Appendix J.

Solomon Water Management Plan v1

Solomon Project
Water Management Plan

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1. INTRODUCTION

1.1 PROJECT BACKGROUND

Fortescue Metals Group Limited (Fortescue) proposes to expand its current operations in the Pilbara region of Western Australia through the development of new mines within the Solomon Project. The Solomon Project involves the development of a new mining province in addition to the Chichester mines already operated by Fortescue at Cloudbreak and Christmas Creek.

The Solomon Project includes two new iron ore mines at deposits known as Firetail and Kings, on greenfield sites approximately 60 kilometres (km) north of Tom Price. The deposits will produce a combined total of up to 80 million tonnes (Mt) of iron ore per annum. The Firetail deposit will produce up to 30 Mt per annum of Brockman fines, comprising a blend of Bedded Iron Deposits (BID) and Detrital Iron Deposits (DID). The Kings deposit will produce up to 50 Mt of ore per annum comprising mostly Channel Iron Deposits (CID) with some Brockman and Detrital ore. Ore from both the Firetail and Kings deposits will be mined by conventional truck and shovel methods using a discrete pit mining concept of placing overburden and waste into mined out areas.

Fortescue also proposes to develop the Solomon rail line which will link the two new mines to Fortescue's existing north-south rail line, approximately 127 km to the east. Processed ore will be transported to Fortescue's existing Herb Elliot Port facilities in Port Hedland for export.

Full details of the proposal are provided in the Public Environmental Review report (FMG, 2010).

1.2 OBJECTIVE

This water management plan for the Solomon Project has been developed in line with the Department of Water *Pilbara water in mining guidelines* (2009). The information provided herein addresses mine water management components as per Table 3 (pages 20-24) of the Guidelines. Table 3 provides a checklist of issues to be considered in preparing a water management plan.

This draft water management plan outlines Fortescue's strategy for managing water over the life of the Solomon Project. The supporting information, prepared in line with Department of Water *Statewide Policy No.19 – Hydrogeological reporting associated with a groundwater well licence* consists of the following reports:

- Solomon Hydrogeological Assessment (MWH, Dec 2010).
- Solomon Project Groundwater Modelling (NTEC, Dec 2010).
- Solomon Project Public environmental Review (Nov 2010)
- Solomon Flood Management (MWH, Dec 2010).

2. BACKGROUND

2.1 HYDROGEOLOGY

Fortescue Metals Group (Fortescue) commissioned MWH to undertake a hydrogeological investigation to characterise the hydrogeological environment of the Solomon Project Area, specifically within the Valley of the Queens, Trinity and the Valley of the Kings located within tenements E47/1333 and E47/1334. These investigations were carried out between May and November 2010. A hydrogeological assessment report (MWH, 2010) describes the findings of the drilling, construction and testing programs undertaken in the main Solomon Project Area.

The key findings of the investigations are:

- A total of fifteen monitoring bores have been constructed in the Solomon Project Area. More specifically, ten in the Valley of the Queens, three in Trinity and two double piezometers in the Valley of the Kings.

- Four test production bores have been drilled, constructed and test pumped. Two test production bores are located in the Valley of the Queens and two are in the Valley of the Kings.

- Hydraulic testing was also carried out on six test production bores from a previous hydrogeologic investigation conducted in 2008, as well as, a Rio Tinto Iron Ore rail construction water supply bore recently acquired by Fortescue Metals Group.

- Extended hydraulic tests of 7 and 10 days duration were undertaken on two test production bores in the Valley of the Kings (SPB1004 and Jorgermeister).

- Groundwater in the Solomon Project area is associated with: *Alluvial*, *colluvial* and *detrital* deposits within the palaeochannels which overlie the CID deposits. The alluvial deposits can also include calcrete and silcrete deposits at palaeo water tables. An *Upper CID* unit which generally has low permeability. An ochreous goethite rich *Lower CID* unit which generally has high permeability from secondary porosity and is considered to be the primary aquifer in the project area.

- The hydraulic gradient in the Solomon Project area suggests it is typically a throughflow system with groundwater flowing from the Valley of the Kings, through Trinity and the Valley of the Queens discharging to Weelumurra Creek. However, during periods of high groundwater levels (present day conditions), localised groundwater gradient reversals occur allowing groundwater to effectively ‘spill’ over bedrock controlled outlets discharging to Kangeenarina Creek Pool and Zalamea Pool. These outflows contribute to the Kangeenarina and Zalamea Pools and suggest the two pools may only be present during periods of high groundwater levels within the Solomon aquifer system.

- The total storage for all saturated units in the Solomon Project area (alluvials, Upper CID and Lower CID) is estimated to be approximately 115 GL. This represents a storage rate of 3.3 GL/km over the 35 km length of the Solomon Project CID deposit.

- The estimated throughflow for the Solomon Project area suggests that throughflow in the Valley of the Kings is approximately 0.16 ML/day. This increases to 1.8 ML/day in the Valley of the Queens and ultimately 2.16 ML/day at the Weelumurra Creek outlet.

- The direct rainfall recharge for the Solomon Project area (70,400,000 m^2) with an annual rainfall of 350 mm/annum is estimated to be 740.2 ML for 3% recharge rate and 2,464 ML for a 10% recharge rate.

- The water quality of the groundwater in the Solomon Project area is considered to be 'fresh' with TDS values ranging from 98 to 764 mg/L.

- The observed significant difference between the water quality of the CID and Bedrock would suggest that groundwater contribution to the CID from the Bedrock is relatively minor.

- In general, there is a trend of decreasing transmissivity towards the eastern extent of the Valley of the Kings (13,700 m^2/day to 1478 m^2/day – maximum values). The exception is at the western extent of the Valley of the Queens in the vicinity of Weelumurra Creek where the permeability decreases (332 m^2/day).

- It is considered that dewatering of the CID deposit can be achieved by the managed withdrawal of groundwater via a dewatering borefield layout oriented along the axis of the deepest part of the CID channel.

2.2 MODELLING

Fortescue commissioned NTEC Environmental Technology to undertake a preliminary modelling study, aimed at describing the groundwater flow processes within the Solomon Project Area. The groundwater model was developed on the basis of data supplied by MWH as described in the report, Hydrogeological Assessment of the Solomon Project (MWH, 2010). The full NTEC report is provided in Appendix A.

3. WATER MANAGEMENT COMPONENTS

3.1 WATER SOURCES

The CID to be mined at Solomon will require dewatering ahead of mining to provide safe, dry mining conditions. This dewatering abstraction will provide the water supply for ore processing, mine operational uses such as dust suppression, and maintenance of phreatophytic vegetation impacted by dewatering drawdowns.

Based on a water supply demand of 10 GL/a, groundwater modelling by NTEC (2010) indicates that the CID aquifer in the Project area will be fully dewatered by end of Mining Year 7. From Year 8, water will be imported to the Project area from a borefield developed in a similar CID aquifer in Serenity Valley. Serenity Valley is located 40km west of Solomon on a Fortescue exploration tenement. Preliminary investigation work in Serenity (MWH, 2010a) has confirmed suitable quality and quantity of water is available in Serenity to meet the project demand of 10 GL/a from Year 8-18. There are no Groundwater Dependent Ecosystems (GDEs) associated with the CID aquifer in Serenity.

3.2 ABSTRACTION

Based on preliminary mine planning, groundwater modelling (NTEC, 2010), indicates that annualised dewatering volumes to Year 7 will range up to 12 GL/a.

Mining Year	Cumulative Volume (GL)	Dewatering Rate (GL/a)
6 months premining	4.9	9.7
1	13.8	8.9
2	23.1	9.3
3	34.9	11.8
4	46.4	11.4
5	55.8	9.5
6	67.5	11.6
7	71.8	4.3

Based on an annual water supply demand of 10 GL/a, dewatering will effectively match demand for the first 7 years of mine operation with periodic excesses as new dewatering borefields are commissioned ahead of mining.

Construction water supplies will be sourced from the CID aquifer and will be in the order of 1 GL over an 18 month period.

Initial dewatering abstraction above construction requirements and ahead of ore processing requirements will be reinjected into the CID aquifer in a tributary CID channel hydraulically disconnected from the initial mining area. This water will be available for future redraw.

3.3 FIT-FOR-PURPOSE WATER USE

Solomon ore processing requires water with a Total Dissolved Solids (TDS) level of less than 1000 mg/L. Other operational uses such as dust suppression can use brackish water up to approximately 5000 mg/L TDS.

The Solomon CID groundwater being abstracted through pit dewatering is of good quality being generally 300 mg/L TDS. The water is considered suitable for all water requirements in the ore processing and operational uses. Deterioration in water quality over time is not anticipated.

3.4 WATER DEPENDENT ECOSYSTEMS

Ephemeral pools exist in Kangeenarina Creek and Zalamea Gorge (FMG, 2010 and MWH, 2010a). These pools are fed by groundwater discharge from the CID aquifer for periods after significant recharge events (cyclones) (MWH, 2010a). During extended periods between major recharge events the pools dry up and there is effectively no surface water present (current condition December 2010). Subsurface water flow maintains the phreatophytic vegetation in these areas for a period until groundwater levels recess to a point when flow to these areas effectively ceases.

Dewatering of the CID will interrupt the flow of groundwater to the areas where pools form and vegetation is dependent on water throughflow. The throughflow rates to the pool areas have been determined from groundwater modelling to range from 9-18 L/sec for the Kangeenarina system and 5-10 L/sec for the Zalamea Gorge system (NTEC, 2010).

It is proposed to manage the phreatophytic vegetation in Kangeenarina Creek and Zalamea Gorge by augmenting water flow in the alluvial material upstream of the pool area. This will be done by injecting water from the dewatering system into the alluvials to maintain water flow to the area. The flow rate will be varied to compensate for seasonal changes (evapotranspiration). This augmentation will be undertaken from Year 2 of mine life when modelling has indicated the pool area in Kangeenarina creek will be impacted by dewatering drawdown.

3.5 WATER DEPENDENT SOCIAL AND CULTURAL VALUES

There are no identified/documented water dependent sites of social or cultural value in the project area. The pool areas in Kangeenarina Creek and Zalamea Gorge are considered to have intrinsic social and cultural value in line with the general value of water in the Pilbara. This value will be maintained via the proposed pool management.

3.6 WATER QUALITY

No significant deterioration in water quality is anticipated during the life of the mine. Acid rock drainage is not considered to be an issue as no acid generating formations will be intercepted in the course of mining (FMG, 2010).

Augmentation of pools will be maintained with the same quality of water as the nature flow system.

Groundwater in the area of CID proposed for reinjection of any dewatering abstraction in excess of processing demand is of similar quality to the dewatering quality.

The combined area of the pits and catchments impacted by the Solomon project is approximately 342km^2 (MWH, 2010b). This represents 1.7% of the overall Lower Fortescue catchment and is therefore not expected to impact significantly on flow volumes, water quality or sediment regimes downstream of the mine area (MWH, 2010b).

The western section of the Solomon mining area (Queens) is located within the Millstream Public Drinking Water Source Area (PDWSA). The combined area of the pits and catchments impacted in the Queens area is approximately 55km^2 which represents 0.4% of the Millstream catchment (MWH, 2010b). Therefore, no significant impact on flow volumes, water quality or sediment regimes is expected downstream of the Queen's mine area. The area is Priority 2 (P2) PDWSA. As such, mining and mineral processing is allowed subject to conditions being placed on the operation. Tailings dams are an incompatible land use in P2. On this basis no tailings facilities will be developed in the Queens area of Solomon.

3.7 EXCESS WATER

Any dewatering abstraction that is excess to ore processing requirements will be reinjected into a tributary section of the CID in Kangeenarina Creek that is hydraulically disconnected from the mining area. The reinjection borefield will be installed for commencement of dewatering as the ore processing demand will not commence until 12 months after commencement of dewatering.

3.8 WATER USE EFFICIENCY

In line with current Chichester operations, Fortescue will incorporate best practice management in the ore processing facilities to minimise water use and maximise water use efficiency.

3.9 OPTIMISATION OF WATER USE

Water use will be optimised by using dewatering abstraction to meet ore processing water supply demands and operational uses such as dust suppression. Any excess to these demands will be reinjected into the CID aquifer away from the mining area. This will allow later withdrawal of this water to meet ore processing demand in times of dewatering shortfalls. Reinjected will also negate any environmental impacts from the discharge of water to the environment.

3.10 CUMULATIVE IMPACTS

There are no perceived cumulative impacts as there are no other mining operations or users drawing from the same groundwater sources.

3.11 STREAM BEDS AND BANKS INTERFERENCE

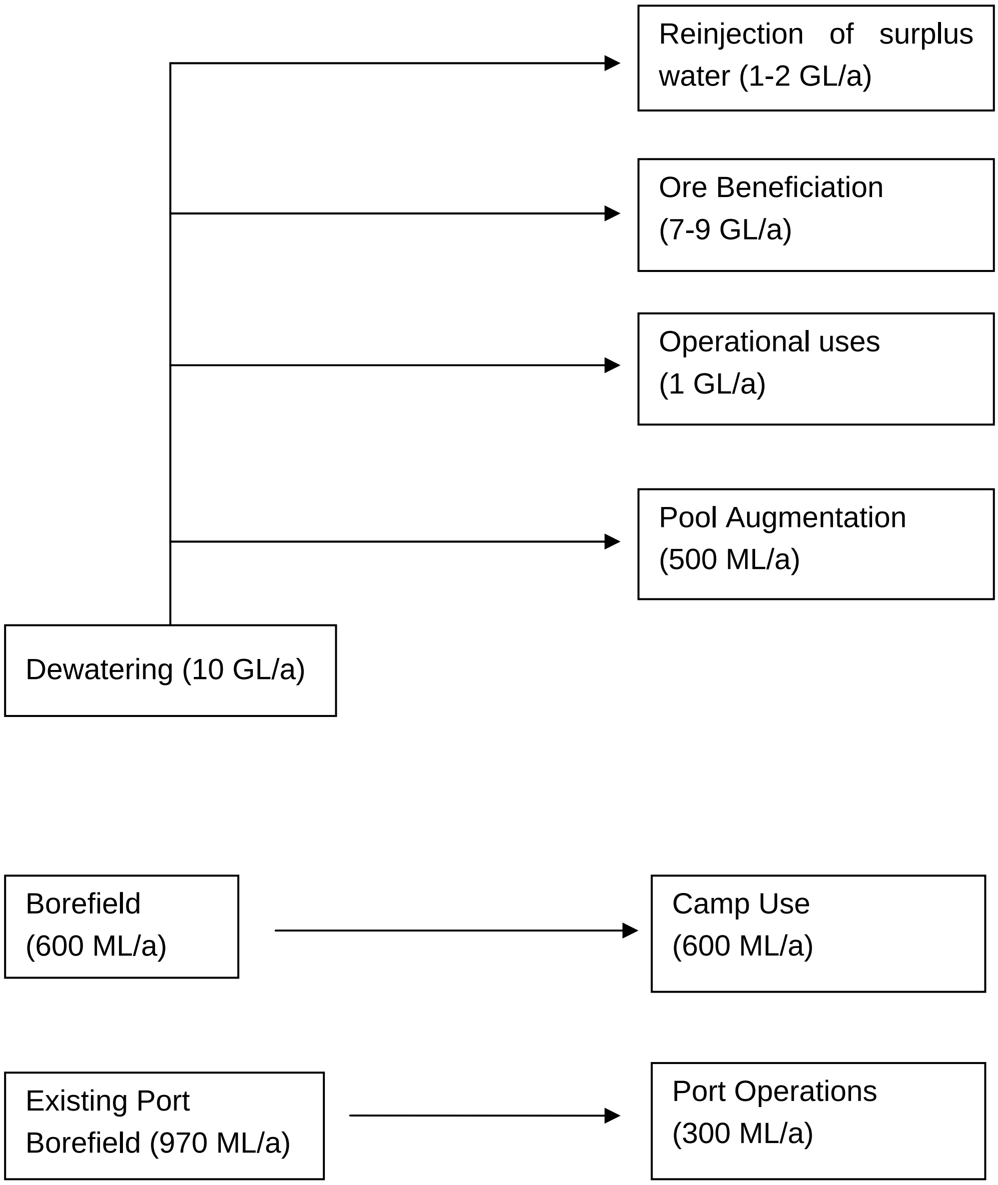
Flood control structures consisting of bunds, drains and retention embankments will be required at various locations during the life of mine (MWH, 2010b). Upon finalisation of the mine plan, individual structures will be referred to the Department of Water.

3.12 POST-CLOSURE MANAGEMENT

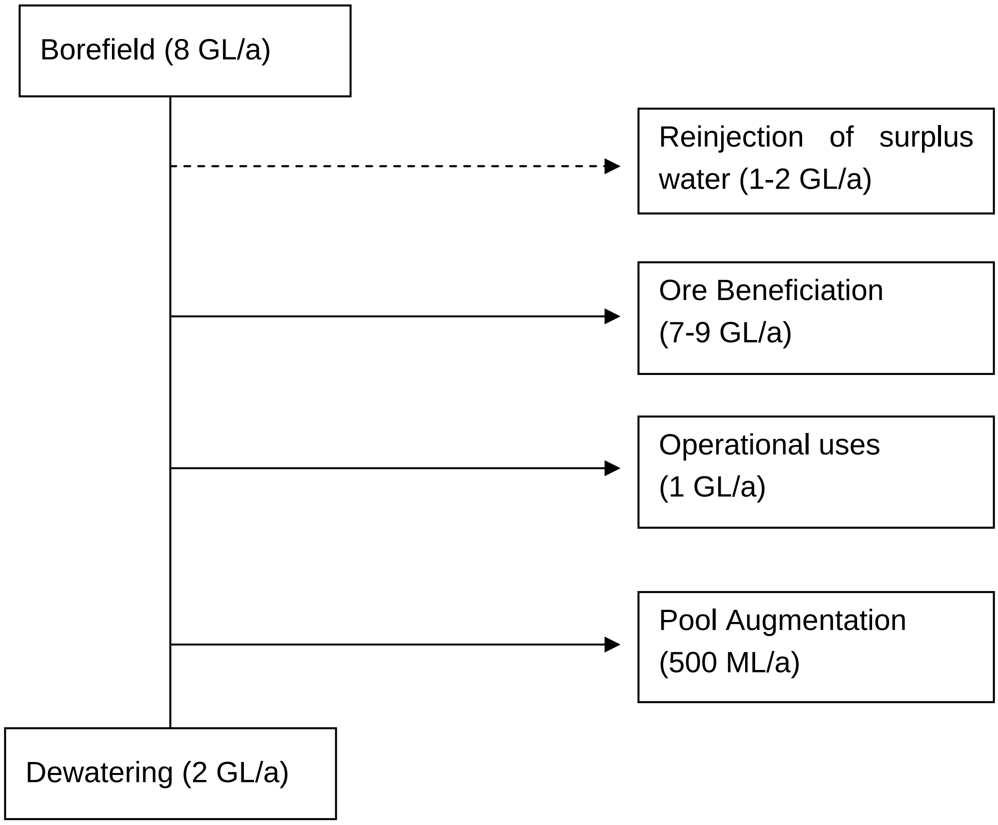
At mine closure, the land surface upstream of the Kangeenarina Creek and Zalamea Gorge pool systems will be reinstated using permeable overburden to provide a throughflow system (FMG, 2010). The resultant mine void is expected to fill with water from rainfall. Due to the anticipated volume of inflows from periodic cyclones and the location of the project area at the headwaters of three catchments, the salinity increase over time is considered to negligible and will be ameliorated by each cyclone event.

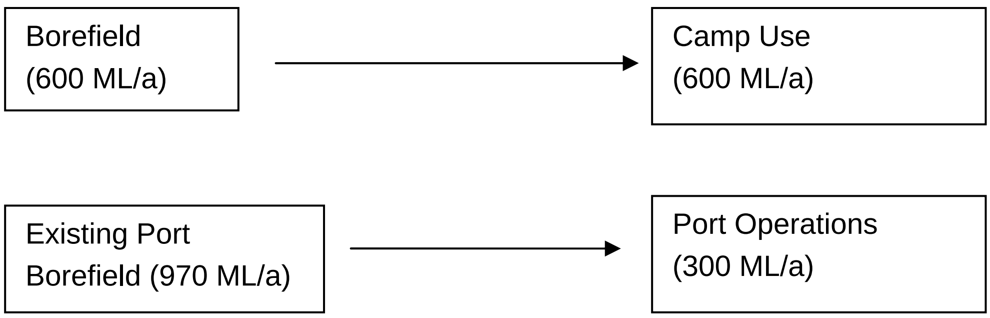
4. WATER BALANCE

The estimated water balance for the Solomon project for **Years 1-7** is provided below. All mine water use during this period will be sourced from the dewatering abstraction.



The estimated water balance for the Solomon project for **Years 8-18** is provided below. An external borefield, drawing from a CID aquifer in Serenity Valley 40km west of the Solomon Project, will provide the main mine water supply.





5. CONCLUSIONS

Detailed investigations have identified sufficient water of appropriate quality available in the Solomon and Serenity CID aquifer systems to meet operational demands for the project life. These water resources are currently unused and their use for mine operations is considered to be a beneficial use.

The Solomon CID will be dewatered ahead of mining to provide safe, dry mining conditions. Any dewatering abstraction that is excess to operational demands will be reinjected into a CID tributary that is hydraulically disconnected from the mining area.

Phreatophytic vegetation in the Solomon area can be maintained through augmentation with water from the dewatering system. There are no GDEs associated with the Serenity CID aquifer.

The western section of the Solomon mining area (Queens) is located within the Millstream Public Drinking Water Source Area. The potential for water quality impacts on Millstream are considered to be negligible due to the relatively small flow contribution from the Queens area of the Solomon Project to the Millstream Catchment. The quality of groundwater and surface water from the Solomon mine area is not expected to deteriorate significantly as a result of mining or mine closure.

6. REFERENCES

Department of Water, 2009. *Pilbara water in mining guidelines*. Water resource allocation planning series Report No.34.

FMG, 2010. *Solomon Project Public Environmental Review*.

MWH, 2010a. *Solomon Hydrogeological Assessment*. Unpublished consultant's report.

MWH, 2010b. *Solomon Flood Management*. Unpublished consultant's report

NTEC Environmental Technology, 2010. *Solomon Project Groundwater Modelling*. Unpublished consultant's report.

Appendices

Appendix A.

Solomon Project Groundwater Modelling (NTEC, 2010)