A study of the cumulative impacts on water quality of mining activities in the Fitzroy River Basin

April 2009

Queensland Government
Environmental Protection Agency

Acknowledgements:

The Department of Environment and Resource Management (DERM) would like to thank staff from the former Departments of Natural Resources and Water, and Mines and Energy who supplied data for this report.

DERM would also like to thank the operators of all coal mines within the Fitzroy Basin who kindly provided the information which formed the basis of this report.

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Executive Summary

This study examines available data to report on the implications of water discharges from mines on water quality in the Fitzroy River Basin. This study was initiated in response to concerns about water quality following the discharge of very large quantities of water from mines in the Fitzroy River Basin from February to September 2008.

The terms of reference for this study (Appendix A) detailed key elements to be covered with the overall purpose being to make recommendations for the management of water discharges from mining activities with respect to water quality.

The study focuses on discharges from coal mining operations as the Fitzroy River Basin's large-scale mining activities are dominated by coal mining and planned coal mine expansions. These operations potentially release far greater volumes of water than any other mining source currently operating. They have also operated for long periods of time giving the best opportunity to examine changes in regulation and management of water quality over time.

The major water quality parameters of concern associated with coal mining are salinity (based on electrical conductivity), heavy metal ion concentrations and acidity/alkalinity. The study has focussed on salinity impacts as these were of major concern to the communities in the areas affected by the mine discharges in 2008 and the available data relates more to salinity than any other contaminant.

The major findings of this study concluded that in the Fitzroy Basin:

- discharge quality limits and operating requirements for coal mine water discharges are inconsistent;
- the discharge quality limits and operating conditions for some coal mines do not adequately protect the downstream values of the environment;
- background data relating to the quality of the waterways receiving discharge water is extremely limited;
- there is insufficient data to quantify the cumulative impacts of mining water discharges;
- additional and ongoing monitoring and analysis is needed to develop a modelling program for assessing cumulative impacts; and
- based on a risk assessment using salinity, six mines were identified as being the highest contributors to potential cumulative impacts (Coppabella, North Goonyella, Goonyella Riverside, Millennium, Peak Downs and Ensham).

The findings for each of the key elements of the study as listed in the terms of reference are provided in detail in the relevant chapters of this study and summarised below.

Regulatory framework for managing the quality of water discharges

The regulation of water discharges from mines has undergone considerable change in relation to the applicable legislation and responsible Government Agency. Since 2001, the former Environmental Protection Agency (EPA), now the Department of Environment and Resource Management (DERM), has regulated water discharges from mines under conditions listed in each mine's environmental authority. When the EPA took control of mining environmental regulation, it generally converted the commitments from the environmental management overview strategies accepted by the former Department of Mines and Energy (DME) to conditions in new environmental authorities. Generally only new or recently amended environmental authorities contain new conditioning arrangements relating to monitoring parameters and toxicity trigger values. Some environmental authorities have not had conditions changed since they were issued so do not necessarily reflect current knowledge nor best management practice. Under the current provisions in the *Environmental Protection Act 1994* (EP Act), environmental authorities may only be amended without agreement of the holder under limited triggers.

Existing approaches to minimising water quality impacts
Water quality impacts are generally managed under conditions set out in environmental authorities. These authorities place limits on water quality indicators such as pH, electrical conductivity or total dissolved solids and total suspended solids. However, the limits set are based on limited knowledge of ambient water quality conditions, are developed on a case by case basis and are subject to intensive negotiations with the mining companies. As a result, the conditions set in environmental authorities do not always reflect best practice for water quality management nor consider the potential cumulative impacts of several mines in the one catchment.

Analysis of currently authorised water discharges
All of the mines in the Fitzroy River Basin except two are permitted to discharge water under varying conditions set out in environmental authorities under the EP Act. The environmental authorities include anywhere from one to 15 approved discharge locations and may list multiple receiving waters, each with different release conditions. A key reason for this variation is the scale of some sites, the ephemeral nature of streams in the region and the difficulty in determining ambient water quality.

Forecast of future mining activities
At the time of writing this report there were about 45 coal mines, 10 significant mineral mines (excluding small mining operations and gemstone mines) and 20 medium to large quarries operating in the Central Queensland region, although not all are in the Fitzroy River Basin. Many of these mines have ore reserves that will enable production beyond 2020. The current global financial situation may impact on new or expansion projects, however, the environmental issues associated with future activities remain a key issue.

Review of water quality data
All of the currently operating coal mines (38) in the Fitzroy River Basin provided data for this study. This data highlighted the different conditions in place across mines and the limited data available in the region. Mine environment monitoring was generally limited to mine tenure and to times when discharges were occurring. There is a general lack of ambient water data.

Analysis of trends in water quality and an assessment of impacts
Previous studies into water quality suggest that the Fitzroy River Basin is a naturally moderate but variable saline system with substantial differences in electrical conductivity levels across sub-catchments. These studies give a broad picture of baseline information for ambient ranges of electrical conductivity (which is a typically a reliable surrogate for salinity) but not for other contaminants. Water quality monitoring, data collection and reporting in the region is undertaken by a diverse range of State and local government agencies, water providers, natural resource management groups, mines and other industries. There is no single entity that collates, manages and analyses water quality data for the catchment.

Analysis of risks associated with changes in water quality and potential cumulative impacts
In the Fitzroy River Basin, the greatest risk to water quality from coal mines is increased salinity levels resulting from occasions when mine water is discharged. Drinking water and aquatic ecosystems are the most sensitive downstream values to be protected from mine discharge waters. The impacts on these ecosystems are not well known because there is insufficient baseline biological and ecological information and no long-term biological monitoring to identify ecological changes over time. Increased salinity will also affect the taste of drinking water and very high levels may affect crops if water is used for irrigation.

The potential for accumulation of salinity in ephemeral streams is high as stream inputs can only be removed by natural flows from rainfall events flushing accumulated salinity from waterholes and the numerous water impoundments along the river system. This study has examined the catchments most at risk of cumulative impacts associated with electrical conductivity through a risk assessment matrix that looks at the discharge information from each mine (frequency, duration, volume and the water quality of the discharge and immediate receiving environment) and the relative location of mines in Fitzroy sub-catchments.

All mine discharges are likely to contribute to cumulative impacts to some degree. This study suggests that there are particular areas in the Fitzroy River Basin catchment of concern. Using the risk assessment matrix, six mines were identified as the highest contributors to potential cumulative impacts. Five of these were in the northern Isaac-Connors sub-catchment. In addition, six mines in the northern sub-catchments were identified as medium contributors, which add to the potential for cumulative impacts for this area. In the southern sub-catchments (e.g. Nogoa, Dawson, Mackenzie), the majority of mines were rated as low contributors, except for one mine.

Recommendations

After considering the findings of this study and following consultation on the draft study with key stakeholders, including Queensland Resources Council; the Technical Working Group; the Queensland Conservation Council and Agforce, the following recommendations are made.

1. Develop appropriate conditions in environmental authorities for mine water discharges

The aim of this recommendation is to standardise environmental authority conditions relating to water discharges so that consistent and appropriate conditions exist across the Fitzroy River Basin.

The aim is to work with mining companies to achieve this by convening a small working group comprising DERM and mining company technical specialists that would consider how discharge limits are set, what limits are acceptable and what this should be based on, when discharges may occur and what monitoring should occur. This is to occur by the end of June 2009.

The preferred option for implementing changes is via voluntary agreement with mining companies. If this is not possible, then it may be necessary to implement changes after requiring and reviewing an environmental audit or by changes to the EP Act to allow for the immediate review and amendment of coal mining authority conditions using the issues identified in this study. Changes to environmental authorities are to occur by the end of December 2009.

2. Develop local water quality guidelines

The aim of this recommendation is establish a collaborative project that enables the setting of local water quality guidelines. This would include mining companies and other stakeholder groups to identify current data and monitoring occurring throughout the region as well as developing a suitable monitoring program to complement the current information. The project plan for this project is to be developed by June 2009.

3. Develop a model for assessing cumulative impacts across the region

The aim of this recommendation is to understand full extent of cumulative impacts of mine water discharges which will be only known once a model is developed to determine the capacity of the catchment in terms of all inputs. This is likely to take at least two years to develop.

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1. Introduction

The Fitzroy is the largest east draining river system in Australia. It is usually regarded as including six major rivers: the Dawson, the Comet, the Nogoa, the Isaac-Connors, the MacKenzie and the Fitzroy. In January and February 2008 rainfall events across the Fitzroy River Basin resulted in the flooding of a number of mines in central Queensland.

Mining companies across the Fitzroy River Basin are permitted to discharge water under conditions specified in Environmental Authorities (EA) issued under the *Environmental Protection Act 1994* (EP Act) by DERM. Transitional Environmental Programs (TEP) can be applied for under the EP Act when the holder of an EA cannot comply with its conditions.

In August 2008, while mines were discharging under TEPs, water quality monitoring indicated salinity was increasing in waterways, dams and weirs and that domestic water supply for some townships using these sources for their drinking supplies was being affected. Queensland Health issued a health alert to the community about the potential health effect of increased salinity for those members of the public having to monitor their sodium intake.

The dewatering of mines focussed public attention on the water quality impacts of all water discharges from coal mines across the Fitzroy River Basin.

The Queensland Government responded to this situation by:

- Establishing a Fitzroy River Water Quality Technical Working Group (TWG) that includes a number of government agencies and experts to further investigate issues including options for remediation of the heightened salt levels in the Fitzroy River Basin;
- The Premier, on 15 October 2008, in response to community concern about these potential issues, appointing Emeritus Professor Barry Hart as her independent advisor and supervisor for an independent research project on the status of the Fitzroy River water quality;
- The former Minister for Sustainability, Climate Change and Innovation, on 16 October 2008, announcing that an independent study into the cumulative impact of mining on the health of the Fitzroy River be undertaken and led by the former EPA; and
- The former EPA establishing a monitoring program to assess the status of the Fitzroy River Basin water quality in relation to the potential impact of mine water discharged from the Ensham Resources coal mine on environmental values: human health (drinking water); irrigation and stock watering and aquatic ecosystem health.

Emeritus Professor Barry Hart's report reviews the current situation regarding water quality in the Fitzroy River resulting from the discharge of 138 Gigalitres (138,000 Megalitres) of floodwater from the Ensham Resources Pty Ltd (Ensham) coal mine located near Emerald.

Emeritus Professor Hart's report found that the decision by the former EPA to issue Ensham with a TEP was justifiable. However, the report also found that the discharge has resulted in impacts on water quality in the Fitzroy River Basin, particularly in relation to increased salinity.

The report also found that the TWG has developed a number of management options to improve water quality in the Nogoa-Mackenzie-Fitzroy system. The report including the headline findings and recommendations can be found at http://www.epa.qld.gov.au/publications/p02740aa.pdf/.

This study on the cumulative impacts on water quality of mining activities in the Fitzroy River Basis examines available data to report on the implications of water discharges from mines on water quality in the Fitzroy River Basin. It provides recommendations to reduce the potential for cumulative impacts, ensure the conditions in environmental authorities reflect best practice for water quality management; and improve knowledge of water quality.

The scope of this study is the impact of water discharges from coal mines, the quality of the discharges, and the impact that those discharges may have on the river environment and the quality of water in the Fitzroy River Basin.

The discharge of water from mines is only one contributor to water quality impacts. Stormwater, treated effluent from townships, tail-water discharges from irrigation areas and overland flows all contribute to the quality of water in the river system and its contaminant load.

This study recognises that the key longer-term measures for addressing these broader impacts include the Great Barrier Reef initiatives such as the Reef Water Quality Protection Plan and investment with the Australian Government in the Caring for Our Country program and the Queensland complementary natural resource management program. The development and implementation of landscape scale responses that lead to the improvement of water quality in our rivers is the primary approach for dealing with cumulative impacts from a broader natural resource management perspective.

1.1 Approach

Currently the major mining activities in the Fitzroy River Basin are related to energy resources. Some metaliferous mine development is planned but only one gold mine is currently operating. Small-scale sapphire gem mining currently occurs, however even in aggregate these mines are confined to a relatively small area. Other mines include quarries, limestone and zeolite mines and small-scale gem mining for thunder eggs and other valuable substances.

The major mining activity in the Fitzroy River Basin is coal mining and coal seam methane gas production. There are plans to significantly increase production through current mine expansions and by developing new mines. Coal seam methane is currently extracted at three general districts across the catchment. At present this activity is relatively small scale but is developing rapidly, with an estimated 10,000 new wells to be drilled over the next 10 years.

This study uses data relating to discharges from coal mining operations as they dominate the Fitzroy River Basin's large scale mining activities. These operations potentially release far greater volumes of water than any other mining source currently, and operate for long periods of time giving the best opportunity to examine changes in regulation and management of water quality over time.

A map of the study area (Fitzroy River Basin catchment) is shown at Figure 1 on page 10.

Study Location

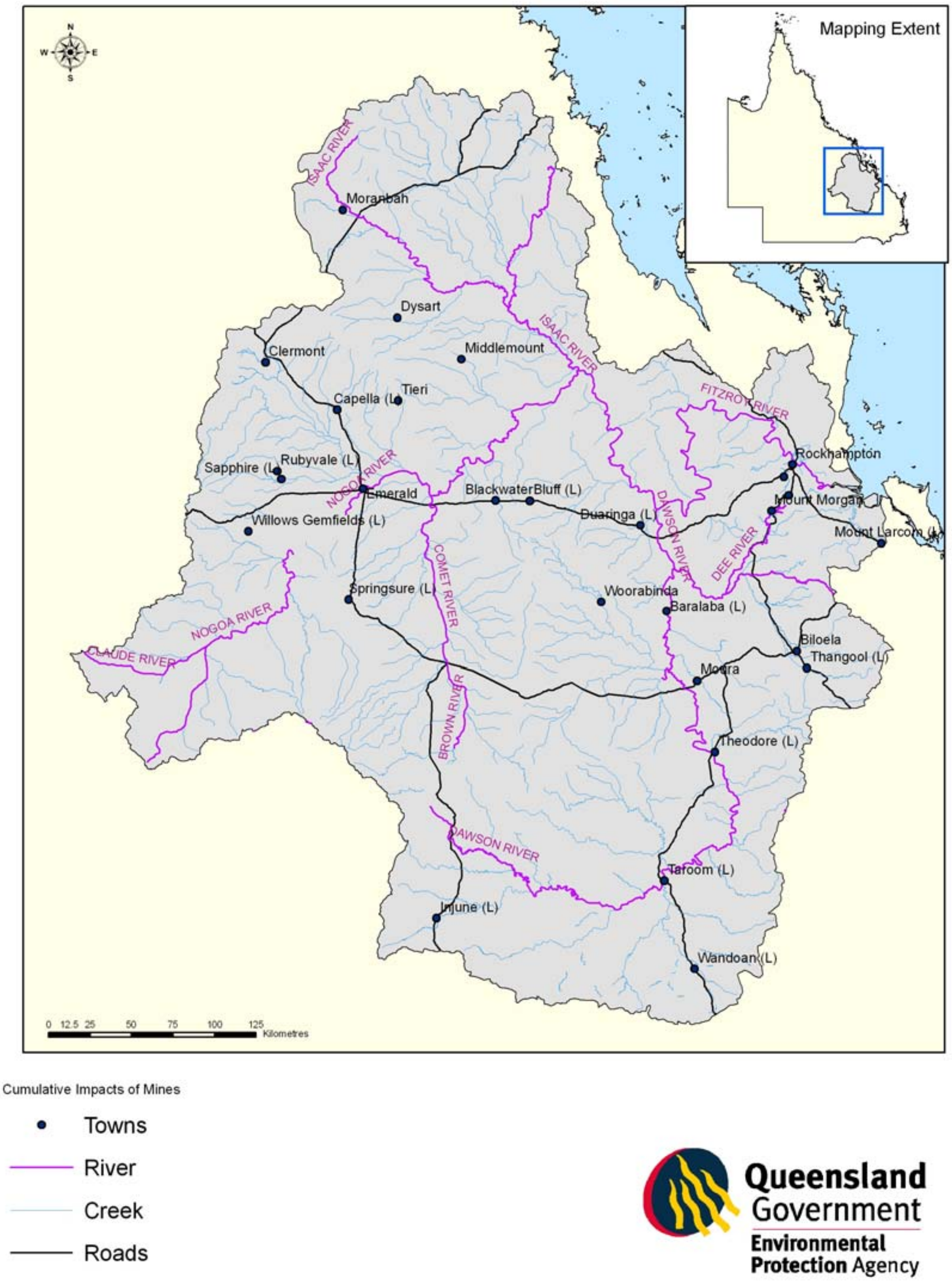

Figure 1 Fitzroy River Basin

2. Mining development and water quality management

2.1 The history and future of mining in the Fitzroy River Basin

The Central Queensland Region produces most of Queensland's high-grade coking coal, and much of the export-traded thermal coal. Extensive coal resources within the region also provide the basis for significant coal seam gas development with potential to supply an emerging liquefied natural gas (LNG) export industry. Proximity to deepwater ports, the presence of a competitive rail system, bulk water and low-cost, reliable electricity supply have helped to establish Central Queensland as a major hub for energy-intensive mineral processing industries, particularly alumina, aluminium, magnesia and cement.

At the time of this report there are about 45 coal mines (12 underground), 10 significant mineral mines (excluding small mining operations and gemstone mines) and 20 medium to large quarries operating in the Central Queensland area, although not all these are in the Fitzroy River Basin. Many of these mines have ore reserves that will enable production beyond 2020. Figure 2 shows the location of current large scale mining activities in the Fitzroy River Basin.

Fitzroy Basin Active Mines

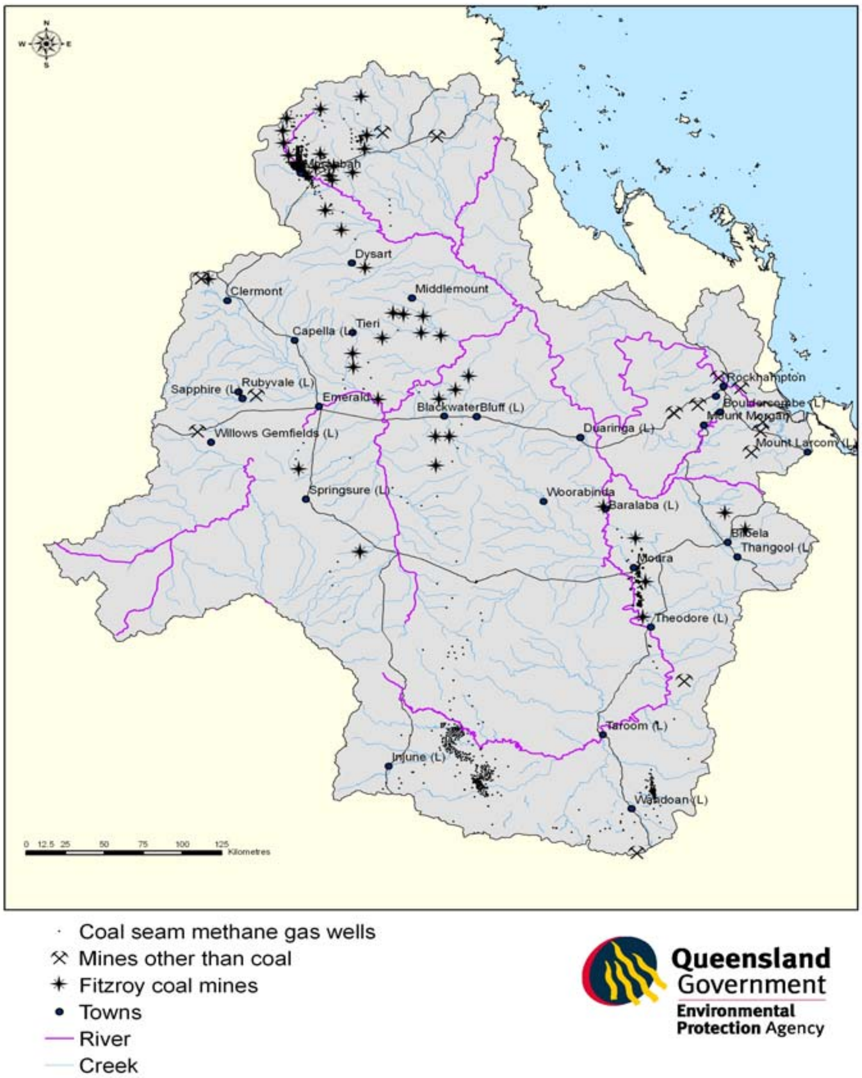

Figure 2 Fitzroy River Basin Active Mines

Coal accounts for more than 95% of the value of all raw minerals produced in Central Queensland and more than 60% of the total value of raw minerals produced in Queensland (DME & ACIL Tasman, 2007). Queensland's total saleable coal production in 2007/08 was around181Mt, with about 90% (~160Mt) derived from mines located in the Fitzroy River Basin. The value of 2007/08 coal production from Central Queensland was about $17.8 billion. Coal mines in Central Queensland directly employed about 19,000 people.

Coal Seam Gas (CSG) has been growing as a valuable commodity since the first production from fields near Moura, at Fairview–Spring Gully near Injune, and Peat-Scotia near Wandoan in the 1990s. Moranbah is now also a contributor to commercial CSG production. CSG makes a significant contribution to Queensland's natural gas supply and will continue to do so with the Department of Mines and Energy (DME) estimating that CSG will satisfy 70% of Queensland's gas usage by 2010. It is expected that there will be minimal impact on water quality by coal seam gas in the future – please refer to Text Box 1 for details.

Text Box 1 Coal Seam Methane in the Fitzroy Basin

Coal seam gas is currently extracted at three general locations across the catchment (in the north near Moranbah, near Moura on the Dawson River, and near Wandoan and Injune in the south of the catchment).

Coal seam gas production results in the production of associated water during the mining operations. Each gas well produces both gas and water, these are separated and the water component is aggregated at a number of central handling locations.

This water varies considerably in quality and quantity between locations and over time. In response to issues associated with managing this water the Queensland Government has established a policy that requires:

- wherever possible direct injection of the water into aquifers with water of equal or worse quality;
- if this is not possible, finding a beneficial use of the water; or
- if this is not possible, treatment of the water to a suitable standard before release to the environment (see http://www.dip.qld.gov.au/growth-strategies/queensland-coal-seam-gas-water-management-policy.html for more detail).

Therefore water quality issues associated with coal seam methane gas production in the catchment should be negligible. During 2007 approximately 4770 ML of water was produced across the Fitzroy Catchment at the three major sites (see Table 1).

Table 1 Water volumes produced by coal seam methane gas wells in the Fitzroy Basin for 2007/08 (source DME, 2009)

Location	Volume (ML)
Moura	24
Moranbah	513.5
Upper Dawson (Fairview, Spring Gully, Peat, Scotia)	4231.9
Total	**4769.4**

2.2 Mining's regulatory framework relating to water discharges

Mining has been regulated in Queensland since the late 1800s. Legislative requirements relating to the potential impact of mining activities, including water discharges, only came into force under the *Mineral Resources Act 1989*. The right to produce associated water from petroleum and coal seam gas operations are provided for under the *Petroleum and Gas (Production and Safety) Act 2004* and the *Petroleum Act 1923*.

When the ANZECC/ARMCANZ (2000) National Water Quality Guidelines first appeared in 1992, EAs for mining companies were commonly conditioned only to protect the downstream environmental value of stock water quality. The protection of ecosystem health was not considered. Conditions placed on discharges were predominately set at the stockwater limit of 1500 mg/L total dissolved solids (TDS) or approximately 2205µS/cm (the standard approximation for converting TDS to µS/cm is TDS (mg/L) = 0.68 × EC (µS/cm) or EC = 1.47 × TDS). When the ANZECC/ARMCANZ (1992) guidelines were updated in 2000 the limits were changed and some mines had their discharge limits amended.

On 1 January 2001, the responsibility for the environmental regulation of mining was transferred from the former DME to the former EPA. All previous licences and approvals for mining activities (around 5,500) became transitional authorities which had to be amended or replaced within five years. Since 2006, mining operations have been required to have DERM approved EAs. Many of the transitional authorities and consequent EAs retained the standards from the DME environmental management overview strategies commitments as conditions of the new EA. It is only new or recently amended EAs that cover a broader range of environmental conditions. Under the new regulatory framework DERM sets levels of environmental assessment for new applications, develops environmental conditions, monitors performance, conducts inspections and audits, ensures adequate rehabilitation and is responsible for enforcement of environmental controls. The steps to achieve this are outlined below.

2.3 Existing approaches to minimising water quality impacts

2.3.1 Operational policy

DERM's operational policy for licensing waste water discharge to Queensland waters provides policy advice and technical information for assessing development applications or environmental authority applications under the EP Act, *Environmental Protection (Water) Policy 1997* (EPP Water), *Integrated Planning Act 1997* and *State Development and Public Works Organisation Act 1971* for environmentally relevant activities discharging residual waste water to Queensland waters. The operational policy includes the consideration of mixing zones, assimilative capacity of receiving waters, environmental offsets, and environmental values and water quality objectives in assessing, deciding and conditioning applications. It also informs applicants in preparing applications.

The Queensland Water Quality Guidelines (2006) and *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* (ANZECC/ARMCANZ 2000) are the key technical guides for assessing and regulating the impacts of waste water discharges to water, particularly in terms of potential impacts on ecosystem health.

2.3.2 Environmental authorities

All mining projects require one or more EA under the EP Act. The holder of a mining tenement cannot carry out any mining activities on site unless those activities are authorised by an EA for the relevant tenement.

DERM initially requires applicants for mining projects that are determined to have a medium to high risk of serious environmental harm to submit an Environmental Management Plan (EM

Plan) during the assessment process. The purpose of an EM Plan is to propose measures and activities that will protect environmental values. The potential impact on environmental values may extend beyond the mining lease to surrounding off lease areas (such as a mine water discharge) and include potential impacts of regional extent (such as the catchment area).

The applicant proposes an environmental protection objective, control strategy and EA condition containing measurable standards and indicators in the EM Plan for each environmental value.

In regards to water, a description of environmental values would include background receiving water monitoring data (where available) to enable DERM to establish release limits. Relatively little background receiving water quality data is available for the Fitzroy River Basin.

When preparing water quality contaminant limits for the release of mine affected water to surface waters the EPP Water requires DERM to consider the following:

- whether the size of the initial mixing zone will adversely affect an environmental value, especially biological integrity and suitability for recreational use;
- whether concentration of contaminants in the initial mixing zone are acutely toxic to the biota;
- the existing quality of the surface water;
- the cumulative effect of the release concerned and any other releases of contaminants to the surface water known to DERM;
- future releases to the surface water known to DERM; and
- water quality objectives for waters outside of (i.e. downstream of) the initial mixing zone.

The ANZECC/ARMCANZ (2000) guidelines are also considered when preparing water quality contaminant limits. These guidelines are used to:

- determine environmental values of receiving waters (i.e. pristine, recreational, agricultural etc.);
- set default limits for relevant contaminants in discharges of mine affected water based on the environmental values of receiving waters; and
- set local water quality objectives (i.e. guideline values) for receiving water quality, including the consideration of ambient water quality where available.

There are issues with using the reference-based water quality guideline values that are contained in the abovementioned documents as objectives for indicators such as pH, electrical conductivity and turbidity. These guidelines have generally been developed from permanent flowing streams. The Fitzroy River Basin has many ephemeral streams, which only flow for a limited time each year. Given the nature of ephemeral streams, it is difficult to obtain suitable water quality data from which to derive water quality guidelines/objectives. The ANZECC/ARMCANZ (2000) guidelines recommend a dataset of the most recent 24 monthly observations which is generally unachievable in ephemeral systems due to intermittent and inconsistent natural flows. Furthermore, this issue is compounded by the current conditions on mining EAs which, in the main, only require mines to monitor water quality during discharge events. This restricts the opportunity to gather ambient data when natural flows in waterways are occurring but the mine is not discharging.

Since amendments to the EP Act in 2000 and the transfer of responsibility for mining to DERM, EAs have included the following conditions for water management:

- divert rainfall runoff away from disturbed areas of the site;
- prevent mine affected and process waters from leaving the site and store in holding dams for on-site uses including process water and dust suppression;
- implement effective erosion and sediment control on site;
- designate authorised release point/s for controlled discharges as a last resort;
- designate a background flow volume or rainfall event required to allow discharges;

- monitor ambient and receiving water quality at a specified frequency and for specified parameters during discharges; and
- limits for specified parameters at end-of-pipe and/or the receiving environment.

For EA approvals and related water discharges, water quality-related licence limits are placed on permits for the following water quality indicators:
- pH;
- electrical conductivity (EC) or total dissolved solids (TDS); and
- total suspended solids (TSS) or turbidity.

The conditions in EAs for new operations have undergone continual improvement to help meet current best practice management. The range of parameters being monitored has expanded from pH, salinity and TSS or turbidity to include a range of additional nutrients and metals. Toxicity trigger values are also specified at end of pipe or the receiving environment which, if exceeded, are used to trigger an investigation into the cause of the exceedence, and if necessary, generate a review of discharging arrangements. However, these new conditioning arrangements have generally only been applied to new EAs, or recently amended EAs. EAs do not expire and there is no automatic process in place where best practice standards are applied to all mining EAs across the board.

As a result of water management conditions specified in EAs changing considerably over time, inconsistency exists in the conditions under which mines operating in the Fitzroy River Basin discharge water. For example, a number of historical EAs allow discharges when there is no other flow in the waterway, and include mixing zones of considerable length which, during discharges, may result in the aquatic ecosystems within the mixing zone being exposed to significantly poorer water quality than under ambient water quality conditions.

The lack of ambient water quality data has meant that the default limits have historically been based on ANZECC/ARMCANZ (2000) guidelines. The limits set may not achieve a suitable level of protection of downstream environmental values for the Fitzroy River Basin and are not always reflective of all relevant water quality objectives (e.g. not recognising the use of the water resource in supplying drinking water and supporting ecosystem values). The lack of long-term and/or regular ambient water quality data has meant that the water quality limits applied to EAs are developed on a case by case basis having consideration of the limited ambient or reference site dataset/s that is available, and negotiations with the individual mining companies.

DERM has been working with the Queensland Resources Council for some time in an effort to develop a template for standard EA conditions so that there is a level of consistency in licensing coal mines across the state.

2.3.3 Transitional Environmental Programs

DERM is able to consider the use of a TEP for a business to continue operation during a period when the business is unable to meet a required environmental standard or the conditions of its EA (mining activities). A key requirement of the TEP is to minimise the potential for environmental harm. The proponent can submit a voluntary draft TEP for assessment or DERM can request a draft TEP be prepared if it considers there is potential or actual environmental harm on site.

Section 330 of the EP Act defines a TEP as “a specific program that, when approved, achieves compliance with this Act for the matters dealt with by the program by:
a) reducing environmental harm; or
b) detailing the transition to an environmental standard”.

The content requirements of a draft TEP are defined in section 331 of the EP Act and include:
a) the objectives to be achieved and maintained under the program for an activity;
b) how the objectives are to be achieved, and a timetable to achieve the objectives, taking into account—
   i) the best practice environmental management for the activity; and
   ii) the risks of environmental harm being caused by the activity;
c) the appropriate performance indicators at intervals of not more than six months;
d) monitoring and reporting compliance with the program.

In deciding a TEP, DERM must consider standard criteria which, among other things, include:
- the principles of ecologically sustainable development as set out in the 'National Strategy for Ecologically Sustainable Development';
- any applicable environmental protection policy (EPP) including the EPPs for air, noise, water and waste;
- the potential effects of any proposals on the character, values and resilience of the receiving environment;
- submissions made by the applicant for a TEP;
- best practice environmental management for the activities proposed;
- the financial implications of any requirements; and
- the public interest.

The legislation requires DERM to approve a draft TEP, approve it with conditions, or refuse the TEP. Public notification is required if the TEP is proposed to operate for longer than three years.

Emeritus Professor Hart's interim report found that there were deficiencies in the TEP process developed in response to the flooding events early in 2008, largely because of poor communication, but also because of the lack of credible monitoring information. DERM has commenced a review of its TEP process.

2.4 Key findings

- Mining has not developed in the Fitzroy River Basin in a uniform way and has undergone periods of rapid expansion and contraction over time depending on the prevailing economic conditions.
- The regulation of water discharges from mines has changed over time in terms of the applicable legislation and responsible Government Agency.
- Many of the existing EAs that provide conditions for discharging waste water are based on very limited ambient water quality data, require little monitoring from the mining companies, and are developed on a case by case basis leading to a lack of consistency across the state.
- EAs for mines in the Fitzroy River Basin vary in terms of:
  - date granted;
  - geographic area;
  - parameters regulated; and
  - release conditions and compliance requirements.

3. Water quality in the Fitzroy River Basin

3.1 Water quality management framework and guidelines

The National Water Quality Management Strategy sets the context for managing water quality and provides a framework for developing management strategies. This national approach to water quality management is underpinned by the development of guidelines which can provide guidance when issues arise. National guidelines allow flexibility of response to different circumstances at regional and local levels. State and/or local jurisdictions can refine these national water quality guidelines either into their own regional guidelines or into specific water quality objectives to protect waterways.

Water quality objectives are the levels or concentrations of indicators needed to protect all the values of a waterway. In defining water quality objectives, the first step is to define what values the water needs to support (e.g. drinking, irrigation, aquatic ecosystem, and recreational uses). Once defined, a suitable water quality guideline can be used as a reference to compare with current water quality and help develop water quality objectives that are catchment specific. For example, EC concentrations of less than 1000 µS/cm may be required to support aquatic ecosystem protection in a stretch of waterway. If this is the most stringent guideline for all values in this waterway, it could become the draft water quality objective. Water quality objectives under the EPP Water are also to consider social and economic factors. This process allows management actions and decision making to be designed for the catchment that will help ensure the water quality objectives are achieved in the future.

The National Water Quality Management Framework has been used to establish water quality improvement plans (WQIPs) for a number of catchments discharging to the Great Barrier Reef. In places like the Mackay Whitsunday catchments the natural resource management group has worked with the Queensland and Federal governments to establish clearly defined water quality objectives and management actions to achieve water quality improvements (see Text Box 2 – WQIPs).

Text Box 2 WQIPs

The Mackay Whitsunday Water Quality Improvement Plan (WQIP) aims to provide water quality suitable for human uses and aquatic ecosystem protection. This plan describes local values deserving protection, how current water quality is impacting on local values and management interventions for rehabilitation of priority habitats and reduction of pollutant loads from diffuse and point sources. Implementation of the WQIP involves management interventions, monitoring and modelling, planning and legislation. A monitoring and modelling strategy has also been developed that recommends that many of the monitoring and modelling activities should also be implemented at a cross-regional reef-wide level. Modelling approaches should also be used in conjunction with appropriately targeted water quality monitoring at paddock, sub-catchment and catchment scale, and includes aquatic ecosystem response monitoring and modelling.

In the Fitzroy River Basin the ANZECC/ARMCANZ (2000) guidelines are used to help establish toxicity trigger values (TTVs) for aquatic ecosystems, recreational and aesthetic uses and primary industries, including irrigation and stock water quality. In some cases, the Queensland Water Quality Guidelines (EPA, 2007) define more localised reference-based guidelines for the protection of aquatic ecosystems where sufficient information from local monitoring is available. Reference-based guidelines are derived from monitoring data in the specific region from unimpacted waterways of a similar type. The guidelines are usually derived from 80th percentiles of long-term data (or 75th percentile for electrical conductivity) and are designed to be compared to the median values of a long-term monitoring data set (typically 12 data points over a year) to provide an assessment of relative condition.

The *Queensland Water Quality Guidelines* provide information on ambient salinity ranges in Fitzroy North and Central Fitzroy. The guideline uses monitoring data from reference sites (permanent flowing streams) to present salinity zone percentiles for the sites in the region. As mentioned, the 75th percentile for electrical conductivity can be used to assess the relative long term condition of a waterway. The higher percentile (such as 90th percentile) could also be used to identify anomalously elevated sites where smaller datasets are available. It should be noted that more local monitoring and investigation may still be required in many cases, particularly where streams are ephemeral as is the case for much of the Fitzroy Catchment. In most of the catchment (Central Fitzroy), 90% of measures for EC were less than 520µS/cm, the 75th percentile was 340µS/cm and the median value was less than 250µS/cm. Values were higher in the Fitzroy north area (median 355µS/cm). However, 90% of measures were less than 1300µS/cm and the 75th percentile was 720µS/cm.

The National Health and Medical Research Council endorses the use of the *Australian Drinking Water Guidelines* (NHMRC, 2004) for setting drinking water quality limits as shown in Table 2 (page 19). This guideline recommends that, based on taste, total dissolved solids in drinking water should not exceed 500 mg/L. The equivalent figure in EC units can be roughly determined by doubling this value. In this report a conversion of 1/0.67 was used to give a limit for drinking water of 746µS/cm. The guidelines suggest that below 500mg/L TDS (conservatively 746µS/cm) the water should be good and above 1000 mg/L (which is 1500µS/cm) is unacceptable.

For other environmental values such as use for irrigation of crops or stock watering, the salinity (or electrical conductivity) threshold is dependent on the crop to be irrigated or stock to be watered, as shown in Table 2 (page 19). The salinity tolerance of crops shown ranges from 1000µS/cm to 4200µS/cm. The salinity tolerance for watering stock is less stringent, for example 5970µS/cm for beef cattle drinking.

Table 2 **ANZECC/ARMCANZ (2000) Guideline and ADWG limits for salinity measured as electrical conductivity for protecting livestock drinking water, irrigation water and drinking water for human consumption environmental values**

Environmental Value	Plant Salinity threshold tolerance in irrigation water*	Tolerance of livestock to salinity in drinking water**	ADWG† limit for salinity in drinking water for human consumption
Cotton	1000 (seedlings) 4000 (adult	-	-
Wheat	3100	-	-
Maize/corn	1100	-	-
Sorghum	3100	-	-
Lucerne	1600	-	-
Sunflower	2500	-	-
Oats	2300	-	-
Barley	4200	-	-
Peas	1200	-	-
Beans	600	-	-
Oranges	1000	-	-
Grapes	1100	-	-
Sheep	-	7460	-
Beef cattle	-	5970	-
Human Drinking Water	-	-	746 (aesthetic – taste)

(units in µS/cm)

* Table 4.2.5 (clay soils) ANZECC/ARMCANZ (2000); clay soils represent the most common soil type for irrigated crops in the Fitzroy River Basin

** Table 4.3.1 ANZECC/ARMCANZ (2000)

† NHMRC (2004), conversion of 1/0.67 for TDS to EC used

3.2 Ambient water quality Fitzroy Basin

The major water quality parameters of concern associated with coal mining are salinity (based on electrical conductivity usually measured in µS/cm), heavy metal and metalloid ion concentrations (mg/L) and acidity/alkalinity (pH).

Background ambient water quality of the Fitzroy River Basin has been examined in three main peer reviewed studies:

- a Fitzroy River Basin specific analysis based on data collected from 1993-1996 (Noble et al. 1996);
- a statewide review of water quality in Queensland waters based on data collected from 1992-1996 (Testing the waters – a report on the quality of Queensland Waters, DEH 1999); and
- a review of water quality as part of the Queensland Water Quality Guidelines (EPA, 2007).

These studies provide data that begins to show what could be described as ambient water quality in the Fitzroy River Basin.

A comparison of the results reported and the default ANZECC/ARMCANZ (2000) guidelines suggests that the Fitzroy is a moderate to highly salty system with slightly alkaline water. The results also show that there are substantial differences in EC levels across sub-catchments. The reports do not provide sufficient information to characterise metal and metalloid concentrations.

3.2.1 Electrical conductivity (EC)

EC is related to the number of dissolved ionic solids in water. Typically the most common ions are those found in salt (sodium chloride), so that EC is typically a reliable surrogate for salinity.

All three studies found that by far the majority of sites had EC levels less than 800µS/cm. The major location where higher EC levels were recorded were on the Dee River downstream from the Mount Morgan copper mine site which has a long history of water quality issues that are now managed by the Department of Mines and Energy.

DEH (1999) recorded only one site close to current coal mines (Crinum Creek) with a median conductivity above 800µS/cm. Noble (1996) recorded two sites (both on the Dee River) with median EC levels above 1500µS/cm. More than 80% of their samples were less than 280µS/cm, and 17% were between 280-800µS/cm. For the sub-basins, median values ranged from 170µS/cm (Comet) to 292µS/cm (Isaac).

3.2.2 Metal concentrations

Limited information has been recorded in relation to background dissolved heavy metal concentrations. Noble et al. (1996) conducted a very limited study of six sites designed to examine the impacts of discharges from the Mount Morgan mine site. This study found levels of heavy metals typically exceeded ANZECC/ARMCANZ (2000) guidelines downstream of the mine site.

3.2.3 pH

This parameter measures the acidity and alkalinity of water. Values less than seven are considered acidic and those above seven alkaline (Noble et al. 1996). The acidity or alkalinity of water can increase the bioavailability and concentration of contaminants such as metals and therefore the relative toxicity of certain contaminants as well as increasing the accumulative effect and potential impact on environmental values.

Most Fitzroy soils are alkaline and this is reflected in water quality. Noble et al. (1996) records the lowest median pH for water quality in the Connors catchment (7.15) and highest (7.97) for the water quality in the Nogoa catchment. Some sites monitored on the Dee River as part of this study did not meet ANZECC/ARMCANZ (2000) and QWQG (EPA, 2007) guideline trigger values (pH 6.5 – 8).

3.3 Water quality data collection and reporting

Water quality monitoring, data collection and reporting in the Fitzroy River Basin is undertaken by a diverse range of State and local government agencies, water providers, natural resource management groups, mines and other industries. Each of these groups does its monitoring, data collection and reporting on water quality differently. There is no single entity that synthesises all available water quality data for the Fitzroy River Basin in a catchment wide context. Text Box 3 illustrates the diverse nature of water quality monitoring that Department of Natural Resources and Water (NRW) and Fitzroy Basin Association (FBA) undertakes.

Text Box 3 Water Quality Monitoring

The Department of Natural Resources and Water (NRW) Water Monitoring
There are a total of 84 government operated water height monitoring stations in the Fitzroy River Basin (FRB). NRW operate a total of 57 gauging stations in the FRB, while SunWater operate another 27 stations.

The majority of NRW stations record stream height data on a continuous basis with 32 of these stations equipped with water quality probes. All stations with water quality equipment have a combined electrical conductivity (EC) and temperature probe. A number of stations also have a pH probe. Either probe is capable of collecting water quality data at 20 minute intervals. A number of stations on major rivers also have telemetry capability. In addition, water samples are collected at 25 of the station sites either 3 or 4 times per year. These samples are analysed for major ions and total and dissolved nutrients (nitrogen and phosphate).

As a part of the NRW Resource Operation Plan (ROP) environmental flow monitoring requirements NRW conduct the Environmental Flow Assessment Program (EFAP). The EFAP monitors spawning and recruitment success of native fish stocks in response to river flows, details can be found at http://www.nrw.qld.gov.au/factsheets/pdf/water/w130.pdf.

NRW also conduct seasonal flood water sampling as a part the Great Barrier Reef Water Quality Improvement Plan, and the Sediment Monitoring Program. Further information on NRW water quality monitoring can be found at http://www.nrw.qld.gov.au/water/index.html.

Fitzroy Basin Association Water Monitoring

The Fitzroy Basin Association, through a regional planning process, is developing water quality targets for the region, identifying potential hotspot areas and prioritising management actions in order to help achieve this common objective.

This monitoring program focuses on sediment, salinity and nutrient (nitrogen and phosphorus) parameters. Simple load and concentration calculations are derived for these parameters. Monitoring is conducted at the neighbourhood catchment scale (~300km² to 2000km² or groups of smaller catchments).

The monitoring focuses on flood event sampling and captures data over the hydrograph for basic load calculations. This is being conducted to provide baseline data and eventually a baseline trend for the amount of sediment and nutrients being carried downstream during rain events. This information supports Natural Resource Management improvements brought about by stakeholders in each neighbourhood catchment.

For more information please visit the website below:
http://www.fba.org.au/programs/priority_neighbourhood_catchments_water_quality_monitoring_program.html

The Fitzroy River Water Quality TWG has developed a draft table of current water monitoring programs in the Fitzroy River Basin as at September 2008 (see Section 7.2 Appendix B on page 45). This list includes a range of monitoring activity that is occurring from ongoing monitoring to monitoring due to the flooding and subsequent dewatering of mines in the Fitzroy River Basin.

In response to the flooding and subsequent dewatering of mines DERM has started an independent Fitzroy River Water Quality, Sediment and Biological Monitoring Program that will monitor and then assess any potential impact(s) of flooded coal pit water discharged from the Ensham Resources coal mine on waterways and related environmental values in the affected reaches of the Fitzroy Basin.

This program will also provide important information for future monitoring. Further details on this monitoring program and progressive results are available from DERM's website at:
http://www.epa.qld.gov.au/publications/p02739aa.pdf/Project_Plan__Fitzroy_Basin_Water_Quality_Monitoring_assessing_the_impact_of_Ensham_Resources_flood_water_release.pdf

DERM is developing a statewide integrated waterways quality monitoring program, comprising the following elements:

- monitoring frameworks based on the processes influencing aquatic ecosystems health in Queensland;
- common techniques, methods and metadata standards for sample collection, handling, analysis, data verification and storage;
- common interpretation and assessment techniques;
- storage and management of collected information in a way to ensure free and rapid access of appropriate information to all stakeholders;
- common indicators and reporting tools; and
- agency roles in water quality monitoring.

This integrated program would benefit from the coordination and inclusion of other monitoring activities such as those carried out by industry and other organisations.

3.4 Key findings

- Drinking water and aquatic ecosystems are the most sensitive downstream environmental values to be protected from discharge waters.
- The Fitzroy River Basin is naturally a moderate but variable saline system with slightly alkaline water overall. Previous studies and the Queensland Water Quality Guidelines show that there are substantial differences in ambient EC levels across sub-catchments.
- There is no overarching comprehensive plan for water quality in the Fitzroy River Basin such as a WQIP that defines environmental values and water quality objectives and considers the cumulative impacts from diffuse and point sources.
- Currently DERM is in the process of developing a statewide integrated waterways quality monitoring program which is expected to be available by June 2009.

4. Data analysis

For the purposes of this study, the EPA contacted the coal mines holding EAs in the Fitzroy River Basin and asked for their monitoring data for the past five years and other relevant information on the approved discharges in their EAs.

The information provided by the coal mines in the catchment has been reviewed. Firstly, the location of the mines and their approved discharges were determined and then grouped into eight sub-catchments. The sub-catchments included:

- Bee/Walker Creeks (Isaac-Connors catchment),
- Anna Creek/Upper Isaac River (Isaac-Connors catchment),
- Ripstone/Stephens Creek/Isaac River (Isaac-Connors catchment),
- Roper/Oakey Creeks, (Nogoa catchment)
- Crinum/Sandy Creeks/Nogoa River, (Nogoa catchment)
- Blackwater Creek/Nogoa River, (Nogoa catchment)
- Ten Mile(Mackenzie catchment), and
- Dawson River /Callide Creek. (Dawson catchment)

Table 6, column three (page 33) identifies the sub-catchment to which the colour shading refers. In Tables 3 (page 25), 4 (page 28) and 5 (page 29) the different colour shading reflects the sub-catchment the mines discharge into.

4.1 Data from authorised discharges

4.1.1 Environmental authorities

Summary of licensed discharge conditions

Current EAs are listed in Table 3 (page 25). These include 40 permits. Of these, mines 34a and 34b are considered together as these authorities are in the process of being amalgamated. All of the EAs permit discharges under certain conditions except for mine 18 and mine 22. Mine 10 was not operational at the time of preparing this report. The EAs include anywhere between one to fifteen approved discharge locations and an EA can have multiple receiving waters, each with different release conditions.

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Table 3 Review of Electrical Conductivity Limits Coal Mine Environmental Authorities in the Fitzroy Catchment

Mine No.	Mine Permit Name	Permit Code	Discharge EC Limit (µS/cm, % background)	Receiving Environment EC Limit (µS/cm)	Conditions Relating to Receiving Environment Stream Flow
1	Hail Creek	M2295		1500	During stream flow
2	South Walker Ck	MIN100552107	2500	2500	During natural flow events
3	Coppabella	MIN100555707	3000	3000	During flow or meets downstream WQ limits
4	Burton	MIN100403206		2500	No release to bed and banks.
5	North Goonyella	MIN100590107	3000	1000	During flow events upstream >2m3/s
6	Goonyella Riverside	MIN200491507		1000 (no flow), 2000 (flow)	During flow and no flow
7	Moranbah North	MIN100557107		1500	Discharge during natural flow >5m3/s
8	Broadlea North	MIN100726908	1500	1500	Release during natural flows only (measure flow)
9	Isaac Plains	MIN100329505	110%		None specified
10	Lenton	MIN100649407	n/a	n/a	n/a
11	Poitrel	MIN100661507	110% background		During flow not specified
12	Millennium	MIM800130703		3000	None specified. Monitoring during events.
13	Carborough Downs	MIN100329305		3000	None specified
14	Moorvale	MIN100555607	3000	3000	During natural flow >200mm depth.
15	Olive Downs	MIN100381005		3000	None specified
16	Peak Downs	MIN100496107	3000	3000 or 1500	During periods of natural flow (measured)
17	Saraji	MIM800014002		3500	During flow, not specified
18	Lake Vermont	MIN100736808	n/a	n/a	n/a
19	Norwich Park	MIM8002300504		2500	During flow events.
20	German Ck	MIM800019402		1000 & 3000	Not specified (monitoring events)
21	Middlemount	MIN100562607	1500 or 80% reference	1500	None specified
22	Foxleigh	MIN100720308		110%	No release permitted

Mine No.	Mine Permit Name	Permit Code	Discharge EC Limit (µS/cm, % background)	Receiving Environment EC Limit (µS/cm)	Conditions Relating to Receiving Environment Stream Flow
23	Oaky Creek	MIM800022002		2000	During flow - specified.
24	Lake Lindsay	MIM800279904		1000	None specified
25	Blair Athol Coal	M5621	2000 or 100% upstream	2000 or upstream	None specified
26	Clermont Coal	MIN100340805	4500 or 100% upstream	1800	None specified
27	Gregory Crinum	MIN100552507	600, 3500	3500	During flow events (measured)
28	Kestrel	MIM800462306	3000 or 110% upstream	2000	During natural flow
29	Ensham	MIM800086202		1000	During natural flow
30	Minerva Coal	MIN100552307	110% upstream	1493*	During flow event
31	Rolleston	MIM800090802	1000	200 & 715	During flow height >1.6m or >0.5
32	Cook Colliery	MIM900140703	3000	2500	During flow events
33	Blackwater Coal	MIM800007802		3000	During flowing creek (flow not specified)
34a	Curragh	MIN100657807	1493 to 2239 depending on upstream	1493 to 2239 depending on upstream	Creek flow >0.2m3/s (Max discharge specified)
34b	Curragh North	MIM800185503	3000	1300	Flow equal to upstream (Max discharge specified)
35	Jellinbah	MIM800087302	2000	1500 or 110% upstream	During flow events
36	Yarrabee Coal	MIM800090202		2836*	During flow (upstream height specified)
37	Dawson North/South/Central	MIN100510607	4000 (500 for passive release <10m3/s)		Flow greater than 5 or 10 m3/s
38	Baralaba Coal	MIM800330805	2985* or 110% of background		None specified
39	Callide	MIN100507307	2000 to 3000	2000	None specified

Colours in column 2 group the mines into the same sub-catchment (named in column 3, Table 6)
* based on EC to TDS conversion of 0.67

Of the most commonly regulated water quality indicators, EC is the most relevant to this study for the following reasons:

- stream inputs can only be removed by natural flows from rainfall events flushing accumulated salinity from waterholes and the numerous water impoundments along the river system (permanent removal), or through infiltration into the groundwater table (temporary removal), thus the potential for accumulation is high;
- there is little water quality data relating to metal based contaminants; and
- there has been recent concerns with elevated salinity in the Fitzroy River Basin.

Applying EC limits

Three main types of EC limits are applied in the EA conditions for the mines reviewed. These include:

- end-of-pipe limits based on a specified numerical value;
- end-of-pipe limits relative to upstream water quality measures (either 100% or 110%); and
- receiving environment limits based on a specified numerical value.

Combinations and permutations of these three limit types are used for the EAs as shown in Table 3 (page 25).

Specified end-of-pipe limits provide the greatest assurance that environment harm will not occur when set appropriately and complied with. They help provide direct knowledge of the discharge to be controlled and regulated. They also provide the best potential for assessing cumulative impacts. The disadvantage of end-of-pipe limits is that they need to be set based on good information which is not available for many sections of the Fitzroy River Basin.

End-of-pipe limits based on upstream measurements provide less assurance for regulation and environmental protection. Given the ephemeral nature of many of the receiving waters for mines in the Fitzroy River Basin, much of the stream flow will be event related. Monitoring of such streams can be technically and logistically challenging with results not always guaranteed. Furthermore, results will generally have large variability, requiring more frequent sampling to receive representative results. An additional important point to this study is that this type of limit does not lend itself to controlling cumulative impacts as it considers discharges occurring upstream but not downstream. Background water quality could potentially worsen moving down the catchment as relative discharge limits would increase with worsening water quality. This type of limit is therefore not suitable for indicators that relate to contaminants that could potentially accumulate in a waterway.

Receiving environment water limits provide a direct measure of water quality changes in the environment but cannot separate the effects of the discharge from other catchment influences. Also, the potential for the monitoring difficulties and potential variability of results arises as discussed above. Nonetheless, limits applied in the receiving environment may be the only alternative where monitoring of end-of-pipe water quality is not possible.

EC-related discharge limits

There was significant variability in the EC limits specified in the EAs reviewed. For end-of-pipe limits, maximum limits varied from 1500µS/cm to 4500µS/cm. Most limits were between 2000µS/cm to 3000µS/cm. Variability in the end-of-pipe limits applied is common and will depend on the circumstance of the release and the type of receiving waters. For example, discharge during high flow events can result in higher dilution, allowing higher EC values in the discharge. Alternatively, discharge during low or no flow would provide no dilution, requiring lower EC values. Understanding and specifying release conditions related to flow of receiving waters is particularly important for these higher EC limits in the EAs.

The majority of discharges approved in the EAs (25) link the release to flows in the receiving waters. However, of these 25 only eight EAs specified the stream flow (or gauging height) at which the release could occur. The remainder did not specify stream flow triggers or how it should be measured. The location where stream flow was required was typically specified.

The remaining thirteen EAs allowed releases in dry weather although monitoring of events was sometimes required.

Maximum EC limits also varied significantly across EAs for receiving environment limits. The limits were generally lower than end-of-pipe limits but ranged from values of 200µS/cm through to values of 4500µS/cm. Limits of 3000µS/cm or greater were common.

4.1.2 Transitional Environmental Programs

Current TEPs for the Fitzroy Catchment are listed in Table 4. These include five approvals, all issued in 2008 following extreme rainfall early in the year. All of the TEPs allow discharge of waste water for extended periods of time, and some TEPs allow discharges during periods of no upstream flow. The TEPs all include a certain discharge period, after which the discharge has to cease to allow inspection of the stream under no discharge conditions.

The EC limits for the TEPs are specified numerical values applied to end-of-pipe measurements and/or receiving waters. Limits vary from 1000µS/cm to 3000µS/cm.

Table 4 Review of Electrical Conductivity Limits for Coal Mine Transitional Environmental Programs (TEPs) in the Fitzroy Catchment

Mine No.	Mine Permit Name	TEP Code	Dates/Duration	Discharge EC Limit (µS/cm, % background)	Receiving Environment EC Limit (µS/cm)	Conditions Relating to Receiving Environment Stream Flow
1	Hail Creek	MAN7274	20 February to 30 June 2008	1500	na	Permitted to occur on a seven day cycle, absence of natural stream flow.
4	Burton	MAN7374	27 March to 30 June 2008		2500	Permitted to occur on a seven day cycle, 14 day inspection
6	Goonyella Riverside	MAN7454	21 May 2008 to 20 May 2009		3000	Permitted to occur on a 28 day cycle, including periods of no detectable flow
29	Ensham	EMD 001-08	29 Feb -, 28 April-, 2 June- 08 to 2 March 09	1200 (2000*)	1000, changed to 1200-2000 (rolling median five weeks)	Permitted to occur on a seven day cycle, 7 day inspection
30	Minerva Coal	EMD 003-08	27 March to 30 June 2008		1493	Permitted to occur on a seven day cycle, 7 day inspection

Colours in column 2 group the mines into the same sub-catchment (named in Column 3, Table 6)
* with approved discharge management plan

The metal-based discharge limits are listed in Table 5 (page 29). The limits are for total metals in receiving waters (i.e. the 'total' metal concentration in the water that includes the sum of metal associated with suspended sediment, and the metal dissolved in the water itself). The limits specified are significantly higher than toxicant trigger values for slightly-to-moderately disturbed systems in the ANZECC/ARMCANZ (2000) guideline. One reason for this is that natural background concentrations of some chemicals may exceed the stated guideline trigger values due to mineralisation from the catchment substrate. In these cases, it is not reasonable to use a guideline value below the background concentration. Monitoring and limit setting for dissolved metals is likely to provide a more useful regulatory mechanism. Limits for aquatic ecosystem protection should also be considered in the future. Further monitoring for total and dissolved metals in the receiving environment of reference/background sites is probably required to determine what limits are achievable for compliance purposes given the likelihood of high background levels of some metals within such a mineral-rich catchment.

Table 5 **Review of Metal Limits for 1 Coal Mine Transitional Environmental Programs (TEPs) in the Fitzroy Catchment. Metals are total metals in mg/L.**

Mine No.	Mine Permit Name	TEP Code	Dates/ Duration	Aluminium	Arsenic	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Zinc
1	Hail Creek	MAN7274	20 February to 30 June 2008	20	0.5	5	0.01		1	1		0.1		0	0.15	1	0.02	20
4	Burton	MAN7374	27 March to 30 June 2008	20	0.5	5	0.01		1	1		0.1		0	0.15	1	0.02	20
6	Goonyella Riverside	MAN7454	21 May 2008 to 20 May 2009	5	0.5	0.01	0.01	1		1	20	0.1				1	0.01	0.05
29	Ensham	EMD 001-08	29 Feb -, 28 April-, 2 June- 08 to 2 March 09	10	0.5	5	0.01	1		1	10	0.1	10	0		1	0.02	5
30	Minerva Coal	EMD 003-08	27 March to 30 June 2008	5	0.5	5	0.01	1	1	1	5	0.1		0	0.15	1		20

Colours in column 2 group the mines into the same sub-catchment (named in column 3, Table 6)

4.2 Risks associated with water quality changes and potential for cumulative impacts

The locations of water quality monitoring sites for monitoring by coal mines are generally confined to mining tenure, which provides good information on local impacts but little information on cumulative impacts. In addition, monitoring is nearly always constrained to occurring while there is a discharge from the mine. This means that data collected would be difficult to use for assessing cumulative impacts unless discharges all occurred together. Furthermore, there is insufficient monitoring data available to determine reference or true background benchmark conditions.

To ascertain the full spatial extent of impact of the discharges and the actual cumulative impact, more downstream monitoring and data would be required.

It was evident that discharges from more than one mine were occurring in numerous sub-catchments at the same time. The potential for cumulative impacts spatially across the sub-catchment and catchment would be increased under such circumstances.

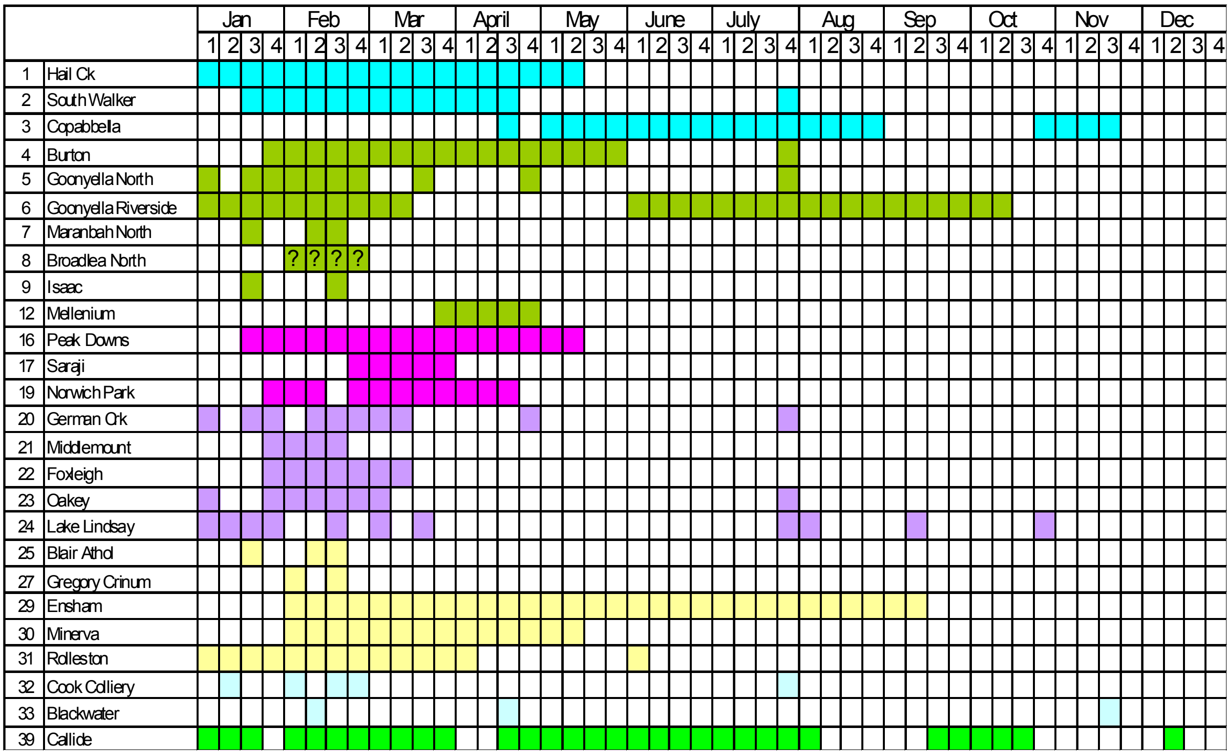
One observation resulting from the review of mine data is the close relative proximity of 19 of the mines in the northern three sub-catchments relating to the upper Isaac River and Connors River (Bee/Walker Creeks).

The potential contribution to cumulative impacts was based on EC data and determined the catchments most at risk. Monitoring data on metal concentrations in receiving waters was received for some mines. In general, the total metal concentrations were quite low and complied with limits specified in the EAs. Some total metal concentration appeared to exceed toxicant triggers for slightly-to-moderately disturbed waters in ANZECC/ARMCANZ (2000) guidelines. Further work and data would be required to undertake local and cumulative impact assessment.

4.2.1 Discharge information

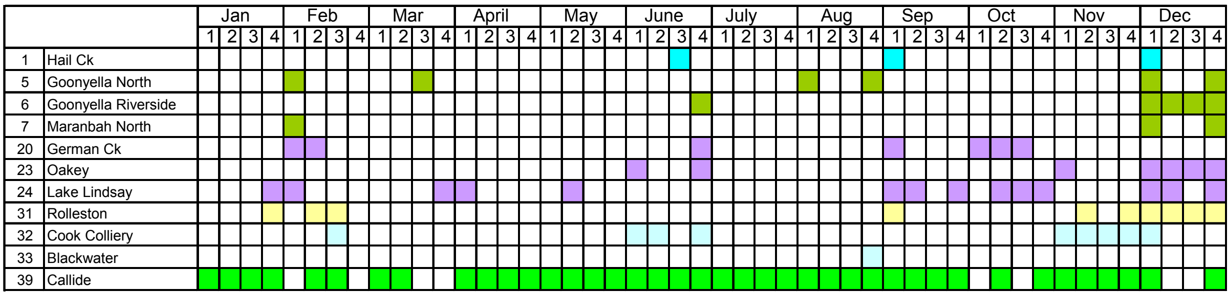
Firstly, the frequency and duration of the discharges over the past five years was examined. A calendar of the discharges from each mine for 2008 and 2007 is shown in Figure 3 and Figure 4 (page 31) respectively (note the figures show weeks where a discharge occurred for at least one of the days in that week). In general, 2008 showed a significantly larger number of mine discharge weeks compared to any other year. In comparison, 2004 (not represented in Figure 3 or Figure 4) showed the least number of discharges and weeks for discharges. The year 2008 corresponded to the significant rainfall event in the early part of the year and the application and approval of the five TEPs that allowed extended periods of release. What is also evident from Figure 3 is that discharges from more than one mine were occurring in numerous sub-catchments at the same time. The potential for cumulative impacts spatially across the sub-catchment and catchment would be increased under such circumstances.

Figure 3 Discharge timetable for Fitzroy mines for 2008.



Coloured weeks indicate a discharge for at least on day of that week. Groupings of similar colour indicate same sub-catchment locations (named in column 3, Table 6 on page 33)
(?) Specific dates were not provided for discharges during this month.

Figure 4 Discharge timetable for Fitzroy mines for 2007.



Coloured weeks indicate a discharge for at least on day of that week. Groupings of similar colour indicate same sub-catchment locations (named in column 3, Table 6).

In general, most EAs were not able to provide discharge flow rates but were able to estimate discharge volumes per event or period. The discharge volumes for 2008 and in some 2007 discharges were determined and are presented in Table 6 on page 33. Where volume data was not available, comments are provided on the frequency or duration of the discharge. Discharge volumes varied significantly from mine to mine and month to month. Numerous mines had zero releases while Mine 6 discharged 31.5GL in 2007/08 and Mine 29 discharged 208GL in 2008. Mines without TEPs discharged no greater than 5.5GL during 2008.

In terms of addressing the potential for impacts (local and cumulative) from salinity in discharges, the EC monitoring data for the most downstream receiving environment monitoring point was reviewed and is presented in Table 6 (page 33). As mentioned previously, monitoring generally occurred during or soon after discharges. As expected, receiving environment monitoring results for EC varied significantly between EAs, between monitoring sites within EAs and also across the five-year period. For the purposes of this study, the maximum EC values for short or extended periods were used.

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Table 6 Salinity Risk Assessment for Coal Mines in the Fitzroy Catchment

No	MINE	Creek/River Sub-catchment	Discharge Volume (ML)/ Frequency	Receiving Environment (RE) EC (μS/cm)	Cumulative Risk
1	Hail Creek	Bee/Walker	7530 (07/08) includes 1000 (TEP)	pre TEP < 1300, TEP no flow <1500	medium
2	South Walker Ck	Bee/Walker	2450 (2008)	low to medium (two EC 1620, 1770)	medium
3	Coppabella	Bee/Walker	3990 (2008)	medium to high <3000	high
4	Burton	Anna/Isaac	795+ (08) not all flow monitored	high EC but generally below 2500 in 2008	medium
5	North Goonyella	Anna/Isaac	5490 (2008), 785 (2007)	high RE EC 1400-2800	high
6	Goonyella Riverside	Anna/Isaac	31500 (07/08) includes 3700 (TEP)	pre 2008 low <1000EC RE , June-Oct 08 high 2-3000 up to 4500 in June	v. high
7	Moranbah North	Anna/Isaac	220 (07/08)	low <400, two high values <1520	low
8	Broadlea North	Anna/Isaac	no volumes, two discharges	low < 320	low
9	Isaac Plains	Anna/Isaac	110 (2008)	v. low EC generally 300, <740	low
10	Lenton	Anna/Isaac	0	*na	v. low
11	Poitrel	Anna/Isaac	604+ (2008)	median RE<1100 for extended period, Local levels higher, some no flow	medium
12	Millennium	Anna/Isaac	no volumes, five week discharge	medium EC<2800 DS RE	high
13	Carborough Downs	Anna/Isaac	no volumes, infrequent	EC generally <500	v. low
14	Moorvale	Anna/Isaac	0	*na	v. low
15	Olive Downs	Anna/Isaac	0	*na	v. low
16	Peak Downs	Ripstone/Stephens /Isaac	5500 (2008)	high RE EC<3500, extended period March-May	high
17	Saraji	Ripstone/Stephens /Isaac	660 (2008)	low to high, RE <3200	medium

No	MINE	Creek/River Sub-catchment	Discharge Volume (ML)/ Frequency	Receiving Environment (RE) EC (µS/cm)	Cumulative Risk
18	Lake Vermont	Ripstone/Stephens /Isaac	0	*na	v. low
19	Norwich Park	Ripstone/Stephens /Isaac	1120 (2008)	high RE EC<2400, low EC during flow	medium
20	German Ck	Roper/Oakey	no volumes, multiple releases	downstream sites low EC <600	low
21	Middlemount	Roper/Oakey	no volumes, one release	low <200EC	low
22	Foxleigh	Roper/Oakey	140	low - rain water (discharge EC 1500, RE 150-1200)	v. low
23	Oaky Creek	Roper/Oakey	108 (2008)	RE generally low EC. Some <1200, +one 1500	low
24	Lake Lindsay	Roper/Oakey	no volumes, multiple releases	generally low, max 1200, Jan 08 1700 Sandy Creek	low
25	Blair Athol Coal	Crinum/Sandy/Nogoa	no volumes, 4 releases	low EC<400	low
26	Clermont Coal	Crinum/Sandy/Nogoa	0	*na	v. low
27	Gregory Crinum	Crinum/Sandy/Nogoa	88 (2008)	low EC<608 except for uncontrolled release 06 high EC, low volume	low
28	Kestrel	Crinum/Sandy/Nogoa	0.5 (2008)	v.low<651TDS	v. low
29	Ensham	Crinum/Sandy/Nogoa	208,000 (include 69000 dilution water)	downstream medium EC>1500 on occasion, Corkscrew high >2000 for two weeks	high
30	Minerva Coal	Crinum/Sandy/Nogoa	no volumes, five day discharge only	generally low<1230	low
31	Rolleston	Crinum/Sandy/Nogoa	no volumes, 17 releases	generally low, EC max 1550	medium
32	Cook Colliery	Blackwater/Nogoa	no volumes (7 overflows)	high EC,4700 - washery discharge	medium
33	Blackwater Coal	Blackwater/Nogoa	20	medium to short term, low volume & High EC (in April)	medium
34	Curragh/Curragh North	Blackwater/Nogoa	<20	low - clean water	v. low
35	Jellinbah	Blackwater/Nogoa	0	negligible	v. low
36	Yarrabee Coal	Ten Mile	0	*na	v. low

No	MINE	Creek/River Sub-catchment	Discharge Volume (ML)/ Frequency	Receiving Environment (RE) EC (µS/cm)	Cumulative Risk
37	Dawson North/South/Central	Dawson/Callide	0	*na	v. low
38	Baralaba Coal	Dawson/Callide	0	*na	v. low
39	Callide	Dawson/Callide	no volumes, multiple releases	low to medium, Majority EC <2500	medium

Colours in columns 2 and 3 group the mines into the same sub-catchment (named in column 3)
* na – not applicable

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4.2.2 Risk assessment for each EA

The final step of the study was to undertake a risk assessment for each EA based on the information provided. Mines identified as high risk that are grouped together have the greatest potential for producing cumulative impacts. The risk assessment was based on the level of EC sampled immediately downstream from the discharge and the volume or frequency of the discharge. Risk assessment categories for each of these have been developed and are shown in Table 7 and Table 8, respectively.

Table 7 **Assessment categories for mine receiving waters EC sampled immediately downstream from discharge for Table 6**

Risk category	EC level	Rationale for EC level (percentiles based on Queensland Water Quality Guideline figures)
very low	<720μS/cm	Ambient conditions for North Fitzroy (based on 75th percentile), approx 95th percentile of guideline for Central Fitzroy
low	<1250μS/cm	90th percentile (North Fitzroy) - limited effects on fish/macroinvertebrates, most crop irrigation possible (except beans & oranges), increased potential effect on drinking water
medium	<2500μS/cm	Reduction in some macro-invertebrate species, potential effect on some fish, greater number of crops effected, higher risk on drinking water
high	>2500μS/cm	Potential effects on all values - loss of aquatic ecosystem, less suitable for irrigation, highest risk to downstream water supplies

Table 8 **Assessment categories for frequency and volume of mine discharges for Table 6**

Risk category	Flow frequency and volume
very low	zero flow, release on only a few days, low volume, e.g. <100ML per year
low	In-frequent flow, couple of major releases, volume <1000ML per year
medium	frequent releases, associated with low stream flow, volumes <10,000ML per year
high	extended release for weeks, dry weather associated, volumes >10,000MLper year
very high	extended release for months, dry weather associated, volumes >10,000MLper year

In terms of risk assessment categories for EC, the likely environmental values and water quality objectives for the freshwater reach of the Fitzroy River were considered. Environmental values of particular interest and most sensitivity to salinity are protection of aquatic ecosystem, crop irrigation and potential use for drinking water.

For EC, four risk assessment categories were developed from very low through to high. Information on reference based aquatic ecosystem guidelines for the Fitzroy Catchment is provided in the Queensland Water Quality Guidelines (2006) and was used for defining the limits for the low and very low risk assessment categories. Percentiles for EC for different sub-catchments are presented in the guidelines and the northern catchments such as the upper Isaac River have naturally higher EC values compared to some other parts of the catchment such as the Nogoa River. Nonetheless, given that a significant proportion of the mines are in this northern area, the guidelines for this area were used for defining the levels (Table 7). It is noted that this break up may not be sufficiently conservative for all parts of the catchment. For the higher risk categories, published information on potential chronic effects on fish and macroinvertebrates was considered (Dunlop et al., 2005; Dunlop & McGregor, 2007; Hart 2008).

For irrigation, EC guideline concentrations from ANZECC/ARMCANZ (2000) were considered. The levels of EC suitable for drinking water are more difficult to define. As noted by the recent report by Hart (2008), sodium concentrations are the key element and water treatment in the area is unlikely to remove any salinity or sodium. The very low risk level will generally protect drinking water. Any of the higher levels listed in Table 7 (page 37) could be of concern if the water is used for reticulated drinking water. However, given the monitoring data under review are in close proximity to the mine discharge some dilution would be expected before the discharge water reached drinking water reservoirs.

The risk assessment categories for frequency/volume of discharge water were divided into five categories from very low to very high. The rationale behind the categories was that with greater volumes and more frequent releases, there would be a greater potential for cumulative effects. This is an essential part of the risk assessment given the locations of the monitoring sites were in close proximity to the mines, often in tributaries off the major streams and generally some distance from the environmental value, particularly for drinking water uses. The categorisation of the volumes was somewhat arbitrary and based on expert opinion. The very low risk assessment categories corresponded to discharges for a few days or less and low volumes (<100ML). The very high risk category corresponded to extended releases for months, dry weather associated and with large volumes greater than 10,000ML.

Based on these risk assessment categories, a cumulative risk assessment matrix was developed to help assess the potential for cumulative risk from the mines and is presented in Table 9. Cumulative risk is broken into five categories from very low through to very high. The rationale behind the matrix was that the cumulative impact risk is a combination of the frequency/volume of the discharge and the EC concentration in the environment during the time of discharge. Very low volume discharges with very low receiving water EC would have very low risk of cumulative impact. Alternatively, an extended continuous large volume release combined with high receiving water EC would have a very high risk of cumulative impacts.

Table 9 **Cumulative risk assessment matrix used to assess the mine discharges in the Fitzroy Catchment**

Frequency/Volume (ML/year)			**EC (μS/cm)**			
			v low	**low**	**medium**	**high**
			<720	**<1250**	**<2500**	**>2500**
v. low	zero/small	<100ML	v. low	low	low	medium
low	few releases, infrequent	<1000	low	low	medium	medium
medium	frequent	<10000	low	medium	medium	high
high	continuous, some dry weather	<100000	medium	medium	high	v. high
v. high	continuous, months	>100000	medium	high	v. high	v. high

The results of the cumulative impact risk assessment for the data obtained from the mines are shown in Table 6 (page 33). Six mines were identified as having a high or very high risk of contributing to cumulative impacts. Five of these were in the two northern Isaac River sub-catchments. In addition, six mines in those catchments were identified as a medium risk of contributing to cumulative impacts, which adds to the potential for cumulative impacts in this area. In comparison in the southern sub-catchments, the majority of mines were rated as low or very low risk of cumulative impact, other than mine 29. It should be noted however that naturally occurring levels of EC are lower in some of the southern catchments and the risk assessment may under predict the cumulative risks for these areas on aquatic ecosystems or drinking water.

Of the six mines rated as high or very high risk, only two were associated with a TEP. The discharges for the remaining four occurred under the existing EA.

To ascertain the full spatial extent of impact of the discharges and the actual cumulative impact, more downstream monitoring and data would be required.

Monitoring data on metal concentrations in receiving waters was received for some mines. In general, the total metal concentrations were quite low and complied with limits specified in the EAs. Some total metal concentration appeared to exceed toxicant triggers for slightly-to-moderately disturbed waters in ANZECC/ARMCANZ (2000) guidelines. In some cases this may be attributable to higher ambient levels due to natural processes of mineralisation. However, further work and data would be required to undertake local and cumulative impact assessment.

4.3 Key findings

- Forty permit holders of coal mines were identified.
- Discharge limits for Environmental Authorities are set for pH, electrical conductivity (or TDS) and total suspended solids (or turbidity). Limits for metals and some additional water quality parameters are not on all EAs but have been imposed on more recent examples.
- Due to data constraints, electrical conductivity (which is a measure of salinity) is the most relevant contaminant to this cumulative impact study for the freshwater reach of Fitzroy River Basin. Knowledge and data on other contaminants will improve the understanding of cumulative impacts.
- Three types of electrical conductivity limits are used in the mine EAs:
    - an end-of-pipe limit based on a specified numerical value;
    - an end-of-pipe limit relative to upstream water quality measures (either 100 or 110%), and
    - receiving environment limit based on a specified numerical value.
- Combinations and permutations of these three limit types are used. End-of-pipe limits are not always used.
- End-of-pipe numerical limits linked to receiving water conditions are recommended as the most effective in regulating and managing the cumulative effect of water discharges.
- There was significant variability in the electrical conductivity limits specified in the EAs for both end-of-pipe and receiving waters. On currently operating mines, limits were as high as 4500μS/cm for end-of-pipe and 3500μS/cm for the receiving environment.
- Understanding and specifying release conditions related to flow of receiving waters is particularly important for these higher EC limits in the EAs. The higher limit values present a potential risk to both local environmental values and broader cumulative impacts during low flow and no flow conditions.
- Many discharges approved in the EAs link the discharge to flows in the receiving waters. However, the minority specified the stream flow (or gauging height) at which the release could occur. Numerous EAs appeared to allow dry weather releases (providing for a potentially higher associated risk of adverse environmental impacts).
- Mine receiving environment monitoring was limited to within mining tenure and was not ideal for assessing cumulative impacts. Monitoring was also generally limited to only times when releases occurred and thereby greatly limited the data relating to background water quality.
- Limits and monitoring of metals was limited to most recent EAs and TEPs and focussed on total metal concentrations. Dissolved metal concentrations would have provided a better gauge of the potential risk that they might pose to aquatic ecosystems. Discharge limits were set consistent with irrigation and stock watering guidelines that are significantly higher than ANZECC/ARMCANZ (2000) toxicant trigger values for aquatic ecosystems.
- Five TEPs were identified for the catchment, all issued in 2008 and all permitted discharge of waste water for extended periods of time, including periods of no natural stream flow.

- In general, data from 2008 (year of flooding in January and February) showed a significantly larger number of mine discharges compared to any other year. Discharges from more than one mine were occurring in numerous sub-catchments at the same time which increases the likelihood for cumulative impacts.
- More downstream data is required to quantify the cumulative impacts from water discharges from mines.
- In the cumulative impact risk assessment of salinity, six mines were identified as having a high or very high risk of cumulative impacts. Five of these were in the two northern Isaac River sub-catchments. In addition, six mines in the northern sub-catchments were identified as a medium risk of cumulative impacts, which adds to the potential for cumulative impacts for this area.
- In comparison in the southern sub-catchments, the majority of mines were rated as low or very low risk of cumulative impact, other than mine 29.
- Of the six mines rated as high or very high risk, only two were associated with a TEP. The discharges for the remaining four occurred under the existing EAs.

5. Recommendations

Recommendations

After considering the findings of this study and following consultation on the draft study with key stakeholders, including Queensland Resources Council; the Technical Working Group; the Queensland Conservation Council and Agforce, the following recommendations are made.

1. Develop appropriate conditions in environmental authorities for mine water discharges

The aim of this recommendation is to standardise environmental authority conditions relating to water discharges so that consistent and appropriate conditions exist across the Fitzroy River Basin.

The aim is to work with mining companies to achieve this by convening a small working group comprising DERM and mining company technical specialists that would consider how discharge limits are set, what limits are acceptable and what this should be based on, when discharges may occur and what monitoring should occur. This is to occur by the end of June 2009.

The preferred option for implementing changes is via voluntary agreement with mining companies. If this is not possible, then it may be necessary to implement changes after requiring and reviewing an environmental audit or by changes to the EP Act to allow for the immediate review and amendment of coal mining authority conditions using the issues identified in this study. Changes to environmental authorities are to occur by the end of December 2009.

2. Develop local water quality guidelines

The aim of this recommendation is establish a collaborative project that enables the setting of local water quality guidelines. This would include mining companies and other stakeholder groups to identify current data and monitoring occurring throughout the region as well as developing a suitable monitoring program to complement the current information. The project plan for this project is to be developed by June 2009.

3. Develop a model for assessing cumulative impacts across the region

The aim of this recommendation is to understand full extent of cumulative impacts of mine water discharges which will be only known once a model is developed to determine the capacity of the catchment in terms of all inputs. This is likely to take at least two years to develop.

6. References

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7. Appendices

7.1 Appendix A

TERMS OF REFERENCE

Background

The dewatering of flooded mine pits at Ensham Coal Mine has resulted in water quality impacts, evidenced by a rise in sodium and salinity levels in the Fitzroy River system which in some places exceed the NHMRC Drinking Water Guidelines for sodium in drinking water.

While it is recognised that the NHMRC Drinking Water Guidelines standard is an aesthetic based value and there is no definitive health based value, readings above this have, and will continue to trigger a public health advisory to people who need to be aware of these levels and take action as appropriate. These are people who are monitoring their salt intake for high blood pressure, cardiovascular disease, chronic kidney failure or any dietary reason and parents of infants less than 6 months of age who are bottle fed.

These water quality impacts are being managed to minimise the effects on town water supplies, downstream river water users and the environment.

The dewatering of flooded mine pits at the Ensham Coal Mine is authorised by a Transitional Environmental Program issued under the *Environmental Protection Act 1994* by the EPA. This is one of a number of Transitional Environmental Programs approved to assist in the recovery of mining operations following the flooding that occurred in the Fitzroy River Basin in January/February 2008.

Mining companies across the Fitzroy River system are permitted to discharge water under the conditions specified in environmental authorities issued under the *Environmental Protection Act 1994* by the EPA. Discharges of water from mines is not the only source of impacts on water quality with stormwater, treated effluent from townships, tail-water discharges from irrigation areas and overland flows all contributing to the quality of water in the river and its contaminant load.

The Rockhampton Regional Council and Central Highlands Regional Council in the second half of 2008 requested the State government to give consideration to undertaking a study of the cumulative impacts on water quality of mining activities in the Fitzroy River system.

Purpose / Scope

The purpose of this study is to investigate current and historical data and report on the overall implications of water discharges from mines on water quality in the Fitzroy River system, and to make recommendations for the management of water discharges from mining activities with respect to water quality. This study focuses only on the impact of water discharges from mines, their quality, and the impact that those discharges may have on the river environment and the quality of water in the Fitzroy River system.

It is recognised that a range of other land uses and management practices may have an impact on water quality. The impact of these is not within the scope of this study.

Key Elements of the Study

The study is to include:

- a brief history of mining development in the Fitzroy River Basin
- a summary of the regulatory framework for management of the quality of water discharges from mining activities (and its evolution over time)

- a summary of existing approaches to minimising water quality impacts of water discharges from mining activities
- an analysis of currently authorised water discharges from mining activities
- a forecast of future mining activities and their potential to impact on water quality
- a review of water quality data, how and where it is collected, by whom and to whom it is reported
- an analysis of trends in water quality and an assessment of impacts
- an analysis of risks associated with changes in water quality
- recommendations for improving water quality data collection, its coordination and management (note this is related to the implementation of Service Delivery and Productivity Commission recommendations)
- recommendations for the future management of water discharges from mining activities

Stakeholders

EPA	NRW	Queensland Health
DPI&F	SunWater	DME
DTRD&I	Regional Councils	Queensland Resources Council
Mining companies	Agforce	Landholders
QFF	Fitzroy Basin Association	

Study Management

The study is to be led by the EPA with a project team made up of staff from the EPA and NRW. The EPA will designate a person from its staff to be the study leader. The study team will be based in Rockhampton. Oversight of the project will be coordinated through a Steering Committee of senior officers from the EPA and NRW.

Consultation will occur with the various stakeholder groups during the life of the study and on the draft study report.

Meetings relating to the management of the study will be held as far as possible by teleconference. Meetings relating to consultation with stakeholders will be held at locations in the Fitzroy River Basin.

It is intended that the study will be based on currently available data and information sets. It is not intended that the study collect new water quality data.

Each party to the study will contribute its own costs with the EPA contributing the cost of publishing the draft and final study report.

7.2 Appendix B

Fitzroy River Water Quality Technical Working Group (TWG)

Table 10 **Existing Monitoring Program of Agencies for September 2008 onwards (Draft 4/12/08) for TWG consideration**

Agency	Monitoring Site	Parameters Monitored	Frequency	Notes
NRW Stream flow monitoring and Surface Water Ambient Network	130113A Mackenzie River at Rileys Crossing	Flow, Rain, temporary EC logger	Continuous	WQ when serviced (3 x per year) Major Ions, Nutrients, EC, pH
	130105A Mackenzie River at Coolmaringa	Flow, Rain, Temp, EC	Continuous	WQ when serviced (3 x per year)
	130003B Fitzroy River at Riverslea	Flow, Rain	Continuous	WQ when serviced (3 x per year)
	130005A Fitzroy River at Eden Bann Weir	Flow, Rain, Temp, EC	Continuous	WQ when serviced (3 x per year)
NRW Great Barrier Reef flood monitoring	The Barrage	Manual Sample	Wet season	Equipment – None Required Service Agreement – Bob Packett to coordinate
	130005A The Gap	Manual and Turbidity probe		Equipment – Turbidity probes installed
	130322A Dawson River	Manual and Turbidity probe		Equipment – Turbidity probes installed Service Agreement – Bob Packett to Sample
	130105A Mackenzie River Lower	Manual and Turbidity probe		Equipment – Turbidity probes installed
	130401A Issacs River	Manual and Turbidity probe		Equipment – Turbidity probes installed
	130404A Connors River	Manual and Turbidity probe		Equipment – Turbidity probes installed
	130504B Comet River	Manual		Service Agreement – Emerald NRW to sample
	130201B Nogoa River @ Emerald	Manual		Service Agreement – Emerald NRW to sample

Agency	Monitoring Site	Parameters Monitored	Frequency	Notes
DPI&F	Tartrus Weir Bedford Weir (between wall and upstream sites) Emerald Town Weir (for comparison / control)	Fork-tailed Catfish (Arius graeffei) Pathology, Bacteriological, Toxological	22, 23 & 24 September	Once off – preliminary at this stage – depending on results could continue. Results due: Path/Bact – Oct, Tox – Nov
NRW EFAP	Nogoa @ Glenlees Nogoa @ Emerald Nogoa @ Bridge Flat Rd Mackenzie @ Rileys Crossing Mackenzie River @Jellinbah Mackenzie @ Honeycomb Mackenzie River @ Duaringa/Apis Rd Comet @ Comet Weir	Fish larvae and egg sampling	Event Monitoring	Dependent on flow conditions for environmental flow monitoring
Ensham Mine (subject to amended TEP)	Upstream and immediately downstream of mine lease	As per condition 12 of June (amended) TEP	Weekly	Dependent on amended TEP conditions
	Bedford, Bingegang, Tartrus and Eden Ban Weirs, Fitzroy Barrage and other water bodies depending on outcome of new TEP (Sept 2008)	As per condition 12 of June (amended) TEP Boat – mid stream, phys at 2m depth intervals, chem at surface and 2m from bottom, for EC, pH, Ions, Metals, Nutrients, others	Weekly	Dependent on amended TEP conditions
	Storage Pit A	As per TEP conditions	Monthly	Dependent on amended TEP conditions
Stanwell	Riverslea Crossing	EC, Turbidity, most ions	Weekly	Has been at weekly interval for last few months, about to stop due to planned EPA monitoring at this site
	Intake water	EC, Turbidity, most ions (?)	Weekly	

Agency	Monitoring Site	Parameters Monitored	Frequency	Notes
EPA	Enhanced EPA monitoring program (10 sites) Comet, Bedford(3), Bingegang(3), Tartrus(3), Moura and Eden Bann(3) Weir's, also - Duck Ponds, Riley's crossing, May Downs crossing (Isaac River) the Fitzroy River Barrage(3)	Water column physiochemical parameters and dissolved metals at multiple sites in weirs, Barrage Total organic carbon and metals in sediments Invertebrates, fish, turtles	Water Quality – every 2 weeks Sediments and biological quarterly	First monitoring trip completed from 28th to 31st Oct 2008 next planned field trip 17th November
	Fitzroy Estuary (6 sites - mouth to Barrage)	Water column physiochemical parameters as per historical ambient program plus 3 metals sampling sites	Fortnightly	Sampled on 30th Oct 2008 next planned field trip 17th November
SunWater	Rileys Crossing	Date & time, depth, temperature, dissolved oxygen (mg/L), pH, electrical conductivity, turbidity, total nitrogen, total phosphorous, sulphides (tailwater only)	Quarterly	Monitoring has been at an increased frequency during recent months due to current water quality issues in the Mackenzie and Fitzroy Rivers
	Bedford Weir	Date & time, depth, temperature, dissolved oxygen (mg/L), pH, electrical conductivity, turbidity, total nitrogen, total phosphorous, sulphides (tailwater only) Cyanobacteria (Blue-green algae) species identification and counts (in storage only)	Quarterly	Headwater (in-storage site), Tailwater site
	Bingegang Weir	As per Bedford	Quarterly	Headwater (in-storage site), Tailwater site

Agency	Monitoring Site	Parameters Monitored	Frequency	Notes
	Tartrus Weir	As per Bedford	Monthly (Oct-May plus July)	Inflow site, Headwater (in-storage site), Tailwater site
	Eden Bann Weir	As per Bedford	Monthly (Oct-May plus July)	Inflow site, Headwater (in-storage site), Tailwater site
Fitzroy River Water	Treated water	EC	Continuous	Ongoing
	Treated water	Potable water monitoring – standard required phys / chem. Parameters	3 Monthly	From September onwards potable water monitored monthly
	Wattlebank Weir	Surface (20-30cm) sample for TN, TP, DO, pH, Temp, EC, Turbidity	Monthly	As part of ROP obligations
	Glenmore WTP intake	Profile (at 1m intervals or smaller) from Surface to bottom, Sample for TN, TP, DO, pH, Temp, EC, Turbidity	Monthly	As part of ROP obligations
	Barrage Outflow	Surface (20-30cm) sample for TN, TP, DO, pH, Temp, EC, Sulphide, Turbidity	Monthly	As part of ROP obligations
Central Highlands Regional Council	Multiple sites – Emerald, Tieri, Blackwater, Duaringa (others?). Town water plus (appears) ad hoc additional monitoring for current water quality issues	Potable water monitoring – standard required phys / chem. Parameters. Plus – ad hoc monitoring for EC, pH, Ions, Metals, Pesticides, PAH's	3 Monthly (?)	Recent additional monitoring weekly (?), future (?)
Fitzroy Basin Association	Bridge Flats Nogoa Comet River @ Capricorn Highway Bedford Weir Bingegang Weir Tartrus Weir Isaac River at Railway (winchester downs) Bee Creek/ Harry Brandt Junction Isaac River on	Major anions + cations, total metals, TSS, TDS, total alkalinity, EC, pH	Late September to Follow up a number of these sites late November	These sites have all been looked at as part of our dewatering investigation

Agency	Monitoring Site	Parameters Monitored	Frequency	Notes
	Wylinga Connors River at twin bridges - Lotus Creek Isaac River at May Downs Crossing Mackenzie Crosssing & Apis Creek Road Dawson River before junction Mac Riverslea Crossing Glenroy Crossing Mornish Bee Creek in Dipperu NP Bee Creek overflow Lagoon in Dipperu NP Bee Creek at Mt Flora			
FBA PNC water quality monitoring	Around 20 sites across the Fitzroy Basin See FBA website for details on sites	Event monitoring looking at TSS, EC, pH, TN, TP	Samples collected by landholders during flood events	