DRAFT REPORT

Water Corporation

East Rockingham Waste Water Treatment Plant - *Water Management Plan*

April 2009

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Reference: 0083144

For and on behalf of Environmental Resources Management Australia Pty Ltd	
Approved by: Signed:	Toby Whincup
Position: Date:	Partner 28th April 2009

CONTENTS

CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

The Water Corporation plans to construct a municipal Wastewater Treatment Plant (WWTP) in East Rockingham, Western Australia (WA) hereafter referred to as "the Site". Located approximately 35 km south of Perth in the City of Rockingham, the East Rockingham Wastewater Treatment Plant (ERWWTP) will occupy a total footprint of 30.7 Hectares (ha)[1]. The Treated Wastewater (TWW) will be discharged to the ocean via the outlet pipeline to the Sepia Depression Ocean Outlet (SDOO) located 4.2km offshore.

In December 2008, Environmental Resources Management Australia Pty Ltd (ERM) prepared an *Initial Environmental Review* for the Water Corporation providing preliminary advice on the environmental and hydrogeological context of the Site and an overview of potential environmental requirements for the construction of the ERWWTP.

Hydrogeological studies conducted as part of the *Initial Environmental Review* suggest that the groundwater at the Site is of a good quality and is potentially suitable for potable use. Based on this, it was recommended that the Water Corporation prepare a Groundwater Management Plan (GMP), Dewatering Management Plan (DMP) and Surface Water Management Plan (SWMP) to help monitor, manage and mitigate potential adverse impacts to surface water and groundwater resources from the development of the ERWWTP.

Subject to the above, ERM was commissioned by the Water Corporation to prepare a preliminary Water Management Plan (WMP) which encompasses the GMP, DMP and SWMP. This document focuses primarily on the water management planning for construction works.

1.2 OBJECTIVES & GOALS

The objectives of the WMP are to:

- provide details on Site management and procedural controls to minimise the potential identified impacts during plant construction;
- provide design strategies for minimising potential impacts to the surrounding groundwater system and surface water features during plant construction that have been identified by the hydrogeological and hydrological investigation (ERM, 2008);

[1] Footprint includes outlet (discharge) pipeline to the SDOO

- put measures in place to monitor for potential impacts of plant construction activities on the surrounding groundwater system and surface water features;

- assess the effectiveness of the Site groundwater management strategies in protecting groundwater and surface water supplies and quality; and

- provide mechanisms for mitigating any potential adverse impacts identified by the monitoring program.

Specifically, the WMP will include the following:

- recommendations for ***Site management*** to minimise any potential impacts identified in the *Initial Environmental Review* (ERM 2008);

- recommendations for ***construction design*** to minimise any potential impacts indentified within in the *Initial Environmental Review* (ERM 2008);

- recommendations on surface and groundwater monitoring sites to adequately delineate baseline water quality and flow conditions and delineate any potential future changes in surface water quality and flows;

- delineation of appropriate water quality parameters for use in water quality monitoring across the Site; and

- selection of appropriate assessment criteria from relevant federal and WA guidance to protect the environmental characteristics of the receiving environment.

1.3 WMP STRUCTURE

To achieve the above mentioned objectives, *Section 2* first summarises the identified potential adverse impacts to groundwater and surface water outlined in the hydrological and hydrogeological report (ERM,2008).

Measures proposed to mitigate the identified impacts are then presented under the following subsections:

- ***Section 3 - Site Management***– Details of the administrative actions and Site procedures that will be adopted to minimise the potential for impacts are outlined. In particular, this section provides a framework for implementing the WMP, details of how Site practices will be managed and procedures that will be required to minimise the potential for impacts;

- ***Section 4 - Construction Design Requirements*** – Details of the design requirements for Site development to minimise identified potential impacts are outlined;

- ***Section 5 - Monitoring and Evaluation*** – Details of the monitoring and evaluation that will be undertaken to assess if Site management, procedural controls and construction design are resulting in appropriate environmental protection are outlined. This section also provides detail on the procedures that will be undertaken to adequately delineate and mitigate potential adverse impacts.

1.4 LIMITATIONS

This WMP has been designed to provide *minimum* environmental management requirements with regards to the surrounding groundwater system and the surface water features affected by the Site.

This WMP has not been prepared to cover broader Occupational Health and Safety (OH&S) issues that should be covered in detail in a specific OH&S plan (as appropriate).

ERM has prepared this WMP in a manner consistent with the normal level of care and expertise exercised by members of the environmental assessment profession. No warranties, expressed or implied, are made.

ERM is not engaged in environmental assessment and reporting for the purpose of advertising sales promoting, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes. The client acknowledges that this report is for the exclusive use of the client, its representatives and advisors and any investors, lenders, underwriters and financiers who agree to execute a reliance letter, and the client agrees that ERM's report or correspondences will not be, except as set forth herein, used or reproduced in full or in parts for such promotional purposes, and may not be used or relied upon in any prospectus or offering circular.

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2 SUMMARY OF IDENTIFIED POTENTIAL IMPACTS

A hydrological and hydrogeological investigation and impact assessment was completed to delineate the potential impacts of the proposed ERWWTP on surrounding groundwater and surface water resources. The key findings of the impact assessment relating to construction are summarised below.

Groundwater Drawdown Impacts

The construction related groundwater drawdown impacts are summarised below.

- dewatering at the Site will not initiate seawater intrusion into the aquifer system;
- Acid Sulphate Soils (ASS) are unlikely to be present at the Site and offsite drawdown during dewatering for construction is unlikely to occur in areas of potential ASS generation;
- groundwater drawdown cones during construction created have potential to extend to surrounding groundwater users. The maximum drawdown simulated at the nearest well (approximately 600m west of the Site boundary) will be approximately 0.5m. Given the overall thickness of the aquifer and general seasonal fluctuations in groundwater this impact was considered to be negligible. However, the depths and the abstraction rates/pumping drawdown in all of the surrounding wells (11 bore potentially impacted) are not currently known. As such, it cannot be ascertained with confidence whether the drawdown impacts simulated will significantly impact the available yield in these wells;
- during construction dewatering, the drawdown cones created are likely to extend to wetland systems to the south and west of the Site. The simulated drawdown is likely to approximate a maximum of 0.7m; and
- the identified dewatering drawdown's were simulated to be mitigated by the construction of an abstraction water recharge system at the Site. However, if a recharge network is adopted to avoid impacts to surrounding groundwater users dewatering rates of between 4,640 m^3/day and 13,000 m^3/day can be expected.

Groundwater Quality Impacts

Groundwater in the shallow aquifer underlying the Site was assessed to be of potable water supply potential. Natural levels of some metals, particularly zinc and nickel were found in excess of ecological threshold criteria for the protection of freshwater ecosystems. Groundwater in this area is also listed on the DoW groundwater web-atlas as being potentially at risk from development. As such, it was recommended that a management plan be developed to prevent contamination of groundwater during construction.

Surface water Run-off Quality Impacts

It was concluded that surface water management would be required to ensure that run-off water is of a suitable quality during construction to prevent adverse impacts to the groundwater and surface water features at and surrounding the Site.

The following sections detail the design requirements, management measures and monitoring that will be under taken to minimise the potential impacts identified by the impact assessment.

3 SITE MANAGEMENT

This section outlines administrative practices that will be implemented to minimise impacts to groundwater elevations and water quality. These practices will be supplemented by the practices described within the PEMP.

3.1 ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES

The Water Corporation will be responsible for overall environmental management (including groundwater, surface water and discharge water management) at the Site and associated pipeline construction. However, all personnel and contractors will be accountable for the protocols outlined in this section through conditions of employment or contracts.

A site superintendent and site supervisor will be assigned to oversee environmental management at the Site. The superintendent will be a Water Corporation representative on Site and the site supervisors main point of contact for environmental management. The site supervisor will be employed by the primary contractor and be directly responsible for environmental performance.

3.2 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLANS (CEMP),

The primary contractor and sub-contractors will be required to submit a CEMP, which will govern environmental practices on Site and will detail the environmental practices that will be undertaken to minimise impact to surface water and groundwater resources at and surrounding the Site.

The CEMP will be submitted to the Water Corporation prior to commencement of the work and in sufficient time to allow the Water Corporation to evaluate the suitability of the proposed strategy. The Water Corporation will then review the CEMP and address any concerns with the contractor.

The CEMP will be flexible and responsive to situations encountered as work proceeds. The contractor will have the ability to adjust the CEMP based on the Site conditions. Any reasons or circumstances necessitating changes made to the CEMP must be documented in writing.

It is critical that all parties are in agreement on the procedures and devices to be used for the protection of the water resources on the Site and in the surroundings prior to commencement of the work.

The goal of the CEMP will be to prevent and/or minimise impacts and where possible, to enhance the environmental values of the surrounding groundwater system and the surface water features affected by the Site. The

development and implementation of this WMP in conjunction with the contractors CEMP will:

- ensure water resource (including dewatering, groundwater and surface water) considerations are part of decision making processes;
- ensure compliance with the requirements of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Environmental Protection Act 1986 (EP Act) referrals and any requirements set as a result of the Environmental Impact Assessment (EIA) process; and
- demonstrate to the stakeholders and public that there is an environmental commitment by all parties involved, both in writing and in action.

3.2.1 CEMP Contents

The CEMP will be required to detail the environmental procedures and practices for: Health Safety and Environmental (HS&E) work method statements adopted to minimise environmental impacts.

At a minimum HS&E work method statements will be provided for:

- environmental management of surface run-off,
- erosion and sedimentation prevention;
- managing groundwater abstraction and recharge;
- preventing air, noise or dust pollution; and,
- preventing contamination of surface water and groundwater.

To manage groundwater abstraction and recharge, the development of a dewatering management plan (DMP) will be undertaken to:

- manage construction within the dewatered zones to minimise the potential for groundwater contamination;
- manage recharge zones to minimise the potential for contamination of recharging dewatered water;
- monitor groundwater and surface water quality and discharge water; and
- respond to spills to avoid recharge water quality being potentially compromised.

The CEMP will also be required to detail , but not necessarily be limited to,:

- ***Induction and training*** on environmental practices and procedures to be adopted at the Site. This is likely to include procedures for environmental

induction prior to construction commencing and job hazard analysis training.

- ***Communication*** processes to effectively communicate environmental information between the superintendent and supervisor and the external stakeholders.

- ***Reporting*** processes to effectively present environmental data to the superintendent. At a minimum this will include environmental control records such as:

    - permits to work;
    - equipment checklists;
    - surface water monitoring;
    - discharge water monitoring;
    - groundwater gauging;
    - groundwater sampling;
    - environmental incident report forms;
    - corrective action forms;
    - a complaints register; and
    - auditing and review of site practices; and

- ***Incident Management Procedures*** to adequately respond to incidents and complete follow up investigations.

3.3 ENVIRONMENTAL REPORTING

Further to the reporting responsibilities outlined in the CEMP the site superintendent will be responsible for interpreting and presenting environmental information obtained as part of the CEMP process. The reporting requirements are presented below.

Environmental Monitoring Reporting

Environmental reporting will be completed at a frequency that is consistent with the environmental monitoring frequency *(to be developed)*. In general this will result in the generation of reports by the Superintendent on the following basis:

- a monitoring report immediately pre-commencement of construction works;

- interim monitoring reports at monthly intervals during operation; and
- a close out monitoring report after completion of the construction works.

Environmental Incident Reporting

A Water Corporation incident report shall be completed by the site supervisor for all environmental incidents associated with water resources on-site and in the surroundings.

An incident investigation report will be prepared by the superintendent to assess the effectiveness of incident response and clean-up and shall be attached to the original incident report and duplicate copies distributed as appropriate.

The contractor will be responsible for submitting any environmental incident reports to statutory authorities in the event of an incident under breach of statute requirements.

Non-Compliance Reporting

Identified instances of non-compliance with the CEMP shall be recorded and reported on the appropriate form as directed by the Water Corporation and must be addressed and closed out by the Superintendent.

Close Out Report

All records of management procedures and monitoring data implemented during the construction of the Site and outlet pipeline will be collated and documented in a closure report assessing the effective implementation of the CEMP and the WMP.

3.4 ENVIRONMENTAL AUDITING

Internal

A program of systematic environmental inspections shall be conducted during all stages of site activities. The CEMP shall detail environmental inspection procedures including:

- monitoring of environmental performance during Site activities and formally reporting on a weekly basis;
- construction crew supervisors' notes on environmental issues (ie. management of water resources on-site) and including these in daily reports; and

- unscheduled inspections as required.

If any issues are identified a corrective and preventative action request (CPAR) system will be developed by the supervisor and approved by the superintendent and will:

- assign responsibility for the corrective and preventive action;
- assign priority of follow-up action and documentation;
- identify and nominate appropriate follow-up action to be undertaken;
- review completed follow-up actions for effectiveness; and,
- advise all appropriate persons of relevant outcomes and/or changes.

External

In addition to the internal auditing, Site audits will be undertaken independently of the monitoring program by suitably qualified environmental auditors. Environmental compliance audits with regards to the water resources on Site shall include:

1) An Environmental Compliance Audit to be conducted at least twice, the first within twelve months of commissioning, to assess compliance with this WMP, regulatory requirements and licence conditions; and,
2) An Environmental Assessment Audit to be conducted within two years of commissioning to assess actual impacts to groundwater and surface water over time.

The audits shall also be conducted in accordance with WA Audit Guidelines and submitted to the Water Corporation. Rectification plans shall then be developed and implemented as required.

3.5 REVIEW

This preliminary WMP shall be reviewed before the commencement of construction and before the commissioning of the Contractor. The reviews will ensure that:

- information and environmental management procedures contained remain current;
- implications of government approvals are incorporated;
- all opportunities for improvement are identified; and,
- any changes to legislation, licence and approval conditions are adhered to.

Reviews shall take the following forms:

- the Water Corporation will consider the above issues on an ongoing basis;
- formal review will be conducted within two months of construction commencing; and,
- a further review of the CEMP will be undertaken by the WWTP operator within one year of commissioning.

3.6 SITE SPECIFIC ENVIRONMENTAL ACTIONS

The CEMP will be required to document the environmental actions that will be undertaken at the Site to minimise the potential for an environmental incident or potential adverse impact to occur. As an example, some environmental actions anticipated to be discussed in the CEMP HS&E work method statements to reduce groundwater and surface water contamination include:

- a dedicated fuels, lubricants and chemicals storage area, which will comprise containment facilities consisting of bunded areas, leak proof trays and impermeable flooring. Where practicable all chemicals will be handled within containment facilities;
- the minimum practicable volume of chemicals shall be stored on-site and chemical use will be minimised where practicable;
- equipment will be available to deal with a chemical spill of all types of fuel, oil or chemicals being used on-site;
- all storage and handling equipment (including transfer hoses etc.) shall be kept in a well maintained condition to minimise equipment spills. Where practicable portable equipment will be housed within temporary containment facilities;
- refuelling or equipment on-site will be completed in an area with spill prevention and containment measures (e.g., drip trays);
- all vehicles and equipment shall be checked daily and maintained so as to minimise drips/leaks of oil and fuel; and
- fuels, lubricants and chemicals shall not be stored on the pipeline easements or outside dedicated bunded storage areas.

Further detail of the above mentioned strategies and additional mitigation strategies can be found within the PEMP in the following sections:

1) *Section 3.3.2*, Water Resources (*Table 3.2*);
2) *Section 4.2*, Waste Management (*Table 4.2*);
3) *Section 4.3*, Fuel, Oil and Chemical Management (*Table 4.3*); and,
4) *Section 4.4*, Emergency Preparedness and Response (*Table 4.4*).

4 DESIGN REQUIREMENTS

The primary aim of this section is to outline construction and operation design requirements to aid in minimising the potential for adverse impact to the surrounding groundwater and surface water features. The design requirements are discussed below in relation to design requirements during construction and plant operation.

4.1 PREVENTION OF ADVERSE GROUNDWATER DRAWDOWN

To minimise impacts from dewatering during construction, dewatered water will require recharge back into the groundwater system. This procedure is generally endorsed by the DoW.

Discharge water will be recharged by a network of recharge wells or by recharge trenches. If construction of plant facilities are staged and if the final surface elevation is 5m the design dewatering/recharge rates of 4,640 m^3/day will be required. However, if the entire Site footprint is dewatered for construction, design dewatering/recharge rates of 13,000m^3/day will be required. Final discussions with the dewatering contractors on the practicalities of these discharge rates will determine the likely approach adopted. Prior to construction, further groundwater flow modelling will be completed to assess the optimal well locations and numbers (or trench dimensions) to ensure the most efficient system (in terms of dewatering rates and expense) is installed.

It is envisaged that an abstraction well and trench recharge system is likely to be the most practical solution for recharging dewatered groundwater based on the following:

- a well recharge system is anticipated to have much greater potential infiltration problems, such as siltation of the recharge wells, compared with a trench recharge system;
- a well recharge system is likely to be more expensive to install and implement than a trench recharge system; and
- a trench recharge system is likely to be more easily incorporated into a system to capture and manage surface run-off from construction areas.

4.2 *PROTECTION OF GROUNDWATER QUALITY*

Site management practices and procedures discussed in *Section 3* will be used to mitigate the potential for contamination of underlying groundwater during plant construction.

4.3 *SURFACE WATER RUN-OFF CONTROL*

Run-off from areas not impacted by construction will be separated from areas impacted by construction and will be allowed to infiltrate naturally. Run-off from impacted/modified areas will be collected within retention basins/settling tanks and monitored for compliance with appropriate discharge parameters before discharge off-site. The DoW recommends that any settling basin or balance tank will have a capacity to contain a minimum of two hours of dewater prior to discharge. Given worst case run-off conditions, this will equate to basin dimensions of 50m x 50m x2 m deep (5,000 m^3). However, the size of this could be reduced proportionately to the percentage of the Site being impacted by construction (i.e., 2000 m^3 when only 40% of Site run-off is impacted by construction activities). Treated and un-impacted surface water will be discharged back into the natural low lying swales system to the south of the site or to the recharge system designed for the Site.

4.4 *SURFACE WATER QUALITY PROTECTION*

Site water management procedures will be used to minimise contamination of surface water run-off. The procedures will typically include actions to:

- separate construction impacted and not impacted run-off areas by construction activities;
- construction of silt traps and barriers to prevent erosions and siltation of waterways;
- treatment/retention (i.e. by baffle tanks or sediment ponds) of run-off from impacted areas prior to discharge off-site.

Details of the procedures adopted will be provided in the contractors CEMP, which will be reviewed by the Water Corporation and or representative for compliance with relevant legislative requirements. In particular the infrastructure, systems and procedures selected will be required to achieve water quality targets listed.

5 *ENVIRONMENTAL MONITORING AND IMPACT RESPONSE*

Environmental monitoring will be undertaken to assess if the construction design and the Site management practices are adequately protecting surface water and groundwater environments. The primary aim of the monitoring program will be to delineate the presence of impacts and establish if the impacts are adverse or negligible.

In particular the monitoring program will:

- provide baseline data of groundwater and surface water elevations and quality to assess background conditions, which will be used as a bench mark for delineation of impacts;

- monitor the dewatering discharge rate and surrounding groundwater elevations during construction dewatering to assess potential drawdown impacts;

- monitor the water quality of recharged water during construction to assess potential impacts to groundwater; and

- monitor the water quality of surface water run-off from impacted construction areas to assess the potential surface water and groundwater quality impacts.

Further to the above, the DoW stipulates that at a minimum the following monitoring should be undertaken at construction sites:

- monitoring of the dewatering discharge rate during the works (continuously metered);

- monitoring of physical parameters at settling pond overflow, e.g., pH, electrical conductivity, alkalinity and turbidity on commencement and then at weekly intervals;

- monitoring of static water levels at piezometers in the surrounding water table to assess drawdown effects (and any possible impacts on structures) at fortnightly intervals;

- analysis of Site-specific chemical and biological parameters using a NATA accredited laboratory on commencement and then at monthly intervals; and

- assess impacts on vegetation, wetlands and water resources by carrying out periodic investigations immediately, during pre-start, every six months after commissioning and at completion.

As such, these items have also been considered in the proposed monitoring framework.

5.1.1 Monitoring Locations

The location of monitoring locations and the rationale for adopting these monitoring locations are presented in *Table 1, Appendix A*.

The location of these monitoring locations has been selected to ensure that groundwater elevations and quality are adequately monitored to ensure that surrounding groundwater users and sensitive wetland systems can be safeguarded.

The proposed locations have been designed to use existing monitoring well infrastructure, however, the locations may change depending on the final location of the dewater system and whether the system comprises recharge wells or a recharge basin/trench. Revision of the locations may result in the presence of some monitoring wells outside the Site boundary.

5.1.2 Analytical Schedule

To assess the variations in groundwater and surface water quality at the Site the following analytical schedule has been selected:

- ammonia;
- biological oxygen demand (BOD);
- cations and anions;
- faecal coliforms;
- field chemical parameters including pH, electrical conductivity (EC), temperature and dissolved oxygen (DO) redox, non-filterable residue, floating matter/foam, sediment/turbidity (total suspended solids);
- metals including arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel and zinc;
- nitrate;
- phosphorus;
- Polynuclear Aromatic Hydrocarbons (PAH);
- presence of chemicals stored on Site and used in the treatment process (*list of chemicals to be potentially used/ stored at the Site to be provided by the Water Corporation*);
- total petroleum hydrocarbons (TPH).

This schedule has been developed with reference to:

- the anticipated contaminants present at the Site during construction;
- a broad understanding of the geochemistry; and
- the indicative analytical schedule presented in the *DoW Water Quality Protection Note for Dewatering of Soils at Construction Sites*.

The analytical suite proposed for each monitoring location is presented in *Table 1, Appendix A*.

5.1.3 Monitoring Frequency

Groundwater and surface water sampling will be in accordance with *DoW Water Quality Protection Note for Dewatering of Soils at Construction Sites*. The sampling frequency proposed for each monitoring location is presented in *Table 1, Appendix A*.

5.2 ASSESSMENT CRITERIA

Delineating a potential adverse impact requires the development of threshold criteria that are considered to represent the threshold between an acceptable and unacceptable (adverse) impact. A discussion of the threshold criteria adopted and rationale behind the criteria is provided below.

5.2.1 Groundwater Drawdown

Due to the absence of a final groundwater abstraction and recharge system layout, it cannot be ascertained with certainty what potential drawdown impacts will be initiated. However, given that the hydrological and hydrogeological report (ERM, 2008) suggests that off-site impacts will be negligible it is anticipated that any variation in drawdown in groundwater elevations outside of seasonal trends would be indicative of a potential adverse impact. Monitoring wells inside the Site boundary would be influenced by localised changes associated with the abstraction/recharge system and would not be representative of seasonal changes in groundwater elevations alone. Therefore, some wells off-site and outside of the immediate influence of the abstraction/recharge system would serve to establish these trends. The off-site wells would need to be located between potentially adversely affected groundwater wells and wetlands and the Site. Due to the absence of long term pre-construction groundwater elevations in these wells, the elevation changes during construction in these wells will be compared against seasonal trends in groundwater elevations in the long-term DoW monitoring wells 2996, 2995 (located 1.1 km south east of the site) and 2997 (located 1.8 km north west of the site). These wells are located outside the area of construction dewatering impact.

5.2.2 Water Quality

Surface and groundwater quality data will be compared to baseline monitoring data and DoW Technical Note conditions and against ANZECC criteria for the protection of 95% of freshwater ecosystems. Groundwater samples will also be compared with the Australian Drinking Water Guideline (ADWG) criteria for potential impacts upon surrounding bores registered for domestic use.

The threshold criteria that will be adopted for assessing the presence of an adverse water quality impact is provided in *Table 2, Appendix A*.

A potentially adverse impact will be considered to exist where identified concentrations are present outside acceptable ranges of background quality variations and if they are above ANZECC, ADWG criteria.

5.3 IMPACT RESPONSE

5.3.1 Groundwater Drawdown

If a potential adverse drawdown impact is identified, further investigations will be initiated to quantify the potential significance of the impact. The process of investigation will include, in order of preference:

- further analytical groundwater modelling investigations to assess if the identified impact at the monitoring wells is resulting in adverse impacts at surrounding sensitive receptors. This will include using the model to establish drawdown threshold values at these wells which will initiate adverse impacts at the surrounding sensitive receptors (i.e., groundwater wells and wetland systems);

- investigation of drawdown at the receptors identified to be potentially impacted. At groundwater wells, this will include investigating the groundwater drawdown and available yields. At wetland systems, this will include conducting flora and fauna surveys immediately upon determination of a potential impact and at monthly intervals thereafter;

- if adverse impacts are identified, a revision of the dewatering system and procedure will be undertaken to reduce potential impacts identified. Analytical groundwater modelling will be used to verify if any proposed changes will mitigate the identified impacts;

- if abstraction/recharge system changes are not feasible, actions will be taken to supplement the water supply at the location of identified impact. This may include but is not limited to the following:

    - the provision of a supplementary water supply to impacted groundwater users; and

- the provision of a supplementary water supply to impacted wetland systems.

5.3.2 Water Quality

If an adverse surface water quality impact is identified, further investigations will be initiated to quantify the potential significance of the impact. The process of investigation will include, in order of preference:

- investigation of the potential source of contaminant identified in excess of criteria. Once identified, the source will be isolated, contained and remediated. Monitoring frequency at impacted points will be subsequently increased to weekly intervals until contaminant concentrations fall below the threshold criteria. Subsequent to this, the CEMP Site management procedures will be investigated and revised to reduce potential for the impact to water quality to occur again;

- if the impact cannot be contained, investigation of potential impact at identified sensitive receptors will be undertaken. This will include the completion of analytical groundwater fate and transport modelling to assess the potential concentrations of contaminant present at down gradient groundwater wells and wetland systems. At wetland systems, if the fate and transport modelling simulates a potential adverse impact, the potential impact at the receptor will be further refined by the completion of an ecological risk assessment;

- if the above investigations suggest impacts have potential to occur, water quality will be monitored at the sensitive receptors (groundwater users and wetland systems) potentially impacted. If any analytes appear above background concentrations and threshold criteria, the following actions will be considered:

    - provision of a supplementary water supply to impacted groundwater users; and,

    - the provision of a supplementary water supply to impacted wetland systems, to reduce impacts to acceptable concentrations.

If Site discharge is occurring directly to a wetland system, which is unlikely given that dewater and surface water run-off will preferably be recharged, flora and fauna surveys will be undertaken to assess the impacts of the discharge waters on the wetland. If an adverse impact is identified, discharge will be re-directed to a different location.

6 REFERENCES

Environmental Resources Management Australia Pty Ltd. (ERM). 2008. *Initial Environmental Review.*

Appendix A

Tables

Table 1 Monitoring Program

Location	*Installation*	*Rationale*	*Water Elevation Network*	*Water Chemistry Network*	*Analytical Suite*	*Sampling Frequency*
Surface Water Run-off Storage Pond Discharge.	*To be installed*	*Assessing the quality of surface run-off from on site construction areas.*	*X*	✓	*Field chemical parameters, Field observation parameters, BOD, TSS, TPH, PAH, major cations and anions, nutrients (ammonia, nitrate, phosphorus) faecal coliforms and site chemical indicator analytes.*	*On commencement and at weekly intervals.*
Construction Dewatering Rate	*To be installed*	*Delineate the pumping rates at which adverse drawdown impacts may be caused and at which dewatering system may be compromised.*	✓	*X*	*NIL*	*Continuously metered*
Construction Dewater	*To be installed*	*Delineate the quality of water being recharged to groundwater from construction dewatering*	*X*	✓	*Field chemical parameters, BOD, TSS, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus and faecal coliforms.*	*On commencement and at weekly intervals.*
MW2	*Existing Installation*	*Delineate the potential for drawdown impacts and water quality impacts to wetland systems south of the site.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*
MW3	*Existing Installation*	*Delineate the potential for drawdown impacts at wells to the north east of the site and to monitor up gradient water quality.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*
MW4	*Existing Installation*	*Delineate the potential for drawdown impacts at wells to the south east of the site and to monitor up gradient water quality.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*

Location	*Installation*	*Rationale*	*Water Elevation Network*	*Water Chemistry Network*	*Analytical Suite*	*Sampling Frequency*
MW5	*Existing Installation*	*Delineate the potential for drawdown and groundwater quality impacts at wells and wetlands to the west of the Site.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*
MW9	*To be installed*	*Delineate the potential for drawdown impacts at wells to the north west of the Site.*	✓	*X*	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*
MW10	*To be installed*	*Delineate the potential for drawdown and groundwater quality impacts at wells and wetlands to the west of the Site.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*
MW11	*To be installed*	*Delineate the potential for drawdown and groundwater quality impacts at wells and wetlands to the west of the Site.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes.*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.*
MW12	*To be installed*	*Delineate the potential for drawdown impacts at wells to the north of the Site.*	✓	*X*	*NIL*	*Pre-commencement, fortnightly intervals during construction and after completion.*
MW13	*To be installed*	*Delineate the potential for drawdown impacts at wells to the east of the Site.*	✓	*X*	*NIL*	*Pre-commencement, fortnightly intervals during construction and after completion.*
MW14	*To be installed*	*Delineate the potential for drawdown impacts at wells to the south of the Site.*	✓	*X*	*NIL*	*Pre-commencement, fortnightly intervals during construction and after completion.*
MW15	*To be installed*	*Delineate the potential for drawdown impacts at wells to the west of the Site.*	✓	*X*	*NIL*	*Pre-commencement, fortnightly intervals during construction and after completion.*

Location	*Installation*	*Rationale*	*Water Elevation Network*	*Water Chemistry Network*	*Analytical Suite*	*Sampling Frequency*
Dampland to the east	-	*Delineate water quality, water elevation and vegetation condition in wetland.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes (sampling to be completed only if surface water is present).* *Vegetation Surveys*	*Pre-commencement, on commencement, at monthly intervals for chemistry during construction (if water present) and after completion.* *Vegetation Surveys to be completed immediately pre start and at 6 monthly intervals after commencement.*
Sumpland to the south	-	*Delineate water quality, water elevation and vegetation condition in wetland.*	✓	✓	*Field chemical parameters, TPH, PAH, major cations and anions, ammonia, nitrate, phosphorus, faecal coliforms and site chemical indicator analytes (sampling to be completed only if surface water is present).* *Vegetation Surveys*	*Pre-commencement, on commencement, at monthly intervals for chemistry and fortnightly intervals for elevation during construction and after completion.* *Vegetation Surveys to be completed immediately pre start and at 6 monthly intervals after commencement.*

Table 2 Water Quality Threshold Criteria

Analyte	Human Health Threshold Criteria	Ecological Threshold Criteria	DoW Technical Note – Dewatering of Soils at Construction Dewatering Sites
Field/Observation Parameters			
Dissolved oxygen (mg/L)	>8 [6]	9-12 [3]	Causes a maximum decrease in the seasonal background dissolved oxygen of less than or equal to ten percent.
Turbidity/Suspended Solids (NTU)	5 [6]	10-100 [3]	Causes discernable deposition of sediment that may affect aesthetic, recreational of ecological values. Field Check: Black Secchi disk should be immediately visible in daylight at the bottom of 85 centimetres depth of water placed in a clean 200 litre drum with a white floor.
Electrical conductivity (mS/cm)	1,000 [6]	300 - 1,500 [3]	-
pH (field)	6.5-8.5 [6]	7.0-8.5 [3]	Causes seasonal background pH to vary by less than or equal to +/- 0.5 units
Temperature	-	-	Causes a maximum seasonal variation of water temperature of less than or equal to +/- two degrees celcius.
Floating Matter/Foam	-	-	Causes no visible floating oil, foam, grease, scum, litter or other objectionable matter.
Solids			
Total Dissolved Solids (mg/L)	500 [6]		Causes a maximum increase in the seasonal background total dissolved solids of less than or equal to ten percent.
TPH			
TPH C_6-C_9 (µg/L)	10 [5]	7 [4]	Causes a maximum increase in the seasonal background of any toxicant of less than or equal to ten percent; and causes a maximum rise in the receiving water's seasonal background concentration of any toxicant to the lesser value of : • 75 percent of the ANZECC and ADWG trigger value/guideline value for relevant water uses; or • criterion for protection of 90% of existing ecosystems.
TPH C_{10}-C_{36} (µg/L)	90 [5]	7 [4]	
PAHs			
Benzo[a]pyrene (µg/L)	0.01 [7]	0.1 [4]	Causes a maximum increase in the seasonal background of any toxicant of less than or equal to ten

Analyte	Human Health Threshold Criteria	Ecological Threshold Criteria	DoW Technical Note – Dewatering of Soils at Construction Dewatering Sites
Naphthalene (µg/L)	-	16 [1]	percent; and causes a maximum rise in the receiving water's seasonal background concentration of any toxicant to the lesser value of: • 75 percent of the ANZECC and ADWG trigger value/guideline value for relevant water uses; or • criterion for protection of 90% of existing ecosystems.
Cations and Anions			
Calcium (µg/L)	-	-	Causes a maximum increase in the seasonal background of any toxicant of less than or equal to ten percent; and causes a maximum rise in the receiving water's seasonal background concentration of any toxicant to the lesser value of : • 75 percent of the ANZECC and ADWG trigger value/guideline value for relevant water uses; or • criterion for protection of 90% of existing ecosystems.
Potassium (µg/L)	-	-	
Magnesium (µg/L)	-	-	
Sodium (µg/L)	180,000 [6]	-	
Chloride (µg/L)	250,000 [6]	-	
Sulphate (µg/L)	500 [7]	-	
Bicarbonate (µg/L)	-	-	
Nitrate (µg/L)	50,000 [7]	700 [1]	Causes a maximum increase in seasonal background nutrient levels of less than or equal to ten percent. For conservation valued wetlands and waterways, causes the seasonal background nutrient levels not to exceed the ANZECC guidelines for relevant default trigger level value for south-west
Nitrite (µg/L)	3,000 [7]	-	
Metals			
Arsenic (µg/L)	7 [7]	13 [1]	Causes a maximum increase in the seasonal background of any toxicant of less than or equal to ten percent; and Causes a maximum rise in the receiving water's seasonal background concentration of any toxicant to the lesser value of : • 75 percent of the ANZECC and ADWG trigger value/guideline value for relevant water uses; or • criterion for protection of 90% of existing ecosystems.
Cadmium (µg/L)	2 [7]	0.2	
Chromium as Cr VI (µg/L)	50 [7]	1.0	
Copper (µg/L)	2,000 [7]	1.4	
Lead (µg/L)	10 [7]	3.4	
Iron (µg/L)	300 [6]	-	
Mercury (µg/L)	1 [7]	0.6	
Nickel (µg/L)	20 [7]	11	
Zinc (µg/L)	3,000 [6]	8.0	

Analyte	Human Health Threshold Criteria	Ecological Threshold Criteria	DoW Technical Note – Dewatering of Soils at Construction Dewatering Sites
Nutrients			
Ammonia (µg/L)	500 [6]	900 [1]	Causes a maximum increase in seasonal background nutrient levels of less than or equal to ten percent. For conservation valued wetlands and waterways, causes the seasonal background nutrient levels not to exceed the ANZECC guidelines for relevant default trigger level value for south-west Australia.
Total Nitrogen (µg/L)	-	1,500 [3]	
Total Phosphorous (µg/L)	-	60 [3]	
Bacteria			
Faecal coliforms (cfu/100mL)	0	-	As present in relevant guidelines.

All data in µg/L unless otherwise specified

- no criteria

ID insufficient data to set guidelines.

1. ANZECC (2000) freshwater trigger value for the protection of 95% of species.
2. ANZECC (2000) guideline value for primary contact by recreational users.
3. ANZECC (2000) default trigger values for physical and chemical stressors for south east Australia for slightly disturbed ecosystems – Wetlands.
4. ANZECC (2000) low reliability value for the protection of 99% of species.
5. World Health Organisation (2005) Petroleum Products in Drinking-water for benzene and aromatic fractions > C10.
6. ADWG (2004) health based guideline value.
7. ADWG (2004) aesthetic based guideline value (used in the absence of a health based value)