

CSM water supply and gas supply pipelines Surface water quality impact assessment

November, 2008

Wandoan Joint Venture



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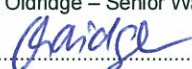
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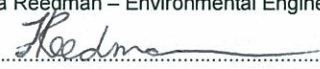
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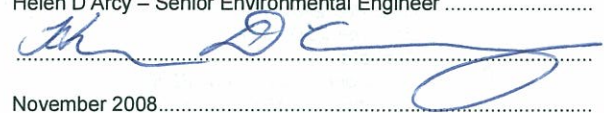
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Glossary

<i>Al</i>	Aluminium
<i>ANZECC</i>	Australian and New Zealand Environment and Conservation Council
<i>As</i>	Arsenic
<i>Cd</i>	Cadmium
<i>Cr</i>	Chromium
<i>Conductivity or EC</i>	Conductivity (electrical conductivity) or salinity are measures of the total concentration of inorganic ions (salts) in the water.
<i>Cu</i>	Copper
<i>DO</i>	Dissolved oxygen
<i>EC</i>	Electrical conductivity
<i>EVs</i>	Environmental values
<i>ESCP</i>	Erosion and Sediment Control Plan
<i>Fe</i>	Iron
<i>Hg</i>	Mercury
<i>Hardness as CaCO₃</i>	Hardness is expressed in mg/L as CaCO ₃ . Increasing calcium and magnesium in waters (hardness) is usually associated with increases in alkalinity. Changes in alkalinity will directly affect metal speciation.
<i>MLA</i>	Mining Licence Application
<i>Mn</i>	Manganese
<i>Ni</i>	Nickel
<i>NO₂ and NO₃</i>	Nitrite and nitrate
<i>OC</i>	Organochlorine Pesticides
<i>OP</i>	Organophosphorus Pesticides
<i>Pb</i>	Lead
<i>Stream order</i>	Streams in geographic terms are awarded order designations. A stream of the first order is a stream which does not have any other stream feeding into it. A stream of the second order is one which is formed by the joining of two or more streams. A third-order stream is one below the confluence of two or more second-order streams; a fourth-order stream is formed by the confluence of at least two third-order streams, and so forth.

<i>TN</i>	Total phosphorus
<i>TP</i>	Total nitrogen
<i>Tributary</i>	A tributary is a stream which flows into another river (a key stream).
<i>TSS</i>	Total suspended solids
<i>Turbidity</i>	The turbidity or 'muddiness' of water is caused by the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus.
<i>WQOs</i>	Water Quality Objectives
<i>Zn</i>	Zinc

Executive summary

The Wandoan Coal Project (the Project) comprises the development of thermal coal resources situated immediately west of the Wandoan township, located in Dalby Regional Council. The Project is located approximately 350 km northwest of Brisbane and 60 km south of Taroom. The coal reserves for this Project exist within three mining lease applications, MLA 50229, 50230 and 50231 and developed by open cut mining with related infrastructure.

This report outlines the water quality assessment associated with the Project's supporting infrastructure including two proposed options for Coal Seam Methane (CSM) water supply pipeline alignments and a gas supply pipeline alignment, as shown in Figure 1–1. The historical Department of Natural Resources and Water (DNRW) water quality data was used for this assessment. DNRW collects, manages and supplies quantitative and qualitative data of the state's freshwater streams and aquifers. The historical water quality monitoring, undertaken by the DNRW, was carried out from 1964 (earliest) to 2005 (latest).

The historical water quality monitoring sites and the respective monitoring frequencies, associated with waterways located in the study area, are listed below:

- 422202A Dogwood Creek at Miles Lat 26:40 S Long 150:11, frequency of sampling not indicated — associated with the southern CSM water supply pipeline alignment; station no longer operating
- 422202B Dogwood Creek at Gilweir Lat 26:43 S Long 150:11 E, frequency of sampling not indicated; station no longer operating — associated with the southern CSM water supply pipeline alignment; station is still operating
- 130344A Juandah Creek at Windamere Lat 26:02 S Long 149:53 E, frequency of sampling not indicated; station is still operating — associated with the gas supply pipeline alignment.

The area associated with the western CSM water supply pipeline alignment that runs from the MLA areas towards Spring Gully Reverse Osmosis Plant, does not have any relevant DNRW water quality monitoring sites that are suitable for this assessment. However, the Aquatic Ecology Impact Assessment technical report provides indicative water quality data for physical parameters relevant to the area.

The parameters monitored at the DNRW locations include electrical conductivity (EC) @ 25C⁰, turbidity, water temperature, pH, hardness as CaCO₃, total suspended solids (TSS), nitrate as NO₃, dissolved oxygen (DO), Aluminum soluble (Al), Iron soluble (Fe), Manganese soluble (Mn) and Zinc soluble (Zn).

The locations of these monitoring sites are shown in Figure 4–1.

The historical water quality monitoring indicated the following water quality exceedances:

- all samples taken for TSS, turbidity and nutrients (i.e. TP and TN) exceed the guideline requirements
- most of the samples taken for heavy metals exceed the 95 % protection trigger values
- DO and *Chlorophyll a* guideline requirements were exceeded at the Dogwood Creek-Gilweir monitoring site.

Following the adoption of the mitigation strategies and measures, surface waters associated with the two proposed CSM water supply pipeline options and gas supply pipeline alignment are likely not to be

degraded compared to existing the water quality on site. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

The implementation of mitigation measures is required to reduce the impact of the following:

- impacts of pipeline construction
- impact of pipeline drainage infrastructure on existing flows
- impacts of potential incidents (e.g. pipeline failure/rupture)
- potential water sources during construction
- measures to reduce weed infestation
- proposal to divert waterways during construction.

The environmental standard of the residual impacts will be managed in accordance with mitigation measures.

1. Introduction

The Wandoan Coal Project (the Project) comprises the development of thermal coal resources situated immediately west of the Wandoan township, located in Dalby Regional Council. The Project is located approximately 350 km northwest of Brisbane and 60 km south of Taroom as shown in Figures 1–1 to 1–3. The coal reserves for this Project exist within three mining lease applications (MLAs), MLA 50229, 50230 and 50231. The coal resources will be developed open cut mining with related infrastructure.

The Project will be developed by the Wandoan Joint Venture. The joint venture partners are Xstrata Coal Queensland Pty Ltd (XCQ), ICRA RPW Pty Ltd and Sumisho Coal Australia Pty Ltd.

The Project was declared a significant Project by the Coordinator-General in December 2007.

This report outlines the water quality assessment associated with the Project's supporting infrastructure including two possible water supply pipeline options carrying coal seam methane (CSM) by-product water, one south of the MLA areas and the other west, and a gas supply pipeline.

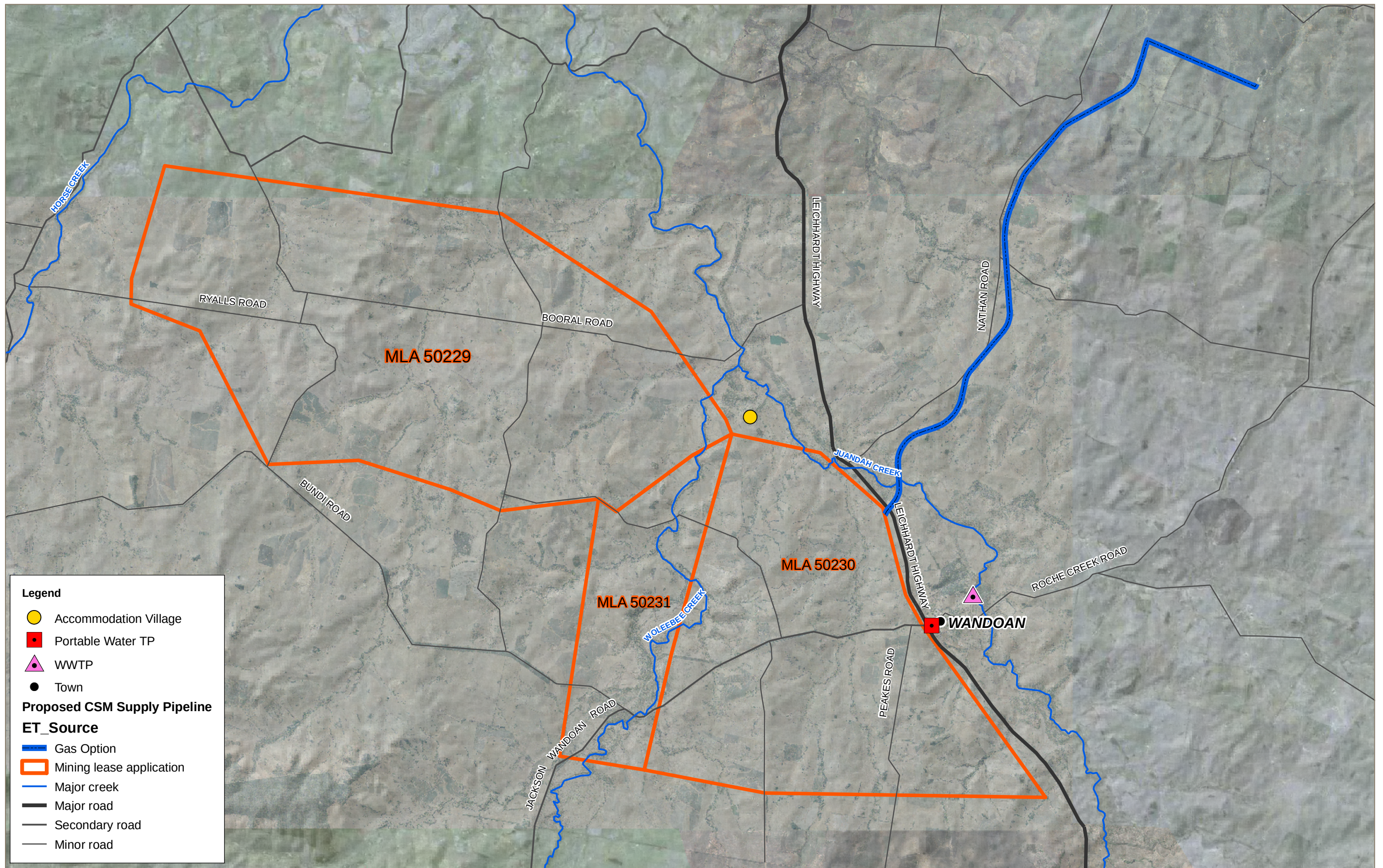
The proposed southern CSM water supply pipeline will run from the Condamine Power Station, along local road reserves and private properties until it reaches the Leichhardt Highway road reserve heading north into the road reserve of Baileys Road, and then at Giligulgul heading north west across private properties to Peakes Road into the MLA areas.

The proposed western CSM water supply pipeline will run from the Spring Gully Reverse Osmosis Plant along local and state controlled road reserves and private properties until it reaches the MLA 50229 boundary and into the MLA areas.

The proposed gas supply pipeline alignment will run from the Peat-Scotia lateral gas line private property boundaries and then adjacent to the proposed eastern easement of the Surat Basin Rail alignment.

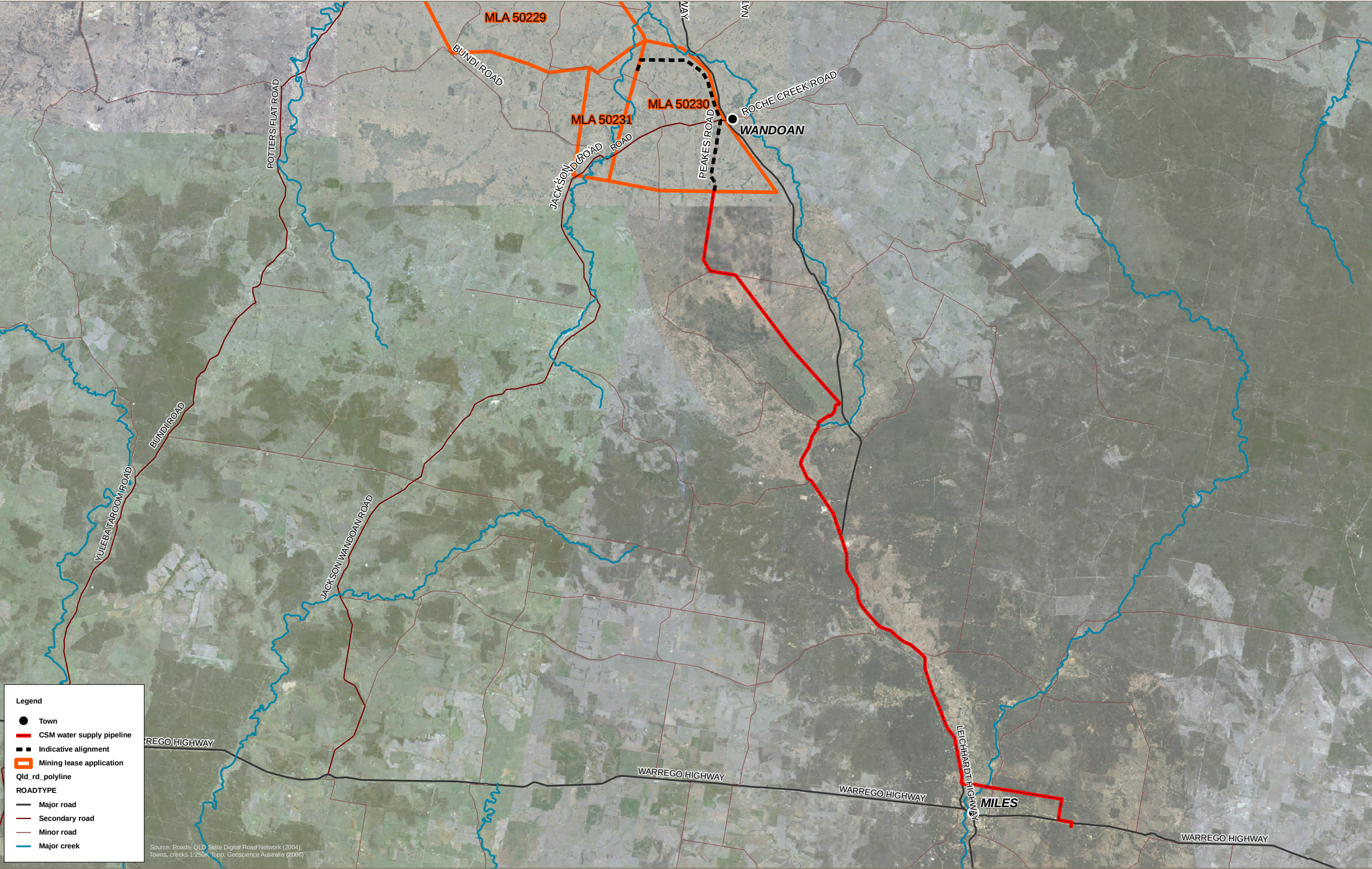
The Project area is predominately used for grazing and crops. Most of the areas have been cleared for agricultural purposes. Grain growing and beef production are now the major land uses for most properties.

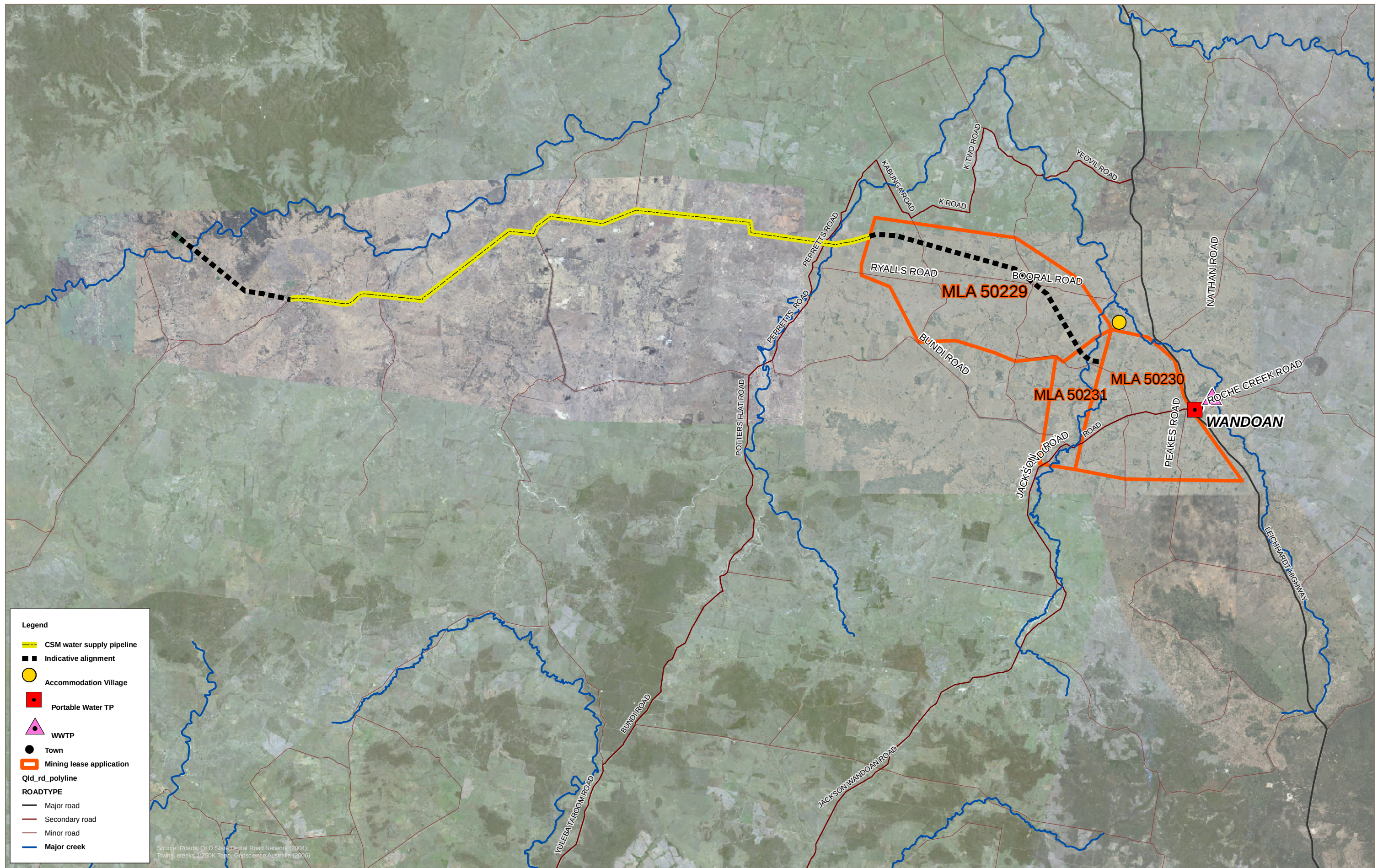
Juandah Creek and Dogwood Creek are the most prominent watercourses in the study area. Juandah Creek flows into the Dawson River approximately 64 km north of the MLA areas, with the Dawson River catchment being part of the Fitzroy River Basin. Dogwood Creek flows into Balonne Condamine River Basin.



J:\A442-ENG\PROJ\2133006C__Wandoan_prefea\10_GIS\Projects\Env\Technical Report\Figure 1-2 Project Area.mxd

Source: Roads, QLD State Digital Road Network (2004); Towns, creeks 1:250K Topo, Geoscience Australia (2006)





2. Methodology of assessment

2.1 Methodology

The methodology of the surface water quality impact assessment for the Wandoan Coal Project is outlined below.

1. Relevant legislation and guidelines

Review of legislation and guidelines potentially relevant to the surface water assessment.

The information required for this task includes relevant legislation, strategies, policies and guidelines.

2. Water quality assessment

The outline of the background water quality of surface water associated with the two possible CSM water supply pipelines and gas supply pipeline alignments.

The information required for this task includes available Department of Natural Resources and Water (DNRW) historical data.

3. Potential impacts

The description of potential impacts associated with the supporting infrastructure of the proposed Wandoan Coal Project.

This task is based on the outcome of previous study tasks (i.e. tasks 1 to 2).

4. Mitigation measures

The description of mitigation strategies required for the supporting infrastructure of the Project to manage the impact on surface water quality.

This task is based on the outcome of previous study tasks (i.e. tasks 1 to 3).

5. Residual impacts

The description of the impacts following implementation of mitigation measures outlined in the report.

This task is based on the outcome of previous study tasks (i.e. tasks 1 to 4).

6. Conclusion and summary of mitigation strategies

The outline of key points of the surface water assessment and the summary of mitigation strategies.

This task is based on the outcome of previous study tasks (i.e. tasks 1 to 5).

3. Relevant legislation and guidelines

The *Environmental Protection (Water) Policy 1997* (EPP Water) is subordinate legislation under the *Environmental Protection Act 1994* that functions as an important tool for ensuring that the broad environmental protection measures are better defined when it comes to the specific issues of protecting water.

The EPP states legally binding standards for water quality. Environmental Values (EVs) and Water Quality Objectives (WQOs) have been established under Schedule 1 of the EPP Water for freshwater.

None of the affected waters are scheduled in Schedule 1 of the Policy through the corresponding Environmental Values and Water Quality Objectives report(s). The environmental values of the receiving waters are therefore deemed to be considered by addressing water quality guidelines. These water quality guidelines are numerical concentration levels or statements for indicators that protect a stated environmental value. The following documents are used to decide the water quality guidelines for an environmental value for water:

- a. site specific documents
- b. the Australian water quality guidelines
- c. documents published by a recognised entity.

The EVs of waters to be enhanced or protected under the EPP Water (1997) are:

- biological integrity of a modified aquatic ecosystem
- suitability for recreational use
- suitability for minimal treatment before supply as drinking water
- suitability for agricultural use and
- suitability for industrial use.

The EPP Water defines an indicator for an environmental value as a property that is able to be measured or decided in a quantitative way. WQOs are generally developed based on the review of the available site specific information that pertains to the associated environmental value. In the policy, it is stated that the *Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 Guidelines* are appropriate to be used to decide water quality trigger values for environmental value indicators for a water body.

The South East Queensland Water Quality Management Strategy is not relevant to this scope of work as the Project is outside of South East Queensland.

3.1 Site based EVs and WQOs

Environmental Values (EVs) for the Wandoan area have not been identified. Dalby Regional Council is in the process of developing EVs for the area.

In this case, where the site specific information is not available, the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 guidelines 'are used as a general tool for assessing water quality and are the key to determining water quality

objectives that protect and support the designated environmental values of water resources, and against which performance can be measured' (ANZECC 2000, p 2.9).

The ecosystem condition that is most appropriate to be applied to the default guideline value (ANZECC 2000) is a 'slightly to moderately disturbed system'. The guideline values refer to the following levels of protection:

- physical and chemical stressors
- toxicants
- biological indicators.

4. Existing environment (water quality)

4.1 Introduction

The historical DNRW water quality data was used for this assessment. DNRW collects, manages and supplies quantitative and qualitative data of the state's freshwater streams and aquifers. The historical water quality monitoring undertaken by the DNRW, was carried out from 1964 (earliest) to 2005 (latest). The information in relation to the historical monitoring data is detailed in Attachment A.

The historical water quality monitoring sites and the respective monitoring frequencies, associated with waterways located in the study area, are listed below.

For the southern CSM water supply pipeline:

- 422202A Dogwood Creek at Miles Lat 26:40 S Long 150:11 E, frequency of sampling not indicated; station no longer operating
- 422202B Dogwood Creek at Gilweir Lat 26:43 S Long 150:11 E, frequency of sampling not indicated; station is still operating.

For the gas supply pipeline:

- 130344A Juandah Creek at Windamere Lat 26:02 S Long 149:53 E, frequency of sampling not indicated; station is still operating.

The area associated with the western CSM water supply pipeline alignment does not have any relevant DNRW water quality monitoring sites that are suitable for this assessment. The Aquatic Ecology Impact Assessment technical report outlines indicative water quality data for physical parameters.

The parameters monitored at the DNRW locations include electrical conductivity (EC) @ 25C°, turbidity, water temperature, pH, hardness as CaCO₃, total suspended solids (TSS), nitrate as NO₃, dissolved oxygen (DO), Aluminum soluble (Al), Iron soluble (Fe), Manganese soluble (Mn) and Zinc soluble (Zn).

4.2 Water quality objectives

The ANZECC (2000) trigger values for physical and chemical stressors, toxicants and biological indicators are outlined below.

4.2.1 Physical and chemical stressors

ANZECC (2000) specifies trigger values applicable to south-east Australia. Relevant trigger values are outlined under the associated ecosystem type including lowland rivers, wetlands, estuarine and marine. The type that applies to the study area is the upland rivers ecosystem (see Attachment B for trigger values).

4.2.2 Toxicants

The guidelines state that

for ecosystems that can be classified as highly disturbed, the 95 % protection trigger values can still apply. However, depending on the state of the ecosystem, the management goals and the approval of the appropriate state or regional authority in consultation with the community, it can be appropriate to apply a less stringent guideline trigger value, say protection of 90 % of species, or perhaps even 80 %. These values are provided as intermediate targets for water quality improvement. If the trigger values have been calculated using assessment factors, there is no reliable way to predict what changes in ecosystem protection are provided by an arbitrary reduction in the factor. (ANZECC 2000, p 3.4–4)

Specifications for the slightly to moderately disturbed ecosystems include the following (ANZECC, 2000, p.3.4-11):

- always preferable to use local biological effects data, such as including Direct Toxicity Assessment (DTA) to derive guidelines
- if local biological effects data is unavailable, then apply 95 % protection levels as default, low-risk trigger values, and/or 99 % values are recommended for certain chemicals as noted in Attachment B (i.e. Table 3.4.1, ANZECC 2000, p. 3.4–5 to 3.4–10)
- precautionary approach may be required for assessment of post-baseline data through trend analysis or feedback triggers
- in the case of effluent discharges, DTA may be required.

4.2.3 Biological indicators

The DTA is a biological measurement that will provide confirmation of the site-specific guideline, or in case there is a low confidence in a desktop assessment (ANZECC, 2000). The ANZECC (2000) guidelines also recommend applying DTA for early detection of short or long term changes in relation to the general inorganic and organic contaminants, and biological assessment objectives for different management situations. The assessment of biological indicators was not undertaken as part of this study.

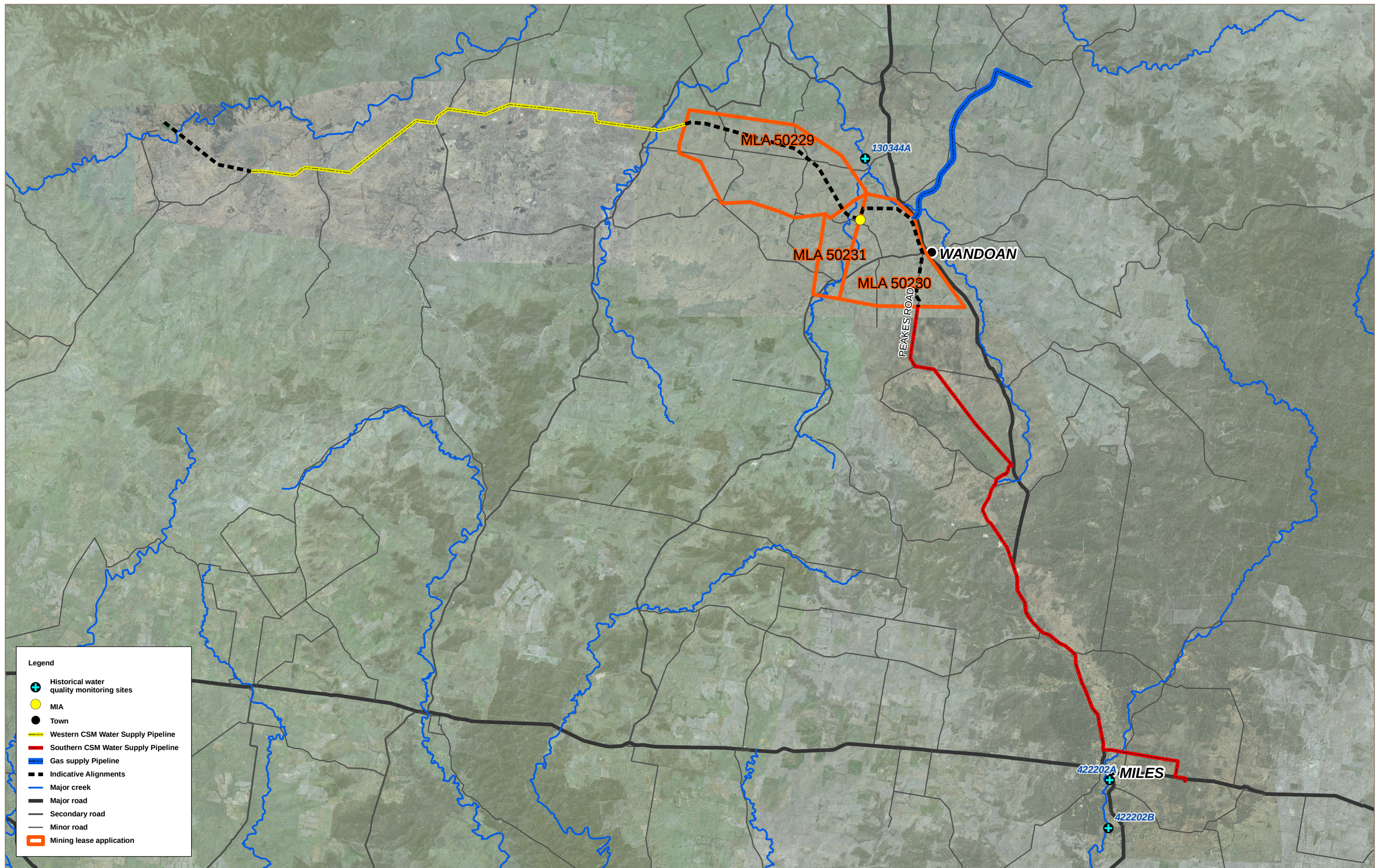
Trigger values for freshwater are outlined in Table 3.4.1 of Attachment B.

4.3 Historical water quality

Figure 4–1 shows the location of the proposed western and southern CSM water supply pipeline options and gas supply pipeline alignment in relation to creeks and historical monitoring sites.

Historical water quality monitoring included a selection of physical/chemical parameters and heavy metals. The historical records show water quality data for physical/chemical parameters and heavy metals (Figure 4–2).

A summary of DNRW water quality is enclosed in Attachment A.



J:\A442-ENG\PROJ\2133006C__Wandoan_prefea\10_GIS\Projects\Env\Technical Report\Figure 2-1 Test Pit and test bore locations .mxd

4.3.1 Water quality characteristics

Water quality values (i.e. minimum, mean and maximum values) associated with monitoring sites and parameters monitored by DNRW (i.e. EC @ 25C°, turbidity, pH, hardness as CaCO₃, TSS, nitrate as NO₃, DO, Al, Fe, Mn and Zn) are shown in Figures 4–2 and 4–3.

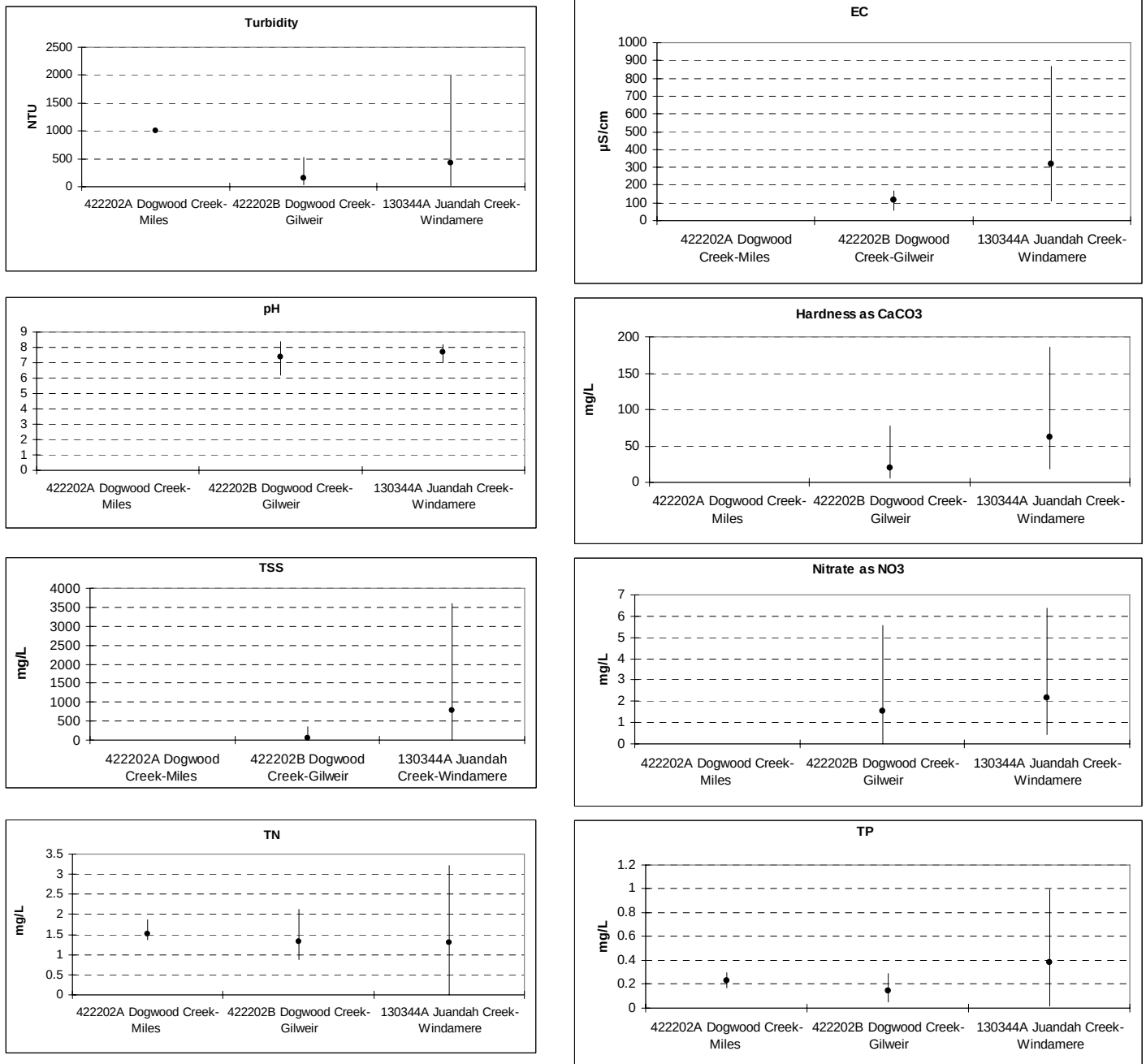


Figure 4-2: Water quality characteristics

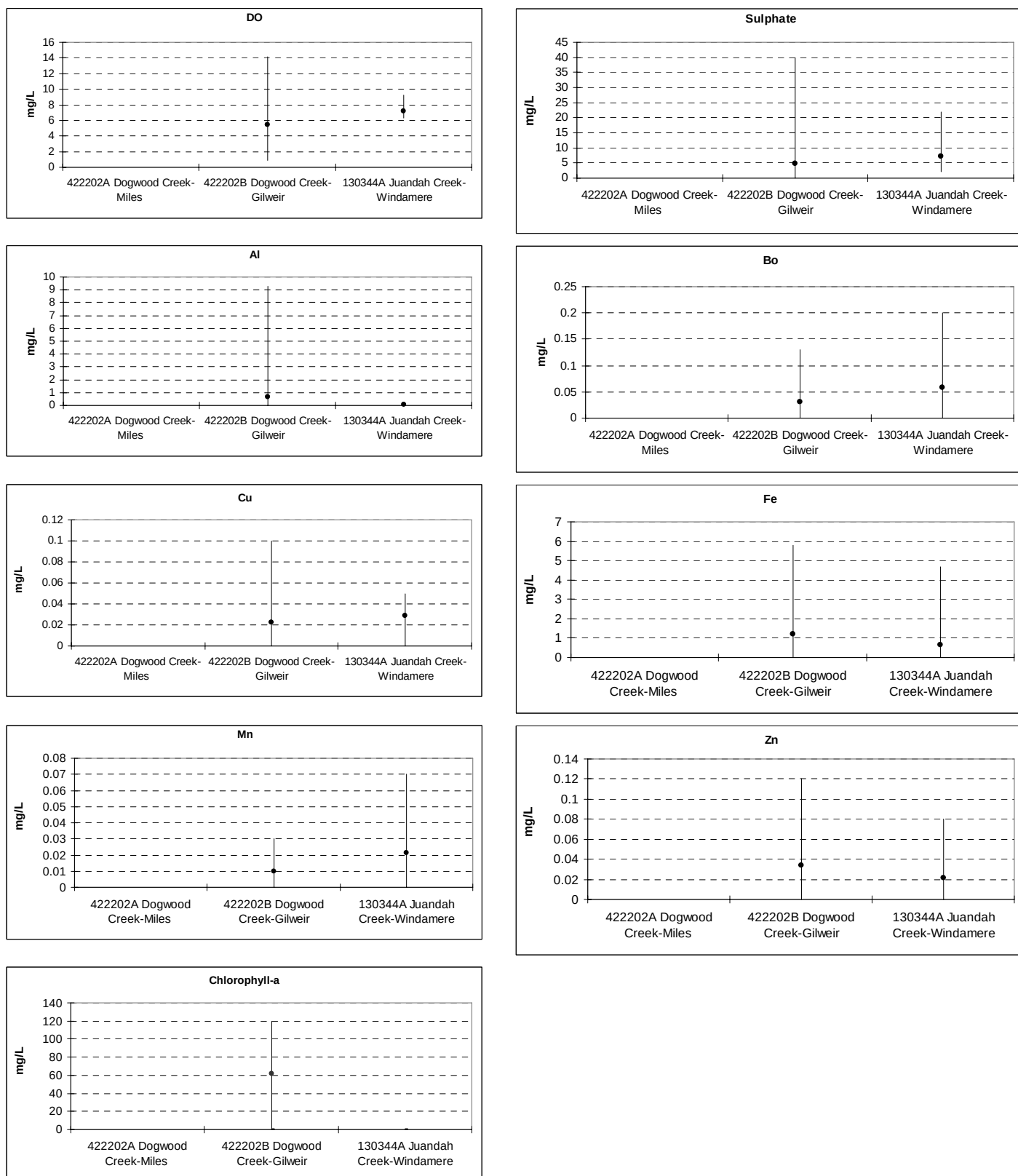


Figure 4-3: Water quality characteristics

4.3.2 Water quality compliance

Table 4–1 shows the water quality compliance with the ANZECC (2000) and Queensland Water Quality Guidelines (QWQG, 2006) guidelines.

Parameters assessed against the guideline values include TSS, turbidity, pH, EC, sulphate, total phosphorus (TP), total nitrogen (TN), Chlorophyll a, total Iron (Fe), Aluminium (Al), Manganese (Mn), Boron (Bo), Copper (Cu), Zinc (Zn). Values marked in red print depict a water quality exceedance.

The historical water quality monitoring indicated the following water quality exceedances:

- all samples taken for TSS, turbidity and nutrients (i.e. TP and TN) exceed the guideline requirements
- most of the samples taken for heavy metals exceed the 95 % protection trigger values
- DO and *Chlorophyll a* guideline requirements were exceeded at the Dogwood Creek-Gilweir monitoring site.

Table 4-1: Historical physical/chemical water quality compliance with the ANZECC (2000) and QWQG (2005)

	TSS (mg/L)	Turbidity (NTU)	pH	EC (mS/cm)	Hardness as CaCO ₃ (mg/L)	Sulphate (mg/L)	TN (mg/L)	TP (mg/L)	DO (mg/L)	Chlorophyll a (mg/m ³)	Fe (mg/L)	Al (mg/L)	Bo (mg/L)	Cu (mg/L)	Mn (mg/L)	Zn (mg/L)
422202A Dogwood Creek-Miles																
Range	nr	1000 ¹	nr	nr	nr	nr	1.37– 1.86	0.71– 0.3	nr	nr	nr	nr	nr	nr	nr	nr
Mean	nr	1000 ¹	nr	nr	nr	nr	1.53	0.232	nr	nr	nr	nr	nr	nr	nr	nr
422202B Dogwood Creek-Gilweir																
Range	6–340	28–520	6.2– 8.4	59–169	5.2–77.16	0–40	0.87– 2.13	0.054– 0.288	0.9– 14.1	3–120	0–5.8	0–9.3	0–0.13	0–0.1	0–0.03	0–0.12
Mean	59.5	160.5	7.4	117.6	19.7	4.86	1.32	0.14	5.4	61.5	1.216	0.691	0.03	0.022	0.01	0.034
130344A Juandah Creek-Windamere																
Range	10– 3,600	11.2– 2,000	7– 8.2	108–865	19–185.8	2–21.8	0.01– 3.22	0.015– 1.00	6.3– 9.2	nr	0–4.7	0–0.15	0–0.2	0–0.05	0–0.07	0–0.08
Mean	775.9	432.2	7.7	315.1	62.5	7.1	1.3	0.38	7.2	nr	0.65	0.047	0.058	0.029	0.021	0.022
GUIDELINE VALUES																
QWQG (2006) — upland streams ³	10	NA	6.5– 7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ANZECC 2000	NA	2–25	NA	30–350	NA	50	0.5	0.05	>6	5	0.34	0.055 ²	0.37 ²	0.0014 ² (H* 19.7 mg/L)	1.7 ²	0.008 ² (H* 19.7 mg/L)
														0.0035 ² (H*62.5 mg/L)		0.02 ² (H*62.5 mg/L)

¹ Single record – insufficient data to determine water quality compliance

nr — no record

² Based on 95% protection level, as recommended in ANZECC (2000) for 'Slightly to Moderately Disturbed' ecosystems

NA — not applicable

³ Upland streams are defined as those at >150 m altitude (ANZEC 2000)

4.3.3 Water quality findings

The historical water quality values indicate the historical nutrient pollution in the Project area. The largest amount of these nutrients is normally generated from the diffuse runoff from the particular (i.e. agricultural) land-use activity and the area or proportion of the catchment devoted to that activity (i.e. nutrient kg/ha/a).

The increased TSS and turbidity values are generally related to sediment-laden runoff associated with soil erosion (i.e. hillslope, gully and bank) and associated distribution via runoff.

The water quality analysis also indicated increased heavy metal levels. Most of the historical samples taken for heavy metals exceed the 95 % protection trigger values (slightly to moderately disturbed systems, ANZECC 2000) including iron (Fe), copper (Cu) and zinc (Zn) recorded at the Juandah Creek-Windamere and the Dogwood Creek-Gilweir monitoring sites (Table 4–1). Table 4–1 also indicates aluminium (Al) exceedance recorded at the Dogwood Creek-Gilweir monitoring site.

The background concentrations associated with the increased pH and hardness suggests that increased heavy metals, at the Juandah Creek-Windamere monitoring site, will precipitate out as metal hydroxides or other salts, thus reducing their toxicity. However, Al concentrations are toxic at both low and high pH and rapid changes in pH, which can occur during land runoff from a storm event, can have an adverse impact on surface water ecosystems (i.e. kill fish). This suggests that a significant (i.e. adverse) environmental impact is more likely to be relevant to catchment and surface waters associated with the Dogwood Creek-Gilweir monitoring site.

The ANZECC (2000, p. 8.3–44) guideline also states the following in relation to stated guideline trigger values for metals:

Natural background concentrations of some chemicals, particularly metals, may exceed the stated guideline trigger values due to mineralisation from the catchment substrate, as distinct from anthropogenic sources. In such cases, it would be unreasonable to insist on a guideline value below the background concentration. High levels of naturally-occurring metals in highly mineralised areas are not necessarily indicative of adverse environmental effects due to possible adaptation of the local fauna.

There is insufficient data available to discuss the existing water quality in terms of seasonal variations or variations with flow.

5. Potential impact and mitigation measures

The disturbed rock and soil if exposed to rainfall carries sediments and salts, metals, trace elements, and/or organic compounds that may impact surface water quality. Potential impacts associated with the two proposed CSM water supply pipeline options and gas supply pipeline alignment may include the following:

- surface water runoff of salts, metals, and trace elements causing potential surface water quality impacts
- exacerbation of poor drainage and erosion
- potential environmental incidents
- increased amounts of pollutants in surface waters due to a lack of minimum vegetative cover.

The potential impact and the associated mitigation measures are outlined in Table 5–1.

Table 5-1: Potential impacts and mitigation measures

Issue	Potential impacts	Mitigation measures
Impacts of pipeline construction	Soil erosion and sediment transportation and deposition that may have the following effect on the environment: - on-site effects: loss of top soil, buried vegetation and buffer zones; silting and damage to trench works during construction; increased downtime on construction sites after storm events; visual impacts - off-site effects: siltation in some weirs, siltation of watercourses and aquatic habitats, introduction of exotic weed species, irregular and unstable land forms due to gully and bank erosion, increased pollution of streams, adverse ecological effects of de-silting of waterways, reduced ecological and aesthetic value of waterways and bushland where pipelines cross.	- Early planning and construction of temporary drainage system will minimise erosion and avoid delays in initial earthworks. - Plans for both temporary and permanent drainage, including design capacities, identification of all proposed temporary and final overland flow paths, and any proposed diversions of overland flow paths of watercourses. - Diversion of upslope water to reduce on-site erosion, reduce total volume of contaminated runoff requiring treatment and reduced downtime following prolonged rain event. - Development and application of Erosion and Sediment Control Plan (ESCP) including the following: - clear definition of soil and water management problems — including existing site conditions, soil and climatic data, critically on-site erosion prone areas, location of the nearest and other relevant environmentally sensitive areas - clear interpretation of proposed control measures including the following actions — minimise disturbance, provide drainage, erosion and sediment control, implement effective revegetation, undertake effective implementation of an approved ESCP - locality plan identifying the development, staging of works, of temporary erosion control measures (in event of unforeseen construction delays) - development of recognised approval processes. - Maintain and supervise implementation of the ESCP, and undertake scheduled inspections. - The effects of drainage works including placement of fill, clearing or any other alterations to existing topography and landform on hydrology will be mitigated in the ESCP. - Undertake monitoring of the effectiveness of ESCP including diary notes/logbook entries of control techniques used on-site,

Issue	Potential impacts	Mitigation measures
		and water quality sampling (i.e. upstream and downstream. Downstream sampling should not be limited to the immediate downstream point, should include full travel path of sediment-laden runoff.
Impact of pipeline drainage infrastructure on existing flows	Disturbances to natural watercourses and riparian zones.	- Undertake construction in flood prone areas during dry months, and undertake planning and staging of works to reduce downtime following periods of heavy rain. - Avoid disturbances to natural watercourses and riparian zones - The extent of flooding will be considered for the timing of the construction works. - Ensure development and application of Erosion and Sediment Control Plan (ESCP).
Impacts of potential incidents during pipeline commissioning and operations (e.g. water pipeline failure/rupture)	Impact on land and surface water (i.e. increased total dissolved solids), and infiltration of CSM water to groundwater.	- Install and operate a pipeline leak detection system — to detect any leaks associated with the pipeline infrastructure. - Identify and implement a suitable surface water monitoring network to monitor potential impact on surface waters associated with pipeline crossings of waterways. - Install a groundwater monitoring system to detect any increases in total dissolved solids as a result of potential infiltration of CSM water to groundwater (beyond background (i.e. existing) levels), where a risk assessment indicates locations where a high potential for pipeline interference, access or rupture exists.
Potential water sources during construction	Time delays and increased erosion/sediment transport due to a lack of reliable supply of suitable water for water trucks for dust control and earth compaction, water pollution control ponds and revegetation works during the construction.	- Ensure a reliable supply of suitable water in form of the local (catchment) water, local water supply, or watercourse discharge. - Ensure development and application of Erosion and Sediment Control Plan (ESCP)
Measures to reduce weed infestation	Weed infestation of construction area and weed distribution downstream.	- Implement on-site measures to minimise weed infestation, including wash down of construction equipment. - Implement the revegetation plan to establish a weed free

Issue	Potential impacts	Mitigation measures
Proposal to divert waterways during construction	- Failure to temporarily divert waterways during the construction that will potentially result in silting and bank damage to trench works during construction. - Disturbances to natural watercourses and riparian zones.	groundcover that will be self regenerating and provide sustainable erosion control. - Ensure development and application of Erosion and Sediment Control Plan (ESCP). - Recognise drainage requirements early in the design phase - Clearly define flow paths on plans and on-site - Divert upslope water around disturbed areas - Ensure early planning and construction of temporary drainage system will minimise erosion and avoid delays in initial earthworks. - Ensure development and application of Erosion and Sediment Control Plan (ESCP).

6. Residual impacts

Following the adoption of the mitigation strategies and measures, surface waters associated with the two proposed CSM water supply pipeline options and gas supply pipeline alignment are likely not to be degraded compared to existing the water quality on site. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

The implementation of mitigation measures listed in Table 5–1 is required to reduce the impact of the following:

- impacts of pipeline construction
- impact of pipeline drainage infrastructure on existing flows
- impacts of potential incidents (e.g. pipeline failure/rupture)
- potential water sources during construction
- measures to reduce weed infestation
- proposal to divert waterways during construction.

The environmental standard of the residual impacts will be managed in accordance with mitigation measures listed above and detailed in Table 5–1.

7. Conclusions

The historical water quality monitoring indicated the following water quality exceedances:

- all samples taken for TSS, turbidity and nutrients (i.e. TP and TN) exceed the guideline requirements
- the historical concentrations associated with the increased pH and hardness suggests that increased heavy metals, at the Juandah Creek-Windamere monitoring site, will precipitate out as metal hydroxides or other salts, thus reducing their toxicity. However, Al concentrations are toxic at both low and high pH and rapid changes in pH, which can occur during land runoff from a storm event, can have an adverse impact on surface water ecosystems (i.e. fish kill). This suggests that a significant (i.e. adverse) environmental impact is more likely to be relevant to catchment and surface waters associated with the Dogwood Creek-Gilweir monitoring site.
- DO and *Chlorophyll a* guideline requirements were exceeded at the Dogwood Creek-Gilweir monitoring site.

Following the adoption of the mitigation strategies and measures, surface waters associated with the two proposed CSM water supply pipeline options and gas supply pipeline alignment are likely not to be degraded compared to existing the water quality on site. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

The implementation of mitigation measures listed in Table 5–1 is required to reduce the impact of the following:

- impacts of pipeline construction
- impact of pipeline drainage infrastructure on existing flows
- impacts of potential incidents (e.g. pipeline failure/rupture)
- potential water sources during construction
- measures to reduce weed infestation
- proposal to divert waterways during construction.

The environmental standard of the residual impacts will be managed in accordance with mitigation measures listed above and detailed in Table 5–1.

8. Summary of mitigation strategies

The implementation of the mitigation strategy (i.e. mitigation measures for the study) to minimise the potential impact on surface water quality in the Wandoan project area is of paramount. The summary of mitigation measures are listed in Table 5–1.

Following the adoption of the mitigation strategies and measures, surface waters associated with the two proposed CSM water supply pipeline options and gas supply pipeline alignment are likely not to be degraded compared to existing the water quality on site. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

The implementation of mitigation measures is required to reduce the impact of the following:

- impacts of pipeline construction
- impact of pipeline drainage infrastructure on existing flows
- impacts of potential incidents (e.g. pipeline failure/rupture)
- potential water sources during construction
- measures to reduce weed infestation
- proposal to divert waterways during construction.

The environmental standard of the residual impacts will be managed in accordance with mitigation measures.

References

Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC). 2000. National Water Quality Management Strategy.

EPA. 2006. Queensland Water Quality Guidelines.

Attachment A

DNRW Water Quality Summary

Raw

Balonne Condamine

Qld NRW WaterShed

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Water Quality Summary by Site

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	SDate	End Date
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*** ** SITE : 422202A Dogwood_Ck Miles

422202A Dogwood Creek at Miles Lat 26:40 S Long 150:11 E GZ 287.347 Datum SD AMTD 114.6kms C_Area 2890.0sq.km Data Commence 01/10/1945 Cease 31/01/1950 Region TBA

422202A Parameter	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Starting Date	End Date
2030.5 Turbidity (Field)	3	1000	-	-	-	1000	1000	0	1/07/2005	1/07/2005
2337 Total Nitrogen	7	1.37	-	-	-	1.86	1.52429	0.15894	3/12/2005	9/12/2005
2363 Total Phosphorus as P	7	0.171	-	-	-	0.3	0.23229	0.04221	3/12/2005	9/12/2005

Qld NRW WaterShed

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Water Quality Summary by Site

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	SDate	End Date
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*** ** SITE : 422202B Dogwood_Ck Gilweir

422202B Dogwood Creek at Gilweir Lat 26:43 S Long 150:11 E GZ 283.156 Datum SD AMTD 107.9kms C_Area 3010.0sq.km Data Commence 01/10/1949 Current Region TBA

422202B Parameter	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Starting Date	End Date
2010.5 Electrical Conductivity @ 25C (Field)	24	59	98	117.5	143.7	169	117.58333	24.62575	19/05/1988	27/02/2005
2030.5 Turbidity (Field)	22	28	68.2	146.5	307.6	520	160.51818	110.47604	31/07/1995	27/02/2005
2080.5 Water Temperature (Field)	39	11	13.2	22.8	28.12	33.9	21.86923	6.0548	26/04/1964	27/02/2005
2100.5 pH (Field)	22	6.2	6.61	7.45	8.1	8.4	7.36818	0.64394	24/01/1994	27/02/2005
2132 Hardness as CaCO3 (calculated)	49	5.2	11.67	19	26.074	77.16	19.69878	10.04591	26/04/1964	14/02/2006
2172 Total Suspended Solids	50	6	10	46.5	103	340	59.46	64.8059	10/04/1973	14/02/2006
2322 Magnesium as Mg - soluble	49	0.9	1.6	2.6	3.52	9.3	2.65918	1.24481	26/04/1964	14/02/2006
2331 Nitrate as NO3	38	0	0.214	1.435	2.21	5.57	1.52	1.185	16/12/1980	14/02/2006
2337 Total Nitrogen	16	0.8689	0.98515	1.27935	1.639	2.1297	1.31728	0.30271	10/08/1998	27/02/2005
2351.5 Oxygen (Dissolved) (Field)	22	0.9	2.22	5.4	8.48	14.1	5.39091	3.03471	31/07/1995	27/02/2005
2363 Total Phosphorus as P	26	0.054	0.07735	0.126	0.2143	0.2876	0.14047	0.06033	16/02/1995	27/02/2005
2401 Sulphate as SO4	43	0	0.976	2.6	10	40	4.86256	6.50261	18/03/1971	14/02/2006
2502 Aluminium as Al - soluble	29	0	0	0.05	1.484	9.3	0.69069	1.79011	24/01/1994	14/02/2006
2551 Boron as B	34	0	0	0.005	0.1	0.13	0.03029	0.04004	10/04/1973	14/02/2006
2622 Copper as Cu - soluble	29	0	0	0.01	0.044	0.1	0.02241	0.02385	24/01/1994	14/02/2006
2682 Iron as Fe	36	0	0	0.515	3.205	5.8	1.21639	1.54317	26/04/1964	14/02/2006
2712 Manganese as Mn - soluble	34	0	0	0.01	0.027	0.03	0.01	0.01044	25/07/1983	14/02/2006
2822 Zinc as Zn - soluble	29	0	0	0.02	0.08	0.12	0.03379	0.03321	24/01/1994	14/02/2006
7001 Chlorophyll-a	2	3	-	-	-	120	61.5	82.73149	12/04/1999	12/07/1999

Qld NRW WaterShed

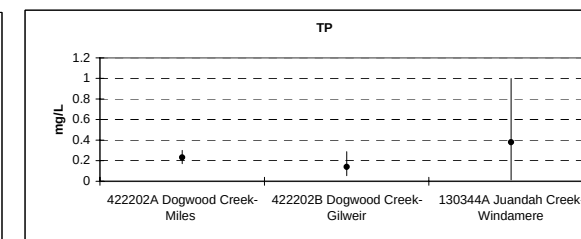
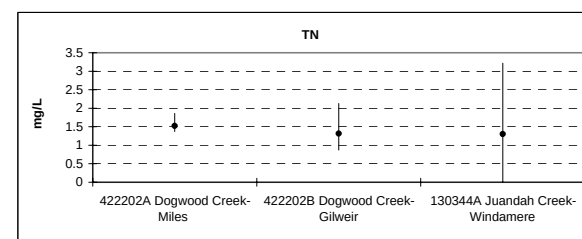
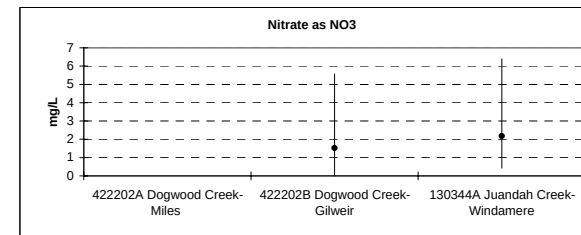
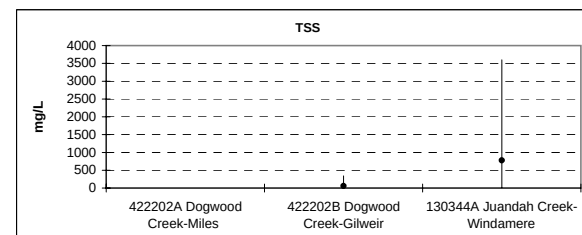
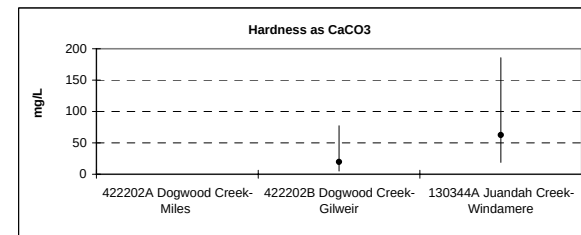
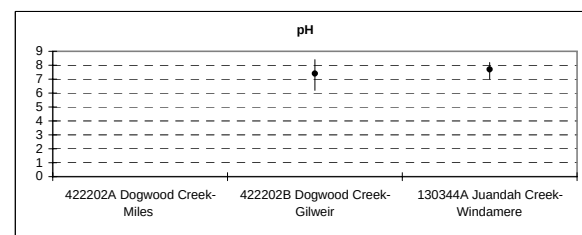
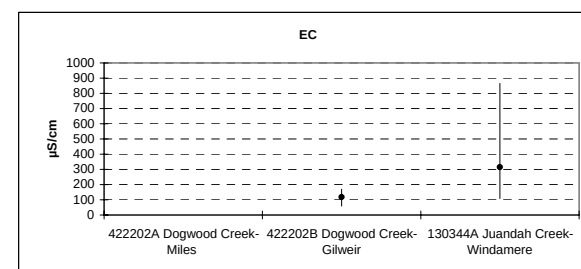
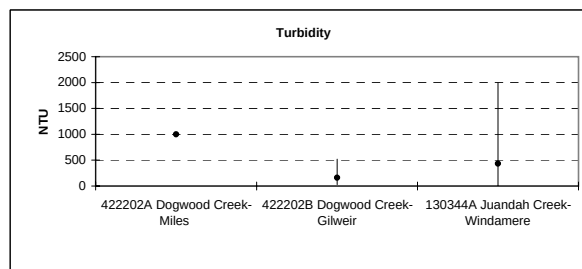
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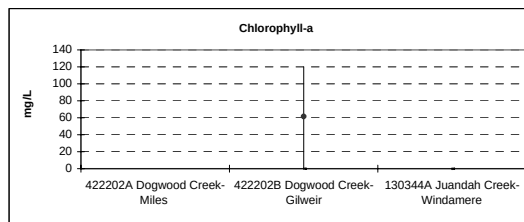
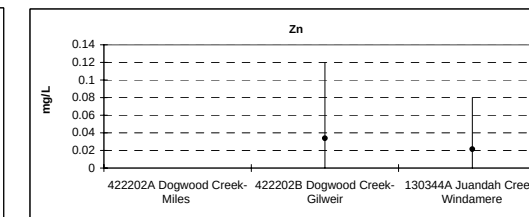
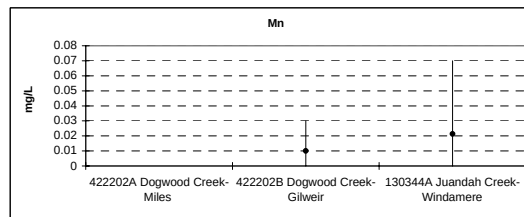
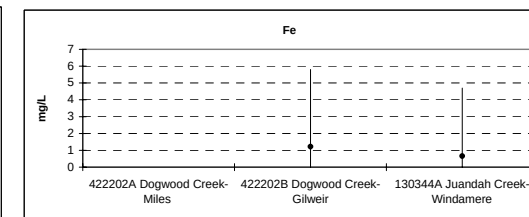
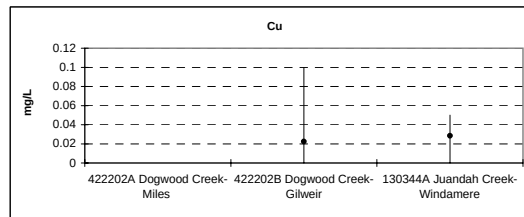
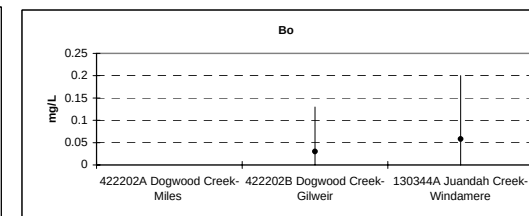
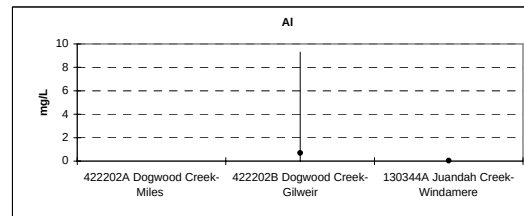
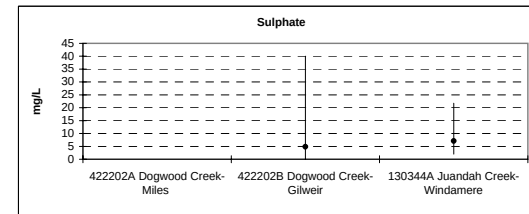
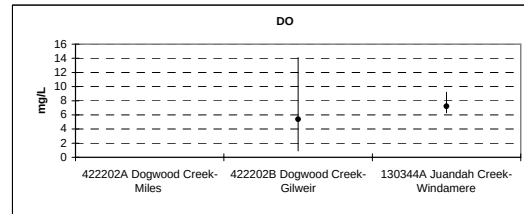
Water Quality Summary by Site

Variable	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	SDate	End Date
Fitzroy - Dawson										
*** ** SITE : 130344A Juandah_Ck Windamere										
130344A Juandah Creek at Windamere Lat 26:02 S Long 149:53 E GZ 217.463 Datum AHD AMTD 62.8kms C_Area 1678.0sq.km Data Commence 27/06/1974 Current Region RCK										
130344A Parameter	Count	Minimum	10 Percent	Median	90 Percent	Maximum	Mean	Std Dev	Starting Date	End Date
2010.5 Electrical Conductivity @ 25C (Field)	19	108	130	199	664	865	315.10526	234.44542	9/01/1985	16/11/2005
2030.5 Turbidity (Field)	10	11.2	14.62	276.5	996.5	2000	432.2	612.61753	28/11/1995	16/11/2005
2080.5 Water Temperature (Field)	19	13	16.96	24.7	30.52	31	23.56316	5.32522	9/01/1985	16/11/2005
2100.5 pH (Field)	12	7	7.043	7.65	8.09	8.22	7.65417	0.39521	11/07/1990	16/11/2005
2132 Hardness as CaCO3 (calculated)	20	19	20	34.5	148.389	185.78	62.5105	53.44051	9/01/1985	16/11/2005
2172 Total Suspended Solids	21	10	12	391	1975	3600	775.85714	938.13252	9/01/1985	16/11/2005
2322 Magnesium as Mg - soluble	20	1.4	1.4	2.35	8.8	12.9	4.125	3.44412	9/01/1985	16/11/2005
2331 Nitrate as NO3	19	0.42	0.58	1.4	4.84	6.4	2.17842	1.84896	9/01/1985	16/11/2005
2337 Total Nitrogen	6	0.01 -	-	-	-	3.22	1.30177	1.08663	7/10/1998	16/11/2005
2351.5 Oxygen (Dissolved) (Field)	9	6.3 -	-	-	-	9.2	7.21889	0.92234	28/11/1995	7/07/2005
2363 Total Phosphorus as P	9	0.0145 -	-	-	-	1	0.37973	0.32186	28/11/1995	16/11/2005
2401 Sulphate as SO4	20	2	2.549	5.9	15.088	21.76	7.1075	5.37884	9/01/1985	16/11/2005
2502 Aluminium as Al - soluble	11	0	0	0.05	0.09	0.15	0.04727	0.04407	2/12/1989	16/11/2005
2551 Boron as B	16	0	0	0.04	0.1	0.2	0.05813	0.056	9/01/1985	16/11/2005
2622 Copper as Cu - soluble	13	0	0.01	0.03	0.05	0.05	0.02846	0.01864	2/12/1989	16/11/2005
2682 Iron as Fe	19	0	0.008	0.03	1.72	4.7	0.65263	1.247	9/01/1985	16/11/2005
2712 Manganese as Mn - soluble	15	0	0	0.02	0.048	0.07	0.02133	0.02066	9/01/1985	16/11/2005
2822 Zinc as Zn - soluble	13	0	0.002	0.02	0.052	0.08	0.02154	0.02304	2/12/1989	16/11/2005

Graphical output

		Maximum	Minimum	Mean
Turbidity	422202A Dogwood Creek-Miles	1000	1000	1000
	422202B Dogwood Creek-Gilweir	520	28	160.5
	130344A Juandah Creek-Windamere	2000	11.2	432.2
EC	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	169	59	117.6
	130344A Juandah Creek-Windamere	865	108	315.1
pH	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	8.4	6.2	7.4
	130344A Juandah Creek-Windamere	8.2	7	7.7
Hardness as CaCO ₃	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	77.2	5.2	19.7
	130344A Juandah Creek-Windamere	185.8	19	62.5
TSS	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	340	6	59.5
	130344A Juandah Creek-Windamere	3600	10	775.9
Nitrate as NO ₃	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	5.57	0	1.52
	130344A Juandah Creek-Windamere	6.4	0.42	2.17842
TN	422202A Dogwood Creek-Miles	1.86	1.37	1.52429
	422202B Dogwood Creek-Gilweir	2.1297	0.8689	1.31728
	130344A Juandah Creek-Windamere	3.22	0.01	1.30177
TP	422202A Dogwood Creek-Miles	0.3	0.171	0.23229
	422202B Dogwood Creek-Gilweir	0.2876	0.054	0.14047
	130344A Juandah Creek-Windamere	1	0.0145	0.37973
DO	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	14.1	0.9	5.39091
	130344A Juandah Creek-Windamere	9.2	6.3	7.21889
Sulphate	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	40	0	4.86256
	130344A Juandah Creek-Windamere	21.76	2	7.1075
Al	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	9.3	0	0.69069
	130344A Juandah Creek-Windamere	0.15	0	0.04727
Bo	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	0.13	0	0.03029
	130344A Juandah Creek-Windamere	0.2	0	0.05813
Copper	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	0.1	0	0.02241
	130344A Juandah Creek-Windamere	0.05	0	0.02846
Fe	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	5.8	0	1.21639
	130344A Juandah Creek-Windamere	4.7	0	0.65263
Mn	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	0.03	0	0.01
	130344A Juandah Creek-Windamere	0.07	0	0.02133
Zn	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	0.12	0	0.03379
	130344A Juandah Creek-Windamere	0.08	0	0.02154
Chlorophyll-a	422202A Dogwood Creek-Miles			
	422202B Dogwood Creek-Gilweir	120	3	61.5
	130344A Juandah Creek-Windamere			





Compliance against ANZECC

	TSS (mg/L)	Turbidity (NTU)	pH	EC (mS/cm)	Hardness as CaCO3 (mg/L)	Sulphate (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	DO (mg/L)	Chlorophyll a (mg/m3)	Fe (mg/L)	Al (mg/L)	Bo (mg/L)	Copper (mg/L)	Mn (mg/L)	Zn (mg/L)
422202A Dogwood Creek-Miles																
Range	nr	1000*	nr	nr	nr	nr	1.37-1.86	0.71-0.3	nr	nr	nr	nr	nr	nr	nr	nr
Mean	nr	1000*	nr	nr	nr	nr	1.53	0.232	nr	nr	nr	nr	nr	nr	nr	nr
422202B Dogwood Creek-Gilweir																
Range	6-340	28-520	6.2-8.4	59-169	5.2-77.16	0-40	0.87-2.13	0.054-0.288	0.9-14.1	3-120	0-5.8	0-9.3	0-0.13	0-0.1	0-0.03	0-0.12
Mean	59.5	160.5	7.4	117.6	19.7	4.86	1.32	0.14	5.4	61.5	1.216	0.691	0.03	0.022	0.01	0.034
130344A Juandah Creek-Windamere																
Range	10-3,600	11.2-2,000	7-8.2	108-865	19-185.8	2-21.8	0.01-3.22	0.015-1.00	6.3-9.2	nr	0-4.7	0-0.15	0-0.2	0-0.05	0-0.07	0-0.08
Mean	775.9	432.2	7.7	315.1	62.5	7.1	1.3	0.38	7.2	nr	0.65	0.047	0.058	0.029	0.021	0.022
GUIDELINE VALUES																
QWQG (2006) – Lowland Streams ⁵	10	50	6.5-8.0	560	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ANZECC 2000	NA	NA	NA	NA	NA	50	0.5	0.05	>6	5	0.34	0.055	0.37	0.0014(H ⁺ 19.7 mg/L) 0.0035 (H ⁺ 62.5 mg/L)	1.7	0.008 (H ⁺ 19.7 mg/L) 0.02 (H ⁺ 62.5 mg/L)

nr no record
* single record

422202A	Parameter	Minimum	Maximum	Mean
	Turbidity (Field)	1000	1000	1000
	Total Nitrogen	1.37	1.86	1.52429
	Total Phosphorus as P	0.171	0.3	0.23229

422202B	Parameter	Minimum	Maximum	Mean
	Electrical Conductivity @ 25C (Field)	59	169	117.58333
	Turbidity (Field)	28	520	160.51818
	pH (Field)	6.2	8.4	7.36818
	Hardness as CaCO3 (calculated)	5.2	77.16	19.69878
	Total Suspended Solids	6	340	59.46
	Nitrate as NO3	0	5.57	1.52
	Total Nitrogen	0.8689	2.1297	1.31728
	Oxygen (Dissolved) (Field)	0.9	14.1	5.39091
	Total Phosphorus as P	0.054	0.2876	0.14047
	Sulphate as SO4	0	40	4.86256
	Aluminium as Al - soluble	0	9.3	0.69069
	Boron as B	0	0.13	0.03029
	Copper as Cu - soluble	0	0.1	0.02241
	Iron as Fe	0	5.8	1.21639
	Manganese as Mn - soluble	0	0.03	0.01
	Zinc as Zn - soluble	0	0.12	0.03379
	Chlorophyll-a	3	120	61.5

130344A	Parameter	Minimum	Maximum	Mean
	Electrical Conductivity @ 25C (Field)	108	865	315.10526
	Turbidity (Field)	11.2	2000	432.2
	pH (Field)	7	8.22	7.65417
	Hardness as CaCO3 (calculated)	19	185.78	62.5105
	Total Suspended Solids	10	3600	775.85714
	Nitrate as NO3	0.42	6.4	2.17842
	Total Nitrogen	0.01	3.22	1.30177
	Oxygen (Dissolved) (Field)	6.3	9.2	7.21889
	Total Phosphorus as P	0.0145	1	0.37973
	Sulphate as SO4	2	21.76	7.1075
	Aluminium as Al - soluble	0	0.15	0.04727
	Boron as B	0	0.2	0.05813
	Copper as Cu - soluble	0	0.05	0.02846
	Iron as Fe	0	4.7	0.65263
	Manganese as Mn - soluble	0	0.07	0.02133
	Zinc as Zn - soluble	0	0.08	0.02154

Attachment B

Water Quality Guideline Values —
ANZECC (2000)

Tables 3.3.2–3.3.3 South-east Australia

The following tables outline default trigger values applicable to Victoria, New South Wales, south-east Queensland, the Australian Capital Territory and Tasmania. Where individual states or territories have developed their own regional guideline trigger values, those values should be used in preference to the default values provided below. (Upland streams are defined as those at >150 m altitude, while alpine streams are those at altitudes >1500 m.)

Table 3.3.2 Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems. Trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types. Data derived from trigger values supplied by Australian states and territories. Chl *a* = chlorophyll *a*, TP = total phosphorus, FRP = filterable reactive phosphate, TN = total nitrogen, NO_x = oxides of nitrogen, NH₄⁺ = ammonium, DO = dissolved oxygen.

Ecosystem type	Chl <i>a</i>	TP	FRP	TN	NO _x	NH ₄ ⁺	DO (% saturation) ^l		pH	
	(µg L ⁻¹)	(µg P L ⁻¹)	(µg P L ⁻¹)	(µg N L ⁻¹)	(µg N L ⁻¹)	(µg N L ⁻¹)	Lower limit	Upper limit	Lower limit	Upper limit
Upland river	na ^a	20 ^b	15 ^g	250 ^c	15 ^h	13 ⁱ	90	110	6.5	7.5 ^m
Lowland river ^d	5	50	20	500	40 ^o	20	85	110	6.5	8.0
Freshwater lakes & Reservoirs	5 ^e	10	5	350	10	10	90	110	6.5	8.0 ^m
Wetlands	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Estuaries ^p	4 ^f	30	5 ^j	300	15	15	80	110	7.0	8.5
Marine ^p	1 ⁿ	25 ⁿ	10	120	5 ^k	15 ^k	90	110	8.0	8.4

na = not applicable;

a = monitoring of periphyton and not phytoplankton biomass is recommended in upland rivers — values for periphyton biomass (mg Chl *a* m⁻²) to be developed;

b = values are 30 µg L⁻¹ for Qld rivers, 10 µg L⁻¹ for Vic. alpine streams and 13 µg L⁻¹ for Tas. rivers;

c = values are 100 µg L⁻¹ for Vic. alpine streams and 480 µg L⁻¹ for Tas. rivers;

d = values are 3 µg L⁻¹ for Chl *a*, 25 µg L⁻¹ for TP and 350 µg L⁻¹ for TN for NSW & Vic. east flowing coastal rivers;

e = values are 3 µg L⁻¹ for Tas. lakes;

f = value is 5 µg L⁻¹ for Qld estuaries;

g = value is 5 µg L⁻¹ for Vic. alpine streams and Tas. rivers;

h = value is 190 µg L⁻¹ for Tas. rivers;

i = value is 10 µg L⁻¹ for Qld. rivers;

j = value is 15 µg L⁻¹ for Qld. estuaries;

k = values of 25 µg L⁻¹ for NO_x and 20 µg L⁻¹ for NH₄⁺ for NSW are elevated due to frequent upwelling events;

l = dissolved oxygen values were derived from daytime measurements. Dissolved oxygen concentrations may vary diurnally and with depth. Monitoring programs should assess this potential variability (see Section 3.3.3.2);

m = values for NSW upland rivers are 6.5–8.0, for NSW lowland rivers 6.5–8.5, for humic rich Tas. lakes and rivers 4.0–6.5;

n = values are 20 µg L⁻¹ for TP for offshore waters and 1.5 µg L⁻¹ for Chl *a* for Qld inshore waters;

o = value is 60 µg L⁻¹ for Qld rivers;

p = no data available for Tasmanian estuarine and marine waters. A precautionary approach should be adopted when applying default trigger values to these systems.

Table 3.3.3 Ranges of default trigger values for conductivity (EC, salinity), turbidity and suspended particulate matter (SPM) indicative of slightly disturbed ecosystems in south-east Australia. Ranges for turbidity and SPM are similar and only turbidity is reported here. Values reflect high site-specific and regional variability. Explanatory notes provide detail on specific variability issues for ecosystem type.

Ecosystem type	Salinity (μScm^{-1})	Explanatory notes
Upland rivers	30–350	Conductivity in upland streams will vary depending upon catchment geology. Low values are found in Vic. alpine regions ($30 \mu\text{Scm}^{-1}$) and eastern highlands ($55 \mu\text{Scm}^{-1}$), and high values ($350 \mu\text{Scm}^{-1}$) in NSW rivers. Tasmanian rivers are mid-range ($90 \mu\text{Scm}^{-1}$).
Lowland rivers	125–2200	Lowland rivers may have higher conductivity during low flow periods and if the system receives saline groundwater inputs. Low values are found in eastern highlands of Vic. ($125 \mu\text{Scm}^{-1}$) and higher values in western lowlands and northern plains of Vic ($2200 \mu\text{Scm}^{-1}$). NSW coastal rivers are typically in the range $200\text{--}300 \mu\text{Scm}^{-1}$.
Lakes & reservoirs	20–30	Conductivity in lakes and reservoirs is generally low, but will vary depending upon catchment geology. Values provided are typical of Tasmanian lakes and reservoirs.
Turbidity (NTU)		
Upland rivers	2–25	Most good condition upland streams have low turbidity. High values may be observed during high flow events.
Lowland rivers	6–50	Turbidity in lowland rivers can be extremely variable. Values at the low end of the range would be found in rivers flowing through well vegetated catchments and at low flows. Values at the high end of the range would be found in rivers draining slightly disturbed catchments and in many rivers at high flows.
Lakes & reservoirs	1–20	Most deep lakes and reservoirs have low turbidity. However, shallow lakes and reservoirs may have higher natural turbidity due to wind-induced resuspension of sediments. Lakes and reservoirs in catchments with highly dispersible soils will have high turbidity.
Estuarine & marine	0.5–10	Low turbidity values are normally found in offshore waters. Higher values may be found in estuaries or inshore coastal waters due to wind-induced resuspension or to the input of turbid water from the catchment. Turbidity is not a very useful indicator in estuarine and marine waters. A move towards the measurement of light attenuation in preference to turbidity is recommended.

Table 3.4.1 Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical *slightly–moderately disturbed systems*; see table 3.4.2 and Section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Chemical		Trigger values for freshwater (µg/L ⁻¹)				Trigger values for marine water (µg/L ⁻¹)			
		Level of protection (% species)				Level of protection (% species)			
		99%	95%	90%	80%	99%	95%	90%	80%
METALS & METALLOIDS									
Aluminium	pH >6.5	27	55	80	150	ID	ID	ID	ID
Aluminium	pH <6.5	ID	ID	ID	ID	ID	ID	ID	ID
Antimony		ID	ID	ID	ID	ID	ID	ID	ID
Arsenic (As III)		1	24	94 ^C	360 ^C	ID	ID	ID	ID
Arsenic (AsV)		0.8	13	42	140 ^C	ID	ID	ID	ID
Beryllium		ID	ID	ID	ID	ID	ID	ID	ID
Bismuth		ID	ID	ID	ID	ID	ID	ID	ID
Boron		90	370 ^C	680 ^C	1300 ^C	ID	ID	ID	ID
Cadmium	H	0.06	0.2	0.4	0.8 ^C	0.7 ^B	5.5 ^{B,C}	14 ^{B,C}	36 ^{B,A}
Chromium (Cr III)	H	ID	ID	ID	ID	7.7	27.4	48.6	90.6
Chromium (CrVI)		0.01	1.0 ^C	6 ^A	40 ^A	0.14	4.4	20 ^C	85 ^C
Cobalt		ID	ID	ID	ID	0.005	1	14	150 ^C
Copper	H	1.0	1.4	1.8 ^C	2.5 ^C	0.3	1.3	3 ^C	8 ^A
Gallium		ID	ID	ID	ID	ID	ID	ID	ID
Iron		ID	ID	ID	ID	ID	ID	ID	ID
Lanthanum		ID	ID	ID	ID	ID	ID	ID	ID
Lead	H	1.0	3.4	5.6	9.4 ^C	2.2	4.4	6.6 ^C	12 ^C
Manganese		1200	1900 ^C	2500 ^C	3600 ^C	ID	ID	ID	ID
Mercury (inorganic)	B	0.06	0.6	1.9 ^C	5.4 ^A	0.1	0.4 ^C	0.7 ^C	1.4 ^C
Mercury (methyl)		ID	ID	ID	ID	ID	ID	ID	ID
Molybdenum		ID	ID	ID	ID	ID	ID	ID	ID
Nickel	H	8	11	13	17 ^C	7	70 ^C	200 ^A	560 ^A
Selenium (Total)	B	5	11	18	34	ID	ID	ID	ID
Selenium (SeIV)	B	ID	ID	ID	ID	ID	ID	ID	ID
Silver		0.02	0.05	0.1	0.2 ^C	0.8	1.4	1.8	2.6 ^C
Thallium		ID	ID	ID	ID	ID	ID	ID	ID
Tin (inorganic, SnIV)		ID	ID	ID	ID	ID	ID	ID	ID
Tributyltin (as µg/L Sn)		ID	ID	ID	ID	0.0004	0.006 ^C	0.02 ^C	0.05 ^C
Uranium		ID	ID	ID	ID	ID	ID	ID	ID
Vanadium		ID	ID	ID	ID	50	100	160	280
Zinc	H	2.4	8.0 ^C	15 ^C	31 ^C	7	15 ^C	23 ^C	43 ^C
NON-METALLIC INORGANICS									
Ammonia	D	320	900 ^C	1430 ^C	2300 ^A	500	910	1200	1700
Chlorine	E	0.4	3	6 ^A	13 ^A	ID	ID	ID	ID
Cyanide	F	4	7	11	18	2	4	7	14
Nitrate	J	17	700	3400 ^C	17000 ^A	ID	ID	ID	ID
Hydrogen sulfide	G	0.5	1.0	1.5	2.6	ID	ID	ID	ID
ORGANIC ALCOHOLS									
Ethanol		400	1400	2400 ^C	4000 ^C	ID	ID	ID	ID
Ethylene glycol		ID	ID	ID	ID	ID	ID	ID	ID
Isopropyl alcohol		ID	ID	ID	ID	ID	ID	ID	ID
CHLORINATED ALKANES									
Chloromethanes									
Dichloromethane		ID	ID	ID	ID	ID	ID	ID	ID
Chloroform		ID	ID	ID	ID	ID	ID	ID	ID
Carbon tetrachloride		ID	ID	ID	ID	ID	ID	ID	ID
Chloroethanes									
1,2-dichloroethane		ID	ID	ID	ID	ID	ID	ID	ID
1,1,1-trichloroethane		ID	ID	ID	ID	ID	ID	ID	ID

Chemical	Trigger values for freshwater (µg/L ⁻¹)				Trigger values for marine water (µg/L ⁻¹)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
1,1,2-trichloroethane	5400	6500	7300	8400	140	1900	5800 ^c	18000 ^c
1,1,2,2-tetrachloroethane	ID	ID	ID	ID	ID	ID	ID	ID
Pentachloroethane	ID	ID	ID	ID	ID	ID	ID	ID
Hexachloroethane	B	290	360	420	500	ID	ID	ID
Chloropropanes								
1,1-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
CHLORINATED ALKENES								
Chloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1-dichloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2-trichloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2,2-tetrachloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
3-chloropropene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloropropene	ID	ID	ID	ID	ID	ID	ID	ID
ANILINES								
Aniline	8	250 ^A	1100 ^A	4800 ^A	ID	ID	ID	ID
2,4-dichloroaniline	0.6	7	20	60 ^c	ID	ID	ID	ID
2,5-dichloroaniline	ID	ID	ID	ID	ID	ID	ID	ID
3,4-dichloroaniline	1.3	3	6 ^c	13 ^c	85	150	190	260
3,5-dichloroaniline	ID	ID	ID	ID	ID	ID	ID	ID
Benzidine	ID	ID	ID	ID	ID	ID	ID	ID
Dichlorobenzidine	ID	ID	ID	ID	ID	ID	ID	ID
AROMATIC HYDROCARBONS								
Benzene	600	950	1300	2000	500 ^c	700 ^c	900 ^c	1300 ^c
Toluene	ID	ID	ID	ID	ID	ID	ID	ID
Ethylbenzene	ID	ID	ID	ID	ID	ID	ID	ID
o-xylene	200	350	470	640	ID	ID	ID	ID
m-xylene	ID	ID	ID	ID	ID	ID	ID	ID
p-xylene	140	200	250	340	ID	ID	ID	ID
m+p-xylene	ID	ID	ID	ID	ID	ID	ID	ID
Cumene	ID	ID	ID	ID	ID	ID	ID	ID
Polycyclic Aromatic Hydrocarbons								
Naphthalene	2.5	16	37	85	50 ^c	70 ^c	90 ^c	120 ^c
Anthracene	B	ID	ID	ID	ID	ID	ID	ID
Phenanthrene	B	ID	ID	ID	ID	ID	ID	ID
Fluoranthene	B	ID	ID	ID	ID	ID	ID	ID
Benzo(a)pyrene	B	ID	ID	ID	ID	ID	ID	ID
Nitrobenzenes								
Nitrobenzene	230	550	820	1300	ID	ID	ID	ID
1,2-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3,5-trinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-methoxy-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-methoxy-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloro-5-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,4-dichloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dichloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID

3.4.2 How guidelines are developed for toxicants

Chemical	Trigger values for freshwater (µg/L ⁻¹)				Trigger values for marine water (µg/L ⁻¹)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
1,2,4,5-tetrachloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,5-dichloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3,5-trichloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-fluoro-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
Nitrotoluenes								
2-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
3-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
4-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
2,3-dinitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dinitrotoluene	16	65 ^c	130 ^c	250 ^c	ID	ID	ID	ID
2,4,6-trinitrotoluene	100	140	160	210	ID	ID	ID	ID
1,2-dimethyl-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dimethyl-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
4-chloro-3-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
Chlorobenzenes and Chloronaphthalenes								
Monochlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichlorobenzene	120	160	200	270	ID	ID	ID	ID
1,3-dichlorobenzene	160	260	350	520 ^c	ID	ID	ID	ID
1,4-dichlorobenzene	40	60	75	100	ID	ID	ID	ID
1,2,3-trichlorobenzene	B	3	10	30 ^c	ID	ID	ID	ID
1,2,4-trichlorobenzene	B	85	170 ^c	220 ^c	20	80	140	240
1,3,5-trichlorobenzene	B	ID	ID	ID	ID	ID	ID	ID
1,2,3,4-tetrachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID
1,2,3,5-tetrachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID
1,2,4,5-tetrachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID
Pentachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID
Hexachlorobenzene	B	ID	ID	ID	ID	ID	ID	ID
1-chloronaphthalene	ID	ID	ID	ID	ID	ID	ID	ID
Polychlorinated Biphenyls (PCBs) & Dioxins								
Capacitor 21	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1016	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1221	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1232	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1242	B	0.3	0.6	1.0	1.7	ID	ID	ID
Aroclor 1248	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1254	B	0.01	0.03	0.07	0.2	ID	ID	ID
Aroclor 1260	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1262	B	ID	ID	ID	ID	ID	ID	ID
Aroclor 1268	B	ID	ID	ID	ID	ID	ID	ID
2,3,4'-trichlorobiphenyl	B	ID	ID	ID	ID	ID	ID	ID
4,4'-dichlorobiphenyl	B	ID	ID	ID	ID	ID	ID	ID
2,2',4,5,5'-pentachloro-1,1'-biphenyl	B	ID	ID	ID	ID	ID	ID	ID
2,4,6,2',4',6'-hexachlorobiphenyl	B	ID	ID	ID	ID	ID	ID	ID
Total PCBs	B	ID	ID	ID	ID	ID	ID	ID
2,3,7,8-TCDD	B	ID	ID	ID	ID	ID	ID	ID
PHENOLS and XYLENOLS								
Phenol	85	320	600	1200 ^c	270	400	520	720
2,4-dimethylphenol	ID	ID	ID	ID	ID	ID	ID	ID
Nonylphenol	ID	ID	ID	ID	ID	ID	ID	ID
2-chlorophenol	T	340 ^c	490 ^c	630 ^c	870 ^c	ID	ID	ID
3-chlorophenol	T	ID	ID	ID	ID	ID	ID	ID
4-chlorophenol	T	160	220	280 ^c	360 ^c	ID	ID	ID
2,3-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID
2,4-dichlorophenol	T	120	160 ^c	200 ^c	270 ^c	ID	ID	ID

Chemical		Trigger values for freshwater ($\mu\text{g L}^{-1}$)				Trigger values for marine water ($\mu\text{g L}^{-1}$)			
		Level of protection (% species)				Level of protection (% species)			
		99%	95%	90%	80%	99%	95%	90%	80%
2,5-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,6-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
3,4-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
3,5-dichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4-trichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,3,5-trichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,3,6-trichlorophenol	T	ID	ID	ID	ID	ID	ID	ID	ID
2,4,5-trichlorophenol	T,B	ID	ID	ID	ID	ID	ID	ID	ID
2,4,6-trichlorophenol	T,B	3	20	40	95	ID	ID	ID	ID
2,3,4,5-tetrachlorophenol	T,B	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4,6-tetrachlorophenol	T,B	10	20	25	30	ID	ID	ID	ID
2,3,5,6-tetrachlorophenol	T,B	ID	ID	ID	ID	ID	ID	ID	ID
Pentachlorophenol	T,B	3.6	10	17	27 ^A	11	22	33	55 ^A
Nitrophenols									
2-nitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
3-nitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
4-nitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
2,4-dinitrophenol		13	45	80	140	ID	ID	ID	ID
2,4,6-trinitrophenol		ID	ID	ID	ID	ID	ID	ID	ID
ORGANIC SULFUR COMPOUNDS									
Carbon disulfide		ID	ID	ID	ID	ID	ID	ID	ID
Isopropyl disulfide		ID	ID	ID	ID	ID	ID	ID	ID
n-propyl sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Propyl disulfide		ID	ID	ID	ID	ID	ID	ID	ID
Tert-butyl sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Phenyl disulfide		ID	ID	ID	ID	ID	ID	ID	ID
Bis(dimethylthiocarbamyl)sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Bis(diethylthiocarbamyl)disulfide		ID	ID	ID	ID	ID	ID	ID	ID
2-methoxy-4H-1,3,2-benzodioxaphosphorin-2-sulfide		ID	ID	ID	ID	ID	ID	ID	ID
Xanthates									
Potassium amyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Potassium ethyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Potassium hexyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Potassium isopropyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium ethyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium isobutyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium isopropyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
Sodium sec-butyl xanthate		ID	ID	ID	ID	ID	ID	ID	ID
PHthalATES									
Dimethylphthalate		3000	3700	4300	5100	ID	ID	ID	ID
Diethylphthalate		900	1000	1100	1300	ID	ID	ID	ID
Dibutylphthalate	B	9.9	26	40.2	64.6	ID	ID	ID	ID
Di(2-ethylhexyl)phthalate	B	ID	ID	ID	ID	ID	ID	ID	ID
MISCELLANEOUS INDUSTRIAL CHEMICALS									
Acetonitrile		ID	ID	ID	ID	ID	ID	ID	ID
Acrylonitrile		ID	ID	ID	ID	ID	ID	ID	ID
Poly(acrylonitrile-co-butadiene-co-styrene)		200	530	800 ^C	1200 ^C	200	250	280	340
Dimethylformamide		ID	ID	ID	ID	ID	ID	ID	ID
1,2-diphenylhydrazine		ID	ID	ID	ID	ID	ID	ID	ID
Diphenylnitrosamine		ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorobutadiene		ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorocyclopentadiene		ID	ID	ID	ID	ID	ID	ID	ID

3.4.2 How guidelines are developed for toxicants

Chemical		Trigger values for freshwater (µg/L ⁻¹)				Trigger values for marine water (µg/L ⁻¹)			
		Level of protection (% species)				Level of protection (% species)			
		99%	95%	90%	80%	99%	95%	90%	80%
Isophorone		ID	ID	ID	ID	ID	ID	ID	ID
ORGANOCHLORINE PESTICIDES									
Aldrin	B	ID	ID	ID	ID	ID	ID	ID	ID
Chlordane	B	0.03	0.08	0.14	0.27 ^C	ID	ID	ID	ID
DDE	B	ID	ID	ID	ID	ID	ID	ID	ID
DDT	B	0.006	0.01	0.02	0.04	ID	ID	ID	ID
Dicofol	B	ID	ID	ID	ID	ID	ID	ID	ID
Dieldrin	B	ID	ID	ID	ID	ID	ID	ID	ID
Endosulfan	B	0.03	0.2 ^A	0.6 ^A	1.8 ^A	0.005	0.01	0.02	0.05 ^A
Endosulfan alpha	B	ID	ID	ID	ID	ID	ID	ID	ID
Endosulfan beta	B	ID	ID	ID	ID	ID	ID	ID	ID
Endrin	B	0.01	0.02	0.04 ^C	0.06 ^A	0.004	0.008	0.01	0.02
Heptachlor	B	0.01	0.09	0.25	0.7 ^A	ID	ID	ID	ID
Lindane		0.07	0.2	0.4	1.0 ^A	ID	ID	ID	ID
Methoxychlor	B	ID	ID	ID	ID	ID	ID	ID	ID
Mirex	B	ID	ID	ID	ID	ID	ID	ID	ID
Toxaphene	B	0.1	0.2	0.3	0.5	ID	ID	ID	ID
ORGANOPHOSPHORUS PESTICIDES									
Azinphos methyl		0.01	0.02	0.05	0.11 ^A	ID	ID	ID	ID
Chlorpyrifos	B	0.00004	0.01	0.11 ^A	1.2 ^A	0.0005	0.009	0.04 ^A	0.3 ^A
Demeton		ID	ID	ID	ID	ID	ID	ID	ID
Demeton-S-methyl		ID	ID	ID	ID	ID	ID	ID	ID
Diazinon		0.00003	0.01	0.2 ^A	2 ^A	ID	ID	ID	ID
Dimethoate		0.1	0.15	0.2	0.3	ID	ID	ID	ID
Fenitrothion		0.1	0.2	0.3	0.4	ID	ID	ID	ID
Malathion		0.002	0.05	0.2	1.1 ^A	ID	ID	ID	ID
Parathion		0.0007	0.004 ^C	0.01 ^C	0.04 ^A	ID	ID	ID	ID
Profenofos	B	ID	ID	ID	ID	ID	ID	ID	ID
Temephos	B	ID	ID	ID	ID	0.0004	0.05	0.4	3.6 ^A
CARBAMATE & OTHER PESTICIDES									
Carbofuran		0.06	1.2 ^A	4 ^A	15 ^A	ID	ID	ID	ID
Methomyl		0.5	3.5	9.5	23	ID	ID	ID	ID
S-methoprene		ID	ID	ID	ID	ID	ID	ID	ID
PYRETHROIDS									
Deltamethrin		ID	ID	ID	ID	ID	ID	ID	ID
Esfenvalerate		ID	0.001 ^A	ID	ID	ID	ID	ID	ID
HERBICIDES & FUNGICIDES									
Bypyridilium herbicides									
Diquat		0.01	1.4	10	80 ^A	ID	ID	ID	ID
Paraquat		ID	ID	ID	ID	ID	ID	ID	ID
Phenoxyacetic acid herbicides									
MCPA		ID	ID	ID	ID	ID	ID	ID	ID
2,4-D		140	280	450	830	ID	ID	ID	ID
2,4,5-T		3	36	100	290 ^A	ID	ID	ID	ID
Sulfonylurea herbicides									
Bensulfuron		ID	ID	ID	ID	ID	ID	ID	ID
Metsulfuron		ID	ID	ID	ID	ID	ID	ID	ID
Thiocarbamate herbicides									
Molinate		0.1	3.4	14	57	ID	ID	ID	ID
Thiobencarb		1	2.8	4.6	8 ^C	ID	ID	ID	ID
Thiram		0.01	0.2	0.8 ^C	3 ^A	ID	ID	ID	ID
Triazine herbicides									
Amitrole		ID	ID	ID	ID	ID	ID	ID	ID
Atrazine		0.7	13	45 ^C	150 ^C	ID	ID	ID	ID

Chemical	Trigger values for freshwater ($\mu\text{g/L}^{-1}$)				Trigger values for marine water ($\mu\text{g/L}^{-1}$)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
Hexazinone	ID	ID	ID	ID	ID	ID	ID	ID
Simazine	0.2	3.2	11	35	ID	ID	ID	ID
Urea herbicides								
Diuron	ID	ID	ID	ID	ID	ID	ID	ID
Tebuthiuron	0.02	2.2	20	160 ^C	ID	ID	ID	ID
Miscellaneous herbicides								
Acrolein	ID	ID	ID	ID	ID	ID	ID	ID
Bromacil	ID	ID	ID	ID	ID	ID	ID	ID
Glyphosate	370	1200	2000	3600 ^A	ID	ID	ID	ID
Imazethapyr	ID	ID	ID	ID	ID	ID	ID	ID
Ioxynil	ID	ID	ID	ID	ID	ID	ID	ID
Metolachlor	ID	ID	ID	ID	ID	ID	ID	ID
Sethoxydim	ID	ID	ID	ID	ID	ID	ID	ID
Trifluralin B	2.6	4.4	6	9 ^A	ID	ID	ID	ID
GENERIC GROUPS OF CHEMICALS								
Surfactants								
Linear alkylbenzene sulfonates (LAS)	65	280	520 ^C	1000 ^C	ID	ID	ID	ID
Alcohol ethoxylated sulfate (AES)	340	650	850 ^C	1100 ^C	ID	ID	ID	ID
Alcohol ethoxylated surfactants (AE)	50	140	220	360 ^C	ID	ID	ID	ID
Oils & Petroleum Hydrocarbons								
Oil Spill Dispersants								
BP 1100X	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 7664	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 8667		ID	ID	ID	ID	ID	ID	ID
Corexit 9527	ID	ID	ID	ID	230	1100	2200	4400 ^A
Corexit 9550	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Most trigger values listed here for metals and metalloids are *High reliability* figures, derived from field or chronic NOEC data (see 3.4.2.3 for reference to Volume 2). The exceptions are *Moderate reliability* for freshwater aluminium (pH >6.5), manganese and marine chromium (III).

Most trigger values listed here for non-metallic inorganics and organic chemicals are *Moderate reliability* figures, derived from acute LC₅₀ data (see 3.4.2.3 for reference to Volume 2). The exceptions are *High reliability* for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

* = *High reliability* figure for esfenvalerate derived from mesocosm NOEC data (no alternative protection levels available).

A = Figure may not protect key test species from acute toxicity (and chronic) — check Section 8.3.7 for spread of data and its significance. 'A' indicates that trigger value > acute toxicity figure; note that trigger value should be <1/3 of acute figure (Section 8.3.4.4).

B = Chemicals for which possible bioaccumulation and secondary poisoning effects should be considered (see Sections 8.3.3.4 and 8.3.5.7).

C = Figure may not protect key test species from chronic toxicity (this refers to experimental chronic figures or geometric mean for species) — check Section 8.3.7 for spread of data and its significance. Where grey shading and 'C' coincide, refer to text in Section 8.3.7.

D = Ammonia as TOTAL ammonia as [NH₃-N] at pH 8. For changes in trigger value with pH refer to Section 8.3.7.2.

E = Chlorine as total chlorine, as [Cl]; see Section 8.3.7.2.

F = Cyanide as un-ionised HCN, measured as [CN]; see Section 8.3.7.2.

G = Sulfide as un-ionised H₂S, measured as [S]; see Section 8.3.7.2.

H = Chemicals for which algorithms have been provided in table 3.4.3 to account for the effects of hardness. The values have been calculated using a hardness of 30 mg/L CaCO₃. These should be adjusted to the site-specific hardness (see Section 3.4.3).

J = Figures protect against toxicity and do not relate to eutrophication issues. Refer to Section 3.3 if eutrophication is the issue of concern.

ID = Insufficient data to derive a reliable trigger value. Users advised to check if a low reliability value or an ECL is given in Section 8.3.7.

T = Tainting or flavour impairment of fish flesh may possibly occur at concentrations below the trigger value. See Sections 4.4.5.3/3 and 8.3.7.