

Life of Mine Tailings Storage Facility Design

Fortescue Metals Group Limited

Cloudbreak Iron Ore Mine

MINEWPER00338AU-AB CB LoM TSF Design Rev1

16 September 2010

Fortescue Metals Group Limited
Level 2, 87 Adelaide Terrace
EAST PERTH WA 6004

Attention: Paul Ridout

Dear Paul:

**RE: Life of Mine Tailings Storage Facility Design
Cloudbreak Iron Ore Mine**

Coffey Mining Pty Ltd is pleased to provide 2 copies of our final report covering the Life of Mine design concept for Tailings Storage Facilities at Fortescue Metals Group Ltd's Cloudbreak Iron Ore Mine.

We trust this information meets your immediate requirements. Should you require clarification of any information, please do not hesitate to contact this office.

For and on behalf of Coffey Mining Pty Ltd



Chris Johns
Associate Engineer

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EXECUTIVE SUMMARY

The Life of Mine Tailings Storage Facility (TSF) design at the Fortescue Metals Group Ltd Cloudbreak Iron Ore Mine involves identification and assessment of suitable mined out pits for use as in-pit TSF.

The design work was undertaken to provide FMG with sufficient information for planning future mine development and to document the tailings management strategy for regulatory review and approvals requirements.

The operation of in-pit tailings storage facilities (IPTSFs) involves controlled deposition of tailings into, and recovery of water from, partially or completely mined out pits to maximise density of the deposited tailings. The tailings management approach at Cloudbreak typically involves concurrent mining activity and tailings deposition for any given pit. This is achieved by construction of in-pit mine waste embankments to separate the tailings storage from the active and future mining areas.

Several key benefits associated with the use of IPTSFs at Cloudbreak include:

- Reduction in clearing of natural vegetation when compared with above-ground alternatives.
- Greater long-term integrity of tailings containment when compared with above-ground alternatives.
- No long-term aesthetic impact, unlike above-ground TSF.
- Lesser capital costs for development compared with alternative forms of TSF.
- Lesser rehabilitation costs compared with above-ground TSF.

The TSF design philosophy at Cloudbreak incorporates two basic embankment designs. The first design comprises compacted fill sourced from waste dumps proximal to the pit. The second design has a downstream mine waste zone dumped in the pit during mining operations, with a nominal 15 m wide compacted upstream zone. The risks associated with embankment stability adjacent to the mining area have been successfully managed at Cloudbreak through adequate design, instrumentation, and monitoring.

Eight proposed mine pits were identified by FMG on the June 2010 Cloudbreak mine plan for use as future IPTSF. The proposed pits were assessed for deposition method, sequencing, capacity, and required maximum embankments to contain a Life of Mine of approximately 17 years.

A consolidation analysis of the Cloudbreak in-pit tailings was undertaken to assess the expected settlement and deformation of tailings deposited in-pit. The model predictions are particularly sensitive to the assumed tailings permeability, and indicate that post depositional settlement will occur over 3 to 7 years for shallow pits above the groundwater table and may take between 5 and 11 years for deep pits with tailings deposition below water table.

On decommissioning, the top surface of the IPTSFs will be covered in overburden and topsoil, and revegetated.

1 INTRODUCTION

This document presents the Life of Mine Tailings Storage Facility (TSF) design at the Fortescue Metals Group Ltd (FMG) Cloudbreak Iron Ore Mine.

The design work was undertaken to provide FMG with sufficient information for planning future mine development and to document the tailings management strategy for regulatory review and approvals requirements.

The design work included:

- documentation of the design and operation for the existing TSF
- assessment of future TSF design concepts based on the FMG mine plan (June 2010)
- development of a 2-Dimensional finite element model describing settlement and deformation of tailings deposited in-pit

The TSF design was prepared in general accordance with DMP standards, and in particular with '*Mining Environmental Management Guidelines, Safe Design and Operating Standards for Tailings Storage*' (May 1999).

The design concepts were developed by Coffey Mining in association with and based on information provided by FMG.

The current mine infrastructure in the vicinity of Cloudbreak is shown on Figure 1.

2 BACKGROUND INFORMATION

At Cloudbreak, all run of mine (ROM) is processed through the OPF, a processing facility able to produce three market products; namely lump, special and rocket fines. Future demand will dictate whether all three products will be produced, however rocket and special fines are currently the primary product being produced. Cloudbreak OPF is a dry run facility with future plans to include a wet plant (desanding plant) which will assist in reducing high levels of naturally occurring silica and alumina in the ROM. Waste from the OPF comprises fine (silt size) and coarse (sand size) residue streams which are co-disposed as slurry in designated tailings storage facilities. Based on the current mine plans the projected Life of Mine is approximately 17 years with approximately 6 Mtpa of tailings residue to be generated for project production rates.

FMG started producing tailings in early 2009 and has typically produced tailings at approximately 2.6 Mtpa to date.

3 SITE DESCRIPTION

The climate, existing landforms, potential impact to flora and fauna, and surface and groundwater setting were considered in the development of the TSF design concept.

3.1 Climate

The following climatic data applies to the mining area:

- Estimated average annual rainfall of 310 mm (as measured at Newman between 1965 – 2003, Australian Bureau of Meteorology).
- Average annual evaporation is estimated at 3,300 mm/year (based on Port Hedland and Marble Bar data).
- The 1 in 100 year 72-hour storm event for the mine area is approximately 4.8 mm/hr (IEAUST, 1987)⁶.

3.2 Landform

Within the eastern Pilbara, the regional topography is dominated by the Hamersley Plateau in the south and the Chichester Ranges in the north, with the two features divided by the Fortescue Valley. The main drainage is the Fortescue River, which flows north-west on Roy Hill Station into the Fortescue Marshes. The pre-mining topography of the project area can be described as gently undulating, with a maximum relief from the Fortescue Valley (400–450mRL) to the Chichester Ranges (500–600mRL) of approximately 50–200m. The Chichester Ranges and the major drainage system of the Fortescue Valley to the south, trend towards west-north-west.

3.3 Geology

The project area lies within the Hamersley Basin where granitoid rocks of the Pilbara Craton are overlain by sedimentary rocks. The lowest of the sedimentary group is known as the Fortescue Group, which is itself overlain, in parts, by the Hamersley Group. These sedimentary formations were originally formed in horizontal layers, but over time, tectonic movement has resulted in folding of the rocks and several major geological faults have developed. Typically, the base of the mined out pits are predominantly low-grade mineralised waste, with significant amounts of yellow/orange chert, and small amounts of white (kaolinised) and purple/blue shale. The low grade waste and chert is present in the form of layered rock, with alternating bands of higher- and lower-Fe rich material, and silica-rich rock. The pit base is typically reasonably hard, but is fractured in some areas due to sub-drill.

3.4 Flora and Fauna

Vegetation in the vicinity of the mine area is a mosaic of low woodland with Mulga in valleys and hummock grasslands, low open tree steppe with Snappy Gum (*Eucalyptus leucophloia*) over *Triodia wiseana*, and Kanji (*Acacia pyrifolia*) over soft spinifex and *Triodia wiseana* hummock grasslands.

The Cloudbreak Project Area has a range of habitats that represent a transition from the samphire flats surrounding the Fortescue Marshes on the southern boundary to the Spinifex covered foothills of the Chichester Ranges to the north. In between lie areas of Spinifex plains, Mulga/Acacia woodlands with or without Spinifex understorey, dissected by *Corymbia* sp. dominated watercourses.

3.5 Hydrogeology

Groundwater levels are a subdued reflection of regional topography. Maximum groundwater levels are observed along the topographic highs associated with rocks of the Hamersley and Fortescue Groups, whilst groundwater levels are lowest in low-lying areas associated with creeks of the Fortescue River system and the Fortescue Marshes. Groundwater both below and close to the Marshes is thought to be saline while closer to the Chichester Ranges the water is fresh. Groundwater levels around the TSF are significantly impacted by mine dewatering. The pit floors are typically of relatively low permeability, but have some vertical cracks and joints.

To date, tailings have been deposited in IPTSF above the pre-existing natural groundwater level. Seepage from the TSF will migrate downwards and to a limited lateral extent.

3.6 Surface Water

The Cloudbreak mining area is located on the southern flanks of the Chichester Plateau, north of the Fortescue Marshes. The Fortescue Marshes comprise extensive intermittent wetlands occupying an area around 100km long by 10km wide (typically) and located in the upper reaches of the Fortescue River. Numerous ephemeral creeks flow into the Marshes from the southern and northern flanks of the Fortescue Valley, including Goman Creek which is close to the Cloudbreak Mine site. Goman Creek has a catchment area of approximately 30km² and during peak flood events carries significant discharge over the lower slopes of the Chichester Plateau. The surface elevation of the Cloudbreak mining area is between 415m to 450m above sea level, which is considered well above any potential flood storage level in the Fortescue Marshes.

Surface water protection bunding is required around the pit perimeter to prevent external surface water from entering the pit. Accordingly, natural water inflow into the IPTSF is by incident rainfall only.

4 TAILINGS STORAGE FACILITY DESIGN

4.1 In-pit Tailings Storage Concept

The in-pit method of tailings disposal has been adopted at Cloudbreak. The operation of in-pit tailings storage facilities (IPTSFs) involves controlled deposition of tailings into, and recovery of water from, partially or completely mined out pits to maximise density of the deposited tailings.

The state regulatory authorities are generally keen to see as many open pits as possible in Western Australia filled with either tailings or mine waste. The following key issues are relevant from a regulatory perspective with respect to IPTSF:

- Presence of any mineralisation in the base of the pit which may be economic.
- Presence of a groundwater resource, and the minimisation of any groundwater contamination.
- Stability of pit walls.
- Tailings characteristics.
- Operational aspects.
- The need for the final tailings surface to be either 5 m above or 5 m below the natural water table.

Several key benefits associated with the use of IPTSFs at Cloudbreak include:

- Reduction in clearing of natural vegetation when compared with above-ground alternatives.
- Greater long-term integrity of tailings containment when compared with above-ground alternatives.
- No long-term aesthetic impact, unlike above-ground TSF.
- Lesser capital costs for development compared with alternative forms of TSF.
- Lesser rehabilitation costs compared with above-ground TSF.

4.2 In-pit Tailings Storage Facility Embankment Design

The tailings management approach typically involves concurrent mining activity and tailings deposition for any given pit. This is achieved by construction of in-pit mine waste embankments to separate the tailings storage from the active and future mining areas.

The TSF design philosophy at Cloudbreak incorporates two basic embankment designs. These may be used individually or in combination and are illustrated on Figure 2. The first design comprises compacted fill sourced from waste dumps proximal to the pit. The second design has a downstream mine waste zone dumped in the pit during mining operations, with a nominal 15 m wide compacted upstream zone.

There are three existing TSFs at the Cloudbreak Mine, namely, the Daydream, Hamilton and Hook IPTSF. Currently, the Daydream and Hamilton IPTSF are near full capacity and tailings deposition has commenced to the Hook IPTSF. Design and construction of the next TSF, identified as Phase 1 Brampton IPTSF, is in progress. The risks associated with embankment stability adjacent to the mining area have been successfully managed at Cloudbreak through adequate design, instrumentation, and monitoring.

The embankment geometry for the two designs shown on Figure 2 is based primarily upon considerations of stability, safety and ease of construction. Minimum batter slopes of 1V : 1.5H have been chosen based on the results of embankment seepage and stability modelling, with flatter upstream batter slopes of 1V : 2H to be adopted where construction of an upstream compacted zone is planned. The design crest width will accommodate large construction equipment, and in has ranged from 35m to 57m based on input from Cloudbreak Mine Operations. It is anticipated that embankments will be founded on competent material at the base of the pit and earthworks construction will occur whilst dewatering measures (if necessary) remain in place, i.e. the embankment footprint area will be dry.

Up to 6m of mine waste was backfilled into the Hook pit to raise the TSF floor elevation up to the original groundwater elevation at approximately RL410m. Mine waste at Cloudbreak typically contains 11% to 30% fines (<75 μ m) and is non-dispersive, and as such the risk of a significant amount of tailings migrating through the mine waste was considered low.

The embankment construction method adopted will vary depending upon several factors including:

- The size of the pit;
- Tailings storage requirements; and
- Scheduling of mine waste movement.

Detailed design of each TSF is undertaken that includes assessment of proposed embankment stability and seepage, TSF water balance considerations, tailings spigot and water return details, operational recommendations, instrumentation details, and freeboard requirements.

4.3 Mine Waste Geochemistry

The geochemistry of mine waste samples was assessed by Graeme Campbell and Associates with regard to implications for mine waste storage, as reported by Coffey Mining (2008)³. A range of mine waste samples derived from the wall-waste zone of the Cloudbreak Deposit were geochemically characterised. Based on the results of this study, the regoliths and waste-bedrocks to be produced during open-pit mining of the Cloudbreak Deposit were classified as Non-Acid Forming (NAF), due to minute/negligible amounts of sulphide-minerals. Enrichments in minor-elements should only be slight, and soluble-salt contents should be low to moderate. The Roy Hill Shales are classified as Potentially-Acid Forming (PAF) however open-pit mining will not extend deep enough for the Roy Hill Shales to be intersected. No geochemical concerns were foreseen for the mine-waste materials to be produced during open-pit mining of the Cloudbreak deposit.

An update to the mine waste geochemical characterisation was initiated in August 2010 with a desktop study of available geochemical data. It is anticipated that recommendations from the study will include a program of sampling and testing selected mine waste samples to verify the assessment.

4.4 Residual Process Chemicals

There is no chemical treatment associated with the operation of the Desanding Plant, but some residual flocculent (BASF Magnafloc 336) may be present in the process water. The following characteristics of the process and tailings return water are anticipated:

- Salinity of process water low to moderate salinity
- Salinity of tailings return water low to moderate salinity
- pH of slurry ex plant 6 to 8
- pH of return water 6 to 8

It is understood that towards the end of mine life, the salinity of the process water and mine tailings will increase from moderately saline to hypersaline quality.

4.5 Tailings Properties

The following engineering properties of the tailings are anticipated based on design parameters and laboratory testwork:

- Average slurry density ex-plant 55% solids (range 45-60%)
- Final tailings dry density (average) 1.5 t/m³
- Particle size distribution 51% passing 75 microns (design)
- Hydraulic Conductivity 10⁻⁷ m/s (estimated)
- Tailings beach slope 1%

5 FUTURE TAILINGS STORAGE FACILITY DESIGN PLAN

The identification and assessment of future mined out pits for tailings storage was undertaken based on the June 2010 Cloudbreak mine plan.

5.1 Assessment of Mine Plan and Future TSF

Eight proposed mine pits were identified by FMG on the June 2010 Cloudbreak mine plan for use as future IPTSF. The proposed pits were assessed for deposition method, sequencing, capacity, and required maximum embankments to contain a Life of Mine of approximately 17 years. Groundwater information was also assessed to identify where the pit floor was in relation to the pre-mining groundwater table. The average groundwater elevation at Cloudbreak is RL411m and was the boundary line used to determine above or below water storage volumes. Total pit capacities were calculated by FMG based on ore reserves and these pit volumes were the assumed maximum capacity available for tailings storage. FMG evaluated the capacity above the water table and calculated the required embankment volumes to contain all materials in-pit. The embankments were set on the pit boundary and raised to the lowest elevation point on the topography of the pit. The assumed embankment geometry was a crest width of 57m at slopes of 1V :1.5H. Pit capacities were evaluated incorporating the loss of depositional capacity due to the embankment.

A table summarising the proposed future in-pit TSF including the sequence, availability, and capacity of each is provided in Appendix A. In addition, a site plan showing the showing the pits identified for tailings disposal and the required earthworks is provided in Appendix A.

Based on the preliminary assessment and by only considering above ground storage availability in the pits initially identified by FMG, there was not sufficient above groundwater table tailings storage for the life of mine. FMG has indicated they would prefer to deposit tailings above water table, and thus would likely identify additional pits to use as IPTSF on a future version of the mine plan. For purposes of identifying the full life of mine tailings storage with the current mine plan, it has been assumed that some 'below water table' tailings deposition would occur. Currently Hook 03_01 has been selected for subaqueous tailings deposition due to the large capacity of the pit.

5.2 Tailings and Process Water Salinity

It is understood that the salinity of ore mined near the end of mine life will be higher than current levels. The TSF design and operational requirements will be reviewed prior to construction of TSF with potentially hypersaline constituents. It is anticipated that the following measures may be required to mitigate release of saline seepage from the TSF:

- Encapsulation of saline tailings within tailings of low to moderate salinity;
- Careful management of saline supernatant water
- TSF cover construction and surface water diversion construction sufficient to mitigate surface water infiltration.

The potential impact of saline seepage to groundwater based on the above considerations will be assessed when additional information is available on the character of the hypersaline tailings and the expected configuration of the IPTSF which would receive them. Additional measures to mitigate saline seepage may be required such as underdrainage system construction and operation and/or saline seepage collection via dewatering wells.

6 TAILINGS STORAGE FACILITY OPERATION

The tailings storage facility operating procedures, inspection criteria, monitoring requirements and log sheets for the TSF are described in the Cloudbreak TSF Operations Manual. The proposed tailings storage approach was designed to:

- Optimise the removal of surface water from the facility;
- Optimise the tailings density and storage capacity; and
- Reduce environmental impacts.

Tailings is typically discharged subaerially as a slurry and deposited in discrete layers from multiple discharge points. The discharge point is to be regularly moved to ensure an even development of the tailings beach. The length of time between successive depositions (i.e. drying time) on any one area will be optimised. Tailings discharge is to be carried out such that supernatant water will drain towards a decant pump in the pit.

The following design considerations have been incorporated into the TSF design.

- Tailings, in the form of slurry, is discharged subaerially from multiple spigots situated on embankments and the IPTSF perimeter.
- Supernatant water is to be recovered by a pontoon-mounted decant pump located in the pit.
- The supernatant pond is to be maintained away from the embankments and at a small size to assist in reducing seepage and evaporation from the surface of the pond and hence will assist in optimizing the water recovery and increasing the tailings density.
- As the IPTSF will be surrounded by bund walls, the only watershed into the TSF will be from incident rainfall. During operation, the facility will have sufficient freeboard capacity. Towards the end of the life of the TSF, the facility should have adequate freeboard available to store the design storm event of a 1 in 100 year average recurrence interval (ARI), 72-hour storm (345mm), plus 200mm and an operational freeboard of 300mm.
- On decommissioning, the exposed tailings surface will be covered with mine waste and rehabilitated with local flora species. Monitoring will be carried out of any ongoing settlement due to tailings consolidation.
- Minimal disturbance of land will be performed in order to allow the project to proceed. Pipelines to and from the pit will be bunded to prevent the uncontrolled spillage of tailings or return water into the surrounding area in the event of pipeline failure.

7 TAILINGS CONSOLIDATION MODEL

A consolidation analysis of the Cloudbreak in-pit tailings was undertaken to assess the expected settlement and deformation of tailings deposited in-pit. The consolidation analyses were undertaken using PLAXIS, a two-dimensional finite element analysis software package which takes into account the non-linear, time-dependent and anisotropic behaviour of soils and rock.

7.1 Model Geometry

Six case studies were analysed for this study. For each case, a 10m wide column of tailings was modelled in the centre of the pit, under conditions simulating two-way vertical drainage. Case 1 (A and B) analysed tailings deposition into a 9m deep dry pit (above groundwater level). Cases 2 and 3 (A and B) analysed tailings deposition into a 53m deep pit in which the natural groundwater level is 41m above the base of the pit. In Case 2 (A and B) the pit was pumped dry prior to and during tailings deposition, and in Case 3 (A and B) tailing deposition was carried out subaqueously (under water) until tailings reached the groundwater level, then sub-aerially thereafter. These cases represent the range of IPTSF conditions expected at the Cloudbreak mine.

The sides of the model were constrained horizontally and the base of the model was constrained vertically.

A boundary condition was placed along the sides of the model to prevent the dissipation of excess pore pressures at this boundary.

Refer to Appendix B for the model geometry.

7.2 Material Parameters

The material parameters of the tailings were based on Rowe Cell test results reported in the Mining Proposal for Tailings Storage (Coffey Mining, 2008). An upper bound (Cases A) and a lower bound (Cases B) tailings permeability was used to represent the potential range of permeability in the tailings. The parameters for the pit foundation were based on experience with similar materials. The parameters are summarised in Table 1.

The tailings behaviour was modelled using the "Soft Soil Creep" model which accounts for time-dependent behaviour and the increase in stiffness of the materials as they are compressed.

Table 1 Material Parameters for Model				
Parameter	Deposited Tailings (Case 1)	Deposited Tailings (Case 2)	Deposited Tailings (Case 3)	Pit Foundation
Type of behaviour	Soft Soil Creep	Soft Soil Creep	Soft Soil Creep	Mohr-Coulomb
Unsaturated Unit Weight (kN/m ³)	24	24	14 (subaqueous) 24 (sub-aerial)	26
Saturated Unit Weight (kN/m ³)	25	25	15 (subaqueous) 25 (sub-aerial)	26
Horizontal Permeability, k_x (m/s)	2.1×10^{-8} (Case 1A) 2.1×10^{-9} (Case 1B)	1.5×10^{-8} (Case 1A) 1.5×10^{-9} (Case 1B)	1.5×10^{-8} (Case 1A) 1.5×10^{-9} (Case 1B)	1.0×10^{-7}
Horizontal Permeability, k_y (m/s)	2.1×10^{-8} (Case 1A) 2.1×10^{-9} (Case 1B)	1.5×10^{-8} (Case 1A) 1.5×10^{-9} (Case 1B)	1.5×10^{-8} (Case 1A) 1.5×10^{-9} (Case 1B)	1×10^{-8}
λ^* (modified compression index)	0.055	0.055	0.055	-
κ^* (modified swelling index)	0.0055	0.0055	0.0055	-
Tailings thickness (m)	9	53	53	-

7.3 Method of Analysis

For each model, the initial conditions consisted of an empty pit. Cases 1 and 2 had an initial groundwater level below the base of the pit, and for Case 3 the initial groundwater level was 41m above the base of the 53m deep pit. The deposition of the tailings for all cases was modelled in discrete stages with the timing based on one year of tailings storage. The tailings were deposited in 3 × 4 month cycles with 6 months drying time between each cycle, resulting in a total deposition time of two years. The drying period allowed more consolidation to occur over the life of the storage, resulting in a higher storage capacity and also reduced the time taken for long-term (post-deposition) consolidation to occur.

The phreatic surface within the tailings mass was updated for each stage of deposition and allowed to drop during the drying periods.

The final stage was run such that minimum pore pressures for 90% consolidation were achieved.

7.4 Results

The in-pit tailings consolidation model results are summarised in Table 2.

Table 2 In-pit Tailings Consolidation Model Results						
Result	Case 1A	Case 1B	Case 2A	Case 2B	Case 3A	Case 3B
	9m thick deposit, sub-aerial		53m thick deposit, sub-aerial		53m thick deposit, subaqueous	
Settlement post-deposition (m)	0.3	0.4	1.2	1.6	1.2	1.9
Time for post-deposition settlement (years)	3	7	3.5	8.5	5.5	11.5

As the permeability of the tailings is significantly lower than the pit foundation, the tailings consolidation is primarily governed by the tailings permeability and the thickness of deposited tailings. Accordingly, the modelled cases with the thicker tailings profiles (Cases 2 and 3), and the lower permeability (Cases 1B, 2B, 3B) experienced much greater settlements and achieved 90% consolidation in a longer time frame.

The expected time for long-term consolidation (post-deposition) is in the range of 3 - 7 years for shallow pits above the water table, 3.5 – 8.5 years for deep pits above the water table and 5.5 – 11.5 years for deep pits below the water table. Refer to Appendix B for the results of expected settlement versus time.

The settlement during the subaqueous deposition stages in Case 3 was much lower than the settlement during the equivalent stages for sub-aerial deposition in Case 2 (3.1m in Case 3A and 5.3m in Case 2A) due to lower achievable density when depositing into water. This results in a longer time period for long-term consolidation (post-deposition) of tailings deposited subaqueously.

8 TSF CLOSURE PLAN

The timing of TSF rehabilitation works will largely depend upon tailings drying and consolidation, with revegetation and rehabilitation to be carried out progressively during the life of mine and on mine closure.

The TSFs will be progressively rehabilitated after they have been filled, along with the mining areas. During the initial start-up phase of a mining area, overburden will be placed off path at a permanent storage area and topsoil will be stockpiled. Following the initial start-up phase, overburden will be returned to the mining void and the final landform will take into consideration pre-mining landform. On decommissioning, the top surface of the TSFs will be covered in overburden and topsoil, and revegetated. The revegetation technique that is adopted for the mining area will be based on site specific trials and experience.

Rehabilitation/decommissioning (closure) plans will be continually updated by FMG to incorporate successful procedures identified in site specific trials throughout the life of the project.

9 REFERENCES

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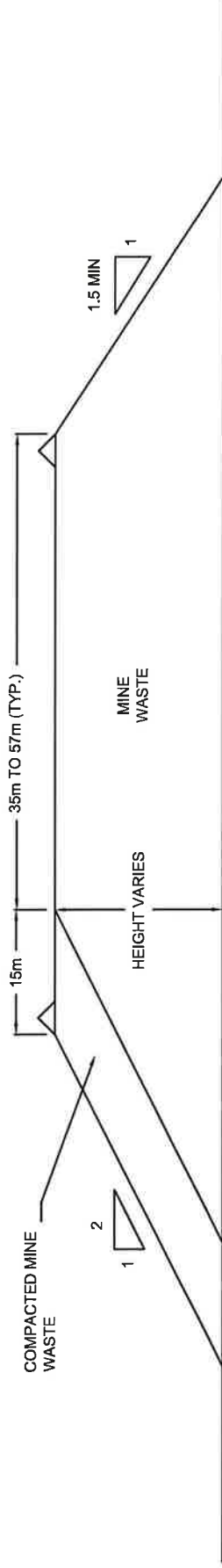
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Figures

UPSTREAM

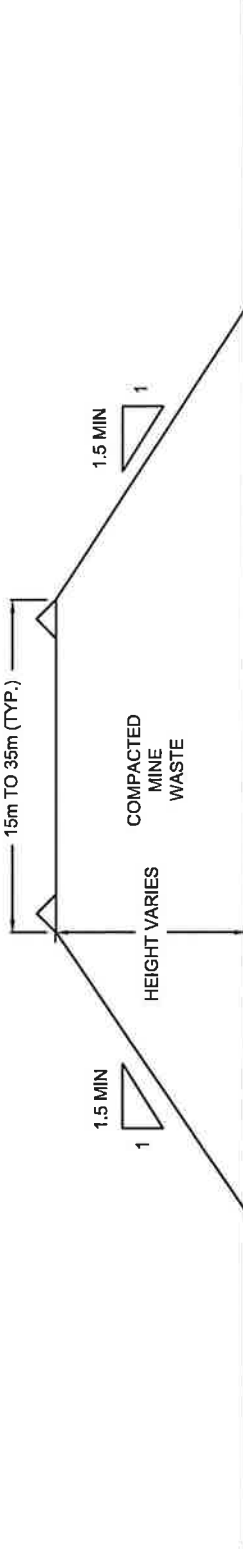
DOWNSTREAM



1. IN-PIT EMBANKMENT - OPTION 1
TYPICAL SECTION
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UPSTREAM

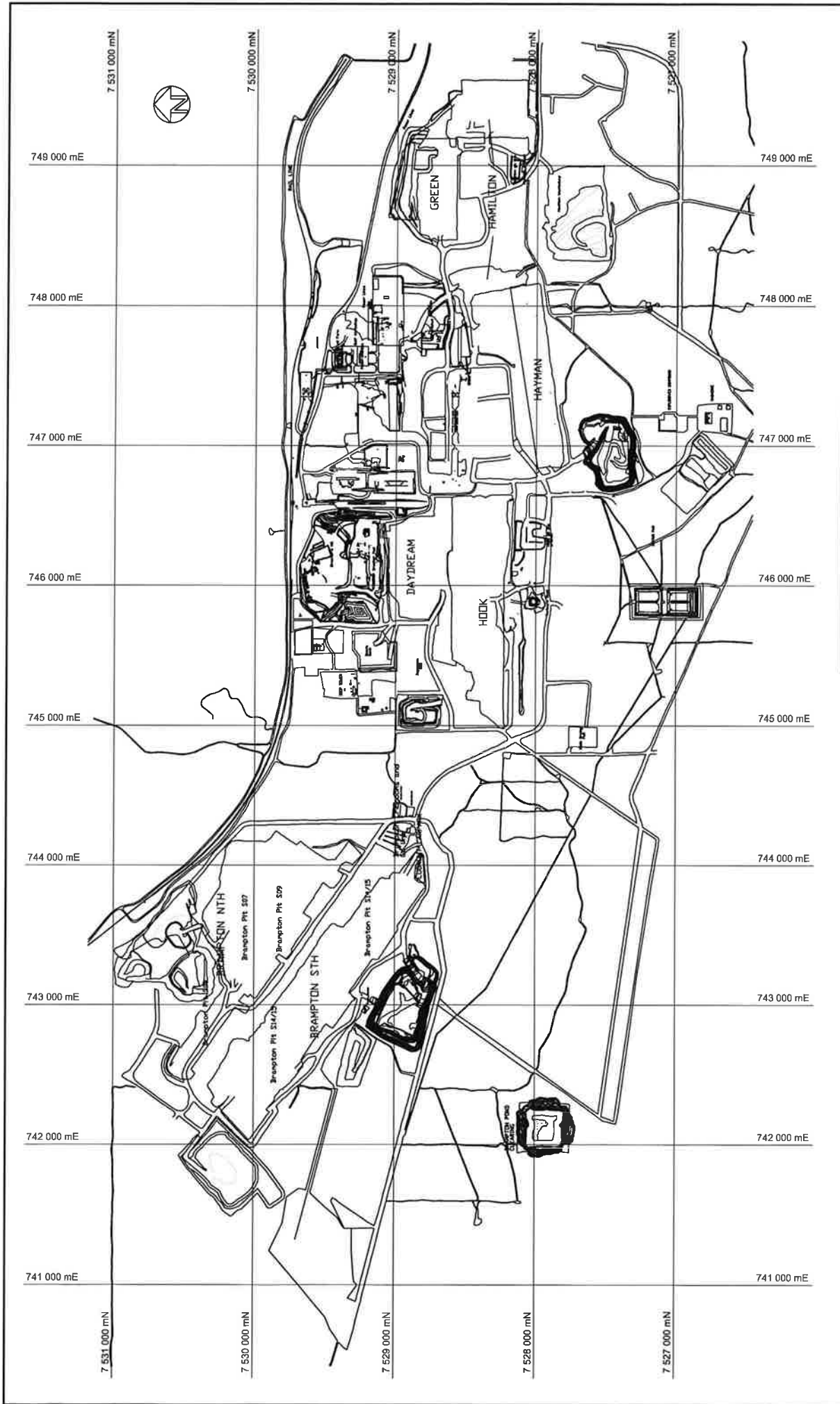
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2. IN-PIT EMBANKMENT - OPTION 2
TYPICAL SECTION
SCALE 1:750

REF: DWG: F:\MINE\Projects\Fortescue Metals Group\MINE\WPER00388AU_Cloudbreak LoA TSF Design\DWG\FMG_LoA_Layout.dwg

Drawn:	CLG	Client:	FORTESCUE METALS GROUP LIMITED
Approved:	CJ	Project:	TSF LIFE OF MINE DESIGN CLOUDBREAK IRON ORE MINE
Date:	06/08/10	Title:	TYPICAL EMBANKMENT SECTIONS
Scale:	1:750	Project no:	MWP00388AU
Original size:	A4	Fig no:	MWP00388AU-02
		Rev:	A



coffey mining SPECIALISTS FROM BOARDROOM TO MINE FACE		Client: FORTESCUE METALS GROUP Project: LIFE OF MINE TAILINGS STORAGE FACILITY DESIGN CLOUDBREAK MINE Title: SITE LAYOUT Project no: MWPP00338AU Fig no: 1 Rev: A
Drawn: GR/FAC Approved: CJ Date: 07/09/2010 Scale: 1:25000 Original Size: A3		

Appendix A

Future In-pit TSF Assessment

CLIENT : FORTESCUE METALS GROUP

LOCATION : CLOUDBREAK MINE

JOB : LIFE-OF-MINE TAILINGS STORAGE PLAN

STORED DRY DENSITY (t/m³) = 1.49

JOB NO : MWP00338AU

DATE : 6/08/2010

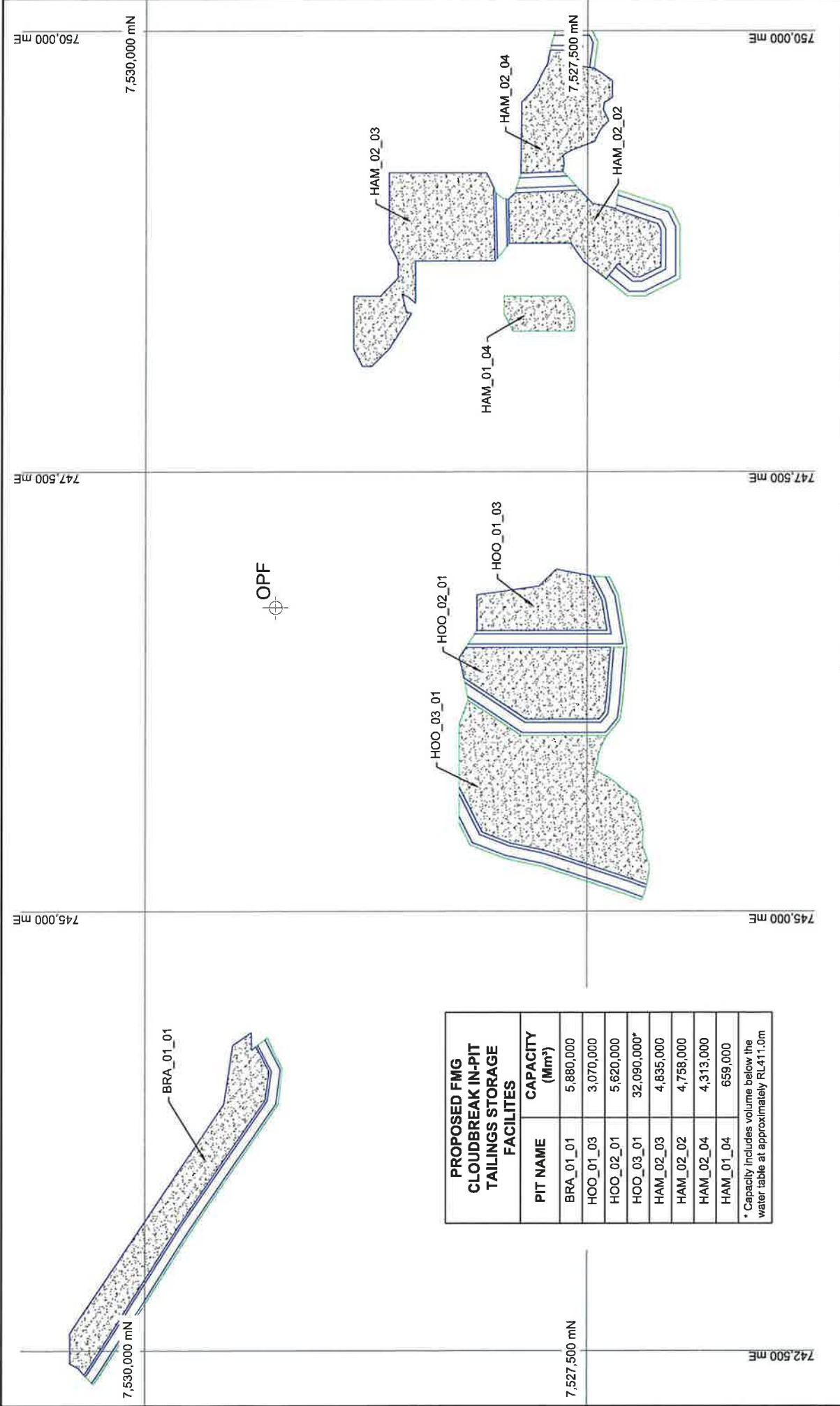
CALC BY : C. LeGrand

FINANCIAL YEAR ENDING	PIT NAME	REMAINING CAPACITY (Mm ³)	PIT CAPACITY AVAILABLE** (Mm ³)	REQUIRED CAPACITY (Mm ³)	REMAINING CAPACITY (Mm ³)
2009	DAYDREAM	--	2.20	0.88	1.32
2010	HAMILTON	1.32	1.16	1.76	0.72
2011	HOOK	0.72	3.76	1.76	2.73
2012	BRA (NORTH)	2.73	3.77	4.15	2.35
2013	BRA_01_01	2.35	5.88	4.15	4.08
2014	HOO_01_03	4.08	3.07	4.15	3.00
2015	HOO_02_01	3.00	16.86	4.15	15.71
2016	HOO_03_01	15.71	32.09	4.15	43.66
2017		43.66		4.15	39.51
2018		39.51		4.15	35.36
2019		35.36		4.15	31.21
2020		31.21		4.15	27.06
2021		27.06		4.15	22.91
2022		22.91		4.15	18.76
2023		18.76		4.15	14.61
2024		14.61		2.89	11.72
2025		11.72		2.89	8.83

** Pit capacity available is volume above the water table, except for HOO_03_01 which includes volume below the water table.

ALTERNATIVE AVAILABLE PITS

PIT NAME	AVAILABLE CAPACITY (Mm ³)
HAM_02_03	4.84
HAM_02_02	4.76
HAM_02_04	4.31
HAM_01_04	6.59



PROPOSED FMG CLOUDBREAK IN-PIT TAILINGS STORAGE FACILITIES	
PIT NAME	CAPACITY (Mm³)
BRA_01_01	5,880,000
HOO_01_03	3,070,000
HOO_02_01	5,620,000
HOO_03_01	32,090,000*
HAM_02_03	4,835,000
HAM_02_02	4,758,000
HAM_02_04	4,313,000
HAM_01_04	659,000
* Capacity includes volume below the water table at approximately RL411.0m	

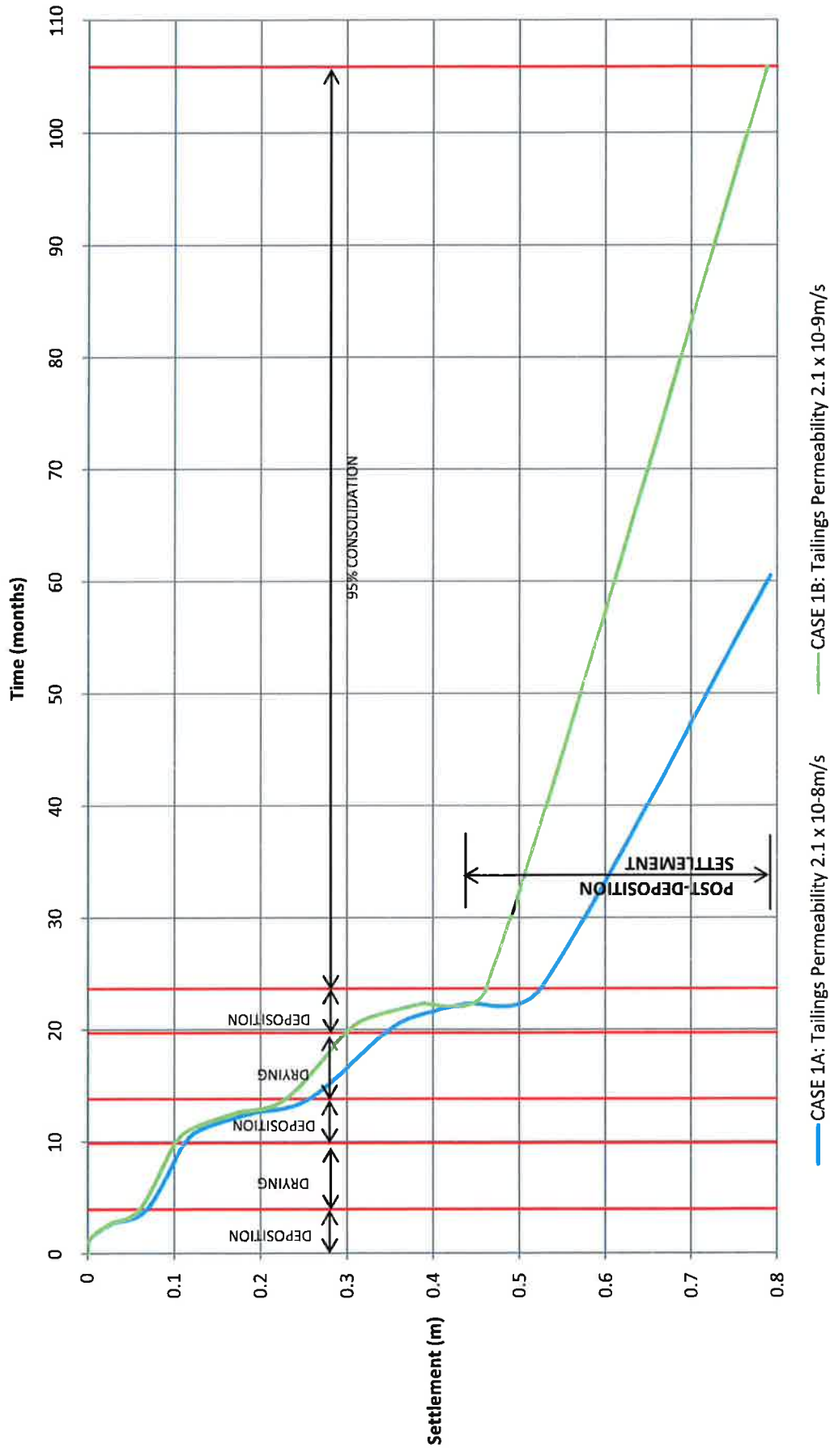
Drawn:		CLG	Client:		FORTESCUE METALS GROUP LIMITED	
Approved:	CJ		Project:		TSF LIFE OF MINE DESIGN CLOUDBREAK IRON ORE MINE	
Date:	06/08/10		Title:		PROPOSED IN-PIT TAILINGS STORAGE FACILITIES	
Scale:	1:20000		Project no:		MWP00388AU	
Original size:	A3		Fig no:		MWP00388AU-01	
			Rev:		A	



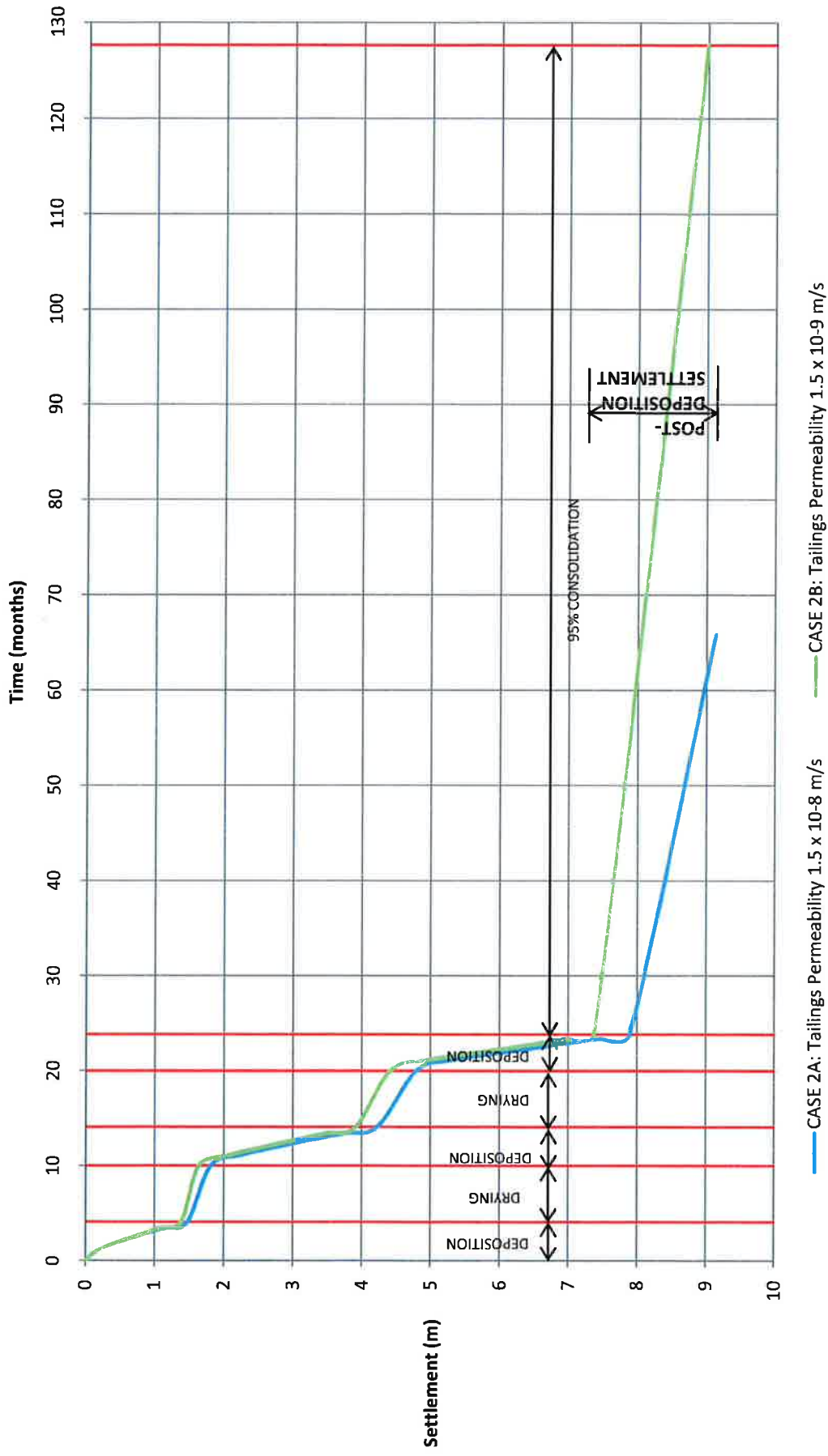
Appendix B

In-pit Tailings Consolidation Model Output

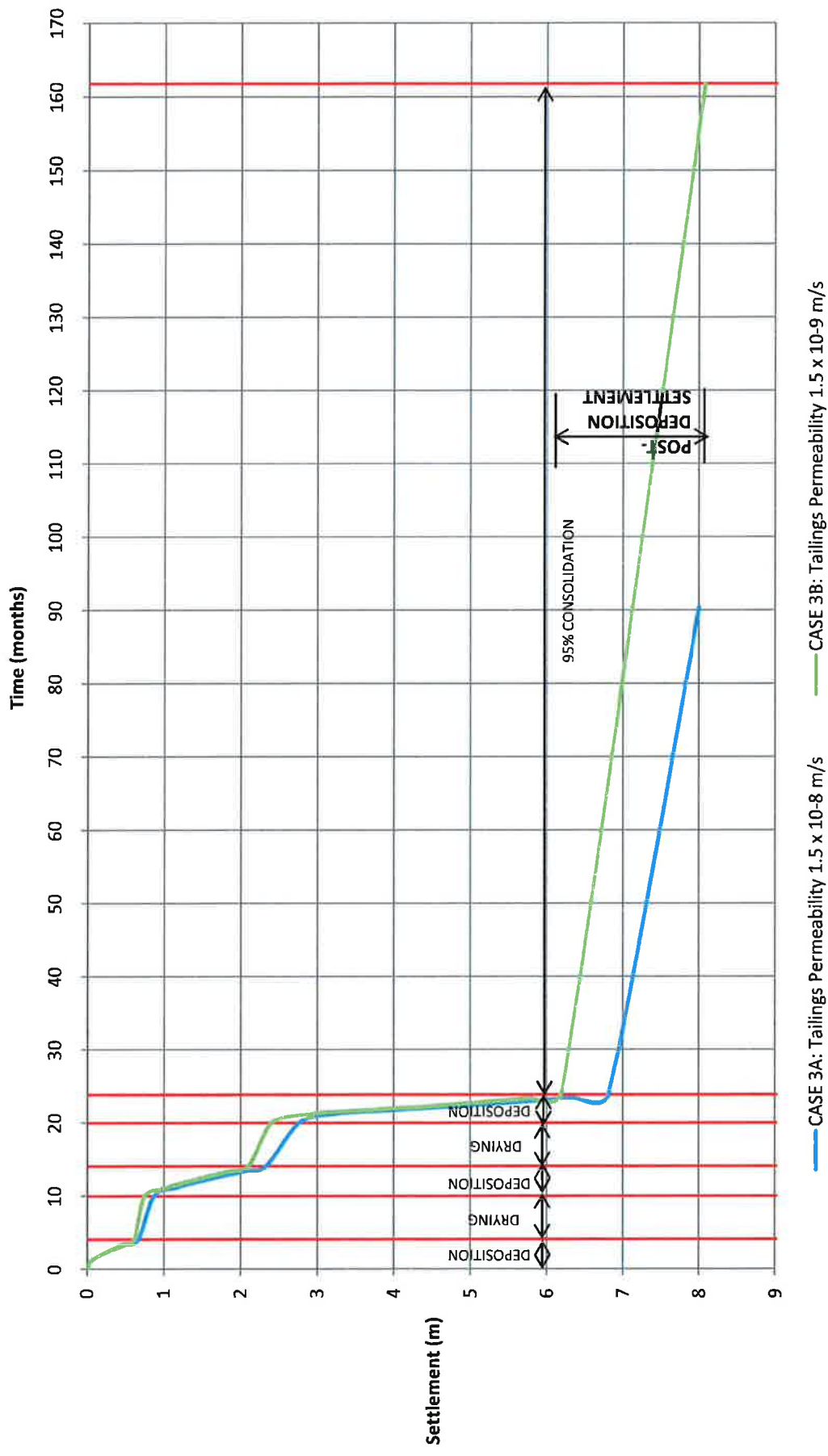
Tailings Settlement Chart: Case 1 **(9m deep, deposition and consolidation above water table)**

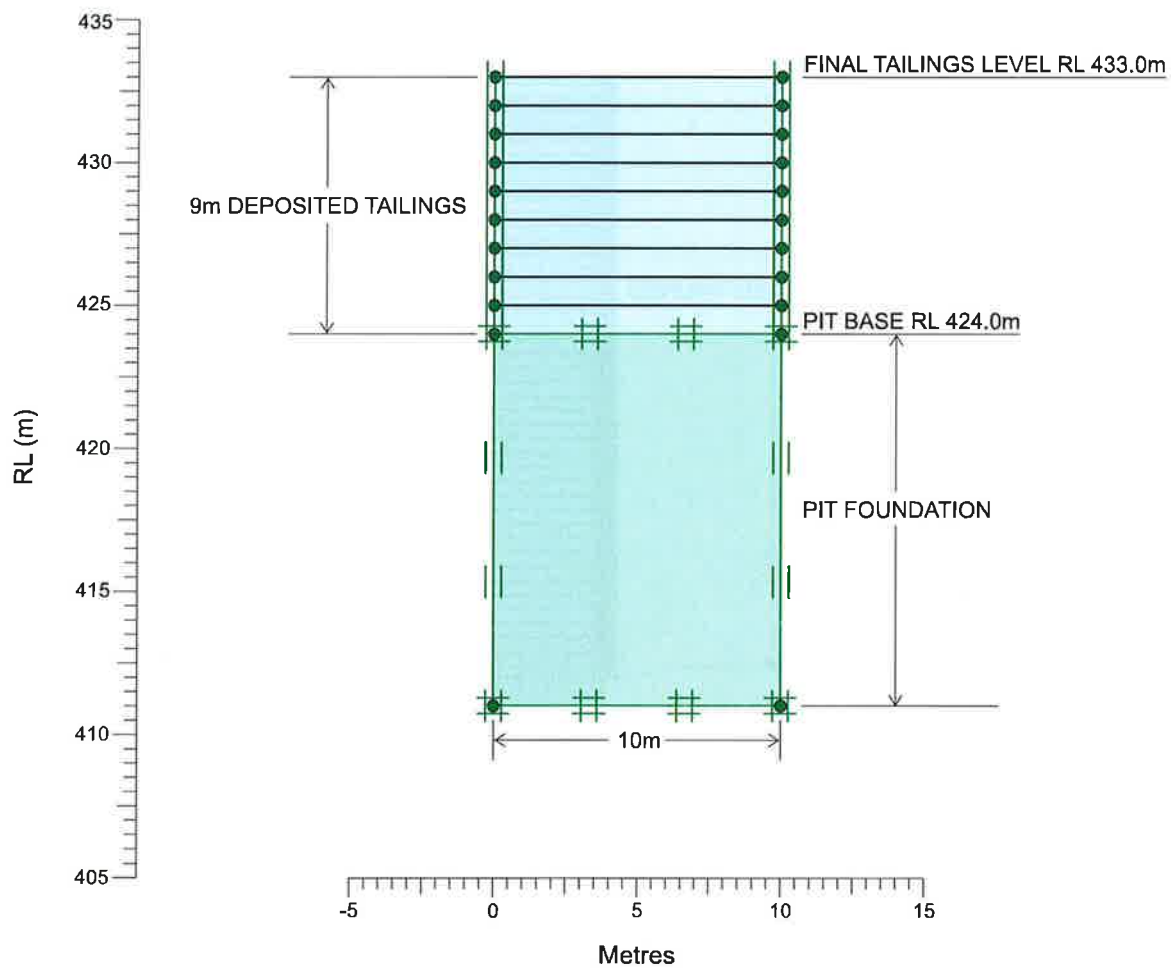



Tailings Settlement Chart: Case 2
(53m deep, deposition above water table, consolidation below water table)

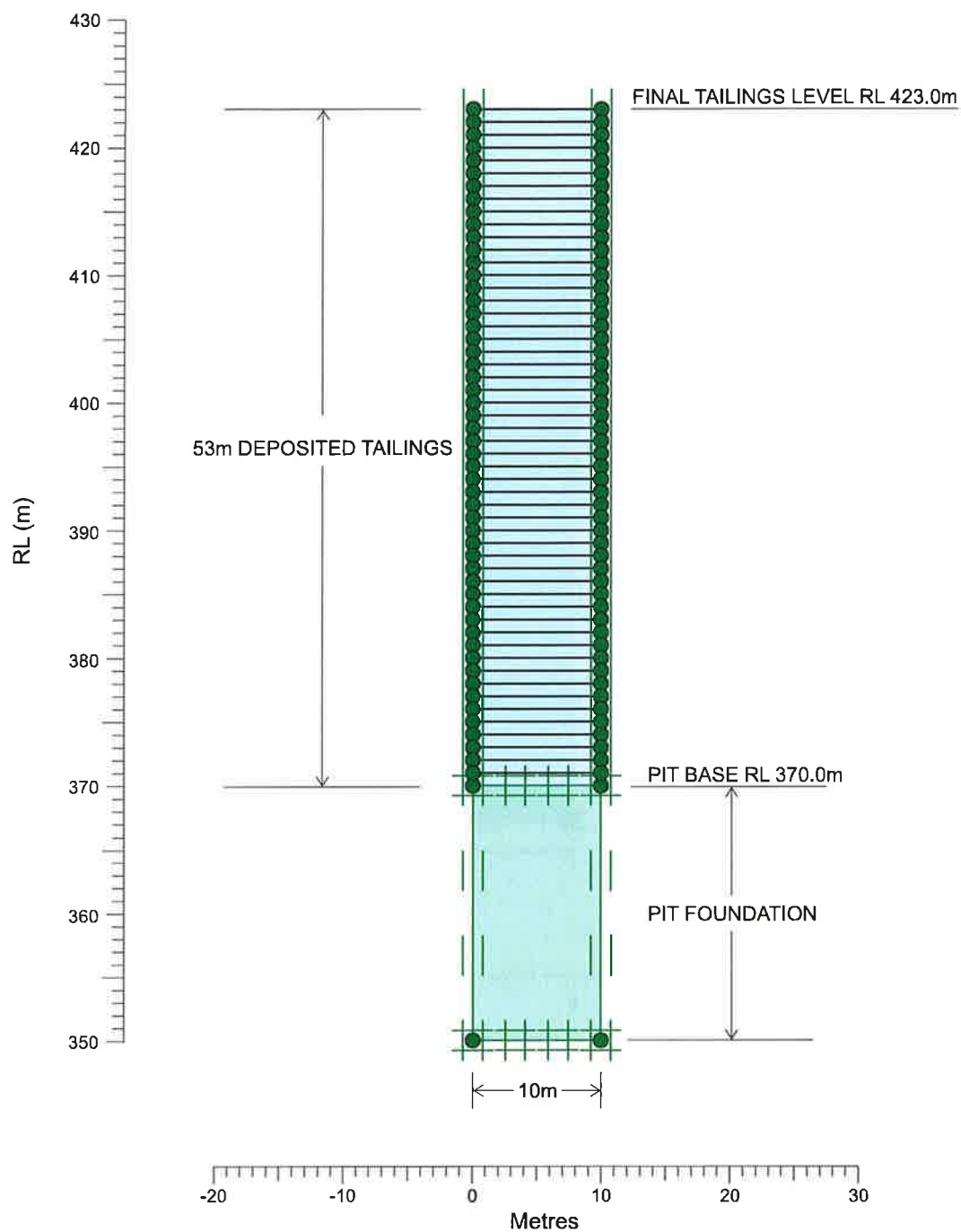



Tailings Settlement Chart: Case 3 (deposition and consolidation below water table)

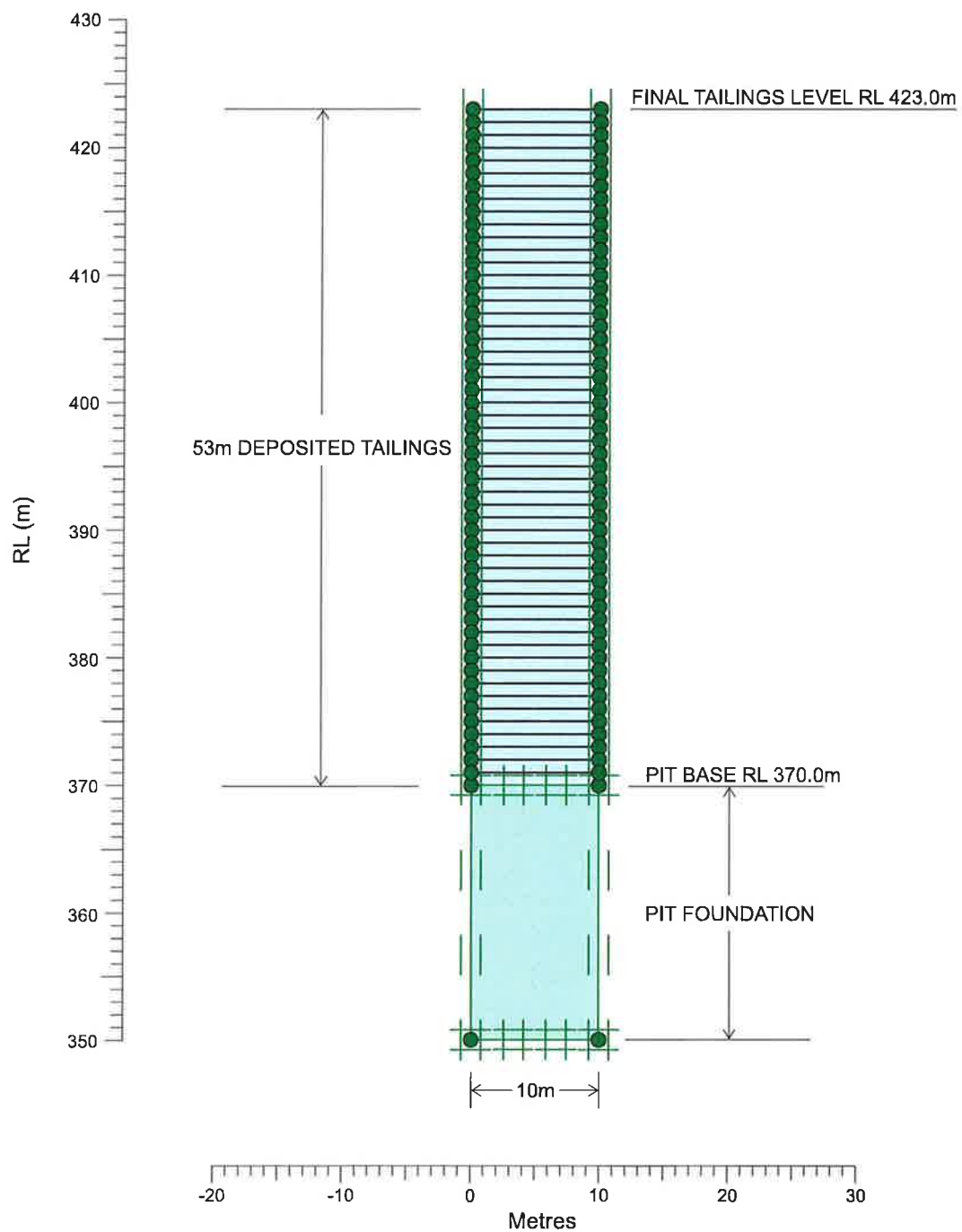





Drawn	LM/FAC	 SPECIALISTS FROM BOARDROOM TO MINE FACE	Client: FORTESCUE METALS GROUP LIMITED		
Approved	CJ		Project: TSF LIFE OF MINE DESIGN CLOUDBREAK IRON ORE MINE		
Date	09/09/2010		Title: CASE 1A AND 1B MODEL GEOMETRY		
Scale	1:250		Project no: MWP00338AU	Figure no: B1	Rev: 0
Original size	A4				



Drawn	LM/FAC	 SPECIALISTS FROM BOARDROOM TO MINE FACE	Client: FORTESCUE METALS GROUP LIMITED		
Approved	CJ		Project: TSF LIFE OF MINE DESIGN CLOUDBREAK IRON ORE MINE		
Date	09/09/2010		Title: CASE 2A AND 2B MODEL GEOMETRY		
Scale	1:500		Project no: MWP00338AU	Figure no: B2	Rev: 0
Original size	A4				



Drawn	LM/FAC	 coffey mining SPECIALISTS FROM BOARDROOM TO MINE FACE	Client:	FORTESCUE METALS GROUP LIMITED		
Approved	CJ		Project:	TSF LIFE OF MINE DESIGN CLOUDBREAK IRON ORE MINE		
Date	09/09/2010		Title:	CASE 3A AND 3B MODEL GEOMETRY		
Scale	1:500		Project no:	MWP00338AU	Figure no:	B3
Original size	A4				Rev:	0

25 February 2011

Fortescue Metals Group
Level 2, 87 Adelaide Terrace
EAST PERTH WA 6004

Attention: **Les Egerton and Paul Ridout**

Dear Sirs:

**RE: Addendum to Cloudbreak Iron Ore Mine Life of Mine Tailings Storage Facility
Conceptual Design Report (16 Sept 2010, rev1)**

1 INTRODUCTION

Further to your request, Coffey Mining Pty Ltd (Coffey Mining) is pleased to provide additional information regarding the conceptual tailings storage facility design for the life of mine at the Fortescue Metals Group (Fortescue) Cloudbreak Iron Ore Mine. The additional information is provided to address feedback received by FMG from the regulatory authority based on review of the *"Life of Mine Tailings Storage Facility Design, Fortescue Metals Group Limited, Cloudbreak Iron Ore Mine"*, Coffey Report MINEWPER000338AU-AB CB LOM TSF Design Rev1, dated 16 September 2010. The report was submitted to the regulator as part of a revised Public Environmental Review (PER) submission for the Cloudbreak Mine.

Specifically, this letter was drafted to respond to comment 87:

In Pit TSF (& section 4.5 of 5.2 of Coffey TSF report) - The management of salty residue from the proposed ore washing process as well as the brine produced from a desalination plant needs to be mentioned in this section.

To facilitate the response, Fortescue provided additional information including correspondence and a draft design report entitled *"Cloud Break Treatment of Saline Water Waste Stream"*, rev 2.0, 23 September 2010, prepared by MWH.

2 WATER TREATMENT RESIDUE PROPERTIES

The proposed processing of saline ore at Cloudbreak will result in a waste stream of sludge residue from a water treatment system. The saline ore is to be mined late (nominally last 5 years) in the 17 year life of mine.

The sludge has a design particle size of less than 10 microns. The sludge is expected to be slightly heavier than typical water treatment sludge and to settle more rapidly. The sludge will be saline and will be disposed in the in-pit tailings storage facilities (IPTSF). The chemicals used in the water treatment system are to be drinking water grade and include ferric chloride (floc), cationic polymer (Magnafloc), and chlorine. It is anticipated that the suspended solids captured in the treatment system will include ferric oxides, silica oxide, aluminium oxide and calcium iron compounds with low organic content.

3 WATER TREATMENT RESIDUE DISPOSAL

The sludge will be pumped to the IPTSF as a slurry and on an intermittent basis. The quantity of sludge generated will depend upon the characteristics of the ore treated and the resulting wash water characteristics. Fortescue has estimated the total volume of sludge solids generated to be in the range of 15,000 m³ to 30,000 m³. This amount is modest in comparison to the estimated 4,000,000 m³ of tailings to be generated and stored annually at Cloudbreak.

The high salinity of the sludge will require placement of the sludge in a manner consistent with the expected saline tailings. As described in the September 2010 TSF design report, the TSF design and operational requirements will be reviewed prior to construction of a TSF with potentially hypersaline constituents. It is anticipated that the following measures may be required to mitigate release of saline seepage from the TSF:

- Encapsulation of saline tailings (and/or treatment residue sludge) within tailings of low to moderate salinity;
- Careful management of saline supernatant water
- TSF cover construction and surface water diversion construction sufficient to mitigate surface water infiltration.

The potential impact of saline seepage to groundwater based on the above considerations will be assessed when additional information is available on the character of the hypersaline tailings and the expected configuration of the IPTSF which would receive them. Additional measures to mitigate saline seepage may be required such as underdrainage system construction and operation and/or saline seepage collection via dewatering wells.

4 CLOSURE

We trust this information meets your immediate requirements. Should you require clarification of any information, please do not hesitate to contact this office.

For and on behalf of Coffey Mining Pty Ltd,



Christopher Johns, M.Sc., P.Eng., MIEAust
Geotechnical / Environmental Engineer

cc: Catherine LeGrand, FMG