Two Estates Project

The Clackmannanshire Field Studies Society [SCIO]

in partnership with

The Inner Forth Landscape Initiative

The Two Lades Project - The Gartmorn Lades

1890 - 2006

Supported by The National Lottery® through the Heritage Lottery Fund

heritage lottery fund

Project Team

Murray Dickie

Susan Mills

Eddie Stewart

© Heritage Lottery Fund and The Clackmannanshire Field Studies Society [SCIO], 2018.
Published and printed by The Clackmannanshire Field Studies Society [SCIO], 2018.

(Unless otherwise stated, the copyright of all photographs is held by CFSS.)

As most of the historical measurements were imperial, metric equivalents have been given.
Known sites have been given six or ten figure NS grid references.

Version 15-02-2018

Contents

1 Introduction:

The Clackmannanshire Field Studies Society obtained a National Lottery grant through the Heritage Lottery Fund, in partnership with the Inner Forth Landscape Initiative. The Society agreed to undertake a four year research project on aspects of the development of the Two Estates of Alloa and Clackmannan, with particular emphasis on the 18th and 19th centuries. The grant enabled local volunteers to be trained and supported to research a number of topics. The Two Lades Project involved identifying, surveying and recording the remains of the Craigrie and Gartmorn lades systems and adding any new historical evidence which was uncovered.

This report is the second part of the story of the Gartmorn Lades system, which was first constructed circa 1690 by John, 6th Earl of Mar as a small earthen dam across the western end of Gartmorn loch feeding a short lade taking water to a drainage engine at his pit at Holton. (1) He later extended the dam and increased its height (2) and, between 1712 and 1713, (3) built a new weir at Forestmill and a lade from Forestmill to the eastern end of Gartmorn loch to supply the loch with water from the River Black Devon. The Erskine family continued to maintain and extend the dam and the lades and built several innovative water powered drainage and winding engines. (4), (5) and (6)

In 1785 the simple earthen dam at Gartmorn was replaced by a 320 yards (293 metres) long, rough-hewn, stone-faced dam at a cost of several thousand pounds. (7) In 1825 the Alloa Collieries were leased to the Coal Company, a partnership of Robert Bald and Robert Jameson (the factor of the Alloa estate). (8) The Coal Company rebuilt Gartmorn dam in 1827 for £300 and started rebuilding the weir at Forestmill in June 1835. (9) The work on the weir was completed in the autumn of that year by the Alloa Coal Company, a partnership formed by William Mitchell, John Moubray, John Craich and David Ramsay. (10) The Alloa Coal Company managed the Gartmorn Dam and its associated lades until 1890, when the Erskine family sold it for £10,000 to Alloa Burgh. (11)

The first report details the development of the Gartmorn Lades and dam from 1690 until 1890. This second report picks up with the sale of the system to Alloa Burgh and its development until 2005, when the system was finally abandoned as a public water supply. (12)

2 Acknowledgments:

- Robert Dingwall, Fiona Graham, Margaret Schofield, Marilyn Scott, David Seaton, Eddie Stewart, Jenni Stewart, Cameron Tonge and Andrew Wood.
- The Clackmannanshire Field Studies Society Executive and Members for proposing and supporting the project;
- The Clackmannanshire Development Trust who provided encouragement, accommodation and supported research and training;
- The National Lottery, through the Heritage Lottery Fund, for their funding;
- The Inner Forth Landscape Initiative for management and training support;
- Local landowners and residents who have supported our survey work and provided us with local information;
- Ordnance Survey OpenData whose easily accessible maps provided us with a base set of locations;
- The National Library of Scotland whose on-line and library-based Ordnance Survey (OS) and geological maps provided the bulk of our locational data; their on-line tools and their staff, who were always knowledgeable and helpful;
- The National Records of Scotland whose amazing collection of family papers, plans and maps, on-line catalogue and supportive staff made our task so much easier and the many families, organisations and individuals who had safeguarded and made this material available;
- ScotlandsPeople and ScotlandsPlaces for their support and access to census and other related information;
- The Royal Commission on the Ancient and Historical Monuments of Scotland for their easily accessible and helpful databases;
- The University of St Andrews whose work on the Acts of the Scottish Parliament has made the documents easily accessible;
- The University of Edinburgh who has made the Statistical Accounts of the Parishes of Scotland available online in an easily used format;
- Google and Google Books who have made so much previously hard to access material freely available on the internet;
- Google Earth for their satellite imagery and powerful tools;
- British Newspaper Archive for a tremendous source of articles and adverts;
- Microsoft for the satellite imagery;
- Inkscape for their freely available, professional quality vector graphics software which was used to create maps and illustrations;
- AOC Archaeology for their training, survey and excavation support and the
- Clackmannanshire Council for their support with library work, information on Gartmorn Dam Country Park and photograph of the old high level filters;
- Not least, to my wife, for her patience, support and understanding.

3 The Alloa Water Act:

As the number of households and industries in Alloa increased through the second half of the 19th century, the demand for water began to threaten the capability of Gartmorn dam. In 1869 the Alloa Coal Company advised the Alloa Burgh Water Commissioners that the level of water in Gartmorn dam was falling so fast that *"the notice of the board should be turned to provide means for husbanding the supply."*(13) The following year it was reported that *"Gartmorn dam was in a very low state last week before the rain came on, and if the rain had not come on at that time, the town would have been without water altogether so far as the dam was concerned."*(14)

In 1879 the Burgh was charging water rates at 6d per 1,000 gallons up to 1,000,000 gallons, 5d per 1,000 gallons from 1,000,000 gallons up to 5,000,000 gallons and all use above 5,000,000 gallons at 3d per 1,000 gallons; giving some idea of the scale of consumption. [2.5 pence per 4,546 litres up to 4,546,000 litres, 2.4 pence per 4,546 litres from 4,546,000 litres up to 22,730,450 litres and all use above 522,730,450 litres at 1.2 pence per 4,546 litres]. The Burgh was already meeting half the cost of maintaining Gartmorn dam and the Water Commissioners were in discussion with Lord Mar and the Alloa Coal Company with a view to taking over control of the dam and lades. (15) Even when supplies were available there were complaints about a lack of water and low pressure from the residents of Greenfield and Claremont, whose properties were on the outskirts of the Burgh and at a height very close to that of the Jellyholm filters. (16) These discussions were encouraged by a severe summer drought in 1887 which threatened to cut off the supply of water to the town. (17)

In 1888 discussions centred around whether to look to Gartmorn for future water needs or to turn to the possibility of a new supply from Dollar Glen in the Ochil hills. Coal had been discovered under Gartmorn dam and the Jellyholm filters and there was considerable concern that future workings might undermine the dam and that the cost of acquiring Gartmorn dam might be prohibitively expensive. (18) An engineering survey of Dollar Glen was undertaken by Mr Reid of Messrs Leslie & Reid, Edinburgh. The option of a dam in the Ochils proved to be both impracticable and extremely expensive. It was calculated that it would cost £40,000 to £50,000 to get a supply of 500,000 gallons (22,730,450 litres) a day, which represented only half of the Burgh's requirements at that time.(19) In 1890 the Burgh began seeking permission through an Act of Parliament to assume control of the Gartmorn Dam and all its aqueducts.(20) and (21)

In 1891 the Water Commissioners agreed to pay Lord Mar £10,000 to compensate him for his coal under the Dam and the Jellyholm filters; for the Dam and aqueducts and also for all water rights and interests he may have there. The town became owners of the water rights which Lord Mar possessed in the river Black Devon, giving full right to take an agreed amount of water from the lade at Forestmill to Gartmorn Loch. Also included was the water power which supplied Forestmill and the thrashing mill, the aqueduct from Forestmill to Gartmorn Loch, all the rights and all the land submerged by the dam (l35 acres – 54.6 hectares), all the coal and minerals belonging Lord Mar and the whole of the lower aqueduct leading from Gartmorn to Keilarsbrae and the filters that supply Sauchie.

It also included the colliery pumping engine and the wheel at Keilarsbrae, together with all the pipes and equipment (which would transfer to the Burgh at the end the lease with the Alloa Coal Company in 1911). Lastly, it included the lands of Jellyholm where the existing filters were situated, together with minerals under 40 yards (36.58 metres) of land all round, which were necessary to protect the filters and keep them at their present level. (22)

Specific details were given of the bulk and compensation volumes required for existing users. Water supplies would continue to be made available from the Keilarsbrae filters to Sauchie, Holton and the Whins areas. Particular mention was made of colliery water-powered pumping engines and supplies for the steam engines at collieries and the engines at the port at Alloa. In every 24 hours a bulk supply of water was to be provided to the following premises at the rate of:-

Carsebridge Distillery	153,000 gallons (695,592 litres),
Keilarsbrae Spinning Mills	200,000 gallons (909218 litres) and some could be sent to Kilncraigs woollen mill,
Hallpark Woollen Mill	15,000 gallons (68,191 litres),
Gabberston Woollen Mills	15,000 gallons – 68,191 litres) and
Springfield Woollen Mills	15,000 gallons) – 68,191 litres)]. (23)

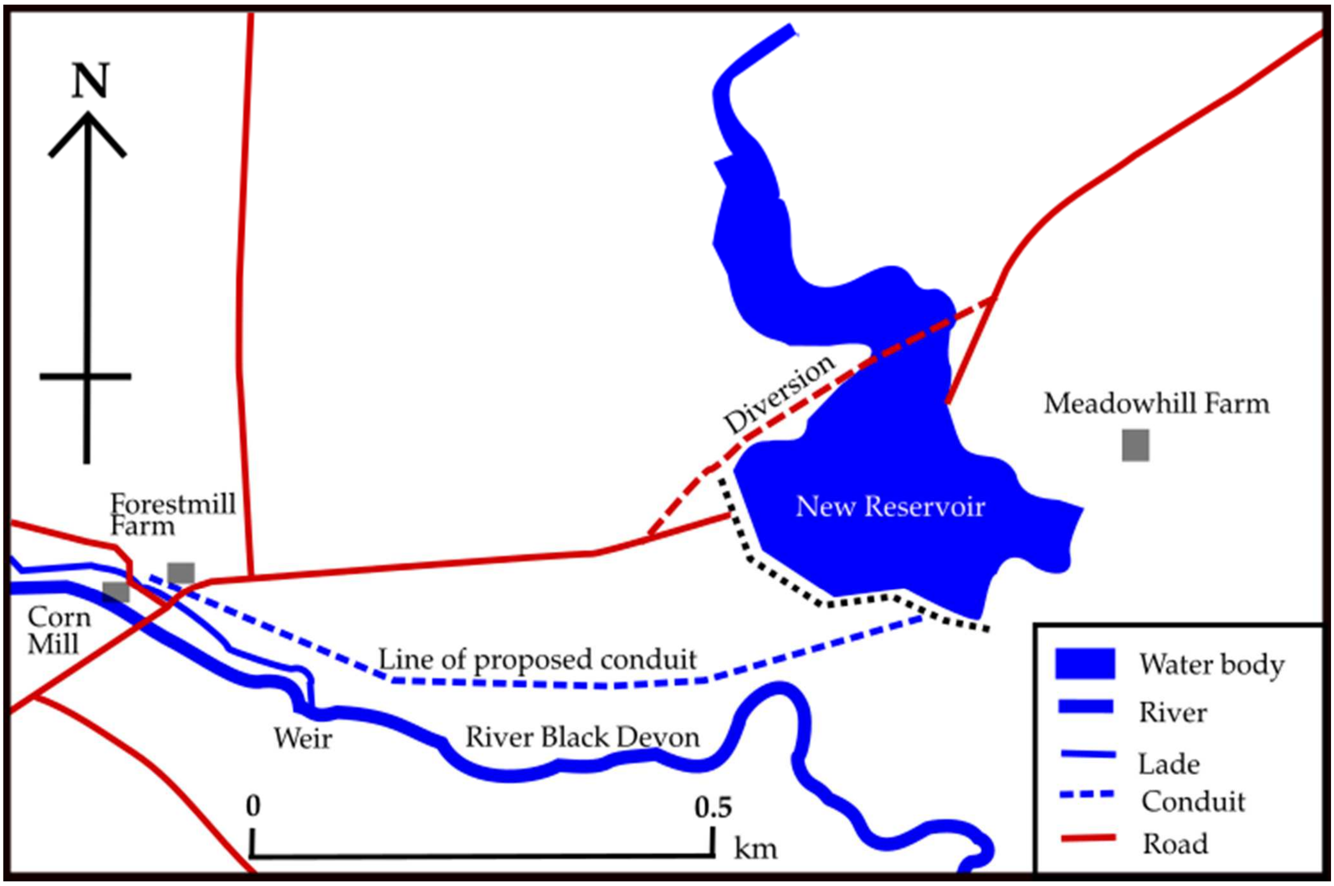
In addition, water from the lower section of the lade (from below the Watermill pit at Sauchie) was to be available to Carsebridge distillery at a rate of 4 million gallon (18.183.460 litres) every week from May to August and 8 million gallons (36,368,720 litres) in each working day in a continuous flow. The distillery was obliged to return any unused water into the Brothie burn. Together with supplies to other smaller factories, mines and steam engines it was calculated that the dam would supply about 1.4 million gallons (6,364,526 litres) per day to bulk and compensation users on top of 1.5 million gallons (6,819,135 litres) to domestic supply.

The Water Commissioners drew up plans for an Act of Parliament to allow them to manage the improvement of Gartmorn dam, weir, lades, filters and pipe works. The Alloa Water Act was first published in 1890 and the copy of the bound plans and statements gives a comprehensive view of the changes which were planned. (24)

4 Meadowhill reservoir:

The new scheme proposed by the Water Commissioners started with the proposed construction of an additional service reservoir upstream from Forestmill adjacent to Meadowhill farm to store extra water brought from higher up the River Black Devon. The proposed reservoir was to be located to the West of Meadowhill Farm.

Figure 1. Proposed new service reservoir.



Based on information from the Alloa Burgh Water Act, Bound Plans, 1890.

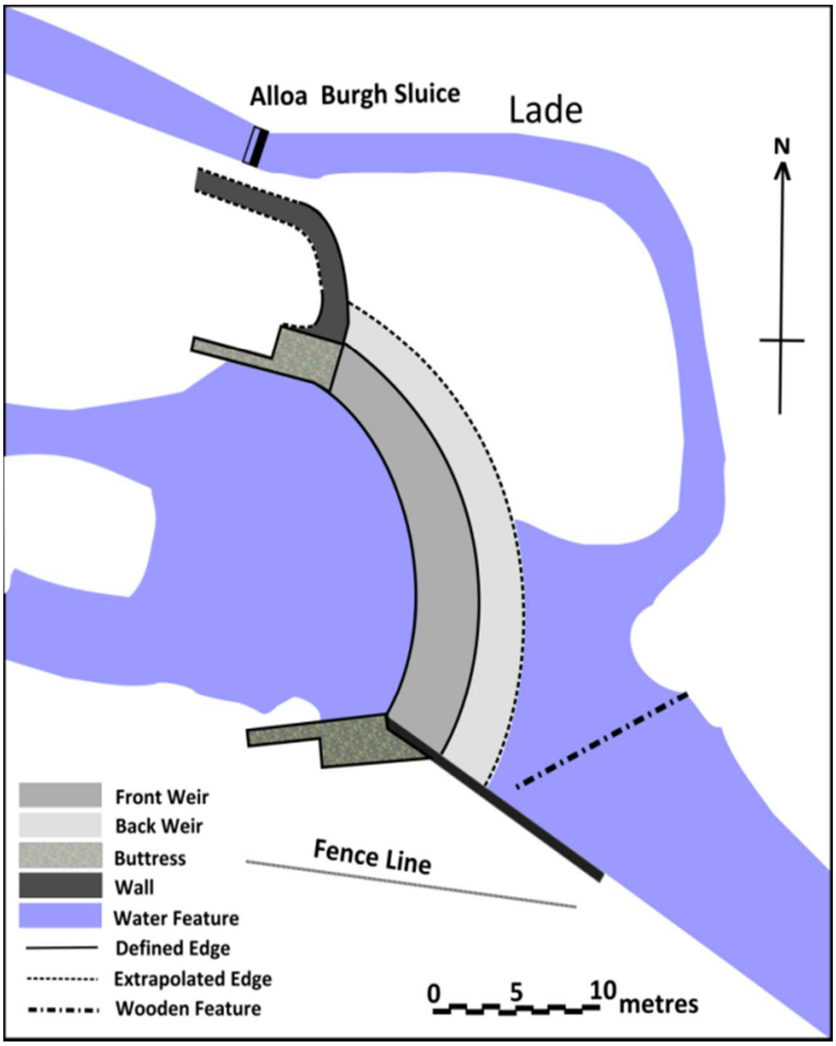
The reservoir was never built; apparently as a result of consideration of the relative costs (See Appendix 1) and an agreement with the Earl of Zetland to include his allocation for the Craigrie lade in exchange for a water supply from the Gartmorn Dam for the town of Clackmannan. The town of Clackmannan had been gifted a municipal water supply by the Earl of Zetland in 1867. (25) Water was taken from the river Black Devon through an 18 inch (45.7 cm) fire-clay pipe in the course of the former Craigrie lade. A hydraulic ram was located in the valley of the Goudnie burn at Riccarton and pumped water up to a 20,000 gallon (90,922 litres) covered storage tank next to Clackmannan Tower. In 1878 the hydraulic ram was replaced by a small turbine, which was more efficient, and a filter bed and an extra 20,000 gallon (90,922 litres) covered storage tank were added. (26) In 1893 the turbine which was used to pump the water to the storage tank at Clackmannan Tower was abandoned and the supply obtained from the 18 inch (45.7 cm) pipe which started from behind a sluice across the Forestmill lade just before it enters Gartmorn dam. This 18 inch (45.7 cm) fire-clay pipe carried water to a large circular settling pond, with filters alongside, to supply the higher levels of Alloa. The water sent to Clackmannan was taken off the 18 inch (45.7 cm) fire-clay pipe by means of a six inch (15.2 cm) iron pipe. [27] There had been much discussion in Alloa about conceding a water supply to Clackmannan, free of charge.

The Water Commissioners pointed out in 1893 that *"There has been a certain amount of surprise expressed that the Town of Alloa in prosecuting a scheme of this kind, should have given away water gratuitously to Clackmannan, but we are proposing in this bill to annex the watershed of the Black Devon, and we are to send down now* (the Forestmill lade) *and forever afterwards, no less a quantity daily than 2 million gallons* (9,092,180 litres). *We cannot in fairness annex the watershed of any community without having due regards to the interests of that community, and we regard it as a small concession to give them 25,000 gallons* (113,652 litres) *a day free, from our pipes in order to obtain what is vital to us, control of the watershed of the Black Devon".* [28] The transfer of the water rights of the lower river Black Devon from Clackmannan to Alloa Burgh were calculated to give Alloa a very considerable amount of water, some of which had been previously supplied to the town of Clackmannan.

5 Forestmill weir:

The front weir, rebuilt in 1835, [29] consists of a curved, ashlar structure of sandstone between buttresses. The weir sits directly on top of the bedrock. Another structure lies behind and in contact with the first. This is built of much courser blocks and possibly represents an earlier weir. On the northern side of the weir a buttress is extended into a wall which curves round to support the lade. A southern buttress is extended with a low wall which compensates for a drop in the level of the land on the southern side of the river. The front weir and the buttresses are all one construction. The front section of the weir is built on a stone kerb which sits directly on the bedrock. The buttresses are built on top of the bedrock.

Figure 2. The Forestmill Weir.



6 Forestmill lade:

The work undertaken by Alloa Burgh in 1892-93, when they purchased the Gartmorn dam and it's lades from the Erskine family; included widening and deepening the Forestmill lade. (30) The lade starts as an open ditch from the northern side of the pool behind the weir which was rebuilt in the summer of 1835 by the Coal Company, with the work being completed later in the year by the Alloa Coal Company. (31) The lade turns westwards, parallel to the river.

6.1 Lade at the weir.

Figure 3. Lade at the pool behind the weir.

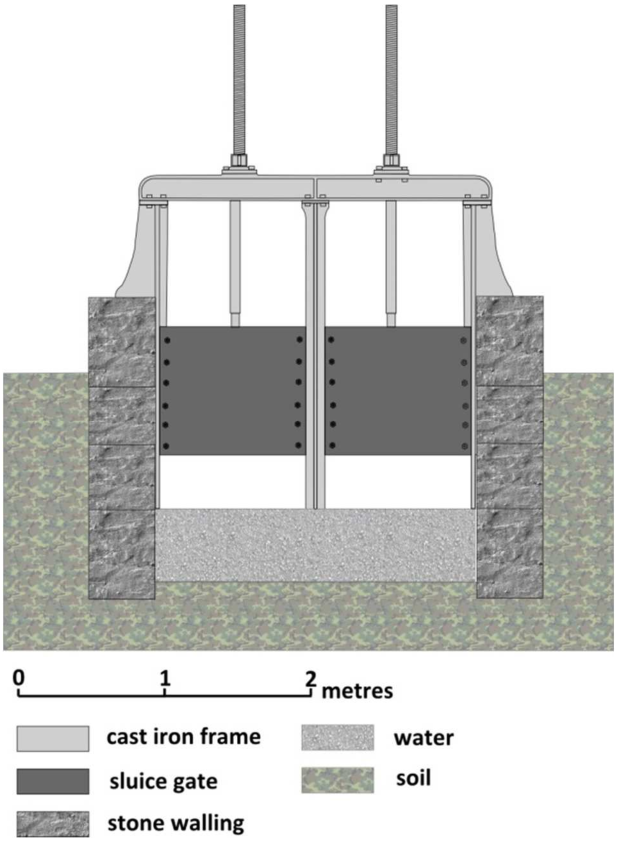
The first structure from the 1891-92 work is the well preserved remains of a sluice to control the flow of water from the river Black Devon into the lade.

Figure 4. Alloa Burgh sluice.

Figure 5. Sluice mechanism.

The sluice is extremely well preserved. Both the metalwork and the woodwork are substantially intact. A number of trees are growing out of the stonework. These have been cut down, but are coppicing and require to be trimmed and treated.

Figure 6. Sluice diagram.



The sluice consists of a very well-constructed cast iron frame holding two screw operated, metal covered wooden sluice gates. A small wooden bridge gives access to the screw columns. The cast metalwork of the sluice is of a particular style which allows similar work undertaken at this time to be identified. The line of the lade is as it was in 1713. The work undertaken in 1891-92 deepened and widened the lade, but did not change its route.

Figure 7. Sluice metalwork

6.2 Modern sluice across the lade and spillway.

The lade was taken over by Central Regional Council in 1975 and parts were refurbished. A modern, substantial concrete-walled sluice was built in the lade just below the Alloa Burgh sluice. (32) A steel gate controls the flow of water into the concrete sluice and a second controls the flow of water into the lade.

Figure 8. Modern sluice.

Figure 9. Modern sluice gate.

The sluice has two sets of slots in the river side. These held large wooden batons which could be removed to set the level of water flowing into the spillway. All the batons have been removed and the water in the lade is now returned to the river. This lowered the level of water in the pool and water only flows across the weir when the river is in flood.

Figure 10. Modern spillway exit.

The spillway directs water through a culvert under the lade path into a concrete structure on the bank of the river. This has grids to prevent large items getting back into the river and a set of baffles which encourage oxygenation of the water.

Figure 11. Lade after sluice.

Except after very heavy rain, the lade is now dry beyond the modern sluice and is slowly filling up with vegetation. The remainder of the lade between Forestmill and Gartmorn Loch is a mixture of wet and dry sections. Most of the length of the lade receives rainfall and some drainage from adjacent fields. The lade bed varies from thick vegetation where it is predominately dry to a layer of composting leaf litter where it is predominately damp or wet.

6.3 Road bridges.

A modern concrete bridge now carries the busy A977 road across the lade [NS 95289 93899]. The bridge separates the lade into two culverts. The modern bridge is built adjacent to and replaces an older stone-built bridge.

Figure 12. Modern concrete road bridge.

Figure 13. Older stone bridge.

This bridge is built of well-cut sandstone with a rounded sandstone coping. It still provides access to the steadings of Forestmill farm [NS 95282 93908]. The metalled road to Forestmill Cottages and Aberdona estate branches off from the A977 here.

6.4 Estate access bridge.

Just beyond this older stone bridge is a modern concrete bridge built over three pipes. This replaced one built of iron which was constructed in 1892 by Mr Peter Rintoull, engineer of Alloa, as part of the Alloa Burgh improvements. [33] The road which crosses it gives access to Aitkenhead farm and the Aberdonna estate.

Figure 14. Refurbished iron bridge.

Figure 15. Forestmill cottages.

Beyond the bridge the lade turns southwards following the course of the river Black Devon. The first section runs in front of Forestmill cottages, where the owners have kept the vegetation under control. The lade is still cut into glacial clay with the excavated material being used to construct the embankment on the downslope side. The embankment supports the lade path.

6.5 Water gauge in the river Black Devon:

Just downstream from the Forestmill cottages there is a small weir across the river Black Devon [NS 95139 93949]. There is a metal gauge plate in the sill of the weir. This acted as a check on the volume of water flowing over the weir. If the flow of water was insufficient to at least fill the cut in the plate, the sluice at the main weir had to be closed to divert more water into the river.

Figure 16. Forestmill river gauge.

Figure 17. Lade overgrown.

At this point the bed and sides of the lade are overgrown [NS 95149 93973]. For much of the rest of its course the lade has slowly filled in with vegetation and leaf litter. Here the lade bed is rarely covered with water and the growth is vigorous. Self-seeded trees have encroached upon the bank. Fortunately, there is little evidence of them having grown in the lade.

6.6 Lade cut into bedrock.

Figure 18. Lade cut through sandstone.

After passing the cottages, the lade is partly cut into the sandstone bedrock [NS 94992 95050]. The cutting exceeds six metres in depth and, in places, the lade is completely cut into the bedrock. The embankment is partly bedrock with an overlay of excavated material on the river side.

Figure 19. Levels of river and lade.

As the lade contours along the top of the gorge of the river Black Devon it maintains its height, while the river drops slowly in level as it proceeds into the gorge. This section of the lade runs through woodland, regularly fills with rainwater and the bed is covered with leaves and a thin layer of vegetation.

6.7 Culvert and sluice at Aitkenhead.

Figure 20. Combined sluice and culvert.

As the lade approaches close to the Aitkenhead farm it is carried across a small stream to the East of the farm steading [NS 95714 64062]. The stream enters a small trough cut into the bedrock under the lade.

In 1975 the lade-side path was carried on a brick-arched bridge over the culvert and the sluice gate was made of wood. William Hutton, the 6th Earl of Mar's colliery manager, refers to the work carried out here in 1712 in a letter he wrote to the 6th Earl of Mar's brother Lord Grange. He had redirected workman away from the cutting through the watershed to carry out further work at Aitkenhead. (34)

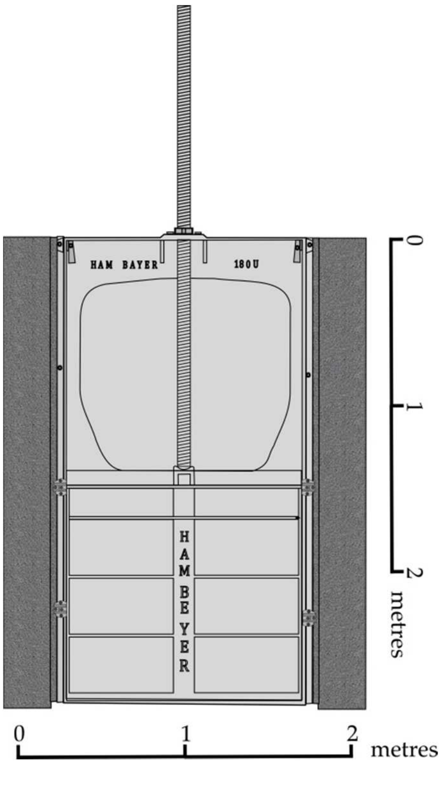
Figure 21. Culvert (1975)

Figure 22. Culvert (2017)

The stone-built culvert has been partially replaced with concrete in the 1970s but you can still see parts of the original stonework above the rock-cut trough carrying the stream under the lade and to the right hand side of the archway.

23. New sluice gate.

Figure 24. Illustration of sluice.



The old wooden sluice gate has been replaced by a new sluice made of steel. The new gate sits between two concrete pillars. It is similar in design to the gates in the new overspill sluice at Forestmill weir. The screw mechanism has been removed. When opened, it drained the water from the lade into the valley of the stream which the lade crossed, directing it to the river Black Devon.

6.8 Farm bridge at Aitkenhead farm.

Figure 25. Small bridge over the lade.

Beyond the sluice there is a small bridge [NS 94587 93913]. This carries a track from the farm steading over to a wider section of the lade-side path and then down to provide access to into a field on the southern side of the lade. Westwards from here the lade bed is often wet and the vegetation less well developed.

Figure 26. Field to South of lade.

This field borders on the northern edge of the gorge of the river Black Devon. It has turf-walled edges. The side of the gorge from Forestmill is covered in old deciduous trees. These represent an important asset as they appear not to have been managed since the lade was constructed.

Figure 27. Lade in open ground.

The lade skirts the northen edge of the field for a considerable distance before rejoining the edge of the river gorge. Here the lade, being in the open, has a much denser growth of vegetation in its bed.

Figure 28. Lade in forested area.

Westwards from the Aitkenhead farm bridge the lade bed is often filled with accumulated rainwater and drainage from the adjacent field and forests. It separates a modern coniferous plantation from the remnant woodland on the edge of the gorge and is shaded by the leaves and needles. As a result, there is very little vegetation growing in the bed of the lade. It is covered with a layer of water and composting leaves.

6.9 Aberdonna estate bridge.

Figure 29. Shawbernaig bridge.

This iron bridge was built in 1892 by Mr Peter Rintoull, engineer of Alloa, for the sum of £140 (35) *"with new piers, new iron girders, concrete top, and girders along the sides"*. (36) The metal work on the bridge is of a style found elsewhere on the 1892-93 works [NS 93943 93841].

Figure 30. Wheel plate on the bridge.

There are two parallel cast iron wheel plates set into the top of the bridge. They would have protected the top surface of the bridge from wear by the iron-rimmed wheels of the horse-drawn carriages and farm carts.

Figure 31. Detail of plate.

The cast iron wheel plates are extremely well made and are closely dove-tailed together at the ends.

Figure 32. Road to Shawbernaig bridge.

The bridge carried road the from Aberdona house [NS 947950] to the bridge across the river [NS 93945 93719] then on to connect with the Stirling to Dunfermline railway line at Clackmannan Road Station [NS 919925].

Figure 33. Ruins of South Lodge.

There are the remains of the Aberdona House old South Lodge [NS 93957 93855] for on the North East side of the estate bridge.

6.10 Repaired section of lade.

In the 1950s a section of the lade suffered a catastrophic collapse into the gorge of the river Black Devon [NS 93582 94049 to NS 93518 94038]. (37) The collapse was due in part to the proximity of the cliff-like edge of the river gorge here and partly to the mode of construction, where much of the embankment on the river side of the lade was constructed of excavated material.

Figure 34. Cliff edge location.

Figure 35. Modern culvert.

The lade was reconstructed with three concrete pipes to provide additional support. (38) These were replaced with plastic pipes as part of the refurbishment of the system by Central regional Council in the 1990's. (39)

Figure 36. Modern sluice.

A sluice with a leaf catcher and spillway was built before the start of the pipelines. [NS 93587 94051]. The sluice has a spillway to regulate the level of water and a valve to allow water to be directed into the river. The construction style is similar to that of the sluice at Forestmill and at Aitkenhead.

Figure 37. Modern spillway.

Figure 38. Run-off channel.

Wire gabions were used to construct a run-off down the cliff to the river Black Devon.

6.11 Lade heads for watershed.

Figure 39. Lade heads for the watershed.

From this point the lade runs through woodland is shaded by trees and is often filled with rainwater, so has very little vegetation growing in the bed. It heads towards the small valley which crosses the watershed between the river Black Devon and the Brothie burn.

Figure 40. Lade in cutting in valley.

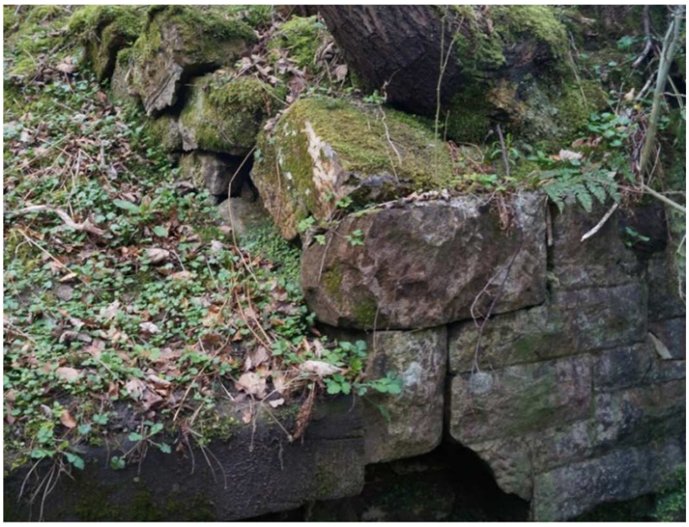
Entering into the valley, the lade now has higher ground on both sides for the first time in its course. Using this valley, the depth of cutting required to take the lade across the watershed has been reduced by more than half. It is likely that the western end of this valley provided the base level for Sorocauld's survey of the route of the lade in 1711.

6.12 Double sluice.

Figure 41. Sluice at the valley end.

There is a sluice at the eastern end of the small valley [NS 93184 94116]. The sluice is at the site of an old bridging point on the stream, carrying the road from Linn Mill [NS 92499 92868] to meet with the road from Fishcross to Coalsnaughton [NS 93341 95638].

Figure 42. Sluice and bridge abut.



The sluice has been built hard against the remains of an old bridge. The stone work of bridge and sluice are different in nature. The bridge is constructed of hand finished ashlar blocks, while the sluice is built of sawn ashlar blocks.

Figure 43. Sluice blocks.

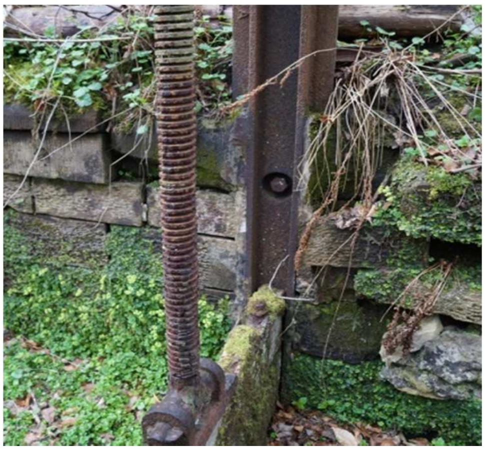
Figure 44. Twin sluice gates.

The lade becomes wider at this point and enters a double sluice with a central pier separating the lade bed into two channels. Each channel has a cast iron frame bolted into the stone walls and each frame has two wooden gates. The southern (nearer) channel has a fixed metal leaf catcher in front of the gates.

Figure 45. Access bridge.

A wooden bridge once crossed the lade over the central pier. It was bolted onto an angled plate attached to the frames of the sluice gates and gave access to the sluice gate mechanisms. A small set of steps carried the path up onto the northern bank of the lade.

Figure 46. Slots and risers.



The gates are made of wood and sit in slots in a frame which is bolted to the wall. Turning a nut on top of the screw lifted up the gates.

Figure 47. Northern double sluice gates.

Looking upstream at the sluice, the two northern gates are in the open position. The central pier has sustained damage at the north eastern corner. These gates are identical in construction to the frames of the gate at the Alloa Burgh sluice at Forestmill. This indicates that the two sluices date from the same period of construction.

Figure 48. Forestmill sluice gate.

The frames of the sluice gates have been cast in the same mould. The method of lowering and raising the gates is identical. Both sluices had a fixed wooden board to allow access to the screws.

Figure 49. Fixed leaf catcher.

There is a fixed metal leaf catcher bolted onto the stonework of the central pier to protect the entrance to the southern channel of the sluice. As this channel led to the intake of the pipeline to the settling pond at the dam, it would be essential to prevent material getting into the channel.

Below the sluice gates the lade is split into two parts. The channels of the two sections of the sluice are very different in nature. The northern channel gates are open and water is still draining through into the course of the lade. The southern channel gates are closed and the channel is blocked by a combination of fallen stone blocks, broken branches and leaf litter.

Figure 50. The gates looking upstream.

Figure 51. The southern channel.

Looking downstream along the line of the southern channel, it is clear that some of this debris is stonework from the bridge pier, which has been dislodged by tree roots. Some is leaves and wood deposited over time. Historical research shows that this southern channel was directed into an 18 inch (46 cms) fire-clay pipe which took water along the southern shore of Gartmorn Loch to a pond on the southern end of the Gartmorn dam. (40)

Figure 52. Clearing the lade.

Photograph courtesy of Andrew Wood

A waterman, living at the cottage at the southern end of the dam, was responsible for maintaining the aqueducts and checking the water gauges. In 1895 at a meeting of the Alloa Burgh Water Commissioners "*Mr Melvin, the water convener, took the opportunity of impressing upon the man the necessity of keeping the lade free from leaves and such like obstructions, and to scrupulously careful in regard to the regular quantity of water being allowed pass through all the gauges in the lade and river*". (41)

Figure 53 Lade below the sluice

Beyond the sluice the nature and the gradient of the Forestmill lade changes dramatically. It becomes a small stream, running on the sandstone bedrock and having a gradient of 1:100 or 1%.

Figure 54. Lade path continues.

The lade path continues down the side of the lade. The lade side of the path is covered in thick bushes. The opposite side runs down the northern edge of a modern plantation of deciduous trees.

Figure 55. Road to ruins of Birkhillend farm.

The lade path eventually joins the Gartmorn round-the-loch path [NS 92872 94118] and a trackway connecting southwards through the ruins of Birkhillend farm [NS 928939] to Linn Mill. The tenants of Birkhillend farm set off a dispute in 1711 between John, the 6th Earl of Mar and the owners of the Clackmannan estate over the right of access to the small valley through the watershed.

The lade path ends at the modern wooden bridge carrying the round-the-loch path over the lade. From this point trackways connect southwards to Linn Mill and the southern section of the round-the-loch path and northwards past Sherrifyards farmhouse to the northern section of the round-the-loch path and to the road from Coalsnaughton to Fishcross.

Figure 56. Bridge to Sherrifyards farm

Figure 57. Alloa Burgh gateposts.

In 1892 complaints were made that "*cattle should still be allowed to wade at large in Gartmorn, and that practically no restriction should be placed upon the swimming of dogs in the water*" (42) and the loch was surrounded by a perimeter fence to protect the water from livestock and, perhaps, small boys. (43) There is a set of gates associated with this fence just below the wooden bridge. These gateposts provided a style for the iron work around the loch.

Finally, the lade enters into the loch in a small inlet. The Forestmill lade, now a tiny stream, was some two to three feet (61 cms to 91 cms) deep in 1892 and delivering two million gallons (9,092,180 litres) a day to the Gartmorn water system (44)

Figure 58. Lade enters Gartmorn loch.

7 High level service supply:

In the latter part of the 19th century housing in Alloa was beginning to be built on the edge of the town on areas of slightly higher ground. In order to provide a supply of filtered water to these higher parts, the 1890 Water Act was designed around new filter beds located above the southern end of Gartmorn dam in order that "…*that the higher districts of the town, Greenfield, Tullibody Road and Claremont are supplied direct.*"[(45)] These filter beds were to be supplied with water taken directly from the southern channel of the double sluice at the end of the lade. [(46)] The water would be conveyed in "…*an 18 inch* (46 cms) *pipe which is led from behind a sluice across the lead which carries water from the Devon to Gartmorn Dam. This 18 inch* (46 cms) *fire-clay pipe was laid for the purpose of taking water to a large circular settling pond, with filters alongside, for the supply the higher levels of Alloa*". [(47)]

7.1 Start of high service supply.

Figure 59. Double sluice southern channel blocked.

Due to the damage caused by a fallen tree and debris in the southern channel of the double sluice, we have not been able to locate the start of the pipeline. However, the line of the pipeline is shown on the Alloa Water plans [(48)] and a wayleave plan agree by the Earl of Zetland. [(49)] Parts of the line of the pipeline show up on the 1945 RAF aerial survey. [(50)] A report of the Alloa Burgh Water Commissioner's inspection in 1895 reported that "*there was depth water of about two feet* (61 cms) *in the aqueduct, but the run was slow owing partly to the bed of the stream being almost uniformly level and partly to the inflow of water through the sluice being regulated by the quantity passing out the lade into the high service pipe. Having reached the point at which the new system begins we inspected the large rose, valves, etc.…*". [(51)]

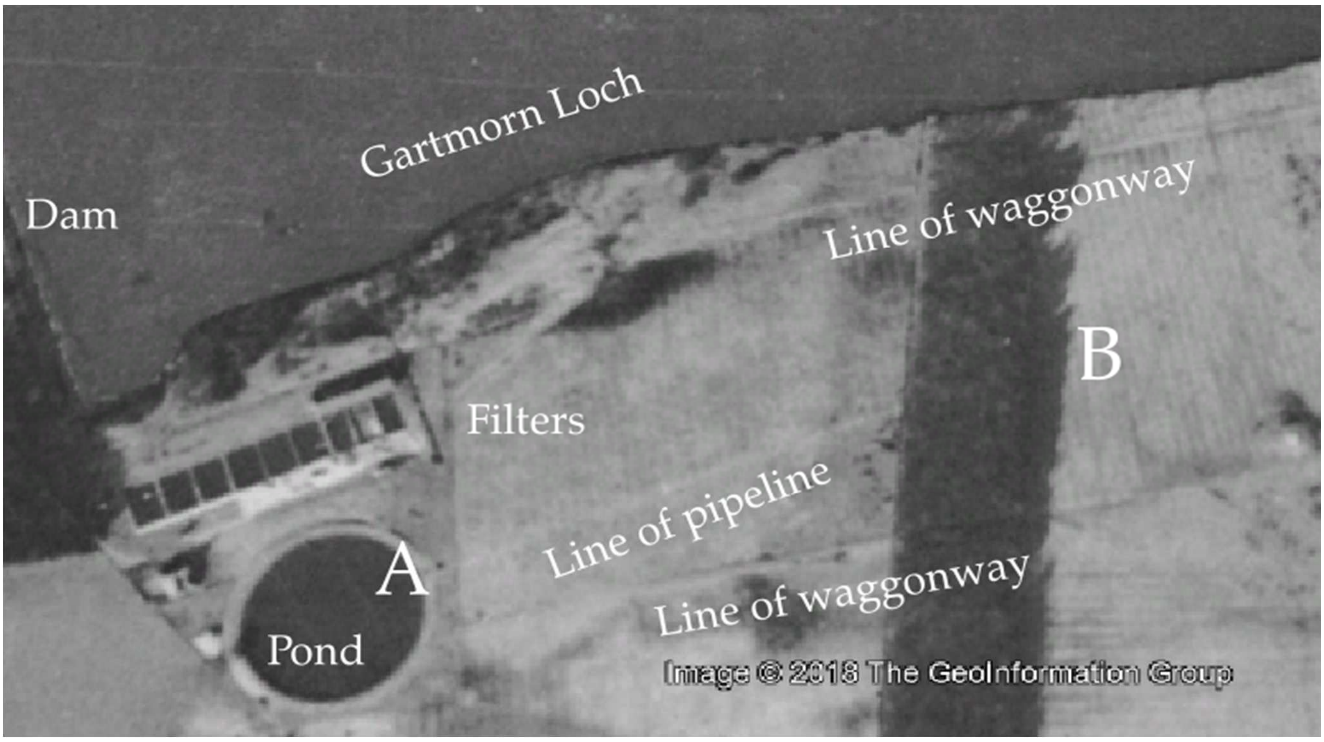
From this record we know that there was a system of filtration and control at the sluice and the input pipe was associated with a "*rose*". Figure 60 shows a contemporary rose from the Gartmorn high level settling pond. We hope that further investigation of the site will reveal more details.

Figure 60. Contemporary rose.

7.2 Fire-clay pipeline.

Fieldwork and the 1945 RAF aerial photograph confirmed the end point (A) and part of the line of the 18 inch (46 cms) fire-clay pipe (A to B) taking water to the settling pond. The line of the pipeline can be seen as a faint, lighter coloured line crossing the field between the eastern edge of the settling pond (point A) and the strip of coniferous trees. The remains of two 19th century waggon roads can also be seen.

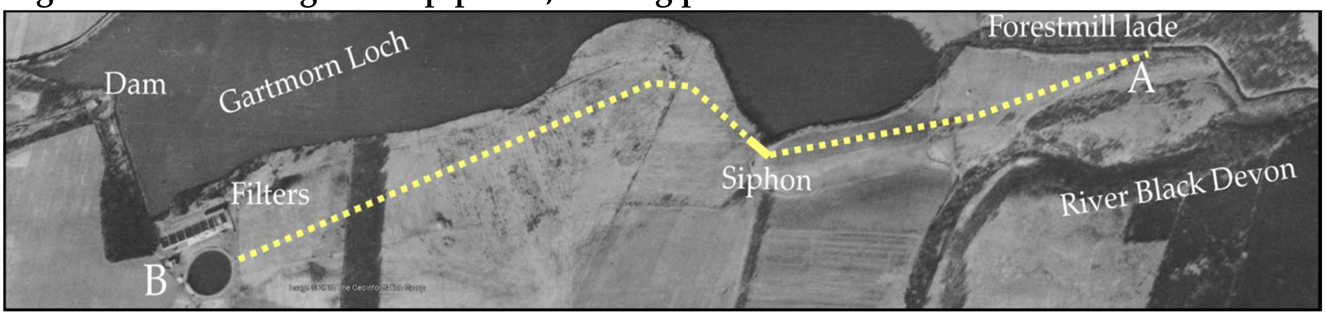
Figure 61. End of pipeline at the settling pond.



© Google Earth RAF 1945 Aerial Photograph

The RAF photograph, wayleaves drawn on the Earl of Zetland's map, the Alloa Water plans and extensive field work identified the likely route of the pipeline from the double sluice on the Forestmill lade (A) to the settling pond at Gartmorn dam (B) on the plan below.

Figure 62. Line of high level pipeline, settling pond and filters.



© Google Earth RAF 1945 Aerial Photograph

We are confident that the majority of the route shown above is that taken by the pipeline, apart from the small section to the West of point A. The Alloa Burgh wayleave plan and contemporary descriptions indicate it starting at the double sluice. It is hoped that further field work will clarify the exact location of the start of the pipeline.

7.3 Siphon crossing valley.

Figure 63. Brick-built chamber.

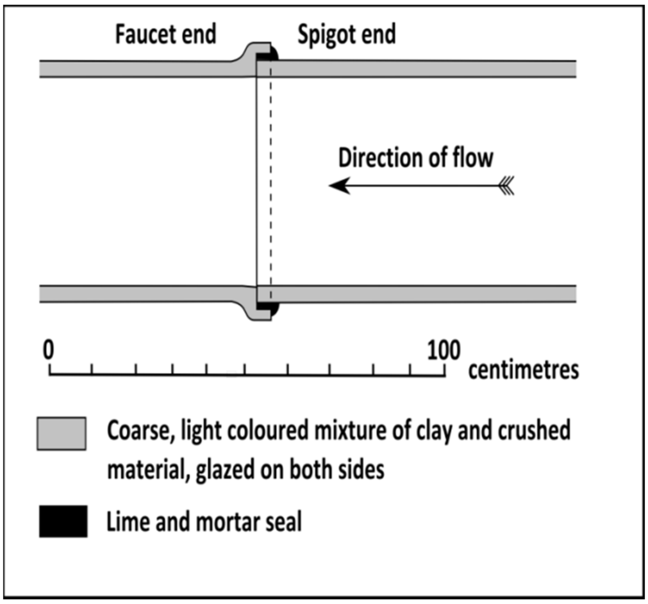
Heading westwards from the sluice, the pipeline reached a small valley on the south eastern corner of Gartmorn Loch. Rather than contour round this valley, the fire-clay pipeline entered a brick-built chamber which connected it to a cast iron pipe [NS 92554 93931]. We are grateful to Jane Coull, the local landowner, for pointing out this site to us.

A glazed, 18 inch (46 cm) diameter, one inch (2.5 cm) thick, four foot (122 cm) long fire-clay pipe enters the chamber from the upstream end.

Figure 64. Clay pipe.

The chamber is square in outline with sides of mortared clay bricks. The top is formed of three layers of corbelled bricks, making the opening narrower. At the time of this photograph there was hardly any water in the pipe. There is a sedimentation mark on the walls of the chamber, showing that the water level in the pipeline was in the past regularly about two thirds up the fire-clay pipe. There was a layer of sediment in a sump below the level of the pipes.

Figure 65. Spigot and faucet joint.



The Spigot end of the pipe is straight, while the faucet end is belled out, allowing the spigot end of the previous pipe to fit inside. This slight difference in diameter gives a small degree of freedom to the joints which allows the pipes to be laid in a straight line or in a slight curve.

This type of joint is capable of working well in a gravity flow system, where the water is not under pressure. The fire-clay pipe entering the chamber has a shaped, thickened end to protect it from damage.

Figure 66. Clay pipe looking upstream.

The inner and outer surfaces of the fire-clay pipe are glazed. The line of the pipes can be seen bearing slightly to the left. This is possible as the pipe has spigot and faucet joints, sealed with mortar and giving a degree of flexibility in alignment. The pipe has only a small quantity of water sitting in the bottom but there is a thin line of wetness above this, suggesting that there was a higher level of water in the recent past.

Figure 67. Craigrie lade fire-clay pipes.

The Craigrie lade had spigot and faucet glazed fire-clay pipes of the same dimensions, being four feet long, with an 18 inch internal diameter and one inch thick walls (123 cm long, 46 cm internal diameter and 2.5 cm thick walls). The Craigrie pipes were laid in 1866 in the bed of the abandoned Craigrie lade to bring a supply of water from Linn Mill to the town of Clackmannan (for fuller details see the Craigrie Lade technical report).[52]

Figure 68. Iron pipe leaving the chamber.

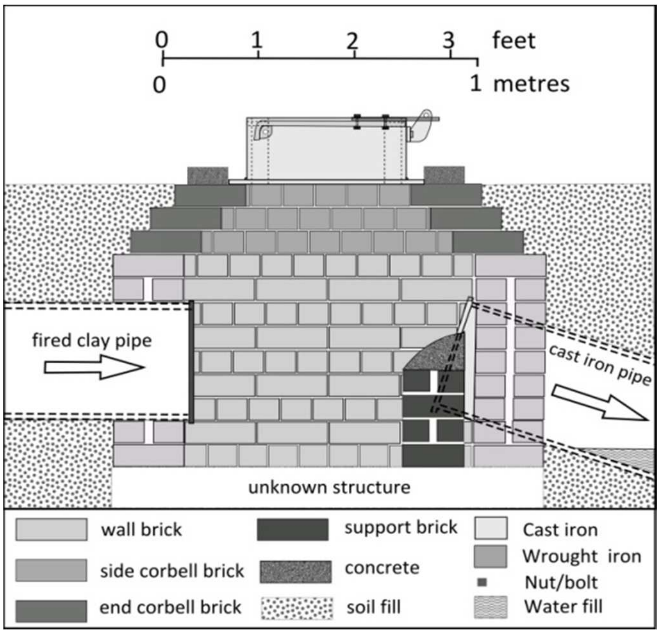
An iron pipe exits the chamber on the downstream side. It is held in place by two small brick-built, concrete covered piers.

While the clay pipe is almost level, the iron pipe slopes downstream at a gradient of about 1:3. This pipe is the start of a siphon, taking the water under the valley to the West.

Figure 69. Iron pipe looking downstream.

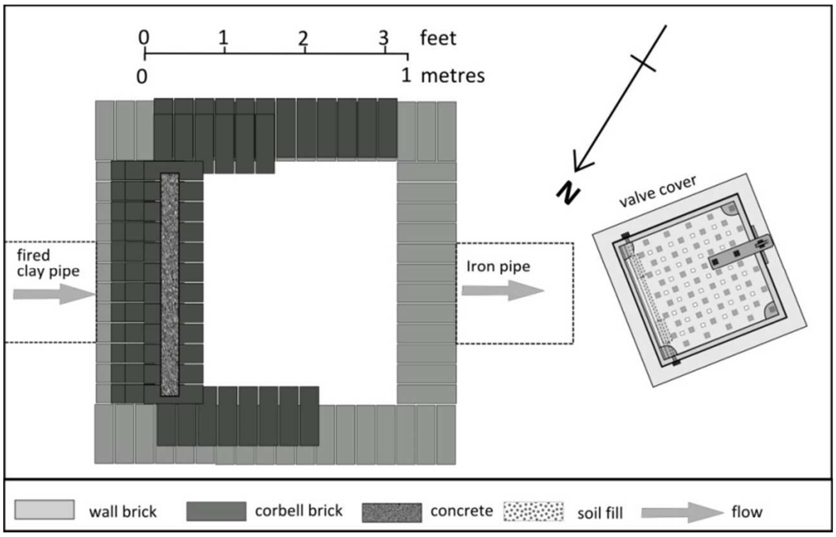
The iron pipe is heavily corroded and filled with water. At the time this photograph was taken the layer of corrosion was damper above the water line, suggesting that the level of water had been significantly higher recently.

Figure 70. Longitudinal section.



The chamber appears to have served a number of purposes. It provided a means of connecting the fire-clay and iron pipes. It had a sump to collect heavy sediment and allowed access to clean it. We were surprised to find that it did not have a drain or gate to stop water flowing into the siphon.

Figure 71. Plan showing corbelled top.



Lying adjacent to the chamber was a cast iron base and hinged cover with a latch to enable the cover to be secured to the base.

Figure 72. Cast iron cover.

This cover appears at one time to have been the on top of the chamber, the brick corbelling having been built to narrow the top opening of the chamber to hold the base. There was a thin concrete slab on the top of the corbelled bricks, perhaps once covering the edge of the base on the upstream side of the chamber.

The sections below show how the corbelled brick top layers would have supported the cast iron cover, keeping the chamber secure.

Figure 73. Cross section upstream.

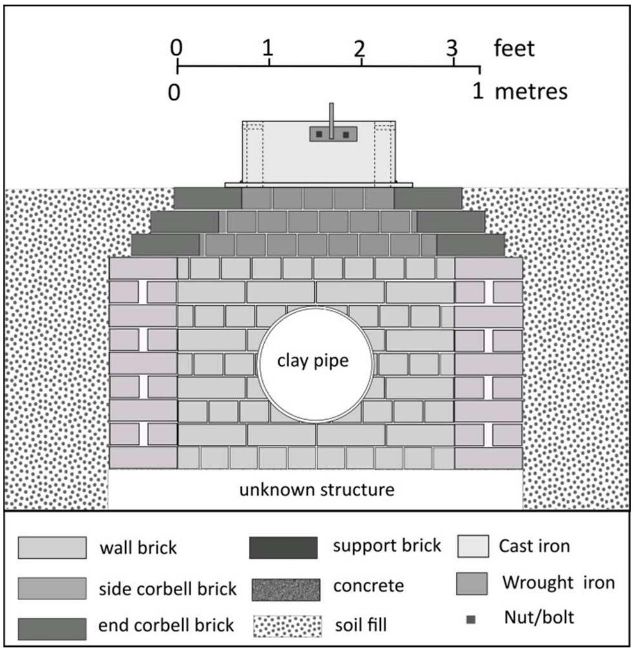


Figure 74. Cross section downstream.

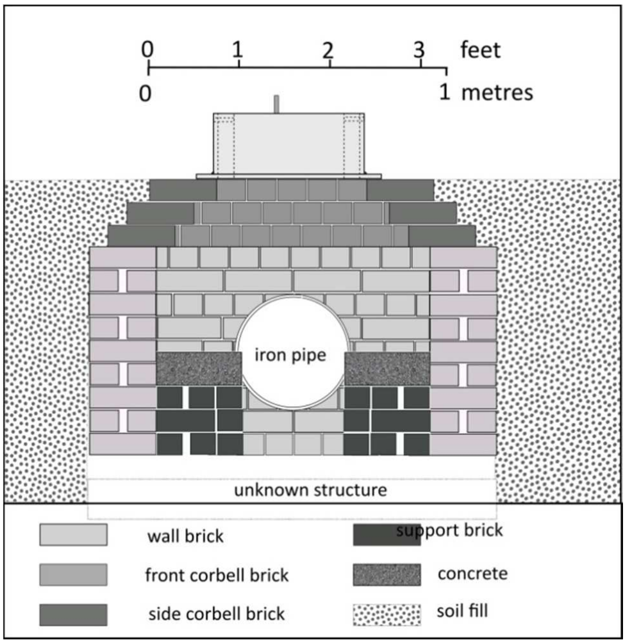


Figure 75. After a period of heavy rain.

This photograph, taken after a period of heavy rainfall, showed the water level in the chamber was significantly higher. The volume of water was too large just to have come in through the chamber top. This suggests that the pipeline might be still receiving water from the lade and the cast iron siphon is still operating.

Figure 76. Line of rushes.

Using a series of poles, a line of sight was established along the line of the cast iron pipe from the edge of the brick chamber to the opposite side of the valley. At a point roughly equal to the height of the chamber there was an isolated clump of rushes and ferns. This was in the form of a short line, coinciding with the line of the wayleave for the pipeline on the Earl of Zetland's map and heading in the same direction. The pipeline then followed the contour of Gartmorn loch, turning as it crosses under the remains of a waggonway running between the early 19th century Clackmannan numbers 12 and 13 pits and heading directly towards the settling pond.

7.4 Inlet number one.

On the eastern edge of the settling pond there is a large, brick-built chamber [NS 91588 93696]. The iron work is similar to than seen at the estate bridge at Shawbernaig.

Figure 77. Inlet number 1.

This was a deep chamber made of bricks with a cope of ashlar blocks of sandstone and an iron fence. The 18 inch (46 cm) fire-clay pipe was at a very shallow depth crossing the adjacent field (less than a metre). The minimum amount of vegetation was removed to enable measurements and photographs to be taken. Wherever possible, all the vegetation was replaced.

Figure 78. Fire-clay pipe.

The inlet pipe was identical to the one seen entering the siphon. It was 18 inches (46 cms) in internal diameter and made of a light yellow fire-clay, glazed on the inside and outside. It was four feet (123 cms) in length, of spigot and faucet design and mortared with cement.

Figure 79. Northern and eastern walls of chamber.

There was an overflow wall in the corner. If the water level in the chamber reached the top of the inlet pipe, water would start flowing over the lip of the overflow wall. Due to the infill of rubble, we were not able to identify the overflow pipe, but the corner of the chamber is in line with an overflow ditch to the North. The inlet chamber had a number of outlet pipes of different sizes, heading off in different directions. In the north western corner of the chamber a 24 inch (61 cm) cast iron reduction pipe connected into a 12inch (30 cm) diameter cast iron pipe.

Figure 80. 24 inch filter.

The 24 inch (61 cms) filter had a bolt-on housing and there were traces of a galvanised filter in the bottom right corner. The reduction pipe and the filter were badly corroded.

Figure 81. 12 inch pipe.

The 12 inch (30.5 cms) pipe was also badly corroded, with a layer of rust in the base.

Figure 82. Four inch pipe.

A four inch (10.2 cms) badly corroded cast iron pipe also went through the northern wall of the chamber. Both of these pipes headed towards the filters and each had a toby box associated with it off the northern edge of chamber.

Figure 83. Toby box.

The presence of toby boxes on the edge of the chamber indicates that both these pipes had a valve to control the flow of water out of the inlet chamber.

Figure 84. One inch lead pipe.

The end of a one inch (2.64 cms) lead pipe was situated out of the eastern wall of the chamber, just below the level of the fire-clay inlet. We have no indication where this pipe went, but its small diameter and lead construction is suggestive of a local supply. Perhaps this pipe took water to the nearby waterman's cottage and/or to the water house to the North of the filter beds.

An 18 inch (45.7 cms) cast iron pipe in the western side of the chamber directed water towards the settling pond. The end of this pipe was unfortunately hidden under unstable rubble. However, the other end was clearly visible and there was a toby box on the western chamber edge in line with it. Lastly, a toby adjacent to the southern wall suggested another pipe took water from this side of the chamber, below the level of the present rubble infill. We know from the historic records that an 6 inch (15 cms) cast iron pipe took water from this inlet to the filter beds at Clackmannan. [53] The plan below shows the details of the inlet chamber and the various pipes.

Figure 85. Plan of inlet chamber number 1.

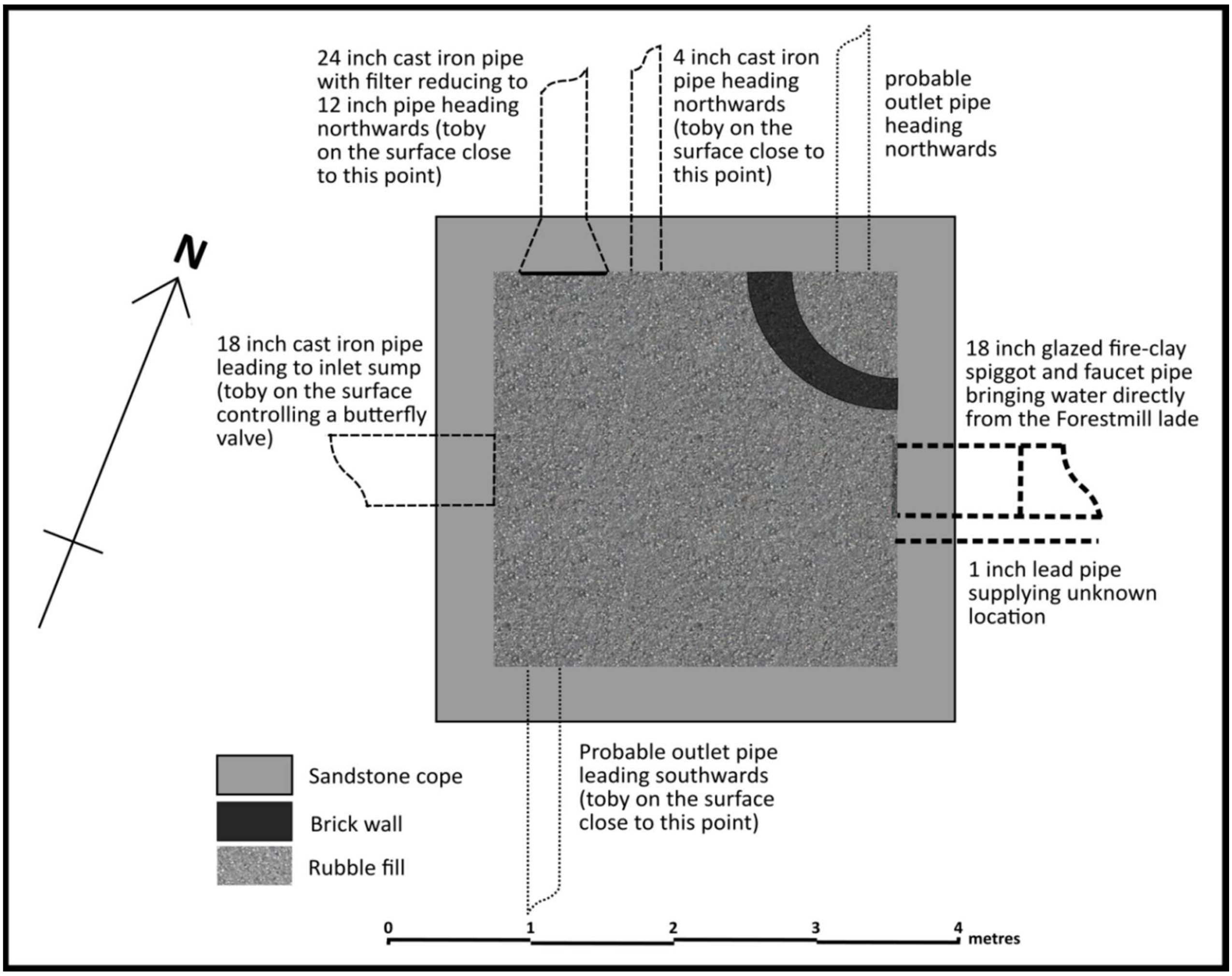
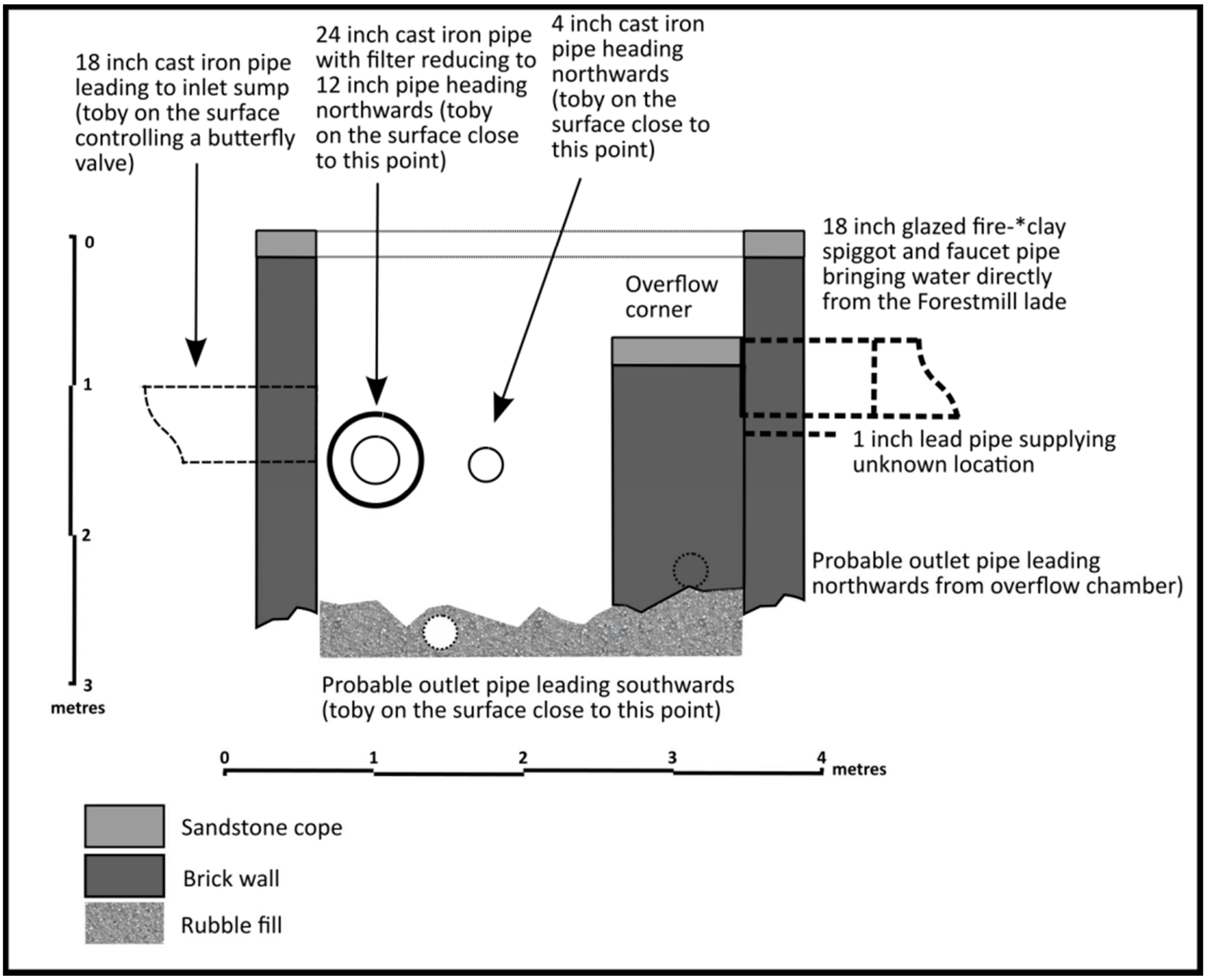


Figure 86. West to East section through inlet chamber number 1.

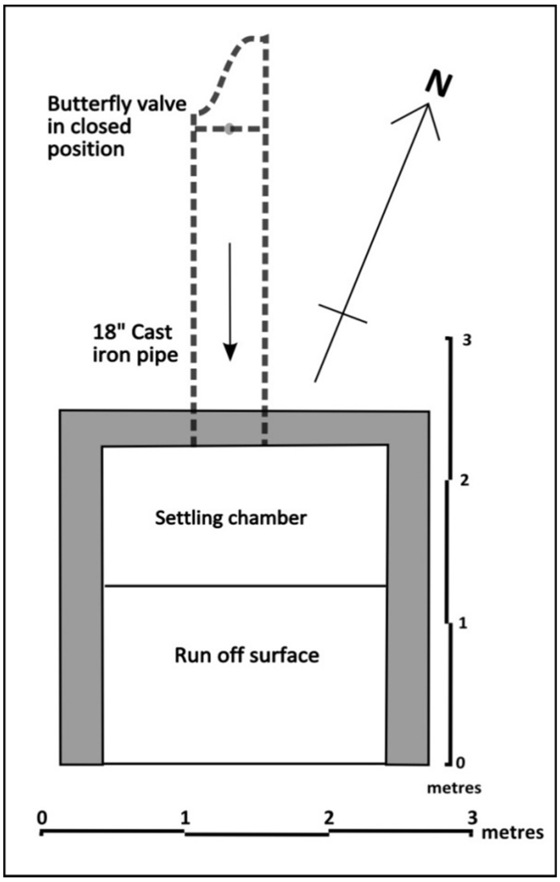


As well as distributing water into different pipes, the chamber would have acted as a trap for larger pieces of debris coming down the fire-clay pipeline from the Forestmill lade.

Figure 87. Outlet chamber on the edge of the pond.

There is an outlet chamber on the edge of the pond, made of well-cut ashlar blocks of sandstone, with a sandstone coping. An 18 inch (45.7 cms) cast iron pipe connects the inlet chamber through to this outlet chamber. The outlet pipe has a small settling chamber in front of the pipe before water was directed into the settling pond.

Figure 88. Plan of outlet chamber.



The 18 inch (45.7 cms) cast iron pipe from the main inlet chamber is badly corroded and a closed valve can be seen at the end of it.

Figure 91. Inside of pipe.

The rusted remans of a circular metal plate can be seen attached to a vertical metal shaft. There is a toby box immediately above this point. The shaft goes up into the toby box, allowing the valve to be opened and closed.

Figure 89. Section through chamber.

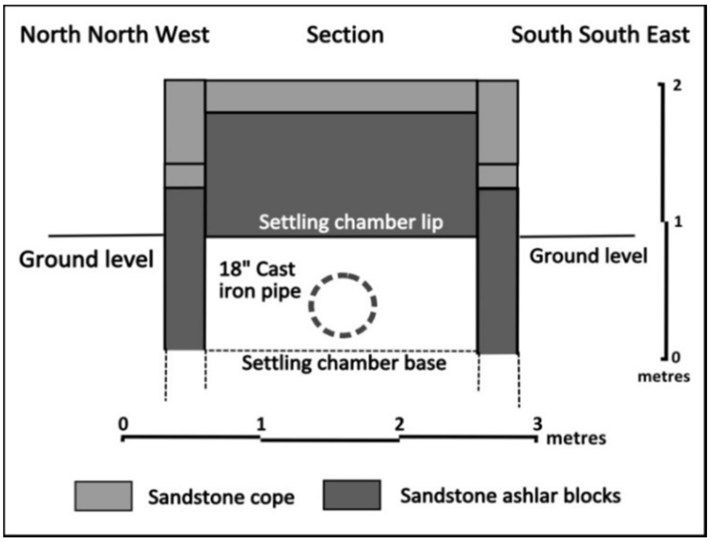
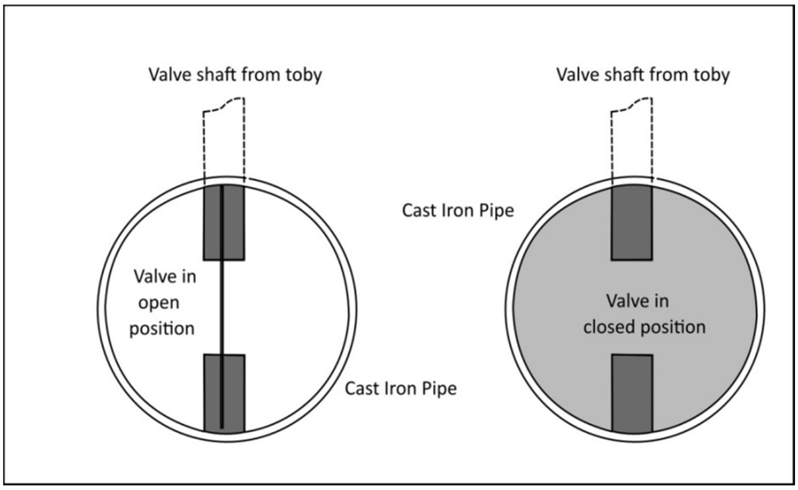


Figure 90. Inlet pipe enters outlet chamber.

Figure 92. Butterfly valve in inlet pipe.

Figure 93. Butterfly valve - open and closed.



A butterfly valve is used to cut off the flow of water where there is not any great pressure in the pipe. When the shaft is turned so that the circular plate is across the pipe, the flow of water is cut off. Turning the plate so that it is in line with the pipe lets the water flow through the pipe.

Figure 94. Toby Box.

The top of the shaft is accessible through the toby box. A square end on the shaft allows it to be rotated. The toby box is lined up with the line of the pipe below. This helps the operator to align the key for rotating the shaft. When the square end is the position shown in the photograph, the valve is either in the fully open or fully closed position. The operator would know the condition of the valve from the flow out of the pipe. A quarter turn of the key will turn the butterfly plate from one condition to the other.

7.5 Settling pond.

Figure 95. Settling pond.

The settling pond is currently filled with rainwater and surrounded by a skirting of mature trees [NS 915936]. It is roughly 58 metres in diameter [54] and of unknown depth. It is surrounded by an embankment of clay, about 1.5 metres above the ground surface.

Figure 96. Settling pond embankment.

The surface of the water presently lies about two metres below the top of the embankment and one and a half metres below the level of the inlet pipe from the number one inlet. The water still appears to be of a considerable depth in the centre of the pond.

7.6 Main settling pond outlet.

The main pond outlet sits on the northern edge of the pond [NS 91530 93711]. The outlet is a vertical cast iron pipe, with a connecting bridge giving access to two square topped shafts leading to slide valves below.

Figure 97. Settling pond outlet tower.

Figure 98. Slide valve screw lifts.

The design of the slides is identical to those on the tower of Gartmorn dam.

Figure 99. Gartmorn dam slide valves.

Two vertical rods are bolted to castings on the side of the pipe. A bar slides up and down between the two side rods. The bar has a vertical, screwed shaft running through its centre, with a squared top end. Using a key to turn the squared end raises and lowers the horizontal bar. The horizontal bar is also attached to the two ends of a u-forked shaft.

Figure 100. Gate valve side fitting

The u-forked shaft connects to the top of a shaft fitted to a sliding gate valve. The gate valve sits within two side plates bolted on to a cast fitting on the pipe. Turning a key on the top of the screwed shaft raises and lowers the gate valve. Both gate valves are sitting in the closed position.

Figure 101. Upper gate valve.

The gate valve is a simple metal plate sitting over a hole in the vertical pipe. Moving the plate up admits water into the pipe. Lowering it back cuts off the water supply. The slides for the gate valve have a metal screen bolted on. This would have prevented floating debris getting down into the pipe.

Figure 102. Lower gate valve.

The two gate valves lie at different heights. The upper valve is just above the current water level in the pond. The lower gate valve is located well below the water level. This arrangement allows the water going into the pipe to be taken from close to the surface or, if the water level in the pond is low, from a greater depth.

7.7 Clackmannan water supply.

A rose-ended six inch (18 cms) cast iron pipe is situated in the South bank of the settling pond [91548 93652]. This location is shown on the wayleave plan from the Earl of Zetland in 1895 as the start of the pipeline from the Alloa Burgh Water Works, by way of Hillend, Fauld (Helensfield) and the Pottery to the filters on King Seat Hill at Clackmannan. [55]

Figure 103. Rose-ended pipe.

A description of a visit by the Alloa Burgh Water Commissioners in 1895 suggests that the compensation supply for the town of Clackmannan was drawn from the settling pond at that time. [56] This pipe is at the same level as the upper gate valve on the settling pond outlet tower (see figure 99) and a "*rose*" was mentioned as part of the input to the 18 inch (45.7 cms) fire-clay pipe from the double sluice on the lade. [57]

Figure 104. Toby box at the inlet.

A toby box on the southern edge of the number one inlet chamber controlled a pipe taking water directly from the chamber. This might be a connection to the Clackmannan pipe providing a supply of water if the level in the settling pond fell below that of the rose-ended pipe. This would work in the same way that the lower valve in the settling pond allowed water to be directed to the Alloa filter beds if the level of the water in the settling pond fell below the level of the upper valve.

A report in 1904 regarding the poor condition of the water supplied to the town of Clackmannan noted that "*When Alloa uses water from this lead, is settled first of all in the pond, and then passed over the filters. The water that goes Clackmannan does not pass through the settling pond.*" and "*..was not pretty to look at much less think of drinking*". (58) It would seem that by this time the supply for Clackmannan was being taken directly from the number one inlet.

Initially it was planned to lay a pipeline from the settling pond to the Earl of Zetland's town supply pipeline at Riccarton. (59) The line was eventually laid to new filter beds and a storage tank built at the top of the High Street. (60) As the town of Clackmannan did not have a settling pond, the water from the high level pipeline went directly into the filters and they had great difficulty dealing with the level of material in it. (61) A new reservoir was built by Clackmannan Council in 1897 in the Ochil hills at Lipney, near Menstrie. (62) Initially supplying the towns of Tillicoultry and Tullibody, a supply of water was taken to Clackmannan circa 1916 to replace that from Gartmorn dam. (63)

Despite the fact that the high level filters at Gartmorn were supplied with water which had gone through the settling pond, they experienced the same difficulty. On the northern side of the settling tanks were a waterman's cottage and "*two filter beds and the large clear water tank within the water-house. This tank, it may be mentioned, is 90 feet* (27.3 metres) *long and 30 feet* (9.1 metres) *broad, and has a depth of about 12 feet* (3.7 metres), *its storage capacity representing over 200,000 gallons* (909,218 litres)". The OS map of 1896 shows three filter beds adjacent to a large water house, so it is possible that the note of "*two filter beds*" was not accurate. (64) The three filter beds shown on the 1896 OS map were each 30 feet (9.1 metres) broad by 60 feet (18.3 metres) long. (65)

Figure 105. Surveying.

A considerable time was spent surveying the heights of the filter beds and settling pond at the dam and comparting them with the height of the remains of the filter beds on top of Kings Seat hill at Clackmannan.

The water level in the main inlet for the settling pond at Gartmorn would have been at a height of about 53 metres Ordnance datum (OD). This dropped to about 52 metres OD above the rose in the pond (if the pond was full). The level in the high level filters below the settling pond would have been at about 49 metres OD.

Figure 106. Clackmannan filter beds.

The inlet for the filter beds at Kings Seat hill at Clackmannan was about 51 metres. It would have been difficult to deliver a supply running from the chamber of the number one inlet at the settling pond using a gravity fed pipeline to the Clackmannan filters. The rose in the pond (if the pond was full) was still possible, but slightly more challenging. It would not have been possible to deliver water from the high level filter beds at Gartmorn to Clackmannan using a gravity fed system.

7.8 High level filter beds.

The 1892 high level water house and filter beds have been lost and are now grassed over. The remains of filter beds built after 1892 have been redeveloped as a sunken garden. These remains give some idea of the design of the original filters.

Figure 107. Filter beds and water house (1980).

Photograph courtesy of Clackmannanshire Council.

The first three filter beds were constructed due North of the settling pond [NS 91539 03765]. The water house and these early beds have gone and the site has been filled in and grassed over, but the cottage and parts of some of the walls and weirs of the later filter beds are still visible.

Figure 108. Early 20th century filter bed walls.

The walls of the beds were constructed of bricks with concrete tops.

Figure 109. Filter bed weir top.

Several weirs, which collected water from the base of the filters on the northern side, were made of brick with concrete tops and metal grilles.

Figure 110. Filter bed weir top.

The photograph on the left looks down into one of the weirs, showing the central connection which took the water from the filters into the water house storage tank. Despite having state of the art filters, "*the water coming down this pipe to the settling pond has recently been so foul that the burgh authorities did not consider it good enough for their own ratepayers, even after passing it through their filters. And so they are pumping water from Gartmorn Dam to supply the Alloa high level fillers.*" [(66)]

7.9 Pumped supply of water from the dam.

The water was taking too long to filter and not coming out with all the impurities removed. A hydraulic ram had been used at Riccarton in 1866 to pump water from the Craigrie lade up to the town of Clackmannan. (67) This had later been replaced by a small water turbine driving a pump. (68) In order to increase the quality of water in the settling pond at Gartmorn dam, the turbine pumped an additional supply of water from the pipe coming from the water tower to the filters at Jellyholm.

Figure 111. Pump house and water house.

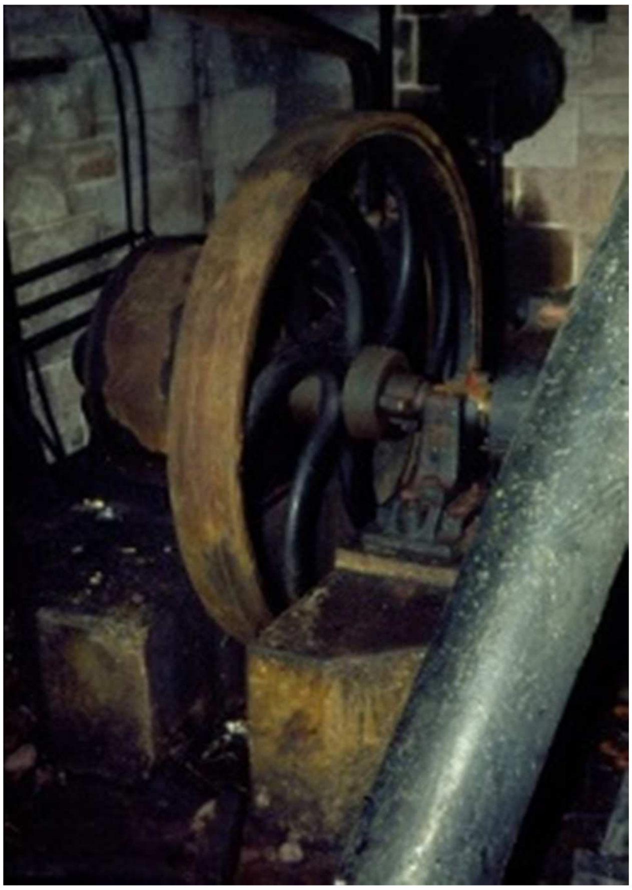
In 1894 a small turbine, made by the Glenfield Company, Kilmarnock, was installed in the pump house (69) (the larger stone building in the photograph). It used the pressure off the supply pipe from the control tower at the dam going to the Jellyholm filters to pump some of it up to the settling pond, The rest continued into the Jellyholm pipeline. In 1904," *the hydraulic was in full operation pumping at the rate of 258 gallons* (1,173 litres) *per minute to the high service system*." (70)

Figure 112. Pump house.

The required head of water for the turbine was 10 feet (3 metres). It was 24 inches (61 cms) in diameter powering a pump 11 ¼ inches (30 cms) in diameter with a 30 inch (76 cms) stroke. It worked at 30 single strokes per minute, delivering about 250 gallons (1,137 litres) of water to a height of 34 feet (10.4 metres). (71) The cost of purchasing and installing the engine was £210.0.0. (72)

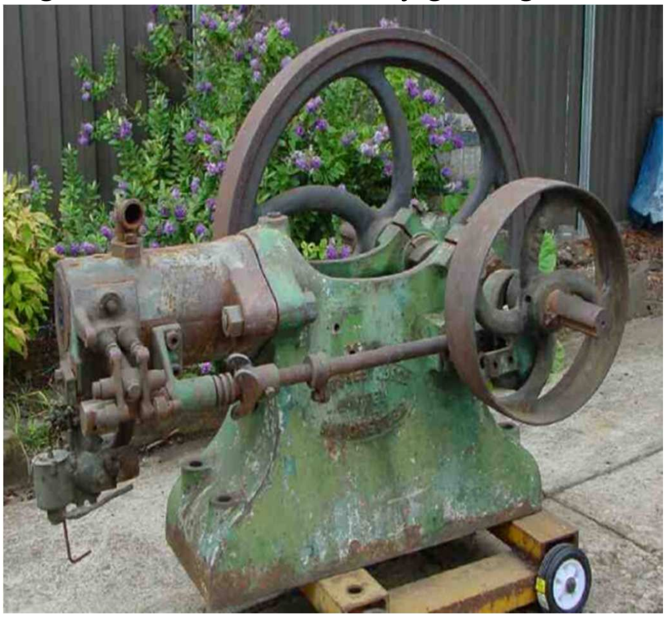
Soon after the water turbine was installed there were concerns as to what would happen if the level of water in the dam fell below the head of water needed to drive it.

Figure 113. Remains of engine (1976)



Following lengthy discussions regarding the pros and cons of town gas versus oil powered engine, a gas engine of nine horse power was installed in 1897. (73) The engine was supplied by Crossley Brothers of Manchester at a cost of £451 and installed by them at a cost of £459, making a total cost of £910. A supply of town gas was obtained from the pipe to Carsebridge in a three inch (7.6 cm) lead pipe at a cost of £648.12.0d. (74) and (75)

Figure 114. Similar Crossley gas engine.



Courtesy of British Made Engines.

The photograph on the left is of a similar Crossley engine from the same period, with its iconic, curved-spoked fly wheel. (76) This engine is the same configuration as the one at Gartmorn, but viewed from the opposite side.

Figure 115. Pipeline at water tower.

A similar pipe to the one in the photograph in figure 113 (above) comes out of the dam to the South of the water tower. This 14 inch (35.6 cms) pipe is part of a siphon and lies directly in line with the pump house. We think that this pipe supplied water to the gas powered pump. The town gas engine drove a three-throw pump (77) with three pumping cyclinders in tandem. It had a capacity of 750 gallons (3,410 litres) per minute, (78) three times the capacity of the water turbine. By 1897, the pump was operating at 1,100 gallons (5,000 litres) a minute, nearly 67,000 gallons (304,588 litres) an hour. (79) As the three-throw pump accepted the flow from the one coming down the pipe from the side of the dam, a similar size of pipe would have been required to take this flow from the pump house to the settling pond.

7.10 Inlet number two.

As well as the main inlet number one from the 18 inch (45.7 cms) fire-clay pipe, there are two other inlets to the settling pond. Inlet number two is an eight inch (20.3 cms) cast iron pipeline, immediately adjacent to the outlet sluice of the settling pond [NS 91530 93711].

Figure 116. Inlet number two.

Figure 117. Cast details on pipe.

The cast iron pipe has standard spigot and faucet joints and a manufacturer's initials "M S & Co" cast into the side of the bend. We think that this pipeline at inlet number two, having a much smaller internal diameter to the one seen at the water tower and the one connected to the gas engine, might have been related to supply from the water turbine. Further research will be required to confirm or refute this.

7.11 Inlet number three.

Inlet number three is a small, ashlar block sandstone structure, very similar to that of inlet number one. It is also built into the inside of the embankment of the settling pond [NS 91563 93710]. A 14 inch (35.6 cms) diameter metal pipe from the North East comes into a settling chamber before flowing over the sill into the settling pond.

Figure 118. Stone-built inlet number three.

Figure 119. Brick sluice at inlet three.

There are the remains of two brick-built piers, one on either side of the outlet pipe. They appear to have retained a wooden sluice gate at one time, perhaps to prevent water from the pipe entering the settling chamber.

The 14 inch (35.6 cms) internal diameter metal pipe is significantly better preserved than the other pipes around the pond.

Figure 121. Inlet three spillway into pond.

We were not able to categorically determine the source of water for inlet three. The style of stonework is very similar to that of other constructions on the site dated to 1891 to 1896 and the pipe size suggests that it might be related to the three-throw gas powered pump.

Figure 123. Section of inlet three.

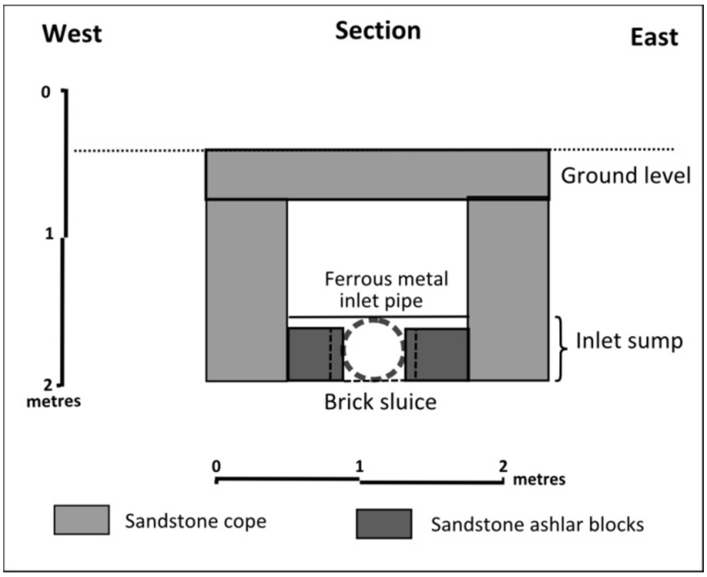
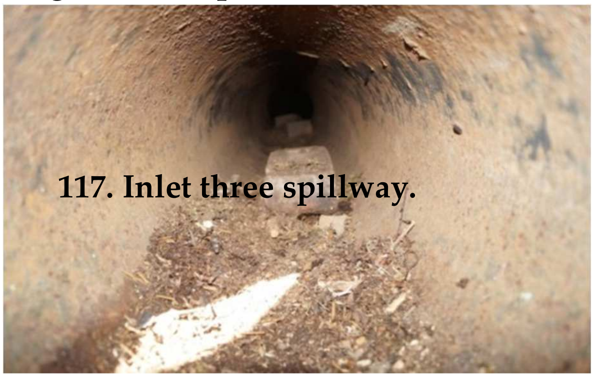
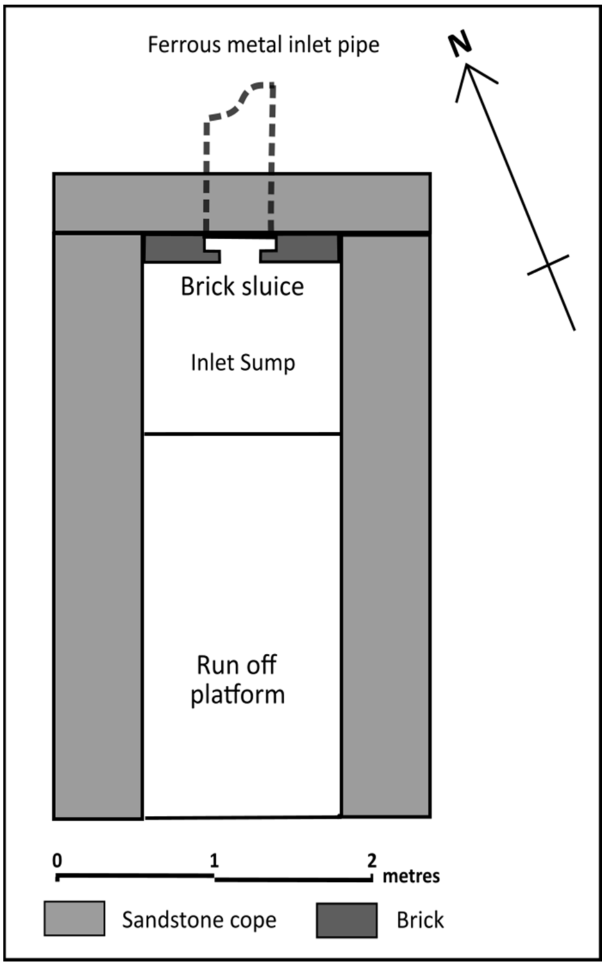


Figure 120. Pipe at inlet three.



The spillway into the settling pond has several mature trees growing in it, so has been abandoned for some time. We were not able to date the abandonment.

Figure 122. Plan of inlet three.



7.12 Overflow channel.

Figure 124. Brick-built chamber.

There is a small brick built overflow chamber at the head of a small ditch running down the eastern edge of the site [NS 91563 93763]. The ditch drains northwards into Gartmorn Loch [NS 91535 93843]. On the second edition 25 inch OS map of 1898 (80) an the revised second edition OS map of 1920, (81) this ditch starts further to the North [NS 91553 93795]. It is shown in its present position on the RAF aerial photograph of 1945. (82) This chamber has two fire-clay pipes leading into it. The larger pipe, with a 12 inch internal diameter, appears to be coming from the main inlet chamber to the South. The smaller pipe, with a four inch internal diameter, is coming from the West. This pipe appears to be associated with a structure immediately to the West of the chamber.

Figure 125. Settling weir.

The overflow ditch enters a small settling weir, just before it goes under the round-the-dam path [NS91568 93808]. Two brick piers with vertical slots could support wooden boards. The small pool behind would have allowed sediments to drop out rather than being carried down into the dam. This suggests that the overflow might have been carrying a flow of silty water at times. The waterman had a sand washer to clean the sand from the filters. (83)

7.13 Other constructions at the settling pond.

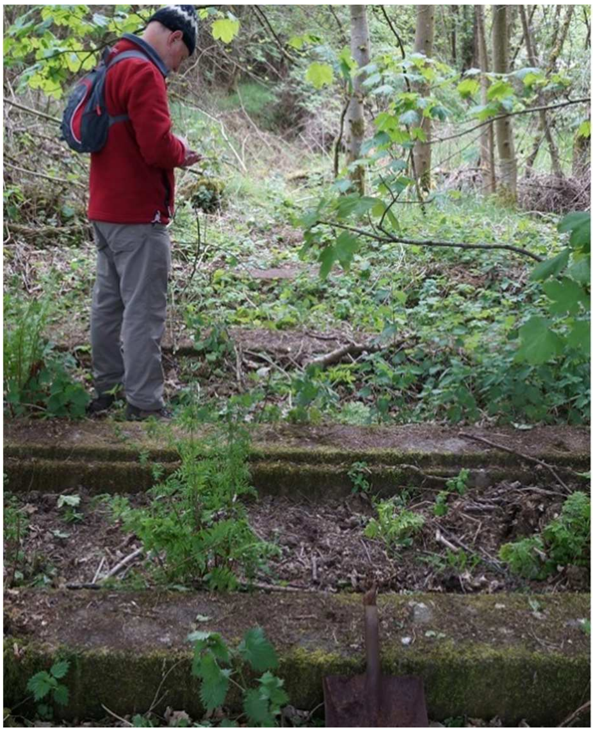
Figure 126. Brick-built structure

We did find two other constructions whose purposes we were not able to identify. The first was a brick-built, double trough immediately next to inlet number three beside the settling pond [NS 91561 93726]. The walls were double thickness brick, reduced now to the tops of the troughs.

The troughs had a white mortar lining and, as they were filled with rainwater, probably made it waterproof. Although the double brick wall had been reduced to the level of the troughs, it looked as if it had been higher.

Figure 127. Trough.

Figure 128. Brick built tank.



The second structure was a rectangular, tank-shaped feature. The outside perimeter wall was composed of double bricks. The top course was laid side across the wall and there was a cast cement cope, slightly narrower than the brick wall. There were three internal walls, linked at the southern end, but not at the northern end.

Figure 129. Slots and slots.

As the cement cope was narrower than the wall, the feature formed horizontal side slots along the top of the walls, possibly for covers. There were also vertical slots in the brick wall close to the open ends of each wall, possibly for boards. The structure was filled with and surrounded by fine sand.

We have no idea of the purpose of either of these structures and would welcome suggestions.

8 Waterman's cottage:

Figure 130. The present cottage.

The waterman's cottage has survived several modernisations almost intact. A tied house ensured that there was always a member of staff available at the site. The waterman was responsible for ensuring that the lades were kept clear, sluices were in working order, levels were adjusted and all compensation gauges were carefully checked.

He was responsible for the high level filters at the dam and ensuring that the volume of water flowing down into Jellyholm filters was maintained and that the flow into the Upper lade met the compensation requirements of the Carsebridge distillery and the Keilarsbrae filters. (84) and (85)

9 The Gartmorn dam:

9.1 Dam.

Figure 131. Gartmorn Dam

In 1891-92 Alloa Burgh had the earthen dam strengthened and heightened and a stone facing and cope installed. The dam was drained in order that these works could be carried out. (86) It was reported in 1897 that "*Before the dam was increased in capacity the top water area when full was 147 acres, and the reservoir was capable of containing 47-48 million gallons. The top water area of the dam at present covers 167 acres and the reservoir has capacity for 48-49 million gallons, giving storage equal to 162 days' requirements*". (87)

A road was built across the top to access the settling pond, filters and waterman's cottage. (88) There also were constructed a central tower to control the flow of water out of the dam to the lower level, a stone-built pump house and a smaller stone-built house over the line of the main outlet from the tower to the lower level. (89)

9.2 Control systems.

The water tower controlled the outflow of water to the water house below (the smaller of the two buildings). The dam provided water to the Jellyholm filters, the Carsebridge distillery and the Keilarsbrae filters, which were still serving the houses in the lower part of Sauchie.

Figure 132. Circular tower.

Figure 133. Control valves.

The tower was accessed by a small bridge. The wall is constructed of carefully fashioned blocks of sandstone and there is an access hatch into the centre void. There are two side valves of the same design as those at the settling tower. The side valves have lifting screws with squared tops and the screws control horizontal bars connected to u-forks, linked to a shaft. Although the valves cannot be seen, it is likely that, as in the settling pond, the two would be at different heights. The top valve would be used when the level in the dam was high. The lower would be used if the water level in the dam dropped. The style of the castings is very similar to the sluice gates.

Figure 134. Depth gauge.

There is now a metric gauge, the original one measured in feet and inches. The level on the gauge was a matter of great concern as the dam had at times been very low, particularly in 1870 when it was seen to be at its lowest level in thirty years. (90) The water tower supplied water to the water house, the smaller stone building below the dam.

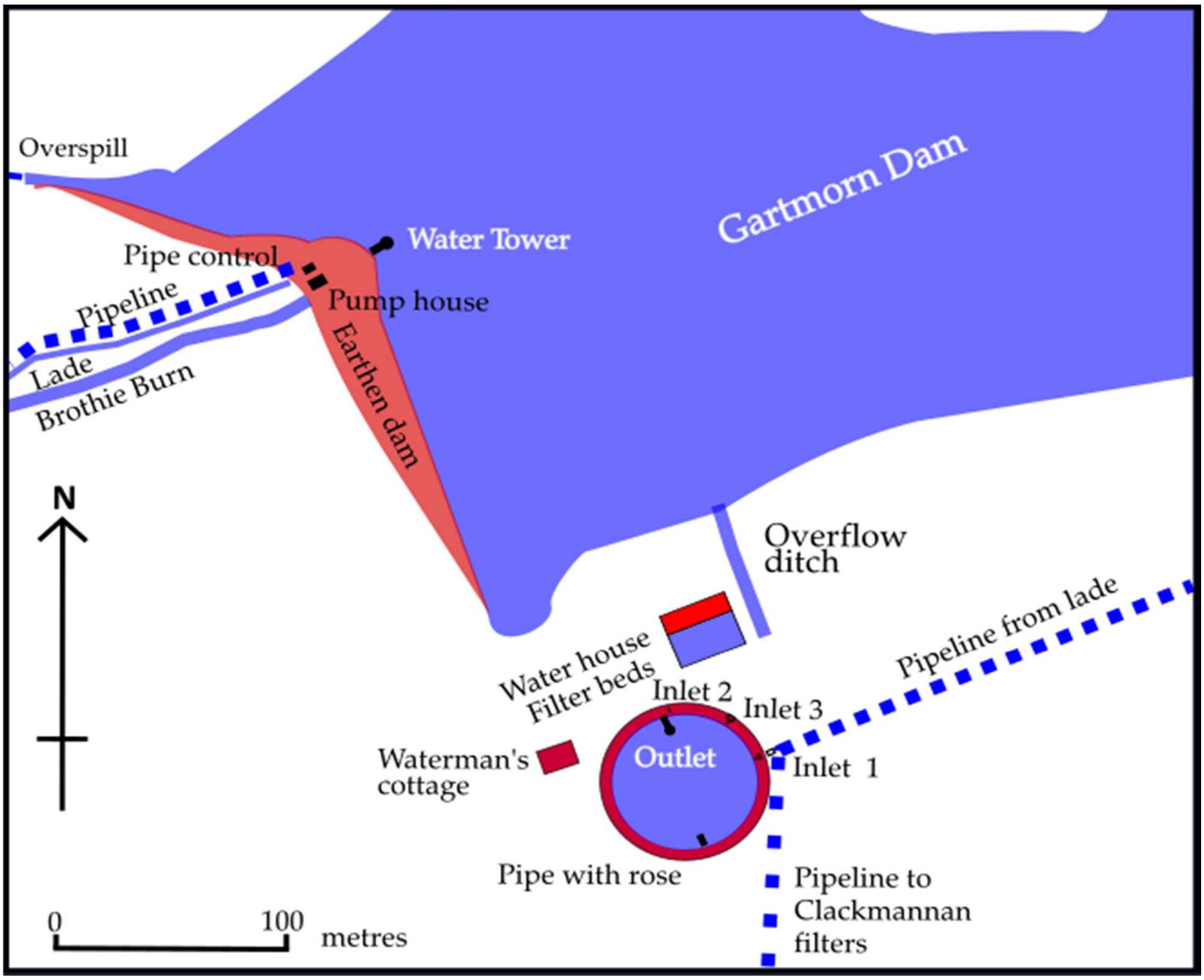
Figure 135. Water House.

The pipeline from the tower entered the water house and was sent in three directions. A cast iron pipe took water to the Jellyholm filters. Water was supplied under pressure to drive the turbine in the adjacent pump house, with some of the flow pumped up to the settling pond. Lastly, water was directed down the Upper Gartmorn lade to supply the filter beds at Keilarsbrae, the Watermill pit and the Carsebridge distillery.

10 Summary of the 1890 supply:

The dam itself provided a substantial storage potential which, when water was supplied from the river Black Devon at Forestmill, gave the town of Alloa a reliable source of water. However, the height of water behind the dam was very close to the higher levels of the town and below the level of the filter beds at Clackmannan. This inspired the Burgh Water Commissioners to go for a supply direct from the Forestmill lade to supply high level filters.

Figure 136. Overview of the Gartmorn dam site (1893).



This was a cost effective option, as the Burgh would be using a gravity fed system and no pumping would be required. Initially, it would appear that the supply for both the high level filters and Clackmannan came from the settling pond. However, the settling pond did not manage to remove the proportion of material from the lade waters which the Gartmorn Loch managed to do and the high level filters could not cope.

The Water Commissioners solved this problem by installing a water turbine below the dam, powered by the pressure from the pipeline to their lower filters at Jellyholm. This was also a cost effective solution, as the turbine would not have any fuel costs. The supply of water from the dam 'diluted' the supply coming directly from the lade and the high level filters now worked effectively.

Concerned about the reliability of the head of water from the dam to power the turbine system, they installed an efficient, auxiliary, town gas powered three-throw pump. This was also a reasonably cost effective solution as the town owned the gas works and the pump was only required if the level of water in the dam fell below a certain level, The turbine and auxiliary pumps were installed in 1892 and 1896 respectively. During this brief period it appears that the supply of water to Clackmannan was sourced directly from the input from the lade (probably inlet number one). In those rare times of very high water level in the loch, excess water would be run into the overspill channel.

By 1920, the number of filter beds at the high level filter site had been increased from three to six. The 1945 RAF aerial photographs show this number increased to nine.

11 Overspill channel:

Figure 137. Spillway.

In 1892, a new overspill and channel was built at the northern end of the dam, connecting into the Brothie burn downstream.

Figure 138. Bottom of spillway channel.

The spillway channel went underneath the two cast iron supply pipes leading from the water house at the dam to the filters at Jellyholm.

Figure 139. Spillway crosses the lade.

The water from the spillway channel was carried across the Upper Gartmorn lade in a stone, concrete and metal trough. The lade is supported at this point by a stone wall which is starting to collapse. A modern wooden bridge carries the lade side path across the channel. This path is one of Clackmannanshire Council's core paths.

12 The Upper Gartmorn lade:

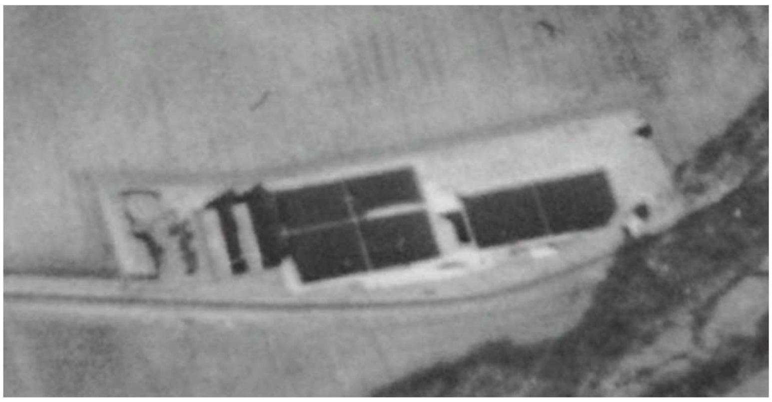
Figure 140. Upper Gartmorn lade.

The Upper Gartmorn lade followed the line established circa 1690 when the 6th Earl of Mar used the water from the small earthen dam across the Brothie burn to power his drainage engine at the Alloa colliery pit at Holton. The Brothie burn lies to the left in this photograph [NS 91223 93051]. The slight depression of the lade can be seen on the right. The 10 inches (25.4 cms) cast iron pipe taking water from the dam to the Jellyholm filters was set in to the bank to the right of the lade. The concrete pipe was added when the new Jellyholm filters were built.

Figure 141. 10 inch (25.4 cms) pipe.

The 10 inch (25.4 cms) supply pipe to the filters installed in 1867 can be seen crossing the spillway channel [NS 91090 93896]. By 1898 the Jellyholm filters had had a much larger water house added, which, in 1909, was reported as holding 550,000 gallons (2,500,350 litres), representing half of an ordinary day's supply to the burgh at that time. [91]

Figure 142. The extended Jellyholm filters.



© Google Earth RAF 1945 Aerial Photograph

By 1920 the western filter bed had been doubled in size. [92] This configuration is shown on the 1945 RAF coverage. [93] A similar view is shown on the 1956 OS 1:25,000 map. [94] In 1928, in order to increase the water pressure for industrial and domestic customers, electric pumps were installed at Carsebridge. [95]

Figure 143. Remains at Jellyholm.

In 1975 responsibility for Gartmorn dam was assumed by Central Region Council. The slow sand filters were replaced by a new building with mechanical filters [NS 90963 93825] in the late 1970's. [96] Following an outbreak of algal bloom in the early 90's, a second filtration system and new filter house was added in 1994 [NS90893 93809] by Central Regional Council (completed by East of Scotland Water) at a cost of £2.5 million. [97]

Following pollution in 2004 from an open cast coal mine near Forestmill [NS 967936] the filtration systems at Jellyholm were choked and the filters were decommissioned in 2005 [98] and the site was finally sold off in 2006. [99] The original filter beds were finally filled in in 2011 [100] and only the tops of some of the outside walls are still visible, together with the access points for the distribution pipes [NS 909938].

Figure 144. Upper lade to Jellyholm farm.

The Upper Gartmorn lade leaves the site of the Jellyholm filters and continues through a field to the West of the site [NS 90754 93893] to the edge of Jellyholm farm [NS 90608 93916]. The line is lost for a short distance, around the steading and farmhouse.

Figure 145. Lade from Jellyholm farm.

At the western edge of the farm the line of the lade reappears along a field edge as depression bordered by a hedge.

Figure 146. Running round Post Hill.

The remains of the lade can then be seen more clearly progressing along the northern slopes of Post Hill to the eastern edge of the old Keilarsbrae complex [NS 89623 93833]. Here it disappears under a modern housing development. Beyond this point, there is no trace of the Upper lade.

13 The Gartmorn Lower lade and lower Brothie burn:

There are traces of the Gartmorn Lower lade complex in the vicinity of Watermill Cottage [NS 89554 93706], where the Sauchie burn and part of the lade entered Carsebridge distillery. Beyond this point successive residential, industrial and retail developments have resulted in the Brothie burn being partly retained, but all traces of the lade system lost. Beyond the ring Road roundabout [NS 88991 92985] the Brothie burn has been culverted to Alloa harbour [NS 88382 92040].

14 Early pollution risks:

A concern arose in 1898 with the sinking of the Sherrifyards pit [NHS 926945], which disposed of its waste water into Gartmorn Loch. A large settling pond was constructed at the side of the pit to remove the sediment and Commissioners agreed that the analysis of the pit water showed no great cause for concern. (101) As the river Black Devon rose in the Saline hills and a great deal of it volume came from that area, the Alloa Burgh Water Commissioners were concerned about the quality of that water. In 1909, they paid a visit to the area where a new coal pit had just been opened and miners' cottages had been constructed. The Commissioners expressed dismay that "*despite notice having been previously given to the mine owners in the two districts that effective steps would be taken to prevent water with a deleterious nature finding its way into the town's supply, it was apparent that the precautionary measures adopted were neither effective nor satisfactory and the generally-expressed opinion was that steps should forthwith be taken put end to state of matter*." It was noted that during the visit "*observations were made which will no doubt prove useful in the event of action being taken by the, Town Council to preserve the quality and wholesomeness of the town supply*". (102)

The water from the burns rising in the Saline hills was examined again in 1910 and it was noted that "*as far as one could discover there was no trace of any description whatever beyond the area of the coalfields recently opened in that district*" and is was evident that "*the owners of the pits were making serious effort to prevent the contamination of the stream. The purification arrangements recently made by the Town Council were in process being out and Dr Crawford, who closely inspected the septic tank and chambers, was of the opinion that when the work was complete all risk of pollution from the pit would obviated*". (103)

15 A new life for Gartmorn Dam:

The old pump house behind the dam served as a visitor centre from 1980 to 1996 and the shell of the old high level filter beds was transformed into a sunken garden. In 1996 a purpose-built visitor centre was added. [104] In 1982 Gartmorn Dam became Clackmannanshire's first Country Park. [105]

Figure 147. Dam level reduced.

Scottish Water now owns Gartmorn dam and the reservoir is redundant for the purposes of water supply, except for some cattle troughs at Jellyholm Farm. In 2013 they invested £440,000 draining water off the Dam and building a new platform and penstocks in the spillway to allow for emergency drawdown of the reservoir so that that if a reservoir breach is imminent then the penstocks can be opened to take the pressure off the dam and reduce the risk of flooding. [106]

Figure 148. Water house re-roofed.

Scottish water has continued to make improvements to the safety and appearance of the dam and the surrounding area. In 2017 they re-roofed the water house and introduced drains to the area below the embankment of the earthen dam.

Figure 149. Well worth a visit.

The Gartmorn Dam Country Park Development Trust was formed in 2016 to encourage local people, the different landowners and concerned organisation to work together to protect and improve the Dam and its environs. [107] In 2017, Clackmannanshire Council let the Visitor Centre out as a coffee shop, now "Dam Good Coffee". The Gartmorn dam, the country park and the surrounding area are well worth a visit. The park is easy to access, has a tremendous history and a wide range of plant and animal life. A range of paths take you round the dam, into the adjacent woodland and through to Coalsnaughton, Sauchie, Forestmill and, by way of Linn Mill, to Clackmannan. There are two car parks close to the head of the dam and an excellent coffee shop.

16 Appendix 1.

Alloa Advertiser - Saturday 7th March, 1891, page 5.

Statement from the Chairman of Alloa Burgh Water Commissioners:

It may be that you would like me to say something about the rates you are likely to pay for the water when you get it under the new scheme. That is a point that I must ask you not to press me to condescend too particularly, for this reason, that everything depends a good deal on how the scheme is carried out. After we get the bill, if we are content with the existing provision of matters the scheme as it stands would cost very little, but on the other hand if we are to go in for the high system it will depend entirely how you carry that out what the cost will be. If you constructed a reservoir (at Meadowhill) and laid down the necessary pipes the cost of the scheme might be £30,000 including all the compensation. If on the other hand you contented yourselves with the Gartmorn supply and only gave a high system for Clackmannan and Alloa it might cost only £20,000. Still we have 50 years we can spread over payments for this water supply and we could and we would probably be able on the security of the rates of the Burgh to borrow what money we required at 3 ½ to 3 ¾ per cent. Taking the amount to be borrowed at £25,000 and presuming the present conditions to go on the annual charge to the Burgh will be £1,250, taking an extreme figure. Against that however, you will make a profit on your surplus water of £400, which reduce the sum to be met by eth community to £850. That would mean an assessment of 5d to 5 ½d per £. I cannot of course promise you that; it might be more, but when I tell you that in Dunfermline, the water rate alone is 1s 10d per £ and in Falkirk 1s 4d per £, you will see that you will not have much cause to grumble if you pay a few pence more than 5d for your water.

17 References.

(References in **bold** were accessed using the internet.)

---

1 Erskine Family Papers, 1735, GD/1346/234/14, National Records of Scotland.
2 Erskine Family Papers, 1708, GD124/15/762/4, Edinburgh, National Records of Scotland.
3 **Bald, R.,** 1815, A General View of the Coal Trade of Scotland, Oliphant, Waugh and Innes, Edinburgh, pages 10 and 11.
4 Erskine Family Papers, 1735, GD124/17/546, Edinburgh, National Records of Scotland.
5 **Bald, R.,** 1815, A General View of the Coal Trade of Scotland, Oliphant, Waugh and Innes, Edinburgh, pages 88 - 89.
6 Erskine Family Papers, 1770, GD124/17/559, National Records of Scotland.
7 **Brodie, W.,** 1845, New Statistical Account of Scotland, Volume 8, Parish of Alloa, page 8.
8 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 16.
9 Erskine Family Papers, 1835, GD124/17/594, National Records of Scotland.
10 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 23.
11 **Alloa Advertiser**, 1891, Alloa, 7th March, British Newspaper Archive, page 5.
12 **CCC1 Scottish Government Property Pages**, 2008, Scottish Government, "Former Treatment Works, near Jellyholm Farm, Sauchie", Edinburgh.
13 **Alloa Advertiser**, 1869, Alloa, 5th June, British Newspaper Archive, page 3.
14 **Alloa Advertiser**, **1870, Alloa,** 17th September, British Newspaper Archive, page 3.
15 **Alloa Advertiser**, 1879, Alloa, 18th October, British Newspaper Archive, page 2.
16 **Alloa Advertiser,** 1883, 10th November, British Newspaper Archive, Page: 2
17 **Alloa Advertiser**, 1891, Alloa, 7th March, British Newspaper Archive, page 5.
18 **Alloa Advertiser,** 1888, Alloa, 26th May, British Newspaper Archive, Page 2.
19 **Alloa Advertiser**, 1891, Alloa, 7th March, British Newspaper Archive, page 5.
20 Alloa Water Act, 1890, Alloa, RHP43708, Bound plans and sections of proposed Alloa water supply works, Edinburgh, National Records of Scotland.
21 **Alloa Advertiser,** 1890, Alloa, 29th November, British Newspaper Archive, page 1.
22 **Alloa Advertiser**, 1891, Alloa, 7th March, British Newspaper Archive, page 5.
23 Alloa Water Act, 1891, London, Alloa Burgh, Alloa Library.
24 Ibid.
25 **Falkirk Herald, 1866, Falkirk,** 20th December 1866, pages 2 and 3, British Newspaper Archive.
26 **Alloa Advertiser, 1904, Alloa,** 7th May, British Newspaper Archive, page 3.
27 **Alloa Advertiser**, 1904, Alloa, 7th May, British Newspaper Archive, page 3.
28 **Alloa Advertiser**, 1891, Alloa, 7th March, British Newspaper Archive, page 5.
29 Erskine Family Papers, 1835, GD124/17/594, National Records of Scotland.
30 Alloa Water Act, 1890, Alloa, RHP43708, Book of Reference, page 2, Edinburgh, National Records of Scotland.
31 Erskine Family Papers, 1835, GD124/17/594, National Records of Scotland.

32 Clackmannan District Council, 1994, Alloa, CW2 Clacksweb eplanning, Application details, 94/00608/FULL.
33 **Alloa Advertiser**, 1892, Alloa, 17th September, British Newspaper Archive, page 3.
34 Erskine Family Papers, 1712, GD124/15/1057/3, Edinburgh, National Records of Scotland.
35 **Alloa Advertiser,** 1892, Alloa, 17th September, British Newspaper Archive, page 1.
36 **Alloa Advertiser,** 1892, Alloa, 13th August, British Newspaper Archive, page 1.
37 CFSS Interview with local resident Jack Archibald, 2015.
38 Ibid.
39 **Clackmannan District Council**, 1994, Alloa, CW2 Clacksweb eplanning, Application details, 94/00608/FULL.
40 **Alloa Advertiser**, 1904, Alloa, 7th May, British Newspaper Archive, page 3.
41 **Alloa Advertiser**, 1895, Alloa, 21st September, British Newspaper Archive, Page 2.
42 **Alloa Advertiser**, 1892, Alloa, 1st April, British Newspaper Archive, Page 2
43 **Alloa Advertiser**, 1896, Alloa, 18th July, British Newspaper Archive, page 1.
44 **Alloa Advertiser**, 1891, Alloa, 4th April, British Newspaper Archive, Page 2.
45 **Alloa Advertiser**, 1895, Alloa, 21st September, British Newspaper Archive, Page 2.
46 Alloa Water Act, 1890, Alloa, RHP43708, Book of Reference, page 2, Edinburgh, National Records of Scotland.
47 **Alloa Advertiser**, 1904, Alloa, 7th May 1904, British Newspaper Archive, page 3.
48 Alloa Water Act, 1890, Alloa, RHP43708, Bound plans and sections of proposed Alloa water supply works, Edinburgh, National Records of Scotland.
49 Zetland Family papers, 1892, RHP80419, Edinburgh, National Records of Scotland.
50 **Google Earth**, RAF 1945 Images, the Geoinformation Group, 2018.
51 **Alloa Advertiser,** 1895, Alloa, 21st September, British Newspaper Archive, page 2.
52 CFSS, 2016, The Two Lades Project, The Craigrie Lade, Alloa, page 22.
53 **Ibid.**
54 **Google Earth,** 2018 and National Library of Scotland georeferenced maps http://maps.nls.uk/geo/explore/#zoom=19&lat=56.1236&lon=-3.7463&layers=6&b=1.
55 Zetland Family papers, 1892, RHP80419, Edinburgh, National Records of Scotland.
56 **Alloa Advertiser**, 1895, Alloa, 21st September, British Newspaper Archive, Page 2.
57 **Ibid.**
58 **Alloa Advertiser**, 1904, Alloa, 7th May, British Newspaper Archive, page 3.
59 Alloa Water Act, 1890, Alloa, RHP43708, Bound plans and sections of proposed Alloa water supply works, Edinburgh, National Records of Scotland.
60 Zetland Family papers, 1892, RHP80419, Edinburgh, National Records of Scotland.
61 **Alloa Advertiser,** 1904, Alloa, 7th May, British Newspaper Archive, page 3.
62 **Alloa Advertiser**, 1896, Alloa, 21st November, British Newspaper Archive, page 1.
63 Gordon, C., 1966, Third Statistical Account of Stirling and Clackmannan, W Collins, Glasgow, Parish of Clackmannan, page 535.
64 **Ordnance Survey**, 1898, Second Edition, 25 inch map, Clackmannanshire, Sheet 140.01, Southampton, National Library of Scotland.

65 **Alloa Advertiser**, 1894, Alloa, 20th October, British Newspaper Archive, Page 3.
66 **Alloa Advertiser**, 1897, Alloa, 2nd October, British Newspaper Archive, page 2.
67 **Ibid.**
68 **Alloa Advertiser**, 1894, Alloa, 20th October, British Newspaper Archive, Page 3
69 **Alloa Advertiser**, 1894, Alloa, 20th October, British Newspaper Archive, Page 3.
70 **Alloa Advertiser**, 1904, Alloa, 7th May, British Newspaper Archive, Page 3.
71 **Alloa Advertiser**, 1894, 20th October, British Newspaper Archive, Page 3,
72 **Alloa Advertiser**, 1896, Alloa, 18 July, British Newspaper Archive, Page 1,
73 **Alloa Advertiser**, 1897, Alloa, 2nd October, British Newspaper Archive, page 2.
74 **Ibid,** Page 2.
75 **Alloa Advertiser**, 1896, Alloa, 19th September, British Newspaper Archive, page 2.
76 English Built Engines, Crossley, http://www.oldengine.org/members/kmorris/webpages/Engeng.html
77 **Alloa Advertiser**, 1897, Alloa, 16th January, British Newspaper Archive, page 3.
78 **Alloa Advertiser**, 1910, Alloa, 25th June, British Newspaper Archive, page 3.
79 **Alloa Advertiser, 1897, Alloa, 16th January, British Newspaper Archive, page 2.**
80 **Ordnance Survey**, 1898, Second Edition, 25 inch map, Clackmannanshire, Sheet Southampton, National Library of Scotland
81 **Ordnance Survey**, 1920, Second Edition (revised), 25 Inch map, Clackmannanshire, Sheet 140.01, Southampton, National Library of Scotland.
82 **Google Earth**, RAF 1945 Images, the Geoinformation Group, 2018.
83 **Alloa Advertiser**, 1897, Alloa, 16th January, British Newspaper Archive, page 2.
84 **Alloa Advertiser**, 1895, Alloa, 21st September, British Newspaper Archive, page 2.
85 **Alloa Advertiser,** 1904, Alloa, 7th May, British Newspaper Archive, page 3.
86 **Alloa Advertiser**, 1896,Alloa, Saturday 18th July, British Newspaper Archive, page 1,
87 **Alloa Advertiser**, 1897, Alloa, 30th October, British Newspaper Archive, page 2.
88 Alloa Water Act, 1890, Alloa, RHP43708, Book of Reference, Alloa water supply works, Edinburgh, National Records of Scotland.
89 **Alloa Advertiser,** 1894, 20th October, British Newspaper Archive, page 3.
90 **Alloa Advertiser**, 1870, Alloa, 17th September, British Newspaper Archive, page 3.
91 **Alloa Advertiser,** 1909, Alloa, 26th June, British Newspaper Archive, page 2.
92 **Ordnance Survey**, 1920, Second Edition (revised), 25 Inch map, Clackmannanshire, Sheet 140.01, Southampton, National Library of Scotland.
93 **Google Earth**, RAF 1945 Images, the Geoinformation Group, 2018.
94 **Ordnance Survey**, 1956, 1:25,000, Sheet NS99, Southampton, National Library of Scotland.
95 Gordon, C., 1966, Third Statistical Account of Stirling and Clackmannan, W Collins, Glasgow, Parish of Clackmannan, page 535.
96 **Engineering Timelines,** 2018, Internet, http://www.engineering-timelines.com/scripts/engineeringitem.asp?id=1342.
97 **Project Case Study**, 2018, Internet, http://www.expertise-limited.co.uk/jellyholm.pdf.

98 **Water Commission,** 2005, internet, WTW000670 JELLYHOLM WTW Operationally Decommissioned 10.4 Jan 05, https://www.watercommission.co.uk/UserFiles/Documents/Commentary.pdf
99 **What Do They Know**, 2018, Internet, https://www.whatdotheyknow.com/request/342908/response/838554/attach/4/WTW%20sites%20sold.docx
100 **Clackmannan District Council,** 2011, Internet, Planning Application 11/00010/FULL, https://eplanning.clacks.gov.uk/.
101 **Alloa Advertiser**, 1910, Alloa, 22nd January, British Newspaper Archive, Page 2.
102 **Alloa Advertiser**, 1909, Alloa, 26th June, British Newspaper Archive, Page 3.
103 **Alloa Advertiser**, 1910, Alloa, 26th June, British Newspaper Archive, Page 3.
104 **Clackmannanshire Council,** 2018, Internet, Gartmorn Dam Country Park, page 3, http://www.clacks.gov.uk/document/2271.pdf .
105 **Gartmorn Dam Country Park Development Trust**, 2018, Internet, http://gartmorndam.btck.co.uk/.
106 **Scottish Water**, 2013, internet, http://www.scottishwater.co.uk/about-us/media-centre/news-archive/gartmorn-dam.
107 **Gartmorn Dam Country Park Development Trust**, 2018, Internet, http://gartmorndam.btck.co.uk/.