

Donazzan's Dam- Pakenham Quarry

Intermediate Inspection

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Intermediate Inspection

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08-Jan-2021

Job No.: 60451395

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Quality Information

Document Donazzan's Dam- Pakenham Quarry
 Ref 60451395
 Date 08-Jan-2021
 Prepared by G. Cosset
 Reviewed by J. Toose

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	08-Jan-2021	Final	Amie Cullum Project Manager- Associate Director	

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Executive Summary

AECOM carried out an intermediate dam inspection at the Donazzan's Dam Site in-line with the ANCOLD recommendations for a Low Consequence Category dam. During the inspection, AECOM's Dams Engineer inspected the embankment and appurtenant structures, estimated the water-level in the reservoir and measured the water levels in the stand-pipe piezometers BH-1 and BH-6.

An aerial survey was also carried out and plan-view and cross-sections of the Dam were prepared.

AECOM 2020 made the following observations during its inspection:

- Wheels ruts on the dam crest have been filled and the crest shows little sign of rutting.
- Beaching material has been placed in the upstream slope of the dam on a distance of about 20 m from the mouth of the spillway located at the south-west end of the dam.
- Rip-rap has been placed in the emergency spillway.

The updated plan-view and cross-sections also indicate that:

- The crest is below RL 127.0m in the western part of the dam and has settled of about 300 mm to RL 127.0m in the area of the cross-section B. The initial design elevation of 127.4 m was used to determine the current FSL.

AECOM recommends to carry-out the following actions:

- Complete an initial assessment and to support the assigned Consequence Category of the Donazzan's Dam.
- Install a survey staff gauge with elevation marks every 0.1 m to measure more accurately the reservoir water level and include the monitoring of the reservoir water level in the monthly inspection.
- Carry-out a land surveying of the dam crest to determine its current elevation and review the FSL accordingly.
- Survey the existing standpipe piezometers (BH-1 and BH-6), the extent of the rip-rap in the spillway, the location and elevation of the outlet pipe and location of the inlet pipe be carried out.
- Monitor the erosion of the spillway channel and side walls following each spill event and major rainfall events.
- Remove any trees/shrubs growing on the embankment or within the spillway chute.

1.0 Introduction

1.1 Scope

AECOM was requested by Holcim (Australia) Pty Ltd to carry out an Intermediate Inspection of the Donazzan's Dam in Pakenham. This inspection is carried out in-line with the ANCOLD recommendations for a Low Consequence Category dam and meet Holcim Environmental Management Plan (Holcim 2015) requirements.

During an Intermediate Inspection, the Dams Engineer inspect the embankment and appurtenant structures and review the surveillance data. The objective is to identify potential deficiencies and provide recommendations for corrective actions (if required).

Holcim has also updated the existing survey of the area and asked AECOM to update the dam layout plan and cross-sections.

The structure of this document is as follow:

- Section 2: Structure Description
- Section 3: Hazard Consequence Category Review
- Section 4: Intermediate Inspection
- Section 5: Update of Plan view and cross-section
- Section 6: Conclusion and Recommendations

1.2 Previous Inspections and Recommendations

According to Holcim EMP a Dam Integrity Review shall be performed every five years. The last Inspection was carried out by Coffey in 2015 as part of their Dam Stability Assessment. It included:

- An intermediate Dam Safety Inspection identifying signs of visual distress in the dam.
- Review of the consequence category assessment confirming the Low Consequence Category.
- Stability analysis of one cross-section of the dam based on the water level indicating the embankment has a suitable factor of Safety.

Four (4) recommendations, listed in Table 1 were made by Coffey (2015).

Table 1 Status of Recommendations made as part of Previous Inspection

Recommendations	Status
To carry out a new survey of the dam	Completed in October 2020
To placed additional rip-rap along areas of the spillway where the underlying natural clay is visible and that a visual assessment of the spillway form part of the monthly checklist	Completed
To install a survey peg, stake, star picket or similar, with depth marks, within the dam, and that records of the water level in the dam are collated as part of the monthly visual inspection	Not started
To fill the wheel ruts on the crest with low permeability material and to restricted from the crest of the embankment, particularly during periods of wet weather	Completed

1.3 Data Review

The following documentation were made available for data review:

- Dam Stability Assessment, Donazzan's Dam, Pakenham – Coffey Geotechnics 2015
- Stability Assessment Clarification, Donazzan's Dam, Pakenham – Coffey Geotechnics 2011
- Dam Stability Assessment, Donazzan's Dam, Pakenham – Coffey Geotechnics 2010
- Routine Visual Inspection sheets

Groundwater level and dam water level data (understood to be estimated from freeboard observations) given in the previous dam inspection (Coffey, 2010 and Coffey, 2015) were also reviewed.

The following information requested as part of the proposal were not made available to AECOM:

- Preliminary Geotechnical Investigation – Coffey Geosciences 2005
- Donazzan's Dam Monitoring Schedule – Readymix 2008

2.0 Structure Description

Little information was available on the design and foundation of the dam in the documentation reviewed. The main information was derived from the 2015 and 2010 Coffey inspection report. The Donazzan's Dam is a 27 ML water retaining dam constructed as part of the water management on site. The Donazzan's Dam receives water pumped from the quarry pit and stormwater runoff. The outlet pipe is located in the western part of the Dam, and travels to the downstream toe where water is discharge in a stream. A rockfill lined emergency spillway is located at the western end of the dam. The full level Supply is 126.4 m (Coffey, 2010).

According to the stability assessment cross-section (Coffey 2010 and 2015), the dam is a homogenous earthfill embankment dam with a maximum height of 10m. The crest width is approximately 5m wide and the dam crest level varies between RL 127.4 to RL 126.9 m. Based on the 2020 survey the slope of the downstream shoulder of the embankment varies between 1H in 2.5V and 1H in 4V. The embankment is founded on a natural clay layer (about 3 to 5 m thickness), overlying weathered bedrock and competent rock.

3.0 Hazard Consequence Category Review

Consequence Category Assessment and review of the Donazzan's Dam (Coffey, 2010 and 2015) were carried out with reference to the descriptions of severity of damage and loss in the ANCOLD Guidelines (ANCOLD, 2012). The main damages and loss are associated with the cost of infrastructure loss and repair of the Dam and the impact on Holcim business and production activities. These damages were considered by Coffey to be minor and the dam was classified as a Low Consequence Category.

As part of this project, a review of the consequence category assessment was carried out based on the information available. The Coffey 2010 and 2015 reports do not provide the following information to support their assessment of the Consequence Category as 'Low':

- Assessment of the risk to human life expressed as population at risk (PAR) or potential loss of life (PLL) as described in ANCOLD (2012).
- Documentation of the assumed severity and loss as described by Appendix B of Guidelines of Consequence Categories for Dams' (ANCOLD 2012).

We recommend that an initial assessment is completed and documented to support the assigned Consequence Category.

4.0 Intermediate Inspection

4.1 Field Works

The dam inspection was carried out by Geraldine Cosset, a Dam Engineer at AECOM on the 12th of November 2020. The field works comprised a walkover of the dam crest, downstream shoulder, downstream toe and the spillway. The upstream shoulder was assessed from the crest. Groundwater level in monitoring wells (BH-1 and BH-6) and estimation of the reservoir water level were carried out. Photographs of the site were also taken and are presented in Appendix A.

4.2 Observations

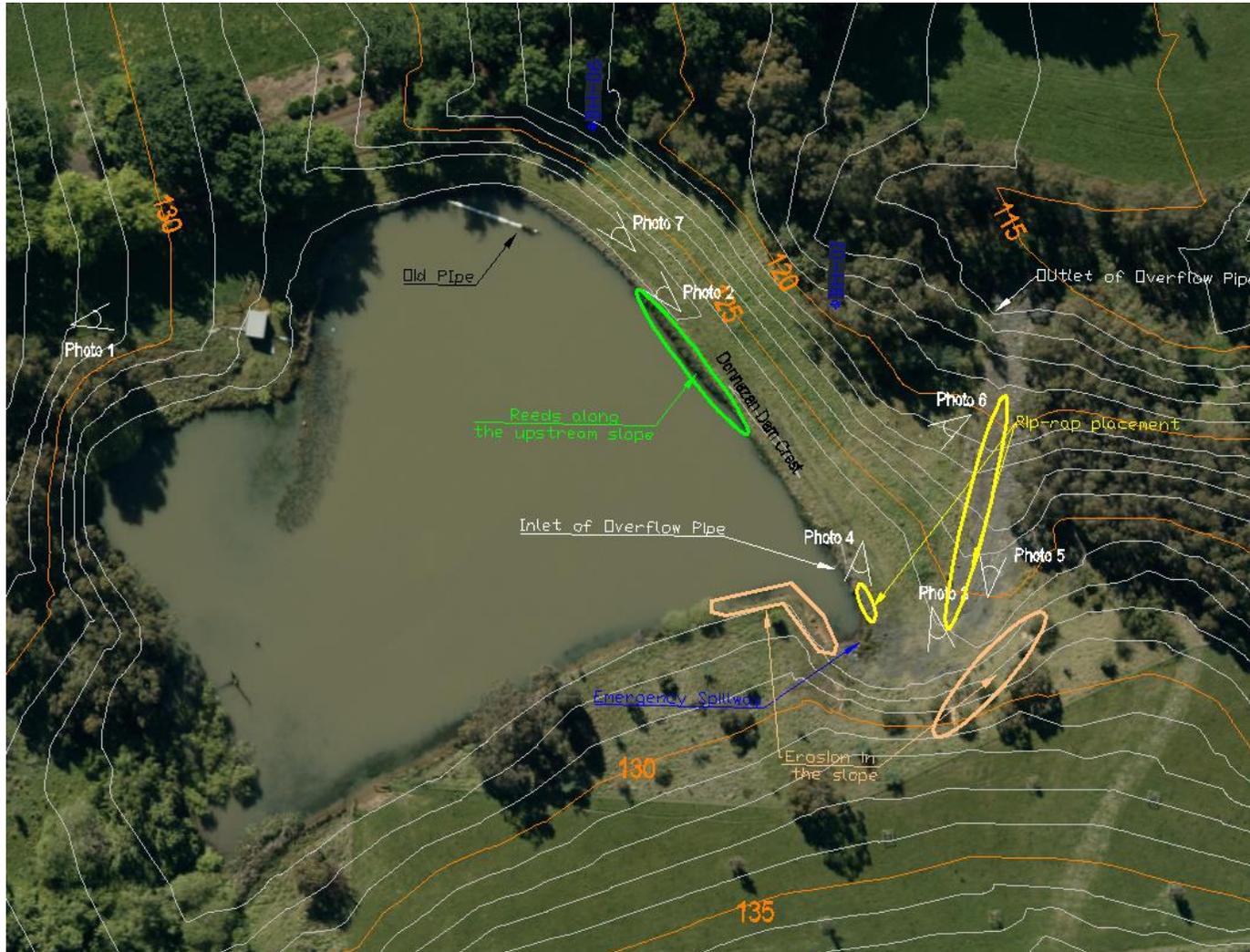
Figure 1 shows the general site layout of Donazzan's Dam and identifies its main components. The site survey shown on the figure was carried out on October 12, 2020. Figure 1 also shows the location of the two monitoring wells (BH-1 and BH-6) measured during the inspection and the location of seven (7) photos taken during the 2020 Inspection. These photos are presented in Appendix A and are compared to photos taken in the 2015 Coffey Intermediate Inspection at the same location.

Photo A-1 is a general view of the Donazzan's Dam taking from the south end. It shows the vegetation has ground along the perimeter of the water reservoir. At the left hand of the photo we see the old inlet pipe that has been left in place to serve as a bird perch.

Appendix B present a plan view of the 2020 survey and three cross-section of the Donazzan's Dam and one longitudinal section of the spillway comparing the 2015 survey and the 2020 survey.

The following sections summarise the main observations made for each dam component.

Figure 1 General Plan View of the Donazzan's Dam



4.2.1 Crest of the Dam

During the AECOM 2020 inspection, the Quarry Manager indicated us that they had backfilled the wheels ruts in the dam crest that were identified during previous inspection. These works were observed during the inspection and the Dam crest shows less sign of wheels ruts as seen when comparing Photos A-2a and A-2b respectively taken in 2015 and 2020.

Figure A-3 shows the presence of reed along the upstream edge of the embankment, limited in area and consistent with the 2015 inspection.

4.2.2 Upstream crest and shoulder of the dam

Beaching, comprising 50 to 150mm diameter crushed rock, is present along the south-eastern edge of the dam, to reduce erosion of the embankment due to wave action. Photo A-4a and A-4b show the beaching condition in 2015 and 2020 respectively, and we note that it is in good condition.

We have noted, and it was confirmed by the quarry manager, that additional beaching material has been placed on the upstream slope of the dam over an extent of about 20 m starting at mouth of the emergency spillway as shown in Figure A-5 in Appendix A.

4.2.3 Spillway

During the AECOM 2020 inspection, erosion of the upstream reservoir banks within the natural hillslopes close to the spillway inlet has been noted. This was also noted in previous inspection. Photo A-6a and A-6b taken in 2015 and 2020 respectively show that erosion has continued in the past year with increase areas of sandy beaches. Photo A-7a and A-7b show that erosion also occurs in the slope upstream of the spillway. Vegetation has been implemented in these areas to help minimise erosion in the slope.

Additional rip-rap was placed within the emergency spillway extent following a flood event that occurred in 2019 and washed away an important part of the rip-rap (see Photo A-8a and A-8b).

We recommend that the erosion of the spillway channel and side walls be monitored following each spill event and major rainfall events.

4.2.4 Downstream slope and toe of the dam

Vegetation and tall grass are present in the downstream slope and at the toe of the Dam which makes it harder to identify movements of material and seepage areas in the slope and at the toe of the dam. During the site inspection no abnormalities were identified. It was noted that planting of vegetation is carried out at the toe of the dam close to the spillway. No toe drain is present at the Donazzan's Dam. Photo A-9a and A-9b taken in 2015 and 2020 respectively show the downstream toe.

We recommend that any trees/shrubs growing on the embankment or within the spillway chute to be removed. No trees or shrubs should be planted on the embankment.

4.3 Groundwater levels and Dam Water Level

Groundwater levels were measured in the monitoring wells BH-1 and BH-6 located at the toe of the dam. The water level in the reservoir was also assessed based on measurement from the crest of the Dam. The 2020 water levels and historical levels are given in Table 2 and shown in Figure 2.

Monitoring of the water level once every five year does not allow for a lot of interpretation. It can be noted that according to these few measures the water level and reservoir level do not fluctuate a lot and the fluctuation seems to indicate that there is a small response in the downstream piezometer levels and the reservoir level however without rainfall data, this cannot be confirmed..

Stability analysis were carried out in 2015 (Coffey, 2015) for a water level in the reservoir at RL 126.5 m and an assumed groundwater level within the embankment which resulted in a Factor of Safety of 1.57.

No standpipes within the embankment are available to measure the groundwater table within the embankment and compare to the groundwater levels assumed in the 2015 stability assessment however we make the following observations:

- The pond water level estimated during the 2020 inspection is at RL 126.2m which is lower than the level assumed in the stability analysis; and.
- The groundwater elevation measured in BH1 at the toe of the dam is approximately 0.65 m below ground level which is lower than that used in the stability analysis.

Therefore, the assumptions for groundwater level at the toe of the embankment and reservoir level used in the 2015 stability assessment remain valid. Note that no review of the geotechnical model/parameters used in the stability analysis has been completed as part of this review.

We recommend, the installation of a survey staff gauge with elevation marks every 0.1 m to help determine more precisely the water level in the reservoir. This water level is a critical input parameter to carry-out stability assessment and would allow to rapidly confirm that the water level is kept below the recommended full supply level.

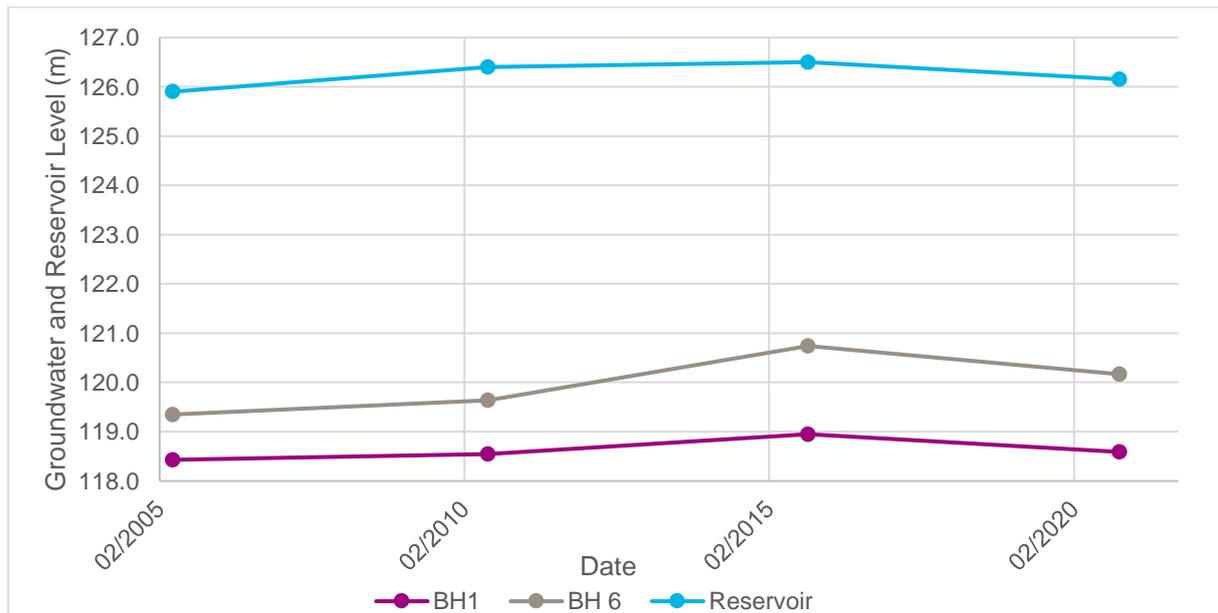
Table 2 Water levels measured in the reservoir, BH-1 and BH-6 at the Donazzan;s Dam

Date	8-May-05 ¹	6-Jul-10 ¹	6-Oct-15 ¹	12-Nov-20 ²
BH-1	118.4	118.6	119.0	118.6
BH-6	119.4	119.6	120.7	120.2
Reservoir WL	125.9	126.4	126.5	126.2

1 Taken from the Coffey (2015) Inspection Report.

2 Considering the Dam crest is at RL 127.4m.

Figure 2 Fluctuation of the Water level in BH-1 and BH-6 and the reservoir water level



5.0 Update of the plan view and cross-sections

An aerial survey of the dam was carried on October 12, 2020 and the layout plan was updated. Cross-sections of the Donazzan's Dam and longitudinal section of the emergency spillway showing the 2015 survey and the October 2020 survey were prepared and are shown in Appendix B.

The cross-sections show that:

- Differences are noted in the toe area but they are probably partly due to the presence of vegetation and trees. There is a lot of vegetation present on the dam which may be the cause of some of the survey differences.
- Dam Cross-section B indicates that the crest is lower than in 2015, and the crest elevation is inconsistent along the crest with the lowest point at about RL 127.0 m. The plan-view also indicates that the western part of the dam is below RL 127.0m. In the initial design, the crest elevation was at RL 127.4 m and was used to determine the FSL (1m below the crest elevation). It would be important to confirm the current elevation of the crest and review the FSL accordingly. We recommend that the crest elevation is built up to be made consistent along the length of the crest at RL 127.4 m to maintain the design freeboard allowance.
- Dam Cross-section C shows modifications have been made to the crest of the dam with reduction in width to approximately about 5 m wide.
- The longitudinal section of the emergency spillway confirms that it has been backfilled with riprap material in the slope and at the mouth of the spillway.
- The survey provided should be updated with the following and the drawing in Appendix B updated to include:
 - the location of the existing standpipe piezometers
 - Extent of riprap within the spillway
 - The location of inlet and outlet pipes.

6.0 Conclusions and Recommendations

An intermediate Dam inspection was conducted at the Donazzan's Dam Site including:

- Walkover and inspection of the site.
- Estimation of water-level in the reservoir.
- Measurement of water levels in the monitoring wells BH-1 and BH-6.

An aerial survey was also carried out and plan-view and cross-sections of the Dam were prepared.

During the AECOM 2020 inspection, it was observed that the embankment is in generally good condition and maintenance works have been carried out. The following observations were made:

- Wheels ruts on the dam crest have been filled and the crest shows little sign of rutting.
- Beaching material has been placed in the upstream slope of the dam on a distance of about 20 m from the mouth of the spillway located at the south-west end of the dam .
- Rip-rap has been placed in the emergency spillway.

The updated plan-view and cross-sections indicate that:

- The crest is below RL 127.0m in the western part of the dam and has settled of about 300 mm to RL 127.0m in the area of the cross-section B. The initial design elevation of 127.4 m was used to determine the current FSL.

We recommend that:

- An initial assessment is completed and documented to support the assigned Consequence Category of the Donazzan's Dam.

- A survey staff gauge with elevation marks every 0.1 m be installed to measure more accurately the reservoir water level and that the monitoring of the reservoir water level be included in the monthly inspection.
- Land surveying of the dam crest be carried out to determine its current elevation and reconstruct the crest to the design crest elevation as required to maintain the design freeboard.
- Survey of the existing standpipe piezometers (BH-1 and BH-6), the extent of the rip-rap in the spillway, the location and elevation of the outlet pipe and location of the inlet pipe be carried out.
- The erosion of the spillway channel and side walls be monitored following each spill event and major rainfall events.
- Any trees/shrubs growing on the embankment or within the spillway chute be removed.

7.0 References

Australian National Committee on Large Dams (ANCOLD), 2012 Guidelines on the Consequence Categories for Dams, October 2012.

Australian National Committee on Large Dams (ANCOLD), 2012 Guidelines on Dam Safety Management, August 2003.

Coffey Geotechnics Pty Ltd, 2015 Proposal for Geotechnical Assessment, Donazzan's Dam, Mt Shamrock Road, Pakenham, Report No. GEOTABTF05709AD-AA, 25 August 2015.

Coffey Geotechnics Pty Ltd, 2011 Stability Assessment Clarification Letter, Dated 7 September 2011.

Coffey Geotechnics Pty Ltd, 2010 Dam Stability Assessment, Donazzan's Dam, Pakenham, Report No. GEOTABTF05709AB-AC, 25 August 2010.

Holcim (Australia), Pty, Ltd., 2015 Pakenham Quarry – Environmental Management Plan, August 2015

Appendix A

Inspection Photos



a) 2015 – General View of Donazzan's Dam
(Coffey, 2015)



b) 2020 – General View of Donazzan's Dam



a) 2015 – Wheels Ruts in the Crest Dam



b) 2020 – Crest Dam





a) 2015 – Beaching in the Downstream Slope
(Coffey, 2015)



b) 2020 – Beaching in the Downstream Slope





a) 2015 – Erosion of the Banks (Coffey, 2015)



b) 2020 – Erosion of the Banks



a) 2015 – Erosion in the Slope Upstream of the Spillway (Coffey, 2015)



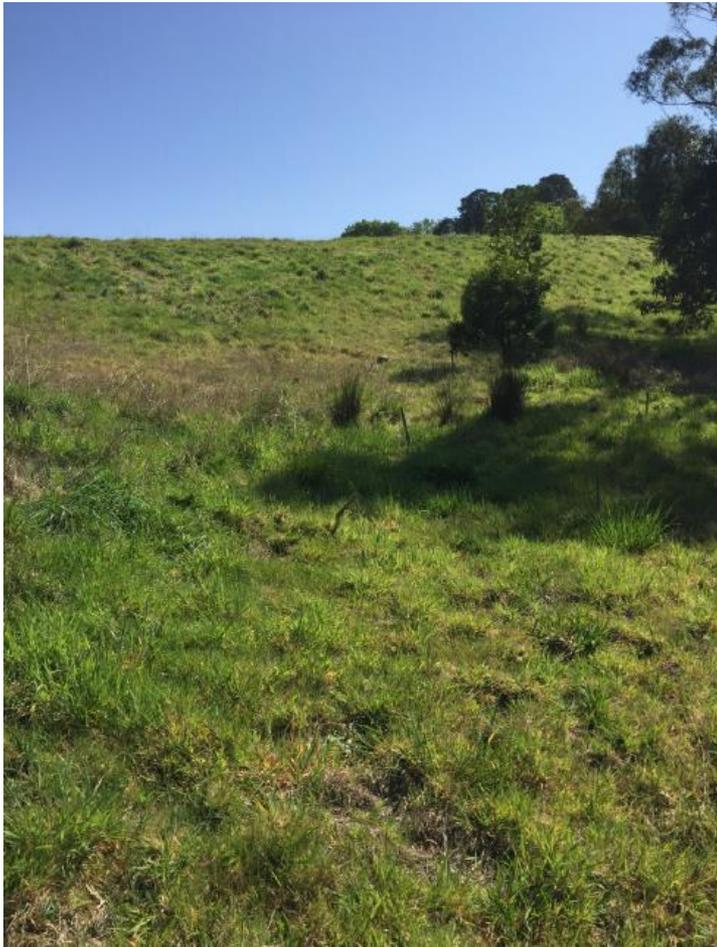
b) 2020 – Erosion in the Slope Upstream of the Spillway



a) 2015 – Emergency Spillway (Coffey, 2015)



b) 2020 – Emergency Spillway



a) 2015 – downstream slope view from the toe (Coffey (2015))

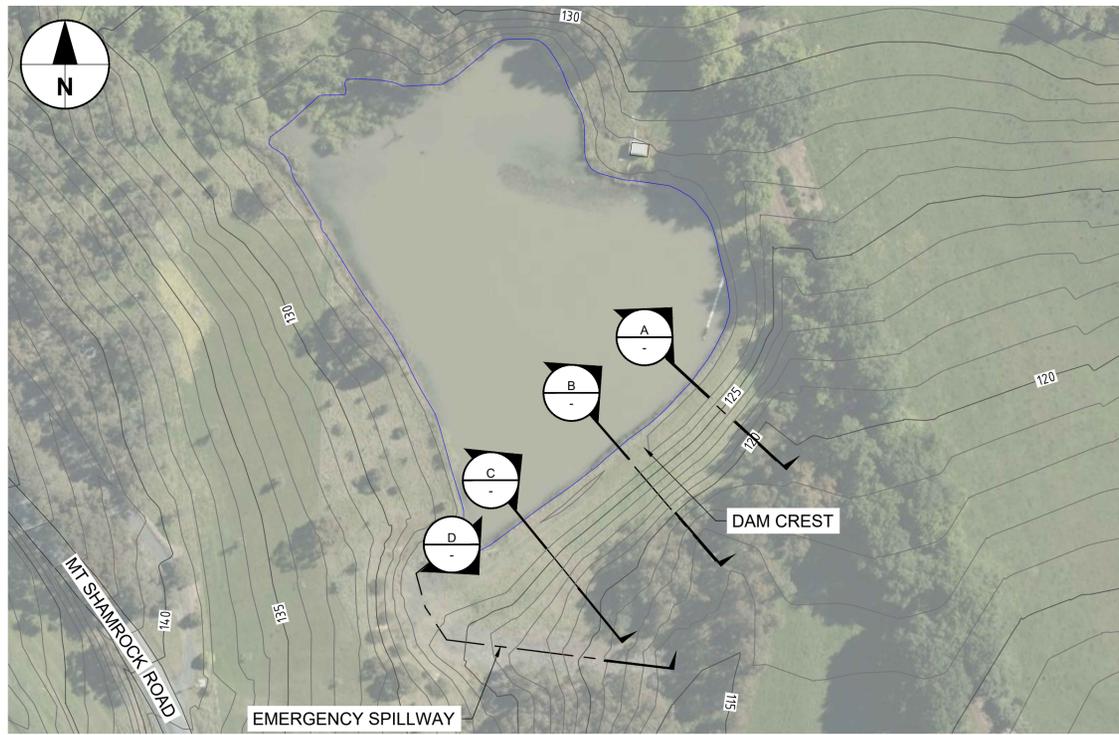


b) 2020 – downstream slope view from the toe

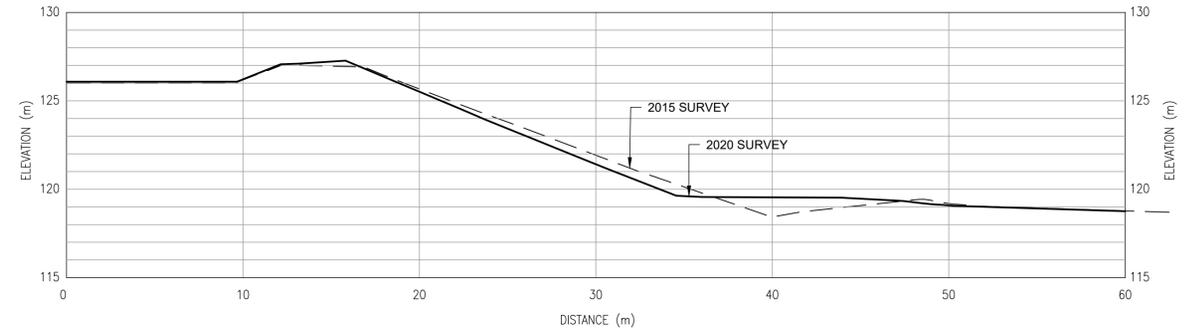
AECOM Imagine it. Delivered.	Client : Holcim Pty Ltd	Project : Donnazan's Dam Intermediate Inspection
	Photo A - 9 : Downstream Slope View from the Toe	

Appendix B

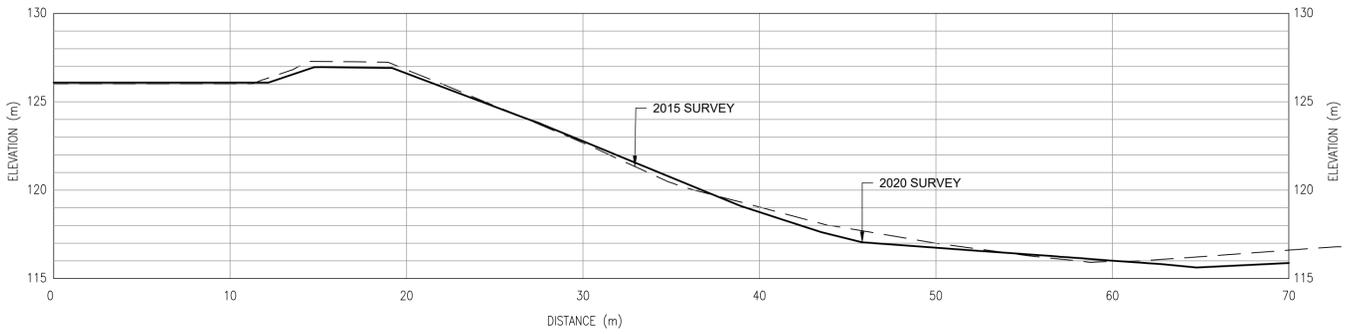
Layout Plan and Typical
Cross-sections of the
Dam



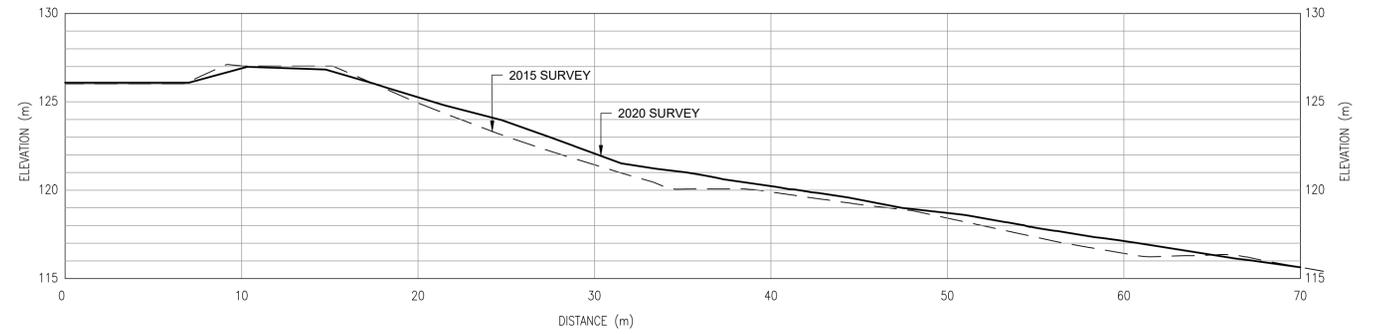
PLAN
Scale 1:1000



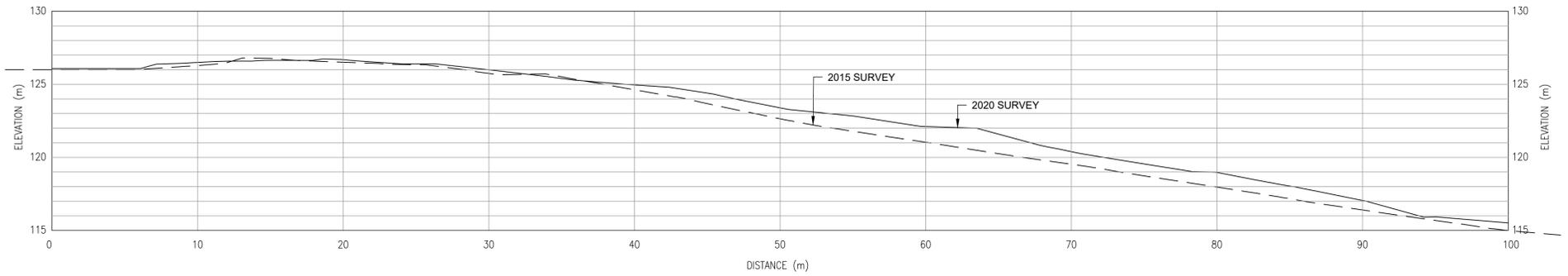
A | DAM CROSS-SECTION
SCALE 1:200



B | DAM CROSS-SECTION
SCALE 1:200



C | DAM CROSS-SECTION
SCALE 1:200



D | EMERGENCY SPILLWAY LONGITUDINAL SECTION
SCALE 1:200

This drawing is confidential and shall only be used for the purpose of this project. The signing of this title block confirms the design and drafting of this project have been prepared and checked in accordance with the AECOM quality assurance system to ISO 9001-2000.



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PROJECT
HOLCIM PAKENHAM
DONAZZAN DAM
2020 INTERMEDIATE
INSPECTION

CLIENT



REGISTRATION

PROJECT MANAGEMENT INITIALS

ISSUE/REVISION

PROJECT NUMBER

DESIGNER	CHECKED	APPROVED
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60451395

PROJECT DATA

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SHEET TITLE

DATUM	SURVEY
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DONAZZAN DAM

PLAN & SECTIONS

I/R	DATE	DESCRIPTION

SHEET NUMBER

SK-001

