Head Office

7 Rheola Street
West Perth
WA 6005 Australia
Tel: +61 8 9429 4888
Fax: +61 8 9226 3388

中钢澳洲中西矿业公司
SINOSTEEL MIDWEST CORPORATION LIMITED

Sinosteel Midwest Corporation Limited
ABN 91 009 224 800

Weld Range Iron Ore Project

Ground Water Management Plan

Document Number WR15-0001-EV-PLN-003

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A	Issued as Final	Ian Findlay	Mike Wood	Wayne Ennor	13 Dec 2011

TABLE OF CONTENTS

TABLES

TERMS AND ABBREVIATIONS GLOSSARY

Abbreviation	Meaning
°C	Degree Celsius
ANZECC	Australian and New Zealand Environment and Conservation Council
bgl	below ground level
BIF	banded iron formation
DEC	Department of Environment and Conservation
DMP	Department of Mines and Petroleum
DoW	Department of Water
DRET	Department of Resources Energy and Tourism (Commonwealth)
EC	Electrical Conductivity
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
GDE	Groundwater Dependant Ecosystems
GLpa	Gigalitre per annum
ha	hectare
IBRA	Interim Biogeographic Regionalisation of Australia
km	kilometre
km2	square kilometre
L/s	litre per second
m	metre
m bgl	metre below ground level

Abbreviation	Meaning
m/day	metre per day
m3	cubic metre
m3/day	cubic metre per day
mg/L	milligrams per litre
ML	mega litters
mm	millimetre
mm/annum	millimetres per annum
mRL	meters Reduced Level (relative to the Australian Height Datum)
OEPA	Office of the Environmental Protection Authority
SMC	Sinosteel Midwest Corporation Limited
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
uS/cm	microSiemens per centimetre
SRK	SRK Consulting (Australasia) Pty Ltd

1.0 INTRODUCTION

Western Australia's economy is heavily dependent on mineral resource projects and its future growth and development rely on the continued viability of resource development projects. The Weld Range Iron Ore Project will provide financial and social benefits for the area through employment, infrastructure and flow-on effect to the non-mining sector.

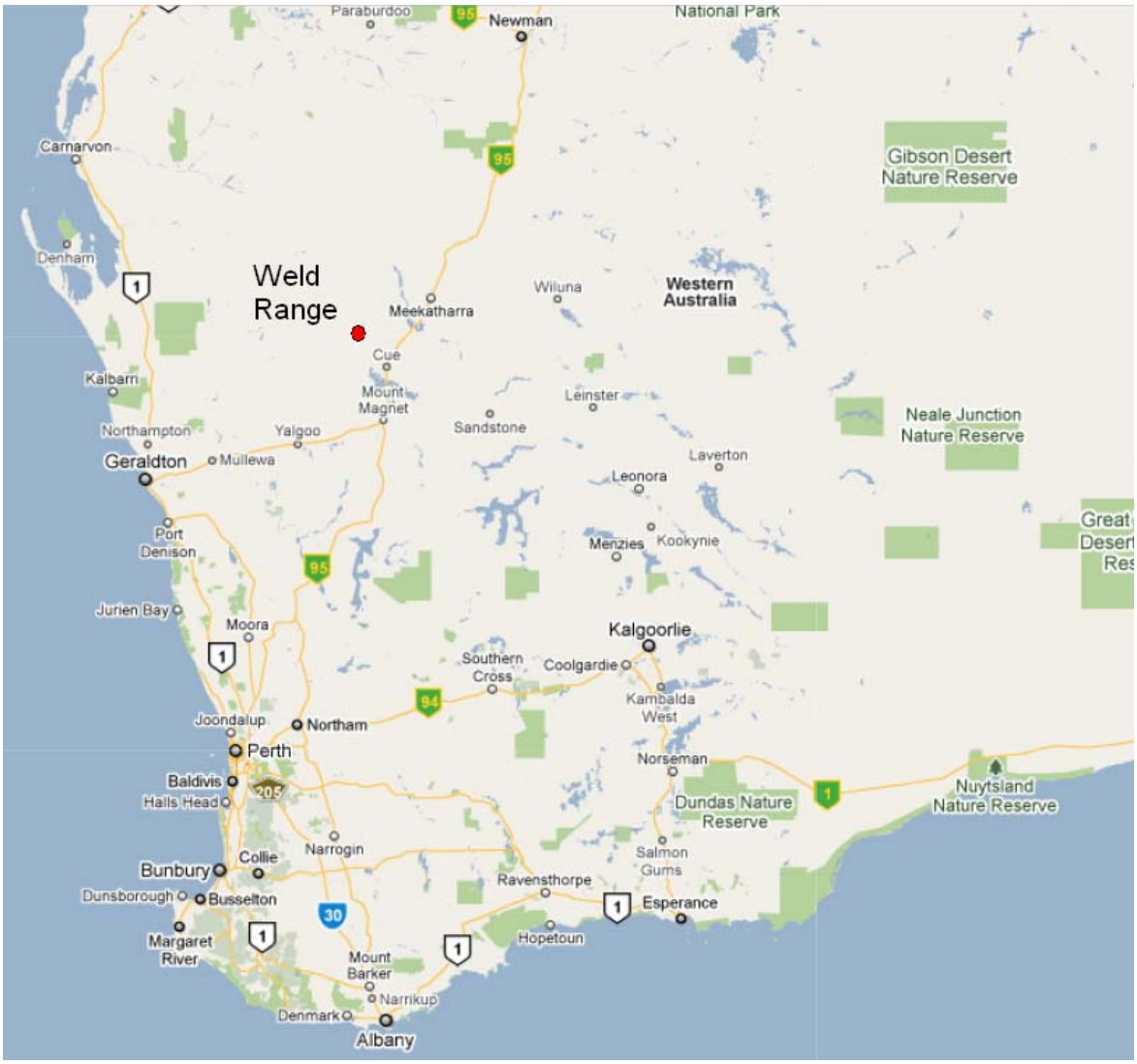


Figure 1.1 Location Map

Sinosteel Midwest Corporation Ltd (SMC) is an incorporated entity set up to conduct mineral exploration, engineering, environmental and economic studies into the feasibility to mine Weld Range 60km NW of Cue.

The Weld Range Iron Ore Project (the Project) is a direct shipping iron ore project with high grade outcrops over a 60 km strike length. SMC is targeting to export 15 million tonnes per annum (Mtpa) of iron ore over a 15 year period, however, this Management Plan covers the first 11 years of planned

operations. To implement this project, major infrastructure will be designed, installed and constructed immediately, with production scheduled for 2014, and decommissioning in 2024.

There are a number of potentially significant environment impacts expected as a result of the Project. As a result, environment management plans for the significant factors have been developed as a primary method of controlling, managing and monitoring these known and expected environmental impacts. The management plans and elements of the Project's Environmental Management System (EMS) that will be used to achieve the environmental objectives, targets and commitments of the Project and the application of mitigation measures.

It is a primary objective that all environmental impacts during operation of the Project are avoided or minimised as far as reasonably practicable; consistent with the principles of environmental protection. Environmental impacts will also be evident during construction of the Project infrastructure and the objectives and management practices within these plans will also apply to these construction activities.

Compliance with commitments outlines in this document will be internally audited by SMC and subject to external audits by the relevant regulatory agencies, including the Department of Environment and Conservation (DEC) and the Department of Mines and Petroleum (DMP).

1.1 Project Overview

The tenements that form the basis for the Project cover a series of hills that rise approximately 250 m above the surrounding plains. The range is some 3 km wide, extends for up to 60 km in length from southwest to the northeast, and consists of a series of parallel ridges with deep incised valleys. High grade iron ore mineralisation occurs within the Weld Range as a series of outcroppings of extensive

goethite-haematite lodes. Many of these outcroppings have been identified along Weld Range. The

proposed operations at Weld Range are expected to have a disturbance footprint of approximately 35.89 km² (3589.1 ha).

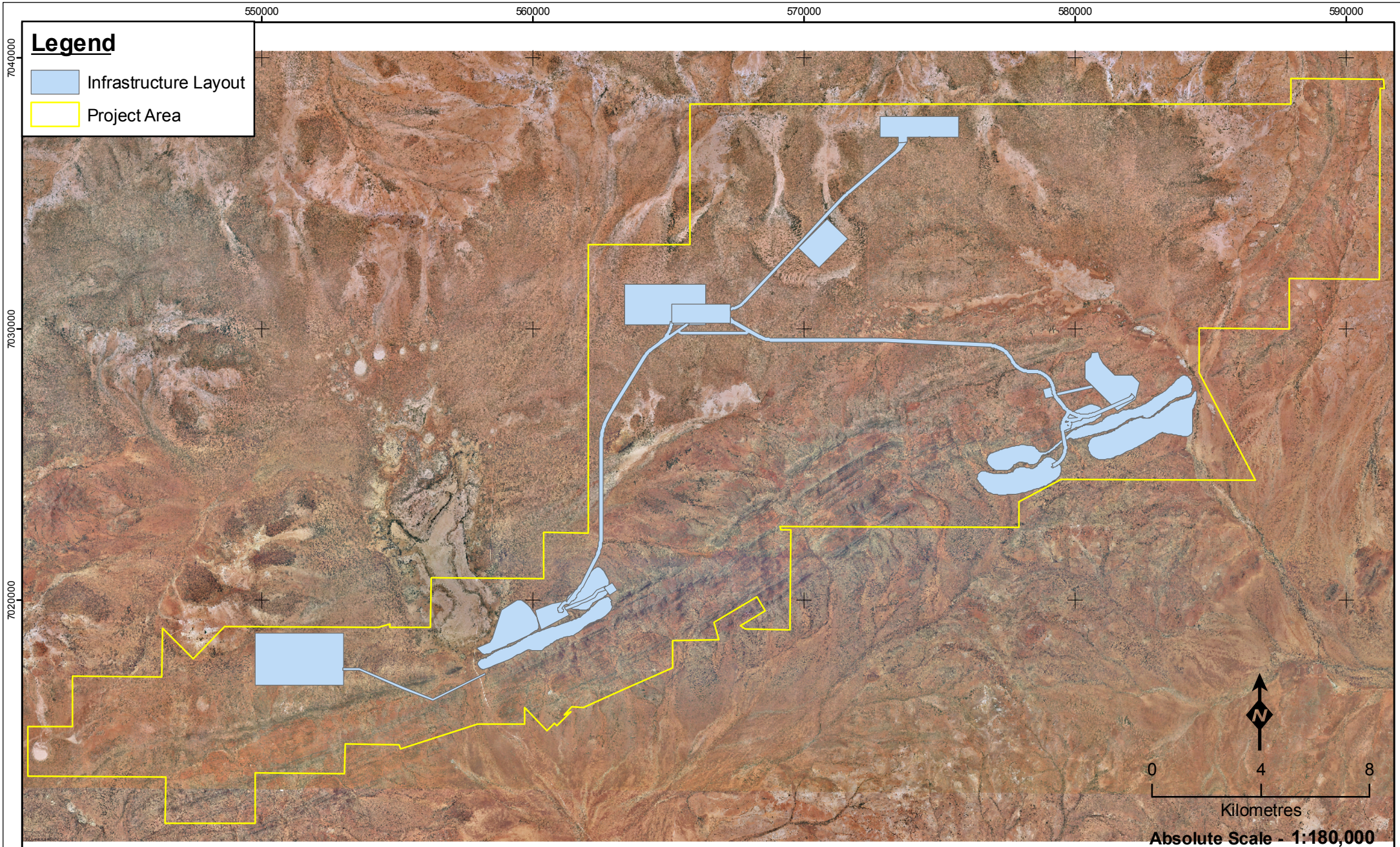
Mining will occur at two main deposits, namely Beebyn and Madoonga. The Beebyn and Madoonga pits will be mined beneath (estimated 200 m pit depths) the ambient water table (encountered from 5 to 50 m below ground level), therefore dewatering will be required to maintain pit stability and a dry working floor. The pit dewatering strategy for Madoonga and Beebyn will be a hybrid of pit perimeter boreholes, drain holes and a limited number of in pit boreholes to dewater the deeper areas of the pits. Water abstraction rates are estimated to be 11.95 GLpa. Groundwater pumping will commence approximately six months before the start of mining operations. Over time, the dewatering will cause an elliptical cone of depression to develop with drawdown, preferentially propagating along the ridges.

Higher volumes of water are expected from Madoonga than from Beebyn. The water from Beebyn is likely to be less saline than that from Madoonga. Fresh water produced from pit dewatering activities at Beebyn will be used during mining and plant operations for dust suppression and treated to provide potable water. The annual water usage for the mining areas, processing facilities and supporting infrastructure has been estimated at 3.19 GLpa to 4.96 GLpa (Table 1.1).

Table 1.1 Summary of Abstraction Volumes and Flowrates

		Estimated Flow Rate, GLpa
Low salinity	Process water, Beebyn	0.25 – 0.26
	Process water, Madoonga	0.25 – 0.26
	Process water, CPF and village	1.18 – 1.68
	Total low salinity	1.69 – 2.20
High salinity	R and M dust suppression Beebyn	0.60 – 0.98
	R and M dust suppression Madoonga	0.60 – 0.98
	R and M dust suppression CPF and village	0.30 – 0.79
	Total high salinity	1.5 – 2.76
	Total water consumption	3.19 – 4.96

Saline water will be discharged via a pipeline to an evaporation pond in close proximity to the Madoonga Pit (Figure 1.2)



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Proposed Changes to the Weld Range Iron Ore Project

Figure: 1.2
Project ID: 1335

Drawn: KC
Date: 13/04/2011

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: KC004

A4

1.2 Purpose

The purpose of this plan is to outline SMC's management strategies for achieving the following environmental outcomes:

- Use groundwater responsibly and efficiently so that high quality water is used only in situations where it is essential, or no other suitable water source is available;
- Optimise the use of surplus water on site to reduce the effects of releases to the environment;
- Minimise the risk of adverse impacts to groundwater resources and environmental values as a result of groundwater abstraction and release during mining;
- Maintain the quality and quantity of groundwater so that existing and potential environmental, social and cultural values, including ecosystem maintenance, are protected; and
- Meet all relevant regulatory requirements relating to the abstraction, use and discharge of groundwater.

This plan identifies the most significant risks to groundwater arising from implementation of the Weld Range iron ore project and describes how SMC will avoid and manage those risks. The plan also outlines monitoring programs that will be implemented to provide evidence of the effectiveness of SMC's management strategies and describes the key contingency measures that SMC will adopt if monitoring results suggest that the management strategies it has put in place are not achieving the target outcomes.

The plan presents an integrated management framework for identifying, managing, monitoring, assessing, and reporting on the impacts of SMC's mining activities on groundwater. The plan also describes SMC's forward programme of additional studies to support ongoing improvement in managing the risk of groundwater impacts from its operations.

1.3 Scope

This plan applies to the abstraction and discharge of groundwater during the construction and operation of the Weld Range iron ore project. The plan does not address post-closure impacts of SMC's activities on groundwater: These are to be addressed in the Mine Closure and Rehabilitation Plan. This plan does not address SMC's arrangements for managing surface water. A separate management plan has been prepared to describe environmental management requirements for surface water.

1.4 Related Documents

This groundwater management plan is one element of SMC's overarching environmental management system. The following SMC environmental management documents may also have a bearing on aspects of the project which may influence SMC's objectives for managing groundwater:

- Surface Water Management Plan (WR15-0050-EV-PLN-001, April 2011)
- Acid Mine Drainage Management Plan (WR15-1015-EV-PLN-001, April 2011)

2.0 RELEVANT LEGISLATION, POLICIES AND GUIDELINES

SMC will, as a minimum, meet all relevant regulatory requirements in managing groundwater – and impacts on groundwater – during the construction and operation of the Weld Range project. The key Western Australian legislation to which SMC will have regard in its management of groundwater includes:

- *Rights in Water and Irrigation Act 1914*
- *Environmental Protection Act 1986*
- *Environmental Protection (Unauthorised Discharges) Regulations 2004*
- *Dangerous Goods Regulations 1992*
- *Contaminated Sites Act 2003*
- *Environmental Protection (Rural Landfill) Regulations 2002*

This EMP has taken into account recommendations contained in the Department of Water's 'Pilbara water in mining guideline - draft for public comment' (Water Resource Allocation Planning series, WRAP no. 32, Department of Water, February 2009). Other guidelines, policies and standards relevant to this plan are listed in Table 2.1.

Table 2.1 Relevant Guidelines, Policies and Standards

Agency	Documentation
Department of Water (DoW)	Statewide policy no. 5 – Environmental water provisions policy for Western Australia (2000)
	Report No 17 -Determining water level ranges of Pilbara riparian species (2010)
	Operational policy no. 1.02 – Policy on water conservation/efficiency plans (2009)
	Operational policy no. 5.12 : Hydrogeological reporting associated with a groundwater well licence (2009)
	Operational policy 5.08 - Use of operating strategies in the water licensing process (2010)
	Pilbara water in mining guideline - draft for public comment (Water Resource Allocation Planning series, WRAP no. 32, February 2009)
Environmental Protection Authority (EPA)	Position Statement No. 4 – Environmental Protection of Wetlands (2004)
Department of Environment and Conservation (DEC)	Contaminated Sites Management Series - Reporting of Known or Suspected Contaminated Sites (2006)
Australian Government - Department of Resources, Energy and Tourism (DRET)	Leading Practice Sustainable Development Program for the Mining Industry - Managing Acid And Metalliferous Drainage (2007)
	Leading Practice Sustainable Development Program for the Mining Industry – Tailings Management (2007)
	Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure and Completion (2006)
Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)	National Water Quality Management Strategy - Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
Standards Australia	Australian Standard - The storage and handling of flammable and combustible liquids (AS 1940-2004)

3.0 BACKGROUND

The project area lies within the West Murchison sub region of the Murchison Interim Biogeographic Regionalisation of Australia (IBRA) zone. This zone is typified by open acacia woodland with an ephemeral understory. The site experiences hot dry summers and mild winters. Rainfall is variable both seasonally and annually, with rain mostly occurring from localised thunderstorms and weak cold fronts. The average annual rainfall is less than 250 mm.

The Weld Range area is within the East Murchison Groundwater Management Unit. Groundwater typically occurs at depths ranging from 5m to 50m below ground level beneath the Quaternary alluvial plain around Weld Range, and also occurs within the bedrock sequence that forms Weld Range. Large volumes of groundwater are present within the Banded Iron Formation (BIF) rock. Recharge to the groundwater system occurs from rainfall infiltration, mainly through creek beds and to a lesser extent on floodplains. Some groundwater recharge can be expected through the creek beds between the ridges that form Weld Range. Groundwater used for watering livestock is currently extracted from relatively shallow bores in the general locality. Groundwater underlying the project is fresh to marginal (Total Dissolved Solids ranging from less than 500 mg/L to about 1500 mg/L). The salinity of the water is generally too high for direct potable use and requires treatment via reverse osmosis.

The Beebyn and Madoonga pits will be mined to depths of around 200 m beneath the watertable; therefore dewatering will be required to maintain a dry working floor and safe mining conditions.

Mine dewatering will produce both fresh and saline water. Fresh water abstracted from the Beebyn Pit will be used in mine processing activities, for dust suppression and will also be treated for use as potable water.

The daily water demand is approximately 7.6 ML per day for the Beebyn Pit operation and 1.7 ML per day for the Madoonga Pit operation. This is estimated to result in a total annual usage of between 3.2 GLpa to 5 GLpa. SMC will use groundwater from pit dewatering to supply Project water requirements. It is not feasible to rely on rainfall as a water supply source due to the low and variable amounts of rainfall and high evaporation in the project area.

Baseline hydrogeological investigation and modelling have indicated that average groundwater abstraction rates will be need to be between 6.7 to 12 GLpa over the proposed mine life of nine years. There will be up to 7 GLpa of surplus water from pit dewatering that will require disposal. SMC proposes to dispose of surplus water to an evaporation/infiltration pond located in close proximity to the Madoonga Pit. The surplus water will generally be saline, with an average Total Dissolved Solids concentration in the order of 25,000 mg/L (range from about 10,000mg/L to 60,000mg/L).

Groundwater will be extracted using a combination of pit perimeter boreholes, drain holes and limited numbers of in pit boreholes. The dewatering will cause an elliptical cone of depression to develop with

drawdown, preferentially propagating along the ridges. For Beebyn, this extraction rate will result in a drawdown of greater 3 m depth in an area extending up to 5000 m from the pit, while for Madoogna the effect will extend for a radial distance of up to 9000 m. Once mining has stopped and dewatering is no longer required it may take up to 25 years for all areas affected by the drawdown to recover (SRK, 2009).

Groundwater modelling further indicates that in the immediate period after cessation of mining the water table of the Beebyn and Madoonga pit lakes will be lower than the surrounding groundwater elevation, creating two open pits which will function as “sinks”, with groundwater flowing towards the pits. Because the initial direction of groundwater flow will be towards the pit voids, the water in the pit lakes will have no influence on the quality of the adjacent groundwater. However, the water quality in the pit lakes could deteriorate over time. The issue of long term pit void water quality is addressed in the Mt Weld Mine Closure and Rehabilitation Plan.

During the construction and operating phases of the project groundwater extraction, use and disposal will have to be managed in a manner that limits any potential environmental impacts. SMC’s proposed management strategies are described in Section 5 of this management plan.

4.0 POTENTIAL ENVIRONMENTAL IMPACTS

The potential impacts to groundwater as a result of the construction and operation of the Project include:

- Disturbance to natural groundwater flow patterns in proximity to the mine pit;
- Localised drawdown of groundwater may impact groundwater dependent vegetation ("phreatophytic vegetation") and/or subterranean fauna;
- Localised drawdown of groundwater may impact availability of groundwater from existing stock watering bores;
- Degradation or contamination of groundwater sources from hydrocarbon or chemical spills;
- Degradation and contamination of groundwater sources from inappropriately constructed and managed TSF and waste rock stockpiles;
- Degradation and contamination of groundwater sources from contaminated re-injected dewatered water;
- Contamination of groundwater as a result of seepage from pit lakes;
- Contamination from inappropriate disposal of evaporation salt waste.

5.0 ENVIRONMENTAL MANAGEMENT

5.1 Key Management Strategies

5.1.1 Fit-for-Purpose Water Use

Originally, SMC had considered disposing of fresh to brackish water from pit dewatering to natural watercourses (fresh water) and by piping saline water to an ephemeral salt lake (Lake Austin) located some 45 km to the south of the project area. However further studies have concluded that a better strategy for managing water from pit dewatering would be to use better quality water to satisfy operational requirements (including dust suppression), and to dispose of more saline water at an evaporation pond located approximately 5km to the west of the Madoonga mine pit.

Groundwater underlying the project site is not suitable as potable water without treatment (via Reverse Osmosis), however the untreated water extracted from the Beebyn Pit will be suitable for use in the process plant and for dust suppression without causing impacts on the surrounding environment. Water extracted from the Madoonga pit will not be used for dust suppression due to the higher levels of salinity. Water from this pit will be discharged (along with excess water from Beebyn) to the discharge evaporation pond

5.1.2 Optimising Water Use Efficiency

Water use efficiency will be reviewed on annual basis. Information on the entire water use system such as water usage rates, the amount of water lost via seepage, leaks and evaporation will be collected. The review will ensure that water is being used in an efficient manner and allow the identification of methods or areas where water use efficiency can be optimised.

5.1.3 Groundwater-Dependent Ecosystems

Groundwater dependent ecosystems (GDE) are those *ecosystems that are dependent on groundwater for their existence and health* (National Water Commission, 2006). These can include vegetation groups that fully or partially depend on shallow groundwater as source of water and subterranean invertebrates.

Groundwater dependent vegetation

Studies carried out on behalf of SMC have identified two units of vegetation which may represent at least a partially GDE. Vegetation group Unit 7a is a mixed shrubland comprising Melaleuca stereophloia and Cratystylis subspinescens over Tecticornia spp /Frankenia laxiflora. Unit 7b is low sparse shrubland and mixed tussock grasses comprising Eucalyptus carnei and E. trivalvis woodland over Cratystylis subspinescens and Muehlenbeckia florulenta. This community is considered locally significant, in that it provides a refuge to threatened fauna species. These units occur in and around

the seasonally inundated saline claypans to the north of the Madoogna pit. The estimated impact to the Community 7b is relatively high, with 38.82% of the community predicted to be impacted by the project. The estimated impact to Community 7a is low, 6.4%.

The degree to which the species which make up Vegetation Units 7a and 7b are dependent upon groundwater is unclear. However it is reasonable to assume that if a species is restricted to environments where groundwater is more readily accessible, there may be some dependence. SMC will carry out further investigations to estimate ecological water requirements of these vegetation units using the approach recently described by DoW for riparian vegetation in the Pilbara (DoW, 2010b).

Current modelling indicates that decreases of between 5 m and 125 m to current groundwater levels could occur over the nine years modelled for the life of the mines at Madoonga and Beebyn. The drawdown contours indicate that significant decline in the water table level could occur in the vicinity of the saline claypans and seasonally inundated zones at Madoonga. Modelling of drawdown cones indicates that the boundary of the drawdown cone, where decreases in the water table are likely to be range from 16 m to 26 m, encompasses approximately 15% to 25%of the main zone of inundation. A

further 5-15% lies between decreases of 26 and 35m and less than 5% between 36 to 46 m.

As noted above, it is yet to be confirmed that the vegetation in these areas is dependent on groundwater but it is assumed that they are likely to be partly dependent and as such shallow reinjection or surface watering methods will likely be successful in counteracting any degradation in vegetation health. On the assumption that the clay pan is at least partly dependent, the following management strategies will be implemented:

- All bores should be located 200 m away from the boundary of the above vegetation communities, as required by DoW.
- A baseline and long-term monitoring programme will be initiated to document any effects on groundwater dependent ecosystems resulting from groundwater extraction in the Project area.
- If vegetation stress is noted, then supplementary water will be provided to counteract the effect of dewatering.
- Monitoring of water quality will also be undertaken to ensure that there is no change in water quality that will adversely affect the GDE.

Subterranean fauna

Baseline investigations in the Project area have not identified any stygofauna or troglofauna likely to be affected by changes in groundwater levels (citation). Therefore, no management controls are required.

5.1.4 Water Dependent Social and Cultural Values

There are approximately 58 existing wells surrounding the Project area which are used for pastoral water supply purposes. It is proposed to monitor these bores to ensure that they are not impacted by drawdown or contamination. As the majority of the bores are on land owned by SMC, these bores will not be used for pastoral purposes during mine operation. Monitoring of bores outside of SMC land will also be undertaken, should changes be noted in these bores (that are not seasonal) then SMC will undertake mitigation works such as deepening of existing bores, drilling new bores or providing stock water by different means.

Baseline investigations and consultation with stakeholders have not identified any other water dependent social or cultural issues that require management.

5.1.5 Water Quality

Groundwater quality will need to be managed to ensure that there is no decline in water quality resulting from dewatering operations, disposal of surplus water or from the storage and use of fuels or reagents. Monitoring will be undertaken to ensure there is no decrease in water quality relative to established background values. Should monitoring indicate that water quality is being impacted then an investigation would be carried out to identify the causes of the impact.

The main potential groundwater quality impacts are likely to arise from seepage of saline water from the evaporation pond and seepage of acidic or metalliferous drainage (AMD) from waste rock dumps and ore stockpiles. Seepage of water from the evaporation pond will be minimised by the pond design which will incorporate a low permeability barrier layer. Groundwater monitoring wells will be located both upgradient and downgradient of the evaporation pond and groundwater levels and field parameters (pH, TDS and EC) will be measured on a monthly basis.

A geochemical characterisation program carried out by SRK has indicated that the ore material and the majority of waste rock is likely to be non-acid forming (NAF). SMC will manage waste which is designated as potentially acid forming (PAF) by encapsulation within cells of NAF waste to minimise the risk of AMD seepage. Groundwater monitoring wells down gradient of the waste rock dumps will be used to monitor groundwater quality. Groundwater levels and field parameters (pH, TDS and EC) will be measured on a monthly basis and samples will be submitted biannually for more comprehensive laboratory chemical analysis, in accordance with Dow guidelines.

5.1.6 Releasing Excess Water

SMC proposes to dispose of saline water produced by dewatering activities at Beebyn and Madoonga by piping the water to an engineered basin located to the west of the Madoonga pit. It is proposed that salts deposited in the basin will be periodically excavated from the pond to maintain storage capacity. Salt evaporate will be transported from site by an approved contractor to an appropriate licensed facility. Perimeter monitoring wells will be installed to allow detection of seepage from the water disposal facility.

5.1.7 Interference with Stream Beds and Banks

Initial options for excess groundwater disposal included the discharge Austin Lake to the south via existing creeks. This would have required the disturbance of the stream beds and banks. This option is no longer being considered.

5.1.8 Cumulative Impacts

The predicted groundwater drawdowns arising from SMC's proposed operations do not overlap with drawdowns from any other significant water users. No cumulative impacts associated with water abstraction are expected. Water discharge from SMC's operations will not be released to the environment: water will be disposed of at a purpose built facility. Accordingly, no cumulative impacts from water disposal are likely. Any effects on groundwater quality associated with seepage from waste storage facility or arising from spillage of fuels or reagents would occur at a local scale and are unlikely to result in cumulative groundwater impacts at an aquifer or catchment scale.

5.2 Monitoring

SMC will implement three types of monitoring to check on the effectiveness of its groundwater management:

- Operational monitoring (pumping rates, water consumption, integrity of pipelines, freeboard in water storages, etc.) to demonstrate that water abstraction and disposal conforms with approval conditions and is consistent with practices assumed in the environmental impact assessment;
- Monitoring of water quality and depth for the purpose of checking for evidence of change in areas potentially affected by SMC's water abstraction or disposal;
- Environmental condition monitoring (vegetation health, for example) to identify symptoms of biological responses to changed groundwater conditions.

Operational monitoring will be carried out and recorded at least weekly (or more often if dictated by operational requirements).

Groundwater quality monitoring will be carried out in accordance with DoW guidelines (DoW, 2009b) and with DoW/DEC licence requirements. A provisional groundwater monitoring schedule is presented in Table 3. Groundwater monitoring boreholes will be installed upstream and downstream of each pit and downstream of the evaporation/infiltration pond. SMC will measure groundwater levels in the monitoring boreholes on a monthly basis. Basic groundwater field parameters (pH, TDS, EC and temperature) will be measured at each monitoring location on a monthly basis. More comprehensive analysis (as outlined in DoW operational policy 5.12) will be carried out on samples collected from the groundwater monitoring bores on a six-monthly basis. Results of groundwater monitoring will be stored in a groundwater monitoring register.

Ongoing flora and vegetation monitoring will be carried at least annually out to document any effects on groundwater dependent ecosystems resulting from groundwater. Monitoring methods will include visual observation and photographic documentation of vegetation condition and may also include quantitative quadrat or transect based surveys.

5.3 Performance Assessment

SMC will assess its performance in relation to groundwater management through the following key indicators:

- SMC fully complies with all relevant approval conditions, including but not limited to DoW and DEC licence requirements;
- Groundwater monitoring shows that impacts are not significantly different to those predicted in the impact assessment and documented in the PER;
- Key management actions (Table 5.1) are fully implemented.

5.4 Management Response and Contingency Actions

In the event that the management actions listed in Table 5.1 do not appear to be achieving SMC's environmental objectives, SMC will investigate the causes of the unsatisfactory performance and will document a proposed alternative management approach, in consultation with relevant stakeholders and specialist advisors, as required. The timing of implementing contingency actions will depend upon statutory requirements and the level of environmental and safety risk involved.

5.5 Reporting and Communications

SMC's senior management team will be notified quarterly of how the operation is tracking against the key indicators for regulatory compliance, performance against predicted groundwater behaviour and implementation of key management actions (Table 5.1).

Reporting to OEPA, DEC, DoW and DMP will be performed annually and in accordance with Ministerial approval conditions, tenement conditions and licence requirements.

Table 5.1 Proposed Groundwater Monitoring Schedule

Monitoring location	Monitoring requirement	Frequency	Management Trigger	Contingency	Reporting
Dewatering bores / sumps	Flow rates (flow meter readings)	Weekly	Monthly abstraction quantity exceeds annual allocation/12	Rerun hydrogeological model to determine likely cause	DoW
	Water levels	Weekly	Dewatering is failing to maintain safe working conditions		DMP
	Water quality - field parameters (i.e. pH, EC, TDS)	Monthly	Quantity of water available for operational purposes is less than 80% of predicted. Quantity of water requiring disposal at evaporation pond exceeds predicted amount by more than 20%	Review operational water balance. Conduct water audit to identify opportunities for reducing use of operational-quality water. Review evaporation pond design.	Annual reports to DoW, DMP and OEPA
	Water quality – hydrochemistry suite	Biannually (May and November)	Water disposed to evaporation pond exceeds assumed salt loading by more than 10%	Review evaporation pond design and consider need for additional containment or seepage detection / interception systems	Annual reports to DoW, DMP and OEPA
Observation Bores - Dewatering	Water levels	Monthly	Annual review of water drawdown contours exceeds predicted extent of drawdown cone by more than 10% **- or -** Drawdown in areas of groundwater dependent vegetation exceeds trigger values calculated using DoW procedure (DoW, Sept 2010).	Rerun hydrogeological model to determine likely cause Review water monitoring results in context of vegetation health monitoring data.	Annual reports to DoW, DMP and OEPA

Monitoring location	Monitoring requirement	Frequency	Management Trigger	Contingency	Reporting
Observation Bores – Minesite, fuel farm, etc.)	Water levels	Weekly	Discernible change from pre-mining water quality	Conduct investigation to determine cause	Annual reports to DoW, DMP and OEPA
	Water quality - field parameters (i.e. pH, EC, TDS)	Monthly	Sequential monitoring events show clear trend away from pre-mining conditions	Conduct investigation to determine cause	Annual reports to DoW, DMP and OEPA
	Water quality hydrochemistry suite (as per DoW hydrogeological reporting guidelines)		Discernible change from pre-mining water quality	Conduct investigation to determine cause and notify DEC if required	Annual reports to DoW, DMP and OEPA
Observation Bores – Regional	Water levels	Monthly	Declining trend in water levels, compared to historic water levels.	Any changes in pastoral water bore levels that cannot be attributed to natural seasonal variations will be mitigated by SMC. This may include deepening of the existing bores, drilling of new bores or providing stock water by other means.	Annual reports to DoW, DMP and OEPA
	Water quality – hydrochemistry suite	Biannually (May and November)	Declining trend in water quality, compared to historic water levels.	Any changes in pastoral water quality that cannot be attributed to natural seasonal variations will be mitigated by SMC. This may include deepening of the existing bores, drilling of new bores or providing stock water by other means.	Annual reports to DoW, DMP and OEPA
Potable bores	Flow rates (flow meter readings)	Monthly	More than 20% increase in per capita water use	Conduct investigation – check for leaks	
	Water quality –	Monthly	Water quality fails to meet	Resample immediately. If necessary, supply potable water	DoH

Monitoring location	Monitoring requirement	Frequency	Management Trigger	Contingency	Reporting
	hydrochemistry suite		ADWG guidelines	from alternative source while conducting investigation.	
Wastewater treatment plant (WWTP)	Flows	Monthly	Per capita flows increase by more than 20%	Conduct investigation	Shire
	Water quality – pH, EC, TDS, TSS, major ions, nutrients, BOD, free chlorine, E.coli	Monthly	Water quality does not meet treatment plant specifications	Resample and conduct investigation	Shire
Evaporation / recharge pond observation bores	Water levels	Weekly	Freeboard exceeds design		DoW / DMP
	Water quality - field parameters (i.e. pH, EC, TDS)	Monthly	Water disposed to evaporation pond exceeds assumed salt loading by more than 10% Declining water quality trend in observation bores compared to pre-mining water quality	Review results of water quality in observation bores to check for discernible impact on groundwater. Review evaporation pond design and consider need for additional containment or seepage detection / interception systems	DoW / DMP
	Water quality – hydrochemistry suite	Biannually (May and November)	Declining water quality trend or discernible shift in major cations and anions in observation bores compared to pre-mining water quality	Review evaporation pond design and consider need for additional containment or seepage detection / interception systems	DoW / DMP

Table 5.2 Key Actions: Groundwater Management

Objective: Use groundwater responsibly and efficiently. Only use high quality water in situations where it is essential, or no other suitable water source is available				
Action	**Purpose**	**Criterion**	**Accountability**	**Timing**
Routinely monitor water use and benchmark against industry best practice	Promote awareness of water use efficiency	Report water consumption to management team quarterly	Production manager	Life of mine
Use grey water from waste water treatment plants for irrigation of amenity plantings where possible.	Reduce use of high quality water for irrigation	Percentage of grey water reclaimed for irrigation or other uses	Manager Environment	Life of mine
Conduct 2-yearly water audits	Identify opportunities for reducing water consumption.	Water used per capita (FTE) Water used per tonne of production	Manager Environment	Life of mine
Manage surplus water to reduce the effects of water releases to the environment				
Action	**Purpose**	**Criterion**	**Accountability**	**Timing**
Surplus water will be disposed of in an engineered evaporation pond	Prevent migration of salts into groundwater	No impact on pre-mining groundwater quality	Manager Environment	Life of mine
Surplus water will be disposed of in an engineered evaporation pond	Prevent mounding of groundwater beneath or surrounding disposal area	No discernible increase in groundwater levels, compared to historic water levels.	Manager Environment	Life of mine
Water exceeding 10,000 mg/L TDS will not be used in dust suppression (except within mine pit, if required)	Prevent salt damage to vegetation and accumulation of salt in surface soils	All dust suppression water will have TDS less than 10,000 mg/L	Construction manager Production manager	Throughout construction Life of mine
If required, a mosquito control programme will be implemented at water storage areas	Reduce disease risk	Adult and larval sampling results meet criteria to be developed in consultation with Department of Health.	Manager, OHS	Life of mine
Manage groundwater abstraction so as to limit the risk of adverse impacts on groundwater resources and environmental values				

Action	Purpose	Criterion	Accountability	Timing
Water abstraction will not exceed DoW water allocation.	Maintain water available to existing pastoral water bore users.	No exceedance of water allocation in any month.	Construction manager Production manager	Throughout construction Life of mine
Monitor vegetation health and groundwater drawdowns; periodically compare with hydrogeological predictions	Protect groundwater dependent biota	Groundwater drawdown trigger values calculated in accordance with DoW guideline Environmental water report series report no. 17 (Determining water level ranges of Pilbara riparian species, September 2010)	Manager, Environment	Prior to start of dewatering and throughout life of mine
Maintain groundwater quality so that existing and potential environmental, social and cultural values – including ecosystem protection – are protected				
Action	**Purpose**	**Criterion**	**Accountability**	**Timing**
Monitoring of groundwater quality in accordance with licence requirements and DoW guidelines (Report 19, Hydrogeological reporting associated with a Groundwater Well Licence)	Demonstrate water quality status	No change in groundwater quality outside the direct mine footprint, compared to pre-mining quality	Manager Environment	Life of mine
Surplus water will be disposed of in a engineered evaporation pond	Prevent migration of salts into groundwater	No impact on pre-mining groundwater quality	Manager Environment	Life of mine
Encapsulate PAF waste rock within NAF waste rock cells.	Prevent migration of AMD into groundwater	No impact on pre-mining groundwater quality	Mine Manager	Life of mine
Hydrocarbons will be managed in accordance with AS1940-2004.	Prevent migration of contaminants into groundwater	No impact on pre-mining groundwater quality	Manager Environment	Life of mine

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