**Title: MUJA TAILINGS STORAGE FACILITY DAMS MANAGEMENT PLAN**

**Document Number: MUJ-PLN-ENV-0001** Revision: **0** **Date: 19/07/2024**

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## REVISION HISTORY

| Revision | Date | Description of change |
|---|---|---|
| 0 | 19/07/2024 | New Management Plan. Superseding MUJ-MAN-ENV-0001 6137502-REP-0 Muja Fly Ash Dam Operation and Maintenance Manual |
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# 1 INTRODUCTION

Muja power station (**MPS**) is owned and operated by Synergy and is located approximately 220km south of Perth and approximately 17km south-east of the town of Collie, Western Australia. MPS is a major supplier of electricity to the southwest interconnected system.

Legislation defines the safety of dams (also identified as reservoir's, tailings and retard basins), anything that could cause safety due to collapse or release of contaminants into the environment. This MPS tailings storage facility dam management plan (**TSFMP**) has been prepared to support the inspection, operation, risk, monitoring and management of the following types of all storage tailings facility (**TSF**) dams:

(a) dual cell fly ash dam (**FAD**) - MCD-PAD-DAM-3541 and MCD-PAD-DAM-3542 DAM (**Section 3**);

(b) supernatant dam (**SNDM**) - MCD-PAD-DAM-356 DAM (**Section 4**);

(c) bottom ash dam (**BAD**) - MS-AD-DAM-402 DAM (**Section 5**); and

(d) temporary ash dam (**TAD**) - MS-AD-DAM-403 DAM (**Section 6**).

The guiding principle for the ongoing management for the TSF is to plan and implement ash deposition safely and efficiently. This document has been prepared to align with this principle and based on the following guidelines:

(a) Australian committee on large dams (**ANCOLD**) guidelines on tailings dams, planning, design, construction, operation and closure 2019;

(b) ANCOLD guidelines on dam safety management 2003;

(c) ANCOLD guidelines on the consequence categories for dams 2012;

(d) department of mines and petroleum (**DMP**) code of practice tailings storage facilities in Western Australia (**WA**) 2013;

(e) work health and safety (General) regulations 2022 (**WHSGR2022**); and

(f) environmental protection (Controlled waste) regulations 2004.

MPS is licenced as a prescribed premises under schedule 1 of the environmental protection regulations 1987. The department of water and environmental regulation (**DWER**) operating licence L4706/1972/17 (DM ID: 25007266) for the existing premises is held by electricity generation and retail corporation, trading as Synergy.

## 1.1 Objectives

The key objectives of this management plan (**MP**) are as follows:

(a) to guide the correct operation, monitoring and maintenance of MPS's TSF dams to achieve the design intent during and after commissioning;

(b) to follow all regulations as described in the MP to ensure safety, compliance and environmental stability; and

(c) to guide key personnel on the actions required to address incidents.

**Note:** it is not the intention of this MP to cover emergency situations. In case of emergency, users of this MP should be familiar with the emergency response procedure (**ERP**), which is referenced in **section 10.2**. Specifically, this MP details procedures for:

(d) safety into the design, construction and operation of the TSF dams;

(e) routine and non-routine operations and maintenance;

(f) management of water return and extreme rainfall;

(g) management of earthquakes;

(h) to ensure the permanent and secure containment of all materials and substances;

(i) SNDM to provide secure containment of water from the FAD;

(j) FAD to ensure the frequent removal of free water from the facility;

(k) to support the reduction of environmental impact with rapid and effective rehabilitation;

(l) monitoring, inspections and surveillance; and

(m) incident planning and non-emergency response.

The long-term goal for the operation of the FAD is to achieve a dense, stable, and unsaturated fly ash deposit, with minimum impact on the environment that can be rehabilitated without excessive difficulty.

## 1.2 Muja climate

The design of Muja's dams, each original construction and/or dam wall raise is catered for storm events both during and after operation. The storm conditions vary depending on the climate, suitable storm condition mitigation measures should be in place if the minimum freeboard will be lost during a storm event. The TSF dam has mitigation measures in place which are emergency spillways, overflow/storage ponds and emergency decant facilities.

All dam raises are calculated on the current climate reviews which is completed during the any dam projects. Below are the averages as found April 2024 (https://www.eldersweather.com.au/climate-history/wa/muja).

***Table 1:** Elders Muja climate history - Muja long-term averages (As of July 2024)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Max (°C) | 31.1 | 30.8 | 28.2 | 23.8 | 20.1 | 17.3 | 16.3 | 17.2 | 18.6 | 21.7 | 25.5 | 28.9 | **23.2** |
| Mean Min (°C) | 13.4 | 14.0 | 12.3 | 8.9 | 6.1 | 4.5 | 4.2 | 4.7 | 5.7 | 7.4 | 9.9 | 11.5 | **8.5** |
| Mean Rain (mm) | 16.6 | 11.6 | 18.8 | 38.0 | 91.6 | 104.8 | 133.2 | 112.8 | 88.8 | 39.0 | 24.3 | 18.7 | **701.6** |
| Mean Rain Days | 2.8 | 3.5 | 5.0 | 8.7 | 12.9 | 15.8 | 20.2 | 18.4 | 15.8 | 11.4 | 7.0 | 5.0 | **127.4** |

## 1.3 Environmental licence

The department of water and environmental regulation (**DWER**) regulates industrial emissions and discharges to the environment through a works approval and licence process, under the environmental protection act 1986. All industrial premises with potential to cause emissions and discharges to air, land or water are known as 'prescribed premises' and trigger regulation under the environmental protection Act. Muja is licenced under DER2014/002698-1 (DM ID: 25007266) and must comply to the following categories:

(a) **category 12:** Screening etc. of material;

(b) **category 52:** Electric power generation;

(c) **category 53:** Flyash disposal; and

(d) **category 61:** Liquid waste facility.

The TSF is identified on this licence and must meet the following conditions as stated on the licence:

*"1.2.2 The licensee shall immediately recover or remove and dispose of spills of environmentally hazardous materials that are liquids, outside an engineered containment system."* (Refer to **section 10.2**)

*"1.2.3 The licensee shall implement all practical measures to prevent stormwater runoff becoming contaminated by the activities on the premises."* (Refer to **section 11.2** and **section 3.15**)

*"1.3.1 The licensee shall ensure that material specified in table 1.3.1 is only stored and / or treated within vessels or compounds provided with the infrastructure detailed in that table and identified in schedule 1."* (Refer to **section 3.6.1**)

***Table 2:** Table 1.3.1 Containment infrastructure*

| Containment point reference and location on Map of emission points and containment infrastructure | Containment cell or dam number(s) | Material | Infrastructure requirements |
|---|---|---|---|
| C1 | BAD settling pond | Supernatant* from the fly ash and BAD and blowdown from cooling tower.<br>Wastewater from Collie a power station comprising cooling tower blowdown and wastewater treatment brine.<br>Wastewater from the MPS central water receival facility (**CWRF**) and desalination plant comprising brine and reverse osmosis rejects. | Compacted insitu soils |
| C3 | Ash storage dam | Fly ash and bottom ash, including brine concentrate used in the flash handling process; reverse osmosis rejects and sludges from the power station water treatment system, and ferric water treatment sludges from the MPS CWRF, desalination plant and groundwater supply system. | Compacted in-situ soils |
| C4 | Supernatant dam | Supernatant* and stormwater from the ash storage dam. | High density polyethylene (**HDPE**) and clay lined with leak detection system |

**Refers to the supernatant water not the dam.*

*"1.3.2 The licensee shall undertake an annual water balance for the ash storage dam (C3). The water balance shall as a minimum consider the following:*

*(a) site rainfall;*

*(b) evaporation;*

*(c) decant water recovery volumes;*

*(d) seepage recovery volumes;*

*(e) volume of water treatment sludges deposited; and*

*(f) volume of fly ash deposited."* (Refer to **section 3.14.2**)

*"1.3.3 The licensee shall operate the ash storage dam in accordance with the MPS ash dam environmental management plan."* (Refer to **section 7.3**)

*"1.3.4 The licensee shall only allow waste to be accepted on to the premises if:*

*(a) it is of a type listed in table 1.3.2;*

*(b) the quantity accepted is below any limit listed in table 1.3.2; and*

*(c) it meets any process requirements listed in table 1.3.2."* (Refer to **section 7.2**)

***Table 3:*** *Table 1.3.2: Waste acceptance*

| Waste | Quantity Limit | Process requirements |
|---|---|---|
| *Wastewater stream from the MPS CWRF, desalination plant and groundwater supply system comprising ferric water treatment sludges* | *25 ML per annual period* | *Ferric water treatment sludges to be discharged to the ash storage dam specified in table 1.3.1* |
| *Wastewater stream from the MPS CWRF and desalination plant comprising brine and reverse osmosis rejects* | *None specified* | *Brine and reverse osmosis rejects to be discharged to the BAD specified in table 1.3.1* |

*"3.1.1 The licensee shall ensure that:*

*(a) all water samples are collected and preserved in accordance with Australian / New Zealand standards (**AS/NZS**) 5667.1;*

*(b) all surface water sampling is conducted in accordance with AS/NZS 5667.4, AS/NZS 5667.6 or AS/NZS 5667.9 as relevant;*

*(c) all groundwater sampling is conducted in accordance with AS/NZS 5667.11; and*

*(d) all laboratory samples are submitted to a laboratory with current national association of testing authorities (**NATA**) accreditation for the parameters to be measured."* (Refer to **section 8.6**)

*"3.1.2 The licensee shall ensure that:*

*(a) monthly monitoring is undertaken at least 15 days apart;*

*(b) quarterly monitoring is undertaken at least 45 days apart; and*

*(c) annual monitoring is undertaken at least 9 months apart."* (Refer to **section 8**)

*"3.4.7 The licensee shall undertake the monitoring in tables 3.4.4, according to the specifications in that table."* (Refer to **section 8.7**)

***Table 4:*** *Table 3.4.4: Monitoring of ambient groundwater quality*

| Monitoring point reference | Parameter | Units | Averaging period | Frequency |
|---|---|---|---|---|
| *MB1A, MB2, MB3, MB3A, MB4, MB4A, MB5, MB5A, MB5B, MB6, MB7, MB7A, MB8, MB8A, MB9A, MB9B, MB9C, MB10A, MB10B, MB11A, MB11B, MB12A and MB12B* | *Standing water level* | *m Australian height datum (**AHD**)* | *Spot sample* | *Quarterly* |
| | *pH* | - | | |
| | *Total dissolved solids, electrical conductivity, sulphate, arsenic, cadmium, chromium (total), copper, lead, iron, manganese, mercury, nickel, selenium and zinc* | *Mg/L* | | |

*"4.1.1 All information and records required by the licence shall:*

*(a) be legible;*

*(b) if amended, be amended in such a way that the original and subsequent amendments remain legible or are capable of retrieval;*

*(c) except for records listed in 4.1.1(d) be retained for at least 6 years from the date the records were made or until the expiry of the Licence or any subsequent licence; and*

*(d) for those following records, be retained until the expiry of the licence and any subsequent licence:*

*(i) off-site environmental effects; or*

*(ii) matters which affect the condition of the land or waters."* (Refer to **section 7.4**)

*"4.1.3 The licensee shall complete an annual audit compliance report (**AACR**) indicating the extent to which the licensee has complied with the conditions of the licence, and any previous licence issued under part V of the Act for the premises for the previous annual period."* (Refer to **section 8.9**)

*"4.2.1 The licensee shall submit to the chief executive officer (**CEO**) an annual environmental report by 30 September in each year. The report shall contain the information listed in table 4.2.1 in the format or form specified in that table."* (Refer to **section 8.7**)

***Table 5:** Table 4.2.1: Annual environmental report*

| Condition or table (if relevant) | Parameter | Format or form |
|---|---|---|
| 1.3.2 | Annual water balance for the ash storage dam | None specified |
| – | Quantity of fly ash and bottom ash removed from the premises summarised in a tabular format for each calendar month | Table |
| Table 3.3.1 | Weekly summary of stormwater discharge volumes and monitoring results | |
| Table 3.4.4 | Ambient groundwater quality monitoring results | None specified |
| 4.1.3 | Compliance | AACR |

Muja is also identified on Collie power station licence L6637/1995/15 (DM ID: 29471731):

*"1.3.7 The licence holder shall only allow waste to be accepted on to the premises if:*

*(a) it is of a type listed in table 1.3.7;*

*(b) the quantity accepted is below any limit listed in table 1.3.7; and*

*(c) it meets any process requirements listed in table 1.3.7."* (Refer to ***section 7.3 and 10.2.1***)

***Table 6:** Table 1.3.7: Waste acceptance*

| Waste | Quantity Limit | Process requirements |
|---|---|---|
| Flyash or bottom ash from the Muja power station | 40,000 tonnes per annum | Accepted into cell 2C of the ash storage dam at no less than 15% v/w moisture content. Deposition to occur in accordance with the Collie power station FAD and runoff dam operations and maintenance (**O&M**) manual (GHD, 2021) or subsequent versions |

# 2 LEADERSHIP COMMITMENT

There is an explicit and enhanced legal requirement for site management to demonstrate leadership and commitment to the TSF dam management. To align with this site leadership should be able to:

(a) demonstrate knowledge of the dam's objectives and provide an overview of where these sit within Synergy's overall vision;

(b) demonstrate that consideration has been made over the coordination of the dam's and other strategic goals and internal processes jointly;

(c) demonstrate that leadership has been shown to the team in terms of communicating the importance of the dam's, ongoing results, and progress versus stated dam objectives; and

(d) be familiar with the process of ensuring and encouraging continual improvement and demonstrate that this culture exists within Synergy because of that leadership.

## 2.1 Responsibilities

### 2.1.1 Head of coal generation

Head of coal generation is accountable for all ash storage facilities used throughout its operations. The ultimate site responsibility rests with the operations manager. Head of coal generation is to accommodate DWER / department of mines, industry regulation and safety (**DMIRS**) site visits for licence audits or delegate as required.

### 2.1.2 Operations manager

(a) accountable for implementation of design and operating procedures;

(b) hosting regular dam management committee meetings;

(c) ensure all monitoring of all TSF dams is completed, reviewed and saved;

(d) accommodate DWER / DMIRS site visits for licence audits;

(e) maintain of FAD equipment and spigot rotations;

(f) safe and reliable operation of our TSF dams to ensure sustainability and adherence to our environmental licence conditions; and

(g) train and maintain competencies for operations personnel.

### 2.1.3 Maintenance manger

(a) train and maintain competencies for maintenance personnel;

(b) maintenance of FAD equipment and spigots;

(c) raising and approving work order (**WO**) for TSF dam's maintenance work;

(d) arrange independent dam safety and maintenance reviews; and

(e) escalate urgent or emergency issues to operations manager.

### 2.1.4 Environmental officer

(a) maintain environmental risk register;

(b) undertaken monitoring of ambient groundwater quality from bores program quarterly and annual reports);

(c) liaising with DWER for incidents and any maintenance work in the quarterly catch ups;

(d) transparency of environmental licence conditions amongst the committee;

(e) review the water balance data and update DWER annually;

(f) accommodate DWER / DMIRS site visits for licence audits; and

(g) prepare annual environment report.

### 2.1.5 Systems engineer

(a) coordinate maintenance and repairs for all TSF dam's;

(b) develop and monitor deposition plans;

(c) undertake annual review of deposition plan compared to actual input tonnage;

(d) develop and regularly update a structural and site risk register;

(e) review monitoring data monthly and identify trends;

(f) review routine inspection forms monthly;

(g) coordinating with internal subject matter expert (**SME**) for annual visual inspection of the TSF dam's;

(h) review any outstanding maintenance WO monthly; and

(i) escalate urgent or emergency issues to operations manager.

### 2.1.6 Operations administration

(a) primary contact for existing inspection contractors for invoicing, PO's and reporting through the Dam.Management.Committee@SYNERGY.NET.AU email;

(b) to maintain the Dam.Management.Committee@SYNERGY.NET.AU email ensuring the current personnel are on the email distribution list;

(c) ensure all inspections reports are current, saved in the document management system and register updated;

(d) attend and minute the dam's management committee meeting; and

(e) monitor and create inspection purchase orders for all TSF dam's.

### 2.1.7 Statutory compliance coordinator

(a) ensure that all relating documents are aligning to the ANCOLD and current processes on site;

(b) ensure all statutory inspections and services are set up in system application and products (**SAP**) aligning with regulatory requirements;

(c) instigates, monitors and supports actions arising from audits;

(d) ensures all equipment documentation is easily located and accessible to all personnel on site;

(e) maintains Empower audit risk and compliance requirements in relation to the dams on site; and

(f) informs senior management and corporate risk and compliance of audit reports.

### 2.1.8 Operations – production / water services supervisors

(a) comply with site procedures on TSF dam's management, including all procedures and requirements in this management plan, all station instruction Muja's (**SIM**) and all plant operating instruction (**POI**);

(b) review routine inspection forms and responsible for uploading and sending to operations administration;

(c) escalate urgent or emergency issues to operations manager;

(d) review of deposition plan with systems engineer as required;

(e) for water management (leeching and runoff);

(f) to implementing alternate water disposal locations when the FAD decant pond exceeds trigger levels; and

(g) ensure they have a current verification of competency and are competent to be working on the TSF dam's.

### 2.1.9 Operations – operation maintainers

(a) comply with site procedures on dam's management, including all procedures and requirements in this management plan, all SIM and all POI;

(b) carry out routine inspections;

(c) record findings and observations in the logbook and reports. Any concerns to be raised with supervisor;

(d) raise SAP notification for all deficiencies / maintenance issues;

(e) monitor FAD pond location, size and distance from walls and manage decant pump operation. Identify when to rotate active spigots in discussion with the systems engineer;

(f) complete piezometer readings reporting (manual and vibrating wire);

(g) manage underdrainage tank levels;

(h) refuel diesel pumps for decant pump and underdrainage systems;

(i) develop and manage site wide water balance;

(j) to implementing alternate water disposal locations when the FAD decant pond exceeds trigger levels; and

(k) provide advice on alternate water disposal locations.

### 2.1.10 Maintenance supervisors (inclusive of contactor supervisors)

(a) coordinate maintenance tasks for the TSF dam's; and

(b) escalate any reported deficiencies on all dam's to the Dam.Management.Committee@SYNERGY.NET.AU email.

### 2.1.11 Maintenance personnel

(a) comply with site procedures on dam's management, including all procedures and requirements in this management plan, all SIM and all POI;

(a) raise SAP notification for all deficiencies / maintenance issues;

(b) ensure they have a current verification of competency and are competent to be working on the dam's;

(c) undertake a personnel risk assessment before working on all dams;

(d) report any incidents/near misses to the supervisor;

(e) set up new deposition points; and

(f) maintain equipment on all dam's (i.e. including piezometers, diesel pumps, maintain deposition pumps, pipes and valves).

## 2.2 Training and awareness

Synergy identifies, assesses and documents its dam management training needs using the training matrix (DM ID: 18691139). The matrix takes into account people who

perform tasks that have the potential to cause ***significant*** impact. By recognising training, competence and awareness programs we may prevent impacts from occurring from employees who operate and manage processes that have the potential to cause significant impact. Dam training, competence and awareness needs are assessed annually and should take into account the following elements:

(a) **competence:** Identify what skills and abilities are required for a person to perform the job function to avoid potential significant impacts (i.e. qualification, internal training, or experience);

(b) **training:** Once the competencies of a particular role have been identified, the level of competency of the employee in that role should be assessed. If the employee does not have all of the identified competencies, training should be assigned to bridge the gap; and

(c) **awareness:** Even employees with the desired competencies need to be made aware of how their task can lead to identified potential impacts.

Training consists of three broad elements:

(a) the first element is the general awareness and information for site personnel associated with dam operations. This will consist of awareness training and reference document;

(b) the second element is formal training and assessment for all staff responsible for operation of TSF dam's. This will be recorded as an enterprise competency against the employees learning profile; and

(c) the third element is the practical in-field consolidation of skills and competencies with a mentor (operator maintainer).

Inspections should be carried out by an operation staff who has completed relevant training courses. Personnel undertaking the inspection should be able to:

(a) appreciate the risks inherent with all TSF dams, to undertake their personal responsibilities with regards to mitigating these risks;

(b) be aware of relevant regulations, codes, guidelines and site-specific documents relating to the facilities;

(c) understand the design background and features including operation and closure considerations;

(d) understand failure modes, potential deformities and safety triggers that might be identified during routine inspections;

(e) plan and prepare for a routine inspection;

(f) inspect and visually assess the condition of components of a facility;

(g) competently report on the visual condition of a facility;

(h) understand the types of instrumentation used for monitoring; and

(i) understanding site specific conditions relating to the facilities.

## 3 DESIGN AND OPERATIONS - FLY ASH DAM (FAD)

As a by-product of coal-fired power generation, the fly ash and bottom ash produced by MPS must be sequestered on site. The FAD was originally constructed between 1981 and 1982 as a single cell storage facility. The FAD is constructed approximately 1 kilometre to the southwest of the station plant buildings. It is situated at the head of a shallow valley incised up to 20m below the surrounding terrain and draining to the south.

The FAD domain comprises the dual-cell which stores fly ash and water, this water is then decanted from the FAD to the supernatant dam. The FAD domain must be managed as a TSF dam in accordance with the relevant guidelines and standards. Water dam guidelines and standards must be applied to the supernatant dam as appropriate.

Fly ash is mixed with water and pumped as a slurry to the FAD, which consists of two cells (cell 1 and cell 2) separated by a central wall. The facility includes two decant structured, one on each side of the central dividing wall. Both cells have been raised since their original construction.

The general arrangement of the FAD is shown in **Figure 1**, indicating the position of cell 1, cell 2 and their associated decant sites, the supernatant dam and the peripheral infrastructure. The original embankments and levees were constructed to a crest level of reduced level (**RL**) 253 m and comprised of:

(a) the main embankment, approximately seven metres high, along the south and southwest perimeters. The main embankment was zoned and included a central impermeable core;

(b) a zoned embankment along the east perimeter;

(c) a levee of impermeable material in the upstream areas; and

(d) a 1 m thick clay blanket on the west and south sections of the FAD floor.


***Figure 1:*** *FAD general arrangement*

Cell 2 was raised in 2017 when a 3m embankment raise (stage B was constructed to increase the crest level to RL 258.5m AHD. Cell 1 was raised in 2020 / 2021, extending

the crest level from RL 258.5m AHD to RL 261m AHD. The works approval for the cell 1 2020 / 2021 raise was documented in GHD report (2021).

Is located in a shallow valley and compromised a main embankment along the southern and south-western perimeter, upstream impermeable levee, and a clay blanket on the FAD floor. Muja manual station common dam manuals - flyash management plan report number tsb 97/02 (index = FAD disposal system, FAD hydrogeological modelling) (DM ID: 5574583) identifies the dam contraction:

*"Construction of the FAD commenced in December 1981 with a design capacity of 2,220,000 m3 and a surface area at the top of the wall of 384,000 m2. The design and construction of the FAD have been previously reported (SECWA, February 1981; Dames and Moore, February 1981; Dames and Moore, April 1981; SECW A, 1982). The storage is provided by approximately 1,100 m of embankments with a maximum height of 15 m, forming the eastern, southern and south-western boundaries. The northern and north-eastern boundaries are levees constructed entirely from low permeability clays."*

## 3.2 Construction timeline

(a) **1981 – Original design of the dam:** Was constructed to RL 253.0m:

(i) **design site investigation:** MPS – dames and moore – stage D – proposed FAD – report – site investigation 1981 (DM ID: 4833358);

(ii) **construction report:** Fly ash disposal area construction report; MPS – stage D SECWA civil and architectural 1982 (Document identified in multiple reports but not located in DM or archives);

(iii) **operating manual:** Muja manual station common dam manuals - flyash management plan report number tsb 97/02 (DM ID: 5574583); and

(iv) **drawings:**

(A) 1981 original design FAD drawings 1 (DM ID: 28825294);

(B) 1981 original design FAD drawings 2 (DM ID: 28820073);

(C) 1981 original design FAD drawings 3 (DM ID: 28820376); and

(D) 1981 original design FAD drawings 4 (DM ID: 28824702).

(b) **2002 – 3m high embankment raise:** Was constructed around the western edge of the embankment (Burns and roe worley, 2002). There is no design or construction report available for this embankment raise and the construction materials used for this embankment are not known;

(c) **2005 – Cell 1 phase 1:** Dividing embankment with a crest elevation of RL 255.5m AHD was constructed to separate the FAD into two cells (cell 1 and cell 2). The dividing embankment was constructed from bottom ash and a decant tower and associated piping were installed:

(i) **design and construction report**:

(A) MPS - FAD management design report by GHD Feb 2005 (DM ID: 4417910); and

(B) FAD storage expansion - phase 1 design report (DM ID: 35276916).

(ii) **operating manual:** GHD - MPS ash dam operating manual (DM ID: 4445684); and

(iii) **drawings:**

(A) 61-15271-C001 Rev A - Ash storage review – Site arrangement and drawing list (DM ID: 4431041);

(B) 61-15271-C002 Rev A - Ash storage review – Decant tower general

arrangement (DM ID: 4431036);

(C) 61-15271-C003 Rev A - Ash storage review – Decant tower general arrangement (DM ID: 4431037);

(D) 61-15271-C004 Rev A - Ash storage review – Typical embankment cross-sections (DM ID: 4431038);

(E) 61-15271-C005 Rev A - Ash storage review – Discharge pipe – longitudinal sections (DM ID: 4431039);

(F) 61-15271-C006 Rev A - Ash storage review – Discharge pipe – details (DM ID: 4431040); and

(G) 61-15271-C007 Rev A - Ash storage review (DM ID: 4431035).

(d) **2007 to 2008 – Cell 1 phase 2:** The cell 1 perimeter embankment crest was raised to RL 258.5m AHD using an upstream construction methodology. The raise was constructed from bottom ash with an upstream clay layer. The dividing embankment was raised to a crest level of RL 258m AHD using bottom ash.

(i) **design report:** 2007 design and construction of cell 1 embankment raise to RL258-5 (phase 2) (DM ID: 26683541);

(ii) **construction report:** 2007 design and construction of cell 1 embankment raise to RL258-5 (phase 2) (DM ID: 26683541);

(iii) **operating manual:** MPS ash dam cell 1 operating manual (DM ID: 4543179); and

(iv) **drawings**:

(A) 61-18075-01 Rev C - Cell 1 embarkment raise general layout (DM ID: 28801396);

(B) 61-18075-02 Rev D - Cell 1 embarkment raise details (DM ID: 28801396);

(C) 61-18075-03 Rev B - Cell 1 embarkment raise embarkment cross sections (DM ID: 28801396);

(D) 61-18075-04 Rev C - Cell 1 embarkment raise embarkment cross sections (DM ID: 28801396);

(E) 61-18075-05 Rev B - Cell 1 embarkment raise embarkment cross sections (DM ID: 28801396);

(F) 61-18075-06 Rev C - Cell 1 embarkment raise embarkment cross sections (DM ID: 28801396);

(G) 61-18075-07 Rev B - Cell 1 embarkment raise monitoring instrumentation details (DM ID: 28801396); and

(H) 61-18075-08 Rev B - Cell 1 embarkment raise drainage through central embarkment (DM ID: 28801396).

(e) **2011 – Cell 2A:** Cell 2 was formalised by constructing an embankment around the perimeter of the cell with a crest elevation of RL 253.0m AHD to RL 255.5m AHD.

(i) **design report:** MPS ash dam design of cell 2 embankment raise to RL 258.5m (DM ID: 4713102):

(ii) **construction report:** MPS construction report Muja FAD embankment raise of cell 2A RL 255.5M (DM ID: 4919865);

(iii) **operating manual:** FAD 17 (2011) O&M manual (DM ID: 6422286); and

(iv) **drawings:**

(A) 61-2145913-C001 Rev 0 - Cell 2 wall raise site plan and drawing index (DM ID: 4693990);

(B) 61-2145913-C002 Rev 0 - Cell 2 wall raise general arrangement (DM ID: 4693990);

(C) 61-2145913-C003 Rev 0 - Cell 2 wall raise general arrangement and set out (DM ID: 4693990);

(D) 61-2145913-C004 Rev 0 - Cell 2 wall raise typical cross sections and details (DM ID: 4693990);

(E) 61-2145913-C005 Rev 0 - Cell 2 wall raise long section (DM ID: 4693990);

(F) 61-2145913-C006 Rev 0 - Cell 2 wall raise cross sections - Sheet 1 of 3 (DM ID: 4693990);

(G) 61-2145913-C007 Rev 0 - Cell 2 wall raise cross sections – Sheet 2 of 3 (DM ID: 4693990);

(H) 61-2145913-C008 Rev 0 - Cell 2 wall raise cross sections – Sheet 3 of 3 (DM ID: 4693990);

(I) 61-2145913-C009 Rev 0 - Cell 2 wall raise decant structure details (DM ID: 4693990);

(J) 61-2145913-C010 Rev 0 - Cell 2 wall raise concrete manhole structure details (DM ID: 4693990);

(K) 61-2145913-C011 Rev 0 - Cell 2 wall raise BAD (DM ID: 4693990);

(L) 61-2145913-C012 Rev 0 - Cell 2 wall raise piezometer locations and details (DM ID: 4693990);

(M) 61-21459-06-C100 Rev K - Supernatant water dam layout plan (DM ID: 4693990);

(N) 61-21459-06-C102 Rev G - Decant layout plan and details (DM ID: 4693990);

(O) 61-21459-06-C103 Rev D - Decant structure details (DM ID: 4693990);

(P) 61-21459-06-C104 Rev C - Decant structure details (DM ID: 4693990);

(Q) 61-21459-06-C105 Rev D - FAD decant pipeline details (DM ID: 4693990);

(R) 61-15271-C003 Rev 0 - Ash storage review decant tower – general arrangement (DM ID: 4693990);

(S) 61-15271-C002 Rev 0 - Ash storage review decant tower – general arrangement (DM ID: 4693990); and

(T) 61-15271-C006 Rev 0 - Ash storage review discharge pipe – details (DM ID: 4693990).

(f) **2015 to 2017 – Cell 2B:** Seepage and movement noted on the embankment downstream face at the south-east corner of cell 1. Repairs carried out in December 2016. Cell 2B raise: embankment raise of cell 2 by 3m incorporating the provision of a leachate collection system comprising underdrainage pipes and collection tanks. The raise increased the crest elevation to RL 258.5m AHD:

(i) **design report:** MPS Cell 2B embarkment raise design report (DM ID: 26686306);

(ii) **construction report:** Manufacturers data report (**MDR**) Y026-MDR-001 (DM ID: 20408878);

(iii) **operating manual:** FAD Cell 2A (2011) O&M manual (DM ID: 6422286); and

(iv) **drawings:**

(A) 61-2145920-C001 Rev 1 Cell 2B general arrangement (DM ID: 28802797);

(B) 61-2145920-C002 Rev 1 Cell 2B overall site – works plan (DM ID: 28802797);

(C) 61-2145920-C004 Rev 1 Cell 2B decant and underdrainage plan (DM ID: 28802797);

(D) 61-2145920-C005 Rev 1 Cell 2B embankment typical sections (DM ID: 28802797);

(E) 61-2145920-C006 Rev 1 Cell 2B embankment typical sections (DM ID: 28802797); and

(F) 61-2145920-C007 Rev 1 Cell 2B underdrainage long section (DM ID: 28802797).

(g) **2019 to 2022 – Cell 1B:** Cell 1B was raised from RL 258.5m AHD to RL 261m AHD (includes interim and buttress project):

(i) **design report:** MPS Cell 1B FAD raise design report (DM ID: 21482403);

(ii) **construction report:**

(A) Muja cell 1B FAD raise construction report 12518730-REP-0 (DM ID: 29089078);

(B) MPS FAD interim deposition construction report (DM ID: 25728298);

(C) FAD Cell 1 seismic deformation assessment (DM ID: 29461336);

(D) 12576140-REP-0 MPS FAD cell 1 buttress construction report including signed certificate (DM ID: 29534458); and

(E) 12576140-LET-1 Muja FAD trigger levels for new piezometers (DM ID: 29616822).

(iii) **operating manual:**

(A) POI CD8.16 FAD deposition storage management (DM ID: 22940672);

(B) POI CD8.18 FAD dust suppression management (DM ID: 29018377);

(C) POI CD8.17 FAD inspection management (DM ID: 29013135); and

(D) MPS - FAD environmental management plan in accordance with L4706_1972_17 (DM ID: 9084770).

(iv) **drawings:**

(A) M127/C/42/1 Rev 0 - FAD cell 1b embankment raise locality plan and drawing list (DM ID: 20548322);

(B) M127/C/43/1 Rev 0 - FAD cell 1b embankment raise site layout (DM ID: 28752072);

(C) M127/C/44/1 Rev 0 - FAD cell 1b embankment raise general arrangement (DM ID: 28747748);

(D) M127/C/45/1 Rev 0 - FAD cell 1b embankment raise underdrainage system plan (DM ID: 28750872);

(E) M127/C/45/2 Rev 0 - FAD cell 1b embankment raise underdrainage system plan (DM ID: 28753687);

(F) M127/C/45/3 Rev 0 - FAD cell 1b embankment raise underdrainage system plan (DM ID: 28753774);

(G) M127/C/45/4 Rev 0 - FAD cell 1b embankment raise underdrainage system plan (DM ID: 28747751);

(H) M127/C/45/5 Rev 0 - FAD cell 1b embankment raise underdrainage system plan (DM ID: 28753689);

(I) M127/C/46/1 Rev 0 - FAD cell 1b embankment raise embarkment geometry main embankment (DM ID: 28753690);

(J) M127/C/46/2 Rev 0 - FAD cell 1b embankment raise embarkment geometry main embankment (DM ID: 28750873);

(K) M127/C/46/3 Rev 0 - FAD cell 1b embankment raise embarkment geometry main embankment (DM ID: 28753775);

(L) M127/C/47/1 Rev 0 - FAD cell 1b embankment raise drainage (DM ID: 28752082); and

(M) M127/C/48/1 Rev 0 - FAD cell 1b embankment raise arrangement and details (DM ID: 28752083).

There have been multiple changes to the FAD embankments since 1982. Key details of the FAD embankments are summarised in **Table 7** and typical cross-sections of the most recent embankment raises are included in **Error! Reference source not found.Figure 2**.

***Table 7:** FAD design parameters*

| Parameter | Item | Value |
|---|---|---|
| Maximum height | Cell 1 | 23m |
| | Cell 2 | 12m |
| Crest width | 5m including windrows and pipelines | |
| Embankment crest level | Cell 1<br>Cell 1 Phase 1<br>Cell 1 Phase 2<br>Cell 1B | RL 253m AHD<br>RL 256m AHD<br>RL 258.5m AHD<br>RL 261m AHD |
| | Cell 2A<br>Cell 2B | RL 255.5m AHD<br>RL 258.5m AHD |
| Downstream slope | Cell 1 | Outer batter slope 1V:3H<br>Side batter slope 1V:2H |
| | Cell 2 | Downstream batter slope below the access track 1V:2.5H |
| Upstream slope | Cell 1 | 1V:3H |
| | Cell 2 | 1V:3H |
| Spillway | Cell 1 | Width 18.115m<br>Depth 500mm |
| | Cell 2 | Width 20m est.<br>Depth 300mm est. |

The FAD was intended to accommodate all fly ash for the design life of the power station. In 2013 GHD was commissioned to develop a forecast to predict FAD expansion construction dates and required capacity until the end of 2030. The existing and future staged capacities are summarised in **Table 8**. The estimated construction dates are based on forecast deposition volumes provided by MPS in 2013.

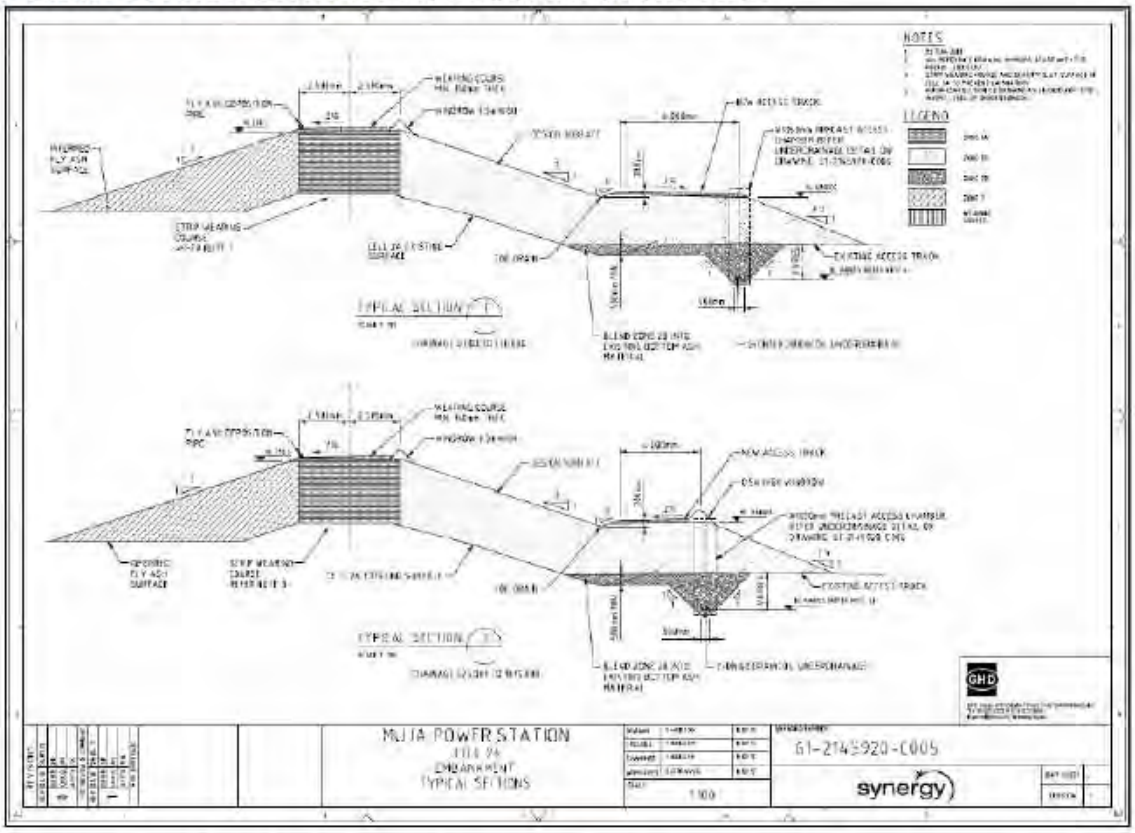



***Figure 2:*** *Cell 2 2016-17 perimeter embankment raise (Cell 2B design report (DM ID: 26686306))*

***Table 8:*** *Estimated FAD storage capacity*

| Stage | Crest elevation (RL m AHD) | Fly ash storage capacity ($m^3$) | Estimated construction commencement date Low and High consolidation (Low: 1.3 $t/m^3$ and High: 1.6 $t/m^3$) |
|---|---|---|---|
| Cell 1 (Original design was only 1 cell) | 253 m | 2,220,000 est. | 1981 |
| Cell 1 Phase 1 | 255.5 m | 258,500 est. | 2005 |
| Cell 1 Phase 2 | 258.5m | Unknown | 2007 / 2008 |
| Cell 2A | 255.5 m | 276,000 est. | 2011 |
| Cell 2B (existing) | 258.5 m | 440,000 est. | 2015 to 2017 |
| Cell 1B (existing / includes buttress) | 261 m | 174,000 est. | 2019 to 2022 |

Geotechnical testing to determine the deposited fly ash properties was undertaken on 20th May 2013 (**Table 9**). The results of this testing indicated that the in-situ dry density of fly ash ranged from 1.40 $t/m^3$ to 1.58 $t/m^3$, with a maximum dry density of 1.68 $t/m^3$. tests were performed on the surface of cell 1.

*Table 9: Summary of fly ash (tailings) properties*

| Parameter | Design value |
|---|---|
| **Average fly ash dry density** | 1.49 t/m$^3$ (Geotechnical Borrow Investigation, GHD 2015) |
| **Angle of internal friction** | 35° |
| **Hydraulic conductivity** | $10^{-7}$ m/sec |
| **Fly-ash beach slope** | 0.5 - 0.7% |

## 3.3 Geochemistry - Fly ash material

As identified in Tailcon report 149-03-3112C-RR001_0A MPS FAD Cell1 Piezo trigger levels (DM ID: 35270669):

*"The fly ash material is composed predominantly of non-plastic sandy SILT material, in general accordance with Australian standard (**AS**) 1726:2017 geotechnical site investigations, with fines (finer than 75 microns) content averaging 77% ± 13%.*

*The GHD (2021b) report has indicated the in-situ fly ash material to possess laboratory-measured specific gravity varying between 2.36 t/m3 and 2.45 t/m3 (averaging 2.4 t/m3), and assumed in-situ bulk density of 15 kN/m3 utilised for their engineering assessments, however have not provided justification for the adopted density magnitude (i.e. FAD storage capacity reconciliation with actual deposited fly ash dry tonnage, on-site density measurement of undisturbed push tube samples).*

*Electric piezocone penetration test (**CPTu**) data contained within the GHD (2021a) report indicate this material to have an average cone tip resistance qc of ~0.35 MPa regardless of depth, with this low qc value implying the impounded fly ash material to be of very loose to loose consistency, however near-zero CPTu U2 porewater pressure readings within this material indicates that it is likely to have normally-consolidated under its own self-weight."*

### 3.3.1 Density

*"Laboratory specific gravity measurement data presented in the GHD (2021a) report indicates the laterite / saprolite to possess soil particle density ranging between 2.58 t/m$_3$ and 2.77 t/m$_3$, averaging 2.64 t/m$_3$. Laboratory density measurements of undisturbed tube samples collected as part of the Dames & Moore (1981) GSI fieldwork indicated in-situ laterite / saprolite bulk density averaging 2.03 ± 0.20 t/m$_3$, and dry density averaging 1.65 ± 0.13 t/m$_3$."*

## 3.4 Embankments

The confining embankments of the FAD are built using the upstream construction technique. Embankments consist of a starter dam, which is raised to provide more storage using a series of upstream raises that rely on the strength of the previously placed fly ash to support each raise. The use of bottom ash in the subsequent embankment raises from the initial starter dam were confirmed in the GHD (2020) report. Bottom ash was used in the construction of the dividing embankment, which formed part of the phase 1 scope of works at the FAD.

The perimeter embankments were not designed as water retaining structures and therefore ponding against the embankments is not permitted. Fly ash is deposited from the perimeter to form a decant pond well away from the embankments. The decant pond must be maintained away from the perimeter embankments to reduce the likelihood of seepage and to preserve the integrity of the embankments. Excess water must not be stored in the FAD. Waste materials other than those prescribed in the environmental licence are not permitted to be stored in the FAD. Stormwater drains must be maintained and free draining.

## 3.5 Deposition planning

Well managed fly ash deposition and water management are crucial for the FAD performance and safety. The key objectives of the fly ash deposition are as follows:

(a) to progressively develop drained and dried fly ash beaches along the perimeter of the FAD; and

(b) to maintain a decant pond around the decant structures.

Total tonnage of fly ash deposited within the FAD must be reviewed on an annual basis in conjunction with the water balance for the FAD to provide input to the deposition planning.

## 3.6 Deposition principles

Deposition planning is undertaken by the systems engineer, based on the deposition principles outlined below. The deposition plan schedules the location, sequence and frequency of rotation of the fly ash deposition points. The deposition plan is communicated to the production supervisors who will implement the plan. Progress against the deposition plan must be monitored during routine inspections.

Deposition is undertaken primarily from multiple spigots. These spigots are manually operated around the perimeter embankment to form a fly ash beach. Deposition locations must be rotated frequently around the perimeter of the FAD. It is important to deposit in thin layers of ash (150mm – 200mm) while maintaining a decant pond adjacent to the decant pump. To maximise water reclamation, solids storage and maintain structural integrity, the spigot locations are monitored on a daily basis.

Deposition principles follow the 300mm freeboard requirements as identified in **section 3.15**. With the rotation of spigots (identified on **section 3.6.2)** this prevents water being trapped in thick layers of deposited ash and promotes solar desiccation of the ash beach.

Deposition should be planned to achieve low velocity. The courser, heavier solid particles will settle out first from the low velocity slurry, resulting in fly ash being deposited along the perimeter and the water and suspended fine particles flowing away from the deposition point. This method of deposition promotes formation of a beach along the perimeter and maintains the decant pond away from the perimeter embankments (>50m), as well as enhancing the extent of water clarification. By regularly monitoring the beach profile, adjusting the flow and rotating between ash deposition stations, the point of depression (deepest part of the pond) can be controlled around the central decant structure.

High discharge rates and unsuitable positioning of the spigots can lead to erosion of the embankments or the formation of channels in the beaches. Channels formed on the tailings beach can result in confined turbulent flow which can increase turbidity in the decant pond or can result in water pooling away from the decant pond. If the deposition velocity is too high, additional spigots should be engaged to reduce the velocity.

### 3.6.1 Fly ash deposition

Deposition locations along the delivery pipeline should be selected to achieve the aims of the deposition plan, the spigots are opened / closed manually. A record of which spigots were in operation and duration are kept in a database (electronic logbook K:\ElecLogBook\ElecLogbook.exe). Please refer to POI CD8.16 FAD deposition storage management (DM ID: 22940672).

The licensee shall ensure that material **section 1.3** Table 1.3.1 containment infrastructure is only stored and/or treated withing vessels or compounds provided with the infrastructure detailed. The management of deposition practices into the ash dam is critical to embankment stability as deposition directly affects the extent and location of the saturation zone within the ash dam, even when the embankments are designed and

constructed in accordance with industry recognised practices (ANCOLD 2019 and DMIRS 2017).

The licence holder currently disposes of a mixture of materials into the FAD other than fly ash and bottom ash. These include brine concentrate, reverse osmosis reject material, sludge from the water treatment system and ferric water treatment, and sludge from the CWRF. The deposition of an additional 1,500 tonnes of solid material (5ML liquid) into the FAD is not significant in itself but when combined with the other materials, and the campaign style of deposition over short timeframes, has the potential to contribute to embankment destabilisation if not managed appropriately.

### 3.6.2 Deposition pipeline and spigots

A DN160 HDPE pipe ring main with spigots at regular intervals is installed on cell 1 and cell 2. Each spigot comprised a tee piece, isolation valve and mining hose inserted into a polyvinyl chloride slotted dropper.

This is to ensure the dam is damp which eliminates the dust risk. For more information on dust control please refer to **section 3.17** and POI CD8.18 FAD dust suppression management (DM ID: 29018377).

***Figure 3 and Figure 4:*** *FAD cell 1 spigot set*

## 3.7 Leachate, seepage and underdrainage collection system

The leachate collection system utilises a collection of underground installed pipes placed on the upstream toe of cell 1 and the downstream toe of cell 2. The leachate systems installed at cell 1 and cell 2 are different but fulfil similar functions. Greater detail regarding the implementation of a leachate collection system at each of the two cells are provided below.

### 3.7.1 Seepage history

The FAD has a history of seepage, which has been exacerbated by water management issues. Decant water is removed from the FAD and pumped to the nearby supernatant dam. The capacity of the supernatant dam is 251.19m / 0.78ha, hence limiting the ability to remove of free water from the FAD while acting as a storage facility. In 2016 significant seepage remediation was required at the south-west corner of cell 1. Key contributors to this seepage were concluded to be:

(a) high pond level in the cell:

  (i) high pond levels led to high phreatic lines in the embankments, which in turn led to the seepage seen in a number of locations next to the perimeter drain. The upstream construction of the embankment raise, which had been utilised for the FAD, was not designed to form a waterproof structure;

  (ii) the high phreatic lines reduced the stability of the embankment and led to slumping;

  (iii) high water pressure against the wall can overwhelm the ability of the slotted underdrain to control phreatic lines; and

(iv) in the area of the slump, the raised area of tailings against the embankment had locally led to trapped water even higher than the pond level, locally increasing hydraulic gradients.

(b) sump excavation:

(i) the nearby sump excavation was not large enough to handle the size of suction intake and flows for the pump. The excavation for the sump locally steepened the toe of the slope, effectively undermining the area that had slumped;

(ii) with high phreatic lines, the toe of the embankment had caved in, thus removing support from the slope above which had locally slumped to form a scarp;

(iii) similar locally steep geometry near the drainage pipes beneath the ramp had, together with high phreatic lines, led to the smaller local slump near the pipes;

(iv) there may have been local zones of slightly higher permeability which had influenced where the slumps occurred and the more concentrated seepage; and

(v) where the slumps occurred, seepage paths had been shortened increasing and concentrating the flow.

(c) perimeter drain pumping:

(i) the drain was intended for storm drainage only and should have been pumped down after storms;

(ii) the high pond levels had led to permanent seepage into the drain; and

(iii) water that accumulated in the drain between times of pumping had contributed to the high phreatic line, compounding the problem.

## 3.8 Cell 1 underdrainage system

The underdrainage trench was excavated to the design levels and then lined with geotextile. The underdrainage system comprised 2 off DN160 drain coil pipes, surrounded by zone 2A filter material. Zone 2B filter rock was used between the top of the zone 2A material and the existing ground level. The drain coil pipes were connected to chambers (concrete well liners) to collect seepage. The western chamber will collect and return the seepage directly back into cell 1 via a diesel skid mounted pump and DN 75 HDPE pipe.

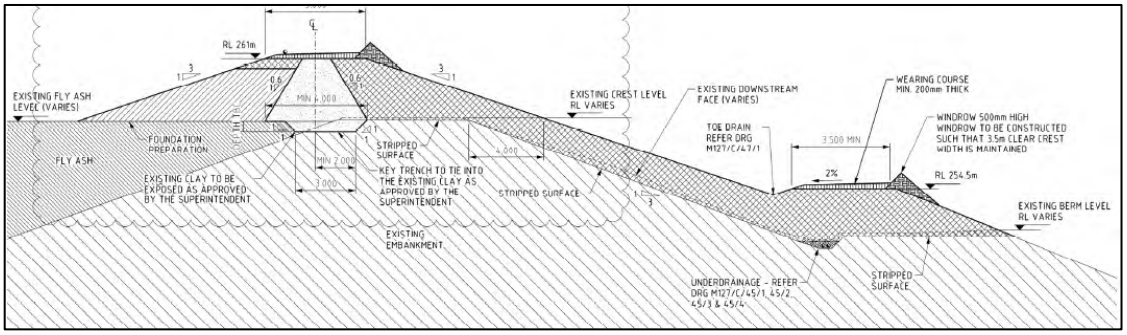



***Figure 5:*** *Cell 1 upstream underdrainage pipe (DM ID: 29089078)*

The south-eastern chamber will collect seepage and discharge to the two existing poly tanks. Due to the benching required from approximately channel (**CH**) 600m to CH 800m to maintain stable sides to the excavation. Refer to **Figure 5** for the typical installation detail. This pipe discharges into the south-east corner of cell 1, drainage site 2.

## 3.9 Cell 2 underdrainage system

Downstream underdrainage was installed as part of the cell 2B raise in 2016-17. This underdrainage consists of two DN160 drain coil pipes installed in a trench underneath the cell 2 lower access road. The intent of this drainage pipe is to collect and manage potentially low pH forming seepage. The construction of this underdrainage pipe is shown in **Figure 6**.

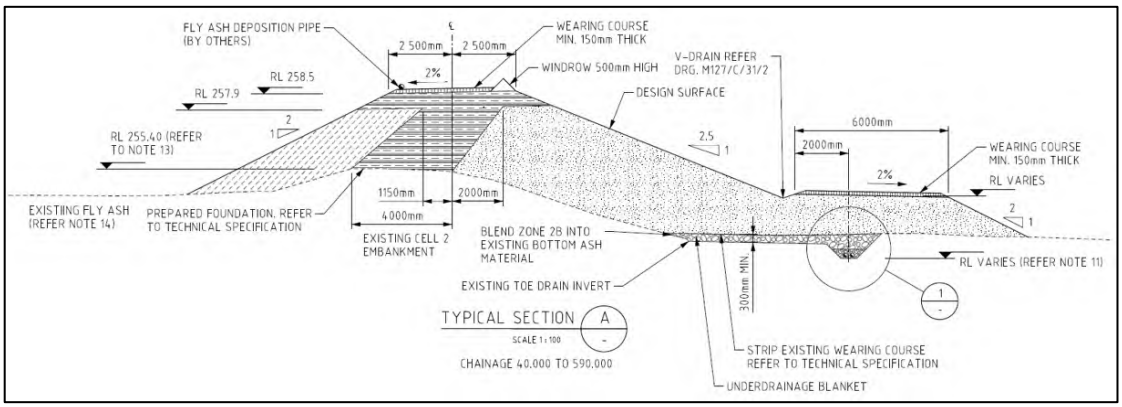



***Figure 6:*** *Cell 2 downstream underdrainage pipe (DM ID: 26686306)*

The underdrainage pipes discharge into tanks, one located on the south bank of the retarding basin (drainage site 1), and one located south-east of cell 2 (drainage site 2). All volumes are live in the T3000 system, please refer to **section 8.9.**

## 3.10 Drainage site 1 and underdrainage access chamber

The site is managed using 1 50kL tank mounted with level indicator and a solar powered digital control panel. The tank has 3 NSF 61-G Emerson pressure valves. The underdrainage water is carried to the tank using a 225mm diameter HDPE pipe connected to the tank. The pump at drainage site 1 is operated automatically when reaches the high level in the tank. The level within the tank is monitored using the digital control system (**DCS**) which reports to the bottom ash control room. The tank is also fitted with a manual level reading. A visual alert is displayed when the tank is 75% full.

A temporary petrol driven pump is installed at underdrainage access chamber to transfer seepage to the supernatant dam. This pump is located adjacent the underdrainage access chamber, and seepage collected in this access chamber was pumped into the supernatant dam via lay flat pipework.

## 3.11 Drainage site 2

The drainage site 2 is managed using 2 off 50kL tanks and the overflow reports directly to the supernatant dam upon pump activation. The sykes CPT100i pump at drainage site 2 is refuelled and automatically as required (refer to **Figure 7**). The two tanks are connected, and the combined level is monitored using the DCS which reports to the bottom ash control room. The tanks are also fitted with a manual level reading. A visual alert is displayed when the tanks are 75% full.

The toe drain on the cell 1 berm also discharges into the underdrainage tanks at cell 2. Seepage collected in the tanks gets pumped to the supernatant dam. An emergency overflow sump is located to the east of the tanks.


***Figure 7 and Figure 8:*** *Drainage site 2 Sykes CPT100i pump*

### 3.12 Decant system

Each cell has a decant tower located centrally along the dividing embankment. This decant tower is comprised of slotted concrete well liners surrounded by aggregate. The decant pipeline was located at the base of the decant tower. Originally, these decant towers operated by gravity, however the decant line has been decommissioned and free water in the FAD is now pumped to the supernatant dam. A diesel pump is located in the middle of the dividing embankment between cell 1 and cell 2 and can pump from the decant tower slotted well liners or from a floating intake in the decant pond.

***Figure 9:*** *Decant Cell 1*

***Figure 10:*** *Decant Cell 2 pump*

The objective of the return water system is to remove free water from the FAD and store it in the supernatant dam for reuse in the power plant. The decant system located in the centre of the FAD along the dividing wall consists of vertical slotted concrete wells surrounded with free draining rockfill. Water collected inside the concrete wells must be pumped to the supernatant dam.

The decant should be maintained in a safe, operational condition and must be accessible at all times. The supernatant decant pond should be maintained against the dividing wall around the decant towers by sequential spigot cycling around the perimeter as outlined in **section 3.5.**

### 3.13 Pipeline operation

Only 1 cell is operated at a time, when that cell is filled, the fly ash process is then moved to the next cell to fill. During that time the cell that is full, a project will be scoped to raise the embarkment wall as per the standards.

#### 3.13.1 Fly ash delivery pipeline between the delivery pumps and the FAD

Fly ash is collected in the ash silo at the power station and mixed with water to create a slurry. This slurry is pumped to the FAD via one of two dual pump series. The delivery

pipeline between the delivery pumps is a DN160 HDPE pipe. The pipeline runs from the delivery pump along the north of the supernatant dam and cell 2 of the FAD to the FAD isolation valve. There are flowmeters between the valve delivery pump arrangement and the FAD. Visual inspection of the pipeline is undertaken during routine inspections.

### 3.13.2 Fly ash deposition pipeline around FAD perimeter

The DN160 deposition pipeline is located on the upstream edge of the embankment crest. The pipeline comprises a combination of Victaulic couplings, bolted connections, and welded connections. There is an isolation valve at the start of the pipeline. No other valves are installed on the deposition pipeline. There are flow meters and leak detection systems installed on the pipeline. Blank flanges are bolted to each end of the delivery pipeline.

### 3.13.3 Pipeline defects or blockages

If a leak or defect is detected in the pipeline during routine inspections the following procedure must be followed by operations service:

(a) advise the production supervisors, who may advise the systems engineer and operations manager if the leak or defect is considered an emergency;

(b) obtain appropriate permits to work;

(c) cease operation of the FAD delivery pumps and isolate the delivery line;

(d) drain the pipeline in accordance with this section;

(e) rectify the defect in the pipeline, and re-weld the pipeline;

(f) recommence operation; and

(g) visually inspect the repaired area, and the re-welded pipeline to confirm the pipeline integrity has been restored.

If there are any blockages in the pipe the T3000 will alarm the operators in the control room to quickly identify where the problem is for rectification. If the blockage is not able to be dislodged, the pipeline must be cut, blockage removed and the pipe re-welded. The stage CD fly ash slurry mixing P&ID's are below:

(a) stage CD dense phase ash disposal fly ash slurry mixing – East - M-CD-1071 SH 6 (DM ID: 5149505); and

(b) stage CD ash disposal fly ash slurry pumps - M-CD-1071 SH 10 (DM ID: 5382675).

### 3.13.4 Draining and flushing the fly ash pipelines

The pipeline is flushed daily at the completion of each ashing (deposition) cycle. The flushing is an automated process initiated when the density in the tanks is below 1.1kg/$m^3$. The pipeline is flushed for approximately two hours using process water, into the FAD through the open spigots.

There are no scour points located along the delivery pipeline. If the delivery pipeline is required to be drained the pipe must be cut at a suitable low point along the pipeline to allow the slurry to drain out of the line. This must be undertaken in consultation with the environmental officer.

## 3.14 Water management strategy

Water management is a crucial aspect of the of the FAD operation. Most problems associated with tailings facilities relate to the water stored. The FAD was not designed for and must not be used as a water storage facility. The following guiding principles should be applied to water management at the FAD:

(a) minimise water storage on FAD by maintaining the smallest decant pond

practicable in relation to required pumping depths and fines agitation / transfer;

(b) decant water is the first preference for fly ash process water;

(c) no additional water shall be added to the ashing process unless there is a shortage of water in the supernatant pond and FAD decant pond;

(d) during high rainfall periods, consider additional options to remove excess water for example;

(i) stop current deposition;

(ii) early transfer of water from supernatant dam to storages higher in the process; supernatant tanks, ash water head tanks, ash settling dams;

(iii) decant pond to supernatant dam, utilising maximum supernatant dam storage volume to increase potential temporary storage on FAD; and

(iv) disposal down the saline line.

Muja has a T3000 system which is set up to monitor all water balance requirements for site. Please refer to **section 8.9**.

***Table 10:*** *Typical water supply issues and the potential rectification actions*

| Issues | Impacts | Solutions |
|---|---|---|
| **Throughput increases** | (a) more water discharged to facilities;<br>(b) fly ash rate of rise increases (affects future stage construction schedule);<br>(c) less effective drying of waste fines; and<br>(d) increased water returned to supernatant dam. | (a) review FAD construction requirements;<br>(b) review decant return size to ensure rate is not limited; and<br>(c) review water: ash mixing ratio. |
| **Throughput decreases** | (a) less water discharged to facilities;<br>(b) fly ash rate of rise decreases (affects future stage construction schedule); and<br>(c) less decant water returned to supernatant dam and MPS. | (a) review FAD construction requirements; and<br>(b) review water: ash mixing ratio. |
| **Beach steeper than assumed** | (a) fly ash solids storage capacity reduced affecting future stage construction schedules;<br>(b) FAD freeboard reduces; and<br>(c) embankments will require unscheduled raise. | (a) review stage storage calculations and review construction schedule; and<br>(b) review slurry density to ensure correct slurry ratio. |
| **Beach flatter than assumed** | (a) decant pond area increases for same pond depth;<br>(b) storm event capacity reduces for same fly ash level; and<br>(c) water freeboard capacity reduces. | (a) amend deposition sequence with more spigots open;<br>(b) review storm water and stage storage design; and<br>(c) review slurry density to ensure correct slurry ratio. |
| **Percent solids of fly ash slurry reduces** | (a) volume of water discharged to facility increases; and<br>(b) fly ash beach may become flatter. | (a) review storm water and stage storage design; and<br>(b) optimise return water usage. |
| **Percent solids of fly ash slurry increases** | (a) less water discharged to facility; and<br>(b) fly ash rate of rise increases (affects future stage construction schedules). | (a) optimise return water usage; and<br>(b) review stage storage calculations and review construction schedule. |
| **Decant water** | (a) increases seepage and underflow potential; | (a) decant water from FAD to supernatant dam and further |

| Issues | Impacts | Solutions |
|---|---|---|
| **pond too large** | (b) may reduce embankment stability;<br>(c) reduces stormwater capacity; and<br>(d) reduces stored density of fly ash. | into the process where possible;<br>(b) review functioning of drainage site tanks and associated pumps to allow free flow of underflow;<br>(c) increase monitoring bore and piezometer monitoring frequency; and<br>(d) engage mechanical water extraction. |
| **Decant water pond too small** | (a) suspended solids affect water return quality for use in plant. | (a) ensure deposition process is functioning and intended; and<br>(b) reduce return water usage and find alternative source. |
| **Incorrect deposition sequence** | (a) isolated ponding;<br>(b) increases seepage potential; and<br>(c) isolation of supernatant pond from decant pump. | (a) amend deposition sequence to reposition pond. |
| **Decant pumps inoperable** | (a) pond volume increases;<br>(b) total water in the system increases; and<br>(c) seepage potential increases. | (a) review storm water design;<br>(b) replace pumping system; and<br>(c) increase monitoring. |
| **Underdrainage pumps inoperable** | (a) underdrainage water head increases; and<br>(b) seepage increases. | (a) replace pumping system; and<br>(b) increase monitoring. |

### 3.14.2 Water balance

The inputs to the FAD are fly ash slurry and rainfall (water and solids), CWRF and rainfall (direct and runoff). The decant pond is reduced by the decant pump extracting water, evaporation, and seepage. Solids added as part of the slurry remain in the FAD as per the intention of the structure. Due to the limited ability for the power station to extract decant water from the FAD, the water balance is critical, and water from other sources should not be added into the FAD.

The water balance is prepared via the T3000 BI portal and reviewed and is reviewed monthly for any changes are made. The water balance report is developed from the environmental licence DER2014/002698-1 (DM ID: 25007266) condition 3.2 (refer to **section 1.3**) as identified below:

(a) site rainfall;

(b) evaporation;

(c) decant water recovery volumes;

(d) underdrainage recovery volumes;

(e) volume of water treatment sludges deposited; and

(f) volume of fly ash deposited.

An onsite weather station will be used for precipitation and evaporation measure. This is important to understand the temporal and spatial variability of rain across the site. The weather station containing the rainfall (pluviometer) is near the FAD to reduce potential variability. Muja has a T3000 system which is set up to monitor all water balance requirements for site. Please refer to **section 8.9.**

## 3.15 Required freeboard

Freeboard is required to protect the dam from overtopping or structural failure during

extreme rainfall events and from failure resulting from water ponding for a prolonged period of time against the embankments and causing an internal, piping related failure. The freeboard requirements specified by the ANCOLD are used as a guide for safe operational practices.

The maximum operating level (**MOL**) was determined in accordance with ANCOLD (2012). The calculated maximum operating levels for cell 1 and for cell 2 of the FAD are presented in **Table 11**. The following assumptions inform the results:

(a) the ANCOLD consequence category for the FAD is 'significant';

(b) a 100-year average recurrence interval, 72-hour rainfall event (for MPS this is 179.28mm) was used to estimate the extreme storage allowance;

(c) the runoff coefficient is assumed to be 1.0 under a conservative scenario for rainfall on embankments; beach and pond (as required by MPS's licence DER2014/002698-1 (DM ID: 25007266) condition 1.2.3 refer to **section 1.3**);

(d) the surface area of the pond has been estimated from the April 2021 survey, and will remain at or below this area as the beach rises uniformly around the perimeter of each cell; and

(e) storage allowance is a function of the trapezoidal shape formed by a flat pond surface, and the beach slope surrounding the pond.

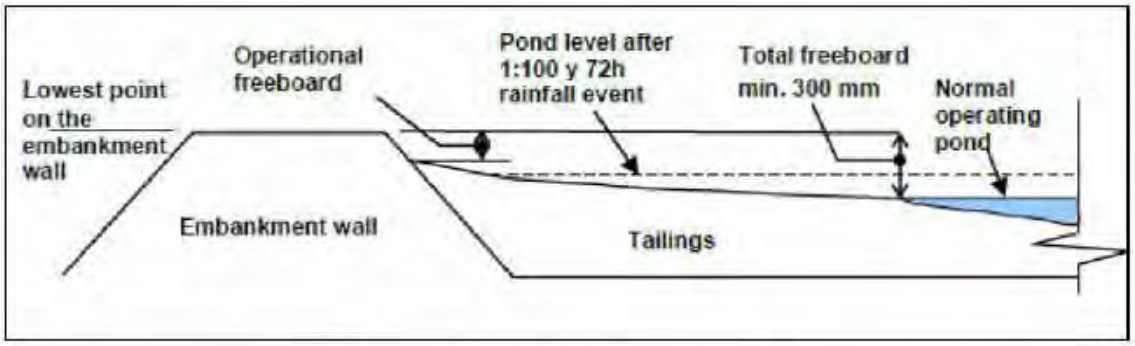



***Figure 11:*** *Freeboard requirements*

***Table 11:*** *Maximum operating levels for cell 1 and cell 2*

| Cell | Planar area ($m^2$) | Runoff from design storm ($m^3$) | ANCOLD contingency storage allowance (m) | Operating freeboard (m) | Dam crest (m) | Spillway invert (m AHD) | Maximum operating pond level (m AHD) | Freeboard (mm) |
|---|---|---|---|---|---|---|---|---|
| 1 | 218,000 | 39,083 | 0.3 | 0.3 | 261 | 260.7 | 260.2 | 300mm |
| 2 | 17,000 | 30,836 | 0.3 | 0.3 | 258.5 | 258.2 | 257.3 | 300mm |

Engineering guidelines recommend a minimum 300mm freeboard for the FAD. Under these guidelines, MPS may continue to deposit fly ash to the embankment crest under the strict condition that the decant pond (water surface elevation) always remains below the MOL. This will require close and frequent supervision of deposition.

The storage volume in the supernatant dam affects the ability to remove water from the FAD. A low-level trigger level of 1000mm has been set, initiating investigation to determine if excess water is in the FAD and why this is not being pumped to the supernatant dam.

## 3.16 Pond control

The ponds must be maintained at the minimum area possible to both maximise density and capacity for storm water. Refer to **Table 11** for the MOL for each cell. If the MOL of

the decant pond is reached (or exceeded) in both cells, it will be necessary to cease deposition and focus shifted to decanting water.

Design of the FAD embankment raise is based on the decant pond not being permitted to contact the external embankments. The design includes a requirement that water not be allowed to build up on the surface of the dam, to the point where the decant pond is less than 50m from the external embankment.

The operations team will target maintaining the ponded water at greater than 50m to the external embankment wall. However, this may not be practical during winter due to increased rainfall. As such, the pond level may exceed that target for these limited periods. The trigger levels and appropriate responses relating to pond position are summarised in **Table 12**.

***Table 12:*** *Pond position trigger levels and actions*

| Trigger | Response level | Action required |
|---|---|---|
| Decant pond within 150m of perimeter embankment | Level 1 | (a) operations manager to be notified; and<br>(b) regular discharge to continue, capacity for increased discharge to be confirmed. |
| Decant pond within 100m of perimeter embankment | Level 2 | (a) operations manager to notify operations manager and environmental officer; and<br>(b) increase decant discharge to maximum capacity. |
| Decant pond within 50m of perimeter embankment | Level 3 | (a) cease deposition; and<br>(b) decant supernatant water at maximum capacity until pond recedes to acceptable distance. |

## 3.17 Dust control

Where excessive dust is evident within the FAD domain, remedial actions are required. Additional management should be implemented where dust may carry to adjacent areas, including occupied areas (area in which people are working) or vegetation.

To ensure management of excessive dust, the T3000 system "main water balance page" weather station has a wind speed monitoring alarm to trigger at 30km/h. This will trigger an alarm will be sent to the operation services team in the BAD control room on the stage C common when the wind speed exceeds 30kph. Once it has been identified as a dust risk the following will commence:

(a) non-active cell:

- (i) **stage 1:** Record alarm and process in the electronic logbook;
- (ii) **stage 2:** Minimising vehicle traffic as much as possible, especially under high wind, reducing vehicle speed limits to 10km on access roads and tracks;
- (iii) **stage 3:** Activate the dust suppression sprinkler system; and
- (iv) **stage 4:** Organisation of a water truck to drive the dam perimeters to spray water on the dam.

(b) active cell:

- (i) **stage 1:** Record alarm and process in the electronic logbook;
- (ii) **stage 2:** Minimising vehicle traffic as much as possible, especially under high wind, reducing vehicle speed limits to 10km on access roads and tracks:
- (iii) **stage 3:** Discharging water through the spigot system. The water is diverted

from the supernatant dam to dredge the dam through the spigots:

(iv) **stage 4:** Organisation of a water truck to drive the dam perimeters to spray water on the dam:

(c) yearly maintenance – both cells:

(i) a maintenance plan is set up in SAP to trigger a yearly dust suppression chemical to be sprayed on both cells after the winter months. This will trigger the contractor supervisors to coordinate the spray liaising with the operations manager and operators prior.

A severe weather warning notification from department of fire and emergency services (**DFES**) a site wide notification is sent out as per the SIM 18.03 severe weather procedure (DM ID: 19610914). Please refer to the POI CD8.18 FAD dust suppression management (DM ID: 29018377).

***Table 13:** Wind speeds (10-minute average) and their associated impacts, produced by the Bureau of Meteorology from the Beaufort Wind Scale*

| | *Units in km/h* | *Description on land* |
|---|---|---|
| Calm | 0 | Smoke rises vertically. |
| Light winds | 19 > | Wind felt on face; leaves rustle; ordinary vanes moved by wind. |
| Moderate winds | 20 – 29 | Raises dust and loose paper; small branches are moved. |
| Fresh winds | 30 – 39 | Small trees in leaf begin to sway; crested wavelets form on inland water. |
| Strong winds | 40 – 50 | Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty. |
| | 51 – 62 | Whole trees in motion; inconvenience felt when walking against wind. |
| Gale | 63 – 75 | Twigs break off trees; progress generally impeded. |
| | 76 – 87 | Slight structural damage occurs – roofing dislodged; larger branches break off. |
| Storm | 88 – 102 | Seldom experienced inland; trees uprooted; considerable structural damage. |
| | 103 – 117 | Very rarely experienced – widespread damage. |
| Hurricane | 118 > | |

## 3.18 Fly ash prediction

Synergy is always reviewing and updating the fly ash prediction for Muja, to date the following has been calculated with the current fly ash removal process in mind. Please refer to Muja tailings dams master database - data reporting and trends (piezometers, fly ash and drone surveys) (DM ID: 19648521).

## 3.19 Fly ash removal

Muja have an agreement to supply fly ash to Hanson since around 2024. Hanson attend site on a daily basis to remove fly ash from the fly ash silo, it is then weighed at Muja's weigh bridge and a monthly report is then sent to the Synergy representatives (Dam.Management.Committee@SYNERGY.NET.AU). Doing this mitigates the environmental risk and extends the life of the FAD. All receipts must be updated in the Muja tailings dams master database - data reporting and trends (piezometers, fly ash and drone surveys) (DM ID: 19648521) and saved in the MCD-PAD-DAM-3541 and 3542 DAM - Fly ash removal correspondence folder (DM ID: 29516221).

## 3.20 Spillway

An emergency spillway was constructed on the southern perimeter embankment of cell 1. The spillway has a nominal crest level of RL 257.74 m at 1V:5H slope.

*Table 14: Spillway rock particle density and water absorption test summary*

| Test Sampling Method | Unit Result | Compliance Requirements (Units) |
|---|---|---|
| Sodium sulphate test (Aggregate soundness) | 0.2% | ≤ 12% |
| Water absorption | 0.5% | ≤ 3% |

***Figure 12:*** *Cell 1 spillway*

***Figure 13:*** *Cell 2 spillway*

## 3.21 Windrows

Windrows were constructed along the downstream edge of the embankment crest to a minimum height of 500 mm. The material was placed using a GPS equipped 30-tonne excavator and compacted by bucket tamping. The windrows were well compacted and met the intended design function.

***Figure 14:*** *Cell 1 windrows*

***Figure 15:*** *Cell 2 windrows*

## 3.22 Geotechnical site investigation

Geotechnical characterisation of foundation soils underlying the cell 1 FAD wall embankment has been undertaken by interpreting and cross-referencing geotechnical site investigation (**GSI**) data contained in:

(a) GHD (2021a) report titled "MPS, geotechnical investigation and instrumentation installation, factual report", dated 1st June 2021 (GHD reference# 12530191-6230-18) (DM ID: 24853993);

(b) Dames & Moore (1981) report title "Site investigation, proposed fly ash dam, MPS – stage 'D'", dated 10th February 1981 (Dames & Moore job# 8038-016-71). This report was retrieved from the state energy commission of WA Muja technical library (DM ID: 1949744).

The geotechnical stability of MPS FAD Cell 1 is dictated by four (**4**) alignments of earthen embankments built to form the fly ash impoundment, referred to herein as the south wall, south-west wall, west wall, and north wall.

The geotechnical stability of each wall is defined by a factor of safety (**$FoS_{slope}$**), with the minimum $FoS_{slope}$ requirement based on stipulations within the ANCOLD 2019 guidelines

for design of dams and appurtenant structures for earthquake and is summarised in **Table 15** below.

***Table 15:*** *Minimum geotechnical slope stability $FoS_{slope}$ requirement for MPS FAD*

| Evaluated soil stress conditions | Minimum $FoS_{slope}$ requirement |
|---|---|
| Static long-term | 1.5 |
| Static short-term | 1.5 |
| Earthquake event | 1.2 |

A geotechnical FAD stability compliance framework, involving definition of several categories representing different states of compliance and stability in relation to the above minimum $FoS_{slope}$ requirement.

Geotechnical engineering assessment was undertaken to identify the critical geotechnical failure mechanism most likely to affect MPS FAD cell 1. The assessment identified the most credible geotechnical failure mechanism to affect MPS FAD cell 1 is related to the high likelihood of in-situ wet / submerged fly ash and bottom ash undergoing full liquefaction under an earthquake, such that geotechnical failure of the MPS FAD cell 1 walls is likely to be initiated provided sufficient portions of in-situ ash material underlying the wall is submerged below a phreatic surface and is fully-liquefied.

As such, the key parameter from which to quantify the risk of geotechnical failure mechanism initiation is the phreatic surface underlying the MPS FAD cell 1 walls and can be interpreted from porewater pressure readings collected by as-built standpipe and VWP already embedded within each wall alignment.

### 3.22.2 Piezometers

Piezometers are an instrument for measuring the underground water pressure. Piezometers are placed in identified boreholes around the FAD to monitor the pressure or depth of groundwater. When there is excessive water from rain or deposition it cause the water pressure to increase and put strain on the dam. MPS has a requirement to have piezometers installed on our FAD, MPS has 2 types of piezometers:

(a) **standpipe piezometers:** The standpipe piezometer is the most basic type of piezometer. It consists of filter tip joined to a riser pipe that extends to the surface. Water flows through the filter tip into the riser pipe. Readings are obtained with a water level indicator; and

(b) **vibrating wire piezometers (VWP):** The vibrating wire piezometer is the most commonly deployed type of piezometer. Suitable for most applications, it can be installed in a borehole, embedded in fill, or suspended in a standpipe. Readings are obtained with a portable readout or a data logger.

Individual trigger levels have been identified for each piezometer currently installed at the FAD these positions and details are given in

**Table 22:** Standpipe and vibrating wire piezometer locations and trigger level warnings

and Error! Reference source not found.). These levels are piezometer specific and show the level of the phreatic surface at which alerts should be raised during monitoring. For more information on piezometer manual and vibrating monthly recording refer to **section 8.4.**

# 4 DESIGN AND OPERATIONS - SUPERNATANT DAM (SNDM)

The supernatant dam (**SNDM**) was constructed 2009/2010 and is located to the north-east of the FAD and specifically cell 2, which is used as an operational buffer to collect and temporarily store ash runoff from cell 1 and cell 2. The stored water is transferred to the upstream facilities for treatment and reuse. The supernatant dam has been designed as per the following:

(a) foundation bed preparation scarified to 150mm and compacted to 95%;

(b) foundation prepared to 150mm thick compacted clay;

(c) 150mm compacted clay layer; and

(d) 1.5mm HDPE geomembrane.

***Figure 16:*** *Supernatant dam*

## 4.2 Geotechnical site investigation

The geotechnical investigation works carried out in May 2008 included testpits, cone penetration test (**CPT**) and soil sampling for laboratory testing. Approximate locations of the investigation works are presented in report for MPS - return water dam conceptual design report (DM ID: 4562314). The following is a summary of the findings from the geotechnical investigation:

(a) limited or no clay material identified at areas close to the existing clay borrow pit;

(b) shallow rock intersected at about 1m below existing ground level to the northwest side of the pit; and

(c) groundwater located at about 8m below ground level at areas other than the northwest side of the pit.

## 4.3 Construction timeline

A summary of the design of the supernatant dam can be found in the following documents:

(a) 2009/2010 construction;

(i) M127-C-0098-003 MPS supernatant water dam layout plan (DM ID: 25369440);

(ii) M127-C-0098-004 MPS supernatant water dam sections and details (DM ID: 25368954);

(iii) M127-C-0098-009 MPS supernatant water dam leakage detection (DM ID: 25368956);

(iv) M127-C-0098-010 MPS supernatant water dam leakage detection (DM ID: 25374050);

(v) M127-C-0098-011 MPS supernatant water dam underdrain sump and recycle pump (DM ID: 25372830); and

(vi) M127-C-0098-013 MPS supernatant water dam underdrain sump and recycle pump (DM ID: 25367231).

(b) 2024 inspection and liner repairs.

Key details of the FAD embankment height and spillway dimensions are summarised in **Table 16** and typical cross-sections of the most recent embankment raises are included in **Figure 18** and **Figure 17.**

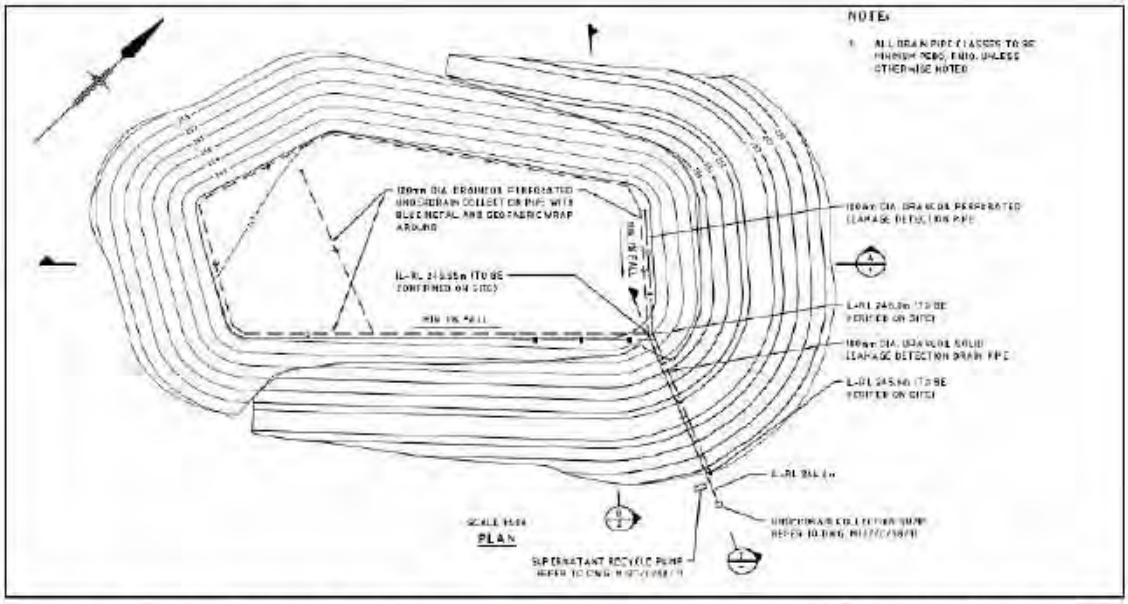



***Figure 17:*** *Supernatant dam position in relation to the FAD M127-C-0098 SH 9 (DM ID: 25368956)*

***Table 16:*** *Supernatant dam design parameter*

| Parameter | Item | Value |
|---|---|---|
| Embankment crest level | Eastern embankment<br>Western embankment | 252.5m AHD<br>253m AHD |
| Size | Aerial view | 251.19m<br>0.78 ha |
| Basement | Profile | RL 244.4 AHD |
| Spillway | Western embankment | **Invert:** RL 252.0m AHD<br>**Width:** 5m<br>**Depth:** 500m<br>**Side slope:** 1V:8H |
| Design earthquake | Peak horizontal acceleration | 0.9 m/s² (≈ 0.09 g) |
| Minimum freeboard | Below dam crest | 500 mm |

## 4.4 Pumping, leakage and underground detection sump

The supernatant dam pumps the water from the dam to the supernatant head tank. The pump details are shown in GHD (2009d), indicating the use of a centrifugal pump linked to supply to the plant area. Underdrainage collected in the underdrain system is recirculated to the supernatant dam. The recycle pump and motor southern cross is 100x65-200 with a nominal speed of 2900 RPM and motor KW 22.

The north side of the supernatant dam, there is a plastic combination screen and check valve intake, this pumps water into the underdrain collection sump. The leakage detection sump at top RL 248.8m to the lowest depth of RL 244.5m, has a precast concrete foundation base to fit DN650 (Class B) precast sewer pipe. At RL 248.3m a

leakage detection sump overflow pipe is installed to the underdrain sump with a maximum fall of 2%.

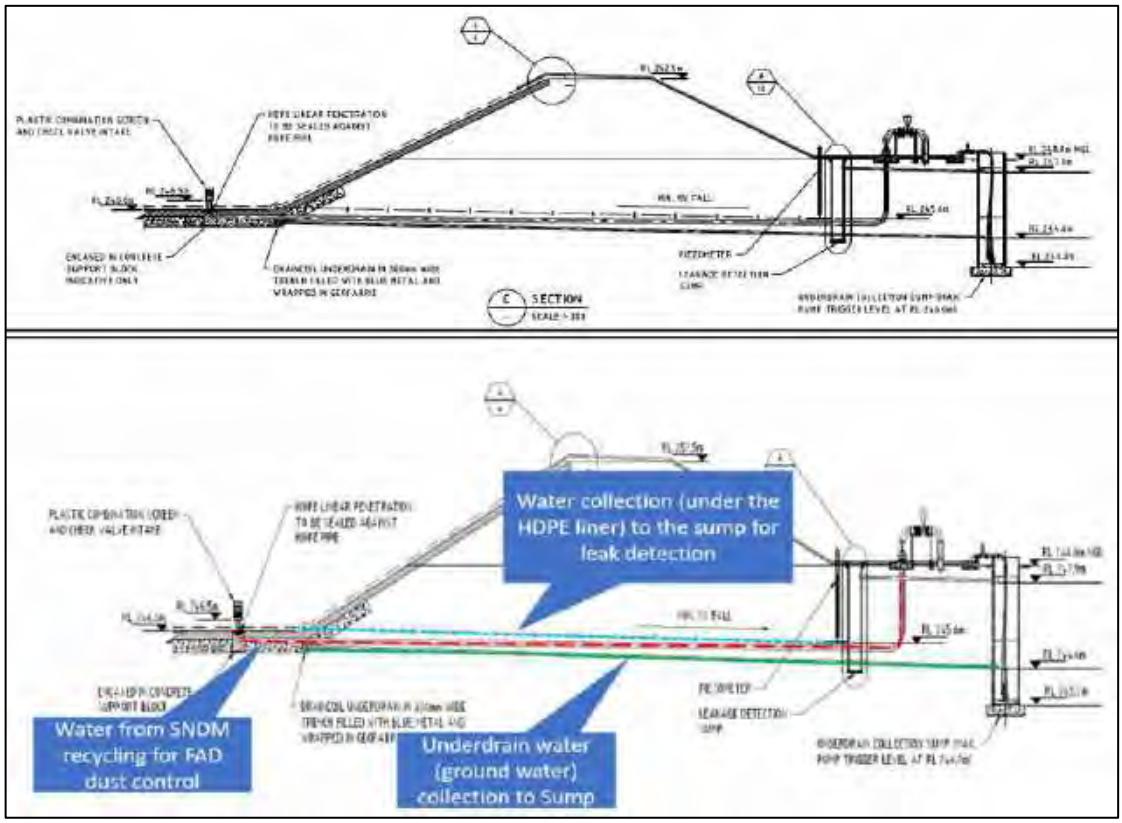



***Figure 18**: Supernatant dam section through embankment and underdrain collection M127-C-0098 SH 9 (DM ID: 25368956)*

The leak detection system located next to the sump is approx. RL 249.3m to the lowest depth of RL 245.6m. This 100mm polyvinyl chloride (**PVC**) standpipe is connected to the leak drainpipe leading to the sump. This leak detection system comprises of 12mm treated wooden dowel fastened into 80mm polystyrene foam (VH-Grade) float of 1m length, dowels painted bright yellow.

## 4.5 Spillway

An emergency spillway was constructed on the northeast perimeter embankment of the SNDM. The spillway has a nominal crest level of RL 252.0m at 1V:8H slope.

# 5 DESIGN AND OPERATIONS - BOTTOM ASH DAM (BAD)

The bottom ash dam (**BAD**) is located to the adjacent to the TAD on the east side of stage AB. This dam is classified as a hillside dam bottom ash is pumped from the boiler plant area for deposition in the BAD. Water extractable salts are therefore mostly leached from the ash prior to deposition. The motive water for the bottom ash is transported to the swirl pit and from the swirl pit it is pumped as a slurry to the BAD.

The BAD was never sized to hold the total life cycle ash production of the station, consequently it requires that ash be removed / excavated to allow continued storage capacity within the dam to be maintained. To ensure that continued operation of the stage CD boilers during the emptying work, the bottom ash must be diverted to the TAD that was constructed for this purpose during the last BAD empty in 2002.

The BAD currently holds 230,000 m3 of bottom ash and to effectively remove this ash from the BAD, access for heavy earth moving equipment is required.

## 5.1 Geochemistry - Bottom ash material

As identified in Tailcon report 149-03-3112C-RR001_0A MPS FAD Cell1 Piezo trigger levels (DM ID: 35270669):

*"The bottom ash material is composed of silty SAND material with trace gravels (fines content averaging 18% ± 11%, gravel content 8% ± 4%) in general accordance with AS1726:2017."*

## 5.2 Construction timeline

A summary of the design of the BAD can be found in the following documents:

(a) **1981 Original design of the dam:** Was constructed to RL 263m:

  (i) **operating manual:** Muja manual station common dam manuals - flyash management plan report number tsb 97/02 (DM ID: 5574583).

(b) **2001 BAD and TAD project:** Wall raise RL 265m:

  (i) **operating manual:** MPS common - burns and roe worley - MPS ash dam management - 11 September 2002 (DM ID: 5578948).

(c) **drawings:**

  (i) M-S-1069-1 (DM ID: 5186436)

  (ii) M4/C/83/1 - Site works adjacent to ash dam (DM ID: 5398550);

  (iii) M4/C/83/2 - Site works adjacent to ash dam (DM ID: 5398552);

  (iv) M4/C/84/1 - Drainage - Arrangement and details in vicinity of ash dam (DM ID: 5398554);

  (v) M4/C/110/1 - BAD runoff - Drainage upgrade plan (DM ID: 5396160);

  (vi) M127/C/11/1 - Ash disposal system - Ash inlets and discharge structure at ash dam (DM ID: 5355749);

  (vii) M127/C/11/2 - Ash disposal system - Discharge structure concrete details (DM ID: 5355751);

  (viii) M127/C/11/3 - Ash disposal system - Discharge structure reinforcement details (DM ID: 5357589);

  (ix) M127/C/11/4 - Ash disposal system - Details of cast iron pipes (DM ID: 5357591);

  (x) M127/C/11/5 - Ash disposal system - Access way steel details (DM ID: 5295510);

(xi) M127/C/11/6 - Ash disposal system - Discharge structure platform details (DM ID: 5295512);

(xii) M127/C/11/7 - Ash disposal system - Discharge structure ladder details (DM ID: 5295514);

(xiii) M127/C/11/8 - Ash disposal system - Access way footing details at dam wall (DM ID: 5295516);

(xiv) M127/C/11/9 - Ash disposal system - Overflow pipe repair details (DM ID: 5295518);

(xv) M127C/C/2/1 - Ash disposal system - Ash settling pond plan and details (DM ID: 5359301);

(xvi) M127C/C/2/2 - Ash disposal system - Ash settling pond plan and details (DM ID: 5359303);

(xvii) M127/D/21/1 - BAD as constructed (DM ID: 5357653); and

(xviii) M127/D/22/3 - BAD base levels (DM ID: 5384855).

***Table 17:** Bottom ash dam (BAD) design parameter*

| Parameter | Item | Value |
|---|---|---|
| Embankment crest level | Embankment | RL 265m AHD |

## 5.3 Emptying the BAD

Since the construction of stages CD at Muja in the early 1980s, an ash dam was constructed to deposit the bottom ash from the 8 boilers on site. This ash is all pumped as a slurry from the bottom of the boilers through pits and pumped to the BAD where the ash is allowed to settle out and the water is recovered for further use in the ashing process. Muja BAD emptying exercise in 2002 (DM ID: 4342434).

In 2002 a memorandum (DM ID: 4329417) advised the BAD has been emptied on a number of previous occasions, each time the amount of the ash effectively removed from the dam has declined:

(a) in January 2001 a contract was let to remove 100,000m3 of bottom ash from the BAD but only 35,000m3 could be removed; and

(b) again in 2024, 40,000 cubic meters of ash was removed and placed on the FAD cell 2 in preparation of the cell 2 lift which will be completed in the near future.

***Figure 19:** Bottom ash dam (BAD)*

## 5.4 Deposition into the BAD

The water-soluble salts remaining in the bottom ash after deposition in the BAD amount to approximately 0.1% by weight. The leaching of salts from the bottom as tends to be relatively slow due to the large particle size, typically 70%, greater than 75um in diameter.

Prior to 2001, bottom ash within the BAD was removed by excavation while the dam remained in service. However, an accident in 2001 which involved the submergence of an excavator in the BAD forced MPS to rethink their deposition strategy.

While the BAD is temporarily out of service, required to be offline, construction projects in place or needs to be drained and cleared, the TAD receives the bottom ash deposition.

## 5.5 BAD operating sequence for removing the BAD from service

Each time the bottom ash is to be removed, the procedure will be to:

(a) divert the stages CD bottom ash slurry pipes to the TAD;

(b) divert the WWTP effluent to the TAD;

(c) divert the stages C and D WTP effluents to the TAD;

(d) let the excess water fill the TAD and overflow to the ash recycle pumps to ensure the ashing system remains in service;

(e) have the contractor dewater the BAD low enough for safe access of machinery before any ash is removed;

(f) remove the amount of bottom ash, as determined on the spreadsheet, from the BAD; and

(g) then restore all pipework back to the BAD until the next time bottom ash is to be removed.

Operation of the valves will be required to maintain the correct water requirements for the ash recycle pumps and water levels in the dams. Portable diesel pumps will be required to maintain water from the settling pond to the ash recycle system. Use of the lower settling pond overflow pump to pump water to the ash head tank will also be required to supplement the water requirements. The sequence follows such that the holding dam is allowed to accept bottom ash slurry for the period it takes to dewater the BAD and remove the determined quantity of ash.

## 5.6 Windrows

Windrows were constructed along the downstream edge of the embankment crest to a minimum height of 500 mm and logs are erected on the eastern part of the dam. The windrows were well compacted and met the intended design function.

***Figure 20:*** *BAD windrows*

# 6 DESIGN AND OPERATIONS - TEMPORARY ASH DAM (TAD)

The temporary ash dam (**TAD**) is located to the adjacent to the BAD, which is used as an alternate storage location for bottom ash deposition. In 2002, a TAD was constructed in the vicinity of the BAD to receive bottom ash slurry, thereby allowing the BAD to be temporarily taken out of service and drained during the bottom ash excavation process.

The location chosen by MPS was an old pond referred to as “ash pond no. 2”. It is unknown whether any geotechnical investigations were completed prior to the commissioning of the new TAD, original design details are also unknown.

***Figure 21:*** *Temporary ash dam (TAD) drone photo (2015)*

## 6.1 Geotechnical site investigation

The TAD is bounded to the north and northeast by the BAD with undeveloped land forming the eastern side and includes water settling ponds. Undeveloped land with trees forms the southern boundary with the western side comprising a narrow strip of trees which includes access tracks onto the TAD. Beyond the trees to the west is an unsealed road with forest beyond that rises in a westerly direction.

The natural ground slopes down to the east reducing in elevation from approximately 266 m AHD at the north-western corner of the TAD to 254 m AHD on the downslope eastern side of the site. The investigation was initially concentrated on the TAD and was later expanded to a shallow borrow area located approximately 450 m south of the TAD. Please refer to ER2571 GHD preliminary geotechnical investigation TAD May 2014 (DM ID: 6334937).

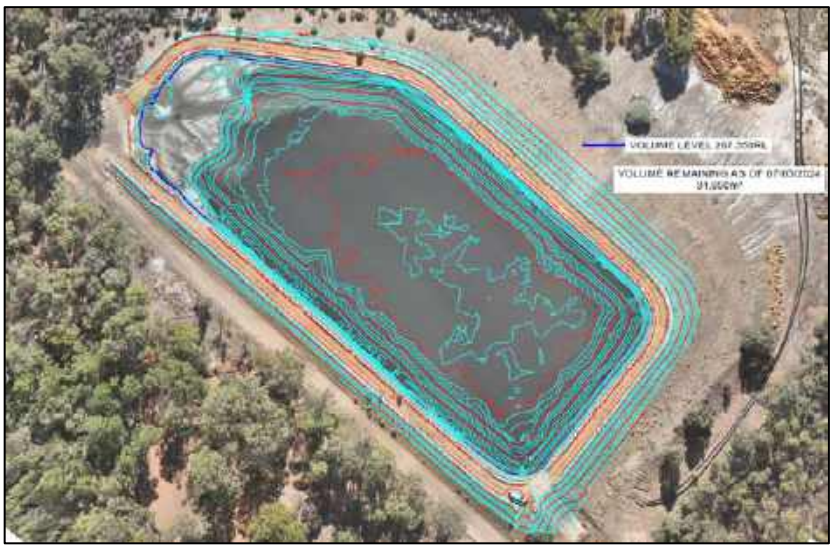


***Figure 22:*** *Muja TAD Survey June 2024 (Reference DM ID: 35093609)*

## 6.2 Stability analysis

A stability analysis for the perimeter embankment was undertaken using limit equilibrium computer software GeoStudio 2007. The north-east perimeter embankment of the TAD was analysed. This was selected as the critical cross section as it was the highest point of the perimeter embankment and its failure would lead to an uncontrolled release of the contained material. The following assumptions were made based on the design:

(a) an upstream rise of the existing perimeter embankment from RL 266 m to RL 267 m; and

(b) upstream slope 1V:3H, downstream slope 1V:2.5H, crest Width 5 m.

## 6.3 Construction timeline

A summary of the design of the TAD can be found in the following documents:

(a) **2002 TAD construction:** The natural ground slopes down to the east reducing in elevation from approximately 266m AHD at the north-western corner of the TAD to 254 m AHD on the downslope eastern side of the site. The ash pond was used to dispose of bottom ash and fly ash, prior to the construction of the BAD and the FAD. The footprint of Ash Pond No 2 is still visible, forming the south-east bench of the existing TAD. The north-east bench consists of loosely placed sand, presumably placed to buttress the current facility.

(b) 2014/2015 Dam raise RL 267m AHD:

(i) **design report:** ER2571 design report (DM ID: 7327270);

(ii) **construction report:** No documentation found for the handover of the TAD;

(iii) **operations and maintenance manual:** No documentation found for the handover of the TAD;

(iv) **drawings:**

(v) M-S-1069-1

(A) M127-C-0016-001 TAD locality plan and drawing list (DM ID: 7454870);

(B) M127-C-0017-001 TAD general arrangement (DM ID: 7454216);

(C) M127-C-0018-001 TAD typical cross sections sheet 1 of 2 (DM ID: 7454760);

(D) M127-C-0018-002 TAD typical cross sections sheet 2 of 2 (DM ID: 10136854);

(E) M127-C-0019-001 TAD inlet and spillway sheet 1 of 2 (DM ID: 7454656);

(F) M127-C-0019-002 TAD inlet and spillway sheet 2 of 2 (DM ID: 10133351);

(G) M127-C-0020-001 TAD typical cross sections sheet 1 of 2 (DM ID: 7454544);

(H) M127-C-0020-002 TAD decant structure sheet 2 of 2 (DM ID: 10128172);

(I) M127-C-0021-001 TAD drainage details (DM ID: 7454546);

(J) M127-C-0022-001 TAD dissipation structure sheet 1 of 2 (DM ID: 7454548); and

(K) M127-C-0022-002 TAD dissipation structure sheet 2 of 2 (DM ID: 10134210).

Key details of the TAD embankment height and spillway dimensions are summarised in Table 18 and typical cross-sections of the most recent embankment raises are included in **Figure 23, Figure 24 and Figure 25.**

***Table 18:** Temporary ash dam (TAD) design parameter*

| Parameter | Item | Value |
|---|---|---|
| Embankment crest level | Embankment crest level<br>Top grate | RL 267m AHD<br>RL 266.5m AHD |
| Spillway | Southern embankment | **Invert:** RL 267m AHD<br>**Width:** 6m<br>**Depth:** 300m<br>**Side slope:** 1V:3H |
| Overflow level | Embankment<br>Top grate | RL 267m AHD<br>RL 266.5m AHD |

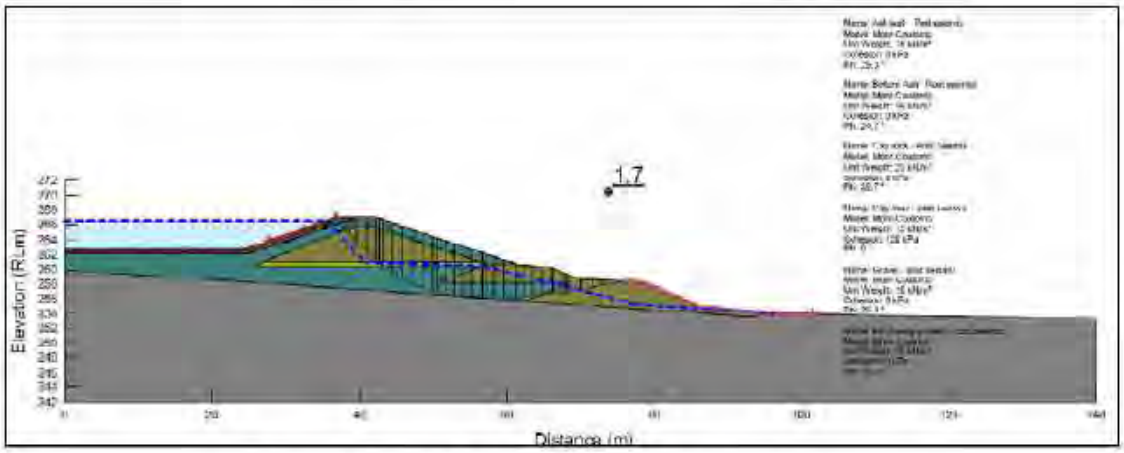



***Figure 23:** TAD slope stability calculation*

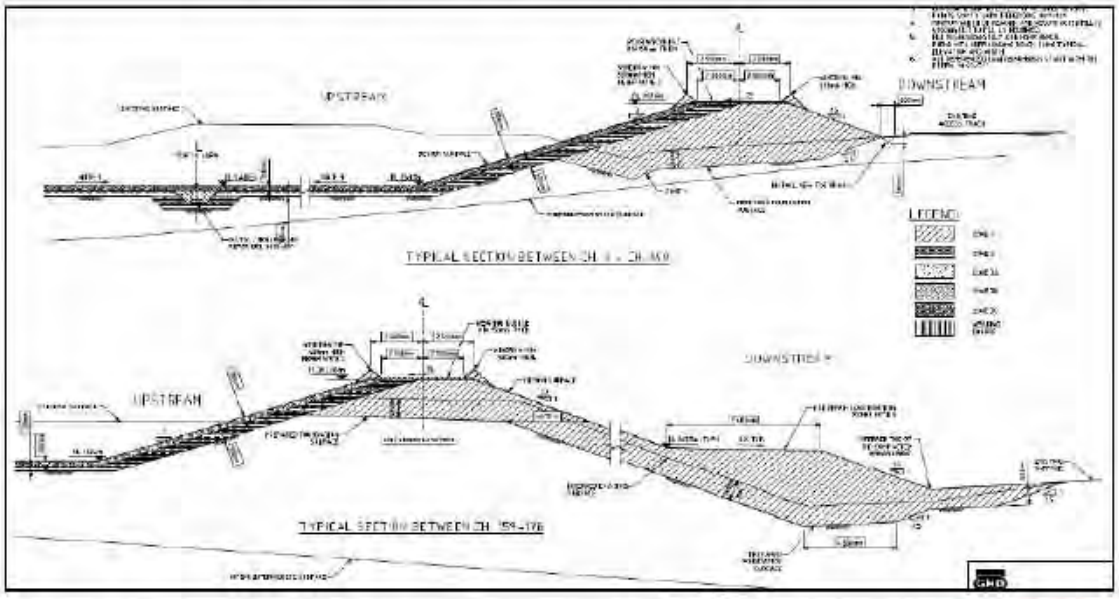



***Figure 24:** TAD embankment cross section sheet 1 M127/C/18/1 (DM ID: 7454760)*

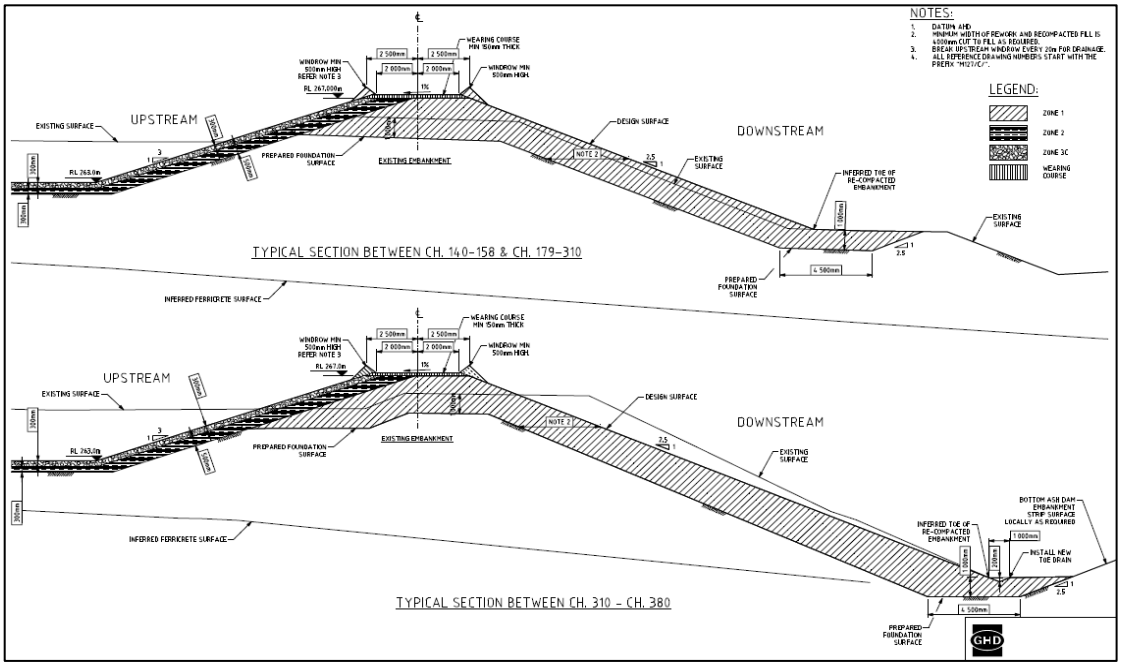



***Figure 25:*** *TAD embankment cross section sheet 2 M127/C/18/2 DM ID: 10136854)*

## 6.4 TAD freeboard requirements

Total freeboard is defined as the vertical distance between the maximum operating pond level and the crest of the dam. This level represents the capacity of the dam to pass an extreme storm. The guidelines on tailings dams (ANCOLD, 2012a) recommends Significant consequence category dams have adequate freeboard to contain the 1:100 AEP, 72hour rainfall event. The guidelines recommend an additional contingency freeboard (to the crest) of 300 mm for significant consequence category dams.

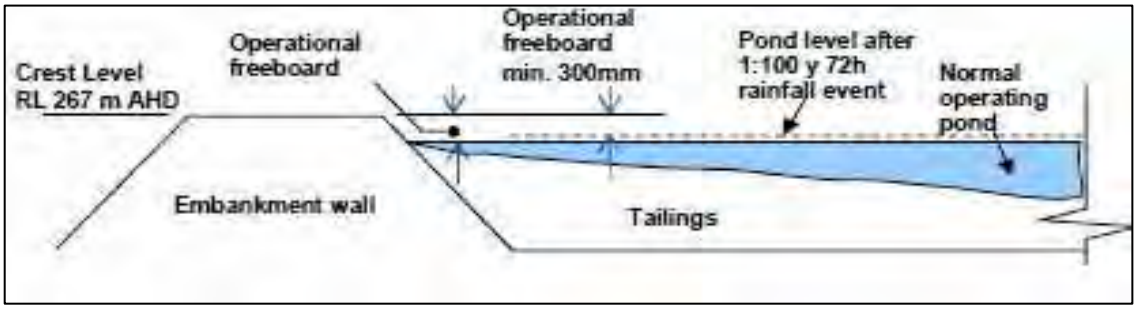



***Figure 26:*** *TAD Freeboard*

## 6.5 Deposition into the TAD

The TAD receives deposition only during each construction phase of the BAD while it is temporarily decommissioned, drained and cleared or in circumstances when the BAD is required to be offline. The required capacity of the TAD is a function of the deposition rate (de-sand rejects and bottom ash) and duration of the construction phase. Prior to each round of service, deposition must be cleared (excavated) from the TAD to restore design capacity.

## 6.6 Decant structure

As part of the TAD remediation in 2014/2015, a new pre-cast decant structure was constructed and replaced the old decant structure. Refer to drawing 61-2145919-C007 and C008 for details (DM ID: 9507732). A two-compartment system was chosen for the recycle pump feed chamber and primary decant. The rectangular compartments would allow easier compaction of the dam embankment, as opposed to circular well liners.

### 6.7 Underdrainage

A underdrainage system was installed in 2014/2015 in the TAD floor which discharges into the secondary decant structure. The underdrainage system is designed to prevent ponding in the TAD while the TAD is not in service. While the TAD is in service, underdrainage will supplement flow to the recycle pumps. TAD M127/C/21/1 underdrainage system (DM ID: 7454546).

### 6.8 Spillway

An emergency spillway was constructed on the southern perimeter embankment of the TAD. The spillway has a nominal crest level of RL 267m at 1V:3H slope.

### 6.9 Windrows

Windrows were constructed along the downstream and upstream edge of the embankment crest to a minimum height of 500 mm. The windrows were well compacted and met the intended design function.

## 7 DESIGN AND OPERATIONS - ALL TAILINGS DAMS

### 7.1 Bore water / groundwater

As defined in FAD environmental management plan in accordance with L4706_1972_17 (DM ID: 9084770). Groundwater monitoring has been undertaken around the FAD since 1982 and now is an operating licence requirement. Analytical results for the FAD over the monitoring period (1982-2014) have been assessed for temporal and spatial trends. Historical trends are based on observations of decreasing and increasing concentrations over time.

Spatial trends are based on the location of increased concentrations across the FAD. A statistical appraisal of results does not form the basis of these observations. Ultramafics (2014) identified three chemical indicators to monitor potential leachate in groundwater from the MPS FAD. Their report noted the following observations:

(a) salinity (as TDS) has increased in nine monitoring bores (MB-6 to MB8, MB-11 and MB31 to MB34) and in 2014 is approximately double those values recorded in 2005;

(b) low chloride/sulphate (Cl:SO4) ratios or higher ratios declining over time were noted in 12 monitoring bores (MB2, MB 7B, MB5-8, MB 10B, MB 12A, MB 31-34); and

(c) strontium was recorded at above routine analytical levels of detection (in milligrams per litre or mg/L) in 12 monitoring bores (MB 3A, MB 4A, MB 7B, MB 5-8, MB 11B, MB 31-34).

### 7.2 Waste management

The environmental licence DER2014/002698-1 (DM ID: 25007266) condition 1.3.4 has set condition for fly ash waste management for site, refer to **section 1.3**. The following waste is identified:

(a) wastewater stream from the MPS CWRF, desalination plant and groundwater supply system comprising ferric water treatment sludges; and

(b) wastewater stream from the MPS, CWRF and desalination plant comprising brine and reverse osmosis rejects.

Also refer to condition 4.2.1 table 4.2.1 annual environmental report in the environmental licence DER2014/002698-1 (DM ID: 25007266), refer to **section 1.3**. This states that the "*Quantity of fly ash and bottom ash removed from the Premises summarised in a tabular format for each calendar month"* this means that all removal of fly ash which is currently completed by fly ash Australia needs to be reported to the environmental team.

The corporate EMS procedure-controlled waste (DM ID: 4593876). This process include the update of MPS controlled waste register (DM ID: 4440328) which is controlled by the environmental team.

## 7.3 Environmental management

The FAD environmental management plan in accordance with L4706_1972_17 (DM ID: 9084770) identifies potential environmental issues associated with the FAD, and guide the implementation of management action, to minimise the potential for and consequence of the potential environmental impacts.

This management plan fulfils the commitment made by Synergy to prepare a FAD environmental management plan as part of the MPS DER licence conditions. The environmental licence DER2014/002698-1 (DM ID: 25007266) condition 1.3.3, refer to **section 1.3**.

### 7.3.1 Environmental reporting

MPS shall submit an annual environmental report to the CEO by 30th September each year. The environmental team develops his report by liaising with SME's, reviewing the Muja tailings dams master database - data reporting and trends (piezometers, fly ash and drone surveys) (DM ID: 19648521), Muja tailings dams master database - VWP calculations (DM ID: 29538354) and communicating to the tailing storage facility committee meetings. This is a condition in our environmental licence as per **section 1.3** table 4.2.1 annual environmental report.

## 7.4 Documentation and information management

Muja uses a compliance database and SAP to monitor and maintain all equipment on site. All documents that are generated or received at Muja are stored in the electronic DM web client and have controls applied. This is a condition in our environmental licence, refer to **section 1.3** condition 4.1.1.

All service, maintenance and inspection records must be maintained as described in the relevant AS. These records must be kept in DM, operations electronic logbook and the compliance database being utilised, so long as they are available to all Synergy personnel to review should the need arise.

Please refer to the Muja dams folder (DM ID: 26549403) which consists of all dam equipment identifications (**EQID**), in each of these folders will have all documentation relating to that equipment. The TSF dams can be found below:

(a) MCD-PAD-DAM-3541 and 3542 DAM Flyash Settling (Cell 1 and 2) (DM ID: 27154953);

(b) MCD-PAD-DAM-356 DAM Supernatant Water (DM ID: 27157347);

(c) MS-AD-DAM-402 DAM Bottom Ash Settling (DM ID: 27156850); and

(d) MS-AD-DAM-403 DAM Alternate Temp Bottom Ash Storage (DM ID: 27154224).

## 7.5 Major and minor plant modifications

No technical change shall be made to plant or associated systems without appropriate assessment, authorisation, implementation and documentation. Management of change - technical (**MOC-T**) is a critical and essential element of a robust and comprehensive risk-based process safety and asset management system.

Technical change to plant or systems may be required from time to time due to new technology, obsolescence, plant performance, reliability, safety, etc. These changes can introduce new hazards / risk, thus there needs to be effective procedures, processes and systems in place for safe and effective management and control purposes.

All technical change is to be appropriately assessed, authorised, implemented, and

documented. This procedure details the MOC-T process within Synergy's coal generation business unit. Please refer to GBU-PRC-ASM-0002 Technical management of change procedure (DM ID: 21751460).

## 7.6 Access / traffic control

The following general site access and stormwater drainage control within the FAD area should be monitored and maintained on a regular basis:

(a) maintain all access tracks to and around the FAD in order to allow safe access all year round for inspections, maintenance, and emergencies;

(b) control access to the FAD so that only those persons authorised to gain access can do so, by providing adequate signage around the FAD. Signs are to be positioned such that they are clearly visible from all the potential access areas on known routes or access to the dam;

(c) traffic on and around the ash storage facility must be controlled so as not to generate excessive dust; and

(d) manage the drainage of stormwater from the embankment and around the embankment toe by maintaining drainage systems.

Roads on and around the FAD are designed for the equipment which are using them. Light vehicles are capable of using the roads all year round, however the 15T franna crane is only suited to dry season use. No apparent stability analysis for the crane has been undertaken to demonstrate that the roads are designed for the equipment using them. However, based on inspection, it would appear the roads may be adequate for the equipment in regular use on the TSF. Please refer to drawing M127/C/27/1 Cell 2 embankment geometry (DM ID: 23410068) for FAD cell 2 embankment and road design. After using heavy mobile equipment on roads around the FAD dams, a visual inspection is required to ensure roads haven't been damaged.


***Figure 27:*** *Fly ash dam traffic management plan (DM ID: 21848022)*

Any area specific requirements due to construction works or other activities, including authorisation requirements, call up procedures, traffic management plans, safe work procedures and personal protective equipment must be complied with. The traffic management plan can be found within SIM 5.74 FAD traffic management plan (DM ID: 21848022).

### 7.6.2 Signage

All signage must comply with the current regulations, please refer to Muja's safety signage compliance SIM 17.06 safety signage compliance (DM ID: 20265171) for guidance on all safety signage for Muja.


***Figure 28:*** *FAD Entrance Signage*


***Figure 29:*** *Signage around the FAD*

## 7.7 Security

MPS have a 24hr security team on site who monitor all areas of access. Personnel are unable to enter site without a site access card which allows you swipe in through the turnstiles. Securities keys roles are to:

(a) ensure the security of personnel, chemicals, processes, equipment, plant, buildings, records and information systems;

(b) location of the site;

(c) ensure there is no sabotage, mischief or terrorism; and

(d) integrity and reliability of the security system and possible requirements for backup support for systems and security personnel.

# 8 MONITORING AND AUDITING

Monitoring is required to maintain all of the TSF safety and to assess the dams performances against the design assumptions. Monitoring of the TSF comprises visual inspections on a routine basis and monitoring of deposition rates, instrumentation, and equipment. Inspection requirements are set out in **Table 19**. There are 4 types of inspections that are identified below:

(a) **routine inspections:** Identification and reporting of deficiencies as part of ongoing duties;

(b) **intermediate inspections:** Identification of deficiencies by visual examination and review of surveillance data against prevailing knowledge;

(c) **comprehensive inspections:** Identification of deficiencies though site inspections evaluating data and applying current criteria and prevailing knowledge; and

(d) **special inspections:** Examination of particular feature for non-routine event (earthquake, heavy flood Etc.).

MPS's environmental licence DER2014/002698-1 (DM ID: 25007266) condition 3.1.2 advises we require monthly, quarterly and annual monitoring in place, refer to **section 1.3**.

*Table 19: FAD inspection requirements*

| Item | Dam | Frequency | Location Maintained | Responsible Person |
|---|---|---|---|---|
| Inspection **(Section 0)** | All Tailings Dams | Daily | Electronic logbook | Operators |
| 2-day spigot shift **(Section 8.2)** | FAD | 2 days | Electronic logbook | Operators |
| Inspection **(Section 8.3)** | All Tailings Dams | Weekly | Electronic logbook | Operators |
| Piezometer manual and vibrating recording **(Section 8.4)** | FAD | Monthly | Electronic logbook | Operators |
| Aerial surveys **(Section 8.5)** | FAD Supernatant | Summer: Monthly Winter: Biweekly | SAP MI# 80022002 | Synergy Compliance |
| Groundwater quality **(Section 8.6)** | All Tailings Dams | Monthly | Pi Vision and Starlims | Synergy Chemists |
| Monitoring of ambient groundwater quality from bores **(Section 8.7)** | All Tailings Dams | DWER Quarterly<br>DWER TRENDS Annual | Compliance Empower | Synergy Environmental |
| Internal Inspection **(Section 8.8)** | All Tailings Dams | Annual | SAP MI# 80016380 and 80016382 | Synergy Civil and Systems Engineer |
| Category 1 inspection and piezometer and stability data review **(Section 8.8.1)** | FAD | Annual | SAP MI# 80016380 | Third-Party Structural Contractor (Dam Engineer) |
| Category 2 Inspections and piezometer and stability data review **(Section 8.8.2)** | Nil | 2 yearly | SAP | Third-Party Structural Contractor (Dam Engineer) |
| Water balance data review **(Section 8.9)** | FAD | DWER TRENDS Annual | Compliance Empower | Synergy Environmental |
| Compliance Audit **(Section 8.10)** | All Tailings Dams | When required | DM ID: 10814850 | Synergy Compliance |
| Addition examinations **(Section 8.11)** | All Tailings Dams | When required | When required | Synergy Engineer and Third-Party Structural Contractor (Dam Engineer) |
| Incident Reports **(Section 8.12)** | All Tailings Dams | When required | Empower ICAM | Synergy Engineer and Third-Party Structural Contractor (Dam Engineer) |

## 8.1 Daily inspection

These involve the normal observations carried out by the personnel responsible for operating the facility and must record apparent problems (operational or structural) or unusual occurrences if observed, and these must be reported to the operations manager immediately. These inspections will normally be done daily in association with the inspection of trapped wildlife in dams and the spigot valves shift.

Muja's operation electronic logbook monitors and maintains the daily inspection on the FAD. Please refer to POI CD8.17 FAD inspection management (DM ID: 29013135) for the process.

## 8.2 2-day spigot shift

Freeboard, deposition and pond is reviewed, and spigots moved (if required) to ensure a 300mm freeboard on cell 1 and 2 advised in **section 3.15.** Please refer to POI CD8.17 FAD inspection management (DM ID: 29013135) for the process. Below is the electronic logbook routine task information:

*"Managing fly ash deposition in Cell 1.*

*The intent of deposition is to maintain the pond in a central location around the centre of the decant structure and any water / pond away from the external walls of the dam. Where the water or pond extends to the closest point of an external wall will be the next deposition point when the spigot requires moving.*

*Can the monitoring of the dam continue with export rates of fly ash recorded each shift in the electronic logbook. The spigots have valves that will need to be used to control the position of the pond and discharge."*

## 8.3 Weekly inspection

A weekly inspection is undertaken by the operators via the electronic logbook. This inspection includes the following:

(a) FAD:

- (i) embankment (crest, inner toe and outer face and toe);
- (ii) access roads and spillways;
- (iii) waste fines delivery pipeline;
- (iv) decant, pumps and pipeline;
- (v) monitoring system;
- (vi) underdrainage drainage sites, tanks, sumps and seepage collection;
- (vii) pool levels;
- (viii) freeboard;
- (ix) pipeline and deposition; and
- (x) general.

(b) supernatant dam:

- (i) embankment (crest, inner toe and outer face and toe);
- (ii) access roads and spillways;
- (iii) HDPE liner;
- (iv) water level;
- (v) leak detection system;
- (vi) decant and pipelines;

(vii) underdrainage, tanks, sumps and seepage collection; and

(viii) general.

(c) BAD and TAD:

(i) embankment (crest, inner toe and outer face and toe);

(ii) access roads and spillways;

(iii) leak detection system;

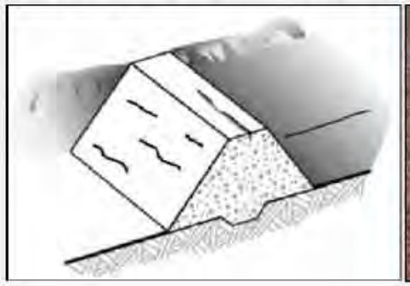
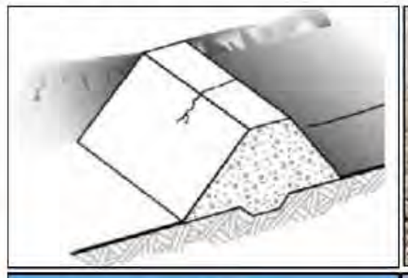
(iv) decant and pipelines; and

(v) general.

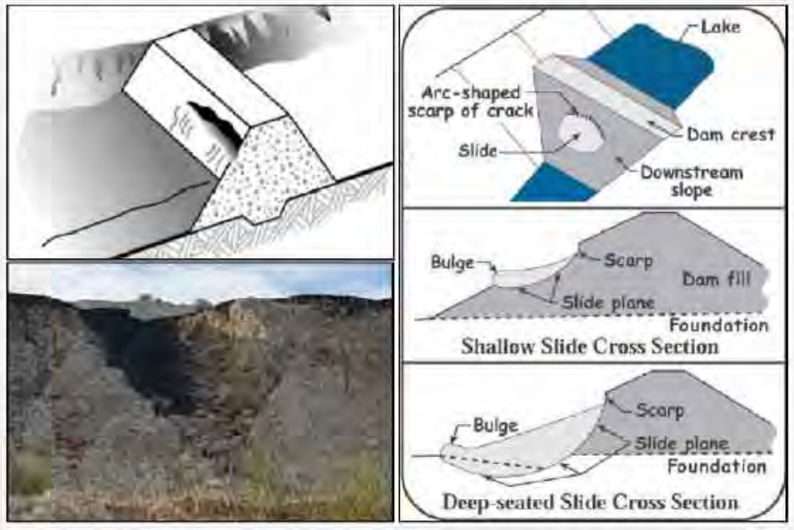
This is identified in the Muja tailings dams weekly inspection form (DM ID: 18971379). On completion of the form, the operator maintainers advise the operator supervisors of any issues or defects, raise any WO (if defects found), a copy of the report is to be retained and provided to be sent to the operation administration and saved in DMS.

All reports are to be sent to the dam management committee and saved in Muja tailings dams - weekly reports (Embarkment, HDPE liner, water and leaks) (DM ID: 24214686). Please refer to POI CD8.17 FAD inspection management (DM ID: 29013135) for the process.

***Table 20:** Weekly inspection requirements*

| Inspection | Description | Causes | Concerns | Action |
|---|---|---|---|---|
| **Embankment:**<br>**Longitudinal crack on crest, upstream and downstream face** | Longitudinal cracks extend parallel to the crest of the embankment and may indicate the early stages of a slide on either the upstream or downstream slope of the embankment. They can create problems by allowing runoff to enter the cracks and saturate the embankment which in turn can cause instability of the embankment.<br>   | **Short:** Isolated cracks are commonly due to drying and shrinkage of the embankment surface and are not usually significant. They are usually less than 1 inch wide and propagate in various directions.<br>**Larger (wider than 1 inch):** Well-defined cracks may indicate a more serious problem. | Possible slope instability.<br>Provides entry point for surface water which can promote erosion / additional movement.<br>Seepage. | Operators to carry out inspection on the embankment to find any defects. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs;<br>(ii) monitor from past inspections, compare and advise if changes have been found;<br>(iii) the embankments, tow downstream areas of the FAD domain shall be monitored for any signs of seepage. Seepage should be monitored for the following:<br>(A) flow rate (if flowing);<br>(B) colour and clarity;<br>(C) changes in flow;<br>(D) unusual vegetation growth or death;<br>(E) changes outside normal operating range to any of the above;<br>(F) new seepage areas; and<br>(G) water contained against external toe of dam wall.<br>(iv) while measuring seepage, flow rates may be difficult due to location of the seepage, an effort should be made to measure the rate of seepage to allow comparison over time. Potential methods to measure seepage or underdrainage include:<br>(A) measure time to fill a bucket of known volume;<br>(B) flow meters on return pumps;<br>(C) V-notch weirs;<br>(D) photographs with a common reference point such as a stake; and<br>(E) painted outline of wet areas.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) seal the cracks to prevent runoff from saturating the embankment; and<br>(ii) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Embankment:**<br>**Transversal crack on crest, upstream and downstream face** | Transverse cracks extend perpendicular to the crest and can indicate differential settlement within the embankment. Such cracks provide avenues for seepage through the dam and could quickly lead to piping, a severe seepage problem that will likely cause the dam to fail.<br>     | **Short:** Isolated cracks are commonly due to drying and shrinkage of the embankment surface and are not usually significant. They are usually less than 1 inch wide and propagate in various directions.<br>**Larger (wider than 1 inch):** Well-defined cracks may indicate a more serious problem. | Possible embankment or foundation instability.<br>Provides entry point for surface water which can promote erosion.<br>Seepage. | |

| Inspection | Description | Causes | Concerns | Action |
|---|---|---|---|---|
| **Embankment:**<br>**Wet areas or seepage on downstream face** | Seepage can emerge anywhere on the downstream face, beyond the toe, or on the downstream abutments at elevations below normal pool. Seepage may vary in appearance from a "soft," wet area to a flowing "spring." It may show up first as an area where the vegetation is lush and darker green. Cattails, reeds, mosses, and other marsh vegetation often become established in a seepage area. Another indication of seepage is the presence of rust-coloured iron bacteria. Due to their nature, the bacteria are found more often where water is discharging from the ground than in surface water. Seepage can make inspection and maintenance difficult. It can also saturate and weaken portions of the embankment and foundation, making the embankment susceptible to earth slides.<br>If the seepage forces are large enough, soil will be eroded from the foundation and be deposited in the shape of a cone around the seepage outlet. If these "boils" appear, professional advice should be sought immediately. Seepage flow which is muddy and carrying sediment (soil particles) is evidence of "piping," and could very possibly cause failure of the dam. Piping can occur along a spillway and other conduits through the embankment, and these areas should be closely inspected. Sinkholes may develop on the surface of the embankment as internal erosion takes place. Please also refer to inspection **"Ponding, seepage, sinkholes and settlement".**<br>  | Wet areas or seepage may develop because of poor soil compaction, sudden drawdown of the lake level, undercutting of the embankment toe, or saturation and weakening of the embankment or foundation. | Possible slope instability or piping failure.<br>Seepage. | Operators to carry out inspection on the embankment to find any defects. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs;<br>(ii) monitor from past inspections, compare and advise if changes have been found;<br>(iii) the embankments, tow downstream areas of the FAD domain shall be monitored for any signs of seepage. Seepage should be monitored for the following:<br>(A) flow rate (if flowing);<br>(B) colour and clarity;<br>(C) changes in flow;<br>(D) unusual vegetation growth or death;<br>(E) changes outside normal operating range to any of the above;<br>(F) new seepage areas; and<br>(G) water contained against external toe of dam wall.<br>(iv) while measuring seepage, flow rates may be difficult due to location of the seepage, an effort should be made to measure the rate of seepage to allow comparison over time. Potential methods to measure seepage or underdrainage include:<br>(A) measure time to fill a bucket of known volume;<br>(B) flow meters on return pumps;<br>(C) V-notch weirs;<br>(D) photographs with a common reference point such as a stake; and<br>(E) painted outline of wet areas.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) seal the cracks to prevent runoff from saturating the embankment; and<br>(ii) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
|---|---|---|---|---|
| **Embankment:**<br>**Low areas or depressions on the crest** | Depressions are sunken low areas of the abutment, toe area, or embankment surface. To a certain degree, minor depressions are common and do not necessarily indicate a serious problem.<br>Depressions can create low areas along the crest, cracks through the embankment, structural damage to spillways or other appurtenant structures, damage to internal drainage systems, or general instability of the embankment. They can also inhibit maintenance of the dam and make detection of stability or seepage problems difficult.<br>  | Excessive settlement of embankment or foundation - They may be created during construction or may be caused by decay of buried organic materials, internal erosion of the embankment, or settlement (consolidation) of the embankment or its foundation.<br>Weak foundation materials, poor compaction of the embankment during construction, or internal erosion of the embankment fill. | Embankment or foundation instability.<br>Internal erosion of embankment material.<br>Seepage. | Operators to carry out inspection on the embankment to find any defects. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location, length, approximate elevation, photographs, sketches, and possibly monitoring stakes; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Embankment:**<br>**Slumps, slides or erosions** | A slide / slump in an embankment or in natural soil or rock is a mass movement of material. Some typical characteristics of a slide are an arc shaped crack or scarp along the top and a bulge along the bottom of the slide. Slides / slumps can be divided into two main groups: shallow and deep-seated. Shallow slides generally affect the top 2 to 3 feet of the embankment surface.<br>  | Slides may develop because of poor soil compaction, the gradient of the slope being too steep for the embankment material, seepage, sudden drawdown of the lake level, undercutting of the embankment toe, or saturation and weakening of the embankment or foundation.<br>**Shallow slides:** Are generally not threatening to the immediate safety of the dam and often result from wave erosion, collapsed rodent burrows, or saturated topsoil.<br>**Deep-seated slides:** Are serious, immediate threats to the safety of a dam. They can extend several feet below the surface of the embankment even below the foundation. A massive slide can initiate the catastrophic failure of a dam. Deep-seated slides are the result of serious problems within the embankment. | Possible slope instability.<br>Seepage. | Operators to carry out inspection on the embankment to find any slumps, slides or erosions. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location, length, approximate elevation, photographs, sketches, and possibly monitoring stakes (**Note:** slump areas or erosion holes deeper than 0.5m); and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
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| **Embankment:**<br>**Spillway** | Spillways are a structure that either form part of a dam or are found just beside one. They are used, when a reservoir is full, to pass floodwater safely, and in a controlled way, over a dam, around it or through it. An overflow spillway is most often constructed as part of a gravity dam or a buttress dam. The spillway section is lower than the other sections of the dam allowing water to flow over its top and down its front face.<br>Spillway sections are usually founded on pilings, ledge, natural soils or a combination of these materials. The effect of uncontrolled leakage through the foundation material over time can cause internal erosion of soils or deterioration of rock. Ensure that the spillway remains as level as possible across its entire width to avoid flow concentration.<br>  | The loss of foundation material from seepage forces may leave voids beneath the spillway, which decreases the overall support for the spillway.<br>Road access over the spillway may disrupt the spillway design.<br>Spillway blockages.<br>Spillway erosion. | Seepage.<br>Blockages.<br>Erosion. | Operators to carry out inspection on the embankment to find any damage to the spillway which include seepage, blockages, design changes during inspection of the dam. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Access roads:**<br>**Roads** | The FAD's access roads constructed around the dam is designed with gravel. A gravel road is a type of unpaved road surfaced with gravel that has been brought to the site from a quarry or stream bed.<br>The problems associated with these roads are gravel loss, shape loss, and rideability. These issues are the result of deterioration factors like inadequate drainage capacity, dust, corrugations, potholes, ruts, loose gravel, and frost damage.<br>  | Excessive vehicles.<br>Excessive high speeds from vehicles.<br>Wear and tear, little to no maintenance.<br>Weather.<br>Vegetation. | Damage to embankment (upstream and downstream).<br>Damage to spillway.<br>Seepage. | Operators to carry out inspection on the access roads to find any damage to the roads which include erosion, potholes, deep tyre tracks, corrugation. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
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| **Access roads:**<br>**Windrows** | A windrow is a long ridge of loose material, for example on the edge of a dirt road or newly graded earthworks. Windrows are barriers built from earth designed to stop vehicles falling down edges. Damages to windrows can be due to vehicle damage, excessive vegetation and weather conditions.<br>  | Excessive vehicles.<br>Excessive high speeds from vehicles.<br>Wear and tear, little to no maintenance.<br>Weather.<br>Vegetation. | Damage to embankment (upstream and downstream).<br>Damage to spillway.<br>Damage to windrows.<br>Seepage. | Operators to carry out inspection on the access roads to find any damage to the windows. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Fly ash surface:**<br>**Sinkholes and settlement** | If the seepage forces are large enough, soil will be eroded from the foundation and be deposited in the shape of a cone around the seepage outlet. If these "boils" appear, professional advice should be sought immediately. Seepage flow which is muddy and carrying sediment (soil particles) is evidence of "piping," and could very possibly cause failure of the dam. Piping can occur along a spillway and other conduits through the embankment, and these areas should be closely inspected. Sinkholes may develop on the surface of the embankment as internal erosion takes place. Please also refer to inspection **"Embankment wet areas / seepage on downstream face".**<br>  | Unsettled flyash<br>Heavy rain / excessive water | Seepage<br>Piezometer triggers | Operators to carry out inspection on the fly ash surface to find any sinkholes and settlement. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location, length, approximate elevation, photographs, sketches, and possibly monitoring stakes; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
|---|---|---|---|---|
| **Fly ash surface:**<br>**Deposition, ponding. water levels and freeboard** | Tailings deposition is an ongoing dynamic process requiring unique operational expertise to strategies and mobilise the required works whilst being able to identify changes, problems and improvements through operational wisdom in order to provide resolution and deliver effective execution.<br>A pond on the surface of the tailings impoundment is called the "supernatant pool"; an underdrain system reclaims this water so it can be pumped back to the mill for re-use. A "beach" of dried slurry forms in the impoundment as solids settle out of the water. When inspecting the pooling/ponding of the dam check for evidence of unusual rises or falls in the pool level. Also, check for the presence of whirlpools or eddies in the pool, which may be an indication of concentrated seepage. If observed, examine the downstream area and adjacent mine openings for corresponding seepage discharge and for the presence of fines being carried by the seepage. The pool area should be free of floatable debris that could block spillways.<br>The pond water level must be monitored visually as part of routine operations and recorded on inspection forms. It should be measured against the freeboard requirements and recorded. It is important to monitor the pond level in relation to the MOL determined for each cell respectively. Visual inspection of the water levels; less than 1 meter below embankment crest and less than 0.3 meter below embankment crest. If between 0.3 and 1 meter below embankment crest: decant water in FAD available to pump to supernatant dam, pump not working, or pipeline blocked or leaking. | Incorrect spigot discharge location / movements. | Seepage.<br>Exceeding licence conditions. | Operators to carry out inspection on the fly ash surface to find any freeboard, deposition and ponding issues. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) any deposition that occurred over the last inspection period, inspect beach profile (directly along the beach towards the pool, not trapped against embankments within depressions or voids created between deposition mounds);<br>(ii) record the pool position, freeboard and estimate the distance away from each wall (north, south, west) and freeboard vertical distance between pool and minimum allowable level on the decant structure (rock filter); and<br>(iii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs. |
| **Pipelines:**<br>**Spigot pipeline**<br>**Delivery pipeline** | Spigot disposal is around the perimeter of the FAD to create a beach between the embankment. This generally means the pond is completely surrounded by beached tailings. The slurry line starts from the silos and ends at the FAD. These pipes are made from Polyethylene (PE) pipes offer durable and flexible solutions. Polyethylene piping is resistant to corrosion in all ground conditions and its flexibility allows it to withstand ground movements.<br>  | Fracture or joint failure in outlet pipe.<br>Seepage along outside of pipe (poor installation / welding).<br>Weather.<br>Clogged / blocked slurry pipeline.<br>Traffic damage. | Seepage. | Operators to carry out inspection on the pipelines to find any deficiencies along delivery pipeline corridor, leakage along pipeline, leakage of valves and dysfunctional spigot. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location, length, photographs, sketches, and possibly monitoring stakes; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
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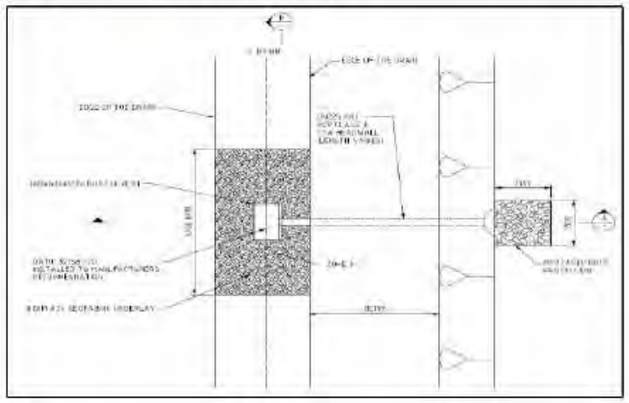
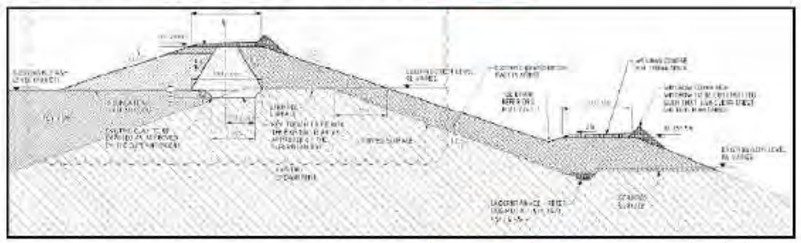
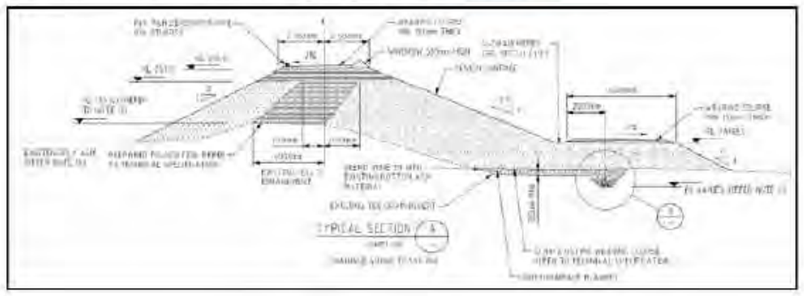
| **Equipment:**<br>**Surface drains, stormwater collection sumps or pits** | Stormwater collection sumps / pits collects excess water and prevents flooding during heavy rain. Stormwater pits are used to hold and control stormwater runoff as the rainwater is slowly discharged through the connected system of drainage pipe. Ensure perimeter drains and sumps are clear of obstructions.<br>  | Pipework failure<br>Overfilling / blockages | Seepage | Operators to carry out inspection on the stormwater collection to find any deficiencies on the sumps, pits or surface drains. If any of these abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed**: Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Equipment:**<br>**Decant and pumps** | Each cell has a decant tower located centrally along the dividing embankment. This decant tower is comprised of slotted concrete well liners surrounded by aggregate. The decant pipeline was located at the base of the decant tower.<br>The decant systems of Muja's FAD is designed to cope with the day-to-day management of the "supernatant pond" as well as storm condition surges. The design of the decant allows for a high surge capacity of storm water to compensate for near future storm events. If the pond cannot drain fast enough (decant system or reclaim/evaporation pond ingress restriction), then the freeboard of the FAD may be lost if a near future storm reoccurs.<br>Visual inspection of the decant systems must be observed for deficiency along water return pipeline corridor, blockage of decant structure, deficiency and leakage of water return pump, leakage along pipeline, pipeline inspection (bursts, blockages), decant pool size, behaviour and location, water / storage levels and water return, conduit leaks, siltation, valves and record decant water volumes pumped to the supernatant water dam. Refuelling should also be undertaken as required.<br>   | Seepage.<br>Failure of structure.<br>Clogged / blocked.<br>Traffic damage. | Damage to equipment.<br>Equipment failure.<br>Structural failure.<br>Leaking / seepage. | Operators to carry out inspection on the decant tower and pumps. If any defects, abnormalities, concerns or breaches have occurred the following should be completed or considered:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
|---|---|---|---|---|
| **Equipment:**<br>**Underdrainage Drainage site 1** | The FAD has 2 drain site locations one on the north of the dam (site 1) and one on the east (site 2). All tanks, motors, pumps and pipework needs to be inspected for damage, leaks or defects.<br><br>**Drain site 1:** The site is managed using 1 50kL tank mounted with level indicator and a solar powered digital control panel. The tank has 3 NSF 61-G Emerson pressure valves. The underdrainage water is carried to the tank using a 225mm diameter HDPE pipe connected to the tank.<br><br>   | Fracture or joint failure in outlet / inlet pipe and tanks.<br><br>Seepage along outside of pipe (poor installation / welding).<br><br>Weather.<br><br>Failure of pipe joints.<br><br>Clogged / blocked slurry pipeline.<br><br>Traffic damage. | Damage to equipment.<br><br>Leaking / seepage. | Operators to carry out inspection on the underdrainage tanks and drainage sites. If any defects, abnormalities, concerns or breaches have occurred the following should be completed or considered:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Equipment:**<br>**Underdrainage Drainage site 2** | The FAD has 2 drain site locations one on the north of the dam (site 1) and one on the east (site 2). All tanks, motors, pumps and pipework needs to be inspected for damage, leaks or defects.<br><br>Bunding should be maintained in the dry condition.<br><br>**Drain site 2:** The site is managed using 2 50kL tanks which are located at drainage site 2 and the overflow reports directly to the supernatant dam upon pump activation. The sykes CPT100i pump at drainage site 2 is refuelled and operated manually as required.<br><br>   | Fracture or joint failure in outlet / inlet pipe and tanks.<br><br>Seepage along outside of pipe (poor installation / welding).<br><br>Weather.<br><br>Failure of pipe joints.<br><br>Clogged / blocked slurry pipeline.<br><br>Traffic damage. | Damage to equipment.<br><br>Leaking / seepage. | Operators to carry out inspection on the underdrainage tanks and drainage sites. If any defects, abnormalities, concerns or breaches have occurred the following should be completed or considered:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
|---|---|---|---|---|
| **Equipment:**<br>**Underdrainage Sumps and seepage collection system** | The leachate collection system utilises a collection of underground installed pipes placed on the upstream tow of cell 1 and the downstream toe of cell 2. The leachate systems installed at cell 1 and cell 2 are different but fulfil similar functions.<br>Cell 1 upstream underdrainage pipe (DM ID: 29089078)<br>  <br>Cell 2 downstream underdrainage pipe (DM ID: 26686306)<br>  | Fracture or joint failure in outlet / inlet pipe and tanks.<br>Seepage along outside of pipe (poor installation / welding).<br>Weather.<br>Failure of pipe joints.<br>Clogged / blocked slurry pipeline. | Damage to equipment.<br>Leaking / seepage. | Operators to carry out inspection on the underdrainage sumps and seepage collection system. If any defects, abnormalities, concerns or breaches have occurred the following should be completed or considered:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) inspection of the leak detection systems for water presence in leak detection sump;<br>(ii) underdrainage tanks and sumps must be observed for flow into and pump flow from the leachate tanks, record seepage volumes in underdrainage. Surface drainage and seepage monitoring – visual observations, seepage measurements, chemical analysis also of value (acid drainage generation);<br>(iii) location and photographs;<br>(iv) monitor from past inspections, compare and advise if changes have been found;<br>(v) the embankments, tow downstream areas of the FAD domain shall be monitored for any signs of seepage. Seepage or underdrainage should be monitored for the following:<br>(A) flow rate (if flowing);<br>(B) colour and clarity;<br>(C) changes in flow;<br>(D) unusual vegetation growth or death;<br>(E) changes outside normal operating range to any of the above;<br>(F) new seepage areas; and<br>(G) water contained against external toe of dam wall.<br>(vi) while measuring seepage, flow rates may be difficult due to location of the seepage, an effort should be made to measure the rate of seepage to allow comparison over time. Potential methods to measure seepage or underdrainage include:<br>(A) measure time to fill a bucket of known volume;<br>(B) flow meters on return pumps;<br>(C) V-notch weirs;<br>(D) photographs with a common reference point such as a stake; and<br>(E) painted outline of wet areas.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
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| **Equipment:**<br>**Piezometer Standpipes** | The standpipe piezometer is the most basic type of piezometer. It consists of filter tip joined to a riser pipe that extends to the surface. Water flows through the filter tip into the riser pipe. Readings are obtained with a water level indicator. Piezometer tubes should be protected with a cap or lid to prevent material or objects from inadvertently dropping down the tube, which could interfere with water level measurements. Piezometer tubes should be painted and otherwise marked to be highly conspicuous so that they are not damaged by mobile equipment. They cannot be read if the water level is near the ground surface (dry).<br>  | Damages from maintenance.<br>Animal / vehicle movement.<br>Weather. | Damage to the standpipe.<br>Blockages in standpipe. | Operators to carry out inspection on the piezometers to find any damage to the piezometers boxes, damage to the ground water monitoring wells, damage to the survey pins and damage to the bollards protecting them. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Equipment:**<br>**Piezometer Vibrating wires** | The vibrating wire piezometer is the most commonly deployed type of piezometer. Suitable for most applications, it can be installed in a borehole, embedded in fill, or suspended in a standpipe. Readings are obtained with a portable readout or a data logger.<br>Look for rust, waterproof enclosure failing and damage to the datalogger, stands, wiring and battery failure. All of these disrupt the data from the piezometers which can give us incorrect or no reading.<br>  | Damages from maintenance.<br>Animal / vehicle movement.<br>Weather. | Damage to electrical equipment.<br>Damage to dataloggers. | Operators to carry out inspection on the piezometers to find any damage to the piezometers boxes, damage to the ground water monitoring wells, damage to the survey pins and damage to the bollards protecting them. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Security and vandalism** | Muja's FAD has been identified as a critical infrastructure and needs to be secure. There are concerns for vandalism or security issues which including but not limited to broken fencing, damaged equipment or graffiti.<br>  | Unauthorised personnel entering site damaging equipment or vandalism.<br>Authorised personnel damaging equipment or vandalism. | Vandalism.<br>Damaged equipment.<br>Broken fencing. | Security to carry out inspection on the security of the dam to find any damage or vandalism to the dam. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br>**to be consulted:** Security and operations manager and supervisor. |

| Inspection | Description | Causes | Concerns | Action |
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| **Vegetation** | **Surrounding areas:** The area surrounding the FAD is predominantly state forest and the nearest sensitive receptor is identified by DWER to be 2.5km from the power station. Dust around the FAD is managed with the use of water tankers and sprayers and chemical dust control solutions.<br><br>**Bare areas:** On an embankment are void of protective cover (e.g. grass, asphalt, riprap etc.). They are more susceptible to erosion which can lead to localized stability problems such as small slides and sloughs.<br><br>**Trees and brush:** Should not be permitted on embankment surfaces or in vegetated earth spillways. Extensive root systems can provide seepage paths for water. Trees that blow down or fall over can leave large holes in the embankment surface that will weaken the embankment and can lead to increased erosion, as is the case in the failed earth embankment dam shown here. Brush obscures the surface limiting visual inspection, providing a haven for burrowing animals, and inhibiting the growth of grass vegetation. Tree and brush growth adjacent to concrete walls and structures may eventually cause damage to the concrete and should be removed.<br><br>**Improper vegetation:** Vegetation that hides the embankment surface, preventing early detection of cracks and erosion. Any residual roots that are larger than 3 inches in diameter must be removed. All roots should be removed down to a depth of at least 6 inches and replaced with a compacted clay material; then 4 inches of topsoil should be placed on the disturbed areas of the slope. Finally, these areas must be seeded and mulched to establish a proper grass cover.<br><br>   | Hides the detection of cracks and can cause cracks and slumps / slides of the embankment.<br><br>Embankment vegetation are providing increased seepage paths. Associated root systems develop and penetrate into the dam embankment. When the vegetation dies, the decaying root systems can provide paths for seepage.<br><br>Provides habitat for rodents and other animals. | Possible slope instability.<br><br>Seepage. | Operators to carry out inspection on the vegetation on or around the dam to find any vegetation (flora, fauna and heritage) changes. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br><br>(a) **to be completed:** Identify, record and monitor:<br>(i) location, photographs and sketches; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br><br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the findings to prepare plans and specifications, if necessary, for repairs.<br><br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |
| **Supernatant dam HDPE liner** | The supernatant dam is double lined with HDPE liner, this liner is used because it is stiffer and this makes it better at resisting tears and punctures.<br><br>Even though HDPE liners are more versatile they still require ongoing inspections to ensure there is no natural or unnatural wear and tear which may include rips, holes, vegetation and deterioration.<br><br>   | Natural wear and tear.<br><br>Weather.<br><br>Animal / vegetation.<br><br>Maintenance. | Seepage. | Operators to carry out inspection on the Supernatant dam to find any HDPE liner defects. If any abnormalities, concerns or defects have occurred the following should be completed or consulted:<br><br>(a) **to be completed:** Identify, record and monitor:<br>(i) location and photographs; and<br>(ii) monitor from past inspections, compare and advise if changes have been found.<br><br>(b) **to be consulted:** The system engineer / dam engineer:<br>(i) investigate the HDPE liner to prepare plans and specifications, if necessary, for repairs.<br><br>(c) **to be consulted:** The environmental team and operations manager and supervisor. |

## 8.4 Monthly piezometer manual and vibrating recordings

Monthly piezometer records are completed by the operator maintainers, this is controlled in the operator's electronic logbook. The standpipe (manual) piezometer levels are dipped and recorded on MPS FAD monthly piezometer record from (DM ID: 18967916) which is sent to the operations administration to upload and save in MCD-PAD-DAM-3541 and 3542 DAM - monthly reports (DM ID: 19612174). The reports are then record on the Muja tailings dams master database - data reporting and trends (piezometers, fly ash and drone surveys) (DM ID: 19648521).

The operator maintainers complete the export of the VWP readings on a Synergy specific laptop. That export data is then sent to the operations administration to upload and save in MCD-PAD-DAM-3541 and 3542 DAM - monthly reports (DM ID: 19612174). The reports are then record on the Muja tailings dams master database - vibrating wire piezometer (VWP) calculations (DM ID: 29538354). These databases determine and monitor the trigger levels to ensure that they are not above the 'trigger point', graphs from this data reviewed during the dam management committee. Please refer to POI CD8.17 FAD inspection management (DM ID: 29013135) for the process.

### 8.4.1 Piezometer trigger levels

Individual trigger levels have been identified for each piezometer currently installed at the FAD. These levels are piezometer specific and show the level of the phreatic surface at which alerts should be raised during monitoring. The trigger levels derive from estimated phreatic levels using current knowledge 149-03-3112C-RR001_0A MPS FAD Cell1 Piezo trigger levels (DM ID: 35270669) and 149-03-3112C-RR002_0B MPS FAD Cell1 TARP (DM ID: 35271873) of the facility operation, embankment geometry and geotechnical properties of the embankment materials.

The trigger parameter and appropriate responses are summarised in **Table 21**. The alert levels should be used with great care and should always be supported by visual inspection of the FAD. Piezometers can get blocked or damaged and provide a false sense of security. These alert levels should be updated after each embankment raise or piezometer raise, after any remedial works of when there are any significant changes in the FAD operation.

***Table 21:** Piezometer trigger levels and actions*

| Trigger | Response level | Action required |
|---|---|---|
| Readings below warning trigger level | **No Response** | **Embankment is geotechnically stable in compliance with ANCOLD FoS / slope requirement**<br>(a) follow normal processes in this management plan; and<br>(b) no other liquid, besides that contained within deposited tailings slurry and/or natural rainfall, is to be introduced into MPS FAD Cell 1. |
| Readings between warning and critical trigger levels | **Level 1** | **Embankment is geotechnically stable, however is non-compliant with ANCOLD FoS / slope requirement**<br>(a) increase piezometer reading frequency to a **THRICE WEEKLY** basis until compliance category assignment is improved to **GREEN**;<br>(b) decant tower pump operations to maximise removal of water such that the supernatant pond surrounding it does not raise any further;<br>(c) underdrain sump pump operations to maximise sump water removal such that piezometer readings do not rise |

| Trigger | Response level | Action required |
|---|---|---|
| | | any further;<br>(d) deposited tailings slurry to be thickened to increase the transported solids content whilst minimizing slurry water deposition into FAD;<br>(e) a minimum of 70% deposited tailings slurry water must be returned to tailings plant for reuse;<br>(f) fresh bore water must not be used for tailings slurry production; and<br>(g) no other liquid, beside that contained within deposited tailings slurry and / or natural rainfall, is to be introduced into MPS FAD Cell 1. |
| Readings above critical trigger level | Level 3 | **Embankment is at risk of geotechnical failure (FoS / slope potentially ≤ 1.0)**<br>(a) increase piezometer reading frequency to a **DAILY** basis until compliance category assignment is improved to **AMBER**;<br>(b) **TAILINGS DEPOSITION MUST CEASE**. Remainder tailings within pipeline (including pipe washout) must be diverted into MPS FAD Cell 2;<br>(c) decant tower pump operations to maximise removal of water such that the supernatant pond surrounding it does not rise any further;<br>(d) underdrain sump pump operations to maximise sump water removal such that piezometer readings do not increase further; and<br>(e) no other liquid, besides that contained within deposited tailings slurry and / or natural rainfall, is to be introduced into MPS FAD Cell 1. |

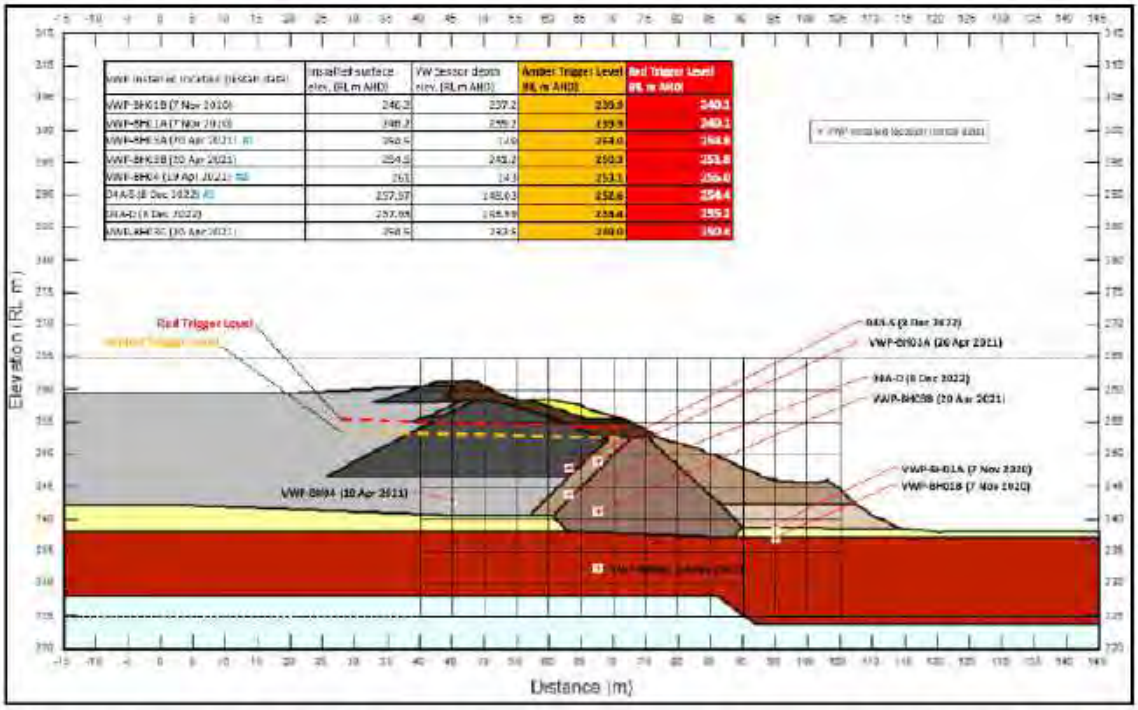


***Figure 30:*** *As-built FAD Cell 1 south wall embankment cross-section B - VWP trigger level profile*

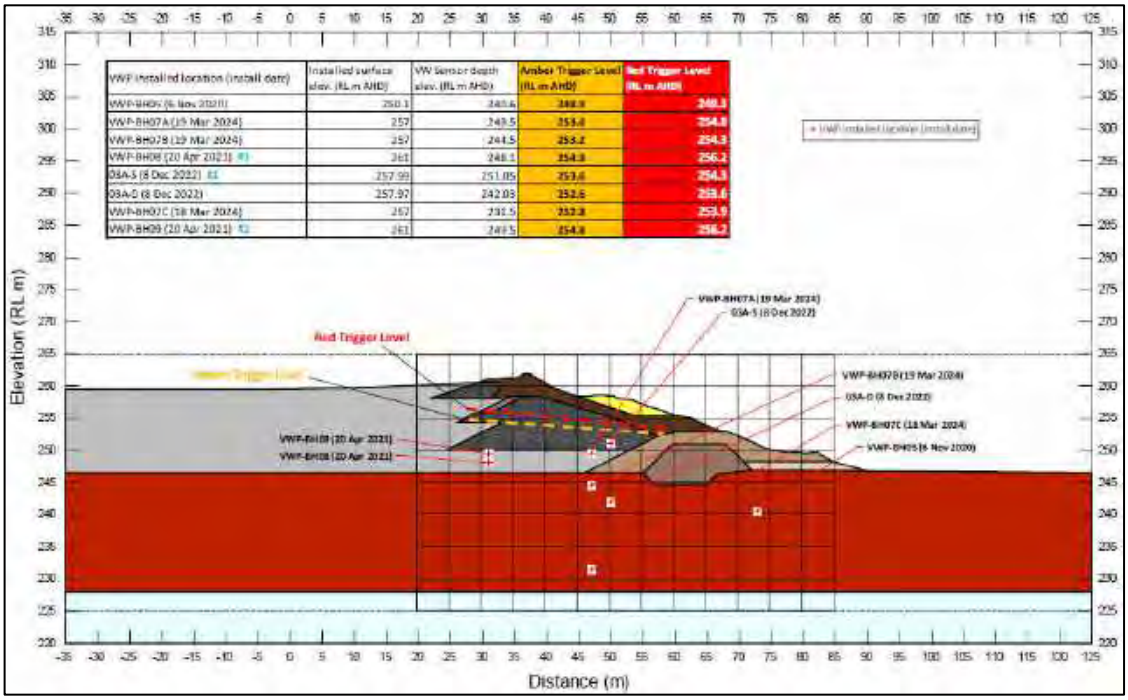


***Figure 31:*** *As-built FAD Cell 1 south-east wall embankment cross-section A - VWP trigger level profile*

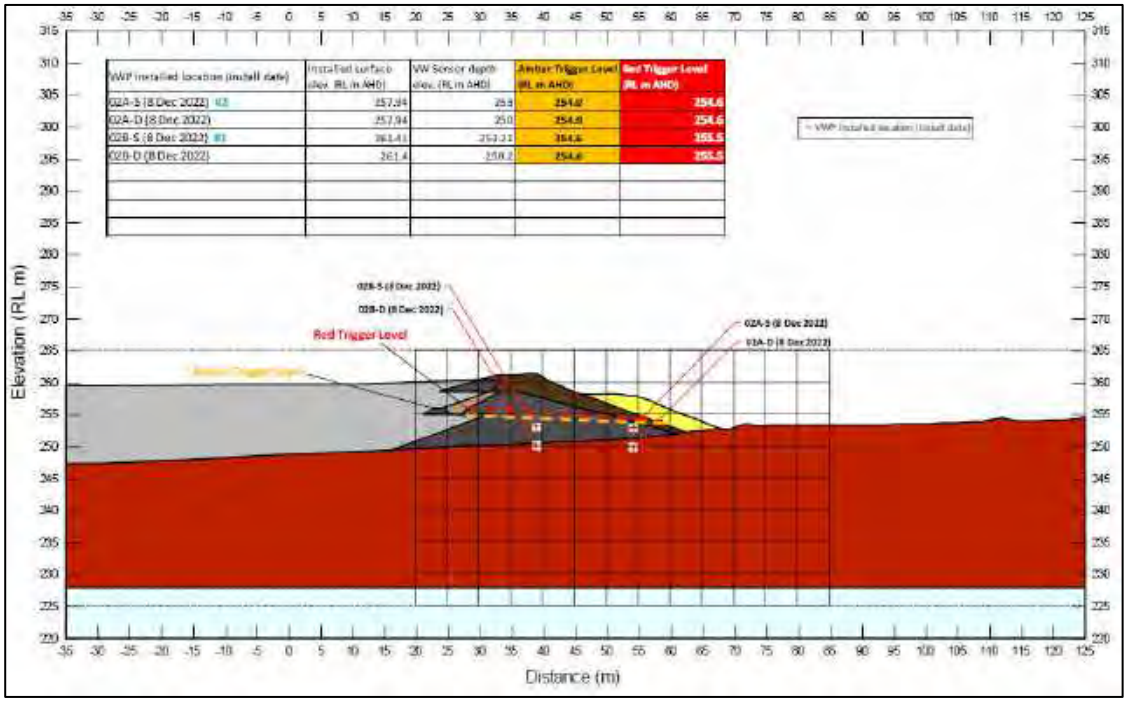


***Figure 32:*** *As-built FAD Cell 1 west wall embankment cross-section G - VWP trigger level profile*

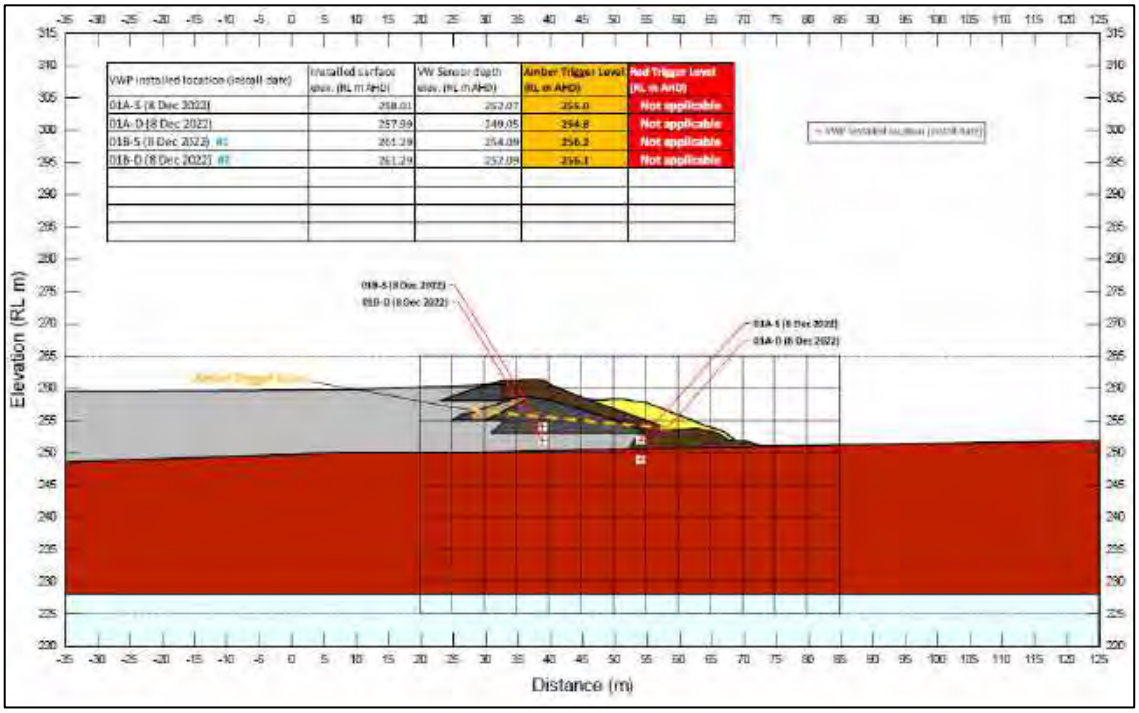


***Figure 33:*** *As-built FAD Cell a north wall embankment cross-section F - VWP trigger level profile*


***Figure 34:*** *FAD vibrating wire and manual dipping piezometers cells 1 and 2*

***Table 22:*** *Standpipe and vibrating wire piezometer locations and trigger level warnings*

| Wall alignment (as-built cross-section figure no.) | Piezometer description (S – standpipe, VW – vibrating wire) | | GPS coordinates (m) (GDA2020/MGA zone 50) | | Installation date | Depth elevation details (RL m AHD) | | VWP trigger level (RL m AHD) corresponding to the following change in geotechnical stability compliance | |
|---|---|---|---|---|---|---|---|---|---|
| | Type | Name | Easting | Northing | | Ground surface at time of installation | VWP sensor or standpipe base level | ⟷ | ⟷ |
| Cell 1 - South wall | Vibrating Wire | VWP-BH01A | 434350 | 6297941 | 7/11/2020 | 246.2 | 239.2 | 239.9 | 240.1 |
| | | VWP-BH01B | 434350 | 6297941 | 7/11/2020 | 246.2 | 237.2 | 239.9 | 240.1 |
| | | VWP-BH03A | 434345 | 6297968 | 20/04/2021 | 254.5 | 249 | 253 | 254.8 |
| | | VWP-BH03B | 434345 | 6297968 | 20/04/2021 | 254.5 | 241.2 | 250.3 | 251.8 |
| | | VWP-BH03C | 434345 | 6297968 | 20/04/2021 | 254.5 | 232.5 | 253.1 | 255 |
| | | VWP-BH04 | 434336 | 6297989 | 19/04/2021 | 261 | 243 | 252.6 | 254.4 |
| | | VWP04A-S | 434340 | 6297975 | 08/12/2022 | 257.97 | 248.03 | 253.4 | 255.2 |
| | | VWP04A-D | 434340 | 6297975 | 08/12/2022 | 257.93 | 243.99 | 249 | 250.4 |
| | Standpipe | *P04*** | NA | NA | 2021 | 261.20 | 245 | 253.1 | 255 |
| Cell 1 - South-west wall | Vibrating Wire | VWP-BH05 | 434131 | 6298006 | 6/11/2020 | 250.1 | 240.6 | 248.9 | 249.3 |
| | | VWP-BH07A | 434146 | 6298023 | 19/03/2024 | 257 | 249.5 | 253.6 | 254.8 |
| | | VWP-BH07B | 434146 | 6298023 | 19/03/2024 | 257 | 244.5 | 253.3 | 254.3 |
| | | VWP-BH07C | 434146 | 6298023 | 18/03/2024 | 257 | 231.5 | 254.8 | 256.2 |
| | | VWP03A-S | 434144 | 6298029 | 8/12/2022 | 257.99 | 251.05 | 253.6 | 254.3 |
| | | VWP03A-D | 434144 | 6298029 | 8/12/2022 | 257.97 | 242.03 | 252.6 | 253.6 |
| | | VWP-BH08 | 434156 | 6298044 | 20/04/2021 | 261 | 248.1 | 252.8 | 253.9 |
| | | VWP-BH09 | 434096 | 6298075 | 20/04/2021 | 261 | 249.5 | 254.8 | 256.2 |
| | Standpipe | *P03*** | NA | NA | 2021 | 261.22 | 250 | 254.8 | 256.2 |
| | | *PZ11*** | NA | NA | 2007 | NA | 248.1 | 4.1 | 3.6 |
| | | *PZ12*** | NA | NA | 2007 | NA | 247.1 | 4.1 | 3.6 |
| Cell 1 - East wall | Vibrating Wire | VWP02A-S | 433953 | 6298282 | 8/12/2022 | 257.94 | 253 | 254 | 254.6 |
| | | VWP02A-D | 433953 | 6298282 | 8/12/2022 | 257.94 | 250 | 254 | 254.6 |
| | | VWP02B-S | 433963 | 6298280 | 8/12/2022 | 261.41 | 253.21 | 254.6 | 255.5 |
| | | VWP02B-D | 433963 | 6298280 | 8/12/2022 | 261.4 | 250.2 | 254.6 | 255.5 |
| | Standpipe | *P02*** | NA | NA | 2021 | 261.22 | 250.2 | 254.6 | 255.5 |
| Cell 1 - North wall | Vibrating Wire | VWP01A-S | 434319 | 6298456 | 8/12/2022 | 258.01 | 252.07 | 255 | *N/A** |
| | | VWP01A-D | 434319 | 6298456 | 8/12/2022 | 257.99 | 249.05 | 254.8 | *N/A** |
| | | VWP01B-S | 434324 | 6298444 | 8/12/2022 | 261.29 | 254.09 | 256.2 | *N/A** |
| | | VWP01B-D | 434324 | 6298444 | 8/12/2022 | 261.29 | 252.09 | 256.1 | *N/A** |
| | Standpipe | *P01*** | NA | NA | 2021 | 261.28 | 252 | 256.1 | *N/A** |
| Cell 1 / 2 - FAD dividing wall | Standpipe | *P05*** | NA | NA | 2021 | 261.16 | 252 | Unknown | *N/A** |
| Cell 2 - West wall | Vibrating Wire | VWP-BH12 | 435096 | 6298336 | 2020 | 254.3 | 244.3 | Unknown | 251.5 |
| | | VWP-BH13 | 435083 | 6298326 | 2020 | 258.8 | 248.8 | Unknown | 252.25 |
| | Standpipe | P5 | Unknown | Unknown | 2005 est. | Unknown | 251.55 | 3.8 | 3.3 |
| | | P6 | Unknown | Unknown | 2005 est. | Unknown | 252.45 | 3.8 | 3.3 |
| Cell 2 - South wall | Vibrating Wire | VWP-BH11A | 434768 | 6298119 | 2020 | 254.3 | 242.3 | Unknown | 252 |
| | | VWP-BH11B | 434768 | 6298119 | 2020 | 254.3 | 232.3 | Unknown | 252 |
| | Standpipe | P1 | Unknown | Unknown | 2005 est. | Unknown | 251.86 | 3.7 | 3.2 |
| | | P2 | Unknown | Unknown | 2005 est. | Unknown | 252.76 | 3.7 | 3.2 |
| | | P3 | Unknown | Unknown | 2005 est. | Unknown | 251.59 | 3.6 | 3.1 |
| | | P4 | Unknown | Unknown | 2005 est. | Unknown | 252.01 | 3.6 | 3.1 |

***Note:** Identified as - cannot fail.

****Note:** Piezometers P01-05 and PZ11-12 Easting and Northing are not available (NA) while the ground surface levels are inferred (where possible) from the 09-May-2024 survey provided.

## 8.5 Aerial Survey

Fly ash delivery and placement must be monitored by operators to comply with the site deposition plan, during the summer on a monthly basis and winter biweekly basis. The FAD beach development is reviewed, on a monthly or fortnightly basis as identified by the dam committee to ensure correct deposition sequencing, this has been accepted by DWER. The average tailings density and actual beach and pond geometry should be assessed using contours from aerial surveys and production data. An unmanned aerial vehicle (**UAV**) was commissioned by Synergy to undertake a visual inspection of the FAD and supernatant dam area and surrounds at the MPS.

The baseline inspection was undertaken in December 2019 using a UAV, often referred to as 'drones', to capture high resolution imagery of the sites and surrounding areas which was then used to create a detailed digital elevation model (**DEM**) and orthomosaic image of the site. The advantage of the methodology developed for this project is that there is no requirement to have people working on the embankments, and the time taken for the capture of the on-site data is less than one day. To undertake the external inspection of these structures manually would require considerably longer timeframes.

Secondary benefits include the creation of a detailed DEM of the asset which contains multiple high-resolution images of every component. This is stored online within the propeller environment and can be compared with previous surveys. The imagery and DEM model were inspected to identify and document the following:

(a) embankment inspections:

(i) **wet areas or seepage**: Inspect embankment, toe drains and 5m external around the perimeter of the embankment FAD for wet areas (seepage); and

(ii) **longitudinal crack on crest**: Inspect the upstream and downstream face of the embankment for longitude cracks:

(A) **short**: Isolated cracks are commonly due to drying and shrinkage of the embankment surface and are not usually significant. They are usually less than 1 inch wide and propagate in various directions; and

(B) **larger** (wider than 1 inch): Well-defined cracks may indicate a more serious problem.

(iii) **transversal crack on crest:** Inspect the downstream face of the embankment for transversal cracks;

(A) **short:** Isolated cracks are commonly due to drying and shrinkage of the embankment surface and are not usually significant. They are usually less than 1 inch wide and propagate in various directions; and

(B) **larger (wider than 1 inch):** Well-defined cracks may indicate a more serious problem.

(iv) **low areas or depressions on the crest:** Inspect embankment downstream and crest for low areas / depression's;

(v) **slumps, slides or erosions:** Inspect embankment downstream and upstream for slumps, slides or erosions;

(vi) **beech Angles:** Inspect and measure the beech angles of the embankment upstream;

(vii) **toe drainage:** Inspect and measure the toe drainage size (water levels);

(viii) **access roads:** Inspect for uneven surface of roads;

(ix) **spills:** Inspect the spillway for fly ash / water movement. This will be critical during the winter months; and

(x) **vegetation:** Inspect for improper vegetation:

(A) vegetation that hides the embankment surface, preventing early detection of cracks and erosion; and

(B) any residual roots that are larger than 3 inches in diameter must be removed.

(b) Fly ash inspection:

(i) **sinkholes and settlement:** Inspect for any sinkholes of settlement;

(ii) **deposition and ponding:** Inspect deposition / ponding location;

(iii) **water levels:** Inspect and measure the water levels; and

(iv) **volume Freeboard:** Inspect the and measure the fly ash volume with the freeboard 300mm requirements in mind, advising on estimate volume left.

All survey documentation is saved in folder Muja tailings dams - survey reports (Includes aerial, capacity, stability assessments) (DM ID: 21988226).

## 8.6 Groundwater quality

Groundwater quality is undertaken by the chemists on a monthly basis to monitor the following:

(a) pH;

(b) chloride;

(c) sulphate;

(d) CI/SO4; and

(e) conductivity.

On the following locations:

(a) FAD Cell 1;

(b) FAD Cell 2;

(c) FAD Supernatant; and

(d) FAD Sump 1 and 2.

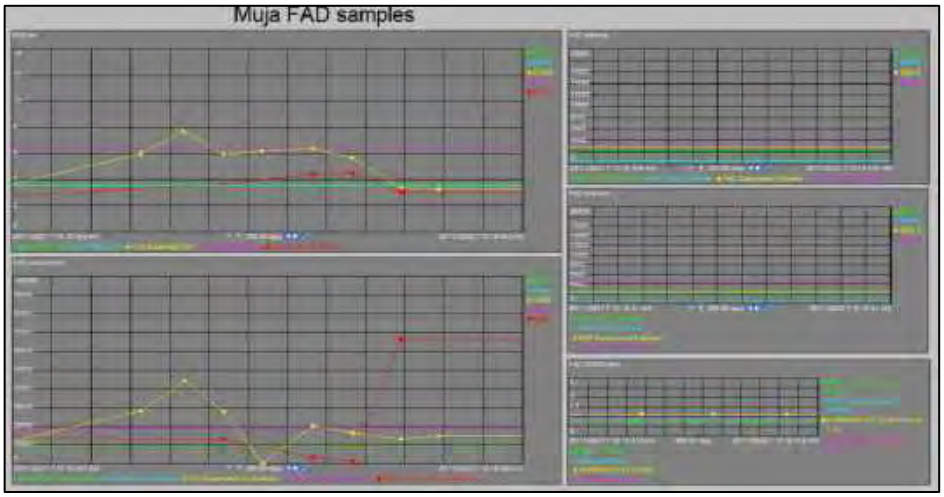


***Figure 35:*** *Starlims report screen*

**Note:** The chemists may not be able to analyse the sample if it's mainly solids, this was communicated with the environmental team, at the time it was advised to stop sampling from there. The risk was reviewed and found not safe to collect the data from these

locations as you needed to go down the dam wall. The Toe Drain sampling point is no longer existing and we are no longer testing the FAD cell 1 and cell 2.

To comply with the environmental licence DER2014/002698-1 (DM ID: 25007266) condition 3.1.1, refer to **section 1.3**. The chemists complete a monthly sample review from the groundwater monitoring boreholes for the Supernatant dam with all reports / data saved in the Pi Proceebook / Pi Vision. Numeric data can be pulled from Starlims which is a laboratory information management system on request.

## 8.7 Monitoring of ambient groundwater quality from bores

Groundwater sampling undertaken on a quarterly basis by the environmental team as per the licence L4706/1972/17 section 3.4.7 The licence shall undertake the monitoring in tables 3.4.4, according to the specification in that table. refer to **section 1.3** condition 3.4.7.

***Table 23:** Summary of geotechnical borehole locations*

| ID | Location | Coordinates (MGA94 Zone 50) | | Ground Level (m, AHD) | Termination Depth (m) |
|---|---|---|---|---|---|
| | | Easting (m) | Northing (m) | | |
| BH01 | Cell 1 | 434350 | 6297941 | 246.2 | 22.5 |
| BH02 | Cell 1 | 434343 | 6297958 | 252.8 | 25.5 |
| BH03 | Cell 1 | 434340 | 6297965 | 253.0 | 27.0 |
| BH04 | Cell 1 | 434334 | 6297989 | 258.4 | 23.5 |
| BH05 | Cell 1 | 434131 | 6298006 | 250.1 | 23.0 |
| BH06 | Cell 1 | 434138 | 6298011 | 252.8 | 26.3 |
| BH07 | Cell 1 | 434141 | 6298020 | 252.8 | 27.0 |
| BH08 | Cell 1 | 434155 | 6298044 | 259.0 | 31.5 |
| BH09 | Cell 1 | 434092 | 6298075 | 258.4 | 11.0 |
| BH10 | Divider Wall | 434578 | 6598152 | 258.0 | 18.5 |
| BH11 | Cell 2 | 434768 | 6298119 | 254.2 | 26.0 |
| BH12 | Cell 2 | 435096 | 6298336 | 253.7 | 12.5 |
| BH13 | Cell 2 | 435083 | 6298326 | 258.7 | 13.8 |

***Table 24:** Groundwater quality monitoring requirements (Table 3.4.4: Monitoring of ambient groundwater quality)*

| Monitoring point reference | Parameter | Units | Averaging period | Frequency |
|---|---|---|---|---|
| MB1A, MB2, MB3, MB3A, MB4, MB4A, MB5, MB5A, MB5B, MB6, MB7, MB7A, MB8, MB8A, MB9A, MB9B, MB9C, MB10A, MB10B, MB11A, MB11B, MB12A and MB12B (23 monitoring bores) | Standing water level (**SWL**) | m(AHD) | Spot sample | Quarterly |
| | pH | - | | |
| | Total dissolved solids (**TDS**)<br>Electrical conductivity (**EC**)<br>Sulphate<br>Arsenic (**As**)<br>Cadmium (**Cd**)<br>Chromium (total) (**Cr**)<br>Copper (**Cu**)<br>Lead (**Pb**)<br>Iron (**Fe**)<br>Manganese (**Mn**)<br>Mercury (**Hg**)<br>Nickel (**Ni**)<br>Selenium (**Se**)<br>Zinc (**Zn**) | Mg/L | | |

Sampling and testing undertaken by independent consultant. Lab testing undertaken at national association of testing authorities lab for groundwater quality. Groundwater level dipping undertaken using sonic methods. Only cross checked with manual dip meter where readings are perceived to be unusual. After the fourth quarter is completed a third

party completes an annual report with findings and trends for the year. Reporting is sent to DWER for review:

(a) quarter 1: July;

(b) quarter 2: October;

(c) quarter 3: January;

(d) quarter 4: April; and

(e) annual June.

A register is updated with the quarterly results MPS FAD master database - quarterly bore monitoring results (Licence 3.4.7 monitoring of ambient ground quality) (DM ID: 4937432). This report spreadsheet is sent to DWER on a quarterly basis.

On an annual basis the quarterly reports and spreadsheet are reviewed by the third-party contractor (360 Environmental) to review and compile a trend analysis. All reports are compiled and reviewed in the MPS FAD master database - quarterly bore monitoring results (Licence 3.4.7 monitoring of ambient ground quality) (DM ID: 4937432). All reports are organised and/or completed by the environmental team are saved in the following locations:

(a) MCD-PAD-DAM-3541 and 3542 DAM - Environmental reports (DM ID: 28768925); and

(b) MCD-PAD-DAM-356 DAM - Environmental reports (DM ID: 28766286).

A total of 24 groundwater monitoring bores have been installed around the FAD as shown in **Figure 36**. The groundwater monitoring requirements as per DWER licence L4706/1972/17 are summarised in **Table 24**.

***Figure 36:*** *Location of groundwater monitoring boreholes for the FAD*

## 8.8 Internal inspection

The annual inspections and intermediate reviews provide a FAD status report and require input from a systems engineer. They include a detailed inspection of the dam, a

review of monitoring data, deposition rates, survey data (if available), beach formation, fly ash properties and emergency procedures and reporting structures. The geotechnical stability of the storage facility is also to be assessed. It is the responsibility of the FAD owner to initiate the inspections. All reports must be saved in the following locations:

(a) MCD-PAD-DAM-3541 and 3542 DAM - Annual reports (DM ID: 28759089); and

(b) MCD-PAD-DAM-356 DAM - Annual reports (DM ID: 28766836).

### 8.8.1 Category 1 inspections

The FAD (both cells) hazard category was determined as per the DMIRS code of practice – tailing's storage facilities in Western (DMP, 2013). The category is assigned in respect to the TSFs hazard rating and highest embankment height. Cell 1B embankments will be greater than 15m in height, the FADs was assigned a hazard category of '**Category 1'**. Refer to **section 9.2.3**. Cell 2B embankments will be greater than 15m in height, the FADs was assigned a hazard category of '**Category 1'**. Refer to **section 9.2.2**.

Category 1 inspections must be carried out by a third party (i.e. not the designer or operator). The following type of data is required:

(a) **dam and reservoir information**: Should be adequate for all levels of assessment (i.e., stability of slopes, earthquake effects, condition of components and materials);

(b) **topographic:** The accuracy and details of the topographic features should be consistent with the accuracy of the assessment of the dambreak affected zone (i.e., inundation maps) and large-scale maps (e.g. 1:10,000 to mapping and surveys produced specifically for the assessment);

(c) **flood characteristics and inundation mapping:** Catchment modelling and hydrology, breach analysis of the dam and downstream routing using current computer modelling programs such as those based on the saint-venant equation;

(d) **downstream community information:** Assemble an accurate picture without a detailed analysis of damage and other effects, usually from effects, usually from professional advice;

(e) **environmental information:** Obtain professional advice;

(f) **services and business implications:** Detailed analysis; and

(g) **documentation:** Data and documentation review of reports and piezometer readings.

All reports must be saved in MCD-PAD-DAM-3541 and 3542 DAM - Category 1 inspection reports (DM ID: 28769261).

### 8.8.2 Category 2 inspections

Category 2 inspections must be carried out by a third party (i.e. not the designer or operator). This is consistent with ANCOLD's 2012 guideline. The following type of data is required:

(a) **dam and reservoir information**: Should be adequate for all levels of assessment (i.e. stability of slopes, earthquake effects, condition of components and materials);

(b) **topographic:** The accuracy and details of the topographic features should be consistent with the accuracy of the assessment of the dambreak affected zone (i.e. inundation maps) and intermediate scale maps (e.g. 1:25,000 to 1:50,000);

(c) **flood characteristics and inundation mapping:** Historical flood data, semi-empirical analysis of the dambreak flood;

(d) **downstream community information:** Check the occupancy of the dwellings;

(e) **environmental information:** General information rom mas, internet searches, reviews of local authorities and government databases;

(f) **services and business implications:** Empirical analysis; and

(g) **documentation:** Data and documentation review of reports and piezometer readings.

## 8.9 Water balance data review

Muja has a T3000 system in which has live data input across multiple locations on site. The T3000 system has a water balance section which identifies the following data:

(a) volumes (slurry, water, fly ash);

(b) rain stations (wind speed, temps, rain rate, solar radiation, day evapotranspiration and barometer); and

(c) process flow (in and out).

The T3000 shows real time data, this data is shown on the T3000 water balance pages which shows the following criteria:

(a) rain fall;

(b) evaporation;

(c) decant water recovery volumes;

(d) cell 2 seepage recovery;

(e) cell 1 seepage recovery;

(f) water treatment sludges – lime;

(g) water treatment sludges - CWRF ferric; and

(h) fly ash.

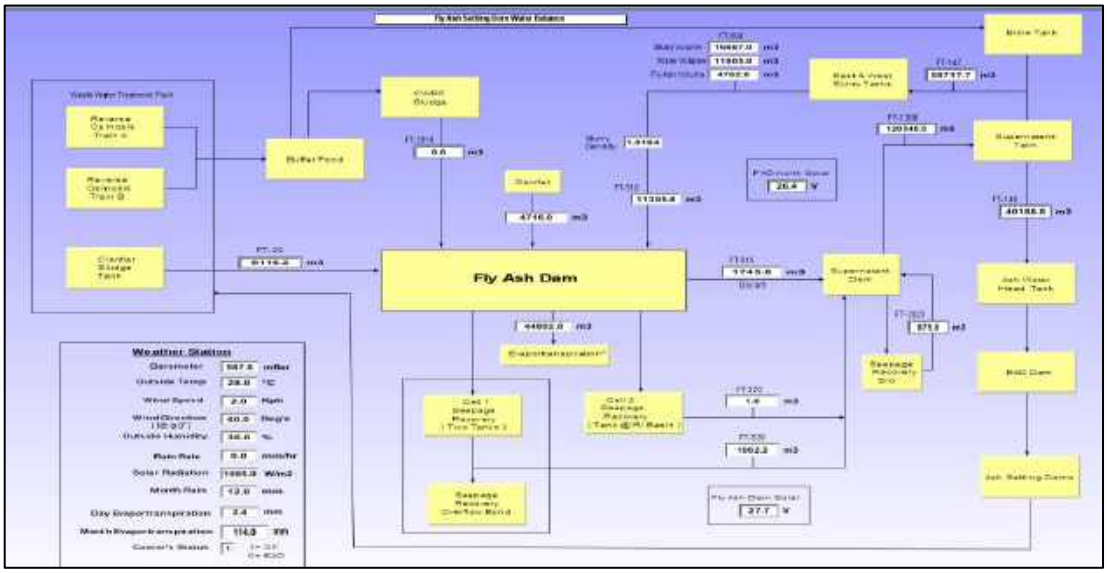


***Figure 37:*** *Main water balance page*

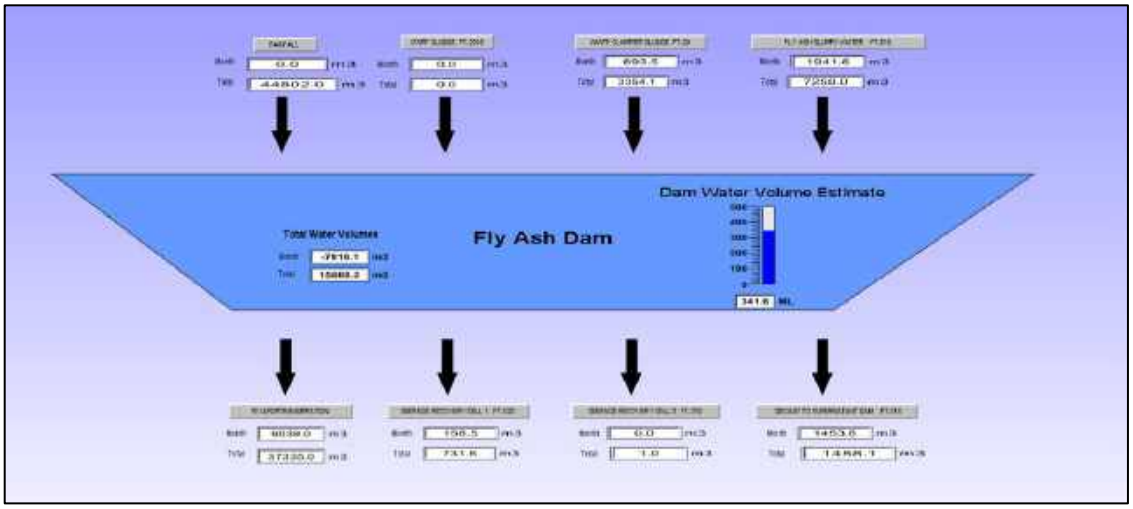


***Figure 38:*** *Simple water balance page*

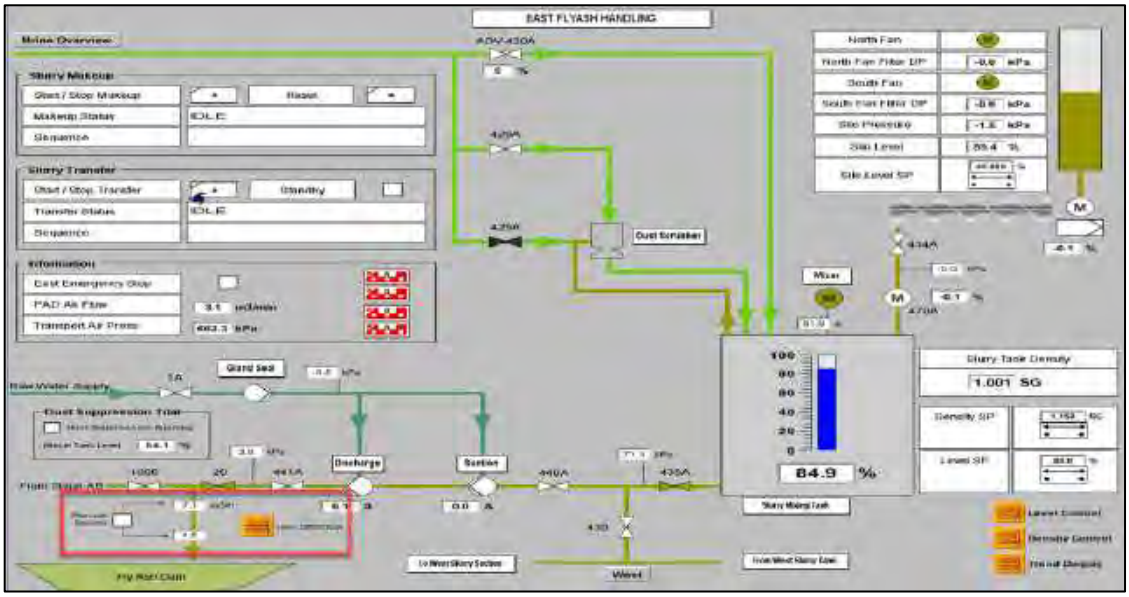


***Figure 39:*** *Leak detection page*

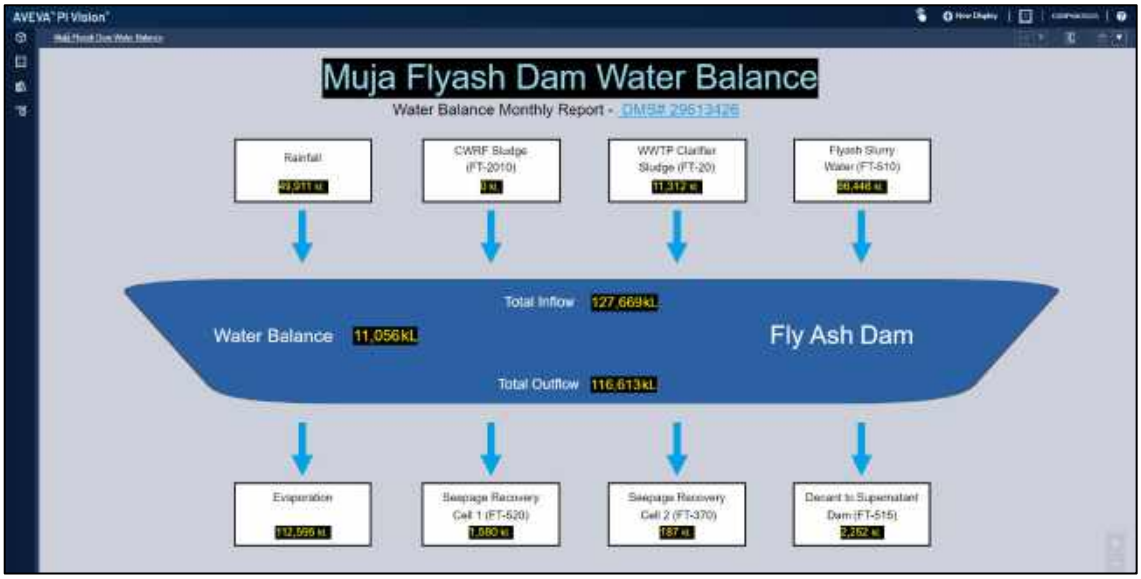


***Figure 40:*** *PI water balance page*

Using Pi, all of the calculations are done in the T3000, the totaliser values have been mapped through to PI and the basic graphic has been recreated in PI Vison for easy access to the information and trending purposes as shown in **Figure 40**.

The T3000 / PI water balance page updates the MPS FAD master database - water balance monthly reporting and trends (T3000 / PI) (DM ID: 29613426) on a monthly basis, this is completed automatically.

## 8.10 Compliance audit

Synergy coordinates a third-party consultant who reviews dam management and provides advice and support to ensure compliance on site. The audit plan for dams are as follows:

(a) **major external audits:** completed by the third-party SME consultant in coordination by the audit and compliance coordinator;

(b) **internal audits:** completed by the audit and compliance coordinator and mechanical engineer six months prior to the major external audit;

(c) **regulatory amendment reviews:** completed by the third-party SME consultant in coordination by the audit and compliance coordinator. This is completed only when there have been amendments to regulatory documentation; and

(d) **internal CCO's:** completed by leaders on site internally through the health, safety and environmental Empower software.

A major external audit of the operation of the TSF shall be carried out by a civil or geotechnical engineer experienced in tailings / ash storage design and dam management. Whenever possible, the person or company who will carry out the audit will be commissioned prior to the scheduled audit date, so that they can progressively review routine inspection and monitoring data over the full period covered by the audit.

To validate the stability of the TSF dams embankment prior to each regulatory audit, verification testing may be performed to ensure the design remains valid. The extent of the testing to be undertaken is to be confirmed by the person or organisation appointed to carry out the intermediate audit.

All past and present audit reports and evidence can be located in Muja statutory compliance audits folder (DM ID: 8847126) and monitored and maintain in the compliance, governance and risk Empower. For Muja's statutory compliance teams audit schedule, refer to Muja – compliance audit planner (DM ID: 10814850).

## 8.11 Addition examinations

Additional examinations are carried out if issues, defects, observations or hazards have been identified. A Synergy engineer and structural contractor (dam engineer) will determine the examination that is required to ensure the integrity of the dam. Additional examinations / inspections must be carried out after the following:

(a) an excessive rain event "8mm" which is triggered in the T3000 system; and

(b) earthquakes.

***Table 25:** Rain event in mm*

| Description: | Amount Rain: |
|---|---|
| Slight rain | <0.5mm per hour |
| Moderate rain | Between 0.5mm - 4mm per hour |
| Heavy rain | Between 4mm - 8mm per hour |
| Very heavy rain | 8>mm per hour |
| Extreme heavy rain | 100mm in 24hrs |

### 8.12 Incident reports

Inspections are carried out after any incident is recorded on the dam. A Synergy engineer and structural contractor (dam engineer) will determine the inspection type and if any assessments are required to ensure the integrity of the dam post incident.

## 9 HAZARD RATING AND DAMBREAK ASSESSMENTS

### 9.1 Risk assessments

Muja TSF dams have been reviewed and a risk assessment completed to ensure the following is captured as per the ANCOLD 2019 requirements:

(a) potential environmental impact:

  (i) material;

  (ii) seepage; and/or

  (iii) abrupt failure of the storage embankment at any stage in its life.

(b) potential impact in terms of safety on any nearby community infrastructure and/or mining developments:

  (i) material;

  (ii) seepage; and/or

  (iii) abrupt failure of the storage embankment at any stage in its life.

(c) potential impact in terms of economics on any nearby community infrastructure and/or mining developments:

  (i) material;

  (ii) seepage; and/or

  (iii) abrupt failure of the storage embankment at any stage in its life.

The FAD environmental management plan advises the following as risks:

(a) FAD (refer to **Table 26**):

  (i) noise:

  (ii) dust:

  (iii) seepage:

  (iv) overflow: and

  (v) dam wall failure.

(b) supernatant dam (refer to **Table 27**).

Please refer to Muja - dam management risk assessment (DM ID: 21990761) and FAD environmental management plan in accordance with L4706_1972_17 (DM ID: 9084770). The FAD risks are also captured in the governance, risk and compliance Empower under risk# 1407, please refer to **Table 28**.

*Table 26: Fly ash environmental risk review*

| Risk | L | C | Risk | Control Measure |
|---|---|---|---|---|
| Noise from dam and equipment | 1 | 1 | Low | Regular servicing of equipment and installation of mufflers on equipment. |
| Dust from dam surface | 2 | 2 | Low | Slurry with water, ash retains moisture, additional water when required. |
| Dust from vehicle movement | 3 | 1 | Low | Monitoring and set low speed limits. |
| Dust from dam walls | 2 | 1 | Low | Not trafficked. |
| Seepage through walls or liner beyond immediate vicinity of FAD | 3 | 1 | Low | Existing controls:<br>(a) constructed of clayey materials; and<br>(b) maintain water level as low as possible.<br>Proposed controls:<br>(a) underdrainage and leachate collection system; and<br>(b) direct leachate from collection sump and decant structure to supernatant dam. |
| Dam overflow | 1 | 1 | Low | Existing controls:<br>(a) freeboard inspections; and<br>(b) spillway to alternate cell.<br>Proposed controls:<br>(a) direct leachate from collection sump and decant to supernatant dam. |

*Table 27: Supernatant dam environmental risk review*

| Risk | L | C | Risk | Control Measure |
|---|---|---|---|---|
| Seepage | 1 | 2 | Low | Double liner and inspection |
| Overflow, localised and global failure | 1 | 2 | Low | Design, spillway, regular inspections, freeboard |

*Table 28: Governance, risk and compliance empower risk bowtie*

| Inherent | | Residual | | |
|---|---|---|---|---|
| C4 | | C4 | L2 | Level 2 |
| Reputation and Customer Confidence | | Reputation and Customer Confidence | | |
| Reputation and Customer Confidence | C4 | Reputation and Customer Confidence | Level 2 | |
| Legal and Compliance | C3 | Legal and Compliance | Level 2 | |
| Financial (inc. Production Loss) | C3 | Financial (inc. Production Loss) | Level 1 | |
| Environmental | C4 | Environmental | Level 2 | |

### 9.1.2 Safe work instructions (SWI)

MPS provide a register of safe work instructions (**SWI**) for day-to-day activities, some of these SWI are in line with this management system. For a complete list of all SWI's please refer to MPS document control index (DM ID: 4352754).

### 9.1.3 Safe work method statement (SWMS)

A safe work method statement (**SWMS**) is a formal process to identify, assess and control hazards relating to a scope of work. A SWMS is compulsory when risk is greater than a low or as prescribed in associated legislation. Please refer to the health and safety management manual (DM ID: 10154684).

### 9.1.4 Take 5

Synergy provide Take 5's for all personnel on site, this is a personal based risk assessment which encourages you to review the task you are about to complete to assess all of the risks and controls in place. If the risk level exceeds 5 that a SWMS will need to be completed. Please refer to the health and safety management manual (DM ID: 10154684).

## 9.2 Dambreak assessments

The dambreak assessment is carried out as per the guidelines on the consequence categories for dams 2012 and the code of practice Tailing's storage facilities in Western Australia. Each dam must have a consequence category classification identified from the result of a dam failure.

| Maximum embankment or structure height | Hazard rating | | |
|---|---|---|---|
| | High | Medium | Low |
| > 15 m | Category 1 | Category 1 | Category 1 |
| 5 - 15 m | Category 1 | Category 2 | Category 2 |
| < 5 m | Category 1 | Category 2 | Category 3 |

***Figure 41:*** *Guidelines on the consequence categories for dams 2012 and the code of practice tailing's storage facilities in Western Australia*

Category 1 inspections must be carried out by a third party (Not the designer or operator). Consistent with ANCOLD's 2012 guideline, the following will be reviewed:

(a) check that the recommendations of previous reviews have been actioned;

(b) confirm that appropriate responses have been made to any incidents or issues arising;

(c) verify compliance with specifications (e.g. inspection, monitoring and quality control);

(d) verify compliance with legislative requirements and tenement conditions;

(e) validate the continued use of the TSF design; and

(f) recommend any necessary operational or design modifications.

### 9.2.2 Fly ash dam cell 2 - dambreak and consequences assessment

A consequence assessment of FAD failure was undertaken to determine the FAD's consequence category in accordance with ANCOLD guidelines on consequence categories for dams 2012b and guidelines on tailings dams ANCOLD, 2012a.

The consequence category is determined by assessing the population at risk (**PAR**) and potential damages and losses arising from downstream inundation caused by a dam break. The consequences will vary according to the type, location and mechanism of the dam failure. Using the ANCOLD, 2012b the FAD was assigned a "**Significant**" consequence category (**Table 29**).

***Table 29:*** *FAD cell 2 ANCOLD (2012b) - consequence category based on PAR*

| Population at Risk | Severity of Damage and Loss | | | |
|---|---|---|---|---|
| | Minor | Medium | Major | Catastrophic |
| < 1 | Very Low | Low | Significant | High C |
| ≤ 1 to < 10 | Significant | Significant | High C | High B |
| ≤ 10 to < 100 | High C | High C | High B | High A |
| ≤ 100 to < 1,000 | | High B | High A | Extreme |
| ≤ 1,000 | | | Extreme | Extreme |

Please refer to the FAD cell 2 dambreak and consequence assessment from 2015 (DM ID: 28710629). The implications of a significant classification for the operation of the FAD are:

(a) the FAD must safely contain rainfall and runoff resulting from a 1 in 100-year, 72-hour storm event; and

(b) inspection requirements are as detailed in **section 8.8.1.**

Please refer to the FAD cell 2 dambreak and consequence assessment from (DM ID: 28710629). Given that the FAD cell 2 has a raised embankment, it was assigned a hazard category of 'Category 1'. For inspection requirements, refer to **section 8.8.1**.

### 9.2.3 Fly ash dam cell 1 - dambreak and consequences assessment

A consequence assessment for cell 1B was undertaken to determine the consequence category in accordance with ANCOLD guidelines on consequence categories for dams 2012b and guidelines on tailings dams ANCOLD, 2012a. The consequence category was determined by estimating the PAR and severity of damages and losses arising from downstream inundation caused by a dam break. The consequences vary according to the type, location and mechanism of the dam failure.

A summary of the framework used to assign a consequence category is presented in **Table 30.** The consequence category is then used to set standards for the design, management and operation of the facility.

***Table 30:*** *FAD cell 1 consequence categories based on PAR (ANCOLD, 2012)*

| Population at Risk | Severity of Damage and Loss | | | |
|---|---|---|---|---|
| | Minor | Medium | Major | Catastrophic |
| < 1 | Very Low | Low | Significant | High C |
| ≤ 1 to < 10 | Significant (Note 2) | Significant (Note 2) | High C | High B |
| ≤ 10 to < 100 | High C | High C | High B | High A |
| ≤ 100 to < 1,000 | Note 1 | High B | High A | Extreme |
| ≤ 1,000 | Note 1 | Note 1 | Extreme | Extreme |

**Note 1:** With a PAR in excess of 100, it is unlikely damage will be minor. Similarly, with a PAR in excess of 1,000 it is unlikely damage will be classified as medium.
**Note 2:** Change to 'High C' where there is potential of one or more lives being lost.

The severity of damage and loss categories used in **Table 30** are detailed in the ANCOLD 2012.

The implications of a significant classification for the operation of the FAD are:

(a) the FAD must safely contain rainfall and runoff resulting from a 1 in 100-year, 72-hour storm event; and

(b) inspection requirements are as detailed in **section 8.8.1.**

Please refer to the FAD cell 1 dambreak and consequence assessment from (DM ID: 22413100). Given that the FAD cell 1 has a raised embankment, it was assigned a hazard category of 'Category 1'. For inspection requirements, refer to **section 8.8.1**.

A geotechnical engineering assessment was undertaken to identify the critical geotechnical failure mechanism most likely to affect MPS FAD Cell 1. The assessment identified the most credible geotechnical failure mechanism to affect MPS FAD Cell 1 is related to the high likelihood of in-situ wet / submerged fly ash and bottom ash undergoing full liquefaction under an earthquake, such that geotechnical failure of the MPS FAD Cell 1 Walls is likely to be initiated provided sufficient portions of in-situ ash material underlying the Wall is submerged below a phreatic surface and is fully-liquefied.

As such, the key parameter from which to quantify the risk of geotechnical failure mechanism initiation is the phreatic surface underlying the MPS FAD Cell 1 Walls, and

can be interpreted from porewater pressure readings collected by as-built standpipe and vibrating wire piezometers (VWP) already embedded within each Wall alignment.

Please refer to 149-03-3112C-RR001_0A MPS FAD Cell1 Piezo trigger levels (DM ID: 35270669) and 149-03-3112C-RR002_0B MPS FAD Cell1 TARP (DM ID: 35271873).

### 9.2.4 Supernatant dam - dambreak and consequences risk assessment

A specific dambreak study has not been undertaken for the supernatant dam. Based on supplied topography, a dambreak of the supernatant dam would likely flow south towards the retardation basin, avoiding the FAD cells. The supernatant dam has not been highlighted as a safety risk regarding dambreak likelihood.

**Table 31:** Supernatant dam consequence categories based on PAR (ANCOLD, 2012)

| Population at Risk | Severity of Damage and Loss | | | |
|---|---|---|---|---|
| | Minor | Medium | Major | Catastrophic |
| < 1 | Very Low | Low | Significant | High C |
| ≤1 to < 10 | Significant (Note 2) | Significant (Note 2) | High C | High B |
| ≤ 10 to < 100 | High C | High C | High B | High A |
| ≤ 100 to < 1,000 | Note 1 | High B | High A | Extreme |
| ≤ 1,000 | Note 1 | Note 1 | Extreme | Extreme |

**Note 1:** With a PAR in excess of 100, it is unlikely damage will be minor. Similarly, with a PAR in excess of 1,000 it is unlikely damage will be classified as medium.
**Note 2:** Change to 'High C' where there is potential of one or more lives being lost.

Please refer to the Muja dam management risk assessment (DM ID: 21990761) for the dambreak study. Given that the supernatant dam is half underground dam with only one side raised, it was assigned a hazard category of 'Category 3'.

The supernatant dam has been risk assessed based on all areas of risk for site, this is found in the ARC Empower risk# 2646.

***Table 32:** ARC Empower risk# 2646*

| Inherent | | Residual | | |
|---|---|---|---|---|
| C3 | | C3 | L3 | Level 2 |
| **Health, Safety and Wellbeing** | | **Environmental** | | |
| Health, Safety and Wellbeing | C3 | Health, Safety and Wellbeing | | Level 2 |
| Reputation and Customer Confidence | C3 | Reputation and Customer Confidence | | Level 2 |
| Legal and Compliance | C3 | Legal and Compliance | | Level 2 |
| Financial (inc. Production Loss and Structural) | C3 | Financial (inc. Production Loss and Structural) | | Level 2 |
| Environment | C3 | Environment | | Level 2 |

### 9.2.5 Temporary ash dam - dambreak and consequences assessment

A consequence assessment of TAD failure was undertaken to determine the TAD's consequence category in accordance with ANCOLD guidelines on consequence categories for dams ANCOLD, 2012b and guidelines on tailings dams ANCOLD, 2012a.

The consequence category is determined by assessing the PAR and potential damages and losses arising from downstream inundation caused by a dam break. The consequences will vary according to the type, location and mechanism of the dam failure.

ANCOLD (2012b) recommends considering a "dam break" simulation to determine the inundation area under various conditions of flooding and, for tailings dams, often assumes that the tailings are replaced with water. Due to the size and location of the TAD, a dam break study has not been conducted. Instead, a qualitative risk assessment

using conservative values has been undertaken as part of this design to assess the consequence category. Refer to **Table 33**.

Using the ANCOLD Guidelines on the Consequences Categories for Dams (ANCOLD, 2012) the TAD was assigned a "Significant" consequence category (**Table 33**)

***Table 33:*** *TAD ANCOLD (2012b) - consequence category based on PAR*

| Population at Risk | Severity of Damage and Loss | | | |
|---|---|---|---|---|
| | Minor | Medium | Major | Catastrophic |
| < 1 | Very Low | Low | Significant | High C |
| ≤ 1 to < 10 | Significant | Significant | High C | High B |
| ≤ 10 to < 100 | High C | High C | High B | High A |
| ≤ 100 to < 1,000 | | High B | High A | Extreme |
| ≤ 1,000 | | | Extreme | Extreme |

The severity of damage and loss categories used in **Table 33** are detailed in the ANCOLD 2012.

Please refer to the MS-AD-DAM-403 - TAD Dambreak and consequences assessment - extract from ER2571 design report - 2014 (DM ID: 28706383). Using a similar method to the dam failure consequence category, the environmental spill consequence category has been determined by considering only the effect of spilling water from the TAD, through the spillway, during an extreme wet weather period. For this type of event, the TAD was assigned a "Very Low" consequence category as identified in **Table 33**.

# 10 INCIDENTS AND EMERGENCIES

## 10.1 Incident reporting

The following incident management procedure shall be followed where an incident has occurred on or near the TSF:

(a) notify supervisor / manager immediately;

(b) register the incident in the health, safety and environment production Empower; and

(c) incident cause analysis method (**ICAM**) processes will be followed for serious incidents.

The DWER will be advised within 24 hours (or close of business the next usual working day) of occurrence of the following:

(a) any uncontrolled release of fly ash and/or liquor (including pipe breaks, overtopping events, or similar);

(b) any major seepage occurrence (e.g. a discernible impact on vegetation, soil contamination; and

(c) any defects in the structure of the TSF (e.g. cracking, slumping of walls, significant wall erosion, day lighting phreatic surfaces, decant collapse).

The department of biodiversity, conservation and attractions Collie office will be consulted where a rare or endangered fauna death occurs on, or in the vicinity of the TSF. This consultation will be used to determine the requirement for additional reporting.

Fauna deaths are not required to be reported to department of biodiversity, conservation and within seven days unless considered to be significant. The definition of significance includes whether the species is listed as a priority or threatened species, if large populations have died or deaths are recurring. Please refer to Synergy's incident classifications for recording and reporting purposes (DM ID: 4755282) and health, safety and environment incident management procedure (DM ID: 11032452).

### 10.2 Muja emergency management plan

Muja has onsite an emergency response team, this team attends incidents on site and around site to ensure the safety of all personnel and equipment. Synergy documents its planned response to emergencies and accidents in its site emergency management plan (DM ID: 5005603) and associated procedures. The implementation of these documents can in the event of an emergency or accident, result in the prevention or mitigation of associated adverse impacts. In Muja's emergency management plan it identifies multiple action cards which relate to different incident types for site, refer to **Table 34**.

If the emergency impacts the environment:

(a) ensure the site environmental officer or responsible officer is represented;

(b) recover, remove and dispose of spills as per the licence condition 1.2.2 (see **section 1.3**); and

(c) comply with statutory reporting requirements within the communication plan for reportable environmental incidents.

***Table 34:** EMP Action cards*

| Incident type and colour code | | |
|---|---|---|
| 1. | Fire (including bushfire) | |
| 2. | Explosion / rapid loss of containment | |
| 3. | Confined space | |
| 4. | Rescue at height / fall from height / suspension | |
| 5. | Medical – only requiring rescue or extrication | |
| 6. | Natural disaster | |
| 7. | HAZMAT | |
| 8. | Malicious / terrorism | |
| 9. | HV electrical | |
| 10. | Structural collapse | |
| 11. | Civil structures including elevated embankment dams (erosion / overtopping) | |

**Note**: Multiple actions card can be used for one incident.

#### 10.2.1 Contingency

A contingency plan is in place for MPS FAD which is captured on the Collie power station licence L6637/1995/15 (DM ID: 29471731), see **section 1.3** condition 1.3.7. Flyash or bottom ash from the MPS with a quantity limit of 40,000 tonnes per annum has been accepted into cell 2C of the ash storage dam at Collie power station at no less than 15% v/w moisture content. Deposition to occur in accordance with the Collie power station FAD and runoff dam O&M manual (GHD, 2021) or subsequent versions.

#### 10.2.2 Rescue equipment

All water dams have lifebuoys in the area. These are maintained on a yearly inspection frequency (MI# 80020558). All life buoys are advised on M300-0070-001 Overall site plan lifebuoy locations.

## 11 DECOMMISSIOING

### 11.1 1996 FAD manual

In 1996 the FAD manual identified a cap and cover process. The general principle adopted in the proposed FAD cap and cover include the following:

(a) overlay the fly ash with a coarse single sized sandy gravel or local rock to provide lateral drainage from within the cap; and

(b) place a covering over the gravel that reflects the local soil profile of the area. This profile would include a clay layer, overlain by a layer of sandy laterite gravel and

then covered with a layer of sandy, humus risk topsoil. There would be no requirement to use additional material to reshape the profile for drainage purposes as the proposed design to deposit the fly ash would adequately facilitate surface drainage. Native vegetation for the site would be sown into the topsoil during the progressive stages of rehabilitation.

Please refer to MCD-PAD-DAM-3541 and 3542 - Original FAD closure plan – 1996 (DM ID: 26421829) for further information on the following:

(a) cap and cover objectives;

(b) project issues;

(c) project concept; and

(d) design requirements.

### 11.2 2019 FAD closure report

A closure plan was developed on the completion of the flay ash cell 1 raise which identified a hummock approach. The concept closure design is designed as follows:

(a) all surface runoff was designed to drain to the north side of the facility where the height of the embankments are lower (as required by MPS's licence DER2014/002698-1 (DM ID: 25007266) condition 1.2.3 refer to **section 1.3**);

(b) the outer slopes of the embankments will be reshaped to 1V:3H to achieve a safe and stable slope profile;

(c) a cover layer will be applied over the facility surface and embankments utilising appropriate erosion resistant materials. The thickness of the cover (and zoning if required) should be confirmed based on the material properties and trials;

(d) a minimum 1% final surface fall toward the north and the hummocks is included;

(e) hummocks are included in the design to slow the flow of the surface runoff;

(f) drainage channels were incorporated along the embankment toes which will effectively drain the surface runoff central area and the outer slopes (as required by MPS's licence DER2014/002698-1 (DM ID: 25007266) condition 1.2.3 refer to **section 1.3**);

(g) rock armouring of the drainage channel was included (thickness of about 1 m) to reduce the risk of scour during high velocity flood events. The thickness and size of rock armouring should be confirmed by hydraulic modelling; and

(h) rock armouring on the embankments was included (thickness of about 1 m, to be confirmed by long term erosion modelling) to reduce erosion. Rock armouring will include 200 mm of topsoil ripped within.

Please refer to MCD-PAD-DAM-3541 and 3542 - Cell 1 and 2 closure report - extract from ER10266 design report - 2019 (DM ID: 22413019) for further information on the following:

(a) closure objectives;

(b) completion criteria;

(c) design requirements; and

(d) recommendations.

### 11.3 Muja closure date announced

In 2022 the WA government announced the closure date of Muja for 2029. With this date in mind a third-party contractor has been organised to review the current closure plans for the FAD and remanent life projections in mind to develop a "life of mine" report. This

will identify the compliance and environmental requirements for the FAD decommissioning plan for Muja. During the development of the "life of mine", roles and responsibilities will be defined, a hazard analysis and risk assessment will be completed.

## 12 TERMS AND DEFINITIONS

| Term | Definition |
|---|---|
| **AACR** | Annual audit compliance report |
| **ANCOLD** | Australian committee on large dams |
| **AHD** | Australian height datum |
| **AS** | Australian standard |
| **AS/NZS** | Australian / New Zealand standards |
| **BAD** | Bottom ash dam |
| **CEO** | Chief executive officer |
| **CH** | Channel |
| **CPT** | Cone penetration test |
| ***CPTu*** | *Electric piezocone penetration test* |
| **CWRF** | Central water receival facility |
| **DCS** | Digital control system |
| **DEM** | Digital elevation model |
| **DFES** | Department of fire and emergency services |
| **DM ID** | Document management identification |
| **DMIRS** | Department of mines, industry regulation and safety |
| **DMP** | Department of mines and petroleum |
| **DWER** | Department of water and environmental regulation |
| **ERP** | Emergency response plan |
| **EQID** | Equipment identification |
| **FAD** | Fly ash dam |
| **$FoS_{slop}$** | Factor of safety |
| **GSI** | Geotechnical site investigation |
| **HDPE** | High density polyethylene |
| **ICAM** | Incident cause analysis method |
| **MDR** | Manufacturers data report |
| **MOC-T** | Management of change - technical |
| **MOL** | Maximum operating level |
| **MP** | Management plan |
| **MPS** | Muja power station |
| **NATA** | National association of testing authorities |
| **O&M** | Operation and maintenance |
| **PAR** | Population at risk |
| **POI** | Plant operating instruction |
| **PVC** | Polyvinyl chloride |
| **RL** | Reduced level |
| **SAP** | system application and products |
| **SME** | subject matter experts |
| **SIM** | Station instruction Muja |
| **SNDM** | Supernatant dam |
| **SWI** | Safe work instruction |
| **SWMS** | Safety work method statement |
| **TAD** | Temporary ash dam |
| **TSF** | Tailings storage facility |
| **TSFMP** | Tailings storage facility management plan |
| **UAV** | Unmanned aerial vehicle |
| **VWP** | Vibrating wire piezometer |
| **WA** | Western Australia |
| **WHSGR2022** | Work health and safety (General) regulations 2022 |
| **WO** | Word order |
| **WTP** | Water treatment plant |
| **WWTP** | Waste water treatment plant |

## 13 REFERENCES

| Number | Title |
|---|---|
| | Environmental protection act 1986 |
| | Environmental protection (Controlled waste) regulations 2004 |
| | Work health and safety (General) regulations 2022 |
| | ANCOLD guidelines on dam safety management 2003 |
| 29546907 | ANCOLD guidelines on tailings dams - planning, design, construction, operation and closure May 2019. |
| 29545678 | ANCOLD guidelines on the consequence's categories for dams October 2012 |
| 29549486 | DMP code of practice tailings storage facilities in Western Australia 2013. |
| 29550159 | Guidelines on the Development of an Operating Manual For Tailings Storage - 1998 |
| 29547608 | MSHA Handbook Series - Dam Inspection and Plan Review Handbook - 2021 |
| 29549358 | Tailings Storage Facility Audit Guide - 2017 |
| 1407 | Governance, risk and compliance Empower under risk# 1407 |
| 28710629 | FAD cell 2 dambreak and consequence assessment |
| 21990761 | Muja - dam management risk assessment |
| 25007266 | DWER MPS operating licence L4706/1972/17 |
| 29471731 | DWER Collie power station operating licence L6637/1995/15 |
| 4593876 | EMS procedure-controlled waste |
| 21751460 | GBU-PRC-ASM-0002 Technical management of change procedure |
| 10154684 | Health and safety management manual |
| 4755282 | Synergy's incident classifications for recording and reporting purposes |
| 11032452 | Health, safety and environment incident management procedure |
| 20265171 | SIM 17.06 safety signage compliance |
| 21848022 | SIM 5.74 FAD traffic management plan |
| 19610914 | SIM 18.03 severe weather procedure |
| 5005603 | SIM 4.32 MPS emergency management plan |
| 22940672 | POI CD8.16 FAD deposition storage management |
| 29018377 | POI CD8.18 FAD dust suppression management |
| 29013135 | POI CD8.17 FAD inspection management |
| 9084770 | MPS - FAD environmental management plan in accordance with L4706_1972_17 |
| 26683541 | GHD, 2007 report on MPS ash dam design and construction of cell 1 embankment raise to RL 258.5m revision 2 September 2007 |
| 26686306 | GHD, 2015a MPS FAD cell 2B design report embankment raise revision B April 2015 |
| 5574583 | Muja manual station common dam manuals - flyash management plan report number tsb 97/02 (index = FAD disposal system, FAD hydrogeological modelling) |
| 22413100 | Dambreak and consequences; extract from cell 1B works approval supporting document |
| 22413019 | Closure extract from cell 1B works approval supporting document |
| 4833358 | MPS Dames and Moore stage D proposed FAD report site investigation 1981 |
| 29461336 | FAD Cell 1 seismic deformation assessment |
| 4417910 | MPS - FAD management design report by GHD Feb 2005 |
| 4445684 | GHD - MPS ash dam operating manual |
| 4543179 | MPS ash dam cell 1 operating manual |
| 4713102 | MPS ash dam design of cell 2 embankment raise to RL 258.5m |
| 4919865 | MPS construction report Muja FAD embankment raise of cell 2A RL 255.5M |
| 6422286 | FAD cell 2A (2011) O&M manual |
| 35276916 | FAD storage expansion - phase 1 design report |
| 20408878 | MDR Y026-MDR-001 |
| 21482403 | MPS Cell 1B FAD raise design report |
| 29089078 | Muja cell 1B FAD raise construction report 12518730-REP-0 |
| 25728298 | MPS FAD interim deposition construction report |
| 29534458 | 12576140-REP-0 MPS FAD cell 1 buttress construction report including signed certificate |
| 35271873 | 149-03-3112C-RR002_0B MPS FAD Cell1 TARP |
| 35270669 | 149-03-3112C-RR001_0B MPS FAD Cell1 Piezo trigger levels_Optimized |
| 26421829 | MCD-PAD-DAM-3541 and 3542 - Original FAD closure plan – 1996 |
| 28825294 | 1981 original design FAD drawings 1 |
| 28820073 | 1981 original design FAD drawings 2 |
| 28820376 | 1981 original design FAD drawings 3 |

| Number | Title |
|---|---|
| 28824702 | 1981 original design FAD drawings 4 |
| 4431041 | 61-15271-C001 Rev A - Ash storage review – Site arrangement and drawing list |
| 4431036 | 61-15271-C002 Rev A - Ash storage review – Decant tower general arrangement |
| 4431037 | 61-15271-C003 Rev A - Ash storage review – Decant tower general arrangement |
| 4431038 | 61-15271-C004 Rev A - Ash storage review – Typical embankment cross-sections |
| 4431039 | 61-15271-C005 Rev A - Ash storage review – Discharge pipe – longitudinal sections |
| 4431040 | 61-15271-C006 Rev A - Ash storage review – Discharge pipe – details |
| 4431035 | 61-15271-C007 Rev A - Ash storage review |
| 28801396 | 61-18075-01 to 08 Cell 1 drawings |
| 4693990 | 61-2145913-C001 to C105 Cell 2 drawings |
| 28802797 | 61-2145920-C001 to C007 Cell 2 drawings |
| 20548322 | M127/C/42/1 Rev 0 - FAD cell 1b embankment raise locality plan and drawing list |
| 28752072 | M127/C/43/1 Rev 0 - FAD cell 1b embankment raise site layout |
| 28747748 | M127/C/44/1 Rev 0 - FAD cell 1b embankment raise general arrangement |
| 28750872 | M127/C/45/1 Rev 0 - FAD cell 1b embankment raise underdrainage system plan |
| 28753687 | M127/C/45/2 Rev 0 - FAD cell 1b embankment raise underdrainage system plan |
| 28753774 | M127/C/45/3 Rev 0 - FAD cell 1b embankment raise underdrainage system plan |
| 28747751 | M127/C/45/4 Rev 0 - FAD cell 1b embankment raise underdrainage system plan |
| 28753689 | M127/C/45/5 Rev 0 - FAD cell 1b embankment raise underdrainage system plan |
| 28753690 | M127/C/46/1 Rev 0 - FAD cell 1b embankment raise embarkment geometry main embankment |
| 28750873 | M127/C/46/2 Rev 0 - FAD cell 1b embankment raise embarkment geometry main embankment |
| 28753775 | M127/C/46/3 Rev 0 - FAD cell 1b embankment raise embarkment geometry main embankment |
| 28752082 | M127/C/47/1 Rev 0 - FAD cell 1b embankment raise drainage |
| 28752083 | M127/C/48/1 Rev 0 - FAD cell 1b embankment raise arrangement and details |
| 4562314 | MPS - return water dam conceptual design report |
| 25369440 | M127-C-0098-003 MPS supernatant water dam layout plan |
| 25368954 | M127-C-0098-004 MPS supernatant water dam sections and details |
| 25368956 | M127/C/98/9 MPS supernatant water dam leakage detection |
| 25374050 | M127/C/98/10 MPS supernatant water dam leakage detection |
| 25372830 | M127/C/98/11 MPS supernatant water dam underdrain sump and recycle pump |
| 25367231 | M127/C/98/13 MPS supernatant water dam underdrain sump and recycle pump |
| 23410068 | M127/C/27/1 Cell 2 embankment geometry |
| 5186436 | M-S-1069-1 |
| 5398550 | M4/C/83/1 - Site works adjacent to ash dam |
| 5398552 | M4/C/83/2 - Site works adjacent to ash dam |
| 5398554 | M4/C/84/1 - Drainage - Arrangement and details in vicinity of ash dam |
| 5396160 | M4/C/110/1 - BAD runoff - Drainage upgrade plan |
| 5355749 | M127/C/11/1 - Ash disposal system - Ash inlets and discharge structure at ash dam |
| 5355751 | M127/C/11/2 - Ash disposal system - Discharge structure concrete details |
| 5357589 | M127/C/11/3 - Ash disposal system - Discharge structure reinforcement details |
| 5357591 | M127/C/11/4 - Ash disposal system - Details of cast iron pipes |
| 5295510 | M127/C/11/5 - Ash disposal system - Access way steel details |
| 5295512 | M127/C/11/6 - Ash disposal system - Discharge structure platform details |
| 5295514 | M127/C/11/7 - Ash disposal system - Discharge structure ladder details |
| 5295516 | M127/C/11/8 - Ash disposal system - Access way footing details at dam wall |
| 5295518 | M127/C/11/9 - Ash disposal system - Overflow pipe repair details |
| 5359301 | M127C/C/2/1 - Ash disposal system - Ash settling pond plan and details |
| 5359303 | M127C/C/2/2 - Ash disposal system - Ash settling pond plan and details |
| 5357653 | M127/D/21/1 - BAD as constructed |
| 5384855 | M127/D/22/3 - BAD base levels |
| 29959883 | Muja BAD Survey Feb 2023 |
| 18691139 | Synergy training matrix |
| 18971379 | Muja Tailings Dams weekly inspection template |
| 18967916 | Muja FAD Monthly Standpipe Piezometer Recording Template |
| 19648521 | Muja Tailings Dams Master Database - data reporting and trends (piezometers, fly ash and drone surveys) |

| Number | Title |
|---|---|
| 4937432 | Muja Tailings Dams Master Database - quarterly bore monitoring results (Licence 3.4.7 monitoring of ambient ground quality) |
| 29613426 | Muja Tailings Dams Master Database - water balance monthly reporting and trends (T3000 / PI) |
| 4440328 | MPS controlled waste register |
| 10814850 | Muja – compliance audit planner |
| 4352754 | MPS document control index |
| 26549403 | Muja dams folder |
| 24214686 | Muja Tailings Dams - Weekly Reports folder |
| 21988226 | Muja Tailings Dams -Survey reports folder |
| 19612174 | MCD-PAD-DAM-3541 and 3542 DAM - monthly reports folder |
| 28768925 | MCD-PAD-DAM-3541 and 3542 DAM - Environmental reports folder |
| 28766286 | MCD-PAD-DAM-356 DAM - Environmental reports folder |
| 28759089 | MCD-PAD-DAM-3541 and 3542 DAM - Annual reports folder |
| 28766836 | MCD-PAD-DAM-356 DAM - Annual reports folder |
| 28769261 | MCD-PAD-DAM-3541 and 3542 DAM - Category 1 inspection reports folder |
| 29516221 | MCD-PAD-DAM-3541 and 3542 DAM - Fly ash removal correspondence folder |
| 8847126 | Muja statutory compliance audits folder |
| 27154953 | MCD-PAD-DAM-3541 and 3542 DAM flyash settling (cell 1 and 2) folder |
| 27157347 | MCD-PAD-DAM-356 DAM supernatant water folder |
| 27156850 | MS-AD-DAM-402 DAM bottom ash settling folder |