



Forestry England

LOWER CANNOP RESERVOIR

**REPORT ON AN INSPECTION UNDER SECTION 10(2) OF THE
RESERVOIRS ACT 1975**

Final

May 2021



Inspecting Engineer
Dr A K Hughes
Dams & Reservoirs Ltd
Hall Farm
Church Lane
North Clifton
Newark
Notts
NG23 7AP

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[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
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[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
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[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
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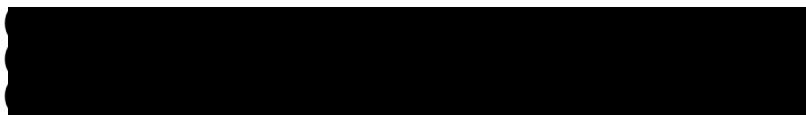
1. NAME AND SITUATION OF RESERVOIR

The reservoir is known as **LOWER CANNOP POND**, situated about 3 km east of Coleford in the Royal Forest of Dean, Gloucestershire.

National Grid Reference SO 608 101 lies within the site.

2. NAME AND ADDRESS OF ENGINEER MAKING THE REPORT

Dr A K Hughes BSc PhD DMS CEng FICE FCIWEM MIMgt
Dams & Reservoirs Ltd
Hall Farm
Church Lane
North Clifton
Newark
Notts
NG23 7AP



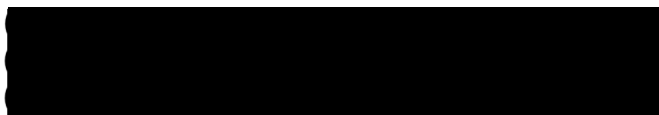
3. PANEL OF WHICH THE ENGINEER IS A MEMBER

All Reservoirs Panel (appointed to the Panel until 31 May 2021).

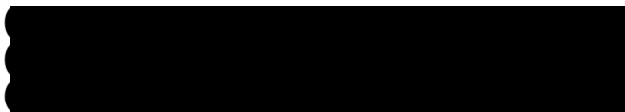
4. NAME AND ADDRESS OF OWNER AND/OR UNDERTAKER

Forestry England	<u>Local office</u>	Forestry England
620 Bristol Business Park		Bank House
Cold Harbour Lane		Bank Street
Bristol		Coleford
BS16 1EJ		Glos
		GL16 8BA

Contacts:



and

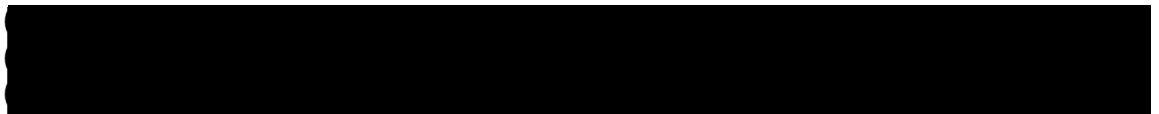


5. NAME AND ADDRESS OF ENFORCEMENT AUTHORITY

Environment Agency
Manley House
Kestrel Way
Sowton Industrial Estate
EXETER
EX2 7LQ

6. DATE OF INSPECTION

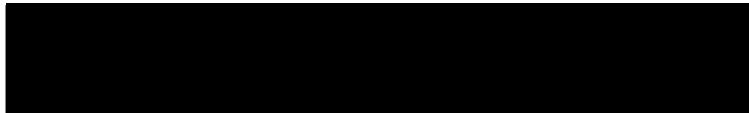
18th March 2021.



7. NAME AND ADDRESS OF SUPERVISING ENGINEER



Stillwater Associates Limited
Alma House – Suite 3
Alma Road
Reigate
Surrey
RH2 0AX



8. CERTIFICATES, REPORTS OF PREVIOUS INSPECTIONS AND OTHER ITEMS OF INFORMATION WHICH WERE PROVIDED TO THE ENGINEER

8.1 Certificates

- (1) Inspecting Engineers Certificate under Section 10(5) of the Reservoirs Act 1975 by Dr A K Hughes dated 6th August 2015.

8.2 Reports

- (1) Inspecting Engineer's Report under Section 10(2) of the Reservoirs Act 1975 by Dr A K Hughes dated 6th August 2015.

8.3 Supervising Engineers Statements

- (1) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 30th April 2015.
- (2) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 25th October 2016.

- (3) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 7th November 2017.
- (4) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 21st June 2018.
- (5) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 12th March 2019.
- (6) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 31st March 2020.
- (7) Supervising Engineer's Statement under Section 12 of the Reservoirs Act 1975 by [REDACTED] dated 31st March 2021.

8.4 Other Information including Drawings

- (1) Prescribed Form of Record Relating to the Reservoir
- (2) Location Plan

9. GENERAL DESCRIPTION

9.1 Description of Reservoir

The reservoir is retained by an earthfill and rockfill embankment with a maximum height of 7 metres and a length of approximately 70 metres, although the length is not well defined.

The reservoir has a capacity of 72,000 cubic metres and a surface area of approximately 22,500 square metres when full to its top water level of approximately 60 metres AOD.

The date of construction is unknown but it likely to be pre-1850 and built for the coal mining and quarrying industries.

9.2 Geology of the Site

In the area of the ponds there are a series of geological faults running north to south which are responsible for the valley and the brook location.

There are Coal Measures in the area and an adit is said to be located for coal workings south of the stone works and running west into the hillside. Cannop Pond is situated on the western side of the Forest of Dean Coalfield.

The solid geology consists of the Pennant and Supra Pennant Group of the Upper Coal Measures. These carboniferous strata are in part, overlain by Head and Alluvium of the Quaternary Age.

The Pennant Group consists dominantly of sandstones, which are often thickly to very thickly bedded, occasional mudstones (shales) and three coal seams of workable thickness. The Supra-Pennant Group consists mainly of mudstones with ranging proportions of sandstones and at least eight workable coal seams. The subdivision is arbitrary, being placed at the base of the Brazilly Coal Seam. The coal seams are of good quality coal, the lower seams being of 'steam' coal but the Churchway and higher seams being dominantly of household coals.

The geological structure of the Cannop Pond area is complicated. Generally, the beds dip eastwards at varying dips up to about 20°. The Cannop Valley however, follows a major structural disturbance belt - the Cannop Fault Belt. This disturbance comprises up to 25 faults. Individual faults have only small down throws, - up to 15 metres. Cannop Pond sits on the alluvial deposits which rest on the Head. The head is predominantly a surface disturbed material which has formed on the slopes and valley bottom.

Three boreholes were drilled in the last 20 years; one to the left of the spillway and two to the right. The holes were 11.8 metres, 9.7 metres and 6.5 metres deep. A void was found in borehole 1 to the left of the spillway and timber discovered. This could have been a timber culvert feeding the leat off the left abutment.

9.3 Catchment

The lower reservoir has a catchment of 14.8 square kilometres.

The catchment is completely forested with no urban development. It is said that a considerable proportion of the inflow to the reservoir comes from a spring in old coal workings or perhaps drainage from old workings.

The average annual rainfall is quoted as 900 mm.

9.4 Dam Details

There are no drawings or construction details of the dam.

There is a short length of embankment with a masonry overflow at the left abutment. For most of the length of 70 metres the upstream shoulder is fill but the downstream shoulder is built up and is the site of a stone works.

The reservoir dams the flow of the Cannop Brook. Upstream of Lower Cannop Pond is Upper Cannop Pond. The upper reservoir has acted as a settling pond to the brook and the lower reservoir.

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

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[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

9.9 Instrumentation

There is no instrumentation on or in the embankment.

9.10 Method of Recording Water Levels

Water levels are recorded by direct measurement onto the overflow weir.

[REDACTED]

[REDACTED]

[REDACTED]

9.12 Valley Downstream of the Dam

The valley runs in a southerly direction through Parkend.

10. GENERAL DESCRIPTION OF THE INSPECTION MADE AND THE CONDITIONS FOUND

10.1 General

I inspected the site on 18th March 2021. I was accompanied by [REDACTED]

[REDACTED]

The weather at the time of inspection was fine, dry and mild and in the preceding two weeks had been changeable with showers.

The water level at the time of the inspection was such that sandbags were placed across the overflow to allow inspection of the base of the channel. Generation was taking place 'using' some of the inflow. There therefore was no spill.

10.2 Catchment

The catchment was seen to be undulating in character and devoted almost exclusively to the forest of the Forest of Dean.

10.3 Dam

The upstream face general has a satisfactory line and level but does support several mature trees particularly on the water's edge. There are also a few small trees near the spillway and on the downstream face. The mature trees have been cut back well. **I recommend mature trees continue to be managed so that they do not become too big or out of balance. I recommend that all small saplings, brambles and trees be removed.** Large slabs of sandstone have been placed at the water's edge to prevent erosion and provide fishing platforms and seem to be in a satisfactory condition. **I recommend any erosion around the fishing platforms be repaired as and when necessary.**

The crest of the dam is used for turning, as a track and as a car park. It is also a footpath and used by fishermen from time to time and mountain bikers. As a result the crest becomes rather rough and potholed at times, and there is little grass cover. However, it is extremely wide and the stone works forms a significant buttress to the dam on the downstream side. **I recommend potholes on the crest are filled from time to time.**

The visible part of the downstream face is very limited in extent. The stone cutting yard forms a significant buttress. There is a small section of embankment to the left of the overflow - this was seen to be in a good condition with good line and level as is the right-hand side of the overflow, although a track has been formed down the slope and good grass cover and the hydro penstock pipeline and chambers is formed to the right of the spillway.

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

10.5 Valve Shaft and Tunnel

There is no valve shaft or tunnel.

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]



10.9 Instrumentation

There is no instrumentation on or in the dam.

10.10 Method of Recording Water Levels

Water levels are recorded by direct measurement off the concrete sill or weir that forms the crest of the overflow.

I recommend that water levels be recorded at monthly intervals and at the time of the Supervising Engineer's visit.





10.14 Area Downstream of the Dam

The valley downstream of the dam runs parallel to the B4234 before entering Parkend where the stream is channelled through the village. The gradient of the valley is low and the valley comparatively wide.

[REDACTED]

11. ADEQUACY AND CONDITION OF WASTE WEIR AND OVERFLOW AND CHANNELS IN CONNECTION THEREWITH

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

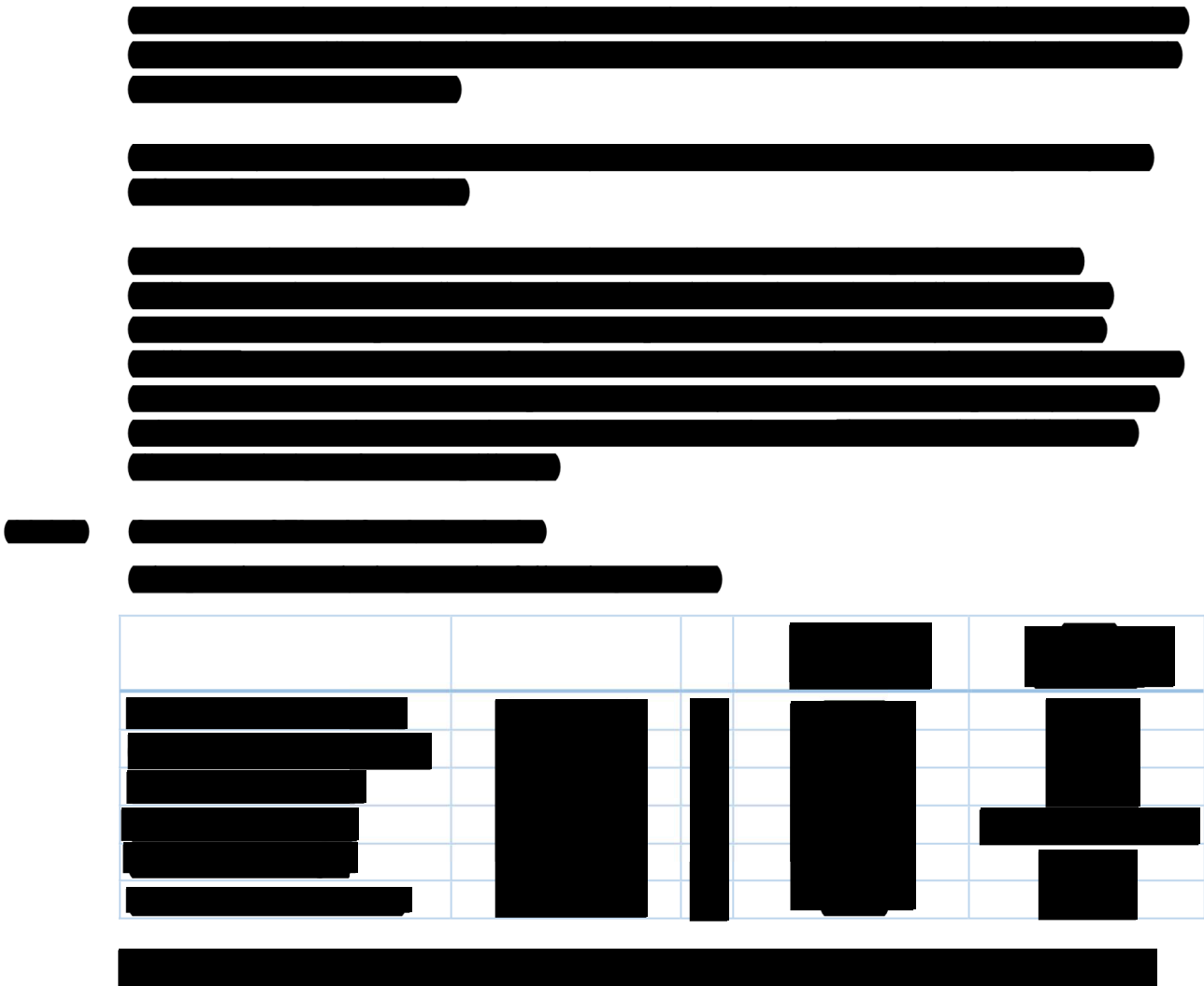
[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



11.2 Alterations to Overflow Sill

There appear to have been some alterations to the overflow sill since the time of the last inspection with an 'illegal' raising carried out by concreting stones onto the weir. Stones have been added to raise the water level by some 100-150 mm.

Remedial works have been carried out in the past in the area adjacent to the weir on the right-hand side and the left wall seems to have been rebuilt.

I recommend the stones which have been placed on the overflow be removed and the original top water level restored.

11.3 Any Alteration in Level to which the Water may be Stored

I consider that the water may continue to be stored up to the formal top water level.

12. SEISMIC RISK

Consideration of the publication ‘An Engineering Guide to Seismic Risk to Dams in the United Kingdom’ published by BRE in 1991 results in the dam being placed in Category I based on the following classification factors:-

Capacity Classification Factor	0
Height Classification Factor	0
Evacuation Requirements Classification Factor	2
Potential Downstream Damage Classification Factor	<u>2</u>
Total Classification Factor	<u>4</u>

The dam lies within Zone B; a zone with a moderate chance of local earthquakes, but larger events are rare. The Guide states that under this classification “it may be sufficient to examine the embankment and any ancillary works for any feature which would be particularly susceptible to damage by earthquake seismic analysis would only be undertaken where such an initial appraisal defines features which are a serious cause for concern”.

The risk of an escape of water is likely only to be associated with sufficient deformation of the downstream slope and I do not consider that any significant deformation would occur. I am also mindful of the comments in Section 7.10 of the guide where it notes *It is unlikely that earthquakes will cause major damage to well built dams on stable foundations in Britain. International experience has indicated that virtually any well built embankment dam can withstand moderate earthquake shaking with peak accelerations up to 0.2g with no detrimental effects. The probability of the occurrence of an earthquake of significantly greater severity at any UK dam is relatively low* I consider that the dam is in a good condition on the basis of obvious visual evidence and the monitoring records, and I do not consider that the seismic risks are sufficient to pose a significant risk to the dam.

I do not consider a seismic safety evaluation is required at this time.

13. SUPERVISION PROVIDED BY THE OWNER/UNDERTAKER

The site is heavily frequented by the public and fishermen as well as by the staff from the stone cutting yard. Ad hoc visits are made by Forestry staff. I believe a formal supervision system should be instigated. **I recommend that Forestry England staff should visit the dam to check its condition at least once a month.**

The Supervising Engineer visits the site once a year.

I will then consider the level of the supervision to be acceptable.

14. CORRECTNESS OF PARTICULARS IN THE PRESCRIBED FORM OF RECORD REQUIRED TO BE KEPT UNDER SECTION 11 OF THE ACT

I did not examine the Prescribed Form of Record relating to the reservoir on this occasion but I was informed by the SE that it is in a satisfactory condition.

I have the following comments on the various parts of the Form as follows:

- | | |
|---------|--|
| Part 1 | I recommend water levels are recorded at monthly intervals and at time of floods (>150 mm over weir) |
| Part 2 | No comment. |
| Part 3 | Amendments are required as a result of this inspection. |
| Part 4 | No comment |
| Part 5 | No comment |
| Part 6 | No comment |
| Part 7 | No comment. |
| Part 8 | No comment. |
| Part 9 | No comment. |
| Part 10 | No comment |
| Part 11 | No comment |
| Part 12 | Additions are required as a result of this inspection. |
| Part 13 | No comment |
| Part 14 | No comment |
| Part 15 | No comment |

Part 16 No comment

15. EMERGENCY PLANNING

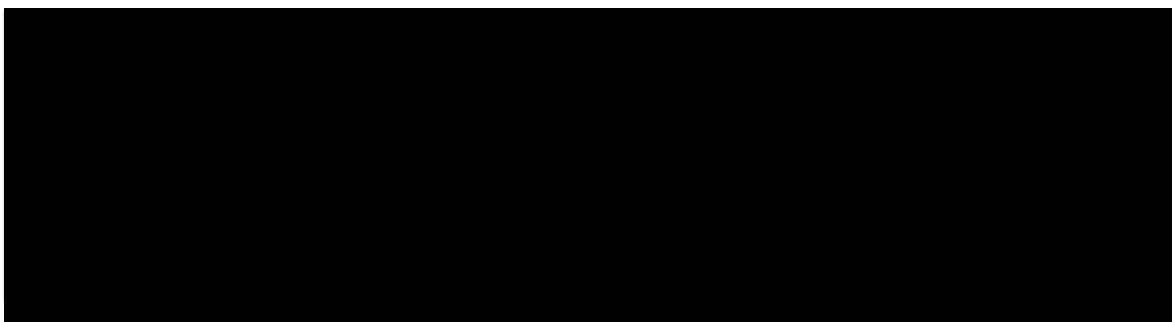
An emergency/pumping plan has been written.

16. FINDINGS AND RECOMMENDATIONS OF THE ENGINEER

16.1 Findings

My findings as a result of the inspection are that:-

- (i) the dam falls within Category C as defined by the publication *Floods & Reservoir Safety (fourth edition)*;
- (ii) the dam falls within Category I as defined by the publication *An Engineering Guide to Seismic Risk to Dams in the United Kingdom* and the *Application Note*;
- (iii) the reservoir/dam is adequately maintained and generally is in a satisfactory condition;



- (vii) no movement of the surrounding land has been noted which might affect the stability of the reservoir;
- (viii) the Undertakers are complying with their obligations under Section 11 of the Act.
- (ix) I have reviewed the previous report and can confirm that any previous recommendations in the interests of safety have been carried out or are no longer required.

16.3 Recommendations as to Measures to be taken under Section 10(3)(b) of the Act (Maintenance).

(These recommendations are enforceable by the Enforcement Authority but do not require Supervision by a Qualified Civil Engineer within the Meaning of the Act)

I recommend that:-

- (i) the trees on the left-hand side of the approach to the weir be lopped and/or trimmed.
- (ii) the area at the end of the left hand approach wall be repaired.
- (iii) the large tree near to the left-hand wall be removed.

I recommend these works are carried out within 2 years of the date of this report.

16.4 Other Recommendations, as to Measures to be taken in Respect of Maintenance

(These recommendations are not enforceable by the Enforcement Authority and do not require Supervision by a Qualified Civil Engineer within the Meaning of the Act)

I recommend that:-

- (i) mature trees continue to be managed so that they do not become too big or out of balance.
- (ii) all small saplings, brambles and trees be removed.
- (iii) any erosion around the fishing platforms be repaired as and when necessary.
- (iv) potholes on the crest are filled from time to time.
- (v) in the short term the joints in the spillway floor be sealed.
- (vi) any trees closer than 1 metre to the wall be removed.
- (vii) periodic pointing of the walls of the spillway be undertaken as and when necessary [REDACTED]

16.5 Measures Recommended in the Interests of Improving Monitoring and Supervision under Section 11 of the Act

I recommend that:

- (i) the penstocks on the hydro system be operated fully against reservoir head at least once a year and a record kept of their operation.
- (ii) any flow at the base of the spillway be watched for signs of increased or turbid flow.
- (iii) water levels be recorded at monthly intervals and at the time of the Supervising Engineer's visit.
- (iv) Forestry England staff should visit the dam to check its condition at least once a month.

16.6 Recommendations in the Matters of Safety Relating to Personnel/Public

None.

The comments with respect to Health and Safety relate only to those elements of Health and Safety associated with the owner and his staff and any other individuals associated with the safety of the dam. They relate only to issues noted during the inspection and should not be considered to be exhaustive or complete. The comments in no way relate to issues associated with others and in particular members of the general public or those using facilities at or visitors to the site.

16.7 Matters to be watched by the Supervising Engineer in accordance with Section 10(4) of the Act

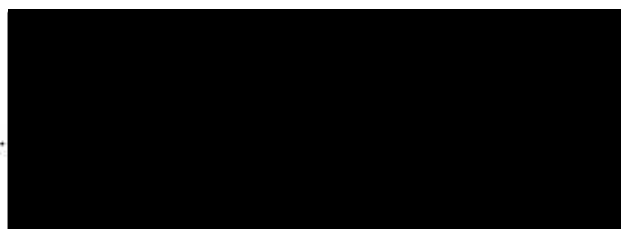
I recommend that the Supervising Engineer visits the site at least once a year and pays attention to any leakage, seepage or settlement and in particular ensures that:-

- (i) the Prescribed Form of Record is complete.
- (ii) any flows at the toe are watched.
- (iii) the spillway and approach is kept free of debris.
- (iv) watches for signs of settlement.
- (v) watches for signs of leakage.
- (vi) watches for signs of damage to the overflow.

16.8 Recommendations as to the Date of the Next Inspection

The next inspection by an Inspecting Engineer under Section 10(2) of the Act should be undertaken within 5 years of this inspection, i.e. before 18th March 2026.

Dated this 7th day of May 2021



This inspection report results from a visual inspection of the reservoir's condition on the date of the inspection. No liability can be accepted in respect of any defects not visually apparent or that arise subsequent to the date of the visit. It is important that the Undertaker or their agents, reports as soon as possible any change in the condition of the reservoir to the Supervising Engineer.

Appointment to All Reservoirs Panel until 31 May 2021.

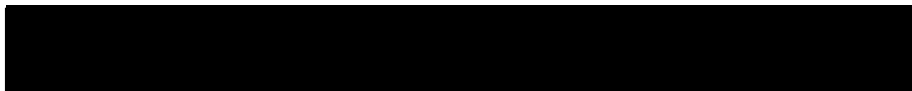
APPENDIX A

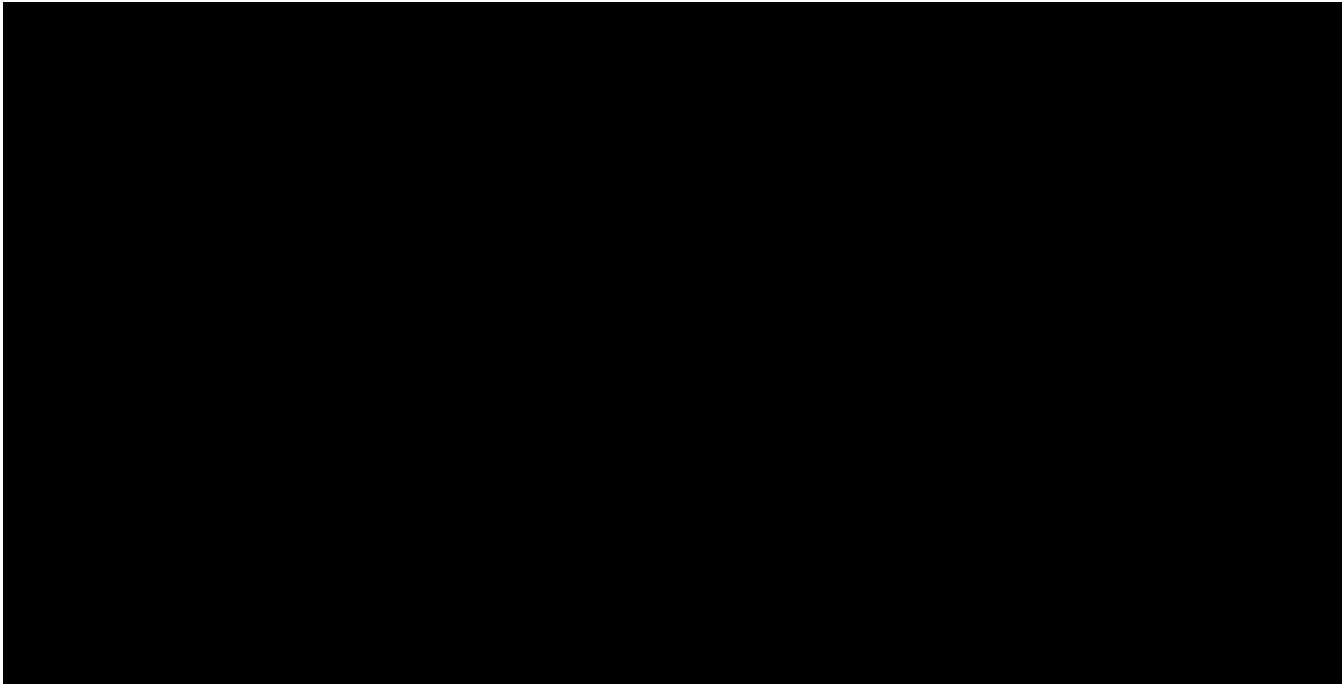


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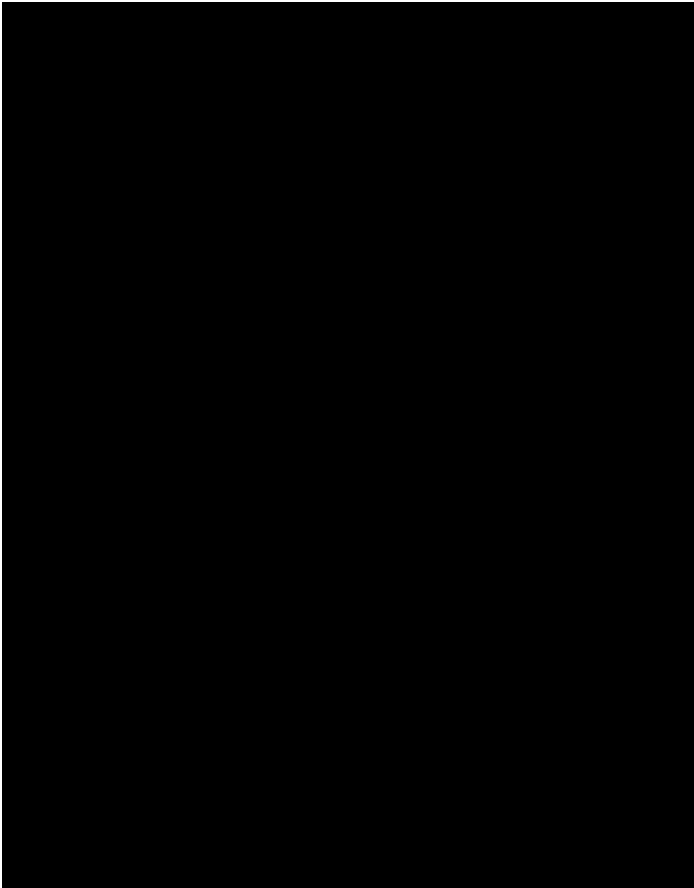
APPENDIX B





APPENDIX C

Photographs



Crest



Hydro intake



Upstream face

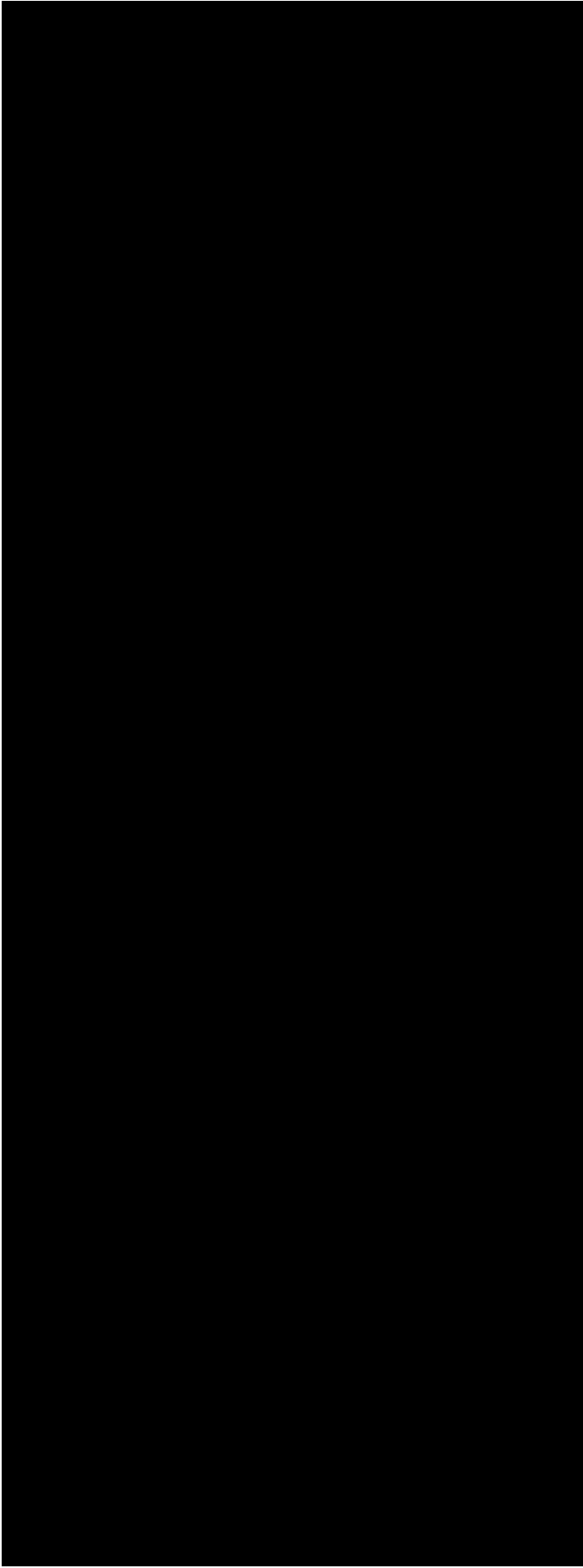


Screen on overflow



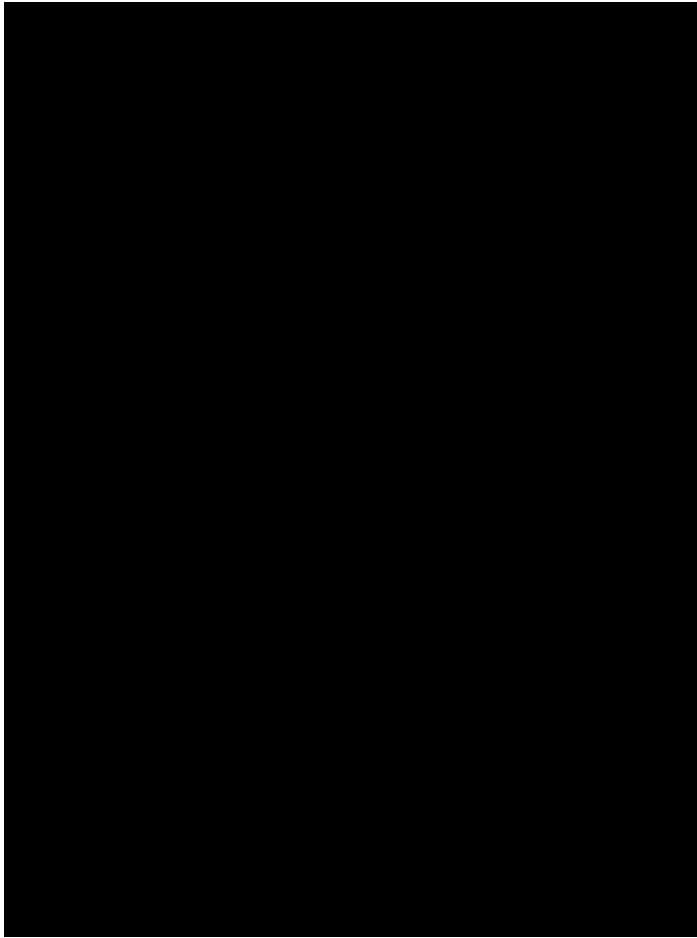


Undermining – upstream left side









End of spillway



Left wall



Right wall



Upstream face



Crest



Upstream face