	766	Nelly Bay	10-3	5,330	180	2,349	442
22	256	Arcadia	10-4	1,769	62	792	154
58	342	Radical Bay	10-5	2,331	20	817	103
57	1,298	Horseshoe Bay	10-6	8,925	125	3,374	467
56	437	Five Beach Bay	10-7	2,971	25	1,041	132
55	163	Rollingstone Bay	10-8	1,091	9	382	48
SB total	4,923			33,233	567	12,747	1,907

Preliminary Summary by WQIP Sub Basin (17/02/09)

Sub Basin	No.	Area	Flow	TSS	TN	TP
		Hectares	ML/yr	t/yr	kg/yr	kg/yr
Crystal Creek SB	1	24,074	288,712	13,633	145,917	20,792
Rollingstone Creek SB	2	21,986	169,790	4,538	72,189	9,515
Bluewater Creek SB	3	28,973	155,189	17,755	105,456	15,484
Black River SB	4	30,258	116,431	12,526	82,120	12,132
Black Basin Sub total		105,291	730,121	48,452	405,682	57,922
Bohle River SB	5	33,155	133,854	13,811	97,486	16,309
Lower Ross River SB	6	13,478	60,464	4,386	41,511	8,053
Upper Ross River SB	7					
Stuart Creek SB	8	11,158	41,943	1,813	21,255	3,116
Alligator Creek SB	9	27,365	116,589	1,165	45,320	5,088
Ross Basin Sub total		85,155	352,849	21,175	205,572	32,567
Magnetic Island	10	4,923	33,233	567	12,747	1,907
Total		195,369	1,116,203	70,194	624,001	92,396

Recalculated Base Case with STPs (pre Cleveland Bay upgrade) WQIP Sub Basin Summary (4/06/2009)

Catchment	Flow	TSS	TN	TP
	ML/Year	kg/Year	kg/Year	kg/Year
Crystal Creek SB	239,279	5,509,675	90,060	9,376
Rollingstone Creek SB	144,288	1,601,949	40,420	4,018
Bluewater Creek SB	145,599	2,805,025	92,637	4,637
Black River SB	114,318	7,190,500	70,591	11,063
Black Basin	643,484	17,107,149	293,708	29,095
Bohle River SB	131,618	9,289,250	191,753	29,795
Lower Ross River SB	53,677	4,202,975	33,097	6,976
Upper Ross River SB	196,735	8,103,000	100,375	12,775
Stuart Creek SB	47,450	1,649,800	200,020	58,400
Alligator Creek SB	104,762	2,103,495	42,687	4,807
Ross Basin	534,242	25,348,520	567,932	112,753
Magnetic Island SB	27,371	341,983	6,282	943
Black Ross WQIP area	1,205,098	42,797,652	867,922	142,791

Note: Black Ross WQIP is the sum of Black Basin, Ross Basin and Magnetic Island. Does not include upgraded figures for Cleveland Bay STP in Stuart Creek sub basin i.e. relates to 2005 base case

Recalculated Base Case with STPs (post Cleveland Bay upgrade) WQIP Sub Basin Summary (29/05/2009)

Sub Basin	Flow	TSS	TN	TP
	ML/Year	kg/Year	kg/Year	kg/Year
Crystal Creek	239,279	5,509,675	90,060	9,376
Rollingstone Creek	144,288	1,601,949	40,420	4,018
Bluewater Creek	145,599	2,805,025	92,637	4,637
Black River	114,318	7,190,500	70,591	11,063
Black Basin	643,484	17,107,149	293,708	29,095
Bohle River	131,618	9,289,250	191,753	29,795
Lower Ross River	53,677	4,202,975	33,097	6,976
Upper Ross River	196,735	8,103,000	100,375	12,775
Stuart Creek	47,450	1,649,800	61,320	20,039
Alligator Creek	104,762	2,103,495	42,687	4,807
Ross Basin	534,242	25,348,520	429,232	74,391
Magnetic Island	27,371	341,983	6,282	943
Black Ross Total	1,205,098	42,797,652	729,223	104,429

Note: Black Ross WQIP is the sum of Black Basin, Ross Basin and Magnetic Island. Includes upgraded figures for Cleveland Bay STP in Stuart Creek sub basin i.e. relates to 2007 not 2005 base case

Recalculated Base Case with STPs by WQIP Sub Basin and Catchment (29/05/2009)

Model SC No.	WQIP No.	Catchment	Flow	TSS	TN	TP
			ML/Year	kg/Year	kg/Year	kg/Year
40	1-1	Crystal Creek	134320	3069650	47085	5146.5
39	1-2	Lorna Creek	3233.9	59130	2317.75	91.615
14	1-2	Lorna Ck /Ollera Ck	9417	613200	8066.5	821.25
38 and 41	1-3	Ollera Creek	49421	579620	15691.35	1302.32
37	1-4	Scrubby Creek	10621.5	220825	5621	390.55
36	1-5	Hencamp Creek	32266	967250	11278.5	1624.25
		Crystal Creek SB	239279.4	5509675	90060.1	9376.485
21	2-1	Rollingstone Creek	58035	784750	16206	1722.8
53	2-2	Unnamed	3905.5	113515	1565.85	260.245
54	2-3	Surveyors Creek	10475.5	123735	3547.8	307.695
35	2-4	Wild Boar Creek	2814.15	11278.5	536.55	54.02
34	2-5	Station Creek	6314.5	45625	1335.9	143.81
51	2-6	Saltwater Creek	38325	300395	8249	919.8
51	2-7	Cassowary Creek				
50	2-8	Leichhardt Creek	24418.5	222650	8979	609.55
		Rollingstone Creek SB	144288.15	1601948.5	40420.1	4017.92
33	3-1	Sleeper Log Creek	33288	620500	21608	1025.65
42	3-2	Two Mile Creek	7592	129575	5292.5	206.225
52 and 43	3-3	Bluewater Creek		1084050	35441.5	1777.55
44	3-4	Deep Creek	44895	970900	30295	1627.9
		Bluewater Creek SB	145598.5	2805025	92637	4637.325
48 and 45	4-1	Black River				
	4-2	Alice River				
		Black River SB	114318	7190500	70591	11063.15
10, 32, 16, 6, 27, 20, 1, 28, 31	5-1	Bohle River	77616.52	5166940	154574.215	21386.9195
2, 26, 11	5-2	Bohle River 2	54001.75	4122310	37178.9	8407.775
4	5-3	Shelly Beach				
		Bohle River SB	131618.27	9289250	191753.115	29794.6945
4	6-1	Pallarenda	6716	186515	3051.4	372.3
23	6-2	Mundy Creek	3044.1	241995	2011.15	427.05
5, 17	6-3	Esplanade	1565.85	175930	959.22	266.085
19, 24	6-4	Ross Creek	9106.75	927100	5821.75	1681.92
9, 29, 30, 18, 12	6-5	Ross River (btdam)	33244.2	2671435	21253.95	4228.525
		Lower Ross River SB	53676.9	4202975	33097.47	6975.88
49	7-1	Ross River (atd)				
49	7-2	Six Mile Creek				

49	7-3	Toonpan Lagoon				
49	7-4	Antill Plains Creek				
49	7-5	Sachs Creek				
49	7-6	Mt Stuart				
		Upper Ross River SB	196735	8103000	100375	12775
7	8-1	Stuart Creek				
7	8-2	Sandfly Creek				
		Stuart Creek SB	47450	1649800	61320	20038.5
13 and 47	9-1	Alligator Creek	60882	1365100	25477	2978.4
8	9-2	Crocodile Creek	28871.5	467200	11388	1186.25
25	9-3	Cocoa Creek	6205	98185	2427.25	249.66
46 and 60	9-4	Cape Cleveland	8803.8	173010	3394.5	393.105
		Alligator Creek SB	104762.3	2103495	42686.75	4807.415
59	10-1	West Coast	8139.5	37595	1562.2	166.075
3	10-2	Picnic Bay	832.2	39055	302.585	80.665
15	10-3	Nelly Bay	4380	121545	1273.85	271.56
22	10-4	Arcadia	1452.7	40880	419.75	91.615
58	10-5	Radical Bay	1905.3	8066.5	368.65	37.595
57	10-6	Horseshoe Bay	2456.45	81395	1715.5	230.68
56	10-7	Five Beach Bay	7300	9818.5	467.2	47.45
55	10-8	Rollingstone Bay	905.2	3628.1	172.28	17.4835
		Magnetic Island SB	27,371	341,983	6,282	943
		Black Basin	643,484	17,107,149	293,708	29,095
		Ross Basin	534,242	25,348,520	429,232	74,391
		Black Ross WQIP area	1,205,098	42,797,652	729,223	104,429

Note: Black Ross WQIP is the sum of Black Basin, Ross Basin and Magnetic Island.

1/06/2009 No STPs

Sub Basin	Flow	TSS	TN	TP
	ML/Year	kg/Year	kg/Year	kg/Year
Crystal Creek	239,279	5,509,675	90,060	9,376
Rollingstone Creek	144,288	1,601,949	40,420	4,018
Bluewater Creek	145,599	2,805,025	92,637	4,637
Black River (no STP)	114,318	7,190,500	69,131	10,016
Black Basin	643,484	17,107,149	292,248	28,047
Bohle River	131,618	9,289,250	78,275	14,136
Lower Ross River	53,677	4,202,975	33,097	6,976
Upper Ross River	196,735	8,103,000	100,375	12,775
Stuart Creek	47,450	1,649,800	18,944	2,957
Alligator Creek	104,762	2,103,495	42,687	4,807
Ross Basin	534,242	25,348,520	273,378	41,651
Magnetic Island	27,371	341,983	6,282	943
Black Ross Total	1,205,098	42,797,652	571,908	70,641

With and No STPs comparison

Sub Basin	Flow	TSS	TN	TP
	ML/Year	kg/Year	kg/Year	kg/Year
Crystal Creek	239,279	5,509,675	90,060	9,376
Rollingstone Creek	144,288	1,601,949	40,420	4,018
Bluewater Creek	145,599	2,805,025	92,637	4,637
Black River (with STP)	114,318	7,190,500	70,591	11,063
Black River (no STP)	114,318	7,190,500	69,131	10,016
		Difference	1,460	1,047
		% difference	2.1%	9.5%
Black Basin	643,484	17,107,149	293,708	29,095
Black Basin	643,484	17,107,149	292,248	28,047
		Difference	1,460	1,047
		% difference	0.5%	3.6%
Bohle River (with STP)	131,618	9,289,250	191,753	29,795
Bohle River (no STP)	131,618	9,289,250	78,275	14,136
		Difference	113,478	15,659
		% difference	59.2%	52.6%
Lower Ross River	53,677	4,202,975	33,097	6,976
Upper Ross River	196,735	8,103,000	100,375	12,775
Stuart Creek (with STP)	47,450	1,649,800	61,320	20,039
Stuart Creek (no STP)	47,450	1,649,800	18,944	2,957
		Difference	42,376	17,082
		% difference	69%	85%
Alligator Creek	104,762	2,103,495	42,687	4,807
(with STP) **Ross Basin**	534,242	25,348,520	429,232	74,391
(no STP) **Ross Basin**	534,242	25,348,520	273,378	41,651
		Difference	155,854	32,740
		% difference	36.3%	44%
Magnetic Island	27,371	341,983	6,282	943
(with STP) **Black Ross Total**	1,205,098	42,797,652	729,223	104,429
(no STP) **Black Ross Total**	1,205,098	42,797,652	571,908	70,641
		Difference	157,315	33,788
		% difference	21.6	32.5

Note: Black Ross WQIP is the sum of Black Basin, Ross Basin and Magnetic Island.

Changes to modelled sub catchments

Modelled areas	TN	TN	Difference	TP	TP	Difference
STP	With	Without		With	Without	
Bohle sub basin						
SC #28	9526.5	9526.5		1627.9	1627.9	
SC #2	11351.5	11351.5		1657.1	1657.1	
SC #11	1007.4	1007.4		144.175	144.175	
SC #26	24,820	22,740	2,081	6,607	3,833	2,774
SC #1	39.055	39.055		5.7305	5.7305	
SC #20	3431	3431		1018.35	1018.35	
SC #6	3007.6	3007.6		916.15	916.15	
SC #16	3171.85	3171.85		551.15	551.15	
SC #31	18,287	16,389	1,898	5,001	2,862	2,139
SC #32	113,150	3,650	109,500	11,133	387	10,746
SC #10	202.21	202.21		21.389	21.389	
SC #27	3759.5	3759.5		1113.25	1113.25	
Bohle totals	191,753	78,275	113,479	29,795	14,136	15,659
Black sub basin						
SC #48	52560	52560		7592	7,592	
SC #45	18,031	16,571	1,460	3471	2,424	1,047
Black totals	70,591	69,131	1,460	11,063	10,016	1,047
Stuart sub basin						
SC #7	61,320	18,944	42,377	20,039	2,957	17,082
Black Ross total change			158,775			34,835

Notes: Shaded rows are modelled sub catchments where changes occur from STP removal
Units are kg/year

2045 no STPs

Model SC No.	WQIP No.	Catchment	TSS	TN	TP
			kg/Year	kg/Year	kg/Year
40	1-1	Crystal Creek	2922000	45656	5004
39	1-2	Lorna Creek	75242	2349	112
14	1-2	Lorna Ck /Ollera Ck	683018	8839	891
38	1-3	Ollera Creek	246909	4456	339
41	1-3	Ollera Creek	642840	16582	1224
37	1-4	Scrubby Creek	275033	6721	438
36	1-5	Hencamp Creek	3174023	25129	3799
		Crystal Creek SB	8019064	109732	11806
21	2-1	Rollingstone Creek	1723980	24800	2648
53	2-2	Unnamed	202349	2444	333
54	2-3	Surveyors Creek	286356	5077	442
35	2-4	Wild Boar Creek	11286	537	54
34	2-5	Station Creek	37621	1256	145
51	2-6	Saltwater Creek	511350	9606	1158
51	2-7	Cassowary Creek			
50	2-8	Leichhardt Creek	244352	9716	621
		Rollingstone Creek SB	3017294	53436	5400
33	3-1	Sleeper Log Creek	606315	22207	983
42	3-2	Two Mile Creek	129664	5296	206
52	3-3	Bluewater Creek	1037310	35575	1479
43	3-3	Bluewater Creek	175685	4894	301
44	3-4	Deep Creek	858338	31010	1359
		Bluewater Creek SB	2807312	98983	4327
48	4-1	Black River (upper and Alice)	6209250	54057	8036
45	4-1	Black River (lower)	1519440	18847	2546
		Black River SB	7728690	72904	10581
10	5-1	Bohle River	8620	202	21
32	5-1	Bohle River	278686	4127	508
16	5-1	Bohle River	515003	4018	782
6	5-1	Bohle River	456563	3002	917
27	5-1	Bohle River	617273	4127	1107
20	5-1	Bohle River	555180	3499	1070
1	5-1	Bohle River	4346	37	6
28	5-1	Bohle River	1161495	8620	1567
31	5-1	Bohle River	2217068	15888	2823
2	5-2	Bohle River 2	1256460	11286	1633
26	5-2	Bohle River 2	2607885	22499	3762
11	5-2	Bohle River 2	115054	1015	148
4	5-3	Shelly Beach			
		Bohle River SB	9793631	78322	14343
4	6-1	Pallarenda	242891	2867	413
23	6-2	Mundy Creek	302792	2301	486
5	6-3	Esplanade	169111	712	217
17	6-3	Esplanade	54788	256	81
19	6-4	Ross Creek	770678	4785	1399

24	6-4	Ross Creek	216593	1304	376
9	6-5	Ross River (btdam)	1077488	9058	1392
29	6-5	Ross River (btdam)	2761290	15267	3346
30	6-5	Ross River (btdam)	359771	2118	606
18	6-5	Ross River (btdam)	258597	1925	402
12	6-5	Ross River (btdam)	180799	1519	226
		Lower Ross River SB	6394797	42114	8943
49	7-1	Ross River (atd)			
49	7-2	Six Mile Creek			
49	7-3	Toonpan Lagoon			
49	7-4	Antill Plains Creek			
49	7-5	Sachs Creek			
49	7-6	Mt Stuart			
		Upper Ross River SB	13222050	124916	17678
7	8-1	Stuart Creek			
7	8-2	Sandfly Creek			
		Stuart Creek SB	3597713	30462	5004
47	9-1	Alligator Creek	2337600	23887	3298
13	9-1	Alligator Creek	2801468	25823	3689
8	9-2	Crocodile Creek	913125	13514	1618
25	9-3	Cocoa Creek	98252	2429	250
46	9-4	Cape Cleveland	58075	1143	133
60	9-4	Cape Cleveland	114323	2250	260
		Alligator Creek SB	6322843	69047	9248
59	10-1	West Coast	42734	1589	176
3	10-2	Picnic Bay	39082	303	81
15	10-3	Nelly Bay	149753	1308	279
22	10-4	Arcadia	31813	380	75
58	10-5	Radical Bay	13806	387	48
57	10-6	Horseshoe Bay	194678	1921	361
56	10-7	Five Beach Bay	9825	468	47
55	10-8	Rollingstone Bay	3631	172	17
		Magnetic Island SB	485322	6527	1084
		Black Basin	21572359	335055	32115
		Ross Basin	39331033	344860	55216
		Black Ross WQIP area	61388714	686442	88416

Note: Updated using 9/6/09, 10/6/09 and 12/6/09 data

Pre settlement to 2045 TSS change (no STPs) Summary

	1850	2005	2005-1850	% change	2021	2021-1850	% change	2045	2045-1850	% change
	TSS kg/yr	TSS kg/yr	TSS kg/yr		TSS kg/yr	TSS kg/yr		TSS kg/yr	TSS kg/yr	
Crystal Creek	967,287	5,509,675	4,542,389	470	6,419,255	5,451,969	564	7,783,625	6,816,339	705
Rollingstone Creek	580,606	1,601,949	1,021,343	176	2,071,368	1,490,762	257	2,775,497	2,194,891	378
Bluewater Creek	582,066	2,805,025	2,222,960	382	2,802,835	2,220,770	382	2,799,550	2,217,485	381
Black River (no STP)	1,520,955	7,190,500	5,669,545	373	7,403,660	5,882,705	387	7,723,400	6,202,445	408
Black Basin	3,650,913	17,107,149	13,456,236	369	18,697,118	15,046,205	412	21,082,072	17,431,159	477
Bohle River (no STPs)	1,954,287	9,289,250	7,334,963	375	8,884,961	6,930,675	355	8,278,529	6,324,242	324
Lower Ross River	759,748	4,202,975	3,443,228	453	4,989,039	4,229,292	557	6,168,135	5,408,388	712
Upper Ross River	3,117,100	8,103,000	4,985,900	160	10,147,000	7,029,900	226	13,213,000	10,095,900	324
Stuart Creek (no STP)	609,550	1,649,800	1,040,250	171	2,427,980	1,818,430	298	3,595,250	2,985,700	490
Alligator Creek	1,901,285	2,103,495	202,210	11	3,789,503	1,888,218	99	6,318,515	4,417,230	232
Ross Basin	8,341,969	25,348,520	17,006,551	204	30,238,483	21,896,514	262	37,573,429	29,231,459	350
Magnetic Island	107,003	341,983	234,980	220	344,275	237,272	222	347,714	240,710	225
Black Ross Total	12,099,885	42,797,652	30,697,767	254	49,279,876	37,179,991	307	59,003,214	46,903,329	388

Pre settlement to 2045 TN change (no STPs) Summary

	1850	2005	2005-1850	% change	2021	2021-1850	% change	2045	2045-1850	% change
	TN kg/yr	TN kg/yr	TN kg/yr		TN kg/yr	TN kg/yr		TN kg/yr	TN kg/yr	
Crystal Creek	45,888	90,060	44,172	96	97,680	51,792	113	109,109	63,222	138
Rollingstone Creek	27,609	40,420	12,812	46	45,353	17,745	64	52,753	25,145	91
Bluewater Creek	27,685	92,637	64,952	235	95,134	67,448	244	98,879	71,193	257
Black River (no STP)	38,763	69,131	30,368	78	70,620	31,857	82	72,854	34,091	88
Black Basin	139,945	292,248	152,304	109	308,787	168,842	121	333,595	193,651	138
Bohle River (no STPs)	46,601	78,275	31,674	68	75,103	28,502	61	70,344	23,744	51
Lower Ross River	18,168	33,097	14,929	82	36,446	18,278	101	41,468	23,300	128
Upper Ross River	77,380	100,375	22,995	30	110,157	32,777	42	124,830	47,450	61
Stuart Creek (no STP)	14,783	18,944	4,161	28	23,543	8,760	59	30,441	15,659	106
Alligator Creek	42,749	42,687	-62	0	53,212	10,463	24	69,000	26,251	61
Ross Basin	199,680	273,377	73,697	37	298,460	98,780	49	336,083	136,403	68
Magnetic Island	5,084	6,282	1,198	24	6,214	1,130	22	6,112	1,028	20
Black Ross Total	344,709	571,908	227,198	66	613,461	268,752	78	675,791	331,082	96

Pre settlement to 2045 TP change (no STPs) Summary

	1850	2005	2005-1850	% change	2021	2021-1850	% change	2045	2045-1850	% change
	TP kg/yr	TP kg/yr	TP kg/yr		TP kg/yr	TP kg/yr		TP kg/yr	TP kg/yr	
Crystal Creek	4,690	9,376	4,686	100	10,272	5,582	119	11,616	6,926	148
Rollingstone Creek	2,941	4,018	1,077	37	4,481	1,540	52	5,176	2,235	76
Bluewater Creek	3,100	4,637	1,537	50	4,510	1,410	45	4,320	1,219	39
Black River (no STP)	4,117	10,016	5,898	143	10,239	6,122	149	10,574	6,457	157
Black Basin	14,849	28,047	13,198	89	29,503	14,654	99	31,685	16,836	113
Bohle River (no STPs)	4,892	14,136	9,244	189	13,527	8,635	177	12,613	7,721	158
Lower Ross River	1,907	6,976	5,069	266	7,676	5,769	302	8,727	6,820	358
Upper Ross River	7,957	12,775	4,818	61	14,731	6,774	85	17,666	9,709	122
Stuart Creek (no STP)	1,537	2,957	1,420	92	3,774	2,237	146	5,001	3,464	225
Alligator Creek	4,618	4,807	190	4	6,581	1,964	43	9,242	4,624	100
Ross Basin	20,910	41,651	20,741	99	46,290	25,380	121	53,248	32,338	155
Magnetic Island	518	943	425	82	946	429	83	952	434	84
Black Ross Total	36,277	70,641	34,364	95	76,739	40,462	112	85,885	49,608	137

2045, 2021 and 2005 minus pre-settlement (1850) natural loads

	1850	2005-1850	2021-1850	2045-1850	1850	2005-1850	2021-1850	2045-1850	1850	2005-1850	2021-1850	2045-1850
	TSS kg/yr	TSS kg/yr	TSS kg/yr	TSS kg/yr	TN kg/yr	TN kg/yr	TN kg/yr	TN kg/yr	TP kg/yr	TP kg/yr	TP kg/yr	TP kg/yr
Crystal Creek	967,287	4,542,389	5,451,969	6,816,339	45,888	44,172	51,792	63,222	4,690	4,686	5,582	6,926
Rollingstone Creek	580,606	1,021,343	1,490,762	2,194,891	27,609	12,812	17,745	25,145	2,941	1,077	1,540	2,235
Bluewater Creek	582,066	2,222,960	2,220,770	2,217,485	27,685	64,952	67,448	71,193	3,100	1,537	1,410	1,219
Black River (no STP)	1,520,955	5,669,545	5,882,705	6,202,445	38,763	30,368	31,857	34,091	4,117	5,898	6,122	6,457
Black Basin	3,650,913	13,456,236	15,046,205	17,431,159	139,945	152,304	168,842	193,651	14,849	13,198	14,654	16,836
Bohle River (no STPs)	1,954,287	7,334,963	6,930,675	6,324,242	46,601	31,674	28,502	23,744	4,892	9,244	8,635	7,721
Lower Ross River	759,748	3,443,228	4,229,292	5,408,388	18,168	14,929	18,278	23,300	1,907	5,069	5,769	6,820
Upper Ross River	3,117,100	4,985,900	7,029,900	10,095,900	77,380	22,995	32,777	47,450	7,957	4,818	6,774	9,709
Stuart Creek (no STP)	609,550	1,040,250	1,818,430	2,985,700	14,783	4,161	8,760	15,659	1,537	1,420	2,237	3,464
Alligator Creek	1,901,285	202,210	1,888,218	4,417,230	42,749	-62	10,463	26,251	4,618	190	1,964	4,624
Ross Basin	8,341,969	17,006,551	21,896,514	29,231,459	199,680	73,697	98,780	136,403	20,910	20,741	25,380	32,338
Magnetic Island	107,003	234,980	237,272	240,710	5,084	1,198	1,130	1,028	518	425	429	434
Black Ross Total	12,099,885	30,697,767	37,179,991	46,903,329	344,709	227,198	268,752	331,082	36,277	34,364	40,462	49,608