



Fortescue
The New Force in Iron Ore

Report

Groundwater Management Plan

Environment

June 2018

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TABLE OF CONTENTS

ACRONYMS	7
1. INTRODUCTION	8
1.1 Requirements for Management Plan	8
1.2 Objective and Scope	8
1.3 Key environmental values.....	12
1.4 Definitions.....	12
1.5 Legislation and Regulatory Framework.....	13
2. ROLES AND RESPONSIBILITIES	14
3. MANAGING ENVIRONMENTAL RISK.....	15
4. ENVIRONMENTAL MANAGEMENT	16
5. MONITORING GUIDELINES	20
5.1 Objectives	20
5.2 Baseline Modelling/ Sampling	20
5.3 Program Summary.....	20
5.4 Monitoring Program Review	26
5.5 Data Handling Statistical Analysis	26
5.6 Contingency Actions.....	27
6. COMPLIANCE.....	31
7. ADAPTIVE MANAGEMENT	31
8. REPORTING	32
8.1 Annual Monitoring Report.....	32
8.2 Annual Compliance Assessment Report.....	32
8.3 Annual Environmental Monitoring Report	32
8.4 Annual/Triennial Aquifer Review	33
8.5 Reporting of Potential Non-Compliances	33

9. REVIEW OF THE PLAN	34
10. STAKEHOLDER CONSULTATION.....	35
11. REFERENCES	37

List of Tables

Table 1:	Acronyms	7
Table 2:	Management Plan Provisions.....	9
Table 3:	Environmental outcomes and measures/targets	10
Table 4:	Commonwealth and State Legislation Relating to Groundwater.....	13
Table 5:	Description of Key Elements of Environmental Management Process to Achieve Identified Objectives.....	16
Table 6:	Key Management Actions for Groundwater Management	17
Table 7:	Monitoring Parameters and Methods	21
Table 8:	Types and Associated Parameters and Site Locations.....	21
Table 9:	Hydrochemistry parameters.....	22
Table 10:	Summary of Groundwater Monitoring Programs.....	25
Table 11:	Trigger Criteria and Associated Contingency Actions.....	28
Table 12:	Stakeholder Consultation, Comments and Responses.....	35

LIST OF FIGURES

Figure 1:	Environmental Consideration and Groundwater Impact Assessment Areas: Eliwana Rail	38
Figure 2:	Groundwater Dependent Vegetation: Eliwana Mine	39

ACRONYMS

The following acronyms, defined in table 1, have been used through this Plan.

Table 1: Acronyms

Acronyms	Definitions
LUC	Land Use Certificate
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
GDE	Groundwater dependent ecosystem
GDV	Groundwater dependent vegetation
TSF	Tailings Storage Facility

1. INTRODUCTION

Fortescue Metals Group (Fortescue) is an integrated business comprised of mine, rail and port operations based in the Pilbara region of Western Australia, with its head office located in Perth.

Detailed background information regarding the projects, timing and nature of Fortescue's environmental approvals under the *Environmental Protection Act 1986* (WA), the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), current operations and plans for future expansion is contained in Appendix 1.

1.1 Requirements for Management Plan

The Groundwater Management Plan is required by the Environmental Scoping document as part of the environmental scoping document for development approval for Fortescue Iron Ore related infrastructure in the Pilbara under:

- Environmental Scoping Document: Action Item 20 - Eliwana Iron Ore Mine Project
- Environmental Scoping Document: Action Item 48 – Eliwana Railway Project

The environmental objectives and targets for groundwater management are outlined in Table 2.

1.2 Objective and Scope

The Plan addresses the EPA's objective for the following key environmental factors:

- inland waters environmental quality “to maintain the quality of groundwater and surface water so that environmental values are protected”
- hydrological processes “to maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.”

The objective of this Plan is to identify the potential direct and indirect impacts on groundwater flows and/or quality and develop management and monitoring measures that maximise the ongoing protection of groundwater dependent systems to be retained from disturbance within and adjacent to Fortescue controlled sites.

This Plan has been provided to meet the requirements of the EPA's “Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plan”. The provisions addressed within this Plan are outlined in Table 2 below.

Table 2: Management Plan Provisions

Provision	Location in Plan
Requirement for Plan	1.1
Outcomes	1.2
Performance Indicators	1.2
Key Environmental values	1.3
Management actions ¹	4
Key environmental impacts and risk	3
Monitoring	5
Corrective actions	5.5
Reporting	8
Adaptive management and review of the EMP	7 and 9
Stakeholder Consultation	10

¹ Outcomes based Environmental Management Plans do not require management actions in accordance with the EPA's "Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plan". Management actions have been included in the Plan to demonstrate effective management of the factor but will not be reported against to demonstrate compliance.

Table 3: Environmental outcomes and measures/targets

Approval	Condition Type	Environmental Outcome	Trigger and Threshold Criteria
Eliwana Railway (Construction only)	Outcome	During construction, groundwater management infrastructure operates as per design to minimise adverse impacts outside of assessed impact areas ²	<p>Trigger Criteria An exceedance of expected groundwater level values outside of the assessed impact areas in comparison to reference sites over two consecutive monitoring events</p> <p>Threshold Criteria Following construction, groundwater level values outside of the assessed impact areas are below baseline values after two years of above average rainfall³</p>
Eliwana Mine	Outcome	No adverse impacts to groundwater quality outside of assessed impact areas ⁴ as a result of implementing the proposal	<p>Trigger Criteria An exceedance of groundwater quality guideline values (see Table 8) in comparison to reference sites over two consecutive monitoring events</p> <p>Threshold Criteria An exceedance of site specific background trigger values⁵ over four consecutive monitoring events in comparison to reference sites AND Subsequent investigations determine that the impacts are likely a result of the implementation of the proposal.</p>
		Groundwater management infrastructure operates as per design to minimise adverse impacts to groundwater dependent vegetation outside of assessed impact areas	<p>Trigger Criteria +/- 1m elevation change between recorded and modelled⁶ levels over two consecutive events</p>

² Refer to *Eliwana Railway Public Environmental Review* (EW-RP-EN-0004)

³ Rainfall to be considered as an average of rainfall measured at Eliwana and Solomon (Castle Camp) weather stations.

⁴ Refer to *Eliwana Iron Ore Mine Public Environmental Review* (EW-RP-EN-0003)

⁵ Site specific trigger values will be developed in accordance with guidance outlined in ANZECC Guidelines

⁶ The modelled value will reference the numerical groundwater model from the most recent Hydrogeological Assessment approved by DWER as part of the current Groundwater Operating Strategy for the Proposal

Approval	Condition Type	Environmental Outcome	Trigger and Threshold Criteria
			<p>Threshold Criteria +/- 2m elevation change between recorded and modelled levels over two consecutive events AND Subsequent investigations determine that the impacts are likely a result of the implementation of the proposal.</p>

1.3 Key environmental values

Key environmental values associated with surface water at the Eliwana Railway and Mine are outlined in the *Public Environmental Review: Eliwana Railway Project* (Fortescue reference EW-RP-EN-0004_A) and *Public Environmental Review: Eliwana Iron Ore Mine* (EW-RP-EN-0003_0) and listed here:

- Conservation significant fauna and their critical habitat
- Conservation significant vegetation and flora
- Groundwater dependent systems.

1.4 Definitions

Groundwater management infrastructure may include bores, sumps and associated pumps, power sources, interconnected pipelines, settlement ponds and direct conveyance pipelines.

Groundwater dependent vegetation (GDV) is defined as terrestrial vegetation that is dependent on the presence of groundwater to meet some or all of its ecological water requirements. GDV as a component of groundwater dependent ecosystems in the Pilbara plays an important ecological role by providing essential habitat and oases of biological diversity and productivity. GDVs are a component of groundwater dependent ecosystems.

Groundwater dependent ecosystems (GDE) are ecosystems that require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services (NWC, 2011). GDEs include aquatic, terrestrial and subterranean ecosystems.

High risk areas are defined as areas where groundwater dependent systems have been identified to be retained from disturbance and potential impacts are significant (as defined through ongoing impact assessment of potential direct and indirect impacts of the project).

Water dependent systems are parts of the environment in which the composition of species and natural ecological processes are determined by the permanent or temporary presence of flowing or standing surface water or groundwater. The in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries, karst systems and groundwater-dependent terrestrial vegetation are all examples of water dependent systems (Department of Water, January 2013). Water dependent systems are addressed in both the Groundwater Management Plan and the Surface Water Management Plan for the Eliwana project.

1.5 Legislation and Regulatory Framework

Fortescue employees and contractors are obliged to comply with all relevant environmental Commonwealth and State legislation. Legislation directly relevant to the management of weeds in Western Australia is provided in Table 3.

Table 4: Commonwealth and State Legislation Relating to Groundwater

Legislation	Application
<i>Biodiversity Conservation Act 2016 (WA)</i>	Conservation and protection of biodiversity and biodiversity components. The Act repeals parts of the <i>Wildlife Conservation Act 1950</i> .
<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>	Assesses the conservation significance of fauna species and forms the framework for significant species protection at the Federal level.
<i>Environmental Protection Act 1986 (WA)</i>	State environmental impact assessment and Ministerial approval process.
<i>Environmental Protection (Unauthorised Discharge) Regulations 2004 (WA)</i>	Prevention of direct discharge of sediment or pollutants to the surrounding surface waters.
<i>Rights in Water and Irrigation Act 1914 (WA)</i>	Relates to rights in water resources, to make provision for regulation, management, use and protection of water resources, to provide for irrigation schemes, and for related purposes.
<i>Soil and Land Conservation Act 1945 (WA)</i>	Addresses the conservation of soil and land resources and the mitigation of the effects of erosion.
<i>Wildlife Conservation Act 1950 (WA)</i>	State process that assesses the conservation significance of fauna species and forms the framework for significant species protection.

The following standards and guidelines are also of relevance to this Plan:

- Water Quality Protection Guidelines for Mining and Mineral Processing (Department of Water, 1999)

2. ROLES AND RESPONSIBILITIES

All Fortescue employees and contractors are required to comply with the requirements of this Plan.

Accountability for fulfilling the requirements of this Plan is dependent on the stage of project development (construction, operations, decommissioning) and the project type (port, rail or mine).

During exploration, the Group Manager Exploration will be accountable for ensuring the requirements of the Plan are met.

During construction stages, whether activities are undertaken by an external service provider or internal Fortescue personnel, the Project Director (Port/ Rail or Mine) will be accountable for ensuring the requirements of this Plan are met.

During operational, decommissioning and closure stages, the General Manager (Port/ Rail or Mine) will be accountable for ensuring the requirements of this Plan are met.

Where responsibilities are delegated, this must be clearly recorded and communicated.

In Section 4 specific Management Actions have been attributed to the appropriate personnel.

When site specific Groundwater Programs are developed to support this Plan, the RASCI framework should be utilised to delegate roles, responsibilities, and review and approval levels. RASCI is used to denote:

R-Responsible	Those who do the work to achieve the task.
A-Accountable	Those who are ultimately accountable for the completion of the deliverable or task and the one to whom the Responsible person is accountable.
S-Supportive	Resources allocated to the Responsible person and who will also assist in completing the task.
C-Consulted	Those whose opinions are sought, two-way communication.
I-Informed	Those whom are kept informed, one-way communication.

3. MANAGING ENVIRONMENTAL RISK

Fortescue actively manages risk by undertaking an Annual Environmental Impact Risk review. Although the review considers all environmental risks, there is a focus on the inherently moderate to high risk impacts. The review considers the effectiveness of management actions that are currently in place for these impacts. The review also considers any relevant incidents that have occurred, if the actions from incident investigations have translated into new management actions, and generally considers the need for any new management actions to ensure lower risk targets can be achieved.

The environmental risks associated with groundwater management at Eliwana Mine include:

- Groundwater abstraction for mine dewatering and water supply
- Injection or infiltration of excess water
- Controlled release of excess water into inactive mining voids or via surface water discharge
- Groundwater drawdown and alteration of hydrological processes as a result of mine dewatering and water supply abstraction
- Groundwater mounding in areas of surplus water injection or infiltration;
- Altered hydrogeology and water balance associated with the creation of permanent and episodic mining void water bodies.

The environmental risks associated with groundwater management at Eliwana Railway include:

- Groundwater abstraction for water supply resulting in localised groundwater drawdown.
- Impacts to groundwater quality associated with hydrocarbon or chemical spills.
- Groundwater abstraction drawdown resulting in impacts to groundwater dependent vegetation.

Section 4 provides the management actions proposed to manage these potential environmental risks at the Eliwana Mine and Railway project.

4. ENVIRONMENTAL MANAGEMENT

A series of environmental management objectives have been developed to mitigate environmental impacts on groundwater dependent systems to be retained from disturbance as approved under the *Environmental Protection Act 1986* and/or the *Environment Protection Biodiversity Conservation Act 1999*. These include:

1. Assess the potential direct and indirect impacts on groundwater levels, groundwater quality and any associated groundwater dependent systems within identified high risk areas.
2. Establish management strategies to minimise potential impacts on groundwater levels, groundwater quality and any associated groundwater dependent systems within identified high risk areas.
3. Develop and implement a groundwater monitoring program to assess the effectiveness of the management strategies to minimise potential impacts on groundwater levels, ground water quality and any associated groundwater dependent systems within identified high risk areas.

For each objective, management actions have been developed to ensure the impacts from Fortescue’s operations are managed, and that appropriate monitoring, reporting and corrective action functions are implemented to support the successful implementation of the management actions.

The key elements of the environmental management process associated with each objective are described in Table 5.

Table 5: Description of Key Elements of Environmental Management Process to Achieve Identified Objectives

Element	Definition/ Description
Objective	What is intended to be achieved
Management Action	Tasks undertaken to enable the objective to be met
Performance Indicators	Metrics for evaluating the outcomes achieved by Management Actions
Reporting/ Evidence	Demonstrates that the Management Action has been applied and the outcome evaluated.
Timing	Period during which the Management Action should be undertaken.
Responsibility	Accountability for ensuring management action is completed. The responsible role is dependent on project timing.

The key management actions, performance indicators, evidence, timing and responsibilities for each objective are provided in Table 6.

Table 6: Key Management Actions for Groundwater Management

Objective 1	Identify the potential direct and indirect impacts on groundwater levels, groundwater quality and associated groundwater dependent systems within identified high risk areas						
Reference	Site Location		Management Action	Performance indicators	Reporting/ Evidence	Timing	Responsibility
	Rail	Mine					
1.1	x	x	When a groundwater management activity requires a 5C Licence under the <i>Rights in Water and Irrigation Act 1914</i> : <ul style="list-style-type: none"> where required, conduct a hydrological assessment in accordance with the parameters outlined in the Operational policy no. 5.12 Hydrological reporting associated with a groundwater well licence (DoW). where required, develop and implement a Groundwater Operating Strategy in accordance with the Operational policy 5.08: Use of operating strategies in the water licensing process. 	<ul style="list-style-type: none"> 5C Licence application completed Hydrological assessment report developed and approved Compliance with Policy no. 5.12 Groundwater Operating Strategy developed, where required 	<ul style="list-style-type: none"> Hydrological assessment report Correspondence with DWER Groundwater Operating Strategy 	Feasibility/ Design	Manager Long Term Planning and Hydrology
1.2	x	x	Conduct a risk assessment to identify high risk areas where groundwater dependent systems have been identified and potential impacts are significant. High risk areas are outside of the assessed impact areas ^{2 and 4} .	<ul style="list-style-type: none"> Risk assessment conducted High risk areas identified 	<ul style="list-style-type: none"> Risk assessment outcomes 	Design	Manager Environmental Approvals/ Project Manager/ Group Manager Environment
1.3	x	x	Where groundwater dependent systems have been identified within identified high risk areas undertake mapping surveys to determine relevant species critical habitat and if future monitoring is required.	<ul style="list-style-type: none"> Mapping survey completed GIS and PIMS updated Future monitoring defined 	<ul style="list-style-type: none"> Mapping survey GIS dataset PIMS record Monitoring Planned 	Design	Group Manager, Environment
1.4	x	x	Conduct a desktop assessment for all LUC ⁷ applications to ensure groundwater dependent systems within high risk areas are identified prior to ground disturbance. Where the works have the potential to impact on groundwater and any associated water dependent systems, apply relevant management measures to the LUC prior to approval.	<ul style="list-style-type: none"> Desktop assessment undertaken Management measures included in relevant LUCs 	<ul style="list-style-type: none"> Desktop assessment LUC approval 	Construction/ Operation	Project Manager/ Site HSES Manager
Objective 2	Establish management strategies to minimise potential impacts on groundwater levels, groundwater quality and associated groundwater dependent systems within identified high risk areas						
Reference	Rail	Mine	Management Action	Performance indicators	Reporting/ Evidence	Timing	Responsibility
2.1	x	x	Ensure staff and contractors are provided with appropriate training to ensure groundwater and associated groundwater dependent systems are protected.	<ul style="list-style-type: none"> Inductions completed Pre-start meetings conducted Role dependent training completed 	<ul style="list-style-type: none"> Induction materials and register of attendees Record of pre-start meetings Training materials/ records 	All stages	Project Manager/ HSES Manager
2.2	x	x	Ensure groundwater management infrastructure location and design aligns with the risk assessment outcomes to minimise impacts to groundwater levels, quality and associated groundwater dependent systems where possible.	<ul style="list-style-type: none"> Location infrastructure aligns with risk assessment outcomes where possible 	<ul style="list-style-type: none"> Risk assessment Monitoring reports 	All stages	Project Manager/ Manager Long

⁷ An internal permit system required to undertake on-ground activities.

			For the Eliwana Rail Project, the impact assessment outcomes are provided in the <i>Groundwater Impact Assessment: Eliwana Rail Water Supply</i> (750ES-3100-RP-HY-0002). For the Eliwana Mine Project, the impact assessment outcomes are provided in the <i>Groundwater Impact Assessment: Eliwana Mining Project</i> (750WH-5700-RP-HY-0001).				Term Planning and Hydrology
2.3		x	Fauna management measures, including exclusion or exit/egress structures, to minimise potential impacts on conservation significant fauna, are in place: <ul style="list-style-type: none"> For infrastructure that poses a fauna entrapment or drowning risk When conducting excavation or trenching activities In accordance with the <i>Conservation Fauna Management Plan</i> (100-PL-EN-0022).	<ul style="list-style-type: none"> Compliance with the Plan No mortality of conservation significant fauna as a result of entrapment, drowning, excavation or trenching activities No significant increase in feral animal records 	<ul style="list-style-type: none"> BMS Record CAR 	Construction/ Operation	Project Manager/ Manager Mine Services or Manager Technical Services
2.4		x	Where a subterranean fauna survey indicates a risk of loss of subterranean species or communities, and those species or communities are deemed significant due to their restricted distribution within the project area, develop a Subterranean Fauna Management Plan as required by the <i>Subterranean Fauna Survey Plan</i> (45-PL-EN-0010).	<ul style="list-style-type: none"> Subterranean fauna surveys completed Where a risk of loss of species or communities identified, Plan developed 	<ul style="list-style-type: none"> Subterranean Fauna survey Subterranean Fauna Plan 	Design	Group Manager Environment
2.5	x	x	Chemical and hydrocarbon storage areas will be designed, constructed and operated in accordance with the requirements outlined in the <i>Chemical and Hydrocarbon Management Plan</i> (100-PL-EN-0011) and a Licence issued under Part V of the <i>Environmental Protection Act 1986</i> .	<ul style="list-style-type: none"> Compliance with Plan Role/area dependent training completed Water quality remains within required limits 	<ul style="list-style-type: none"> Laboratory sample results AEMR 	Construction/ Operation	Project Manager/ NPI Manager
2.6		x	When injecting or infiltrating excess dewater into a compatible aquifer utilise methods outlined in the Operational Policy 1.01 managed Aquifer Recharge in Western Australia (DoW) and an applicable and approved Groundwater Operating Strategy as required under a 5C Licence.	<ul style="list-style-type: none"> Compliance with Policy 1.01 Compliance with the requirements outlined in the corresponding Groundwater Operating Strategy 	<ul style="list-style-type: none"> Annual aquifer review Triennial aquifer review 	Operation	Planning Manager
2.7		x	When dewatering activities result in volumes in excess of what can be injected into a compatible aquifer and/or utilised for onsite activities such as dust suppression and OPF operations, discharge surplus water to the environment in accordance with the requirements of the Surface Water Management Plan (100-PL-EN-1015).	<ul style="list-style-type: none"> Surface Water Management Plan implemented 	<ul style="list-style-type: none"> CAR 	Operations	Planning Manager
2.8	x	x	When an uncontrolled release of water has occurred as a result of Fortescue activities and the release has caused or is likely to cause pollution or environmental harm, investigate and report the incident in accordance with the <i>Incident Event Management Procedure</i> (100-PR-SA-0011).	<ul style="list-style-type: none"> Incident reported 	<ul style="list-style-type: none"> BMS records Where required Regulator notification 	Construction/ Operation	Project Manager/ Manager Mine Services
2.9		x	Where post closure mine voids are present within the project boundary and impacts to groundwater dependent systems are expected, the requirements of the <i>Eliwana Mine Closure Plan</i> (EW-PL-EN-0001) will be adhered to.	<ul style="list-style-type: none"> Mine Closure Plan implemented 	<ul style="list-style-type: none"> Monitoring reports CAR AER 	Closure	Planning Manager
2.10	x	x	Conduct progressive rehabilitation of disturbed areas no longer required for operations, including bores and associated infrastructure, in accordance with the <i>Eliwana Mine Closure Plan</i> (EW-PL-EN-0001) and the <i>Integrated Rail Network Closure Plan</i> (R-PL-EN-0041) developed in accordance with the Guidelines for Preparing Mine Closure Plans.	<ul style="list-style-type: none"> Mine Closure Plan implemented 	<ul style="list-style-type: none"> Monitoring reports CAR AER 	Closure	Planning Manager / Manager Rail Maintenance

Objective 3	Site Locations		Develop and implement a groundwater monitoring program to assess the effectiveness of the management strategies to minimise potential impacts on groundwater levels, groundwater quality and associated groundwater dependent systems within identified high risk areas.				
Reference	Rail	Mine	Management Action	Performance indicators	Reporting/ Evidence	Timing	Responsibility
3.1	x	x	Ensure baseline modelling and groundwater sampling are undertaken to: <ul style="list-style-type: none"> Document groundwater levels and quality within impact and reference sites Identify baseline modelling and groundwater quality at impact and reference sites Compare data across impact and reference sites (and/or regional monitoring sites where available). 	<ul style="list-style-type: none"> Baseline modelling and /or groundwater sampling undertaken for all sites Data comparison undertaken 	<ul style="list-style-type: none"> Baseline monitoring reports 	Design/ Construction/ Operations	Project Manager/ Manager Long Term Planning and Hydrology
3.2		x	Implement a groundwater monitoring program in areas identified as high-risk areas where groundwater dependent systems have been identified and potential impacts are significant.	<ul style="list-style-type: none"> Monitoring program implemented 	<ul style="list-style-type: none"> Monitoring reports Compliance Assessment Report (if the Plan is conditioned under the EP Act) Annual aquifer review Triennial aquifer review 	Construction/ Operations/ Decommissioning and Closure	Manager Long Term Planning and Hydrology
3.3		x	Where monitoring indicates a potential impact on groundwater levels and/or quality or associated groundwater dependent systems, implement contingency actions defined in Table 11. Update this Plan where required to inform an adaptive management approach to groundwater management across the business.	<ul style="list-style-type: none"> Monitoring program implemented Contingency actions implemented 	<ul style="list-style-type: none"> Monitoring reports Compliance Assessment Report (if the Plan is conditioned under the EP Act) Annual aquifer review Triennial aquifer review 	Construction/ Operations/ Decommissioning and Closure	Manager Long Term Planning and Hydrology
3.4		x	Implement the sites surface water monitoring program as defined in the Surface Water Monitoring Plan to detect any impacts on surface water dependent systems (inclusive of partial and infrequent dependent systems) as a result of a change in groundwater levels and/or quality.	<ul style="list-style-type: none"> Monitoring program implemented 	<ul style="list-style-type: none"> Monitoring report Reporting records 	Construction/ Operation/ Decommissioning/ Closure	HSES Manager
3.5		x	Implement the sites conservation significant fauna monitoring program as defined in the Conservation Significant Fauna Monitoring Plan to detect any impacts on conservation significant fauna and associated habitat as a result of a change in groundwater levels and/or quality.	<ul style="list-style-type: none"> Monitoring program implemented 	<ul style="list-style-type: none"> Monitoring report Reporting records 	Construction/ Operation/ Decommissioning/ Closure	Group Manager Environment
3.6		x	Implement the sites vegetation health monitoring program as defined in the Vegetation Health Monitoring Plan to detect any impacts on conservation significant flora and vegetation as a result of a change in groundwater levels and/or quality.	<ul style="list-style-type: none"> Monitoring program implemented 	<ul style="list-style-type: none"> Monitoring report Reporting records 	Construction/ Operation/ Decommissioning/ Closure	Group Manager, Environment

5. MONITORING GUIDELINES

A monitoring program is required to measure the effectiveness of the management actions as defined in this Plan. The outcomes of the monitoring program will contribute to ongoing improvements in management actions to ensure an adaptive management approach is adopted.

5.1 Objectives

The guiding objectives of the groundwater monitoring program includes:

1. Determine whether the levels and water quality in groundwater dependent systems potentially impacted by Fortescue activities are significantly different from baseline modelling and/or control site values.
2. Monitor and measure the success of management measures to inform an adaptive management approach.
3. Obtain adequate data to measure spatial and temporal changes in site hydrology within Fortescue controlled sites.

Baseline and operational monitoring will be informed by the findings of the monitoring itself as they become available. These findings may similarly lead to ongoing refinements to this Plan and its management strategies to ensure an adaptive management approach is undertaken during Fortescue activities.

5.2 Baseline Modelling/ Sampling

Initial hydrogeological modelling has been conducted as part of the Eliwana Mine groundwater impact assessment to obtain a representative baseline dataset of the site hydrogeology.

Baseline sampling for groundwater quality will be conducted where possible prior to construction to obtain an accurate baseline dataset.

5.3 Program Summary

An effective monitoring program may be adaptive over time, dependent on quality and quantity of data collected from each site, with innovations in monitoring techniques and methodologies incorporated into program design over time. This would however be dependent on and be driven by the quality and quantity of data collected from each site, coupled with a periodic review of monitoring methods. Further, program design should be based on replicable sampling at impact and reference sites.

A set of monitoring parameters and methods have been selected to provide broad coverage of potential changes in groundwater flow and quality that can be expected under a range of different mining related impacts. The number of monitoring parameters will vary depending on the approval conditions and groundwater dependent systems.

Groundwater sampling should be conducted in accordance with the requirements of AS/NZS 5667.11:1998 *Water Quality – Sampling - Guidance on Sampling of Groundwaters*.

Monitoring will be undertaken in accordance with the *Groundwater Sampling Procedure* (CH-PR-WM-0001).

A summary of monitoring parameters and methods have been provided in Table 7.

Table 7: Monitoring Parameters and Methods

Monitoring Parameter	Method
Rainfall	Rainfall gauge
Hydrochemistry	Sample collection (field)/ Analysis (lab)
Field EC and pH	Water quality meter (field)
Water levels	Water level indicator (field)

Table 8 provides the monitoring parameters to be monitored per location type within Fortescue controlled sites where water is present and accessible.

Table 8: Types and Associated Parameters and Site Locations

Type	Parameter	Frequency	Site
Rainfall	Rainfall	Quarterly ⁸	Suitable location within representative catchment boundary and within the approval boundary
Select bores near: Landfill TSF Waste dumps GDE	Field EC and pH	Quarterly	Monitoring Bores Dewatering and Injection Bores Abstraction Bores
Select bores near: Landfill TSF Waste dumps GDE	Groundwater levels ⁹	Quarterly	Monitoring Bores Dewatering and Injection Bores Abstraction Bores

⁸ Rainfall data will be captured daily with a quarterly download frequency.

⁹ Bores for groundwater level are to be outside the modelled drawdown extent

Type	Parameter	Frequency	Site
Select bores near: Landfill TSF Waste dumps	Hydrochemistry ¹⁰¹¹	Quarterly	Monitoring Bores Dewatering and Injection Bores Abstraction Bores
Select bores near ¹² : Waste dumps TSF	See <i>Acid and Metalliferous Drainage Sampling Plan</i> (100-PL-EN-1014)	As required ¹²	Monitoring Bores
Select bores near: Bulk Fuel Facilities Landfill Bioremediation Areas	Total Recoverable Hydrocarbons	Quarterly	Monitoring Bores

Table 9 provides the hydrochemistry parameters to be monitored for those select bores near the landfill, TSF and Waste Dumps.

Table 9: Hydrochemistry parameters

Type	Parameter
TDS	TDS
Anions	Alkalinity
	Chlorine
	Nitrate
	Sulfate
	Fluoride
Cations	Calcium
	Potassium
	Magnesium
	Sodium
Metal Suite	Arsenic
	Chromium
	Copper
	Mercury
	Nickel
	Lead
	Strontium

¹⁰ See Table 9

¹¹ ANZECC water quality guidelines, 95% protection level value

¹² Waste landforms will be monitored when determined to be a potential source in the sites source, pathway, receptor risk model as defined by the *Acid and Metalliferous Drainage Management Plan* (100-PL-EN-1016).

Type	Parameter
	Zinc
	Aluminium
	Boron
	Cobalt
	Iron
	Manganese
	Antimony
	Selenium
	Barium
	Bismuth
	Lithium
	Molybdenum
	Tin
	Thorium
	Titanium
	Uranium
	Vanadium
	Tungsten
	Yttrium
Ultra-low detection limits	Silver
	Beryllium
	Cadmium
	Thallium

Contingency actions (Section 5.6) and reporting (Section 8) requirements will be implemented where required.

Monitoring locations will be finalised once the Mine Plan is approved.

Results of the groundwater monitoring program will also inform and be informed by the following monitoring programs to determine impacts to ecosystem health:

- Conservation significant fauna
- Vegetation health
- Surface Water
- Subterranean fauna (where surveys have identified a restricted species and management and monitoring is required).

A summary of the groundwater monitoring program is provided in Table 10.

Table 10: Summary of Groundwater Monitoring Programs

Area/ Aspect to be monitored	Location	Parameter	Collection Method	Frequency
Rainfall	Centroid, upper reaches of catchments. On high ground away from buildings, vegetation	Rainfall	Field Collection/ Rainfall gauge	Quarterly ⁸
Landfill TSF Waste Dumps Bulk Fuel Facility GDEs	Within the referenced aquifer and upgradient and downgradient from the potential impact source	Field EC and pH	Field Collection/ water quality meter	Quarterly
TSF Waste Dumps Bulk Fuel Facility GDEs		Groundwater level ⁹	Field Collection/ water level indicator	Quarterly
Landfill TSF Waste Dumps Bulk Fuel Facility		Hydrochemistry	Sample Collection (field)/ Analysis (Lab)	Quarterly
Waste Dumps Landfill		See <i>Acid and Metalliferous Drainage Sampling Plan</i> (100-PL-EN-1014)	Sample Collection (field)/ Analysis (Lab)	As required ¹²
Bulk Fuel Facility Bioremediation Area		TRH	Sample Collection (field)/ Analysis (Lab)	Quarterly

5.4 Monitoring Program Review

The overarching monitoring program will be technically assessed and reviewed upon acceptance of this plan and then every three years thereafter. The main objective of the assessment and review will be to ensure that the methods, parameters and frequency used are considerate and appropriate to the findings of the monitoring program. If no triggers are exceeded (detailed in Table 11) after three years, the frequency of monitoring will be reduced to a frequency supported by the review.

Monitoring sites may need to be adapted over time in response to project impacts.

Contingency action (Section 5.6) and reporting requirements (Section 8) will be implemented where required.

5.5 Data Handling Statistical Analysis

Data will be handled in accordance with the data handling protocol established as part of the annual monitoring tender. The protocol will include the requirements as to data storage and protection, data extraction, quality control, analysis, interpretation, reporting and presentation.

The protocol will also directly reference and align with the requirements detailed in *Document Control, Information Management* (100-ST-DC-001) and *Geographic Information Systems and Raw Data Guidelines* (100-GU-EN-0009).

Statistical analysis of data will be undertaken where data permits. Where data capture allows, analysis will include using time series line charts for each parameter and scatterplots to determine relationships between parameters. If parameter relationships appear to be present or exceedances or trends occur determine cause and implement corrective actions.

The results of chemical and physical data should be analysed after every sample event, values of each parameter should be compared against trigger values to determine if an exceedance has occurred.

Monitoring reports will also be provided to the State and Commonwealth Governments as dictated by annual reporting requirements. In addition, the monitoring raw data will be made available to the Western Australian State Government and the Commonwealth Government upon request or where conditioned to provide.

5.6 Contingency Actions

Contingency actions will be initiated during construction, operational and decommissioning activities when an exceedance of a trigger is identified, and monitoring indicates that implemented management measures are not successfully mitigating impacts on groundwater dependent systems and/or the management objectives are not being achieved.

Contingency actions for groundwater monitoring triggers have been developed in Table 11.

Table 11: Trigger Criteria and Associated Contingency Actions

Outcome	Trigger/ Threshold Criteria	Contingency Action
<p>Railway</p> <p>During construction, groundwater management infrastructure operates as per design to minimise adverse impacts outside of assessed impact areas¹³</p>	<p>Trigger Criteria</p> <p>An exceedance of expected groundwater level values outside of the assessed impact areas in comparison to reference sites over two consecutive monitoring events</p> <p>Threshold Criteria</p> <p>Following construction, groundwater level values outside of the assessed impact areas are above baseline values after two years of above average rainfall¹⁴</p>	<p>Trigger Contingency Actions</p> <ul style="list-style-type: none"> • Determine whether the changes observed in the impact sites are comparable to baseline modelling/sampling • Re-examine applied monitoring parameters to validate they are operating within management levels • Increase monitoring frequency • Identify the reason for the change and where it was caused by construction, operations or decommissioning/closure activities, review management measures with an adaptive management response. <p>Threshold Contingency Actions</p> <ul style="list-style-type: none"> • Implement contingency measures within 24 hours of the exceedance being identified. • Identify the reasons for the exceedance: <ul style="list-style-type: none"> ○ Where it was caused by construction activities, extend the monitoring program to include an additional recharge event to determine if groundwater quality and level values recover. Where required under the approval, report the exceedance.

¹³ Refer to *Eliwana Railway Public Environmental Review* (EW-RP-EN-0004)

¹⁴ Rainfall to be considered as an average of rainfall measured at Eliwana and Solomon (Castle Camp) weather stations.

Outcome	Trigger/ Threshold Criteria	Contingency Action
		<ul style="list-style-type: none"> ○ Where it was not caused by construction, resume monitoring until monitored levels recover to baseline values.
<p>Mine (1) No adverse impacts to groundwater quality outside of assessed impact areas¹⁵ as a result of implementing the proposal</p>	<p>Trigger Criteria An exceedance of groundwater quality guideline values (see Table 8) in comparison to reference sites over two consecutive monitoring events</p> <p>Threshold Criteria An exceedance of site specific background trigger values¹⁶ over four consecutive monitoring events in comparison to reference sites</p> <p>AND</p> <p>Subsequent investigations determine that the impacts are likely a result of the implementation of the proposal.</p>	<p>Trigger Contingency Actions</p> <ul style="list-style-type: none"> • Determine whether the changes observed in the impact sites are comparable to baseline modelling/sampling • Re-examine applied monitoring parameters to validate they are operating within management levels • Increase monitoring frequency • Identify the reason for the change and where it was caused by construction, operations or decommissioning/closure activities, review management measures with an adaptive management response.
<p>Mine (2) Groundwater management infrastructure operates as per design to minimise adverse impacts to groundwater dependent vegetation outside of assessed impact areas</p>	<p>Trigger Criteria +/- 1m elevation change between recorded and modelled¹⁷ levels over two consecutive events</p> <p>Threshold Criteria +/- 2m elevation change between recorded and modelled levels over two consecutive events</p> <p>AND</p>	<ul style="list-style-type: none"> • Mine (2) only - Recalibrate the model developed during baseline modelling <p>Threshold Contingency Actions</p> <ul style="list-style-type: none"> • Implement contingency measures within 24 hours of the exceedance being identified.

¹⁵ Refer to *Eliwana Iron Ore Mine Public Environmental Review* (EW-RP-EN-0003)

¹⁶ The modelled value will reference the numerical groundwater model from the most recent Hydrological Assessment approved by DWER as part of the Groundwater Operating Strategy for the Proposal.

¹⁷ The modelled value will reference the numerical groundwater model from the most recent Hydrogeological Assessment approved by DWER as part of the current Groundwater Operating Strategy for the Proposal

Outcome	Trigger/ Threshold Criteria	Contingency Action
	<p>Subsequent investigations determine that the impacts are likely a result of the implementation of the proposal.</p>	<ul style="list-style-type: none"> • Identify the reasons for the change: <ul style="list-style-type: none"> ○ Where it was caused by construction, operation or decommissioning activities, submit a plan with actions within 21 days of the determination being made by the OEPA. ○ Where it was not caused by construction, operation or decommissioning activities, resume standard monitoring frequency. • Report the threshold exceedance to the OEPA within 7 days of the exceedance being identified. • Provide evidence to the satisfaction of the OEPA which allows determination of the cause of the exceedance within 21 days of the exceedance being identified. • Where the exceedance is a result of construction, operation or decommissioning activities, submit a plan of actions within 21 days of the determination being made by the OEPA. • Continue to implement actions to remediate the exceedance until approval to cease has been given by the OEPA.

6. COMPLIANCE

Fortescue ensures compliance with its legal obligations through first party quality assurance by site and corporate environment teams with a focus on effective environmental management through the implementation of the Fortescue wide Environmental Management System (EMS).

Fortescue has adopted a risk based approach to monitor compliance with its legal obligations. Site environment teams will monitor their compliance with this Plan and the required site specific management and monitoring programs using the *Self-Verification of High Risk Environmental Legal Obligations Guideline* (100-GU-EN-0030).

Where non-conformance issues or opportunities for improvement are identified these will be documented and tracked via the Business Management System (BMS).

7. ADAPTIVE MANAGEMENT

Fortescue will implement adaptive management practices to learn from the implementation of mitigation measures, monitoring and evaluation against management targets, to more effectively meet the conditioned environmental objective. Adaptive management practices that will be assessed for the vegetation health management and monitoring program as part of this approach may include:

- Evaluation of the monitoring program, data and comparison to baseline data and reference sites on an annual basis to verify whether responses to project activities are the same or similar to predictions
- Evaluation of assumptions and uncertainties of the management and monitoring program
- Re-evaluation of the risk assessment and revision of risk based priorities as a result of monitoring outcomes
- Review of data and information gathered over the review period that has increased understanding of site environment in the context of the regional ecosystem
- Review of management actions as the project matures and new management measures and technologies become available that may be more effective for environmental management
- Assessment of changes which are outside the control of the project and the management measures identified (i.e. a new project within the area or region; regional change affecting management)

Review of the Environmental Management Plan will be undertaken following the review of the associated monitoring program and the corresponding results

8. REPORTING

8.1 Annual Monitoring Report

An Annual Monitoring Report will be developed with the results of the monitoring programs across all Fortescue controlled sites. This report will outline the monitoring data captured during the reporting period and the analysis required to report compliance against management targets and conditioned environmental objectives.

8.2 Annual Compliance Assessment Report

Fortescue is required to report against its compliance with the Management Plan in the Compliance Assessment report prepared in accordance with the OEPA's Post Assessment Guideline for Preparing a Compliance Assessment Report, Post Assessment Guideline No. 3.

Annual Compliance Assessment Reports (CAR) are required to be submitted in accordance with relevant Ministerial Statements conditions.

The reporting requirements against management targets and conditioned environmental objectives are provided in Table 1. In the event that trigger criteria were exceeded during the reporting period, the CAR will include a description of the effectiveness of the contingency actions that have been implemented to manage the impact and any adaptive management measures applied as a result of the exceedance.

Currently, the Eliwana Iron Ore Mine Project is not required to report on compliance with the Groundwater Management Plan. Once approval is granted under Part IV of the *Environmental Protection Act 1986* and implementation of the Groundwater Management is conditioned in the Ministerial Statement, Fortescue will adhere to the reporting requirements outlined in section 9.2 of this Plan.

8.3 Annual Environmental Monitoring Report

Fortescue is required to report environmental monitoring data, as required by Operating Licences issued by the Department of Water and Environmental Regulation under Part V of the *Environmental Protection Act 1986*.

An Annual Environmental Monitoring Reports (AEMR) will be submitted in accordance with the relevant licence conditions once the Eliwana Mine project is approved and a licence is issued.

8.4 Annual/Triennial Aquifer Review

Fortescue is required to develop an Annual Groundwater Monitoring Summary and a Triennial Groundwater Monitoring Review as required by a Groundwater Operating Strategy issued under the *Rights in Water and Irrigation Act 1914*. Annual and Triennial reporting will be undertaken for the Eliwana Mine Project in accordance with the Operational Policy 5.08 in “*Use of Operating Strategies in the Water Licensing Process* (DoW, 2010).

During construction, the Eliwana Railway Project will utilise existing bores within the Southern Fortescue Borefield approved under the Solomon Iron Ore Project – Sustaining Production Proposal. Reporting requirements will be undertaken in accordance with the existing Groundwater Operating Strategy.

8.5 Reporting of Potential Non-Compliances

Fortescue is required to report against monitoring outcomes as per conditioned timeframes. Trigger criteria and where required threshold criteria have been identified in Table 1.

In the event that monitoring, tests, surveys or investigations indicate an exceedance of a management target in Table 1 Fortescue will report an exceedance of a management target in accordance with the requirements of the relevant Ministerial Statement condition(s).

Currently, the Eliwana Iron Ore Mine Project is not required to report on compliance with the Groundwater Management Plan. Once approval is granted under Part IV of the *Environmental Protection Act 1986* and implementation of the Groundwater Management is conditioned in the Ministerial Statement, Fortescue will adhere to the reporting requirements outlined in the Ministerial Statement.

9. REVIEW OF THE PLAN

Review of this Plan will be undertaken every five years or as required by a condition. Revisions of this Plan will be submitted to the relevant State and Commonwealth Governments for approval, in accordance with relevant approval conditions.

10. STAKEHOLDER CONSULTATION

Fortescue has undertaken extensive stakeholder consultation program whereby landowners, regulators and other relevant parties have been consulted with regard to investigation and design of the mine sites and port and rail infrastructure through the environmental approvals process.

Regulatory agencies will be consulted in accordance with the requirements of the EPA’s “Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plan”.

Table 4 will be updated following receipt of stakeholder comment as a result of the review and approval process.

Table 12: Stakeholder Consultation, Comments and Responses

Stakeholder	Correspondence	Comment	Change
DWER – Regions	CMS17164	The proponent has prepared a site-specific Eliwana Groundwater and Surface Water management plans to support the ERD submission. RSW will comment on the content and acceptability of these plans during the assessment period, makes note that whilst the plans presented contain information on potential management strategies, the plans do not define which surface and groundwater features are significant and will need management.	See attached Figures for relevant groundwater features.
DWER – Regions	CMS17164	No proposed management strategies (triggers and thresholds) established within the plan rather the plan commits to develop these strategies. It is unclear that this addresses the work required for task 18 of the scoping requirements.	Following discussions with the EPA, the Plan has been revised to support an outcomes-based approach. The Plan now meets the requirements of the EPA’s “Instructions on how to prepare <i>Environmental Protection Act 1986</i> Part IV Environmental Management Plan”. Which specifies trigger and thresholds criteria to be established where an outcomes-based condition is being proposed. Water quality triggers have been identified within the Plan through reference to the ANZECC Guidelines, Water Quality Protection Guidelines for Mining and Mineral Processing and Water Quality Protection Note 68 where triggers are identified.

Stakeholder	Correspondence	Comment	Change
DWER - Regions	CMS 17164	As mentioned, the proponent has submitted the more general Pilbara wide groundwater and surface water management plans applicable to the Chichesters and Solomon Operations. These plans are not applicable because the ESD requires standalone Eliwana surface water and groundwater plans to be submitted to support the Eliwana operations.	EPA's "Instructions on how to prepare <i>Environmental Protection Act 1986 Part IV Environmental Management Plan</i> ". enables proponents to draft factor-based plans for multiple operations. This is the approach Fortescue is using for its EMP development program.
DWER -Terrestrial Ecosystems	CMS 17164	The SWMP and GWMP are also inadequate. They are plans to develop plans rather than containing specific information, management actions, monitoring techniques and SMART trigger and thresholds required. The SWMP should include management actions for maintaining sheet flow dependent vegetation.	<p>Following discussions with the EPA, the Plan has been revised to support an outcomes-based approach. The Plan now meets the requirements of the EPA's "Instructions on how to prepare <i>Environmental Protection Act 1986 Part IV Environmental Management Plan</i>". Which specifies trigger and thresholds criteria to be established where an outcomes-based condition is being proposed.</p> <p>Management actions are not required under outcomes based plans – see EPA's "Instructions on how to prepare <i>Environmental Protection Act 1986 Part IV Environmental Management Plan</i>". Management actions have been included in the Plan to demonstrate effective management of the factor but will not be reported against to demonstrate compliance.</p> <p>Management actions (Section 4), Monitoring methods (Section 5) and triggers and thresholds (Table 2) are outlined in the Plan as required under the Instructions.</p>

11. REFERENCES

Department of Water, January 2013. Managing the hydrology and hydrogeology of water dependent ecosystems in urban development, Guidance Note 7.

Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and Australian and New Zealand Environment and Conservation Council (ANZECC) 2000.

Australian guidelines for water quality monitoring and reporting. National Water Quality Management Strategy paper No 7, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and Australian and New Zealand Environment and Conservation Council (ANZECC) 2000, *National Water Quality Management Strategy: Australian Guidelines for Urban Stormwater Management.*

Richardson, E, Irvine, E, Froend, R, Book, P, Barber, S & Bonneville, B 2011, Australian groundwater dependent ecosystems toolbox part 1: assessment framework, National Water Commission, Canberra.

Figure 1: Environmental Consideration and Groundwater Impact Assessment Areas: Eliwana Rail

Figure 2: Groundwater Dependent Vegetation: Eliwana Mine