

REPORT OF AN INSPECTION MADE UNDER SECTION 10
OF THE RESERVOIR ACT 1975

Williestruther Reservoir



Prepared for

Scottish Borders Council

October 2015



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LEFT HEADER

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Document History

Report Title: Williestruther Reservoir - Report of an Inspection made under Section 10 of the Reservoirs Act 1975

Client: Scottish Borders Council

This document has been issued and amended as follows:

Version	Date	Description
1.0	12/10/2015	Issue to Client

DISCLAIMER

This document has been prepared by J G Penman (“the Inspecting Engineer” on behalf of CH2M HILL (“CH2M”), solely for the Scottish Borders Council (“ the Client”). No liability is accepted for any use of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

This document has been prepared on the basis of a visual inspection of the relevant structures by the Inspecting Engineer, a review of data supplied to the Inspecting Engineer by the Client and discussion between the Inspecting Engineer and the Client. No liability is accepted in relation to any defects which were not visually apparent on the date of inspection or which become apparent subsequent to the inspection, or in respect of information which was not brought to the attention of the Inspecting Engineer by the Client at the time of the inspection or prior to the date of this document.

General

1.1 Name and Situation of Reservoir

Williestruther Reservoir is situated about 3km south of Hawick in the Scottish Borders at National Grid Reference NT 492115.

1.2 Name and address of Engineer making the Report

James G Penman
CH2M HILL
Burderop Park
Swindon
Wiltshire
SN4 0QD
Tel: 01793 816482
Email: james.penman@ch2m.com

1.3 Panel of which the Engineer is a member and expiry date of appointment

All Reservoirs Panel. Appointment valid to 8th February 2020.

1.4 Name and address of Undertaker

Scottish Borders Council
Technical Services Department
Newton St Boswells
Melrose
TD6 0SA

1.5 Name and address of Enforcement Authority

Scottish Borders Council
Technical Services
Newton St Boswells
Melrose
TD6 0SA

1.6 Date of Inspection

The inspection was carried out on 11th August 2015. I was accompanied by:

Frank Scott – Scottish Borders Council
John Walker – CH2M – Supervising Engineer
Alan McGowan – CH2M

1.7 Name and address of Supervising Engineer

Mr John Walker
CH2M HILL
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Glasgow
G31 3AU

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Expiry date of panel appointment: 31st December 2016

Certificate, reports and previous inspections and other items of information which were provided to the Engineer

2.1 Reports and certificates

The previous reports and certificates which were made available are summarised below:

- Section 10(3) Inspection Report by Mr P William, January 2006

There were no recommendations of measures to be taken in the interests of safety detailed in the 2006 Inspection Report.

2.2 Prescribed Form of Record

This was presented for review. A commentary on the Prescribed Form of Record is provided in Section 6.1.

2.3 Supervising Engineer's Statements

The following statements were presented for review:

- Statement by Supervising Engineer under Section 12(2) of the Act by John Walker – March 2014

2.4 Other Information

Other information provided was as follows:

- Technical Note – Williestruther Flood Routing, Halcrow July 2003

General Description

3.1 Reservoir

Williestruther Reservoir is an impounding reservoir on a tributary of the Slitrig Water.

The reservoir characteristics as detailed in the Prescribed Form of Record are:

Top water level (TWL)	206.35mAOD
Capacity at TWL	111,400m ³
Surface area at TWL	52,000m ²

The fetch as shown on OS Landranger Sheet 79 is 550m. This disagrees with Part 7 of the Prescribed Form of Record. The OS Map agrees with Google Earth imagery and is considered to be correct.

3.2 Geology

The geological survey of Great Britain mapping shows Williestruther Reservoir to lie on the Gala Group of the Llandovery series of Greywackes, shales flags and grits.

3.3 Catchment

The reservoir has a natural catchment of 1.89km² lying to the south west of the dam. The catchment comprises upland rolling grassland.

3.4 Dam details

The dam is an earth embankment about 45m long which is curved upstream in plan.

The downstream face is at a gradient of about 1v:2h. The crest is 5m wide and incorporates a 2.5m wide surface road. There is a wire fence along the upstream side of the road.

The upstream face incorporates a masonry wall which extends to 250mm above top water level. The wall is topped with stone sets which are tied together with iron staples. The wall is understood to be about 1.6m high. Above the wall the upstream face is at a gradient of 1v:2.5h and is protected by stone pitching. The slope below the masonry wall is reported to be at a gradient of 1v:3h.

The dam is understood to have been constructed in the early 19th century. Construction details are unknown.

3.5 Details of modifications, remedial works and history

At an unknown date the capacity of the spillway was increased by adding a 750mm dia pipe through the embankment crest.

The crest of the embankment has been raised since the last Section 10 Inspection as part of road resurfacing works.

3.6 Spillway

The spillway is at the right abutment of the dam and comprises a number of pipes passing through the embankment crest. There are twin 375mm diameter precast concrete pipes and a single 750mm diameter precast concrete pipe all with a common invert level of 206.35mAOD.

There is a short, tapering section of insitu concrete culvert at the inlet to the 750mm pipe. The 375mm pipes have a concrete headwalls with short wingwalls.

All three pipes have a nominal fall and discharge through a common outlet structure leading into an unlined channel which connects back to the stream bed in the base of the valley.

3.7 Bottom Outlet

The bottom outlet comprises a 225mm dia pipe passing beneath the embankment on the line of the original stream bed. Details of the upstream end are unknown. The outlet is controlled by a 225mm diameter in-line valve located in a chamber at the downstream toe of the embankment. 8m downstream of the valve chamber there is a second chamber which acts as an energy dissipater on the outlet. The connection from the valve chamber enters the chamber at low level. A separate 450mm pipe acts as an overflow to the chamber and itself discharges through a small outlet structure to the stream bed downstream.

3.8 Instrumentation

There is no formal instrumentation on this reservoir. Level surveys are undertaken on the crest to check for settlement

3.9 Method of recording water levels

Water levels are recorded at a gauge board located on the masonry wall near to the centre of the upstream face of the embankment.

3.10 Access

The reservoir is located immediately adjacent to an unclassified road and there is a tarmac roadway along the crest of the embankment. There is good access to the dam crest, but none to the downstream toe.

3.11 Valley downstream of the dam

The valley downstream of the dam is relatively narrow and flows in a north easterly direction to pass under the B6399 and join the Slitrig Water. There is a single house in the floodplain of the Slitrig water adjacent to the stream from Williestruther.

Condition of the Reservoir

4.1 General

The reservoir was inspected on 12th August 2015. The weather was warm and sunny with a light breeze. The reservoir level was 20mm above top water level.

4.2 Catchment

The catchment is predominately open, undulating farmland. There do not appear to have been any changes to the catchment in recent times.

4.3 Dam

The dam is generally in good condition and is being well maintained. There are no indications of instability or settlement.

The upper part of the upstream face is now fully covered by grass which has grown up through the stone pitching (see photo 1). The grass is being cut three times per year and has good grass cover. The grass will be helping to stabilise the stone pitching.

The masonry wall at top water level is in good condition with no indications of movement. Some of the iron staples tying the capping stones have corroded but this does not appear to have affected the stability of the wall. There is no vegetation growing within the masonry

The downstream face was fully accessible but quite overgrown with this season's growth of grass and wild flowers (see photo 4). It is recommended that the downstream face should be maintained in the same condition as the grassed portion of the upstream face ie cut three times per year.

The crest road is in good condition (see photo 3).

An overhead electricity cable runs along the crest of the dam. One of the posts is leaning slightly (see photo 4) but this is understood to be unchanged in recent years and is not considered to be an indication of instability.

A new car park has recently been constructed on the natural ground at the right end of the dam (see photo 4). This provides access to a footpath around the reservoir.

4.4 Spillway

The spillway and outlet channel are in satisfactory condition. The pipes were all discharging freely with no blockages (see photo 7).

The outlet channel is unlined but appears stable with no indications of ongoing erosion (see photo 9).

The baffle boards in front of the spillway have been partially dislodged and should be reinstated (see photo 6).

4.5 Bottom outlet

The bottom outlet was tested on the day of the visit. The valve operated freely and the outlet was seen to discharge to the stream. The flow was initially very silty, but cleared significantly over a ten minute period. Both chambers and their covers are in good condition.

The valve chamber was full of water to a level 1120mm below cover level. This is understood to be usual and is considered to be a reflection of the groundwater level in the adjacent area. Because the chamber was flooded it was impossible to inspect the valve. It would be worthwhile to arrange for the chamber

to be pumped out at the time of the next Statutory Inspection. The water level was unchanged when the valve was opened which demonstrates that there is no leakage from the valve.

4.6 Settlement and movement

Embankment crest levels are reported in the Supervising Engineer's Annual Statement. Levels are taken at 15m intervals along the tarmac section of the embankment crest.

No significant settlement was recorded between 2012 and 2014. The road was resurfaced in March 2011 which resulted in some low spots being raised by up to 250mm.

The lowest point on the crest is currently at an elevation of 208.32mAOD

4.7 Instrumentation

There is no instrumentation at the dam.

4.8 Method of recording water levels

Water levels are recorded from a gauge board mounted on the masonry wall on the upstream face of the dam. The gauge is surrounded by a baffle to limit the effects of wave action. The numbers on the gauge board have been partially scoured off and are now difficult to read. It is recommended that the gauge board is replaced.

4.9 Access for maintenance and emergency

There is good access along the crest of the dam. The outlet works could potentially be accessed by way of the fields adjacent to the downstream toe.

4.10 Movement of surrounding land which might affect the stability of the reservoir

There is no evidence of any instability in the land surrounding the reservoir.

4.11 Area downstream of the dam

The area downstream of the dam was found to be unchanged from that shown of the latest Ordnance Survey mapping.

Engineer's Findings

5.1 Adequacy of the spillway

5.1.1 Categorisation

The previous Inspecting Engineer placed the dam in Category C as set out in "Floods and Reservoir Safety, 3rd Edition" on the basis of the low risk to people and property downstream. I endorse the categorisation.

Since the last inspection "Floods and Reservoir Safety" has been updated to the 4th edition. This revision introduced new concepts of a Design Flood and a Safety Check Flood. The revised guidance also recommends that wave freeboard should be determined on the basis of *overtopping discharge* rather than a wave run-up allowance.

In accordance with "Floods and Reservoir Safety" 4th edition the appropriate assessment floods for a Category C reservoir are:

Design Flood	150 year flood
Safety Check Flood	1000 year flood

In the Design Flood event there should be no overtopping. This is defined as an overtopping discharge of less than 0.001l/s/m. For Category C dams there is also a minimum freeboard requirement of 0.4m in the Design Flood.

In the Safety Check Flood some overtopping is permitted. For Williestruther Reservoir a maximum allowable overtopping discharge of 0.1l/s/m is considered to be appropriate

5.1.2 Flood studies

Previous flood studies report the peak inflow for the 1000 year flood as 5.82m³/s. The reported peak outflow is 1.74m³/s with an associated Stillwater reservoir level of 207.68mAOD. These values have been checked by the "Rapid Method" detailed in Floods and Reservoir Safety and found to be credible.

No details of the 150 year flood are provided.

5.1.3 Freeboard

Flood routing and wave overtopping discharges have been calculated in accordance with Floods and Reservoir Safety, 4th edition. The minimum Embankment crest level is 208.32mAOD. The findings of the analysis are summarised below:

Flood	Max Stillwater reservoir level (mAOD)	Wave freeboard provided (m)	Estimated overtopping discharge ¹ (l/s/m)	Max tolerable overtopping discharge (l/s/m)	Wave freeboard required (m)	Min acceptable crest level (mAOD)	Margin from lowest existing crest level (m)
Design (150 yr)	207.33	0.99	<0.001	0.001	0.98	208.31	0.01
Safety Check (1,000 yr)	207.68	0.64	0.07	0.10	0.61	208.29	0.03

Note 1. In mean annual hourly maximum wind

The above analysis demonstrates that the freeboard is currently just adequate. It will be important to ensure that a minimum crest level of 208.32m is maintained.

5.2 Adequacy of the dam

The slopes of the inner and outer faces are both 1v:2.5h. These slopes are not unusual for this type of dam and there are no indications of instability. The stability of the dam is considered to be acceptable.

5.3 Adequacy under seismic loading

The seismic safety of the dam has been assessed using the recommended criteria given in the 1991 BRE publication "An Engineering Guide to the Seismic Risk to Dams in the UK" and the more recently published "Application Note" to the guide published in 1998.

From an examination of the surrounding area and the information provided in the guide, the risk classification may be derived as follows:

		Classification Factor
Capacity	0.11Mm ³	2
Height of dam	<15m	0
Evacuation requirements	1-100	4
Potential downstream damage (Low)		4
Total		10
Dam Category (Table 3)		II
Level of safety evaluation		E _b

Table N5 of the Application Note indicates that for Category II dams it is necessary to look for features particularly vulnerable to earthquake damage and undertake seismic analysis only if such features are found. There are no features which are particularly vulnerable to earthquake damage at Williestruther so no seismic assessment is considered to be necessary.

5.4 Efficiency of means of lowering and controlling inflows to the reservoir

The estimated capacity of the outlet at top water level is 0.15m³/s.

With a reservoir surface area of 52,000m² this would achieve an initial drawdown rate of 0.25m per day which is considered to be adequate for a Category C reservoir.

New guidance on drawdown rates is due to be published shortly and the drawdown rate should be reviewed in the context of the new guidance at the time of the next Section 10 Inspection.

Supervision provided by the Undertaker

6.1 Correctness of the particulars in the Prescribed Form of Record

The Prescribed Form of Record was reviewed and found to be complete and up to date. Water level readings are being entered at weekly intervals. The following points were noted:

Part 3 - Include details of this inspection

Part 7 – Correct the Fetch from 230m to 550m

6.2 Frequency of surveillance by the Undertaker

The reservoir is understood to be visited weekly by the Undertaker. This regime is considered to be satisfactory.

Recommendations

7.1 Statement in relation to previous measures to be taken in the interests of safety

There were no recommendations of measures in the interests of safety in the previous Section 10 report.

The report does however state that a 0.52m high wave wall was constructed along the full length of the dam crest after the last inspection. This appears to be an error. There is no wave wall but the freeboard was nevertheless increased by raising the road level.

7.2 Measures to be taken in the interests of safety under Section 10(6) of the Act

The following measures are recommended:

- none

7.3 Other measures recommended to be taken

The following measures are recommended:

- the gauge board should be replaced
- repair the baffle at the spillway inlet

7.4 Other matters of maintenance and safety of personnel/public

The following measures are recommended:

- maintain the existing practice for cutting the grass on the upstream face of the embankment
- cut the grass on the downstream face of the embankment three time per year (as for the upstream face),
- operate the outlet valve at intervals of no more than 6 months

7.5 Directions in respect of records under Section 11 of the Act

7.5.1 Water Level

The water level in the reservoir should continue to be recorded at weekly intervals.

7.5.2 Crest Level Survey

The embankment crest should be resurveyed prior to the next Section 10 inspection.

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

The Supervising Engineer should visit the dam at least once per year. In addition to the normal requirements of an embankment dam, the Supervising Engineer should take special note of the following:

- any indication of deterioration of the outlet pipe bearing in mind that the pipe is normally pressurised and that failure of the pipe could lead to erosion of the embankment fill

7.7 Date of the next inspection under Section 10

The next Inspection by an Inspecting Engineer under Section 10 (2) of the Act should be undertaken within ten years of this inspection, ie before 11th August 2025.

SECTION 8

Signature of Inspecting Engineer and date of report

James G Penman

12th October 2015

Expiry of 5-year panel appointment 8th February 2020

Appendix A Photographs



Photo 1 – Upstream face of embankment viewed from right abutment



Photo 2 – Upstream face of embankment viewed from left abutment



Photo 3 – Embankment crest

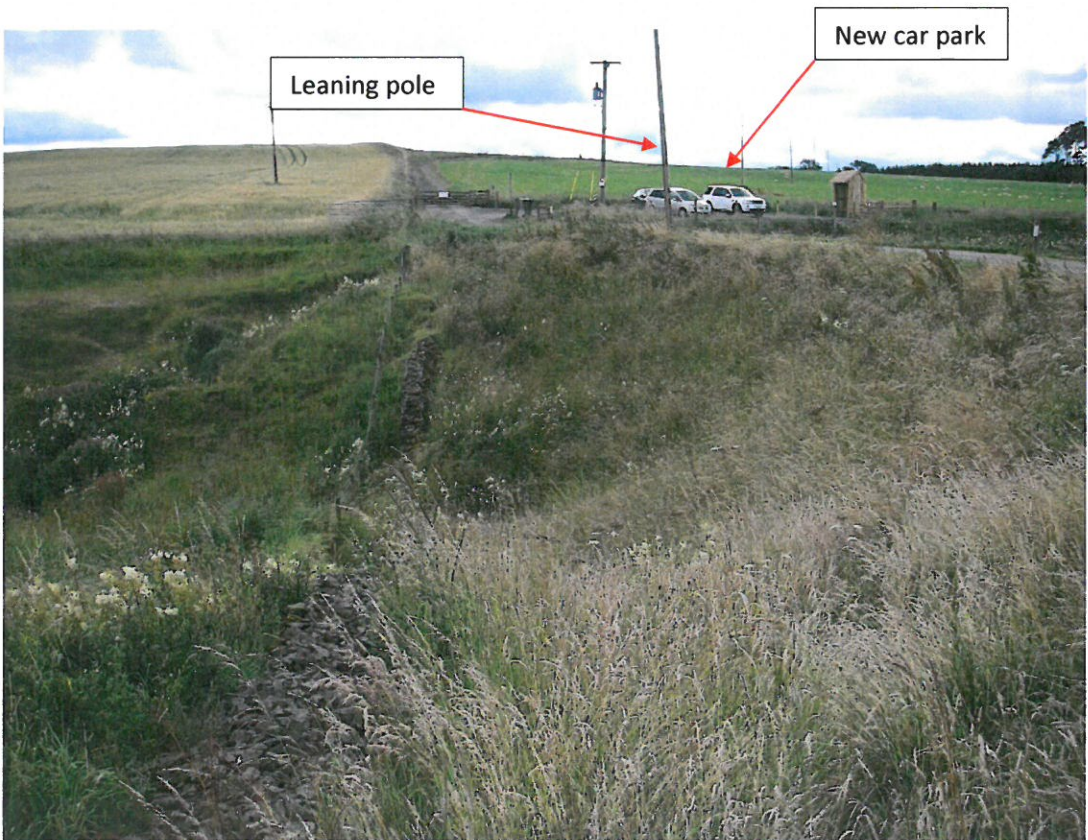


Photo 4 -Downstream face of embankment viewed from right abutment



Photo 5 - Downstream face of embankment viewed from right flank



Photo 6 – Spillway inlet showing damaged baffle board



Photo 7 – Internal arrangement of 750mm dia outlet pipe (looking downstream)



Photo 8 – Outfall from spillway pipes



Photo 9 – Spillway channel between outlet from pipes and stream bed



Photo 10 – Manhole on scour valve



Photo11 – Outlet discharging at full capacity



Photo 12 – Gauge board



Photo 13 – Valley downstream of dam

Appendix B
Section 10(5) Certificate

RESERVOIRS ACT 1975

INSPECTING ENGINEER'S CERTIFICATE UNDER SECTION 10(5)

I, James Guthrie Penman of Burderop Park, Swindon, Wiltshire, being a member of the All Reservoir Panel, appointed by Scottish Borders Council to carry out an inspection of the reservoir known as williestruther Reservoir situated at National Grid Reference NT 492 115, made a report of that inspection on 11 August 2015 which does not include recommendations as to measures to be taken in the interests of safety. That report includes a recommendation as to the time of the next inspection of the reservoir, which should be made within ten years ie no later than 11th August 2025.

Signature of Engineer

J G Penman CEng, MICE

Date: 12th October 2015

