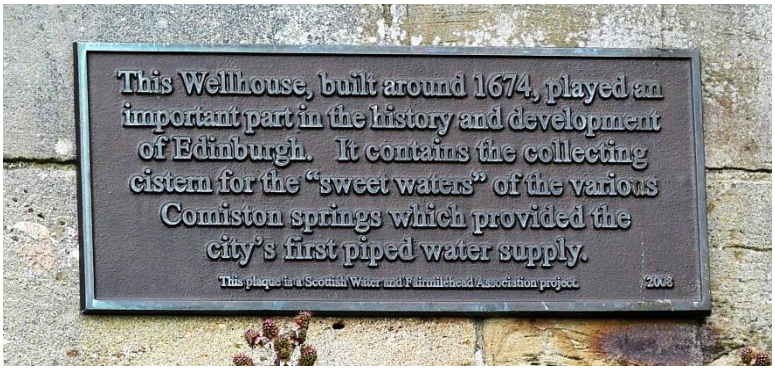
APPENDIX 1; The History of Edinburgh's Water Supply

The upper reaches of a number of the Lothian rivers and their tributaries have been dammed to form reservoirs which are associated with the water supply to Edinburgh and the neighbouring areas. I refer to some of these artificial bodies of water in my accounts of the historical journeys along these rivers, but it seems worthwhile to present a short overview of how these water systems developed. I have made particular use of a document, written by James Colston for the Edinburgh and District Water Trust, of which he was a member, and circulated in 1890; it is now available on the internet, as are other documents which I reference, and which fill in the gap between medieval times and the present day.



Although Colston is nothing loth to draw general information from ancient sources like the bible, his historical account begins in the 16th century, when Edinburgh's population of c12000 was supplied with water by wells, some private, others public and seemingly concentrated in the Cowgate, the southernmost and lower of the two main east/west roads which defined the town. By the end of that century, water from the South or Burgh Loch, now drained to create the Meadows, was also being brought to the town centre presumably in barrels set on carts. As the population grew, consideration was given to drawing water from Duddingston Loch, but by the latter part of the 17th century attention had focussed on springs at Comiston, a considerable height above the city, so making a gravity driven flow to the centre possible. By 1681, a lead pipe had been installed between a collection house at Comiston, still standing as shown in the photograph, and two reservoirs one at Heriot Green, just east of the Flodden Wall in the grounds of Heriots Hospital, now the well-known school, and the other on Castle Hill; the former supplied the south side of the town while the latter fed 5 cisterns in the town centre from where water could be drawn off. The supply rate peaked at 5625 gallons per hour, a healthy flow but it was often less as it depended in part on how much recent rainfall there had been. Enhancements were made over the next hundred years; other springs at Comiston were connected, and iron pipes of larger diameter were installed in 1722 but the flow remained of the same order for several decades. It is ironical, given what we know now

about ill-effects associated with lead pipes, that there were protests when they were replaced by cheaper rusty iron.

By Webster's credible estimate, Edinburgh's population in 1755 had risen to 57000. With those numbers to supply, and the occurrence of not infrequent droughts, new water sources became a priority, and the eyes of the burgh council lighted on springs at Swanston on the northern slopes of the Pentland Hills. However the landowner, Trotter of Mortonhall, who had extensive holdings to the south of Edinburgh, fought the scheme all the way to the House of Lords, whether in an attempt to prevent its implementation, or to increase the compensation he received, I do not know. At any rate it was 1760 when water started flowing from Swanston to the Castle Hill reservoir, at a rate which peaked at 22500 gallons per hour. This was a substantial increase but unfortunately, as with the Comiston supply the flow rate was weather-dependent, sometimes falling to 20% of the maximum after a spell of dry weather. By that time, prosperous citizens could arrange to have water piped into their houses, at a price, though the poorer majority of the population still had to rely on public wells, a range of hand-carried vessels including custom-built stoups, and either their own physical efforts or the services of paid water caddies.

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The population of the city continued to rise rapidly, reaching 71000 in the first national census of 1801, and once again additional supplies had to be sought. A scheme to build a reservoir on the north side of the Pentland Hills, at the headwater of the Bonaly Burn (which becomes the Braid Burn, and then the Figgate Burn before reaching the Firth of Forth at Portobello), and where Torduff reservoir is now, was scuppered by the opposition of landowners. With the burgh council floundering to some degree, the opportunity was seized by a private company to bring in the next enhancement, which was the first to affect one of the rivers of interest here, the North Esk. The scheme was certainly notable for the technical experts consulted, namely Professor John Playfair, Sir John Rennie, and Thomas Telford, and when eventually built, it proved worthy of their involvements. Water was collected from Crawley and Glencorse Springs, at the south-eastern end of the Pentland Hills and brought by aqueduct and tunnel into the centre of the city; the total flow available through the existing Comiston/Swanston and new Glencorse pipelines was increased threefold to 65300 gallons per hour, though it was subject to the variability usually associated with springs. They had previously fed the Glencorse Burn which flows into the River North Esk, so, to compensate the owners of the mills driven by its flow, a reservoir, Edinburgh's first, shown in the photograph above, was constructed near the headwaters of the burn, from which water could be released to top up the river. With the wisdom of hindsight, it is perhaps surprising that the great minds involved did not also recommend building a reservoir to ensure a more constant supply to the city than could be had by collecting the variable outflows from springs. It may have

been partly a matter of cost, but there were fears about the quality of water drawn from reservoirs which were only to be allayed later in the century when satisfactory filtration arrangements were devised. It is interesting also to note that Telford's report contained an analysis of the chemicals in the water, and compared them with existing supplies in other places; as ever he left less to chance than other contemporary engineers.

It was thought that this latest expansion of supply would suffice for some decades at least, but this expectation proved unrealistic. There was a prolonged period of severe drought in the early 1840s, especially in 1842, and apart from causing a much reduced outflow from the springs, the reservoir at Glencorse dried up, so giving the mill-owners along the River North Esk the right to divert water from the springs supplying Edinburgh. This brought about a crisis, but a serious problem had been fast approaching anyway, because the population, which had to be supplied had more than doubled to 166878, not just because of the rapid growth of the city, but because the water company had taken on the responsibility for supplying the then-separate burghs of Leith and Portobello as well. The response was typically chaotic; the existing water company came forward with ambitious plans to increase supply, but another company was formed to try to get in on the act, and it produced its own different scheme. As a result, each of them tried to get approval for an Act of Parliament to progress a scheme, and both were rejected. However, the existing company prevailed when it brought forward an amended proposal, which gained parliamentary approval.

The new scheme was transformative. It involved the construction of 6 new reservoirs at Bonaly, Clubbiedean, Torduff, Thriepmuir, Harlaw, and Loganlea, spread across the Pentland Hill range, and the raising (and thickening) of the dam at Glencorse Reservoir, so substantially increasing its capacity as well. The main innovation was the provision of reservoirs to collect and store spring water in times of plenty so that it no longer ran to waste, thereby at least mitigating the effects of drought. The objection to supplying water for domestic use in this way had been the expectation that it would be muddy and impure, so would clog up distribution pipes and cause illness. Filter beds employing layers of sand and gravel were installed at first at Glencorse, and soon afterwards, at Torduff, through which all the water was passed to get round this perceived problem. In effect, this meant that a significant proportion of the water flows in the River North Esk and the Water of Leith was being managed, and account had to be taken of the other major users; the mill-owners retained their right to have water released from Glencorse Reservoir to preserve a minimum flow rate in the River North Esk, and the amount allowed to them was increased, while similar rights were given to mill-owners along the Water of Leith. In 1853, when the work had been completed the population to be supplied had increased again to 195984, but water could be delivered at a steady rate of 194250 gallons per hour. This was more than double the water flow per head available after the previous major enhancement in 1820.

The water company did not rest there and as early as 1856, a scheme was brought forward to harness springs at Colzium, on the north face of the Pentland Hills, to the west of the other developments. Once again, the scheme had two elements, namely collection arrangements for the spring water which was piped into the main system, and a reservoir at Harperrig to provide compensation flows into the Water of Leith for mill-owners. When the new source became available in 1860, the population to be supplied had increased to 203580, but the available delivery rate had more than kept pace at 238500 gallons per hour. Next came a scheme to harness springs at Crosswood, even further to the west which again comprised collection arrangements and a compensation reservoir, this time for mill-owners on the Linhouse Water and the River

Almond. For all that the water company had achieved much in increasing the supply available per person, they came under attack because Edinburgh seemed to be lagging in that regard compared with other cities, with its consumption per head little more than half that in Glasgow and a third of that in Dublin.

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As is normal in such situations, the burgh councils of Edinburgh, Portobello and Leith asked an expert to report, and they received a recommendation that they should obtain water from St. Mary's Loch in the upper valley of the River Tweed, in Selkirkshire. Accordingly, they promoted a parliamentary bill to allow the St. Mary's Loch scheme to proceed, and also to take over the assets of the private water company, forming a public trust. Once again the matter reached the House of Lords because of objections by both the landowner concerned, Lord Napier, and the water company. Eventually an act of parliament was obtained to allow the formation of the public trust, but a combination of muddle, duplicitousness and intemperate statements by one Lord Provost in particular, killed the St. Mary's Loch scheme, though not before another parliamentary campaign had been fought at some cost, and a larval flea purportedly found in St. Mary's Loch had assumed the unlikely role of a deadly parasite. The eventual outcomes were the replacement of most of the trustees, who had become toxic by association with what was by then a very unpopular proposal and their unwillingness to consider other options for increase in the water supply. The only scheme left on the table was a vague proposal to build many more reservoirs in the Pentland Hills, supposedly this would have been enough to double the supply, but there was little clarity about where they should be, and the assumed cost seemed unrealistically low.

By 1872, matters had moved forward to the extent that the new membership of the trust were able to review reports on what might be termed an enhanced Pentland Hills scheme, a number of Moorfoot Hills schemes, built round the headwaters of the River South Esk, and a scheme based on the Lyne Water, a northern tributary of the River Tweed. The engineer's view of the first of these schemes was equivocal. Estimating the target supply rate based on a population of 260000 as 325000 gallons per hour, (an increase of c85000 gallons per hour on what was then available) he did not dispute that well-sited reservoirs in the Pentland Hills could compensate to some degree for a deficit in meeting the new requirements at times of drought, but he insisted that a negotiated reduction of the amount of water steered into the rivers to drive the mills would also be necessary. Compared to this conditional support, he was more enthusiastic about developing the Moorfoot Hills options, the best of which he thought capable of supplying 269000 gallons per hour, additional to the then supply from the Pentland Hills, even allowing for the compensatory flow which would have to be passed into the River South Esk, to satisfy mill-owners along its course. In its favour was the fact that the large excess over the extra flow thought necessary in the short term (c85000 gallons per hour) would allow other towns in the area to be supplied in addition to Edinburgh and its environs, and ought to extend the time interval before increasing population necessitated a search for a further enhancement.

Bizarrely given that a short time before there had seemed to be no viable schemes, another then appeared as the project of the private Midlothian Water Company, which proposed taking water from the valley of the Manor Water, another tributary of the River Tweed, to the north-west of St. Mary's Loch. Parliamentary approval was gained quickly and easily, and the Edinburgh trustees were then faced with the prospect of

losing control of the city's water supplies, only a year after their faction had gained control of the public trust. This galvanised them into action, and plebiscites were held in each of the three burghs which provided trustees. Edinburgh and Portobello voted in favour of the Moorfoot scheme, and although Leith supported the Manor scheme, the usual process of seeking approval for the former scheme began. This proceeded relatively smoothly, although the Midlothian Water Company had to be bought off, and there was the usual haggling with landowners and mill-owners. The necessary engineering work was put in train and by 1879, Gladhouse Reservoir had been created and nearby Portmore Loch adapted as a reservoir; at the same time a pipeline had been laid to bring the water to a new treatment works which had been constructed at Alnwickhill on the south side of the city. A ceremonial opening of both took place on Friday 13th June, though it is interesting to note that afterwards complaints were made by consumers about the quality and poor taste of Gladhouse water. It is hard to know now if there was anything tangible in this, but tests found nothing, so it was most likely just troublemaking by those who had failed to get their way over the choice of scheme, or simply disliked the idea of drinking reservoir water rather than spring water. A significant proportion of the water leaving Gladhouse and Portmore reservoirs was destined for the River South Esk, and to allow further topping up, two compensation reservoirs were built to the north of Gladhouse, namely Edgelaw which opened in 1880 and Rosebery which opened in 1885.

In a sense, that development more or less concludes the story of how Edinburgh's growing water needs impacted on the Lothian rivers, because increasing demands since the late 19th century have been met from sources further afield. The system as it was then is shown in the map on the next page, with the three Pentland Hills collection pipes drawing from springs and reservoirs to the north (two of them) and south of the range, respectively from the Water of Leith and its feeders (with contributions from the Crosswood Burn which flows to the River Almond, and the Bonaly Burn which reaches the sea as the Figgate Burn), and from the River North Esk and its feeders. The collection pipe from the Moorfoot Hills is also shown, and it draws from the River South Esk and its feeders, as it heads towards Alnwickhill in the city.

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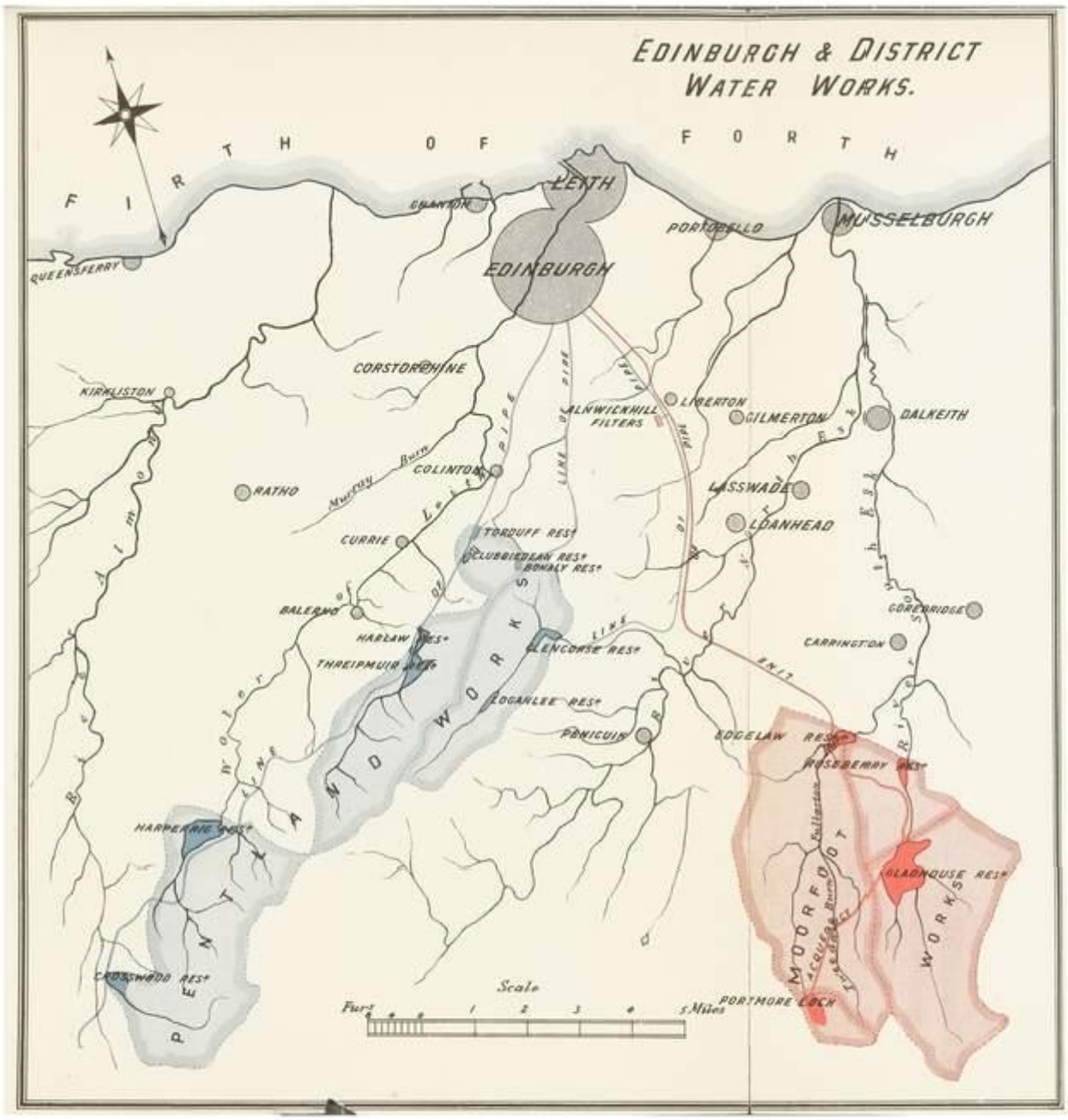
It is worth updating the story, albeit briefly. The idea of drawing water from the headwaters of the River Tweed had been around for some time in the late 19th century, though it was thought that the Moorfoot Hills scheme would postpone any further development until well into the 20th century. Nonetheless, the city population, and the rather larger population supplied by the water trust, continued to increase rapidly; the former had reached 316000 by 1901, so further developments became essential and exactly 20 years after Gladhouse Reservoir had been opened, Talla Reservoir began supplying the city through pipelines connected to its predecessors, Gladhouse and Glencorse. As a result the total available water supply rate was increased from 509000 gallons per hour, by 810000 gallons per hour to over 1.3 million gallons per hour. No further storage reservoir was deemed necessary until 1969 when Fruid Reservoir with a similar potential supply rate to that of Talla was opened, although a new treatment plant had been built at Fairmilehead in 1909. The last major development, before the present day, was the opening of Megget Reservoir, just south of Talla, in 1982, with the potential to deliver, via the latter reservoir, 2.1 million gallons per hour to the city.



By then, the total available supply rate had reached 4.2 million gallons per hour compared to the estimated supply needed for a population approaching half a million, which was 2 million gallons per hour. The 4 treatment plants which existed then, namely Alnwickhill, Fairmilehead, Marchmont (near Balerno) and Rosebery could deliver 2.6 million gallons per hour, a smaller margin, so their uprating was seen as the next priority, and plans were prepared. For all the developments up to the end of the 19th century, powerful mill-owner's lobbies had ensured that the rivers were kept running fairly full to drive their mills and most of the reservoirs we now see were installed with that in mind, while spring water was collected at source to supply the city. Watermills are an artefact of the past, so it is environmental and perhaps aesthetic considerations that now dictate how much water is normally allowed to flow down the rivers; additionally, some of the reservoirs have assumed a new role, in holding back water after downpours to prevent flooding downstream.

Finally, I shall tie up a few loose ends concerning water supply arrangements in West and East Lothian which also affect the Lothian rivers. As regards the former I shall not elaborate, save to note that the river systems involved are the Rivers Almond, and Avon, and to highlight the reservoir at Cobbinshaw at the west end of the Pentland Hills which was built in 1818 to supply water to the Union Canal at a location near Livingston. It is on the headwaters of the Bog Burn which connects to the River Almond by way of the Murieston Water, and the supply route is by way of these streams to a point on the River Almond where water is diverted into a lade which takes it to the canal. As regards East Lothian, reservoirs have been built on the northern slopes of the Lammermuir Hills, allowing water from springs feeding tributaries of the River Tyne to be tapped and collected. Thus, Lammerloch on the Kidlaw Burn began to supply Prestonpans in 1902, replacing a local well as a source of water, Stobshiel Reservoir on the Birns Water, 6½km south-west of Gifford was opened in 1911, and Hopes Reservoir on Hopes Water, 6½km south of Gifford was opened in 1933; there are other reservoirs further east towards Dunbar. The relatively late dates of construction compared with the Edinburgh supply are noticeable, and explain the fact that through most of the 19th century, the water supplies, at least to the coal-mining areas in the west of the county were provided by wells which were often unreliable and unhygienic; indeed the mining operations seem to have disrupted the flows from springs into wells in such places as Tranent, where there were a number of cholera outbreaks. No doubt, matters were better ordered in the more prosperous rural parts of the county, and I have found references to the utilisation of springs at Aberlady, Keithhill, Longyester, Gifford, Chesters, Innerwick, Oldhamstocks, Dunbar, and Stenton. In 1969 Whiteadder Reservoir with an area of 121ha was opened, transforming the water supply arrangements such that the mean supply rate to East Lothian users reached 300000 gallons per hour.

Although I knew the locations of most of the reservoirs before I began this project, I knew little of the history, and in particular was unaware of the distinction between compensation and normal storage reservoirs, so I have been enlightened, and hopefully any reader will find the story interesting.