Two Estates Project

Clackmannanshire Field Studies Society

in partnership with

The Inner Forth Landscape Initiative

Clackmannanshire Colliery Waggonways

(Revised Edition 30/07/2016)

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Cover: Walking the Clackmannan Waggonway at Westfield, © Alba Photographs, 2014.

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Introduction

The Clackmannanshire Field Studies Society obtained a National Lottery grant through the Heritage Lottery Fund in partnership with the Inner Forth Landscape Initiative 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. Both estates had been extremely active in coal mining and extensive horse-drawn waggonway networks had been constructed to transport coal away from their pits.

These networks played a key part in the development of coal mining and had never been comprehensively researched. In addition, the physical remains, while still substantial, have been steadily removed by industrial, commercial and residential development. It was decided to concentrate the first year's work on researching the rise and decline of these waggonways and recording their remains.

The research was extended to include the other three colliery waggonways which had been constructed at Kennetpans, Coalsnaughton and Alva. Twenty three local volunteers were involved in undertaking the desk and field based research into these waggonways from May 2014 to June 2015.

Additional field surveys on new projects and the on-going collection of information has added to our understanding of the development of the waggonways and this second revision incorporates this new information.

Acknowledgements:

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- Ordnance Survey Open Data whose easily accessible maps provided us with a base set of locations for rivers, streams and the boundaries of modern urban areas;
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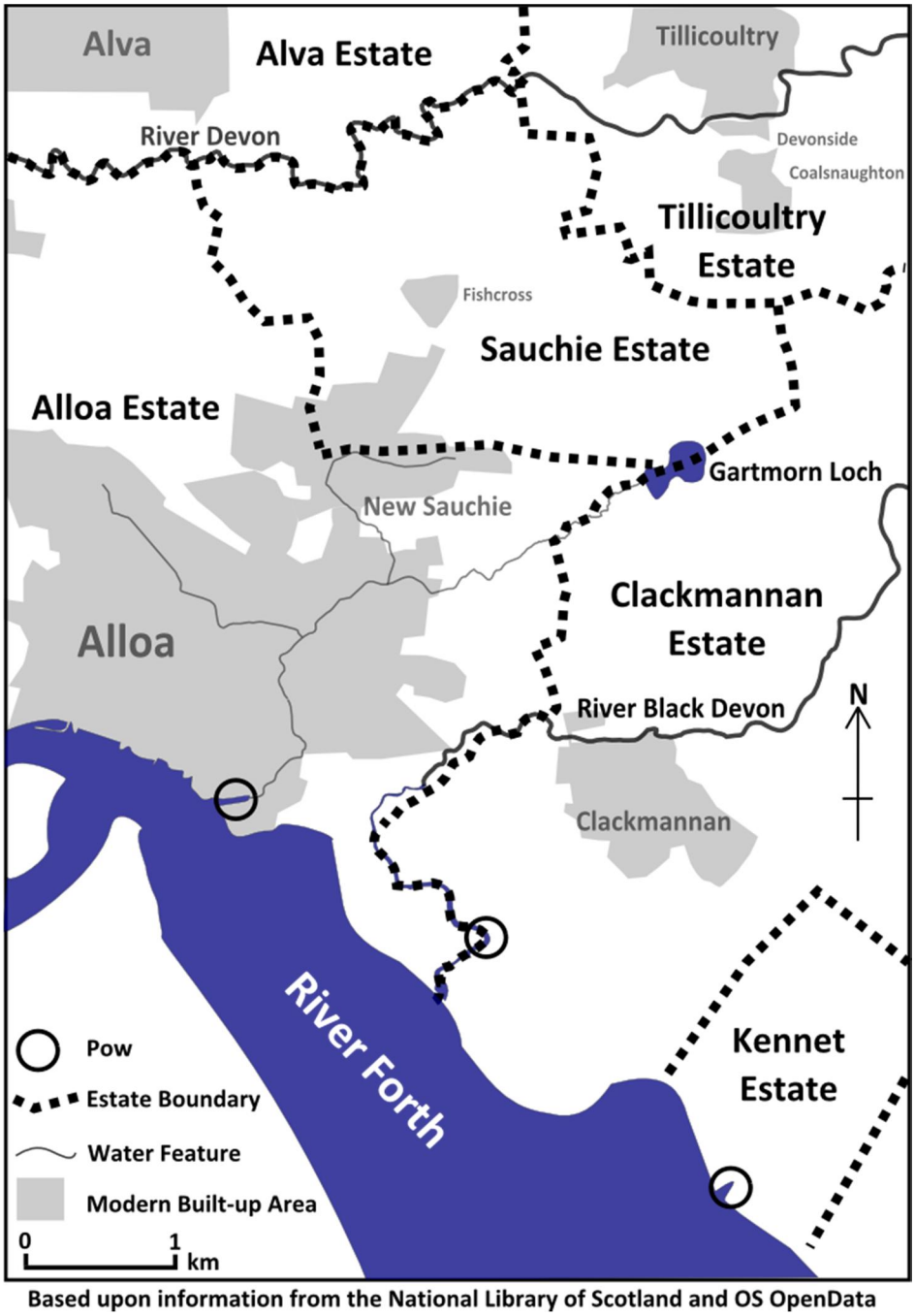
With special thanks to Eddie Stewart and Susan Mills for their constant support, David Seaton for his stalwart research and my wife for her amazing patience and consideration.

The Clackmannanshire Estates: At the close of the 17th century the area of research was divided into six principal estates. While estate boundaries were complex and subject to change through time, these estates were roughly located on the map as: Alloa Estate, owned by John, 6th Earl of Mar in the south west; [1] the Clackmannan Estate, David Bruce of Clackmannan, in the south centre; [2] the Alva Estate, Sir John Erskine in the north west; [3] the Sauchie Estate, Lady Schaw in the centre; [4] the Tillicoultry Estate, owned by Lady Tillicoultry in the north east [5] and the Kennet Estate, owned by David Bruce of Kennet in the south east. [6]

Figure 1. Clackmannanshire Estates, circa 1700.



Based upon information from the National Library of Scotland and OS OpenData

Early Coal Mining in Scotland and Clackmannanshire: The earliest records of systematic coal working in Scotland come from the monastic records of the 12th and 13th Centuries. In 1291 Dunfermline Abbey was given the right to work coal on the lands of Pittencrief. [7] These early workings were located on the coast or on the sides of a valley where seams were exposed. Coal was dug out until the workings became flooded or the roof was in danger of collapsing, when new workings were opened. Where seams lay close to the surface, small shafts were dug and workings belled out at the base. Again, these workings would be abandoned when drainage or roof collapse problems occurred.[8] By the 14th and 15th centuries, more extensive workings became accessible by the use of day-levels; sloping tunnels driven up from a stream in the base of a valley to intersect with the coal seam. The area of coal above this point could then be drained. Once the initial cost of driving the day-level, had been met, maintenance costs were low and shafts, usually not more than 70 – 80 feet (25 metres) deep, provided a means of getting the coal to the surface. [9]

By 1426, the Scottish Parliament recognised that coal and other goods being traded by sea had a tax value and passed an act ensuring that all goods coming by water, including coal, be recorded and sellers were obliged not to avoid this process. [10] There is evidence that some coal was used at this time as a domestic fuel. Pope Pius II, on a visit to Scotland in 1435, noted that, *"in the absence of wood, a sulphurous stone, dug out of the earth, was used for fuel"* and observed *"half-naked beggars at the church doors, receiving this substance by way of alms*". [11] By 1563 the exporting of coal was the subject of punitive legislation as it had resulted in a *"…great multitude of coal continually carried out of this realm, not only by strangers but also by the lieges and inhabitants of the same, which is now becoming the common ballast of empty ships and gives occasion of the most exorbitant dearth and scantness of fuel within the same…*.". [12]

The earliest known record of a coal pit in Clackmannanshire was on the Alloa estate in 1519 [13] and by the end of the 16th century there are records of coal also being worked on the estates of Clackmannan [14] and Sauchie. [15] However, increasing legislation placed heavy burdens on coal owners and in 1609 Sir Alexander Schaw of Sauchie, who was working coal near his home, became the chief spokesman for all Scottish mine owners. He campaigned for the abolition or modification of all restrictive laws, regulations and duties. [16] A custom duty of 48 shillings per ton of coal was rescinded in 1625 in response to answers to the Scottish Parliament who agreed that *"The estaittis haveing at lenth hard the saidis awnaris upoun this poynt and the trewth of thair affirmatioun being knowne to sindrie of thame and the matter being putt to voitting, it was fund that without a seine and evident hurt to the cuntrey this custome could*

not be impoised upoun the coale". [17] So successful was Schaw in his demands for a revaluation of the coal-pits in Clackmannanshire that this was ordered in 1649. [18] By the middle of the 17th century much of Scotland's trade was centred round the North Sea [19] and the Alloa and Sauchie estates were transporting coal to Alloa Pow for export. [20] In 1631 John, 2nd Earl of Mar, wrote a letter of support for Peter Breware, declaring that he "*trades in transporting coal to Flanderis [Vlaanderen, Belgium] and importing other wares to Scotland*" and a request to "*all and sundry to give him aid*". [21] In addition to this export trade, there was a market for "panwood" (i.e. small coals) from the salt pans springing up along the Forth estuary and this growing industrial market became a great encouragement to the development of coal mining. [22] The domestic demand for coal was still very limited and for another century peat remained in use as the main domestic fuel in most country districts. [23]

The earliest pits at Alloa were very small surface workings or shallow workings drained by a day level. [24] The introduction of horse powered gins offered the chance to work seams which could not be drained by day levels, but were costly to run. An indication of this cost is found in the granting by King James VI on the 20th May 1596 of a coal export licence to Sir Alexander Bruce of Airth on payment of £40. The reason given for the request for the licence was the high cost of keeping colliers (both men and women) and the loss of 3 to 4 score (60 – 80) horses "*working continually to keep his coalheuchs dry*". He also stated that he had borne a considerable cost in providing corn and straw for his horses. [25] Windmills were tried as a source of power, but not found to be reliable when round-the-clock drainage was required. [26]

There is a record of a horse powered drainage engine at the Alloa colliery in the late 17th Century being "*cog and run – a wheel with teeth running into a trunion or lanthorn pinion, as in the old corn mill*", with chains and buckets used to drain to a depth not exceeding 15 fathom (30 metres). [27] This bucket and chain gin was powered by water from Gartmorn Dam, but did not have enough water to work all the time as the dam was fed by the Brothie Burn, a small stream. [28] By the end of the 17th century, the introduction of water powered drainage machines allowed the mining deeper seams of coal at a lower cost. By 1715, water powered drainage gins had been installed in the collieries at Clackmannan, [29] Alloa [30] and Alva [31]. The remains of a grain windmill, later converted to a dovecot, [32] are to be seen on former Sauchie Estate (NS 8982294984), indicating the lack of a source of usable water power in the area of higher ground on the south side of the river Devon on the estates of Alva, Sauchie and Tillicoultry. The new gin at Alloa was described in 1713 as a

water wheel located in the Carsebridge Colliery with buckets and pudding link chains, draining a shaft 40 fathoms (80 metres) deep to the nine foot coal. [33]

Most of the coal from pits in the Forth estuary was exported by sea and mined as great or sea coal. These were large pieces of between one and one and a half cwts. (51 to 102 kg) which were cut by the miners, carried by women bearers up stair pits to the surface and packed into ships to prevent breakage. [34] Ships carried only small loads and any Great Coal damaged in transit lost a great deal of value and sometimes was not worth anything. In 1614 an agreement between Sir John Bruce of Airth and a London coal merchant stipulated that each ship "*… should contain 40 tons of coals and no more*" and that "*all the dust or smaller coal be cast and not accepted... "*. [35] The export trade in coal was a source of revenue to landowners who owned harbours and had the right to payment for their use. The Erskine family were granted the privilege of the port and harbour of Alloa by James VII in 1685. [36] In addition, the road leading from the north into the town of Alloa and on to the harbour was owned and maintained by the Erskine family and they had the right to demand "gate mail" for each chalder (1.52 metric tons) of coal transported to the harbour. [37] Seams were worked by the method of Stoop and Room with the stoops being left unworked to hold up the roof. This meant that a substantial proportion of coal was not mined (estimated by Robert Bald in 1841 as about one third of a seam). He also noted that, as chews (small pieces of coal) and culm (coal dust) were not of great worth, they were sometimes thrown into the waste areas of the pit. [38]

Roads were so poor that coal for inland sale had to be borne on the backs of ponies that carried two hundred weights (100 kilogrammes) at a time [39] while coal carried to the shore was transported in small farmers' carts carrying only about six hundred weights (306 kilogramme. [40] A description of carts of this period was given in the Old Statistical Account of Alloa: "*The carts in common use consisted of a few boards, ill-put together, and of a size not larger than a good wheel barrow, placed upon a thick wooden axle, which was fixed to some low wheels, composed of three pieces of wood, joined together by two or three large wooden pins. The axle turned round with the tumbrill wheels*". [41] As well as being only capable of carrying a small quantity of coal, this means of transporting coal was mainly limited to drier weather [42] and not considered reliable. [43] Mining coal was an expensive business. As well as the cost of sinking shafts and providing drainage, there was the difficulty of acquiring and keeping miners. In 1606 the Scottish Parliament had legislated that "*no person within this realm hereafter shall fee, hire or conduce any salters, colliers or coal-bearers without a sufficient testimonial of their master whom they last served*" and included provision whereby "*vagabonds*" could be

placed into compulsory labour as colliers or salters [44] Despite colliers being virtually enslaved to the colliery owners, in 1655 a financial statement of the Mar estate in Alloa noted that the Alloa colliery had been unprofitable for the past seven years on account of lack of colliers [45] and in 1735 Sir John Erskine of Alva recorded the names of colliers who had run away. [46] Even when coal was carried to the surface, there was the danger of theft. Court records for Clackmannan on the 23rd December, 1698 indicate that *"the sherrif depute unlaws (fines) the heall inhabitants within the town of Clackmannan and green thereof in five pound Scots for each one of them for stealing and resetting of coal (other than 21 named individuals)".* [47] There was also the risk of fire, either from arson [48] or from the use of oil lamps and candles, which could close workings for a long period of time. Both the Alloa [49] and Sauchie [50] collieries suffered major fires, which shut pits for twenty to thirty years and put seams above and below the fire at risk. There was also the constant risk of breaking through into old, uncharted workings which might be filled with water. [51] Lastly, there was a preference in all the towns supplied with coal from the pits in the Forth Estuary for Great Coal in the form of single large lumps of coal about one to one and a half cwts (51 to 102 kilogrammes) in weight. This preference did not affect pits in other areas of Great Britain. It caused a considerable loss of income for coal pit and ship owners in the Forth estuary and their difficulty marketing smaller coals (chews, dross and culm) was only mitigated by the demand for cheap fuel from the salt pans. [52] The author of the Old Statistical Account of Alloa noted in 1796 that "*more estates have been lost than made by working coal mines*". He made the point that it was very expensive to sink a pit and maintain it and that, as coal did not command a great price, only by mining a considerable volume could a reasonable profit be made. [53]

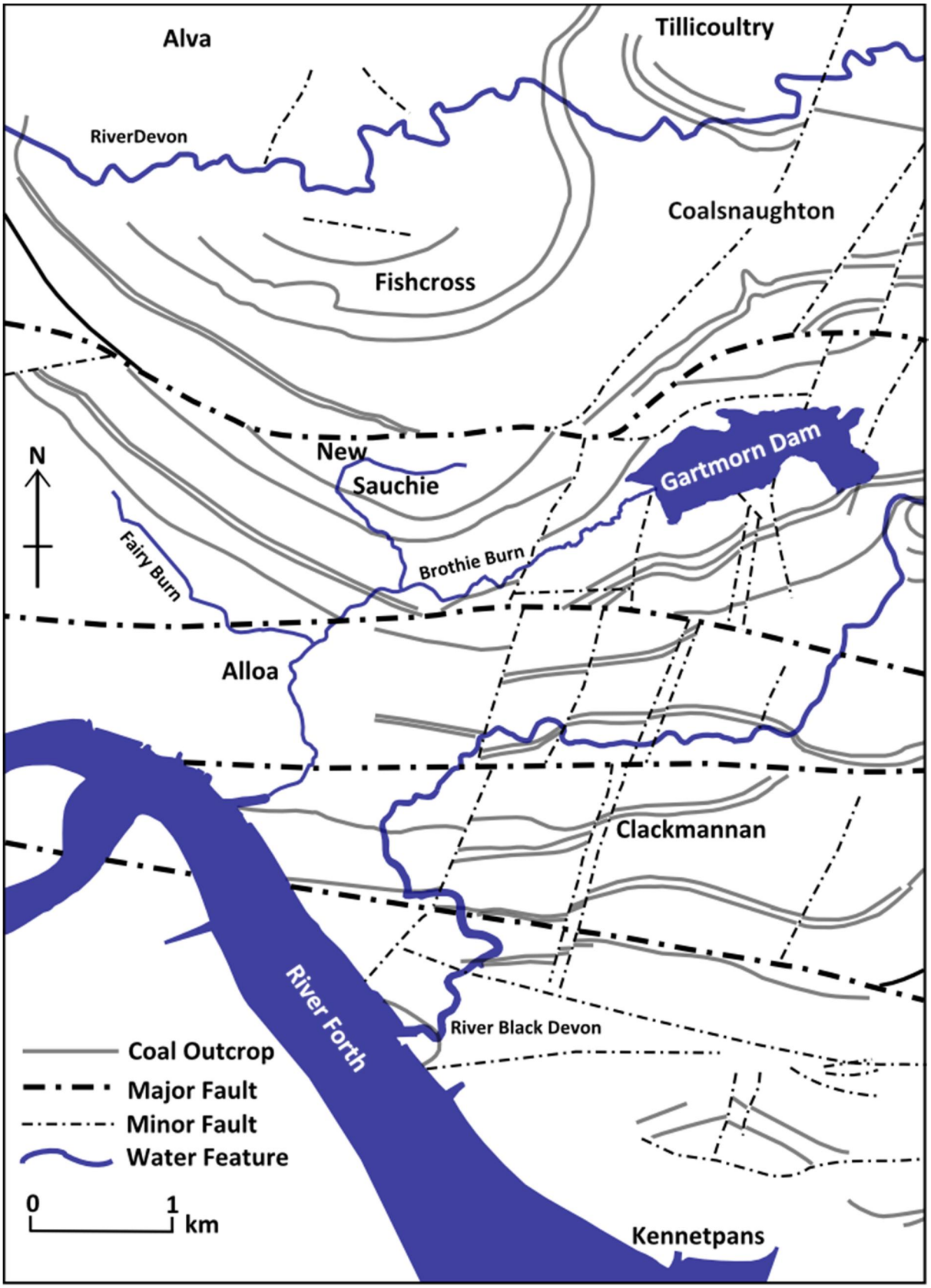
Helped by Alloa becoming a customs port in 1710, [54] the trade in coal and salt from Alloa, Clackmannan and Kennetpans began to grow. By 1750 it is reported that as many as 170 vessels lay in the Forth at one time to receive the produce of the mines and salt pans from Alloa to Culross. [55] However, the families of Erskine of Alloa and Bruce of Clackmannan were unable to take advantage of this; Sir John Erskine, the Sixth Earl of Mar, having been exiled to France for his part in the unsuccessful Jacobite uprising of 1715 [56] and David Bruce of Clackmannan having gone into bankruptcy, partly as a result of the cost of improving his pits. [57] The Clackmannan estate passed to the Dalrymple family [58] while the Alloa estate was managed by the Commission for Forfeited Estates for a time [59] before being purchased back by the Erskine family of Grange in 1724. As the son of the purchaser had married his cousin the daughter of the 6th Earl, the control of the Estate returned to the Erskine family of Alloa. [60]

Geology of the Clackmannanshire Coalfield: In the late 17th century, with cheaper and more reliable drainage provided by extensive day levels or drainage engines, mining in Clackmannanshire moved from small scale, shallow workings to slightly larger, deeper pits. As a result of mining deeper seams, the nature of the coal seams and the shape of the landscape began to play a more significant part in the development of mining. Robert Bald, an eminent 19th century mining engineer, provided a concise, accurate description of the Clackmannanshire Coalfield in the New Statistical Account of Alloa in 1841 and noted the opportunities and challenges it offered to mine owners. [61] The coalfield was known to be in the form of an elliptical basin, extending some eleven kilometres from the west of Alva to the east of Dollar and some seven kilometres from the Ochil hills in the north to the river Forth in the south. As a result of the basin shape, most of the coal seams dipped to the North or North East at a slope of about 1 in 6.

The basin was crossed by three major West to East faults. These were the Abbey Craig Fault [a throw of 91 metres], the Alloa Fault [a throw of 146 metres] and the Polmaise Fault [a throw of 165 metres]. These faults divide the basin into four coalfields. The Coalyland coalfield lay to the north of the Abbey Craig fault, the Carsebridge coalfield lay between the Abbey Craig fault and the Alloa fault and the Clackmannan and Kennet Coalfields lay between the Alloa fault and the River Forth, divided into north and south sections by the Polmaise fault. There were also a considerable number of North to South faults, mainly in the eastern half of the basin. The Coalyland coalfield had very few such faults, while the other coalfields were divided by many North to South faults into small wedges.

This meant that the Coalyland collieries and the collieries in the western section of the Carsebridge coalfield were easier to work, as their coal seams were largely undisturbed. The eastern part of the Carsebridge coalfield and the Clackmannan and Kennet coalfields were heavily faulted into small, wedge-shaped blocks and had to be worked in small, separate sections.

Figure 2. Geology of the Clackmannanshire Coalfield.



Based upon information from the National Library of Scotland and OS OpenData

There were a great many coal seams in the Clackmannanshire coalfield and the thickness of the seams varied considerably from place to place. One coal, for example, varied from six feet at Fishcross to three feet at Clackmannan. [62] The vertical section below was created by John Williamson, of the Geological Survey in 1877. It shows all of the significant coal seams. [63] A horizontal line indicates a thin parting between adjacent seams.

Coal, rough	1 ft. 6 ins	
Coal, rough	1 ft. 8 ins	
Coal, rough	2 ft. 0 ins	{Two Foot Coal and ironstone
Coal	3 ft. 6 ins	
Coal	3 ft. 0 ins	
Coal	2 ft. 2 ins	{Upper Five Foot Coal
Coal	3 ft. 1 ins	{Upper Five Foot Coal
Coal	2 ft. 0 ins	{Four Foot Coal
Coal	2 ft. 2 ins	{Four Foot Coal
Coal	2ft 0 ins	
Coal	1 ft. 11 ins	
Coal	0 ft. 10 ins	Blackband Ironstone
Coal	9 ft. 8 ins	{Nine Foot Coal
Coal	2 ft. 8 ins	{McNeish Coal
Coal	0 ft. 6 ins	{Crowburn ironstone
Coal	1 ft. 7 ins	
Coal	1 ft. 5 ins	{Coal Mosie
Coal	5 ft. 3 ins	{Lower Five Foot Coal (Alloa Cherry)
Coal	2 ft. 2 ins	{Alloa Splint Coal
Coal	3 ft. 8 ins	{Coalsnaughton Main Coal

Bald noted that the surface of the lower land in Clackmannanshire could be divided into three major types. Next to the river Forth was a wide, level alluvial plain or Carse of heavy clay, rising landwards. This was separated by a sharp rise from another relatively level area of heavy clay at about 40 metres. Above this were rolling clay ridges orientated in a West to East direction, with a blunt end to the West. [64] A modern interpretation of this landscape indicates the lowest area is composed of marine and estuarine alluvium known as Carse clays and has a landward edge at about 10 metres OD marked by a steep feature separating it from level, raised marine deposits at about 40 metres. Above this, the landscape was underlain by glacial clay, moulded by the flow of ice into west to east ridges called drumlins. The thickness of glacial clay varies greatly, from a thin skin to a depth of 60 metres North of Alloa. [65]

The Alloa Waggonway: In the mid-18th century the pits of Alloa, Clackmannan and Kennetpans were relatively close to the shore. In contrast, the transport of coals from the pits on the estates of Alva, Tillicoultry and Sauchie to the shore was more difficult. Not only were these pits further away from the shore, the Erskine family had developed a "coal road" through their estate to the town of Alloa and on to the shore. They had established the right to charge other landowners for using it and for loading their coals at Alloa harbour. [66] As a result, these three estates had the bear the additional cost of this "gatemail".

In his proposals for the improvement of his estate and the town of Alloa, John, 6th Earl of Mar has proposed a "Lime Tree Walk" down the centre of Broad Street, linking the old town to the harbour. One of his drawings shows a proposed "Coal Road" parallel to Broad Street designed to take the coal carts off his "Lime Tree Walk". [67] However, the Roy Military Survey of Scotland (Highland area - circa 1750) shows the line of the coal road from the harbour (NS 884920) up the line of Broad Street, suggesting that the Earl's proposed by-pass was never constructed. [68] The coal road continued from the top of Broad Street, through the Coalgate into the High Street and then along the northern edge of the town of Alloa, past the Erskine's mining settlement of "*Coleton*", then northwards past the 6th Earl of Mar's 1713 "*Water Engine*" on to the junction with the Tullibody to Coalsnaughton road at modern day Fishcross (NS 8989395363). Wood's map of the Town of Alloa in 1825 shows the route of the waggonway from the shore, following the line proposed by the 6th Earl of Mar for his "coal road". [69]

By the middle of the 18th century it was clear that the transport of coal from pits to the shore was becoming a serious issue. While the gatemail was a source of income to the Alloa Estate, the maintenance of the coal road was a drain on it. [70] More importantly, the use of farm carts on poor quality roads meant that the movement of coal was difficult, unreliable, costly and, as great or sea coals (large pieces) were being transported, likely to lead to damage and loss of value. The use of horse drawn waggonways had become common in English and Welsh coalfields for some time and several had been introduced in other parts of Scotland. [71] These waggonways were constructed of a number of cross pieces of wood (sleepers) upon which two wooden rails were pinned. Waggons had cast iron, flanged wheels which kept them on the rails. [72] The waggonways were usually single tracks, with regular passing places and routes were carefully planned to offer a gentle slope down which waggons could pulled with ease. The gentle slope meant that the main tasks of the

horse were to get the waggons moving when loaded and pull them back up the slope when emptied. [73]

As the second half of the 18th century began, several events came together which must have encouraged the Erskine family to consider constructing a waggonway. In 1757 a new 265 feet long quay had been built on the north bank of Alloa Pow. [74] By 1759 they had coal workings in both the Carsebridge colliery at Coleton [75] and in at the Collyland colliery. [76] In 1760 there was a serious trade slump, reflected in the accounts of the Alloa Colliery, perhaps encouraging Lady Frances Erskine to set up her Glassworks at Alloa Shore. [77] Essential raw materials for making glass were easily available – sand and ashes of seaweed from lower down the Forth Estuary, salt from the saltpans at Kennetpans and Clackmannan and coal from the Erskine's collieries. [78] Alloa harbour was extended again in 1761 with an additional 181 feet (54 metres) long quay linking two older ones. [79] The Nine Foot coal at the Alloa Carsebridge colliery was worked out by 1763 [80] and new workings were opened in 1764 at 48 fathoms (88 metres) to access the Upper Five Foot coal there. These new workings were drained by a waterwheel at the Watermill Pit (NS 8947293708) driving pumps made from hollowed out plane trees. [81] In the same year a Newcomen steam engine was built at the Collyland colliery to drain the Nine Foot coal there. [82] All of these developments would enable the Erskine family to increase their coal extraction and facilitate export from the shore at Alloa.

The First Alloa Waggonway, 1767-68: The Estate of Mar was at this time entailed, meaning that it was passed on to the eldest male in the family with restrictions on the sale or rental of the property. [83] In 1767, with the consent of Lady Frances Erskine, a contract was agreed by the trustees, to let the coal workings to a co-partnership of Haig, Deas and Company for a period of seven years, ending in 1774. The co-partnership was formed mainly of Alloa merchants and some Edinburgh merchants. [84] A second contract in 1772 for the construction of a waggonway to Collyland [85] refers to a first seven year contract having still two years to run. This suggests that the construction of the first waggonway from the shore to the Alloa colliery was started in 1767. As this second contract indicates that "*The terms and conditions of the tack the same as the last except the prices*", it implies that this earlier contract to lease the coals to Haig, Deas and Company was linked to the construction of the first waggonway. The terms of the Collyland contract in 1772 also indicate that the first waggonway was funded by a loan with both the Erskines and the co-partnership contributing to the payment of the interest and repayment of the capital being

undertaken by the Erskine estate. There is further evidence supporting the opening of the first waggonway line in 1768. [86]

An anonymous sketch suggests a route for the first Alloa waggonway. Although it is undated, it is thought to have been drawn up shortly before the waggonway was built. [87] Starting at Alloa harbour, a single track would turn northwards across the Carse, with a cutting taking the waggonway up on to the higher ground. A passing place would afford the opportunity for waggons going up to pass waggons coming down. The valley of the Fairy Burn was to be crossed by a bridge and the route would then turn eastwards, leading to a long straight terminating at a coal fauld. The sketch also shows the Erskine's "Coal Road" crossing the Fairy Burn on a "Coal Bridge" and the waggonway then skirting the southern edge of the Coal Road. Another anonymous, undated sketch shows the detail of a proposed wooden waggonway bridge across the Fairy Burn. [88] This was to be five feet (1.52 metres) broad and made of five inch (12.7 cm) planks supported by 10 inch (25.4 cm) couples.

Comparison with the actual route of the waggonway shown on the First Edition Ordnance Survey 25 inch maps of 1861-63 [89] shows the same key points of harbour, cutting, passing place, bridge and straight section, suggesting that the sketch plans were implemented more or less as proposed. The first waggonway was constructed with the rails formed from *Scots fir scantlings 4 inches by 5 inches* (10 to 12.5 cms.) *fixed by wooden pins to sleepers near to each other.* A second top rail of the same material was soon added, but this wore rapidly and was replaced with a rail of beech. The waggonway was transporting horse drawn waggons weighing about one ton (1.02 metric tons) and carrying a chalder of coal (1.52 metric tons). [90] Although there is no contemporaneous evidence, it is likely that this first waggonway had an early branch near the shore to the Erskine's Alloa Glass Works, the line of which is shown on Woods map of Alloa in 1825. [91] The waggonway carried much more coal than could be transported along the Coal Road by cart and the journey was also faster, more reliable and very much smoother, therefore there was less danger of the Great Coals being damaged.

Field research has shown that this section of the waggonway was 2.08 kilometres in length, starting at an elevation of 24 metres near the Whins Toll, descending steadily until it reached an elevation of 3 metres at the Alloa Shore. Google Earth was used to establish lengths and elevations. Wherever possible, elevations were checked against contours and spot heights on Ordnance Survey (OS) maps. The line of the old Coal Road runs southwards from New Sauchie (NS 8932693832) down Hallpark Road to the Whins Toll (NS 8943093467). Somewhere along the line of this section

would have been the coal fauld, collecting coals from the access pits of the Erskine's Alloa Colliery in the Carsebridge coalfield which was drained by the newly sunk Watermill pit (NS 8946993704). There is a very wide roadside footpath at the Whins Toll (NS 8942593495) which was on the line of the waggonway. A pathway from the Whins Toll (NS 8939493403) follows the route of the waggonway into Argyll Street (NS8933493373), where it continues to another pathway (NS 8893793237) which leads to a 19th century bridge over the railway (NS 8879293121). This bridge was built when the Fairy Burn was culverted to enable the construction of Alloa station and is on the site of a waggonway bridge shown on Wood's map of Alloa in 1825, named as the "Goat Bridge". [92] The railway bridge was raised in height recently when the Alloa to Kincardine line was reopened.

The next section of the waggonway has been lost by the development of a dual carriageway but the line is picked up by a pathway leading into a cutting heading towards the shore. The cutting is very well preserved, having been paved, and now serving as a pedestrian route from the town centre (NS 8863593053). It has been bridged at some point at two points; Mars Place (NS 8857592939) and Bedford Place – two adjoining bridge sections (NS 8847792643) and has a broader section (NS 8850692732 to NS 8854692858) which corresponds to the proposed passing place on the sketch plan and the location of a passing place shown on the first edition of the OS 25 inch map in 1863. [93] There are traces of the remains of a small embankment (from NS 8841892425) running southwards from the line of the waggonway cutting. The start of the branch line into the glass works is preserved as modern day Castle Street but all other remains at the shore have been lost to development.

The Collyland Extension, 1772-1774: By 1771 the first waggonway was so successful that the Erskine's considered extending it to their colliery at Collyland. [94] Tracking the route of this extension proved much more difficult as it did not appear in its entirety on any early maps and there are two conflicting suggestions in secondary sources. There are several references which suggested a route from near the Whins in the Carsebridge area (NS 8941693522), via Fairfield Road to Collyland (NS 884953). These included a local publication by Adamson in 1980 where it is stated that the waggonway ran up the "Tinker's Loan" towards Collyland, a route which locals called the "Coalin Road". [95] There were also suggestions that it might have reached Collyland by way of Fishcross to Diverswell (NS 890958), to the south of Collyland. [96]

There is record in the Erskine Family papers detailing the proposals for the construction of an extension of the waggonway to Collyland in 1772. [97]

Unfortunately, while it gives many details of the work required and the financial arrangements, it does not give any indication of the route. In return for a seven year tack (lease) of the coals the tacksmen (lessees) would be required to pay the estate a fixed rate for each chalder (1.52 metric tons) from the Alloa colliery of 6s and 4 1/2d (32 new pence) and the Collyland colliery of 7s 2½p (36 new pence), deliver the coal to the shore and have it loaded on board ship. Once the coal was sold at the shore, they would be required to pay the estate half the value of any sale price beyond the fixed rates. The proposed contract estimated that the tacksmen could make a profit of some £300 per annum. The contract also includes a requirement to build a pier to the west side of the Pow at Alloa, enclose a 100 acres (40.5 hectares) of land with hedges and ditches, construct a barn and stables and run the resulting farm for a year.

The proposed contract stipulated that the lessee would be responsible for constructing the waggonway, provide waggons and horses and have the pier, farm and the waggonway operating by September 4th, 1772. The contract mentions an earlier tack which had still two years to run, which is referred to as "*your present tack*" and offered the new lease on the same condition, except the prices required for coals. Although the contract does not name the potential tacksmen (lessees), the reference to "*your present tack*" with two years still to run, suggests that this proposal was linked to the seven year tack granted to Haig, Deas and Company in 1767.

The terms of the second contract suggest that the first waggonway was funded by a loan and that a new loan for the improvements to the pier and farm and construction and fitting out of the waggonway was £2,020. It was indicated that the Erskine estate would meet most of the costs of interest and all of the capital repayments. The proposed new contract suggests that the average volume of coals produced in the previous three years was: "*Alloa Coals - 7,640 Chalders* (11,644 metric tons) *of the Coalyland Coals – 6,000 chalders* (9,144 metric tons)". It goes on to indicate that money would be provided by the estate for the wages of the shoregrieve at Alloa harbour and for loading the coal on board ship, which would usually be undertaken as soon as the waggons reached the shore. The tacksmen would be responsible for paying for a shore guide and £101 annual interest on a loan of £2,020.

The proposed contract concludes by suggesting that the Tacksmen could make 6 9/12 d (2.9 new pence) profit per chalder (1.52 metric tons) on the Alloa Coal and 4 3/12 d (1.75 new pence) profit per chalder (1.52 metric tons) on the Collyland coals, making a gross profit of £300. It also suggested that the price of the Collyland coals might increase, giving a possible additional profit of some £62 per annum. This suggestion is supported by an advertisement in the Edinburgh Caledonian Mercury

on the 14 December 1772 which stated that "*There are now offered, at both Alloa and Coalyland, some new pits of coal, of the finest quality, and at the following prices : Coaly land Main Coal, being of the same seam of the well-known Old Sauchy coal, at 8s. 4d. per waggon. Alloa Newton coal, hard and splinty, fit for any market, at 7s 6d (37.5 new pence) per waggon. Alloa Old Gin coal at 7 s (35 new pence)*". [98] The use of the term "per waggon" for the Alloa Newton coal suggested that the waggonway might have been extended to Holton. The reference to the Coalyland coal being the same seam as the Old Sauchy coal fits with it being the Nine Foot coal, which outcrops just to the south of the Old Sauchie colliery. [99]

Project volunteers spoke with a number of local residents who confirmed the term "Coalin Road" and identified it as starting on Fairfield Road (NS 89037694244) and rising NW up the line of the present B908. An examination of the First Edition of the 25 inch OS map of 1863 [100] showed a waggonway running from the route connecting to Alloa harbour (NS 8917694027) up the line of Fairfield Road and turning NW (NS 89037694244) towards the No. 9 Pit (NS 89037694244) which was shown as abandoned.

Google Earth's cover of the area shows two distinct straight lines in the woodland area at the summit of the B908. The more westerly line is 175 metres long, follows the adjacent field boundary and leads into a distinct crop mark in the field to the north. This crop mark runs in a NW direction for 540 metres and ends at the site of an old shaft (NS 8794095282) marked on the 1926 Second Edition of the Geological Survey of Scotland map. [101]

Figure 3. Cuttings and Crop Marks.

The second line runs from the first (NS 8853094781) and heads northwards for about 180 metres to the summit of the ridge (NS 8859294659). There is no evidence on the 1926 geological map at the end of this line but the Coal Authority's Interactive Map shows two mine shafts near to this location. [102]

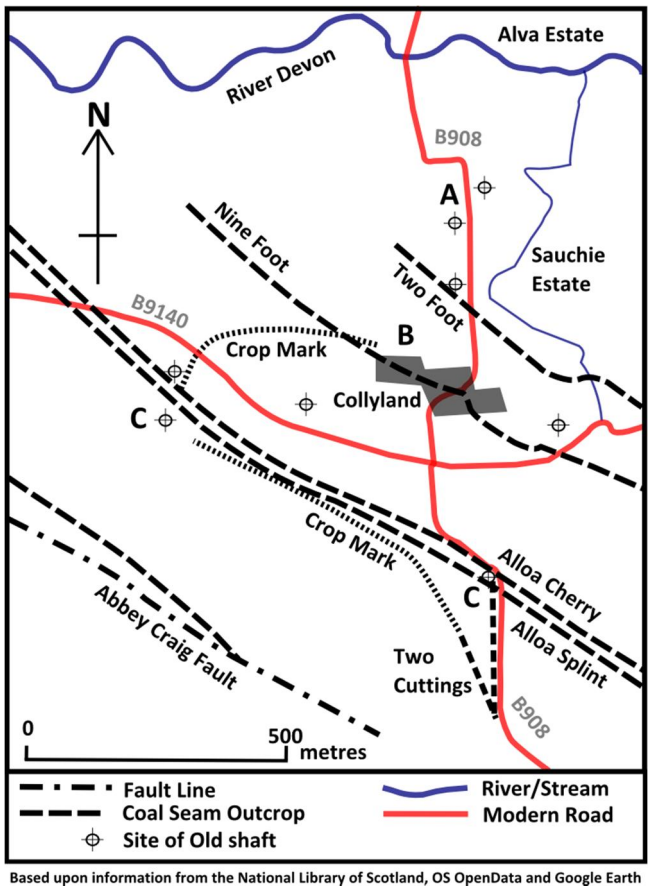
Field research showed that these two lines were substantial cuttings, two to three metres wide at the base and two to three metres in depth. There is a substantial ridge of clay spoil between them, containing small pieces of coal. The route from the pit at the summit of the ridge runs downhill all the way to the Alloa shore. The line of the crop mark would have taken the waggonway downhill in a north westerly direction, creating a gradient up which waggons would have had to be pulled. The route chosen runs across the slope, rising up from the possible pit site (elevation 44 metres) to the summit of the route (elevation 56 metres) over a distance of some 657 metres (Google Earth). This gives an average gradient of 1 in 55, which would not have been a difficult task for a horse drawing a waggon and coals weighing two and a half tons. One of our volunteers stated that, as a boy, he had regularly driven a loaded farm cart from Collyland to Sauchie along the route of the B908 – the summit section of this route having a gradient of 1 in 15.

On Google Earth coverage a second crop mark shows up in two fields to the west of the hamlet of Collyland. This drops 10 metres in elevation over a length of 400 metres, giving a gradient of 1:40. The remains of the cuttings and crop marks suggest that there were two different periods of coal extraction, the first in 1764 to access

shafts close to the outcrop of the Nine foot coal near to the hamlet of Collyland and the second at a later date to access shafts on the Upper Five Foot coal.

The remains of the mining hamlet at Collyland (NS 884953) are adjacent to the outcrop of the Nine Foot coal. [103] The March (estate boundary) between the Alloa estate and the Sauchie estate is the small burn immediately to the east of this hamlet, [104] so the bulk of the coal seams within this area of the Alloa estate lie to the west of the stream. In 1764 the first steam powered pumping engine in Clackmannanshire, a Newcomen engine "*supposed to be one of the best of the old construction*", was built at the Erskine's Collyland colliery (NS 886958) [105] "*near to the river Devon to drain the 9 Foot Coal at a depth of 48 fathoms*" (90 metres). [106] The Nine Foot coal outcrops near the hamlet of Collyland at an elevation of 29 metres and the elevation of the land adjacent to the River Devon is 16 meters lower, at about 13 metres. As the average dip of the coal seams in the Clackmannanshire basin is 1 in 6 to the NE, for the Nine Foot coal to be reached by a shaft 48 fathoms (90 metres) deep at an elevation of 13 metres, the shaft would need to be located roughly 620 metres away from the outcrop. This would place it along the line of the Diverswell Farm track (NS 8876295747 to NS 8879995749). The Second Edition of the Geological Survey map shows two old shafts in that area on the Alloa Estate (area B on figure 4). [107]

Figure 4. Collyland Pits and Waggonways.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

Women bearers were still carrying coals to the surface in of most of the pits in Clackmannanshire at this time [108] and access shafts were generally located close to the outcrop, so that women had the minimum distance to climb. Given the NE to NNE dip in the Clackmannan Coalfield, it is usual to have the drainage shaft further down the seam, so it is likely that the 1764 access shaft to the Nine Foot coal was in the locality of the hamlet of Collyland. (Area A in Figure 4) with a drainage shaft further to the NE, draining the maximum area of the seam lying on the Alloa estate (area B in Figure 4).

The two shafts further upslope on the ridge (marked C on Figure 4) sit on the outcrop of the Upper Five foot coal (also known as the Alloa Cherry coal). The Second Edition map of the Geological Survey of Scotland [109] shows the shaft marked A as being abandoned in 1898 and last being worked at 42 fathoms (77 metres) to the Alloa Cherry coal so these higher level workings might represent a later stage of mining at Collyland.

The Old Statistical Account of Alloa states that the extension to Collyland increased coal sales from 10,000 to 11,000 chalders (15,241 to 16,735 metric tons) to 15,000 to 16,000 chalder (22,861 to 24,385 Metric tons). [110] In 1773 John Frances Erskine succeeded to the Mar Estates [111] and in 1774 appointed Alexander Bald as manager of his collieries and the waggonway. [112] There are papers in the Erskine family collection indicating concerns in 1779 regarding the debts of Haig, Deas and Company. [113] There is also a proposal in that year to lease the Great Coal of Alloa to James Stein, merchant at Kilbagie, John Stein, merchant at Kennetpans, and John Jameson [Jamieson], sheriff clerk of Clackmannan. [114] It is not known whether this proposal was acted upon but, by 1774, the second seven year tack of the coals and the waggonway would have run out.

The historical and field research points to the Collyland colliery in 1767 working an extensive area of the Nine Foot coal, accessed by a shaft or shafts near the hamlet of Collyland. The high cost of installing a Newcomen engine and pumps to drain the workings would provide a strong incentive to get coals from this thick, high quality seam to market. The physical remains and crop marks suggest that there were two different periods of coal extraction linked to the waggonway: the first in 1764 to access shafts close to the outcrop of the Nine Foot coal near to the hamlet of Collyland (area B in Figure 4) and the second at a later date to access shafts on the Upper Five foot coal higher up on the ridge to the south (shafts C in Figure 4). Research found no direct evidence of a line to Collyland via Fishcross, other than two secondary references to it. The strength of evidence currently favours a route via Fairfield, but the route via Fishcross remains open to further research.

Field research also indicated that the majority of the line of the route from Collyland via Fairfield to the Whins Toll is still visible, partly as crop marks, in the remains of cuttings and as the line of a modern roadway. It was 3.01 kilometres in length, starting at Collyland at an elevation of 33 metres, rising to 56 metres at the summit and then falling to 23 metres near the Whins Toll. The bulk of the route down from the summit to Sauchie has been redeveloped several times with the reconstruction of Fairfield Road and a short section of the B908. The line of the last

section is preserved as a separate path (NS 8917994021) running eastwards under the line of the former Devon Valley railway (NS 8927593895) and then turning south as a wide footpath on the eastern side of Hallpark Road and then Whins Road.

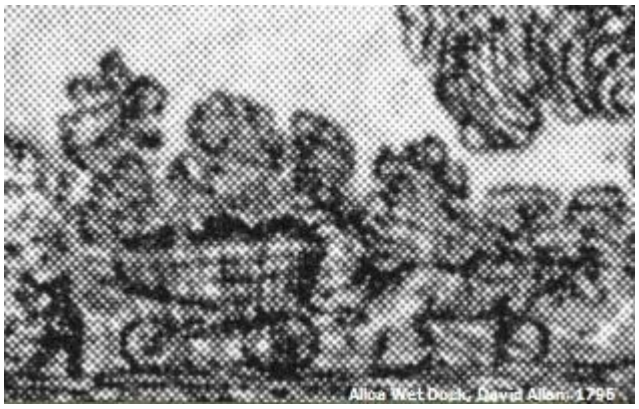
The Redevelopment and Extension of the Waggonway, 1774 – 1800: The New Statistical Account of Alloa (circa 1841) gives a detailed listing of the various stages of improvements carried out on the Alloa Waggonway, some of which are roughly dated. Prior to 1785 there had been a trial using a cast iron plates to protect the upper wooden rail from wear. This was described as "*plating the wooden rails with cast-iron in pieces of four feet long, of an inch and a quarter square; each piece of rail having three projecting ears with holes, through which a pin was driven to fix the iron-rail in its place. This plan proved quite abortive, for the instant the wood gave way or yielded, the cast-iron was broken, and it was found so useless and so expensive that it was thrown aside altogether. The engineers then never once contemplated the substitution of cast-iron rail of a proper form, in lieu of the wooden-rail*". [115]

The Old Statistical Account of Alloa (c. 1791) was co-authored by the Reverend James Frame and John Francis Erskine, owner of the Alloa estate. A very detailed description is given of the construction of the new waggonway in 1785 when the Alloa waggonway was considered to be worn out and the track was replaced with two wooden rails with a malleable iron bar on top. [116] "*The sleepers are very broad and only 18 inches (45 cms) from centre to centre. A rail of foreign fir, 4 inches (10 cms) square is pinned down to them; and another rail, of the same dimensions, is laid over it, and the whole beat up in good clay; and on top of the upper rail is laid a bar of malleable iron, of 1 3/4 inches (4.45 cms) breadth and nearly 6/8th thick (2 cms). The waggons have cast iron wheels, 27 ½ inches diameter (70 cms), and are supposed to weigh altogether about a ton (*1 Metric ton*). A waggon carried 30 cwts of coals* (1.52 Metric tonnes), *and three waggons are linked together by chains, so that one horse draws 4 ½ tons of coal at once, and the declivity of the way is so gentle that the same horse draws with ease the 3 empty waggons back to the coal-hill. The advantage of putting the weight into 3 waggons, in place of 1, is very considerable: They are easier to fill and empty, and the throwing the weight over a greater surface, does less damage to the waggon way, and is likewise easier for the horse as it is well known, that almost the only stress that a horse has, on a good waggon way, is in the starting of the waggon; therefore, if the whole 4 ½ tons were put into one waggon, the difficulty would be great; as the waggons, when standing still, are close to one another, and the chains that link them together are 2 feet long, the horse has only 30 cwts of coals to put in motion; for, when he starts the first waggon, the impetus of it, if it does not actually move, greatly assists in moving the second and third. The first expense of making this kind of waggon way, is undoubtedly great,*

being at least 10s. (50 new pence) per running yard (0.914 metres), yet the proprietor has long been reimbursed, and is a considerable gainer, for although this road has been made these six years, it has required no repair worth mentioning, and is now near as good as when first laid*." The Account also notes that "*The collieries in the neighbourhood use a considerable quantity of hay; their usual price is 4d (0.4 new pence) per stone (6.35 kilogrammes)*".

A painting by David Allan in 1786 shows a horse drawing a waggon with the words "Alloa No 15 - 40 cwts" on the side. [117] A waggon driver is walking alongside holding on to a very large brake handle. The waggon is constructed of wood and has four cast iron wheels. An etching of the new dry dock at Alloa by Allan in 1796 shows a similar waggon, horse and driver in the background. Again the waggon has a large rear brake and the driver is at the rear. [118]

Figure 5. Etching of Alloa Wet Dock, 1796, David Allan.



The painting and etching suggest that single waggons were still being used at times, despite the upgrading in 1785. The shape of the waggon is the same in both the painting and etching, being much broader at the top than the base.

There is evidence that the route of the Collyland waggonway extension was added to in 1790 with a branch to the new Fly (NS 8831094357) and Pompee (NS 8857394111) pits. [119] These pits lie to the south of Collyland and separated from it by the Abbey Craig fault, so were working in the Alloa Coalfield. The First Edition Ordnance Survey 25 inch map shows that by 1863 all these pits had been abandoned, but the start of the route is shown up Fairfield Road and there are indications from tracks and field boundaries of the routes to the other pits. [120] Field research shows that, while substantial parts of the eastern sections of these routes have been lost to housing developments, parts of the western sections have been preserved as farm tracks and field boundaries or are visible as crop marks on aerial coverage and the three pits sites are left as sterile, undeveloped areas.

Circa 1791 the Old Statistical Account of Alloa indicates the importance of the export trade in coal, noting that "t*he Port has 115 ships registered of 7,241 tonnage with some 500 men employed. Greatest number of vessels engaged in the coal trade with exports to the Firth of Forth and the east and north of Scotland of some 50,000 tons, also some 6,000 tons, together with valuable quantities of glass bottles from the glass house are exported to Denmark, Norway, Germany, Holland and Portugal*." It was also noted that "*Large coal is*

sent to sea from the shore - sold at between 8s.6p per chalder of 30 cwts (1.52 metric tons) *while smaller coal or chaws are sold from the coal hill at the pit for 13d per cart of 6 cwts* (305 kilogrammes)". [121] Small coals were selling at nearly half the price of large coal, a great attraction to coal using industries. The Account notes that an iron foundry [122] and brick and tile works [123] had been established for some time at the shore at Alloa. It is likely they were connected by branches to the Alloa waggonway, possibly as soon as they were established. The Old Statistical Account goes on to record that for the iron foundry "*The metal was generally brought from Carron and used to cast waggon wheels and small pots, etc."* The route of the branch to the Brick and Tile works is shown connected to the Glass Works branch (NS 8805092429) on Wood's map of the Town of Alloa in 1825. [124] Field research shows that parts of these routes are preserved in the lines of Castle Street, Glasshouse Loan, Craigward Place and Kelliebank.

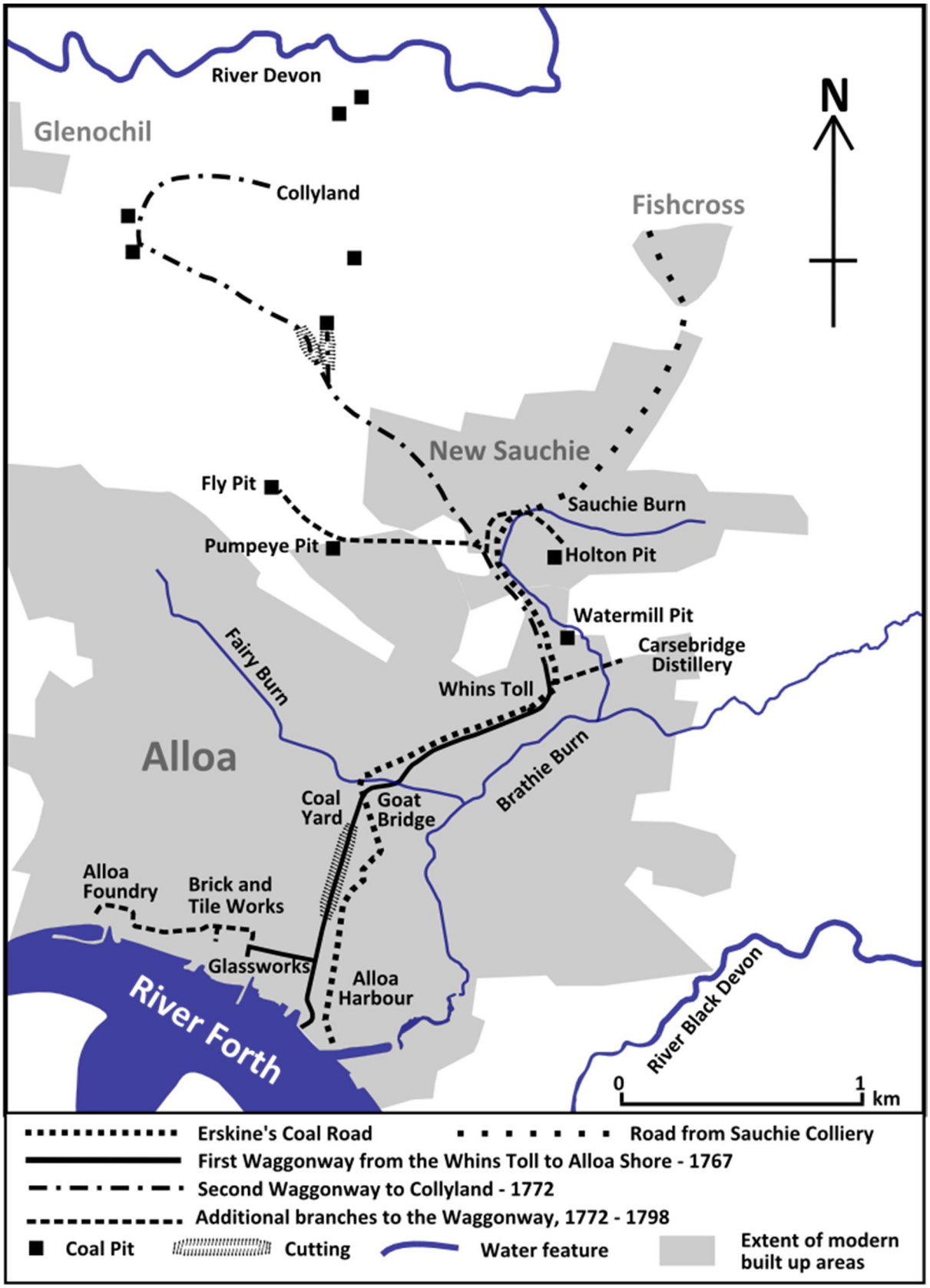
In 1792 the Devon Company co-partnership was set up to utilise the mineral deposits under the Sauchie Estate. [125] A coal pit had access to the waste of the Nine Feet coal, which had a band of iron-rich, blackband ironstone on top of it. These waste workings had previously been partly worked by the Carron Iron Company. [126] In 1793 the Devon Company negotiated a lease with the Cathcart family for land at Eastside, to the NE of modern Fishcross (NS 897958) to construct an iron works and to mine coal and ironstone. [127] One of the co-partners of the Devon Company was John Roebuck Junior, the son of Dr. Roebuck the founder of the Carron Company, and he reported in 1795 that were some technical difficulties in getting the furnaces working properly. He noted that "*The Devon Iron Works started with two furnaces and a Newcomen steam engine, but with only one boiler and an insufficient supply of raw materials. One furnace closed and the remaining furnace was only producing some 20 tons of iron per week. The air supply to the furnace was altered by increasing the stroke of the Newcomen Engine and increasing the diameter of the air pipe. This increased the output of the furnace to 33 tons of iron per week. From 25th November 1795 to July 30 1796 the furnace produced 1,188 tons of iron*". [128]

The author of the Old Statistical Account of Tillicoultry laments (circa 1795) that "*The Devon Company have been tacksmen of the coal for more than a year and a half, but have wrought none, except a very small quantity for land sale. The design of taking coal, without working it, is incomprehensible. While coals remain underground, they are of no value, either to the proprietor or the tacksman."* [129] (This statement suggests that Tillicoultry Old Statistical Account dates to 1795 as the Devon Iron Company started work in 1873.)

The Devon Iron Works had no local access to limestone for the blast furnaces and had to import supplies from the eastern areas of the Forth Estuary at Charleston in Fife [130] and Skateraw in East Lothian. [131] As well as carting limestone from Alloa harbour to the works, cast iron had to be carried down to the shore. The proprietors of the iron works found themselves needing to use the coal road to Alloa Harbour and being subject to the Erskine's gate mail. This increased two-way traffic would have had an impact on the road. In 1798 the owners of the Devon Iron Works wrote to John Francis Erskine demanding that he make repairs to the coal road. [132] John Francis Erskine then enquired of his legal advisers how far he "*is bound to keep the above road in repair at least for carriages which now contain a load of about 18 cwts in place of 6 cwts as formerly*". [133]

In the same year, a lease was granted by John Francis Erskine of Mar to "John Bald and Company, distillers, of Waulkers Park near the Carse Bridge in the parish of Alloa". [134] It is likely that at this time a short branch of the waggonway was constructed to this distillery. By the end of this period, the main spinal waggonway from Alloa harbour to Collyland had been rebuilt with wooden, iron plated rails and had branches at the shore to a glassworks, foundry and brick and tile works, branches to three pits in the Fairfield area of Sauchie and a possible branch to the Carsebridge distillery.

Figure 6. The extent of the Alloa Waggonway in 1798.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

New Coalfields and Partners, 1798-1840: The trade in coal continued to expand and new markets were being sought. In 1800 Alexander Bald, the long serving manager of the Alloa Collieries, suggested using the Forth and Clyde canal to send coal to the towns growing up around Glasgow. [135] In 1802, some of the pressure was taken off the Erskine's coal road when the Ochil Turnpike Trust built a road from Tillicoultry to Alloa. Unfortunately, in 1804 there was a major fire in the Collyland workings. [136] This was reported by Robert Bald as being "*in the Nine Feet coal at Collyland. This was an accidental fire occasioned by a candle igniting rotten prop-wood. The fire lasted 18 months. The pumps were stopped and a brook was brought along the surface and poured some 300 feet* (93metres) *into the pit. The fire was extinguished but the pit remains drowned to this day* (1828)". [137] As the Nine Foot coal outcrops at the main Collyland shaft, the shaft down which the water was poured is likely to have been situated on the floor of the valley of the river Devon to the NE of the hamlet of Collyland. The colliery was abandoned and in 1806, almost certainly in response to the loss of this substantial seam, John Francis Erskine commissioned new pits at Holton Square, (Holton Nos. 1 and 2), the Peackock Pit near the Whins Toll [138] and leased seams in the New (South) Sauchie colliery from the Estate of the Earl of Mansfield where new pits were sunk in the area immediately to the South and West of modern day Fishcross. [139] The South Sauchie Colliery lay to the South of the Tullibody to Coalsnaughton road. [140]

Sometime between 1806 and 1810, the Alloa waggonway network was again rebuilt, this time with a gauge of 3' 3" (1.10 metres) using cast iron edge rails and sleepers, allowing eight one ton waggons to be brought down by one horse. [141, 142 & 143] In order to move coal from the these new pits to the shore, an extension was built to the waggonway [144] and the route of this new branch is shown on the First Edition 25 inch OS maps (1862-63). [145 & 146] It ran from the line of the waggonway extension to Holton (NS 8916794112) heading north eastwards up the slope behind the miner's houses of New Sauchie and along the western edge of the new Ochil Turnpike road. It then entered a cutting curving round to the North West (NS 8966794895 to NS 9000795037) before heading towards the South Sauchie engine pit site (NS 899951). [147]

Field work has shown that the first section is preserved in the line of Holton Crescent. The branch to Holton has been lost to multiple developments, as has the line north eastwards up the hill behind the miners' houses. However, this north eastwards line has been preserved by property boundaries (from NS 8917994252 to NS 8979394652). The next part of the line has also been lost to development but the cutting leading to the Sauchie engine pit is still clearly visible, to the west of the A908

(from NS 8998994917 to NS 8998495081). This cutting is bounded on both sides by substantial, very overgrown hawthorn hedging, a hallmark of waggonways in Clackmannanshire in rural areas. Beyond this, the line of the route is again partly preserved in property boundaries. The route is 1.53 kilometres long, starting at 47 metres at the South Sauchie Engine Pit and descending steadily to 30 metres at the junction with the Collyland line on the B908.

In 1823 Alexander Bald suggested the Erskine family take a more hands-off approach to the Alloa Collieries and that they should be managed by a trust. [148] The Erskine Trust was set up in 1825, with Robert Bald, Robert Jameson and representatives of the Erskine family. [149] In 1824 a branch line was built to connect the waggonway extension to the Sauchie Colliery across the Ochil Turnpike Trust road to a pit sunk on a new lease of coals on the Sauchie estate. [150] This link is shown on the First Edition 25 OS 1862 map from a passing place and junction (NS8987294694) to a pit (NS 8997594730). Field research showed no evidence of this short line. A map of the town of Alloa, dated 1825, [151] shows the line of the Alloa waggonway from the shore to the Whins. The earlier connection at the shore to the glassworks and the brick and tile works are also shown. There is another connection shown from Castle Street (NS 8795092450) to the Grange Distillery, owned by Stein and Company (NS 8794092711) and, close to the Whins Toll, there was a short link from the waggonway into the Hutton Park brewery (NS891932).

In 1825 John Frances Erskine, the 7th Earl of Mar, sold the Alloa Glassworks. [152] Following his death later in that year, the estate passed for a short time to his son, Thomas, 8th Earl Mar. [153] Thomas died in 1828 [154] and the estate then passed to his son; John Francis Miller Erskine, 9th Earl of Mar; who began extensive improvements to it. [155] After the death of the 9th Earl of Mar in 1835, a number of prominent business men in Alloa formed a co-partnery, the Alloa Coal Company, to take over the lease of the Alloa Colliery and waggonway and the lease of the South Sauchie colliery. The partners were William Mitchell, John Moubray, John Craich (manager for the Mar Trustees); David Ramsay (a merchant in Leith who acted as selling agent for the Earl of Mar's coal); Alexander Meldrum (manager of the Devon Iron Works) and Ebenezer Ramsay (a solicitor in Alloa). [156] & [157] In 1835 the Alloa Coal Company extended the waggonway at the South Sauchie Engine pit eastwards to connect with pits at Burnie, Brandyhill and Bailliesdub. [158] William Mitchell, John Craich and William Wingate had new ships built at Kincardine to carry coals from Alloa to Leith and they were followed by a number of Alloa merchants who became involved in the coastal export of coal. [159]

The works of the Devon Iron Company lay on the east side of the new turnpike road from Tillicoultry to Alloa (NS 898959). As the Iron Company wished to use the Alloa Coal Company's waggonway they entered into an agreement with the Alloa Coal Company in 1837, so that a short length of waggonway (the Sauchie waggonway) could be constructed to link the iron works to the Alloa waggonway. The Trustees of the Ochil Turnpike objected to this arrangement as it would cross the turnpike road, but an agreement was entered into between them and the Devon Iron Company that, for an annual payment of £220, the Devon Iron Company should take "*from the lessees of the Alloa and South Sauchie collieries the use of the colliery railways*". [160] The route of the Sauchie waggonway from the iron works is shown on a scroll plan of the North Sauchie Colliery, drawn in 1839. [161] It came eastwards out of the iron works (NS 89870958810), crossed the turnpike road by means of a bridge (NS 9019395784), looped around the back of Devon Village (NS 901956), crossed the Fishcross to Coalsnaughton road (NS 9022995386) and then joined the main Alloa waggonway close to the Sauchie Engine pit (NS 9000994992). There is also a faint pair of lines on the 1839 plan, suggesting that the Alloa waggonway continued westwards from the iron works towards the Crophill pit.

By 1839 the Devon Iron Company negotiated wayleaves with the estates of Mansfield, Erksine and Zetland to extend the Sauchie waggonway southwards into the Alloa and Clackmannan estates. Mackie's 1845 map of the route of the Alloa waggonway from the Alloa and North Sauchie Collieries to Alloa harbour shows the routes of the Alloa Coal Company waggonway lines in the area, including the line of the Sauchie waggonway, crossing the turnpike road on a bridge. The Sauchie waggonway was now incorporated into the Alloa Coal Company's network. [162] The Devon Iron Company's new waggonway ran southwards from the mid-point of the Sauchie waggonway (NS 9023195384) as it crossed the Fishcross to Coalsnaughton road and then headed southwards to connect with the existing Clackmannan waggonway which ended at a harbour at Clackmannan Pow (NS 895903) at the mouth of the river Black Devon. The line from Sauchie waggonway to link with the Clackmannan waggonway was specifically constructed in order to allow the iron works to access supplies of coal and ironstone from the Clackmannan collieries. [163] The New Statistical Account of Clackmannan indicates that by 1841 this waggonway was in operation and the Devon Iron Company also had access to the Alloa waggonway and Alloa harbour. [164] The development and decline of the Sauchie and Clackmannan waggonways is dealt with in a following chapter.

The Alloa Coal Company re-opened the Collyland Colliery in 1838, [165] this time working the coals from the area of South Sauchie engine pit. [166] The reopened pit had difficulty with flooding from an old colliery on the Alva side of the river Devon. The problem was eventually solved by cutting a new channel for the river on land where the coal seams had not been worked by the Alva pits. Mackie's 1845 map of the waggonway from the harbour at Alloa to the Sauchie Collieries [167] shows it the waggonway had been extended from the South Sauchie Engine (Number 1) pit, northwards to a pit at Crophill (NS 8948695779) on the North Sauchie colliery with a second link to the Devon Iron Works and a branch leading from the South Sauchie engine pit (NS 8991295177) eastwards to pits at Brandyhill (NS 9080295409) and Gartenstars (NS 9122895341). In the same year a waggonway branch was built to connect the Sauchie Number 9 pit (Lornshill) (NS 8807694670). [168]

Field research shows that the line of the first part of the route from the Devon Iron Works eastwards has been preserved as a modern road. The curve southwards has been lost to ploughing and the development of the road to Coalsnaughton. The line behind Devon Village heading south westwards is in the form of a well preserved embankment with hawthorn hedging, serving as a footpath. Modern housing developments have affected the next part of the route which starts as a footpath and then end as a property line. The final section through Schawpark golf course remains as a well preserved line, with remnants of hawthorn hedging. The branch is 860 metres rising from 38 metres at the site of the Devon Iron Works to 53 metres at its summit as it crosses the Coalsnaughton road, rising with a gradient of 1 in 57. This is one of only three sections of the Alloa waggonway which have an uphill gradient away from the pit. The line then runs south westwards for 430 metres, dropping to 48 metres as it joins the main line of the waggonway from the South Sauchie engine pit.

The line from the South Sauchie Engine pit to the Crophill pit has been preserved by the boundary wall of Fishcross primary school and then northwards towards the pit as a footpath, partially embanked on the western side, which links to a short section of paved road. Beyond this point, the routes to the Crophill pit and the Devon Iron Works have been lost to development. The route to the Crophill pit is 0.85 kilometres in length, dropping from 47 metres at the South Sauchie Engine Pit, to 36 metres at the level of the Devon Iron Works site and then to 27 metres at the Crophill Pit. The first section is 525 metres in length so has a upward gradient towards the shore of 1:55, which is the same gradient as the most northerly part of the 1774 extension to Collyland. The section down to the Crophill pit is 320 metres

long and drops from 36 metres to 27 metres, giving an upward gradient towards the shore of 1:36, the steepest of the three upward leading parts of the entire Alloa waggonway.

The route of the branch eastwards to Brandyhill and Gartenstars pits has mostly been lost to development, apart from a well preserved section of embankment along the north edge of the B9140 road from Fishcross to Coalsnaughton (NS 90357953393 to NS 9069295396). The route from Brandyhill to the South Sauchie Engine pit is 970 metres long, dropping from 66 metres at Brandyhill to 47 metres at the South Sauchie Engine pit. The extension to Gartenstars was 568 metres long and dropped from 76 metres at Gartenstars to 66 metres at its junction with the Brandyhill branch. The first section of the waggonway to the No 9 Pit is now part of Fairfield Road, the middle section has been lost to development and the western section has been preserved by the line of a farm track. The No 9 branch was 1.31 kilometres long and dropped steadily from 55 metres at the No 9 pit to 27 metres at Fairfield Road.

The Shift to Malleable Iron Rails and Competition, 1841 to 1867: The Alloa waggonway was rebuilt again in 1841, this time using Bedlington Patent edge rails of malleable iron, fixed to stone blocks with cast iron chairs. [169] This improvement in the way allowed a horse and driver to move eight one ton waggons. The gauge of the new construction is not known but by this time most railways were being constructed to the British Standard gauge of 4 feet 8 1/2 inches (1.23 metres). [170] The first Edition 25 inch OS map shows the Alloa waggonway with one direct connection to the Devon Valley railway line at the Devon Iron Works, [171] & [172] suggesting that they might have shared the same gauge.

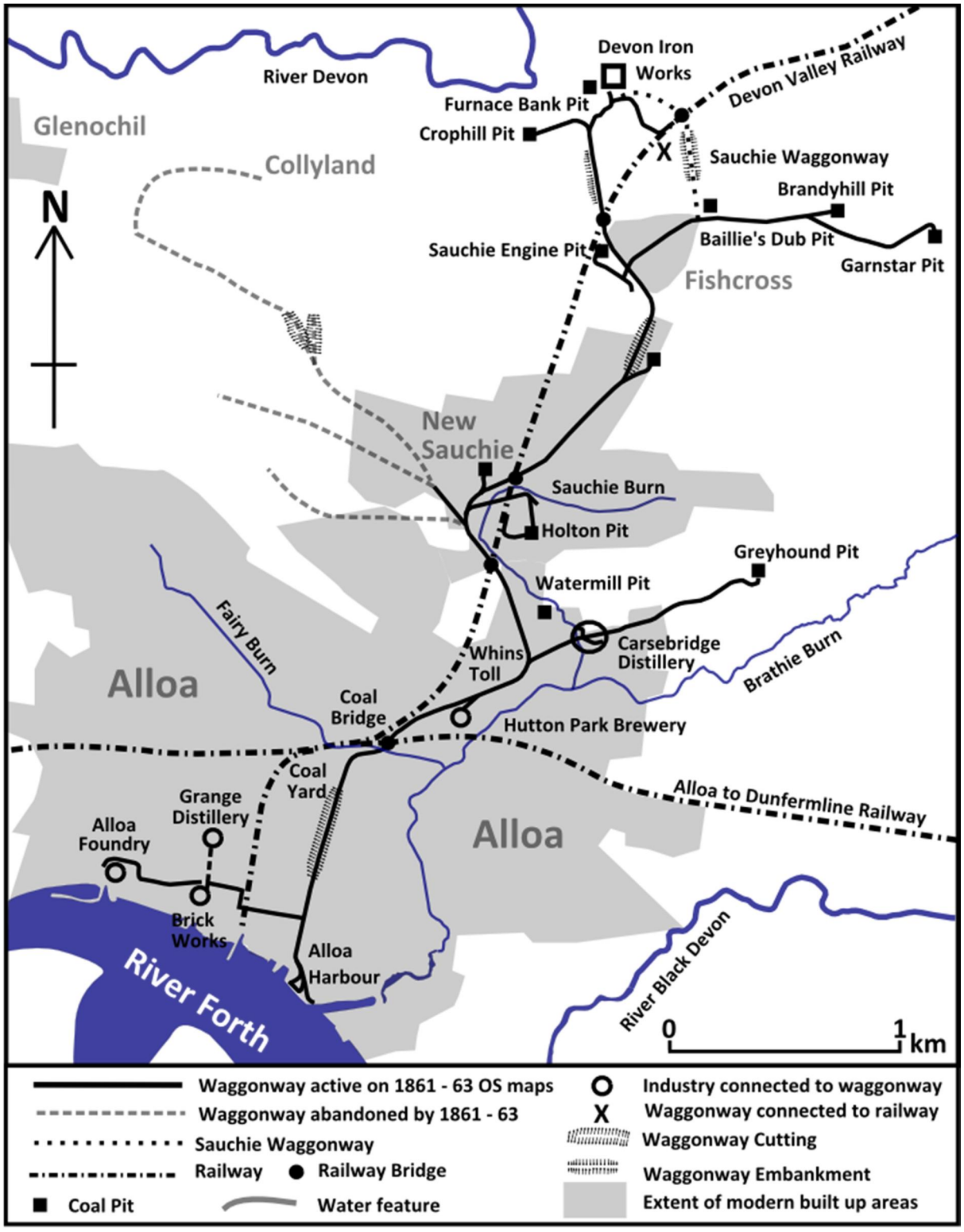
In the same year the Ochil Turnpike Trust raised a legal action against the use of the Alloa waggonway, suggesting that coal should be carried by the turnpike road. However, the court found in favour of the Erskine family. [173] A similar challenge was offered to the waggonway in 1850 when the Stirling to Dunfermline Railway extension was proposed to the Devon Valley Railway. The railway company proposed construction work which would cut across the route of the waggonway, preventing coal being taken to the harbour but the Coal Company took the issue to Parliament and the conditions of the original Act were upheld. The Railway Act included bridges at Alloa (NS 8879593117), Sauchie (NS 8928093912, NS 8936094280 and NS 8939094285) and Fishcross (NS 8980095385). The Devon Valley branch line from Alloa reached a temporary terminus at Glenfoot (NS 9095896166) in 1851 and then Tillicoultry in 1852. [174]

A map of the Alloa Colliery in 1853 shows that a branch of the waggonway had been built from the Carsebridge distillery (NS 8967393555) to the Greyhound pit (NS 9049193789). [175] This was the last branch built to a smaller-sized pit. In 1854 mining at the Devon Colliery was stopped due to a serious flood [176] and the workings did not resume until 1880 [177] and the Devon Iron Works was suffering serious financial difficulties leading to its sale in 1854. [178] The furnaces were finally drawn in 1858 and, while their closure represented a loss of a 30,000 ton contract to the Alloa Coal Company, the steady growth in sea trade and increasing demands from the railways helped to overcome it. [179]

The First Edition OS 25 inch maps of 1861 to 1863 show the waggonway having lost several of its earlier branches but still extensive. [180, 181, 182, 183 & 184] An additional, separate "tramway" was shown alongside the shore at Alloa, connecting a brick and tile works (NS 8795392494) to the Alloa Foundry (NS 87601925910). There was a complex set of waggonway sidings at the shore (NS 883920) with two turntables leading to lines towards the quay. The Alloa mainline railway had reached to sidings close the shore but there were no direct connections to the Alloa waggonway.

Figure 7. Waggonway at Alloa Shore, 1863.

Figure 8. Extent of the Alloa Waggonway in 1861-63.

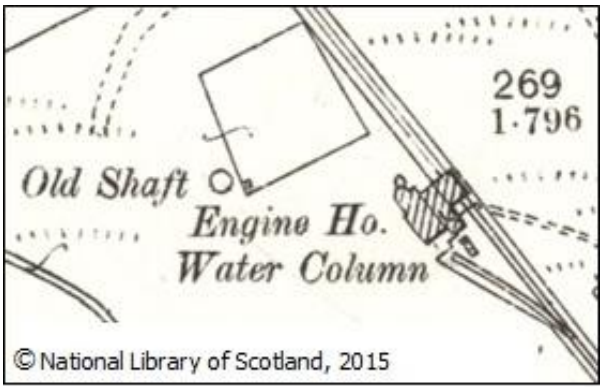


Based upon information from the National Library of Scotland, OS OpenData and Google Earth

A New Partnership and a Change of Scale, 1872: The Alloa Coal Company was reconstituted in 1872, forming a joint partnership with the Clackmannan Coal Company. [185] In the years before and after this reconstitution a considerable number of smaller pits were closed, accompanied by the abandonment of several of the waggonway branches. In 1869, the Alloa Cherry Coal seam was abandoned at Sauchie No 1 (or West Pit) Nos 2 -21, Arnswell, Auchinbaird, Baillie's Dub, Birchwood, Blackett's, Blackfaulds, Brandyhill, broom, Burneye Engine, Cooke's, Crophill, Dovecote, Fly Easter, Furnace Bank No1, Garnstar, Hennings. Holeyards, Horse, Hunter's, Lawswell, March, Maither's, Parritch, Pitfairn, Sheep Park and Willie's Pulpit. [186] This was followed in 1884 with the working of the Lower Five Feet coal abandoned at Holton Nos 1 and 2, Carse, Keillersbrae, Old Mains, Pumpeye, Reekie Row, Sprotwell and Watermill. [187] In 1893 the workings in the Upper Five Feet, Lower Five Feet, Nine Feet and Alloa Splint coals were abandoned at Broom, Carse, Fly, Greyhound, Greyhound no 2 and Holton no 2. [188]

During the same period, the Alloa Coal Company opened several new, larger and deeper pits. Whinhill pit (NS 9009592838) was opened in 1872 [189] and connected to the waggonway from part of the branch line to the Carsebridge distillery and the old Greyhound pit (NS 8993093597). It had a small branch into the Hilton Fire Clay Brick and Tile Works (NS 898933) and sidings alongside the Alloa to Dunfermline railway, but no direct connection to it. [190] The Forthbank pit (NS 8867291783) was opened in 1875 [191] with a main line railway connecting it to the Alloa Shore. [192] The Alloa Colliery (NS 9091193996) was opened in 1887 [193] and the waggonway extended to it in 1889 from the Holton branch line (NS 8945394284). [194] Sherrifyards Colliery was opened in 1895 [195] and Adamson noted a waggonway connecting it to the branch line to the Alloa Colliery. [196] However, both the Alloa Colliery and the Sherrifyards pit are shown on the 1898 OS maps as being connected to the Devon Valley railway at Holton by a "mineral line", with no connection to the Alloa waggonway. [197]

Figure 9. Engine House at Fishcross.



The Devon Colliery became one of the largest managed by the Alloa Coal Company and the Second Edition OS 25 inch map of 1899 shows an "Engine House" at the site of the old North Sauchie engine pit (NS 8989995182). This building sits beside and across the single track line of the waggonway leading northwards to the Devon Colliery. [198]

Interviews with local residents suggest that this engine house was associated with an inclined plane which was used to pull waggons up the incline from the Devon Colliery. The new housing development on the site is named "Engine Green".

Field research has shown that the branch from the Whins toll to the Greyhound pit extended the branch to Carsebridge distillery and is preserved as a paved road, now leading to Jellyholm farm. It is 1.09 kilometres long and drops from 35 metres at the Greyhound pit to 22 metres at the Whins Toll. The line to the Alloa Colliery was 1.59 kilometres long and drops from 54 metres at the Alloa Colliery to 32 metres at Holton. The first section from Holton has been lost to development but a well preserved embankment lies on the South side of Gartmorn road (NS 9007894152 to NS 9070294064).

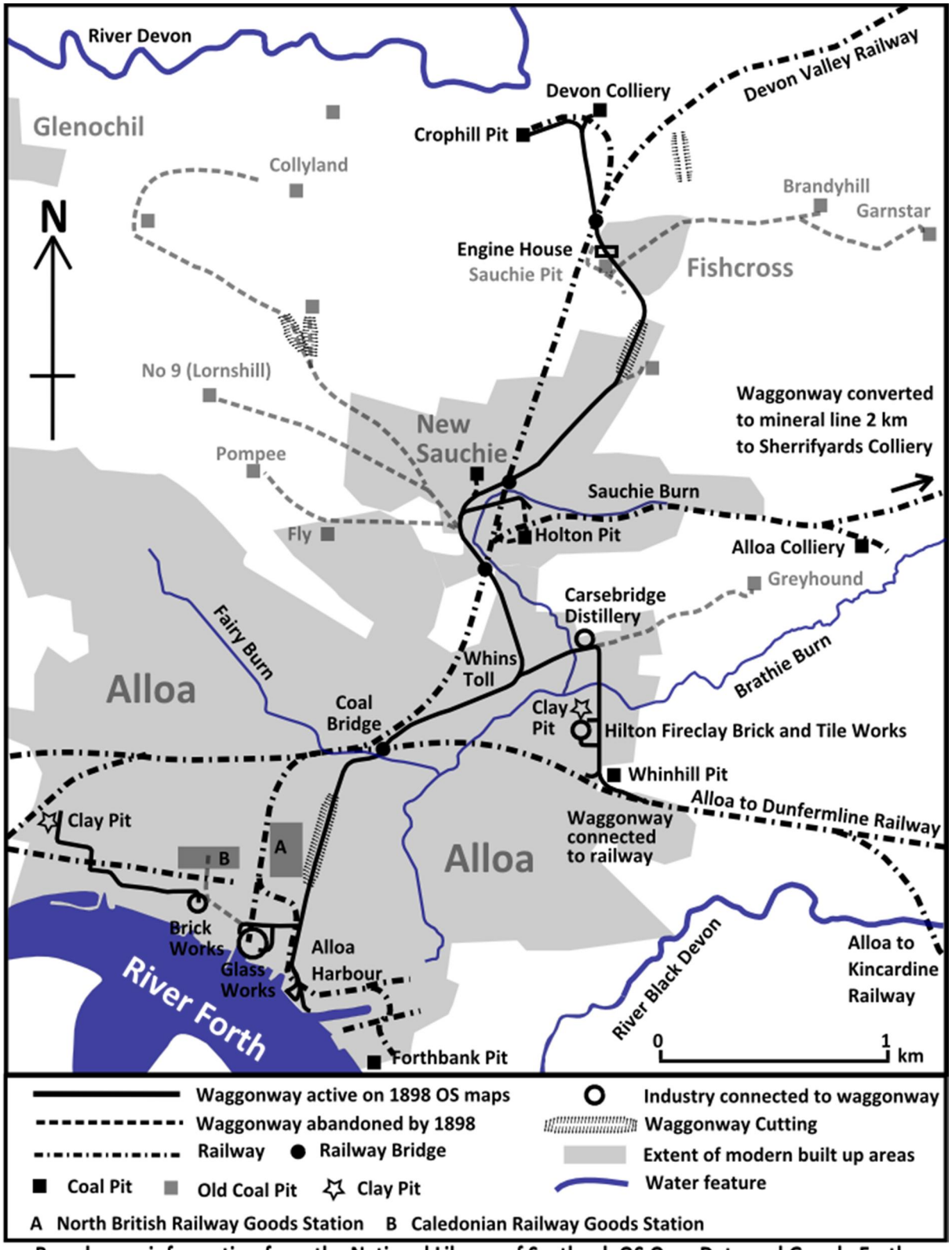
Most of the line from Fishcross to the Burneye and Garnstars pits has been lost to redevelopment, ploughing and tree planting, apart from a well preserved embankment running along the south side of Gartmorn Road (NS 9015094145 to NS 9070594067), now used as a roadside pathway. The branch to the Whinhill pit was 782 metres long and dropped from 27 metres at the Whinnhill Pit to 24 metres at its junction with the Greyhound branch and its line is preserved as a rough track. The waggonway branch to Sherrifyards Colliery came off the branch to the Alloa Colliery (NS 9081194057) and followed the north shore of Gartmorn Dam eastwards for a distance of 2.22 kilometres and is virtually level along its length.

Figure 10. Possible Stone Block.

A stone was found in Gartmorn Dam adjacent to this line. It was drilled and might be a waggonway stone block used to support an iron chair. Nearly all this route has been preserved in the line of the entrance road to the Gartmorn Nature Reserve and a pathway along the shore of Gartmorn Loch.

The route of the Forthbank railway line has been lost to several redevelopments. It was 324 metres long to Alloa Shore and was virtually level along its length.

Figure 11. The Alloa Waggonway in 1898-99.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

A Limited Company and Larger Deeper Pits: In 1898 the Alloa Coal Company became a Company Limited by Guarantee [199] and the Second Editions of the OS maps show the Alloa Waggonway as a single main line, connecting the Devon Colliery (NS 897958) down past Holton to the Shore at Alloa. There were still branch lines to the Carsebridge distillery, the Hilton Fire Clay Brick and Tile Works, the Whinhill pit and the Alloa Glassworks (there is an issue with the Glassworks branch as it is shown on the 1899 Second Edition OS 25 inch map but not on the 1899 Second Edition OS 6 inch map). The branch line to Alloa and Sherrifyards Collieries was no longer connected to the waggonway at Holton, but was now a mineral line connected to the Devon Valley railway. [200] There was still a separate tramway connecting the brick and tile works close to the Alloa shore to a clay pit to the North West. [201]

Two postcards of the wet dock at the harbour at Alloa show the waggonway, steam loading cranes and vessels loading coal. The first card is a coloured view, carries a trademark shield containing J & M, surmounted by a stags head and underlain by "Caledonian Series" and was published by J & A McCulloch & Company, circa 1903. [202]

Figure 12. View of Alloa Wet Dock, circa 1903.

A three-masted sailing vessel flying a Danish flag is tied up at the quay of the wet dock. A large steam derrick crane is sitting on the quayside behind the vessel and a smaller steam crane is next to it.

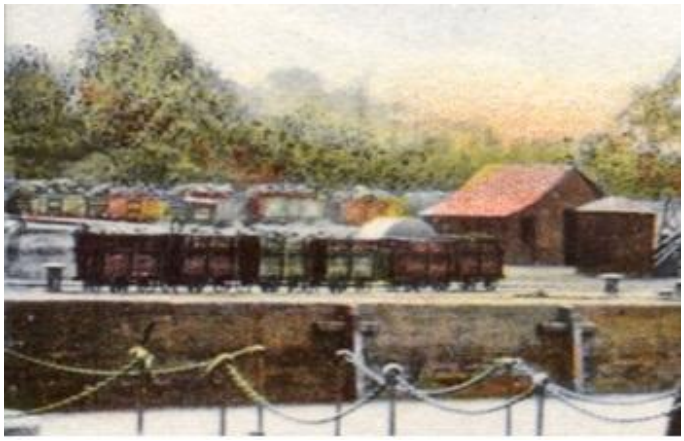


Figure 13. Detail of waggons.

Six coal waggons are shown linked together on the left hand side of the postcard. They are made of wood, have several vertical and horizontal strengthening pieces and spoked wheels.

Figure 14. View of Alloa Wet Dock, pre – 1910.

A second black and white postcard from a pre-1910 "Ideal Series" shows a small steam vessel tied up at the same quay. A single waggon is sitting on the quayside waggonway. The two steam derrick cranes are visible behind the vessel. [203]

Figure 15. Detail of waggon.

This enlargement of the postcard gives a clear view of the larger top than base area, the reinforcing pieces on the sides and rear of the waggon and the detail of the wheels; showing that they had spokes. In comparing the design with that of the first waggons, while the overall size might have varied as loadings were changed from one and a half tons to one ton, the basic design had stayed very much the same.

Figure 16. Waggon Shapes.

The Final Closure, 1924: The 1920 Second Edition, Revised 25 inch OS maps show the Alloa waggonway reduced to a main line running from Holton to the Alloa Shore with a branch into the Glassworks. There was a single branch to the Whinhill pit with a connection to the Hilton Fire Clay Brick and Tile Works (NS 898933) and the Carsebridge distillery. The small tramway from the brick and tile works at the shore to the clay pit had now been abandoned. [204 & 205]

Following the end of the First World War a period of depression ensued, with rising costs, falling prices and industrial action in both mines and railways. [206] The Alloa Coal Company was developing interests in even large pits, many of them outside Clackmannanshire and, following further sales and price drops, [207] the Alloa waggonway was finally closed in 1924. [208]

The Alloa waggonway was in turn a major asset to the Erskine family, the Erskine Trust and the Alloa Coal Company. In 1792, with the waggonways to the Alloa and Collyland collieries constructed, the author of the Old Statistical Account of Alloa reported that the "*Port has 115 ships registered of 7,241 tonnage with some 500 men employed. Greatest number of vessels engaged in the coal trade with exports to the Firth of Forth and the east and north of Scotland of some 50,000 tons, also some 6,000 tons, together with valuable quantities of glass bottles from the glass house are exported to Denmark, Norway, Germany, Holland and Portugal*". [209] Previously, this would have required some 180,000, 6 cwt cart trips. Using the waggonway, it now only required some 37,000 waggon trips and these trips were faster, less demanding of horses and drivers and caused much less damage to the valuable Great Coal. At that time, a horse and driver hauled a single chalder (1.5 tons) waggon. The introduction of cast iron edge rails in 1810 enabled a horse and driver to move three chalder waggons (4.5 tons) and the introduction of malleable iron rails on stone blocks, circa 1840, enabled a horse and driver to move eight one ton waggons. [210]

The value of the waggonway to the various owners is reflected by the regular upgrading of the way, its continuous use over a period of 157 years and its coexistence with mainline railways for 75 years, nearly half of its life span. While a substantial proportion of the routes have been lost to redevelopment, the lines of many have been preserved by their use as roads and pathways and a few have been well preserved in undeveloped land.

The Clackmannan Waggonway: This was the most challenging network to research. This was due to the complex, shifting ownership of the various sections, the amalgamation of two separate waggonways (the Sauchie waggonway and the Clackmannan waggonway), its relationship, in its middle period, with the development and decline of the Devon Iron Company and the complex co-partnership and partner relationships between the Clackmannan Coal Company, the Devon Iron Company and the Alloa Coal Company.

There is evidence of a salt panning industry in the area in 1672 when Charles, 5th Earl of Mar, with consent of Alexander Mylne [or Milne], merchant burgess of Linlithgow, makes over to Sir Henry Bruce of Clackmannan "*a meadow or saltgrass at the west end of the Pannis at Craigton* (later Kennetpans)". [211] There is also a reference to saltpans at Clackmannan [212] and Alloa. [213] At the same time, the Clackmannan estate was working coals and when Henry Bruce of Clackmannan died in 1674, his estate included 3,500 chalders (5,334 metric tons) of coal. [214] Sir Henry Bruce's son David spent considerable sums of money improving coal mines on his estate at Clackmannan and Sauchie. [215] By 1699 it is recorded that the pits in the vicinity of Clackmannan were drained by a water engine, which was supplied by a canal from the river Black Devon. [216]

Unfortunately, in 1704, David Bruce was made bankrupt and sought protection from his debtors, declaring his state of insolvency was due to liabilities which he had incurred as heir to his father and subsequent expenditure in working the coal mines at Clackmannan and Sauchie. [217] In 1708 the estate was purchased by Colonel William Dalrymple of Glenmuir, one of David Bruce's principal creditors. [218] In 1711 he agreed with Sir John Erskine, 6th Ear of Mar, the right to use the harbour and Pow of Clackmannan. [219] In the same year, Sir John Erskine made an agreement to use sandstone from the Clackmannan estate quarry at Westfield for improvements on the Alloa estate. [220]

A rough sketch of 1713 shows the town of Clackmannan, a water engine draining the coal pits and the small settlement of Powsyde (Powside - NS 9020909) on the tidal reaches of the River Black Devon where the coals were embarked. [221] The river at Powside has been floored at some time with sandstone blocks and embanked with similar blocks on the East bank. A plan of the Estate of Alloa circa 1720 shows the location of coal pits and a water engine, in an area immediately to the South of the Parkmill, between the River Black Devon (NS 818919) and the base of King's Seat Hill (NS 909919). [222] These pits would have been mining the Nine Foot Coal at a shallow depth. [223] The pits were abandoned by 1745 [224] but the water engine

continued to drain the Clackmannan pits for at least another 50 years. [225] Once the Nine Foot coal had been abandoned, workings moved further South into another faulted block of coal seams and the Alloa Cherry coal and the Alloa Splint coal were mined. [226] These workings were closer to the Pow.

The First Waggonway: The first direct evidence of a waggonway at Clackmannan is a painting of Clackmannan Tower, by John Clerk in 1775. [227] This shows Clackmannan Tower, a coal pit with stairs, women bearers, an overseer, a tally clerk and mine drainage waterwheel. It also shows a small section of waggonway with a single waggon. While it is difficult to be precise about measurements, the waggonway has two rails, laid on rows of sleepers made from small rounded logs, grouped in threes and spaced about the same distance apart as the rails are spaced from each other. The waggon is shown as being as high as it is broad and the length is shown as some three times the breadth. The waggon wheels are shown as having four circular holes and slightly smaller in diameter than the waggon is broad. The background detail of the picture suggests that the coal pit was close to the original tidal harbour of Clackmannan Pow (NS 902909).

Much of the land to the South of Powside is below the level of high tides and was originally extensive areas of tidal mud flats and saltmarsh. There are records of an early embankment built by John, 2nd Earl of Mar, in the early 17th century. [228 & 229] During the period 1772 to 1830 the estates of Alloa and Clackmannan built further, more extensive sea walls to reclaim much of the land for agriculture. Each of these embankments followed along the banks of the river Black Devon and each came closer to the shore of the river Forth. The depth of water at Powside at high tide was 10 feet (3 metres), while the depth of water at the junction with the River Forth was 20 feet (6 metres) and in 1772 Sir Lawrence Dundas, 1st Baronet, now the owner of the Clackmannan estate, straightened and deepened the mouth of the river Black Devon at its junction with the Forth. [230] As the size of ships increased during the 18th century, some were no longer able to travel up to the harbour at Powside and the Clackmannan waggonway was extended in 1776 from the usual landing place at Powside along the top of a new embankment on the bank of the Black Devon to a point closer to the mouth of the river. [231] A later plan confirms the location of two waggonway piers ("*shipping births*") [232] (NS 8985390454 and NS 8985490408).

Figure 17. The Landing Place at Powside.

The base of the river Black Devon, lined with squared sandstone blocks and the eastern embankment paved with similar sandstone blocks supported at the base by a wooden plank held back by wooden piling. The embankment is divided into sections separated by wooden planks.

Figure 18. The Changing Course of the Black Devon.

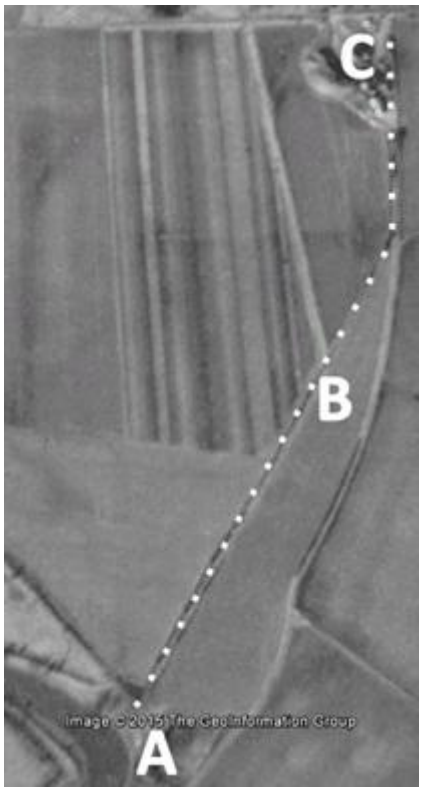
The mouth of the river Black Devon originally meandered across an extensive salt flat. It was straightened and deepened in 1772 and 1832 by Sir Lawrence Dundas, 1st Baronet, and his son, Sir Thomas Dundas, 2nd Baronet. Earlier courses can be seen to the left of the picture.

By 1796 the Clackmannan waggonway served several pits working the Alloa Cherry, Alloa Splint and Coal Mosie seams and that the average distance from the pits to the shore was three quarters of a mile (1.2 kilometres). Waggons were transporting one and a half tons of coal to Clackmannan harbour and about 7,000 tons were annually exported to Leith, Dunbar, Perth, Dundee, Montrose and other places. [233]

Figure 19. A crop mark to the Carse Pit.

Google Earth aerial cover [234] shows a distinct crop mark and physical link connecting the site of the Old Carse pit in the top left hand corner (NS 8976891509) to the main waggonway route along the embankment at Powside in the bottom right hand corner (NS 9024790967). This crop mark is aligned with the remains of an embankment running NE from Powside.

Figure 20. Old Mill and Craigrie Branch.



The RAF 1945 aerial cover, in Google Earth, shows another embankment leading from Powside (A) to the site of the Old Mill pit at Heatherhouse (B) and then on to the Craigrie or Watermill pit (C). [235]

A later embankment, leading NNW from B, was built when the Clackmannan waggonway was extended to reach the Clackmannan Northfield seams.

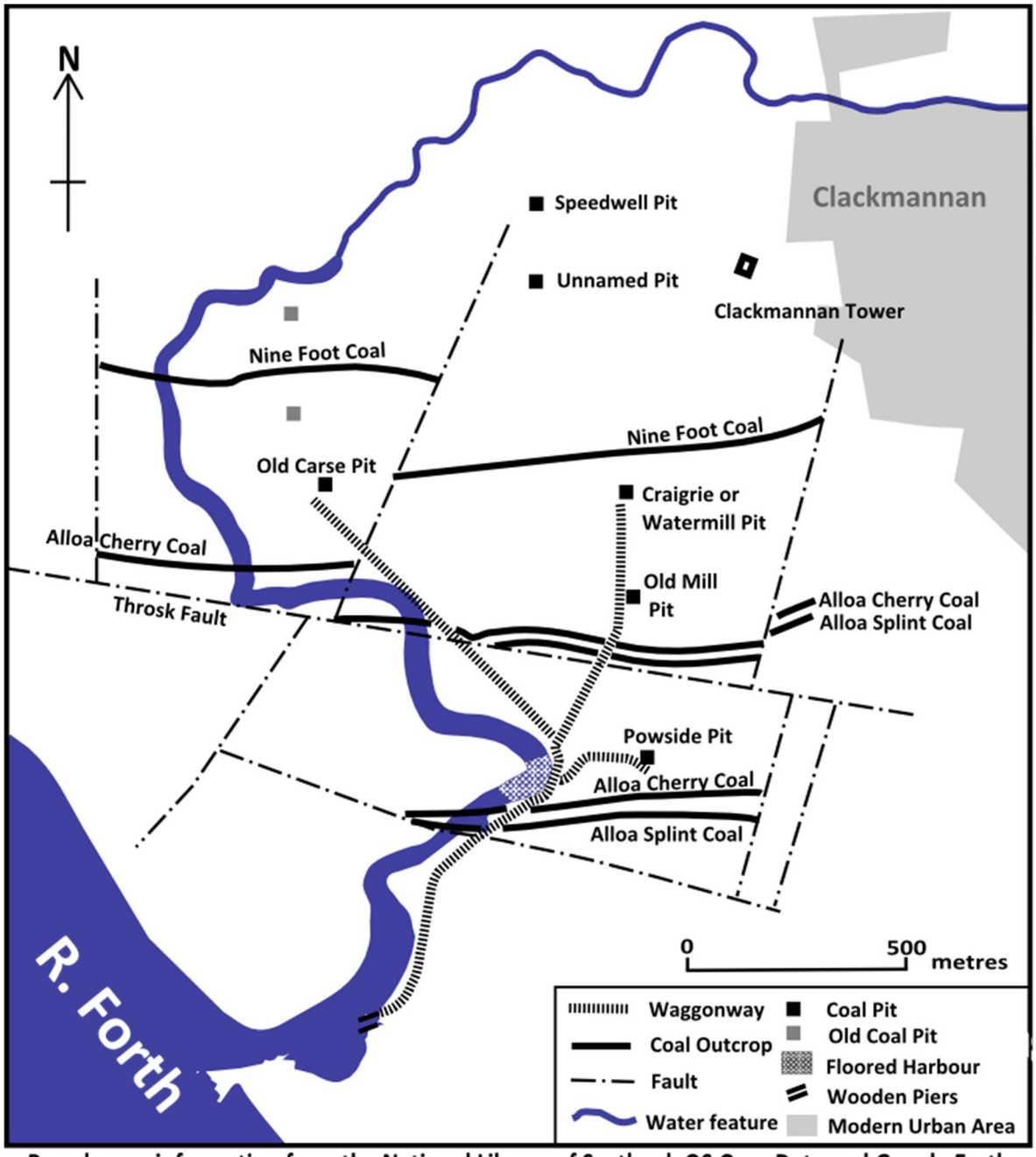
© The Geoinformation Group, Google Earth, 2015

Fieldwork showed that the line of the waggonway from Powside (NS 9023990952) to the most recent harbour on the shore of the Forth (NS 8954590333) has been preserved on the embankment along the river Black Devon. The embankment is 1.11 kilometres in length, starting at an elevation of 2 metres at Powside and remaining level along its route. Very little remains of the shipping berths, other than a few stumps of the wooden piling (NS 8984990446 and NS 8985490410) and small sections of embankments leading to them. The original stone harbour at Powside (NS 9022990984 to NS 9022190905) is still remarkably well preserved, although now showing signs of slippage.

The embankment from Powside towards the Carse pit is still preserved on the edge of a small section of reclaimed land (NS 9023191012 to NS 9003391232) and is visible as a crop mark on Google Earth (NS 9003391232 to NS 8978391484) ending at a dark crop mark at the site of the pit (NS8979691474). It is 0.62 kilometres long, starts at an elevation of 4 metres at the site of the Old Carse pit and end at an elevation of 2 metres at Powside. The embankment from Powside to Heatherhouse is preserved as a field

The remains of the waggonway from Powside to the Old Mill pit (NS 9042991284) are preserved as a field boundary, with one or two hawthorn bushes along the fence line. It continues on to the Craigrie pit site (NS 9043191551) as a field boundary and then a farm track. The waggonway is 0.62 kilometres in length and starts from an elevation of 6 metres at the site of the Craigrie pit to 4 metres at the site of the Old Mill pit to 2 metres at Powside.

Figure 21. Clackmannan Waggonway circa 1796.



A Change of Management to the Clackmannan Coal Company, 1810: At the beginning of the 19th century, the Clackmannan pits were directly managed by the Lawrence, 1st Marquis of Zetland. [236] There are two references to the Clackmannan waggonway being extended from the Devon Iron Works to Clackmannan Pow circa 1806. [237] & [238] However, the second of these references refers to the "Clackmannan waggonway" being owned by the Earl of Mansfield, who owned the Sauchie estate and a third reference in 1807 refers to "*a wagon-way of recent and singular construction*" serving the Devon Iron Works. [239] The first two references appear to confuse the

extension of the Alloa Waggonway to the South Sauchie colliery in 1806 [240] and the construction of the Sauchie waggonway, a small line built on the Sauchie estate to connect the Devon Iron Works to the Alloa waggonway at the South Sauchie Engine pit in 1837. [241] The line of the Sauchie waggonway is shown on a plan of 1839. [242] Together, the second and third references suggest that the Devon Iron Works had some degree of access to the Alloa waggonway from 1806 and that this was improved in 1837 by the construction of a branch on the Earl of Mansfield's estate in to connect directly with the Alloa waggonway.

By 1810, the Earl of Zetland leased the Clackmannan Collieries to the Clackmannan Coal Company, a partnership between George Taylor and John Brown. [243] In 1814, the Clackmannan Coal Company sought relief from the rental for the lease of the Clackmannan colliery, suggesting that the collieries were not proving to be a commercial success. [244] In 1830, pits in the vicinity of the village of Westfield (NS 902916) which had been working the Nine Foot, Five Foot, Alloa Cherry and Alloa Splint coals, were abandoned [245] but new pits were soon opened in the Southfield coalfield at Craigrie (NS 904915) [246] and in the Northfield coalfield at Hillend (NS 912929), where there is a record of 143 inhabitants living there in 1831, along with 16 pigs, 60 hens and 50 pigeons. [247] There is no direct historical evidence to accurately date the extension of the waggonway from Powside to these two pits. However, there is later contract in 1841 between the Clackmannan Coal Company and Lawrence, 1st Marquis of Zetland. This lease relates to the Northfield and Southfield collieries of Clackmannan and refers to access to a waggonway and Clackmannan harbour, suggesting that by 1831 the Clackmannan waggonway had been extended as far north as Northfield, in which the Hillend pit is situated.[248]

The waggonway was carried southwards from Fauld (modern day Helensfield) across the valley of the River Black Devon on a substantial embankment and a bridge supported on two sandstone built side walls and a central pier. The Alloa to Kincardine railway line was carried over the waggonway on a stone bridge, which has been replaced when the line was reconstructed to take coal to Longannet power station.

Figure 22. The embankment across the valley of the River Black Devon.

Figure 23. The remains of the pier of the bridge across the Black Devon.

The waggonway was then carried along the south side of the valley of the River Black Devon and then swung around the side of Kingseat Hill in a series of cuttings, embankments and composite cuttings. The use of composite cuttings was very common and efficient method of creating a level track when running along a slope. Material was cut away on the upslope side of the line and then used to build an embankment on eth downslope side.

By 1832, the river Black Devon had reverted to its pre-1772 course and was undermining the Earl of Mar's embankment on the West side of the river. Proposals were drawn up to change the course of the Black Devon, construct a new

embankment to the shore of the Forth and build a new harbour there. [249] The plan was implemented in 1832 and the Clackmannan waggonway now had three embarkation points: Powside, the two shipping berths close to the mouth of the Black Devon and a substantial harbour on the shore of the River Forth. There is very little left of this harbour, other than a few stumps of the wooden piers, earth mounds which connected the waggonway on the embankment to the piers and a few bricks from the harbourmaster's office. The shipping berth piers remain as stumps, but the stonework of the original landing place is still fairly well preserved.

A New Partnership with the Devon Iron Company, 1834: The development of the Clackmannan waggonway was to change dramatically with the involvement of the Devon Iron Company. In 1834, the Clackmannan Coal Company was in financial difficulties and the two partners surrendered the lease of the Clackmannan collieries to the Devon Iron Company, along with two thirds of their shares. [250] The iron works had initially utilised coal and ironstone from pits in the immediate locality and used Alloa harbour and the Earl of Mar's Coal Road to bring limestone from Charleston for the furnaces and to export cast iron bars and iron goods. Limestone still had to be imported and coal, originally supplied solely from the Devon Iron Company's own pits, was now being mined in association with the Clackmannan Coal Company. [251]

In 1837 the Devon Iron Company negotiated with the Mansfield Estate, the Alloa Coal Company and the Ochil Turnpike trust to construct a short waggonway (the Sauchie waggonway) from the east side of the iron works, across the turnpike road and then south eastwards to join the Alloa waggonway. [252] In 1839 they negotiated a series of wayleaves with the Mansfield (Sauchie), Mar (Alloa) and Zetland (Clackmannan) estates to construct a waggonway to carry coal and ironstone from the Clackmannan collieries to the Devon Iron works. [253] The Earl of Mar owned an area of land at Jellyholm, which linked the land owned by the Mansfield estate at Sauchie to Zetland's Clackmannan estate. There was a period of discussion between the Earl of Mar and the Devon Iron Company regarding the lease of land at Jellyholm, in particular regarding a clause in the lease which stated that the waggonway could only be used to bring coals to the works and "*for no other purpose*". The wording in the lease made clear that this clause was inserted to protect the financial interests of the Alloa Coal Company's waggonway and the Earl of Mar's financial interests in Alloa harbour. An agreement was reached that this clause would be rewritten to state that "*the waggon road could be used to move coal to the iron works and transport equipment from the ironworks to the pits, but for no other purpose*". It

would appear that the original clause was deleted and the new clause was attached as a separate piece of paper. In transcribing the contract, the paper addition was misplaced, the clause was omitted and the two parties signed the lease without any restriction. The contract was agreed in 1839 with a yearly rental charge of £60 for access to the land and the wayleave. The Earl of Mar noticed this omission in 1843 and initiated legal proceedings in 1845, but no record was found of the case going to court.

By 1841 products from the Devon Iron Works were carried by the Alloa Coal Company and Clackmannan Coal Company colliery waggonways to the harbours at Alloa and Clackmannan. [254] In the same year the Zetland estate leased the seams of coal, ironstone and fireclay under the north and south portions of the Zetland estate to the Clackmannan Coal Company and Devon Iron Works for 23 years. [255] For the use of the waggon road and shipping place at Clackmannan shore, there was an annual rent of £150. For the minerals, there was an annual rental of £200 for the first year of the lease and then £400 per year thereafter plus:

a) Coal: Inland coal – less than 5/5d, 1/7th and more than 5/5d, 1/8th. Shipped coal –then less than 6/-d, deduct 7d for carriage then 1/8th and more than 6/-d, deduct 7d for carriage then 1/7th.
b) Ironstone (per ton of 22 ½ cwts): from the nine foot waste, 1/-d per ton, other seams, 6d per ton.
c) Fireclay (per ton of 22 ½ cwts): 3d per ton.
d) All coals used for drainage, pit head fires, ventilation and workers heating to be free of burden.
e) North and South coalfield outputs to be recorded and reported separately. Separate records were to be kept for sea coal and chaws.
f) All wood for new colliers housing to come from the estate's plantation.
g) No claims for damages resulting from breaching of the embankment.

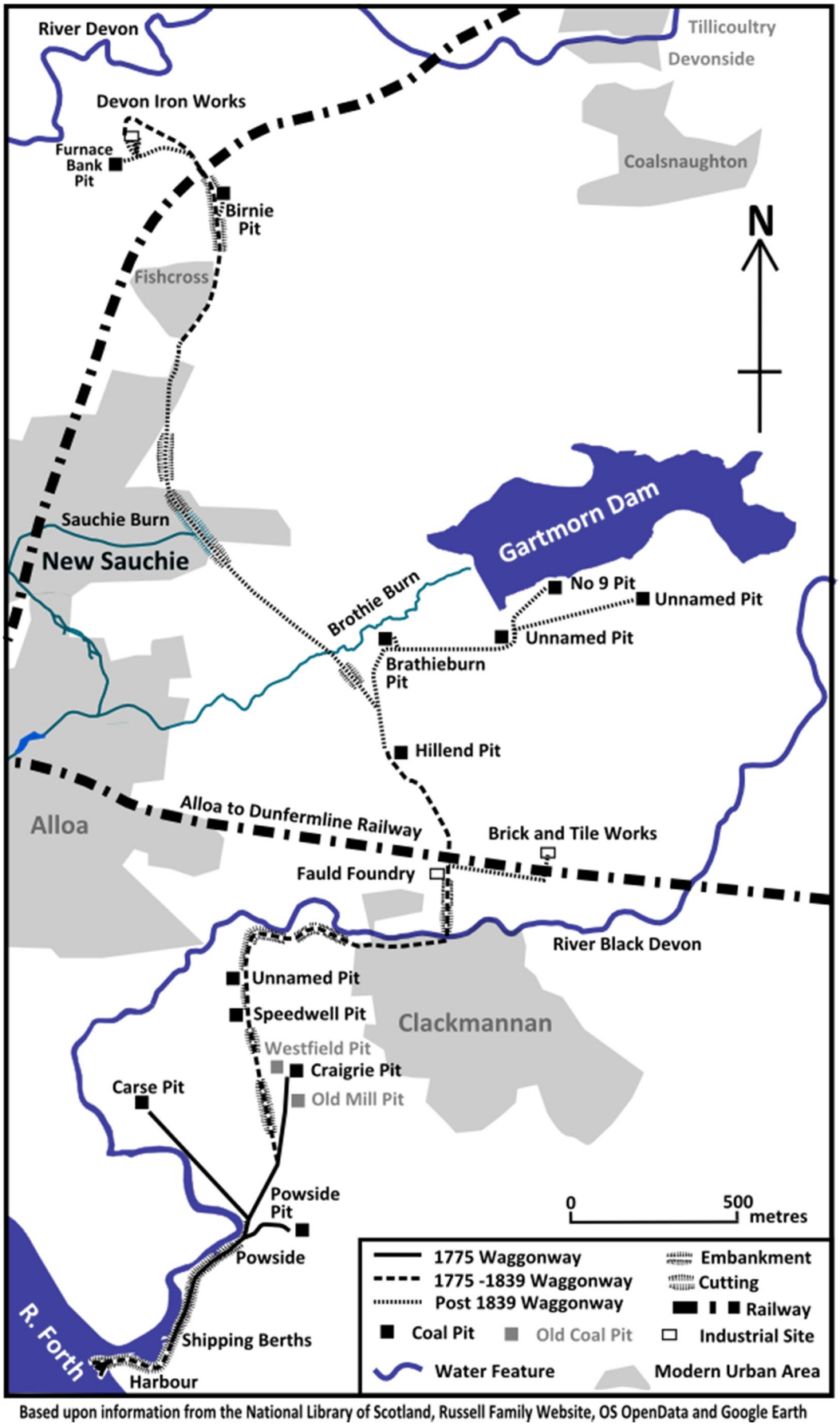
This lease indicates that the two companies were working together to mine coal, ironstone and fireclay and were using the linked Sauchie and extended Clackmannan waggonway to supply the Devon Iron Works as well as shipping coal from Clackmannan harbour. The New Statistical Account notes in 1841 "*Some 500 tons of coal are worked each day. 200 tons are consumed in the parish, mostly at the Devon Iron Works and the remainder is shipped to Scotland and beyond*". [256]

Between 1837 and 1839 the Devon Iron Company secured a direct link between the iron works and the Alloa waggonway (by way of the Sauchie waggonway) and then between the Sauchie waggonway and an extension to the Clackmannan

waggonway. This extension started at some point South of Jellyholm farm. Both the Alloa and the Clackmannan waggonways were being used to import coal, ironstone and limestone and export pig iron and iron goods. The Clackmannan waggonway now extended from the Devon Iron Works in the North (NS 898958) to a harbour at the shores of the Forth (NS 895903). In 1841 a seam of blackband ironstone was discovered above the two foot coal at Clackmannan and was worked by the Devon Iron Company. [257]

Field research shows that the first section from the Devon Iron Works (NS 8978595885) to Bankhead Farm (NS 9009995903) is preserved by the line of a metalled road. The section starts at an elevation of 39 metres and rises to 42 metres over a distance of 238 metres. The next section is 137 metres long and has been lost with the infilling of a cutting on the Devon Valley railway. A footpath picks up the line of the waggonway (NS 9019395786) at an elevation of 43 metres and rises along a well preserved embankment to cross the Fishcross to Coalsnaughton road (NS 9022095392) at an elevation of 54 metres over a distance of 423 metres. From here, the line of the waggonway is preserved in the boundary lines of modern developments, entering the Schawpark golf course (NS 9016095190) at an elevation of 54 metres over a distance of 202 metres. The line continues through the golf course with the odd line of hawthorns marking its route to exit the golf course (NS 8998694366) at an elevation of 42 metres over a distance of 870 metres. The next part of the line lies under a housing development to Gartmorn Road (NS 9011794159), with a small section of an embankment having been removed and left as open space (NS 9001394296 to NS 9009394199). The line crossed Gartmorn Road at an elevation of 35 metres and the embankment continued for a distance of 253 metres ending at an elevation of 35 metres (NS 9026393996). The route of the waggonway has been ploughed out for a distance of 717 metres. It once crossed the Gartmorn lade and the Brothie Burn, reaching a shelterbelt at an elevation of 31 metres (NS 9077693491). Here it crosses through the shelter belt and the route is preserved by a double hedge of hawthorn bushes to the junction with the Brathieburn branch (NS 9090993336) at an elevation of 28 metres over a distance of 217 metres.

Figure 24. Clackmannan Waggonway circa 1845.



Based upon information from the National Library of Scotland, Russell Family Website, OS OpenData and Google Earth

Another New Partnership, 1848: Coal was by now the fuel in general domestic use and was for sale at about 6s (£0.30) per ton with collier families having a free supply. [258] An extensive brick and tile works was in operation to the north of Clackmannan (NS 9168292586) [259] and was connected to the waggonway. [260] Despite an expanding market, the Clackmannan Coal Company was put up for sale in 1848 and the colliery lease was bought out from the Devon Iron Company by Robert Moubray (a partner in the Alloa Coal Company) and the brothers, Andrew and Alexander Mitchell. The new partners reconstituted the Clackmannan Coal Company in 1849. [261] A number of pits were closed in the Southfield colliery [262] and new pits were opened in the Northfield colliery along the South shore of Gartmorn Dam [263] with a branch linking them to the Clackmannan waggonway north of the Hillend pit (NS 9090893340). [264]

The first of four pits on the Gartmorn branch was Brathieburn and was associated with a small miners' row. There was no reference to the row in the 1841 census return, [265] but it was included as a bustling miners' row in the 1851 return. [266] There is borehole record showing that in 1850 the colliery owners were exploring the Alloa Cherry coal seam and the Alloa Splint coal seam to the east. [267] This part of the Clackmannan Northfield coalfield is separated into a of small wedges by a series of north to south and east to west faults [268] and it is likely that the other Brathieburn pits represented the extension of workings into adjacent wedges of coal.

During the construction of the Alloa to Dunfermline railway agreement had been reached in 1848 for a diversion of the Clackmannan waggonway, with bridges at Fauld (modern day Helensfield) and the entrance to the Clackmannan brick works, to carry the railway across the waggonway. [269] The diversion took the form of lowering the bed of the waggonway to minimise the height of bridges built to carry the railway across it.

Fieldwork shows the waggonway at the Brathieburn No 3 (NS 9169393897) is at an elevation of 54 metres and drops to 50 metres at Brathieburn 2 (NS 9147693589) over a distance of 346 metres. The line of the waggonway has been partly lost by the development of the Alloa Burgh water works in 1891 and is only faintly visible in woodland close to the pit site. The branch from Brathieburn 4 pit (NS 9194993646) is at an elevation of 63 metres and drops to Brathieburn 2 at 50 metres over a distance of 444 metres. It is just visible in the east in an area of woodland but is only seen as a cropmark in the western part. From Brathieburn 2 at 50 metres, the waggonway drops to Brathieburn 1 pit (NS 9096193620) at 36 metres over a distance of 554 metres. The line is preserved as a field boundary. The line from Brathieburn 1 is

preserved as a well metalled farm track and drops from 36 metres at Brathieburn 1 to 27 metres at the Hillend pit (NS 9088393147) over a distance of 500 metres. The waggonway continues along the farm track to the line of the Alloa to Dunfermline railway (NS 9120992627) dropping to 21 metres over a distance of 562 metres. The branch from the brick and tile works (NS 9175292577) starts at 23 metres and drops to 21 metres at Fauld (NS 9120892588) over a distance of 623 metres.

The Clackmannan bypass has cut across the line of the waggon way before a short section is preserved in the street of the hamlet of Fauld (now Helensfield) (NS 9121092544) leading to a crop mark in the field to the south, where it once joined the embankment leading to the bridge over the Black Devon. The route drops from 21 metres at the Alloa to Dunfermline railway to 19 metres at the start of the embankment over a distance of 236 metres. The embankment is 90 metres long (NS 9120492362 to NS 9120292280) and ends at an elevation of 19 metres. There are remains of the north and south retaining walls and the lower part of the central pier on the northern bank of the river Black Devon. There is a black and white oblique aerial photograph in the Canmore collection showing the remains of the north bridge wall and central pier. [270] The route westwards along the south side of the Black Devon has been lost to development. It starts at the end of the bridge across the river Black Devon (NS 9120092266) at 19 metres, remaining at that level until crossing the Alloa to Clackmannan road (NS 9085292240). The route of the waggonway follows round through the western edge of the Back Wood as a right of way (to NS 9038492294) dropping to 18 metres over a distance of 464 metres. A number of cuttings, embankments and composite cutting/ embankments keep the route level. Once leaving the Wood the line of the waggonway is preserved as a farm track for a distance of 810 metres, dropping to an elevation of 5 metres at the junction with the old Alloa to Kincardine road (NS 9033391573). The waggonway once continued along a substantial embankment for a distance of 385 metres, joining the original waggonway to the Old Mill and Craigrie pits at an elevation of 4 metres (NS 9039491246). The embankment was removed in the 1940s to extend the field. [271]

Closure of the Devon Iron Company: In 1828 a fire was discovered in the North Sauchie colliery. It is thought to have started in a waste heap above an abandoned shaft sunk by the Devon Iron Company's to rework the Blackband ironstone in the roof of the Nine Feet waste. [272] James Wilson, manager of the Devon Iron Company agreed that they would construct a barrier to encircle the fire to prevent it spreading and, hopefully, put it out. In 1839 the Devon Iron Company, now having spent £15,000 attempting to control the fire, took legal action against the Mansfield estate to recover their costs. The court decided in favour of the Earl of Mansfield and the company's involvement in the fire placed a huge financial strain on them. [273] While the barrier did help to contain the fire, it did not extinguish it and it burned for nearly 30 years, destroying large areas of coal and making the colliery almost impossible to work. It was finally extinguished in 1850 by a steam jet designed by Sir Goldsworthy Gurney, which carried a mixture of nitrogen and carbon dioxide down into the mine from a furnace on the surface. [274]

The Devon Iron Company were also having to cart in ironstone from mines at Vicarsbridge and Mellochglen, to the south of Dollar [275] and blackband ores from the Craigrie pit at Clackmannan and from Lethams, near Saline. [276] They were initially using the Statute Labour roads and a report to the Commissioners of Roads indicated that they had been obliged to make a contribution of £30 per annum, or 2d. (0.01p) per cart, by allowing a portion of the road to get into such bad condition that they were unable to drive their carts over it (the 2d against £30 represents equivalence to 3,200 carts). [277] The Company had a similar financial experience when shifting to the Turnpike road. [278] In 1843 the Company surrendered their lease of the Sauchie Colliery to the Alloa Coal Company, agreeing to purchase 30,000 tons of coal annually. [279] While they were producing cast iron of a high quality due to the quality of the ore they were using, [280] the output from their furnaces was quite small, being only 7,000 tons in 1846. [281] In that year John Christie of the Devon Iron Works, bought the Crawford Pit, near Dunfermline, perhaps as an additional source of raw materials. [282] By 1850 the Company was facing financial difficulties [283] and in 1854, following a major flood, the Devon Colliery was abandoned. [284] This perhaps represented the last straw for the partners and they decided to offer the iron works for sale. [285] A notice in the Edinburgh Gazette indicated that "*We the Subscribers, the sole Parties representing the Concern carrying on Business as Ironmasters at Devon, near Alloa, under the name of The Devon Company, having sold the Devon Ironworks, alongst with the Leases and Ironstone Workings of Devon, Killarnie, and Alva, to Mr Andrew Christie, of Townhill Colliery, Dunfermline, with entry on 30th June last, ceased at that date to have any interest therein. July 10, 1854*". [286] Alexander Christie had been manager at

the works from 1848-1854, in partnership with John Wilson of Dundyvan. [287] The iron works closed in 1856 and the furnaces were drawn for the last time. [288] Alexander Christie placed the works on the market later that year, but no buyer was found. [289] In 1857 the Alva estate took legal action against the Devon Iron Company for the illegal extraction of coal, so coal mining operations were still on-going at that time. [290]

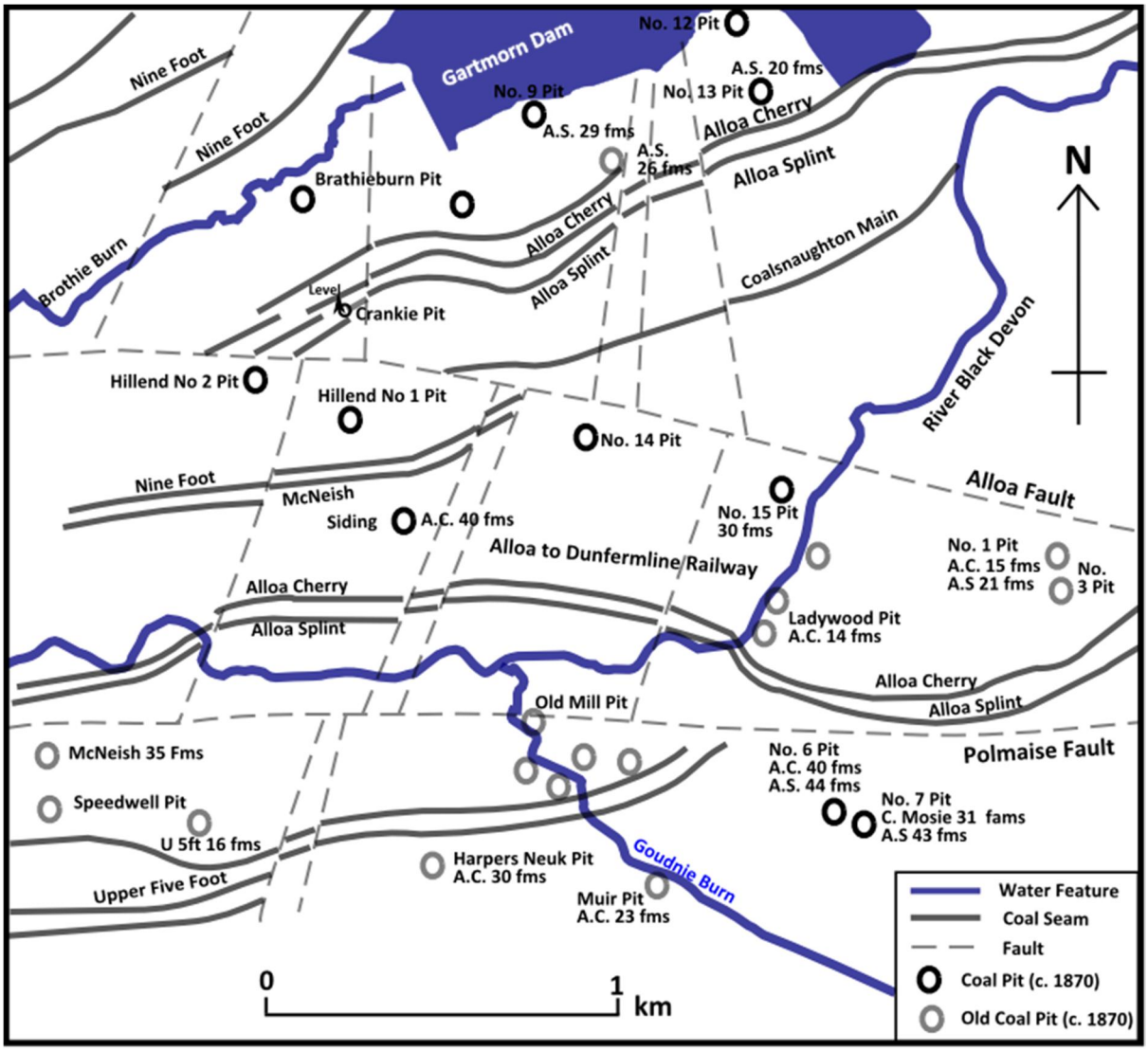
In May 1858 there was a notice of a public sale, followed by another notice in November of a roup sale, with the upset price further reduced. [291] A further sale was held in November and the sale notice on 05/11/1858 indicated that there were three blast furnaces, blowing engine, foundry, turning and boring machinery, private railways, lease of coal, ironstone, limestone and fireclay and houses, [292 & 293] so at that time the line of the Clackmannan Waggonway was still in place. Finally, in 1861, the proprietors of Devon Iron Works resolved to break up and clear away the extensive iron works. The machinery, utensils and material were sold to Messrs Watters and Murdoch, Glasgow. [294] Beyond that time, the section of the Clackmannan waggonway to the north of the Hillend junction with the Brathieburn branch would have been abandoned.

The Clackmannan Branches, 1863 - 1878:

The Clackmannan Coalfield was divided into the Northfield and Southfield collieries, lying roughly to the North and South of the Main Street of Clackmannan village respectively. The area is covered in numerous East to West and North to South faults, creating a patchwork of small blocks of coal. This meant that a number of small pits had to be sunk, restricted to the coal seams within one of the faulted blocks.

In the latter of the 19th century, much effort went into working these blocks. Horse drawn waggonways were an ideal, easy to construct, low cost method of moving coal from the scatter of small pits to the harbour. The waggonways were usually extended from the main line to the harbour eastwards into new blocks.

Figure 25. The Geology of the Clackmannan Branches:



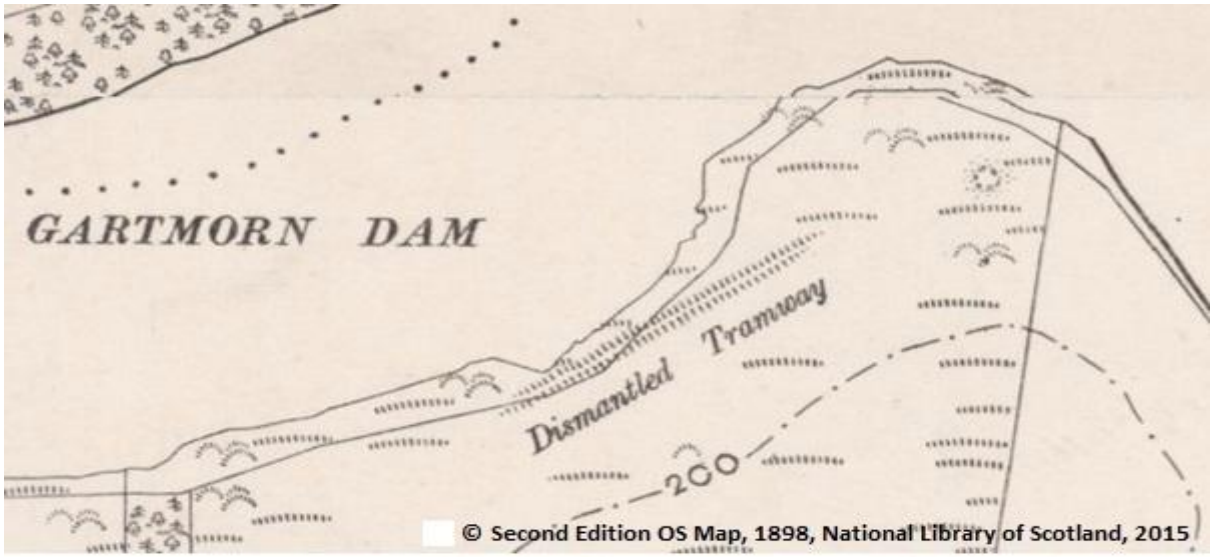
Based upon information from the National Library of Scotland, OS OpenData and Google Earth

The 1898 Six inch Second Edition OS map of Clackmannan records a number of sections of "abandoned tramways", the remains of embankments and shows the Alloa and Kincardine branch of the North British Railway bridging across the route of the Clackmannan waggonway (NS 91220492379) with a second bridge (NS 9125692251) close to the site of Clackmannan Station. [295] None of these are shown on the Six inch First Edition OS map of 1861. [296] In addition, there are substantial changes between the two maps in terms of field boundaries in areas where the lines of abandoned tramways and embankments are indicated on the 1898 map. This evidence points to the Clackmannan waggonway still being active in this area at the time the Alloa to Kincardine branch railway was constructed in 1892 [297] and the construction of a number of additional sections post 1861.

Three waggonway branches have been identified: an extension to the Brathieburn branch along the south side of Gartmorn Dam, the Grassmainston branch and the Goudnie Burn branch.

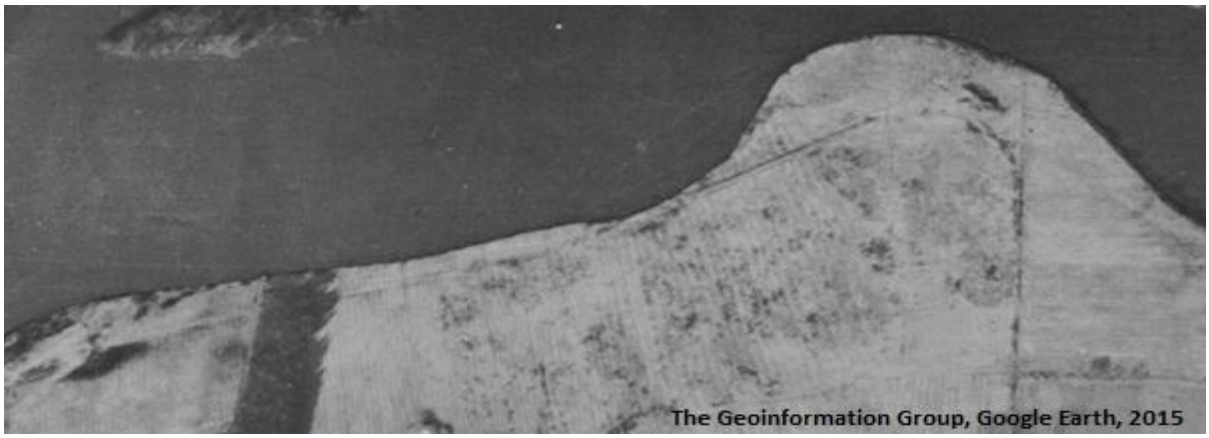
The Brathieburn Extension: The extension to the Brathieburn branch was the subject of field training run by AOC Archaeology on behalf of the Inner Forth Landscape Initiative in May 2015. Historical evidence came from the Second Edition 25 inch OS map, which showed the existence of the remains of an embankment. [298]

Figure 26. Map Evidence of the Brathieburn Waggonway Extension.



The line of the waggonway extension shows up clearly on the 1945 RAF coverage in Google Earth, [299] where the entire route is clearly visible.

Figure 27. Aerial Evidence of the Brathieburn Waggonway Extension.



A team of volunteers surveyed the line of the waggonway extension and undertook an excavation through a section of embankment in May 2015. The waggonway was followed from the site of the Brathieburn No 6 pit (NS 9235093904), where it started at ground level at an elevation of 62 metres. The waggonway starts

on the ground surface heading northwards. It is then gradually lifted upwards on an embankment (NS 9236493941) which increases in height to some two metres. It reaches the site of the Brathieburn No 5 pit (NS 9235294195) where it curves round to head west south westwards towards the No 4 Brathieburn pit.

Figure 28. Excavation, May 2015.

The waggonway embankment was excavated close to the pathway (NS9236794087). It was found to be composed mainly of a mixture of small pieces of white sandstone, cream sandstone and large quantities of a soft, dark blue blaes. A borehole record from close to the site indicates that the shaft would have been sunk through white and cream sandstone and dark coloured blaes to the Alloa Splint Coal. [300]

Figure 29. Detail of Section.

© Quinn Photography, 2015

The embankment contained a number of larger, flattish pieces of sandstone and a layer of these had been laid on the surface of the embankment close to its base to provide a degree of strengthening. Ash was present in layers in the embankment and a large mass was found in the centre. A newspaper report of 1868 records a fire at this colliery, [301] which had been working the Alloa Cherry and Alloa Splint coals. The fire started in the

Number 12 pit (the one nearest to the excavation of the embankment). This was a combined access and ventilation shaft, with a wooden separator up the middle of the shaft. There was a firebrick box some distance up from the bottom of the shaft which was fired with coal, to create an updraft to drive ventilation. It was thought that the fire was started when this box was overloaded at the end of a Saturday shift, the heat setting an adjacent seam of "foul coal" on fire. By the time the fire was spotted the following morning the shaft timbers were well ablaze, eventually destroying the pit head gear. Efforts to put out the fire with streams of water failed, as did attempts to reach the bottom from the connecting Number 13 pit. The burning shaft was then filled in and Number 13 pit sealed off, putting 100 miners out of work. The use of this shaft for ventilation might explain the presence of large amounts of ash in the embankment.

A section of a cast iron plate rail and two hand-made wrought iron nails were uncovered in the trench on top of the embankment just beneath the soil cover.

Figure 30. Plate Rail and Nails

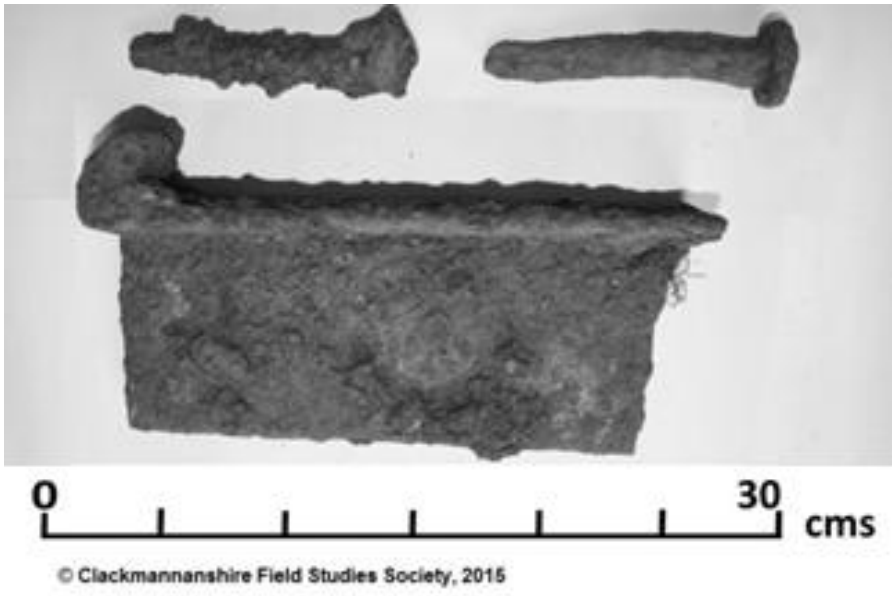
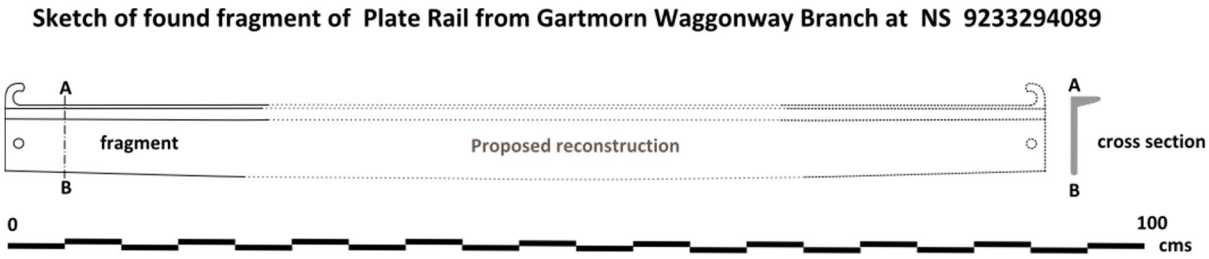


Figure 31. Reconstruction of Plate Rail.



The reconstruction is based on the standard three foot length of plate rail known to be in common use. [302] Being of cast iron, the length had to be kept short to prevent breakage. The use of a combination of a hole and a hook at each end allowed the rails to be arranged along a curve. Plate rails were introduced in England as early as 1756 and became widespread. [303] However, the waggonways of north-east England saw an almost total conversion from wooden to iron edge-rail although the use of plate-rail underground was popular even in areas which used edge-rail overground. [304]

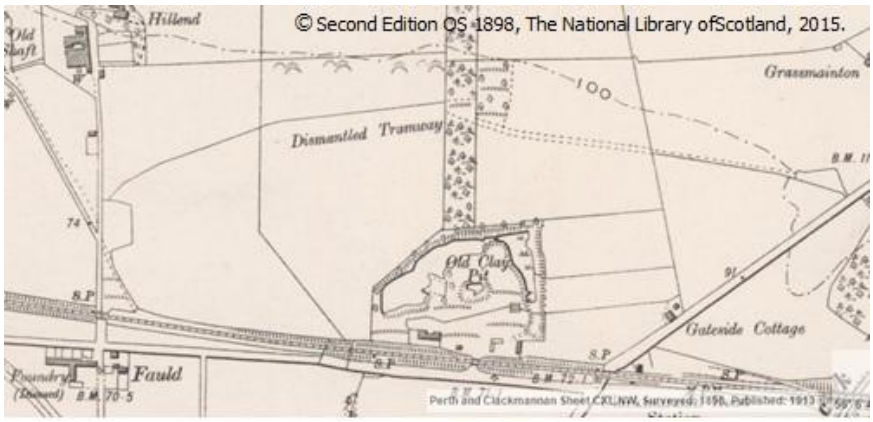
It is known that the Alloa waggonway started and went through all its various reconstructions using edge rails and had been rebuilt in 1841 with malleable iron edge rails. Unfortunately, there are no historical records of the type of rails used on the Clackmannan waggonway and this single piece of plate rail is the only evidence so far. The Ordnance Survey name books for Clackmannan records a small foundry at Fauld in 1863, owned by the 1st Earl of Zetland which was noted as exclusively casting rails for the Clackmannan waggonway. [305] There is also a record of a small smithy at Fauld [306] on the First Edition OS map of 1861. These two small industrial sites, together with the section of rail and nails uncovered in the excavation suggest that the track used by the Clackmannan waggonway when the Brathieburn extension was built might have been a plateway. Alternatively, the fragment might have been part of an underground system of haulage in use in the Brathieburn pits. More evidence would be required to confirm this.

Field research showed that the embankment continued from the site of the Brathieburn No 5 pit for a distance of 474 metres, gradually reducing in height until it was back close to ground level at an elevation of 54 metres. A small section of the embankment has been cut through to enable the slope to the south to be drained. This section reveals that at this point the waggonway foundation is composed of very large blocks of sandstone. Rabbit scrapings along the length of the embankment turned up fragments of blaes and furnace ash.

The waggonway was followed for another 95 metres at close to ground level where it crossed through a narrow windbreak of Scots pine and entered a field at an elevation of 54 metres. The aerial photograph (Figure 24) shows a crop mark in the field leading 131 metres to the junction with the line of the waggonway from the Brathieburn Number 4 pit (NS 9167293852) at an elevation of 54 metres.

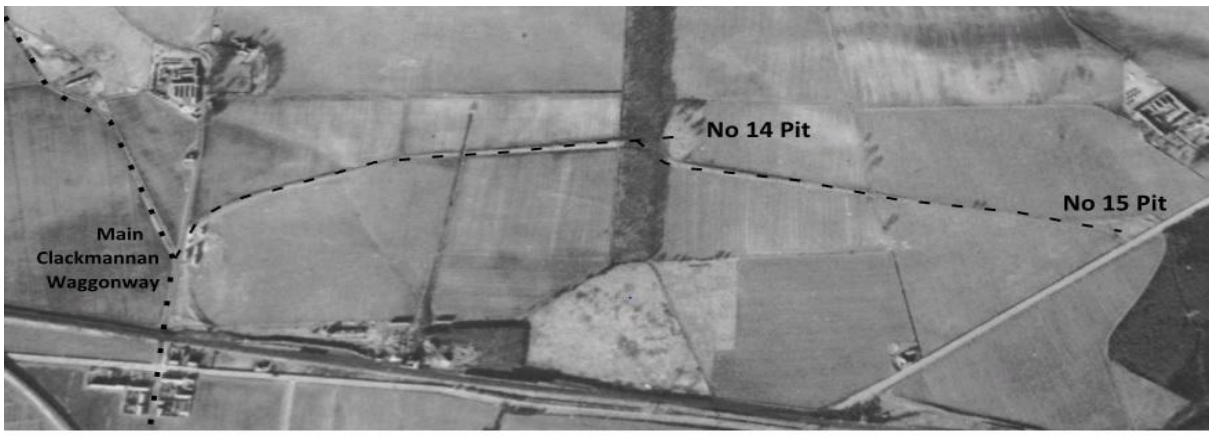
The Grassmainston Branch: Field research showed that Grassmainston branch started at the site of the Clackmannan Northfield Number 15 Pit (NS 92227492776) at an elevation of 40 metres then carried along the remains of a low embankment with remnants of a hawthorn hedge edging the southern side. At a distance of 255 metres the route enters a narrow plantation close to the site of the Clackmannan Northfield Number 14 Pit (NS 92227492776) at an elevation of 53 metres. The route continues for 41 metres through the trees, exiting at an elevation of 53 metres and joins another section leading from the Number 14 pit (NS 9178092920). The line of the Grassmainston branch is marked on the 1898 Second Edition Six Inch map with farm track and field boundaries showing the path of the former waggonway. [307]

Figure 32. Second Edition OS Six Inch Map, 1898.



The 1945 RAF aerial coverage (below) shows the branch extremely clearly. [308] The route and the pit numbers suggest that a section of waggonway was first constructed to connect the Number 14 pit over a distance of 107 metres to the main Clackmannan waggonway at another pit (NS 9121492775) close to the junction with the waggonway from the Devon Iron Works at an elevation of 22 metres. The waggonway to the Number 15 pit was added later.

Figure 33. RAF 1945 Aerial Photograph, Google Earth.



The Goudnie Burn branch: This was tracked using a combination of maps, aerial photographs and field work. The starting point was the Second Edition OS Six Inch map of 1898. [309]

Figure 34. Rail Bridge and Embankment.

This map showed (top left corner) that the railway line was bridged over a small, dead-end roadway. A small section of embankment was shown (bottom right corner).The larger view of the map to the east showed an odd line of field boundaries leading to an old coal pit.

Figure 35. The Goudnie Branch on the Second Edition 1898 Six Inch OS map.

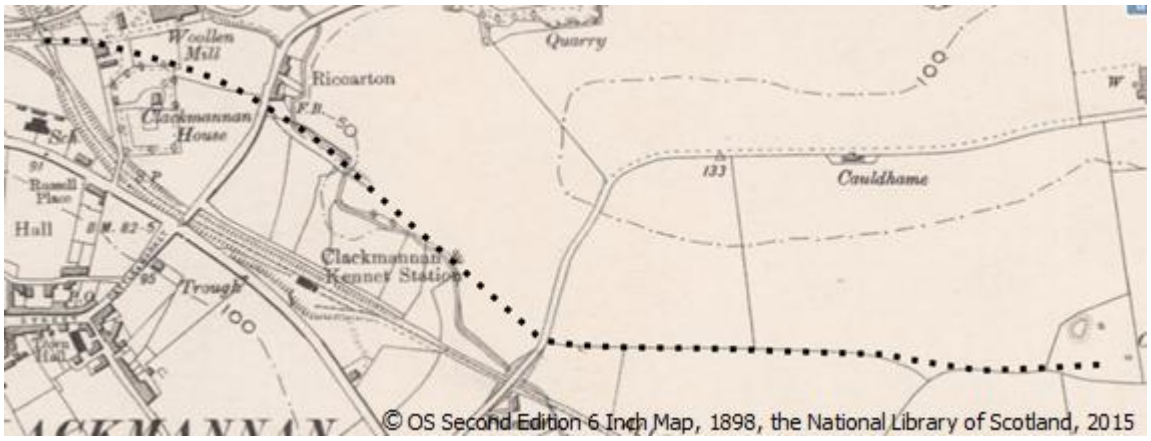


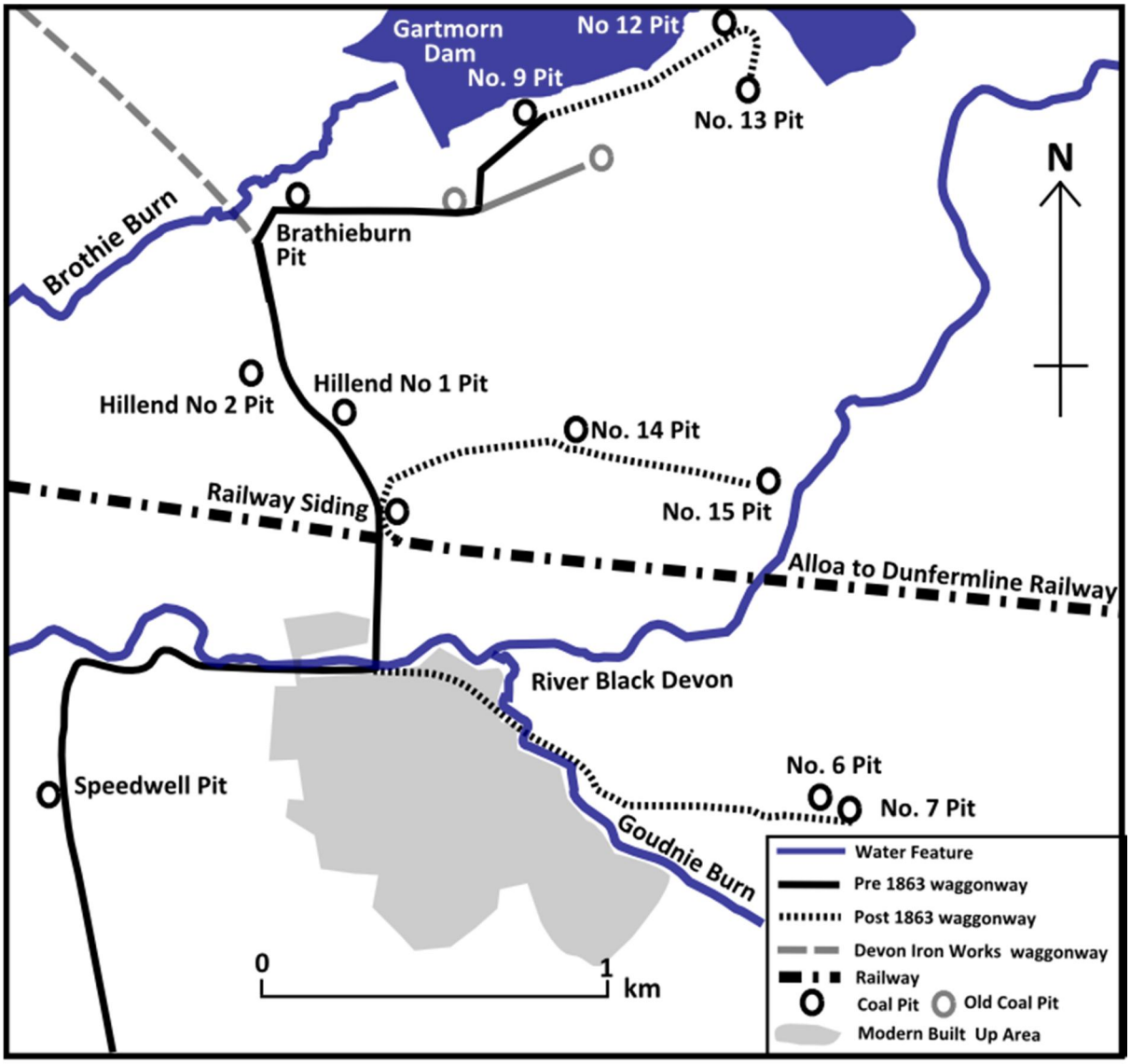
Figure 36. The Goudnie Branch on the 1945 RAF Aerial Coverage.

A 1945 RAF aerial photograph shows the line of the branch more clearly. [310] The 1920 Geology Survey map named several of the pits along the Goudnie burn and Grassmainston branches. The two pits at the end of the Goudnie Burn were the Clackmannan Northfield Nos 6 and 7 pits. The two pits on the Grassmainston branch were the Nos 14 and 15 pits. All of these pits are listed in 1873 on the Scottish Mining Website with Clackmannan Coal Company working the Alloa Cherry and Alloa Splint coals. [311] The Brathieburn pits were not named. The geology of the area shows a number of small, faulted wedges. Each wedge had to be mined separately by small shallow workings with separate waggonway branches. Field research showed that the Goudnie branch started at the Number 7 pit (NS 9255091807) at an elevation of 20 metres and there are traces of the first 200 metres as unused land. The remainder of the branch has been ploughed out or lost under the Clackmannan bypass or housing developments. The branch was 1.4 kilometres long and joined the main Clackmannan waggonway at an elevation of 20 metres.

The Clackmannan branches of Goudnie Burn, Grassmainston and the Brathieburn extension were built to support a series of smaller scale pits in an area where the geological faults have created a number of small wedges of coal seams.

Records of land sales of the Clackmannan Coal Company [312] indicate that in the period 1863 to 1873 coal was being sold at Fauld (modern Helensfield) delivered by carrier and also sold on through the Alloa to Dunfermline railway siding. Records of sales at Clackmannan Pier [313] covering the same time period show the bulk of sales to other Inner Forth estuary ports (principally Leith and Grangemouth), with sales to ports on the east coast of Britain and across the North Sea and into the Baltic.

Figure 37. The Clackmannan Branches c. 1870.



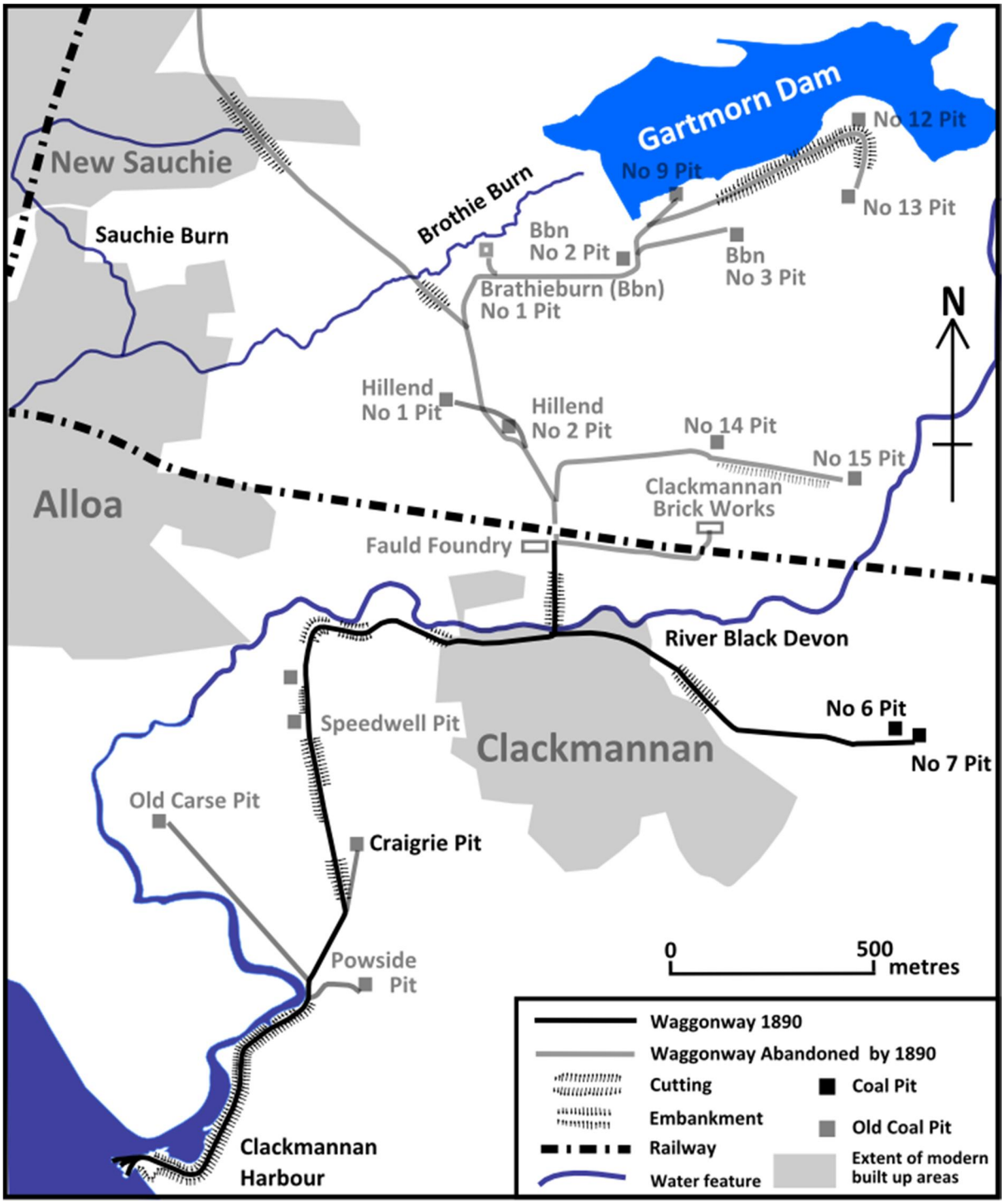
Based upon information from the National Library of Scotland, OS OpenData and Google Earth

The Closure of the Clackmannan Waggonway: Census returns for the area close to Clackmannan harbour show that there was a harbourmaster at Heatherhouse, in 1841: John A Lange, aged 50, Harbourmaster and weigher, Born in Fredrikstad, Norway [314], in 1861 at Heatherhouse, William Houston, Harbourmaster, born in Fossaway, Perthshire [315] and in 1871 at Heatherhouse, ? Hunter, shoremaster. [316]The 1881 census return does not record a harbourmaster. However, there is still a connection with the harbour as John Braun was recorded in Powside as a "*Pilot in the Forth*". [317]

A Board of Trade inquiry was held in Dundee Sherriff court in 1890 regarding the loss of the steamship Newport. [318] The evidence given at this inquiry indicated that the Clackmannan Coal Company had spent £3,000 in 1889 to dredge mud from the area off the pier and establish new buoys. It also noted that coal at Clackmannan pier was loaded on board ships using a steam crane to lift waggons and metal chutes to pour coal into the holds. Evidence was given by Just Anker Lange, harbourmaster at Clackmannan; William Marshal, pilot at Alloa and Henry Ferris, manager of the Clackmannan Coal Company. Mr Ferris stated that the Company shipped a large quantity of coal, and Clackmannan had always been considered a safe tidal harbour. Both the harbour master and the pilot stated that there were no hard objects on the bed of the anchorage, but that vessels were partly or wholly aground at low tide. The finding of the court regarding the loss of the vessel Newport indicated that she left port in "*a good and seaworthy condition, except that in all probability she had been strained while loading. The qualification is an important one and ought to be taken note of by those interested in the future of Clackmannan as a coal port, as well as owners and masters frequenting the Firth of Forth for coal cargoes."* A similar finding from the court several months later regarding the loss of the steamship "Swallow" [319] must have raised serious questions about the future of Clackmannan Pier.

At the turn of the century the OS maps of the area show a number of contradictions. The Third Edition of the OS One Inch Map (1904) shows a line from the Goudnie Burn pits to Clackmannan Pier, with a branch to Fauld (modern day Helensfield). [320] The Second Edition of the OS 25 Inch map (1898) shows only a line from the Craigrie Quarry to the railway near Clackmannan Station on the Alloa to Kincardine line. [321] Although there is no direct evidence for the closure of the pier, the last pits on the Clackmannan branches stopped working the Alloa Cherry coal seam in 1894 [322] and were finally abandoned in 1900 when they stopped working the Alloa Splint coal. [323] It is likely that the last section of waggonway and the pier were abandoned at or soon after 1900.

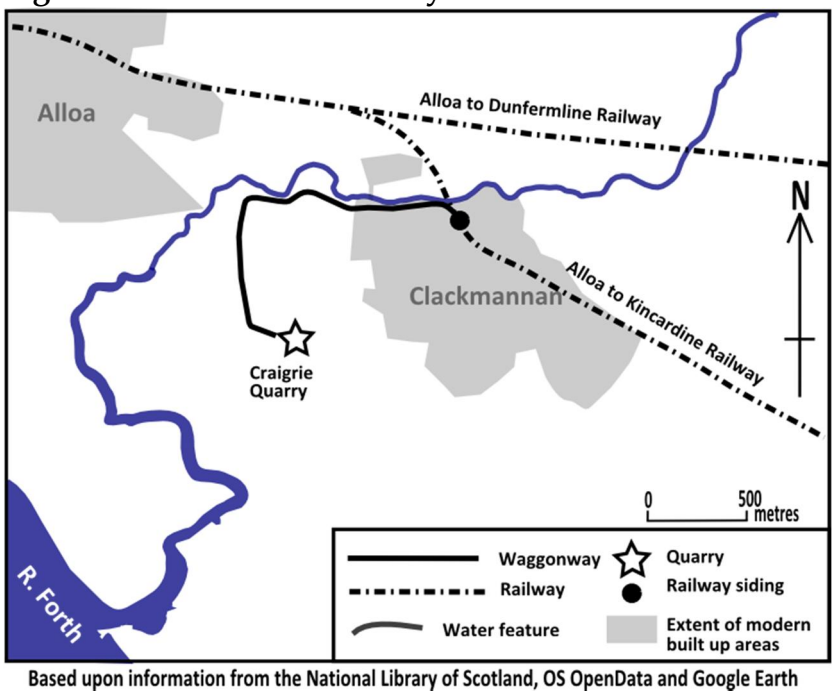
Figure 38. Clackmannan Waggonway circa 1890.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

The Westfield Tramway, circa 1898: The Clackmannan waggonway route had many cuttings and embankments to ensure a gentle, steady gradient. Once the route was no longer used to move coal, part of it was reused as the route of a "*Tramway*" connecting the Westfield quarry (NS 903916) to the Alloa to Kincardine railway line (NS 9128092187). The line of the waggonway was used from the quarry (NS 9031491675) to the point where it once crossed the river Black Devon (NS 91117292244). Two small sections were added: a 135 meter section of spur at the quarry (NS 9030891713 to NS 9043191651) and a small 170 metre curve to link directly with the mainline railway (NS 9112992241 to NS 9127692193). [324] This direct link suggests that the gauge of the tramway was the same as that of the railway. A retired miner in Clackmannan indicated that he once had a booklet with a picture of a steam train on the line of the waggonway near to the Craigrie quarry, hauling waggons loaded with sandstone. [325] Field research revealed that the curve joining the tramway to the mainline railway has been lost to housing development. Aerial photographs revealed the remains of the spur line into the Craigrie quarry. [326] By 1920, the line had been abandoned. [327]

Figure 39. Westfield Tramway 1898.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

This part of the waggonway is one of the best preserved and most accessible sections in Clackmannanshire. It has a number of cuttings and embankments to carry it down the side of the river Black Devon and out on to the Carse. These take the route of the waggonway around the side of Kings Seat Hill. They are complex and demonstrate the high level of engineering used to keep the bed of the waggonway at a level, with the minimum amount of construction.

The following plans and sections show the complexity of these engineering features.

Figure 40. Survey of Site at Clackmannan (NS 9063492307 to NS 9057192319).

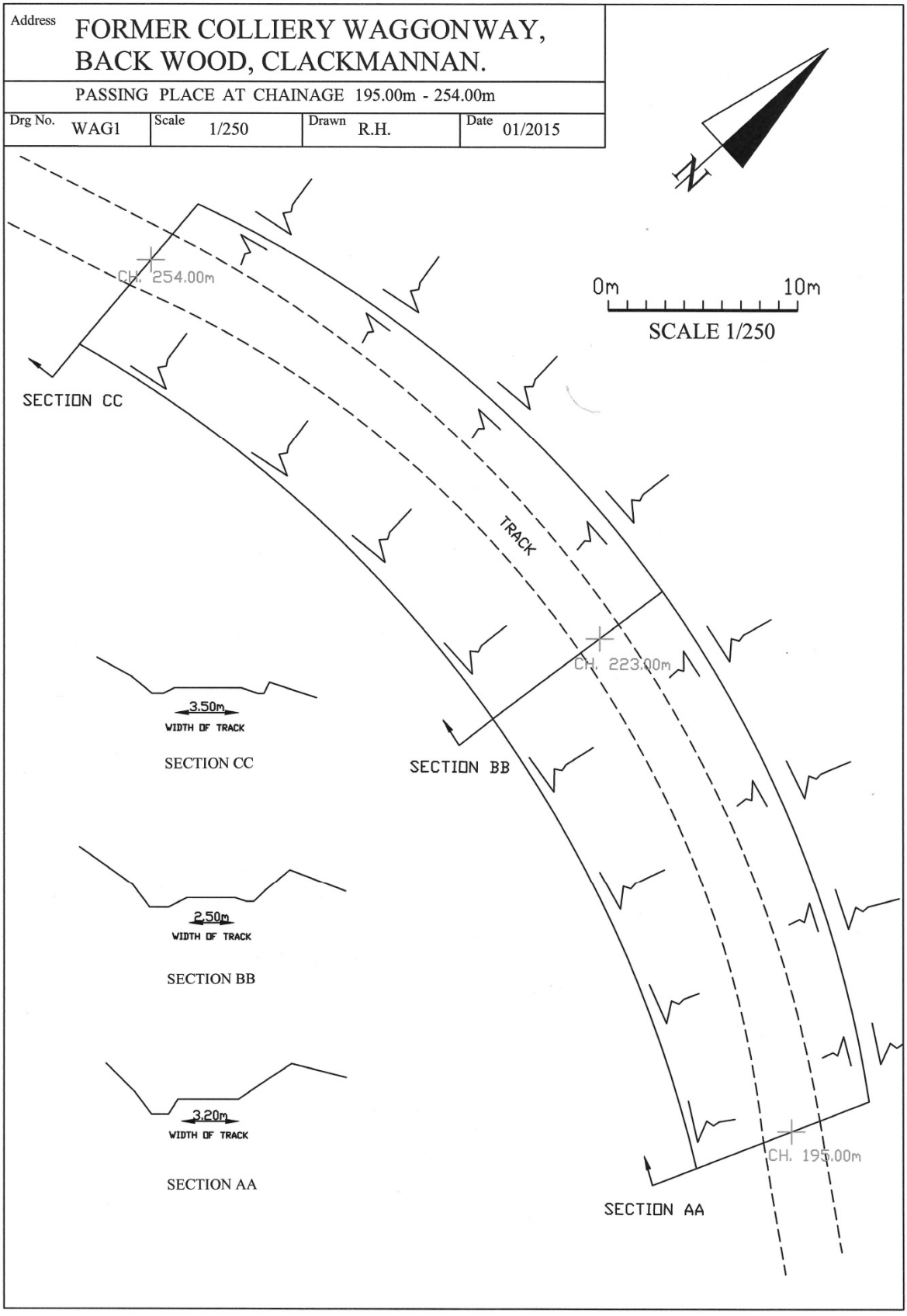
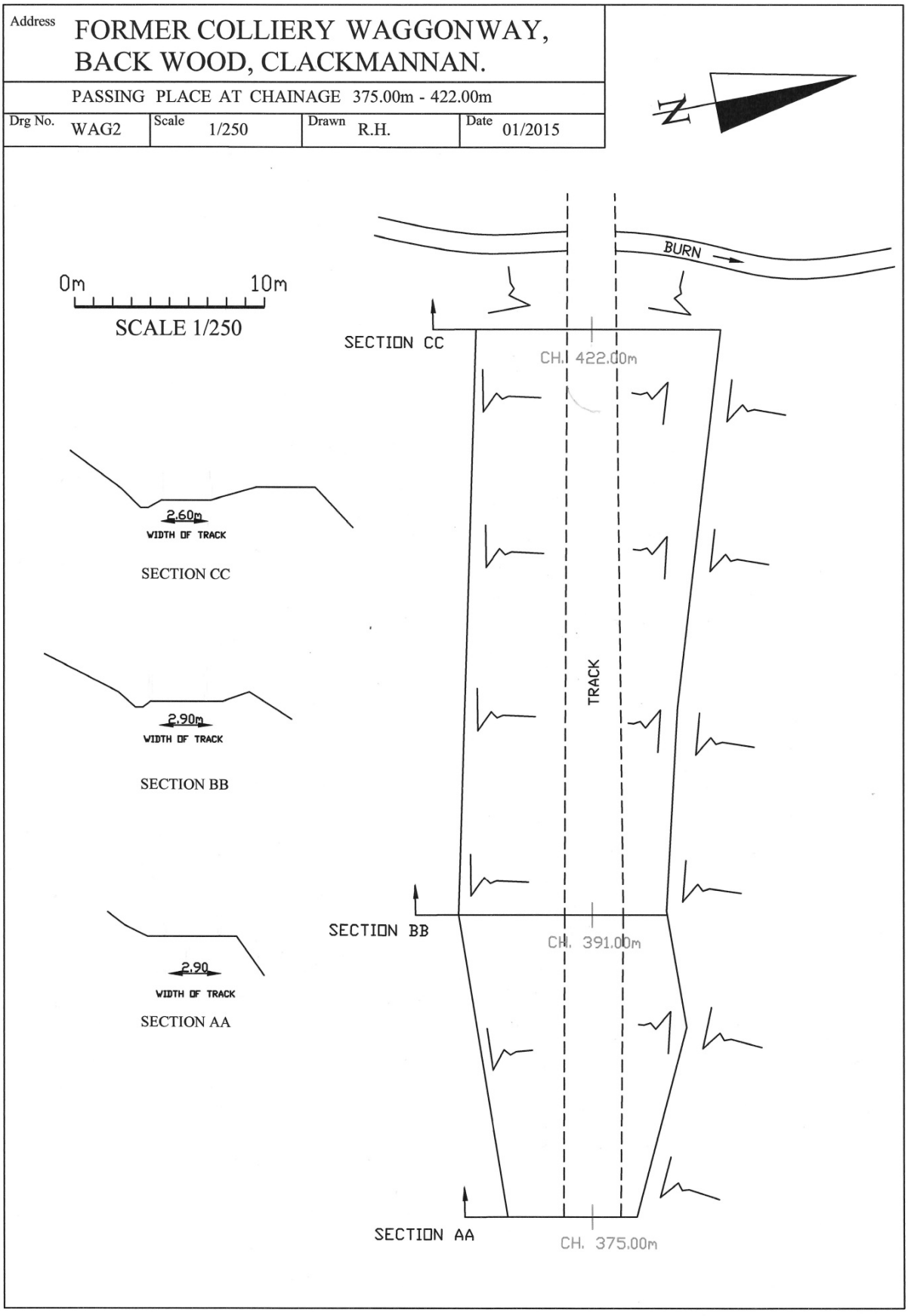


Figure 41. Survey of Site at Clackmannan (NS 9044192282 to NS 9041392286).

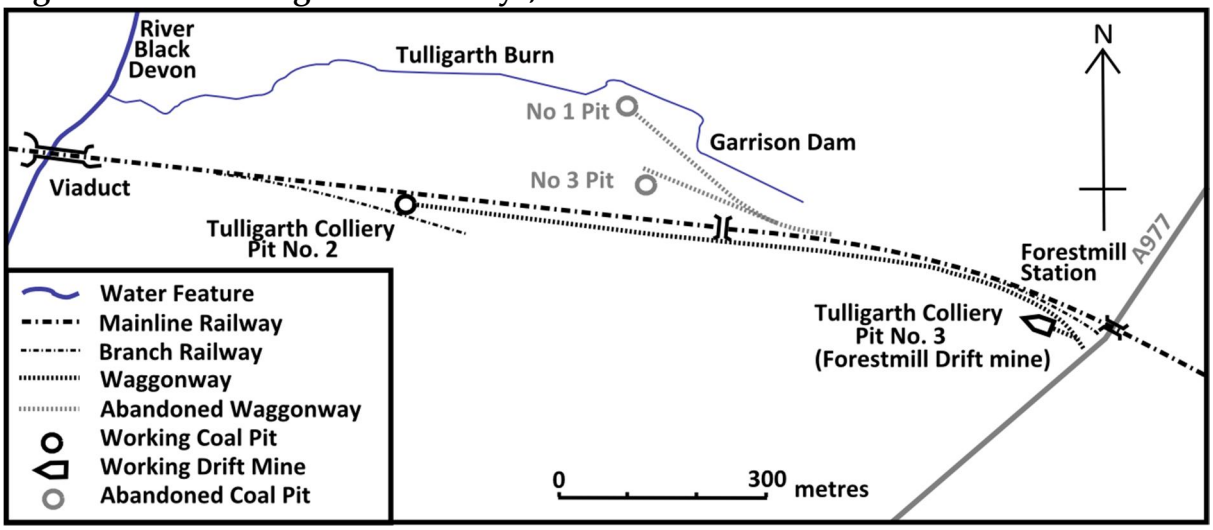


The Tulligarth Colliery (and Pretoria pit) Tramways: There were two last waggonways built in the Clackmannan area associated with the working of the Tulligarth Colliery. Evidence of these was uncovered during field survey work being undertaken on the Clackmannan Colliery Lade system in the area of the Tulligarth (or Garrison Dam). The Tulligarth colliery started working here in the 1860's. The First Edition Twenty Five Inch O.S. map of 1861 [328]shows the Tulligarth Number 1 pit connected directly to the Alloa to Dunfermline railway line by a "Tramway". A site survey revealed that this was carried across the bed of the old Garrison Dam on a very broad embankment, suggesting that the tramway may have been a branch of the railway, connected directly to the Alloa to Dunfermline line.

Figure 42. Waggonway Embankment crossing the bed of the Tulligarth Dam.

The Second Edition Six Inch O.S. map shows that these workings had been abandoned by 1898 [329]. The Second Edition Twenty Five Inch O.S. map, revised in 1920 [330], shows two workings to the South of the Alloa to Dunfermline railway line. The Tulligarth Colliery Number 2 (Pretoria Pit), had a branch line connecting it to the Alloa to Dunfermline railway. A tramway had been constructed to join this pit to Pit Number 3, which lay directly to the South of the Forestmill Station. The O.S. map shows the tramway running alongside the Alloa to Dunfermline railway line, but with no connection to it. The tramway was a single track with a passing place at Pit Number 3. This was a drift mine and the tramway branches off from a track leading from the mine entrance to a waste tip. The map shows the tramway to be of a narrower gauge than the mainline railway.

Figure 43. The Tulligarth Tramways, circa 1920:



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

While neither of these pits is shown on the Ordnance Survey Second Edition 25 Inch map, revised in 1898, there was an accident recorded at the Pretoria pit in 1906, when five miners were trapped by floodwater when they broke into old workings. Fortunately, the men were able to reach a higher level in the mine and were sustained with air and supplies lowered into a borehole sunk into the workings. They were eventually rescued after being entombed for 90 hours. [331]

The Pretoria pit was still in operation in June 1915, when the Scotsman newspaper reported the death of Robert Fyfe, [332] partner in the firm of Messrs J Fyfe and Company, owners of the pit. The Third Edition of the One Inch map (revised in 1923-26) [333] shows the Pretoria pits abandoned, although the Tulligarth colliery continued to operate into the early 1940's. [334]

The Kennetpans Waggonway.

Kennetpans, as the name suggests, was once a thriving salt panning site, using local coal and water from the estuary of the Firth of Forth to produce salt and then exporting this by sea from the small pow. [335] The salt pans of the Forth estuary relied on a ready supply of cheap coal as it required some eight chalders of coal to produce one chalder of salt. Unfortunately, as the process only took just over a day to complete, the salt did not have time to crystallise to form the large crystals which resulted from the much slower process of evaporation by sunlight. The resulting "small salt" from the pans was of an inferior quality. [336] They also relied on cheap labour and salters who worked in the pans were, by act of Parliament, the property of the estate until this was abolished by Parliament in 1775. [337] The peak of the Scottish salt trade was at the close of the 16th century, when large quantities were exported to the Baltic States. [338] The earliest records of coal mining and salt panning in the upper Forth estuary are from this period when it was decreed that any ship laden *"in the narrow watter of the Firth of Forth at the Powis of Alloa, Auch [Airth?], Grangemouth, and sic uther partis quhair na schippis usit to tak thair full laidynning of before*" [339]. The trade was heavily dependent on export to countries around the North Sea and this often created shortages in the home market. As a result, there were numerous bans and licensing conditions introduced. [340]

The earliest record found directly relating to the coal and salt industries at Kennetpans was in 1642, when the Kennet coal is mentioned [341] and then in 1672 when "*the Pannis at Craigton*" is mentioned. [342] Craigton was located immediately adjacent to Kennetpans. [343] The salt pans consumed nearly all of the small coals produced by local mines. [344] This was a great encouragement to mine owners who were exporting great coals, and saw the small coals as an inferior by-product which was hard to sell at a profit. [345]

There are records of a considerable trade in salt from the upper Forth Estuary well into the mid-18th century, [346] but the end of the 18th century, most of the salt being used in the North Sea fisheries was being produced in the Cheshire salt mines. [347] The waters of the Upper Forth estuary are brackish, so it is likely that pans at Kennetpans, Clackmannan and Alloa were less economical to work than those further out into the main estuary. The demand for panned salt declined to such an extent that these salt pans were abandoned, with a serious effect on the demand for local coal. [348] The Old Statistical Account of Clackmannan notes in 1794 that "*The Kennet coal consists of two seams: one of 30 inches thick and another of 36. It was given up in 1726, and begun again to be wrought in 1759. It has at present a small fire engine; but it*

is probable that it was once level free, as there is no trace remaining of any engine being upon it when it was first wrought". [349] The statement "level free" suggests that the early Kennetpans mines were located in the higher ground near Kilbagie, where they could have been drained by a day level. The salt pans would have been located at the shore.

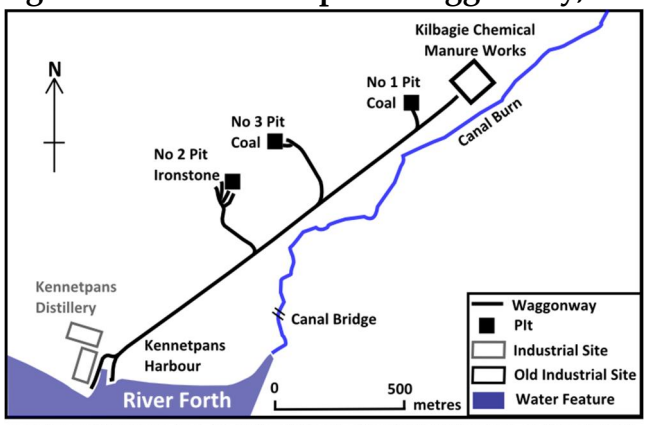
Fortunately, as the salt panning industry died out another industry took its place. Circa 1770, Andrew Stein established a distillery at Kennetpans (NS 912889) which, run by his son John Stein, was to become the largest distillery in Scotland. Around 1777, the nearby distillery of Kilbagie (NS 928899) was opened by James Stein, brother of John Stein, owner of Kennetpans. Kilbagie was operated as a distillery by the Steins until around 1845. [350] There was a gap in production between 1788 and 1794 due to bankruptcy caused by punitive taxation. [351] The extent of the works was reflected in its great size, the buildings themselves covering some 7 acres. In the 1780's it produced some 3,000 tuns of whiskey annually, using 30,000 imperial quarters of grain for production, with the used grain feeding 7,000 cattle in its outhouses. The distillery kept about 850 acres in cultivation for its exclusive use. [352]

The Old Statistical Account of Clackmannan (circa 1794) records that, in terms of the Kennet coalfield, "*The distilleries in the parish consume a great part of this coal. It produces yearly about 6,000 tons of great coal, besides a considerable quantity of chows. After the year 1788, when the distilleries were stopped, about 2,000 tons were yearly shipped to Leith. It has also a very extensive land sale*". [353] The Account describes *"A small rivulet runs through the middle of the works, and drives a threshing mil and all the grinding mills necessary for the distillery; besides supplying with water a canal, which communicates with the river Forth, of about a mile in length, cut for the purpose of conveying both the imports and exports of the distillery".* [354] It also mentions "*the pow at Kennetpans, belonging to Mr. Bruce of Kennet, is much smaller than the other* (Clackmannan Pow), *but capable of being greatly enlarged. It has 17 feet of water at spring tides."* There is now no trace of this canal, but the Ordnance Survey Name Book records in 1861 that the Canal Burn was "*a small stream which issues from Pepper Mill Dam in the parish of Tulliallan, and flowing southward discharges itself into the River Forth at Kennetpans. When Kilbagie Distillery was in operation, a portion of this stream was formed into a Canal for the purpose of conveying grain to that place from the wharfs at Kennetpans*". [355] These references identify the principal function of the canal was bringing in the large volume of grain which would have been required to supply the distillery and exporting the output from the distillery. The First Edition Six Inch OS map of 1861 [356] shows a narrow water course to the east of the waggonway named "Canal Burn". This stream also provides water

to a dam at the harbour with a sluice, perhaps to help remove the silt from the harbour, as was the case at Alloa. The Second Edition Revised 25 Inch OS map in 1913 [357] shows a water course running along the side of the works at Kilbagie and this is still very evident on the ground. This lines up with the route of the waggonway, but is now feeding into the canal Burn as it meanders across the Carse. There is still a substantial water course running along the north western side of the waggonway in its southern section. It may be that the waggonway was developed along the line of the canal, which would explain why little or no trace of it can be seen. Looking at the maps of the area it is evident that the shortest route from Kilbagie to Kennetpans harbour follows the line taken by the waggonway.

The Kennetpans distillery was abandoned in 1825 and in 1845 the Kilbagie distillery, now run by George Dunlop and Company, was converted to a grain distillery using a Coffey Still, continuing until the company was sequestrated in 1852. [358] In 1849 the Kennetpans coalfield was leased to Francis Greer, a mine owner from Dunfermline [359] who appears to have continuously operated the pits until at least 1866. [360, 361 & 362] At some point prior to 1860 the Kilbagie canal was augmented or replaced by a waggonway. The website of the Kennetpans Trust suggests that the waggonway was constructed at a very early period [363] but neither the First nor New Statistical Accounts of Clackmannan Parish make any mention of it, which might suggest that it might have been built close to or after 1841. Francis Greer, the mine owner first mentioned as a lessee of the colliery in 1849 may well have been involved in initiating, or at least developing, the waggonway.

Figure 44. The Kennetpans Waggonway, 1861.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

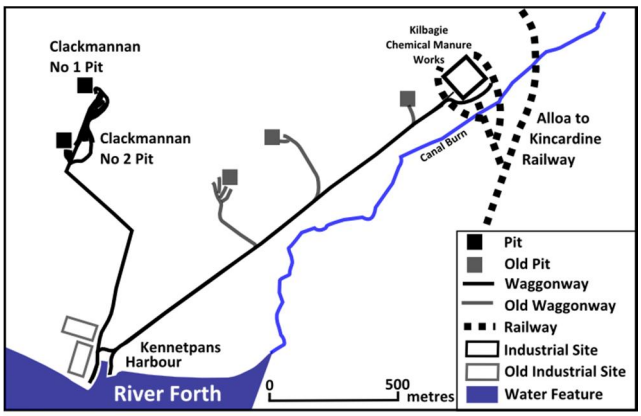
By 1860 the site at Kilbagie had become a Chemical Manure Works and the First Edition OS 25 inch map of 1861 [364] shows these new works (NS 9275389869) connected to the harbour at Kennetpans (NS 913888) by a short single track waggonway with passing places.

The harbour had two quays, east and west on either side of a basin. The waggonway split to serve both quays, with three jetties, sidings and turntables to enable waggons to be taken to the side of the jetties. Branches from the main line connect with two coal pits (NS 9258289866 and NS 9206189737) and an ironstone pit and (NS 9180989414). The Geological Survey of

1920 names these as the Numbers 1, 2 and 3 Pits. The Number 1 Pit worked the Alloa Splint and Alloa Cherry Coals, the Number 2 Pit worked the Nine Foot coal, with a band of ironstone on the roof and the McNeish coal and the Number 3 Pit worked the Alloa Splint and Alloa Cherry coals. [365] The Ordnance Survey Name Book records in 1861 that "*There are three wharves erected at this place for the exportation of coals from the pits in the immediate vicinity*". [366]

In 1874 Kilbagie was taken over by J. A. Weir and Company who constructed a paper mill [367] and the Kennetpans coalfield was leased by Lord Balfour of Burleigh to the Clackmannan Coal Company. The lease was for 21 years and included Kennet and lands of Kilbagie with the right to use the railway from Kilbagie and the harbour at Kennetpans (shared with the paper company and Lord Balfour). The Clackmannan Coal Company upgraded the railway and harbour at a cost of £2,000. However, the coal being mined was soon worked out [368] and in order to recover the money spent on berths, jetties and cranes two new pits were sunk in 1875, one on Lord Balfour's land and the other on part of Ferryton owned by the Earl of Mar. [369] A new single track waggonway connected these pits to Kennetpans and linking up there with the original waggonway to Kilbagie. The branches from the Kilbagie waggonway to the three earlier pits had been abandoned. [370]

Figure 45. The Kennetpans Waggonway, 1898.



The new waggonway was a single track connecting the Number 1 pit (NS 9126089797) and the Number 2 pit (NS 9135290002)) to wharves at the harbour. By this time the paper mill has a branch line from the Alloa to Kincardine railway. On the Kennetpans Trust website there is a painting of the harbour showing a substantial network of sidings, wharves and jetties with a large number of ships loading and waiting to be loaded. [371] Most of the vessels are sailing ships, but there is one shown with a funnel as well as masts and there is a steam derrick crane on the West jetty. There is also a photograph of the West Jetty which shows a small, two-masted sailing ship and a steam derrick crane which is very similar to the one shown on postcards of Alloa wet dock. There is also a single waggon sitting on the jetty. The waggon is very similar in size and design to the ones shown at Alloa wet dock, but the sides are vertical, with the top the same area as the base and the wheels are set

more closely together. The Second Edition revision of the Ordnance Survey 25 Inch OS maps of 1913 show all the waggonways abandoned. [372]

Field research has shown that there are very few traces of the two waggonways at Kennetpans. The Kilbagie waggonway extends for 1.4 kilometres from an elevation at the edge of the Kilbagie industrial site (NS 9253189715) at an elevation of 6 metres to the edge of Kennetpans harbour (NS 9138188940) at an elevation of 4 metres. There is no trace of the route to the Number 2 pit. The routes to the Numbers 1 and 3 pits are preserved in crop marks and field boundaries. The site of the Number 1 pit remains as a spoil heap. The waggonway to the Clackmannan Colliery sites is 1.2 kilometres in length and starts at the Clackmannan Number 2 pit (NS 9137290027) at an elevation of 5 metres, passes the Number 1 pit (NS 9126789808) at an elevation of 5 metres, joins the line of the Lookabootye Brae (NS 9122589709) at an elevation of 5 metres and then turns down the entrance road to Kennetpans (NS 9148489459) at an elevation of 4 metres. It follows this road down to the edge of the harbour (NS 9132488940) at an elevation of 4 metres. The loss of most of the waggonway routes is mainly due to their being on level, rich farmland and therefore having being ploughed out. More recently, the approach road for the Clackmannanshire Bridge cut across the line of the waggonway to Kilbagie.

In its lifetime this waggonway network connected a major distillery, a chemical manure works, a paper mill and five coal and ironstone pits to Kennetpans harbour. The early availability of a canal and the market provided by the distilleries for large quantities of coal look as if they delayed the need for a waggonway. The main purpose of the waggonway seemed to be to convey coal and ironstone from the pits for export from Kennetpans harbour. Mining and the use of the waggonway and harbour were closely associated with the Kennet estate, Francis Greer and the Clackmannan Coal Company.

The Coalsnaughton and Devonside Waggonway: This was the second smallest waggonway network in Clackmannanshire and there are few direct historical records relating to it, apart from the Ordnance Survey maps of 1862, 1898 and 1920. It did not prove possible to find a sheet of the Second Edition of the Geological Survey (1920), which had provided extremely valuable information for other areas. In addition, much of the network has been lost to development.

The Coalsnaughton coalfield was part of the Tillicoultry estate and the coal seams, being in the Coalyland coalfield, lie partly under the ridge of land forming the southern shoulder of the valley of the river Devon and partly under the floor of the valley itself. The coal seams on the ridge had been worked since the 17th century, [373] drained by means of a day level. [374] Exports then were sent to the harbour at Alloa [375] and were subject to the Erskine's Gatemail, [376] which by 1792 was 4d per chalder. [377] The author of the Old Statistical Account of Tillicoultry reported in 1795 that there were four different seams of coal drained by level: [378]

No.	Depth	Description
1st	12 fathoms (18 m.)	(Alloa Cherry Coal) mixed cherry coal, 3 feet thick;
2nd	15 fathoms (24 m.)	(Nine Feet Coal) rough soft coal of an excellent quality, 6 feet thick;
3rd	20 fathoms (37 m.)	(Alloa Splint Coal) good clean splint, 2½ feet thick; and
4th	30 fathoms (55 m.)	(Coalsnaughton Main Coal) the principal seam is about 5 feet thick and is "*a durable splint well adapted for exportation and the foreign market, particularly Holland*".

He also indicated that "*Only the second and fourth seams had been worked and the roofs are all good, except on the second seam, where it runs towards the crop (surface). But it is very valuable, as it contains balls of ironstone in the roof of an exceeding good quality. Eighty acres of the second seam, and twenty acres of the fourth, may still be wrought by the level; but by erecting a steam engine, an immense quantity may be gained*. About 1790, 20 pickmen had been employed and some 3,000 chalders (4,500 metric tons) of coal had been exported, but the workings had been discontinued [379] coals had been carried to the shore at Alloa in farmers' carts [380] and the author of the Account felt that the construction of a waggonway to the shore at Alloa would encourage the proprietor to recommence mining. [381] These were the two common problems facing mine owners in this area in the 18th century: mine drainage and transporting the coals to the shore for export.

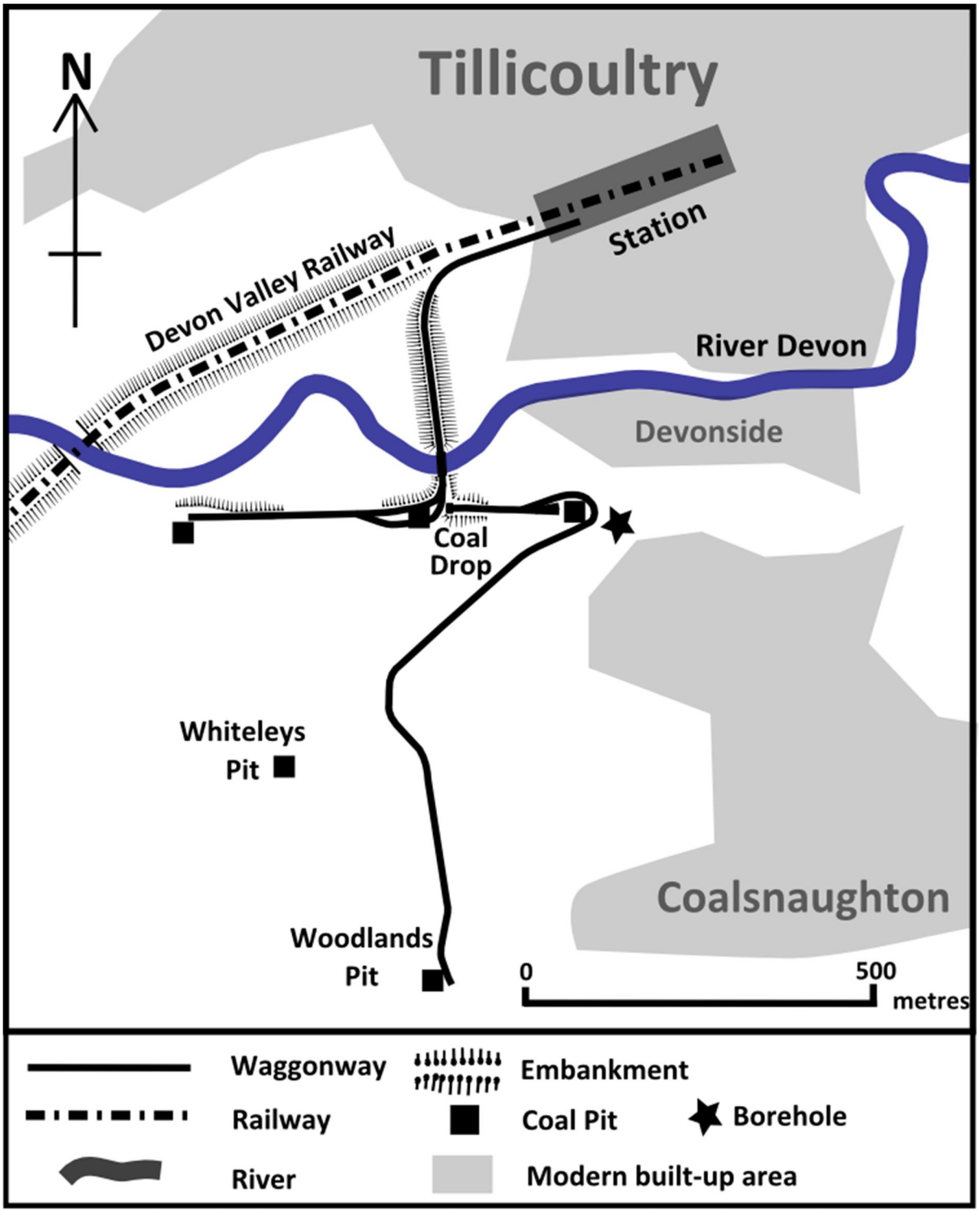
The Tillicoultry estate passed through a number of different owners in the 18th century and was sold off in several parcels to different owners in 1802. [382] By 1823

the Coalsnaughton coals had been leased to John Francis Erskine [383] and in 1824 a waggonway extension was constructed eastwards from the Alloa Waggonway (NS 8989295201) to the Gartenstars pit (NS 9122895341). [384] The Ochil and the Alloa to Kinross turnpike roads were built after 1802, providing better access from the shore at Alloa and some Coalsnaughton coal was carted using the Alloa and Kinross Turnpike. [385] In 1835 Robert Bald took over the lease of the Woodland and Devonside collieries at a rent of £400 [386] and in 1841 it was reported that "*There are no coals sent to Alloa to be exported, although there is now a good turnpike-road, as there is a great demand from the country round, and from the north side of the hills, to which large quantities are driven, by the Yetts of Muckhart*." [387] This trade appears to have developed over the previous century as there is an account in 1740 for coal due to "*James Lindesay of Alva, including 107 horses loaded with Mellock coal"*. [388]

In 1852 the Stirling to Dunfermline railway had been extended to Tillicoultry [389] where Robert Bald had the lease of the Woodland and Devonside collieries. [390] By 1855 Robert Bald had relinquished the lease of the Devonside and Woodlands collieries to his former manager, James Snowdone. [391] The First Edition OS 25 inch map shows that by 1861, two separate waggonways had been constructed to take coal from three pits on the Devonside colliery (NS 9135796238, NS 9165696246 and NS 9185196210) and one pit on Woodlands colliery (NS 9168895632) to the Devon Valley Railway at Tillicoultry station (NS 9191496629). [392] The map shows that the lines of the two sections were not directly linked, but were connected by means of a coal drop (NS 9169896277). As James Snowdone still owned the lease to the collieries in 1866 [393] it is likely that the waggonways were built under his management.

Figure 46. Coal drop connecting the Woodlands to the Devonside Waggonway.

Figure 47. Coalsnaughton Waggonway in 1861.

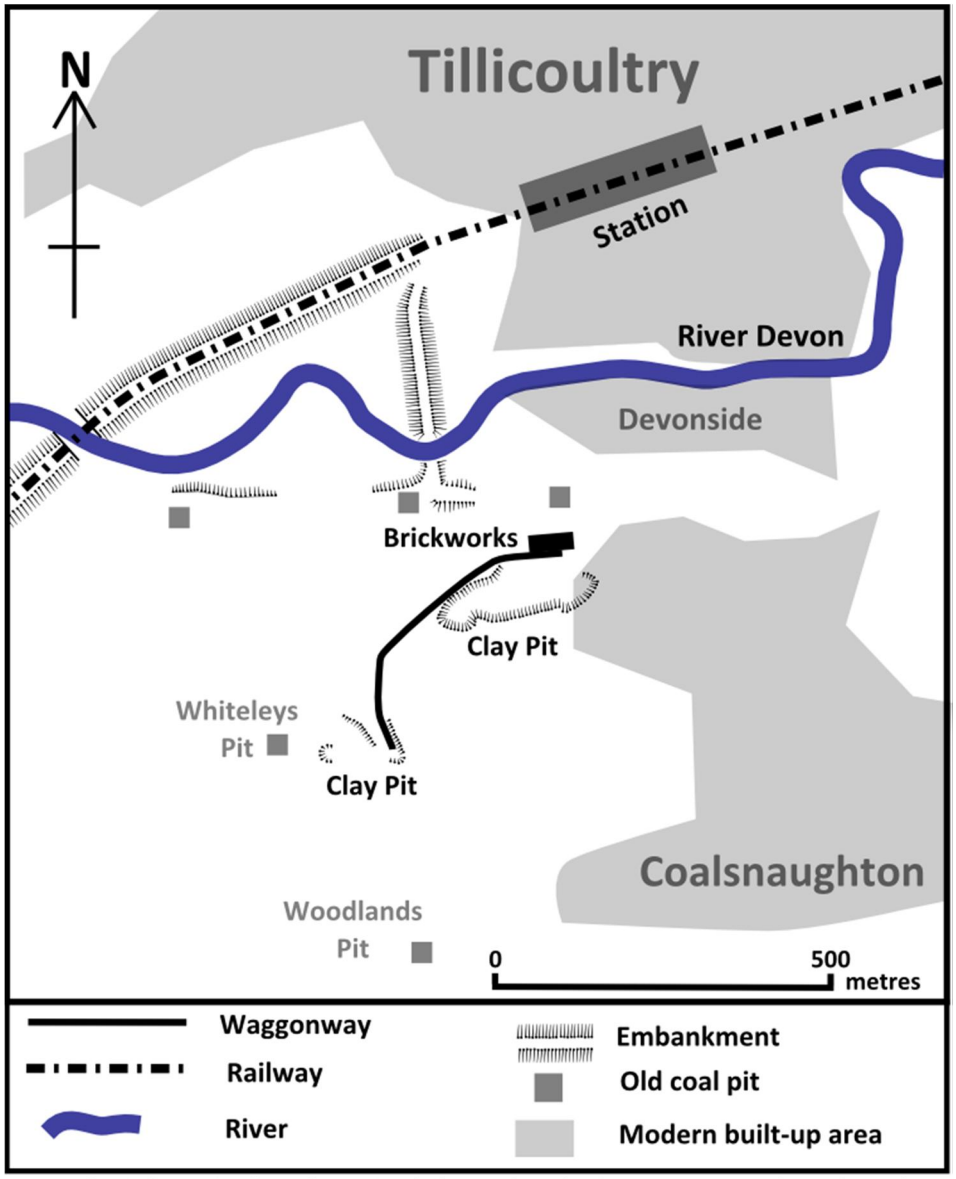


Based upon information from the National Library of Scotland, OS OpenData and Google Earth

In 1869 the leases of the Devonside and Woodlands collieries were taken over the Clackmannan Coal Company. [394] In 1877 the Devonside and Woodland workings were abandoned (Rough, Splint, Coalsnaughton Main and Craw) [395] and the lease passed to the Alloa Coal Company. [396]

By 1899, the Second Edition of the OS 25 inch map showed that most of the waggonway network had been abandoned, leaving only a small section connecting a brick works at Devonside (NS 9185196180) to a clay pit to the South (NS 916959). [397] By 1920, this small section of waggonway had been abandoned. [398] A borehole sunk in 1959 (NS 9184496111) found the Coal Mosie, 3 feet 5 inches thick (1.04 metres) at a depth of 5 fathoms (9.14 metres). [399]

Figure 48. Coalsnaughton Waggonway in 1899.



Based on information from the National Library of Scotland, OS OpenData and Google Earth

Field research has shown that the line of the former Devon Valley Railway is still visible. The line of the waggonway is walkable from the remains of the viaduct across the River Devon (NS 91249963590) to the western edge of the site of the former station (NS 9189596638).

The line of the waggonway from the station is preserved as an open area (NS 9178596609). This is bounded on the southern edge by trees and a curving pathway leads to the remains of a large embankment (NS 9169296343) which once carried the waggonway across the floor of the valley to a bridge over the River Devon. The elevations of the line from the station, across the river to the coal drop are: 17 metres at the station, 16 metres at the start of the curve to 19 metres on the South bank of the Devon and 21 metres at the site of the coal drop. This is a fall of 5 metres from the coal drop (NS 9169896263) to the sidings at Tillicoultry station over a distance of 490 metres: a gradient of 1 in 98. The waggonway coming down from the Woodlands colliery reaches the turnpike road at an elevation of 27 metres and a horizontal distance of 75 metres from the coal drop. In order for the two waggonways to have connected directly this would have involved a 6 metres drop over 73 metres: a gradient of 1 in 12. There simply was not enough room for a simple direct connection with a reasonable gradient. The elevation of the Woodland pit is 73 metres and the waggonway travelled 786 meters downslope to reach the turnpike road at 27 metres: a fall of 46 metres over a distance of 787 metres, a gradient of 1 in 17. This is still a substantial gradient for a single track waggonway.

The site of the coal drop has been modified over the years by garden developments and the introduction of a modern footpath. The two pits to the west have been covered over by a landfill site. The third pit, on the South side of the turnpike road was redeveloped as a brick works, which in turn has been redeveloped as garages. The route of the waggonway to the Woodlands pit (NS 9168595636) is preserved in field boundaries and hedge and wood edges. The site of the pit is now in a house garden with small sections of stonework still visible.

The Alva Waggonway: This was the smallest waggonway in Clackmannanshire and the only three map records directly relating to it are the OS 25 inch First (1862), Second (1899 and Second Edition Revision (1920). Fortunately, a considerable proportion of the line of the route is still visible. At the end of the 17th century the Alva estate was owned by the Erskines of Alva (related to the Erskines of Alloa). [400] The coal seams run through most of southern part of the parish of Alva, close to the river Devon. [401] There is evidence that the seams were worked in the late 17th and early 18th centuries by Sir John Erskine of Alva and in 1717 negotiations were in hand with David Landale [Landels] of Burns for a water wheel for a coal sink to the West of the village of Alva. [402] A lease agreement in 1729 names the Alva colliery as "*Coblecrock*". [403] Legal papers from the Alva estate mention aspects of coal working in 1731 to 1736, [404, 405 & 406] including the naming of colliers who had run away, a practice

which Sir John Erskine could not understand - "*They are such odd creatures these coalyiers*". The Old Statistical Account of Alva notes in 1796 that the Alva coals had been worked for a short period about 50 years previously, when Sir John Erskine had mined a considerable amount of coal. [407] He had constructed a canal along the route of the river Devon to the shore of the Forth in order to export the mined coal [408] and in 1796 the remains of the canal could be "*easily traced*". Supporting evidence for the canal is contained in another legal paper of 1730, which relates to the control of navigation on the River Devon, especially the sluices at Tullibody, where the river Devon is held back by a weir before it joins the Forth. [409]

In 1766 the engineer James Watt was commissioned to survey the route of a possible canal from Cambus to Dollar to enable the coals of the various estates to be exported. He reported that the difference in level from the Forth to Dollar was trifling and that a canal could be made for a sum of £2,000. [410] The canal would only have had to have been constructed on certain sections of the river as some parts were able to be used without being modified [411] but the canal was never built [412] and the Alva pits seem to have been abandoned at or near to that time. [413] The Old Statistical Account goes on to record that the demand for coal was increasing and comments on "*the prodigious consumption of Lord Cathcart's coal, by an iron works lately erected on that Nobleman's estate*". [414] The author expressed the opinion that the proprietor of the Alva Estate will soon resume coal mining. [415] At this time, coal from Alva going for export was taken to the shore at Alloa by farmers using small carts. [416]

By 1826 the Johnstone family were the proprietors of the Alva estate and Robert Johnstone had begun discussions with Robert Bald, with a view to reworking the coal seams. Bald was extremely cautious, citing geological problems related to the workings, but later negotiated for a mineral lease and the siting of colliers houses. [417] In 1835 the Alloa Coal Company were experiencing difficulties reopening their Collyland pits due to water from the river Devon flooding in to their workings from two old pits in Alva. After failing to find a solution, it was finally decided to divert the river on to a section of the coalfield where the coals had never been worked. [418] The old course of the river is shown on the First Edition OS 25 inch map in 1862, [419] while the new course is shown on the Second Edition OS 25 inch map in 1898 [420] indicating that the diversion took place between these two dates.

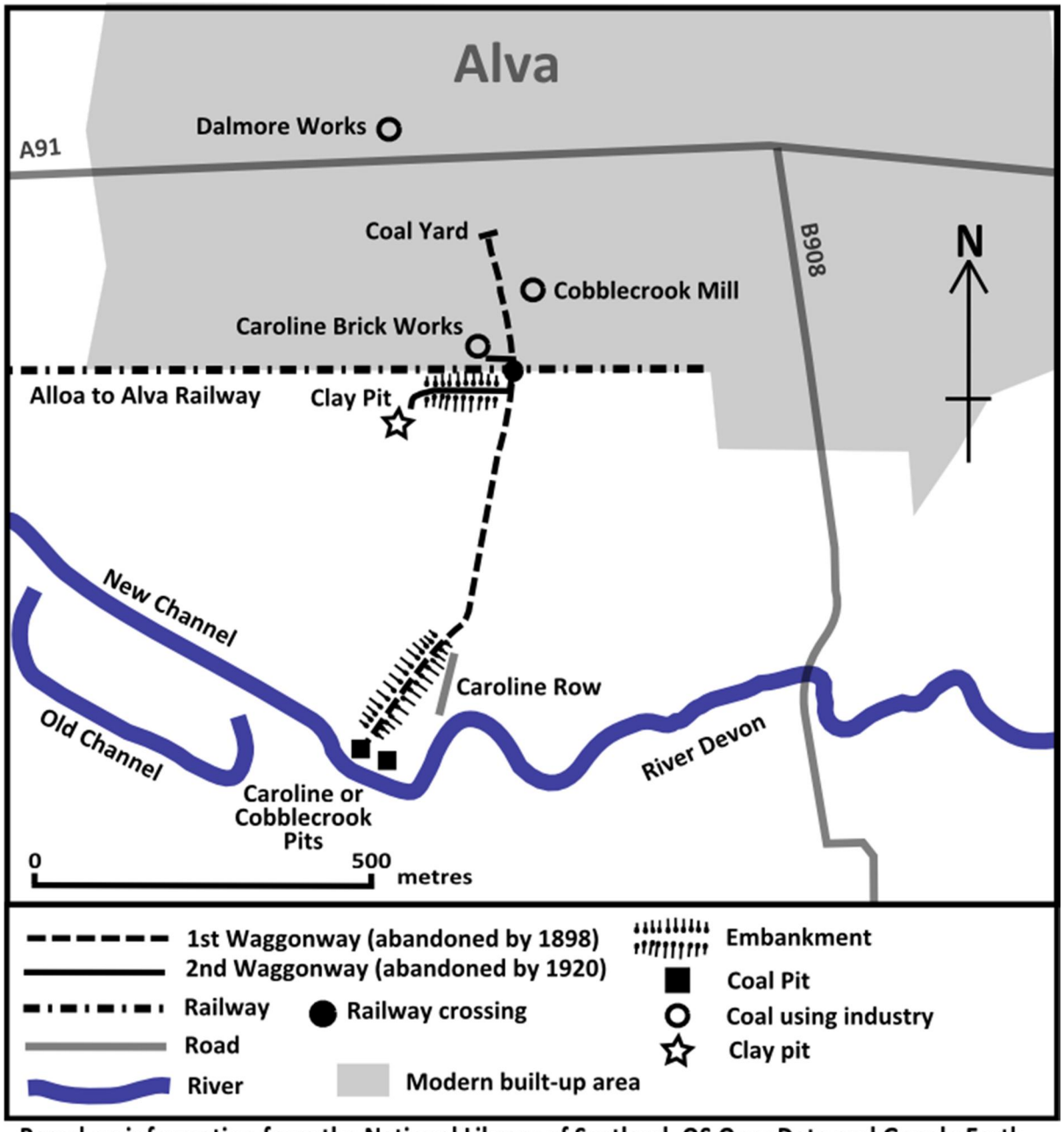
In 1854 James Johnstone owned a pit on his estate at Glenfoot (NS 9081996359) near the hamlet of Marchglen [421] but the workings of the Nine Foot coal were abandoned there in 1855. [422] In 1857 he was involved in legal action against the

Devon Iron Company regarding their illegal extraction of his coals, probably from the area of the Glenfoot pit. [423]

In 1862 the First Edition OS 25 inch map shows a coal pit near to the River Devon next to a small tenement of eight single rooms, called Caroline Row. [424] A single track "*tramway*" with no passing places is shown heading northwards towards the western edge of the village of Alva. It ends with a very short second line at a small loading dock close to the Cobblecrook mill. [425] The OS name book for this site indicates that Caroline Row was owned by James Johnstone in 1861 and was inhabited by colliers working in the nearby pit. [426] Surprisingly, an exhaustive search of the census returns for the Parish of Alva in 1841, 51, 61 and 71 revealed no mention of any families living in Caroline Row or Cobblecrook and no record of any individuals employed as colliers or miners. [427] The list of Plans for Abandoned Mines [428] indicates that, in 1872, the Cobblecrook Number 1 and Number 2 pits were abandoned, stating that they had been working the Lower Five Feet, Alloa Splint and the Nine Feet coals. Another reference for the same year notes that the Collyland and Cobblecrook Numbers 1 and 2 pits had been abandoned, having been working the Coalsnaughton Main coal. There is also a reference to the loss of the value of the Cobblecrook pits to the Valuation Roll of Alva when they were closed in 1873. [429] Beyond this time, the estate leased the coal seams to the Alloa Coal Company [430] who worked them from the Devon Colliery.

The Second Edition OS 25 inch map [431] show that the waggonway from the Cobblecrook pits had been abandoned by 1899 but there was a short, single track waggonway leading from a clay pit (NS 876967) to a small brick works (NS 8777896794). The Second Edition Revision OS 25 inch map [432] shows that this small section of waggonway had been abandoned by 1920.

Fig 49. The Alva Waggonways, 1861 and 1898.



Based on information from the National Library of Scotland, OS OpenData and Google Earth

Field research shows that the lines of the most northerly section of the earlier waggonway from Caroline Row and the waggonway from the clay pit to the brickworks have been lost to development. From the bottom of Cobblecrook Lane to close to the pit site the line of the route has been preserved as a farm track with the odd hawthorn bush on the fence line on the eastern side. The final section is still preserved as an embankment, with two rows of hawthorn hedge on either side. The site of the pits has been lost to development and there is now no trace of Caroline Row. One of the project volunteers recalled traces of the stone outlines of Caroline Row in an area of very overgrown hawthorn bushes, a deep hollow some 10 metres

across and some seven metres deep at the end of the waggonway embankment at the site of the pit and the remains of a low embankment adjacent to the abandoned clay pit.

The coal seams under the Alva estate were difficult to work, being almost entirely below the level of the river Devon. In addition, getting coal to the shore was also challenging. A simple canal had allowed Sir John Erskine of Alva to get his coals to the Forth. A second attempt to extend this project did not succeed and the Alva coals seem to have gone to land sale. This was facilitated by means of a waggonway to connect to the town of Alva to the Cobblecrook (or Caroline) pits. The coals of the Alva estate were utilised by the Devon ironworks, their lease being transferred following the sale of the iron works in 1858. [433] Beyond that, the Alva coals were leased to the Alloa Coal Company and worked from the new Devon colliery. [434]

Conclusion: While the Clackmannanshire waggonways have different histories, they share a number of common features. They were all constructed to assist with the movement of bulk materials, mainly coal from pits. They were all horse-drawn, single line waggonways with passing places. Most of the routes had a very gentle downward slope or very little gradient at all. There were two very small sections of the Alloa waggonway, where it was connecting with pits in the Coalyland colliery in the valley of the river Devon, which had an upward slope. The section at Collyland took a winding route across the slope to reduce the gradient and the line from Fishcross to the Devon colliery appears to have had power winding at its later stages. The first part of the Sauchie waggonway had a similar difficulty as the Devon Iron Works was located on the lower southern slope of the valley of the river Devon.

The waggonways all appear to have been constructed after the local estate owners had decided to lease their coals, rather than work them themselves and, in the cases of the Alloa and Kennetpans waggonways, the costs appear to have been at least partly met by the lessees. Initial costs seem to have been burdensome, but the substantial increase in the amount of coals being handled covered costs quickly. However, several of the lessees experienced financial difficulties which, in at least one case, ended in bankruptcy. Despite these challenges, the waggonways greatly improved the transport of coal from the pits and were responsible for moving very large quantities of coal quickly and easily. This improvement enabled a substantial increase in mining activity.

It is clear that the most profitable aspect of the early coal trade was exporting from the shore, both coastwise and across the North Sea. The Alloa, Clackmannan and

Kennetpans waggonways were specifically built with this in mind. Having once had a canal link with the Forth at Cambus, the collieries in the Devon Valley were later denied a more substantial canal link. This led to the need to use the Coal Road to Alloa shore or rely on land sales. As a result, both the Alva and Tillicoultry estates were much more dependent on land sales, had a slower pace of the development of coal mining and the later arrival of waggonways. In the case of Alva, the waggonway supported local sales and, in the case of Tillicoultry, supplied local markets and fed into the mainline railway system.

Being of a smaller scale than mainline railways, waggonways were ideally suited for the pattern of mining in Clackmannanshire in the 18th and early 19th centuries where the geology of the coalfields led to a scatter of small pits, often working their way sequentially across several faulted areas. New branches could be laid fairly quickly and cheaply and then easily abandoned as seams were worked out. The success of the waggonways can be measured by the considerable increases in the volume of coal being transported. They were also successful in remaining in use for a considerable period after main line railways were introduced. With the exception of the Coalsnaughton waggonway and one possible link between the Devon Iron Works and the Devon Valley railway, the waggonway networks stayed entirely separate from the mainline railway system. Only when much larger scale mining took place in the late 19th and early 20th centuries did the mines in Clackmannanshire change over completely to mineral railways and branch sidings from the mainline railways.

All of the waggonways were associated with industrial sites which used coal as a fuel, including iron works, a glass works, foundries, brick and tile works, distilleries, breweries and textile mills. Often when a waggonway was no longer used to move coal, a part was re-used, mainly to transport materials from clay pits and quarries.

While a very large amount of historical information is available regarding the development, decline and management of the waggonways and the movement of coal by road, there have hardly been any references found to the men and women who worked to transport the coals. David Allan's portrait of a waggon and driver and his etching of Alloa Dry Dock are the only two visual records we found. In 1841 the New Statistical Account of Alloa indicates that "*one man and horse can do work of 27 with a pay rate of 3.5p per ton*". [435] In 1870 the Falkirk Herald reported that "a man named Francis Love, waggon driver in the service of the Clackmannan Coal Company, while driving several loaded waggons to the shore, fell before one of them, the first wheel of which went over his left leg". [436] The 1891 census returns for

the village of Westfield, near Clackmannan, records that there were three colliery waggon drivers residing there. Francis Love aged 67 lived at number 5 while James Hogg aged 56 and his son Joseph Hogg aged 24 lived at number 8.

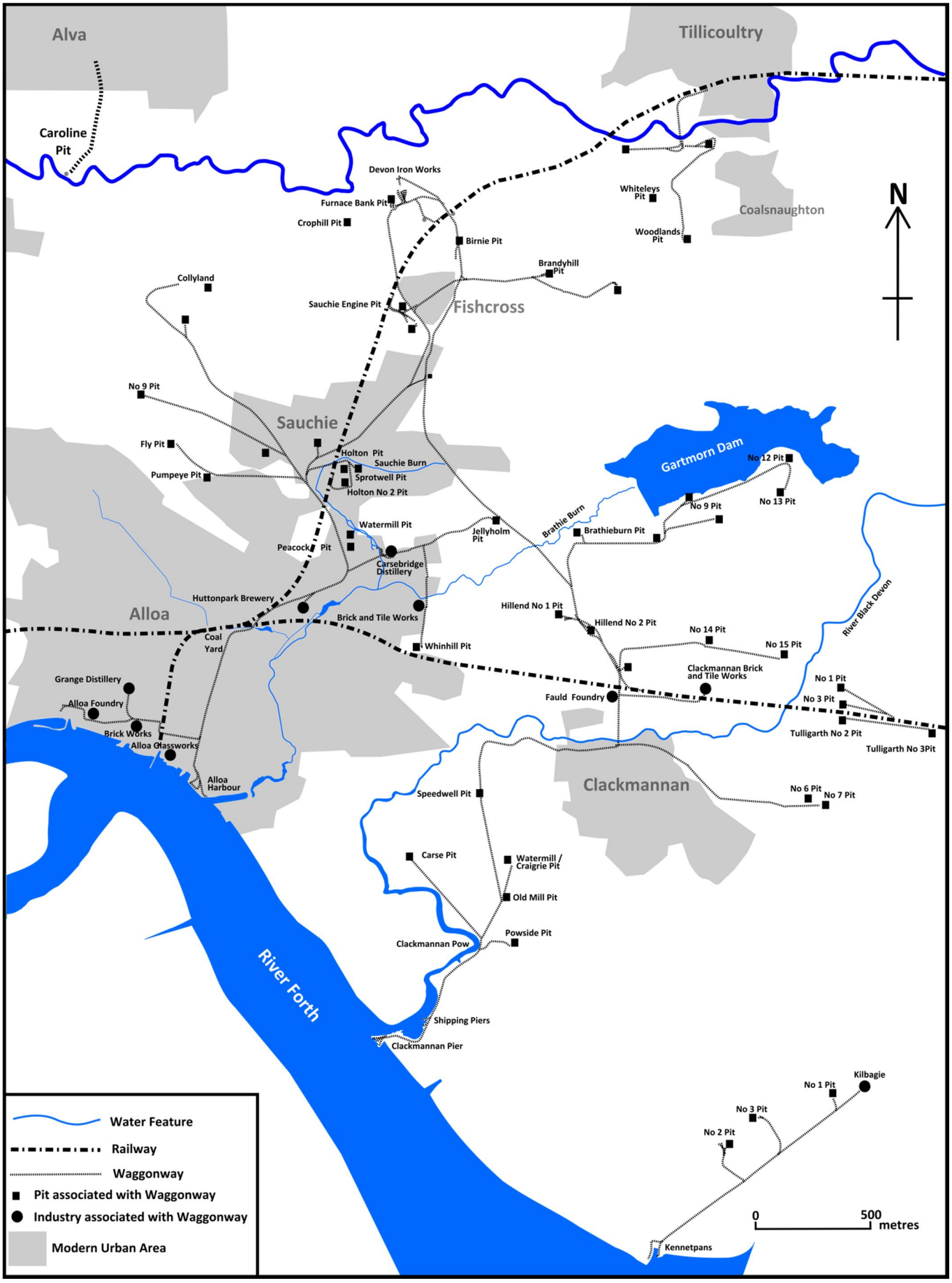
In addition to the use of the waggonway, all collieries had land sales. Carvel mentions that, in 1847 the Alloa Coal Company had many thousands of tons of coal going to land sales as far north as Perth and employed 7 carters, two of whom were women. [437]

Industrial, residential and rural developments, particularly over the past 50 years, have resulted in the loss of considerable sections of the waggonways. However, many routes have been preserved by their use as roads, pathways and tracks. The best preserved length of section runs along roadways, on pathways and footpaths from the woodland at the summit of the Collyland extension (NS 8845794921), down Fairfield road, following the broad footpath along Hallpark Road to the Whins Toll (NS 8941193435). The route then runs along Argyll Street, across the railway line at Alloa station (NS 8876993089 where the construction of the town centre dual carriageway has removed a 50 metre section. It resumes at the north end of Primrose Street (NS 8864293057) and follows the line of the substantial cutting leading to the shore, ending at traces of a small embankment (NS 8844192514). The route covers a distance of 4.5 kilometres.

The best preserved rural section is the 1.2 kilometres link from near the Mary Bridge at Clackmannan (NS 9085092245), through the Back Wood and on to the junction with the old Alloa to Kincardine road (NS 9031491575). This short section has a number of complex cuttings, embankments and composite cutting / embankments which illustrate the simple engineering solutions which were used to keep the waggonway sloping gently down towards the shore.

The following map shows the routes of all of the waggonways identified by volunteers during the project.

Figure 50. All identified waggonway routes in Clackmannanshire, 1766 – 1924.



Principal On-line Sources:

Bing Maps:	http://https://www.bing.com/maps
British Geological Survey:	http://www.bgs.ac.uk/data/mapViewers/home.html
British Newspaper Archive:	https://www.britishnewspaperarchive.co.uk/
Canmore:	http://canmore.org.uk/
Charting the Nation:	http://www.chartingthenation.lib.ed.ac.uk/index.html
Google Books:	https://books.google.com/
Google Earth:	https://earth.google.co.uk
Kennetpans Trust:	http://www.kennetpans.info
National Library of Scotland:	http://maps.nls.uk/
National Records of Scotland:	http://www.nrscotland.gov.uk/research/
Ordnance Survey Open Data:	https://www.ordnancesurvey.co.uk/business-and-government/products/opendata-products-grid.html
RCAHMS:	http://www.rcahms.gov.uk/
ScotlandsPeople:	http://www.scotlandspeople.gov.uk/
ScotlandsPlaces:	http://www.scotlandsplaces.gov.uk/
Scottish Mining Website:	http://www.scottishmining.co.uk/
Statistical Accounts:	http://edina.ac.uk//stat-acc-scot/
The Scottish Parliament:	http://www.rps.ac.uk/

References:

1 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 11.
2 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 6.
3 **National Records of Scotland**, 1717, GD164/1068, Edinburgh, NRS.
4 **National Records of Scotland**, 1718, GD110/1101, Edinburgh, NRS.
5 **National Records if Scotland**, 6th Earl of Mar, 1712, GD124/15/1047/14, Edinburgh, NRS.
6 **National Records of Scotland**, 1673, GD11/184, Edinburgh, NRS.
7 NCB, 1958, A Short History of the Scottish Coal-Mining Industry, Edinburgh, Pillans and Wilson, page 34.
8 NCB, 1958, A Short History of the Scottish Coal-Mining Industry, Edinburgh, Pillans and Wilson, page 36.
9 NCB, 1958, A Short History of the Scottish Coal-Mining Industry, Edinburgh, Pillans and Wilson, page 36.
10 **Scottish Parliament**, 1426, James I: 1426, 11/13 March, Perth/Edinburgh, Legislation, Edinburgh, St Andrews University.
11 **Ady**, C.M, 1913, Pius II, (Aeneas Silvius Piccolomini), The Humanist Pope, London, Methuen and Company, page 44.
12 **Scottish Parliament**, 1563, Mary I: 1563, 4 June, Edinburgh, Legislation, Edinburgh, St Andrews University.
13 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 3.

14 Gordon, T.C, 1936, The History of Clackmannan, Glasgow, Civic Press, page 78.
15 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 3.
16 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 5.
17 **Scottish Parliament**, Charles I: 1625, 27th October, Legislation, Edinburgh, St Andrews University.
18 **Records of the Parliament of Scotland**, Charles II, Edinburgh, 4th August, 1649 Act and commission for a new valuation, Edinburgh, St Andrews University.
19 **Lynch, M**, 2001, The Oxford Companion to Scottish History, New York, Google Books, page 197.
20 **National Records of Scotland**, 1638, GD124/17/512, Edinburgh, NRS.
21 **National Records of Scotland**, 1631, GD124/17/511, Edinburgh, NRS.
22 **National Records of Scotland**, 1638, GD11/127, Edinburgh, NRS.
23 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 5.
24 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 25.
25 **Armstrong, W** , 1889, Proceedings of Society of Antiquities of Scotland Vol 24, 1889-90, Papers on export of coals from Scotland 1596 , Edinburgh, Society of Antiquities of Scotland, page 474-475.
26 **Bald, R**, 1812, A General View of the Coal Trade, Edinburgh, Oliphant, Waugh and Innes, page 7.
27 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 26.
28 **National Records of Scotland**, 1705, GD406/1/5423, Edinburgh, NRS.
29 Gordon, T.C, 1936, The History of Clackmannan, Glasgow, Civic Press, page 171.
30 **National Records of Scotland**, 1712, GD124/15/1057/3, Edinburgh, NRS.
31 **National Records of Scotland**, 1717, GD164/1068, Edinburgh, NRS.
32 **Hume, J,** Canmore ID 47208.
33 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 26.
34 **Bald, R**, 1812, A General View of the Coal Trade, Edinburgh, Oliphant, Waugh and Innes, page 43.
35 **Armstrong, W**, 1889, Proceedings of Society of Antiquities of Scotland Vol 24, 1889-90, Papers on export of coals from Scotland 1596 , Edinburgh, page 476.
36 **Acts of Scottish Parliament**, 1685, Parliament of James VII, 1685 23 April, Edinburgh.
37 Cambridge University, 1911, Cambridge County Geographies, Clackmannan and Kinross, Cambridge, Cambridge University Press, page 47.
38 Bald, R, 1812, A General View of the Coal Trade, Edinburgh, Oliphant, Waugh and Innes, page 48.
39 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 5.

40 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 41.
41 **Frame, J and Erskine**, F, 1796, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 609.
42 **Duncan, J,** 1791-99, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 131-2.
43 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 617.
44 **Acts of Scottish Parliament**, 1606, James VI: 9 July 1606, Perth, Legislation.
45 National Records of Scotland, 1655, GD124/17/515, Edinburgh, NRS.
46 **National Records of Scotland**, 1735, GD164/1681, Edinburgh, NRS.
47 Wallace, J, 1890, The Sherrifdom of Clackmannan, Edinburgh, James Thin, page 70.
48 **Scottish Parliament**, James VI: 1592, 3 April, Edinburgh, Legislation, St Andrews University.
49 **Bald, R**, 1828, The Edinburgh New Philosophical Journal, Edinburgh, Adam Black, page 110.
50 **Porter, D.H**, 1998, The Life and Times of Goldsworthy Gurney, Cranbuy, NJ, USA, Associated University Presses Inc..
51 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 38.
52 **Bald, R,** 1812, A General View of the Coal Trade, Edinburgh, Oliphant, Waugh and Innes, page 52.
53 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 617.
54 **National Records of Scotland**, 1710, GD18/2920, Edinburgh, NRS.
55 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 6.
56 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 13.
57 Wallace, J, 1890, The Sherrifdom of Clackmannan, Edinburgh, James Thin, page 52.
58 Wallace, J, 1890, The Sherrifdom of Clackmannan, Edinburgh, James Thin, page 54.
59 **National Records of Scotland**, 1715, E645/39, Edinburgh, NRS.
60 **National Records of Scotland**, 1724, GD124/17/534, Edinburgh, NRS.
61 **Brodie, W,** 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 22.
62 **Bald, R,** 1819, Memoirs of the Wernerian Natural History Society, Volume 3, 1817-20, page 129.
63 **Williamson, J,** 1877, Geological Survey of Scotland, Vertical Sections of the Stirling and Clackmannan Coalfield.
64 **Brodie, W,** 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 20.
65 HMSO, 1970, The Geology of the Stirling District, Edinburgh, HMSO, page 268.

66 **Frame, J and Erskine, F**, 1791-98, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 641.
67 **National Records of Scotland**, c 1702, RHP 13258 Edinburgh, NRS.
68 **Roy, Sir W**, 1747-55, The Roy Military Survey of Scotland (Highland area), Internet, British Library.
69 **Wood, J,** 1825, Plan of the Town of Alloa from actual survey, Edinburgh, National Library of Scotland.
70 **Osburn, W**, 1791-99, Old Statistical Account, Volume 15, Tillicoultry, Edinburgh, Sir John Sinclair of Ulbster, page 198.
71 Baxter, B, 1966, Stone Blocks and Iron Rails, Newton Abbot, David & Charles, page 62.
72 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 30.
73 Robertson, C, 1983, The Origins of the Scottish Railway System, Edinburgh, John Donald, page 6.
74 **Graham, A**, PSAS, Volume 101, 1968-69, Archaeological Notes on some harbours in Eastern Scotland, Edinburgh, Proceedings of the Scottish Society of Antiquaries, page 214.
75 **Roy, Sir W**, 1747-55, The Roy Military Survey of Scotland (Highland area), Internet, British Library.
76 Buchannan, J.B, 1759, A Plan of the marche twixt the Coalyland & Sauchy Grounds with the wasteings of the Coalyland coal, Alloa, National Library of Scotland.
77 Carvel, J.L, 1953, The Alloa Glass Works, Edinburgh, T and A Constable, page 6.
78 Carvel, J.L, 1953, The Alloa Glass Works, Edinburgh, T and A Constable, page 7.
79 Graham, A**, 1971, PSAS, Volume 101, 1968-69, Archaeological Notes on some harbours** in Eastern Scotland, Edinburgh, Proceedings of the Scottish Society of Antiquaries, page 214.
80 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 724-5.
81 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 28.
82 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 27.
83 **National Records of Scotland**, 1824, GD124/17/82, Edinburgh, NRS.
84 **National Records of Scotland**, 1767, GD124/17/557, Edinburgh, NRS.
85 **National Records of Scotland**, 1772, GD124/17/562, Edinburgh, NRS.
86 **Frame, J and Erskine, F**, 1791-98, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 617.
87 **National Records of Scotland,** 1760, RHP13268, Edinburgh, NRS.

88 **National Records of Scotland,** 1760, RHP13269, Edinburgh, NRS.
89 **Ordnance Survey,** 1898, Second Edition 25 inch map Sheets CXXXIX.8 and CXXXIX.4, Southampton, National Library of Scotland.
90 **Brodie, W,** 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 30.
91 **Wood, J,** 1825, Plan of the Town of Alloa from actual survey, Edinburgh, National Library of Scotland.
92 **Wood, J**, 1825, Plan of the Town of Alloa from actual survey. , Edinburgh, National Library of Scotland.
93 **Ordnance Survey**, 1863, First Edition 25 inch map, Clackmannanshire Sheet CXXXIX.4, Southampton, National Library of Scotland.
94 **National Records of Scotland**, 1772, GD124/17/562, Edinburgh, NRS.
95 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 7.
96 Robertson, C, 1983, The Origins of the Scottish Railway System, Edinburgh, John Donald, page 20.
97 **National Records of Scotland**, 1772, GD124/17/562, Edinburgh, NRS.
98 **Caledonian Mercury,** 1772, Caledonian Mercury, Edinburgh, Google Books.
99 Geological Survey of Scotland, 1926, Clackmannanshire, Sheet 133, SE, Edinburgh, National Library of Scotland.
100 **Ordnance Survey**, 1862, First Edition 25 inch map Perth and Clackmannan, Clackmannanshire Sheet CXXXIII.16 (Combined), Southampton, National Library of Scotland.
101 Geological Survey of Scotland, 1926, Clackmannanshire, Sheet 133 SE (1899), Southampton, National Library of Scotland.
102 **Coal Authority**, 2015, Interactive Map Viewer, Keyworth, British Geological Survey.
103 Geological Survey of Scotland, 1899, Six inch Map, Clackmannanshire, Sheet 133, SE, Edinburgh, National Library of Scotland.
104 Buchannan, J.B, 1759, A Plan of the marche twixt the Coalyland & Sauchy Grounds with the wasteings of the Coalyland coal, Alloa, National Library of Scotland.
105 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 617.
106 Br**odie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 27.
107 Geological Survey of Scotland, 1899, Six inch Map, Clackmannanshire, Sheet 133, SE, Edinburgh, National Library of Scotland.
108 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 615.
109 Geological Survey of Scotland, 1899, Six inch map, Clackmannanshire, Sheet 133, SE, Edinburgh, National Library of Scotland.

110 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 16.
111 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 14.
112 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 617.
113 **National Records of Scotland**, 1779, GD124/17/565, Edinburgh, NRS.
114 **National Records of Scotland**, 1779, GD124/17/564, Edinburgh, NRS.
115 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 30.
116 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 617-618.
117 Allan, D, 1785, Alloa Waggon, Alloa, National Museum of Scotland.
118 Crowther Gordon, T, 1951, David Allan, the Scottish Hoggarth, Edinburgh, Private Publication, page 3.
119 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 7.
120 **Ordnance Survey**, 1863, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIX.4, Southampton, National Library of Scotland.
121 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 637.
122 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 623.
123 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 596.
124 **Wood, J**, 1825, Plan of the Town of Alloa from actual survey. , Edinburgh, National Library of Scotland.
125 **Day, J,** 1915, Clackmannan and Kinross, Cambridge, W.A. Robertson, page 46.
126 **National Records of Scotland**, 1814, RHP1237/2, Edinburgh, NRS.
127 **Court of Session**, 1829, Cases Decided in the Court of Session, Volume 7, Edinburgh, William Blackwood, page 643.
128 **Roebuck,** J, 1795, Transactions of the Philosophical Societies of all the Nations, Volume 13, Nichols and Son.
129 **Osburn, W**, 1791-99, Old Statistical Account, Volume 15, Tillicoultry, Edinburgh, Sir John Sinclair of Ulbster, page 197-8.
130 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 611.
131 **Graham, A**, 1971, RCAHM Skateraw Harbour, Edinburgh, RCAHMS.
132 **National Records of Scotland**, 1798, GD124/17/569, Edinburgh, NRS.
133 **National Records of Scotland**, 1798, GD124/17/377, NRS.
134 **National Records of Scotland**, 1798, GD124/17/378, Edinburgh, NRS.
135 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable.
136 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 27.

137 **Bald, R**, 1828, The Edinburgh New Philosophical Journal, Edinburgh, Adam Black, page 110.
138 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
139 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 31.
140 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 252.
141 Baxter, B, 1966, Stone Blocks and Iron Rails, Newton Abbot, David & Charles, page 229.
142 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 30.
143 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 41.
144 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 77-84.
145 **Ordnance Survey**, 1862, First Edition 25 inch maps, Clackmannanshire Sheet CXXXIII.16 and Clackmannanshire Sheet CXXXIII.16, Southampton, National Library of Scotland.
146 **Ordnance Survey**, 1863, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIX.4, Southampton, National Library of Scotland.
147 **National Records of Scotland**, 1814, RHP1237/2, Edinburgh, NRS.
148 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 16.
149 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 16
150 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 77-84.
151 **Wood, J**, 1825, Plan of the Town of Alloa from actual survey. , Edinburgh, National Library of Scotland.
152 **National Records of Scotland**, 1825, GD124/17/412, Edinburgh, NRS.
153 **The Peerage**, 2011, page 2590.
154 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 16.
155 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 16.
156 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 77-84.
157 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 23 & 28.
158 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
159 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 46.
160 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 77-84.
161 **National Records of Scotland**, 1339, RHP3561, Edinburgh, NRS.

162 **National Records of Scotland**, 1845, RHP226, Edinburgh, NRS.
163 **National Records of Scotland**, 1838, GD124/6/346, Edinburgh, NRS.
164 **Balfour, P**, 1837-41, New Statistical Account, Volume 8, Clackmannan, Edinburgh, Church of Scotland, page 125.
165 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 38.
166 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 28.
167 **National Records of Scotland**, Mackie, J, 1845, RHP226, Edinburgh, NRS.
168 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
169 **Brodie, W,** 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 30.
170 **Wikipedia**, 2015, https://en.wikipedia.org/wiki/Track_gauge_conversion.
171 **Ordnance Survey**, 1863, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIII.12 (Combined), Southampton, National Library of Scotland.
172 **Ordnance Survey**, 1863, First Edition 25 inch map, Perth and Clackmannan Clackmannanshire Sheet CXXXIII.16 (Combined), Southampton, NRS.
173 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 39.
174 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 40.
175 **National Records of Scotland**, 1853, RHP151/1, Edinburgh, NRS.
176 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 82.
177 **Alloa Advertiser**, 1882, Alloa, page 3.
178 **Edinburgh Gazette**, 1854, Edinburgh.
179 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 49.
180 **Ordnance Survey**, 1862, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIII.12 (Combined), Southampton, NRS.
181 **Ordnance Survey**, 1862, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIII.16 (Combined), Southampton, National Library of Scotland.
182 **Ordnance Survey**, 1861, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIV.13 (Clackmannan), Southampton, National Library of Scotland.
183 **Ordnance Survey**, 1863, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIX.4 (Combined), Southampton, National Library of Scotland.
184 **Ordnance Survey**, 1863, First Edition 25 inch map, Clackmannanshire, Sheet CXXXIX.8, Southampton, National Library of Scotland.
185 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 54.
186 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 10.
187 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 8.
188 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 3.

189 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
190 **Ordnance Survey**, 1898, Second Edition 25 inch map, Clackmannanshire, Sheet 139.04, Southampton, National Library of Scotland.
191 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
192 **Ordnance Survey**, 1898, Second Edition 25 inch map, Clackmannanshire Sheet 139.08, Southampton, National Library of Scotland.
193 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 83.
194 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
195 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 83.
196 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
197 **Ordnance Survey**, Second Edition 25 inch OS map, Clackmannanshire Sheet 139.04, Southampton, National Library of Scotland.
198 **Ordnance Survey**, Second Edition OS 25 inch map, Clackmannanshire Sheet 133.16, Southampton, National Library of Scotland.
199 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 89.
200 **Ordnance Survey**, 1898, Second Edition OS 6 inch map, Clackmannanshire Sheet 138 SE, Southampton, NRS.
201 **Ordnance Survey**, 1898, Second Edition OS 6 inch map, Clackmannanshire Sheet 139 NE, Southampton, National Library of Scotland.
202 J &A McCulloch & Company, circa 1910, Postcard of Alloa Harbour, Yvonne Gill-Martin.
203 Unknown, Ideal Series, circa 1910, Postcard of Alloa Harbour, Yvonne Gill-Martin.
204 **Ordnance Survey**, 1922, Second Edition, Revised 25 inch OS, Clackmannanshire Sheet 139.4 (Combined), Southampton, National Library of Scotland.
205 **Ordnance Survey**, 1922, Second Edition Revised, 25 inch map, Clackmannanshire, Sheet 139.8, Southampton, National Library of Scotland.
206 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 108-112.
207 Baxter, B, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 115.
208 **Railscot**, 2015, A History of Britain's Railways.
209 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 637.
210 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 30.
211 **National Records of Scotland**, 1672, GD/124/771, Edinburgh, NRS.

212 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 623.
213 **Bald, R**, 1812, A General View of the Coal Trade, Internet, Google Books, page 84.
214 Gordon, T.C, 1936, The History of Clackmannan, Glasgow, Civic Press, page 98.
215 Carvel, J.L., 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 6.
216 Gordon, T.C. 1936, The History of Clackmannan, Glasgow, Civic Press, page 171.
217 Wallace, J, 1890, The Sherrifdom of Clackmannan, Edinburgh, James Thin, page 52.
218 Wallace, J, 1890, The Sherrifdom of Clackmannan, Edinburgh, James Thin, page 54.
219 **National Records of Scotland**, 1711, GD124/17/259, Edinburgh, NRS.
220 **National Records of Scotland**, 1711, GD124/15/1024/7, Edinburgh, NRS.
221 **National Records of Scotland**, 1713, GD18/1042, Edinburgh, NRS.
222 **National Records of Scotland**, 1713, RHP12358, Edinburgh, NRS.
223 Geological Survey of Scotland, 1920, Geological Survey Sheet CXL NW, National Library of Scotland.
224 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, London, HMSO, page 3.
225 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 622.
226 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 622.
227 Clerk, J, 1775, Painting of Clackmannan Tower, Edinburgh, National Museums of Scotland.
228 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, pages 612-613.
229 **Roy, Sir W**, 1747-55, The Roy Military Survey of Scotland (Highland area), Internet, British Library.
230 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 611.
231 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 612/613.
232 **National Records of Scotland**, 1832, RHP13272, Edinburgh, NRS.
233 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 623.
234 **GetMapping and Digital Globe**, Google Earth, Internet, Google Earth.
235 **The Geoinformation Group**, Google Earth, Internet, Google Earth.
236 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 57.
237 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 7.

238 Baxter, B, 1966, Stone Blocks and Iron Rails, Newton Abbot, David & Charles, page 230.
239 **Chalmers, G**, 1807, Caledonia, an Account, Historical and Topographical of North Britain, Volume 7, Paisley, Alexander Gardner, page 95.
240 Baxter, B, 1966, Stone Blocks and Iron Rails, Newton Abbot, David & Charles, page 229.
241 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, pages 77-84.
242 **National Records of Scotland**, 1839, RHP3561, Edinburgh, NRS.
243 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 57.
244 **National Records of Scotland**, 1814, GD173/26, Edinburgh, NRS.
245 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 6.
246 **National Records of Scotland**, 1833, RHP80659, Edinburgh, NRS.
247 **National Records of Scotland**, 1831, GD173/26, Edinburgh, NRS.
248 **National Records of Scotland**, 1841, GD173/26, Edinburgh, NRS.
249 **National Records of Scotland**, 1832, RHP13272, Edinburgh, NRS.
250 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 57.
251 **National Records of Scotland**, 1841, GD173/26, Edinburgh, NRS.
252 Court of Session, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 77-84.
253 **National Records of Scotland**, 1838, GD124/6/346, Edinburgh, NRS.
254 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 49.
255 **National Records of Scotland**, 1841, GD173/26, Edinburgh, NRS.
256 **Balfour, P,** 1837-41, New Statistical Account, Volume 8, Clackmannan, Edinburgh, Church of Scotland, page 124.
257 Memoirs of the Geological Survey, Scotland, Special Report on the Mineral Resources of Great Britain, Volume XI, Iron Ores, 1840, Tanfield, Morrison and Gibb, page 9.
258 **Balfour, P,** 1837-41, New Statistical Account, Volume 8, Clackmannan, Edinburgh, Church of Scotland, page 137.
259 **Balfour, P,** 1837-41, New Statistical Account, Volume 8, Clackmannan, Edinburgh, Church of Scotland, page 129.
260 **Ordnance Survey**, 1866, Second Edition, Six inch map, Perthshire, Sheet CXL, Survey date: 1863, Southampton, National Library of Scotland.
261 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 57.
262 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 6.
263 Adamson, J, 1980, Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, page 8.
264 **Ordnance Survey**, 1866, First Edition 25 inch OS map, Clackmannanshire, Sheet CXL.5 (Combined), Southampton, National Library of Scotland.

265 Census Returns of Scotland, 1841, Census Returns, Clackmannan Parish, 1841, Edinburgh, ScotlandsPeople.
266 Census Returns of Scotland, 1837, Clackmannan Parish, Brathieburn, 1851, Edinburgh, ScotlandsPeople.
267 **Borehole Records**, 2015, British Geological Survey, Interactive Viewer, Borehole Records.
268 Geological Survey of Scotland, 1901, Clackmannanshire, Sheet 140, NW, Edinburgh, National Library of Scotland.
269 **National Records of Scotland**, 1848, RHP43694, Edinburgh, NRS.
270 **Aerofilms**, Canmore collection (image SC 1256200, Edinburgh, RCAHMS
271 Graham, W, 2015, Oral History Interview, CFSS.
272 **Bald, R**, 1828, The Edinburgh New Philosophical Journal, Edinburgh, Adam Black, page 112.
273 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland and in the House of Lords on Appeal from Scotland, Volume 12, Edinburgh, M Anderson and Co, page 251.
274 **Porter, D.H**, 1998, The Life and Times of Goldsworthy Gurney, Cranbuy, NJ, USA, Associated University Presses Inc..
275 **Balfour, P,** 1837-41, New Statistical Account, Volume 8, Clackmannan, Edinburgh, Church of Scotland, page 125
276 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 48.
277 **HMSO**, 1859, Report of the Commissioners for Inquiring into Matters relating to Public Roads in Scotland, 1859, Edinburgh, Google Books.
278 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 14, Edinburgh, Anderson & Co, page 524.
279 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 49.
280 **Johnstone, J**, 1839, The Mechanics Magazine, Museum, Register, Journal and Gazette, Volume XXVIII, London, W.A. Robertson.
281 **Notes**, 1846, The Mechanics Magazine, Museum, Register, Journal and Gazette, Volume XXV, London, W.A. Robertson.
282 **Campbell, J**, A Wee Keek Back, Internet, page 309.
283 Grange Papers, 1850, Grange Papers acc 5381 Box 17, Bo'ness, National Library of Scotland.
284 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 82.
285 Baxter, B, 1966, Stone Blocks and Iron Rails, Newton Abbot, David & Charles, page 230.
286 **Edinburgh Gazette**, 1854, Edinburgh, The Gazette.
287 **Mayer, J**, 1872, Iron and Steel Institute, Volume II, 1872, Iron Industry and Trade, The Iron Manufactury in Scotland, London, F.N. Spon, page 36.
288 McGregor, M, 1920, Memoirs of the Geological Survey, Scotland, Special Report on the Mineral Resources of Great Britain, Volume XI, Iron Ores, Tanfield, Morrison and Gibb, page 5.

289 Alloa and Hillfoots Advertiser, 1856, Article on Devon Iron Works, Alloa, Alloa Library, page 3.
290 Alloa and Hillfoots Advertiser, 1857, Article on Devon Iron Works, Alloa, Alloa Library, page 3.
291 **Glasgow Herald**, 1858, Glasgow Herald, Glasgow, Glasgow Herald, page 3.
292 **Glasgow Herald**, 1858, Glasgow Herald, Glasgow, Glasgow Herald, page 3.
293 Alloa and Hillfoots Advertiser, 1858, Article on Devon Iron Works, Alloa, Alloa Library, page 3.
294 Alloa and Hillfoots Advertiser, 2014, Alloa and Hillfoots Advertiser, Alloa, Alloa and Hillfoots Advertiser.
295 **Ordnance Survey**, 1900, OS Second Edition Six Inch Perthshire, Sheet CXL.NW, Southampton, National Library of Scotland.
296 **Ordnance Survey**, 1866, OS First Edition Six Inch Perthshire, Sheet CXL.NW, Southampton, National Library of Scotland.
297 **Railscot** - A history of Britain's Railways, Internet, 2015.
298 **Ordnance Survey**, 1901, OS First Edition Six Inch, Perth and Clackmannan Sheet CXL.NW, Southampton, National Library of Scotland.
299 **RAF 1945 Aerial Cover**, 2015, Google Earth.
300 **British Geological Survey**, Borehole Records, Internet, 2015.
301 **Paisley Herald and Renfrew Advertiser**, page 3, 1868, Paisley, British Newspaper Archive, 2015.
302 **Wikipedia**, 2015, https://en.wikipedia.org/wiki/Wagonway, Internet, Wikipedia.
303 Baxter, B, 1966, Stone Blocks and Iron Rails, Newton Abbot, David and Charles, page 47.
304 **Gomersal, H and Guy**, A, 2015, A Research agenda for the Early British Railways http://www.rchs.org.uk/trial/Research%20agenda.pdf, Internet, rchs.org.uk, pages 5 to 7.
305 **Ordnance Survey**, 1861, **Ordnance Survey** Name Book -OS1/8/3/26, Edinburgh, ScotlandsPlaces.
306 **Ordnance Survey**, First Edition OS Six Inch Map, Perthshire, Sheet CXL, Southampton, National Library of Scotland.
307 **Ordnance Survey**, 1901, First Edition Six Inch map, Perth and Clackmannan, Sheet CXL.NW, Southampton, National Library of Scotland.
308 **Google Earth**, 1945 Aerial Coverage, Internet.
309 **Ordnance Survey**, 1901, First Edition Six Inch map, Perth and Clackmannan, Sheet CXL.NW, Southampton, National Library of Scotland.
310 **Google Earth**, 1945 Aerial Coverage, Internet.
311 **Lists of Mines**, 1873, Scottish Mining Website, Collieries in Clackmannanshire, 1873, Scottish Mining Website (www.scottishmining.co.uk).
312 Records of James Dawson, Clackmannan Coal Company, Land Sale Records at Fauld, 1861-1873, Dawson Family Papers.

313 Records of James Dawson, Clackmannan Coal Company, Records of Sales at Clackmannan Pier, 1861-1873, Dawson Family Papers.
314 Census Returns of Scotland, 1841, Census Returns, Clackmannan Parish, Edinburgh, ScotlandsPeople.
315 Census Returns of Scotland, 1861, Census Returns, Clackmannan Parish, Edinburgh, ScotlandsPeople.
316 Census Returns of Scotland, 1841, Census Returns, Clackmannan Parish, Edinburgh, ScotlandsPeople.
317 Census Returns of Scotland, 1841, Census Returns, Clackmannan Parish, Edinburgh, ScotlandsPeople.
318 **The Dundee Advertiser, Page 3**, 1890, Dundee, British Newspaper Archive, 2015.
319 **Dundee Courier and Argus, page 3,** 1890, British Newspaper Archive, 2015.
320 **Ordnance Survey**, 1901, Third Edition One Inch map, Sheet 39, Southampton, National Library of Scotland.
321 **Ordnance Survey,** 1898, Second Edition 25 Inch, Clackmannanshire, Sheet 140.05, Southampton, National Library of Scotland.
322 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 6.
323 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 6.
324 **Ordnance Survey**, 1901, First Edition Six Inch map, Perth and Clackmannan Sheet CXL.NW, Southampton, National Library of Scotland.
325 Graham, W, 2015, Oral History Interview, Clackmannan, Clackmannanshire Field Studies Society.
326 **Bing Maps**, 2015, Aerial Coverage, Internet, HERE, Microsoft Corporation.
327 **Ordnance Survey**, 1922, Second Edition Revised 25 Inch map, Perth and Clackmannan Sheet 140.05, Southampton, National Library of Scotland.
328 **Ordnance Survey,** 1861, First Edition 25 Inch, Perth and Clackmannan Sheet, CXL.6 and sheet CXL.2, Southampton, National Library of Scotland.
329 **Ordnance Survey**, 1898, Second Edition Six Inch map, Perth and Clackmannan, Sheet CXL.NW, Southampton, National Library of Scotland.
330 **Ordnance Survey**, 1922, Second Edition Revised 25 Inch map, Clackmannanshire, Sheet 140.06, Southampton, National Library of Scotland.
331 **The Scotsman,** 1906, Wednesday 7th February, Midlothian, Scotland, page **8**, The British Newspaper Archive.
332 **The Scotsman**, 1915**,** Thursday 10 June, Midlothian, Scotland, page **7,** The British Newspaper Archive.
333 **Ordnance Survey**, 1923, Third Edition One Inch map, Sheet 39, Southampton, National Library of Scotland.
334 **Stirling Observer**, 1940, Thursday 1st February, Stirling, Page 1, The British Newspaper Archive.

335 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 623.
336 **Rorke, M**, 2001, Scottish Overseas Trade, 1275/86-1597, The University of Edinburgh (Ph.D. Thesis), page 214.
337 **Brodie, W,** 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 33.
338 **Talbott, S**, 2015, Conflict, Commerce and Franco-Scottish Relations, 1560–1713, Rutledge, page 58.
339 **Rorke, M**, 2002, Scottish Overseas Trade, 1275/86-1598, The University of Edinburgh (Ph.D. Thesis), page 220.
340 **Rorke, M**, 2001, Scottish Overseas Trade, 1275/86-1597, The University of Edinburgh (Ph.D. Thesis), page 230.
341 **National Records of Scotland**, 1642, GD11/142, Edinburgh, NRS.
342 **National Records of Scotland**, 1672, GD/124/771, Edinburgh, NRS.
343 **Ordnance Survey**, 1861, First Edition 25 inch map, Clackmannanshire Sheet CXL.13, Southampton, National Library of Scotland.
344 **Bald, R,** 1812, A General View of the Coal Trade, Internet, Google Books, page 84.
345 **Frame, J and Erskine, F**, 1792, Old Statistical Account, Volume 8, Alloa, Edinburgh, Sir John Sinclair of Ulbster, page 617.
346 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 6.
347 **HMSO**, 1817, Parliamentary Papers, House of Commons and Command, Volume 3, London, page 23.
348 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 623.
349 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 623.
350 **Townsend, B**, 2013, Scotch Missed, Castle Douglas, Neil Wilson Publishing, not paged.
351 Scotch Whisky Association, www.dcs.ed.ac.uk/home/jhb/whisky/history.html, Internet, 2015.
352 Beveridge, D, 1888, Between the Ochils and the Forth, Edinburgh, William Blackwood and Sons, page 206.
353 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 623.
354 **Moodie, R**, 1791-99, Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, page 626.
355 **Ordnance Survey**, 1861, **Ordnance Survey** Name Book, OS1/8/3/57, Edinburgh, ScotlandsPlaces.
356 **Ordnance Survey**, 1866, First Edition 6 Inch map, Stirlingshire, Sheet XVIII, Southampton, National Library of Scotland.

357 **Ordnance Survey**, 1913, Second Edition Revised 25 Inch map, Clackmannanshire, Sheet 140.13, Southampton, National Library of Scotland.
358 **Townsend, B**, 2013, Scotch Missed, Castle Douglas, Neil Wilson Publishing, Not Paged.
359 **National Records of Scotland**, 1849, RHP24824, Edinburgh, NRS.
360 Geological Survey of Great Britain, 1855, Memoirs of the Geological Survey of Great Britain, Volume 12, London, Longman, page 203.
361 **Lists of Mines**, 1860, Scottish Mining Website, Collieries in Clackmannanshire, 1860, Scottish Mining Website (www.scottishmining.co.uk).
362 **Lists of Mines**, 1866, Scottish Mining Website, Collieries in Clackmannanshire, 1866, Scottish Mining Website (www.scottishmining.co.uk).
363 **Kennetpans Trust Website**, 2015, Internet.
364 **Ordnance Survey**, 1863, First Edition 25 Inch map, Clackmannanshire, Sheets CXL.9, CXL.10 and CXL.13, National Library of Scotland.
365 Geology Survey, 1921, Second Edition 6 Inch OS Map Sheet, Clackmannanshire, Sheet CXL. SW, National Library of Scotland.
366 **Ordnance Survey** Name Book, 1861, OS1/8/3/62, ScotlandsPlaces.
367 **Townsend, B**, 2013, Scotch Missed, Castle Douglas, Neil Wilson Publishing, page Not Paged.
368 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 59.
369 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 9.
370 **Ordnance Survey**, 1901, Second Edition 6 Inch OS Map, Clackmannanshire, Sheet CXL. SW, Southampton, National Library of Scotland.
371 **Kennetpans Trust Website**, 2015, Internet.
372 **Ordnance Survey**, 1920, Second Edition Revised 25 Inch map, Clackmannanshire, Sheets CXL.9, CXL.10 and CXL.13, Southampton, National Library of Scotland.
373 **National Records of Scotland**, 1694, GD124/17/526, Edinburgh, NRS.
374 **Osburn, W**, 1791-99, Old Statistical Account, Volume 15, Tillicoultry, Edinburgh, Sir John Sinclair of Ulbster, page 197.
375 **National Records of Scotland**, 6th Earl of Mar, 1712, GD124/15/1047/14, Edinburgh, NRS.
376 **National Records of Scotland**, 1758, GD124/6/269, Edinburgh, NRS.
377 **Osburn, W**, 1791-99, Old Statistical Account, Volume 15, Tillicoultry, Edinburgh, Sir John Sinclair of Ulbster, page 198.
378 Edinburgh, Sir John Sinclair of Ulbster, page 197.
379 **Osburn, W**, 1791-99, Old Statistical Account, Volume 15, Tillicoultry, Edinburgh, Sir John Sinclair of Ulbster, page 197.
380 **Duncan, J**, 1791-99, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 131.

381 **Osburn, W**, 1791-99, Old Statistical Account, Volume 15, Tillicoultry, Edinburgh, Sir John Sinclair of Ulbster, page 215-6.
382 **Schaw, P**, 1827, Cases decided in the Court of Sessions volume 5, Edinburgh, Blackwood and Sons, page 823.
383 **National Records of Scotland**, 1823, GD124/17/586, Edinburgh, NRS.
384 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, page 77-84.
385 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 23.
386 **Court of Session**, 1840, Reports of Cases Decided in the Supreme Courts of Scotland, Volume 14, Edinburgh, Anderson & Co, pages 523-525.
387 **Anderson, H**, 1841, New Statistical Account, Volume 8, Tillicoultry, Edinburgh, Church of Scotland, Page 69.
388 **National Records of Scotland**, 1740, GD112/15/269, Edinburgh, NRS.
389 **Wikipedia,** Stirling and Dunfermline Railway, 1851, https://en.wikipedia.org/wiki/Stirling_and_Dunfermline_Railway#The_Alloa_Railway, 2016.
390 **Lists of Mines**, 1854, Scottish Mining Website, Collieries in Clackmannanshire, 1854 Scottish Mining Website (www.scottishmining.co.uk).
391 Memoirs of the Geological Survey of Great Britain, London, 1855, Volume 12, page 203.
392 **Ordnance Survey**, 1898, First Edition OS 25 inch map, Clackmannanshire, Sheet CXXXIV.09, Southampton, National Library of Scotland.
393 **Lists of Mines**, 1866, Scottish Mining Website, Collieries in Clackmannanshire, 1866, Scottish Mining Website (www.scottishmining.co.uk).
394 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 58.
395 Mines Department, 1931, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, London, HMSO, page 7.
396 **Lothian, J**, 1877, Lothians Annual Register, Alloa, J. Lothian, page 87.
397 **Ordnance Survey**, 1898, Second Edition 25 inch map, Clackmannanshire, Sheet 134.09, Southampton, National Library of Scotland.
398 **Ordnance Survey**, 1920, Second Edition Revision 25 inch map, Clackmannanshire, Sheet 134.09, Keyworth, National Library of Scotland.
399 **British Geological Survey**, 1791-99, Geology of Britain Viewer, Edinburgh, British Geological Survey, page 144.
400 **Duncan, J**, Old Statistical Account, Volume 18, Alva, Sir John Sinclair of Ulbster, page 180.
401 **Brown, A**, 1717, New Statistical Account, Volume 8, Alva, Edinburgh, 1834-45.
402 **National Records of Scotland**, 1729, GD164/1068, Edinburgh, NRS.
403 **National Records of Scotland**, 1731, GD124/17/540, Edinburgh, NRS.
404 **National Records of Scotland**, 1735, GD164/1679, Edinburgh, NRS.
405 **National Records of Scotland**, 1736, GD164/1681, Edinburgh, NRS.

406 **National Records of Scotland**, 1791-99, GD164/1684, Edinburgh, NRS, page 144.
407 **Duncan, J,** 1791-99, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 145.
408 **Duncan**, J, 1730, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 146.
409 **National Records of Scotland**, 1796, GD24/1/1012, NRS, page 81.
410 **Mylne, A**, 1791-99, New Statistical Account, Volume 8, Dollar, Edinburgh, page 145.
411 **Duncan, J,** NSA, Old Statistical Account, Volume 18, Alva, Alva, Sir John Sinclair of Ulbster, page 180.
412 **Brown, A**, 1791-99, New Statistical Account, Volume 8, Alva, Edinburgh, 1834-45, page 144.
413 **Duncan, J**, 1791-101, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 145.
414 **Duncan, J,** 1791-99, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 145.
415 **Duncan, J**, 1791-99, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, page 131-2.
416 **Duncan, J**, 1826, Old Statistical Account, Volume 18, Alva, Edinburgh, Sir John Sinclair of Ulbster, Page 130.
417 **National Records of Scotland**, 1944, NRAS3263, Edinburgh, NRS, page 38.
418 Carvel, J.L, 1862, 100 Years in Coal, Southampton, T and A Constable, page 46.
419 **Ordnance Survey**, 1862, OS First Edition 25 inch map, Clackmannanshire, Sheet CXXXIII.11, Southampton, National Library of Scotland.
420 **Ordnance Survey**, 1898, OS Second Edition 25 inch map, Clackmannanshire, Sheet 133.11, Southampton, National Library of Scotland.
421 **Lists of Mines**, 1931, Scottish Mining Website, Collieries in Clackmannanshire, 1854, London, Scottish Mining Website (www.scottishmining.co.uk), page 8.
422 Mines Department, 1857, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, Alloa, HMSO, page 3.
423 Alloa and Hillfoots Advertiser, 1862, Article on Devon Iron Works, Southampton, Alloa Library.
424 **Ordnance Survey**, 1862, OS First Edition 25 inch map, Perth and Clackmannan Clackmannanshire Sheet CXXXIII.11, Southampton, National Library of Scotland.
425 **Ordnance Survey**, 1862, OS First Edition 25 inch map, Perth and Clackmannan Clackmannanshire Sheets CXXXIII.11 and CXXXIII.12, Edinburgh, National Library of Scotland.
426 **Ordnance Survey**, 1861, **Ordnance Survey** Name Book, Alva, Edinburgh, ScotlandsPlaces.
427 Census Returns, Alva Parish, 1841 to 1881, Edinburgh, ScotlandsPeople, page 4.

428 Mines Department, 1936, Catalogue of Abandoned Mine Plans, Vol 5, Scotland, Clackmannanshire, Stirling, HMSO, page 110.
429 Stirling Natural History and Archaeological Society, Volume LVIII, 1875, Alloa, Learnmonth & Sons (Drummond, Mrs), page 87.
430 **Lothians Annual Register,** Lothian, J, 1862, Lothians Register, Alloa, page 96.
431 **Ordnance Survey**, 1862, OS Second Edition 25 inch map, Perth and Clackmannan Clackmannanshire Sheet 133.11, Southampton, National Library of Scotland.
432 **Ordnance Survey**, 1920, Second Edition Revision 25 inch map, Perth and Clackmannan, Clackmannanshire Sheet 133.11, Southampton, National Library of Scotland.
433 **Aris's Birmingham Gazette**, Page 3, 1858, Birmingham, British Newspaper Archive.
434 **Lothians Annual Register,** Lothian, J, 1862, Lothians Register, Alloa, page 96.
435 **Brodie, W**, 1834-45, New Statistical Account, Volume 8, Alloa, Edinburgh, Church of Scotland, page 31.
436 **Falkirk Herald**, page 3, 1870, Falkirk, British Newspaper Archive, 2015.
437 Carvel, J.L, 1944, 100 Years in Coal, Edinburgh, T and A Constable, page 50.